Preparing for Automated Vehicles in Vermont

A Report to the Vermont General Assembly
Per Section 15 Act 38 (2017)

Vermont Agency of Transportation
Policy, Planning, and Intermodal Development Division

One National Life Drive
Montpelier, VT 05633-5001
802-828-2784
www.vtrans.vermont.gov

January 15, 2018

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ACTIVITIES 1

3.0 AUTOMATED VEHICLE BACKGROUND AND ISSUES 3

Figure 1: Five Levels of Vehicle Automation 4

Figure 2: Concerns of Vermont AV Workshop Participants 7

4.0 STRATEGY TO PREPARE FOR AUTOMATED VEHICLES IN VT 7

4.1 Encourage Testing of AVs on Public Roads in VT 7

4.2 Remove Statutory Barriers to AV Deployment 9

4.3 Next Steps 9

ATTACHMENT A: AV WORKSHOP MEETING NOTES 11

1.0 INTRODUCTION

Section 15 of the 2017 Transportation Bill (Act 38) directs the "…Secretary of Transportation to convene a meeting of public and private stakeholders…to gather information related to and raise awareness of opportunities and challenges related to AVs [automated vehicles], and identify policy areas requiring further research or possible legislation." This report addresses the requirement that the Secretary report back to the House and Senate Transportation Committees on the Agency's activities and recommends a strategy to prepare Vermont for automated vehicles.

2.0 SUMMARY OF ACTIVITIES

Section 15 of Act 38 required the convening of a meeting of public and private stakeholders with expertise related to:

1) the licensing of automated vehicle (AV) operators and the registration of AVs;
2) AV operator education and training;
3) insurance and liability issues related to AVs;
4) enforcement of laws governing AV operation;
5) inspections of AVs;
6) testing of AVs in Vermont;
7) emergency response practices in relation to AVs;
8) infrastructure needs associated with the rollout of AVs; and
9) social, economic, and environmental consequences of the rollout of AVs.

The Agency conducted a two and half hour workshop on Automated Vehicle Impacts in Vermont as part of the annual meeting of the Vermont Highway Safety Alliance (VHSA) held on November 8, 2017 at the Hilton Hotel in Burlington, VT. Conducting the AV workshop in conjunction with the VHSA annual meeting provided an efficient means to gather stakeholders with expertise in the topic areas listed above. The workshop was proceeded by a 45-minute presentation from Dr. Jim Hedlund from the Governor's Highway Safety Association, a national organization representing the state and territorial highway safety offices that implement federal grant programs to address behavioral highway safety issues. Dr. Hedlund is the author of "Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States" (Prepared for GHSA, 2017) and provided background information on AVs to set the stage for the workshop.

The workshop was organized around three general topic areas: (1) Legal and regulatory issues, (2) operator education and emergency response, and (3) Infrastructure, socioeconomic and environment. VTrans staff presented a series of questions for each topic area and gathered responses from workshop participants using a web-based polling tool to compile and summarize results in real time. Expert panels were organized for each topic area to comment on responses from workshop participants and to expand on specific issues. Approximately 45 people participated in the workshop representing a diverse set of interests. Detailed meeting notes, and a lists of workshop participants and expert panel members are attached.

In addition to the automated vehicle workshop, VTrans carried out the following activities to increase awareness about AVs, to establish partnerships and to build staff knowledge about the wide range of issues:

- Northeast Autonomous Vehicle Summit (March 30, 2017). The summit was organized by the Connecticut DOT and the University of Connecticut. It brought together public transportation agencies and academia with representatives from the private sector that are driving the transition to automation including traditional automobile industry and non-tradition businesses such as Uber and Google. Additional information is available here: https://ctsrc.uconn.edu/home/ne-autonomous-vehicle-summit/ .

- Annual Meeting of the Vermont Driver and Traffic Safety Education Association (May 24, 2017). VTrans staff provided an overview of connected and automated vehicles to increase awareness for driver education instructors and to gather their input on how AVs could affect driver education curriculum.

- Building off lessons from the Northeast AV Summit, VTrans worked with Maine DOT to convene a meeting of all New England State DOTs to share information on AV related activities (June 20, 2017). This group is using an existing pooled fund from the New England Transportation Consortium to conduct a research project that will identify regulatory, policy and infrastructure issues that cross state lines, and to develop an action plan to address the issues. Multi-state issues have not been researched significantly yet in the country.

- Uniform Law Commission Observer (June 2017). VTrans staff became observers of the ULC drafting committee for a model Highly Automated Vehicles Act. The Uniform Law Commission (also known as the National Conference of Commissioners on Uniform State Laws) works for the uniformity of state laws. It is a non-profit unincorporated association, comprised of state commissions on uniform laws from each state, the District of Columbia, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands. The ULC has prepared a Draft Template for an Automated Vehicle Act. Additional information is available here: http://uniformlaws.org/Committee.aspx?title=Highly%20Automated%20Vehicles.

- Vermont Police Chief Association (December 20, 2017). To supplement information gathered from the VT AV Workshop, VTrans held a focused discussion with two members of the VT Chiefs Association. The VT Chief Association offered to assist with any proposed legislation.

- I-95 Corridor Coalition Connected and Automated Vehicle Workshop (December 11-12, 2017). VTrans is a member of the I-95 Corridor Coalition. The coalition is a partnership of transportation agencies, toll authorities, public safety, and related organizations,

from the State of Maine to the State of Florida, with affiliate members in Canada. The Coalition provides a forum for key decision makers to address transportation management and operations issues of common interest along the East Coast. This workshop provided an opportunity to learn directly from some of the state DOTs leading in the testing and deployment of AVs. Additional information is available here: http://i95coalition.org/.

