

# CONNECTED AND AUTOMATED VEHICLES

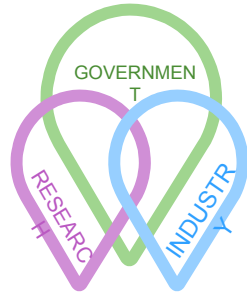
## MINNESOTA'S TRANSPORTATION FUTURE

MN TOWARD ZERO DEATHS  
NOVEMBER 14, 2023

# CAV IN MN



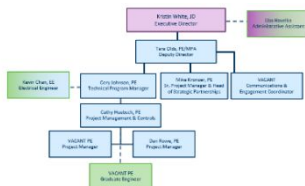
Governor's Council



Innovation Alliance



Interagency CAV Team (I-CAV)



CAV-X Team and Internal Working Group



# GOVERNOR'S COUNCIL ON CAV

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## VISION

Building a future of transportation system that is safe, equitable, accessible, efficient, healthy, and sustainable.

## MISSION

- Collaborate with stakeholders.
- Partner with academic institutions and private industry.
- Engage communities to prepare Minnesota for a future with emerging transportation technologies.

# CAV INNOVATION ALLIANCE



## SAFETY

- Bike and ped detection
- Crash data
- Driver training
- Human factors research
- Updating licensing and registration
- Multi-modal AV
- Vulnerable road user engagement

## LABOR and WORKFORCE

- Curriculum
- STEM outreach
- workforce data
- Training pilots

## CONNECTIVITY and DATA

- Privacy principles
- Policy framework
- Security by design
- 3<sup>rd</sup> party data sharing

## INFRASTRUCTURE INVESTMENT

- Fiber partnerships
- Pavement markings
- Signal upgrades
- Cold weather testing
- Automated delivery
- CAV readiness

## EDUCATION and OUTREACH

- CAV ambassadors
- Conferences
- Demos
- Public engagement
- Fact sheets
- Newsletters
- Summits
- Webinars

- **Mission:** Build a statewide coalition for transportation technology.
- Coordinates and aligns the state's CAV organizations and work.
- Reports to and advises Advisory Council.
- Collaborates across industry and sectors.
- Provides technical expertise.



# CAV PLAN AND PRINCIPLES

# CAV STRATEGIC PLAN



Update in progress

- CAPITAL INVESTMENT.
- RESEARCH & DEVELOPMENT.
- PARTNERSHIPS.
- REGULATION AND POLICY.
- OPERATIONS AND MAINTENANCE.

- MULTIMODAL.
- STRATEGIC STAFFING.
- COMMUNICATIONS.
- LONG-RANGE PLANNING.

# CAV GUIDING PRINCIPLES

**Goal:** Guide stakeholders and leaders to ask the right questions when developing policy, programs and directing investment.

1. Safety is paramount.
2. Advance transportation equity.
3. Promote public health and sustainability.
4. Prioritize shared mobility and accessibility.
5. Innovation.
6. Agile infrastructure investment.
7. People-focused policy.
8. Economic prosperity and quality of life.
9. System resiliency through data access and security.

## Minnesota CAV Guiding Principles

Below are Minnesota draft CAV Guiding Principles. Each of these principles has general policy statements, followed by key questions to ask policy makers, government, industry, and community when developing new CAV programs or policies. These questions can be asked when developing policy, when scoping and selecting projects, and in evaluating program success and can be shared with local agencies, communities, and stakeholders. Principles including safety, equity and innovation should be principles reflected through all these policy and programmatic priorities. These principles are not in hierarchical order, rather they are meant to be holistically considered when developing new ideas or programs.

