ACES Primer
(Autonomous, Connected, Electric, and Shared Vehicles)

Preparing our Region for
Autonomous & Connected Vehicles
Miniconference – April 26, 2019

What will the world truly look like in 2075?

- All vehicles SAE Level 5, fully IoT capable, and non-fossil fuel

What will the world truly look like in 2075?

- All commercial trucking driverless and platooned

What will the world truly look like in 2075?

- Downtown cores only accessible to shared AVs, bikes, and peds

What will the world truly look like in 2075?

- Signal-less intersections the norm – vehicles negotiate space-time dynamically

What will the world truly look like in 2075?

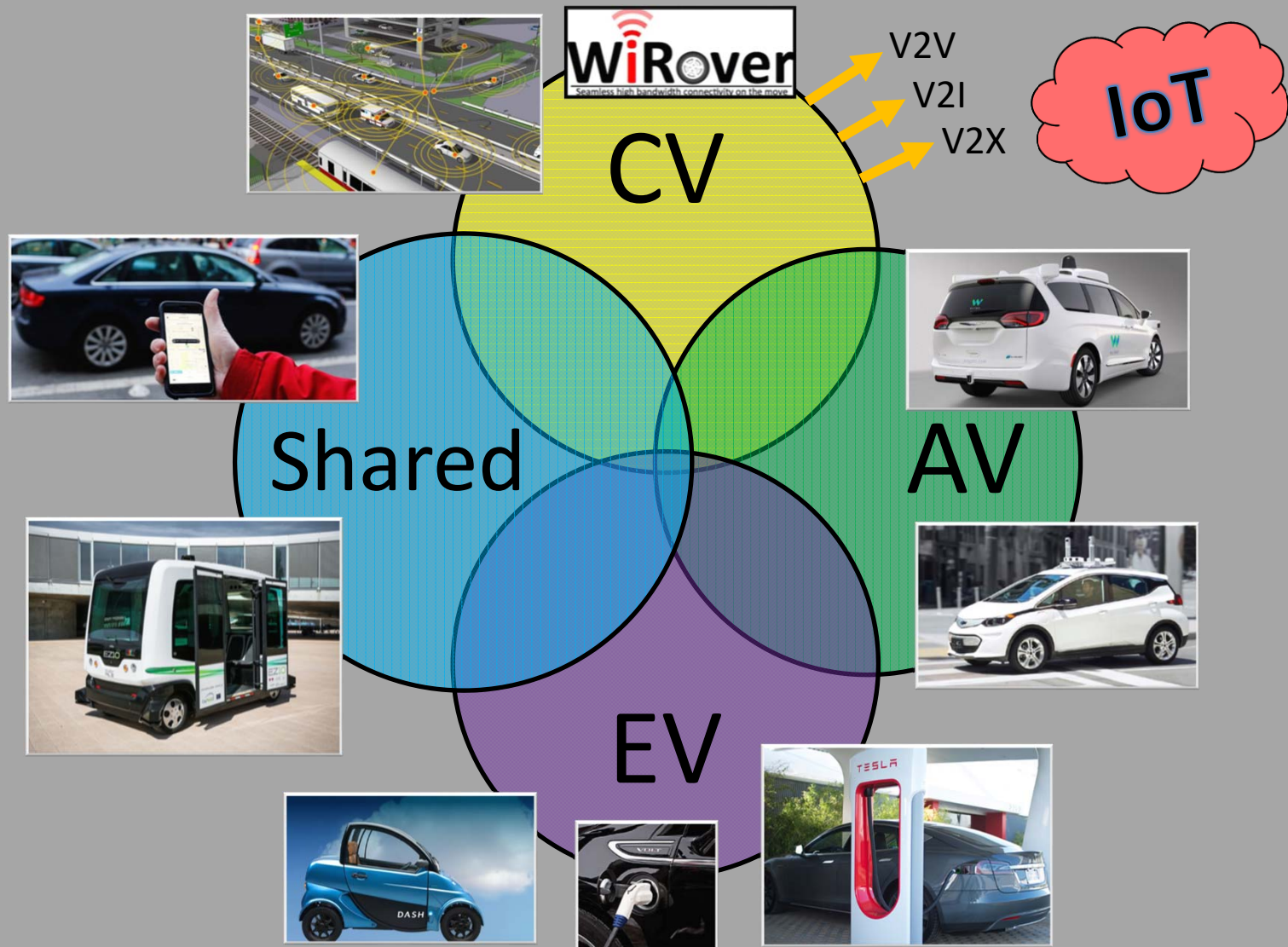- Car ownership limited to rural areas where most own a share of a pooled vehicle

What will the world truly look like in 2075?

