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State of the State: Michigan's Infrastructure

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T he State of Michigan is well positioned for economic, social and environmental leadership: The combination of engineering talent, powerhouse academic institutions, unparalleled freshwater ecosystems, automotive and mobility leadership and more distinguish the state on a national level. Appropriately caring for and investing in its infrastructure can help drive the state toward an economically robust, environmentally sustainable and socially just future.

- **Transportation & Mobility:** Building on its history of mobilizing the world, Michigan has an opportunity to demonstrate leadership in future mobility that prioritizes carbon neutrality, public health and safety, and economic strength. Addressing rapidly deteriorating transportation infrastructure is key.

- **Energy:** Given Michigan's stated goals on carbon neutrality, shifting the state's energy system to become increasingly digital, decarbonized and distributed is essential. Efforts to upgrade and expand existing aging infrastructure are important as well.

- **Water:** A severe public health crisis has illustrated the consequences of underinvestment and decision-making without adequate community representation. The state has an opportunity to use machine learning to identify and replace hazardous water lines and address stormwater and wastewater vulnerabilities, and move toward a Michigan that is purer for all.

- **Information & Communications:** Enhanced information and communications infrastructure can enable proactive, real-time asset management across all infrastructure. It can also expand connectivity and access to education, employment and health services. With advancements in digital infrastructure, continued efforts to bolster integrated cybersecurity defense are critical.

Key Insights

1. **Any plans for infrastructure investment should put racial justice at the forefront.** Infrastructure investment decisions have a long history of perpetuating systemic racism. Building on recent announcements to recognize and confront racism as a public health issue within the state, appropriate representation on decision-making councils is crucial for more equitable and just infrastructure planning. Activating recommendations outlined by the Michigan Environmental Justice Council is also important.

2. **Addressing a history of underinvestment and reactive infrastructure management starts with information.** The Michigan Infrastructure Council, created in 2018 to advance a shared vision for infrastructure that advances public, environmental and economic health, includes public and private-sector representatives. Through the council, water and transportation infrastructure asset management plans will lay the foundation for data-driven, proactive management using a digital data repository.

3. **Michigan has gaps in its physical infrastructure that pose public health and safety risks that require additional investment.** Following a long period of underinvestment, Michigan's infrastructure is aging and deteriorating rapidly. Water and transportation infrastructure have presented immense public health and safety issues. Critical infrastructure fixes can mitigate severe health, safety and economic risks.

4. **Investments in digital and physical infrastructure, in coordination with the private sector, will be paramount in building on Michigan's economic and cultural vibrancy.** Investing in smart infrastructure that both meets residents' immediate needs and accelerates the state's economic and industry leadership is crucial. Safeguarding engineering and manufacturing talent while enabling a clean, safe and connected global economy will elevate the state's leadership.

M ichigan is an economically, culturally and environmentally diverse state that drives the mobilization of the global economy, continues to nourish vibrant communities and boasts vast freshwater and forest ecosystems. From the construction of the Soo locks in the mid-1800s to the nation's first stretch of concrete highway and its first four-way traffic light in the early 1900s[1], Michigan has long been a national leader in infrastructure. Today, our world is undergoing unprecedented change through the COVID-19 pandemic: The very way we live, work and play has been disrupted.

Beyond the pandemic, a series of converging macro-trends set the stage for economic, environmental and social disruption. Climate events are increasing in severity and frequency, creating an imperative to decarbonize. Meanwhile, global GDP, population and emissions are expected to grow in tandem, and whether non-OECD countries will be able to decouple CO_2 emissions and economic growth is uncertain. Technological innovation unlocks new solutions, from digital technologies like artificial intelligence and machine learning to low-to-zero carbon energy and mobility solutions. Emerging policies and shifts in investment patterns reflect increased social, regulatory and economic pressure around carbon emissions.

Geopolitically, as the world shifts toward multipolarity, distrust within and among nations grows, despite global crises of climate change and COVID-19 requiring a collaborative global atmosphere. Socially, confronting the consequences of unjust social constructs such as slavery, colonialism and imperialism leave communities grappling with systemic racism, anti-Semitism and gender inequity.

In this complex and intense global context, we examine Michigan's infrastructure and consider opportunities for climate-positive investments that will elevate just economic development. This report synthesizes publicly available information on Michigan's infrastructure, identifies knowledge gaps, profiles key stakeholders and describes opportunities for investment based on economic, human capital, climate and public health benefit. It also begins to explore how Michigan's current infrastructure may deter or help advance social and racial justice. Examined infrastructure types include **transportation & mobility, energy**, **water**, and **information & communications**.

Stakeholder maps provide a view of **government & municipalities**, **local organizations & institutes**, **investors & innovators**, and **private-sector stakeholders** that have either been developing relevant innovations or may have a vested interest in policies and data access in each infrastructure type. The maps are not exhaustive but rather should serve as a reference point for understanding key players in the space.

This report includes recommended areas for potential investment (Appendix A) and a resource guide (Appendix B). The lists of potential investments offer opportunities for advancement within each sector; while not exhaustive, these investment opportunities look more closely at opportunity areas examined in the body of the report. The resource guide includes a list of references within each infrastructure type, along with notes about the degree to which each resource evaluates infrastructure comprehensively and objectively. This report should serve as a starting point for further analysis: Progress can be made on organizing statewide infrastructure data to improve ease of access, and quantitative analysis based on a more complete data set can better inform decision-making processes around Michigan's infrastructure.

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1   "National Firsts," MDOT, Link

Michigan faces road and bridge infrastructure that is deteriorating more rapidly than current funding allows it to be upgraded. Many residents lack easy access to transit solutions.

Michigan has the ambition to secure global leadership in mobility by demonstrating early scaled adoption of technologies that promote safety, accessibility and electrification, while mobilizing the state's engineering and manufacturing talent. The success of this venture depends in part on Michigan's ability to address its crumbling transportation infrastructure and confront a history of transit injustice.

From the automotive industry's inception, with the Model T introduced in 1908, Michigan's role in mobilizing our global economy and accelerating the second industrial revolution is paramount. For over a century, academic institutions have generated premier engineering talent, unparalleled investment in R&D has driven continued innovation, and social norms and cultural frameworks evolved around the budding automotive industry. Today, the transportation and mobility industry is shifting, as technological trends around connectivity, shared mobility, electrification and autonomy have converged. The traditional automotive industry faces an existential challenge.

Moving forward, converging innovations across connectivity, multimodality, electrification and autonomy will give way to a new mobility system that is safe, seamless and sustainable. This new mobility ecosystem is enabled by bridging digital infrastructure with physical, and it is differentiated by new business models. It will include unprecedented cross-sector engagement, innovative financing mechanisms, interoperability among technologies and modes (such as vehicle-to-grid) and a high-touch customer experience. As the sector evolves rapidly toward a new mobility future, the state's ability to sustain its industry leadership on a global scale, as well as its ability to provide a safe, seamless and sustainable mobility experience, hinges in part on its ability to upgrade its infrastructure.

