21ST CENTURY INFRASTRUCTURE COMMISSION REPORT

Prepared for
Governor Rick Snyder

The 21st Century Infrastructure Commission's research is composed of two major works: this report titled “21st Century Infrastructure Commission Report,” and a shorter executive summary, which is intended to highlight the most important elements of the full report. Both were published on Wednesday, November 30, 2016.

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Letter from Commission Chair

Dear Governor Snyder:

On behalf of Michigan's 21st Century Infrastructure Commission, I am pleased to present to you the Commission's final report, which we are confident will serve as a 50-year vision for improving the state's infrastructure system and enhancing the quality of life for all Michiganders. A robust, reliable, and sustainably funded infrastructure system allows for healthy communities, long-term economic prosperity, and more and better jobs—providing a solid foundation for our state's future.

This report is the first of its kind in the nation to offer comprehensive recommendations across asset types: water, transportation, energy, and communications infrastructure. It provides a current assessment of Michigan's infrastructure systems, a vision for the state's future, and how we can bridge the gap between those two things. The Commission, composed of industry experts, educators, business leaders, and government officials from across the state, came together to produce a set of implementable recommendations that prioritize the health and safety of Michigan's residents. Months of research, discussions with the public, and input from outside experts have allowed us to present a plan that we are confident will improve the quality of life for all Michiganders.

This report is an important first step in improving Michigan's infrastructure, but our work is not done. For too long, we have underinvested in our infrastructure systems and treated our assets as separate entities. In order to stay at the forefront of emerging technologies and remain competitive in an increasingly global world, we must start to think of our infrastructure systems in an integrated and holistic way.

Improving infrastructure today and for future generations is a responsibility every Michigander needs to take seriously. As Michigan looks to the future, it is essential that we have the infrastructure systems to match our goals. Sound and modern infrastructure is vital to the health and well-being of the people of Michigan and will help support our growing economy in the future. Michigan's residents deserve reliable, safe, and affordable infrastructure, and we look forward to creating a 21st century infrastructure system with you.

Sincerely,

S. Evan Weiner
Chair
21st Century Infrastructure Commission

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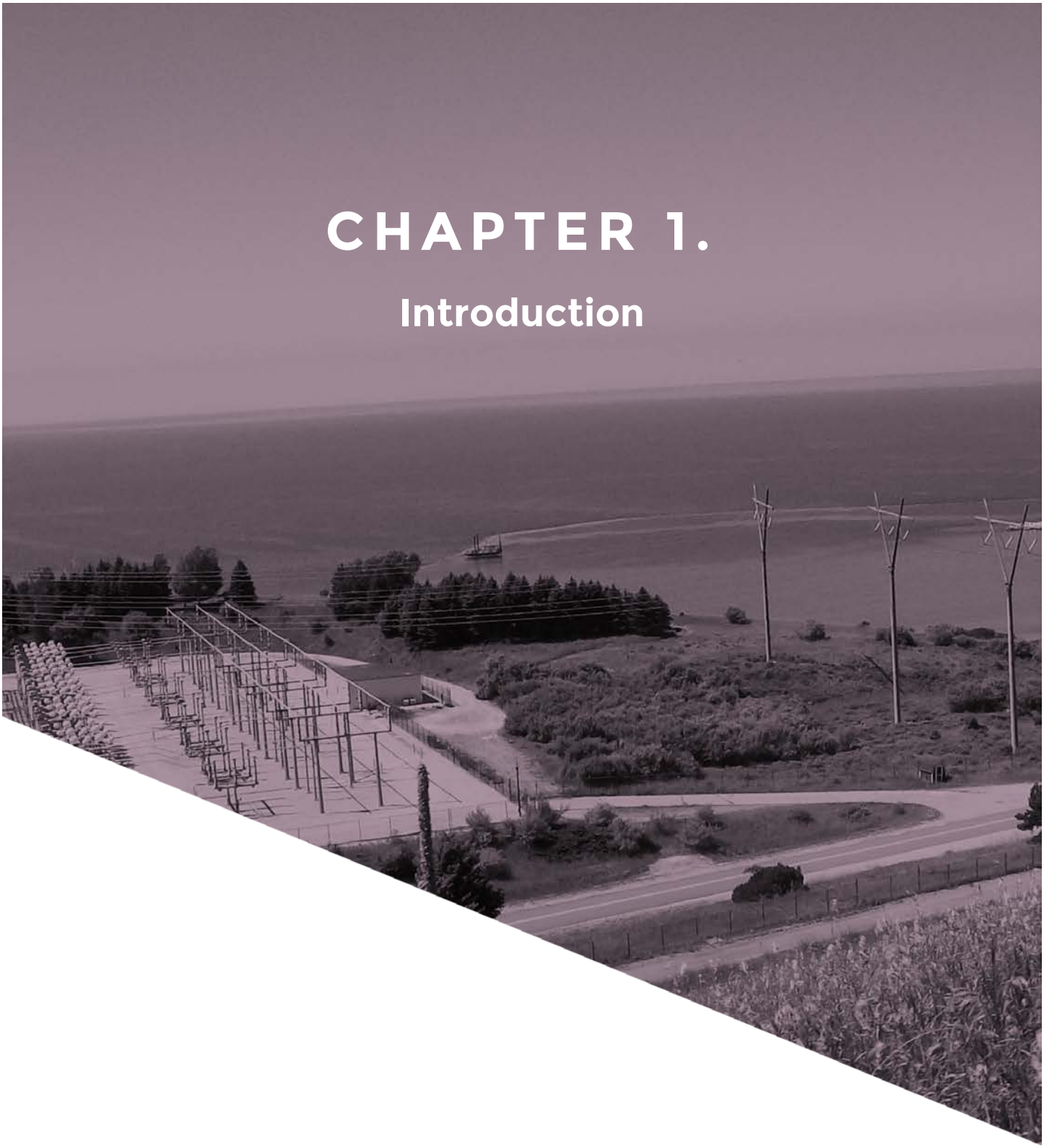


CHAPTER 1.

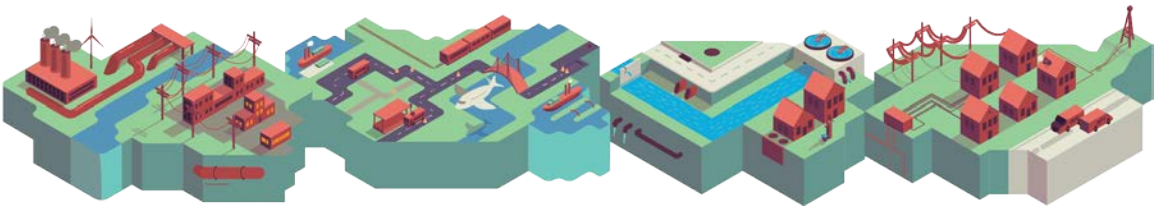
Introduction

Background

Infrastructure is the foundation of Michigan's modern economy and quality of life. When most people hear the term "infrastructure," they often think of roads or bridges; however, these assets are just pieces of a larger, more complex picture that includes water and sewer systems, drains and stormwater systems, broadband and communication systems, and electricity and natural gas networks.

Michigan's infrastructure is aging, and maintenance has been deferred for decades, leaving us in a state of disrepair. Failing infrastructure interrupts daily life, slows commerce, jeopardizes public health, pollutes the environment, and damages quality of life. This is evidenced by the condition of our current system:

- **39 percent of roads** are in poor condition (TAMC 2015)
- **27 percent of bridges** are structurally deficient or functionally obsolete (MiBRIDGE 2016)
- Water contamination in the city of Flint threatens the health and safety of its residents
- Since 2008, an average of **5.7 billion gallons** of untreated sewage flowed into Michigan waterways (MDEQ October 2016 a.)
- **64 rivers** that drain 84 percent of Michigan's Lower Peninsula tested positive for human sewage (Verhougstraete et al. 2014)
- Nearly **25 percent of beaches** experienced closures in 2015 (MDEQ May 2016)
- Approximately **130,000 (10 percent) of the state's 1.3 million septic systems** are likely experiencing operational problems (Creagh 2016)
- Property damage from flooding is increasing (Saunders 2014)
- Approximately **12 percent of the state's households** lack access to advanced broadband service (Connect Michigan 2015)
- Planned power plant retirements in the Upper Peninsula have posed challenges to balancing reliability and affordability



Without intervention—including adequate planning, management, and investment—Michigan will continue to experience infrastructure failures, leading to impacts on our public health, environment, and overall quality of life.

The 21st Century Infrastructure Commission (referred to as "the Commission") recognizes the need to ensure the health, safety and welfare of Michigan's residents. Infrastructure planning, management, and investment that holistically acknowledges transportation, water, stormwater, energy, and communications needs is the best way to ensure protection of public health, the environment, and the state's future economic growth.

A 21st century infrastructure system in Michigan must have resilient, adaptive, and robust infrastructure systems in both rural and urban communities. Outcome-based decision-making tools and appropriate incentives will drive the development of sound 21st century infrastructure systems. Michigan must establish regulatory and tax policies that encourage infrastructure innovation and investment, and build public confidence. In order to achieve efficiencies and support adequate investment, public and private partners at all levels must coordinate asset management and planning across infrastructure types and work together to leverage diverse, integrated, and sustainable funding.

The 21st Century Infrastructure Commission

To address the state's infrastructure needs, Gov. Rick Snyder created the 21st Century Infrastructure Commission, an advisory body of 27 members[1] that has developed a long-term vision and associated recommendations to drive Michigan toward that vision. As Executive Order No. 2016-5 states, "[s]ound and modern infrastructure is vital to the health and well-being of the people of Michigan, as well as Michigan's economy and vibrant communities."

The commission's vision states:

> *Michigan will lead the nation in creating 21st century infrastructure systems that will include, at a minimum, innovative technology, sustainable funding solutions, sound economic principles, and a collaborative and integrated asset management and investment approach that will enhance Michiganders' quality of life and build strong communities for the future.*

Throughout the process of building recommendations for this report, commissioners participated in monthly meetings of the full Commission, along with biweekly meetings of asset-focused subgroups. The Commission also included technical advisors in the process to ensure stakeholder input was heard and incorporated into discussion. In order to receive input from stakeholders

[1] William Moritz served the Commission in his capacity as interim director of the MDNR, but was replaced when Keith Creagh reassumed his post as director of the MDNR.

across Michigan, the group hosted six listening tour events in various locations throughout the state and regularly solicited input from the public through the 21st Century Infrastructure Commission website (for more information on the public engagement process and timeline, see Appendix B).

EXHIBIT 1. Michigan's Infrastructure Through the Years

1951	Public Act 51 is enacted, which dictates how transportation revenue is distributed in Michigan based on a funding formula.
1960s 1970s	The federal highway program expands our transportation infrastructure; Clean Water Act leads to significant investments in wastewater collection and treatment; our state park system undergoes expansion. Michigan's largest gas storage site, Belle River Mills, becomes active in 1965. Michigan sees its greatest development in electric generating facilities ever. The Comprehensive Transportation Fund is created in 1972.
1988	Michigan voters overwhelmingly approve the $800 million Quality of Life bond.
1991	The Michigan Telecommunications Act is enacted, establishishing a state regulatory framework for telecommunications technology.
1997	A $.04 increase in the state gas tax is approved to help fix the state's roads and bridges.
1998	The Clean Michigan Initiative bond of $675 million was passed by voters.
2002	Michigan voters approve the $1 billion Great Lakes Water Quality bond.
2010	Merit Network announces the award of two multimillion dollar grants to build over 2,200 miles of fiber-optic infrastructure in Michigan.
2011	Gov. Rick Snyder delivers a special message on infrastructure calling for a goal of increasing infrastructure investment by $1–$1.4 billion a year.
2012	Governor Snyder delivers the first of two special messages on energy. Michigan Cyber Range is inaugurated by Governor Snyder.
2015	The state begins taking action to resolve the Flint water crisis. Governor Snyder signs a $1.2 billion package to improve Michigan's roads.
TODAY	The 21st Century Infrastructure Commission releases a visionary plan to address Michigan's infrastructure for the next 50 years.

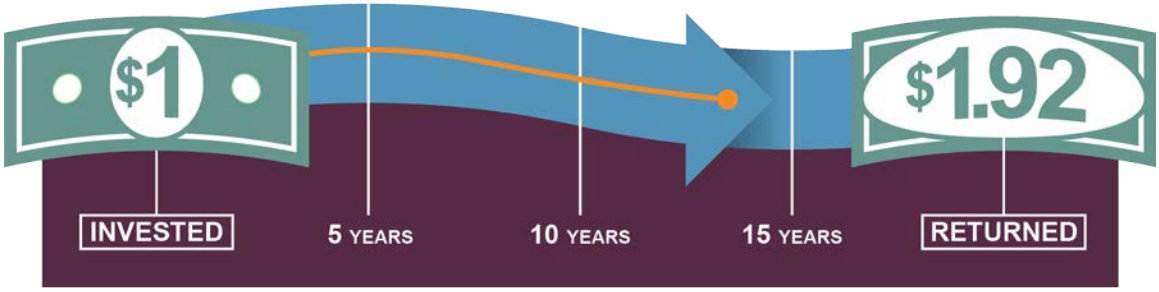
National Infrastructure Spending

Michigan is not alone in its infrastructure challenges. Infrastructure needs abound in communities and states across the country and around the world. In 2013, the American Society of Civil Engineers (ASCE) gave America's infrastructure overall a grade of "D-plus," and reports that the nation would need to spend an additional $3.6 trillion by 2020 to raise national infrastructure to a state of good repair. Given the recent Flint water crisis and growing concern about the condition of underground infrastructure across the state, Michigan's portion of the investment needs has likely grown significantly.

During the past decade, states across the U.S. have been cutting public infrastructure spending, causing infrastructure investment to drop from a high of 3 percent of the nation's gross domestic product (GDP) in the late 1960s to less than 2 percent in 2014 (McNichol 2016). States have not been alone in cutting spending on infrastructure; since 2003, federal spending on infrastructure has fallen by almost 19 percent, while spending by states and municipalities has dropped by approximately 5 percent (McNichol 2016).

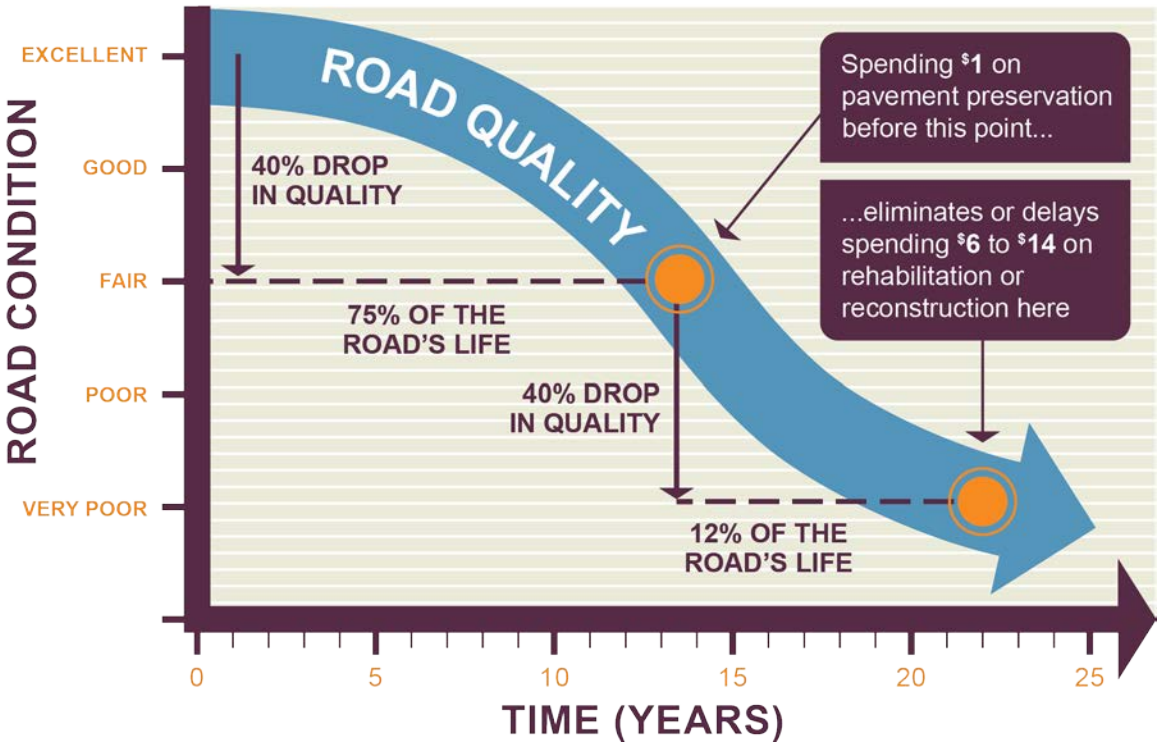
This decline in investment has emerged despite strong evidence that spending on physical infrastructure has a positive return on investment. The return on infrastructure investment is nearly twice initial spending because it is frequently less expensive to maintain existing infrastructure than it is to repair or replace it, and newly created infrastructure is far less likely to need repairs or replacements. On average, every $1.00 spent on nonresidential construction has an economic impact of $1.92. For transportation and power investment, $1 returns $4.24, while $1 of spending on water and sewer assets returns $2.03 in revenue (Cohen 2012).

EXHIBIT 2. Return on Infrastructure Investment



Not only are there sizable economic arguments for infrastructure investment, there is also a case to be made for making infrastructure improvements sooner rather than later. As shown in the example in Exhibit 3, deferring infrastructure investment will actually make a project more expensive, as the costs of infrastructure repair and or replacement increases as infrastructure quality declines.

EXHIBIT 3. Road Condition and Preservation



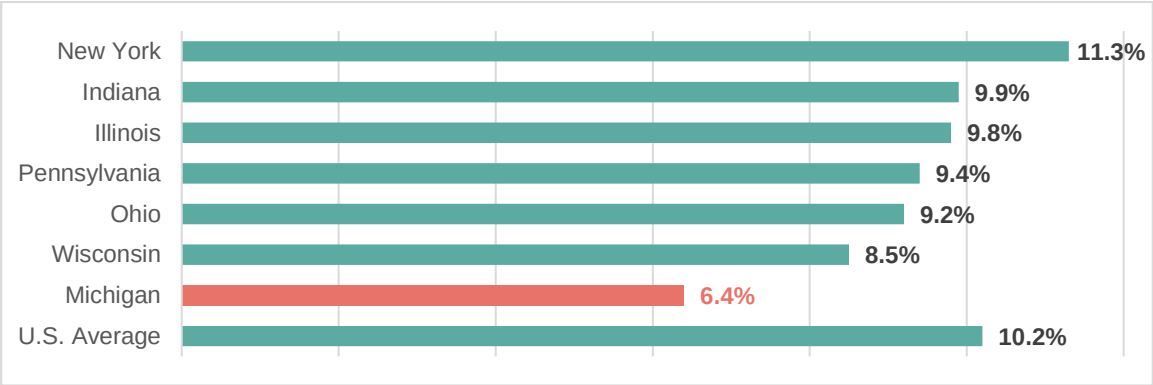
Source: AASHTO and TRIP 2009.

Current investment in infrastructure varies significantly by state. The share of a state's budget devoted to capital spending can vary greatly based on factors such as geographic size, population density, and the age of existing infrastructure. Several large states with small populations—Alaska, North Dakota, and South Dakota—spent more than 10 percent of their budget on capital expenses in 2013.

At the other end of the spectrum, however, three states–California, Vermont, and Michigan–spent less than 4 percent of their budgets on infrastructure.

As shown in Exhibit 4, Michigan's average annual investment of 6.4 percent between 2010 and 2014 positions the state at the bottom of the spectrum nationally; this is partially a result of our unwillingness to identify and fund needed investments (Deloitte 2016). In fact, from 2002 to 2013, Michigan had the third largest decline in state and local infrastructure spending as a share of GDP (McNichol 2016).

EXHIBIT 4. State and Local Capital Spending Comparison



Note: Percent of total expenditure, annual average 2010-14.
Source: Deloitte 2016.

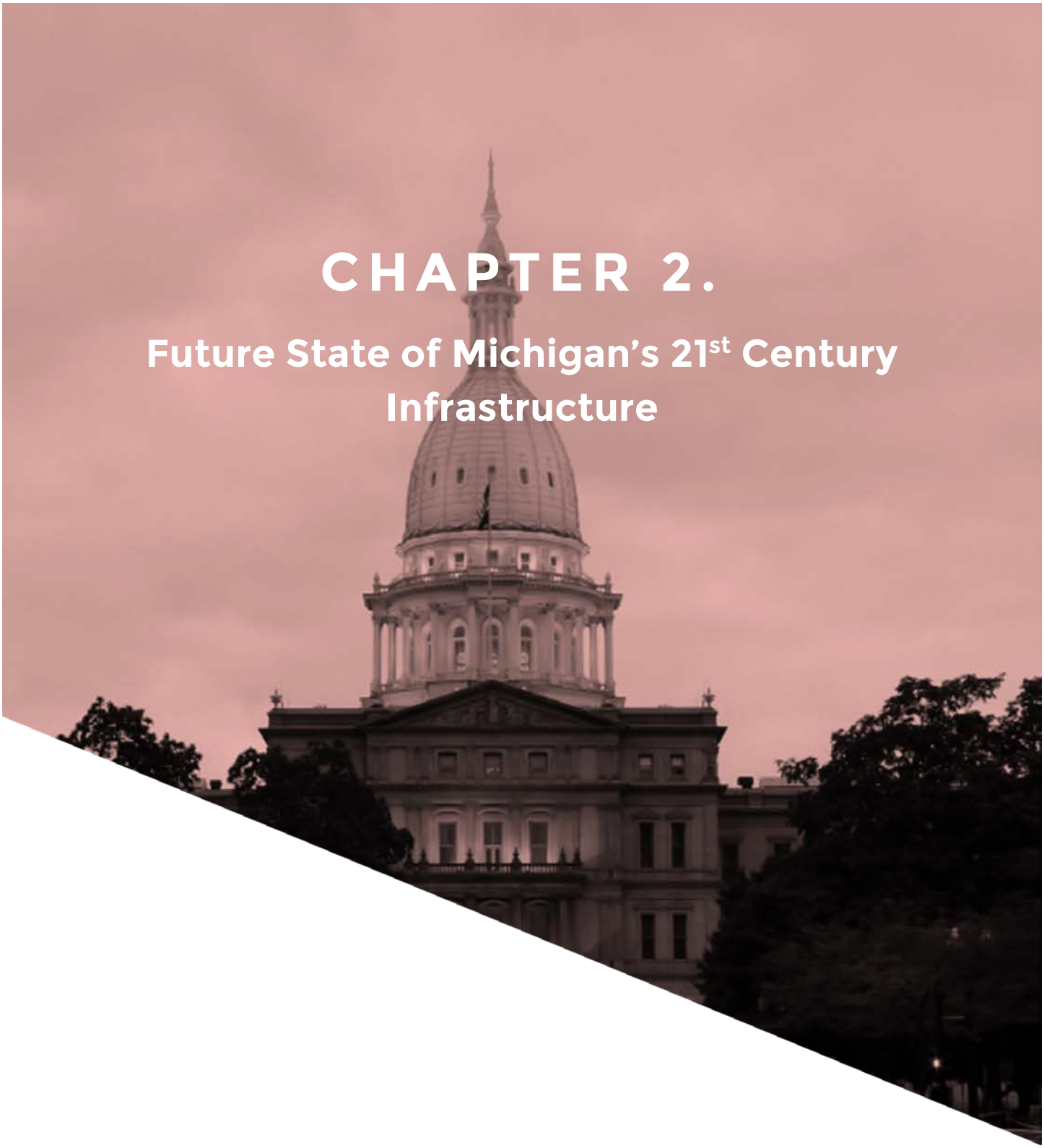
Purpose

The purpose of this report is to give policymakers and the public an overarching view of Michigan's infrastructure needs, as articulated by the Commission. The report identifies the need for a statewide asset management system and Michigan Infrastructure Council (Chapter 3), and makes specific recommendations in four key areas of infrastructure: communications (Chapter 4), energy (Chapter 5), transportation (Chapter 6), and water (Chapter 7). Funding challenges and opportunities are described in Chapter 8.

This report is not an operational plan, nor does it suggest a specific funding package. Instead, it outlines the challenges and opportunities facing Michigan's infrastructure system, identifies key recommendations for action, and provides a menu of short-term needs and long-term goals for consideration by policymakers and the public.

Recommendations are numbered according to the chapter in which they appear, and then by topic area. Where feasible, the Commission identified the anticipated investment needed for each recommendation in this report, and potential public or private funding sources. Several recommendations developed by the Commission are for consideration by the Michigan Legislature, and out of deference to the legislative process, the Commission did not attach cost figures to any legislative recommendations.

Finally, policymakers and the public should recognize that this report is part of a larger process to set the foundation for Michigan's future, articulated by Governor Snyder in his 2016 State of the State address, during which he also created the 21st Century Education Commission and the Building the 21st Century Economy Commission. The recommendations outlined in this report will provide job opportunities for Michigan's workforce, including engineers, skilled construction trades, and other skilled infrastructure occupations. The Commission encourages the Building the 21st Century Economy Commission to fully review and assess how this report's recommendations can be folded into their vision for Michigan's economic future.



CHAPTER 2.

Future State of Michigan's 21st Century Infrastructure

21ST CENTURY SMART STATE

FUTURE STATE OF MICHIGAN

A smarter state improves quality of life by building infrastructure that optimizes technologies and enables new work processes, services, and products. This construction relies on evaluating residents' experiences with safety, security, health, energy, transportation, and communication. Michigan's future state will be experienced in the following ways:

TRAILS

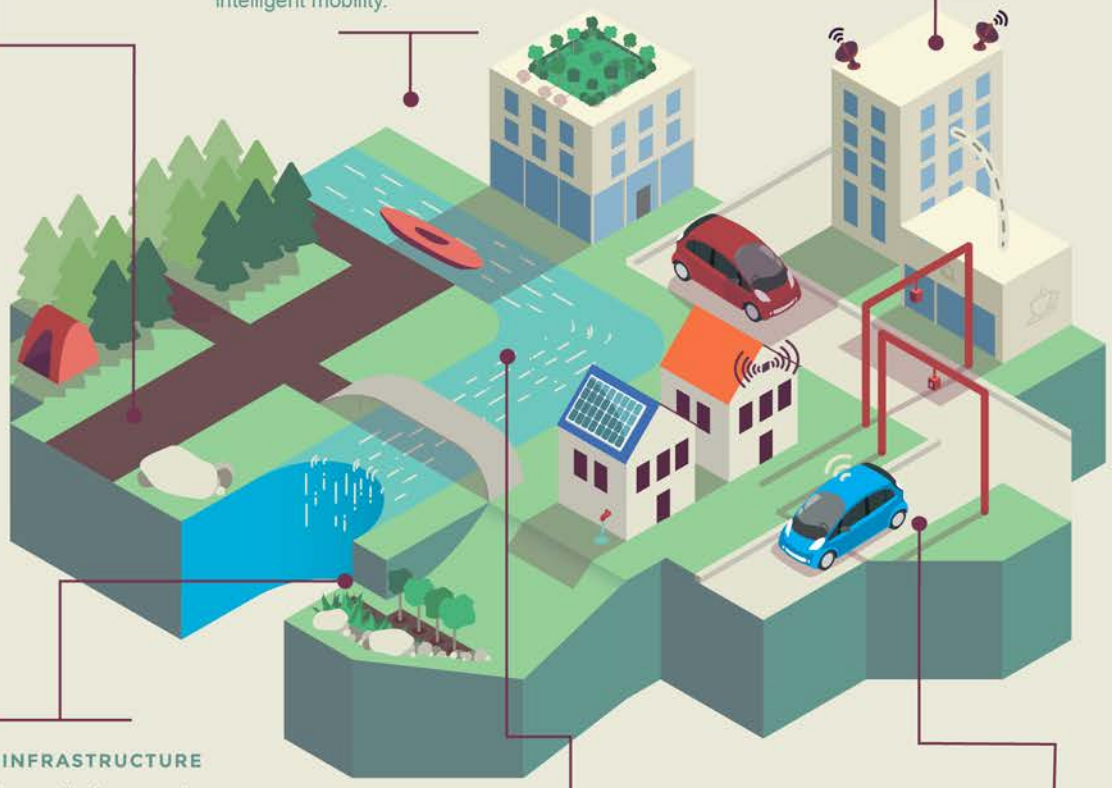
- Statewide efforts like the Iron Belle Trail have improved cross-community trail linkages and economic development opportunities, continuing Michigan's legacy as "The Trail State."

SMART ENVIRONMENTS

- Medical devices transmit patient data from homes to hospitals and alert first responders in case of an emergency, allowing more residents to age in place.
- Street lights make communities safer by prompting city workers to replace the light bulb before it burns out.
- Technology alerts law enforcement of crime or suspicious activity as it happens so they can arrive on the scene sooner.
- Using data from intelligent sensors, control systems will optimize and manage the flow of people and vehicles out of urban infrastructure to coordinate intelligent mobility.

COMMUNICATIONS

- Advanced broadband technology enables employees to work from anywhere, at any time, and provides students with the ability to access educational resources even in the most rural areas.
- Michigan will continue to set industry standards in cyber security by finding innovative ways to defend critical information, control access and identity management, and embrace new and emerging technologies.



GREEN INFRASTRUCTURE

- Stormwater and drainage systems manage water in a way that maximizes benefits to people and nature.
- Michigan's road and rail systems ensure that rivers, streams, and drains remain free flowing to protect ecosystem health and safely move people and goods.

WATER

- Water utilities are financially stable and provide safe, reliable, and high-quality service for all residents.
- Water systems are designed and built using the best available cost-effective technologies to equitably provide services to residents and businesses.
- Infrastructure will monitor water quality and water levels and alert government officials to maintenance issues before larger, more costly problems develop.

TRANSPORTATION

- Michigan leads the way in research and development of intelligent vehicles.
- Intelligent traffic systems allow commuters to avoid congestion by suggesting alternative travel routes.

Guiding Principles

The 21st Century Infrastructure Commission's goal is to enhance Michigan residents' quality of life, drive economic growth, and create a strong foundation for vibrant communities. We can achieve this by planning for 21st century infrastructure systems that are safe, reliable, efficient, and cost-effective for all residents.

The Commission developed the following guiding principles to direct the recommendations for creating a 21st century infrastructure system for the state of Michigan:

- **Create infrastructure systems that enhance quality of life, enable economic growth, and provide a strong foundation for vibrant communities.** Strong, modern infrastructure is vital to attracting and retaining residents and businesses. Infrastructure systems serve as the backbone for our communities; therefore, we should preserve, maintain, and improve our infrastructure systems.
- **Promote coordination, cooperation, and communication.** All levels of government and infrastructure entities in Michigan are incentivized to coordinate, cooperate, and communicate throughout the infrastructure planning, management, and implementation process. Programs and infrastructure projects need to have clear, established objectives and performance metrics, which track progress and effectiveness of work undertaken.
- **Build a culture of strategic investment through asset management**. Infrastructure asset management uses a continuous improvement model and a risk-based approach, ensuring infrastructure needs are prioritized and funded.
- **Design infrastructure systems that are adaptable, flexible, and resilient.** Michigan's infrastructure should be able to adapt to changing demographics and technologies, as well as climate impacts. To maximize public health protection, Michigan's infrastructure should also be safe and resilient in the face of cyber and physical threats.
- **Leverage a variety of public and private investment and financing resources.** A range of funding and financing options will ensure adequate investment in and operation of safe, reliable, efficient, and cost-effective infrastructure. Coordination of project planning and implementation across infrastructure sectors will facilitate optimal solutions as well as shared sourcing and cost allocation.
- **Encourage meaningful public engagement.** Transparency, accountability, and opportunities for public engagement are reflected in infrastructure planning, prioritization, economically sustainable funding models, and financing mechanisms that result in high levels of satisfaction with infrastructure service.
- **Prioritize environmental quality and sustainability efforts across all infrastructure sectors.** Sustainable practices, including green infrastructure, environmental efficiency, and beneficial reuse, are prioritized in infrastructure planning.
- **Embrace emerging technologies, visionary planning principles, and innovative approaches.** Infrastructure designers and providers embrace new technology and cutting edge planning principles to meet the needs of 21st century infrastructure systems in project planning, design, and implementation.

Outcomes

In addition to developing guiding principles, the Commission and its technical advisors—with input from stakeholders—assessed Michigan's current and future state of infrastructure. The Commission then developed a series of recommendations to achieve this vision.

The Commission's recommendations are organized across this report by four key types of infrastructure: communications, energy, transportation, and water. The Commission also developed a set of cross-cutting recommendations that impact all areas of infrastructure (presented in Chapter 3). Regardless of the type of infrastructure, however, the Commission developed recommendations that will lead Michigan to realize the following outcomes:

EP

Economic prosperity: The state's infrastructure system serves as the platform for our economic success, including our communities, businesses, and residents. Our infrastructure systems must be built for a 21st century Michigan to fully meet the state's current needs and expectations. Modern infrastructure and coordinated investments are essential to support the economic prosperity of our state.

HE

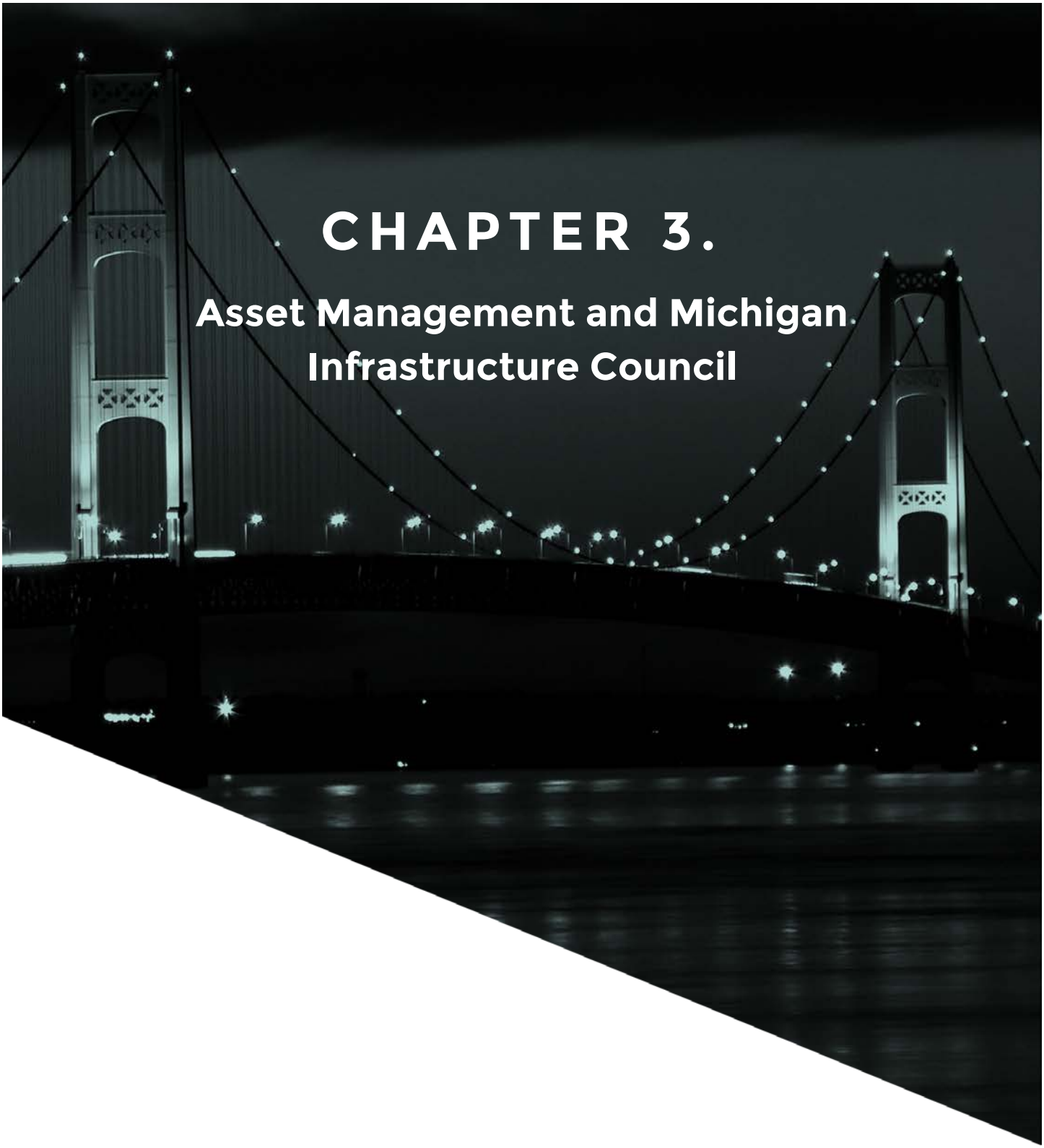
A healthy environment: The state's infrastructure system is interconnected with the health of our people, environment, and communities. Investments in communications, energy, transportation, and water networks and technologies support a Pure Michigan that, in many ways, defines the character of our state.

QS

Reliable, high-quality service: The state's infrastructure system provides its users with reliable, high-quality services to support vibrant communities and business operations. Our transportation systems move people and cargo effectively and efficiently, our energy systems provide affordable and reliable electricity and heat to homes and businesses, our communications systems enable Michiganders to stay connected in a global world, and our water management systems protect and enhance public and environmental health.

VI

Value for investment: The state's infrastructure system is supported through wise investments that ensure we get the most value from limited financial resources. Through coordinated asset management across Michigan's infrastructure systems, we can make strategic and optimal decisions about infrastructure repair and replacement to ensure greater value for our investments.



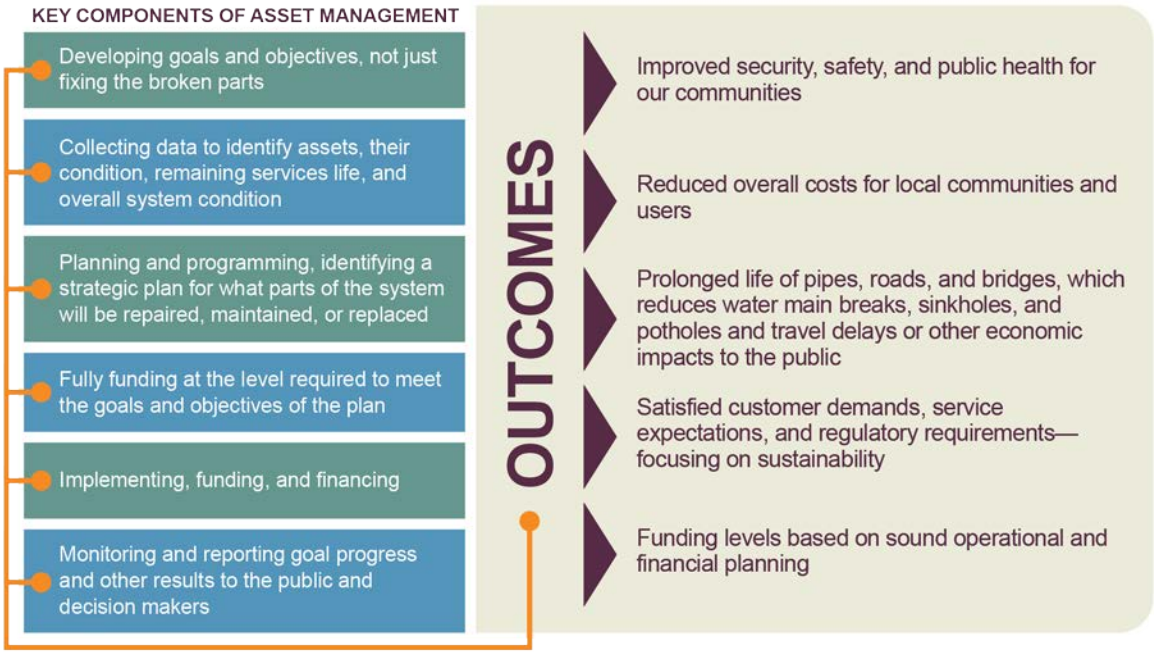
CHAPTER 3.

Asset Management and Michigan Infrastructure Council

Throughout its work, the 21st Century Infrastructure Commission encountered a set of key issues that impact all areas of Michigan's infrastructure system. This chapter highlights those issues, and two key recommendations to address them.

The first key issue Michigan faces in developing a 21st century infrastructure system is determining how to get more value out of our assets over their entire service life. The best way to accomplish this is through asset management—the practice of identifying and managing infrastructure in a cost-effective and efficient manner based on continuous collection of data (see Exhibit 5).

EXHIBIT 5. Asset Management Model



Asset management involves continually inventorying and assessing infrastructure condition so that planned maintenance can be done, which extends the service life of an asset before it has to be replaced. This makes it more economical to maintain performance. The result is cost savings for local communities and users, satisfaction for customers, and improved security, safety, and public health for our communities. Implemented in a standardized and systematic way across infrastructure types, asset management can improve coordination and increase cost savings even further.

Asset management is not a new concept for Michigan; we have been recognized by the Federal Highway Administration as a national leader in statewide transportation asset management data collection and planning, through the Michigan Transportation Asset Management Council (TAMC), but additional work is needed to make the state a leader in systematic, holistic infrastructure asset management and planning (U.S. DOT FHA 2014).

Communities that utilize effective asset management can attest that identifying strategic investments in preventive maintenance, repair, and rehabilitation of infrastructure assets is much more cost-effective than reconstructing the “worst first”.

The foundation of asset management, and a strong water infrastructure system, begins with inventorying your assets, says Bob Belair, manager of Canton Township’s Department of Public Works. “Data is key. Once you have data, then you can institute asset management.” For nearly 15 years, Canton Township has been collecting data on their water and sewer systems, including the size and material of pipes, valves, hydrants, manhole locations, pump stations, and lift stations. They’ve also scanned in about 70,000 as-built plans for their water and sewer systems, which include specific details of each section of pipe, including age. In addition, Canton Township collects data on when and where water main breaks happen. With all of this information, they were able to design an in-house risk assessment tool for their entire water system that helps with their budgeting and water main replacement program. This risk assessment tool identifies potential impacts to the community of water main breaks, helping to prevent water boil advisories, and maintain pipes to prevent them from breaking.

The second key issue is coordination in the way we plan for and manage infrastructure across and among levels of government, and with private sector entities that build and manage infrastructure. Traditionally, public infrastructure in Michigan has been managed individually by sector. Particularly in the case of water infrastructure, there is limited information regarding the location and condition of mains, lead service lines, and leaks, which complicates investment decisions. Planning and funding cycles for different types of infrastructure are often not coordinated, and public and private infrastructure owners may not be aware of each other’s planning and decision-making processes. This results in the inefficient use of public money. For example, when a road is reconstructed or resurfaced, there is not consistent coordination with water and sewer utilities, gas, electric and communications companies to plan underground projects. As a result, sometimes newly surfaced roads are ripped apart to enhance or repair underground utilities, increasing costs—potentially compromising the integrity of the new road surface and needlessly affecting public travel.

21st Century Vision for Michigan

The 21st Century Infrastructure Commission recommends a two-tiered approach to ensure Michigan is effectively implementing asset management and coordinated planning and investment across infrastructure types and at all levels of government:

First, early in 2017 the State should establish a **regional infrastructure pilot** to identify existing infrastructure data and gaps, determine an appropriate comprehensive database system to house this data, and begin to coordinate amongst asset management data and planning across infrastructure sectors. The regional infrastructure pilot would also operationalize a statewide asset management process and database system across infrastructure types. This pilot should be established through an Executive Order of the Governor. Key State departments, in conjunction with public agencies and private entities, will be responsible for leading and conducting this effort. The scope of this pilot program is to develop a comprehensive asset management database.

Second, by 2018 the Michigan Legislature should establish the **Michigan Infrastructure Council,** a body that coordinates infrastructure-related goals as described below (referred to as "the Council"). The Council, authorized by legislative statute, should have three main functions, with the overarching goal of improving the level of service to the public at the lowest annual cost:

- Leverage the development of the pilot for implementation and maintenance of a common statewide asset management process and database
- Develop a long-term, integrated infrastructure strategy for the state, and communicate relevant project information to decision-making bodies
- Design, oversee, and coordinate the distribution of incentives and funding and financing opportunities, with an eye toward ensuring that funding cycles and processes promote cooperation between asset owners and reward projects that address multiple infrastructure needs with a single project

These two approaches are described below in recommendations 3.1 and 3.2.

