Innovation Meets Asphalt: What Wireless Charging Roads and Connected Corridors Mean for Maintenance Crews

Connor Moore – Engineer, Connected, Automated, and Electrified Vehicles

MooreC45@michigan.gov

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Leading the Way in Connected and Electric Infrastructure

Connected and Automated Vehicle (CAV) Corridor – I-94

- A first-of-its-kind smart road deployment
- Enhancing safety, efficiency, and automation
- Real-time insights from sensor-enabled infrastructure

Wireless Charging Road – Mile-long Electric Road in Detroit

- North America's first public in-road wireless EV charging pilot
- Supports dynamic charging for electric vehicles in motion
- Laying the groundwork for scalable, sustainable mobility

Michigan: A Global Hub for Mobility Innovation

- Industry-leading partnerships
- Real-world testing and deployment
- A blueprint for the future of transportation

Michigan Department of Transportation's Mission

Serving and connecting people, communities, and the economy through transportation.

Cross-collaboration across State of Michigan agencies to support widespread adoption and research.

MEDC MICHIGAN ECONOMIC DEVELOPMENT CORPORATION

MICHIGAN OFFICE OF FUTURE MOBILITY & ELECTRIFICATION

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MICHIGAN STATE POLICE

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

LEO

MICHIGAN INFRASTRUCTURE OFFICE

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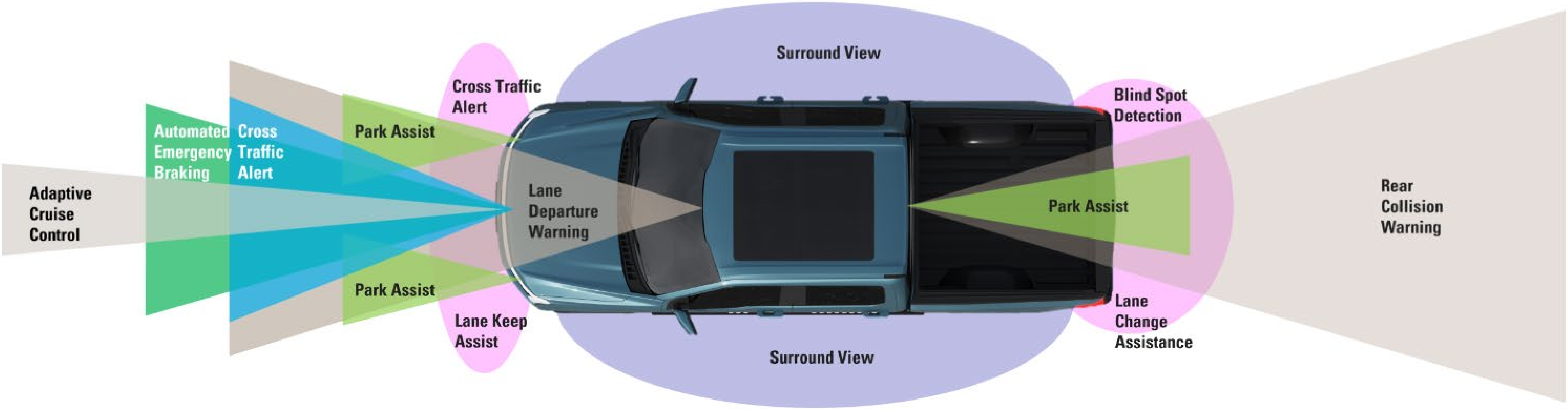
Michigan 2045 Mobility
A transportation plan for a connected future #MM45

- Long-range transportation plan
- Freight plan
- Rail plan
- Active Transportation Plan
- Transit Strategy

Future of Vehicles

CAVs are vehicles that automate the driving experience and can send and/or receive information to and from outside sources. The vehicles use a combination of on-board sensors, software, and communications equipment to automate the driving task.



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First-of-its-kind connected corridor in Southeast Michigan

Purpose:
- Create an innovative project to maximize benefits of advanced vehicles and encourage similar integration of technologies across the state of Michigan
- Upgrade roadways with smart road technology
- Improve pavement conditions and operations

Need:
- Bridge the technology gap between advanced vehicles and roads
- Enhance road maintenance and incident response

- **Improve** Safety On The Corridor
- **Improve** Mobility On The Corridor
- **Reduce** Congestion
- **Support** Advanced Vehicles In Michigan

