Chicago Metropolitan
Agency for Planning

433 West Van Buren Street
Suite 450
Chicago, IL 60607

COORDINATING COMMITTEE

AGENDA - FINAL

Wednesday, September 14, 2022

8:00 AM

Please join from your computer, tablet or smartphone.

https://us06web.zoom.us/j/81818095319?pwd=WVZOM1J1bERzTjZXUzNTaHJJcitoQT09

1.0 Call To Order

2.0 Agenda Changes and Announcements

2.01 Requests for Agenda Changes **22-136**

2.02 Executive Director's Announcements **22-243**

ACTION REQUESTED: Information

3.0 Approval of Minutes

3.01 Draft Meeting Minutes from May 11, 2022 **22-356**

ACTION REQUESTED: Approval

Attachments: Coordinating Committee Draft Meeting Minutes 05.11.2022

4.0 New Business

4.01 Transportation Committee Report **22-399**

PURPOSE & ACTION: Staff will provide an overview of the Transportation Committee's work plan, including a summary of committee work to date, discussion of performance measures, and an overview of future work.

ACTION REQUESTED: Information

Attachments: CMAP Committee Annual Report Transportation Committee 2022

4.02 ADA Transition Planning **22-358**

PURPOSE & ACTION: Staff will provide an overview of CMAP's ADA transition planning work.

ACTION REQUESTED: Information

4.03 ON TO 2050 Plan Update **22-439**

PURPOSE & ACTION: CMAP has been developing the federally required update to ON TO 2050, which is due in October 2022. CMAP made the plan available for public comment from June 10 to August 13, 2022. CMAP also held a public hearing online and at CMAP's offices on August 11.

ACTION REQUESTED: Information

Attachments:

- Board memo on public comment
- 2023-28 TIP Document Final Draft Sept2022
- Financial Plan Appendix September 2022
- Indicators Appendix September 2022
- Plan Update Narrative September 2022
- Regionally Significant Projects Benefits Appendix September 2022
- Socioeconomic Forecast Appendix September 2022
- System Performance Report Appendix September 2022
- Transportation Conformity Analysis Appendix September 2022
- Travel Demand Model Documentation Appendix September 2022

5.0 Other Business

6.0 Public Comment

7.0 Next Meeting

The next meeting is scheduled for November 9, 2022

8.0 Adjournment

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COORDINATING COMMITTEE

MEETING MINUTES - DRAFT

Wednesday, May 11, 2022

8:00 AM

Please join from your computer, tablet or smartphone.

https://us06web.zoom.us/j/86995115309

1.0 Call To Order

Coordinating Committee Chair Reinbold called the meeting to order at 8:02 a.m., and reminded the members that the meeting was being live-streamed. Stephane Phifer was asked to call the roll.

Present	Richard Reinbold, Matthew Brolley, Stefan Schaffer, Jessica Hector-Hsu, Aaron Durnbaugh, and Bob Tucker
Absent	Diane Williams

Staff Present: Erin Aleman, Amy McEwan, Jason Navota, Stephane Phifer, Katie Piotrowska, Alex Ensign, Kasia Hart, Austen Edwards, Yousef Salama, Jennie Vana, Elizabeth Ginsberg.

Others Present: Leslie Phemister

2.0 Agenda Changes and Announcements

2.01 Requests for agenda changes **22-160**

2.02 Executive Director’s Announcements **22-161**

Executive Director, Erin Aleman, gave opening comments about the Infrastructure Investments and Jobs Act, and CMAP's new Annual Committee Reports, that align committee work to the agency's strategic direction and advancement of ONTO 2050.

3.0 Approval of Minutes

3.01 Draft Meeting Minutes - March 9, 2022 **22-145**

Attachments: Draft Meeting Minutes 03.09.22

A motion was made by Bob Tucker, seconded by Jessica Hector-Hsu, that the agenda item be approved. The motion carried by the following vote:

Aye:	Richard Reinbold, Matthew Brolley, Stefan Schaffer, Jessica Hector-Hsu, Aaron Durnbaugh, and Bob Tucker
Absent:	Diane Williams

4.0 New Business

4.01 Infrastructure Investment and Jobs Act (IIJA) Update **22-208**

Attachments: IIJA Regional Coordination

Deputy Executive Director for Planning, Stephane Phifer, provided an overview of the Infrastructure Investment and Jobs Act (IIJA), and CMAP's role in facilitating regional coordination around funding opportunities. The presentation included an overview of the implementation of the IIJA’s formula and competitive programs.

4.02 Committee Annual Reports **22-217**

Attachments: 4.02_CommitteeReports_Memo_2022-05-11
CMAP Committee Annual Report Template

Director of Strategic Alignment and Innovation, Alex Ensign, provided an overview of the new Annual Committee Reports template. This format will align CMAP's committee work with the agency's Strategic Direction, and will allow the Coordinating Committee and the working level committees to annually report its activities to the CMAP Board.

Following the presentation the Committee discussed opportunities to exchange ideas and information among working level committees through annual reporting. The Chairs of the Regional Economy, Climate and Transportation Committees also updated Coordinating Committee members about the content of their last committee meetings.

5.0 Other Business

There was no other business before the Committee.

6.0 Public Comment

This is an opportunity for comments from members of the audience.

There was no public comment.

7.0 Next Meeting

The next meeting will be September 14, 2022

8.0 Adjournment

The meeting was adjourned at 8:31a.m. by Chair Reinbold. The next scheduled meeting of Committee is September 14, 2022.

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433 West Van Buren Street, Suite 450
Chicago, IL 60657
cmap.illinois.gov | 312-454-0400

Transportation Committee Annual Report

Committee charge

The Committee serves as a working committee to both the MPO Policy Committee and the CMAP Board and will consider recommendations and policy decisions prior to MPO Policy Committee action.

Goals and objectives

The Committee's vision is: "Promote a regional Transportation system that is safe, efficient, and accessible while sustaining the region's vision related to the natural environment, economic and community development, social equity, and public health."

Summary of work

Work to date

For 2022, the Committee’s focus has been on the ON TO 2050 Update and the many pieces that feed into the update which include the financial plan, regionally significant projects (RSPs) and their evaluation, the system performance report, plan indicators, the socioeconomic forecast, transportation modeling and the air quality conformity as well as the FFY 2023-2028 Transportation Improvement Program (TIP).

The committee reviews and approves amendments to the TIP which is one of the main responsibilities of a Metropolitan Planning Organization and provides a five-year financial picture for the federal transportation dollars in the region along with regionally significant projects.

In February, the Committee held a special meeting to discuss and approve the Unified Work Program (UWP) at the request of Secretary Osman and the MPO Policy Committee. The UWP provides federal transportation planning dollars to the region. The meeting was required so that issues involved in the selection of core and competitive programs could be resolved.

The committee continues to be actively engaged in the conversation about traffic safety in the region. In 2019, safety rose to one of the top priorities of the committee which ultimately led to the creation of the Safety Action Agenda.

Other topics and presentations covered so far this year include ITS Architecture, RTA Strategic Plan, Mobility Recovery, Pavement Management Plan and National Science Foundation sidewalk inventory project.

Discussion on performance measures

The performance measures discussed by the Committee revolve around the National Performance Management Measures which cover transportation asset condition, system performance, and safety.

Baselines

See the System Performance Report Plan Appendix.

Current levels

See the System Performance Report Plan Appendix.

Outstanding work

The Committee is scheduled to meet on September 16, November 18 and December 16, 2022. The work of the Committee will include ON TO 2050 Update approval recommending the plan to the MPO Policy Committee and CMAP Board for adoption, the mobility recovery work, federal safety performance measures and the approval of TIP amendments along with the discussion of prioritized transportation investments resulting from Infrastructure Investment and Jobs Act.

Future work

Safe systems approach to transportation, ADA Transition Plans, transit recovery, implementation of IIJA, climate issues and the newly proposed greenhouse gas emissions performance measures will be of particular interest to the Committee.

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cmap.illinois.gov | 312-454-0400

MEMORANDUM

To: CMAP Board

From: CMAP Staff

Date: September 7, 2022

Subject: ON TO 2050 Plan Update public comment summary

Purpose: CMAP is developing the federally required update to ON TO 2050, which is due in October 2022. CMAP made the plan available for public comment from June 10 to August 13, 2022. CMAP also held a public hearing online and at CMAP's offices on August 11. Staff will present on the plan components and the public comments received on the draft.

Action Requested: Information

The Chicago Metropolitan Agency for Planning (CMAP) invited stakeholders to provide input during the ON TO 2050 plan update process at key stages and for specific technical components. Stakeholders included the general public, members of the CMAP board and committees, municipal representatives, and regional transportation advocates. CMAP's engagement initiatives for the plan update generated more than 500 responses and comments.

Public engagement summary

CMAP provided the general public with timely information and used its website, e-newsletters, and social media to invite the public to participate in the development of the plan update and to comment on the draft. The agency offered opportunities to participate in multiple events and through several channels, including virtual roundtable discussions, email and web comments, presentations to the CMAP Board and committees, social media, and a public hearing. Four roundtable discussions in April and May 2022 guided development of the draft plan. Formal public comment on the draft plan itself opened on June 10, 2022, and closed August 13, 2022, following the public hearing on August 11, 2022.

Public hearing

CMAP held a public hearing for public comment on the plan update as required by the Regional Planning Act (the Act), 70 ILCS 1707/40. In accordance with the Act, notice of the public hearing was published in a newspaper having a general circulation in the Chicago region more than 30 days prior to the date of the hearing. Attachment A is the Chicago Tribune Corporation's certificate of publication of the legal notice on June 13, 2022.

The public hearing was a hybrid event, and stakeholders participated by attending in person in CMAP's offices and on Zoom.

Phase	Activities	Participants
Stakeholder engagement February through May 2022	Roundtable discussions: April 14, 2022 April 28, 2022 May 5, 2022 May 12, 2022	54
Public comment period June 10 through August 13, 2022	Emails and web comments, letters, social media posts	510
	August 11, 2022: Hybrid public hearing in CMAP's offices and on Zoom	33

Public comment summary

What follows is a summary of public comment received during the public comment period. Many of the individual comments received followed common themes, which are summarized below. These themes emphasize:

- The importance of continuing to improve how we understand the impacts of transportation investments on communities and the region,
- The need for more focused work on transportation safety, and
- The need to more deeply the ongoing challenges of transportation safety in the region, and the need to integrate climate considerations more deeply in CMAP's work.

CMAP staff have crafted responses to each of these themes. The complete log of comments follows the summarized themes and responses. Organizational stakeholders, including village and township leadership, as well as community partners will receive individual letters of response to their thoughtful feedback.

Key theme	Response
Impact of roadway expansion on climate mitigation efforts	Commenters expressed concern about the inclusion of roadway expansion projects as Regionally Significant Projects due to climate impacts. The Plan Update reaffirms the regional goal of developing a multimodal transportation system and maintains ON TO 2050's call to intensify climate mitigation efforts. Reducing greenhouse gas emissions requires compact infill development, improved pedestrian and bicycle infrastructure, and increased investments in public transit as well as considerable expansion in renewable energy systems, energy efficiency and retrofits, and electrification of our

	transportation system. CMAP will continue to work across these many areas to mitigate climate impacts and recover from the effects of climate change. CMAP is continuously evaluating regional performance measures and adjusting our tools and processes for understanding the impact transportation has on quality of life across the region. This includes how we model roadway expansion, as well as advances in greenhouse gas emissions modeling.
Transportation system safety and accessibility	Commenters emphasized the importance of continuing to make investments and update policies to improve transportation safety and accessibility in the region, particularly for vulnerable travelers. Road safety. CMAP launched a program of work to improve regional traffic safety, including by creating new safety data resources on issues like speeding, competing for competitive planning and capital funds, and convening regional stakeholders to promote joint problem solving. Transit safety. CMAP is currently developing a report of legislative recommendations to support the region's transit system in consultation with the Regional Transportation Authority (RTA). The report will address transit safety considerations insofar as the user experience is critical to public confidence in the system, system ridership, and transit employee hiring and retention. Accessibility. CMAP launched a program to help every community in northeastern Illinois establish Americans with Disabilities Act (ADA) transition plans over the next ten years. Additionally, the agency is currently exploring new ways to support the region's dial-a-ride services and better integrate them into the broader mobility system.
Need to transparently prioritize scarce public resources, including Infrastructure Investment and Jobs Act (IIJA) funding	Commenters expressed the preference that new funding coming to the region be fairly allocated in a transparent and performance-based manner. The new federal Infrastructure Investment and Jobs Act (IIJA) seeks to make transformative transportation investments that advance equity, environmental, climate, resilience, and safety goals. Those federal goals align with the Plan Update's core principles of inclusive growth, resilience, and prioritized investment. As the coordinating regional agency, CMAP is a resource to all communities and counties in northeastern Illinois. Since IIJA became law, CMAP has focused on leveraging the increased infrastructure funding for our region, coordinating around new competitive grant programs, and preparing regionally significant projects. CMAP believes that developing clear,

	transparent, and regionally-supported methods for prioritizing projects and IIJA funding upholds the Plan Update's core principles, improves the region's competitiveness for discretionary federal funds, and accelerates progress towards regional goals.
Support for strategies that promote walking, biking, and transit	Commenters broadly expressed support for non-single occupancy vehicle modes (e.g., walking, biking, transit) and proposed a variety of ways that CMAP and the region should encourage residents to travel by these modes. In general, CMAP devotes a significant portion its annual work plan to projects that support the residents' ability to travel by active modes. Recent examples include the Regional Sidewalk Inventory and Northern Lakeshore Trail Connectivity Plan. Historically, bicycle and pedestrian projects have not been specifically included in the Regionally Significant Projects list because of their relatively small capital costs. As a reminder, Regional Significant Projects are: • Projects that cost at least $100 million and (a) change capacity on the National Highway System (NHS) or is a new expressway or principal arterial; or (b) change capacity on transit services with some separate rights-of-way or shared right-of-way where transit has priority over other traffic. • Projects that cost at least $250 million, regardless of the facility type or work type. They are, however, accounted for within the Financial Plan for Transportation in the "system enhancements" category. This category includes capital and operational enhancements or improvements not already constrained under other categories. Examples include bicycle, pedestrian, and ADA improvements, as well as highway management and operations, including intelligent transportation systems. The Plan Update provides $43.7 billion in enhancement investments between now and 2050. For the next regional plan, CMAP commits to improving transparency of these investments to better support their critical role in advancing the region's goals.
Rural land preservation	Commenters expressed concern over the loss of farmland due to development in the region. CMAP provides technical assistance to urban, suburban, and rural communities. Our technical assistance helps us better understand the

	issues and specific needs of rural communities. We look forward to exploring how we can better use that local work to inform our regional approaches. In the upcoming year, CMAP will begin scoping for the next regional plan. Your comments are helpful as we consider how to approach that work. We look forward to your continued involvement.
Tri-County Access Project	Commenters opposed the inclusion of the Tri-County Access project in Lake County as a Regionally Significant Project. The Tri-County Access project was not submitted for evaluation as a Regionally Significant Project for the ON TO 2050 Update. Therefore, it is not included in the plan's Regionally Significant Projects list, which can be found in the Regionally Significant Projects Benefits Report appendix.

Public comment log

View the full appendix of public comments collected through our public engagement process.

FFY 2023-28 transportation improvement program

September 2022 draft

Table of Contents

Chapter 1: Introduction

About CMAP

The Chicago Metropolitan Agency for Planning (CMAP) MPO Policy Committee is designated by the governor of Illinois and northeastern Illinois local officials as the region's Metropolitan Planning Organization (MPO). It is the decision-making body for all regional transportation plans and programs for the northeastern Illinois Metropolitan Planning Area. The MPO Policy Committee plans, develops, and maintains an affordable, safe, and efficient transportation system for the region, providing the forum through which local decision makers develop regional plans and programs.

The CMAP Board and MPO Policy Committee have jointly adopted a memorandum of understanding that is the framework for integrating land use and transportation through CMAP's regional comprehensive planning process. It was most recently revised and reaffirmed on June 19, 2019. The agreement covers the working relationship between the two boards, whose responsibilities are defined in the Regional Planning Act and federal legislation. By adopting this agreement, the MPO Policy Committee and CMAP Board affirmed their commitment to coordinate and integrate the region's planning for land use and transportation in an open and collaborative process.

Metropolitan Planning Area

The Metropolitan Planning Area (MPA) is the region in which the federally regulated metropolitan transportation planning process must be carried out. The MPA encompasses the Census-defined urbanized area and the contiguous geographic area(s) likely to become urbanized within the next 20 years. Portions of the Chicago, IL-IN urbanized area extend into northwest Indiana. By agreement, the Northwestern Indiana Regional Planning Commission assumes responsibility for these areas. By a similar agreement, the Southeastern Wisconsin Regional Planning Commission assumes responsibility for the portion of the Round Lake Beach-McHenry-Grayslake, IL-WI urbanized area that extends into Wisconsin.

The 2010 Census included portions of DeKalb County in northeastern Illinois' urbanized area. In March 2013 the CMAP Board and MPO Policy Committee approved expanding the MPA to include Sandwich and Somonauk townships in DeKalb County. The governor approved the expanded MPA in September 2014. Revisions to the MPA as a result of the 2020 Census are not required to be finalized until June 1, 2024, and are therefore not reflected in this document.

In addition to planning for the urbanized area, the MPO Policy Committee is responsible for transportation planning in the air quality nonattainment area. The nonattainment area includes Goose Lake and Aux Sable Townships in Grundy County, which are outside the MPA. An agreement between Grundy County and CMAP establishes that CMAP is responsible for federally regulated transportation planning in this township. Chapter 5 includes more details regarding the non-attainment area and transportation conformity requirements.

About the TIP

The CMAP Transportation Improvement Program (TIP) consists of two parts: this document describing the metropolitan planning and programming process, and the approved list of projects for the CMAP planning area. This document is subject to the requirements described below and is updated at least every four years. In between updates, other documents and resources referenced in this document may be updated from time to time. These updates can be found on the CMAP website (www.cmap.illinois.gov), typically under the MPO Policy Committee or Transportation Improvement Program headings. CMAP makes every effort to maintain consistent URL addresses when updates are posted to the CMAP website. However, readers of this document may contact CMAP staff for assistance locating the most current version of any resource linked in this document. The approved project list is amended frequently and is managed with an online database called eTIP, described later in this chapter.

Requirements

The requirements for the development and content of the TIP are contained in Title 23 USC §450.326. The TIP is required to cover a minimum of four years, must be updated at least every four years, and must be approved by the MPO and the governor. Years beyond the required four years are considered informational by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA). In nonattainment and maintenance areas, the MPO, FHWA, and FTA must make a conformity determination in accordance with the requirements of the Clean Air Act and the U.S. Environmental Protection Agency's (U.S. EPA) transportation conformity regulations (40 CFR Part 93, Subpart A). The TIP must be developed to ensure that when implemented, the projects included in the TIP will help the region to make progress toward achieving the performance targets established under Title 23 USC §450.306(d) and must include a description of the anticipated effect of the TIP toward achieving the performance targets. The projects contained within the TIP must be consistent with the goals of the metropolitan transportation plan and must be able to be implemented using the public and private resources identified in the financial plan included in the TIP. All regionally significant projects requiring an action by the FHWA or the FTA, regardless of fund source, must be included in the TIP.

Overview of the CMAP TIP

The Federal Fiscal Year (FFY) 2023-28 TIP is one of the short-term implementation tools for ON TO 2050, the region's comprehensive regional plan and federally required long-range transportation plan. The TIP is metropolitan Chicago's six-year agenda of surface transportation projects. Based on federal fiscal years that start on October 1, the TIP includes projects expected to receive federal funding in each FFY. The TIP also includes regionally significant projects funded by non-federal sources. Non-federally funded projects that are not regionally significant are not required to be included in the TIP. Many local/municipal, township, county, state, and tollway projects fall into this category.

The TIP is a tool for communication between different levels of government and the general public. It helps the transportation community and the public track the use of local, state, and federal transportation funds. The TIP also facilitates a discussion about regional transportation needs and helps MPO members, other transportation implementers, and planning organizations establish a transportation program that implements the goals of ON TO 2050, as described in detail in Chapter 2.

Project programming is a dynamic process. Competition for the limited funds detailed in Chapter 3 arises from demands to maintain the system, make improvements to alleviate congestion, improve air quality and safety, and develop alternatives that respond to shifting travel demands and economic development opportunities. Project selection is described in Chapter 4, and conformity analysis requirements and the analysis performed by CMAP are further explained in Chapter 5. The dynamic nature of project programming and the large number of projects in the TIP result in numerous TIP revisions throughout the year. Revisions may be made to a project's scope, fund sources, cost, and/or schedule, and projects may be added to or removed from the TIP. Revisions to projects that affect air quality conformity are made semi-annually. The process for the submittal and approval of TIP revisions is detailed in Chapter 6.

The eTIP database

The most significant element of the TIP is the program of projects. The online eTIP database, described in detail in Chapter 6 and Appendix 1, is the official record of federal transportation funding and regionally significant state or locally funded projects. The database is a secure online tool for programmers to submit new projects and project changes for consideration by the CMAP Transportation Committee and MPO Policy Committee. The Federal Highway Administration and Federal Transit Administration (FTA) use the eTIP database to ensure that projects submitted for federal participation are deemed a priority for the region. The database can also be used by the public to view upcoming transportation projects in their community and the region.

The eTIP public site etip.cmap.illinois.gov displays the most recently approved program of projects. Visitors to the site can search, filter, and sort the approved TIP projects, view project details, including a history of project amendments, select and view projects by county, and locate projects on an interactive map. Project details can be printed, and project lists can be downloaded.

The secure website is used for the submittal, management, and approval of TIP amendments, verification of fiscal constraint, and tracking of FHWA obligations. The secure site is used by the more than 30 programmers that represent local, regional, state, and federal governments, and transportation providers that partner with CMAP to develop the TIP.

Partners involved in the TIP development process

Numerous partners have roles in developing the TIP and directly programming projects for implementation.

Local government

Municipalities, counties, and townships plan, design, engineer, construct, operate, and maintain local transportation facilities and services.

Municipalities

The Council of Mayors provides a conduit for communication between local elected officials and regional transportation agencies. The Council of Mayors Executive Committee was formed in 1981 and was organized to formalize and strengthen input from the region's suburban municipalities regarding regional transportation planning and programming decisions. The committee helps to develop policies to assist the region in meeting air quality and transportation planning requirements and to assure regional equity in planning and funding decisions. Each of the 11 subregional councils is represented on the Council of Mayors Executive Committee and is responsible for programming local municipal projects in the TIP. Subregional council staff also assist townships, park districts, forest preserve districts, and other local entities with programming and managing project implementation in the TIP.

The City of Chicago participates in TIP development through the Chicago Department of Transportation (CDOT) and the Chicago Department of Aviation (CDOA).

Counties

The counties plan and program transportation improvements for their jurisdictions. County staff often assist townships and forest preserve districts with programming and managing project implementation in the TIP. There is also strong programming coordination between the counties and the subregional councils, particularly for federally funded projects.

Operating agencies

State of Illinois

The state plans, programs, finances, and implements major transportation projects throughout Illinois via the Illinois Department of Transportation (IDOT).

Illinois Tollway

The Illinois State Toll Highway Authority (Tollway) operates, builds, and maintains an extensive toll highway system in northern Illinois and is responsible for programming regionally significant projects in the TIP.

Transit agencies

The region's three service boards — the Chicago Transit Authority (CTA), Metra, and Pace — operate and maintain the region's transit system, with financial oversight, funding, and regional transit planning from the Regional Transportation Authority (RTA). Each service board and the RTA are responsible for programming projects in the TIP.

Class I railroad companies

Class I railroads participate in program development through their coordination with other regional transportation agencies and their participation in CMAP's committee structure. The railroads partner with other agencies to program publicly funded projects in the TIP.

Public Participation

Consistent with Title 23 USC §450.316, CMAP's Public Participation Plan was updated in June 2019 to guide CMAP's proactive public engagement of the residents and constituencies of northeastern Illinois to plan a multi-modal transportation system that meets the region's economic, development, and sustainability goals. The Public Participation Plan establishes core values for public engagement, explains how CMAP conducts meaningful and accessible public participation, and outlines strategies for broadening and deepening the agency's public engagement in its planning processes, including engagement of residents in the region's economically disconnected areas and those with limited English proficiency.

The development of ON TO 2050 was a publicly driven process and included activities such as keypad polling, workshops, topical forums, and interactive kiosks. More than 100,000 people from across the region were engaged in this process. The ON TO 2050 Update reaffirms the region's commitment to the principles, goals, and strategies developed through that collaborative process. It also refreshes the region's socioeconomic forecast, travel model, indicators and system performance, financial plan, conformity analysis, and regionally significant projects, as required quadrennially by federal law. As a result, the public participation in the update process included a series of roundtable discussions with community and government stakeholders, as well as an informational webinar and hearing for the general public. As discussed in Chapter 2, ON TO 2050 influences the investment decisions that lead to the development of the TIP and the selection of individual projects discussed in Chapter 4. The proposed 2023-28 TIP was included as part of the outreach for the ON TO 2050 Update.

The TIP program of projects is updated and amended regularly through the CMAP Transportation Committee, as described in Chapter 6. Amendments are posted on the eTIP public website, and linked within committee meeting materials that are available for public comment one week prior to committee consideration. Major project changes with the potential to affect the region's air quality undergo a conformity analysis that is reviewed and released for a 30-day public comment period by the Transportation Committee, and is presented to the CMAP Board for a recommendation to the MPO Policy Committee for approval. The public is encouraged to attend all CMAP committee meetings, and materials for those meetings are posted to the CMAP website one week prior to committee meetings.

Title VI & environmental justice

ON TO 2050 includes inclusive growth as one of the three principles and provides the basis for analysis for environmental justice and Title VI.

As a recipient of federal funds from FHWA and FTA, CMAP complies with Title VI of the Civil Rights Act. CMAP operates its programs and services without regard to race, color, and national origin. The Title VI Program is updated periodically and was last updated in June 2017.

CMAP complies with the provisions of the Environmental Justice Executive Order 12989. The TIP is consistent with ON TO 2050 with respect to environmental justice.

Chapter 2: Relationship to ON TO 2050

ON TO 2050 is the regional comprehensive plan and long-range metropolitan transportation plan for northeastern Illinois. The development of ON TO 2050 built on three years of work, including goal setting, technical analysis, research, public engagement, and development of shared priorities. The agency's committees and many partner organizations played a significant role in developing and implementing the plan's recommended policies and investments, and will continue to play a role in the plan's ongoing implementation. The Transportation Improvement Program (TIP) is one of the plan's implementation vehicles and has a role to play in accomplishing the recommendations of the plan.

ON TO 2050 framework

The development of ON TO 2050 identified three clear, overarching principles that inform every recommendation in the plan: inclusive growth, resilience, and prioritized investment. Each principle supports the others. Resilience depends on robust investments and planning that prepare the region for future changes, both known and unknown. In turn, achieving true resilience requires inclusive growth so that the region's residents, families, and households have sufficient resources to respond when a crisis occurs and have the ability to fully participate in economic and civic life. And the need for inclusive growth likewise necessitates prioritized investment, which ensures our resources are carefully targeted to achieve local and regional goals, while broadening economic participation to increase and sustain prosperity. Together, the three principles cut across ON TO 2050's core recommendations for regional prosperity, community, environment, governance, and mobility.

ON TO 2050 Mobility principles and recommendations

The three principles of ON TO 2050 are embedded throughout the *Mobility* chapter. This chapter outlines recommendations to prioritize investment of limited resources to efficiently maintain existing infrastructure while securing new revenues for needed enhancements; improve resilience by ensuring that infrastructure can adapt to changes in climate and technology; and promote inclusive growth by improving mobility options that spur economic opportunity for low-income communities, people of color, and people with disabilities. These principles guide the below recommendations that are considered in a variety of ways when project selection is completed by each programming or implementing agency.

Harness technology to improve travel and anticipate future impacts (full recommendation)
Transportation technology is evolving rapidly, providing opportunities to more effectively manage the region's existing transportation assets and provide more seamless multimodal travel for people and goods throughout the region. There are near-term opportunities to coordinate traffic operations, invest in communications technology, and better leverage and communicate real-time data about the transportation system.

Projects in the TIP that include in their scope of work Intelligent Transportation Systems, Signal Modernization, Interconnects and Timing, Electronic Tolling, Travel Demand Management, upgrades to rail Communications, Power, and Signal (CPS) infrastructure, and other facility modernization support this recommendation. Project selection methodologies that place an emphasis on inclusion of technology solutions also support this recommendation.

Make transit more competitive (full recommendation)
The region's public transit system has long been one of Chicagoland's most critical assets. Even as travel patterns change and private transportation services proliferate, the region needs to make public transit a competitive option in order to stay competitive in the global economy. Making transit competitive requires coordinated regional action, not just by transit agencies, but also by municipalities, road agencies, and funding authorities. Transit agencies need to balance increased investment in transit's core strengths — frequent, fast, reliable service in areas of moderate and high density — with its role in providing critical access to opportunity for people with limited mobility or without access to personal vehicles. Transit agencies alone cannot increase ridership. Municipalities need to plan for transit-supportive land uses, particularly increased employment densities near transit, in order to enable future service enhancements. Road agencies can facilitate design and policy changes that improve transit service operating on their facilities. Most crucially, the region as a whole needs to commit to raising additional funding for needed transit improvements.

Projects in the TIP that include in their scope of work improvements and additions to transit facilities, operations, and assets, and projects that include improvements to bicycle and pedestrian facilities to increase access to transit support this recommendation. Project selection methodologies that place an emphasis on ensuring funded projects improve access to transit also support this recommendation.

Retain the region's status as North America's freight hub (full recommendation)
The massive concentration of freight activity in northeastern Illinois provides a competitive advantage that helps to drive the regional economy. A robust freight network also ensures that residents and businesses get the goods they need in a timely manner. However, freight activity raises significant infrastructure and regulatory challenges and can have significant impacts on local quality of life. Effective policy, planning, and programming for freight across the region must involve collaboration across the public and private sectors to carefully balance economic, livability, and infrastructure funding concerns. Although the region's counties and transportation stakeholders have recently come together to improve truck permitting and implement the recommendations of the Chicago Region Environmental and Transportation Efficiency (CREATE) program, they must pursue more collaborative action on funding, policy, and project development to truly support our freight network. Local governments have important tools to support the efficient movement of freight, orderly development of freight facilities, and appropriate balance between local costs and benefits of freight activity, but need assistance from other stakeholders to analyze and address freight issues that cross jurisdictional boundaries.

Projects in the TIP that include in their scope of work railroad grade separations, improvements to rail infrastructure, and improvements to highway facilities to accommodate trucks support this recommendation. Project selection methodologies that place an emphasis on the safe and efficient movement of freight and goods also support this recommendation.

Leverage the transportation network to promote inclusive growth (full recommendation)
Cultivating high-quality, context-sensitive transportation options that link low-income communities and people of color to jobs, training, and education improves quality of life and promotes inclusive growth, which can lead to longer and stronger periods of economic growth for the entire region. The policies and investments that created persistent patterns of exclusion and segregation have also led to excessive commute times between some marginalized communities and growing regional employment centers. As the region pursues aggressive strategies to maintain and improve the transportation system, we must do more than prevent these populations from falling further behind. We must take intentional steps to support them in catching up. This will mean focusing resources on authentic engagement, building local

capacity to compete for public investments, improving commute options, and improving access to public rights of way.

Projects in the TIP that include in their scope of work improvements to multimodal access, public transit, ride-sharing, or bike-sharing service increases or improvements support this recommendation. Project selection methodologies that improve access to transportation funding for economically disadvantaged communities also advance this recommendation.

Improve travel safety (full recommendation)
Perhaps the most fundamental duty of any transportation provider is to protect the safety of those in the public right of way. Improved roads, vehicle technologies and public policies have dramatically reduced traffic injuries and fatalities over the last 40 years but have yet to eliminate driver behaviors, such as speeding and distracted driving, which are the primary causes of crashes. In fact, traffic fatality rates have been climbing in recent years, particularly for crashes involving cyclists and pedestrians. While focusing on eliminating traffic fatalities by 2050 is an aggressive goal, it is achievable through a combination of strategies, including improving roadway design and incident management, expanding use of safety data in transportation funding decisions, and improving driver training and enforcement policies. Striking the right balance among these strategies is important, particularly in communities of color that experience disproportionately high rates of serious injuries and fatalities, but also raise serious concerns around racial profiling, use of force, and disproportionate impacts of traffic fines. Nearly every TIP project that includes an infrastructure component incorporates safety improvements in support of this recommendation.

Projects funded with federal Highway Safety Improvement Program (HSIP) funds or Safe Routes to Schools (SRTS) funds are among the many projects that are primarily focused on addressing safety. Project selection methodologies that place an emphasis on ensuring funded projects improve safety for all system users also support this recommendation.

Improve resilience of the transportation network to weather events and climate change (full recommendation)
A resilient transportation network is one that can continue to provide seamless mobility, even in the face of a changing climate. Approximately half of the days in a typical year have weather conditions that affect driving and contribute to road closures, traffic slowdowns, crashes, and damage to electronic devices such as traffic lights, message signs, and cameras. Climate change is already causing more frequent road flooding, snowstorms, and heat- and cold-related pavement and communication failures. These capacity and performance issues are only expected to worsen. The region needs to anticipate worsening disruption of the transportation system caused by climate change as it invests in reconstructing and enhancing existing transportation assets. In addition, implementing the electricity and communications infrastructure that supports traffic management under normal operating conditions can enable the transportation system to respond to extreme conditions.

TIP projects that improve traveler information and incident management, and projects that address stormwater and flooding issues support this recommendation. Project selection methodologies that place an emphasis on inclusion of green infrastructure and sustainability also support this recommendation.

Fully fund the region’s transportation system (full recommendation)
Northeastern Illinois needs to invest in maintaining and enhancing the transportation system to keep up with demand and promote regional economic vitality. However, traditional transportation revenue sources can no longer keep up with increasing costs, and without additional sustainable, dedicated, adequate revenue sources, the region will be unable to maintain the system in its current state of repair, let alone implement needed enhancements.

Projects selected for inclusion in the TIP are limited by the resources available. More robust programs would be possible with this recommendation.

Enhance the region’s approach to transportation programming (full recommendation)
The scarcity of transportation dollars demands that they be spent wisely and transparently. In the CMAP region as well as the rest of the state, transportation funding is largely allocated via formulas set in law or simply adhered to by custom. These formulas are not responsive to changing conditions, can spread funding too thin for any individual agency to accomplish more significant projects, and can prompt decision makers to focus on the money itself rather than on how individual projects address or do not address transportation needs. Performance-based funding promises a more accountable process for programming transportation projects, using a variety of measures to allocate scarce resources. Implementing asset management plans for roads and transit facilities can help communities maintain better infrastructure conditions over a longer term at lower costs.

The TIP is the mechanism for implementing this recommendation. The application of performance targets and project selection processes are described in greater detail throughout this document.

Build regionally significant projects (full recommendation)
Regionally significant projects (RSPs) are capital investments in the region’s expressways, transit system, and arterials with impacts and benefits that are large enough to warrant additional discussion through the regional planning process. These include large reconstruction projects and additions to the system. ON TO 2050 focuses particularly on projects that reconstruct or enhance the existing network, with few expansion projects. Implementation of many of these projects will require action not only on the projects themselves, but on implementing strategies to provide additional local, regional, state, and federal transportation revenues.

The inclusion of RSPs in the TIP, as described in more detail later in this chapter, supports this recommendation.

Performance Targets

One of the most significant policy changes in the federal Moving Ahead for Progress in the 21st Century (MAP-21) transportation law, enacted in 2012, was to institute a national performance measurement system for the highway and transit programs. Implementation of this system requires state DOTs, MPOs, and transit agencies to work together to set targets that define the performance they want to achieve. Select federal performance measures for infrastructure condition, safety, congestion, and emissions are closely aligned with recommendations in the ON TO 2050 *Mobility* chapter. Some of these measures are plan indicators and are described in detail in the *Indicators* appendix and the *Systems Performance Report* appendix of the plan update. Each measure includes a description, methodology, and discussion of the region’s targets. As projects progress to implementation, potential impacts will be compared to actual impacts to develop strategies for focusing programming on projects that have a positive effect on the performance targets.

TIP programmers self-identify if each project has the potential to influence one of eight performance target categories: safety, pavement condition, bridge condition, travel reliability/congestion, non-single-occupant vehicle (SOV) travel, emissions reduction, transit asset condition, and transit safety based on project types, work types, and other scope elements described in these guidelines. As summarized in the table below, 93% of all TIP projects have the potential to impact one or more of the performance target categories. Projects that do not influence the targets may include transit operations, transit-support facilities, highway drainage projects, shoulder sweeping, and other miscellaneous work. This information is analyzed in greater detail in the annual Obligations and Performance Reports.

TIP project count and cost by performance target category, as of July 29, 2022

Performance target category	Number* of projects	% of projects	Total cost of projects	% of total cost
Highway Safety	390	23%	$4,007,742,559	13%
Pavement Condition	630	37%	$4,958,747,852	16%
Bridge Condition	386	23%	$5,304,002,179	17%
Congestion Reduction	175	10%	$4,525,899,140	15%
Non-SOV Trips	273	16%	$3,273,160,734	11%
Emissions Reduction	194	11%	$2,407,615,655	8%
Transit Asset Condition	90	5%	$12,193,545,463	39%
Transit Safety	96	6%	$6,455,673,180	21%
None	104	6%	$4,171,639,291	13%
All TIP Projects**	1688	---	$30,965,728,529	---

*Note: 28% of the projects have the potential to impact multiple performance targets and are reported (number and cost) in all categories of potential influence.
**Excludes illustrative projects, many of which are ON TO 2050 RSPs that influence multiple performance target categories.

While the self-identification of projects' potential impacts on performance targets is one step toward connecting targets to actions, CMAP must also work with regional partners and programmers to develop plans, targets, and programming methodologies going forward. As implementers have been developing safety and asset management plans, CMAP works with them to understand how policies are developed and how those will impact performance measures. For example, a switch to preventative maintenance of pavement can increase short-term costs and/or potentially increase the amount of pavement in poor condition as reconstruction resources are reallocated to preventative maintenance. However, over the medium to long term, this should result in a net improvement in system condition.

The development of asset management plans for both highways and transit has also increased regional understanding of the data sets available, regional needs, and best practices in asset management. This has resulted in the use of this data both directly by CMAP and partners.
CMAP is building on the work done at the state and regional level to bring these concepts to more partners. CMAP has assisted over 65 municipalities and one county in northeastern Illinois in developing pavement management plans. In addition, CMAP's Local Technical Assistance team is now completing the first local safety plan and will incorporate lessons learned into future local safety plans, and other plans developed by the team.

CMAP has also incorporated the performance target categories into the project selection methodologies for the region's allotments of STP, CMAQ, and TAP funding – placing greater value on projects that can do more to influence the targets. The performance targets and ON TO 2050 indicators are also a significant part of the RSP project evaluation process.

Draft note: Links and data within this section are subject to change prior to final publication.

Regionally significant projects

Regionally significant projects (RSPs) are capital investments in the region's expressways, transit system, and arterials with impacts and benefits that are large enough to warrant additional discussion through the regional planning process. These include large reconstruction projects and additions to the system. The federal government requires regional planning agencies to demonstrate fiscal constraint by determining that sufficient resources will be available to construct projects recommended in the plan. Careful selection of these projects must meet the federal standard of fiscal constraint, while also helping to achieve regional goals. These constrained projects can help the region meet today's needs, adapt to changing mobility patterns for goods and people, and support economic success overall. Only constrained projects are eligible to receive federal transportation funds and obtain certain federal approvals. Investment in RSPs must balance many priorities, including carefully allocating the region's limited transportation revenues. The ON TO 2050 Update therefore includes a relatively small number of constrained RSPs as priorities and recommends further study of others that are classified as "unconstrained." The plan update focuses particularly on projects that reconstruct or enhance the existing network, with limited expansion projects. This is due in part to the plan's priorities and to fiscal constraint. Implementation of many of these projects will require action not only on the projects themselves, but on implementing additional local, regional, state, and federal transportation revenues. To identify constrained RSPs, CMAP solicited candidate projects from partner agencies and undertook an extensive evaluation of the benefits of the projects, which is documented in the *ON TO 2050 Update Regionally Significant Projects Benefits Report*. Candidate projects meet one of the following thresholds:

1. Costs at least $100 million and either (a) changes capacity on the National Highway System or is a new expressway or principal arterial, or (b) changes capacity on transit services with some separate rights of way or shared right of way where transit has priority over other traffic.

2. Costs at least $250 million and improves the state of good repair for a particular highway or transit facility.

Evaluation of each project focused on the current need, the modeled benefit with 2050 population and employment, and the degree to which the project fits with ON TO 2050 planning priorities.

Regardless of the implementation schedule for RSPs, these projects are included in the approved TIP project list and all associated conformity determinations. RSPs that will be funded, in whole or in part, in FFYs 2025-50 are considered to be illustrative. Early planning phases of RSPs that are classified as “unconstrained” may also be included in the approved TIP, but in order for funding for design, right of way acquisition, construction, or implementation of these projects to be included in the TIP, the ON TO 2050 Update would need to be amended. For the purposes of constraining RSPs in the ON TO 2050 Update, the cost of fixing existing infrastructure is accounted for separately in the financial plan forecast, and only the cost associated with new capacity requires identifying additional available resources to meet fiscal constraint. In the TIP, all project costs are accounted for, including components that are considered maintenance or system preservation in ON TO 2050.

Chapter 3: Financial Plan

Project programming is a dynamic process. Competition for limited funds arises from demands to maintain the system, make improvements to alleviate congestion, improve air quality and safety, and develop alternatives that respond to shifting travel demands and economic development opportunities. The resources available for transportation projects come from a variety of federal, state, local, and private sources. The cost of projects selected for inclusion in the 2023-28 TIP cannot exceed the revenues that are reasonably expected to be available in those years, from both public and private sources.

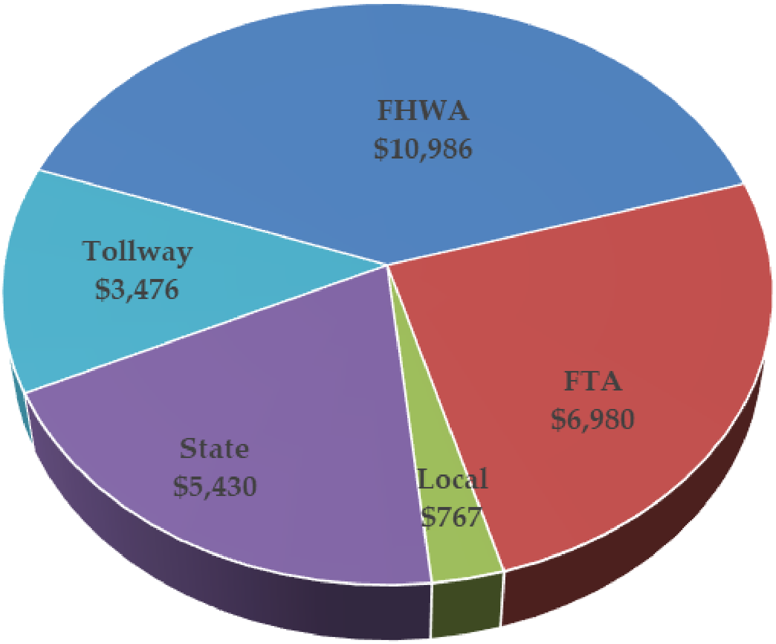
Financial resources

Projects in the TIP are funded through a combination of public and private sources. Public funding is the primary source of funding in the TIP. Public funding is a combination of federal, state, regional, and local funds. The major sources of public funds are a variety of taxes, such as motor fuel taxes (federal, state, and local), sales taxes (state and local), vehicle registration fees, and tolls (particularly from the Tollway).

Forecasting future funding levels, even in the short term, requires several assumptions to be made. The first assumption is that federal transportation programs will continue through FFY 2028 and that the modest (about 2%) annual increases identified for many programs in the IIJA will be enacted each year. In addition to the expected increases in federal funding, state and local funding levels have seen significant increases with the passage of the Rebuild Illinois Capital Plan and the Tollway's *Move Illinois: The Illinois Tollway Driving the Future* capital program. Theses revenues can reasonably be expected to be available for capital programming during FFY 2023-2028.

CMAP estimates that there will an unprecedented level of investment of $28.35 billion available to implement projects in the TIP during this six-year period, or approximately $4.7 billion annually. This is significantly more than the region has typically obligated or awarded annually. Over a four-year period (2016 - 2019) the region averaged $3.15 billion in obligations and awards. Figure 1 illustrates the estimates of public funding for capital investments that CMAP reasonably expects will be available for programming in the TIP between FFY 2023-28.

Figure 1:
Estimated FFY 2023 - 2028 Available Funding for Programing in the TIP (millions)



While federal regulations allow for the use of reasonably expected revenues in constraining the TIP, CMAP relies on a more conservative approach using actual apportionments for fund sources that are active in the baseline year of the TIP and only those slight increases that are codified in law. Further, the CMAP region is classified as a nonattainment area for Ozone and must therefore limit revenues in the first two years of the TIP to those for which funds are available or committed.

CMAP updates the baseline estimates on an annual basis by developing a state/regional resources table. The table is provided to CMAP's Transportation Committee for information and is posted on the CMAP website as part of the TIP documentation. Though it is uncommon, this table may be updated more often than annually to reflect changes to actual apportionments. The resources included in the table are reflected in the eTIP database, and funds cannot be programmed in excess of these resources. To ensure continuity in programming, when updated each year, the estimated resources are projected for the next five years, even though the final year(s) may extend beyond the period (FFY 2023-28) of this TIP document; any funds programmed in those years are considered illustrative. The sections below describe the resources included in the state/regional resources table. In addition to forecasting future federal resources, estimates of previously unobligated FHWA funds are also compiled annually. These funds are referred to as carryover funds and are only made available to program in the TIP in current FFY. These funds are not new funds and are not included in the estimates of reasonably expected revenues shown in Figure 1.

Federal resources

Projects in the TIP make extensive use of federal transportation funding. On an annual basis, CMAP develops estimates for specific formula-based federal transportation funding programs that are available to the region.

FHWA State Resources:
FHWA State Resources are funds that are programmed by IDOT. Historically 45 percent of all of the federal resources available to IDOT statewide are obligated in northeastern Illinois, but that percentage varies considerably by individual federal fund source. Because it is impossible to predict from year to year what specific mix of federal fund sources will be utilized by IDOT on projects in the CMAP area, the current practice is for 74% of the state apportionment of FHWA sources to be made available for programming in the TIP to give IDOT maximum flexibility to program these funds as circumstances dictate. The apportionments are derived from FHWA apportionment notices and reflect apportionments as shown in the FHWA's Financial Management Information System (FMIS). It is the responsibility of IDOT to ensure that the State Transportation Improvement Program (STIP) fiscal constraint determination considers all programming of federal funds statewide.

FHWA Regional Resources:
FHWA Regional Resources are funds that are programmed by CMAP and local agencies such as the Councils of Mayors or Counties. Regional resources are based on FHWA suballocation of apportionment guidance, and IDOT memorandums and circulars pertaining to regional resource allocations for STP-Local, STP-Shared Fund, TAP-Local, STP-Bridge, and STP-County.

FTA Resources:
FTA Resources are available to the RTA and its service boards for programming. These formula funds are apportioned by urbanized area. As discussed in Chapter 1, the CMAP MPA includes two urbanized areas, both of which extend beyond state boundaries. FTA apportionments for the entire area are published in the Federal Register and are split between northeastern Illinois and northwestern Indiana, and between northeastern Illinois and southeastern Wisconsin. These urbanized area splits are negotiated annually and approved by the three MPOs. The most current resolutions documenting these splits are available on the MPO Policy Committee webpage.

After the urbanized area splits have been negotiated, the RTA suballocates these funds among the service boards. These suballocations are then used to constrain programming in the TIP by FTA fund source and transit agency.

State resources

There are a variety of state resources, including public transportation funds, state motor fuel tax, vehicle registration fees, and bonds, which are used not only to maintain, operate, and enhance the existing system, but also to provide matching funds for projects using federal funds. These funds must be appropriated by the Illinois General Assembly. The use of state funds for programming in the TIP is not constrained.

Local resources

The region has a variety of local resources that are used to maintain and operate the existing system, provide matching funds for projects using federal funds, and fund transportation improvement projects throughout the region. Local motor fuel tax, sales tax specifically collected for distribution to transit agencies, and Tax Increment Financing (TIF) district funds are examples of these fund sources. Toll revenues collected by the Tollway for exclusive use by the Tollway are also considered a local fund source. The use of local funds for programming in the TIP is not constrained.

Other reasonably expected revenues

The ON TO 2050 financial plan forecasts revenues and expenditures to maintain and operate the transportation system in northeastern Illinois. To allow for operating and maintaining the system in its current condition over the planning period, as well as system condition improvements, system enhancements, and capacity expansions to be implemented, reasonably expected revenues are considered and included in the ON TO 2050 Update financial plan revenue forecasts. In addition to the federal, state, and local revenue amounts and sources previously mentioned, ON TO 2050 anticipates that other revenues described in the *ON TO 2050 Update Financial Plan for Transportation Appendix* will become available between FFY 2023-28. Where action is needed by the federal government, State of Illinois, and municipalities to realize these revenues, CMAP does not program against them in the TIP until the necessary action is taken by these bodies.

Operations and maintenance

The *ON TO 2050 Update Financial Plan for Transportation Appendix* details the assumptions and methodologies for forecasting system-level costs and revenue sources that are reasonably expected to be available to adequately operate and maintain federal-aid highways and public transportation. Forecasts for the costs of operations and administration were estimated from historical expenditures. The forecast for maintenance costs is based on the investment needed to maintain current conditions and not increase the backlog of facilities in fair or poor condition. While more public funding is necessary to bring the transportation system into a better state of good repair, forecasted revenues are sufficient to maintain the existing road network and operate the region's transit system over the period covered by the TIP. IDOT's Multi-Year Improvement Program (MYP) for state fiscal years 2023-28 allocates 68% of the state program to maintaining roads and bridges. The *2022 RTA Operating Budget, Two-Year Financial Plan, and Five-Year Capital Program* indicate that the region will have enough resources to adequately operate the transit system.

Demonstration of fiscal constraint

CMAP utilizes the eTIP database for ensuring fiscal constraint is maintained on a continuous basis. The revenues discussed above are input into the eTIP constraint tables by fund source and FFY, and in the case of suballocated sources, by the lead programming agency. All individual financial line items utilizing these constrained sources are summed and a report of the balance between revenues and programmed funds is provided. The report is accessible to CMAP staff, TIP programmers, IDOT, FHWA, and FTA staff, can be generated at any moment in time, and can be filtered to include in-progress, pending, and/or approved TIP changes. While the default report view provides subtotals by fund source, users can expand the report to include a list of all project line items included in those subtotals. The TIP is determined to be constrained when the balances for all fund sources are zero or positive. In the event that pending changes cause any balance to be negative, CMAP staff utilizes the project-specific information to work with individual programmers to resolve over-programming of funds. Each FFY is summed independently, and balances in any year are assumed to be carried forward to the next year.

Fiscal constraint and Advance Construction

Advance Construction (AC) is an innovative financing tool in which FHWA allows states to accelerate transportation projects using non-federal funds while maintaining eligibility to be reimbursed with federal funds at a later date. AC is not a funding category and does not provide additional federal funding. As no federal funds are actually obligated when in AC status, these funds are not subtracted from available revenues when determining constraint. When IDOT is ready to seek federal reimbursement of these funds, typically upon receiving an invoice for work completed, a conversion from AC to federal obligation is requested. These conversions are indicated as “ACC,” or Advance Construction Conversion, in the TIP. Once converted to ACC, funds are again subject to fiscal constraint. IDOT utilizes an automated system to notify programmers of both AC and ACC actions on a weekly basis, so that these actions are accurately represented in the TIP programming information and fiscal constraint determination.

Chapter 4: Project selection

The programming process in northeastern Illinois is complex and is carried out by a number of partner agencies. Programming begins with the selection of projects, and the authority to make those selections varies primarily by fund source. While all project selection processes consider the priorities of ON TO 2050, many processes include additional considerations, as described in this chapter. While the authority to select projects varies, the region collaborates on project selection and program development through committees such as CMAP's STP Project Selection Committee and CMAQ Project Selection Committee, and through a variety of cooperative agreements and the implementation of Unified Work Program projects and studies.

Projects selected by CMAP and Subregional Councils

The Infrastructure Investment and Jobs Act (IIJA) apportions certain federal funds to urbanized areas and non-attainment areas and delegates project selection authority to the MPO. The methodologies used by CMAP to select projects that will utilize these funds are described below.

CMAQ and TAP-L

The federal Congestion Mitigation and Air Quality (CMAQ) Improvement Program provides funding to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide, or particulate matter. Eligible activities include public transit, bicycle and pedestrian facilities, travel demand management strategies, alternative fuel vehicles and facilities serving these vehicles, diesel retrofits and replacements, shared micromobility, and other projects likely to contribute to the attainment of maintenance of a national ambient air quality standard. The federal Transportation Alternatives Program (TAP) is funded with a set-aside of Surface Transportation Block Grant (STBG) funding for smaller-scale projects such as pedestrian and bicycle facilities, recreational trails, safe routes to school, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity. The portion of the set-aside that is programmed by the MPO is referred to locally as TAP–Local or TAP-L.

CMAP utilizes a competitive process to select projects for inclusion in the CMAQ and TAP-L programs. The program development and management is overseen by the CMAQ and TAP Project Selection Committee (CMAQ PSC). Application requirements, scoring criteria, and other elements of project selection are reviewed by the CMAQ PSC prior to each call for projects, which generally occur every two years and are documented in a Program Application Booklet. The most recent call for projects occurred in 2021, and the next call is anticipated in 2023. Information on the most recent call for projects and historic programs is available on the CMAQ/TAP-L Program Development webpage.

The primary consideration for CMAQ project selection is the cost-effectiveness of projects' air emissions reductions. Additional Transportation Impact Criteria are evaluated and used as a secondary scoring measure. Completion of the Regional Greenways and Trail Plan is the primary focus of the TAP-L program.

STP

Federal Surface Transportation Block Grant (STBG) funding, programmed by CMAP as STP-Local and STP-Shared, provides a suballocation of funding to the urbanized area from funds apportioned to the state for a broad range of eligible transportation projects. Due in part to the broad project eligibilities, historic practices, and differing subregional emphasis on the individual priorities of ON TO 2050, a portion of the STP programming authority is delegated to the regional Councils of Mayors and City of Chicago by the MPO Policy Committee. The distribution of funding and programming procedures are outlined in an agreement between the Council of Mayors and City of Chicago.

Regional Shared Fund (STP-Shared)

The shared fund was established for the purpose of supporting larger-scale regional projects that address regional performance measures and the goals of ON TO 2050. The programming authority distributed to the shared fund is derived from a set-aside of the region's annual allotment of STP funds. Project selection is a region-wide competitive process overseen by the STP Project Selection Committee (STP PSC).

Project eligibility is focused on projects of significant cost and multi-jurisdictional projects in eight categories that address federal performance measures and priorities of ON TO 2050: road reconstructions, transit station rehabilitation or reconstructions, bridge rehabilitation or reconstructions, highway/rail grade crossing improvements, road expansions, bus speed improvements, corridor or small area safety improvements, and truck route improvements.

Projects are selected for funding from applications submitted during calls for projects, which generally occur every two years. The most recent call for projects occurred in 2021, and the next call is anticipated in 2023. Applications are evaluated using the criteria set forth by the STP PSC prior to each call for projects. These criteria emphasize the desire to bring projects to completion, address needs with cost effective improvements, and implement planning factors that are an integral part of ON TO 2050, while also considering local preferences at the subregional level. Information on the most recent call for projects and historic programs is available on the regional transportation call for projects webpage

Local Programs (STP-L)

After the shared fund set-aside, the amount of programming authority distributed to each council and the City of Chicago is calculated via a performance-based formula that determines each subregion's proportional share of the following performance measures on the local jurisdiction system of roadways that are federal-aid eligible:

1. Pavement Condition. To be measured as lane-miles in poor condition as defined in 23 CFR 490.
2. Bridge Condition. To be measured as square feet of deck area in poor condition as defined in 23 CFR 490.
3. Congestion. To be measured as congested centerline miles, until such time as data is available to calculate peak hour excess delay as defined in 23 CFR 490.
4. Safety. To be measured as the number of annual serious injuries and fatalities for the most recent year from IDOT's annual crash data extract.
5. SOV travel. To be measured as the total number of single occupant vehicle (SOV) commuters based on the most recent American Community Survey.

Beginning in 2025, and every five years thereafter, the subregional distribution of programming authority will also include an assessment of improvements made in each subregion since the prior proportional calculation. Up to 10% of the overall regional apportionment will be allocated based on each subregion's proportional share of improvements to the performance measures.

The development of local programs is a transparent, competitive process, subject to public engagement at several steps in the process. Each subregional council of mayors issues a call for projects every two years, on a consistent schedule region wide. The most recent calls for projects were conducted in 2022. Each council uses a published points-based methodology to evaluate and select projects for funding. Likewise, while the City of Chicago does not issue a traditional call for projects, projects proposed from within the Chicago Department of Transportation (CDOT) are evaluated using a points-based methodology. Each individual subregional council and the City establishes its own points-based methodology for selecting projects, and a minimum of 25 percent of those points are allocated to regional priorities that support ON TO 2050. Recommended programs of projects are subject to public comment prior to being adopted by each council or the City, and also undergo public comment as part of the TIP approval and amendment process.

Projects selected by IDOT

The State of Illinois, through IDOT, directly selects projects for implementation with certain federal fund sources and state fund sources. Some selection processes are competitive and open to local agencies, while others are internal to IDOT.

Competitive Programs for Local Agencies

The IDOT Local Programming Matrix provides a high-level overview of funds available to local agencies. Regular calls for projects are held for the Highway Safety Improvement Program, Safe Routes to School (SRTS), and Illinois Transportation Enhancement Program (ITEP), funded in part with the Transportation Alternatives set-aside of STBG funds, the Economic Development Program (EDP), and the Truck Access Route Program (TARP). Historically, IDOT has held regular calls for their Rail-Highway Grade Crossing Safety Program, funded with the federal Railway-Highway Crossings Program (RHCP). See Appendix 2 for the TIP programming codes for these fund sources. The selection criteria for these competitive programs are published in Notices of Funding Opportunities (NOFOs) through Illinois' Grant Accountability and Transparency Act (GATA) portal and through IDOT issued Circular Letters. CMAP generally has an advisory role in the selection of projects under these IDOT programs.

With the enactment of the IIJA, IDOT is likely to revise the Illinois Special Bridge Program (formerly known as the Major Bridge Program) for State Fiscal Year (SFY) 2024 and beyond to utilize Bridge Formula Program funds. IDOT is also evaluating new IIJA programs such as the National Electric Vehicle Infrastructure (NEVI) Formula Program, the Carbon Reduction Program, and the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program, which may lead to additional state and local programming as implementation decisions are made.

Other IDOT programs

Each year, IDOT develops a multi-year, multimodal program of projects utilizing a variety of state and federal fund sources, known as the Multi-Year Highway Improvement Program (MYP). The priorities of the FY 2023 – 2028 program are to maintain and preserve existing roads and bridges, with a special emphasis on the National Highway System (NHS) and structurally deficient bridges on the NHS. IDOT uses a data-driven decision process and policies of the state's Transportation Asset Management Plan (TAMP) to prioritize capacity projects and develop the program. IDOT seeks partner and public input in program development though online surveys, open houses, workshops, and hearings.

Projects selected by transit providers

Guided by the Regional Transit Strategic Plan, the RTA's three service boards operate and maintain the region's transit system utilizing federal, state, and local fund sources. Information on their programming and project selection processes is available on their websites (CTA, Metra, and Pace). The RTA also conducts a competitive process for funding projects under the FTA Section 5310 Enhanced Mobility of Seniors and Individuals with Disabilities Program.

Projects selected by others

United States Department of Transportation (US DOT)

The US DOT conducts several competitive programs nationwide, including the Bridge Investment Program, PROTECT Grants, Charging and Fueling Infrastructure, Congestion Relief Program, National Infrastructure Project Assistance Program ("Mega-projects"), RAISE, INFRA, Railroad Crossing Elimination Grants, All Stations Accessibility Program, and others. The selection criteria for these programs are established and announced by US DOT. Projects within the CMAP MPA selected to receive these fund sources are included in the TIP.

Illinois Tollway

The Illinois Tollway selects and programs projects to utilize toll revenues on their system within the region. These projects may be included in the TIP.

Counties and Townships

IDOT allots some federal fund sources by formula or agreement to other entities for project selection. Township Road Districts receive an annual allocation of funding for the Township Bridge Program. In northeastern Illinois, STBG funds reserved for rural projects, programmed as STP-Counties (a.k.a. STP-C) are allocated to Lake, McHenry, Kane, and Will counties. The counties work together to identify projects to utilize these funds through the District 1 branch of the Illinois Association of County Engineers. Rural STBG funds allocated to Kendall County and portions of DeKalb and Grundy counties that are within the CMAP MPA are programmed by those counties, in coordination with IDOT, as STP-State Programmed Rural (a.k.a. STP-R). Counties may also program non-federal fund sources, such as Motor Fuel Tax and RTA Sales Tax, in the TIP. The counties rely heavily on the priorities within their Long Range Transportation Plans and Capital Improvement Programs when selecting projects to be funded.

Municipalities

Although it is rare, projects selected by municipalities to be funded with local fund sources such as Motor Fuel Tax, may be included in the TIP. Municipalities use a variety of methods to select these projects, including their Capital Improvement Programs.

Changes to Major Projects from the 2019–24 TIP

ON TO 2050 included 46 fiscally constrained Regionally Significant Projects (RSPs) that were included in the 2019-24 TIP. Four projects were amended into ON TO 2050 and the 2019-24 TIP. While some stages of RSPs have been completed, including the Pace Milwaukee Avenue PULSE service (TIP ID 17-14-0003) which is a part of the "Pulse Near Term" RSP project (RSP ID 102A), none of the ON TO 2050 RSPs have been fully completed. As part of the ON TO 2050 Update, five RSPs have been removed from ON TO 2050 and the 2023-28 TIP, and the rest (45) remain RSPs in the ON TO 2050 Update and are included in the 2023-28 TIP.

TIP ID(s)	Project	Status
ON TO 2050 RSPs continuing in the ON TO 2050 Update		
01-02-9009	Chicago Union Station Master Plan Implementation Phase I - RSP 85	Engineering underway
01-02-9018	Metra Rock Island Improvements - RSP 70 - Future Project	Engineering underway
01-06-0051	CREATE - Central Av at BRC RR (GS-02) - RSP 151	Phase 1 notice to proceed issued
01-06-0052	IL 43 (Harlem Avenue) at 65th Street / BRC RR - RSP 109	Phase 2 Engineering scheduled to being in FFY 2022
01-07-0001	Southwest Service Improvements / 0186 Major - CREATE 75th Street Corridor Improvement Project - RSP 67	Construction underway
01-12-0019	I-90 I-94 Circle Interchange from I-290 Congress Parkway to Adams Street (Circle Interchange Reconstruction), Under Van Buren St. - RSP 33	Construction in progress
01-13-0012	US 12 US 20 at Stony Island Ave - RSP 112	Phase 2 Engineering underway
01-17-0025	Roadway Improvements to Support the Update to the South Lakefront Framework Plan: RSP -A2	Construction Package 1 began in FFY 2021; Construction Package 2 scheduled to begin in FFY 2022
01-18-0011	South Lakefront-Museum Campus Access Improvements RSP-104 - Future Project	Project Scoping
01-18-0012	North Lake Shore Drive Improvements - RSP 89	Phase 1 Engineering began in FFY 2019
01-19-0024	I-90 / I-94 Kennedy and Dan Ryan Expressway Reconstruction (Hubbard Street to 31st Street) RSP -136 - Future Project	No project activity
01-19-0025	I-90 Kennedy Expressway RSP -138 - Future Project	No project activity
01-19-0026	I-94 Edens Expressway Reconstruction RSP -139 - Future Project	No project activity
01-19-0027	I-90/I-94 Kennedy Expressway Reconstruction (Edens Junction to Hubbard Street) RSP -140 - Future Project	No project activity
01-94-0006	254.001 Red Line Extension from US 12 US 20 95th St to 130th - RSP 57	Engineering continuing; Construction scheduled to begin in FFY 2022
01-98-0114	I-190 O'Hare Access Rds from Bessie Coleman Dr. to Cumberland Ave I-190	Phase 2 Engineering for Bessie Coleman Dr in FFY 2022; Construction of various stages scheduled beginning in FFY 2023

TIP ID(s)	Project	Status
	Access and Capacity Improvements (I-190 Access Improvements) - RSP 32	
03-18-0006	I-90 WB Improvements from IL 43 to I-190 - RSP 32	Construction to be completed in FFY 2022
03-18-0017	I-290/IL 53 Interchange Improvement - RSP 21 - Future Project	No project activity
03-96-0021	Elgin-O'Hare East Extension from Gary Road to O'Hare West Bypass Elgin O'Hare Western Access (Elgin-O'Hare East Extension & Add Lanes, Western O'Hare Bypass) - RSP 20	Multi-stage project. Construction underway and completed on several stages, with south leg stages to begin in FFY 2022 and beyond
04-00-0023	I-290 Eisenhower Expy from US 12/45/20 Mannheim Rd to Racine Ave - RSP 30	Pump station construction completed; Land acquisition for mainline reconstruction underway
06-19-0011	I-55 Stevenson/Barack Obama Presidential Expressway Reconstruction (US-41 Lake Shore Dr to I-80) RSP -137 - Future Project	No project activity
07-94-0008	I-294 Tri-state Tollway at I-57 Interchange Addition - RSP 22	Ongoing engineering, land acquisition, and construction
08-19-0040	I-290/IL-53 Reconstruction (Lake-Cook Road to I-88) RSP -141 - Future Project	No project activity
08-95-0024	IL 83 Kingery Hwy from 31st St to N of 55th St, 63rd St (south of) to Central Avenue - RSP 111 - Future Project	No project activity
09-10-0030	US 20 Lake St from W of Randall Rd to E of Shales Parkway - RSP 113	Phase 2 engineering in progress
09-12-0036	I-80 Reconstruction from Ridge Rd to US 30 Lincoln Hwy, Long Term - RSP 36	Bridge expansion underway; Mainline reconstruction engineering underway
10-02-0013	US 45/IL 83 (Old Half Day Rd.) from IL 60 Townline Rd to Ill 22 (Half Day Rd) - RSP 114	Phase 2 engineering and land acquisition underway
10-07-0001	IL 60/IL 83 from IL 176 to Townline Rd (IL 60) - RSP 10	Phase 2 engineering underway
10-09-0024	IL 131 Green Bay Road from Russell Road to Sunset Avenue - RSP 14	Phase 2 engineering underway
10-09-0147	IL 83 Milwaukee Ave from Petite Lake Rd to IL 120 - RSP 13	Phase 1 engineering underway
10-09-0149	IL 173 Rosecrans Rd from IL 59 to US 41 (Skokie Hwy) - RSP 15	Phase 2 engineering underway
11-00-0001	IL 31 Front St from S of IL 120 Belvidere Rd to N of IL 176 (Terra Cotta Ave) (HPP1457) & Drainage Ditch 4 miles S of US 12 - RSP 6	Phase 2 engineering and land acquisition underway
11-06-0018	IL 47 from Charles Rd to US 14 - RSP 110	Phase 2 engineering authorized to begin in FFY 2022
11-07-0014	IL 47 Eastwood Drive from US 14 Northwest Hwy to Reed Road - RSP 110	Construction underway @ Kishwaukee River; Phase 2 engineering continues on additional stages

TIP ID(s)	Project	Status
11-16-0008	IL 62 (Algonquin Rd), IL 25 (JF Kennedy Memorial Dr.) to IL 68 (Dundee Rd.) - RSP 11	Phase 1 engineering in progress
12-02-9034	I-55 from I-80 to Coal City Rd - RSP 34 - Future Project	No project activity
12-06-0041	I-55 from Weber Road to US 30; I-55 At Airport/Lockport Rd & At Ill 126 - RSP A3	Phase 2 engineering scheduled to begin in FFY 2022
12-10-9001	I-55 Managed Lane from I-355 to I-90 I-94 (I-55 Stevenson Express Toll Lanes) - RSP 146	Phase 2 engineering scheduled to begin in FFY 2022
12-12-0037	I-80 U.S. 30 to I-294 - RSP 37 - Future Project	No project activity
12-13-0004	CH 74 Laraway Road from US 52 to IL 43 Harlem Ave - RSP 55	Phase 2 engineering and land acquisition underway; Construction scheduled to begin in FFY 2022 for Nelson to Cedar stage.
12-16-0027	I-55 @ Ill 129, Ill 129 to Lorenzo Rd, I-55 Frontage Rds: Kavanaugh Rd to Lorenzo Rd & at Lorenzo Rd. - RSP 34	Phase 2 engineering in progress
12-18-0019	I-55 - I-80 to US 52 (Jefferson St) and @ ILL 59; US 52 Jefferson St - River Rd to Houbolt Rd - RSP A4	Phase 2 engineering and land acquisition underway; Construction scheduled in FFY 2022 for I-80 to US 52 at IL 59 stage; Construction underway for I-55 at IL 59 stage
13-16-0009	I-294 Central Tri-State Reconstruction and Mobility Improvements - RSP 23	Construction underway; scheduled to continue beyond FFY 2025
13-18-0005	I-290/I-88/I-294 Interchange Improvement - RSP 24	Phase 1 underway
13-19-0016	I-94 Bishop Ford Expressway Reconstruction RSP-135 - Future Project	No project activity
13-19-0017	I-57 Reconstruction (I-94 to I-80, I-80 to Will / Kankakee border) RSP -35 - Future Project	No project activity
16-10-9001	304.004 CTA: North Red/Purple Line Modernization from Howard Station to Belmont Station CTA North Red/Purple Line Modernization - RSP 58A	Implementation underway with construction funding extending beyond FFY 2024
16-13-0005	Ashland Avenue from Irving Park Road to 95th Street (CTA 045.015 - Ashland BRT) - RSP 106	Construction and implementation underway
16-18-0002	South Halsted BRT - RSP 108 - Future Project	No project activity
16-18-0003	Blue Line Capacity Project - RSP 147	Engineering underway
16-18-0004	Red Purple Modernization Future Phases - RSP 58B - Future Project	Project scoping
16-19-0039	CTA Blue Line Forest Park Reconstruction, RSP -93	Implementation underway
17-18-0001	Pulse Dempster Line - RSP 102A	Engineering underway
17-18-0002	Pulse 95th Street Line - RSP 102A - Future Project	No project activity

TIP ID(s)	Project	Status
17-18-0003	Pulse Halsted Street - RSP 102A - Future Project	No project activity
17-18-0004	Pulse Harlem Ave - RSP 102A - Future Project	No project activity
17-18-0005	Pulse Oak Brook: Cermak Road - RSP 102A - Future Project	No project activity
18-07-0669	UP West Line - New Start (3869) - RSP 69	No project activity
18-07-0670	UP NW Line New Start (3870) - RSP 66	No project activity
18-10-9001	Metra UP North Improvements - RSP 68 - Future Project	No project activity
18-18-0008	BNSF Improvements - RSP 72 - Future Project	No project activity
18-18-0009	Milwaukee District West Improvements - RSP 79 - Future Project	No project activity
18-18-0010	A-2 Crossing Rebuild RSP - 98 - Future Project	No project activity
ON TO 2050 RSPs not continuing in the ON TO 2050 Update		
01-19-0009	O'Hare Express Service: RSP - A1	No project activity
07-14-0003	CH B66 FAU 1629 Vollmer Road from CH W46 FAU 2831 Kedzie Avenue to FAU 2845 Western Avenue - RSP 145	Phase 1 engineering nearing completion.
09-18-0015	Randall Road from North County Line Road to Orchard Road - RSP 46 - Future Project	No project activity
12-18-0021	Wilmington-Peotone Road: IL Route 53 to Drecksler Road - RSP 56 - Future Project	No project activity

Chapter 5: Conformity analysis

Northeastern Illinois does not attain national ambient air quality standards (NAAQS) for ozone. It is classified as a marginal non-attainment area for the 2015 8-hour ozone standard, serious non-attainment area for the 2008 8-hour ozone standard, and attainment (maintenance) for the 1997 8-hour ozone standard. Federal register notices have been published (March and April 2022), which if approved as a final rule will have the region redesignated as attainment of the 2008 ozone NAAQS and reclassified as Moderate for the 2015 ozone NAAQS. As a nonattainment area the region must implement a transportation program that will help to reduce levels of pollutants that contribute to ground level Ozone, specifically Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx), to national standards.

Nonattainment areas are designated by the U.S. EPA based, in part, on recommendations from the Illinois Environmental Protection Agency (IEPA). IEPA's recommendation follows U.S. EPA guidelines for identifying nonattainment areas. This includes not just monitor data, but also emissions data, urbanization patterns, meteorology, and so on. Technical information on this process can be found on the IEPA website. CMAP and the IEPA have established an Intergovernmental Agreement for Coordination of Air Quality Related Transportation Planning.

Nonattainment areas are established independent of metropolitan planning organization or MPA boundaries and are distinct for each standard. The northeastern Illinois nonattainment area under the 2008 and 2015 8-hour ozone standard includes Cook, DuPage, Kane, Lake (IL), McHenry, and Will counties, Aux Sable and Goose Lake Townships in Grundy County and Oswego Township in Kendall County. The nonattainment area also includes Lake and Porter counties in northwest Indiana, and a portion of Kenosha County in southeast Wisconsin. The Northwestern Indiana Regional Planning Commission and Southeastern Wisconsin Regional Planning Commission handle conformity requirements for those two areas. An agreement between Grundy County and CMAP establishes that CMAP is responsible for federally regulated transportation planning in Aux Sable and Goose Lake townships. Also, while only Oswego Township in Kendall County is within the nonattainment area, because the entire county is within the CMAP MPA, all projects within the county are subject to CMAP's modeling and conformity.

As part of the transportation planning and programming process, CMAP staff evaluates the impact of proposed transportation activities will have on VOC and NOx mobile source emissions within the region. The conformity analysis must demonstrate that the mobile source emissions resulting from the plan and TIP meet the requirements of (i.e., "conform to") the Motor Vehicle Emissions Budget (MVEB) for the region and that the transportation conformity rules and regulations are being followed.

Interagency consultation is required under the transportation conformity rule, as described in 40 CFR 51.402. In the northeastern Illinois region, these procedures are addressed through the Tier II Consultation process. Decisions made through this interagency consultation process guide the MPO in making conformity determinations.

Conformity procedures, documentation, and frequently asked questions (FAQs) are documented and updated as needed on the Conformity Analysis page of the CMAP website.

Current conformity analysis

The current conformity analysis for the ON TO 2050 Update and the FFY 2023-28 TIP consists of these documents:

ON TO 2050 Update Air Quality Conformity Analysis Appendix
ON TO 2050 Update Socioeconomic Forecast Appendix
ON TO 2050 Update Travel Demand Model Documentation Appendix

Conformity amendments

The conformity analysis is updated at least semi-annually. Updates are initiated with the submittal of TIP changes by project sponsors. The staff analysis of the requested changes is reviewed by the Transportation Committee and released for a 30-day public comment period. Comments are addressed and reviewed by the Transportation Committee and approved by the MPO Policy Committee. U.S. DOT and IDOT provide final approval of the amendments.

All federally funded projects with Not Exempt work types must be modeled and included in the conformed TIP in order to receive federal funding. A list of all work types and their exempt status can be found in Appendix 2. Updates to the work types can be found on the TIP Programmer Resources web page. RSPs included in ON TO 2050 are conformed, regardless of funding status, due to their regional significance and scope. Other RSPs are required to be conformed as well, whether or not they will utilize federal funding. Projects designated as unconstrained in ON TO 2050 cannot be conformed without a plan amendment.

To be conformed, projects must have funding identified for Phase 2 Engineering, Right of Way, Construction, or Implementation included in the active years (the current federal fiscal year plus the four subsequent federal fiscal years) of the TIP. Project location, description, and scope (work types) must be defined and model information, including a completion year, must be provided in the eTIP database. Unless they are subject to hot spot analysis, projects are not individually conformed. A project is said to be conformed if that project is included in the most recently conformed TIP.

Chapter 6: TIP amendment procedures

The CMAP TIP is regularly amended by updating the details of the approved project list to reflect changes in project scope, schedule, and funding status. Amendments may be administrative in nature or may be formal amendments requiring a variety of agency and public review and approval by the MPO Policy Committee, or their designee. Amendments to CMAP's TIP must be approved by the State of Illinois for incorporation into the STIP. The TIP and STIP changes must be approved by FHWA and FTA, certifying that all federal transportation planning requirements were met. TIP amendments are completed and documented within the eTIP database.

Types of amendments

There are three categories of TIP amendments. The TIP Change Quick Reference document is a resource for determining the type of amendment that is the result of a particular change to a project's information.

Administrative

Administrative amendments are those which do not require public review and comment, demonstration of fiscal constraint, or a conformity determination. Changes to exempt work types, schedule changes within the active years of the TIP, and changes to non-federal funding are administrative. Certain financial changes, such as placing a phase in Advance Construction status or changes below the formal amendment thresholds described below, may also be administrative. Changes to illustrative projects, except ON TO 2050 regionally significant projects, are administrative. Administrative amendments submitted in eTIP take effect immediately when reviewed and accepted by CMAP staff.

Transit projects obligated through the FTA are not subject to the same schedule as those obligated by FHWA through the IDOT process. Therefore, to facilitate transit project phases moving forward in a timely manner, separate administrative amendments may be created for projects obligated through FTA and those obligated through FHWA.

Formal

Formal amendments are significant changes to the scope, schedule, or limits of a project, or financial changes within the active years of the TIP that exceed the thresholds described below. The addition of federal funds to a project previously funded with only state/local funds or the deletion of all federal funds from a project is a formal amendment. The introduction or removal of a project phase within the active years of the TIP, regardless of the fund source, is a formal amendment.

A cost change is a formal amendment if the percent change (positive or negative) within the active years of the TIP exceeds the percent shown in the table below, based the federal project cost before the change.

Federal Project Cost Before Change	Percent Change (±)
$0 - $999,000	100%
$1,000,000 - $4,999,000	50%
$5,000,000 - $9,999,000	25%
≥ $10,000,000	20%, up to a max. of ± $10,000,000

Formal amendments require seven days public comment and approval by the Transportation Committee.

Conformity

Conformity amendments are formal amendments that can affect air quality conformity in the region. Scope and limit changes, project schedule changes, and adding/deleting not exempt work types are the most common conformity amendments. Conformity amendments require transportation and air quality modeling. The modeling results and the details of the TIP changes are subject to a minimum of 30 days of public comment. Following the comment period, the MPO Policy Committee considers approval.

Schedule

The majority of highway, bicycle, and pedestrian projects contained in the CMAP TIP are accomplished through the IDOT state letting process. As such, the regular schedule for amending the TIP is derived to meet deadlines associated with the state's letting schedule. The state letting schedule, a master schedule of meetings and due dates, and a calendar of TIP amendment actions for each FFY are available on the TIP Programmer Resources page of the CMAP website.

Each formal amendment period requires the submittal of new TIP projects and changes to existing projects 10 days prior to CMAP's Transportation Committee. Submittals are reviewed by CMAP staff and are posted for public comment on the eTIP website and as part of the Transportation Committee meeting materials. TIP changes associated with the semi-annual conformity determination are due a minimum of three months prior to the MPO Policy Committee meeting at which approval will be sought. Submittals are reviewed by staff for travel demand and air quality modeling. The staff analysis is presented for Transportation Committee review and is released for a 30-day public comment period. Comments are addressed and reviewed by the Transportation Committee and are recommended to the MPO Policy Committee for approval.

Submittal and approval

Project sponsors submit amendment requests for CMAP staff review through the eTIP website. For changes to existing projects, staff confirms the type of amendment (administrative or formal) being proposed and verifies that the change description is adequate to summarize the action being taken. If the scope of the project is being changed, staff confirms that there is no change to the exempt status of the project, no change to the project's potential to influence performance targets, and that any accompanying cost changes are reasonable for the revised scope. If the cost of a project is being changed, staff verifies that change has been approved by the entity responsible for programming the fund source(s) that is changing and that the financial change is reasonable based on any other changes, such as scope or schedule, that are proposed. Staff is not obligated to approve any changes administratively and may elevate any submittal to a formal amendment for public comment and committee approval.

When new projects are submitted, a more rigorous staff review occurs to ensure the project supports the implementation of ON TO 2050, that the information provided is logical and accurate, and that the proposed funding is available within the region. In particular, staff verifies that the project location information provided in the project title or description aligns with the project location information, eTIP map, and any attached documents. Staff also reviews the project description and attached documents, and if necessary, discusses the project with the programmer to verify that the selected work types accurately reflect the scope of the project and that the programmer's indicated expectations for the project's potential to influence performance targets are reasonable. When reviewing the scope, staff verifies the exempt status of the project, considers if the project meets the RSP thresholds, and considers if the project supports ON TO 2050. Except for projects funded with sources programmed directly by CMAP, staff does not have the authority to force project sponsors to include certain scope elements, such as sidewalks or bicycle accommodations, in projects. Although ON TO 2050 encourages a focus on maintenance and modernization of the existing system, it does not explicitly prohibit any project scope or type, therefore staff does not have the authority to deny implementation of any project that meets the eligibility criteria of the fund source(s) being used for the project. For projects that are entering the TIP prior to the completion of phase 1 engineering alternatives analysis, the scope may be less developed than for projects that have undergone appropriate NEPA actions to determine a preferred alternative. Finally, staff confirms that adequate funding is available in the region in the FFYs indicated in the submission, that the implementation and funding schedule is reasonable, and, if any of the proposed funding sources are competitive, that the project as described in the TIP submission was selected by the appropriate selecting body.

During the change review process, staff may make minor corrections to information provided by the programmer prior to accepting the change. Staff may also deny a submittal to allow programmers to provide additional information, make any major corrections, and resubmit their request. Administrative changes accepted by CMAP staff immediately become a part of the approved TIP project list and are posted to the eTIP public website. Formal and conformity amendments accepted by CMAP staff are held until the amendment period is closed and are compiled into a draft amendment report. The amendment report displays the updated project information and provides a before-and-after summary of the scope, schedule, financial, and other changes made for each project. Once reviewed by the public and approved by either the Transportation Committee or MPO Policy Committee, the approval is entered into the eTIP database, and IDOT, FHWA, and FTA are notified of the availability of the amendment for State review. If satisfied with the amendment, IDOT will enter their approval in the eTIP database certifying that approval and incorporation of the amendments into the STIP and requesting Federal review. Upon FHWA and FTA approval in eTIP, all reviewing parties and CMAP receive this notice:

> Chicago Metropolitan Agency for Planning (CMAP) Formal Amendment [number] and the corresponding amendment to the [current] Statewide Transportation Improvement Program (STIP) has been approved by [name] on [date]. Based on the FHWA, Illinois Division and FTA Region 5 ongoing oversight of the planning activities for the Chicago MPO-CMAP, the federal agencies find that the transportation planning process of the region substantially meets the planning requirements described in 23 CFR 450. The public transportation projects listed in the TIP amendment report and amended to the STIP are eligible for project authorization requests.

These federal approvals establish the new approved TIP project list. The approval dates for all amendments are reported on the Amendments tab of the eTIP public website. Notes from reviewers may also be displayed.

Program & project versions

The eTIP database is workflow based with each program of projects referred to as a "TIP Document" or "TIP Action." Each program corresponds to the starting FFY and amendment number. Each project within the TIP also has sequential versions, with each amendment to the project adding a new project version. The below terms and definitions from the eTIP Fact Sheet: Project Versions and Status explain the eTIP workflow.

TIP Document: The TIP Document (or TIP) is the approved *program* of projects, as amended throughout the federal fiscal year (FFY). A new TIP program is started each FFY (starting October 1) and is made up of the projects and line items that have funding in the starting FFY, plus the next four years. Illustrative projects, with all funding in prior years and/or future years, may also be included in the TIP document; however, illustrative projects cannot receive federal funding authorizations.

TIP documents are numbered sequentially by FFY. Using FFY 2017 as an example, the numbering is as follows:

17-00: The starting document for the FFY, created via an adoption. TIP years are 2017-21.
17-01: The first formal amendment to projects contained in the 17-00 TIP.
17-01.1: The first administrative amendment to projects contained in the 17-00 TIP, corresponding to formal amendment 17-01.
17-01.2: The second administrative amendment to projects contained in the 17-00 TIP, corresponding to formal amendment 17-01.
17-02: The second formal amendment to projects contained in the 17-00 TIP. Changes may be cumulative.
17-02.1: The first administrative amendment to projects contained in the 17-00 TIP, corresponding to formal amendment 17-02.
17-xx: Other amendments as needed throughout the year, including conformity amendments.
18-00: The starting document for FFY 2018. TIP years are 2018-22.

Adoption: Changes made to carry projects forward into the new TIP program at the beginning of each FFY are called an adoption in the eTIP workflow process. Only administrative changes are made during the adoption.

Administrative amendment: Changes that are below the financial thresholds for a formal amendment or that do not otherwise require Transportation Committee or MPO approval are administrative amendments and are typically indicated by a decimal point in the TIP Document number. For example, 17-01.**1**, 17-01.**2**, 17-02.**1**.

Formal amendment: Changes that exceed financial thresholds, or significantly change the scope or schedule of projects and require Transportation Committee or MPO Policy Committee approval are formal amendments, and typically do *not* have a decimal point in the TIP Document number. For example, 17**-02**, 17-**03**. Conformity amendments are a type of formal amendment.

Version: Project versions increase sequentially with each administrative or formal amendment submitted for a project, regardless of the TIP Document(s) containing the project.

Status: A project version either is the "Approved" version, or is a proposed amendment to the approved version, that is "In Progress" (🔓), "In Denied" (⊘), "Pending" (↗), or "Accepted" (☑).

In Progress:	A user has saved a change to a project, but has not submitted the change to CMAP. Additional changes may be made by the user.
In Denied:	CMAP staff reviewed a change, but cannot accept the change until corrections are made.
Pending:	A user has submitted a change for CMAP staff review. CMAP staff has neither accepted nor denied. Only CMAP staff can make additional changes; users can “unsubmit” to make changes, putting the project back into “In Progress.”
Accepted:	CMAP staff has accepted a submitted change. Accepted administrative changes are immediately posted to the eTIP public site. Accepted formal changes are held for Transportation Committee or MPO Policy Committee approval and are not posted to the eTIP public site until approved (See eTIP Fact Sheet - Amendment Approval Flow Chart).

Appendix 1: eTIP database overview

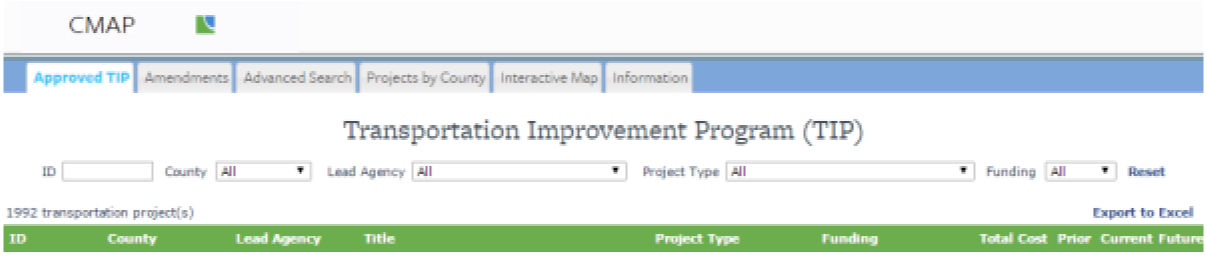
The online eTIP database is the official record of federal transportation funding and regionally significant state or locally funded projects. The database is a tool for programmers to submit new projects and project changes for consideration by the CMAP Transportation Committee and MPO Policy Committee. The FHWA and FTA utilize the eTIP database to ensure that projects submitted for federal participation are deemed a priority for the region and can be accomplished using the region's reasonably expected revenues. As performance-based programming evolves at the national, state, and regional levels, the eTIP database will also be used to collect additional project data and analyze how funded projects in the region meet performance targets to inform future programming decisions.

eTIP public website

The below sections of this appendix, also available on the eTIP Help webpage, describe individual pages within the eTIP public website. A 26-minute training presentation is also available to view or download (.mp4, 55.4 MB).

Navigating eTIP

eTIP has six distinct parts: the Approved TIP, Amendments, Advanced Search, Projects by County, an Interactive Map, and detailed project information. The eTIP home page is the Approved TIP tab.



Transportation Improvement Program (TIP)

ID
County: All
Lead Agency: All
Project Type: All
Funding: All

1992 transportation project(s)

- The Approved TIP tab is a list of projects, sorted by TIP ID, that make up the currently approved TIP, including administrative changes that have been accepted by CMAP staff.
- The Amendments tab displays an overview of actions taken or in progress to modify the scope, schedule, financial, or other project information.
- The Advanced Search tab provides visitors a means to locate project information by title, description, location, lead agency, project type, or specific federal fund source.
- The Projects by County tab provides a summary of the number, type, cost, and available funding for projects within selected counties.
- The Interactive Map allows visitors to search by a specific address or zoom in to an area to view programmed projects.
- Detailed project information can be obtained by selecting a specific project on any of these tabs.

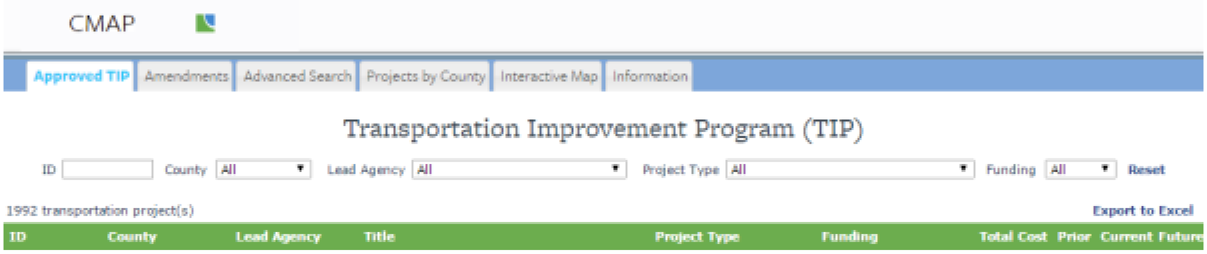
Project lists on every tab can be sorted by clicking on the column title, and project lists can be exported to Microsoft Excel.

Approved TIP

The TIP is a five-year program of surface transportation projects throughout northeastern Illinois. Based on federal fiscal years which start on October 1, the TIP includes projects expected to receive federal funding. The TIP also includes regionally significant projects funded by state and local sources. The Approved TIP tab is a list of projects, sorted by TIP ID, that make up the currently approved TIP, including administrative changes that have been accepted by CMAP staff.

The approved TIP may also include projects that are illustrative, which are included in the multi-year B-list (MYB). These projects are planned to be completed when funding becomes available. Most major capital projects fall into this category. These projects are labeled as “FUTURE PROJECT” in the Approve TIP. Projects with funds both in prior and future years, but no funds in the current TIP years are also included as future projects.

Projects with funding in past years may also be included in the Approved TIP listing if they are in progress and could still have cost changes. Projects that are not expected to experience any cost changes are designated as “COMPLETED.”



Transportation Improvement Program (TIP)

ID

County: All

Lead Agency: All

Project Type: All

Funding: All

1992 transportation project(s)

ID	County	Lead Agency	Title	Project Type	Funding	Total Cost	Prior	Current	Future

The Approved TIP listing contains the following fields:

ID

The TIP ID is the unique identification number for the project within the TIP database. The ID is based on the Lead Agency and location of the project, plus the year in which the project was first included in the TIP database.

County

“County” is the county in which the project is wholly or partially located. Projects that benefit the entire region, or are not location-based, are considered to be “Region-wide” projects. A quick search of projects by county can be completed at any time using the County drop-down list at the top of the page.

Lead agency

The lead agency is the organization responsible for programming and managing project funding in the CMAP TIP. The lead agency may differ from the agency responsible for implementing the project. For example, projects using state and federal funds that are implemented by municipalities are typically programmed and managed in the CMAP TIP by one of the 11 subregional Councils of Mayors. A quick search of projects by lead agency can be completed at any time using the Lead Agency drop-down list.

Title

Project titles typically include the location of projects and may also describe the type of work being done. If a project does not yet have any funding programmed in the TIP, the title indicates that it is a “Future Project.” The title also indicates when projects are “Completed.”

Project type

A project's type helps to classify the major purpose of the project, and is helpful when analyzing performance goals included in GO TO 2040. A quick search of projects by type can be completed at any time using the Project Type drop-down list.

Funding

A quick search of projects by funding can be completed at any time using the Funding drop-down list.

Federal	Indicates that federal funds are being used for the project. Federally funded projects typically also include state, local, and/or other funds.
State	Indicates that state funds are being used for the project. No federal funds are included. Local and/or other funds may be included.
Local	Indicates local funds are being used for the project. No federal or state funds are included.
Other	Indicates that funds other than federal, state, or local are being used for the project.

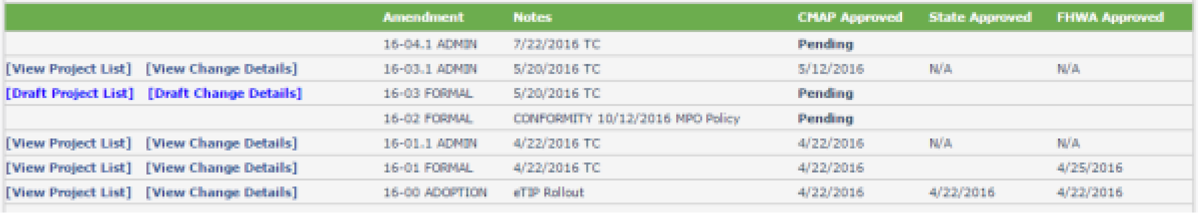
Total Cost and percentages

Total Cost includes the cost for all phases of a project, regardless of the source, timing, or availability of funds. The percentages following the Total Cost reflect the portion of the project's total cost programmed in years prior to the current TIP years (prior), the percentage of that cost currently programmed (current), and the percentage of that cost which is not yet available for programming in the TIP (future).

Amendments

TIP amendments are significant changes to the scope, schedule or limits of a project or significant financial changes. There are three types of amendments: Administrative (Admin) amendments are minor changes that are accepted by CMAP staff. Formal Amendments are more significant scope, schedule, or financial changes which require seven days public comment and approval by the Transportation Committee. Formal Conformity Amendments are significant changes to scope or schedule for capacity related projects that may affect the region's ability to meet air quality standards. Conformity amendments require 30 days public comment and approval by the MPO Policy Committee. Amendments to CMAP's TIP must be approved by the state of Illinois for incorporation into the State Transportation Improvement Program (STIP). The TIP and STIP changes must be approved by FHWA and FTA, certifying that all federal transportation planning requirements were met. The formal amendment which occurs at the start of each federal fiscal year (FFY) is referred to as an Adoption. The annual adoption removes the just-completed FFY from the TIP, brings the illustrative year into the TIP, and adds a new illustrative year.

The Amendments tab contains the following information:



		Amendment	Notes	CMAP Approved	State Approved	FHWA Approved
		16-04.1 ADMIN	7/22/2016 TC	**Pending**		
[View Project List]	[View Change Details]	16-03.1 ADMIN	5/20/2016 TC	5/12/2016	N/A	N/A
[Draft Project List]	[Draft Change Details]	16-03 FORMAL	5/20/2016 TC	**Pending**		
		16-02 FORMAL	CONFORMITY 10/12/2016 MPO Policy	**Pending**		
[View Project List]	[View Change Details]	16-01.1 ADMIN	4/22/2016 TC	4/22/2016	N/A	N/A
[View Project List]	[View Change Details]	16-01 FORMAL	4/22/2016 TC	4/22/2016		4/25/2016
[View Project List]	[View Change Details]	16-00 ADOPTION	eTIP Rollout	4/22/2016	4/22/2016	4/22/2016

[View Project List] link
Click on this link to view the projects included in the listed Amendment.

[View Change Details] link
Click on this link to view a report containing the details of changes included in the listed Amendment.

[Draft Project List] link
Click on this link to view projects pending committee, state, and federal approval in the listed Amendment.

[Draft Change Details] link
Click on this link to view a report containing the details of changes pending committee, state, and federal approval in the listed Amendment.

Amendment
The sequential title and type of the TIP amendment.

Notes
The date of the CMAP committee meeting, either the Transportation Committee (TC) or MPO Policy Committee, at which the amendment was, or will be, considered.

CMAP Approved
The date on which the amendment was or will be approved by either the Transportation (TC) or MPO Policy Committee.

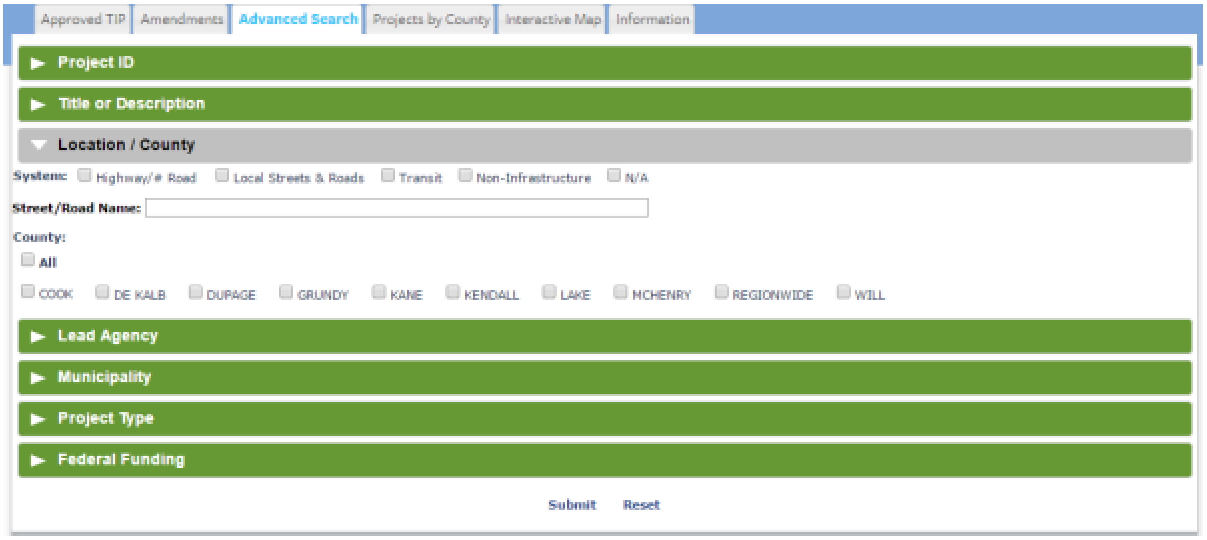
State Approved
The date on which the amendment was approved by the Illinois Department of Transportation for incorporation into the STIP.

Federal Approved
The date on which the amendment was approved by the Federal Highway Administration (FHWA).

Advanced search

The Advanced Search page allows users to locate project details using filters when the TIP ID is not known or multiple results are needed. Users can search using one or more fields on the search form. The more fields that are used, the narrower the results will be. Due to the unpredictable nature of the data entered, it is best to start with a broad search, using one or two fields, then add other fields to narrow down the results.

Search criteria are grouped into six themes: Project ID, Title or Description, Location/County, Lead Agency, Project Type, and Federal Funding. Each theme contains different search criteria described below. Groups can be revealed/hidden by clicking on the arrow next to the theme name. Criteria can be selected from multiple groups. Hiding a group does not clear the selections within that group. After selecting and entering the desired search criteria, click the Submit button at the bottom of the form. To modify search results, change the desired criteria and click the Submit button again. To clear all search criteria, click the Reset button.



Project ID

An advanced search by TIP ID can be completed using the Project ID search.

Title or description

Users may search for projects based on project title or description by entering any keyword that may be contained in any of the project title, description, project location or limits fields.

Location/county

Users may search for projects based on location in three different ways: By System, Street/Road Name, and/or by County.

Highway/#Road	Any road or street that is numbered, such as an interstate (I-90), US highway (US 14), state route (IL 59), or County Highway (CH 11)
Local Streets & Roads	Streets and roads that are not numbered (Main Street, First Avenue, etc.). Local streets also include off-road trails (e.g., Illinois Prairie Path)
Transit	Includes bus and train routes, stops, stations, yards, etc. as well as freight rail corridors (such as CREATE) and facilities. Public transit operations and support are also included.
Non-Infrastructure	Includes educational, marketing, direct emissions reduction, and other projects that do not directly involve improvements to the transportation network.
N/A	Projects that are not location-based or are at locations, such as schools or parks, that are not included above

Street/road name: Can be searched by entering any keyword that may be contained in any of the project location or limits fields, including the County, Municipality and Other Project Location Information fields. Keywords entered are searched as phrases. For example, entering First Street will not return results for projects on First Av, 1st St , First St., First North Street, etc. Only projects that contain the exact phrase “First Street” will be returned. Municipalities, counties and numbered routes (I-90, US 14, CH 7, IL 62, etc.) can also be entered in this field.

County: Users can check the appropriate box(es) to search for projects wholly or partially within one, multiple, or all counties.

Municipality

Users may select one of more municipalities, townships, or other agencies from the list by checking the appropriate box(es). Note that selecting “County-wide” or “Region-wide” will not return all projects in the county/region, only those for which the lead agency selected these values for the project.

Lead agency

Users may select one or more lead programming agency from the list by checking the appropriate box(es). The lead agency can be related to the combination of the project’s geography, fund sources and work types. Typical programming responsibilities are:

Councils of Mayors	Program federal and some state fund sources when a local government is the implementing agency. The Councils represent local governments within a collar county (DuPage, Lake, etc.) or portion of Cook County (Central, Northwest, South, etc.)
Counties	Program federal and local funds when the county is the implementing agency.
CDOA	Programs aviation projects at Chicago’s airports.
CDOT	Programs all projects within the city of Chicago, except some CMAQ or state funded projects.
CMAP	Programs CMAQ projects that are not programmed by Councils of Mayors, IDOT, or CDOT. Also programs Major Capital Projects, Constrained, and Unconstrained projects included in GO TO 2040.
CTA	Programs all CTA sponsored projects, except some CMAQ projects.
FHWA	Programs projects located within federal lands
IDOT	Programs most state-funded projects, by district, bureau and division.
ISTHA	Programs projects on Illinois tollways.
Metra	Programs all Metra-sponsored projects, except some CMAQ projects.
Pace	Programs all Pace-sponsored projects, except some CMAQ projects.
RTA	Programs all RTA-sponsored projects, except some CMAQ projects.

Project type

Users may select one or more project types from the list by checking the appropriate box(es).

Federal funding

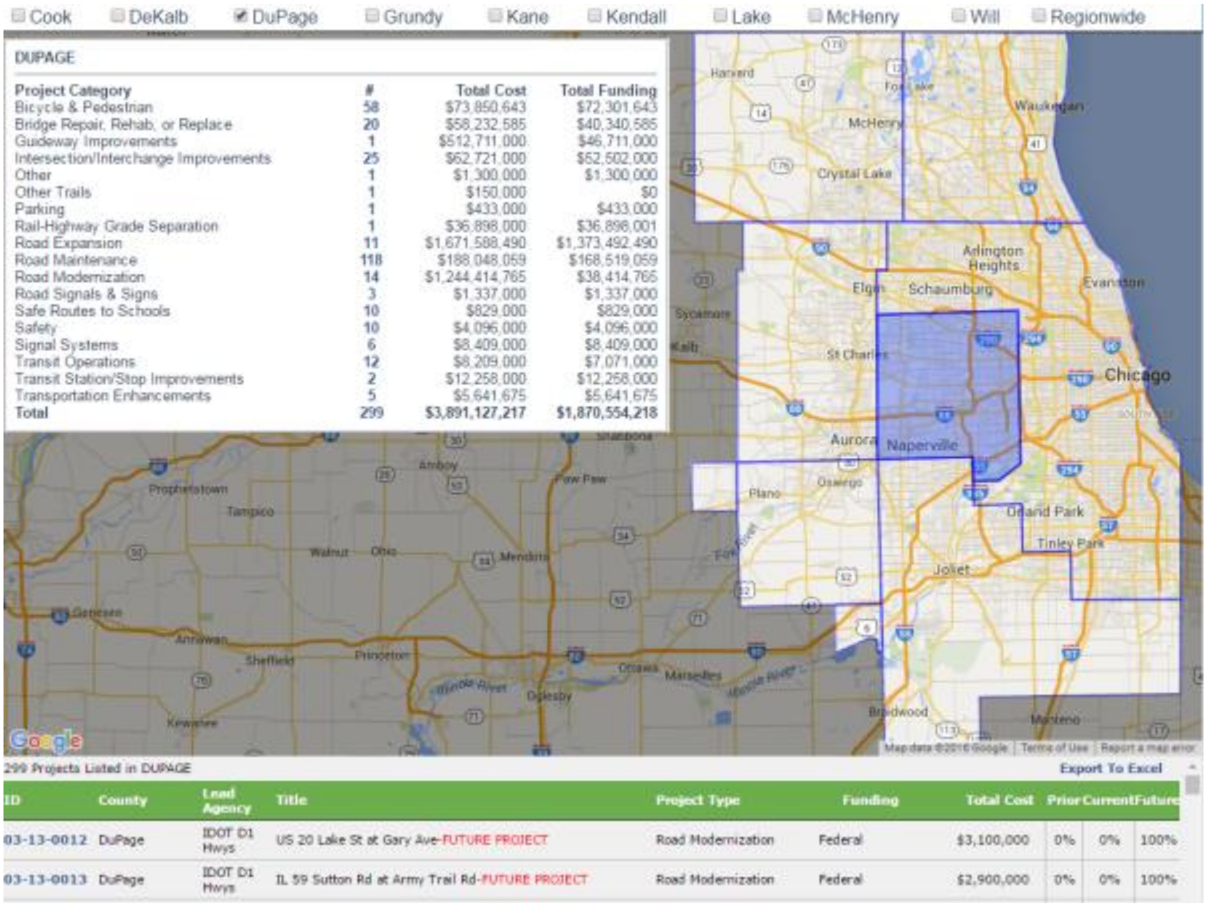
Users may select one or more federal fund sources from the list by checking the appropriate box(es). Any project that contains any financial line (including future lines) with the selected fund source will be returned. A description of current fund sources, including how they are distributed, who is responsible for programming and whether they are federal, state or local, is available on the TIP Programmer Resources page of the CMAP website.

When using Advanced Search it is important to consider that search results depend entirely on the data entered in the TIP database by programmers. For example, if the programmer did not include the marked state route number in the project description, searching by state route will not return any results. Roadway name abbreviations, such as Ave or Av, Blv or Blvd, etc. are inconsistently entered in the TIP database; omitting them from searches will produce better results. Finally, if a programmer misspelled anything when entering the project in the TIP database, the project will not be found unless the misspelling is duplicated in the search criteria.

Projects by County

The Projects by County tab allows users to view a regional map, select a county, and view a summary of the type, cost, and funding for transportation projects in the selected county. The selected county is highlighted on the map and a complete list of projects within the county is displayed below the map. The results are purely geographical and do not take lead agency into account. Region-wide projects are those that are not location specific and/or provide benefits to the entire region. Multiple counties may be selected at the same time. Grand totals for the entire region can be viewed by selecting every category.

The summary table displays the project categories that are included in the selected location(s). The “#” column is the number of projects in each category. “Total Cost” is the total estimated cost to complete the projects, from preliminary engineering through construction. “Total Funding” is the portion of that cost that has been expended or is currently programmed in the TIP. By clicking a number in the “#” column, the list of projects below the map will be filtered by the selected project category. Users may export the data they’ve selected on the map at any time by clicking “Export to Excel” below the map.



DUPAGE

Project Category	#	Total Cost	Total Funding
Bicycle & Pedestrian	58	$73,850,643	$72,301,643
Bridge Repair, Rehab, or Replace	20	$58,232,585	$40,340,585
Guideway Improvements	1	$512,711,000	$46,711,000
Intersection/Interchange Improvements	25	$62,721,000	$52,502,000
Other	1	$1,300,000	$1,300,000
Other Trails	1	$150,000	$0
Parking	1	$433,000	$433,000
Rail-Highway Grade Separation	1	$36,898,000	$36,898,001
Road Expansion	11	$1,671,588,490	$1,373,492,490
Road Maintenance	118	$188,048,059	$168,519,059
Road Modernization	14	$1,244,414,765	$38,414,765
Road Signals & Signs	3	$1,337,000	$1,337,000
Safe Routes to Schools	10	$829,000	$829,000
Safety	10	$4,096,000	$4,096,000
Signal Systems	6	$8,409,000	$8,409,000
Transit Operations	12	$8,209,000	$7,071,000
Transit Station/Stop Improvements	2	$12,258,000	$12,258,000
Transportation Enhancements	5	$5,641,675	$5,641,675
Total	299	**$3,891,127,217**	**$1,870,554,218**

299 Projects Listed in DUPAGE

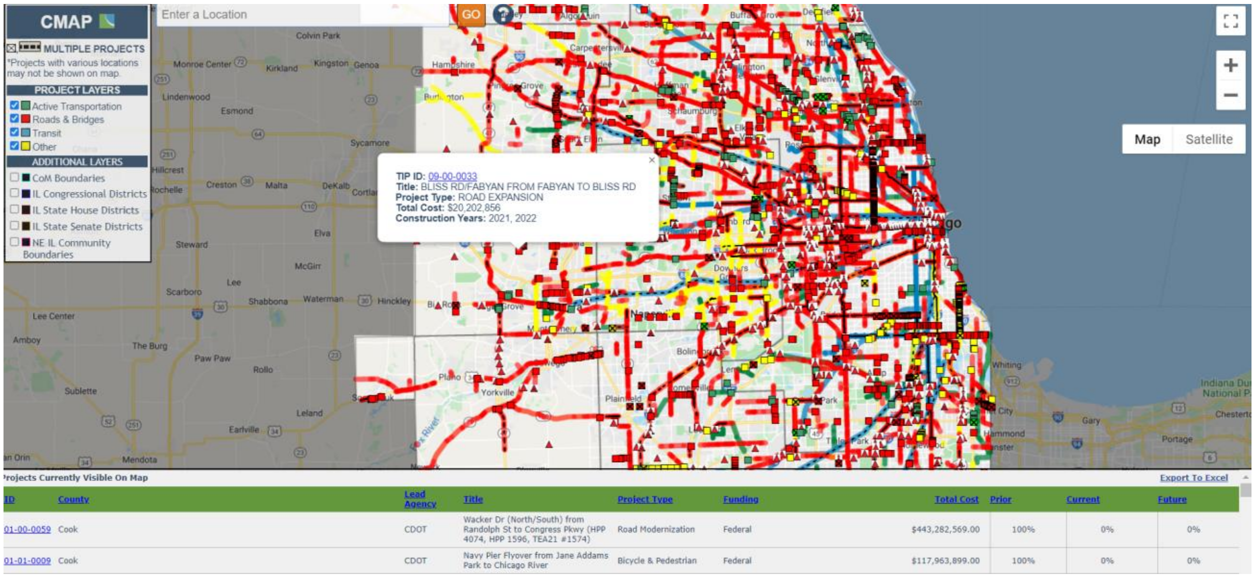
ID	County	Lead Agency	Title	Project Type	Funding	Total Cost	Prior	Current	Future
03-13-0012	DuPage	IDOT D1 Hwys	US 20 Lake St at Gary Ave-FUTURE PROJECT	Road Modernization	Federal	$3,100,000	0%	0%	100%
03-13-0013	DuPage	IDOT D1 Hwys	IL 59 Sutton Rd at Army Trail Rd-FUTURE PROJECT	Road Modernization	Federal	$2,900,000	0%	0%	100%

Interactive Map

The Interactive Map tab is a Google map; all standard Google Maps search and navigation methods apply. Users may also select a satellite view or street view. To return to the Approved TIP tab from the interactive map, click on the “Back to Approved TIP” link in the legend.

Projects contained in the TIP database that can be represented on a map can be found on the Interactive TIP Map by entering the address or intersection at which the project is located, then zooming in or out and clicking on the project line or point. Users may turn project type layers on and off by checking or unchecking the appropriate boxes in the top left corner of the map. All projects that are visible on the map’s current extent are listed below the map. Users may export the data they’ve selected on the map at any time by clicking “Export to Excel” below the map.

The project information that is displayed contains a link (on the TIP ID) to the project overview page within the TIP database in addition to the project title, type, total cost, and construction years. Projects such as “Various resurfacing in Cook County” or “Purchase Buses” cannot be represented on the map and should be located using the Advanced Search page.



TIP ID: 09-00-0033
Title: BLISS RD/FABYAN FROM FABYAN TO BLISS RD
Project Type: ROAD EXPANSION
Total Cost: $20,202,856
Construction Years: 2021, 2022

rojects Currently Visible On Map

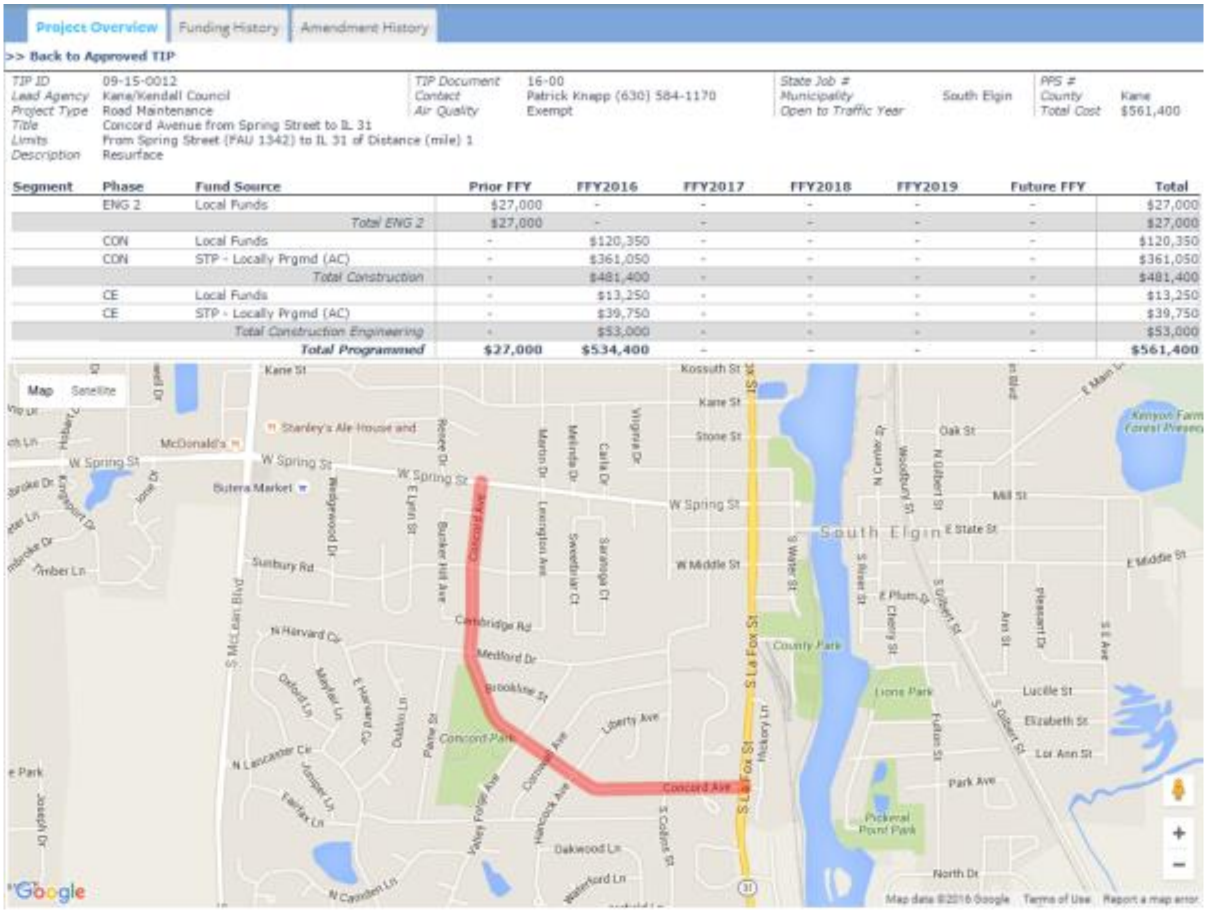
ID	County	Lead Agency	Title	Project Type	Funding	Total Cost	Prior	Current	Future
01-00-0059	Cook	CDOT	Wacker Dr (North/South) from Randolph St to Congress Pkwy (HPP 4074, HPP 1596, TEA21 #1574)	Road Modernization	Federal	$443,282,569.00	100%	0%	0%
01-01-0009	Cook	CDOT	Navy Pier Flyover from Jane Addams Park to Chicago River	Bicycle & Pedestrian	Federal	$117,963,899.00	100%	0%	0%

Project details

By clicking on the ID, users can access details of a project. The detail page displays the details of each individual project, as currently adopted, including a Project Overview, Funding History, and Amendment History. To return to the Approved TIP tab from any project details page, click on the “Back to Approved TIP” link.

Project Overview

In addition to the basic information displayed in list view, the Project Overview page provides more detailed project information including a description of work, contact information, funding details, and a project location map.



TIP ID 09-15-0012
Lead Agency Kane/Kendall Council
Project Type Road Maintenance
Title Concord Avenue from Spring Street to IL 31
Limits From Spring Street (FAU 1342) to IL 31 of Distance (mile) 1
Description Resurface

TIP Document 16-00
Contact Patrick Knapp (630) 584-1170
Air Quality Exempt

State Job #
Municipality South Elgin
Open to Traffic Year

PPS #
County Kane
Total Cost $561,400

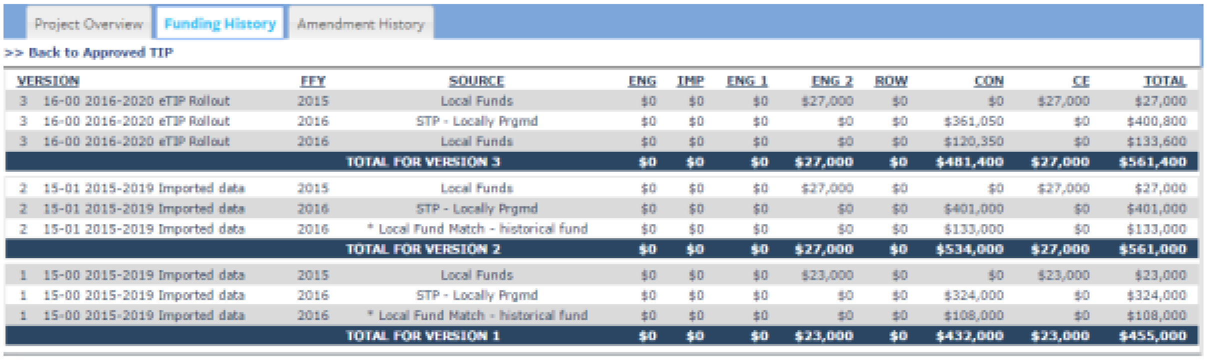
Segment	Phase	Fund Source	Prior FFY	FFY2016	FFY2017	FFY2018	FFY2019	Future FFY	Total
	ENG 2	Local Funds	$27,000	-	-	-	-	-	$27,000
		Total ENG 2	$27,000	-	-	-	-	-	$27,000
	CON	Local Funds	-	$120,350	-	-	-	-	$120,350
	CON	STP - Locally Prgmd (AC)	-	$361,050	-	-	-	-	$361,050
		Total Construction	-	$481,400	-	-	-	-	$481,400
	CE	Local Funds	-	$13,250	-	-	-	-	$13,250
	CE	STP - Locally Prgmd (AC)	-	$39,750	-	-	-	-	$39,750
		Total Construction Engineering	-	$53,000	-	-	-	-	$53,000
		Total Programmed	**$27,000**	**$534,400**	-	-	-	-	**$561,400**

TIP ID	The unique identification number for the project within the TIP database
Lead Agency	The organization responsible for programming and managing the project in the CMAP TIP
Project Type	The category of the project, based on the primary type(s) of work being done
Title	The Lead Agency's project title, which typically includes the location and/or type of work being accomplished. If a project does not yet have any funding programmed in the TIP, the title indicates that it is a "Future Project." Once a project is substantially complete, and is not expected to experience any cost changes, the title indicates it is "Completed."
Limits	Indicates the primary location of the project
Description	A brief narrative description of the project
TIP Document	The most recently approved adoption or amendment in which the project is included
Contact	The name and phone number of the lead agency staff person that can answer questions about the project.
Air Quality	Indicates the exempt status of a project (whether the project and any subsequent changes are subject to air quality conformity analysis) and, if appropriate, the conformity status of the project.
State Job #	The State Job Number assigned to the project phase by IDOT (state Job Numbers are unique to each phase of the project)

PPS #	The Annual Program Number assigned to the project by IDOT (PPS Numbers are unique to each phase of the project)
Municipality	The municipality(ies) in which the project is located
County	The county(ies) in which the project is located
Open to Traffic Year	The calendar year in which the project is expected to be substantially complete, and open for public use. Note that most projects do not fully "close" during implementation.
Total Cost	The total cost of all phases of the project, whether included in the TIP or not.
Segment	Larger, more complex projects may be broken down into logical segments for implementation. The segments that contribute to the funding displayed for each phase and fund source are listed.
Phase	Indicates the phase funded from listed fund source. Phases are described in more detail below.
Fund Source	The source of funds for the line item. A description of current fund sources, including how they are distributed, who is responsible for programming and whether they are federal, state or local, is available on the TIP Programmer Resources page of the CMAP website.
FFY	The federal fiscal year (FFY) in which funds for the line item will be authorized (for federal fund sources) or expended (for state or local fund sources). The federal fiscal year is from October 1 to September 30. "Prior" indicates funds were applied prior to the current TIP years; "Future" indicates funds will be applied after the current TIP years.
Total (column)	The total column is the sum of funding, by phase and fund source.
Total <phase> (row)	The total <phase> row is the sum of funding for the listed phase, in each FFY.
Total Programmed (row)	The total funding programmed in each FFY.
Map	If the project can be represented on a map, the map displayed below the project overview presents the project location. Standard Google Maps navigation applies, including zooming in/out, satellite view and street view.

Funding History

The Funding History page allows users to view the federal fiscal year, fund source, project phase, and total funding programmed for the project in each project version. The most recent programming is shown at the top of the list.

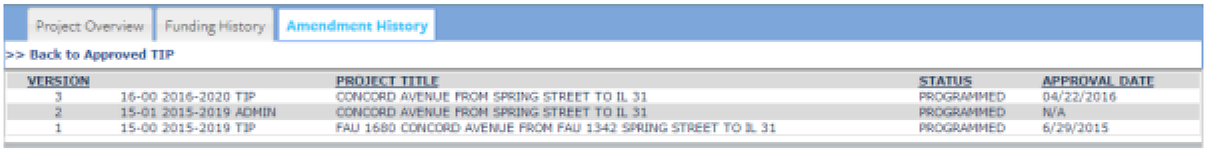


VERSION	FFY	SOURCE	ENG	IMP	ENG 1	ENG 2	ROW	CON	CE	TOTAL
3 16-00 2016-2020 eTIP Rollout	2015	Local Funds	$0	$0	$0	$27,000	$0	$0	$27,000	$27,000
3 16-00 2016-2020 eTIP Rollout	2016	STP - Locally Prgmd	$0	$0	$0	$0	$0	$361,050	$0	$400,800
3 16-00 2016-2020 eTIP Rollout	2016	Local Funds	$0	$0	$0	$0	$0	$120,350	$0	$133,600
		TOTAL FOR VERSION 3	$0	$0	$0	$27,000	$0	$481,400	$27,000	$561,400
2 15-01 2015-2019 Imported data	2015	Local Funds	$0	$0	$0	$27,000	$0	$0	$27,000	$27,000
2 15-01 2015-2019 Imported data	2016	STP - Locally Prgmd	$0	$0	$0	$0	$0	$401,000	$0	$401,000
2 15-01 2015-2019 Imported data	2016	* Local Fund Match - historical fund	$0	$0	$0	$0	$0	$133,000	$0	$133,000
		TOTAL FOR VERSION 2	$0	$0	$0	$27,000	$0	$534,000	$27,000	$561,000
1 15-00 2015-2019 Imported data	2015	Local Funds	$0	$0	$0	$23,000	$0	$0	$23,000	$23,000
1 15-00 2015-2019 Imported data	2016	STP - Locally Prgmd	$0	$0	$0	$0	$0	$324,000	$0	$324,000
1 15-00 2015-2019 Imported data	2016	* Local Fund Match - historical fund	$0	$0	$0	$0	$0	$108,000	$0	$108,000
		TOTAL FOR VERSION 1	$0	$0	$0	$23,000	$0	$432,000	$23,000	$455,000

Version	The history of changes to projects is controlled and documented using “versions.” The version number and adoption or amendment during which the version was approved is indicated.
FFY	The federal fiscal year in which the funding was programmed for that version.
Source	The source of funds of the amounts that follow.
ENG	The amount of funding for general engineering from the specified source.
IMP	The amount of funding for implementation from the specified source.
ENG 1	The amount of funding for Phase 1 Preliminary Engineering from the specified source.
ENG 2	The amount of funding for Phase 2 Design Engineering from the specified source.
ROW	The amount of funding for right-of-way from the specified source.
CON	The amount of funding for construction from the specified source.
CE	The amount of funding for Phase 3 Construction Engineering from the specified source.
Total	The total amount of funding from the specified source.
Total for Version #	The total amount of funding, by phase, for the listed version of the project.

Amendment History

The Amendment History provides a list of each Adoption or Amendment that included the project.



VERSION		PROJECT TITLE	STATUS	APPROVAL DATE
3	16-00 2016-2020 TIP	CONCORD AVENUE FROM SPRING STREET TO IL 31	PROGRAMMED	04/22/2016
2	15-01 2015-2019 ADMIN	CONCORD AVENUE FROM SPRING STREET TO IL 31	PROGRAMMED	N/A
1	15-00 2015-2019 TIP	FAU 1680 CONCORD AVENUE FROM FAU 1342 SPRING STREET TO IL 31	PROGRAMMED	6/29/2015

Version	The history of changes to projects is controlled and documented using “versions.” The adopted version will always be the version of the project that is presented. A listing of all project versions since the roll-out of eTIP is available on the Amendment History tab.
Project Title	Reflects abbreviated location data and programming agency project name data.
Status	Indicates the status of the project in the eTIP database – either “Programmed” or “Completed.”
Approval Date	The date on which CMAP approved the amendment.

Tools for programmers

eTIP is a “workflow” driven system that allows users to take more control over the management of project changes. Users submit administrative modifications, amendments, and conformity changes separately, preventing minor changes from being held up awaiting committee approval. Users are able to validate data entry, receive clear notification of errors, and save changes in progress at any time, with full control over when to make the final submission of saved changes to CMAP.

Individual projects

A project’s database page has multiple tabs for programming information, obligation and amendment history, location maps, documents, and associated project identifiers.

Project information

The project information area of the project form contains basic project information including the project title and description, project type and specific work types, contact information, and location information. All of the programmed funding for the project and the project's total cost is displayed in the programming information area. A series of questions about the project provide information about federal performance measures and project elements that are important to the implementation of ON TO 2050.

Project location

Programmers are responsible for mapping project locations, with assistance, review, and correction by CMAP staff. Project mapping capabilities are included for roads, on-street bicycle and pedestrian facilities, and transit rail lines. Users are also able to view and/or export GIS shapefiles and associated project data, such as pavement condition, traffic volumes, structural ratings, and more.

Project IDs

The Project IDs tab provides a simple method of entering various ID numbers associated with the project, all of which are searchable.

Project Documents

The Documents page contains associated project file links attached by the individual programmer or CMAP staff. Programmers are encouraged to include project information forms, funding agreements and applications, project photos, design approval letters, media coverage, public involvement notifications, and more. CMAP and reviewing agencies are also encouraged to attach relevant documents, such as funding program award letters and cost change approvals. Establishing a central location for complete project information.

Project amendment history

The history of changes to projects is controlled and documented using "versions." The Amendment History tab displays a log of versions from project creation within eTIP to completion. Each project version in the log indicates the version number, TIP document, project title, programming status, and dates of CMAP, state, and federal approval.

Reports

eTIP gives users the ability to customize reports utilizing the sort and filter functions. While filtering varies slightly by the type of report, in general users can select the starting TIP document, any amendments to the document (approved or pending), and the type of changes (in progress, pending, or accepted) to include. Reports can also generally be filtered by project type, lead agency, county, and major implementation group. Select reports also contain a filter for funding type(s).

Amendment reports

The Amendment Summary report displays the pending TIP changes for the TIP Action(s) and project status selected. This report indicates each project's conformity designation, the year the project is expected to be open to traffic, the project's lead programming agency, project title, project cost information (before and after revisions), a reason for the change, and a narrative of the revisions listing the specific project changes. This report is used by CMAP staff to produce the amendment summary memo presented to the Transportation Committee.

Similar to the Amendment Summary report, the Amendment Narrative report displays the projects and the change reasons for the selected TIP Action(s) and project status. This report indicates the year the project is expected to be open to traffic, project title, project cost information (before and after revisions), and a narrative of the revisions listing the specific project changes.

Grouped reports

Five pre-formatted reports, grouped by County, Lead Agency, Major Implementation Group, Municipality, or Project Type, and sorted for user convenience are available.

Conformity reports

The Conformity Network report is used by CMAP staff to monitor and export changes of *Not Exempt* and *Exempt Tested* projects included in the travel demand model for the semi-annual conformity determination.

The Conformed Projects report is a listing of all *Not Exempt* and *Exempt Tested* projects included in the travel demand model grouped by scenario year. The report includes each project's lead agency, project type, major implementation group and a detailed project description.

Financial reports

The Line Items Report allows users to create a project listing report with the most granular details. For each project, this report lists the federal fiscal year in which funding is programmed, detailing the fund source, amount programmed by phase, total cost of the phase, as well as all identification numbers associated with each phase of the project.

The Agency Financial Constraint and Financial Constraint reports are used to monitor fiscal constraint. Federal fund sources are subject to fiscal constraint by federal fiscal year (FFY). Some sources are constrained region-wide, and others are constrained by programming agency. The Financial Constraint reports display the constraint applied to federal fund sources by fund source and year for the entire region. For sources such as locally programmed STP or FTA 5307 funds that are constrained by agency, the Agency Financial Constraints report shows the constraint by agency, fund source, and year. The financial constraint reports are customizable to be filtered by project status and type, lead agency, and county and to include or exclude revenue, balance detail, and all funds.

The $ Programmed By Fund report allows users used to drill down to the specific projects that contain line items with selected fund sources. It can also be used to display a selection of projects for which users have edit or read-only rights of a specific type, for a specific lead agency, and/or a specific geographic area.

Obligation reports

The Obligation by Fund Category report provides an at-a-glance summary of the federal obligations contained in the FHWA FMIS database in the CMAP area through the prior day for the selected FFY. Obligations are grouped by funding category and tabulated by federal program code. Users can drill-down to the individual TIP projects included in each program code or funding category. All individual line items, with TIP ID, federal program code, the date of the last obligation action, and the obligation amount can also be viewed by clicking on the "ALL" link in this report.

The Obligation Balance report provides a listing of individual federal project number obligations alongside corresponding TIP programming information. This report is primarily a worksheet for CMAP staff use in identifying differences between programming and obligations, and to identify obligations that have been downloaded from FMIS that are not able to be matched to an existing TIP project. However, it can be filtered by an individual lead agency, programmed or obligated fund source and can be used as a tool to quickly identify TIP projects that have potential to be obligated in the selected FFY and TIP projects that do not have a federal project number included in the project information.

The Obligation Project Mapping Report identifies mismatches in federal project and state job numbers in the TIP and in FHWA's FMIS database. This report also provides a link to allow an immediate update of the FMIS data contained in eTIP, which is auto-updated nightly.

Data exports

TIP users can export a variety of data for use in other applications. The Funding Info download contains individual financial line items. The Project Info download contains basic information for every version of each project. The GIS shapefile download contains the line and point files that make up the map of TIP projects.

Other reports

The majority of the other reports are intended for CMAP staff use in modifying the valid values for the drop-down lists contained in eTIP. However, a few of these reports may also provide value to users.

Fund Name Report

Lists all of the fund sources within eTIP and indicates if they are current or historic, subject to fiscal constraint, eligible for Advance Construction, and, for federal sources, what the minimum state or local match percentage is.

Scheduled Projects

Provides the project schedule information for each project or segment of a project. When exported to Excel, this report can be used to sort or filter projects by target obligation or letting dates.

Project Questions Report

Provides basic project identification information and the answers to all project questions. When exported to Excel, this report can be used to generate lists of projects with specific answers, such as all projects that include a freight or ITS component, or all projects that address each performance target.

Obligation tracking

A nightly upload of transactions from FHWA's Financial Management Information System (FMIS) database is summarized within the Obligation tab of each project by federal fiscal year and by project. Using federal and state project IDs for matching, obligations are compared to programmed data to display a projects' unobligated balance. Funds in Advance Construction (AC) and expenditures against obligations are also displayed. Detailed transaction data and historical data transferred from the previous database to eTIP may also be viewed.

Tools for state and federal partners

Financial Constraint

Federal fund sources are subject to fiscal constraint by federal fiscal year (FFY). Some sources are constrained region-wide and others are constrained by programming agency. The sum of all line items of each fund source within each FFY in the TIP database is compared to the funds available for that source, in that FFY and if applicable, by that programming agency. The sum programmed, including any pending TIP changes (increases and decreases in funding), must be less than or equal to the funds available. Funds available can be found by running a Financial Constraint report for the fund source in question, with pending TIP actions included. If the balance available is less than the amount programmed on a project that is being changed, other TIP changes must be made to decrease programming in order for the current change to be accepted.

The Financial Constraints report displays the constraint applied to federal fund sources by fund source and year for the entire region. For sources such as locally programmed STP or FTA 5307 funds that are constrained by agency, the Agency Financial Constraints report shows the constraint by agency, fund source, and year. The financial constraint reports are customizable to be filtered by project status and type, lead agency, and county and to include or exclude revenue, balance detail, and all funds.

TIP action approvals

State and Federal users designated by their agencies as having the authority to approve CMAP TIP amendments are provided with an approval interface when logging in to eTIP. Any amendments that have been approved by CMAP, through either the Transportation Committee or MPO Policy Committee, are presented for state and federal action.

Reviewers can open a list of projects included in each amendment and can view the individual project details by selecting the TIP ID of interest. Reviewers can also view the full amendment report that provides the updated project information and a summary of changes included in the amendment. When their review is complete, reviewers can open an approval window where they enter the date of approval and select the name of the person approving the amendment.

Calls for projects

The eTIP system is also used for calls for projects for CMAP's funding programs. Basic project and applicant information, including scope, location, contact, and requested funding, is entered directly into the database. Applicants use the eTIP mapping tool to "draw" their project (where applicable), and required and supplemental forms are attached to the project within the database. Projects selected for funding are then easily transferred from the CFP module to the active TIP after public comment periods and committee approvals.

Appendix 2 – Fund sources

TIP projects receive federal funding through several sources administered by the U.S. DOT through the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA). Multiple non-federal programs, including state and local programs, also provide funding for TIP projects. All TIP fund sources are described below, with abbreviations used in the eTIP database and information about the agencies that select projects, program projects in the TIP, and implement projects. For federal fund sources, information about the level of fiscal constraint applied to the fund source in the TIP is also provided. Historical funds are fund sources that are still tracked in eTIP but are no longer actively being added to projects. The list of fund sources with descriptions is regularly updated and available on the TIP Programmer Resources web page. Additional information about federal funding programs are also available in FTA Program Fact Sheets and FHWA Fact Sheets.

Draft note: As guidance is issued for new Infrastructure Investment and Jobs Act (IIJA) programs, this appendix will be updated.

Active Federal Funds

All Stations Accessibility Program (ASAP)
Programmed as: All Stations Accessibility Program
Competitive grants to assist transit providers in financing capital projects to upgrade the accessibility of legacy rail fixed guideway public transportation systems for people with disabilities by increasing the number of existing stations or facilities for passenger use that meet or exceed the new construction standards of Title II of the Americans with Disabilities Act of 1990. Not fiscally constrained.

Bridge Formula Program
Programmed as: I Bridge – State Prgmd and Bridge – Local Prgmd
New formula program under the Infrastructure Investment and Jobs Act to replace, rehabilitate, preserve, protect, and construct highway bridges. Unless project selection authority is delegated to the MPO, projects are selected by IDOT, then programmed and implemented by the subregional councils, counties, CDOT, and major implementing agencies. Fiscally constrained at the regional level.

Bridge Investment Program
Programmed as: Bridge Investment Pgm – Pln, Bridge Investment Pgm – Proj, and Bridge Investment Pgm – Lg Proj
New discretionary program to improve bridge and culvert condition, safety, efficiency, and reliability. Eligible projects include those to replace, rehabilitate, preserve or protect bridges on the National Bridge Inventory and those to replace or rehabilitate culverts to improve flood control and improve habitat connectivity for aquatic species. Projects are selected by U.S. DOT and programmed by implementing agencies. Fiscally constrained at the regional level.

Carbon Reduction Program
Programmed as: Carbon Reduction Pgm
New formula program for projects designed to reduce transportation emissions, defined as carbon dioxide (CO2) emissions from on-road sources. Projects are expected to be selected by IDOT, in

consultation with CMAP, then programmed and implemented by the subregional councils, counties, CDOT, and major implementing agencies. Fiscal constraint is anticipated at the regional level.

Congestion Mitigation & Air Quality Improvement Program
Programmed as: CMAQ and CMAQ PM2.5
Federal formula funds for projects that will contribute to improving air quality and mitigate traffic congestion in areas that do not meet the National Ambient Air Quality Standards (NAAQS). Projects are selected by the CMAP Board and MPO Policy Committee, then programmed and implemented by the subregional councils and major implementing agencies. Fiscally constrained at the regional level.

Congestion Relief Grant Program
Programmed as: Congestion Relief Grant Pgm
Federal funds to advance innovative, integrated, and multimodal solutions to reduce congestion and the related economic and environmental costs in the most congested metropolitan areas. Projects are selected by FHWA and programmed by implementing agencies. Not fiscally constrained.

Consolidated Rail Infrastructure and Safety Improvements (CRISI)
Programmed as: Consolid Rail Infra and Safety Imps
Federal funds for projects that reduce congestion, improve short-line and regional railroad infrastructure, relocate rail lines, enhance multi-modal connections and facilitate service integration between rail and other modes such as at ports or intermodal facilities. Projects are selected by U.S. DOT and programmed by implementing agencies. Not fiscally constrained.

Coronavirus Response and Relief Supplemental Appropriations Act Funds
Programmed as: CRRSAA-Bridge, CRRSAA-County, CRRSAA-Local, CRRSAA-Shared Fund, CRRSAA-State, and CRRSSA-5307
Federal formula funds through Title IV of the Coronavirus Response and Relief Supplemental Appropriations Act, 2021. Projects selected by CMAP's STP Project Selection Committee (CRRSAA-Shared Fund), subregional councils (CRRSAA-Local), local governments (CRRSAA-County), IDOT (CRRSAA-State and CRRSAA-Bridge), and the transit service boards (CRRSAA-5307). CRRSAA-Shared Fund and CRRSAA-Local projects were selected from the five-year STP-Shared Fund and STP-Local active and contingency programs. Projects that promote innovation, equity, and/or safety that were ready for implementation within the current federal fiscal year were targeted for these funds. Projects are programmed and implemented by the subregional councils and major implementing agencies. Fiscally constrained at the regional, subregional (CRRSAA-Local), and implementing agency (CRRSAA-5307) level.

FTA 5307 Urbanized Formula
Programmed as: FTA 5307 Urban Formula
Federal formula funds for capital improvements to transit systems in all urbanized areas of the country. Funds are allocated to the service boards by the RTA, and projects are selected, programmed, and implemented by the service boards. Fiscally constrained at the agency level.

FTA 5309 Capital Investment Grants
Programmed as: FTA 5309 Core Capacity, FTA 5309 (CIG - New Starts), and FTA 5309 (CIG – Small Starts)
Federal funds for projects that are substantial corridor-based capital investments in existing fixed guideway systems, including heavy rail, commuter rail, light rail, streetcars, and bus rapid transit, that

increase capacity by at least 10 percent in corridors that are at capacity today or will be in five years. Projects are selected by FTA and programmed and implemented by the service boards. Not fiscally constrained.

FTA 5310 Enhanced Mobility of Seniors and Individuals with Disabilities
Programmed as: FTA 5310 Elderly/Disabled
Federal formula funds to improve the transportation needs of seniors and persons with disabilities by removing barriers to transportation service and expanding transportation mobility options. Projects are selected and programmed by IDOT's Office of Intermodal Project Implementation and the RTA. Not fiscally constrained.

FTA 5312 Public Transportation Innovation
Programmed as: FTA 5312 Research
Competitive federal funds to advance innovative public transportation research and development. Projects are selected by FTA and are programmed and implemented by the recipient service boards. Not fiscally constrained.

