



# **PennDOT Act 130 Reporting: Evaluating the Impact of Connected and Automated Vehicles to the Commonwealth of Pennsylvania**

**FINAL REPORT**

**January 08, 2025**

**By:**

**HAV Advisory Committee**

**PennDOT:** Derrick Herrmann, Kevin Tobias

**Pennsylvania State University:** Yuyan Pan,  
Xianbiao Hu, Nikhil Menon, Vikash Gayah, Ilgin  
Guler, Andisheh Ranjbari

**TraffiQure LLC (DBE/SWaM):** Sean Qian

**The Pennsylvania State University**

**The Thomas D. Larson Pennsylvania  
Transportation Institute**



**COMMONWEALTH OF  
PENNSYLVANIA DEPARTMENT  
OF TRANSPORTATION**



**CONTRACT # 4400023298/512101**

**WORK ORDER # PSU WO 012**

2 **Technical Report Documentation Page**

<b>1. Report No.</b> PSU WO 012		<b>2. Government Accession No.</b>		<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b>  PennDOT Act 130 Reporting: Evaluating the Impact of Connected and Automated Vehicles to the Commonwealth of Pennsylvania				<b>5. Report Date</b> January 2025	
				<b>6. Performing Organization Code</b>	
<b>7. Author(s)</b>  Derrick Herrmann, Kevin Tobias, Yuyan Pan, Xianbiao Hu, Nikhil Menon, Vikash Gayah, Ilgin Guler, Andisheh Ranjbari and Sean Qian				<b>8. Performing Organization Report No.</b>  XXX	
<b>9. Performing Organization Name and Address</b>  The Thomas D. Larson Pennsylvania Transportation Institute The Pennsylvania State University				<b>10. Work Unit No. (TRAIS)</b>	
				<b>11. Contract or Grant No.</b> 4400023298/512101	
<b>12. Sponsoring Agency Name and Address</b>  The Pennsylvania Department of Transportation Bureau of Planning and Research Commonwealth Keystone Building 400 North Street, 6th Floor Harrisburg, PA 17120-0064				<b>13. Type of Report and Period Covered</b>  Final Report (04/08/24 – 01/08/25)	
				<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b>					
<b>16. Abstract</b>  This report presents the findings from focus groups conducted in 2024. The primary objective of the research was to provide a comprehensive analysis of the impact of Act 130 within Pennsylvania's unique context. The study examines the specific benefits and challenges of Highly Automated Vehicles (HAVs), with a focus on workforce development, economic growth, accessibility, and mobility improvements. The findings are intended to support PennDOT in its efforts related to HAVs and offer actionable insights and recommendations to policymakers, helping Pennsylvania maximize the benefits of HAV technology while addressing potential challenges.					
<b>17. Key Words</b>  HAVs; Act 130; focus group; R&D; workforce transformation; workforce and economic implications; accessibility and mobility				<b>18. Distribution Statement</b>	
<b>19. Security Classif. (of this report)</b>  Unclassified		<b>20. Security Classif. (of this page)</b>  Unclassified		<b>21. No. of Page</b>  80	<b>22. Price</b>  \$99,893.07

4	Table of Contents	
5	<b>Acknowledgments and Disclaimers</b> .....	<b>5</b>
6	<b>Executive Summary</b> .....	<b>6</b>
7	<b>1. Introduction</b> .....	<b>11</b>
8	<b>2. Review the State of the Art</b> .....	<b>15</b>
9	<b>2.1 Impacts of HAV on Workforce</b> .....	<b>15</b>
10	<b>2.2 Impacts of HAV on Economic</b> .....	<b>17</b>
11	<b>2.3 Impacts of HAV on Accessibility</b> .....	<b>19</b>
12	<b>2.4 Impacts of HAV on Mobility</b> .....	<b>20</b>
13	<b>3. Research Methodology</b> .....	<b>23</b>
14	<b>3.1 Focus Group Preparation</b> .....	<b>24</b>
15	3.1.1 Understanding Act 130 .....	25
16	3.1.2 Development of Questionnaires .....	25
17	<b>3.2 Establishment and Conduct of Focus Groups</b> .....	<b>26</b>
18	3.2.1 Stakeholder Identification .....	26
19	3.2.2 Focus Group Establishment and Participant Engagements .....	26
20	<b>3.3 Individual Interviews</b> .....	<b>27</b>
21	<b>3.4 Review and Summarizing Results</b> .....	<b>28</b>
22	<b>4. Focus Group Formation and Data Collection</b> .....	<b>30</b>
23	<b>4.1 Participant Selection and Invitation</b> .....	<b>30</b>
24	<b>4.2 Focus Group Categorization</b> .....	<b>31</b>
25	<b>4.3 Execution of Focus Groups</b> .....	<b>33</b>
26	<b>4.4 Holding Short Meetings</b> .....	<b>36</b>
27	<b>4.5 Analysis of the Composition of Participants</b> .....	<b>37</b>

28	<b>5. Impact Analysis of Workforce and Economic Implications.....</b>	<b>39</b>
29	<b>6. Impact Analysis of Improvements to Accessibility and Mobility .....</b>	<b>51</b>
30	<b>7. Recommendations .....</b>	<b>58</b>
31	<b>Appendix A Q&amp;A Documents for Understanding Act 130.....</b>	<b>61</b>
32	<b>Appendix B Interviewer Script for Workforce and Economic Impact.....</b>	<b>71</b>
33	<b>Appendix C Interviewer Script for Accessibility and Mobility Impact .....</b>	<b>72</b>
34	<b>Appendix D Information of Identified Stakeholders .....</b>	<b>73</b>
35	<b>(1) Benefits and Implications to the Commonwealth’s workforce .....</b>	<b>73</b>
36	<b>(2) Economic Benefits and Implications to the Commonwealth .....</b>	<b>74</b>
37	<b>(3) Improvements to Accessibility for Persons with Disabilities .....</b>	<b>75</b>
38	<b>(4) Improvements to Mobility Options for the General Public .....</b>	<b>76</b>
39	<b>Appendix E Information of Final Focus Groups Participants .....</b>	<b>78</b>
40	<b>References .....</b>	<b>81</b>
41		
42		

43 **Acknowledgments and Disclaimers**

44 This material is based upon work supported by the Pennsylvania Department of Transportation (PennDOT) under  
45 the award number 4400023298/512101, project number PSU WO 012. This report was prepared as an account of  
46 work sponsored by PennDOT. Neither PennDOT nor any agency thereof, nor any of their employees, makes any  
47 warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or  
48 usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe  
49 privately owned rights. Reference herein to any specific commercial product, process, or service by trade name,  
50 trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or  
51 favoring by PennDOT or any agency thereof. The views and opinions of authors expressed herein do not necessarily  
52 state or reflect those of PennDOT or any agency thereof.

53 The views expressed in the article do not necessarily represent the views of PennDOT. PennDOT retains and the  
54 publisher, by accepting the article for publication, acknowledges that PennDOT retains a nonexclusive, paid-up,  
55 irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for  
56 PennDOT purposes.

57

58 **Executive Summary**

59 Pennsylvania's legislative framework for Highly Automated Vehicles (HAVs) has undergone significant evolution  
60 with the enactment of [Act 130 of 2022](#), a comprehensive amendment to Title 75 (Vehicles). Building on the  
61 foundations established by [Act 117 of 2018](#), which introduced Chapter 85 specifically addressing HAVs, Act 130  
62 refines this framework. It offers detailed definitions and guidelines for the HAV Advisory Committee, enhancing  
63 Pennsylvania's legal infrastructure to support the complexities of HAV technology and ensuring the state's vehicle  
64 laws meets the advanced demands of HAVs. Act 130 requires the HAV Advisory Committee to complete a set of  
65 special reports as detailed in 75 Pa. CS § 8503 (j) to be submitted to the Pennsylvania House and Senate  
66 Transportation Committees. The report shall evaluate the following with respect to highly automated vehicles  
67 authorized by this chapter:

- 68 (1) Benefits and implications to this Commonwealth's workforce.
- 69 (2) Economic benefits and implications to this Commonwealth.
- 70 (3) Improvements to accessibility and mobility for persons with disabilities.
- 71 (4) Improvements to mobility options for the general public.
- 72 (5) Suggested changes to the laws of this Commonwealth.

73 The primary objective of this research was to conduct a thorough analysis of the impact of Act 130 within the unique  
74 context of Pennsylvania. This study explores the distinct benefits and challenges of HAVs, focusing on workforce  
75 development, economic growth, accessibility, and mobility improvements. Our goal is to provide actionable insights  
76 and recommendations for policymakers to help Pennsylvania harness the advantages of HAV technology while  
77 mitigating potential challenges. This research aims to contribute to shaping the future of transportation in  
78 Pennsylvania, aligning with the commonwealth's specific needs and objectives.

79 This executive summary outlines the process and findings from expert focus groups conducted in 2024. In  
80 collaboration with PennDOT and the HAV Advisory Committee, our research team identified 93 potential  
81 participants with relevant expertise across various sectors, including HAV vendors/software developers/automakers,  
82 trade associations, non-government organizations (NGOs), government agencies, consulting firms, academic  
83 researchers, and transit companies. From this pool, 35 experts agreed to participate in the focus group discussions.  
84 These sessions provided a diverse representation of backgrounds and perspectives, essential for a comprehensive  
85 discussion on the implications of HAVs in Pennsylvania.

86 The discussions were held across five focus group sessions on September 3, 4, 5, 12, and 13, supplemented by three  
87 shorter individual sessions on September 13, 20, and 26. These discussions were centered on Act 130's implications

88 and the broader effects of HAVs on Pennsylvania’s workforce, accessibility, and mobility. The focus groups explored  
89 four key topics:

- 90 • Benefits and implications to this Commonwealth’s workforce.
- 91 • Economic benefits and implications to this Commonwealth.
- 92 • Improvements to accessibility and mobility for persons with disabilities.
- 93 • Improvements to mobility options for the public.

94 Below, we provide a summary of the focus group findings, offering insights into how the introduction of HAVs can  
95 shape various aspects of public life and policy in Pennsylvania.

96 **Workforce and economic implications**

- 97 1. Act 130 marks a turning point for Pennsylvania's HAV industry: The enactment of Act 130 has brought  
98 legislation to support the testing and deployment of HAVs in Pennsylvania, marking a significant turning  
99 point in the state's highly automated vehicle industry. Prior to this legislation, the lack of legal support led  
100 some automated driving R&D companies to contemplate relocating or shifting significant portions of their  
101 business to other states, where early supportive laws were already in place. The enactment of Act 130 has  
102 not only enabled more comprehensive testing and scaling opportunities for AV companies in Pennsylvania  
103 but has also created a supportive legal environment that encourages these companies to stay and grow within  
104 the state. This legislation has helped protect existing jobs, facilitated the creation of new ones, and paved the  
105 way for significant growth in Pennsylvania’s highly automated vehicle industry in the coming years.
- 106 2. Economic potential of HAVs in freight transportation: Focus group participants discussed the impact of  
107 HAVs across various sectors, including transit, passenger vehicles, freight, and more. There were multiple  
108 participants who felt strongly that HAVs hold significant economic potential for the freight sector, with  
109 benefits likely to materialize more immediately in freight compared to other sectors.
- 110 3. Creation of new job opportunities in the era of HAVs: The introduction of HAVs is anticipated to generate  
111 many job opportunities across Pennsylvania over the next decade, encompassing a wide range of sectors and  
112 skill sets. To succeed in this rapidly evolving landscape, workers will need to combine traditional mechanical  
113 skills with advanced expertise in areas such as artificial intelligence, cybersecurity, and data analysis.
- 114 4. Talent retention in the HAVs sector: Talent retention was another key topic discussed during the focus group  
115 session. Participants shared a concerning trend that individuals, particularly younger generations who earn  
116 AV/robotics-related degrees in Pennsylvania, often leave the state to pursue opportunities elsewhere.  
117 Participants acknowledged that the passing of Act 130 is a positive development. This legislation enables  
118 vendors to test HAVs in Pennsylvania, which could eventually lead to a transition into the manufacturing

119 phase. It will be interesting to see how these changes influence job opportunities and talent retention in the  
120 years ahead.

- 121 5. Impact on suburb/rural area economies: Participants discussed and found that HAVs offer significant  
122 opportunities to enhance connectivity and economic vitality in rural areas by improving first-mile and last-  
123 mile transit solutions. By bridging gaps in transportation services, HAVs can revitalize rural communities  
124 through improved job access, stronger links between rural and urban regions, and greater overall regional  
125 equity.
- 126 6. Post-research and development (R&D) opportunities: Some participants mentioned that, as Pittsburgh and  
127 its surrounding regions increase R&D investments in automated driving and HAV testing, a clustering effect  
128 of related technology companies may emerge, fostering a robust innovation ecosystem. This ecosystem will  
129 attract businesses specializing in crucial automated driving technologies—such as sensors, software  
130 development, and integrated systems—further accelerating technological integration and advancement.
- 131 7. The need to continuously monitor evaluate impact: Participants note that the economic impact of Act 130  
132 has not yet fully materialized. For example, one participant explicitly noted the economic impact does not  
133 exist yet, since the act was only passed recently. They also noted that workforce changes will likely evolve  
134 over several years as the situation unfolds. Additionally, it remains unclear which businesses have obtained  
135 licenses under the new law since its enactment. Therefore, ongoing and long-term evaluations of workforce,  
136 economic, accessibility, and mobility factors are necessary to fully understand Act 130’s influence on the  
137 development of HAVs in Pennsylvania.
- 138 8. Economic potential of HAVs in the Pittsburgh region suggested by participant’s previous research: One  
139 participant referenced a conservative estimate from research [42] regarding the economic impact of the  
140 Pittsburgh region’s automated systems industry. According to this study, the industry currently encompasses  
141 71 companies employing over 6,300 individuals, generating significant economic benefits for the area.

142  
143 **Improvements to accessibility and mobility.**

- 144 1. Impact on people with disabilities and older adults: A general consensus among focus group participants is  
145 that HAVs have the potential to significantly improve accessibility for individuals with disabilities and older  
146 adults by offering a wider range of travel options and more convenient, on-demand services. However, to  
147 fully realize the benefits of HAVs for disabled and older passengers, participants highlighted several critical  
148 factors that need to be addressed.
- 149 2. Enhancing accessibility through first and last mile connectivity: Participants generally agreed that HAVs  
150 could significantly improve accessibility, particularly in regions with limited transportation options, such as

151 rural areas or underserved urban communities. In these locations, inadequate public transit services often  
152 leave residents with few reliable travel options. By offering convenient and flexible transportation solutions,  
153 HAVs can help bridge this gap, connecting people to vital services, employment opportunities, and essential  
154 resources that would otherwise be difficult to reach.

- 155 3. HAVs as a supplement to public transportation systems and freight industry: Many participants concurred  
156 that HAVs have the potential to complement—rather than compete with—public transportation systems and  
157 the freight industry, improving efficiency, expanding coverage, and enhancing cost-effectiveness.
- 158 4. Potential impact on urban and rural areas: Most participants believe that in urban environments, HAVs have  
159 the potential to significantly extend the reach of existing public transportation systems, such as subways and  
160 regional rail networks. By offering efficient first-mile and last-mile solutions, HAVs can make it easier for  
161 residents to access transit hubs and reach destinations not directly serviced by traditional transit routes. This  
162 enhanced connectivity can lead to improved mobility within cities, reduced traffic congestion, and a more  
163 integrated urban landscape. Ultimately, the integration of HAVs can result in more efficient and user-friendly  
164 transportation systems that benefit all city dwellers.
- 165 5. Improving road safety through HAVs technology: HAVs are poised to significantly enhance road safety by  
166 strictly adhering to traffic laws and minimizing risks associated with human error. Unlike human drivers,  
167 who can be prone to distractions, fatigue, or misjudgments, HAVs operate based on consistent, data-driven  
168 decision-making processes. This adherence to traffic rules leads to more predictable and safer behavior on  
169 the road, potentially reducing the number of traffic violations and accidents. Participants believe by  
170 removing common human-related errors, HAVs can create a safer driving environment and improve overall  
171 road safety for everyone.
- 172 6. Upgrading infrastructure to support HAVs and public transportation: Infrastructure improvements are crucial  
173 for optimizing the performance of HAVs and enhancing the overall public transportation system. Upgrading  
174 road markings, protected spaces for vulnerable road users (VRUs), and others were discussed.

175  
176 **Recommendation on policy and legislation updates**

- 177 1. Some focus group participants, particularly those representing HAV vendors and trade associations,  
178 suggested reducing regulatory oversight for Level 3 automated vehicles.
- 179 2. Some focus group participants recommended avoiding state-specific testing and reduce regulations.
- 180 3. Some focus group participants recommended allowing individual ownership under Act 130.
- 181 4. Enhancing public trust in highly automated vehicles is a shared concern.