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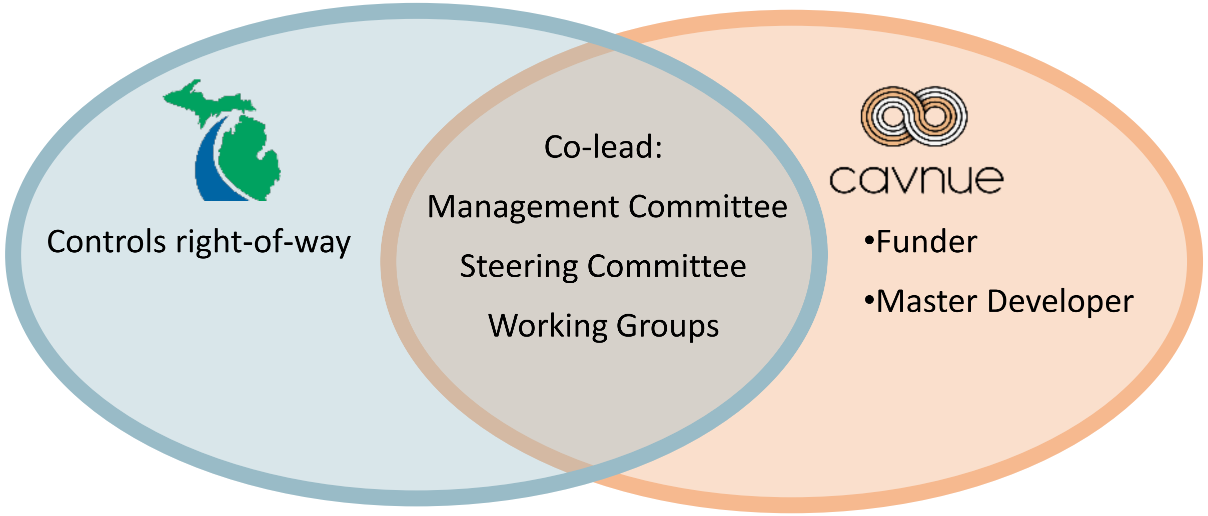
Unique Public-Private Partnership

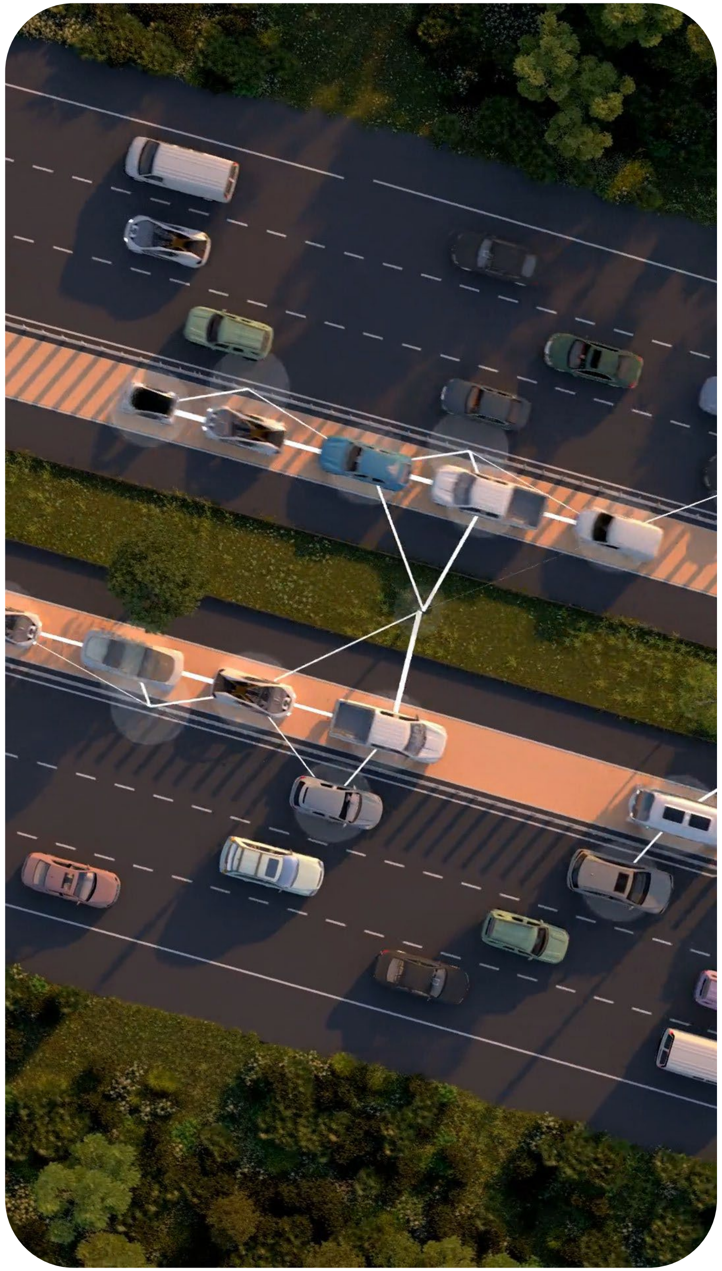
MDOT and Cavnue are partners in the co-creation process of this project



With involvement from a broad and growing set of additional partners:

Funding

- The project is a partnership between MDOT and Cavnue.
- MDOT is currently working with Cavnue on the funding and operational elements of the project.
- To date, outside of staff time, MDOT has not provided any funding. The feasibility work, including conceptual design, permitting, and the National Environmental Policy Act (NEPA) study, has been funded by Cavnue.
- Construction of the project is expected to be privately funded, and Cavnue would participate in the operations of the CAV corridor.