FTA 5337 State of Good Repair
Programmed as: FTA 5337 Good Repair
Federal formula funds to provide capital assistance for the maintenance, replacement, and rehabilitation of rail fixed guideway and high-intensity motorbus systems to maintain a state of good repair or to develop and implement Transit Asset Management plans. Funds are allocated to the service boards by the RTA and projects are selected, programmed, and implemented by the service boards. Fiscally constrained at the agency level.

FTA 5337 Rail Vehicle Replacement
Programmed as: FTA 5337 Rail Vehicle Repl (Comp)
Competitive program to provided capital assistance for the preplacement of rail rolling stock. Projects are selected by the FTA and programmed and implemented by the service boards. Not fiscally constrained.

FTA 5339 Bus and Bus Facilities
Programmed as: FTA 5339A Bus (Formula) and FTA 5339B Bus (Comp)
Federal formula and discretionary funds to replace, rehabilitate, and purchase buses and related equipment, and to construct bus-related facilities. Formula-funded projects are selected, programmed, and implemented by the service boards. Discretionary projects are selected by the FTA and are programmed and implemented by the service boards. Formula funds are constrained at the agency level. Competitive funds are not fiscally constrained.

FTA 5339C Low- or No-Emission Bus
Programmed as: FTA 5339C Low or No Emission Bus
Competitive funding for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities. Projects are selected by the FTA and programmed and implemented by the recipient service boards. Not fiscally constrained.

High-Speed Intercity Passenger Rail Program
Programmed as: High Speed Rail
Federal funds to build new high-speed rail corridors, upgrade existing intercity passenger rail corridors, and lay the groundwork for future high-speed rail services through corridor and state panning efforts. Projects are selected by U.S. DOT and programmed by implementing agencies. Not fiscally constrained.

Highway Safety Improvement Program
Programmed as: Hwy Safety Improve Pgm
Federal formula funds for highway safety improvement projects on any public road, which includes projects that protect pedestrians and bicyclists. Projects are selected by IDOT and programmed and implemented by the subregional councils and major implementing agencies. Fiscally constrained at the regional level.

Homeland Security
Programmed as: Homeland Security
Federal grant funds for planning, equipment, training, and exercise needs that assist in the preparation, prevention, and response to terrorist attacks and other disasters. Projects are selected by the Department of Homeland Security and programmed by the recipient agency. Not fiscally constrained.

Intelligent Transportation Systems Program
Programmed as: Intelligent Transportation Pgm
Federal funds for the research, development, and operational testing of Intelligent Transportation Systems (ITS) aimed at solving congestion and safety problems, improving operating efficiencies in transit and commercial vehicles, and reducing the environmental impact of growing travel demand. Projects are selected by U.S. DOT and programmed by implementing agencies. Not fiscally constrained.

National Electric Vehicle Infrastructure (NEVI) Program
Programmed as: Natl Electric Vehicle Infra, EV Infrastructure – Corridor, EV Infrastructure - Community
Federal formula funds to strategically deploy electric vehicle charging infrastructure and to establish an interconnected network to facilitate data collections, access, and reliability along designated alternative fuel corridors identified in the state’s Electric Vehicle Infrastructure Deployment Plan. Project selection, programming, and implementation is TBD. Fiscal constraint is anticipated at the regional level.

National Highway Performance Program
Programmed as: NHPP and NHPP – Bridge Penalty
Federal formula funds for projects on National Highway System (NHS) bridges and roadways. These consist of interstate highways and other principal arterials that support progress toward achievement of national performance goals for improving infrastructure condition, safety, mobility, or freight movement on the NHS. Projects are selected and programmed by IDOT. Fiscally constrained at the regional level.

National Highway Freight Program
Programmed as: Natl Hwy Freight Pgm
Federal formula funds for states to improve the efficient movement of freight on the National Highway Freight Network. Projects are selected by IDOT through a competitive annual program and programmed by implementing agencies. Fiscally constrained at the regional level.

National Infrastructure Project Assistance Program (Mega)

Programmed as: Mega Grant Prgm

Federal funds to support large, complex projects that are difficult to fund by other means and are likely to generate national or regional economic, mobility, or safety benefits, including highway and bridge projects on the National Multimodal Freight Network, the National Highway Freight Network, or the National Highway System, freight intermodal or rail projects that provide a public benefit, rail-highway grade separation or elimination, and intercity passenger rail projects. Projects are selected by U.S. DOT. Programming and implementation is TBD. Not fiscally constrained.

Nationally Significant Multimodal Freight & Highway Projects (INFRA)

Programmed as: INFRA

Federal funding for multimodal freight and highway projects of national and regional significance to improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas.

Other – Federal

Programmed as: Other - Federal

Other federal funds that are not frequently utilized in the northeastern Illinois region. Not fiscally constrained.

Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT)

Programmed as: PROTECT (Formula) and PROTECT (Discretionary)

Federal formula and discretionary funds to increase the resilience of the transportation system. Project selection, programming, and implementation is TBD. Fiscal constraint is anticipated at the regional level.

Rail-Highway Safety

Programmed as: Rail-Hwy Safety

Federal formula funds for safety improvements to reduce the number of fatalities, injuries, and crashes at public grade crossings. Projects are selected by IDOT and programmed and implemented by IDOT, subregional councils and major implementing agencies. Not fiscally constrained.

Railroad Crossing Elimination Progarm

Programmed As: Railroad Xing Elim Pgm

Federal funds for projects that create grade separations – such as overpasses and underpasses – as well as closures, track relocations, and improvement or installation of warning devices at crossings if related to a separation or relocation project. Projects are selected by the Federal Railroad Administration and programmed by implementing agencies. Not fiscally constrained.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE)

Programmed as: RAISE

Federal funds to support projects that will have a significant impact on the nation, a metropolitan area, or a region. Projects are selected by U.S. DOT and programmed and implemented by subregional councils and major implementing agencies. Not fiscally constrained.

Recreational Trails Program
Programmed as: Rec Trails
Federal formula funds set aside from the Transportation Alternatives Set-Aside for the development and maintenance of recreational trails and trail-related facilities for both non-motorized and motorized recreational trail uses. Projects are selected by the Illinois Department of Natural Resources (IDNR) and programmed by the subregional councils and major implementing agencies. Not fiscally constrained.

Reduction of Truck Emissions at Ports
Programmed As: Reduction of Truck Emissions at Ports
Federal funds to reduce truck idling and emissions at ports, including through the advancement of port electrification. Projects are selected by U.S. DOT. Programming and implementation is TBD. Not fiscally constrained.

Safe Routes to School
Programmed as: Safe Routes to School
Federal formula funds for projects that enable and encourage primary and secondary school children to walk and bicycle to school. Projects are selected by IDOT and programmed and implemented by the subregional councils and major implementing agencies. New allotments of these funds were discontinued in MAP-21. However, these projects and programs remain eligible under STBG and the Transportation Alternatives Set-Aside and will continue to be selected and programmed under this heading. Fiscally constrained at the regional level.

Safe Streets and Roads for All
Programmed as: Safe Streets and Roads for All
Federal funds to develop and implement Comprehensive Safety Action Plans to prevent roadway deaths and serious injuries. Projects are selected by U.S. DOT. Programming and implementation are TBD. Not fiscally constrained.

Surface Transportation Block Grant
Programmed as: STP-County, STP-Locally Prgmd, STP-Shared Fund, STP-State Prgmd Rural, STP-State Prgmd Urban
Federal formula funds to preserve and improve the condition and performance of federal-aid eligible highways, public bridges, tunnels, pedestrian and bicycle infrastructure, and transit capital projects. Projects are selected and programmed by CMAP (STP-Shared Fund), subregional councils (STP-Locally Prgmd), local governments (STP-County), and IDOT (STP-State Prgmd Rural, STP-State Prgmd Urban). Fiscally constrained at the subregional level (STP-County and STP-Locally Prgmd) and regional level.

Transportation Alternatives Set-Aside
Programmed as: TAP – Locally Prgmd, TAP - State Prgmd
Federal formula funds set-aside from the Surface Transportation Block Grant (STBG) program for the development and maintenance of smaller scale but critically important multimodal projects such as pedestrian and bicycle facilities, historic preservation, vegetation management, environmental mitigation related to stormwater and habitat connectivity, recreational trails, safe routes to school, and vulnerable road user safety assessments. Project selection is by IDOT (TAP – State Prgmd) under the Illinois Transportation Enhancement Program (ITEP) and CMAP (TAP – Locally Prgmd).
Projects are programmed and implemented by subregional councils and major implementing agencies. Fiscally constrained at the regional level.

Transportation Infrastructure Finance and Innovation Act (TIFIA)
Not a federal fund source per se, TIFIA provides federal credit assistance to public agencies for transportation projects of national and regional significance. Projects are selected by U.S. DOT and programmed by the recipient agency. Not fiscally constrained.

State Funds

Consolidated County
Programmed as: Consolidated County
State formula funds distributed to all counties, excluding Cook. Projects are selected and programmed by the implementing agency.

Economic Development
Programmed as: Econ Dev Pgm
State funds used to provide assistance in improving highway access to new or expanding industrial, distribution, or tourism developments with a focus on the retention and creation of permanent full-time jobs. Projects are selected by IDOT and programmed by the implementing agency.

Emergency Repair
Programmed as: Emergency Repair
State funds to assist with the expense of repairing serious damage to Federal-aid highways after the FHWA has determined that natural disasters or catastrophic failures have occurred.

Grade Crossing Protection Fund
Programmed as: Grade Xing Protection
State discretionary funds for safety improvements at rail-highway crossings. Projects are selected by IDOT and programmed by the subregional councils and major implementing agencies.

High Growth Cities
Programmed as: High Growth Cities
State formula funds distributed to municipalities with populations over 5,000 and experiencing above normal growth. Projects are selected and programmed by the implementing agency.

Illinois Commerce Commission Grade Crossing Protection Fund
Programmed as: ICC- RR Safety
State funds to assist local highway agencies and railroads with the cost of making safety improvements at public highway-rail crossings on local roads and streets. Projects are selected and programmed by IDOT.

Illinois Funds
Programmed as: IL Funds and IL Funds – Transit
State funds used for highway and/or transit projects. Projects are selected and programmed by IDOT.

Needy Township

Programmed as: Needy Township

State formula funding program to assist townships and road districts that do not meet minimum revenue requirements for maintaining local roads. Projects are selected and programmed by the implementing agency.

Rebuild Illinois

Programmed as: Rebuild Illinois

State funds generated from the sale of bonds for infrastructure improvements that include investments in roads, bridges, public transit, and railroads. A portion of the funds are distributed to municipalities for projects they select, with IDOT approval, and are programmed by the subregional councils. Another portion is distributed to the transit service boards for projects they select and program. IDOT may also select and program projects to utilize a portion of the funds not distributed to other entities.

State Match – Chicago

Programmed as: *State Match – Chicago*

State funds used to match federal funds for projects in the City of Chicago. Projects selected and programmed by CDOT are reviewed by IDOT for state participation.

State Matching Assistance

Programmed as: *State Matching Assistance*

State funds used to assist counties in matching federal funds. Projects selected and programmed by counties are reviewed by IDOT for state participation.

Township Bridge Program

Programmed as: *Township Bridge Prgm*

State formula funds distributed to townships and road districts for the construction of bridges. Projects are selected and programmed by the subregional councils and major implementing agencies.

Truck Access Route Program (TARP)

Programmed as: *Truck Access Rt Prgm*

Competitive program to assist local governments with upgrading roads to accommodate 80,000-pound truck loads. Projects are selected by IDOT and programmed by the subregional councils and major implementing agencies.

Local Funds

Chicago Transit TIF

Programmed as: *Transit TIF – Chicago*

The City of Chicago’s transit tax increment financing district funds used to match federal funds used for transit projects. Projects are selected by the City of Chicago and programmed by CTA.

Federal Flexible Match

Programmed as: *Fed Flex Match*

Matching funds through the Federal Flexible Match Program that allows a variety of public and private contributions to be counted toward the non-Federal match (local match) for federally funded projects. Projects selected and programmed by implementing agencies are reviewed by IDOT for eligibility and use of flexible match.

Ground Transportation Tax
Programmed as: Ground Transportation Tax
Funds generated through fees imposed by the City of Chicago on businesses providing vehicles for hire in Chicago. Projects selected and programmed by CDOT.

Invest in Cook
Programmed as: *Invest in Cook*
Cook County discretionary Motor Fuel Tax funds used for projects that implement Cook County's long-range transportation plan, Connecting Cook County. Projects are selected by Cook County and programmed by the subregional councils and major implementing agencies.

Local Funds
Programmed as: *Local Funds*
Funds from local jurisdictions' general revenue. Projects are selected and programmed by the implementing agency.

Motor Fuel Tax
Programmed as: *MFT-Local, MFT-State Allocation*
Funds from taxes on fuel collected either by local jurisdictions (MFT-Local) or by the state and allocated to local jurisdictions (MFT-State Allocation) for the purpose of improving, maintaining, repairing, and constructing highways. Projects are selected and programmed by the implementing agency.

RTA Bonds
Programmed as: *RTA Bonds*
Revenue bonds issued by the RTA with debt service paid using RTA revenues. Projects are selected and programmed by the implementing agency.

RTA Sales Tax
Programmed as: *RTA Sales Tax and RTA Tax – Collar Counties*
Funds collected through sales tax in the six-county RTA service area, distributed to the counties and service boards. Projects are selected and programmed by the implementing agency.

Service Board Funds
Programmed as: *Service Board Funds*
State formula funds from the Illinois state sales tax collected in the six-county RTA service area distributed to CTA, Metra and Pace. Projects are selected and programmed by the service boards.

Tollway Funds
Programmed as: *Tollway Funds*
Funds collected by the Illinois State Toll Highway Authority (Tollway) for exclusive use on the tollway system. Projects are selected and programmed by the Tollway.

Tollway - Move Illinois
Programmed as: Tollway – Move IL
Illinois Tollway capital program funds. Projects are selected and programmed by the Tollway.

Transportation Development Credits

Programmed as: Trans Credit – Local/State Hwy, Trans Credit – Transit)

Toll revenue capital expenditures used as credit toward the non-federal matching share of eligible highway programs and transit projects. Projects are selected and programmed by the implementing agency after requesting and receiving approval from IDOT for the use of credits.

Other Funds

Local

Programmed as: *Other - Local*

Other local funds such as special assessments over and above the standard property tax rate and/or special taxing districts designed to finance local governments' infrastructure improvements. Projects are selected and programmed by the implementing agency.

Private Funds

Funds from private entities. Projects are selected and programmed by the implementing agency.

U.S. EPA Clean Diesel

United States Environmental Protection Agency discretionary funding for projects that reduce diesel emissions from existing engines. Projects are selected by U.S. EPA and programmed by implementing agencies.

Historic Funds

American Recovery and Reinvestment Act (ARRA)

Programmed as: ARRA – Local, ARRA – State/Highway

Federal formula funds through the American Recovery and Reinvestment Act of 2009. Projects selected by subregional councils (ARRA-Local) and IDOT (ARRA-State/Highway). Projects were programmed and implemented by the subregional councils and major implementing agencies.

Bridge Discretionary Program

Programmed as: Bridge Discretionary Program

Federal discretionary program in FFY 2005 to improve the condition of highway bridges through replacement, rehabilitation, and system preventative maintenance. Projects were selected by U.S. DOT and programmed and implemented by major implementing agencies.

Equity Bonus

Programmed as: Equity Bonus

Funding utilized to ensure each state's annual federal apportionment will be at least a specified percentage of that state's contributions to the highway Account of the Highway Trust Fund. Assigned to projects by IDOT in coordination with FHWA.

FTA 5316 Job Access and Reverse Commute (JARC) Program

Programmed as: FTA 5316 JARC

Federal formula funds for capital, planning, and operating expenses for projects that transport low-income individuals to and from jobs and activities related to employment, and for reverse commute projects. Projects were selected, programmed, and implemented by the service boards.

FTA 5317 New Freedom
Programmed as: FTA 5317 New Freedom
Federal formula funds to reduce barriers to transportation services and expand the transportation mobility options available to people with disabilities beyond the requirements of the ADA of 1990. Projects were selected, programmed, and implemented by the service boards.

High Priority Projects
Programmed as: HPP, HPP SAFETEA-LU, HPP TEA-21, Sec 117 Earmark, and Sec 125 Earmark
Federal funds for specific High Priority Projects earmarked by Congress. Projects were selected by Congress and programmed and implemented by the subregional councils and major implementing agencies.

High-Speed Rail Hazard Elimination
Programmed as: HSR Hazard Elim
Federal discretionary funding for safety improvements at highway-rail grade crossings along federally designated high-speed rail corridors. Projects were selected by the Federal Railroad Administration and FHWA and programmed and implemented by major implementing agencies.

Illinois Jobs Now!
Programmed as: Illinois Jobs Now
State funds from the 2014 state capital construction program, “Illinois Jobs Now!” Projects are selected and programmed by IDOT.

Interstate Maintenance
Programmed as: Interstate Maintenance
Federal formula and discretionary funding for resurfacing, restoring, rehabilitating and reconstructing routes on the Interstate System. Projects were selected by IDOT (formula) and U.S. DOT (discretionary) and programmed and implemented by IDOT.

National Corridor Infrastructure Improvement Program
Programmed as: Natl Corridor Inf. Imp
Provided competitive funding for highway projects in corridors of national significance to promote economic growth and international or interregional trade. Projects were selected by the U.S. DOT and programmed and implemented by IDOT.

National Highway System Program
Programmed as: NHS
Federal formula funds for projects on the National Highway System. Projects were selected and programmed by IDOT. MAP-21 replaced the NHS program with the NHPP program.

Projects of National and Regional Significance
Programmed as: Natl/Reg Significance
Competitive program under MAP-21 to improve the safe, secure, and efficient movement of people and goods to improve the national economy. Projects were selected by U.S. DOT and programmed by IDOT. Not fiscally constrained.

Rail Line Relocation & Improvement Capital Grant Program
Programmed as: Rail Reloc & Imp

Federal funds for local rail line relocation and improvement projects that improve rail traffic safety, motor vehicle traffic flow, community quality of life, or economic development, or involve relocation of any portion of the rail line. Projects were selected and programmed by IDOT.

Repurposed Earmarks
Programmed as: Repurposed Earmarks
Reprogrammed funds that were originally earmarked for specific projects and were not obligated for those projects. Projects receiving repurposed earmarks were selected by IDOT, in consultation with affected programmers and implementers. Not fiscally constrained.

Surface Transportation Program (STP) Bridge
Programmed as: STP-Bridge
Federal formula funds set aside from STBG for the rehabilitation, replacement, preservation, and protection of bridges and tunnels. Projects were selected by IDOT and programmed and implemented by subregional councils and major implementing agencies. This fund source was replaced by the Bridge Formula Program; however, a balance of funds remains available for programming and this fund code (STP-Bridge) may be utilized for programming FFY 2022 and FFY 2023 Bridge Formula Program and Bridge Investment Program funds. Fiscally constrained at the regional level.

Surface Transportation Program (STP) – Enhancements
Programmed as: STP-Enhancements
Federal formula funds for projects such as bicycle and pedestrian facilities, historic preservation and others that enhance the transportation system. Projects were selected by IDOT and programmed by subregional councils, CMAP and IDOT. This fund source was replaced by the Transportation Alternatives Program under MAP-21, however a balance of funds remains available for programming. Fiscally constrained at the regional level.

Transportation Investment Generation Economic Recovery
Programmed as: TIGER
Federal funds to support projects that will have a significant impact on the nation, a metropolitan area, or a region. Projects were selected by U.S. DOT and programmed by subregional councils and major implementing agencies. Not fiscally constrained.

Transportation, Community, and System Preservation Program
Programmed as: TCSP
Federal discretionary planning, implementation, and research grants to investigate and address the relationships among transportation, community, and system preservation plans and practices.

Transit Investment in Greenhouse Gas & Energy Reduction (Tigger)
Programmed as: Tigger
Federal discretionary program for capital investments that assist in reducing the energy consumption or greenhouse gas emissions of a transit agency. Projects were selected by FTA and programmed and implemented by the service boards.

Appendix 3 – Work Types

All work types are listed below, with codes and names used in the eTIP database, exempt status, and descriptions. This listing is grouped by project type and classification.

Work types included in the scope of a project determine whether the project is subject to travel demand modeling or air quality conformity. If any Not Exempt work type is included in the project scope, the overall project is considered to be Not Exempt and the project must be included in the travel demand model and conformed. If no Not Exempt work types are included in the project scope, but any Exempt Tested work types are, the overall project is considered to be Exempt Tested. Exempt Tested projects are included in the travel demand model, but do not require conformity analysis. Projects that do not include any Not Exempt or Exempt Tested work types in their scope are considered Exempt and are not included in the travel demand model and are not subject to conformity analysis.

Work types also determine if a project is classified as maintenance, modernization, or expansion. If a project includes any expansion work types, the overall project is typically considered to be an expansion project. Projects that are not expansion projects but include any modernization work type are typically considered to be modernization projects. Projects that contain only maintenance work types are considered to be maintenance projects. Some exceptions to these typical classifications exist. For example, when expanding or modernizing bicycle, pedestrian, or ADA facilities as part of a roadway maintenance project, the overall project will be classified as modernization.

CMAP may update the work types in eTIP from time to time. The most current list of work types can be found on the TIP Programmer Resources web page.

Work Type Code	Work Type Name	Exempt Status	Description
Bicycle and Pedestrian - Maintenance			
E-SharedMaint	Maintain Shared Path Facility	Exempt	Maintain Existing Shared Path Facility
E-ADAMAINT	Maintain/Repair ADA Infrastructure	Exempt	Maintain or Repair Existing ADA Infrastructure (Roadways)
E-BIKEMAINT	Maintain Bicycle Facility	Exempt	Maintain Existing Bicycle Facility
E-PEDMAINT	Maintain Pedestrian Facility	Exempt	Maintain Existing Pedestrian Facility
Bicycle and Pedestrian - Modernization			
E-ADAIMP	Improve ADA Infrastructure	Exempt	Improve Existing ADA Infrastructure (Roadways)
E-ADANEW	New ADA Infrastructure	Exempt	Install New ADA Infrastructure (Roadways)
E-BIKEIMP	Improve Bicycle Facility	Exempt	Improve Existing Bicycle Facility
E-BIKEPARK	Bicycle Parking	Exempt	Install New Bicycle Parking
E-PEDIMP	Improve Pedestrian Facility	Exempt	Improve Existing Pedestrian Facility
E-SharedModern	Improve Shared Path Facility	Exempt	Improve Existing Shared Path Facility
E-SRTS	Safe Routes to School	Exempt	Provide Safe Routes to School
Bicycle and Pedestrian - Expansion			
E-BIKENEW	New Bicycle Facility	Exempt	Build New Bicycle Facility
E-PEDNEW	New Pedestrian Facility	Exempt	Build New Pedestrian Facility
E-SharedNew	New Shared Use Path	Exempt	Build New Shared Use Path
Bridge - Maintenance			
B-DECK	Bridge Deck - Repair/Rehab	Exempt	Repair or Rehabilitate Bridge Deck

Work Type Code	Work Type Name	Exempt Status	Description
B-HYD	Bridge Deck - Hydro-Demolition	Exempt	Rehabilitate Bridge Deck Using Hydro-Demolition
B-OVR	Bridge Deck - Overlay	Exempt	Overlay Bridge Deck
B-PCHF	Bridge Deck - Full Depth Patching	Exempt	Complete Full Depth Patching on Bridge Deck
B-PCHP	Bridge Deck - Partial Depth Patching	Exempt	Complete Partial Depth Patching on Bridge Deck
B-PNT	Bridge/Structure - Paint	Exempt	Paint Bridge
B-REPAIR	Bridge/Structure - Reconst/Rehab No Chng In #, Wdth, of Lane	Exempt	Reconstruct/Repair Bridge
B-SUB	Bridge Substructure - Repair/Rehab	Exempt	Repair or Rehabilitate Bridge Substructure
B-SUP	Bridge Superstructure - Repair/Rehab	Exempt	Repair or Rehabilitate Bridge Superstructure
Bridge - Modernization			
B-RECNFG	Bridge/Structure - Reconst/Rehab Chng in Lane Use/Widths	Exempt Tested	Reconfigure Bridge
B-REPLACE	Bridge/Structure - Replace	Exempt	Replace Bridge
Bridge - Expansion			
B-NEW	Bridge/Structure - New	Not Exempt	Build New Bridge
Highway - Maintenance			
H-C/G	Highway/Road - Curb and Gutter	Exempt	Work On Curb and Gutters
H-CLVT	Highway/Road - Repair/Replace Culvert	Exempt	Repair or Replace Culvert
H-INTRC	Highway/Road - Intersection Reconstruction	Exempt	Reconstruct Intersection (Within Current Footprint)
H-IRS	Highway/Road - Intermittent Resurfacing	Exempt	Resurface Part of Road
H-PATCH	Highway/Road - Pavement Patching	Exempt	Patch Pavement
H-RCINKND	Highway/Road - Reconstruct in Kind	Exempt	Reconstruct Road with No Change to Number of Lanes or Pavement Width
H-RS	Highway/Road - Resurface (With No Lane Widening)	Exempt	Resurface Road with No Change to Lane Widths
Highway - Modernization			
E-NOIS	Noise Attenuation	Exempt	Reduce Noise by Road
H-ALIGN	Highway/Road - Vertical/Horizontal Alignment (e.g. Clearance)	Exempt	Adjust Alignment of Road
H-CLTL	Highway/Road - Continuous Bi-Directional Turn Lanes	Exempt Tested	Add Bi-Directional Turn Lane
H-HOT3	Highway/Road - HOT 3-Plus Lanes	Not Exempt	Add High Occupancy Toll Lane
H-HOV	Highway/Road - HOV Lanes	Not Exempt	Add High Occupancy Vehicle Lane
H-INFO	Highway/Road - Directional/Informational Signs	Exempt	Install Informational Signs

Work Type Code	Work Type Name	Exempt Status	Description
H-INTIMP	Highway/Road - Intersection Improvement	Exempt	Improve Intersection (Add/Change/Remove Turn Lanes or Otherwise Alter Current Footprint)
H-IPASS	Highway/Road - I-Pass Improvement	Exempt Tested	Improve tollway I-Pass System
H-RAB	Highway/Road - Roundabout	Exempt	Build Roundabout
H-RCNST	Highway/Road - Reconst with Change In Use Or Width Of Lane	Exempt Tested	Reconstruct and Widen Road with No Change to Number of Lanes
H-RL	Highway/Road - Remove Lanes	Not Exempt	Remove Lanes from Road
H-RRGS	Highway/Road - Railroad Grade Separation	Not Exempt	Highway-Railroad Grade Separation
H-WRS	Highway/Road - Widen Lanes and Resurface	Exempt Tested	Resurface and Widen Road with No Change to Number Of Lanes
I-RCNST	Interchange - Reconstruction	Exempt	Reconstruct Interchange with No Change to Movements
Highway - Expansion			
H-AL	Highway/Road - Add Lanes	Not Exempt	Add New Through Lanes to Road
H-EXT	Highway/Road - Extend Road	Not Exempt	Extend Road
H-NEW	Highway/Road - New Road	Not Exempt	Build New Road
I-EXP	Interchange - Expand (New Movements Added to Interchange)	Not Exempt	Add New Ramps/Movements to Interchange
I-NEW	Interchange - New	Not Exempt	Build New Interchange
Highway - Other			
E-LS	Enhancement – Landscaping	Exempt	Conduct Landscaping
H-COR	Highway/Road - Corridor Improvement	Not Exempt	Improve Overall Road Corridor (Added Capacity)
H-EV	Highway/Road – Electric Vehicles	Exempt	Electric Vehicles
H-EVINF	Highway/Road – EV Infrastructure	Exempt	Infrastructure to charge electric vehicles
H-GRNINF	Highway/Road – Green Infrastructure	Exempt	Install green infrastructure treatments, such as bioswales, permeable pavers, etc.
H-STWATR	Highway/Road – Stormwater Infrastructure	Exempt	Install Stormwater Infrastructure
H-UTIL	Highway/Road - Utility Relocation	Exempt	Relocation Of Utilities
Safety			
A-BAR	Safety - Barriers	Exempt	Install Safety Barriers
A-BEA	Safety - Beacons	Exempt	Install Safety Beacons
A-FNC	Safety - Fencing	Exempt	Erect Safety Fencing
A-GRD	Safety - Guardrails	Exempt	Erect Safety Guardrails
A-LTS	Safety - Lighting	Exempt	Install Safety Lighting
A-MED	Safety - Median Projects	Exempt	Work On Road Median to Improve Safety
A-OPT	Safety - Opticom Equipment	Exempt	Install Opticom Safety Equipment
A-OTH	Safety - Other	Exempt	Safety Improvement
A-PMRK	Safety - Pavement Marking	Exempt	Install Safety Pavement Marking
A-RDIET	Safety - Road Diet	Exempt Tested	Convert Lane to Bicycle Facility to Improve Safety

Work Type Code	Work Type Name	Exempt Status	Description
A-RRXING	Safety - Railroad Crossing Improvements	Exempt	Install Railroad Crossing Safety Improvements
A-SHDR	Safety - Shoulder Improvements	Exempt	Improve Shoulder Safety
A-SKIDT	Safety - Skid Treatments	Exempt	Install Safety Skid Treatment
Signals			
S-ASNG	Signals - Add Signals at Single Intersection	Exempt	Add Traffic Signals to An Intersection
S-MOD	Signals - Modernization	Exempt	Upgrade Traffic Signals
S-NEW	Signals - New Signals for Multiple Intersections	Not Exempt	Add Traffic Signals to Several Intersections
S-TIM	Signals - Interconnects and Timing	Not Exempt	Coordinate Traffic Signal Timing
Transit - Maintenance			
C-MAINT	Rail Stations - Maintain, Rehabilitate, Replace	Exempt	Maintain Rail Station
F-YRDS	Facility - Towers and Yards	Exempt	Work On Rail tower or Yard
J-REHAB	Rolling Stock - Rehabilitate Vehicles	Exempt	Rehabilitate Buses/Trains
J-REP	Rolling Stock - Replace Existing Vehicles	Exempt Tested	Replace Buses/Trains
M-MAINT	Multi-Modal Center - Maintain, Rehabilitate, Replace	Exempt	Maintain Multi-Modal Center
M-RELOC	Multi-Modal Center - Relocate	Exempt Tested	Move Multi-Modal Center
O-OPS	Operations - Transit Operating Assistance	Exempt	Fund Transit Operating Assistance
P-MAINT	Parking - Maintain, Rehabilitate, Replace	Exempt	Maintain Commuter Parking Lot
R-MAINT	Rail Line - Maintain, Rehabilitate, Replace	Exempt	Maintain Rail Line
U-CPSMAINT	CPS - Maintenance	Exempt	Maintain Transit Communications, Power and Signal Equipment
V-MAINSTOR	Vehicle Facility - Maintenance/Storage	Exempt	Work On Vehicle Maintenance or Storage Facility
V-MAINT	Vehicle Facility - Maintenance	Exempt	Work On Vehicle Maintenance Facility
V-STOR	Vehicle Facility - Storage	Exempt	Work On Vehicle Storage Facility
X-MAINT	Transfer Facility - Maintain, Rehabilitate, Replace	Exempt	Maintain Transfer Facility
Transit - Modernization			
C-IMP	Station - Improve with Change In Service	Exempt Tested	Improve Rail Station
C-MOD	Rail Stations - Modernize, Replace	Exempt	Modernize Rail Station
C-RELOC	Station - Relocate	Exempt Tested	Move Rail Station
D-FAC	ADA - Transit Facility Improvements	Exempt	Improve Disability Access to Transit Facility
D-VEH	ADA - Transit Vehicle Improvements	Exempt	Improve Disability Access to Transit Vehicle
F-OFC	Facility - Office Facilities/Equipment	Exempt	Acquire Office Facility and/or Equipment

Work Type Code	Work Type Name	Exempt Status	Description
F-REV	Facility - Revenue Collection Equipment	Exempt	Acquire Revenue Collection Equipment
F-SHOP	Facility - Shop Facilities/Equipment	Exempt	Acquire Shop Facility and/or Equipment
F-SPTV	Facility - Signal Priority for Transit	Exempt	Install Transit Signal Priority System
F-TRN	Facility - Bus Turnaround	Exempt	Install Bus Turnaround
J-FUEL	Rolling Stock - Alternate Fuels	Exempt	Acquire Alternative Fuel Buses/Trains
J-INF	Alternative Fuel Infrastructure	Exempt	Install Alternative Fuel Infrastructure
J-RETRO	Rolling Stock - Retrofit Engine	Exempt	Retrofit Bus/Train Engines
M-IMP	Multi-Modal Center - Improve with Change In Service	Exempt Tested	Improve Multi-Modal Center
P-RELOC	Parking - Relocate Lot or Garage	Exempt Tested	Move Commuter Parking Lot
R-IMP	Rail Line - Improve Line	Exempt Tested	Improve Rail Line
T-IMP	Bus Routes - Major Service Improvement	Not Exempt	Make A Major Improvement to Bus Routes
T-IMPSVC	Bus Routes - Improve Service	Exempt	Improve Bus Service
U-COM	CPS - Communications	Exempt	Work On Transit Communications
U-CPSIMP	CPS - Improvement	Exempt	Modernize Transit Communications, Power and Signal Equipment
U-POW	CPS - Power	Exempt	Work On Transit Power
U-SIGS	CPS - Signals	Exempt	Work On Transit Signals
X-IMP	Transfer Facility - Improve with Change In Service	Exempt Tested	Improve Transfer Facility
X-MOD	Transfer Facility - Modernize, Replace	Exempt	Modernize Transfer Facility
X-RELOC	Transfer Facility - Relocate	Exempt Tested	Move Transfer Facility
C-NEW	Station - New	Not Exempt	Build New Rail Station
J-EXP	Rolling Stock - Expand Fleet	Not Exempt	Expand Bus/Train Fleet
M-NEW	Multi-Modal Center - New	Exempt Tested	Build New Multi-Modal Center
P-EXP	Parking - Expand Number of Spaces	Exempt Tested	Add Spaces to Commuter Parking Lot
P-NEW	Parking - New Lot or Garage	Exempt Tested	Build New Commuter Parking Lot
R-EXP	Rail Line - Expand Line	Not Exempt	Extend Rail Line or Expand Line Capacity
R-NEW	Rail Line - New Line	Not Exempt	Build New Rail Line
T-EXP	Bus Routes - Major Expansion	Not Exempt	Expand Bus Routes Significantly
T-NEWSVC	Bus Routes - New Service	Exempt	Introduce New Bus Service
X-NEW	Transfer Facility - New	Exempt Tested	Build New Transfer Facility
Transit - Other			
O-C&A	Operations - Contingency and Administration	Exempt	Fund Contingency and Administration
Other Work Types			
E-HIS	Historic Preservation	Exempt	Preserve Historic Facility
Z-Museum	Miscellaneous - Transportation Museum	Exempt	Transportation Museum
E-MODE	Travel Demand Management	Exempt	Implement Travel Demand Management

Work Type Code	Work Type Name	Exempt Status	Description
Z-OTH	Miscellaneous - Project Types Not Listed	Not Exempt	Work On Miscellaneous Project Requiring Air Quality Analysis
Z-OTHEX	Miscellaneous - Exempt Projects	Exempt	Work On Miscellaneous Project Not Used in Air Quality Analysis
Z-OTHXTST	Miscellaneous - Exempt Tested Projects	Exempt Tested	Work On Miscellaneous Project Type Included in The Travel Demand Model

ON TO 2050 update financial plan for transportation appendix

September 2022 draft

Contents

Summary

Federal law requires metropolitan planning organizations to demonstrate fiscal constraint by determining that sufficient funding resources will be available to invest in the transportation system, as recommended in the long-range plan. Specifically, federal regulations require "for purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain Federal-aid highways" and "public transportation" (23 CFR § 450.324(f)(11)).

To achieve federal requirements, the Chicago Metropolitan Agency for Planning (CMAP) must assess the anticipated expenditures and revenue sources necessary to carry out the operation, maintenance, and expansion of the region's surface transportation system over the planning period (2023-50). Long-range financial forecasting requires determining a base set of assumptions regarding revenue and expenditures trends, understanding the future implications of current policies, and development of a robust, accurate, and straightforward methodology that is appropriate for a planning-level forecast. This appendix to the ON TO 2050 update provides detail on the methodology used in the financial plan for transportation forecast. The ON TO 2050 update summary also contains the recommendations of the financial plan.

The following table details the ON TO 2050 update's financial plan for transportation, including forecasting revenues and funding allocations to planned investments on the system. The forecast indicates that the revenues projected to be available over the planning horizon will be sufficient to operate and maintain the transportation system in its current condition. However, the expected funding would be insufficient to cover regional priorities for improving asset condition, enhancements, or expansions to the system. To meet the region's asset condition targets, fiscally constrained enhancements and expansions within the long-range planning context, and ensure sufficient operational funding, the region will need to continue to prioritize the advancement of new and innovative revenue sources as major policy priorities in the ON TO 2050 update.

Adding five reasonably expected revenues to the forecast will make a total of $526 billion available over the planning period. Of that total, 82 percent (or $431.32 billion) is necessary to operate, administer, and maintain the system in its current condition. This leaves 18 percent (or $94.68 billion) to allocate toward improving system condition, as well as enhancing and expanding the system over the 2023-50 planning period.

As required by federal regulations, revenues and expenditures were forecast in year of expenditure dollars rather than real or constant dollars, meaning inflationary increases are included in the forecasts.

Forecasted transportation revenues and expenditure allocations, 2023-50, in billions of year of expenditure dollars

Revenues	
Federal revenues	$80.8
State revenues	$199.6
Local revenues	$207.7
Subtotal baseline revenues	$488.0
Toll major highway reconstructions and new highway capacity	$13.0
Replace state motor fuel tax (MFT) with road usage charge	$10.0
Expand the sales tax base to additional services	$9.0
Regional revenue source	$4.0
Local parking pricing expansion	$2.0
Subtotal reasonably expected revenues	$38.0
Total revenues	**$526.0**
Expenditures	
Operate and administer roadway system	$120.0
Operate and administer transit system	$136.3
Maintain current roadway condition	$109.4
Maintain current transit asset condition	$63.7
Subtotal cost to administer, operate, and maintain in current condition	$429.5
Improve system condition	$30.8
Make system enhancements	$43.7
Full cost of constrained regionally significant projects	$84.8
Capital cost allocated as maintenance and reconstruction	—$59.8
Offsetting revenues from tolling and value capture	—$3.0
Subtotal constrained new capacity cost of regionally significant projects	$22.0
Total expenditures	**$526.0**
Note: revenues and expenditures do not add up to the subtotals due to rounding	

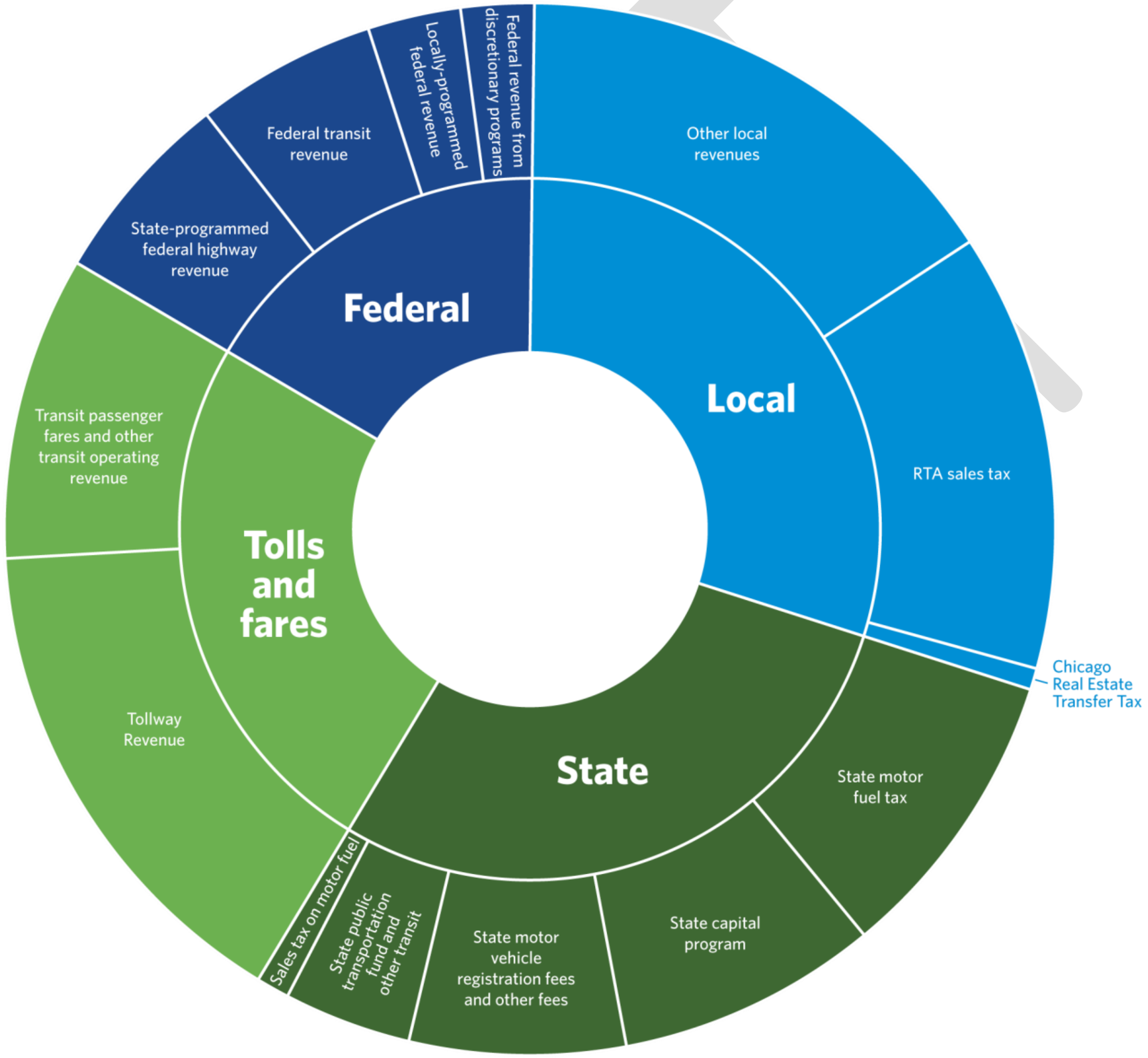
Revenues

Revenue forecasts are intended to account for all funding resources expected to be available to administer, operate, maintain, improve, enhance, and expand the transportation system. In the fiscal constraint, all revenue sources are aggregated prior to the process of allocation to expenditure categories. This approach is suited to a long-range planning process focused on determining regional investment priorities rather than budgeting for a program. In addition, the approach fits with CMAP recommendations emphasizing the need to use transportation user fees imposed on drivers for all transportation modes.

Baseline revenues

The baseline revenue forecast totals $488 billion over the 28-year planning period. The baseline revenue forecast includes all existing revenue sources the region receives for transportation purposes and does not include any new sources. The forecasts assume that northeastern Illinois will continue to receive revenues from federal, state, and local sources for constructing, operating, administering, and maintaining the current roadway and transit system. This includes periodic transit fare and toll rate increases, which will be necessary to ensure sufficient revenues to pay for these systems over the 28-year planning period. The chart below provides forecasts for specific revenue sources, followed by methodology and assumptions.

Baseline revenue forecast, 2023-50, in year of expenditure dollars



Locally programmed federal revenue: $13.9 billion

These funds represent the annual federal apportionment that is passed to the Chicago metropolitan region for programming. This includes the federal fund sources of the Congestion Mitigation and Air Quality Improvement Program (CMAQ), Transportation Alternatives Program-Local, Carbon Reduction Program, Surface Transportation Program-Local, and Surface Transportation Program-Counties.[1] Revenue estimates through 2026 are based on CMAP estimates for expected funding from the Infrastructure Investment and Jobs Act (IIJA). Federal revenues to the region grew at a rate of 1.5 percent between 2010 and 2021. After 2026, revenues were assumed to increase annually by this same 1.5 percent rate.

Federal revenue from discretionary programs: $10.4 billion

Forecasted revenues include those allocated by the federal government at the discretion of the U.S. Department of Transportation (USDOT) rather than by formula. The region is assumed to receive a similar share of grants over the planning period as it has in recent years. Programs tend to vary over time. Current programs including New Starts, BUILD, INFRA, All Stations Accessibility Program, Congestion Relief Program, Reconnecting Communities Pilot Program, RAISE, Safe Streets and Roads for All, Active Transportation Infrastructure Investment Program, and Strengthening Mobility and Revolutionizing Transportation (SMART). Federal revenues to the region grew at a rate of 1.5 percent between 2010 and 2021. After 2026, revenues were assumed to increase annually by this same 1.5 percent rate.

Federal transit revenue: $27.0 billion

Forecasted revenues include State of Good Repair and Urbanized Area Formula Grant programs, as well as other federal transit formula grants.[2] Revenue estimates through 2026 are based on CMAP estimates for expected funding from IIJA. Federal revenues to the region grew at a rate of 1.5 percent between 2010 and 2021. After 2026, revenues were assumed to increase annually by this same 1.5 percent rate.

State-programmed federal highway revenue: $29.6 billion

These funds represent the annual federal apportionment programmed by Illinois. This includes the federal fund sources of National Highway Performance Program; Surface Transportation Program; National Highway Freight Program; Highway Safety Improvement Program; Transportation Alternatives Program; Recreational Trails; the Bridge Investment Program; National Electric Vehicle Formula Program; and the PROTECT program.[3] Revenue estimates through 2026 are based on CMAP estimates for expected funding from IIJA, and 74.43 percent of the statewide total annual apportionment in those years was assumed to go to northeastern Illinois. Federal revenues to the region grew at a rate of 1.5 percent between 2010 and 2021. After 2026, 45 percent of the statewide total annual apportionment was assumed to go to

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[1] For more information on regional transportation programs administered by CMAP, see http://www.cmap.illinois.gov/mobility/strategic-investment/regional-transportation-programs.

[2] For more information on Federal Transit Administration programs, see https://www.transit.dot.gov/grants.

[3] For more information on Federal Highway Administration programs, see https://www.fhwa.dot.gov/specialfunding.

northeastern Illinois, and revenues were assumed to increase annually by this same 1.5 percent rate.

State motor fuel tax: $45.6 billion

As of March 2022, the current motor fuel tax (MFT) rate was 39.2 cents per gallon (46.7 cents per gallon of diesel). Rebuild Illinois indexed the base rate to inflation beginning in 2019. Given high inflation between March 2021 and March 2022, Illinois approved a six-month freeze of the state motor fuel tax index, effective July 1, 2022. Nevertheless, CMAP forecasts the MFT rate will grow by 8.6 percent in 2023. After 2023, the rate is assumed to grow an average of 2.5 percent annually.

These funds include the portion of state motor fuel tax revenue retained by the Illinois Department of Transportation (IDOT) for the Road Fund and State Construction Account. After accounting for various statutory deductions, the region is assumed to receive 45 percent of these revenues for the purposes of funding state road construction and maintenance projects, estimated to total $18 billion. The Regional Transportation Authority also receives funding based on allocations set in statute — forecasted to total $10.6 billion. This forecast also includes statutory disbursements to counties, townships, and municipalities. Those disbursements are forecasted to total $17 billion. Statutorily, Cook County receives a 16.74 percent share, and the remaining county share is based on motor vehicle registration fees received. Township share is based on share of mileage of township roads, and the municipal share is based on population.

CMAP used forecasted annual vehicle miles traveled (AVMT) and average miles per gallon (MPG) to estimate revenue. For AVMT, CMAP used 2045 forecasts developed by the Illinois Department of Transportation and extrapolated the forecast to 2050. Average annual percent change in AVMT between 2023-50 was 0.8 percent for passenger vehicles and 0.7 percent for other vehicles.

For passenger vehicle MPG estimates, CMAP created estimates based on National Highway Traffic Safety Administration (NHTSA) rules for Corporate Average Fuel Economy (CAFE) standards, estimated standards for 1978 through 2029 model years for cars and light trucks, and data about vehicle fleet from the Federal Highway Administration's 2017 National Household Travel Survey. CMAP estimates vehicle fuel economy for passenger vehicles statewide will reach a fleetwide average of 34.5 MPG by 2050. While these CAFE standards are being finalized, fuel economy across the entire vehicle fleet is still expected to increase with consumer choice, new technology, and adherence to standards promulgated by other states. For non-passenger vehicles, MPG was assumed to improve with NHTSA fuel efficiency standards for medium- and heavy-duty vehicles.

Sales tax on motor fuel: $5.4 billion

The state's portion of the state retailer's occupation tax generated from the sale of motor fuel will be deposited in the Road Fund, with increasing portions allocated to the Road Fund during

2023, 2024, and 2025, and reaching 100 percent in 2026 and thereafter. The forecast uses average Midwest gas prices from the U.S. Energy Information Administration from the past year — $2.51 for regular and $2.82 for diesel — and deducts various taxes included in the prices. The forecast assumes the price of motor fuel will grow at a rate of 0.1 percent annually. Gallonage assumptions are the same as above.

State motor vehicle registration fees and other state fees: $32.5 billion

These revenues include annual vehicle registration fees, certificate of title fees, overweight fines, permit fees, and operator's license fees collected by Illinois. The revenues are deposited into the Road Fund and State Construction Account. Motor vehicle registration fee revenues to the Road Fund and State Construction Account were assumed to grow at a rate of approximately 0.5 percent annually. Other types of fees in this category were forecast to grow approximately 1.8 percent annually. The region is assumed to receive 45 percent of these revenues for the purposes of funding state road construction and maintenance projects. Recent fee increases enacted as part of Rebuild Illinois are included here. Future fee rate increases were not assumed in this category, as they would likely be accounted for in future state capital programs.

State capital program: $39.2 billion

State capital programs typically are funded with a variety of revenue increases, including fee increases on sources like vehicle registration and certificate of title. It is assumed the state will enact a capital program two additional times during the planning period in 10-year intervals. Funding levels were assumed to grow 2.5 percent annually with Rebuild Illinois funding levels assumed as the baseline.

Tollway revenue: $74.7 billion

This forecast includes toll revenues forecasted to be collected on the 294-mile system, as well as other operating revenues. The current toll rate structure went into effect in 2012, with the commercial rate adjusted annually for inflation. Toll revenue projections were derived from estimates that were prepared by CDM Smith for the Illinois Tollway in November 2020. The projection assumed the annual adjustment in commercial toll rates would be 2 percent annually. CMAP also included an assumption of two passenger toll rate adjustments throughout the planning period. Other operational revenues, such as concessions and miscellaneous income, were forecast to grow at a compound rate of 2.3 percent annually.

State Public Transportation Fund: $18.4 billion

These funds represent state matching funds for transit, which are equal to 30 percent of Regional Transportation Authority (RTA) sales tax, state use tax disbursements to the RTA, and the portion of Chicago real estate transfer tax revenues reserved for the CTA. The forecast equals 30 percent of the forecasts of these revenues.

Other state transit: $700 million

Illinois has provided funding each year to support Pace's Americans with Disabilities Act (ADA) Paratransit service since 2010. Illinois also provides reduced fare reimbursements to the service boards. Both reduced fare reimbursements and ADA support are forecast to remain at current levels annually for the planning period — $17.6 million and $8.4 million, respectively.

RTA sales tax - $65.9 billion

The RTA sales tax is equivalent to 1.25 percent of sales in Cook County (including the RTA sales tax and the RTA's share of the state sales tax) and 0.75 percent of sales in DuPage, Kane, Lake, McHenry, and Will counties. The RTA receives two-thirds of the collar county revenues. Sales tax revenues accruing to the RTA are assumed to grow 2.8 percent annually throughout the planning period. The RTA also receives disbursements of state use tax, which are expected to grow at a rate of 3.3 percent on average.

A third of collar county revenues generated from the RTA sales tax, Collar County Transportation Empowerment Funds, are returned to DuPage, Kane, Lake, McHenry, and Will counties to be used for roads, transit, and public safety. During the planning period, revenues total $6.7 billion and annual growth averages 3 percent. Growth assumptions were based on projected population growth combined with inflationary assumptions.

Chicago real estate transfer tax (RETT): $2.2 billion

The $1.50 per $500 of value of Chicago's RETT is transferred to the Chicago Transit Authority (CTA). Revenues were forecast to grow at an average rate of 2.7 percent annually.

Transit passenger fares and other transit operating revenue: $45.8 billion

This includes passenger fares for the CTA, Metra, Pace, and Pace ADA, as well as other revenues for the RTA, CTA, Metra, Pace, and Pace ADA. Other revenues come from sources like advertising, investment income, and Medicaid reimbursements. Revenues were forecast to grow at an average rate of 2 percent annually. To the extent ridership does not substantially return to normal levels by the beginning of the planning period, it is assumed fare revenue will be supplemented by other federal or state operating support. Other operating revenues are assumed to grow at a rate of 1.2 percent annually, based on assumed rates of growth in system revenue and ridership.

Other local revenues: $76.6 billion

These are funding sources used for transportation purposes by counties, townships, and municipalities. Funding sources include property tax revenue, sales tax revenue, local motor fuel taxes and impact fees. Revenues were calculated for municipalities and townships using the 2017 U.S. Census of Governments data. County revenues were obtained from recent county budget documents. Revenues were adjusted to the current year using the change in the Consumer Price Index and population growth. To forecast to 2050, growth rates for CMAP population forecasts were added to an annual 2.5 percent inflationary adjustment. Average annual growth regionwide was 3 percent.

County MFTs for DuPage, Kane, Lake, McHenry, and Will counties were forecast separately using the same methodology for the state MFT. But baseline fuel economy was derived separately for each county and AVMT growth was calculated using growth rates in AVMT for each county for each air quality conformity analysis year. These revenues are expected to total $2.2 billion over the planning period.

Reasonably expected revenues

New and modernized revenues must be implemented to ensure the future viability of the region's transportation system. Despite new funding, federal, state, and local revenue sources remain unsustainable in the long term to fully fund regional priorities for the maintenance, operation, enhancement, and expansion of the region's transportation system. Federal guidance permits the inclusion of new revenue sources that can be reasonably expected to be made available to carry out the transportation plan. The ON TO 2050 update proposed $38 billion total across five reasonably expected revenues that represent policy changes that would require actions at the state and local levels. Precedent within the region and across the country suggests all five revenue sources could be reasonably expected to be implemented over the planning horizon. The Mobility chapter of ON TO 2050 contains more detail on these policy recommendations, and the following describes the methodology behind the forecast. The following methodology is intended to be congruent with CMAP recommendations, but the assumptions do not necessarily constitute proposals for precisely how these would be imposed.

The following do not include funding sources recommended in the plan, like a federal gas tax increase or a federal cost of freight services fee. It is assumed the federal government will have to enact this revenue source, as well as ON TO 2050's recommendation to increase the federal gas tax, to continue to fund federal transportation programs at the levels authorized in IIJA without general fund transfers. The baseline forecast already assumes continued federal funding at these levels throughout the planning period, and does not include tolling, value capture, or financing approaches like public-private partnerships that are specific to particular projects. Therefore, in the financial plan, they can be used to offset the cost of specific regionally significant projects rather than being included as reasonably expected revenue.

Toll major highway reconstructions and new highway capacity: $13 billion

Much of the region's expressway system must be rebuilt during the next thirty years. Tolling currently untolled facilities in conjunction with planned reconstruction would help pay for the costs of reconstruction, as well as free up revenues for the remainder of the system. The forecast assumes project-specific tolling revenues will grow at a rate of 0.8 percent annually following the year of construction. This is the compound annual growth rate for tolls collected each year between 2015 and 2050 based on CMAP's evaluation modeling for regionally significant projects.

Replace state MFT with a road usage charge: $10 billion

Northeastern Illinois would receive revenues from replacing the state motor fuel tax with a road usage charge in the first five years of the planning period at a rate of 2 cents per mile. The rate would be indexed to an inflationary measure, assumed to be 2.5 percent annually for the purposes of the forecast. The forecast assumes that fund would accrue to northeastern Illinois in the same manner as the state MFT currently does.

Expand the sales tax base to additional services: $9 billion

Expansion of the sales tax to include additional services would result in additional RTA sales tax revenues, as well as state sales tax disbursements to the RTA. The forecast assumes additional consumer services would be added to the sales tax base by approximately 2026, resulting in a 15 percent increase in the base. Revenues are assumed to grow at a rate of 3.6 percent annually, which is the average annual growth rate for personal consumption expenditures in Illinois for certain consumer services over the past 20 years. The forecast assumes no additional Public Transportation Fund revenue. This forecast does not include revenues that would accrue to the state or other local jurisdictions due to a sales tax base expansion.

Regional revenue source: $4 billion

Given the unique investment needs of northeastern Illinois, a regional revenue source could help match federal funds, implement regional transportation priorities, and advance modernization initiatives. The forecast assumes the regional revenue source would be imposed as a 5 percent fee on the trip fares paid to transportation network companies. Base trip and fare assumptions for the region were derived from an analysis of Chicago data and CMAP's My Daily Travel survey. The forecast assumes the tax base would grow 2.5 percent annually throughout the planning period as a result of increases in trips and fares.

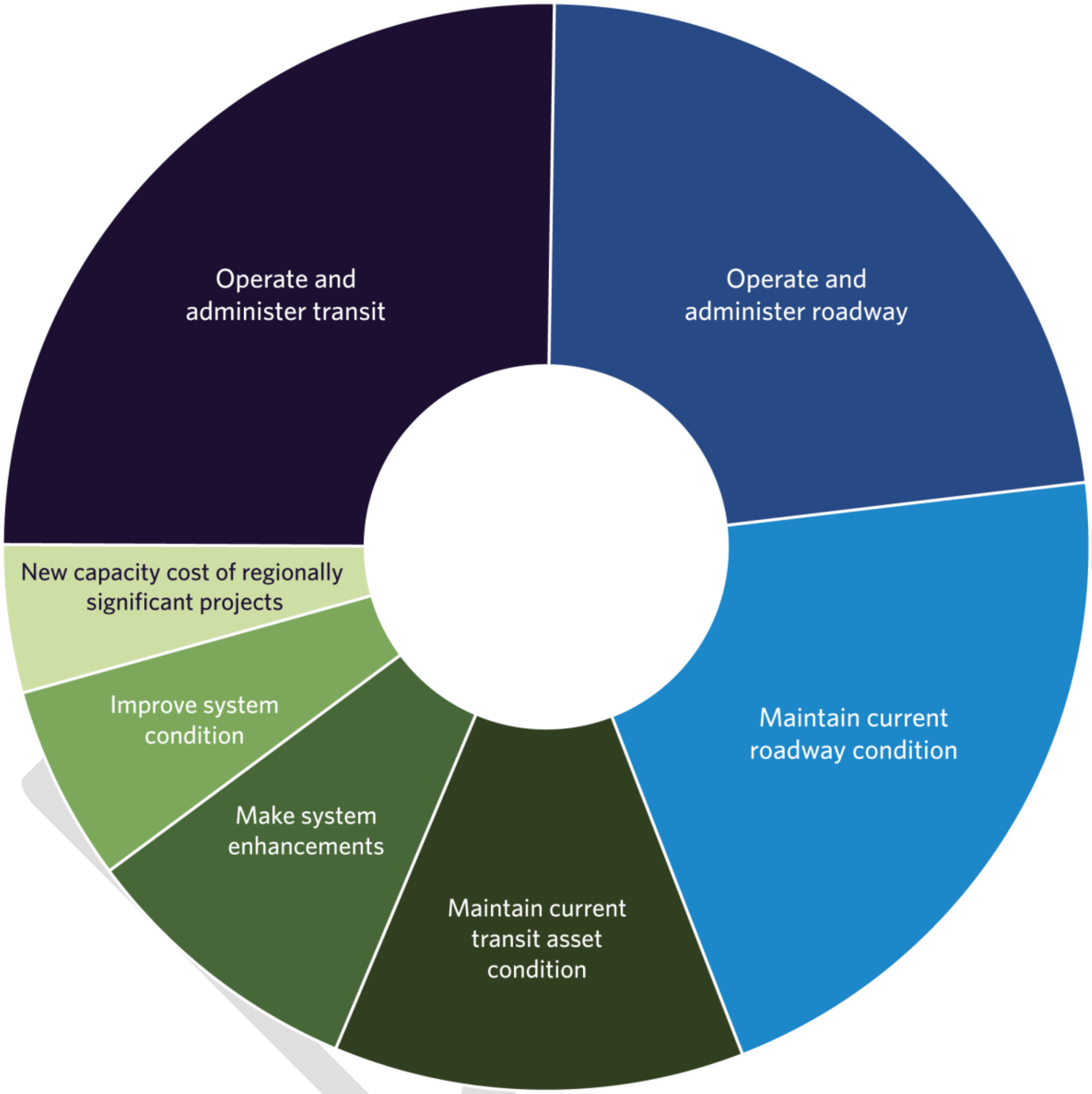
Local parking pricing expansion: $2 billion

Municipalities in the region would increase the number of priced parking spots in the region throughout the planning period. Pricing of unpriced parking spots would be phased in annually, starting with 600 spaces in the first year. The number of priced spaces would accelerate as the concept gained popularity for the efficacy in managing the public right-of-way. Prices and rate structures would vary by location. It was assumed the regional average would total $5 per day with inflationary rate increases of 2.5 percent annually for the purposes of this forecast. Given the local nature of parking pricing, these revenues could be used for local transportation investments.

Expenditures

The financial plan for transportation prioritizes how to invest available revenues by allocating planned expenditures into different categories. These categories account for funding for administering, operating, maintaining, improving, enhancing, and expanding northeastern Illinois' transportation system. The following section provides an overview of these categories.

ON TO 2050 update expenditure allocations, 2023-50, in year of expenditure dollars



Operations and administration

This category includes the cost of administering, operating, and servicing debt for the region's existing roadway and transit system. This assumes no operational enhancements, but the continued operation of the existing system. This includes employee costs, rent, utilities, non-capital repairs, fuel, and debt service, as well as other costs needed to administer daily operations of the transportation system.

Roadway expenditures: $120 billion

The forecast consists of operations and administrative costs for IDOT District 1, Illinois Tollway, counties, townships, and municipalities, including Tollway debt service and state debt service for Series A bonds. Tollway and IDOT District 1 operating and administrative expenditures were forecasted linearly based on the most recent 20 years of available data. During the planning period, annual growth averaged 2.6 percent for IDOT District 1 and 2.1 percent for the Illinois Tollway. Tollway interest payments were forecast based on past trends, and growth averaged 2 percent annually during the planning period. Series A bond payments were forecast to grow linearly at an average rate of 1.8 percent annually during the planning period, and it was assumed that 45 percent of these costs were attributable to the region.

County budget documents provided baseline county expenditures for 2019. Municipal and township expenditures were estimated from the local highway operations expenditures reported to the 2017 Census of Governments and adjusted to the current year based on inflation and population growth. County, township, and municipal expenditures were assumed to grow at an average rate of 3 percent annually during the planning period due to growth in the region’s population and growth in inflation.

Transit expenditures: $136.3 billion

The forecast includes operating, administration, and debt service costs for the RTA, CTA, Metra, Pace, and Pace ADA. Operating and administrative expenditures were forecast to grow an average of 2.7 percent annually during the planning period. The interest portion of debt service payments were forecasted to grow an average of 0.7 percent annually.

Capital maintenance to maintain current asset conditions

The forecast includes the cost of capital maintenance on the region’s roadway and transit system based on maintaining current conditions. The expenditure forecast is based on the investment needed to keep these conditions constant and not increase the backlog of facilities in fair or poor condition. These expenditure forecasts include capital maintenance expenditures completed in tandem with regionally significant projects but do not include any costs that would address a need for increased capacity on the transportation system.

Based on analysis and input from transportation agencies, staff inflated maintenance unit costs for year-of-expenditure using a 2.5 percent rate, which was also used in ON TO 2050. Over the past 20 years, the average annual percent change in the U.S. Consumer Price Index was 2 percent. FHWA’s National Highway Construction Cost Index has experienced average annual increases of 2.2 percent over the past decade.

Roadway capital expenditures: $109.4 billion

Capital maintenance includes costs for expressways, arterials, collectors, local roads, bridges, and signals. The scenarios used assumed current asset conditions would be maintained during the planning period. Various transportation departments provided feedback on modeling assumptions, unit costs, and lifecycle assumptions.

For road with condition data, CMAP staff used IDOT's asset management spreadsheet tool to forecast the cost to maintain pavement condition in its current condition. IDOT's tool can evaluate the impacts of different investment options for both pavements and bridges. CMAP only used the pavement tool because CMAP had its own in-house bridge model already developed. The spreadsheet tool facilitates the analysis of programming funds for different pavement treatments using deterioration rates and treatment costs. Overall, 90 percent of the roadway miles included in the model are in acceptable condition. Interstates are 89 percent. Other NHS roadways are 92 percent, and other IDOT facilities are 87 percent.

The main inputs for the IDOT tool are pavement condition and roadway improvement costs. Pavement condition, measured in Condition Rating Survey (CRS), used in the model came from the 2020 Illinois Roadway Information System public file. The roadway miles were broken down by facility type and CRS rating. The roadway improvement costs used in the model were developed through collaboration with CMAP stakeholders. The improvement costs were broken down by improvement and facility type (interstate and non-interstate). Upcoming IDOT and Illinois Tollway pavement improvement projects were accounted for in the forecast.

CMAP staff used its bridge model to forecast capital maintenance expenditures for bridges, based on deterioration curves for Illinois, from National Bridge Inventory data. The model considers the condition of the deck, substructure, and superstructure. If one or more components of the bridge is in fair or poor condition, it will trigger an improvement to the bridge. The scenario used assumed current bridge conditions would be maintained during the planning period.

Staff forecasted capital maintenance expenditures on other roadway assets, such as local roads and traffic signals, based on assumptions of the typical cycles with which roadway maintenance projects are performed today. These assumptions then are applied to the inventory of roadway assets in the region. These capital assets make up a large portion of the forecast, in part, because local roads make up the majority of the region's roadway network.

Transit capital expenditures: $63.7 billion

This includes capital maintenance costs for the CTA, Metra, Pace, and Pace ADA. RTA's Capital Optimization Support Tool provided data to forecast asset condition and investment needs for a period of 2023-45, with extrapolation for the final five years of the planning period. The scenario assumed the current condition of assets would be maintained across the planning period. Expenditures were inflated 2.5 percent annually. The following table provides more detail on asset condition by transit asset category.

Transit asset condition in northeastern Illinois by federal performance measure category, 2020

Category	Percent
Buses beyond useful life	6.7%
Rail vehicles beyond useful life	30.2%
Non-fixed route vehicles beyond useful life	43.4%
Track with performance restrictions	5.7%
Facilities in marginal or fair condition	20.6%
Non-revenue vehicles beyond useful life	37.7%
Rail equipment beyond useful life	62.6%

Source: National Transit Database

Improve system condition

This category constrains investments to help achieve targets for various asset condition measures. Federal transportation law requires transportation planning efforts to incorporate performance measures for infrastructure condition, among other topics. This funding allocation includes $30.8 billion to improve the condition of pavement, bridge, and transit assets. These estimates use similar methodology as the capital maintenance expenditures. The following table provides an overview of how the financial plan allocates funds toward meeting system condition goals.

Allocations toward meeting asset condition goals, 2023-50, in billions of year of expenditure dollars

Transit assets from 61% to 68% in good repair	$22.1
Roadways from 90% to 98% in acceptable condition	$6.2
Bridges from 85.8% to 97% in acceptable condition	$2.5
Total allocation for improving system condition	**$30.8**

System enhancements

This category includes capital and operational enhancements or improvements not already constrained under other categories. Examples include bicycle, pedestrian, and ADA improvements, as well as highway management and operations, including intelligent transportation systems. Expansions that do not meet the definition of regionally significant projects is another example, along with culvert maintenance that is not accounted for the bridge model and intersection improvements. The region needs to make these investments, particularly multimodal improvements that provide residents with low-cost mobility options. It is assumed $43.7 billion constrained in this category is sufficient to reasonably provide for these enhancements to the system.

Regionally significant projects

To identify candidate regionally significant projects (RSP), CMAP solicited projects from partner agencies and then extensively evaluated the benefits of the projects, which is documented in the Regionally Significant Project benefits report. Projects required to be evaluated as a RSP are those that meet one of the following thresholds:

1. Costs at least $100 million and either
    a. changes capacity on the National Highway System or is a new expressway or principal arterial, or
    b. changes capacity on transit services with some separate rights of way or shared right of way where transit has priority over other traffic
2. Costs at least $250 million and improves the state of good repair for a particular highway or transit facility

This category allocates funding toward expansion elements of constrained RSPs, while the cost of maintaining existing infrastructure in constrained projects is accounted for in the baseline forecast. The constrained RSPs total $84.8 billion, which includes capital costs ($22.6 billion for new capacity and $59.8 billion for reconstruction) and incremental operating costs on new capacity ($2.4 billion). These costs consider anticipated cost inflation by the time the project is constructed and begins operation.

ON TO 2050 acknowledges transit projects can generate revenue that can be used to offset their costs. Transit Facility Improvement Areas (TFIA) — in which a form of value capture can be used to fund transit capital investments — are assumed to generate revenue to support $3 billion in bond funds to offset transit project costs through existing and new TFIAs. The amount constrained for new capacity after taking these revenues into account totals $22 billion.

ON TO 2050 plan update indicators appendix

September 2022 draft

Contents

Introduction

This document contains the details of the ON TO 2050 plan update indicators, which serve as benchmarks for monitoring the progress of plan implementation. Where possible, each plan recommendation is tracked by one or more indicators. Indicator target values for the years 2025 and 2050 have been specified to quantify actual plan progress and to track how well the region is achieving its goals in both the near and long term. The targets should not be viewed as projections or forecasts, but rather as optimistic outcomes that are achievable with the successful implementation of ON TO 2050.

This report documents all the indicators and targets used in the ON TO 2050 plan update. Most are unchanged from the original ON TO 2050 indicators adopted in 2018, although several have required some modifications to their data source, methodology, and/or targets.

Plan update indicator refinement process

Since the adoption of ON TO 2050, CMAP has continued to track the indicators over time as new data became available. However, challenges arose for updating certain indicators due to data unavailability, retroactive revisions to baseline data, and changes to methodology. As part of the plan update process, CMAP carefully reviewed each of the indicators to identify the issues and made the necessary adjustments to data sources, analysis procedures, and/or targets for the problematic indicators to ensure that they can continue to be updated. All these changes are described in detail under "plan update revisions" in the indicator-specific tables that form the bulk of this document. The "preventable hospitalizations by race and ethnicity" indicator that was included in ON TO 2050 has been eliminated because CMAP was never able to obtain the necessary data. No new indicators have been added.

Document layout

The remainder of the report is divided into sections that correspond to the five chapters of ON TO 2050. Each section includes a discussion of the indicators that relate primarily to that chapter (although several indicators are related to topics in multiple chapters).

The discussion for each indicator includes a summary of its relevance to the plan's recommendations, a description of the data sources and methodology used to calculate it, target values for the near term (2025) and the long term (2050), and a brief discussion of the indicator's status in relation to the original ON TO 2050 indicator. Some indicators also have an "inclusive growth perspective" that reports the indicator's values by race and ethnicity or within economically disconnected areas (EDAs, areas with concentrations of both low-income households and persons of color or limited English proficiency population) and disinvested areas (predominantly nonresidential places with struggling local economies). This additional detail will help CMAP track progress on inclusive growth. These "inclusive growth perspectives" also function as secondary indicators.

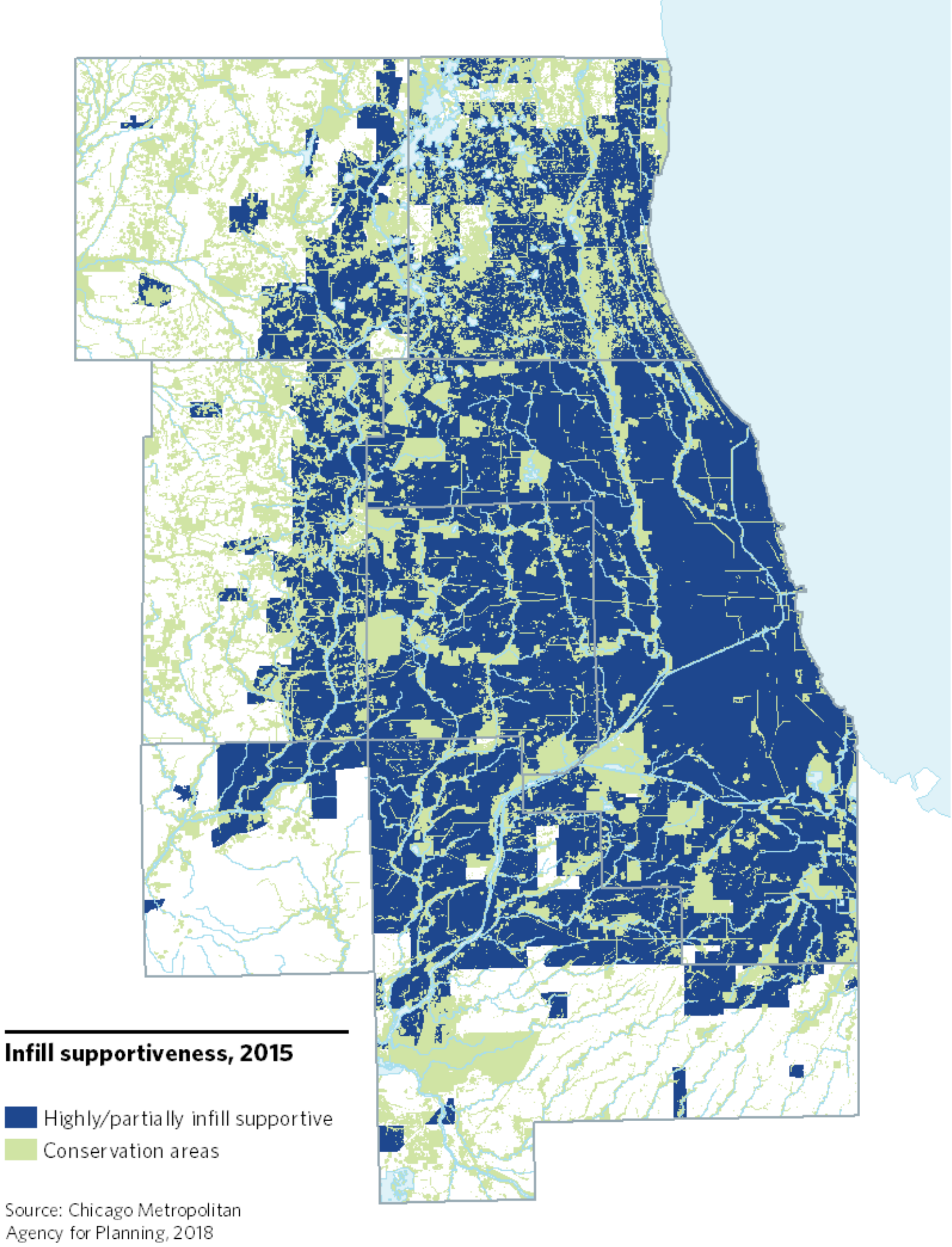
A final section details the set of secondary indicators that will supplement the information provided by the core indicators. Many of these specifically focus on the theme of inclusive growth. The secondary indicators do not have target values but were chosen to help tell a more complete story and address data gaps in the core indicators.

For a comprehensive list of all ON TO 2050 indicators, please refer to the table of contents.

Community indicators

Share of post-2015 development occurring in infill supportive areas

Indicator	This indicator uses the Northeastern Illinois Development Database (NDD) to measure the cumulative share of development that occurs in the region's highly and partially infill supportive areas (with any overlapping conservation areas excluded). This measure addresses a critical element of ON TO 2050: encouraging development in existing communities where infrastructure to support it is already in place, while also avoiding the expansion of new infrastructure with long-term maintenance costs. For this indicator, the term "development" is used in a general sense to include both new development and redevelopment of existing uses. Residential and non-residential development will be tracked separately. **Related recommendations:** Target infill, infrastructure, and natural area investments; invest in disinvested areas
Methodology	This indicator will track the share of new residential units and the share of new non-residential square footage that occurs in highly and partially infill supportive areas. The 2015 infill supportiveness index was created based on existing land cover, population, employment, and road density. Existing development and infrastructure were identified, focusing on four major indicators: developed area, road infrastructure, housing density, and employment density. The index highlights parts of the region that are best able to support infill development. For this indicator, the infill supportiveness index will be modified to exclude any portions of the highly and partially infill supportive areas that are also covered by the ON TO 2050 conservation areas layer, which identifies key natural resources that are priorities for conservation. The 2015 infill supportiveness index and conservation areas layer will be held constant over the life of the plan as a way to measure infill supportive development using a control geography representing areas with existing infrastructure in place. The following map shows the conservation areas layer and the portions of the infill supportive areas that will be used as the basis for identifying infill supportive developments.



Infill supportiveness, 2015

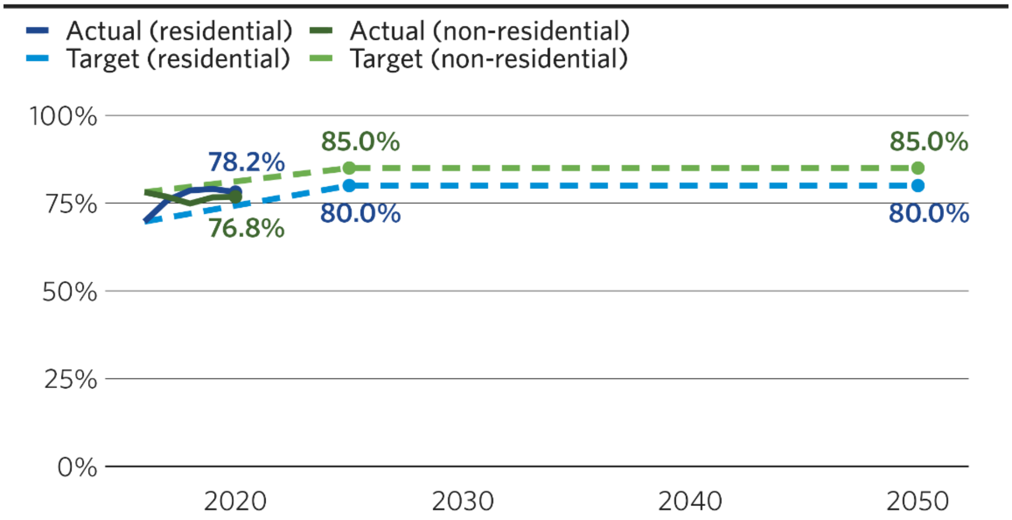
Source: Chicago Metropolitan Agency for Planning, 2018

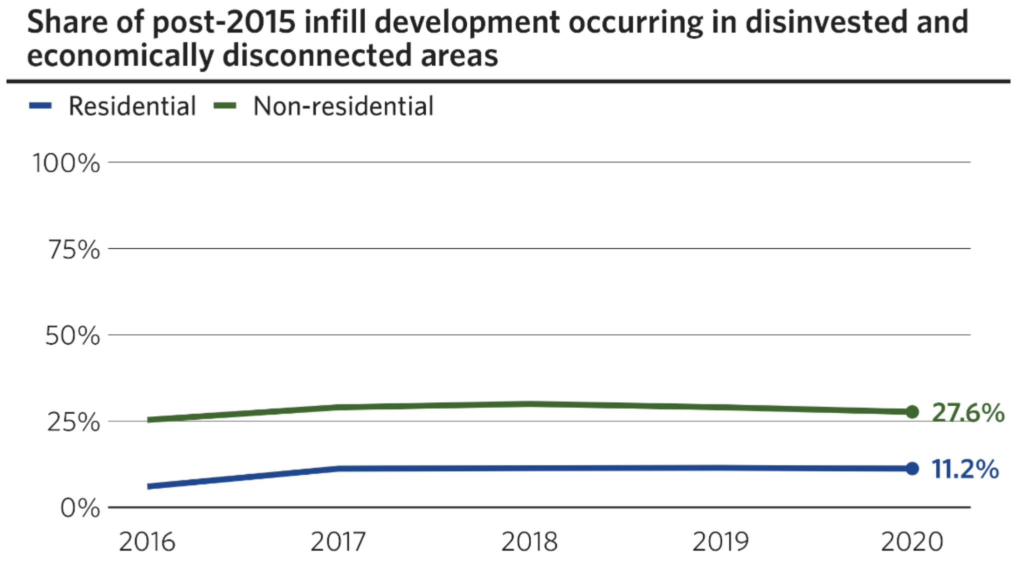
The NDD tracks all significant development and redevelopment in the seven-county region. Developments must meet one of the following criteria to be included in the NDD:

- Consume at least once acre of land, OR
- Consist of at least 10 residential units, OR
- Consist of at least 10,000 square feet of non-residential space

The NDD covers new construction, renovations with a change in land use (e.g., commercial to residential), and expansions of existing uses (e.g.,

	school additions). In general, if a development results in a change of population or employment, it is included in the NDD. The database does not include individual homes that may meet the above criteria unless they are part of a larger development; renovations where there is no change in land use; or condominium conversion of existing rental buildings.
Targets	Due to the disparate nature of residential and non-residential development, separate target values and units of measurement will be used to track the progress of each development type. Reporting residential development in terms of units and non-residential development in terms of square footage is the industry standard; there is no simple method to develop an equivalency between the two. Targets are based on recent trends in residential and non-residential development and consider forecasted growth in housing units and jobs in the Chicago metropolitan region. 80 percent of residential developments and 84 percent of non-residential developments from 2000 to 2015 occurred within highly and partially infill supportive areas. Since 2016, 80 percent of residential developments and 78 percent of non-residential developments that have either been completed or approved and are expected to be completed by 2025 are within highly and partially infill supportive areas. The 2025 residential and non-residential targets reflect a near-term share of development in highly and partially infill supportive areas that is the greater of the 2000-2015 (completed) and 2016-2025 (expected and completed) rates, rounded to the nearest 5 percent. The 2050 targets assume that trend will be sustained in the long term by promoting strategies supportive of infill development. All targets reflect forecasted infill development and assume implementation of ON TO 2050's infill-related strategies. **<u>Residential development</u>** **2025:** 80 percent or more of new residential units developed since 2015 located within highly and partially infill supportive areas **2050:** 80 percent or more of new residential units developed since 2015 located within highly and partially infill supportive areas **<u>Non-residential development</u>** **2025:** 85 percent or more of non-residential square footage developed since 2015 located within highly and partially infill supportive areas

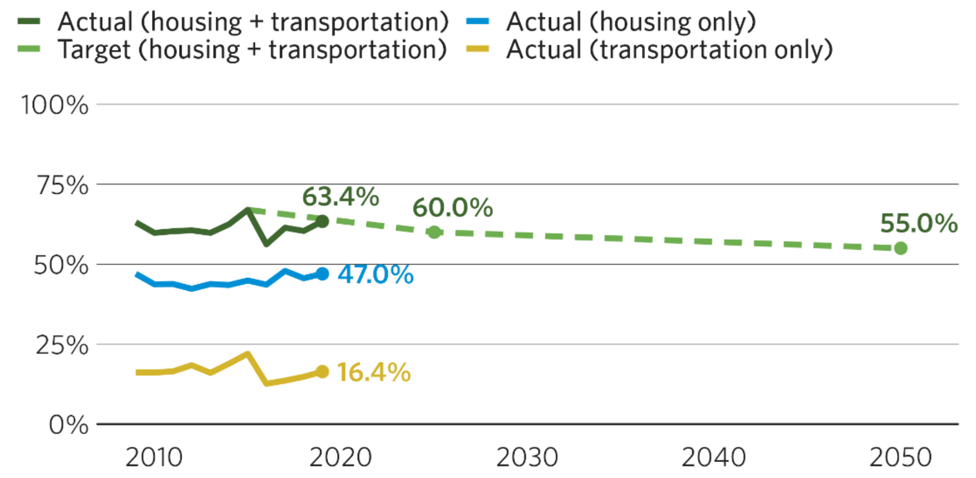
	2050: 85 percent or more of non-residential square footage developed since 2015 located within highly and partially infill supportive areas  Share of post-2015 development occurring in infill supportive areas
Inclusive growth perspective	Infill development and land use patterns are crucial to promoting economic growth in many economically disconnected and disinvested areas and in connecting the region's economically disconnected and disinvested area residents to economic opportunity. As a secondary indicator, ON TO 2050 tracks the share of new infill development occurring in economically disconnected and disinvested areas. In 2010, approximately 37 percent of the region's housing units and 30 percent of its non-residential square footage were located in economically disconnected or disinvested areas. However, economically disconnected and disinvested areas accounted for only 15 percent of new infill residential units and 21 percent of new infill non-residential square footage between 2000 and 2015. CMAP recommends increased infill development in economically disconnected and disinvested areas to increase efficient use of limited resources and help these communities grow.

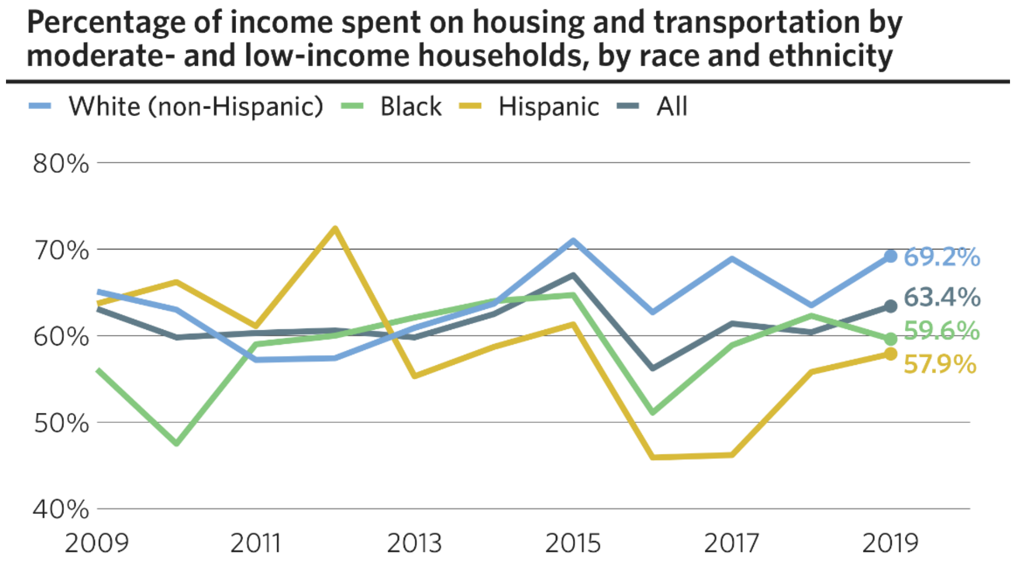
	 **Share of post-2015 infill development occurring in disinvested and economically disconnected areas**
Plan Update revisions	This indicator is based on data from CMAP's Northeastern Illinois Development Database (NDD). When the original analysis was done for ON TO 2050, the database query used by staff was inadvertently including developments that were completed, but whose completion year was not entered into the database and therefore may have been completed outside of the time period of interest. This error was not discovered until after ON TO 2050's adoption, but has been corrected for the Plan Update. The change in the baseline data has made the original residential targets obsolete, although the non-residential targets have been maintained. Whereas the original indicator's targets were set by calculating the *average* share of infill supportive developments from 2000-2015 (completed) and 2016-2025 (completed or expected), staff propose to instead use the *maximum* of the two for the revised targets. Residential development has had a relatively steady infill supportive share (around 80%) since 2000. Non-residential development had a lower infill supportive share in 2016-2025 (78%) than in 2000-2015 (84%), likely due to the recent construction of large warehousing and distribution facilities at the edges of the region.

Percentage of Income Spent on Housing and Transportation by Moderate- and Low-Income Households

Indicator	This measure estimates the share of household income spent on housing and transportation (H+T) costs for moderate- and low-income households. For analysis purposes, any household with an income below 80 percent of the regional median family income are defined as low- and moderate-income. Data are from the Consumer Expenditure Survey (CES), which the

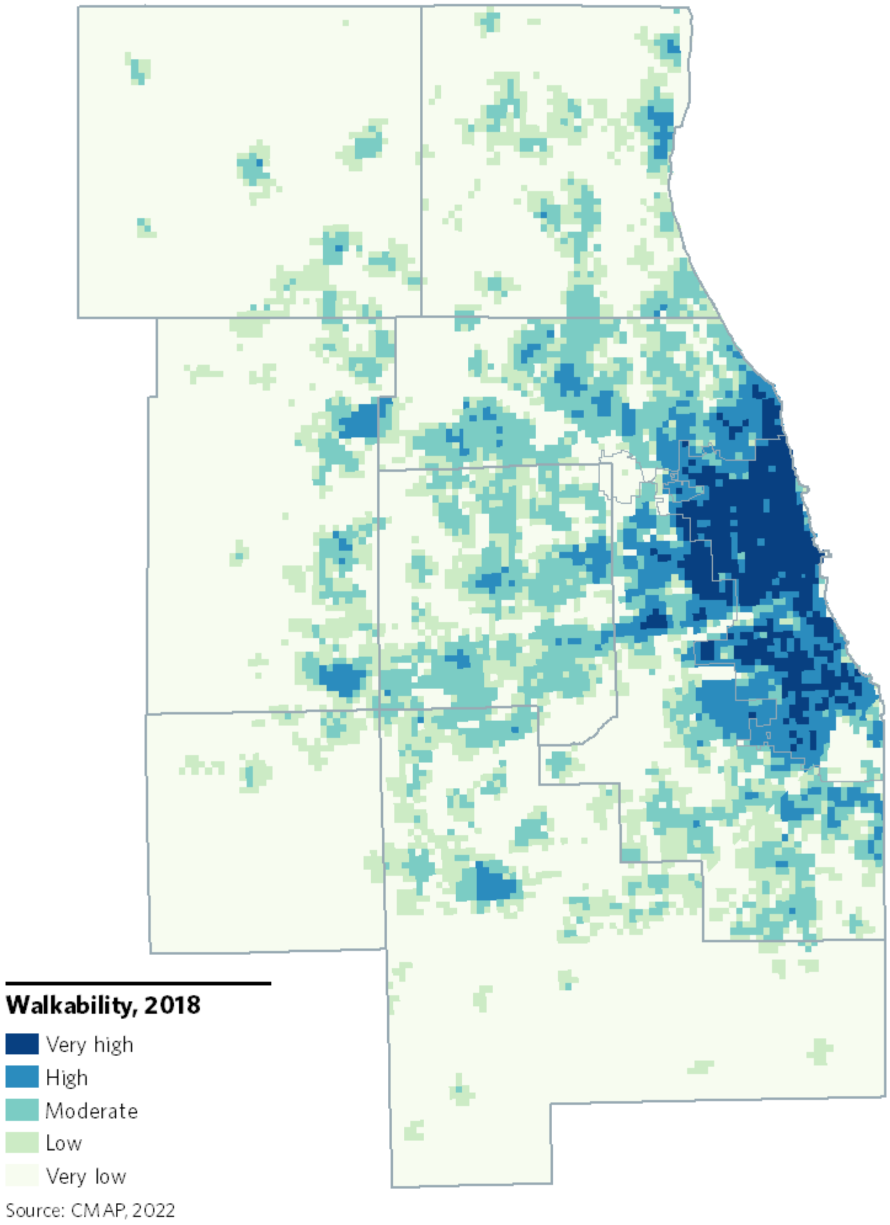
	U.S. Bureau of Labor Statistics (BLS) conducts annually. The survey collects information on household income and expenditures, including those for housing and transportation. Data are reported for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA). **Related recommendations:** Match regional and local housing supply with the types that residents want; leverage the transportation network to promote inclusive growth (mobility).
Methodology	In order to account for inflation in both incomes and spending, “low- and moderate-income households” are defined as those whose income is below 80 percent of the regional median family income. An upper bound of 80 percent of the regional family income was chosen to match the top “moderate income” threshold used by the U.S. Department of Housing and Urban Development (HUD) for a number of its programs, including public housing, Housing Choice Vouchers, and the Community Development Block Grant program (although HUD sets different thresholds depending on the number of people in a household). For each analysis year, the regional median income is estimated using a grouped frequency distribution based on American Community Survey (ACS) five-year data for the seven-county region. This measure is calculated using public-use microdata (PUMD) files from the CES. While the PUMD allows greater in-depth analysis of expenditure data, certain caveats exist when using the data and comparing results to the published summaries on the BLS website. As with many surveys, masking values are used for certain data items when specific criteria are met in order to protect survey respondents’ privacy. BLS’ own data do not incorporate this imputed, top-coded, or suppressed data. Those missing data points are compensated through weighting mechanisms calculated by the BLS that are unavailable to the public. In addition, while the PUMD allow for detailed statistical analyses for specific variables, such analyses may have high margins of error because the survey responses are weighted to be statistically valid at the national level and not necessarily at the regional level.
Targets	Staff reviewed regional affordability trends using this methodology since 2009, along with trends in overall housing affordability since 2000. The number of cost-burdened households (i.e., households paying more than 30 percent of their income on housing costs) has increased by more than 10 percentage points for both owners and renters. From 2009 to 2015, the combined H+T metric ranged from 60 to 67 percent, driven heavily by low- and moderate-income households spending a greater share of income on transportation costs. The 2025 target represents a near-term return to the

	2009-2015 low of 60 percent (from 2013). The 2050 target represents a continued decrease from the 2025 target, taking into account the range in which this metric has historically fluctuated, the policies of ON TO 2050, and the share of households expected to live outside of highly infill supportive areas. **2025:** 60 percent or less of income spent on housing and transportation by moderate- and low-income residents. **2050:** 55 percent or less of income spent on housing and transportation by moderate- and low-income residents. **Percentage of income spent on housing and transportation by moderate- and low-income households** 
Inclusive growth perspective	As a secondary indicator to this core indicator, ON TO 2050 tracks the share of household income spent on housing and transportation costs for moderate- and low-income households by race and ethnicity. On average, Black and white households have seen increases in the share of household income spent on housing and transportation costs since 2009. Hispanic households have seen an overall decrease in that time, although they have also seen increases since 2016. Data for other racial and ethnic households, including Asian households, are not shown here due to small sample size.

	 Percentage of income spent on housing and transportation by moderate- and low-income households, by race and ethnicity
Plan Update revisions	This indicator has not been modified.

Population and Jobs Located in Highly Walkable Areas

Indicator	ON TO 2050 places a high priority on supporting development of compact, walkable communities to help meet increasing demand for these places, support transit, and improve mobility. This indicator tracks the percentages of the region's population and jobs located in areas with "high" or "very high" walkability. To assess walkability, CMAP created an index that considers multiple factors contributing to walkability: nearby amenities, block length, intersection density, population and employment densities, tree canopy cover, bicycle or pedestrian fatalities and serious injuries, and sidewalk coverage. **Related recommendations:** Support development of compact, walkable communities; make transit more competitive (mobility).
Methodology	The walkability layer is a localized metric that takes into account the number and types of amenities reachable on foot in 30 minutes, average block length, intersection density, population and employment densities, tree canopy cover, and the number of bicycle or pedestrian fatalities and serious injuries in a given subzone. Subzones with scores above 50 are considered to have "high" walkability, and those with scores above 100 are considered to have "very high" walkability. This indicator tracks the percentages of the entire region's population and jobs that are located within these subzones.

	 **Walkability, 2018** Source: CMAP, 2022
Targets	To increase walkability, targeted investments are required to make areas with “moderate” walkability more walkable, thereby shifting them into the “high” category. Such investments could include filling the gaps in sidewalk coverage, greater transit frequency and connectivity, improved pedestrian and bicyclist facilities, increased tree canopy cover, and a greater number or variety of amenities. Densification of population and jobs would also help communities to become more walkable. The 2050 targets assume that the top quartile of currently “moderately” walkable subzones (ranked by their respective walkability scores) can reach

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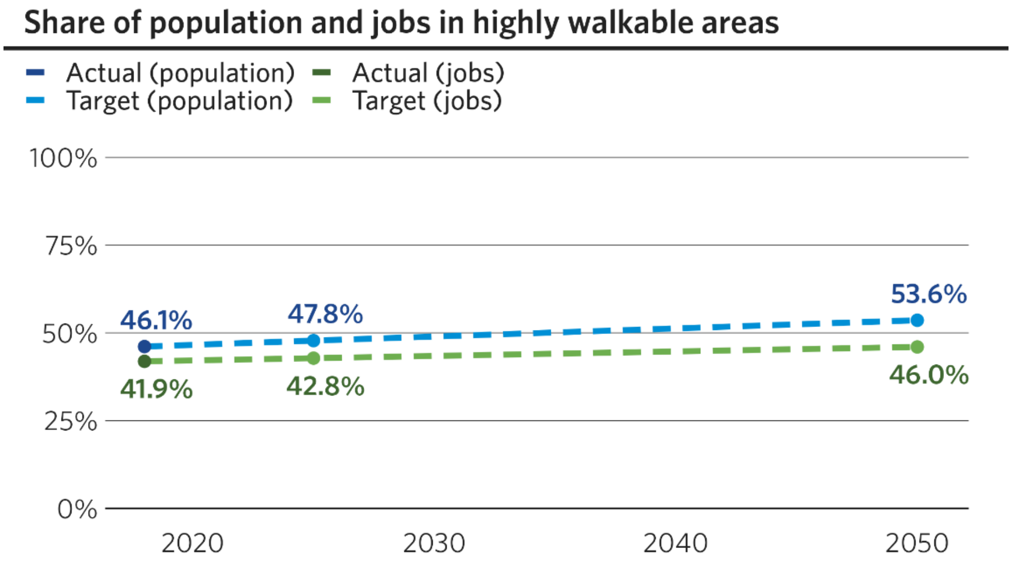
“high” walkability by 2050 with targeted investments. These subzones account for approximately 2.5 percent of the region’s land area, and are concentrated in suburban communities. The 2025 targets were derived from a straight-line interpolation between the 2018 and 2050 values.

2025: At least 42.8 percent of jobs and 47.8 percent of population located in areas of “high” or “very high” walkability

2050: At least 46.0 percent of jobs and 53.6 percent of population located in areas of “high” or “very high” walkability



Share of population and jobs in highly walkable areas

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<td>Plan Update revisions</td>
<td>When ON TO 2050 was adopted, the walkability index did not include a sidewalk coverage factor due to a lack of available data at the regional scale. Since then, CMAP has developed a regional sidewalk inventory that indicates the presence or absence of sidewalks on every road in the region. The walkability index methodology has been updated to include sidewalk coverage as a major factor. This resulted in a change to the indicator’s baseline data. Additionally, the targets were informed by the ON TO 2050 socioeconomic forecast – specifically, how future population and jobs will be distributed throughout the region – and have been revised to take into account not only the updated baseline data, but also the revised socioeconomic forecast.</td>
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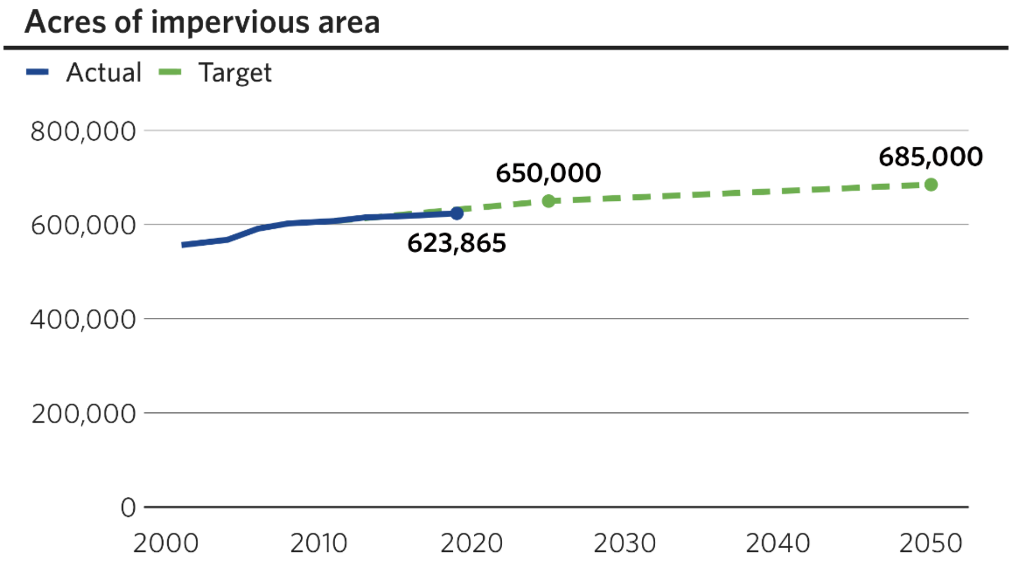
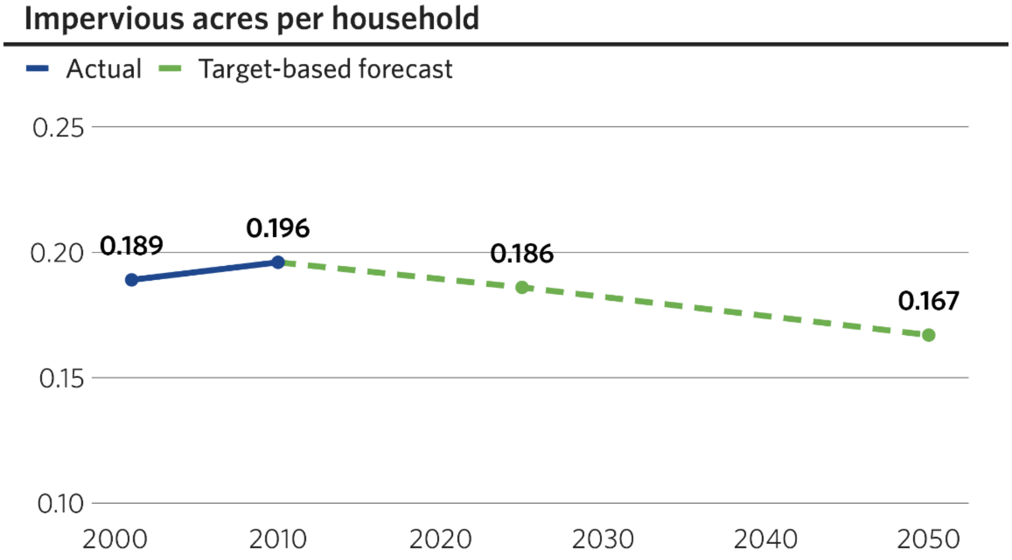
Environment Indicators

Acres of Impervious Area

Indicator	This indicator measures the total number of acres of impervious surfaces in the region; it is the entire amount of hard surface (such as buildings, sidewalks and streets) in the landscape. Imperviousness is an important environmental indicator because it is negatively associated with various measures of the biological health and physical integrity of surface waters. **Related recommendation:** Protect and enhance the integrity of aquatic systems.
Methodology	This indicator's data comes from the National Land Cover Database (NLCD) imperviousness dataset, published every two to three years by the U.S. Geological Survey (USGS). The dataset is based on satellite imagery and reports the percentage of impervious cover for each raster cell, each of which is a 30-meter square. Acres of impervious cover are a straightforward calculation (raster cell percent imperviousness multiplied by area, then summed for the whole region).
Targets	CMAP's regional socioeconomic forecast projects that households and jobs will each grow by approximately 12 percent over 2010 levels by 2025, and by approximately 26 percent over 2010 levels by 2050. The target methodology assumes that growth in impervious cover will slow from the current rate as the region's population and employment density increase through infill and reinvestment. The 2025 target for impervious acreage represents a growth rate in impervious cover from 2010 equal to 60 percent of the rate of household and job growth over the same period (i.e., a 7 percent increase in acreage over 2010). The 2050 target represents growth in impervious cover from 2010 equal to 50 percent of the rate of household and job growth over the same period (i.e., a 13 percent increase in acreage over 2010). While the targets show growth in total impervious acreage, they represent a continual decline in the region's impervious area on a per-household, per-capita, and per-job basis. **2025:** 650,000 acres or less of impervious area **2050:** 685,000 acres or less of impervious area

	 Acres of impervious area The following chart shows how the impervious acreage targets translate to a per-household rate, based on forecasted numbers of households from the ON TO 2050 Plan Update socioeconomic forecast. While growth in impervious acreage has recently outpaced growth in households, the targets would reflect a reversal of this trend.  Impervious acres per household
Plan Update revisions	The NLCD imperviousness data dates to 2001 and has historically been updated every five years. With the most recent update including 2019 data, USGS significantly revised their methodology for calculating percent imperviousness. They have retroactively updated all imperviousness data from 2001 through 2016 to be consistent with the latest methodology. They

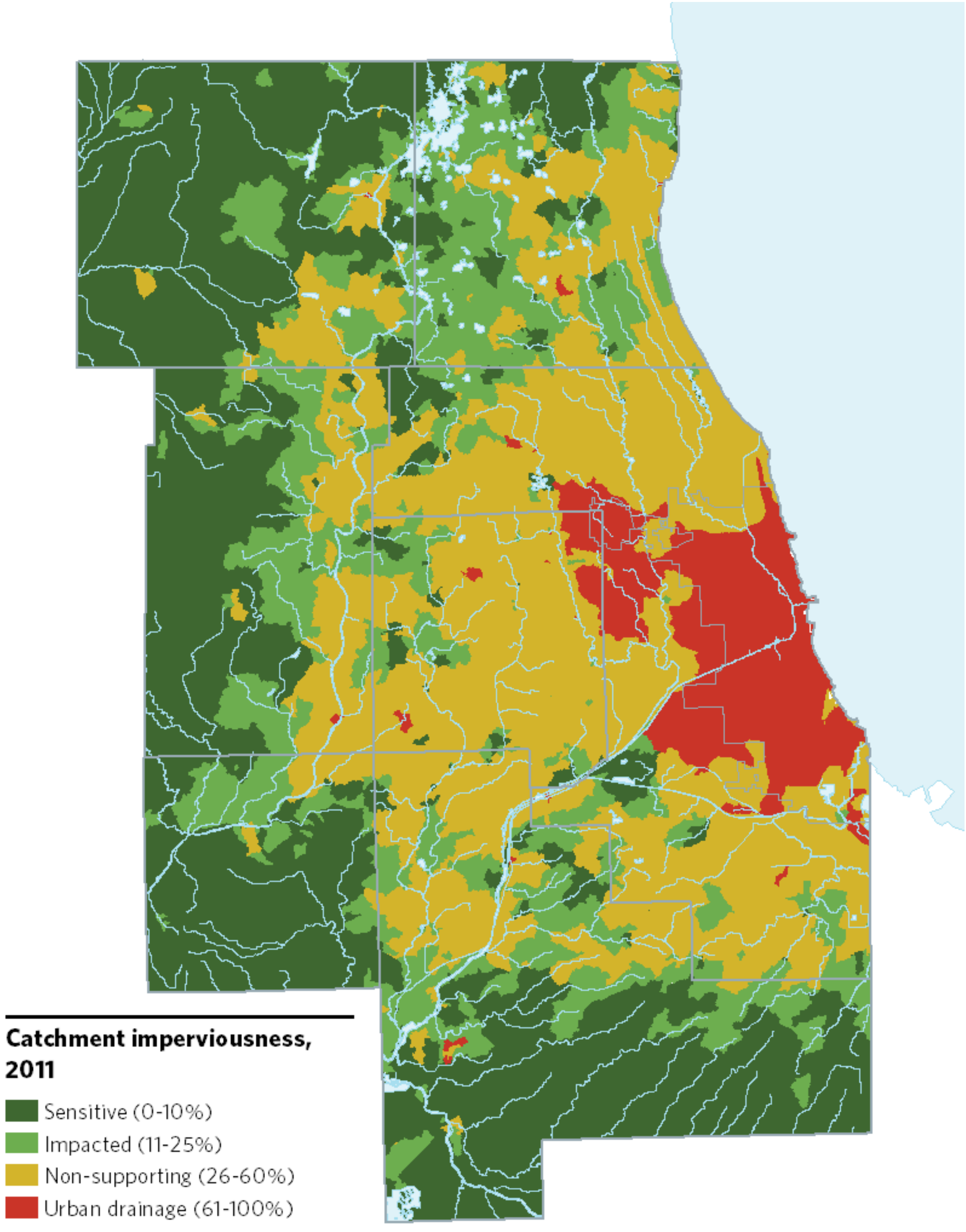
	have also increased the frequency of data updates from every five years to every two to three years. The change in methodology has resulted in an across-the-board increase in CMAP's calculations of impervious area: the older version of the data used for ON TO 2050 showed 555,536 acres of impervious area in the CMAP region in 2011, compared to 607,649 acres in the revised 2011 data. This is an increase of 52,113 acres, or 9.4%, due purely to USGS' methodological changes. This major increase in the baseline data has made the targets established in ON TO 2050 obsolete; in fact, the 2019 data shows that we have already surpassed the original 2025 target of 605,000 acres of impervious area. The targets have been updated by applying the original target-setting methodology to the revised NLCD data and socioeconomic forecast.

Regional Land in Watersheds Below 25 Percent Impervious Coverage

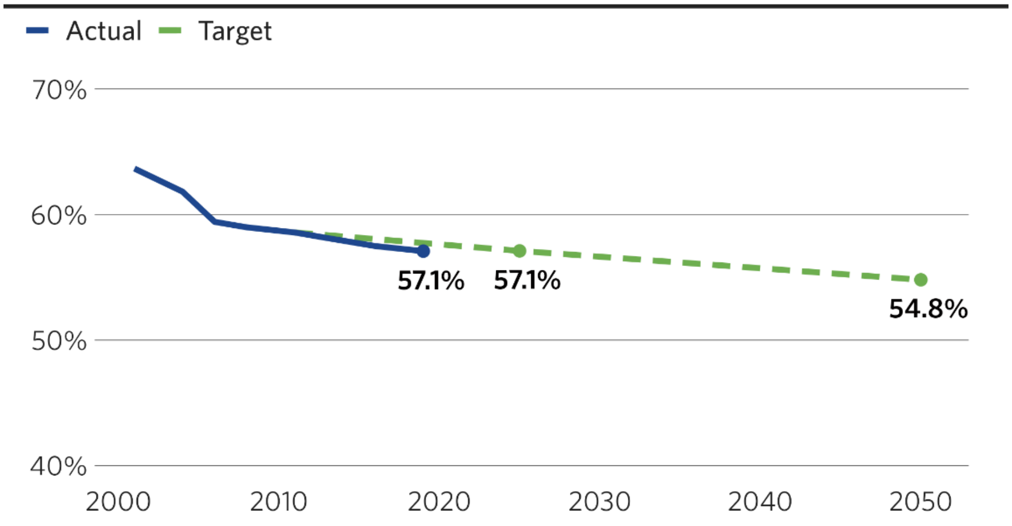
Indicator	This indicator tracks the change in impervious surface by watershed catchment throughout the region as an indicator of health and integrity of aquatic resources. Specifically, it tracks the total percentage of the region's land area located in catchments with 25 percent or less impervious coverage. Many of the region's water resources are not meeting all goals of the Clean Water Act, and many waterbodies—especially small headwater streams—have not yet been assessed. Given this lack of data, this indicator uses the impervious cover model to understand watershed health and water quality. Research has shown that small watersheds with less than 10 percent impervious cover tend to be associated with healthy streams. Further increases of impervious cover (up to 25 percent) can lead to impacted streams that could be restored with intervention. Small watersheds with increases in impervious coverage (up to 60 percent) are considered non-supporting, and when impervious coverage exceeds 60 percent, full restoration of urban drainage systems to pre-development habitat quality may not be possible. **Related recommendation:** Protect and enhance the integrity of aquatic systems.
Methodology	Using the NLCD and the U.S. Environmental Protection Agency's National Hydrography Dataset Plus (NHDPlusV2), the percent imperviousness of each small watershed catchment in the CMAP region (with median and mean

areas of 406 and 890 acres, respectively) can be calculated and categorized into four groupings. The map below shows catchments in the region divided into the following groups (the first two of which combine to form the basis of this indicator):

- Sensitive: 0-10 percent impervious
- Impacted: 11-25 percent impervious
- Non-supporting: 26-60 percent impervious
- Urban drainage: 61-100 percent impervious

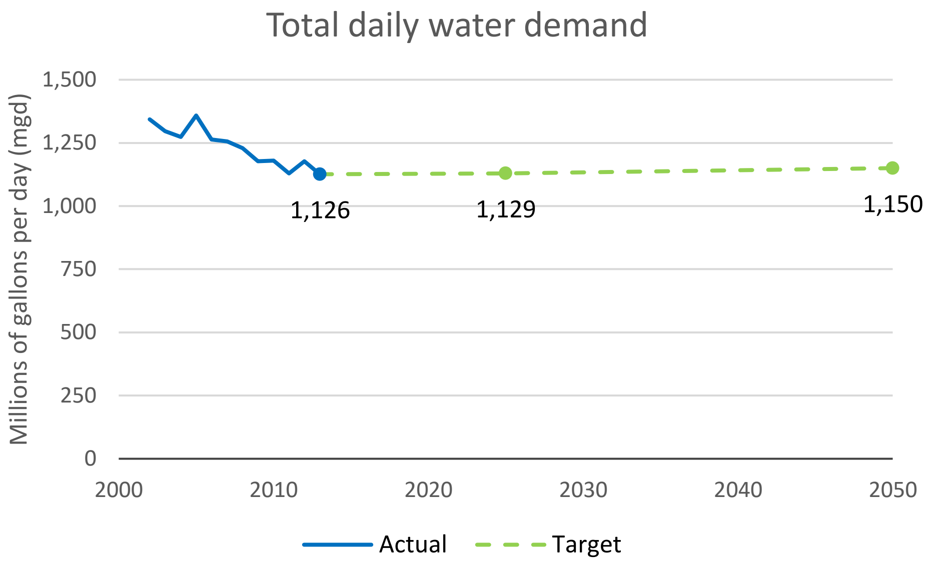
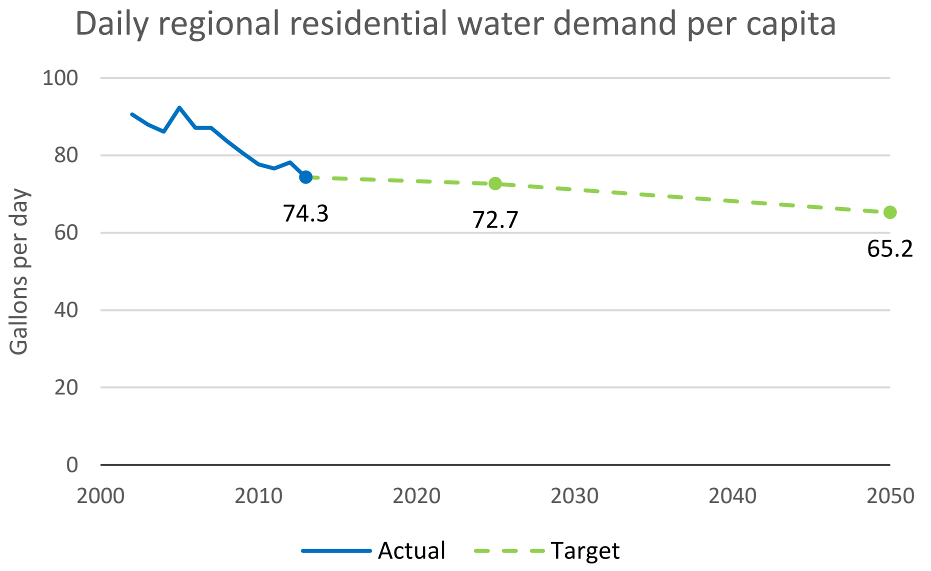


Source: CMAP, 2022

Targets	Using NLCD imperviousness data from 2001-11, past trends were analyzed to understand the recent decline in the proportion of the region in the sensitive and impacted categories. Reflecting the policy goal of maintaining as many watershed catchments in the sensitive and impacted categories as possible, the target methodology assumes that growth in impervious cover will slow as the region's population and employment density increase through infill and reinvestment. Specifically, the indicator assumes the rate of change for each category will continue at 60 percent of the 2001-11 rate through 2025, and 50 percent of the 2001-11 rate from 2025 until 2050. (These are the same rates as overall impervious acreage increases from the *Acres of Impervious Area* indicator targets, p. 16.) **2025:** 57.1 percent or more of region's land in watersheds below 25 percent impervious **2050:** 54.8 percent or more of region's land in watersheds below 25 percent impervious **Share of region's land in watersheds below 25 percent impervious** 
Plan Update revisions	This indicator relies on the same imperviousness data as *Acres of Impervious Area* (p. 16) and has seen a similar shift in its baseline data due to the retroactive methodological changes made by USGS. As a point of comparison, the original data used for ON TO 2050 showed that 61.2% of the region's land was in watersheds whose percent imperviousness was 25% or lower. The revised 2011 data, by contrast, shows 58.6% of the region's land in such watersheds — a difference of roughly 68,000 acres. The targets have been updated by applying the original target-setting methodology to the revised NLCD data.

Water Demand

Indicator	This indicator tracks total daily water demand, as well as per capita demand for residential water use. Total water demand includes water that is withdrawn, treated, and delivered to residential, industrial, commercial, governmental, and institutional users via public supply water systems, as well as industrial and commercial wells. Assessing long-range forecasted demands can inform the region on the sufficiency of water supply and encourage actions that conserve water, protect supply, and/or pursue alternative drinking water sources. **Related recommendation:** Coordinate and conserve shared water supply resources.
Methodology	Water demand data, in millions of gallons used daily, is provided to CMAP directly by the Illinois State Water Survey (ISWS) each year. Public water supply systems are maintained by municipalities, sub-regional authorities, or private companies. Private wells may serve industrial enterprises, commercial businesses, and park and golf course irrigation. Per capita values for residential water use will be based on the population served by the public supply water systems and not the entire population of the region, as a small portion of the region's population (less than 4 percent) receives water from private wells and is termed self-supplied domestic sources.
Targets	This indicator has two sets of targets -- one measuring total daily water demand, and one measuring daily residential water demand on a per capita basis. Per capita measurement allows for an examination of water conservation as an increase in total demand due to population or industrial growth can mask gains in conservation. At the same time, it is important to examine total demand because potable water is a finite resource and growth in our region is expected to increase the demand for water in 2050 above the current level of consumption. <u>Total daily water demand</u> **2025:** 1,129 million gallons of water used daily **2050:** 1,150 million gallons of water used daily

	 Daily regional residential water demand per capita **2025:** 72.7 gallons of water used daily per capita **2050:** 65.2 gallons of water used daily per capita 
Plan Update revisions	CMAP is in the process of updating the water demand forecast with more advanced techniques than were used in the original ON TO 2050 versions, and these new forecasts will likely prompt a change of the indicator's targets.

	Since CMAP is still awaiting some revised baseline data from ISWS, and since the water demand forecasts are still under development, it is currently unclear how much the updated baseline data and targets will deviate from the original ON TO 2050 indicator. The water demand indicator and targets will be updated when the water demand forecasts are complete.

Greenhouse Gas Emissions

Indicator	This indicator measures the total amount of greenhouse gas (GHG) emissions produced in the CMAP region. GHG emissions are calculated using the International Council for Local Environment Initiatives (ICLEI) Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) BASIC methodology, which includes all emission from buildings, solid waste, wastewater, and intraregional transportation. Emissions are reported in million metric tons of carbon dioxide equivalent (MMTCO$_2$e). **Related recommendation:** Intensify climate mitigation efforts.
Methodology	The GHG inventory is conducted every five years using the GPC Basic methodology. Due to irregularities caused by the COVID-19 pandemic and subsequent stay-at-home orders, the most recent inventory was conducted for calendar year 2019, rather than 2020. This inventory also includes emissions from takeoffs and landings at Midway and O'Hare international airports for the first time. Total emissions are calculated at the regional and county level, with the City of Chicago and Suburban Cook County separated for more detailed analysis. More information about GPC protocols is available online from ICLEI.[1]
Targets	Since GO TO 2040 (the precursor to ON TO 2050), CMAP has been committed to a "stabilization pathway" that would limit global temperature rise to below 2° Celsius (3.6° Fahrenheit). This pathway would require the region to reduce its greenhouse gas emissions by at least 80 percent, relative to 2019 levels, by the year 2050. **2025:** 93.66 MMTCO$_2$e or less **2050:** 26.09 MMTCO$_2$e or less

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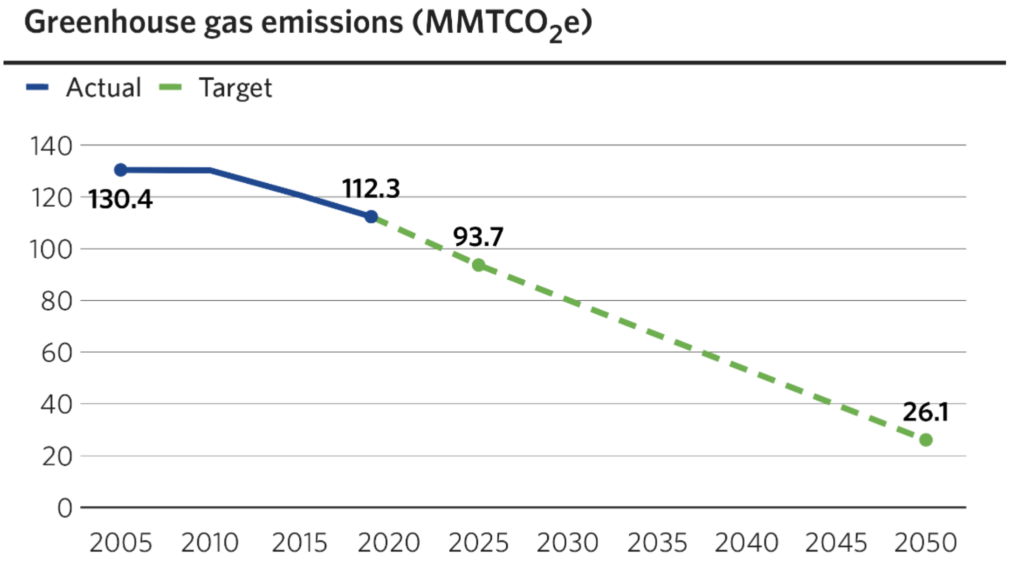
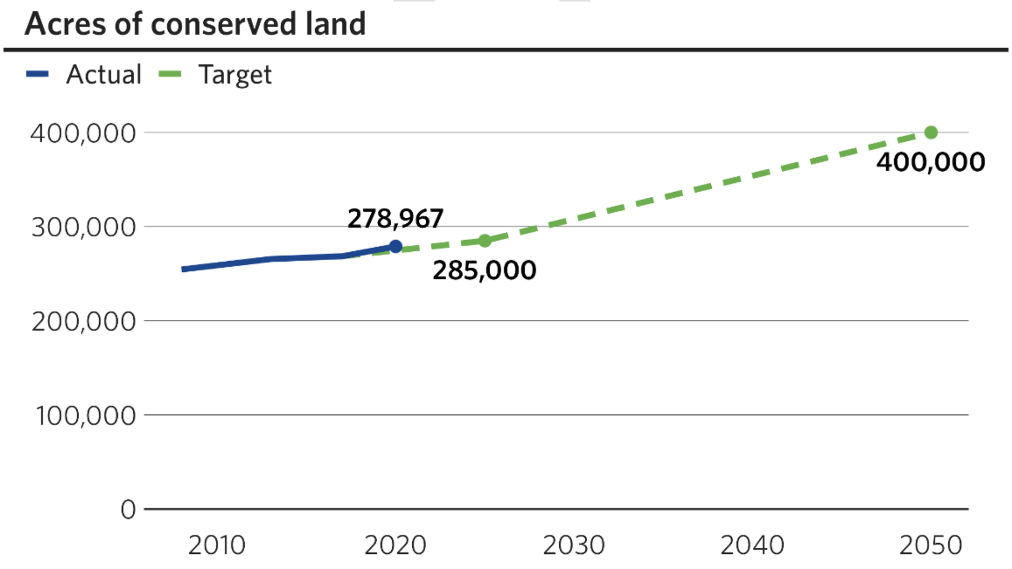
[1] ICLEI – Local Governments for Sustainability, "The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)," http://old.iclei.org/activities/agendas/low-carbon-city/gpc.html.

	
Plan Update revisions	In ON TO 2050, this indicator’s data and targets were based on the 2015 regional greenhouse gas inventory. The 2019 regional greenhouse gas emissions inventory used a modified methodology to capture some additional emissions that were not included in the past. Specifically, it included a new, region-specific emissions factor for electricity consumed in northeastern Illinois. (The prior inventory did not accurately capture the large proportion of electricity provided by nuclear generation plants within the ComEd service area.) Additionally, the 2019 inventory included emissions data from takeoffs and landings at Midway and O’Hare international airports. Finally, it used MOVES3, the newest iteration of the EPA’s transportation modeling software, to calculate on road and nonroad emissions. The updated inventory provides retroactive estimates for 2010 and 2015 emissions that are more comparable to the 2019 data.

Acres of Conserved Land

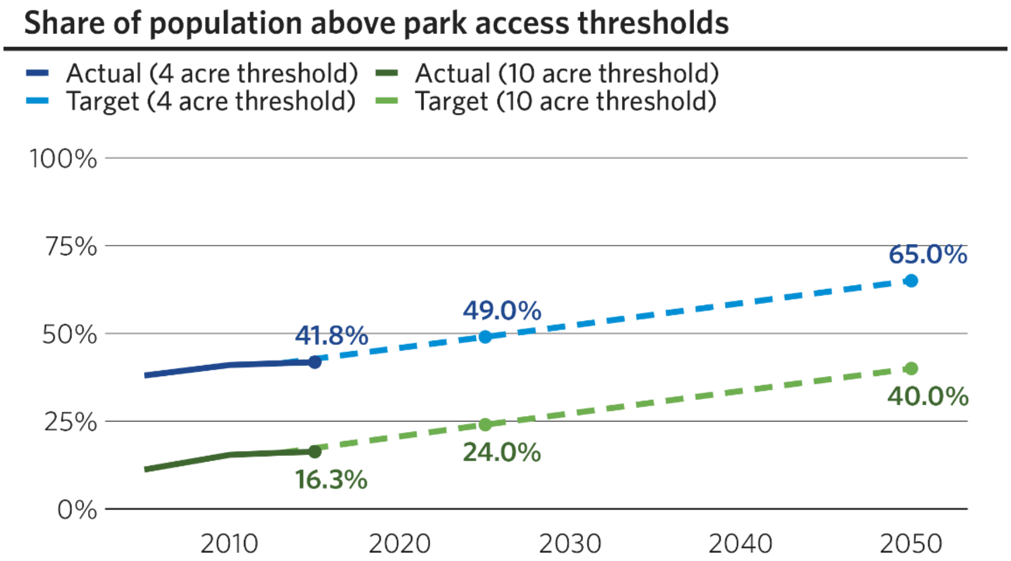
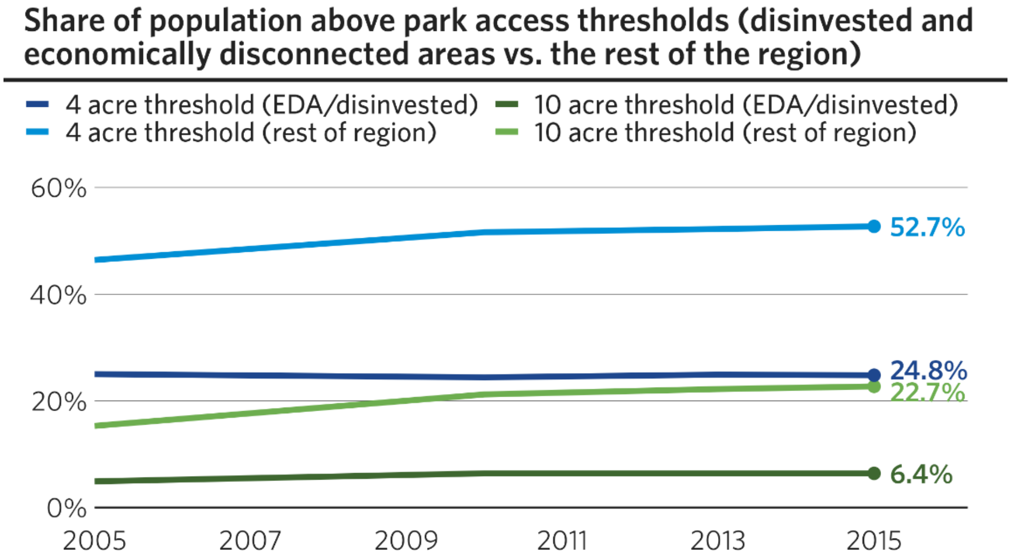
Indicator	This indicator measures the total number of acres in the region used for land and water preservation (i.e., forest preserves, natural areas, and conservation easements). This measure does not include acres of recreational parkland in the region, land used for golf courses, unprotected farmland, or land used for historic preservation. **Related recommendation:** Integrate land preservation into strategic growth efforts.
Methodology	Information on preserved open space is gathered from each county’s forest preserve district, CMAP’s Land Use Inventory and the National Conservation Easement Database. The National Conservation Easement Database is a

	regularly updated geospatial dataset maintained by the Trust for Public Land and Ducks Unlimited. Each time the CMAP Land Use Inventory is updated, its "open space, primarily conservation (code 3300)" parcels are combined with the other datasets from the county forest preserve districts and NCED, using data as close in time to the Land Use Inventory as possible. Once these datasets have all been merged, total acreage is calculated.
Targets	The 2025 target was developed by continuing a straight-line increase in acres of open space in the region based on the rate of land conservation from 2008 to 2017. The 2050 target matches the long-term target from GO TO 2040. **2025:** 285,000 acres or more of conserved land **2050:** 400,000 acres or more of conserved land Acres of conserved land 
Plan Update revisions	This indicator has not been modified.

Access to Parks

Indicator	This indicator measures per capita access to parks based on geographic proximity to recreational open space. Values are reported as the percentage of the regional population with access to at least four acres of parkland per 1,000 residents and at least 10 acres per 1,000 residents. Generally, the four-

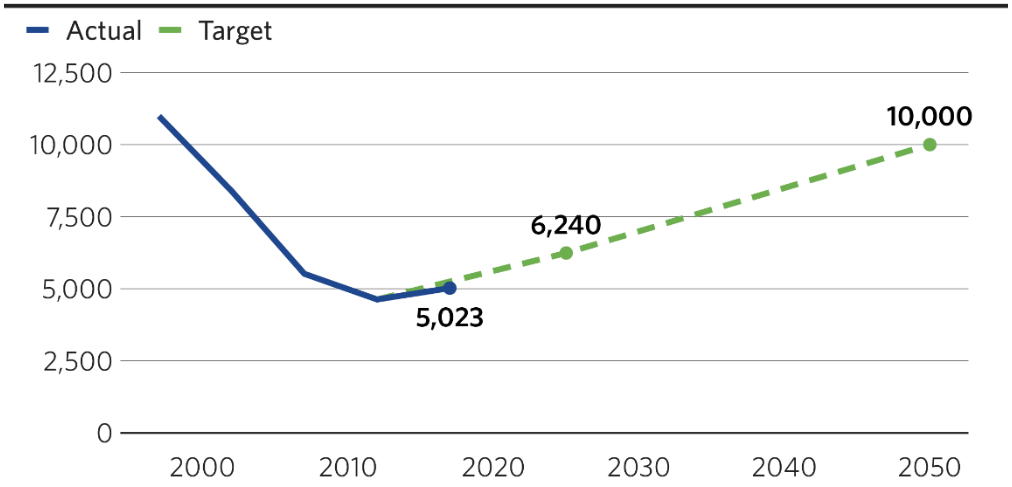
	acre standard is appropriate for denser communities, while the 10-acre standard is intended for less-dense areas. **Related recommendations:** Improve natural resources through the redevelopment process; Target infill, infrastructure, and natural area investments (Community).
Methodology	The data for this indicator come from the CMAP land use inventory (most recently 2015) and the U.S. Census (2015 population estimates). Park access is tracked at the subzone level. A subzone's population is considered to have access to any park acreage within a half-mile radius of the subzone's centroid, and additionally to any park acreage in "community parks" (larger than 35 acres) within a one-mile radius. A subzone's population only has access to park acres that fall within these radii (i.e., if a portion of a large park falls within the radius, only the acres of that portion are counted). Each acre of parkland is then divided by the total population with access to it (from all nearby subzones), and then each of those subzones is allocated a share of that acreage by multiplying its population by that park's acres-per-person value. The population of each subzone with 4+ or 10+ cumulative acres of parkland per 1,000 residents are then aggregated to determine the region's total access to parks.
Targets	For ON TO 2050, CMAP estimated the percentage of the population that could gain access to four or 10 acres per 1,000 residents by strategically targeting currently vacant land (defined in the CMAP Land Use Inventory as "land in an undeveloped state, with no agricultural activities nor protection as open space") for conversion to parks in areas currently below these park access thresholds. With an optimal conversion of some of the region's vacant land into parks, it would be possible for 65 percent of the population to have access to four or more acres of parkland per 1,000 residents, and for 40 percent to have access to 10 or more. While CMAP does not advocate for converting all vacant land to parks, this number provides a useful "ballpark" estimate for what is possible. This is an ambitious goal, but not unattainable, as land use changes during the next 35 years may reduce the land needed for transportation and utility corridors, while changes in precipitation patterns may increase the demand for open space providing stormwater management. Once these 2050 targets were identified, a straight-line projection was used to determine interim targets for 2025. <u>Four or more acres per 1,000 residents</u> **2025:** 49 percent or more of region's population **2050:** 65 percent or more of region's population

	<u>Ten or more acres per 1,000 residents</u> **2025:** 24 percent or more of region's population **2050:** 40 percent or more of region's population  Share of population above park access thresholds
Inclusive growth perspective	As a secondary indicator to this core indicator, ON TO 2050 will track access to parks for residents in disinvested and economically disconnected areas. Disparities exist in access to parks between residents in economically disconnected and disinvested areas and those in the remaining parts of the region. Residents in economically disconnected and disinvested areas have lower access to parks regardless of development density.  Share of population above park access thresholds (disinvested and economically disconnected areas vs. the rest of the region)

Plan Update revisions	This indicator has not been modified, although the secondary inclusive growth indicator has been renamed for accuracy. It was originally called “access to parks in economically disconnected areas” and is now “access to parks in disinvested and economically disconnected areas.”

Acres of Farmland Used to Harvest Produce for Direct Human Consumption

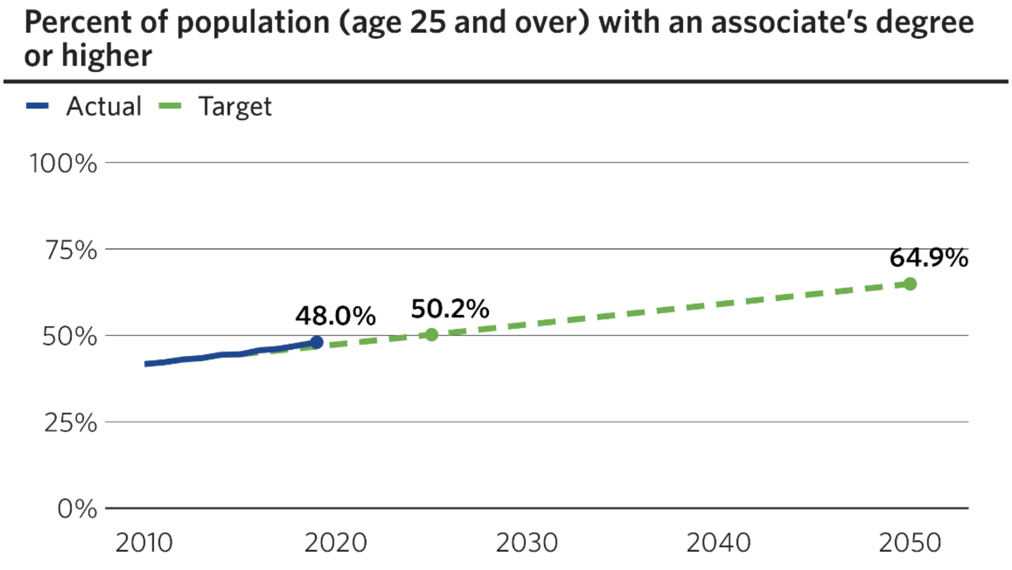
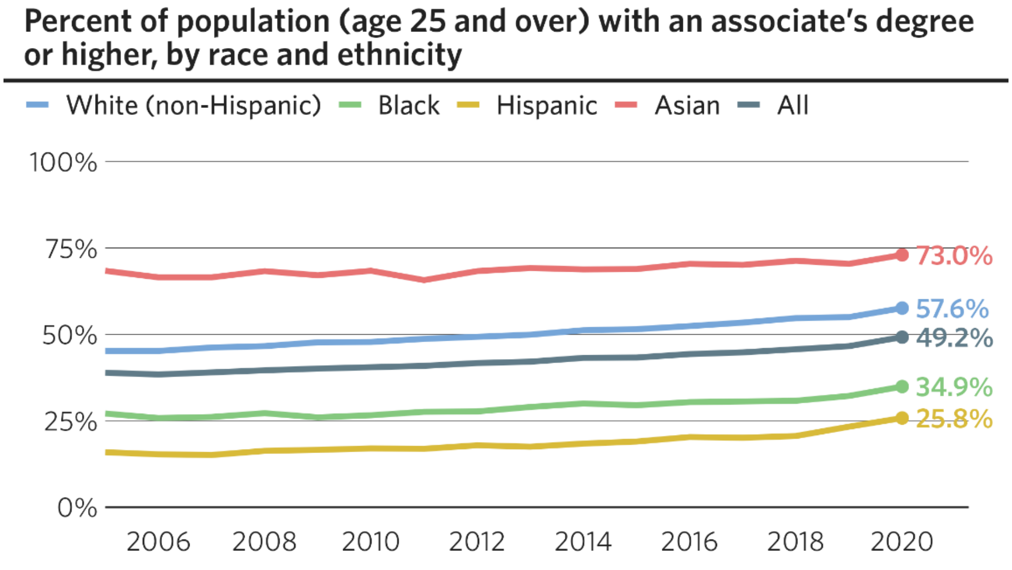
Indicator	This indicator tracks the total number of farmland acres in the region that support food for direct human consumption. The U.S. Department of Agriculture defines “direct consumption” as the totals found in these categories: orchards, peanuts, potatoes, sweet potatoes, and vegetables. This data excludes community gardens and other entities not counted in the Census of Agriculture. **Related recommendation:** Integrate land preservation into strategic growth efforts.
Methodology	The data for this indicator is from the U.S. Census of Agriculture, which the U.S. Department of Agriculture conducts every five years. The most recent completed census is 2017. The acreage total for the region is the sum of the per-county acreage from Table 29 (Vegetables, Potatoes, and Melons Harvest for Sale) and Table 30 (Land in Orchards). The acreage totals may be slightly below the true number because the Census does not report acreage totals for counties where there are few enough farms that reporting acreage would result in disclosing data for individual farms.
Targets	The goal for this indicator is for the acreage of farmland used to harvest produce for direct human consumption to increase at the same rate originally targeted by the GO TO 2040 Plan Update: a 75 percent increase by 2040. Because ON TO 2050’s policy goals for this topic are unchanged and no new data is available for this indicator, the new targets reflect the same annual rate of increase as those in the GO TO 2040 Plan Update. The chart below shows a decline in the number of acres in the region used to harvest produce for direct human consumption from 1997 through 2012, although it rebounded slightly by 2017. Achieving the 2050 goal will increase the number of acres used for this purpose to a level comparable to that seen in the year 2002 by 2040. The 2025 goals reflect a straight-line increase from 2012 conditions to hit that 2040 target, while the 2050 goal reflects a slightly higher, rounder target than continuing the straight-line increase would produce.

	2025: 6,240 acres or more of farmland used to harvest produce for direct human consumption **2050:** 10,000 acres or more of farmland used to harvest produce for direct human consumption **Acres of farmland used to harvest produce for direct human consumption** 
Plan Update revisions	This indicator has not been modified.