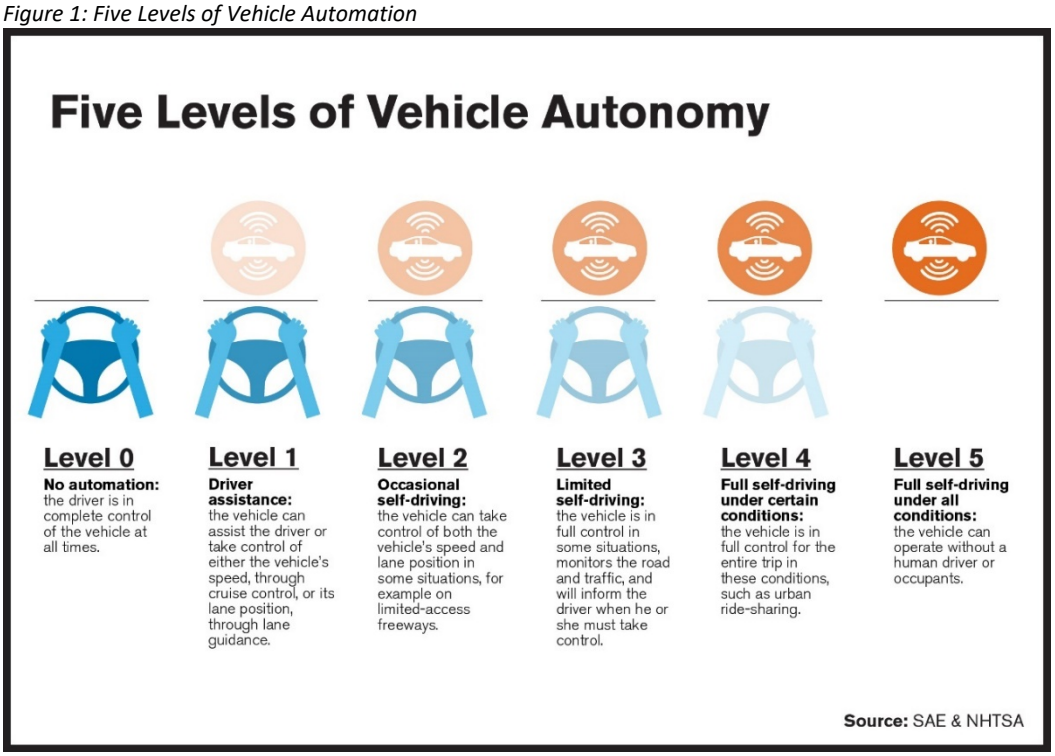
- VTrans staff provided an overview of connected and automated vehicles to increase awareness and to gather input at the following additional events:
    - Northern New England Chapter of the American Planning Association Annual Meeting (September 7, 2017).
    - South Burlington Business Association Annual Meeting (November 2, 2017)
    - VTrans Lunch and Learn (December 6, 2017)
    - Vermont Public Transit Advisory Committee (December 13, 2017)

3.0 AUTOMATED VEHICLE BACKGROUND AND ISSUES

There is an overwhelming amount of information available on the technology and implications related to automated vehicles. This section does not attempt to provide a comprehensive discussion of all topics related to automated vehicle. Rather, this section provides a summary of some basic information and highlights the issues that are most relevant to preparing for automated vehicles in Vermont.

- There are different levels of automation. The definitions provided in *Figure 1* were developed by the Society of Automotive Engineers (SAE) and are gaining widespread acceptance by policy makers. For all but level 5, humans will continue to have some responsibility for driving tasks.

Figure 1: Five Levels of Vehicle Automation



- There is a wide range of opinions about the time it will take for AVs to be deployed and in use by the general public. One forecast, prepared by Dr. Hedlund from the GHSA, suggests that vehicles with some level of automation will increase their share of the fleet from 1-2% in 2020 to 40-60% by 2050. The implication is that there will be a mix of conventional vehicles and vehicles with different levels of automation on the road for many decades to come. An example of a forecast on the opposite end of the spectrum that was prepared by RethinkX, a think tank that analyzes technology driven disruptions, is that 95% of passenger miles travelled will be in automated vehicles by 2030[1].

- The expected benefits of automated vehicles most often cited in literature include reducing crashes (most of which today are caused by human error); increasing mobility and independence for persons that cannot currently drive and who have no other reasonable alternatives; reducing traffic congestion and the need to widen roadways through increased efficiency; reducing household transportation costs; reducing tailpipe emissions including green-house gases; and reducing the need for parking. Because AVs could reduce the cost of travel, and could make travel time productive, people may be willing to commute longer distances, dispersing land use and resulting in more vehicle miles traveled. The magnitude of these potential benefits and other consequences is

[1] "Rethinking Transportation 2020-2030 The Disruption of Transportation and the Collapse of the Internal-Combustion Vehicle and Oil Industry", RethinkX, May 2017

uncertain and will depend on the extent to which automated vehicles are shared in a "transportation as a service" model versus a model where most individuals own an AV.

- The emerging guidance and legislation from the Federal Government seeks to balance public safety while also providing the flexibility needed by the private sector to innovate as it develops automated driving systems.

    - Voluntary Policy Guidance: The US Department of Transportation published "A Vision for Safety" in September 2017 which provides a policy framework to facilitate the safe deployment of automated vehicles. It is a voluntary guidance that outlines 12 safety elements for consideration by the developers of automated driving systems. The guidance states that the federal and state regulatory roles for motor vehicle operations will remain relatively unchanged and will also apply to automated vehicles. In general, the federal government is responsible for regulating the safety of motor vehicles and related equipment and states are responsible for licensing, registration, traffic laws (rules of the road), insurance and vehicle inspections. The guidance recommends best practices for state legislatures and state highway officials.

    - SELF DRIVE Act (HR3338)[1]. The Act was passed by the U.S. House of Representatives in September 2017. It prohibits states from banning self-driving vehicles; grants exemptions to existing safety standards for a company's first 100,000 vehicles in an effort to speed up their production into the market; and requires manufacturers to develop plans to thwart cyberattacks on the digitally-run automated vehicles. Consistent with the USDOT's voluntary guidance, the SELF DRIVE Act preserves the authority of states to enact laws or issue regulations regarding other aspects pertaining to AVs, including: registration, licensing, driving education and training, insurance, law enforcement, crash investigations, safety and emissions inspections, congestion management pertaining to AVs, and the sale, distribution, repair or service of AVs. The Act is currently under consideration by the US Senate's Commerce, Science and Transportation Committee.

- Many states are actively developing laws on the testing and deployment of automated vehicles. Based on an October 2017 survey by the Uniform Law Commission, approximately 20 states have either enacted legislation or have an executive order related to automated vehicles. Legislation is pending in another ten states. There are approximately 20 states including Vermont, with no legislation. Much of the legislative activity has occurred since 2015, with 2017 being a particularly active year. The ULC

[1] Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act

notes a wide variety in the scope, structure and strategy among the states. Differences identified include: "Some principally address the research and development testing of automated driving systems; others also envision commercial deployment; Some envision a robust role for state agencies; types of automated driving system developers, some preclude local regulation, and some immunize automakers from liability for harms connected with third-party modifications"

- Automated and connected vehicle technology will make it possible for trucks to travel in platoons of two or more vehicles. Platooning trucks maintain a set, close distance to each other which reduces aerodynamic drag on the following vehicles. The result is lower fuel consumption and costs for the entire convoy. Connected vehicle technology, which allows vehicles to communicate with each other is making truck platooning possible, in advance of more sophisticated on-board automation and is being tested in the United States and other countries. Truck platooning could help reduce freight costs for Vermont businesses. However, truck platoons may not be appropriate for all Vermont highways and it may be useful to identify specific routes where platooning is permitted.