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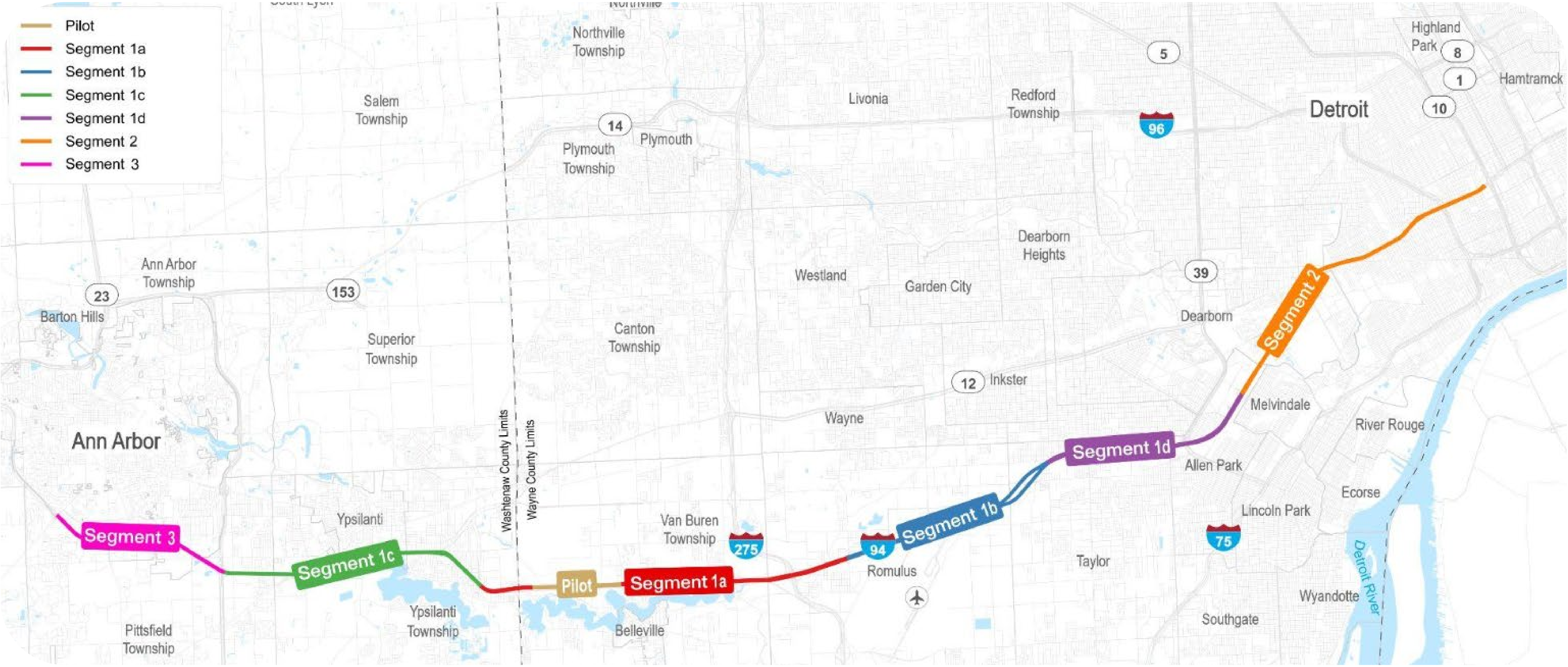
MDOT intends to deploy Smart Road technology along I-94.



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MDOT is adopting Smart Road technology to make roads safer and more efficient.

First-of-its-kind CAV Lane is complete and open to the public on Interstate 94 – 3-mile proof-of-concept

Components of a Dedicated CAV Lane

- **Physical** Infrastructure
- **Digital** Infrastructure
- **Coordination** Infrastructure
- **Operational** Infrastructure

Image: CAVNUE Rendering of an automated and connected vehicle traffic

Image: I-94 connected corridor lane

Alternatives

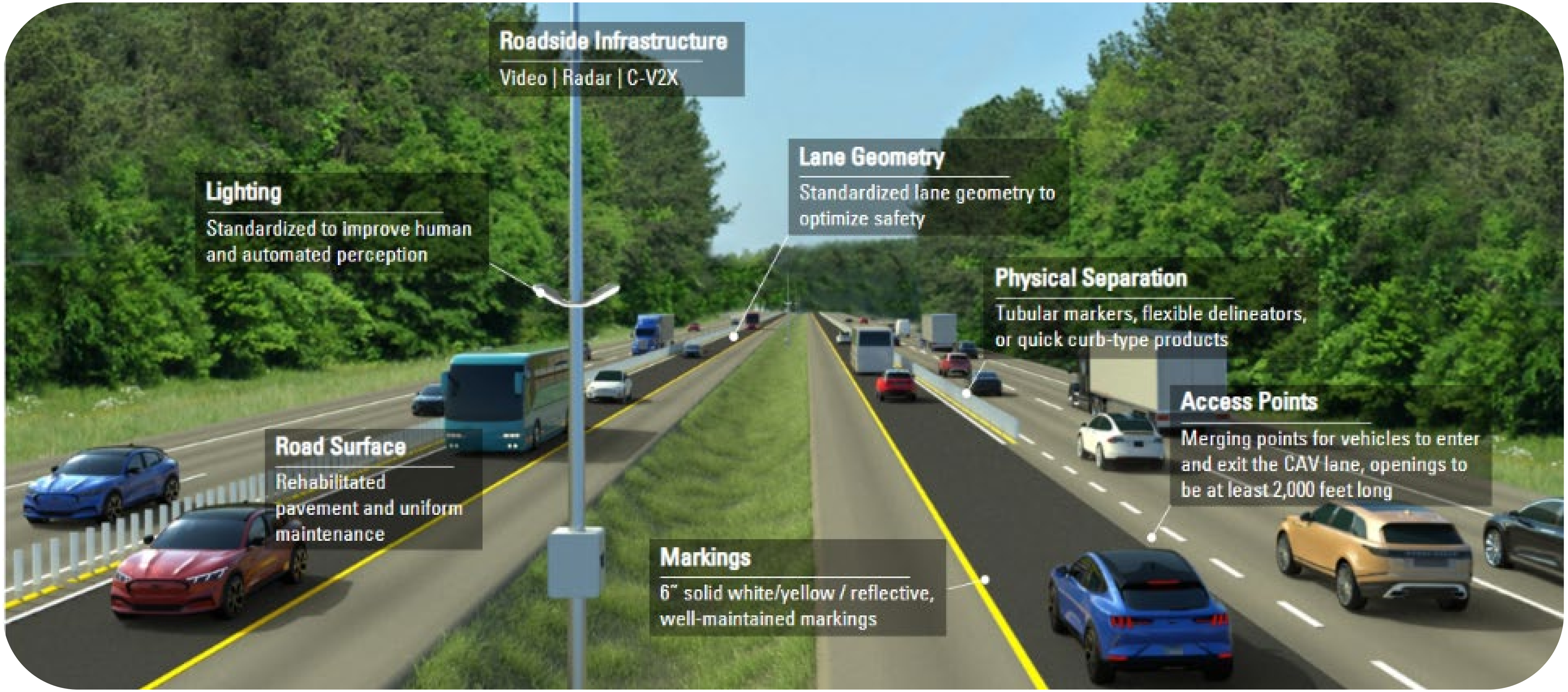
Alternatives Considered but Not Carried Forward

