Preparing for the Future of Transportation

PennDOT's Approach to Automated Vehicles

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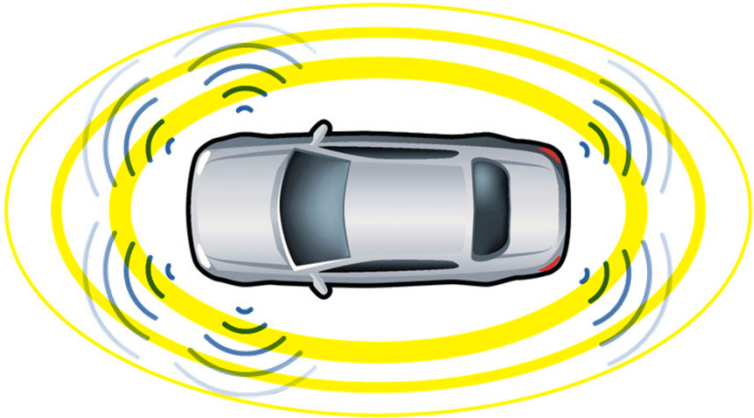
Automated

VS

Cooperative
Automated



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Automated Vehicle

Audi RS 7 piloted driving concept

Driver assistance systems

10/14

Audi

Front camera:

- Audi active lane assist
- ACC with Stop&Go function
- Speed limit display
- Audi pre sense / front / plus
- Audi adaptive light

Ultrasonic sensors at side:

- Park assist with display of surroundings

Front, rear and top-view cameras:

- Parking system plus with front and rear camera
- Park assist with front and rear camera

Ultrasonic sensors at rear:

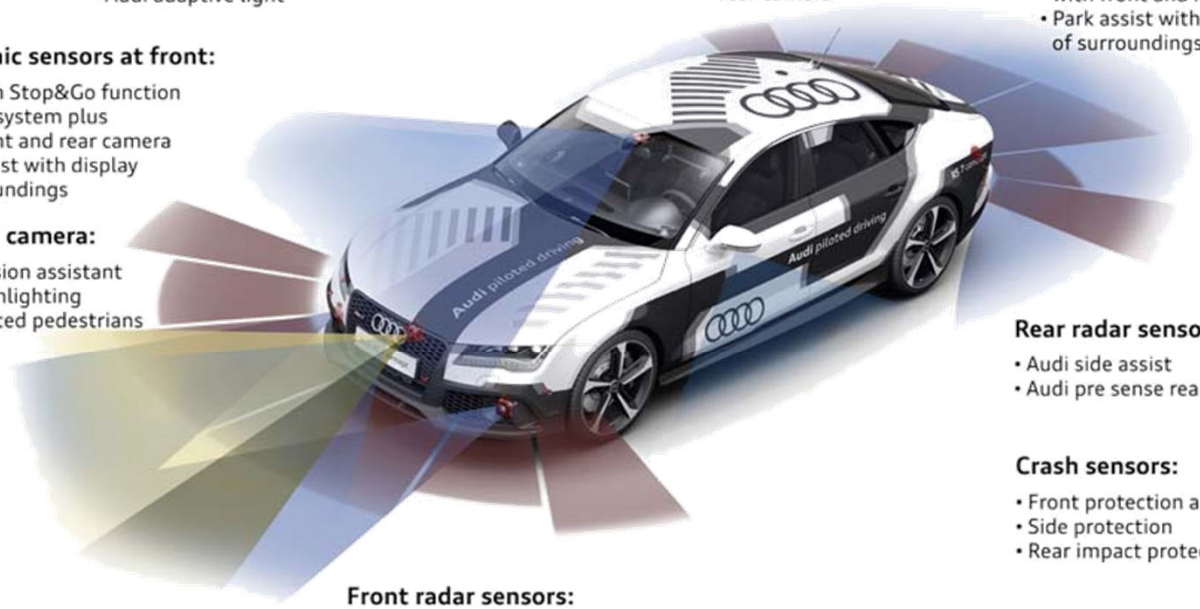
- Parking system plus with front and rear camera
- Park assist with display of surroundings

Ultrasonic sensors at front:

- ACC with Stop&Go function
- Parking system plus with front and rear camera
- Park assist with display of surroundings

Infrared camera:

- Night vision assistant with highlighting of detected pedestrians



Rear radar sensors:

- Audi side assist
- Audi pre sense rear / plus

Crash sensors:

- Front protection adaptivity
- Side protection
- Rear impact protection

Front radar sensors:

