CITY OF DETROIT **FROM "MOTOR CITY" TO "MOBILITY CITY"**

U.S. DEPARTMENT OF TRANSPORTATION - BEYOND TRAFFIC: THE SMART CITY CHALLENGE

FEBRUARY 4TH, 2016

TABLE OF CONTENTS

SECTION 1: VISION- EQUITABLE MOBILITY, FROM "MOTOR CITY" TO "MOBILITY CITY"

Long the heart of the American automobile industry, the City of Detroit is prepared to again play a national leadership role with a new vision for equitable mobility, transforming Detroit from **"Motor City" to "Mobility City"**. Funding received from the Smart City Challenge will be used to build a mix of hard and soft infrastructure that provides equitable access to affordable and time-efficient mobility solutions.

The **City of Detroit**, supported by:

- **Michigan Department of Transportation (MDOT)**, a national leader in intelligent transportation system (ITS) solutions;
- **University of Michigan (UM)**, the leading research institution for connected and automated vehicles; and
- **NextEnergy**, a nationally recognized accelerator for energy and transportation technologies

will partner with **industry leaders such as General Motors (GM) and innovators such as Google's SideWalk Labs** to add **"smart" technologies** (sensors, cameras, communications, software apps, and data analytics), **specialized vehicles** (connected, automated, and electric vehicles) and **new business models** (car sharing, ride sharing, bike sharing, smart parking, and multimodal fare payment) to **improve safety, mobility and the environment in Detroit.**

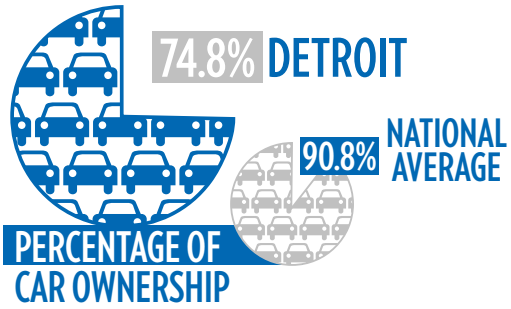
Making these investments in Detroit will have a significantly greater impact on equity and inclusion than they would in any other city in America due to our unique mobility challenges. In addition, our approach will create repeatable models for community engagement, asset mapping, and low cost and high speed investment strategies for mid-sized cities across the country.

Detroit is uniquely positioned to lead the nation in the development and deployment of these smart city mobility solutions because:

1. IT MATTERS MOST HERE.

In no other mid-sized cities are **car ownership rates so low** (74.8% in Detroit vs. national average of 90.8%), **jobs so spread out** (115,000 Detroiters leave the city for jobs vs. 65,000 who live and work in the city), and **transit systems so underdeveloped and fragmented** (65% of transit dependent households are beyond a 10 minute walk to transit options and only 22% of the regions jobs are accessible within a 90 minute fixed route transit commute). In addition, Detroit has **one of the highest poverty rates** among mid-sized cities (39.3% of Detroit households live below the poverty line) and **lowest employment rates** (53% of Detroiters age 18-64 worked any hours last year vs. national average of 75%).

1 IN 3 DETROIT RESIDENTS ARE LIVING BELOW THE POVERTY LINE (39.3%)



1 IN 5 OF TRANSIT-DEPENDENT HOUSEHOLDS ARE BEYOND A 30-MINUTE WALK TO FIXED-ROUTE TRANSIT

As the Motor City, we have a legacy transportation system and land use patterns almost totally reliant on personal auto ownership. As a result, many Detroiters lack affordable access to mobility. Our urban core, while rapidly being re-developed to include walkable neighborhoods with transit, car share and bike share options, is still dominated by auto patterns, with the resulting negative congestion, parking land use, pedestrian and biker safety issues, and environmental impacts. But the biggest impact may be the economic hardship driven by the lack of affordable, accessible mobility options. **Our key challenge, then, is to leapfrog the limitations of our 20th century personal auto-based transportation with 21st century smart city technologies that enable cleaner, smarter, more efficient and, perhaps most importantly, equitable mobility solutions - to transform from Motor City to Mobility City.**

Building a next-generation transportation system which provides efficient and effective access in a low-density environment will fundamentally change the lives of many lower-income individuals and families that currently face daunting transportation challenges, and will create models that can be used in mid-sized cities all across the country.

Moreover, providing additional and more seamlessly connected mobility options will substantially accelerate the re-population of the City of Detroit. Introducing these smart, technology-enabled, equitable mobility options allows us to accelerate the re-building of Detroit by fostering neighborhood vibrancy, walkability and density, with less need for car ownership and parking, or the massive investments in fixed route transit services that such urban forms typically require. Investing in smart infrastructure to provide flexible multimodal options eliminates the need for massive investments in hard transit infrastructure.

While cities across America are investing tens of billions of dollars in rail and bus rapid transit (BRT) systems to link and densify neighborhoods, we in Detroit, with the Smart City grant, will implement smart technologies and develop new service models to achieve many of the same goals more quickly and less expensively. In addition, investing in this technology now, as we are aggressively redeveloping and re-building our city, allows us to re-shape our land use planning and regulation, so that we can actively shape neighborhoods in partnership with these investments.

> The vision of "Mobility City" is to implement 21st century smart city technologies to enable cleaner, smarter, more efficient and, perhaps most importantly, equitable mobility solutions.

2. WE KNOW HOW TO SOLVE IT.

We will partner with industry leaders to add smart technologies, specialized vehicles and new business models to provide equitable solutions that improve safety, mobility and environment in Detroit.

We will form a Program Management Office in the Office of the Mayor supported by:

- **MDOT**, a national leader in ITS solutions;
- **UM**, the leading research institution for connected and automated vehicles and home to the Transportation Research Institute **(UMTRI)**, the Mobility Transformation Center **(UM-MTC)** which operates **MCity**, a 32 acre test facility for connected and automated vehicles, and the Sustainable Mobility & Accessibility Research & Transformation program **(UM-SMART)**, a systems-based approach to catalyze systematic and fundamental transformations of mobility / accessibility systems consistent with a sustainable human future;
- **NextEnergy**, a nationally recognized accelerator for energy and transportation technologies.

At the core of our proposal are key infrastructure assets and partnerships already in place or under development. Specifically, we plan to:

- **Build out the information communications technology (ICT) infrastructure** on the backbone of existing dedicated short range communications (DSRC), public street lighting, and traffic light systems to provide expanded DSRC, sensors, cameras, data backhaul and ubiquitous Wi-Fi capabilities. *Key partners*: Public Lighting Authority (PLA), MDOT, Sidewalk Labs, Rocket Fiber, ATT, Verizon*
- **Provide connected, automated vehicle and electric vehicle fleets.** Fleets will be used for car share, ride share, shuttle and delivery business models/use cases. Connected, automated vehicles will be used to provide first mile/last mile connections to transit nodes. Electrified fleets will be used to explore long-range electric car share options for first mile/last mile movement, and long-range electric delivery vans; both with potential for bidirectional and/or smart charging so value-to-the-grid applications can be tested and evaluated. *Key partners*: GM, Ford Motor Company (Ford), UM-MTC, MDOT, DENSO, Robert Bosch (Bosch), DTE Energy*
- **Explore car share, bike share, and ride share business models** that effectively address first-mile/last-mile challenges, as well as provide low-income mobility access and low-income employment. Explore value of ride share and/or car share business models to optimize the MetroLift Paratransit, Job Access and Reverse Commute (JARC) and New Freedom programs through improved DDOT service levels and/or public-private partnerships to provide on call services through third-party provider(s). *Key partners*: GM, Ford, MDOT, DDOT, Lyft*
- **Optimize existing parking solutions, shuttle routes and vehicles using connected technologies and specialized connected vehicles**, while partnering with anchor employers, health care providers and educational institutions. Consider opt-in building owner involvement in smart mobility solutions (kiosks, time-to-arrival notification, etc.). *Key partners*: GM, Rock Ventures Family of Companies (Rock Ventures), DTE Energy, Detroit Medical Center (DMC), Henry Ford Health System (HFHS), Wayne State University (WSU), Detroit College for Creative Studies (CCS)*
- **Create a connected access card "Mobility Passport" to provide ride request, single fare access, and parking payment options** across public-private services. Mobility Passport will include single payment software, a dynamic pricing engine, and point-to-point messaging frameworks. *Key partners*: Sidewalk Labs, Urban Insights, EastBanc Technologies*
- **Build out DDOT bus system, M1 Rail, Detroit People Mover (DPM) and Rosa Parks Transit Center with connected kiosks, shelters, and station technologies.** Equip DDOT buses with communications and sensor technologies to serve as Wi-Fi mobile hot spots and enable safety, security, location, and road condition applications. *Key partners*: DDOT, M-1 Rail, DPM, Sidewalk Labs*
- **Develop traffic management solutions, smart parking, event management and emergency traffic signal preemption** by leveraging existing MDOT and City of Detroit traffic operations centers and expanded network of smart traffic lights. Consider dynamic scheduling for DDOT buses, and real-time mapping and monitoring capability. Build on existing Argonne National Laboratory (ANL) partnership to leverage POLARIS framework transportation model. *Key partners*: MDOT, Bosch, DENSO, ANL*
- **Develop 3D streets location and traffic management protocols** (consider 3D urban delivery test case) by leveraging USDOT affiliated testbed operated by Detroit Aircraft Corporation. *Key partners*: Detroit Aircraft Corporation, PLA, Cisco, ATT*
- **Develop smart, connected delivery capabilities** that include dynamic scheduling, point-to-point route planning and delivery notification. *Key partners*: Ford Motor Company, Sidewalk Labs, EastBanc Technologies*

*See Section 7 for full list of partners & capabilities

3. IT'S BEST REALIZED HERE AND NOW.

Detroit's proximity to the auto industry: The ecosystem here in Detroit and southeast Michigan is already poised as a global mobility center. Proximity to the global automotive OEMs, especially our partners GM and Ford, as well as the key Tier 1 suppliers who are already working on the most advanced connected and automated vehicle technologies, makes Detroit the perfect place to invest in real-world infrastructure so that the latest connected and automated vehicles can be tested in a real-world environment.

As connected and automated vehicle technologies move through development and testing at the 300+ automotive R&D centers in the region, through the off-roadway simulation facilities at UM-MCity, the 32-acre testing environment designed to put highly-automated vehicles through their paces before they can be safely deployed on actual roadways, they will have a nearby willing neighbor, the City of Detroit, that can support the next step: real vehicles, on real roads, under real city conditions.

As the auto industry is working toward Level 4 automation, it is critical that their scientists and engineers are co-located with everything they need to keep the innovations moving forward— a robust supply chain of innovation partners, world class research and testing facilities, and a nearby marketplace so that their urban scientists can conduct the human/machine interface (HMI) studies, i.e., watch real people in real situations, in order to move forward towards fully automated vehicles.

Detroit is ready. Detroit is poised at a unique moment in time when there is a compelling vision, a recently built track record of addressing real challenges, the near-perfect mix of enabling infrastructure in place so that there is something to build upon, and real mobility challenges that invite a rich set of pilots and rollouts. The last time Detroit had such an opportunity to rebuild itself was in 1805, after a fire swept through the City that left one building standing. It has been said the smartest city is yet to be built because it is in the building that the smart technologies can be deployed. Detroit is poised for such a re-building.