- Right General-Purpose Lane Alternative - Equip the existing right side general-purpose lane with Cavnue's digital infrastructure and a series of physical improvements. This alternative was not carried forward due to the operational complications between the lane and the existing freeway entrance on/off ramps and interchanges.
- Inside Shoulder-Running Alternative - Equip the existing inside (left) shoulder with Cavnue's digital infrastructure and a series of physical improvements. This alternative was not carried forward because several segments along the project corridor have limited right of way to accommodate a shoulder-running lane.
- Additional Lane Alternative - Adding a lane in each direction of I-94 for a technology-enabled express lane. This alternative was not carried forward due to limited right of way to accommodate an additional lane.

Alternatives Carried Forward

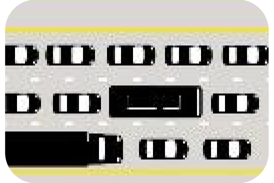
- No Build Alternative - Required to be included in accordance with Federal Highway Administration (FHWA) Technical Advisory T 6640.8A.
- Build Alternative - Equip the existing inside (left) general-purpose lane with Cavnue's digital infrastructure and a series of physical improvements. Vehicles would be able to access the lane through access points to be at least 2,000 feet in length to accommodate merging. The Build Alternative would operate similarly to that of a managed lane frequently found in other states.

CAVNUE – Connected and Automated Corridor



Detroit to Ann Arbor, Michigan

Operations



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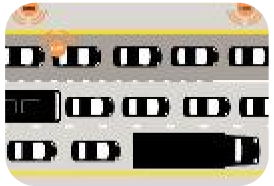
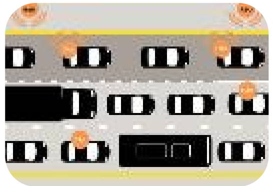
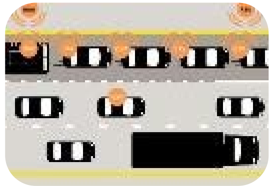


Day One
(est. 2025)
Mixed Traffic



Transition Period
(2025-2045)
% of CAVs Increases
Over Time



Future State
(est. 2045)
CAVs Only

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Immediate Benefits for All Users

The project would feature technologies and improvements that create the following benefits for all users of the corridor:

Improved pavements and high-quality lane striping.

Real-time insights, such as road conditions and hazards along the entire corridor, to vehicles, drivers, incident response teams.

Image: Testing on Michigan's I-96 live as of January 2022

Reduced incident response dispatch times as a result of automated incident detection along the entire project corridor.

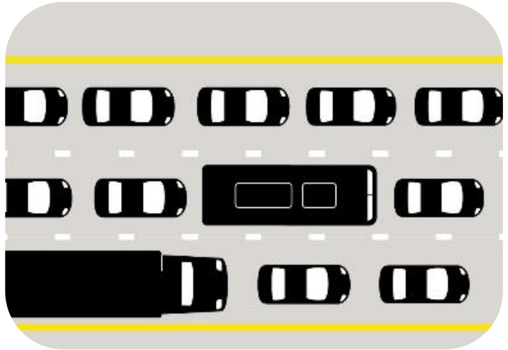
Opportunities for frequent and reliable transit service.

Image: Metro Silver Line, a freeway-running bus rapid transit system in Los Angeles, California

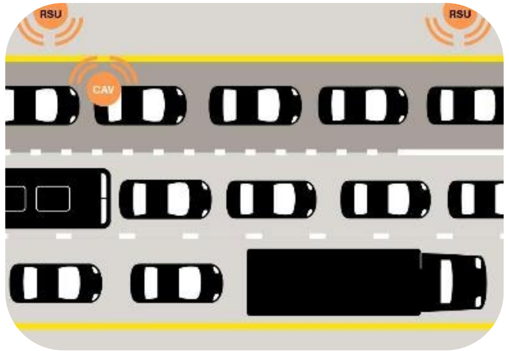
Operations

The project area would initially be open to both CAV and non-CAVs. Motorists would be able to access the express lane with their existing vehicle. As CAVs become more widely adopted in the future, the lane may have restrictions to CAVs only.