- ACC with Stop&Go function
- Audi pre sense / front / plus

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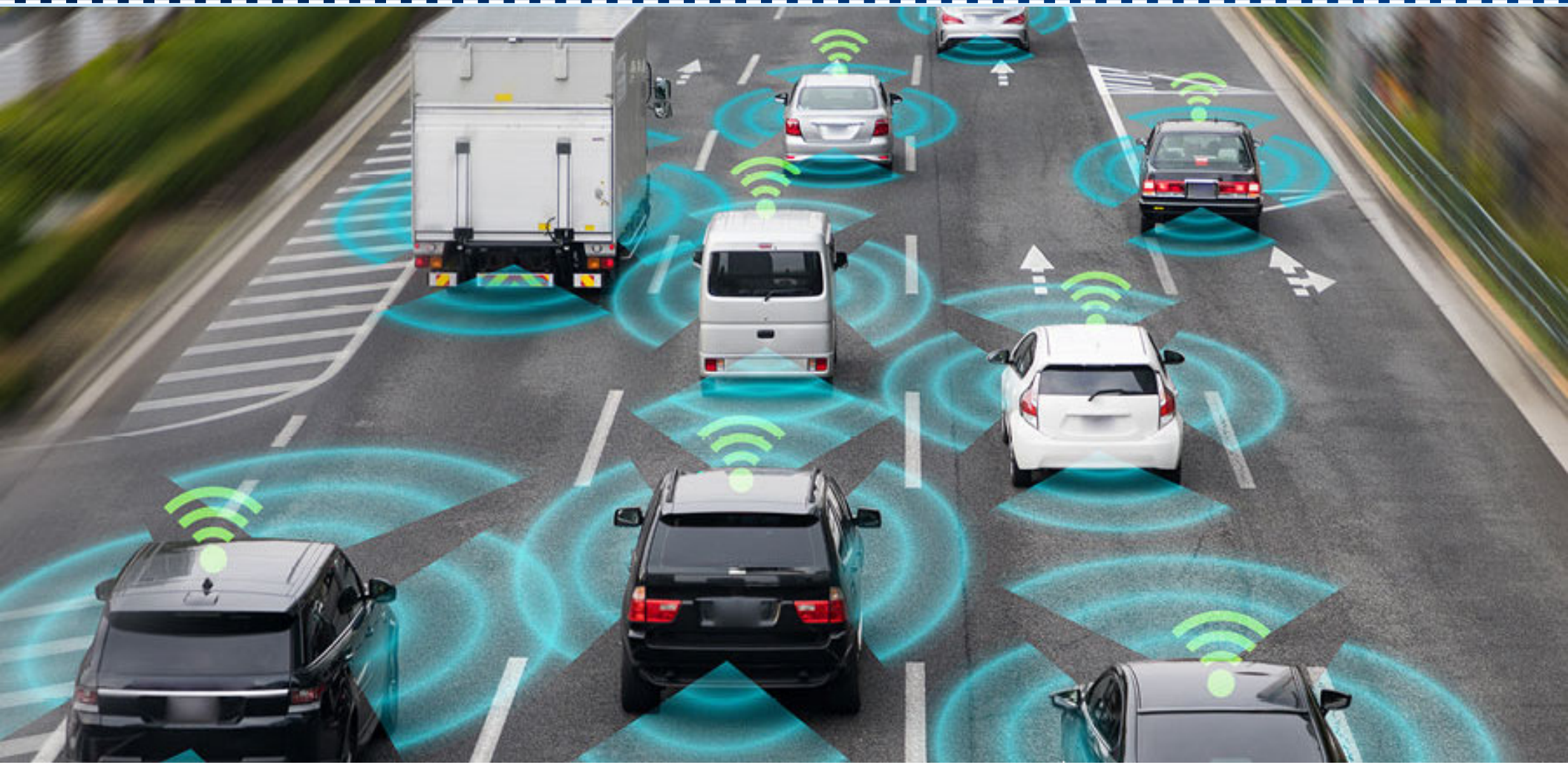
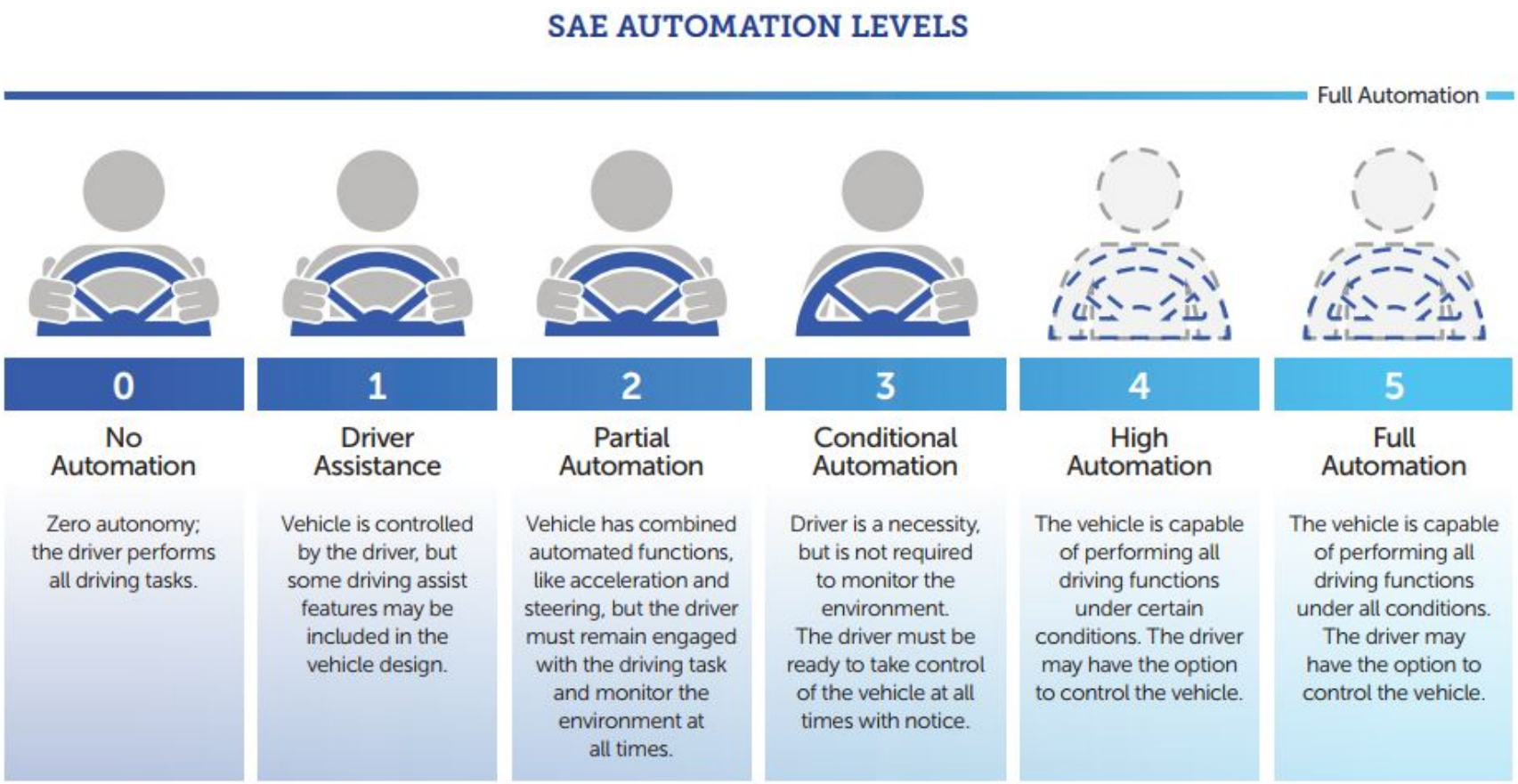
Cooperative Automated Vehicles