Similar information was provided to participants in the VTrans AV Workshop held on November 8, 2017. Some major observations from the workshop are:

- When asked an open-ended question about what concerns them most about self-driving cars in Vermont, workshop participants mentioned safety and the transition from conventional to automated vehicles most often (Figure 2).
- Most (84%) of workshop participants believe Vermont should require a permit for the testing of automated vehicles on public roads, and about half believe that municipalities should have a role in the permit process.
- One panel member with an expertise in insurance noted that liability with AVs is complicated. With a less-than-Level 5 vehicle (which requires the human to be responsible for driving tasks under different circumstances) each situation would require a review of facts. Were there warnings that a driver ignored? Was it system failure? Was it a combination? There might need to be a complete shift from the current approach of vehicle liability to something more like product liability to limit how many entities can be sued.
- Most (69%) of meeting participants believe the Vermont's ability to facilitate deployment of AVs is important to the state's economic future.
- Most (83%) of AV workshop participants believe that Vermont should actively prepare for and facilitate the testing and deployment of automated vehicles. Fewer participants (17%) believe Vermont should wait to see how AV technology evolves.
- Issues identified as most urgent to address were regulating the testing of AVs on public roads, clarifying barriers to AV deployment in traffic laws and regulations, and clarifying liability and insurance requirements.

Response to all questions asked and complete meeting notes are included in the attachment.

Figure 2: Concerns of Vermont AV Workshop Participants

4.0 STRATEGY TO PREPARE FOR AUTOMATED VEHICLES IN VT

Vehicles with some level of automated driving technology can be expected on Vermont highways in the not-too distant future. It is highly likely there will be a mix of conventional vehicles and vehicles with some level of automation on Vermont highways for several decades to come. The potential mobility, social and economic benefits of automated vehicles are significant, but the timing and magnitude of the benefits and consequences are uncertain. In the short term, Vermont should focus on facilitating the transition by making automated vehicles available to Vermonters in a safe and efficient way by:

1. Providing the statutory authority for a permit processes that allows and regulates the testing of AVs in Vermont; and

2. Providing the statutory authority to explicitly accommodate and specifically regulate automated driving on public roads in Vermont by the general public.

Each of these actions is discussed in more detail below followed by a recommended next step.

4.1 Encourage Testing of AVs on Public Roads in VT

Vermont should create a permit process that encourages the testing of automated driving systems in Vermont, while also protecting the travelling public.

As noted above, many states have passed legislation that allows for and regulates the testing of AVs on public roads. The primary reason to encourage the testing of automated driving systems

on VT public roads is to facilitate their deployment in the state so that Vermont residents, businesses and visitors will benefit as soon as practical from the new technology. Testing in Vermont could help build public confidence that automated driving systems are feasible in our rural, cold weather, and hilly state. Testing could provide a local opportunity for law enforcement, emergency responders, highway engineers and other stakeholders to learn and gain experience with the technology. At the same time, an efficient and non-burdensome AV testing permit process would ensure that measures are implemented during the testing to provide for the safety of the traveling public.

There are no laws in in Vermont that explicitly prohibit or allow the testing of automated vehicles on public roads. An automated vehicle can travel legally on a VT road now if it complies with current state laws in VSA Title 23 that regulate the registration of vehicles, licensing of drivers, operation of vehicles on the road, insurance requirements and vehicle inspection. However, to fully evaluate the unique functionality and performance of an automated vehicle, developers may need waivers from certain laws. For example, 23 VSA § 1241 requires a locking device to prevent a motor vehicle from being set in motion by its own motive power; and 23 VSA § 1111 states that "…(n)o person shall permit a motor vehicle to stand unattended without first stopping the engine, locking the ignition, removing the key from the ignition and effectively setting the brake". These two examples might make testing of Levels 4 and 5 automated vehicle system illegal on a public roads. There may be other statutory barriers that would require waivers. An AV testing permit process would identify the barriers and provide waivers while also requiring measures to protect the travelling public if an automated driving system fails to perform as expected.

Statutory authority that creates the permitting process will be required. There is guidance from USDOT on establishing a permitting process, and the American Association of Motor Vehicle Administrators (AAMVA) will be providing model testing legislation in early 2018 for use by states that wish to encourage testing while also ensuring safety. Legislation passed by other states, and their experiences to date, will also be useful. Issues that need to be considered in the development of a permit process include:

- Designation of a Lead Agency responsible for managing, reviewing, and issuing approval/denials of applications for testing
- Ability to accommodate applications that may involve multiple entities
- Requiring a safety and compliance plan
- Requiring insurance, bond, or self-insurance. Many states require $5 million of liability insurance.
- Defining the role of municipalities. Should approval be limited to the state level? Should approval from municipalities be required? The Massachusetts DOT requires an MOU between the Commonwealth and any municipality with roads that would be involved in the testing of an AV.
- Involving law enforcement in the approval process
- Maintaining the ability to suspend permission if necessary due to lack of compliance
- Public notification requirements.

4.2 Remove Statutory Barriers to AV Deployment

Vermont should review and clarify state statutes, primarily in VSA Title 23, that create barriers to the safe and responsible deployment of automated vehicles that have passed on-road tests, satisfy the federal motor vehicle safety standards and regulations, and are available and ready for use by the general public.

One overarching need is assigning legal obligation for compliance with Title 23. The terms "operator", "person", "driver" and "motorist" are used throughout Title 23 when referring to an individual that is responsible for complying with the law's requirements and may need modifications to account for automated driving systems. Assigning legal obligation for compliance with traffic laws is complicated by the entities that will be involved with the deployment of automated vehicles. Entities include the user of the automated driving system, owner of the vehicle, insurer of the vehicle, manufacturer of the vehicle and developer of the automated driving system. The Unified Law Commission suggests creating a new entity – the Automated Driving Provider. The Automated Driving Provider, which could be any of the entities listed above, would be the person that expressly warrants the automated operation of an associated automated vehicle to be reasonably safe before the vehicle owner would be able to register the vehicle. Other options should be considered.

Examples of other Title 23 statutes that may need to be modified to remove a barrier or to clarify how a requirement relates to automated driving include:

- Should the definition of standard equipment be expanded to incorporate automated driving system technology (§ 4 (37))?
- Should a junior be allowed to operate a vehicle with an automated driving system (§ 607)?
- Are the current minimum liability insurance amounts adequate (§ 800)?
- Can an automated vehicle travel on a public road without an operator or any passengers (§ 1111)?
- Does the operator of an automated driving system need to be in the same position as the operator of a conventional vehicle (§ 1124)?
- Are there situations when the prohibition on the use of handheld portable electronic devices (§ 1095b) and texting (§ 1099) can be removed for operators of partially automated vehicles (Levels 3 and 4)?

Some modifications may be justified soon, while others can wait as the technology advances over time. In addition to modifying existing statutory language, it will also be necessary to add language for new definitions (such as: Automated Driving Provider, Automated Driving System, Automated Operation, Automated Operation Insurance, Automated Vehicle), and to add additional requirements for driver licensing, vehicle registration, and insurance.

4.3 Next Steps

1. **Create a multi-disciplinary working group to develop AV testing and deployment legislation.** The observations above are based on a preliminary review of Title 23 by

VTrans Policy, Planning and Research staff with the purpose of understanding the level of effort necessary to modify Title 23 to accommodate testing and remove barriers to deployment of automated vehicles for use by the general public. A multi-disciplinary working group should be created to perform a comprehensive review and to develop specific statutory language for proposed legislation in 2019. The working group should include VTrans staff from Policy, Planning and Research, DMV, VTrans Legal, and Legislative Council. The working group would involve other experts in insurance, law enforcement and emergency response when working on statutes specific to those areas, and would also gather input from the Vermont League of Cities and Towns on draft language. Other stakeholders would be contacted as necessary.