Since taking office, Mayor Duggan has made significant progress in terms of rebuilding infrastructure in the City of Detroit and raising the quality and responsiveness of police, fire, and city services. The city has gone from bankruptcy to balanced books. Detroit is ahead of schedule on its plan to outfit the city with 65,000 smart, connected, LED streetlights. Detroit has cut EMS response times in half and shaved 12 minutes off of police response times. More than 7,500 vacant, dangerous structures have been demolished. And there are 80 more buses on the streets, the most in 20 years. In other words, Detroit's ability to take big challenges head-on and solve them is only getting stronger.

We are moving beyond basic services, and are focused on rebuilding Detroit using 21st century technologies. We are in the midst of:

- Rebuilding our streetlights with smart technologies that facilitate Wi-Fi, DSRC, cameras, sensors and backhaul through the PLA

City street lights provide ICT backbone: 65,000 lights to be upgraded by 2016. Source: PLA

- Upgrading our bus fleet with connected vehicle technologies that provide better safety, rider security, and locational information so we can better serve our riders;
- Improving our downtown and midtown using transit, smart parking, car share and bike share so our precious land is not needed for parked cars, and the people who live, work and visit can get around in timely and affordable ways.

We have basic transit assets in place (DDOT, SMART and Windsor Transit bus services, DPM, and Amtrak) as well as new assets coming on line (M1 Rail and BRT) and numerous private services offering campus-based or user group shuttle services (See Sections 3A and 8 for a complete description of existing transportation assets). Investing now, through the Smart City Challenge, to connect these assets with smart technologies, and supplement their value through new business models has the potential to create quantum improvements in equitable mobility access and overall service levels at a fraction of the cost of building traditional transit assets.

Our infrastructure to support connected and automated vehicles and connected citizens already includes:

- MDOT's Southeast Michigan Transportation Operations Center located just outside of Downtown Detroit as well as the City of Detroit's Traffic Management Center in Southwest Detroit;
- Connected vehicle and DSRC networks throughout the Detroit Metropolitan area, including the country's first urban canyon installation in downtown Detroit, the Ann Arbor Connected Vehicle Test Environment (AACVTE) with over 2800 vehicles and 25 road units deployed, and USDOT affiliated test beds in Midtown at NextEnergy and Detroit's east side at the Coleman A. Young Municipal Airport (City Airport) operated by Detroit Aircraft Corporation;
- High-speed, gigabit fiber-optic communications networks by Merit Network and Rocket Fiber;
- In-depth mapping capabilities currently provided to the City of Detroit from Nearmap.

4. DETROIT CAN GET IT DONE.

Detroit has the leadership capacity and the partnership network to get it done. The City of Detroit has demonstrated effective leadership, alignment and working relationships at the city, state, and federal levels of government, as well as a track record of creating significant private investment and public-private partnerships. Highlights of recent accomplishments are summarized in the table below.

In addition, Section 3B describes more examples of strong leadership from the Mayor's office, proven experience and expertise in large scale connected vehicle pilots, well established pattern of public private partnerships, and enabling steps already in place.

To complement the City's capabilities and position Detroit for Mobility City, Detroit has world class partners from industry and innovation networks described in Section 7, as well as thought leaders UM-MTC (connected and automated vehicle technologies), MDOT (exploration and deployment of ITS), and NextEnergy (public private partnerships to deploy technologies).

FIGURE 1: CITY OF DETROIT RECENT ACCOMPLISHMENTS

REGIONAL COMPETENCIES	RECENT ACCOMPLISHMENTS
Renewed city leadership & organization	2015 rebuilding of the City's finance, IT & planning departments
Physical investments and property revitalization	$5.2+ billion in private investment in property between 2013-2014; successfully scaling demolition + land sales processes to address urban blight
Strong post-bankruptcy commitments	New public-private partnerships, renewed cooperation between city hall and the city council, greater collaboration among regional entities, strong support from State of Michigan ($366M)
Energized public and philanthropic involvement	More than $480M in philanthropic support for M1Rail, Grand Bargain to address funding gap in bankruptcy agreement, fund of funds investment in New Economy Initiative, and 3 year Detroit Future City project (framework for Detroit future with over 38,000 citizen inputs)

FIGURE 2: MOBILITY CITY - THE BIG IDEAS

BIG IDEA	First Mile/ Last Mile Transportation	Connected and/ or Automated Vehicles	Mobility Passport	Networked EVs	Smart Parking
					
Technology/ Infrastructure	Automated (level 3 to 4) EVs and I.C.E. vehicles to provide safe, simple and seamless connection to and from key transportation hubs and other strategic land-use destinations	Creation of a network of connected public & private vehicles (bus, EVs, Internal Combusion Engine (I.C.E.), shuttles, & bicycles) & fixed assets linked by a common application/portal to provide real-time & seamless multimodal transportation options	Smart application or smart card enabling single fare payment system for integrated public transit, participating private transit systems and parking as well as remote automated service requests throughout the system	Deployment of networked EVs for car and ride-sharing in Detroit neighborhoods which is fully integrated into the smart grid for vehicle-to-grid services, in addition to smart charging	Deployment of smart parking technologies to minimize congestion, maximize land use and provide convenience to those who live, work and play in Detroit
Innovation	First use of automated vehicles on public roads	Validation and integration of open source applications aligning public and private transportation devices, systems and assets	First deployment of e-commerce technology into a single card/ application that integrates multi-modal public and private transportation options	First deployment of EV car sharing completely integrated with the smart grid and offering bidirectional charging	Integration of multiple technologies which communicate parking availability to the public on public roads and in publically & privately owned parking lots & structures
Identified Partners	City of Detroit, MDOT, NextEnergy, GM, Ford, DENSO, Bosch, M-1 Rail, UM, CCS, WSU, HFHS, DMC, DTE, Rock Ventures, Verizon, ATT, Lyft, IBM, NREL	City of Detroit, MDOT, NextEnergy, PLA (DSRC), GM, Ford, DENSO, Bosch, Siemens, Sidewalk Labs, Urban Insights, UM, WSU, HFHS, DMC, DTE, Rock Ventures, ATT, IBM, NREL	City of Detroit, MDOT, NextEnergy, GM, Ford, M-1 Rail, SMART, SEMCOG, DPM, Detroit Bike Share, EastBanc Technologies, Urban Insights, Bosch, Rock Ventures, ATT, IBM, Verizon, Sidewalk Labs	City of Detroit, DTE, NextEnergy, PLA (DSRC), GM, Ford, NREL, WSU, HFHS, DMC, Rock Ventures, ATT, IBM	City of Detroit, MDOT, NextEnergy, PLA (DSRC), GM, Ford, DENSO, Bosch, WSU, HFHS, DMC, DTE, Rock Ventures, Verizon, ATT, IBM, NREL
Vision Elements	ALL (1 through 12)	ALL (1 through 12)	1, 2, 3, 4, 5, 7, 9, 10, 11, 12	2, 3, 4, 5, 7, 8, 9, 10, 11, 12	2, 3, 4, 5, 6, 7, 9, 10, 11, 12

FIGURE 3: MOBILITY CITY - HOW PEOPLE WILL LIVE, WORK, VISIT & DELIVER

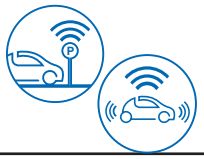
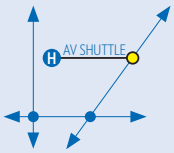
	LIVE	WORK	VISIT	DELIVER
USER SCENARIOS	Elderly Detroit resident has an 8 a.m. doctor appointment at the DMC 	Detroit resident commutes to Wayne State University, has a mid-day doctor appointment 	Suburban resident rides with friends to a Tigers game on Saturday 	Delivery truck must get produce from Eastern Market delivered to restaurants throughout Detroit 
ISSUES TODAY	• Physical mobility to reach transit routes • Indirect bus routing • Multiple lengthy connections	• Multiple lengthy connections/ different systems • Doctor not accessible via transit	• Lack of parking locations and availability • Lack of integrated parking-to-destination trip information	• Challenges of just-in-time delivery of perishables to restaurants • Congestion resulting from delivery to restaurants without alleys
TRAVEL IN MOBILITY CITY	• Resident calls into *integrated mobility* system the night before her appointment, orders and pays for end-to-end trip • She takes a local *ride share* pick up at 7:30 for a short trip to the Gratiot line stop  • She boards the bus, and takes it to the Mack Avenue stop  • The *AV shuttle* is waiting for her at the stop, saving two lengthy bus connections  • She arrives at the front door of the DMC 	• Before leaving home, he uses the *integrated mobility app* to schedule & pay for end-to-end trip • An *AV shuttle* picks him up at front door and delivers him to the M-1 Rail stop just as the next train is arriving  • He scans the bar-code on his phone for prepaid fare to board the train  • After a short walk from Woodward, he arrives at Wayne State for work  • At noon, he walks to the nearby *EV car share* location and rents a car for two hours to drive to his doctor appointment 	• En route to the game, she uses the *smart parking app* to identify parking options • She chooses a less expensive parking option at Wayne State with a shuttle service, pre-pays for parking • She scans the prepaid bar-code on her phone to enter the parking lot, and receives time to the next shuttle  • Her group boards the shuttle and arrives at Comerica Park, avoiding congestion  • After the game, her group uses the *integrated app* to plan a trip to a Midtown restaurant via M-1 Rail before returning to their cars	• Restaurant enters orders into Detroit's *smart delivery system* twice daily • Eastern Market receives order, places request for *on-demand delivery* truck  • Nearby on-demand delivery truck responds, picks up shipment from Eastern Market, as well as other time-sensitive shipments nearby • Delivery truck arrives at restaurant to deliver requested order  • Delivery *payment* is made through smart delivery system 

FIGURE 4: MOBILITY CITY - BENEFITS TO CITIZENS AND GOVERNMENT

	First Mile/ Last Mile Transportation	Connected &/ or Automated Vehicles	Mobility Passport	Networked EVs	Smart Parking
					
CITIZEN BENEFITS					
Improve Safety	✓	✓			✓
Reduce Wait Time	✓	✓			✓
Reduce Travel Time	✓	✓	✓	✓	✓
Improve Convenience	✓	✓	✓	✓	✓
Improve Reliability of Arrival Times	✓	✓			✓
Reduce Transit Cost			✓		✓
Reduce Traffic	✓	✓		✓	✓
CITY OF DETROIT BENEFITS					
Improve Services	✓	✓	✓	✓	✓
Leverage Existing Investments	✓	✓	✓	✓	✓
Reduce Environmental Impact	✓	✓		✓	✓
Improve Operational Efficiencies	✓	✓	✓	✓	✓
Increase Property Values	✓			✓	✓

SECTION 1A: OUR APPROACH

This effort will be led by the newly formed **Office of Smart Infrastructure** within the Mayor's Office with the primary responsibility to connect and coordinate the work and resources of external partners/ stakeholders, as well as internal city departments. The project team supporting the City of Detroit will include experienced connected, automated and ITS vehicle systems leadership and project implementation professionals from MDOT, UM and NextEnergy.