Transportation and mobility include the movement of goods and people and both personal and shared mobility, spanning ground, water and air. In 2019, Michigan recorded 100+ billion vehicle miles travelled,[2] 528+ million tons of freight moved,[3] and over 38 million air passengers flown to or from Michigan airports.[4] Michigan roadways cover over 120,000 miles; roughly 39% of paved federal-aid roads and 51% of non-federal-aid roadways are rated in poor condition. An assessment of the pavement life cycle shows that between 2016 and 2019, roads deteriorated faster than they

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2   "Annual Vehicle Miles Traveled," Michigan Department of Transportation, 2019, Link

3   "Michigan Freight Rail System," Presentation, Michigan Mobility 2045, MDOT, 2020, Link

4   "Total Scheduled Passengers: 2019 Airport Facility Year to Date Record," Michigan Department of Transportation, 2019, Link

could be improved, with a net deterioration of 3.6%.[5] As more roads decline into poor condition, the cost to fix and maintain them rises. Along with the $1.2 billion annual addition to the transportation budget through a 2015 road funding package, an additional $2.2 billion annually is estimated to be required to repair and maintain Michigan's roads. According to a Michigan Department of Transportation (MDOT) analysis, without additional funding, the proportion of roads in poor condition could comprise up to two-thirds of the state's entire roadway system by 2028.[6]

As the state looks to lead in global mobility, it boasts 500+ miles of roadway equipped for connected and automated vehicles (CAVs), 14 connected vehicle deployment projects and two globally recognized CAV testing facilities.[7] Also, plans to develop a CAV corridor with cutting-edge digital, physical and operational infrastructure between Ann Arbor and Detroit was announced in August 2020, led by the State of Michigan in partnership with Cavnue, founded by Sidewalk Infrastructure Partners.[8]

A recently anointed Office of Future Mobility and Electrification (OFME) leads the charge to advance mobility investment, infrastructure, innovation and talent in the state. In cooperation with MDOT, which is developing "Michigan Mobility 2045: MDOT Long-Range Transportation Plan," as well as stakeholders such as the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Michigan Economic Development Coordination (MEDC) and the Michigan Public Service Commission (MSPC), the OFME will work across government, academia and the private sector. In coordination, the Transportation Asset Management Council, a subcouncil of the Michigan Infrastructure Council (MIC), has initiated an integrated asset management planning process, and provided guidance on data collection, developed a reporting hub, and created dashboards with recent data on pavement and bridge conditions. This represents a significant step toward statewide coordination of integrated asset management focused on mobility.

Current transportation and mobility investment opportunities can be divided into two categories: investments in transportation services for freight and people moving within Michigan, and investments in enabling global future mobility leadership. These two categories are symbiotic: Investing in either will help advance the other. Currently, investment is required to execute adequately funded road maintenance, expansion in transit and alternatives to personally owned vehicles, and development of infrastructure for vulnerable road users (such as cyclists and pedestrians). In a statewide survey for the state's Long-Range Transportation Plan, citizens prioritized maintaining existing roads, reducing traffic congestion, expanding transportation services for seniors and people with disabilities, and investing in transportation alternatives such as passenger rail and bicycle and pedestrian infrastructure. Citizens also prioritized improving the quality of existing infrastructure over investing in net new infrastructure, and they preferred to manage increased demand through technology and alternate modes rather than increased capacity via additional lanes.[9]

A comprehensive, data-driven, uniform understanding of existing infrastructure assets is essential to informing decisions. Though in early stages, efforts by the Transportation Asset Management Council (TAMC), supplemented by MDOT's efforts, demonstrate progress toward this goal. Aggregating and promoting transparent access to statewide mobility data assets, and building out real-time data capabilities, will help inform decisions for governing bodies, the private sector

5   "Michigan Transportation Asset Management Council: Michigan's 2019 Roads & Bridges Annual Report," Michigan Transportation Asset Management Council, 2019, Link

6   "The Rising Costs of Road Repair," State Notes: Topics of Legislative Interest, Michigan Senate Fiscal Agency; Michael Siracuse, Fiscal Analyst and David Zin, Chief Economist, 2019, Link

7   "Michigan is AutoMobility," MichAuto, 2020, Link

8   "Michigan, Cavnue Creating Road of Future Between Ann Arbor and Detroit," Sidewalk Infrastructure Partners, 2020, Link

9   "Phase I Public and Stakeholder Participation Summary and Evaluation," MDOT State Long-Range Transportation Plan, Michigan Mobility 2045, Link

and innovators alike. To secure future mobility leadership on a global scale, Michigan has the opportunity to demonstrate and scale early technologies and solutions, through efforts such as a coordinated electric vehicle (EV) charging infrastructure rollout plan. Michigan currently has about 1,600 public and private charging stations, roughly 4% of what California has.[10] Michigan also trails leading states in the number of EV registrations.[11] This effort will be central to OFMI's work. Overall, deteriorating road infrastructure and expansion of mobility services need to be addressed in parallel to investments to enable a future that safeguards Michigan's industry leadership in automotives and mobility.

Figure A

TRANSPORTATION & MOBILITY STAKEHOLDER MAP

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10 "Electric Vehicle Charging Outlets by State," Alternative Fuels Data Center, U.S. DOE, 2020, Link

11 "Electric Vehicle Registrations by State," Alternative Fuels Data Center, U.S. DOE, 2020, Link

Michigan's aging energy infrastructure is currently centered around hydrocarbons. Natural gas capacity has enabled the state to relax its coal imports, but to meet the state's carbon neutrality goal, electric and renewable infrastructure needs to be upgraded.

As the future of energy systems is increasingly digital, distributed and decarbonized, Michigan has the opportunity to build on pilot-scale efforts and invest in grid modernization, interstate interconnection, energy storage and renewable infrastructure. Developing an independent, objective assembly of public and private stakeholders representing the full industry, potentially in coordination with the MIC as a subcouncil, will help to ensure the environmental sustainability of energy infrastructure progress.

As global energy demand continues to rise, the growing threat and consequences of climate change have created an imperative to decarbonize. New industries are emerging around renewable energy, energy storage, zero-emissions transportation and energy efficiency. Despite the global COVID-19 pandemic, renewable electricity generation grew by almost 7% in 2020, as investment continues to grow.[12] Renewables and energy storage technologies have come down the cost curve to be more competitive with hydrocarbons at utility scale. Globally, citizen and market pressure around climate action are rising, and in Michigan, the announcement of the 2050 carbon neutrality goal,[13] in combination with the state Renewable Portfolio Standard,[14] set the stage for an energy transition. In recent decades, the state of Michigan has relied predominantly on hydrocarbons such as coal, natural gas and propane to generate electricity, heat and energy. Michigan is differentiated nationally by its natural gas storage capacity (nearly 1.1 trillion cubic ft.[15]), while it begins to phase out coal-powered plants and increase its renewable energy footprint. Embracing a data-driven, distributed and digital approach to seamless energy delivery, with an emphasis on decarbonization and an eye for energy justice, will position utilities and Michigan more broadly for a more resilient, sustainable, customer-centric energy system.