- 182 5. Some focus group participants recommended establishing a detailed emergency response protocol for HAVs  
183 that includes procedures for identifying, securing, and disabling vehicles in emergency situations.
- 184 6. Some focus group participants recommended establishing enhanced training programs for first responders  
185 (e.g., police officers, firefighters, paramedics, hazmat teams) to effectively manage emergency situations  
186 involving HAVs, thereby improving safety and preparedness.
- 187 7. Some focus group participants recommended prioritizing the repair and maintenance of critical  
188 transportation infrastructure, such as road markings, signs, and traffic lights, to support the safe integration  
189 of HAVs into Pennsylvania’s transportation network.
- 190 8. Some focus group participants recommended implementing policies to encourage the deployment of HAVs  
191 in rural areas to improve first-mile and last-mile transit solutions, enhance connectivity, and support regional  
192 economic growth.

193

194 **1. Introduction**

195 The rapid advancement in automated vehicle (AV) technology is expected to transform transportation in the coming  
196 decade. It is widely predicted that AVs will be in extensive use by around 2040, though estimates of when they will  
197 become fully mainstream vary (Litman, 2020). In another research, (Nikitas et al., 2021) suggest that by 2035, 75%  
198 of global light-duty vehicle sales will be self-driving vehicles, which would significantly reduce the demand for  
199 professional driving jobs. The development of Connected and Automated Vehicles (CAVs) is anticipated to impact  
200 numerous industries profoundly. Based on preliminary research into AV-related impacts, the industries expected to  
201 experience the most substantial shifts include automotive, technology, freight movement, personal transport, auto  
202 repair, medical care, insurance, law, infrastructure, land development, digital media, policing, and oil and gas  
203 (Clements & Kockelman, 2017).

204 As Highly Automated Vehicle (HAV) technology rapidly progresses, various states in the U.S. have introduced  
205 legislation to support its development. In Pennsylvania, the legislative framework for HAV is evolving with [Act 130](#),  
206 a comprehensive amendment to Title 75 (Vehicles), signed into law in November 2022. This act strengthens  
207 Pennsylvania's role as a national leader in HAV research and development by establishing the regulation and  
208 operation of HAVs within the state. Building on Act 117, which introduced Chapter 85 to Title 75 specifically for  
209 HAVs, Act 130 refines the framework by defining and guiding the HAV Advisory Committee, thus enhancing the  
210 legal infrastructure to meet HAV technology's complex demands and aligning Pennsylvania's vehicle laws with the  
211 advanced requirements of HAVs.

## Act 130 for Highly Automated Vehicles in Pennsylvania



### Overview of Act 130

- Updates the legal framework for the deployment and operation of Highly Automated Vehicles (HAVs) in the state.
- Aims to enhance public safety, establish operational standards, and provide guidelines for the certification and regulation of automated driving systems (ADS).

### Key Provisions

- Amends the state's vehicle code (Title 75) to refine definitions, rules, equipment standards, inspections, and regulations related to HAVs.

- HAVs definition: motor vehicles equipped with an ADS capable of performing the entire dynamic driving task. HAVs include vehicles with automation levels 3 to 5.
- Platoon definition: a group of buses, military vehicles, or trucks that travel closely together using electronic systems to safely maintain shorter distances between each other.

### Deployment Guidelines

- Eligible entities to hold HAV certificates include firms, partnerships, associations, corporations, or educational or research institutions.
- Individual persons are not typically recognized as certificate holders.
- When an HAV is involved in an accident, the responsible party must immediately contact a duly authorized police department and PennDOT to report the accident.

### Compliance and Penalties

- Transferring a certificate of title without indicating a specific use or condition results in a \$200 fine.
- Operating an HAV in violation of regulations incurs a fine of at least \$1,000 upon conviction.

### Impact Assessment

- Provides enhanced safety measures for HAV operations, including specific accident response protocols.
- The HAV Advisory Committee will continuously evaluate the impacts of HAVs on public safety.

### Contact Information

- Phone: 717-787-2838
- Email: [penndotav@pa.gov](mailto:penndotav@pa.gov)



HAV Advisory Committee Act 130 Legislation

212

213

Figure 1 Act 130 Overview

214

Act 130 marks a major advancement and a milestone in Pennsylvania's regulatory approach to HAVs, particularly as it establishes the first legal pathway toward driverless operations, which were previously prohibited in the state.

215

216

The act focuses on safety standards, operational protocols, and integrating HAVs into existing transportation systems.

217

It mandates the formation of an advisory committee to steer HAV policy development, ensuring input from diverse stakeholders.

218

Additionally, Act 130 establishes testing and certification procedures for HAVs, balancing public safety concerns with support for innovation.

219

This structured regulatory framework and stakeholder collaboration are key to Pennsylvania's journey toward a modern and safe transportation ecosystem.

220

Together with Title 75 and Act 117, Act 130 forms a comprehensive legal foundation that governs HAV operation and testing while considering the technology's broader societal impacts.

221

By highlighting HAVs, the act emphasizes the importance of exploring how this technology will transform various facets of society.

222

Analyzing the impact of Act 130 on Pennsylvania is essential as the state navigates the transformative landscape of Highly Automated Vehicles.

223

This legislative act marks a pivotal step for the Commonwealth in adopting HAV technology, making it critical to understand its implications fully.

224

Studying Act 130 allows the Commonwealth to assess its influence on workforce dynamics, economic changes, and improvements in accessibility and mobility, particularly for individuals with disabilities.

225

Additionally, Act 130 positions Pennsylvania as a leader in HAV adoption, underscoring the need for thoughtful policy development and implementation.

226

This study aims to provide

227

228

229

230 insights and actionable recommendations that contribute to informed policymaking, ultimately positioning  
231 Pennsylvania at the forefront of HAV innovation and helping the state maximize benefits while addressing potential  
232 challenges and risks.

233 Penn State has been entrusted with supporting Pennsylvania Department of Transportation in this critical endeavor.  
234 The primary goal of this research project is to provide a comprehensive analysis of Act 130's impact within  
235 Pennsylvania's unique context. Specifically, the team will examine the implications of Act 130 and the broader  
236 effects of HAVs on Pennsylvania across four key areas:

- 237 • Benefits and implications to this Commonwealth's workforce.
- 238 • Economic benefits and implications to this Commonwealth.
- 239 • Improvements to accessibility and mobility for persons with disabilities.
- 240 • Improvements to mobility options for the public.

241 By delivering detailed insights and recommendations, this study will support effective policymaking, reinforcing  
242 Pennsylvania's role as a leader in HAV innovation and maximizing benefits for the Commonwealth while  
243 proactively addressing potential challenges and risks.

244 We structure the report as follows:

245 [Section 2](#) of this report provides an overview of this existing research, aiming to build upon these foundations with  
246 a focus specifically tailored to Pennsylvania. In the expansive field of HAVs, our research acknowledges the  
247 extensive body of recent studies that have deepened understanding of HAV technology's potential impacts. While  
248 these studies are primarily global or national in scope and may not directly address Pennsylvania's unique context,  
249 they offer valuable insights in terms of study designs, methodologies, and findings that can inform and strengthen  
250 our approach.

251 [Section 3](#) documents the methodology used to support this project. In collaboration with PennDOT and the HAV  
252 Advisory Committee, our research team identified 93 potential participants with relevant expertise across various  
253 sectors, including HAV vendors/software developers/automakers, trade associations, non-government organizations  
254 (NGOs), government agencies, consulting firms, academic researchers, and transit companies. From this pool, 34  
255 experts agreed to participate in the focus group discussions. These sessions provided a diverse representation of  
256 backgrounds and perspectives, essential for a comprehensive discussion on the implications of HAVs in  
257 Pennsylvania.

258 [Section 4](#) details the specific processes and steps of organizing the focus groups. We utilized Google Forms to survey  
259 participants' availability and divided them into five focus groups based on theme and availability. Due to scheduling

260 conflicts, one-on-one sessions were conducted with a few key stakeholders who were unavailable for the group  
261 sessions.

262 [Sections 5](#) and [6](#) summarize the findings from the focus group and one-on-one sessions, focusing on workforce and  
263 economic impacts, and accessibility and mobility impacts, respectively. [Section 7](#) summarizes the recommendations  
264 concerning Pennsylvania’s HAV legislation and PennDOT policies and procedures, aimed at informing future policy  
265 decisions.

266 The appendix contains multiple task deliverables for reference, providing interested readers with detailed insights  
267 into the research methodology and steps. These include Appendix A Q&A Documents for Understanding Act 130  
268 designed to help readers better understand the Act, Appendix B Interviewer Script for Workforce and Economic  
269 Impact Analysis, Appendix C Interviewer Script for Accessibility and Mobility Impact Analysis, Appendix D  
270 Information of Identified Stakeholders, and Appendix E Information of Final Focus Groups Participants.

271

272 **2. Review the State of the Art**

273 HAVs are expected to bring systematic impacts to many facets of our society. For example, research in North  
274 Carolina demonstrates their potential to enhance safety and efficiency (Bardaka et al., 2019). However, it was also  
275 found that personal AVs may induce travel demand, resulting in a 5.4% increase in daily vehicle hours traveled, and  
276 a 17.2% increase in daily hours of delay. A study on commercial and shared vehicle operations reveals operational  
277 optimizations, promising enhanced efficiency and cost-effectiveness (Part et al., 2021). Meanwhile, HAVs’  
278 environmental impact is examined in (Massar et al., 2021), presenting a nuanced view, acknowledging that their  
279 effects on greenhouse gas emissions depend on factors like vehicle efficiency and energy sources. These reports  
280 collectively portray HAVs as transformative forces,  
281 offering benefits in safety, mobility, and sustainability,  
282 yet necessitating careful infrastructure and regulatory  
283 considerations.

284 Acknowledging the importance of building upon the  
285 existing knowledge base rather than reinventing the  
286 wheel, we undertake a brief yet systematic review of  
287 these pioneering HAV-related studies in this chapter.  
288 This review serves as the foundation upon which we will  
289 build our research, leveraging the collective insights and  
290 experiences of researchers from diverse geographical  
291 contexts to tailor our approach effectively to the specific  
292 needs and dynamics of Pennsylvania. In the remainder  
293 of this chapter, we will elaborate on the benefits and  
294 improvement of HAVs from four aspects: workforce,  
295 economy, accessibility, and mobility.

296 **2.1 Impacts of HAV on Workforce**

297 HAVs technologies are poised to bring significant changes to the workforce. In the US, the Department of Commerce  
298 estimates that 15.5 million U.S. workers were employed in occupations that could be affected (to varying degrees)  
299 by the introduction of AVs (Beede & Powers, 2017). They divide these occupations into “motor vehicle operators”  
300 and “other on-the-job drivers.” Motor vehicle operators are occupations for which driving vehicles to transport  
301 persons and goods is a primary activity, are more likely to be displaced by AVs than other driving-related occupations.



Figure 2 Representative existing studies

302 Groshen et al. (2018) estimate that 60 to 65 percent of heavy and tractor-trailer driver jobs could be eliminated with  
303 full adoption of Level 4 or 5 driving automation. Although current data are somewhat outdated, approximately  
304 300,000 to 500,000 long-haul trucking jobs exist within a total of two million heavy truck and tractor-trailer positions  
305 nationwide (USDOT, 2021). Millions more hold roles where driving is a secondary duty, such as construction  
306 workers, utility workers, real estate agents, appraisers, and tradespeople who drive between job sites. Additionally,  
307 over five million jobs in automotive repair and highway maintenance support these driving roles. Overall, driving  
308 automation may offer other on-the-job drivers improved productivity and working conditions, though motor vehicle  
309 operators face greater risk of displacement.

310 Automated trucks offer unique opportunities to generate significant economic growth and create well-paying new  
311 jobs in California. A new study released by the Silicon Valley Leadership Group Foundation found that the impact  
312 of automated trucking in California would increase the state's economy by upwards of \$6.5 billion or more, as well  
313 as grow wages and employment for workers without prompting mass driver layoffs (Waschik, 2021). They found  
314 that 45,475 jobs at national level are increased by 2050, equivalent to an increase of 0.023 percent. In California,  
315 there are 2,394 jobs created under this scenario--an increase of 0.010 percent. New hiring reaches a minimum of  
316 about--11,600 in 2033, about 1.6 percent of baseline employment of long-haul truckers in 2033. But by the time the  
317 whole fleet has been converted to accommodate automation, net hiring ultimately trends to about +20,000,  
318 particularly in areas such as managing high-value goods, hazardous materials, or cross-border movements.

319 Michigan's heritage as driving force behind America's auto industry is well known and highly regarded. The 20%  
320 of Michigan workers directly participating in the automotive industry. The decreased demand for drivers will  
321 inevitably stem directly from the commercialization of automated technologies (Brogan, 2018). The new job  
322 opportunities are mainly concentrated in the following areas: automated vehicle testing, research and development,  
323 vehicle maintenance and management. These jobs can be made up for on the state through new mobility jobs related  
324 to technology, but this pivot will require a certain degree of retraining. On the other hand, a Texas Department of  
325 Transportation study on Level 2 commercial truck platooning concluded that the technology is ready for  
326 commercialization under certain road, fleet, and operational conditions (Yankelevich et al., 2018). Focus groups with  
327 industry leaders and officials in Texas, California, and Michigan (N=33) suggested that workers in roles impacted  
328 by automation could transition to emerging positions, such as remotely supporting AV passengers, monitoring AV  
329 operations, and providing customer service. Participants also stressed the importance of public awareness campaigns  
330 to build trust in AVs, highlighting a demand for marketing, public relations, and communication professionals.

331 The report by Securing America's Future Energy (SAFE) assesses the regional unemployment impact of AV  
332 deployment, noting the highest effect in the Northeast, where unemployment could increase by 0.06–0.14 percentage  
333 points, and a slightly lower impact in the Midwest, with a peak increase of 0.06–0.13 points. The report also

334 highlights expected increases in accessible job positions in specific cities due to AV deployment: Benton Harbor,  
335 MI (+228%), Gary, IN (+215%), Elmira, NY (+111%), and Wilmington, DE (+201%), largely due to reduced  
336 commuting times.

337 A recent Chamber of Progress report estimates that each 1,000 AVs produced and deployed annually will generate  
338 about 190 manufacturing and servicing jobs (Chamber of Progress, 2024). Key findings include: (1) a moderate  
339 economic scenario projecting the deployment of 9 million AVs over the next 15 years, creating 114,000 jobs, and  
340 (2) an optimistic scenario with 36 million AVs deployed, adding 455,000 jobs. Additionally, jobs in the AV industry  
341 are well-paying, with 82% offering wages above the U.S. median. AVs could strengthen the U.S. auto industry's  
342 resilience and foster new job centers in tech-rich regions. To capitalize on these economic opportunities, further  
343 technology development is essential.

344 In summary, the adoption of HAV technologies represents both a disruptive shift and an opportunity within the U.S.  
345 workforce. While certain sectors, particularly those with driving as a primary duty, may face significant changes or  
346 risks of displacement, the broader implications for the economy indicate potential growth and job creation across  
347 various fields.

## 348 **2.2 Impacts of HAV on Economic**

349 HAVs are expected to have profound economic implications. The U.S. Chamber of Commerce forecasts substantial  
350 economic growth potential, driven by enhanced productivity and efficiency, and an annual savings of \$94 billion  
351 from fewer accidents (Shapiro & Yoder, 2023). A University of Texas study echoes this, projecting significant  
352 economic benefits through reduced transportation costs and optimized logistics (Clements & Kockelman, 2017).  
353 Another study discusses the potential of AVs to stimulate economic growth through technological innovation and  
354 improved transportation systems (Winston & Karpilow, 2020). Similar studies can also be found in Europe (Raposo  
355 et al., 2022; Alonso et al., 2020).

356 The automotive industry, a key sector in the U.S. economy employing 1.7 million people and contributing \$500  
357 billion in annual wages (about 3–3.5% of GDP), is the most directly impacted by AVs (Clements & Kockelman,  
358 2017). AVs are expected to reshape vehicle use, design, and business strategies across industries. Americans  
359 currently spend 84 billion hours annually driving (about 373 hours per person), time that could be redirected toward  
360 productive activities if vehicles were self-driving. Research by Securing America's Future Energy (SAFE, 2018)  
361 estimates that by 2050, AVs could reduce direct economic losses by \$118 billion per year and improve quality of  
362 life by \$385 billion annually, with total benefits ranging from \$3.2 to \$6.3 trillion.

363 McKinsey estimated that the economic gains of driverless vehicles in the trucking industry could range from \$100  
364 billion to \$500 billion/year by 2025. The bulk of these savings would come from the elimination of the wages of

365 truck drivers. Morgan Stanley estimated software costs rising from 10% of current car values to 40% in a CAV  
366 environment. IHS Technology estimated that U.S. self-driving software and its corresponding updates will grow  
367 from \$680 million in 2025 to \$15.8 billion in 2040.