Prosperity Indicators

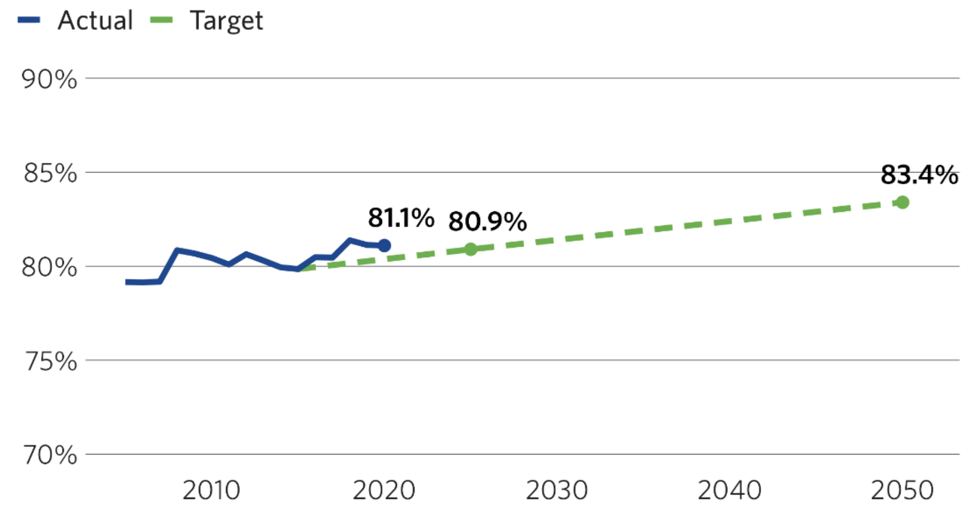
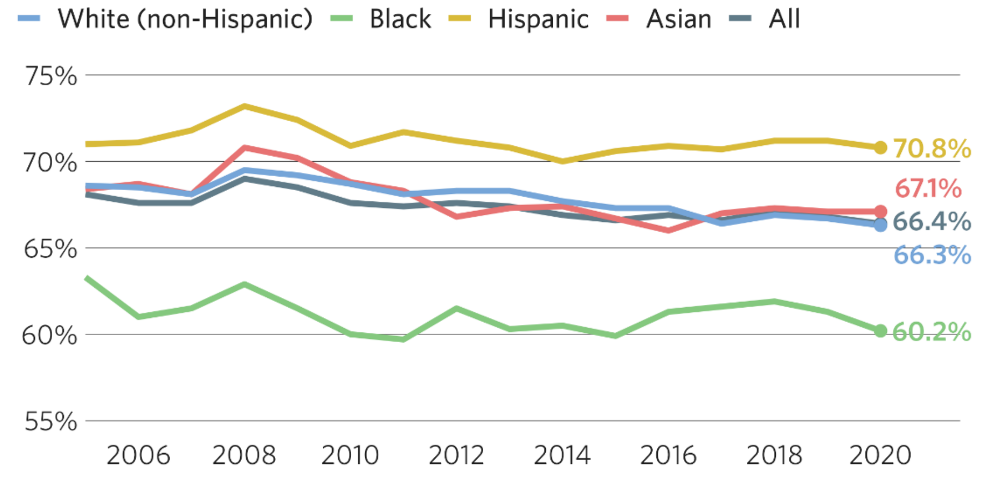
Educational Attainment

Indicator	This measure reports the proportion of residents in the Chicago region aged 25 and older who hold at least an associate's degree. Higher levels of educational attainment create benefits for both individuals and regional economies. As residents receive additional postsecondary education, they can generally expect increased median earnings and a decreased likelihood of joblessness. On a regional scale, these trends translate to lower unemployment rates and greater economic output. The inclusion of associate's degrees in this measure helps to highlight the important role community colleges play in improving education and workforce development and reflects the significance of "middle-skill" jobs in our regional economy. **Related recommendation:** Prioritize pathways for upward economic mobility.
Methodology	Data come from the U.S. Census Bureau's annual American Community Survey (ACS). The ACS reports educational attainment data as raw counts of county residents aged 25 or older holding particular levels of education (e.g., high school diploma, some college but no degree, associate's degree, bachelor's degree, and graduate or professional degree). The proportion of residents in metropolitan Chicago holding an associate's degree or higher is then calculated by adding the appropriate counts for the seven counties of the CMAP region and dividing the sum by the total seven-county population age 25 or older.
Targets	In 2019, 48.0 percent of the regional population aged 25 and older held an associate's degree or higher, exceeding the national average of 40.6 percent. Data from the ACS show that higher education levels are generally on the rise, in the region and nationwide. Between 2009-14, the proportion of the region's residents holding an associate's degree or higher increased by an average of 0.59 percentage points per year, ahead of the national average of 0.51 percentage points per year. The targets reflect a continuation of that growth rate through 2050. **2025:** 50.2 percent or more of the region's population (aged 25 and older) with at least an associate's degree **2050:** 64.9 percent or more of the region's population (aged 25 and older) with at least an associate's degree

	 Percent of population (age 25 and over) with an associate's degree or higher
Inclusive growth perspective	As a secondary indicator, ON TO 2050 also tracks the proportion of residents in the Chicago region aged 25 and older with at least an associate's degree, by race and ethnicity. Disparate outcomes exist across races and ethnicities in educational attainment. Black and Hispanic residents have educational attainment rates lower than the regional average and significantly lower than Asian and white residents, although all have seen increases in educational attainment in recent years.  Percent of population (age 25 and over) with an associate's degree or higher, by race and ethnicity
Plan Update revisions	This indicator has not been modified.

Workforce Participation

Indicator	This indicator tracks the percentage of the regional population (aged 20-64) that is either working or actively looking for work. An increase in workforce participation is generally viewed as a positive indicator of regional economic opportunity. Increased participation suggests a decrease in the number of discouraged workers — individuals who are able to work but currently unemployed, and who have not searched for employment in the last four weeks due to a lack of suitable options or a lack of success through previous job applications. However, workforce participation is a complex measure because it tracks the number of both employed and unemployed persons currently looking for work. Thus, an increase in unemployment can register as an increase in workforce participation. Similarly, decreases in workforce participation may be due to an increase in the number of discouraged job seekers, or to an increase in the number of people choosing to retire early or leave the workforce for other reasons. Even with these caveats, an increase in workforce participation is generally indicative of a healthy economy. **Related recommendation:** Conduct regional planning for human capital.
Methodology	Data come from the U.S. Census Bureau's annual American Community Survey (ACS). The data are available at the county level and have been combined into a regional measure using a population-weighted average.
Targets	The Chicago region experienced a 0.6 percentage point decrease in its workforce participation rate between 2010 and 2015, despite the region's recovery from the 2007-09 recession. Among peer metropolitan areas, fluctuations in workforce participation rates tend to mirror each other, suggesting that macroeconomic factors contribute heavily to such trends. The goal established in ON TO 2050 is for the Chicago region is to return to its previous 10-year high of an 80.9 percent workforce participation rate by 2025 and then maintain this steady annual growth rate of 0.1 percentage points through 2050. As of 2020, the workforce participation rate was 81.1 percent, surpassing the 2025 target. The COVID-19 pandemic and its economic fallout led to extraordinary labor market displacement and volatility, amid business closures and public health restrictions to curb the spread of the virus. The lasting impacts of the COVID-19 pandemic remain to be seen. The recovery so far has been marked by both low unemployment and (anecdotally) decisions not to participate in the labor force due to early retirements, the

	cost of family care, or other economic and quality of life factors. The targets reflect the aim to maintain the region's robust, longer-term trajectory. **2025:** Regional workforce participation rate of at least 80.9 percent **2050:** Regional workforce participation rate of at least 83.4 percent **Workforce participation rate (ages 20-64)** 
Inclusive growth perspective	As a secondary indicator, ON TO 2050 also tracks the workforce participation rate of the population in the Chicago metropolitan statistical area aged 16 and older, by race and ethnicity. Demographic groups participate in the workforce at differing rates. Workforce participation among Black residents is significantly lower rates than average, while it is significantly higher among Hispanic workers. **Workforce participation rate (ages 16 and older), by race and ethnicity** 

Plan Update revisions	This indicator has not been modified.

Employment in STEM Occupations

Indicator	This indicator tracks employment in science, technology, engineering, and mathematics (STEM) fields in the seven-county Chicago region. The demands of many professions are becoming increasingly complex as technology drives innovation and growth in today's economy. Workers employed in STEM occupations play a significant role in fostering new ideas that lead to economic growth. Yet growth in STEM occupations in the Chicago region has lagged behind STEM growth in peer regions. **Related recommendation:** Support the region's traded clusters.
Methodology	Data comes from the Bureau of Labor Statistics' (BLS) Quarterly Census of Employment and Wages (QCEW). Annual QCEW data are used to estimate employment in science, technology, engineering, and mathematics fields in the seven-county CMAP region. Data can be sourced directly from the BLS or from Economic Modeling Specialists International for ease of use. The occupations specified for this indicator reflect the STEM occupations as defined by the federal Standard Occupational Classification (SOC) Policy Committee in 2010.[2]
Targets	The Chicago region experienced a 0.12 percentage point increase in the share of STEM occupations between 2010 and 2017. Despite the Chicago region's diverse industry mix and exceptional education and research institutions, regional STEM employment closely mirrors that of the U.S. overall. In 2017, 12.5 percent of workers in the Chicago region filled positions in STEM occupations, compared with 12.7 percent nationwide. However, regional STEM employment lags behind other peer metropolitan areas, such as Boston, New York, and Washington, D.C. From 2010 to 2017, the share of STEM employment in the Chicago region grew by an average of 0.017 percentage points annually. Targets are based on the goal to double the region's annual growth rate to 0.034 percentage points per year through 2025, and then to maintain robust STEM activity by matching the U.S. annual growth rate of 0.024 percentage points per year. **2025:** 12.8 percent or more of region's jobs in STEM occupations **2050:** 13.4 percent or more of region's jobs in STEM occupations

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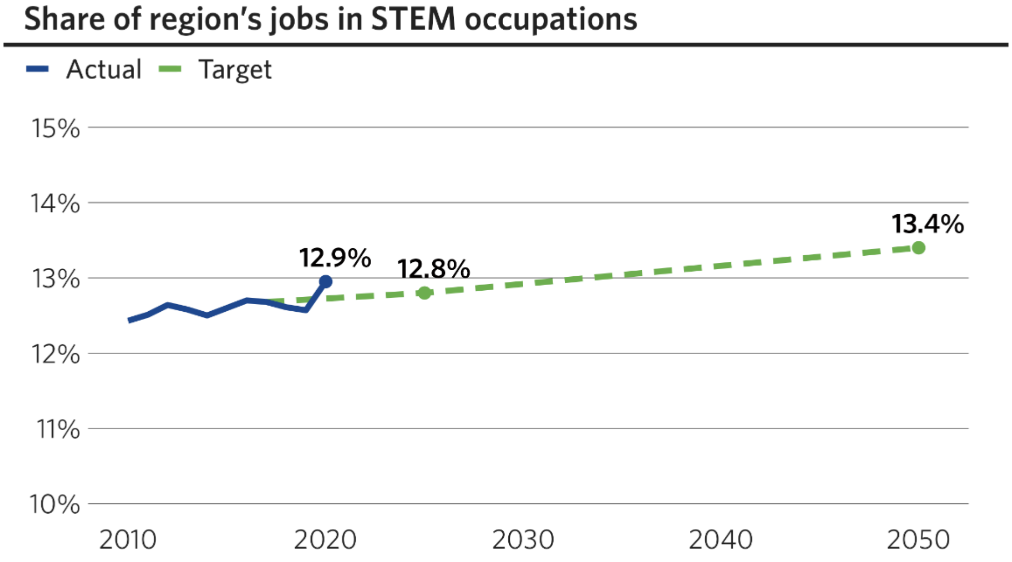
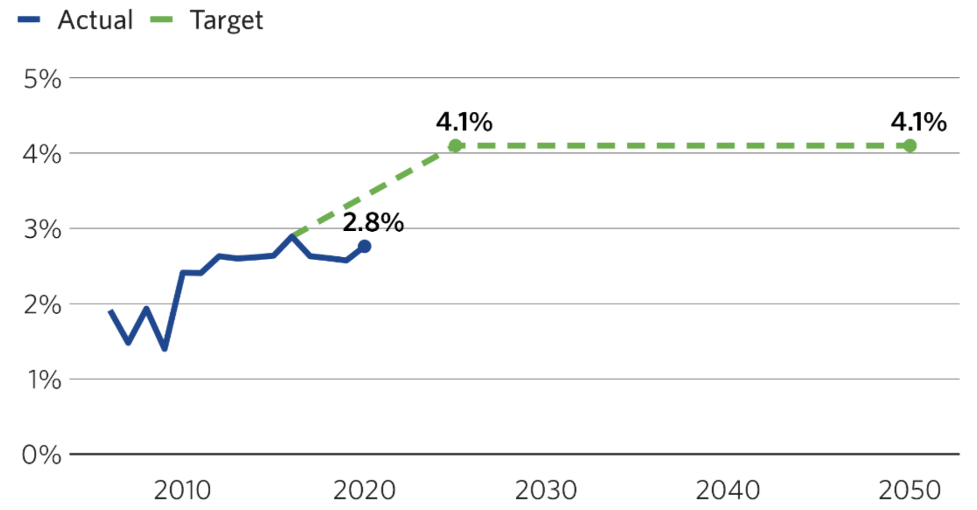
[2] U.S. Bureau of Labor Statistics, "An Overview of Employment and Wages in Science, Technology, Engineering, and Math (STEM) Groups," April 2014, https://www.bls.gov/opub/btn/volume-3/an-overview-of-employment.htm.

	
Plan Update revisions	This indicator has not been modified.

Venture Capital Funding

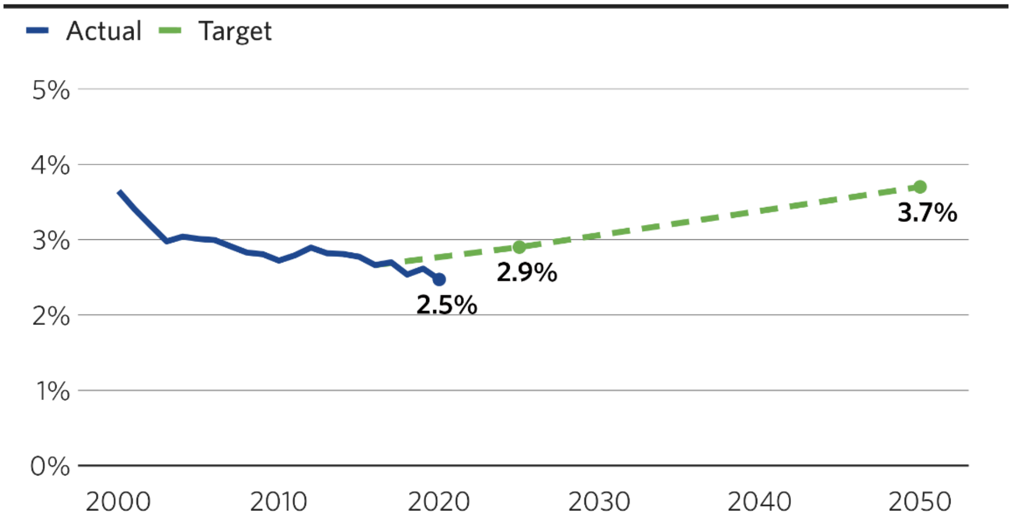
Indicator	This indicator measures the State of Illinois' share of total U.S. venture capital (VC) deals. Innovation in new goods, services, processes, and technologies drives economic growth. Some of these innovations reach the commercial market through new business startups. These newly created firms can face substantial costs for researching, developing, and marketing new products or services. In these instances, investors can support high-risk, potentially high-growth startup companies through venture capital funding. Venture capital therefore plays an important role in the business startup process by providing support to businesses before they are financially sustainable or able to access traditional funding streams. Such investments tend to finance innovative ideas and companies in high-growth sectors. **Related recommendation:** Pursue regional economic development.
Methodology	Data are published in the quarterly PitchBook-NVCA Venture Monitor report. The data used for this indicator represent a "best guess" of venture capital activity by region and state. Venture Monitor tracks data specifically for the Chicago-Naperville-Elgin, IL-IN-WI combined statistical area (CSA) somewhat inconsistently, depending on whether the region was in the top 10 CSAs by deal flow for a given quarter. Since most of the venture capital funding in the state flows to the region, this indicator is based on state-level data, which is consistently reported.

Targets	Since the mid-1990s, the state of Illinois has accounted for 1-3 percent of all VC deals in the U.S. Trends show that the Great Lakes region (defined as Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) is accounting for an increasing proportion of total VC deals; however, Illinois' proportion of deals has not kept pace. From 2002 to 2016, the Great Lakes region's share of national VC deals grew by an average of 0.13 percentage points per year. The goal between now and 2025 is to increase the number of VC deals in the state such that Illinois' share of total U.S. VC deals matches that Great Lakes growth rate. This growth would mirror the increases seen by peer regions such as Northern California and New York. Because venture capital deal-making is partially driven by industry mix, the goal for the Chicago region will be to reach 4.1 percent of all VC deals nationwide by 2025, and then maintain this level of robust investment activity and availability into 2050. **2025:** Illinois accounts for at least 4.1 percent of all U.S. venture capital deals **2050:** Illinois continues to account for at least 4.1 percent of all U.S. venture capital deals **Illinois' share of U.S. venture capital deals** 
Plan Update revisions	This indicator was originally based on data in the MoneyTree report, produced by CB Insights and published quarterly by PwC. Unfortunately, PwC discontinued publication following the Q1, 2021 edition. CMAP has identified an alternative data source, the PitchBook-NVCA Venture Monitor, which serves as an authoritative quarterly report on venture capital activity nationally. Like similar sources on private companies or their funding rounds, the report's underlying dataset relies on reported and projected data. This can result in potential challenges like reporting delays, voluntary or selective reporting bias, or an under-coverage of some sectors, business types, and

	geographies. The data used for this indicator therefore represent a best guess and a snapshot in time of venture capital activity. Differences in methodologies and reporting bases in the alternative data source result in across-the-board increases in the estimated number and dollar amount of venture capital deals in Illinois over the past two decades. However, the state's share of U.S. figures remains largely consistent, with approximately 2.7% of deals and 1.9% of dollar amounts nationally in 2020. The targets have been revised to reflect trends in the PitchBook-NVCA Venture Monitor's Great Lakes region (defined as Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) as well as the updated baseline data. This Great Lakes region has grown more slowly as a share of national activity (0.13 percentage points per year) than original estimates based on the MoneyTree report (0.3 percentage points), resulting in lower but still robust targets for the Chicago region.

Patenting Activity

Indicator	This indicator tracks the total number of utility patents (for "any novel, non-obvious, and useful machine, article of manufacture, composition of matter or process") issued to residents and businesses in the Chicago region by the U.S. Patent and Trademark Office (USPTO). High levels of patenting generally indicate a talented regional workforce and businesses with a strong capacity to conduct research and development. These ideas can generate significant value. Prior analysis has found that U.S. workers in industries with higher-than-average levels of intellectual property and patenting earn significantly more than those in other industries do, despite no significant difference in education levels. At the same time, the invention of new products and services enhances the competitiveness of our region's industries. Patents can play a special role in encouraging innovation by granting inventors exclusive rights to use or license an invention for a set period of time. These rights help businesses capitalize on their investments in research and development and provide a competitive edge in the marketplace. **Related recommendation:** Enhance economic innovation.
Methodology	USPTO provides data on U.S. utility patents issued annually via the PatentsView data platform. Data represents the 14-county Chicago metropolitan statistical area. According to USPTO, utility patents may be granted "to anyone who invents or discovers any new or useful process, machine, article of manufacture, or composition of matter, or any new or useful improvement thereof." CMAP attributes patenting activity to metropolitan areas based on the home or business address of the first-

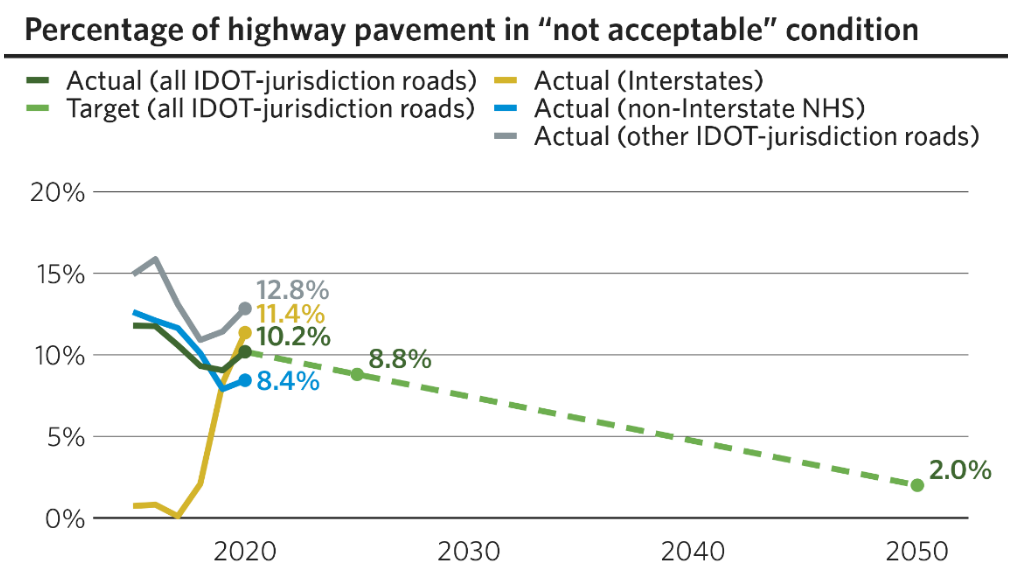
	named or primary inventor to reflect the most likely location for related research and development. Data and analysis for this indicator focus exclusively on "utility patents," referred to throughout simply as patents.
Targets	This indicator's targets are specified as a percentage of total U.S. patents. This allows benchmark comparisons between the Chicago region, peer regions, and national trends. In 2016 the Chicago MSA accounted for 2.9 percent of the U.S. population, but only 2.7 percent of total patent output originating in the U.S. The goal for 2025 is for the region to increase its patent output to match its 2016 "fair share" of patent output equivalent to its population share (2.9 percent). The top 25 most populous metro areas accounted for 42.4 percent of the U.S. population and 53.6 percent of the nation's patents in 2016. In other words, they produced 26 percent more than their "fair share" of patents. The goal for 2050 is for our region to match the patent output rate of the top 25 metropolitan areas and to have a patent output share that is 26 percent more than the region's share of national population. **2025:** 2.9 percent or more of U.S. origin patents issued in northeastern Illinois. This is equivalent to our region's current "fair share" of patents (i.e., a patent output share/population share ratio equal to 1.00). **2050:** 3.7 percent or more of U.S. origin patents issued in northeastern Illinois. This represents the goal of achieving 26 percent more than our region's current "fair share" of patent output (i.e., a patent output share/population share equal to 1.26). **Region's share of U.S. origin utility patents** 

Plan Update revisions	This indicator has not been modified.

Mobility Indicators

Percentage of Highway Pavement in "Not Acceptable" Condition

Indicator	Maintaining the existing transportation network and improving state of good repair are substantive priorities of ON TO 2050. Pavement condition provides a good measure of user experience of the facility and is also an indicator of the region's level of reinvestment in existing infrastructure. This indicator measures the percentage of roadway miles in the region under IDOT's jurisdiction that are in "not acceptable" condition. It includes National Highway System (NHS) and some non-NHS roadways. **Related recommendation:** Enhance the region's approach to transportation programming.
Methodology	Pavement condition, measured in the Condition Rating Survey (CRS), comes from the 2020 Illinois Roadway Information System (IRIS) public file. The roadway miles are broken down by facility type and CRS rating. Following IDOT's Transportation Asset Management Plan (TAMP), a CRS value of below 5.5 for Interstates and 5.0 for other NHS and non-NHS routes indicates pavement in "not acceptable" condition. IDOT selected these CRS values because they represent the threshold at which preservation treatments are no longer cost effective.
Targets	Current (2020) CRS data indicate that 10.2% of the NHS and roadways under IDOT jurisdiction are in "not acceptable" condition. Pavement condition had been improving, but recently that trend has been reversed with pavement condition getting worse, especially on the interstate system with the mileage in "not acceptable" condition jumping from 0.1 percent of Interstate miles in 2017 to 11.4 percent of Interstate miles in 2020. The pavement target was developed based on the review of the available historic data, trends, and current pavement condition. IDOT's commitment to asset management and actively incorporating more pavement preservation into its program. Pavement preservation will allow for roads to stay in "acceptable" condition for longer and be more cost efficient in the long term. The additional funding that will be available through the passage of the Rebuild Illinois Capital Plan and the Infrastructure Investment and Jobs Act will play a significant role in improving asset condition. **2025:** 8.8 percent or less of IDOT-jurisdiction roadway miles in "not acceptable" condition

	2050: 2.0 percent or less of IDOT-jurisdiction roadway miles in "not acceptable" condition 
Plan Update revisions	This indicator was originally based on a federal performance measure for which CMAP is required to track and establish near-term targets, but which only covered roadways in the NHS. It has been updated to provide a more complete assessment of the region's pavement condition by including *all* roads under IDOT jurisdiction (which includes the NHS roads that were previously tracked). The measure has also been updated to use IDOT's Condition Rating Survey (CRS) classification of pavement condition, which classifies pavement as being in either "acceptable" or "not acceptable" condition. The baseline data and targets have both been updated to reflect the change in roadway coverage and pavement condition rating methodology.

Percentage of Highway Bridge Area in "Poor" Condition

Indicator	Like pavement condition, tracking bridge condition helps measure the region's progress on improving the existing transportation system. This indicator measures the percentage of the region's bridge deck area in "poor" condition. While a "poor" classification is the lowest condition rating for a bridge, it should be noted that it does not necessarily mean that a specific bridge is unsafe. **Related recommendation:** Enhance the region's approach to transportation programming.

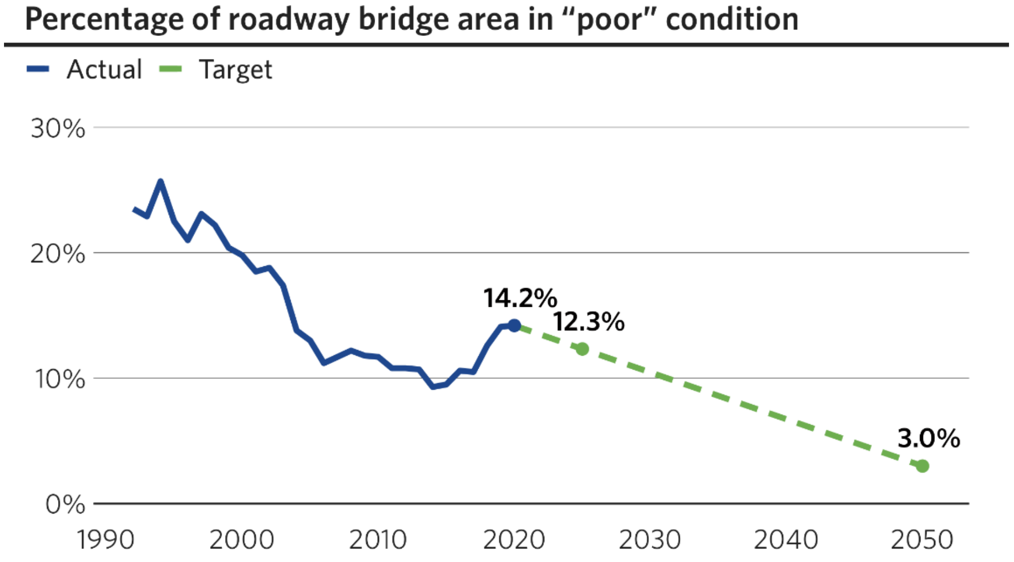
<table>
<tr><td>Methodology</td><td>Data come from the Federal Highway Administration’s (FHWA) annual National Bridge Inventory (NBI). NBI data is available for all bridges that carry NHS routes and that are over 20 feet in length. Bridge conditions ratings are identified through a scheduled inspection process, and are identified as requiring significant maintenance, rehabilitation, or replacement.

Note that prior to 2018, the NBI used the term “structurally deficient.” This term was redefined in accordance with the Pavement and Bridge Condition Performance Measures final rule, to align with the new MAP-21 “poor” condition federal standard.</td></tr>
<tr><td>Targets</td><td>Current (2020) NBI data indicate that 14.2 percent of the region’s bridge deck area was classified as being in “poor” condition, which is the highest percentage since 2003. Over the last decade, the measure has fluctuated between 9.3 and 14.2 percent, but since the average NHS bridge in the CMAP region was built in 1971, more old bridges can be expected to lapse into the “poor” condition every year.

The targets were developed based on a review of historical trends, average bridge characteristics, and consideration of the potential new bridges with high quality deck area. The 2025 and 2050 targets call for a continuation of the long-term rates of improvement, and adequate funding levels that allow for the continuation of timely bridge maintenance programs. IDOT’s commitment to asset condition and incorporating bridge preservation work will help extend the life cycle of bridges and keep them in “good” or “fair” condition longer. Like pavement, with the passage of the Rebuild Illinois Capital Plan and the Infrastructure Investment and Jobs Act, bridge condition is expected to improve with all the new funding available to implementers.

2025: 12.3 percent or less of bridge deck area in “poor” condition

2050: 3.0 percent or less of bridge deck area in “poor” condition</td></tr>
</table>

	
Plan Update revisions	This indicator was originally based on a federal performance measure that CMAP is required to track and establish near-term targets for. It has been updated to capture the condition of the region's infrastructure more fully by including all 3,015 bridges in the region, rather than only the 1,375 National Highway System (NHS) bridges included in the federal measure. The revised measure does not include culverts. The baseline data and targets have both been updated to reflect the change in roadway coverage.

Transit Asset State of Good Repair

Indicator	Maintaining the existing transportation network and improving state of good repair are substantive priorities of ON TO 2050. In particular, recent investment in the transit system has been insufficient to keep system condition from declining. **Related recommendation:** Enhance the region's approach to transportation programming. ***(a) Percentage of fixed-route buses that have met or exceeded their useful life*** This measures the percent of active revenue public transit buses that have exceeded their useful life. This represents the number of vehicles that have reached an age where maintenance cost and vehicle performance issues are likely to increase. **This measure is also a federally required performance measure.**

Methodology

A snapshot of the active vehicle fleet is reported each year to the National Transit Database (NTD), including the year of manufacture. Note that a useful life benchmark (ULB) of 12 years is used for Pace and 12-15 years for Chicago Transit Authority (CTA) based on agency priorities and operating conditions.

Number of active buses (2020) reaching ULB, by year

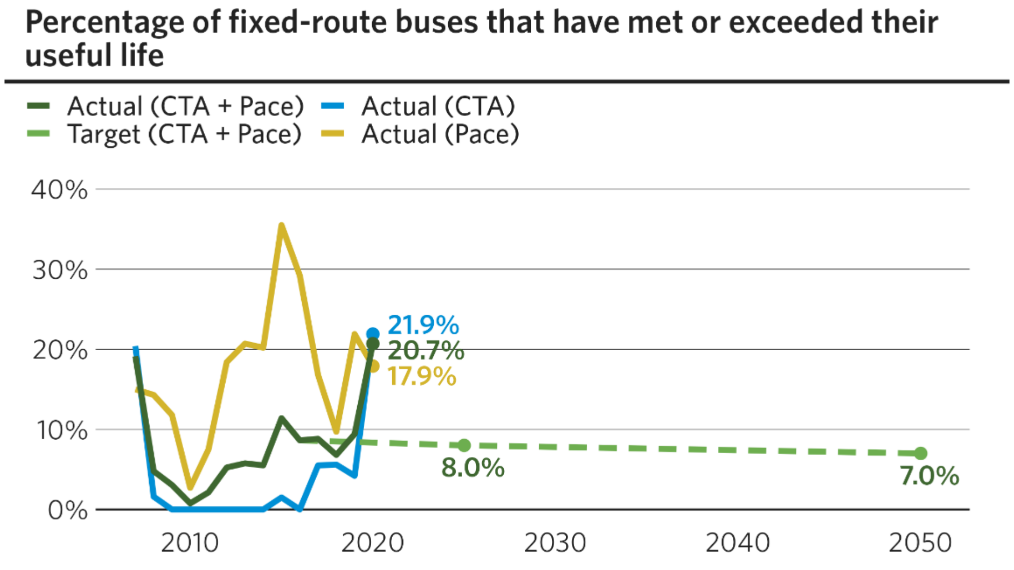
Year reaching ULB	CTA buses	Pace buses
2013		1
2015		44
2016	103	
2017	111	53
2018		3
2019		102
2020	332	38
2021	237	25
2022	443	58
2023	226	6
2025		90
2026	18	37
2027		76
2028	84	90
2029	94	172
2030	184	11
2031	147	
2032	6	91
2033	25	
Total	**2,010**	**897**

Targets

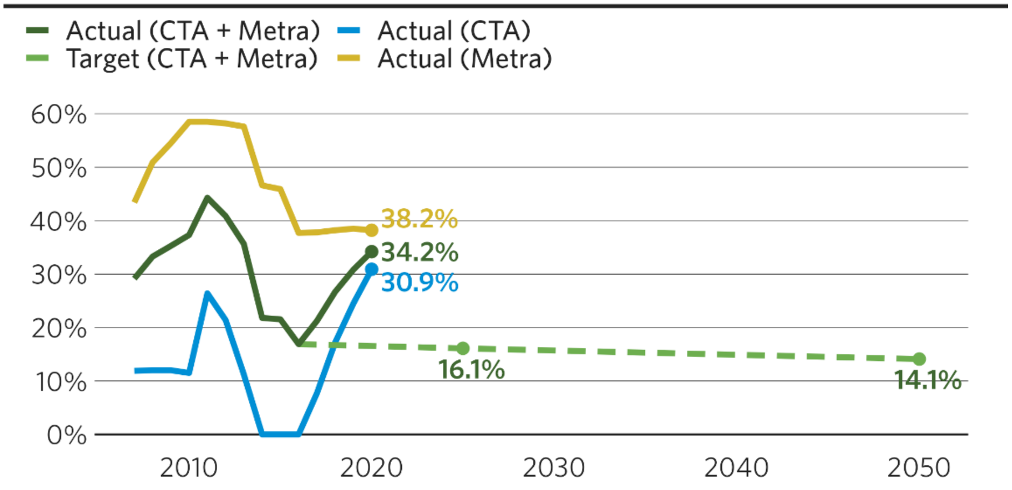
State, federal, and transit agency capital programs can result in large purchases of new vehicles, which then reach their ULB at the same time. By 2025, 47 percent of Pace's and 72 percent of CTA's current bus fleet will have reached their ULB. As of 2020, 20.7 percent of buses have exceeded their useful life. Financial projections for ON TO 2050 include funding being directed toward reducing the state of good repair backlog. This would result in an improvement in bus condition to 7.0 percent of buses beyond their useful life in 2050.

2025: 8.0 percent or fewer buses exceed their useful life benchmark

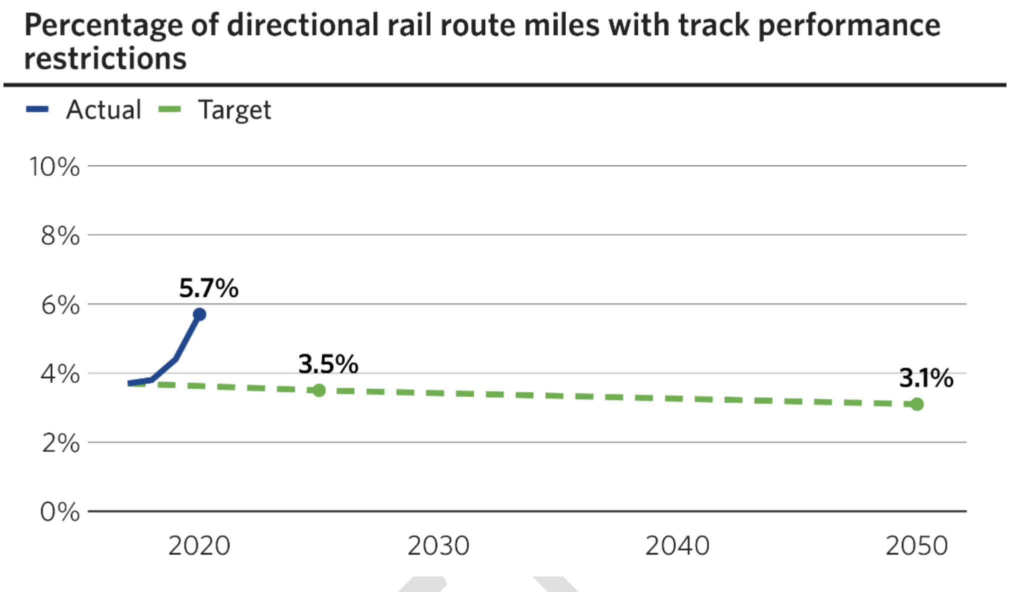
2050: 7.0 percent or fewer buses exceed their useful life benchmark

	
Plan Update revisions	This indicator has not been modified.

Indicator	***(b) Percentage of rail vehicles that have met or exceeded their useful life*** This measures the percent of active revenue public transit rail vehicles that have exceeded their useful life. This represents the number of vehicles that have reached an age where maintenance cost and vehicle performance issues are likely to increase. **This measure is also a federally required performance measure.**
Methodology	A snapshot of the active vehicle fleet is reported each year to the National Transit Database (NTD), including the year of manufacture. The CTA plans for rail vehicles to be used for 34 years, while Metra plans for 30 years of useful life. This does not include non-revenue equipment such as maintenance vehicles.
Targets	State, federal, and transit agency capital programs can result in large purchases of new vehicles, which then reach their ULB at the same time. Currently 16.9 percent of rail vehicles are beyond their ULB. Financial projections for ON TO 2050 include funding being directed toward reducing the state of good repair backlog. These targets are consistent with that plan. **2025:** 16.1 percent or fewer rail vehicles exceed their useful life benchmark **2050:** 14.1 percent or fewer rail vehicles exceed their useful life benchmark

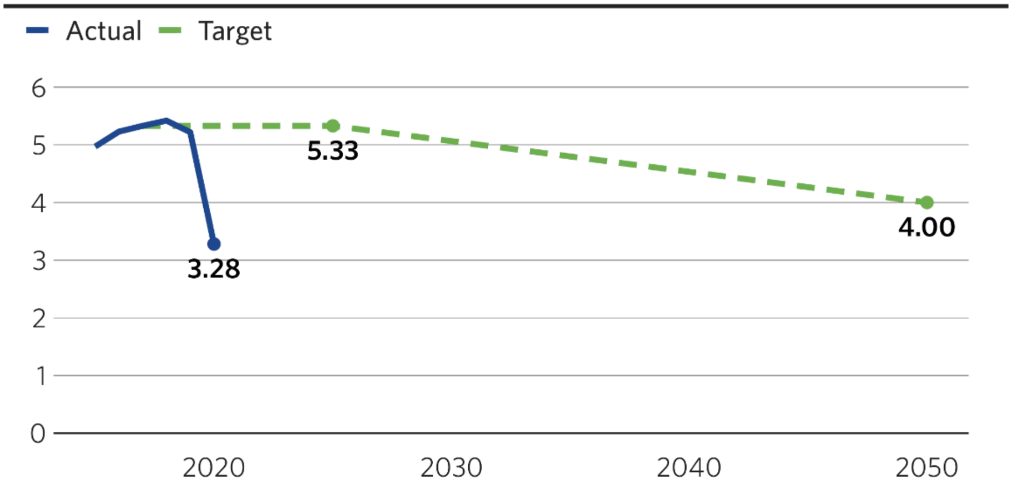
	Percentage of rail vehicles that have met or exceeded their useful life 
Plan Update revisions	This indicator has not been modified.

Indicator	***(c) Percentage of directional rail route miles with track performance restrictions*** This indicator measures the percent of transit rail track with performance restrictions. The CTA refers to these as “slow zones,” where trains are required to operate at slower than normal speeds. This could be the result of construction, power systems, signals, or other issues. Elimination of slow zones can help to make transit more competitive by decreasing travel times and improving reliability. **This measure is also a federally required performance measure**.
Methodology	Starting in 2017, this data is available in the National Transit Database maintained by the FTA. The annual performance measure for Infrastructure is an average of each month’s performance restriction at 9:00 AM local time on the first Wednesday of each month.
Targets	Slow zones have a number of root causes. For example, trains reduce speed to protect workers in construction zones. The rail system may always have some level of speed restrictions for safety around construction and unexpected events. Improvements in transit asset management and system reconstruction can help minimize slow zones. Financial projections for ON TO 2050 include funding being directed toward reducing the state of good repair backlog. These targets are consistent with that plan. **2025:** 3.5 percent of track or less with performance restrictions

	2050: 3.0 percent of track or less with performance restrictions 
Plan Update revisions	This indicator has not been modified.

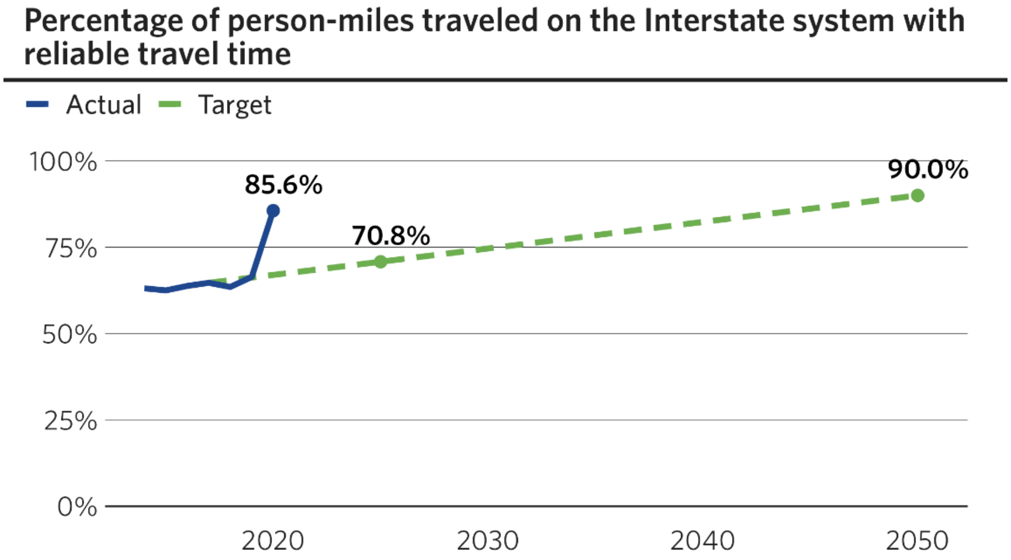
Average Congested Hours of Weekday Travel for Limited Access Highways

Indicator	Congestion has negative effects on the regional economy (in terms of wasted time) and air quality (in terms of additional emissions). This indicator measures how long the region's expressways are congested during weekday travel on average. "Congested hours" is defined as the number of hours each weekday that travelers could travel at least 10 percent faster in free-flow conditions. **Related recommendation:** Build regionally significant projects.
Methodology	This indicator is calculated using 5-minute, non-holiday weekday vehicle probe (travel time) data from FHWA's National Performance Measurement Research Data Set (NPMRDS).
Targets	The goal for 2050 is to attain a one hour, 20-minute reduction in the average number of hours per weekday that the region's expressways are congested. The short-term goal for 2025 is to keep the same duration of average weekday congestion as 2017: 5.33 hours. The short-term goal reflects the fact that there are not many capital improvements that will be completed on the expressway system by 2025. Additionally, it could take a number of years before new vehicle technology has fully penetrated the market. The lower congestion goal in 2050 reflects anticipated new vehicle technology, capital improvements to the transportation network, and the implementation of

	operational strategies like congestion pricing, incident management, and truck delivery times to address congestion. **2025:** 5.33 hours or less of congestion **2050:** 4.00 hours or less of congestion Average congested hours of weekday travel for limited access highways 
Plan Update revisions	This indicator has not been modified.

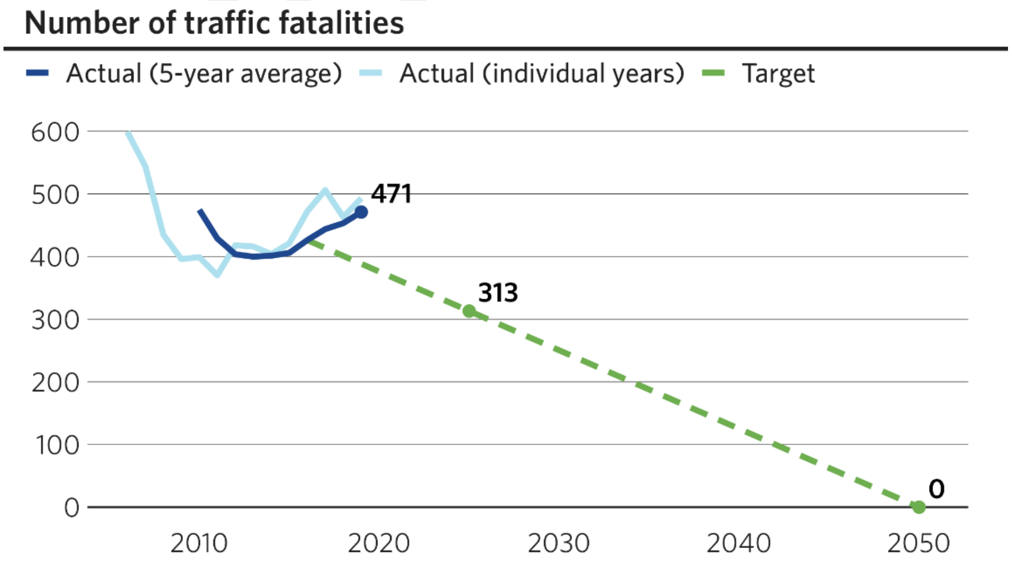
Percentage of Person-Miles Traveled on the Interstate System with Reliable Travel Time

Indicator	Unreliable travel times on these critical roads requires their users to budget extra time to ensure they arrive at their destinations on time. This increases commutes, limits movement of goods, and otherwise reduces quality of life and economic efficiency. The Level of Travel Time Reliability (LOTTR) is defined as the ratio of the longer travel times (80th percentile) to a “normal” travel time (50th percentile). The measure is the percentage of person-miles traveled on the region’s Interstate system that meet this definition of reliability. Using person-miles rather than vehicle-miles gives equal weight to all individuals using the roads. **This measure is also a federally required performance measure.** **Related recommendation:** Harness technology to improve travel and anticipate future impacts.
Methodology	This measure is based on data from FHWA’s NPMRDS or equivalent. Speed and volume data are collected in 15-minute intervals between 6 a.m. and 8

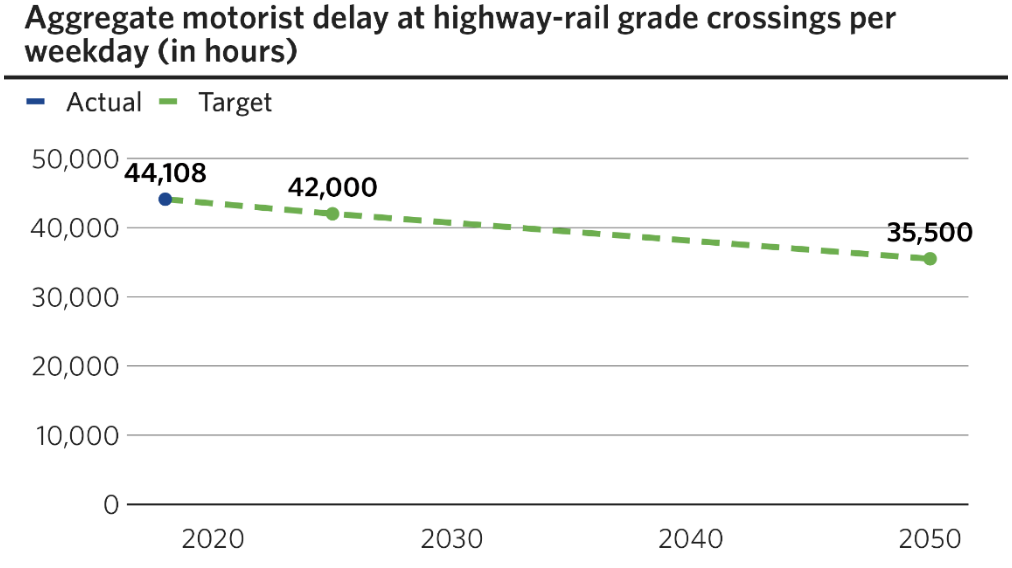
	p.m. local time. Person-miles are calculated by combining traffic volumes and vehicle occupancy data.
Targets	Operations programs that, for example, improve incident management or implement advanced traffic management, could result in short term improvement despite the lack of new projects on the system. Regionally significant projects, travel demand management, and vehicle technology are expected to improve reliability over the long term, despite increasing population. This improvement could be limited by an increase of severe weather events. A 2050 target of 90 percent was set based on the results of CMAP's own travel modeling analyses of strategies to improve reliability. Full reliability can never be achieved due to uncontrollable factors like weather. **2025:** 70.8 percent or more of person-miles traveled on the interstate system are reliable **2050:** 90.0 percent or more of person-miles traveled on the interstate system are reliable  Percentage of person-miles traveled on the Interstate system with reliable travel time
Plan Update revisions	This indicator has not been modified.

Number of Traffic Fatalities

Indicator	Ensuring a safer transportation system – for all modes – is a growing priority for the nation and region. ON TO 2050 offers strategies to improve safety for drivers, bicyclists, and pedestrians. To track progress, this measure tracks the five-year rolling average of the number of fatalities in the CMAP region on all

	public roads. This includes all motor vehicle fatalities and any pedestrians and cyclists involved. After declining for several decades, traffic fatality rates began increasing again in 2010, likely due to a combination of increased driving during the economic recovery and the rise of distracted driving fueled by smartphone usage. **This measure is also a federally required performance measure.** **Related recommendation:** Improve travel safety.
Methodology	Illinois traffic crash reports provided by IDOT are used to calculate the number of fatalities that occur per year within the CMAP region. A five-year rolling average is then calculated from the five most recent years' data.
Targets	Because traffic deaths are preventable, the region should strive for zero traffic related fatalities by 2050. Many of CMAP's partners have embraced the goal of achieving zero traffic related fatalities. This goal can be achieved through a holistic approach to safety that includes the 4 E's (Education, Enforcement, Engineering, and Emergency Response) of traffic safety. Additionally, improvements in vehicle technology are expected to play a significant role in reducing traffic fatalities. **2025:** 313 or fewer fatalities per year **2050:** Zero fatalities per year 
Plan Update revisions	This indicator has not been modified.

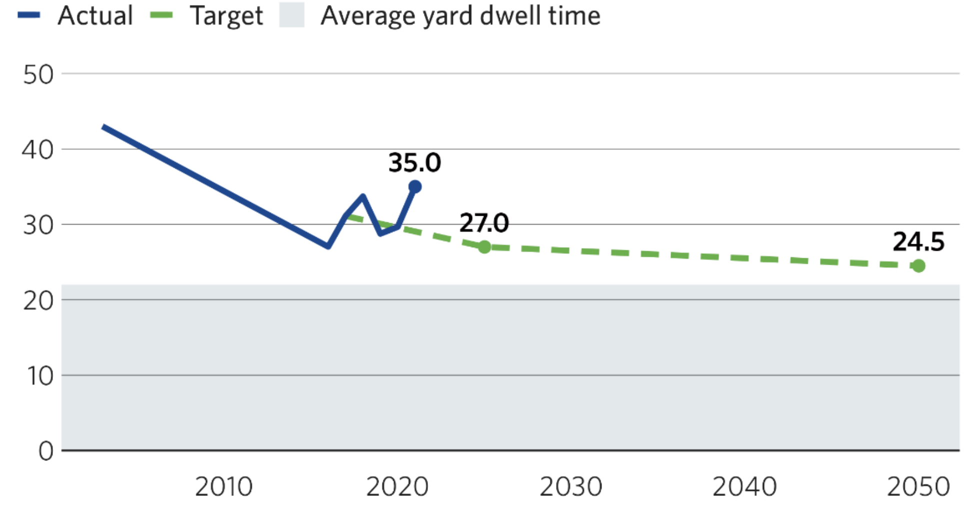
Motorist Delay at Highway-Rail Grade Crossings

Indicator	CMAP estimates that weekday motorist delay at the region's grade crossings cost residents $332 million in wasted productivity in 2018 alone. This indicator measures the aggregate hours of delay per weekday experienced by motorists at railroad crossings in the seven-county CMAP region. **Related recommendation:** Maintain the region's status as North America's freight hub.
Methodology	The source for these data is periodic analyses conducted by the Illinois Commerce Commission (ICC), which provide detail about delay at each grade crossing in the region. This data is then aggregated to calculate the region wide daily average.
Targets	From 2002 to 2011, a number of strategies were implemented that resulted in a large reduction in weekday delay — these include closing lines and grade crossings, re-routing of service, and service realignments. The pace of change slowed from 2011 to 2017. In the future, the pace of change will reflect the most recent rate of change. Proposed targets reflect trends from 2011 to 2017 and are consistent with 17 proposed CREATE grade separations being completed by 2050. **2025**: 42,000 hours or less of motorist delay at grade crossings per weekday **2050:** 35,500 hours or less of motorist delay at grade crossings per weekday  **Aggregate motorist delay at highway-rail grade crossings per weekday (in hours)**
Plan Update revisions	The methodology by which CMAP has calculated motorist delay at highway-rail grade crossings in the past made many simplifying assumptions. This had the effect of significantly underestimating the actual delay caused by these

	crossings. Staff have since refined the methodology to account for several missing sources of delay. Among the improvements are the use of observed train speeds instead of estimates, hourly traffic counts instead of daily, and queue clearance rates after gates are raised. These methodological improvements have resulted in a nearly six-fold increase in our estimates of motorist delay at highway-rail grade crossings (44,108 hours per weekday in 2018, compared to approximately 7,500 hours using the original methodology). As a result, the indicator targets established in ON TO 2050 are no longer meaningful. Staff have applied the ON TO 2050 delay reduction targets (in percentage rather than absolute terms) to the updated baseline data to produce new targets.

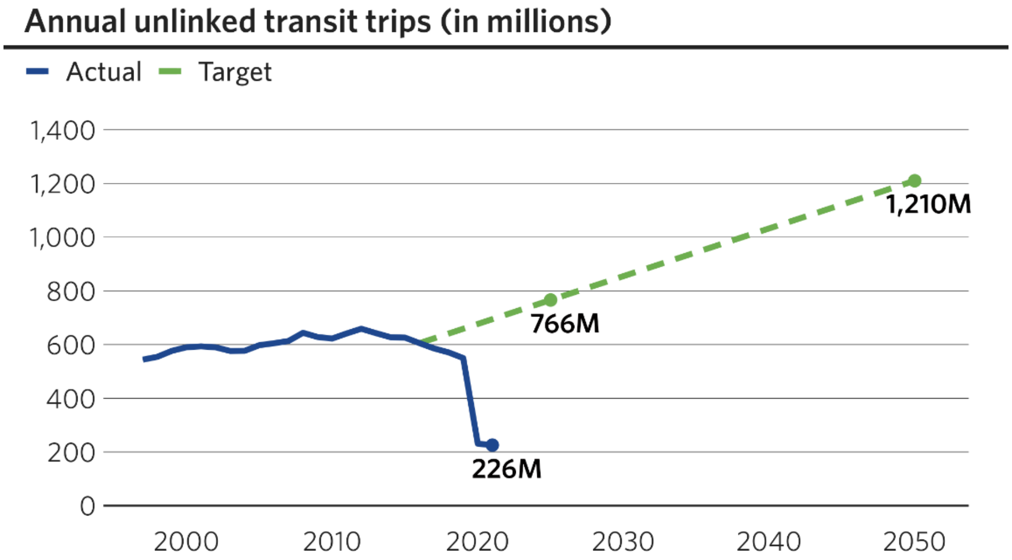
Chicago Terminal Carload Transit Time

Indicator	The indicator measures the fluidity of the Chicago Terminal, which is important to the economic strength of the region's rail industry. This measures the annual average time carload freight takes to get through the core of Chicago's rail freight hub, the Chicago Terminal, extending from the City of Chicago to roughly the Indiana Harbor Belt Railway in the near-west suburbs. Much of the carload freight needs to pass through classification yards in the Chicago Terminal, where the interchange is made between predominantly eastern railroads, predominantly western railroads, Canadian railroads, and smaller regional and industrial railroads. The measure also indicates how fast trains are moving – a slow train will block a highway-rail grade crossing longer than a fast train. **Related recommendation:** Maintain the region's status as North America's freight hub.
Methodology	Data is provided to CMAP for the Chicago Transportation Coordination Office by the Association of American Railroads' data provider, RailInc. The information is also provided to and posted by the Surface Transportation Board. The terminal transit time includes both "dwell time" in the classification yards, totaling about 22 hours, and the time spend traveling to and from those yards. Carload freight excludes containerized and single-purpose, through-routed unit trains.
Targets	The targets reflect a return to 2016 conditions by 2025, and cutting the remaining transit time, less yard dwell time, in half by 2050. A fixed yard dwell time of 22 hours, consistent with recent observations, is assumed. The amount of time trains spend in classification yards is beyond the control of

	any CMAP policy recommendations, so the targets focus solely on decreasing the time spent traveling to and from them. **2025:** 27.0 hours or shorter carload transit time **2050:** 24.5 hours or shorter carload transit time Chicago Terminal carload transit time (annual average, in hours) 
Plan Update revisions	This indicator has not been modified.

Annual Unlinked Transit Trips

Indicator	This indicator tracks the total number of annual unlinked transit trips. Trips are “unlinked” in that this is a total count of boardings, so that an individual making one transfer is counted as two unlinked trips. Increased transit ridership reduces greenhouse gas emissions, reduces roadway congestion, and improves air quality. **Related recommendation:** Make transit more competitive.
Methodology	This value is taken directly from the National Transit Database and unlinked trips are the only way the Federal Transit Administration reports transit service used by the public. Data are reported separately for CTA, Metra, and Pace (including paratransit services).
Targets	The 2050 target has been set in keeping with the goal of doubling transit ridership over 2016 levels. In 2016, the region had an average 72 unlinked transit trips per resident per year. With forecasted increases in population by 2050, doubling transit ridership would increase the average number of trips

	by 58 percent to 114 per resident per year, which is lower than San Francisco’s current per resident trip rate. Achieving this target will require regional action by not just the transit agencies, but also municipalities, highway agencies, and funding authorities. Transit agencies cannot sustain fast, frequent, reliable service without supportive land use change. Effective transit service results from a combination of strategic investment in transit service and coordinated land use planning. Locating jobs and residences near transit has a powerful positive effect on ridership. CMAP analysis shows that taking steps to increase employment density near transit stations and pricing parking would have more impact on ridership compared to many other strategies for capital investment and service expansion.[3] **2025:** 766 million or more unlinked transit trips **2050:** 1.21 billion or more unlinked transit trips 
Plan Update revisions	This indicator has not been modified.

Population and Jobs with at Least “Moderately High” Transit Availability

Indicator	This indicator will report the percentage of population and jobs with at least moderately high transit availability. This is based on a CMAP-created index that considers multiple factors: proximity to transit stops, frequency of service, destinations reachable without a transfer, and walkability. For a specific area, this index is intended to measure the relative level of access

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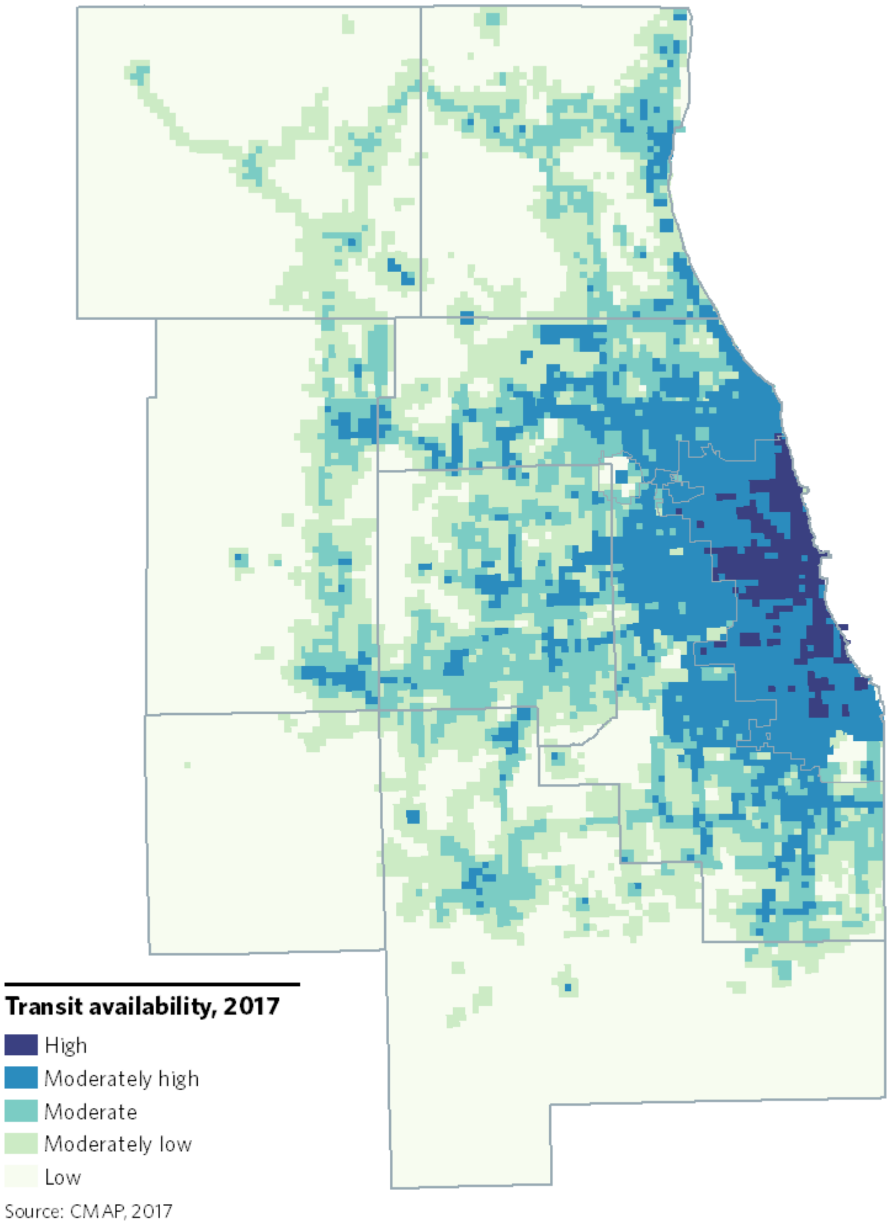
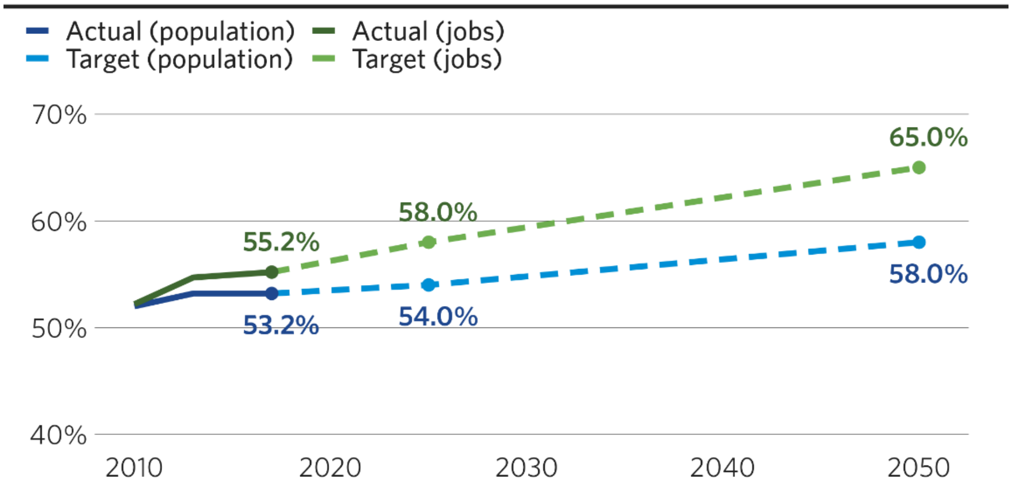
[3] Chicago Metropolitan Agency for Planning, “Transit Ridership Growth Study,” August 2017, http://www.cmap.illinois.gov/documents/10180/0/Transit+Ridership+Growth+Study_final.pdf.

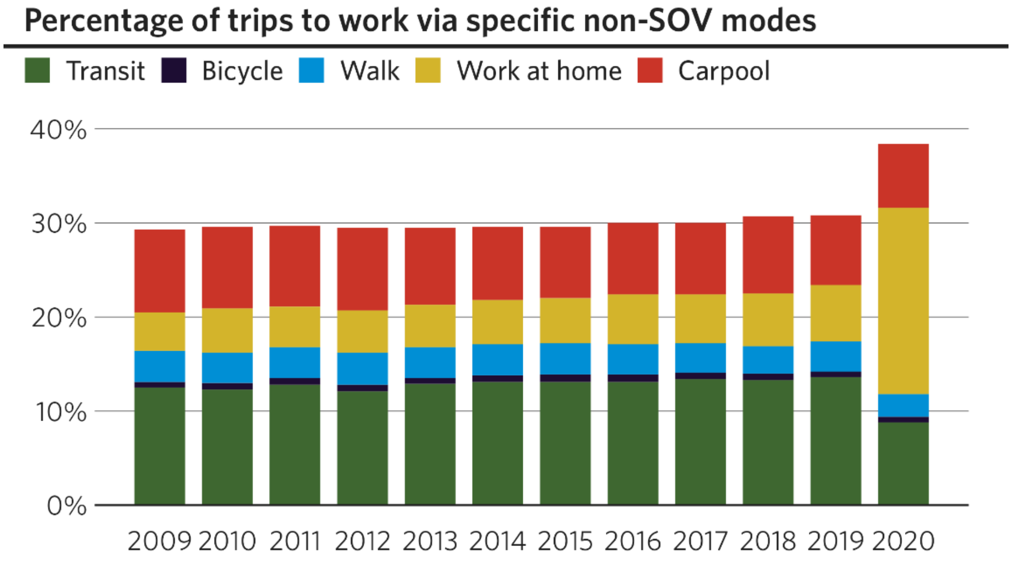
	residents and workers have to the transit system, regardless of their actual choice of mode. **Related recommendation:** Make transit more competitive.
Methodology	The Transit Availability Index is a metric that takes into account transit service frequency, pedestrian friendliness, network distance to transit stops, and number of subzone connections. Each factor is measured individually at the subzone level and an index value is assigned to each subzone. The Transit Availability Index is then the average of these four factor indices that have been assigned to each subzone. This measure tracks the percent of the population in the two highest categories (4 or 5 on a five-point scale).

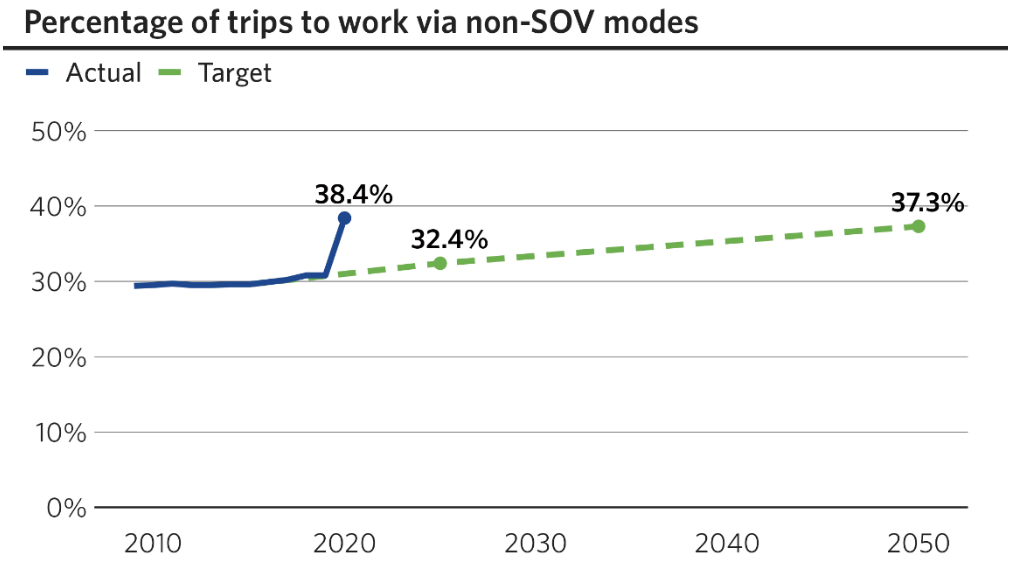
	 Source: CMAP, 2017
Targets	The proposed transit availability targets (below) could be reached if many regionally significant projects were completed, along with policies to encourage infill development and improvements to walkability around transit stations.

	2025: At least 58 percent of jobs and 54 percent of population with “moderately high” or “high” transit availability **2050:** At least 65 percent of jobs and 58 percent of population with “moderately high” or “high” transit availability Share of population and jobs in areas with “moderately high” or “high” transit availability 
Plan Update revisions	This indicator has not been modified.

Percentage of Trips to Work via Non-SOV Modes

Indicator	Encouraging multimodal travel makes the best use of the system, reduces greenhouse gas emissions, and improves quality of life. This measure tracks the share of trips to work by non-single occupancy vehicle (non-SOV) modes for trips to work. These modes include carpool, public transportation, walking, bicycling, and work at home. Higher levels of non-SOV travel would yield numerous benefits: reduced congestion, better air quality, and healthier residents, to name a few. This measure is similar to the MAP-21 performance measure for non-SOV travel, but uses slightly different geography and Census data. **Related recommendations:** Make transit more competitive; Harness technology to improve travel and anticipate future impacts; Improve travel safety.
Methodology	Annual releases of the U.S. Census Bureau’s ACS dataset – table B08301 – are used to track mode share in the region. The data is assembled from county-level data, using 1-year samples for Cook, DuPage, Kane, Lake, McHenry and Will, and 5-year samples for Kendall (for which the full level of detail

	required is not available in the 1-year samples). While targets are only set for overall non-SOV mode share, CMAP will track the share of the specific modes that are considered “non-SOV”: carpool, public transportation, walk, bicycle, and work at home (telecommuting). Trips by driving alone, motorcycle, taxicab, and “other means” are excluded. The chart below shows this data for 2009-20. In 2020, non-SOV mode share increased sharply, driven by a surge in telecommuting during the COVID-19 pandemic (at the expense of all other modes). The extent to which increased telecommuting and the resultant decrease in other modes persists beyond 2020 remains to be seen. 
Targets	Recent data indicate that non-SOV travel is increasing in the region. Recent increases in non-SOV travel have been driven largely by an increase in people working at home, even pre-pandemic. Implementation of policies to support transit, cycling, and walkability will enable this trend to continue. A 2050 target of 37.3 percent is consistent with the target of doubling transit ridership (see *Annual Unlinked Transit Trips*, p. 53). The 2025 target is based on a straight-line interpolation between 2016 ACS data and the 2050 target. **2025:** 32.4 percent or more trips to work via non-SOV modes **2050:** 37.3 percent or more trips to work via non-SOV modes

	
Plan Update revisions	This indicator has not been modified.

Number of Intersections with Transit Priority or Queue Jumping

Indicator	Road infrastructure and technology affect the speed, frequency, and reliability of transit ridership, but lie outside the control of the transit agencies themselves. Closer partnerships between transit and agencies responsible for roadways hold promise to create integrated, multimodal corridors. These approaches support transit ridership at relatively modest cost. This indicator tracks the implementation of projects that give priority to transit service. Transit Signal Priority (TSP) utilizes vehicle location and wireless communication technologies to advance or extend green times at signalized intersections. This can help reduce bus travel times, improve schedule adherence, and reduce operating costs. TSP is also an important component of Bus Rapid Transit (BRT) and Arterial Rapid Transit (ART) projects. Queue jumps can work in conjunction with TSP or on their own to allow a bus to go through an intersection ahead of other vehicles. **Related recommendation:** Make transit more competitive; harness technology to improve travel and anticipate future impacts.
Methodology	CMAP worked with Pace, CTA and the RTA to track Transit Signal Priority (TSP) and queue jumps in the region. There are approximately 4,800 signalized intersections in the region along bus routes. In 2018, 84 of these had bus priority.

Locations of intersections with transit priority, 2018

Major Street / Location	TSP signals	Queue jump signals	Total
Ashland Ave	40		40
Canal St		1	1
Clark St		1	1
Dearborn St		1	1
Franklin St		1	1
Jeffery Ave	6	1	7
La Salle Dr		1	1
Wabash Ave		1	1
Wells St		1	1
Wash. St (Lake Co.)	10		10
Harvey TC	20		20
Grand Total	**76**	**8**	**84**

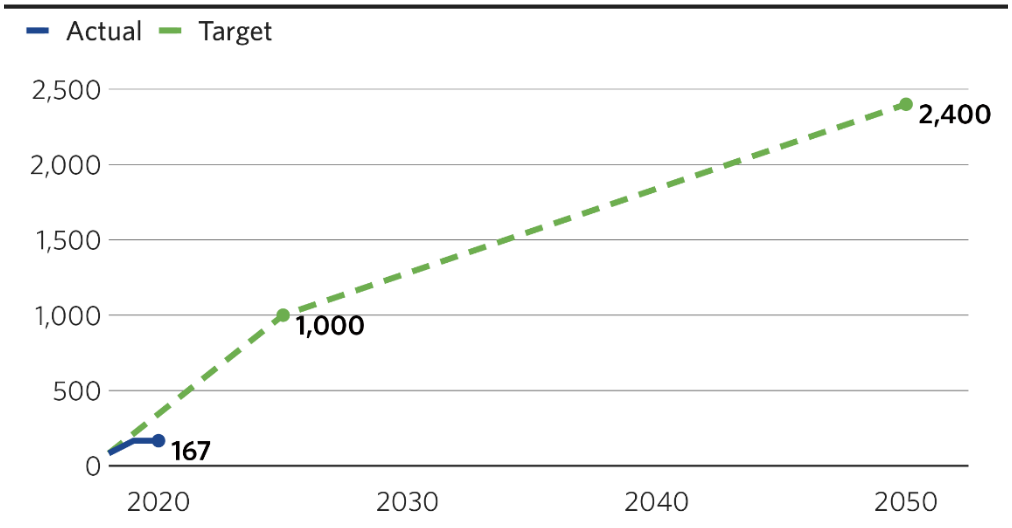
Targets

In addition to the 84 existing intersections with TSP and/or queue jumping when ON TO 2050 was adopted, over 400 signal improvements were in advanced planning or engineering to be in place by 2020 (although as of 2020, the completed total was only up to 167). Future efforts should continue to improve intersections until at least half of intersections that serve buses have bus priority.

2025: 1,000 intersections or more with TSP or queue jumping

2050: 2,400 intersections or more with TSP or queue jumping

Number of intersections with transit priority or queue jumping



Plan Update revisions	This indicator has not been modified, although it has been renamed for accuracy. It was previously called “number of traffic signals with transit priority and/or queue jumping.”

Miles of Roadway with Transit Preference

Indicator	This indicator tracks the allocation of road space to buses. Providing extra space or right of way to buses improves travel time and reliability. This takes many forms throughout the region. Bus on shoulder and flex lanes allow buses on expressways to bypass slower traffic. Dedicated bus lanes, such as the Loop Link project, provided bus priority on local streets all day. Some bus lanes are shared with only bikes. Peak hour lanes provide a dedicated lane for buses when demand is highest and are otherwise used for parking or general travel. The region has one busway, the McCormick Busway, which provides a dedicated road for buses serving special events. **Related recommendation:** Make transit more competitive.
Methodology	Information for transit agencies was used to create an inventory of bus preference. In 2018, there were 108.3 miles of bus preference in the region. The majority of this mileage is along expressways.
Targets	When ON TO 2050 was adopted in 2018, there were 108.3 miles of bus preference in the region, most of which had been built since 2008. Pilot projects have shown that these improvements can improve ridership. **2025:** At least 250 miles of roadway with transit preference (50 on urban streets) **2050:** At least 500 miles of roadway with transit preference (100 on urban streets)

Locations of roads with bus preference, 2018

Lane type	Project	Miles
Bus on shoulder	Edens BOS	25.2
Bus on shoulder	I-55 BOS	38.8
Flex lane	Addams / Tollway	31.0
Busway	McCormick Busway	4.6
Peak hour	Jeffery Jump	4.0
Bus lane	Loop Link	2.1
Bus lane	Downtown Chicago	1.5
Bike/bus lane	Cortland/Clark	1.0
Total		**108.3**

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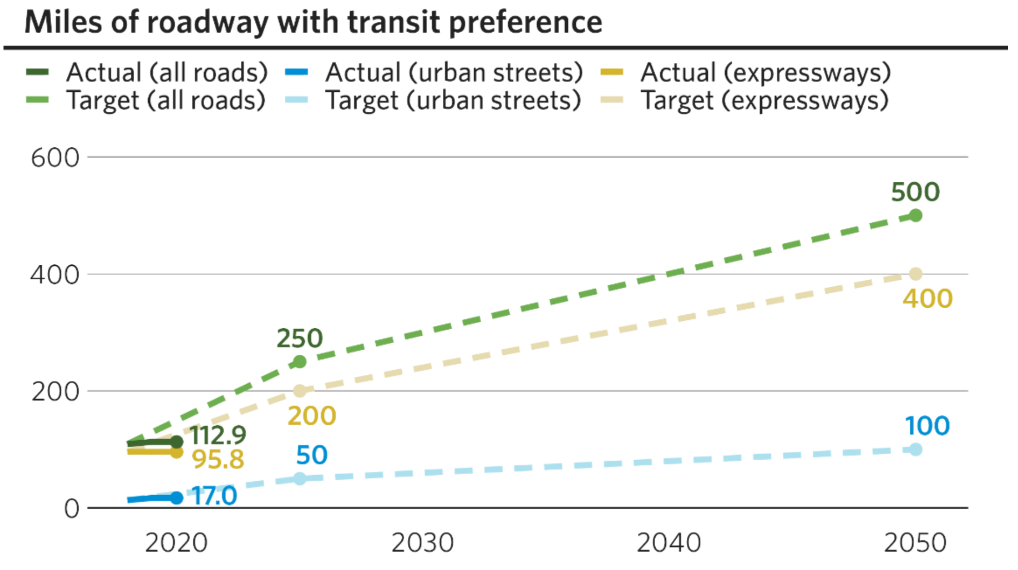

Miles of roadway with transit preference

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<tr><td>Plan Update revisions</td><td>This indicator has not been modified.</td></tr>
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Percentage of Regional Greenways and Trails Plan Completed

Indicator	This indicator tracks the total miles of all trails in the Northeastern Illinois Regional Greenways and Trails Plan (RGTP) that are completed or let for construction. The RGTP includes not only off-street trails, but key on-street facilities and side paths. The RGTP includes trails in Aux Sable Township in Grundy County. Out-of-region connections to systems in Indiana and Wisconsin are not included in indicator totals. **Related recommendation:** Improve travel safety; Build regionally significant projects.
Methodology	CMAP updated the RGTP in 2016 based on input from all seven counties, forest preserve and conservation districts, Councils of Mayors, and the City of Chicago. The revised Plan now includes 3,163 miles of existing, programmed, and planned facilities in Illinois. Information on trail status is maintained by CMAP staff in the Bikeway Inventory System (BIS)..[4]

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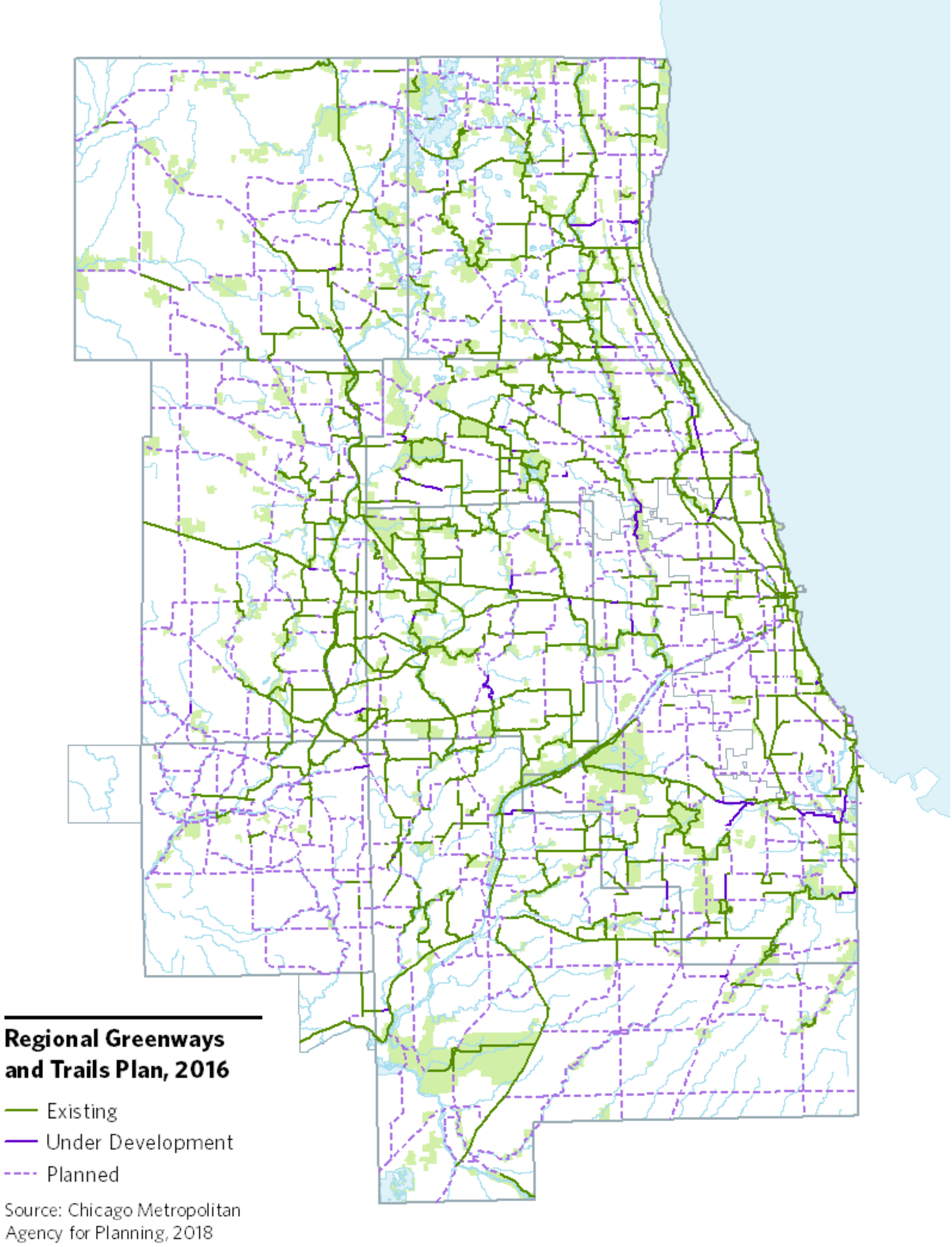
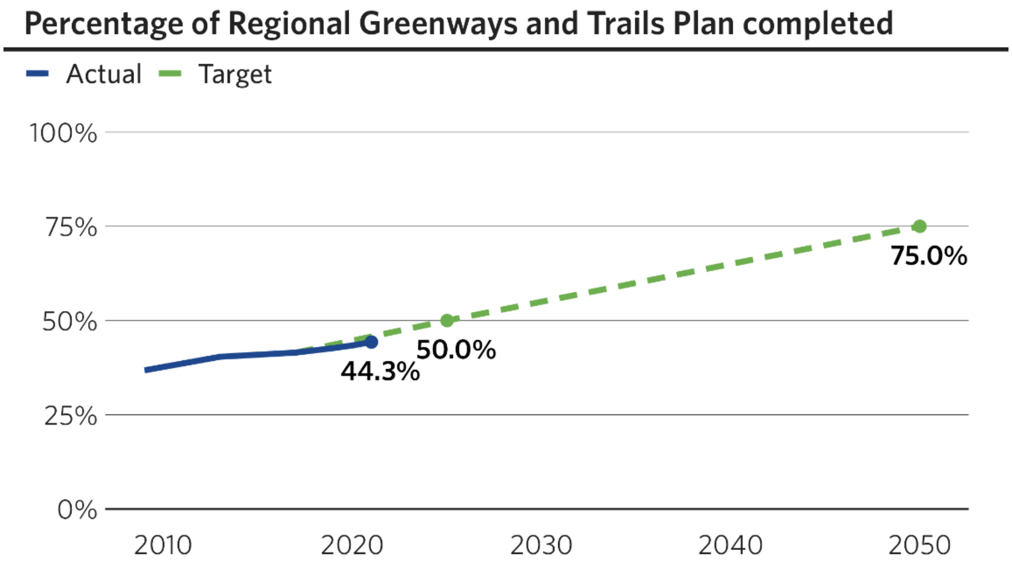
[4] Chicago Metropolitan Agency for Planning, "Bikeway Inventory System (BIS)," June 2018, https://datahub.cmap.illinois.gov/dataset/bis.

	 **Regional Greenways and Trails Plan, 2016** Source: Chicago Metropolitan Agency for Planning, 2018 The RGTP categorizes trails as existing (including let for construction), programmed, planned, or future. Programmed trails, which have been tapped to receive funds for their development, total about 62 miles, or an additional 2 percent of system miles to be completed by 2020, showing system development remains roughly on-track. Periodic updates to the RGTP and changes in trail alignments, particularly as conceptual lines are constructed, have modest impacts on this indicator.
Targets	As of 2017, 41.5 percent of the 2016 RGTP has been completed, including both existing and programmed trail miles. Extrapolating the average annual

	rate of completion from 2009 to 2017 would yield 49 percent completion by 2025 and 68.1 percent completion by 2050. The proposed targets are slightly higher than those figures. **2025:** 50 percent or more of RGTP completed **2050:** 75 percent or more of RGTP completed  Percentage of Regional Greenways and Trails Plan completed
Plan Update revisions	This indicator has not been modified.

Governance Indicators

Municipalities with Per Capita State Revenue Disbursement Below 80 Percent of Regional Median

Indicator	Municipalities with strong revenue levels relative to public service needs may be better able to maintain their fiscal condition and serve their residents and businesses. This may also lead to greater capacity to achieve local and regional goals. This indicator will track per capita state revenue disbursements to municipalities in northeastern Illinois, relative to the regional median. Illinois municipalities receive revenue through state disbursements of several revenue sources, including income, use, sales, motor fuel, and personal property replacement tax revenue.[5] These revenues may be based on current land use, population, or similar factors, but some disbursements are based on long established criteria that may no longer relate to service and infrastructure needs or current conditions in a given community. The amount of revenue municipalities collect varies throughout the region and depends on local land use mix, the composition of their tax structures, and the level of service the community desires from the municipality. State statutory criteria for revenue disbursements to municipalities also drive divergences, as the criteria do not always relate to the level of public services required or to a municipality's capacity to raise its own revenue from its own tax base. **Related recommendation:** Develop tax policies that strengthen communities and the region.
Methodology	State disbursements to municipalities occurring in calendar year for 2015 were totaled and normalized by municipal population data from the 2015 U.S. Census Population Estimates. For state disbursements, income tax revenues, use tax revenues, state motor fuel tax revenues, state sales tax revenues, and personal property replacement tax revenues disbursed to municipalities were obtained from the Illinois Department of Revenue and IDOT. The median per capita disbursement for the region was $277, and 74 municipalities were at least 20 percent less than the median level.

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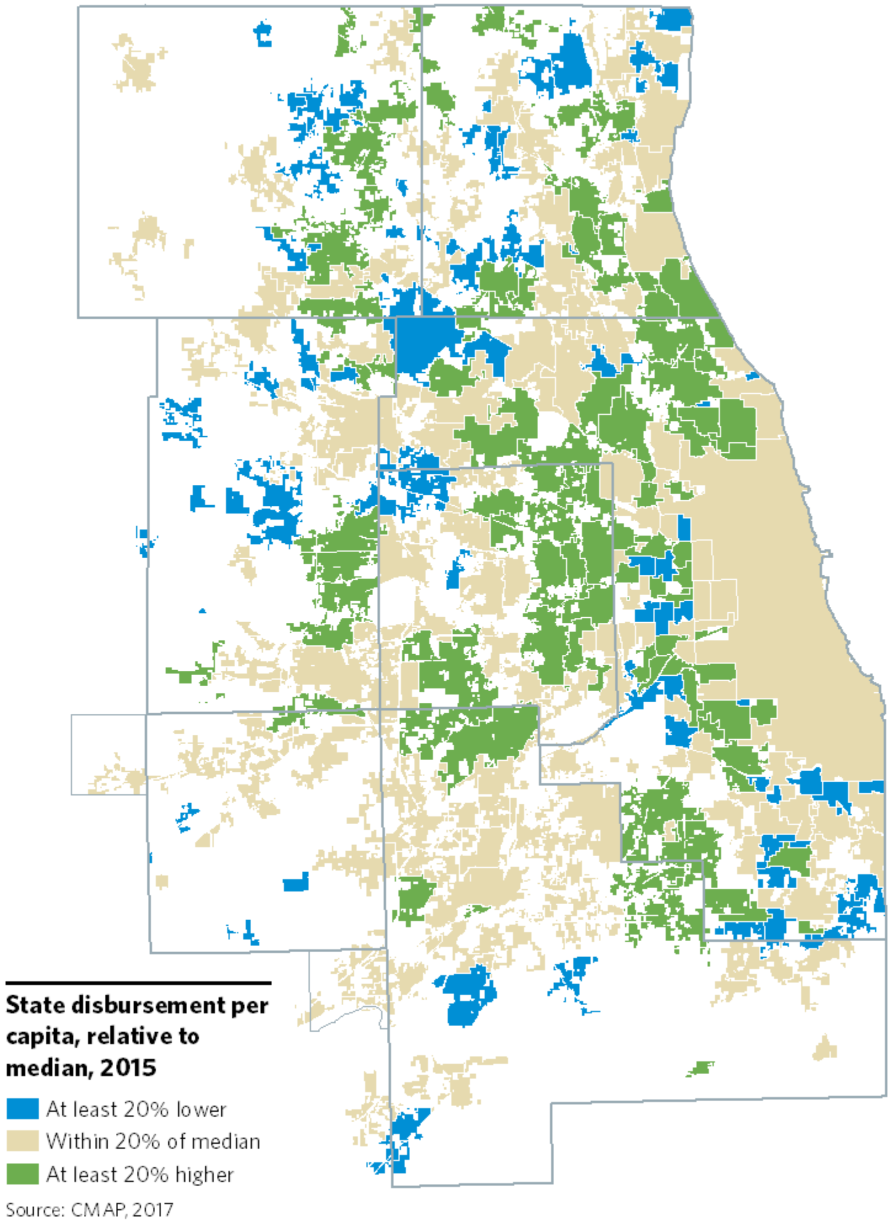
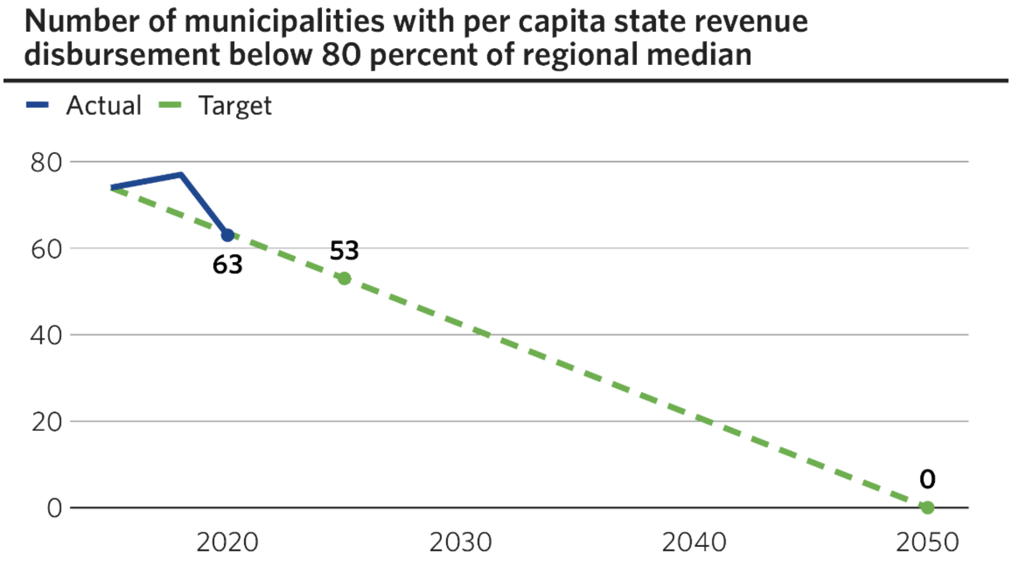
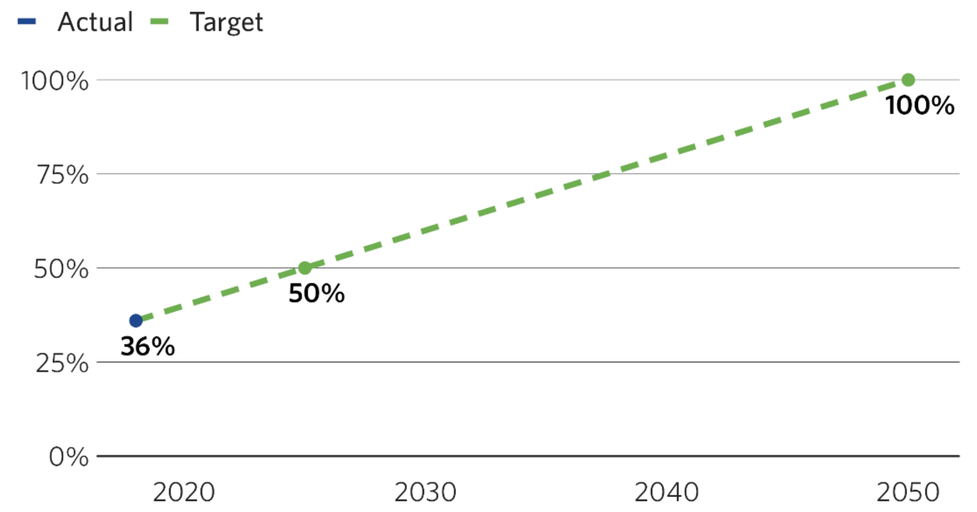
[5] Chicago Metropolitan Agency for Planning, "Tax Policies and Land Use Trends," March 2017, http://www.cmap.illinois.gov/documents/10180/517351/Tax+Policy+and+Land+Use+strategy+paper.

	 **State disbursement per capita, relative to median, 2015** 🟦 At least 20% lower ▨ Within 20% of median 🟩 At least 20% higher Source: CMAP, 2017
Targets	Zero was chosen as the 2050 target because the goal is to ensure that every municipality has sufficient revenues and to lessen the role that state statutory criteria plays in the wide divergences across municipal revenue levels. While it is conceivable that not every municipality requires this level of state support today, the general goal is to increase municipal capacity, including among smaller municipalities that may experience growing needs over the planning period. The 2025 target was derived by following a

	straight-line decrease between the 2015 figure (74 municipalities) and the 2050 target. **2025:** 53 municipalities or fewer with per capita state revenue disbursement below 80 percent of the regional median **2050:** Zero municipalities with per capita state revenue disbursement below 80 percent of the regional median  Number of municipalities with per capita state revenue disbursement below 80 percent of regional median
Plan Update revisions	This indicator has not been modified.

Local Governments That Train Appointed Board Members

Indicator	This indicator tracks the number of local governments whose appointed board members with development review authority have recently completed relevant professional development training. The indicator includes not only plan commission and zoning board members, but also other boards charged with development review such as Historic Preservation and Environment Committees. Strategy development for ON TO 2050 indicated that appointed board members, as well as government staff and elected officials, who regularly engage in trainings are more familiar with best practices and better prepared to fulfill their roles in service of their communities. **Related recommendation:** Build local government capacity.

Methodology	CMAP conducts the Municipal Plans, Programs, and Operations Survey on a biennial basis, soliciting information on a variety of topics from all of the region's 284 municipalities and seven counties. Beginning with the 2018 survey, and continuing for each subsequent survey, a question will be included to establish the amount, and types, of training that have been undertaken over the subject time period by each local government's appointed board members.
Targets	With the understanding that appointed board members who receive support by provision of trainings are better prepared to serve their communities, the 2050 target is that all local governments train their appointed board members. The 2025 target is a linear interpolation between the 2018 rate and the 2050 target. **2025:** 50% or more of local governments train appointed board members **2050:** 100% of local governments train appointed board members Share of local governments that train appointed board members 
Plan Update revisions	This indicator has not been modified.

Secondary Indicators

This section details the set of secondary indicators that will supplement the information provided by the core indicators in the earlier sections. Many of these specifically focus on the theme of inclusive growth. The secondary indicators do not have target values, but they did go through the same review process as the core indicators. They were chosen to help tell a more complete story and address data gaps in the core indicators.

Inclusive Growth Secondary Indicators

Share of Post-2015 Infill Development Occurring in Disinvested and Economically Disconnected Areas

See "Inclusive growth perspective" portion of *Share of Post-2015 Development Occurring in Infill Supportive Areas* (p. 6).

Percentage of Income Spent on Housing and Transportation by Moderate- and Low-Income Households, by Race and Ethnicity

See "Inclusive growth perspective" portion of *Percentage of Income Spent on Housing and Transportation by Moderate- and Low-Income Residents* (p. 10).

Access to Parks in Disinvested and Economically Disconnected Areas

See "Inclusive growth perspective" portion of *Access to Parks* (p. 25).

Educational Attainment by Race and Ethnicity

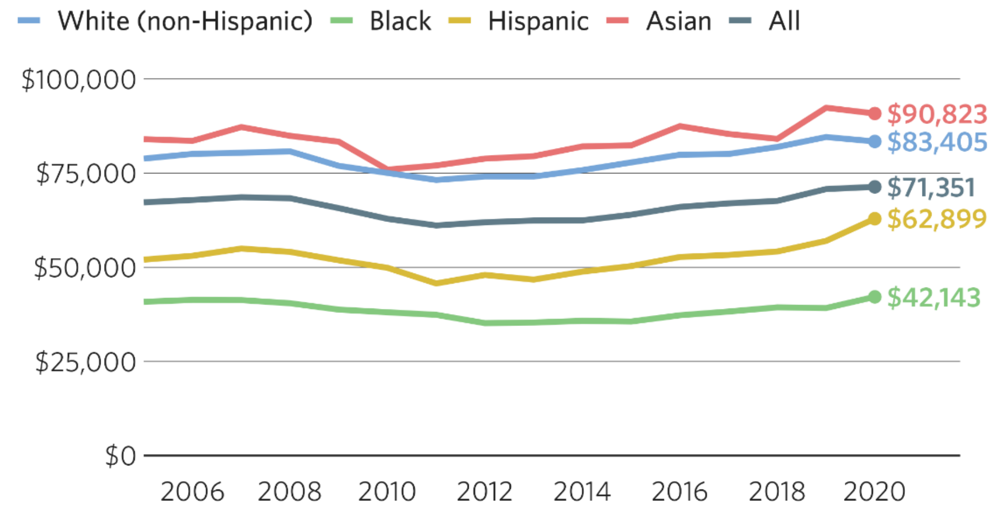
See "Inclusive growth perspective" portion of *Educational Attainment* (p. 30).

Workforce Participation by Race and Ethnicity

See "Inclusive growth perspective" portion of *Workforce Participation* (p. 32).

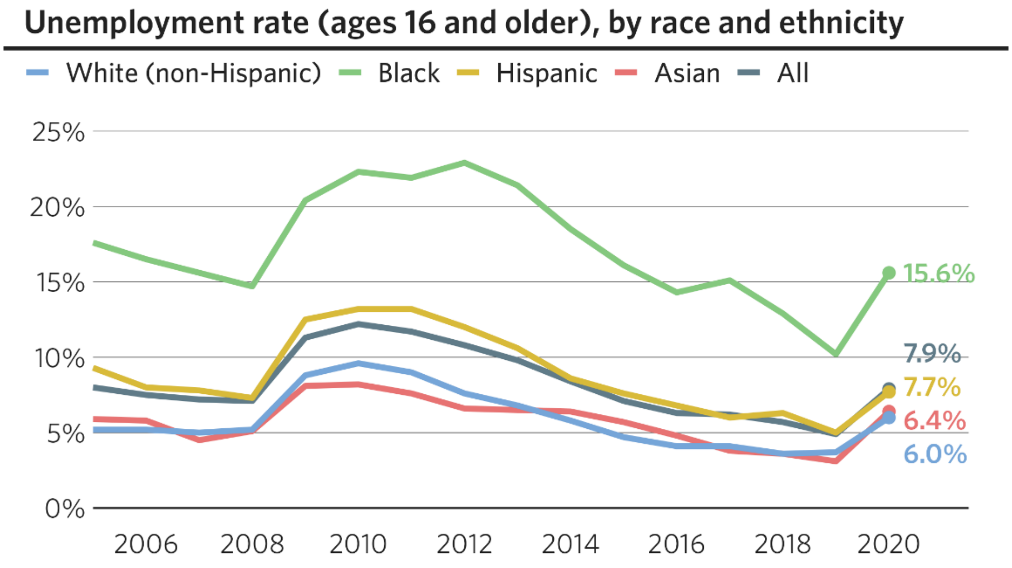
Median Household Income by Race and Ethnicity

Indicator	This indicator measures median household income by race and ethnicity in the Chicago metropolitan statistical area (in current year dollars). Median household income reflects the economic well-being of a region's population and highlights the hardships that impede residents of color from sharing in regional prosperity. This data highlights an existing need for collaborative efforts on inclusive growth that promote economic opportunity, particularly for the region's Black and Hispanic households. Economic and workforce

	development efforts must meet the needs of a changing and diversifying economy and promote growth of and access to jobs with pathways for upward mobility. **Related recommendation:** Use collaborative leadership to address regional challenges (Governance).
Methodology	The data for this indicator come directly from the ACS. Inflation adjustments are made using the Bureau of Labor Statistics' Consumer Price Index for All Urban Consumers: All Items (CPI-U). Data indicates significant disparities across demographic groups. Black and Hispanic households have median household incomes lower than the regional median. **Median household income (2016 dollars), by race and ethnicity** 
Plan Update revisions	This indicator has not been modified.

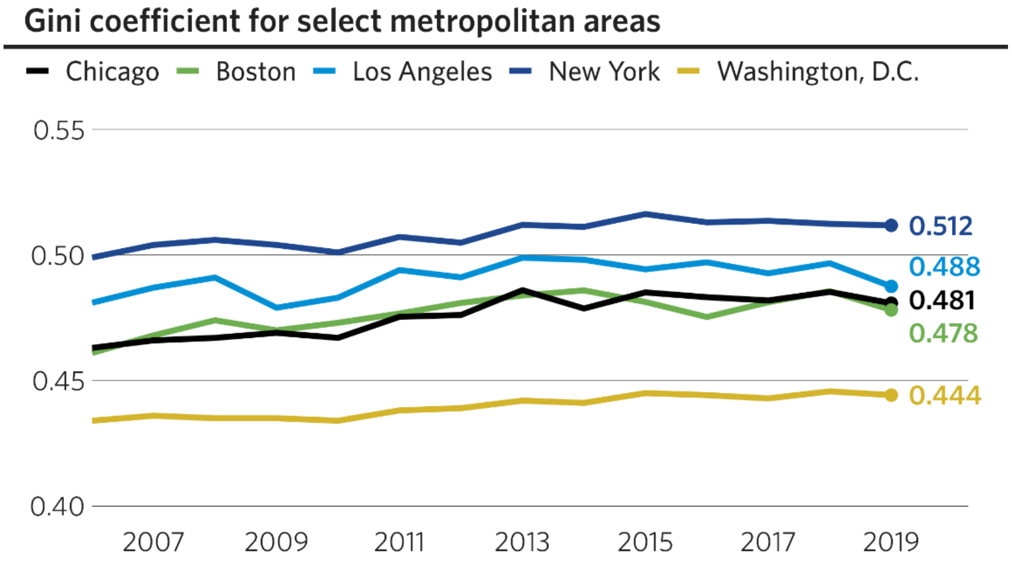
Unemployment by Race and Ethnicity

Indicator	This indicator tracks unemployment rates for the population age 16 years and over in the Chicago metropolitan statistical area by race and ethnicity. Unemployed residents are not currently well connected to opportunities provided by the region's economy, and — as a result — a substantial portion of the region's human capital is untapped. Creating pathways for unemployed workers to fully contribute to and benefit from the regional economy will help it grow to individual and regional benefit. **Related recommendation:** Conduct regional planning for human capital (Prosperity).

Methodology	The data for this indicator come directly from the ACS. This indicator measures the share of labor force participants who are currently unemployed in the Chicago metropolitan statistical area by race and ethnicity. Employment outcomes differ across racial and ethnic groups in the Chicago region. Black and Hispanic residents have higher unemployment rates relative to Asian and white residents.  Unemployment rate (ages 16 and older), by race and ethnicity
Plan Update revisions	This indicator has not been modified.

Gini Coefficient

Indicator	This indicator summarizes income inequality in the Chicago region. The Gini coefficient measures the dispersion of income across the income distribution in the Chicago metropolitan statistical area (MSA). The Gini coefficient is measured between 0 to 1, representing perfect equality and perfect inequality, respectively. Broad-based growth can facilitate economic mobility and help decrease inequality. Increasing economic equity can increase both individual prosperity and regional growth, developing periods of economic growth that are stronger and more sustainable. **Related recommendation:** Pursue regional economic development (Prosperity).
Methodology	The data for this indicator come directly from the ACS, which is released annually. The Gini coefficient measures the degree to which a society deviates from perfect equality in which all households have an equal share of

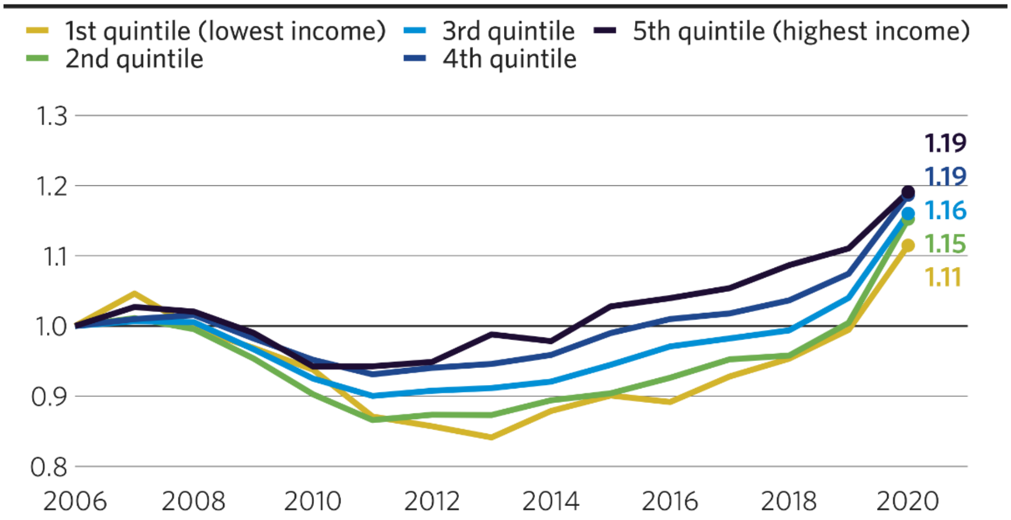
	total income. This indicator is measured at the Chicago MSA geography and includes several peer MSAs for context. Recent data indicates a Gini coefficient of 0.488 for the Chicago MSA in 2019. Further analysis indicates that income inequality has generally been increasing in the Chicago MSA in the last 10 years. Similar trends are also seen in peer MSAs.  Gini coefficient for select metropolitan areas
Plan Update revisions	This indicator has not been modified.

Change in Mean Household Income Since 2006 by Quintile

Indicator	This indicator measures change in mean household income since 2006 by quintile in the Chicago metropolitan statistical area. The degree to which regional prosperity is shared among all segments of the population drives long-term economic success of regional economies. To meet its potential, the region's economy requires opportunities for all residents to contribute to and benefit from its growth. Promoting an inclusive model of economic growth can improve outcomes for lower-quintile households and increase the size of the overall economy. **Related recommendation:** Use collaborative leadership to address regional challenges (Governance).
Methodology	Data for this indicator come from the ACS, which reports mean household income by quintile. The ACS calculates means of household income by dividing aggregate household income by the number of households. This is done for each quintile, or one-fifth of the total number of households. The

<table>
<tr><td></td><td>change in mean household income will be inflation-adjusted and indexed to 2006.

Recent data indicates differences in the change of mean household income by quintile. All quintiles experienced declines in mean household income during the Great Recession and have since started to recover. However, the bottom two quintiles experienced the greatest decline in mean household income and have recovered at a slower pace than higher earning households.

Change in mean household income since 2006 by quintile
 </td></tr>
<tr><td>Plan Update revisions</td><td>This indicator has not been modified.</td></tr>
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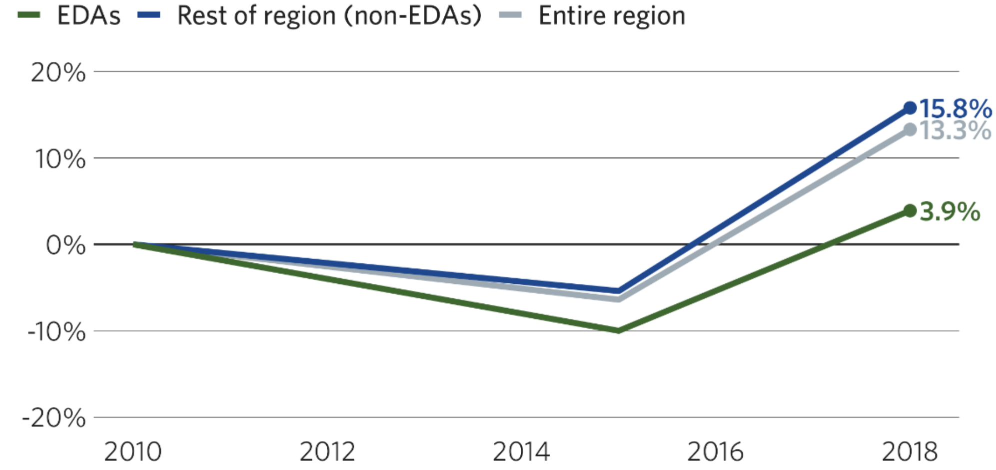
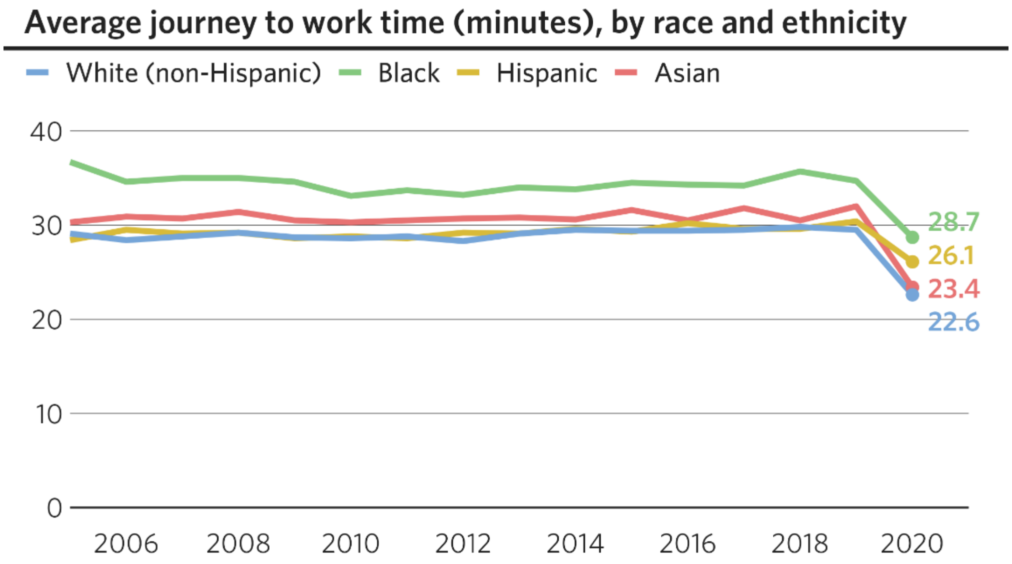
Change in Non-Residential Market Value in Disinvested and Economically Disconnected Areas Since 2010

Indicator	This indicator measures percent change in aggregate non-residential market value in economically disconnected areas and disinvested areas versus the remaining parts of the region. Non-residential land uses include commercial, industrial, institutional, mixed use, and vacant. ON TO 2050 highlights reinvestment in disinvested areas—such as building on existing community assets, identifying unique and regulatory tax solutions to persistent vacancy and abandonment, and building municipal and private sector capacity—as a key strategy for improving outcomes and revitalizing communities. **Related recommendation:** Invest in disinvested areas (Community).

Methodology	Data for this indicator come from county assessor data. Data indicates that aggregate non-residential market value — market value for commercial, industrial, institutional, mixed use, and vacant land uses — has declined across the region between 2010 and 2015. Decline in non-residential market value is more severe in the region's economically disconnected and disinvested areas than in the remaining areas of the region. Aggregate non-residential market value decreased by 10 percent in economically disconnected and disinvested areas between 2010 and 2015, roughly five percentage points more than the decline seen in the remaining parts of the region. **Change in non-residential market value in disinvested and economically disconnected areas since 2010** 
Plan Update revisions	This indicator has not been modified, although it has been renamed for clarity. The original name did not include "since 2010."

Average Journey to Work Time by Race and Ethnicity

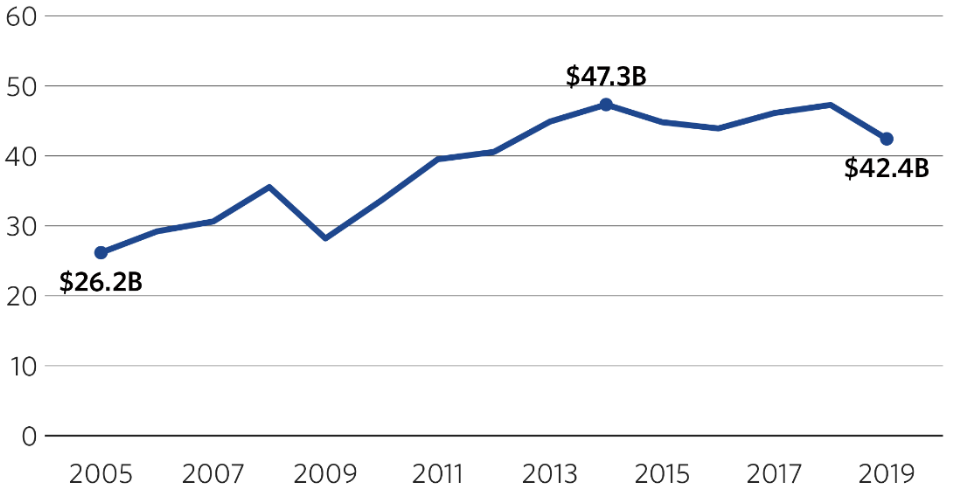
Indicator	This indicator measures the average one-way commute time of workers in the Chicago metropolitan statistical area by race and ethnicity, inclusive of all modes of transportation. Longer commute times decrease the productivity of workers and hinder their ability to connect to available and attainable employment opportunities. Local and regional planning should emphasize improving commute times and options for residents facing long commutes by providing high-quality transportation options that are cost efficient and increase residential access to fruitful economic opportunities. This will require shifts in transportation, land use, and economic development planning and policy.

	Related recommendation: Leverage the transportation network to promote inclusive growth (Mobility).
Methodology	Data for this indicator come from the ACS Public Use Microdata Sample (PUMS). Average journey to work time in minutes is the average one-way travel time for workers to get from home to work across all modes of transportation (including telecommuting). The measure is calculated by dividing the aggregate travel time by the total number of workers who do not work at home. In 2020, the average journey to work time dropped sharply across all racial and ethnic groups due to an increase in working at home in response to the COVID-19 pandemic. The extent to which this decline persists beyond 2020 remains to be seen.  Average journey to work time (minutes), by race and ethnicity
Plan Update revisions	This indicator has not been modified.

Other Secondary Indicators

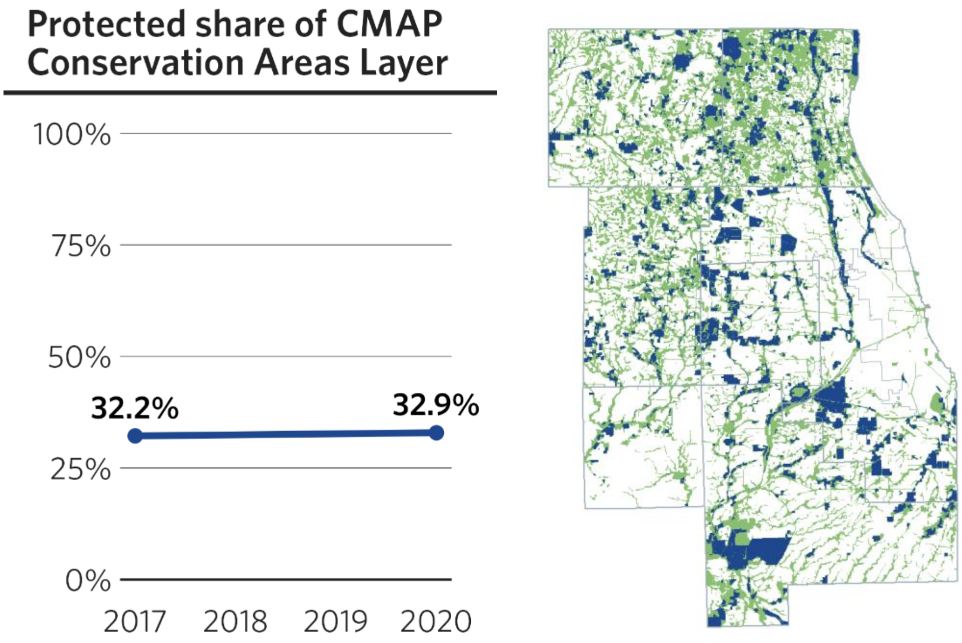
Manufacturing Exports

Indicator	This measure tracks the total value of manufactured goods exported from the region. Historically, manufacturing has been a key driver of economic growth in the region and this secondary indicator reflects the plan’s call for organizing regional economic development around its industry clusters. The export of goods connects metropolitan economies like the Chicago region with a growing global consumer base. Exports have played an important role in past economic recoveries for both Chicago and peer metropolitan

	economies. Data comes from the U.S. Census Bureau's Origin of Movement series. **Related recommendation:** Support the region's traded clusters (Prosperity).
Methodology	The U.S. Census Bureau's Origin of Movement series attributes export sales to metropolitan areas based on the ZIP code in which payment for a good is received. Data specifically for manufactured goods can be obtained by summing the total of all manufacturing North American Industry Classification System (NAICS) codes (31-33). The geography for this data is the Chicago-Naperville-Elgin metropolitan statistical area. **Value of region's manufacturing exports (in billions of dollars)** 
Plan Update revisions	This indicator has not been modified.

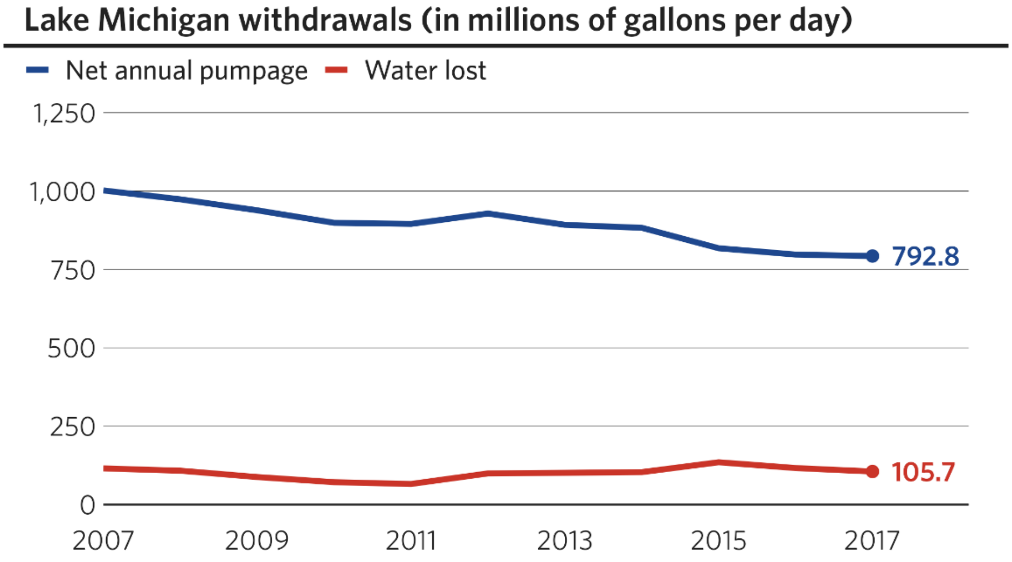
Protected Share of CMAP Conservation Areas Layer

Indicator	This indicator measures what percentage of CMAP's Conservation Areas Layer lies within conserved land and water areas, including public open space and conservation easements. It provides a measure of how effectively land and water preservation implementers are aligning their efforts with regional conservation priorities. **Related recommendation:** Integrate land preservation into strategic growth efforts (Environment).
Methodology	The Conservation Area Layer combines county-level green infrastructure plans with regional analysis of key land, water, and habitat resources to map conservation priorities across the region. It will be updated in the future as

	new data become available and counties create or update their green infrastructure plans. This secondary indicator uses the same “conserved land” areas as the core *Acres of Conserved Land* indicator (p. 24). The indicator is calculated by calculating the acreage of the Conservation Areas Layer overlapped by conserved land, then converting that into a percentage of the area covered by the entire Conservation Areas Layer (835,222 acres).  **Protected share of CMAP Conservation Areas Layer**
Plan Update revisions	This indicator has not been modified.

Lake Michigan Withdrawals

Indicator	In addition to overall water demand (see *Water Demand*, p. 21), water use from Lake Michigan is an area of interest for the CMAP region. In response to a U.S. Supreme Court consent decree, the State of Illinois regulates Lake Michigan water use for those communities with an allocation for lake water. This secondary indicator measures water use and levels of non-revenue water loss from community water suppliers in order to track conservation and water loss reduction efforts. **Related recommendation:** Coordinate and conserve shared water supply resources (Environment).
Methodology	The State of Illinois Department of Natural Resources (IDNR) Office of Water administers the Lake Michigan Allocation program, which governs Lake

	Michigan water use for those communities with an allocation.[6] Permittees receive an allocation of water with several conditions, including implementation of conservation practices and reduction of water loss. IDNR tracks water withdrawals and the level of water loss, known as non-revenue water, from Lake Michigan Permittees on an annual basis. Levels of water loss above the state's threshold (12 percent non-revenue water in 2015, decreasing to 10 percent by 2019) indicate that some communities' water systems are not in compliance with the Rules and Regulations for the Allocations of Water from Lake Michigan (IL Admin. Code, Title 17, Part 3730). This indicator will track net annual pumpage and non-revenue water in millions of gallons per day (mgd), as reported by community water suppliers to IDNR. Lake Michigan withdrawals (in millions of gallons per day)
Plan Update revisions	This indicator has not been modified.

Deep Bedrock Aquifer Withdrawals

Indicator	In addition to reporting on overall water demand (see *Water Demand*, p. 21) and the diversion of water from Lake Michigan (see *Lake Michigan Withdrawals*, p. 77), it will also be instructive to measure total annual groundwater withdrawals from deep bedrock aquifers (Ancell Unit of bedrock and deeper) in the CMAP region (measured in millions of gallons per

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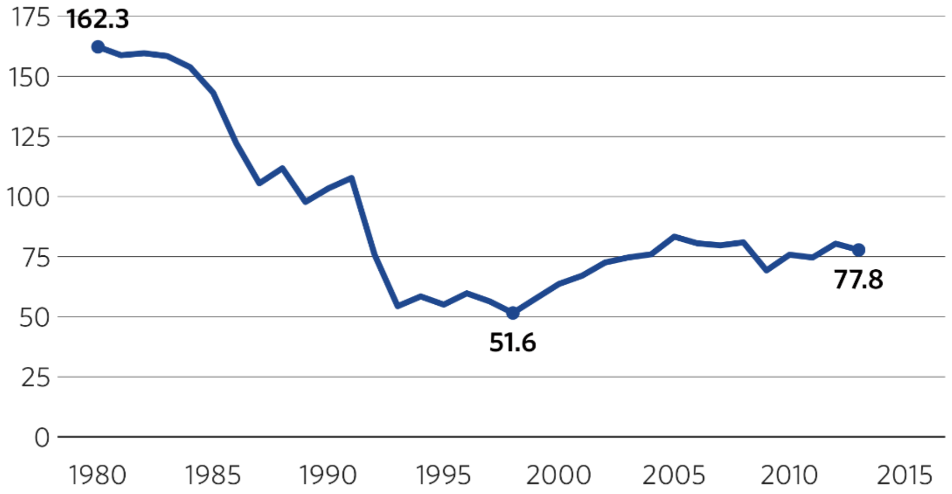
[6] Illinois Department of Natural Resources, "Lake Michigan Water Allocation," https://www.dnr.illinois.gov/waterresources/pages/lakemichiganwaterallocation.aspx.

	day). This will help provide a more complete assessment of water conservation in the region. **Related recommendation:** Coordinate and conserve shared water supply resources (Environment).
Methodology	The Illinois State Water Survey (housed at the University of Illinois at Urbana-Champaign) is the source for this groundwater data, which is reported annually in gallons per year. CMAP converts this data into millions of gallons per day (mgd). **Deep bedrock aquifer withdrawals (in millions of gallons per day)** 
Plan Update revisions	This indicator has not been modified.

ON TO 2050 update summary

September 2022 draft

Contents

Introduction

Northeastern Illinois has seen significant change over its history, rising above adversity to determine its own future. Important shifts in our economy, technology, and infrastructure promise continued innovation and prosperity. But our future success is not guaranteed. A host of both new and enduring challenges risk lasting damage and decline. The past four years have shown that we cannot foresee every obstacle. Yet, the ON TO 2050 update maintains a clear vision of what priorities need to be advanced to achieve an inclusive and thriving region.

Metropolitan Chicago brings immense assets to this work. We are home to a diverse and talented population of 8.6 million residents. Their skills and ingenuity reflect a heritage of creating products at the forefront of technology, life sciences, business services, advanced materials, and clean energy. World-class institutions of education, research, and culture make us an international destination, and rich natural resources support a tradition of agriculture, recreation, and resilience. Together, these assets provide for a vibrant quality of life across different and unique communities. Many people have found a place in northeastern Illinois to build their families, homes, and businesses. But we are leaving too many communities behind. Our history is marred by the ongoing effects of discrimination and disinvestment, with marginalized groups still unable to share in much of the region's progress. We are among the most segregated large metropolitan areas in the U.S.,[1] and the consequences hold us all back. A more equitable region will be a more prosperous and resilient region. Achieving our goals requires action now so that people of color, those with disabilities or low incomes, and other marginalized groups can contribute their full potential to regional success.

Despite the disparities that divide us, we are one region, on the move. Our futures are inextricably linked as commerce and workers flow continuously across local borders. Each day, more than half of us cross a county boundary or into and out of Chicago to work, often relying on the nation's second largest transit network and 10 interstate highways. More than 1,100 miles of trails and extensive on-street bikeways provide active connections across the region. And we are the hub of North American freight, with six Class I railroads, one of the nation's largest and fastest-growing air-cargo hubs, and the only maritime connection between the Great Lakes and the Mississippi River system. Over $3 trillion in goods move through the region annually. These facilities support the most diversified large metropolitan economy in the U.S., but they are under continued threat from inadequate investment and extreme weather.

A changing climate already impacts our lives. Our streets and sewers must handle greater flash flooding, heat waves, and extreme storms. The hardest impacts fall most often on marginalized communities. To prevent the most severe impacts of climate change, northeastern Illinois needs to reduce greenhouse gas emissions by approximately 10 percent annually to approach

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[1] John R. Logan and Brian Stults. 2021. "The Persistence of Segregation in the Metropolis: New Findings from the 2020 Census" Diversity and Disparities Project, Brown University, https://s4.ad.brown.edu/Projects/Diversity

net zero by 2050. A cleaner, more efficient economy will require transformative change, but we have a strong foundation to build from, if we act now.

Northeastern Illinois adopted ON TO 2050 in October 2018, after a three-year process featuring extensive research, analysis, and public outreach. The Chicago Metropolitan Agency for Planning (CMAP) — along with its many partners and stakeholders — developed the plan to have a long time horizon and enduring value for guiding regional priorities on transportation investments, development, the environment, the economy, and other issues affecting quality of life. Recent shifts have refined the region's approach in important ways but also underscore the enduring value of the path ON TO 2050 lays out. The ON TO 2050 update maintains the plan's principles, policies, and goals, while refreshing key technical components of the plan in accordance with federal law.

The plan update is organized as follows:

- **The region today** describes how the experience of the last four years reaffirms ON TO 2050's principles of inclusive growth, resilience, and prioritized investment.
- **Progress toward our goals** celebrates implementation successes over the last four years and reiterates the key goals of the plan's Community, Prosperity, Environment, Governance, and Mobility sections.
- **Key findings from the update process** provides analysis on important changes in our forecasted population, transportation investments, and funding resources.
- **Where we go from here** maps the path forward to put ON TO 2050's recommendations and strategies into action.
- **Appendices** cover many aspects of plan development in greater detail.

The region today

Seizing our destiny will depend as much on our values as our strengths. The region has made great strides in the past four years to heed calls for change and achieve its goals, even as it grappled with the COVID-19 pandemic. These experiences have reemphasized and refined the principles that must shape our future. Inclusive growth, resilience, and prioritized investment continue to guide ON TO 2050.

Resilience

Metropolitan Chicago's communities, infrastructure, and systems must be able to thrive in the face of uncertainty of any type. In the four years since the adoption of ON TO 2050, our resilience has been tested in ways we could not foresee — most profoundly by the COVID-19 pandemic. The pandemic re-exposed the complex factors that make disadvantaged communities — particularly people of color and those with low income — more vulnerable to crisis. These experiences reinforced the need to further invest in resilience strategies that strengthen communities' ability to adapt to both known and unknown challenges.

Above all, the region endured a tremendous human cost from COVID-19. More than 20,000 residents of northeastern Illinois died, leaving behind families, friends, and neighbors to grieve their loss. Others are still grappling with the virus's long-term health and economic effects. A CMAP survey found that by mid-2021, nearly 3 in 10 regional residents had lost income or work hours due to the pandemic. Even as conditions improved, declines in jobs and consumer spending led to mounting challenges, particularly for women, people of color, those with low income, the leisure and hospitality industry, and small businesses. In countless ways large and small, the pandemic disrupted the lives of all our residents.

The COVID-19 pandemic also posed enormous challenges to the region's transportation system. Travel patterns changed drastically, as residents adjusted to restrictions, closures, remote work, and online learning. Car travel fell by nearly 50 percent, congestion by 40 percent or more, and regional transit ridership by as much as 80 percent, resulting in higher travel speeds and more traffic deaths on our roads.

As the region recovers, travel is increasing. But the transportation system will need to accommodate new and different demands moving forward — particularly on the region's extensive transit network. Ridership remains well below 2019 levels, and more regional workers will continue to work remotely, at least part of the time, compared to pre-pandemic levels. Without sufficient fare revenue, transit services oriented around peak commute times need funding alternatives that ensure frequency, reliability, speed, and safety for all riders. To ensure the transportation system continues to provide access to opportunities throughout the region, officials must plan for a system that is operationally and financially resilient to these shifting demands.

Much work also remains to respond to the risks of climate change posed by the emissions generated by our transportation system. While COVID-related shifts may have slightly reduced regional greenhouse gas emissions in 2020, these gains may have already been reversed by increased truck traffic. As we work to build more financial and operational resilience into the day-to-day reality of our roads and rails, we must also commit to reducing emissions. Failure to deliver on this priority will have devastating consequences for future generations as challenges we are facing today from increased precipitation and higher temperatures only accelerate.

As the COVID-19 pandemic fades, northeastern Illinois must keep these factors in mind, so that we emerge even more resilient than before — whether to additional impacts from the pandemic, the realities of a changing climate, or other challenges. And we must continue to adapt our infrastructure, natural systems, and social structures to mitigate the risk of future shocks and stresses while ensuring all our communities can recover in the face of change.

Inclusive growth

Today, our children's chances of upward economic mobility are still shaped by their race or ethnicity, where they live, their disability status, and their socioeconomic status. Large disparities remain across nearly all indicators of success, perpetuated by historical legacies and modern-day policies. And the region is failing to close these gaps. Regions with more economic and social equity provide greater access to opportunity for all residents and enjoy longer, stronger periods of prosperity and growth. To achieve its full potential, our region needs to fully commit to inclusive growth programs and policies in order to grow our economy by enabling opportunity for all.

Much has also changed since ON TO 2050 was adopted. During the pandemic, the murders of George Floyd and other Black lives reignited a movement for racial justice. Voices throughout the region have called for action on disrupting patterns of exclusion and ending systemic racism. Doing so requires the urgency of this moment to result in meaningful policy change centered on creating equitable outcomes for all people.

Today, northeastern Illinois is wasting much of its human capital — embodied in the talents and skills of marginalized residents — even as it becomes more diverse. People of color accounted for more than half (51.6 percent) of the region's total population for the first time in 2020, and now one in four residents identify as Hispanic. But our changing economy excludes and marginalizes many people of color. CMAP analysis indicates that lower-income residents across demographic groups have left the Chicago metropolitan region over the last decade, contributing to a net decline of over 69,000 Black residents. More policies and resources that enable inclusive growth — like improving career pathway programs and investing in disinvested areas — are needed to reverse these trends by providing greater economic opportunity for marginalized residents in northeastern Illinois.

The transportation system, particularly the transit system, also has a significant role to play in enabling inclusive growth by providing access to amenities and job centers. Research shows shorter travel times are a significant indicator of upward economic mobility[2], yet Black residents in northeastern Illinois have to spend more time than other residents traveling to access daily needs like jobs, education, doctor appointments, and grocery stores. Households with low income, older residents, and people of color also tend to take fewer trips compared to white residents but are more likely to use transit, given its affordability relative to the high costs of owning and operating a personal vehicle. And residents with disabilities are significantly more likely to stay at home due to accessibility challenges that hinder access and contribute to physical and social isolation. Persistent racial disparities in educational

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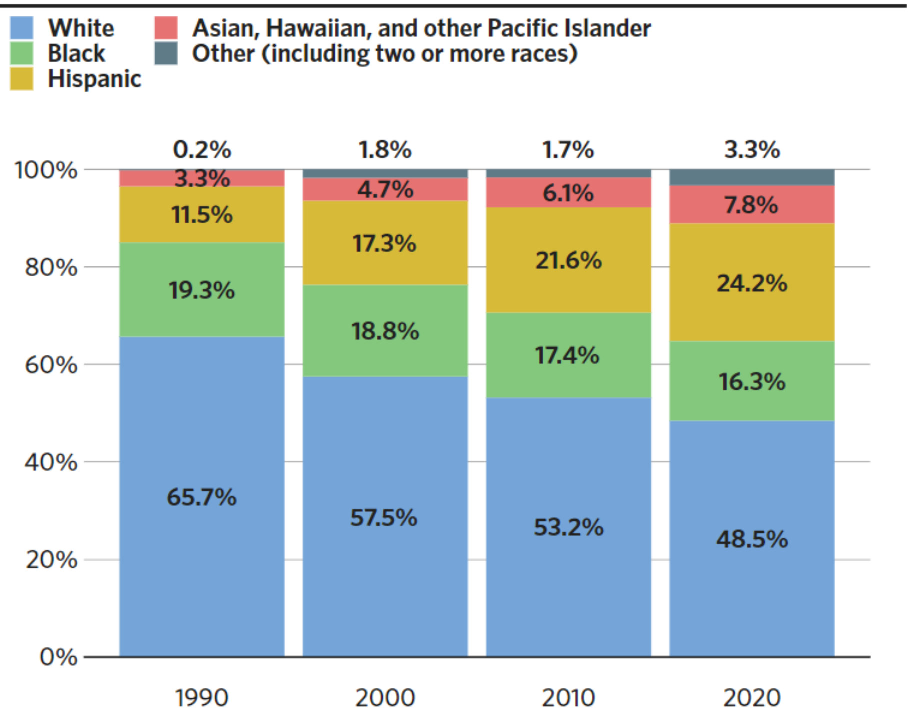
[2] Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014. "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States." Quarterly Journal of Economics 129 (4): 1553–1623.

attainment, unemployment, transportation access, and many other measures undermine efforts to sustain inclusive growth.

Disparities in local economic development can also impair residents' access to quality housing, schools, public services, and other resources. These inequities greatly shape the choices and opportunities available to residents, particularly members of marginalized communities. Solutions to promote vital places and drive investment in disinvested areas are required to comprehensively promote inclusive growth and build a more equitable region.

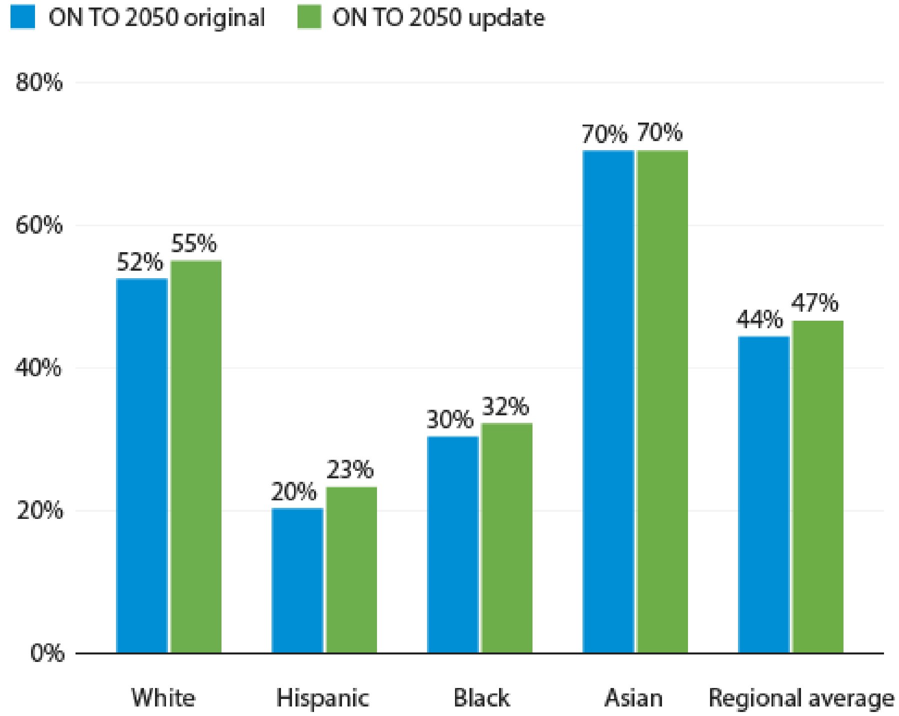
Federal policy has already begun to shift toward advancing racial equity. Executive orders have significantly increased the responsibility of federal agencies to account for racial disparities in their policies, and the Justice40 initiative aims to ensure that at least 40 percent of federal climate investments go to underserved communities affected by poverty and pollution. Still, more work is needed regionally to help advance these goals in our own communities, including through our infrastructure and technical assistance investments.

Population by race in the CMAP region, 1990 to 2020



Source: Chicago Metropolitan Agency for Planning analysis of U.S. decennial census data 1990, 2000, 2010, and 2020

Educational attainment by race and ethnicity in northeastern Illinois



Source: Chicago Metropolitan Agency for Planning analysis of American Community Survey (ACS) 1-Year data, 2016 and 2019*

*Due to the impact of the COVID-19 pandemic, educational attainment by race and ethnicity was not included in the Census Bureau's ACS 1-Year 2020 data release

Prioritized investment

One positive development from the last four years is that both state and federal leaders and policymakers have made significant progress to fund the region's transportation system. ON TO 2050 places major focus on the need to provide resources to fully fund the region's transportation needs using sustainable, long-term resources.

In 2019, the State of Illinois approved Rebuild Illinois, a capital plan that not only committed $33.2 billion to repair and enhance the region's bridges, roads, railroads, and transit assets, but also secured future funding sources through a combination of policy changes and fee increases. The most significant of these is the decision to double the motor fuel tax and index it to inflation, a key ON TO 2050 recommendation. However, work remains to be done as more of our vehicle fleet electrifies or becomes more fuel efficient in the future, necessitating the region's transition from the gas tax to a road user charge model to maintain stable funding for transportation.

In 2021, the federal government approved the Infrastructure Investment and Jobs Act (IIJA). Northeastern Illinois will receive a portion of the more than $567 billion in transportation funding between 2022 and 2026. After decades of stagnant funding, the bill represents a significant funding increase over existing federal transportation programs, including through the development of new formula funds that will come to CMAP on behalf of the region. It also introduces wide-ranging new programs and requirements aimed at accelerating investments that mitigate against climate change and more equitably address how investments flow to marginalized communities. While IIJA is a positive step forward, the federal government has not approved new or increased sources of transportation revenues that would ensure funding continues. We must continue to seek sustainable, adequate revenue sources for transportation investments, like expanding the sales tax base to include services, pricing parking, or imposing a regional fee on transportation network company rides.

We must carefully use this money to invest in our transportation system. The overall condition of the system has continued to decline since the adoption of ON TO 2050. Our roads and bridges could be in better shape. The region's transit agencies face large state of good repair backlogs. And many expressways must be rebuilt over the next 30 years. The region will need to prioritize additional funding resources for maintenance to meet these needs. Even with these generational investments, long-term sustainable funding for the transportation system remains elusive.

Transit asset condition in northeastern Illinois by federal performance measure category, 2020 category	Percent
Buses beyond useful life	6.7%
Rail vehicles beyond useful life	30.2%
Non-fixed route vehicles beyond useful life	43.4%
Track with performance restrictions	5.7%
Facilities in marginal or fair condition	20.6%
Non-revenue vehicles beyond useful life	37.7%
Rail equipment beyond useful life	62.6%

Source: National Transit Database

This need to prioritize investments using transparent, accountable, and data-informed decision-making also applies beyond the transportation system investments that are central to CMAP's purview. Limited resources shape how all levels of governments make decisions on how capital investments, technical assistance, and other public resources are deployed in the region.