Levels of Automation



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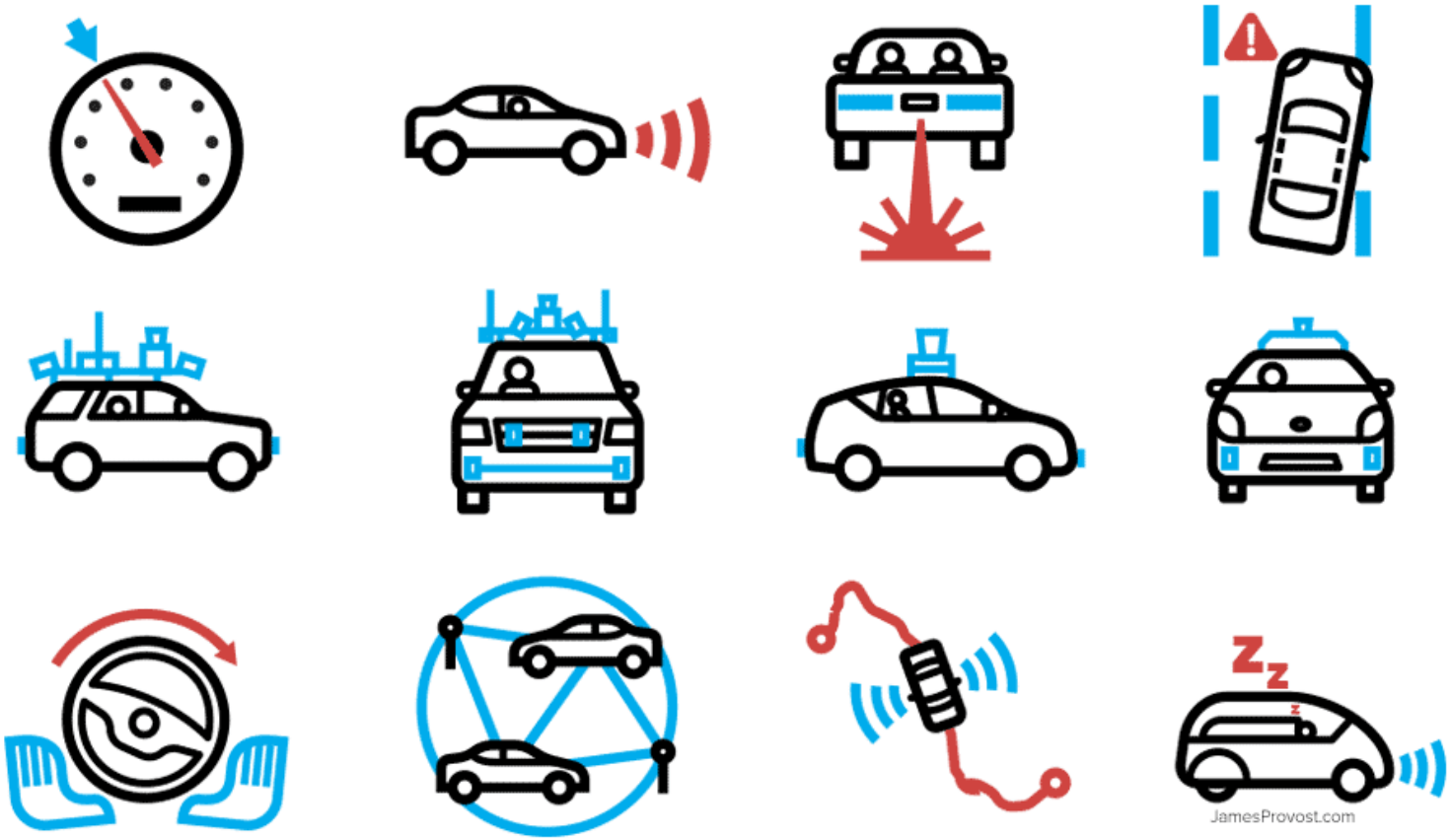
Automated Vehicle Progression



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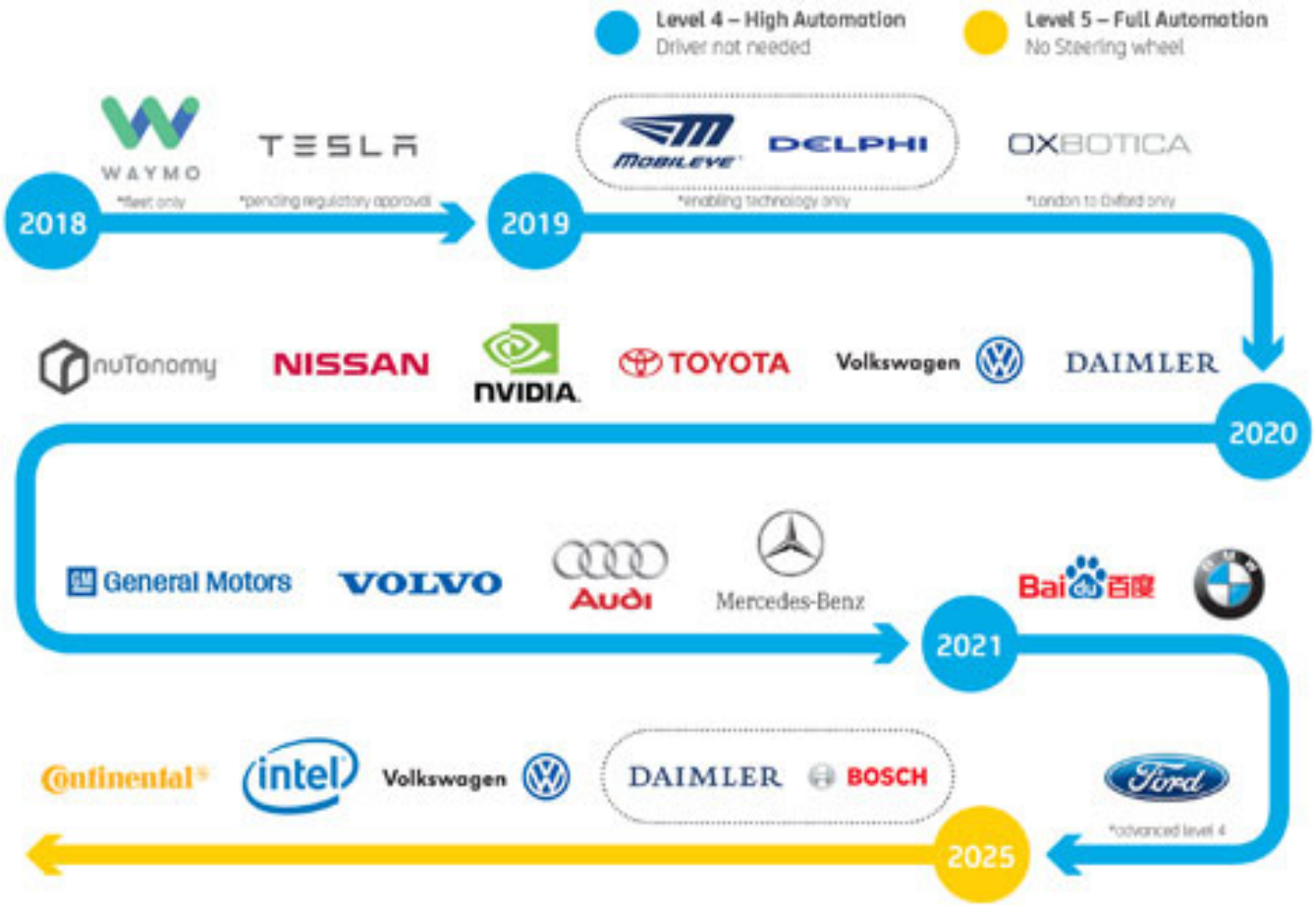
Current Technology