- SAE Level 0-4 cars/motorcycles operate under historic licenses on non-freeways and are seen as infrequently as a horse and buggy

What will the world truly look like in 2075?

- It depends on a combination of how we plan it, what people place emphasis on as important, and what the incentives are

- With connected and automated vehicles, this can be a wide spectrum

- How do we get there?
    - Multidisciplinary Collaboration
    - Testing and Validation
    - Public Engagement
    - Urban, Regional, and Rural Planning
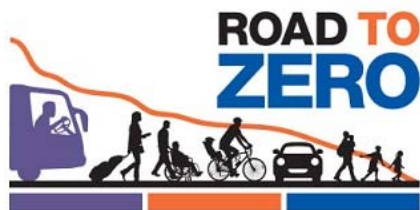   - Artificial Intelligence
    - Navigating the "messy middle"

WAYMO

UBER

FORD

TESLA

GM

CASE IH

Trends, Implications, Motivations: Safety

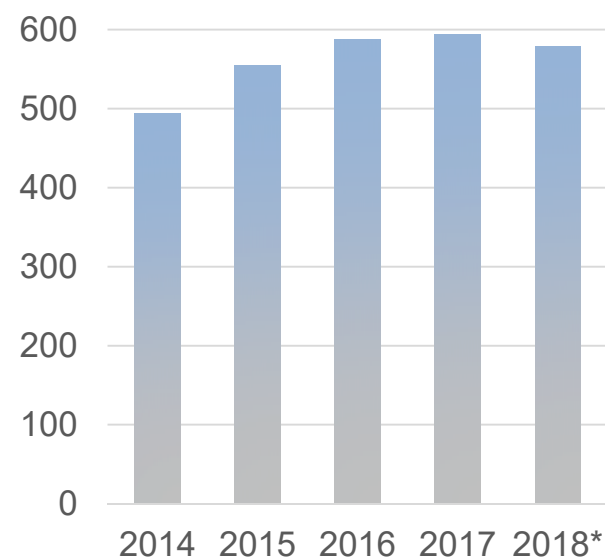## Traffic Fatalities Rising

Nationally:

- 2015-2016, Largest two-year increase in 50 years

- In 2017, 37,133 deaths

- 90+% Attributable to Human Error

ROAD TO ZERO

Wisconsin:

Pedestrian deaths now up to 15% of all traffic deaths

Advanced Driver-Assistance Systems (ADAS)

Back-Up Camera
Shows you a view behind your car when backing up

Automatic Emergency Braking System
May brake for you if a front-end crash is imminent

Blind Spot Monitor
Helps you know what cars might be hidden to your left or right

Lane Departure & Lane Keeping Systems
Warns you if you're drifting out of your lane and may steer you back

Automatic Parallel Parking
Helps you safely navigate into a parallel spot. You control braking, it controls steering

MyCarDoesWhat.org
A website that answers all your questions about new car safety technologies.