2. **VTrans should continue to monitor and assess the longer-term implications of automated vehicles.** The Agency should continue to coordinate with other state agencies and Vermont stakeholders, neighboring states and national organizations to stay abreast of changes and to recommend actions when necessary.

ATTACHMENT A: AV WORKSHOP MEETING NOTES

Automated Vehicle Impacts in Vermont
November 8, 2017 Workshop

Notes

Also see Polling Results

The polling at the beginning of the workshop identified limited participation by the enforcement and emergency response communities. Mr. Segale said there may be additional outreach to incorporate these perspectives. He expressed appreciation to all participants and especially for having the perspectives of regulators, insurance specialists, IT, and auto dealers included.

Discussion 1: Legal and Regulatory Issues

Expert Panelists:

Kevin Gaffney	VT Dept. of Financial Regulations
Cathie Curtis	American Association of Motor Vehicle Associations (AAMVA)
Scott Davidson	VT DMV Chief Inspector
Jim Hedlund	Highway Safety North

Permitting by Vermont for testing AVs, and municipal participation

- Permitting facilitates discussion with manufacturers and testing entities. It gives a role in determining any limits on where AVs may be tested, for example not in school zones, not at certain speeds, or not in certain weather. If keeps participants informed about what is happening.
- Ms. Curtis said so far municipalities have found it productive. Vermont League of Municipalities is an important voice. The national League of Municipalities did a useful study.
- Is there taxi permitting in Vermont? Yes, in Burlington.
- AAMVA expects to release guidelines in February regarding permits for AVs.
- Transportation Network Company (TNC) legislation is expected to come in Vermont this year. There have been many insurance issues discussed.
- Self-Drive Act in discussion nationally proposes less of a role for NHTSA regarding AVs than it has had for traditional vehicles. There are bills in the House and Senate with exemptions from safety standards for AVs.

Liability

- Liability with AVs is complicated. With a less-than-Level 5 vehicle each situation would require review of facts. Were there warnings that a person ignored? Was it system failure? Was it a combination?
- There might need to be a complete shift from the current approach of vehicle liability to something more like product liability to limit how many entities can be sued.

Should AV operators have a special license? This question pertains to any level.

- Already require endorsements for buses and trucks.

Should AVs have a special license plate/other indication?

- Would like to know how car ahead will behave especially during the period of transition.
- Ms. Curtis said that an indication added to license plates would interfere with specialty plates. Especially because cars are not in auto-drive mode all the time.

- There was discussion of a badge on the vehicle of some type. Uber drivers display a "U" badge in their rear windows. The badge could be electronically turned on when auto-drive was engaged. It could also be electronically communicated for law-enforcement purposes.

Discussion 2: Operator Education and Emergency Response

Expert Panelists:

Terry McDonnell	NY State Police
Barbara Brody	VT Driver and Traffic Safety Association
Jim Hedlund	Highway Safety North

Ms. Brody said it will be important for the State to create a relationship with auto dealers. Dealers currently show buyers how to set up cell phone technology. The dealer will have some important role with educating drivers on how to use their additional auto-drive features.

Operator Education

- Currently in Vermont younger teens need to take drivers education or can wait until they turn 18 and skip it. It was suggested that all novice drivers take driver's ed. There will be a need to provide multiple kinds of training: for novice drivers, for those new to the technology, and also brand-specific training. It should be recognized that there will be people who will want to stay with traditional cars and the market for used cars may escalate.
- Senior drivers may be more likely to choose not to use new technology. A discussion with 75 to 100 females at four Vermont senior living facilities didn't find anyone willing to get into an automated vehicle.
- Young drivers may assume they don't need to learn how to drive, but then they will not be prepared to take the wheel when necessary.
- Would current drivers remain safe if they haven't done it in a while but need to take control? This led to discussion of the large amount of training required of pilots on simulators to use auto-pilot in planes even though auto-pilot is only allowed after take-off and before landing and with someone on the ground knowing what is happening.
- Should re-certification become a requirement for drivers on a regular schedule, for example as is required to maintain CPR certification?
- Mr. McDonnell said this is a transformational change in transportation like the change from horses to cars. It is difficult to predict the repercussions.

Emergency Response

- One possibility is self-driving ambulances and fire engines that allow trained staff to focus on providing medical assistance or preparing.
- How would it work if a vehicle without anyone in it disobeys a traffic law or is in a crash?

Operator Expectations

- It makes a difference whether there is a person with some control at some high level such as with Uber or air control as compared to whether the person who initiated the trip has complete responsibility.
- Who is the responsible party for a trip and how would an automated trip be set in motion? The answer was thought to include use of a cell phone, but that would mean the initiator is not necessarily the person in the vehicle.

- There were some mixed views about whether it would be all right to be impaired and in control of an automated vehicle. Similarly, there was discussion of whether there should be age limits (such as a minimum of five years old) or minimum limits to cognitive ability for "drivers."
- Would AVs require occupants to buckle up? Depends on laws and market forces.
- If a fully automated vehicle makes an error, can you tell it to stop? Mr. McDonnell said you can probably tell it stop where safe but not "don't run that light." Further discussion of whether there is a "kill switch" suggested this is to be determined.

Certification and Regulation

- Different laws in different states is a problem. In the near future this will require a big communication effort. In the long term, national level laws will probably be needed.
- Who certifies that self-driving vehicles are safe if not a federal entity? Mr. McDonnell noted that California considered third party testers but couldn't figure out who that would be. They would face liability as well. In the earlier discussion there was assumption that someone other than the manufacturer would be checking marketing claims and safety.

Privacy

A tremendous amount of information will result from AVs, more even than the large amount available about people now. Privacy is mentioned in bills in current national discussion.

AI Ethical/Moral Questions

- Which person's life gets prioritized?
- What happens if there's a pet in the road?
- What happens if a car jacker tried to take advantage of AI rules?
- Would hitting someone cause problems for highly advanced AI?

Discussion 3: Infrastructure, Socioeconomic, and Environmental

Expert Panelists:

Kevin Marshia	VTrans Chief Engineer
Lisa Aultman-Hall	UVM Transportation Research Center
Charlie Baker	Executive Director, Chittenden County RPC
Jim Hedlund	Highway Safety North

Mr. Baker raised a fundamental question for each of us and for the broader discussion: How much do we trust technology? All of these discussions involve differing levels and leaps of faith.

Infrastructure and Environment

- Should AVs use gravel roads? If not, how should they interact with that large part of Vermont's road network? AVs are increasingly relying on the scanned network rather than the road infrastructure.
- Mr. Marshia noted there are less-obvious infrastructure demands likely to come. The additional public investment needed in things like pavement markings, communications, and more/less/different roads is unknown.
- Vehicles are still going to have to go somewhere to park and potentially charge. This could mean more miles travelled or need for significant numbers of new park and ride lots, potentially with charging stations. Mr. Baker noted it's hard to site park and ride lots.
- Will probably require fiber optic build-out. Future data needs of public agencies are unknown.

