# Automated Vehicle Guidebook
## FOR MUNICIPALITIES

pennsylvania
DEPARTMENT OF TRANSPORTATION

PUB 847 (4-24)

# CONTENTS

# ACRONYMS AND ABBREVIATIONS

| Acronym | Definition |
|---|---|
| **ADA** | Americans with Disabilities Act |
| **ADAS** | Advanced Driving Assistance System |
| **ADS** | Automated Driving System |
| **AI** | Artificial Intelligence |
| **AV** | Automated Vehicle |
| **AVIRP-FG** | Automated Vehicle Incident Response Plan - Field Guide |
| **CAV** | Connected and Automated Vehicles |
| **CV** | Connected Vehicle |
| **DDT** | Dynamic Driving Task |
| **FAQ** | Frequently Asked Questions |
| **HAV** | Highly Automated Vehicle |
| **LiDAR** | Light Detection and Ranging |
| **MPO** | Metropolitan Planning Organization |
| **MUTCD** | Manual on Uniform Traffic Control Devices for Streets and Highways |
| **NHTSA** | National Highway Traffic Safety Administration |
| **NIST** | National Institute of Standards and Technology |
| **ODD** | Operational Design Domain |
| **PennDOT** | Pennsylvania Department of Transportation |
| **PMD** | Photonic Mixer Device |
| **PTC** | Pennsylvania Turnpike Commission |
| **RPO** | Rural Planning Organization |
| **SAE** | Society of Automotive Engineers International |
| **TNC** | Transportation Network Companies |
| **USDOT** | US Department of Transportation |

# GLOSSARY OF TERMS

## Advanced Driving Assistance Systems (ADAS)

The hardware and software, typically employing sensors such as cameras, radar, and LiDAR, collectively aid the driver in a safer and easier driving experience.

## Automated Driving System (ADS)

The hardware and software, typically employing sensors such as cameras, radar, and LiDAR, that collectively can perform the entire dynamic driving task on a sustained basis, regardless of whether limited within a specific operational design domain and whether a Level 3, 4, or 5 driving automation system under SAE J3016.

## Certificate Holder

A firm, co-partnership, association or a research institution holding a valid certificate of compliance in accordance with Chapter 85 of Title 75 (relating to Highly Automated Vehicles)

## Certificate of Compliance

A certificate authorizing the operation of a Highly Automated Vehicle in accordance with Chapter 85 of Title 75.

## Developer

A natural person, firm, co-partnership, association, or corporation who builds or creates hardware and software applications utilized in an ADS.

## Dynamic Driving Task (DDT)

The operational (steering, braking, accelerating, monitoring the vehicle and trafficway) and tactical (responding to events, determining when to change lanes, turning, signaling, etc.) aspects of driving, but not the strategic (choosing destinations and waypoints) aspect of the driving task.

## Emergency Service Responder

An individual acting in an official capacity as a police officer, sheriff, deputy sheriff, firefighter, fire police, fire marshal, rescue personnel, ambulance personnel, towing and recovery personnel, hazardous material response team member, or emergency medical service personnel.

## Highly Automated Vehicle (HAV)

A motor vehicle equipped with an ADS. This term excludes a personal delivery device. An HAV is a vehicle that can operate in high or full automation mode meaning that a human driver (onboard or remote) is NOT required to take control of the vehicle's operation. This definition encompasses automated vehicles considered Level 3, 4, or 5 under SAE J3016.

## Highly Automated Vehicle Driver

An individual who is an authorized employee or contractor of a certificate holder and who is responsible for all or part of the dynamic driving task for an HAV and is:

1. on board the highly automated vehicle; or
2. in a remote location in the United States, the highly automated vehicle can be monitored and controlled.

## Incident

A situation involving a motor vehicle in motion that includes at least one harmful event (such as injury or property damage).

## Law Enforcement

Any officer, agency, or official authorized to direct or regulate traffic or make arrests relating to Title 75 of the Pennsylvania Code.

## Operational Design Domain (ODD)

The places, conditions, and settings (including roadway conditions, materials, surface treatments, speed, traffic, environmental and weather conditions) that an HAV operator determines its HAVs are ready to operate safely.

## Operator

The firm, co-partnership, association, research institution or corporation authorized to operate HAVs in Pennsylvania.

## Passenger

Any person in a vehicle who is not in the driver's position and not responsible for performing any part of the dynamic driving task.

## Roadway

The entire width between the boundary lines of every way publicly maintained that is designed or ordinarily used for vehicular travel.

## Ride-Hailing

The ability for a user—through an app, website, or other service—to hire a personal vehicle to take them to a destination.

## Ride-Hailing Fleet

A group of many ride-hailing vehicles that are operated by a single individual or corporation.

## Safety Management Plan

Plan developed by an HAV certificate holder to provide adequate safety in case of ADS failure. The plan should contain no proprietary information regarding the ADS.

## Traffic Control Device

Signs, signals, markings, and devices placed or erected by the authority of a public body or official having jurisdiction to regulate, warn, or guide traffic.

# EXECUTIVE SUMMARY

In the fall of 2022, Pennsylvania enacted Act 130, which legalizes commercial operations of highly automated vehicles (HAVs) and provides provisions for HAV certification, regulations, and safety. HAVs are a rapidly advancing technology, and you may have questions about how they work, their safety, and how they might affect your municipality.

This guide is designed to help your municipality best prepare for HAVs. Act 130 designates PennDOT as the sole regulatory authority of HAVs within Pennsylvania, and, in collaboration with municipal partners, PennDOT will oversee and lead the development of rules that govern HAV operations. To accomplish this goal, PennDOT seeks to provide guidance and training to municipalities. This guide serves as a starting point for doing just that and is written for elected and appointed municipal officials, municipal staff, law enforcement, and emergency service responders.

For those new to the topic, the Introduction provides an overview of what automated vehicles (AVs) are, how they work, and the different levels of automation, including the difference between AVs and HAVs. This guide focuses on HAVs, vehicles with a high level of automation that allows them to operate without a human driver controlling the vehicle. The Introduction also reviews the state of the industry and expectations for the future, including potential deployment models, such as automated freight and ride-hailing fleets.

This guide also outlines the roles of federal, state, and municipal governments. Federal government, specifically the National Highway Traffic Safety Administration (NHTSA), is the lead federal vehicle safety regulator, and as such, PennDOT defers to NHTSA for federal motor vehicle safety requirements. Act 130 directs PennDOT to develop regulations, which will be available in 2023. Act 130 also prohibits municipalities from enacting their own regulations on HAVs, ensuring uniformity across the Commonwealth.

The remainder of this guide consists of one or two-page summaries on topical areas relating to HAVs. While it will be helpful to those who wish to immerse themselves in the topic of HAVs – perhaps a designated municipal HAV lead, the guide does not have to be read front-to-back, cover-to-cover to be of value to your organization. Municipal leaders, managers or employees interested in particular topics can jump to those sections most pertinent to their daily activities.

## Topics covered under the guidance include:

- **General**
- **Safety**
- **Traffic Enforcement**
- **Interacting with Emergency Service Responders**
- **Infrastructure and Risk Management**
- **Potential Fiscal Impacts**
- **Planning, Land Use, and Zoning**
- **Enhancing Mobility**

The guide also includes appropriate resources for learning more about HAVs, including the PennDOT HAV website and PennDOT Automated Vehicle Incident Response Plan app, as well as a template to permit any interested municipalities to prepare their own right-sized municipal action plan easily.

Due to the rapidly evolving nature of HAVs both legally and technologically, this guide will be a living document with regular updates.

# INTRODUCTION

## What are Automated Vehicles?

Automated vehicles (AVs) are vehicles—cars, trucks, buses, or other vehicles—equipped with hardware and software, capable of performing all of the real-time operational and tactical functions required to operate a vehicle in on-road traffic. A vehicle is considered automated only if at least some of the dynamic driving tasks (safety-critical control functions such as steering, accelerating, and braking) take place without a human driver. Vehicles equipped with sensors to provide a human with a safety warning (e.g., light or sound to indicate the presence of another vehicle or object) are not considered automated.

There is a broad spectrum of AVs, and you may already be more familiar with AVs than you think. Most new vehicles today are equipped with some level of automation such as adaptive cruise control and lane-centering technology. On the higher end of the automation spectrum are vehicles that can drive themselves without a human driver, called highly automated vehicles (HAVs).

Because recent legislation enables their operation within Pennsylvania, this guide will focus on HAVs. **HAVs are AVs that can operate in high- or full-automation mode, meaning no human is driving the vehicle when the automated driving features are engaged.**

## Why Should Municipalities Care?

HAVs are a rapidly advancing technology, and it is expected that HAV adoption will continue to grow. Pennsylvania—and more specifically, Pittsburgh—has emerged as one of several centers in the U.S. where the industry has blossomed due to the presence of technology-focused universities and industry incubators. While there is no way to precisely estimate how many HAVs will be operational on what schedule, the number of HAVs and the number of localities they operate will likely grow over the coming years.

### AV Terminologies

There are a wide variety of terminologies used to describe AVs. Although many people use these terms interchangeably, doing so may cause confusion. For clarity and to align with recent legislation, PennDOT uses “automated vehicle” for the vehicles discussed in this guide and does not use terms such as “driverless vehicle,” “autonomous vehicle,” or “self-driving vehicle.”