…and so much more

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SAE Levels of Vehicle Automation

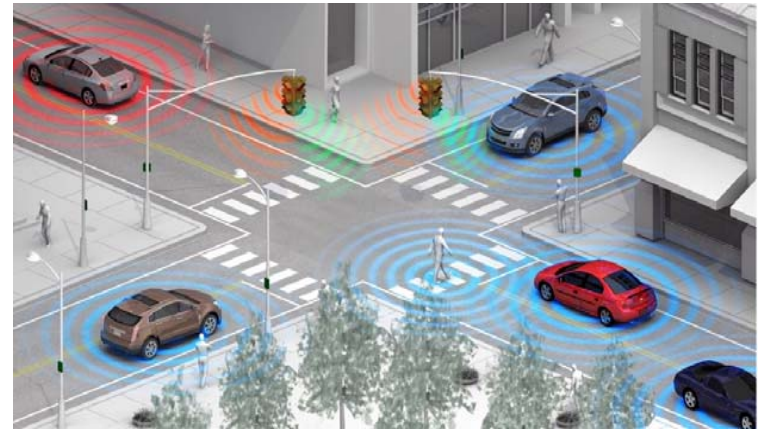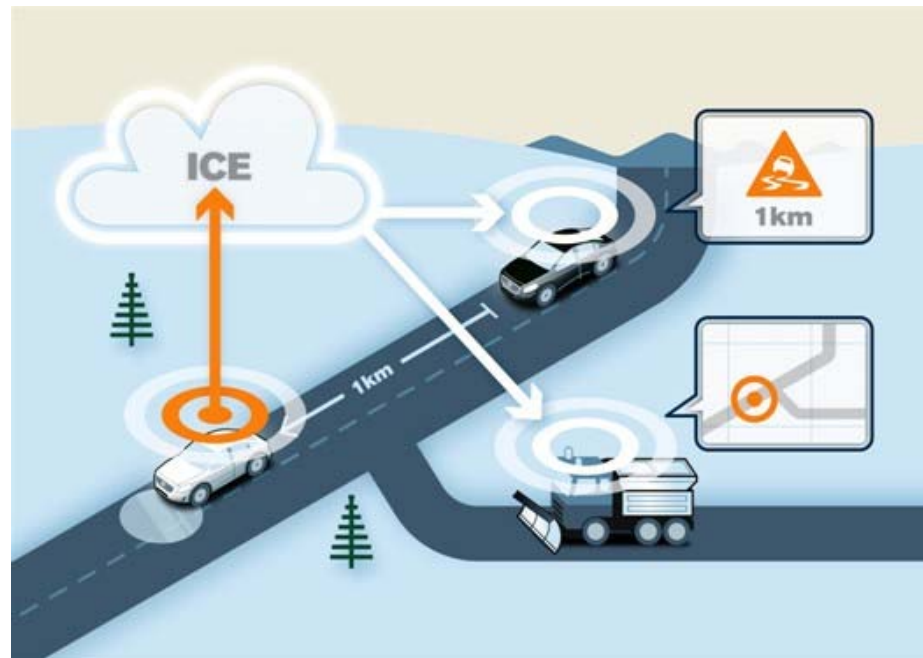| 0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

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Connected Vehicles – Overview

- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Anything (V2X)
  - Pedestrians
  - Bicycles / motorcycles / mopeds
- Connected everything – Internet of Things
- Basic Safety Messages (BSM) broadcast every 1/10th of a second
  - Vehicle position, speed, heading, acceleration, size, brake system status
- Vehicles and infrastructure need to be equipped to gain benefit