MDOT and UM are well known program partners for the USDOT with years of experience leading work on a national scale involving all facets of connected and automated vehicles and ITS. They bring systems and applications already developed into the smart city environment, such as vehicle-to-infrastructure applications, and the back-end data processing systems needed to handle a smart city transportation network. Since 2012, UMTRI has been leading the USDOT connected vehicle safety pilot model deployment and its follow-on study and has outfitted 2,800+ vehicles (cars, trucks, buses, motorcycles and bikes) with DSRC connected technologies, installed 25 roadside units throughout the greater Ann Arbor, MI area, and has collected 100+ billion records and over 70+ terabytes of data over 3.5 years. In 2014, MDOT partnered with the City of Detroit to develop the country's first urban canyon connected vehicle test bed as a demonstration project for the 2014 ITS World Congress in Detroit.

NextEnergy is one of the nation's leading accelerators of advanced energy and transportation technologies and specializes in assembling public-private partnerships in order to demonstrate and deploy next generation technologies. Since its founding in 2002, they have participated in over $160 Million in programs with industry partners, and secured funding from the Department of Energy, Department of Transportation, Department of Defense, Environmental Protection Agency, Economic Development Administration of the Department of Commerce, National Institute of Science and Technology, and the National Science Foundation, as well as the State of Michigan.

FIGURE 5: OFFICE OF SMART INFRASTRUCTURE ORGANIZATIONAL CHART

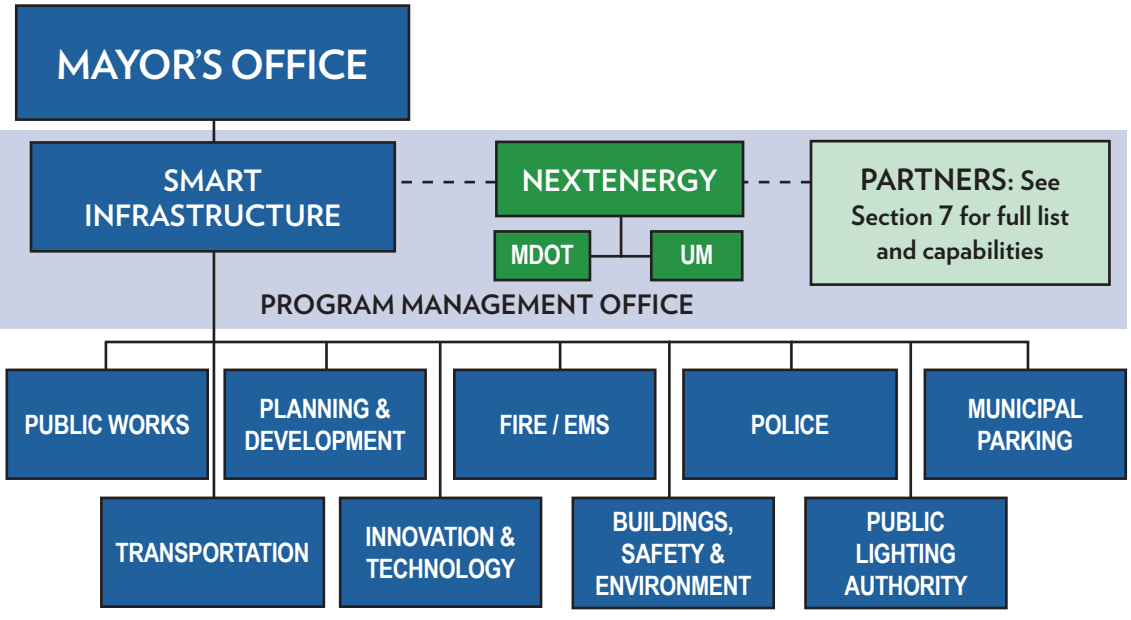


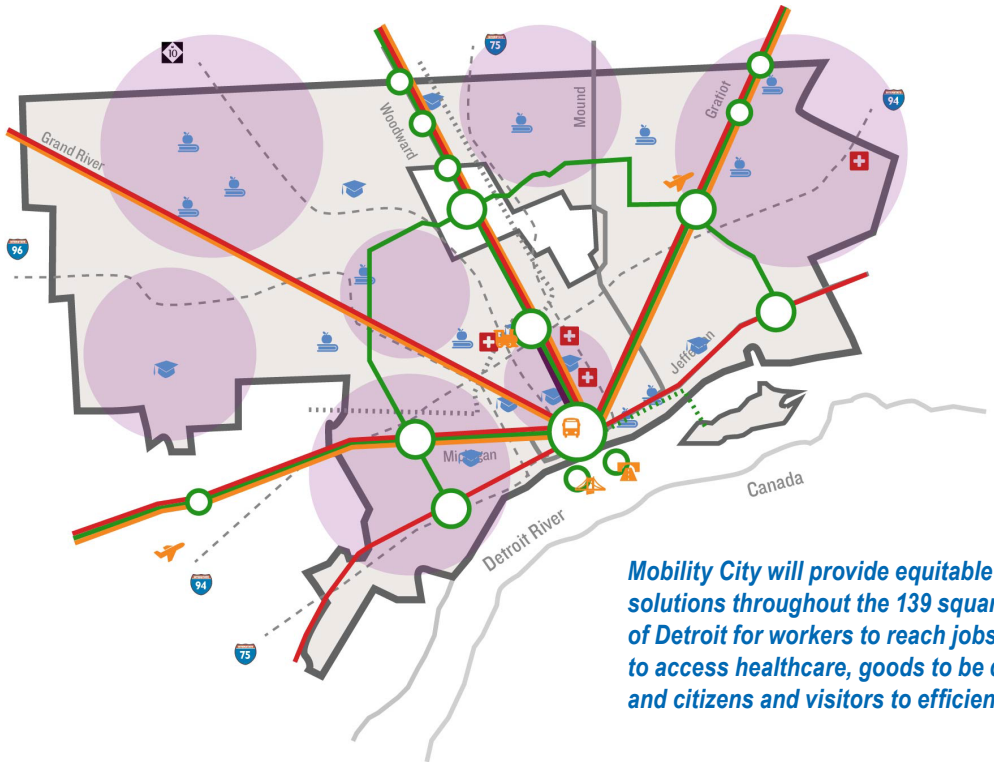
FIGURE 6: OTHER KEY PARTNERS (SEE SECTION 7 FOR A FULL LIST OF PARTNERS & CAPABILITIES)

CATEGORY	KEY PARTNER SUMMARY
Project Management	UM, MDOT, NextEnergy
OEMs	GM, Ford (vehicles, technology, consulting, ride share, e-bike)
Tier 1 Suppliers	DENSO, Bosch, Ricardo, IAV Automotive (road side equipment, connected vehicle and vehicle charging technologies, sensors and soft-ware solutions)
Infrastructure & Software Solutions	Sidewalk Labs, CISCO, IBM, Detroit Labs, AT&T, Verizon, Microsoft, Sirius XM, DTE
Pilots, Use Case & Business Models	WSU, HFHS, DMC, CCS, Rock Ventures, DTE, GM, Detroit Aircraft Corporation
University/research partners	UM, WSU, National Renewable Energy Lab (NREL), ANL

SECTION 2: POPULATION CHARACTERISTICS

According to the 2010 census, Detroit's population was 713,777, which was 19.1% of the 2010 Detroit urbanized area (UZA) population of 3,734,090, making Detroit the 12th largest UZA. UZA density was 2,792.5 persons per square mile (89th most dense), while density in Detroit proper was 5,144 persons per sq. mile (9th most dense). Using these census data, Detroit fits the desired definition of a mid-sized city with a dense urban population typical for a mid-sized city.

FIGURE 7: CITYWIDE MOBILITY CHALLENGES



Mobility City will provide equitable mobility solutions throughout the 139 square mile City of Detroit for workers to reach jobs, disabled to access healthcare, goods to be delivered, and citizens and visitors to efficiently travel.

SECTION 3: CITY CHARACTERISTICS & INVENTORY

SECTION 3A: EXISTING PUBLIC TRANSPORTATION SYSTEM

The existing public transportation system consists of the city bus system operated by DDOT, regional bus systems, local and regional rail, as well as a number of private shuttles operating to serve anchor institutions, hospitals, university campuses, and hotel, restaurant and entertainment districts. A summary of the system is presented below, graphically presented in the site plan in section 4, and detailed in Section 8.

FIGURE 8: EXISTING TRANSPORTATIONS SYSTEMS

	SPECIFICATIONS
DDOT	320 Transit Buses; 36 Service Routes; 85,000 Route Miles; 25M Annual Riders
SMART	Suburban transit system with commuter-oriented service to Downtown Detroit during peak hours; SMART has 43 route with 5,325 stop transit bus system connecting surrounding cities within the urbanized area to Rosa Parks Transit Center within the central business district
Transit Windsor	Cross border tunnel bus, carrying riders from Windsor, Ontario to Rosa Parks Transit Center and various entertainment and sports locations
Bus Rapid Transit (BRT)	High capacity BRT service is being planned on three major corridors in the city and surrounding counties. BRT vehicles will operate in dedicated travel lanes (similar to Light Rail Transit), offer premium amenities at station locations, and utilize ITS technology that allow BRT vehicles to traverse the corridor with limited stops at traffic
Detroit People Mover (DPM)	2.9 mile overhead rail system within the central business district
M1 Rail	3.3 mile light rail system with 20 stations serving 12 locations, to be operational by Q2 of 2017 within the deployment area
Amtrak	Seven trains per day

In addition, Detroit has major highways (I-75, I-94, I-96, M-10) and an arterial roadway system (Jefferson, Gratiot, Van Dyke, Woodward, Grand River and Michigan Avenues) that form the roadway system for moving people and goods in to and around the city.

On a daily basis, 65,000 workers move within, 176,000 come to, and 115,000 travel outside Detroit for jobs.

Smart City Mobility Passport will create more value from upgraded DDOT fleet of 320 buses. Source: DDOT

The PLA has initiated a new lighting system – from the electric grid, to circuits, poles, and lights, and is deploying sensor technology on all 65,000 poles located across approximately 140 square miles of Detroit, allowing the PLA to efficiently maintain and track the lights and how they are functioning. These lights use 802.15.4 mesh and 802.11 Wi-Fi, protocols that can be connected at the software layer and tied into the city-wide network. Where high bandwidth is required for sensors, video edge processing, and data backhaul, Wi-Fi access points can be strategically located for Wi-Fi nodes and other devices. The 802.11 and 802.11p Wi-Fi protocols also create a scalable platform for integration with traffic management, parking management, metering back-haul, vehicle communications, security, and a host of potential applications and data analytics.

The roadway system also forms the basis for regional BRT, with street lighting and traffic lights forming the basis for the information communications technologies necessary to support Mobility City.

SECTION 3B: ENVIRONMENT THAT IS CONDUCIVE TO DEMONSTRATING SMART CITY STRATEGIES

There are four main indicators of how the current environment is conducive to the proposed Mobility City project:

1. STRONG LEADERSHIP from the mayor's office, with support from regional partners and multiple levels of government. The region has undergone unprecedented challenges in the form of the largest municipal bankruptcy ever. The leadership of Mayor Duggan, with support from the state legislature, the governor, private investors, and philanthropic partners were all critical to the successful transition through bankruptcy, and the ultimate transformation of the city's government. This project benefits from the common vision of the challenges, and paths to overcome the challenges of the region, that was forged in that process. There is an unprecedented level of support and cooperation in the region, and a common understanding and commitment to establishing the region as a leader in mobility solutions. It will benefit Detroiters, and the key industries that drive our regional economy, if 21st century mobility solutions are invented and deployed here in southeast Michigan. And the City of Detroit, as the dense urban capital of the region, is the perfect focal point for that deployment.