As HAVs become more common within the Commonwealth, they may begin to impact municipal policy and operations in various ways. Through discussions with AV industry experts and stakeholders and through a survey of Pennsylvania municipal officials, the Pennsylvania Department of Transportation (PennDOT) identified the following topics as areas of interest for municipalities to ready themselves for HAVs:

- Safety
- Traffic Enforcement
- Interacting with Emergency Service Responders
- Infrastructure and Risk Management
- Potential Fiscal Impacts
- Planning, Land Use, and Zoning
- Enhancing Mobility

## Purpose of this Guide

This guide is designed to help your municipality best prepare for HAVs. PennDOT understands that municipal officials have many questions on this emerging and evolving topic. While this guide may not answer every question, it serves as a starting point to educate yourself on HAVs so that you are empowered to engage with, learn about, and ready your municipality for HAVs in the way you think is best suited to your locality.

Correspondingly, the purpose of this guide is NOT to mandate your municipality take any particular action, nor is it to predict precisely how HAVs may or may not impact your municipality in the future.

The primary purpose of this guide is to:

- Better educate municipal partners on the coming world of HAVs
- Explain how certain municipal responsibilities may change or evolve over the coming years due to HAVs
- Engage municipalities on critical topics they may face so PennDOT can have more inclusive policy discussions
- Provide support, guidance, and resources to help municipalities prepare for this emerging mobility option

Currently, this guide only covers certain aspects of HAVs that are only permitted on limited access roadways and are not pertinent to municipalities. This guide is intended to be a living document and will be updated online at www.penndot.pa.gov/AV as technologies, regulations, and best practices emerge.

## Developing a Municipal HAV Action Plan

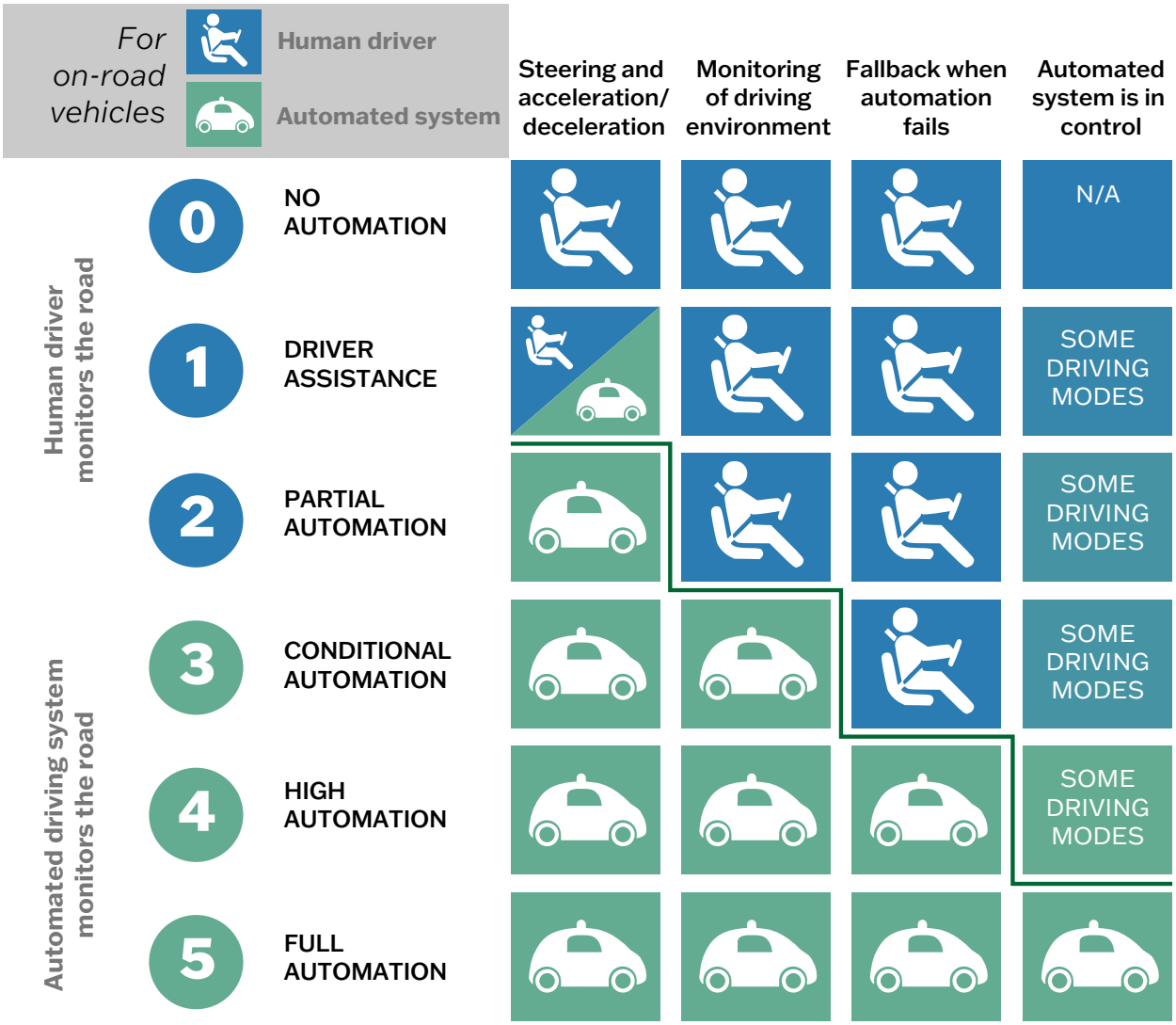
This document will help your municipality develop your own right-sized Municipal HAV Action Plan. Appendix A contains a consolidated list of all the potential recommended actions from the plan with an easy-to-edit template that municipalities can use to create their HAV Action Plan. Based on your municipal level of interest and resources, each city can choose those actions that are of greatest interest to them.

# AUTOMATED VEHICLES: AN OVERVIEW

Automated vehicles (AVs) are complex and come in a spectrum of levels of automation. This section will provide some basic information on AVs, their potential benefits, how they work, and some expectations based on current industry trends.

## Levels of AVs

Vehicle automation has been an incremental process. To provide common terminology about how advanced an AV is, the U.S. Department of Transportation (USDOT), through the National Highway Traffic Safety Administration (NHTSA), has adopted the Society of Automotive Engineers International (SAE) standard definitions. They are summarized in the chart below. Legislators, transportation agencies, and practitioners are encouraged to follow these definition levels. For consistency, current Pennsylvania laws use the terminology as defined by SAE.




Source: SAE International

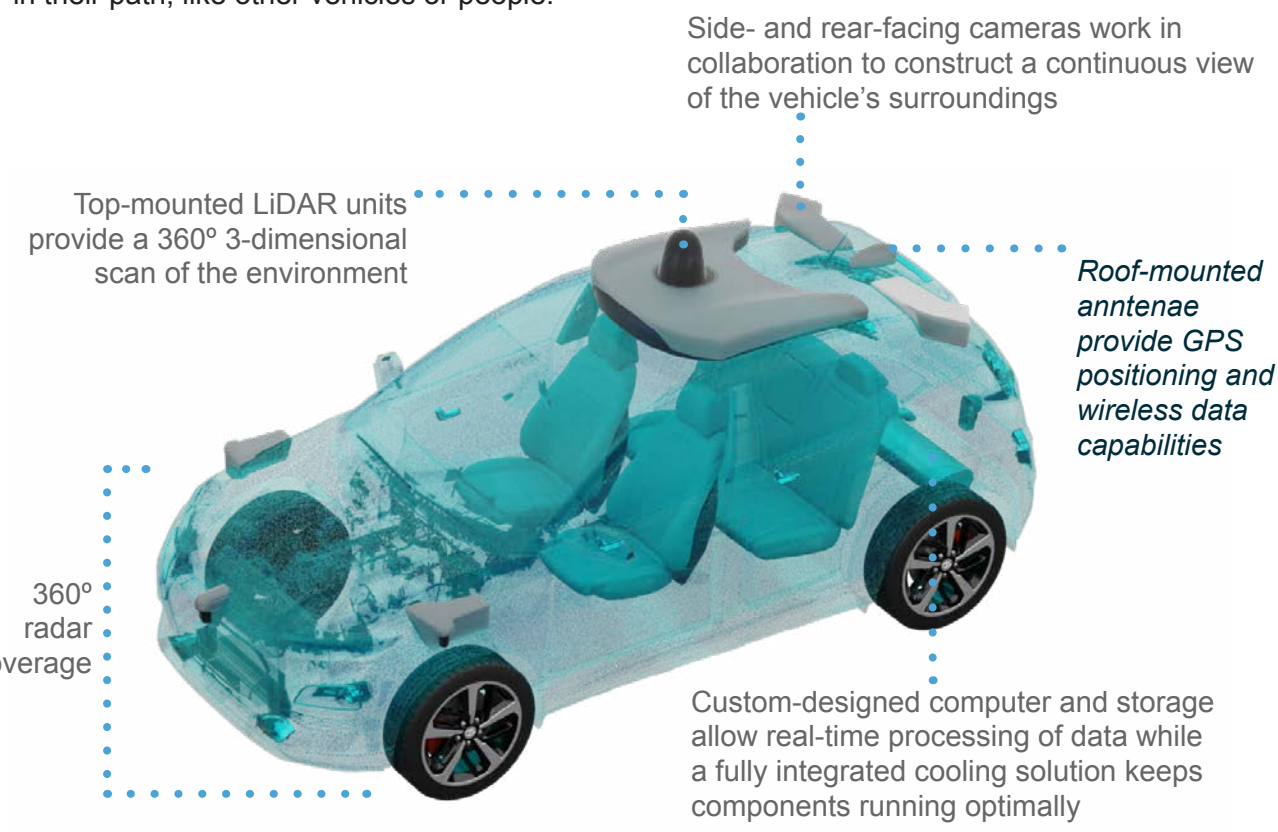
There is a significant distinction between Level 2, where a human driver is aided by an advanced driving assistance system (ADAS) and must perform some parts of the driving task, and Level 3, where the automated driving system (ADS) can perform the entire driving task and, at times, no human driver needs to control the vehicle. The difference between an ADAS and ADS separates Level 1 and 2 AVs from Level 3, 4, and 5 AVs: an ADAS assists an onboard operator for a safer drive, whereas an ADS is capable of operating the vehicle itself.