Some communities have a wealth of expertise and resources to develop strategies for meeting local needs, while others struggle to raise revenues for public services and basic infrastructure. Much of these disparities are due to structural issues; for instance, the way the state disburses shared revenues (like sales tax proceeds) does not effectively support municipalities with a very low tax base. Efforts are ongoing to address these gaps but are currently inadequate to the scale of the need. Nonetheless, progress is possible. For example, in the last cycle, CMAP and the Regional Transportation Authority (RTA) completely reworked the call for technical assistance to target planning support to the needs of historically marginalized communities. This included rethinking the types of assistance CMAP offers, moving away from just developing comprehensive plans and recognizing the granular support communities need to implement plans. In addition, CMAP has begun to cultivate peer learning and exchange by partnering communities of different capacity levels in working groups on issues of shared concern. These efforts further underscore how partners at all levels of government must collaborate to develop and implement creative solutions to reinvest in communities.

Progress toward our goals

Since ON TO 2050 was adopted, the region has made substantial progress on a number of ON TO 2050 recommendations. This section celebrates the implementation successes of the last four years and reiterates the key goals of the plan's Community, Prosperity, Environment, Governance, and Mobility sections.

Prosperity

Northeastern Illinois will thrive by making the region more competitive, expanding economic opportunity, and reducing inequity. Global forces — like the COVID-19 pandemic, the transition to clean technologies, and an aging and diversifying society — have only sharpened the need to work together to face today's greatest opportunities and challenges. At the same time, northeastern Illinois' long-term future success will depend on more fundamental factors like the region's industry mix, talent pools, and progress toward racial equity.

Individual communities play a pivotal role in our economy. Many took swift action to counter the pandemic's worst impacts on workers and small businesses. Cook County launched an innovative business advising program to help entrepreneurs navigate resources and adapt to new pressures. Lake County, Woodstock, Batavia, Chicago Heights, and many others connected business owners with emergency low-cost loans and provided grants to improve health precautions or meet short-term expenses. The countless actions of individuals, nonprofits, companies, and governments helped to sustain our communities and position the region for a strong recovery.

New initiatives are also already underway to build a more resilient and inclusive future. mHUB, the leading innovation center for physical product development and manufacturing, has assisted over 450 startups since launching in 2017. Together, these companies have raised more than $1 billion in capital — establishing new sources of growth that leverage our traded industry clusters. Other cluster initiatives like the Chicago Metro Metal Consortium, the Chicagoland Food and Beverage Network, P33, and Current can help unlock the region's full potential. New partnerships in our multimodal freight industry are also rallying support to rehabilitate key infrastructure and improve environmental justice. CMAP developed a master plan for the Illinois International Port District and secured more than $21.5 million in Rebuild Illinois funding that will maintain the port as a vital maritime connection and community resource.

Efforts to increase upward economic mobility are also tapping into the region's greatest asset — its people. The Illinois Equity in Attainment Initiative brought together 25 colleges and universities to publicly commit to eliminating racial and socioeconomic gaps in degree completions by 2025. Each institution is implementing a comprehensive, evidence-based plan to achieve annual graduation targets for Black, Latino, and low-income students. The Education Systems Center at Northern Illinois University is also leading the push to improve a regional system of middle-skills pathways that lead to industry credentials and quality jobs. This work will help to expand proven models for ensuring individuals see career progression as they navigate the complex world of education, skills training, and work.

Environment

ON TO 2050 calls for the region to intensify climate mitigation efforts by moving away from fossil fuels while also preparing to recover from the effects of climate change. Reducing greenhouse gas emissions requires compact infill development, improved pedestrian and bicycle infrastructure, and increased investments in public transit as well as aggressive expansion in renewable energy systems, energy efficiency and retrofits, and electrification of our transportation system. Local governments and transportation agencies are taking the lead in this transformation. Plans and strategies to reduce fossil fuel use, like Chicago's Climate Action Plan, CTA and Pace's commitment to zero emissions by 2040, and Metra's piloting of zero emission locomotives and trainsets reveal both the urgency and innovation supporting this work.

CMAP continues to provide data on greenhouse gas emissions and support partners in climate action planning, most recently by helping the Metropolitan Mayors Caucus develop strategies for local governments. Illinois jumpstarted its transition to 100 percent clean energy with the Climate and Equitable Jobs Act. Local governments are reducing barriers to renewable energy, with over 50 communities recognized by the SolSmart program for supporting solar energy development. CMAP is collaborating with partners to support the transition from fossil fuels, including investigating electric vehicle infrastructure needs and other transportation mitigation strategies and policies.

Planning for climate resilience requires managing risk from future climate impacts. Recognizing the increased frequency and intensity of storm events due to climate change, Lake County updated development standards to reflect today's storms. Building off a project with the Central Council of Mayors, CMAP is currently working with transportation, stormwater, and emergency management departments to assess the vulnerabilities of the region's transportation network to climate impacts. While climate change will bring more rain to the region, drinking water shortages are a threat in areas that are growing the fastest. Communities in Will County banded together to work with the Illinois State Water Survey to better understand their water quantity and quality constraints and make more informed decisions about infrastructure investment.

Community

The changes and challenges since ON TO 2050 was adopted only further emphasize the importance of reinvesting in communities, targeting resources, encouraging collaboration on fiscal and economic issues, preserving high-quality open space and agricultural assets, and promoting housing choice.

The region cannot succeed without concerted investment to rebuild jobs, amenities, and resources in areas where people with low income live. Investment for continued economic growth and success for the entire region must include investments in communities with limited resources to rebuild. CMAP worked with the Federal Highway Administration (FHWA), Illinois Department of Transportation (IDOT), and other partners to make it easier for high-need communities to apply for federal infrastructure funds. High-need communities can now use transportation development credits as local match for Surface Transportation Program (STP), Congestion Mitigation and Air Quality Improvement (CMAQ), and Transportation Alternatives Program (TAP) applications. Since 2018, nine projects have been funded using this option.

ON TO 2050 also calls for creative approaches to support disinvested communities. The Southland Development Authority launched in 2019 as a new collaboration among business, civic, and political leaders to make coordinated investments in the south suburbs. It builds on a multi-year planning process led by CMAP and its partners to pursue structural changes in weak market areas with extensive assets and often-overlooked opportunities for redevelopment.

ON TO 2050 envisions action not just by CMAP, but by many different groups. Communities across the region have been exploring strategies to make the homes in their area ready for an aging population, increasing diversity, and changing living patterns. The City of Chicago permitted accessory dwelling units, or coach houses, for the first time in 63 years. Accessory dwelling units provide housing opportunities for older adults, empty nesters, and young adults who want to live close to family members. The Village of Northbrook adopted its first inclusionary housing ordinance to increase the amount of housing affordable to people with moderate and low incomes. The Metropolitan Mayors Caucus formed a collaborative that brings together over 50 municipalities to share strategies on how to prepare communities as the population becomes older.

Governance

Governments must lead together and collaborate through governance solutions and innovations in order for northeastern Illinois to become an inclusive, thriving region. We can build on ongoing efforts to raise the region’s ability to address our problems, including better coordination, technical assistance, municipal capacity-building, and tools for driving data-driven decision-making.

The pandemic forced governments to rethink service delivery and governance processes, rapidly adapting and innovating to meet the needs of the region's communities in transformative and inspiring ways. In 2020, CMAP joined state, county, and municipal partners to coordinate pandemic relief through the [Regional Economic Recovery Task Force](). CMAP partnered with Cook County to develop an [equity-based model]() to distribute $51 million of CARES Act relief funds to its 129 municipalities. This collaborative effort ensured Cook County's most vulnerable communities had resources to continue delivering services during the crisis, while creating lasting partnerships.

As recommended in ON TO 2050, CMAP developed and implemented a new [Capacity Building Program](), an innovative suite of technical assistance offerings designed to increase the capacity of local governments to support historically marginalized communities. The program helps communities make visible changes — clean up properties, begin construction, enhance public spaces — while advancing their long-term vision.

CMAP also helped foster governmental collaboration through the award-winning McHenry County [Coordinated Investment Study](). This ambitious plan convened more than 100 governments to identify strategies for coordinated investment and service provision. The county quickly implemented a key recommendation of the study, staffing its first-ever shared services coordinator position.

Mobility

ON TO 2050 called on the region to take bold steps toward a well-integrated, modern, multimodal transportation system that seamlessly adapts to changing travel demands and reliably moves people and goods. At the time the plan was adopted, the region's transportation network already wrestled with changing travel patterns and rapidly evolving technologies. In the years since, the transportation system has been even further tested by the enormous challenges of the COVID-19 pandemic and the associated shutdowns. Innovation and cooperation continue to be important to improve regional mobility and ensure a system that works better for everyone.

Even with progress on funding our transportation system at the federal and state level, the region must also change how it allocates these funds to support critical regional goals. To this end, CMAP established the Surface Transportation Program (STP) Shared Fund in 2018 with the goal of allocating funds toward projects that result in regional benefit. The STP Shared Fund dedicates 15 percent of the region's overall STP funding and focuses on supporting larger-scale, multijurisdictional projects that improve regional performance measures and enhance equitable access to the transportation system.

As noted earlier, the region must prioritize maintenance because the overall condition of the transportation system has declined since the adoption of ON TO 2050. To help, CMAP established the Pavement Management Program in 2018. Incorporating systematic processes for pavement preservation and maintenance and repair activities in annual work programs allows municipalities to prioritize investments that extend the life of their pavement assets. CMAP secured IDOT State Planning and Research grant funds, which allowed the program to create pavement management plans for approximately 40 municipalities.

Growing the economy inclusively will require leveraging the transportation system to address equity and mobility challenges in northeastern Illinois. CMAP and a consortium of regional partners released recommendations for improving equity in transportation fines, fees, and fares. Furthering these goals, the Illinois Tollway instituted violation forgiveness programs, reduced late fees for unpaid tolls, and expanded its programs to subsidize tolls for households with low income in the region. The state also passed the SAFE-T Act in 2021, ensuring Illinois will no longer suspend driver's licenses for drivers with unpaid fees.

CMAP will be improving safety and access for people with disabilities throughout the region by developing a program to help communities plan for and implement needed accessibility improvements. Only 22 municipalities — 11 percent of the region — currently have Americans with Disabilities Act (ADA) transition plans as required by Title II of the ADA.

After declining for several decades, traffic fatality rates in the region began climbing upward in 2010 and have continued to rise since the COVID-19 pandemic began. Perhaps the most fundamental duty of any transportation provider is to protect the safety of those in the public right of way. As a result, CMAP and its partners established a Regional Safety Action Agenda to affirmatively address the growing numbers of traffic fatalities and serious injuries. By focusing on engineering, education, emergency services, enforcement, and equity, the Safety Action Agenda is addressing long-term regional traffic safety in a comprehensive, equitable, data-driven, and collaborative way.

Key findings from the update process

In updating ON TO 2050, CMAP reviewed and reconsidered many plan elements. Staff worked with partners to revisit how we should measure whether our transportation system is meeting our goals, what progress we have made on key performance targets and indicators, and how anticipated changes in ON TO 2050 will impact emissions in the region. For additional details about the many elements reviewed when updating ON TO 2050, please see the technical appendices to this report.

This section highlights key findings from three of the most important features of the update:

- The **socioeconomic forecast**, which helps the region understand how we will grow and change over the next 28 years by considering how we have grown in the past. A strong understanding of the future level and distribution of jobs and population is critical to decision-making about transportation and land use investments recommended by ON TO 2050.

- The determination of **regionally significant projects**, which identifies capital investments in the region’s expressways, transit system, and arterials with impacts and benefits that are large enough to warrant additional consideration through the regional planning process.
- The development of a **financial plan for transportation,** which prioritizes how the region will use anticipated transportation funds between now and 2050, including how much will go to operating and maintaining the current system compared to expanding it.

Socioeconomic forecast

As part of the plan update process, CMAP is required to create a new forecast of regional population and jobs over the 28-year plan horizon to 2050. More information about this process can be found in the Socioeconomic Forecast appendix.

The findings from this new forecast combined with analysis of the 2020 decennial census reaffirm that many of the trends found in ON TO 2050 remain. While Illinois was one of only three states that lost population between 2010 and 2020, all seven counties in northeastern Illinois grew over the last 10 years. And yet, as a region, northeastern Illinois’ population growth trajectory has slowed in recent decades and continues to lag behind peer regions. Compared to the period between 1990 and 2000, when the regional population grew by 11.6 percent, metropolitan Chicago grew by 3.5 percent between 2000 and 2010, and by only 1.7 percent between 2010 and 2020.

A key driver of slow population growth in the region is prolonged net declines of Black residents. Nevertheless, due to Hispanic and Asian population growth, northeastern Illinois continues to diversify. As of 2020, the white (not Hispanic or Latino) population now accounts for less than half — 48.5 percent — of the region’s population for the very first time. The region also continues to get older, as the baby boom generation ages and birth rates for younger generations decline. The growing senior population — age 65 and older — accounts for 14.5 percent of the population as of 2020, compared to 12.3 percent in 2015.

To account for these high-level trends, as well as the unprecedented impact of the COVID-19 pandemic on northeastern Illinois’ economy and regional employment levels, CMAP produced a revised socioeconomic forecast that estimates the characteristics of the seven-county Chicago metropolitan region's population and employment in the year 2050. Compared to the prior forecast, which projected that the region would add 2.3 million new residents and 920,000 new jobs between 2015 and 2050, CMAP now projects that the region will add 1.5 million new residents and 600,000 jobs between 2020 and 2050.

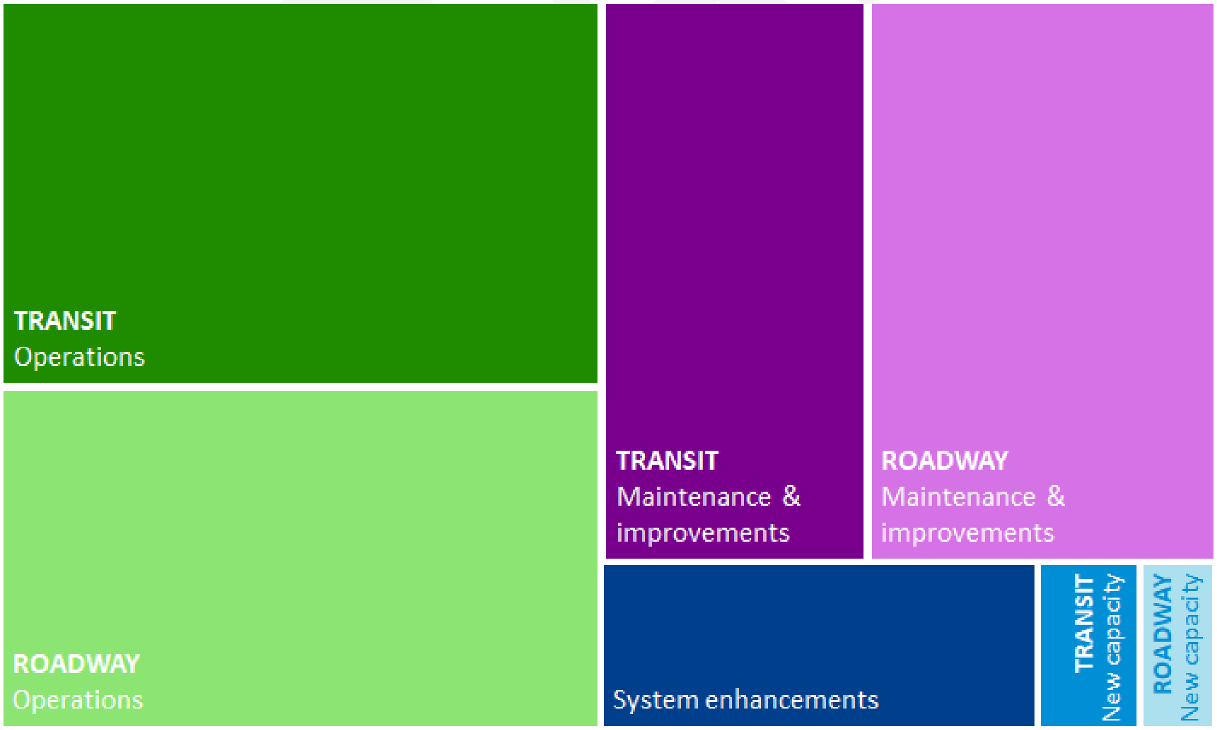
In the face of prolonged lackluster population growth, an aging and diversifying population, widespread racial and economic disparities, and aging and obsolete infrastructure, it remains critical that the region prioritize strategic and sustainable development practices — including prioritizing infill development, targeting resources in disinvested areas, and protecting natural resources — over greenfield development and expansion.

Financial plan for transportation

As part of the plan update process, CMAP is required to establish a new financial plan for transportation that prioritizes how the region will use the anticipated $526.0 billion in transportation funds between now and 2050, including how much will go to operating and maintaining the current system versus enhancing or expanding it. More detail about the financial plan is in the Financial Plan for Transportation appendix.

The IIJA and Rebuild Illinois will help the region make critical investments in its transportation system. The financial plan for the ON TO 2050 update contains sufficient revenue to operate and maintain the existing system in its current condition, as well as selectively expand the system. Almost 90 percent of anticipated future funding goes to operating and maintaining the current system in the financial plan, compared to about 4 percent for adding new capacity.

ON TO 2050 update forecasted expenditure allocations, 2023-2050



While the vast majority of funds supporting this program come from local, state, and federal revenues, the financial plan does lay out five “reasonably expected” revenues forecasted to generate an additional $38 billion necessary to meet the transportation system’s future needs. These revenues are anticipated resources CMAP determines the region must take action to implement over the 28-year plan horizon in order to sustain the transportation system. In previous versions of the financial plan, raising the gas tax and indexing it to inflation was considered a reasonably expected revenue but has now been recategorized due to the affirmative action taken by the state in Rebuild Illinois. For the ON TO 2050 update, the reasonably expected revenues include proceeds from:

- **Replacing the state motor fuel tax with a road usage charge** of 2 cents per mile
- **Enlarging the sales tax base to include additional consumer services** in order to grow the tax base by 15 percent in line with the practices of other large states
- **Establishing a regional transportation network company (TNC) fee** by charging a 5 percent fee on rides served by companies like Uber and Lyft
- **Tolling major highway reconstructions and new highway capacity** to help rebuild the existing system and better manage congestion
- **Expanding priced parking throughout the region** and improving the efficiency of curb management

Together, these measures can help the region meet the long-term challenges of investment needed to maintain, operate, enhance, and expand the region’s transportation system. While none are easy, it is imperative that northeastern Illinois continue to seek sustainable, adequate transportation revenue sources beyond one-time capital bills in order to deliver the transportation system that is required to become the prosperous, equitable region we envision.

Complicating this already challenging picture is the fact that our transit service boards, CTA, Metra, and Pace, are still struggling with the financial impacts of the pandemic. Ridership remains well-below 2019 levels, and more regional workers will continue to work remotely, at least part of the time, compared to pre-pandemic levels. Consequently, the region must explore funding alternatives. Budgeting for operation of the existing system as forecast in the financial plan is only one part of this puzzle. New funding sources and operational strategies may be needed to help transit agencies attract riders and deliver frequent, reliable, convenient and safe services, especially for transit-dependent residents.

Regionally significant projects

The resources developed in the financial plan are put into specific uses by the regionally significant projects (RSPs) development process for the plan update. RSPs are capital investments in the region’s expressways, transit system, and arterials with impacts and benefits that are large enough to warrant additional consideration through the regional planning process. These include large reconstruction projects as well as additions to the system. The federal government requires regional planning agencies to demonstrate "fiscal constraint" by showing that sufficient resources will be available to construct projects recommended in the plan.

RSPs support ON TO 2050's principles, particularly emphasizing the need to use the region's limited resources to invest in existing infrastructure to modernize and improve asset condition to achieve a state of good repair. Projects are prioritized into two categories: "constrained" and "unconstrained." Only constrained projects are eligible to receive federal transportation funds and obtain certain federal approvals. These constrained projects can help the region meet today's needs, adapt to changing mobility patterns for goods and people, and support economic success overall. Projects that are categorized as "unconstrained" require further action, such as additional study, and/or cannot be completed within the limits of the region's forecasted revenues.

To identify candidate RSPs, CMAP solicited projects from partner agencies. Regional transportation implementors submitted both unconstructed projects previously identified in ON TO 2050 and new projects considered for the first time under the plan update process. A total of 76 projects were considered. Candidate projects meet one of the following thresholds:

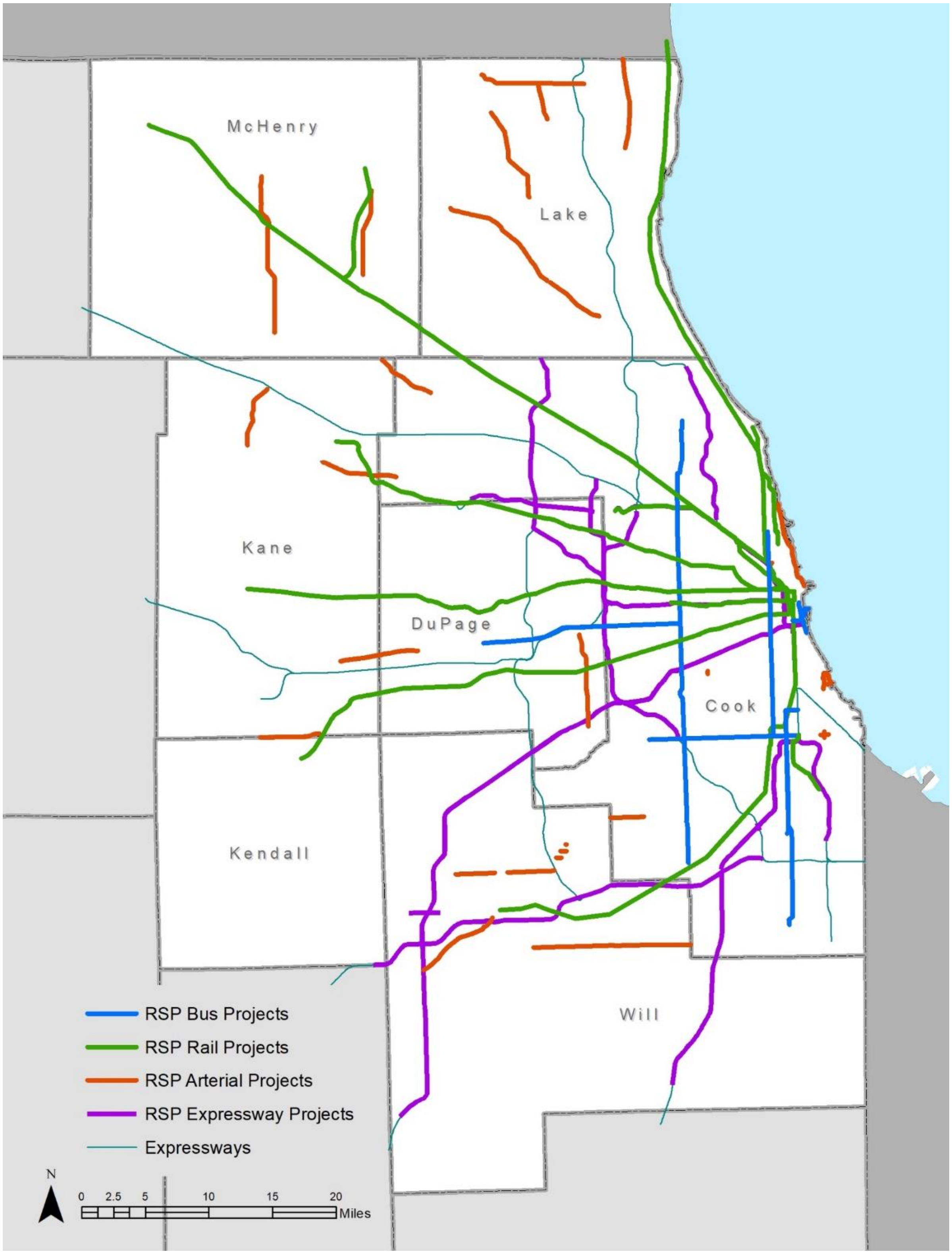
- Costs at least $100 million and either
  - Changes capacity on the National Highway System or is a new expressway or principal arterial, or
  - Changes capacity on transit services with some separate rights of way or shared right of way where transit has priority over other traffic
- Costs at least $250 million and improves the state of good repair for a particular highway or transit facility

Evaluation of each project focused on the current need, the modeled benefit with 2050 population and employment, and the degree to which the project fits with ON TO 2050 planning priorities. See the Regionally Significant Projects Benefits Report appendix for more details about methodology.

The ON TO 2050 update carries forward many projects from ON TO 2050, as well as adds in select new projects proposed by partner agencies. In total, 71 RSPs are constrained in the ON TO 2050 update, 21 transit projects, 25 expressway projects, and 25 arterial projects.

Many types of projects do not meet the technical thresholds for RSPs but are nonetheless important to consider for funding and implementation as systematic enhancements to the transportation system. This includes a wide variety of smaller projects like Intelligent

Transportation System (ITS) investments, intersection improvements, bike trails, accessibility improvements, and safety countermeasures that can help make progress toward a seamless, multimodal transportation system.


McHenry
Lake
Kane
DuPage
Cook
Kendall
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RSP Bus Projects
RSP Rail Projects
RSP Arterial Projects
RSP Expressway Projects
Expressways
N
0
2.5
5
10
15
20
Miles

Where we go from here

Since 2020, we have reoriented our work to meet our new and long-standing challenges and help the region seize the opportunity before us. Through the mobility recovery project, we are working with our regional partners to develop a visionary mobility strategy for the post-COVID world. Through the Community Collaborative, we are committed to developing a durable and meaningful way to involve historically underserved communities in the transportation decision-making process. Through the Safety Action Agenda, we are building a coalition to make sure our streets are safer for everyone. Through our ADA work, we are helping create a region that is more accessible for everyone. It is critical that we bring the insights and recommendations from these efforts to bear on the next regional plan, including how we identify and evaluate the region's highest priority transportation projects.

Despite this progress, there are many areas where we need to dig in. We do not yet have a clear understanding of the pandemic's durable impacts on how people and goods move around the region. Freight and logistics may be our regional strength, but freight congestion is only expected to increase. This activity will likely further impact Black and Latino communities that are already disproportionately harmed by emissions from the transportation sector. Transit, a critical part of our transportation system, is facing a funding crisis. And, given the evidence before us, we need to weave climate resilience into all we do. The next plan must speak to each of these topics deeply.

We also recognize that, in order to effectively engage in this work, we will need new analytical tools and decision-making processes to better evaluate policies and projects. CMAP is committed to working with our stakeholders and partners to better leverage our data and expertise to support and prioritize future investment in accordance with the region's long-term goals.

Transportation touches everything. It is about people, quality of life, equity, opportunity, and jobs. It's about keeping people safe. It is about our economic strength and resiliency. It's about our environment and climate. If we are going to thrive and compete as the third-largest metropolitan area in the country, we need big, bold, sustainable solutions to our transportation challenges. Our core principles of inclusive growth, resilience, and prioritized investment are even more relevant today. We are ready to convene, prioritize, and build consensus. Help us drive transformative change in our region.

ON TO 2050 update regionally significant projects benefits report appendix

September 2022 draft

Contents

Introduction

As northeastern Illinois's Metropolitan Planning Organization (MPO), the Chicago Metropolitan Agency for Planning (CMAP) is required by federal law to develop a list of major transportation projects every four years. The list identifies regionally significant projects that are to be implemented between now and 2050 (the horizon year of ON TO 2050, the region's long-range plan). These projects represent capital investments in the region's expressways, arterials, and transit system. This group of regionally significant projects (RSPs) are large enough to warrant additional discussion through the regional planning process. This group of projects also must be fiscally constrained, meaning sufficient revenues must be reasonably available in the future to implement them. This document describes the RSPs and the process CMAP employed to identify and evaluate them. The final list of selected RSPs to be included in the ON TO 2050 update is not a part of this document.

RSPs support ON TO 2050' s principles of inclusive growth, prioritized investment, and resilience. These projects emphasize the need to use the region's limited resources to invest, modernize, and improve existing infrastructure to achieve a state of good repair. Projects are prioritized into two categories: "constrained" and "unconstrained". Only constrained projects are eligible to receive federal transportation funds and obtain certain federal approvals. These constrained projects can help the region meet today's needs, adapt to changing mobility patterns, and support the region's economic success. Projects that are categorized as "unconstrained" require further action, such as additional study or a determination that the projects cannot be completed within the limits of the region's forecasted revenues. Because the region has limited funds available for expansions or improvements, the RSP evaluation process is intended to generate a list of prioritized projects that help the region meet its goals.

More than 70 projects have been identified through the RSP process, representing more than $84 billion in year of expenditure dollars. CMAP staff estimates $485 billion in core revenues will be available over the planning horizon of 2023-2050. After adding reasonably expected revenues, the region is forecasted to have approximately $520 billion in revenues verses a need of $429 billion just to maintain and operate infrastructure in current condition. The remaining revenue would be split between projects that can reach a state of good repair, enhance, and expand the transportation system. However, the expenditures needed to achieve a state of good repair have tripled since ON TO 2050 because of declines in the system's overall condition. This highly constrained environment generates the need for strong understanding and evaluation of the tradeoffs between projects, policies, and revenue recommendations.

Northeastern Illinois does not currently meet national ambient air quality standards for ozone. To be included in the plan, RSPs also are evaluated for their conformity to air quality standards. A future transportation system that includes the RSPs must demonstrate that it does not produce pollutants exceeding a pre-set standard (known as the motor vehicle emissions budget). The pre-set standard helps the region meet national air quality standards, and it is one part of an overall air pollution reduction strategy. When these conditions are met, the plan is considered to be in air quality conformity. While this document reports changes in air pollution emissions associated with each project individually, the official conformity analysis will ultimately be based on all of the projects that are fiscally constrained in the plan and the Transportation Improvement Program (TIP).

Process

Because it is not practical to itemize all projects expected over a multi-decade planning horizon, MPOs typically list only projects of a certain size or type. The update to ON TO 2050 maintains the same definition of RSPs. The definition covers:

1. Projects that cost at least $100 million and (a) change capacity on the National Highway System (NHS) or is a new expressway or principal arterial; or (b) change capacity on transit services with some separate rights-of-way or shared right-of-way where transit has priority over other traffic.
2. Projects that cost at least $250 million, regardless of the facility type or work type.

Candidate projects are compared to the cost thresholds based on current dollars (any conversion to year-of-expenditure, or YOE, cost is carried out by CMAP when necessary to meet federal rules). The entire project cost, not just the cost of the added capacity, is used to determine whether the project is regionally significant.

Note: Project submitters may develop a project proposal comprising a program of similar projects if individual projects would not meet the proposed thresholds. Projects that change capacity are those with non-exempt TIP work types[1]. In other words, projects that already are considered under federal rules to demonstrate air quality conformity.

To identify candidate RSPs, CMAP solicits projects from partner agencies. Regional transportation implementors submitted both unconstructed projects previously identified in ON TO 2050 and new projects that were considered for the first time under the plan update process. A total of 75 projects were considered.

The final universe of projects to be considered for inclusion in the ON TO 2050 update is shown in **Figures 1** through **Figures 3**. They are listed under the "Project descriptions" section in this report.

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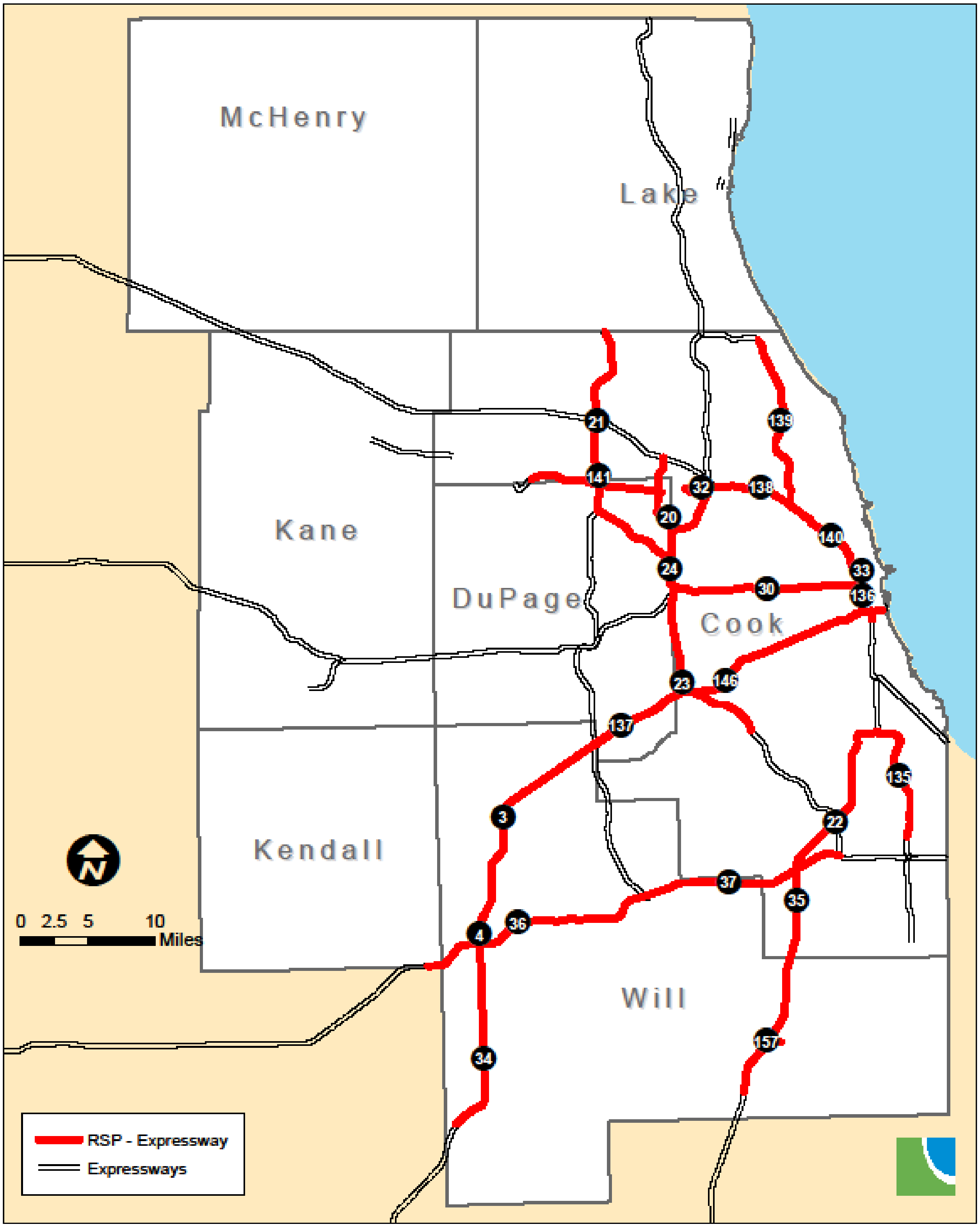
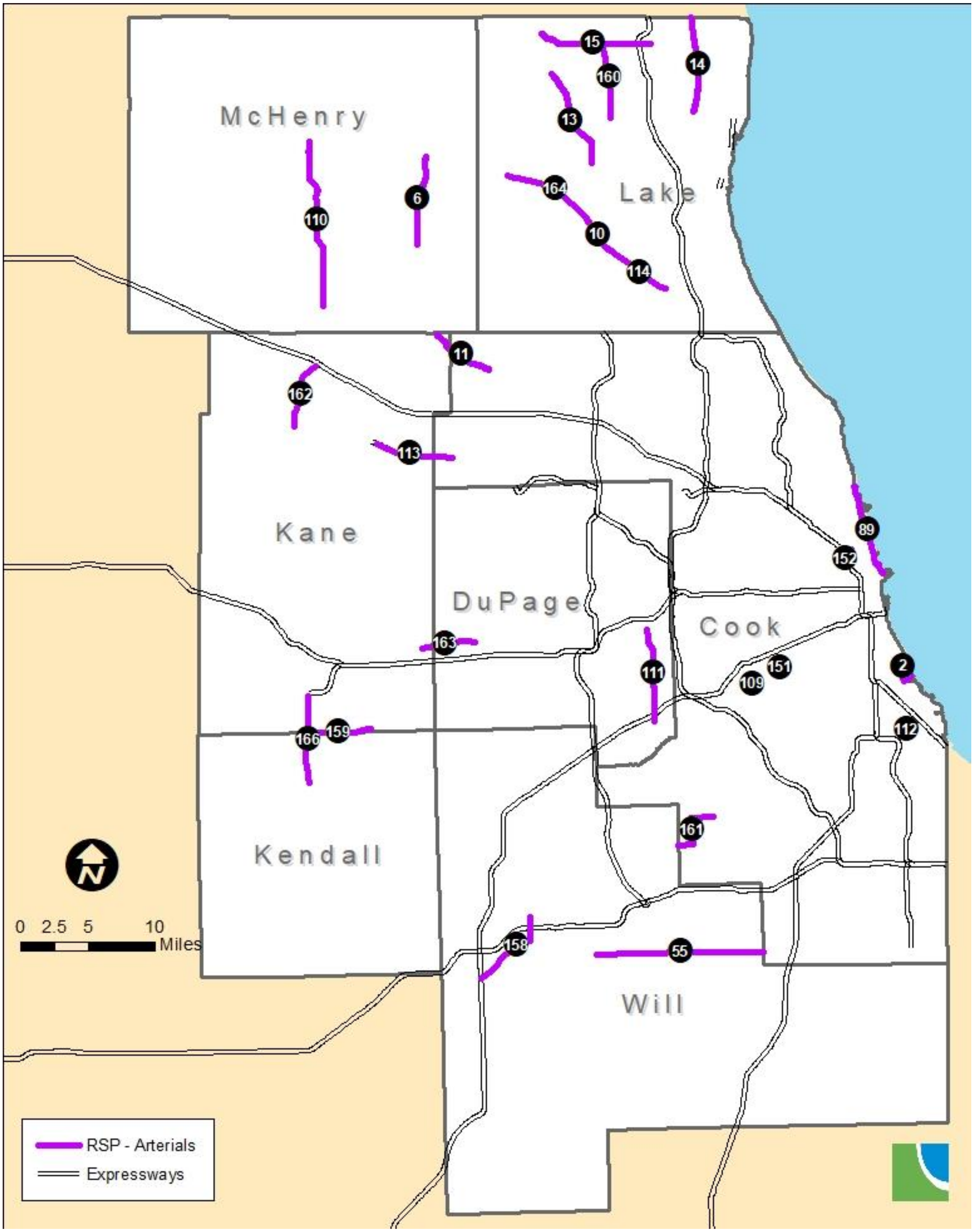
[1] Chicago Metropolitan Agency for Planning, "Transportation Improvement Program Work Types," April 2022, http://www.cmap.illinois.gov/documents/10180/33012/TIP+Work+Types_Updated+2-19-13.pdf/780844b6-4d26-4c00-9eeb-0a19e296b9f7.

Figure 1. Proposed Regionally Significant Projects – Expressways



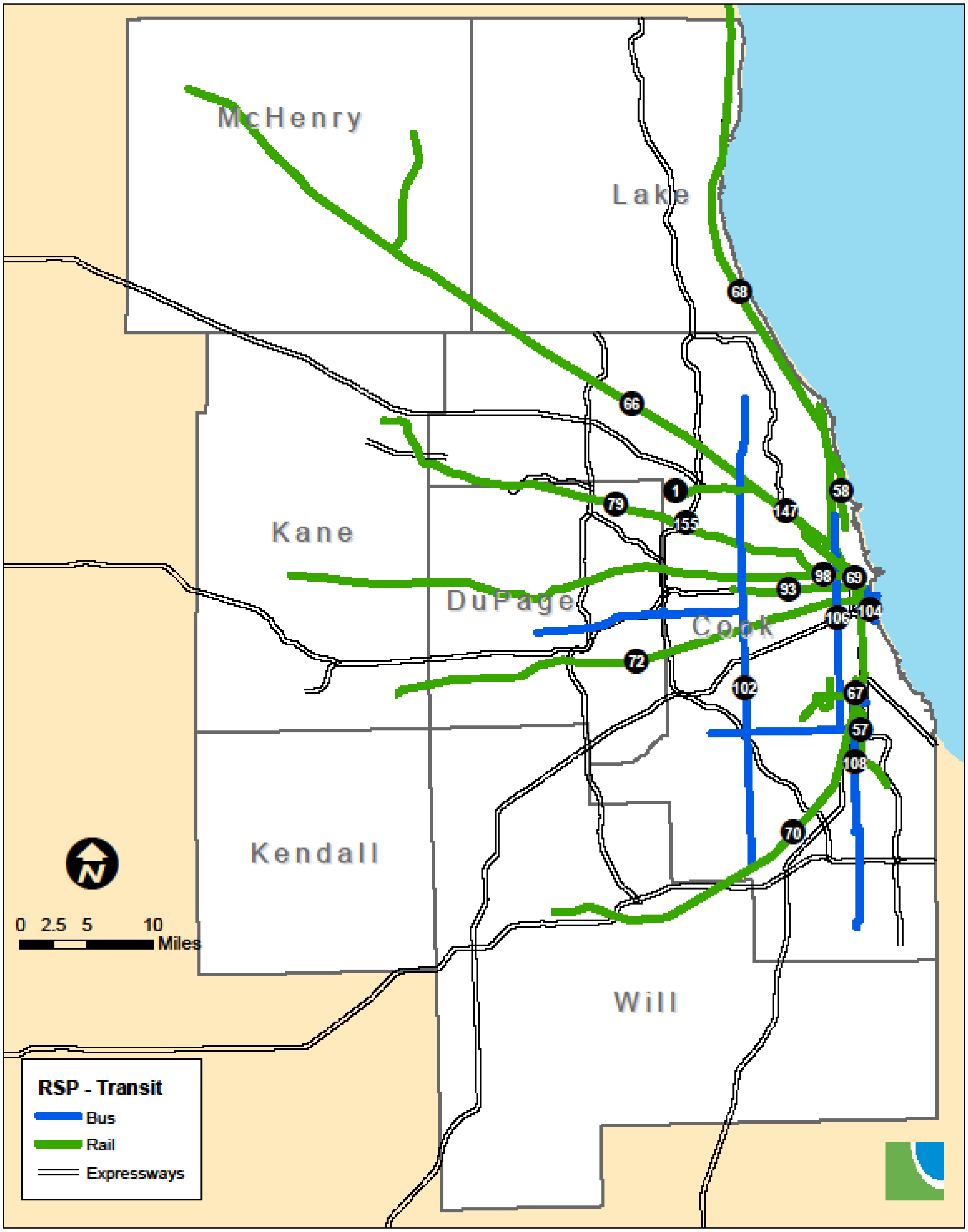
Source: Chicago Metropolitan Agency for Planning.

Figure 2. Proposed Regionally Significant Projects – Arterials



Source: Chicago Metropolitan Agency for Planning.

Figure 3. Proposed Regionally Significant Projects – Transit



Source: Chicago Metropolitan Agency for Planning.

Project evaluation

Project cost estimates

This section presents the estimated cost of all the major capital projects considered and documents the estimation methodology. Federal rules on fiscal constraint require costs to be in year-of-expenditure dollars (YOE) and include capital, as well as operations and maintenance (O&M) costs. Estimates of both types of costs are needed, as well as the years in which these expenditures are expected to take place. CMAP staff worked with implementers to update project information including scope, costs, phasing plans, and the portion of the project cost that would involve the addition of new capacity. The need to understand the project cost for adding capacity versus the amount needed for maintenance also is important in this process. The two cost categories have different budgetary constraints within the planning process.

Capital costs

In most cases, capital costs were provided by the project submitter. The level of analysis and engineering completed varies greatly between projects, meaning some costs and benefits presented in proposals are better understood than others.

When provided in current or earlier year dollars, costs were escalated to YOE by assuming a 2.5 percent annual cost of inflation — the same assumption used in the Financial Plan for Transportation for the ON TO 2050 update. Project phasing also was considered when that information was available. When the project submitter provided costs in YOE but used a different cost escalation factor, costs were deflated using the project submitter's factor to the base year and then escalated at 2.5 percent.

In CMAP's Financial Plan for Transportation for the ON TO 2050 update, the constrained cost of RSPs is only the amount needed to build and operate new capacity. Many RSPs, however, include elements of reconstruction, as well as capacity addition. For example, Projects that add lanes frequently include reconstruction of the existing facility along with addition of the new traffic lane. The proportion of capital costs required for new capacity and reconstruction was provided directly by the project submitter.[2] The Financial Plan for Transportation for the ON TO 2050 update separately includes the cost to reconstruct existing facilities under the operations and maintenance and the system enhancement allocation categories.

Operating costs

Operating costs for highway projects were estimated by applying costs per year and per lane-mile to the amount of new capacity, then inflating the cost each year by 2.5 percent. The unit cost estimate for non-tolled highways was derived from IDOT District 1's costs for fiscal year

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[2] The definition of "new capacity" is not necessarily the same as that used for programs such as FTA core capacity.

2009-13 operations on the interstate and arterial system. The estimate for tollway projects was derived from the Illinois Tollway's operating costs for the Elgin-O'Hare Western Access project.

Transit operating costs were estimated using the revenue service hours calculated from modeled service, and unit costs taken from the National Transit Database (NTD). Again, transit operating costs were inflated by 2.5 percent each year. In a few cases, improvements to existing lines are expected to decrease operating costs, generally by making service faster and reducing the revenue hours required for a given number of runs. Anticipated fares associated with a project — calculated as the service board-specific average fare from NTD multiplied by the annual number of new riders on the project — were subtracted from the operating cost.

Cost summary for projects

The full list of projects with costs is presented in **Table 1**. The table below contains the new capacity costs considered for fiscal constraint, while the last column contains the project reconstruction costs. Costs for new capacity are shown in YOE and are calculated from the project costs provided by the submitter, implementation years, and percent of cost for new capacity. Ultimately, some projects will have revenues associated with them from tolling and value capture that help offset their costs in the Financial Plan for Transportation for the ON TO 2050 update.

Table 1. Costs of Regionally Significant Projects

	Project Information				Cost for new capacity			
Project	RSP ID	Project submitter	Est. start year for construction	Percent of cost for new capacity	Capital cost, YOE (billon $)	Operating costs to 2050, YOE (billon $)	Total project cost, YOE (billon $)	Reconstruction costs, YOE (billon $)
Arterial Projects								
Elston-Armitage-Ashland-Cortland Intersection Improvement	152	CDOT	2027	0%	0.00	0.000	0.00	0.30
South Lakefront Improvements-Roadway and Path Improvements	A2	CDOT	2023	20%	0.04	0.000	0.04	0.15
IL 31/Front St from IL 120 to IL 176	6	IDOT	2026	50%	0.06	0.003	0.07	0.06
IL 60/IL 83 from IL 176 to Townline Rd (IL 60)	10	IDOT	2030	50%	0.08	0.001	0.08	0.08
IL 62/Algonquin Rd from IL 25 to IL 68	11	IDOT	2035	50%	0.09	0.001	0.09	0.09
IL 83 Milwaukee Ave from Petite Lake Rd to IL 120	13	IDOT	2035	50%	0.14	0.002	0.14	0.14
IL 131 Green Bay Road from Russell Road to Sunset Ave	14	IDOT	2030	50%	0.04	0.003	0.05	0.04
IL 173 Rosecrans Rd from IL 59 to US 41	15	IDOT	2035	50%	0.19	0.002	0.19	0.19
Caton Farm Bruce Road Corridor from US 30 to IL 7/159th St	53	Will Co	2040	69%	0.61	0.004	0.62	0.28
Laraway Road from US 52 to IL 43 Harlem Ave	55	Will Co	2040	50%	0.07	0.003	0.07	0.07
North DuSable Lake Shore Drive Improvements	89	IDOT	2035	10%	0.62	0.002	0.62	5.59
IL 43 (Harlem Avenue) at 65th Street / BRC RR	109	IDOT	2030	5%	0.01	0.000	0.01	0.15
IL 47 from Charles Rd to Reed Rd - RSP 110	110	IDOT	2025	50%	0.24	0.006	0.25	0.24
IL 83 Kingery Hwy from 31st St to N of 55th St, 63rd St to Central Ave	111	IDOT	2036	50%	0.10	0.002	0.10	0.10
US 12/US 20 at Stony Island Ave	112	IDOT	2025	5%	0.01	0.001	0.01	0.10
US 20 Lake St from W of Randall Rd to E of Shales Parkway	113	IDOT	2026	5%	0.01	0.003	0.01	0.12

	Project Information				Cost for new capacity			
Project	RSP ID	Project submitter	Est. start year for construction	Percent of cost for new capacity	Capital cost, YOE (billon $)	Operating costs to 2050, YOE(billon $)	Total project cost, YOE(billon $)	Reconstruction costs, YOE(billon $)
Arterial Projects								
US 45/IL 83/Old Half Day Rd from IL 60 to Ill 22	114	IDOT	2030	50%	0.10	0.001	0.10	0.10
Central Av at BRC RR (CREATE)	151	IDOT	2021	0%	0.00	0.000	0.00	0.18
US 6 from I-55 to US 52	158	IDOT	2040	50%	0.14	0.000	0.14	0.14
US 30 from IL 47 to Albright Rd	159	IDOT	2040	50%	0.09	0.000	0.09	0.09
US 45 and Milburn By-Pass from IL 173 to IL 132	160	IDOT	2040	50%	0.08	0.001	0.09	0.08
IL 47 from s/o I-90 to s/o Old Plank Rd	162	IDOT	2040	50%	0.11	0.001	0.11	0.11
IL 56 from Kirk Rd to IL 59	163	IDOT	2040	50%	0.11	0.001	0.11	0.11
IL 60 from IL 120 to IL 176	164	IDOT	2040	50%	0.15	0.001	0.16	0.15
IL 7/143rd St from Will-Cook Line to IL 7/Southwest Hwy	161	IDOT	2023	40%	0.07	0.006	0.08	0.11
IL 47 from Cross St to Kennedy Rd	166	IDOT	2026	33%	0.05	0.002	0.05	0.10
Expressway Projects								
I-294 Tri-state Tollway at I-57 Interchange Addition	22	IDOT	2010	50%	0.03	0.001	0.03	0.03
I-290 Eisenhower Expy from US 12/45/20 Mannheim Rd to Racine Ave	30	IDOT	2028	20%	0.76	0.012	0.77	3.04
I-190 Access Improvements	32	IDOT	2026	20%	0.21	0.003	0.21	0.82
I-90/I-94 Circle Interchange from I-290 Congress Parkway to Adams St	33	IDOT	2023	20%	0.00	0.001	0.00	0.00
I-55 from IL 129 to Lorenzo Rd, I-55 Frontage Rds from Kavanaugh Rd to Lorenzo Rd	34	IDOT	2040	20%	0.04	0.000	0.04	0.18
I-55 from I-80 to Coal City Rd	34	IDOT	2041	20%	0.25	0.009	0.25	0.98

	Project Information				Cost for new capacity			
Project	RSP ID	Project submitter	Est. start year for construction	Percent of cost for new capacity	Capital cost, YOE (billon $)	Operating costs to 2050, YOE (billon $)	Total project cost, YOE (billon $)	Reconstruction costs, YOE (billon $)
Expressway Projects								
I-57 Reconstruction (I-80 to Kankakee County)	35	IDOT	2045	0%	0.00	0.000	0.00	1.63
I-80 Reconstruction from Ridge Rd to US 30 Lincoln Hwy	36	IDOT	2030	20%	0.28	0.014	0.30	1.13
I-80 from US 30 to I-294	37	IDOT	2040	80%	2.88	0.008	2.89	0.72
I-94 Bishop Ford Expressway Reconstruction (I-57 to US 6)	135	IDOT	2030	0%	0.00	0.000	0.00	1.13
I-90/1-94 Kennedy and Dan Ryan Expressways Reconstruction (Hubbard ST to 31st)	136	IDOT	2030	0%	0.00	0.000	0.00	5.03
I-55 Stevenson Expressway Reconstruction (LSD to I-80 excluding RSP 146 limits)	137	IDOT	2035	0%	0.00	0.000	0.00	5.20
I-90 Kennedy Expressway Reconstruction (Jane Addams to I-94 merge)	138	IDOT	2035	0%	0.00	0.000	0.00	2.80
I-94 Edens Expressway Reconstruction (Tollway spur to Lawrence Ave)	139	IDOT	2035	0%	0.00	0.000	0.00	2.92
I-90/I-94 Kennedy Reconstruction (Edens Junction to Hubbard ST)	140	IDOT	2045	0%	0.00	0.000	0.00	3.23
I-290/IL-53 Reconstruction (I-88 to Lake-Cook RD)	141	IDOT	2045	0%	0.00	0.000	0.00	5.89
I-57 Reconstruction (I-94 to I-80)	142	IDOT	2045	0%	0.00	0.000	0.00	2.47
I-55 Managed Lane from I-355 to I-90 I-94 (I-55 Stevenson Express Toll Lanes)	146	IDOT	2040	80%	0.71	0.021	0.73	0.18
I-57 @ Eagle Lake Rd	157	IDOT	2026	100%	0.23	0.000	0.23	0.00

	Project Information				Cost for new capacity			
Project	RSP ID	Project submitter	Est. start year for construction	Percent of cost for new capacity	Capital cost, YOE (billon $)	Operating costs to 2050, YOE (billon $)	Total project cost, YOE (billon $)	Reconstruction costs, YOE (billon $)
Expressway Projects								
I-55 from Weber Road to US 30; I-55 At Airport/Lockport Rd & At IL 126	A3	IDOT	2028	13%	0.03	0.000	0.03	0.19
I-55 from I-80 to US 52 and @ ILL 59; US 52/Jefferson St from River Rd to Houbolt Rd	A4	IDOT	2028	16%	0.04	0.009	0.05	0.20
Elgin O'Hare Western Access	20	Tollway	2023	100%	0.70	0.063	0.76	0.00
I-290/IL 53 Interchange Improvement	21	Tollway	2032	0%	0.00	0.001	0.00	0.45
I-294 Central Tri-State Reconstruction and Mobility Improvements	23	Tollway	2018	10%	0.07	0.026	0.10	0.62
I-290/I-88/I-294 Interchange Improvement	24	Tollway	2018	0%	0.00	0.004	0.00	0.41
Transit Projects								
Chicago Union Station Master Plan Implementation	85	CDOT	2026	100%	1.13	0.026	1.16	0.00
Chicago Union Station Master Plan Implementation-Phase II	88	CDOT	2041	100%	2.00	0.051	2.05	0.00
South Lakefront-Museum Campus Access Improvements	104	CDOT	2025	100%	0.22	0.174	0.20	0.00
Ashland-Ogden Metra Infill Station	153	CDOT	2030	100%	0.34	-0.022	0.31	0.00
O'Hare Express Service	A1	CDOT	2025	100%	0.00	0.000	0.00	0.00
Red Line Extension (South)	57	CTA	2025	95%	2.31	0.320	2.63	0.12
Red Purple Modernization Phase One	58A	CTA	2019	62%	0.39	0.000	0.39	0.24
Red Purple Modernization Future Phases	58B	CTA	2030	60%	3.60	-0.117	3.48	2.40

	Project Information				Cost for new capacity			
Project	**RSP ID**	**Project submitter**	**Est. start year for construction**	**Percent of cost for new capacity**	**Capital cost, YOE (billon $)**	**Operating costs to 2050, YOE (billon $)**	**Total project cost, YOE (billon $)**	**Reconstruction costs, YOE (billon $)**
Transit Projects								
Blue Line Forest Park Reconstruction	93	CTA	2023	15%	0.26	0.034	0.29	1.47
Ashland Avenue BRT (Irving Park to 95th)	106	CTA	2027	75%	0.12	0.271	0.39	.04
Blue Line Core Capacity	147	CTA	2030	54%	0.59	0.392	0.99	0.51
Brown Line Core Capacity	165	CTA	2032	50%	1.72	0.085	1.81	1.70
South Halsted BRT	108	CTA/Pace	2026	75%	0.18	0.082	0.21	0.04
Southwest Service Improvements / 75th Street Corridor Improvement Project	67	IDOT	2013	25%	0.33	-0.046	0.28	0.99
BNSF Extension-Oswego/Plano	71	Kendall Co	2045	100%	1.27	0.029	1.30	0.00
UP NW Line New Start	66	Metra	2026	50%	0.30	-0.139	0.16	0.30
UP North Line Improvements	68	Metra	2036	25%	0.14	0.343	0.49	0.43
UP West Line - New Start	69	Metra	2033	25%	0.17	-0.118	0.05	0.52
Rock Island Line Improvements	70	Metra	2029	25%	0.15	0.101	0.25	0.46
BNSF Improvements	72	Metra	2040	25%	0.11	0.042	0.15	0.32
Milwaukee District West Improvements	79	Metra	2040	25%	0.25	0.058	0.31	0.75
A-2 Crossing Rebuild	98	Metra	2028	25%	0.33	0.046	0.37	0.98
Milwaukee Corridor Improvements	156	Metra	2030	75%	N/A	N/A	N/A	N/A
I-294 Tri-State Express Bus Stations	155	Pace	2026	100%	0.13	0.157	0.28	0.00
Pulse Near Term	102A	Pace	2019	100%	0.11	-0.006	0.11	0.00

Evaluation measures

The planning process identifies projects that help the region meet its transportation, economic, land use, environmental, and quality-of-life goals. The evaluation framework for the update is the same one used for ON TO 2050; however, several important differences exist from the original ON TO 2050 project evaluations. These include:

- **Revised socioeconomic forecast**: New population and employment forecasts were developed for the plan update to take advantage of more recent census data on the regional population and account for the impacts of the COVID-19 pandemic on the region's economy. A new land-use model (UrbanSim) helped develop the spatial distribution of households, population, and jobs in 2050. This local area allocation of people and employment provides the foundation for the analysis of the RSPs. More information about UrbanSim and the regional socioeconomic forecast is available in the Regional Socioeconomic Forecast Appendix. The socioeconomic data used for the RSP evaluations was a draft version of the 2050 forecast for the plan update.

- **Travel demand model update:** CMAP's trip-based travel demand model was one of the primary tools used to conduct the RSP evaluations. The travel model was updated to reflect the travel behavior captured in the most recent household travel survey (My Daily Travel), which concluded data collection in spring 2019. Additionally, other procedural improvements, such as expanding the number of transportation mode options and including a work-from-home allocation model, were implemented in the model. More information can be found in the Travel Demand Model Documentation Appendix.

- **Updated data inputs:** Data input files used to conduct the evaluations were updated in instances where more recent data were available. In addition to the population and employment data, this included revised information on green infrastructure, water resources, bridge and pavement condition, traffic safety and reliability, and transit asset conditions.

The RSP evaluation framework classifies performance metrics into three categories. Those categories cover addressing today's needs, improving 2050 travel, and implementing ON TO 2050 planning priorities. The following part of this section describes the project evaluation measures within those three categories.

Addressing today's needs

Given the region's scarce resources and the significant deficiencies on the system — ranging from safety problems on highways to capacity constraints on the rail system — ON TO 2050 evaluates projects based on the severity of existing needs at a project location. If a proposed highway capacity project addresses an area with high congestion, high crash rate, and poor pavement condition, then it should be a higher priority than a project where these needs are not as great. Different measures are used to evaluate the needs that transit (**Table 2**) and highway (**Table 3**) projects address. For more details on the evaluation measures, see Appendix A.

Table 2. Current need measures for transit project evaluation

Average asset condition	Individual assets or groups of assets across the system have been assigned a numerical rating based on age and FTA's asset condition scale where 5 is "like new" and 1 is "in need of immediate repair." These conditions are averaged across each line and weighted by estimated replacement cost in to develop this measure. Low numbers indicate that a line has many old assets in need of replacement; high numbers indicate that a particular line is newer. A project that addresses assets in poorer condition is considered a higher priority.
Capacity constraint	Capacity constraints limit the amount of service that can be provided and lead to crowded conditions. Capacity is measured as the ratio of maximum passenger loads to capacity on CTA rail and, on Metra, the number of trains each day where 95% or more of the seats are occupied. Projects that address more significant capacity constraints are considered higher priority. The raw capacity constraint values were also rescaled to compare more easily between Metra and CTA in a way described in the Appendix A.
Reliability	Reliability is measured as route on-time performance (Metra) or headway adherence (bus, CTA rail). The source is transit agency data.
ADA improvement	ADA compliance is a significant need on the existing transit system and an area where the transit agencies will be making significant investments. This measure is "Yes" if a project significantly reduces or eliminates an existing ADA deficiency. Otherwise, the rating is "No."

Table 3. Current need measures for highway project evaluation

Structural deficiency of bridges	Measured as square feet of bridge deck on bridges along a project that are categorized as deficient. Projects that address a greater amount of structurally deficient bridge deck area are considered higher priority.
Pavement condition	For expressways and arterials, a combination of Condition Rating System (CRS) and International Roughness Index (IRI) is used, scaled 1-100 from best-to-worst condition for the NHS system. Projects that address pavements in worse condition are considered higher priority and receive a higher index value.
Safety	The severity of safety problems addressed by a project is measured by the rate of serious injury and fatal crashes occurring per VMT on the project segments, scaled 1-100. A project addressing a more severe safety problem is considered a higher priority and receives a higher index value.
Mobility	Mobility is measured as a combination of the intensity of congestion (measured with the Travel Time Index, or TTI) and the duration of congestion (measured as hours of congestion throughout the day). The measures are weighted equally and rescaled 1-100. A capacity project addressing a more severe congestion problem is considered a higher priority and receives a higher index value.
Reliability	This measure rates the severity of existing travel time unreliability using the planning time index (PTI), scaled to a value 1-100. A capacity project addressing a more severe reliability problem is considered a higher priority and receives a higher index value.

2050 performance

Projects also are evaluated based on how they are expected to perform in the year 2050 (**Table 4** and **Table 5**). CMAP's trip-based travel demand model was used to model each expressway and transit project and estimate reductions in congestion, changes in crash rates, and changes in other measures expected from implementing candidate projects. The evaluation was supported by generic modeling on the NHS arterials, using the travel model rather than on a project-by-project basis. For ON TO 2050, the Regional Transportation Authority (RTA) computed 2050 transit project performance using a combination of the FTA's Simplified Trips on Projects (STOPS) model developed and calibrated for northeastern Illinois and the RTA Access Tool that was created to measure the accessibility of jobs by transit. For the ON TO 2050 update, those processes were replaced with comparable ones that relied on the travel demand model.

Travel conditions in the year 2050 were modeled with and without each of the proposed expressway or transit RSPs. The change between no-build (without the project) and build (with the project) measures was calculated by using the difference between the appropriate scenarios. All projects were evaluated using the region's existing and committed network, which includes the existing 2019 road and transit network along with projects from the Northeastern Illinois TIP[3] that are expected to exist in 2050. Each build scenario included the existing and committed network plus the project in question. For phased transit projects (such as CTA's Red Purple Modernization), later phases had their no-build scenarios adjusted to include earlier phases in addition to the 2019 base network. The characteristics of individual projects were coded into the model based on information supplied by the project submitters. More details on the evaluation measures are available in Appendix A.

In addition to reporting absolute project benefits, project cost-effectiveness also was computed using the current year (2021) capital cost of the project plus 10 years of operating cost, divided by each evaluation measure. This results in an estimated cost per unit of change, such as dollars per new rider or dollars per minute of travel time change.

Table 4. 2050 performance measures for transit project evaluation

Project ridership (daily)	The number of boardings on the project in 2050, reflecting the total number of users benefitted by the project.
Regional trips (daily)	The incremental change in transit use, measured as linked transit trips per day, caused by the project in 2050. This shows how much a project increases overall regional trip making.
Work trip transit travel time (minutes)	This measure computes the difference in average commute time for workers region wide. Commute time includes in-vehicle transit time, wait time, walk transfer time, and auto time to access transit.
Project user commute time (minutes)	This measure computes the difference in average commute time for project users where transit could be used in both build and no-build scenarios. It excludes areas

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[3] The TIP, available at https://etip.cmap.illinois.gov/, is a compendium of funded projects on which some phase of work is expected in the next five years.

	where transit was not available in the no-build scenario. The components of commute time are the same as above.
Job accessibility (count of jobs)	Measures the change in the average number of jobs each household in the region can reach by transit within both 60 and 90 minutes. The time thresholds include in-vehicle transit time, wait time, walk transfer time, and auto time to access transit.
Fatalities and serious injuries per year	This is an estimate of fatalities and serious injuries (type K and A) avoided due to mode shift from auto to transit.

Table 5. 2050 performance measures for expressway project evaluation

Congested vehicle hours traveled (VHT) in region (hours daily)	Congested VHT measures the time all vehicles in total spend in congestion. If a project reduced a typical trip time in congested conditions by five minutes for 10,000 cars, then the change in congested VHT would be five minutes * 10,000 cars ÷ 60 minutes/hour = 833 hours saved.
Congested VHT in corridor (hours daily)	Because in some cases a project may have a modest impact on performance at the regional scale but a large impact in the vicinity of the project, this measure assesses the reduction in congested VHT for all vehicles within a five-mile buffer around the project.
Regional work trip travel time (minutes)	Measures the change in the average travel time for commutes beginning within the CMAP seven-county area.
Work trip travel time within corridor (minutes)	Measures the change in the average travel time for commutes beginning only within the five-mile buffer around the project.
Job accessibility (count of jobs)	Measures the change in the average number of jobs each household can reach by auto within 45 minutes.
Fatalities and serious injuries per year	This measure estimates the change in fatalities and serious injuries (type K and A) resulting from the project based on five-year crash rates for interstates and non-interstates.

Planning priorities

The projects were assessed for their contributions to priorities of the ON TO 2050 update (**Table 6**). Given the important role of inclusive growth in ON TO 2050, the evaluation looks closely at how well projects would benefit residents of Economically Disconnected Areas (EDAs), places with high concentrations of residents with low income, persons of color, or residents with limited English language proficiency. To assess a project’s ability to help the region grow economically, the analysis also examines aspects of the economic impact and support of freight movement of proposed projects. To support ON TO 2050’s reinvestment recommendations, the analysis examines how well a project supports infill development in already-developed parts of the region. For highway investments, the analysis examines how projects might encourage development in priority conservation areas and sensitive water resources, or if they place additional burdens on areas with groundwater scarcity. More details on the evaluation measures are available in Appendix A.

Table 6. Planning priorities for transit projects

Project use by residents of Economically Disconnected Areas (EDAs)	This is the proportion of project ridership estimated to come from EDAs and measures the degree to which a project directly benefits residents of those areas.
Support for infill development	Captures the degree to which a project supports growth in areas that are appropriate for infill development based on a 1-100 index. Projects that serve areas that are highly supportive of infill receive up to 100, while projects that serve areas that minimally support infill score as little as 0.
Economic impact due to industry clustering	Annual dollar value of increased labor productivity by enhanced businesses-to-business interaction and access to larger labor pool brought about by a project's changes to transit travel times.
Freight improvement	Measures the impact the project will have on critical freight supporting infrastructure such as truck routes and freight rail. Benefits to freight are rated on a -25 to 100 scale, with -25 representing potential disbenefits and 100 representing significant improvements to freight movement.
Number of low barriers to entry jobs accessible for residents of EDAs	This measure assesses the average number of higher-wage jobs that do not require a college degree that are accessible to households living in EDAs within 60 and 90 minutes by transit.
Greenhouse gas emissions (metric tons/day in 2050)	By reducing auto vehicle miles traveled (VMT), transit projects tend to reduce greenhouse gas emissions.

Table 7. Planning priorities for highway projects

Congested VHT for heavy trucks in region (hours daily)	To estimate project benefits to freight, this measure captures the change in congested VHT for heavy commercial vehicles.	Expressway
Congested VHT for heavy trucks in corridor (hours daily)	Measures the change in congested VHT for heavy commercial vehicles only within a five-mile buffer around the project.	Expressway
Freight improvement	Measures the impact the project will have on freight based on specific changes the project will include. This is the same measure used to evaluate transit projects, listed in Table 6.	Expressway, Arterial
Greenhouse gas (GHG) emissions (metric tons/day)	Emissions of GHGs by autos is sensitive both to total VMT and vehicle speed.	Expressway
Development pressure in conservation areas (count of new households)	By increasing highway access, highway projects may encourage development in important conservation areas. For expressways, this measure estimates the potential increase in households in conservation areas. For arterials, the measure of impact is simply the number of acres of priority conservation area within the project's travel shed, converted to a 1-100 score.	Expressway
Direct impact on conservation areas	Conservation areas close to a transportation project can be damaged in the process of roadway expansion, or by increased traffic volumes. For expressway projects that add capacity through new roadway or expansion of existing roadway, this measure indicates the level of direct impact a project has on nearby natural areas. The measure is a function of the amount of conservation area overlapped by a project and a new lane factor. This measure uses a relative index to evaluate projects against each other.	Expressway
Development pressure in areas at risk of groundwater	Like development pressure in conservation areas, this measure evaluates the potential increase in number of households in areas with groundwater desaturation.	Expressway

desaturation (count of new households)		
Impervious area (acres)	Increased impervious surface is a proxy for negative impacts on water resources. This measure estimates total new impervious surface created either as a direct result of the road project or based on the projected spinoff development.	Expressway
Project use by residents of EDAs (percent of VMT)	This is the proportion of VMT on a project from trips originating in EDAs, and reflects the degree to which a project directly benefits the residents those areas.	Expressway, Arterial
Fine particulate matter emissions in EDAs (g/day)	Fine particulate emissions have a negative impact on public health. This measure determines the degree to which a project would cause changes in fine particulate matter emissions in EDAs where health impacts are expected to be especially high.	Expressway
Accessibility of low barrier to entry jobs for residents of EDAs (count of jobs)	This measure assesses the average number of higher-wage jobs that do not require a college degree that are accessible to households living in EDAs within 45 minutes by auto.	Expressway
Economic impact due to industry clustering (dollars per year)	Dollar value of increased labor productivity by enhanced businesses-business interaction and access to larger labor pool brought about by a project's changes to transit travel times. For arterial projects, this is an indexed value rather than a dollar value.	Expressway, Arterial
Support for infill development	Captures the degree to which a project supports growth in areas that are appropriate for infill development based on a 1-100 index. Projects that serve areas that are highly supportive of infill receive up to 100, while projects that serve areas that minimally support infill score as little as 0.	Expressway
Benefit to key industries	This measure assesses the degree to which projects benefit key industries. Key industries were identified by the number of jobs in regionally specialized, export-oriented industries with higher than average in-region transportation costs. This value is indexed 1-100, with 100 representing the best score for a project.	Expressway, Arterial
Benefit to areas with industrial vacancy	This measure identifies the degree to which projects benefit distressed industrial areas. Distressed industrial areas were identified by current vacancy. Projects serving distressed industrial areas are considered to be higher priority because of their ability to improve these area's competitiveness. This value is indexed 1-100, with 100 representing the best score for a project.	Expressway, Arterial
GIV impact score	Percentile rank of conservation areas in project travel shed.	Arterial
Expected traffic growth (percent)	Expected percent growth in traffic from 2019 to 2050 using existing and committed transportation networks.	Arterial

Full evaluation results

The following projects were not evaluated, as they are already in the construction phase or are funded:

- RSP 24 – I-290/I-294 Interchange Improvement
- RSP 33 – Jane Byrne Interchange Reconstruction
- RSP 58A – North Red/Purple Line Modernization Phase One

- RSP 67 – Southwest Service Improvements/75th Street Corridor Improvement Program
- RSP 69 – UP-West Upgrade
- RSP 85 – Chicago Union Station Master Plan Implementation Phase 1
- RSP 93 – Forest Park Reconstruction Phase 1

The following tables present the performance data collected for each transit, expressway, and arterial project.

Transit

Table 8. Transit project evaluation for today's needs (projects with no data are excluded)

				Capacity constraint			
Project submitter	**RSP ID**	**Description**	**Avg. Asset condition***	**Raw****	**Rescaled**	**Reliability**	**ADA Improvement**
CTA	58A	Red Purple Modernization Phase One	2.47	1.15	9	97.0%	Yes
CTA	58B	Red Purple Modernization Future Phases	2.47	1.15	9	97.0%	Yes
Metra	66	UP NW Line New Start (3870)	N/A			93.0%	No
Metra	68	Metra UP North Improvements	2.87	3	3	95.3%	No
Metra	69	UP West Line - New Start (3869)	2.98			92.3%	No
Metra	70	Metra Rock Island Improvements	3.44			92.0%	No
Metra	72	BNSF Improvements	N/A	6	6	95.0%	No
Metra	79	Milwaukee District West Improvements	3.33			95.1%	No
CDOT	88	Chicago Union Station Master Plan Implementation-Phase II	N/A	TBD		N/A	Yes
CTA	93B	Blue Line Forest Park Reconstruction	2.56	1.00	6	92.0%	Yes
Metra	98	A-2 Crossing Rebuild	N/A			N/A	No
CTA	147	Blue Line Core Capacity Project	2.87		6	93.0%	No
Metra	156	Metra Milwaukee Corridor Improvements	N/A			93.6%	TBD
CTA	165	Brown Line Core Capacity	N/A	1.10	8	96.0%	No

*2016 average asset condition data used

Table 9. Transit project 2050 performance

			Modeled Characteristics		2050 Performance							
Project submitter	RSP ID	Description	Change in annual bus revenue hours ('000s)	Change in annual fixed guideway revenue hours ('000s)	Project daily ridership ('000s)	Change in daily regional transit trips ('000s)	Change in work trip travel time (minutes)	Change in project user commute time (minutes)	Change in # of jobs accessible within 90 min, for avg. resident ('000s)	Change in # of jobs accessible within 60 min. for avg. resident ('000s)	Change in Fatalities and Serious Injuries per year
CTA	57	Red Line Extension (South)	(18)	14	132	0.8	(0.10)	(0.49)	8	6	-2.2
CTA	58B	Red Purple Modernization Future Phases	0	(1)	216	7.5	(0.08)	(0.01)	4	4	-14.6
Metra	66	UP NW Line New Start (3870)	0	4	3	1.0	(0.02)	(5.72)	17	9	-8.1
Metra	68	Metra UP North Improvements	0	21	31	4.7	(0.19)	(4.95)	12	8	-10.7
Metra	70	Metra Rock Island Improvements	0	7	19	3.5	(0.03)	(3.69)	8	8	-6.3
Kendall County	71	BNSF Extension-Oswego/Plano	0	2	35	0.2	0.02	(0.15)	6	5	-3.9
Metra	72	BNSF Improvements	0	8	55	6.8	(0.28)	(6.60)	24	20	-9.7
Metra	79	Milwaukee District West Improvements	0	3	31	5.9	(0.10)	(1.86)	11	5	-13.0
CDOT	88	Chicago Union Station Master Plan Implementation-Phase II	0	53	129	2.5	(1.04)	(3.36)	21	23	-7.0
CTA	93B	Blue Line Forest Park Reconstruction	0	(2)	99	7.3	(0.12)	(0.44)	5	5	-10.5
Metra	98	A-2 Crossing Rebuild	0	(1)	57	NB	(0.02)	(0.24)	4	4	-7.0
Pace	102	Pace Short Term ART	45	0	5	2.6	(0.04)	(8.04)	13	9	-6.6
CDOT	104	South Lakefront-Museum Campus Access Improvements	(2)	0	33	NB	(0.10)	(1.83)	5	5	-7.4
CTA	106	Ashland Avenue BRT (Irving Park to 95th)	54	0	15	6.6	(0.17)	(3.39)	9	9	-8.3

			Modeled Characteristics		2050 Performance						
Project submitter	RSP ID	Description	Change in annual bus revenue hours ('000s)	Change in annual fixed guideway revenue hours ('000s)	Project daily ridership ('000s)	Change in daily regional transit trips ('000s)	Change in work trip travel time (minutes)	Change in project user commute time (minutes)	Change in # of jobs accessible within 90 min, for avg. resident ('000s)	Change in # of jobs accessible within 60 min. for avg. resident ('000s)	Change in Fatalities and Serious Injuries per year
CTA	108	South Halsted BRT	11	0	3	0.6	0.01	(0.98)	5	5	-3.3
CTA	147	Blue Line Core Capacity Project	0	27	95	NB	(0.29)	(1.58)	11	11	-1.6
CDOT	153	Ashland-Ogden Metra Infill Station	0	0	61	2.8	0.07	(0.01)	3	4	-3.4
Pace	154	South Halsted Bus Enhancements	12	0	0.4	NB	(0.03)	(5.39)	5	5	-3.5
Pace	155	I-294 Tri-State Express Bus Stations	36	0	3	3.6	0.04	(33.01)	37	15	-5.1Fixed
Metra	156	Metra Milwaukee Corridor Improvements	0	9	1	6.2	(0.05)	(5.88)	4	4	-14.4
CTA	165	Brown Line Core Capacity	0	(5)	114	4.4	(0.12)	(0.49)	5	4	-11.3
CDOT	A1	O'Hare Express Service	0	94	3	0.7	(1.38)	(21.02)	498	276	1.0

NB = no benefit

Table 10. Transit project 2050 cost effectiveness

Project submitter	RSP ID	Description	Project cost characteristics		Cost-effectiveness of 2050 performance				
			2021 Capital cost $M	10 Years incremental operating cost $M	Dollars per project rider ('000s)	Dollars per change in regional ridership ('000s)	Dollars per change in work trip transit travel time $M	Dollars per change in jobs accessible in 60 minutes $M	Dollars per change in jobs accessible in 90 minutes $M
CTA	57	Red Line Extension (South)	2.43	0.14	19	3,096	(26)	0.43	15.98
CTA	58A	Red Purple Modernization Phase One	0.62	-	Not evaluated				
CTA	58B	Red Purple Modernization Future Phases	6.00	(0.05)	28	794	(74)	1.57	141.57
Metra	66	UP NW Line New Start (3870)	0.53	(0.05)	182	460	(24)	0.06	2.28
Metra	67	Southwest Service Improvements / 75th Street Corridor Improvement Project	1.14	-	Not evaluated				
Metra	68	Metra UP North Improvements	0.40	0.09	16	103	(3)	0.06	5.36
Metra	69	UP West Line - New Start (3869)	0.51	(0.06)	Not evaluated				
Metra	70	Metra Rock Island Improvements	0.50	0.04	29	154	(18)	0.07	1.73
Kendall County	71	BNSF Extension-Oswego/Plano	0.70	0.05	21	3,141	37	0.14	7.26
Metra	72	BNSF Improvements	0.27	0.04	6	45	(1)	0.02	0.45
Metra	79	Milwaukee District West Improvements	0.63	(0.03)	19	100	(6)	0.11	2.94
CDOT	85	Chicago Union Station Master Plan Implementation	1.00	0.01	Not evaluated				
CDOT	88	Chicago Union Station Master Plan Implementation-Phase II	2.00	0.05	16	812	(2)	0.09	1.87
CTA	93B	Blue Line Forest Park Reconstruction	1.73	(0.08)	17	226	(14)	0.34	71.83
Metra	98	A-2 Crossing Rebuild	1.10	0.02	20	NB	(56)	0.30	16.70
Pace	102	Pace Short Term ART	0.15	(0.00)	32	57	(4)	0.02	0.21
CDOT	104	South Lakefront-Museum Campus Access Improvements	0.20	(0.01)	6	NB	(2)	0.09	1.87
CTA	106	Ashland Avenue BRT (Irving Park to 95th)	0.16	0.04	13	30	(1)	0.02	0.76

Project submitter	RSP ID	Description	Project cost characteristics		Cost-effectiveness of 2050 performance				
			2021 Capital cost $M	10 Years incremental operating cost $M	Dollars per project rider ('000s)	Dollars per change in regional ridership ('000s)	Dollars per change in work trip transit travel time $M	Dollars per change in jobs accessible in 60 minutes $M	Dollars per change in jobs accessible in 90 minutes $M
CTA	108	South Halsted BRT	0.15	0.03	67	310	18	0.04	1.72
CTA	147	Blue Line Core Capacity Project	1.10	0.18	13	NB	(4)	0.12	3.24
CDOT	153	Ashland-Ogden Metra Infill Station	0.27	(0.01)	4	91	4	0.06	4.40
Pace	154	South Halsted Bus Enhancements	0.04	0.02	141	NB	(2)	0.01	0.49
Pace	155	I-294 Tri-State Express Bus Stations	0.11	0.06	56	48	4	0.01	0.21
Metra	156	Metra Milwaukee Corridor Improvements	-	0.04	80	7	(1)	0.01	0.73
CTA	165	Brown Line Core Capacity	2.43	(0.06)	21	542	(20)	0.55	17.95
CDOT	A1	O'Hare Express Service	1.00	-	294	1,395	(1)	0.00	0.09

NB = no benefit

Table 11. Transit project planning priorities

Project submitter	RSP ID	Project	Project use by residents of EDAs	Support for infill development	Economic impact due to industry clustering ($M)	Freight Improvement	Change in access to low barrier to entry jobs for residents of EDAs in 60 minutes	Change in access to low barrier to entry jobs for residents of EDAs in 90 minutes	Change in greenhouse gas emissions (metric tons/day)
CTA	57	Red Line Extension (South)	32%	77%	$50	-	161	326	(42)
CTA	58B	Red Purple Modernization Future Phases	25%	72%	$165	-	42	82	(124)
Metra	66	UP NW Line New Start (3870)	4%	34%	$45	-	209	218	(58)
Metra	68	Metra UP North Improvements	24%	64%	$42	-	91	660	(71)
Metra	70	Metra Rock Island Improvements	31%	56%	$33	50	314	519	(44)
Kendall County	71	BNSF Extension-Oswego/Plano	24%	59%	$44	-	103	107	(56)
Metra	72	BNSF Improvements	35%	66%	$185	25	676	864	(71)
Metra	79	Milwaukee District West Improvements	22%	67%	$52	25	202	725	(99)
CDOT	88	Chicago Union Station Master Plan Implementation-Phase II	30%	75%	$288	-	1,096	1,413	(48)
CTA	93B	Blue Line Forest Park Reconstruction	29%	79%	$57	-	23	170	(85)
Metra	98	A-2 Crossing Rebuild	34%	66%	$67	-	67	179	(51)
Pace	102	Pace Short Term ART	28%	83%	$3	-	713	1,289	(44)
CDOT	104	South Lakefront-Museum Campus Access Improvements	45%	81%	$0.4	-	150	247	(50)
CTA	106	Ashland Avenue BRT (Irving Park to 95th)	55%	88%	$7	-	258	288	(68)
CTA	108	South Halsted BRT	67%	83%	$0	-	105	124	(50)

Project submitter	RSP ID	Project	Project use by residents of EDAs	Support for infill development	Economic impact due to industry clustering ($M)	Freight Improvement	Change in access to low barrier to entry jobs for residents of EDAs in 60 minutes	Change in access to low barrier to entry jobs for residents of EDAs in 90 minutes	Change in greenhouse gas emissions (metric tons/day)
CTA	147	Blue Line Core Capacity Project	30%	79%	$86	-	395	534	(36)
CDOT	153	Ashland-Ogden Metra Infill Station	25%	66%	$56	-	59	(157)	(30)
Pace	154	South Halsted Bus Enhancements	77%	73%	$0	-	122	130	(22)
Pace	155	I-294 Tri-State Express Bus Stations	47%	62%	$3	-	804	3,071	(18)
Metra	156	Metra Milwaukee Corridor Improvements	13%	83%	$1	-	56	140	(108)
CTA	165	Brown Line Core Capacity	23%	72%	$114	-	132	163	(96)
CDOT	A1	O'Hare Express Service	1%	57%	$4	-	10,827	19,473	23

NB = no benefit

Expressways

Table 12. Expressway project evaluation for today's needs

Project submitter	RSP ID	Description	Structural deficiency of bridges (thousands	Pavement condition	Safety	Mobility	Reliability
IDOT	22	I-294/I-57 Interchange Addition	New facility				
IDOT	30	I-290 Eisenhower Reconstruction and Managed Lane	0	33	9	91	92
IDOT	32	I-190 Access Improvements	57	33	12	57	48
IDOT	33	Jane Byrne Interchange Reconstruction	Not evaluated				
IDOT	34	I-55 Add Lanes and Reconstruction	0	23	74	22	40
IDOT	36	Western I-80 Reconstruction and Mobility Improvements	278	46	30	21	18
IDOT	37	I-80 Managed Lanes	0	30	43	23	22
IDOT	146	I-55 Stevenson Managed Lanes	65	29	32	63	62
IDOT	157	I-57 at Eagle Lake Road	New facility				
IDOT	A3	I-55 from Weber Road to US 30; I-55 at Airport/Lockport Road & at IL 126	0	66	32	11	14
IDOT	A4	I-55 - I-80 to US 52 and at IL 59; US 52 - River Road to Houbolt Road	0	66	5	6	2
Tollway	20	Elgin O'Hare Western Access	New facility				
Tollway	21	I-290/IL 53/I-90 Interchange Improvement	0	18	6	72	100
Tollway	23	I-294 Central Tri-State Reconstruction and Mobility Improvements	33	38	1	45	50
Tollway	24	I-290/I-294 Interchange Improvement	Not evaluated				

Table 13. Expressway project 2050 performance

Project submitter	RSP ID	Description	Change in congested vehicle hours traveled (VHT) in region ('000s hours daily)	Change in congested VHT in corridor (1000's hours daily)	Change in regional work trip travel time (minutes)	Change in work trip travel time in corridor (minutes)	Change in job accessibility ('000s)	Change in fatalities and serious injuries per year
IDOT	22	I-294/I-57 Interchange Addition	0.6	0.4	0.01	-0.01	0.0	1.1
IDOT	30	I-290 Eisenhower Reconstruction and Managed Lane	3.1	6.0	-0.09	-0.28	51.5	-2.3
IDOT	32	I-190 Access Improvements	-5.6	-5.5	0.00	-0.01	1.1	0.8
IDOT	33	Jane Byrne Interchange Reconstruction	Not evaluated					
IDOT	34	I-55 Add Lanes and Reconstruction	-10.6	-7.0	0.00	0.03	1.0	-4.5
IDOT	36	Western I-80 Reconstruction and Mobility Improvements	-22.8	-7.1	-0.05	-0.47	2.1	-10.0
IDOT	37	I-80 Managed Lanes	-26.9	-4.6	-0.09	-0.52	11.8	-16.7
IDOT	146	I-55 Stevenson Managed Lanes	-30.9	-11.7	-0.20	-0.56	47.8	-13.4
IDOT	157	I-57 at Eagle Lake Road	-0.3	0.2	0.00	-0.08	-0.4	0.8
IDOT	A3	I-55 from Weber Road to US 30; I-55 at Airport/Lockport Road & at IL 126	-2.8	0.3	-0.01	0.03	2.7	-1.1
IDOT	A4	I-55 - I-80 to US 52 and at IL 59; US 52 - River Road to Houbolt Road	-0.6	-0.7	0.00	-0.02	0.9	0.0
Tollway	20	Elgin O'Hare Western Access	-28.7	-23.1	-0.05	-0.21	8.6	-9.4
Tollway	21	I-290/IL 53/I-90 Interchange Improvement	6.9	-0.5	0.01	0.03	1.0	-5.5
Tollway	23	I-294 Central Tri-State Reconstruction and Mobility Improvements	-24.2	-13.9	-0.07	-0.15	16.4	-8.0
Tollway	24	I-290/I-294 Interchange Improvement	Not evaluated					

Table 14. Expressway project 2050 performance cost-effectiveness

Project submitter	RSP ID	Description	2021 capital cost $M	10 years Incremental operating Cost $M	Dollars per change in congested VHT in region ('000s)	Dollars per change in Congested VHT in corridor ('000s)	Dollars per change in regional work trip travel time $B	Dollars per change in work trip travel time in corridor $B	Dollars change in job accessible in 45 minutes ('000s)
IDOT	22	I-294/I-57 Interchange Addition	50	0.23	NB	NB	NB	5	NB
IDOT	30	I-290 Eisenhower Reconstruction and Managed Lane	3,200	5.2	NB	NB	36	11	62
IDOT	32	I-190 Access Improvements	911	1.1	163	165	NB	91	868
IDOT	33	Jane Byrne Interchange Reconstruction	1	0.3	Not evaluated				
IDOT	34	I-55 Add Lanes and Reconstruction	890	8.8	84	128	NB	NB	914
IDOT	36	Western I-80 Reconstruction and Mobility Improvements	1,131	6.4	50	160	23	2	550
IDOT	37	I-80 Managed Lanes	2,250	7.0	84	491	25	4	191
IDOT	146	I-55 Stevenson Managed Lanes	556	18.4	18	48	3	1	12
IDOT	157	I-57 at Eagle Lake Road	206	0.1	638	NB	NB	3	572
IDOT	A3	I-55 from Weber Road to US 30; I-55 at Airport/Lockport Road & at IL 126	183	0.2	65	NB	18	NB	68
IDOT	A4	I-55 - I-80 to US 52 and at IL 59; US 52 River Road to Houbolt Road	199	4.0	307	277	NB	10	234
Tollway	20	Elgin O'Hare Western Access	666	21.8	23	29	13	3	78
Tollway	21	I-290/IL 53/I-90 Interchange Improvement	326	0.6	NB	717	NB	NB	343
Tollway	23	I-294 Central Tri-State Reconstruction and Mobility Improvements	659	9.0	27	47	9	4	40
Tollway	24	I-290/I-294 Interchange Improvement	388	1.3	Not evaluated				

NB = No Benefit

Table 15. Expressway project planning priorities

Project submitter	RSP ID	Description	Change in congested VHT for heavy trucks in region ('000s daily hours)	Change in congested VHT for heavy trucks in corridor ('000s daily hours)	Freight improvement	Change in greenhouse gas emissions (metric tons/day in 2050)	Change in development pressure in conservation areas (count of new households)	Direct impact on conservation areas	Development pressure in areas at risk of groundwater desaturation (count of new households)	Change in impervious area (acres)	Project use by residents of EDAs (% of VMT)	Change in fine particulate Matter emissions in EDAs (g/day in 2050)	Change in access to low barrier jobs for EDAs (job count)	Economic impact due to industry clustering ($M)	Support of infill development	Benefit to key industries	Benefits to areas with industrial vacancy
IDOT	22	I-294/I-57 Interchange Addition	0.04	0.21	100	-28.1	0	Low	0	0	29	-56	0	$1.5	22	25	33
IDOT	30	I-290 Eisenhower Reconstruction and Managed Lane	-0.79	-0.01	88	-24.7	115	Medium Low	126	49	30	1,071	3,572	$97.1	64	75	75
IDOT	32	I-190 Access Improvements	-0.33	0.00	38	-54.9	145	Medium Low	170	17	8	-134	-13	$9.1	50	91	91
IDOT	33	Jane Byrne Interchange Reconstruction	Not evaluated														
IDOT	34	I-55 Add Lanes and Reconstruction	-1.47	-1.47	89	-4.4	132	Medium High	295	38	3	-569	50	$1.6	5	16	16
IDOT	36	Western I-80 Reconstruction and Mobility Improvements	-5.13	-2.43	100	-96.4	100	Medium	39	52	10	-1,278	130	$6.1	16	33	25
IDOT	37	I-80 Managed Lanes	-1.39	0.40	100	-130.3	97	Medium High	217	53	13	-954	581	$13.9	22	50	58
IDOT	146	I-55 Stevenson Managed Lanes	-1.21	-0.27	100	-34.1	171	High	316	110	23	-927	2,622	$79.0	45	66	66

Project submitter	RSP ID	Description	Change in congested VHT for heavy trucks in region ('000s daily hours)	Change in congested VHT for heavy trucks in corridor ('000s daily hours)	Freight improvement	Change in greenhouse gas emissions (metric tons/day in 2050)	Change in development pressure in conservation areas (count of new households)	Direct impact on conservation areas	Development pressure in areas at risk of groundwater desaturation (count of new households)	Change in impervious area (acres)	Project use by residents of EDAs (% of VMT)	Change in fine particulate Matter emissions in EDAs (g/day in 2050)	Change in access to low barrier jobs for EDAs (job count)	Economic impact due to industry clustering ($M)	Support of infill development	Benefit to key industries	Benefits to areas with industrial vacancy
IDOT	157	I-57 at Eagle Lake Road	-0.31	-0.02	80	-22.6	0	Low	0	0	7	-125	-117	$0.05	5	8	8
IDOT	A3	I-55 from Weber Road to US 30; I-55 at Airport/Lockport Road & at IL 126	-0.50	-0.11	92	-39.2	113	Medium	130	48	6	-385	129	$1.0	16	41	50
IDOT	A4	I-55 - I-80 to US 52 and at IL 59; US 52 - River Road to Houbolt Road	-0.54	-0.21	92	-37.3	139	Low	204	11	5	-178	-33	$0.6	8	0	0
Tollway	20	Elgin O'Hare Western Access	-2.27	-1.57	77	12.7	117	High	184	157	13	300	744	$50.4	50	100	100
Tollway	21	I-290/IL 53/I-90 Interchange Improvement	-0.25	-0.05	87	-79.6	0	Low	0	0	14	-370	15	$0.3	34	58	41
Tollway	23	I-294 Central Tri-State Reconstruction and Mobility Improvements	-3.15	-1.45	100	-23.1	104	High	83	51	10	-1,845	896	$28.1	45	83	83
Tollway	24	I-290/I-294 Interchange Improvement	Not evaluated														

Arterials

Table 16. Arterial project evaluation for today's needs

Project submitter	RSP ID	Description	Structural deficiency of bridges (1000 ft2)	Pavement condition	Safety	Mobility	Reliability
CDOT	152	Elston-Armitage-Ashland-Cortland Intersection Improvement	0	41	32	77	86
CDOT	A2	South Lakefront Improvements	14	44	55	50	45
IDOT	6	IL 31/Front Street	0	33	8	42	27
IDOT	10	IL 60/IL 83	0	66	5	64	67
IDOT	11	IL 62/Algonquin Road	0	47	8	41	39
IDOT	13	IL 83/Milwaukee Avenue	0	20	18	43	49
IDOT	14	IL 131/Green Bay Road	0	14	6	38	21
IDOT	15	IL 173/Rosecrans Road	0	35	13	45	42
IDOT	89	North DuSable Lake Shore Drive Improvements	16	44	27	79	82
IDOT	109	IL 43/Harlem Avenue	0	51	28	66	38
IDOT	110	IL 47	2	28	11	44	31
IDOT	111	IL 83/Kingery Highway	0	18	15	66	68
IDOT	112	US 12/US 20	0	39	79	80	92
IDOT	113	US 20/Lake Street	59	38	41	27	21
IDOT	114	US 45/IL 83/Old Half Day Road	0	22	13	60	39
IDOT	151	CREATE - Central Avenue	0	42	18	75	85
IDOT	158	US 6	0	36	10	33	30
IDOT	159	US 30	0	45	9	45	49
IDOT	160	US 45 and Milburn By-Pass	0	28	3	24	18
IDOT	161	IL 7/143rd Street	0	20	4	50	30
IDOT	162	IL 47	0	33	7	40	26
IDOT	163	IL 56	0	43	7	41	41
IDOT	164	IL 60	0	51	9	38	45
IDOT	166	IL 47	0	37	10	51	34
Will	53	Caton Farm-Bruce Road Corridor	0	27	25	53	54
Will	55	CH 74/Laraway Road	0	20	20	39	26

Table 17. Arterial project planning priorities

Project submitter	RSP ID	Description	GIV impact index	Expected traffic growth (percent)	Project use by residents of EDAs (percent VMT)	Economic impact due to industry clustering	Benefits to key industries	Benefits to areas with industrial vacancy	Freight improvement
CDOT	152	Elston-Armitage-Ashland-Cortland Intersection Improvement	56	8	27	45	96	87	5
CDOT	A2	South Lakefront Improvements	8	14	35	8	88	91	5
IDOT	6	IL 31/Front Street	84	10	3	5	12	29	33
IDOT	10	IL 60/IL 83	52	10	8	6	20	16	27
IDOT	11	IL 62/Algonquin Road	28	10	12	3	68	70	34
IDOT	13	IL 83/Milwaukee Avenue	32	17	8	6	24	25	28
IDOT	14	IL 131/Green Bay Road	16	19	19	1	32	0	28
IDOT	15	IL 173/Rosecrans Road	80	28	7	2	60	54	28
IDOT	89	North DuSable Lake Shore Drive Improvements	48	N/A	21	58	84	83	3
IDOT	109	IL 43/Harlem Avenue	44	13	33	44	80	75	77
IDOT	110	IL 47	92	33	3	3	40	41	27
IDOT	111	IL 83/Kingery Highway	100	5	7	59	100	100	37
IDOT	112	US 12/US 20	24	33	41	4	56	58	67
IDOT	113	US 20/Lake Street	96	16	13	10	92	95	38
IDOT	114	US 45/IL 83/Old Half Day Road	68	11	10	22	64	45	27
IDOT	151	CREATE - Central Avenue	12	30	35	18	52	62	25
IDOT	158	US 6	40	75	15	12	0	8	67
IDOT	159	US 30	36	84	7	3	16	33	29
IDOT	160	US 45 and Milburn By-Pass	0	25	3	0	28	4	26
IDOT	161	IL 7/143rd Street	4	110	6	13	4	12	1
IDOT	162	IL 47	88	51	2	0	72	66	29
IDOT	163	IL 56	60	12	14	6	76	79	27
IDOT	164	IL 60	72	15	10	6	44	37	3
IDOT	166	IL 47	76	86	3	2	48	72	71
Will	53	Caton Farm-Bruce Road Corridor	20	58	12	6	8	20	28
Will	55	CH 74/Laraway Road	64	38	11	7	36	50	27

Project descriptions

Projects are sorted first by transit, expressway, and arterial, and then by project submitter and RSP ID number.

Transit

West Loop Transportation Center Phase I (CDOT, RSP ID# 85)

Project description

This project would improve the existing facilities east of and within Union Station. The project would increase the capacity within the existing footprint of the station by creating new platforms and tracks, and repurposing inactive tracks and platforms. It also expands the passenger-carrying capacity of existing platforms by reconfiguring the station's internal spaces to increase passenger capacity and creating the capability to through-route some intercity trains.

West Loop Transportation Center Phase II (CDOT, RSP ID# 88)

Project description

This project would construct the West Loop Subway component of the West Loop Transportation Center. This project would include a new underground transitway along Clinton and/or Canal streets with key transfer stations located between the Eisenhower Expressway and Lake Street in Chicago. The subway may also include multiple levels or alignments within the West Loop area to accommodate additional tracks and platforms for inter-city and/or commuter trains.

South Lakefront-Museum Campus Access Improvement (CDOT, RSP ID# 104)

Project description

This project would add new access points and stations to the existing McCormick Place Busway, transforming it into the South Lakefront Busway. The project also considers alternatives for linking Museum Campus institutions with each other, as well as CTA's Red and Green Lines, the proposed South Lakefront Busway, and the rapidly redeveloping Cermak Road corridor that extends from McCormick Place to Motor Row and Chinatown. CTA bus routes #2, #6, #J14, #26, and #28 are expected to use the McCormick Place Busway.

Ashland-Ogden Metra Infill Station (CDOT, RSP ID# 153)

Project description

This will construct a new Metra station between Ashland and Ogden avenues, serving the UP-W, MD-N, MD-W, and NCS lines, as well as potentially Amtrak.

O'Hare Airport Express Service (CDOT, RSP ID# A1)

Project description

Express train service between O'Hare International Airport and Chicago's central business district. As currently envisioned, this would be constructed and operated by a private entity but neither the exact scope of service nor the alignment have been determined.

Red Line Extension (South) (CTA, RSP ID# 57)

Project description

The CTA Red Line Extension Project will extend the Red Line south from the 95th Street terminal to the vicinity of 132nd Street in Chicago. The proposed 5.6-mile heavy rail extension will include four new stations near 103rd Street, 111th Street, Michigan Avenue, and 130th Street. Multimodal connections at each station would include bus, bike, pedestrian, and park and ride facilities. The project also would include a new railyard and shop near 120th Street. The project is a major component of CTA's Red Ahead program, a comprehensive initiative for maintaining, modernizing, and expanding Chicago's most traveled rail line.

Red Purple Modernization Phase One (CTA, RSP ID# 58)

Project description

The Red Purple Modernization Phase One project will expand capacity along the CTA's Red and Purple heavy rail lines. The project includes several elements that will allow CTA to expand service in the corridor. The Lawrence to Bryn Mawr Modernization (LBMM) will modernize, expand, and strengthen ADA accessibility at four Red Line stations (Lawrence, Argyle, Berwyn, and Bryn Mawr). The LBMM project will reconstruct six miles of track and structure from Leland Avenue on the south to near Ardmore Avenue on the north. The Red-Purple Bypass (RPB) will construct a grade-separated bypass for the Brown Line at Clark junction, just north of the Belmont station. This would remove the largest physical capacity constraint in the RPM corridor, where three separate services on six tracks merge onto four tracks. This work also will realign and replace approximately 1.4 miles of associated mainline (Red and Purple line) tracks from Belmont station on the south to the stretch of track between Newport and Cornelia avenues on the north. This work would increase speed, reliability, and capacity in the project corridor. Work also includes a new signal system from Belmont to Howard, covering over 23 miles of track. This new signal system would allow for increased throughput of trains and increased reliability of operation, as well as a pre-stage work and upgrades to the Broadway substation.

Red Purple Modernization Future Phases (CTA, RSP ID# 58)

Project description

This project would continue the modernization and expansion of the Red and Purple Lines, from the Addison to Sheridan stations and from the Thorndale to Linden stations. Work would include reconstructing track, structures, viaducts, expanded stations and platforms, and adding ADA accessibility. This phase may also include addressing capacity constraints at Howard Yard, construction of infill power substations (based on power needs), and other related infrastructure improvements within the corridor. The project will seek funding from the federal Core Capacity program.

Blue Line Forest Park Reconstruction (CTA, RSP ID# 93)

Project description

This project would reconstruct the Forest Park branch of the Blue Line. It includes full modernization of existing infrastructure, rehabilitation of all track and ballast, ADA accessibility and modernization of stations, and upgrades to power systems and future capacity increases. The project will reconstruct and reconfigure the Forest Park terminal and yard. The Forest Park Branch Program will be delivered in phases. The first phase is funded ($360,992,660). It includes track work (subway portal to IMD), Racine station, and the Hermitage substation.

Ashland Ave BRT (CTA, RSP ID# 106)

Project description

This project would construct a Bus Rapid Transit line in the Ashland Avenue corridor between Irving Park Road and 95th Street.

South Halsted BRT (CTA/Pace, RSP ID# 108)

Project description

This project would add Bus Rapid Transit service or other bus improvements to the Halsted corridor between the 79th Street Red Line station and the Harvey Transportation Center.

Blue Line Core Capacity (CTA, RSP ID# 147)

Project description

This project will use results from a comprehensive planning study that will recommend a package of capacity improvements for CTA's Blue Line from the Forest Park terminal to the O'Hare terminal. This package will be intended to meet Core Capacity CIG requirements. Work may include rehabilitating stations and platforms to allow for longer trains, upgrading ADA accessibility, identifying turnback locations or storage tracks to allow for feeder trains, modifying track geometry, upgrading power systems, reconfiguring and reconstructing the rail yard and shop, modifying signal systems, and enhancing other technology to improve operations. Upgrades to existing infrastructure based on current condition may be recommended, if required, even if it does not meet Core Capacity requirements.

Brown Line Core Capacity (CTA, RSP ID# 165)

Project description

The project would address capacity issues on the Brown Line that have emerged since the Brown Line Capacity Expansion project was completed in 2009. It would add capacity by reconstructing the yard and shop, reconfiguring the Kimball terminal, constructing new turnback track west of the Western Brown Line station, reconstructing tight radius curves, and upgrading signal and power systems. Additional state of good repair projects could be coupled with this project (but are not included in this estimate and are not eligible for federal 5309 Core Capacity funds).

BNSF Extension-Oswego/Plano (Kendall County, RSP ID# 71)

Project description

This project would extend Metra BNSF service from its current terminus in Aurora to Oswego in Kendall County. Preliminary engineering and environmental analysis have been initiated. It has been exempted from the New Starts evaluation process by federal action. The project involves an extension of RTA service since Kendall County falls outside of RTA's service area. Project financing requires special attention as a result. Metra has identified Kendall County as the sponsor for this project. The total cost is dependent on the final stop and several other variables that will be determined as the engineering work continues.

UP Northwest Line Extension (Metra, RSP ID# 66)

Project description

This project would extend the Union Pacific Northwest line to Johnsburg in McHenry County, improve signals and tracks, and add two infill stations at Prairie Grove and the eastern side of Woodstock, as well as new coach yards in Woodstock and Johnsburg.

SouthWest Service Improvements / 75th St CIP Elements (Metra, RSP ID# 67)

Project description

This project, which is part of the CREATE 75th Steet Corridor Improvement Project, would allow Metra's SouthWest Service to move from Union Station to the LaSalle Street station. This change would increase the frequency of service on the SouthWest Service line. The project would also construct a new track that improves reliability and reduces operational conflicts.

UP North Line Improvements (Metra, RSP ID# 68)

Project description

This project would install additional crossovers and track improvements, construct an outlying coach yard, upgrade existing stations for increased capacity, construct a new station at Peterson Avenue, and improve the existing UP-N Hubbard Woods station.

UP West Line Improvements (Metra, RSP ID# 69)

Project description

This project would construct a third mainline track for segments that are double tracked. It also would upgrade the signal system, enhance safety through various improvements, and add new crossovers.

Rock Island Line Improvements (Metra, RSP ID# 70)

Project description

This project would construct a third mainline track to the nine-mile, double-track portion between Gresham junction and a point north of the 16th Street junction. The project builds on the CREATE P12 Project, a rail flyover that eliminates the conflict between Metra trains and freight and Amtrak trains.

BNSF Line Improvements (Metra, RSP ID# 72)

Project description

This project would improve tracks, signals, and other elements along the BNSF Line to support growth in ridership and upgrades to the capacity of the line.

Milwaukee District West Line Improvements (Metra, RSP ID# 79)

Project description

This project would improve tracks, signals, and other elements along the Milwaukee District West Line to support increased capacity.

A-2 Crossing (Metra, RSP ID# 98)

Project description

This project would build a flyover to replace the A2 Crossing near Western Avenue and Kinzie Street between Union Pacific and Milwaukee District tracks. The rebuilt flyover will help reduce conflicts between Metra's Milwaukee District North, Milwaukee District West, North Central Service, and Union Pacific West trains. It also will help passengers save travel time.

Metra Milwaukee Corridor Improvements (Metra, RSP ID# 156)

Project description

This project would provide a direct, high-quality transit link between downtown Chicago and O'Hare, the region's busiest airport. This would involve portions of new dedicated track to best serve the growth in the express and local markets. Metra is studying this project to refine the scope, costs, and benefits.

Pulse-ART Expansion – Near Term (Pace, RSP ID# 102)

Project description

This project would expand the Pulse Network (Arterial Rapid Transit) at various locations. Pace currently operates the Milwaukee Line and is in the process of implementing the Dempster Line. Other expansions include the Halsted and 95th Street Lines, both currently in the environmental review phase of the project development process, with engineering design and construction funding for the 95th Street Line anticipated through the CMAQ program. More information on the Halsted Line is included separately in the South Halsted Bus Enhancements project (Pace, RSP ID# 154). The Cermak Line is planned as the next Pulse corridor to advance. Other existing and potential Near-Term Priority Pulse corridors such as Harlem Avenue and North Avenue are currently being evaluated by Pace and will be identified in future updates to the RSP list as applicable.

South Halsted Bus Enhancements (Pace, RSP ID# 154)

Project description

This project would expand the Pulse Network (Arterial Rapid Transit). Pace and CTA are coordinating on the South Halsted Bus Corridor Enhancement project, an 11-mile corridor along South Halsted Street between 79th Street in Chicago and Pace's Harvey Transportation Center. It includes both 79th and 95th streets between Halsted Street and the CTA Red Line. This corridor is shared by CTA and Pace bus service between 95th Street and 127th Street in Chicago. CTA solely provides service north of 95th Street along the corridor, while Pace solely provides service south of 127th Street. Project improvements include the construction of the Pulse Halsted Line, CTA bus station improvements north of 95th Street, queue jumps and bus-only lane segments, CNG-powered Pulse buses, and transit signal upgrades within Chicago.

Transit signal priority (TSP) locations at suburban intersections is being pursued separately through an RTA regional TSP grant.

I-294 Tri-State Express Bus Stations (Pace, RSP ID# 155)

Project description

This project will construct two new in-line bus rapid transit stations along the 1-294 Tri-State Tollway at various locations, including: O'Hare oasis in Schiller Park, south of Irving Park Road and east of Mannheim Road; and just north of Cermak Road in Oak Brook at the former toll plaza facility. Improvements include new bus shelters, platforms, transfer opportunities to local Pace fixed route services, passenger amenities, and pedestrian infrastructure and ADA upgrades, as well as connections to a new Pace Express service proposed along the Tri-State corridor. Additional improvements at the Cermak Road location in Oak Brook include bus-only ramps, platforms a park-and-ride lot, and a pedestrian bridge spanning the tollway, as well as potential connections to the Pulse Cermak and/or Roosevelt Lines. At the O'Hare oasis location, buses would use the existing ramps and passengers may benefit from a pedestrian bridge planned by the Illinois Tollway Authority. Total project cost on this sheet includes additional facility upgrades currently being considered in this corridor. The costs are being finalized as coordination with the Tollway on this project and the proposed station designs continues.

Expressway

I-290 Managed Lane (IDOT, RSP ID# 30)

Project description

This project would reconstruct and modernize the I-290 (Eisenhower Expressway) from the I-88 interchange to Racine Avenue. The project includes an express toll lane from Mannheim Road to Racine Avenue and coordination with the Forest Park Blue Line reconstruction project.

I-190 Access Improvements (IDOT, RSP ID# 32)

Project description

This project consists of reconfiguring arterial access to I-190 and O’Hare International Airport to improve mobility and reduce collisions, as well as ultimately reconstruct and add capacity to mainline I-190.

Jane Byrne Interchange (IDOT, RSP ID# 33)

Project description

This project would reconstruct and modernize the Jane Byrne Interchange (interchange of I-90/I-94 with I-290). While mostly involving reconstruction, the project would add capacity in the form of an additional lane on the east-north and north-west ramps, as well as three new flyovers. A new through-lane also will be added on I-90/I-94 through the interchange.

I-55 Add Lanes and Reconstruction (IDOT, RSP ID# 34)

Project description

This project would reconstruct I-55, add a lane in each direction, and improve interchanges through western Will County from the I-80 interchange south to Coal City Road.

I-57 Add Lanes (IDOT, RSP ID# 35)

Project description

This project would reconstruct I-57 and interchanges from I-80 to the Kankakee County border.

I-80 Add / Managed Lanes (IDOT, RSP ID# 36)

Project description

This project would add a lane to I-80 through southwestern Cook and Will counties from Ridge Road to U.S. Route 30.

I-80 Managed Lanes (IDOT, RSP ID# 37)

Project description

This project would add a managed lane in each direction to the existing six-lane cross section between U.S. Route 30 and I-294.

I-94 Bishop Ford Expressway (IDOT, RSP ID# 135)

Project description

This project would reconstruct the Bishop Ford Expressway (I-94), including interchanges, from I-57 to U.S. Route 6, and implement bus on shoulders, and add auxilliary lanes from I-57 to Stoney Island.

I-90/1-94 Kennedy and Dan Ryan Expressways (IDOT, RSP ID# 136)

Project description

This project would reconstruct the Kennedy and Dan Ryan Expressways (I-90/I-94) from Hubbard Street to 31st Street. The work would include widening the road for managed lanes, reconstructing and widening Hubbards Cave, reconstructing interchanges, and replacing bridges.

I-55 Stevenson Expressway (IDOT, RSP ID# 137)

Project description

This project on I-55 would reconstruct all general purpose lanes from Lake Shore Drive to I-80; rehabilitate pavement on managed lanes; add lanes from Lake Shore Drive to I-90/I-94; add an auxiliary westbound lane from I-355 to Illinois Route 53; reconstruct I-90 and I-294 interchanges; allow buses on shoulders south of I-355 to Illinois Route 126; and preserve various other interchanges.

I-90 Kennedy Expressway (IDOT, RSP ID# 138)

Project description

This project on I-90, from Jane Adams tollway to the I-94 merge, would add managed lanes, reconstruct the road, reconstruct and preserve interchanges, and reconstruct bridges.

I-94 Edens Expressway (IDOT, RSP ID# 139)

Project description

This project on I-94, from the tollway spur to Lawrence Avenue, would reconstruct the road, widen and convert bus-on-shoulder lanes to managed lanes, reconstruct and replace bridges, and reconstruct and preserve service interchanges.

I-90/I-94 Kennedy Expressway (IDOT, RSP ID# 140)

Project description

This project on I-90/I-94, from the Edens junction to Hubbard Street, would convert express lanes to managed lanes, and reconstruct the road and service interchanges.

I-290/IL-53 (IDOT, RSP ID# 141)

Project description

This project would reconstruct I-290 and Illinois Route 53 from I-88 to Lake Cook Road. It includes widening the road for auxiliary lanes southbound from Illinois Route 390 to I-355 and from Illinois Route 56 to South York Street. It also would reconstruct interchanges and bridges.

I-57 (IDOT, RSP ID# 142)

Project description

This project would reconstruct I-57 from I-94 to I-80 and add lanes from 95th Street to 111th Street. It also would allow for bus on shoulder implementation and reconstruct interchanges.

I-55 Stevenson Managed Lane (IDOT, RSP ID# 146)

Project description

The project would add managed lanes within the existing median of I-55 between I-90/I-94 and I-355. The corridor is anticipated to include Intelligent Transportation Systems (ITS), which would help manage congestion.

I-57 at Eagle Lake Road (IDOT, RSP ID# 157)

Project description

This project will construct a new full interchange at Illinois Route 57 and Eagle Lake Road to improve accessibility.

I-55 from Weber Road to US 30; I-55 at Airport/Lockport Rd & at IL 126 (IDOT, RSP ID# A3)

Project description

This project would improve access to I-55 by reconstructing and transforming the partial interchange at Illinois Route 126 to a full interchange. It also would construct a new interchange at Airport Road/Lockport Street and make ancillary improvements. The interchanges at Illinois Route 126 and Airport/Lockport are separated by approximately two miles.

I-55 - I-80 to US 52 (Jefferson St) and at IL 59; US 52 Jefferson St - River Rd to Houbolt Rd (IDOT, RSP ID# A4)

Project description

This project would improve regional mobility and provide better local interstate access. The portion of the project involving I-55, from I-80 to U.S. Route 52, would convert a partial interchange to a full-access interchange at I-55 and Illinois Route 59. This work would include a new structure over I-55 and add auxiliary lanes from Route 59 to U.S. Route 52. The portion of the project involving Route 52, from River to Houbolt roads, includes reconstruction, bridge widening and repair, widening pavement, and adding turn and through lanes.

Elgin O'Hare Western Access (Tollway, RSP ID# 20)

Project description

This project would provide a new, limited-access facility to reduce congestion and improve access to O’Hare International Airport. The project includes three main components. It would reconstruct and widen the existing Elgin-O'Hare Expressway (Illinois Route 390). It would extend the expressway east to O'Hare. It also would add an expressway around the western side of O'Hare from I-90 to I-294 (the western bypass). All three components would be tolled.

I-290/IL 53 Interchange Improvement (Tollway, RSP ID# 21)

Project description

This project would reconfigure the existing system interchange to alleviate the bottleneck between I-290/Illinois Route 53 and I-90.

I-294/I-57 Interchange Addition (IDOT, RSP ID# 22)

Project description

This project would construct a full-access interchange between I-294 and I-57, improve accessibility to and from the south suburbs, and improve north-south regional travel. The project has been divided into two phases. The first phase involves constructing new ramps to connect northbound I-57 to northbound I-294 and southbound I-294 to southbound I-57. It also would construct an entrance and exit ramp from I-294 to 147th Street. The second phase of the project involves the remaining interchange connections.

I-294 Central Tri-State Mobility Improvements (Tollway, RSP ID# 23)

Project description

This project would reconstruct and improve the Central Tri-State from Balmoral Avenue to 95th Street. The project would upgrade pavement, integrate flex lanes, implement SmartRoad technology, widen roads where needed, and reconfigure the interstate interchanges. It also potentially could add local access interchanges, as well as add barriers to reduce noise, improve stormwater management, and better accommodate truck and freight activity. This project would bring the corridor into a state of good repair.

I-290/I-294 Interchange Improvement (Tollway, RSP ID# 24)

Project description

This project would reconfigure the existing system interchange between I-290 and I-294.

Arterial

Elston-Armitage-Ashland-Cortland Intersection Improvement (CDOT, RSP ID# 152)

Project description

This project will realign Elston Avenue to the Mendell Street right-of-way. This will increase intersection spacing to improve traffic safety and capacity for all modes. The project will relocate one existing railroad viaduct over Elston and replace and expand two existing railroad viaducts over Armitage Avenue. It also will build an Armitage Avenue bridge over North Branch to strengthen the street grid and improve traffic safety and circulation in this congested area.

South Lakefront Improvements (CDOT, RSP ID# A2)

Project description

The project would involve closing certain road segments and improving others. Improvements include adding a southbound travel lane on South DuSable Lake Shore Drive from 57th Drive to Hayes Drive. Specifically, the project will remove sections of Cornell Drive, Midway Plaisance, and Marquette Drive. It would add capacity on Stony Island Avenue, DuSable Lake Shore Drive, and small remaining sections of Cornell and Midway. The project's bicycle and pedestrian improvements include new and improved trails, pedestrian refuge islands and curb extensions, and five new underpasses. Transit improvements include bus stop relocation and consolidation, bus bulbs, and traffic signal modernization to allow for future implementation of interconnected signals or transit signal priority.

IL-31 Front Street (IDOT, RSP ID# 6)

Project description

This project would add lanes to Illinois Route/Front Street from Illinois Route 120 to Illinois Route 176.

IL-60 (IDOT, RSP ID# 10)

Project description

This project would add lanes to Illinois Route 60, from Illinois Route 176 to the CN Railroad tracks. It also would create a grade separation, dettaching Illinois Route 60 from the railroad tracks.

IL-62/Algonquin Road (IDOT, RSP ID# 11)

Project description

This project would add lanes to Illinois Route 62/Algonquin Road from Illinois Route 125 Illinois Route 68.

IL-83/Barron Boulevard (IDOT, RSP ID# 13)

Project description

This project would add lanes to Illinois Route/Barron Boulevard from Petite Lake Road to Ilinois Route 120/Belvidere Road.

IL-131/Greenbay Road (IDOT, RSP ID# 14)

Project description

This project would add lanes to Illinois Route 131/Green Bay Road from Russell Road to Sunset Avenue.

IL-173/Rosecrans Road (IDOT, RSP ID# 15)

Project description

This project would add lanes to Illinois Route 173/Rosecrans Road from Illinois Route 59 to U.S. Route 41/Skokie Highway.

North DuSable Lake Shore Drive Reconstruction (IDOT, RSP ID# 89)

Project description

This project would reconstruct U.S. Route 14/DuSable Lake Shore Drive from Hollywood Avenue to Grand Avenue. The project could will improve safety and make it easier for all users to reach neighboring communities. This well-traveled corridor also has high bus transit ridership and provides a key travel facility for bicyclists and pedestrians. The corridor is limited in size, making high quality transit options with enough capacity essential. This project will ensure the corridor can accommodate growing travel demand now and in to the future.

IL-43/Harlem Avenue (IDOT, RSP ID# 109)

Project description

This project would separate Illinois Route 43 from the BRC Railroad tracks at 65th Street.

IL-47 (IDOT, RSP ID# 110)

Project description

This project would add lanes to Illinois Route 47, north of Charles Road, to U.S. Route 14. It also would improve and replacetheUP Railroad bridge.

IL-83/Kingery Highway (IDOT, RSP ID# 111)

Project description

This project would add lanes to Illinois Route 83 from 31st Street to 55th Street, as well assouth of 63rd Street to south of Central Avenue.

US-12/95th Street (IDOT, RSP ID# 112)

Project description

This project would improve the intersection of U.S. Route 12/95th Street and Stony Island Avenue. It will relcoate bridge and railroad tracks.

US-20/Lake Street (IDOT, RSP ID# 113)

Project description

This project would reconstruct U.S. Route/Lake Street, west of Randall Road to east of Shales Parkway. The project involves replacing bridges and improving safety and intersections.

US-45/Olde Half Day Road (IDOT, RSP ID# 114)

Project description

This project would add lanes to U.S. Route 45/Olde Half Day Road from Illinois Route60/Townline Road to Illinois Route 22/Half Day Road.

Central Avenue (IDOT, RSP ID# 151)

Project description

This project would separate Central Avenue from the Belt Railway of Chicago tracks at 54th Street. The project is GS2 in the CREATE program.

US 6 from I-55 to US 52 (IDOT, RSP ID# 158)

Project description

This project will increase the capacity of U.S. Route 6 from I-55 to U.S. Route 52.

US 30 from IL 47 to Albright Road (IDOT, RSP ID# 159)

Project description

This project will add lanes and reconstruct existing ones on U.S. Route 30 from Illinois Route 47 to Albright Road. The bridge also will be replaced.

US 45 and Milburn By-Pass from IL 173 to IL 132 (IDOT, RSP ID# 160)

Project description

This project will add lanes and reconstruct existing ones on U.S. Route 45, north of Milburn Bypass to north of Illinois Route 173.

IL 7/l43rd Street from Will-Cook Line to IL 7/Southwest Highway (IDOT, RSP ID# 161)

Project description

This project will reconstruct Illinois Route 7 (143rd Street) from the Will-Cook line to Illinois Route 7 (Southwest Highway).

IL 47 from south of I-90 to south of Old Plank Road (IDOT, RSP ID# 162)

Project description

This project will add lanes and reconstruct existing ones on Illinois Route 47, south of I-90 to south of Plank Road.

IL 56 from Kirk Road to IL 59 (IDOT, RSP ID# 163)

Project description

This project will add lanes and reconstruct existing ones on Illinois Route 56 (Butterfield Road) from Illinois Route 25 to Illinois Route 59 (Joliet Road)..

IL 60 from IL 120 to IL 176 (IDOT, RSP ID# 164)

Project description

This project will add lanes and reconstruct existing ones on Illinois Route 60 from Illinois Route 120 (Belvidere Road) to Illinois Route 176.

IL 47 from Cross Street to Kennedy Road (IDOT, RSP ID# 166)

Project description

This project will add lanes and reconstruct existing ones on Illinois Route 47 from Cross Street to Kennedy Road.

Caton Farm-Bruce Road Corridor (Will County, RSP ID# 53)

Project description

This project will address a new east/west corridor within north central Will County. The work involves upgrading existing roads and adding and aligning new roads. Improvements include adding a new crossing over the Des Plaines River Valley, adding and upgrading a dozen signals, and creating a number of new structures.

Laraway Road (Will County, RSP ID# 55)

Project description

This project would add lanes to Laraway Road from U.S. Route 52 to Harlem Avenue.

Appendix A. Evaluation measure details

Addressing today's needs: Transit

Asset condition

Transit asset condition is measured using the Federal Transit Administration's (FTA) asset condition scale (**Table A1**). The score for a project is the value-weighted average for the assets that will be improved or replaced as part of the project. Projects that do not have a state-of-good-repair element receive a score of "N/A." Data comes from transit agencies.

Table A1. FTA condition scale

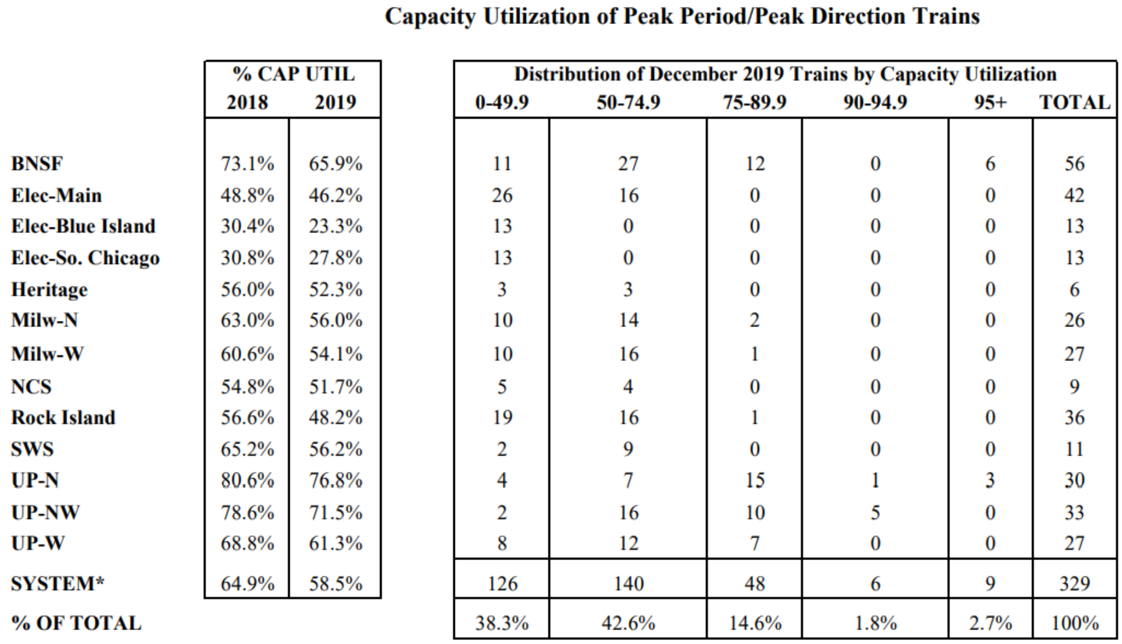
Rating	Condition	Description
Excellent	4.8—5.0	No visible defects, near-new condition
Good	4.0—4.7	Some slight defective or deteriorated components
Adequate	3.0—3.9	Moderately defective or deteriorated components
Marginal	2.0—2.9	Defective or deteriorated components in need of replacement
Poor	1.0—1.9	Seriously damaged components in need of immediate repair

Capacity constraint

There are several ways to measure capacity, including line capacity, signal capacity, electrical system capacity, etc. While all these measures are important, passenger capacity utilization is the most straightforward to estimate and align with FTA Core Capacity requirements. Capacity is only considered for rail projects in the context of ON TO 2050. Bus route capacity tends to be more limited by roadway capacity, which is addressed through improvement projects, such as adding lanes, or through operational treatments, such as transit signal priority. Bus route capacity, therefore, is not a driver of major transit capital project selection.

FTA considers commuter rail to be over capacity when cars are 95 percent full. Consequently, rail lines that frequently carry over-capacity trains are considered to have the highest need for capacity improvements. For example, in **Figure A1** below, BNSF has six trains a day with over 95 percent capacity. Metra lines were ranked based on relative capacity need using information from 2019.

Figure A1. Metra capacity utilization



Capacity Utilization of Peak Period/Peak Direction Trains

	% CAP UTIL		Distribution of December 2019 Trains by Capacity Utilization					
	2018	2019	0-49.9	50-74.9	75-89.9	90-94.9	95+	TOTAL
BNSF	73.1%	65.9%	11	27	12	0	6	56
Elec-Main	48.8%	46.2%	26	16	0	0	0	42
Elec-Blue Island	30.4%	23.3%	13	0	0	0	0	13
Elec-So. Chicago	30.8%	27.8%	13	0	0	0	0	13
Heritage	56.0%	52.3%	3	3	0	0	0	6
Milw-N	63.0%	56.0%	10	14	2	0	0	26
Milw-W	60.6%	54.1%	10	16	1	0	0	27
NCS	54.8%	51.7%	5	4	0	0	0	9
Rock Island	56.6%	48.2%	19	16	1	0	0	36
SWS	65.2%	56.2%	2	9	0	0	0	11
UP-N	80.6%	76.8%	4	7	15	1	3	30
UP-NW	78.6%	71.5%	2	16	10	5	0	33
UP-W	68.8%	61.3%	8	12	7	0	0	27
SYSTEM*	64.9%	58.5%	126	140	48	6	9	329
% OF TOTAL			38.3%	42.6%	14.6%	1.8%	2.7%	100%

Source: Capacity Utilization of Trains: Commuter Rail System, December 2019.

Heavy rail utilization is measured by the FTA and based on usable space per passenger. Table 21 of the CTA's System Wide Rail Utilization and Capacity Analysis[4] provides the number of passengers relative to vehicle capacity (which is like usable space per passenger) at each hour of the day. The most congested period for each train was used to rank the magnitude of capacity constraint on CTA rail.

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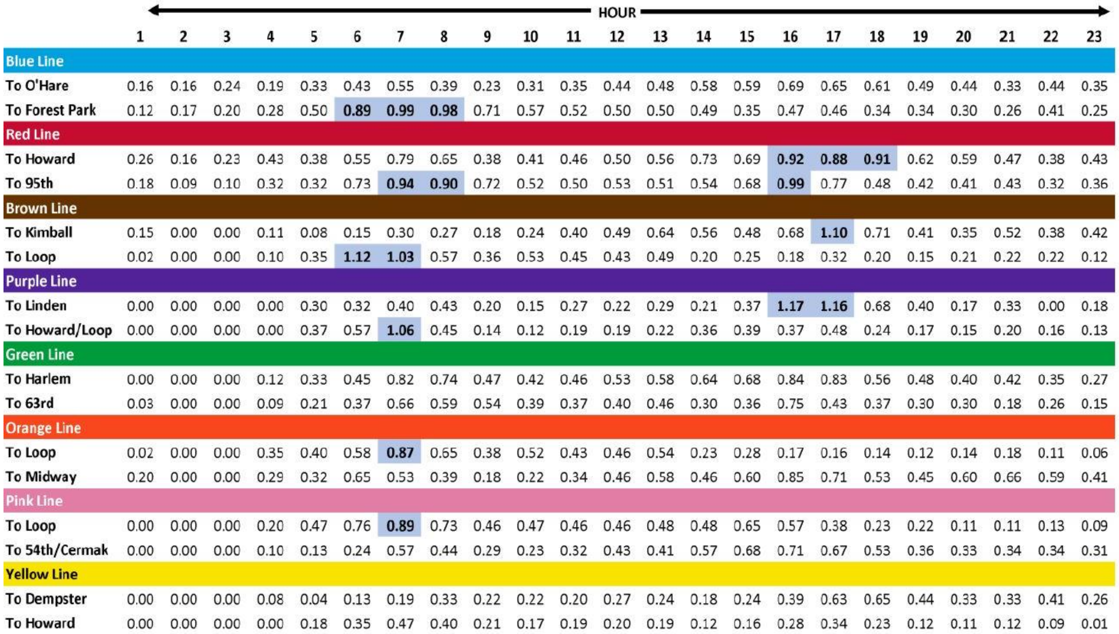
[4] Chicago Transit Authority, "System Wide Rail Capacity Study," 2017, https://www.transitchicago.com/assets/1/6/RP_CDMSMITH_RCM_Task2AExecutiveSummary_20170628_FINAL.pdf.

Figure A2. Chicago Transit Authority rail capacity utilization



											HOUR											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Blue Line																							
To O'Hare	0.16	0.16	0.24	0.19	0.33	0.43	0.55	0.39	0.23	0.31	0.35	0.44	0.48	0.58	0.59	0.69	0.65	0.61	0.49	0.44	0.33	0.44	0.35
To Forest Park	0.12	0.17	0.20	0.28	0.50	**0.89**	**0.99**	**0.98**	0.71	0.57	0.52	0.50	0.50	0.49	0.35	0.47	0.46	0.34	0.34	0.30	0.26	0.41	0.25
Red Line																							
To Howard	0.26	0.16	0.23	0.43	0.38	0.55	0.79	0.65	0.38	0.41	0.46	0.50	0.56	0.73	0.69	**0.92**	**0.88**	**0.91**	0.62	0.59	0.47	0.38	0.43
To 95th	0.18	0.09	0.10	0.32	0.32	0.73	**0.94**	**0.90**	0.72	0.52	0.50	0.53	0.51	0.54	0.68	**0.99**	0.77	0.48	0.42	0.41	0.43	0.32	0.36
Brown Line																							
To Kimball	0.15	0.00	0.00	0.11	0.08	0.15	0.30	0.27	0.18	0.24	0.40	0.49	0.64	0.56	0.48	0.68	**1.10**	0.71	0.41	0.35	0.52	0.38	0.42
To Loop	0.02	0.00	0.00	0.10	0.35	**1.12**	**1.03**	0.57	0.36	0.53	0.45	0.43	0.49	0.20	0.25	0.18	0.32	0.20	0.15	0.21	0.22	0.22	0.12
Purple Line																							
To Linden	0.00	0.00	0.00	0.00	0.30	0.32	0.40	0.43	0.20	0.15	0.27	0.22	0.29	0.21	0.37	**1.17**	**1.16**	0.68	0.40	0.17	0.33	0.00	0.18
To Howard/Loop	0.00	0.00	0.00	0.00	0.37	0.57	**1.06**	0.45	0.14	0.12	0.19	0.19	0.22	0.36	0.39	0.37	0.48	0.24	0.17	0.15	0.20	0.16	0.13
Green Line																							
To Harlem	0.00	0.00	0.00	0.12	0.33	0.45	0.82	0.74	0.47	0.42	0.46	0.53	0.58	0.64	0.68	0.84	0.83	0.56	0.48	0.40	0.42	0.35	0.27
To 63rd	0.03	0.00	0.00	0.09	0.21	0.37	0.66	0.59	0.54	0.39	0.37	0.40	0.46	0.30	0.36	0.75	0.43	0.37	0.30	0.30	0.18	0.26	0.15
Orange Line																							
To Loop	0.02	0.00	0.00	0.35	0.40	0.58	**0.87**	0.65	0.38	0.52	0.43	0.46	0.54	0.23	0.28	0.17	0.16	0.14	0.12	0.14	0.18	0.11	0.06
To Midway	0.20	0.00	0.00	0.29	0.32	0.65	0.53	0.39	0.18	0.22	0.34	0.46	0.58	0.46	0.60	0.85	0.71	0.53	0.45	0.60	0.66	0.59	0.41
Pink Line																							
To Loop	0.00	0.00	0.00	0.20	0.47	0.76	**0.89**	0.73	0.46	0.47	0.46	0.46	0.48	0.48	0.65	0.57	0.38	0.23	0.22	0.11	0.11	0.13	0.09
To 54th/Cermak	0.00	0.00	0.00	0.10	0.13	0.24	0.57	0.44	0.29	0.23	0.32	0.43	0.41	0.57	0.68	0.71	0.67	0.53	0.36	0.33	0.34	0.34	0.31
Yellow Line																							
To Dempster	0.00	0.00	0.00	0.08	0.04	0.13	0.19	0.33	0.22	0.22	0.20	0.27	0.24	0.18	0.24	0.39	0.63	0.65	0.44	0.33	0.33	0.41	0.26
To Howard	0.00	0.00	0.00	0.00	0.18	0.35	0.47	0.40	0.21	0.17	0.19	0.20	0.19	0.12	0.16	0.28	0.34	0.23	0.12	0.11	0.12	0.09	0.01

Source: Chicago Transit Authority System Wide Rail Utilization and Capacity Analysis*,* November 2016.

Note: Projects are matched to the utilization of the line with the maximum capacity constraint. For example, moving the Metra SouthWest Service (SWS) to LaSalle Street station would impact all trains on the congested south concourse of Union Station. While this project is on the SWS infrastructure, it would receive a higher value for its impact on the capacity of the BNSF.

In the project evaluation, the capacity utilization on the line is provided both in raw form (ratio of passenger utilization to capacity for CTA and the number of trains per day with more than 95 percent of seats occupied for Metra), as well as in the following rescaled form. The data available for each mode was used to set relative need on a 10-point scale, with “10” having the highest passenger capacity utilization and “0” having no capacity issues. Most lines with current capacity issues would be scored between 1 and 9, as shown in the table below. No line received a score of 10 to accommodate future ridership growth or revised data from the operators. Rail lines not listed would receive a score of 0, indicating they do not have passenger utilization issues.

Table A2. Need scoring for capacity utilization

	Metra		CTA	
Score	**# Trains with >95% seats occupied per day**	**Lines**	**Passenger Utilization Ratio**	**Lines**
10	10		1.20	
9	9		1.15	Purple
8	8		1.10	Brown
7	7		1.05	
6	6	BNSF	1.00	Red, Blue
5	5		0.95	
4	4		0.90	
3	3	UP-N	0.85	Pink, Orange
2	2		0.80	Green
1	1		0.75	
0	0	All other	<0.75	Yellow

Source: Chicago Metropolitan Agency for Planning analysis based upon Metra and CTA rail capacity utilization data.

Reliability

For Metra rail, the latest published on-time report is used. For CTA rail, agency information on headway adherence is used. Pace Suburban Bus also provided on-time route statistics which were referenced for locations where projects were proposed.

Addressing existing ADA deficiency

This measure indicates if an existing ADA deficiency is significantly reduced or resolved because of a project. The measure is either “Yes” or “No.” For example, a reconstruction project that rebuilt a rail line and several stations would be rated as “Yes” because ADA non-compliant stations would be upgraded during the reconstruction with improvements such elevators. Extension projects and new service do not address an existing deficiency regardless of their design and are categorized as “No.” BRT and ART projects that significantly improve station boarding and information access are rates as “Yes.”

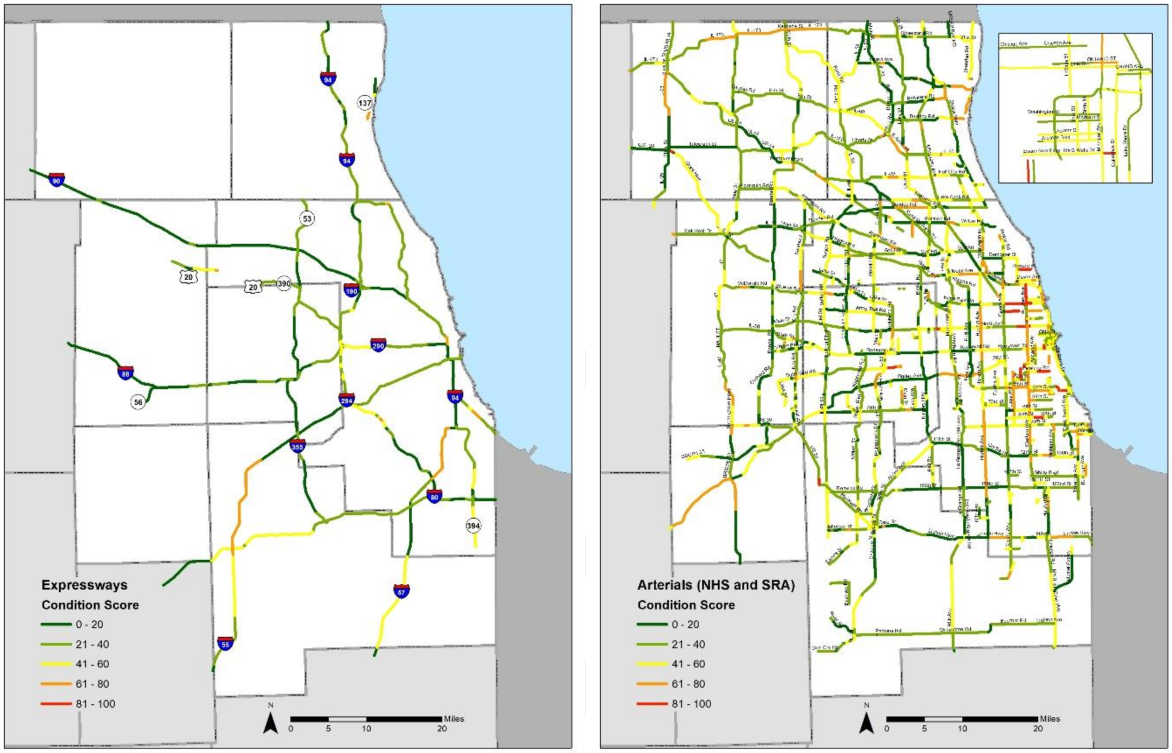
Addressing today’s needs – Highways

Pavement condition

For expressways and arterials, condition is assessed based on information about the International Roughness Index (IRI) and the Condition Rating System (CRS) available from the Illinois Roadway Information System (IRIS). IRI measures ride quality while CRS is a more holistic measure of condition. CRS was rescaled from 1 – 9 to 100 – 0, while IRI was rescaled 100 – 0 using the 95th percentile as the maximum. The resulting condition need score is weighted as

(0.8 * CRS score) + (0.2 * IRI score). The project score is the lane-mileage weighted average of the scores of the segments included in the project. A higher number indicates worse condition and more need. Both the expressway and arterial measures are shown in Figure A3.

Figure A3. Expressway condition score (left) and arterial pavement condition score (right)



Source: Chicago Metropolitan Agency for Planning analysis of IRIS data.

Bridge condition

For both expressways and arterials, bridge condition is measured by the area of bridge deck that is structurally deficient. For projects with reconstruction elements, the total deck area of the structurally deficient bridges on the project segment is reported. In other words, a project that addresses more structural deficiency is better than one that addresses less — all else being equal.