Funding and Fuel Sources

- Who will pay for public investments requested especially as fuel taxes continue to drop.
- Many discussions seem to imply that AVs will use electricity for fuel. There were some questions about the likelihood of that, but also mention that after 2050 all new vehicles in the UK will have to be electric.
- How else would an AV fuel up?

Social Implications

- If cars park away from downtowns, there could be more room for downtown activity including redevelopment, walking, and bicycling.
- How do we learn from the unintended consequences of the last major change—building the interstate system? AVs could result in a major wave of people choosing to live ever-further away and then needing more infrastructure (roads, schools, water/sewer, other sprawl issues). Need to consider community and public costs.
- There should be focus on community-building in legislation. For example, there could be a cost structure built in of four or more times the fee to drive empty vehicles to outside of certain municipal boundaries.

Economic Considerations

- This might allow keeping more seniors in the northeast and retaining their cash in local economies
- Need for communication and coordination with Canada; Vermont is part of an interrelated regional and international area

Social Equity

- Ms. Aultman-Hall noted that people currently spend 18 to 22% of their incomes on transportation, and higher than that in low-income households. If the cost of transportation goes up with more technology what would this mean? There are sources stating that a shared transportation service would be less expensive. An effect could be sharper differentiation of transportation resources by income.
- If the differentiation leads to low-income people relying on sharing services, how long does it take such services to be set up in rural areas and what is their quality there?
- Technology continues to evolve ever-faster. Ms. Aultman-Hall said some serious people are speaking about personal flying machines with wings that fold up to go into garages. Part of the differentiation may be "mobility toys" for people who can afford them.
- Aside from the traditional safety discussion there may be personal safety matters raised such as "Do I want to be alone in an AV in NYC at night?" and "Will it become more dangerous to be a short person when there is more reliance on electronic scanning and reduction in driver-oriented features?"

Wrap-up

- Mr. Hedlund praised the quality of the discussion and said Vermont really got its money's worth from the afternoon.
- Mr. Segale thanked the participants. He said there may be need for small group follow-up to explore some of the different issues raised. These groups would probably be convened by VTrans.

Participant		Association	Email Address
Mario	Dupigny-Giroux	Vtrans OHS	mario.dupigny-giroux@vermont.gov
Roger	Thompson	FHWA-VT	roger.thompson@dot.gov
Gabby	Freeman	Vermont Clean Cities	gmfreema@uvm.edu
Rick	Scott	ADS IT Support- AOT	rick.scott@vermont.gov
Matt	Lofgren	ADS	matt.lofgren@vermont.gov
Josiah	Raiche	ADS	josiah.raiche@vermont.gov
Keith	Flynn	GHSP	keith.flynn@vermont.gov
Diane	Baraw	Norwich Academy	dbaraw@norwich.edu
Jim	Barow	GHSP	james.barow@vermont.gov
Charles	Farmer	IIHS	cfarmer@iihs.org
Bruce	Nyquist	Vtrans	bruce.nyquist@vermont.gov
Jake	Elovirta	DMV Police	william.elovirta@vermont.gov
Dan	Goodman	AAA	goodman.daniel@nne.aaa.com
Scott	Davidson	DMV	scott.davidson@vermont.gov
John	Flannigan	DPS/VSP	john.flannigan@vermont.gov
Barbara	Murphy	State Legislature	bmurphy@leg.state.vt.us
Erica	Quallen	VHB	equallen@vhb.com
David	Grover	RSG	david.grover@rsg.com
Karen	Sentoff	UVM TRC	ksentoff@uvm.edu
Heather	Zuk	UVM Driver Rehab	heather.zuk@uvmhealth.org
Sarah	Zimmerman	UVM Driver Rehab	sarah.zimmerman@uvmhealth.org
Bill	Mitchell	RideSafe VT	bill@ridesafevt.com
Jacqui	LeBlanc	Vtrans	jacqueline.leblanc@vermont.gov
Lisa	Aultman-Hall	UVM	laultman@uvm.edu
Trevor	Whipple	S.Burlington Police	twhipple@sbpdvt.org
Baird	Morgan	AARP DS	cbairdmorgan@gmail.com
Doug	Masson	AARP DS	douglasmasson@myfairpoint.net
Kevin	Gaffney	VT DFR	kevin.gaffney@vermont.gov
Pat	Murray	VT DFR	pat.murray@vermont.gov
Mary	Eversole	VIAA	mary@viaa.org
Jesse	Devlin	AOT	jesse.devlin@vermont.gov
Ian	Griffith	AOT	ian.griffith@vermont.gov
Ben	Tietze	Vtrans	benjamin.tietze@vermont.gov
Kara	Yelinek	AOT	kara.yelinek@vermont.gov
Rick	Bryant	Stantec	rick.bryant@stantec.com
Ken	Robie	Vtrans	ken.robie@vermont.gov
Barb-	Brow	VDTS EVT	bashavt@comcast.net
Kevin	Marshia	Vtrans	kevin.marshia@vermont.gov
Jim	Hedlund	HSN	jhedlund@sprynet.com
Terey	McDonnel	NYSP	terence.mcdonnel@trgopeg.ny.us
Catherine	Curtis	AAMUA	ccurtis@aamua.org
Nancy	Avery	Vtrans	nancy.avery@vermont.gov
Clare	Buckley	VT Auto Dealers Assn	cbuckley@leoninepublicaffairs.com
Eleni	Churchill	CCRPC	echurchill@ccpcvt.org
Charles	Baker	CCRPC	cbaker@ccrpcvt.org
Jonathan	Dowds	UVM TRC	jdowds@uvm.edu
Susan	McAvoy	GHSP	susan.mcavoy@vermont.gov
Scott	Deschamps	WorkSafe	scottd@worksafetci.com
Rich	Tatkow	VERMAC	richard.tatkow@vermac.com
Nancy	Andrus	DMV	nancy.andrus@vermont.gov
Sai	Sarepalli	CCRPC	ssarepalli@ccrpcvt.org

VTrans Staff and Meeting Facilitators

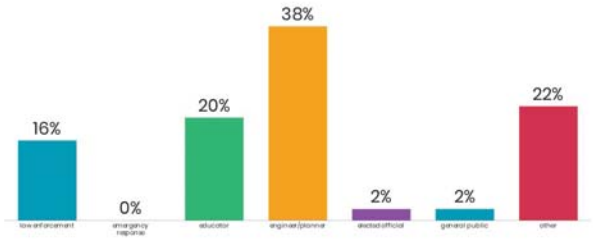
Joe	Segale
Emily	Parkany
Sommer	Bucossi
Zoe	Neaderland

Panel Members

Kevin	Gaffney	VT Dept. of Financial Regulations
Cathie	Curtis	American Association of Motor Vehicle Associations (AAMVA)
Scott	Davidson	VT DMV Chief Inspector
Jim	Hedlund	Highway Safety North
Terry	McDonnell	NY State Police
Barbara	Brody	VT Driver and Traffic Safety Association
Kevin	Marshia	VTrans Chief Engineer
Lisa	Aultman-Hall	UVM Transportation Research Center
Charlie Baker	Baker	Executive Director, Chittenden County RPC

Mentimeter

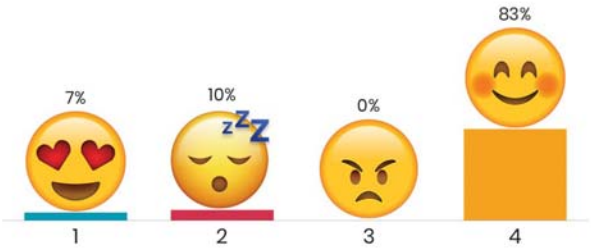
(1/7) Which of the following groups do you represent?