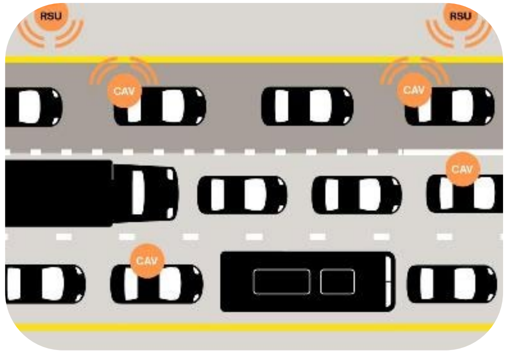
Trucks, which comprise less than 10 percent of traffic along the project corridor, would continue to use the right-most general-purpose lane consistent with Chapter 257.634 of the Michigan Vehicle Code.



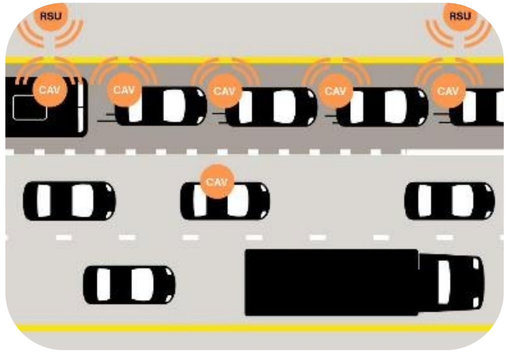
Today



Day One (established 2025)
Mixed Traffic



Transition Period (2025-2045)
Percent of CAVs Increases Over Time



Future State (established 2045)
CAVs Only

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Maintenance and Emergency Vehicle Access

Maintenance

- The project would provide MDOT with a suite of sensors and cameras that would automatically identify road incidents and areas requiring maintenance.

Emergency Vehicle Access

- Emergency vehicles would be able to enter and exit the express lane through designated entrance and exit locations along the corridor, which is anticipated to be positioned between every existing I-94 on and off ramp.
- As part of the design and National Environmental Policy Act (NEPA) process, the project team would be working closely with emergency services representatives, such as the Michigan State Police, to understand and incorporate access requirements into the project.

Image: CAVNUE Rendering of Michigan's I-94 Project

Pilot Testing Began Spring 2024

The project will provide 3-miles of connected and automated vehicle testing during non-peak traffic hours.

I-94 is showing early signs of positive ADAS impact through civil infrastructure alone.

- Initial analysis conducted with OEM teams for retail ADAS-equipped vehicles on I-94 show a trend of the CAV Lane's physical infrastructure improving ADAS usage and performance.
- Insights provided from usage imply:
- CAV Lane Utilization - vehicles choosing to drive in the CAV lane
- CAV Lane may be enhancing L2 system use
- CAV Lane may be enhancing L2 performance

National Environmental Policy Act (NEPA)

What is NEPA?

National Environmental Policy Act of 1969

- Under NEPA, the environmental, social and economic effects of a proposed project are evaluated prior to making decisions.
- NEPA has three levels of review, depending on the complexity of a proposed action.
    - Categorical Exclusion (CE)
    - Environmental Assessment (EA)
    - Environmental Impact Statement (EIS)

- This project was evaluated as an EA, which was made available for public review on Nov. 15, 2024.

NEPA Study

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The draft NEPA Environmental Assessment document studied resources ranging from social, economic and environmental topics.

Environmental Resource	Potential for Significant Adverse Effects	Proposed Mitigation
Traffic	No. Proposed project would not result in significant changes in travel time.	As the design of the proposed project progresses, relevant safety analysis will be conducted to ensure the facilitation of safe lane merge and operations.
Pedestrians, Bicyclists and Transit	No. Proposed project supports existing pedestrian, bicyclist and transit plans.	None proposed.
Contaminated Hazardous Waste Sites	No. No high-risk contaminated sites are located within the proposed project.	Prior to construction, a preliminary site investigation will be conducted to inform best practices for handling hazardous soils, if present.
Construction Impacts	Short-term construction effects may occur while the proposed project is being built.	During the design phase, MDOT will evaluate opportunities to reduce the duration of construction. MDOT will alert the public of major construction activities that could cause disruptions through traffic signs and notices published in the local and social media.
Indirect and Cumulative Impacts	No. Traffic diversion impacts were evaluated but did not result in any discernable changes in roadway speeds.	No impacts are expected, diversion of traffic into low income and minority communities will be reviewed two, five, and 10 years after user fees are in place.

View the full environmental document by scanning the QR code:

Powering the Future: The Road to Wireless EV Charging

- In September 2021, Gov. Gretchen Whitmer first announced the pilot initiative to develop the nation's first wireless charging infrastructure on a public road
- Part of a broader ecosystem of connected and smart infrastructure
- Accelerates the shift to clean, sustainable transportation
- Supports continuous operation for fleets and future autonomous vehicles
- In-road coils deliver power wirelessly to equipped EVs
- Reimagining how EVs stay charged—while in motion

Dynamic Inductive Electric Vehicle Charging

- Inductive EV charging in-road
- Inductive EV charging in-motion (dynamic)
- First dynamic inductive charging on active road in North America

Project Objectives

- Promote sustainable transportation
- Enhance transportation infrastructure
- Increase accessibility
- Stimulate economic development
- Lead technological innovations

Global Landscape of Electreon's Wireless Charging Road System

UPS, Michigan


USA Michigan


Norway, Trondheim


Sweden, Visby

Germany, A6

Israel, BRT

USA, L.A.