368 Introducing automated vehicles will also bring economic benefits to the government, such as reduced healthcare  
369 costs due to fewer road accidents. Research by (Shapiro & Yoder, 2023) has found that accident rates would fall  
370 sharply (compared with accident rates in 2021) if AVs represented 25 percent of U.S. motor vehicles. With Basic  
371 AVs, they estimate 571,000 fewer accidents, 5,000 fewer fatalities, and economic savings of \$38 billion. With  
372 Standard AVs, they estimate 1,145,000 fewer accidents, 9,000 fewer fatalities, and economic savings of \$75 billion.  
373 With Highly AVs, they estimate 1,442,000 fewer accidents, 12,000 fewer fatalities, and \$94 billion in savings.

374 In 2019, the National Highway Traffic Safety Administration (NHTSA) estimated the motor vehicle crashes cost  
375 American society \$340 billion and examines the costs of one year of crashes that killed an estimated 36,500 people,  
376 injured 4.5 million, and damaged 23 million vehicles. More recent data indicate that the annual social cost of  
377 accidents has exceeded \$1 trillion. A conservative estimate suggests that if automated vehicles only address accidents  
378 caused by severe driver errors (such as distraction, drunk driving, and speeding), they will bring over \$500 billion in  
379 benefits annually. Automated vehicles could also bring \$58 billion in benefits to society by reducing oil consumption  
380 and significantly lowering congestion costs by improving road capacity and reducing bottlenecks.

381 Visich (2019) estimates that widespread adoption of AVs could generate nearly \$800 billion annually in social and  
382 economic benefits by 2050. These benefits primarily stem from reducing vehicle crashes, returning productive time  
383 to commuters, enhancing energy security by lowering oil dependence, and providing environmental gains. Key  
384 components include \$71 billion from congestion mitigation, \$118 billion from economic impact of accident  
385 reduction, \$385 billion in quality-of-life improvements, \$58 billion from reduced oil consumption, \$153 billion in  
386 time savings, and \$10 billion from reduced taxi service costs.

387 A new study released by the Silicon Valley Leadership Group Foundation (Waschik, 2021) found that the impact of  
388 automated trucking in California would increase the state's economy by upwards of \$6.5 billion or more, as well as  
389 grow wages and employment for workers without prompting mass driver layoffs.

390 In conclusion, the economic potential of HAVs spans a wide array of sectors, with the promise of substantial  
391 productivity gains, reduced accident costs, and significant quality-of-life improvements. The automotive industry  
392 stands at the forefront of this transformation, likely reshaping employment, design, and usage patterns. Additionally,  
393 AVs could yield major societal benefits by mitigating accidents, improving quality of life and access, reducing  
394 congestion, and lowering oil consumption, collectively contributing to an estimated economic benefit of up to \$6.3

395 trillion by mid-century. As deployment progresses, these technologies offer a transformative pathway toward a more  
396 efficient, safe, and economically robust future.

### 397 **2.3 Impacts of HAV on Accessibility**

398 HAV studies also emphasize their transformative potential for individuals with disabilities. How AVs can  
399 significantly enhance transportation services for people with disabilities is systematically reviewed in (Dicianno et  
400 al., 2021). Michigan State University’s report on AVs for special needs individuals points to increased mobility  
401 independence (Kassens-Noor et al., 2021). Another study presents an interesting view of AVs as both a potential  
402 boon and a challenge for people with disabilities (Bhuiya et al., 2022). Similar studies were also conducted by ITS  
403 America, National Highway Traffic Safety Administration, and others (Bayless & Davidson, 2019; Claypool et al.,  
404 2017).

405 People with disabilities form a unique but substantial group. According to U.S. Census data, nearly one in five people  
406 in the United States has a disability. There are over 57 million people with disabilities in the United States, and more  
407 than 40% of them rely on others for transportation, while over 70% are completely restricted in their travel. It is  
408 estimated that due to physical or economic limitations, age, or vehicle malfunctions, 10% to 20% of the adult  
409 population in the U.S. cannot or should not drive (Kassens-Noor et al., 2021). Because reliance on cars is a common  
410 feature of typical American cities, non-drivers often face limited transportation options while bearing the economic,  
411 social, and environmental costs caused by drivers. The large population of people with disabilities also represents a  
412 significant potential demand for transportation services.

413 AVs present a promising solution for addressing the travel needs of people with disabilities, potentially enhancing  
414 their mobility and access to essential services. AVs could significantly increase employment opportunities and  
415 independence for people with disabilities and seniors alike. According to studies by the U.S. Chamber of Commerce  
416 and the AARP Policy Institute, widespread AV adoption could lead to over a 14% rise in annual miles traveled by  
417 non-drivers, with substantial gains in mileage for seniors and those with special needs: standard AVs are projected  
418 to increase seniors’ mileage by 2.5 billion miles and non-drivers’ by 1.3 billion miles, while highly automated AVs  
419 could boost travel for people with disabilities by 4.6 billion miles, seniors by 4.9 billion, and non-drivers by 2.4  
420 billion (Dunmoyer, 2024; Bayless & Davidson, 2019). Compared to the usual 1% annual increase in Vehicle Miles  
421 Traveled (VMT), AVs have the potential to substantially expand travel accessibility, driving a notable increase in  
422 overall travel volume.

423 Moreover, a study by the National Institute on Disability indicates that eliminating transportation barriers to  
424 employment for people with disabilities through the adoption of AVs could bring 9.2 million new labor force  
425 participants, generate \$867.7 billion in GDP, \$1.6 trillion in economic output, and \$417 billion in new income.  
426 Additionally, it is estimated that accessible AVs could increase employment opportunities for up to 2 million people

427 with disabilities. Currently, there are 18 to 25.5 million people with travel restrictions in the U.S., including 13.4  
428 million aged 18 to 64 and 11.2 million aged 65 or older. All these groups will benefit from AVs.

429 However, the impact of AVs and how they will be implemented are still subject to numerous planning, political,  
430 technical, and ethical debates. People with disabilities face travel barriers due to the lack of accessible transportation  
431 options, lack of awareness and information about available services, scheduling issues, high transportation costs, and  
432 insufficient funding in insurance models. Recent findings suggest that people with disabilities may face  
433 discrimination when trying to purchase or operate AVs, whether through laws targeting them or the vehicle systems  
434 themselves (Dicianno et al., 2021). Furthermore, awareness and willingness to accommodate people with special  
435 needs, as well as understanding what their needs might be, have not been well studied.

436 To enable people with disabilities to practically and independently use AVs, issues related to door-to-door navigation,  
437 signage, and curbside pick-up/drop-off must be addressed. For those facing physical barriers, such as mobility-  
438 impaired or visually impaired individuals, navigating through obstacles in the built environment to meet vehicles or  
439 reach bus/taxi stops will still be a challenge. Mobile device-based assistive applications that tag (or otherwise identify  
440 and report on) obstacles in the built environment can be valuable tools to help mitigate this challenge (Sivakanthan  
441 et al., 2023). AVs may also need street-level data to successfully locate, navigate, and park at accessible pick-up and  
442 drop-off points along sidewalk corridors.

443 In conclusion, the widespread adoption of automated vehicles holds the potential to significantly enhance mobility  
444 and independence for people with disabilities. By offering more flexible travel options, AV technology can not only  
445 improve their quality of life but also create new employment opportunities and economic benefits.

## 446 **2.4 Impacts of HAV on Mobility**

447 The advent of HAVs is also set to revolutionize public mobility. For example, a “Mobility 2030” report predicts a  
448 transformation in the mobility landscape, emphasizing more efficient and accessible transportation systems (Simpson  
449 et al., 2019). The USDOT’s “Preparing for the Future of Transportation” document highlights the integration of AVs  
450 into existing transport networks, promising enhanced safety and reduced congestion (USDOT).

451 According to previous studies, AVs can improve traffic flow. In uninterrupted traffic, automated vehicles can  
452 increase road capacity by 50%. A simulation study on a four-lane highway found that traffic flow improved when  
453 the penetration rate of automated vehicles exceeded 30%. When the penetration rate exceeded 40%, the impact of  
454 automated vehicles was significant (Park et al., 2021). Additionally, other studies have found that when the  
455 penetration rate of automated vehicles reaches 100%, road capacity in urban areas increases by 40%, while highway  
456 capacity increases by 80%.

457 In terms of travel time, research has shown that AVs are more effective on congested roads, significantly reducing  
458 travel time when the adoption rate is 20% (Llorca et al., 2022). Automated driving reduces the burden of commuting,  
459 which may encourage people to move farther from their workplaces, leading to urban sprawl. The average  
460 commuting distance is expected to double, and VMT will increase by one-third. Therefore, the large-scale adoption  
461 of automated vehicles is expected to influence residential choices, prompting households to choose suburban or rural  
462 areas farther from their workplaces. In scenarios of high market penetration for automated vehicles, particularly  
463 connected and automated vehicles, the proportion of the population in suburban and rural areas will increase.

464 Furthermore, automated driving technology is expected to enhance freight efficiency and reduce freight costs.  
465 Automated vehicles are anticipated to lower energy consumption and vehicle emissions, provided the technology is  
466 effectively implemented and widely adopted. In the Triangle Region of North Carolina (Bardaka et al., 2021), it is  
467 predicted that by 2045, with a 75% market penetration rate of personal automated vehicles, the daily VMT will  
468 increase by 3.6%, and traffic congestion will also significantly increase.

469 A recent report from the Center for Sustainable Systems at the University of Michigan summarizes the potential  
470 energy impacts of AV mobility. The report notes that AVs are expected to reduce congestion, leading to a 0-4%  
471 decrease in fuel consumption, though this benefit may be offset by increased VMT. Additionally, AVs may promote  
472 eco-driving practices that reduce energy use by up to 20%; however, if AV algorithms do not prioritize efficiency,  
473 actual fuel savings could be negligible. Platooning, where vehicles travel closely together, is expected to lower  
474 energy consumption by 3-25%, depending on factors like vehicle numbers, spacing, and type.

475 The emphasis on comfort and productivity in AVs could de-emphasize performance features like rapid acceleration,  
476 potentially reducing fuel consumption by 5-23%. Increased AV safety may also reduce the likelihood of crashes,  
477 which could allow for lighter vehicles, further lowering fuel use by 5-23%. Right-sizing vehicles according to  
478 specific trip needs could decrease energy use by 21-45%, particularly when combined with a ride-sharing model.

479 However, higher highway speeds enabled by AV safety improvements may increase fuel consumption by 7-30%.  
480 Travel costs are also expected to drop with AVs due to lower insurance and time costs, likely boosting travel demand  
481 and potentially increasing energy use by 4-60%. New user groups, such as elderly and disabled individuals, are  
482 expected to increase VMT, adding 2-10% to fuel consumption. Finally, ride-sharing models that leverage AVs could  
483 cut energy use by 0-20% due to reduced labor costs. Overall, these factors suggest that AV adoption may lead to  
484 both substantial energy savings and increased demand.

485 In summary, the widespread adoption of HAVs has the potential to transform public mobility, enhancing the  
486 efficiency, accessibility, and sustainability of transportation systems. Studies and reports forecast that AV integration  
487 can significantly improve traffic flow and road capacity, particularly when penetration rates are high, while reducing

488 travel time on congested roads. However, increased ease of commuting could lead to urban sprawl as people move  
489 farther from their workplaces, potentially increasing VMT. Freight efficiency is also expected to improve,  
490 contributing to reduced transportation costs and energy use.

491 **3. Research Methodology**

492 This section documents the methodology developed for this project. Our aim was to analyze the impact of workforce,  
493 economic, accessibility, and mobility considerations under Act 130 in Pennsylvania. We organized focus groups to  
494 collect data, and the overall research framework supporting our approach is illustrated in Figure 3.

495 **Phase 1–Focus Group Preparation:** The initial phase involved preparing for the focus groups to ensure their  
496 effectiveness and relevance. This included clarifying the discussion themes and objectives, designing appropriate  
497 questions, and guiding participants to share relevant perspectives and experiences. Preparation also involved a  
498 thorough understanding of Act 130 and the development of related questionnaires to facilitate targeted discussions.

499 **Phase 2–Conducting Focus Groups:** In this phase, we established and conducted the focus groups to complete data  
500 collection and gather experts' opinions on the development of HAVs in Pennsylvania. This process enabled us to  
501 capture both qualitative and quantitative data, providing insights into the opportunities, challenges, and potential  
502 impacts of HAV deployment. The diverse perspectives collected—from technical to regulatory and societal—will  
503 be crucial for informing future research directions and policy recommendations.

504 **Phase 3–Individual Interviews:** To enhance the results of our project, we conducted individual interviews as a  
505 supplementary measure to refine our research. These interviews allowed us to delve deeper into specific topics that  
506 emerged during the focus group discussions, enabling a more comprehensive understanding of expert insights on  
507 HAVs and Act 130. Gathering detailed and personalized responses helped us address any gaps in the data, validate  
508 key findings, and enhance the overall robustness of our conclusions.

509 **Phase 4–Review and Summary of Results:** The final phase involved reviewing and summarizing the results, which  
510 enabled us to draw meaningful conclusions from the collected data. We recorded the responses from the focus group  
511 experts and converted them into qualitative and quantitative data, providing a balanced perspective on the insights  
512 gained. This step allowed us to analyze patterns, identify key themes, and quantify the significance of various  
513 viewpoints. By systematically organizing the data, we ensured that the findings accurately reflect the experts'  
514 opinions and provide valuable input for decision-making and future research directions in the development of HAVs  
515 in Pennsylvania.

516 For a more detailed description of these processes, please see the subsequent sections in this chapter.

517

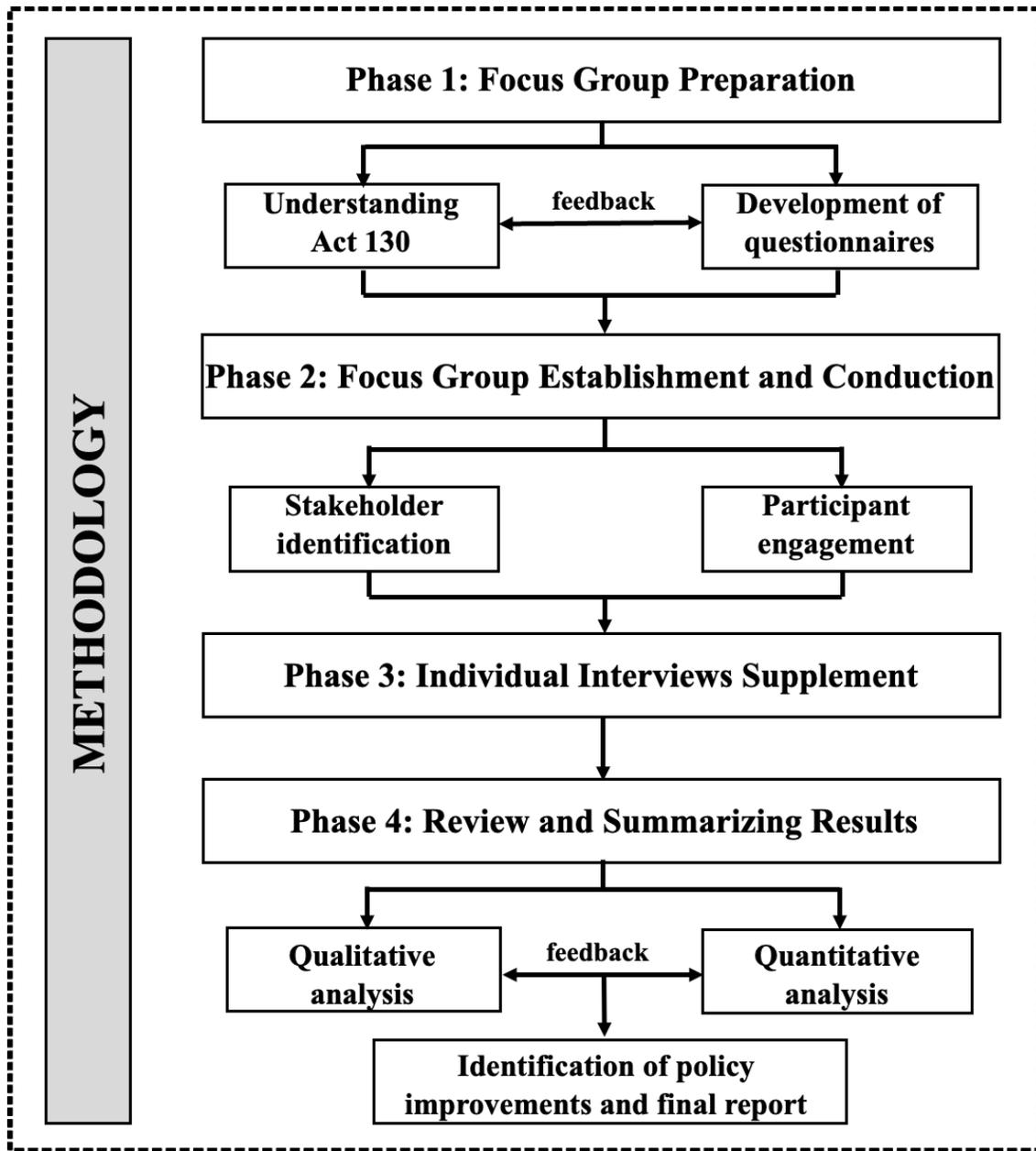


Figure 3 Overview of the research methodology

518

519

### 520 3.1 Focus Group Preparation

521 Preparation for the focus group is a foundational step essential to ensuring an effective and relevant discussion on  
 522 HAVs. This phase includes a series of structured steps to clarify key themes and objectives, enabling a targeted and  
 523 meaningful exploration of participants' insights.