Suppose you are familiar with Tesla's Autopilot or General Motors' Super Cruise, which can automatically steer but still require an alert human driver. In that case, you are already familiar with a Level 2 AV. Several vehicles are currently being sold that would provide Level 2 automation in some environments, such as highways.

Levels 3 through 5 are considered HAVs. Because of recent Pennsylvania legislation legalizing HAVs, this guide will focus primarily on the impacts of and preparations for HAVs.

## How Do AVs Work?

AVs use special sensors to help them understand their surroundings. These sensors include radar, light detection and ranging (LiDAR), ultrasonic, photonic mixer device (PMD), cameras, and night vision devices. They can detect other cars, bicycles, pedestrians, traffic lights, and even bad weather. These sensors allow AVs to adjust their speed, stay in their lane, and avoid objects in their path, like other vehicles or people.




The software inside AVs learns how to interact with the things it detects through simulations and actual driving on roads. It learns how to make quick decisions about what to do when it sees something and the rules of the road, like how to read signs and follow traffic laws. AVs even learn about traffic norms in certain places, like the "Pittsburgh Left" where the first left-turning vehicle gets priority at an intersection.

AVs don't just rely on sensors and software. They also have information about the roads, lanes, and other important features of the environment. AV engineers create virtual models of the area where an AV will operate. This helps the AV understand its surroundings even when its sensors can't see certain things, like a curb blocked by another vehicle. The virtual models also help navigate places where the sensors may not work well, such as in the dark or during bad weather. The AV keeps these models stored locally on-board, so it can still operate even if it loses connection to the outside world.

When engineers map out an area for an AV, they also create an operational design domain (ODD). This defines the specific areas and conditions where the AV can safely operate. They consider things like the type of road, the conditions, the materials used, and even the weather and traffic. The AV is programmed to only work within its defined ODD. It's up to the operator to ensure an HAV stays safe within those boundaries, regardless of the road or infrastructure.

## Potential Benefits of AVs

Partial or complete automation of vehicles has the potential to provide a variety of benefits by reducing or removing the need for a human to operate the vehicle. Potential benefits of AVs, and particularly of HAVs, include:

**Improvements in road safety.**

**More equitable mobility and access for those who cannot drive—e.g., persons with disabilities, seniors, etc.**

**Economic benefits due to less lost productivity.**

**Increased travel options.**

**Cost savings due to reduced collisions.**

**Reduced stress of driving.**

**Reduced fuel consumption and emissions.**

**Reduced incident-related congestion.**

**In the future, with widespread adoption, potentially reduce congestion.**

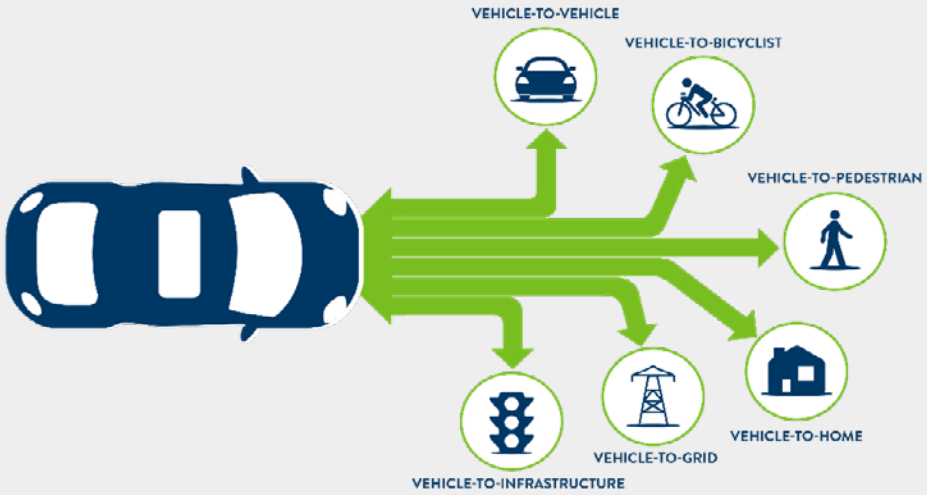
## What is the difference between connected and automated vehicles?

### Automated Vehicles

AVs use technology to steer, accelerate, and brake with little to no human input.


### Connected Vehicles

Connected vehicles use technology to either communicate with each other; connect with traffic signals, signs, and other road items; or obtain data from a cloud through systems such as cellular (5G), Wi-Fi, and Bluetooth technologies. This information exchange will help with safety and improve traffic flow.




Source: Minnesota Department of Transportation

### The Difference

Sometimes the ideas of connected and automated are confused and discussed as if one. While they will likely be interrelated as technologies advance, they are separate concepts and not necessarily linked. Most new vehicles today are “connected” in the sense that they can communicate to a host of parties or infrastructure. Many AVs are connected, but AVs can operate without being connected to other vehicles or infrastructure. Given that AVs are not required to be connected vehicles, and many are not, this guide does not presume connectivity for AVs.

## Anticipated Deployment Models

As HAVs become more common in Pennsylvania, various deployment models may exist. The prevailing deployment models will likely primarily depend on market conditions discussed in the following section. Below are some possible deployment models that your municipality should know about.

### Ride-hailing fleets

HAVs have the potential to operate much like other ridesharing services (e.g., Uber and Lyft), but without a human driver. Riders might order a ride-hailing HAV through an app. In this deployment model, the HAV operator would be the company that operates the fleet. This model is often considered "mobility on demand." Fleets could also be operated for private use, such as a university or office park offering campus shuttle service, or a homeowners' association or apartment complex offering HAVs for residents' use only.

### Automated freight

Using HAVs for freight across cities, regions, states, and even countries may eventually provide benefits such as reduced trucking costs and reduced supply chain disruptions, ultimately reducing the cost of consumer goods.

### Automated delivery

In addition to freight uses, HAVs may be used for delivering goods locally, such as retail purchases and groceries. Like shared ride-hailing models, these HAVs would likely be owned and operated by a company, but they would transport goods not people.

## Where the Market is Going

Currently, certain HAV companies such as Waymo and Cruise offer ride-hailing services in localities such as San Francisco, CA, and Phoenix, AZ. Automated trucking also is in testing in states such as Arizona, New Mexico, and Texas through operators that include Aurora, TuSimple, Kodiak Robotics, and Waymo. Because of these current operations in other states, similar shared ride-hailing and automated freight models will likely be the first deployment models and uses to appear in Pennsylvania as well.

## Timeline for Deployment

While not yet widespread, HAVs are here. Despite currently limited operations, their footprint is expected to expand over time. As many of these operations are private business operators, it is difficult for public agencies to know their exact business plans, service models, and deployment timelines; however, as all operators will need to apply for HAV deployment through PennDOT, PennDOT will know in advance when, where, and how operators intend to deploy.

Having a small number of HAVs operating within a jurisdiction will likely be minimally impactful; the more difficult challenge will come when deployments become larger. Since much about deploying HAVs is unknown, forecasting "widespread deployment" is challenging. The timeline for wider deployments will depend on the continued pace of technological advancement, evolving business priorities and models, public acceptance, operational economics, and the ability to scale. However, there will likely be growth, or possibly significant growth, in HAV deployments during the next five to ten years.

# Legislation

## Federal

To date, the U.S. Congress has yet to pass any legislation about HAVs outside of an act relating to funding research detailed below.

The Surface Transportation Reauthorization and Reform Act, which was signed into law in December 2015, called for grants for automated vehicle research, including government reports to assess and recommend implementation paths for automated vehicle technologies, applications, and policies.

Since 2015, Congress has made various attempts to introduce bills that would create federal policy around HAV safety, security, certifications, manufacturing, and operations; however, a bill has yet to come to a vote.

The most recent bill introduced regarding HAVs is the SELF DRIVE Act, introduced in 2021, which would establish the federal role in ensuring the safety and security of HAVs and would preempt states from enacting laws that differ from national standards regarding the design, construction, or performance of HAVs. As of July 2023, this bill has yet to be brought to a vote.

Although Congress has not passed any legislation, the US National Highway Traffic Safety Administration (NHTSA), the lead federal vehicle safety regulator, most recently issued its final ruling allowing companies to build and deploy AVs that do not have traditional manual controls provided that these vehicles meet the same crashworthiness standards as manually controlled vehicles.

## Commonwealth of PA

In late 2022, Act 130 of 2022 (Act 130) was signed into law. This legislation authorizes an HAV to operate at Level 3, 4, or 5, as defined by the SAE, with or **without a human driver** on roadways in PA. Prior to Act 130, HAVs could only operate on PA roadways with safety operators present. PennDOT is the lead Commonwealth agency on HAVs and is the sole regulatory authority within Pennsylvania. PennDOT will defer to NHTSA for federal motor vehicle safety compliance.

**Act 130:**

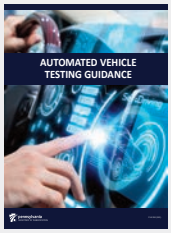
- Creates a pathway for self-certification that authorizes HAV companies and organizations to operate HAVs in Pennsylvania.
- Permits certificate holders to operate anywhere in the state provided they provide municipalities with 10 days' written notice.
- Requires PennDOT to collect information about the vehicle, HAV driver, accident contact information, and safety information, including the process that an emergency service responder should follow in the event of an incident.
- Instructs PennDOT to develop regulations that are currently being drafted and will be available in 2023.
- Goes into effect in July 2023.