45

Mentimeter

(2/7) Which emoji best represents you today?



42

Mentimeter

(3/7) Would you ride in an AV today?

45

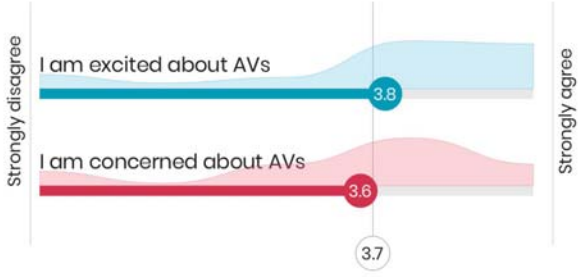
Mentimeter

(4/7) Would you buy an AV when available?

45

Mentimeter

(5/7) How do you rate these statements?



46

Mentimeter

(6/7) What do you find exciting about the possibility of a self-driving car?

41

Mentimeter

(7/7) What concerns you most about self-driving cars?

44

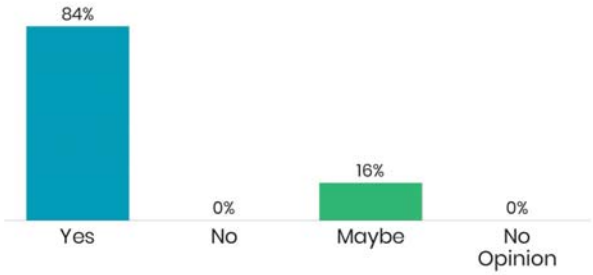
Mentimeter

Discussion 1: Legal and Regulatory Issues

Testing of AVs in Vermont

Mentimeter

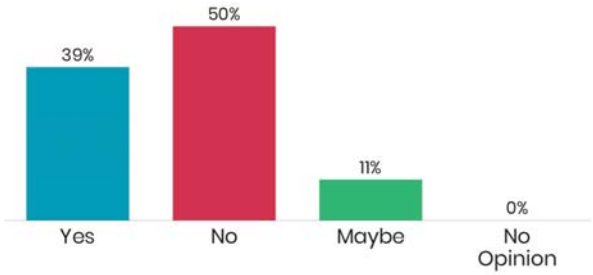
(1/10) Should VT require a permit for the testing of AVs on state and local roads?



37

Mentimeter

(2/10) Should municipalities have a role in the issuance of AV testing permits?



38

Mentimeter

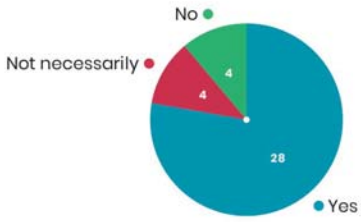
(3/10) What role should municipalities have?

Notification	Advisory	None
They should be a stakeholder in the discussion.	Infrastructure	Minimal
Guidance, but not veto power	Awareness	Set regulatimd
Shouldn't. Too complicated and need to drive all over VT	Permitting for testing on town highways and local roads	Part of discussion
		Monitoring compliancy
	Public outreach Regulation	

33

Mentimeter

(4/10) Should the general public be notified when AVs are being tested on public roads?



36

Mentimeter

(5/10) What issues need to be addressed in an AV testing permit?

Liability	Insurance, liability, restrictions	Liability.
Infrastructure	Safety liability	Liability Responsibility
Local ordinances	Clear expectations	Safety, insurance, liability
Accident areas, school zones speed limits	Liability, restrictions on time / day / location.	Capability, restrictions, safety, and security
Safety, liability	Liability and insurance	Safety, location, contingency

29

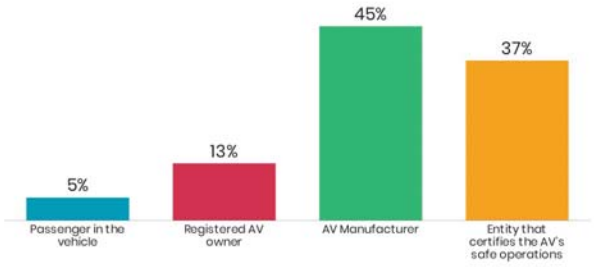
Mentimeter

Discussion 1: Legal and Regulatory Issues

Insurance and licensing related to AVs

Mentimeter

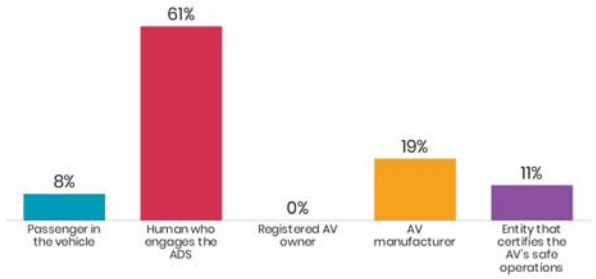
(6/10) Where should liability be assigned if a fully automated (100% self-driving) vehicle runs off a snow covered road and crashes into a tree?



38

Mentimeter

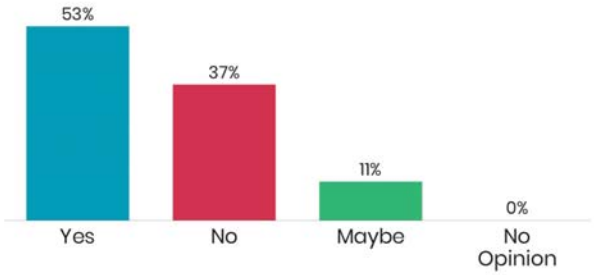
(7/10) Where should liability be assigned if a partially automated vehicle runs off a snow covered road and crashes into a tree (while automated)?



36

Mentimeter

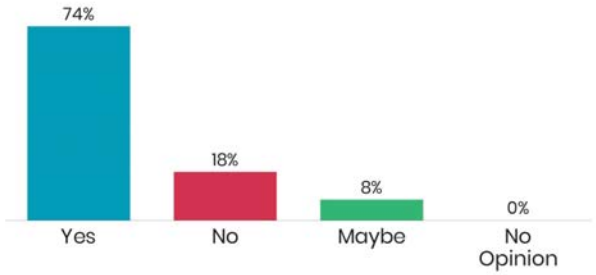
(8/10) Should AV operators have a special license?