3.1 REGIONAL INFRASTRUCTURE PILOT

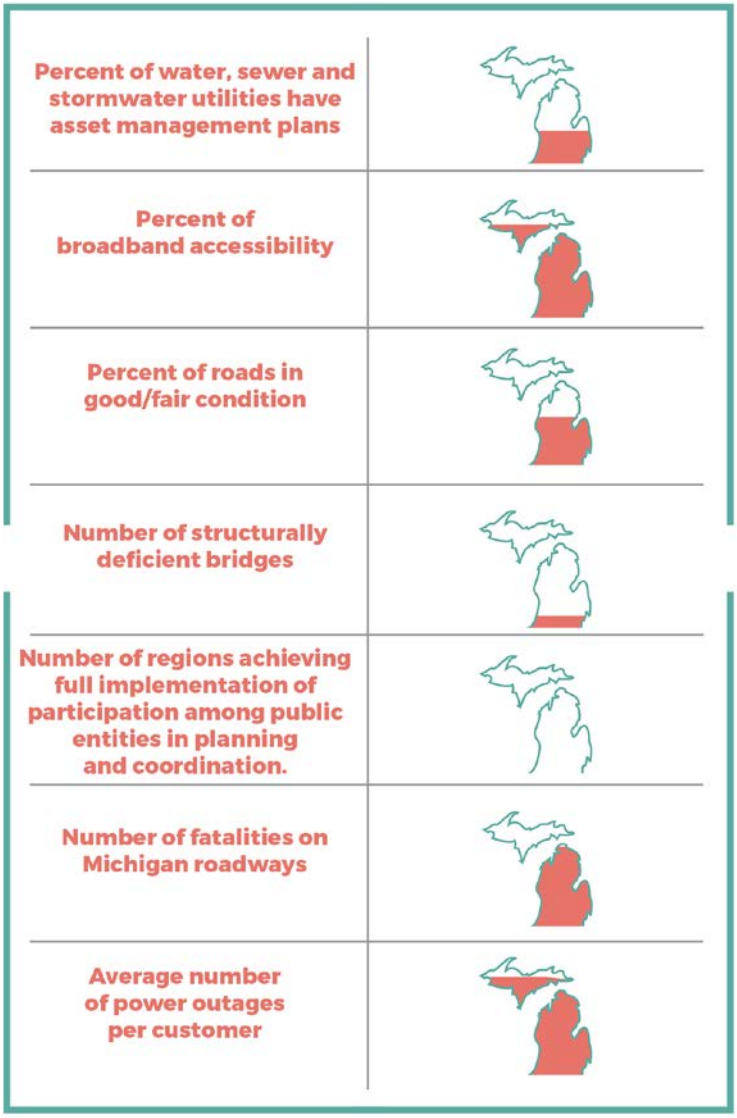
A regional infrastructure pilot should be immediately established to identify existing data and data needs within the region and an appropriate system to house and analyze this information. The regional infrastructure pilot should also immediately identify critical stakeholders to assist in this process and begin to coordinate asset management across infrastructure sectors. The regional infrastructure pilot should be established through an executive order of the Governor to test and operationalize a statewide asset management database system. Key departments within the executive branch should conduct this effort and serve as the pilot leaders, such as the Governor's Office, the Michigan Department of Technology, Management and Budget (DTMB), the Michigan Department of Environment Quality (MDEQ), the Michigan Department of Natural Resources (MDNR), the Michigan Department of Transportation (MDOT), and the Michigan Public Service Commission (MPSC). Key stakeholders, including public agencies and private utilities, should also be included in the pilot. The process for establishing the pilot should include, at a minimum, the following steps:

- **Identify pilot region:** The pilot leaders should identify a pilot region (ideally a Michigan Prosperity Region) that is best positioned with a foundation of asset management practices, data collection, and the ability to coordinate amongst infrastructure stakeholders.
- **Leverage and expand the efforts of TAMC:** The initial focus should be on transportation, water, and sewer, and include other asset types as issues surrounding inventorying condition, prioritization, and improved decision making at both the project and system levels, and security are addressed and the best methods for coordinating with private asset owners are identified.
- **Develop database:** The pilot leaders should ensure the chosen software is compatible across asset types and aligns with current asset management efforts that may already be underway across the state. Existing data storage, asset tracking, and reporting tools should be leveraged, such as the TAMC's Investment Reporting Tool, Michigan Technological University's Roadsoft database, and the Michigan Geographic Framework repository.
- **Identify and define data elements:** The pilot leaders should identify, define, and inventory existing and needed infrastructure asset data and data elements (condition, material, age, remaining service life, ownership, planned investment, etc.). The database must use a core set of data elements that enable tracking and assessment of investments, management actions, asset status, and desired outcomes. Common data elements and performance measures will allow comparisons across communities and utilities. Pilot leaders should establish partnerships with federal, state, local, and private entities to help leverage geographic information systems (GIS) data and to develop processes to secure information as necessary to protect public health and safety. Database development must ensure balanced attention to the collection, management, integration, analysis of relevant data, and delivery of useful information to decision makers.
    - MDEQ should work with stakeholders to review and assess existing programs and identify best practices of their current sewer and stormwater asset management initiatives during the pilot phase. A summary of their macro data should be provided to the Michigan Infrastructure Council upon establishment to ensure ongoing efforts are compatible with various permits (i.e., Stormwater, Asset Management, and Wastewater [SAW] Program and National Pollutant Discharge Elimination System [NPDES] permits have embedded asset management requirements). New funding for drinking water, sewer, and stormwater asset management plans should integrate with the Michigan Infrastructure Council's goals, policies, and database.
- **Identify database system**: Pilot leaders should identify a database that uses a core set of data elements that enable tracking and assessment of investments, management actions, asset status, and desired outcomes. Database development must ensure balanced attention to the collection, management, integration, analysis of relevant data, and delivery of useful information to decision makers. The database system must allow for the following:
    - Infrastructure condition assessments, identification of investment needs and subsequent plans for the rehabilitation of old assets, and construction of new assets—with a measured goal of improved system ratings toward specific targets—and collaboration among participating entities on all of these activities (online and offline).

- Participation from public and private entities and facilitation among private and public asset holders, without requiring private sector partners to reveal confidential business information.
- A snapshot of the condition of assets and integrated infrastructure planning coordination and adaptive management of assets.

The pilot may also make recommendations as to additional functions a statewide system may benefit from, including analytic and decision-making tools as well as how to provide a user-friendly interface where a snapshot of state, regional, and local system performance can be viewed by the public (see Exhibit 6).

EXHIBIT 6. Example Snapshot of System Performance



- **Engage stakeholders and partners:** The pilot should identify key public and private infrastructure stakeholders in the region across water, transportation, energy, and communications infrastructure to help with this pilot. Stakeholder engagement will be critical during development of the database to agree on standards and policies that will allow for effective interoperability across data sets, while maintaining integrity and security of the data. Stakeholders will also be important in coordinating asset management planning across infrastructure sectors.
- **Identify regional structure and incentives:** The pilot should identify an appropriate regional structure and/or authority to plan, analyze, and coordinate infrastructure across assets at the regional level. This information would then be reported up to the Michigan Infrastructure Council for statewide aggregation. The Council would also identify State of Michigan incentives for these regional entities that would lead infrastructure planning and delivery in the region across sectors. Specifically, the regions identified by the pilot should address water and transportation regional planning efforts through the following steps:
    a. Water:
        i. Encourage and/or incent regional solutions for water, sewer, and stormwater needs in order to gain economies of scale. As a first step, the MDEQ should engage in the regional water quality planning process outlined in Section 208 of the federal Clean Water Act.
        ii. Convene discussions with local communities, utilities, State of Michigan agencies, and professional associations to review local infrastructure asset management plans, master land use plans, and capital improvement plans. Support consolidation and reuse of existing infrastructure, ensure that new infrastructure investments are strategic and optimized, and address issues arising from excess capacity or stranded investment.
        iii. Identify opportunities in communities through local master planning in communities to optimize systems experiencing declines in water usage or sewage output associated with demographic shifts.

b. Transportation:

i. Identify and work with stakeholders across all modes to complete a comprehensive assessment and determine what transportation infrastructure is needed and the appropriate location to support the industries and communities expected in the future.

ii. Work with local agencies and transportation stakeholders to identify areas of the state where excess road infrastructure undermines the potential for community success, develop context sensitive solutions to transportation problems, and encourage the use of design solutions that make more effective and beneficial use of the excess road capacity, while respecting and serving the community.

iii. Work with local agencies to encourage cross-collaboration, particularly smaller jurisdictions that may not have sufficient expertise with context-sensitive solutions for right-sizing, encourage greater coordination between agencies, and provide technical assistance to local agencies seeking solutions that help right-size their infrastructure.

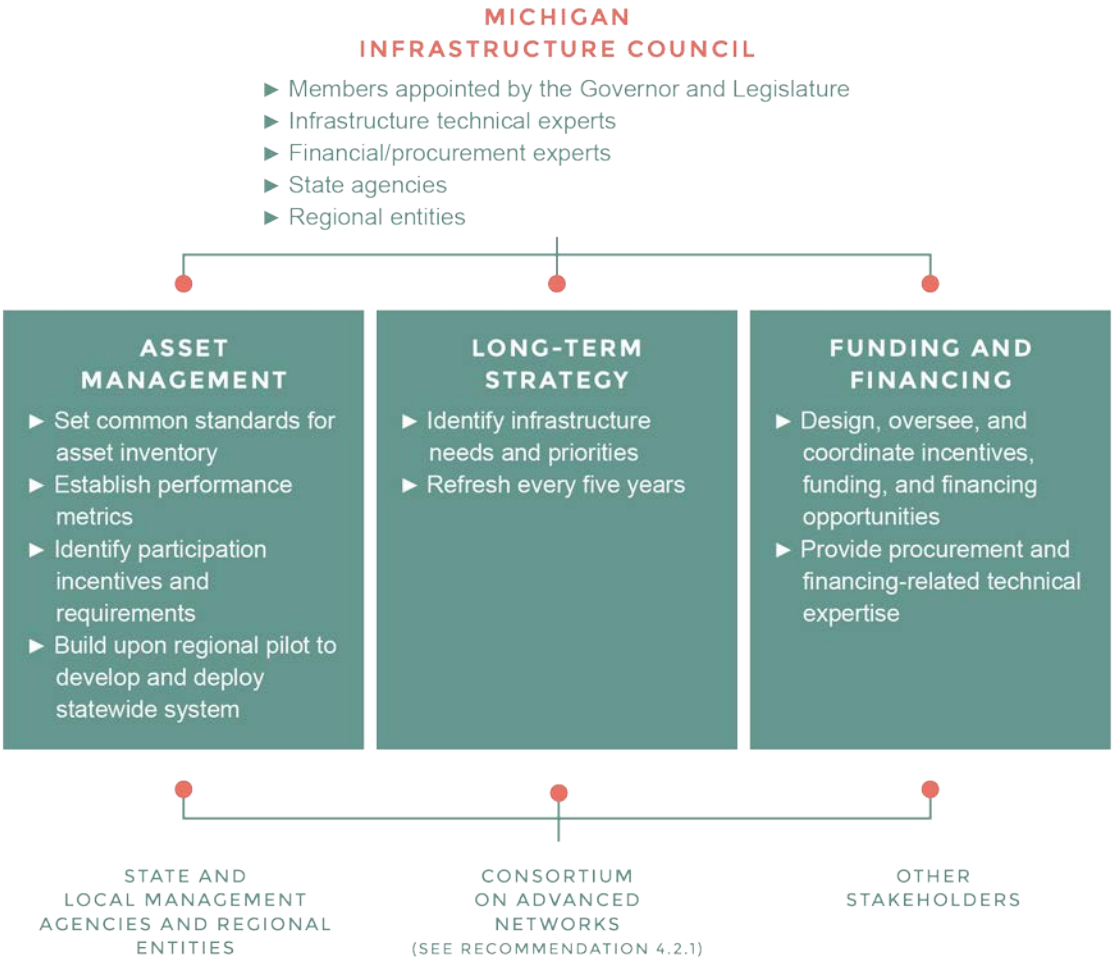
- **Asset management database statewide deployment:** Within one year of the establishment of the pilot, pilot leaders should provide a set of recommendations to the Michigan Legislature, Governor, and Michigan Infrastructure Council (contingent upon establishment by statute) for deployment of a statewide asset management database system and regional structure to plan asset management and direct information statewide. The statewide development and implementation of this database and regional structure should be recommended based upon the successes and lessons learned of the pilot.
- **Funding:** The estimated cost of the pilot program is $2 million in state funding, which includes the development and completion of the pilot analytics database, initial data collection, and initial training.
- **Staffing:** Key state departments, regional, and local public and private stakeholders will provide staffing support to the pilot program.

3.2 MICHIGAN INFRASTRUCTURE COUNCIL

In order to coordinate and unify efforts to implement comprehensive asset management, the Michigan Legislature should create the Michigan Infrastructure Council. This Council should consist of members appointed by the Governor and the Legislature, including:

- Infrastructure technical experts from the public and private sectors representing transportation, water, energy, and communications
- Financial/procurement experts from public and private sectors
- Representatives of key state departments
- Representatives of regional entities

EXHIBIT 7. Michigan Infrastructure Council



At the Council's inception, terms of members should be staggered. At the end of initial appointments, terms should be three years in length. The chairperson of the Commission should be selected from among the voting members of the body. Key state departments, including a representative from the department or office selected to house the database, should provide qualified administrative staff, and regional entities should also provide qualified technical assistance to the Commission. The Council should have the following three main responsibilities, which are further detailed below:

- Expand the regional asset management infrastructure pilot to deploy the asset management database process and system
- Develop a long-term, integrated infrastructure strategy for publicly held assets in Michigan, as well as coordinate with private utilities
- Design, oversee, and coordinate incentives; funding; and financing opportunities for Michigan's various infrastructure asset types

Expand the Regional Asset Management Infrastructure Pilot to Deploy the Asset Management Database Process and System Statewide

The Council should lead deployment of the statewide asset management process and database system, and ensure inclusion of the following components:

- **Basic components:** Basic components of the system need to be determined, such as an inventory of assets; asset conditions; current and desired customer level of service; and operations, maintenance, capital, and replacement costs.
- **Consistent standards:** Consistent standards should be developed for collecting data on asset condition, risk-based asset planning, and making decisions regarding capital expenditure programs.
- **Key metrics:** Key metrics for the overall system rating at the state, regional, and agency level should be developed, along with the level of investment needed to hit targeted system ratings. Performance targets must be established and reported. An example dashboard that could be used to communicate
- **Public access to information:** Provide a user-friendly interface where a snapshot of state, regional, and local system performance can be viewed by the public (see example in Exhibit 6).
- **Security:** Protocols should be developed and implemented that ensure data security at the local, regional, and state levels.
- **Participation:** Participation benchmarks/minimum thresholds for state, regional, local, and private entities should be established. Entities that exceed those benchmarks will be provided incentives (see below).
- **Incentives and requirements:** To identify incentives that can be deployed through existing funding and regulatory authority, the Michigan Infrastructure Council will work with the MDEQ, DTMB, MPSC, MDNR, MDOT, and any other relevant agencies to conduct a review of all regulatory and financing programs for opportunities to require beneficial asset management.

- **Regions:** The Council should implement the recommendation from the pilot regarding the appropriate regional structure and/or authority to plan, analyze, and coordinate infrastructure across assets at the regional level.
- **Predictive analytics:** Tools are needed to identify repetitive patterns of failures, other trends, and areas of opportunity for preventative maintenance, demonstrate the savings of preventative investment, and compare annualized life-cycle costs for different options. Predictive analytics should be explored as part of the capabilities of the database.
- **Opportunities for coordinated project planning:** The database for public infrastructure planning would provide opportunities for coordination by allowing private-sector infrastructure owners (e.g., most communications and energy providers) to participate, in a way that maximizes the ability for coordinated project planning, without revealing confidential business information. The Council should develop an approach and system to enhancing communication at a stage early enough to permit coordination in planning (private asset owners receive notifications of potential public projects planned nearby and vice versa).
- **Funding:** The Michigan Legislature should appropriate adequate funds from the General Fund budget for the expansion of the statewide database. Funding should also be appropriated for the implementation of the statewide asset management system, including providing licenses to users at an affordable cost, training users on how to use the database, and providing ongoing staffing and user support.
- **Timeline:** After completion of the pilot, a rollout of the statewide system should be implemented within two years of the creation of the Michigan Infrastructure Council.
- **Additional considerations:**
    - Asset management responsibility, practices, data collection, and analysis will remain decentralized, as it is today, residing with the private, public, local, and state infrastructure asset owners.
    - The statewide framework and guidelines should be designed so that even though all asset owners (private, public, local, and state) will be encouraged to participate, there are different expectations for owners depending on capacity and how critical their assets are (e.g., local, rural asset owners with few infrastructure assets would not have the level of planning and reporting requirements as those in larger cities). A minimum value should be established for inclusion in the framework (e.g., assets valued under a certain monetary amount are not included in the asset management framework).

Develop a Long-term, Integrated Infrastructure Strategy for Publicly Held Assets in Michigan and Coordinate with Private Utilities

The Council should develop a long-term, integrated infrastructure strategy for publicly held assets in Michigan, as well as coordinate with private utilities. This strategy should include the following:

- **Comprehensive infrastructure plan:** Based on the information in the statewide infrastructure asset management database, the Council should develop and refresh an infrastructure plan at least every five years. The plan should include an articulation of infrastructure asset condition, needs, and priorities. The Council should also have the

ability to receive confidential information from private infrastructure owners and use that information in development of its infrastructure plan.

- **Investment needs:** Advise the Governor, the Michigan Legislature, local agencies, and private stakeholders of five-, ten- and 20-year investment needs to reach targeted overall system ratings, with a goal of leveling annual investments to long-term predictable amounts.
- **Accountability and transparency:** Make information readily available and accessible to the public through regularly published needs assessments/reports and dashboards that depict the condition and trends of infrastructure investments and operations at the local, regional, and state levels, including benchmarking against other states.
- **Communication regarding project decisions:** Recognizing that private and public decision-making timelines are difficult to align and that funding structures differ, the Council should play a vital advisory role to the various decision-making bodies. At the time funding or permitting decisions are made, the Council should advise decision makers whether projects are a) part of coordinated planning efforts, and thus especially cost-effective, or b) off-cycle when compared to planned investments by other infrastructure owners, and thus likely to needlessly increase costs.
- **Smarter state:** As mentioned in the communications infrastructure recommendations in Chapter 4 of this report, the Council should explore structural options including public-private partnerships (P3s) to ensure inclusion of network intelligence in infrastructure planning and monitoring. Retrofit technologies should be considered, pursued, and incorporated as they become available for upgrades and maintenance activities to existing and future infrastructure.

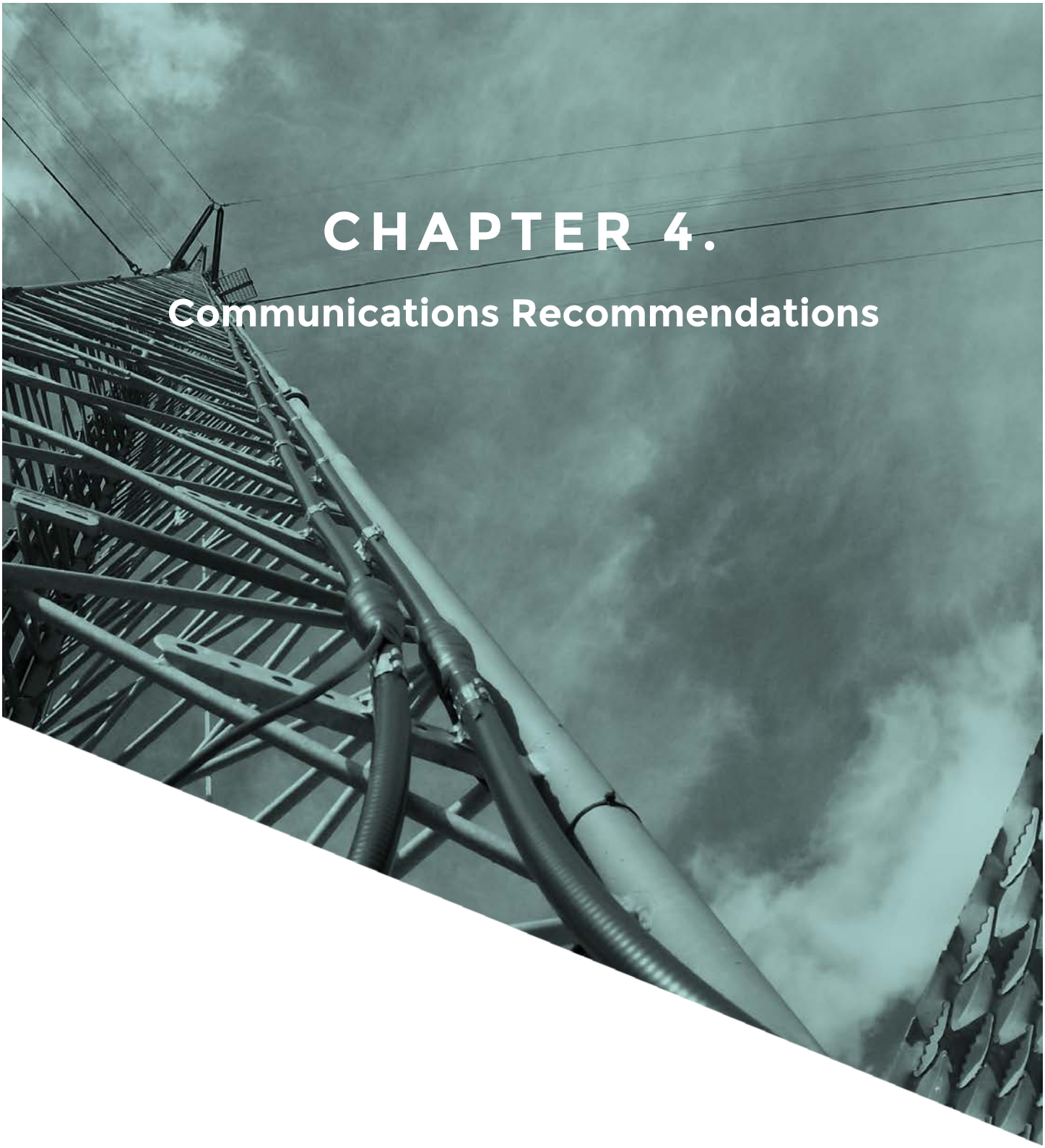
Design, Oversee, and Coordinate Incentives; Funding; and Financing Opportunities for Michigan's Various Infrastructure Asset Types

The Council should design, oversee, and coordinate incentives, funding, and financing opportunities for Michigan's various infrastructure asset types. The Council's work on funding and financing should include the following steps:

- **Incentives:** Identify and leverage incentives using existing funding and regulatory authority to ensure high participation among public entities in planning and coordination and private asset owners in participation in coordination opportunities.
- **Review of regulatory and financing programs:** Work with the Governor's office and all relevant state agencies on an ongoing basis to conduct a review of all regulatory and financing programs for opportunities to require asset management and use of the system.
- **Funding:** Research and provide advice to the Governor, state departments, and the Michigan Legislature on infrastructure funding capacity, level of effort and needs, innovative and new infrastructure funding sources and financing options, ways in which to leverage federal funds, and legislative and regulatory changes needed for improving infrastructure planning and management efficiencies.
- **Priorities:** Review regional planning efforts, identify funding needs, identify integrated planning opportunities, and determine a list of funding priorities by region for the State of Michigan, Governor's Office, and/or Legislature. Those priorities and opportunities should

be both made available to the public when determined and should provide the basis for recommendations to decision-making bodies regarding whether specific projects are in line with those priorities.

- **Procurement and financing expertise and coordination:** Provide procurement and finance-related technical expertise on projects determined to be high value and high risk for the State, including identifying opportunities for public and private infrastructure funding, financing, and procurement, as well as identifying, and potentially overseeing, alternative funding sources.

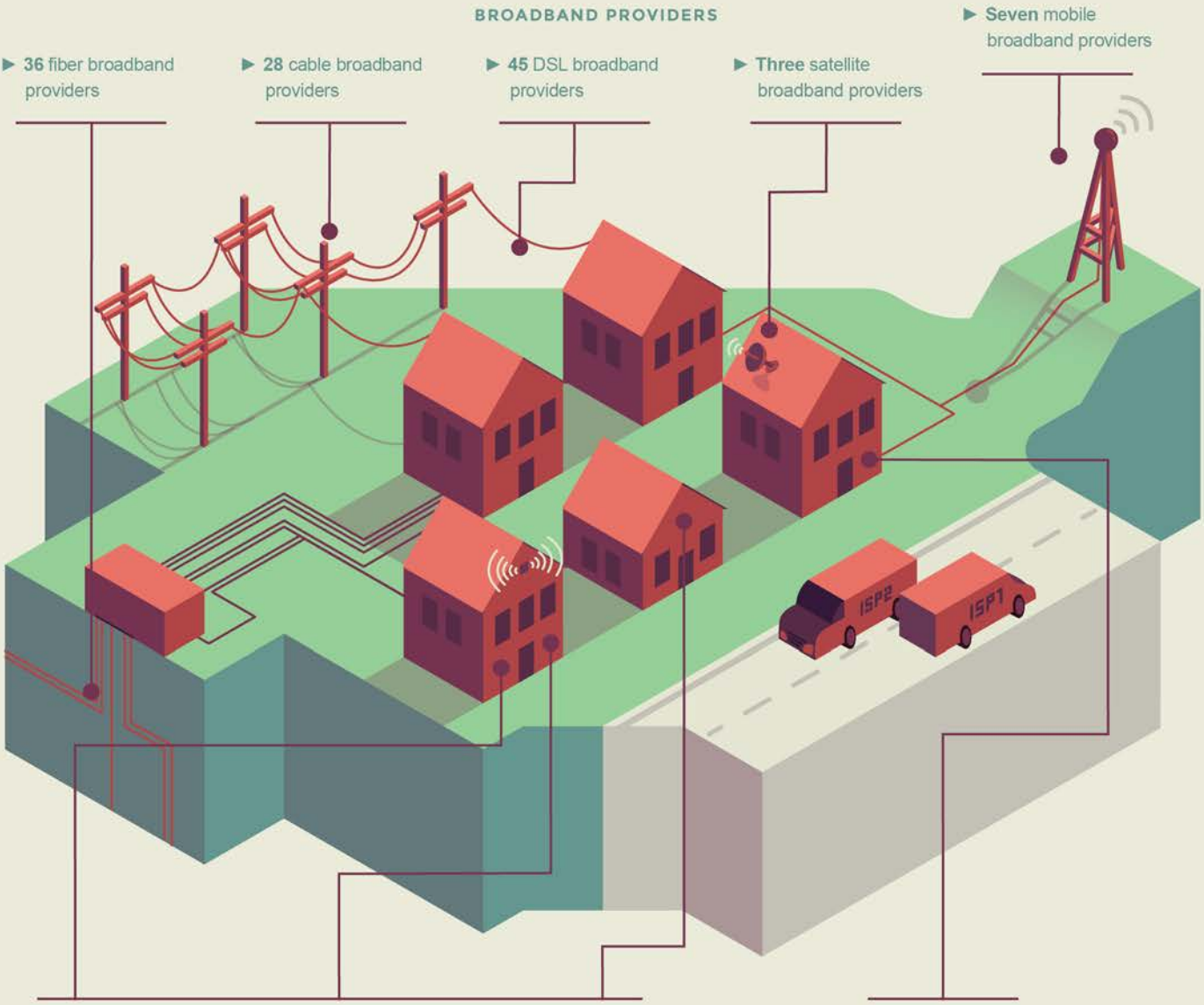


CHAPTER 4.

Communications Recommendations

CURRENT STATE OF MICHIGAN'S COMMUNICATION INFRASTRUCTURE

Infrastructure systems in Michigan should enhance residents' quality of life, enable economic growth, and create a strong foundation for vibrant communities. In order to obtain safe, reliable, and resilient communications systems in the 21st century, we must first understand the current reality of communication infrastructure in Michigan:



BROADBAND ACCESS

- Of Michigan households, **12 percent** lack access at national benchmark speeds.
- More than **450,000 households** still lack access to advanced broadband service.
- Certain areas of the state have low density of households, businesses, and institutions, which results in limited or no return on investment for delivering service to these places, thus creating a gap in investment.

BROADBAND ADOPTION

- Of Michigan households, **27 percent** do not subscribe to broadband service.
- In many cases, adopting a broadband connection can be out of reach for residents due to the technology required or expensive service delivery.
- There is a lack of digital literacy and/or technical skills to understand and utilize broadband connection.

In order to unlock the potential of new technology, Michigan must ensure that secure, reliable, affordable, and universal advanced communications services are available to all residents. Affordable, high-speed broadband[2] service is essential for the advancement of education, health, public safety, research and innovation, civic participation, e-government, and economic development.

The Internet is already a part of everyday life for most Michiganders. People and businesses depend on it every day for communication, banking, commerce, leisure, and more. While access to the Internet and technology has, in many respects, made daily life easier, it comes with the risk that someone could access our private information. High-profile examples of cyber attacks have seemingly become more prevalent in daily life—from the recent hack of the Democratic National Committee, to attacks on the electric grid in Ukraine, to a breach of around five million Yahoo! accounts. As more devices connect online, and more information is shared over the Internet, the risk of cyber attacks increase.

> *It is vital to the safety of Michigan residents and the state's economic prosperity that critical information and assets are protected from cyber security threats.*

Michigan must also recognize the way that current and emerging technologies are converging to create new opportunities and encourage an adaptive model that can enable new delivery methodologies for broadband such as fiber-optics, wireless, satellite, and other technologies yet to be developed. The most enduring and powerful technological changes on the horizon are the Internet of Things[3] (IoT) and artificial intelligence/machine learning (AI).[4] Combined, these technologies will transform the way in which we experience daily life. Technological innovation will enable a variety of new modes of human interaction and societal transformations, from aging in the home to viewing transportation as a service.

The IoT comprises an expansive system of connected remote sensors that can communicate real-time information, both to one another and a central controller, and perform remote control functions. Essentially, the IoT creates a connection between the physical and the digital worlds. Imagine a large office building that can monitor and control the pace of its elevators to optimize departures of cars from an attached parking structure, and sync with traffic lights, as well as with intelligent vehicles to minimize traffic congestion during rush hour. This system, as imagined, offers several potential benefits—including reduced fuel consumption, fewer greenhouse gas emissions, less time spent in traffic, and possibly even fewer collisions. These technologies will depend on communications infrastructure that can adapt to new demands and the changing nature of

[2] Broadband is a descriptive term for evolving digital technologies that provide consumers a signal switched facility offering integrated access to voice, high-speed data service, video-demand services, and interactive delivery services (FCC January 28, 2014).

[3] IoT is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment (Gartner 2016).

[4] Machine learning is a technical discipline that aims to extract certain kinds of knowledge/patterns from a series of observations. Depending on the type of observations provided, it splits into three major sub disciplines: supervised learning, where observations contain input/output pairs (a.k.a. labeled data); unsupervised learning, where those labels are omitted; and reinforced learning, where evaluations are given of how good/bad a certain situation is (Dawson 2016).

technology. As potential technological changes are identified, the State will need to ensure changes are developed deliberately, to protect the safety and security of individuals while balancing with concerns about privacy and autonomy.

The Internet of the 21st century will have a profound effect on the economy and lives of Michigan's residents. It will measure the quality of the air we breathe and the water we drink. It will benefit the quality of our commute and speed the flow of goods along the supply chain, ultimately to the consumer in a better and less expensive way. It will enhance public health and public safety; help the aging population stay independent longer and enhance the quality of the healthcare we receive; help us more efficiently consume energy; help enhance productivity from Michigan's crops; keep us safer and help deliver richer educational and recreational experiences for Michigan residents and visitors.

This chapter outlines a series of recommendations to ensure that Michigan is a communications leader, and that the state is prepared for the pervasive use of Internet-connected sensors and beacons, and that a priority is placed on ensuring network connectivity is available to people everywhere.

Recommendations Key

EP	Economic Prosperity	HE	A Healthy Environment
QS	Reliable, High-quality Service	VI	Value for Investment
0-2	Implementation Start (in years)	0-2	Implementation Complete (in years)

4.1 MAKING MICHIGAN A SMARTER STATE

Where is Michigan today?

Technologies offer tremendous potential; it is predicted that by the year 2020, there will be an estimated 50 billion things connected to the Internet, but there is still uncertainty about the number, type, and application of new technologies. There are no widely accepted technical standards for the IoT, including data storage, management, and sharing among stakeholders. This uncertainty makes it difficult to determine how Michigan must prepare itself for the future, yet the State lacks policies related to implementation of the IoT, specifically regarding to the ownership and sharing of data, security controls, and privacy. Any new policies and regulations must be properly balanced so Michigan can realize the benefits that stem from greater access to data, data sharing, and shared services. Where these technologies do exist, Michigan can leverage its buying power to help define product development and accelerate the maturation, effectiveness, and deployment of technologies.

21st Century Smarter State

A smarter state improves the quality of a citizen's life by constructing an infrastructure that optimizes IoT technologies to enable potentially radical new work processes, services, and products. This construction relies on evaluating residents' experiences related to, for example, safety, security, health, energy, transportation, and communication. In general terms, the smarter state creates contextualized or demographically aligned service offerings that match the aspirations of the residents, community and society. With the increasing volume of data and insights, the orchestration of context based on data and insights becomes a critical focus of improved governance methodologies.

For the most part, the technical capabilities required to achieve the vision of a "smarter state" have yet to be invented, and it is possible that some of the necessary components to achieve this will remain undeveloped during the next 30 to 50 years. According to the International Telecommunication Union (ITU)—an international organization charged with standardizing communications technologies, such as the 5G wireless network roadmap—the technology required to properly enable the IoT will not be broadly defined and available before 2020 (ITU September 2016).

What does a 21st century Michigan look like?

Michigan is a global leader in the development, deployment, and adoption of new technologies, and the creation of smart environments and communities. This includes leading in the promotion of technologies that support smarter city[5] development; adoption of low-power, wide-area networks and state-of-the-art wireless technology networks; research into communications technology such as AI, machine-to-machine communication and machine learning; and deployment of IoT

[5] Cities are becoming "smarter," through better predictive analytics and real-time decision making as governments, businesses, and communities increasingly rely on technology to overcome the challenges from rapid urbanization. What makes a smarter city is the combined use of software systems, server infrastructure, network infrastructure, and devices to better connect several critical city infrastructure components and services: administration, education, healthcare, public safety, real estate, transportation, and utilities. The concept of the smarter city is pushing Chief Information Officers in federal, state, and local governments and their technology teams to further evaluate emerging technologies and engage with key stakeholders within and outside of their organizations to provide city administration and residents with better information and outcomes.

technology through flexible policies and regulations. Michigan also builds upon its rich history in transportation and logistics innovation by continuing to develop and commercialize technologies required for the next generation of intelligent vehicles, as well as manned and unmanned aerial vehicles (see section 6.9: Intelligent Vehicle Technology recommendations). Michigan's leadership position is underpinned by a robust cyber security ecosystem,[6] and its established partnerships with the automotive, financial, healthcare, education, energy, military, law enforcement, critical infrastructure, and the private/public sectors. These advances promote a more connected, smarter Michigan that uses interactive, interconnected technology to identify and address problems before they become too big to solve.

Technology also promotes more effective collaboration—resulting in better service for businesses, visitors, and residents—and expands the economy while dramatically increasing Michigan's attractiveness as a place to live, work, and play. Technology will provide value to aging and disabled populations, including housing, transport, healthcare, communication and community support services, leisure, and culture (Skouby et al. 2014). Technologies will serve to create smart and enabling environments where people will find themselves empowered (Coetzee 2016). Smart infrastructure that leverages IoT technology and services can be transformative by improving mobility, wayfinding, communication, and access to information for the aging and populations with disabilities. A smarter Michigan will be safer, healthier, and more efficient for everyone.

Given the rapid pace of changes in technology, Michigan's progress is measured and reviewed annually to ensure its place as a top-five state, with a thorough review of the broader goals and benchmarks occurring every four years.

Some of the opportunities offered in a 21st century Michigan will include:

- Highways that allow commuters to quickly find an alternate route and avoid congestion from a highway accident
- Transit stops that provide easily accessible route information for visitors or other passengers
- Destinations that recognize return visitors and welcome them with information they can use to make their experience more enjoyable
- Street lights that make communities safer by prompting city workers to replace the light bulb before burning out
- Technology that alerts law enforcement of crime or suspicious activity as it happens so they can arrive on the scene sooner
- Infrastructure that monitors water quality and water level and alerts government officials to maintenance issues before larger, more costly problems develop
- Healthcare devices that allow patients to monitor their symptoms and alert them if they need to seek treatment
- Homes that allow residents to age in place

[6] To keep pace with the ever-evolving and persistent cyber threats, Michigan's focus is on prevention, detection, response, and accountability, while increasing our key partnerships within the automotive, financial, healthcare, education, energy, military, law enforcement, critical infrastructure, and private/public sectors.

How do we get there?

4.1.1 The State of Michigan should create the Consortium on Advanced Networks (see recommendation 4.2.1) to develop a vision, a plan, and execution roadmap to enact the state's digital transformation by investing in emerging technologies, supporting academia in research related to the IoT, building an adaptive IoT workforce, and forming appropriate policies to create a smarter state. Ensuring appropriate security measures are included in all IoT implementation projects should be part of this roadmap. The Building the 21st Century Economy Commission, established by Governor Snyder in June 2016 to develop a comprehensive economic vision for Michigan, should consider this recommendation during their deliberations.

Estimated investment needed: Will utilize existing staff resources

EP 0-2 0-2

4.1.2 The Michigan Economic Development Corporation (MEDC), in partnership with relevant state agencies, should create a fund to support efforts that will make Michigan a global leader in smart technology development and deployment. The fund will provide seed and matching funds to key stakeholders to incentivize innovation, research, and development on advanced communications and other smart technologies (including AI; machine-to-machine communication; machine learning; and transportation, water, wastewater, and stormwater technologies). The fund will also support cities in identifying, implementing, and funding smart technology investments that appropriately serve their communities.

Estimated investment needed: $10 million of state funds annually

EP 3-5 3-5

4.1.3 The DTMB should actively participate in relevant workgroups and committees of the National Association of Chief Information Officers and the International Telecommunications Union to position Michigan as a technological leader.

Estimated investment needed: Will utilize existing staff resources

EP 0-2 0-2

4.1.4 The Michigan Infrastructure Council (see Chapter 3) should engage in P3s to ensure IoT adoption is included in infrastructure planning and retrofit technologies are considered, pursued, and incorporated as they become available for upgrades and maintenance activities to existing and future infrastructure.

Estimated investment needed: Will utilize existing staff resources

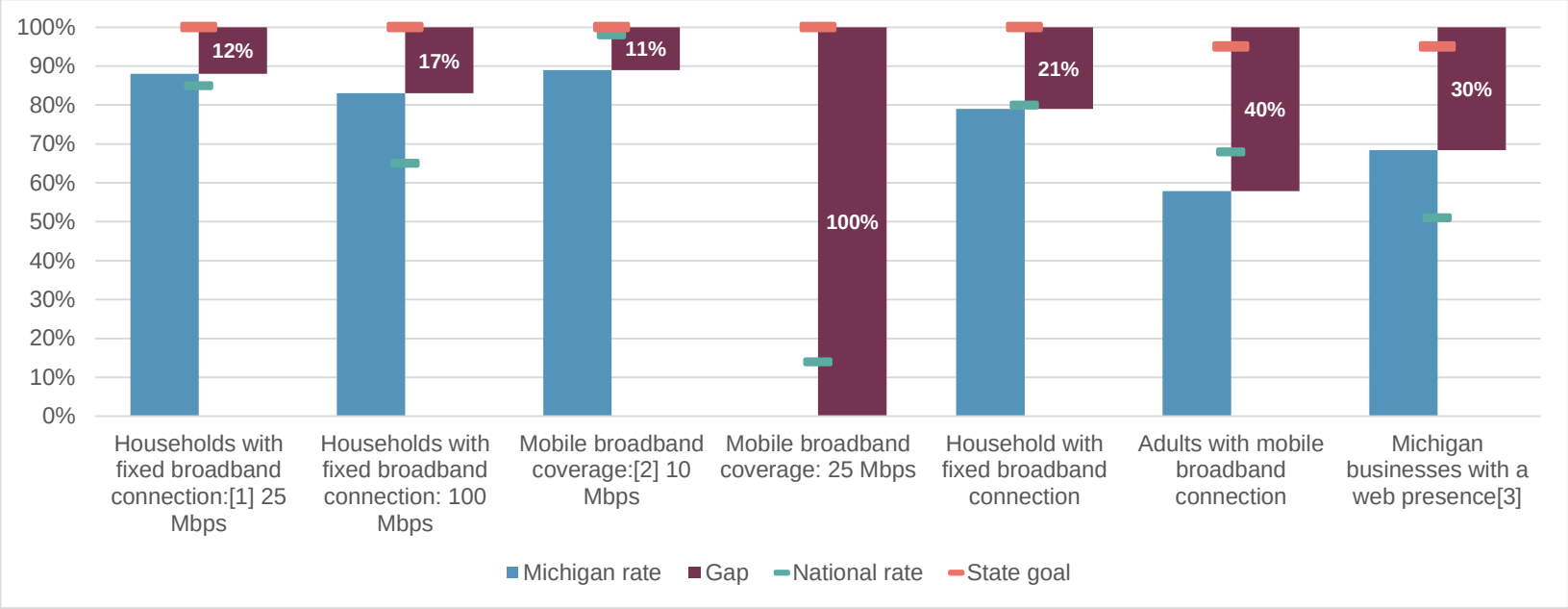
EP 3-5 3-5

4.2 IMPROVING BROADBAND ACCESS AND ADOPTION

Where is Michigan today?

Michigan has made a concerted effort over the past decade to expand the availability of broadband services by leveraging federal programs, such as the Universal Service Fund and the Connect America Fund. Through incentives provided through these federal programs and investments made by the state's broadband providers, Michigan has come a long way in improving broadband access and adoption. Michigan's current achievement for broadband access and adoption is detailed below in Exhibit 8.

EXHIBIT 8. Broadband Access and Adoption: Current State, Goals, and Gaps



Source: Connect Michigan 2015; National Broadband Map 2014; U.S. Census Bureau 2016; Pew Research 2016; Todd 2015.

Despite efforts, there are still barriers to achieving these goals and addressing the gaps between the current and desired future states:

- Certain areas of the state have low density of households, businesses, and institutions, which results in limited or no return on investment for delivering service to these places—thus creating a gap in investment.
- The processes for installing communications infrastructure can often be long and cumbersome.
- There is limited federal, state, and local government authority to encourage or require broadband deployment in underserved areas.
- In many cases, adopting a broadband connection can be out of reach for residents, due to the technology required or service delivery being too expensive.
- Some people may not be aware of how broadband adoption can impact their quality of life.
- There is a lack of digital literacy and/or technical skills to understand and utilize a broadband connection.

What does a 21st century Michigan look like?

Michigan is a top-five state for broadband access and adoption, recognizing that broadband access is vital to ensuring residents and businesses to succeed. The deployment of broadband technology provides a range of potential benefits, such as expanded access to healthcare and educational resources, economic opportunities, and improved public safety, among other benefits. Michigan's residents and businesses have access to affordable advanced broadband services, even in previously unserved and underserved areas, and tools and training are available to adopt a broadband connection.

By promoting broadband access and adoption, thus creating a "broadband superhighway," Michigan will:

- Enable interconnection of assets across infrastructure types, such as transit, water systems, energy, and governmental services
- Ensure every business has access to advanced broadband networks to enable local economic growth
- Ensure every student in the state has high-speed broadband network access at school and at home to enhance learning opportunities, eliminate the "homework gap"[7] for P–20 students, grow opportunities for workforce career development, and increase the opportunity and percentage of Michigan residents attending, and graduating college
- Connect state and local governments in order to provide new, improved, enhanced, and more efficient services to their constituencies
- Improve and expand the ways transportation, healthcare, tourism, and other industries deliver products and services

[7] The homework gap refers to the disadvantage for students especially those from low-income households who lack broadband access at home. This makes it more difficult to do school work that increasingly relies on Internet access (Pew Research Center April 2015).

Michigan's position as a top-five state for broadband access availability for residents, businesses, and institutions means that:

- All residents and businesses have access to a fixed broadband connection with a download speed of at least 25 Mbps and an upload speed of 3 Mbps by 2020 and a download speed of at least 100 Mbps by 2024.
- All community anchor institutions[8] have access to a fixed broadband connection with download and upload speeds that meet the minimum recommended speeds for their sector by 2024.
- All areas of the state (geographic) have access to a mobile broadband connection with a download speed of at least 10 Mbps by 2020 and at least 25 Mbps by 2024.

As a top-five state for broadband adoption—where residents, businesses, and institutions have the opportunity and ability to fully engage in digital society and the digital economy—Michigan has achieved the following goals:

- 95 percent of residents have adopted a fixed and mobile broadband connection at home by 2024.
- 95 percent of Michigan businesses have a Web presence by 2020.
- All community anchor institutions have adopted a fixed broadband connection by 2024.

How do we get there?

4.2.1 The Governor should issue an executive order establishing the Michigan Consortium on Advanced Networks, an advisory body comprising stakeholders from the nonprofit, public, and private sectors and academia. The group would be charged with improving coordination among stakeholders in addressing mobile and fixed broadband access and adoption issues in the state, as well as making Michigan a smarter state. The Consortium would comprise individuals representing varied interests, such as state government, telecommunications providers, broadband providers, video service providers, wireless carriers, and more. The Governor would appoint the members of the Consortium, including its chair(s). The Consortium would also provide advice and counsel to the Michigan Infrastructure Council on communications-related infrastructure. In addition to helping Michigan become a smarter state (see recommendation 4.1.1), the Consortium would perform the following advisory functions:

- **Policy coordination:** Recommend policy changes to improve mobile and fixed broadband access in the state, including streamlining and expediting permit and approval processes for locating and constructing new broadband infrastructure.
- **Technical assistance:** Support local and state agencies in working with the private sector to increase mobile and fixed broadband access in Michigan, such as providing guidance on the creation of P3s to support the joint use of existing horizontal and vertical assets and

[8] Community anchor institutions are schools; libraries; medical and healthcare providers; public safety entities; community colleges and other institutions of higher education; and other community support organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband service by vulnerable populations—such as low-income residents, the unemployed, and the elderly (FCC November 18, 2011).

network facilities to reduce over-building; expedite new connections for residents, businesses, and institutions; encourage economies of scale in rural communities; and support installing universal conduits for new construction projects.

- **Asset management:** Continue and expand efforts to map and research mobile and fixed broadband access and adoption to more efficiently respond to changing needs of communities, residents, businesses, institutions, and private-sector broadband providers.
- **Digital literacy education:** Expand, improve, and create pragmatic digital literacy programs at the state and local level. The programs should respond to the digital literacy and technology training needs of Michigan businesses and support a tech-savvy workforce, as well as inform consumers, businesses, tribal governments, and community anchor institutions about the importance of fixed and mobile broadband availability and adoption. Educational activities could include convening an annual statewide broadband conference with the purpose of providing an opportunity for cross-sector collaboration and the sharing of best practices in the expansion of mobile and fixed broadband access, adoption, and use across the state.
- **Funding options:** Provide funding—and help identify funding and financing from all available sources and programs—to entice investors to provide affordable mobile and fixed broadband access to households and businesses statewide, making Michigan a top-five state for mobile and fixed broadband access and adoption:
    - Providing a subsidy[9] to stimulate private sector investment that makes available state-of-the-art broadband access to the portion of Michigan's population that currently doesn't have access to at least 10Mb/1MB fixed broadband service because of low population density and other factors that make service delivery uneconomical for providers.
    - Creating a financing program to remove the installation cost barrier for customers who want to pay for one-time costs for conduit or equipment to prepare the site to receive commercially available broadband connections to their home or building;
    - Developing a grant or revolving loan program to assist local units of government and private sector broadband providers in collaboratively establishing P3s to support the sharing and joint use of existing horizontal and vertical assets and network facilities to reduce over-building; expedite new connections for residents, businesses, and institutions; encourage economies of scale in rural communities; and support installing universal conduits for new construction projects across the various levels of right-of-way jurisdictions.
    - Monitoring and maximizing funding opportunities that support the adoption of mobile and fixed broadband among families and individuals that qualify for the

[9] According to the Federal Communications Commission's (FCC's) Connect America Cost Model, the estimated subsidy required to make it economical for private sector broadband providers to invest in installing fiber-to-the-premises broadband access with a download speed of 100 Mbps infrastructure in rural areas of the state is approximately $2.2 billion over 25 years ($89 million annually). Of this total subsidy amount, $645.7 million can be provided by the FCC's Connect America Fund, leaving a balance of $1.57 billion in subsidies needed over the next 25 years. This subsidy combined with the private investment it would stimulate—which is estimated to be an equal or greater amount—represents the estimated total cost of connecting the 17 percent of Michigan's population that currently do not have access.

federal lifeline program, but who do not have access to a low-cost mobile and fixed broadband program.[10]

Estimated investment needed: $50 million of state funding, annually over ten years[11]

QS 0-2 11+

4.3 SECURING MICHIGAN'S DIGITAL INFRASTRUCTURE

Where is Michigan today?