Vehicle to Vehicle Communications
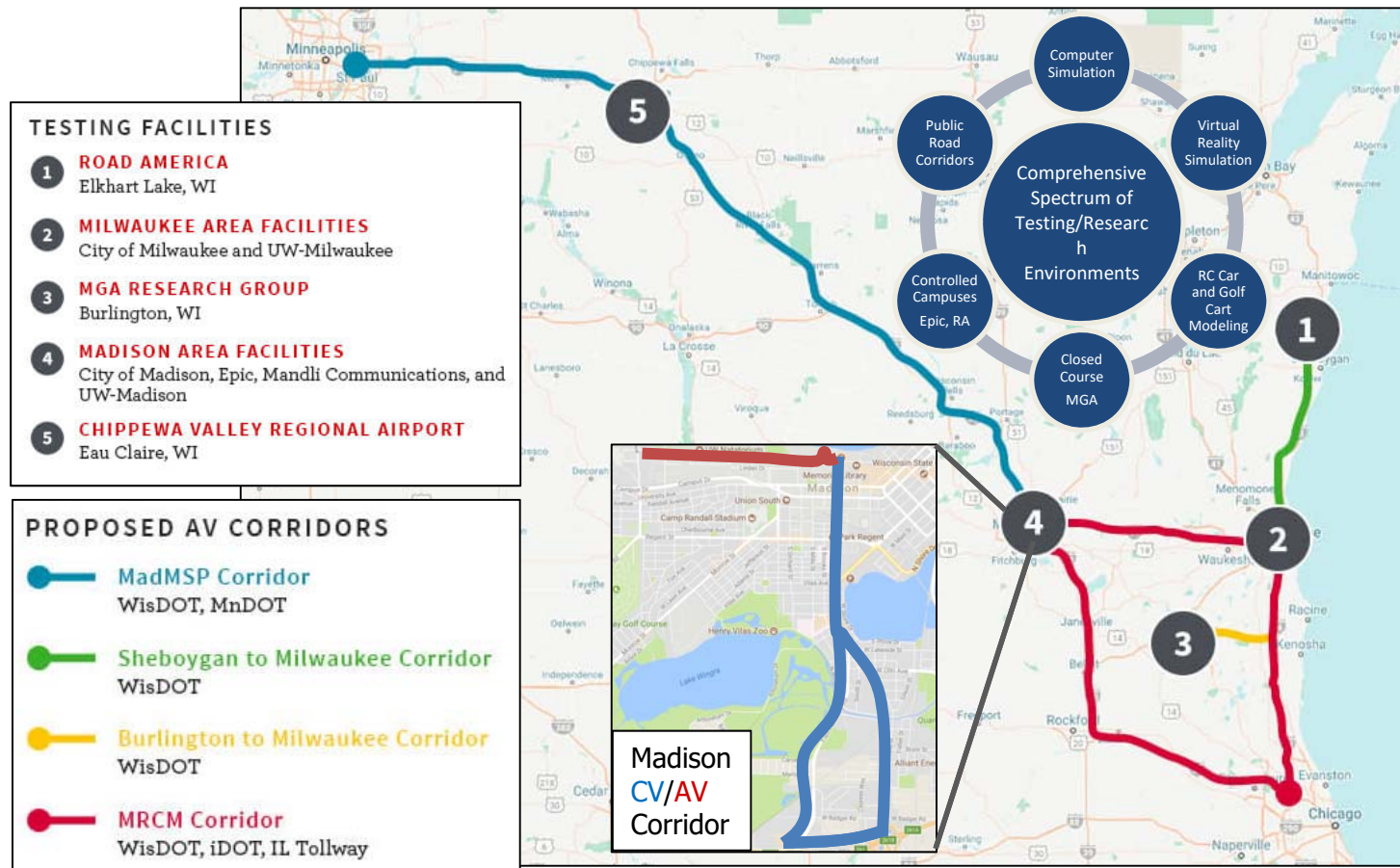# Road Hazard Notification