2. PROVEN EXPERIENCE AND EXPERTISE in the large scale execution of existing and planned expansion of connected vehicle pilots in conjunction with the USDOT, MDOT, UM, and the City of the Detroit. Since 2012, UMTRI has been leading the USDOT connected vehicle safety pilot model deployment and its follow-on study, the Ann Arbor Connected Vehicle Test Environment (AACVTE). UMTRI has developed and successfully deployed vehicle and roadside equipment, DSRC communications and connectivity protocols, and data capture/ data analysis required for connected vehicle technology deployed on real city streets. UMTRI has outfitted 2,800+ vehicles (cars, trucks, buses, motorcycles and bikes) with DSRC connected technologies, installed 25 roadside units throughout the greater Ann Arbor, MI area, and has collected 100+ billion records and over 70+ terabytes of data over 3.5 years.

3. WELL-ESTABLISHED PATTERN OF PUBLIC-PRIVATE PARTNERSHIPS to accomplish regional priorities. There are a number of recent public-private partnerships that provide evidence of our region's ability to successfully implement projects similar to what is being proposed:

- M-1 Rail is a $179.4 million transit project led by private businesses and philanthropic organizations providing 63% of the project funding, in partnership with local government, the State of Michigan, and federal support. The project involves the design, construction and operation of a 3.3-mile circulating streetcar line to run along the city's Woodward Avenue by 2017.
- The nation's first freeway lighting system built by public-private partnership will install newer, more energy efficient LED lighting across bridges, tunnels and roadways within the Detroit metro region freeway system by 2017.
- Detroit is a national leader in developing and maintaining greenways and biking facilities through public-private partnerships, including a current partnership between the city planning department and the Detroit Riverfront Conservancy to design and develop the eastern waterfront, as well as the "Midtown Loop" – a 3.5 mile greenway loop and 1.5 mile Dequindre Cut extension connecting New Center, WSU, DMC and the Riverwalk.

4. A NUMBER OF ENABLING STEPS already in place, or expected to be completed within the timeline of this project:

- Formation of Regional Transit Authority: In 2012, the Southeast Michigan Regional Transit Authority (RTA) was created by the Michigan Legislature through Public Act No. 387, creating a 10-member board with appointees by the Mayor of Detroit; Wayne, Oakland, Macomb and Washtenaw Counties; and the Governor of Michigan. The purpose of the RTA is to plan for and coordinate public transportation in the four-county region, including the City of Detroit;
- Investments in street lighting infrastructure: PLA will complete the installation of 65,000 smart light poles throughout Detroit in 2016;
- Investments in transit systems assets: DDOT bus upgrades, SMART and BRT plans, M1 Rail;
- Investments in connected vehicle technologies: 17 signals that are presently equipped with intelligent technologies as part of the country's first urban canyon connected vehicle test bed, which was implemented in 2014, as a demonstration project for the 2014 ITS World Congress;
- City planning and development efforts: extensive land use and transportation planning that has yielded a common vision and set of priorities.

SECTION 3C: CONTINUITY OF COMMITTED LEADERSHIP AND CAPACITY

A strong and committed team is behind Detroit's "Mobility City" project:

- City leadership for the project comes from: Mayor's Office, Department of Public Works (DPW), Department of Innovation and Technology (DoIT), Planning and Development Department, DDOT, PLA;
- State and regional public partners include: MDOT, the Southeast Michigan Council of Governments (SEMCOG) and the Regional Transportation Authority (RTA);
- Private sector leadership comes from NextEnergy, a nonprofit energy and transportation accelerator providing project management and administering Detroit Smart City, an industry-led consortium with DENSO and DTE dedicated to the development and advancement of Smart City technologies in Detroit;
- University leadership comes from UMTRI, and UM-MTC which operates UM-MCity and UM-SMART; and WSU, for its strengths in urban planning and land use, as well as computer science and technology (WSU is a member of MetroLab Network, a recently-launched network of more than 20 city-university partnerships focused on "smart cities");
- Industry partners include major OEMs (GM and Ford for vehicles, technology, consulting, ride share, e-bikes interest); Tier 1 suppliers (DENSO and Bosch for road side equipment, connected vehicle technologies, vehicle charging

technologies, sensors and software solutions); Pilot/use case partners (shuttle, parking, and safety use cases: WSU, HFHS, DMC, CCS, Rock Ventures, GM); and infrastructure/ software solutions partners (Sidewalk Labs, CISCO, IBM, Microsoft, DTE);

- Research partners include UM, WSU, NREL and ANL.

SECTION 3D: COMMITMENT TO INTEGRATING THE SHARING ECONOMY

The sharing economy is defined and characterized by the realization that assets communities leverage together have more value than ones we can only utilize as individuals. It provides new opportunities for products and services to be delivered and consumed by everyone. Both are critical to building an equitable future filled with opportunities for every Detroiter. By inventing new, and building upon existing models for sharing transportation, communications, technology, and public health assets, our city is poised to not only share better, but to also be smarter about how we do it.

Specifically, we're developing strategies and partnerships to share ICT assets with organizations including DTE, PLA, City Public Lighting Department, and Rocket Fiber. We're exploring ways to weave a rich network of connected, shared, shuttle services that leverage existing routes and fleets deployed by institutions such as HFHS, DMC, WSU, Rock Ventures and DDOT. We have sharing economy based mobility start-ups (RideHop, SPLT) as well as established players (Zipcar, Lyft, Uber, and GM's recently announced Maven) already active in the area. And we have global OEMs (GM, Ford) and university leadership (UM-SMART) committed to better understanding the ride share and mobility-as-a-service (MaaS) options for meeting mobility needs in Detroit.

SECTION 3E: CLEAR COMMITMENT TO MAKING OPEN, MACHINE-READABLE DATA ACCESSIBLE

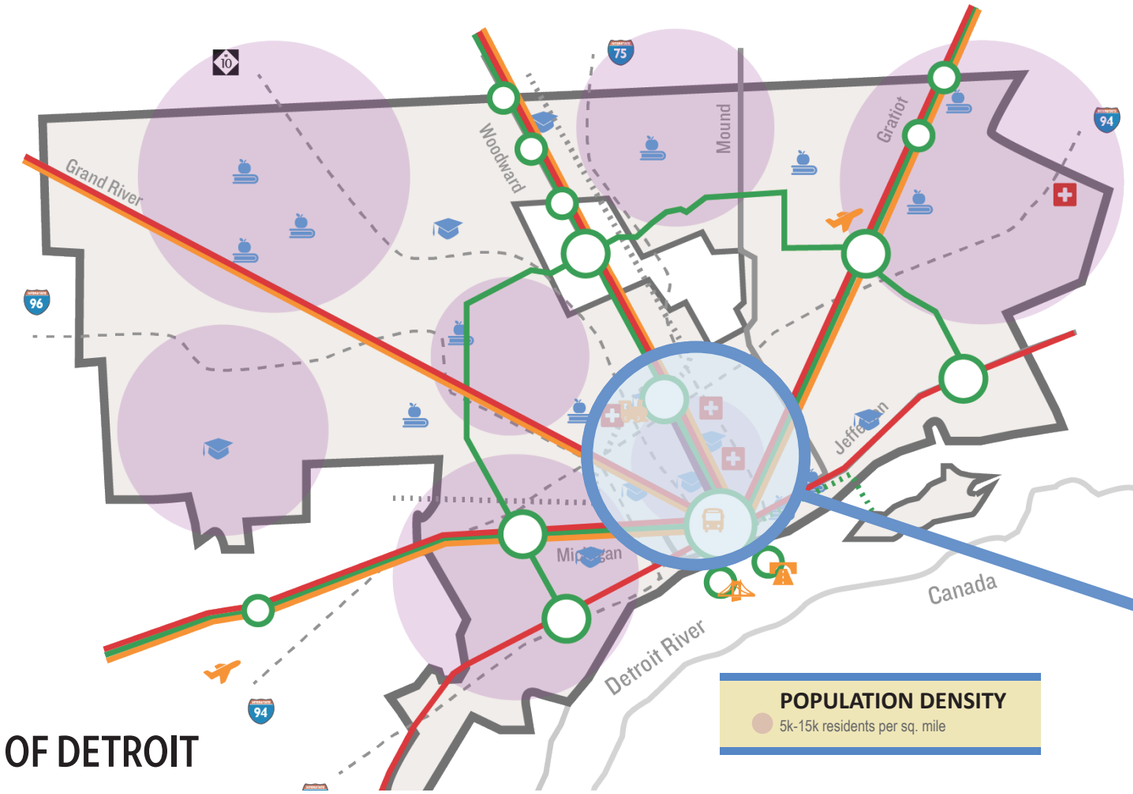
The City of Detroit has launched its *Government Open Data Access to All* initiative (Executive Order 2015-2) and open data portal in order to increase public access to valuable data and information concerning city government operations and service delivery. This tool exists to enable opportunity by reducing barriers to access the public data and information and promoting trust, transparency, and accountability between City agencies and the people we serve. This data is freely available in formats that are understandable to humans, can be processed by software and machines, and formatted according to national technical standards to facilitate visibility and reuse of published data.

The portal offers access to standardized data that can be easily retrieved, combined, downloaded, sorted, searched, analyzed, redistributed and re-used by individuals, businesses, researchers, journalists, developers, and government to process, trend, and innovate.