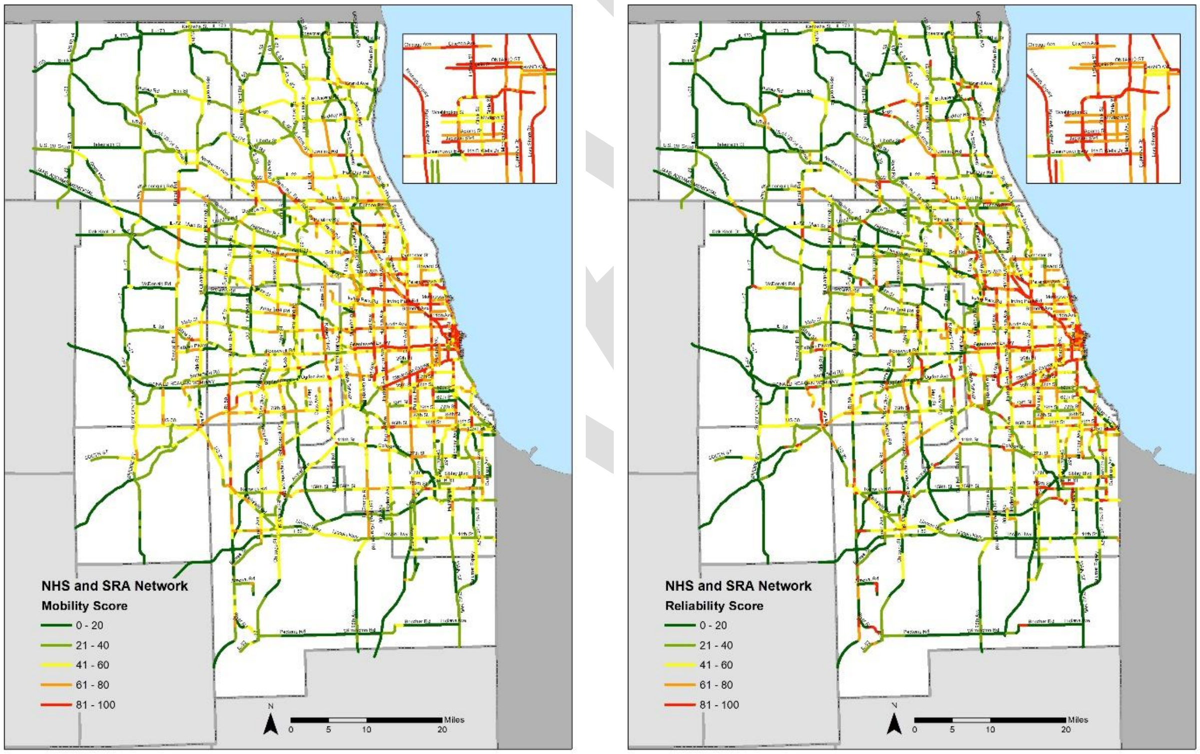
Mobility

Mobility is a composite of the Travel Time Index (TTI) and the congested hours on a segment that represents the intensity and duration of congestion. TTI is congested travel time divided by the free flow travel time, while congested hours is the number of hours each day that a segment is at least lightly congested (i.e., has a TTI ≥ 1.1). Both measures result from the HERE probe-based travel time data. The score is based on the worst road direction and the worse of the AM or PM peak. To convert the TTI and congested hours segment measurements into scores, the segment measurement was divided by the 95th percentile value of all the observations and multiplied by 100. Any measurement above the 95th percentile received a score of 100. The final mobility need score is equal to (0.5 * TTI score) + (0.5 * congested hours score). The project score is the lane-mileage weighted average of the scores of the segments included in the project. A higher score indicates more need and, therefore, a higher priority location.

Reliability

Reliability is based on the planning time index (PTI), or 95th percentile travel time divided by uncongested travel time. The planning time index also results from the HERE probe-based speed data. Segment scores were developed using the same assumptions for the mobility score (i.e., using the worst road direction and the worst of the AM or PM peak index). The reliability need is equal to the planning time index score, indexed 1-100. The project score is the lane-mileage weighted average of the scores of the segments included in the project. A higher score indicates more need and a higher priority location.

Figure A4. Mobility score (left) and reliability score (right)



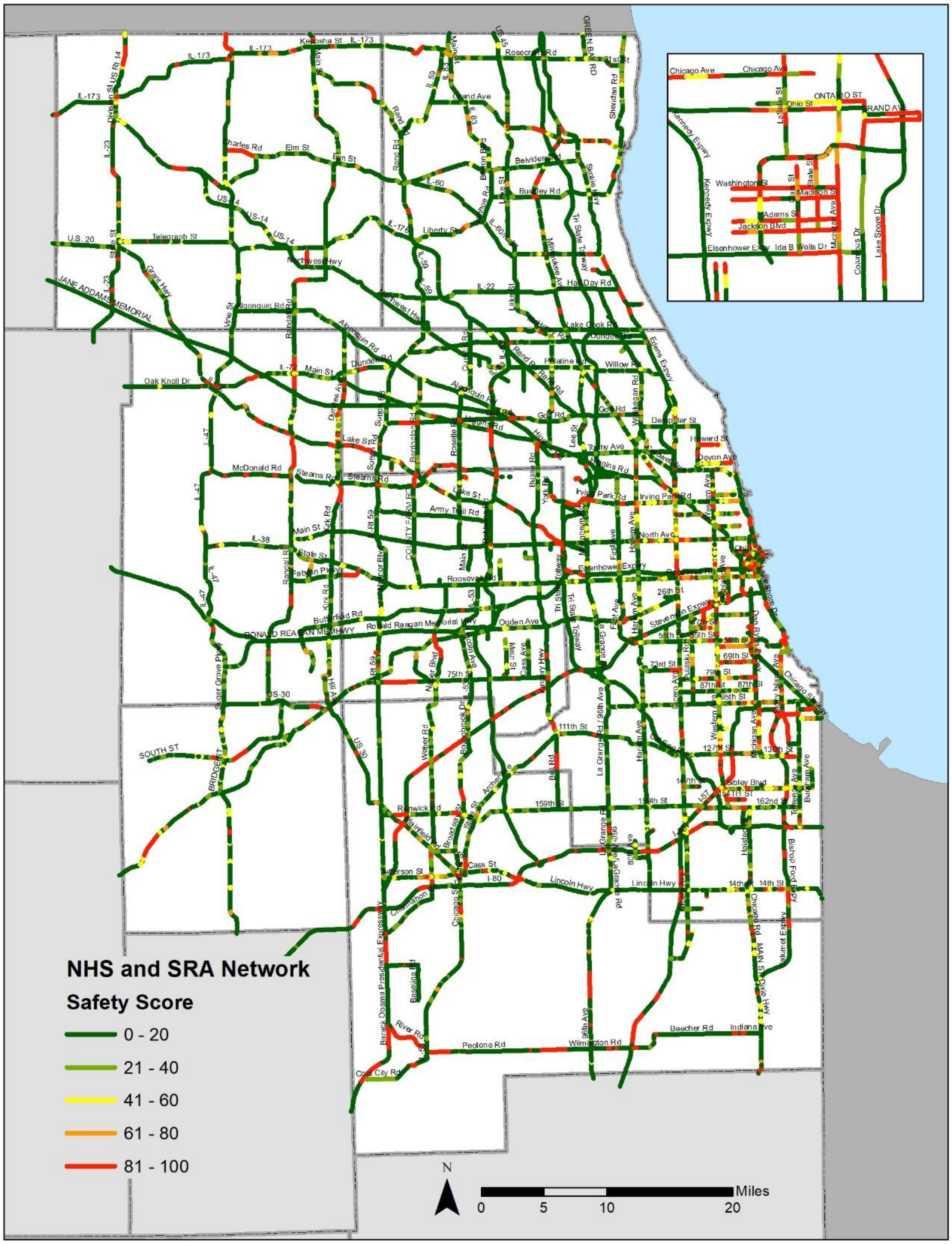
Source: Chicago Metropolitan Agency for Planning analysis of IRIS and HERE data.

Safety

The degree to which a project addresses safety needs is based on the severity of the safety problems on the project segments, as measured by the 2015 total crash serious injury and fatality rate per VMT. It is assumed that safety issues will be addressed during the design process. Rates for each segment were rescaled by dividing the segment measurement by the

95th percentile value of all the observations and multiplying by 100. Any measurement above the 95th percentile received a score of 100. The project score was the lane-mileage weighted average of the scores of the segments included in the project. A higher score indicates more need and a higher priority at the location.

Figure A5. Safety score



Source: Chicago Metropolitan Agency for Planning analysis of IRIS and IDOT Safety Portal data.

2050 Performance: Transit

Travel benefits are estimated using CMAP's travel demand model. Travel benefits are reported for the seven-county CMAP region only, not the larger modeling region. The measures include:

Project ridership (daily)

This measure is the model estimate of the total number of daily boardings expected for the project. Every passenger using a project will get some benefit from the project.

Change in regional ridership (daily)

This measure is the estimate of new regional transit trips expected because of the project. This is a measure of regional travelers who switch to the transit mode.

Change in vehicle revenue hours (annual)

This metric is based on schedules used for modeling. Daily revenue hour values are annualized to inform annual operating cost. Some values are negative, usually indicating that one mode is being replaced by another.

Change in VMT (daily)

This measure is the expected increase or decrease in auto vehicle miles traveled (VMT) each day because of the project, as estimated by the model. It considers the change in auto person miles traveled (PMT) converted to auto VMT based on a regional average vehicle occupancy. This may decrease when a transit project attracts former auto drivers but may occasionally increase in circumstances when a new transit project induces park-and-ride customers to travel longer distances to access an improved service.

Change in average regional work trip transit travel time (minutes)

This measure is the average build time minus average no-build times, where the times are calculated by multiplying transit work trips by access type (walk, kiss and ride, park, and ride) and by corresponding access type transit trip times, and then divided by total transit trips. Travel time includes both the line-haul portion of the trip as well as access time (park and ride, kiss and ride, walk, bike, transit transfer). Work trip travel time is estimated by processing model outputs.

Change in project user commute time (minutes)

For work trips using the project, average transit trip time is calculated for the build and no-build scenarios only including trip interchanges where making a transit trip was possible in both scenarios. Newly served areas which did not allow a transit trip under the no-build condition are excluded from the calculation as "new markets." Travel time includes both the line-haul portion of the trip as well as access time (park and ride, kiss and ride, walk, bike, transit transfer). Work trip travel time is estimated by processing model outputs.

Change in fatality and serious injuries per year

Transit travel has a much lower rate of fatal crashes and somewhat lower rate of serious injury crashes. By reducing auto travel, transit is estimated to avoid be fatalities or serious injuries by reducing opportunities for crashes.

Change in jobs accessible within 90 minutes and 60 minutes for average resident

The model is used to determine the average number of jobs that can be reached by a household from anywhere in the region within both a 90- and a 60-minute transit travel time. To estimate the change in jobs accessible, the average number of jobs accessible to a household in the no-build condition is subtracted from the average number of jobs accessible to a household in the build condition. The difference measures the regional improvement in accessibility the transit project provides based on improved travel times.

2050 Performance: Expressways

2050 travel conditions with and without the project are compared to estimate project travel benefits. All projects were evaluated using an "existing and committed" network, which includes the 2019 network with Northeastern Illinois TIP projects expected to be existing in 2050. Most TIP projects are small arterial improvements. However, the Elgin-O'Hare Western Access is under construction today, and it is expected to be completed soon. The project is tested by adding it to the existing and committed network, running the regional trip-based model, and extracting desired results. The change between no-build and build measures was calculated accordingly, using the difference between the appropriate scenarios. The characteristics of individual projects were coded into the model based on information supplied by the project submitters.

Congestion reduction

Congestion reduction is measured by change in daily vehicle-hours traveled in congested conditions ("congested VHT"), both in the CMAP region and in a five-mile corridor around the facility. It includes all network traffic occurring within the CMAP area, even if it originates or is destined to areas outside the CMAP area. Congested highway links were identified with a volume/capacity ratio exceeding 0.9 and located within the CMAP area. Total volume was multiplied by the congested travel time for each of eight time periods of the day. This calculation includes all vehicles, both autos and trucks. The change between build and no-build was calculated by simple subtraction of one total from the other.

For the corridor congested VHT, only links within the five-mile buffer of the project were considered. These links were identified through a GIS exercise for both build and no-build conditions. The total for the corridor includes traffic on the new project. For heavy truck regional and corridor congested VHT, the calculations were carried out in the same way, but only heavy truck vehicles were multiplied by link travel time.

Change in work trip travel time

Average work travel time is calculated for both the build and no build scenarios by multiplying home based work auto person trips originating within the CMAP area by the A.M. peak congested highway time and then dividing by total CMAP area home-based work person trips. The no-build average is subtracted from build average.

Job access

To estimate the number of jobs per household that can be reached by auto within 45 minutes, the AM Peak auto travel time was used. This measure is a weighted average per household, so the households at the origin are multiplied by the employment accessible within 45 minutes at the destination. These zonal origin values are summed, the divided by the total number of CMAP area households. The measure is the build average minus the no-build average number of jobs.

Change in number of fatal and serious injuries per year

A project's effect on fatalities and serious injuries is estimated by calculating the total VMT on expressways, arterials, and collectors and then multiplying those values by the appropriate 5-year crash rate for the facility types. The rates only include K and A crashes. On average, arterials are the most dangerous facility per vehicle mile of travel and expressways are the least dangerous. Typically, building additional expressway capacity will draw motorists off of the arterial system and on to the safer expressway system, reducing fatalities and serious injuries. The measure was build minus the no-build expected number of fatalities and injuries.

Planning priorities

Equity impact (project use by EDAs)

CMAP is pursuing an inclusive growth[5] strategy that is meant to help the Chicago region achieve stronger, more sustained prosperity. The emphasis on inclusive growth is reflected in the regionally significant project evaluation. Like in many regions across the nation, minority populations and populations of low income in northeastern Illinois often are geographically

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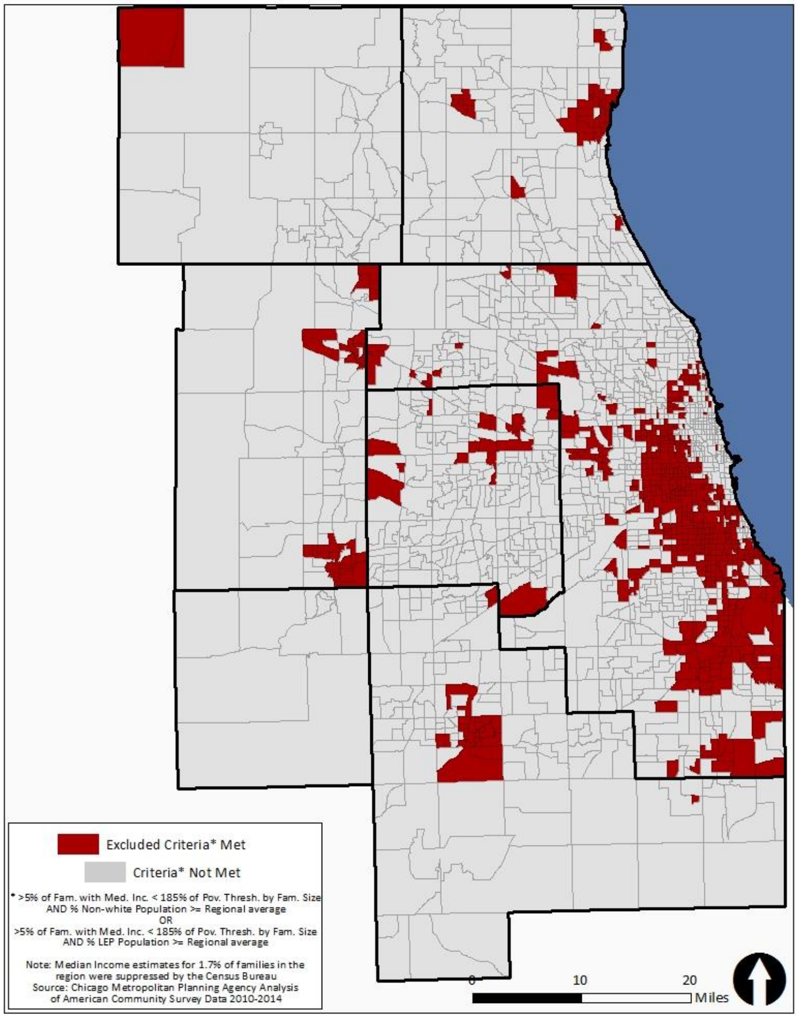
[5] Chicago Metropolitan Agency for Planning, "Inclusive Growth," 2017, http://www.cmap.illinois.gov/documents/10180/515753/Inclusive+Growth+strategy+paper/0f01488d-7da2-4f64-9e6a-264bb4abe537.

concentrated. Segregation by race and income has a deleterious impact on the residents who are secluded within these areas. It also has a negative impact on the entire region.[6] CMAP has identified these areas within the region, calling them “economically disconnected areas” (EDAs).

To be considered an EDA, a census tract must have a concentration of either low-income population and persons of color, or low-income population and limited-English speaking population. The inclusive growth strategy paper explores this methodology in more detail and provides analysis of the differential outcomes for residents of EDAs.

Figure A6. Economically Disconnected Areas in the Chicago region



Source: Chicago Metropolitan Agency for Planning analysis.

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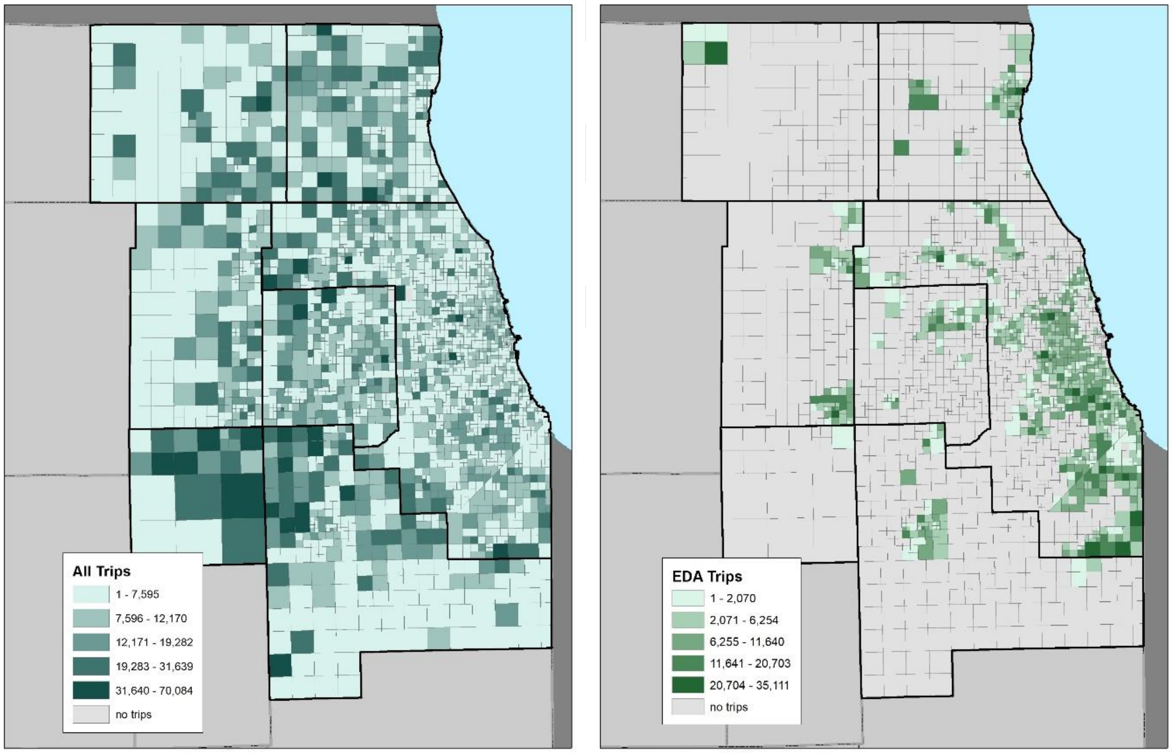
[6] Chicago Metropolitan Agency for Planning, “Fair Housing and Equity Assessment: Metropolitan Chicago,” 2013, http://www.cmap.illinois.gov/livability/housing/fair-housing.

Transit project benefits to EDAs ("equity impact") are measured as the estimated percent of trips on a project that originate from a model zone within the EDAs layer. This layer is based on census tracts, which are then apportioned to travel model subzones and then summed to the traffic analysis zone level. The zonal proportion of economically disconnected area population is applied to the origin of the project trip table, which tracks the origins and destinations of trips using the identified project. The origin zone values are summed, resulting in an estimate of the total of such community trips using the project. This number is divided by total project ridership to arrive at the percent of ridership from EDAs. This is the evaluation measure. For highway projects, the analogous evaluation measure is the percent of VMT on the project that originates in an EDA.

The map in **Figure A7** shows an example analysis for the I-290 Managed Lanes project. The map on the left shows the number of total trips using the project by origin zone, while the map on the right shows just the trips expected to originate within EDAs.

Figure A7. Total trips (left) and trips from Economically Disconnected Areas (right) using I-290 Managed Lanes project



Source: Chicago Metropolitan Agency for Planning analysis.

Low barrier to entry jobs accessible to EDAs

While the percent of trips or percent of VMT on a project originating in EDAs is one measure of benefit to these communities, another important question is the degree to which a project provides these communities with access to jobs. This gives rise to the secondary question of whether residents of disadvantaged communities can take advantage of accessible jobs given their education and training. These questions were analyzed in combination by determining the number of low-barrier but relatively high-paying jobs accessible to EDAs within 60- and 90-minute commutes (transit projects) or 45 minutes (highway projects) with and without a candidate project.

The starting point for this analysis is occupational employment and job openings data (2014 and projected 2024) and worker characteristics (2014) data from Table 1.7 of the Employment Projections program[7] of the U.S. Bureau of Labor Statistics. The table was filtered to identify jobs with:

- Positive projected growth 2014-24
- Median annual wage higher than the national median ($36,200)
- Educational requirements for entry, including:
    - no formal educational credential,
    - high school diploma or equivalent, or
    - postsecondary non degree award
- Less than five years of work experience required

Next, using a crosswalk between occupations and industries, the percent of jobs for each six-digit North American Industrial Classification System (NAICS) code that fall into the middle-skill category was calculated. Then Dun and Bradstreet point GIS data were used to identify the locations and counts of jobs by industry. The map in **Figure A8** shows subzones expected to have 50 or more jobs in low-barrier industries.

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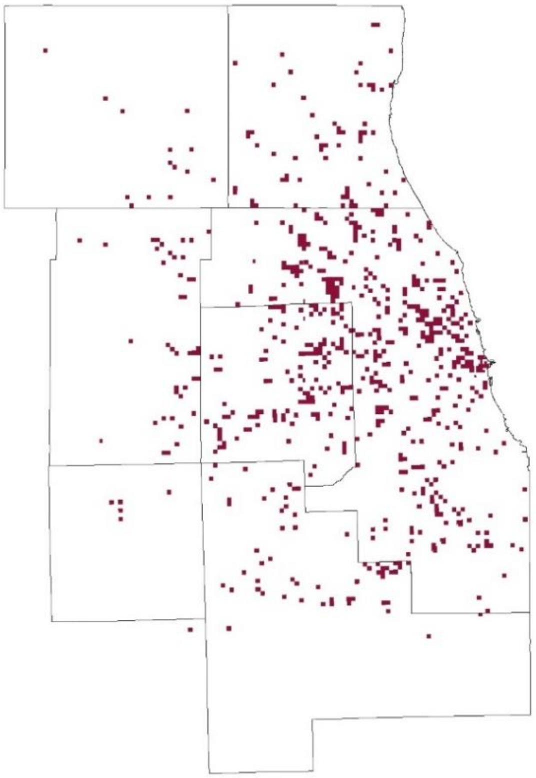
[7] U.S. Bureau of Labor Statistics, "Employment Projections and Occupational Outlook Handbook," accessed May 2018, https://www.bls.gov/news.release/ecopro.toc.htm.

Figure A8. Concentrations of jobs with low barriers to entry by subzone



Source: Chicago Metropolitan Agency for Planning analysis of U.S. Bureau of Labor Statistics and Dun and Bradstreet data.

A transit project’s ability to improve access to low-barrier jobs for EDAs is estimated by first running the trip-based model for each candidate project to determine the change in total jobs accessible to households in the region in aggregate. In these results, the subset of origin-destination (O-D) pairs with origins in excluded community subzones is flagged. The number of low-barrier jobs by destination subzone is also appended to the table. Finally, the table is queried to determine the change in the number of low-barrier jobs accessible within 60 and 90 minutes for workers living in economically disconnected area model zones.

A highway project’s ability to improve access to low-barrier jobs for EDAs is estimated by an analogous method based on the CMAP regional travel model, only using a 45-minute travel time.

Infill support

This measure captures the degree to which a project supports growth in areas that are appropriate for infill development. Based on work done for the CMAP Infill and TOD Snapshot

Report,[8] the region is divided into three categories: minimal, moderate, and highly supportive of infill development (as shown in the map below). The zonal acres in each category are calculated in GIS based on four inputs: housing density, road density, employment density, and land cover.

- Housing unit density — Housing units per square mile (2010-14 ACS)
- Employment density — Employment per square mile (2015 Illinois Department of Employment Security)
- Road density — Road miles per square mile (2016 Navteq)
- Land cover — Percent of a block group that is not agriculture or natural land (2011 National Land Cover Data set and 2010-15 data CMAP's Northeastern Illinois Development Database)

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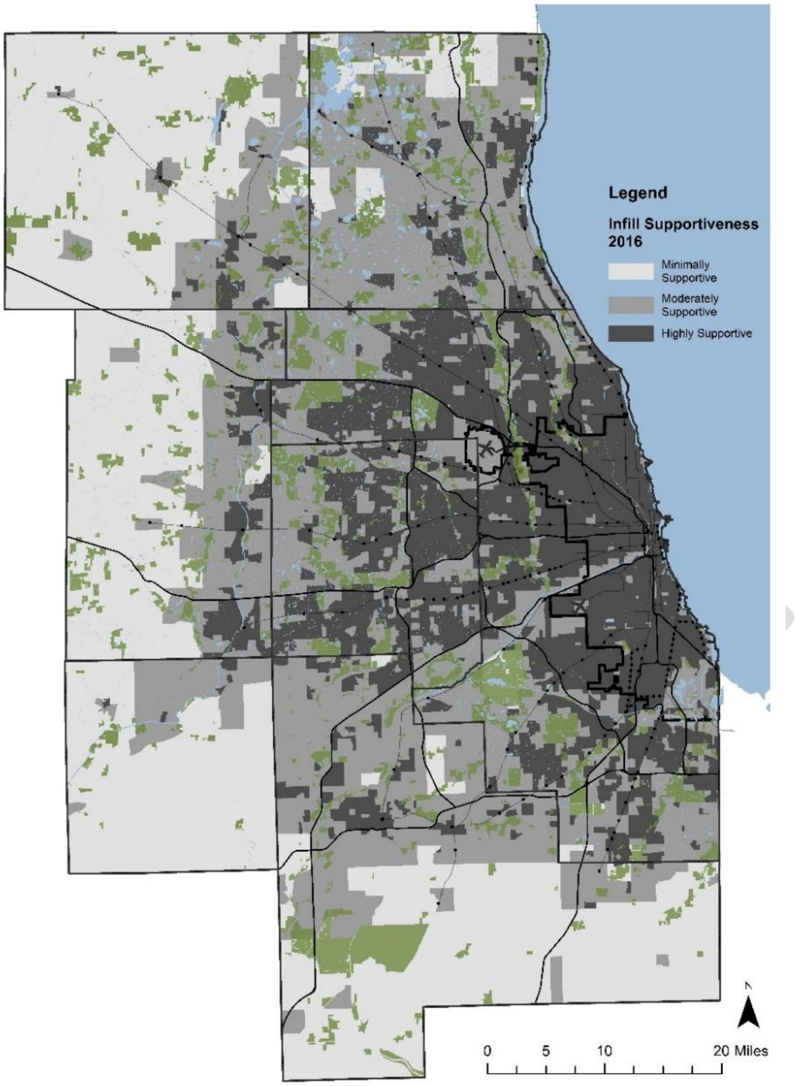
[8] Chicago Metropolitan Agency for Planning, "Infill and TOD," 2018, http://www.cmap.illinois.gov/documents/10180/0/Infill+and+TOD+Snapshot+Report.pdf/4273b7d1-0a16-4c2f-a93e-dce1c2a472fd.

Figure A9. Infill supportiveness



Source: Chicago Metropolitan Agency for Planning analysis.

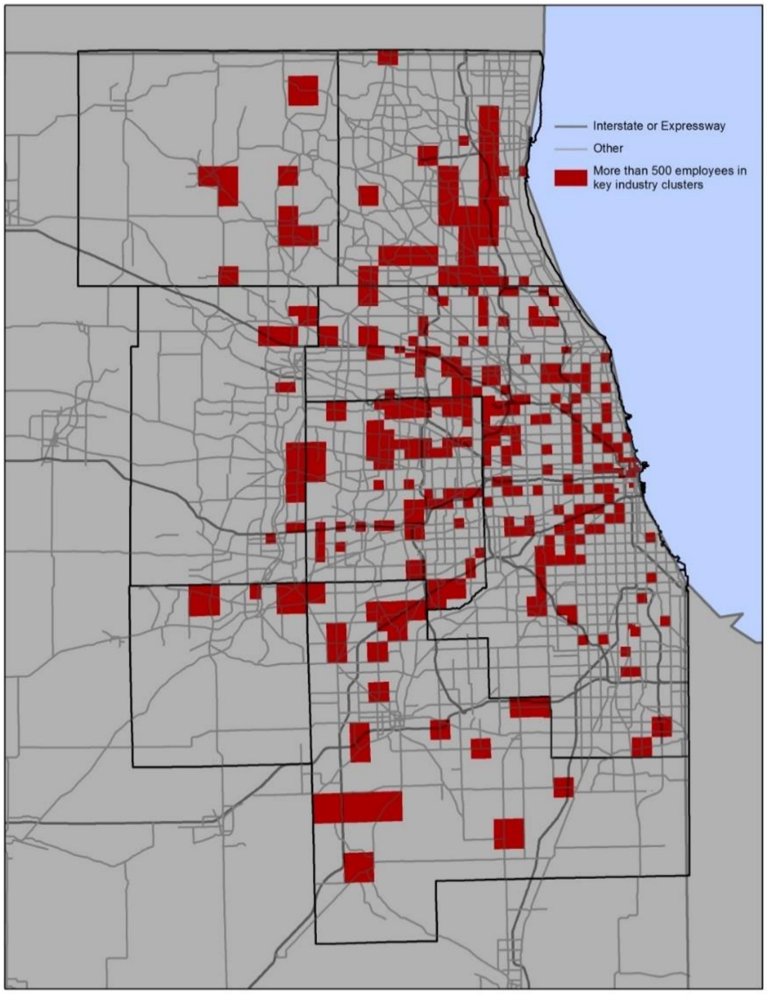
To calculate the infill support score, the project travel shed is identified. This is a table of all the trips using the project derived from the travel model analyses. To determine how well the project serves an origin or destination, the proportion of trips using the project/total trips is calculated. A zone with a high proportion of trips using the project is better served than one with a small proportion. This proportion is applied separately to the acres of high, medium, and low supportive land use acres by origin and destination. Finally, a weighted score is calculated based on the fraction of the acreage in each category where minimally supportive = 0 points, moderately supportive = 50 points, and highly supportive = 100 points. The mix of land uses is the critical characteristic, thereby eliminating the risk that a large project gets a better score merely because it has a larger market.

Benefits to key industries and addressing disinvested industrial areas

While direct mobility benefits of transportation projects are widely understood to have positive economic impacts, the broader changes in economic productivity triggered by transportation investments are a relatively new direction in transportation and economic research. New or improved transportation in an area allows those who live there to access more destinations in a shorter time and allows people from other parts of the region to access the area more quickly and easily. In areas where transportation projects increase access to new customers or labor pools, land values may increase, vacant properties may be developed for new use, and existing businesses may become more profitable.

To evaluate the potential economic impact of arterial transportation projects, CMAP identified the travel shed for each project and calculated the number of jobs in “key industries” within each travel shed. Key industries are industries that are export-oriented, regionally specialized, and sensitive to changes to in-region road transportation costs. Export-oriented industries bring money into the region from national and international markets and have been identified through past CMAP analysis on traded clusters. Regionally specialized industries are clusters with special strength and prominence in northeastern Illinois as compared to the nation, measured as a location quotient greater than 1.0. Industries that spend a higher-than-average percent of their expenditures on in-region transportation are most likely to see profitability and productivity gains from transportation improvements. CMAP also calculated the square footage of vacant flex and industrial rentable building area (RBA) in each project’s travel shed as a measure of a project’s potential to generate new economic activity. Key industry employment and industrial vacancy are each indexed 1-100, with 100 being the best score for a project.

Figure A10. Concentrations of jobs in key industry clusters



Source: Chicago Metropolitan Agency for Planning analysis.

Economic impact from industry clustering

As documented by CMAP[9] and others, there are widely known benefits to geographical clustering by industry. For instance, industries requiring specialized skills benefit from having a large common labor pool. Individual businesses cab draw from a larger supply of labor, while the labor pool itself is more productive because of “knowledge spillovers” as workers interact and move from firm to firm, introducing improvements to business processes. In another example, businesses in an industry cluster may serve as suppliers to one another.

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[9] Chicago Metropolitan Agency for Planning, “Industry clusters in the Chicago metropolitan region,” September 2015, https://www.cmap.illinois.gov/updates/all/-/asset_publisher/UIMfSLnFfMB6/content/industry-clusters-in-the-chicago-metropolitan-region

Benefits of clustering

Industries tend to purchase and consume one another's products in the process of transforming goods and services from raw materials to final products.

Many of the industries require workers with related skills, which can result in a strong labor pool for employers and good job prospects for workers.

Because of labor pooling, supportive entities, and related industries, ideas and innovation can flourish through formal and informal associations, worker movement, and creation of related businesses.

Sources: Chicago Metropolitan Agency for Planning and U.S. Cluster Mapping project.

This is connected to transportation infrastructure because roads and transit help encourage this clustering or agglomeration effect. For instance, a new road or new transit line that shaves a few minutes off typical travel times near a particular industry cluster effectively has expanded the common labor pool by making more workers available within a certain drive time. It also has increased the possibility of knowledge spillovers, making workers more productive. These changes in the business landscape can be measured as the change in available workers within a certain travel time and then as the "effective density" of employment (that is, the number of jobs in a zone plus the number of jobs located in nearby zones, scaled by the travel time between these zones). As the travel time decreases due to a transportation investment, effective density increases. The change in effective density is then translated into an increase in economic output through a method refined by researchers in the United States with the second Strategic Highway Research Program[10].

Effective density, again, is the number of jobs in a zone plus the number of jobs located in nearby zones, scaled by the travel time between these zones. In other words:

$$D = \frac{E_i}{t_{ii}^{\alpha}} + \sum_{j}^{i \neq j} \frac{E_j}{t_{ij}^{\alpha}}$$

In this equation, *D* is effective density, E_i is the employment in zone *i* (the analysis zone), E_j is the employment in each zone *j*, t_{ij} is the travel time between zones *i* and *j*, and α is a factor that measures "decay" in the importance of changes in travel time as travel times get shorter. Travel

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[10] Economic Development Research Group, "SHRP2 Project C11: Accessibility Analysis Tools: Technical Documentation and User's Guide," July 2013, https://planningtools.transportation.org/files/3.pdf.

time between zones is taken from the CMAP travel demand model. The first term of the equation is referred to as the scale factor and represents travel time within a model zone. Travel times within a zone used in the scale factor are determined by averaging the travel times to the neighboring zones and dividing the average by two. The effective density is calculated for the build and no-build condition.

Once the change in effective density resulting from a project is calculated, the next step is to estimate how this affects productivity. Numerous studies have estimated how productivity increases with increased effective density in various industries. CMAP's review of the literature suggests that the general categories of production, construction, consumer services, and producer services had different responses to industry clustering mediated by transportation, as measured by the elasticity of productivity — the percent change in productivity resulting from a 1 percent change in effective density. This is shown below:

Table A3. Industrial groupings used for the calculation of wider transportation economic benefits

Industry group	NAICS codes	Elasticity of productivity
Production	11, 21, 31, 32, 33	0.021
Construction	23	0.034
Consumer Services	42, 44, 45, 48, 71, 81	0.024
Producer Services	51, 52, 53, 54, 55, 56	0.083
General	All others	0.043

Source: Daniel Graham, Stephen Gibbons, and Ralf Martin, "Transport Investment and the Distance Decay of Agglomeration Benefits," (February 2009).

The total increase in economic output is calculated from the change in productivity resulting from the transportation project and the regional average output per worker, as follows:

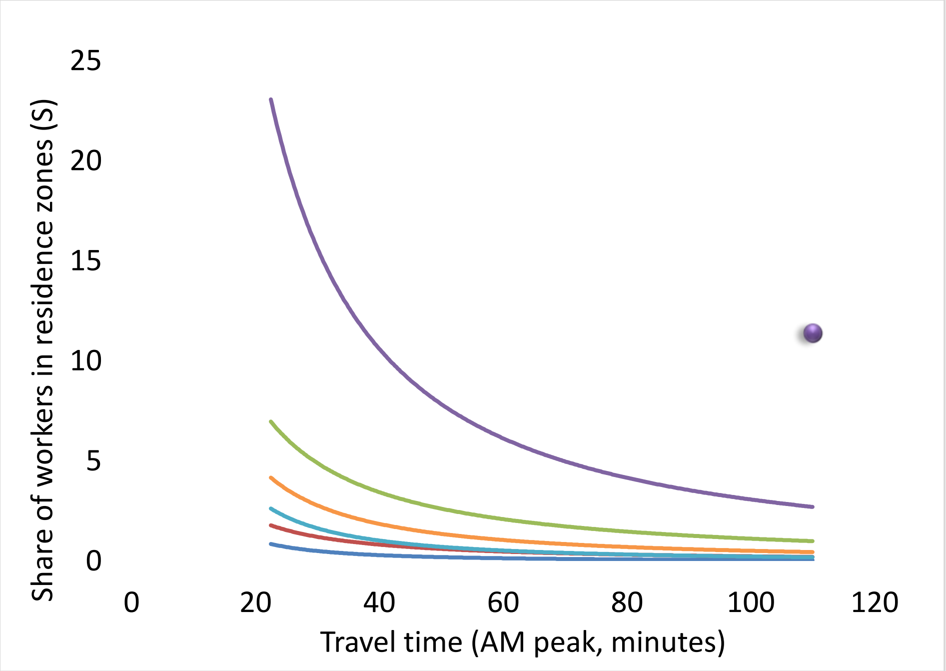
$$\Delta Y = \sum_i \sum_k \left(\frac{D_{b,k}}{D_{nb,k}} - 1 \right) \mu_k \, w_k Z E_{i,k}$$

In this equation, ΔY is change in gross regional product, $D_{b,k}$ is effective density in industry group k with the project and $D_{nb,k}$ is without the project, μ_k is the elasticity of productivity for industry group k, $E_{i,k}$ is the number of employees of industry group k in the zone i, w_k is the wages per worker in the industry, and Z is a factor that relates wages to gross regional product. Wages are a proxy for economic output, as GRP has additional factors included that are missed by the simple aggregation of wages. To estimate the total effect on GRP, a multiplier is used. In the CMAP region, $Z = 3.11$. The data on employment are from the unemployment insurance file (ES-202) from Illinois Department of Employment Security, 1st quarter 2015. Each zone is processed five times using the five elasticities of productivity in the table above.

In addition to increasing the productivity of the labor force through effective density, a second effect from a transportation project is increased economic output due to an increase in the total supply of workers available to businesses in a zone. In other words, if commute times are reduced for the workforce, a business could attract workers at a lower cost. The lower commute times will increase the labor pool who might work at a location. The concept behind this estimate of economic impact due to transportation projects is that, by shortening commutes, employers in a zone will be able to capture more of these potential workers, increasing the labor supply.

To estimate this effect, CMAP used a method based on techniques developed originally by the Department for Transport in Britain[11]. Using data from the Census Longitudinal Employer-Household Dynamics (LEHD) dataset[12], the first step is to determine the zones of residence for the employees in each zone in the region. Then, based on the no-build travel times between these zones (the morning peak period of 7:00 a.m. to 9:00 a.m. was used), the fraction of the workers in each residence zone who travel to a given employment zone was plotted against the travel time between these zones. As in **Figure A11** below, six groups were determined empirically to represent varying degrees of sensitivity to commute time.

Figure A11. Distance decay of employment zones



Source: Chicago Metropolitan Agency for Planning analysis.

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[11] Department for Transport, "TAG UNIT A2.1: Wider Impacts," January 2014, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/427091/webtag-tag-unit-a2-1-wider-impacts.pdf.

[12] U.S. Census Bureau, "Longitudinal Employer-Household Dynamics," accessed May 2018, https://lehd.ces.census.gov/.

The points in the chart above were fit with curves of the form $S = at^{\beta}$ where S is the share of workers in residence zones who work in an employment zone, t is travel time, a is a constant used to fit the curve, and β is a curve-fitting parameter that measures sensitivity to travel time savings. The parameters for each group are as follows:

Group	a	β	Group	a	β
1	1542.6	-1.35	4	326.88	-1.401
2	315.45	-1.224	5	117.45	-1.344
3	421.97	-1.631	6	249.48	-1.823

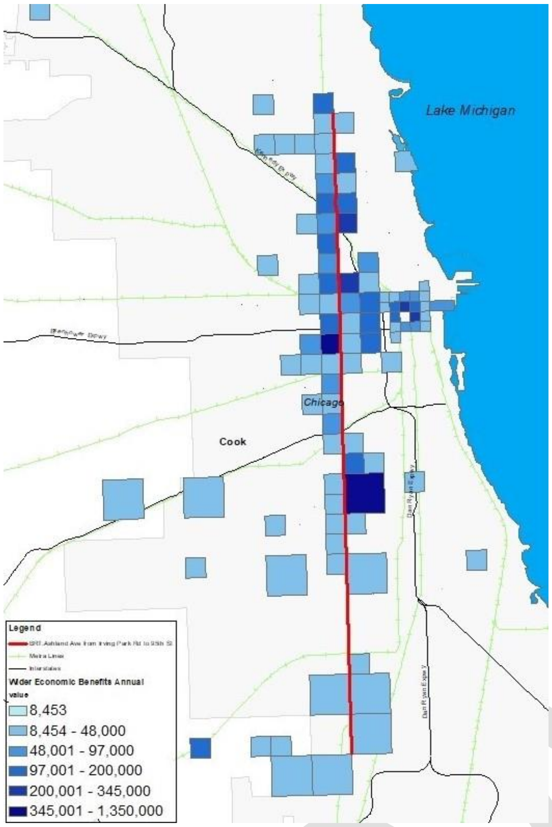
To translate this into economic output, the travel time for each O-D pair is put into the formula for employment share sensitivity to commute time (one of the 6 versions) for the build and no-build conditions. If the travel time decreases, a greater share of a residential zone's workers would be attracted to working in an employment zone. The potential workers for each employment zone from all zones containing households was summed, and then the resulting values for all employment zones were summed.

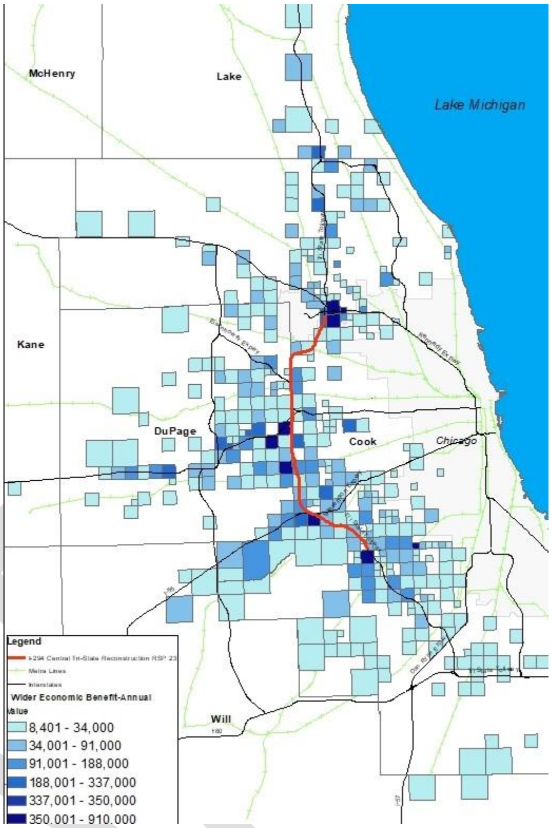
$$\Delta Y = \sum_i \sum_k \left(\frac{S_b}{S_{nb}} - 1\right) \mu_k \, w_k ZE_{i,k}$$

In this formula, S_{nb} is the share of workers in all residence zones who work in an employment zone i in the no-build condition, S_b is the share who potentially would work in employment zone i given improved commute times, and the other symbols are as defined previously. The elasticity of productivity was applied to the ratio of potential workers with the project and without the project to translate the increase in labor supply into an increase in economic output.

The results of analyzing two projects – Ashland Bus Rapid Transit and the I-294 Central Tri-State Mobility Improvements – are shown in Figure A12. As expected, increased economic output tends to be clustered most near the project itself because travel time savings are greatest there – improvements tend to "wash out" further away from the project. But the results also depend on the industry mix and the existing output per worker in the area, as well as the number of employees nearby.

Figure A12. Example economic impacts for Ashland BRT (left) and I-294 Mobility Improvements (right)

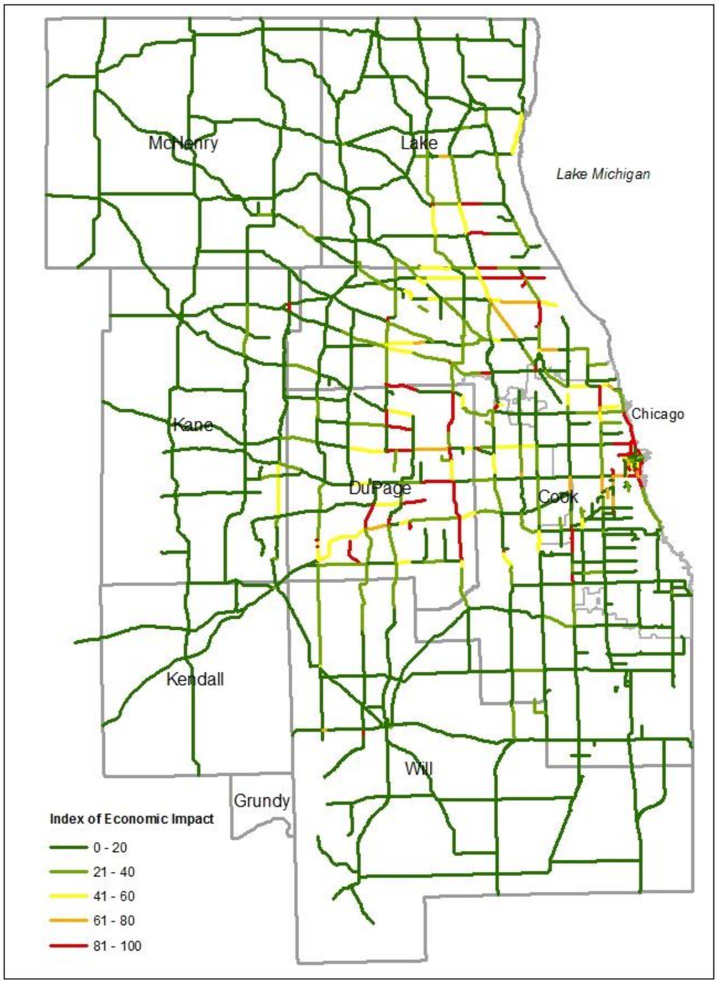




Source: Chicago Metropolitan Agency for Planning analysis of model outputs.

Because arterial projects were not modeled directly, the economic impacts of added capacity were modeled indirectly based on a network analysis. All segments of the NHS were coded in the CMAP travel demand model with a 10 percent increase in capacity. Then, the traffic assignment portion of the model was run for each segment sequentially. The resulting changes in zone-to-zone travel times within the travel shed of that segment were then used to estimate economic impact as described above. The economic impact for each segment was then converted to a 0 – 100 proportional score and mapped as in Figure A13. Individual RSPs were evaluated by overlaying the proposed project. New arterials were scored based on the parallel routes.

Figure A13. Economic impact network scoring for arterial projects.



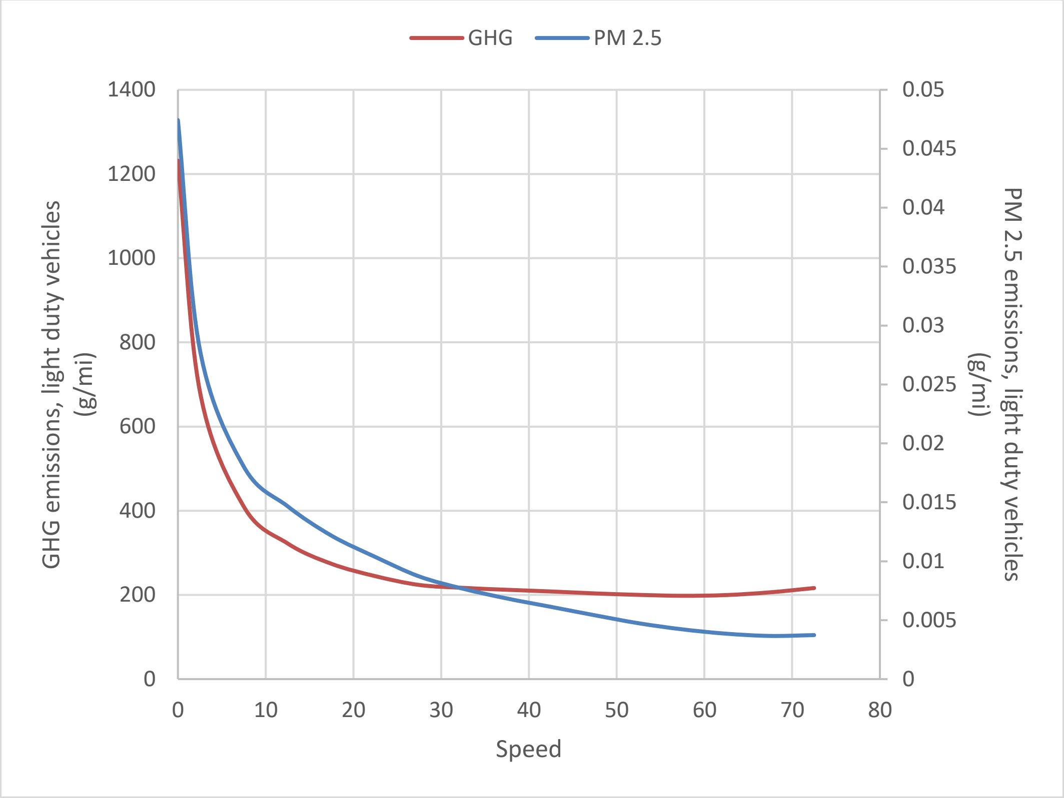
Source: Chicago Metropolitan Agency for Planning analysis.

In general, the technique provides a reasonable way to estimate the comparative economic impacts of candidate transportation projects by their effects on labor productivity. This ties well into CMAP's policy work in industry clustering. It does not capture benefits to shippers, the benefits of having a larger customer base within a certain area, or the macroeconomic effects of reduced household and business transportation costs. In project evaluations for GO TO 2040, CMAP had used the commercial economic impact software TREDIS, which does attempt to account for these additional benefits. As a result, economic impact estimates for projects in the ON TO 2050 update are considered partial estimates and are generally smaller than estimated in GO TO 2040.

Greenhouse gas and particulate matter emissions

Greenhouse gas and particulate matter emissions estimates are based on changes in regional VMT and vehicle speed caused by the project. The VMT change is multiplied by an emissions factor for vehicles in grams per mile derived from the U.S. Environmental Protection Agency's Motor Vehicle Emissions Simulator (MOVES) model, which is the model used in air quality conformity analysis. The GHG emissions reduction benefit of reducing VMT depends on the speed of the vehicles comprising the eliminated VMT. A chart depicting the influence of speed on emissions rates is shown below.

Figure A14. GHG and PM2.5 emissions rates by speed



Source: Rate table developed by Chicago Metropolitan Agency for Planning from U.S. Environmental Protection Agency MOVES model.

The CMAP travel model is used to tabulate VMT by speed bin and vehicle type. VMT is then multiplied by the appropriate emissions factor from a rate table. CMAP applied this method to estimate the effect of expressway and transit projects on regional greenhouse gases. This method also was used to determine the change in PM 2.5 emissions within excluded communities for expressway projects.

Natural resource impact

To estimate the impact of transportation projects on critical natural resources, CMAP calculates the potential spinoff household and employment development caused by changing accessibility. This information is used to estimate the potential additional impervious surface caused by the project. This does not include the project itself. CMAP then compares the location of new development with important natural resources, identified as the conservation areas layer. This includes conservation areas, high-quality watersheds, and aquifers experiencing unsustainable rates of groundwater drawdown.

CMAP uses the regional travel demand model to estimate a project's potential impact to the transportation network. Specifically, the model estimates the change in relative accessibility of each model subzone — quarter-section sized geographies that CMAP uses for household and employment forecasting. For each project, the difference in commute travel times between build and no-build is calculated for each zone-to-zone trip interchange. The probability of household change was based on the change in zonal accessibility.

For all projects, the ON TO 2050 update draft household and employment forecasts for 2050 are the no build forecast. The accessibility is increased by adding the project to the network to represent the build condition. The resulting probability of increase in households is applied to the forecast 2050 households or employment. The difference between build and no build households is included in a GIS file for comparison with conservation areas and aquifers at risk of partial or complete desaturation. The direct impact of expressway projects on natural resources is highly dependent on detailed engineering, but a planning-level estimate of impact is calculated by creating a 500-foot buffer around each project and calculating the amount of conservation area contained within the buffer. To account for the greater impact on nearby natural areas of new construction versus reconstruction of existing facilities, the conservation area within the buffer was multiplied by the ratio of new lane miles to total proposed lane miles.

Measures of impervious cover change are a proxy measure of water pollution, erosion, and the urban heat island effect. Impervious surface creation is estimated from a subzone-level statistical relationship between imperviousness in the 2006 National Land Cover Dataset and the density of households and jobs. This statistical relationship is applied to the change in potential households and jobs in 2050 resulting from the project's accessibility improvement, as previously described. The total acres of impervious surface created because of each project is tallied, as is the acreage of impervious surface created in high quality sub-watersheds (those with less than 10% existing impervious cover). The direct impervious surface created because of the project construction is calculated based on the assumption that additional lanes are 12 feet wide and that new projects would also have 10-foot paved outside shoulders and 4-foot paved inside shoulders, consistent with AASHTO interstate design standards.

Freight impact

The freight impact measure captures potential positive and negative impacts on the region's freight capacity. For highway projects, we consider whether the project improves the National Highway Freight System (including proposed Critical Urban Freight Corridors), the truck volume on the highway to be improved, and whether the highway improvement is on a Class I/Class II designated truck route. For transit projects, we considered the implementation of CREATE, operations or infrastructure improvements on rail lines with substantial freight use (more than 12 freight trains per day), and how the project might potentially increase or decrease freight-passenger conflicts on the region's rail system. For both transit and highway projects, the benefits to freight are rated on a -25 to 100 scale, with -25 representing potential disbenefits and 100 representing significant improvements to freight movement.

Appendix B. Glossary

ACS - American Community Survey
ADA – Americans with Disabilities Act
ART – Arterial rapid transit
BNSF – BNSF Railway, operator of Metra’s busiest line
BRT – Bus rapid transit
CDOT – Chicago Department of Transportation
CMAP – Chicago Metropolitan Agency for Planning
COST – Capital Optimization Support Tool, developed by the RTA
CRA - Condition rating system (for roads)
CREATE – Chicago Region Environmental and Transportation Efficiency Program
CTA – Chicago Transit Authority
CVHT - Congested vehicle hours traveled
DOT – Department of Transportation
EDA – Economically Disconnected Area, as defined by CMAP’s Inclusive Growth ON TO 2050 strategy paper
FTA – Federal Transit Administration
GHG – Greenhouse gas
GIS - Geographic information system
GRP - Gross regional product
HERE - A map data provider
IDOT – Illinois Department of Transportation
IRI - International Roughness Index
IRIS - Illinois Roadway Information System
LEHD - Longitudinal Employer Household Dynamics
MOVES - Motor Vehicle Emissions Simulator
NAICS - North American Industry Classification System
NHS -National Highway System
NTD – National Transit Database
O&M – Operations and maintenance
PTI - Planning Time Index
RBA - Rentable building area
RPM – Red Purple Modernization, a CTA rail project on the north side of Chicago
RSP – Regionally Significant Project
RSP ID – RSP identification number, created by CMAP for evaluation
RTA – Regional Transportation Authority
SRA - Strategic regional arterial
STOPS - Simplified Trips on Projects, an FTA model
TIP – Transportation Improvement Program
TOD – Transit-oriented development

TREDIS - Transportation Economic Development Impact System
TTI - Travel Time Index
UP – Union Pacific, operator of three Metra lines
VHT – Vehicle hours traveled
VMT – Vehicle miles traveled
YOE$ – Year-of-expenditure dollars

ON TO 2050 plan update socioeconomic forecast appendix

September 2022 draft

Contents

Introduction

This document provides an overview of CMAP's socioeconomic forecasting process and results in support of the ON TO 2050 plan update. High-level results will be presented here. A more complete set of data tables will be made available on the CMAP Data Hub at: https://datahub.cmap.illinois.gov/dataset/2050-forecast-of-population-households-and-employment after plan adoption in October 2022.

Socioeconomic forecasts are a required element in a metropolitan planning organization's long-range transportation plan, with a horizon year that is at least 20 years out from the plan's adoption date.[1] The results serve dual purposes: they provide an understanding of forecasted population and employment trends to help shape plan recommendations, and they serve as an input to CMAP travel models for air quality conformity analyses, as well as for small-area traffic projections.

The forecast has two major components: the regional socioeconomic forecast and local projections, which are the disaggregation of regional totals down to the local level. These two exercises draw on different disciplines. The regional forecast is an exercise in demographics and macroeconomics, while the local forecast is a spatially oriented exercise that requires more of a focus on local constraints to growth, transportation accessibility, real estate supply, and a host of other factors. The next two sections describe these processes in greater detail.

While the forecast is driven by transportation planning needs, these projections are also used by CMAP staff, as well as by partner agencies, local communities, economic development organizations, and watershed planners. In acknowledgement of these diverse needs, CMAP is committed to providing results with more demographic and temporal detail beyond basic travel model requirements. While much of this detail is limited to the regional totals, it does provide an overview of general demographic trends in northeastern Illinois forecasted for the coming decades.

Note: Like most forecasting efforts, many of the underlying assumptions behind this forecast are trend-based and do not account for unanticipated behavioral changes (let alone major disruptions, such as the COVID-19 pandemic). As such, the best one can claim for a forecast is that it is defensible and based on reasonable assumptions.

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[1] U.S. Government Publishing Office, *Electronic Code of Federal Regulations*, Title 23/Chapter I/Subchapter E/Part 450.324 https://www.ecfr.gov.

Part 1: 2050 regional socioeconomic forecast update

Introduction

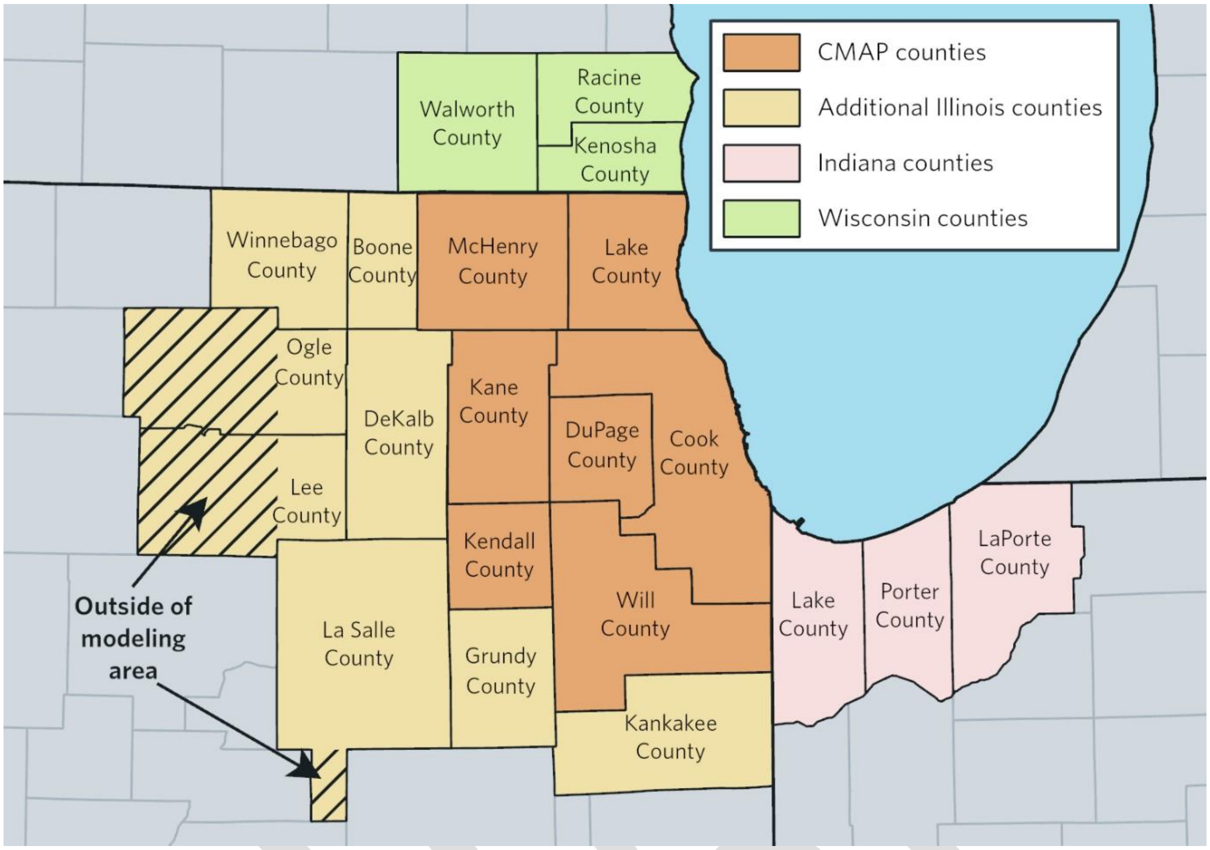
The technical approach for the regional socioeconomic forecast mirrors that of the original ON TO 2050 forecast, which was produced by Louis Berger, Inc. CMAP staff split the project into two contracts for the plan update cycle, the goal being to develop a sustainable process that will allow staff to generate forecasts in-house in subsequent plan cycles. To that end, CMAP entered into an inter-governmental agreement with the Applied Population Laboratory (APL) at the University of Wisconsin-Madison to review the Berger approach to the demographic forecast and advise on best practices and data sources so that CMAP could develop a stand-alone demographic model for continued use. CMAP also contracted with the firm EBP to provide the agency with an employment forecast based on projections from Moody's Analytics with modifications to account for differences in employment sector definitions and adjust for accounting of temporary workers, as well as to provide documentation and source code so that the agency can replicate these processes in the future.

Much of the data used to inform the population and employment models are derived from state- and county-level sources. As a regional planning agency, CMAP recognizes the importance of inter-county dependencies and that it is unreasonable to expect counties to grow in isolation of one another. As this is a regional forecasting exercise, all county-level inputs from the demographic and employment models were summed into regional totals for the regional forecast; sub-regional (county, township, travel model zone) output totals were generated through the local forecast process, described in Part 2 of this document.

Part 1 will discuss the methods, data, and assumptions behind the demographic and economic models, followed by the steps taken to reconcile the results of the two models. Regional population, household, and employment projections are presented at the end of this section.

Note: While the regional forecast was developed specifically for the seven-county CMAP region, this effort produced projections for a wider, 21-county area (**Figure 1**) coinciding with the area modeled by CMAP's travel demand models. The broader area is necessary so that the entire modeling area is informed by a forecast produced with consistent methodology. Results for areas outside of the seven-county CMAP region are used solely as travel model inputs and are not considered part of the official ON TO 2050 forecast; therefore, they will not be reported here.

Figure 1. Twenty-one county modeling area



Demographic model: Data, methods, and assumptions

CMAP's population projections for 2025–2050 are founded on an established demographic technique called the cohort component method. In short, this method analyzes the historical patterns of the primary elements of population change — fertility, mortality, and migration — and extends them into the future either by trending these past indicators or harnessing them to predictions at a larger geographic scale, such as a state or the nation. Recognizing that it is difficult to choose and justify the scale and timing of major trend changes in long-term forecasting, CMAP's projection methodology tended toward continuation of existing observed trends plus additional rate change modifications in order to avoid extreme, unsustainable, or illogical results within the forecast period (an example of this is the age 15–19 fertility rate in **Figure 2**).

In addition to the cohort component process, CMAP applies a labor force model to supplement net migration assumptions. This model incorporates employment projections to reconcile the working-age population (labor supply) with the anticipated labor force demand.

Data collection, formatting, and projection were performed in R, an open-source statistical programming language.[2] Census data were retrieved and analyzed using tidycensus and the tidyverse collection of R packages; charts were produced with ggplot2 (a graphics package for R), and cmapplot, a CMAP-developed customization of ggplot2 that applies agency graphics standards to R products.

The major elements of the demographic model are described below, including data sources and assumptions developed in consultation with APL. Additional detail is available in the report *Demographic forecast technical report, ON TO 2050 plan update*, available on the CMAP Data Hub after plan adoption in October 2022. Much of the text below is excerpted from this report.

Births/fertility

Data on births and deaths were obtained from the Illinois Department of Public Health, Indiana State Department of Health, and Wisconsin Department of Health Services to develop fertility rates, as well as mortality rates discussed in the next section. Data on births were used to calculate age-specific fertility rates (ASFRs) for the years 1990-2010, grouped into six age cohorts (in five-year ranges from ages 15-19 through 40-44). Historic rates showed two distinct trends: fertility rates for the under-30 cohorts showed a marked decrease, while all age-30-and-above cohorts showed moderate increases. These trends were carried forward into the forecast years using a logarithmic trend projection, which allows for a gradual slowing of trends in acknowledgement of the uncertainty of these trends carrying forward into the future. **Figure 2** (below) depicts the historic (1990-2010) and projected (2020-2050) fertility rates by age cohort, reported as live births per 1,000 females. Total births are generated by multiplying projected ASFRs by the projected number of women in each age range.

Deaths/mortality

The most common single-number metric for discussing mortality is life expectancy at birth, typically calculated separately for men and women because each sex faces different mortality risks across their lifetimes. Life expectancy is a synthesized one-number estimate based on the mortality rates (or, conversely, survival rates) of age-specific cohorts over a period of time such as one year, five years, or a decade; life expectancy aids our understanding of a geographic area's mortality patterns through time or in comparison among geographies (see **Figure 3**, below).

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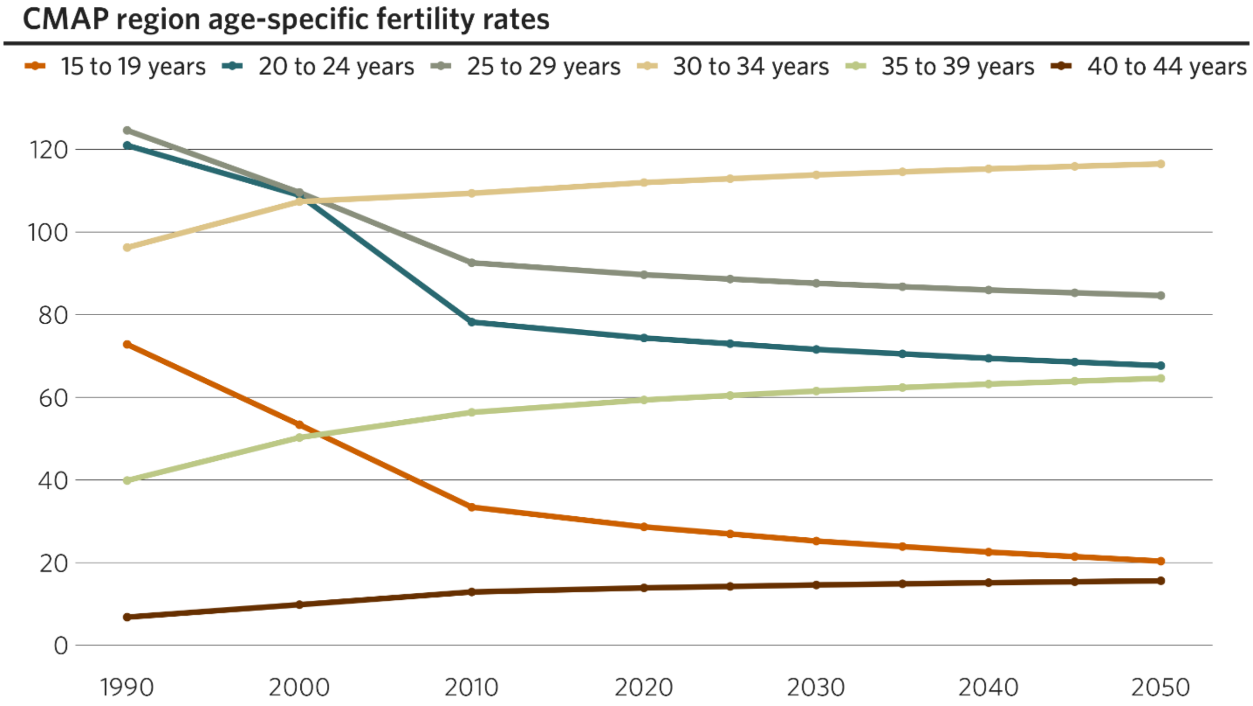
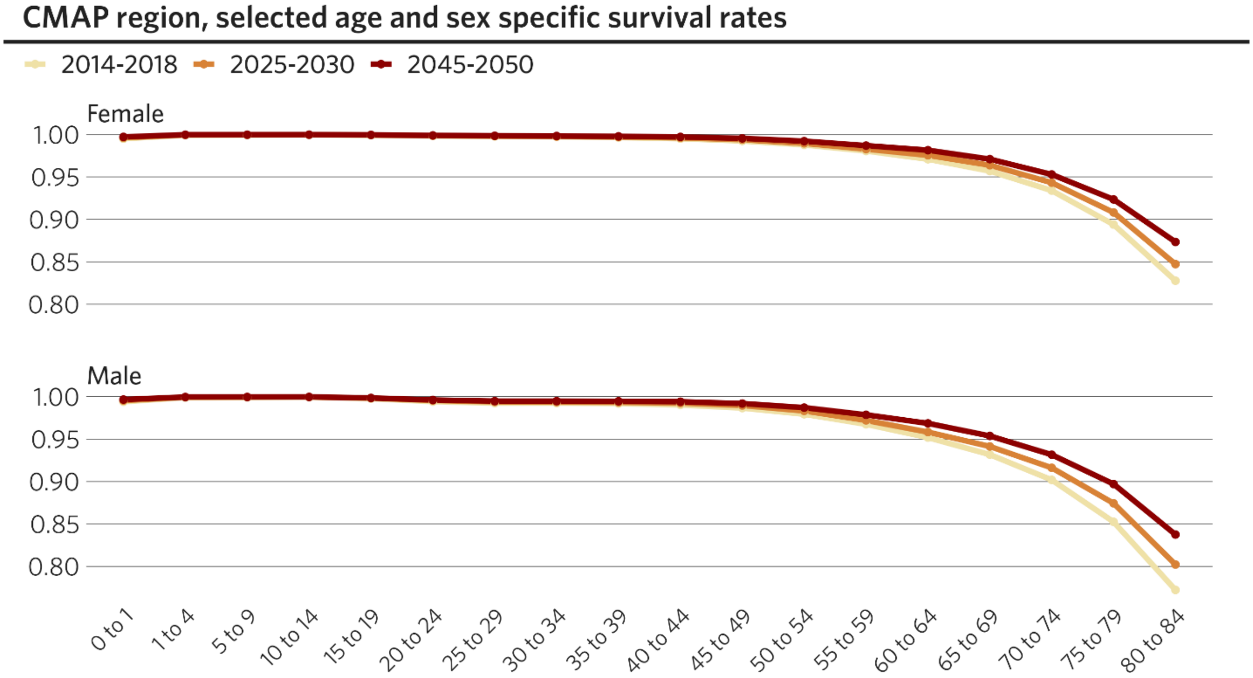
[2] R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

Figure 2. Historic and projected fertility rates for the CMAP region



Source: Census Bureau 1990-2010, CMAP Demographic Projection 2020-2050

Figure 3. CMAP region, selected survival rates by age and sex



Note: 2014-2018 mortality rates are derived from local health department data. 2025-2030 and 2045-2050 rates are projections based on local data and Social Security Administration national projections.

From 1990 through 2010, life expectancy in the CMAP region showed strong gains, increasing 5.7 years for men and 3.6 years for women, while the gap between men and women shrank from 7.0 years to 4.9 years. Even from 2010 to the 2014-2018 period — the most recent period age- and sex-specific death data could be collected from county health departments — life expectancy improved for both men and women.

Across the forecast period, following national mortality patterns predicted by the Social Security Administration, average life expectancies in the CMAP region are expected to continue to increase, albeit more modestly than in recent decades.[3] Male life expectancy at birth may reach 80.7 years in the 2045-2050 period, while female life expectancy may reach 84.9 years. As with recent history, the projections indicate that the male-female life expectancy gap will continue to shrink, from 5.1 years in 2014-2018 to 4.2 years by 2050.

Migration

The measurement of migration is best understood as a "net" process — people migrate into an area over a period of time, and others move out of that same area; the net gain or loss due to migration is the result of the in-flow minus the out-flow. Unlike births and deaths, which are recorded as official vital events, measures of in- and out-migration are difficult to ascertain. Thus, for the purposes of population projections, net migration is calculated through a residual process: it is estimated as the difference between the total population change and natural increase (births minus deaths).

Migration itself consists of two streams: domestic (within the United States) and international. Like gross in- and out-migration, obtaining accurate records or estimates of these domestic and international components is difficult. For these projections, only total net migration values are calculated. The region's net migration, in total, has varied extensively across the past three decades. After a decade of positive net migration in the 1990s, the region experienced net out-migration during the 2000s and 2010s.

Net migration also follows particular patterns based on age and sex; the age- and sex-specific rates form the basis of projected migration. For the 2014-2018 base period, estimates of the CMAP region's net migration were calculated using births, deaths by age and sex, and the total estimated population by age and sex.

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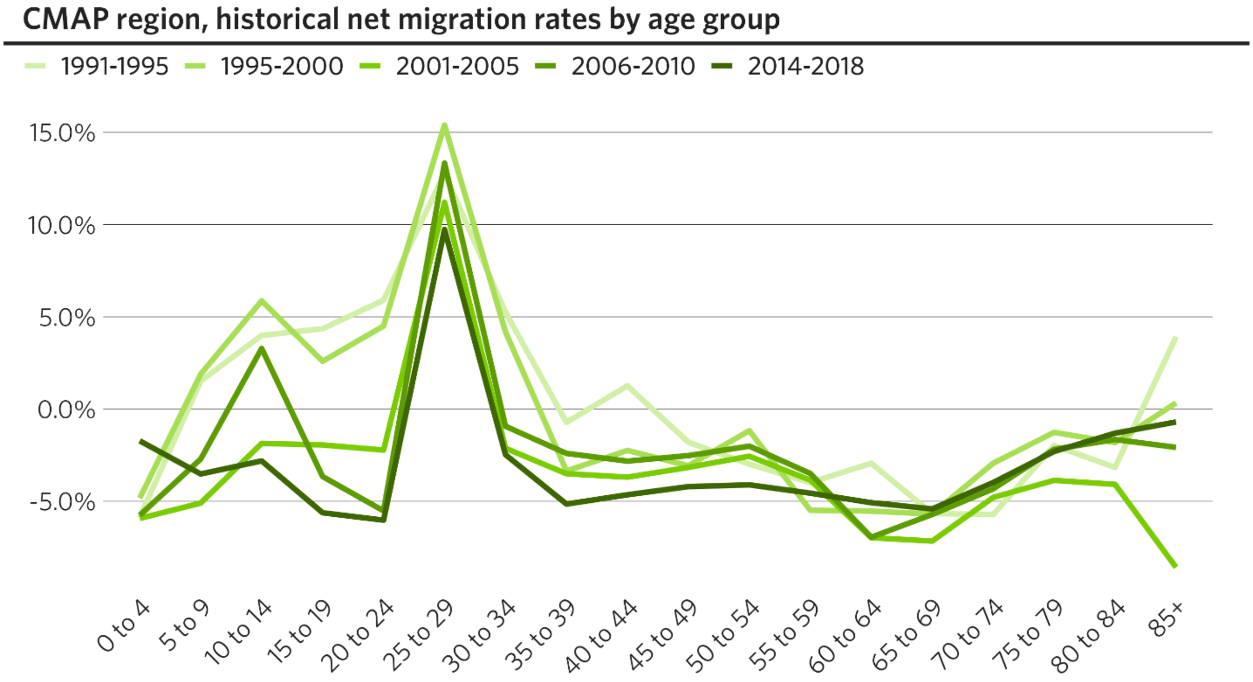
[3] Social Security Administration, "2019 Trustees Report." https://www.ssa.gov/oact/HistEst/PerLifeTables/2019/PerLifeTables2019.html

Figure 4. Historic net migration rates by age for the CMAP region



Historical net migration rate is a percentage of the total number of people in the age group at the start of the five-year period. Rate sign indicates in-migration (positive) or out-migration (negative.)

Because recent total net migration was negative (see 2014-2018 migration in the graph above), many of the migration rates by age and sex are negative. One distinctive difference is the consistently strong net in-migration for residents ages 25-29. Like most larger metropolitan areas in the country, the Chicago metropolitan region attracts many young post-college graduates. These figures form baseline net migration assumptions, which are then adjusted based on regional economic expectations (discussed in the demographic and economic integration section later in this chapter).

Additional demographic variables

The following variables were developed as additional model outputs to form a more complete demographic picture of the region.

Household formation

The calculation of households from population totals is an important component of the forecast, as the number of households is a key input to additional CMAP analyses and products. Due to delays with the 2020 census, data from the 2010 census were used to determine age-specific headship rates, which help account for changing household formation patterns and changes in the age distribution of the total population. Headship rates are applied to the household population to calculate the total number of households. The summed total of households by all cohorts yielded the total number of households for each forecast year. Household totals are also summarized into three age-of-householder categories for travel model purposes.

Race and ethnicity

Estimations of the population by race and ethnicity are broadly summarized by five non-overlapping categories: Hispanics of any race, non-Hispanic white persons, non-Hispanic Black persons, non-Hispanic Asian persons, and non-Hispanic persons of other or a combination of races.

Like the ON TO 2050 forecast approach, a mixed log-linear rate projection approach was applied to age-specific race and ethnicity data collected in the 1990, 2000, and 2010 censuses. This approach accounts for the recent rapid growth of certain groups but moderates the rate of growth across the 30-year projection period to avoid illogical results by the year 2050, and balances recent observed trends with uncertainty about future changes in population change.

The Census Bureau has identified changes in survey design and self-identification as significant factors for recent trends in race/ethnicity estimations.[4] Further work is necessary to better characterize, understand, and project demographic trends in the CMAP region.

Group quarters populations

All demographic modeling described up to this point addressed only the household population. To develop a total population estimate, projections must also account for group quarters populations, both institutionalized (nursing homes, prisons, etc.) and non-institutionalized (college dormitories, military quarters, etc.). To estimate the change in group quarters populations, 2010 census data were used to calculate the proportions of people in group quarters arrangements relative to the 2010 total population. These proportions were applied forward with the exception of the military quarters population (located exclusively in North Chicago at Naval Station Great Lakes), which was held constant.

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[4] U.S. Census Bureau, "2020 Census Illuminates Racial and Ethnic Composition of the Country." 12 Aug 2021, https://www.census.gov/library/stories/2021/08/improved-race-ethnicity-measures-reveal-united-states-population-much-more-multiracial.html

Economic forecast: Data, methods, and assumptions

In August 2020 CMAP issued RFP #243, “Regional Employment Forecast,” and selected the firm EBP to develop the economic portion of the regional socioeconomic forecast. Scope requirements were:

- Report by NAICS two-digit sector using Bureau of Labor Statistics definitions
- Reallocate employment totals from NAICS sector 561320 (Temporary Help Services) into the sectors that temp workers actually work in; provide totals for reallocated and un-reallocated
- Report total employment (including self-employed), as well as wage and salary only
- Develop a baseline/likely scenario along with low/pessimistic and high/optimistic scenarios reflecting the uncertainty that typically surrounds employment forecasts

An overview of EBP’s approach to the employment forecast is presented below. For a more thorough description of the process, please see *Chicago region employment forecast: 2021 Update*, available on the CMAP Data Hub after plan adoption in October 2022.

Benchmarking historical employment

Unlike a census of population where every individual is counted as one person, counts of employment are subject to a variety of definitional challenges regarding part-time jobs, self-employed workers, domestic workers, and multiple-job holders. For the purposes of this report, “employment” is primarily based on average annual employment by sector as reported by the Bureau of Labor Statistics’ Quarterly Census of Employment and Wages (QCEW), which collects employment and wage data from employers covered under state unemployment insurance programs. To round out employment estimates, two other sources were used: the Railroad Retirement Board to account for railroad workers not counted in QCEW, and the American Community Survey for a count of self-employed workers. Excluded from these estimates are active-duty military, private household workers, and elected officials.

The reallocation of workers counted under Temporary Help Services (colloquially referred to as “temp workers”) was informed by the Contingent Worker Supplement to the Census Bureau’s Current Population Survey. For land use and travel demand modeling purposes, it’s preferable to have temp workers identified by the industries in which they actually work.

Four separate benchmark series of historical (2010–2020) employment by NAICS 2-digit sector were developed to suit different agency purposes:

- Total employment without temp worker reallocation

- Total employment with temp worker reallocation (the series used for reporting in this section)
- Wage and salary employment without temp worker reallocation
- Wage and salary employment with temp worker reallocation (the series used for travel and land use modeling, used in Part 2 of this report)

Forecasting employment

Forecast employment totals for each series are based on May 2021-vintage forecasts produced by Moody's Analytics. The projections that serve as the official regional forecast are Moody's "baseline," where there is an equal probability (50 percent) that the economy will perform better or perform worse over the forecast period. Two alternative scenarios were also produced to illustrate the range of possible outcomes: an "upside" scenario (only a 4 percent probability that the economy would perform better), and a "downside" or slow-growth scenario where the economy underperforms throughout the forecast period. Assumptions behind these scenarios can be found in the appendices in the *Chicago region employment forecast: 2021 update* report.

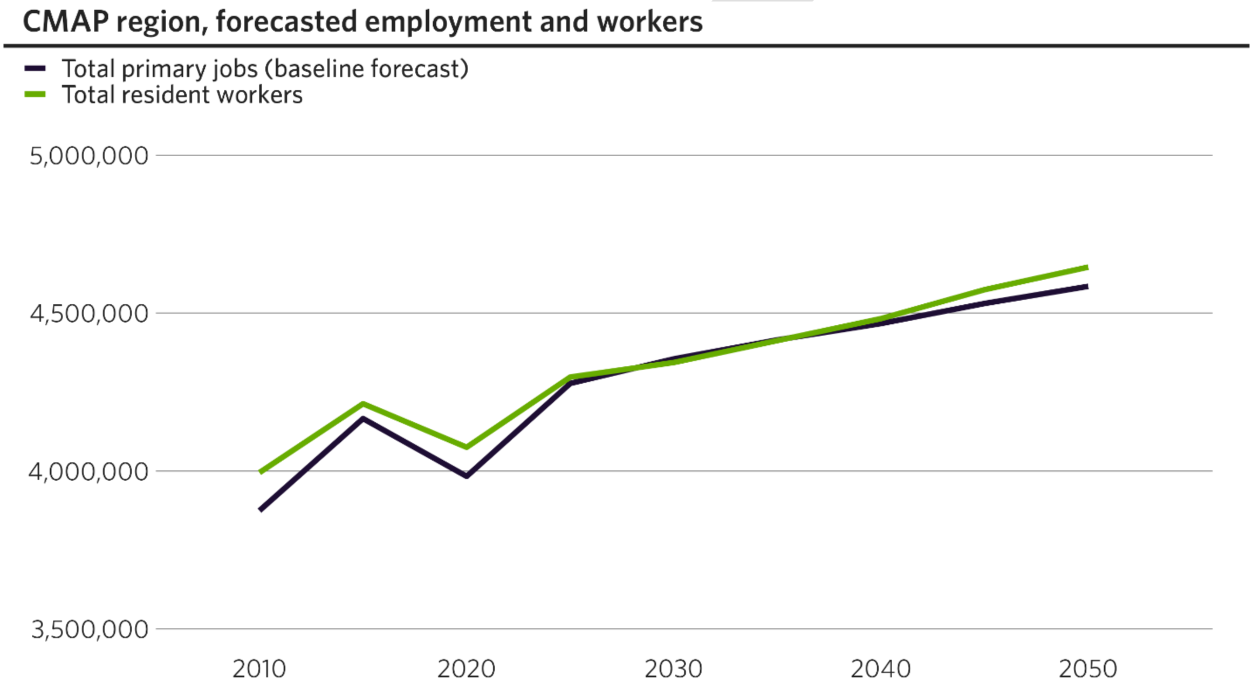
Integration of demographic and economic models

The population and employment models described above operate independent of one another. An additional step is necessary to reconcile labor demand (employment) with labor supply (workers, a subset of the total population). If the rate of employment growth outpaces the number of workers available to fill those positions (through natural increase and baseline net migration), then migration rates are adjusted to address the increased demand for labor. This process primarily affects projections for the working-age population but, as many of these workers are of parenting age, there is a follow-on increase in the youth population as well.

A modified version of Louis Berger's labor-induced migration adjustment model from the ON TO 2050 forecast was used to connect net migration with labor demand. This method retains the assumption that job prospects are a major motivator for people to relocate to northeastern Illinois, a major economic center of the nation. This method also accounts for and excludes additional elements, such as group-quarter populations, non-resident workers, and workers who hold multiple jobs.

For each five-year forecast period, the number of resident workers in the region is estimated by applying a series of modifying factors to the household population: Congressional Budget Office projected labor force participation[5] and unemployment rates,[6] and an out-of-region worker correction factor developed by Berger.[7] Baseline net migration estimated by the demographic model was then modified until the number of estimated resident workers roughly matched the number of primary jobs, within a limited (<3 percent) margin. This estimate of "economic migrants" was allocated across different age groups to retain the known characteristics of net migration in and out of the region (see Migration section above).

Figure 5. Comparison of primary employment and resident workers for the purpose of calculating total net migration



Primary jobs estimated from total employment. Resident workers estimated from projected population, labor force participation rate, and other factors. See the Demographic Forecast Technical Report, ON TO 2050 Plan Update for additional details.

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[5] Congressional Budget Office, "The 2021 Long-Term Budget Outlook." https://www.cbo.gov/publication/57038

[6] Congressional Budget Office, "An Update to the Budget and Economic Outlook: 2021 to 2031." https://www.cbo.gov/publication/57339

[7] Louis Berger, "Chicago Region Socioeconomic Forecast Final Report" (2016), p. 46. https://datahub.cmap.illinois.gov/dataset/2050-forecast-of-population-households-and-employment

Socioeconomic forecast: Regional results

All results below are for the aggregate, seven-county CMAP region. For sub-regional results please refer to Part 2: Local forecast update. Microsoft Excel versions of all tables will be available on the CMAP Data Hub after plan adoption in October 2022.

Regional population forecast

Forecasts are reported in ten-year intervals for space considerations. A five-year interval version will be available on the CMAP Data Hub.

Table 1. Projected total population, 2020-2050

Total population	2020 (census)	2030	2040	2050
Total population	8,577,735	9,142,057	9,717,333	10,028,854
Non-Hispanic white	4,159,107	4,454,990	4,568,211	4,548,372
Non-Hispanic Black	1,396,303	1,464,567	1,506,422	1,504,683
Non-Hispanic Asian	663,475	807,399	954,695	1,081,180
Non-Hispanic other*	285,541	162,038	182,286	198,255
Hispanic	2,073,309	2,253,063	2,505,718	2,696,364
Percent of total	**2020 (census)**	**2030**	**2040**	**2050**
Non-Hispanic white	48.5%	44.4%	45.6%	45.4%
Non-Hispanic Black	16.3%	15.1%	15.5%	15.5%
Non-Hispanic Asian	7.7%	8.8%	10.4%	11.1%
Non-Hispanic other*	3.3%	1.7%	1.8%	2.0%
Hispanic	24.2%	24.6%	27.4%	29.5%

** Includes: American Indian or Alaska Native (non-Hispanic), Native Hawaiian or other Pacific Islander (non-Hispanic), some other Race (non-Hispanic), and two or more races (non-Hispanic).*

Table 2. Age distribution, 2020 (estimated) and 2050 (projected)

Age group	2020 (census)*	2020 share of total	2050	2050 share of total
0-4	501,945	5.9%	528,877	5.3%
5-17	1,414,967	16.5%	1,501,052	15.0%
18-24	757,136	8.8%	879,221	8.8%
25-44	2,392,250	27.9%	2,353,373	23.5%
45-64	2,198,060	25.6%	2,471,687	24.6%
65-84	1,148,321	13.4%	1,847,042	18.4%
85 & over	165,056	1.9%	447,602	4.5%
TOTAL	8,577,735		10,028,854	

** Due to delays in the release of 2020 Census results, age totals were estimated from 2019 Population Estimates Program county-level results, with proportions applied to 2020 Census Redistricting county-level population totals, then summed to produce regional totals by age group.*

Table 3. Household and group quarters projections

Household population	2020 (census)	2030	2040	2050
Total population in households	8,447,265	8,984,745	9,537,951	9,829,133
Total households*	3,266,741	3,639,601	3,903,663	4,108,756
Average household size	2.59	2.47	2.44	2.39
Group quarters population	**2020 (census)**	**2030**	**2040**	**2050**
Total	130,470	157,312	179,382	199,721
Non-institutional**	67,305	70,940	75,668	80,779
Institutional**	63,165	86,372	103,714	118,942

** Census PL94-171 table H1, "Occupied Housing Units"*

*** Institutional/non-institutional definitions follow Census Bureau designations*

Regional employment forecast

Table 4. Total employment by NAICS sector, 2019-2050

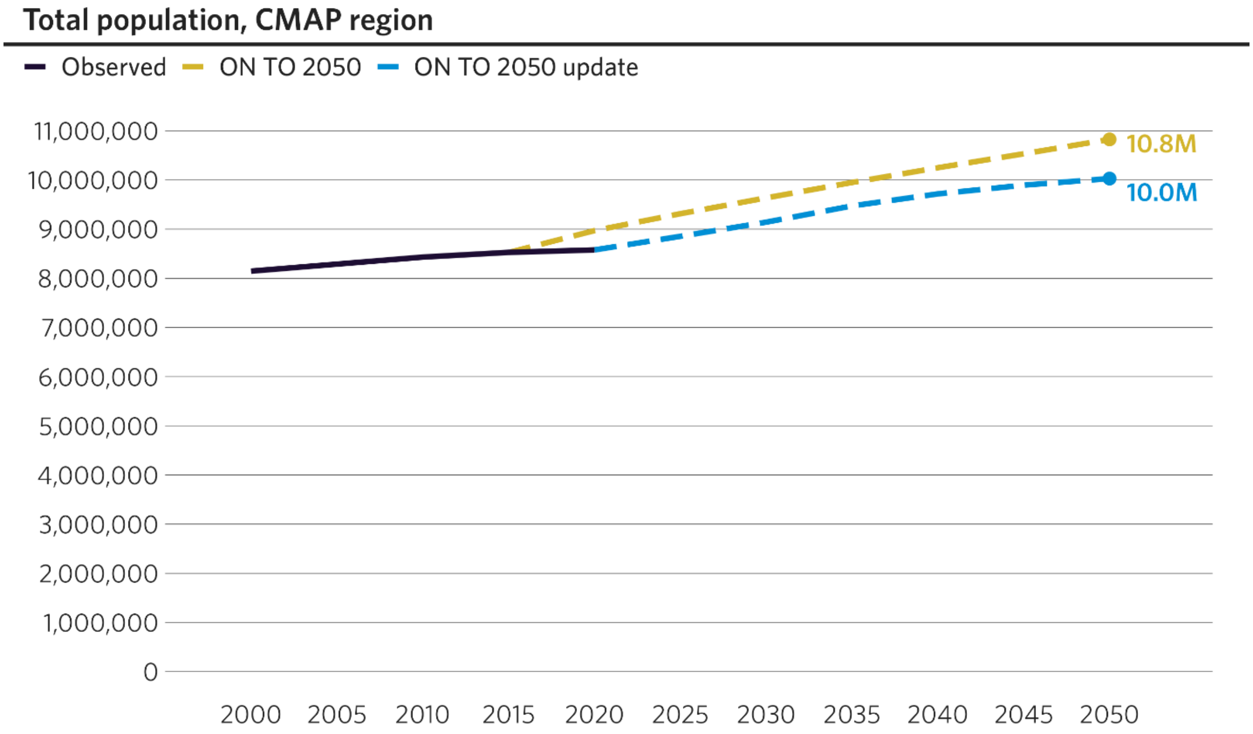
Group	Sector	NAICS	2019	2030	2040	2050
O	Ag., for., fish. and hunt.	11	12,688	11,593	11,157	10,771
O	Mining	21	1,917	1,791	1,735	1,599
T	Utilities	22	14,435	13,240	11,740	10,091
O	Construction	23	219,568	222,393	227,984	237,666
M	Manufacturing	31-33	388,473	350,163	320,543	297,751
T	Wholesale trade	42	221,531	218,183	212,809	200,089
R	Retail trade	44-45	428,246	445,823	448,192	476,170
T	Transp. and wareh.	48-49	287,796	323,390	331,627	326,427
S	Information	51	86,992	81,829	81,996	82,118
S	Finance and insurance	52	230,491	250,217	265,577	282,804
S	Real estate and rental and leasing	53	89,490	90,941	96,694	103,092
S	Professional, scientific and technical services	54	387,388	435,403	473,360	497,008
S	Mgmt. of companies and enterprises	55	68,871	75,316	81,961	86,171
S	Administrative/waste services	56	254,773	267,916	291,992	307,197
S	Educational services	61	400,515	417,264	423,873	424,423
S	Health care and social assistance	62	580,904	610,721	618,001	616,739
S	Arts, entertainment, and recreation	71	125,634	95,573	103,894	117,667
S	Accommodation and food services	72	388,859	329,128	358,042	405,908
S	Other services (exc. pub. administration)	81	198,059	190,196	190,027	193,531
G	Public administration	92	146,532	137,177	134,452	131,891
	TOTAL		**4,533,162**	**4,568,258**	**4,685,656**	**4,809,114**

Comparison to the original ON TO 2050 regional forecast

The new forecast totals for both population and employment are lower than the ON TO 2050 forecast published in 2018. The differences are presented below, followed by an explanation of some of the underlying factors.

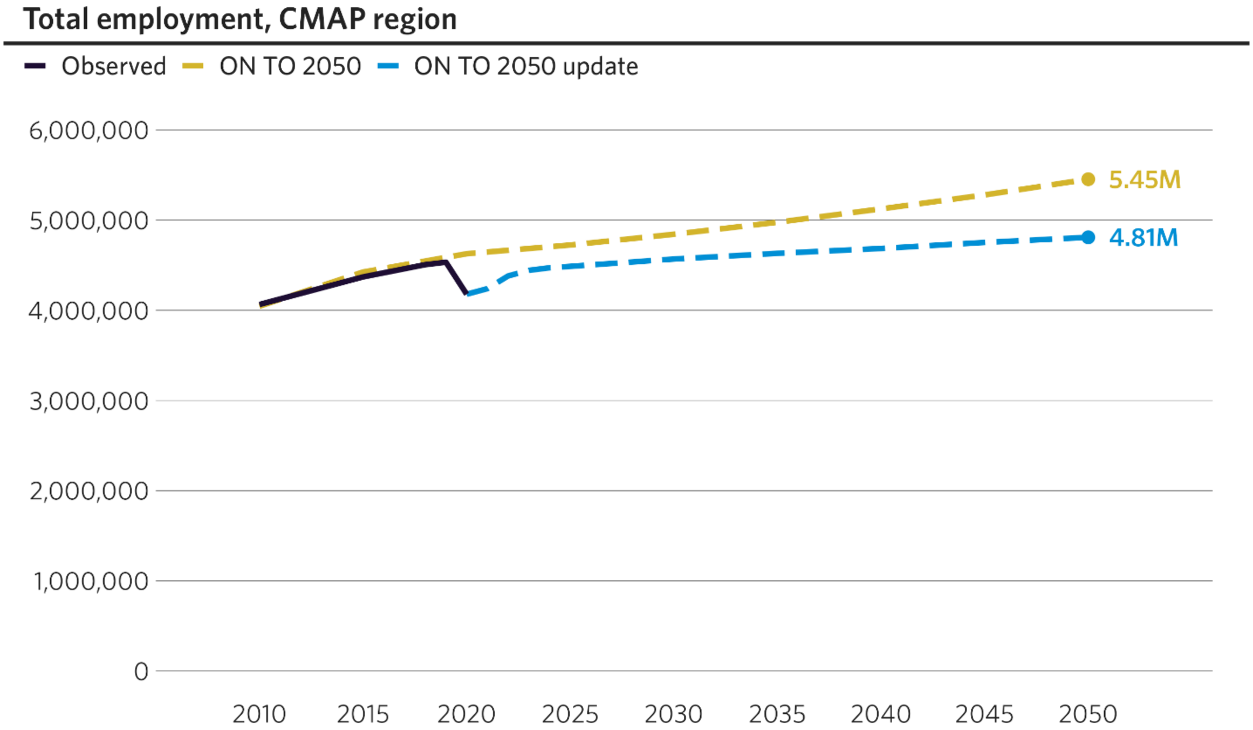
The current population projection of just over ten million persons by 2050 represents a decrease of over 800,000 from the original ON TO 2050 forecast. The graph below shows the region's population growth since 2000 and the divergence of the two forecasts beginning with the year 2015 (the base year for the previous forecast.

Figure 6. ON TO 2050 and plan update population forecasts compared



Similarly, the employment forecast is lower by roughly 600,000 jobs by 2050 from the original ON TO 2050 forecast of over 5.4 million:

Figure 7. ON TO 2050 and plan update employment forecasts compared



Two major contributors to this lowered forecast are lackluster population growth in the previous decade and the impact of the COVID-19 pandemic on regional employment. One additional factor is less obvious: the original ON TO 2050 forecast included a "human capital plus transportation" scenario that we opted not to use in the plan update. That scenario pushed up the previous employment forecast by 175,000 jobs, a number which represents 27 percent of the overall difference between this updated forecast and the original ON TO 2050 forecast; since migration assumptions in the population forecast are based in part on employment projections, there was a follow-on increase in population as well.

Part 2: 2050 Sub-regional forecast update

Introduction

CMAP has invested in the land use microsimulation model UrbanSim to develop local forecasts for the ON TO 2050 update and subsequent plan cycles. Microsimulation models work at a highly disaggregate level (parcels, in the case of UrbanSim), predicting the activities of individual "agents" (households and jobs) over a highly detailed landscape that includes representations of individual buildings, along with known constraints (e.g., zoning) and development events, to simulate land use change in the region over the forecast period. This model has several advantages over the spreadsheet-based Local Area Allocation tool used for ON TO 2050:

- Accounts for local conditions and capacity with parcel-level land use and zoning data
- Creates new residential and non-residential space in a more realistic manner with a developer model
- Allows for more flexible geographic aggregation from a parcel base
- Accommodates complex policy structures for the development of "what if" scenarios

Part 2 will describe the UrbanSim land use model in greater detail, followed by a discussion of model data requirements and the factors employed in the model for the plan update scenario. Sub-regional (county-level plus Chicago) population, households, and employment projections are presented at the end of this section.

The UrbanSim land use model

The UrbanSim model was first developed at the University of California, Berkeley in the late 1990s and has evolved over the years with funding from the National Science Foundation, U.S. Environmental Protection Agency, and the Federal Highway Administration. It is actively used at several metropolitan planning organizations, including the Metropolitan Transportation Commission (California Bay Area), Puget Sound Regional Council (Seattle), the Southeast Michigan Council of Governments (Detroit), and the Metropolitan Council (Minneapolis/St. Paul).

CMAP's implementation of UrbanSim is a cloud-hosted service maintained by UrbanSim, Inc. of Berkeley, California. Model architecture is maintained on GitHub, and model runs are controlled using UrbanCanvas, a browser-based web interface. This document will not attempt to discuss all the workings of UrbanSim but will primarily focus on CMAP data inputs and model enhancements implemented to obtain results for the current forecast cycle. General UrbanSim concepts can be found at https://urbansim.com/urbansim, including documentation of their parcel model.[8]

UrbanSim overview

UrbanSim consists of several sub-models that represent the actions of developers, households, and employers. These include:

- Real estate price model: predicts the per-square-foot rents and prices for each building.
- Real estate developer model: identifies likely locations for new development based on the demand for additional space (forecasted households and employment), allowed uses and densities (zoning), and profitability (prices). Includes a "proforma" model, which evaluates all allowed uses for a site and determines which are likely to be profitable. See Appendix 1 for an overview of the UrbanSim developer model.
- Employment and household transition models: account for new jobs/households (or the loss thereof) in the region, based on regional forecast control totals that determine the number of households by type and employees by industry sector.
- Employment and household relocation models: predict households and employees that may relocate within the region in each model year.
- Household tenure choice model: predicts whether moving households choose to rent or own the housing unit they occupy.
- Employment and household location choice models: predict the location of new (transition models) or relocating (relocation models) households and employment, based on existing available or newly built space.

A graphic representation of these models and their interactions is available in UrbanSim's online documentation.[9]

Model estimation and calibration

Model estimation is the process of identifying a set of variables that help explain patterns of urban activity, quantifying the relationships of these patterns to cross-sectional variables as known parameters, and determining their relative importance. Calibration involves adjusting these parameters to match longitudinally observed (change over time) data. Estimation and calibration were performed by UrbanSim staff as part of the model development contract.

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[8] UrbanSim, Inc. "Parcel-level UrbanCanvas Modeler Documentation." https://cloud.urbansim.com/docs/parcel-model/modeler-index.html.

[9] UrbanSim, Inc. "UrbanSim Parcel Model." https://cloud.urbansim.com/docs/general/documentation/urbansim%20parcel%20model.html

Appendix 2 includes entries on the CMAP UrbanSim GitHub Wiki that describe these steps in greater detail.

UrbanSim models can be run using either estimated or calibrated coefficients; early model runs employing calibrated coefficients overemphasized growth in the urban core. This was mitigated by switching to cross-sectionally estimated coefficients in the employment location choice model and assigning a dummy variable to the calibrated household location choice model to de-centralize household growth.

Model data requirements

This section provides a brief overview of the datasets that were collected or created as part of the model development process.

Base-year (2010) datasets

While the model is used to predict growth patterns from the present to the year 2050, the actual modeling period begins at the year 2010 to allow the use of observed (post-2010) trends in model calibration and validation. A detailed description of requirements for these datasets is included in UrbanSim's online documentation.[10]

Table 5. Core base-year (2010) datasets collected for UrbanSim

Requirement	Source	Comment
Parcel geometry	CMAP 2010 Land Use Inventory (LUI) (based on county parcel GIS files)[11]	Many parcels were dissolved into more meaningful "properties" to prevent awkward or unlikely redevelopment of smaller parcels within a larger development.
Parcel attributes	CMAP 2010 LUI, county assessor data	Assessor data were used to obtain land values and tax-exempt status.
Building types	CMAP	List developed to correspond closely with existing LUI land uses (see Appendix 3).
Building footprints	Microsoft (Bing), county GIS files, raster landcover data	Automated process to choose best available source for a given area.
Building attributes	County assessor data, CoStar, commercial websites, LiDAR	Data on building size, value, age, price, and rent. There is no single source for any of these attributes, and many values were estimated or imputed.
Building area per job	U.S. Green Buildings Council, Commercial Buildings Energy Consumption Survey, in-house research	Reported by building type (see Appendix 3) to establish area-per-worker assumptions for forecasted buildings.

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[10] UrbanSim, Inc. "Parcel-level UrbanCanvas Modeler Documentation, Data Overview." https://cloud.urbansim.com/docs/general/documentation/urbansim%20parcel%20model%20data.html.

[11] CMAP, "Land Use Inventory for Northeast Illinois, 2010." https://datahub.cmap.illinois.gov/dataset/land-use.

Requirement	Source	Comment
Households/ persons	Census Public Use Microdata Sample (PUMS)	A complete base-year synthetic population was generated using the PopulationSim platform.
Establishments	Dun & Bradstreet (D&B)	Anonymized to sector and job count, geocoded and assigned to buildings based on proximity and known sector/building type relationships.

Regional forecast of households and employment

CMAP’s regional forecast (described in Section 1 of this report) is the source of the annual households and employment totals (“controls”) throughout the forecast period. As part of the interaction with the agency’s four-step travel demand model, household counts need to be broken out by several attributes. Totals generated by the regional demographic model, reported at five-year intervals, were interpolated into annual totals to satisfy UrbanSim requirements.

Table 6. Household control variables

Variable	Description
Number of persons in household	Minimum: 1, Maximum: 7
Age of head of household	Three categories: 16–34, 35–64, 65 and over
Household income	Four categories with breaks at the 25th, 50th, and 75th percentile
Race of head of household	Five categories: Hispanic, Asian non-Hispanic, Black non-Hispanic, white non-Hispanic, other non-Hispanic
16- or 17-year-old in household	Yes/no

Employment control totals relied on the consultant-provided regional employment forecast described in Section 1. Wage and salary, not total employment, is used in UrbanSim for consistency with agency travel model requirements. Five-year totals from the employment forecast were interpolated to provide annual controls required by UrbanSim with one exception: due to the pandemic-related drop in 2020 employment (and rapid near-recovery in subsequent years), employment was interpolated between 2019 and 2025. This was done to limit the number of jobs being removed and then potentially being placed in different locations by UrbanSim in subsequent years. While this provides the model with an inflated number of 2020 jobs, model results for that year are not used by the travel model nor in any reporting of 2020 employment used in this document.

Group quarters (GQ) populations were modeled outside of UrbanSim, using 2020 census PL94-171 block-level counts by the seven major GQ types (institutional: adult correctional facilities, juvenile facilities, skilled nursing facilities, other; non-institutional: college/university student housing, military quarters, other). The increase by GQ type over the forecast period were applied directly at the block level as localized increases in the GQ population. Military quarters population, represented in the region solely by Naval Station Great Lakes in North Chicago, is held constant over the forecast period.

Constraints to development

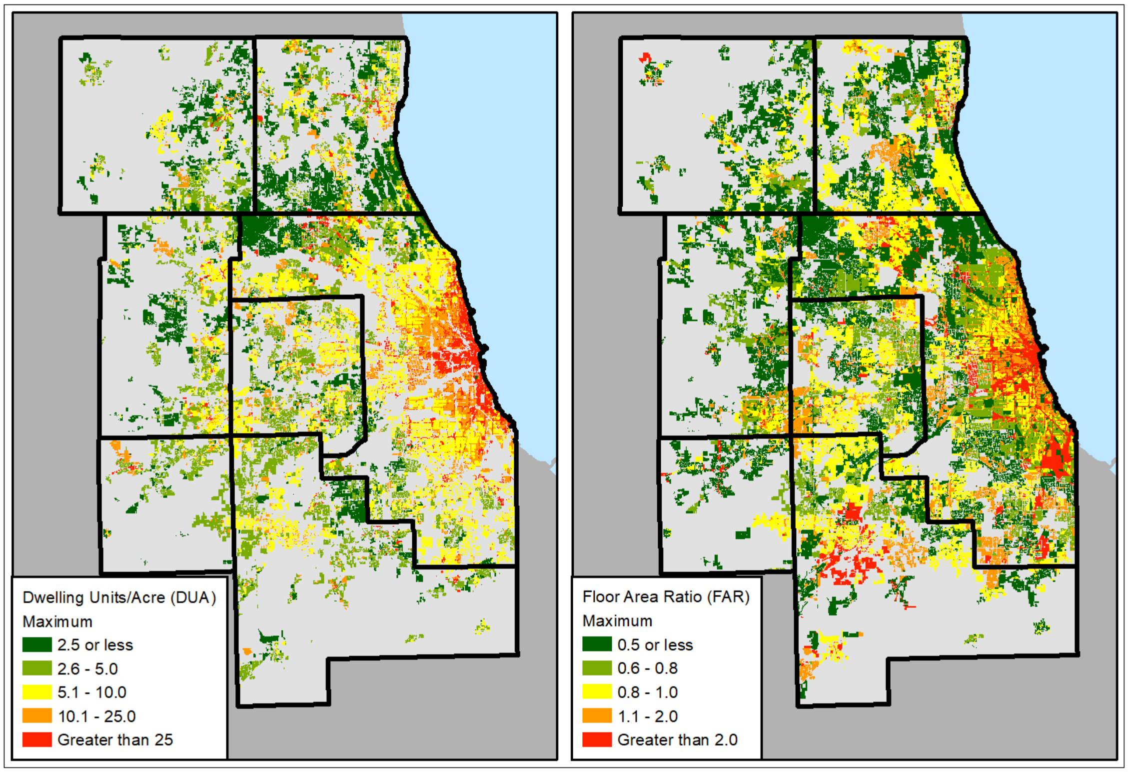
Limits to development are represented in two places in the model. At the parcel level, properties identified as protected open space in the CMAP Land Use Inventory are tagged undevelopable; this was augmented with more recent research to ensure that newly acquired open space was also tagged as undevelopable. Additionally, an undevelopable overlay was created for parcels using FEMA's National Flood Hazard Layer, with a parcel's developable acreage reduced by the percentage of that parcel intersected by that layer.

The second significant constraint on development is local zoning, which limits the type and intensity of development that can occur within each jurisdiction. In the original ON TO 2050 forecast, this concept was articulated through "Urban Classifications," generalized characterizations of development capacity based on existing household and employment density. Working at a more disaggregate level for this cycle allowed us to incorporate zoning, allowing the model to respect community-defined standards for density and use.

CMAP staff undertook a major effort in 2018 and 2019 to collect zoning boundary GIS files (or create them from zoning maps posted online), as well as research local zoning ordinances to identify per-district allowed uses, along with maximum allowable floor area ratio (FAR) and dwelling units per acre (DUA). These data translated directly into the types of buildings that could be allowed on a given parcel, with FAR limiting the size of a non-residential building that could be built on the parcel, and DUA limiting the number of housing units that could be built on the parcel (after subtracting for undevelopable acreage). CMAP was greatly aided in this effort by staff from SB Friedman Development Advisors, who were engaged in a similar effort at the same time. All 284 municipalities in the CMAP region are represented, as well as the unincorporated areas of the seven counties (see **Figure 6**, below).

There are limitations to these data. The collection period was 2018-19, so ordinances updated since that time are not reflected in the model. Special overlay areas, such as historical districts, are not represented. Many ordinances did not explicitly state FAR/DUA values required by the model, so were calculated using other reported restrictions (such as minimum lot size) or inferred from contextual information (similar densities/uses in proximity).

Figure 8. Development constraints: municipal zoning



Known development activity

CMAP's Northeastern Illinois Development Database (NDD) was used to provide UrbanSim with known development activity beyond the 2010 base year, as well as upcoming development projects (the "development pipeline"). NDD records are represented in UrbanSim as individual (or collections of) buildings as an initial step to preempt the developer model from considering or building on those parcels. To conform to model requirements, thousands of NDD records were retrofitted with additional information required for UrbanSim but not collected for NDD. Data used by UrbanSim include status (proposed, committed, under construction, completed), building type, building size (for non-residential buildings), number of residential units, average unit size, and number of affordable units; also, development start year and duration, and flag to indicate whether this is a redevelopment. **Table 7** below lists the post-2020 NDD-derived development assumptions used in UrbanSim.

Table 7. Development pipeline assumptions, 2020 and later, from CMAP's development database (NDD)*

	Residential (units)	Commercial (sq. ft.)	Warehouse/ dist. (sq. ft)	Industrial other (sq. ft)	Other (sq. ft.)
Chicago	28,779	16,185,913	2,069,915	423,454	2,033,234
Suburban Cook	3,212	1,686,414	6,876,592	0	316,064
DuPage	3,420	1,078,833	4,366,554	0	229,124
Kane	1,368	280,725	2,759,146	213,088	3,601
Kendall	228	0	30,742	14,000	0
Lake	393	101,800	2,494,133	0	154,692
McHenry	4,567	28,250	183,000	610,000	358,684
Will	2,849	212,105	8,439,248	906,517	280,421
REGION	**44,816**	**19,574,040**	**27,188,588**	**2,153,059**	**3,375,820**

** Excludes projects that broke ground before 2020*

A separate effort identified larger proposed projects for which we do not have enough information to create an NDD record. This "speculative" project list was researched for the most current available information on proposed types, sizes, and locations of buildings that might be included in each development.

Table 8. Additional development assumptions

Development	Location	Total residential units	Total non-res sq. ft.
One Central	Near South Side (Chicago)	9,240	4,800,000
Lincoln Yards	Lincoln Park/West Town (Chicago)	3,900	1,494,000
Invest SouthWest*	North Lawndale (Chicago)	0	400,000
Bronzeville Lakefront	Douglas (Chicago)	300	595,000
Chicago Bears Move	Arlington Heights	0	4,130,000
AT&T Redevelopment	Hoffman Estates	550	679,683
South Suburban Airport	Peotone	0	850,000

** Represents one Invest SouthWest project whose proposal was not accepted by our deadline. All other Invest SouthWest projects are included in the core development pipeline input.*

All development pipeline data (with attendant unit counts, building size, etc.) are assigned to parcels within the UrbanSim model. After placing these developments (and subtracting new built space from overall new building demand implied by the regional forecast), the remaining building demand is satisfied through the developer model.

Manual adjustments

UrbanSim allows for the manual adjustment of pre-defined areas based on expert opinion and knowledge of the region. This feature is extremely useful in larger institutional settings, which do not conform to behaviors represented in the developer and location choice models. A set of adjustments was identified (Appendix 4) and employment targets created for each area based on existing (2019) employment by industry sector. Employment totals were then forecasted throughout the model period using the per-sector projected increase in regional employment as a guide.

Adjustments for airport and university areas were developed in collaboration with CMAP's travel model team as part of their special generators effort. The proposed South Suburban Airport near Peotone is included in this list, with size and function assumptions based on recent presentations by the Chicago Southland Economic Development Corporation focusing on a cargo airport;[12] the parcel footprint was based on the inaugural configuration in the 2012 Airport Plans Report.[13] The region's two national laboratories (Argonne and Fermilab), as well as Naval Station Great Lakes, were added to this list by the land use team.

Extra-regional model

In addition to the parcel-level microsimulation model developed for the CMAP region, three models representing portions of Illinois, Indiana, and Wisconsin were constructed that correspond with the larger modeling area covered by agency travel models (see **Figure 1** in Part 1). These are aggregate, zone-level models whose base geography is consistent with CMAP travel model subzones.

Data requirements for the zone-based models are less rigorous (e.g., zone-level totals of households and employment, rather than representations of individual households and jobs) and are based on existing development patterns and estimates of additional capacity. This effort is necessary to represent the interaction between the CMAP region and the greater CMAP travel-shed; it is not, however, part of the official CMAP forecast, and results are not presented here. Forecasted household and employment data will be available in the conformity analysis data on the CMAP Data Hub after plan adoption in October 2022. Documentation of UrbanSim's zone-based model can be found on the UrbanSim website.[14]

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[12] "Column: Amazon growth is driving demand for a third Chicago airport near Peotone, officials say." *Daily Southtown*, 30 April 2021.

[13] AECOM, prepared for the Illinois Department of Transportation. South Suburban Airport Master Plan Draft, 27 September 2012. https://www.southsuburbanairport.com/MasterPlan/reports/ALP/DRAFT_AirportPlansReport-September27-2012.pdf

[14] UrbanSim, Inc. "Zone-level UrbanCanvas Modeler Documentation." https://cloud.urbansim.com/docs/zone-model/modeler-index.html

Policy influence and implementation

This section reviews the market and policy factors used in the original ON TO 2050 local forecast and how those factors were applied in UrbanSim for the forecast update, including two scenario factors unique to UrbanSim's modeling structure that allow for targeted spatial modifications, which align forecast results with ON TO 2050 plan goals.

ON TO 2050 allocation factors and UrbanSim equivalents

As in the original ON TO 2050 forecast, there is a prescriptive element to the updated forecast, meaning it represents one possible outcome if plan recommendations are implemented. The ON TO 2050 forecast had several factors to represent market-based drivers of growth, as well as policy-based "levers" that encourage growth in areas prioritized by the plan, with a result consistent with the goal of encouraging development in infill-supportive areas and reinvesting in disinvested and economically disconnected communities.

The factors used to develop the ON TO 2050 forecast are presented below, with a discussion of how each was addressed in UrbanSim.

Local share of regional households/employment

ON TO 2050 description:

> This factor emphasizes the importance of reinvesting in existing developed areas and incorporating existing densities. Developed areas would be more likely to receive additional residents and employees, and already-dense areas would receive higher amounts (within the prescribed limits of those areas' Urban Classifications).

Base-year population and employment distribution was included as an input to the model estimation process (see Appendix 2).

Local share of overall households/employment over time

ON TO 2050 description:

> This factor builds on the market exhibited by recent growth trends. Prioritizing this factor would emphasize new residents and employment in growing parts of the region.

Observed changes in population and employment between the 2010 base year and latest-available data were used for model calibration.

Property value

ON TO 2050 description:

> This factor serves as an indicator of market potential. Property value depends on many factors, including transportation accessibility, recent development trends, agglomeration, tax rates, and existing densities. At base, higher property values indicate higher market demand for an area.

Property value, as well as square-foot estimates of prices and rents, are used in UrbanSim developer/proforma models.

Auto/transit accessibility

ON TO 2050 description:

> This factor measures the time required to commute to work from various parts of the region ... Auto and transit accessibility are based on the average generalized cost calculations estimating the average time it takes to travel from one Traffic Analysis Zone (TAZ) to all other TAZs in the region, weighted by population (for the household allocation) and employment (for the employment allocation).

Loading travel model accessibility data ("skims") directly into UrbanSim replaces this factor, with parcel accessibility inherited from the TAZ that it occupies. Since accessibility evolves over the forecast period due to new or improved transportation facilities and updated population/employment distributions, there is a periodic interaction between UrbanSim and the CMAP travel demand model for the years 2019, 2025, 2030, 2035, 2040, and 2050. Updated household/employment distributions are fed to the travel model, and a new set of skims are uploaded back into the UrbanSim model and used for accessibility estimates in subsequent model years.

Municipal envelope

ON TO 2050 description:

> This factor uses the 2010 municipal boundaries, plus some adjacent area, to allocate growth. GO TO 2040 had a target for 75 percent of new non-residential square footage and 60 percent of new residential units to occur within the 2010 municipal envelope. Prioritizing this factor would emphasize growth in existing incorporated areas.

This concept is manifested in the zoning data which represent development constraints. Unincorporated areas are controlled by county zoning regulations, which generally have lower prescribed densities and more limitations on the types of activities allowed. Incorporated area extent was based on boundaries depicted on each community's zoning map, or the extent of the shapefile received from the municipality.

Infill supportiveness

ON TO 2050 description:

> CMAP has classified the region into areas with high, moderate, and low potential for infill ... Prioritizing this factor would emphasize reinvestment in existing communities, as well as less-developed areas with municipal plans in place.

The approach to infill for the plan update concentrated on upzoning (increasing the maximum allowed residential density) as the primary tool for encouraging infill development. Increased potential for infill development was directed to outer suburban areas away from sensitive watersheds (as defined by the ON TO 2050 watershed integrity local strategy map[15]), with additional emphasis placed on areas close to Metra rail stations. Final infill lever values are reported in the next section.

Disinvested/economically disconnected areas

ON TO 2050 description:

> Disinvested areas are defined as mature areas that have experienced a combination of population decline, low property values, and high rates of vacancy in residential, commercial, and/or industrial property. Economically disconnected areas (EDAs) contain concentrations of low-income households with either a minority or limited English proficiency population. ON TO 2050 places a priority on renewed public and private investment in these communities. Staff used property value, vacancy, and employment data to identify disinvested areas; assignment of EDAs was based on research in support of the Inclusive Growth strategy paper.[16]

ON TO 2050 disinvested/EDA designations at the census tract level were assigned to all parcels within those tracts.[17] The factor is represented in the UrbanSim proforma (developer) model as an assumption that development costs will be subsidized in these areas, making the proposed development more likely to generate a profit, thus more likely to be built over the forecast period. Final subsidy assumptions are reported in the next section.

Simulation scenario parameters used for the plan update

Unlike the ON TO 2050 local allocation tool, not all the factors discussed above can be articulated as a simple set of values. Exceptions are those factors used as policy levers to encourage development in infill-supportive areas, as well as investing in disinvested and economically disconnected communities. Because of the complex interrelationships among sub-models within UrbanSim, simple one-size-fits-all values for these two levers are not realistic, as they may result in over-building in areas that need little support, and not providing enough support in other areas.

The infill lever used to represent infill supportiveness focused on incorporated areas in outer counties (Kane, Kendall, McHenry, and Will) with existing residential development, away from sensitive watersheds; higher increases were assigned to zoning districts within ½ mile of a Metra station. Housing unit density (maximum allowed dwelling units per acre, or DUA) was doubled in districts in these areas that allowed single-family detached as the sole residential use. Initial runs incorporating this process resulted in over-building in DuPage and Lake

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[15] CMAP, "Local Strategy Map: Watershed Integrity." https://www.cmap.illinois.gov/2050/maps/watershed

[16] CMAP, "Inclusive Growth." https://www.cmap.illinois.gov/onto2050/strategy-papers/inclusive-growth

[17] CMAP, "Local Strategy Map: Economically Disconnected and Disinvested Areas." https://www.cmap.illinois.gov/2050/maps/eda

counties; removing the lever from these two counties allowed for more equitable growth among suburban areas.

Table 9. Upzoning levers employed in scenario

Area	Allowed residential types	DUA increase	Start year
Within ½ mile of Metra station	Multiple types	40%	2025
	Single-family detached only	100%	
More than ½ mile from Metra station, 15% of area already developed, not in sensitive watershed	Multiple types	25%	
	Single-family detached only	100%	

The disinvested/EDA subsidy lever was tested and modified (based on interaction with the infill/upzoning lever) to arrive at a subsidy rate that yielded positive growth (in terms of a reasonable increase in jobs and households) in these areas. These subsidies are incorporated in the UrbanSim proforma (developer) model as an assumption that a publicly sponsored subsidy program will reduce development costs in these areas, making the proposed development more likely to be built over the forecast period. The set of census tracts defined as disinvested or economically disconnected in the original ON TO 2050 plan were used for this scenario.

Table 10. Subsidy levers employed in scenario

Area	Subsidy	Start year	End year
Disinvested or disinvested + EDA	3%	2025	2034
EDA alone	2%		
Disinvested or disinvested + EDA	2%	2035	2045
EDA alone	1%		

Socioeconomic forecast: Sub-regional results

Plan updates are intended to incorporate new data and revised assumptions within an existing policy framework, with outcomes that generally reflect those of the original plan. With an updated regional forecast predicting over 800,000 fewer persons and 600,000 fewer jobs by 2050, a corresponding decrease in local forecasts is inevitable. Additionally, the adoption of a land use model for local forecast development means that the distribution of growth won't match the earlier forecast. The spreadsheet tool used in the original ON TO 2050 forecast was indiscriminate in that two places with identical characteristics would be assigned an equal amount of growth; UrbanSim, which creates location-specific developments in response to highly detailed local conditions, will generate different patterns of growth throughout the region.

Local forecast totals

Below are summarized results and maps of the ON TO 2050 Update Local Area Allocation process. Additional data will be made available in October 2022 on the CMAP Data Hub. Census 2020 figures are from the PL94-171 Redistricting file, with the household count based on reported "occupied housing units." 2019 employment estimates are from EBP's benchmark series, with the Chicago share of Cook County's employment based on the city's share of Cook County employment in estimates published by the Illinois Department of Employment Security.[18]

Table 11. Current and projected total population by county and Chicago

	2020 (census)	2030	2040	2050	2020 share	2050 share
Cook	5,275,541	5,565,681	5,860,178	6,016,160	61.5%	59.9%
DuPage	932,877	991,827	1,045,371	1,050,807	10.9%	10.5%
Kane	516,522	566,803	618,878	652,547	6.0%	6.5%
Kendall	131,869	147,715	166,418	192,704	1.5%	1.9%
Lake	714,342	772,156	818,377	832,443	8.3%	8.3%
McHenry	310,229	334,725	374,788	419,425	3.6%	4.2%
Will	696,355	762,379	842,521	887,392	8.1%	8.8%
TOTAL	**8,577,735**	**9,141,286**	**9,726,531**	**10,051,478**		
Chicago	*2,746,388*	*3,138,765*	*3,214,049*	*3,216,869*	*32.0%*	*32.0%*
Suburban Cook	*2,529,153*	*2,426,916*	*2,646,129*	*2,799,291*	*29.5%*	*27.8%*

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[18] Illinois Department of Employment Security, "Where Workers Work." https://ides.illinois.gov/resources/labor-market-information/where-workers-work.html

Table 12. Current and projected household population by county and Chicago

	2020 (census)	2030	2040	2050	2020 share	2050 share
Cook	5,195,182	5,472,179	5,752,031	5,894,478	61.5%	59.8%
DuPage	919,059	975,578	1,026,426	1,029,346	10.9%	10.4%
Kane	511,034	560,214	611,118	643,818	6.0%	6.5%
Kendall	131,467	147,221	165,847	192,055	1.6%	1.9%
Lake	694,376	750,501	794,911	807,420	8.2%	8.2%
McHenry	308,386	332,319	371,915	416,139	3.7%	4.2%
Will	687,761	752,607	831,546	875,146	8.1%	8.9%
TOTAL	**8,447,265**	**8,990,619**	**9,553,794**	**9,858,402**		
Chicago	*2,698,875*	*3,086,626*	*3,155,064*	*3,151,094*	*31.9%*	*32.0%*
Suburban Cook	*2,496,307*	*2,385,553*	*2,596,967*	*2,743,384*	*29.6%*	*27.8%*

Table 13. Current and projected total households by county and Chicago

	2020 (census)	2030	2040	2050	2020 share	2050 share
Cook	2,086,940	2,263,483	2,374,380	2,478,534	63.9%	60.3%
DuPage	348,216	392,058	419,758	427,932	10.7%	10.4%
Kane	180,374	213,795	242,297	262,179	5.5%	6.4%
Kendall	43,534	55,599	64,357	76,067	1.3%	1.9%
Lake	253,386	294,469	320,568	332,903	7.8%	8.1%
McHenry	114,282	132,453	153,455	176,411	3.5%	4.3%
Will	240,009	287,728	328,821	354,690	7.3%	8.6%
TOTAL	**3,266,741**	**3,639,585**	**3,903,636**	**4,108,716**		
Chicago	*1,142,725*	*1,202,728*	*1,233,740*	*1,302,281*	*35.0%*	*31.7%*
Suburban Cook	*944,215*	*1,060,755*	*1,140,640*	*1,176,253*	*28.9%*	*28.6%*

Table 14. Current and projected wage and salary employment by county and Chicago

	2019	2030	2040	2050	2019 share	2050 share
Cook	2,616,967	2,650,089	2,723,164	2,803,465	62.8%	63.6%
DuPage	618,700	560,446	567,198	575,172	14.8%	13.1%
Kane	213,345	221,159	224,519	228,566	5.1%	5.2%
Kendall	29,176	35,289	36,173	37,159	0.7%	0.8%
Lake	340,908	340,571	343,329	347,695	8.2%	7.9%
McHenry	97,534	120,002	122,099	123,680	2.3%	2.8%
Will	250,380	265,362	279,463	290,205	6.0%	6.6%
TOTAL	**4,167,010**	**4,192,918**	**4,295,945**	**4,405,942**		
Chicago	*1,382,076*	*1,358,744*	*1,404,343*	*1,452,706*	*33.2%*	*33.0%*
Suburban Cook	*1,234,891*	*1,291,345*	*1,318,821*	*1,350,759*	*29.6%*	*30.7%*

Figure 9. Household density by township and Chicago Community Area, 2020 (census) and 2050 (projected)

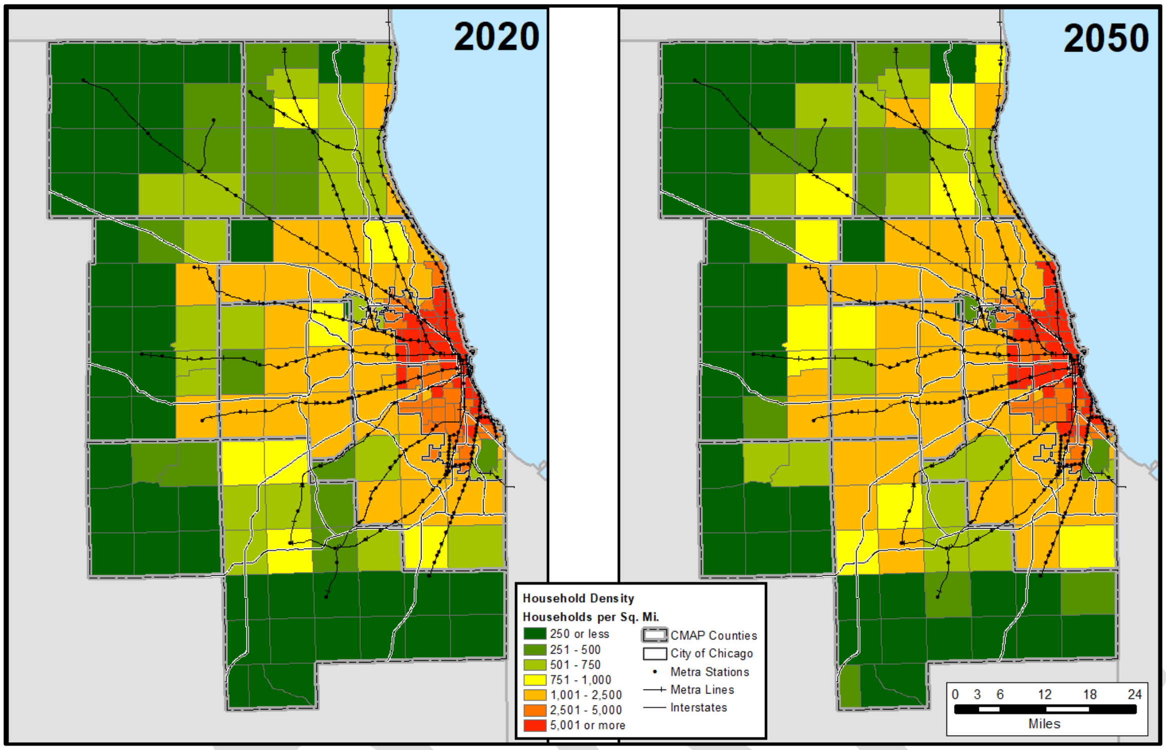
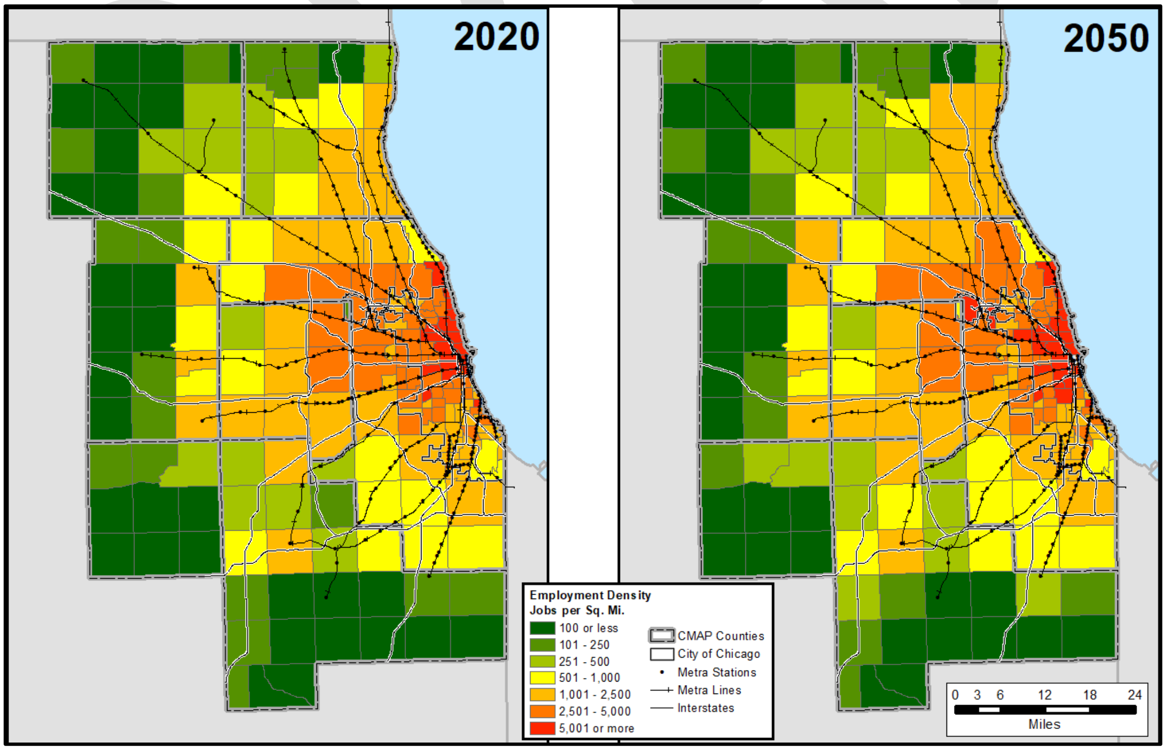


Figure 10. Employment density by township and Chicago Community Area, 2020 (modeled) and 2050 (projected)



Variances with the regional forecast

Some discrepancies will be apparent when comparing results from the local forecast with those from the regional forecast in Part 1. The three contributing factors are discussed below.

Household population: Methodological differences between the regional demographic model (which works at the person level) and UrbanSim (which models entire households) result in discrepancies between the forecasted regional household population in Part 1 and the totals reported here. As both models mature, we will be able to bring these numbers in closer alignment in upcoming forecast cycles.

Group quarters population: 2020 census results were not available in time for inclusion in regional demographic modeling efforts. After the delayed release of the PL94-171 file, the decision was made to incorporate 2020 group quarters counts in the local forecast, with a modification of the scaling process described in Part 1 to accommodate these data.

Employment definitions: Wage and salary employment, described as "workers who receive wages, salaries, commissions, tips, payment in kind, or piece rates [including] employees in both the private and public sectors"[19] is reported in the local forecasts to correspond with CMAP travel demand model requirements. Regional forecasted employment in Part 1 reports total employment (wage and salary plus self-employed).

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[19] Bureau of Labor Statistics Glossary, "Wage and salary workers." https://www.bls.gov/bls/glossary.htm#W

Appendix 1: UrbanSim developer model overview

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This page provides a high-level overview of UrbanSim's developer model and its input parameters. The aim is to provide a general description of the process through which the model represents decisions taken by developers in the real estate market and updates the buildings table with extra capacity for every simulation year. Understanding the general logic behind the model, as well as the role of each input parameter, will allow refining the proforma inputs to better represent the context in the CMAP region.

Broadly speaking, the developer model is divided in two steps: feasibility and developer. The feasibility step tests multiple combinations of land use and floor-area-ratio (FAR) for every parcel in the model, returning the most profitable FAR and building configurations for each land use combination in each parcel. This information is then used by the developer step to select the parcels in which new buildings will be built to match existing residential and non-residential demand. A more detailed description of the two steps is given below.

Feasibility step

The feasibility step simulates the typical process that a developer would undergo when deciding what type of development would be most profitable for a given parcel and applies this same logic to all the parcels in the model at a time. The main process can be outlined as follows:

- The proforma is initialized based on the user inputs from the proforma.yaml file, including information about the specific forms that will be tested. Here, each form will represent a combination of land uses that could potentially be built in a parcel (i.e., 80 percent retail, 20 percent residential).
- The sites to analyze and their characteristics are defined based on the parcels table, removing previously pipelined sites.
- For each form (corresponding to a given land use mix):
    - Each potential development site is assigned an acquisition cost that comes from the current yearly rent (either empirical data of rents in the city or forecasts).
    - The model estimates the costs and revenues that would result from building at different alternative densities in the site. (This is done by estimating costs and revenues that could be obtained from different FARs in each site, with the list of FARs to test being specified by the user inside proforma.yaml).

  - Profit calculations for each potential FAR include the effect of parking requirements, parking costs, building costs at different heights, profit ratio requirements, building efficiency, parcel coverage, and cap rate, among others.
  - Zoning constraints, such as maximum FAR and allowable uses, are taken into account at this point, filtering out those developments that are unfeasible or not allowed. For maximum FAR, the model selects the minimum between the max_far field, and the max FAR that would result from other zoning limits (max heights, max dua, etc).
  - The model generates a feasibility table with the building characteristics that yielded maximum profit for each development site. Building characteristics that make part of the feasibility table include FAR, parking configuration, building sqft, parking ratio, stories, construction time, residential sqft, non-residential sqft, building cost, financing cost, total cost, building revenue, and profit.

The core cost and revenue calculations performed to select the most profitable FAR for each development site for each potential form (land use or land use combination) take place within the Square Foot Proforma API, inside the lookup() function of the feasibility step. The general logic for these calculations is the following:

- Total building area (building bulk) is calculated multiplying FAR by the site area (sqft).
- Building costs are calculated by multiplying built area by cost per sqft for the given building configuration.
- Total construction costs are calculated as the sum of building costs and land costs.
- The loan amount is calculated as total construction costs times loan-to-cost ratio.
- Financing costs are calculated based on the loan amount using the following variables: construction time, drawdown factor, interest rate, loan fees.
- Total development costs are calculated as the sum of construction costs and financing costs.
- To calculate the area (sqft) that will generate rent, common areas and parking are subtracted from the total building area using the parking_sqft_ratio and building_efficiency variables.
- The area that generates rent is multiplied by weighted rent values and divided by the cap rate to calculate the revenue that will be generated by the building.
- Finally, the profit is calculated as the revenue minus total development costs.

- Costs, revenues, and profits are all allowed to be modified by the user through custom callback functions.

One important thing to note is that the feasibility step does all the profit calculations in terms of square footage and has no representation of units (it does not differentiate between rent attained by 1BR, 2BR, or 3BR, and change the results accordingly). Since getting data on unit mixes in the current building stock is extremely difficult, most feasibility computations here happen on a square foot basis, and the developer step handles the translation to units.

Developer step

Having identified the development configuration that would maximize profit for each site-form combination, the main objective of the developer step is to select the sites where buildings will be added on a given simulation year to satisfy demand, and to modify the buildings table to reflect this extra capacity. The main input for the developer step is the feasibility table resulting from the previous step, as well as the demand for residential units and non-residential space on a given simulation year.

For a given simulation year, the developer step can be described as follows:

- The demand for residential units (target_units) is calculated based on the number of forecasted households, the number of existing residential units, and the target vacancy rate. Similarly, the demand for non-residential sqft is calculated based on the number of jobs generated each year, the number of available job spaces, and a target vacancy rate.

- The probability of selecting a given building/development is calculated based on the profit values from the feasibility table. The default function calculates this probability for each site in the feasibility table as the ratio between the profit per unit of area of the site and the sum of profit per unit of area over all feasible sites.

- Using the probability distribution over the potential development sites, the model runs a random function to select specific sites where new developments will be built to meet existing residential demand.

- Both the function to calculate probability based on profit values and the function to select development sites based on the probability distribution can be customized by the user.

- Selected developments are dropped from the feasibility table.

- The buildings table is updated, adding extra capacity in terms of new buildings and new residential units.

Appendix 2: UrbanSim estimation/calibration

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Model estimation strategy

This wiki page discusses the approach taken with respect to model estimation. The following UrbanSim models in the CMAP model system required statistical estimation of parameters:

- the household location choice model (multinomial logistic regression)
- the employment location choice model (multinomial logistic regression)
- the hedonic model of real estate prices (ordinary least squares regression)

All estimated coefficients were generated within UrbanSim via Jupyter notebooks. Coefficients are estimated on local CMAP data and not borrowed.

Specification of the location choice models in UrbanSim involves deciding which alternative (i.e., location) characteristics should be considered in the model (i.e., explanatory variables). It also involves determining whether to stratify the estimation by some characteristic of the agents making location choices (i.e., segmentation). Stratification reflects the hypothesis that different groups of agents have different locational preferences. For specifying price models, the modeler decides which observations dataset to use (e.g., buildings), which explanatory variables to use, and how to segment the model into sub-models (e.g., by building type).

Both adding/dropping explanatory variables and changing the model stratification are easy to do in the UrbanSim framework and the notebooks that have been prepared for CMAP. New variables are defined using simple pandas expressions (syntax of the Python pandas library). Each model can be iteratively re-specified and re-estimated quickly during the process of developing a desired model specification. In UrbanSim, the model estimation process is tied closely to simulation. Estimation and simulation both take place within the same code-base and framework. In a properly configured model, simulation can occur right after estimation.

We have variable categories in mind when starting the specification/estimation process (based on hypotheses in the literature), but the specific variables to use depend on local data, review of estimation results (examining coefficient sign, significances, measures-of-fit, and other diagnostics), and an iterative process of trying different specifications.