Vehicle to Infrastructure Communications Intersection Warning
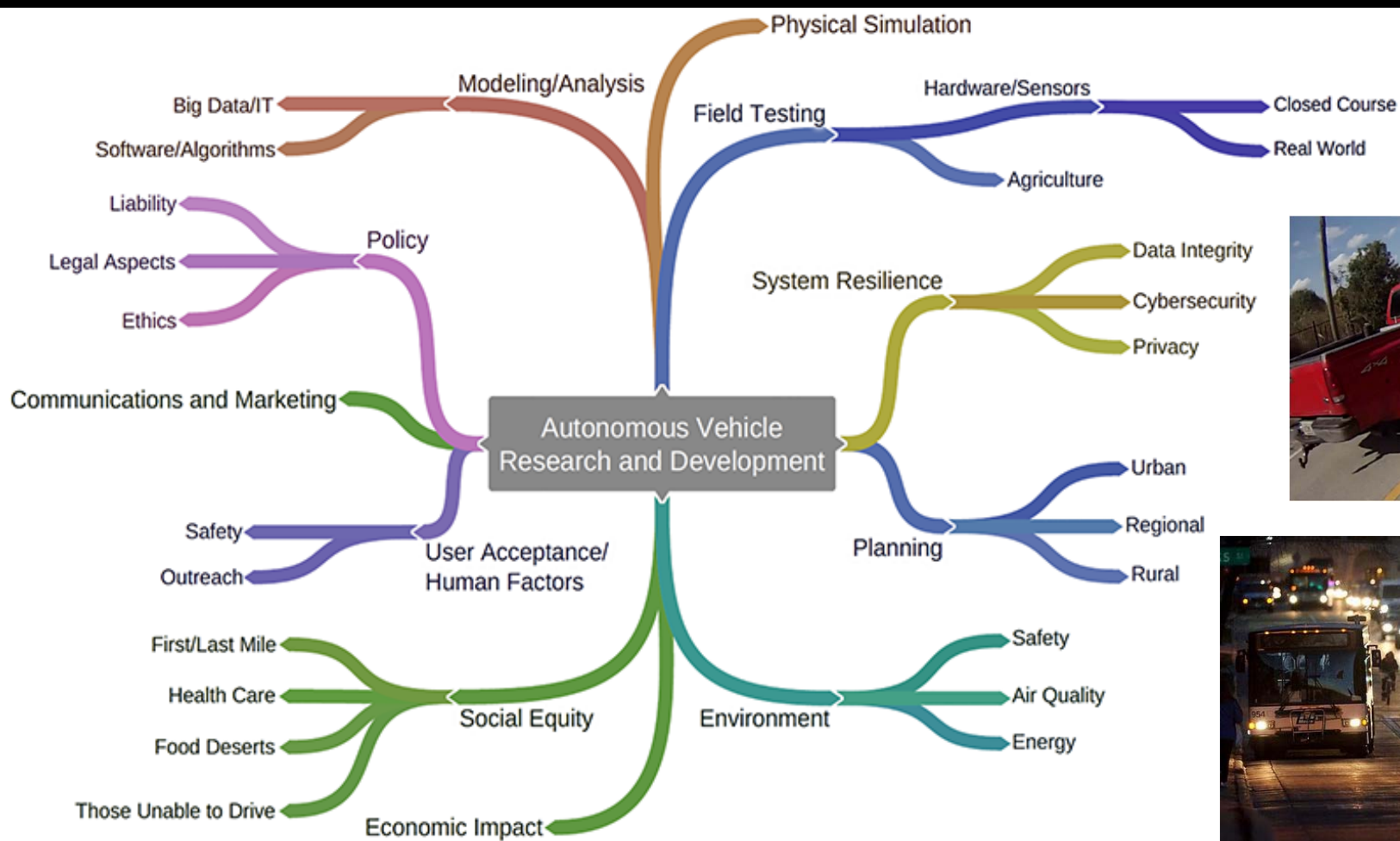
Biggest Issues Surrounding AV/CV

- Vehicle Cybersecurity

- Information Privacy

- Vehicle Ethics

- Crashworthiness

- System Disengagements / Driver Re-Engagement

- Complex Driving Situations

- Deep Learning / Artificial Intelligence

- Vehicle Assertiveness

- **Technology is coming – Will we shape it or let it shape us?**

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TESTING FACILITIES

1. **ROAD AMERICA**
   Elkhart Lake, WI

2. **MILWAUKEE AREA FACILITIES**
   City of Milwaukee and UW-Milwaukee

3. **MGA RESEARCH GROUP**
   Burlington, WI

4. **MADISON AREA FACILITIES**
   City of Madison, Epic, Mandli Communications, and UW-Madison

5. **CHIPPEWA VALLEY REGIONAL AIRPORT**
   Eau Claire, WI

PROPOSED AV CORRIDORS

- **MadMSP Corridor**
  WisDOT, MnDOT

- **Sheboygan to Milwaukee Corridor**
  WisDOT

- **Burlington to Milwaukee Corridor**
  WisDOT

- **MRCM Corridor**
  WisDOT, iDOT, IL Tollway

Comprehensive Spectrum of Testing/Research Environments

- Computer Simulation
- Virtual Reality Simulation
- RC Car and Golf Cart Modeling
- Closed Course MGA
- Controlled Campuses Epic, RA
- Public Road Corridors