Mobility City will leverage 200+ miles of bike lanes through bike share. Source: MDOT

SECTION 4: SITE MAP

FIGURE 9: CITY OF DETROIT MAP



CITY OF DETROIT

POPULATION DENSITY
5k-15k residents per sq. mile

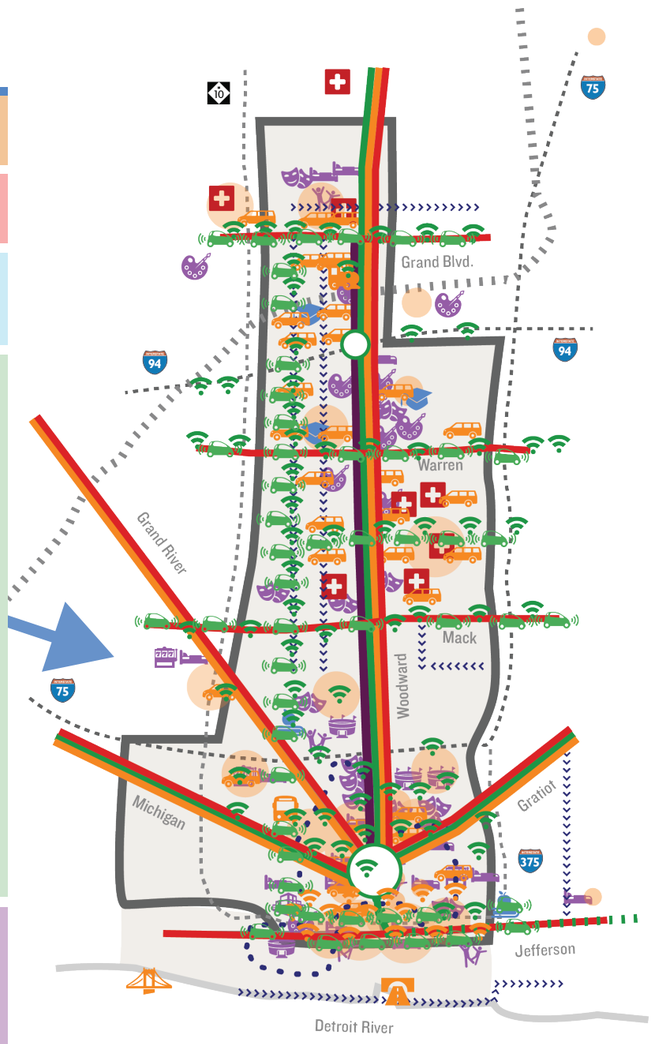
JOBS
Largest Detroit Employers

HEALTH CARE
Hospital

EDUCATION
High School
College

TRANSPORTATION
Tier 1 BRT Route (Planned)
Transit Node (Planned)
Rail (Planned)
CAV (Planned)
RSE (Planned)
M1 Light Rail
Bike Lane
People Mover
SMART Bus
DDOT Bus
Surface Street
Highway
Rail
Bridge to Canada
Tunnel to Canada
Airport
Rosa Parks Transit Center
Train
Shuttle
RSE

ENTERTAINMENT
Museum
Stadium (Includes proposed)
Theatres/Music
Casino
Hotel
Convention Center
Event



MIDTOWN/DOWNTOWN CORRIDOR

KEY CHALLENGES

As Motor City, our key challenge is to leapfrog the limitations of our 20th century personal auto-based transportation with 21st century smart city technologies.

As Mobility City, we will provide equitable mobility solutions all across the City of Detroit through first mile/last mile multimodal options to connect to transit nodes using car share, ride share and bike share, and Mobility Passport, a connected access solution to provide ride request, and single fare and parking payment options.

In addition, we will enable multimodal mobility in the dense Midtown/Downtown corridor that includes connected and/or automated vehicles; car share, ride share, bike share, and walkable options; smart parking, and networked EVs to promote a car-free/car-light mobility lifestyle.

SECTION 5: ALIGNMENT WITH 12 ELEMENTS

A "Connected Vehicle" can mean many things in today's technology-driven society. Connected vehicles and transportation elements are critical components of any smart city concept; in short, a vehicle that is "connected" means information and data is shared between transportation system users, and the system itself.

Michigan, and the Detroit area in particular, has a successful history of developing and implementing connected vehicle solutions in partnership with our automobile companies, technology companies, local, state and federal partners.

We believe that there are mature, connected vehicle technologies and solutions that can help us achieve our vision of improving the safety, mobility and environment of Detroit. These solutions would be based on two predominate communication technologies, cellular communication (4G/LTE), and dedicated short range communications (DSRC/5.9 GHz communications) and include leading edge software solutions and urban analytics. Below is a summary of key aspects of our Mobility City proposal and how they map to USDOT vision elements.

FIGURE 10: MOBILITY CITY - KEY ASPECTS

TECHNOLOGY ELEMENTS	
Vision Element #1: Urban Automation	*Mobility City will focus on the following:* • Networks of on-demand, shared, semi-automated shuttles to connect Detroiters to employment, health care, education, service, cultural, and entertainment destinations throughout the city, using DDOT, DPM, RTA, M-1 Rail, and other infrastructure as their backbone • Expanded network of DSRC/LTE connected in-road and above-ground sensors, enhancing our ability to collect environmental, traffic, and road condition data that can enable semi- and/or fully-automated vehicles • Generated data will be transferred to both the DPW & MDOT respective transportation management centers for analysis and real-time information dissemination to increase traffic safety and reduce congestion, as well as use for performance measurement and long-term planning • Smart parking infrastructure, coupled with automated shuttle services to workplaces and entertainment locations, which will be available to both publicly- and privately-managed parking lots and structures
Vision Element #2: Connected Vehicles	*Mobility City will focus on solving the following challenges:* • **First mile/ last mile access from transit to destination:** connected, electrified fleet of first and last mile car share from smart transit hubs to M1 and DPM • **Traffic disruption from delivery vehicles:** connected delivery vehicles with dynamic scheduling and route notification capabilities • **Safety of all transportation system users as a top priority:** vehicle-to-infrastructure (V2I) applications can be implemented to significantly improve the safety of transportation system users, including red light violation warnings and pedestrian crossing warnings • **Traffic congestion limit on mobility of all transportation modes:** V2I applications can be implemented that would allow for prioritization of multimodal transit through the project area (a multimodal intelligent traffic signal system) • **Mobility and safety challenges of all modes of transportation during special events:** the same applications developed to address "every day" safety and mobility challenges can be adapted to address special event traffic management, which frequently impacts all transportation modes throughout the city • **Adverse weather impact on all modes of transportation:** keeping the city's transportation system open during inclement weather is important for all users. Road weather vehicle-to-vehicle (V2V) and V2I systems can be used by city maintenance and transit services to ensure all users can be minimally disrupted • **Long and variable wait times at Detroit international border crossings:** V2I applications can be deployed that will provide accurate border crossing times to transit system users that tie into the city's bus transit center • **Urban traffic congestion due to drivers looking for parking:** smart parking, connected shuttles from parking areas to destinations will reduce daily congestion

TECHNOLOGY ELEMENTS (CONTINUED)	
Vision Element #3: Intelligent, Sensor-Based Infrastructure	*Mobility City will focus on the following legacy/new infrastructure investments:* • **Connected vehicle test bed:** 17 signals that are equipped with DSRC, which was the country's first urban canyon connected vehicle test bed, installed in 2014. • **Traffic signals:** 150 of the city's 800 traffic signals equipped with ITS technology have the capability of being monitored and controlled from a satellite transportation center. We will utilize these traffic signals in the project area, as well as additional signals along major corridors that will be equipped with ITS technology for this initiative. • **Smart streetlights:** 60,000 smart-enabled streetlights and sensor-based technology upgrades planned for broadband Wi-Fi, light management, V2X communications and fiber-based data backhaul. This connectivity will allow greater visibility and data-sharing capabilities citywide, providing real-time monitoring, location-based services, fleet management, greater efficiency and better asset tracking with reduced costs. • **Real time data:** To be installed sensors that will collect and deliver real-time pedestrian, non-motorized, and traffic flow data that will be analyzed by multiple city agencies to support the services provided to the city's residents, businesses and visitors. We will collect and forward traffic data to transportation management centers for analysis and real-time adjustments to increase safety and reduce congestion.
INNOVATIVE APPROACHES TO URBAN TRANSPORTATION ELEMENTS	
Vision Element #4: Urban Analytics	*Mobility City will:* • Meld multiple data streams to gather disparate data sets for compilation and analysis • Use data tools to distill and glean useful information, as well as evaluate key metrics and performance measures • Expand data visualization for operations command center • Analyze data for trends that will be utilized by city operations, such as the Detroit Police, so that deployment efforts are consistent with those needed to maximize public safety • Analyze data to support decisions made by city development officials, including planning and public works agencies, that are responsible for designing and maintaining an infrastructure that best meets the needs of the project area • Examples of data to be leveraged and applications include: o Dynamic scheduling for buses, ride share and paratransit o Parking management and enforcement o Traffic management, including vehicle queue lengths o Video surveillance and video analytics (edge processing) o Theft detection o License plate recognition o Loitering detection and detection of objects left behind o Incident response
Vision Element #5: User-Focused Mobility Services and Choices	*Mobility City will:* • Provide transportation choices to individuals on a real-time basis through integrated user apps • Enable first mile/last mile solutions with heavy emphasis on bike sharing, car sharing and ride-sharing models • Implement Mobility Passport to facilitate trip planning and history, payment and data management

INNOVATIVE APPROACHES TO URBAN TRANSPORTATION ELEMENTS (CONTINUED)	
Vision Element #6: Urban Delivery and Logistics	*Mobility City will focus on the following:* • Technology (802.11) from the infrastructure to provide dynamic routing and cross-docking capabilities to commercial trucks delivering to high-density urban areas: PLA is deploying 802.154, 802.11 and 802.11P DSRC capabilities which align with current commercial telematics systems, with the potential to provide carriers with real-time traffic and accident-management information to optimize routing • Detroit Eastern Market as a test bed for a multi-carrier cross-docking pilot: 450 commercial vendors ship fresh, perishable food out of the Detroit Eastern Market's 32-acre facility daily, with individual carriers sending shipments to the same destinations within the city. Use dynamic routing data for carriers to same and close by destinations to improve carrier load-out/weight-out on routes, reducing the total number of trucks and congestion • USDOT affiliated test bed at Detroit City Airport to explore 3D delivery options (drones) • Smart parking technologies and communications to schedule delivery times and for traffic management for most efficient delivery of freight within the urban center • Network of connected e-bikes and scooters for parcel/package delivery within the urban center to minimize congestion
Vision Element #7: Strategic Business Models and Partnering Opportunities	Due to the City of Detroit's position as a global center for connected and automated vehicle technologies, partnering opportunities abound (summarized in Section 7). Below are the new business models that will be made possible through co-investment, data-collection methods and open-data architectures associated with Mobility City: • Car share, bike share, ride share • Public-private partnerships combining ride share and paratransit • Public-private partnerships combining private shuttle fleets with public transit • Car share fleets provided using ride share business model to create accessible employment for low income residents • Smart parking and automated shuttles and/or car share to limit parking needs • Co-op delivery fleets for food based start-ups and small to medium enterprises • City opportunities to monetize bus, kiosk, stations real estate and Wi-Fi for consumer apps
Vision Element #8: Smart Grid, Roadway Electrification, and Electric Vehicles	*Mobility City will:* • Install electric vehicle charging station networks and management systems to communicate charging station information directly to the car for payments, reservations, locations, and availability • Test and evaluate value-to-grid applications with long-range electric car share vehicles for first mile/last mile movement, and long-range electric delivery vans, both with potential for bidirectional and/or smart charging • Expand the network of charging stations integrated into the smart grid for smart charging based on time-of-use, demand response, peak shaving, and support vehicle-to-grid (V2G) use cases and business models • Utilize DTE Energy and NextEnergy's current networks that include level 1 and 2 AC, level 1 DC, wireless, and bidirectional systems within the city's urban core • Validate new value propositions and business models leading to increased penetration of EVs which can be replicated in other cities