While Michigan currently imports 14.9 million tons of coal annually, in addition to 2.3 million tons of petroleum and coal products,16 future baseload is anticipated to rely on natural gas, reducing

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12 "Renewables 2020," IEA, 2020, Link

13 "Michigan vows to go carbon neutral by 2050, increase oversight of utility resource plans," UtilityDive, 2020, Link

14 "Michigan Renewables Portfolio Standard," DSIRE, 2018, Link

15 "Michigan: State Profile and Energy Estimates," U.S. Energy Information Administration, 2019, Link

16 "Michigan Freight Workshop," Michigan Mobility 2045, Link

dependence on imports and taking advantage of storage capacity.[17] Michigan's natural gas infrastructure includes 55,000+ miles of distribution pipelines and 3.2 million service lines.[18] Natural gas heats 75% of Michigan homes, so major climate events such as the polar vortex of 2019 that threaten natural gas infrastructure can leave millions of citizens vulnerable. Existing infrastructure is aging, and it requires repair or replacement to improve reliability.[19] Michigan has the highest residential propane use in the nation, with two in-state fractionators and massive underground storage capacity.[20]

Regarding low-carbon energy sources, Michigan is home to one of the largest hydroelectric pumped storage power plants in the world.[21] It ranks 15th among states in wind electricity generation[22] and 36th in solar energy generation.[23] Many turbines have been outfitted with technologies and solutions for cold weather, improving load predictability in colder temperatures.[24] Most electricity transmission and distribution infrastructure (such as poles, underground wires and circuit breakers) has been in service for more than 50 years and has outlived its design life. Utility risk-based planning models reveal aging distribution infrastructure and poor vegetation management practices as the most pertinent reliability and safety risks to the electric system. Investor-owned utilities have been replacing aging infrastructure to comply with standards and to modernize the distribution grid through technologies such as net metering.[25]

The Michigan Public Service Commission (MPSC), in coordination with EGLE, the Michigan Electric Cooperative (MECA) and Michigan grid operators MISO and PJM, have been leading efforts to mitigate risk and modernize the grid through working groups such as MI Power Grid. This is a starting point for preparing for a cleaner, more resilient, distributed energy future. Efforts moving forward should encourage scaling distributed energy generation: As Michigan's net metering policy has evolved to a distributed generation policy, an independent council may seek to evaluate the implications and consider infrastructure projects, such as utility-scale storage that can accelerate Michigan's renewable future.

Energy infrastructure investment opportunities fall into two categories: risk mitigation and system modernization. Aging electric and natural gas infrastructure (storage, transmission, compression and distribution) presents the risk of leaks and outages. Transmission enhancements, such as maintenance, expansion and interstate interconnection, coupled with distribution upgrades, including main and service line replacement, will mitigate risk and improve service delivery. The MPSC implements investment recovery mechanisms to identify and accelerate the removal of pipelines that present the highest risk. Investments in bolstering cybersecurity preparedness are essential to meet heightening regulations and to mitigate informational and operational risk.[26]

As the energy industry evolves to become increasingly digital, distributed and decarbonized, investment in innovation and infrastructure modernization can empower Michigan to provide leading service to its constituents, and to do its part to address the global climate crisis. Investments in distributed energy resources can promote resilience alongside grid modernization efforts, enable consumers to evolve into "prosumers" to boost demand-side management, and help mitigate

17   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

18   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

19   "Here's what we need to do to strengthen Michigan's energy infrastructure | Opinion," Sally Talbery, Chairman on the Michigan Public Service Commission, Detroit Free Press, 2019, Link

20   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

21   "Michigan: State Profile and Energy Estimates," U.S. Energy Information Administration, 2019, Link

22   "Michigan: State Profile and Energy Estimates," U.S. Energy Information Administration, 2019, Link

23   "Michigan Solar," Solar Energy Industry Association, 2020, Link

24   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

25   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

26   "Statewide Energy Assessment - Final Report," MPSC, 2019, Link

risk.[27] Leveraging AI for preventive maintenance and advanced metering infrastructure can improve the state's emergency response. Overall, opportunities exist to improve the accessibility and comprehensiveness of energy asset data, currently primarily managed via the MPSC. The MIC indicates a step toward that, but a dedicated, independent council focused on energy infrastructure might present a more holistic approach to evaluating energy infrastructure, beyond the current focus on traditional hydrocarbon infrastructure, and might be more inclusive of distributed energy resources.

Figure B

ENERGY STAKEHOLDER MAP

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27   "Digital Innovation: Creating the utility of the future," Deloitte Insights, 2019, Link

Despite an abundance of freshwater, Michigan's water infrastructure has suffered from a period of underinvestment and has led to some severe public health and safety consequences. A lack of clear, publicly available and aggregated information about water infrastructure assets has impeded strategic maintenance and replacement.

Improving Michigan's water infrastructure begins with clear, complete and accessible information. As the Flint water crisis demonstrated, an opportunity exists to leverage AI and machine learning to aggregate location and performance data on water infrastructure to inform asset management decisions and mitigate risk.

In a world of increasing freshwater scarcity, the Great Lakes State is distinguished by an abundance of freshwater. For generations, water has shaped the development of Michigan's communities and economy: The Great Lakes shorelines are hubs of economic activity, the "Pure Michigan" campaign attracts flocks of awe-seeking tourists, and abundant water has enabled Michigan's industrial and agricultural success. Michigan is home to a $60 billion "blue economy."[28] However, a period of disinvestment in water infrastructure, sewer overflows, water service line contamination and aging water infrastructure has led to severe public health, environmental and economic consequences, especially in economically disadvantaged areas. A 2016 study estimates that Michigan and infrastructure owners have underinvested in drinking water infrastructure by $284 million to $563 million each year.[29,30] Significant investment in coordinated water asset management inventory, assessment and replacement is critical across drinking water, wastewater and stormwater systems. Up-front investment will enable a proactive infrastructure management approach, rather than a reactive one focused on risk mitigation.

Michigan boasts 3,288 miles of shoreline, 11,000 inland lakes, 51,000 miles of river systems and 6,500,000 acres of wetlands. Despite being home to the Great Lakes, which contain 21% of the world's freshwater, as well as several subsurface aquifers, municipalities face scarcity, contamination and aging treatment and distribution systems. Between 2013 and 2014, an estimated 5.7 billion gallons of untreated sewage flowed into Michigan waterways.[31] Initial asset management programs reveal deteriorating stormwater infrastructure, with no funded path toward systematic repair.

28   "Michigan Blue Economy: Making Michigan the World's Freshwater & Freshwater Innovation Capital," Michigan Blue Economy: John Austin, Alan Steinman, 2015, Link

29   "Michigan's Water Infrastructure Investment Needs," Public Sector Consultants, 2016, Link

30   "Report Card for Michigan's Infrastructure," American Society of Civil Engineers (ASCE), 2018, Link

31   "21st Century Infrastructure Commission Report: Chapter 7. Water Recommendations," 21st Century Infrastructure Commission (Commissioned by Rick Snyder), 2016, Link

Michigan's 2,600 dams offer water supply, hydropower, irrigation and recreation, but many are aging and require additional funding to be maintained. For example, the Edenville Dam was destroyed in 2020, which then caused the downstream Sanford Dam to overflow, leading to roughly $200 million in property damage. This followed decades of citations for noncompliance with safety regulations, the 2018 revocation of Edenville's license to generate hydroelectric power, and transfer in regulatory oversight to the state, which classified it in fair condition.[32]

Governor Gretchen Whitmer's announcement of a $500 million investment to rebuild Michigan's water infrastructure signifies a large step toward ensuring affordable access to clean water, and it is estimated to support over 7,500 Michigan jobs.[33] The program will invest in drinking water quality (such as through lead service line replacement in disadvantaged communities), wastewater protection (such as clean water infrastructure grants and a failing septic system elimination program). The Water Asset Management Council, a subset of the Michigan Infrastructure Council (MIC) housed within EGLE, will be critical in ensuring a coordinated water asset management approach. Ongoing efforts such as the Great Lakes Restoration Initiative, which is anticipated to drive a $3.7 billion to $7 billion increase in property values and long-term economic development, will also be paramount. Water is inherent to Michigan's global identity: Adequately maintaining its water resources is critical to preserving its freshwater ecosystems, the health of its blue economy, and the well-being of its communities.