While Michigan is already a top performer in cyber security[12] preparedness, the rate of advances in technology means that Michigan must constantly improve to stay ahead of threats (Spidalieri 2015). In order to provide state-of-the-art cyber security, Michigan must address several barriers. Currently, Michigan's public sector struggles to attract and retain top talent in the cyber field, due to significant wage discrepancies between the public and private sectors. Michigan has attempted to address this wage gap by creating an information technology (IT) student assistant classification and an entry level IT classification for students with associate's degrees, developing a performance pay schedule for longer-term high performing IT staff, and increasing new IT employee salaries upon hiring. Also, entities working in Michigan's cyber security ecosystem lack an exemption from Freedom of Information Act (FOIA) legislation, which creates a barrier to sharing cyber threat and vulnerability information between and amongst public and private entities.

The state's experience as a cyber security leader makes it evident that strong collaboration is an important step in ensuring this ecosystem remains strong and committed. Michigan has engaged private and public experts through recurring conferences and Chief Security Officer Kitchen Cabinet meetings, leveraged the Michigan Cyber Range, and formed the Michigan Cyber Civilian Corps to share best practices and network with seasoned cyber professionals.

What does a 21st century Michigan look like?

As more and more information gets shared and interactions occur online, Michigan will set industry standards in cyber security by finding innovative ways to defend critical information, manage access and identity management, and embrace new and emerging technologies. Michigan

[10] The FCC's Lifeline program provides discounts on phone service for low-income consumers. The Commission expanded the program to include broadband services in 2016 (FCC August 11, 2016).

[11] Note that the recommended $50 million annual investment is not enough to fully implement this recommendation, but the Commission is also recommending identifying funding from other available sources and programs—such as the Connect America Fund—to fill the gap.

[12] Cyber security encompasses a broad range of practices, tools, and concepts related closely to those of information and operational technology security. Cyber security is distinctive in its inclusion of the offensive use of information technology to attack adversaries (Walls 2013).

maintains its security and cyber-readiness through ongoing revision and refinement of the following five elements:

- A published cyber security strategic plan
- A published incident response strategy
- Governance structures and regulatory mechanisms in place to fight cyber crime
- Capacity and systems in place to support timely and coordinated information sharing of cyber threat intelligence across agencies and stakeholders
- Investment in cyber security research and development, education, and capacity building

How do we get there?

4.3.1 DTMB should develop a ubiquitous enterprise log management as a service system, or cyber hub,[13] that allows the cyber security ecosystem to understand new, emerging and historical cyber threats by leveraging advanced and predictive analytics. This will allow Michigan and their partners to detect, respond to, and mitigate cyber incidents through real-time analysis.

Estimated investment needed: $3 million of state funding annually for two years

QS 0-2 0-2

4.3.2 DTMB should work to build a cyber-focused workforce, in partnership with the Merit Network, by continuing efforts of the Regional Cybersecurity Education Collaboration (RCEC). The vision of the RCEC is collaboration between the higher education community and key private sector partners to address the widening gap between the supply of skilled cyber security professionals and the demand for those skills. The overall goal is to provide a robust cyber security curriculum to institutions throughout Michigan via a mix of face-to-face and distance learning courses at two-year and four-year colleges.

Estimated investment needed: $1 million of state funding annually for two years, and private donations for scholarships

QS 0-2 3-5

[13] A cyber hub is designed to operationalize existing cyber data, information, and intelligence for the cyber security ecosystem to establish a common operating picture by leveraging predictive and real-time analytics. Cyber hubs provide decision making support to enable organizations to anticipate and respond to cyber events.

4.3.3 DTMB should increase Michigan Civilian Cyber Corps (MiC3) membership to 200 members and invest in development and training for the MiC3. This increase in membership will ensure small and medium-sized organizations have a low-cost cyber security option in case of attacks. In addition, the corps will also support the cyber ecosystem in case of large-scale attacks to Michigan's critical infrastructure.

Estimated investment needed: $2 million annually for five years from state and private funds

QS 3-5 3-5

4.3.4 The Governor should create a shared virtual chief information security office (CISO) to provide consulting and advisory services to multiple local governments. Led by the chief information security officer, the virtual CISO will develop, implement, monitor, and support cyber program activities for multiple local governments. The virtual CISO would also serve as a conduit for cooperation among and between local governments and other state, federal, and nonprofit agencies to support the mission of cyber security. Participating agencies would pay for this service through annual fees.

Estimated investment needed: $750,000 of state funding total over two years

QS 0-2 0-2

4.3.5 DTMB should enhance threat intelligence gathering and sharing among states, federal agencies and private sector partners develop responses to common threats, in keeping with guidance published by the National Institute of Standards and Technology.

Estimated investment needed: $3 million of state funding annually for five years

QS 3-5 3-5

4.3.6 DTMB should advocate for changes to the state's Freedom of Information Act (FOIA) exemptions—which currently prevents Michigan agencies from communicating and coordinating with infrastructure asset owners about cyber and physical security threats/attacks—to allow for appropriate exemptions for agencies protecting Michigan's critical infrastructure. This could cover any communications between the government and private entities, as well discussions on defensive measures. Exemption in terms of cyber threat information is key because, it protects any vulnerability systems may have discovered as well as cyber security assessments and plans. It also protects any additional information that may be included in the data shared.

Estimated investment needed: Will utilize existing staff resources

QS 0-2 0-2

4.3.7 Entities within the cyber security ecosystem should collaborate to develop a public awareness campaign and other learning opportunities to educate residents, consumers, and families about the reality of online risks and promote cyber safety practices among residents, particularly children and businesses. The public outreach program could include ways to alert residents and businesses about serious security failures, potentially delivered via MiPage. The vision is a system like a recall notification program for things like routers, Internet cameras, audio and video recording equipment, consumer devices (e.g., Amazon Echo, deadbolts, and Internet-connected locks). Residents purchase these items through normal retail channels, but are rarely provided with security updates or patches.

Estimated investment needed: $1.25 million to $2 million of state funding, annually for five years

QS 3-5 3-5

4.3.8 Work with the cyber security ecosystem and other entities to design and encourage the adoption of a curriculum focusing on technology throughout the science, technology, engineering, and mathematics (STEM) education system to ensure the next generation's workforce is prepared to take on the challenges related to information technology and cyber security.

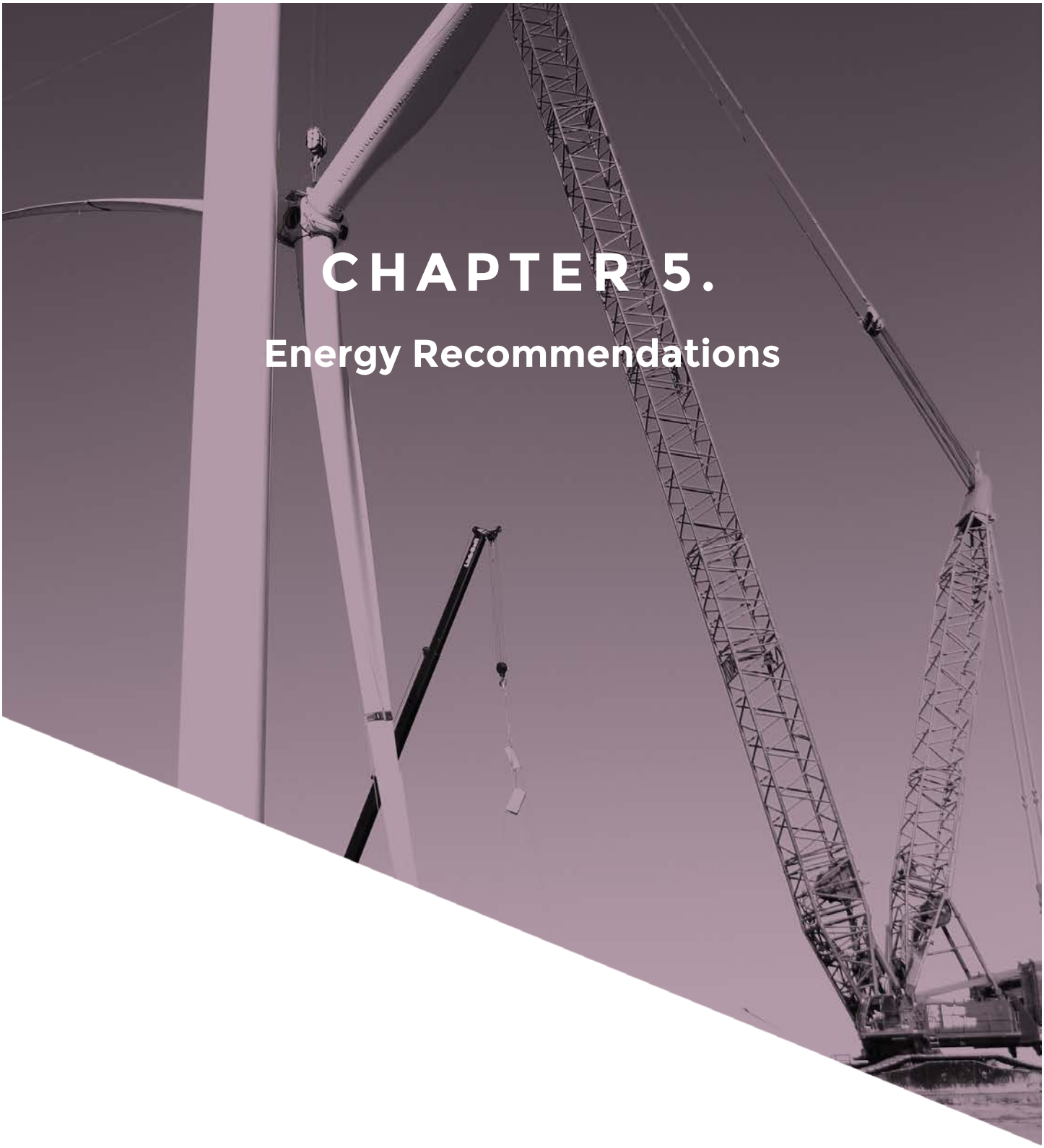
Estimated investment needed: $960,000 of state funding annually (for staffing and materials) for five years

QS 3-5 3-5

4.3.9 Michigan should develop a next-generation solution to centrally manage identity and authentication management for workers, partners, and residents. This includes a mature identity framework based on a consumption-based application program interface application economy, rather than pushing identity to individual applications. These enhancements will position Michigan to offer high-quality user experiences, maintain better security, and operate a less complex IT environment.

Estimated investment needed: $5 million initially to develop, then $3 million annually for five years

QS 3-5 3-5



CHAPTER 5.

Energy Recommendations

CURRENT STATE OF MICHIGAN'S ENERGY INFRASTRUCTURE

Infrastructure systems in Michigan should enhance residents' quality of life, enable economic growth, and create a strong foundation for vibrant communities. In order to obtain efficient, reliable, and cost-effective energy systems in the 21st century, we must first understand the current reality of energy infrastructure in Michigan:

RESOURCE ADEQUACY

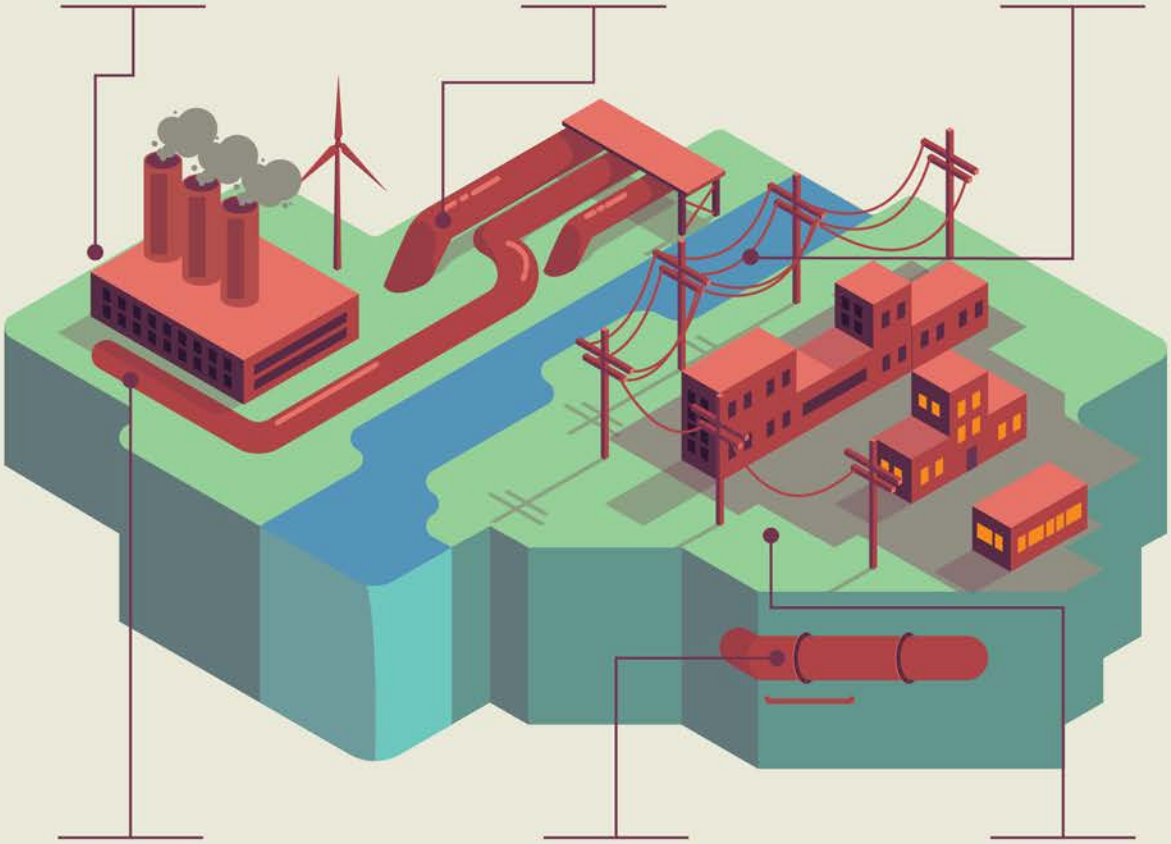
- Planned power plant retirements have raised concerns about the state having adequate electric resources to meet customers' demand.
- In 2017, much of Michigan's Lower Peninsula could fail to meet its reliability requirements by approximately **520 MW.**

CLEANER ENERGY SOURCES

- Michigan has met its goals for reducing energy waste and building renewable energy generation.
- By 2015, Michigan received **9 percent** of its electricity from renewable sources and reduced energy waste by **7 percent.**

ELECTRIC RELIABILITY

- On average, Michigan customers experience less than one outage per year, meeting the Governor's goal.
- Michigan does not meet the Governor's goal for duration of electric outages. On average, Michigan customers experience outages for more than **150 minutes** each year.



NATURAL GAS SAFETY

- Michigan has roughly **5,688 miles** of at-risk natural gas distribution pipeline.
- As of 2015, utilities have replaced nearly **700 miles** of these pipelines; however, another **6,700 miles** have been identified for replacement over the next 25 to 30 years.

STORAGE CAPACITY

- Michigan has the most underground natural gas storage capacity of any state—**11.6 percent** of the nation's total storage capacity.

ECONOMIC DEVELOPMENT

- Despite higher-than-average industrial energy prices, Michigan has been successful in attracting new businesses. Utilities have worked to offer a variety of attractive services that help new businesses choose Michigan.

Energy is an integral part of modern day life. It powers Michigan's manufacturers, provides essential heating and cooling for homes and businesses, enables us to connect to and communicate with the global economy and world at large, and delivers countless other functions on a daily basis. Despite the crucial role energy plays in our lives, however, it is often taken for granted until its absence draws our attention. Recognizing this importance, Governor Snyder has spent considerable time during his administration developing goals related to energy, culminating in the release of his 2015 special message, *Ensuring Affordable, Reliable, and Environmentally Protective Energy for Michigan's Future*. The 21st Century Infrastructure Commission has used this work and the Governor's goals as the basis for their recommendations.

The energy sector is undergoing significant change. New technologies are a major driver of these changes as they unlock new opportunities for customers to monitor and control their energy use, make forms of renewable energy more affordable, increase the adoption of alternative fuel vehicles, and help reduce the environmental impact of energy use and production. In addition, a major shift is occurring in the nation's electric system, as many older electric generation resources are retiring due to age and stricter environmental regulations. Planned power plant retirements have raised concerns about whether there are adequate electric resources to meet customers' demand. Michigan only has to look to the recent events in the Upper Peninsula to see the impacts that power plant retirements can have on customers. When the largest power plant in the Upper Peninsula planned to retire, customers were forced to pay to prop up the plant, because shutting it down would have impacted reliability. Had it not been for efforts by the State and private partners to come to a better solution, customers would be trapped in a system that would not be adaptable, affordable, or equally reliable, and with a worse environmental outcome. This example highlights how vital it is to make smart decisions when it comes to planning for its energy future.

The following chapter outlines the Commission's recommendations to support Michigan's 21st century energy infrastructure and ensure that the sector will be built on a foundation of affordability, reliability, adaptability, and environmental protection.

The Commission's vision is that Michigan's energy system supports all our needs at reasonable prices, and that energy infrastructure generates and distributes resources efficiently fostering residents' and businesses' confidence in Michigan's long-term growth and continued success.

Recommendations Key

EP	Economic Prosperity	HE	A Healthy Environment
QS	Reliable, High-quality Service	VI	Value for Investment
0-2	Implementation Start (in years)	0-2	Implementation Complete (in years)

5.1 RESOURCE ADEQUACY

Where is Michigan today?

Michigan's risk of devastating outages is serious and growing. The MPSC's five-year electric capacity outlook, released on July 22, 2016, expressed concern that "load serving entities in the Lower Peninsula do not have adequate capacity within the state to meet reserve requirements. In addition, there is uncertainty about whether capacity supplies at the regional level will be available to fill this gap" (MPSC 2016).

> *Michigan's looming potential capacity shortfall could create reliability challenges during periods of peak demand in 2018.*

Michigan has real experience with the devastating impacts a widespread outage can bring. In 2003, the Northeast blackout resulted in the loss of power to six million Michigan residents for up to two days. Michigan's economy lost an estimated $1 billion when businesses and industrial production were forced to shut down. Detroit Metropolitan Wayne County Airport halted operations, General Motors was forced to close its warehouses, Ford Motor Company's production offices, and facilities ceased operation, and Marathon Oil Corporation's Detroit refinery lost 500,000 barrels of output (ELCON 2004).

Efforts are already underway to ensure Michigan has adequate generation and transmission capacity resources into the future. The MPSC, in cooperation with Michigan's primary regional transmission operator, the Midcontinent Independent System Operator (MISO), has filed a tariff change with the Federal Energy Regulatory Commission (FERC) that, if approved, would help resolve the state's potential capacity shortfall (MAE 2016). Legislative changes will still be necessary to fully implement and secure Michigan's energy future.

What does a 21st century Michigan look like?

Michigan ensures that its residents and businesses never experience massive power outages due to lack of electric supply. The State requires companies that provide electricity to Michigan customers to be prepared to serve customers' needs with adequate energy supplies.

How do we get there?

5.1.1 The Michigan Agency for Energy (MAE) and the MPSC should continue to work with MISO and other stakeholders to reform Michigan's current electric market structure by requiring all electric providers to protect their customers from massive outages due to lack of supply by securing adequate capacity resources. In addition, MAE and the MPSC should continue to collaborate with legislative partners, as needed, to ensure adequate generation and transmission capacity resources are developed.

Estimated investment needed: Covered by private sources

EP 0-2

5.1.2 MAE and the MPSC should closely monitor all proposed solutions to the energy supply concerns in the Upper Peninsula and work with stakeholders to ensure resolution implementation by 2019.

Estimated investment needed: Covered by private sources

EP 0-2

5.2 ENERGY WASTE REDUCTION

Where is Michigan today?

The Governor has made energy affordability a central tenet of his energy policy and has established a goal that Michigan's residential customers should spend less on their combined energy bills (electric and heat) than national averages.

> *To date, the state has met the Governor's goal for energy affordability; Michigan households' energy bills are below the national average.*

In 2014, Michigan ranked 21st in the country, with a combined annual electric/gas bill of $2,397.49 per household (U.S. EIA 2015; U.S. EIA 2016a; U.S. EIA 2016b; U.S. EIA 2016c).

However, despite the economic benefits of promoting efficient energy use and reducing energy waste, Michigan's current energy policy creates several barriers for the amount utilities can spend on their energy-efficiency programs and restricts customers' access to innovative financing programs for waste reduction efforts. This arbitrarily limits utilities' efforts to reduce energy, and restricts customers' ability to make decisions that could reduce their household energy burden.

Additionally, Michigan's current energy policy inhibits utilities from choosing energy waste reduction by not allowing utilities to decouple[14] their electric rates. Currently, utilities' revenue is tied to the sale of electricity, which creates a challenge for utilities that pursue least-cost energy-efficiency measures because these investments reduce energy consumption and, in turn, revenue. State policies currently under consideration would enable utilities to choose to reduce energy waste without jeopardizing utilities' financial health.

What does a 21st century Michigan look like?

Michigan benefits from expanded options for customers choosing energy waste reduction through on-bill financing programs. The state's utilities invest in the most cost-effective energy resources, such as energy waste reduction, instead of being limited by arbitrary caps.

How do we get there?

5.2.1 The Michigan Legislature should remove the artificial cap on how much utilities can spend on energy-efficiency programs and provide the MPSC with the ability to evaluate energy waste reduction like any other resource.

HE 0-2 6-10

5.2.2 The Michigan Legislature should ensure that there is no financial disincentive for the use of cost-effective energy waste reduction.

HE 0-2 6-10

5.2.3 The Michigan Legislature should remove the prohibition on on-bill financing for energy waste reduction efforts.

HE 0-2

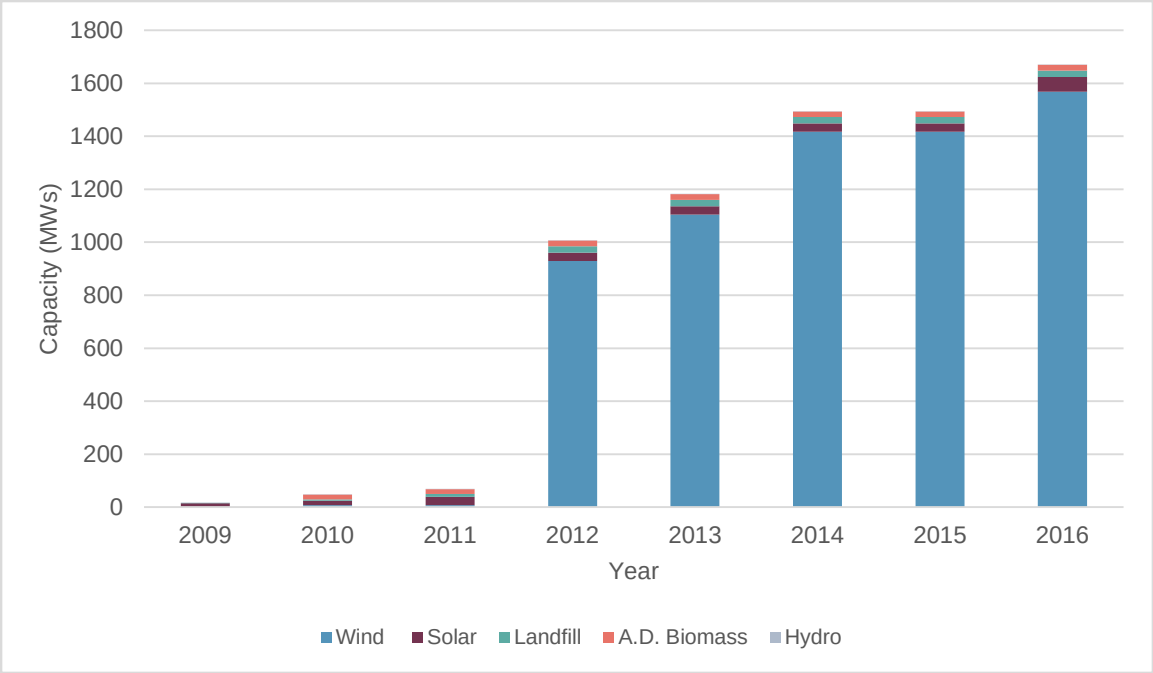
[14] Decoupling is an adjustable price mechanism that removes the link between the amount of energy sold and a utility's revenue requirement.

5.3 CLEANER ENERGY SOURCES

Where is Michigan today?

In 2008, Michigan established its first renewable energy standard, setting a goal of reducing energy waste and building renewable energy generation. By 2015, Michigan met these goals, receiving 9 percent of its electricity from renewable energy and reducing energy waste by 7 percent. Waste reduction has helped avoid significant costs associated with coal, natural gas, and energy production facilities while making Michiganders' homes and businesses more comfortable and energy bills more affordable. Since 2008, Michigan has met, exceeded, and maintained its mandate of 1 percent of energy waste reduction per year. However, existing law prevents utilities from spending more than 2 percent of their budget on waste reduction, even if this forces them to buy more expensive equipment instead. By reducing the amount of energy produced by coal and replacing it with cleaner renewables, natural gas, and energy waste reduction, Michigan will help promote a cleaner environment.

EXHIBIT 9. Renewable Energy Capacity by Commercial Operation Date



Source: MPSC 2016.

What does a 21st century Michigan look like?

By sustaining current efforts and investment levels related to energy waste reduction, Michigan achieves its goal of meeting 30 percent of its electric energy needs from the cleanest sources, including renewable energy and energy waste reduction, by 2025. Over the same time period, Michigan reduces harmful emissions from its electric power sector, including emissions of mercury, sulfur oxides (SOx), nitrogen oxides (NOx), and particulate matter (PM).

How do we get there?

5.3.1 The MPSC and MAE should continue to work together to ensure continued investment in energy waste reduction, meeting at least 15 percent or more of Michigan's energy needs by eliminating energy waste between now and 2025, as well as meeting any of its additional capacity needs from a combination of cleaner technologies, including renewables and natural gas.

Estimated investment needed: Covered by private sources

QS 0-2 6-10

5.3.2 Through coordinated efforts, the MPSC, MAE, and MDEQ should continue to ensure that emissions from the electric power sector are reduced by helping utilities choose the cleanest energy sources for the future, in consideration with affordability and reliability.

Estimated investment needed: Covered by private sources

QS 0-2 6-10

5.3.3 The MPSC and MAE should work to reduce barriers to additional cost-effective renewable energy investment by reducing barriers to interconnection, net metering, and siting.

Estimated investment needed: Covered by private sources

QS 0-2

5.4 ELECTRIC RELIABILITY

Where is Michigan today?

Governor Snyder has made electric reliability an important part of his overall energy goals, as it is vital to the health and success of Michigan families and businesses. He has put forward two goals related to the duration and frequency of electric outages that measure reliability using two industry standard metrics—the System Average Interruption Frequency Index (SAIFI) for outage frequency and the System Average Interruption Duration Index (SAIDI) for outage duration. The Governor's goals are that Michigan residents should experience, on average, less than 1.00 outage per year,

and total combined outages should last less than 150 minutes. As calculated using the current methodology, between 2008 and 2016, the average Michigan resident experienced outage frequencies that were consistently below the Governor's goals (see Governor's Energy and Environment Dashboard).[15]

Michigan has begun improving electric reliability by making investments that provide greater insight into the cause and location of an outage through the deployment of advanced metering infrastructure (AMI) or smart meters. AMI will improve efficient deployment of line workers by alerting utilities to areas affected by an outage without relying on customers to report disruption. As of today, Michigan utilities have installed 3,544,389 smart meters, and the MPSC expects that 90 percent of Michigan customers will have a smart meter installed by 2018.

In addition to the deployment of AMI, Michigan can do more to improve reliability by continuing to invest in the distribution system and by emphasizing ongoing efforts such as vegetation management, which keeps trees and other natural materials from contacting or damaging infrastructure assets. Michigan can also expand the metrics it uses to track reliability performance to include metrics that measure the outage experience for individual customers in order to provide a more comprehensive look into customer experience. Reliability metrics, such as customers experiencing long interruption durations (CELID) and customers experiencing multiple interruptions (CEMI), offer different ways to view the outage experience for individual customers. By incorporating these metrics into current reliability reporting, Michigan can better measure the impacts of electric outages and make more informed decisions related to improving reliability.

What does a 21st century Michigan look like?

Michigan meets the Governor's goals for reliability, continues reducing the frequency and duration of electric outages, and ensures that customers do not experience significant disruptions in their service. Michigan performs in the top half of states for the duration of electric outages and in the top quartile for the number of outages and prolonged outages (greater than three days) associated with major events that disrupt the economy and quality of life.[16]

[15] The MPSC currently collects IEEE 1366 reliability indices from the regulated utilities annually in the following dockets: U-12270, U-16066, and U-16067. These indices are weighted annually based on the number of customers served by each utility in order to calculate the average Michigan citizen's reliability experience, which is posted on the Governor's dashboard.

[16] Although SAIDI and SAIFI measure average customer reliability in Michigan, often the individual customer experiences can be disguised by these statistics. In order to ensure no customers are left behind with electric reliability goals, it is critical that measures are in place to ensure each individual customer has an expectation of high reliability.

How do we get there?

5.4.1 Michigan's utilities should take steps to expedite their response to outages and restore power to their customers in a timely manner by completing plans to deploy AMI while also evaluating additional measures, like vegetation management and other distribution investments. Smaller electric utilities that do not currently have plans to deploy AMI in their service territory should evaluate potential benefits and deploy where prudent and cost effective.

Estimated investment needed: Covered by private sources

QS 0-2 0-2

5.4.2 The MPSC and MAE should convene a stakeholder group with the aim of establishing a performance goal for CELID and CEMI metrics and requirements in order for utilities to provide information related to these metrics, as well as their current reliability reporting.

Estimated investment needed: Covered by private sources

QS 0-2 0-2

5.4.3 The MPSC should evaluate investments that provide greater insight into equipment condition and system loading, such as supervisory control and data acquisition, which will allow for greater insight into distribution system operation, enabling proactive maintenance to address problems prior to these issues resulting in an outage.

Estimated investment needed: Covered by private sources

QS 0-2 0-2

5.4.4 The MPSC should evaluate proposed new capital investments through a transparent, forward-looking distribution system planning process, and monitor proposed changes to the distribution system planning process for each utility as needed on an ongoing basis.

Estimated investment needed: Covered by private sources

QS 0-2 3-5

5.5 NATURAL GAS SAFETY

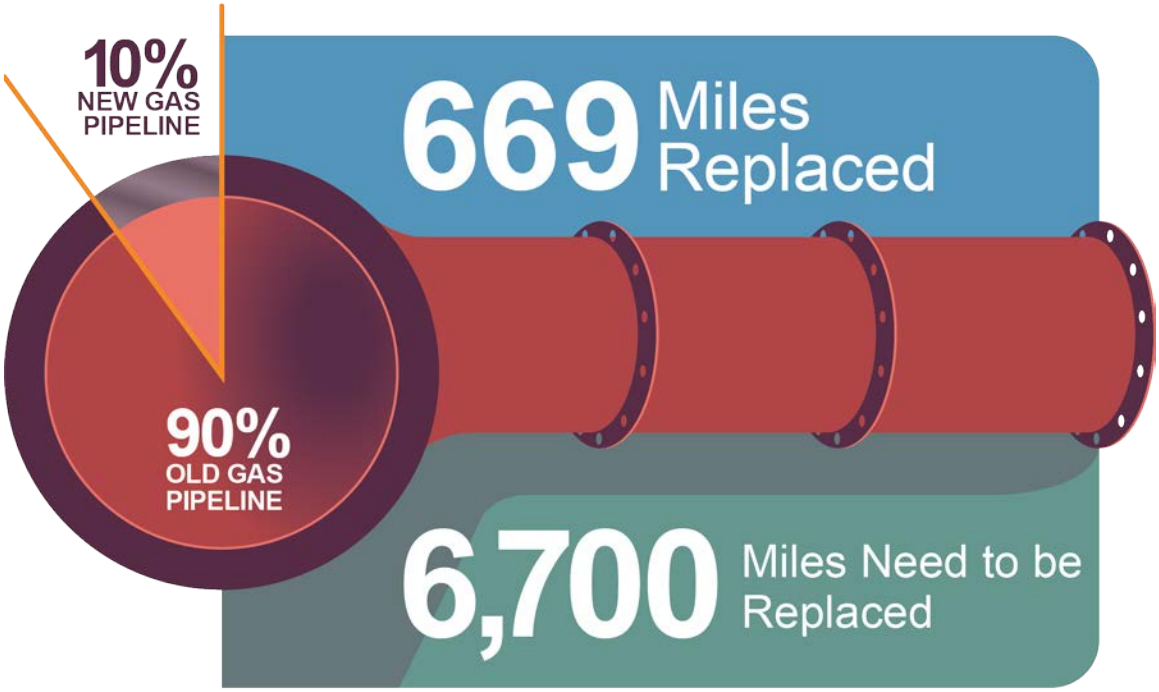
Where is Michigan today?

Many miles of Michigan's pipeline infrastructure that transports natural gas are outdated or have surpassed their useful lifespan, making them one of the State's most pressing issues regarding its energy future.

> *The federal Pipeline and Hazardous Materials Safety Administration (PHMSA) has identified roughly 5,688 miles of at-risk natural gas pipe in Michigan.*[17]

This is approximately 50 percent of all the at-risk pipe identified in PHMSA's 11-state Central Region. The MPSC approved accelerated main replacement programs for utilities beginning in 2011, work towards replacing at-risk pipe is currently underway, and Michigan's natural gas utilities are working to replace all of the at-risk pipelines in the next 25 to 30 years. As of 2015, Michigan utilities have replaced 669 miles of at-risk main distribution pipeline. However, another 6,700 miles of at-risk distribution pipeline have been identified for removal and replacement (as shown in Exhibit 10).

EXHIBIT 10. Percent of At-Risk Natural Gas Pipeline in Michigan



[17] At-risk pipe is identified as unprotected and protected bare steel, unprotected coated steel, cast/wrought iron, and copper pipe that is more susceptible to corrosion or leaks.

What does a 21st century Michigan look like?

In much the same way that the reliability of Michigan's electric grid is important, the state's natural gas system provides a vital source of energy that is used to heat millions of homes and provide electricity. Michigan's natural gas distribution system is well maintained and has received necessary upgrades that ensure safe, reliable operations.

How do we get there?

5.5.1 The MPSC should consider further accelerating plans to replace at-risk natural gas distribution pipe beyond the currently planned 25- to 30-year window by evaluating utilities' current replacement timelines. Emphasis should be placed on coordinating replacements with local investment in other infrastructure asset categories to accelerate progress and leverage investment.

Estimated investment needed: Covered by private sources

QS 0-2 11+

5.6 ADAPTABLE REGULATION

Where is Michigan today?

The energy sector is undergoing dramatic changes as the costs of renewable energy decline, new emerging technologies give consumers more control over their energy use, and environmental regulations force existing generation sources to curb emissions.

> *Over the past decade, Michigan's utilities have begun to transition their generation portfolios to include new, cleaner energy sources (such as wind and solar), but more can be done to ensure that the energy Michigan needs to power its future is reliable, affordable, and protective of the environment.*

Under State law, there are currently regulatory barriers and incumbent funding structures that inhibit Michigan's ability to respond to and adopt new, emerging energy technologies. It is possible that the MPSC will be able to respond to new technologies through its existing regulatory authority, but some cases may call for legislative change. One major barrier is the Certificate of Need (CON) process, which only allows utilities to seek preapproval for projects with costs exceeding $500 million and excludes renewable energy projects, emission control upgrades, and investment in energy waste reduction. Changes to the CON process are included in pending legislation before both chambers of the Michigan Legislature.

What does a 21st century Michigan look like?

Michigan's energy future is secure and its regulatory framework is adaptable, allowing the state's energy providers to pursue and adopt new and cleaner technologies.

How do we get there?

5.6.1 The Michigan Legislature, in consultation with MAE and the MPSC, should act to remove the barriers in the current CON process that prevent the MPSC from weighing all large investments against alternatives and determining the impact on reliability, affordability, adaptability, and protection of the environment.

QS 0-2 0-2

5.6.2 The MPSC and MAE should continue efforts to ensure that Michigan's regulations are adaptable in the face of new technologies. The need for regulatory changes should be evaluated as new technologies emerge.

Estimated investment needed: Will utilize existing staff resources

QS 0-2

5.7 INFORMATION SECURITY

Where is Michigan today?

Currently, state agencies cannot serve as a clearinghouse for security information or issues related to infrastructure assets, due to the nature of Michigan's Freedom of Information Act law. Under current provisions, if information related to security is shared with the State, that information could be obtained through a FOIA request from an outside individual. This undermines the State's ability to communicate and coordinate with infrastructure owners to protect critical assets from physical and cyber threats. Without an exemption to the FOIA, the State of Michigan cannot provide needed assistance related to coordination of and response to the security of critical infrastructure assets.

What does a 21st century Michigan look like?

Michigan has well-defined systems for sharing information about critical infrastructure assets so that it can effectively plan for and communicate about physical and cyber security threats. This information sharing system enables state agencies (e.g., the MPSC and MAE) to communicate with infrastructure asset owners effectively while balancing the need for increased transparency and information sharing regarding security concerns.

How do we get there?

5.7.1 The Michigan Legislature, together with MAE and the MPSC, should revise FOIA exemptions to allow the appropriate agencies to communicate with infrastructure asset owners about physical and cyber security, and alleviate concerns related to the security of sensitive information when the State is working with infrastructure asset owners.

Estimated investment needed: Covered by private sources

VI 0-2 0-2

5.8 BUSINESS ATTRACTION AND ECONOMIC DEVELOPMENT

Where is Michigan today?

Energy affordability and utility-provided services are vital to Michigan businesses. In many cases, energy costs and utility service offerings can be important determinants for businesses' site selection. For manufacturing and industrial companies, energy costs can make up a significant portion of their total operating costs, and energy costs must not deter companies from investing in Michigan. As of May 2016, Michigan ranked 33rd in industrial electric price affordability within the United States.[18]

Despite having electricity and natural gas prices that are higher than the national average, Michigan has had recent success in securing new business development.

> *In 2015, Site Selection magazine ranked Michigan the sixth best in the nation for new and expanded corporate facilities; in that same year, there were 217 new projects in Michigan that met the magazine's selection criteria (MEDC 2016).*[19]

However, given its industrial rates, Michigan will need to continue its efforts to retain and attract businesses through work with the state's utilities, regulators, and businesses to ensure that energy is not a limiting factor in Michigan's growth.

While price is a major consideration for businesses, it is not the only one. Many other factors can play a role in business' site selection decisions and can lead to business attraction despite higher energy prices. These aspects include utility-offered services, such as access to high-voltage

[18] Unlike in many other states where industrial energy rates are subsidized by other customer classes, Michigan law requires rates to be based on cost of service.

[19] To be included in the selection, projects must meet one of the following criteria: (a) involve a capital investment of at least $1 million, (b) create at least 20 new jobs, or (c) add at least 20,000 square feet (1,858 square meters) of new floor area.

reliability assurances, energy-efficiency offerings and incentives, dynamic rate options, and specific energy sources. Utilities are already working with the MEDC to provide prospective businesses with a quote that estimates the cost of service for a new facility and location within five days. This helps customers get a real sense of their potential energy costs and avoid hidden or unexpected costs, as well as enabling them to work with a utility service provider to generate creative ideas for meeting companies' needs.

What does a 21st century Michigan look like?

Michigan attracts new businesses and energy-intensive industries by offering competitive energy prices, flexible rate structures, and programs that help companies control their energy costs.

How do we get there?

5.8.1 The MPSC and MAE should work together with utilities and companies to expand opportunities for industrial customers to participate in programs that help them reduce energy bills, such as demand response programs.

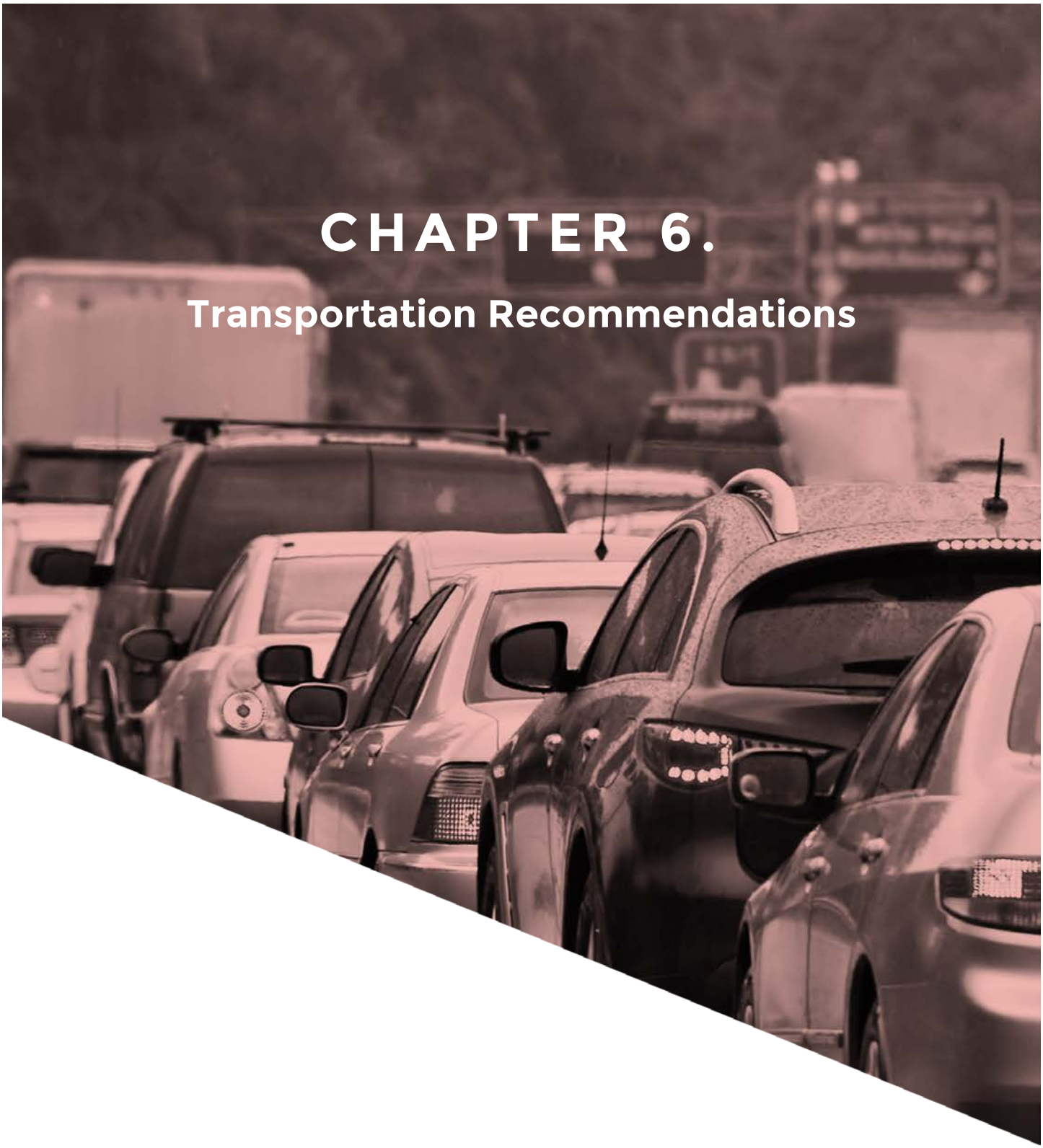
Estimated investment needed: Covered by private sources

VI 0-2 0-2

5.8.2 The MPSC, MAE, and MEDC should confer regularly to continue improving the factors that impact business decisions and engage stakeholders about additional opportunities for business attraction.

Estimated investment needed: Covered by private sources

VI 0-2 0-2



CHAPTER 6.

Transportation Recommendations

CURRENT STATE OF MICHIGAN'S TRANSPORTATION INFRASTRUCTURE

This long-term transportation plan will improve Michigan's deteriorating roads and bridges, making them safer for Michigan's families. The plan approved today is fiscally responsible and protects key investments essential to our state's comeback.

NONMOTORIZED

- Michigan has more than **20,000 miles** of trails, including **2,700 miles** of rail trails supporting transportation, recreation, and tourism.
- While Michigan's nonmotorized options continue to grow, it is still a patchwork system that can prevent safe connections between communities.

RAIL LINES

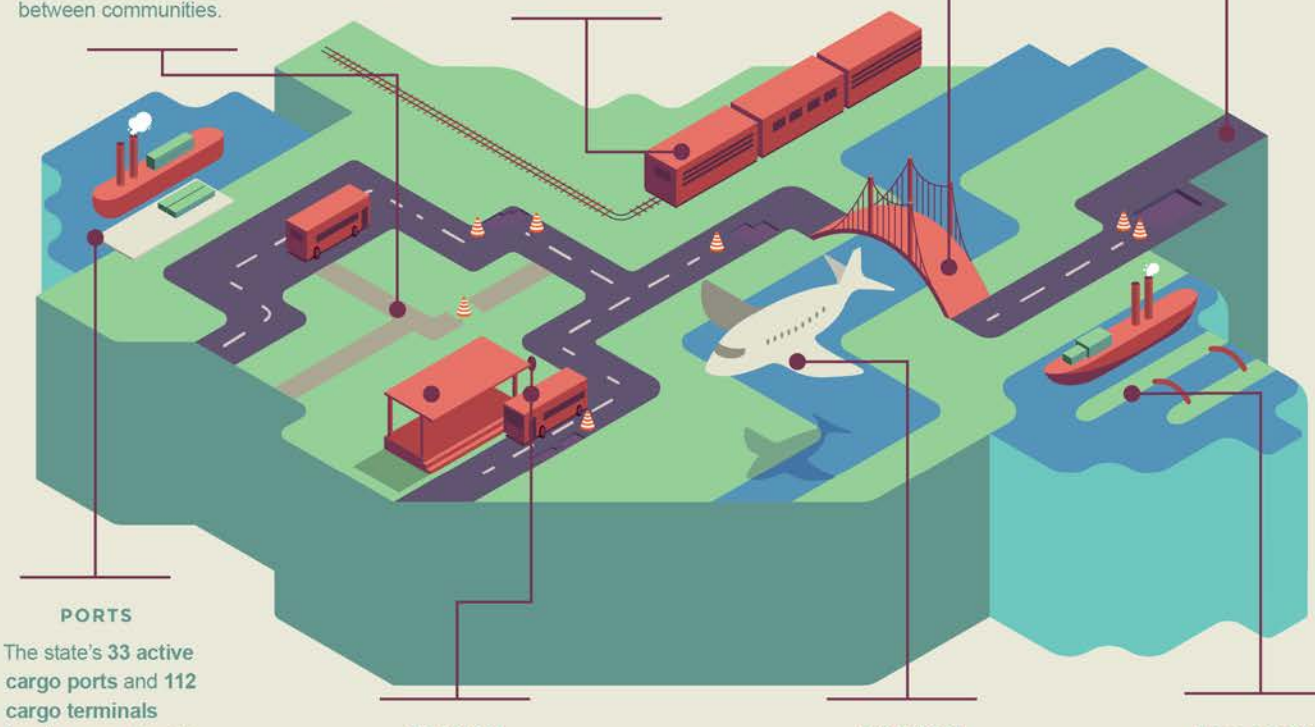
- Approximately **3,600 miles** of active rail lines carry **100 million tons** of freight cargo.
- Ridership on passenger rail routes has increased by nearly **40 percent** in the last ten years.
- The lack of passenger rail capacity and the sharing of track between freight and passenger trains restricts mobility and economic development.