Variable categories we seek to include in location choice model specifications include real estate characteristics, regional accessibility variables, local accessibility variables, and price. For example, a regional accessibility variable we might try is “employment within 20 minutes auto travel time in the a.m. peak period." This variable would be calculated based on skims from the travel model (stored in the UrbanSim travel_data table). A local accessibility variable we might try is whether there is a school within one mile along the local street network, or retail square footage within a half mile. These kinds of variables would be calculated using the Pandana network accessibility library. In the location choice models, price is a key variable that we try in the specifications. It is hypothesized that, ceteris paribus, households/employment will prefer lower prices (i.e., price will have a negative coefficient), although it is not uncommon in discrete choice models of housing location to find insignificant or even counter-intuitive signs on price variables due to omitted variables that are correlated with price. We also typically include clustering variables. For example, household income interacted with mean income within 400 meters may be tried as an explanatory variable to identify tendencies for income clustering. Similarly, in the employment location choice model, we may try a variable for the number of jobs of the same sector within the zone to capture agglomeration economies.

We start the variable selection process by adding variables to the specification based on behavioral considerations. For example, typical household location choice model explanatory variable categories include:

- price
- residential building characteristics (e.g., year_built)
- neighborhood characteristics
- local and regional accessibility
- interaction variables, such as price interacted with income, or a demographic attribute interacted with a location attribute

Typical employment location choice model explanatory variables include:

- price
- building characteristics (e.g., building type, year_built)
- agglomeration/clustering (e.g., number of jobs within same sector within one mile)
- density (e.g., employment density, population density)
- regional accessibility (skim-based or logsums, e.g. population_within_20_minutes)
- local accessibility (e.g., local street-network based variable)
- composition of households and employment in neighborhood

- If retail-sector, population-seeking variables

Typical real estate price model explanatory variables include:

- distance to local amenities/disamenities
- building characteristics (e.g., year_built)
- regional accessibility (skim-based or logsums, e.g., employment_within_15_minutes)
- neighborhood characteristics (e.g., density, local accessibility, composition)
- Small-area vacancy rates
- Possible (only as needed): geographic dummies for local fixed effects

New variables are defined as python/orca functions in variables.py, and then the variable is added to a model specification using the notebooks, and then the model is estimated and evaluated. We check for fit and significance. If a key behavioral variable (e.g., accessibility) has an intuitive sign but is not significant, we may still retain it for sensitivity reasons.

After trying a set of intuitive behavioral variables, if the model fit is still low, we iteratively try other variables in the specification that have less intuitive interpretations. These less intuitive behavioral variables may be proxying for unobserved factors / unaccounted behaviors, and they help the model to have appropriate spatial associations if behavioral variables alone result in low measures of fit.

For any variable added to a model specification, we consider the resulting metrics:

- Variable significance (t-score)
- Model fit (r2, pseudo-r2)
- Inter-variable correlation matrix to check for multicollinearity (see the plots in the notebook). Correlation coefficients above .6 or so may lead us to reject a variable.
- Variable skew. Excessively skewed variables can result in unreliably estimated parameters. A skew value of greater than 5 or 10 often means we'll try log-transforming the variable to reduce skewnesss.
- Visual assessment of probability plots, or predicted price plots in the case of price models

- If a specification results in a warning being printed about lack of convergence, we make sure to re-run estimation, as the coefficients may not be valid.

Model calibration

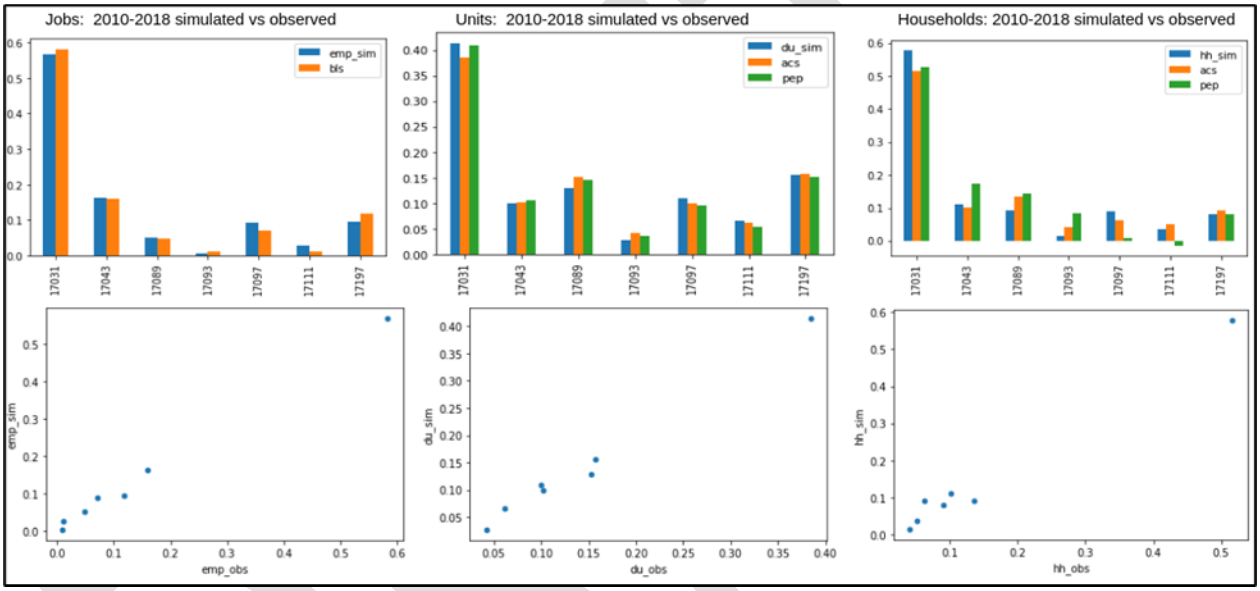
UrbanSim models are estimated using cross-sectional datasets (as represented by the base-year data prepared for the CMAP model); this cross-sectionally-estimated model system is used for forecasting small-area longitudinal patterns of urban growth. “Calibration” in the UrbanSim context means calibrating the temporal dynamics of the simulation to observed longitudinal data. As part of the calibration process, the UrbanSim parameters most likely to have generated observed longitudinal outcomes are inferred. This can help ensure that the model validates better in a forecasting context, a context where the temporal dimension is key.

The approach taken to calibration for the CMAP UrbanSim model is to first frame UrbanSim as a differentiable function, then define an objective function describing the longitudinal accuracy of the model, and then to optimize the objective function by tuning the estimated parameters of the UrbanSim model using automatic differentiation and gradient descent. This can be described as tuning the cross-sectionally-estimated parameters in light of longitudinal data to aid the forecasting accuracy of the model. Note that we are tuning the behavioral parameters of the model, not introducing dummy variables or k-factors to tune; avoiding unnecessary dummies and k-factors is advantageous from the point of view of not dampening the sensitivity of the model system. The model system can then be simulated with either the estimated coefficients or the calibrated coefficients. In the UrbanSim community, simulating based purely on cross-sectionally estimated coefficients is valid, so calibration can be viewed as an optional step. UrbanSim calibration is still an open area of research, and most regions in the past have simulated with cross-sectionally estimated coefficients, but as UrbanSim’s calibration methodologies have been progressing recently, CMAP may choose to take advantage of the calibrate form of their model system.

The goals of model calibration are to move relative spatial variation of simulated growth towards observed patterns (proxy for unobserved costs and variables not accounted for by the models as specified given finite data) and incorporate information from longitudinal data (model estimation is based on cross-sectional data, as mentioned). In both location choice model calibration and proforma calibration, we conduct reverse-mode differentiation (i.e., backpropagation) on the computation graph of the CMAP UrbanSim model to calculate gradients of the scalar-valued loss function (mean-squared error between simulated/observed longitudinal outcomes) with respect to array-valued arguments (the various model input parameters we want to calibrate). We then pass the gradients to an optimizer and do gradient-based optimization to adjust parameter values and minimize the loss.

The calibrated model system was simulated from the 2010 base year to 2018, and then comparisons were made between simulated outcomes and observed outcomes in the 2010-2018 period. This helps to validate the model's performance. The figure below compares simulated with observed outcomes along the employment, residential unit, and household dimensions. The top row contains bar charts of simulated county growth shares compared to observed county growth shares. The bottom row contains scatter plots of the same data. These charts illustrate that the model system's output has a reasonable level of correspondence with observed data on urban growth in the CMAP region.

Figure 11. UrbanSim calibration results



Appendix 3: Building types used in UrbanSim

The table below is a list of all building types represented in UrbanSim, along with square feet-per-job assumptions for all non-residential uses.

Table 15. Building types and utilization assumptions

Building type ID	Building type	Sq. ft. per job	Source
1110	Single-family detached	N/A	
1120	Single-family attached (townhomes / duplexes)	N/A	
1130	Mobile homes	N/A	
1210	Condominium	N/A	
1220	Apartment	N/A	
2110	Mixed use - residential + retail	588	U
2120	Mixed use - residential + office	437	C
2130	Mixed use - residential + services	800	E
3100	Hotel	1,500	E
4000	Storage	8,961	C
4100	Office (Chicago central business district)	300	E
4100	Office	350	E
4210	Grocery store	447	C
4220	Eating and drinking	356	C
4230	Retail - neighborhood	588	S
4240	Retail - strip shopping	758	C
4250	Retail - shopping mall	903	C
4260	Big box retail	826	E
4270	Financial services	305	C
4280	Auto sales / parts / repair	922	C
5100	Light industrial / flex	463	U
5200	Manufacturing	535	U
5300	Warehousing / distribution	1,916	C
6110	Elementary / middle school	1,025	C
6140	High school	1,105	C
6150	College / university	1,003	C
6210	Medical office building	603	C
6230	Hospital	222	C
6300	Parking structures	21,000	E
6400	TCU (transport communication utilities)	2,000	E
6510	Stadium / arena / convention center	1,716	C
6520	Museum	1,884	E
6530	Religious	2,463	C
6540	Other cultural / civic / recreation	1,000	E
6610	Administrative / judicial	434	E

Building type ID	Building type	Sq. ft. per job	Source
6620	Public works / fire / police	256	C
7100	College dormitory	3,127	C
7200	Nursing home	262	C
7300	Military housing	7,818	E
8100	Agriculture	2,500	E
8200	Mining	2,500	E
9000	Other misc.	2,500	E

Sources:

- **C**: U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey (CBECS), 2012 Public Use Microdata file.[20]
- **E**: CMAP in-house estimate based on CoStar building size/type data with Dun & Bradstreet employment counts.
- **U**: "Building Area per Employee by Business Type," a 2008 document attributed to the U.S. Green Buildings Council but is not available on their website. Originally obtained for CMAP by Louis Berger for the ON TO 2050 forecast.[21]

Note: These sources estimate the number of employees who might occupy a building during peak use. Since we require the total number of employees the building could accommodate over the course of a typical work week, factors were applied to those types which operate beyond a 40-hour week. Examples: retail operations are generally open evenings and weekends; hospitals are continually open (although not necessarily operating at peak). CBECS microdata includes data on operating hours per week, which was used to develop these factors.

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[20] U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey. https://www.eia.gov/consumption/commercial/data/2018/index.php?view=microdata

[21] A copy of this document can be found on the City of Davis (California) website, https://www.cityofdavis.org/home/showpublisheddocument?id=4579

Appendix 4: Adjustment areas

Universities and other institutions with locally controlled employment.

Table 16. Adjustment areas and 2050 employment controls

Adjustment area	2050 employment
O’Hare International Airport	57,377
Midway International Airport	10,636
South Suburban Airport*	334
University of Illinois at Chicago	20,560
Northwestern University	10,886
University of Chicago	23,666
Loyola University	4,684
DePaul University (Lincoln Park and downtown)	6,363
College of DuPage	2,600
Harper College	1,674
College of Lake County	1,363
Moraine Valley Community College	1,223
Naval Station Great Lakes	4,499
Argonne National Laboratory	4,693
Fermilab	2,434
Northern Illinois University (external Illinois model, including surrounding TAZ)	5,061
Gary/Chicago Airport (external Indiana model)	336

** Assumes primary function as air cargo airport*

ON TO 2050 plan update system performance report appendix

September 2022 draft

Contents

Introduction

Ten years ago, MAP-21 instituted a national performance measurement system for the highway and transit programs. After several years of rulemaking, CMAP, IDOT, and transit agencies each have adopted targets for federal measures. As the four-year target period approaches for many of the targets adopted with ON TO 2050 in 2018, the region can begin to see how it is making progress towards our federal goals. This report provides details of the federal performance measures as part of the ON TO 2050 plan update.

The targets identified tie directly to ON TO 2050 policy priorities. In addition, they are linked to several long-range plan indicators and, where possible, the financial plan. Seven of 16 plan mobility indicators[1] are also federal performance measures. These were selected as the measures that best aligned with plan goals and policies. While federal measures set targets for the next one to four years, plan indicator targets are for the year 2050. Additionally, the federal condition measures for transit and highway systems are key metrics used in the financial plan to estimate maintenance and modernization needs.

This appendix contains all current federally-required performance targets for the CMAP MPO. It is organized into 5 sections:

- Highway Safety
- Highway Asset Condition
- System Performance
- Transit Asset Management
- Transit Safety (New)

Each section includes a description of the research that informed the target selection and a description of CMAP's efforts to integrate the targets into the programming process and the Transportation Improvement Program (TIP). ON TO 2050 also includes a number of long-range quantitative indicators that partly overlap the federally-required performance measures. For these overlapping measures, this appendix presents the short-range target (for 2023, 2025, or 2026, depending on the measure), while the indicators appendix presents the longer-term target for the measure.

Outreach on federal measures is primarily done through committees and as a component of the outreach for the long-range plan update. The following reports were taken to committees since ON TO 2050 was adopted in 2018. In addition, the CMAQ and TAP project selection committee meets regularly to discuss matters related to the system performance measures.

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[1] CMAP, "Plan Indicators webpage" https://www.cmap.illinois.gov/2050/indicators

- February 2022 –Transportation Committee – Plan update on federal performance measures
- January 2022 – MPO Policy – ON TO 2050 update – Federal performance measures
- January 2022 – CMAP Board and MPO policy – Highway safety performance targets
- December 2021 – Transportation Committee – Highway safety performance targets
- March 2021 – CMAP Board and MPO Policy - Transit safety targets
- March 2021 – CMAP Board and MPO Policy – NHS pavement condition targets
- February 2021 – Transportation Committee – Pavement condition targets
- February 2021 – Transportation Committee – Transit safety targets
- January 2021 - CMAP Board and MPO Policy – Regional highway safety performance targets
- December 2020 – Transportation Committee – Highway safety targets
- October 2020 – MPO Policy – CMAQ Performance Report
- April 2020 – Transportation Committee – Safety targets
- January 2020 - CMAP Board and MPO Policy – Regional highway safety performance targets
- November 2019 –Transportation Committee – Regional highway safety performance targets
- August 2019 – Transportation Committee – Highway safety – CMAP and IDOT
- January 2019 - CMAP Board and MPO Policy – Regional highway safety performance targets
- November 2018 – Transportation Committee – Regional highway safety targets
- October 2018 – CMAP Board and MPO Policy – Plan adoption – 2018 System Performance Report

Performance Measures and the Transportation Improvement Program

As required by federal law, CMAP is describing the anticipated effect of projects in the TIP[2] toward achieving performance targets. This process will evolve over time, as additional data are collected and trends become clearer. CMAP is currently requesting that implementers identify projects that impact performance measures in the eTIP by checking the box or boxes corresponding to seven performance target groups: safety, transit asset condition, pavement condition, bridge condition, travel reliability/congestion, non-SOV travel, and emissions reduction. Additional questions, directly related to each performance measure, will be added in the future in order to better understand the magnitude of a project's impact.

The National Highway System (NHS) is the focus of the road performance measurement requirements. The NHS is a federal designation for roadways considered important to the nation's economy. In the CMAP region, this includes all interstates, many principal arterials, and limited mileage of intermodal connectors that provide important access to the NHS. The NHS has changed over time. Historic data reflects the NHS approved in the reporting year and has not been adjusted to reflect the 2018 NHS update or expected future changes.

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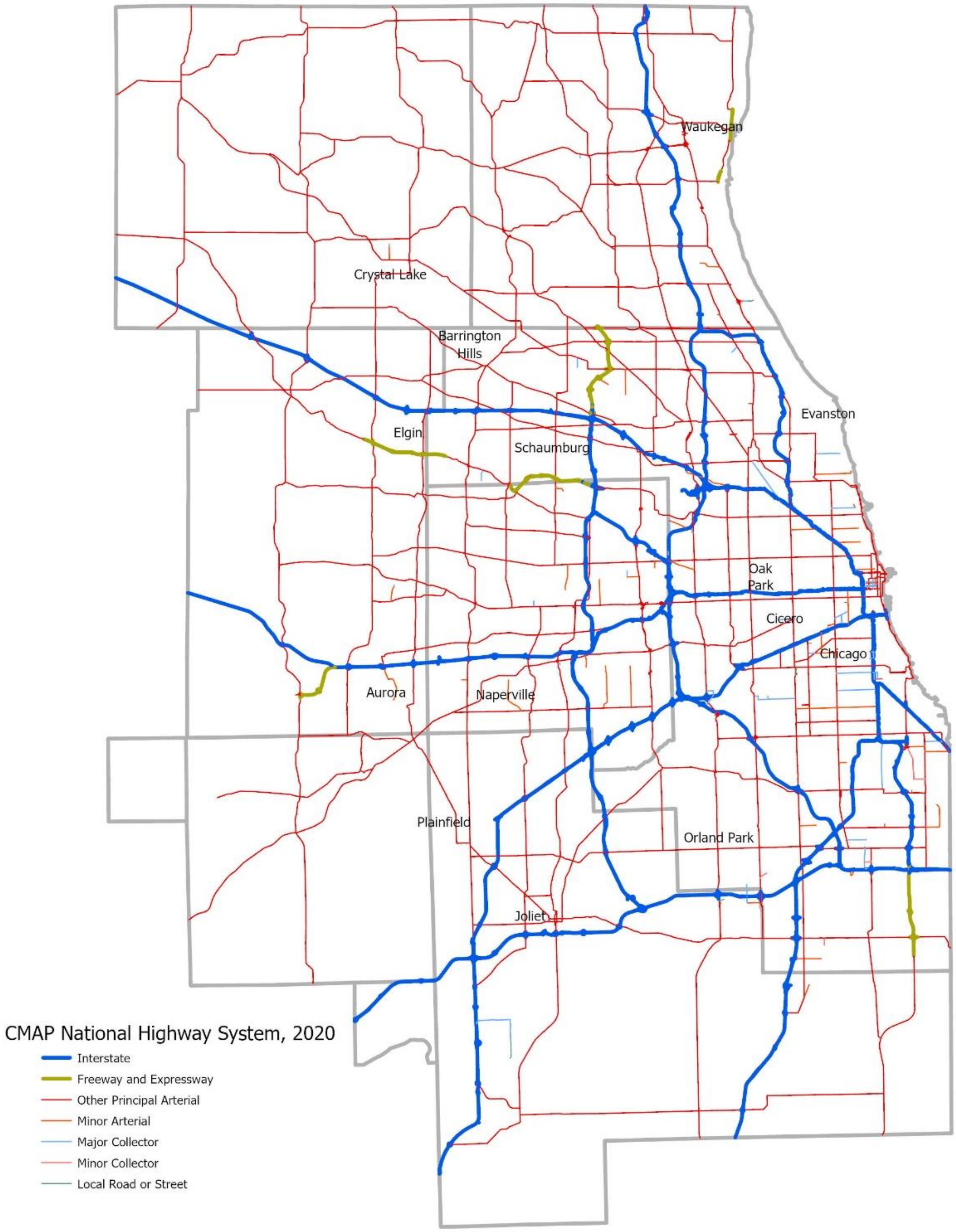
[2] Link to TIP documentation to be updated.

National Highway System in northeast Illinois, 2020



Highway Safety

The safety performance measures require state DOTs and MPOs to establish safety targets as five-year rolling averages on all public roads for:

1. Number of fatalities
2. Rate of fatalities per 100 million vehicle miles traveled (VMT)
3. Number of serious injuries
4. Rate of serious injuries per 100 million VMT
5. Number of non-motorized fatalities and non-motorized serious injuries

Metropolitan Chicago has unique safety needs. The CMAP region greatly influences the safety performance trends at the statewide level because of its share of the state's population and multimodal transportation system. The region accounts for 47 percent and 56 percent of the state's five-year average for fatalities and serious injuries, respectively. When it comes to non-motorized fatalities and serious injuries, the region accounts for roughly 78 percent of the state's total. This is due to the high number of pedestrians and cyclists compared to the rest of the state.

Injuries and fatalities from traffic crashes vary considerably from year to year due to numerous factors; the five-year average is meant to smooth large changes. Following national trends, both the state and region have experienced an increasing trend in the five-year average for fatalities and rate of fatalities per 100 million VMT and at the same time a decreasing trend for the number of serious injuries and rate of serious injuries per 100 million VMT. The non-motorized measure saw a decrease in the 2020 five-year average compared to previous years. According to FHWA's most recent assessment, IDOT did not meet or make significant progress toward meeting the 2015-2019 fatality-related and non-motorized targets. However, significant progress was made on the serious injuries-related targets.

Under federal guidelines, MPOs can choose whether to set quantitative targets or commit to help implement the state's target by planning for and programming safety projects. CMAP has chosen to support IDOT's 2022 safety targets.[3] For each measure, baseline data is shown for both the state and CMAP area. All targets shown for safety are state targets. The CMAP data is provided for context and informational purposes only.

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[3] Note that by agreeing to support IDOT's safety targets, the MPO is not agreeing to any specific share of the decrease in fatalities and serious injuries. Instead it is agreeing to integrate the targets as goals in the metropolitan planning process and to plan and program projects that help meet the State's targets.

Research and projects

The ON TO 2050 white paper on traffic safety[4] builds from the understanding that traffic deaths and injuries are preventable. Infrastructure improvements can improve the safety of our roads, particularly when paired with policy recommendations such as increasing the importance of traffic safety in programming decisions. In general, however, the paper concludes that behavioral change is by far the most important factor in safety improvement.

In addition to the traffic safety white paper, two other reports have significant analysis of safety in the region. The Highway System Performance Trends[5] report looks at safety trends for the CMAP region in comparison to the rest of the state. In addition, it details the location and type of facility for serious injuries and crashes. The Non-motorized Transportation report[6] dives deep into pedestrian and bicycle crashes in the region and identifies steps that local communities can take to improve safety for these users.

In the fall of 2020, CMAP announced a new Safety Action Agenda, a multi-pronged traffic safety program aimed at understanding and addressing the range of issues that threaten users of the region's transportation network. The Safety Action Agenda is a multi-year effort to develop a regional strategy for improving traffic safety. This project lays out policy research that CMAP and potentially other agencies need to undertake to help improve traffic safety at the state, regional, and local level. CMAP staff formed a resource group consisting of regional partners working on various aspects of safety to help guide and develop a regional strategy for improving traffic safety. For FY22, the resource group identified speed management and bicycle and pedestrian safety as focus areas. CMAP staff continue to engage with the group to compile best practices and develop actionable recommendations and strategies to reduce traffic fatalities and serious injuries on all roadways, regardless of jurisdiction.

In addition, CMAP applied for and was awarded a State Planning and Research (SPR) grant to take a deeper dive into speeding related crashes and identify problem locations. The SPR grant includes funding to purchase data and hire a consultant to analyze regional vehicle speed data to identify corridors where vehicle speed issues coincide with high rates of crashes. CMAP plans to potentially work with the agency that has jurisdiction over the identified corridor and help implement safety countermeasures and policies to make the corridor safer for all roadway users through speed management. In addition to purchasing and analyzing the speed data, the SPR grant will allow CMAP to purchase equipment that can track vehicle speed through a

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[4] Chicago Metropolitan Agency for Planning, "Traffic Safety White Paper," ON TO 2050 Report, April 2018, https://www.cmap.illinois.gov/documents/10180/845900/Traffic+Safety+white+paper.pdf.

[5] Chicago Metropolitan Agency for Planning, "Highway System Performance Trends," ON TO 2050 Snapshot Reports, September 2017, https://www.cmap.illinois.gov/documents/10180/71423/Highway+Performance_FINAL_9-15-17.pdf/6b33ea28-1138-cf8f-8691-bdd4a8af575c.

[6] Chicago Metropolitan Agency for Planning, "Non-Motorized Transportation," ON TO 2050 Report, October 2017, https://www.cmap.illinois.gov/documents/10180/620327/Non-motorized+transportation+report.pdf.

corridor. This equipment, along with crash data, will be used to capture the impact of the countermeasure and/or policies implemented along the corridor.

CMAP coordinates with IDOT on safety both at the staff level and with IDOT representation on several committees. IDOT has prepared a Highway Safety Plan (HSP)[7] and Strategic Highway Safety Plan (SHSP)[8], as required by federal law. These state documents set priorities for the primary safety-focused programs in Illinois.

Plans and reports from IDOT, CMAP, and other partners informed selection of the federal performance targets below and the recommendations in the ON TO 2050 long-range plan. In addition, these recommendations will be incorporated into the programming process and reflected in the TIP.

Incorporating safety measures into local programming

While numerous actions are needed by the public and private sectors to improve traffic safety, CMAP has a particular role in some areas. Building upon CMAP's role in project selection for locally-programmed federal funds, CMAP has incorporated safety performance as a larger priority in transportation project selection. Incorporating safety performance measures into programming decisions helps achieve regional safety targets and make sure this vital aspect of transportation receives adequate consideration.

To facilitate progress on highway safety targets, many of the recommendations identified in the 2017 traffic safety white paper are currently being implemented. CMAP has incorporated highway safety into its annual work plan and programming decisions. Traffic safety has become an annual work plan item and CMAP is assisting communities in traffic safety planning through CMAP's Local Technical Assistance (LTA) and Shared Fund programs. In addition, traffic safety continues to be included as a component of project evaluation for CMAP's planning and programming efforts.

Local solutions will be critical to addressing challenges in different types of communities. CMAP's LTA program has expanded its focus on traffic safety by including traffic safety specific project types in its program and has incorporated traffic safety in projects where possible. The initial traffic safety-related project awarded through the LTA program, a local road safety plan for the Village of Flossmoor is being develop through stakeholder engagement, collaboration, and data analysis to tailor it to the local safety issues on all roads in the village. Furthermore, the CMAP LTA program just awarded three communities (Bellwood, Calumet City, and Riverdale) with site-specific safety plans for four intersections and one corridor. For the

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[7] Illinois Department of Transportation, "Highway Safety Plan," accessed December 17, 2021, https://idot.illinois.gov/transportation-system/safety/highway-safety-plan.

[8] Illinois Department of Transportation, "Strategic Highway Safety Plan," accessed December 17, 2021, https://idot.illinois.gov/transportation-system/transportation-management/planning/SHSP.

intersection locations, CMAP will work with the community and a consultant to develop an intersection design study and safety action plan. A consultant, with input from CMAP and the community, using a complete streets approach will complete the corridor safety study. CMAP continues to include traffic safety in program and project evaluations. The CMAQ and STP-L Shared Fund programs incorporate safety into project evaluations and many of the 11 Council of Mayors STP project evaluation included safety as a measure. Traffic safety is included in the evaluation of regional significant projects[9] in the ON TO 2050 regional plan and plan update.

While these efforts will continue and ideally expand, making a significant impact on deaths and serious injuries requires more work. Further work across the region, for example, will be necessary to address other dimensions such as racial inequities or disparities for other sensitive populations. CMAP will continue to work with its partners to explore new avenues to address traffic safety through its planning and programming activities.

Fatalities

Measure	This measure tracks the five-year rolling average of the number and rate of vehicle-related fatalities in the CMAP region on all public roads.
Methodology	Traffic fatalities are identified in the Fatality Analysis Reporting System (FARS). This data is used to calculate the number of fatalities that occur per year within the CMAP region. VMT data comes from CMAP analysis of IDOT published data.
Proposed Targets	CMAP supports IDOT's goals:[10] To reduce the statewide traffic fatalities from 1,081.0 (2016-20 average) to 1,038.2 by December 31, 2022.

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[9] Regionally Significant Projects Benefits Report, CMAP https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Regionally+Significant+Projects+Benefit+Report+Appendix.pdf/

[10] Illinois Department of Transportation, "Highway Safety Plan."

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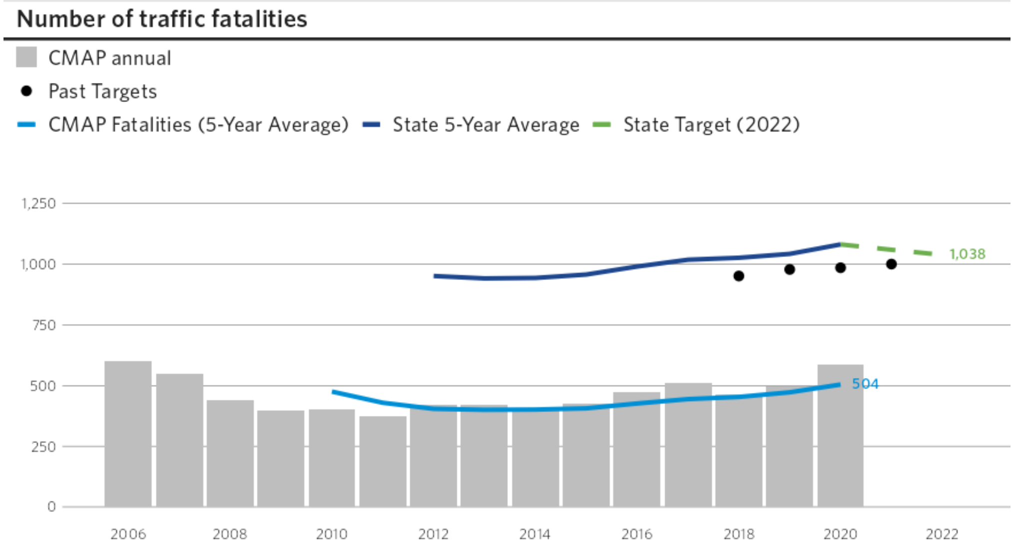
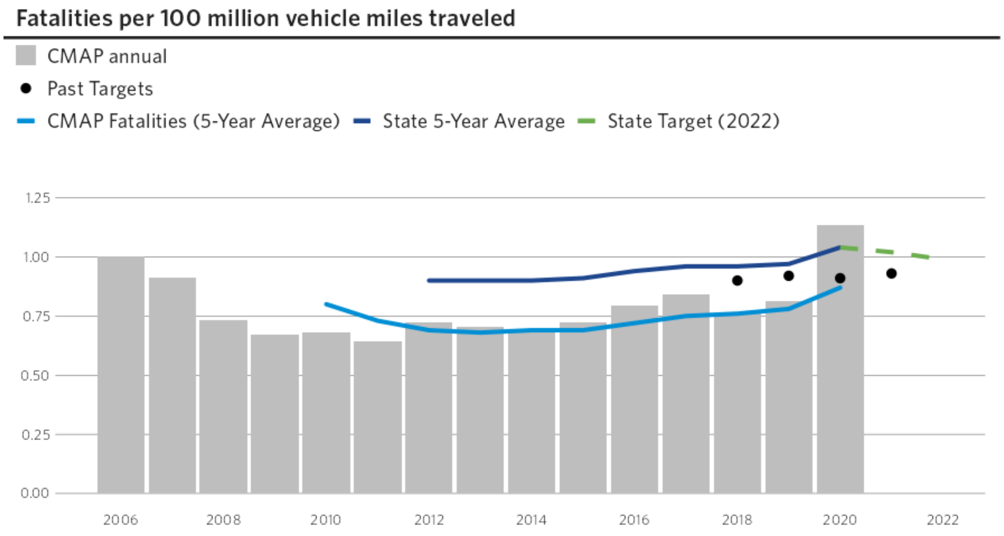


And

To reduce the statewide traffic fatality rate per 100 million vehicle miles traveled (VMT) from 1.04 (five-year 2016-20 average) to 0.99 (five-year 2018-22 average) by December 31, 2022.



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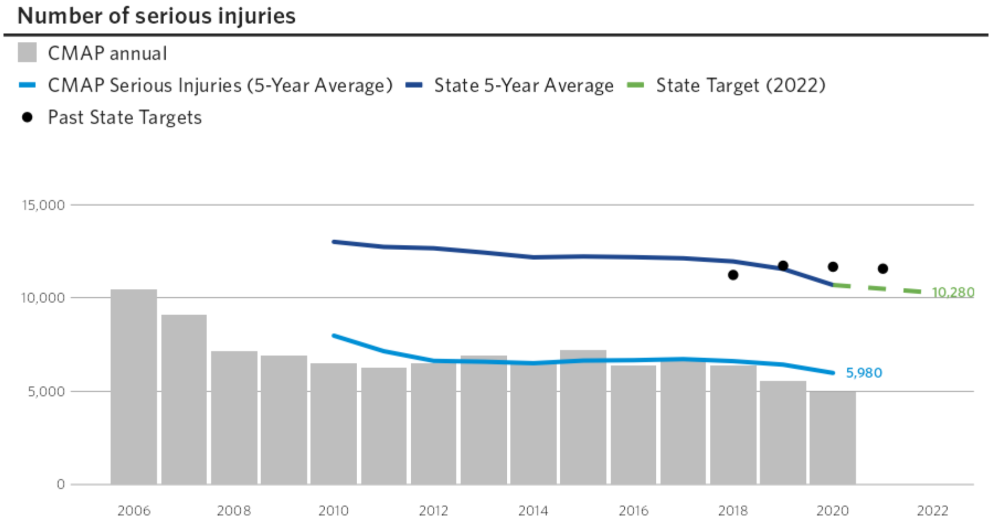
</tr>
<tr>
<td>Plan Update revisions</td>
<td>This measure has not been modified</td>
</tr>
</table>

Serious injuries

Measure	This measure tracks the five-year rolling average number and rate of serious injuries resulting from traffic crashes in the CMAP region on all public roads.
Methodology	Illinois traffic crash data provided by IDOT are used to calculate the number of serious injuries that occur per year within the CMAP region. VMT data comes from CMAP analysis of IDOT published data.
Proposed Targets	CMAP supports IDOT's goals:[11] To reduce the statewide severe injuries from 10,704.00 (five-year 2016-20 average) to 10,280.10 (five-year 2018-22 average) by December 31, 2022.  And To reduce the statewide severe injury rate per 100 million vehicle miles traveled (VMT) from 10.17 (five-year 2016-20 average) to 9.77 (five-year 2018-22 average) by December 31, 2022.

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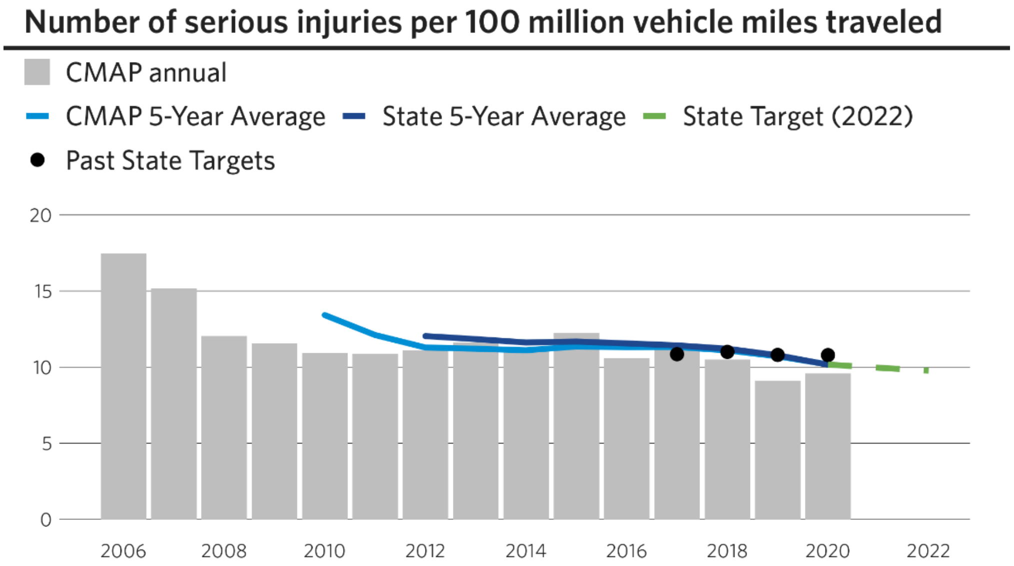
[11] Illinois Department of Transportation.

	
Plan Update revisions	This measure has not been modified.

Non-motorist fatalities and serious injuries

Measure	This measure tracks the five-year rolling average of the number of non-motorist fatalities and serious injuries resulting from traffic crashes.
Methodology	Traffic fatalities are identified in the Fatality Analysis Reporting System (FARS). Illinois traffic crash data provided by IDOT are used to calculate the number of serious injuries that occur per year within the CMAP region.
Proposed Targets	CMAP supports IDOT's goal:[12] To reduce the number of statewide non-motorized fatalities and serious injuries from traffic crashes from 1,490.60 (five-year 2016-20 average) to 1,431.60 (five-year 2018-20 average) by December 31, 2022.

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[12] Illinois Department of Transportation.

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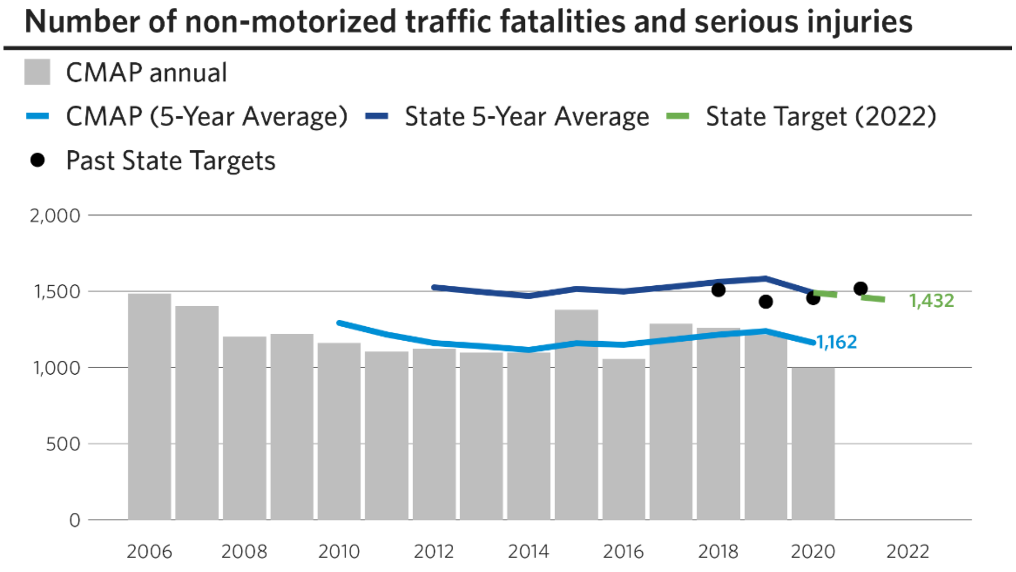
<tr><td></td><td>
</td></tr>
<tr><td>Plan Update Revisions</td><td>This measure has not been modified</td></tr>
</table>

Highway Asset Condition

A well-maintained system is a primary concern of every transportation agency. Given the maturity of the system in the Chicago area, the majority of highway agency investment has been devoted to maintaining roads and bridges. As a result, over the past decade and a half, road and bridge condition has improved on the NHS, but that improvement has stalled in the past few years as agency budgets have diminished. Furthermore, many major reconstruction projects needed on the expressway system remain unfunded, however this may change in the future because of new funding opportunities with the passage of the Rebuild Illinois Capital Plan and the Infrastructure Investment and Jobs Act.

Research and projects

In preparation for the ON TO 2050 plan, CMAP compiled the Highway System Performance Trends[13] report that examines the condition of the highway system and strategies for improvement. CMAP's research on transportation asset management was summarized in a memorandum[14] and committee presentation. Findings included opportunities to expand and better utilize pavement management systems as well as supporting IDOT and local agencies as they develop asset management plans.

This recommendation has been realized at the local level, with CMAP's pavement management program that has assisted over 65 municipalities and 1 county in northeastern Illinois. The pavement management program started as a pilot program with 12 municipalities. To continue the program, CMAP applied for and was awarded a State Planning and Research (SPR) grant to greatly expand the program. While the majority of the roads that the pavement management plans cover are not part of the NHS, it is a very beneficial program CMAP offers to its partners. Pavement management allows an agency to move from worst-first, reactive planning to proactive, performance-based planning to make the most effective use of available funds over time.

In addition, CMAP actively participates with the Construction Materials – Asset Management (CAM-AM) group. CAM-AM is made up of pavement engineers from across the region to discuss and share best practices on asset management.

Because of CMAP's concern with infrastructure investment and trends that affect infrastructure condition, many other CMAP reports indirectly touch on pavement and bridge condition. For example, a changing climate has potential to significantly impact pavement and bridges.

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[13] Chicago Metropolitan Agency for Planning, "Highway System Performance Trends."

[14] Chicago Metropolitan Agency for Planning, "Transportation Asset Management Recommendations," Memo, January 2017, https://www.cmap.illinois.gov/documents/10180/517091/AssetManagementRecommendations.pdf/d23d60e1-4092-cd58-f7e8-e1601d234f76.

CMAP's Climate Resilience Strategy Paper[15] details how the region will be impacted by climate change and highlights the need to build a resilient transportation network that has strong infrastructure, multiple transportation options, and adopts best practices in infrastructure management.

Incorporating pavement and bridge condition into local programming

Of the locally programmed federal fund sources, only the Surface Transportation Block Grant program is used for pavement and bridge condition improvement. Pavement condition measures are widely included in Councils of Mayors project selection methodologies, with some prioritizing projects on the NHS. The federal performance measures are incorporated into programming for bridges and pavement for the "shared fund" component of the local Surface Transportation Program.

National highway system pavement condition

<table>
<tr>
<td>Measure</td>
<td>
This measures the percentage of NHS lane miles in the region that have "good" or "poor" pavement condition. Pavement condition is calculated using a combination of three pavement distresses for asphalt and jointed concrete (JCP) and two pavement distresses for reinforced concrete (CRCP). The International Roughness Index (IRI), cracking percent, rutting and faulting are the pavement distresses used to determine if a pavement is in good, fair, or poor condition.

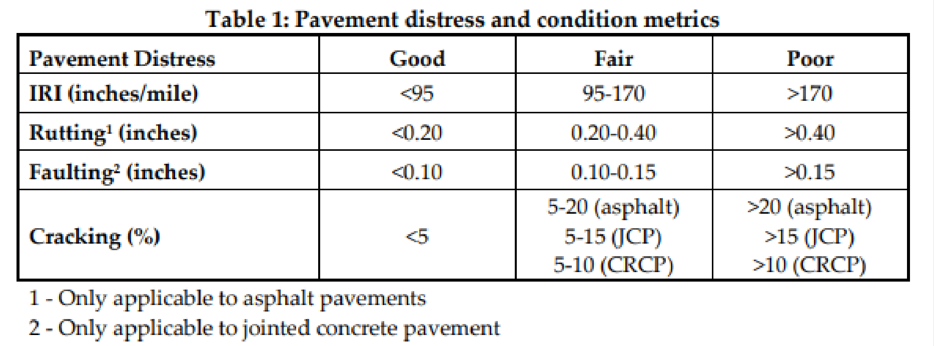

Table 1: Pavement distress and condition metrics

<table>
<tr><th>Pavement Distress</th><th>Good</th><th>Fair</th><th>Poor</th></tr>
<tr><td>IRI (inches/mile)</td><td><95</td><td>95-170</td><td>>170</td></tr>
<tr><td>Rutting[1] (inches)</td><td><0.20</td><td>0.20-0.40</td><td>>0.40</td></tr>
<tr><td>Faulting[2] (inches)</td><td><0.10</td><td>0.10-0.15</td><td>>0.15</td></tr>
<tr><td>Cracking (%)</td><td><5</td><td>5-20 (asphalt)
5-15 (JCP)
5-10 (CRCP)</td><td>>20 (asphalt)
>15 (JCP)
>10 (CRCP)</td></tr>
</table>

1 - Only applicable to asphalt pavements
2 - Only applicable to jointed concrete pavement

In order for a JCP or asphalt pavement to be in good condition, all three pavement distress metrics must be in good condition and for CRCP both pavement distress metrics must be in good condition. If two or more pavement distress metrics are in poor condition, the pavement is in poor condition. For all other pavement distress metric combinations, the pavement is in fair condition. Pavements that are in good condition suggests
</td>
</tr>
</table>

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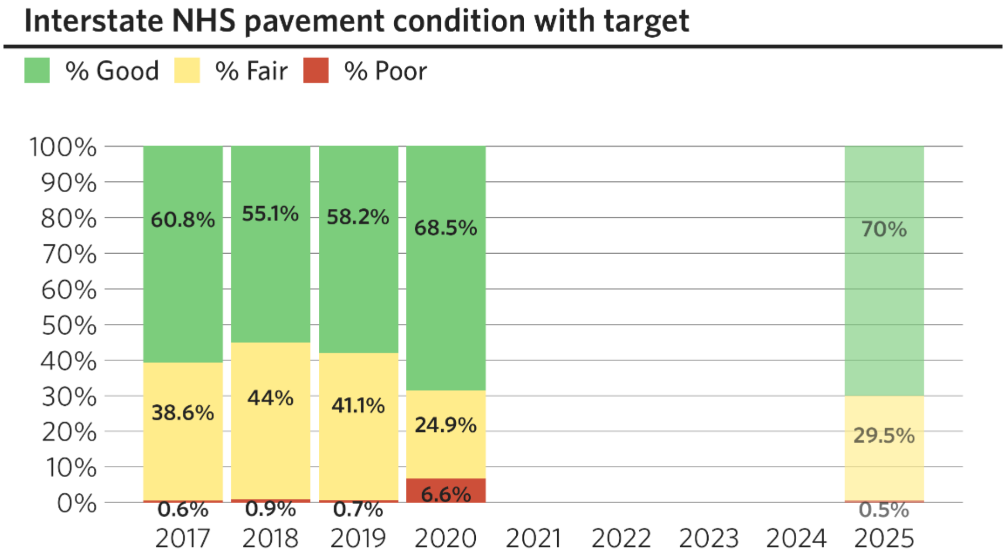
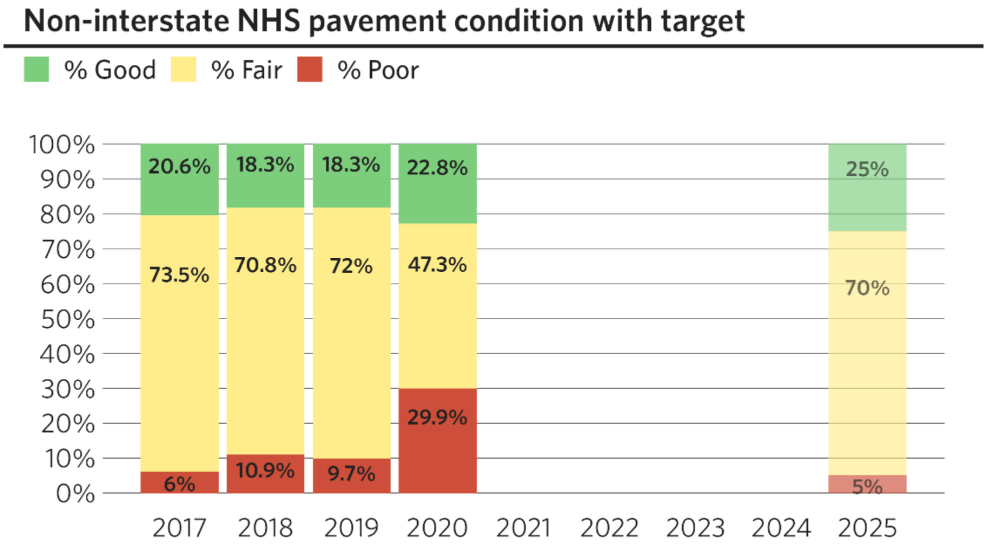
[15] Chicago Metropolitan Agency for Planning, "Climate Resilience," ON TO 2050 Strategy Paper, December 2016, https://www.cmap.illinois.gov/documents/10180/470714/Climate%20Resilience%20Strategy%20Paper/dd610883-d00f-407d-808b-484f9800a3f6.

<table>
<tr><td></td><td>no major investment is needed and pavements in poor condition suggests major reconstruction is needed. Pavement condition provides a partial understanding of the condition of the roadway, the current metrics only measure surface distress and not the condition of the base of the roadway.</td></tr>
<tr><td>Methodology</td><td>The pavement condition data is provided by IDOT, and the lane miles for each pavement condition classification are summed for all roads in the NHS. Interstate and non-Interstate roads are tracked separately.</td></tr>
<tr><td>Proposed Targets</td><td>

Interstate NHS
2025 targets: At least 70.0 percent good, no more than 0.5 percent poor



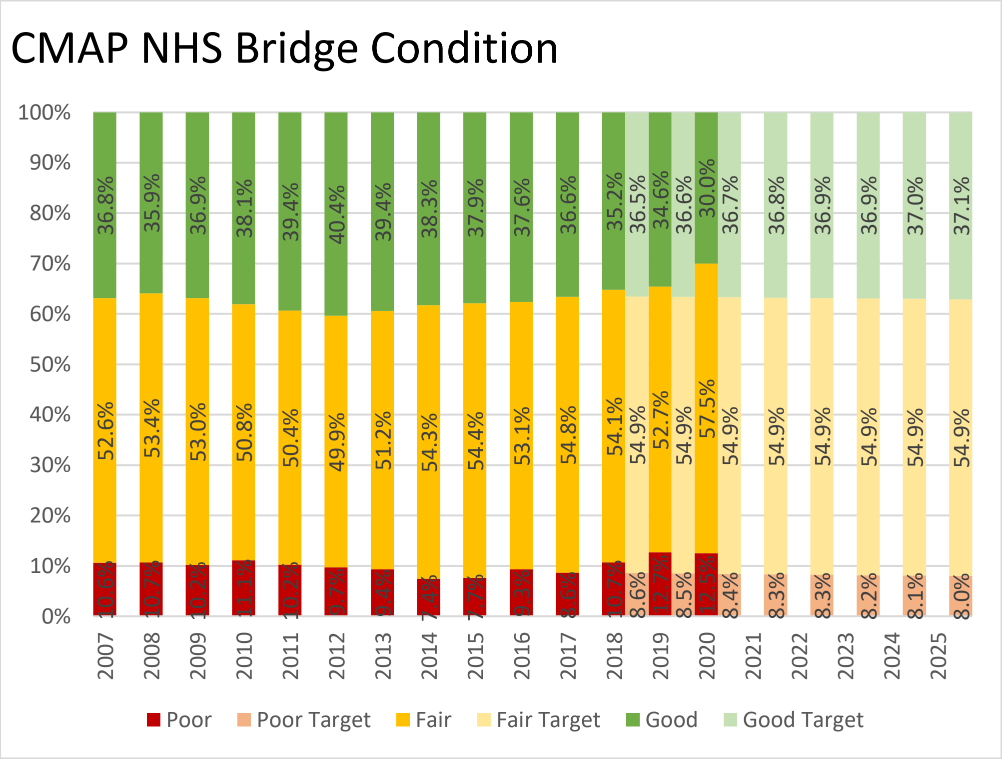
Non- Interstate NHS
2025 targets: At least 25.0 percent good, no more than 5.0 percent poor



</td></tr>
</table>

Plan Update revisions	CMAP used international roughness index or IRI data to set the target in the 2018 plan because data on cracking needed for the full measures was not available. Complete data is now available and was used.

National highway system bridge condition

Measure	This measures the percentage of bridge deck area of NHS that are in "good" or "poor" condition. While a "poor" classification is the lowest condition rating for a bridge, it should be noted that it does not necessarily mean that a specific bridge is unsafe, only that it requires more frequent inspection.
Methodology	Data come from the Federal Highway Administration's (FHWA) annual NBI. NBI data is available for all bridges that carry NHS routes and that are over 20 feet in length. Bridge condition is determined through a scheduled inspection process and classified by the lowest rating of NBI condition ratings for deck, superstructure, substructure, or culvert. If the lowest rating is greater than or equal to 7, the bridge is classified as good; if it is less than or equal to 4, the classification is poor. Bridges with all components rated 5 or 6 are classified as fair.
Proposed Targets	**2025 targets:** At least 37.1 percent good and no more than 8.0 percent poor 
Plan Update revisions	This measure has not been modified

System Performance

"System performance," the term utilized in the federal performance measure rulemakings, includes a variety of measures relating to the effectiveness of the Congestion Mitigation and Air Quality Improvement (CMAQ) program, truck travel time reliability, and use of alternative modes of transportation. These are relevant measures for the CMAP region, and ON TO 2050 emphases better utilization and management of the existing transportation system rather than significant capacity expansion. System enhancements typically have higher benefit-to-cost ratios than capacity expansion projects. Better utilizing the existing system means fewer single-occupant trips, more reliable and less-congested roads, and fewer toxic emissions. The Chicago region is also the nation's premier freight hub with $3 trillion in goods moving through the region each year; unreliable travel times not only impact commuters but can impact the economic competitiveness of the region's freight industry.

The pandemic has had a significant positive impact on several system performance measures. CMAP has been monitoring these changes and reporting out in a series of transportation system analysis[16]. Travel for all purposes decreased early in the pandemic and working from home increased dramatically. This has helped the region significantly exceed targets related to congestion in the short term. While there are some signs that traffic could return to historic levels, it is too soon to fully know the long-term consequences of the pandemic on travel. Even before the pandemic, work from home was the non-single occupant vehicle component that was growing the fastest. This will certainly be accelerated by the pandemic.

Research and projects

A number of CMAP's ON TO 2050 papers address measures included under system performance. The Non-motorized Transportation Report[17], Transit Modernization Strategy Paper[18], and Transit Ridership Growth Study[19] each look at providing new and improving existing alternatives to driving such as transit, biking, and walking. Driving is expected to continue to be the most used mode in the region even after recommended improvements to other modes. The Highway Operations Strategy Paper[20] provides a variety of strategies for improving reliability and reducing congestion on the road network. Freight is an important part

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[16] https://www.cmap.illinois.gov/covid-response

[17] Chicago Metropolitan Agency for Planning, "Non-Motorized Transportation."

[18] Chicago Metropolitan Agency for Planning, "Transit Modernization," Strategy Paper, ON TO 2050 Strategy Paper (Chicago, Illinois: Chicago Metropolitan Agency for Planning, 2017), http://www.cmap.illinois.gov/onto2050/strategy-papers/transit-modernization.

[19] Chicago Metropolitan Agency for Planning, "Transit Ridership Growth Study," Strategy Paper, ON TO 2050 Strategy Paper (Chicago, Illinois: Chicago Metropolitan Agency for Planning, August 2017), http://www.cmap.illinois.gov/onto2050/strategy-papers/transit-ridership-growth.

[20] Chicago Metropolitan Agency for Planning, "Highway Operations," ON TO 2050 Strategy Paper, February 2017, https://www.cmap.illinois.gov/documents/10180/517371/Highway+Operations+Strategy+Paper/26cff0fc-876a-4843-9fe5-c9aedbf73ddd.

of the region's economy. CMAP has done extensive work on the freight industry including a summary of regional freight infrastructure[21] and a Regional Strategic Freight Direction.[22]

CMAP is actively participating in the Regional Transportation Management Center (RTMC) study IDOT is leading which if constructed will have a significant impact on how CMAP's partners operate the transportation network in real-time. The RTMC will provide a central location (in-person or virtual) where operators will be able to address transportation system issues in real time and be proactive in addressing reliability issues as they come up on the Interstate and non-Interstate NHS. The RTMC will enable operators and planners to track system performance and enhance signal timing and other operations-related improvements to make the system less congested and more reliable.

CMAP recently updated the Regional Intelligent Transportation System (ITS) Architecture. The Regional ITS Architecture is a roadmap for transportation systems integration and represents a shared vision of how each transportation agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region. Many of the projects in the ITS Architecture will make the system operate more reliably

Incorporating system performance into local programming

In northeastern Illinois, CMAP programs CMAQ funds through the MPO Policy Committee. The purpose of CMAQ is to fund transportation projects or programs that contribute to the attainment or maintenance of National Ambient Air Quality Standards in specific areas. The CMAP region receives CMAQ funds because of nonattainment and maintenance areas in the region. The primary consideration for CMAQ projects is the cost-effectiveness of their air emissions reductions, measured as either the cost per kilogram of volatile organic compounds (VOC) reduced or the cost per kilogram of fine particulate matter (PM2.5) reduced. Projects are ranked by their air quality cost-effectiveness within in their project type category. Additional Transportation Impact Criteria supplement project evaluation and cover performance areas similar to the federal system performance measures, including improving travel time reliability, increasing transit ridership, and reducing congestion.

Percent of trips to work via non-SOV modes

Measure	This measure tracks the share of trips to work by non-single occupancy vehicle (non-SOV) modes for trips to work. These modes include carpooling,

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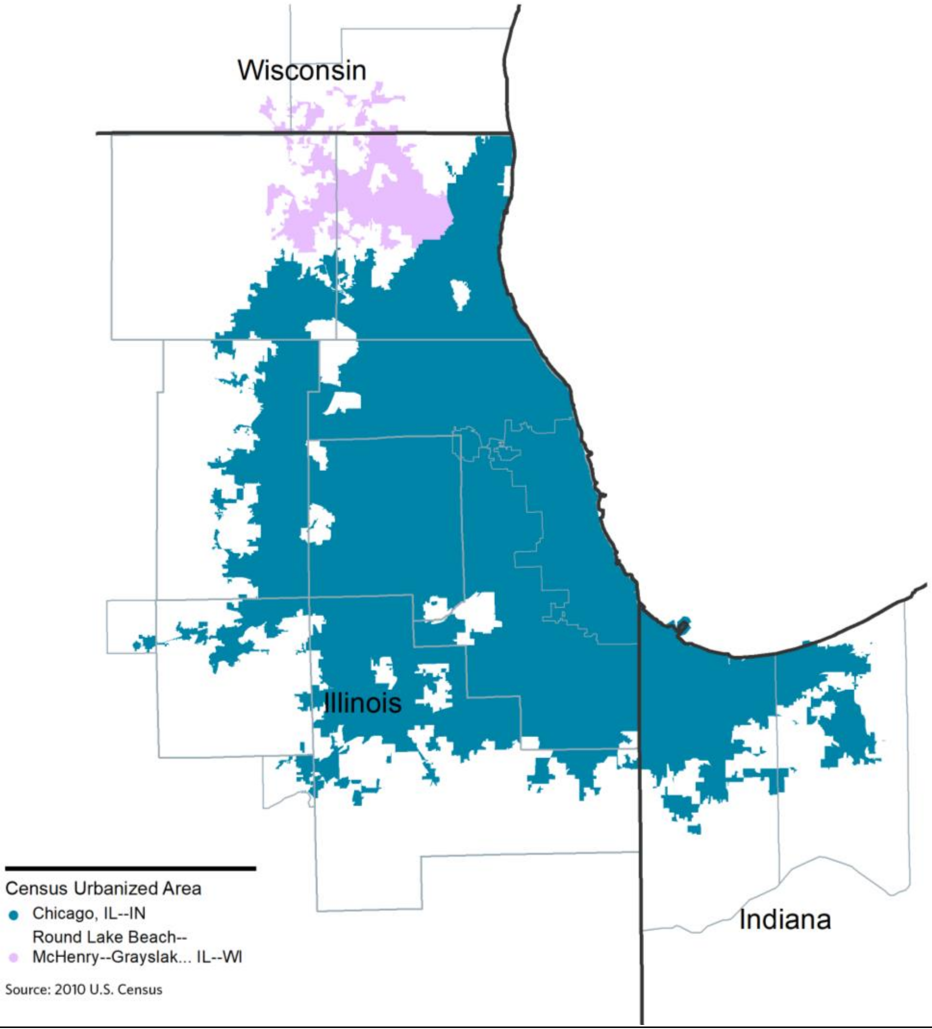
[21] Chicago Metropolitan Agency for Planning, "The Freight System," ON TO 2050 Snapshot, May 2017, https://www.cmap.illinois.gov/documents/10180/517119/FY17-0095+Freight+Snapshot.pdf/3ae1174d-d8f4-4005-8a9f-e02eb87eeac2?t=1494536618000.

[22] https://www.cmap.illinois.gov/documents/10180/826017/FINAL+Regional+Strategic+Freight+Direction+with+cover_2-6-18.pdf

<table>
<tr><td></td><td>public transit, walking, “other means” and working from home. This measure is similar to the ON TO 2050 Indicator, but uses slightly different geography and Census data. The non-SOV travel is included in the required MPO CMAQ Performance Plan[23] which is done on a two- and four-year timeline and turned into FHWA.</td></tr>
<tr><td>Methodology</td><td>Five-year estimates from U.S. Census Bureau’s American Community Survey (ACS) dataset – table DP03 – are used to track mode share in the urbanized area. CMAP boundaries cover two census-defined urbanized areas. The Chicago urbanized area includes portions of Indiana, and the Round Lake Beach-McHenry-Grayslake urbanized area includes portions of Wisconsin. (see map below.) This measure tracks the percentage of commuters that predominantly do not commute by driving alone in a car, van, or truck. The below table shows this data for 2010-20.



Source: 2010 U.S. Census</td></tr>
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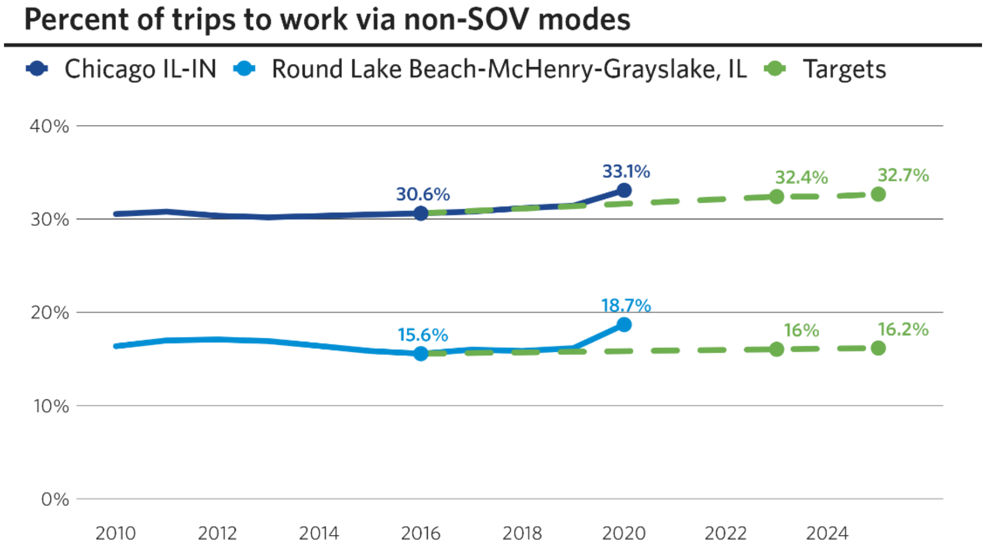
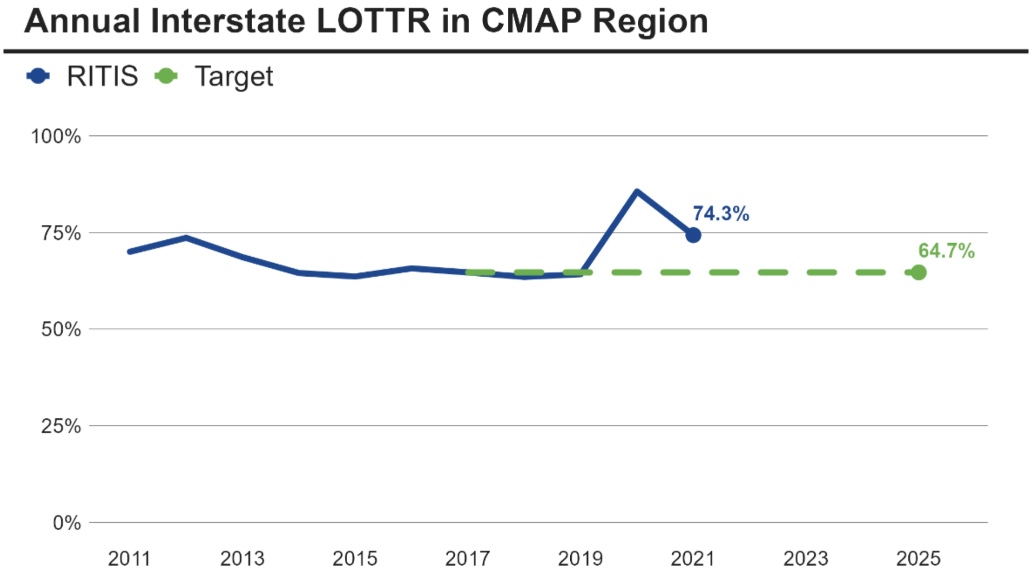
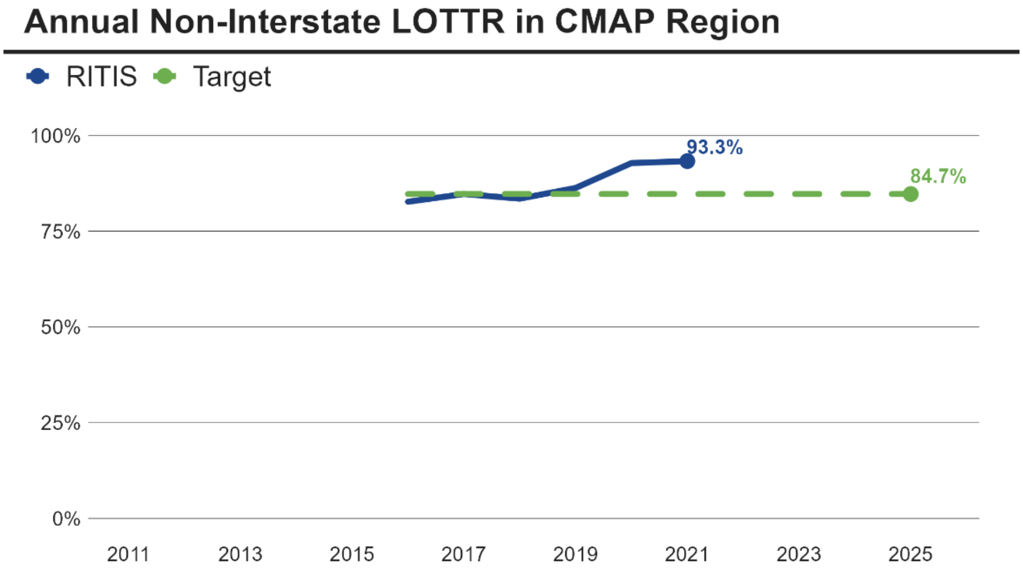
[23] https://www.cmap.illinois.gov/documents/10180/38326/CMAQ+Mid-Point+Performance+Plan+2020_Oct2020.pdf/5eaee75e-2261-5259-e78c-992a54e9f767?t=1644609857416

Proposed Targets	**Chicago, IL-IN targets** **2023:** At least 32.4 percent **2025:** At least 32.7 percent. **Round Lake Beach--McHenry—Grayslake IL-WI** **2023:** At least 16.0 percent **2025:** At least 16.2 percent  Percent of trips to work via non-SOV modes Targets are set in coordination with all States and Metropolitan Planning Organizations associated with the Urbanized Area. (NIRPC, INDOT, CMAP, and IDOT)
Plan Update revisions	In 2018, this measure was only required of urbanized areas with a population greater than 1 million. Starting in 2022, it is required of areas with a population of 200,000. With a population of 287,012 in 2019, Round Lake Beach-McHenry-Grayslake urbanized area now requires a separate target.

Highway Reliability

Measure	The Level of Travel Time Reliability (LOTTR) is defined as the ratio of longer travel times (80th percentile) to a "normal" travel time (50th percentile) for a given roadway segment. The measure is the percentage of person-miles (vehicle miles multiplied by occupancy) traveled on the NHS where this ratio is less than 1.5, which is considered reliable. Using person-miles rather than vehicle-miles gives equal weight to all individuals using the roads.

	Non-interstate travel is generally more reliable than interstate travel for several reasons. Reasonable alternative routes are more often available for trips on non-interstates, especially in parts of the region with a grid street network. Lower volumes and speeds mean that incidents on non-interstates typically have a smaller impact.
Methodology	This measure is calculated using data from the FHWA's National Performance Management Research Data Set (NPMRDS). The NPMRDS provides travel time by road segment for the NHS in 15-minute intervals. Travel times are provided for passenger, freight, and combined values. Along with the travel time information, a geographic file of the road segments is provided through the NPMRDS. The geographic file includes information for each road segment including length in miles, average annual daily traffic, functional classification, and other roadway attributes. The measure is calculated for both the interstate and non-interstate systems using the combined vehicle travel times. The LOTTR ratio is generated by dividing the 80th percentile travel time of all vehicles by the normal travel time (50th percentile) of all vehicles for four reporting periods. The four reporting time periods include: • 6 a.m. – 10 a.m. weekdays • 10 a.m. – 4 p.m. weekdays • 4 p.m. – 8 p.m. weekdays • 6 a.m. – 8 p.m. weekends The segments' length is multiplied by the annual traffic volume of the segment and the occupancy factor for vehicles. An occupancy factor of 1.7 was used, following the guidance published by the FHWA. The sum of reliable segments (LOTTR below 1.50 for all time periods) is divided by the total of all segments. This results in the ratio of person-miles of travel that are reliable to total person-miles of travel and expressed in the nearest 0.1 percent. NPMRDS data is collected by INRIX and processed by University of Maryland CATT Lab. This data is made available to CMAP on the Regional Integrated Transportation Information System (RITIS) platform.
Proposed Targets	**Interstate NHS** **2025 target:** At least 64.7 percent

	 **Non-interstate NHS** **2025 target:** At least 84.7 percent 
Plan Update revisions	Targets were set in 2018 using observed data from both HERE and INRIX. Sufficient history is available from INRIX via RITIS now so HERE data is no longer included. Targets set in 2018 remain unchanged.

Annual hours of peak hour excessive delay per capita on the national highway system

Measure	The Peak Hour Excessive Delay (PHED) measures traffic congestion. It is the extra amount of time people spend in congested conditions in their urban area during peak periods. The PHED is calculated using the travel time of 20 mph or 60 percent of the speed limit on the NHS in the urbanized area. It is weighted by vehicle volume and occupancy. The PHED is included in the required MPO CMAQ Performance Plan[24] which is done on a two- and four-year timeline and turned into FHWA.
Methodology	This measure is calculated using data from the FHWA's NPMRDS. The NPMRDS provides travel time by road segment for the NHS in 15-minute intervals. Travel times are provided for passenger, freight, and combined values. Along with the travel time information, a geographic file of the road segments is provided through the NPMRDS. The geographic file includes information for each road segment including length in miles, average annual daily traffic, functional classification, and other roadway attributes. A conflation process was used to assign speed limit information to the NPMRDS data. The 4:00 p.m. – 8:00 p.m. afternoon peak is used to be consistent with CMAP's travel model time periods. The PHED is calculated for each 15-minute interval in the peak periods for all segments in the Chicago urban area. The 15-minute interval PHED is calculated in the following steps: • Segment length divided by a segments speed threshold (larger of 20 mph, or 60 percent of speed limit) times 3,600 • Segment travel time minus the result from above step • If result from above step greater than 0, then result divided by 3600 • Result from above step multiplied by the 15-minute volume and the average vehicle occupancy for the segment • The results from the above steps are summed for the urban area and divided by the urbanized area population The total PHED is divided by the urbanized area population to calculate the peak-hour excessive delay per capita. IDOT provided access to the Regional

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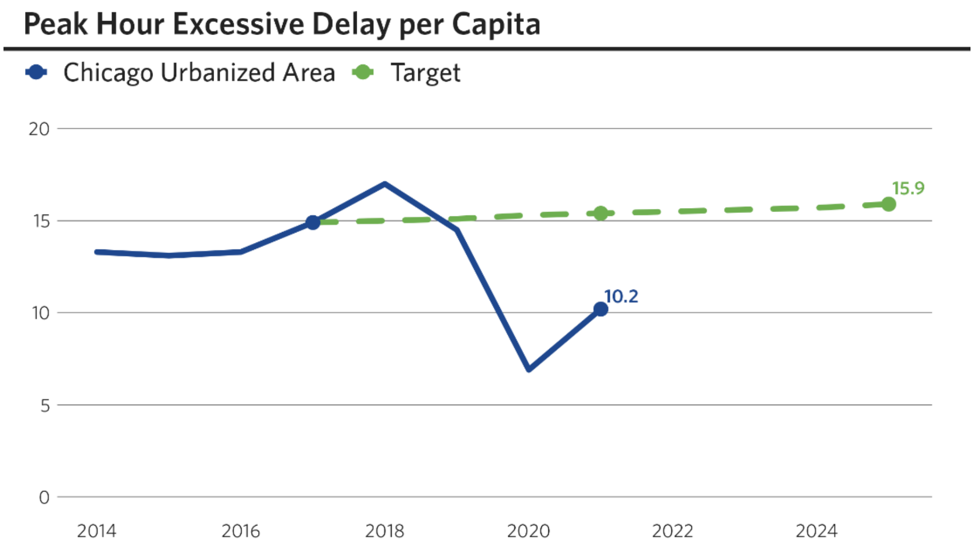
[24] https://www.cmap.illinois.gov/documents/10180/38326/CMAQ+Mid-Point+Performance+Plan+2020_Oct2020.pdf/5eaee75e-2261-5259-e78c-992a54e9f767?t=1644609857416

<table>
<tr><td></td><td>Integrated Transportation Information System (RITIS)[25] tool that was used to calculate this measure.</td></tr>
<tr><td>Proposed Target</td><td>Chicago, IL-IN target
2025: 15.9 hours per capita

Peak Hour Excessive Delay per Capita

Targets are set in coordination with all States and Metropolitan Planning Organizations associated with the Urbanized Area. (NIRPC, INDOT, CMAP, and IDOT)</td></tr>
<tr><td>Plan Update revisions</td><td>This measure has not been modified.</td></tr>
</table>

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[25] Regional Integrated Transportation Information System www.ritis.org

Total emissions reduction of on-road mobile source emissions

Measure	This performance measure tracks the emissions reduced by transportation projects funded through the CMAQ program[26] and is referred to as Total Emissions Reduction. The Total Emissions Reduction is included in the required MPO CMAQ Performance Plan[27] which is done on a two- and four-year timeline and turned in to FHWA. Northeastern Illinois' non-attainment criteria pollutants are Ozone and Particulate Matter 10 microns (PM_{10}) as reported in Environmental Protection Agency's Green Book[28]. The emissions that are the primary precursors for Ozone are Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NOx). In the recent past, the region was also in non-attainment for Particulate Matter 2.5 microns ($PM_{2.5}$). While in attainment for $PM_{2.5}$ emissions, it still poses a significant health risk to many residents of northeastern Illinois. Because of this, targets are being shown for $PM_{2.5}$ but are not required at this time. Currently, PM_{10} emissions are not calculated as part of the CMAQ project evaluation process. Currently Lyons Township in western Cook County and southeast Chicago are declared maintenance areas for $PM_{10.}$ The maintenance areas are not the result of mobile source emissions, but a point source problem related to quarry activities within the township and industry. Because the emissions are unrelated to transportation and mobile sources the target will be listed as zero.

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[26] Details of the CMAQ program in northeastern Illinois can be found here: http://www.cmap.illinois.gov/mobility/strategic-investment/cmaq

[27] https://www.cmap.illinois.gov/documents/10180/38326/CMAQ+Mid-Point+Performance+Plan+2020_Oct2020.pdf/5eaee75e-2261-5259-e78c-992a54e9f767?t=1644609857416

[28] Environmental Protection Agency, "Green Book website," accessed March 2022, https://www.epa.gov/green-book

<table>
<tr><td>Methodology</td><td>The Total Emissions Reduction measure for each of the criteria pollutants or applicable precursors for all projects reported to FHWA’s CMAQ Public Access System[29] are calculated to the nearest one thousandth by using the daily kilograms of emission reductions. CMAP calculates the daily kilograms of emission reductions as part of the project evaluation and selection process and provides that information to IDOT for entering into FHWA’s CMAQ Public Access System.

CMAP has combined the total daily emissions for the current five-year CMAQ program (2022 through 2026) to develop an annual estimate which was used to generate the two-year and four-year targets.
<table>
<tr><th></th><th>Daily VOC (kg)</th><th>Daily NOx (kg)</th><th>Daily $PM_{2.5}$ (kg)</th><th>Daily PM_{10} (kg)</th></tr>
<tr><td>2022-2026 Total Program</td><td>523.377</td><td>2755.257</td><td>105.830</td><td>0.000</td></tr>
<tr><td>Annual Estimate</td><td>104.675</td><td>551.051</td><td>21.166</td><td>0.000</td></tr>
</table>
</td></tr>
<tr><td>Proposed Targets</td><td>
<table>
<tr><th></th><th>Daily VOC (kg)</th><th>Daily NOx (kg)</th><th>Daily $PM_{2.5}$ (kg)</th><th>Daily PM_{10} (kg)</th></tr>
<tr><td>2023 (2-year Target)</td><td>209.351</td><td>1102.103</td><td>42.332</td><td>0.000</td></tr>
<tr><td>2025 (4-year Target)</td><td>418.702</td><td>2204.206</td><td>84.664</td><td>0.000</td></tr>
</table>
</td></tr>
<tr><td>Plan Update revisions</td><td>This measure has not been modified.</td></tr>
</table>

Truck Travel Time Reliability (TTTR) Index

Measure	The Truck Travel Time Reliability (TTTR) is defined as the ratio of the longer travel times (95th percentile) to a “normal” travel time (50th percentile) for a given segment on the interstate system. Higher values for this measure indicate that interstate travel is more unpredictable for local and national freight companies. The Chicago region is the nation’s freight hub, so

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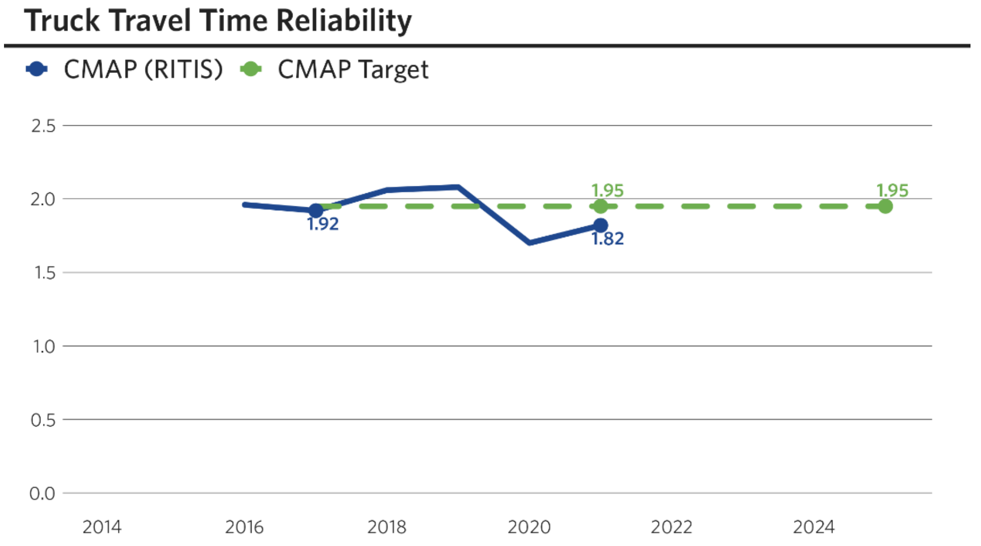
[29] Federal Highway Administrations, “CMAQ Public Access System website”, accessed May 2018 https://fhwaapps.fhwa.dot.gov/cmaq_pub/

	unreliable travel time on the interstate system can impact the entire country.
Methodology	This measure is calculated using data from the FHWA's NPMRDS. The NPMRDS provides travel time by road segment for the NHS in 15-minute intervals. Travel times are provided for passenger, freight, and combined values. Along with the travel time information, a geographic file of the road segments is provided through the NPMRDS. The geographic file includes information for each road segment including length in miles, average annual daily traffic, functional classification, and other roadway attributes. The measure is calculated using freight travel times. Travel time for all vehicles may be used where there are no data for trucks. The TTTR ratio is generated by dividing the 95th percentile travel time by the normal travel time (50th percentile) for interstate segments only for five reporting periods. The five reporting time periods include: • 6 a.m. – 10 a.m. weekdays • 10 a.m. – 4 p.m. weekdays • 4 p.m. – 8 p.m. weekdays • 8 p.m. – 6 a.m. all days • 6 a.m. – 8 p.m. weekends The maximum TTTR ratio of the five periods is selected and multiplied by the segment length. The sum of all segments is then divided by the total interstate system mileage. NPMRDS data is collected by INRIX and processed by University of Maryland CATT Lab. This data is made available to CMAP on the Regional Integrated Transportation Information System (RITIS) platform.
Proposed Targets	**2025 target:** Less than 1.95

	
Plan Update revisions	Targets were set in 2018 using observed data from both HERE and INRIX. Sufficient history is available from INRIX via RITIS, so HERE data is no longer included. Target remains unchanged from 2018

Transit Asset Condition

Past plans from CMAP and the RTA both called for additional funding for transit capital programs. Since these plans were adopted, Rebuild Illinois and the Infrastructure Investment and Jobs Act were passed, providing new capital funds for transit at the state and federal level. While these two bills provide needed, near-term capital funding boosts, sustained long term capital funding increases are needed to reduce the capital backlog. In addition, transit providers across the nation face new gaps in operating budgets because of declining fare revenue as people shift to more remote or hybrid work because of the pandemic. It is not clear how both funding and operations will change as a result.

The region's transit agencies face a massive state of good repair (SOGR) backlog, with limited resources expected to be available over the ON TO 2050 planning horizon. CMAP works with the RTA, CTA, Metra, and Pace to coordinate and support transit investment in the region. In addition to the work that each operating agency does, the RTA has prepared "Capital Asset Condition Assessment Reports"[30] for the entire region that are used to inform the ON TO 2050 financial plan and update. CMAP was partner in the RTA led transit strategic plan[31] called Invest In Transit and staff are participating in the process of developing the next plan to be released in 2023.

Research and projects

In preparation for ON TO 2050, CMAP staff developed several reports that make recommendations regarding transit asset management. Many aspects of the transit system were illustrated in the Transit Trends Snapshot.[32] CMAP brought together a group of partners and experts to make recommendations for the Transit Modernization Strategy Paper.[33] Finally, asset management practices for the region were reviewed in a Transportation Asset Management Recommendations Memo.[34] CMAP continues to collaborate with the RTA on development of their COST capital asset tool.

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[30] Regional Transportation Authority, "Capital Asset Condition Assessment Reports website," accessed May 2018 https://www.rtachicago.org/index.php/finance-management/program-management.html

[31] Regional Transportation Authority, "Invest In Transit The 2018-2023 Regional Transit Strategic Plan for Chicago and Northeast Illinois," 2018, http://www.rtachicago.org/index.php/plans-programs/regional-transit-strategic-plan.html

[32] Chicago Metropolitan Agency for Planning, "Transit Trends," ON TO 2050 Snapshot, November 2017, https://www.cmap.illinois.gov/documents/10180/814344/FY18-0043+Transit+Trends+Snapshot_web_FINAL.pdf/08b323bc-b94c-558f-482b-20f5a26fe5f8?t=1517957135943.

[33] Chicago Metropolitan Agency for Planning, "Transit Modernization."

[34] Chicago Metropolitan Agency for Planning, "Transportation Asset Management Recommendations."

Following the passage of Rebuild Illinois, the RTA began a process of evaluating the capital funding allocation process. CMAP provided input and support for the RTA's performance-based capital allocation process[35] and Framework for Transit Capital Investment.[36]

In addition to the capital planning work done by the RTA quantified the impacts of the new funding[37] and, each transit agency is required to develop a Transit Asset Management Plan (TAM)[38]. These plans document the people, processes and tools that come together to achieve policy goals. Plans are available online from CTA[39], Metra[40], and Pace.[41]

Incorporating transit asset management into local programming

With one of the oldest transit systems in the nation, the Chicago region spends a significant portion of transit capital funding on maintenance and repairs. When programming projects, CMAP with transit agencies make progress toward reducing their state of good repair backlog. In addition to the programming processes at each agency and the RTA, TERM asset condition score is included by CMAP in evaluation for CMAQ, STP-Shared Fund and Regionally Significant Projects. A guiding principle of the ON TO 2050 plan is to invest in the existing system, with limited expansion. This is reflected in the measures and projects selected.

Transit rolling stock

Measure	Percent revenue vehicles that have met or exceeded their useful life. This measures the percent of active revenue public transit vehicles that have met or exceeded their useful life, or the age when it is typically most cost effective to replace the vehicles.
Methodology	A snapshot of the active vehicle fleet is reported each year to the National Transit Database (NTD), including the year of manufacture. The useful life

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[35] Regional Transportation Authority, "Presentation on Performance-Based Capital Allocation," https://www.rtachicago.org/sites/default/files/documents/aboutus/meeting_documents/6-17-21/BRD061721-6e%20Final.pdf.

[36] Regional Transportation Authority, "Framework Transit Capital Investments," 2020, https://www.rtachicago.org/sites/default/files/documents/businessandfinance/Framework-Transit-Capital-Investments_0.pdf.

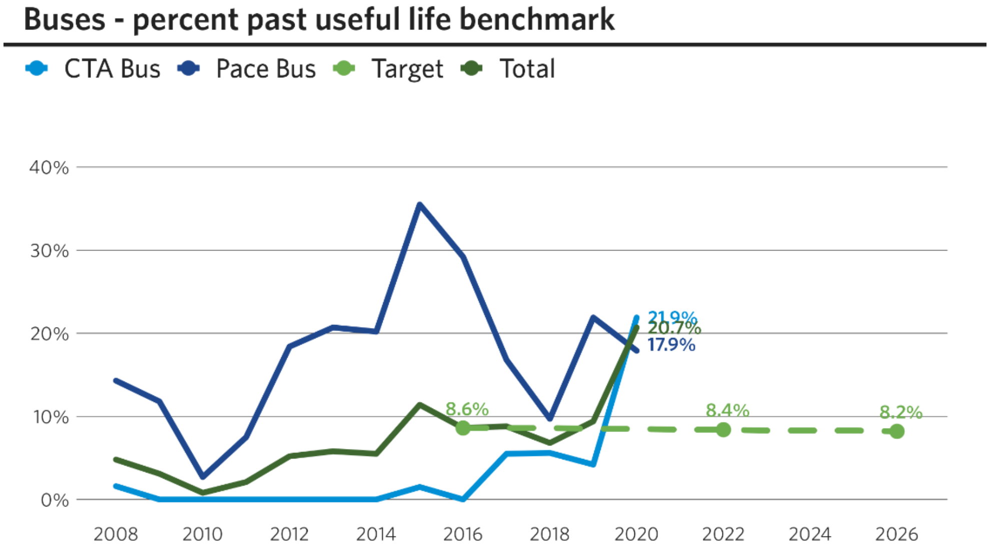
[37] Regional Transportation Authority, "Potential Impacts of State Funding on Transit State of Good Repair," July 2020, https://www.rtachicago.org/sites/default/files/documents/businessandfinance/Analysis%20of%20Impacts%20of%20State%20Funding%20White%20Paper.pdf.

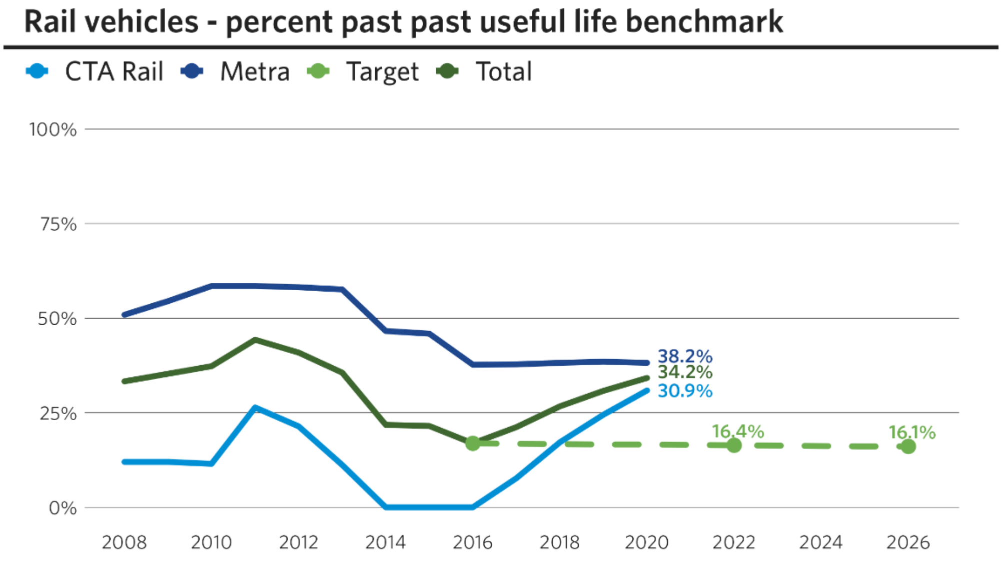
[38] 49 CFR Part 625

[39] https://www.transitchicago.com/performance/

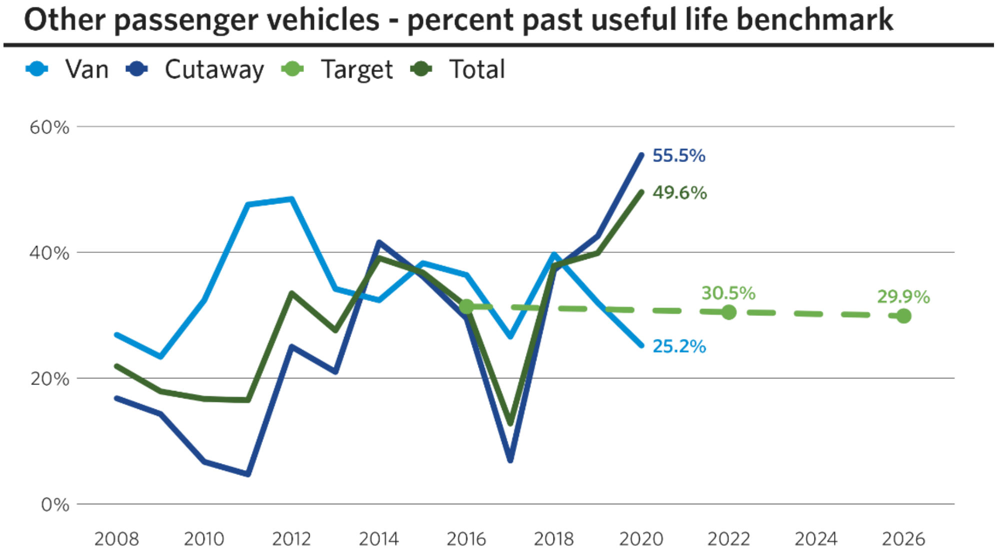
[40] https://metra.com/transit-asset-management-plan

[41] https://www.pacebus.com/pace-transparency

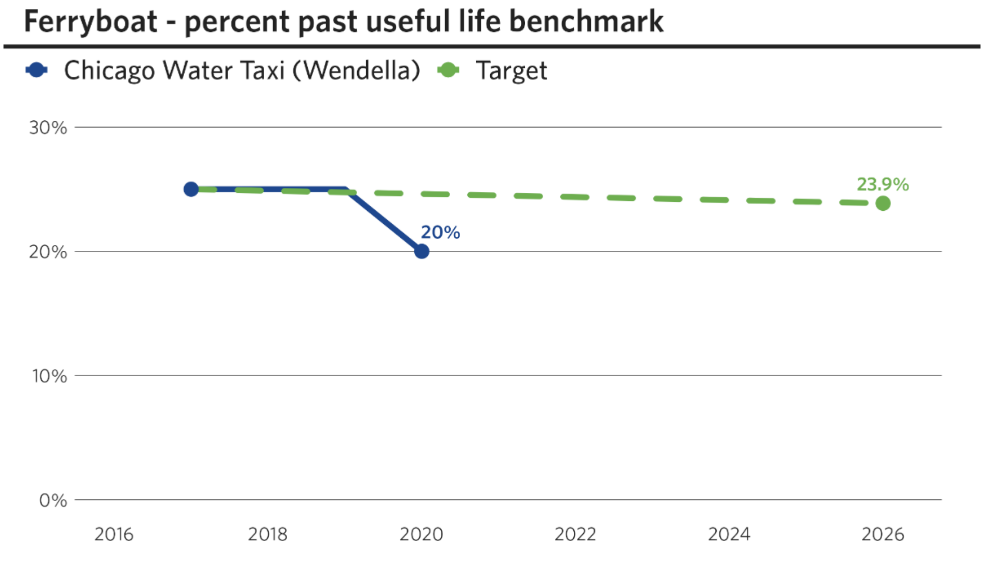
	benchmark (ULB) represents the age where maintenance cost and vehicle performance issues are likely to increase. CMAP has uses the ULB reported to NTD by each transit agency for their assets. Useful life benchmarks: Bus: CTA – 12-15 years, Pace – 12 years Rail: CTA – 34 years, Metra – 30-39 years Other passenger vehicles: Pace – four or five years (This includes a variety of services such as paratransit, vanpool, dial a ride, and on demand.) Ferryboat: Wendella – 42 years
Proposed Targets	**2026 targets:** **Bus:** Less than 8.2 percent of vehicles past ULB **Rail:** Less than 16.1 percent of vehicles past ULB **Other passenger vehicles:** Less than 29.9 percent of vehicles past ULB **Ferryboat:** Less than 23.9 percent of vehicles past ULB 



Rail vehicles - percent past past useful life benchmark

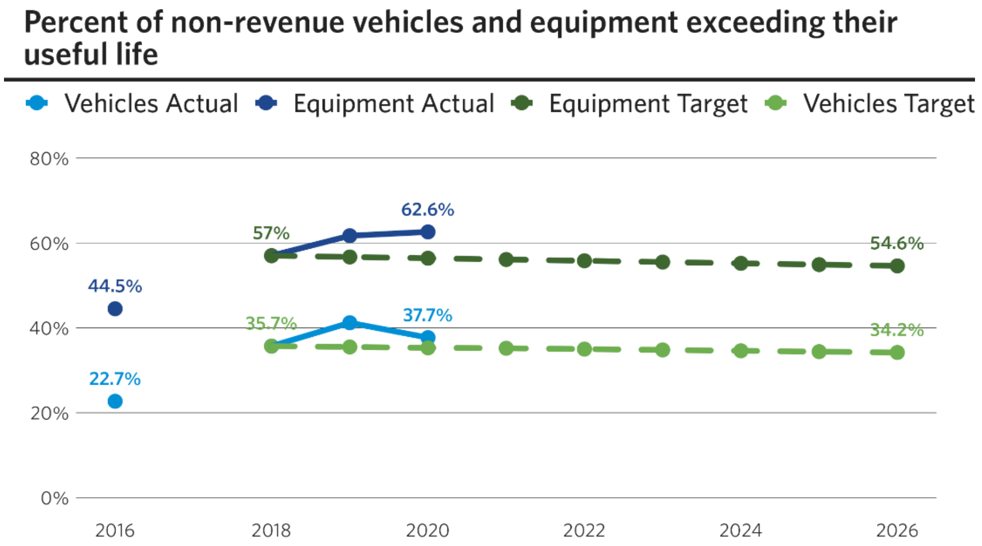


Other passenger vehicles - percent past useful life benchmark

	
Plan Update revisions	The formula for calculating the number of vehicles past useful life benchmark was changed from "exceeded" useful life to "met or exceeded". This change was applied to past years data. This results in a slightly higher percent of vehicles past ULB in some years. Past targets were based on all CTA buses ULB of 15 years. CTA now uses 12, 14 and 15 years for different types of fixed route buses. "Non-fixed route" was renamed "Other passenger vehicles" to better algin with FTA asset classes. Wendella Water Taxi received some FTA capital funding for vehicles but no federal operating support, and was added.

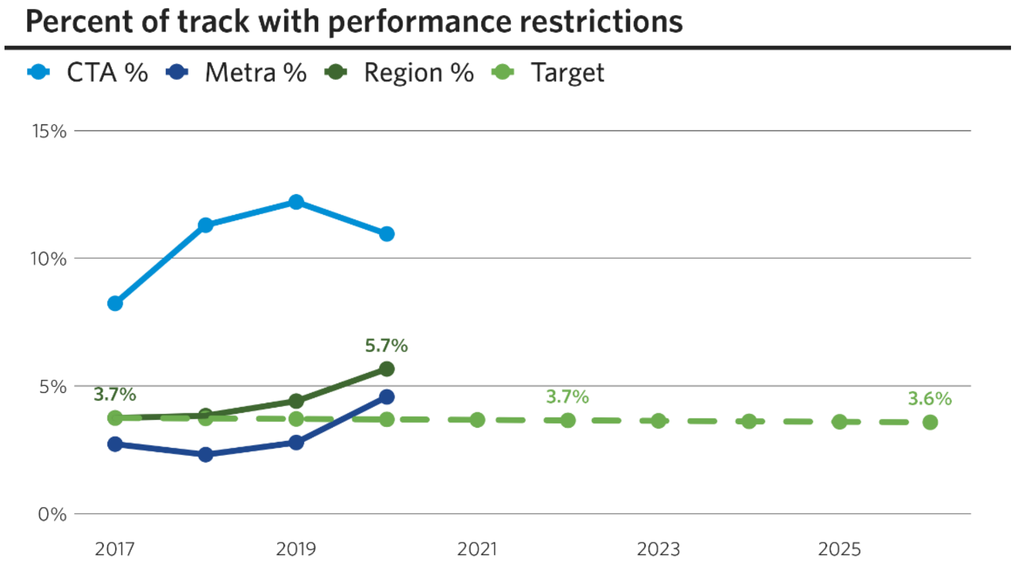
Transit non-revenue service vehicles and equipment

Measure	Percent of non-revenue vehicles and equipment that have met or exceeded their useful life. This measures the percent of non-revenue vehicles that have exceeded their useful life. This represents the number of vehicles that have reached an age where maintenance cost and vehicle performance issues are likely to increase. The vehicle types include trucks, cranes, and trailers. Much of the equipment is used for rail maintenance such as ballast cars, rail grinders, and tie pluggers.

Methodology	The useful life benchmark is determined by the transit agencies and varies by asset type for both non-revenue vehicles and equipment from 10 to 25 years. Each transit agency maintains an inventory of vehicles and equipment including the year of manufacture. Data for 2016 comes from transit agency memos because NTD data was not yet available. It is shown because it was used to set past targets, but it may not represent the same set of assets as standardized NTD data.
Proposed Targets	**2026 targets:** No more than 54.6 percent for non-revenue vehicles, no more than 34.2 percent for equipment  Percent of non-revenue vehicles and equipment exceeding their useful life
Plan Update revisions	This target was first set before data was available from the National Transit Database. Starting in 2018, NTD data is available – the NTD represents a more consistent data set – so the baseline has been adjusted to use this data source.

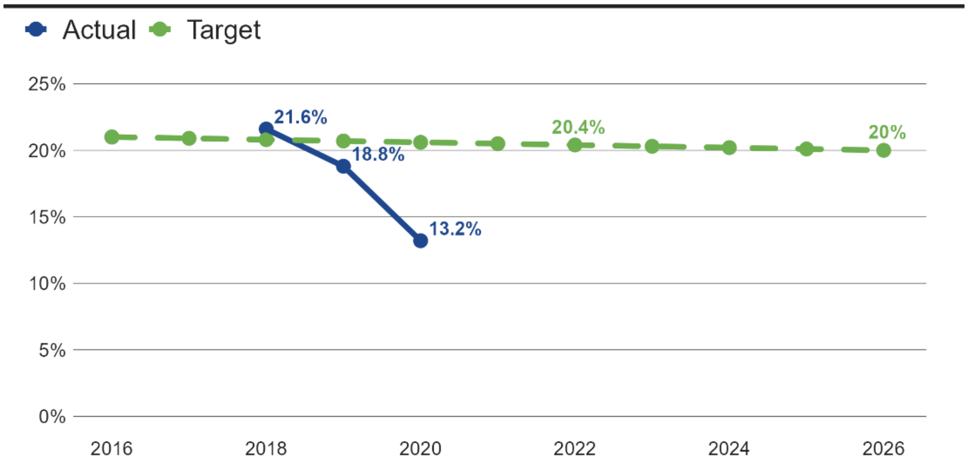
Transit infrastructure

Measure	Percent of directional rail route miles with track performance restrictions.
Methodology	This measures the percent of transit rail track with performance restrictions or “slow zones” where trains are required to operate at slower than normal speeds. This could be the result of track age, construction, power systems, signals, or other issues. Note that Metra track condition is regulated by the FRA.
Proposed Targets	**2026:** Less than 3.6 percent

	 Percent of track with performance restrictions
Plan Update revisions	Metra is receiving more complete information from partner railroads, which results in increased rate relative to past years.

Transit facilities

Measure	Percent of transit facilities with an asset class condition rating below 3 on the FTA's Transit Economic Requirements Model scale. This measure quantifies the condition of transit facilities including maintenance buildings, administrative buildings, passenger stations, and parking facilities.
Methodology	The Federal Transit Administration has developed a 5-point scale for classifying the condition of assets called the Transit Economic Requirements Model (TERM). TERM Scale: 4.8-5.0: Excellent 4.0-4.7: Good 3.0-3.9: Adequate 2.0:2.9: Marginal 1.0-1.9: Poor Transit agencies assess the condition of the components (such as plumbing and HVAC) of major facilities then aggregate the component level data to obtain an overall facility condition rating. A facility is deemed to be in good

	repair if it has a condition rating of 3, 4, or 5 on this scale and is deemed to not be in good repair if it has a rating of 1 or 2.
Proposed Targets	**2026 target**: Less than 20.0 percent **Percent of transit facilities rated in marginal or fair condition** 
Plan Update revisions	NTD data on asset conditions is more robust.

Transit Safety

Transit safety targets are required by the performance-based planning and programming (PBPP) rulemakings enacted in accordance with the Public Transportation Agency Safety Plan (PTASP) Final Rule[42].

Metra is exempt from PTASP requirements because it is regulated for safety by the Federal Railroad Administration (FRA) rather than the FTA. Accordingly, Metra has developed a System Safety Program Plan (SSPP) under the FRA[43]. Under MAP-21, states have additional safety oversight responsibilities for heavy rail transit[44]. In Illinois, IDOT oversees two covered systems: CTA rail and Bi-State Development MetroLink light rail (St. Louis).

The National Public Transportation Safety Plan (NPTSP) guides the national effort in managing the safety risks and hazards within our nation's public transportation systems. The plan centers on the FTA's Safety Management System (SMS) approach to improving the industry's safety performance. It also established performance measures to improve the safety of public transportation systems that receive federal financial assistance. Transit agencies, MPOs, and states are required to set targets for these measures. The FTA has not established penalties for not meeting safety performance targets.

The safety performance measures require transit agencies, state DOTs and MPOs to establish safety targets for:

(1) Number of fatalities by mode
(2) Rate of fatalities per revenue mile by mode
(3) Number of serious injuries by mode
(4) Rate of serious injuries per revenue mile by mode
(5) Number of reportable events by mode
(6) Rate of safety events per revenue miles by mode
(7) Reliability — Mean distance between mechanical failure by mode

CMAP sets targets by mode for:

Heavy Rail (CTA)
Bus (CTA and Pace)
Non-fixed route: Paratransit (Pace) and Vanpool (Pace)

Ferryboats and Commuter Rail are exempt from FTA safety target setting.

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[42] Public Transportation Agency Safety Plan Final Rule https://www.govinfo.gov/content/pkg/FR-2018-07-19/pdf/2018-15167.pdf

[43] For more information about FRA safety plans see 49 CFR Part 270

[44] FTA State Safety Oversight Program https://www.transit.dot.gov/state-safety-oversight

Each transit provider is required to develop an Agency Safety Plan. The plan and safety performance targets are reviewed and updated annually. The MPO is not required to set new transit safety targets each year but can choose to revisit the MPO's safety performance targets based on the schedule for preparation of its system performance report that is part of the Metropolitan Transportation Plan (MTP). In March 2021, CMAP MPO Policy Committee and Board adopted two-year transit safety targets following adoption of targets by CTA and Pace. This document adopts four-year targets to align with the planning cycle of the update to ON TO 2050.

Research and projects

In preparation for target setting, CMAP hosted a transit safety summit in January 2021 that included representatives from IDOT, CTA, Pace, Metra, RTA, FTA, and CMAP. Discussion included plan development, recent safety efforts by each agency, target setting, response to COVID-19, technology, and future activities. Agencies shared that recent plans largely formalize existing safety practices in one place in a consistent manner. These plans have elevated the visibility of safety in organizations, at all levels.

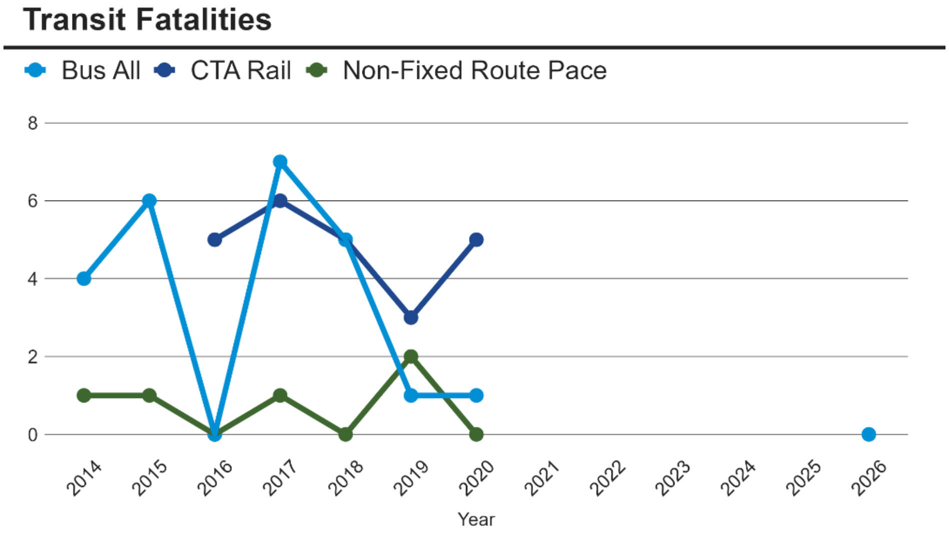
Incorporating transit safety into local programming

Transit safety is the most recent federal performance measure rule to be finalized. CMAP staff and the transit agencies are just beginning to find ways to reflect and enhance how transit safety is incorporated in regional programming. Asset condition is incorporated into CMAQ and RSP evaluations. Improving the condition of the regions assets often results in both operating performance and safety improvement. Safety has long been a factor in the project prioritization of the transit agencies. This emphasis has become more formalized with recent TAM and PTASP plans. There is an opportunity to bring transit safety staff into the conversation CMAP has been leading on roadway safety. Many of the same highway safety issues, such as CMAP's current focus: speeding, are impacting buses that operate in the same environment. The experience of transit agencies will be valuable as CMAP will be focusing on pedestrian safety next as part of the safety action agenda.

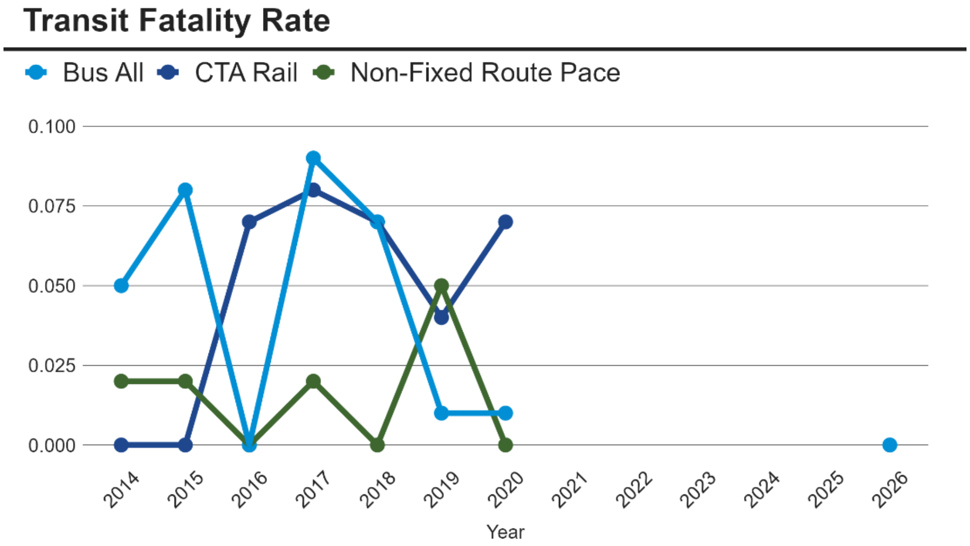
Fatalities

<table>
<tr><td>Measure</td><td>Total number and rate per million vehicle revenue miles of fatalities reported to the NTD (deaths confirmed within 30 days), excludes trespassing, security events (other crimes) and suicide-related fatalities by mode.</td></tr>
<tr><td>Methodology</td><td>Fatality data comes from the “Safety & Security Major-Only Time Series Data” table of the National transit database maintained by the FTA.
Total fatalities are divided by the vehicle and passenger car revenue miles to get the rate per million revenue miles. Security events are excluded.</td></tr>
<tr><td>Proposed Targets</td><td>

2026 fatality and fatality rate target: Zero fatalities – all transit modes



Transit Fatalities



Transit Fatality Rate

</td></tr>
</table>

Plan Update revisions	This measure was adjusted to reflect FTA guidance[45]. Fatalities related to security events are no longer included. All transit safety targets have been updated to reflect Public Transit Agency Safety Plan Modal Category guidance.

Serious Injuries

Measure	Total number and rate per million vehicle revenue miles of injuries reported to the NTD excluding injuries resulting from assaults and other crimes (security events).
Methodology	Injury data comes from the “Safety & Security Major-Only Time Series Data” table of the National transit database maintained by the FTA. Total injuries are divided by the vehicle and passenger car revenue miles to get the rate per million revenue miles. Security events are excluded. Injuries include those in which the injured party required hospitalization for more than 48 hours, commencing within 7 days from the date of the event, incurred a fracture of any bone (except simple fractures of fingers, toes, or nose), severe hemorrhages, nerve muscle, or tendon damage, internal organ injury, or second-degree burns on more than 5 percent of the surface of the body.
Proposed Targets	**2026 Injury targets**: Less than: Rail: 46 injuries and a rate of 0.65 Bus: 439 injuries and a rate of 6.06 Non- Fixed Route: 62 injuries and rate of 1.60

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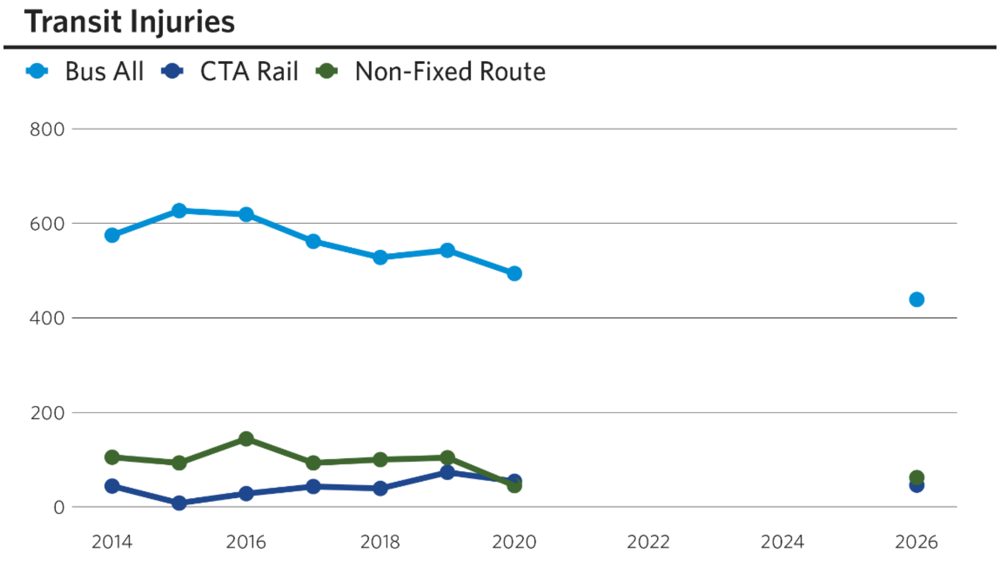
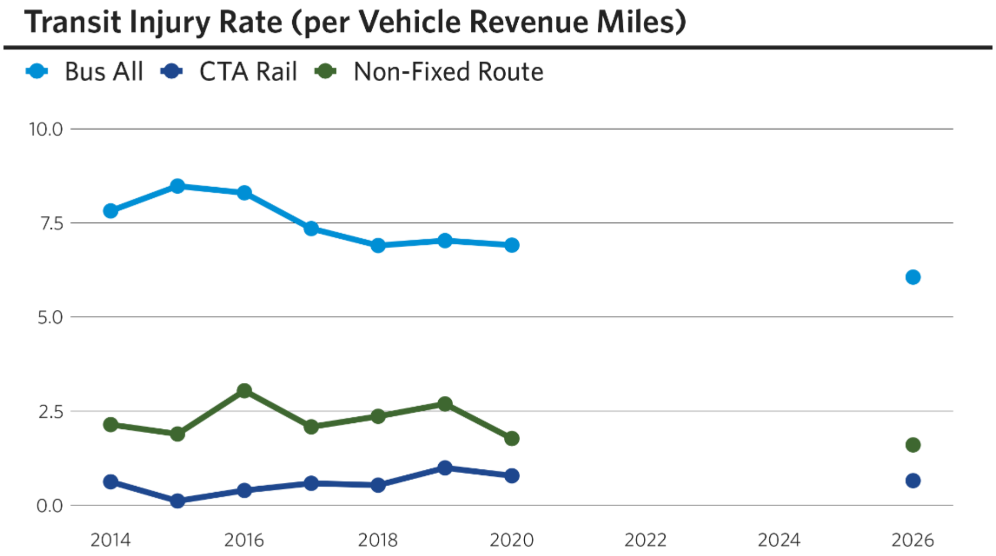
[45] https://www.transit.dot.gov/regulations-and-programs/safety/public-transportation-agency-safety-program/safety-performance

	 Transit Injuries  Transit Injury Rate (per Vehicle Revenue Miles)
Plan Update revisions	Targets are adjusted based on FTA guidance[46] to exclude injuries that result from assaults and other crimes. All transit safety targets have been updated to reflect Public Transit Agency Safety Plan Modal Category guidance.

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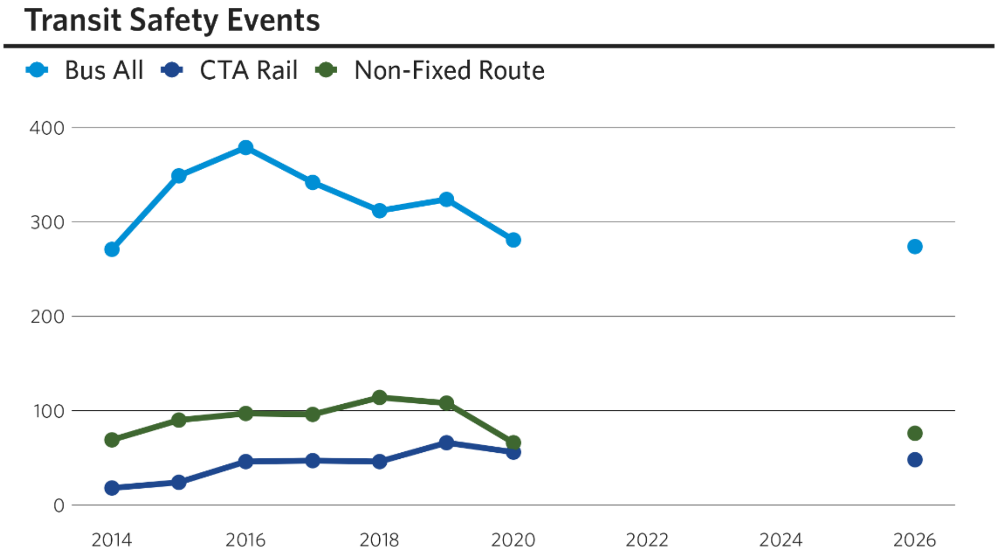
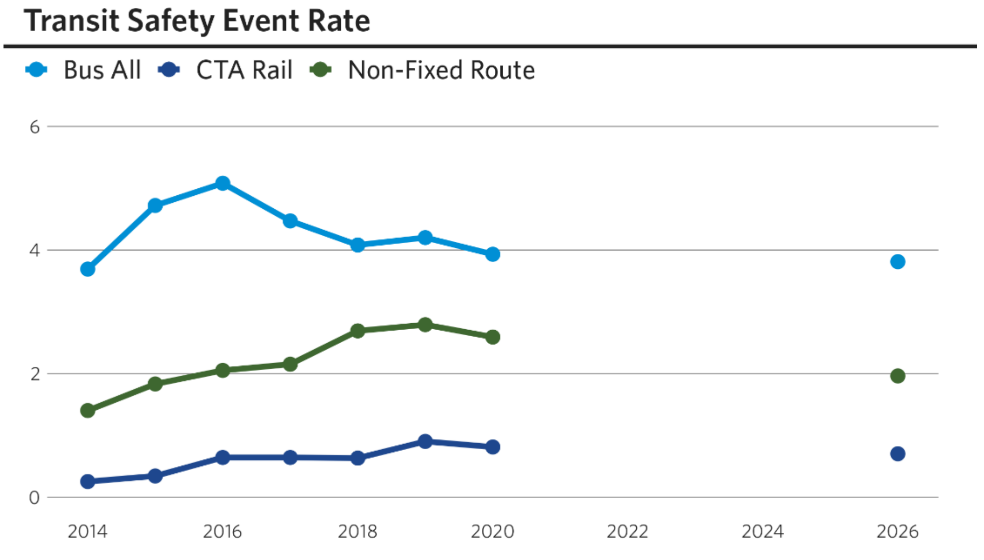
[46] https://www.transit.dot.gov/regulations-and-programs/safety/public-transportation-agency-safety-program/safety-performance

Safety Events

Measure	Total number of reportable events and the rate per total vehicle revenue miles by mode.
Methodology	Safety Events under the Major-Only Time Series are reported monthly to the FTA, and data is reported in the National Transit Database in five categories: 1. Collisions (includes all collision types reported to NTD, excludes suicides) 2. Derailments (includes all derailments reported to NTD) 3. Fires (includes all fires reported to NTD) 4. Security (includes all security events reported to the NTD) 5. NOC ("Not Otherwise Classified" includes all other reportable events) The all-security events (#4) such as assaults are removed, and the rate is per million revenue miles.
Proposed Targets	**2026 event targets**: Less than: **Rail:** 48 events and a rate of 0.70 **Bus:** 274 events and a rate of 3.81 **Non- Fixed Route:** 76 events and rate of 1.96 

	Transit Safety Event Rate 
Plan Update revisions	Targets are adjusted based on FTA guidance[47] to exclude events that result from assaults and other crimes. All transit safety targets have been updated to reflect Public Transit Agency Safety Plan Modal Category guidance.

Reliability

Measure	Mean distance between major mechanical failures by mode.
Methodology	The NTD defines a major mechanical system failure as a failure of some mechanical element of the revenue vehicle that prevents the vehicle from completing a scheduled revenue trip or starting the next scheduled revenue trip because vehicle movement is limited or due to safety concerns. This value is reported in miles.
Proposed Targets	**2026 reliability targets:** At least: **Rail:** 150,000 miles **Bus:** 6,637 miles **Non-Fixed Route:** 49,881 miles

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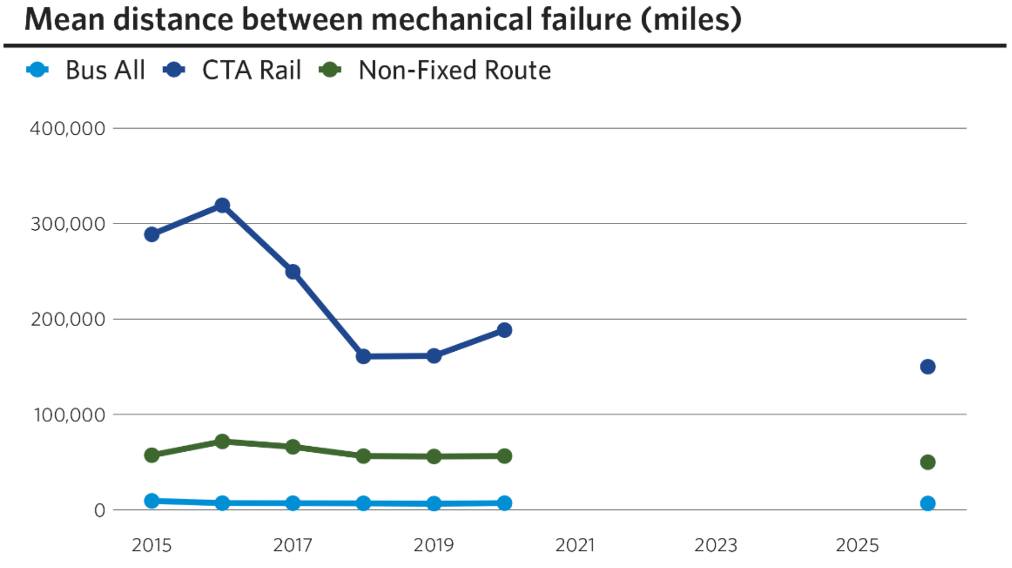
[47] https://www.transit.dot.gov/regulations-and-programs/safety/public-transportation-agency-safety-program/safety-performance

<table>
<tr><td></td><td> </td></tr>
<tr><td>Plan Update revisions</td><td>All transit safety targets have been updated to reflect Public Transit Agency Safety Plan Modal Category guidance.</td></tr>
</table>

Conclusion

Target setting is both a technical and policy-setting exercise. As part of updating and developing targets, CMAP staff have processed several data sets for the region. In additional to using this data for various analysis and programming tasks, staff are working on developing a dashboard that will make this data more accessible to policy makers and the public. Targets, and the region's performance toward targets, will continue to be incorporated into analysis, work plans, and committee discussions.

ON TO 2050 plan update air quality conformity analysis appendix

September 2022 draft

Table of contents

Tables

ON TO 2050 Update and Federal Fiscal Years 2023-2028 TIP Conformity

Conformity finding

Chicago Metropolitan Agency for Planning (CMAP) staff finds that the ON TO 2050 update and the *Federal Fiscal Year 2023-2028 Transportation Improvement Program (FFY 2023-28 TIP)* conform to the State Implementation Plan (SIP) for the 8-hour Ozone National Ambient Air Quality Standards (NAAQS) based on the results of the conformity analysis.

This report makes the determination that the region's transportation plan and program satisfy all applicable criteria and procedures in the conformity regulations. The *Transportation Conformity Analysis for the 8-Hour Ozone National Ambient Air Quality Standards* documentation is the subject of a public comment period from June 10-August 13, 2022. CMAP will recognize, consider, and respond to comments received. The ON TO 2050 update and FFY 2023-2028 TIP, including this conformity determination, will be brought to the CMAP Metropolitan Planning Organization Policy Committee and Board for approval and update in accordance with federal regulations on October 12, 2022.

History of attainment status

Ozone

1997 Ozone NAAQS

Based on air quality monitoring data gathered from 1988-90, the northeastern Illinois area was designated as a "severe" nonattainment area for the 1-hour national ambient air quality standard (NAAQS) for ozone by the U.S. Environmental Protection Agency (U.S. EPA) on November 6, 1991 (56 FR 56694). The northeastern Illinois ozone nonattainment area included the counties of Cook, DuPage, Kane, Lake, McHenry, and Will, the townships of Aux Sable and Goose Lake in Grundy County, and Oswego Township in Kendall County. The Indiana counties of Lake and Porter were also included in the nonattainment area.

On April 15, 2004, U.S. EPA issued final designations of areas not attaining the 8-hour NAAQS for ozone promulgated in 1997 under the Clean Air Act (69 FR 23898). The same area of northeastern Illinois and northwestern Indiana was designated as a moderate nonattainment area under this standard. On August 13, 2012, U.S. EPA issued a final rule finding the region in attainment of this standard, approving the Illinois Environmental Protection Agency's (Illinois EPA) redesignation request, and approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for volatile organic compounds (VOC) and nitrogen oxides (NOx) for use in conformity (77 FR 48062).

2008 Ozone NAAQS

On June 11, 2012, U.S. EPA issued final designations of areas not attaining the 8-hour NAAQS for ozone promulgated in 2008 (77 FR 34221). The northeastern Illinois nonattainment area included the counties of Cook, DuPage, Kane, Lake, McHenry, and Will, the townships of Aux Sable and Goose Lake in Grundy County, and Oswego Township in Kendall County. The Indiana counties of Lake and Porter were included in the nonattainment area, as were Pleasant Prairie and Somers townships in Kenosha County, Wisconsin. These areas were designated as marginal nonattainment, meaning that they are expected to attain the NAAQS by the attainment year of 2015. The region did not reach attainment in 2015. This resulted in the designation for the aforementioned areas to be reclassified from marginal to moderate nonattainment on May 4, 2016, by the U.S. EPA (81 FR 26697). On September 23, 2019, the region was reclassified from moderate to serious nonattainment for failing to meet the 2008 Ozone NAAQS by U.S. EPA (84 FR 44238). On March 10, 2022, a federal register notice (87 FR 13668) to approve the Illinois portion of the Chicago-Naperville, Illinois-Indiana-Wisconsin area to attainment of the 2008 ozone standard was published for public comment. While the final approval of the redesignation to attainment of the 2008 ozone NAAQS has not yet been done, it is anticipated that that will occur during the late spring or summer of 2022. On May 20, 2022, the U.S. EPA published a final rule that redesignated the Illinois Portion of the Chicago-Naperville, Illinois-Indiana-Wisconsin Area to attainment of the 2008 ozone standard and approved a revision to SIP to include a 2008 ozone maintenance SIP with a horizon year of 2035 (87 FR 30828). In the notice a revised Motor Vehicle Emissions Budget (MVEB) for 2035 and beyond of 65 tons/day of VOCs and 110 tons/day of NO_x was also included.

2015 Ozone NAAQS

On October 26, 2015, the U.S. EPA issued the final rule for the 2015 NAAQS, which strengthened the ozone standard from .075 parts per million (ppm) to .070 ppm for the 8-hour standard. On April 30, 2018, the U.S. EPA published the nonattainment area designations on its website. It designated as marginal nonattainment five counties and two partial counties in the Chicago area nonattainment area: Cook, DuPage, Kane, Lake, and Will counties, Aux Sable and Goose Lake townships in Grundy County, and Oswego Township in Kendall County. The U.S. EPA also designated as part of the nonattainment area Calumet, Hobart, North, Ross, and St. John townships in Lake County, Indiana. In Wisconsin, it designated a portion of Kenosha County bounded by the Lake Michigan shoreline on the east, the Kenosha County boundary on the north, the Kenosha County boundary on the south, and the 88th Avenue (including the entire avenue) on the west as the Wisconsin portion of the of the Chicago-Naperville, Illinois-Indiana-Wisconsin Area nonattainment area for the 2015 ozone NAAQS[1]. On June 14, 2021, U.S. EPA approved revising the initial Air Quality Designation for 14 counties and partial counties across the country including McHenry County and parts of Porter County, Indiana, and Kenosha County, Wisconsin (86 FR 31438) from attainment to nonattainment of the 2015 ozone NAAQS. This action resulted in the 2008 and 2015 having the same ozone nonattainment areas for Chicago-Naperville, Illinois-Indiana-Wisconsin. On April 13, 2022, the U.S. EPA published a notice in the federal register (87 FR 21842) of the intent to reclassify, by operation of law, the region

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[1] U.S. Environmental Protection Agency, “Chicago, IL-IN-WI Nonattainment Area Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD),” 2018, https://www.epa.gov/sites/production/files/2018-05/documents/il_in_wi_chicago_final.pdf.

from Marginal to Moderate nonattainment area due to a failure to attain the current ozone NAAQS by August 3, 2021. As noted above, the region was redesignated as being in attainment for the 2008 ozone NAAQS. However, as shown in the redesignation approval the region has a 3-year ozone design value of .075 which is the minimum met the standard for the 2008 ozone NAAQS. A 3-year design value of .070 is required to meet the 2015 ozone NAAQS. Data from recent ozone seasons suggest that the region is highly unlikely to demonstrate attainment of the 2015 ozone NAAQS by the moderate attainment date of September 24, 2024 and will likely be bumped up to serious nonattainment at that time.

$PM_{2.5}$

Based on air quality monitoring data gathered from 2001-03, the northeastern Illinois area was designated as a "moderate" nonattainment area for the 1997 annual $PM_{2.5}$ NAAQS by the U.S. EPA on April 5, 2005 (70 FR 944). The northeastern Illinois $PM_{2.5}$ nonattainment area includes the counties of Cook, DuPage, Kane, Lake, McHenry, and Will, the townships of Aux Sable and Goose Lake in Grundy County, and Oswego Township in Kendall County. The Indiana counties of Lake and Porter are also included in the nonattainment area.

On October 2, 2013, U.S. EPA issued a final rule finding the region in attainment of the 1997 annual $PM_{2.5}$ standard, approving Illinois EPA's redesignation request, and approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for direct $PM_{2.5}$ emissions and NOx for use in conformity (78 FR 60704).

On January 15, 2012, U.S. EPA issued a final rule lowering the annual $PM_{2.5}$ NAAQS from 15.0 micrograms per cubic meter to 12.0 micrograms per cubic meter (78 FR 3086). On December 13, 2013, Illinois EPA submitted a recommendation to U.S. EPA that the same counties and townships be designated as nonattainment as have been designated for the prior $PM_{2.5}$ and ozone NAAQS. U.S. EPA's review of Illinois EPA's designation request determined that the data used to support a determination was not valid. Because the U.S. EPA could not make a determination that a violation existed, it could not make a designation for the Chicago region. The result was that Cook, DuPage, Kane, Lake, McHenry, and Will counties, Aux Sable Township and Goose Lake Township in Grundy County, and Oswego Township in Kendall County were determined to be "unclassifiable." On October 9, 2018, U.S. EPA proposed to approve a redesignation for Illinois from "unclassifiable" to "unclassifiable/attainment" (83 FR 50556). Once Illinois, specifically northeast Illinois, received a determination that the monitor data for a 3-year period was valid (as shown in the federal register notice above), it could be determined that the region met the $PM_{2.5}$ NAAQS. Since the area had already been redesignated to attainment for the 1997 annual $PM_{2.5}$ NAAQS, transportation conformity no longer applied on the effective date of the final $PM_{2.5}$ SIP requirements rule, which was October 24, 2016.[2]

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[2] U.S. Environmental Protection Agency, "Transportation Conformity Guidance on the Revocation of the 1997 Annual $PM_{2.5}$ NAAQS https://19january2017snapshot.epa.gov/sites/production/files/2016-10/documents/420b16072.pdf

Overview of the conformity process

The transportation conformity provisions of the Clean Air Act Amendments of 1990 require that the metropolitan planning organization (MPO) for northeastern Illinois determine if the region’s transportation plan, program, and projects conform to applicable SIPs and that emissions — taken as a whole from the plan, program, and projects — will not negatively impact the region’s ability to meet the NAAQS deadlines. Conformity to a SIP means that the region’s transportation plan and program:

1) Will not cause any new violations of the NAAQS;
2) Will not cause any worsening of existing violations; and
3) Will not delay efforts to attain the NAAQS in a timely manner.

This demonstration is conducted by comparing motor vehicle emissions estimates developed from implementation of the ON TO 2050 plan update and the FFY 2023–28 TIP for specific analysis years to the motor vehicle emissions budgets (MVEBs) contained in the applicable SIP.

Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) must also make a conformity determination for the ON TO 2050 plan update and the TIP. In addition, the region’s TIP needs to be amended into the Statewide TIP (STIP), and that amendment must be approved by FHWA and FTA.

The purpose of this report is to document the process and findings developed as part of the transportation conformity analysis of the ON TO 2050 plan update and the FFY 2023–28 TIP.

Summary of 8-Hour ozone conformity process

The Illinois EPA submitted a redesignation request and maintenance SIP for the 1997 8-hour ozone standard to U.S. EPA on March 18, 2009. In 2011, Illinois EPA submitted a revised redesignation request that included proposed budgets developed with the U.S. EPA’s Motor Vehicle Emission Simulator (MOVES) model. U.S. EPA approved these MOVES-based budgets and found them adequate for conformity on August 13, 2012. On March 28, 2014, Illinois EPA submitted to U.S. EPA updated MVEBs for its maintenance SIP. On October 6, 2014, U.S. EPA published approval of the revised budgets in the Federal Register (79 FR 60073).

As previously mentioned, on May 20, 2022, a federal register notice (87 FR 30828) to redesignate the region to attainment of the 2008 ozone NAAQS was published. It included a maintenance plan designed to demonstrate that the Chicago area is in attainment of the 2008 ozone NAAQS through 2035. The notice also included a revised MVEB budget for 2035 and beyond (MVEB prior to 2035 was unchanged). With 2035 being the final year of the 2008 ozone maintenance plan that year needed to be added as a scenario year to CMAP transportation conformity process so that maintenance of the 2008 ozone NAAQS could be demonstrated. The revised MVEB and inclusion of 2035 as a scenario year to be modeled was discussed at a Tier II Consultation meeting on April 7, 2022. Conformity analysis for the ON TO 2050 update and FFY 2023-2028 TIP evaluated mobile source emissions in the region against these MVEB for scenario years 2025, 2030, 2035, 2040, and 2050.

Federal acceptance of the plan and TIP

The most recent federal review of the TIP conformity determination occurred on January 13, 2022. The U.S. Department of Transportation (U.S. DOT), through the FHWA Illinois Division and the FTA Region 5, found that the conformity analysis performed by CMAP met the applicable criteria of 40 CFR 51 and 93, and approved the amendment to the FFY 2019-24 TIP.

Interagency consultation

Interagency consultation is required under the transportation conformity rule, as described in 40 CFR 93.105. In the northeastern Illinois region, these procedures are addressed through the consultation process described below and through the work of CMAP's committees, working committees, and other groups as described in the region's Public Participation Plan.[3]

In the northeastern Illinois region, consultation involving CMAP, Illinois EPA, Illinois Department of Transportation (IDOT), Regional Transportation Authority (RTA), FHWA, FTA, U.S. EPA, and other entities as appropriate, facilitates the local, regional, and state decision-making process by providing a forum for all affected federal, state, regional, and local agencies to discuss and resolve important issues. Decisions made through this interagency consultation process guide CMAP in making the conformity determination.

Consultation process

The consultation process facilitates the regional planning process in several ways. First, consultation assures early and proactive participation by the U.S. EPA, FTA, and FHWA in the plan and TIP development process. Second, consultation serves as a forum for interagency communication and understanding to prevent or resolve potential obstacles in the conformity process. Finally, the expertise of the federal agency representatives is relied upon for assistance in interpreting air quality regulations, transportation plan requirements, and TIP requirements.

Acceptable means of communication for the purpose of consultation include telephone, fax, email, person-to-person communication, and arranged meetings. The consultation team has found that having all parties present at meetings greatly facilitates interagency coordination and assures mutual understanding of issues and determinations. Therefore, CMAP relies heavily upon scheduled consultation meetings with federal agency representatives and other members of the consultation team.

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[3] Chicago Metropolitan Agency for Planning, "Public Participation Plan," 2019, https://www.cmap.illinois.gov/documents/10180/996489/Public+Participation+Plan+FINAL.pdf/7204bc72-0def-6682-2bf3-9832b705c70b.

The consultation group is comprised of representatives of FHWA, FTA, U.S. EPA, Illinois EPA, IDOT, RTA, and CMAP.

The consultation process in northeastern Illinois consists of two levels, or "tiers." Tier I participants include federal representatives from headquarters offices in Washington, D.C. Tier II participants include federal representatives from U.S. EPA's Region 5 office, FTA's Region 5 office, FHWA's Division Office, Illinois EPA, IDOT, RTA, and CMAP. In addition to the standing members of the consultation team, representatives of local transportation implementing agencies and other stakeholders are invited to attend as appropriate. The Tier I consultation team is convened in the event the Tier II team is unable to resolve a particular issue.

The consultation process used during the development of the ON TO 2050 update, FFY 2023-28 TIP, and this conformity analysis consisted solely of Tier II meetings.

The consultation team meets at the CMAP office on an as-needed basis; however, it has historically met at least twice a year. Every attempt is made to schedule meetings so that all representatives can attend, but meetings are held whether or not all members are present. No decision is put into effect until all parties involved in the consultation process agree.

To provide a reference for discussion items and issue resolution, CMAP staff prepares meeting summaries following the completion of each scheduled consultation meeting. These summaries are reviewed for accuracy and approved by the consultation team at a subsequent meeting. Following resolution of an issue, staff typically provides a verbal update to pertinent CMAP committees to assist committee members in their decision-making processes.

Summary of formal consultation meetings

Agendas, minutes of consultation meetings, and other materials used by the Tier II Consultation Team are available on the CMAP website.[4]

Public participation

The Public Participation Plan adopted by the CMAP Board and the MPO Policy Committee in June 2019[5] establishes the mechanisms by which CMAP reaches out to its many stakeholders and the public.

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[4] Chicago Metropolitan Agency for Planning, Tier II Consultation webpage, http://www.cmap.illinois.gov/committees/other-groups/tier-ii-consultation.

[5] Chicago Metropolitan Agency for Planning, "Public Participation Plan," 2019, https://www.cmap.illinois.gov/documents/10180/996489/Public+Participation+Plan+FINAL.pdf/7204bc72-0def-6682-2bf3-9832b705c70b.

A formal public comment period for the draft Transportation Conformity Analysis for the $PM_{2.5}$ and Eight-Hour Ozone National Ambient Air Quality Standards will be held from June 10-August 13, 2022. A formal public hearing will be held August 11, 2022. Comments are accepted via fax, mail, and email.

CMAP or the Tier II Consultation committee will respond to any public comments received during the public comment period on the conformity analysis.

Procedures for determining regional transportation demand

The procedures for determining regional transportation demand are subject to requirements set out in the conformity regulations, at 40 CFR 93.122(b).

The *Travel Demand Model Documentation*[6] appendix describes the modeling process used to develop inputs from the travel demand model for this transportation conformity analysis. This material demonstrates the inherent behavioral connections between regional land use, demographics, transportation infrastructure, and policy input to the quantification of travel demand levels and patterns, and the subsequent measurement of transportation system performance, which the models contain.

The following is a description of how CMAP's demand model meets the specific criteria from the regulations:

Paragraph	**Requirement**	**How the requirement is satisfied**
(b) (1) (i)	Network-based travel models must be validated against observed counts (peak and off-peak, if possible) for a base year that is not more than 10 years prior to the date of the conformity determination. Model forecasts must be analyzed for reasonableness and compared to historical trends and other factors, and the results must be documented.	The models were validated against 2019 ground counts and will be documented in the 2022 CMAP Travel Demand Model Validation Report.
(b) (1) (ii)	Land use, population, employment, and other network-based travel model assumptions must be documented and based on the best available information.	The socioeconomic forecasts used are based on the best available information including census data and a sound methodology as described in the *Regional Socioeconomic Forecast*[7] appendix of the ON TO 2050 update.

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[6] Chicago Metropolitan Agency for Planning, "Travel Model Documentation," https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Travel+Demand+Model+Documentation+Appendix.pdf/

[7] Chicago Metropolitan Agency for Planning, ON TO 2050 plan update socioeconomic forecast appendix, https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Socioeconomic+Forecast+Appendix.pdf/

(b) (1) (iii)	Scenarios of land development and use must be consistent with the future transportation system alternatives for which emissions are being estimated. The distribution of employment and residences for different transportation options must be reasonable.	The analysis uses forecasts of population, employment, and land use developed by CMAP. The Local Area Allocation process described in the *Regional Socioeconomic Forecast*[8] specifically accounts for the interaction between residential and business locations; transportation system improvements; and land values and redevelopment policies. The transportation simulation model has been structured with a feedback mechanism. Analysis and scenario testing were performed on land use/transportation interactions during the development of ON TO 2050 update.
(b) (1) (iv)	A capacity-sensitive assignment methodology must be used, and emissions estimates must be based on a methodology that differentiates between peak and off-peak link volumes and speeds, and uses speeds based on final assigned volumes.	Separate capacity restraint assignments are produced to estimate vehicle miles and travel speeds for eight time periods during the day. Results of the separate period assignments are accumulated into daily volumes and tabulated by vehicle mile by speed range as required for the emission calculations.
(b) (1) (v)	Zone-to-zone travel impedances used to distribute trips between origin and destination pairs must be in reasonable agreement with the travel times estimated from final assigned traffic volumes. Where use of transit currently is anticipated to be a significant factor in satisfying transportation demand, these times should also be used for modeling mode splits.	The modeling process includes three iterations through the steps of destination choice, mode split, and assignment. The final distribution and assignment of vehicle trips is based on the times from the third model iteration. In the iteration process, the highway and transit times for each step are the same for destination choice, mode split, and assignment.