Germany, Balingen


Israel, Rosh Ha'ayin


USA, Utah


France, A10


Germany, Kalsruhe


Italy, Arena of the future


China, Shandong province

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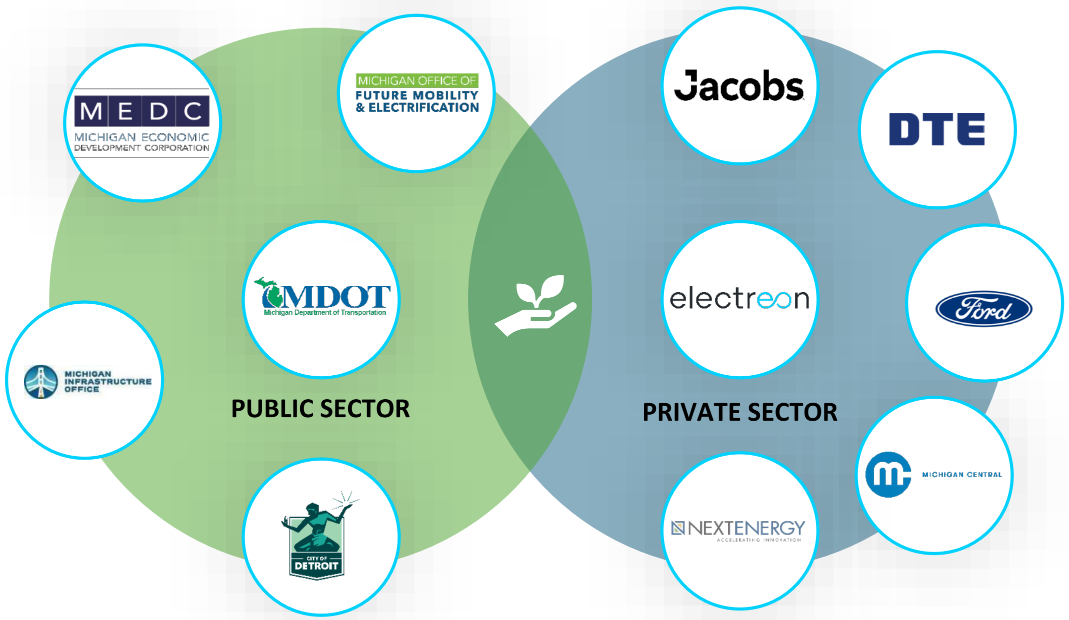
Electreon's Wireless Charging Road System Components

Above ground management unit.

In-road charging system made of under-road coil segments.

Energy transfer uses resonant induction between two coils.

America’s First Public EV Charging Road Opened in 2024



PHASE 1 – CITY OF DETROIT STREET

- ¼ mile of dynamic inductive charging (14th St.)
- 2 static inductive charging spots (Michigan Central Station)

PHASE 2 – STATE OF MICHIGAN HIGHWAY

- ¾ mile of dynamic inductive charging on Michigan Avenue (US-12)

Smart, Electric, Connected, Shared, and Autonomous Urban Mobility

Passenger vehicles

Shuttle

Transit

Freight

Last mile delivery

Benefits to Inductive Charging

Shared Platform for All EVs, Including AVs

No Visual Impacts
Minimal real estate or building adaptations required

Distributes Energy Demand Over Time & Space
Flattens peak energy demand to lower operational costs