BRIDGES

- Michigan has more than **11,000 bridges.**
- **1,200** of the state's bridges are structurally deficient or functionally obsolete.

ROADS

- Michigan's **600 road agencies** manage over **120,000 route miles.**
- **38 percent** of Michigan roads are in poor condition.



PORTS

- The state's **33 active cargo ports** and **112 cargo terminals** handle approximately **70 million tons** of cargo yearly.
- For the past few decades, many of Michigan's in-water navigation channels have not been maintained, limiting the efficiency of ports across the state.

TRANSIT

- More than **70 local transit systems** provide approximately **90 million passenger trips** annually.
- Three intercity passenger rail routes serve almost **750,000 riders** annually.
- Transit systems need funding to improve reliability and provide a broader range of service. Unfortunately, any publicly funded transit expansion in Michigan comes at the expense of other transit entities.

AVIATION

- More than **38.4 million passengers** are served through Michigan airports each year.
- Airports accommodate over **672.8 million pounds** of cargo and freight.
- Michigan's aviation system faces fiscal challenges, including decreased local resources for airport improvement and an increased reliance on state and federal grant programs.

SOO LOCKS

- **67 million tons** of cargo travel through the Soo Locks each year.
- A six-month shutdown would result in a national recession and **11 million U.S. jobs** lost.

Michigan has long been a leader in transportation innovation, building the nation's first mile of concrete highway (1909), installing the first traffic light (1918), deploying the first highway snow plow (1922), and building two of the nation's first three-level interchanges to service the Willow Run bomber plant (1940s), and opening of the Mackinac Bridge – the longest suspension bridge in the Western Hemisphere (1957).

Michigan has a history of many multimodal successes. Michigan is a recognized global leader in intelligent vehicle technology. It is also home to over 20,000 miles of nonmotorized trails, the most of any state in the country. In 1929, Michigan built the first crisscrossed aviation runways at Ford Airport in Dearborn, and in 2002, the new McNamara Terminal at Detroit Metropolitan Airport opened for business. In 2013, Michigan was the first state outside the Northeast Corridor to implement 110 mile-per-hour intercity train speeds between Kalamazoo and the Michigan/Indiana border. And the upcoming opening of the new Gordie Howe International Bridge has the potential to revolutionize the logistics industry in Michigan, making it an internationally competitive intermodal transportation and distribution hub.

EXHIBIT 11. Major Milestones of Michigan's Multimodal Transportation System

1909	The nation's first mile of concrete highway is built in Michigan
1918	Michigan installs its first traffic light
1922	The state deploys the first highway snow plow
1940s	Michigan builds two of the nation's first two-level interchanges to service the Willow Run bomber plant
1957	The Mackinac Bridge opened—the longest suspension bridge in the Western Hemisphere

Transit has been a big part of Michigan's intermodal transportation history, including state support for rural and specialized transit that predated federal transit programs. The recent Regional Transit Authority (RTA) ballot initiative narrowly failed voter approval. This proposal would have provided Southeast Michigan with a long-term solution for regional transit. Proponents will continue to work toward new strategies on RTA funding.

Michigan has been a transportation leader in asset management for roads and bridges, solidified by the formation of the TAMC in 2000. Because of transportation's robust history of asset management and data collection, transportation agencies across the state have very clear and scientifically sound information on the condition of their infrastructure, reported annually to the State Transportation Commission and the Michigan Legislature.

> *Although Michigan remains a leader in asset management planning, due to a lack of funding it has struggled with implementing its transportation asset management plan. As a result, Michigan has been unable to develop and maintain a world-class, intermodal transportation system.*

According to the 2015 report from the TAMC, 39 percent of federal aid roads under local jurisdiction are in poor condition and 27 percent of all bridges in the state are structurally deficient or functionally obsolete. State highways, which were only rated 8 percent poor as recently as 2008, are currently 16 percent poor and projected to deteriorate even more rapidly in the years to come. Many bus transit systems are fragmented, inefficient, expensive, and unreliable. In addition, Michigan lacks robust rail transit as an option for travelers. Transit connectivity to city centers from Michigan's airports is inconvenient, if available at all. Meanwhile, marine infrastructure suffers from under funding. For example, the largest lock in the Soo Locks—the Poe Lock—is 50 years old; it is the only passage from Lake Huron to Lake Superior for 1,000 foot freighters and an unplanned closure would cause great economic harm to the nation.

The solid, scientific asset management data on declining road and bridge condition in Michigan means that an undeniably large investment will be needed to repair those roads and bridges. Deteriorating road and bridge conditions are a factor in road-related accidents and injuries; by improving Michigan's road and bridge condition, Michigan's residents and out-of-state visitors will be afforded a safer and more reliable transportation system. Transportation agencies across the state are very grateful for the transportation revenue package signed into law in 2015.[20] The asset management analysis predicted this added investment would not be enough to revive and sustain the condition of Michigan's roads, bridges, and transit over the long term, let alone prepare Michigan for the 21st century.

The past decade of piecemeal approaches to transportation funding, at both the state and the federal level, have undermined our state's progress.

> *The condition of Michigan's transportation systems did not erode overnight, but over several decades.*

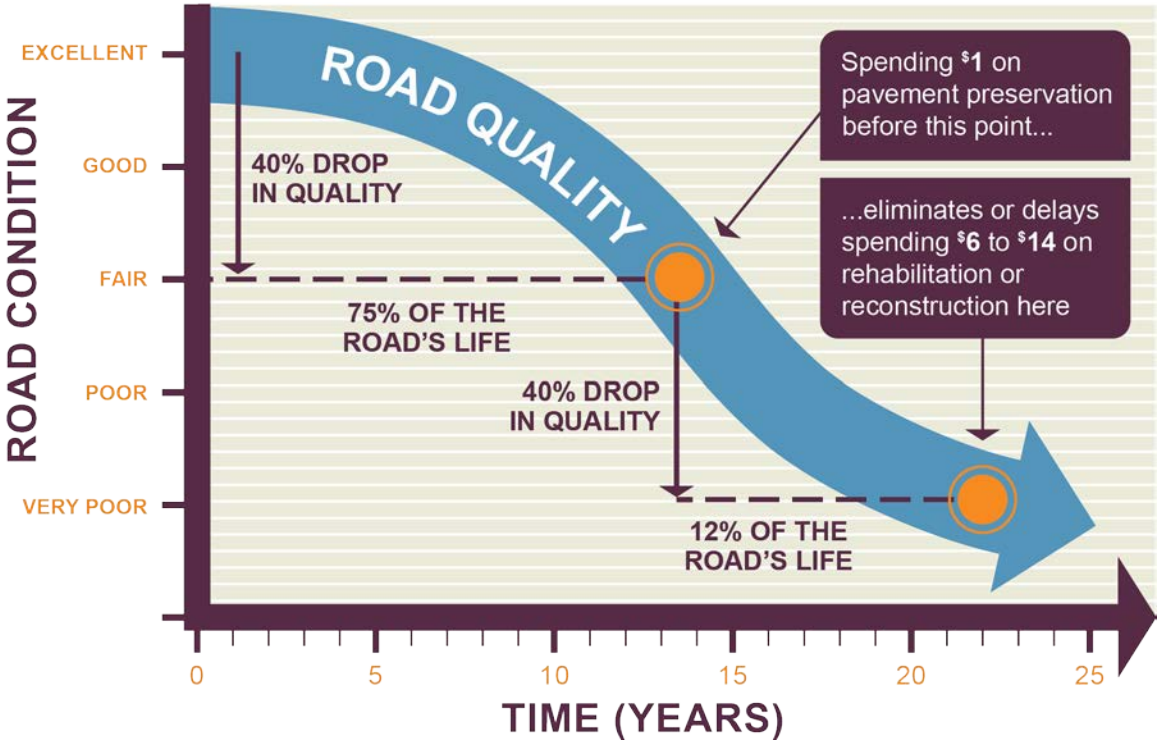
[20] In November 2015, the Michigan Legislature enacted a package of bills that provide new revenue for transportation. Beginning in 2017, there will be $450 million of new revenue, increasing to $1.2 billion (including $600 million of general funds) by 2021.

Shifting demographics have also made it difficult for transportation systems to remain reliable and efficient. It will take several decades to bring Michigan's intermodal systems back to a state of good repair that residents, businesses and travelers can rely on.

Sustainable funding sources at the state, federal, and local level are required to halt the continuing deterioration of transportation infrastructure and allow Michigan to take advantage of 21st century technology that will provide improvements to transportation service and safety.

Investment in transportation infrastructure provides a significant economic impact. On average, every $1.00 invested in the transportation sector infrastructure has an estimated economic impact of $4.24. The sizeable economic benefits associated with infrastructure investment are not the only reason to invest. There is also a case to be made for making infrastructure improvements sooner rather than later because deferring infrastructure investment will actually make a project more expensive as the costs of infrastructure repair and or replacement increases as quality declines. As shown in Exhibit 12, spending $1 on pavement preservation when a road is in fair condition eliminates or delays spending $6 to $14 on reconstruction when it is in very poor condition.

EXHIBIT 12. Road Condition and Preservation

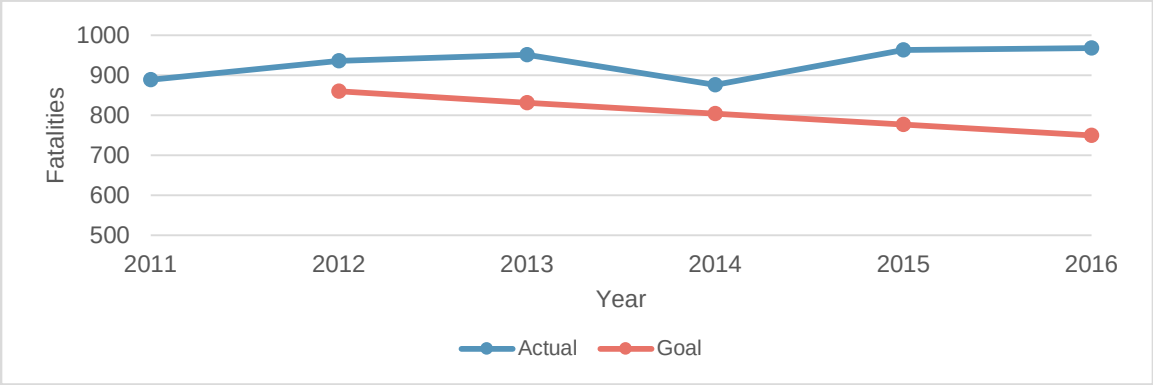


Source: AASHTO and TRIP 2009.

Value for money is important, but providing safe transportation systems is critical. As of November 29, 2016, there were 968 traffic deaths in Michigan in 2016 (MDOT n.d.). It is estimated that there will be more than 1,000 fatalities by the end of 2016. In addition to human suffering, fatalities and injuries cost Michigan nearly $9.6 billion in 2010 (U.S. DOT NHTSA 2015). Michigan currently has an active program titled, Toward Zero Deaths, that works to reduce traffic fatalities. The graph

below shows historical and current statewide motor vehicle fatalities—it is clear that without the proper investment in road and bridge condition, we are headed in the wrong direction.

EXHIBIT 13. Statewide Fatalities



Note: Actual projection expected to reach more than 1,000 deaths by the end of 2016.
Source: MDOT n.d.

The following recommendations outline ways to improve investment in Michigan's transportation infrastructure, while dramatically improving public safety through improved road and bridge conditions and the use of futuristic technology. These proposals offer a variety of high-quality, interconnected, efficient, and safe travel choices to improve the quality of life for all residents and Michigan's businesses. Michigan is poised to lead the development and deployment of 21st century transportation technologies, including intelligent vehicle technology and a robust intermodal transportation system. These recommendations chart a visionary path for Michigan's transportation planning, funding, and delivery systems to ensure safe, reliable, efficient, and cost-effective solutions.

Recommendations are organized by mode of transportation, future innovations, and sustainable funding opportunities.

Recommendations Key

EP	Economic Prosperity	HE	A Healthy Environment
QS	Reliable, High-quality Service	VI	Value for Investment
0-2	Implementation Start (in years)	0-2	Implementation Complete (in years)

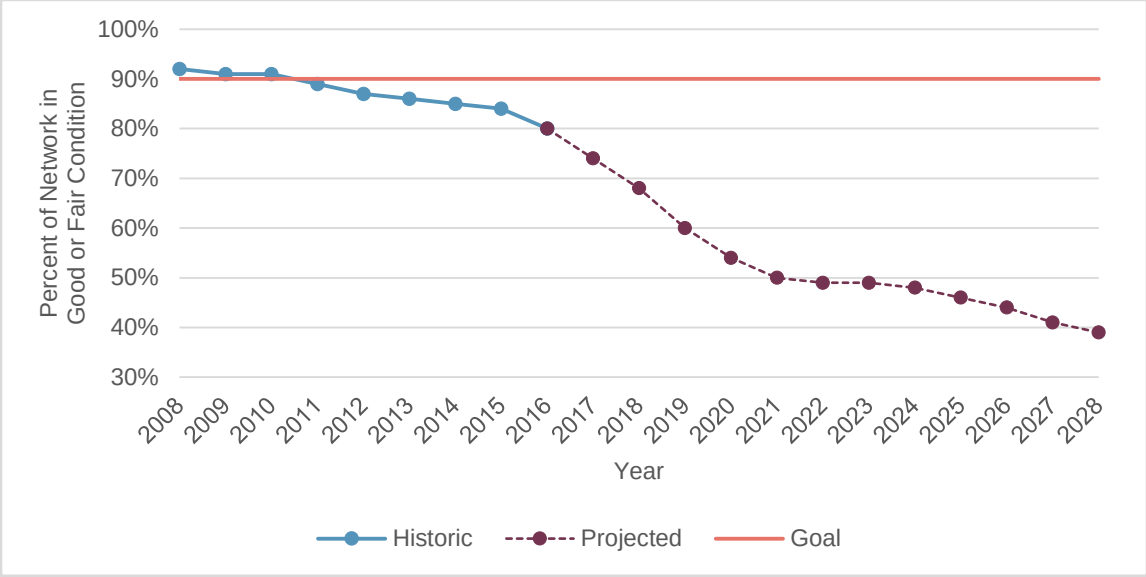
6.1 ROADS/BRIDGES – ROAD AND BRIDGE CONDITIONS

Where is Michigan today?

In 2007, Michigan achieved clear goals that were set for the condition of roads and bridges (90 percent good/fair), but has not been able to sustain that high level of performance since. While transportation agencies are certainly very grateful for the legislative action that will provide some new state funding for transportation beginning in 2017, the reality is that the need for investment, particularly in roads and bridges, will not be fully addressed by that action. Beginning in 2017, $450 million in new revenue from state gas taxes and vehicle registration fees will be distributed to more than 700 transportation agencies. That number rises to $600 million in 2018, but the full distribution of the entire $1.2 billion revenue package will not occur until 2021. Michigan's asset management agencies predict that without increased investment, road and bridge conditions will continue to deteriorate, and the conversation that has surrounded transportation funding in Michigan will remain necessary.

Michigan has 122,000 miles of roads, the ninth largest road network in the nation. Of all those miles, 36,500 miles are federally recognized as the most highly used portion of the system, carrying 96 percent of commercial traffic and 89 percent of all traffic in Michigan. It is imperative that Michigan repair these vital roads and bridges to ensure the safety of the traveling public.

EXHIBIT 14. Historical/Projected Trunkline Pavement Condition



Source: MDOT 2012.

Additional investment in highways and bridges will not only improve the condition of the systems that we use every day, it will also provide significant financial and safety benefits to the state and the public. Investing an additional $1.6 billion in state highway and bridge infrastructure annually would create or sustain 18,000 jobs, increase the gross state product by $1.5 billion annually, increase real personal income by $1.1 billion annually, and decrease economic loss due to fatalities.

What does a 21st century Michigan look like?

Michigan's road and bridge conditions are 95 percent good/fair for Interstates and principal arteries; 85 percent good/fair for other state highways; and 85 percent good/fair for county primary and major city roads. Michigan has the safest roads in the nation, striving for zero traffic fatalities in the next 30 to 50 years. More robust investment in transportation from new and sustainable sources of funding preserves vital infrastructure that is integral to Michigan's economic success. Appropriate reinvestment in the most highly used roads and bridges ensures a safe and reliable transportation system, supports new business growth and development, expands international commerce, and bolsters Michigan's manufacturing, tourism, and agriculture industries.

6.1.1 The Michigan Infrastructure Council and transportation agencies should work with the Michigan Legislature to identify and enact revenue options that will provide predictable and sustainable funding sufficient to return most higher level roads and bridges to good or fair condition. Given the magnitude of the need, a strong combination of state, federal and local funding will be needed to adequately solve the problem.

Estimated investment needed: $1 billion of state funds annually for Interstate and U.S. freeways and bridges; $600 million of state funds annually for other state highways and bridges; $600 million of state funds annually for other highly used roads and bridges under local jurisdiction[21]

EP 0-2 11+

[21] Estimates of investment required for state highways were generated by MDOT; estimates for roads under local jurisdiction were derived from "Michigan's Roads Crisis: How Much Will It Cost to Maintain Our Roads and Bridges? 2014 Update;" both estimates take into account the revenue from the new funding package.

6.2 ROADS/BRIDGES – BRIDGES AND CULVERTS

Where is Michigan today?

Michigan roads have hundreds of thousands of bridges, culverts, and other drainage infrastructure components, many of which are decades old and on the verge of failure. State agencies have identified at least 65,000 points throughout the state where Michigan's road and rail systems intersect with surface water systems. Many of these points may be undersized for current and future watershed conditions, increasing the potential for flooding. When flooding occurs or structures fail there are safety, environmental, economic, and social impacts.

What does a 21st century Michigan look like?

Michigan's road and rail systems are designed to ensure that rivers, streams, and drains remain free flowing to protect ecosystem health, as well as investments in transportation infrastructure.

How do we get there?

6.2.1 State, county, and local agencies should design and install road-stream crossings to ensure safe pedestrian and vehicle passage, and natural stream function and aquatic organism passage. Design approaches should match the life cycle of the road-stream crossing to future watershed conditions.

Estimated investment needed: $40 million of state funds

EP 6-10 11+

6.2.2 MDOT and MDNR should continue to follow state and federal required inspection processes for bridges, as well as hydraulic and drainage analysis for culverts. These agencies should complete regular statewide inspections of all in-service bridges to determine and record conditions using the newest available technologies and techniques. They should support research of new materials and accelerated processes for design and construction of bridges to maximize the life of structures while improving safety and reducing overall life-cycle costs. MDOT and MDNR should use asset management and preventative maintenance to extend the life of bridges.

Estimated investment needed: Will utilize existing staff resources

EP 3-5 6-10

6.2.3 MDOT should work with local road agencies to encourage inspection of culverts greater than five feet in diameter at least once every five years. Inspection results should be included in local road agencies' asset management plans.[22]

Estimated investment needed: $4 million of state funds annually

EP 3-5 6-10

6.2.4 MDOT should undertake a pilot project to inspect and document all culverts running under state trunkline highways in one county, for the purpose of assessing data collection costs for a statewide asset management inventory of state highway culverts.

Estimated investment needed: Will utilize existing staff resources

EP 0-2 0-2

6.3 ROADS/BRIDGES – SEASONAL WEIGHT RESTRICTIONS

Where is Michigan today?

Michigan's paved roads are made of concrete or asphalt, and while they may appear solid, they can become particularly fragile during the spring months, when frost is leaving the ground. As frost melts beneath a paved road, the road bed can become saturated with water, making it unstable and susceptible to damage by trucks and heavy equipment.

To protect paved roads during the spring, Michigan road agencies have seasonal weight restrictions that limit heavy loads. MDOT and local road agencies may have different load restrictions based on the structural capacity of their roads. The depth of frost governs the restriction time frame. Restrictions are lifted when the frost is completely gone.

Trucking companies can respond to weight restrictions in a variety of ways—by reducing loads, adding trips, traveling more complicated routes, delaying deliveries, or even shutting down and laying off workers until restrictions are lifted. All of these responses drive up transportation costs.[23]

Every day that can be subtracted from seasonal load and speed restrictions saves shippers money, but a few days' error in restricting loads can cause significant pavement damage, which costs taxpayers money. Because of different weather and soil conditions, there will always be variety in the duration of weight restrictions across the state, but MDOT uses automated ground-temperature collection coupled with statistical models of frost behavior to more precisely minimize the imposition

[22] Inspection costs are estimated at between $300 and $350 per culvert.
[23] According to a 2015 survey by the American Transportation Research Institute, the average marginal cost of operating a truck is $63.70 per hour.

of spring weight restrictions. Local road agencies typically follow MDOT's recommendations, but are not obligated to do so.

What does a 21st century Michigan look like?

Michigan's road agencies collaborate to develop consistent regional standards for identifying times when the roads can be reopened to transport goods by truck. Advances in technology allow transportation agencies to collect and report real-time data on weather and temperature conditions that has helped minimize the impact of seasonal weight restrictions. Based on asset management and economic priorities, a robust all-season network of roads adequately serves shippers.

How do we get there?

6.3.1 MDOT and local road agencies should work together to improve regional consistency and the permitting process in order to create coordinated seasonal weight restriction systems between road agencies.

Estimated investment needed: Will utilize existing staff resources

EP 3-5 6-10

6.3.2 Based upon economic considerations, MDOT and local communities should evaluate and prioritize the need to convert additional roads to all-season conditions. Using the statewide asset management database (as referenced in Chapter 3), and in coordination with public agencies and private utilities, plan and fund the conversions to all-season roads in a timely and strategic manner.

Estimated investment needed: $450,000 per lane mile, for the incremental additional cost of reconstructing as an all-season road rather than a seasonally-restricted road

EP 6-10 11+

6.4 TRANSIT, PASSENGER, AND FREIGHT RAIL

Where is Michigan today?

Michigan's bus transit, passenger rail, and freight rail systems are part of an intermodal transportation system with a diverse mix of facilities in both public and private ownership. All three of these systems compete for state funding from the Comprehensive Transportation Fund (CTF); therefore, improvements in any one mode come at the expense of the others. Each of these three modes is addressed below:

- **Bus transit:** Michigan's bus transit system is diverse, with 79 public transit agencies, including 20 urban transit organizations and 38 specialized transportation providers. Residents make more than 100 million trips annually on local public bus transit in Michigan.

Operation of bus transit systems contributes an estimated $740 million to the economy each year and support over 5,000 jobs annually.

Transit provides mobility for those who do not own a car or cannot drive. Bus transit improves safety and air quality, reduces road traffic, and encourages economic development. Transit service in many Michigan communities needs improvement to better serve riders, such as county-wide service, Saturday/Sunday service, or service that crosses county lines. Investment is needed to ensure buses remain in a state of good repair to provide safe, efficient transit service.

There are also a number of efforts to expand transit service in urban areas. Unique partnerships can assist in these efforts, such as the QLine in Detroit, which is primarily privately funded. The bus rapid transit (BRT) service in Grand Rapids, along with other BRT systems nationwide, serve as a model for the four-county region of Southeast Michigan, and Lansing.

National models have shown that every dollar invested in light rail or rapid transit can return up to six dollars in economic benefits, including local economic development around transit stops.

Operations and capital improvements compete with other funding requirements from the CTF. The recent Southeast Michigan four-county RTA ballot initiative narrowly failed voter approval. This proposal would have provided Southeast Michigan with a long-term solution for regional transit, any publicly funded transit expansion in Michigan comes at the expense of all other transit in Michigan.

- **Intercity passenger rail:** In contrast to bus transit systems that are largely operated locally, intercity passenger rail service is provided by Amtrak, a federal entity. As required by federal law, the State of Michigan provides support for Amtrak passenger rail service from the CTF. Michigan also contracts with Amtrak for the operation of trains that add or extend service to three routes, linking Detroit/Pontiac, Grand Rapids, and Port Huron with Chicago. In 2012, MDOT acquired 135 miles of passenger rail track between Kalamazoo and Dearborn, which are being improved to expand existing 110-mile-per-hour (mph) passenger rail service in the Chicago-Detroit corridor. Improvements underway include double-tracking portions of the corridor; track rehabilitation; installation of new signals and positive train controls; station renovation, construction, or relocation in Pontiac, Troy, Dearborn, Jackson, and Battle Creek; and a multistate partnership to acquire new locomotives and rail cars. New stations have also been constructed in East Lansing and Grand Rapids to upgrade passenger service in other rail corridors.

  Population, employment, and income across Midwestern states are projected to grow over the long term, and this growth is expected to result in an increase in intercity travel throughout the Midwest. The lack of existing passenger rail capacity and the sharing of track between freight and passenger trains currently create operational problems that restrict both mobility and economic development.

- **Freight rail:** Most of Michigan's freight rail assets are privately owned and maintained, and most investments are made by private companies. The freight rail system includes approximately 3,600 miles of tracks across the state, operated by 24 freight railroads, including four Class I railroads, two regional railroads, and 15 short-line railroads. MDOT oversees approximately 665 miles of State-owned rail lines.

  Because most rail assets are privately held, the full need for additional investment is not known. MDOT uses CTF dollars to preserve state-owned rail lines, and provide freight economic development loans that encourage private investment. MDOT also provides dedicated Michigan Transportation Fund (MTF) and federal dollars to assist with safety enhancements at railroad crossings that benefit both railroads and road users. The ratio of public and private funding for rail projects varies depending on the project.

  The Commission's vision to reinvent Michigan as a center of international trade requires developing freight infrastructure that will meet the modern-day demands of a globalized economy. MDOT competes for federal funds to assist with rail capital enhancements that will improve freight rail services. For example, the State of Michigan is taking the lead in a partnership with the four Class I railroads to develop the Detroit Intermodal Freight Terminal (DIFT), which will consolidate and expand the intermodal terminal capacity serving Southeast Michigan. For this $539 million project, the State will provide 60 percent of the funding, with the private railroads providing 40 percent. The project, which will take several years to complete, will improve junction points among the railroads and provide improved access between the intermodal terminals and the highway system. Improved facilities and increased intermodal traffic will result in fewer long-distance truck trips on Michigan's highway system.

What does a 21st century Michigan look like?

Michigan has a reliable and safe rail system, consisting of an integrated freight network that serves a global economy, higher speed passenger rail, and a robust transit network that meets the needs of both urban and rural communities throughout the state.

- **Bus transit:** The four-county area in Southeast Michigan has a BRT solution. Transit systems are more reliable and provide a broader range of service, including county-wide, cross-county, and Saturday/Sunday service where appropriate. Buses are maintained in a state of good repair, emissions are reduced with clean diesel buses, repair costs are reduced, and reliability is increased. Urban areas of the state are served by BRT or commuter rail. Allowing BRT to have signal priority at intersections will make it a more efficient alternative, and reduce time between destinations. Greater use of mobile technology for transit systems allows more passengers easy access to information regarding the timing. These safe, efficient and cost-effective transit systems attract more riders.
- **Intercity passenger rail:** Rail service provides 110-mph service throughout the Detroit-Chicago corridor, and MDOT works with the railroads to install positive train control across the state, and initiates commuter rail service where appropriate, increasing ridership, creating jobs, and bringing economic opportunities and new talent to Michigan.

Good transit systems promote residential density and economic development along their corridors. Regional transit systems provide mobility and employment access to residents across a given region. Improvements to passenger rail service support economic development near rail stations, spurring investment that serves both existing neighborhoods and areas targeted for a transition from industrial uses to urban infill development. The introduction of passenger stations in existing or planned commercial settings strengthen business and development opportunities. Transit services, particularly in Michigan's large urbanized areas, are expanded to produce 21st century service, and Michigan cities will use these investments to compete nationally and globally.

- **Rail freight:** Investment in intermodal projects such as the DIFT in Southeast Michigan increases capacity and interconnectivity and helps provide for future intermodal freight demand to support Michigan's economic competitiveness. The DIFT creates 4,500 permanent jobs in Michigan, with 2,360 of those in the Detroit area, along with over 600 construction jobs in the peak construction year. Additionally, there is increased government revenue of more than $1 billion (2008 dollars) by 2030 as a result of increased business activity. Efficiencies and reliability are improved, therefore reducing operating costs to shippers, air pollution, and crashes (MDOT 2010).

  In rural areas like Northern Michigan and the Upper Peninsula, freight rail remains a critical option, particularly for exporting agricultural products and timber. The State preserves rail access in these underserved communities by working with private sector railroads to preserve and improve rail.

How do we get there?

6.4.1 The Michigan Legislature should enact alternative sources for transit funding or provide additional funding for the CTF to encourage robust bus transit, passenger rail, and rail freight systems in Michigan. Increasing the amount of available match funds from the State of Michigan will also allow transit agencies to seek greater federal capital funding.

Estimated investment needed: $430 million per year of state funds from the CTF

EP 0-2 6-10

6.4.2 Transit agencies should integrate new technology into their transit services and work with MDOT to support their efforts to modernize their technology systems.

EP 0-2 6-10

6.4.3 MDOT should continue to work in partnership with the railroads to develop components of the DIFT as warranted by increasing volumes of railroad traffic.

Estimated investment needed: A one-time investment of $539 million of public ($323 million) and private ($216 million) funding over several years

EP 0-2 11+

6.4.4 MDOT should identify current and future passenger and freight rail service needs and gaps in Michigan as part of its effort to update the federally required State Rail Plan and State Freight Plan.

Estimated investment needed: Will utilize existing MDOT staff resources

EP 0-2 3-5

6.5 MARINE FREIGHT – SOO LOCKS

Where is Michigan today?

The Soo Locks are a critical part of the freight transportation infrastructure of the Great Lakes region. Located on the St. Mary's River between Michigan and Ontario, the Soo Locks are owned and operated by the U.S. Army Corps of Engineers and provide a vital link between Lake Superior, the other Great Lakes, and the rest of the world. Nearly 4,000 American, Canadian, and foreign flag vessels pass through the locks annually, carrying more than 65 million tons of iron ore, stone, low-sulfur coal, grain, cement, and other cargoes. Approximately 80 percent of the raw materials used by U.S. steel manufacturers, as well as much of the low-sulfur coal used by regional electric utilities, pass through the locks. The nearly 50-year-old Poe Lock is the only lock capable of accommodating the largest Great Lakes vessels that carry 70 percent of all cargo passing through the locks and account for 3.2 percent of the total U.S. GDP (U.S. Department of Homeland Security October 2015; Kowall 2016). This critical reliance on a 50-year old single lock is unwise and unsustainable.

The U.S. Department of Homeland Security recently completed an analysis of the impacts resulting from a six-month unscheduled closure of the Poe Lock. The findings are staggering: there would be a complete shutdown of Great Lakes steel production; 75 percent of U.S. integrated steel production would cease; 80 percent of iron ore mining would cease; and nearly 100 percent of the North American appliance, auto, construction equipment, farm equipment, mining equipment, and railcar manufacturing would cease. There would be 11 million job losses in the U.S., plus more in

Canada and Mexico, and a $1.1 trillion decrease in GDP (U.S. Department of Homeland Security October 2015). This would likely result in widespread bankruptcies and a recession.

Today, the construction of the new lock has been and remains stalled. In 1986, Congress authorized construction of a second large lock equal in size to the Poe Lock in order to provide the necessary capacity and redundancy. The new lock will be constructed on the site of two obsolete locks built during World War I that are now permanently closed. Except for some limited preliminary construction in 2009–2010, the project has stalled due to lack of federal funding. As originally authorized, the project required a nonfederal cost share of approximately 35 percent. Subsequent legislation in 2007 removed that requirement, and the project is now authorized for construction at full federal expense. A remaining obstacle is a low benefit-to-cost estimate for the project, the result of flawed assumptions in the original methodology. The U.S. Army Corps of Engineers is currently conducting an economic reevaluation based on more accurate assumptions. The study is scheduled to be completed in December 2017 and is expected to produce a significantly higher benefit-to-cost ratio, which will allow the Chief of Engineers to formally advance the project to Congress for funding.

What does a 21st century Michigan look like?

The Governor, Michigan's Congressional delegation, Michigan Legislature, and private stakeholders impacted by the Soo Locks work together to demonstrate the importance to national commerce of the new lock. As a result, a new lock is constructed with dimensions equal to the existing Poe Lock, providing long-term capacity, reliability, and redundancy for operation of the system. The potential for a long-term loss of 11 million jobs nationally and $1.1 trillion hit to the U.S. economy is eliminated. As a vital component of the Great Lakes' regional transportation system, the Soo Locks infrastructure is maintained and updated to accommodate commerce needs.

How do we get there?

6.5.1 The Michigan Legislature should pass a resolution to urge the federal government to expedite completion of the Economic Reevaluation Report currently being prepared by the U.S. Army Corps of Engineers and to provide the necessary funding to construct the new lock.

Estimated investment needed: Approximately $580 million of federal funding invested over several years

Implementation: Report should begin in the immediate term (0-2 years) and be completed in the short term (3-5 years)[24]

EP 0-2 3-5

[24] New lock construction should be completed in the medium to long term (6-11+ years)

6.6 MARINE FREIGHT – PORT AUTHORITY LANDSIDE IMPROVEMENTS

Where is Michigan today?

Michigan's Port Authority Act (P.A. 639 of 1978) authorizes the establishment of port authorities in cities and counties. To date, the Detroit/Wayne County Port Authority is the only such authority established under this act. Currently, the act defines port facilities as various infrastructure components related to marine transportation, which are specifically owned by the port authority. This ownership provision is viewed as a constraint to further develop a port's commercial or recreational maritime activities, because it limits the port authority's ability to work with landside private sector partners. In 2014, there were 29 active cargo ports that handled 68.1million tons of cargo (MDOT 2015).

What does a 21st century Michigan look like?

Public port authorities help develop the marine transportation system that serves Michigan's businesses and industries. Port authorities work in partnership with the private sector to address the needs of commerce, without jeopardizing existing private sector operations or investments. Michigan sustains or increases the commercial activity generated by its ports each year.

How do we get there?

6.6.1 The Michigan Legislature should consider legislation that provides port authorities with the flexibility to form private sector partnerships for the purposes of developing contiguous and adjacent landside infrastructure consistent with the local vision for the port.

EP 0-2 0-2

6.7 MARINE FREIGHT – ROUTINE PORT MAINTENANCE

Where is Michigan today?

Maintenance of Michigan's port infrastructure is critical for the efficient operation of our intermodal transportation system. There are two major components of port infrastructure: onshore marine terminal facilities, and the in-water navigation channels that serve them. With only a few exceptions, the vast majority of terminals in Michigan are owned and operated by private companies, which are responsible for their maintenance.

Many of Michigan's commercial ports are served by federal navigation channels that were authorized by Congress. The U.S. Army Corps of Engineers is responsible for maintaining these channels, typically by dredging them to their authorized depths, with funds from the Harbor Maintenance Trust Fund. For the past few decades, many of these channels have not been

maintained at their full authorized dimensions because the federal administration has only released about half of the taxes collected and deposited into the trust fund. Recent federal legislation will eventually ensure that all the taxes collected will be used for their intended purpose, and maintenance of the federal channels should no longer be a major issue.

These federal navigation channels do not extend all the way to the shore, and individual terminal owners are responsible for dredging at their own docks and out to the federal channels. If channel dimensions are not maintained, vessels must be light loaded, or worse, become commercially unusable.

While the U.S. Army Corps of Engineers annually assesses the dredging needs for the federal channels, there is a lack of information regarding maintenance needs at the docks themselves as well as in the private navigation channels serving those docks. The Conference of Great Lakes and St. Lawrence Governors and Premiers established the Maritime Task Force which completed a first-ever maritime transportation system asset inventory. While the conference does not have the authority to inspect the infrastructure at private marine terminals, it does have an interest in understanding the total needs for the marine transportation system. Toward that end, the conference established the Maritime Data Working Group to update the existing marine transportation system asset inventory, identify available data and data gaps, and document public and private sector investments. While the dredging needs for public navigation channels are readily identifiable, those for private docks will likely remain incomplete. Data that are ultimately collected can be used to guide future public policy and funding decisions to increase the efficiency of the freight transportation system.

What does a 21st century Michigan look like?

Michigan has an extensive system of congressionally authorized federal navigation channels that were constructed and are maintained by the U.S. Army Corps of Engineers. All public channels are maintained at their congressionally authorized depth. The private sector has developed most of the landside port infrastructure, including marine terminals, based on the existence of these public navigation channels. The public channels are properly maintained in order to preserve continued operations of Michigan's commercial ports.

How do we get there?

6.7.1 The Office of the Governor, Michigan's Congressional delegation, and the Michigan Legislature should encourage Congress to provide the necessary funds and encourage the U.S. Army Corps of Engineers to prioritize fully maintaining the federal navigation channels at their congressionally authorized dimensions to ensure that port conditions do not deteriorate.

Estimated investment needed: Will utilize existing staff resources

HE 0-2

6.7.2 The Conference of Great Lakes and St. Lawrence Governors and Premiers should specifically analyze the dredging needs for individual docks and nonfederal navigation channels, including privately owned facilities to the greatest degree possible.

Estimated investment needed: Will utilize existing staff resources

HE 0-2

6.7.3 MDOT should encourage the appropriate state, county, and city road agencies to work together to perform infrastructure assessments that would evaluate the needs of "last mile" roads that serve as connectors linking port facilities with the highway system.

Estimated investment needed: Will utilize existing MDOT staff resources

HE 0-2

6.8 AVIATION

Where is Michigan today?

Michigan's aviation infrastructure is supported through a complex system of federal, state, and local partnerships and funding mechanisms. While most view Michigan's aviation infrastructure simply as one of the 18 commercial service airports in cities like Detroit, Grand Rapids, and Flint, the state's other 217 general aviation airports and public heliports contribute to a robust and vibrant overall aviation system able to connect travelers, businesses, emergency responders, and others within minutes.

The State of Michigan continually monitors pavement condition using a measure termed Pavement Condition Index and is described on a range of 0 or failed pavement to 100 or excellent pavement. The overall PCI for the state's most utilized airports is 66. While airport pavements are critical and continually monitored, and maintained they are supplemented by unseen systems like weather observation stations, navigational aids, and instrument landing systems which aid in the safe arrival and departure of aircraft.

The continued rise in operating, maintenance, and construction costs coupled with major airlines reducing service to rural areas has increased the financial burden on local municipalities, which in most cases, own their airport. Programs like the Federal Aviation Administration Airport Improvement Program and the State of Michigan's Airport Improvement Program support local municipalities that require assistance in maintaining their existing infrastructure.

In recent years and in response to reduced revenue collections, the Michigan Legislature sought to increase funds available for airport improvements by dedicating a portion of sales tax revenue to the State Aeronautics Fund and MDOT's airport grant programs. This additional revenue helps support small community airports that serve as a lifeline to major hubs, and allows larger airports to attract additional federal grants.

What does a 21st century Michigan look like?

Michigan's airport infrastructure is included in the statewide asset management database. Michigan's future aviation system finds solutions for many of the fiscal challenges that exist today including decreased local resources available for airport improvement. The goal is to continue growing aviation's annual $10 billion contribution to the economy (MDOT 2016).

Additionally, airports are faced with new challenges, including larger and heavier aircraft at the large commercial service airports and increased very light jet (VLJ) business and personal aircraft at the general aviation airports. The proliferation of unmanned aerial systems, some of which can carry a large payload and possibly passengers, may also pose unprecedented challenges and opportunities for community airports across the state.

How do we get there?

6.8.1 MDOT will complete a comprehensive assessment of general aviation needs across Michigan as part of the ongoing Michigan Airport System Plan update, as well as examine existing capacity, use, costs, and revenues the State receives in order to determine whether the system of airports properly supports the future needs of Michigan communities.

Estimated investment needed: A one-time cost of $425,000 to update the plan, using state funds[25]

QS 0-2 0-2

6.9 INTELLIGENT VEHICLE TECHNOLOGY

Where is Michigan today?

Michigan is the global leader in intelligent vehicle[26] technology that includes connected, autonomous, and automated technologies. Michigan is currently vying for federal designation as the nation's testing facility for intelligent vehicle technology, but it is in direct competition with California's Silicon Valley and other centers of innovation. Planet M, an initiative run by the MEDC and MDOT, is working to make the state the global center of mobility and innovative transportation technology. In partnership with numerous auto manufacturing companies, technology companies, private stakeholders, and Michigan universities, the State is working to lead the nation in advancing this technology. Planet M is Michigan's initiative to advance intelligent vehicle technology, such as the U.S. Department of Technology's testing facility in Oakland County, a deployment in the city of Detroit, and the Safety Pilot Model Deployment/Ann Arbor Connected Vehicle Test Environment. MDOT also partnered with the University of Michigan to develop the Mcity Test Facility and to

[25] A consultant contract is already in place to develop the Michigan Airport System Plan.

[26] "Intelligent vehicle technology" refers to connected, autonomous, or automated vehicle technology throughout this chapter.

continue development of the American Center for Mobility at the site of the former Willow Run Ford Motor Company manufacturing complex in Ypsilanti.

There are implications for infrastructure investment that accompany these new technologies, but the industry is so new, and advancing so rapidly, that it is difficult to identify all of them with any certainty. However, Michigan remains committed to keeping its global leadership position.

What does a 21st century Michigan look like?

Advancements in intelligent vehicle technology optimize the movement of people and goods and dramatically increase safety, supporting the Toward Zero Deaths program. Intelligent vehicles are the most transformative transportation advancement in generations, reshaping 21st century transportation. The technology changes cities, commuting, the freight industry, and even the vehicle ownership model. Intelligent vehicle technology is the key to Michigan achieving its zero fatality goal in the next 30 to 50 years. Michigan is the world leader of this technology transformation.

Intelligent vehicle technology is part of a larger discussion about the Internet of Things (IoT), a system of interrelated objects that can transfer information over a network without requiring human-to-human or human-to-computer interaction (see Chapter 4). The implications of the IoT for the transportation industry are significant; it transforms the way manufacturers make vehicles and requires a change in how transportation agencies deliver services to meet the ever-changing needs of 21st century mobility. Advancements in technology dramatically increase safety by eliminating human error and environmental risks, and provide mobility to a greater portion of the population, including the elderly, disabled, and children. These advancements also shape Michigan's economy. As a focal point of the global automotive industry, Michigan gains much from new vehicle research, development, and manufacturing.

How do we get there?

6.9.1 The Michigan Legislature, Governor, and relevant stakeholders should pass, sign, and support the implementation of currently proposed legislation that will enable Michigan to stay at the forefront of the intelligent vehicle industry.

QS 0-2 0-2

6.9.2 MDOT and the MEDC should work with auto manufacturing companies, technology companies, private stakeholders, and Michigan universities to support the development of intelligent vehicle through investment in research, and develop a plan to invest in the installation of new technology.

Estimated investment needed: Will utilize existing staff resources

QS 0-2 0-2

6.9.3 The Governor's Office and MDOT should promote Michigan as the focal point of the global intelligent vehicle industry.

Estimated investment needed: $20 million of state funds per year for continued installation and implementation of intelligent vehicle technology

QS 0-2

6.9.4 MDOT and the MEDC should leverage unique partnerships between governmental agencies, companies, universities, and other organizations to advance Michigan's intelligent vehicle industry.

Estimated investment needed: $2 million of state funds for staff time and consultant contract

QS 0-2

6.9.5 The Michigan Infrastructure Council (see Chapter 3) should include an emerging technologies group that is tasked with research, education, and coordination of implementing innovative technologies that impact infrastructure planning and delivery, particularly the emerging autonomous vehicle industry.

Estimated investment needed: Will utilize existing MDOT staff resources or consultant contract

QS 0-2

6.10 SIGNALIZED INTERSECTION TECHNOLOGY

Where is Michigan today?

Traffic congestion is prevalent on many arterial corridors in Michigan. Since traffic signals serve as the primary points of delay along these routes, improving traffic signal efficiency offers the greatest potential for reducing motorist delay and increasing safety. Much of Michigan's traffic signal infrastructure is antiquated, particularly on county and city arterial networks. While traffic signal modernization is occurring throughout the state, there are hundreds of inefficient traffic signals still in operation.

What does a 21st century Michigan look like?

Recognizing that we cannot build our way out of congestion, Michigan improves the operation of what we have—without adding lanes. This is particularly relevant in urban areas where signalized arterial corridors are vital for moving traffic via multiple modes. Michigan leads the nation in traffic signal efficiency, maximizing the safety and capacity of signalized arterial corridors using state-of-

the-art technologies. Our traffic signals are “smarter,” in order to respond to changing traffic demands, reduce motorist delay, and increase safety. Comparatively, improved signal timing typically requires little or no infrastructure costs and produces a very high benefit to cost ratio by operating the existing system with greater efficiency and reduced congestion. For example, improvements to an 11-intersection arterial in Saint Augustine, Florida, showed reductions of 36 percent in arterial delay, 49 percent in arterial stops, and 10 percent in travel time, resulting in an annual fuel savings of 26,000 gallons and a cost savings of $1.1 million (U.S. DOT FHA 2015).

How do we get there?

6.10.1 The Michigan Infrastructure Council should work with local road agencies to elevate traffic signal infrastructure as a key asset of similar importance to road condition and bridge condition and encourage each road agency to pursue a goal to modernize and optimize the timing of 90 percent of traffic signals in congested corridors with current and emerging technologies, including signal communications, interconnectivity, transit signal priority, and vehicle detection equipment.

Estimated investment needed: These investments are included in MDOT, county, local asset management plans, and annual budgets.[27]

QS 3-5 6-10

6.11 NONMOTORIZED TRANSPORTATION

Where is Michigan today?

Many Michigan communities have undertaken robust local planning efforts to invest in nonmotorized transportation through local “complete streets”[28] policies and nonmotorized plans.

In fact, Michigan is a leader in local implementation of nonmotorized transportation innovations, like the development of rail trails that preserve railroad right-of-way for use by pedestrians and bicyclists; road diets, where four-lane roads are converted to three vehicle lanes and two bike lanes; and local Complete Streets policies.

[27] The cost to update intersection timing is currently estimated at $4,000 per signal, and the current cost to replace a signalized intersection with new technology is estimated at $150,000 per intersection (DeVries 2016).

[28] Complete streets is a transportation policy and design approach that requires streets to be planned, designed, operated, and maintained to enable safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation.

Meanwhile, MDOT and Michigan's metropolitan planning organizations collaborate on regional-level nonmotorized planning initiatives, and statewide efforts, such as the Iron Belle Trail, are improving cross-community trail linkage efforts.

While Michigan's nonmotorized transportation options continue to grow, it is still a patchwork system that can prevent nonmotorized users from making safe connections between communities. More regional coordination and cooperation is necessary to fully develop recreational tourism options that might help visitors fully utilize our world-class trail system and on-road bicycle route system.

What does a 21st century Michigan look like?