To ensure consistency across the state, PennDOT will oversee and lead the development of the rules that govern HAV operations in collaboration with PennDOT's municipal partners. As new legislation and regulations emerge, PennDOT will continue to provide legislative and regulatory updates to municipalities through PennDOT's website and Pennsylvania's municipal associations.

## Municipal

Just as any federal legislation around HAVs would preempt state legislation, state legislation preempts and supersedes any policy, resolution, or ordinance that may exist at the municipal level that regulates the operation of an HAV. Local authorities can exercise police powers on streets and highways provided that police powers do not burden or discriminate against an HAV. For example, if a municipality has restricted delivery services, the restriction must apply similarly to non-automated delivery services, such as FedEx, UPS, and the US Postal Service.

# HOW PENNDOT IS PREPARING FOR HAVS




PennDOT published AV Testing Guidance Pub 950

Act 130 becomes law

Act 117 allowing platoons to operate on public highways was signed in 2018

PENNSYLVANIA AUTOMATED VEHICLE SUMMIT 2022

5th AV Summit held

The Smart Belt Coalition formed in 2016 between agencies and academic institutions in MI, OH, and PA

PENNSYLVANIA AUTOMATED VEHICLE SUMMIT -2017-

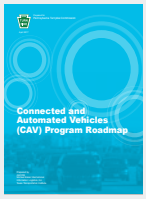
1st AV Summit held

PennDOT created the Office of Transformational Technology

First AV pilot launched at Carnegie Mellon University

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

PennDOT published Connected and Autonomous Vehicles 2040 Vision

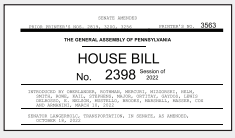



The Pennsylvania Turnpike Commission finalized the Connected and Automated Vehicles Program Roadmap

Vehicle Platooning Policy is released.

Summit Series held to spark dialogues about AVs

PennDOT produced the PA Joint Statewide Connected and Automated Vehicles Strategic Plan




Act 130 authorizing HAVs was signed into law in late 2022

# PENNDOT'S COMMITMENT TO SUPPORTING MUNICIPALITIES

PennDOT will continue discussions with municipal officials and continuously review its program to identify additional needs and opportunities to support PennDOT's municipal partners.

## Will PennDOT require any reporting that Municipalities could also monitor or review?

All HAV certificate holders must submit vehicle and HAV driver information, contact information for accidents, a safety management plan, nonproprietary information submitted to NHTSA, and consent to operating in compliance with the Vehicle Code. Confidential information collected by PennDOT will not be subject to the Right to Know Law; however, upon request PennDOT will provide municipalities with applicable information. Any information shared with municipalities must be kept confidential.

### Where can residents get more information?

Your constituents may have questions and concerns about HAVs and will likely be looking for guidance and information. Municipalities should consider, with the support of PennDOT materials, making information about HAVs available to the public. As HAVs progress, PennDOT will continue to provide information, such as online guides and videos, as well as in-person trainings to assist assist municipal partners in educating the public.

PennDOT's website at www.penndot.pa.gov/AV will contain a list of certificate holders, location where the HAV is expected to operate, name, and contact information for accident claims and registered agent for service of process, orders issued by the Secretary, and regulations and guidelines.

## Will PennDOT serve as the primary lead for providing input or reporting issues?

PennDOT has several initiatives that will continue to advance and support HAVs in Pennsylvania. Information on these initiatives can be found on PennDOT's Automated Vehicle webpage.

In addition, you may contact PennDOT's HAV Team at penndotav@pa.gov with any suggestions, comments, questions, or issues.

### Commonwealth Support

PennDOT will be developing training programs, webinars, and written guidance based on emerging needs and feedback from municipalities. In developing this document, PennDOT collected more than 300 responses from county, city, borough, and other municipal officials. PennDOT will continue to actively engage our municipal partners to learn how the Commonwealth can best support localities as HAVs are adopted. This guide also will be hosted online at www.penndot.pa.gov/AV as a living document with updates as HAV usage grows and evolves.

# HAV TOPICS

The next section of this guide consists of one or two-page summaries on particular HAV topics.

Below is a sample of what you will see on the subsequent pages.


**General**


**Safety**


**Traffic Enforcement**


**Interacting with Emergency Service Responders**


**Infrastructure and Risk Management**


**Potential Fiscal Impacts**


**Planning, Land Use, and Zoning**


**Enhancing Mobility**

## How to Use This Guide

This guide is organized to permit the reader to browse topics that interest you and your municipality. Topics were identified primarily through responses to a survey of municipal officials that solicited feedback about key issues and concerns regarding HAVs. Each topic area consists of a short overview, potential actions your municipality may wish to consider, a frequently asked questions section, and additional resources to help your municipality prepare for HAVs.

# HAV TOPIC TEMPLATE

## Overview

This section briefly introduces the topic area and how it relates to HAVs. It summarizes key facts and provides a high-level overview of what you need to know.

## Actions

This section lists potential actions your municipality may wish to consider to prepare for the rollout of HAVs. Actions are organized by anticipated cost and effort, with the "low" level actions being best suited to a municipality that is not engaged with HAVs, and the "high" level actions being best suited to a municipality that is highly engaged with HAVs. As you consider taking these actions, evaluate your municipalities' resources and experiences in balance with your localities' unique expectations for HAVs, as the impacts of HAVs will vary across the Commonwealth.

## Proposed Actions

**Low**

- Low to no investment.
- Low number of resources and effort required.
- Target audience: municipalities with little to no engagement with HAVs.

**Medium**

- Some investment.
- Medium number of resources and effort required.
- Target audience: municipalities with some or moderate engagement with HAVs.

**High**

- Larger investment.
- Larger number of resources and effort required.
- Target audience: municipalities already well-engaged with HAVs.

## Key Questions

This section provides a list of questions and answers you may have as municipal officials regarding the topic area. This section is designed so that it is easy to scan for the questions and answers you are most interested in, like an FAQ.

## Additional Resources

This section provides resources from PennDOT, industry experts, and professional organizations that offer more information on the topic area and may assist you in executing the potential actions

# GENERAL

## Overview

The possibilities for the use and operation of HAVs are extensive, and as HAVs are still a new and emerging technology, we have yet to determine how HAVs will operate. While operators may use HAVs for a wide variety of purposes, currently, the most likely use cases are for personal mobility, such as ridesharing and taxi services, or shipping, freight, and delivery.

## Proposed Actions

**Low**

- Designate a municipal lead for HAVs.

**Medium**

- Present PennDOT's HAV presentation to your Mayor, Council, or other elected officials.
- Monitor and notify your communities if HAVs begin to operate in your jurisdiction.
- Engage a group of citizens, potentially through your MPO/RPO to create a citizens' HAV working group.
- Develop a municipal HAV Action Plan.
- Convene an internal HAV working group to implement your municipal HAV Action Plan, possibly including your elected official(s), engineer, chief of police, and fire/EMS chief.

**High**

- Perform periodic updates to your municipal HAV Action Plan.

## Key Questions

### Who can operate an HAV?

In Pennsylvania, only firms, co-partnerships, associations, corporations, and educational or research institutions are eligible to be certificate holders. Personal ownership is prohibited.

### Is there a certification or registration process for an HAV to operate in my municipality?

Yes. Proposed regulations require operators to submit completed forms to PennDOT for approval before operating. Law also requires that operators notify PennDOT before operating in a new jurisdiction. PennDOT will maintain and post a list of municipalities where HAVs operate on its website. Act 130 preempts municipalities from creating their processes for certification or registration.

### Will there be rules around who can and can't use HAVs?

Currently, there are no regulations around who can be an occupant or a sole occupant in an HAV. Much like ride-hailing transportation network companies (TNCs) such as Uber and Lyft, operators may create rules around who is permitted as a vehicle occupant or unaccompanied occupant. HAV occupancy regulations relating to topics such as unaccompanied minors may be created in the future at the federal and/or state level. Currently, state law prohibits highly automated school buses and school vehicles.

### Will HAVs be permitted by the right to operate everywhere in the state?

Under Act 130, HAVs are permitted to operate everywhere within the state, provided that operators give municipalities a minimum of 10 days' written notice. PennDOT will continue to work with the industry to clarify under what conditions HAVs can operate and will examine concerns around operations on certain road types such as unstriped and unpaved roads.

### Will the new laws or regulations require municipalities to do anything new?

New state laws and regulations do not require municipalities to create new or updated ordinances or regulations or take further actions. If a municipality did have any laws regulating or restricting HAVs, those laws may now be superseded by Commonwealth HAV legislation.

### Does a person who is legally able to drive need to be present for an HAV to operate?

Whether a legal, licensed driver is required to be in the vehicle will depend on an HAV's design and intended operations. Vehicles designed to require driver control under certain circumstances will require that a licensed human driver to be present or a trained remote operator be available to take control if needed.

### Will HAVs be insured?

Yes, insurance requirements are detailed in Act 130. Current law requires a minimum amount of $1 million (per incident) in insurance.

### Do HAVs impact sovereign immunity?

Recent legislation does not change existing immunity as outlined in 42 Pa. C.S. § 8501 except regarding § 8542 "Exceptions to governmental immunity".

### How will HAVs benefit Pennsylvanians?

HAVs without a human driver may provide new, enhanced, and/or lower-cost transportation opportunities for people who cannot or are unable to drive, including some seniors, persons with disabilities, and those who choose not to obtain a license.

### Will HAVs need to be certified in some way?

All HAV certificate holders operating HAVs within Pennsylvania must be self-certified as required under the law. HAVs are required to be registered and licensed just as other vehicles. Additionally, law enforcement personnel should note that titles of HAVs shall be branded according to law.