Limitations of Michigan's water infrastructure, compounded by uncoordinated decision-making around infrastructure, were brought to light during the ongoing Flint water crisis. Following a switch from delivering water from Lake Huron to delivering water from the Flint River via aged infrastructure and without adequate treatment, residents faced lead poisoning, pneumonia and other health problems. Furthermore, thousands of residents receive water through lead pipes, which, in 2016, were ordered to be replaced by the state.[34] An effort to leverage machine learning and GIS to locate lead pipes in the area for replacement was undertaken by leaders in academia, in cooperation with Flint decision-makers.[35] This crisis highlights the consequences of underinvestment, the need for infrastructure upgrades across the state, and the opportunity to leverage machine learning and AI to mitigate risk.

Publicly accessible, aggregate statewide data on water infrastructure is neither current nor exhaustive. Information lives with multiple organizations, and digital accessibility varies. Gov. Whitmer's announcement of the $500 million investment will begin to address critical gaps, but a coordinated data aggregation effort will enable more proactive management in the future. With a comprehensive, data-driven, uniform understanding of existing infrastructure assets and their condition, hazardous water service lines, aging stormwater systems, and failing wastewater infrastructure can be addressed systematically. Coordinated data aggregation can inform a systematic approach to maintaining and operating water infrastructure proactively.

32 "Gov. Gretchen Whitmer launches investigation into Midland dam failures," Bridge Michigan, 2020, Link

33 "Governor Whitmer Announces MI Clean Water: A Historic $500 Million Investment to Rebuild Michigan's Water Infrastructure," The Office of Governor Gretchen Whitmer, 2020, Link

34 "Flint Water Crisis: Everything You Need to Know," NRDC, 2018, Link

35 "ActiveRemediation: The Search for Lead Pipes in Flint, Michigan," Jacob Abernethy, Alex Chojnacki, Arya Farahi, Eric Schwartz, Jared Webb, 2018, Link
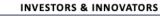
Figure C

WATER STAKEHOLDER MAP

*Interactive Map: "Why it's so hard to know exactly how much of Michigan's water is bottled and sold," NPR 2017

Many Michigan households lack Internet connection, limiting access to essential services amid the global pandemic. As information infrastructure becomes a key enabler to virtually every sector, cybersecurity threats continue to rise.

Michigan has the opportunity to invest in digital infrastructure that will help inform asset management optimization and elevate innovation leadership across multiple sectors, such as mobility. Continuing to build on cybersecurity defenses through a coordinated, multi-stakeholder effort will also promote the state's leadership.

Information and communications infrastructure underpins economic development. At its best, telecommunications infrastructure is a catalyst for economic development; at its worst, it is a deterrent. As networks become pervasive across virtually all sectors, communications infrastructure will need to become increasingly resilient and sophisticated. Improved connectivity and access to real-time information promotes advancement in each of the aforementioned sectors: Transportation & mobility, energy and water. For example, connectivity infrastructure will enable intelligent transportation systems (ITS), CAV technologies, real-time infrastructure monitoring and real-time energy management. The rising prominence of the Internet of things (IoT) enables massive amounts of data to be collected and used via connected devices and infrastructure. IoT presents an opportunity to improve safety, access to information and trust between citizens and government, through technologies such as digital signage, predictive analytics for preventive maintenance of transportation infrastructure, and sensors to optimize energy and water distribution based on real-time consumption.[36] Michigan is actively investing in improving its information and communications infrastructure to promote access and system resilience. Additional investments in IoT technologies, cybersecurity resilience and increased bandwidth will position the state for continued economic growth.

COVID-19 has exacerbated dependence on communications infrastructure: Many citizens rely on broadband infrastructure and services to access education, employment and critical health information. An estimated 1.2 million Michigan households do not have permanent Internet access at home, leading to $1.8 billion to $2.7 billion in potential economic benefit left unrealized. To promote accessibility, Whitmer recently announced $12.7 million in Connecting Michigan Communities grants, alongside a task force devoted to providing underserved communities with high-speed Internet access.[37] Through the Federal Communications Commission (FCC) Rural Digital Opportunity Fund, Michigan is being awarded $363 million to expand access to broadband and high-speed Internet.[38] Also, the USDA is investing $10.1 million to provide broadband access

36   "The public sector will bring the IoT into the mainstream," Medium, Truphone, 2019, Link

37   "Gov. Whitmer announces initiative to increase high-speed internet across Michigan," 2020, Link

38   "Michigan secures $363 million in federal funding to increase access to rural high-speed internet," MEDC, 2020, Link

in unserved and underserved communities in rural Michigan, as part of the ReConnect program.[39] Through these programs and more, broadband is being installed in underserved areas, including the Upper Peninsula, making working and learning possible from remote areas.[40] In partnership with the state, Nonprofit Connected Nation: Michigan is working to coordinate the effort to expand broadband access, providing resources on coverage and providers.[41] These measures are expected to advance accessibility significantly, but additional efforts to bridge the digital divide will likely be needed into the future.

As information and communications infrastructure becomes increasingly essential across virtually all sectors, it also becomes an increasingly compelling target for cybersecurity threats. As of 2015, the state blocked 650,000+ cyber attacks daily. Annually, it blocked 2.5 million web browser attacks, 179.5 million HTTP-based attacks, 79.5 million network scams and 5.2 million intrusions.[42] Close cooperation among the Department of Technology, Management & Budget, the Michigan State Police, the National Guard and the private sector has bolstered Michigan's defenses. The Michigan Cyber Civilian Corps program empowers volunteer security professionals to handle cybersecurity incidents across the state, while the Cyber Partners program aims to improve cybersecurity at the county and local levels. Cyber threats grow as Michigan begins to digitize its infrastructure asset management.

Michigan is undertaking early efforts to streamline information on its infrastructure through the MIC's infrastructure asset management planning. For example, the "Dig Once" project portal will leverage GIS technology to notify owners of telecommunications, construction, water and energy infrastructure of overlap in projects and will encourage cooperation. A coordinated effort to gain a comprehensive understanding of existing infrastructure assets will inform upgrades to infrastructure, including technologies monitoring key infrastructure assets in real-time and leveraging predictive analytics. This new information infrastructure will underpin future investments across all of Michigan's infrastructure.

Areas for potential investment within information and communications infrastructure include expanding connectivity access and digital literacy, bolstering cybersecurity preparedness, and digitizing infrastructure assets via the IoT. Efforts discussed above are critical in expanding connectivity access and promoting digital literacy. It is important to ensure citizens are building technical fluency so that they can appropriately use broadband and its accompanying services (such as telehealth) once they gain access.

Expanding digital information infrastructure presents additional cyber risk. Recognizing increasing threats, Whitmer requested $20 million to support emergency response, threat intelligence and vulnerability assessments to improve protections for information infrastructure.[43] Michigan has made early investments in IoT technologies at a pilot scale, such as the CAV infrastructure. To advance Michigan toward a smarter digital economy, investments in modernizing communications infrastructure and IoT technologies will be critical. When executed effectively, IoT technologies meld the digital and the physical, and they provide comprehensive, critical, real-time information to optimize factors such as air and water quality, public health and safety, and energy and water efficiency. Overall, Michigan's information and communications infrastructure is fundamental to advancing holistic infrastructure management and expanding access to critical broadband connectivity, and it is fortified by proactive cybersecurity protection.