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[8] CMAP, ON TO 2050 plan update socioeconomic forecast https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Socioeconomic+Forecast+Appendix.pdf/

(b) (1) (vi)	Network-based travel models must be reasonably sensitive to changes in the time(s), cost(s), and other factors affecting travel choices.	The joint mode-destination choice logit mode-choice model contains the full range of pricing (or cost) variables in the individual utility equation expressions for private auto, hired auto, transit, and non-motorized modes. These cost variables include destination zone parking cost, rail station parking cost, automobile operating cost (cents per mile), tolls, and transit fares. In addition, the transit path selection uses the transit fares as one of the key parameters in selecting the transit path. The use of transit fares in path building is very important in a region that has transit options including commuter rail, rapid transit, express bus, and local bus. The impact of tolling on vehicle route choice is realized in the traffic assignment procedures through generalized cost calculations, which make the choices sensitive to changes in toll amounts.

Travel demand for ozone conformity

Because the ozone NAAQS are based on daily measurements, the vehicle miles of travel (VMT) estimates for conformity analysis are daily values. Furthermore, because the highest ozone concentrations are monitored during the summer, the VMT estimates are adjusted to be daily VMT for a summer weekday. The travel demand model runs produce weekday averages over the year, so the VMT results of the model runs are adjusted by increasing the model averages to summer weekday averages, based on analysis of traffic monitoring data by IDOT. The adjusted VMT values are then used as input to U.S. EPA's MOVES3 emissions model. The adjustment factors are:

Table 1: **Average daily traffic (ADT) conversion factors**

Facility	**Multiplier**
Arterial	1.0700
Expressway	0.9969
Local	1.0700
Ramp	1.0700

Latest planning assumptions

Socioeconomic forecasts

A major input to any transportation demand modeling process is the socioeconomic data used to develop the number and types of trips to be assigned to the transportation system. There are three components to this data: the geographic or spatial component, the socioeconomic variables used to describe or characterize these areas, and the base and forecast years that define the time horizons for the analysis.

CMAP has systematically forecast 2050 population, employment, and economic activity from the land use and transportation strategies of ON TO 2050. The CMAP travel demand models are then used to estimate travel behavior, congestion, and VMT resulting from these forecasts. Population and employment estimates were developed for five-year increments through the regional socioeconomic forecast process. These forecasts are used for interim conformity years and are tested against transportation improvements expected to be implemented at the time. A description of the method used to prepare the forecasts and data summaries are included in the ON TO 2050 socioeconomic forecast update.[9]

Transit operating policies

The RTA develops operating and capital budgets and plans[10] that are updated annually and serve as the basis for considering the impact of transit operating policies on travel demand model estimates. These documents include projections over the near term of key transit operating policies including fare, service, and ridership levels.

Because the most recent conformity determination was adopted in January 2022, transit operating policies (including fares and service levels) and assumed transit ridership have not changed. The impacts of the COVID-19 pandemic are not reflected in the travel demand model or the mobile source emissions modeling as the base year is 2019. Future impacts regarding transit ridership caused by the COVID-19 pandemic are uncertain and warrant further evaluation but at this time data that can be used for modeling to support long-term changes in transit ridership, have yet to be developed.

Transit fares and highway costs in the conformity analysis

The transportation model used in the conformity analysis requires information on the cost of transportation by each mode. Of particular importance are the relative costs of transportation versus all other costs, and the relative costs of the transit and auto modes to each other. Auto costs used in the model are based on the cost to own and operate an

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[9] Chicago Metropolitan Agency for Planning, ON TO 2050 plan update Socioeconomic forecast, https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Socioeconomic+Forecast+Appendix.pdf/

[10] Regional Transportation Authority, Finance & Management webpage, http://www.rtachicago.org/index.php/finance-management.html.

automobile, parking costs, and charges for tollway facilities. Transit costs include information on the base fares, transfers, and access costs.

It was assumed that the relative costs of the two transportation modes (highway and transit) would be the same in the future years as that which existed in the base year. This treatment of future costs for the transit mode and for the toll component of the auto operating cost is consistent with observed trends.

Transportation Control Measures (TCMs)

TCMs were used to develop SIPs related to the one-hour ozone standard, including the 15 percent Rate of Progress (ROP) SIP (1993), control strategy SIP (1995), 1996 ROP SIP, 9 percent control strategy SIP (1998), and 9 percent ROP control strategy SIP (1999). All the TCMs adopted for these SIPs were implemented by 1999.

The ozone maintenance SIP, which has budgets found adequate for conformity, assume no TCMs. Thus, no such measures are identified here.

Emissions budgets and modeling scenarios

Five analysis years are included in the region's conformity analyses:

- 2019 – the base year (not modeling for conformity)
- 2025 – the horizon budget year for the 1997 ozone maintenance SIP
- 2030 – an intervening year not more than 10 years apart from the preceding and succeeding scenario years
- 2035 – the proposed horizon budget year for the 2008 ozone maintenance SIP.
- 2040 – an intervening year not more than 10 years apart from the preceding and succeeding scenario years
- 2050 – the horizon year of the plan

Ozone conformity

Mobile source emissions budgets for ozone precursors — VOC and NOx — were developed by Illinois EPA as part of the 8-hour ozone maintenance SIP. On August 13, 2012, U.S. EPA issued a final rule approving and finding adequate MVEBs for 2008 and 2025 (77 FR 48062). As previously stated, the proposed rule for the redesignation for the 2008 ozone NAAQS to attainment have a budget that can be used for 2035 and beyond which is what CMAP, in consultation with the Tier II committee has chosen to do.

These are the budgets that are used in conformity determinations by CMAP.

Table 2: Motor Vehicle Emissions Budget (MVEB) by Model Year

Model year	VOC (tons/day)	NOx (tons/day)
2025	60.13	150.27
2030	60.13	150.27
2035	65.00	110.00
2040	65.00	110.00
2050	65.00	110.00

Illinois EPA and CMAP worked closely during the development of the VOC and NOx emission budgets to determine the appropriate MOVES model settings. This conformity demonstration uses the same applicable settings in MOVES runs as were used in developing the SIP budgets. A full discussion of the settings and input files is provided in the *Travel Model Documentation Report*.[11]

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[11] Chicago Metropolitan Agency for Planning, Travel Model Documentation Report, 2022, https://www.cmap.illinois.gov/documents/10180/1439048/ON+TO+2050+Update+Travel+Demand+Model+Documentation+Appendix.pdf/ .

Off-network calculations

The final estimate of regional emissions does not include credit for off-network calculations. However, many of the projects not currently incorporated explicitly in the travel demand model have been programmed using federal Congestion Mitigation and Air Quality Improvement Program funds. These funds are programmed by CMAP on the basis of the project's demonstrated air quality benefits. A benefit evaluation method has been developed for each type of project. The methods are structured so that, if appropriate, a project's benefits can be incorporated in the appropriate SIP by the Illinois EPA as a TCM, or used in conformity determinations.

Emissions Calculation

CMAP is required to use the most current version of the U.S. EPA's Motor Vehicle Emission Simulator, MOVES3 for transportation conformity analyses (86 FR 1106). As stated in the Federal register notice, MOVES3 is the latest state- of-the art upgrade to EPA's modeling tools for estimating emissions from cars, trucks, buses, and motorcycles based on the latest data and regulations. MOVES3 uses a variety of data inputs. Illinois EPA provides CMAP data on meteorology, inspection/maintenance programs, and fuels used in the region. The Illinois Secretary of State provides vehicle registration data for the region. CMAP provides various VMT data along with average speeds, and road types for the region. Data not provided by Illinois EPA, Illinois Secretary of State, or CMAP is derived from U.S. EPA, such as day and monthly VMT fractions. It should be noted that the MOVES3 model includes a number of updates from the previous model, MOVES 2014a that CMAP had been using. New regulations, features and significant new data incorporated in MOVES3 are:

- Improvements to heavy-duty (HD) diesel running emission rates based on manufacturer in-use testing data from hundreds of HD trucks.
- Updated emission rates for HD gasoline and compressed natural gas (CNG) trucks;
- Updated light-duty (LD) vehicle emission rates for hydrocarbons (HC), CO and NO_x- based on in-use testing data;
- Updated LD PM rates for Model Year (MY) 2004 and later, incorporating data on gasoline direct injection engines;
- New fuel characteristic data from EPA fuel compliance submissions;
- Updated fuel effect calculations to better characterize the base fuel used to develop LD base emission rates;
- The effects of the HD Phase 2 GHG rule;
- The effects of the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule on light-duty fuel economy.

It should be noted that in U.S. EPA testing, NO_x emissions estimates were higher in future modeled years. This is due to higher running emissions from heavy-duty trucks outweighing declines from heavy-duty hoteling. When CMAP conducted tests of the MOVES3 model, increased NO_x emissions were also observed and in fact the results seen in table 3 also reflect an increase in NO_x emissions compared to MOVES modeling conducted for prior transportation conformity analysis. The transportation conformity analysis CMAP conducts consists of a calculation of total emissions for each required analysis year. The total emissions must be lower than the corresponding approved motor vehicle emission budgets (MVEB) for ozone precursors; Volatile Organic Compounds (VOCs) and Oxides of Nitrogen (NO_x). The geographic distribution of emissions within the region is not considered in conformity calculations.

When the travel simulation process is complete, several additional steps need to be taken to calculate scenario emissions. The regional model results must be transformed to be compatible with the MOVES3 emission rate structure. The MOVES3 model must then be run to produce emission rates that match the transportation data available and reflect the region's environmental and vehicular conditions. This chapter explains how the mobile source emission rates are developed and how the total emissions are calculated from the assignment results. The steps completed to compute the scenario network-based mobile source emissions are given below.

Model Data Processing

Highway networks are built with zone connectors coded to lengths proportional to zone size, so connector link volumes represent the amount of "local" travel needed to reach the regional highway system. Thus, this conformity analysis does not have a separate off-network mobile emission component. Mobile source emission estimates based upon the network traffic assignment reflect both specifically coded non-local roadways and local non-coded roadways.

The highway assignment process produces two basic pieces of information essential to calculating emissions: link loads and link speeds. While essential, the information on link loading is not a perfect match for use with the MOVES emission rates. While the assignment model defines vehicles in terms of how much of a roadway's available capacity to carry traffic is used for a given loading, the MOVES model defines vehicles in terms of engine type and size. For assignment, it makes no difference if a vehicle is diesel or gasoline powered, but it does impact the calculation of emission rates. Highway assignment accounts for the different operating characteristics of various vehicle types using the concept of vehicle equivalents[12] (VEQ). In the simplest case a standard passenger auto is one VEQ, while a semi-trailer truck is three VEQs. The truck occupies approximately the same physical space on the roadway as several standard passenger cars and interacts with other traffic in ways akin to multiple standard vehicles. For example, the truck takes more time to reach cruising speed from a stop than an individual standard passenger auto; the amount of time is similar to that needed by several standard passenger cars to reach cruising speed when driver reaction delay and vehicle spacing are considered. However, the emissions from a large truck and several standard autos are not the same (especially if the truck is diesel powered).

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[12] Comparable terms also used are passenger car equivalents (pce) and passenger car units (pcu).

During the data processing, the travel model vehicle classes must be converted to the MOVES vehicle classes.

The time-of-day highway assignment process makes use of the modeling software’s ability to keep track of multiple vehicle classes (as described in the Traffic Assignment chapter). The travel information of fixed route public transportation buses is also included. Table shows the correspondence between the MOVES vehicle types and the travel demand model vehicle classes. It also includes the correspondence with the HPMS (Highway Performance Monitoring System) vehicle types.

Table 3. Correspondence between MOVES and HPMS Vehicle Types

MOVES Vehicle Type & Description	HPMS Vehicle Type & Description	VHT Distribution Source from Travel Model
11: Motorcycle	10: Motorcycles	(use auto distribution)
21: Passenger Car	25: Passenger Cars	autos
31: Passenger Truck	25: Other 2 axle-4 tire vehicles	b-plate trucks
32: Light Commercial Truck	25: Other 2 axle-4 tire vehicles	light duty trucks
41: Intercity Bus	40: Buses	(use transit bus distribution)
42: Transit Bus	40: Buses	transit bus
43: School Bus	40: Buses	(use transit bus distribution)
51: Refuse Truck	50: Single Unit Trucks	(use medium duty trucks under 200 miles distribution)
52: Single Unit Short-haul Truck	50: Single Unit Trucks	medium duty trucks under 200 miles
53: Single Unit Long-haul Truck	50: Single Unit Trucks	medium duty trucks 200+ miles
54: Motor Home	50: Single Unit Trucks	(use medium duty trucks 200+ miles distribution)
61: Combination Short-haul Truck	60: Combination Trucks	heavy duty trucks under 200 miles
62: Combination Long-haul Truck	60: Combination Trucks	heavy duty trucks 200+ miles

Following the completion of a region travel demand model run for an Air Quality Conformity Analysis, the results must be processed and formatted for input into MOVES3 for emissions calculation. Two scripts are used to first export the relevant information from Emme® and then to process it into the data inputs MOVES requires. In addition to basic network link data (e.g., length and number of lanes), the first script also captures the following information for every link in a scenario network by the TOD highway assignment:

final loaded speed

number of autos

number of b-plate trucks
number of light trucks
number of medium truck VEQ
number of heavy truck VEQ
number of fixed route public transit buses
number of long-distance (i.e., traveling at least 200 miles) medium and heavy trucks

After the appropriate data have been extracted from the travel demand model, a second script processes the data for input into MOVES. This script performs a number of functions. First, vehicle equivalents are converted to the actual number of vehicles so that VMT and vehicle hours of travel can be computed for each link in all of the TOD networks. The modeled vehicles are converted into MOVES vehicle categories, as shown in Table .

Next, the model network links are converted into the MOVES road types; this correspondence is shown in Table. The links are identified based on the volume-delay function they reference. The urban/rural designation is determined by the *areatype* (capacity zone) value attached to the from-node of each link: a value less than nine is considered urban and a value greater than or equal to nine is rural. Note that “off-network” in the MOVES model refers to processes that generate emissions but are not associated with being on a road. These include starts, emissions from a parked vehicle, and extended idling by heavy-duty trucks.

Table 4. Correspondence between MOVES Road Types and Model Links

MOVES Road Type & Description	Model Volume-Delay Function
1: Off-Network	N/A
2: Rural Restricted Access	rural 2,3,4,5,7,8
3: Rural Unrestricted Access	rural 1,6
4: Urban Restricted Access	urban 2,3,4,5,7,8
5: Urban Unrestricted Access	urban 1,6

A set of link speed bins is created to store the link data. The lowest bin reflects link speeds under 2.5 miles per hour (MPH). The bins then proceed in 5- mile per hour increments beginning with 2.5<=MPH<7.5 MPH and ending with 67.5<=MPH<72.5. A final bin captures links with speeds of at least 72.5 MPH.

Finally, the vehicle-specific VMT and VHT values are disaggregated from the time period totals into hourly values for each link. The script then produces the following files for use by MOVES:

1. **Average Speed Distribution** – This file contains the share of daily VHT summarized for each vehicle type within each unique combination of [road type – hour of the day – speed bin] category. Within each group of [road type – vehicle type – hour of the day], the values must sum to one. MOVES requires a VHT distribution for all of these categories. If the results of a model run do not provide a distribution for a given category, the following substitutions are made:
   - Bus – when no distribution is available for rural restricted access facilities, the distribution from urban restricted access facilities is used. This applies to vehicle types 41, 42, and 43.
   - Single-unit Long-haul truck – when no distribution is available, the distribution from Single-unit Short-haul truck is used. This applies to vehicle types 53 and 54.
   - Combination Long-haul truck – when no distribution is available, the distribution from Combination Short-haul truck is used. This applies to vehicle type 62.
2. **Road Type Distribution –** This file contains the daily share of VMT for each [vehicle type – road type] combination. Within each vehicle type, the VMT shares must sum to one. The same substitution method described above is implemented if necessary.
3. **Ramp Fraction –** This file reports the share of total freeway VHT that occurs on ramps. This value is reported separately for urban and rural restricted access facilities.
4. **Hourly VMT Fraction –** This file contains the hourly share of daily VMT for each [vehicle type – road type – hour of the day] combination for weekdays. The shares within each [vehicle type – road type] category must sum to one. The Average Speed Distribution substitution method is used if necessary.
5. **HPMS Daily VMT –** This file contains total VMT by road type summarized by HPMS vehicle type.

MOVES Model Emissions Calculation

This conformity analysis used MOVES3.03, the current version of the approved U.S. EPA emissions model. The default database is from the November 2020 release by U.S. EPA . Files used to supply the input to calculate the emissions inventory for each of the emissions types (VOC and NOx for ozone) are included on the following pages. Descriptions of the input commands and changes for other scenario years are also given.

For ease of execution, one MOVES run was created for each scenario year. The runs developed inventories for both VOC and NOx ozone precursors.

MOVES allows the user to calculate emissions rates, which can be applied to VMT, or to calculate emissions inventories, which can be compared directly to SIP budgets. Since a limited number of "small" MOVES runs are required for conformity, and the calculation of inventories from emissions rates requires detailed VMT, trip and fleet size breakdowns, CMAP prefers to run MOVES in inventory mode. Running MOVES in inventory mode is also consistent with the approach that Illinois EPA uses for their emissions modeling and was discussed and agreed upon through the Tier II consultation process.

MOVES Model Settings Used in Conformity Analysis

This section describes the various inputs used to obtain emission inventories from MOVES for conformity analysis:

Navigation Panel input

County Data Manager input

Navigation Panel Input

Each MOVES run requires completion of the parameters in the navigation panel. CMAP has chosen to make a separate run for each analysis year and by the inspection maintenance (IM) area and non-inspection maintenance (non-IM) area. The IM area is the portion of the nonattainment area where registered vehicles are subject to the Illinois EPA IM program. The non-IM area is the portion of the nonattainment area where registered vehicles are not subject to the Illinois EPA IM program. The IM and non-IM areas are defined by zip codes in Illinois law. The emission results from the IM and non-IM areas are combined to create the total emissions for the nonattainment area. The parameters in the navigation panels and their inputs are listed below. Unless otherwise indicated, the parameters are the same for each year that is modeled.

Description – a narrative description to identify the run; this varies slightly between analysis years to help distinguish them. It has no effect on emissions.

Scale – The county scale is selected, as recommended for conformity analyses. The inventory calculation type is selected.

Time Spans – The Time Aggregation Level is set to hour, as recommended in the guidance. The year is set to the appropriate analysis year. Both weekdays and weekends are selected, as are all months and all hours. These are required for the annual $PM_{2.5}$ emissions inventory; for ozone precursors, only July weekday data are used from the output database.

Geographic Bounds – In MOVES3 the user must select a county to model. CMAP, tested running MOVES for each county in the Illinois portion of the nonattainment area. The model running time was a significant increase from the custom domain approach CMAP used with MOVES 2014a. As an example, it took about 12 hours to run one scenario year, such as 2025 (including pre and post database preparation and analysis) in MOVES 2014a. Running MOVES 3 for each county, the modeling time increased to about 50 hours per scenario year. As there are five scenarios years to model, 250 hours of modeling time was a substantial increase in time. In consultation with U.S. EPA's office of Transportation and Air quality and the Tier II consultation committee, it was decided that CMAP could divide the region into two parts, an IM area and non-IM area (as CMAP had done using MOVES 2014a), using a representative county for each area. The representative county for the IM area is Cook County, and the non-IM area is McHenry County.

Onroad Vehicles – All fuel types are selected, and all available vehicle types are selected for each fuel type. (Only motorcycles are not available for diesel fuel; only inter-city buses and combination long-haul trucks are not available for gasoline.)

Road Type – All five road types (Off-Network, Rural Restricted Access, Rural Unrestricted Access, Urban Restricted Access, Urban Unrestricted Access) are selected.

Pollutants and Processes – The following pollutants are selected. In most cases subsidiary pollutants are required; they are listed following each pollutant. In all cases, all applicable processes are selected (achieved by selecting the pollutant check box to the left of the pollutant name in the window):

a. Volatile Organic Compounds – Total Gaseous Hydrocarbons and Non-Methane Hydrocarbons
b. Oxides of Nitrogen (NOx) – no subsidiary pollutants are required
c. Primary Exhaust $PM_{2.5}$ – Total – Primary $PM_{2.5}$ – Organic Carbon, Primary $PM_{2.5}$ – Elemental Carbon, Primary $PM_{2.5}$ – Sulfate Particulate (Sulfate Particulate requires Total Energy Consumption)
d. Primary $PM_{2.5}$ – Brakewear Particulate (combined with Primary Exhaust $PM_{2.5}$ and Tirewear to produce total $PM_{2.5}$)
e. Primary $PM_{2.5}$ – Tirewear Particulate (combined with Primary Exhaust $PM_{2.5}$ and Brakewear to produce total $PM_{2.5}$)
f. CO_2 Equivalent – Total Energy Consumption, Atmospheric CO_2, Nitrous Oxide, Methane, Total Gaseous Hydrocarbons

Input Data Sets – No databases are used for input other than the default MOVES database, and the run-specific inputs entered through the County Data Manager.

Output

a. General Output – Each run's output is sent to a separate database. As noted previously, the emissions for ozone are estimated in one run; thus a conformity analysis consists of 10 MOVES runs, and hence there are 10 output databases. Mass units are specified as grams, energy as millions of BTU, and distance as miles. The activity output selected is distance traveled and population.

b. Output Emissions Detail – Time is set to hour, and the location is set to county. No vehicle/equipment categories are selected. Among the On Road/Off Road selections, Road Type and Source Use Type are selected.

c. Database – The names follow the convention of tipamendment yyyymmdd_all_YYYY_out, where yyyymmdd is the date of the Policy Committee consideration, "all" refers to all pollutants, YYYY is the analysis year and "out" means that this is the output file. If other types of analysis are conducted, the "tipamendment" portion of the name is changed appropriately. If only selected pollutants are estimated, then the "all" is changed appropriately.

Advanced Performance Features – These parameters to improve program performance in complex run situations are not used in the conformity analysis.

County Data Manager Inputs

The County Data Manager allows the analyst to include specific data for the geography under consideration and the analysis year in the MOVES dataset. Much of the data comes from the travel demand model.

Database – The input database unique to this MOVES run is created here. CMAP currently creates a separate database for each run. The names follow the convention of tipamendment_yyyymmdd_YYYY_in, where yyyymmdd is the date of the Policy Committee consideration, YYYY is the analysis year and "in" means that this is the input file. If other types of analysis are conducted, the "tipamendment" portion of the name is changed appropriately. The database will be associated with the county chosen in the geographic bounds. If a different county is selected, then a new database needs to be created. CMAP prepares a spreadsheet that has all the inputs for each scenario year and IM/non-IM area as a separate in the spreadsheet.

Road Type Distribution – The fraction of VMT for each vehicle type by road type is calculated from the travel demand model results, based on the classification of each link in the network.

Source Type Population – Data from the Secretary of State's office was examined for suitability in this input. The data yielded inconsistent results, so the default procedure suggested in the Technical Guidance was used. The procedure uses national default values relating vehicles to VMT which are applied to VMT from the travel demand model to estimate populations. The default procedure yielded a motorcycle population that was clearly inconsistent with the region's actual population. Therefore, motorcycle registration data from the Illinois Secretary of State's office was used to create a more realistic estimate.

Vehicle Type VMT

a. Annual VMT by vehicle type is calculated by expanding average weekday VMT resulting from the travel demand model. This takes place in two steps. First, model VMT is summarized by MOVES category vehicle type and facility type. Using vehicle count data from IDOT's monitoring program, average weekday VMT is factored into average daily VMT for all days, including weekends. Again, using IDOT monitoring data, daily VMT for each month is adjusted to be a percentage of annual average daily VMT. The annual average daily VMT (based on the travel demand model) is then adjusted to the monthly daily averages and multiplied by the number of days in the month to obtain monthly VMT. The monthly VMT values are summed to yield annual VMT
b. Monthly – Each month's fraction of annual VMT, by vehicle type, is computed using the same data and factors as the annual VMT described previously. However, the monthly VMT values are converted to fractions of the annual total rather than simply being summed.
c. Daily – Since the travel demand model results are for average weekdays only, IDOT traffic monitoring data were used to estimate the weekday vs. weekend VMT fractions. These observed data are limited because they do not include information by vehicle type. Therefore, the weekday and weekend fractions used to create the MOVES inputs are the same for all vehicle types. Finally, off-network (road type 1) data are not part of the IDOT monitoring system, so the Cook County default values were used.
d. Hourly – The travel demand model results support the calculation of VMT by time of day, road type and vehicle type. A post-processing routine was used to generate this input directly from the model results. The same values were used for both weekday and weekend days.

I/M Programs – The inspection and maintenance program description was created by staff at the Illinois Environmental Protection Agency, which administers the program. The same basic file is used for each analysis year. They differ in that the last model year of vehicle inspected depends on the analysis year; this parameter thus varies from year to year (increasing with later years).

Age Distribution – The vehicle age distribution is calculated by CMAP using the most current vehicle registration file from the Illinois secretary of state. This creates a base year age distribution file. The base year data is then input into the U.S. EPA's age distribution spreadsheet to create an age distribution for which every scenario year is being modeled.

Average Speed Distribution – The average speed distribution is developed by post-processing the travel demand model results. The travel demand model produces annual average weekday results, but there are no other sources for weekend speed distributions. Thus, the weekday values from the model were also used for the weekend.

Fuel Type and Technologies – MOVES defaults were used for all vehicle types.

Fuel

a. Fuel Supply – The types of fuel supplied to the region were supplied by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years, except that the input file has a year in it, which is set to the analysis year.
b. Fuel Formulation – the formulation of the fuels in the region is also supplied by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years.

Meteorology Data – These data are from climate records at O'Hare Airport, as compiled in the MOVES input format by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years.

At the conclusion of a MOVES run, a summary report is generated using the MOVES interface. This summary report produces daily emissions inventories by month and day type (weekday versus weekend). These inventories are then multiplied by the number of weekdays and weekend days in each month to produce the annual $PM_{2.5}$ emissions inventories. For ozone inventories, the summary results for the July weekday are used directly.

Modeled projects

Projects included in the ON TO 2050 update and FFY 2023-28 TIP transportation demand estimation modeling process are listed on the CMAP website. Regionally significant projects included in the ON TO 2050 update are listed and discussed in detail in the plan's mobility section; TIP projects that require conformity are listed on the CMAP Conformity Analysis page under the Conformity Amendments section.[13]

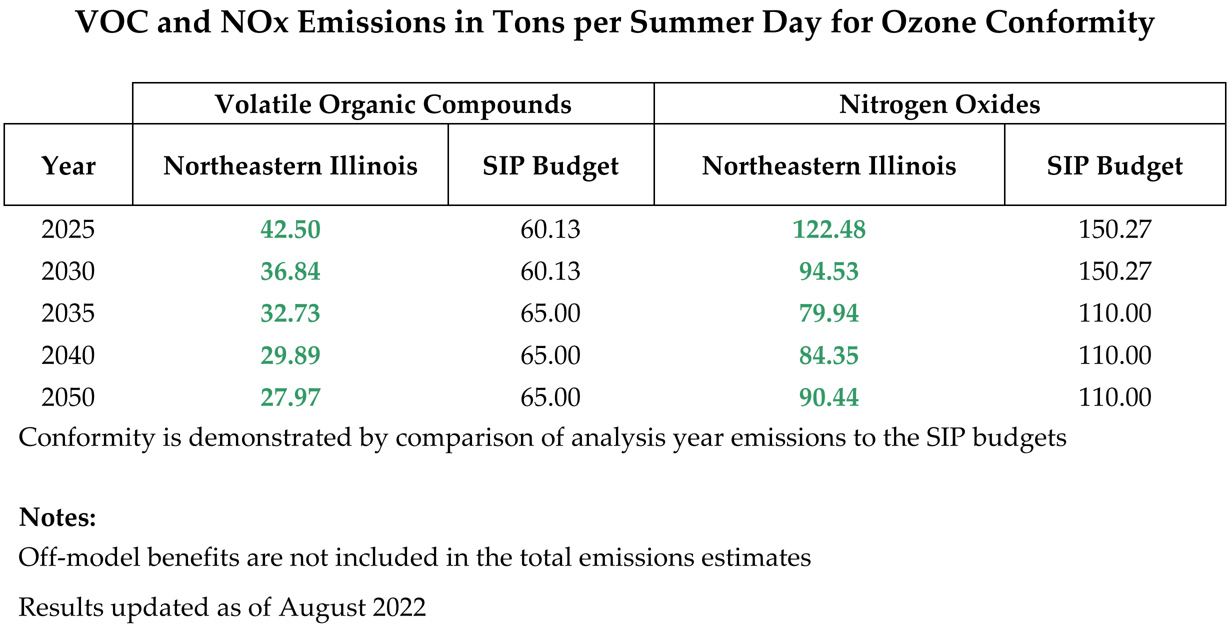
Results of the conformity analysis

Results of the conformity analysis for the ON TO 2050 plan update and the FFY 2023-28 TIP are given below. CMAP maintains a policy of accepting amendments and updating the conformity analysis semiannually. The results of the most recent conformity analysis are listed on the CMAP Conformity Analysis web page under Current Conformity Analysis.[14]

Ozone conformity results

The VOC and NOx emissions estimates for each of the scenario years are shown in Table 3. No credits are taken for projects that have air quality benefits but are not represented within the transportation networks. As shown in the table, the emission results from the conformity analysis for the analysis years show that the VOC and NOx emissions are lower than the applicable SIP budgets, and conformity for the 8-hour ozone standard is demonstrated.

Table 5: VOC and NOx emissions in tons per summer day for ozone conformity



VOC and NOx Emissions in Tons per Summer Day for Ozone Conformity

	Volatile Organic Compounds		Nitrogen Oxides	
Year	**Northeastern Illinois**	**SIP Budget**	**Northeastern Illinois**	**SIP Budget**
2025	**42.50**	60.13	**122.48**	150.27
2030	**36.84**	60.13	**94.53**	150.27
2035	**32.73**	65.00	**79.94**	110.00
2040	**29.89**	65.00	**84.35**	110.00
2050	**27.97**	65.00	**90.44**	110.00

Conformity is demonstrated by comparison of analysis year emissions to the SIP budgets

Notes:

Off-model benefits are not included in the total emissions estimates

Results updated as of August 2022

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[13] Public eTIP website, Amendments for the Transportation Improvement Program, https://etip.cmap.illinois.gov/#tabs-2.

[14] Chicago Metropolitan Agency for Planning, Conformity Analysis webpage, http://www.cmap.illinois.gov/mobility/roads/conformity-analysis.

Conclusion

The conformity analysis conducted by CMAP concludes that the ON TO 2050 plan update and the FFY 2023-28 TIP meet all applicable requirements for conformity for the 8-hour ozone standard. The ON TO 2050 plan update and the FFY 2023-28 TIP are recommended for approval by the MPO Policy Committee, FHWA and FTA.

The *Transportation Conformity Analysis for the and 8-Hour Ozone National Ambient Air Quality Standards* was the subject of a public comment period running from June 10 through August 13, 2022. This report and the accompanying appendices make the determination that the region’s transportation plan and program satisfy all applicable criteria and procedures in the conformity regulations and comply with all applicable implementation plan conformity requirements.

ON TO 2050 plan update travel demand model documentation appendix

September 2022 draft

Contents

Overview

Like its predecessor agency, the Chicago Area Transportation Study (CATS), the Chicago Metropolitan Agency for Planning (CMAP) is the primary agency responsible for the development and maintenance of travel forecasting methods for northeastern Illinois. CMAP/CATS has been developing and improving these travel forecasting procedures regularly since 1956. CATS originally developed and employed travel demand models to assist in the development of regional transportation plans. The four-step modeling process (trip generation, trip distribution, mode split, and traffic assignment) was fundamental from the beginning. Early enhancements focused on making the process run more quickly on the computers available at the time and on the calibration of individual model components. As time passed and transportation questions changed, the model was updated, revised, and extended to answer them.

In the 1970s, in response to concerns about improving public transit, CATS concentrated enhancement activities on the mode split model and transit assignment techniques.

In the late 1970s and early 1980s, efforts were focused on adapting the modeling process to subarea and project specific studies. For example, CATS developed a block-by-block zone system for the downtown Chicago-area. Trips were generated based on zonal floor space from a building-by-building file of the area. Networks were coded with detailed pedestrian links. These techniques were employed to evaluate transit alternatives for the central business district. Similarly, zone sizes were reduced and more detailed highway networks were coded in suburban areas to evaluate freeway proposals.

When federal regulations were changed to require emissions estimates for conformity analysis, the regional models were initially employed as they then existed. It was in 1994 when the first significant model changes, explicitly motivated by conformity issues, were implemented. Since then, CATS, and now CMAP, has committed substantial resources to develop models that are responsive to the needs imposed by air quality requirements. CMAP continuously strives to improve its travel forecasting techniques in response to policy priorities.

This report documents the current status of CMAP's regional travel demand model. Much of the text in this document is drawn from predecessor reports developed for the adoption of the GO TO 2040 plan[1] and the ON TO 2050 plan[2]. Since that time, a number of procedural and model coefficient updates have been implemented within the CMAP model.

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[1] Chicago Metropolitan Agency for Planning, "Travel Model Documentation Final Report" (2010, October), here.

[2] Chicago Metropolitan Agency for Planning, "ON TO 2050 Travel Demand Model Documentation" (2018, October), here.

Overview of the regional model structure and process

The CMAP trip-based travel demand model has been updated to reflect the travel behavior reported in the My Daily Travel survey. Additionally, the model has been revised to include several modeling procedure improvements and enhancements, which will be discussed in this document. The present CMAP region, for analysis purposes, includes the counties of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will in Illinois, as well as parts of other counties in Illinois, Indiana, and Wisconsin that buffer the region.

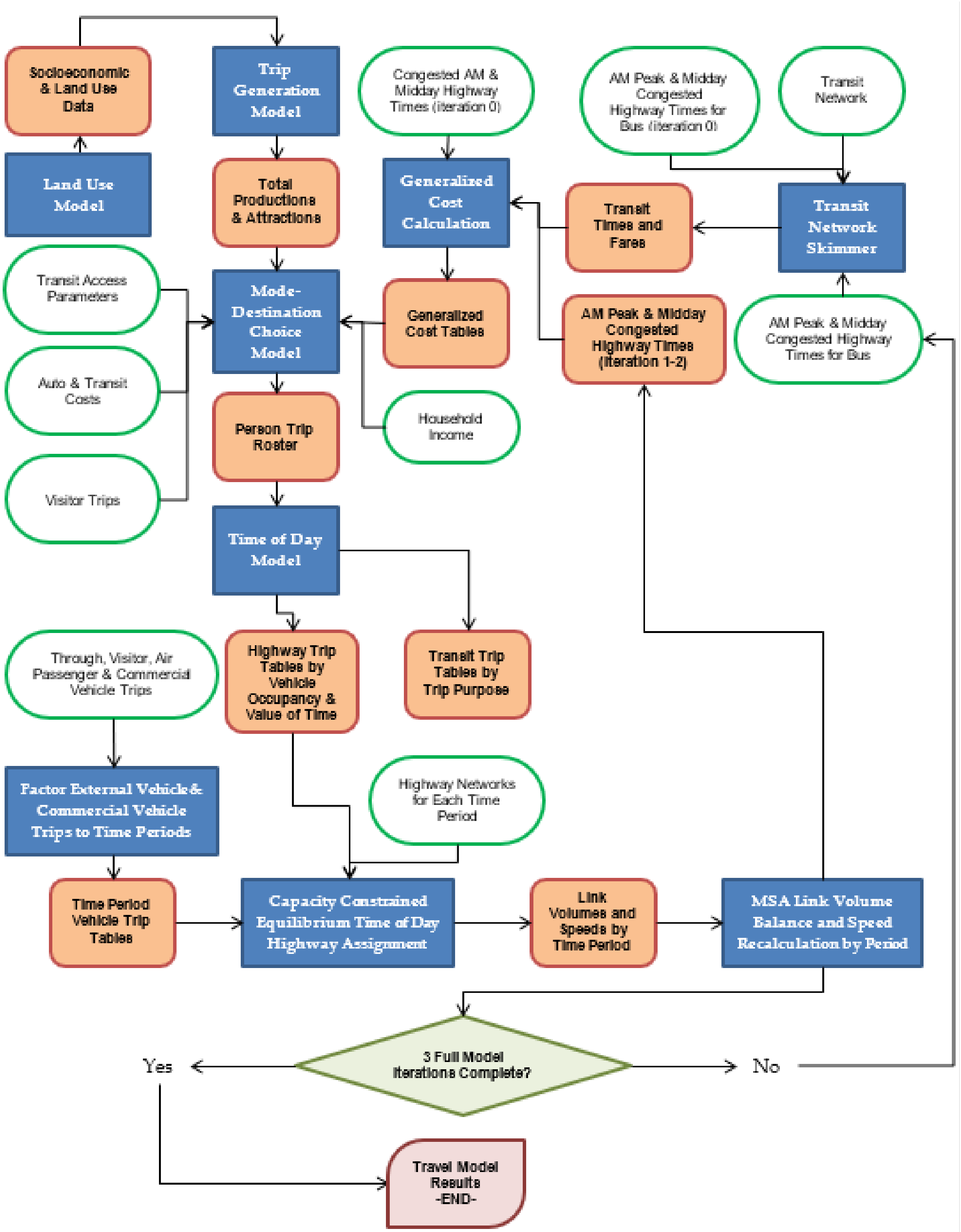
Figure 1 contains a flow chart showing the general steps used in the travel-demand-modeling process. The ovals in the chart represent data inputs that feed model procedures and processes. These model processes are represented by the blue rectangles. The orange rectangles denote data generated by the model processes. In most instances, these also serve as input to subsequent procedures.

Socioeconomic and land use data are supplied to the travel model from the UrbanSim land use model. UrbanSim provides information on the spatial distribution of households, population, and employment throughout the modeling area, which is used to estimate where trips begin and end. UrbanSim provides a synthetic population for the region, which includes a variety of characteristics of both the households and the people who live in them.

Trip generation is the first sequential step in the trip-based model. It is how land use planning/zoning quantities are converted into trip productions (beginnings) and attractions (endings) that serve as measures of transportation demand. The process uses an enumeration of all households in the modeling area and matches them to households from the My Daily Travel survey to develop trips made by household members. For home-based trips, trip ends located at the travelers’ homes are defined as productions, and trip ends located at the non-home end are defined as attractions. A new improvement in the trip generation model is the explicit handling of households with at least one worker working from home. The output of trip generation is a complete set of trip productions and attractions. These are complete lists of trip starting and ending locations, segmented by specific trip purposes, but at this stage the trip ends are unconnected to one another.

The next model in the process is a new joint mode-destination choice model, which simultaneously answers the questions of “where are trips going” (i.e., what are the origin and destination zones for each trip) and “what mode is being used to get there”? This model is implemented as a hierarchical nested logit model. Trips are estimated for five trip purpose categories, including: home-based work trips for residents of low-income households; home-based work trips for residents of high-income households; home-shopping trips; all other home-based trips; and all non-home-based trips.

Figure 1. Modeling process overview



The modal options included in the mode-destination-choice model are greatly expanded from the previous version of the CMAP model. It includes single-occupant vehicles (driving alone), private vehicles with two occupants, private vehicles with at least three occupants, taxis, regular ride hail using a transportation network company (TNC), shared ride hail using a TNC, transit, walking, and biking. Procedures used to estimate auto and transit costs were ported over from the prior version of the CMAP model and retain the use of Monte Carlo simulation, which attempts to decrease the errors inherent in modeling when average values are used. By contrast Monte Carlo simulation allows models to use knowledge of the distribution of attributes and probabilistically select them — a meaningful number of simulations is generally run to minimize variability in the results. Monte Carlo simulation is used to estimate parking costs, the traveler's income, and the access and egress times from the primary transit routes.

Following mode-destination choice, a new time-of-day model is run for auto-based trips to determine which of the eight time-of-day periods modeled by CMAP the trip occurs in. These models are sensitive to road congestion during the course of the day. Additionally, a set of “deadhead” trips is created for taxi and TNC trips. These represent no-fare trips the drivers make between dropping off a passenger and picking up the next one.

The final step of the travel demand procedures is the assignment models. The highway assignment and transit assignment models rely on two different algorithms. The highway assignment model uses the vehicle trips developed from the time-of-day model and a description of the transportation system to estimate the volume of trips on each segment of the road network. For the air quality analysis, the highway assignment procedure is essential for estimating the vehicle miles traveled (VMT) on each highway segment and also estimating the speed of each highway segment. The highway assignment step has two significant features that are important for both transportation and air quality analysis. First, because it is a capacity-constrained equilibrium assignment, the level of service (in terms of travel time) worsens as additional volumes are assigned to each link. Second, the equilibrium procedure solution ensures that simulated travelers are not able to improve their level of service (i.e., travel time) by any alternate routing. For each individual simulated traveler, travel times are optimal to the supply and demand of transportation because the traveler cannot find a shorter route.

The transit assignment model is a multipath procedure that evaluates the potential times and costs of all the transit strategies between an origin and destination, identifies the good strategies, and creates zone-to-zone times and costs. This model is also used to assign person trips to the transit network. The transit assignment model is important because it generates the transit times and costs used by the mode-destination-choice model, while the assignment of trips to transit routes is needed for project studies.

As shown in Figure 1, the steps of mode-destination choice, time-of-day modeling, and time-of-day assignment are iterated through three times (iterations zero through two). Morning peak congested times and distances are used for the work-trip purposes and midday times and distances are used for the nonwork purposes to determine trip destinations and modes. To create these, the link volumes from each full model iteration time-of-day assignment are combined (the step termed “volume balancing and speed recalculation”) with the link volumes from the same period in the previous iterations using the Method of Successive Averages (MSA). For example, the link volumes resulting from the first and second iterations of the time-of-day highway assignment for period three are combined using the MSA procedure, then skimmed to produce the highway travel information input to the generalized cost calculation for the next iteration of the process.

This process is enhanced through the inclusion of iterative feedback involving the transit system. During initial global iteration zero, the transit schedules for morning peak and midday service are used to feed the generalized cost calculation but are overwritten for links where estimated congestion would cause the bus to fall behind its schedule. Buses that operate on roads are obviously impacted by other traffic on the road (and vice versa). Once the congested roadway times are calculated at the end of global iteration zero, they are fed back into the appropriate transit schedules, which are adjusted to reflect the traffic conditions. These updated transit times are then used in the revised generalized cost calculations. Buses that have special operating priorities (such as bus-on-shoulders or traffic signal vehicle pre-emption) are only subject to the congested roadway times for the appropriate segments of their itinerary.

The time-of-day traffic assignment procedure more realistically matches travel demand to network supply and structure as these vary over the course of 24 hours. The time-of-day procedure relies on a multiclass traffic assignment, enabling the conformity emissions analysis to reflect link volumes by specific vehicle type rather than using regional or statewide averages. The traffic assignment also includes consideration of tolling where the separate vehicle classes experience different toll rates and toll rate weights, based on differing values of time for the vehicle classes. Separate assignments estimate highway vehicle-miles and travel speeds for eight time periods during the day:

- The 10--hour late evening-early morning off-peak period (8:00 p.m. to 6:00 a.m.)
- The shoulder hour preceding the morning peak hour (6:00 to 7:00 a.m.)
- The morning peak two hours (7:00 to 9:00 a.m.)
- The shoulder hour following the morning peak hour (9:00 to 10:00 a.m.)
- A four-hour midday period (10:00 a.m. to 2:00 p.m.)
- The two-hour shoulder period preceding the evening peak hour (2:00 to 4:00 p.m.)
- The evening peak two hours (4:00 to 6:00 p.m.)
- The two-hour shoulder period following the evening peak hour (6:00 to 8:00 p.m.)

Results of the separate period assignments are accumulated into daily volumes and tabulated into the vehicle-mile-by-vehicle-type-by-speed-range tables needed for the vehicle emission calculations. The assignment results are also used to support project, program, and policy analyses.

The remainder of this document discusses each component of the trip-based model and describes the various data inputs required to run the model.

Travel model data inputs

A number of data inputs are required to provide the trip-based models with the information necessary to estimate travel patterns. “Demand” side information includes travel surveys to inform the models, as well as socioeconomic data on where people live and work. “Supply” side data include the physical road and transit networks. Different zone systems are used to aggregate data to meaningful geographies. This chapter briefly describes the data used to develop and apply the regional model.

Travel survey data

Travel models are behavioral models of travel choices made by people and require data describing observed travel behavior. These data come from household travel surveys. The original CATS home interview survey was taken in 1956 and consisted of almost 40,000 household interviews. The present set of models was originally developed using a 1970 home interview survey, which obtained the daily travel patterns for over 21,000 households in the region.

In 1979, a much smaller home interview was conducted. This survey was combined with the 1980 Census Journey to Work data and was used to review and modify the agency’s modeling procedures. Between 1988 and 1991, another large-scale home interview survey (over 19,000 households) was conducted. The information from this survey and the 1990 and 2000 censuses have been used to update and modify the travel demand procedures.

Starting in January 2007 and lasting one year, CMAP completed a comprehensive travel and activity survey for northeastern Illinois called “Travel Tracker.” A total of 10,552 households participated in either a one-day or two-day survey, providing a detailed travel inventory for each member of their household on the assigned travel day(s). As a test of available technology, 460 Travel Tracker participants also volunteered to wear global positioning devices (GPS) or to use auto-based devices to track their travel.

Most recently, data collection for the latest regional travel survey called “My Daily Travel” began in summer 2018 and concluded in spring 2019. Nearly 12,400 households participated, logging their detailed travel information for one day.[3] A quarter of these households recorded their itineraries via a GPS-enabled mobile app.

In addition to the home interview surveys, there have been several other data collection efforts, including a 1986 Commercial Vehicle Survey, a 1963 Pedestrian Survey, a 1987 Survey of Parkers in the Chicago Central Business District, and a 1991 Survey of Parking Spaces in the

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[3] As with the Travel Tracker survey, the Northwestern Indiana Regional Planning Commission (NIRPC) conducted the My Daily Travel survey in coordination with CMAP to collect the same data for three counties in northwest Indiana. The CMAP My Daily Travel survey data are available on the CMAP Data Hub.

Chicago Central Business District. All of these surveys have been used to enhance the region's travel demand procedures.

Socioeconomic data

Socioeconomic data used for trip generation estimates are generated by UrbanSim and guided by the regional socioeconomic forecast. UrbanSim is a land use microsimulation model that predicts the activities of individual "agents" (households, employers) over individual parcels and buildings. Several sub-models control the number and distribution of regional household and population including the employment and household transition models, employment and household relocation models, household tenure choice model, and employment and households location choice models. While UrbanSim is used to predict growth patterns from the present to the year 2050, a 2010 base year is used to allow calibration and validation of the model based on observed (post-2010) trends. A synthetic population is developed for 2010, as described in the population synthesis section of this document, and UrbanSim sub-models evolve this population over the years. Controls for the 2010 population come from the "2010 Census SF1 tables H007 – Hispanic or Latino Origin of Householder by Race of Householder"; the "H013 – Household Size"; the "P022 – Household Type by Age of Householder"; and the "ACS 2008-12 tables B23025 - Employment Status for the Population 16 Years and Over and B19001 – Household Income in the Past 12 Months".

Household control totals from the regional socioeconomic forecast are provided to UrbanSim to ensure reasonable household and population outputs for each year after 2010. The regional socioeconomic forecast consists of a demographic model and an economic model. The demographic model provides population projections for 2020-2050 using the cohort-component method. Results are provided at the sub-regional level. There are four sub-regions: the 7-county CMAP region, external Illinois modeling areas, external Indiana modeling areas, and external Wisconsin modeling areas. The ON TO 2050 update employment forecast was prepared by a consultant and reports two-digit NAICS sector employment by county for several scenarios.

More information about UrbanSim and the regional socioeconomic forecast, as well as a discussion of their sources, is available in the Socioeconomic Forecast Appendix.

A few additional pieces of information are needed by the travel demand model, including:

Regional Median Income: To obtain an accurate estimate of median household income for the 21-county modeling area, the 2014-2018 ACS Public Use Microdata Sample (PUMS) was used, as it provides exact incomes for every surveyed household. Since the Public Use Microdata Areas (PUMAs) cannot perfectly represent the 21 counties in the modeling area, the closest possible approximation (which includes all of LaSalle County, but none of Lee or Ogle) was used. The PUMS incomes (in 2018 dollars) were inflation-adjusted to 2019 dollars using the Bureau of Labor Statistics' Consumer Price Index (All Goods). Using this technique, the 2014-2018 regional median income was estimated to be $68,300 (in 2019 dollars).

Private Vehicle Occupancy Rate of All Worker Trips to Work: This is the ratio between the number of workers traveling to work in a zone (all workers, not just those in households) who commute by auto (single-occupant vehicles and carpool) divided by the number of vehicles used for those trips. Estimates of modeling area resident worker flows at the census tract level were taken from the 2012-2016 CTPP—table A302103, Means of transportation (18) (Workers 16 years and over). For each flow, workers were summed across auto modes and number of vehicles was calculated as vehicles = sov + (hov2/2) + (hov3/3) + (hov4/4) + (hov5_or_6/5.5) + (hov7_or_more/7.1). Workers and vehicles were allocated to zones using the workplace tract and average vehicle occupancy to each workplace zone was calculated as stated above.

Group Quarters population: The travel model requires information on residents of non-institutionalized group quarters, namely persons in military barracks, in college or university dormitories, and in other group quarters. These data are based on the 2020 Census SF-1 block-level table P5, "Group Quarters Population By Major Group Quarters Type." At the time of computation, combined Group Quarter population totals were not available by age breakouts at the block-level. The 2010 Census age distributions were used to generate age breakouts by creating a 2010 block group file with proportions each age group. Block-level populations were geocoded to subzones using block centroids. Base-year (2019) estimates by subzone are based on each subzone's share of the 2010 total for each Group Quarters type, excluding Dorm Group Quarters population, and are scaled to match 2019 regional estimates provided by the regional socioeconomic forecast. Dormitory Group Quarter data are also based on 2020 Census SF-1 block-level table P5, "Group Quarters Population By Major Group Quarters Type." Since these data do not require age breakouts, the census data were used directly. Three rates were calculated for each sub-region using 2020 Census data: the percentage of the total population that lives in group quarters, the percentage of group quarters population that are non-institutionalized, and the percentage of non-institutionalized group quarter population that live in dorms. These rates were applied to the total population by sub-region from the regional socioeconomic forecast to determine dormitory population totals by sub-region and growth rates across the forecast period. Growth rates for each sub-region were applied to base-year dormitory population in subzones within the respective region for the forecasting period.

Highway network

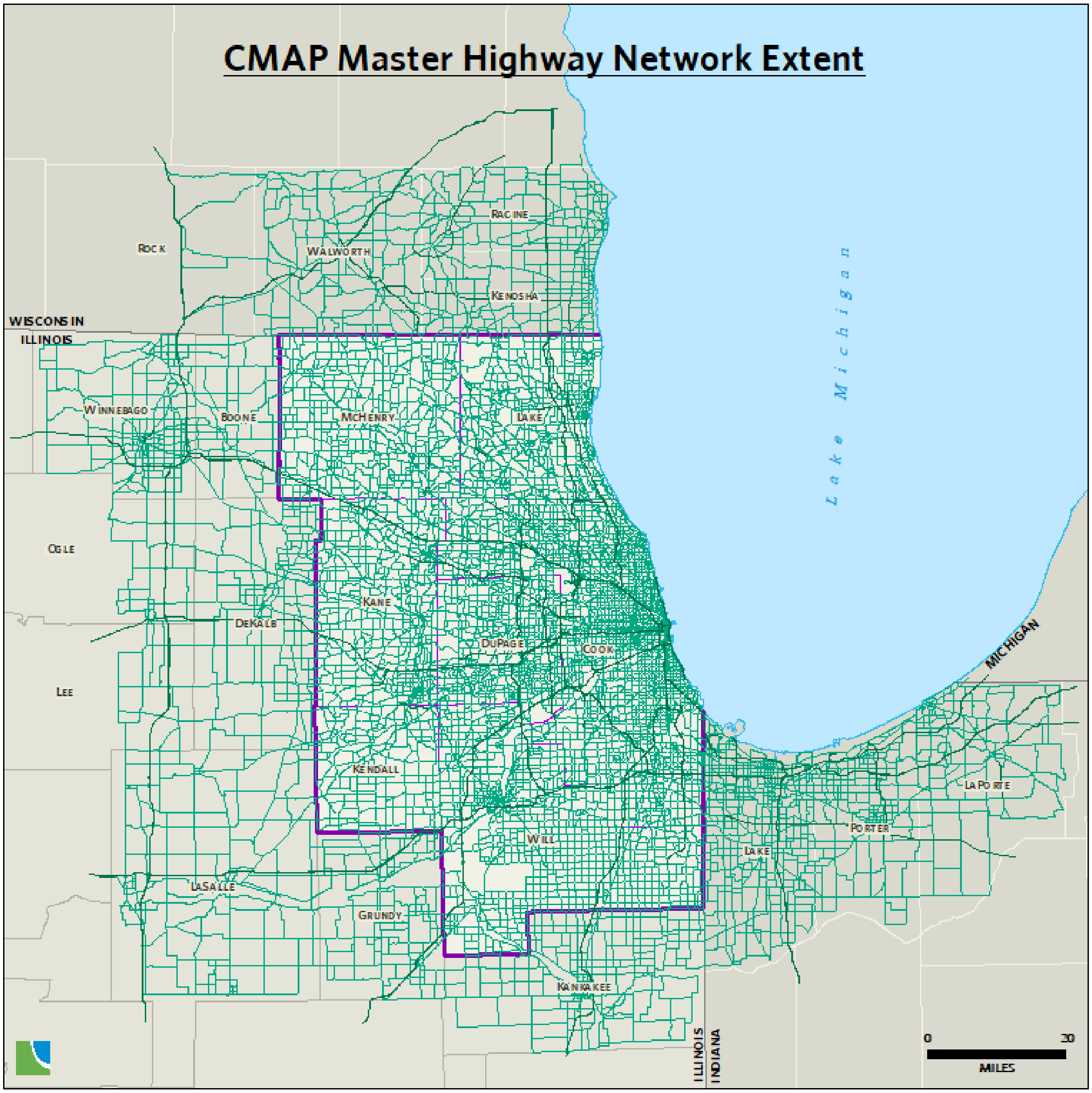
The Master Highway Network (MHN) is the official road network database used to develop travel demand model networks at CMAP. The MHN includes roads within northeastern Illinois that have a functional classification of "Minor Collector" or higher. In certain instances, additional local roads have been included in the MHN to provide connectivity within the network.

The MHN covers an area of more than 10,000 square miles and extends into northwestern Indiana and southeastern Wisconsin, as shown in **Figure 2**. The MHN includes roads for the following areas:

- Illinois: 12 full counties (Boone, Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, Will, and Winnebago) and three partial counties (LaSalle, Lee, and Ogle)
- Indiana: Three full counties (Lake, LaPorte, and Porter – corresponding to the Northwestern Indiana Regional Planning Commission’s planning area)
- Wisconsin: Three full counties (Kenosha, Racine, and Walworth – the southern portion of the Southeastern Wisconsin Region Planning Commission’s planning area) plus additional minimal road network extending into two other counties (Milwaukee and Rock)

The MHN is a collection of links and nodes representing road segments and intersections throughout the region. It contains information on more than 57,400 directional road segments and includes more than 21,200 nodes. The MHN is a comprehensive database for CMAP’s regional travel demand modeling needs. It contains not only existing road segments and intersections, but also future planned facilities and improvements. The MHN itself is edited and maintained using ESRI’s ArcGIS Geographic Information System (GIS) software. The MHN has a current base year of 2015, meaning that the road attributes on existing facilities represent the “on-the-ground” conditions from that year. It is a relational database (specifically, an ESRI file geodatabase) that maintains spatial and topologic relationships between features classes. The feature classes that define the road network in the MHN are arcs (also called links) and nodes. The projection of the data is State Plane Coordinate System, Illinois East zone, North American Datum of 1927. The unit of length is the U.S. survey foot.

Figure 2. CMAP Master Highway Network



Network arc-node topology

MHN arcs represent road segments located between intersections. Most arcs in the MHN are digitized as bidirectional links with the appropriate direction-specific attributes coded to the link. Expressways are digitized as a set of parallel single-direction links to replicate their limited-access characteristics.

Table 1 lists the highway network link variables contained in the arc attribute table that are relevant to CMAP's production modeling work. The attribute table also contains additional information not currently used for modeling purposes. As most links in the network represent bidirectional road segments, attributes must be included for each direction. Variable names ending in "1" describe attributes in the anode-bnode direction of the link (this is the "from-to" direction of a link that is recognized by GIS software based on how the link was digitized). Those variable names ending in "2" represent attributes in the opposite direction. The directions variable indicates whether a link is a single or bidirectional segment and has three possible values, which determines how link attributes are coded:

1. The link represents a single direction of travel. No second direction variables are coded (i.e., they equal 0).
2. The link represents both directions of travel and all attributes are the same in both directions. No second direction variables require coding (except applicable parking restrictions).
3. The link represents both directions of travel and at least one attribute differs between the two directions. All second direction variables require explicit coding.

The baselink variable identifies whether a segment represents an existing facility (value of one) or a future facility (value of zero, referred to as skeleton links). If baselink=0, only anode, bnode, miles and directions are coded on highway links. All other link attributes are fairly straightforward in their definition. Each link in the MHN is identified by a unique anode-bnode-baselink combination (variable *ABB*).

Table 1. Master Highway Network link attributes

Variable	Description
ANODE	Links "from" node.
BNODE	Links "to" node.
BASELINK	Link description flag: 0 = future project link ("skeleton" link), attributes added via highway project coding 1 = existing network link ("base" link), all attributes present
ABB	Unique arc ID, of the form "*ANODE-BNODE-BASELINK*".
MILES	Link length in miles.
TYPE1 & 2	Facility Type: 1=Arterial 2=Freeway (controlled-access) 3=Freeway-Arterial Ramp 4=Expressway (limited-access) 5=Freeway-Freeway Ramp 6=Centroid Connector 7=Toll Plaza 8=Metered Ramp
TOLLDOLLARS	Toll amount in dollars for autos with I-PASS. If link type is 7 (toll plaza), this is applied as a fixed-cost toll; for other link types, it is applied as a per-mile rate.
AMPM1 & 2	Time period restrictions: 1=open all time periods (1-8) 2=open a.m. periods (2-5) only, e.g. Kennedy reversible lanes inbound 3=open p.m. periods (1, 6-8) only, e.g. Kennedy reversible lanes outbound 4=open off-peak periods (1, 5) only
SIGIC	Signal interconnect flag: 0=no, 1=yes
POSTEDSPEED1 & 2	Posted speed limit (mph).
THRULANES1 & 2	Number of driving lanes. [This represents the most-restrictive capacity on the link, i.e. the fewest number of lanes present at any single point.]
PARKLANES1 & 2	Number of on-street parking lanes.
PARKRES1 & 2	Peak period parking restrictions, when on-street parking is not available and an extra through lane is available. *Coded separately for each direction on all 2-way links.* Code is text string of affected time periods (currently only 3 & 7). Default blank value means no peak period parking restrictions.
THRULANEWIDTH1 & 2	Average driving lane width (feet).
DIRECTIONS	Link directions flag: 1=one way 2=two way, attributes in both directions identical 3=two way, at least one attribute different in opposing direction
MODES	Modes permitted on link: 1=all vehicles 2=all vehicles (with truck restrictions from *TRUCKRES* applied) 3=trucks only 4=transit only (only called for transit networks) 5=HOV only
TRUCKRES	Detailed truck restriction codes, which translate into the following model coding: No restriction known/codeable: 0, 6, 15, 20, 22-24, 26, 28, 32, 33, or 36 No trucks: 1 or 18; also, 21 in time period 1 only No trucks except B-plates: 2-4, 9-11, 13, 25, 35, or 37; also, 12 in time period 1 only

	No medium or heavy trucks: 7, 8, 14, 16, 17, 19, 27, 29, 31, 34, 38-47, or 49 No heavy trucks: 5, 30, 45, 48
VCLEARANCE	Vertical clearance (inches). The following mode restrictions are applied for non-zero values: Clearance < 162”: no heavy trucks Clearance < 150”: no medium/heavy trucks Clearance < 138”: no light/medium/heavy trucks

Nodes in the MHN represent intersections between roads or junctions where road segments converge/diverge, such as an entrance ramp merging into an expressway through lane. The arc-node topology enforced in the MHN is that nodes represent the end points of arcs and arcs with common end points are connected. CMAP’s modeling staff maintains a set of scripts that automatically update highway network topology after edits have been made and populate several attribute fields. These scripts (along with various other MHN processing scripts) are maintained in a publicly accessible GitHub repository at github.com/cmap-repos/mhn_programs.

Node attribute variables are listed in **Table 2**. These mostly serve to define the network arcs by providing values for *anode* and *bnode*. Values for the entire set of node variables listed are automatically populated through scripting. All node attributes are automatically populated by the scripts.

Table 2. Master Highway Network node variables

Variable	Description
NODE	CMAP network node ID.
POINT_X	Auto-generated x-coordinate (NAD27 IL East State Plane feet).
POINT_Y	Auto-generated y-coordinate (NAD27 IL East State Plane feet).
SUBZONE17	Subzone ID from current CMAP modeling subzone system.
ZONE17	Zone ID from current CMAP modeling zone system.
CAPZONE17	2017 Capacity Zone code: 1=Chicago Central Business District (2009 subzones 1-47) 2=Remainder of Chicago Central Area (2009 subzones 48-80) 3=Remainder of City of Chicago (2009 subzones 81-976) 4=Inner ring suburbs where Chicago street grid is generally maintained 5=Remainder of Illinois portion of the Chicago Urbanized Area 6=Indiana portion of the Chicago Urbanized Area 7= Other Urbanized Areas and Urban Clusters within the CMAP Metropolitan Planning Area plus other Urbanized Areas in northeastern Illinois 8=Other Urbanized Areas and Urban Clusters in northwestern Indiana 9=Remainder of CMAP Metropolitan Planning Area 10=Remainder of Lake County, IN (rural) 11=External area 99=Points of Entry – not defined in the Capacity Zone system
IMAREA	Illinois Vehicle Inspection and Maintenance Program area flag: 0=no, 1=yes

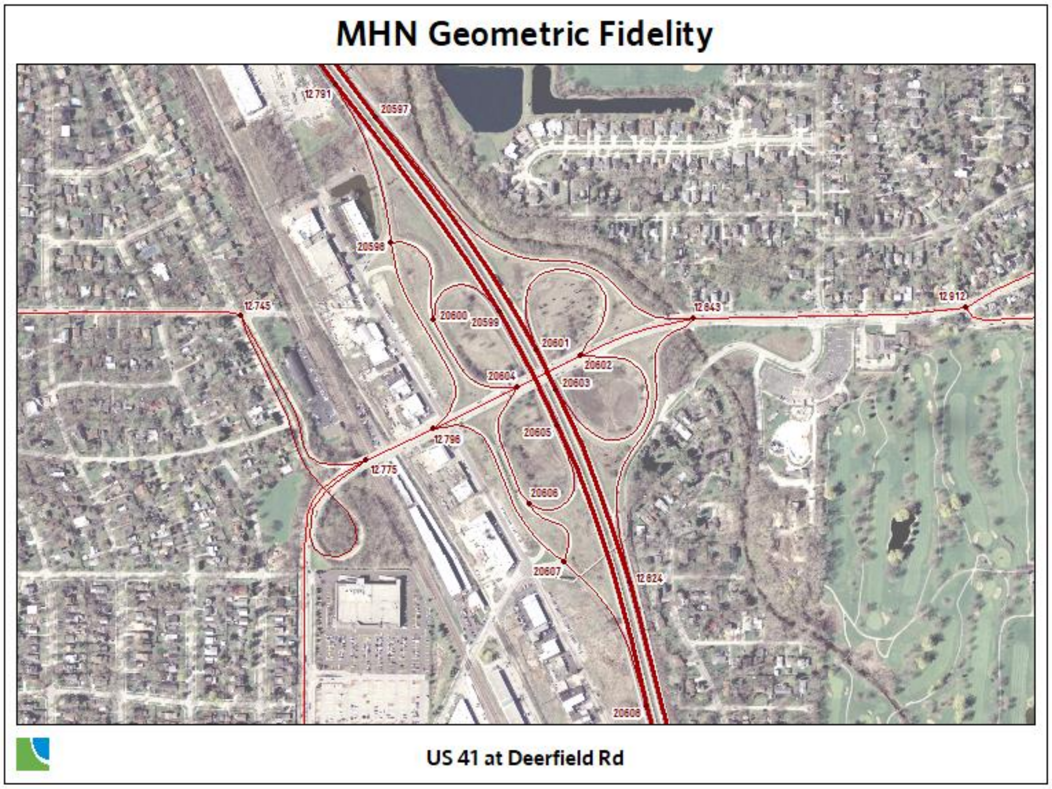
Spatial and geometric accuracy

CMAP ensures the MHN is spatially and geometrically accurate with respect to:

- Geocoding intersections to spatially accurate locations
- Applying vertex coordinates to links to replicate road geometry
- Ensuring expressway interchanges are fully expanded to include ramps representing all possible traffic movements

Figure 3 illustrates the network accuracy for one interchange in the MHN.

Figure 3. Master Highway Network accuracy



Highway project coding

The MHN includes links serving as placeholders for future planned facilities, identified by *baselink*=0. The Northeastern Illinois Transportation Improvement Program (TIP) database is the repository of project information for planned and programmed projects. Relying solely on the TIP database for project information provides a single direct link for reconciling model network coding with the planned improvement.

The MHN geodatabase stores highway project coding in a table containing detailed attributes and a line feature class containing the project ID, completion year and geographic extent. A group of network links is selected by their unique *ABB* values to define an individual highway project. The highway project line feature class contains summary information for each project, as shown in **Table 3**. Each project is represented by a single, multi-part line feature, which is automatically generated based on the links referenced in the detailed coding table. This data structure allows a single highway project to be associated with numerous MHN arcs and, by extension, allows a single MHN arc to be associated with multiple highway projects. The result is the project coding table contains one record for every arc referenced by every highway project.

Table 3. Master Highway Network highway project line feature class attributes

Variable	Description
TIPID	TIP project identification number.
COMPLETION_YEAR	Project completion year from TIP. Inactive projects have a value of 9999.

The project coding table is used to store link attributes that will be updated or applied when the associated highway projects are completed. An action code determines how the attributes for each link are processed. The list of section table variables, shown in **Table 4**, most directly correspond to MHN arc attributes. As with the arc attribute table, variables ending in "1" apply to the "from-to" direction of the link, while those ending in "2" apply to the "to-from" direction. During network processing, data from the arc attribute table are updated (overwritten) on the fly with project coding table entries to represent conditions after the project is implemented. Only those attributes changing due to project implementation are coded in the section table.

Project coding rules for parking lanes are slightly different than for other variables. The values for this attribute are added to (or subtracted from) arc table coding to yield the final result. This allows for these attributes to be increased, decreased, or removed. This is necessary because there is no practical way to determine whether a zero in the section table represents no change in conditions or the removal of this attribute.

Four action codes control the link processing. Action code 1 modifies the coded attributes on links with existing attributes. Action code 4 is applied to new links (skeleton links), which have no attributes except *miles* and *directions*. Action code 2 is used when new links replace an old link without any change in its attributes, such as when a new intersection is introduced into the network. This action code requires to fill in the *replace_anode* and *replace_bnode*. These represent the nodes of the link where the attributes will be drawn from. Action code 3 deletes a link from the network.

Table 4. Master Highway Network highway project coding table fields

Variable	Description
TIPID	TIP project identification number.
ABB	Reference to unique arc ID, of the form "*ANODE-BNODE-BASELINK*".
ACTION_CODE	CMAP action code: 1=modify (change an existing network link)

	2=replace (replace an existing link with a new one but retain all attributes) 3=delete (remove a link from the network) 4=add (add a new link to the network)
NEW_TYPE1 & 2	New facility type number.
ADD_SIGIC	Add signal interconnect to link (code=1).
NEW_THRULANEWIDTH1 & 2	New average driving lane width (feet).
NEW_THRULANES1 & 2	New number of driving lanes.
NEW_POSTEDSPEED1 & 2	New speed limit (mph).
REP_ANODE REP_BNODE	*ANODE* and *BNODE* of MHN link providing attributes, ONLY for action_code=2.
NEW_TOLLDOLLARS	New I-PASS toll amount for autos (dollars). If link type is 7 (toll plaza), this is applied as a fixed-cost toll; for other link types, it is applied as a per-mile rate.
NEW_DIRECTIONS	New directions flag.
ADD_PARKLANES1 & 2	Add/remove parking lanes, coded number will be added to number in MHN arc attributes to calculate final lanes (code positive to add, negative to remove).
NEW_AMPM1 & 2	New time period restrictions.
NEW_MODES	New modes permitted.
TOD	Time-of-day code indicating specific time periods when changes are applied. Default of blank or 0 means changes applied to all periods. Code is text string of affected time periods: 1=8 p.m. – 6 a.m. (overnight) 2=6 a.m. – 7 a.m. 3=7 a.m. – 9 a.m. (AM peak) 4=9 a.m. – 10 a.m. 5=10 a.m. – 2 p.m. (midday) 6=2 p.m. – 4 p.m. 7=4 p.m. – 6 p.m. (PM peak) 8=6 p.m. – 8 p.m.

Storing the existing and future highway network components in a single database allows the analyst to ensure project and base network information reconciliation is handled comprehensively with all of the analysis networks for a particular application, at one step, existing in a single dataset. Storing the MHN in a GIS format also greatly simplifies project-coding tasks. The MHN structure allows for:

- Analysis into multiple future years: Assignable networks are produced that maintain consistent project coding into future years (e.g., a project that is built in an earlier year will be included in all subsequent networks).

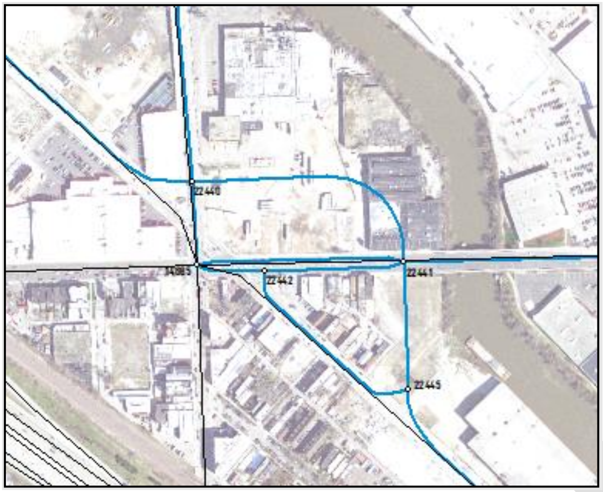
- Analysis across multiple scenarios: Assignable networks are produced that maintain consistent project coding between differing analysis scenarios (e.g., a project that is included in one land use scenario will be identically coded in any other appropriate scenario).

This topology was in direct response to the types of comparative evaluations that were necessary under the air quality conformity baseline/action rules. With approval of a state implementation plan budget, conformity analysis no longer entails a baseline/action test, so a simpler hierarchy is used. Nonetheless, this ability is useful within any forecasting exercise where multiple time frames and scenarios are compared (e.g. land use/transportation interactions).

A list of modeled project TIP identification numbers and the year that they are to be constructed is all that is required to create a set of highway network files for the travel demand modeling software (Emme®). The completion year is attached to each project and stored in the highway project line feature class. As complete project coding information exists in the feature class and associated coding table, simple database queries can select only those records needed to prepare the desired analysis year network. A set of scripts written in Python and SAS® process all the project coding information, apply the attribute updates to the set of links comprising the scenario network, and create a set of time-of-day link and node attribute files suitable for import into Emme®. **Figure 4** illustrates this process.

Figure 4. Highway network coding example

MHN Network

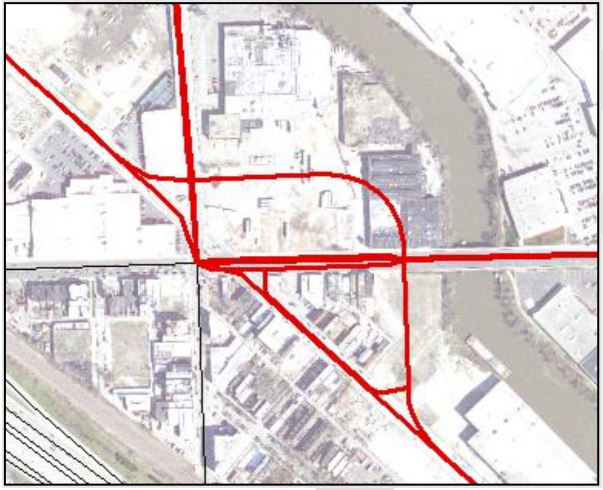


Step 1.
All existing road facilities (black) and a planned realignment (blue) are coded into the MHN. The project will reroute the diagonal road northeast of the current six-way intersection and convert part of it to a service road.

Emme Network – Base Year Scenario

Step 2.
An Emme base year scenario network is created. Since the road realignment has not yet happened, it is not reflected in the model network.

MHN Network Project Coding



Step 3.
All links impacted by the project are associated with the project ID through a route system (red). The link coding contained in the route system's section table serves as a set of instructions on how to process each link. The coding identifies which links associated with this project to: (1) modify the characteristics of, (2) replace existing links, (3) delete from the network, and (4) add as new links.

Emme Network – Future Year Scenario

Step 4.
A future scenario modeling network includes the realigned road and new intersections. Since this particular project was actually completed in 2018, it is displayed with current imagery showing the final result.

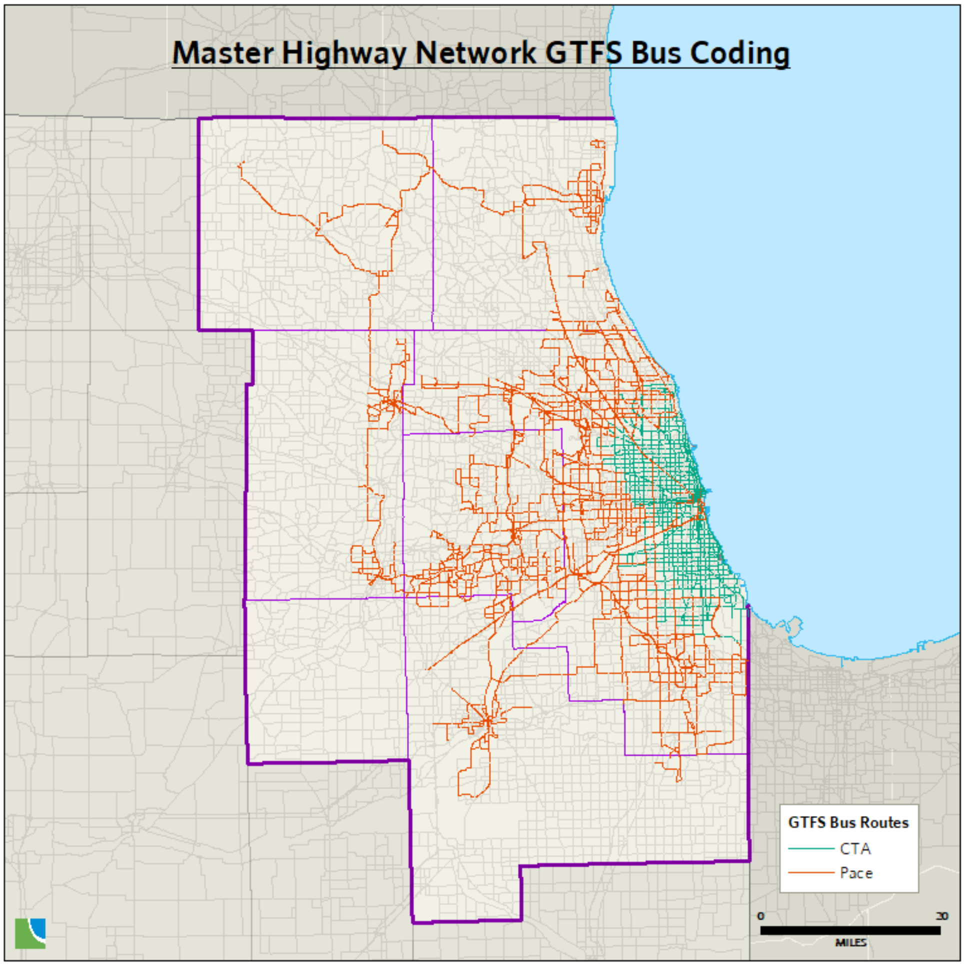
Bus route coding

The northeastern Illinois region has one of the most extensive public transportation systems in North America. Bus and rail service is provided by three public operating agencies, including the Chicago Transit Authority (CTA), Metra commuter rail, and Pace suburban bus. Each of the three agencies has its own board, management, and operating personnel. The agencies' service areas overlap to varying degrees and many riders' trips involve transfers between services provided by different operators.

The CTA operates bus service within Chicago and several adjacent suburbs. Pace operates nearly exclusively in the suburbs, with some express service to downtown Chicago. Pace operates regular bus routes, feeder buses that provide connections to suburban Metra commuter rail and CTA rail stations, and all paratransit service in the region, as well as a vanpool program and some long-distance express buses. Bus route coding maintained in the model networks includes publicly-operated, fixed-route service. It does not include vanpools, paratransit, or subscription service.

Existing bus service coding is maintained as two separate pairings of a route feature class and an itinerary table within the MHN — similar to the highway project coding structure. One pairing is for the base network, based on route data from 2015. Another is based on more current route data (currently 2016), which forms the basis for most future model networks. The data structure ensures bus coding always reconciles with the underlying highway network arcs. Bus routes are forced to conform to the available MHN links. If a particular route uses local streets that are not included in the MHN, the coding for the route is altered accordingly so that it only uses MHN links. **Figure 5** shows the extent of the region's bus service.

Figure 5. MHN General Transit Feed Specification-Based Base Bus Coding, 2015



Bus coding in the MHN includes the complete itinerary (or node-by-node path) of the bus route and attributes associated with each itinerary segment. Bus routes are coded as single-direction runs. CMAP bus coding is derived from General Transit Feed Specification (GTFS) data files created by the transit operators. The GTFS files contain data on all runs of every bus during the entire week. As CMAP models weekday traffic, the bus coding data from the GTFS files are limited to a representative weekday (Wednesday).

Conversion of the GTFS data from its raw form into usable bus coding proceeds through the following steps:

- Geographic data are stored in MySQL. Python scripting is used to identify a group of potential MHN nodes that corresponds to each of the bus stop locations contained in the data files.

- Using a set of rules, a MySQL query determines which stop(s) is assigned to specific MHN nodes. Bus run data are then reformatted into itineraries, which include departure and arrival times at each itinerary stop, calculated from the GTFS time associated with each stop. At this stage, the itineraries are somewhat independent of the MHN network. While they are constructed using MHN nodes, there is no guarantee the itinerary segments formed correspond to actual network links, as defined by a specific anode-bnode combination. This is true because a particular bus may not stop at a consecutive set of connected nodes within the network, especially if it is express service.

- Reconciliation with the network arcs is accomplished through a set of SAS and Python scripts. In instances where the segments do not align with a network arc, a shortest path algorithm is used to link the itinerary segment nodes together by building a useable path on the network. The segment attributes are then apportioned over the new sections appropriately and they are inserted into the bus route itinerary. Additional logical tests are performed and faulty data (such as an itinerary segment with the same node at both ends or a route with an initial departure time equal to the final arrival time) are corrected using a set of rules. The result is a set of itineraries with all segments corresponding to MHN links. Automated procedures ensure logical coding is developed. For instance, coded buses are not allowed to travel the wrong direction on a one-way link.

- The bus route and itinerary data are then imported into the MHN geodatabase by a Python script that automatically generates the line features representing each run from the underlying arcs.

As with the highway project coding, bus-run details are stored in a set of related itinerary tables. These tables relate to the arc table in the same manner as the highway project coding tables. The bus-run-line features and itinerary tables are linked through the *transit_line* variable, which is a unique identifier given to each bus run.

Table 5 highlights the data fields maintained in the MHN that are used to describe bus route attributes. The variables shaded in blue correspond to header information Emme requires when reading in bus itineraries. Other attributes are merely informational. Note that at this point the *headway* value only represents the total minutes in the time-of-day period within which the bus run occurs. The actual bus service headway is calculated at a later stage, when individual runs are grouped into representative runs.

Table 5. Master Highway Network base and current bus run feature class attributes

Variable	Description
TRANSIT_LINE	Unique CMAP bus run identifier. (Mode + 5-digit number, starting at 00000 for base, 50000 for current.)
DESCRIPTION	Real-world description of bus route (format: "*ROUTE_ID LONGNAME*: *DIRECTION* TO *TERMINAL*").
MODE	Bus mode code: B=CTA regular service Q=Pace express service E=CTA express service L=Pace local service P=Pace regular service
VEHICLE_TYPE	Bus vehicle type code (based on mode code): 25-27=mode B 29=mode Q 31-33=mode E 30=mode L 28=mode P
HEADWAY	Length of the time-of-day period (in minutes) within which the bus run falls, since every run is represented individually.
SPEED	Average bus route speed in MPH from GTFS data; minimum value of 15 allowed. [Not used in CMAP modeling but a non-zero value is required by Emme.]
FEEDLINE	Unique GTFS identifier for each run.
ROUTE_ID	Number of bus in route name (e.g. 52A, 112, X98).
LONGNAME	Proper name of bus in route name (e.g. Wentworth, Halsted/95th).
DIRECTION	Predominant direction of travel for bus run.
TERMINAL	Location of final stop on bus run.
START	Start time of bus run in seconds.
STARTHOUR	Start hour of bus run.

The actual itinerary information for bus routes is contained in the itinerary table variables, which are listed in **Table 7**. The itinerary provides the node-by-node path on the MHN that the bus follows. Again, most of these variables reflect information Emme expects to receive when bus routes are imported.

Two GTFS-based bus coding route systems exist simultaneously in the MHN database:

- Bus_base: GTFS–based coding that corresponds to CMAP’s model base year of 2015 (reflecting service at that time).

- Bus_current: Coding built from the most recent GTFS data files. This represents up-to-date coding and is used as the basis for future modeling scenarios.

Each of the bus route systems listed above contains over 25,000 bus runs comprising roughly 750,000 itinerary segments, representing one weekday of service. For purposes of modeling travel demand, the bus runs are combined into representative bus routes. A script analyzes the runs of each bus route that occur during a time-of-day period and uses the stopping pattern to determine which are similar enough to be collapsed into a “typical” directional bus route. The start times of all the individual runs that are associated with a representative bus route are used to calculate the service headway that goes into the travel demand model.

Table 6. Master Highway Network base and current bus itinerary table fields

Variable	Description
TRANSIT_LINE	Unique CMAP bus run identifier. (Mode + 5-digit number, starting at 00000 for base, 50000 for current.)
ITIN_A	CMAP node number bus travels from.
ITIN_B	CMAP node number bus travels to.
ABB	Unique ID of the segment's corresponding MHN arc.
ITIN_ORDER	Order number of bus segment in itinerary, sequentially increasing from 1 for each run.
LAYOVER	Layover time in minutes applied to *ITIN_B*. Default=3.
DWELL_CODE	Code for stops (corresponding Emme code), applied to *ITIN_B*: 0=stop allowed (default time of 0.01 minutes) 1=no stop (#) *available for future use:* *2=alighting only (>)* *3=boarding only (<)* *4=boarding & alighting allowed (+)* *5=dwell time factor (*)*
ZONE_FARE	Incremental zone fare in cents.
LINE_SERV_TIME	Itinerary segment travel time in minutes.
TTF	Emme transit time function code: 0,1=1 2=2 (used for Bus Rapid Transit/Arterial Rapid Transit only)
DEP_TIME	Time departing node *ITIN_A* (seconds since midnight).
ARR_TIME	Time arriving at node *ITIN_B* (seconds since midnight).
LINK_STOPS	Number of stop locations from GTFS data that were combined into itinerary segment.
IMPUTED	Flag indicating segment was imputed by shortest path algorithm during import. 0=not applicable. 1=itinerary segment created by shortest path algorithm. 2=segment modified by logic to condense unreasonable vacillation in itinerary.

Table 7 lists the eight time-of-day (TOD) modeling periods used by CMAP for traffic assignment. It also includes the selection rules used to determine which TOD period a particular bus run falls in, and it shows the number of representative bus routes (from **bus_current**) used in the travel demand model. This information is used to provide background bus volumes on roadway links during traffic assignment.

For purposes of transit assignment, only four TOD periods are used: 1=Overnight/Early AM (6 p.m. – 6 a.m.), 2=AM Peak (6 a.m. – 9 a.m.), 3=Midday (9 a.m. – 4 p.m.) and 4=PM Peak (4 p.m. – 6 p.m.). The AM Peak and Midday periods in this scheme are used to generate the transit level-of-service variables used to develop zonal generalized costs for the destination-mode choice model.

Table 7. Time-of-day base bus routes

Time Period	Selection Rule	Number of Bus Routes
1 – (8 p.m. – 6 a.m.)	*Starthour* >=20 or *Starthour* <=5	606
2 – (6 a.m. – 7 a.m.)	*Starthour* =6	631
3 – (7 a.m. – 9 a.m.)	7<= *Starthour* <=8	698
4 – (9 a.m. – 10 a.m.)	*Starthour* =9	497
5 – (10 a.m. – 2 p.m.)	10<= *Starthour* <=13	503
6 – (2 p.m. – 4 p.m.)	14<= *Starthour* <=15	645
7 – (4 p.m.– 6 p.m.)	16<= *Starthour* <=17	653
8 – (6 p.m. – 8 p.m.)	18<= *Starthour* <=19	563

Future bus coding

While the GTFS data provide for existing bus service, future bus routes also are coded in the MHN to represent planned or programmed service. Consistent with GTFS bus runs, future bus routes are generally coded as single-direction service. While GTFS routes are coded on existing network links (*baselink*=1), future routes are coded to run on future highway network links (i.e., links that will be in the network in the horizon year of the projects being modeled). Thus, it is convenient to have the highway project coding information stored in the same database as the bus coding.

Table 8 lists the future bus route information stored in the line-feature-classes-attribute table. Many of these variables provide the bus route information Emme requires to build transit routes and have the same definition as in the GTFS-based bus coding table. The notes field is used to store TIP project numbers or other useful information related to future bus service. The following variables provide instructions on how the future routes are processed:

- Scenario: Identifies all of the specific modeling scenarios that individual bus routes should be included in
- Replace: Identifies the existing GTFS route(s) that will be replaced by the future route coding, if any
- Reroute: Identifies the existing GTFS route(s) that will be modified by the future route coding, if any
- TOD: Indicates which time-of-day networks will include the future bus service

Table 8. MHN Future Bus Route Attributes

Variable	Description
TRANSIT_LINE	Unique CMAP bus route identifier. (Mode + 5-digit number, starting at 99000 for future.)
DESCRIPTION	Real-world description of bus route.
MODE	Bus mode code.
VEHICLE_TYPE	Bus vehicle type code.
HEADWAY	Average bus headway for Peak periods (TOD 3/7/AM) in minutes. This coded value will only be applied during those periods. *A value of zero indicates that the headway for the existing route coding from route flagged in REPLACE will be used (i.e., there will be no change in service frequency).*
SPEED	Average bus route speed in MPH; default value of 12 used. [Not used in CMAP modeling but a non-zero value is required by Emme.]
SCENARIO	Future scenarios bus line will be used in. Must include ALL scenarios that will contain route. May NOT be blank
REPLACE	Identifier of the existing bus route coding that will be replaced by the future project. A blank indicates the future route is not replacing existing routes. Constructed as: Uppercase mode letter + "-" + route number. If multiple existing routes are being replaced by the same future route, separate the affected route numbers with colons. *Note: the replacement will only occur in the time periods identified in the TOD field.*
REROUTE	Identifier of the existing bus route coding that will be modified by the future project. A blank indicates the future route coding is not modifying existing routes. Constructed as: Uppercase mode letter + "-" + route number. If multiple existing routes are being modified by the same future route, separate the affected route numbers with colons. *Note: the replacement will only occur in the time periods identified in the TOD field.*
TOD	Transit assignment time-of-day periods when the new coding will be implemented. As with SCENARIO, all applicable time periods must be listed. *A value of zero indicates that the new coding will be applied to all time periods.*
NOTES	TIP ID number (and possibly other descriptive information). Entries must be separated by colons. 30 character limit.

As with the highway project coding, CMAP modeling staff maintain a set of scripts that generate scenario-specific TOD transit network input files for the travel demand model. While processing of the base/current year bus routes is relatively straight-forward, the future bus routes require additional logic to process all changes correctly. The following rules are used to generate future scenario TOD transit network input files:

1. New routes only appear in the specific time periods identified in the TOD field, or in all periods if TOD=0.

2. The replace field identifies current bus routes that will be replaced by the future coding for the time periods in TOD. These current routes are deleted from the network. The routes are identified by the letter Mode code and the Route_id from the route table.

3. The reroute field identifies current bus routes that will be modified by the future coding for the time periods in TOD. These current route itineraries are replaced with the future itinerary coding between the start and end points of the future itinerary coding. All

other information for the modified routes remains the same. The routes are identified by the letter Mode code and the Route_id from the route table.

4. Several potential values are used to determine future headways:
    a. Coded headway: This is the headway coded for future bus routes. It applies only to AM and PM peak time periods.
    b. Factored headway: the value is Coded headway (if it's greater than zero) times a TOD multiplier [3 for period 3; 4 for period 1].
    c. Replaced headway: The TOD headways for the bus routes being replaced by future service (this value is calculated when the bus runs are collapsed into representative routes). To avoid having to apply directional headways to the future service, this value is the minimum of the current directional headways.
    d. Mode headway: The average headway for a time period for a given bus mode (B,E,P,L,Q) based on the existing bus routes, excluding those being replaced
    e. Last chance headway: A final future headway value if all other options fail; set to 90 minutes

The logic used to determine the final TOD future headway for each future route is:

- Priority 1: If Replaced headway is nonzero and is less than Factored headway, use Replaced headway. If that does not apply, go to Priority 2.
- Priority 2: If Factored headway is nonzero, use Factored headway. If that does not apply, go to Priority 3.
- Priority 3: The future headway is the maximum of [Mode headway, Last chance headway]

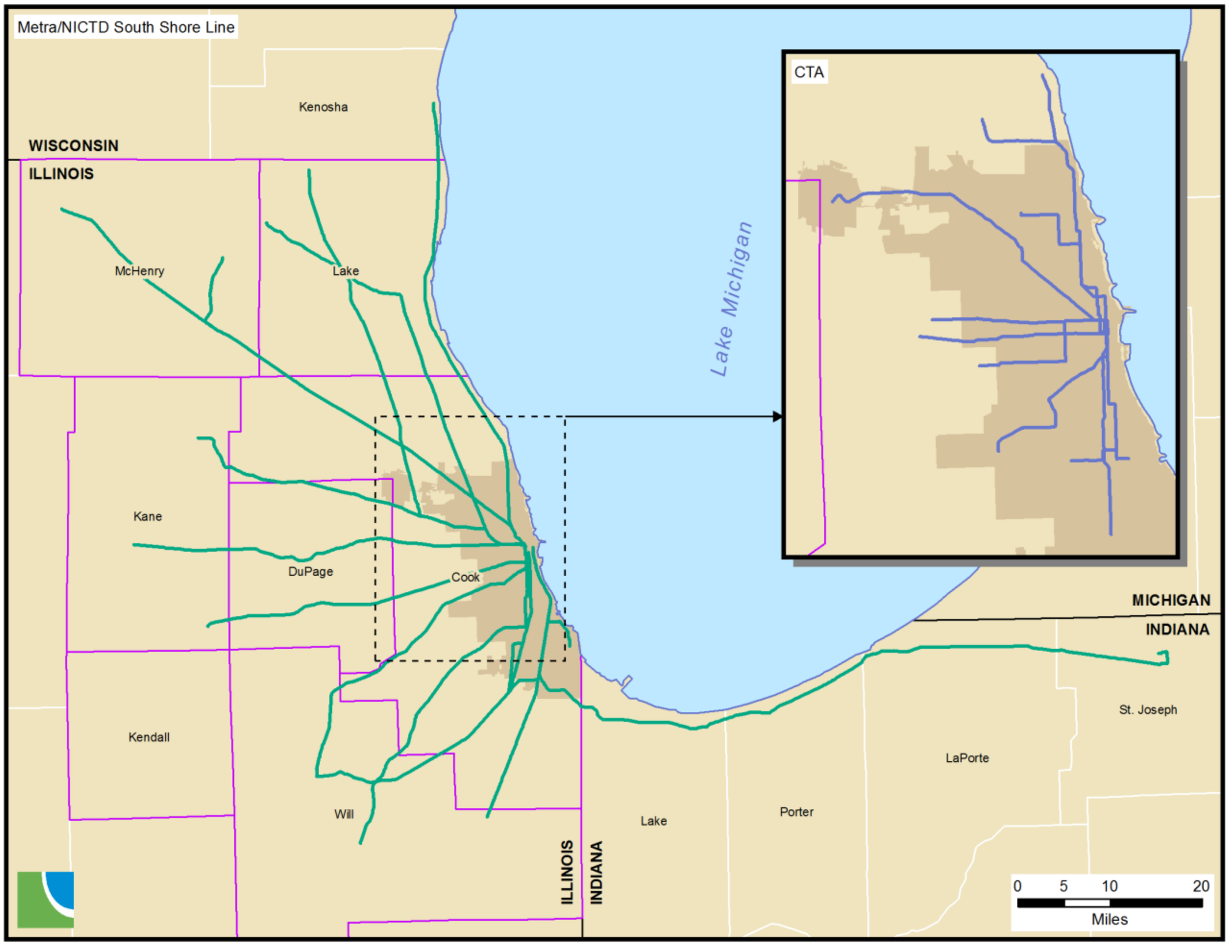
The final outcome is that the future headway for non-peak periods cannot be less than the headway in the peak periods. Regardless of priority, headway is capped by the length of the time period the service is operating in.

Rail network

The Master Rail Network (MRN) is stored in a file geodatabase, which contains all rail segments representing heavy and commuter rail service in northeastern Illinois. The geodatabase stores all feature class data needed to build rail transit networks for regional analyses, including arcs, nodes, rail routes and itineraries. While it would be possible to combine the MHN and MRN into one relational database, the rail network has few link attributes compared to the highway network, and it is much smaller in scope than the MHN. Thus, it is easier to maintain them separately. The MRN is stored in the same projection as the highway network database, so that they work together seamlessly. Like the MHN, the MRN is maintained with a set of scripts stored in a publicly accessible GitHub repository.

In addition to bus service, the CTA operates heavy rail transit within the city of Chicago and several adjacent suburbs. Suburban commuters are served by Metra's radial rail services oriented between suburban areas and the central area. There are several Metra stations within the city of Chicago, and some Metra lines parallel CTA rail lines. Additionally, the Northern Indiana Commuter Transportation District operates commuter rail service between downtown Chicago and South Bend, Indiana. The extent of the MRN is illustrated in **Figure 6**.

Figure 6. Master Rail Network



Topology rules within the MRN are enforced programmatically by rebuilding the routes each time the network is updated or new routes are imported using the arc geometry. In addition to being an efficient way to process the data, this procedure also ensures rail routes will always be coincident with the underlying arcs (which is necessary for selecting scenario-specific route coding).

Link fields

Table 9 lists the rail network link variables contained in the arc table and are the variables required by the travel demand modeling software. Most of the arcs represent the rail line segments that connect stations (either mode “C” for CTA rail or mode “M” for Metra). Two other kinds of links are included in the MRN on a limited basis — transfer links connecting different rail service and walk links providing access or egress to the service. These auxiliary links are discussed in detail later.

Table 9. Master Rail Network link attributes

Variable	Description
ANODE	CMAP "From" node.
BNODE	CMAP "To" node.
MILES	Link length in miles.
MODES1	Modes permitted on anode-bnode direction of link (string of mode letters).
MODES2	Modes permitted on bnode-anode direction of link (string of mode letters); blank if link is only 1 direction.
DIRECTIONS	Link directions flag: 1=one-way, 2=two-way.

Node fields

Node variables are listed in **Table 10**. The nodes represent rail stations or, in a few instances, rail line junctions that are not actual stations. Rail service does not stop at junction locations. In addition to a unique identifier for each station, the node table contains information on the availability of parking at the rail stations. The value *pspace* indicates the number of parking spaces available at the station and the cost of parking is stored in *pcost*. Both values represent conditions in the base year of the MRN. Thus, *pspace* equals zero if no parking is available and *pcost* equals zero if there is no fee.

Table 10. Master Rail Network node attributes

Variable	Description
NODE	CMAP node number; used to assign ANODE and BNODE values in arc table. CTA rail: uses range 30000-39999 Metra: uses range 40000-49999
LABEL	Node label (4-character station name).
PSPACE	Number of parking spaces at node in base scenario; zero if not used in base scenario.
PCOST	Parking cost at node in base scenario; zero if not used in base scenario.
FTR_PSPACE	Number of parking spaces at node in future scenarios. This text string uses the format “s1:p1:s2:p2: …” where s=the hundred’s place value from CMAP’s scenario numbering scheme and p=the number of parking spaces in the corresponding scenario. Each value must be separated by a colon.
FTR_PCOST	Parking cost at node in future scenarios; same format as *ftr_pspace*.

Future scenario parking information is also stored in the node attribute table in variables *ftr_pspace* and *ftr_pcost*. A *ftr_pspace* value of “4:150:6:200” is interpreted as follows: The node will have 150 parking spaces, beginning in scenario 400 and 200 parking spaces beginning in scenario 600. The value is assigned through scenarios until a later scenario is specified, so the node will have 150 parking spaces in scenario 500, as well. While it is easier for the analyst to read this value if the scenarios are coded in chronological order, the processing programs do not require this to assign the correct value to each scenario. Values for *ftr_pcost* are coded using the same format.

Rail route coding

As with bus coding stored in the MHN, rail service coding in the MRN is built from GTFS data files for a representative weekday (Wednesday). Each individual run of every rail line is stored in the database, representing a single direction of travel. Processing of the GTFS rail service data into usable model coding follows the same set of procedures and logical reviews as bus route data. Rail service coding is stored in the geodatabase as a pair of related tables containing information on the rail run and its itinerary.

Table 11 lists the variables in the rail route table. As with bus route coding, the variables are a combination of header fields that Emme requires when reading in rail itineraries (highlighted in blue) and GTFS fields maintained for clarity. These variables have the same definition in both the bus and rail route tables, although the values may differ. Special attention is given to the transit line name variable (*tr_line*) in the rail coding.

Table 11. Master Rail Network rail route attributes

Variable	Description
TR_LINE	Unique CMAP rail run identifier (6 characters).
DESCRIPTION	Real-world description of rail run (20 characters maximum – limit imposed by Emme).
MODE	Rail mode code: C=CTA rail M=Metra/NICTD
VEHICLE_TYPE	Rail vehicle type code (based on mode code): 1-5=mode C 6-24=mode M
HEADWAY	Rail headway (in minutes). A value of 99 indicates headway will be set to the length of the time-of-day period within which the rail run falls. In future routes, headway values can be different if headway changes throughout day. In this case the value is in a colon delimited format with the TOD periods followed by the effective headway for those periods. (e.g. 234678am:6.7:5:11.3:1:19.2)
SPEED	Average rail route speed in MPH from GTFS data; minimum value of 15 allowed. [Not used in CMAP modeling but a non-zero value is required by Emme.]
FEEDLINE	Unique GTFS identifier for each run.
ROUTE_ID	For CTA: lists line (Blue, Red, etc.). For Metra: lists train run number.
LONGNAME	Lists the proper name of the train line (Blue Line, Union Pacific Northwest, etc.).
DIRECTION	Lists final stop on train run.
START	Start time of train run in seconds.
STARTHOUR	Start hour of train run.

To allow for simple identification of runs on a specific rail line, the following rail route naming scheme is applied to the six-character *tr_line* variable.

- First character: lowercase Mode letter.
- Second and third characters: two letter line identifier (lowercase).
- Fourth through sixth characters: unique counter for each Mode-line combination, starting with “001” for base runs and “401” for current runs (automatically generated).

The three-character rail line coding prefixes are summarized in Table 12.

Table 12. Rail line coding prefixes

Transit Agency	Line	Coding Prefix
CTA	Blue	cbl
	Brown	cbr
	Green (Ashland branch)	cga
	Green (Cottage Grove branch)	cgc
	Orange	cor
	Pink	cpk
	Purple	cpr
	Red	crd
	Yellow	cye
Metra	BNSF	mbn
	Heritage Corridor	mhc
	Metra Electric	mme
	Milwaukee District North	mmn
	Milwaukee District West	mmw
	North Central Service	mnc
	Union Pacific Northwest	mnw
	Rock Island District	mri
	SouthWest Service	msw
	Union Pacific North	mun
	Union Pacific West	muw
NICTD	South Shore	mss

The itinerary information for rail lines is stored in a related data table, and the contents are listed in **Table 13**. These variables provide the same information as their counterparts in the bus itinerary tables. One variable of interest is the zone fare variable (*zn_fare*). This value applies to commuter rail lines, and it is the marginal cost per ride (in cents) for traveling between fare zones. It is calculated as:

- [the difference between monthly pass costs from station zone to zone A] x [100 cents] / [40 (the average number of one-way rides for a monthly pass holder, assuming 20 workdays per month].

For example, a Union Pacific North (UP-N) line monthly pass from Kenilworth (zone D) to Ogilvie Transportation Center (zone A) is $181.25. A monthly pass from Wilmette (zone C) to Ogilvie is $159.50. The *zn_fare* on the link between Kenilworth and Wilmette is: [(181.25 - 159.50) x (100)]/40 = 54.38.

As with the bus coding, two GTFS-based rail coding route systems exist simultaneously in the geodatabase:

- all_runs_base: GTFS–based coding that corresponds to a base year of 2015 (reflecting service at that time)
- all_runs: Coding built from the most recent GTFS data files. This represents up-to-date coding, and it is used as the basis for future modeling scenarios.

Each of the rail route systems listed above contain more than 2,500 rail runs, made up of more than 76,000 itinerary segments, representing one weekday of service. For travel demand modeling purposes, the CTA rail runs are combined into representative rail routes. This is accomplished using the same script and "collapsing" logic that is applied to the bus run coding. All individual commuter rail runs are allowed to pass through to the travel demand model unchanged.

Table 13. Master Rail Network itinerary attributes

Variable	Description
TR_LINE	Unique CMAP rail line identifier (6 characters).
ITIN_A	CMAP node number of first node of link rail run travels on.
ITIN_B	CMAP node number of second node of link rail run travels on.
IT_ORDER	Order number of rail segment in itinerary.
LAYOVER	Layover time in minutes applied to *Itin_B*. Default=3.
DWELL_CODE	Code for stops (corresponding Emme code), applied to *Itin_B*: 0=stop allowed (default time of 0.01 minutes) 1=no stop (#) *available for future use:* *2=alighting only (>)* *3=boarding only (<)* *4=boarding & alighting allowed (+)* *5=dwell time factor (*)*
ZN_FARE	Incremental zone fare in cents.
TRV_TIME	Itinerary segment travel time in minutes.
DEP_TIME	Departure time at beginning of segment from GTFS data (in seconds).
ARR_TIME	Arrival time at end of segment from GTFS data (in seconds).
IMPUTED	Flag indicating segment was imputed by shortest path algorithm during import. 0=not applicable. 1=itinerary segment created by shortest path algorithm.

Future rail coding

As with the bus coding, there is a need to store future rail project information for use by the travel demand model. The route coding table for future rail service includes the same set of fields as the existing coding, as well as a few additional fields shown in **Table 14**. The *tod* variable identifies all specific time-of-day periods that individual future rail routes should be included in. The *scenario* variable identifies all specific modeling scenarios that individual rail routes should be included in. The *notes* variable contains the TIP identification number of the project and may include other descriptive information about the project. The *action* variable requires a more detailed explanation.

Table 14. Future rail route additional attributes

Variable	Description
TOD	Time-of-day periods that rail route will be used in. A string of ALL TOD periods (1–4) that will contain the route. Applies to new service routes (ACTION=1) only.
SCENARIO	Future scenarios rail line will be used in. A string of ALL scenarios (first digit of three-digit code) that will contain route. May NOT be blank.
ACTION	Action code for the route.
TIP_ID	TIP ID number.
COMPLETION_YEAR	Year in which the project is to be completed.
RSP_ID	ID for regionally significant projects.
NOTES	Other descriptive information. Entries must be separated by colons. 30 character limit.

Implementation of the GTFS-based rail coding required a reimagining of how future rail project coding would be handled. The desired outcome was to maintain the simple, spreadsheet-based future service coding procedures CMAP has used for years. To achieve this, an *action* code variable was added to the required attributes in the future route table. This value describes what type of service or improvement is being implemented and instructs the processing scripts on how to handle the data input. A brief description of the future rail *action* codes is provided in **Table 15**.

Table 15. Future rail coding action codes

Action Code	Meaning	Discussion
1	New line or service.	The entire itinerary must be coded.
2	Travel time reduction on selected links.	*Itin_A* and *Itin_B* define the nodes between which the travel times will be reduced (only the end points need to be coded). Code both directions of travel if applicable. The *Trv_Time* value represents the % reduction applied to the base year travel time (for instance 0.1 means a 10% reduction). To apply the travel time savings to the entire itinerary, code *Itin_A* and *Itin_B* as the beginning and ending nodes on the line and code *Layover*=99. If the time reduction applies to multiple lines, each must be coded separately.
3	New station.	*Itin_A* and *Itin_B* define the nodes between which the new station will be inserted. Store node number of new station in *Layover*. Code both travel directions if applicable.
4	Line extension.	Itinerary only contains the coding for the additional segments to be added to the base year runs. Code both directions of additional segments if applicable. For extension at ending terminal, code *IT_Order* values beginning with 1001. For extension at beginning station, use negative values.
5	Shift to different downtown station.	The SWS will switch from Union Station to LaSalle Street Station – essentially this is just swapping one link for another at the CBD end of the itinerary. In itinerary coding: *Itin_A* and *Itin_B* are the original nodes defining the link. *Layover* holds the new node number. *IT_Order* is used to identify which node is being replaced by the value in *Layover*: 1=*Itin_A* and 2=*Itin_B*. Code both travel directions if applicable.
6	Placeholder for TIP identification number.	When a future project reaches its time horizon and is implemented, it gets coded into the current routes. At this point the project could be removed from the future routes, except it is necessary to maintain the project's TIP ID in the future routes. To do this without affecting the network, the project is coded like an action code 2 with a 0% travel time reduction
7	New consolidated rail station.	Two existing rail stations are being consolidated and replaced with a new station. In itinerary coding: *Itin_A* and *Itin_B* are the remaining nodes between which the new station will be inserted. *Layover* holds the new station node number. Code both travel directions if applicable.

When the future rail coding is processed to create scenario transit networks, new lines/service (*action*=1) are added to the set of existing ones to increase the total. For *action* codes 2-5 and 7, the changes described in the coding are applied to the existing transit routes (no actual processing is performed for *action*=6). Additionally, modified unique counters (characters four through six in *tr_line*) are used for future rail lines:

- For action=1: the counter should be a 900 series (i.e., starting with "9" followed by two digits beginning with "01").
- For action codes 2-7: the counter should start with two asterisks (one if the counter requires two digits) followed by a counter. For example, mri**1 identifies the coding as a general improvement that will apply to all runs on the specified line.

Future rail itinerary coding contains the same fields as the existing itinerary coding, except for the GTFS-derived fields. The use of the *action* code allows for a great deal of flexibility in coding the itineraries. CMAP staff uses this flexibility to rely upon one future rail coding template where the definitions of the itinerary fields are dependent upon the *action* code applied to the specific route. The benefit to the analyst of using this coding scheme is only minimal future rail coding input is required to implement the desired changes. Processing scripts perform all the painstaking work.

Zone systems

Three different zone systems are used in the regional travel demand model. The zone systems all serve different purposes within the regional travel demand model.

Trip generation zones

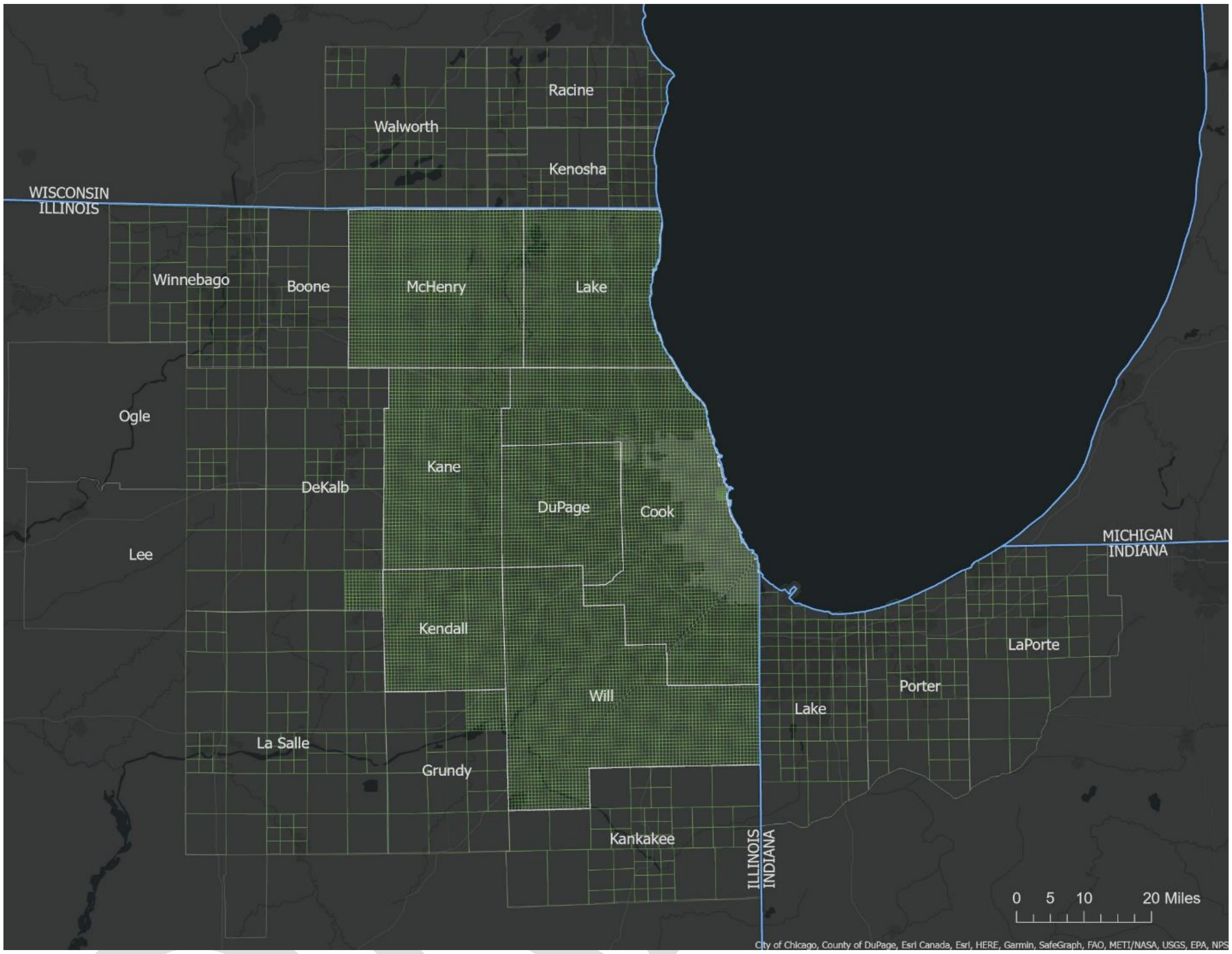
Trip generation zones (or subzones) are the smallest level of geography used in the travel demand model. Subzones are quarter-section-sized geographies that CMAP uses for household and employment forecasting. The current edition of the subzones is known as "Subzone17" (identifying the year in which it was developed). This most recent improvement to the subzones included adding a few hundred more subzones by replacing previous Census-based subzone boundaries with boundaries based on the Public Lands Survey Systems (PLSS). The CMAP modeling region comprises 17,418 subzones (shown in **Figure 7**).

Quarter-sections are based on PLSS subdivision of land into township and range, and then into sections. Two major benefits of using this system as the basis for the subzones are:

- The geometry does not change (unlike Census-based geography).
- The PLSS sections conform in most cases to state, county, and township boundaries (unlike other referencing systems, such as the U.S. National Grid).

As indicated by their name, the trip generation zones (**Figure 7**) are used to aggregate socioeconomic data into geographic units suitable for providing input to the trip generation model to generate trip productions and attractions. Trip generation zones serve as the base level for CMAP's modeling zone systems. The two remaining zone systems are created by aggregating the subzones into larger geographies. Thus, the subzones always nest perfectly within the other zone systems.

Figure 7. CMAP trip generation zones

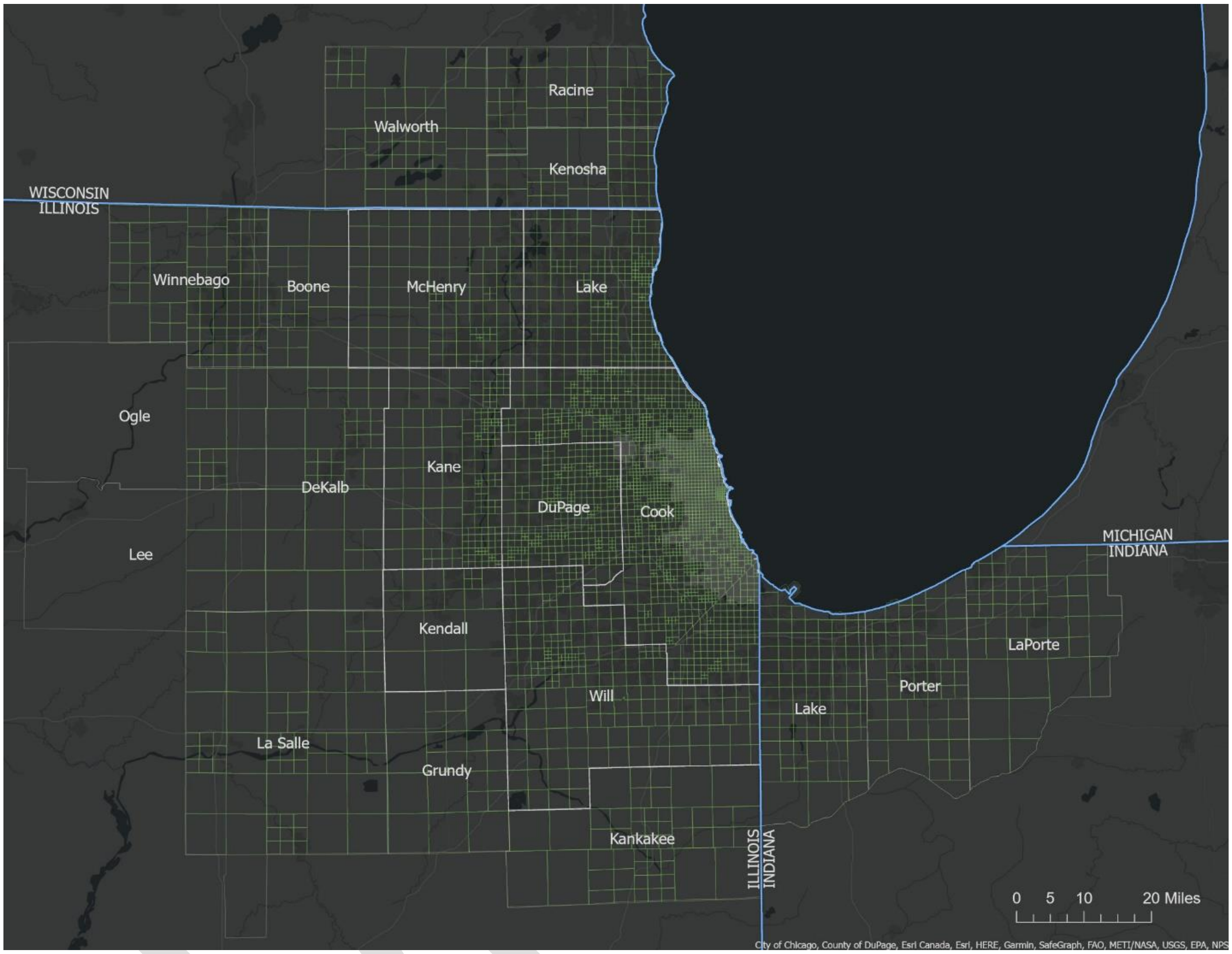


Modeling zones

While the trip productions and attractions are generated in a zone system based on survey quarter-sections, this level of detail is not used for the remaining modeling processes. At this time, the space and computing capabilities required to complete calculations on matrices composed of over 17,000 trip generation zone origins and destinations (more than 300 million values) is not available. Therefore, the subzones are aggregated into the CMAP modeling zone system for the remaining three steps of the modeling process — trip distribution, mode choice, and assignment.

Figure 8 shows the 3,632 modeling zones for the CMAP region. These zones generally follow the survey township geography. Zones either are sections (approximately one square mile) or regular subdivisions of townships (4-square-mile ninths of townships, 9-square-mile quarters of townships, or whole townships). The modeling zones are equivalent to their underlying subzones outside of the CMAP planning area. Additionally, there are 17 external zones, or points of entry, that are not shown. These are arrayed around the outside of the pictured zone system, representing trips on major highways entering the region.

Figure 8. CMAP modeling zones



The density of the modeling zones (and by extension the subzones) increases within downtown Chicago. The Chicago Central Business District (CBD) is a pre-GIS convention established by CATS and NIPC that was based on boundaries set at Chicago Avenue, Halsted Street, and Roosevelt Road. It includes modeling zones 1 through 47. The larger Central Area also was established by CATS and NIPC prior to GIS to reflect the high density of trips made in this area. It is based on the boundaries at North Avenue, Ashland Avenue, and Cermak Road. The Chicago Central Area is shown in **Figure 9**.

The Central Area includes modeling zones 1 through 77. Of the 77 zones, 30 are quarter-section sized zones (one-half mile by one-half mile). Most remaining modeling zones (representing the CBD) are quarter-quarter-section sized zones (one quarter-mile by one quarter-mile).

Figure 9. CMAP central area zones

City of Chicago, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc., METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

To simplify selecting discrete geographic areas, the modeling zones are numbered consecutively by county and township. The city of Chicago is consecutively numbered, starting with the CBD (1-47), the Central Area (48-77), the Transit Hub (78-121) — which provides a one-mile buffer around the Central Area — and then by townships for zones within the city limit. **Table 16** lists the correspondence between subzones, modeling zones, and geographic areas.

Table 16. CMAP subzone-zone correspondence

COUNTY		ZONE17		SUBZONE17	
FIPS	Name	First	Last	First	Last
17031	Cook	1	1732	1	3895
	Chicago (excluding DuPage portion)	1	717	1	983
	CBD	1	47	1	52
	Chicago Central Area	1	77	1	84
	Chicago Transit Hub	1	121	1	129

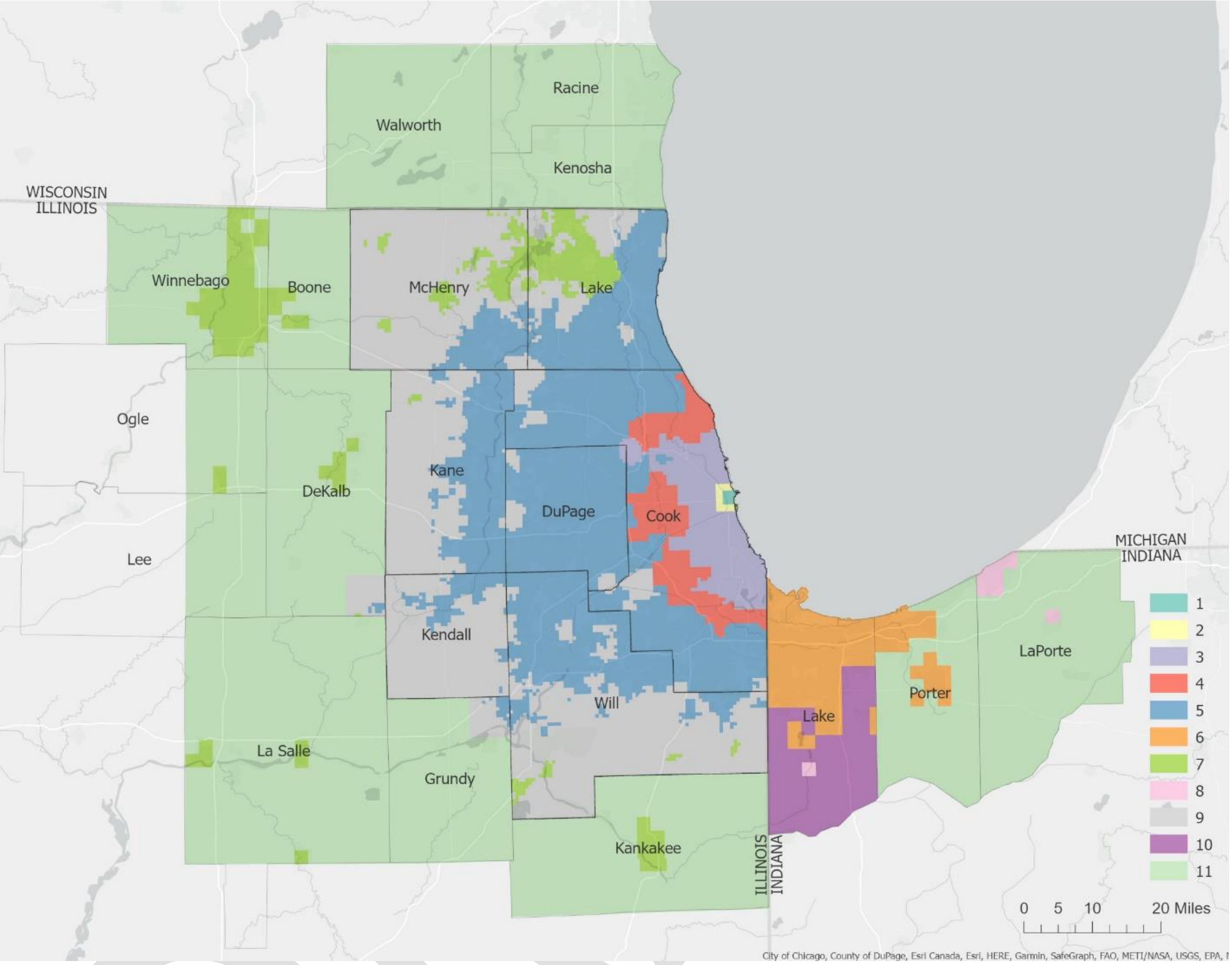
17043	DuPage	1733	2111	3896	5252
	Chicago portion	1733	1734	3896	3904
17089	Kane	2112	2304	5253	7406
17093	Kendall	2305	2325	7407	8702
17097	Lake	2326	2583	8703	10598
17111	McHenry	2584	2702	10599	13042
17197	Will	2703	2926	13043	16426
17063	Grundy	2927	2950	16641	16807
	Aux Sable Township	2949	2949	16664	16807
17007	Boone	2951	2975	16427	16451
17037	DeKalb	2976	3021	16452	16640
	Sandwich & Somonauk Townships	2977	2977	16454	16597
17091	Kankakee	3022	3073	16808	16859
17099	LaSalle (partial)	3074	3145	16860	16931
17103	Lee (partial)	3146	3151	16932	16937
17141	Ogle (partial)	3152	3168	16938	16954
17201	Winnebago	3169	3247	16955	17033
18089	Lake, IN	3248	3344	17034	17130
18091	LaPorte, IN	3345	3400	17131	17186
18127	Porter, IN	3401	3467	17187	17253
55059	Kenosha, WI	3468	3512	17254	17298
55101	Racine, WI	3513	3568	17299	17354
55127	Walworth, WI	3569	3632	17355	17418
	POEs	3633	3649	N/A	

Capacity zones

The final zone system used in the regional travel demand model is the capacity zone system (displayed in **Figure 10**). As with the modeling zones, these zones are built by aggregating the subzones. The capacity zones help estimate general road capacity for the highway assignment procedures. Some specific calculations that use the capacity zone value include:

- Calculation of an ordinal arterial functional class within the model
- Calculation of the number of inbound approaches into an intersection
- Estimation of traffic signal green-to-cycle ratios and signal cycle length for ramps connecting arterials and expressways

Figure 10. CMAP capacity zones



The values of the capacity zone system are listed below in **Table 17**. Within the travel demand model structure, the capacity zone values are stored as a node attribute in the highway network database. Thus, the values in the table below correspond to the values of the *areatype* variable in the highway network node table discussed in Section 2.3.

Table 17. CMAP capacity zone codes

Capacity Zone Value	Description

1	Chicago Central Business District (2009 subzones 1-47).
2	Remainder of Chicago Central Area (2009 subzones 48-80).
3	Remainder of City of Chicago (2009 subzones 81-976).
4	Inner ring suburbs where Chicago street grid is generally maintained.
5	Remainder of Illinois portion of the Chicago Urbanized Area.
6	Indiana portion of the Chicago Urbanized Area.
7	Other Urbanized Areas and Urban Clusters within the CMAP Metropolitan Planning Area plus other Urbanized Areas in northeastern Illinois.
8	Other Urbanized Areas and Urban Clusters in northwestern Indiana.
9	Remainder of CMAP Metropolitan Planning Area.
10	Remainder of Lake County, IN (rural).
11	External area.
99	Points of Entry – not defined in the Capacity Zone system.

Analysis network preparation

Preceding sections briefly discussed the procedures used to take the highway network and transit service information from the GIS databases and process it for use in modeling networks. Processing programs export data from the model network databases, and update the highway network and transit service characteristics based on the scenario network being created. After all characteristics are updated, a set of text files suitable for importing into the travel demand software is created, containing the data defining the transportation network.

Highway network

Separate import files are created for each of the time-of-day (TOD) highway networks, as well as for one all-inclusive highway network. The TOD networks contain time-period specific changes to links, such as time-of-day parking restrictions and reversible lanes. Each TOD highway network has a set of four import files — two defining link attributes and two defining node attributes. The files contain the standard link and node attributes required by the travel demand software, as well as extra attributes (denoted by "@") used within the travel demand model. The files are imported into the modeling software to create the TOD highway networks.

Highway network link attributes are shown in **Table 18** with required attributes highlighted in blue. Link modes are defined to enable a multiple vehicle class highway assignment that matches the vehicle types used for emission calculations. Mode "A" is the primary auto mode, and all other modes are secondary auto modes. No transit modes are included in the highway network because the transit network exists as a separate entity. This also means that no transit-only links (such as rail links or dedicated busways) are included in the highway network.

Secondary auto modes "S" for single occupancy vehicle (SOV) and "H" for high occupancy vehicle (HOV) allow high occupancy vehicle facilities to be represented in the network. For example, mode "S" would not be coded on HOV links. All links in the network allowing high occupancy vehicles would include mode code "H."

Secondary auto mode “T” is a general truck mode coded on all network links that allow trucks. By excluding truck modes, commercial vehicles can be prohibited from facilities, such as Lake Shore Drive, and the Kennedy and Dan Ryan express lanes. The additional truck modes “b,” “l,” “m,” and “h” permit more specialized coding of truck prohibitions to represent local restrictions or the testing of truck-only facilities based on weight classes.

Table 18. Model Highway Network link attributes

Variable	Description		Source
i	From node.		Batchin files
j	To node.		
len	Link length in miles.		
mode	Modes on link: A=primary auto S=single occupant auto (SOV) H=high occupancy auto (HOV) T=general truck	 b= B plate truck l=light truck m=medium truck h=heavy truck	
lanes	Number of driving lanes.		
vdf	Volume-delay function code. 1=arterial street 2=freeway 3=freeway-arterial ramp 4=expressway	 5=freeway-freeway ramp 6=zone centroids connector 7=link where toll is collected 8=metered entrance ramp	
@speed	Speed limit or CMAP free speed.		
@parkl	Number of parking lanes along roadway.		
@sigic	Link with interconnected signals.		
@width	Driving lane width in feet.		
@toll	Toll amount in dollars.		
@ftime	Uncongested link travel time in minutes.		macros
@emcap	Level of Service E lane capacity on link.		
@artfc	Arterial link functional class: 1 = Principal Arterial 2 = Major Arterial	 3 = Minor Arterial 4 = Collector	
@gc	Green time to cycle length ratio.		

A link’s volume-delay function (VDF) is based upon the five categories in CMAP's link capacity calculations, which include arterial, freeway, arterial-freeway ramp, expressway, and freeway-to-freeway ramps. Three additional volume-delay functions are included for links connecting zone centroids to the network, links where tolls are collected, and metered freeway entrance ramps.

In addition to these standard variables required by the modeling software, some additional link attributes are included in the network. Many supplemental variables come directly from the MHN database. Other attributes used in the macros include the link's posted speed limit, as well as whether curb parking is allowed and the average width of driving lanes. For toll collection links, the amount of the toll also is included.

Table 19 lists the highway network node variables that are used. Standard node attributes are the node number and the x- and y-coordinates of the node. Node extra attributes are additional quantities associated with the node, including the zone number and area type (capacity zone value) at the node location. Area type definitions are listed in **Table 17**.

Table 19. Model Highway Network node attributes

Variable	Description	Source
i	Node number.	Batchin files
xi	x-coordinate (NAD27 IL East State Plane feet).	
yi	y-coordinate (NAD27 IL East State Plane feet).	
@zone	Modeling zone node resides in.	
@atype	Capacity Zone values (refer to Section 2.5).	
@napp	Number of approach links.	macros
@cycle	Traffic signal cycle length in minutes.	

After the TOD highway networks are imported into the travel demand software, two macros prepare the additional link and node attributes needed for the time assignments. The first macro, *Ftime.Capacity,* calculates link lane capacities in vehicles per hour, and uncongested speeds based on link characteristics, such as functional class, lane width, and posted speed limit. The network database also includes variables to flag those links that change characteristics depending on the time, such as links that have peak period parking restrictions. These factors also are considered when link capacity is calculated.

The calculations in the *Ftime.Capacity* macro generally are consistent with the capacity procedures found in the 1985 Highway Capacity Manual and the 1994 update to the manual. The capacities of arterial street links reflect the type of signalized intersection at the link's j-node, or downstream node. The macro first analyzes the links entering a node, and then estimates the capacity for each approach link based on generalized signalized intersection characteristics. Capacities for ramps between freeways and arterial streets ending at signalized intersections are determined in the same manner as arterial streets.

The concept behind this process is link capacities. Uncongested travel times must always be recalculated before an assignment is run, rather than be maintained as static network variables in the database. The capacities and uncongested travel time for links ending at a signalized intersection depend on the characteristics of all approach links into the intersection, not just the link of interest. As a result, link capacities and uncongested travel times depend on network topology. Adding, removing, or modifying a link affects the capacities and uncongested travel times of all links that intersect it at a signalized intersection. Calculating these network quantities as part of the assignment procedure ensures they are current when the assignment is carried out. This approach simplifies the introduction of certain types of improvements into the modeled network. The effects of parking restrictions, traffic control device improvements, signal progression, and intersection improvements can be modeled in the macro, eliminating lengthy manual adjustment of capacities and times on a link-by-link basis.

The *Ftime.Capacity* macro develops some extra link attributes, which briefly are described. Link uncongested travel time, @ftime, is calculated and is used in the volume-delay functions. It should be noted that this travel time does not contain any intersection delay, which is calculated separately by the volume-delay functions. Capacity values, calculated by the macro, @emcap, are hourly lane capacities at level-of-service E. Link capacity for the time, referenced within the volume-delay functions, is later obtained by multiplying @emcap by the number of driving lanes on the link and the number of hours in the assignment time.

The second macro, *Arterial.Delay,* repeats many of the same calculations as *Ftime.Capacity*. It again evaluates approach links at signalized intersections and estimates signal cycle lengths at the j-nodes of arterial street links. It also estimates the proportion of the cycle length allocated to traffic on the link. These two quantities are retained in extra node and link attributes — @cycle and @gc, respectively — to be used later in the volume-delay functions that estimate intersection delays. An ad hoc functional class (@artfc) also is assigned to arterial street links based on the location of the link, its speed limit, and number of driving lanes. This functional class only is used to allocate green time at signalized intersections, which depends on the cycle length, and the number and types of conflicting approach links. The final link extra attribute in the table is the ratio of green time to cycle length, @gc, at the downstream node of a link. This value is used in the volume-delay functions.

Transit network

The model uses coded transit networks reflecting transit service in the morning peak period (6:00 to 9:00 a.m.) and the midday period (9:00 a.m. to 4:00 p.m.). A transit network contains over 12,000 bus and rail mode links, totaling nearly 5,700 miles in length. While the highway network data are all contained within the MHN database, the transit network comprises three separate components that must be integrated to create transit modeling networks, including:

1. Bus route coding: All current and future bus route coding is stored in the route systems of the MHN geodatabase. This coding includes the following transit modes — B (CTA regular bus service), E (CTA express bus), P (Pace regular service), L (Pace local service), and Q (Pace express service).

2. Rail route coding: All current and future rail route coding is stored in the rail-route systems of the MRN geodatabase. This coding includes modes C (CTA rail) and M (Metra rail).

3. Auxiliary links: In addition to the transit coding itself, model transit networks require a system of auxiliary links to provide needed connections. Auxiliary links provide transfer links between different transit modes or lines that do not pass through the same nodes, as well as walk access to transit service from zone centroids (trip beginning) and walk

egress from transit service to zone centroids (trip end). A set of auxiliary links is created dynamically when the transit network files are generated. The procedures used to create the auxiliary links are discussed below. Zones requiring drive access are not provided with auxiliary dive access links. Drive access is handled by a matrix calculation that will be discussed later.

Table 20 lists the auxiliary link modes included in the transit networks. The transit network modes are case sensitive, which means all transit modes are uppercase and all auxiliary link modes are lowercase. The three types of auxiliary links are transfer links connecting transit lines to one another, access links to connect a zone centroid to transit service at the beginning of a trip, and egress links connecting transit service to a zone centroid at the end of a trip. Transfer links are bi-directional while access and egress links only serve one direction of travel. In practice, access and egress links are generally bi-directional links with the appropriate mode assigned to the appropriate direction. O'Hare International Airport's "People Mover" transit service is a special auxiliary link type reflecting service moving travelers between O'Hare terminals and a multimodal center.

Table 20: Auxiliary link modes

Link Type	Mode	Description
Transfer	b	Bus-Bus walk.
	c	Bus-CTA rail walk.
	m	Bus-Metra walk.
	d	Metra-Metra walk.
	r	CTA rail-CTA rail walk.
	t	CTA Rail-Metra walk.
Access	u	Home-Bus walk.
	v	Home-CTA rail walk.
	w	Home-Metra walk.
Egress	x	Bus-Work walk.
	y	CTA rail-Work walk.
	z	Metra-Work walk.
	k	O'Hare People Mover

Transfer links

There are six different transfer link modes, each identifying a connection between different types of transit service. Transfer links are needed when two services are physically separate because they don't share a station node. While Metra and CTA rail service are identified separately by the auxiliary links, no such distinction is made between CTA and Pace bus service. All bus service is combined into "bus." All transfer links are bi-directional, so passengers can move in either direction between the transit lines. Transfer links "r," "t," and "d" are hard-coded in the MRN and are read directly into the final transit network via the rail.network file. The remaining transfer links are created as follows:

- Mode b: All highway network arterials (type=1 in the MHN) located in modeling zones 1-78, representing an area just slightly larger than Chicago's Central Area, are assigned mode “b”. This allows trips to use “sidewalks” along arterial links for transfers. These links are included in the input file bus.network.
- Mode c: The Euclidean distance is calculated between CTA rail stops and all bus stops. A maximum distance of one-eighth mile (660 feet) is allowed between CTA rail stops in the CBD and bus stops. A maximum distance of a half mile (2,640 feet) is allowed between bus stops and the remaining CTA rail stops. The shortest mode “c” link available to connect a CTA rail stop to each bus route is retained. As CTA rail stations may be served by multiple bus routes, there may be instances where more than one mode “c” link connects a bus route to the same CTA rail stop. This only occurs if the shared stop was not the shortest link from the CTA rail stop for all the affected bus routes. These auxiliary links are stored in access.network.
- Mode m: Straight-line distances are calculated between Metra stops and all bus stops. Maximum distances of a quarter mile (1,320 feet) and 0.55 miles (2,904 feet), respectively, are allowed between Metra stops and CTA bus stops, and Metra stops and Pace bus stops. Mode “m” links are attached to all bus stops determined to be within the allowable distance. There are no constraints on connecting a Metra stop to multiple stops on the same bus route or on connecting a bus stop to multiple Metra stops. These auxiliary links are stored in access.network.

Access and egress links

Access and egress links are specific to modes, so there are three access modes connecting zone centroids to different types of transit service and three egress modes connecting transit service to a centroid. Each access and egress modes apply to only one direction. For example, a centroid is connected to a Metra station by one mode “w” link from the centroid to the station, and one mode “z” link from the station to the centroid. In practice, this usually, but not always, results in a two-way link with different modes in each direction. The access and egress links are created as follows:

- Modes u and x, generic bus access and egress: The Euclidean distance between centroids and transit stops is calculated to determine access and egress link length. Bus stops are separated into CBD and non-CBD stops. A maximum distance of a quarter mile is allowed between centroids and CBD bus stops, while a maximum of 0.55 miles is allowed between centroids and the remaining bus stops. The access/egress links are merged with bus itineraries, connecting multiple links per transit line to the same centroid. This allows for numerous access/egress connections between the same bus route-zone centroid pair if the itinerary varies by direction. Redundant access and egress links are eliminated, and links are grouped by centroid and sorted by link length in ascending order. A maximum of eight mode “x” links are kept for each CBD centroid.

No more than two mode “x” links are retained for each non-CBD centroid. A maximum of three mode “u” links are saved per centroid. These auxiliary links are stored in access.network.

- Modes v and y, CTA rail access and egress: The straight-line distances are calculated between centroids and CTA rail stops. A maximum distance of 0.55 miles is allowed between CTA rail stops and zone centroids. By rule, each CTA rail station is connected to the centroid of the zone it resides in with an assigned distance of 0.55 miles if the link length exceeds 0.55 miles. The remaining access links are ranked in ascending order and are assigned to centroids until the maximum allowable number is reached. A maximum of three mode “v” links is assigned to each centroid in a zone with a CTA rail station. The same process is used for the egress links. Maximums of seven and three mode “y” links are assigned to centroids in the CBD and outside the CBD, respectively, in addition to the connection to the station zone. These auxiliary links are stored in access.network.

- Modes w and z, Metra rail access and egress: Metra station access and egress links follow the same basic procedures as CTA rail station links. A maximum distance of 0.55 miles is allowed for these links. Metra stations are connected to the centroid of the zone they are within, and a length of 0.55 miles is assigned to the link if it exceeds the distance limit. Unlike with the other access and egress links, there is no constraint on the number of Metra access and egress links per centroid, so all are put in the final network. These auxiliary links are stored in access.network.

Table 21 summarizes the processing rules used to develop the auxiliary links. When the processing is completed, the result is a set of scenario transit network files that are formatted to be imported into a single scenario of the travel demand software.

Table 21: Auxiliary link processing rules

Mode	Maximum Distance	Forced to Connect to Centroid?	Maximum Number of Links per Centroid
c	⅛ mile in CBD ½ mile outside CBD	No	N/A
m	¼ mile for modes BE 0.55 miles for modes PLQ	No	N/A
u, x	¼ mile in CBD 0.55 miles outside CBD	No	u – 3 x – 8 in CBD, 2 outside CBD
v, y	0.55 miles	Yes	v – forced + max. of 3 additional y – forced + max of 7 additional in CBD, forced + max of 3 additional outside CBD
w, z	0.55 miles	Yes	N/A

Zonal impedances

A primary role of transit networks is to generate transit level of service variables for the generalized cost procedures used in the destination-mode choice model. Impedance matrices are created for zone-to-zone in-vehicle times, fares, first wait time and remaining out-of-vehicle time. In the logic of the CMAP models, the zone-to-zone quantities are all measured from the point where transit service is first boarded rather than the actual trip origin. Access modes, times, and costs are generated using Monte Carlo simulation techniques. These techniques will be discussed later in the document.

Zone-to-zone impedances are built using the time and cost components of the transit network. Time components are weighted to reflect the relative disutility to the traveler. For instance, walking time is weighted at two times the rate of time spent within a transit vehicle. Similarly, fares are weighted so they can be combined with times to create an overall measure of the impedance of a particular path.

A multi-path transit assignment is completed to provide transit impedances for zones that have walk access to a transit station. For zones with no walk access to a transit station, highway impedances from a complementary highway assignment are used to index the origin zone to a station zone that minimizes drive access and transit impedance to the destination. All cost components in the impedance matrix between the auto access zone with no walk access and the destination are replaced with cost components from the selected station zone to the destination. The result is, instead of the zone being disconnected, the origin to destination times and costs are populated with times and costs reflecting the selected station. In this application, a generalized parking cost is calculated to reflect on- and off-street parking availability and cost.

The transit network scenario also is used to generate travel districts based on a hierarchy of services present in the zone. This is analogous to CMAP's historic use of first, last, and priority mode categorization. The mode matrices are constructed based upon the transit services likely to be used when moving between these zone groups.