### Are HAV operators required to report anything?

Yes. Certificate holders will be required to report their operations as outlined in regulations, which are under development.

### Will all HAVs be required to be electric?

While it is expected that many vehicle manufacturers and operators are migrating toward electric vehicles, there are currently no requirements that HAVs be electric.

## Additional Resources

- *Act 130*
- *PennDOT, Automated Vehicle Testing FAQs*
- *PennDOT, YouTube, What are automated vehicles?*
- *National Highway Traffic Safety Administration, Automated Vehicles for Safety*
- *US Department of Transportation, Automated Vehicles Comprehensive Plan, January 2021*
- *US Department of Transportation, Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, January 2020

# SAFETY

## Overview

Public safety—for both occupants and those outside of HAVs—remains the paramount priority for PennDOT. While HAVs may never be infallible, they have the potential to substantially reduce human error-related risks from driving and significantly improve road safety for both occupants and those outside of vehicles. While vehicle safety standards are generally the domain of federal regulators, PennDOT fully supports the National Highway Traffic Safety Administration's (NHTSA's) oversight of safe testing, development, and deployment of HAVs and Federal Motor Vehicle Safety Standards. Additionally, PennDOT will require HAVs to meet existing Commonwealth standards for motor vehicle inspections. HAVs are required to follow all rules of the road and are subject to the same legal consequences as any other motor vehicle. As part of the self-certification process, operators must submit a safety management plan describing the safety elements in the HAV's development, management, and operation.

Operators are required to report all crashes involving fatalities, injuries, and property damage. PennDOT will continue to monitor crashes involving HAVs to understand the operators' performance in Pennsylvania. Finally, PennDOT will continue to work with federal and municipal partners to identify, evaluate, and implement best practice requirements to ensure emerging safety practices for HAVs are adopted.

## Proposed Actions

**Low**

- Monitor industry publications (ITE Journal, etc.) for emerging practices for HAV safety.

**Medium**

- Establish a working group with emergency service responders to advance awareness and discuss HAV safety and safety protocols.

**High**

- Once AVs are operational in your municipalities, promote resources that educate the public about safely interacting with HAVs.

## Key Questions

### Will HAVs be safe for vulnerable road users—such as children, seniors, pedestrians, and cyclists?

By reducing or removing human error, HAVs will likely cause fewer crashes than human-driven vehicles. HAVs are equipped with technologies that detect pedestrians and cyclists and may even be able to predict the behaviors of children or others entering the roadway.

### Will HAVs be designed to be as physically sturdy and safe as current vehicles?

In short, yes. USDOT is responsible for regulating the safety of motor vehicles, including HAVs. PennDOT defers to NHTSA for federal motor vehicle safety compliance. PennDOT oversees vehicle inspections and will require the same inspection requirements for HAVs, though it is possible that HAV-focused safety inspection requirements may emerge over time.

### What measures are being taken to ensure that HAVs are safe?

Both federal and state governments have roles in ensuring the roadworthiness and safety of HAVs, similar to their roles in ensuring the same for manually driven vehicles. At the federal level, NHTSA

is the lead agency in these activities; at the state level, PennDOT leads these activities. As such, PennDOT builds upon NHTSA standards. PennDOT reviews applications to ensure that the AV deployers follow industry best practices for the safe development and deployment of HAVs.

### Are HAVs currently operating in Pennsylvania?

Testing of HAVs has been legal in Pennsylvania since October 24, 2018. Currently, seven companies are performing HAV testing within the state.

### Will municipalities receive notification of HAV operations within their jurisdiction?

Act 130 requires the HAV certificate holder to notify the municipality of the intent to operate an HAV within that municipality at least 10 days before operation (§ 8508). The law also requires PennDOT to collect and display on its website a list of municipalities where HAVs will operate (§ 8505).

### How will pedestrians and cyclists know how to communicate intentions with HAVs? Can HAVs interpret hand signals from people directing traffic, pedestrians, and cyclists?

AV developers have been and will continue to work on the system's ability to acknowledge and respond to a range of human hand signals - whether law enforcement officers, construction traffic coordinators, pedestrians, or cyclists.

### How will HAVs know local or regional driving norms (e.g., the Pittsburgh left)?

HAV developers, testers and deployers are and will continue to capture unique local driving behaviors and norms and build them into their HAV programming. Artificial intelligence (AI) learning may additionally assist HAVs to adopt unique driving norms.

### How will information be exchanged if an HAV is involved in an incident?

Like other vehicles, HAVs are required to stop as close as safely possible to the scene of any accident. The certificate holder of the HAV, or their representative, is responsible for providing registration and financial responsibility to the duly authorized police department. Typically, this will mean that if an HAV is manned, the human driver, whether remote or in-vehicle, will share this information and if an HAV is unmanned, the HAV certificate holder or their representative team will communicate this information. This information must also be visible from the outside of the HAV via a visual identifier. Service responders can access emergency response protocols for the various HAV operators through the Automated Vehicle Incident Response Plan – Field Guide (AVIRP-FG) Mobile App available on the Apple and Google app stores.

### How are HAV incidents being reported?

Incidents involving fatality, injury, or damage requiring towing must be reported to the duly authorized police department immediately in accordance with Title 75 § 3746(a) and reported to PennDOT in compliance with HAV regulations. The reporting form includes a field to indicate automation. Additionally, at the federal level, NHTSA serves as the clearinghouse for HAV crashes.

## Additional Resources

- *Act 130*
- *The Automated Vehicle Safety Consortium™ (AVSC)*
- *National Highway Traffic Safety Administration, Automated Vehicles for Safety*
- *National Highway Traffic Safety Administration, Automated Driving Systems 2.0: A Vision for Safety, September 2017*
- *National Highway Traffic Safety Administration, Voluntary Safety Self-Assessment*
- *National Highway Traffic Safety Administration, Standing General Order 2021-01 – Incident Reporting for Automated Driving Systems and Level 2 Advanced Driver Assistance Systems*

# TRAFFIC ENFORCEMENT

## Overview

Traffic stops and investigations involving HAVs are beginning to occur and will become more prevalent as deployments increase. HAVs are required to fully comply with all traffic laws and regulations. HAVs are expected to respond to a range of law enforcement officer actions such as flashing lights and manual traffic control devices (e.g., roadway traffic control crews) from enforcement officers.

Under Pennsylvania law, currently, the responsible party for violations is the certificate holder of the HAV. If a driver is present in the HAV, police may also charge the HAV driver.

## Proposed Actions

**Low**

- Establish a lead within your local police force to monitor the topic of traffic enforcement for HAVs.

**Medium**

- Have all law enforcement officers participate in IRP training.
- Ensure law enforcement is trained to properly use the AVIRP-FG app

**High**

- Provide periodic updates to law enforcement officers on advances in HAV operations within Pennsylvania.
- Once notified of an operation within your jurisdiction, provide training to law enforcement officers on how to interact with HAVs.
- Participate in HAV law enforcement training programs.

## Key Questions

### Will HAVs fully comply with traffic rules and regulations such as speed limits, no stopping zones, or no parking zones?

HAVs are required to operate in full compliance with applicable traffic laws and regulations and are programmed to know rules of the road. Sensors, such as HAV cameras and detectors, interpret signed and marked roadway regulations, and on-board digital mapping provide HAVs with a backup of this information.

### How do enforcement officers interact with HAVs?

HAVs are programmed to respond to emergency lights and sirens. AV developers are continuing to work on hand signals from emergency personnel. AV engineers continue to develop and refine programming and protocols. To support deployment, additional training videos for enforcement officers will become available as related issues arise and are resolved.

### Are enforcement officers required to have any additional equipment to interact with HAVs?

Currently, there is no need for additional enforcement equipment.

### How will enforcement officers or emergency responders interact with or guide HAVs during short-term closure or detour for events such as roadway maintenance or downed power lines?

HAVs can maintain situational awareness, including interacting with emergency service responders and detecting objects such as boxes, debris, and downed power lines.

### How will violations be assigned?

Like any other vehicle, all HAVs will have license plates. Non-moving violations, like parking violations, will be ticketed to the license plate. For moving violations, the process may change slightly. Should police pull over the HAV, the vehicle should identify and stop in a safe location. At that point, an enforcement officer can contact the HAV operators at their respective emergency response lines to discuss the situation. Contact information must be listed outside of an HAV and provided on the PennDOT AV Website and in the PennDOT AVIRP-FG app. As deployments expand, PennDOT will work with law enforcement to develop additional online training resources.

### Will there be an increased need for enforcement officers or automated enforcement technologies?

There is no need for additional law enforcement at this time. With HAVs programmed to follow traffic laws and reduced human error, there may eventually be less need for traffic enforcement; however, due to relatively low initial deployment rates, traffic enforcement needs should not change in the near term.

### Can a municipality temporarily prohibit or restrict operations of HAVs for emergencies, special events, or other safety concerns?

A local authority may prohibit or regulate the use of designated streets by any class or kind of traffic, provided that the regulation or prohibition is not specific to or discriminate against an HAV (§ 6109(a)(13) of Title 75). For example, if your municipality would like to restrict vehicle access to a street for construction or a parade, the municipality must restrict access to all vehicles, not just HAVs.