Michigan holds a top-five ranking in the development of bicycle and pedestrian infrastructure. Communities offer robust nonmotorized transportation options for both transportation and recreation purposes. Stretching from one corner of the state to the other, the completed Iron Belle Trail is one of the longest designated state trails in the nation, a recreational tourism draw that will bring visitors from across the world to enjoy Michigan's pristine forests, cool rivers, and charming towns.

Across Michigan, communities have adopted complete streets planning principles at the regional level to help knit together disparate sections of on-road bicycle facilities and off-road trail networks that were previously a patchwork system. With strong regional nonmotorized planning processes in place, communities statewide have created seamless regional nonmotorized system linkages that help people of all ages and abilities stay active and connect to jobs, housing, and services, both on bike and on foot.

How do we get there?

6.11.1 MDOT should continue to work with road agencies to encourage full integration of bicycle and pedestrian planning into transportation infrastructure planning, including by implementing performance measures that evaluate the connectivity of nonmotorized facilities.

Estimated investment needed: Will utilize existing MDOT staff resources

VI 0-2 6-10

6.11.2 MDOT and MDNR should work with regional transportation coordinating bodies to encourage or incentivize communities to coordinate their nonmotorized investments and work toward improving connectivity across communities.

Estimated investment needed: Will utilize existing staff resources

VI 0-2 6-10

6.11.3 MDOT and MDNR should study the potential to create new incentives or realign existing incentives to further enhance and encourage coordinated nonmotorized planning, both between communities and at the regional level.

Estimated investment needed: Will utilize existing staff resources

VI 0-2 3-5

6.12 RIGHT-SIZING

Where is Michigan today?

Today, we are still using the road and bridge infrastructure that was built to support the state's booming 20th century manufacturing economy. Roads and bridges that once carried thousands of cars a day may currently carry much less traffic and present opportunities for right-sizing.

Right-sizing transportation infrastructure can take many forms. Right-sizing can involve adapting underused rights-of-way to safely serve bus, rail, bicycle, and pedestrian travel, as well as cars and trucks. It can mean managing operations to maximize the effectiveness of the existing system without adding new capacity. It can include modernizing existing infrastructure, incorporating new technology, updating to meet new safety standards, and adding capacity where appropriate.

Right-sizing infrastructure can also lead to a greater emphasis on placemaking and context-sensitive solutions that serve the needs of motorists, but are still aligned with local needs, whether a large urban downtown or a small town main street.

What does a 21st century Michigan look like?

In the 21st century, transportation infrastructure needs to support a greater variety of businesses and a new, more mobile workforce. New technology and continued innovation improve not just physical infrastructure but how the assets are used. More flexible designs and new transportation technology make transportation systems and the communities they serve safer and more adaptive, as well as technologically smarter and more connected. Better, more efficient, and more coordinated transportation alternatives make Michigan more attractive to young talent and better serve the mobility needs of an aging population. These modern transportation systems also better support Michigan's growing 21st century economy.

How do we get there?

6.12.1 MDOT should identify and work with stakeholders across all modes to complete a comprehensive assessment that determines the kind of transportation infrastructure that is needed—and where—to support the industries and communities Michigan expects to have in the future.

Estimated investment needed: Will utilize existing staff resources or a consultant contract

VI 0-2 3-5

6.12.2 MDOT should continue to work with local agencies and transportation stakeholders to identify areas of the state where excess road infrastructure undermines the potential for community success, develop context sensitive solutions to transportation problems, and encourage the use of design solutions that make more effective and beneficial use of the excess road capacity.

Estimated investment needed: Will utilize existing staff resources or a consultant contract

VI 0-2

6.12.3 The Michigan Infrastructure Council should work with local agencies to encourage and incent cross-collaboration and opportunities for consolidation to provide transparent, safe, efficient, and cost-effective solutions. To encourage right-sizing metrics for safety, operations and administration are utilized resulting in low-cost, high-quality outcomes.

Estimated investment needed: Will utilize existing staff resources

VI 0-2

6.12.4 MDOT, metropolitan planning organizations, and regional planning organizations should encourage greater coordination between agencies and provide technical assistance to local agencies seeking solutions that help right-size their infrastructure.

Estimated investment needed: Will utilize existing staff resources

VI 0-2

6.13 ACT 51 REVIEW

Where is Michigan today?

Public Act 51 of 1951 governs the distribution of transportation revenue in Michigan. The legislation provided reasonable formulas for the distribution of transportation revenue to state highways, county roads, and city and village streets based on the best data available to policymakers of the 1950s.

While so much has changed since 1951, Act 51 remains the formula by which transportation revenue is distributed in Michigan. There have been many amendments in the past 65 years, most notably the increase in state share to match federal funds in the late 1950s, creation of the CTF in the 1970s, the addition of the Transportation Economic Development Fund in the 1980s, and the creation of the TAMC at the start of this century. These amendments clearly reflect the times in which they were enacted.

The many amendments to Act 51 have created a complicated formula that is only fully understood by experts. Taxpayers and road users want greater transparency. Better data, as well as a greater federal emphasis on performance measurement, mean that transportation providers need to be more accountable for system performance. Technology and globalization now impact the future of transportation systems in ways that were unimaginable in 1951.

What does a 21st century Michigan look like?

Act 51 has been reviewed and updated to ensure that transportation funding is distributed in a way that serves Michigan's 21st century economy. Michigan's transportation funding mechanisms collect enough user fee revenues to preserve the system, and the State distributes fees to transportation agencies to appropriately meet needs. Road agencies across Michigan invest transportation funds to maximize public and road user benefits.

How do we get there?

6.13.1 The Michigan Infrastructure Council should work with the Michigan Legislature and transportation stakeholders to revise Act 51 to make the distribution of state transportation revenues simpler, equitable, more transparent, and more accountable, while improving system outcomes.

Estimated investment needed: Will utilize existing staff resources

VI 0-2 6-10

6.14 LOCAL REVENUE GENERATION OPTIONS

Where is Michigan today?

Counties, cities, and villages depend heavily on state aid to tend to local roads and streets. The local agency shares of the MTF awarded through the Act 51 formula were once sufficient to maintain major local streets and cover much of the cost of minor local streets as well; however, fuel tax revenues have fallen as road maintenance costs have risen.

Most cities and villages and some counties supplement state street aid with local funds. Most counties require that townships contribute to the cost of improving county local roads. For the vast majority of municipalities, property taxes are the only locally controlled tax available for additional funding. Local funds may come from general purpose revenues or from a dedicated roads millage.

Using property taxes—including General Fund operating revenue or dedicated road millages—to fund local transportation infrastructure is problematic for several reasons. For example, some communities had large declines in taxable value during the recession or owing to outmigration, and the constitution limits the rate at which revenues recover with growth in the economy. Additionally, property taxes are paid by a community's residents and business owners and do not account for people who commute into municipalities for work or entertainment, nor do they vary with use and demand of transportation infrastructure in the way that fuel taxes and vehicle registration fees do.

What does a 21st century Michigan look like?

Transportation infrastructure has a significant impact on a community's economy, vitality, and sense of place. In the 21st century, local agencies have a greater variety of transportation revenue options. Good, reliable intermodal transportation systems attract economic development and help build strong, healthy communities for residents and businesses.

How do we get there?

6.14.1 The Michigan Legislature should enact legislation to enable new methods of generating local revenue to increase transportation investment including, but not limited to, a regional-option gasoline tax and impact fees from land developments that burden road systems or from permits for driveways that diminish traffic flow. Additional legislative considerations should include regional-option sales taxes, levied in addition to the Michigan sales tax, which are used for transit operations in many states and could be made eligible for road and transit infrastructure use as well as regional-option vehicle registration surtax. This existing authorization for the four-county Regional Transit Authority (RTA) area could be extended statewide to allow other regions to levy this surtax.

VI 0-2 11+

6.15 ROAD AND BRIDGE USER FEES

Where is Michigan today?

Road and bridge infrastructure is almost exclusively funded through a combination of user fees in the form of vehicle registration fees and federal and state gas taxes. Recent fluctuations in these once very predictable and reliable fees have exposed a need to identify and adopt a fair, stable, and predictable basis to supplement or supplant the motor fuels fee and registration tax.

The fuel taxes paid by each vehicle depend on the vehicle's fuel efficiency, and revenue falls as the overall efficiency of the vehicle fleet rises in response to new fuel-efficiency standards, or as fuel-burning vehicles are replaced by electric cars. This has been problematic for transportation agencies and will likely impact transportation revenue even more dramatically in the years to come.

Currently, other states are piloting a per-mile fee calculated by a device combining a GPS receiver with a cellular signal or dedicated radio transmitter, most notably in Washington, Oregon, and California. Such devices are in use for trucks in several European countries, as well. Although per-mile fees are more expensive to collect than fuel taxes, the hardware is regarded as proven.

What does a 21st century Michigan look like?

Michigan has a road and bridge user fee system that is equitable and serves as a stable funding source. A properly executed user fee system provides a long-term funding solution for deteriorating transportation infrastructure. The 21st century transportation system has a funding mechanism that keeps up with advancements in technology and infrastructure planning. The goal is to find a sustainable funding mechanism for transportation to replace the gas tax, which has been unreliable in the past.

How do we get there?

6.15.1 MDOT and the DTMB should pilot test a per-mile fee system (such as GPS-based) in Michigan and use that test to become the first state to distribute user fees among road jurisdictions or within regions based on the miles of travel in each jurisdiction or region.

Estimated investment needed: Between $1 million and $10 million to design and initiate the pilot, collect data and revenue, distribute revenue, and analyze the results[29]

VI 0-2 6-10

[29] Oregon is currently piloting a GPS fee of 1.5 cents per mile. The pilot is limited to 5,000 cars and light-duty commercial vehicles. Michigan's pilot project could potentially use the state vehicle fleet. As part of the pilot test, the State may refund fuel and registration taxes for vehicle owners electing to pay fees on a per-mile basis as calculated by on-board devices, including in-state truck operators.

6.16 TOLLING

Where is Michigan today?

State road user fees and federal aid are not sufficient to reconstruct the Interstate System in Michigan, nor in any other state. The cost of modernizing the system will be greater than the cost of original construction, now that it is in use and the nation's entire economy flows over it continuously. But neither Congress nor the Michigan Legislature is likely to restore the fuel tax to the purchasing power it had when the Interstate System was built.

Michigan's freeways were among the nation's first, and are now 50 to 60 years old. Reconstruction and improvement is years overdue, but due to budget constraints, most of the system is not programmed for work in the foreseeable future.

Federal law permits the use of tolls to finance infrastructure improvements in the following instances:

- Newly constructed lanes added to existing toll-free Interstate highways can be tolled so long as the facility has the same number of toll-free lanes after construction as it did before.
- The initial construction of highways, bridges, and tunnels on the Interstate System may be constructed as toll facilities, although Michigan is not contemplating the addition of new Interstate routes.
- Non-Interstate routes may be reconstructed as toll facilities. This includes routes such as US-23, US-131, M-10, etc.
- Any toll-free bridge can be reconstructed or replaced as a toll facility. Rhode Island is considering an innovative program where all Interstate bridges will be electronically tolled for commercial vehicles and the revenue used for investment in Interstate pavements and bridges.
- A range of tolling options are available under the federal Value Pricing Pilot program, as long as the tolls used on each facility vary with the level of congestion on the facility. There are a limited number of slots available for participation in this program, and while none of the slots are currently available, some are expected to open in the future.
- Toll-free Interstates can be reconstructed as toll facilities though the Interstate System Reconstruction and Rehabilitation Pilot Program (ISRRPP). Only three slots are available for participation in this program, and all three are taken now. However, it is expected that one or more slots will soon become available for other interested states, and Michigan could position itself to be assigned a slot in order to enable tolling.

Tolling under any of the existing federal authorities can only be accomplished if the Michigan Legislature authorizes the use of tolling in Michigan. Steps can be taken to secure a slot in one of the federal toll pilot programs prior to obtaining legislative approval. However, the use of toll finance needs to be authorized in state law before the state can move too far down the road to tolls.

What does a 21st century Michigan look like?

New revenue options, such as tolling, help Michigan compete with modern transportation systems across the world. Michigan is able to reconstruct freeways on a more immediate timeline, using toll-based revenue sources to cover the costs. Reasonably priced tolls cover the portion of the cost that is not covered by federal aid. Under a tolling system, the cost of freeway reconstruction would be removed from MDOT's budget, freeing existing road user fees that go to freeway reconstruction for use on the rest of Michigan's road system. Michigan's first toll road, US-23, is operational, generating $138 million a year.

How do we get there?

6.16.1 MDOT should position Michigan to apply for the Interstate System Reconstruction and Rehabilitation Pilot program (ISRRPP) if one of the openings becomes available.

Estimated investment needed: Will utilize existing staff resources to develop the application[30]

VI 0-2 3-5

6.16.2 The Michigan Legislature should enact a bill authorizing toll finance as an option for road finance in Michigan to indicate to the Federal Highway Administration that Michigan is ready to implement a pilot tolling project through the ISRRPP.

Estimated investment needed: Will utilize existing staff resources

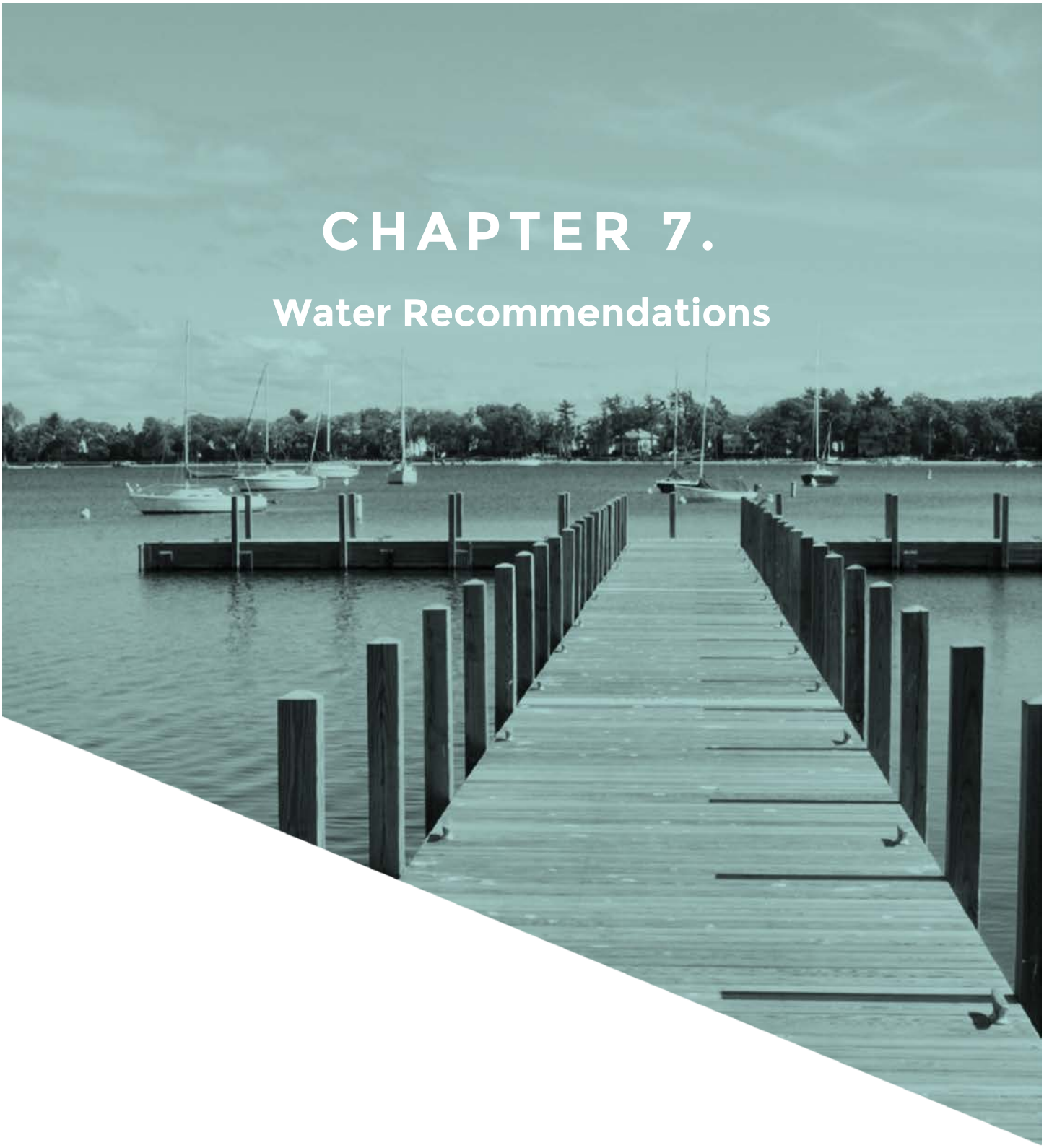
VI 0-2 6-10

6.16.3 MDOT should work with the Office of the Governor and the Michigan Legislature to encourage Michigan's Congressional delegation to authorize toll finance on existing federal-aid roads.

Estimated investment needed: Will utilize existing staff resources

VI 0-2 3-5

[30] If Michigan implemented tolling, there is an estimated $325,000 per mile of initial capital costs for electronically tolled Interstates. (That would cost about $87 million for the 270-mile length of Interstate 94 from Port Huron to New Buffalo).



CHAPTER 7.

Water Recommendations

CURRENT STATE OF MICHIGAN'S WATER INFRASTRUCTURE

Infrastructure systems in Michigan should enhance residents' quality of life, enable economic growth, and create a strong foundation for vibrant communities. In order to obtain safe, reliable, and resilient water systems in the 21st century, we must first understand the current reality of water infrastructure in Michigan:

DAMS

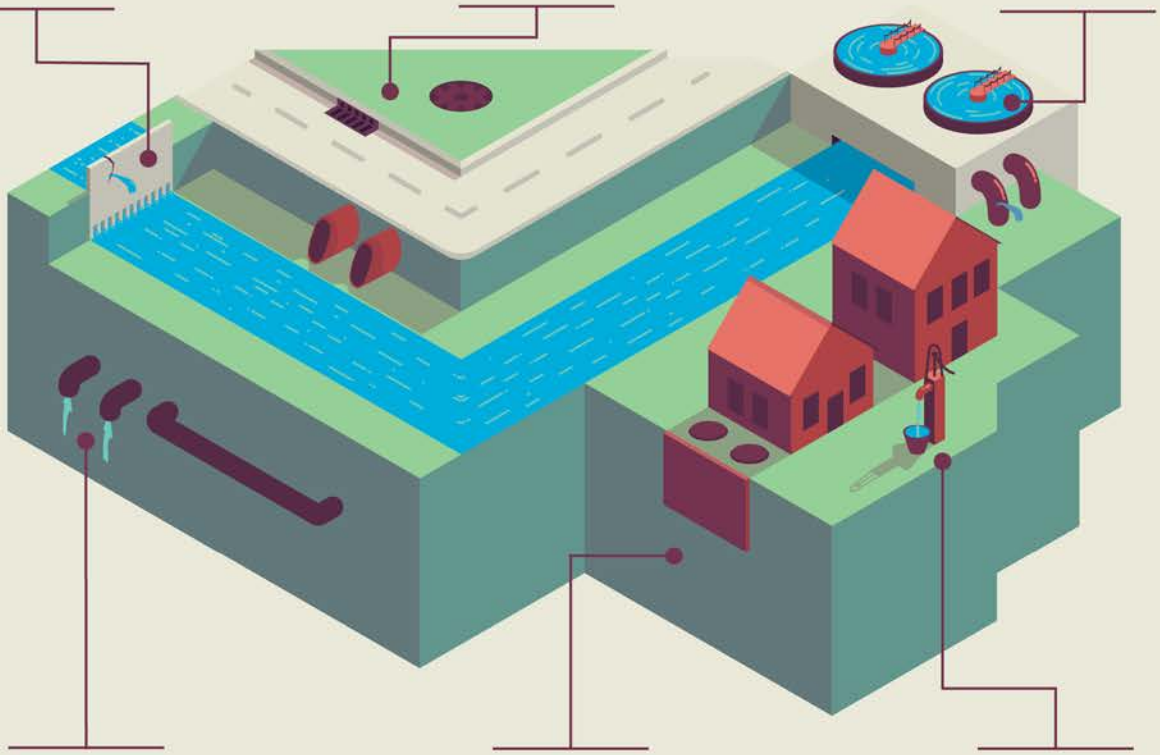
- Michigan has an estimated **2,600 dams,** many of which were built decades ago.
- More than **10 percent** of rated dams are in poor or unsatisfactory condition.

DRAINAGE SYSTEMS

- Drainage systems capture stormwater through open ditches, underground pipes, retention, and treatment systems to prevent flooding.
- **35,000 miles** of county drains serve more than **17 million acres.**
- Many communities lack sustainable funding mechanisms to support drainage systems.

MUNICIPAL WASTEWATER

- **1,080 community municipal wastewater treatment systems** serve **70 percent** of Michigan residents.
- Since 2008, an average of **5.7 billion gallons** of untreated sewage flowed into Michigan waterways.



MUNICIPAL DRINKING WATER

- **1,390 community water systems** supply **75 percent** of the state's residents and businesses.
- Most water systems were built at least **50-100 years** ago and need repair and replacement.
- Many water systems are continually underinvested.
- Drinking water systems commonly lose between **10 and 50 percent** of the drinking water they produce due to leakage.

SEPTIC SYSTEMS

- Septic systems serve **30 percent** of Michigan residents.
- Of the **1.3 million systems** in the state, at least **10 percent** are estimated to be failing. Some estimates suggest the rate may be as high as **25 percent.**
- Michigan is the only state in the country without a sanitary code, which would provide a unified standard for septic system performance, inspections, and maintenance.

PRIVATE WELLS

- Of Michigan's residents and businesses, **25 percent** obtain their water from more than **1 million private wells,** the most of any state in the nation.
- Groundwater and private wells are critical to the success of agriculture.
- Groundwater resources must be protected to ensure access to safe drinking water.

Michigan has unparalleled fresh water resources, including 11,000 inland lakes, groundwater resources, and 36,000 miles of streams, wetlands, and beaches. This vast water network—combined with our unique position within the Great Lakes, the world's largest freshwater system—provides exceptional opportunities. However, it also means we have a great responsibility to ensure Michiganders have the healthiest water system in the world.

Michigan's water system provides drinking water to millions of people, sustains unique and pristine habitats, and offers world-class recreation opportunities. Residents rely on this system for public health and environmental, recreational, and economic benefits.

> *To sustain Michigan's future, we must manage the state's water resources wisely to protect and enhance their value, including maintaining and enhancing the viability of our water, sewer, and stormwater infrastructure systems.*

Currently, Michigan has an $800 million annual gap in water and sewer infrastructure needs, compiled from decades of deferred maintenance and a lack of knowledge on the condition of our water-related assets.[31]

The Flint water crisis has placed a national spotlight on the impacts of deteriorating infrastructure, declining population and system usage, fragmented decision making, and severe underinvestment in critical water infrastructure. Flint is not alone. Other Michigan communities need water infrastructure investment to address water quality concerns, including Oscoda Township and Ann Arbor. These two communities face the complex problem of chemicals that contaminate local groundwater supplies, causing hundreds of homeowners to abandon their wells and seek alternative drinking water sources. Michigan's municipal systems need to be evaluated for defective and inadequate infrastructure to ensure long-term safety and public health.

Beyond drinking water, there are other challenges to Michigan's water infrastructure. An average of 5.7 billion gallons of raw sewage flowed into Michigan's waters between 2013 and 2014 (MDEQ October 2016 a.). Sixty-four rivers that drain 84 percent of the land area in the Lower Peninsula tested positive for human sewage (Verhougstraete et al. 2014). Nearly 25 percent of beaches experienced closures in 2015 (MDEQ May 2016). 20 percent of our beaches do not meet public health protection standards. Maintaining and updating our wastewater and stormwater infrastructure is critical to solve this problem so all Michigan residents can access these resources without risk to their health.

The Commission has recognized that a 21st century water infrastructure system begins with being able to identify the location and condition of Michigan's water, sewer, and stormwater infrastructure. This knowledge and data will identify infrastructure shortcomings to develop a long-range plan for a safe, reliable, cost-effective and efficient system. In addition, this information will assist revisions to water and sewer rate structures, to reflect the full cost of providing service to maximize infrastructure investments and stop deferring needed maintenance activities.

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[31] The annual funding gap for water and sewer infrastructure needs is considered a conservative estimate using the best available information. As condition assessments and asset management plans are developed, this estimate may increase.

This chapter outlines a series of water-related recommendations to provide clean, safe water that enables a high quality of life, stimulates economic development, and protects public health and the environment.

Recommendations Key

EP	Economic Prosperity	HE	A Healthy Environment
QS	Reliable, High-quality Service	VI	Value for Investment
0-2	Implementation Start (in years)	0-2	Implementation Complete (in years)

7.1 ENSURING PUBLIC AND ENVIRONMENTAL HEALTH

Where is Michigan today?

Drinking water and wastewater investments, as well as regulatory programs, focus on sector and individual source compliance rather than systematic methods for supporting comprehensive environmental and public health outcomes. As evidenced by aging infrastructure—and the city of Flint, Oscoda Township, and other communities that are experiencing public health impacts associated with contaminants in drinking water—without adequate information, planning, and investment, the level of public and environmental health will continue to worsen.

What does a 21st century Michigan look like?

Michigan's water-related infrastructure investments and regulatory programs lead the nation in providing integrated approaches that successfully protect public safety and environmental health. The results are a safe, reliable, cost-effective and efficient water-related infrastructure system.

How do we get there?

7.1.1 The MDEQ should provide financial assistance to communities in need to invest in replacing aging infrastructure where there are immediate risks to public health or the environment due to lagging water infrastructure investments. Public health and environmental emergencies will be immediately mitigated by accessing emergency funds for failing infrastructure

Estimated investment needed: $25 million of state funds annually, dependent on the number of immediate public health or environmental risks identified

EP 0-2 11+

7.1.2 The MDEQ should develop an outcome-based regulatory framework that ensures compliance is achieved, while enabling flexibility of means and methods through a permitting system that supports innovation to achieve public and environmental health goals. State and local programs should be revised to achieve these outcomes. Following these revisions, the State of Michigan should evaluate regulatory staffing levels and requirements for MDEQ and MDHHS as well as local training and certification to ensure that environmental and public health outcomes are achieved.

Estimated investment needed: Will utilize existing staff resources; the estimated investment needed should be reevaluated as regulations are revised

EP 3-5 6-10

7.1.3 The MDEQ should use resources such as the recommendations of the National Drinking Water Advisory Council, municipal utilities, current U.S. Environmental Protection Agency (U.S. EPA) standards, and evolving research to inform legislative updates to the regulation of drinking water. As regulations are updated, communities may face additional costs to meet revised standards that may not be anticipated in local capital improvement plans or rate structures (i.e., the need to replace lead service lines). The MDEQ should partner with the Michigan Infrastructure Council, Michigan Department of Treasury, and drinking water utilities to determine the extent of potential financial impacts and provide funding to offset some of these costs to help communities meet revised standards.

Estimated investment needed: $50 million in funding each year for ten years; administered through the Drinking Water Revolving Fund

EP 0-2 11+

7.1.4 The MDEQ should provide grants and technical assistance to schools to develop and implement a science-based drinking water quality testing and remediation program for lead and other contaminants. The program should use established guidelines to develop an appropriate level of testing for schools based on age, plumbing vintage and materials, and water quality.

Estimated investment needed: A one-time state investment of $4.5 million

EP 0-2 6-10

7.1.5 The MDEQ and MDHHS should incorporate science-based research in establishing drinking water standards and evaluate sources of drinking water contamination as technology advances, enabling better detection of pollutants to determine whether further controls are warranted in drinking water and wastewater systems.

Estimated investment needed: Will utilize existing staff resources

EP 0-2

7.1.6 The MDEQ should continue to provide funding through the Clean Michigan Initiative (CMI) to assist with cleanup efforts of contaminated properties that threaten public health and drinking water supplies. This will require a new, successful ballot initiative to fund the CMI into the future.

Estimated investment needed: $35 million of state funds each year for ten years

EP 0-2 11+

7.1.7 The MDEQ and MDHHS, local municipalities, and utilities should expand public outreach, engagement, and communication efforts regarding regulatory standards to manage risk and ensure public and environmental health are maintained, and the necessity of water supply, sewer, and stormwater investments.

Estimated investment needed: Will utilize existing staff resources, asset management plans, and rate structures

EP 0-2

7.1.8 The MDEQ and MDHHS, in partnership with drinking water system operators, regional partners, and federal agencies, should expand comprehensive real-time surface and groundwater monitoring to detect potential threats to water supplies, develop early responses, and provide regular public reporting.

Estimated investment needed: $1 million of state funds annually

EP 3-5 11+

7.2 WATER ASSET MANAGEMENT

Where is Michigan today?

Unlike Michigan's transportation system, there is no comprehensive state requirement for the collection of data on water and sewer infrastructure conditions. The lack of information about existing water infrastructure conditions and long-term investment needs jeopardizes service quality, safety, public health and reliability. This adds to the legacy costs for communities and utilities.

> *The lack of information about existing water infrastructure conditions and long-term investment needs compromises both service quality and reliability.*

In addition, the technical and financial resources needed to adequately invest in infrastructure is beyond the reach of many service providers that operate in older communities. The problem is threefold: 1) the infrastructure is older and in need of a larger investment; 2) shrinking population has resulted in stranded capacity; and 3) the economic wherewithal of typical residential customers is far below what it was when systems were first put in place, with many at or below poverty indices.

What does a 21st century Michigan look like?

Michigan's drinking water, sewer, stormwater, and dam infrastructure systems all are regularly assessed and maintained to ensure the health and safety of Michigan's residents. The location and condition of public water infrastructure is identified, enabling strategic management and investment

in these systems. Michigan's investments are transparent and cost effective, facilitating a high level of public trust. This public trust is a foundation for sustained investment and quality service.

Local governments and water utilities have the necessary tools to regularly inventory, assess, and strategically invest in their water assets.

How do we get there?

7.2.1 The MDEQ should compile and evaluate asset management plans submitted under the first phase of the Stormwater, Asset Management, and Wastewater program. If necessary, the program should be updated to ensure that completed asset management plans are comprehensive and provide sufficient detail for planning purposes and meet MDEQ criteria. Following a program review and update, the MDEQ should provide additional funding to incent and assist municipalities and public utilities that have not established asset management plans for their stormwater and wastewater systems. Any updates to the program should also ensure that condition assessments and asset management plans are developed in a manner that enables consistent reporting in a statewide asset management database system supported by the State of Michigan (see Chapter 3).

Estimated investment needed: $400 million of state funds, distributed at a rate of approximately $80 million per year for five years[32]

HE 0-2 6-10

[32] The SAW program was previously allocated $450 million, which has supported the development of asset management plans for approximately 50 percent of the state's wastewater and stormwater systems.

7.2.2 The MDEQ should expand the current SAW program, to provide a portion of the funding necessary to complete condition assessments and the development of asset management plans for drinking water supply systems. Asset management plans for drinking water infrastructure should identify and prioritize infrastructure elements with risks to public health, such as lead service line replacement, which would decrease the risk of drinking water serving as a pathway of contamination. Asset management plans should develop local strategies to conduct coordinated lead service line replacement. Additionally, asset management plans should assess, maintain, and restore source watersheds and their ability to reliably and sustainably provide high-quality water for drinking water systems. Funding provided to these municipal agencies should be proportional to the size of the system (e.g., number of users, miles of infrastructure, and nature and extent of source watershed[s]). These revisions should ensure that condition assessments and asset management plans are developed in a manner that enables consistent reporting in the previously mentioned database.

Estimated investment needed: $350 million distributed at a rate of $70 million per year for five years[33]

HE 0-2 6-10

7.3 21ST CENTURY WATER INFRASTRUCTURE

Where is Michigan today?

Water-related infrastructure is aging and insufficient across urban, suburban, and rural areas of the state, particularly in our legacy cities.[34]

The high cost of replacement and maintenance, combined with declining water usage creates a daunting challenge. Excess distribution capacity impedes effective operations, and antiquated infrastructure prevents dependable, cost-effective service delivery. These challenges can cause undesirable public health, environmental, and economic impacts. In some rural areas of the state, keeping and attracting land-based industries depends upon access to wastewater treatment systems, potable water, and drain infrastructure.

[33] $350 million represents an average of $250,000 per asset management plan for the state's approximately 1,400 community drinking water supplies.

[34] Legacy cities are considered "older, industrial urban areas that have experienced significant population and job loss, resulting in high residential vacancy and diminished service capacity and resources." For more information, see www.legacycities.org.

What does a 21st century Michigan look like?

Michigan's water-related infrastructure, including water supply, sewer, and stormwater systems, in conjunction with other infrastructure types, serves as the platform for economically and socially prosperous communities and supports a healthy environment. Our water systems are designed and built using the best available technologies to equitably provide services to residents and businesses.

How do we get there?

7.3.1 The Michigan Infrastructure Council and other asset management entities should partner with economic development entities to identify and prioritize areas for targeted infrastructure water, sewer, and stormwater replacements or upgrades. These targeted investments should be consistent with local land use master plans and seek to leverage the availability of investments in other infrastructure (such as roads and communications networks) and other business development assets (such as a labor force or production facilities); as well as maximize economic development, investment, and employment opportunities. The capital improvements in these areas should be reflected in the approved local program.

Estimated investment needed: Will augment existing programs

HE 0-2 6-10

7.3.2 The Michigan Department of Agriculture and Rural Development (MDARD) should help support access to wastewater treatment capacity, potable water, and drain infrastructure in rural communities to promote land-based industries such as food, fiber crops, tourism, and mining, in order to keep rural communities competitive in a global economy.

Estimated investment needed: $10 million of state funds annually

HE 0-2 11+

7.4 FISCALLY SUSTAINABLE WATER, SEWER, AND STORMWATER PRICING MODELS

Where is Michigan today?

Inadequate and inconsistent information on the condition of water infrastructure and resources prevent system managers from developing sustainable funding models.

Water and sewer rates do not always reflect the full cost of providing water and sewer service. This unintentionally undermines economic efficiency and the financial sustainability of those systems. In some cases, communities bill utilities to pay for services rendered that would otherwise have to be paid out of the General Fund. While these charges are legitimate if properly allocated, it can lead to mistrust—jeopardizing the ability of water utilities to sustain rates and revenues at adequate levels. In other cases, local general funds (usually financed largely by property taxes rather than user fees) are used to subsidize water rates, meaning that rate revenues are not sufficient to support capital and operating costs. This General Fund subsidization is unsustainable due to Michigan's tax structure, making underinvestment and risk of failure of water infrastructure more likely.

What does a 21st century Michigan look like?

Michigan's water and wastewater systems are adequately and sustainably funded in both the short and long term. Certainty and transparency exists for all parties and entities paying water utility rates. Using an enterprise concept for rate structures, revenues generated by rates cover all capital, operation, maintenance, and replacement expenditures based on asset management plans. Any subsidies or General Fund transfers to water infrastructure systems would be limited and transparent. Pricing models ensure Michigan gets the most value for investments in our water, wastewater, and stormwater systems, as well as provide an ideal level of service to customers. These systems ensure continuous improvement models to maximize value to all people and entities that benefit from these systems, and protects and sustains natural resources. Water infrastructure system operators employ asset and information management systems that provide customers the transparency and confidence that infrastructure is being well managed on a sustainable basis. Management systems are in place that ensure that water infrastructure maintenance and improvement is done in coordination with other infrastructure systems to provide customers with the most cost-effective deployment and operation.

How do we get there?

7.4.1 Through new policy, state auditing, regulatory processes, and technical support, Treasury and MDEQ should require self-sufficient transparent operation of enterprise organizations for water, sewer, and stormwater utilities that are supported by rate structures that cover all capital, operation, maintenance and replacement expenditures based on up-to-date asset management plans. This should include the development of mechanisms to provide financial assistance to ratepayers with a demonstrated financial need. The MDEQ should convene a stakeholder workgroup to develop these mechanisms in a context that fits Michigan's structure for fees and taxes.

Estimated investment needed: Establishment of requirements and development of financial assistance mechanisms funded through existing staff resources; $1 million needed annually to seed the financial assistance program[35]

HE 6-10 6-10

[35] Funding amount should be reevaluated after rate structures are adjusted.

7.4.2 Utilities should engage in customer outreach when developing financing and ratemaking processes for all water, sewer, and stormwater utilities to achieve greater degrees of transparency.

Estimated investment needed: Will utilize existing staff resources

HE 3-5 6-10

7.4.3 The MDEQ and Treasury should evaluate and modify Michigan's Water Pollution Control Revolving Fund, better known as the State Revolving Fund (SRF), to increase opportunities for participation in the program. At a minimum, the following components should be evaluated:

- Enhancing education and outreach to help market the program to communities and assist them through the SRF process
- Streamlining the SRF application process to make participation more attractive in a competitive interest rate environment
- Providing direct financial support through the project planning phase or allowing reimbursement for these costs once a loan is approved (the S2 grant program may serve as a model)
- Providing for a longer loan time horizon to parallel the life of infrastructure assets
- Providing for the option to discount the interest rate based on outcomes achieved (e.g., asset management, regional partnerships, public and environmental health benefits)
- Analyzing various interest and loan scenarios in relation to assuring the fund is sustainable in the long term

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.4.4 The Michigan Legislature should adopt legislation authorizing stormwater utilities that is consistent with the *Bolt v. City of Lansing*[36] decision, establishes the requirements for structuring and charging a fee, and provides a streamlined process for local adoption. This legislation should establish the requirement for all users of stormwater services to pay for sustainable service delivery on a proportionate basis and provide incentives for alternate approaches to stormwater management.

HE 0-2 0-2

[36] The *Bolt v. City of Lansing* decision has precluded most municipalities in Michigan from establishing stormwater utilities. The decision requires stormwater assessment to be based on the unique contributions of individual properties.

7.4.5 Water utility rate structures should incorporate incentives to promote water-use efficiencies to reduce operating costs and delay or eliminate the need for capital investment.

Estimated investment needed: Will utilize existing staff resources and rate structures

HE 0-2 6-10

7.5 GREEN INFRASTRUCTURE

Where is Michigan today?

Michigan's water management systems were originally designed to remove water from property as swiftly as possible, which significantly altered streams and rivers, increased water quality problems, and degraded habitat. Variability of weather and climate could further strain existing drainage infrastructure and require new approaches to protect public health and prevent flooding and water pollution. Currently, there are few funding and financing mechanisms to support green infrastructure.

What does a 21st century Michigan look like?

Michigan leads the country by developing integrated and sustainable approaches to manage the quantity and quality of stormwater and surface water. A variety of optimization and simulation modelling approaches are used to assist water planners with developing and implementing plans. The impact of stormwater runoff on the total water cycle is significantly reduced and the state embraces low-impact design standards on land development projects. Michigan's water supply, wastewater, stormwater, and surface water management systems are integrated to provide the best outcomes for public and environmental health.

How do we get there?

7.5.1 The Michigan Department of Licensing and Regulatory Affairs (LARA), MDEQ, MDNR, and MDOT should encourage the integration of low-impact development/design standards and green infrastructure for stormwater management. Local jurisdictions should update their local ordinances to incorporate policies that incent the use of green infrastructure approaches that seek to optimize the joint benefits of stormwater management and green infrastructure—unless there are clear engineering, economic, environmental, or social reasons to select traditional engineering approaches. Model ordinance language from the Low Impact Design Manual for Michigan should be the basis for revisions. These ordinances should include stormwater quality and quantity planning for all projects.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 3-5

7.5.2 To enhance community resiliency and optimize costs, the MDEQ and MDNR should facilitate the development of tools that enable stormwater and wastewater system owners, managers, and operators to fiscally and operationally manage green infrastructure through asset management plans.

Estimated investment needed: Will utilize existing staff resources

HE 6-10 11+

7.5.3 Treasury and the MDEQ should update and revise funding and financing mechanisms that support infrastructure investments to incent evaluation and implementation of both efficiency-oriented approaches and green infrastructure.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.5.4 The MDEQ should periodically review and revise its programs and permitting requirements to ensure that engineering and design practices for sanitary sewer overflow (SSO) and combined sewer overflow (CSO) correction and stormwater management are based on assumptions that anticipate increased storm intensity and/or frequency.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 6-10

7.5.5 Drinking water, wastewater, and stormwater agencies should evaluate the resiliency of systems and facilities that enhance a community's readiness for increased storm intensity and/or frequency as well as their timely recovery as part of their asset management planning.

Estimated investment needed: See recommendation 7.2.1, SAW asset management funding

HE 0-2 6-10

7.5.6 The MDEQ, MDARD, and county drain commissioners should develop draft revisions and then work with other stakeholders to provide recommendations to the Michigan Legislature to update the Michigan Drain Code (if appropriate) and municipal separate storm sewer system (MS4) program to better facilitate joint action and collaboration among jurisdictions to manage stormwater on a watershed basis. Chapter 22 of the drain code should be updated to allow petitions to request development of collaborative watershed management plans as well as watershed-based engineering and design studies. The code should also be updated to allow performance-based (rather than prescriptive) mechanisms to incent property owner behavior to achieve water quality and quantity outcomes.

Estimated investment needed: Will utilize existing staff resources

HE 3-5 6-10

7.5.7 The MDEQ, MDARD, and county drain commissioners should develop draft revisions then work with other stakeholders to provide recommendations to the Michigan Legislature to address inconsistencies between the drain code and MS4 programs, with a goal of more explicitly authorizing projects focused primarily on management of water quality, especially in urbanized areas. MDEQ would still retain all authority over MS4 programs while allowing the drain commissioners to assist petitioning municipalities with implementation, particularly for permit requirements that are not grant eligible.

Estimated investment needed: Will utilize existing staff resources

HE 3-5 6-10

7.5.8 Relevant state agencies, including the DTMB, and the MDEQ should assess properties to identify and implement opportunities to use green infrastructure to manage stormwater. The MDNR and MDOT should be the first agencies to conduct this evaluation.

Estimated investment needed: Will utilize existing staff resources

HE 3-5 6-10

7.6 ONSITE WELL AND WASTEWATER TREATMENT SYSTEMS

Where is Michigan today?

Approximately 25 percent of Michigan residents and businesses obtain their water from private wells, of which there are more than one million—the most of any state in the nation (Creagh 2016). Michigan's farms also predominately use private wells for their agricultural operations. Moreover, about 30 percent of Michigan residents are served by onsite wastewater treatment systems, commonly called septic systems. It is estimated that 10 percent or more of Michigan's 1.3 million septic systems are failing (MDEQ 2016). While the majority of residents are connected to sanitary sewers, more than half of new home construction occurs in areas without sewer systems and requires onsite treatment system installation.

> *Michigan is the only state in the country without a sanitary code to protect its waters and public health.*

Michigan does not have a uniform standard for septic system performance, inspections, or periodic maintenance.

Well and septic systems, when properly installed and maintained, can provide an environmentally sound and cost-effective method to supply and treat water on individual properties. Subdivisions and condominium developments not contiguous to municipal systems frequently use small community systems, which may not be as environmentally sound over the long term and are often not adaptable to new users. This suggests that, over time, these systems may be undercutting municipal rate bases and the opportunity of improving economies of scale. Once installed, the performance of individual onsite water and wastewater systems are not well tracked, and the apparent high failure rates for these systems threaten both environmental and public health.

What does a 21st century Michigan look like?

Onsite water wells and wastewater treatment systems provide safe, affordable drinking water as well as wastewater disposal in rural areas of Michigan where investments in community systems do not make economic sense. Michigan has programs that ensure that individual systems are safe, properly maintained, and do not cause individual or cumulative environmental consequences. Information that helps make data-driven decisions is collected, compiled, and made publicly available.

How do we get there?

7.6.1 The MDEQ, MDHHS, and LARA should revise regulations to require county and municipal governments, as well as water and sewer utilities, to use planning and permitting processes, taxes, fees, and other policies to promote connection to public water supply and wastewater treatment systems when they are available or when a new or expanded municipal system would be cost effective. This should include the development of utility service districts as part of asset management planning. New decentralized community systems should be required to demonstrate full life-cycle economic benefits, with consideration of other sustainability principles. For example, this may include the development of utility service districts as part of asset management planning.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.2 The MDEQ, MDHHS, and LARA, in partnership with local health departments, should encourage local governments to adopt ordinances requiring new homes and businesses with failed onsite wastewater treatment systems to connect to established community systems if they are available within 200 feet, consistent with Michigan Public Health Code (Act 368).

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.3 The Michigan Legislature should pass new legislation that would enable local governments to adopt ordinances requiring homes and businesses to connect to community drinking water systems when onsite water wells fail if they are within 200 feet of an existing system.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.4 Communities should use Section 208 of the federal Clean Water Act to plan wastewater treatment facilities under an area-wide wastewater treatment management plan. In such cases, the MDEQ should use the permissive authority granted under Act 451, Part 21, Rule 39 to ensure that state or national permits (e.g., National Pollutant Discharge Elimination System) are addressed consistently with the approved Section 208 plan.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.5 The MDEQ and local health departments should strengthen permitting requirements to allow community systems only where a municipal system connection is not available, cost effective, or environmentally necessary. Community systems should be adaptable to future increases in the number of users, demonstrate a financially supported asset management plan, and provide for eventual connection to a municipal system.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.6 The MDEQ and MDHHS should work with the Michigan Legislature and local public health departments to update Michigan's Statewide Sanitary Code. The revised code should include 1) inspections of septic and community systems on a routine basis (e.g., every five years); 2) an approval route for alternative systems where public health or environmental quality is at risk; 3) minimum requirements for permitting; 4) a local health department–based, statewide registry of septic systems, including location, installation, and inspection dates; and 5) requirements for maintenance, pumping, repair, or replacement based on inspection results. This information should be included in the statewide asset management database system.

Estimated investment needed: Will utilize existing staff resources

HE 0-2 0-2

7.6.7 The MDEQ and MDHHS should develop a financing mechanism such as a low-interest revolving loan fund or loan loss reserve program to support maintenance and replacement of existing onsite and community systems for system owners with a demonstrated need for financial assistance.

Estimated investment needed: $20 million of state funds annually[37]

HE 0-2 11+

[37] Michigan has an estimated 1.3 million septic systems, which have an average lifespan of about 25 years. This suggests that approximately 52,000—4 percent—of all septic systems should be replaced on an average annual basis. This may require annual investment of approximately $780 million. Septic systems are private infrastructure that can affect public health and environmental quality. Similar to other investments property owners make, septic systems should be primarily funded privately. State support should be provided to owners of failed systems with demonstrated financial need. Michigan counties that have enacted inspection programs have estimated failure rates of approximately 25 percent; $20 million annually assumes that approximately 10 percent of owners of failed systems would need financial assistance to replace their systems.

7.7 EMBRACING NEW TECHNOLOGY TO DEVELOP 21ST CENTURY UTILITIES

Where is Michigan today?

Most of Michigan's drinking water and wastewater management systems were built between 50 and 100 years ago and utilize outdated technology and approaches for treatment, distribution, and collection.