Madison CV/AV Corridor

International

SOUTHEAST UNIVERSITY

Breadth, Complexity, Edge Cases

Madison CV/AV Corridor – Connected Corridor

Research and Development Projects

- Satisfies SPaT Challenge
- 26 DSRC deployment
- TSP/MMITSS application
- Transit/VRU interaction apps
- Red light violation warning
- V2I general testing
- Simulation-to-design
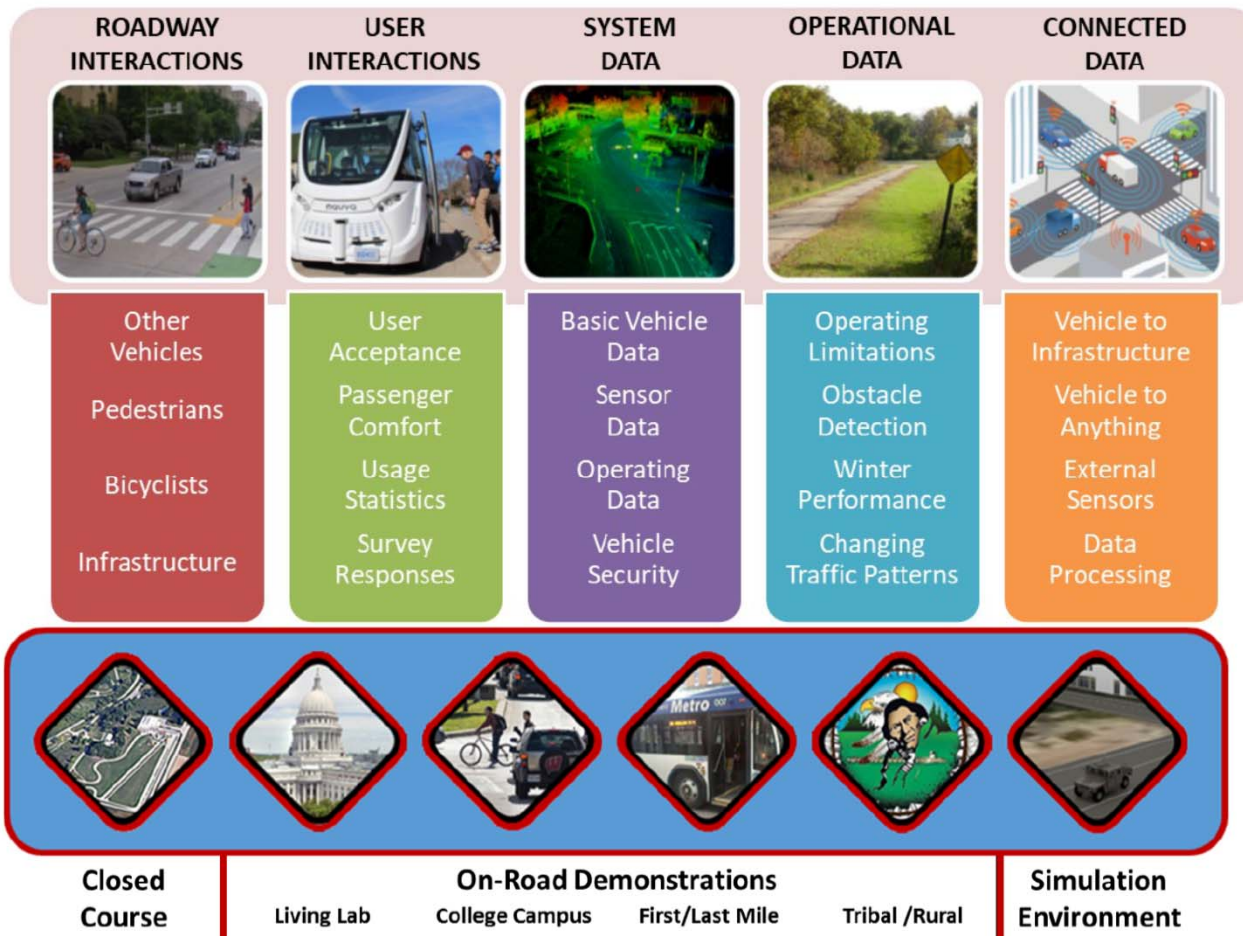- Preparation for 5G