## Additional Resources

- *Waymo, Waymo First Responders Training, YouTube, November 21, 2019*
- *Waymo, Jaguar I-PACE Waymo Emergency Response Guide and Law Enforcement Interaction Protocol (PDF)*
- *Cruise, Interacting with a Cruise Autonomous Vehicle: A Guide for First Responders*
- *Goodison, Sean E., et al, Priority Criminal Justice Needs Initiative, The RAND Corporation, Autonomous Road Vehicles and Law Enforcement, 2020*
- *Woods, Jordan B., North Carolina Law Review, Volume 100, No. 2, Conventional Traffic Policing in the Age of Automated Driving*
- *Hurtado, Patrick, International Association of Chiefs of Police, Police Chief Magazine, Implications of Self-Driving Vehicles*
- *Cowper, Thomas J., and Levin, Bernard H, Law Enforcement Bulletin, Autonomous Vehicles: How Will They Challenge Law Enforcement?*

# INTERACTING WITH EMERGENCY SERVICE RESPONDERS

## Overview

First responders must be familiar with HAVs to respond effectively to emergencies in which an HAV is present. PennDOT will assist emergency service responders by providing resources and developing trainings, but municipalities can also take the initiative to encourage their first responders to review HAV emergency trainings to familiarize themselves with HAVs. Several HAV operators have set up briefings, hotlines, and training for first responders during testing.

Just as first responders must know how to interact with HAVs, HAVs must comply with first responders. HAV operators have programmed HAVs to generally mimic human drivers' responses to emergency personnel, including safely pulling over and stopping as directed. Pennsylvania law requires that HAVs stay on the scene of a crash (or as close thereto as is safely possible) until first responders have collected required information from the vehicle or driver. In the event of an incident, HAVs or their certificate holders (or someone on their behalf) are required to contact the duly authorized police department to make a report and communicate registration and financial responsibility information to the police department. HAVs are also required to have the owner's contact information visible on the exterior of the vehicle.

## Proposed Actions

**Low**

- Establish a working group with emergency service responders to advance awareness and discuss safety protocols.

**Medium**

- Provide periodic updates to emergency responders on advances in HAV operations within Pennsylvania.
- Have all emergency responders watch a current HAV emergency response training video.

**High**

- Once notified of operation within your jurisdiction, require all emergency responders watch a current HAV emergency response training video.
- Participate in HAV emergency responder trainer programs.

## Key Questions

### How do emergency responders interact with HAVs?

HAVs are programmed to respond to emergency lights and sirens, with ongoing development involving hand signals. To support deployment, training videos for emergency responders are available from many operators and will be updated as protocols evolve.

### Are emergency responders required to have any specialized training to interact with HAVs?

Many HAVs have unique design features that may require special procedures or actions during an emergency. Once a jurisdiction is notified that HAVs are operating within their jurisdictions, emergency responders should learn to use the PennDOT AVIRP-FG mobile app (available through Apple and Google) and watch emergency responder training videos from operators who will be operating HAVs within the jurisdiction.

### How can emergency responders obtain specific information regarding different vehicles and operators if an incident or injury is on board?

PennDOT has created an AVIRP-FG mobile app that includes every HAV certificate holder's Emergency Service Responder Plan. These plans include identifying and securing the vehicle, disengaging the automated driving system (ADS), and extrication, towing, firefighting, and post-crash considerations.

In addition, HAVs are required to have an external visual identifier with contact information in the event of an incident. Emergency responders can also contact the HAV operators at their respective Contract Response Lines listed in the PennDOT AVIRP-FG app to discuss any emergency response issues.

### Who will be involved if there's an incident?

In addition to local or state law enforcement and other emergency responders, it is likely that PennDOT, NHTSA, and the National Transportation Safety Board will all play roles depending on the incident type.

### What reporting is required for an HAV incident?

Incident reports for an HAV will be completed consistent with Title 75 § 3744. This statute requires drivers to report an incident if there is an injury or death, or if vehicle damage prevents the involved parties from driving away from the scene. If an HAV driver is on board and the HAV is not operating with the ADS engaged, the HAV driver must provide name, address, registration, and driver's license and information related to financial responsibility upon request. If a human driver is not present, the certificate holder or a person on their behalf must communicate registration and financial responsibility information.

## Additional Resources

- *Waymo, Waymo First Responders Training, YouTube, November 21, 2019*
- *Waymo, Jaguar I-PACE Waymo Emergency Response Guide and Law Enforcement Interaction Protocol (PDF)*
- *Cruise, Interacting with a Cruise Autonomous Vehicle: A Guide for First Responders*
- *Emergency Responder Safety Institute, Responder Safety Learning Network, Autonomous Vehicles Training Program*
- *Trimble, Tammy and Travis Terry, Virginia Tech Transportation Institute for the Governors Highway Safety Administration, Law Enforcement, First Responder and Crash Investigation Preparation for Automated Vehicle Technology, August 2021*

# INFRASTRUCTURE AND RISK MANAGEMENT

## Overview

Operators are currently developing "self-contained" HAVs that are not dependent upon new systems or infrastructure. Therefore, HAVs are not anticipated to create any new actions, mandates, or infrastructure requirements for your municipality. In this way, there are fundamentally no changes in your responsibilities from what they are today—primarily to maintain your roadways in good repair.

## Proposed Actions

**Low**

- Continue to operate and maintain existing transportation infrastructure in a state of good repair.

**Medium**

- Create a risk management plan as part of your HAV Action Plan.

**High**

- Pilot connected vehicle technologies to improve intersection performance and safety.
- Assess your municipal roadway infrastructure: line striping, signage, road condition, etc.

## Key Questions

### Do HAVs create any new expectations, requirements, or responsibilities regarding transportation infrastructure?

The primary expectation for municipalities is that you continue to operate and maintain existing transportation infrastructure in a state of good repair. While there are no requirements, some municipalities may explore ways to optimize the operational benefits of HAVs through connected equipment such as connected traffic signals. However, any actions your municipality may choose to take are optional.

### Will AVs require a new or higher standard of construction or maintenance for any municipal infrastructure?

Ultimately it is the HAV operators' responsibility to ensure the HAV can operate safely and securely in any environment in which they are authorized to operate. Vehicles must be designed to work on infrastructure as-is. However, municipalities may make improvements that would benefit all road users, including HAVs. Currently, there are, proposed changes to the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) that will have updated requirements for pavement markings, signals, and dynamic changeable signs, which will be applied broadly, but are not specific to HAV operation. As discussed in the General section, HAVs do not change current laws regarding sovereign immunity.

### Will municipalities have to change how we assess and prioritize infrastructure investments?

While municipalities may wish to consider prioritizing paving and street marking improvements as part of an updated safety initiative improvement outside of typical maintenance standards of care are not required as a result of HAVs.

### Will HAV operators provide any operational or safety data to municipalities?

Under current law, HAV operators are not required to provide data to municipalities. Voluntary agreements regarding the provision of information could be established between HAV operators and municipalities.

### How do HAVs interact with unmarked or unsigned roads? Do roads now need markings or new signage?

HAV operators must determine where and under what conditions their HAVs can safely function. Operators may choose to restrict HAV operations on specific roads or certain road types (e.g., unpaved, limited access, etc.)—or under certain conditions (e.g., snowstorms) until they feel their vehicles can operate safely in those environments. Certificate holders must detail the proposed conditions in which their HAV is designed to operate to PennDOT as part of the authorization process.

## Additional Resources

- *Federal Highway Administration, Impacts of Automated Vehicles on Highway Infrastructure, Publication No. FHWA-HRT-21-015, March 2021*
- *Newcomb, Doug, Society of Automobile Engineers, "Prepping cities for vehicle autonomy," December 14, 2021*
- *Neef, Dale, American City & Country, "When it comes to autonomous vehicles, it's time municipalities got into the driver's seat," July 2021*

**Cybersecurity**

HAVs rely on sensing, collecting, and processing large amounts of data to navigate safely. Because many HAVs may also be connected, there are concerns about susceptibility to security risks. NHTSA is leading cybersecurity efforts through collaboration with government agencies, vehicle manufacturers, and the public to develop an approach to preventing data breaches, hacking, and other cyberattacks. Cybersecurity is one of NHTSA's 12 Safety Assessment points and encourages HAVs to follow best practices as published by several national and international cybersecurity organizations, including NHTSA, the National Institute of Standards and Technology (NIST), SAE International, the Alliance of Automobile Manufacturers, the Association of Global Automakers, the Automotive Information Sharing and Analysis Center (Auto-ISAC), and others.

PennDOT guidelines require HAV testers to meet industry standards and best practices around mitigating cybersecurity risk. PennDOT guidance for HAVs will promote best practices around cybersecurity and continue to monitor and support federal cybersecurity-recommended best practices.

# POTENTIAL FISCAL IMPACTS

## Overview

While hard to predict for individual municipalities, it is anticipated that for most, any potential revenue impacts will not occur quickly—perhaps over the course of several decades. Municipalities should consider long-term implications to their operations and community. For example, as HAVs are more widely deployed as a shared transportation mode, there may be some effects on revenues relating primarily to parking revenue, traffic violations, and potentially transit fare revenue. The extent of these impacts will depend on the uptake and adoption rates of HAVs in your region, planned business models, and resulting changes to your community's trip-making. However, if significant adoption begins to occur, municipalities may want to monitor auto-related revenues (e.g., paid parking, traffic violations, etc.) more closely and begin to account for potential changes to revenue.

## Proposed Actions

**Low**

- Present PennDOT's HAV presentation to your Mayor, Council, or other elected officials.

**Medium**

- Develop an estimate and schedule for how much the HAV action Plan will cost.

**High**

- Perform an analysis of the current impact of vehicle-related revenues on your municipal budget - meter revenue, off-street revenue, parking permits, fines, etc.

## Key Questions

### Can municipalities charge special fees for HAVs?

Municipalities can't charge special fees for HAVs operating in their area, however, existing fees tied to pre-existing for-fee services or permits will continue to apply equally to HAVs. For example, surcharges on ridesharing or delivery services may still apply to services provided by HAVs and manually operated vehicles alike.