39 "Trump Administration Invests $10.1 Million in High-Speed Broadband in Rural Michigan," 2020, Link

40 "Jobs, Michigan & Leadership in the Economy of Tomorrow," Michigan Economic Center, 2017, Link

41 "Connected Nation: Michigan," Link

42 "Michigan Cyber Initiative 2015," 2015, Link

43 "Fiscal Years 2021 and 2022 Executive Budget Recommendation: Technology, Management, and Budget," 2020, Link

Figure D

INFORMATION & COMMUNICATIONS STAKEHOLDER MAP

2020 has peeled back the curtain on a tangle of systemic issues: racial injustice, environmental injustice, public health inequities, voter suppression and food insecurity, to name a few. In many cases, infrastructure development has perpetuated systemic discrimination against groups based on race or socioeconomic status. The designation of racism as a public health crisis and the imperative surrounding creating a more inclusive health system demonstrate progress. Moving forward, ensuring representation at the decision-making tables around infrastructure can help to promote more just and equitable decisions. Following are a few historic examples for consideration within each infrastructure type.

Transportation & Mobility

The development of the interstate highway system functioned to encourage suburbanization, to disrupt inner-city communities composed of minorities, and to increase sprawl.[44] In Michigan, Detroit's freeways were routed through predominantly Black communities, displacing longtime residents.[45] For many years, suburbs have pushed back on the expansion of transit, perpetuating racial segregation. In Michigan, the cost of car ownership is high, with car insurance premiums that are 90% higher than the national average,[46] and high vehicle damage costs associated with poor road conditions. Recent efforts to identify and eliminate transit deserts in Detroit should be mirrored at the state level.[47] Infrastructure design and planning principles—such as solving for the most vulnerable, expanding the planning table to include community members, and looking to new, innovative funding mechanisms for transit—can help address some of these systemic barriers.

Energy

In the U.S., white households consume more energy than Black, Latino or Asian households, but Black households spend 7.6% of their income on energy, while white households spend 5%. Black and Latino families spend more to heat and cool their homes, indicating that the homes are, on average, less energy-efficient than those of white and Asian people.[48] Three million low-income Michigan households face a gap of $1,250 per year between affordable energy bills and actual energy bills. Low-income residents also tend to occupy homes with lower energy efficiency, leading to severe energy insecurity.[49] An examination of Michigan residential savings finds that for every 1 kWh saved in low-income homes, up to 22 kWh are saved in higher-income homes. Utility efficiency investment programs may perpetuate this problem: The same study indicates that for every $1 invested in programs intended for low-income customers, up to $4.34 was invested in programs intended for higher-income customers.[50] Roughly 1 in 8 Michigan households neither qualify for government-funded efficiency programs nor meet the criteria for traditional loans, leaving them in an energy efficiency coverage gap. The introduction and funding of Michigan Saves, the nation's first nonprofit green bank, could help to close this gap with additional funding.[51]

Water

The Flint water crisis is perhaps the most severe example of environmental injustice in Michigan. In a predominantly Black city with roughly 40% of residents living in poverty, the community suffered severe health problems following the state's decision to switch the water source from

44   "Highways as a Barrier to Equal Access," Yale Rubin, 1973, Link

45   "Origins of 'Redevelopment,'" Walter P. Reuther Library, Wayne State University, Link

46   "Car insurance rates by state, 2020 edition," 2020, Insure, Link

47   "Carefully-Planned Mobility Makes Transportation Accessible For All," MichAuto, 2018, Link

48   "This prof is shedding light on energy injustice - and how to fix it," Grist, 2020, Link

49   "Study Finds Socioeconomic Disparities in Statewide Energy Efficiency Investments & Energy Savings," Urban Energy Justice Lab, 2018, Link

50   "Study Finds Socioeconomic Disparities in Statewide Energy Efficiency Investments & Energy Savings," Urban Energy Justice Lab, 2018, Link

51   "Study finds an energy efficiency funding coverage gap exists in Michigan," Urban Energy Justice Lab, 2020, Link

Lake Huron to the Flint River. The recommendations that the resulting Environmental Justice Work Group formed should be leveraged as a framework for the future (including establishing proper governance at the state level and establishing measurable targets for eliminating childhood lead poisoning).[52] Water access has also been a historic challenge: In 2014, the Detroit Water and Sewerage Department terminated service to over 20,000 Detroit residents.[53,54] A moratorium on water shutoffs has been extended through 2022,[55] with a consideration to end them permanently through a water affordability plan.

Information & Communications

Michigan's digital divide has become preeminent in the COVID-19 pandemic, as people increasingly rely on connectivity to access essential services such as education, employment and even health care online. Certain Michigan school districts estimate that as many as 54% of their students lack digital access; these districts are largely concentrated in areas with high percentages of low-income students, and high percentages of students of color.[56] Another study estimates that up to 70% of school-age children in Detroit lack Internet access, with a large portion relying on mobile-only access. While significant investment is entering the city's commercial and certain residential areas, marginalized neighborhoods have been "digitally redlined."[57] Several efforts funded at multiple levels of government and by the public sector aim to address this disparity. For example, the Connecting Michigan Communities grant projects are working to provide access to 10,900 households, businesses and community anchor institutions. Also, all projects have committed to promoting digital literacy by providing training and materials to residents and businesses.[58]

52 "Environmental Justice Work Group Report: MIchigan as a global leader in environmental justice," 2018, Prepared for Governor Rick Snyder, Link

53 "Water shutoffs in Detroit," ACLU, 2018, Link

54 "Mapping the Water Crisis: The Dismantling of African-American Neighborhoods in Detroit," We the People of Detroit Research Collective, 2016, Link

55 "Detroit extends water shutoff moratorium through 2022," Detroit News, 2020, Link

56 "Michigan's Digital Divide," The Education Trust - Midwest, 2020, Link

57 "Mapping Detroit's Digital Divide," University of Michigan Urban Laboratory, 2020, Link

58 "Gov. Whitmer announces initiative to increase high-speed internet across Michigan," 2020, Link

Any plans for infrastructure investment should put racial justice at the forefront. As discussed in an assessment of environmental justice in Michigan, a Michigan-specific environmental justice screening tool that factors health, environmental and social indicators into decision-making and infrastructure planning would advance the state's leadership in this sphere.[59] Consulting with Black and brown communities and tribal councils, and improving race and gender representation in the decision-making bodies that are responsible for infrastructure planning, will improve Michigan's infrastructure management approach.

Addressing a history of underinvestment and reactive infrastructure management starts with information. Efforts to align on a comprehensive view of infrastructure data are an important first step. Currently, the MIC is leading such an effort. The MIC was established following the 21st Century Infrastructure Report and Pilot program, and it serves to bring together a diverse set of stakeholders to "define a vision for Michigan's infrastructure that provides the foundation for public and environmental health, economic prosperity, and quality of life."[60] The MIC's two formal sub-councils, the Transportation and Water Asset Management Councils (TAMC and WAMC) are tasked with delivering asset management plans. The councils have begun efforts to aggregate comprehensive infrastructure data and release an asset management readiness scale, and they have demonstrated progress in facilitating coordination among different infrastructure owners. A wide range of local organizations and institutes, industry leaders, and innovators and investors form a diverse ecosystem of stakeholders that supplement this work. Following the initial asset management plan, the state can improve its ability to proactively manage infrastructure through sensors and platforms that generate real-time performance data and inform predictive maintenance.