Madison CV/AV Corridor – Connected Corridor

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Research and Development Projects

Automated Shuttle Deployment

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Research and Development Projects

Project Chrono – CV/AV Simulation

Research and Development Projects

- CAVE (Connected autonomous vehicle emulator)
- Multi-agent support
- Vehicles built from subsystems
- DSRC simulation
- LiDAR/Radar simulation

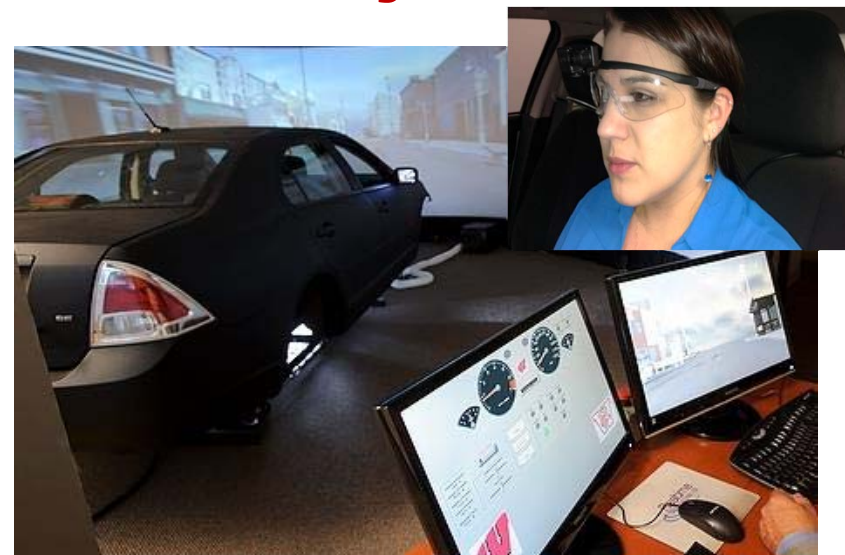# HAVI – Human AV Interaction

Research and Development Projects

- Full-scale driving simulation
- Partial automation research
- Driver reengagement
- Disengagement scenarios
- Driver attentiveness / distraction
- ADAS/CV driver notification strategies
- AV interaction with human drivers
- Vehicle assertiveness

SC&C – Smart and Connected Communities

Research and Development Projects
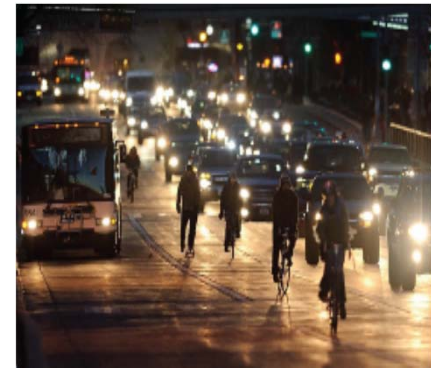
- Dynamic routing
- First-mile/last-mile connectivity
- Food and transit deserts
- Shared Madison data platform
- Smart parking algorithms
- IoT compatibility
- Urban analytics

REACT – Resident Engagement on Automated and Connected Technologies

Research and Development Projects

- Rural engagement workshops
- Aging community outreach
- Low-income community outreach
- Users with disabilities
- Vulnerable industry sector research
- Public outreach and education events
- Multidisciplinary graduate degree development

That's great, but what should we do?

- When should states, regions, cities, and municipalities get involved with ACES?

- How should states, regions, cities, and municipalities get involved with ACES?

- What transportation and/or transportation-related problems does your municipality currently have?

- Which groups of your citizens have a disproportionate amount of transportation issues?

- What are the limitations of the current system in serving these citizens?

- What origins/destinations have the greatest transportation needs?

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Thank You

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Stay Engaged

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Call: **608-890-0509**

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