### Will the advent of HAVs change municipal funding from PennDOT?

Introducing HAVs in your municipality will not impact PennDOT's contributions to municipalities.

## Additional Resources

- *Fagan, Mark et al., Harvard Kennedy School Taubman Center for State and Local Government, Autonomous Vehicles are Coming: Five Policy Actions Cities Can Take Now to Be Ready, "Policy Action 5: Reposition Revenues", Pages 56-64*
- *Harper, Corey and Constantine Samaras, American Scientist, "Bargain-Hunting Robocars Could Spell the End for Downtown Parking," Vol. 107, No. 6, November-December 2019*
- *Mares, Rafael et al., Conservation Law Foundation, How Autonomous Vehicles Will Drive Our Budgets, June 2018*

# PLANNING, LAND USE AND ZONING

## Overview

While HAVs are not expected to impact travel patterns, as adoption rates pick up substantially, municipalities could see changes in how, when, and where people and goods travel, vehicle miles traveled, congestion and travel times, and use of curb space.

For most municipalities, planning or land use impacts may depend on operator business plans and will likely not occur quickly. As the technology matures and adoption increases, PennDOT will monitor and can guide municipalities on anticipating changes in traffic levels, ownership rates, mode share, and parking.

## Proposed Actions

**Low**

- Present on HAVs to the Planning Board or Commission.

**Medium**

- Develop a municipal HAV Action Plan.
- When updating your municipal comprehensive plan including language, policies, or actions to reflect the likely coming of HAVs.

**High**

- Consider improvements to your zoning and building codes to reflect reduced parking and increased demand for ride sharing.
- Participate in your MPO's/RPO's HAV task force.

## Key Questions

### Will HAVs impact comprehensive plans?

While there is no urgent need to rewrite your municipal plan due to HAVs, you may wish to consider the likely impacts of HAVs during the next update to your municipal or multi-municipal comprehensive plan (review is required every ten years by the Pennsylvania Municipalities Planning Code, Act 247 of 1968).

### Should rural, suburban, and urban municipalities plan differently for HAVs?

HAVs likely will be deployed first in more urban and suburban areas with more controlled environments. Rural areas will have more time to digest potential planning and land use implications.

### Will zoning changes be permitted that could limit where HAV fleets could locate?

Zoning regulations relating to vehicle maintenance, parking, and other vehicle fleet facilities will remain valid provided that regulations do not specifically target or limit HAVs.

### Should we prepare to manage curb space differently?

While HAV operations are expected to be limited initially, some municipalities may wish to consider changes to curb space management at this time. Considerations may include potential increases in pick-ups, drop-offs, loading, and delivery in certain areas such as ridesharing, delivery, and freight HAV uses increase.

### Do we need to reconsider parking requirements?

HAVs are unlikely to have any notable near-term impact on parking; however, you may wish to consider an increase in ridesharing and decrease in private vehicles use which may translate to lower parking demand in the longer term. HAV adoption may also translate to a change in parking demand rather than a reduction of it, such as a shift in downtown parking demand to an increased demand for parking in more remote areas.

## Additional Resources

- *Fagan, Mark et al., Harvard Kennedy School Taubman Center for State and Local Government, Autonomous Vehicles are Coming: Five Policy Actions Cities Can Take Now to Be Ready, "Policy Action 2: Rethink Curb Design and Street Space Allocation", Pages 32-40*
- *Stein, Gregory M., Florida State University Law Review [Vol. 48:193], The Impact of Autonomous Vehicles on Urban Land Use Patterns, 2021*

**Economic Impact on Local Industries**

As an emerging technology, HAVs have the potential to disrupt certain transportation-related industries such as automotive parts manufacturing, automotive repair, trucking, public transit, and taxi and ridesharing. HAVs may also lead to a decrease in transportation-related injuries, thereby potentially reducing demand on emergency responders and hospital emergency staff. However, there may also be opportunities for job creation relating to manufacturing and repair of HAV technologies, and opportunities resulting from improved access to existing employment centers, connections to transit stations, and increased ease of goods movement.

### Additional Resource

*Tripp, Simon et al., Regional Industrial Development Corporation and the Greater Pittsburgh Chamber of Commerce, Forefront: Securing Pittsburgh's Break-out Position in Autonomous Mobile Systems, September 2021*

# MUNICIPAL STAFFING AND TRAINING

## Overview

It is not expected that municipalities will need to take on new responsibilities or new staffing in the near term as HAVs begin to deploy. Most operators recognize the challenges facing municipalities and opt for paths that require limited to no further municipal involvement. While it is anticipated that no new staffing will be required, municipalities may need to take on some modified responsibilities where it makes sense. Emergency response and traffic enforcement may require additional municipal staff and volunteer training. PennDOT will continue to monitor the needs for new municipal training through conversations on both the local and national levels as HAV deployment unfolds to proactively address any new municipal workforce issues as they are identified or arise.

## Proposed Actions

**Low**

- Monitor PennDOT announcements for training opportunities.
- Remain engaged with and communicate to PennDOT anticipated municipal training needs.

**Medium**

- Monitor USDOT's HAV program for new training opportunities and resources.

**High**

- Once operational in your municipality, hold training for police officers.
- Once operational in your municipality, hold training for emergency responders.
- Once operational in your municipality, invite HAV industry professionals to visit your HAV working group or to facilitate a session with your designated HAV Municipal Lead.

## Key Questions

### Will HAVs impact the municipal workforce?

In the near term, there should be little, if any, impact on most municipalities as HAV deployments will be limited initially. Over the longer term, with likely increased compliance with traffic laws, new technological means to monitor and enforce traffic violations, and improved road safety, there may be a reduced need for related activities such as manual traffic enforcement. In most cases, HAVs will reduce the need for certain activities and allow municipal staff to prioritize other responsibilities.

## Will the state be developing any training programs for municipalities?

Early municipal interactions with HAVs will likely involve law enforcement officers and emergency responders. Training resources are identified in those sections. If PennDOT determines a need for additional municipal training programs relating to HAVs, they will be shared through its website. If training is needed, it will be provided through PennDOT or the Commonwealth.

### Potential Operational Opportunities for Municipalities

While some municipal operations use cases have started to emerge, most still appear to be far off. Uses such as automated street sweeping or snow maintenance might be ripe for automation at some point, but it is unlikely they will be ready for implementation anytime soon. As use cases emerge and evolve, you may begin to hear of pilot projects through organizations such as the American Public Works Association (APWA).

# ENHANCING MOBILITY

## Overview

HAVs will likely be deployed under several different models. In the near term, HAVs will likely be owned and operated by private companies for either passenger or service delivery use. Depending on the predominant usage, HAVs may present opportunities for more equitable mobility and access for those with driving limitations, such as seniors and persons with disabilities, and improve connections to jobs, health care, schools, retail, and each other.

## Proposed Actions

**Low**

- Continue to monitor the PennDOT HAV website for new and updated training videos and guides.

**Medium**

- Monitor and notify your communities if HAVs begin to operate in your jurisdiction.

**High**

- Looking for opportunities to share information and ideas on HAVs with neighboring municipalities.
- Work with your transit provider to consider potential new and innovative ways to provide public transit.

## Key Questions

### Could HAVs create new or enhanced mobility options for those with driving limitations such as seniors or persons with disabilities?

Because certain HAVs do not require a human driver to be present, HAVs will likely provide new transportation opportunities for those unable to operate or have difficulty operating a vehicle. Currently, it will be up to the HAV operator to create rules around who will be allowed or required in an HAV (e.g., whether a licensed driver must be present).

### Will HAVs be accessible for persons with disabilities?

Pennsylvania Law requires that the HAV Advisory Committee develop a report which will evaluate the improvements to accessibility and mobility for persons with disabilities within 18 months of Act 130 going into effect.