Michigan has gaps in its physical infrastructure that pose public health and safety risks that require additional investment to address. Much of Michigan's road, bridge, water and energy infrastructure was built 50 to 100 years ago and is deteriorating faster than it can be upgraded. The pace of decline will continue to increase; additional funding can help the state slow that decline and progress toward proactive infrastructure management.

Investments in digital and physical infrastructure, in coordination with the private sector, will be paramount in building on Michigan's economic and cultural vibrancy. In the shifting economy, Michigan is considering funding smart infrastructure that accelerates Michigan's global recognition as a leader in mobility, strengthens the state's engineering and manufacturing talent hubs, and secures a more sustainable, safe and connected future. Investments in low-to-no-carbon energy storage, transmission and distribution infrastructure will also generate clean-tech jobs and advance Michigan toward its 2050 carbon neutrality goal. Efforts to expand cybersecurity leadership on a global scale can be accelerated by cooperating with innovators.

Questions for further research:

- How can the State of Michigan best ensure adequate racial, tribal and gender representation in decision-making around infrastructure?

- How should the state balance efforts to address crumbling infrastructure with efforts to invest in technologies and solutions that can bolster Michigan's economic and industry leadership?

- What would it take to transition to a fully digital, integrated, cloud-based asset management system? How could it be set up to promote data-driven decision-making, ease of access and cost savings?

59   "Assessing the State of Environmental Justice in Michigan," 2019, University of Michigan, Link
60   "Michigan Infrastructure Council Annual Report Fiscal Year 2020," MIC, 2020, Link

- What is the condition, age, ownership, maintenance schedule and use of any given infrastructure asset in the state at any given point in time?

- What innovative financing solutions can be employed to support climate-positive infrastructure investments?

- What are the specific economic, public health, human capital and climate implications of proposed and potential infrastructure improvements?

- What are the implications of expanding the MIC's subcouncils (beyond the TAMC and WAMC) to include impartial councils on energy and communications infrastructure? Which additional stakeholders should be included?

The following infrastructure investment opportunities were aggregated for consideration. Opportunities are not exhaustive but indicative of the types of investments that the state and other stakeholders (such as private-sector entities) are likely to evaluate. Each opportunity has been ranked across public health, climate, human capital and economic development. Rankings are purely qualitative and based on research referenced in this report. This is an example of an initial analysis. Moving forward, a more quantitatively rigorous analysis on an array of potential investments should be considered once more complete information is available. The analysis should engage multiple stakeholders from both the public and private sectors. **GREEN** indicates a high value derived, **YELLOW** a neutral value derived (could also indicate both significant positives and negatives), and **RED** an overall negative value derived.

#	Infrastructure Investment Opportunity	Description	Public Health	Climate	Human Capital	Economic Development
1. Transportation & Mobility						
1	Road Maintenance	Address roads, highways and bridges in 'poor' condition	Yellow	Yellow	Green	Yellow
1.1	Expand low-carbon transportation alternatives	Expand existing services such as passenger rail, bike lanes, bus transit (e.g., regional transit in Southeast Michigan)	Green	Green	Green	Yellow
1.2	Improve transit reliability and accessibility	Expand current routes, improve digital infrastructure	Green	Green	Green	Yellow
1.3	EV charging infrastructure rollout	Activate EV infrastructure rollout to enable fleet electrification and boost EV registrations; partner with utilities to ensure low-carbon energy is used	Green	Green	Green	Green
1.4	Drone + Electric Vertical Takeoff and Land (EVTOL) infrastructure	Install vertiports for EVTOL pilots; gain certification for beyond-visual-line-of-sight flight operations for movement of critical goods (e.g., medications)	Yellow	Green	Green	Green
1.5	Zero-emission fleet (via electrification or alternative fuels)	Subsidize hydrogen refueling stations; or invest in fleet electrification capabilities	Green	Green	Green	Green
1.6	Freight modal expansion	Rail or Soo Locks expansion	Yellow	Red	Green	Green
1.7	Connected and Autonomous Vehicle (CAV) Enablement	Invest in enabling technologies (e.g., vehicle-to-grid, vehicle-to-infrastructure) to enable improved safety, load management and traffic throughput	Green	Yellow	Yellow	Green
1.8	Improve congestion via digital mobility management	Implement mobility 'operating system' that integrates multiple data streams to optimize for factors such as congestion mitigation, pollution reduction, or emergency management	Green	Green	Yellow	Green
1.9	AI-driven preventive maintenance	Invest in technologies and sensors to monitor transportation infrastructure, and conduct maintenance proactively	Green	Yellow	Red	Yellow
2. Energy						
2	Natural Gas Distribution Enhancements	Maintenance, main and service line material upgrade and replacement, and potential expansion of natural gas distribution infrastructure	Red	Red	Green	Yellow
2.1	Digitization of electricity infrastructure	Implement technology enabling demand-side management, vehicle-to-grid integration and distributed generation management	Yellow	Green	Green	Green
2.2	Transmission infrastructure expansion	Upgrade and expand electric transmission infrastructure, incorporate distributed generation	Yellow	Yellow	Green	Yellow
2.3	Passive design/building efficiency measures	Reduce energy consumption of buildings through measures such as passive design, and efficiency upgrades following building energy audits	Yellow	Yellow	Yellow	Yellow
2.4	Cyber & emergency resilience	Boost system-wide resilience across stakeholders to ensure reliability of critical energy infrastructure in the event of an emergency or cyber incident	Green	Yellow	Yellow	Yellow
2.5	Energy storage: utility-scale and distributed	Build out storage capacity to ease the transition to renewables, at the utility, community and residential scales	Green	Green	Yellow	Yellow
2.6	Grid modernization	Upgrade, expand and digitize the distribution grid to ensure reliability, efficiency and resilience	Yellow	Yellow	Green	Green
2.7	Carbon Capture, Use & Storage (CCUS)	Evaluate the environmental and economic feasibility to store CO2 in Michigan's vast underground reservoirs	Yellow	Yellow	Yellow	Yellow
2.8	Invest in emerging renewable energy sources	Source new solutions and technologies from universities and innovators to pilot and scale (e.g., biomass powered by invasive species, dist. hydropower)	Green	Green	Yellow	Yellow
2.9	AI-driven preventive maintenance	Invest in technologies and sensors to monitor energy infrastructure, and conduct maintenance proactively	Green	Yellow	Red	Yellow