Automated Vehicle Timeline



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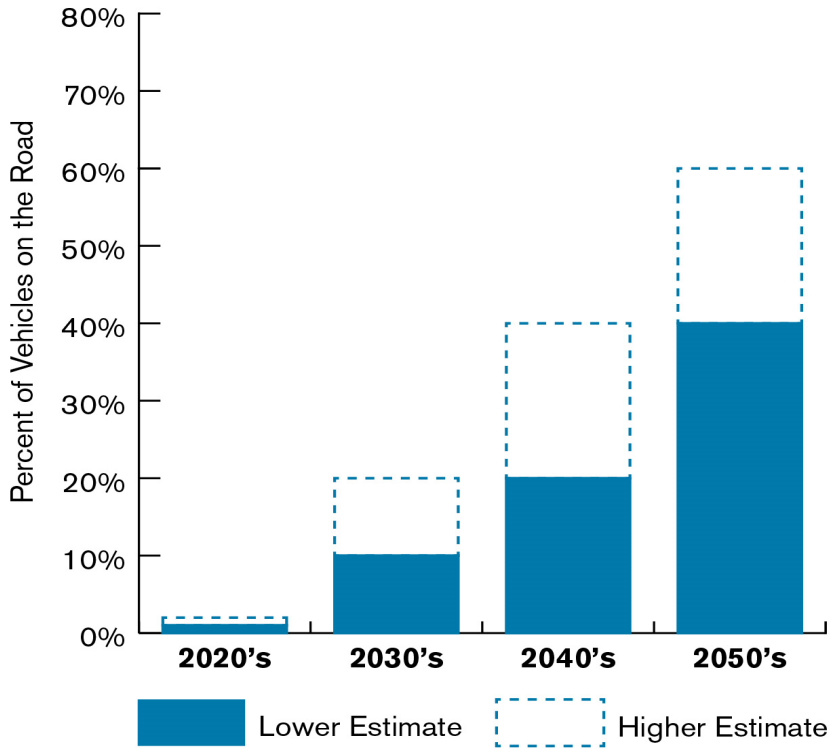
Automated Vehicle Penetration Projections

(as a percentage of all vehicles on the road)



2020's: Large Price Premiums
(01%-02%)

2030's: Moderate Price Premiums
(10%-20%)

2040's: Minimal Price Premiums
(20%-40%)

2050's: Standard on Most New Vehicles
(40%-60%)

Source: GHSA

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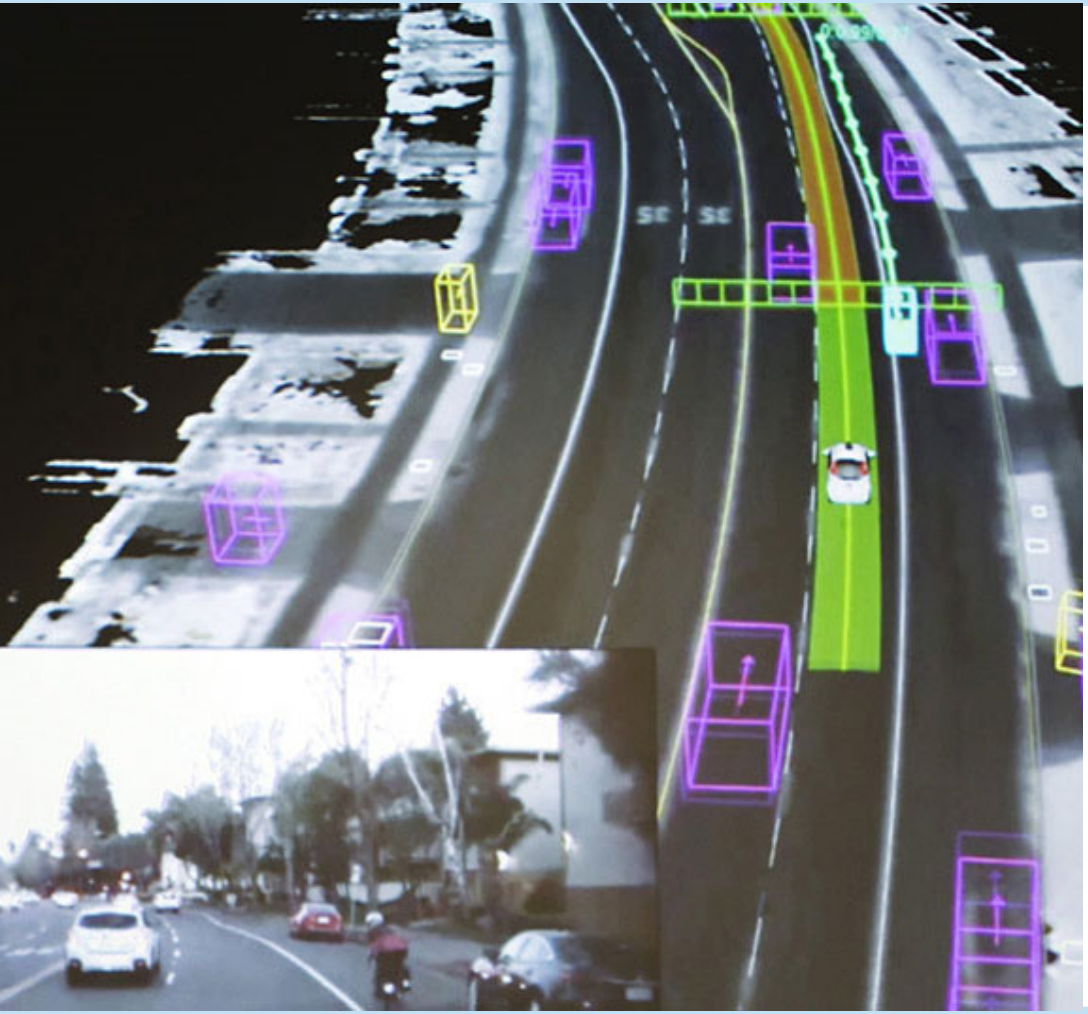
How Will Our Roads Change – Lanes