Many government procurement specifications and policies do not include mechanisms to evaluate and utilize new technologies or alternative materials that can provide cost savings and enhance environmental outcomes. Regulatory policies can discourage innovation because permitting entities are unfamiliar or uncomfortable with new technologies, materials, or use of old technologies and materials in new and novel ways.

What does a 21st century Michigan look like?

Michigan's water supply, wastewater, and stormwater utilities embrace ideas, partnerships, and cost-effective emerging technologies and materials. This holds substantial promise for more efficient water and energy use, recovery of resources (such as nutrients), and improvement of environmental and public health outcomes.

How do we get there?

7.7.1 The MDEQ, municipalities, and local utilities should put in place a process to periodically review and update new technologies, procurement manuals, or standard operating practices to allow for open competition for technology and materials meeting relevant professional standards (e.g., American Water Works Association, Michigan Water Environment Association). Regulatory programs should be updated to further enable innovative approaches to achieve environmental and public health outcomes.

Estimated investment needed: Will utilize existing staff resources

QS 3-5 6-10

7.7.2 The MDEQ, municipalities, and local utilities should put in place a process to periodically review and update regulatory programs, implement methods of continuous improvement, and create standard work to further enable innovative approaches to achieve environmental protection and public health outcomes, as well as to control costs.

Estimated investment needed: Will utilize existing staff resources

QS 3-5 6-10

7.7.3 The MDEQ should work with municipal utilities to amend the current wastewater regulatory framework to advance the State of Michigan's Water Resource Recovery Facility framework and educate municipalities about the benefits of these approaches.

Estimated investment needed: Will utilize existing staff resources

QS 6-10 6-10

7.7.4 The MDEQ should work with municipal utilities to amend the current drinking water regulatory framework to advance the development of 21st century water utilities and inform municipalities about the benefits of these approaches.

Estimated investment needed: Will utilize existing staff resources

QS 6-10 6-10

7.7.5 The MDEQ should encourage and incent strategies like resource recovery, as well as energy conservation and management options at wastewater and drinking water facilities, to help conserve resources and drive down costs. Revisions to Michigan's revolving loan fund could help incent those changes.

Estimated investment needed: Will utilize existing staff resources

QS 6-10 6-10

7.7.6 The MDEQ should support innovation through partnerships and or funding with Michigan universities to expand research programs in the drinking water and wastewater fields.

Estimated investment needed: $1 million of state funds annually

QS 3-5

7.7.7 The MDEQ and water utilities should support new and emerging cost-effective technologies (such as smart metering and loss management technology) through permitting requirements that integrate water utilities with innovative communication and energy networks.

Estimated investment needed: Varying; the cost of new technologies should be integrated locally into cost of service

QS 0-2 0-2

7.8 DAMS

Where is Michigan today?

Michigan is home to an estimated 2,600 dams—many of which were built decades ago to supply power and run mill operations (Lane 2016). While many of these structures continue to serve a valuable purpose, others are in disrepair, risking failure that can cause significant ecological and economic damage, and threaten public safety (MDEQ 2016).

These decades-old dams have deteriorated due to age, erosion, poor maintenance, flood damage, or antiquated design, and they are particularly vulnerable during high water flow events.

> *Since the early 20th century, more than 300 dam failures have been documented in Michigan.*

In addition, significant adverse environmental effects of dams interrupting the natural flow of water, material, and organisms have been documented. The risk of failure, in conjunction with adverse effects on tributaries, suggests that dams that no longer serve a valuable purpose should be candidates for removal.

Dams are not routinely assessed for social and economic value and operational risks, which hinders reaching informed decisions on reinvestment, repair, removal, or replacement. Adequate, consistent, and long-term funding sources are limited for dam removal. Removal costs are highly variable and dependent on factors such as sediment contaminant levels, sediment volumes, surrounding infrastructure, wetland-related issues, and more. Furthermore, information is lacking regarding the number, condition, and ownership of low-head barriers that are not regulated under Parts 307 and 315 of the Natural Resources and Environmental Protection Act.

What does a 21st century Michigan look like?

Michigan has far fewer dams than it did at the turn of the 21st century. Given the original purposes for dam construction dating back to the 1800s, many of these relics have met their useful lifespan and have been removed or modified to help restore the natural functions of river ecosystems, such as upstream and downstream passage of biological organisms, nutrient transfer, and recreation. Dams that continue to provide benefits to society, such as reservoirs that provide water supply, recreational opportunities, and wildlife habitat and refuge, will have investment mechanisms to ensure their maintenance and structural integrity over their remaining useful life.

How do we get there?

7.8.1 The MDEQ's Dam Safety Program should maintain a publicly accessible geospatial data layer within the statewide asset management system that includes the number, condition, risk, and ownership of public, and private, regulated and nonregulated dams in the state. Working with partner organizations, the MDEQ should develop publicly available decision-support tools and training programs to assess risk, reinvestment and removal options for dams and low-head barriers. The tools should help communities and owners of dams evaluate potential safety, social-cultural, biological, ecological, and economic tradeoffs associated with the removal or maintenance of a dam. Utilizing the inventory of dams and the decision-support tool, the State should continue to support removal and maintenance of dams depending on the individual risks and benefits of each dam.

Estimated investment needed: $227 million of state funding over 20 years[38]

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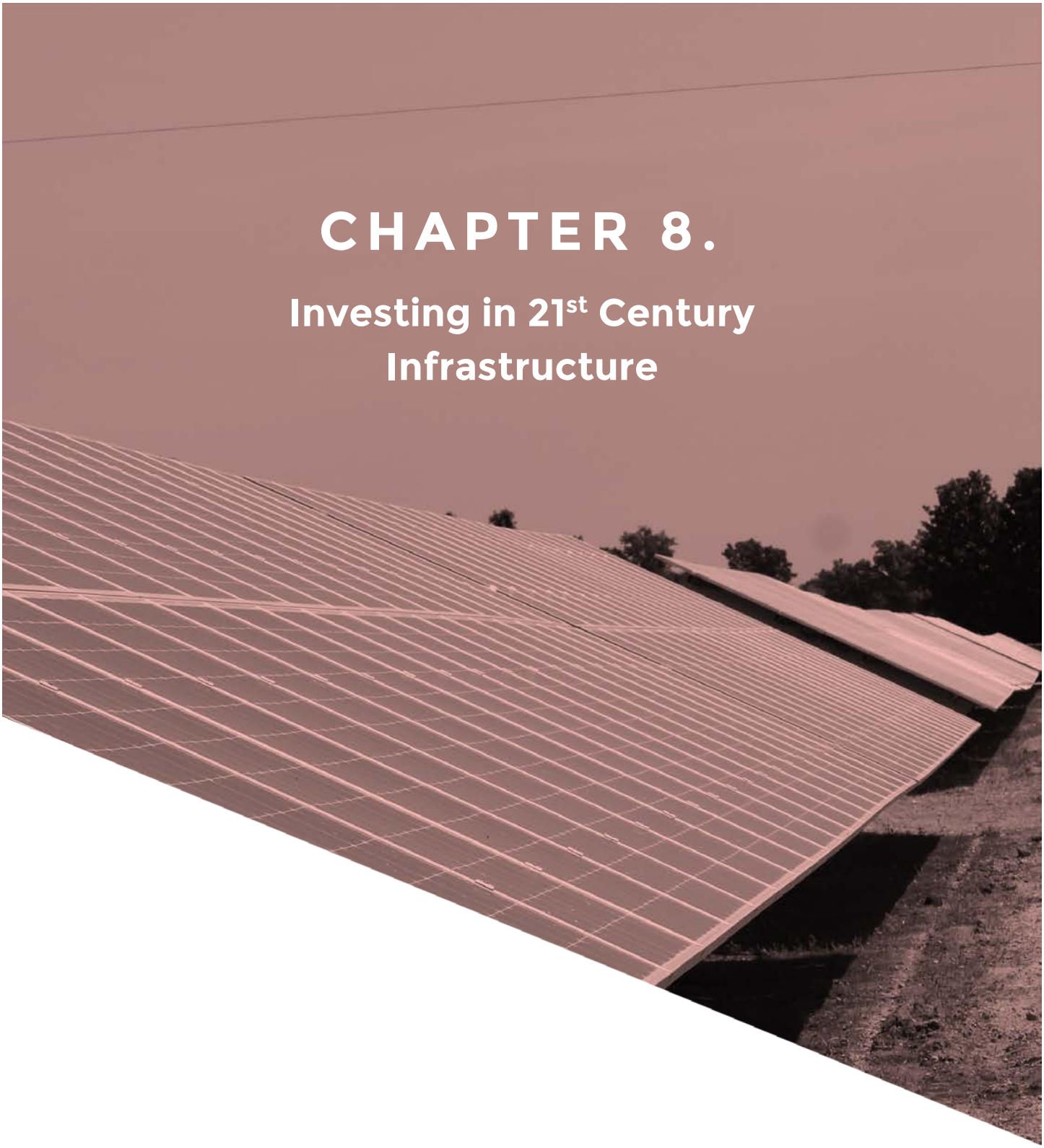
[38] The figure represents $10 million to develop and update the dam inventory database and develop decision-support tools to help assess removal or maintenance options. The MDEQ's Dam Safety Program currently estimates that an additional $225 million is needed for dam management, which may be refined with additional data.



CHAPTER 8.

Investing in 21st Century Infrastructure

Investing in our infrastructure—our roads and bridges; water, sewer, and stormwater systems; and energy and communications networks—is essential for ensuring 1) public health and safety, 2) quality of life, and 3) sustainable economic growth for all Michigan residents.

Michigan's transportation and water infrastructure is in poor condition, getting a D rating from the American Society of Civil Engineers. Infrastructure funding gaps are growing rapidly, adding to the accelerated deterioration of our systems. Current poor conditions now require total reconstruction efforts instead of less costly maintenance programs. According to the U.S. Census Bureau, Michigan spends $470 per capita on transportation—the national average is $795. The average annual capital spending as a percent of total spending is 2.4 percent less than the Great Lakes regional average. This means Michigan spends $2.5 billion less per year than the rest of the Great Lakes states. Michigan is falling behind and needs a new model for the 21st century.

Investment in infrastructure provides a return on investment and can build a solid foundation for a 21st century Michigan that includes safe, reliable, cost-effective, and efficient infrastructure systems for the next 30 to 50 years.

This chapter provides an overview of report recommendations that require public investment to fully implement. It also outlines current and potential funding sources and financing mechanisms to meet 21st century infrastructure needs. The Commission identified the following principles to address funding needs, which will optimize further state investment:

- Maximize utilization of user fees in alignment with supply and demand principles
- Leverage federal funding, taking full advantage of all funding match opportunities
- Identify and prioritize efficiency and coordination through asset management
- Finance long-term investments to capitalize on the time value of money

The creation of a statewide asset management strategy and system and the Michigan Infrastructure Council will ensure the investments outlined in this chapter deliver 21st century infrastructure outcomes that:

- Coordinate across infrastructure types
- Identify and assess our water infrastructure
- Upgrade water infrastructure and clean up contaminated properties to keep Michigan's water drinkable, swimmable, and fishable
- Bring our roads and bridges to a good or fair condition
- Build on Michigan's reputation as a global center for intelligent transportation systems
- Develop Michigan as a top-five state for broadband access and adoption
- Establish Michigan as a global leader in smart technology development and adoption

Investing in 21st Century Infrastructure Strategy and Asset Management

The first key issue Michigan faces in developing a 21st century infrastructure system is assessing our current infrastructure and its condition. The best way to accomplish this is through asset management—the practice of managing infrastructure in a cost-effective and efficient manner based on continuous collection of data on the location and condition of infrastructure. Although Michigan is a national leader in transportation asset management data collection and planning, there is not a requirement for every road agency to have an asset management plan. Although most agencies deploy some elements of an asset management process, many have not adopted a written plan with goals, projections, a financial plan, and a corresponding capital improvement program. For water and sewer infrastructure location and condition, limited data exists at the local level, and no information exists at the statewide level.

The Commission has identified as a top priority the establishment of an information system allowing coordinated planning between communications, energy, transportation, and water projects at local, regional, and statewide levels. Coordinating asset management at all levels, along with implementing full-cost accounting practices will enable communities to ensure systems are financially self-sustaining and provide revenue through appropriate rate setting to cover the cost of that infrastructure over the whole useful life of that asset and the full cost of service.

As outlined in Chapter 3, the Commission recommends the creation of a regional infrastructure pilot to operationalize coordinated asset management. To initiate the pilot, the State should invest $2 million for the initial development of an analytics database, data collection, and initial training for public and private stakeholders to inventory asset condition, identify needs, and develop plans. This will enable integrated infrastructure planning and adaptive management of assets. Additional funding will be required to expand deployment across the state.

A key recommendation to support development of 21st century infrastructure systems includes the establishment of the Michigan Infrastructure Council (referred to as “the Council”). The Council should assess the effectiveness of the pilot database and work toward implementation and maintenance of a common statewide asset management database. In addition to developing a long-term, integrated statewide infrastructure strategy in coordination with infrastructure decision-making bodies, the Council should design, oversee, and coordinate the distribution of incentives and funding for new infrastructure investments. The Council should ensure that funding cycles and processes promote cooperation and efficiencies between asset owners and reward projects that address multiple infrastructure needs with cost-effective collaboration and best practice funding and financing plans.

Investing in 21st Century Communications Infrastructure

Current Funding Sources and Financing Mechanisms

Michigan's communications infrastructure is funded primarily through the private sector based on an anticipated return on investment from consumer, business, and public sector subscribers. Other funding for communications infrastructure comes from federal programs, such as the Federal Communications Commission's Universal Service Fund Programs that have provided resources to Michigan, including the following:

- The Connect America Fund has provided a total of $645.7 million to support delivering broadband access to rural areas.
- The Lifeline Program provides approximately $6.5 million annually to support discounted broadband service for low-income consumers.
- The Schools and Libraries Program of the Universal Service Fund, commonly known as the E-Rate Program, provided approximately $58 million annually between 1998 and 2015 to help schools and libraries to obtain affordable broadband.
- The FCC Healthcare Connect Fund provides funding to increase access to broadband for eligible healthcare providers, primarily in rural areas. In 2015, the program brought approximately $3.25 million to Michigan to support broadband for rural healthcare providers (FCC August 26, 2016).

Beyond these federal funds from the Universal Service Fund, Michigan also received one-time funding of $171 million from the American Recovery and Reinvestment Act of 2009. There has also been limited state and local investment in communications infrastructure, as well as direct investment through educational institutions, which usually target very specific needs.

Investment Needs

Broadband Access and Adoption

Through incentives provided by federal programs and investments made by the state's broadband providers, Michigan has come a long way in improving fixed and mobile broadband access and adoption. However, 17 percent of households in Michigan lack fixed broadband coverage with download speeds of 100 Mbps and 11 percent of Michigan households lack mobile broadband coverage with 25 Mbps download speeds. Although Michigan is keeping pace nationally, we fall short of our goal of 100 percent access for both fixed and mobile broadband.

As detailed in Chapter 4, the Commission recommends steps to close this gap and position Michigan as a top-five state for broadband access and adoption. This includes the establishment of an advisory body—the Michigan Consortium on Advanced Networks—to coordinate policy, provide technical assistance, expand mapping and research of broadband access and adoption, expand digital literacy programs, and identify funding and financing mechanisms for mobile and broadband access and adoption.

To address funding needs, the Consortium needs to ensure all opportunities for federal funding and matching funds are fully utilized, including private sources of funding and financing, as well as innovative delivery options. Expanding broadband access could also be funded by an increase in the fee charged to telecommunications providers through the METRO Act, which was designed to assist in managing and maintaining public rights-of-way and to reduce conflicts with providers. Providers currently pay an annual fee of five cents per linear foot, which generates between $25 and $30 million per year and is distributed to local governments on a formula basis (MML 2015). Funding could also be provided through a surcharge to broadband service subscribers or through the state's General Fund. Expanding broadband access could also be financed as part of an infrastructure bond, bank, or P3.

The Michigan Legislature may also consider creation of a broadband technology tax credit for broadband service providers to encourage deployment of high-speed access.

Smart Technologies

The Commission also recommends the creation of a fund to support efforts that will make Michigan a global leader in smart technology development and deployment. The fund would provide seed and matching funds to incent innovative research and development on advanced communications and other smart technologies. In addition, this fund would support cities in identifying, implementing, and funding smart technology investments that appropriately serve their community. The Commission recommends this fund be established by the MEDC in partnership with other relevant state agencies—it could be funded through the Michigan Strategic Fund or the state's General Fund.

Cyber Security

To maintain Michigan's position as a top-five state for cyber security, the Commission recommends steps to continually keep pace with and respond to threats for critical infrastructure, as well as develop and implement programs to attract and retain talent in the cyber field. Cyber security recommendations could be funded through the state's General Fund and administered by DTMB.

Exhibit 15 summarizes recommendations for needed investment in Michigan's communications infrastructure.

EXHIBIT 15. Communications Infrastructure Investment Gaps

Rec. #	Description	Annual Investment Gap	Investment Term	Total Investment Gap	Investment Impact
4.1.2	Smart Technology Fund: Seed and matching funds to incent innovation of smart technologies	$10 million	5 years	$50 million	Michigan is a global leader in the evolution, deployment, and adoption of new technologies, and the creation of smart environments and communities.
4.2.1	Broadband investment in areas of need	$50 million	10 years	$500 million	Michigan is a top-five state for broadband access and adoption.
4.3.1	Cyber hub development	$3 million	2 years	$6 million	Michigan remains a top-five state for cyber security, where residents, businesses, and institutions can fully and confidently engage in a digital society and the digital economy.
4.3.2	Regional cyber security education collaboration	$1 million	2 years	$2 million	
4.3.3	Michigan Civilian Cyber Corps	$2 million	5 years	$10 million	
4.3.4	Virtual chief information security office	$375,000	2 years	$750,000	
4.3.5	Threat intelligence enhancements	$3 million	5 years	$15 million	
4.3.7	Cyber safety public awareness campaign	$2 million	5 years	$10 million	
4.3.8	Technology curriculum design and adoption	$960,000	5 years	$4.8 million	
4.3.9a	Develop next-generation identity and authentication solutions	$5 million	One-time	$5 million	
4.3.9b	Implement next-generation identity and authentication solutions	$3 million	5 years	$15 million	
Total				**$618.6 million**	

Investing in 21st Century Energy Infrastructure

Current Funding Sources and Financing Mechanisms

Despite being largely privately owned, the vast majority of Michigan's energy infrastructure is subject to regulation at the state, federal, or local level. These regulatory entities review utilities' prices, customer service, planning, and investment, allowing for reimbursement of appropriate expenditures. Generally speaking, to make investments in infrastructure, investor-owned utilities must first seek approval from regulators tasked with reviewing proposed expenditures and determining if costs are reasonable and prudent.

Investment Needs

Michigan's energy infrastructure has an existing funding structure for investment; thus, the Commission's recommendations do not include funding recommendations. However, the state's energy infrastructure is likely to require significant investment in the coming years. A majority of Michigan's electricity has traditionally been generated with coal as a fuel source, and most of the plants that were constructed in the sixties and seventies in Michigan were coal-fired. Many of those plants are coming to the end of their lives for regulatory and economic reasons. Other sources of energy, notably natural gas and renewable sources, will likely replace those plants. Reducing energy waste will also need to play an increasing role in our resource mix. The electric grid will need to undergo modernization to allow Michigan to take full advantage of these newer technologies and savings opportunities. Additionally, many of our natural gas pipelines were constructed with older materials and need to be replaced with newer materials that can provide better long-term safety.

Michigan needs to make many important and long-reaching energy decisions in the coming years. The state's decision-making processes should be improved to better look at the various alternatives and weigh them for adaptability, reliability, affordability, and protection of the environment. Updates to current federal and state processes for decision making could complement funding mechanisms in the current law to ensure Michigan's energy infrastructure meets—and continues to meet—the state's goals for reliability, affordability, and protection of the environment.

Investing in 21st Century Transportation Infrastructure

Current Funding Sources and Financing Mechanisms

Funding for the maintenance and preservation of Michigan's transportation system comes primarily from three sources: state fuel taxes, federal fuel taxes, and state vehicle registration fees. Only in the past few years has significant funding for roads been provided by Michigan's General Fund.

State Funding

Revenue from state gas and diesel taxes and registration fees is deposited into the MTF. The Michigan Constitution restricts the use of that revenue to roads, with up to 10 percent available for transit. Beginning in January 2017, the MTF will begin to see an increase in revenue, thanks to 2015 legislative action that will increase gas taxes by 7.3 cents per gallon, diesel taxes by 11.3 cents per gallon, and vehicle registration fees by 20 percent.

Funds flowing to the MTF are distributed to more than 700 transportation agencies across the state. After a series of administrative and other deductions are taken from the MTF, the remainder flows to MDOT, county road commissions, municipalities, and the CTF, which funds local bus transit, passenger and freight rail improvements, intercity bus transportation, and public ferries. These distributions are required by Public Act 51 of 1951, as amended.

The CTF derives its revenue from the MTF distribution, as well as 4.65 percent (of the 6 percent) of sales tax revenue collected from automotive-related retailers (gas stations and auto dealers). For example, in 2017, $91 million in auto-related sales taxes will flow to the CTF (MDOT 2016). Appropriation of General Fund revenues to the CTF varies from year to year.

Federal Funding

Federal aid provides roughly one third of Michigan's transportation budget each year, and is a vital part of the transportation capital construction budget. Federal fuel taxes, and other minor federal transportation-related taxes, are credited to the federal Highway Trust Fund. Federal highway aid is not cash, but a reimbursement for qualifying capital expenditures. It cannot be used for routine maintenance, such as snow plowing or pothole patching, which must be funded from state revenues. Federal highway aid must be matched from state or local funds, typically at a ratio of 80:20 percent. About $1.1 billion per year in federal funds is available for six major highway programs. Federal highway aid is divided by Act 51; 75 percent goes to state highways and 25 percent goes to local roads and streets.

Federal transit funding is generally allocated directly to public transit agencies. About $240 million per year in federal transit aid is provided to local public transit agencies or for discretionary grants for public transportation projects.

In FY 2015, the U.S. Department of Transportation initiated the FASTLANE program, which provides competitive grant funding for projects that address critical freight issues facing our nation's highways and bridges. The inaugural FASTLANE program provided $800 million in grants nationwide, although no Michigan projects were selected as part of that competitive process.

Local Funding

Local road and transit agencies in Michigan (83 county road commissions, 533 cities and villages, and 79 transit agencies) also invest in transportation infrastructure, and townships invest in county roads within their borders. According to Act 51 financial reports filed with the state, contributions by Michigan counties, cities, villages, and townships totaled $192 million in 2015 for local road and bridge maintenance, construction, and reconstruction. Michigan townships contributed an additional $46 million to road projects in 2015; cities and villages contributed an additional $235 million to transportation (CRA 2016). Local government contributions are generated from a variety

of sources, including local general funds, special assessments, millages, and public-private partnerships.

In the past decade, as transportation agencies struggled to find sufficient funds to sustain the condition of their transportation systems, the number of county-wide millages used for roads increased from 11 counties to 28 counties (CRA 2016).

Investment Needs

Roads and Bridges

In 2007, Michigan achieved established goals for the condition of state highways and bridges (90 percent good/fair) through asset management planning; however, the state has not been able to sustain that high level of performance. Through the roads package passed by the Michigan Legislature in 2015, beginning in 2017, an expected $450 million in new revenue from state gas taxes and vehicle registration fees will be distributed to more than 700 transportation agencies. That number rises to $600 million in 2018, and the full distribution of the entire $1.2 billion revenue package will occur in 2021. But even with these investments, an estimated $2.2 billion annual gap will remain. Closing this gap is essential to reach the state's goals for road condition—95 percent good or fair condition for Interstates and principal arterials; 85 percent good or fair condition for state highways and bridges; and, 85 percent good or fair condition for local roads and bridges—and to ensure Michigan is building and maintaining 21st century transportation infrastructure.

Multimodal Transportation Systems

Michigan's bus transit, passenger rail, and freight systems all compete for the same funding from the CTF, which is funded largely through a distribution of the MTF. The estimated MTF transfer to the CTF for FY 2015–16 is $169.3 million (Hamilton 2016). A smaller revenue source for the CTF is the auto-related sales tax, which was estimated to total $97.1 million in FY 2015–16. Interest on the fund balance and other revenue sources bring the total CTF revenue to approximately $267 million for FY 2015–16. While the CTF will receive a share of the increase to state gas taxes and registration fees in 2017 and beyond, the CTF was not included in the distribution of general funds proposed by the Michigan Legislature for roads and bridges in 2019, 2020, and 2021.

Recognizing that because of increasing fuel-efficiency standards, the gas tax will not remain a viable source of transportation funding indefinitely, the Commission has recommended alternative funding sources to fund roads and bridges. These alternatives are described in detail in Chapter 6 and outlined in Exhibit 21. While these options could help address the transportation funding gap in the long term, they will take time to implement. Meanwhile, a substantial funding shortfall remains (see Exhibit 16). Beyond further increases in the state gas tax and continued General Fund contributions, viable options to support critical road and bridge infrastructure in the near term are limited. Financing critical reconstruction needs through a bond, bank, or P3 should be considered. Increased federal funding for transportation must also be part of the solution. Through successful asset management, Michigan is well positioned to make good use of federal funding for transportation infrastructure.

EXHIBIT 16. Roads, Bridges, and Multimodal Transportation Annual Investment Gaps

Transportation Mode	Current Annual Investment	Annual Investment Need	Annual Gap
Interstates and other principal arterials	$1.2 billion	$2.2 billion	$1.0 billion
State highways and bridges	$250 million	$850 million	$600 million
Local roads and bridges	$740 million	$1.34 billion	$600 million
Multimodal	$420 million	$850 million	$430 million
Total	**$2.61 billion**	**$5.24 billion**	**$2.63 billion**

Bridge and Culvert Inspections

As described in Chapter 6, there are safety, environmental, economic, and social impacts when there are bridge and culvert failures, especially when flooding occurs at older bridge or road-stream crossings. The Commission recommends an annual state investment to support design, installation and inspection of road-stream crossings to ensure safe passage, natural stream function, aquatic organism passage, support of commercial activity and uninterrupted traffic flow. Local inspections could be funded through the state's General Fund. Design changes and construction of new crossings identified as a result of inspections could be funded through the MTF.

Intelligent Vehicle Technology

As described in Chapter 6, cooperation between the public and private sectors is helping to position Michigan as the global center of mobility and intelligent vehicle technology. While Michigan is already preparing to implement intelligent vehicles, the implications for infrastructure investment are not certain, given rapidly advancing technologies. The Commission has made a series of recommendations to continue to advance Michigan as a global mobility center, including investment in continued installation and implementation of intelligent vehicle technology, partnership development, and continued implementation of traffic signal synchronization. These investments could be funded through a combination of general funds and the Michigan Strategic Fund, and P3s could be a potential financing or project delivery source.

Exhibit 17 summarizes recommendations for additional needed investment in Michigan's transportation infrastructure.

EXHIBIT 17. Transportation Infrastructure Investment Gaps

Rec. #	Description	Annual Investment Gap	Investment Term	Total Investment Gap	Investment Impact
6.1.1	Reconstruct Interstate and other principal arterials	$1.0 billion	15 years	$15 billion	95 percent of Interstates and other principal arterials are in good or fair condition.
6.1.1	Reconstruct other state highways	$600 million	15 years	$9 billion	85 percent of other state highways are in good or fair condition.
6.1.1	Reconstruct roads under county or city jurisdiction	$600 million	15 years	$9 billion	85 percent of county primary roads and city major streets are in good or fair condition.
6.2.1	Design and install stream crossings	$40 million	5 years	$200 million	Road infrastructure, wetlands, and water quality are protected and safe passage of people and freight is ensured through continued viability of culverts.
6.2.3	Inspect local culverts greater than five feet in diameter	$4 million	5 years	$20 million	
6.4.1	Invest in multimodal (bus transit, passenger rail, and freight) systems[39]	$430 million	15 years	$6.45 billion	Michigan has a reliable, safe, and integrated multimodal system serving both urban and rural communities throughout the state.
6.4.3	Develop components of the DIFT	$323 million[40]	One-time	$323 million	Rail yards in southeast Michigan are consolidated resulting in relieved congestion, improved service, and environmental justice.
6.9.2	Install and implement intelligent vehicle technology	$20 million	10 years	$200 million	Michigan's positon as a global mobility center is advanced.
6.9.4	Advance intelligent vehicle technology industry through P3s	$2 million	10 years	$20 million	
Total				**$40.2 billion**	

Source: U.S. DOT FHA 2016; MDOT 2016.

[39] Multimodal investments include operating assistance required by Act 51.

[40] Includes only public investment needs; the total investment need for the DIFT is $539 million and this difference is expected to be funded through private investment. Tax increment financing could be utilized to support the public portion of the DIFT investment.

Investing in 21st Century Water Infrastructure

Current Funding Sources and Financing Mechanisms

Michigan's public drinking water and wastewater treatment systems are funded primarily through user fees, although some municipalities choose to underwrite these costs with general funds. When financing the initial capital improvements for new infrastructure and large-scale replacements, communities sometimes borrow money through the state's revolving loan funds, including the Clean Water State Revolving Loan Fund and the Drinking Water Revolving Loan Fund. Additionally, Michigan has a long history of voter support for general obligation bonds, such as the Clean Michigan Initiative and the Great Lakes Water Quality bond, to support environmental quality and water-related infrastructure. While the Clean Michigan Initiative has provided funding since 1998, the funds are expected to be fully depleted in 2017. Given current low interest rates, and to decrease administrative burden, many communities are turning to the open bond market to finance water infrastructure improvements. The USDA Rural Development Department also provides funding to rural communities to support water infrastructure. Private water wells, onsite wastewater treatment systems, stormwater infrastructure, and dams are the responsibility of individual owners.

Urban stormwater infrastructure is frequently funded when new development occurs as part of the original development costs. However, due to regulatory challenges, few communities have established a dedicated funding mechanism, such as a stormwater utility, to support maintenance and replacement costs, leaving municipalities to defer maintenance or pay for these expenses through their general funds. Drains outside of cities are frequently owned and operated by drain commissions as special purpose public corporations and paid for by property owners in the watershed on a proportional basis, depending on how much water they contribute to the drain.

Investment Needs

Asset Management

Michigan has an estimated $800 million annual gap in water and sewer infrastructure needs, compiled from decades of deferred maintenance. However, there is a high level of uncertainty regarding this need, due to a lack of data on infrastructure condition. While revenue to support infrastructure needs is primarily provided by ratepayers and local general funds, investment in asset management planning is essential to aligning rates with needs.

The State began awarding funds through the Stormwater, Asset Management, and Wastewater (SAW) program in 2014 to assist communities in asset management planning for wastewater and stormwater systems; stormwater management planning; innovative technology and project planning; and design for wastewater and stormwater systems. SAW awards grants and low-interest loans for wastewater construction projects designed to protect water quality and public health. The funds for SAW are expected to be fully utilized by 2018, while most wastewater and stormwater systems will still need asset management plans. As described in Chapter 7, the Commission recommends additional state investment in asset management planning and expansion of SAW to include drinking water.

Asset management planning is a short-term investment that has a long-term impact; therefore, it is appropriate for financing. Current SAW grants for wastewater and stormwater asset management planning are funded through general obligation debt authorized through the Great Lakes Water Quality Bond of 2002. Debt service on the bond is provided through the General Fund. The State should utilize the remaining $290 million of authorization available in the Great Lakes Water Quality Bond to provide additional SAW grants and continue to fund debt service through the General Fund. An additional $460 million in general obligation debt will need to be issued to completely fund stormwater, wastewater, and drinking water asset management planning.

These investments will enable system managers to align water and sewer rates with the full cost of providing water, sewer, and stormwater service, ensuring fiscally sustainable pricing models. Sustainable pricing models are essential to ensure the most value for investments, protection of public health and the environment, reliable service to customers, and a reduction in local general fund subsidies for water. Accurate reporting of needs also positions Michigan to optimize federal funding allocation for wastewater and drinking water revolving loan funds.

Drinking Water and Wastewater Investments

As detailed in Chapter 7, the Commission recommends investments in the state's aging drinking water and wastewater infrastructure. These recommendations include dedicated funding to address immediate public health risks and to meet drinking water regulations, as well as funding to support drinking water testing and remediation in schools, contaminated site cleanup, and monitoring expansion. These investments will enable Michigan to protect public safety and environmental health and result in safe, reliable, cost-effective, and efficient water-related infrastructure systems.

Rural Water Infrastructure Improvements

As described in Chapter 7, Michigan does not have a uniform standard for septic system performance, inspections, or periodic maintenance. The Commission recommends appropriate state agencies develop a financing mechanism such as a low-interest revolving loan fund or loan loss reserve program to support maintenance and replacement of existing onsite and community systems for system owners with a demonstrated need for financial assistance. These investments will help ensure safe and affordable drinking water, as well as wastewater disposal in rural areas. The Commission also recommends investments in wastewater treatment capacity, potable water, and drain infrastructure in rural communities to promote land-based industries—such as food, fiber crops, tourism, and mining—which will help rural communities to compete in the global economy.

Water Technology Innovations

The Commission also makes recommendations to encourage water technology innovation, which can provide cost savings and enhance environmental outcomes. This includes partnerships with Michigan universities to expand research programs in the drinking water and wastewater fields.

Dam Maintenance and Removal

Dam deterioration and failures can cause significant ecological and economic damage, affecting public health. As described in Chapter 7, dams are not routinely assessed to ensure informed decisions on reinvestment, repair, removal, or replacement. Adequate, consistent, and long-term

funding sources are limited for dam removal and removal costs are highly variable. The Commission recommends investments to inventory dam conditions and provide ongoing funding for the maintenance and removal of dams depending on the individual benefits of each dam. These investments will help to ensure improved safety, fish and wildlife habitat, and recreation opportunities.

Exhibit 18 summarizes recommendations for needed investment in Michigan's water infrastructure.

EXHIBIT 18. Water Infrastructure Investment Gaps

Rec. #	Description	Annual Investment Gap	Investment Term	Total Investment Gap	Investment Impact
7	Water and sewer infrastructure capital investments	$800 million[41]	20 years	$16 billion	All Michigan public water and sewer infrastructure is maintained resulting in reduced water main breaks, increased response to emergency infrastructure needs, and reduced public health risks.
7.1.1	Community infrastructure emergency response	$25 million[42]	20 years	$500 million	Public health and environmental emergencies are immediately mitigated by accessing emergency funds for failing infrastructure.
7.1.3	Drinking water infrastructure regulatory upgrades	$50 million	10 years	$500 million	All drinking water systems are upgraded to meet new state drinking water standards.
7.1.4	School drinking water testing and remediation planning	$4.5 million	One-time	$4.5 million	All Michigan schools use science-based methods to evaluate drinking water quality and develop appropriate remediation strategies.
7.1.6	Contaminated site cleanup	$35 million	10 years	$350 million	3,000 contaminated properties are cleaned up, protecting public health and drinking water supplies.
7.1.8	Real-time surface and groundwater monitoring expansion	$1 million	20 years	$20 million	Michigan's drinking water sources are protected with the highest level of security, resulting in early warnings to residents over concerns with water quality.
7.2.1	Stormwater and wastewater asset management planning	$80 million[43]	5 years	$400 million	All permitted drinking water, wastewater, and stormwater facilities identify and assess the condition of public water and sewer infrastructure.
7.2.2	Drinking water asset management planning	$70 million	5 years	$350 million	

[41] This figure includes an estimated annual gap in water and sewer infrastructure needs. This is considered a conservative estimate using the best information available. As condition assessments are completed, this estimate is expected to increase. Ratepayers are the primary funding source for this investment gap.

[42] Based on investment the State made in Flint for approximately 10 percent of the service line replacements, a similar amount may be needed for various other communities across the state.

[43] The average investment over the last three years is $97 million; current SAW funding ends in 2018.

Rec. #	Description	Annual Investment Gap	Investment Term	Total Investment Gap	Investment Impact
7.3.2	Rural wastewater, potable water, and drain infrastructure	$10 million	20 years	$200 million	Five rural local units of government are selected each year for the research, planning, design, and/or construction of wastewater, potable water, or drain infrastructure projects to support rural economic development, public health and the environment.
7.6.7	Need-based septic system replacement and maintenance revolving loan program	$20 million[44]	20 years	$400 million	Onsite and community wastewater systems are maintained or replaced for those with demonstrated financial need protecting public health and environmental quality.
7.7.6	Water innovation partnerships	$1 million	10 years	$10 million	Michigan incorporates innovative technologies into infrastructure, resulting in reduced costs for residents and improved service.
7.8.1a	Dam database, inventory, and field assessments	$2 million	One-time	$2 million	The State, communities, and dam owners have decision-support tools and training to assess reinvestment and removal options for dams.
7.8.1b	Dam maintenance and removal	$11.25 million	20 years	$225 million	Michigan's 2,600 dams are maintained or removed, resulting in improved safety for unanticipated failures, improved fish and wildlife habitat, and better recreation opportunities.
Total				**$19 billion**	

[44] This figure is based on the annual estimated cost of replacing 10 percent of failing septic systems. The State investment would subsidize low-income septic system owners who do not have resources to replace failing systems.

Asset management will help to ensure rates can fully align with infrastructure investment needs. The Council should work collaboratively with state departments to establish parameters for administration of these funding needs. In addition, a water infrastructure user fee could be established to support need-based infrastructure investments.

Addressing the Investment Gap

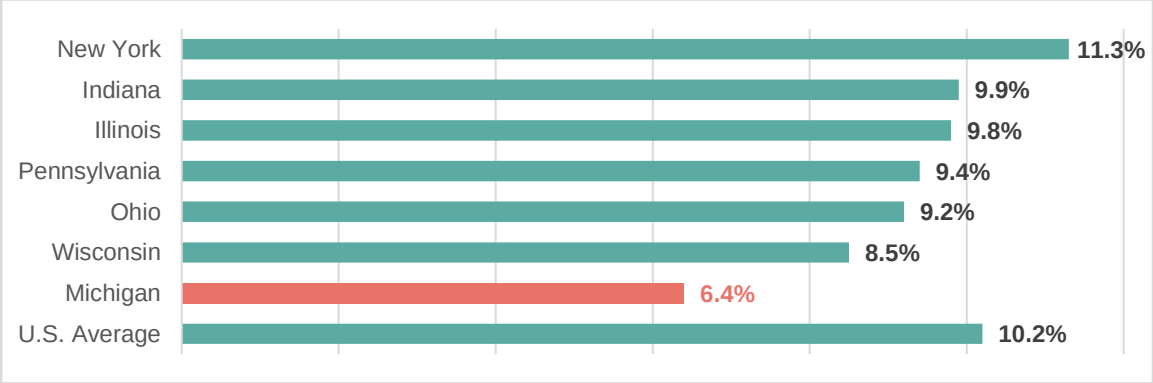
Michigan's infrastructure investment gap exceeds $60 billion over the next 20 years with an **annual investment gap of nearly $4 billion,** as seen in Exhibit 19.

EXHIBIT 19. Infrastructure Investment Gaps Summary

	Transportation	Water	Communications	Energy
Forecasted Annual Investment Gaps	Approximately $2.7 billion	Approximately $1 billion	Approximately $70 million	N/A, largely private utility investment
Forecasted Investment Gaps Over the Next 20 Years	Approximately $40 billion	Approximately $19 billion[45]	Approximately $600 million	N/A

As depicted in Exhibit 20, relative to neighboring states and the national average, Michigan underinvests in capital infrastructure spending at the state and local level (Deloitte 2016). Addressing this substantial gap will require a combination of local, state, federal, private, and user fee investments, as well as financing strategies to meet long-term needs.

EXHIBIT 20. State and Local Capital Spending Comparison



Note: Percent of total expenditure, annual average 2010-14.
Source: Deloitte 2016.

[45] This figure includes an estimated $800 million annual gap in water and sewer infrastructure needs. This is considered a conservative estimate using best information available. As condition assessments are completed, this estimate is expected to increase and rate structures should be adjusted to serve as the primary source for funding this gap.

Potential Revenue Options

Exhibit 21 outlines examples of revenue sources that could provide funding for infrastructure needs. This is not an all-inclusive list of revenue sources; it does not include local user fees, federal funding opportunities, or private investment. This table and the descriptions that follow provide a menu of options for consideration to directly fund infrastructure needs or to provide revenue for debt service to finance long-term needs.

EXHIBIT 21. Examples: Revenue Generation Options

Potential Revenue Sources	Asset Type	Example Scenario	Estimated Annual Revenue Generation Potential
Dedicated sales tax for infrastructure	All infrastructure	1 percent increase	$1.5 billion
Dedicated statewide property tax	All infrastructure	1 mill increase	$325 million
Broadband service surcharge	Communications	$1.54 per month surcharge on 2.7 million broadband service bills	$50 million
METRO fee	Communications	11 cents per linear foot increase	$50 million
Fuel tax	Transportation	10 cent per gallon increase	$500 million
Local revenue generation options	Transportation	Up to $40 county-wide registration fee or ten-cent county-wide gas tax	$400-500 million
Mileage-based user fee	Transportation	1 cent per mile based on current average miles driven statewide	$970 million
Nonmotorized transportation registration fee	Transportation	$10 per year, for two million bikes, kayaks, canoes	$20 million
Tolling	Transportation	5 cents per mile on 360 miles of US-23	$138 million
Vehicle registration fee	Transportation	20 percent increase	$200 million
Water infrastructure user fee	Water	$1 per 10,000 gallons based on the state's annual water withdrawal	$36 million

Definitions

- **Dedicated sales tax for infrastructure:** Sales taxes are collected when nonexempt goods and services are sold. A dedicated sales tax could be used to support infrastructure investment needs for all asset types. A constitutional amendment would need to be enacted, which would require a vote of the people.
- **Dedicated property tax for infrastructure:** Property taxes are a commonly used method of raising revenue to support public services and investment. Michigan provides funding to K–12 schools through a statewide dedicated property tax. A similar approach could be used to support infrastructure investments. A constitutional amendment may need to be enacted, which would require a vote of the people.

- **Broadband service surcharge:** There are approximately 2.7 million households with fixed, terrestrial broadband services. A surcharge placed on broadband bills could provide funding to support broadband access and adoption statewide.
- **METRO fee:** Telecommunications providers that own facilities located in a public right-of-way are subject to METRO fees that assess an amount for each linear foot of right-of-way use. Increasing the current fee from $.05 to $.16 could provide funding to support broadband access and adoption investment needs.
- **Fuel tax:** Fuel taxes are charged on gasoline sales to support transportation infrastructure on a per gallon basis. An additional fuel tax increase could generate funding to support road and bridge infrastructure investment needs.
- **Local revenue generation options:** Counties, cities, and villages supplement state aid with local funds. Currently, property taxes are the only locally controlled tax available for additional local funding. The Legislature could enable new methods of generating local revenue, such as regional-option sales taxes, gas taxes, vehicle registration fees, and land impact fees to invest in local road and transit infrastructure.
- **Mileage-based user fee:** An alternative or supplement to a fuel tax charges motorists based on the number of miles traveled. Depending on the complexity of the assessment, fees can be adjusted based on travel locations, times, congestion levels, road type, and ability of the user to pay.
- **Nonmotorized transportation registration fee:** Registration fees are a commonly used approach to support infrastructure investments for different modes of transportation. For example, motor vehicles, watercraft, and even airplanes are charged registration fees to support roads, harbors, and airports. Nonmotorized transportation registration fees on bicycles, kayaks, canoes, and other modes could generate revenue to support the development and maintenance of nonmotorized transportation routes.
- **Tolling:** Tolls are fees charged for passage on a public or private roadway that are used to support development and maintenance of roadways. Tolling on some Michigan freeways could provide funding to support road and bridge infrastructure investments needed for those freeways.
- **Vehicle registration fee:** Motor vehicles are required to register with the Secretary of State on an annual basis. These fees are used to support development and maintenance of roadways. An additional increase in the vehicle registration fee could generate funding to support transportation infrastructure needs.
- **Water infrastructure user fee:** Households and commercial operations use water for a variety of purposes such as cooking, cleaning, and hygiene. On a statewide basis, municipal water supplies withdraw approximately 360 billion gallons annually. A $1 fee per 10,000 gallons could provide revenue to support water-related infrastructure investments (Great Lakes Commission 2015).

Financing Strategies

Historically, public funding for infrastructure has occurred on a "pay as you go" cycle in which annual operating and capital budgets allocate dollars to maintain or expand infrastructure. Increasingly, states and cities have relied on general obligation and other types of bonds to finance infrastructure projects. As states and countries diversify funding sources, some have set explicit limits or targets for levels of indebtedness. Oregon, for example, has capped the amount of debt the State will issue for infrastructure projects and has focused on other sources of funding such as fees, special revenues (e.g., lottery), and private investments (State of Oregon Office of the Governor 2012).

Today, best practice–level infrastructure management systems utilize a diverse mix of funding, including public and private investments, to maintain, improve, and expand infrastructure. In addition to the traditional public funding mechanisms like general funds and traditional bonds, some states and countries have utilized more innovative tools to ensure adequate capital to fund projects, and to improve efficiencies. These tools include infrastructure banks and P3s.

State Bond Financing

Bond financing is a funding strategy that involves the State borrowing money from bond holders with a promise to pay back the principal plus interest at a predetermined future date. This strategy lends itself well to some infrastructure projects. Bonding should only be used for projects with a long useful life, and bond funds should not be used to pay for operations. Bonds are generally structured to be paid back over the useful life of a project. The principal and interest on the bonds can be repaid with user fees or some other revenue source. One advantage of bond financing is that the users receiving the benefits can also be made to pay the costs of the system. For example, if bonds are used to pay for a water system, users can be charged for the debt service as part of their water bills. If funds were saved in advance to pay for a project, current taxpayers would be paying to support a project that benefits future taxpayers.

There are two primary types of bonds issued by the State of Michigan. General obligation (GO) bonds are backed by the full faith and credit of the State; nongeneral obligation (non-GO) bonds, also referred to as revenue bonds, are debt instruments supported by a dedicated revenue source or a state appropriation (Zin 2016).

GO bonds are provided for under Article IX, Section 15 of the Michigan Constitution. The full faith and credit pledge means that the debt service for these bonds has priority over other obligations. Basically, the State promises to do whatever it takes to pay these bonds, including raising taxes if necessary. Issuing GO bonds requires an affirmative vote of two-thirds of the Legislature, and a majority vote in a statewide general election.

Non-GO bonds are provided for under Article IX, Sections 9 and 13. The Legislature can authorize the issuance of these bonds through the enactment of statutes—a new statute is not needed every time bonds are issued. The Legislature can give the authority to issue bonds as needed to a government entity. Non-GO bonds are not backed by the full faith and credit of the State, and are subject to "appropriation risk," meaning there is a risk that the Legislature will not appropriate sufficient funds to fully pay the debt service when bond payments are due. Non-GO bonds are seen as slightly riskier than GO bonds by lenders. They generally carry a lower bond rating and a slightly higher interest rate. Non-GO bonds are much more commonly issued due to the difficulty of issuing GO bonds.