### Could an AV service impact transit ridership?

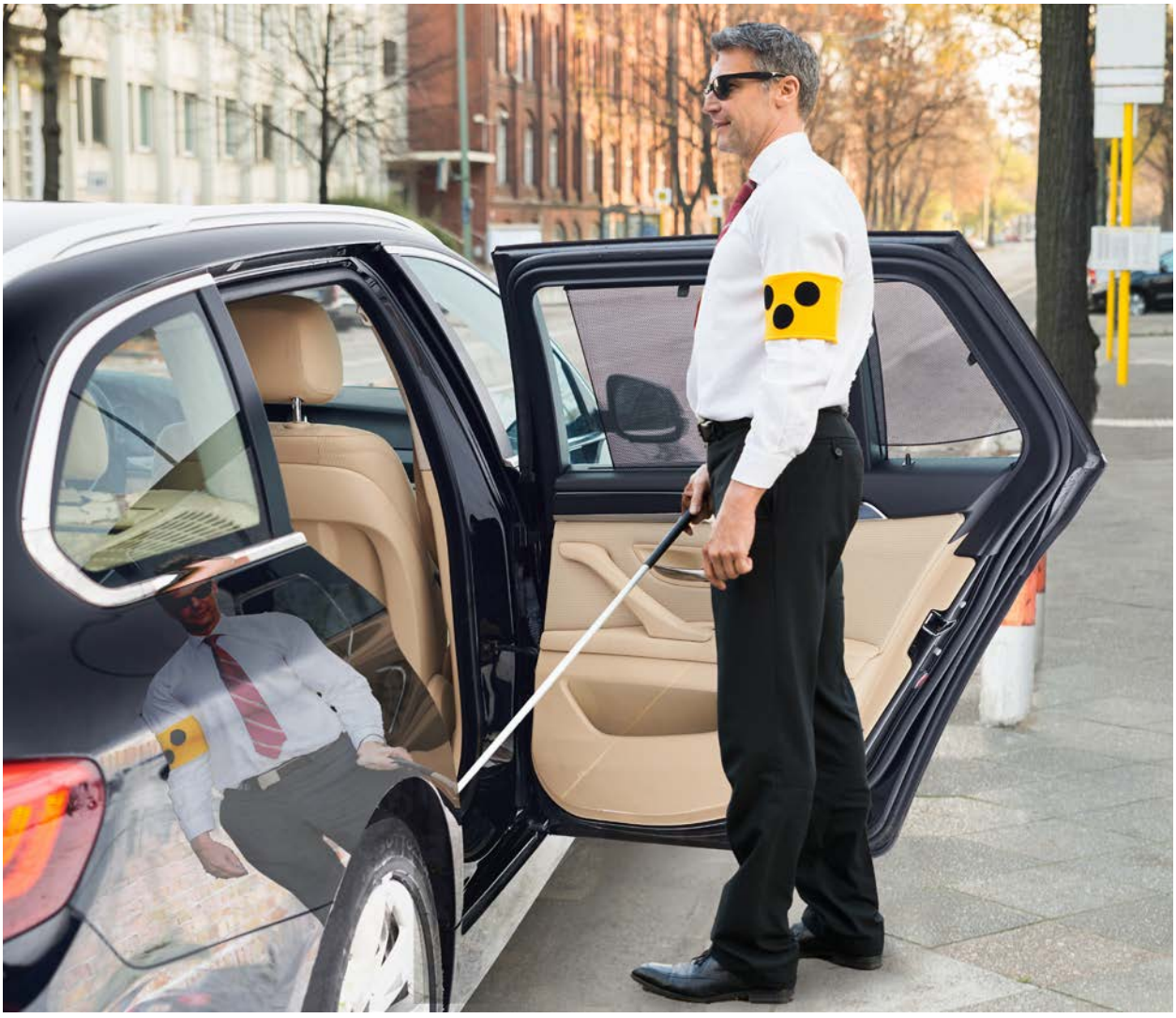
While it is too early to predict potential impacts on transit presently, it is possible that HAVs could enhance transit services in various ways: HAV ridesharing may supplement public transit or could integrate with it by providing new connections to existing stops.

### What is the anticipated business model for shared HAVs?

Current shared HAV passenger ride-hailing operations around the country are market-based, with HAV fleet operators setting pricing. Likely, any shared HAV passenger ride-hailing operations in Pennsylvania will initially be priced much like existing ride-hailing services.

## Additional Resources

- *Society for Automotive Engineers, SAE Standards Development, "Automated Driving System Dedicated Vehicles promise mobility benefits for persons with disabilities."*
- *National Aging and Disability Transportation Center, The ADA & Accessible Ground Transportation*
- *UC Davis Institute of Transportation Studies, NCST Webinar: Preparing for Automated Vehicles in Rural America, March 30, 2022*



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# APPENDIX A: MUNICIPAL HAV ACTION PLAN TEMPLATE

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# ACTIONS

| Low Level<br>**Actions that require lower investment, resources, and investment**<br>**Target audience: municipalities with little to no engagement with HAVs** | Lead | Due |
|---|---|---|
| Monitor and notify your communities if HAVs begin to operate in your jurisdiction. | | |
| Establish a working group with emergency service responders to advance awareness and discuss HAV safety and safety protocols. | | |
| Establish a “lead” within your local police force to monitor the topic of traffic enforcement for HAVs. | | |
| Have all law enforcement officers watch a current HAV emergency response training video. | | |
| Ensure law enforcement is trained in the proper use of the mobile app. | | |
| Establish a working group with emergency service responders to advance awareness and discuss safety protocols. | | |
| Have all emergency responders watch a current HAV emergency response training video. | | |
| Continue to operate and maintain existing transportation infrastructure in good repair. | | |
| Monitor PennDOT’s HAV program for new training opportunities and resources. | | |
| Remain engaged with and communicate to PennDOT anticipated municipal training needs. | | |
| Provide copies of and/or facilitate a discussion of this guide with other municipal and elected officials. | | |
| Designate a Municipal Lead for HAVs. | | |
| Present PennDOT’s HAV presentation to your Mayor, Council, or other elected officials. | | |

| Medium Level<br>**Actions that require medium investment, resources, and investment**<br>**Target audience: municipalities with some or moderate engagement with HAVs** | Lead | Due |
|---|---|---|
| Develop a municipal HAV Action Plan. | | |
| Convene an internal HAV working group to implement your municipal HAV Action Plan - possibly lead elected, engineer, chief of police, fire/EMS chief. | | |
| Engage a group of citizens, potentially through your MPO/RPO to create a citizens' HAV working group. | | |
| Monitor industry publications for emerging practices for HAV safety. | | |
| Provide periodic updates to law enforcement officers on advances in HAV operations within Pennsylvania. | | |
| Provide periodic updates to emergency responders on advances in HAV operations within Pennsylvania. | | |
| Create a risk management plan as part of your HAV Action Plan. | | |
| Monitor USDOT's HAV program for new training opportunities and resources. | | |
| When updating your municipal comprehensive plan, include language, policies, or actions to reflect the likely coming of HAVs. | | |
| Participate in municipal association working groups. | | |

| High Level<br>**Actions that require a more significant investment, more resources, and more investment**<br>**Target audience: municipalities already well-engaged with HAVs** | Lead | Due |
|---|---|---|
| Locally promote resources that educate the public about how to safely interact with HAVs. | | |
| Once notified of an operation within your jurisdiction, provide training to law enforcement officers on how to interact with HAVs. | | |
| Participate in HAV law enforcement training programs. | | |
| Once notified of an operation within your jurisdiction, require all emergency responders watch a current HAV emergency response training video. | | |
| Participate in HAV emergency responder trainer programs. | | |
| Pilot connected vehicle technologies to improve intersection performance and safety. | | |
| Once operational in your municipality, hold training for police officers. | | |
| Once operational in your municipality, hold training for emergency responders. | | |
| Once operational in your municipality, invite HAV industry professionals to visit your HAV working group or to facilitate a session with your designated HAV Municipal Lead. | | |
| Encourage your staff to participate in industry-related HAV events. | | |

| High Level<br>**Actions that require a more significant investment, more resources, and more investment**<br>**Target audience: municipalities already well-engaged with HAVs** | Lead | Due |
|---|---|---|
| Perform an analysis of the current impact of vehicle-related revenues on your municipal budget - meter revenue, off-street revenue, parking permits, fines, etc. | | |
| Facilitate a community discussion on HAVs. | | |
| Encourage the local automotive industry to build connections with operators. | | |
| Participate in your MPO's/RPO's HAV task force. | | |
| Assess your municipal roadway infrastructure - line striping, signage, roadways. | | |
| Consider revisions to your zoning and building codes to reflect reduced parking. | | |
| Assess the potential impact on parking and consider a plan for possible uses of repurposed parking lots. | | |
| Work with your transit provider to consider potential new and innovative ways to provide public transit. | | |
| Look for opportunities to share information and ideas on HAVs with neighboring municipalities. | | |
| Perform periodic updates to your municipal HAV Action Plan. | | |

# APPENDIX B: RECOMMENDED RESOURCES

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# RESOURCES

- *SAE J 3016-2021: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles.*
- *SAE Levels of Driving Automation https://blog.ansi.org/?p=158517*
- *USDOT's Automated Vehicles Comprehensive Plan, Monday, January 11, 2021 USDOT_ AVCP.pdf*
- *Pennsylvania Joint Statewide Connected and Automated Vehicles Strategic Plan, Final Report, PennDOT, July 9, 2018*
- *Automated Vehicle Testing Guidance, PennDOT, July 23, 2018*
- *Glossary of Connected and Automated Vehicle Terms VERSION 1.0 March 2018 Prepared by the University of Virginia Center for Transportation Studies Hyungjun Park, Zulqarnain Khattak, and Brian Smith*
- *"Preparing Communities for Autonomous Vehicles", American Planning Association, 2017*

# APPENDIX C: DETAILED SAE LEVELS OF AUTOMATION CHART

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# SAE **J3016**™ LEVELS OF DRIVING AUTOMATION™

**Learn more here:** sae.org/standards/content/j3016_202104



| | SAE LEVEL 0™ | SAE LEVEL 1™ | SAE LEVEL 2™ | SAE LEVEL 3™ | SAE LEVEL 4™ | SAE LEVEL 5™ |
|---|---|---|---|---|---|---|
| What does the human in the driver's seat have to do? | **You <u>are</u> driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering | | | **You <u>are not</u> driving** when these automated driving features are engaged – even if you are seated in the "driver's seat" | | |
| | **You must constantly supervise** these support features; you must steer, brake, or accelerate as needed to maintain safety. | | | When the feature requests, you must drive | These automated driving features will not require you to take over driving | |
| | **These are driver support features** | | | **These are automated driving features** | | |
| What do these features do? | These features are limited to providing warnings and momentary assistance | These features provide steering OR brake/ acceleration support to the driver | These features provide steering AND brake/ acceleration support to the driver | These features can drive the vehicle under limited conditions and will not operate unless all required condition are met | | This feature can drive the vehicle under all conditions |
| Example Features | • automatic emergency braking<br>• blind spot warning<br>• lane departure warning | • lane centering **OR**<br>• adaptive cruise control | • lane centering **AND**<br>• adaptive cruise control at the same time | • traffic jam chauffer | • local driverless taxi<br>• pedals/ steering wheel may or may not be installed | • same as Level 4, but feature can drive everywhere in all conditions |



Source: SAE International


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