Human Error

- Eliminate driver wander
- Reduction up to 20%

Consistent Wheel Paths

Reduced Following Distance

- Platooning

Dedicated Lanes

- HOV/HOT → AV Lanes
- Hard Shoulder Running

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How Will Our Roads Change – Markings/Signage

Reduced Signage

- Incorporated
- Connected

Pavement Markings

- 6″ vs 4″
- Tapes vs. Paint

HD Mapping

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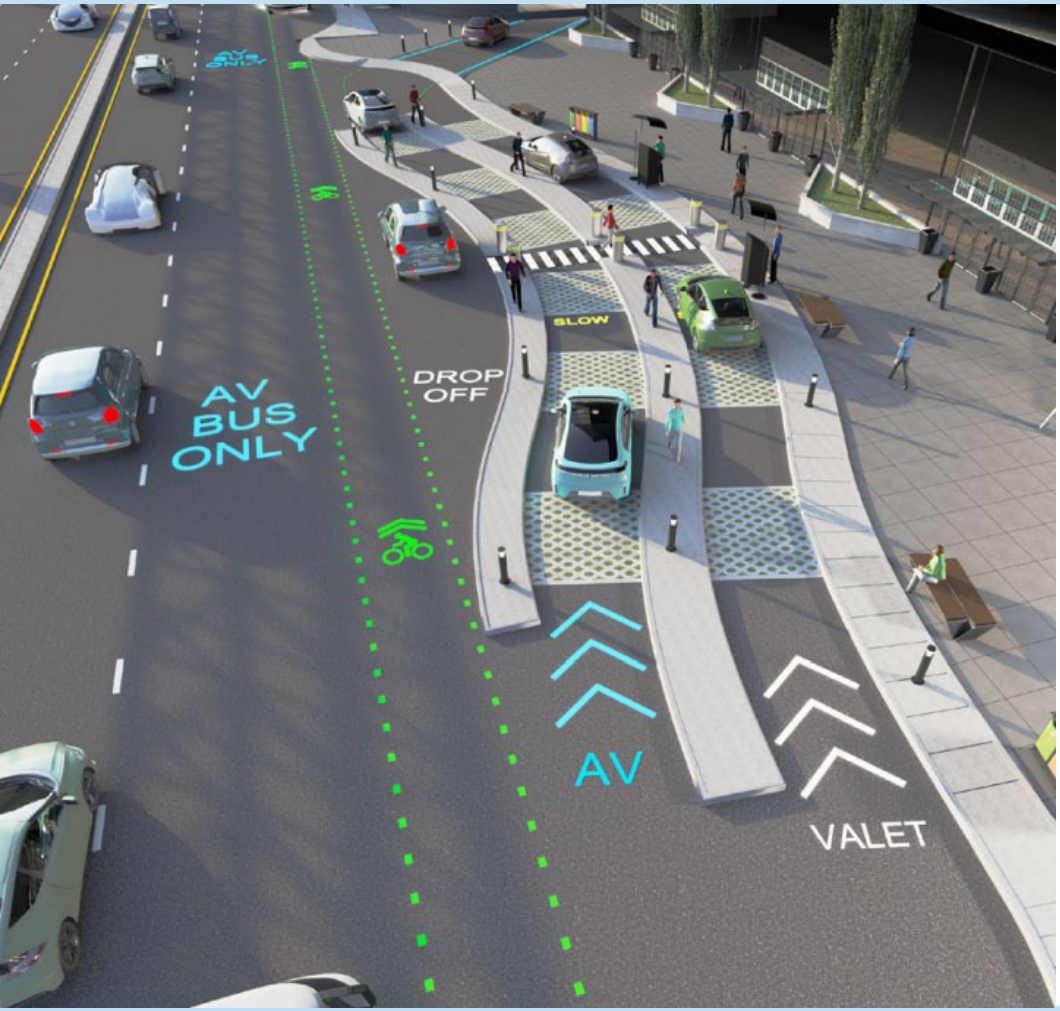
How Will Our Roads Change – Pick-up/Drop-off Locations



Reinventing the Curb

Fighting for Space

- AVs
- Shared Mobility
- Deliveries
- Transit

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How Will Our Roads Change – Parking

Self Parking

- Reduces on-street parking

Urban Centers Shift

- Remote Parking

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How Will Our Roads Change – Electrification

AVs + Evs

- Shared Mobility Model
- Weight

Dynamic Electric Vehicle Charging

- Shared Mobility Model
- Select locations

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How Will Our Roads Change – Situational Awareness

Lots of Data

- 4,000GB per day

Pavement Conditions

- Roughness
- Potholes
- Traction
- Visual Imagery

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How Will Our Roads Change – Work Zones