524

525 **3.1.1 Understanding Act 130**

526 The initial task in our project involved gaining a comprehensive understanding of Act 130 of 2022. This task was  
527 essential, as it established the groundwork for all subsequent activities in the study. Our team examined the specifics  
528 of Act 130, analyzing its clauses, objectives, and potential impacts on the current transportation ecosystem. In  
529 collaboration with the PennDOT team, we also conducted an in-depth review of related state policies and procedures.  
530 This review was crucial for identifying gaps or opportunities for improvement within the existing framework in light  
531 of the new legislation.

532 To support this understanding and prepare for an effective focus group discussion, we developed a series of  
533 informational materials. These included (1) an informative brochure outlining the key aspects of Act 130, and (2) a  
534 comprehensive Q&A document addressing potential questions that arose during the focus group sessions, ensuring  
535 the team was well-prepared for meaningful discussions, as detailed in [Appendix A](#).

536 These materials were developed through an iterative process, with continuous refinement to ensure clarity and  
537 accuracy. Our objective was to create resources that not only enhanced our team’s understanding but also served as  
538 valuable reference materials for stakeholders involved in subsequent project phases. By the end of this phase, our  
539 project team had a thorough understanding of Act 130 and its relationship with existing transportation policies in  
540 Pennsylvania. This foundational knowledge was essential for the successful execution of future project tasks,  
541 particularly in enabling informed and productive focus group discussions.

542 **3.1.2 Development of Questionnaires**

543 After reviewing Act 130 and multiple HAV-related studies, our focus shifted to constructing effective tools for our  
544 study—specifically, questionnaires designed to gather targeted insights from focus groups. We employed a  
545 systematic approach to carefully develop each questionnaire, ensuring alignment with our research objectives. This  
546 process began with formulating questions that addressed key aspects of Act 130’s impact, crafted to be clear, unbiased,  
547 and structured to elicit detailed responses.

548 The questionnaire was designed by drafting questions that addressed specific impact areas of Act 130, balancing  
549 open-ended and closed questions to collect both quantitative and qualitative data. The draft then underwent a  
550 thorough review by PennDOT to refine questions for relevance, clarity, and effectiveness. Based on feedback, we  
551 made necessary revisions and finalized the questionnaire to ensure it captured pertinent data effectively. The final  
552 product was a set of precise, well-constructed questionnaires, detailed in [Appendices B](#) and [C](#).

553 By carefully defining the scope of discussion, we crafted questions that were not only relevant but also encouraged  
554 participants to share diverse perspectives and personal experiences. This phase also included a comprehensive review  
555 of Act 130 to fully understand its implications, along with the development of related questionnaires aimed at

556 addressing core issues surrounding HAV implementation. This thorough preparation ensured that discussions  
557 remained focused and productive, allowing participants to explore specific areas of interest and policy considerations  
558 while fostering deeper engagement with the topic at hand.

## 559 **3.2 Establishment and Conduct of Focus Groups**

### 560 **3.2.1 Stakeholder Identification**

561 In this phase, we focused on identifying key stakeholders and setting up focus groups. In close collaboration with  
562 the HAV Advisory Committee, we identified individuals and groups either directly impacted by or with expertise in  
563 areas such as Pennsylvania’s workforce, economic implications, accessibility, and overall mobility.

564 During the stakeholder identification process, we worked closely with the HAV Advisory Committee to identify  
565 stakeholders based on their impact, influence, or expertise in HAVs implementation. Potential sources for  
566 stakeholder identification include:

- 567 • Recommendations from the HAV Advisory Committee
- 568 • Past attendees of the Transportation Engineering and Safety Conference (TESC)
- 569 • Previous participants of the PA AV Summit
- 570 • Attendees from past ITS Pennsylvania events
- 571 • Connections that Penn State and Larson Transportation Institute (LTI) have built and maintained.

572 The final list of identified stakeholders is shown in Appendix D.

### 573 **3.2.2 Focus Group Establishment and Participant Engagements**

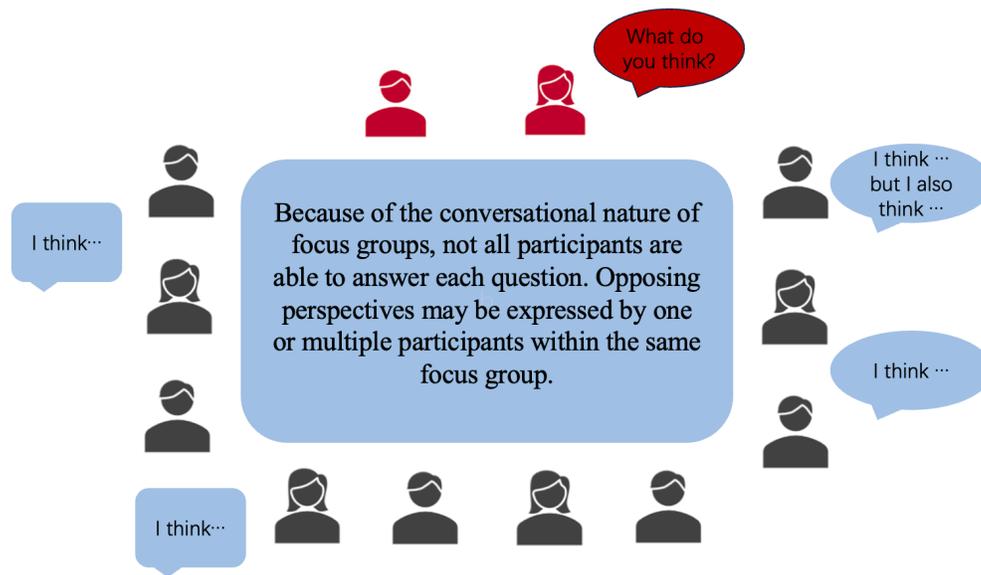
574 After identifying the stakeholders, we organized them into two distinct focus group categories. The first group  
575 centered on workforce and economic implications, while the second focused on accessibility and mobility  
576 enhancements. We carefully planned the logistics for these focus groups, including scheduling, meeting formats, and  
577 strategies to address potential challenges, fostering productive and insightful discussions. Detailed information on  
578 the focus group stakeholders is provided in Section 4.

579 The primary objective of these focus groups was to extract meaningful insights that directly informed our research  
580 goals, aiming to yield actionable data that significantly deepened our understanding of HAVs' multifaceted impacts.  
581 We anticipated gaining a rich, multi-dimensional perspective that would guide subsequent stages of the project,  
582 particularly in shaping evaluations and recommendations tailored to Pennsylvania's unique context.

583 Conducting these focus groups was central to our research project, as it allowed us to capture valuable insights from  
584 key stakeholders. Through the careful execution of these sessions, our goal was to gather high-quality qualitative  
585 data that substantially contributed to the overall objectives of our project. The focus group structure was illustrated

586 in Figure 4. Each session was moderated to ensure all voices were heard, encouraging open and honest dialogue  
587 aligned with our research objectives. Participants were encouraged to share their perspectives on issues relevant to  
588 their expertise. Due to the conversational nature of focus groups, not all participants may have responded to each  
589 question, and opposing perspectives may have emerged among participants. We strived to create a supportive  
590 environment for active participation, characterized by a welcoming atmosphere, clear discussion topics, and  
591 engaging questioning techniques.

592 Sessions were recorded with participants' consent to facilitate thorough analysis. Recordings were transcribed  
593 verbatim, and additional notes were taken to capture non-verbal cues and group dynamics. Confidentiality was  
594 strictly maintained to ensure participants felt comfortable sharing openly. After each session, our focus shifted to  
595 preparing the collected data for analysis, which included tasks such as transcribing recordings, organizing notes, and  
596 structuring the data for efficient and thorough analysis.



597

598

**Figure 4 Collecting data through structured focus group conversations**

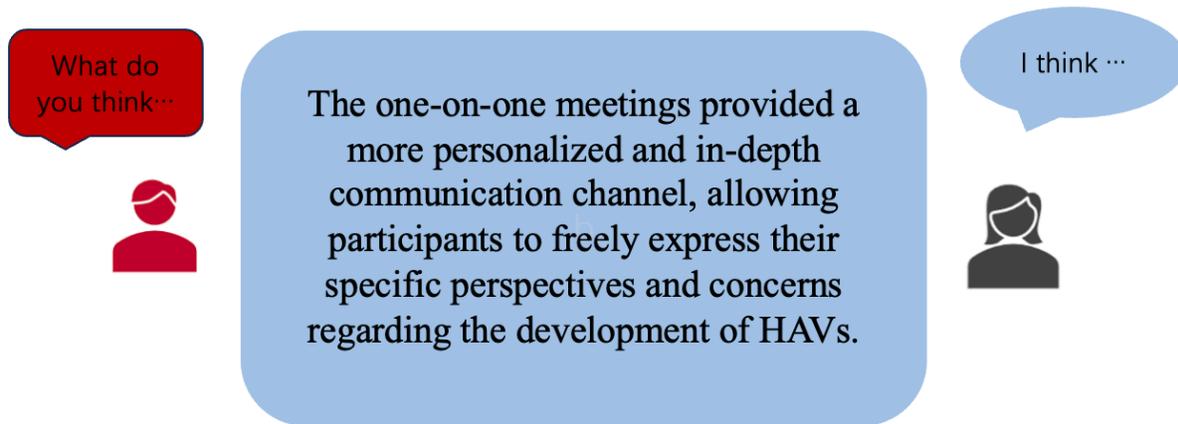
599

### **3.3 Individual Interviews**

600 To gain further insights and feedback on HAV development in Pennsylvania, we organized additional one-on-one  
601 meetings following the focus group sessions. These meetings provided a unique platform for personalized, in-depth  
602 discussions, allowing participants to openly share specific concerns, experiences, and suggestions that may not have  
603 surfaced in the group setting. This format enabled us to explore areas of interest more thoroughly, clarify any  
604 ambiguities, and deepen our understanding of individual perspectives on HAV implementation and its implications.  
605 Using structured guiding questions, we gathered targeted feedback on topics such as traffic safety, privacy, and local

606 employment impacts. The results from these one-on-one discussions provided valuable data for subsequent project  
607 analyses, helping us craft more precise policy recommendations tailored to Pennsylvania.

608 Figure 5 illustrates the structure of the one-on-one interviews, with the moderator posing HAV-related questions and  
609 the participant sharing their insights.



610

611

**Figure 5 Collecting data through one-to-one meeting conversations**

612

### 613 3.4 Review and Summarizing Results

614 In this phase, we analyzed and synthesized the data obtained from the focus group sessions, serving as a crucial step  
615 in converting raw data into coherent, actionable insights. Our aim was to ensure that the rich qualitative and  
616 quantitative data collected was effectively harnessed to inform and summarize results.

- 617 • **Data Organization:** Initially, all collected data, including transcriptions, notes, and recordings, has  
618 undergone systematic organization to ensure efficient analysis.
- 619 • **Qualitative Analysis:** By employing qualitative data analysis methods, the team has identified recurring  
620 themes, patterns, and discrepancies within the responses. This process has involved coding the data and  
621 categorizing it into meaningful groups.
- 622 • **Quantitative Analysis:** We have reviewed the quantitative data materials mentioned by experts during the  
623 group meetings, carefully reading and extracting key data information. Additionally, we have analyzed  
624 information regarding the types of organizations represented by the experts participating in the conference,  
625 which has helped ensure the comprehensiveness of our data.
- 626 • **Key Findings Synthesis:** Upon completion of the analysis, the team has distilled the extensive data into core  
627 insights relevant to the study's objectives.

628       • **Insight Translation:** The final step has involved translating these key findings into actionable insights,  
629       interpreting the data within the context of our research goals. This process has led to practical  
630       recommendations and strategies.

631 Finally, our identification of Policy Improvements was a comprehensive endeavor aimed at enhancing PennDOT’s  
632 existing policies and procedures about HAVs in response to the insights gained from our research. This task was  
633 structured into multiple phases to ensure a thorough and effective approach:

- 634       • **Policy Review and Analysis:** In the initial phase, a meticulous review of PennDOT’s related policies and  
635       procedures has taken place. This review has concentrated on understanding the alignment of these policies  
636       with Act 130 and the insights derived from our research. The primary goal has been to pinpoint areas where  
637       current policies may require adjustments to address the challenges and opportunities presented by HAVs.
- 638       • **Data-Policy Alignment:** In this phase, we have harmonized the findings from our focus groups with the  
639       existing policy framework. This has involved mapping specific insights to relevant policy areas and  
640       identifying any disparities or gaps.
- 641       • **Gap Analysis and Recommendations:** Once gaps have been identified, a comprehensive analysis has been  
642       conducted to comprehend the implications of these gaps. Concrete recommendations have been developed,  
643       encompassing proposals for new policies or amendments to existing ones to better align with the realities of  
644       HAVs in Pennsylvania.

645

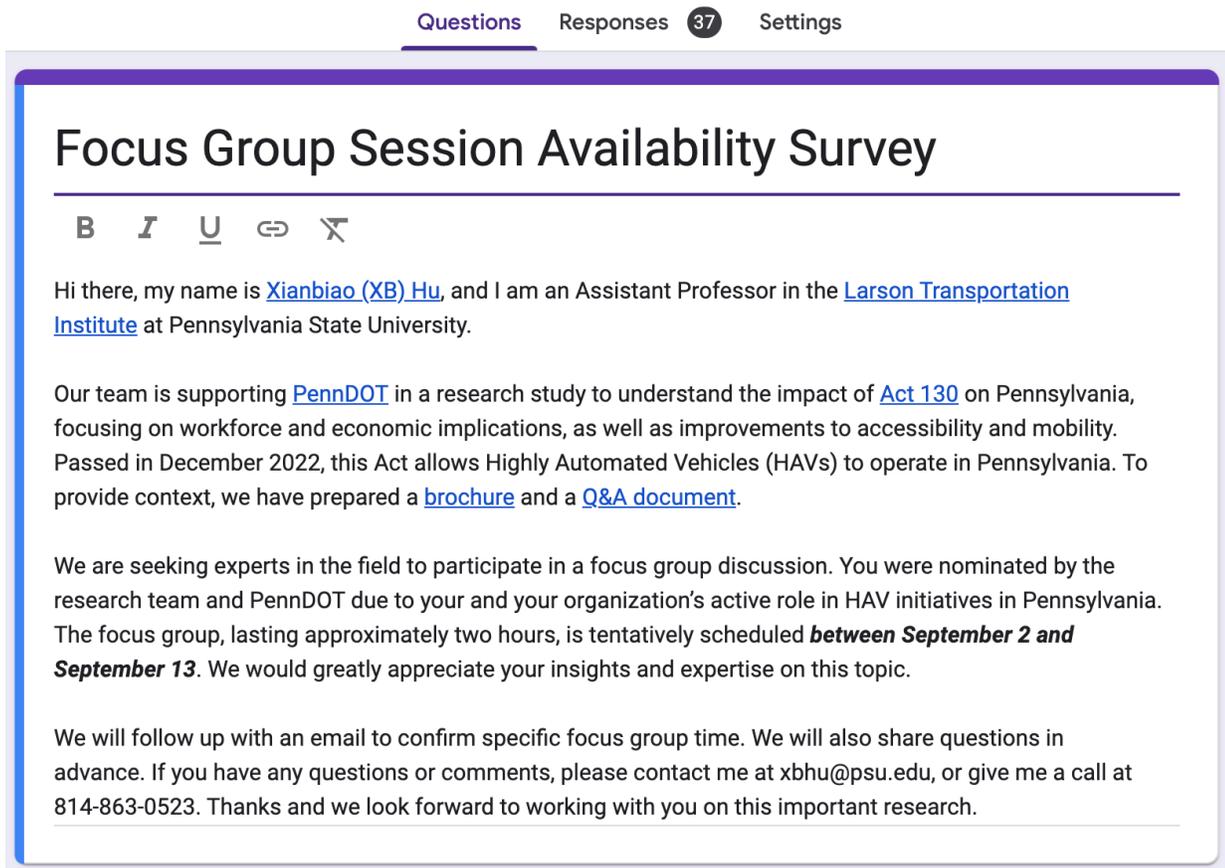
646 **4. Focus Group Formation and Data Collection**

647 To assess the impact of Act 130 on Pennsylvania’s economy, workforce, accessibility, and mobility, we organized  
648 focus groups and invited experts to discuss HAV-related issues. This chapter outlines the selection of 93 participants,  
649 their division into five focus groups, and the follow-up process. The key discussions and insights from the experts  
650 are documented in the detailed process below.