The State should determine the most cost-efficient options over the longterm to fund and finance priority infrastructure needs. One financing option to consider is bond financing for priority infrastructure needs, given currently low interest rates, our favorable credit rating, and financing capacity. Michigan's current Moody's credit rating is Aa1 stable and our net tax-supported debt as a percentage of personal income is 1.8 percent compared to a median of 2.5 percent amongst other states. A bond could provide some funding for much needed investments in stormwater and drinking water asset management, critical drinking water infrastructure, road and bridge reconstruction, and expansion of broadband access statewide. Financing $1 billion over 30 years at a 3 percent interest rate would require approximately $50–55 million in annual debt service. This would equate to approximately $13 per Michigan household annually or $1.10 per month. The Council could advise on how the bond funding could be utilized and options for providing debt service in conjunction with appropriate authorities and agencies. Exhibit 22 includes an example of potential uses of an infrastructure bond.

EXHIBIT 22. Infrastructure Bond Example

Asset Type	Potential Investment	Example Investment
Water	Drinking water asset management	$250 million
	Wastewater asset management	$250 million
	Critical drinking water infrastructure	$100 million
Transportation	State road and bridge reconstruction	$250 million
	Matching funds for local transportation investments	$100 million
Communications	Broadband access expansion	$50 million
Total		**$1 billion**

Infrastructure Banks

Infrastructure banks are state-owned banks that can finance and coordinate high-value infrastructure investments. Banks allow for borrowing (or loan guarantees) from public and private entities to fund public-serving infrastructure projects. Infrastructure banks can be used for projects requiring large lines of credit, which in some cases, allows an entity to multiply its infrastructure investment capacity. Infrastructure bank loans also use delayed-repayment mechanisms, which allows key projects to move forward even if they will not generate user fees or yield savings for many years (Miller et al. 2012).

Several states have public banks that play some role in infrastructure. One of the oldest such institutions is the Bank of North Dakota, although its infrastructure participation in recent years has been limited (Bank of North Dakota 2016). Created in 1994, the California Infrastructure and Economic Development Bank finances public infrastructure and private development to promote jobs, contribute to a strong economy, and improve quality of life (State of California 2015). The Pennsylvania Infrastructure Bank leverages state and federal funds to accelerate priority

transportation projects by providing low-interest loans (Pennsylvania Department of Transportation 2016). In addition, Connecticut recently established both an infrastructure bank to assist public and private entities with infrastructure financing and a green bank to finance energy efficiency projects (Connecticut Green Bank 2016; S.B. 402 2016).

Michigan may consider implementing a multisector infrastructure bank with a major focus on economic development as a solution to address the broad range of infrastructure needs. Legislation would need to be passed in Michigan to establish an infrastructure bank. Michigan has a history of comparable infrastructure financing mechanisms, including the Drinking Water State Revolving Loan Fund and the Clean Water State Revolving Loan Fund. A bank structured as an authority with a board could be aligned with the asset management planning and technical assistance body to vet and prioritize projects. The Council could serve as a planning and policy authority for an infrastructure bank in conjunction with appropriate boards and agencies. Exhibit 23 includes an example of potential uses of an infrastructure bank.

EXHIBIT 23. Infrastructure Investment Bank Example

Asset Type	Potential Investment	Example Annual Investment
Water	Drinking water system upgrades	$50 million
	Community emergency response	$25 million
	Septic system loan fund	$20 million
Transportation	Local roads, bridges, and transit reconstruction	$150 million
Communications	Broadband access expansion	$25 million
Water and Transportation	Emergency needs	$30 million
Total		**$300 million**

Public-Private Partnerships

A ***public-private partnership*** is a long-term, performance-based, contractual arrangement between a public agency and a private sector entity. A P3 arrangement allows for the use of private dollars to construct a public asset, and the private investor is repaid through future, long-term revenue streams associated with constructed assets. P3s usually involve one or more private company investors, private equity funds, and/or institutional investors (Deloitte 2016).

In essence, P3 is another method available to public authorities to procure and deliver major infrastructure projects. P3s may take a variety of forms and generally involve some combination of key aspects of a project, including the design, construction, finance, operation, and maintenance. There is also a variety of payment mechanisms associated with P3 projects, which include user fees/tolls, service fee or availability payments, and milestone payments, among others. Financing

required for P3 deals may be raised by the private partner, or by the public authority, depending on the nature of the P3 transaction.

While P3 is not suitable for all infrastructure projects, on large or more complex projects it has proven to be effective at bringing innovation, optimized risk transfer, accelerated delivery, and a whole-life costing approach (that involve more sophisticated preventative and predictive asset management techniques, which can significantly reduce long-term cost of ownership of the asset) which can bring the lowest overall total cost of ownership to the public sector. Some form of P3s can be utilized in a number of sectors, including transportation, water and wastewater, social infrastructure (public buildings, universities, schools, court houses, corrections facilities, VA hospitals, social housing), energy and utilities, and technology (broadband, data centers).

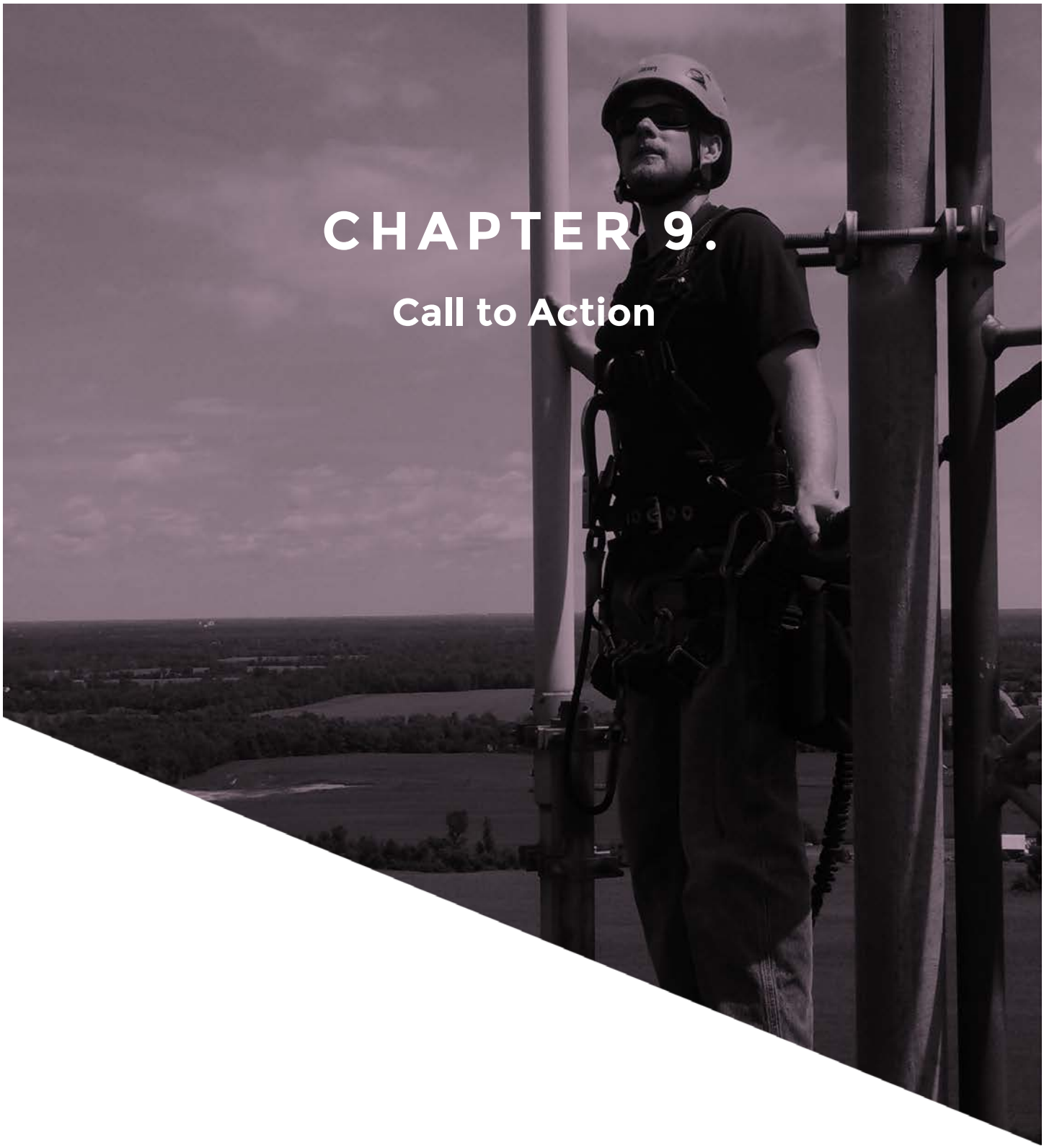
P3 may not deliver the cheapest source of financing but if well-structured can deliver infrastructure more efficiently and cost effectively over the whole life of the asset. The synergies inherent in private sector innovation across design, build, finance and maintenance can provide significant value to the public sector while ensuring high quality service to the public users. Better value includes fewer cost overruns and project delays (due to increased construction, operational, and demand efficiencies such that taxpayers or ratepayers do not bear costs if the project exceeds time expectations, goes over budget, or underperforms), as well as greater investment in durable, flexible infrastructure because of the private sector responsibility for the asset. All of this results in lower life-cycle costs through decreased energy usage, lower maintenance costs, and enhanced resiliency (Sabol 2014).

P3s build and operate many tolls and some bridges, water and energy assets, and airports. Virginia and Florida are two states that have led the way with the implementation of large-scale and innovative toll road P3s to improve infrastructure condition and boost capacity. Virginia has supplemented their economy with billions of dollars from the private sector leading to road upgrades such as express lanes and high occupancy toll (HOT) lanes. Florida encourages private investment in roads and has a Florida Council for P3s to share knowledge between the public and private sectors (Deloitte 2016).

The use of P3s is enhanced by the State of Michigan's creation of a public-private partnership commission, the use of design-build-finance for certain projects by the Michigan Department of Transportation, and encouragement for the state, municipalities, and private industry to undertake projects utilizing P3s. P3s are further encouraged by recent federal policy. Presently pending and working its way through the Michigan Legislature is a new P3 bill intended to further the development of infrastructure (Foster Swift 2016). This may provide a signal to private sector investors that the state is receptive to alternative project delivery options. The Council should explore opportunities to utilize P3s to support infrastructure investment needs, particularly in the transportation sector.

Conclusion

Michigan has an annual funding gap of nearly $4 billion to address critically required infrastructure improvements and maintenance. Current taxes and user fees do not raise sufficient revenue and the state lacks sustainable funding sources to build infrastructure systems for today, as well as for the future. Coordinated asset management and the Michigan Infrastructure Council's leadership can help to prioritize infrastructure planning and investment, as well as provide incentives that encourage collaboration and efficiencies to deliver value to Michigan's residents, who pay the tab. User fees and existing ratepayer structures are the primary funding sources for improvements to infrastructure. Some one-time costs for system build-outs, management tools, and high-risk needs can be frontloaded in this low-interest environment. These one-time and immediate investments get Michigan back on track for safe and reliable infrastructure providing a return on investment, jobs, and economic prosperity. Now is the time to plan for the next 30 to 50 years, driving sound investments for the 21st century.



CHAPTER 9.

Call to Action

As called for in Governor Snyder's 2016-5 Executive Order, this report outlines ambitious goals for Michigan's infrastructure for the next 30 to 50 years. With implementation of these recommendations, Michigan will lead the nation in creating an integrated and holistic infrastructure planning, management, investment and delivery system—one that residents have confidence in. This system will prioritize public health and safety, and solidify Michigan's status as a global leader as we move forward into the 21st century.

Michigan's ability to achieve the 21st Century Infrastructure Commission's vision depends on policymakers taking action today, and prioritizing infrastructure as the foundation of strong communities and increased quality of life. Sound and modern infrastructure is vital to the health and well-being of the people of Michigan and will help support our growing economy.

Today, infrastructure is siloed in our state. There are 619 separate road agencies, 79 transit agencies, 1,390 drinking water systems, 1,080 wastewater systems, 116 electric utilities, ten natural gas utilities, and 43 broadband providers. Coordinated infrastructure planning and management is a necessary foundation to a successful future system. Michigan must implement an integrated asset management database system, create a Council to oversee long-term coordination and strategy, invest in infrastructure systems in a sustainable way, and remain committed to embracing emerging technologies. Achieving these overarching goals, in addition to the sector-specific recommendations put forth in this report, will ensure reliable, safe, efficient, and cost-effective systems.

As a first step, we must identify a strategic way to better manage our infrastructure in order to make informed decisions. Chapter 3 calls for the State to implement an effective statewide asset management system—one that collects reliable data and information across all types of infrastructure. A statewide coordinated infrastructure system would make Michigan a national leader in infrastructure management.

To initiate this game-changing endeavor, the Commission urges the Office of the Governor to establish a regional infrastructure pilot in early 2017 to begin operationalizing a statewide asset management database. By 2018, the Michigan Legislature should establish the Michigan Infrastructure Council, an entity that can leverage the lessons learned in the regional pilot and help to coordinate and unify infrastructure efforts across the state in the decades to come. The database and Council will help the State, regions, local governments, and utilities make informed, strategic decisions, save taxpayer dollars, create opportunities for coordinated infrastructure projects and ensure a 21st century infrastructure system.

Our residents deserve reliable, safe, efficient, and cost-effective infrastructure—a 21st century infrastructure system that creates a foundation for the future. This report is the first step in an entirely new approach to planning, managing, and delivering infrastructure in the state of Michigan. By outlining the challenges and opportunities facing Michigan's infrastructure system and identifying key recommendations for action, the Commission aimed to give policymakers and the public the information and vision needed to begin implementation. We must agree to modernize and invest in our infrastructure systems, recognizing that investments today will create jobs and economic opportunity, attract and retain businesses, and save taxpayer dollars. The Commission looks forward to working together to build this vision as Michigan looks to the 21st century and beyond.

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APPENDIX A.

Recommendations Table

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Communications	**4.1**	**Making Michigan a Smarter State**		
Communications	4.1.1	The State of Michigan should create the Consortium on Advanced Networks (see recommendation 4.2.1 below) to develop a vision, a plan, and execution roadmap to enact the state's digital transformation by investing in emerging technologies, supporting academia in research related to the IoT, building an adaptive IoT workforce, and forming appropriate policies to create a smarter state.	Immediate term (0-2 years)	Immediate term (0-2 years)
Communications	4.1.2	The Michigan Economic Development Corporation (MEDC), in partnership with relevant state agencies, should create a fund to support efforts that will make Michigan a global leader in smart technology development and deployment.	Short term (3-5 years)	Short term (3-5 years)
Communications	4.1.3	The DTMB should actively participate in relevant workgroups and committees of the National Association of Chief Information Officers and the International Telecommunications Union to position Michigan as a technological leader.	Immediate term (0-2 years)	Immediate term (0-2 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Communications	4.1.4	The Michigan Infrastructure Council (see Chapter 3) should engage in P3s to ensure IoT adoption is included in infrastructure planning and retrofit technologies are considered, pursued, and incorporated as they become available for upgrades and maintenance activities to existing and future infrastructure.	Short term (3-5 years)	Short term (3-5 years)
Communications	**4.2**	**Improving Broadband Access and Adoption**		
Communications	4.2.1	The Governor should issue an executive order establishing the Michigan Consortium on Advanced Networks, an advisory body comprising stakeholders from the nonprofit, public, and private sectors and academia. The group would be charged with improving coordination among stakeholders in addressing mobile and fixed broadband access and adoption issues in the state, as well as making Michigan a smarter state.	Immediate term (0-2 years)	Long term (11+ years)
Communications	4.2.1.1	**Policy coordination:** Support local and state agencies in working with the private sector to increase mobile and fixed broadband access in Michigan.		
Communications	4.2.1.2	**Technical assistance:** Provide guidance for local and state agencies working with the private sector to increase mobile and fixed broadband access in Michigan.		
Communications	4.2.1.3	**Asset management:** Continue and expand efforts to map and research mobile and fixed broadband access and adoption.		
Communications	4.2.1.4	**Digital literacy education:** Expand, improve, and create pragmatic digital literacy programs at the state and local level.		
Communications	4.2.1.5	**Funding options:** Provide funding—and help identify funding and financing from all available sources and programs–to entice investors to provide affordable mobile and fixed broadband access to households and businesses statewide, making Michigan a top-five state for mobile and fixed broadband access and adoption.		

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Communications	**4.3**	**Securing Michigan's Digital Infrastructure**		
Communications	4.3.1	DTMB should develop a ubiquitous enterprise log management as a service system, or cyber hub,[46] that allows the cyber security ecosystem to understand new, emerging and historical cyber threats by leveraging advanced and predictive analytics.	Immediate term (0-2 years)	Immediate term (0-2 years)
Communications	4.3.2	DTMB should work to build a cyber-focused workforce, in partnership with the Merit Network, by continuing efforts of the Regional Cybersecurity Education Collaboration.	Immediate term (0-2 years)	Short term (3-5 years)
Communications	4.3.3	DTMB should increase Michigan Civilian Cyber Corps (MiC3) membership to 200 members and invest in development and training for the MiC3.	Short term (3-5 years)	Short term (3-5 years)
Communications	4.3.4	The Governor should create a shared virtual chief information security office to provide consulting and advisory services to multiple local governments.	Immediate term (0-2 years)	Immediate term (0-2 years)
Communications	4.3.5	DTMB should enhance threat intelligence gathering and sharing among states, federal agencies and private sector partners develop responses to common threats, in keeping with guidance published by the National Institute of Standards and Technology.	Short term (3-5 years)	Short term (3-5 years)
Communications	4.3.6	DTMB should advocate for changes to the state's Freedom of Information Act (FOIA) exemptions—which currently prevents Michigan agencies from communicating and coordinating with infrastructure asset owners about cyber and physical security threats/attacks—to allow for appropriate exemptions for agencies protecting Michigan's critical infrastructure.	Immediate term (0-2 years)	Immediate term (0-2 years)

[46] A cyber hub is designed to operationalize existing cyber data, information, and intelligence for the cyber security ecosystem to establish a common operating picture by leveraging predictive and real-time analytics. Cyber hubs provide decision making support to enable organizations to anticipate and respond to cyber events.

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Communications	4.3.7	Entities within the cyber security ecosystem should collaborate to develop a public awareness campaign and other learning opportunities to educate residents, consumers, and families about the reality of online risks and promote cyber safety practices among residents, particularly children and businesses.	Short term (3-5 years)	Short term (3-5 years)
Communications	4.3.8	Work with the cyber security ecosystem and other entities to design and encourage the adoption of a curriculum focusing on technology throughout the science, technology, engineering, and mathematics education system	Short term (3-5 years)	Short term (3-5 years)
Communications	4.3.9	Michigan should develop a next-generation solution to centrally manage identity and authentication management for workers, partners, and residents.	Short term (3-5 years)	Short term (3-5 years)
Energy	**5.1**	**Resource Adequacy**		
Energy	5.1.1	The Michigan Agency for Energy (MAE) and the MPSC should continue to work with MISO and other stakeholders to reform Michigan's current electric market structure by requiring all electric providers to protect their customers from massive outages due to lack of supply by securing adequate capacity resources.	Immediate term (0-2 years)	Ongoing efforts
Energy	5.1.2	MAE and the MPSC should closely monitor all proposed solutions to the energy supply concerns in the Upper Peninsula and work with stakeholders to ensure resolution implementation by 2019.	Immediate term (0-2 years)	Ongoing efforts
Energy	**5.2**	**Energy Waste Reduction**		
Energy	5.2.1	The Michigan Legislature should remove the artificial cap on how much utilities can spend on energy-efficiency programs and provide the MPSC with the ability to evaluate energy waste reduction like any other resource.	Immediate term (0-2 years)	Medium term (6-10 years)
Energy	5.2.2	The Michigan Legislature should ensure that there is no financial disincentive for the use of cost-effective energy waste reduction.	Immediate term (0-2 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Energy	5.2.3	The Michigan Legislature should remove the prohibition on on-bill financing for energy waste reduction efforts.	Immediate term (0-2 years)	Ongoing efforts
Energy	**5.3**	**Cleaner Energy Sources**		
Energy	5.3.1	The MPSC and MAE should continue to work together to ensure continued investment in energy waste reduction, meeting at least 15 percent or more of Michigan's energy needs by eliminating energy waste between now and 2025, as well as meeting any of its additional capacity needs from a combination of cleaner technologies, including renewables and natural gas.	Immediate term (0-2 years)	Medium term (6-10 years)
Energy	5.3.2	Through coordinated efforts, the MPSC, MAE, and MDEQ should continue to ensure that emissions from the electric power sector are reduced by helping utilities choose the cleanest energy sources for the future, in consideration with affordability and reliability.	Immediate term (0-2 years)	Medium term (6-10 years)
Energy	5.3.3	The MPSC and MAE should work to reduce barriers to additional cost-effective renewable energy investment by reducing barriers to interconnection, net metering, and siting.	Immediate term (0-2 years)	Ongoing efforts
Energy	**5.4**	**Electric Reliability**		
Energy	5.4.1	Michigan's utilities should take steps to expedite their response to outages and restore power to their customers in a timely manner by completing plans to deploy AMI while also evaluating additional measures, like vegetation management and other distribution investments. Smaller electric utilities that do not currently have plans to deploy AMI in their service territory should evaluate potential benefits and deploy where prudent and cost effective.	Immediate term (0-2 years)	Immediate term (0-2 years)
Energy	5.4.2	The MPSC and MAE should convene a stakeholder group with the aim of establishing a performance goal for CELID and CEMI metrics and requirements in order for utilities to provide information related to these metrics, as well as their current reliability reporting.	Immediate term (0-2 years)	Immediate term (0-2 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Energy	5.4.3	The MPSC should evaluate investments that provide greater insight into equipment condition and system loading, such as supervisory control and data acquisition, which will allow for greater insight into distribution system operation, enabling proactive maintenance to address problems prior to these issues resulting in an outage.	Immediate term (0-2 years)	Immediate term (0-2 years)
Energy	5.4.4	The MPSC should evaluate proposed new capital investments through a transparent, forward-looking distribution system planning process, and monitor proposed changes to the distribution system planning process for each utility as needed on an ongoing basis.	Immediate term (0-2 years)	Short term (3-5 years)
Energy	**5.5**	**Natural Gas Safety**		
Energy	5.5.1	The MPSC should consider further accelerating plans to replace at-risk natural gas distribution pipe beyond the currently planned 25- to 30-year window by evaluating utilities' current replacement timelines. Emphasis should be placed on coordinating replacements with local investment in other infrastructure asset categories to accelerate progress and leverage investment.	Immediate term (0-2 years)	Long term (11+ years)
Energy	**5.6**	**Adaptable Regulation**		
Energy	5.6.1	The Michigan Legislature, in consultation with MAE and the MPSC, should act to remove the barriers in the current CON process that prevent the MPSC from weighing all large investments against alternatives and determining the impact on reliability, affordability, adaptability, and protection of the environment.	Immediate term (0-2 years)	Immediate term (0-2 years)
Energy	5.6.2	The MPSC and MAE should continue efforts to ensure that Michigan's regulations are adaptable in the face of new technologies. The need for regulatory changes should be evaluated as new technologies emerge.	Immediate term (0-2 years)	Ongoing efforts

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Energy	**5.7**	**Information Security**		
Energy	5.7.1	The Michigan Legislature, together with MAE and the MPSC, should revise FOIA exemptions to allow the appropriate agencies to communicate with infrastructure asset owners about physical and cyber security, and alleviate concerns related to the security of sensitive information when the State is working with infrastructure asset owners.	Immediate term (0-2 years)	Immediate term (0-2 years)
Energy	**5.8**	**Business Attraction and Economic Development**		
Energy	5.8.1	The MPSC and MAE should work together with utilities and companies to expand opportunities for industrial customers to participate in programs that help them reduce energy bills, such as demand response programs.	Immediate term (0-2 years)	Immediate term (0-2 years)
Energy	5.8.2	The MPSC, MAE, and MEDC should confer regularly to continue improving the factors that impact business decisions and engage stakeholders about additional opportunities for business attraction.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	**6.1**	**Road and Bridge Conditions**		
Transportation	6.1.1	The Michigan Infrastructure Council and transportation agencies should work with the Michigan Legislature to identify and enact revenue options that will provide predictable and sustainable funding sufficient to return most higher level roads and bridges to good or fair condition.	Immediate term (0-2 years)	Long term (11+ years)
Transportation	**6.2**	**Bridges and Culverts**		
Transportation	6.2.1	State, county, and local agencies should design and install road-stream crossings to ensure safe pedestrian and vehicle passage, along with natural stream function and aquatic organism passage.	Immediate term (0-2 years)	Long term (11+ years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	6.2.2	MDOT and MDNR should continue to follow state and federal required inspection processes for bridges, as well as hydraulic and drainage analysis for culverts. These agencies should complete regular statewide inspections of all in-service bridges to determine and record conditions using the newest available technologies and techniques.	Short term (3-5 years)	Medium term (6-10 years)
Transportation	6.2.3	MDOT should work with local road agencies to encourage inspection of culverts greater than five feet in diameter at least once every five years. Inspection results should be included in local road agencies' asset management plans.	Short term (3-5 years)	Medium term (6-10 years)
Transportation	6.2.4	MDOT should undertake a pilot project to inspect and document all culverts running under state trunkline highways in one county, for the purpose of assessing data collection costs for a statewide asset management inventory of state highway culverts.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	**6.3**	**Seasonal Weight Restrictions**		
Transportation	6.3.1	MDOT and local road agencies should work together to improve regional consistency and the permitting process in order to create coordinated seasonal weight restriction systems between road agencies.	Short term (3-5 years)	Medium term (6-10 years)
Transportation	6.3.2	Based upon economic considerations, MDOT and local communities should evaluate and prioritize the need to convert additional roads to all-season conditions. Using the statewide asset management database (as referenced in Chapter 3), and in coordination with public agencies and private utilities, plan and fund the conversions to all-season roads in a timely and strategic manner.	Medium term (6-10 years)	Long term (11+ years)
Transportation	**6.4**	**Transit, Passenger, and Freight Rail**		
Transportation	6.4.1	The Michigan Legislature should enact alternative sources for transit funding or provide additional funding for the CTF to encourage robust bus transit, passenger rail, and rail freight systems in Michigan.	Immediate term (0-2 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	6.4.2	Transit agencies should integrate new technology into their transit services and work with MDOT to support their efforts to modernize their technology systems.	Immediate term (0-2 years)	Medium term (6-10 years)
Transportation	6.4.3	MDOT should continue to work in partnership with the railroads to develop components of the DIFT as warranted by increasing volumes of railroad traffic.	Immediate term (0-2 years)	Long term (11+ years)
Transportation	6.4.4	MDOT should identify current and future passenger and freight rail service needs and gaps in Michigan as part of its effort to update the federally required State Rail Plan and State Freight Plan.	Immediate term (0-2 years)	Short term (3-5 years)
Transportation	**6.5**	**Soo Locks**		
Transportation	6.5.1	The Michigan Legislature should pass a resolution to urge the federal government to expedite completion of the Economic Reevaluation Report currently being prepared by the U.S. Army Corps of Engineers and to provide the necessary funding to construct the new lock.	Immediate term (0-2 years)	Short term (3-5 years)
Transportation	**6.6**	**Port Authority Landside Improvements**		
Transportation	6.6.1	The Michigan Legislature should consider legislation that provides port authorities with the flexibility to form private sector partnerships for the purposes of developing contiguous and adjacent landside infrastructure consistent with the local vision for the port.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	**6.7**	**Routine Port Maintenance**		
Transportation	6.7.1	The Office of the Governor, Michigan's Congressional delegation, and the Michigan Legislature should encourage Congress to provide the necessary funds and encourage the U.S. Army Corps of Engineers to prioritize fully maintaining the federal navigation channels at their congressionally authorized dimensions to ensure that port conditions do not deteriorate.	Immediate term (0-2 years)	Ongoing efforts

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	6.7.2	The Conference of Great Lakes and St. Lawrence Governors and Premiers should analyze the dredging needs for individual docks and nonfederal navigation channels specifically, including privately owned facilities to the greatest degree possible.	Immediate term (0-2 years)	Ongoing efforts
Transportation	6.7.3	MDOT should encourage the appropriate state, county, and city road agencies to work together to perform infrastructure assessments that would evaluate the needs of “last mile” roads that serve as connectors linking port facilities with the highway system.	Immediate term (0-2 years)	Ongoing efforts
Transportation	**6.8**	**Aviation**		
Transportation	6.8.1	MDOT will complete a comprehensive assessment of general aviation needs across Michigan as part of the ongoing Michigan Airport System Plan update, as well as examine existing capacity, use, costs, and revenues the State receives in order to determine whether the system of airports properly supports the future needs of Michigan communities.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	**6.9**	**Intelligent Vehicle Technology**		
Transportation	6.9.1	The Michigan Legislature, Governor, and relevant stakeholders should pass, sign, and support the implementation of currently proposed legislation that will enable Michigan to stay at the forefront of the intelligent vehicle industry.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	6.9.2	MDOT and the MEDC should work with auto manufacturing companies, technology companies, private stakeholders, and Michigan universities to support the development of intelligent vehicle through investment in research, and develop a plan to invest in the installation of new technology.	Immediate term (0-2 years)	Immediate term (0-2 years)
Transportation	6.9.3	The Governor’s Office and MDOT should promote Michigan as the focal point of the global intelligent vehicle industry.	Immediate term (0-2 years)	Ongoing efforts

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	6.9.4	MDOT and the MEDC should leverage unique partnerships between all governmental agencies, companies, universities, and other organizations to advance Michigan's intelligent vehicle industry.	Immediate term (0-2 years)	Ongoing efforts
Transportation	6.9.5	The Michigan Infrastructure Council (see Chapter 3) should include an emerging technologies group that is tasked with research, education, and coordination of implementing innovative technologies that impact infrastructure planning and delivery, particularly the emerging autonomous vehicle industry.	Short term (3-5 years)	Ongoing efforts
Transportation	**6.10**	**Signalized Intersection Technology**		
Transportation	6.10.1	The Michigan Infrastructure Council should work with local road agencies to elevate traffic signal infrastructure as a key asset of similar importance to road condition and bridge condition and encourage each road agency to pursue a goal to modernize and optimize the timing of 90 percent of traffic signals in congested corridors with current and emerging technologies, including signal communications, interconnectivity, transit signal priority, and vehicle detection equipment,	Short term (3-5 years)	Medium term (6-10 years)
Transportation	**6.11**	**Nonmotorized Transportation**		
Transportation	6.11.1	MDOT should continue to work with road agencies to encourage full integration of bicycle and pedestrian planning into transportation infrastructure planning, including by implementing performance measures that measure the connectivity of nonmotorized facilities.	Immediate term (0-2 years)	Medium term (6-10 years)
Transportation	6.11.2	MDOT and MDNR should work with regional transportation coordinating bodies to encourage or incentivize communities to coordinate their nonmotorized investments and work toward improving connectivity across communities.	Immediate term (0-2 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	6.11.3	MDOT and MDNR should study the potential to create new incentives or realign existing incentives to further enhance and encourage coordinated nonmotorized planning, both between communities and at the regional level.	Immediate term (0-2 years)	Short term (3-5 years)
Transportation	**6.12**	**Right-sizing**		
Transportation	6.12.1	MDOT should identify and work with stakeholders across all modes to complete a comprehensive assessment that determines the kind of transportation infrastructure that is needed—and where—to support the industries and communities Michigan expects to have in the future.	Immediate term (0-2 years)	Short term (3-5 years)
Transportation	6.12.2	MDOT should continue to work with local agencies and transportation stakeholders to identify areas of the state where excess road infrastructure undermines the potential for community success, develop context sensitive solutions to transportation problems, and encourage the use of design solutions that make more effective and beneficial use of the excess road capacity.	Immediate term (0-2 years)	Ongoing efforts
Transportation	6.12.3	The Michigan Infrastructure Council should work with local agencies to encourage and incent cross-collaboration and opportunities for consolidation to provide transparent, safe, efficient, and cost-effective solutions.	Immediate term (0-2 years)	Ongoing efforts
Transportation	6.12.4	MDOT, metropolitan planning organizations, and regional planning organizations should encourage greater coordination between agencies and provide technical assistance to local agencies seeking solutions that help right-size their infrastructure.	Immediate term (0-2 years)	Ongoing efforts
Transportation	**6.13**	**Act 51 Review**		
Transportation	6.13.1	The Michigan Infrastructure Council should work with the Michigan Legislature and transportation stakeholders to revise Act 51 to make the distribution of state transportation revenues simpler, equitable, more transparent, and more accountable, while improving system outcomes.	Immediate term (0-2 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Transportation	**6.14**	**Local Revenue Generation Options**		
Transportation	6.14.1	The Michigan Legislature should enact legislation to enable new methods of generating local revenue to increase transportation investment including, but not limited to, a regional-option gasoline tax and impact fees from land developments that burden road systems or from permits for driveways that diminish traffic flow. Additional legislative considerations should include regional-option sales taxes, levied in addition to the Michigan sales tax, which are used for transit operations in many states and could be made eligible for road and transit infrastructure use as well as regional-option vehicle registration surtax.	Immediate term (0-2 years)	Long term (11+ years)
Transportation	**6.15**	**Road and Bridge User Fees**		
Transportation	6.15.1	MDOT and the DTMB should pilot test a per-mile fee system (such as GPS-based) in Michigan and use that test to become the first state to distribute user fees among road jurisdictions or within regions based on the miles of travel in each jurisdiction or region.	Immediate term (0-2 years)	Medium term (6-10 years)
Transportation	**6.16**	**Tolling**		
Transportation	6.16.1	MDOT should position Michigan to apply for the Interstate System Reconstruction and Rehabilitation Pilot program (ISRRPP) if one of the openings becomes available.	Immediate term (0-2 years)	Short term (3-5 years)
Transportation	6.16.2	The Michigan Legislature should enact a bill authorizing toll finance as an option for road finance in Michigan to indicate to the Federal Highway Administration that Michigan is ready to implement a pilot tolling project through the ISRRPP.	Immediate term (0-2 years)	Medium term (6-10 years)
Transportation	6.16.3	MDOT should work with the Office of the Governor and the Michigan Legislature to encourage Michigan's Congressional delegation to authorize toll finance on existing federal-aid roads.	Immediate term (0-2 years)	Short term (3-5 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	**7.1**	**Ensuring Public and Environmental Health**		
Water	7.1.1	The MDEQ should provide financial assistance to communities in need to invest in replacing aging infrastructure where there are immediate risks to public health or the environment due to lagging water infrastructure investments.	Immediate term (0-2 years)	Long term (11+ years)
Water	7.1.2	The MDEQ should develop an outcome-based regulatory framework that ensures compliance is achieved, while enabling flexibility of means and methods through a permitting system that supports innovation to achieve public and environmental health goals. State and local programs should be revised to achieve these outcomes.	Short term (3-5 years)	Medium term (6-10 years)
Water	7.1.3	The MDEQ should use resources such as the recommendations of the National Drinking Water Advisory Council, municipal utilities, current U.S. Environmental Protection Agency (U.S. EPA) standards, and evolving research to inform legislative updates to the regulation of drinking water.	Immediate term (0-2 years)	Long term (11+ years)
Water	7.1.4	The MDEQ should provide grants and technical assistance to schools to develop and implement a science-based drinking water quality testing and remediation program for lead and other contaminants.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	7.1.5	The MDEQ and MDHHS should incorporate science-based research in establishing drinking water standards and evaluate sources of drinking water contamination as technology advances, enabling better detection of pollutants to determine whether further controls are warranted in drinking water and wastewater systems.	Immediate term (0-2 years)	Ongoing efforts
Water	7.1.6	The MDEQ should continue to provide funding through the Clean Michigan Initiative (CMI) to assist with cleanup efforts of contaminated properties that threaten public health and drinking water supplies.	Immediate term (0-2 years)	Long term (11+ years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.1.7	The MDEQ and MDHHS, local municipalities, and utilities should expand public outreach, engagement, and state and local communication efforts regarding regulatory standard to manage risk and ensure public and environmental health are maintained, and the necessity of water supply, sewer, and stormwater investments.	Immediate term (0-2 years)	Ongoing efforts
Water	7.1.8	The MDEQ and MDHHS, in partnership with drinking water system operators, regional partners, and federal agencies, should expand comprehensive real-time surface and groundwater monitoring to detect potential threats to water supplies, develop early responses, and provide regular public reporting.	Short term (3-5 years)	Long term (11+ years)
Water	**7.2**	**Water Asset Management**		
Water	7.2.1	The MDEQ should compile and evaluate asset management plans submitted under the first phase of the Stormwater, Asset Management, and Wastewater program. If necessary, the program should be updated to ensure that completed asset management plans are comprehensive and provide sufficient detail for planning purposes and meet MDEQ criteria.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	7.2.2	The MDEQ should expand the current SAW program, to provide a portion of the funding necessary to complete condition assessments and the development of asset management plans for drinking water supply systems.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	**7.3**	**21st Century Infrastructure Systems**		
Water	7.3.1	The Michigan Infrastructure Council and other asset management entities should partner with economic development entities to identify and prioritize areas for targeted infrastructure water, sewer, and stormwater replacements or upgrades.	Immediate term (0-2 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.3.2	The Michigan Department of Agriculture and Rural Development (MDARD) should help support access to wastewater treatment capacity, potable water, and drain infrastructure in rural communities to promote land-based industries such as food, fiber crops, tourism, and mining, in order to keep rural communities competitive in a global economy.	Immediate term (0-2 years)	Long term (11+ years)
Water	**7.3**	**Understanding Risk**		
Water	7.3.1	The State of Michigan, local municipalities, and utilities should expand public outreach, engagement, and state and local communication efforts regarding how regulatory standards are developed to manage risk and ensure public and environmental health are maintained, as well as why water supply, sewer, and stormwater investments are necessary	Immediate term (0-2 years)	Ongoing efforts
Water	7.3.2	The State of Michigan, in partnership with drinking water system operators, regional partners, and federal agencies, should expand comprehensive real-time surface and groundwater monitoring to detect potential threats to water supplies, develop early responses, and provide regular public reporting	Immediate term (0-2 years)	Long term (11+ years)
Water	**7.4**	**Fiscally Sustainable Water, Sewer, and Stormwater Pricing Models**		
Water	7.4.1	Through new policy, state auditing, regulatory processes, and technical support, Treasury and MDEQ should require self-sufficient transparent operation of enterprise organizations for water, sewer, and stormwater utilities that are supported by rate structures that cover all capital, operation, maintenance and replacement expenditures based on up-to-date asset management plans.	Medium term (6-10 years)	Medium term (6-10 years)
Water	7.4.2	Utilities should engage in customer outreach when developing financing and ratemaking processes for all water, sewer, and stormwater utilities to achieve greater degrees of transparency.	Short term (3-5 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.4.3	The MDEQ and Treasury should evaluate and modify Michigan's Water Pollution Control Revolving Fund, better known as the State Revolving Fund (SRF), to increase opportunities for participation in the program.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.4.4	The Michigan Legislature should adopt legislation authorizing stormwater utilities that is consistent with the *Bolt v. City of Lansing*[47] decision, establishes the requirements for structuring and charging a fee, and provides a streamlined process for local adoption.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.4.5	Water utility rate structures should incorporate incentives to promote water-use efficiencies to reduce operating costs and delay or eliminate the need for capital investment.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	**7.5**	**Green Infrastructure**		
Water	7.5.1	The Michigan Department of Licensing and Regulatory Affairs (LARA), MDEQ, MDNR, and MDOT should encourage the integration of low-impact development/design standards and green infrastructure for stormwater management.	Immediate term (0-2 years)	Short term (3-5 years)
Water	7.5.2	To enhance community resiliency and optimize costs, the MDEQ and MDNR should facilitate the development of tools that enable stormwater and wastewater system owners, managers, and operators to fiscally and operationally manage green infrastructure through asset management plans.	Medium term (6-10 years)	Long term (11+ years)
Water	7.5.3	Treasury and the MDEQ should update and revise funding and financing mechanisms that support infrastructure investments to incent evaluation and implementation of both efficiency-oriented approaches and green infrastructure.	Immediate term (0-2 years)	Immediate term (0-2 years)

[47] The *Bolt v. City of Lansing* decision has precluded most municipalities in Michigan from establishing stormwater utilities. The decision requires stormwater assessment to be based on the unique contributions of individual properties.

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.5.4	The MDEQ should periodically review and revise its programs and permitting requirements to ensure that engineering and design practices for sanitary sewer overflow (SSO) and combined sewer overflow (CSO) correction and stormwater management are based on assumptions that anticipate increased storm intensity and/or frequency.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	7.5.5	Drinking water, wastewater, and stormwater agencies should evaluate the resiliency of systems and facilities that enhance a community's readiness for increased storm intensity and/or frequency as well as their timely recovery as part of their asset management planning.	Immediate term (0-2 years)	Medium term (6-10 years)
Water	7.5.6	The MDEQ, MDARD, and county drain commissioners should develop draft revisions and then work with other stakeholders to provide recommendations to the Michigan Legislature to update the Michigan Drain Code (if appropriate) and municipal separate storm sewer system (MS4) program to better facilitate joint action and collaboration among jurisdictions to manage stormwater on a watershed basis. Chapter 22 of the drain code should be updated to allow petitions to request development of collaborative watershed management plans as well as watershed-based engineering and design studies.	Short term (3-5 years)	Medium term (6-10 years)
Water	7.5.7	The MDEQ, MDARD, and county drain commissioners should develop draft revisions then work with other stakeholders to provide recommendations to the Michigan Legislature to address inconsistencies between the drain code and MS4 programs, with a goal of more explicitly authorizing projects focused primarily on management of water quality, especially in urbanized areas.	Short term (3-5 years)	Medium term (6-10 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.5.8	Relevant state agencies, including the Department of Technology, Management, and Budget, and the MDEQ should assess properties to identify and implement opportunities to use green infrastructure to manage stormwater. The MDNR and MDOT should be the first agencies to conduct this evaluation.	Short term (3-5 years)	Medium term (6-10 years)
Water	**7.6**	**Onsite Well and Wastewater Treatment Systems**		
Water	7.6.1	The MDEQ, Michigan Department of Health and Human Services (MDHHS), and LARA should revise regulations to require county and municipal governments, as well as water and sewer utilities, to use planning and permitting processes, taxes, fees, and other policies to promote connection to public water supply and wastewater treatment systems when they are available or when a new or expanded municipal system would be cost effective.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.6.2	The MDEQ, MDHHS, and LARA, in partnership with local health departments, should encourage local governments to adopt ordinances requiring new homes and businesses with failed onsite wastewater treatment systems to connect to established community systems if they are available within 200 feet, consistent with Michigan Public Health Code (Act 368).	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.6.3	The Michigan Legislature should pass new legislation that would enable local governments to adopt ordinances requiring homes and businesses to connect to community drinking water systems when onsite water wells fail if they are within 200 feet of an existing system.	Immediate term (0-2 years)	Immediate term (0-2 years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.6.4	Communities should use Section 208 of the federal Clean Water Act to plan wastewater treatment facilities under an area-wide wastewater treatment management plan. In such cases, the MDEQ should use the permissive authority granted under Act 451, Part 21, Rule 39 to ensure that state or national permits (e.g., National Pollutant Discharge Elimination System) are addressed consistently with the approved Section 208 plan.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.6.5	The MDEQ and local health departments should strengthen permitting requirements to allow community systems only where a municipal system connection is not available, cost effective, or environmentally necessary. Community systems should be adaptable to future increases in the number of users, demonstrate a financially supported asset management plan, and provide for eventual connection to a municipal system.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.6.6	The MDEQ and MDHHS should work with the Michigan Legislature and local public health departments to update Michigan's Statewide Sanitary Code. The revised code should include 1) inspections of septic and community systems on a routine basis (e.g., every five years); 2) an approval route for alternative systems where public health or environmental quality is at risk; 3) minimum requirements for permitting; 4) a local health department–based, statewide registry of septic systems, including location, installation, and inspection dates; and 5) requirements for maintenance, pumping, repair, or replacement based on inspection results.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	7.6.7	The MDEQ and MDHHS should develop a financing mechanism such as a low-interest revolving loan fund or loan loss reserve program to support maintenance and replacement of existing onsite and community systems for system owners with a demonstrated need for financial assistance.	Immediate term (0-2 years)	Long term (11+ years)

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	**7.7**	**Embracing New Technology to Develop 21st Century Utilities**		
Water	7.7.1	The MDEQ, municipalities, and local utilities should put in place a process to periodically review and update new technologies, procurement manuals, or standard operating practices to allow for open competition for technology and materials meeting relevant professional standards (e.g., American Water Works Association, Michigan Water Environment Association).	Short term (3-5 years)	Medium term (6-10 years)
Water	7.7.2	The MDEQ, municipalities, and local utilities should put in place a process to periodically review and update regulatory programs, implement methods of continuous improvement, and create standard work to further enable innovative approaches to achieve environmental protection and public health outcomes, as well as to control costs.	Short term (3-5 years)	Medium term (6-10 years)
Water	7.7.3	The MDEQ should work with municipal utilities to amend the current wastewater regulatory framework to advance the State of Michigan's Water Resource Recovery Facility framework and educate municipalities about the benefits of these approaches.	Medium term (6-10 years)	Medium term (6-10 years)
Water	7.7.4	The MDEQ should work with municipal utilities to amend the current drinking water regulatory framework to advance the development of 21st century water utilities and inform municipalities about the benefits of these approaches.	Medium term (6-10 years)	Medium term (6-10 years)
Water	7.7.5	The MDEQ should encourage and incent strategies like resource recovery, as well as energy conservation and management options at wastewater and drinking water facilities, to help conserve resources and drive down costs. Revisions to Michigan's revolving loan fund could help incent those changes.	Medium term (6-10 years)	Medium term (6-10 years)
Water	7.7.6	The MDEQ should support innovation through partnerships and or funding with Michigan universities to expand research programs in the drinking water and wastewater fields.	Short term (3-5 years)	Ongoing efforts

Asset Type	Rec. #	Rec.	Implementation Start	Implementation Complete
Water	7.7.7	The MDEQ and water utilities should support new and emerging cost-effective technologies (such as smart metering and loss management technology) through permitting requirements that integrate water utilities with innovative communication and energy networks.	Immediate term (0-2 years)	Immediate term (0-2 years)
Water	**7.8**	**Dams**		
Water	7.8.1	The MDEQ's Dam Safety Program should maintain a publicly accessible geospatial data layer within the statewide asset management system that includes the number, condition, risk, and ownership of public, and private, regulated and nonregulated dams in the state. Working with partner organizations, the MDEQ should develop publicly available decision-support tools and training programs to assess risk, reinvestment and removal options for dams and low-head barriers.	Short term (3-5 years)	Long term (11+ years)

APPENDIX B.

Public Engagement

Governor Snyder launched the 21st Century Infrastructure Commission on March 10, 2016. The goal of this Commission was to identify long-term strategies to help ensure that Michigan's infrastructure is updated and efficient. The 27-member Commission comprises industry experts from business, government, and infrastructure-related fields.