- 1. Safety is Paramount:** Continue to work towards a transportation system that has no fatalities and decrease severe and serious crashes. Provide multi-modal safe systems that promote transportation efficiency. Proactively address disproportionately impacted demographics that are over or under-represented in traffic safety data.
  - **Questions to ask:** Does this support safety for all communities, including people who walk, bike, use transit and other modes? Does this advance the state's Safe Routes to Schools, State Highway Safety Plan and other community health goals? Does this provide appropriate regulatory oversight to ensure compliance with safety goals? Can the CAV safely return control if an error occurs? Can the AV proactively predict the behavior of other drivers and road users? How does the CAV follow traffic laws? Does the CAV alert operators when they need to take over, if applicable? How is the safety of the vehicle validated or tested? Is the technology safe from cyber-attack and security risks? How does this policy or program advance *Toward Zero Death* goals and those embodied in *Complete Streets*, *Safe Routes to Schools* and *Highway Safety Plans*? Does this provide a safety benefit to diverse geographical and/or for diverse demographics in the state? Does this create a more welcoming and physically safe environment for people of all modes?
- 2. Advance Transportation Equity:** Advance policies that promote transportation equity. View our work through an equity lens. Meaningfully engage communities to have a voice in expressing how CAV can advance their goals. Recognize transportation's role in dividing communities and recommit to removing systemic barriers. Improve affordable access to destinations in all areas, improving access from rural communities. Uphold public interest with clarity and transparency. Transportation equity ensure the benefits and burdens of transportation spending, services, and systems are fair, which historically have not been fair, and people - especially Black, Indigenous and People of Color - are empowered in transportation decision making.
  - **Equity questions to ask:** Who was involved in the decision or policy development? Does the policy lead to disparate impacts to any one community? Does this advance the state's racial equity and social justice goals? Did you engage the public to understand community goals to use CAV technology? Did you engage communities directly impacted by the project or program? Did you allow input and feedback from the public to impact work where appropriate? Have you engaged Black, Indigenous and communities of color? Did you involve advocacy groups for pedestrian safety, cycling, and people with disabilities? How did you give power to others? Have we informed and engaged communities enough on CAV to make informed decisions? What is the right way to communicate and inform internal and external stakeholders about project innovation and development?
- 3. Promote Public Health and Sustainability:** Protect active transportation to promote healthy communities, which are vital to a thriving Minnesota. Advance system stewardship and sustainability principles to remain resilient in an ever-changing climate. Advance technology and policy that minimize environment impacts. Maximize deployment of AVs as low-emission vehicles in the near term and zero-emission vehicles in the long term. Employ eco-driving strategies. Advance goals to reduce greenhouse gas emissions and develop sustainable funding that addresses the gas-tax funding gap and more resilient transportation system funding.
  - **Questions to ask:** Does it promote goals in MndOT's *Sustainability Report* and the state's *enterprise sustainability* goals to reduce greenhouse gas emissions and energy consumption? Does it positively affect active transportation? Does it put impacts to people over impacts to vehicles?
- 4. Prioritize Shared Mobility and Accessibility:** Promote inclusive policies that meet the needs of all users. Understand that multi-modal mobility is crucial to an integrated transportation system. All transportation options must be accessible and affordable. Connect CAV technology with other modes, including freight, air, ports, rail, and others like aerial mobility. Develop intermodal interoperability to decrease congestion and maximize efficiency. Understand the

CAV Policy Guiding Principles, July 2021



# CAV PUBLIC DEMOS IN MN



# MN CAV PUBLIC DEMOS

## GOALS



Advance technology – in all seasons and for all people



Engage with communities



Increase transportation options



Enhance the workforce and economic opportunity

**MED CITY  
=MOVER**



**BEARTRACKS**



**goMARTI**

# DEMONSTRATION PROJECTS



## Med City Mover

- Rochester, MN
- 12-month test
- 2 - EasyMile vehicles
- Downtown urban
- 6 passengers
- 2 stops
- Slow moving
- Electric



## Bear Tracks

- White Bear Lake, MN
- 12-month test
- 1 - Navya vehicle
- Suburban
- 8 passengers
- 4 stops
- Slow moving
- Electric



## goMARTI

- Grand Rapids, MN
- 18-month test
- 5 - May Mobility Toyota Siennas
- Rural downtown
- 5 passengers
- 70+ stops
- Roadway speeds
- Gas

# WHAT HAVE WE LEARNED



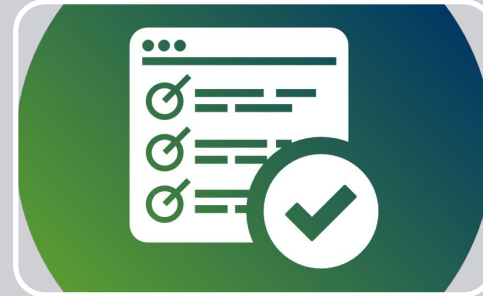
## Technology

- Vehicle
- Infrastructure's role



## Weather

- Conditions
- Environment changes



## Project Building

- Purpose
- Location
- Roles
- Length



## Safety

- Defined
- Who benefits?

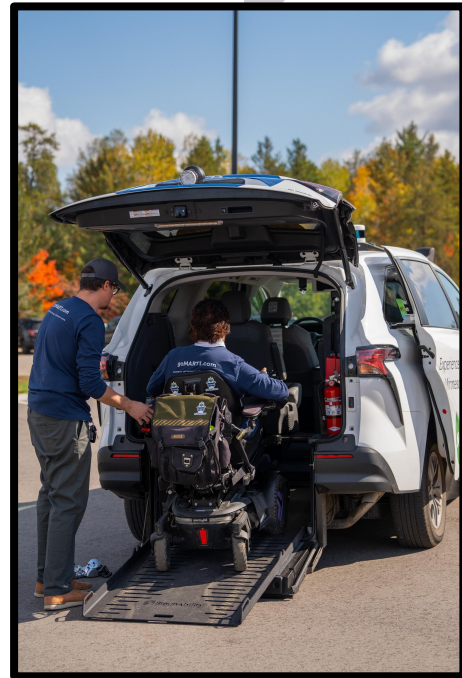
# SHAPING POLICY AND TESTING

Tech isn't "there" yet

Share information

Be prepared

What do we want?





# DRIVE MN



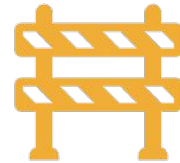
# DRIVE MN GOAL

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**PROJECT GOAL AND FOCUS AREAS:** UNDERSTAND INFRASTRUCTURE READINESS FOR CAV APPLICATIONS AND HOW VEHICLE AUTOMATION RESPONDS TO EACH FOCUS AREA.