Work Zone Warnings

- Pattern Changes
- Speed Reductions

Safety Alerts

- Drivers
- Workers

Work Zone Automation

- TMAs

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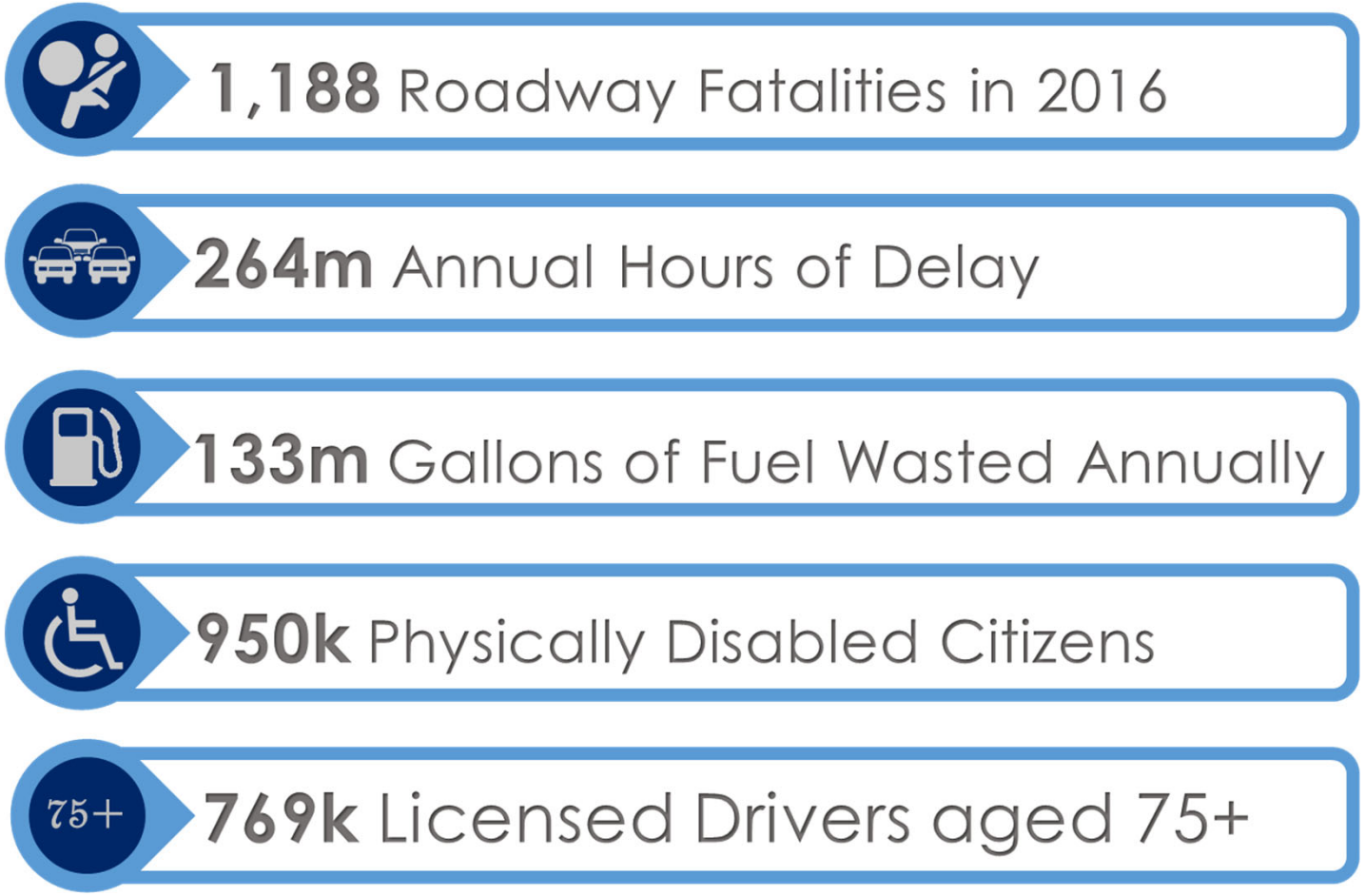
What is Pennsylvania Doing to Prepare?

The Need for AVs in Pennsylvania



2016 Numbers

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AV Policy Task Force

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Public Sector:

- U.S. Department of Transportation Federal Highway Administration
- PENNA TURNPIKE
- pennsylvania STATE POLICE
- pennsylvania DEPARTMENT OF COMMUNITY & ECONOMIC DEVELOPMENT
- pennsylvania INSURANCE DEPARTMENT
- pennsylvania DEPARTMENT OF AGING
- pennsylvania DEPARTMENT OF EDUCATION
- PENNSYLVANIA PUC PUBLIC UTILITY COMMISSION
- TRI-COUNTY TCRPC REGIONAL PLANNING COMMISSION
- DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION
- CITY OF PITTSBURGH
- City of ALTOONA Pennsylvania

Academia:

- Carnegie Mellon University
- Penn UNIVERSITY of PENNSYLVANIA
- PennState
- CCAC

Advocacy:

- AAA
- masite THE BIRTHPLACE OF ITE
- ATA AMERICAN TRUCKING ASSOCIATIONS
- Intelligent Transportation Society ITS PENNSYLVANIA
- PMTA Pennsylvania Motor Truck Association
- AFL-CIO
- PENNSYLVANIA ASSOCIATION FOR JUSTICE
- ifp
- AARP
- THE EHRLICHMAN GROUP
- PPTA Pennsylvania Public Transportation Association
- ECKERT SEAMANS

Industry:

- GM
- Audi
- UBER
- TOYOTA RESEARCH INSTITUTE
- GlobalAutomakers
- SAE INTERNATIONAL
- AURORA
- PELOTON
- ARGO AI
- Royal TRUCK & EQUIPMENT, INC.