651 **4.1 Participant Selection and Invitation**

652 We carefully selected 93 participants based on their expertise and relevance to the focus group themes. The detailed  
653 information of those participants is shown in Appendix D. An invitation email was sent to each participant, outlining  
654 the study’s objectives and requesting their participation in the focus group sessions.

655 To gather responses efficiently, we designed a questionnaire survey that was distributed via email. We successfully  
656 collected 34 responses using Google Forms.



657

658

**Figure 6 Focus group session availability survey**

⋮

Which time periods are you available for the focus group sessions? (Select all that apply) \*

- Sept 3 (Tuesday): 3PM–5PM
- Sept 4 (Wednesday): 9AM–11AM
- Sept 5 (Thursday): 3PM–5PM
- Sept 6 (Friday): 10AM–12PM
- Sept 9 (Monday): 10AM–12PM
- Sept 11 (Wednesday): 10AM–12PM
- Sept 12 (Thursday): 1PM–3PM
- Sept 13 (Friday): 10AM–12PM
- Sept 13 (Friday): 3PM–5PM

659

660

**Figure 7 Available time slots**

661

One week after the first email, we sent a reminder email to those who hadn't filled out the Google Form.

662

663

#### **4.2 Focus Group Categorization**

664

Participants' availability and research interests were analyzed and categorized, leading to the initial formation of five

665

focus groups.

	A	B	E	F	G	H	I	J	K	L	M
1	Organization	Category	Sept 3: 3PM-5PM	Sept 4: 9AM-11AM	Sept 5: 3PM-5PM	Sept 6: 10AM-12PM	Sept 9: 10AM-12PM	Sept 11: 10AM-12PM	Sept 12: 1PM-3PM	Sept 13: 10AM-12PM	Sept 13: 3PM-5PM
2	Motional	Workforce							Workforce		
3	Pennsylvania Department of Education	Workforce		Workforce					Workforce	Workforce	
4	Kittelson & Associates, Inc.	Mobility	Mobility	Mobility			Mobility	Mobility	Mobility	Mobility	Mobility
5	Michael Baker International	Workforce	Workforce				Workforce			Workforce	Workforce
6	University of Pittsburgh	Accessibility	Accessibility	Accessibility							
7	Southeastern Pennsylvania Transportation Authority (SEPTA)	Mobility				Mobility					Mobility
8	Aurora	Economic									Economic
9	Motor Carrier Safety Advisory Committee	Workforce	Workforce	Workforce			Workforce	Workforce	Workforce		
10	Regional Industrial Development Corporation (RIDC)	Economic	Economic	Economic					Economic		
11	Carnegie Mellon	Workforce	Workforce	Workforce			Workforce			Workforce	Workforce
12	PA Turnpike Commission	Economic		Economic		Economic		Economic	Economic	Economic	
13	Michael Baker International	Accessibility	Accessibility			Accessibility	Accessibility				Accessibility
14	Executive Deputy Secretary of Policy & Planning, Office of G	Economic								Economic	
15	City of Philadelphia	Workforce									Economic
16	University of Pittsburgh	Workforce	Workforce	Workforce			Workforce			Workforce	Workforce
17	Southwestern Pennsylvania Commission	Accessibility	Accessibility				Accessibility				
18	PA Department of Aging	Accessibility	Accessibility			Accessibility		Accessibility	Accessibility	Accessibility	Accessibility
19	Centre Regional Planning Agency	Mobility	Mobility	Mobility		Mobility	Mobility	Mobility		Mobility	Mobility
20	Southeastern Pennsylvania Transportation Authority (SEPTA)	Mobility	Mobility	Mobility		Mobility	Mobility	Mobility		Mobility	Mobility
21	Drive Engineering	Economic		Economic				Economic			
22	Carnegie Mellon	Mobility						Mobility			Mobility
23	Delaware Valley Regional Planning Commission	Accessibility	Accessibility	Accessibility			Accessibility	Accessibility	Accessibility	Accessibility	Mobility
24	Autonomous Vehicle Industry Association	Accessibility						Accessibility	Accessibility	Accessibility	Accessibility
25	Centre Area Transportation Authority (CATA)	Mobility	Mobility				Mobility	Mobility	Mobility		Mobility
26	Conference of Minority Transportation Officials (COMTO)	Workforce	Workforce			Workforce					
27	Pennsylvania Driving Under the Influence Association	Workforce	Workforce	Workforce		Workforce	Workforce			Workforce	Workforce
28	PA Motor Truck Association	Workforce	Workforce			Workforce				Workforce	Workforce
29	Lattitude AI	Workforce					Workforce	Workforce	Workforce	Workforce	Workforce
30	TealNet: The Voice of the Innovation Economy	Accessibility				Accessibility					Accessibility
31	City of Pittsburgh, Department of Mobility and Infrastructure	Mobility		Mobility			Mobility		Mobility	Mobility	Accessibility
32	Rabbit Transit	Workforce		Workforce							
33	SAE International	Economic						Economic	Economic		
34	Southeastern Pennsylvania Transportation Authority (SEPTA)										

667

Figure 8 Statistics and grouping of participants

668

669 We sent an email to participants to inform them about the preliminary group assignments and to reconfirm their  
 670 availability. During this follow-up, a few participants withdrew due to scheduling or thematic conflicts.

99 **Focus group: Impact of highly automated vehicles on PA Workforce and Economics**

🕒 Tuesday, September 3, 2024 from 3:00 PM to 5:00 PM  
 2 hours

📍 Microsoft Teams Meeting

🔔 15 minutes before

📄 Focus\_group\_workfo... 19.5 KB

📄 ACT 130 QA docume... 422.4 KB

📄 Brochure\_v3\_final.pdf 133 KB

[Download All](#) · [Preview All](#)

671

Dear [Redacted]

Thank you once again for responding to our email and agreeing to provide input on the impact of Highly Automated Vehicles (HAVs) in Penn State Harrisburg, and myself. Our focus will be on Workforce and Economics. Attached, you will find a list of questions.

As background, a new Act (Act 130) was passed in December 2022, allowing Highly Automated Vehicles (HAVs) to operate in Pennsylvania. It requires you to submit an annual report that evaluates the impact of HAVs in the Commonwealth. This evaluation will focus on:

1. **Benefits and implications to the Commonwealth's workforce** (focus of this session)
2. **Economic benefits and implications to the Commonwealth** (focus of this session)
3. Improvements to accessibility and mobility for persons with disabilities (not the focus of this session)
4. Improvements to mobility options for the general public (not the focus of this session)
5. Identified areas where current policies and procedures may need to be changed or supplemented.

To help you better understand the Act, we have prepared a [brochure](#) and a [Q&A document](#), which are also attached for your reference.

We look forward to speaking with you in a week! In the meantime, if you have any questions or if the scheduled time no longer works for you, please let us know. We would love to meet with you online prior to the focus group session as well.

XB

--  
Xianbiao (XB) Hu, Ph.D.

672

673

### Figure 9 Send meeting invitation details

674

#### 4.3 Execution of Focus Groups

675

Each focus group was conducted on the scheduled dates, with discussions centered around their respective themes.

676

In the end, we identified 30 participants to participate in 5 focus groups. In each focus group, 2 Penn State team

677

members acted as the moderator and facilitator. The following is the specific information.

678

##### (1) Focus Group 1

679

Time: Sept 3 (Tuesday): 3PM--5PM

680

Theme: Workforce/Economic

681

Moderator/ Facilitator: Xianbiao (XB) Hu, Nikhil Menon

682

Participants: (5)

683

##### Table 1 Information on participants of focus group 1

<b>Organization</b>
Michael Baker International
Motor Carrier Safety Advisory Committee
Regional Industrial Development Corporation (RIDC)

PA Motor Truck Association
Conference of Minority Transportation Officials (COMTO)

684 **(2) Focus Group 2**

685 Time: Sept 4 (Wednesday): 9AM--11AM

686 Theme: Accessibility/Mobility

687 Moderator/ Facilitator: Xianbiao (XB) Hu, Nikhil Menon

688 Participants: (7)

689 **Table 2 Information on participants of focus group 2**

Organization
Michael Baker International
Kittelson & Associates, Inc.
Centre Area Transportation Authority (CATA)
Delaware Valley Regional Planning Commission
Centre Regional Planning Agency
Southwestern Pennsylvania Commission
University of Pittsburgh

690 **(3) Focus Group 3**

691 Time: Sept 5 (Thursday): 3PM--5PM

692 Theme: Workforce/Economic

693 Moderator/ Facilitator: Xianbiao (XB) Hu, Nikhil Menon

694 Participants: (6)

695 **Table 3 Information on participants of focus group 3**

Organization
Pennsylvania Driving Under the Influence Association
Southeastern Pennsylvania Transportation Authority (SEPTA)

Rabbit Transit
Carnegie Mellon
PA Turnpike Commission
University of Pittsburgh

696 **(4) Focus Group 4**

697 Time: Sept 12 (Thursday): 1PM--3PM

698 Moderator/ Facilitator: Xianbiao (XB) Hu, Nikhil Menon

699 Theme: Workforce/Economic

700 Participants: (7)

701 **Table 4 Information on participants of focus group 4**

Organization
Motional
Executive Deputy Secretary of Policy & Planning, Office of Governor Josh Shapiro
PA Department of Aging
SAE International
Autonomous Vehicle Industry Association
Latitude AI
City of Pittsburgh, Department of Mobility and Infrastructure

702 **(5) Focus Group 5**

703 Time: Sept 13 (Friday): 10AM—12PM

704 Theme: Accessibility/Mobility

705 Moderator/ Facilitator: Xianbiao (XB) Hu, Ilgin Guler

706 Participants: (5)

707 **Table 5 Information on participants of focus group 5**

Organization
Southeastern Pennsylvania Transportation Authority (SEPTA)
Aurora
City of Philadelphia
Carnegie Mellon
TechNet: The Voice of the Innovation Economy

708 **4.4 Holding Short Meetings**

709 In order to gather additional information and feedback on HAV development in Pennsylvania, we organized three  
710 brief one-on-one meetings following the focus group sessions. The specific details are as follows.

711 **(1) Short Meeting 1**

712 Time: Sept 13 (Friday): 3PM--3:30PM

713 Theme: Workforce/Economic/Accessibility/Mobility

714 Moderator/ Facilitator: Xianbiao (XB) Hu

715 Participants: (3) from Ford Motor

716 **(2) Short Meeting 2**

717 Time: Sept 20 (Friday): 3PM—3:30PM

718 Theme: Workforce/Economic/Accessibility/Mobility

719 Moderator/ Facilitator: Xianbiao (XB) Hu

720 Participants: (1) from StackAV

721 **(3) Short Meeting 3**

722 Time: Sept 26 (Friday): 3PM--3:30PM

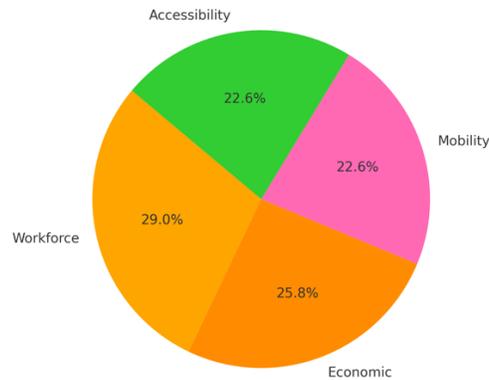
723 Theme: Workforce/Economic/Accessibility/Mobility

724 Moderator/ Facilitator: Xianbiao (XB) Hu

725 Participants: (1) from Drive Engineering

726 **4.5 Analysis of the Composition of Participants**

727 We collected information about the participants and the types of organizations they represented, resulting in the  
728 following details.

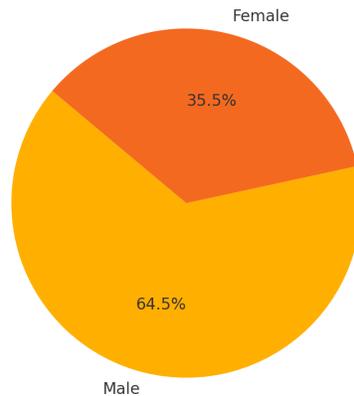


729

730

**Figure 10 Participants research area distribution**

731 Figure 10 shows the distribution of participants by research area in the dataset. Of these, 9 participants are in the  
732 field of Workforce, accounting for 29%; 8 participants are in the field of Economic, accounting for 25.8%; 7  
733 participants are in the field of Mobility; and 7 participants are in the field of Accessibility, which also accounts for  
734 22.6%. This indicates that the participating experts almost cover the four research areas on average, ensuring the  
735 comprehensiveness of the data.

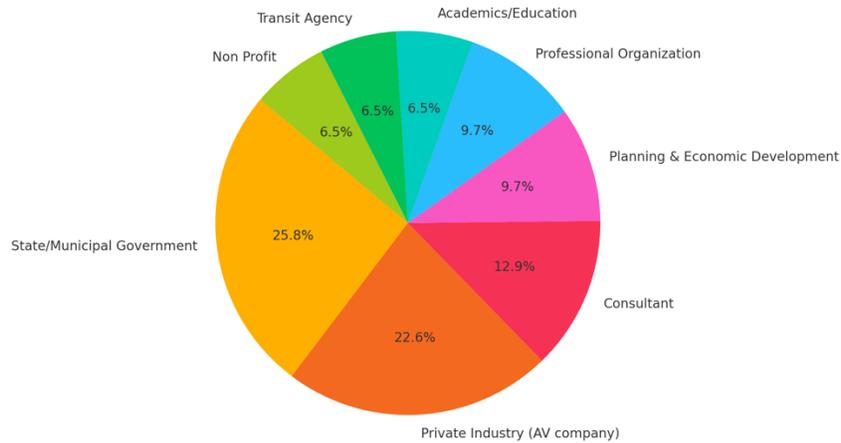


736

737

**Figure 11 Participants gender distribution**

738 Figure 11, a pie chart, shows the gender distribution in the dataset: males comprise 64.5% (20 participants), while  
739 females comprise 35.5% (11 participants). Overall, there were more male participants than female participants,  
740 suggesting that we considered not only the advice of male participants but also the insights of female experts.



**Figure 12 Participants organization category distribution**

741

742

743 Figure 12 shows the distribution of sectors or organizations represented by the participants. The largest group is from  
 744 State/Municipal Government, making up 25.8% (8 participants), followed by Private Industry (AV companies) at  
 745 22.6% (7 participants) and Consultants at 12.9% (4 participants). Planning & Economic Development and  
 746 Professional Organizations each constitute 9.7% (3 participants). The remaining groups—Academia/Education,  
 747 Transit Agencies, and Non-Profits—each account for 6.5% (2 participants). This distribution demonstrates a diverse  
 748 representation, with notable contributions from government and private industry sectors.

749 Overall, the distribution of organization types represented by the participants reflects substantial involvement from  
 750 government and private industry, along with diverse contributions from academia, consulting firms, non-profit  
 751 organizations, and professional associations. This broad engagement brings a wide range of perspectives and in-  
 752 depth insights to the research assessing the impact of HAVs development on workforce, economy, accessibility, and  
 753 mobility in Pennsylvania, underscoring the fairness of our focus group expert panel composition and the  
 754 comprehensiveness of the data collected for this project.

755

756 **5. Impact Analysis of Workforce and Economic Implications**

757 This chapter summarizes the focus group findings and provides a comprehensive analysis of the workforce and  
758 economic impacts of Act 130 and Highly Automated Vehicles across various sectors and regions in Pennsylvania. It  
759 highlights potential economic benefits, increased freight efficiency, and opportunities for job creation in both urban  
760 and rural areas. The chapter also explores the transformative effects HAVs are expected to have on traditional  
761 industries, workforce training, and job roles.

762 Below, we present 13 key observations from the focus group sessions, with *italic text* indicating direct statements  
763 from participants.

764 **1. Act 130 marks a turning point for Pennsylvania's HAV industry**

765 The enactment of Act 130 has brought legislation to support the testing and deployment of HAVs in Pennsylvania,  
766 marking a significant turning point in the state's automated vehicle industry. For example, one participant commented  
767 that Act 130 *“paves the way for better things to come. It opens the door for testing, which is crucial for AV companies*  
768 *to achieve scale—one of the most significant aspects of the legislation.”* Another participant noted that *“testing was*  
769 *not allowed legally until Act 130 was in place. The Act enabled AV companies to move beyond the R&D stage.”*

770 Prior to this legislation, the lack of legal support led some automated driving R&D companies to contemplate  
771 relocating or shifting significant portions of their business to other states like California, Arizona, and Texas, where  
772 early supportive laws were already in place. This potential exodus posed a threat to Pennsylvania’s economy and  
773 could have reduced local job opportunities. Focus group participants mentioned that on the same day the Act was  
774 enacted, Argo AI announced its bankruptcy, leading to the later establishment of Stack AV and Latitude AI. In  
775 particular, StackAV chose to retain Argo AI’s R&D facilities and 250 employees in Pennsylvania, thereby preserving  
776 local jobs. One participant stated that, *“If Act 130 had not been passed, Stack AV would still be formed but not in*  
777 *Pennsylvania. So the 250 employees would not be here. Act 130 ... is a big step and allows companies to test in*  
778 *Pennsylvania”*.