INNOVATIVE APPROACHES TO URBAN TRANSPORTATION ELEMENTS (CONTINUED)	
Vision Element #9: Connected, Involved Citizens	*Mobility City will access feedback from the community via both primary interviews and secondary research:* • Host ongoing community engagement events to obtain feedback on core services and access citywide, in partnership with the city's planning department, Department of Neighborhoods and Detroit City Council • Reference Detroit Future City's visionary framework, Detroit 2020, that collected feedback from 38,000 Detroit citizens on how to develop strong neighborhoods connected with transportation corridors and greenways • Obtain community feedback on transportation and access to core services, which was released in January 2016 SEMCOG report, Access to Core Services in Southeast Michigan *Deployment examples will include:* • Equipping the bus fleets with "mobile hot spot" technology for citywide internet connectivity • Deploying vehicle-to-pedestrian and vehicle-to-bicycle detection technology to enhance non-motorized safety • Building out DDOT bus system, M1 Rail, DPM and Rosa Parks Transit Center with connected kiosks, shelters and station technologies
SMART CITY ELEMENTS	
Vision Element #10: Architecture and Standards	The ITS infrastructure installed by the city is in compliance with interoperable regional ITS architecture and its connected vehicle infrastructure deployed in 2014 is in compliance with the following DSRC industry standards and specifications: • SAE J2735 DSRC Message Set Dictionary to promote the use of standardized message sets, data frames, and data elements and ensure interoperability across vehicle-based and roadside devices • IEEE 1609.x Wireless Access in Vehicular Environments (WAVE) Communication Standards to provide standard architecture, services, security, operations and protocols that enable secure wireless communications in support of various safety, mobility, environmental and commercial applications • T-10001-T2-05_RSE_Device_Design_Specification to ensure roadside infrastructure complies with federal specifications for durability, configuration, functionality and interoperability. This specification may be modified based on lessons learned from recent deployments to better support the Detroit Test Bed • IPv6 Internet Protocol version 6: intended to replace IPv4 as the backbone of Internet communications • IEEE 802.15.4 [AM1] Specifies the physical layer and media access control for lower rate personal area networks (LR-WPANS) This network provides for the Wi-Fi mesh network • IEEE 802.11 [AM2] Standard for tele-communications and information exchange between wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications This specification allows broadband Wireless internet • IEEE 802.11p Amendment [AM3] to IEEE 802.11 to add WAVE to ITS applications. This includes data exchange between high-speed vehicles and between vehicle and roadside infrastructure This deployment will inform standards for automated vehicles, especially given the proximity to the auto industry and SAE.

SMART CITY ELEMENTS (CONTINUED)	
Vision Element #11: Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology	*Mobility City will leverage existing platforms and relationships to their fullest potential for maximum value, biasing toward systems that:* • Build smart, redundant, fault-tolerant, secure ICT infrastructure that leverages best practices in design and deployment using cellular, Wi-Fi, DSRC, high speed fiber optics and other emerging communications protocols • Consume and generate data adherent to open standards • Create open, flexible, APIs • Comprise low-cost components of a robust intelligence system, including sensors and other simple, open, Internet of Things (IoT) building blocks • Protect privacy via cyber physical security technology so that no personally identifiable information will be inappropriately shared or released
Vision Element #12: Smart Land Use	*Mobility City will embrace a model for making land-use and transportation decisions in tandem, so that:* • Densities can be concentrated citywide in ways that maximize transportation options and investment • Detroit becomes host to "20-minute neighborhoods", i.e. every neighborhood has walkable access within 20 minutes to grocery stores and commercial services, as well as multimodal access to jobs, healthcare, education and entertainment elsewhere in the city • Land use for parking will be reduced as utilization of on-demand shared mobility lessens the need for individually-owned vehicles • Streets can be made more pedestrian and bike friendly with low-speed automated people movers which can detect and avoid vulnerable road users • Land-use planning and design enhance safe, aesthetically pleasing, green and efficient mobility choices

SECTION 6: KEY RISKS

The City of Detroit team includes partners at UM, MDOT and NextEnergy who are experienced in deploying these technologies with similar USDOT programs, and are experts in identifying, assessing, and mitigating risks in such a program. Broadly, technical risks are present with any early deployment of new technology, especially where technical specifications are not fully finalized and products not fully verified. MDOT, UM and NextEnergy are highly experienced in identifying and mitigating these early tech risks, and successful strategies will include ensuring backwards compatibility and updateable software, in conjunction with a systematic risk management methodology.

In order to manage risks systematically, the City of Detroit team will employ generally accepted project management principles and methods to conduct the risk management process. Overall, the main purposes of the risk management process are to:

- Plan ways and means to eliminate negative risks and to reduce their probability of occurrence;
- Plan responses to enhance positive risk;
- Define strategies to apply and respond to those risks when they occur;
- Assign responsible groups and individuals to apply strategies as the risks occur;
- Monitor new risks continuously throughout the project.

Through a series of structured meetings we will first identify the risks using brainstorming techniques, document review (device specifications, timing plans, etc.), expert judgment, and incorporate lessons learned from the team's knowledge base. The output will be the risk register, in the form of the Risk Management Log.

For each item on the risk register, a qualitative analysis will be completed that will assess and determine the probability (P) of occurrence and the impact (I) of the risk. To reduce the potential influence of bias, the probability of occurrence and the impact of risk will be defined and implemented consistently for all risks in the register.

A quantitative analysis will ensue that will determine the level of threat (P*I) then the risk will be prioritized. For each high-priority risk a formal risk response plan will then be identified to develop options and actions to enhance opportunities and to reduce threats to the project objectives. A risk response owner shall be identified to take responsibility for each agreed to and funded risk response. Planned risk responses will be incorporated by inserting resources and activities into the budget, schedule, and project management plan as needed.

As the program progresses, the risks will be monitored and controlled by implementing the risk response plans, tracking identified risks, monitoring residual risks, identifying new risks and evaluating risk process effectiveness.

The policy risks can be mitigated by limiting the impact of state/federal policies, which are outside of the city's control, by focusing on connectivity applications and services which provide equitable mobility and create efficiency within city services. Technical and institutional risks can be mitigated by controlling the deployment area and managing the applications to minimize the cost impacts of technology and operations.

Mobility City will connect walkable neighborhoods through transit nodes. Source: MDOT

FIGURE 11: POTENTIAL RISK REGISTER

RISK	RISK TYPE	RISK DESCRIPTION	(P)	(I)	P * I
1	Technical	Lack of agreed-to communication standards & protocols which would minimize interoperability & limit the potential for wide-scale deployment	0.7	0.8	0.56
2	Technical	Lack of agreed-to technical standards for autonomous deployment during program timeline	0.7	0.5	0.35
3	Policy	Lack of legislation to allow for use of automated vehicles on public roads	0.3	0.4	0.12
4	Institutional	Unsuccessful negotiations with approved contractors leading to increased cost & delays with implementation	0.3	0.4	0.12
5	Policy	Ability for city to implement potential changes in policy with respect to open data & privacy	0.2	0.5	0.10
6	Policy/ Institutional	Ability for city to monetize value of infrastructure and/or engage with others to generate revenue through new business models	0.2	0.5	0.10

(P = Probability, I = Impact)

SECTION 7: PARTNERS

For this program, Detroit has world-class partners from industry, thought leaders in connected and automated vehicle technologies, and innovation leaders in software solutions and urban analytics.

Because of the deep expertise and experience in the region, there are a number of working relationships already in place, summarized in the table below and in the attached letters of support and capabilities:

FIGURE 12: PARTNERS

PROGRAM TEAM: City of Detroit, NextEnergy, UM, MDOT			
PARTNER TYPE	**ORGANIZATION**	**AREA(S) OF EXPERTISE/INTEREST**	**VISION ELEMENTS**
OEMs	General Motors	AV Consulting, Driver Assist Automation, V2X, User Experience, Urban Delivery & Logistics, Smart Grid, Business Models, Multimodal	1-8,11-12
	Ford Motor Company	AV Consulting, Driver Assist Automation, V2X, User Experience, Urban Delivery & Logistics, Smart Grid, Business Models, Multimodal	1-8,11-12
Tier 1 Suppliers	DENSO	AV, CV, DSRC, Wireless Charging, EV Car Sharing, Smart Parking, Sensors	1-3,8
	Robert Bosch	AV, CV, Community App, Parking, Sensors, Traffic Lights, E-Bikes, EV Retrofit, E-Payment, Business Models	1-9,11
Infrastructure & Software Solutions	IBM	Urban Automation, Intelligent Sensor-Based Infrastructure, Urban Analytics, Smart Grid, Roadway Electrification, and EV's, Architecture & Standards, ICT	1,3,4,8,10,11
	Cisco	CV, Urban Analytics, Architecture & Standards, ICT	1,3,4,7,9,10,11
	ATT	CV, Urban Delivery & Logistics, Data Management, ICT	2,4,6,11
	Verizon	CV, Urban Delivery & Logistics, Data Management, ICT	2,4,6,11
	Sirius XM	CV, Data Management, ICT	2,4,11
	Microsoft	Data Connectivity, Middleware: Cloud Data Exchange, E-Payment	3,4,5,9
	Siemens	Urban Automation, Urban Analytics, Standards, Resilient Information & Communications	1,4,10,11
	Sidewalk Labs	Data Connectivity, Middleware: Cloud Data Exchange, Citizen Interface, Community Apps, Simulation, E-Payment	3,4,5,9
	HERE	Mapping, Navigation	1,2,5,9
	EastBanc Technologies	User Experience, Business Models, ICT, Data Management	3,4,5,7,9,11
	iOmniscient	Urban Analytics, Video Recognition	4
	Detroit Labs	Software Development	1-3
	Urban Insights	Urban Analytics	4
	Peloton	Commercial CV	2
	Truck Smart Parking Solutions	CV, Infrastructure	2,3

PARTNER TYPE	COMPANY	AREA(S) OF EXPERTISE/INTEREST	VISION ELEMENTS
University/ Research	University of Michigan (UMTRI, MTC, M-City, SMART)	CV, AV Technologies, Smart Parking, Urban Analytics, Urban Planning, Systems Design	1-5;7,10,12
	Wayne State University	Computer Science, Data Analytics, IoT, Urban Planning	1-7;9;12
	Argonne National Laboratory	Urban Analytics (POLARIS Framework)	4
	National Renewable Energy Laboratory	Data Analytics, Smart Grid, Research Results	4,6,8
Pilots, Use Case & Business Model Test Case	Rock Ventures (Bedrock Real Estate; Rocket Fiber; Quicken Loans; RideHop)	Multimodal Wayfinding (Connected Shuttles), Parking Apps, Connected, Involved Citizens, Mobile Hot Spots, Fare Consolidation, Buildings Integration, Gigabyte Fiber Network	1-7;9;12
	College of Creative Studies	Multimodal Wayfinding (Connected Shuttles), Parking Apps, Mobile Hot Spots, Fare Consolidation	1-7;9;12
	Detroit Medical Center	Multimodal Wayfinding (Connected Shuttles), Connected, Involved Citizens, Parking Apps, Mobile Hot Spots, Fare Consolidation, Patient Transport	1-7;9;12
	Henry Ford Health Systems	Multimodal Wayfinding (Connected Shuttles), Connected, Involved Citizens, Parking Apps, Mobile Hot Spots, Fare Consolidation, Patient Transport	1-7;9;12
	Lyft	CV, Connected, Involved Citizens ,Business Models	2,5,7,9
	DTE Energy	EV Car Sharing, Smart Grid Apps, Multimodal Wayfinding (Connected Shuttles), Connected, Involved Citizens, Parking Apps, Mobile Hot Spots, Buildings Integration	1-7;8;9;12
	General Motors	EV Car Sharing, Smart Grid Apps, Multimodal Wayfinding (Connected Shuttles), Connected, Involved Citizens, Parking Apps, Mobile Hot Spots, Buildings Integration	All
	Detroit Aircraft Corporation	Urban Automation; Urban Delivery and Logistics	1,6
	Wayne State University	Multimodal Wayfinding (Connected Shuttles), Connected, Involved Citizens, Parking Apps, Mobile Hot Spots, Emergency Response, Traffic Management	1-7;9;12