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Act 117 of 2018

1st AV Legislation in Pennsylvania

- **Automated Work Zone Vehicles**
  - Fully automated vehicles
  - Restricted to active work zones
  - Must be implemented by PennDOT or PA Turnpike
- **Platooning**
  - Limited to two or three buses, military vehicles or motor carriers.
  - Restricted to limited access roadways
  - Must have visual identifier
  - Must submit operations plan for evaluation
- **Highly Automated Vehicle Advisory Committee**

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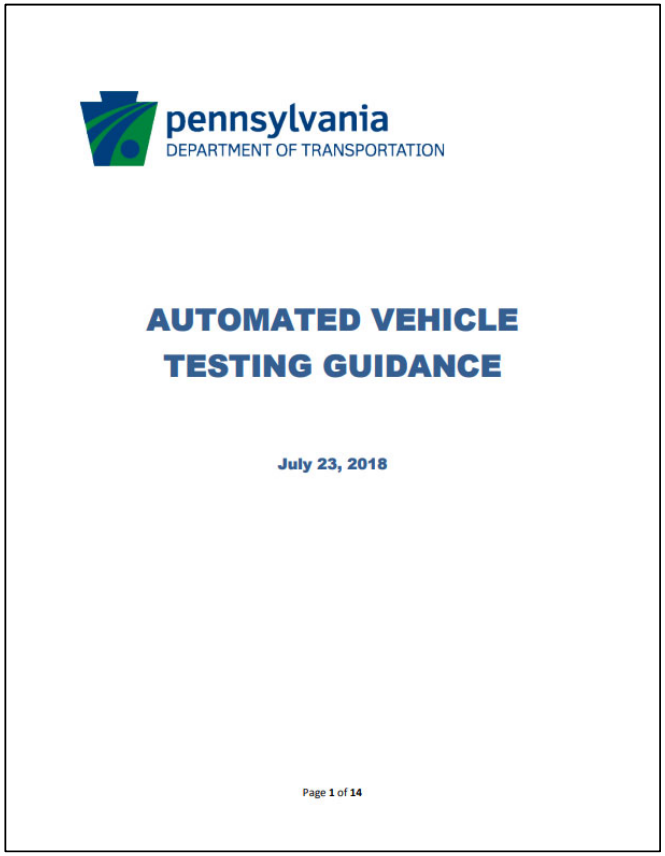
AV Testing Guidance

Guidance strengthen testing safety by focusing on the safety driver, not the AV technology.

- Update to 2016 AV Testing Policy
- Consulted key stakeholders including multiple AV testers and the AV Policy Task Force
- Guidance is voluntary, but compliance is expected
- Testers must submit a Notice of Testing
  - Tester Information (e.g., contact info and Point-of-Contact)
  - Vehicle Information (e.g., plate number, make/model, and VIN)
  - Safety Driver Information (e.g., name, license number, and training info)
  - Location of planned testing
  - Safety and Risk Mitigation Plan or NHTSA Voluntary Safety Self-assessment
  - Enhanced Performance Driver Training Plan **only if traveling over 25mph with one safety driver
- Letter of Authorization granted to five testers
  - Other applications under review