779 In summary, the enactment of Act 130 has not only enabled more comprehensive testing and scaling opportunities  
780 for AV companies in Pennsylvania but has also created a supportive legal environment that encourages these  
781 companies to stay and grow within the state. This legislation has helped protect existing jobs, facilitated the creation  
782 of new ones, and paved the way for significant growth in Pennsylvania’s automated vehicle industry in the coming  
783 years.

784 **2. Economic potential of HAVs in freight transportation**

785 Focus group participants discussed the impact of HAVs across various sectors, including transit, passenger vehicles,  
786 freight, and more. There were multiple participants who felt strongly that HAVs hold significant economic potential

787 for the freight sector, with benefits likely to materialize more immediately in freight compared to other sectors. One  
788 participant mentioned that “*Pennsylvania is a highly trucking dependent state. About one in 15 jobs rely on trucking*  
789 *here in Pennsylvania, we have a lot of trucking companies in the Commonwealth*”, and another statement that “*We*  
790 *believe that automated trucking has a probably a significant role to play in the future and has a lot of opportunity*  
791 *for the industry*”. Another participant seconded and said, “*I think, first and foremost, my personal opinion is and*  
792 *always has been that, if we're going to see the biggest impact of HAVs in Pennsylvania, it's absolutely going to be in*  
793 *freight*”. Other statements like “the biggest bucket is in the freight”, and “automated truck is where the quickest  
794 return is” were also observed.

795 Participants also discussed that for urban freight, HAVs can autonomously navigate and deliver goods, minimizing  
796 the need for human couriers. By streamlining delivery operations and minimizing labor costs, HAVs contribute to  
797 overall economic benefits for businesses that rely on urban freight distribution. On the other hand, for intercity freight,  
798 the impact of HAVs could be even more pronounced, particularly on long-haul trucking jobs. Automated trucks can  
799 operate continuously without breaks, thereby lowering the demand for human drivers in long-distance transportation.  
800 This continuous operation also reduces the need for truck parking facilities, as “*HAVs don't require regular rest*  
801 *stops*”. Eliminating the necessity for extensive parking infrastructure streamlines logistics processes, reduces  
802 infrastructure costs, and further enhances economic efficiency in freight transport.

803 Moreover, HAVs are expected to transform the trucking industry workforce by reshaping traditional roles and  
804 creating new job opportunities. As HAVs become more prevalent, positions will shift towards managing these  
805 vehicles, including operators, maintenance staff, and logistics system dispatchers. Skilled workers will be needed to  
806 troubleshoot and provide technical support for automated delivery systems. This shift fosters new career  
807 opportunities and encourages the workforce to develop more technologically advanced skill sets.

### 808 **3. Creation of new job opportunities in the era of HAVs**

809 The introduction of HAVs is anticipated to generate many job opportunities across Pennsylvania over the next decade,  
810 encompassing a wide range of sectors and skill sets.

811 Participants identified several areas where new job categories are likely to emerge, including

- 812 - HAV maintenance,
- 813 - Robotics,
- 814 - Sensor calibration,
- 815 - Infrastructure support,
- 816 - Automated inspection,
- 817 - Software development.

- 818 - Supporting functions, such as operating & servicing vehicle, cleaning, and customer support
- 819 - AV fleet management,
- 820 - Remote drivers
- 821 - Data security,
- 822 - First responder
- 823 - System optimization
- 824 - Insurance
- 825 - Attorney

826 While HAVs are expected to create new jobs, demand for some traditional roles, like truck and passenger vehicle  
827 drivers, may decline. Companies like Uber, for example, may increasingly rely on HAVs for their ride-sharing  
828 services, reducing the need for human drivers. This shift underscores the dual impact of HAVs on the labor market:  
829 fostering new opportunities in emerging technologies while potentially phasing out certain existing transportation  
830 jobs.

831 One participant remarked, *"The share may change, but the total will increase. More vehicles, more capital*  
832 *expenditure, and hiring will continue to grow."* Another participant noted that *"HAVs are poised to transform the*  
833 *workforce by reshaping existing job roles rather than eliminating them."* Another participant from transit agencies,  
834 when asked of how HAV technology may impact transit drivers, noted that *"As far as it impacting the workforce?*  
835 *maybe it's something like... automated vehicles, could run during the shifts that nobody wants, because it is so hard*  
836 *to hire anyone right now"*. However, it is important to note that the true impact of the AV industry remains uncertain,  
837 as we are still in the early stages of AV deployment.

838 The primary challenge will be managing this transition effectively, ensuring that the workforce is adequately  
839 prepared and supported as these changes take place. Participants also discussed how AVs might influence overall  
840 workforce demand, emphasizing the importance of proactive planning to navigate this evolving landscape.

841

#### 842 **4. Workforce transformation in the HAVs era**

843 To succeed in this rapidly evolving landscape, workers will need to combine traditional mechanical skills with  
844 advanced expertise in areas such as artificial intelligence, cybersecurity, and data analysis. Participants discussed  
845 and noted that robust training and reskilling programs will be crucial to meet the growing demand for skilled labor  
846 in these emerging areas. Workers will need to acquire new competencies, particularly in fields like automated platoon  
847 management and HAV system maintenance. Educational institutions, vocational programs, and employers must  
848 collaborate to equip the workforce with the necessary skills to operate, maintain, and oversee these sophisticated

849 systems. Such programs will help workers transition into new roles and maintain overall employment levels despite  
850 the shifts brought about by automation.

851 One area that will see significant change is the insurance industry, particularly for claims adjusters. Traditionally,  
852 claims adjusters physically assess vehicle accidents by inspecting the scene and determining the causes based on  
853 available evidence. With the introduction of HAVs, this process will shift to a more data-driven approach. Equipped  
854 with advanced sensors, cameras, and data recording systems, HAVs can capture comprehensive information about  
855 driving conditions, vehicle performance, and events leading up to an accident. As a result, the insurance claims  
856 process itself will need to adapt to HAV technology. With the vast amounts of data HAVs provide, insurance  
857 companies will be able to automate many aspects of the claims process, from accident reporting to liability  
858 determination. Claims adjusters may transition into roles overseeing these automated systems, ensuring that data is  
859 accurately analyzed and that claims are processed promptly. New positions focused on data verification, system  
860 audits, and customer support could also emerge, helping maintain transparency and trust in an increasingly automated  
861 claims process.

862 The role of vehicle maintenance and inspection will also undergo significant changes as HAV technology becomes  
863 mainstream. Traditional vehicle mechanics and inspectors, who are trained to work on conventional internal  
864 combustion engine vehicles, will need to develop expertise in advanced software, electronics, and automated driving  
865 systems. Skills in areas such as software diagnostics, sensor calibration, and automated system troubleshooting will  
866 become essential.

867 This shift towards HAVs presents numerous opportunities for workforce upskilling and the creation of new job roles.  
868 Professionals in various sectors will require training in the operation, maintenance, and oversight of automated  
869 systems. This evolution will increase the demand for educational programs and certifications focused on HAV  
870 technology, ensuring that workers are equipped with the necessary skills to thrive in this changing landscape.

871

## 872 **5. Talent retention in the HAVs sector**

873 Talent retention was another key topic discussed during the focus group session. Participants highlighted a  
874 concerning trend: individuals, particularly younger generations, who earn AV/robotics-related degrees in  
875 Pennsylvania often leave the state to pursue opportunities elsewhere. For example, one participant mentioned that  
876 *“but the biggest thing of all, I think, is that we’re losing our, our young people, and people are moving out of*  
877 *Pennsylvania... you know Carnegie Mellon, we have a great system of higher education here. That’s a great*  
878 *opportunity, especially in this area, but the kids graduate from this universities and they move out of Pennsylvania.*  
879 *So that is happening. You know it has been happening for years. We keep losing folks to a lot of those other states.*

880 *People have been mentioning to Southern States and that's part of the reason our tax base is declining. Population*  
881 *is aging and we just don't have the workforce to continue to support it. So I think this is an opportunity to build an*  
882 *industry, you know that can we can we can grow in Western Pennsylvania and if we put some resources into it and*  
883 *really help ensure that that it has the resources that it needs in order to grow.”*

884 Part of the reason, as one participant noted, is that *while Pennsylvania excels in AV and robotics R&D, it lags in the*  
885 *post-R&D phases, particularly AV testing and manufacturing—areas that potentially offer more significant job*  
886 *opportunities*. Some participants compared Pittsburgh to other mid-sized cities in the Sunbelt, such as Detroit,  
887 Milwaukee, Cincinnati, and Columbus, in terms of GDP and job opportunities, expressing concerns that  
888 Pennsylvania may be falling behind.

889 Participants acknowledged that the passing of Act 130 is a positive development. This legislation enables vendors to  
890 test HAVs in Pennsylvania, which could eventually lead to a transition into the manufacturing phase. It will be  
891 interesting to see how these changes influence job opportunities and talent retention in the years ahead.

892 To address the challenge of an aging workforce in the trucking and related industries, proactive strategies are  
893 essential for attracting younger individuals to the HAV sector. As many current employees approach retirement, the  
894 industry must develop a new generation of skilled professionals to fill emerging HAV-related roles. One effective  
895 strategy is to partner with technical schools, vocational programs, and higher education institutions to establish a  
896 strong talent pipeline. These collaborations can provide young people with the education and training needed to excel  
897 in fields such as HAV maintenance, software development, and system optimization.

898 Building a strong industry presence is also crucial for engaging and inspiring younger individuals. Initiatives such  
899 as HAV-focused internships, apprenticeships, and mentorship programs can give students and early-career  
900 professionals hands-on experience, making careers in the HAV industry more appealing. Industry leaders should  
901 actively participate in career fairs, offer workshops, and highlight the exciting opportunities HAV technology  
902 presents. By emphasizing potential growth, innovation, and technological advancement, the HAV sector can create  
903 a strong connection with future talent.

904 Raising awareness about HAV careers through targeted campaigns in schools and communities across Pennsylvania  
905 can further attract young professionals. By showcasing the cutting-edge nature of HAV technology, long-term career  
906 prospects, and the societal benefits of working in this sector, these campaigns can inspire a new wave of skilled  
907 workers. Educating the public about the importance of the HAV industry to the future of transportation will help  
908 draw interest from the next generation of professionals.

909 Collectively, these strategies will help the HAV industry address its aging workforce, ensure sustained growth, and  
910 maintain Pennsylvania’s leadership in automated vehicle technology. By implementing partnerships with

911 educational institutions, creating hands-on learning opportunities, and conducting effective awareness campaigns,  
912 the industry can cultivate a robust pipeline of skilled workers ready to meet the demands of this evolving field.

## 913 **6. Preparing the workforce training for the future of HAVs**

914 As the demand for expertise in electric and automated vehicle systems grow, specialized training programs are  
915 becoming increasingly essential. This need is particularly evident for technicians working in maintenance shops,  
916 manufacturing, and warehousing. With the rise of Level 2 and Level 3 automation, workforce training programs  
917 must focus on real-world applications to ensure employees can effectively manage and operate emerging  
918 technologies. Comprehensive and diverse training initiatives will be critical as the HAV industry continues to evolve,  
919 ensuring that workers are prepared to meet the challenges posed by these technological advancements.

920 Workforce training is crucial for the successful promotion and expansion of HAV technology. Employees must  
921 acquire new skills to manage and operate these advanced systems, highlighting the importance of upskilling,  
922 especially as automation begins to change traditional roles in the automotive and transportation industries. Training  
923 should cover areas such as automated systems operation, software integration, and cybersecurity. Additionally,  
924 specialized programs should be developed for emerging roles, including automated vehicle test engineers, data  
925 analysts, machine learning specialists, and artificial intelligence engineers. HAV-specific certifications and safety  
926 training will ensure system operators have the expertise and knowledge to maintain safe operations.

927 Collaboration between industry and educational institutions is vital to develop relevant curricula and provide hands-  
928 on training opportunities. By partnering with technical schools, vocational programs, and universities, HAV  
929 companies can help shape programs that equip students with the necessary skills. Offering internships and  
930 apprenticeships can give future employees practical experience in HAV-related roles. Workers in industries impacted  
931 by HAV technology, such as trucking and public transportation, will require reskilling in areas like digital literacy,  
932 automation, and fleet management. Additionally, employees must be trained in legal and ethical considerations to  
933 ensure compliance with regulations and maintain public trust in automated vehicle technology.

934 Support from both government and industry is essential to ensure effective workforce development in the HAV  
935 sector. Governments can offer funding and incentives for training programs, while public-private partnerships can  
936 help ensure that these programs are well-targeted and effective. Given the rapid pace of HAV technology  
937 development, continuous learning and professional development are crucial. Regular updates, participation in  
938 industry conferences, and attending workshops will help employees stay competitive and adapt to evolving demands.

939 By implementing comprehensive workforce training programs, regions like Pittsburgh will be better prepared for the  
940 future deployment of HAV technology. Ensuring that employees have the skills necessary to operate, maintain, and

941 oversee automated systems will help promote the growth and success of the HAV industry, ultimately benefiting the  
942 economy and the broader community.

943

#### 944 **7. Impact on suburb/rural area economies**

945 Participants discussed and found that HAVs offer significant opportunities to enhance connectivity and economic  
946 vitality in rural areas by improving first-mile and last-mile transit solutions. By bridging gaps in transportation  
947 services, HAVs can revitalize rural communities through improved job access, stronger links between rural and  
948 urban regions, and greater overall regional equity. In areas where public transportation is limited, HAVs can play a  
949 transformative role in expanding transportation options, effectively reducing the accessibility gap for residents and  
950 workers.

951 Increased mobility through HAVs in suburban and rural areas can also help residents access essential services more  
952 easily, such as jobs, healthcare, and education. This expanded accessibility has the potential to boost local economies  
953 by making rural regions more appealing to both residents and businesses. Furthermore, HAVs could attract more  
954 tourists and visitors to these areas by reducing transportation barriers. This influx can lead to increased activity and  
955 revenue for local businesses, including restaurants, retail shops, and service providers, thus supporting the economic  
956 growth of rural communities.

957 HAV technology can also have a profound impact on key rural industries, particularly agriculture. Automated  
958 vehicles can be employed for tasks like planting, harvesting, and transporting goods, thereby improving efficiency  
959 and productivity in agricultural operations. Additionally, automated freight transport can streamline logistics, reduce  
960 transportation costs for local producers, and increase the competitiveness of rural businesses in the broader market.  
961 This technological advancement in HAVs could lead to more robust economic growth and resilience within rural  
962 economies.

963

#### 964 **8. Post-research and development (R&D) opportunities**

965 Some participants mentioned that, as Pittsburgh and its surrounding regions increase R&D investments in automated  
966 driving and HAV testing, a clustering effect of related technology companies may emerge, fostering a robust  
967 innovation ecosystem. This ecosystem will attract businesses specializing in crucial automated driving  
968 technologies—such as sensors, software development, and integrated systems—further accelerating technological  
969 integration and advancement. As a result, Pittsburgh’s traditional manufacturing industry can transition towards more  
970 intelligent and high-end production processes, including the manufacturing of components like sensors, LiDAR, and

971 automated control systems. Automation and digitalization will also make these manufacturing processes more  
972 efficient and intelligent.

973 Enhanced R&D capabilities in the region are also poised to draw significant investment and create numerous high-  
974 skilled jobs. According to one participant, *this growth will lead to opportunities for automated vehicle developers,*  
975 *test engineers, data scientists, and other high-tech roles.* These developments would boost local talent  
976 competitiveness and expand employment opportunities in Pittsburgh’s high-tech sector.

977 To ensure the success of these efforts, supportive government policies and the development of critical infrastructure,  
978 such as data centers, will be essential. Collaboration between government agencies and private enterprises will play  
979 a key role in accelerating industry transformation and promoting sustained regional growth. By working together,  
980 these stakeholders can create an environment that supports technological integration, fosters innovation, and  
981 maintains Pittsburgh’s position as a leader in automated driving technology.