#	Infrastructure Investment Opportunity	Description	Public Health	Climate	Human Capital	Economic Development
3. Water						
3	Address toxic water service lines	Replace lead service lines, specifically within low-income communities	🟩	🟩	🟩	🟩
3.1	Machine learning and AI to accelerate line replacement	Cooperate with academia and the private sector to leverage technologies to identify and replace hazardous lines	🟩	🟩	🟨	🟩
3.2	Address sewage and septic system failures	Upgrade infrastructure around treatment of sanitary waste to prevent leaks, overflows and discharge of raw sewage	🟩	🟩	🟩	🟩
3.3	Improve stormwater management systems	Reduce stormwater runoff by retaining and treating stormwater	🟩	🟩	🟩	🟨
3.4	Coastal environmental and economic resilience	Evaluate and invest in coastal erosion solutions given rising Lake Michigan waterline, resulting erosion and property damage/loss	🟩	🟨	🟩	🟨
3.5	Contamination mitigation and elimination (e.g., PFAS)	Identify areas with high levels of PFAS, and ensure removal from drinking water	🟩	🟩	🟩	🟩
3.6	Groundwater monitoring and proactive management	Leverage groundwater infrastructure to monitor groundwater levels and condition to monitor pollutant levels, and groundwater sensitivity to climate change	🟩	🟩	🟩	🟩
3.7	Digital asset aggregation and management	Catalog existing water infrastructure in a cloud-based platform, including data on performance, ownership, condition and maintenance schedule	🟩	🟨	🟩	🟨
3.8	Wastewater & municipal water efficiency	Lower emissions from wastewater and municipal water plants by evaluating emissions reductions opportunities (e.g., improving pump efficiency)	🟩	🟩	🟩	🟩
4. Information & Communications						
4	Coordinated infrastructure cyber defense	Build integrated approach to protect infrastructure (e.g., water, energy) from cyber attacks; improve ability to isolate vulnerabilities	🟩	🟨	🟨	🟨
4.1	Coordinated 5G rollout	Coordinate with the private sector to accelerate 5G rollout to accelerate developments in sectors such as mobility	🟨	🟨	🟩	🟨
4.2	Leverage big data	Evaluate the use of anonymized mobile data and/or scaled GIS data to drive decision-making around infrastructure	🟩	🟩	🟨	🟨
4.3	Central Digital Asset Inventory	Create a comprehensive, digital, central inventory of statewide data assets for storing, sharing and accessing data	🟨	🟨	🟩	🟨
4.4	IT infrastructure modernization	Upgrade central IT infrastructure to enable cloud-based data sharing, access and storage	🟨	🟨	🟩	🟨
4.5	Urban digital communications infrastructure	Convey key information (e.g., public health, traffic updates) to citizens who may not have digital capabilities or Internet access via digital signage	🟩	🟥	🟨	🟨
4.6	Expand broadband coverage and digital fluency	Build on investments in coverage expansion, to ensure access to education, employment and digital health services	🟩	🟨	🟩	🟨
4.7	Intelligent system monitoring	Leverage AI to monitor intelligence systems for irregularities or potential cyber threats	🟩	🟨	🟨	🟩

The following resources were compiled based on publicly available reports across each infrastructure type. This resource guide is not intended to be exhaustive but to provide a starting point for helpful resources. Notes regarding the objectivity and extent to which it evaluates infrastructure comprehensively are included. **Sources that are particularly helpful are indicated with bold titles.**

Title	Source	Year	Description	Notes
All Infrasture Types				
Michigan Infrastructure Council Annual Report FY2020: Developing a 30-Year Infrastructure Strategy for Michigan	Michigan Infrastructure Council (est. 2018); Michigan Department of Treasury	2020	Summary of MIC charter, initial programs and progress to date on Infrastructure Asset Management cataloging	Focuses on process rather than specific infrastructure
Access: https://www.michigan.gov/documents/mic/5700_MIC_Annual_Report_2020_703681_7.pdf				
MIC: 180-Day Report - Developing a 30-Year Infrastructure Strategy for Michigan	Michigan Infrastructure Council; Michigan Department of Treasury	2019	Summary of the introduction to the MIC, and 3-year work plan outlining the Infrastructure Asset Management approach	Details the MIC work plan, not infrastructure-specific
Access: https://www.michigan.gov/documents/mic/MIC_180_Day_Report_Final_March_1_647964_7.pdf				
Jobs, Michigan, & Leadership in the Economy of Tomorrow		2017	Description of current differentiating attributes of Michigan's economy, as well as opportunities for the future; with a focus on economic development (e.g., talent, jobs, industry leaders, academic centers of excellence)	Does not provide a comprehensive view of infrastructure
Access: https://static1.squarespace.com/static/5a31a397e5dd5b97586824e5/t/5bbd4f2f9140b76c6c5bb9f5/1539133257475/ Jobs+Michigan+and+Leadership+in+the+Economy+of+Tomorrow.pdf				
21st Century Infrastructure Commission Report	21st Century Infrastructure Commission (Commissioned by Gov. Rick Snyder)	2016	Created for Governor Rick Snyder, the 21st Century Infrastructure Commission completed a report on infrastructure, including a 50-year vision with recommendations across water, transportation, energy and communications. The report ultimately led to the creation of the MIC. It offers a summary of current state, gaps and recommended next steps.	Helpful starting point to understand current state (as of 2016) and recommended next steps
Access: https://www.michigan.gov/documents/snyder/21st_Century_Infrastructure_Commission_Final_Report_1_544276_7.pdf				
Investing in Michigan's Infrastructure: Building for Economic Growth	Business Leaders for Michigan	2016	Assessment of opportunities to improve infrastructure, leveraging leading practices from other states and cities. Report looks at financing mechanisms as well as recommendations for infrastructure planning.	Helpful supplement to other reports, this focuses more on the economics of potential investments. Does not provide a comprehensive view of infrastructure.
Access: https://businessleadersformichigan.com/wp-content/uploads/2020/01/Summary-Report-BLM-MI-Infrastructure-Funding-Policy-Findings-Final-0111217.pdf				
Transportation & Mobility Infrastructure				
Michigan is Automobility	MichAuto (MEDC)	2020	Fact sheet on the automotive and mobility industry, with statistics on economic development, talent and industry investment	Doesn't focus on infrastructure, not a comprehensive view
Access: http://michauto.org/wp-content/uploads/2020/02/MichisAuto_2020.pdf				
Transportation Asset Management Council: Dashboards, Interactive Maps, Reporting Hub	Transportation Asset Management Council	2020	TAMC website houses interactive maps featuring annualized average data on road and bridge quality, traffic and planning organization locations. Includes a "Reporting Hub" access portal for a variety of state reporting systems and tools. It also includes data visualizations of bi-annual data ("dashboards") on pavement, bridge, traffic, safety, maintenance, finance and culverts.	This website is a good starting point to access recent data on the state of transportation infrastructure.
Access: https://www.michigan.gov/tamc/				

Transportation & Mobility Infrastructure *continued*				
Michigan Mobility 2045: Phase I Public and Stakeholder Participation Summary and Evaluation	MDOT	2020	Public and stakeholder input on the long-range transportation plan (MM2045), specifically on capital investments, safety and mobility in multimodal transit, efficiency, and issues important to include in the plan. As a note, the federally required State Rail and Freight Plans will be included in MM2045.	Doesn't focus on infrastructure, rather on public perceptions. Exhaustive report pending release in 2021.
Access: http://www.michiganmobility.org/files/upload/resource_library/public_and_stakeholder_summary_and_evaluation.pdf				
Michigan Transportation Asset Management Council: Michigan's 2019 Roads & Bridges Annual Report	Michigan Transportation Asset Management Council (created in 2002, shifted in MIC in 2018)	2019	Summary of 2019 data on pavement and bridge conditions, investment opportunities and proactive asset management practices	Comprehensive view of road and bridge data in Michigan, demonstrating progress and investment opportunities as part of the Transportation Asset Management Plan
Access: https://www.michigan.gov/documents/tamc/2019_TAMC_Roads__Bridges_Annual_Report_WEB_690991_7.pdf				
2019 Freeway Congestion & Reliability Report	MDOT, Wayne State University	2019	Overview of Michigan freeway performance (focused on congestion), broken down by region	Focuses on highways, does not represent transportation and mobility comprehensively
Access: https://www.michigan.gov/documents/mdot/Congestion_Reliability_Report_Ch_1_Intro_673946_7.pdf				
Moving Michigan Forward: 2040 State Long-Range Transportation Plan	MDOT	2016	Exhaustive view of Michigan's goals, challenges, status of aviation, freight, highway, bridge and road infrastructure	Published in 2016 for Governor Rick Snyder under the leadership of former MDOT Director Kirk Steudle, this information isn't up to date. The pending MM2045 plan will have more recent data.
Access: https://www.michigan.gov/documents/mdot/2016_SLRP_PRINT_530128_7.pdf				
Highway/Bridge Whitepaper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/2040_Highway-Bridge_White_Paper_Final_31716_521164_7.pdf				
Freight Whitepaper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/Freight_White_Paper_Draft_readyforweb_40816_521013_7.pdf				
Aviation Whitepaper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/Aviation_White_Paper_Final_1_11_16_521132_7.pdf				
Connected and Automated Vehicles and New Technology White Paper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/2040_SLRP_CAV_NewTech_readyforweb_40816_521014_7.pdf				
Nonmotorized Whitepaper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/2040SLRP_NonmotorizedTransp20116_512805_7.pdf				
Intercity Passenger Rail Service White Paper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/2040_MITP_Intercity_Rail_Service_White_Paper_40416_521158_7.pdf				
Intercity Passenger Bus Service White Paper	MDOT	2016	Inventory of system assets, condition and performance	Information isn't up to date; anticipated update pending release of MM2045
Access: https://www.michigan.gov/documents/mdot/Intercity_Bus_White_Paper_readyforweb_521155_7.pdf				