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AV Testing & Testers

AURORA

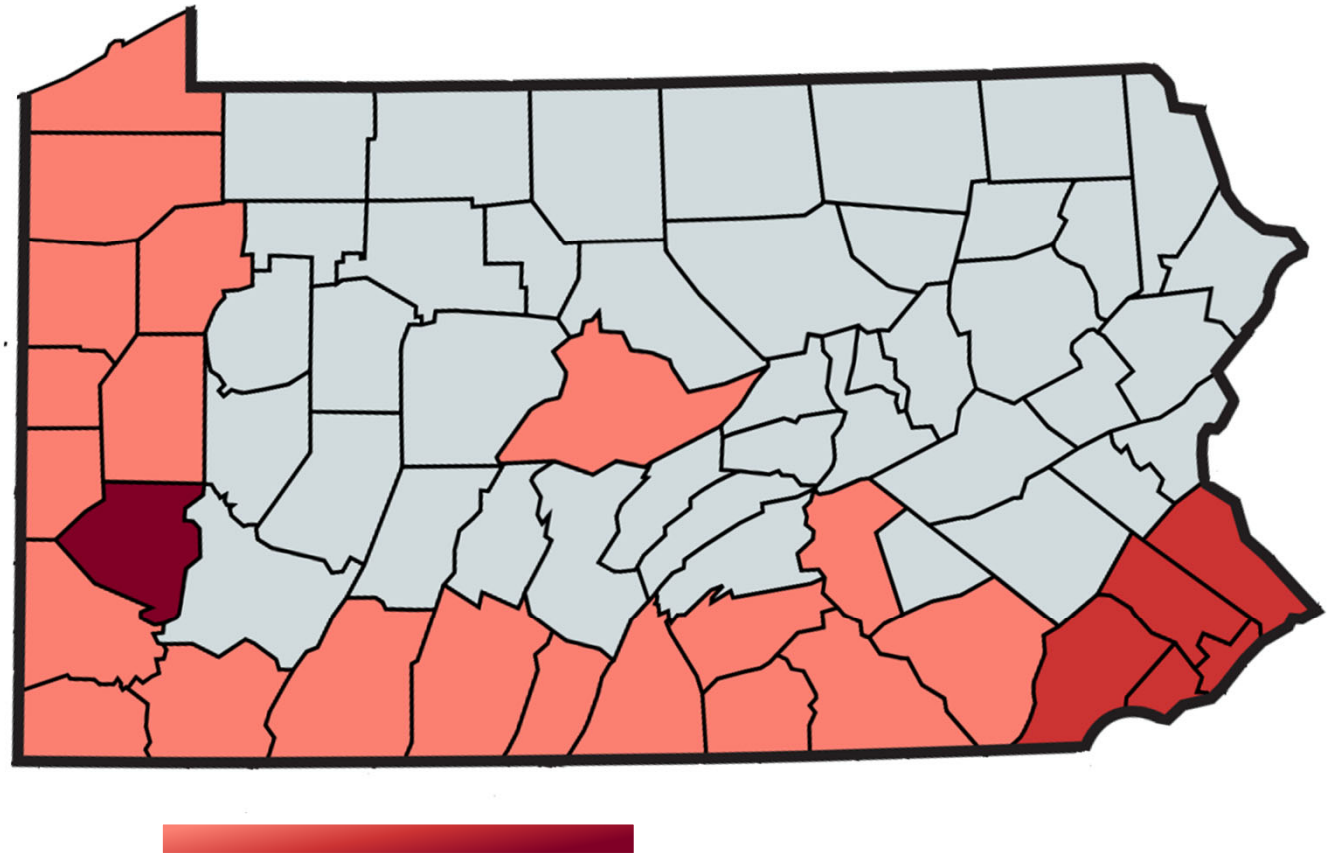
Qualcomm

Carnegie Mellon University

UBER

ADVANCED TECHNOLOGIES CENTER

ARGO AI



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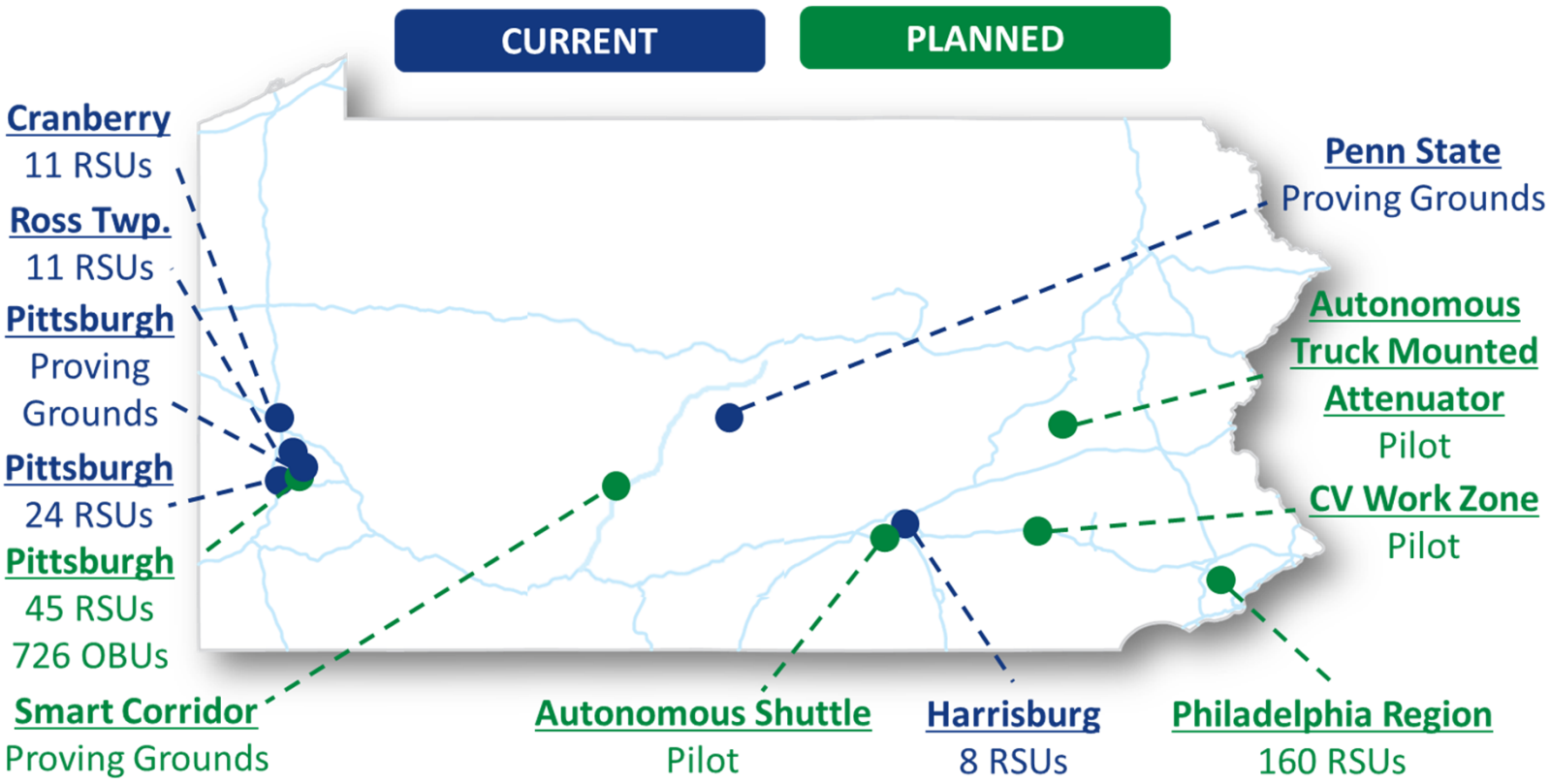
CAV Deployments



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PennSTART

Partnership between PennDOT, PA Turnpike, and Penn State

- **Focus Areas**
  - Traffic Incident Management
  - Connected/Automated Vehicles
  - ITS/Tolling/Signals
  - Transit
  - Commercial Vehicles
  - Bike/Ped.
  - Aviation including UAV
- **Approach**
  - Feasibility Study [completed 2018]
  - ConOps/Business Plan/Facility Requirements [Ongoing]
  - Design [Fall 2019]
  - Construction [Fall 2020]
  - Operation [Spring 2022

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CAV Strategic Plan

5 objectives per business area.
Each includes:

- Foundational Needs
- Existing Gaps
- Applicable Day 1 Uses
- Recommend Actionable Steps
- Appropriate Level of Investment
- Timeframe
- Impacts to Existing and Planned Initiatives
- Metrics
- Assumptions
- Impacts to the Capability Maturity-Model

International/National/Regional Participation

- International
  - Australia Peer Exchange
  - China Automotive Technology and Research Center (CATARC)
  - France Peer Exchange
- National
  - AASHTO - CAV Working Group
  - AAMVA - AV Best Practices Working Group
  - Cooperative Automated Transportation (CAT) Coalition
  - Multiple Pooled Fund Studies
  - Multiple TRB and NCHRP Projects
- Regional
  - Smart Belt Coalition
  - I95 Corridor Coalition

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Public Outreach

- Speaking Engagements
  - 111 engagements in 2017
- Demonstrations
  - Harrisburg demonstration for Legislature
  - Gettysburg demonstration for law enforcement
  - State College demonstration for key stakeholders
- Pennsylvania AV Summit
  - Policy discussion with a focus on local government, workforce development, and planning.
  - 1st Summit – State College 2017
    - 300 attendees
  - 2nd Summit – Pittsburgh 2018
    - 400 attendees

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QUESTIONS?

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