Simple Vehicle Integration
Compatible with any battery technology

Minimize Vehicle Battery Size
Weight, impacts and costs

Metering and Billing system
Dynamic energy metering system on board

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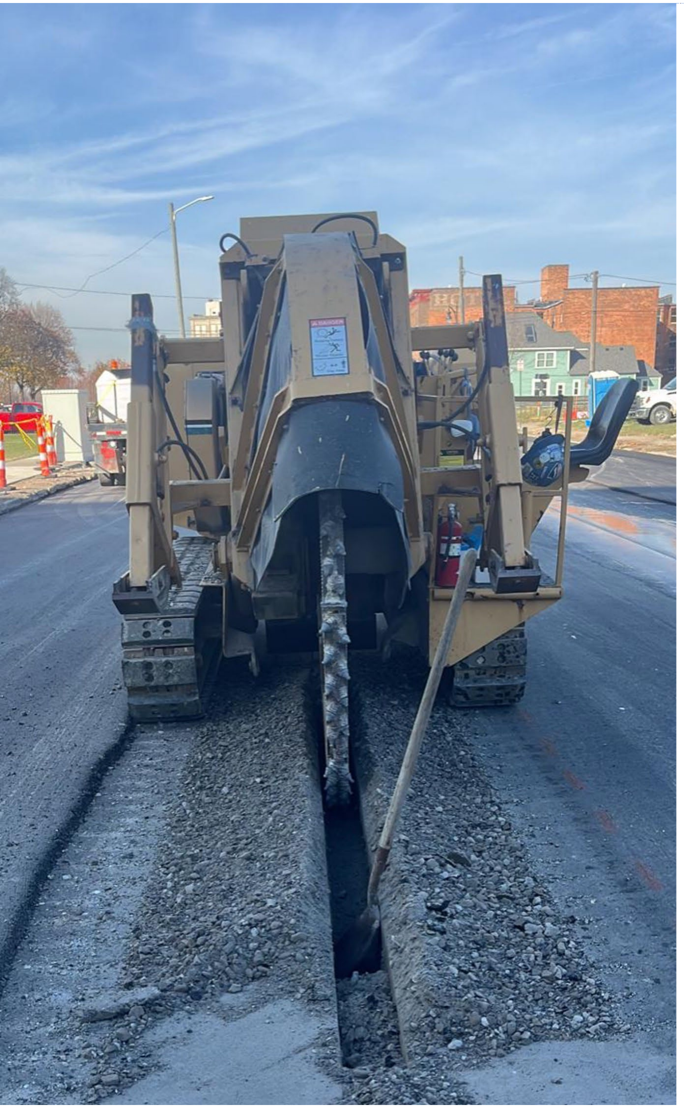
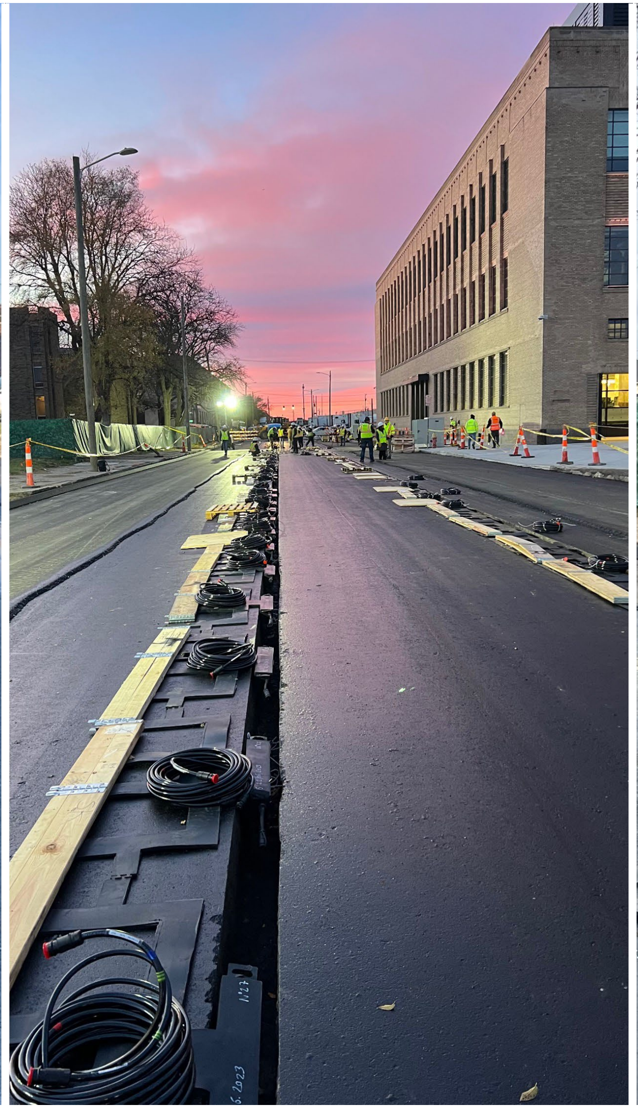
14th Street Construction





14th Street – ¼ Mile Of Inductive Charging

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14th Street – Asphalt Paving and Rolling

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Maintaining the Inductive Charging Road

- Surface defects observed on 14th St during Spring.
- Result of separation, likely due to paving in too low temperature.
- Depth of crack is ~1 inch.
- Not a result of system components.
- 1.5” was removed from the surface
- 24ft in length

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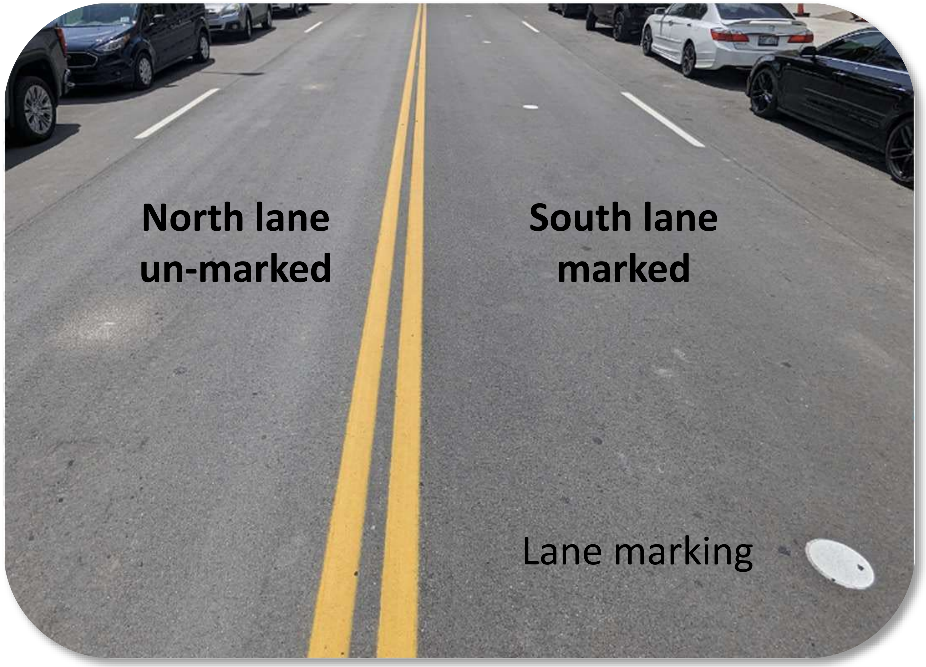
Key Metrics and Findings