Energy Infrastructure				
2020 - MPSC Annual Report - Fiscal Year 2019	Michigan Infrastructure Council (est. 2018); Licensing and Regulatory Affairs	2020	Report describing the MSPC organization, partnerships, special projects, activities & accomplishments	Offers a summary of special infrastructure projects executed in FY19, with some summary information on energy infrastructure demand
Access: https://www.michigan.gov/documents/mic/MPSC_2019_Annual_Report_682678_7.pdf				
Michigan Statewide Energy Assessment	MPSC	2019	Detailed assessment of Michigan's energy system, with deep dives into electric, natural gas and propane infrastructure. Assesses cyber and physical vulneratbilities, the energy emergency management system, and recommendations for improvements.	Provides detailed information on energy infrastructure, focused on hydrocarbon supply with a smaller focus on renewables and distributed energy resources
Access: https://www.michigan.gov/documents/mpsc/2019-09-11_SEA_Final_Report_with_Appendices_665546_7.pdf				

Water Infrastructure				
Michigan Water Asset Management Council: 2019 Annual Report	Michigan Water Asset Management Council, Michigan Department of Environment, Great Lakes, and Energy	2020	Includes a summary of FY19 activities (e.g., development of asset management templates), and future activities. The report doesn't provide any current state information on infrastructure.	
Access: https://www.michigan.gov/documents/mic/2019_Water_Asset_Management_Council_Annual_Report_688979_7.pdf				
Lake to Tap: A Citizen's Guide to Michigan's Water Systems and Issues	The Center for Michigan; Bridge Michigan (publication)	2019	Published to increase citizen engagement around Michigan water issues, this offers a summary of issues surrounding water governance, the Blue Economy, Great Lakes and other surface waters, and drinking water in Michigan.	
Access: https://www.bridgemi.com/sites/default/files/water_issue_guide.pdf				
Michigan's Water Infrastructure Investment Needs	Public Sector Consultants; for the Michigan Infrastructure & Transportation Association	2016	Assessment of infrastructure investment required to meet current standards, and whether current investments across the state are sufficient to meet these standards. Focused on capital improvements rather than O&M.	WAMC is newer, so annual report does not include current state water infrastructure data
Access: http://publicsectorconsultants.com/wp-content/uploads/2016/12/MI-Water-Infrastructure-Investment-Needs-FINAL-1.pdf				
21st Century Infrastructure Commission Report: Chapter 7. Water Recommendations	21st Century Infrastructure Commission (Commissioned by Gov. Rick Snyder)	2016	Created for Governor Rick Snyder, the 21st Century Infrastructure Commission completed a report on infrastructure, including a 50-year vision with recommendations across water, transportation, energy and communications infrastructure. The report ultimately led to the creation of the MIC. This chapter focuses on water infrastructure.	Helpful starting point to understand current state (as of 2016) and recommended next steps
Access: https://www.michigan.gov/documents/snyder/Ch_7_-_Water_Recommendations_551286_7.pdf				
Sustaining Michigan's Water Heritage: A Strategy for the Next Generation	Michigan Office of the Great Lakes, in collaboration with EGLE, DNR, MDARD, MEDC	2016	Created for Governor Rick Snyder, this report offers a 30-year vision for water in Michigan with detailed recommendations.	Does not provide a comprehensive view of water infrastructure
Access: https://www.michigan.gov/documents/deq/deq-ogl-waterstrategy_538161_7.pdf				
Michigan Blue Economy: Making Michigan the World's Freshwater & Freshwater Innovation Capital	Michigan Blue Economy: John Austin, Alan Steinman	2015	Offers a deep dive into the role of water in Michigan's story, including industrial and economic development, placemaking, education and community development	Does not provide a comprehensive view of water infrastructure
Access: https://michiganblueeconomy.org/wp-content/uploads/2015/03/Michigan-Blue-Economy-Report.pdf				

Water Infrastructure *continued*				
Detroit Water and Sewerage Department Technical Memorandum 7: Michigan's Blue Economy	CDM Smith	2015	Created as part of the 2013-2015 update to the Water Master Plan created by CDM Smith for the Detroit Water and Sewerage Department, the Blue Economy section focuses on applying the principles outlined in John Austin's "Michigan Blue Economy" to the DWSD to inform recommendations.	Does not provide a comprehensive view of water infrastructure
Access: https://detroitmi.gov/sites/detroitmi.localhost/files/2018-05/TM-07_Michigans_Blue_Economy.pdf				
Information & Communications Infrastructure				
The Michigan Broadband Map	Connected Nation, MEDC, MPSC, Michigan Department of Technology, Management, and Budget	2020	Interactive GIS-enabled map of broadband access (fiber, cable, DSL, fixed wireless, broadband, mobile wireless, unserved areas)	Helpful starting point to understand broadband coverage in Michigan
Access: https://gis.connectednation.org/portal/apps/webappviewer/index.html?id=98c4d702d00040c9be673787bfeb8162				
Consumers Energy Electric Distribution Infrastructure Investment Plan (2018-22)	Consumers Energy	2018	Consumers Energy investment plan for electric distribution, provided to the MPSC	The Consumers Energy investment plan offers some summarizing information on infrastructure gaps and planned investments.
Access: https://www.michigan.gov/documents/mic/Consumers_Energy_5_year_Electric_Distribution_and_Maintenance_Plan_645063_7.pdf				
DTE Energy Distribution Operations Five-Year (2018-22) Investment and Maintenance Plan: Final Report	DTE	2018	DTE investment plan for electric distribution, provided to the MPSC	The DTE investment plan offers some summarizing information on infrastructure gaps and planned investments.
Access: https://www.michigan.gov/documents/mic/DTE_5_Year_Electric_Distribution_and_Maintenance_Plan_644845_7.pdf				
Michigan Broadband Roadmap	21st Century Infrastructure Commission	2018	Report summarizing broadband access and availability, access to unserved areas, and approach to increasing adoption and advancing the state's broadband ecosystem	Detailed information & communications infrastructure assessment, including current state (as of 2018) and recommendations. Developed by a consortium of public- and private-sector representatives.
Access: https://www.michigan.gov/documents/mic/MCAN_final_report_697198_7.pdf				