SECTION 8: EXISTING TRANSPORTATION INFRASTRUCTURE

Due to its relatively large land mass (139 sq. miles), Detroit has a large, dispersed transportation network that is primarily road-based. The primary transportation system is jointly operated by the Detroit and MDOT. The city and MDOT have a long history of cooperation on addressing the continuous safety, mobility and environmental challenges associated with an urban transportation network. Through this partnering, cooperation, and series of investments in technology, a foundation has been developed for a 21st century smart city. The key transportation infrastructure assets are summarized in the table below:

Coming soon: Smart City

Hard infrastructure

PLA mesh network, connected poles, conduit/ fiber (Rocket Fiber), cameras, sensors, kiosks/ displays, smart bus stops, smart bike racks

Soft Infrastructure

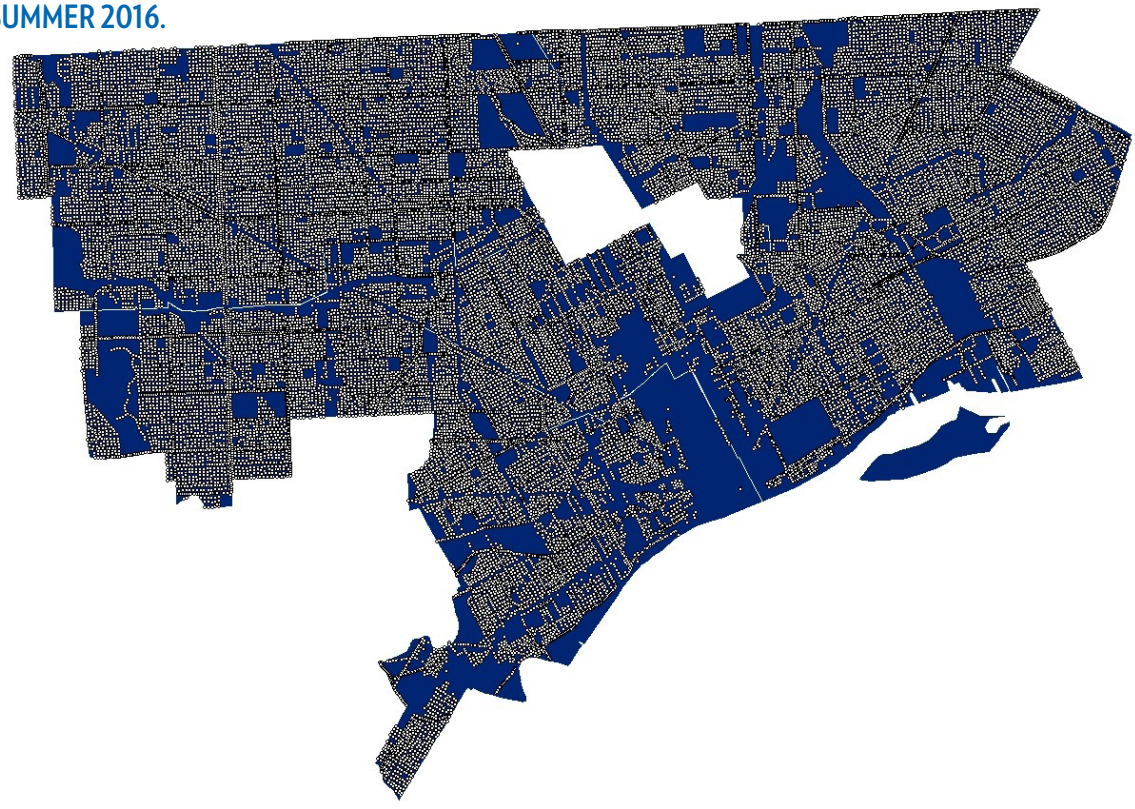
Single-payment software, dynamic pricing engine, analytics + prediction engine, real-time mapping & monitoring, point-to-point messaging framework

FIGURE 13: KEY TRANSPORTATION INFRASTRUCTURE ASSETS

TRANSPORTATION ELEMENT	DESCRIPTION
Road-based	• 125.5 freeway miles • 83.43 country road miles • 724 major street miles • 1864 residential street miles • 200 miles of bike lanes and shared use paths
Transit Services DDOT	• 320 transit buses; 36 routes; 85,000 route miles; 25M annual riders • Operates transit service within Detroit, Hamtramck, and Highland Park and provides some service to neighboring communities in Wayne, Oakland, and Macomb Counties • Largest transit system in southeastern Michigan and provides service on 36 routes with a peak-hour requirement of 230 buses • Fixed-service weekday ridership: ~90,000 customers • Maintenance facilities: 3 (Shoemaker, Gilbert, Central/Admin) • Transit Centers: 2 (Rosa Parks Transit Center, State Fair Transit Center) • Bus stops: 5,600+ • Provides approximately 600,000 trips each week and served nearly 25 million customers in 2014 • 24 hour service is offered on selected routes; all other routes offer service 21 hours/day on weekdays and 19 hours/day on Saturdays and Sundays • Basic adult fare is $1.50. Reduced fares are offered pending eligibility during all hours of service • Paratransit service, MetroLift, offers complementary service origin-to-destination anywhere within DDOT service area for those who are unable to use fixed-route buses and service. • In 2014, MetroLift provided over 250,000 small bus trips • In June 2014, launched Job Access and Reverse Commute (JARC) and New Freedom programs. JARC offers door-to-door service up to 30 miles each way for $1.50 to Detroit residents seeking work or going to school with incomes under 150% of the poverty level. New Freedom provides transportation options to people with disabilities seeking integration into the workforce. • As of June 2015, over 4,200 residents have joined the programs and make over 4,000 JARC and 400 New Freedom trips each week
SMART	• 43 routes with 5,325-stop transit bus system connecting surrounding cities within the urbanized area to Rosa Parks Transit center within the central business district
M1 Rail	• 3.3 mile light rail system with 20 stations serving 12 locations to be operational by Q2 of 2017 within the deployment area
Amtrak	• Intercity rail service with 7 trains per day to nearby suburbs, western Michigan, Chicago, IL
Detroit People Mover	• 2.9 mile overhead rail system within central business district
Windsor Transit	• Operates cross border tunnel bus, carrying riders from Windsor, Ontario to Rosa Parks Transit Center and various entertainment and sports locations
Bus Rapid Transit (BRT)	• High capacity BRT service is being planned on three major corridors in the city and surrounding counties. • BRT vehicles will operate in dedicated travel lanes (similar to Light Rail Transit), offer premium amenities at station locations, and utilize ITS technology that allow BRT vehicles to traverse the corridor with limited stops at traffic signals

TRANSPORTATION ELEMENT	DESCRIPTION
Shared Use Mobility Services	• Zipcar, Lyft, Uber, Maven, Zagster, Detroit Bike Share
ICT	In addition to the common carrier ICT services available in most cities, Detroit has: • Advanced lighting system through PLA with 60,000 SMART-enabled street lights currently installed, with an additional 5000 streetlights to be installed by summer 2016 • Gigabit fiber capability through Merit Network and Rocket Fiber • Forward-leaning electric utility DTE Energy with smart meters and ICT enabled local distribution system
ITS DPW	Traffic operations center: • 92 traffic signals with emergency vehicle pre-emption • 67 CCTV • 73 advanced detection systems • 17 DSRC-equipped intersections • 150 of the city's 800 traffic signals are equipped with IT technology and have the capability of being monitored and controlled from a satellite transportation center
MDOT	Transportation operations center: • 114 CCTV • 79 MVDS • 41 DMS • 34 miles of fiber optics along freeways (31 owned, 3 leased)
International Border Crossings	• Detroit/Windsor International Tunnel • Ambassador International Bridge

FIGURE 14: THE MAP BELOW INDICATES THE LOCATION OF THE SMART STREETLIGHTS INSTALLED IN DETROIT AS OF DECEMBER 2015. THE REMAINDER OF THE 65,000 STREETLIGHTS WILL BE INSTALLED BY SUMMER 2016.



SECTION 9: DATA DEFINITIONS AND TREATMENT

The acquisition, process, use and security of data is the focal point of any 21st century smart city. In addition to the existing data sources already used by the city and our partners, there will be countless sources of new information available, the management of which will be critical for implementing the Mobility City vision.

Currently, the City of Detroit collects data across all subjects and service areas. Much of that data is made available to the public via the City Open Data Portal. We also combine operational data with public and private data available from other sources such as the federal government and our regional utilities. Relevant data currently collected is summarized in Figure 15.

From comprehensive public safety data to land-use and right-of-way utilization, there are many potential connections between today's data collection efforts and tomorrow's smarter, more connected mobility infrastructure. Here are the outcomes that will result from integrating existing data with new data to be collected using more sophisticated management and analysis systems:

- Rich data layering ⟶ better policy decisions ⟶ better outcomes for Detroiters
  - Better targeted service routes/areas
  - Options that better serve current/trending demographics
- Planning-driven infrastructure: Connecting routing/mobility to economic activity
  - Where people are moving
  - Where businesses are opening/growing
  - Where people congregate
  - Where building activity is occurring
- New opportunities created
  - Using transit to drive growth
  - Better connecting people to work and educational centers
- Healthier Detroiters
  - Better connecting people to health services
  - Greening our infrastructure
  - Promoting walking/biking
- Increased visibility of transit options
  - Use web/app analytics to target promotional activities
  - Increased precision of wayfinding

FIGURE 15: CURRENT DATA COLLECTED

CATEGORY	DATA WE COLLECT
Public Safety	Police *Response times *Incident types *Fleet status/maintenance/reliability *Public perception/satisfaction
	Fire *Response times *Fire types *Fleet status/maintenance/reliability
	EMS *Response times
Transportation	Ridership Bus pullouts On-time performance Fare revenue Fleet status/maintenance/reliability
Right-of-way Usage	Permits Traffic patterns
Land Use	Property transfers Sales Vacancy Foreclosure
Economy	Jobs and unemployment Education infrastructure Large- and small-scale residential/ commercial development
Public Health	Immunization Air quality
V2I Data (Elements 1, 2, and 3)	Vehicle location pinging (roadway volumes/intersection congestion) Transit vehicle location Transit stop utilization Traffic infraction reporting Traffic accident reporting

The MDOT Data Use Analysis and Processing (DUAP) program provides a platform and system that supports performance management by enhancing agency-wide usage of connected vehicle (CV) data, mobile data (AVL, cellular data, etc.), and fixed data (ITS/Infrastructure Sensors) to increase data sharing, availability, and awareness across the agency. Towards this objective, the cornerstone of the DUAP program is to integrate CV data, mobile data, and fixed data into a unified system of systems that is accessible by personnel across MDOT. This will provide MDOT system users with a platform to iteratively define, analyze, and refine their need for making decisions.

CV technology enables MDOT to collect and communicate data to the DUAP system, where it is processed, quality checked, and analyzed. This provides information related to the current state of the transportation system. The intent is to provide a platform for the MDOT users to iteratively access this data, analyze it, and refine it to satisfy their needs.