982

983 **9. The need to continuously monitor and evaluate impact**

984 With the construction of the PennSTART testing track and the support provided by Pennsylvania’s HAV law—Act  
985 130, the state is expected to attract numerous companies for research and testing. This influx is anticipated to  
986 strengthen Pennsylvania's automated driving sector and benefit its economy and job market. However, because Act  
987 130 was enacted relatively recently (on November 3, 2022) and the corresponding certificate of compliance  
988 guidelines were only issued in October 2024—effectively making this the law's first year in practice—it is  
989 challenging to immediately assess the law’s direct economic, and workforce impacts or improvements in  
990 accessibility and mobility.

991 Some participants note that the economic impact of Act 130 has not yet fully materialized. For example, one  
992 participant explicitly noted the *economic impact does not exist yet, since the act was only passed recently.* They also  
993 noted that workforce changes will likely evolve over several years as the situation unfolds. Additionally, it remains  
994 unclear which businesses have obtained licenses under the new law since its enactment. Therefore, ongoing and  
995 long-term evaluations of workforce, economic, accessibility, and mobility factors are necessary to fully understand  
996 Act 130’s influence on the development of HAVs in Pennsylvania.

997

998 **10. Pennsylvania’s climate and terrain is a challenge for HAVs testing**

999 Automated driving technology develops incrementally, and many companies initially choose to test their vehicles in  
1000 regions with simpler, more favorable conditions—such as California, Arizona, and Texas—to minimize early-stage

1001 complexities. However, as the technology matures, Pennsylvania’s challenging climate and terrain become  
1002 invaluable for rigorous testing. In winter, heavy snowfall can make automated vehicle testing significantly more  
1003 difficult, providing essential data on how these vehicles handle adverse weather conditions. Cities like Pittsburgh,  
1004 which hosts several automated driving firms, offer some of the most complex terrains in the United States, presenting  
1005 additional hurdles for testing HAVs.

1006 Participants mentioned that although Pennsylvania’s challenging weather and terrain may have seemed like  
1007 drawbacks in the early stages of automated driving development, they now provide crucial, realistic testing  
1008 environments. *As the demand for advanced and rigorous testing scenarios grows, Pennsylvania’s unique conditions*  
1009 *are likely to attract more automated driving companies.* This shift highlights the importance of varied and demanding  
1010 testing environments for the continued advancement and integration of HAV technology.

1011

## 1012 **11. Emergency responder training for HAVs**

1013 Some participants mentioned that *enhanced first responder training is crucial for managing HAV emergencies*  
1014 *effectively.* Specialized training should help responders understand how HAV systems operate and react during and  
1015 after an accident. Unlike conventional vehicles, HAVs are equipped with various sensors, cameras, and onboard  
1016 computer systems that control their driving functions. After a collision or emergency, these systems may shut down,  
1017 remain active, or even continue to move automatically if not properly disabled. First responders must be trained to  
1018 identify these systems and know how to safely deactivate them to prevent further risks. This knowledge is essential  
1019 to protect both responders and bystanders from harm.

1020 Another critical aspect of HAV-specific training is learning how to accurately document and report accidents  
1021 involving automated vehicles. HAVs often have onboard data recording systems, similar to airplane "black boxes,"  
1022 which store information such as vehicle speed, system responses, and sensor data before and during an incident. First  
1023 responders should be trained on how to access and secure this data without damaging it, as it can be vital for accident  
1024 investigations and legal purposes. Additionally, responders need to provide detailed reports on the HAV involved,  
1025 noting any malfunctions, system shutdowns, or unexpected vehicle behaviors.

1026 To ensure first responders are fully prepared for real-world HAV incidents, training programs should include  
1027 simulated emergency scenarios that mimic potential accidents involving automated vehicles. These simulations  
1028 might involve scenarios such as collisions in urban environments, rollovers, fires in electric HAVs, or multi-vehicle  
1029 pileups involving both conventional and automated vehicles. By practicing in controlled environments, first  
1030 responders can develop the necessary skills and confidence to respond quickly and safely in actual emergencies.

1031

1032 **12. Economic potential of HAVs in the U.S. suggested by participant’s previous research**

1033 A participant cited research [41] indicating that the U.S. economy could generate up to \$4.1 trillion in total value  
1034 between 2025 and 2035 from the deployment of HAVs in delivery services and associated benefits. This total  
1035 includes an estimated \$3.4 trillion from direct economic impacts—such as operational efficiencies and cost  
1036 savings—and \$0.719 trillion from wider benefits like improved road safety, time savings, and reduced transportation  
1037 emissions.

1038 This research also projects a significant increase in demand for delivery AVs, estimating that by 2035 there could be  
1039 a need for 3.1 million such vehicles to accommodate 35–40 million daily automated deliveries. As automated vehicle  
1040 technology advances and consumer acceptance of curbside delivery grows, approximately 23% of relevant vehicle  
1041 miles traveled (VMT)—amounting to about 191 billion VMT for shopping and errand trips—could be replaced by  
1042 HAV delivery services by 2035. These findings suggest that the integration of automated delivery vehicles could  
1043 substantially contribute to economic growth, enhance efficiency in transportation, and provide environmental  
1044 benefits over the next decade.

1045

1046 **13. Economic potential of HAVs in the Pittsburgh region suggested by participant’s previous research**

1047 One participant referenced a conservative estimate from research [42] regarding the economic impact of the  
1048 Pittsburgh region’s automated systems industry. *According to this study, the industry currently encompasses 71*  
1049 *companies employing over 6,300 individuals, generating significant economic benefits for the area.* Key findings  
1050 from the report include:

- 1051 • **Job Creation:** The 6,300 direct jobs in this industry support more than 8,600 additional jobs through indirect  
1052 and induced effects, resulting in a total impact of over 14,900 jobs in the region.
- 1053 • **Labor Income:** Employees in the automated systems industry contribute approximately \$651 million in  
1054 direct labor income, with total labor income (including indirect and induced effects) reaching \$1.2 billion.
- 1055 • **Economic Output:** The industry generates an estimated \$1.5 billion in direct economic output and supports  
1056 nearly \$3 billion in total economic output when considering indirect and induced effects.
- 1057 • **Tax Revenues:** It contributes over \$161 million in direct local, state, and federal tax revenues, with total tax  
1058 revenues reaching nearly \$347 million when including indirect and induced effects.
- 1059 • **Employment Multiplier:** Each employee in the automated systems industry supports approximately 2.36  
1060 additional employees in other industry sectors, illustrating the sector’s broad economic influence.

1061 These findings underscore the substantial direct and indirect economic contributions of the automated systems  
1062 industry in the Pittsburgh region, highlighting its potential for continued growth and regional development.

1063

1064 ***Challenges discussed during the focus group meetings:***

- 1065 1. **Competition from other states:** Pennsylvania faces competition from states like Texas and Arizona, where  
1066 regulatory hurdles are fewer and HAVs testing is more advanced. Stakeholders worry that if Pennsylvania  
1067 doesn't foster a more dynamic and open environment for HAV development, it could miss out on valuable  
1068 economic opportunities and lose its potential for industry leadership. Furthermore, legal regulations remain  
1069 inconsistent across different states.
- 1070 2. **The needs for refinements in legislation:** While Act 130 is a positive step, further refinements might be  
1071 necessary. For example, as technology advances, ownership allowances for Level 3 vehicles might be  
1072 expanded, with permits required only for Levels 4 and 5, ensuring the legislation keeps pace with innovation.  
1073 Additionally, the law might need to revise its detailed requirements for mirrors. Levels 4 and 5 may not  
1074 require mirrors, as they rely on sensors like cameras, LiDAR, and radar to perceive their surroundings. These  
1075 sensors can provide a broader field of view than the human eye and can more accurately detect obstacles, as  
1076 well as the distance and speed of other vehicles, thus reducing or eliminating blind spots. However, for Level  
1077 3, the driver is still required to take control in certain situations. In such cases, mirrors remain necessary for  
1078 the driver to observe the external environment.
- 1079 3. **Open testing environment:** Some participants mentioned that Pennsylvania should strike a balance between  
1080 regulation and openness to create a favorable environment for HAVs testing and deployment, while  
1081 upholding strict safety standards. Establishing a more open and dynamic testing landscape is crucial for  
1082 attracting companies to set up operations in the state.
- 1083 4. **Streamlining self-certification:** Streamlining the vehicle self-certification process is essential to reducing  
1084 bureaucracy and fostering innovation. Industry stakeholders, in particular, expressed a preference for self-  
1085 regulation, emphasizing the importance of efficiency and transparency in certification procedures.
- 1086 5. **Possibility for reduced regulation:** To minimize regulatory burdens, some stakeholders suggested that  
1087 PennDOT may consider involving third-party oversight to help streamline processes and create a more  
1088 business-friendly environment, enabling HAVs companies to thrive in Pennsylvania.
- 1089 6. **Infrastructure maintenance:** Some participants suggested that there is an urgent need to repair and  
1090 maintain infrastructure, such as road markings, signs, and lights, to support the integration of automated  
1091 vehicles. As HAVs deployment grows, infrastructure wear will intensify, necessitating proactive  
1092 maintenance to ensure safety and functionality.

1093  
1094  
1095  
1096  
1097  
1098  
1099  
1100

- 7. **Remote driving and CDL drivers:** Concerns remain about the demand for Commercial Driver’s License (CDL) holders, especially in the remote operation of HAVs. This raises safety issues, including the significant risks posed if a remote driver were to operate a vehicle under the influence of alcohol or drugs.
- 8. **Taxation and aging population:** Pennsylvania’s relatively high tax rates, compared to states like Texas, may reduce its appeal to HAVs companies. Furthermore, with the state ranking second in the nation for an aging population, this demographic shift could present challenges to industry growth and workforce development.

## 1101 **6. Impact Analysis of Improvements to Accessibility and Mobility**

1102 This chapter discusses the focus group findings on the multifaceted impacts of HAVs on accessibility and mobility  
1103 in Pennsylvania. For people with disabilities and older adults, HAVs provide new travel options that enhance  
1104 independence but require design improvements to ensure seamless access and safety. In both urban and rural areas,  
1105 HAVs can strengthen "first and last mile" connections to public transit, improving accessibility where traditional  
1106 options fall short. As a supplement to public transportation, HAVs offer potential cost savings and flexibility, though  
1107 they may also compete with existing systems and raise equity concerns in underserved areas. Deploying HAVs will  
1108 necessitate infrastructure upgrades, such as enhanced road markings and improved sidewalks, to maximize safety  
1109 for all road users, including vulnerable groups like cyclists. However, challenges—such as regulatory uncertainty,  
1110 public trust, Americans with Disabilities Act (ADA) compliance, data privacy, and equitable resource distribution—  
1111 must be addressed to fully realize the benefits of HAVs across diverse communities and create a balanced  
1112 transportation ecosystem.

1113 Below, we present 6 key observations from the focus group sessions, with *italic text* indicating direct statements  
1114 from participants.

### 1115 **1. Impact on people with disabilities and older adults**

1116 A general consensus among focus group participants is that HAVs have the potential to significantly improve  
1117 accessibility for individuals with disabilities and older adults by offering a wider range of travel options and more  
1118 convenient, on-demand services. For those living in areas with limited public transportation, such as rural or  
1119 underserved urban communities, HAVs can fill the gap by providing door-to-door transportation solutions. This  
1120 enhanced accessibility is crucial for individuals who depend on consistent and dependable means to reach essential  
1121 destinations like medical appointments, workplaces, and educational institutions. Moreover, by offering flexible and  
1122 affordable travel options—comparable in cost to riding a bus—HAVs can cater to a broader demographic, ensuring  
1123 that these services remain both economically feasible and scalable.

1124 To fully realize the benefits of HAVs for disabled and older passengers, participants highlighted several critical  
1125 factors that need to be addressed. One participant with a disability emphasized, based on personal experience, the  
1126 importance of *improving vehicle ingress and egress without relying on driver support*. This includes designing  
1127 accessible entry points, adjustable seating, and other modifications to accommodate individuals using mobility aids,  
1128 such as wheelchairs. For instance, HAVs should enable individuals to independently operate the docking mechanism,  
1129 allowing them to board the vehicle without assistance. Second, there must be *“a clear emergency protocol and  
1130 procedure for cases when an HAV malfunctions or leaves passengers stranded on the road”*—especially vital for the  
1131 disabled community who may not have the ability to seek help independently. Establishing these protocols builds

1132 trust and ensures that passengers can rely on HAVs even in unexpected situations. Additionally, building trust in the  
1133 safety and reliability of HAV technology is paramount, as many potential users may feel apprehensive about relying  
1134 on automated systems. Public education, transparent safety measures, and accessible features (such as voice-  
1135 activated controls for people with visual impairments) can help alleviate concerns and promote broader acceptance  
1136 of HAVs as a legitimate transit option.

1137 Despite the promising potential of HAVs, one participant mentioned that “*adapting these vehicles to meet the needs*  
1138 *of various groups, including those with visual or cognitive impairments, or specific medical requirements, presents*  
1139 *significant challenges.*” The necessary modifications—such as installing ramps, specialized seating, or assistive  
1140 technologies—can come at a high cost, potentially limiting widespread implementation of fully accessible HAVs.  
1141 Addressing infrastructure shortcomings, such as poorly maintained sidewalks for wheelchair users, is also essential  
1142 to ensure HAVs can successfully provide door-to-door service. For instance, improving sidewalks and providing on-  
1143 demand scheduling can be crucial for individuals who rely on HAVs to reach their destinations on time, such as for  
1144 medical appointments. Furthermore, integrating HAV services with healthcare systems was emphasized as a priority.  
1145 A participant with a disability specifically suggested that “*medical trips should be covered by medical insurance*”  
1146 and posed the question, “*Can clinics or hospitals validate parking tickets or AV tickets?*” Such integration could  
1147 greatly benefit individuals who require regular medical transport and depend on insurance to cover travel costs. To  
1148 achieve true inclusivity, policymakers, transportation planners, and HAV developers should collaborate to overcome  
1149 both the technical and economic hurdles. Encouraging a cultural shift in transportation habits will also be challenging,  
1150 as people adapt to viewing HAVs as another form of transit. Ensuring affordable pricing, reliable scheduling, and  
1151 extensive coverage is necessary to build user confidence and integrate HAVs seamlessly into existing transportation  
1152 ecosystems.

1153 Ultimately, addressing these factors will be crucial for ensuring that HAVs can truly benefit people with disabilities,  
1154 older adults, and other underserved groups. By offering accessible, trustworthy, and economically viable  
1155 transportation solutions, HAVs have the potential to improve independence and quality of life for many individuals.  
1156 As the technology continues to evolve, careful consideration of user needs, alongside supportive infrastructure and  
1157 policies, will be key to achieving the full promise of HAVs in enhancing mobility and access for all.

1158

## 1159 **2. Enhancing accessibility through first and last mile connectivity**

1160 Participants generally agreed that HAVs could significantly improve accessibility, particularly in regions with  
1161 limited transportation options, such as rural areas or underserved urban communities. In these locations, inadequate  
1162 public transit services often leave residents with few reliable travel options. By offering convenient and flexible

1163 transportation solutions, HAVs can help bridge this gap, connecting people to vital services, employment  
1164 opportunities, and essential resources that would otherwise be difficult to reach.

1165 Some participants mentioned that *a key advantage of HAVs is their ability to provide effective “first-mile” and “last-*  
1166 *mile” connectivity*. These terms refer to the initial and final segments of a journey where passengers must travel  
1167 between their starting point or destination and a public transit hub—such as a train station or bus stop. Several  
1168 participants from transit agencies and operators highlighted the potential value of HAVs in complementing existing  
1169 public transit systems. They noted that HAVs could enhance seamless connections during critical stages of travel,  
1170 improving the overall transit experience. This integration effectively extends the reach of public transit, making it  
1171 more accessible to individuals living in areas not directly served by traditional routes. As a result, HAVs can help  
1172 fill the transportation gaps that many underserved communities face.

1173 By integrating HAVs into existing transportation networks, the range of travel options available to diverse  
1174 populations can be significantly expanded. HAVs are uniquely suited to cater to various groups, including individuals  
1175 with disabilities, older adults, and residents in underserved areas who may struggle with current transportation  
1176 limitations. With more accessible and reliable transit options provided by HAVs, these populations can experience  
1177 improved mobility and greater independence. This enhanced accessibility can lead to a better quality of life, as people  
1178 gain the ability to more easily access essential services, education, job opportunities, and community activities.

1179

### 1180 **3. HAVs as a supplement to public transportation systems and freight industry**

1181 Many participants concurred that HAVs have the potential to complement—rather than compete with—public  
1182 transportation systems and the freight industry, improving efficiency, expanding coverage, and enhancing cost-  
1183 effectiveness.