The effects of congestion on bus travel times are included in the transit skimming procedures. The modeled bus travel times start with scheduled times from the GTFS files produced by the transit service providers. In iteration zero, the scheduled times for the morning peak and midday scenarios are compared to congested auto travel times from a comparable model run. The congested times are used if they are longer than the scheduled bus times. After each full model iteration, bus travel times are again updated with auto travel times when the auto time is longer than the scheduled time. The transit impedance matrices are recalculated with each iteration and maintain a consistent relationship with the auto travel times. This is important because the relationship between auto and transit travel times is an important determinant of the regional model results. An additional feature allows the schedule time to be retained by coding the transit travel time function as two where congested times should not be considered.

This is helpful for scenarios that include bus rapid transit or other similar services that will not be impacted by prevailing traffic conditions.

Ancillary data input files

In addition to the network datasets, several ancillary data files contain information on transit service levels, park-and-ride availability, CBD parking, and auto operating costs. These files are briefly described in this section.

M01 file

The M01 file ("ALLPURPOSE_M01.TXT") stores several variables to provide the destination-mode choice model with zonal transit availability, and park and ride characteristic parameters. Some of the parameters are calculated using transit network characteristics and are specific to each scenario network. The contents of the M01 file are summarized in **Table** 22.

Table 22: M01 file attributes

Field Name and Position	Description
Zone Number (1)	Modeling zone number.
Zone Type (2)	1 – Chicago Central Area zone (1-77) 2 – Chicago zone outside of the Central Area (78-309) 3 – dense suburban zone (more than 500 activities [population + employment] per square mile) 4 – remaining suburban zones
Park and Ride Cost (3)	The cost of parking at the park and ride lot closest to the zone's geographic centroid. This represents the lowest rate of either the daily parking rate or the cost of a monthly parking pass divided by twenty work days.
Median zone household income (4)	The median household income in the zone (in $100s) derived from POPSYN_HH.CSV (2019 dollars).
Park and ride availability (5)	A binary value indicating that the zone has park and ride access if there is a park and ride location within ten miles of the zone's geographic centroid.
Average waiting time for bus service in zone for home-work trips (6)	The average wait time for bus work trip (in minutes) for modes BEPQ. Calculated as the mean of (headway*0.5) for all bus stops served by selected modes within the zone during the AM peak period. To account for spatial inaccuracy, stops are buffered by 0.1 miles. *Maximum value is 99, default value of 99 used for zones with no bus service.*
Average waiting time for bus service in zone for non-work trips (7)	The average wait time for bus non-work trip (in minutes) for modes BEPQ. Double the wait for bus work trip (as a proxy for midday service). *Maximum/missing values set to 99.*
Average waiting time for feeder bus service in zone for home-work trips (8)	The average wait time for feeder bus work trip (in minutes) for mode L. Calculated as the mean of (headway*0.5) for all bus stops served by mode L within the zone during the AM peak period. To account for spatial inaccuracy, stops are buffered by 0.1 miles. *Maximum/missing values set to 99.*
Average waiting time for feeder bus service in zone for non-work trips (9)	The average wait time for feeder bus non-work trip (in minutes) for mode L. No feeder bus service in off-peak period, so: *all values set to 99.*

Home-work trip auto work end auto occupancy (10)	Zone vehicle occupancy rate for commuters (i.e., workers per vehicle), measured at destination (work) location. Calculated using data from Table 2-2 of the 2012-16 5-year CTPP.

DISTR file

The DISTR files contain zonal transit approach distribution parameters, which are used to determine mode choice. The parameters are calculated using transit network characteristics and are specific to each scenario network. **Table 23** describes the DISTR file fields.

Table 23: DISTR file attributes

Mode Category	Field Number	Description
	1	CMAP modeling zone number.
Commuter rail (fields 2-4) CTA rail (fields 5-7) Park and Ride (fields 14-16)	2,5,14	Mean distance in miles to station (or park and ride). *Calculation*: A distance calculation is performed to find the rail station closest to each subzone centroid. The closest station distances are then aggregated to the zonal level to determine the mean distance weighted by subzone households. The maximum mean distance is set to 19.95 miles. The analysis is performed separately for the commuter rail stations, rapid transit stations and park and ride locations.
	3,6,15	Standard deviation of distance to station (or park and ride). *Calculation*: The standard deviation is calculated as the square root of the sum of [the zonal variance calculated above and a subzone variance, estimated to be 0.042].
	4,7,16	Type of Mode Choice distribution. 101 (default) = normal distribution. 102 = exponential distribution.
Bus (fields 8-10) Feeder Bus (fields 11-13)	8, 11	Minimum bus stop distance (miles). *Calculation*: A set of bus stop buffers (incremented by 0.1 miles from 0.1 up to 1.1 miles) are created. The buffers are overlaid with the zone system to determine the proportion of each zone covered by each buffer. The minimum bus stop distance is determined by the size of the smallest buffer that covers any part of the zone. The value is set to 999 for zones that are not covered by any portion of the largest buffer. The analysis is performed separately for bus (modes BEPQ) and feeder bus (mode L) stops.
	9, 12	Maximum bus stop distance (miles). *Calculation*: The maximum bus stop distance is determined by the size of the smallest buffer that covers the entire zone (for practical reasons the threshold is 97% of the zone). The value is set to 999 for zones with a minimum distance of 999 or is set to 1.1 if no buffer meets the coverage threshold and the minimum distance is not 999.
	10, 13	Proportion of the zone within minimum walking distance. *Calculation*: This value is calculated as the area of the zone covered by the minimum distance buffer divided by the area of the zone covered by the maximum distance buffer. This value is set to 999 for zones with a minimum distance of 999.

Three separate DISTR files are used: HO_DISTR.TXT, HW_DISTR.TXT and NH_DISTR.TXT. As with the M01 file, two separate formats of the DISTR file are created, including one for home-based work trips and one for the other trip purposes. The only difference between the formats is that the feeder bus fields (11-13) are all set to 999 for the home-based other and nonhome-based files.

M023 file

The M023 file contains transit fare and auto operating cost data used by the pre-distribution and mode choice models. The cost data reflect 2019 values. The file is composed of six records, including:

- CTA fares
- Pace feeder bus fares
- Pace regional bus fares
- Auto operating costs in 5-mile-per-hour increments for speeds between 0-40 miles per hour
- Auto operating costs in 5-mile-per-hour increments for speeds between 40-80 miles per hour
- Average auto operating costs per-mile-by-zone-type used to estimate transit access/egress costs

The CTA fares used in the M023 file are:

- Bus boarding fare is $1.51
- Rail transit boarding fare is $1.70
- First transfer is $0.19
- Link-Up pass per ride is $1.38 (approximately equal to $55 monthly cost divided by 40 trips per month)

The Pace fares used in the M023 file are:

- Feeder bus boarding is $1.38 (assumes Link-Up pass)
- CBD feeder bus fare is $0.00 (fare calculations revised and no longer used)
- Pace current regular fare is $1.58
- Pace first transfer is $0.24

Auto operating costs were updated to reflect current fuel consumption and the current costs of tires, maintenance, and gasoline. These costs were derived from two sources. A 2016 publication by AAA was the source for the per-mile costs of auto maintenance and tires. These values were adjusted to 2019 using the Consumer Price Index. Figures on the average gasoline consumption per mile were obtained from the U.S. Energy Information Administration. A $3.00 per gallon gasoline cost was assumed to convert the gasoline consumption into a cost per mile. The resulting costs per mile for auto travel are listed in **Table 24**.

Table 24: M023 file auto operating costs

Cents per mile

Miles/ Hour	Fuel Used Gallons/Mile	Gasoline (@$3.00/Gal)	Tires	Maintenance	Total
0-5	0.060	18.08	1.06	5.62	24.76
5-10	0.049	14.69	1.06	5.62	21.37
10-15	0.041	12.43	1.06	5.62	19.11
15-20	0.036	10.74	1.06	5.62	17.42
20-25	0.032	9.61	1.06	5.62	16.29
25-30	0.030	9.04	1.06	5.62	15.72
30-35	0.030	9.04	1.06	5.62	15.72
35-40	0.030	9.04	1.06	5.62	15.72
40-45	0.030	9.04	1.06	5.62	15.72
45-50	0.029	8.76	1.06	5.62	15.44
50-55	0.029	8.76	1.06	5.62	15.44
55-60	0.029	8.76	1.06	5.62	15.44
60-65	0.031	9.32	1.06	5.62	16.00
65-70	0.034	10.17	1.06	5.62	16.85
70-75	0.037	11.02	1.06	5.62	17.70
75-80	0.040	11.87	1.06	5.62	18.55

The last record in the file contains the average per mile auto operating cost for each of the four zone types (defined in the M01 file). The M023 data is collapsed into six records, which are shown in Table 25. All values are reported in cents.

Table 25: M023 file layout

	Field Locations							
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	35-40
CTA Fares	151	170	19	138				
Feeder Bus Fares	138		0					
Pace Fares	158		19					
Auto Operating Costs by 5 MPH	2476 1572	2137 1544	1911 1544	1742 1544	1629 1600	1572 1685	1572 1770	1572 1855
Auto Operating Costs by Zone Type	2000	1700	1500	1500				

CBD parking file

CBD parking costs also are important to the mode choice and distribution models. A database of selected central area parking facilities is used to provide parking cost distribution information to the composite cost and mode choice models. The specification of the variables and fields is described in CATS Working Paper 95-01. Files are generated for use by both the -pre-distribution and mode-choice models. The parking supply database currently is treated as a fixed input unless a scenario is testing the effect of downtown parking costs on regional mode choice.

There are two different CBD parking files. The first file identifies the parking supply characteristics of each Central Area zone that contains parking. Each zone in this set has five records with the following information:

- Central Area parking zone number
- The probability of finding parking within the zone at or below the threshold parking cost (this value must be 100 percent in each zone's fifth record)
- The threshold parking cost in cents per hour
- The savings in parking costs in cents per hour determined by subtracting the threshold parking cost from the maximum parking cost in the zone
- The amount of time needed to walk one block in the CBD (180 seconds)

A sample of the parking supply records for CBD zone 5 is displayed in **Table 26**. Note the maximum cost to park in this zone was identified as $6.00 ($48.00 per eight-hour day).

Table 26: CBD Parking File 1 — sample parking supply records

CBD Parking Zone	Parking Probability (0.0001)	Threshold Cost (cents/hour)	Cost Savings (cents/hour)	Walk Speed (seconds/block)
5	2000	153	447	180
5	3000	154	446	180
5	6000	178	422	180
5	8000	311	289	180
5	10000	600	0	180

The parking supply records were updated using the following procedures. A website for downtown parking availability (bestparking.com) provided data for these values. Off-street parking facilities were organized by Central Area parking zones. The least costly daily rate for each facility was determined using either the early bird daily rate, daily rate, hourly rate multiplied by nine hours, or a monthly rate divided by 20 workdays. Each parking facility in a zone was assumed to have the same selection probability. Probabilities of facilities in the same zone and with the same best daily rate were combined. Cumulative rate probabilities for each zone were then totaled from least to most expensive parking facility and the cost savings compared to the most expensive facility in each zone were calculated. Five parking supply records were created from the parking probabilities and threshold costs. In zones with many off-street parking locations, threshold costs were selected to yield nearly equal probability intervals.

User characteristics are important to the cost paid for parking, and they were updated in 2020 using data from the My Daily Travel survey. These characteristics include the percentage of people who have access to free parking, and the percentage of trips by auto occupancy. Both characteristics are stratified by income. While it may seem curious to input quantities that are estimated by the models, these travel characteristics are needed to compute the free versus pay CBD parking and the parking costs per person. Given their role in the cost calculations, they only need to be rough estimates based on observed travel.

The user characteristics are included in the second CBD parking file. There are only five records in this file. These records are ordered by household income ranges and include the following variables for Central Area commuters:

- The upper value of the household income quintile range (last record is the lower bound of the highest quintile)
- The percentage of Central Area auto commuters with free parking
- The percentage of all Central Area workers taking transit to the Central Area
- The percentage of Central Area auto commuters in single-occupant vehicles
- The percentage of Central Area auto commuters ridesharing in two-person vehicles
- The percentage of Central Area auto commuters carpooling in three-person vehicles
- The percentage of Central Area auto commuters carpooling in four-or-more-person vehicles.

The user characteristics are shown in **Table 27**. Most of the values do not change with income. This is due to the limited sample of Central Area parkers found in My Daily Travel.

Table 27: CBD Parking File 2 user characteristics

			Auto Occupancy			
Income Quintile	Park Free	Transit	One	Two	Three	Four or More
29999	32.6	41.3	85.4	10.1	0.8	3.7
59999	32.6	43.5	85.4	10.1	0.8	3.7
99999	32.6	53.9	85.4	10.1	0.8	3.7
149999	32.6	53.6	85.4	10.1	0.8	3.7
150000	32.6	49.1	85.4	10.1	0.8	3.7

Monte Carlo simulation

A major source of inaccuracy in travel demand modeling is the use of average values, such as the average cost of parking in a traffic analysis zone or the average income of the traveler. The CMAP/CATS travel demand analysts recognized this potential source for inaccuracy early, perhaps, before anyone else was aware of the problems that could be generated by using average values. The solution was to identify the major areas affected by average values and use a method that would "convert" the average values into individual values. This methodology is called a Monte Carlo simulation technique, and, after the Chicago application, the technique also was used in the Dallas-Fort Worth region and the Cleveland region. Presently, Monte Carlo simulation is used widely in travel demand modeling practices.

A Monte Carlo simulation focuses on selecting a representative value for a measure with this value being selected at random from a distribution of potential values. **Table 29** shows an example where 1,000 parking spaces are spread out over six parking garages in an area, with each lot having the following characteristics.

Table 28: Monte Carlo example

Parking Lot	Spaces	Daily Cost	Probability
A	150	$3.50	0.150
B	175	$3.75	0.175
C	275	$3.25	0.275
D	75	$1.25	0.075
E	150	$3.50	0.150
F	175	$3.25	0.175

In this case, the weighted average parking cost for the 1,000 spaces is $3.26. But a few "lucky" people (7.5 percent) could park for $1.25 and some "unfortunate" people (17.5 percent) have to pay $3.75. The difference between the average cost and the low cost is $2.00 while the difference between the average cost and the high cost is 50 cents. These differences are substantial given that a major determinant of mode use is the cost of using the mode. In a Monte Carlo simulation, a specific parking lot would be "selected" using a random number draw. The probability of being selected is a function of a relative parameter — in this case, the number of spaces. Therefore, the inexpensive parking lot would be selected 7.5 percent of the time, while the most expensive lot would be selected about 17.5 percent of the time.

Throughout the CMAP trip-based model, Monte Carlo simulation is used to determine several components of the submodels. **Table 29** summarizes how Monte Carlo simulation is used.

Table 29: Monte Carlo simulation applications

Model	Monte Carlo Applications

Trip Generation	Selection of household workers who work-from-home. Work-from-home frequency for workers who telecommute less than five days a week. Selection of survey household to use for trip enumeration.
Mode-Destination Choice	Traveler’s household income. Distances to available approach modes for transit access. Distances to available departure modes for transit egress. Parking costs. Walk distance from parking lot to destination. Final selection of destination and mode.
Time-of-day	Selection of time period for trip.

Population synthesis

CMAP uses an open platform for population synthesis called PopulationSim to generate a synthetic population for the modeling region for 2010 — the UrbanSim base year. PopulationSim generates household weights that satisfy marginal control distributions using entropy maximization-based list balancing. It then expands households using these weights to create a full synthetic population. The file, **HH_IN.TXT** (Table 30), provides the marginal control distributions for various attributes at the household and person level. The number of households and building types are specified at the subzone level. Household size bin counts are specified at the regional level. The remaining attributes are specified at the zone level. Data from the 2008-2012 PUMS is used for the disaggregate population sample, or seed data. A geographic crosswalk is used to provide a correspondence between subzones, zones, and PUMAs.

Once the synthetic distribution has been developed, an output file, called **POPSYN_HH.TXT**, is created to provide the relevant information needed by the trip generation model. The variables in this file are listed in **Table 31**. This file provides the household information the trip generation model will use to create trips for each enumerated household.

Populations for model years 2019-2050 come from UrbanSim. A script converts UrbanSim household and person output tables to the tables required by the trip-based model. To guide the evolution of the 2010 population through 2050, household control tables are developed and provided as inputs to UrbanSim for each year between 2010 and 2050. To produce the household counts at the disaggregate level required for the model, synthetic populations are created for every fifth year between 2010 and 2050. Marginal control distributions for these future-year populations come from the CMAP demographic model. All attributes are specified at the sub-regional level except for the number of households, which is specified at the subzone level, as required by the population synthesizer. Since the household totals are only provided by the demographic model at the sub-regional level, the base-year distribution of subzone households is preserved through 2050.

Table 30. HH_IN.TXT input file

Variable	Description	Format
SUBZONE	The trip generation subzone, which must be in sequence in the file from low to high values.	Integer (1-25000)
SUBZONE HOUSEHOLDS	Number of households in the trip generation subzone.	Integer
ADULTS	Total adults (sixteen and older) in the subzone.	Integer
WORKERS	Total adult workers in the subzone.	Integer
CHILDREN	Total children (fifteen and younger) in the subzone.	Integer
INCOME CATEGORY 1	Census income data in 2019 dollars: Households in category 1 (under $30,000)	Integer
INCOME CATEGORY 2	Households in category 2 ($30,000 - $59,999)	Integer
INCOME CATEGORY 3	Households in category 3 ($60,000 - $99,999)	Integer
INCOME CATEGORY 4	Households in category 4 ($100,000 and over)	Integer
AGE OF HOUSEHOLDER CATEGORY 1	Households in subzone where head of household is under 35	Integer
AGE OF HOUSEHOLDER CATEGORY 2	Households in subzone where head of household is 35-64	Integer
AGE OF HOUSEHOLDER CATEGORY 3	Households in subzone where head of household is 65 and older	Integer
HOUSEHOLD SIZE 1	Number of 1-person households	Integer
HOUSEHOLD SIZE 2	Number of 2-person households	Integer
HOUSEHOLD SIZE 3	Number of 3-person households	Integer
HOUSEHOLD SIZE 4	Number of 4-person households	Integer
HOUSEHOLD SIZE 5	Number of 5-person households	Integer
HOUSEHOLD SIZE 6	Number of 6-person households	Integer
HOUSEHOLD SIZE 7	Number of 7-or-more-person households	Integer
BUILDING TYPE 1	Households of building type 1 (mobile home or trailer)	Integer
BUILDING TYPE 2	Households of building type 2 (One-family house detached)	Integer
BUILDING TYPE 3	Households of building type 3 (One-family house attached)	Integer
BUILDING TYPE 4	Households of building type 4 (2 apartments)	Integer
BUILDING TYPE 5	Households of building type 5 (3-4 apartments)	Integer
BUILDING TYPE 6	Households of building type 6 (5-9 apartments)	Integer

BUILDING TYPE 7	Households of building type 7 (10-19 apartments)	Integer
BUILDING TYPE 8	Households of building type 8 (20-49 apartments)	Integer
BUILDING TYPE 9	Households of building type 9 (50+ apartments)	Integer
BUILDING TYPE 10	Households of building type 10 (boat/RV/van/etc.)	Integer
RACE/ETHNICITY CATEGORY 1	White (not Hispanic) population	Integer
RACE/ETHNICITY CATEGORY 2	Black (not Hispanic) population	Integer
RACE/ETHNICITY CATEGORY 3	Asian (not Hispanic) population	Integer
RACE/ETHNICITY CATEGORY 4	Hispanic/Latino (any race) population	Integer
RACE/ETHNICITY CATEGORY 5	Other/multiple race (not Hispanic) population	Integer
PRIVATE AUTO COMMUTE MODE SHARE	This is the ratio between the workers in the subzone who commute by auto (single occupant vehicles, carpool, and taxi) divided by the workers in the subzone.	Real number
SIDEWALK DENSITY	Miles of sidewalk per square mile from CMAP's regional sidewalk inventory – a measure of pedestrian friendliness	Real number

Table 31. POPSYN_HH.CSV output file

Variable	Description
SUBZONE	The trip generation subzone.
HHTYPE	Household type code for the synthetic household – one of 624 values based on the combination of Adults-Workers-Children-Age of Householder and Income Index (see Trip Generation section).
VEHICLES	Number of vehicles available in the synthetic household (PUMS data)
SERIALNO	Unique identifier assigned to the household in the ACS data.
STPUMA5	Concatenation of the State FIPS code and the 5% PUMA number.
ROWCOL	Variable identifying the location of the synthetic household in the region: 1 = Inner Chicago 2 = Outer Chicago and Inner Suburbs 3 = Mid Suburban 4 = Fringe and External Areas
ADULTS	Number of adults in the synthetic household.
WORKERS	Number of workers in the synthetic household.

CHILDREN	Number of children in the synthetic household.
INCOME CATEGORY	Income category for synthetic household (2019 dollars): 1 = under \$30,000 2 = \$30,000 - \$59,999 3 = \$60,000 - \$99,999 4 = \$100,000 and over
AGE CATEGORY	Age of head of householder for synthetic household: 1 = householder age 16-34 2 = householder age 35-64 3 = householder age 65+
HHVTYPE	Household vehicle type code for the synthetic household – one of 624 values based on the combination of Adults-Workers-Children-Age of Householder and Vehicles Available (see Trip Generation section).
INCOME	Household income of the synthetic household (in 2019 dollars).

Trip generation

Trip generation is the first of the four sequential steps used by CMAP to forecast travel behavior. It is the means by which land use planning/zoning quantities, such as households and employment, are converted into trip origins and destinations that serve as transportation demand measures. The trip generation process links the region's current and forecasted socioeconomic characteristics — the variables that drive travel demand — with the remaining sequential steps used to estimate choices of a trip destination, its mode, and route.

Trip generation is based upon an enumeration of all households in the study area. Each trip generation subzone is populated fully with specific households drawn from CMAP's My Daily Travel survey to meet desired criteria. Since the household sample is small relative to total regional households, a survey household may appear multiple times in the same subzone. Trips reported by these households are used, instead of the typical trip generation methodology, based upon trip generation rates. This approach eliminates the intermediate step of estimating trips generated per person or household.

As the trip generation model software executes, it creates temporary files of households tabulated by composition, income, and vehicle ownership. These files have value beyond their role in trip generation. For example, these household files might prove useful in studies dealing with issues of social and economic justice related to alternative transportation investments. The code was revised to allow users to save these intermediate datasets.

To account for observed and projected changes in work-from-home behavior, two targets are set for work-from-home behavior for each model years: the overall share of workers who usually work-from-home ("usualwfh") and the overall share of workers who work remotely one to four a week ('tc14'). These targets are implemented through a process that uses person and household attributes from the synthetic population to flag workers as working from home five or more days a week, working from home one to four days a week, or not working from home.

Attributes used in determining work-from-home status are means of transportation to work, household income, worker industry, and worker education level. Inputs into the process define relationships between variables (see **Table 32**). Data for these files came from analysis of work-from-home workers in travel survey data and 2015-2019 PUMS data.

Table 32. Work-from-home model inputs

Name	Description
incdist	Defines distributions of workers across income bins for 'low' and 'high' income industries.
indusmix	Defines distribution of workers across industries for each work-from-home group (usualwfh and tc14)
indp_naics	NAICS2 and SIPP crosswalk

lowlist	List of NAICS2 industries where <60% of work-from-home workers are in the highest income group. Corresponds to the 'low' distribution in incdist.
highlist	List of NAICS2 industries where >=60% of work-from-home workers are in the highest income group. Corresponds to the 'high' distribution in incdist.
eduw	List of education weights for the usualwfh group in order of ascending education level.
eduwtc	List of education weights for the tc14 group in order of ascending education level
tcportions	Distribution of work-from-home days within tc14 group in ascending day order.(1 day per week at home, 2 days, etc.)

The final output file, called **HH_WFH_STATUS.CSV**, assigns a work-from-home status to each household. Since the relevant information for the travel model is whether workers worked from home on the modeled day, workers who work-from-home one to four days a week are assigned work-from-home probabilities based on the "tcportions" input, and then a random number is used to determine final assignments.

Table 33. HH_WFH_STATUS.CSV output file

Variable	Description	Data type
SERIALNO	Unique identifier assigned to the household in the ACS data.	INT
FLAG	Work-from-home status for the household. 1 = at least one worker with 'usualwfh' status in household 2 = at least one worker with 'tc14' status in household that is working on the modeled day, and no workers with 'usualwfh' status in household	INT
WFHWORKERS	Number of people working from home in the household on the modeled day	INT
TC14NW	Flag to indicate if there are tc14 workers in the household that are not working on the modeled day 0 = no people in this category 1 = at least one tc14 worker present who is not working	INT

Model processing steps

The revised trip generation model has a linear logic identical to past versions of the model. This logic also corresponds to subroutines in the model's FORTRAN code. The main processing steps in the model are briefly summarized below.

Model control keywords

A number of important parameters (displayed in **Table 35**) are supplied to the FORTRAN code through the file **TG_INPUT.TXT**. These keywords are read from the file and control the operation of the program, including whether to generate trips or only populate the trip generation subzones with ACS PUMS households. The keywords are checked for internal consistency. The file **TG_OUTPUT.TXT** that generates reports as the program executes is opened.

Table 34. Trip generation input file parameters

Variable	Description	Model Run Values
TITLE	An 80-character name identifying the model run enclosed in single quotes	
SUBZONES	Number of trip generation subzones in the study area	17418
PUMA5	Number of Census 2010 five percent sample PUMAs in the modeled study area	74
ZONES	Zones used in the remaining CMAP models for trip distribution (linking of trip ends into trips between zones), mode choice (allocation of trips to travel modes), and assignment (allocation of trips to highway and transit routes)	3632
COUNTIES	Number of counties in the study area	21
TRIPGEN	A true/false variable: When true the program will populate trip generation subzones with CMAP survey households and estimate trip productions and attractions (must be TRUE)	True
HHENUM	A true/false variable: When true the program will populate trip generation subzones with ACS PUMS households without estimating trips (must be FALSE – this functionality is no longer supported)	False
SAVE_FILE	A true/false variable that causes all intermediate program files to be retained after the model run is completed	True
EXP_TTYPE	A true/false variable: When true, all files and reports include 49 trip types based upon trip purposes in the CMAP household travel survey. When false, files and reports have the eleven trip types formerly used by CMAP	True
SYNTH_VEH	A true/false variable: When true, the available household vehicles developed through the population synthesizer are used. When false, the vehicle availability submodel is used to estimate vehicles available for each household	False
MODE_CHOICE	A true/false variable: When true, creates a file used by the Mode Choice model.	True
IN_EMPFACT	Employment in Indiana is multiplied by this factor. This variable and the following one for Wisconsin are included to offset possible systematic differences in employment definitions and estimation methods between CMAP and neighboring MPOs	1.0
WI_EMPFACT	Employment in Wisconsin is factored by this value	1.0
SWIDX_MAX	Maximum value used by the vehicle availability submodel for subzone sidewalk density (miles of sidewalk per square mile) – this value replaces the Pedestrian Environment Factor	40.0
REPLICATE_MAX	Maximum number of times a specific survey household can be matched to a synthetic household before resampling occurs	1900

RESAMPLE_MAX	Maximum number of times resampling will occur if a survey household has reached Replicate_max	100
GQ_ATT1	List of group quarters attributes for persons in military barracks: workers per person, work trip rate and share of motorized work trips (set to 1.0 as non-motorized factoring is no longer implemented in Trip Generation)	1.00,2.00,1.00
GQ_ATT2	List of group quarters attributes for persons in dormitories	0.385,0.770,1.000
GQ_ATT3	List of group quarters attributes for others ages 16-64	0.306,0.612,1.000
GQ_ATT4	List of group quarters attributes for others ages 65 and older	0.12,0.24,1.00
RNSEED	The program uses random numbers in the process that selects households to populate subzones. This keyword allows the user to repeat the same sequence of random numbers when set to a positive value	211

Study area geography

The trip generation model uses the geographic input file **GEOG_IN.TXT**, to define various geographies. Arrays defining the study area geography — trip generation subzones, zones, PUMAs, counties, etc. — are loaded and cross-referenced.

Table 35. GEOG_IN.TXT input file

Variable	Description	Format
SUBZONE	The trip generation subzone, which must be in sequence in the file from low to high values.	Integer (1-25000)
COUNTY	A five digit code identifying the county where the subzone is located. The first two digits are the state Federal Information Processing Standards (FIPS) code for the state and the remaining three digits are the county FIPS code. (Example: DuPage County is 17043).	Integer (1-99999)
COUNTY NAME	Ten character county name enclosed in double quotes.	Alphanumeric
STATE	Two character state code enclosed in double quotes.	Alphanumeric
FIVE PERCENT PUMA	Five digit numeric code for five percent PUMAs (2010 Census).	Integer (1-99999)
ZONE	Modeling zone.	Integer (1-5000)
CHICAGO	Variable is set to 1 when trip generation subzone is inside Chicago; 0 elsewhere.	Integer (0 or 1)

CBD	Variable is set to 1 when trip generation subzone is inside the Chicago CBD; 0 elsewhere. The first forty-seven trip generation subzones presently make up the Chicago CBD.	Integer (0 or 1)
ROW-COLUMN	Variable identifies the portion of the region that previously provided the tables of cross-classified households for the procedure to disaggregate households within smaller trip generation subzones. 1 = Inner Chicago 2 = Outer Chicago and Inner Suburbs 3 = Mid Suburban 4 = Fringe and External Areas	Integer (1-4)
AREA	Area of the trip generation subzone in square miles.	Real Number
CMAP	Variable is set to 1 when trip generation subzone is inside the CMAP planning area; 0 elsewhere.	Integer (0 or 1)

Household Type Table

Within the trip generation model households are classified by one of 624 different categories (HHTYPE) defined by the composition of the household. Households initially are cross classified by:

- Adults [1, 2, 3, 4, or more adults]
- Workers [0, 1, 2, 3, or more workers]
- Children 15 years and younger [0, 1, 2, 3 or more children]
- Income categories
- Age of householder [16-34, 35-64, or 65 and older categories].

Workers include all employed persons (classes of worker 1 through 8 in the 2014-18 PUMS person file), a small number of family business, or farm unpaid workers. Six hundred and twenty-four different types of households are possible with this scheme. This is less than all possible combinations of the household stratifying variables because of the constraint that households must have a number of adults that is equal to or greater than the number of workers. Thus, there are only 13 possible combinations of adults and workers (rather than 16) as shown in **Table 37**.

Table 36. Adult-worker household types

		Adults in Household			
		1	2	3	4 or more
	0	1	2	3	4
	1	5	6	7	8
	2		9	10	11

Workers in Household	3 or more			12	13

The 13 adult-worker categories provide a key to the numbering of all 624 categories. The adult-worker categories are nested within the other stratifying variables of age of householder, income quartile and number of children. **Table 38** shows the complete list of household-type definitions.

Table 37. Household-type definitions

Householder ≤ 34			35 ≤ Householder ≤ 64			Householder ≥ 65		
Household Type	Children	Income Category	Household Type	Children	Income Category	Household Type	Children	Income Category
1-13	0	1	209-221	0	1	417-429	0	1
14-26	1	1	222-234	1	1	430-442	1	1
27-39	2	1	235-247	2	1	443-455	2	1
40-52	3+	1	248-260	3+	1	456-468	3+	1
53-65	0	2	261-273	0	2	469-481	0	2
66-78	1	2	274-286	1	2	482-494	1	2
79-91	2	2	287-299	2	2	495-507	2	2
92-104	3+	2	300-312	3+	2	508-520	3+	2
105-117	0	3	313-325	0	3	521-533	0	3
118-130	1	3	326-338	1	3	534-546	1	3
131-143	2	3	339-351	2	3	547-559	2	3
144-156	3+	3	352-364	3+	3	560-572	3+	3
157-179	0	4	365-377	0	4	573-585	0	4
170-182	1	4	378-390	1	4	586-598	1	4
183-195	2	4	391-403	2	4	599-644	2	4
196-208	3+	4	404-416	3+	4	612-624	3+	4

The file, **PUMS_HHTYPE_IN.TXT,** is read into the trip generation model and is used to define the 624 household types. Household income categories were derived from the household income options available in the My Daily travel survey.

Table 38. PUMS_HHTYPE_IN.TXT input file

Variable	Description	Format
HOUSEHOLD TYPE	Code indicating cross-classification of household (as per numbering in Table 3).	Integer (1-624)
ADULTS IN HOUSEHOLD	Coded 1, 2, 3, or 4 with code 4 equal to 4 or more.	Integer (1-4)
WORKERS IN HOUSEHOLD	Coded 0, 1, 2, or 3 with code 3 equal to 3 or more.	Integer (0-3)
CHILDREN IN HOUSEHOLD	Coded 0, 1, 2, or 3 with code 3 equal to 3 or more.	Integer (0-3)
HOUSEHOLD INCOME QUARTILE	Coded 1, 2, 3, or 4 from low to high income categories (in 2019 dollars). 1 = under $30,000 2 = $30,000 - $59,999 3 = $60,000 - $99,999 4 = $100,000 and over	Integer (1-4)
AGE OF HOUSEHOLDER CODE	Age of head of householder index: 1 = householder age 16-34 2 = householder age 35-64 3 = householder age 65+	Integer (1-3)

Load synthetic households

The synthetic households from UrbanSim are read into the program, populating each subzone with a list of unique households identified by household type. These are stored in **POPSYN_HH.CSV**.

Household vehicle availability

The household vehicle ownership sub-model is applied to estimate the vehicle ownership levels for each household. This effectively adds an additional dimension (vehicles available in the household) to the cross-classification of households. Household types are redefined with vehicle availability, replacing income quartile.

The household vehicle availability sub-model is a discrete choice logit model similar to models that predict mode choice behavior. There are three or four possible vehicle level choices for each household, depending on the number of adults (workers plus nonworking adults) in the household. Single-adult households may have zero, one, or two or more vehicles. Larger households have the alternatives of zero, one, two, or three or more vehicles.

Each vehicle availability level has an associated utility. In these logit models, utilities are weighted linear combinations of household and subzone variables that have been entered or developed in earlier steps. Model estimation consists of determining which variables best explain observed vehicle availability levels and the relative importance of these variables in the utility expressions. The utilities also may include bias constants that indicate preferences toward certain vehicle availability levels that are not otherwise accounted for by the utility expressions.

The vehicle availability sub-models have the following general form:

$$\text{Prob}\{\text{Vehicle Availability Level } i\} = \frac{e^{u_i}}{\sum_i e^{u_i}}.$$

Where u_i is the utility of household vehicle availability level *i*, which is computed by the linear equation:

$$u_i = \sum_j \alpha_{ij} H_j + \beta_i.$$

For these utility equations:

1. The model coefficient α_{ij} is the weight attached to the *j*'th independent household variable for household vehicle availability level *i*.
2. H_j is the *j*'th independent household variable (number of workers in household, household income quartile, etc).
3. The constant β_i is the bias toward vehicle availability level *i*, and it must equal zero for at least one alternative.

Model coefficients for the sub-models were estimated with data from the CMAP Travel Tracker survey. After completing estimation, several incremental changes to the sub-models were introduced. This includes some model coefficients were similar for different levels of vehicle availability and the utility equations were modified to replace these multiple coefficients with a single coefficient across utility equations. Two, a few marginally significant model coefficients became insignificant and were dropped. Lastly, a complete set of bias coefficients for location and age of householder were estimated.

Model calibration was completed by adjusting bias coefficients, so that estimated and observed levels of household vehicle ownership matched within the study area. Additional bias constants also were included to account for the new age of householder household variable. The modified vehicle availability sub-models finally were coded into the CMAP trip generation model code. For the travel model update, the original pedestrian environment factor (PEF) was replaced with the sidewalk density index (SDI), which was capped at the same maximum value as the PEF. The PEF was a walkability metric estimated from street network data provided by NAVTEQ. The SDI is derived from CMAP's 2018 Regional Sidewalk Inventory and measures the miles of sidewalk per square mile. However, only 86 percent of the modeling subzones, located exclusively in the seven-county area, have data from this inventory. For those subzones, SDI is equal to of subzone area. For the remaining subzones, the SDI value is estimated based on a linear regression model using the former walkability metric.

The vehicle availability sub-model was not re-estimated, as it still provides a good match to observed data. The following table lists the coefficients in the logit equation utilities that comprise the household vehicle availability sub-model. Separate models were estimated and calibrated for three different sized households defined by the total adults (workers plus nonworking adults) in the household. Each line in the table lists the model coefficients for estimating the utility attached to that level of vehicle availability for one of the three household type models.

Table 39. Vehicle availability sub-model coefficients

	One Adult Household Vehicle Availability			Two Adult Household Vehicle Availability				Three or More Adult Household Vehicle Availability			
Variable	0	1	≥ 2	0	1	2	≥ 3	0	1	2	≥ 3
Sidewalk Density Index (Maximum=40)	0.0616	0.0319		0.1280	0.0631	0.0336		0.1703	0.0659	0.0659	
Workers?											
≥ 1 (0/1)		0.4731	0.4731			0.6940	0.6940		1.114	1.114	1.114
≥ 2 (0/1)						0.5198	0.5198			0.7934	0.7934
≥ 3 (0/1)											1.389
Income Quartile?											
≥ 2 (0/1)		1.182	1.766		1.702	2.466	2.466		0.9492	1.487	1.487
≥ 3 (0/1)		0.9910	1.690			0.8650	0.8650			0.8723	1.571
= 4 (0/1)			0.467			0.4517	0.8827			1.390	1.834
Commute Auto Mode Share		4.677	4.677			5.284	5.284			4.959	4.959
Nonworking Adults											0.1491
Children?											
≥ 1 (0/1)						0.2218					
Household Location Bias											
1. Inner Chicago		-2.600	-5.077		2.018	-2.827	-4.393		2.806	-1.836	-1.631
2. Rest of Chicago and Inner Suburbs		-2.676	-4.823		2.259	-2.637	-3.944		2.552	-2.139	-1.789
3. Mid-Suburbs		-2.869	-4.914		2.151	-2.728	-4.126		1.547	-2.783	-2.668
4. Far Suburbs and Fringe		-3.082	-4.984		1.925	-3.144	-4.302		2.272	-2.430	-2.278
Age of Householder Bias											
16-34		0.392	0.394		0.392	0.394	0.403		0.392	0.394	0.403
35-64		0.401	0.465		0.401	0.465	0.574		0.401	0.465	0.574
≥ 65		0.249	0.218		0.249	0.218	0.007		0.249	0.218	0.007

The vehicle availability sub-model is applied to each of the enumerated households. The household type variable is then revised to include household vehicle availability (HHVTYPE). It has the same structure as the original household type variable listed in **Table 37**, except that four levels of vehicle availability (0, 1, 2 or 3 or more vehicles) replace the income quartile value. At the conclusion of the vehicle availability model, the file, **SIMULATED_HHVEH.TXT,** is written to store the category of simulated vehicles available for each household, so that it can be used in the trip enumeration process. The contents of this file are displayed in **Table 41** below.

Table 40. SIMULATED_HHVEH.TXT

Variable	Description
PUMS SERIAL NUMBER	PUMS household serial number for the enumerated household
VEHICLE AVAILBILITY CATEGORY	Simulated vehicle availability category for the enumerated household: 0=0 vehicles, 1=1 vehicle, 2=2 vehicles, 3=3+ vehicles
RECORD NUMBER	The record number of the household in POPSYN_HH.CSV

Once the number of household vehicles has been simulated, the next step is separating work-from-home households from households that have no workers working from home. Each group of households is stored as a separate array, so it can be processed. The file, HH_WFH_STATUS.CSV, which was created by the work-from-home allocation model, is used to determine which group each household belongs to.

Household trip productions and attractions

The subzones have been populated with the households from the population synthesis. The next step is to pair each one with a comparable household from the My Daily Travel survey, so that actual trips can be assigned to specific households. Household trip generation can then be accomplished without the intermediate step of computing trip generation rates. **Table 42** below defines the 49 trip purposes recognized in the trip generation model.

Table 41. CMAP expanded trip purposes

Origin Activity	Destination Activity	Trip Code
Worker		
Home (P)	Workplace-Low Income Households (A)	1
	Workplace-High Income Households (A)	2
	Work-Related (A)	3
	School (A)	4
	Non-home or Work at Residences [visit] (A)	5
	Non-home or Work Not at Residences (A)	6
	Shop (A)	7
Work (P)	Non-home or Work at Residences [visit] (A)	8
	Non-home or Work Not at Residences (A)	9
	Shop (A)	10
Work (O)	Work (D)	11
Non-home or Work at Residences [visit] (O)	Non-home or Work at Residences [visit] (D)	12
	Non-home or Work Not at Residences (D)	13
	Shop (D)	14
Non-home or Work Not at Residences (O)	Non-home or Work at Residences [visit] (D)	15
	Non-home or Work Not at Residences (D)	16
	Shop (D)	17

Shop (O)	Non-home or Work at Residences [visit] (D)	18
	Non-home or Work Not at Residences (D)	19
	Shop (D)	20
Nonworking Adult Home (P)	School (A)	21
	Non-home at Residences (A)	22
	Non-home Not at Residences (A)	23
	Shop (A)	24
Non-home at Residences [visit] (O)	Non-home at Residences (D)	25
	Non-home Not at Residences (D)	26
	Shop (D)	27
Non-home Not at Residence (O)	Non-home at Residences (D)	28
	Non-home Not at Residences (D)	29
	Shop (D)	30
Shop (O)	Non-home at Residences (D)	31
	Non-home Not at Residences (D)	32
	Shop (D)	33
Child 12-15 Home (P)	School (A)	34
	Non-home at Residences (A)	35
	Non-home Not at Residences (A)	36
	Shop (A)	37
School (P)	Non-home at Residences (A)	38
	Non-home Not at Residences (A)	39
	Shop (A)	40
Non-home at Residences (O)	Non-home at Residences (D)	41
	Non-home Not at Residences (D)	42
	Shop (D)	43
Non-home Not at Residences (O)	Non-home at Residences (D)	44
	Non-home Not at Residences (D)	45
	Shop (D)	46
Shop (O)	Non-home at Residences (D)	47
	Non-home Not at Residences (D)	48
	Shop (D)	49

A file of travel survey households is read from **HI_HHENUM_IN.TXT.** This file has a serial number identifying the household, the household type, characteristics of the household, and trips made by the household during the weekday surveyed. Trips in this input file were tabulated in the same manner as earlier versions of the program. Trip files that were the basis for trip generation rates simply were resumed by household. Trip purpose definitions are unchanged and rules for the linking of trips are the same as in previous versions.

The end result is 48 different trip purposes, including 19 for workers, 13 for nonworking adults, and 16 for children between the ages of 12 and 15, as listed in the preceding table. Note that in the input file **HI_HHENUM_IN.TXT,** 49 trip purposes are allowed for the splitting of home productions-work attractions into home-work trips made by low and high income households by the trip generation model. The first trip purpose in the file includes all home productions to work attractions, while the second trip purpose serves as an empty placeholder.

Each non-work-from-home synthetic household is matched to a survey non-work-from-home household using the following process, which encompasses four mutually exclusive methods. These include:

1. If there are seven or more survey households with the same vehicle-based household type (HHVTYPE) within the resident PUMA, one of these households is selected randomly as the match (match category 1).

2. If there are less than seven survey households in the PUMA with the correct HHVTYPE, they are combined with households of the same type in the ring of adjacent PUMAs around the central PUMA. If this results in at least seven households of the specific type, one of these households in this larger group is selected randomly as the match (match category 2).

3. If there are less than seven survey households of the same type in the adjacent geography, but seven or more in the full study area, one of these households is selected randomly as the match (match category 3).

4. If there are less than seven survey households of the same type in the full study area, a final match category (match category 4) ensures all remaining households find a match in the survey households, regardless of how small the likelihood is that the household occurs. Households initially are categorized into 13 groups, which correspond to the combinations of adults and workers in the households. These groups then are subdivided based on the number of children in the household (0, 1, or 2+). Large groups (those with at least 500 households) are further subdivided based on the number of household vehicles (0, 1, or 2+). At this stage, groups with fewer than 20 households are recombined based on the adult-worker-Chcldren combinations. The end result is 43 household categories that all have a minimum of 20 households to select from.

A similar process is used to match synthetic work-from-home households to work-from-home survey households. A notable difference is work-from-home households are matched based on the resident PUMA and the household type based on income (HHTYPE) not the number of vehicles. Work-from-home matches use HHTYPE because a strong income component was discovered in analyzing these households for the work-from-home allocation model. These households use the same match priority as the non-work-from-home households. For the final match category, households are divided into groups based on the adult-worker combinations, the presence or absence of children, and the household income category. Groups with fewer than 20 households are aggregated based on the adult-worker-children combinations to achieve that minimum number of members. The result is 24 household categories to select survey households from.

Table 42. HI_HHENUM_IN.TXT input file

Variable	Description	Format
PUMA	A seven-digit code with the first two digits equal to the FIPS state code and the last five digits equal to the PUMA.	Integer (1700104-5550000)
HHVTYPE	The revised household type code based on vehicle availability in the survey household.	Integer (1-624)
SERIAL NUMBER	The eight-digit household code from the My Daily Travel.	Integer
ADULT	Number of adults in survey household.	Integer
WORKER	Number of workers in survey household.	Integer
NONWORKER	Number of non-workers in survey household.	Integer
CHILD	Number of children aged 0-15 in survey household.	Integer
CHILD 12-15	Number of children aged 12-15 in survey household.	Integer
VEHICLES	Number of vehicles available in survey household.	Integer
TRIPS1	Household's home production-work attraction trips.	Integer
TRIPS2	Empty placeholder.	Integer
TRIPS3	Household's home production-work related attraction trips.	Integer
….	….	….
TRIPS49	Household's shop-shop trips by child 12-15.	Integer

The processing of the survey households into match categories is handled outside of the trip generation model. The results are read into the model via files. Work-from-home households use the information in **HHID_choices1.csv** and **HHID_choices2.csv**. The first file, which fields are shown in **Table 43**, provides the following information: the resident PUMA, the household type code (HHVTYPE), the match category used (for tracking purposes), and the positions of the first and last potential households that can be matched against in the array in the second file. The second file (**HHID_choices2.csv**) is an array of household serial numbers that correspond to the set of households available within each match category. For this final match category, it lists the households available within each subgroup discussed above. Households within each selection category do not have an equal probability of being chosen. Household expansion weights from the My Daily Travel survey are used to develop a cumulative probability distribution within each selection category to better reflect observed household data and minimize the likelihood that extremely rare households replicate a large number of times during the enumeration process. The file also contains the probability of each household being selected from its match category.

Comparable files are used to enumerate trips for the WFH households (**HHID_wfh1.csv** and **HHID_wfh2.csv**). These contain the same fields as their counterparts; however, the household type identifier in the work-from-home version is HHTYPE. Two values in **TG_INPUT.TXT** help prevent individual survey households from being replicated an excessive number of times during the enumeration process. A maximum replicate value is provided. This is not a hard ceiling on the value but once a survey household has been selected this many times, it will trigger resampling of the synthetic household, up to the maximum number of iterations identified.

Table 43. HHID_choices1.csv input file

Variable	Description	Format
PUMA	A seven-digit code with the first two digits equal to the FIPS state code and the last five digits equal to the PUMA	Integer
HOUSEHOLD TYPE	Household vehicle type code (HHVTYPE)	Integer
MATCH CATEGORY	A numeric code identifying the household match methodology used to match the enumerated household with a survey household: 1 = household in PUMA 2 = household in adjacent PUMA 3 = household in region 4 = final match category	Integer (1-4)
CHOICES START	Identifies the start location in HHID_choices2.csv of the first potential household to match against based on PUMA-HHVTYPE	Integer
CHOICES END	Identifies the end location in HHID_choices2.csv of the final potential household to match against based on PUMA-HHVTYPE	Integer

Table 44. HHID_choices2.csv input file

Variable	Description	Format
SERIAL NUMBER	The eight-digit household code from the My Daily Travel survey	Integer
PROBABILITY	The cumulative probability (based on My Daily Travel household weights) of the specific household being selected within the PUMA-HHVTYPE category	Real

All enumerated synthetic households are written to the fixed-width output file **HI_HHENUM_TRIP_OUT.TXT** as they are selected. Trip productions and attractions are summed by subzone, organized, and reported as in previous versions of the trip generation model.

Table 45. HI_HHENUM_TRIP_OUT.TXT output file

Variable	Description	Format
SUBZONE	The trip generation subzone, which must be in sequence in the file from low to high values.	Integer (5 Characters)
PUMA	A seven digit code with the first two digits equal to the FIPS county code and the last five digits equal to the PUMA.	Integer (7 Characters) (
HHTYPE	The original income quartile household type code.	Integer (4 Characters) (1-624)
HHVTYPE	The revised vehicle availability household type code.	Integer (4 Characters) (1-624)
VEHICLES	Modeled household vehicles available	Integer (2 Characters)
ROW-COLUMN	Geographic identifier. 1 = Inner Chicago 2 = Outer Chicago and Inner Suburbs 3 = Mid Suburban 4 = Fringe and External Areas	Integer (2 Characters)
SERIAL NUMBER	Eight digit household serial number assigned to the household in the My Daily Travel survey.	Integer (8 Characters)
ADULT	Number of adults in survey household.	Integer (3 Characters)
WORKER	Number of workers in survey household.	Integer (3 Characters)
NONWORKER	Number of non-workers in survey household.	Integer (3 Characters)
CHILD	Number of children aged 0-15 in survey household.	Integer (3 Characters)
CHILD 12-15	Number of children aged 12-15 in survey household.	Integer (3 Characters)
SURVEY VEHICLES	Number of vehicles available in survey household.	Integer (3 Characters)
TRIPS1	Household's home-work trips by low income worker.	Integer (3 Characters)
TRIPS2	Household's home-work trips by high income worker.	Integer (3 Characters)
TRIPS3	Household's home production-work related attraction trips.	Integer (3 Characters)

….	….	….
TRIPS49	Household's shop-shop trips by child 12-15.	Integer (3 Characters)
PUMS SERIAL NUMBER	Thirteen digit household serial number from ACS data.	Integer (13 Characters)
MATCH CATEGORY	Matching method used to enumerate household trips.	Integer (1 Character)
WORK-FROM-HOME	Work from home flag for household.	Integer (1 Character)
INDEX LOCATION	Record number of household in POPSYN_HH.CSV.	Integer (8 Characters)

Group quarters trip generation

The CMAP survey did not specifically gather travel data from group quarters residences. The ACS does collect some limited information on persons in group quarters, including institutionalized and non-institutionalized persons. For trip generation, it is assumed institutionalized persons do not travel independently, which means group-quarters trip generation applies only to individuals in dormitories, military barracks, group homes, and the like. A second assumption is all children in group quarters are in institutions and do not travel independently.

As noted, four types of group quarters residents remain to be considered, including:

- Persons in military barracks
- Persons in college/university dorms
- Persons aged 16 to 64 in other types of group quarters
- Persons aged 65 or more in other types of group quarters

A trip generation subzone input file, called **GQ_IN.TXT**, containing workers and nonworking adults in non-institutionalized group quarters, is read by the program.

Table 46. GQ_IN.TXT input file

Variable	Description	Format
SUBZONE	The trip generation subzone, which must be in sequence in the file from low to high values.	Integer (1-25000)
GQ MILITARY	Persons in military barracks	Integer
GQ UNIVERSITY	Persons in college/university dormitories	Integer
GQ OTHER (16-64)	Persons in other group quarters aged 16 to 64	Integer
GQ OTHER (≥ 65)	Persons in other group quarters aged 65 and older	Integer

Group-quarters trip rates for non-work trips were developed using data from the My Daily Travel survey. These rates are read into the model via an input file. The format of the file is listed in **Table 48** below. Home-work trip rates were developed from the 2014-18 ACS PUMS person file, which provided the number of workers per person in group quarters and the home-work trip rate. Trip rates for group-quarters, non-work trips are the household survey rates for workers and non-workers in single person, low income, zero vehicle households.

Table 47. Group quarters trip rates

Variable	Description
TRIP TYPE	Type of trip production (3-33) – [home-work trip rates are read from TG_INPUT.TXT]
TRIP PRODUCTION RATE	My Daily Travel trip generation rate

Allocation of non-home trip ends

At this point in the logic of the CMAP trip generation model, all trips generated by persons residing inside the modeled study area (both in households and group quarters) are accounted for. Due to the synthetic household information, the location of the home end of each trip also is known. What remains to be determined is where the non-home trip ends are located. These are allocated to trip generation subzones in this step of the model.

To allocate an attractiveness share, a function of employment, households, or school enrollment (depending on the trip's purpose) is calculated for each subzone. Since Chicago's central business district is atypical in its mix of employment, subzones within the central business district are weighted differently from non-central-business-district subzones. After totaling the shares for all subzones, trip ends then are proportionally allocated to subzones by these shares. The input **ATTR_IN.TXT** is read into the model to supply the employment values necessary for the allocation.

Table 48. ATTR_IN.TXT input file

Variable	Description	Model Run Values
SUBZONE	The trip generation subzone, which must be in sequence in the file from low to high values.	Integer (1-25000)
RETAIL EMPLOYMENT	Retail employment in the trip generation subzone.	Integer
TOTAL EMPLOYMENT	Total employment in the trip generation subzone.	Integer
FRACTION OF HIGH EARNERS	The fraction of workers working in the subzone with earnings above the regional median worker earnings.	Real Number

The two employment quantities in **ATTR_IN.TXT** are derived from the employment data provided by UrbanSim. The fraction of higher income workers working in the subzone was estimated from the 2012-16 CTPP. Employment figures for Indiana and Wisconsin are factored by the control variables WI_EMPFACT and IN_EMPFACT immediately after the file is read. Weights for allocating non-home productions or origins are listed in **Table 49** below. The tables display coefficients that have been normalized since the values are only used to create relative weights for the allocations.

Table 50 is a similar table listing the weights used for allocating non-home attractions or destinations. These weights were updated using My Daily Travel survey data and **SCHOOL_IN**.**CSV**, a new input file of high school and university enrollment by subzone. SCHOOL_IN was developed specifically to guide the allocation of home-school trips for adults. It is comprised of data from the National Center for Education Statistics and the Illinois State Board of Education. It includes both public and private schools. Certain non-home trip ends (at residence, shop, school) are now restricted in subzones entirely within airport boundaries. After workplace attractions are allocated, they are factored into workplace attractions for workers with above and below median earnings by the factors in the **ATTR_IN.TXT** input data set.

Table 49. Allocation weights for origin non-home trip ends

				Employment Category					
		Households		**Retail**		**Non-Retail**		**Total**	
Origin activity	**Destination activity**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**
Worker (non-WFH)	Non-home/Work at Residence (A)							1.000	3.048
Work (P)	Non-home/Work Not at Residence (A)							1.000	0.765
	Shop (A)							1.000	1.901
Work (O)	Work (D)							1.000	1.837
Non-home/Work at Residence (O)	All Destinations (D)	1.000	1.401						
Non-home/Work Not at Residence (O)				1.000	0.401	0.050	0.097		
Shop (O)				1.000	1.129				
Worker (WFH)	Non-home/Work at Residence (A)							1.000	6.545
Work (P)	Non-home/Work Not at Residence (A)							1.000	2.525
	Shop (A)							1.000	4.900
Work (O)	Work (D)							1.000	2.059
Non-home/Work at Residence (O)	All Destinations (D)	1.000	1.010						
Non-home/Work Not at Residence (O)				1.000	0.963	0.038	0.195		
Shop (O)				1.000	1.227				
Nonworking Adult									
Non-home at Residence (O)	All Destinations (D)	1.000	1.281						

Non-home Not at Residence (O)				1.000	0.734	0.046	0.176		
Shop (O)				1.000	1.441				
Child 12-15									
School (P)	All Attractions (A)	1.000	2.599						
Non-home at Residence (O)		1.000	22.00						
Non-home Not at Residence (O)	All Destinations (D)				1.000		0.137	0.065	
Shop (O)				1.000	1.000				

Table 50. Allocation weights for destination non-home trip ends

				Employment Category						
		Households		**Retail**		**Non-Retail**		**Total**		
Origin activity	**Destination activity**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**	**CBD**	**Non-CBD**	**Enroll-ment**
Worker (non-WFH)										
Home (P)	Workplace (A)							1.000	0.755	
	Work-Related (A)			1.000	3.103	0.241	0.634			
	School (A)									1.000
	Non-home/Work at Residence (A)	1.000	1.132							
	Non-home/Work Not at Residence (A)			1.000	0.623	0.042	0.180			
	Shop (A)			1.000	1.430					
Work (P)	Non-home/Work at Residence (A)	1.000	2.309							
	Non-home/Work Not at Residence (A)			1.000	0.383	0.095	0.106			
	Shop (A)			1.000	1.882					
Work (O)	Work (D)							1.000	1.550	
All Origins (O)	Non-home/Work at Residence (D)	1.000	1.414							
	Non-home/Work Not at Residence (D)			1.000	0.401	0.051	0.099			
	Shop (D)			1.000	1.106					
Worker (WFH)										
Home (P)	Workplace (A)							1.000	0.755	
	Work-Related (A)			1.000	3.103	0.241	0.634			
	School (A)									1.000
	Non-home/Work at Residence (A)	1.000	0.567							
	Non-home/Work Not at Residence (A)			1.000	0.941	0.024	0.208			
	Shop (A)			1.000	0.938					
Work (P)	Non-home/Work at Residence (A)	1.000	0.738							

	Non-home/Work Not at Residence (A)			1.000	0.641	0.027	0.158			
	Shop (A)			1.000	0.556					
Work (O)	Work (D)							1.000	2.722	
All Origins (O)	Non-home/Work at Residence (D)	1.000	0.990							
	Non-home/Work Not at Residence (D)			1.000	0.938	0.036	0.189			
	Shop (D)			1.000	1.217					
Nonworking Adult										
Home (P)	School (A)									1.000
	Non-home at Residence (A)	1.000	1.173							
	Non-home Not at Residence (A)				1.000		0.263	0.088		
	Shop (A)			1.000	1.634					
All Origins (O)	Non-home at Residence (D)	1.000	0.985							
	Non-home Not at Residence (D)			1.000	0.754	0.047	0.180			
	Shop (D)			1.000	1.530					
Child 12-15										
Home (P)	School (A)	1.000	1.511							
	Non-home at Residence (A)	1.000	36.33							
	Non-home Not at Residence (A)			1.000	2.501	0.031	0.324			
	Shop (A)			1.000	1.000					
School (P)	Non-home at Residence (A)	1.000	16.44							
	Non-home Not at Residence (A)				1.000		0.922	0.058		
	Shop (A)			1.000	1.000					
All Origins (O)	Non-home at Residence (D)	1.000	16.44							
	Non-home Not at Residence (D)				1.000		0.922	0.058		
	Shop (D)			1.000	1.000					

External trip ends

After accounting for all trips made by study area residents, the next step is to factor out trip ends for trips with one trip end outside the modeled study area. In the model, only home-workplace trips for households are factored in this manner. This is largely due to data limitations. The CMAP survey sample is far too small for any reliable estimation of these factors and only the CTPP commuting data are available. Additionally, home-workplace trips are lengthier than other trip purposes and more likely to have one trip end outside the area modeled. Trips by persons residing in group quarters are not factored for external trip ends.

Summary home-workplace tables were first developed from CTPP Table A302103, using data from the five-year (2012-2016) American Community Survey estimates. These tables contain the home to workplace commutes for workers by 5 percent PUMAs. Because CTPP journey-to-work flows use PUMAs as the residence geography but use POWPUMAs (which resemble counties) as the workplace geography, CTPP Table A202105 was used to calculate the share of all trips to POWPUMA by tract. After removing workers who work at home, the tables have three components. These components include workers who travel to work and who (1) live and work inside (internal-internal) the modeled study area; (2) workers who live outside (external) the study area, but work inside (internal) the study area; and workers who (3) live inside (internal) the study area, but work outside (external) the study area.

External trip factors to adjust the home productions and workplace attractions in a 5 percent PUMA were developed from the tables in the following manner. The home production factor is the fraction of all trips from internal households (internal-internal plus internal-external) linked to external workplaces (internal-external), and the workplace attraction factor is the fraction of all trips to internal workplaces (internal-internal plus external-internal) that are linked to external households (external-internal). Home productions in 5 percent PUMS are factored first followed by workplace attractions. These external trip factors are entered in an input file named **EXT_IN.TXT.**

Home Production Factor = [internal-external] / ([internal-internal] + [internal-external])

Workplace Attraction Factor = [external-internal] / ([internal-internal] + [external-internal])

Table 51. EXT_IN.TXT input file

Variable	Description	Format
FIVE PERCENT PUMA	Seven digit numeric code for five percent PUMAs (two digit county FIPS code plus four digit code for five percent PUMA).	Integer
EXTERNAL PRODUCTION FACTOR	Fraction of home productions in home-workplace trips linked to external workplace attractions.	Real Number
EXTERNAL ATTRACTION FACTOR	Fraction of workplace attractions in home-workplace trips linked to external home productions.	Real Number

Create final vehicle trip output file

The last subroutine in the trip generation model code creates two output files (**TRIP49_PA_OUT.TXT** and **TRIP49_PA_WFH_OUT.TXT**) for use in the remaining CMAP models.

These files contain the final vehicular trip ends for internal trips for all residents in the modeled study area.

Table 52. TRIP49_PA_OUT.TXT output file

Variable	Description	Format
SUBZONE	Trip generation subzone (1-25000) (6 characters)	Integer (I6)
ZONE	Modeling zone number (1-5000) (6 characters)	Integer (I6)
TRIP TYPE	Trip type (1-11 when EXP_TTYPE= false, or 1-49 when EXP_TTYPE= true). (2 characters)	Integer (I2)
HH PRODUCTIONS	Household trip productions/origins for trips within the modeled study area. (9 characters, 1 decimal place)	Real Number (F9.1)
HH ATTRACTIONS	Household trip attractions/destinations for trips within the modeled study area. (9 characters, 1 decimal place)	Real Number (F9.1)

A final procedure of the trip generation model creates **TG_HHENUM_OUTPUT.TXT**, a file that lists the subzone and zone of each enumerated household, as well as the HHVTYPE. This file is subsequently used in the mode-destination choice model. CMAP currently writes the 49 purposes and processes the results, combining the trip purposes and aggregating the trip ends to the modeling zone system used in the remainder of the modeling process.

Table 53. TG_HHENUM_OUTPUT.TXT output file

Variable	Description	Format
SUBZONE	Trip generation subzone.	Integer
ZONE	Modeling zone number.	Integer
HOUSEHOLD VEHICLE TYPE	Household type code based on vehicle availability.	Integer

Mode-destination choice model

In a marked departure from past versions of CMAP's trip-based model, the updated model does not execute trip distribution and mode choice as two separate, sequential models. Rather, an integrated mode and destination choice model is implemented as a hierarchical nested logit model. This model was estimated using full-information, maximum-likelihood methods.

The 49 types of trips created during trip generation are aggregated into the following trip purposes, which are modeled by the full mode-destination choice model.

- Home-based work trips for residents of low-income households (HBWL). The regional median household income value is used to determine whether households fall into the low- or high-income categories.
- Home-based work trips for residents of high-income households (HBWH).
- Home-based shopping trips (HBS).
- All other home-based trips not included in the first three categories (HBO).
- All non-home-based trips (NHB).

Nine discrete modal alternatives are included in the model, listed in **Table 54**. This represents a major improvement from the binary auto-transit mode choice alternatives included in prior versions of the model. A private auto group nest includes single- and multiple-occupancy vehicles. The hired auto group nest includes three modal alternatives not previously available in CMAP's trip-based model, including taxi and transportation network company (TNC) options for passengers using either the regular or the shared-ride services. The final group of alternatives (which is not implemented as a nest) includes the non-auto modes of transit, walking and biking. Past versions of CMAP's trip-based model did not include non-motorized modes of transportation (walking and bicycling) beyond the trip generation model.

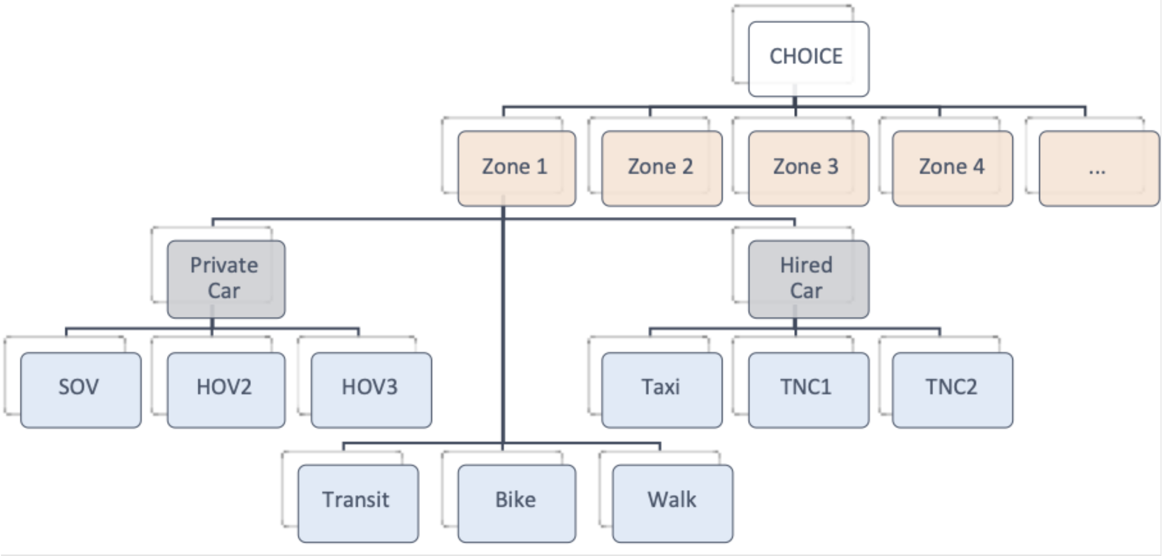
Table 54. Modal alternatives

Modal Alternative	Group	Description
1	Private Auto Nest	Single occupant private vehicles
2		High occupancy private vehicles – 2 occupants
3		High occupancy private vehicles – 3 or more occupants
4	Hired Auto Nest	Taxi
5		Transportation Network Company – regular ride hail
6		Transportation Network Company – shared ride hail
7		Transit
8		Walk
9		Bicycle

Figure 11 shows the structure of the hierarchical nested logit model. The top of the hierarchy is the attraction zone for each trip. This is the non-home end for all home-based trips and the trip destination for all other trip purposes. No sampling of alternatives is implemented during

model application. So, for each trip, the total mode and destination alternatives is 32,688 (9 modes x 3632 zones).

Figure 11. Mode-destination choice model logit structure



Source: Cambridge Systematics

Each modal alternative considered has its own cost components that factor into the utility calculations. These cost components and utility calculations are discussed in the following sections. **Table 55** lists the general cost attributes included in the calculations that apply across modes. The procedures to calculate costs for private auto trips, and transit access and egress were ported over from the prior version of CMAP's trip-based model.

Table 55. Mode-destination choice cost components

Value	Description
50	Number of trips used to determine average impedance
3	Walk speed (MPH)
14	Driver's value of time per minute (cents)
2.0	Ratio of out of vehicle time (OVT) to in-vehicle time (IVT)
35	Auto fixed cost for driver (cents)
20	Auto fixed cost for passenger (cents)
2	Walk time from park and ride lot to platform (minutes)
Zonal approach speeds	**Area definition**
7 (auto), 5 (bus)	Chicago Central Area zone
15 (auto), 10 (bus)	Chicago zone outside of the Central Area
20 (auto), 12 (bus)	dense suburban CBD zone
30 (auto), 17 (bus)	remaining suburban zones

Private auto costs

Auto operating costs are calculated using the information in the M023 file. Auto times and distances are pulled using zone-to-zone assigned times and distances. Matrices of morning peak conditions are applied to home-based work trips, and matrices of midday conditions are applied to all other trip types.

Parking costs are estimated using different methods depending on the trip purpose and destination. As noted, home-based work trips to the central area use Monte Carlo simulation and the central business district parking file data to estimate parking costs, including the possibility of free parking. Parking costs for destination zones outside of Chicago's central area are applied using the rates in the following table. Currently, these hourly rates are the same for all purposes, but the flexibility exists to alter the rates by trip purpose.

Table 56. Private auto costs

Hourly parking costs (cents)	Area definition
80	Chicago Central Area zone
10	Chicago zone outside of the Central Area
20	dense suburban CBD zone
0	remaining suburban zones
Parking duration (hours)	
10 – home-based work trips	
6 – all other home-based trips	
3 – non-home based trips including visitors	

Hired auto costs

The same time and distance skims used for private autos are also used for the utility calculations for hired autos. In addition, these modal options have additional costs reflected in fares and surcharges, which are discussed below. These cost components are stored in the file cmap_trip_config.yaml, which is used by the mode-destination choice model.

Taxi

A single set of taxi rates based on Chicago medallion rates for in-city trips is used to estimate rates for these trips. Fares for taxi trips outside of Chicago have similar rates and are far less numerous, so the single set of rates is used. **Table 58** below lists the taxi rates and wait times that are used in the cost estimation. The airport departure surcharge is applied to specific zones for O'Hare and Midway airports.

Table 57. Taxi costs

Cost (cents)	Description

325	Initial base fare
225	Per-mile cost
41.667	Cost per minute, regulated at 25 cents per 36 seconds
400	Airport departure surcharge
Wait time (minutes)	**Area definition**
1 (peak), 2 (offpeak)	Chicago Central Area zone
5 (peak), 7 (offpeak)	Chicago zone outside of the Central Area
10	dense suburban CBD zone
15	remaining suburban zones

Transportation network companies

The TNC cost structure is similar to that used for taxis, however separate costs are applied for pooled versus regular service, which are summarized in **Table 58**. TNCs implement a downtown Chicago surcharge applied to specific zones. In addition, a special surcharge is applied to Chicago's airports and major attractions.

Table 58. Transportation network company costs

Cost (cents)		Description
TNC	*Pooled*	
136 (peak), 163 (offpeak)	68 (peak), 128 (offpeak)	Initial base fare
109	106 (peak), 101 (offpeak)	Per-mile cost
28 (peak), 26 (offpeak)	0	Cost per minute
485	0	Minimum fare
257	257	Booking fee not included in minimum fare (in 2019 $1.85 to the company, 72¢ taxes)
500	500	Surcharge for O'Hare and Midway airports, Navy Pier and McCormick Place
0 in 2019, 175 thereafter	0 in 2019, 175 thereafter	Downtown Chicago surcharge applied 6am – 10pm
Wait time (minutes)	**Area definition**	
1 (peak), 2 (offpeak)	Chicago Central Area zone	
5	Chicago zone outside of the Central Area	
5	dense suburban CBD zone	
15	remaining suburban zones	

Transit costs

Unlike the auto modes, the utility calculations for transit modes must include estimates of the costs passengers incur when accessing and egressing the transit service. As noted, the FORTRAN-based transit access and egress calculation procedures used in past versions of CMAP's trip-based model were transferred into Python. The underlying logic of the level of service calculations is unchanged, and it is based on a random distribution of transit access characteristics based on the geography and service levels of each zone.

The concepts of first mode, priority mode, and last mode are used to identify available transit access and egress options. These mode identifiers are based on the following hierarchy of modes, listed from highest to lowest priority: Metra, CTA rail, and bus. First mode is identified by skimming the transit network for zonal interchanges by using the transit access links listed in **Table 20** based on the priority hierarchy. Similarly, the transit egress links are used to identify last mode for zone pairs. The priority linehaul mode is determined based on the combinations of first and last mode.

There are five potential transit approach (access) modes: 1-Walk, 2-Bus, 3-Park and Ride, 4-Kiss and Ride, and 5-Feeder Bus. Monte Carlo simulation is used to determine the access and egress distance for each of the approach options — recall the DISTR files contain different distances by zone for Metra, CTA rail, bus, feeder bus, and Park and Ride. Fewer options are available for transit egress, based on the following rules:

- Walk is always available as an access and egress option.
- For Bus priority mode, walk is the only available access and egress option.
- For Rail priority modes:
    - Park and Ride is only available as an access option for home-based trips.
    - Kiss and Ride is only available as an access option for HBW trips.
    - Park and Ride, Kiss and Ride, and Feeder Bus are not available as egress options.

Table 59 below summarizes the logic of the transit access and egress cost calculations.

Table 59. Transit access and egress cost logic

Approach Option	Cost Components
Walk (first or last mode)	• The only approach cost is the time to walk to the bus. For work trips in the CBD, this cost is increased by 20 percent. • The walk time is multiplied by the driver's value of time and the OVT factor.
Bus (first or last mode) Feeder Bus (first mode only)	• Walk time – Simulated distance to walk divided by walk speed (increased by 20% in the CBD to account for congested walking conditions). Value multiplied by the OVT factor and the driver's value of time. • Drive time – Approach distance divided by the zone type auto speed multiplied by the driver's value of time. • Wait time – Zonal average wait time for bus multiplied by the OVT factor and the driver's value of time. • Cost – Based on the zone location the appropriate fares and transfer costs are included.
Park and Ride (first mode only)	• Walk time – Default walk time from parking lot to platform multiplied by the OVT factor and the driver's value of time. • Drive time – Approach distance divided by the zone type auto speed multiplied by the driver's value of time. • Cost – Driving distance multiplied by the per-mile auto operating costs based on zone type. The fixed driver auto costs and half of the parking costs are added to this.
Kiss and Ride (first mode only)	• Walk time – Default walk time from parking lot to platform multiplied by the OVT factor and the driver's value of time.

	- Drive time – Approach distance is divided by the zone type auto speed and multiplied by the driver's value of time. This is multiplied by three (to cover the time traveled by the driver and passenger, as well as an assumed trip by the driver back home) and by the driver's value of time. - Cost – Driving distance multiplied by the per-mile auto operating costs based on zone type. Double the auto passenger fixed costs are added to this.

Utility calculations

This section shows the utility formulas for each modal alternative in the mode-destination choice model. Two placeholder variables are listed in the equations to reflect where the specific value varies based upon the specific conditions:

- [*PK|OP*] – reflects that either PEAK or OFFPEAK values will be used. PEAK values are applied for home-based work trips (HBWH, HBWL) and OFFPEAK values are applied for all other trip purposes.

- [*PURPOSE*] – reflects the variable value specific to each trip purpose.

Each of the utility equations includes the same formula for utility at the trip destination, which is shown in the following table and referenced by name ("utility_destination") in the subsequent modal utility formulas. "P" values represent the model coefficients while the "X" variables are the actual trip values.

Table 60. Utility_destination

Formula
P.samp_af * X('log(1/actualdest_samp_wgt)') + P.log_attraction * X.actualdest_log_attractions_[*PURPOSE*] + P.intrazonal * X('o_zone == actualdest') + P('distance[1]: up to 5') * X('piece(actualdest_auto_dist_OFFPEAK,None,5)') + P('distance[2]: 5 to 10') * X('piece(actualdest_auto_dist_OFFPEAK,5,10)') + P('distance[3]: over 10') * X('piece(actualdest_auto_dist_OFFPEAK,10,None)')

In the following tables shaded blocks represent groups of conditional logic and identify which components are applied when specific conditions are met.

Table 61. SOV (1) utility

Formula	Conditions
P.cost * 0.01 * X.actualdest_auto_opcost_[*PK|OP*] + P.totaltime * X.actualdest_auto_time_[*PK|OP*] + P.cost * 0.01 * X.actualdest_auto_parking_cost_[*PURPOSE*] + P.unavail * X('1-actualdest_auto_avail_[*PURPOSE*]') + utility_destination	
+ P.cost * 0.01 * X.actualdest_auto_toll_hiinc_PEAK	If HBWH

+ P.cost * 0.01 * X.actualdest_auto_toll_loinc_PEAK	If HBWL
+ P.cost * 0.01 * X.actualdest_auto_toll_OFFPEAK	Not HBW
+ P.AUTO_ozone_autopropensity * X.ozone_autopropensity	If NHB
+ P.AUTO_dzone_autopropensity * X.actualdest_autopropensity	If NHB
+ P.AUTO_no_veh * X('hhveh==0')	Not NHB
+ P.AUTO_sufficient_veh * X('hhveh>=hhadults')	Not NHB

Table 62. HOV2 (2) utility

Formula	Conditions
P.Const_HOV2 + P.cost * 0.005 * X.actualdest_auto_opcost_hov_[*PK|OP*] + P.totaltime * X.actualdest_auto_time_[*PK|OP*] + P.cost * 0.005 * X.actualdest_auto_parking_cost_[*PURPOSE*] + P.unavail * X('1-actualdest_auto_avail_[*PURPOSE*]') + P('HOV2_distance[1]: up to 5') * X('piece(actualdest_auto_dist_OFFPEAK,None,5)') + P('HOV2_distance[2]: 5 to 10') * X('piece(actualdest_auto_dist_OFFPEAK,5,10)') + P('HOV2_distance[3]: over 10') * X('piece(actualdest_auto_dist_OFFPEAK,10,None)') + utility_destination	
+ P.cost * 0.005 * X.actualdest_auto_toll_hov_hiinc_PEAK	If HBWH
+ P.cost * 0.005 * X.actualdest_auto_toll_hov_loinc_PEAK	If HBWL
+ P.cost * 0.005 * X.actualdest_auto_toll_OFFPEAK	Not HBW
+ P.AUTO_ozone_autopropensity * X.ozone_autopropensity	If NHB
+ P.AUTO_dzone_autopropensity * X.actualdest_autopropensity	If NHB
+ P.AUTO_no_veh * X('hhveh==0')	Not NHB
+ P.AUTO_sufficient_veh * X('hhveh>=hhadults')	Not NHB

Table 63. HOV3+ (3) utility

Formula	Conditions
P.Const_HOV3 + P.cost * 0.0033 * X.actualdest_auto_opcost_[*PK|OP*] + P.totaltime * X.actualdest_auto_time_[*PK|OP*] + P.cost * 0.0033 * X.actualdest_auto_parking_cost_[*PURPOSE*] + P.unavail * X('1-actualdest_auto_avail_[*PURPOSE*]') + P('HOV3_distance[1]: up to 5') * X('piece(actualdest_auto_dist_OFFPEAK,None,5)') + P('HOV3_distance[2]: 5 to 10') * X('piece(actualdest_auto_dist_OFFPEAK,5,10)')	

+ P('HOV3_distance[3]: over 10') * X('piece(actualdest_auto_dist_OFFPEAK,10,None)') + utility_destination	
+ P.cost * 0.0033 * X.actualdest_auto_toll_hov_hiinc_PEAK	If HBWH
+ P.cost * 0.0033 * X.actualdest_auto_toll_hov_loinc_PEAK	If HBWL
+ P.cost * 0.0033 * X.actualdest_auto_toll_OFFPEAK	Not HBW
+ P.AUTO_ozone_autopropensity * X.ozone_autopropensity	If NHB
+ P.AUTO_dzone_autopropensity * X.actualdest_autopropensity	If NHB
+ P.AUTO_no_veh * X('hhveh==0')	Not NHB
+ P.AUTO_sufficient_veh * X('hhveh>=hhadults')	Not NHB

Table 64. Taxi (4) utility

Formula	Conditions
P.Const_TAXI + P.cost * 0.01 * X.actualdest_taxi_fare_[*PK|OP*] + P.ovtt_dist * X('actualdest_taxi_wait_time_[*PK|OP*]/actualdest_auto_dist_[*PK|OP*]') + P.totaltime * X.actualdest_taxi_wait_time_[*PK|OP*] + P.totaltime * X.actualdest_auto_time_[*PK|OP*] + P.unavail * X('1-actualdest_auto_avail_[*PURPOSE*]') + utility_destination	
+ P.cost * 0.01 * X.actualdest_auto_toll_hiinc_PEAK	If HBWH
+ P.cost * 0.01 * X.actualdest_auto_toll_loinc_PEAK	If HBWL
+ P.cost * 0.01 * X.actualdest_auto_toll_OFFPEAK	Not HBW

Table 65. TNC (5) utility

Formula	Conditions
P.Const_TNC1 + P.cost * 0.01 * X.actualdest_tnc_solo_fare_[*PK|OP*] + P.ovtt_dist * X('actualdest_tnc_solo_wait_time_[*PK|OP*]/actualdest_auto_dist_[*PK|OP*]') + P.totaltime * X.actualdest_tnc_solo_wait_time_[*PK|OP*] + P.totaltime * X.actualdest_auto_time_[*PK|OP*] + P.unavail * X('1-actualdest_auto_avail_[*PURPOSE*]') + utility_destination	
+ P.cost * 0.01 * X.actualdest_auto_toll_hiinc_PEAK	If HBWH
+ P.cost * 0.01 * X.actualdest_auto_toll_loinc_PEAK	If HBWL
+ P.cost * 0.01 * X.actualdest_auto_toll_OFFPEAK	Not HBW

Table 66. TNC shared ride (6) utility

Formula	Conditions
P.Const_TNC2	
+ P.cost * 0.01 * X.actualdest_tnc_pool_fare_[PK|OP]	
+ P.ovtt_dist * X('actualdest_tnc_pool_wait_time_[PK|OP]/actualdest_auto_dist_[PK|OP]')	
+ P.totaltime * X.actualdest_tnc_pool_wait_time_[PK|OP]	
+ P.totaltime * X.actualdest_auto_time_[PK|OP]	
+ P.unavail * X('1-actualdest_auto_avail_[PURPOSE]')	
+ utility_destination	
+ P.cost * 0.005 * X.actualdest_auto_toll_hiinc_PEAK	If HBWH
+ P.cost * 0.005 * X.actualdest_auto_toll_loinc_PEAK	If HBWL
+ P.cost * 0.005 * X.actualdest_auto_toll_OFFPEAK	Not HBW

Table 67. Transit (7) utility

Formula	Conditions
P.Const_Transit	
+ P.cost * 0.01 * X.actualdest_transit_fare_[PK|OP]	
+ P.totaltime * X.actualdest_transit_ovtt_[PK|OP]	
+ P.cost * 0.01 * X.actualdest_transit_approach_cost_[PK|OP]	
+ P.totaltime * X.actualdest_transit_approach_drivetime_[PK|OP]	
+ P.totaltime * X.actualdest_transit_approach_walktime_[PK|OP]	
+ P.totaltime * X.actualdest_transit_approach_waittime_[PK|OP]	
+ P.unavail * X('1-actualdest_transit_avail_[PURPOSE]')	
+ P.ovtt_dist * X('actualdest_transit_ovtt_[PK|OP]/actualdest_auto_dist_[PK|OP]')	
+ P.ovtt_dist * X('actualdest_transit_approach_walktime_[PK|OP]/actualdest_auto_dist_[PK|OP]')	
+ P.ovtt_dist * X('actualdest_transit_approach_waittime_[PK|OP]/actualdest_auto_dist_[PK|OP]')	
+ P.transit_intrazonal * X('o_zone == actualdest')	
+ utility_destination	
+ P.transit_areatype2 * X('fmin(ozone_areatype, actualdest_areatype)==2')	if HBW
+ P.transit_areatype3 * X('fmin(ozone_areatype, actualdest_areatype)==3')	if HBW
+ P.transit_areatype4 * X('fmin(ozone_areatype, actualdest_areatype)==4')	if HBW
+ P.transit_walk_is_short * X('hard_sigmoid(actualdest_transit_approach_walktime_OFFPEAK, 4.0, 2.0)')	not HBW
+ P.totaltime * X('piece(actualdest_transit_ivtt_OFFPEAK, None, 20)')	if NHB
+ P.ivtt_longtransit * X('piece(actualdest_transit_ivtt_OFFPEAK, 20, None)')	if NHB
+ P.totaltime * X.actualdest_transit_ivtt_PEAK	not NHB

Table 68. Walk (8) utility

Formula
P.Const_WALK + P('walk_time[1]: up to 0.5') * 20.0 * X('piece(actualdest_auto_dist_OFFPEAK,None,0.5)') + P('walk_time[2]: 0.5 to 1.0') * 20.0 * X('piece(actualdest_auto_dist_OFFPEAK,0.5,1.0)') + P('walk_time[3]: over 1.0') * 20.0 * X('piece(actualdest_auto_dist_OFFPEAK,1.0,None)') + P.walk_intrazonal * X('o_zone == actualdest') + P.walk_areatype2 * X('fmax(ozone_areatype, actualdest_areatype)==2') + P.walk_areatype3 * X('fmax(ozone_areatype, actualdest_areatype)==3') + P.walk_areatype4 * X('fmax(ozone_areatype, actualdest_areatype)==4') + utility_destination

Table 69. Bicycle (9) utility

Formula
P.Const_BIKE + P.bike_time * 5.0 * X.actualdest_auto_dist_OFFPEAK + P.bike_intrazonal * X('o_zone == actualdest') + utility_destination

Table 70 contains the parameter coefficient used by the mode-destination choice models. Within the model setup, these are stored in the file choice_model_params.yaml.

Table 70. Mode-destination Choice utility coefficients

Parameter Name	Coefficient Value				
	HBWH	HBWL	HBS	HBO	NHB
AUTO_no_veh	-2.02066	-2.65281	-3.92282	-2.97073	
AUTO_sufficient_veh	0.5191	0.68889	0.85566	0.73426	
AUTO_dzone_autopropensity					2.60971
AUTO_ozone_autopropensity					7.90263
Const_BIKE	-0.89455	-0.99458	-1.84804	-1.61996	3.65973
Const_HOV2	-0.16685	-0.24609	-0.61997	-0.22962	-0.35372
Const_HOV3	-0.21808	-0.42901	-1.75348	-0.76186	-1.00224
Const_TAXI	-2.43109	-3.83044	-5.25362	-2.94266	4.04201
Const_TNC1	-2.00835	-2.41751	-3.81618	-2.14956	4.50598
Const_TNC2	-2.45527	-2.83838	-4.5589	-2.98712	3.14278
Const_Transit	0.60101	0.47997	-0.96321	-0.11176	5.95385
Const_WALK	2.41291	3.90819	6.59669	4.67085	9.95457
"HOV2_distance[1]: up to 5"	-0.06489	-0.11065	0.00903	0.01789	-0.01031
"HOV2_distance[2]: 5 to 10"	-0.1154	-0.04924	0.04928	-0.00016	-0.07672
"HOV2_distance[3]: over 10"	-0.01322	-0.00281	-0.02346	-0.01658	-0.01814

"HOV3_distance[1]: up to 5"	-0.12523	-0.15448	0.10127	0.03982	0.00184
"HOV3_distance[2]: 5 to 10"	-0.14759	-0.12639	0.02328	-0.0128	-0.06865
"HOV3_distance[3]: over 10"	-0.01706	-0.01717	-0.02685	-0.01766	-0.04031
HOV_no_veh	-2.10331	-2.03895	-2.69883	-2.32442	
HOV_sufficient_veh	0.47615	0.39123	0.80028	0.7002	
HOV_dzone_autopropensity					2.20619
HOV_ozone_autopropensity					7.95808
Mu-Dest	0.5835	0.84041	1	0.91735	1
Mu-HiredCar	0.43763	0.63017	0.75	0.68801	0.75001
Mu-PrivateCar	0.43763	0.63017	0.74886	0.68801	0.75
bike_intrazonal	-1.66368	-0.99402	-0.44227	-0.67678	0.61382
bike_time	-0.02779	-0.06334	-0.14701	-0.07551	-0.02974
cost	-0.01187	-0.02941	-0.03047	-0.02544	-0.10698
"distance[1]: up to 5"	-0.49797	-0.44518	-0.72976	-0.6121	-0.46865
"distance[2]: 5 to 10"	-0.25104	-0.25571	-0.51086	-0.40179	-0.33348
"distance[3]: over 10"	-0.08139	-0.09135	-0.13174	-0.10823	-0.06413
intrazonal	0.39465	0.02173	-0.87171	-0.4601	-0.03194
log_attraction	1	1	1	1	1
ovtt_dist	-0.15985	-0.07639	-0.24676	-0.27477	-0.26852
samp_af	1	1	1	1	1
totaltime	-0.01703	-0.01471	-0.03	-0.02545	-0.03
ivtt_longtransit					-0.01098
transit_areatype2	-1.37468	-1.24414			
transit_areatype3	-2.73032	-3.34803			
transit_areatype4	-2.53971	-1.74231			
transit_intrazonal	1.62543	1.28361	2.83389	2.15625	3.58213
transit_walk_is_short			1.65236	0.52585	0.72322
unavail	-999	-999	-999	-999	-999
walk_areatype2	0.14898	0.6465	0.07938	0.43434	0.57519
walk_areatype3	-0.25213	0.08906	-1.48492	-0.01967	0.97573
walk_areatype4	-0.6561	0.01831	-1.77384	-0.31775	1.08625
walk_intrazonal	-0.39866	-1.11304	-1.23659	-0.83539	-0.32773
"walk_time[1]: up to 0.5"	-0.15077	-0.26811	-0.47627	-0.30856	-0.18778
"walk_time[2]: 0.5 to 1.0"	-0.05047	-0.05885	-0.09588	-0.08353	-0.09049
"walk_time[3]: over 1.0"	-0.04512	-0.07886	-0.10566	-0.08477	-0.0938

During execution of the mode-destination choice model, the Python code directly reads skim matrix values to perform the utility calculations. **Table 71** summarizes the matrices used to determine the utility of each modal option. Note that matrices applied for HBW trips reflect morning peak conditions, while the matrices applied for non-work trips reflect midday travel conditions. The utility calculations include the effects of tolling. The presence of tolls increases the cost to travelers of using specific routes, so it is accounted for within the traffic assignment procedures. The increased travel cost also impacts the choice of travel mode and is included in the utility calculations.

Table 71. Utility calculation matrices

	Matrix	
Auto		
	HBW	Non-work
Travel time - SOV	44	46
Travel time - HOV	76	46
Travel distance – SOV	45	47
Travel distance – HOV	77	47
Toll – SOV low income	111	NA
Toll – SOV high income	114	NA
Toll – HOV low income	112	NA
Toll – HOV high income	115	NA
Toll	NA	117
Transit		
	HBW	Non-work
In-vehicle time	822	922
Out of vehicle time	823	923
Headway	838	938
Fare	828	928
First mode	829	929
Priority mode	830	930
Last mode	831	931

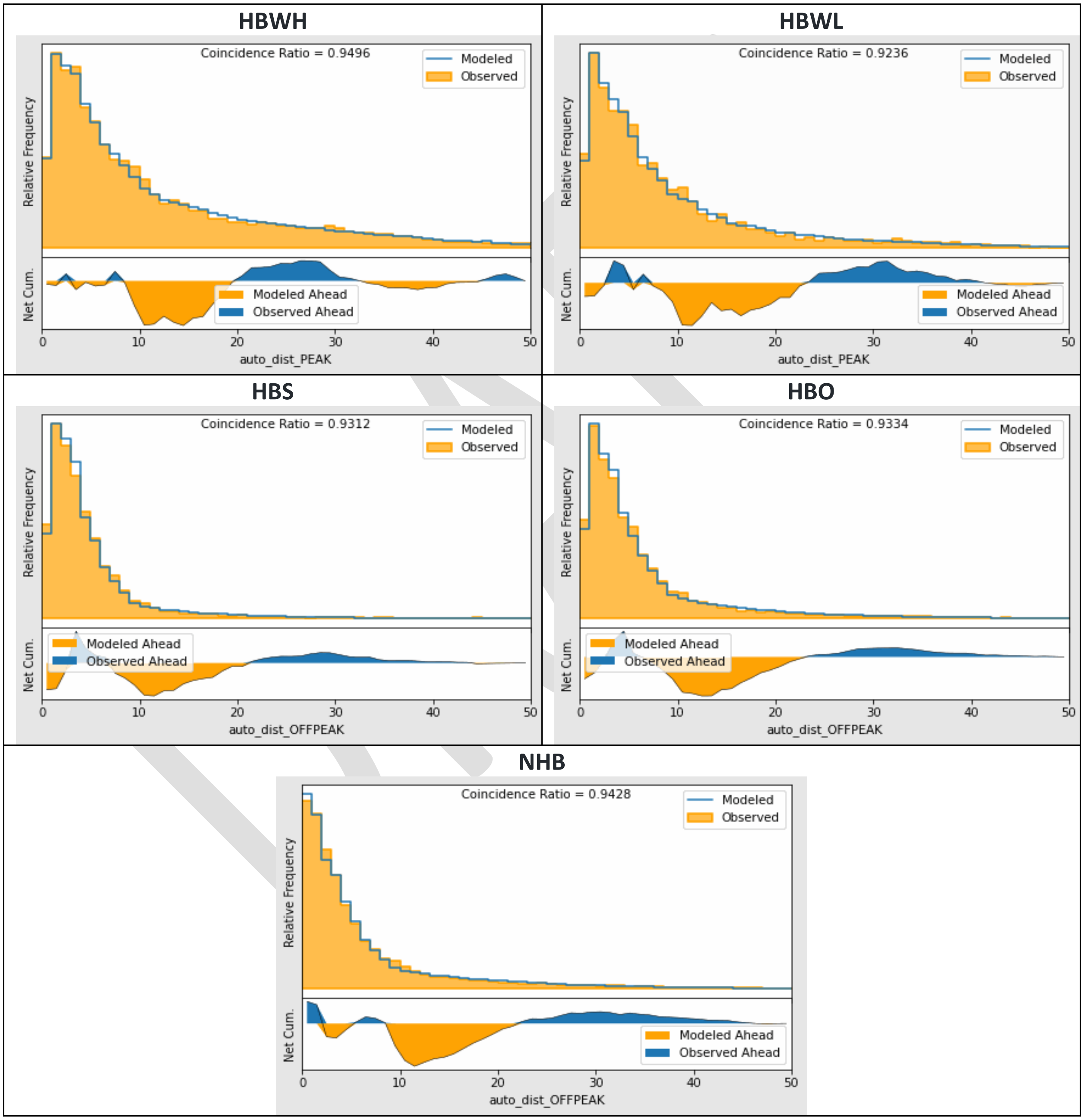
A file of the propensity of home-based trips to be attracted to zones based on a private auto mode share (SOV or HOV) is used to adjust the probability that non-home-based trips produced in these zones also will use a private auto mode. This file is created during each global iteration of the model and is used in the subsequent iteration of the mode-destination choice model. A default file (default_auto_propensity.csv.gz) is used during the initial model iteration.

As noted in trip generation, modeled households are divided into two groups — those with no workers working from home and those with at least one worker who works from home with some frequency. This results in separate sets of trip productions and attractions. This bifurcation of the trip data continues through mode-destination choice. The model is first run on the trip data for households with no workers who work-from-home and then is run again for the other group of trips. While the parameters of the mode-destination choice models are the same between the two groups, the trip productions and attractions do differ, resulting in unique utility functions and different behavior patterns.

Model estimation

The trip-based model is not a full microsimulation. Only a representative set of trips is modeled for each origin zone. No destination sampling is used in the mode-destination choice model. Typically, such sampling is used to ensure the model provides good coverage of less attractive destinations. A weighted sampling approach was used to estimate the model, which used fully disaggregated trips from the My Daily Travel survey. After testing several sizes, a sample size of 25 destinations ultimately was used and provided parameter estimates that are statistically indistinguishable from larger sample sizes. **Figure 12** below shows some model estimation results that were generated by the Larch package, which was used to estimate the model.

Figure 12. Model estimation destination probabilities by distance



Visitor trips

The update to CMAP's trip-based model includes daily demand for visitor trips — trips with both ends located within the modeling area made by people whose home location is outside of the modeling area. This demand was developed using 2019 LOCUS mobile location data to create a base year zone-to-zone visitor trip table. The mode choice model for non-home base trips is used to determine the travel mode for visitor trips, with constants shifted so visitors have a higher likelihood of using taxis and TNCs than residents would for nonhome-based trips.

Visitor trips assigned to the SOV mode must also be categorized by value of time level for traffic assignment. The value of time distribution for visitor trips is assumed to mirror that for resident nonhome-based trips. The VOT distribution is shown in **Table 80**.

As the visitor trip table reflects 2019 trips, a set of growth factors were developed to represent increased visitor demand in future scenarios. These growth factors were developed based on historical trends in the growth in air passengers at O'Hare and Midway airports, and the growth in tourism nationally and for Chicago. The growth factors assume visitor demand in northeastern Illinois returns to 2019 pre-pandemic levels in 2023. The visitor trip growth rates are shown in **Table 72**.

Table 72. Visitor trip growth factors

2019	2025	2030	2035	2040	2045	2050
1.00	1.05	1.18	1.34	1.51	1.70	1.92

Time-of-day model

After the mode-destination-choice model runs, the time-of-day model is applied to auto trips (for both private and hired autos). This model separates auto trips into the eight time-of-day periods modeled by CMAP. The time-of-day model is sensitive to congested travel times during the course of the day. It is a simple multinomial logit model that has alternative specific constants that reflect behavioral preferences and the duration of each period. The utility functions are also sensitive to mode choice as TNC use is significantly different than private auto use. Many TNC trips happen in the evening and overnight periods.

The time-of-day utility formula is listed in **Table 73**. Two placeholder variables are listed in the equations to reflect where the specific value varies based on the specific conditions:

- [*TOD label*] – the time period label refers to the following: ‘EA’=evening/early morning; ‘AM1’=pre-AM peak shoulder; ‘AM2’=AM peak; ‘AM3’=post-AM peak shoulder; ‘MD’=midday; ‘PM1’=pre-PM peak shoulder; ‘PM2’=PM peak; and ‘PM3’=post-PM peak shoulder.

- [*TOD period*] – the numeric time-of-day period (1-8). MF461-468 are skimmed highway times for SOVs for each period.

Table 73. Time-of-day model utility formula

Formula	Conditions
P.ASC_[*TOD label*] + P.time * X.mf46[*TOD period*] + P.hiredcar_[*TOD label*] * X('mode9 in ('TAXI','TNC1','TNC2')')	
+ P.ASC_[*TOD label*]_r * X.paFlip	not NHB
+ P.hiredcar_[*TOD label*]_r * X('(mode9 in ('TAXI','TNC1','TNC2'))*paFlip')	if HBW, HBO

The following table contains the parameter coefficient used by the time-of-day model. Within the model setup, these are stored in the file tod_model_params.yaml. Parameters ending with “_r” represent the reverse trip. These are only applied to home-based trips, meaning they represent the attraction-production trip.

Table 74. Time-of-day model parameters

Parameter name	Coefficient value				
	HBWH	HBWL	HBS	HBO	NHB
ASC_AM1	-1.1259	-1.1102	-1.8298	-1.2922	-1.8283
ASC_AM1_r	-1.1231	-0.9133	-0.3437	-0.126	

ASC_AM2	0	0	0	0	0
ASC_AM2_r	0	0	0	0	
ASC_AM3	-2.5156	-1.8888	-0.2645	-1.14	-0.8498
ASC_AM3_r	0.7526	0.7235	0.7867	0.6787	
ASC_EA	-1.9622	-1.6429	-1.5805	-1.5318	-1.348
ASC_EA_r	1.6611	2.1924	2.47	2.7275	
ASC_MD	-1.4857	-0.9077	1.3482	0.1653	1.2409
ASC_MD_r	2.2103	1.838	1.6184	1.5238	
ASC_PM1	-2.2204	-1.8976	0.2849	-0.4321	0.5517
ASC_PM1_r	3.7918	3.4383	2.2642	1.8336	
ASC_PM2	-2.3658	-2.4245	0.3984	0.1484	0.2782
ASC_PM2_r	3.654	3.6741	2.1922	1.5952	
ASC_PM3	-3.9189	-4.0392	-0.0874	-0.9093	-0.6194
ASC_PM3_r	4.0171	4.3707	2.2669	2.5158	
hiredcar_AM1	-0.2335	-1.1946	-11.7505	1.00E-04	0.8795
hiredcar_AM1_r	-12.1216	-10.706		0.189	
hiredcar_AM2	0	0	0	0	0
hiredcar_AM2_r	0	0		0	
hiredcar_AM3	1.0709	0.9707	-0.1476	0.0347	0.4629
hiredcar_AM3_r	-14.0951	0.0756		-0.1058	
hiredcar_EA	-0.1723	0.5339	-17.5549	0.9544	2.8669
hiredcar_EA_r	3.1961	1.6282		1.5105	
hiredcar_MD	0.3483	0.4738	0.0168	0.2375	0.7199
hiredcar_MD_r	0.6849	0.262		-0.378	
hiredcar_PM1	-1.5686	0.7303	0.0839	-0.2086	0.9617
hiredcar_PM1_r	2.5324	-0.0527		0.2851	
hiredcar_PM2	-1.3687	-0.497	0.6512	0.6264	1.2375
hiredcar_PM2_r	3.3293	1.1441		-0.642	
hiredcar_PM3	0.7728	-16.158	1.209	1.6335	2.0767
hiredcar_PM3_r	1.5941	17.7847		-0.5611	
time	-0.0551	-0.0367	-0.0273	-0.0552	-0.0200

Hired auto deadhead trips

Within the model, a set of deadhead trips are generated for taxis and TNCs to represent trips connecting revenue trips. These are the trips that drivers make once a passenger is dropped off to reach the location where the next passenger will be picked up. The method links together the destinations of taxi and TNC trips (when passengers are dropped off and thus, the productions for deadhead trips) with the origins of taxi and TNC trips (when the new passenger is collected and thus, the attractions for deadhead trips) within each time period. A simplifying assumption is made that these productions and attractions are balanced within each period.

Distribution of the deadhead trips is accomplished using a simple gravity model with congested travel time skims for the time period as the impedance. The result is drivers travel close to the minimum distance needed to serve the revenue trips. This reflects the rational behavior of drivers trying to minimize the distance of trips traveled without a fare. For traffic assignment, these trips are added to the SOV trip tables using the value of time shares listed in **Table 80**.

Final trip roster

Completion of the time-of-day model results in the creation of a set of parquet files, which use columnar data storage to reduce file sizes. These parquet files collectively contain the roster of trips created by the models and can be used to develop specific trip demand tables. The labeling for these files is "choice_simulator_trips_[*range of zones*]_HBWH_HBWL_HBS_HBO_NHB_[*typical*|*wfh*].pq" where:

- Range of zones lists the origin zones included in the file typical|wfh identifies whether the trips are from households with at least one worker who works from home or from households with no workers working from home.

Table 75 lists the fields contained in the parquet files.

Table 75. Parquet file fields

Variable	Description
trips	Number of trips
purpose	Trip purpose (HBWH, HBWL, HBS, HBO, NHB, VISIT, DEAD)
mode	Trip mode (numeric value)
o_zone	Origin zone (the beginning of the actual trip – may not be the home/production zone)
d_zone	Destination zone (the end of the actual trip – may not be the attraction zone)
a_zone	Attraction zone (either the production or attraction zone, depending on trip directionality)
hh_autos	Number of household vehicles available (0,1,2+) – applicable only for home-based trips
hh_inc5	Household income category of the trip maker (in 2019 dollars): 1=less than $30,000, 2=$30,000-$59,999, 3=$60,000-$99,999, 4=$100,000-$149,999, 5=$150,000+
timeperiod	Time period labels; NA applied to transit, walk and cycling trips

During execution of the time-of-day model, home-based trips (which are modeled in production-attraction format rather than origin-destination format) are converted to origin-destination trips using the following factors to create the attraction-production trips.

- Home-based work high income: 0.459
- Home-based work low income: 0.443
- Home-based shopping: 0.647
- Home-based other: 0.513

Traffic assignment

The final step in the trip-based model is traffic assignment. This is the step that takes all of the travel demand and routes trips over the highway network. A final step after completion of the time-of-day model is the creation of time-period-specific demand matrices that are used for the highway assignment. Person trips are converted to vehicle trips for these matrices, meaning auto occupancy is accounted for. The following vehicle occupancy rates are used for HOV trips with at least three people.

- Home-based work trips: 3.36
- All other home-based trips: 3.31
- Nonhome-based and visitor trips: 3.39

Special trip handling

In addition to auto vehicle trips, several other classes of vehicle trips are included in traffic assignment. These require special data-handling procedures to create the demand matrices.

Commercial vehicle trips

CMAP models truck trips for four truck classes: B-plate, light trucks, medium trucks, and heavy trucks. B-plate trucks are vans, pickup trucks, and sport utility vehicles with performance characteristics similar to passenger cars and carrying “B” license plates. These license plates are issued to vehicles weighing less than 8,000 pounds. Light trucks are “step vans” and smaller delivery vans, which carry weight plates D-J and MD-MJ. Medium trucks are defined as heavy fixed-wheelbase trucks, such as concrete mixers, scavenger trucks, double rear axle refrigerator units, and some other lighter weight articulated vehicles carrying weight plates K-T and MK-MT. This covers trucks weighing between 28,001 and 64,000 pounds. Finally, heavy trucks comprise the 73,280- and 80,000-pound maximum load vehicles, which are tractor-trailer combinations. These carry weight plates of V-Z.

In the past, CMAP used vehicle registration files from the Illinois Secretary of State’s office to develop “base year” trip totals for each of the truck classes. The relationship between registered vehicles and actual trips was always somewhat tenuous, but it provided the best available information at the time. CMAP currently uses more robust data to develop the base year trip totals that inform the trip-based model, including:

- <u>B-plate trucks</u>: These license plates can be issued to either personal or commercial vehicles; however, for purposes of modeling these trucks as a specific vehicle class, CMAP is interested in the commercial vehicle demand only. The personal vehicle demand is included in the household trips. An analysis of b-plate vehicle registrations was conducted for the Illinois counties in the CMAP modeling area using current data from the Illinois Secretary of State’s office. Using the registrations and total population in these counties, an average rate of b-plate vehicles per person was developed. This rate was applied to the remaining counties in the CMAP modeling area to determine total b-plate vehicles registered within the modeling area. It was factored by 10 percent to reflect external b-plates that operate on the road network within the modeling area. To determine commercial use of b-plates, national auto sales information from the last two decades was used to determine the increased share of auto sales comprised of trucks/minivans/SUVs. That was combined with Illinois data from the Vehicle Inventory and Use Survey on the share of miles by these vehicle types used for commercial purposes. Finally, an analysis of b-plate vehicles included in the My Daily Travel survey provided the average number of trips made daily. This value multiplied by the number of b-plate vehicles provides an estimate of daily commercial trips for this vehicle class.

- Heavy trucks: Data on heavy truck trips within the CMAP modeling area was purchased from the American Transportation Research Institute (ATRI). This dataset was analyzed to determine the number of trips heavy vehicles make within the CMAP modeling area and identify the specific locations they visit.
- Light and medium trucks: The data purchased from ATRI does not include these truck classes. Instead, the number of trips for these trucks is derived from vehicle registration data and established relationships in the number of trips these truck classes take relative to heavy trucks. As an extra level of data verification, the reasonableness of these trip values was confirmed by reviewing the results of a truck demand model developed for IDOT to support the Illiana Expressway analysis.

Once the truck trips were developed, they were converted to a year 2000 “base value” to provide a set of trip values consistent across all truck classes. These base values were developed assuming a growth rate of 10 percent per decade, the same growth used to forecast future truck trips. **Table 76** presents the base trip totals by vehicle class.

Table 76. Truck trip totals by vehicle class

Truck type	Base year 2000 total
B-plate trucks	1,468,500
Light trucks	246,500
Medium trucks	229,500
Heavy trucks	395,000

Once the total number of trucks per class is determined, the non-heavy truck trips are allocated to production and attraction zones based on development patterns that come from UrbanSim. The measure of development is represented by nonhome-based trip productions. These most closely related to total development with an emphasis on employment density. The process is a simple allocation of trips to zones based on the zonal share of the total regional development. The distribution of trips is then created based on trip length distribution parameters derived from data on light and medium truck trips in the region purchased from INRIX.

For b-plate trucks, the trip length distribution was enhanced using odometer readings collected by the Illinois Environmental Protection Agency as part of the vehicle inspection and maintenance program. These readings were obtained for the seven CMAP counties and Grundy County. Specific vehicles were matched to the Illinois Secretary of State registration data to isolate b-plate trucks from the resulting dataset, and the distribution of average daily vehicle miles traveled was calculated for b-plates.

The distribution of heavy truck trips is also weighted using information from UrbanSim. For the seven CMAP counties, a buildings file is generated that includes the square footage of buildings identified by land-use category. The square footage of non-residential buildings is multiplied by the appropriate average trip rate for combination unit trucks for the land use, as identified in NCHRP Report 298, and the values are summarized at the zonal level. These values are not used as actual productions and attractions but merely as weights for the distribution process to help differentiate between the pickup/delivery needs of different types of land uses. Distribution weights for the remainder of the modeling area are developed in a similar manner but require an additional step. No building-level information is provided for this geography, so it is synthesized using employment by industry and the average building area per job, so that zonal truck trip rates can be estimated. Data from the ATRI file was used to develop trip length distribution parameters for heavy trucks.

The size and operating characteristics of commercial vehicles require them to be treated differently than automobiles during traffic assignment. Prior to the traffic assignment process, truck vehicle trips are converted to trips measured in vehicle equivalents. The truck vehicle trips are converted using the following factors:

- B-plate and light trucks equal one vehicle equivalent.
- Medium trucks equal two vehicle equivalents.
- Heavy trucks (and buses) equal three vehicle equivalents.

Point-of-entry trips

Point-of-entry trips represent three categories of travel: auto travel entering/leaving the modeled region on major expressways, heavy truck travel entering/leaving the region on major expressways, and auto travel to and from the region's airports entering/leaving the region. Point-of-entry locations are external zones (numbered 3633 through 3649) and are not modeled in the same way as the rest of the region's travel because there is little knowledge about the traveler, the trip purpose, or the destination. These trips are created based on observed traffic counts at the locations in question and some assumptions about the travel behavior of the trip maker, including an assumption that external travelers are indifferent about the actual length of the trip within the region (i.e., their destination is fixed).

Base year trip production totals for highway point of entry are derived from expressway traffic counts at locations around the region. Base year trips for airport point of entry are based on an analysis of observed enplanements. To create future productions and attractions, the base year number of total trips is factored using the same growth rates as commercial vehicles: 10 percent per decade. The year 2015 POE productions are presented in **Table 77**.

Table 77. Point-of-entry base year productions

Truck type	Base year 2015 total
Auto external	255,600
Truck external	109,500
Air traveler	69,500

All point-of-entry trips are handled at the same time using a gravity model. To begin, an impedance file based on a gamma function was created. To accomplish this, a destination vector of non-work trip attractions plus a weighted number of point-of-entry trips was calculated. Again, this information is used as a measure of development density with an emphasis on employment density. The impedance matrix is proportional to the productions multiplied by the attractions and inversely proportional to the square of the midday travel distance (capped at 60 miles):

$$Impedance = \frac{(.0001 * (POE\ Productions * Destination\ Development))}{(60.max.travel\ distance)^2}$$

The impedance matrix is balanced using the original productions at the origin, and trip attractions apportioned to destinations based on zonal shares of non-work attractions and zonal point-of-entry totals as the attractions.

At this point, the balanced trip matrix must be separated into its component pieces to be used within the traffic assignment procedures. Trips with origins at the expressway points-of-entry (zones 3633-3649) are extracted to a matrix, which is summed with its transpose matrix. This represents the total external expressway daily trip table. Thirty percent of the trips in this daily trip table are apportioned as external truck trips. The remaining 70 percent are allocated to external auto trips. To determine air traveler trips, all trips with origins in the region are extracted to another matrix, which is also summed with its transpose matrix. External truck trips are assumed to be heavy commercial vehicles. Thus, this demand matrix is factored by three vehicle equivalents prior to the traffic assignment.

Tolling

Within the traffic assignment procedures, tolling is reflected in the generalized cost of a road segment. While all of the user classes perceive the same travel time on a link, they may perceive differing generalized costs. This scheme allows different vehicle classes to be assessed different toll amounts. It also allows for differing toll amounts to be charged to the user classes based on the time-of-day. CMAP's traffic assignment includes seven user classes:

1. SOVs with a low value of time

2. SOVs with a medium value of time

3. SOVs with a high value of time
4. HOVs
5. B-plate and light trucks
6. Medium trucks
7. Heavy trucks

The generalized cost on toll links reflects travel time and a fixed link cost. The fixed link cost is the traveler's value of time multiplied by a perception factor, which reflects that users may not perceive 100 percent of the cost of a toll during a trip. **Table 78** lists the hourly values of time used for each user class. Values of time for commercial vehicle drivers were developed using information published by the Bureau of Labor Statistics on the mean hourly wages for drivers of heavy and light trucks in the Chicago region. Values of time for household vehicles were developed using a method described by Lemp and Rossi.[4]

Table 78. Vehicle Value of Time and Perception Factor by User Class

User class	Hourly value of time	Perception factor
SOV value of time bin 1	$2.30	2.25
SOV value of time bin 2	$7.20	2.25
SOV value of time bin 3	$24.00	2.00
HOV2	$9.00	2.25
HOV3+	$14.00	2.25
B-Plate truck	$24.00	1.00
Light truck	$32.00	1.00
Medium truck	$47.00	1.00
Heavy truck	$52.00	1.00
External auto	$18.00	1.00
Air traveler	$30.00	1.00

The generalized cost process converts the value of time into a minutes per dollar value that is multiplied by the toll amount. This straight-forward calculation fails to take into account all of the other elements that individuals consider when determining whether the cost of a tolled route is "worth it." User classes may not perceive the cost of paying a toll as 100 percent of the actual amount. Transponder users, for instance, are not paying cash out-of-pocket for each toll and may only "see" the cost when they view a monthly credit card statement (at which point

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[4] Lemp, J. and T. Rossi (2018) Practical Framework to Incorporate Value of Time Heterogeneity in an Aggregate Travel Model. Proceedings of the Annual Transportation Research Board Conference, Washington, D.C.

the cost has already been incurred). Additionally, the expected travel time savings from using the tollway may more than offset the perceived cost of the toll. Similarly, commercial vehicle drivers may be reimbursed for toll expenses or their Just-in-Time delivery responsibilities may play a much larger role in routing decisions than tolls. The perception factors in **Table 78** are an attempt to quantify these individual decisions and effectively increase the user classes' value of time, lowering their minutes per dollar and the effective impedance of tolling. The perception factors were calibrated using vehicle class volumes on tollway facilities.

As noted, three value of time bins (low, medium, and high) are used to categorize SOV trips. The value of time for a specific trip is not solely a function of income but is also related to the trip purpose and the perceived "cost" of not arriving on time. Work trips and attending a concert may have high values of time associated with them, while a routine shopping trip may have a low value of time. **Table 79** shows how SOV work trips are distributed across the three value of time bins and household income categories.

Table 79. SOV work trip VOT distribution

VOT groups	Total share of trips	Income category 1 share	Income category 2 share	Income category 3 share	Income category 4 share
VOT1	12.4%	47.2%	23.3%	10.2%	1.3%
VOT2	51.3%	48.2%	61.3%	58.2%	30.0%
VOT3	36.4%	4.7%	15.4%	31.6%	68.7%

Table 80 shows the value of time factors applied to categorize the remaining trip demand into the VOT bins. Drive to transit trips are assumed to be mostly work trips, which is why their VOT distributions are similar. The VOTs for external and air passenger trips are assumed to be higher than average. Implementation of this VOT scheme ensures that route choice decisions are sensitive to changes in toll amounts.

Table 80. Value of time distribution

VOT category	Visitor trips	Deadhead trips	Drive to transit trips	External trips
Low VOT bin	30 percent	70 percent	15 percent	10 percent
Medium VOT bin	55 percent	25 percent	50 percent	45 percent
High VOT bin	15 percent	5 percent	35 percent	45 percent

Assignment time periods

The principal objective behind multiple period highway assignments is to develop more accurate estimates of vehicle-miles by different speed ranges and vehicle classes for air quality conformity analyses. Separate assignments estimate highway vehicle-miles and travel speeds for eight time periods during the day:

- The 10-hour late evening-early morning off-peak period (8:00 p.m. to 6:00 a.m.)
- The shoulder hour preceding the morning peak hour (6:00 to 7:00 a.m.)
- The morning peak two hours (7:00 to 9:00 a.m.)
- The shoulder hour following the morning peak period (9:00 to 10:00 a.m)
- A five-hour midday period (10:00 a.m. to 2:00 p.m.)
- The two-hour shoulder period preceding the afternoon peak period (2:00 to 4:00 p.m.)
- The early evening peak two hours (4:00 to 6:00 p.m.)
- The two-hour shoulder period following the evening peak period (6:00 to 8:00 p.m.).

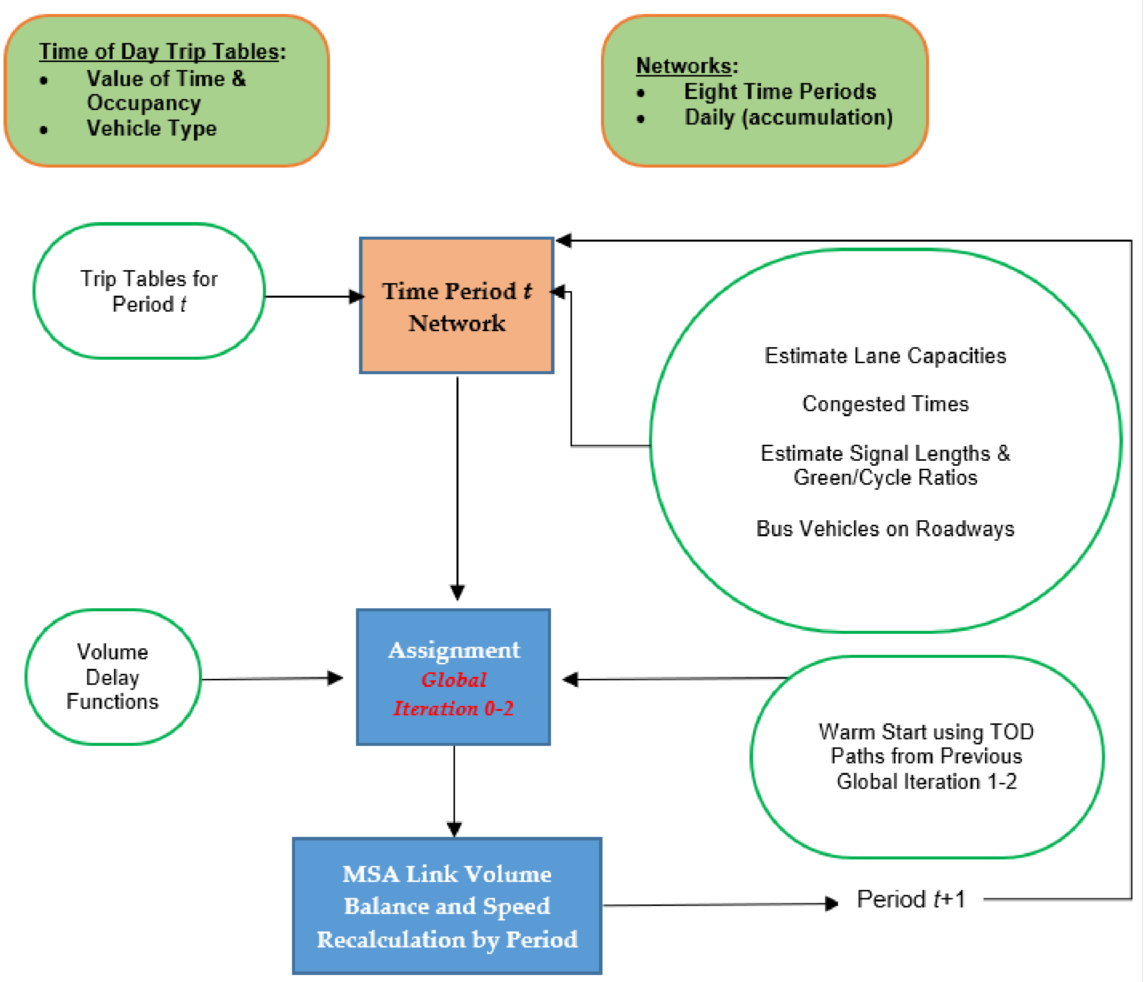
Figure 13 is a schematic diagram that shows the sequence of steps in the multiple time period assignment. Nine highway network scenarios are first assembled (eight time-of-day specific networks and a ninth all-inclusive network to hold the sum of daily information). The presence of time-of-day restrictions on highway network links allows for variation between the TOD networks. At present, these restrictions are modeled on the Kennedy Expressway reversible lanes and an on-ramp from eastbound IL Route 38 to eastbound I-290, as well as on arterials with peak period parking restrictions. In practice, the eight TOD periods use a total of four unique highway networks:

- A morning peak network used in the morning peak and its shoulders.
- A midday network used during time period 5.
- A evening peak network used in the evening peak and its shoulders.
- An overnight network used in time period 1.

The travel model proceeds through three global iterations. During each iteration, the time period assignments are executed, and the assignment results are averaged with the results of the TOD assignment for the same period from the previous global iteration using the Method of Successive Averages (MSA). This results in a final link volume for each time period. These are used to estimate the morning peak and midday travel times, which are fed back into the rest of the modeling process. The effects of bus operations on other traffic also are accounted for in the assignment process, as buses operating on shared-use facilities are included in the volume-delay function calculations.

After three passes through the time-of-day modeling process, the results of the separate MSA period assignments are accumulated into daily volumes. The results also are tabulated into the vehicle-mile-by-vehicle-type-by-speed range tables needed for the vehicle emission calculations. The completion and summarizing of the eight period assignments is highly simplified by using scripts to automate repetitive processes.

Figure 13. Multiple Time Period Highway Assignment Process



The actual traffic assignment is accomplished using a path-based algorithm in Emme®. This procedure uses the projected gradient method to reach network equilibrium, in place of the commonly used linear approximation method (Frank-Wolfe algorithm). The path-based assignment reaches finer levels of convergence in a shorter time than the standard assignment. Another benefit of the path-based assignment is the paths generated during the assignment are saved (one for each assigned vehicle class) in files that can be used to conduct detailed analyses after the assignment is finished. These are, in fact, a critical component of incorporating tolls into mode-destination-choice procedures.

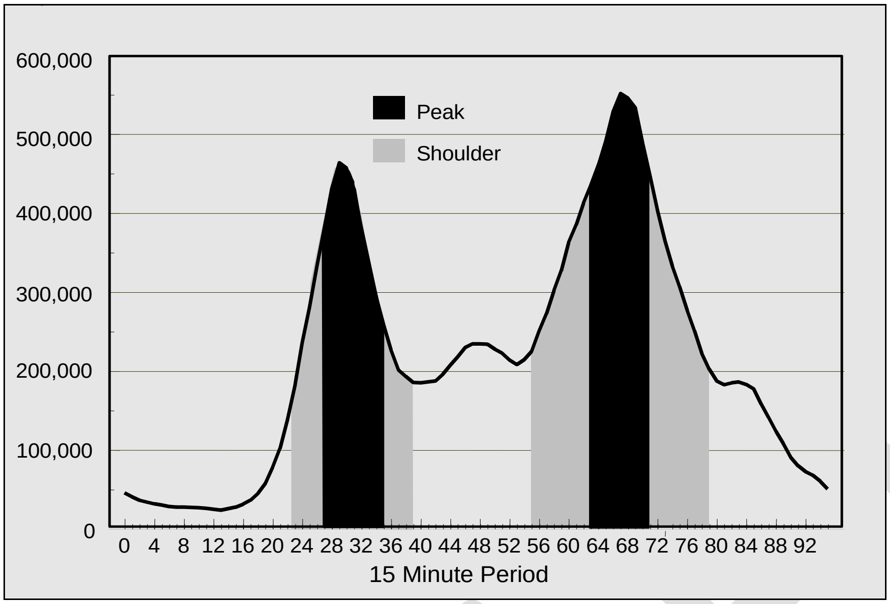
The path-based traffic assignment works on an origin-destination pair basis and works to iteratively solve the problem. Vehicle trips are assigned to the road network and the zone-to-zone travel costs (generalized cost including travel time and tolls) are determined. The algorithm seeks equality in costs among alternative paths between the same O-D pair. For example, if a new path is significantly "shorter" than the current ones, it is added to the set. All paths that carry flow are adjusted simultaneously. Traffic flows are shifted from paths with higher-than-average path costs to those with lower-than-average path costs. The amount of flow changes to shift to other paths is calculated with each iteration of the algorithm. Each traveler chooses the best path – the one that minimizes their travel cost. If a better path is available, travelers will select it. This is Wardrop's "user optimal" principle. It also means that an individual's route choice impacts other travelers.

The process begins by calling the macro for the first period assignment (the overnight period). The appropriate network scenario is selected and the corresponding demand matrices for the time period are called to assign the trips. For the first time period, the standard set of volume-delay functions (discussed below) are loaded, the scenario is prepared for assignment, and a full equilibrium assignment is completed. The procedure repeats through the remaining time periods. When the eight time periods are completed, the link volumes and travel times are successively averaged with the same time periods from previous global iterations. This occurs for the second and third global iterations since iteration 0 has no previous iteration to be averaged with. The result is a set of eight modeled scenarios representing each time period and containing the final MSA volumes and speeds.

The logic of the equilibrium assignment process is slightly altered after the first global iteration of the model. The TOD path files from the previous global iteration are loaded and are used as the starting point for the traffic assignment. This allows the traffic assignment to get a "warm start." The assignment is then readied for additional iterations and the remaining equilibrium assignment iterations are completed.

The travel data that led to selecting the eight time periods is illustrated in **Figure 14**. This is a plot of the auto driver and auto passenger trips in motion reported in CATS' 1990 household travel survey. Trips were accumulated at the end of 96, 15--minute periods throughout the day. The plot shows a moving average of these accumulated trips calculated over four consecutive 15-minute periods. The moving average smooths out the irregularities in the plot that are caused by the tendency of surveyed travelers to report trip start and completion times to the nearest quarter-hour or half-hour. An analysis of the Travel Tracker data confirmed that the eight time periods are still relevant. Thus, they continue to be used.

Figure 14. Time Distribution of Auto Driver and Passenger Trips



The plot shows the distinct peaking of auto travel during the morning and evening peak periods. The large number of trips in motion during peak travel periods is due not only to increased trip making during these time periods. Peak period auto trips also stay in motion longer because they are more likely to be lengthy work trips subjected to slower congested peak period travel speeds.

The plot in **Figure 14** is not symmetric because the evening peak period is longer and slightly worse than the morning peak. The two peak periods are separated by a midday period that has a fairly uniform number of trips in motion, except for a bulge in trip making around the noon lunch period. Trips in motion plateau between 8:00 and 9:00 p.m. after the evening peak period, and then quickly decline during the late-night period.

The two assignment peak periods are defined differently because of these auto travel characteristics. The shading under the **Figure 14** curve shows the peak and shoulder periods used in the multiple time period assignments. A two hour morning peak (7:00 to 9:00 a.m.) and two, one-hour morning peak shoulder periods (6:00 to 7:00 a.m. and 9:00 to 10:00 a.m.) effectively cover the morning peak period. Six hours are needed to capture the evening peak period, including: a two-hour early evening peak (4:00 to 6:00 p.m.) plus two hour afternoon and evening peak shoulder periods on either side of the PM peak (2:00 to 4:00 p.m. and 6:00 to 8:00 p.m.). This leaves a nearly uniform four-hour midday period between the two peaks (10:00 a.m. to 2:00 p.m.), and an off-peak period (8:00 p.m. to 6:00 a.m.) covering the late evening and early morning hours.

The time period assignments provide a more detailed and accurate picture of congestion effects in the highway network, which is advantageous for several reasons. While daily estimated traffic volumes may just be marginally improved compared to volumes produced by average daily assignments, estimates of network speeds are substantially improved and regional vehicle-miles of travel agree more closely with state estimates of daily vehicle-miles. Since congestion is more correctly modeled, impacts from proposed highway improvements that reduce congestion are also more accurately reproduced by the time period assignments.

Time-of-day factors

Auto trips processed through the mode-destination-choice model proceed to the time-of-day model, where they are assigned to one of the eight TOD periods. Truck trips and the external auto trips are not part of this process, so factors are applied to convert this demand into TOD trips. These factors are listed in **Table 81**.

TOD factors for the other trips were developed using the following methods:

- Heavy trucks: Time-of-day factors for these vehicles were derived directly from the ATRI truck trip dataset. These same factors are applied to external truck trips.
- Light and medium trucks: Factors for these vehicles were developed using transaction data from the Illinois Tollway; specifically focusing on Tier 2 and Tier 3 transactions (which correspond to CMAP's light and medium truck categories, respectively). These data were combined with hourly count data of single unit trucks on Cook County arterials provided by IDOT. The final factors represent an averaging of these two data sources.
- All other vehicles: The TOD factors for all other vehicles were developed from the model validation time-of-day traffic analysis.

Table 81. Auto person trip time-of-day factors

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
external auto	0.161	0.054	0.129	0.050	0.214	0.132	0.150	0.110
AirPass to/from airports	0.161	0.054	0.129	0.050	0.214	0.132	0.150	0.110
B trucks	0.161	0.054	0.129	0.050	0.214	0.132	0.150	0.110
L truck	0.143	0.052	0.142	0.066	0.264	0.147	0.112	0.074
M trucks	0.174	0.049	0.129	0.061	0.251	0.139	0.113	0.084
H trucks	0.216	0.039	0.102	0.059	0.249	0.118	0.092	0.125
external trucks	0.216	0.039	0.102	0.059	0.249	0.118	0.092	0.125

Volume-delay functions

The volume-delay functions (VDFs) are used to represent the congestion that occurs on links as traffic volumes increase. The volume-delay functions include estimated traffic signal characteristics for links that end at signalized intersections. This means that assignments are sensitive to signal characteristics and can reflect major signal modernization programs. In addition to more accurately representing the characteristics of the network, these signal sensitive volume-delay functions allow the emission reductions from signal improvements to be evaluated.

CMAP’s volume-delay functions have evolved from their initial versions because of the previous functions’ limitations when they were used for time period assignments. Their most severe limitation was that freeways and expressways tended to be over-assigned in the congested peak time periods. Several factors contributed to this peak period over-assignment including: (1) an unrealistic initial peak period assignment since paths were built using uncongested travel times; (2) the inability to model bottlenecks in the freeway network that occur during peak periods, and; (3) not restricting freeway on-ramps whose peak period capacities were controlled by metering. The approach taken was to alter the volume-delay functions for freeways, expressway and metered freeway entrance ramps so that travel times increase far more quickly after capacity is reached. The capacities of metered on-ramps are also set to maximum metered flow rates.

Note that the link volume included in the volume-delay function calculations includes all assigned auto and truck traffic (in VEQs), as well as buses operating on the roadway links, represented as three vehicle equivalents. The capacity values in CMAP’s VDFs represent lane capacities at level of service E traffic conditions except for arterials (vdf1) and ramps connecting freeways (vdf5), which reflect level of service C.

VDFs for links ending at signalized intersections (vdf1 and vdf3)

Intersection delays in the volume-delay functions are based upon the Webster equation.[5] In this equation, intersection delay has uniform and incremental components, and both are rather complicated to calculate. For CMAP’s volume-delay functions, simpler regression equations were fit to calculated uniform and incremental delays for a range of signal cycle lengths and green time-to-cycle length ratios.

The regression equations for uniform and incremental signal delays are combined with link travel time estimates in the first (arterial) and third (freeway exit ramp to arterial) volume-delay functions as follows:

Link travel time between intersections is:

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[5] F. V. Webster and B. M. Cobbe. *Traffic Signals*. Road Research Laboratory, Ministry of Transport Road Research, Technical Paper No. 56, 1966.

$$T_{link} = T_0 \times \left(1 + 0.15 \times \left(\frac{volume}{capacity}\right)^4\right)$$

This is the widely used BPR (Bureau of Public Roads) function where T_{link} equals the link's travel time without any intersection delay and T_0 is the uncongested link travel time without intersection delay. The uncongested link travel time is computed using the maximum speed permitted on the link. Quantity *volume* is the link's traffic volume for the time period in auto equivalents. Capacity represented within the link travel time function is approximately the service volume at level of service C. It is calculated as 75 percent of the level of service E time period link capacity. Note that link capacity is calculated by multiplying the hourly lane capacity by the number of lanes and the number of hours in the assignment time period.

Uniform intersection delay is the maximum of zero or:

$$D_u = 5.96 \times \left(\frac{volume}{capacity}\right) - \left(0.234 \times cycle \times \frac{green}{100}\right) + (0.21 \times cycle) - 4.47$$

Where D_u is the average uniform intersection delay at the link's j-node in seconds. *Green* is the green time allowed the link at the j-node intersection and *cycle* is the cycle length at the intersection. Both quantities are in seconds. The uniform delay is restricted to positive values in the volume-delay functions.

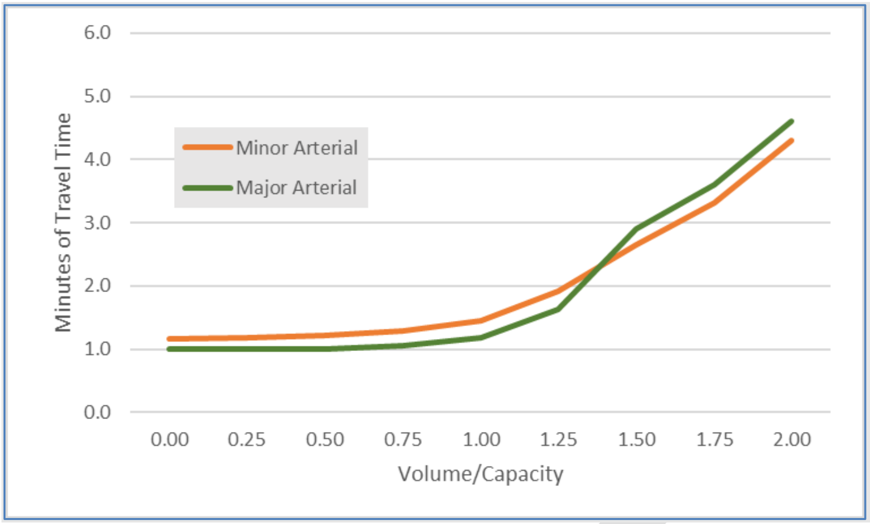
Incremental delay at intersections is the maximum of zero or:

$$D_i = 2.65 \times \left(\frac{volume}{capacity}\right)^8 - \left(7.3 \times \frac{green}{100}\right) + 0.338$$

Where D_i is the average incremental intersection delay at the link's j-node in seconds. Incremental delay is also restricted to positive values in the volume-delay functions.

Figure 15 shows the estimated travel times for a major and minor arterial including intersection delay. Both arterials have an uncongested travel time of one minute between intersections. For the minor arterial the signal cycle length at the j-node is ninety seconds, and the link receives thirty seconds of green time in the cycle. The signal cycle length at the j-node is 120 seconds for the major arterial, with ninety seconds of green time in the cycle. The major arterial is allowed more green time at the j-node than the minor one and intersection delays on the major link are less than on the minor link until the volume to capacity ratios exceed 1.25. Both volume-delay relationships have a kink in them because the maximum combined uniform and incremental intersection delay is limited to one cycle length.

Figure 15. Example Volume-Delay Functions for Two Arterial Links



VDFs for freeways and expressways (vdf2, vdf4 and vdf5)

The second (freeway), fourth (expressway) and fifth (freeway-freeway ramps) volume-delay functions start with a variation on the BPR function. Additional adjustments were made to the expressway function: uncongested link travel times on freeway links were reduced 15 percent to reflect drivers' tendency to exceed speed limits on high-volume facilities at low traffic volumes, and the link capacity value was increased by 300 vehicles to reflect traffic management and operations strategies implemented on the region's Interstate system. For all three of these VDFs the exponent was increased from the BPR value to increase travel times more dramatically for volume to capacity ratios greater than one. The quantity T_0 is determined by the maximum legal speed

For Freeways (vdf2):

$$T_{link} = \left(\frac{T_0}{1.15}\right) \times \left(1 + 0.15 \times \left(\frac{volume}{capacity + 300}\right)^8\right) \times \left(1 + 0.15 \times Minimum\left(\frac{volume}{capacity}\middle|1.0\right)\right)$$

For Expressways (vdf4):

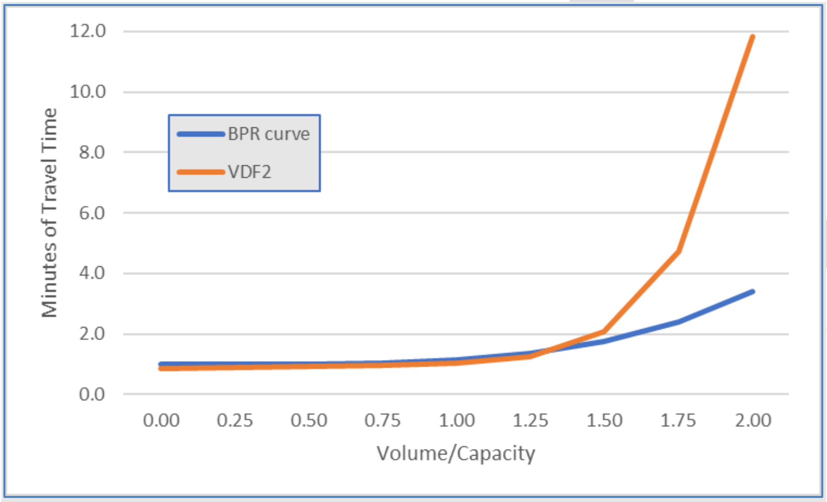
$$T_{link} = T_0 \times \left(1 + 0.15 \times \left(\frac{volume}{capacity}\right)^8\right) \times \left(1 + 0.15 \times Minimum\left(\frac{volume}{capacity}\middle|1.0\right)\right)$$

For Freeway-to-Freeway ramps (vdf5)

$$T_{link} = T_0 \times \left(1 + 0.15 \times \left(\frac{volume}{capacity}\right)^8\right)$$

Figure 16 compares expressway link travel times CMAP's VDF to those from the original BPR volume-delay function for a one mile link with a maximum speed of 60 miles per hour. At volume to capacity ratios below 1.25, both functions predict very similar link travel times; in fact the CMAP value is slightly below that of the BPR curve due to the lower initial uncongested travel time. For volume to capacity ratios greater than 1.25, the travel time predicted by CMAP's function is higher and rapidly increases because the volume to capacity ratio is exponentiated to a higher power.

Figure 16. Revised BPR Volume-Delay Function for Freeway Links



VDF for metered freeway entrance ramps (vdf8)

For metered freeway entrance ramps, the original BPR function is revised so that travel time greatly increases when the link volume exceeds the maximum metered flow rate. This effectively restricts the ramp's volume to the metered flow rate. The adjusted BPR function is:

$$T_{link} = T_0 \times \left(1 + 0.15 \times \left(\frac{volume}{metered\ flow}\right)^{10}\right)$$

The maximum metered flow rate is taken as 720 vehicles per hour per lane, or an average vehicle delay at the ramp metering signal of five seconds.

VDF for links with tolls (vdf7)

The original toll collection link volume-delay function implemented in the trip-based model decades ago attempted to measure delay at the toll collection facility itself through the generalized cost (time and money) of using the facility. This particular method of reflecting the impact of tolls on individuals' route choice makes little sense today given the state of toll collection technology. The entire system operated by the Illinois Tollway uses electronic toll collection technology: mainline plazas require no reduction in operating speed and no-stop tolling is available at ramp tollbooths. Further, the vast majority of toll transactions in the CMAP region use transponders, thus only a small share of tollway drivers even stop at plazas.

The current toll collection link volume-delay function merely reflects the travel time on the link (generally coded as 200 feet long) based on the average speed of the incoming link. These links are of negligible length within the larger overall network. Thus, no attempt is made to constrain their capacity. The true impact of tolling on route choice is measured through the generalized cost procedures described earlier.

Link speeds

Traffic volume on every link for each period of the day is one product of the time-of-day network assignment. The speed of travel for each link is calculated by an equation that uses the volume-capacity ratio for the link as the independent variable. The following equations are used to produce the final link speed.

Freeways:

$$S=S_0 \frac{1}{1+0.15\ (V/C)} \quad x \quad \frac{1}{1+0.15\ (V/C)^8} \qquad \text{for } V/C \leq 1$$

$$S=S_0 \frac{1}{1+0.15\ (V/C)^8} \qquad \text{for } V/C > 1$$

Arterials:

$$S=S_0 \frac{1}{(\ln(S_0) * 0.249) + 0.153\ (\ V/(C * .75))^{3.98}}$$

Where:

S = Speed on link used for emission calculation
S_0 = Initial Speed on link
V/C = Volume-Capacity ratio for the link

These curves represent modifications to the BPR curves that have been used at CMAP and other agencies for many years. Consistent with a national trend for agencies to use modified curves based on local data, these curves are based on the information gathered from local empirical data. The freeway curve is the same as used in the volume delay functions in the time-of-day assignment iterations. The arterial curve is slightly modified to better correlate with the empirical data. The data used to develop the modification is from IDOT's traffic sensor system for the expressway system as well as CATS-conducted speed runs for the arterial system. This data base is documented in CATS Working Paper 95-09: Travel Time Database and Structure Chicago Area Expressway System (September 1995), and CATS Working Paper 97-09: 1994, 1995 and 1996 Combined Travel Time Database Documentation: Arterial Highway System (July 1997)[6]. The methodology for the curve development is presented in CATS Working Paper 97-12: Method for Adjusting Modeled Speeds Based on Empirical Speed Data (August 1997).

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[6] Note: All CATS Working papers are available on the CMAP Data Hub.

Emissions calculation

As northeastern Illinois does not meet federal air quality standards for ozone, CMAP must show the region's long range transportation plan and Transportation Improvement Program meet established emission budgets. This is the Air Quality Conformity process. Final link volumes and link speeds from the travel demand model serve as inputs to the vehicle emissions model, which is used to make the conformity determination. Please refer to the Air Quality Conformity Analysis Appendix for more information.