The Commission recognized early on that public engagement would be key to ensuring that the needs and expectations of Michigan residents are reflected in their final recommendations. To this end, the Commission developed a public engagement strategy with the following goals:

- Gather feedback and input from the public, both in person and online.
- In an effort of transparency, provide regular updates from the Commission.
- Increase exposure to the importance of creating a 21st century infrastructure plan and strategy via the listening tour stops.

Public Engagement Schedule

The following graphic outlines the public engagement schedule that commissioners engaged in throughout this process. Commissioners participated in three stakeholder roundtable discussions and three listening tour events hosted in six locations, traveling across Michigan between July and September 2016 to meet with residents and learn about their infrastructure needs.

LISTENING SESSIONS AND STAKEHOLDER DISCUSSIONS THROUGHOUT THE STATE

TRAVERSE CITY STAKEHOLDER ROUNDTABLE DISCUSSION

Small-business owners, community leaders, and local economic developers

TOPICS

- Rural energy distribution
- Agricultural processing waste management
- Difficulties local governments face when trying to raise revenue for infrastructure investment
- Ensuring long-term sustainability of infrastructure systems
- High-quality cell phone coverage
- Solar and renewable energy

WEST MICHIGAN LISTENING TOUR

Over 60 members of the public as well as community and business leaders from the West Michigan region

TOPICS

- Public education on the benefits of well-coordinated and well-planned infrastructure systems
- Mobile congestion issues
- High transportation costs for businesses
- Ensuring public safety when planning and managing public transportation, especially for special needs populations
- Need for intermodal transportation systems

ESCANABA STAKEHOLDER ROUNDTABLE DISCUSSION

Sixteen small business owners, community and business leaders, and economic development representatives

TOPICS

- Broadband access in rural areas of the state to help small businesses succeed and allow young talent to live and work anywhere
- Rail investment and maintenance needed, especially for short-line service
- Stability of energy prices and delivery

NORTHERN MICHIGAN LISTENING TOUR

Over 100 members of the public as well as community and business leaders from the Northern Michigan region

TOPICS

- Increase access to high-speed Internet and broadband
- Lack of investment in the Soo Locks
- Sustainable, renewable, and efficient energy infrastructure

FLINT STAKEHOLDER ROUNDTABLE DISCUSSION

Flint and Genesee County community leaders and residents and members of the Flint Water Interagency Coordinating Committee

TOPICS

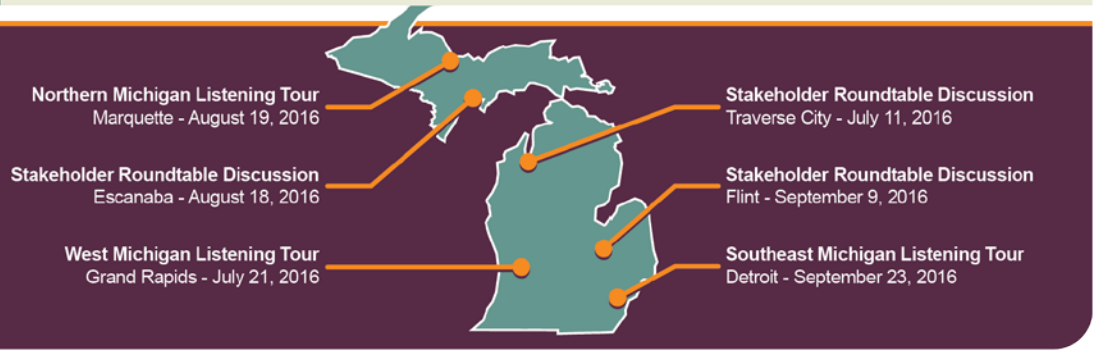
- Lack of resources, tools, and funding for local governments in regards to infrastructure maintenance and investment
- The need for Michigan to have safe, reliable, and affordable water infrastructure

SOUTHEAST MICHIGAN LISTENING TOUR

Over 50 members of the public, as well as community and business leaders from the region, and representatives from the Detroit RiverFront Conservancy, Eastern Market, and the Detroit Experience Factory

TOPICS

- Capacity issues of infrastructure systems
- Embrace future "smart" technologies
- Public safety when planning and managing public transportation
- Investment in high-quality, safe bike infrastructure
- Regional transit system

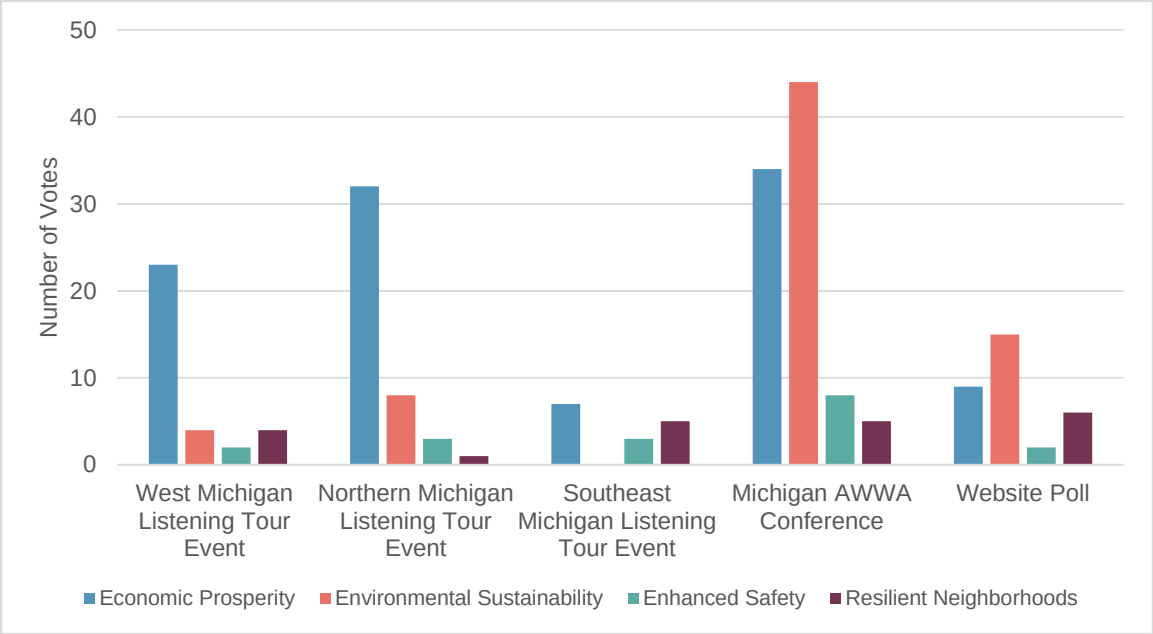


Feedback from Public Engagement

At each of the public outreach events hosted by the Commission, residents raised the need for a statewide, comprehensive asset management program, the expectation of affordable and safe water and sewer systems, and the need to embrace emerging "smart" technologies. In order to engage with and receive additional feedback from Michiganders statewide, commissioners solicited comment through their website (miinfrastructurecommission.com) and a public email address. Over 2,539 individuals visited the website, 176 answered poll questions, and 69 comments were posted to a public discussion board. Results of these interactions were compiled and presented to the Commission on a regular basis to help inform their decisions.

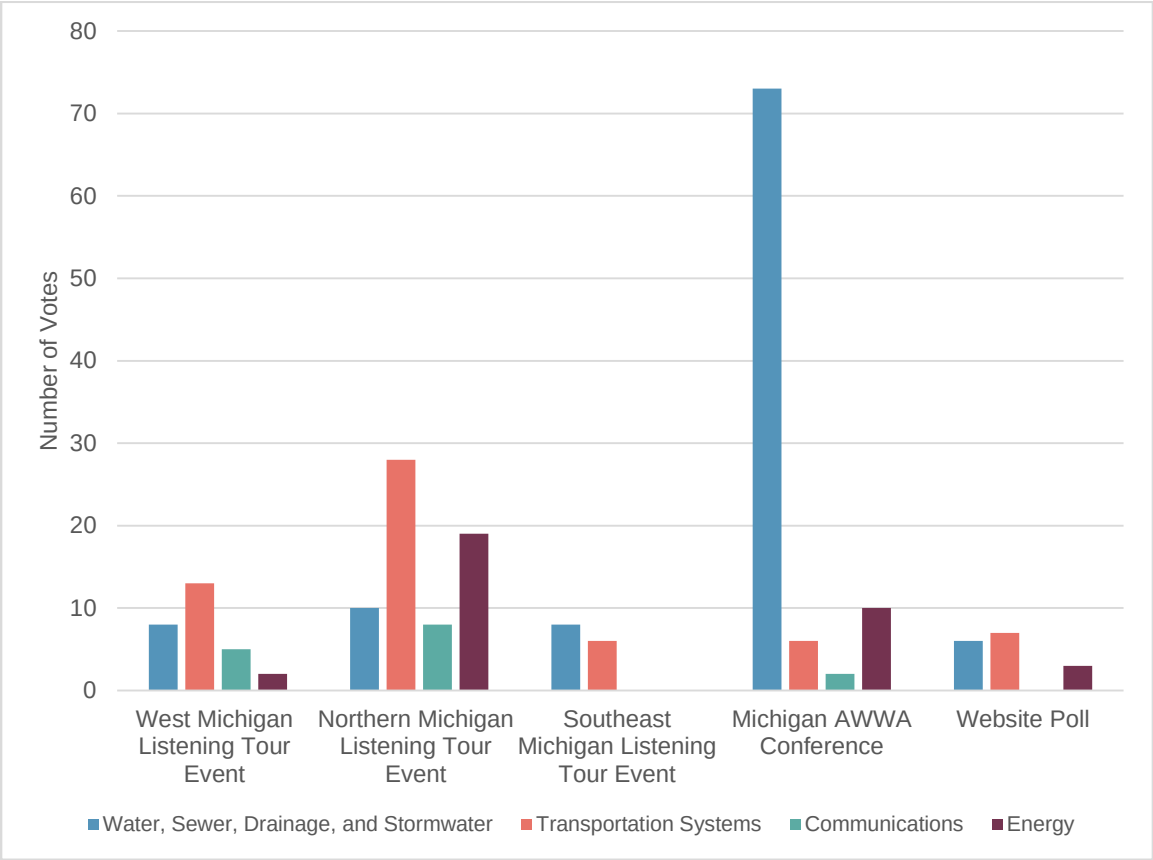
The public participated in multiple polls online and at listening tour events regarding the importance of infrastructure investment, which the Commission utilized while developing recommendations. Below are graphs indicating the results of these polls as of October 29, 2016.

EXHIBIT 24. Biggest Benefit of 21st Century Infrastructure



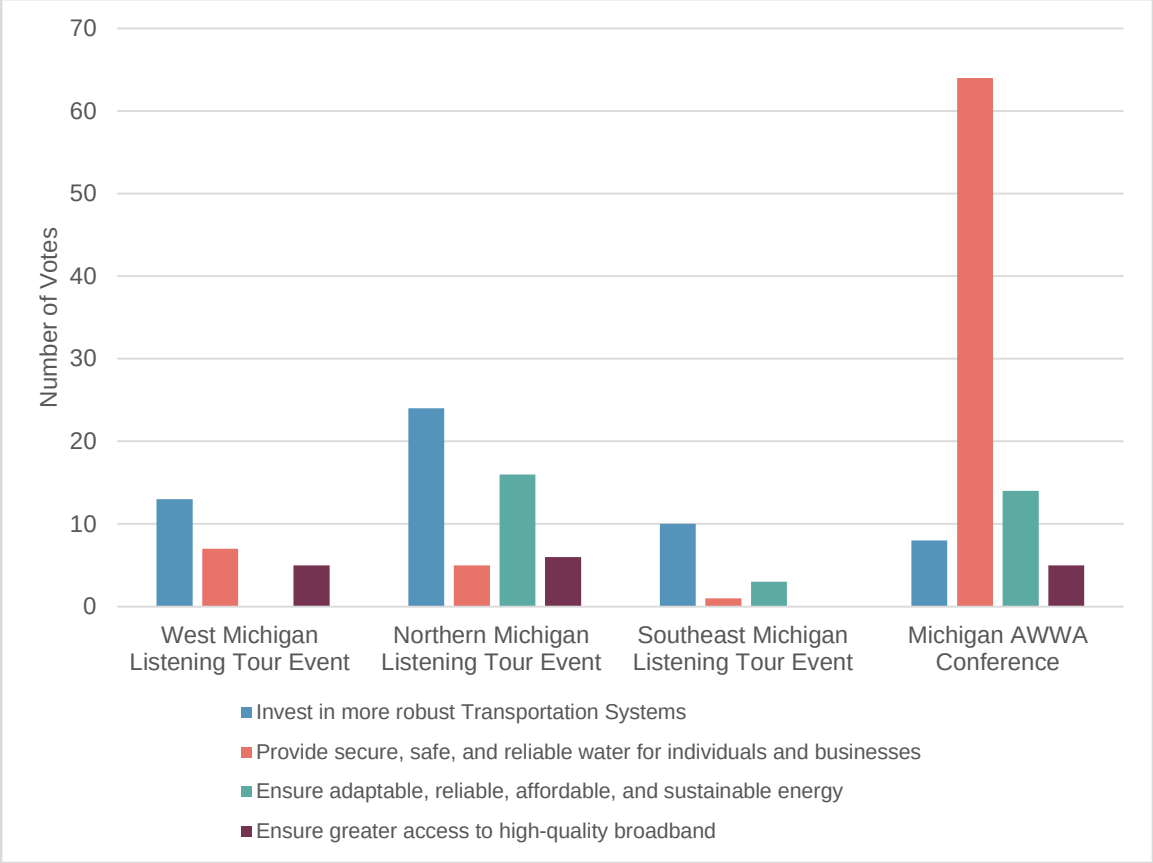
Source: Responses collected at three listening tours across the state and comments received through the Michigan Infrastructure Commission website.

EXHIBIT 25. Most Important Type of Infrastructure by Region



Source: Responses collected at three listening tours across the state and comments received through the Michigan Infrastructure Commission website.

EXHIBIT 26. Best Infrastructure Systems to Retain and Attract Residents and Businesses



Source: Responses collected at three listening tours across the state and comments received through the Michigan Infrastructure Commission website.

The following table provides a more detailed assessment of the major themes commissioners heard from listening tour attendees and roundtable discussion participants. A dot next to a theme indicates it was brought up by an attendee at the corresponding event.

EXHIBIT 27. Themes by Region

	Traverse City Roundtable	West Michigan Listening Tour	Escanaba Roundtable	Northern Michigan Listening Tour	Flint Roundtable	Southeast Michigan Listening Tour
Overarching Themes						
Create, maintain, and incentivize a comprehensive asset management program	●	●	●	●	●	●
Ensure long-term sustainability of infrastructure systems	●	●	●	●		●
Fix capacity issues with current infrastructure systems	●	●	●			●
Provide efficient, sustainable, affordable, cost-effective, and reliable infrastructure systems	●	●	●	●		●
Embrace future or “smart” technology	●	●	●	●	●	●
Utilize P3s	●	●	●	●		●
Water/Wastewater/Stormwater/Drainage						
Provide affordable and safe water and sewer systems	●	●	●	●	●	●
Manage and fund stormwater drains in a sustainable, comprehensive manner					●	●
Help local governments finance the creation and maintenance of culverts					●	
Educate the public on well and septic maintenance			●	●		●
Regulate and manage private property drinking water and sewer systems			●	●		
Communications and Energy						
Increase access to high-speed Internet and broadband	●	●	●	●		●
Address rural energy distribution issues (natural gas and propane)	●		●	●		
Ensure high-quality and reliable cell phone service	●		●	●		
Provide sustainable, renewable, and efficient energy infrastructure		●	●	●	●	●
Transportation Systems						
Ensure public safety when planning and managing public transportation, especially for special needs populations		●		●	●	●

	Traverse City Roundtable	West Michigan Listening Tour	Escanaba Roundtable	Northern Michigan Listening Tour	Flint Roundtable	Southeast Michigan Listening Tour
Transportation Systems						
Provide intermodal transportation systems	●	●		●	●	●
Invest in Soo Locks maintenance and the building of a new lock	●	●	●	●	●	
Plan for local capacity issues during peak tourism time	●					
Address mobile congestion issues		●				●
Transportation system repair needed	●	●	●		●	●
Address high transportation costs for businesses		●	●	●		
Create and utilize interconnected port and rail systems		●	●	●		
Seasonal weight restrictions on roadways are a hindrance to businesses			●			
Invest in high-quality, safe bike infrastructure			●			
Invest in air travel and commuter rail development that encourages tourism and local economic development			●	●		
Regional transit systems needed						●
Diversify transportation assets			●	●		
Policy and Funding						
Lack of resources, tools, and funding for local governments	●	●	●	●	●	●
Connect small businesses and communities to grant and financing opportunities	●				●	
Lack of new tools for local economic development		●				●
Create and enforce standards for basic levels of function and reliability for all infrastructure systems		●				
Reward/do not punish cities that invest in infrastructure without waiting for an emergency	●	●	●	●		
Spread investment costs across all current and future users		●				
Utilize user fees, local millages, low- and no-interest loans, and revolving loan funds		●				●
Better support for local governments in asset management and planning			●	●	●	●

	Traverse City Roundtable	West Michigan Listening Tour	Escanaba Roundtable	Northern Michigan Listening Tour	Flint Roundtable	Southeast Michigan Listening Tour
Policy and Funding						
Coordinate state agencies to jointly review routing and citing of permit applications				●		
Strategically invest and make efficient use of infrastructure		●	●	●		●
Redesign revenue collection systems						●
Other						
Invest in infrastructure workforce development	●	●	●	●	●	●
Educate the public on the benefits of well-coordinated and well-planned infrastructure systems	●	●				
Invest in systems that protect the environment	●		●	●		●
Engage younger generations in the infrastructure policy debate			●	●		
Prioritize public health in infrastructure planning and investment					●	
Enhance collaboration among service providers						●
Involve the deaf community, other special needs communities, and non-English-speaking communities in the planning of infrastructure systems					●	

APPENDIX C.

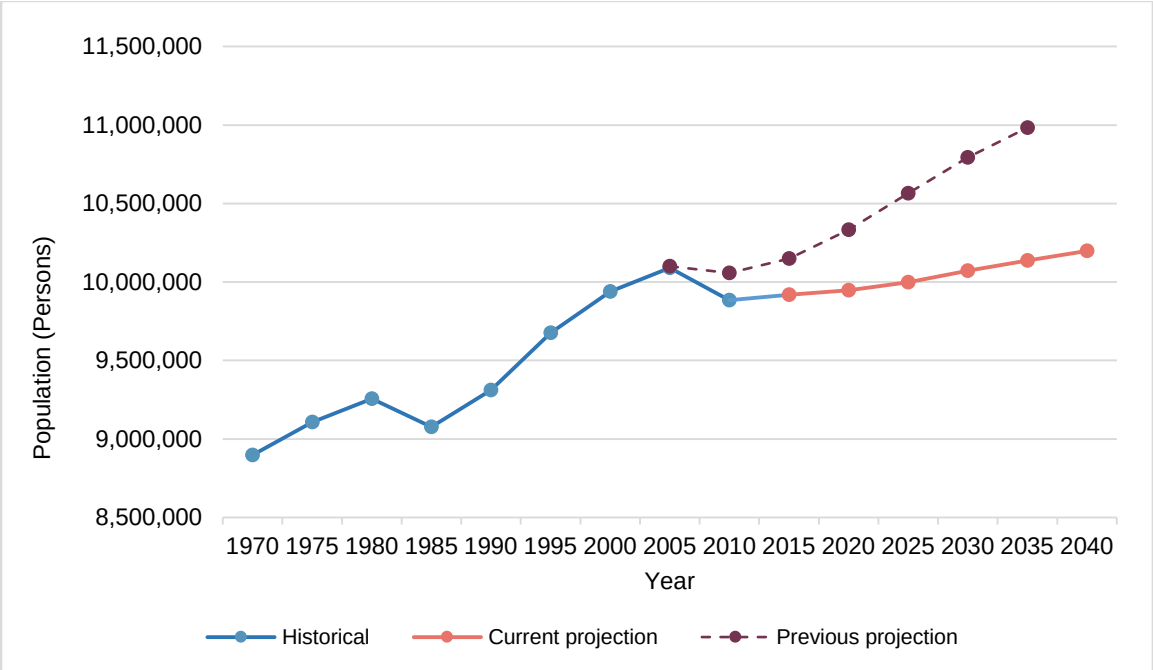
Demographic Trends and Forecasts

Michigan's demographic past and future add challenges to adequately funding its infrastructure systems. The demand for infrastructure is heavily shaped by population trends, and as communities grow, the need for greater infrastructure grows as well. As a community's population declines, however, there is a profound impact on an area's ability to maintain and operate its existing infrastructure systems.

Population

According to *Moving Michigan Forward: 2040 State Long-range Transportation Plan*, between 2000 and 2010, Michigan lost approximately 55,000 residents, as the nation experienced a major economic recession. While continuing population loss in not expected, it has contributed to a much lower forecast of Michigan's population growth than was previously projected.

EXHIBIT 28. Michigan Population, 1970–2040

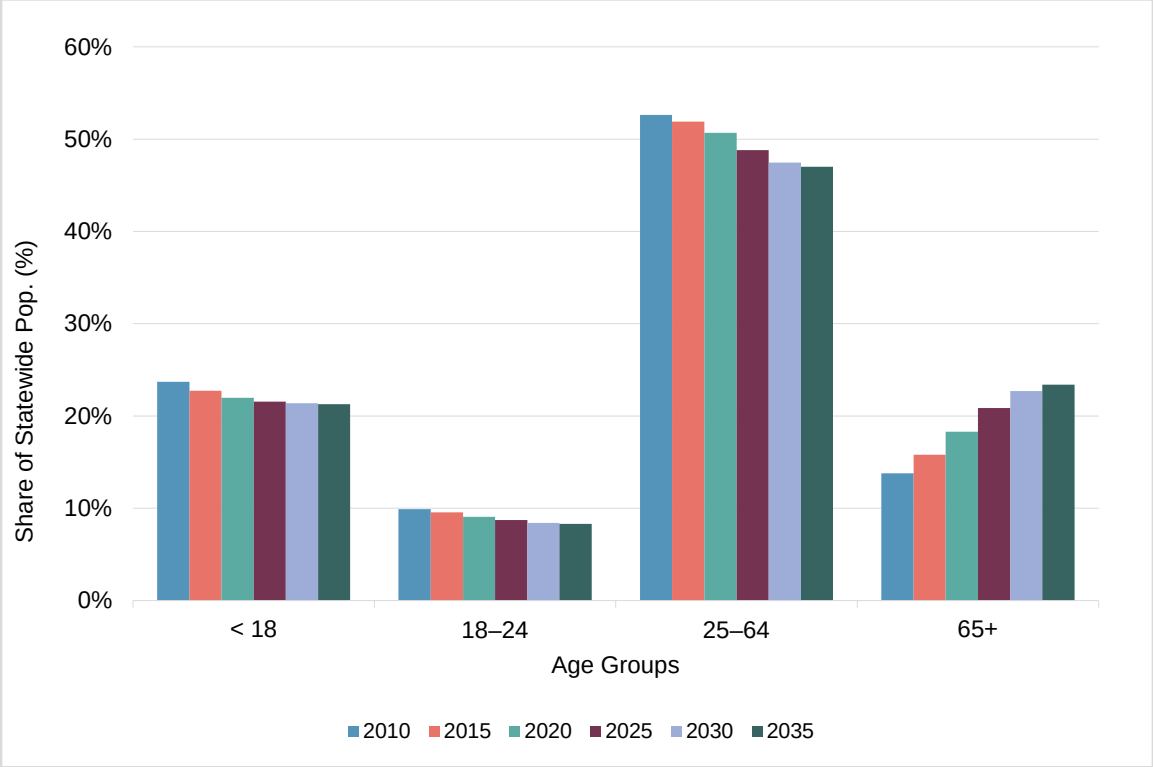


Source: MDOT July 2016.

Michigan's population growth will be accompanied by a significant shift in the share of age groups:

- Michiganders aged 25–64 will still make up the largest share of the state's population; however, this group will shrink from 51.9 percent of the population in 2015 to 47.2 percent by 2040. This decline will have important repercussions for Michigan, as it is also the largest working population and the most able to bear user fees and taxes to fund infrastructure service and delivery.
- All age groups will decline by 2040 except the group aged 65 years or older, which will increase by 82 percent from 2010 to 2040. An increase this significant will affect the types of infrastructure and services the state can provide to Michigan residents.

EXHIBIT 29. Share of Statewide Population by Age Group, 2010–2040



Source: MDOT July 2016.

Over the last four decades, Michigan has lost a significant number of residents who have moved to other states (domestic migration). The State Long Range Plan projects that net migration will remain negative through 2030, but migration overall will be positive. The bulk of this positive migration is due to international migration (people moving to Michigan from other countries), which is helping to offset outmigration and a shrinking labor force. Without international migration, Michigan would see declining populations through 2040.

EXHIBIT 30. Domestic and International Migration: Michigan, 1980s–2030s

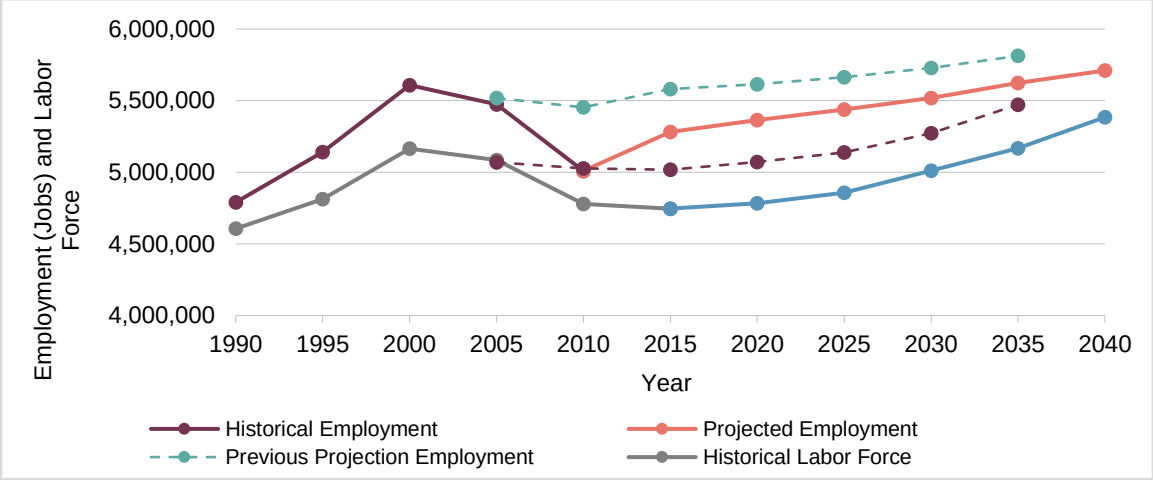
	1980s	1990s	2000s	2010s	2020s	2030s
International Migration	100,700	113,600	256,213	235,405	294,921	364,405
Domestic Migration (aged 65+)	-13,400	-20,400	-45,307	-35,091	-46,768	-44,172
Domestic Migration (aged < 65)	-658,500	-33,900	-690,100	-421,174	-291,795	-231,655
Total Net Migration	**-571,200**	**59,300**	**-479,194**	**-220,860**	**-43,642**	**88,578**

Source: MDOT July 2016.

Employment

Michigan lost more than 450,000 jobs during the economic recession between 2000 and 2010.[48] However, the state is recovering from these losses, and employment is projected to rebound slowly in the coming decades. The State Long Range Plan projects that total employment will grow at an annual rate of 0.7 percent through 2020, after which the growth rate is projected to slow to 0.3 percent per year. Michigan's total employment is expected to be constrained during this period due to a reduced projected labor force caused by the declining share of Michigan's working-age population. The labor force is projected to grow at 0.5 percent annually from 2015 to 2040, recovering to peak labor force levels by 2035. Michigan's total employment and labor force are shown below in Exhibit 31.

EXHIBIT 31. Michigan Total Employment and Labor Force, 1990–2040

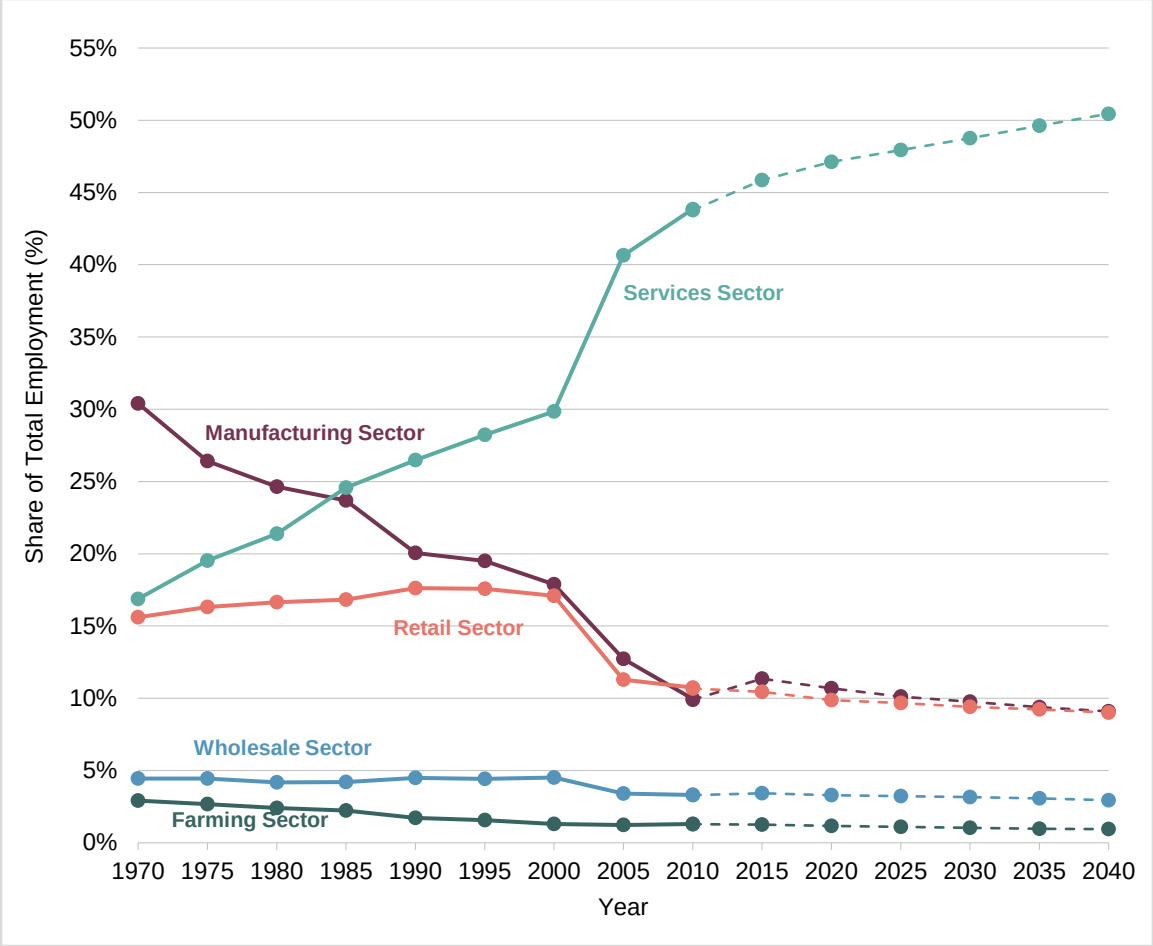


Source: MDOT July 2016.

[48] Monthly data on Michigan payroll jobs is also published by the U.S. Bureau of Labor Statistics (BLS). According to the BLS, Michigan recorded a sharp drop of 766,400 private sector payroll jobs from 2000 to 2010. However, the state has added 463,600 private sector jobs from December 2010 to September 2016.

The composition of Michigan's employment has changed significantly during the last 40 years and will continue to change during the 2010–2040 forecast period (Exhibit 32). The manufacturing sector's share of the employment base has dropped sharply and steadily, from 30 percent in 1970 to just 10 percent by 2010, and it is expected to continue to decline, though at a slower rate, to about 9 percent by 2040. The services sector, which includes healthcare, has increased dramatically from about 17 percent in 1970 to near 44 percent in 2010, and it is expected to grow to almost 50 percent by 2040.

EXHIBIT 32. Share of Michigan Employment by Sector, 1970–2040



Source: MDOT July 2016.

The projections of Michigan's population and employment composition will frame the types and levels of infrastructure services that are planned for Michigan's residents and businesses in the future.

APPENDIX D.

Best Practices Research

Background

The 21st Century Infrastructure Commission was charged with developing a plan to incentivize and encourage coordinated, long-term asset planning and management across multiple infrastructure types and all levels of government. To help the Commission better understand how Michigan could meet this charge, Public Sector Consultants (PSC) evaluated best practice models for integrated infrastructure planning and investment strategies from around the world, including more than ten different countries and 20 states across the U.S. PSC and the Executive Office of the Governor also interviewed several experts to supplement these best practice models. Deloitte Consulting also assisted with providing some research findings on best practices. This document summarizes the research that was presented to the Commission in June and July 2016.

Elements of Success

In PSC's review of infrastructure planning efforts from around the world, we found several models that utilize forward-looking, comprehensive, and integrated approaches to infrastructure asset management that reap the rewards of greater efficiency, access to additional investment resources, and more long-term technical solutions. Although each model has some unique processes or areas of focus, we identified six common elements of their success, including:

- Articulated vision for the future of infrastructure
- Planning processes that include a long-term planning horizon and regular updates
- Establishment of a coordinating or decision-making body
- Detailed asset inventory and condition assessment
- Projections of need based on nontraditional data and uncertainties (e.g., climate impacts, disruptive industry changes, etc.)
- Diverse mix of funding and financing tools

Articulated Vision for the Future of Infrastructure

States and countries that have adopted comprehensive and coordinated infrastructure planning processes have articulated a clear vision that describes desired outcomes or a desired future for their system. In many cases, the vision is codified in law or a policy resolution and has guided initial infrastructure asset management plans and subsequent updates. The vision for a future state often reflects a driving need—such as a rapidly growing population, impending climate risks, or power

outages due to capacity constraints—and is typically accompanied by a set of guiding principles to define how these places judge their future success. In California, for example, the Infrastructure Planning Act requires that any infrastructure proposed for funding in the state's plan must be consistent with the following priorities:

- Promote infill development and equity by rehabilitating, maintaining, and improving existing infrastructure and reusing previously developed, underutilized land, particularly in underserved areas.
- Protect environmental and agricultural resources.
- Encourage efficient development patterns by locating new infrastructure in an area appropriately planned for growth and served by adequate transportation and services, as well as by minimizing ongoing costs to taxpayers (State of California 2015)

Cities, including Portland, Oregon and London, England; states, including Minnesota, Ohio, and New York; and countries, including Canada and New Zealand, have developed forward-looking visions for their infrastructure systems. They aim to modernize their systems, advance their economic position, and build and maintain infrastructure that will protect public health and improve quality of life.

Long-term Planning Horizon

While infrastructure planning time horizons vary across states and countries, many comprehensive plans cover at least ten years, with most planning for 20 years or more. Most states and countries with longer planning horizons also have accompanying short-term action or budget plans. London, for example, has a comprehensive infrastructure plan that goes to 2050, but requires five-year business plans to ensure that economic changes and cost-to-consumer forecasts are continually included in the planning process (Greater London Authority 2014).

By law, the Governor of California is required to develop and submit a five-year infrastructure plan to the legislature along with the annual budget bill. The plan details proposed infrastructure investments, and outlines how those investments relate to the five-year plan objectives, including maintenance, improvements, and new infrastructure (State of California 2015).

Several other places utilize planning horizons for integrated infrastructure spanning ten or more years, including Oregon, New York, Canada, the United Kingdom, New Zealand, and Australia.

Coordinating Body

Another defining characteristic of model infrastructure planning systems is the establishment of a coordinating body or agency that is designed to break down traditional silo-based approaches to capital investment and infrastructure management and take a comprehensive look at statewide infrastructure investment. Through strategic collaboration and information sharing, a coordinating body can better leverage existing investment dollars and tactically allocate capital investment funding to maintain infrastructure, grow the economy, and create jobs. States and countries with infrastructure coordination bodies or agencies also focus on integrating project-level planning and investment across related infrastructure types or geographies to improve efficiencies and reduce costs.

PSC identified leading infrastructure coordinating bodies, including:

- **London:** After the 2012 Olympic Games were held in London, city government identified the need for citywide integrated infrastructure planning. As a coordinating body, the London Infrastructure Commission was created to continue this work and to carry out the vision of the London Infrastructure Plan 2050. This body is made up of economists; heads of global design and construction firms; public consultants in energy, water, transport, and information technology; infrastructure finance experts; and members of London First, an organization dedicated to making London the world's best city in which to do business (Whitelaw 2014).
- **Canada:** Canada's coordinating body, Infrastructure Canada, leads the country's federal efforts to ensure that Canadians benefit from world-class modern public infrastructure. The department makes investments, builds partnerships, develops policies, delivers programs, and fosters knowledge across the country. It works with provinces, territories, municipalities, the private sector, nonprofit organizations, and other federal departments and agencies, to address local and regional needs and advance national priorities. Infrastructure Canada reports to Parliament through the Minister of Infrastructure and Communities (Infrastructure Canada 2011).
- **New York:** The New York Works Task Force was initially charged with developing a long-term plan to strategically allocate capital investment funding in order to grow the economy and create jobs. Since completing the ten-year plan, the task force has worked closely with Regional Economic Development Councils to identify and invest in regional projects that maximize long-term economic growth (New York Works Task Force 2013).

Asset Management

An asset management plan, which includes a detailed inventory and assessment of public (and in some cases, private) assets, is another common element of a modern infrastructure management approach. The practice of asset management is used to guide systematic investment at strategic points in an asset's typical life cycle—including design, construction, Commissioning, operating, maintaining, repairing, modifying, replacing, and decommissioning or disposing of an asset.

Models of strong asset management approaches from around the globe include a comprehensive, baseline inventory of infrastructure that:

- Characterizes infrastructure condition
- Provides information on ownership
- Identifies key issues and risks associated with that infrastructure
- Tracks projected investment needs
- Measures progress
- Helps identify areas of integration between related infrastructure projects

London, England's infrastructure plan, for example, is integrated across housing, commercial, civil and public, energy, water, transportation, education, and medical/health facilities. The London Infrastructure Commission has worked with public and private parties to extensively map existing infrastructure, including condition and capacity assessments, and has aggregated data on

projected needs and planned projects into a comprehensive plan and online mapping tool. This tool allows people to see patterns of infrastructure development and concentration, identify opportunities for coordinated infrastructure construction, and track progress.

Planning for Uncertainty

Another best practice of coordinated infrastructure planning is recognizing that there is a great deal of uncertainty inherent in projecting the future. Therefore, model infrastructure planning processes are moving away from conventional, deterministic approaches that rely on single-scenario forecasting methods that acknowledge and accommodate various uncertainties (Wong 2013). New York, California, Minnesota, London, New Zealand, and Australia proactively evaluate and incorporate uncertainties into demand projections, infrastructure types, costs, and siting decisions.

Three primary uncertainties necessary to guide infrastructure plans are:

- Population change and density
- Technology innovation
- Nontraditional planning factors

Population Change and Density

Planning for uncertainty means using dynamic forecasting methods, including scenario planning and flexible design strategies, to better ensure infrastructure systems efficiently deliver services over the long term. During the 2000s, many older industrial cities in Michigan, as well as other states in the Great Lakes region lost a substantial percentage of their population. Although this phenomenon has serious implications for infrastructure service and delivery, most traditional population projections were not built to assume population loss.

Based on this experience, many planners recognize the need to better anticipate future changes in population and demand. When population does decline, some services can be downsized, but infrastructure is often immobile and costs tend to be fixed, so at times, it is more expensive to operate a system when demand is reduced (Hoornbeek and Schwarz 2009). While communities need to provide good service to the residents who remain in depopulating communities, they also need to anticipate future changes in population and demand–including growth. Planners and policymakers are increasingly looking to more dynamic forecasting methods that embrace uncertainty.

Technology Innovation

From smart meters to 5G mobile communication, processes at the best practice level address the profound impacts of technological change on infrastructure planning. For example, the London Infrastructure Plan 2050 devotes an entire chapter ("Open to Radical Change") to methods for tackling the uncertain impacts of new technology and innovation. Given the potential changes expected to be introduced as new technologies emerge, the Commission engaged the global technology research firm Forrester to help provide insights into this evolving world. Forrester provided members of the Commission with an in-depth overview of current and anticipated technology trends that will likely drive a more connected, efficient society. Forrester's team of

experts provided information about a variety of topics, including the IoT and how technology is enabling smarter cities.

Nontraditional Planning Factors

Best practice planning processes address the uncertainties presented by changing weather and climate patterns, from shifting precipitation levels to changing freeze-thaw cycles. These processes recognize the need for new approaches to understand vulnerabilities—across infrastructure systems and specific assets—to take appropriate actions to minimize risk and increase resiliency. Two U.S. states have moved to address this kind of uncertainty. Access Ohio 2040 calls for a Statewide Climate Variability Study and the Minnesota GO 50-Year Vision for Transportation addresses the trunk highway system's vulnerability to increased flooding events (Minnesota Department of Transportation 2012).

Model infrastructure plans also account for nontraditional planning factors, such as:

- Economic changes, such as major industry shifts and new types of businesses that disrupt industries
- Changing user preferences, such as the sharing economy (e.g., Uber) or desire for clean energy sources
- Decentralization of infrastructure services, such as the utility of the future concept
- Political changes, including major regulatory or legal changes

Funding and Financing

In most U.S. states, including Michigan, major infrastructure such as transportation, water, and wastewater systems are funded largely through public dollars, including tax revenue, license fees, and general obligation bonds. The energy sector is the exception, as generation, production, and distribution systems for electricity and natural gas are typically developed and managed privately or through P3s.

Historically, public funding for infrastructure has occurred on a pay-as-you-go cycle in which annual operating and capital budgets allocate dollars to maintain or expand infrastructure. Increasingly, states and cities have relied on general obligation and other types of bonds to finance infrastructure projects. As states and countries diversify funding sources, some have set explicit limits or targets for levels of indebtedness. Oregon, for example, has capped the amount of debt it will issue for infrastructure projects and has focused on other sources of funding such as fees, special revenues (e.g., lottery), and private investments (State of Oregon Office of the Governor 2012; State of Oregon 2016).

Today, best practice-level infrastructure management systems utilize a diverse mix of funding, including public and private investments, to maintain, improve, and expand infrastructure. In addition to the traditional public funding mechanisms like General Funds and traditional bonds, some states and countries have utilized more innovative tools to ensure adequate capital to fund projects and to improve efficiencies. These tools include infrastructure banks and P3s.

Infrastructure banks are state-owned banks that can finance and coordinate high-value infrastructure investments. These banks allow for borrowing (or loan guarantees) from public and

private entities to fund public-serving infrastructure projects, and can be used for projects requiring large lines of credit, which in some cases, allows an entity to multiply its infrastructure investment capacity. Infrastructure bank loans also use delayed-repayment mechanisms, which allows key projects to move forward even if they will not generate user fees or yield savings for many years (Miller, Costa, and Cooper 2012).

California and Pennsylvania each have an infrastructure bank (Deloitte 2016). Created in 1994, the California Infrastructure and Economic Development Bank finances public infrastructure and private development to promote jobs, contribute to a strong economy, and improve quality of life (State of California 2015). The Pennsylvania Infrastructure Bank leverages state and federal funds to accelerate priority transportation projects by providing low-interest loans (Pennsylvania Department of Transportation 2016).

P3s are another innovative tool that offer opportunities for government, business, and private sector organizations to collaboratively invest in and own public infrastructure, resulting in greater efficiencies. A 2009 study of the United Kingdom's infrastructure projects found that 65 percent of P3-related construction was on-budget, while only 54 percent of public sector-led projects were delivered on-budget. Similarly, a study of Australian P3s determined that these projects had cost overruns of 1 percent, compared to an average cost overrun of 15 percent for public-led projects. Europe uses P3s extensively, accounting for nearly 45 percent of global P3 projects ($353 billion in infrastructure development) in 2011, compared to 9 percent in the U.S. (Istrate 2011).

Expert Interviews

To further inform the Commission, PSC and the Executive Office of the Governor conducted telephone interviews to gather information on how some communities are implementing infrastructure planning, including asset management and rate structure modifications. These interviews included the manager of the London Infrastructure Mapping Application (IMA) and a representative of the Washington, D.C. water and sewer authority.

City of London

In many states, including Michigan, data on the location and condition of infrastructure assets are managed and analyzed by separate entities, leading to planning and investment inefficiencies. The City of London has worked extensively on this issue, creating a coordinating body, the London Infrastructure Delivery Board, and a tool, the Infrastructure Management Application (IMA), to capture and assess data, prioritize projects, and fund infrastructure across the city.

In August 2016, PSC, the Executive Office of the Governor, and the infrastructure Commission met with Andrew McMunnigall via conference call to discuss how they implemented the London Infrastructure Delivery Board and the how they manage the £550,000[49] IMA asset management tool. These two innovations have been successful at providing the following:

- Insight for private and public stakeholders into London's future growth, development, and infrastructure project pipeline
- Opportunities for joint delivery of infrastructure projects, reducing construction costs and disruption (McMunnigall 2016)

District of Columbia Water and Sewer Authority

Washington, D.C. recently completed an 18-month process of restructuring their water and sewer rates. A solid revenue source is integral to sustaining water and sewer infrastructure over the long life of these assets, especially in times when water consumption is declining and maintenance is deferred. The District of Columbia Water and Sewer Authority restructured its rates to reflect the full cost of operating, maintaining, repairing, and replacing water and sewer infrastructure.

The new multiyear rate structure focuses on affordability—including providing qualifying households with discounts of up to 50 percent—while incorporating the full cost of service with fixed fees and charges instead of volumetric rates. These changes include instituting a water system replacement fee to fund one percent of water system replacement compared to the national average of one-third of one percent and instituting a system availability fee (a hook-up charge) for new developments.

The restructuring has required the District of Columbia Water and Sewer Authority to utilize innovative financing mechanisms for their water infrastructure assets. They have issued a $2.6 billion 100-year bond for the D.C. Clean Rivers Project, which will create a deep underground tunnel system to alleviate combined sewer overflows. With such a long bond life, the asset matches the liability and has intergenerational equity such that the cost of the asset is spread across generations benefiting from it. The District of Columbia Water and Sewer Authority has also issued green bonds and social impact bonds. These bonds finance programs with environmental benefits, helping to identify the public value for such financing, in addition to identifying where the rate of return depends on the performance of green infrastructure (Kim 2016).

Conclusion

The 21st Century Infrastructure Commission examined these best practice elements, examples, and expert interviews throughout the Commission recommendation development process. The recommendations presented in this report have incorporated many of these methods and approaches to integrated infrastructure planning and investment strategies from around the world.

[49] Equal to $721,985 using August 2016's exchange rate of 1.3127 USD:1 GBP.