38

Mentimeter

(9/10) Should AVs be identifiable through a special license plate or other means?



38

Mentimeter

(10/10) Are there additional questions or comments regarding Legal and Regulatory Issues before moving on?

Hacking	No	Who is responsible for keeping datasets up to date?
Trucks	Driver Training...	Who is responsible for liability
DUI	None	Should the rules be different for "shared" vehicles?
We as a state need to be thorough but aggressive to get this done.	Driver training	Clarity on where liability lies for different situations
	Can you get a DUI in an AV?	

25

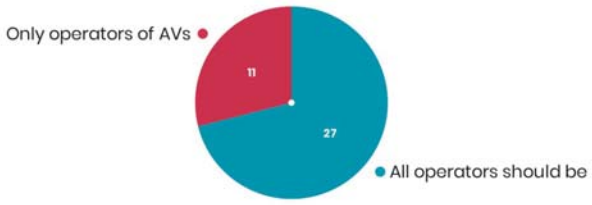
Mentimeter

Discussion 2: Operator Education and Emergency Response

AV operator education and training

Mentimeter

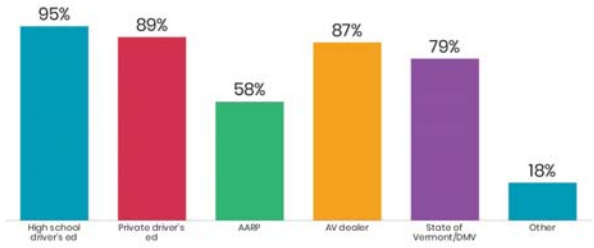
(1/10) AVs and conventional vehicles will share the roads. Should all operators be required to be educated in the use of AV technology?



38

Mentimeter

(2/10) Who should provide AV education?



38

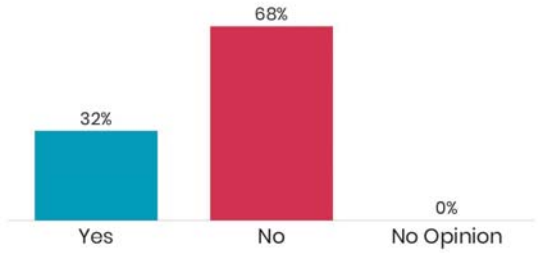
Mentimeter

Discussion 2: Operator Education and Emergency Response

Enforcement of laws governing AV operation

Mentimeter

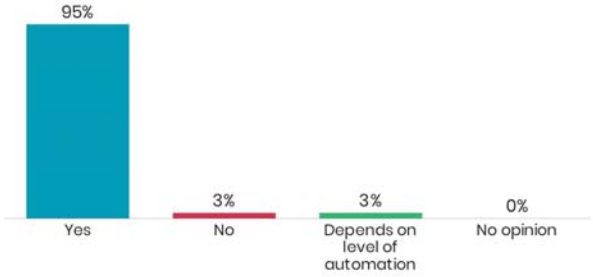
(3/10) Should an operator of a partially automated vehicle be allowed to text while in automated driving mode?



38

Mentimeter

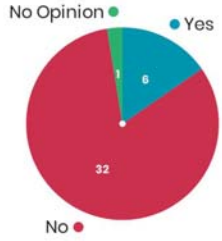
(4/10) Should operator of a partially automated vehicle be in the driver seat at all times, even when the vehicle is in automated mode?



37

Mentimeter

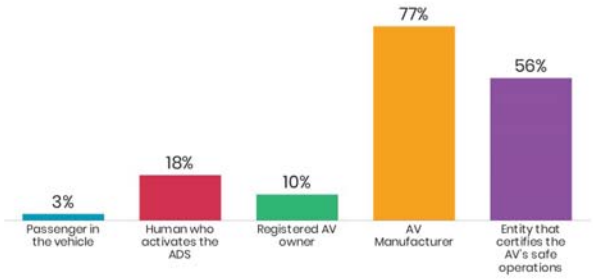
(5/10) Should all passengers in a fully automated vehicle be subject to impaired driving laws?



39

Mentimeter

(6/10) If an AV makes an error and violates a traffic law, who is responsible?



39

Mentimeter

(7/10) What new traffic laws are needed for safe AV operations?

31

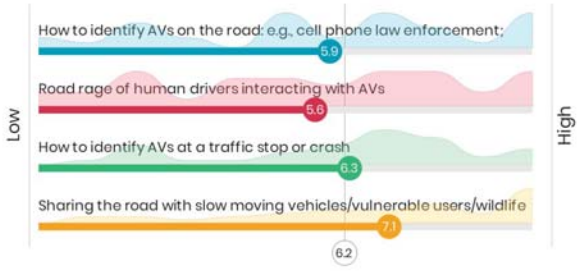
Mentimeter

Discussion 2: Operator Education and Emergency Response

Emergency response practices in relation to AVs

Mentimeter

(8/10) What is your level of concern about the following law enforcement and emergency response issues:



38

Mentimeter

(9/10) How could these concerns be addressed or are there concerns missing?

Clear legislation and rigorous testing/inspections	Legislation	Test driving
Update laws and regulations	State laws	Visitors to the state
Maintenance of autonomous vehicle- example: cleaning sensors so things like pedestrians and wildlife are detected	Autonomous security and protection	Exhaustive testing.
	Data privacy	Legislation Laws Education Certification of AV Training from the dealer level
	Vehicle Maintenance?	

35

Mentimeter

(10/10) Are there additional questions or comments regarding Operator Education and Emergency Response before moving on?

What data is contemplated being gathered by the manufacturer?	Many questions, few answers	No
How do onboard systems interact or remain isolated? How do users interact with various systems?	Emergency response vehicles have to weave and avoid other vehicles How would this work with AV?	Will the public be accepting of more stringent recurring training?
Several unknowns	Will all of the data gathered by hardware and software developers be available to other stakeholders?	Maybe there could be regular virtual testing for drivers.

9

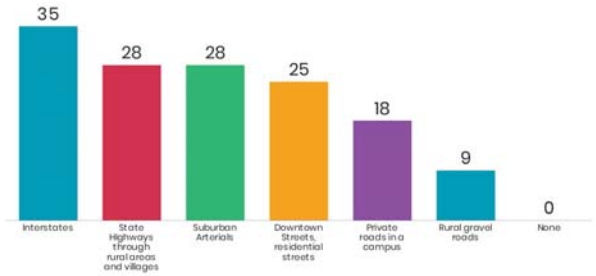
Mentimeter

Discussion 3: Infrastructure, Socioeconomic and Environmental

Infrastructure needs associated with the rollout of AVs

Mentimeter

(1/11) Which types of roads/streets are suitable for AV use in VT? Pick all that apply.



35

Mentimeter

(2/11) What other physical challenges should we be thinking about?