Impacts To Energy Received

- Observed greater traffic southbound vs northbound resulting in reduced efficiency due to vehicle alignment avoiding vehicles/pedestrians etc.
- South lanes (marked) consistently show (about 8%) greater energy received compared to north (unmarked) lanes.

Cumulative totals (8/1/2024 – 1/31/25)	
Total EV Dynamic Energy – North Lane [Wh]	Total EV Dynamic Energy – South Lane [Wh]
26.9K	28.93K

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Funding the Wireless Charging Road

Infrastructure Investment

- Initial costs vary based on project scale, road length, and existing infrastructure

Installation Costs

- MDOT contributed $1.9M in funding; Electreon raised the remainder

Vehicle Integration Costs

- EVs need receivers to use wireless charging

Operational & Maintenance Costs

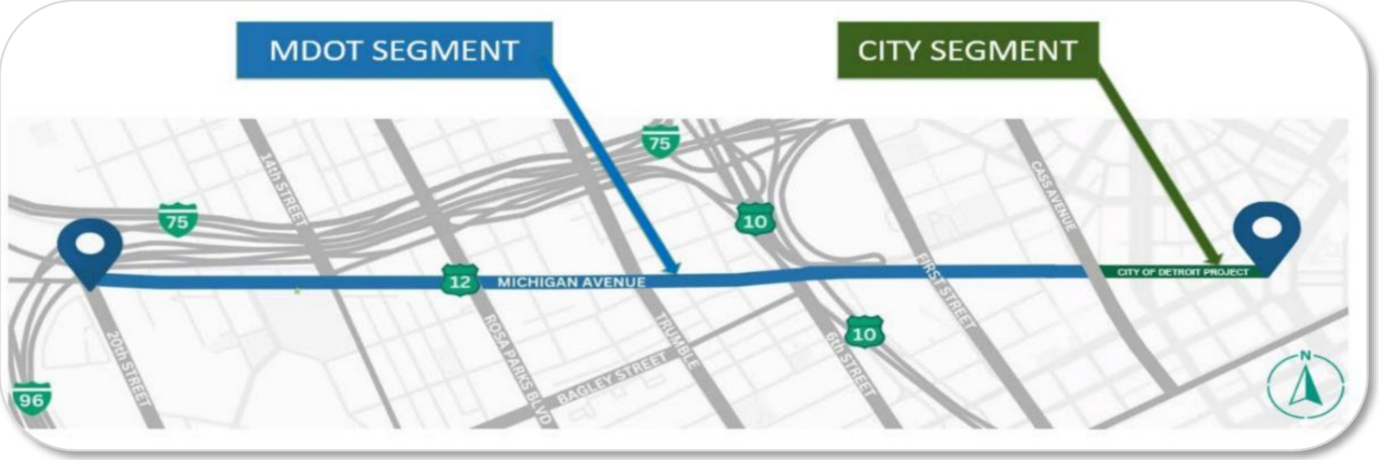
- Lower than plug-in chargers due to fewer moving parts
- Regular monitoring and occasional repairs

Funding & Business Models

- Public-private partnerships, federal/state grants, and utility incentives help offset costs
- Potential revenue streams from subscription or per-mile charging

Next Steps for Michigan’s Inductive Charging Road

- Phase 2 – Michigan Ave (US-12)
- ¾ mile loop
- Increased traffic
- Management units
  - Identify locations
- More use cases
  - Fleets
  - Public transit



Michigan, Electreon, UPS, and Xos, Inc. to advance dynamic and stationary wireless charging for commercial delivery fleets.

Innovative Use Cases in Action:

- Integration of Electreon's wireless charging technology into Xos step vans.
- Installation of stationary wireless chargers at a UPS Detroit facility for overnight charging.

Key Benefits of Wireless Charging Solutions:

- Reduced vehicle downtime and enhanced fleet efficiency.
- Lower Total Cost of Ownership (TCO) for commercial fleets.
- Extended vehicle range without costly grid upgrades or oversized batteries.

Funding and Strategic Support:

- $200,000 from the Michigan Mobility Funding Platform (MMFP).
- Backing from the Michigan Central Scale Fund to foster technology scaling and innovation.

Future and Ongoing CAVE Research

Inductive Charging Research – Heavy Duty Vehicle Use Cases

Objectives

- Evaluate the efficacy of IVC in overcoming range anxiety for different EV users
- Investigate the current IVC technology characteristics
- Identify IVC installation and maintenance requirements
- Assess the cost of IVC implementation

Use Case Development

- Transit routes
- Intercity highways
- Border crossings
- Central business district
- Pick up/drop off areas of points of interest

Transit

Commercial Motor Vehicles

Questions or comments?

VISIT ONLINE TO LEARN MORE:

WIRELESS CHARGING ROAD

CONNECTED CORRIDOR ON I-94

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