SECTION 10: ITS/CATV STANDARDS

Michigan has had a strong role in supporting the development and implementation of ITS and connected vehicle standards since the infancy of the programs. Both our public agency and automotive sector partners understand the importance of such standards to producing a viable, interoperable system suitable for broad national deployment, and as such have been active participants, working closely with USDOT and standards organizations such as SAE, IEEE, AASHTO and others in the development of technology standards, certification processes and architecture development.

The Detroit region is home to one of the first ITS deployments in the country. Beginning in 1962, MDOT and the City of Detroit deployed a freeway management system along M-10, an early version of what is today used in major cities across the world to help monitor and manage freeway operations. Today, both the City of Detroit and MDOT have extensive ITS assets on arterials and freeways across the city. These deployments have been governed by the regional ITS architecture. Our team partners have played a lead role in the development and update of the ITS architecture, which was last updated in 2015. The update reflects and serves as a foundation for many emerging technologies envisioned in the Smart Cities Initiative.

As it relates to emerging technologies, team partners including the City of Detroit, MDOT and UM, collectively have more connected vehicle deployment experience than any entity in the country, collaborating on major pilot initiatives, including the Safety Pilot Model Deployment, deployments for the 2014 ITS World Congress in Detroit, and on-going initiatives in Ann Arbor and the regional Smart Corridor initiative. These represent the largest deployments of current generation connected vehicle DSRC roadside units (RSUs) and other supporting infrastructure. Our team partners worked closely with USDOT on these deployments and application of the standards for RSUs, and have had continuous dialogue during the process of updating these standards. These pilots also represented the first

Detroit Riverfront Conservancy is just one example of effective public private partnerships transforming Detroit.
Source: MDOT

scaled deployment using many of the message standards under development for connected vehicles, a process which has added value to further defining the standards. These deployments built off of certification processes conducted by USDOT on RSUs, and incorporated inter-operability testing elements as part of the pilot efforts. These deployed systems will serve to support the Smart Cities vision, but more importantly, this team experience will allow for rapid deployment and adaptation to changes in standards in this emerging area.

In anticipation of broader regional and statewide deployment of connected vehicle systems, MDOT is partnering with USDOT to become one of the first users of the Connected Vehicle Reference Implementation Architecture (CVRIA). CVRIA represents the latest efforts to develop a scalable architecture for connected vehicle systems that identifies mechanisms for data flows to and from vehicles via roadside or "cloud" infrastructure. This implementation will provide a common architecture and platform to link all partner connected vehicle assets and serve as a foundation for an expanding deployment, including the Smart Cities vision. Further, this collaboration will provide valuable feedback to help refine the CVRIA into a more mature architecture for national application.

Our team has a long history of sharing lessons learned to further development of standards and architectures, and is actively engaged in supporting these efforts with organizations in this space. We are committed to continuing these efforts through implementation of the Smart Cities vision.

SECTION 11: GOALS AND METRICS

While the overall goals of this project are to improve safety, mobility and the environment through equitable mobility solutions, below are a number of subgoals and metrics that will be tracked:

FIGURE 16: SUMMARY OF GOALS AND METRICS

GOALS	METRICS
Provide the most equitable mobility system in the nation	Distribution of starting points for trips: time to a node
	Percentage of region's jobs accessible to those without a car
Provide a unique suite of enhanced transportation options to drive population growth & unlock development potential	New residential construction permits
	New commercial construction permits
Leapfrog all other cities with next-level technology solutions deployed across the city	Percentage of population utilizing innovative mobility services
	Cameras and sensors installed
	App downloads and usage stats
	Connected card usage
Safety	Reduced traffic accidents
	Reduced crime incidents along transit infrastructure
Infrastructure condition	Road resurfacing vs. road rebuilds as a % of DPW paving projects
	Traffic signal repairs/replacements
System reliability	On-time performance
	Customer satisfaction
	Median trip length
Freight movement and economic vitality	Parking tickets issued to freight vehicles
	Parking revenue from vehicles with congestion score > X
Environmental sustainability	Air quality

SECTION 12: CAPACITY OF APPLICANT/ PARTNERSHIPS

Detroit has the leadership capacity and the partnership network to accomplish our goals for Mobility City, our Smart City Challenge. The City of Detroit has demonstrated effective leadership, alignment and effective working relationships at city, state, and federal levels of government, as well as a track record of creating significant private investment and public-private partnerships.

The Mobility City Project Approach, outlined in Section 1, brings in program partners MDOT, UM-MTC & UMTRI and NextEnergy for their subject matter expertise and project management skills; MDOT for large scale infrastructure projects incorporating ITS technologies; UM-MTC for connected and automated vehicles pilots, and NextEnergy for public-private partnerships to support deployment of advanced technologies.

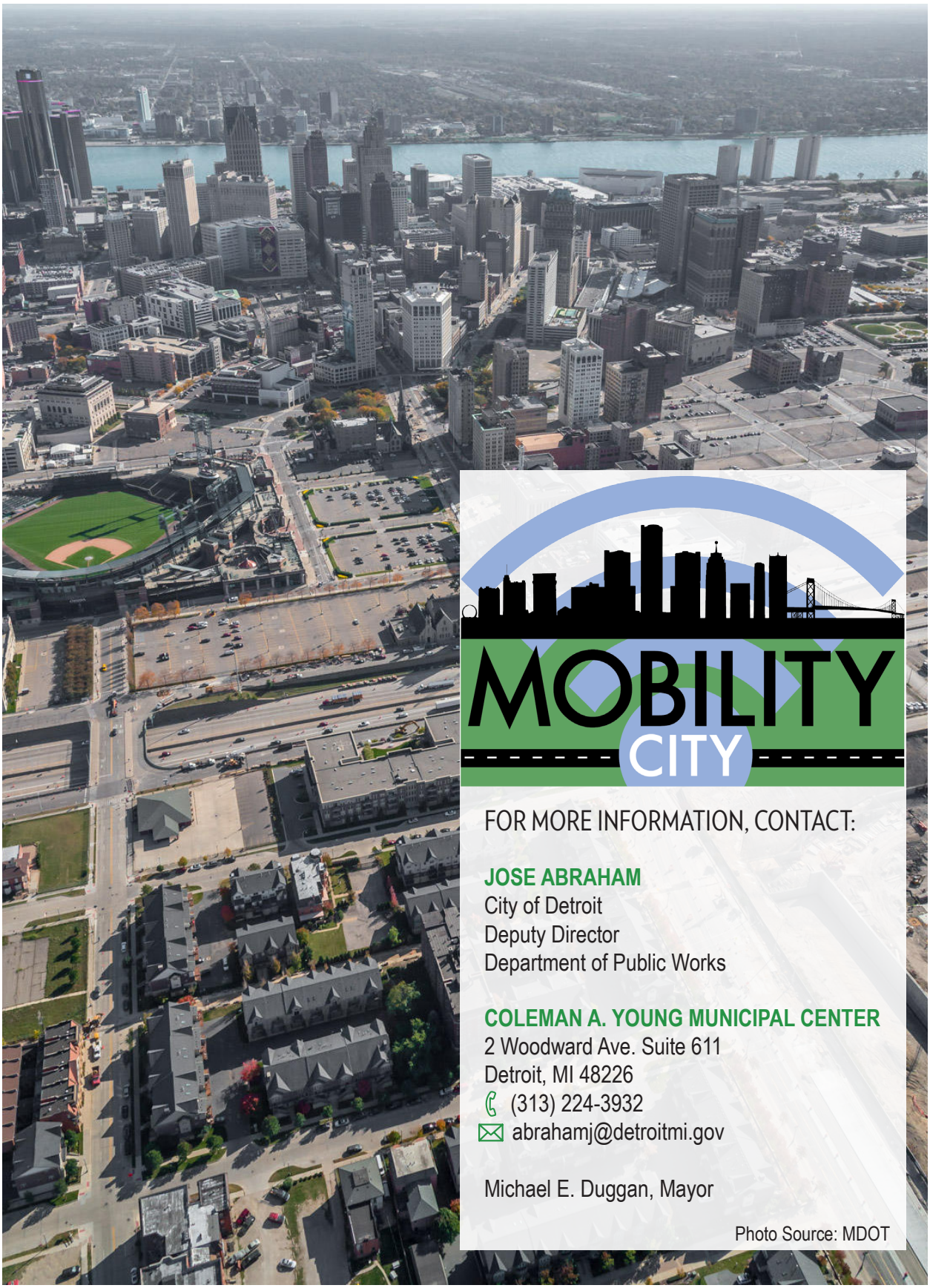
Mobility City has world class partners from industry, as outlined in Section 7 and showcased by GM and SideWalk Labs. Detroit and southeast Michigan has the greatest concentration of industry partners in connected automated vehicles/smart mobility technologies anywhere in the world with three global OEMs, a significant portion of Tier 1 suppliers, and over 300 R&D centers all located here. Consequently the infrastructure players, big data and applications-based software solutions providers want to be here as well. Qualcomm has a demonstration center at NextEnergy, CISCO is a partner for the build out of the PLA's advanced street lighting system as well the USDOT affiliated test bed for automated/autonomous vehicles in the 3D space under development at City Airport, Detroit Labs and Rock Ventures have located their IT-based businesses in downtown Detroit.

And lastly, the assets to be leveraged in the region, outlined in Sections 1, 3 and 8 provide both the basic backbone for smart city mobility in the communications and transportation investments that are here, as well as the palette for creating smart city mobility solutions that work for Detroit (what's not yet here) through the planning and partnership approaches the region has undertaken to transform Detroit from Motor City to Mobility City.

SECTION 13: LEVERAGING FEDERAL RESOURCES

Detroit's Mobility City will leverage hundreds of millions of dollars in existing smart, connected assets, including new transit assets (M1 Rail, DDOT buses), ICT assets (PLA, Rocket Fiber, Merit Network, DSRC corridors and test beds), and connected automated vehicle development centers and test beds (UM-MCity, NextEnergy, Detroit Aircraft Corporation). In addition, the strength of the private sector partners, and their interest and willingness to provide in-kind product and engineering support, is likely to result in significant leverage for this specific program.

The region has a strong tradition of mobilizing private investment, state support, and more recently, philanthropic investment to leverage federal funds and/ or to ensure that regional priorities are addressed. Examples include M1 Rail, TIGER grants, National Manufacturing Innovation Institutes, the Detroit Riverfront Conservancy, and of course, the greatest example of leveraging, the Grand Bargain, which closed the gap on Detroit's bankruptcy by providing $816M for Detroit pensioners and the protection of the art collection of the Detroit Institute of Art. We expect significant support to leverage federal funds based on this community's practice of collaborative investing across multiple sectors. This attribute positions Detroit, through this project, to be a strong implementer in addressing major regional and city challenges, while positioning, not only the city, but the region as the global center for mobility, or "Mobility City".



MOBILITY CITY

FOR MORE INFORMATION, CONTACT:

JOSE ABRAHAM
City of Detroit
Deputy Director
Department of Public Works

COLEMAN A. YOUNG MUNICIPAL CENTER
2 Woodward Ave. Suite 611
Detroit, MI 48226
(313) 224-3932
abrahamj@detroitmi.gov

Michael E. Duggan, Mayor

Photo Source: MDOT