TRAFFIC CONTROL  
DEVICES

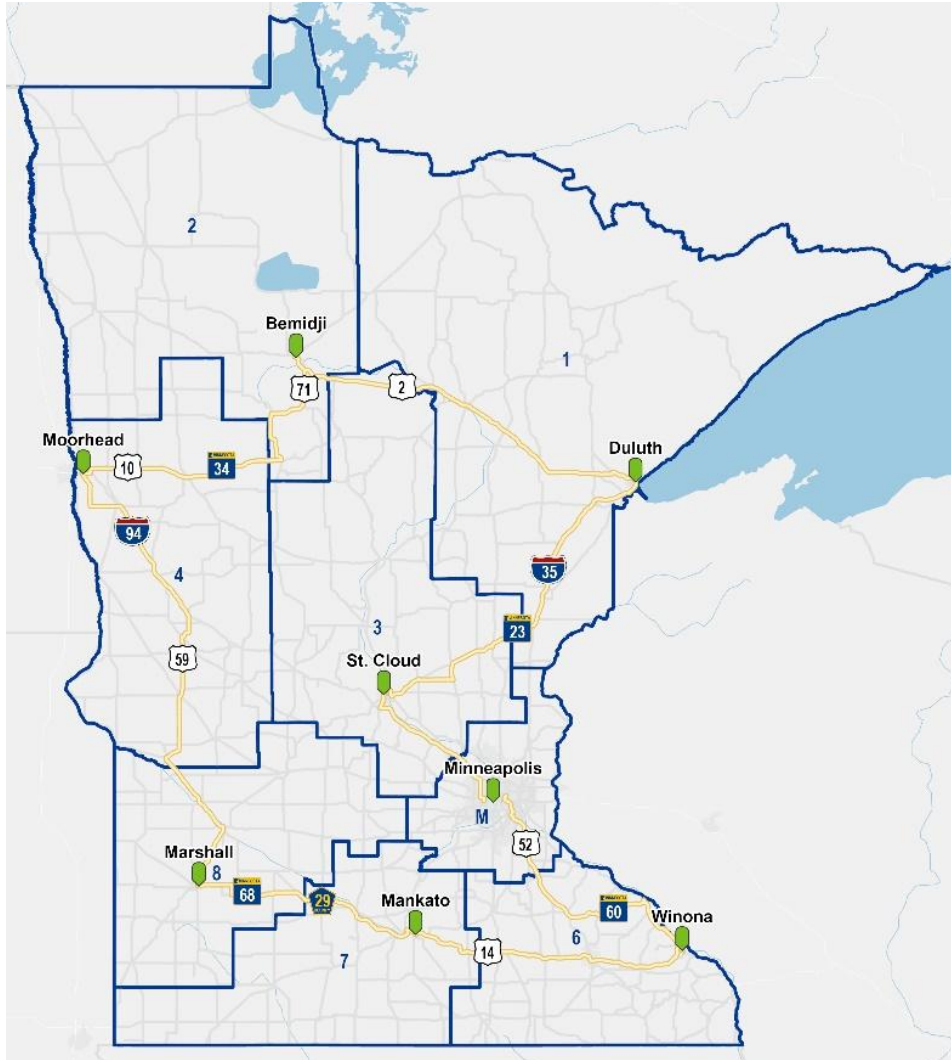


CONSTRUCTION  
WORK ZONES



ROADWAY SIGNING  
& PAVEMENT  
MARKINGS

# EVENT DESTINATIONS AND ROUTE LEGS



- LEG 1: ST. LOUIS PARK TO ST. CLOUD
- LEG 2: ST. CLOUD TO DULUTH
- LEG 3: DULUTH TO BEMIDJI
- LEG 4: BEMIDJI TO MOORHEAD
- LEG 5: MOORHEAD TO MARSHALL
- LEG 6: MARSHALL TO MANKATO
- LEG 7: MANKATO TO WINONA
- LEG 8: WINONA TO U OF M





# FINDINGS AND HIGHLIGHTS



FREEWAY RAMPS AND  
TURN LANES



POOR LANE MARKING  
CONDITION AND VISIBILITY



CONSTRUCTION AND  
MAINTENANCE ACTIVITIES




POOR CONTRAST



TIGHT CURVATURE



EXTREME SHADOWING



FOG



MNROAD TESTING AREA



# MORE PROJECTS

## On-going

- Geofence Construction Notifications
- Automated Truck Mounted Attenuator
- Lane-Boundary Guidance
- Community Driven CAV
- goMARTI
- Systems Engineering guidance
- CAV Strategic Plan update

## In the works

- Variable speed guidance
- Queue warning
- Workzone safety
- Asset assessment with machine vision
- Bridge hit detection



# THANK YOU

MINNESOTA CONNECTED AND AUTOMATED VEHICLES PROGRAM

[MNDOT.GOV/AUTOMATED](https://mndot.gov/automated)

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