Work zones	The notch	Cell data signal
Mud season	Church street	Snow, ice
Potholes	Degraded line striping	Markings
Ped zones	Construction	Black ice
Vehicle to infrastructure communications	Charging stations,	Do we need cell service to operate AV?

36

Mentimeter

(3/11) What changes might be necessary to make Vermont highways ready for AVs?

More cell towers	Less potholes	Funding
Fiber and cell coverage	Better cell coverage and mapping	Better lane markings
More cell service	Signage/markers	More robust communications network
Better interoperable road data	Better mapping	Better markings
RFID defined lanes?	Full cell coverage	Dedicated lanes (at least in

30

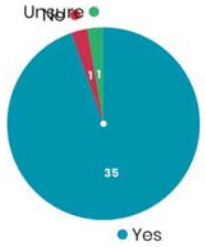
Mentimeter

Discussion 3: Infrastructure, Socioeconomic and Environmental

Social, economic, and environmental consequences of the rollout of AV

Mentimeter

(4/11) Do you believe that AVs could lead to a reduction of crashes?



37

Mentimeter

(5/11) Why do you think AVs will reduce crashes?

Constant sensing of their environment	Removing people	Less human error.
Remove human error	No human error	Human error eliminated
Eliminates human error	Less human input	Getting rid of humans
Eliminate human error	Reduce opportunity for human error	People are very error prone.
Human error	Reduce driver error	Remove the human factor

33

Mentimeter

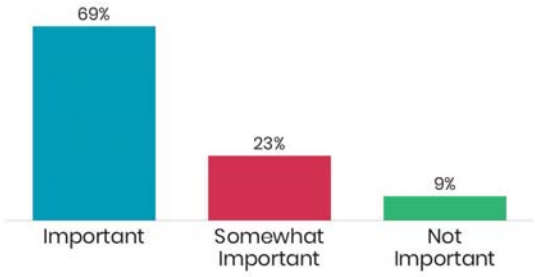
(6/11) Why do you think AVs will increase crashes?

They wont	Software bugs	No
Technology glitch	Won't	Increasing walkers and bikers
Error	Malfunction of technology	Hacking
Can't see potholes	Hacking/security issues/glitches	Only severity of crashes if AV failure
Faulty av	Still humans driving with AV	Human drivers will try to take

27

Mentimeter

(7/11) Is Vermont's ability to facilitate the safe deployment of AVs important to the state's economic future?



35

Mentimeter

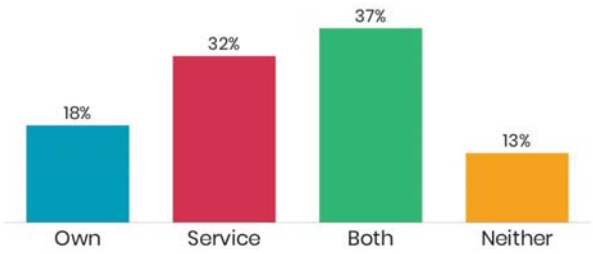
(8/11) Why do you believe AVs are important (or not important) to the state's economic future?

Tourism.	Stimulate downtowns and connect rural towns	Freight
Tourists	Won't have a choice. It's coming either way	Connect to our regional economy
Tourism. People coming fro other states	To keep up with the world around us.	Enhanced mobility of older population
Moving the elderly, reducing manufacturing cost	Remain competitive with other states.	Allow visitors from other states and companies to come here

39

Mentimeter

(9/11) Would you prefer to own an AV or use AV as a service?



38

Mentimeter

(10/11) What social, economic and environmental opportunities and challenges do AVs present in VT?

Land use opportunities in our centers	Affordability	Job displacemt
In AV as service, what is the wait time in rural areas?	Sustainable electricity production	Who will be able to afford them? How much will they cost?
General resistance to change and technology	Where do we put all of the parking if not in or downtowns?	Senior mobility, esp in non-urban environment.
Cost Charging stations everywhere	Changing mentalities around vehicle ownership	Passengerless vehicle miles

28

Mentimeter

(11/11) After our Infrastructure Needs and Social, Economic and Environmental Discussion, do you have additional comments?

Charlie had a good point about higher fees for empty miles.	Personal safety like for women	More work needs to be done.
Security/hacking/terrorism	Lifespan on vehicles? Constant updates like our phone? What waste is associated with that piece	We are going to need a lot of help....
Who has the right of way between an AV and a drone?	Taxation issues-utilize the embedded information and substitute user tax per mile instead of gas tax.	Connectivity is going to be crucial. V2v and v2i are going to have to be cutting edge and robust and secure.
What is an alternative to the gas tax to fund AV		What do we do with people

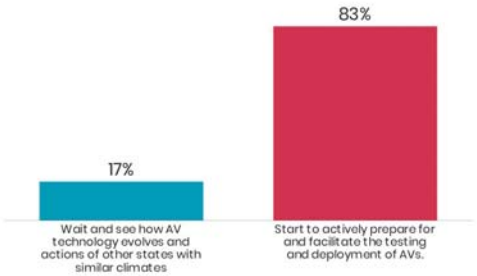
25

Mentimeter

Wrap-up and where do we go from here?

Mentimeter

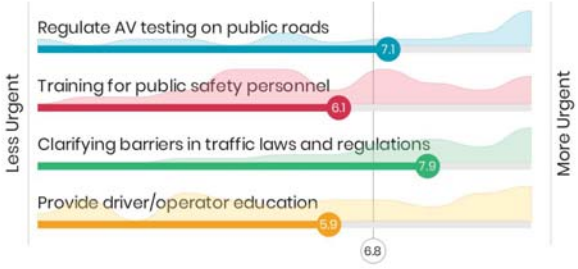
(1/3) What should VT's general approach to AVs be:



30

Mentimeter

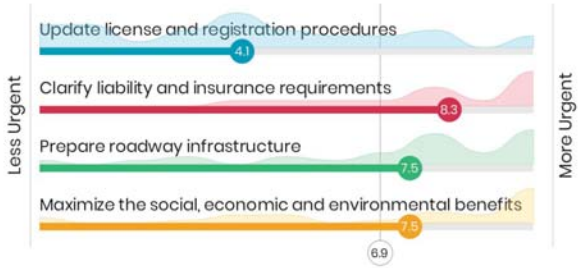
(2/3) (Part 1) Rank the urgency of the following AV related issues



30

Mentimeter

(2/3) (Continued) Rank the urgency of the following AV related issues



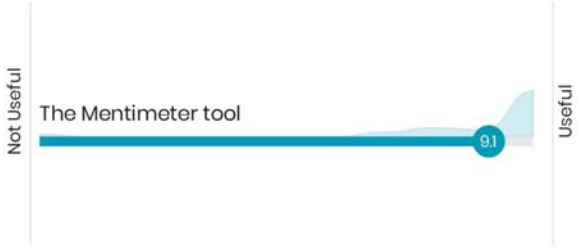
30

Mentimeter

THANK YOU!

Mentimeter

(3/3) How do you feel about this tool?



31