1184 In the realm of public transportation, HAVs can fill critical gaps by providing flexible, on-demand services that  
1185 connect passengers to transit hubs or destinations not easily accessible through traditional routes. This supplementary  
1186 role can increase the overall efficiency and coverage of public transportation networks, making travel more seamless  
1187 and convenient for passengers. As one participant mentioned, *“HAVs present a great opportunity to complete that*  
1188 *first and last mile of travel from public transportation hubs.”* Another participant echoed this sentiment, stating that  
1189 *“HAVs can be a great supplement to current transportation in urban areas, particularly supporting the existing*  
1190 *public transportation system in places like Philadelphia.”*

1191 Beyond passenger transportation, the freight industry also stands to benefit significantly from HAV deployment.  
1192 HAVs can enhance transportation efficiency by enabling continuous operation, especially in long-haul and intercity  
1193 freight scenarios. This includes the ability to *“operate during nighttime hours when human drivers would typically*

1194 *require rest, thereby extending operating hours and keeping goods moving around the clock*". The result is not only  
1195 faster delivery times but also increased operational capacity.

1196 Additionally, HAVs offer the potential to reduce costs in both public transportation and freight sectors. In freight  
1197 transport, HAVs can lower labor expenses and fuel consumption by optimizing driving patterns and reducing the  
1198 need for human drivers. Similarly, for public transportation systems, HAVs provide cost-effective solutions on routes  
1199 where traditional buses or trains may not be economically viable. A participant from transit agencies noted that  
1200 *"automated vehicles, could run during the shifts that nobody wants, because it is so hard to hire anyone right now"*.  
1201 This makes HAVs a practical supplement to existing transportation services, offering both operational benefits and  
1202 cost savings across multiple industries.

1203

#### 1204 **4. Potential impact on urban and rural areas**

1205 Most participants believe that in urban environments, HAVs have the potential to significantly extend the reach of  
1206 existing public transportation systems, such as subways and regional rail networks. By offering efficient first-mile  
1207 and last-mile solutions, HAVs can make it easier for residents to access transit hubs and reach destinations not  
1208 directly serviced by traditional transit routes. This enhanced connectivity can lead to improved mobility within cities,  
1209 reduced traffic congestion, and a more integrated urban landscape. Ultimately, the integration of HAVs can result in  
1210 more efficient and user-friendly transportation systems that benefit all city dwellers.

1211 Participants mentioned that *"in rural areas, where public transportation options are often limited or nonexistent,*  
1212 *HAVs can play a crucial role in filling these gaps and improving overall mobility"*. By providing on-demand and  
1213 flexible transportation services, HAVs can help residents access essential services such as healthcare, employment,  
1214 and education more easily. This improved accessibility can help rural populations overcome geographic barriers,  
1215 creating stronger connections between rural communities and urban centers. Additionally, the deployment of HAVs  
1216 in rural regions can contribute to the revitalization of local economies by making these areas more accessible and  
1217 attractive to both visitors and businesses.

1218 Beyond these immediate impacts on urban and rural transportation, HAVs have the potential to reshape commuting  
1219 patterns and influence business locations, ultimately affecting land use and economic landscapes. As HAVs offer  
1220 more flexible and efficient transportation options, *"people may become more willing to live farther from their*  
1221 *workplaces"*, potentially leading to significant changes in residential development and urban sprawl. Businesses  
1222 might also reconsider their locations, balancing the benefits of central urban areas with the increasing accessibility  
1223 of suburban and rural regions. These shifts could prompt profound changes in land use planning, transportation  
1224 infrastructure development, and the overall economic dynamics of both urban and rural areas.

1225

1226 **5. Improving road safety through HAVs technology**

1227 HAVs are poised to significantly enhance road safety by strictly adhering to traffic laws and minimizing risks  
1228 associated with human error. Unlike human drivers, who can be prone to distractions, fatigue, or misjudgments,  
1229 HAVs operate based on consistent, data-driven decision-making processes. This adherence to traffic rules leads to  
1230 more predictable and safer behavior on the road, potentially reducing the number of traffic violations and accidents.  
1231 Participants believe by removing common human-related errors, HAVs can create a safer driving environment and  
1232 improve overall road safety for everyone.

1233 A major factor behind this improvement is that human error is a leading cause of road accidents, and HAV technology  
1234 is designed to address this issue effectively. Participants agree that HAVs can eliminate many of the mistakes human  
1235 drivers commonly make, such as abrupt lane changes, speeding, or failing to stop at intersections. Equipped with  
1236 advanced sensors, cameras, and real-time data analysis capabilities, HAVs react more quickly and accurately to  
1237 changing road conditions than human drivers. This ability to make precise, split-second decisions can help prevent  
1238 accidents that often result from delayed or incorrect human responses, thereby reducing the likelihood of collisions  
1239 and fatalities.

1240 Beyond safeguarding drivers and passengers, HAVs offer enhanced protection for vulnerable road users like  
1241 pedestrians and cyclists. These vehicles come equipped with sophisticated detection systems capable of identifying  
1242 and tracking the movements of pedestrians and cyclists. As a result, HAVs can adjust their speed and trajectory to  
1243 avoid collisions, prioritizing the safety of these more vulnerable groups. This focus on protecting pedestrians and  
1244 cyclists can contribute to creating safer urban environments where all road users can coexist more confidently. By  
1245 reducing the number of traffic-related injuries and fatalities, HAVs stand to make a significant positive impact on  
1246 public safety and wellbeing.

1247

1248 **6. Upgrading infrastructure to support HAVs and public transportation**

1249 Infrastructure improvements are crucial for optimizing the performance of HAVs and enhancing the overall public  
1250 transportation system. Upgrading road markings is one significant area of focus. HAVs rely heavily on clear and  
1251 well-maintained lane markings to navigate accurately. By investing in more durable and visible road markings, cities  
1252 and regions can ensure that HAVs operate more efficiently and safely, reducing the risk of confusion or accidents.  
1253 These improvements not only benefit automated vehicles but also create a safer driving environment for human  
1254 drivers.

1255 The construction of protected spaces for vulnerable road users (VRUs) is also considered a critical factor in  
1256 supporting the integration of HAVs into transportation networks. When discussing key infrastructure preparations,  
1257 a participant suggested that he would “*prioritize divided bike lanes and protected bike lanes, which directly benefit*  
1258 *their users. Additionally, providing well-maintained and accessible sidewalks improves mobility by enabling people*  
1259 *to reach bus stops more easily. This keeps pedestrians out of the streets, minimizing their impact on AVs and*  
1260 *addressing other safety concerns.*” Protected bike lanes encourage more people to use bicycles as a sustainable mode  
1261 of transportation, thereby promoting a more balanced, multi-modal transport network. In this way, bike lane  
1262 infrastructure improvements contribute to a safer and more inclusive transportation system for everyone. Renovating  
1263 sidewalks is another essential infrastructure improvement that benefits both HAVs and the public. For HAVs, well-  
1264 maintained and clearly defined sidewalks help enhance pedestrian detection and improve navigation in densely  
1265 populated areas, allowing automated vehicles to operate more safely and efficiently. For pedestrians, upgraded  
1266 sidewalks improve accessibility, particularly for individuals with disabilities, older adults, and families with strollers.  
1267 This leads to a more inclusive transportation environment where pedestrians feel safer and more confident using  
1268 sidewalks alongside HAV technology. By ensuring that sidewalks are accessible and safe, cities foster an  
1269 environment where walking becomes a more viable and attractive option for everyone.

1270 Collectively, these infrastructure improvements lead to a more robust and user-friendly public transportation system.  
1271 Upgrading road markings, constructing protected bike lanes, and renovating sidewalks creates a safer, more efficient,  
1272 and inclusive environment for all road users. As HAVs become more prevalent, these enhancements to infrastructure  
1273 not only optimize their performance but also ensure that pedestrians, cyclists, and traditional vehicles can coexist  
1274 harmoniously. By addressing the needs of various modes of transportation, cities can better support the effective  
1275 integration of HAVs while enhancing overall mobility, accessibility, and safety for everyone.

1276

1277 ***Challenges discussed during the focus group meetings:***

- 1278 1. **Improving HAVs ADA compliance for people with disabilities:** HAVs technology has not yet fully  
1279 addressed the needs of individuals with various disabilities. Issues such as difficulty fastening seat belts,  
1280 challenges with voice controls, and the inability of wheelchair users to board and exit vehicles independently  
1281 are still common. These often require assistance from service personnel, adding complexity to operations  
1282 and limiting accessibility.
- 1283 2. **Equity issues:** Concerns exist that vulnerable groups—such as ethnic minorities and low-income  
1284 populations—may be underserved by HAVs services. Companies might prioritize more profitable urban  
1285 areas, potentially neglecting rural and low-income communities, thereby widening the gap in transportation  
1286 equity.

- 1287 3. **Worsening traffic conditions:** Some participants expressed concerns that, if not properly managed, HAV  
1288 services could reduce transit ridership and worsen urban traffic congestion in cities like Philadelphia. For  
1289 example, low operating speeds, such as 3 mph in downtown areas to avoid parking, could create moving  
1290 bottlenecks instead of alleviating congestion. Striking a balance in resource allocation is essential to avoid  
1291 negative impacts on existing public transportation systems and to prevent further traffic issues.
- 1292 4. **Infrastructure and technical limitations:** HAVs require supportive infrastructure, including well-  
1293 maintained pavement markings, reliable GPS and 5G networks, connected traffic signals, and accessible  
1294 crosswalks. However, these technologies are not yet widely available, particularly in rural areas, where  
1295 inadequate infrastructure limits the effectiveness and expansion of HAV services.
- 1296 5. **Liability and regulatory issues:** Determining liability in accidents involving both human and machine  
1297 errors remains a challenge. Despite legislation like Pennsylvania’s Act 130, uncertainties persist regarding  
1298 how these laws will be applied in practice, creating ambiguity around responsibility in the event of an HAV-  
1299 related accident. As HAVs technology advances, insurance premiums and coverage terms will likely change  
1300 significantly, adopting a more dynamic, data-driven approach that uses real-time vehicle data to influence  
1301 claims processing and reshape the HAVs insurance landscape.
- 1302 6. **Public acceptance and education:** Building public trust in HAVs is crucial for their widespread adoption.  
1303 This requires enhanced education and demonstration projects to effectively communicate the benefits and  
1304 limitations of HAVs technology. Public skepticism, particularly among older adults who may distrust  
1305 technology, must be alleviated through targeted efforts to build confidence and showcase the advantages of  
1306 HAVs.
- 1307 7. **Data security and privacy:** As HAVs collect vast amounts of data, ensuring its secure storage and proper  
1308 use is a major concern. Protecting this data from breaches or misuse is essential to maintaining public trust  
1309 and complying with privacy regulations.

1310

1311 **7. Recommended Changes to Policies and Legislation**

1312 Based on the focus group experts' discussion, the following recommendations summarize potential changes and/or  
1313 additions needed to current PennDOT policies and procedures.

- 1314 1. Some focus group participants, particularly those representing HAV vendors and trade associations,  
1315 suggested reducing regulatory oversight for Level 3 automated vehicles. Level 3 vehicles may not require a  
1316 HAVs certificate. It was suggested that these vehicles should not be included in the certificate regulatory  
1317 framework, as they operate with human oversight and do not fully meet the criteria for higher levels of  
1318 autonomy that require additional regulation.
- 1319 2. Some focus group participants recommended avoiding state-specific testing and reduce regulations. One  
1320 participant mentioned that *“having 50 different regulations, one for each state, would create significant*  
1321 *challenges in terms of compliance and consistency across jurisdictions”*. Another participant also noted that  
1322 the Eastern U.S. region poses more challenges due to smaller state sizes, where a single trip can easily cross  
1323 multiple state borders. Significant regulatory differences between states can make compliance difficult for  
1324 vendors. A unified regulatory framework is suggested to streamline the process and reduce complexity.
- 1325 3. Some focus group participants recommended allowing individual ownership under Act 130. Restricting  
1326 individual ownership may negatively impact business models of many automakers, who rely on individual  
1327 vehicle sales. Allowing this ownership would support existing business practices and encourage broader  
1328 market participation.
- 1329 4. Enhancing public trust in highly automated vehicles is a shared concern. Several focus group participants  
1330 recommended launching public education campaigns and demonstration projects to build trust in HAV  
1331 technology, especially among people with disabilities and older adults. These outreach initiatives should  
1332 alleviate public concerns, highlight the benefits of HAVs, and strengthen confidence in the technology.
- 1333 5. Some focus group participants suggested revising the 10-day notice requirement for municipalities outlined  
1334 in the act, which states: *“A certificate holder shall notify in writing the governing body of the municipality*  
1335 *of the intent to operate an HAV within the boundaries of the municipality at least 10 days prior to*  
1336 *commencing operations.”* They argued that requiring a 10-day notice for a municipality that the HAV will  
1337 merely pass through is unnecessary. Additionally, the absence of an identified point of contact (POC) often  
1338 leaves municipalities unaware of such notifications and unable to respond effectively within the 10-day time  
1339 frame.
- 1340 6. In section 4, *“Highly automated vehicles.--If an HAV is operating on highways of this Commonwealth, a*  
1341 *rear visibility system comprised of a set of devices or components, that together perform the function of*  
1342 *producing the rearview image, shall be considered a mirror or a similar device to a mirror, and shall be*

1343 excluded from the measurement of the width of the HAVs consistent with applicable Federal and State laws.”  
1344 Some focus group participants recommended to refine the requirement for mirrors for different level of  
1345 HAVs. Levels 4 and 5 may not require mirrors, as they rely on sensors such as cameras, LiDAR, and radar  
1346 to perceive their surroundings. For Level 3, however, the driver must still take control in certain situations,  
1347 making mirrors necessary for observing the external environment.

- 1348 7. In Section 9, the act states: “A certificate holder is required to self-report to the department any accident in  
1349 this Commonwealth involving the certificate holder’s HAVs if the accident resulted in bodily injury, serious  
1350 bodily injury, death, or damage to property. The department shall establish the time frame for self-reporting  
1351 an accident, provided that the time frame is no less than six hours from the occurrence of the accident.”  
1352 Some focus group participants believe the six-hour window is too short and shared past experiences where  
1353 reporting within such a limited time frame was challenging or not feasible.
- 1354 8. Some focus group participants recommended establishing a detailed emergency response protocol for HAVs  
1355 that includes procedures for identifying, securing, and disabling vehicles in emergency situations. This  
1356 protocol should cover post-crash events, handling high-voltage areas, and ensuring access to essential  
1357 documents such as insurance, vehicle identifiers, and keys.
- 1358 9. Some focus group participants recommended enhancing the integration of automated vehicle systems with  
1359 the Department of Motor Vehicles (DMV) by updating existing procedures to accommodate automated  
1360 vehicle requirements. This will support more efficient coordination during emergencies and ensure the  
1361 system is prepared for future technological advancements in both AVs and EVs.
- 1362 10. Some focus group participants recommended establishing enhanced training programs for first responders  
1363 (e.g., police officers, firefighters, paramedics, hazmat teams) to effectively manage emergency situations  
1364 involving HAVs, thereby improving safety and preparedness.
- 1365 11. Some focus group participants recommended prioritizing the repair and maintenance of critical  
1366 transportation infrastructure, such as road markings, signs, and traffic lights, to support the safe integration  
1367 of HAVs into Pennsylvania’s transportation network.
- 1368 12. Some focus group participants recommended implementing policies to encourage the deployment of HAVs  
1369 in rural areas to improve first-mile and last-mile transit solutions, enhance connectivity, and support regional  
1370 economic growth. They expressed concerns that without such measures, AV vendors might prioritize urban  
1371 areas with higher demand, leaving rural communities underserved.
- 1372 13. The research team recommends that PennDOT continuously monitor and evaluate the impact of Act 130,  
1373 while periodically reviewing public input and feedback. Since both Act 130 and its guidelines were only  
1374 recently issued, the full impact is expected to unfold over the coming years. Furthermore, as vendors begin  
1375 applying for certification and initiating the deployment process, it is anticipated that additional feedback will

1376 emerge. The HAV committee should remain attentive to this input and address it promptly through timely  
1377 discussions.

- 1378 14. The research team suggests that as vendors submit the data specified in the "Certificate of Compliance  
1379 Guidelines" to PennDOT, the state should develop a comprehensive plan to analyze, publish, and utilize this  
1380 information. This includes ongoing accident reporting, compliance reports, and safety reporting data. For  
1381 instance, states like California regularly publish AV collision and disengagement reports. By analyzing AV  
1382 safety metrics—such as miles per disengagement—and creating visualizations of disengagements, crash  
1383 frequency, and locations, as well as tracking how these metrics evolve over time, PennDOT could  
1384 significantly enhance public understanding and, in turn, foster greater trust in the technology.

1376  
1377  
1378  
1379  
1380  
1381  
1382  
1383  
1384  
1385

1386 **Appendix A Q&A Documents for Understanding Act 130**

**General Summary**

1387 **1. Q: What is Act 130?**

1388 **A:** Act 130 refers to a piece of legislation enacted in Pennsylvania that addresses various aspects related to Highly  
1389 Automated Vehicles.

1390 **2. Q: When do the different sections of Act 130 take effect?**

1391 **A:** The effective dates for the provisions of Act 130 are as follows:

- 1392 (1) Section 11 of the Act, which outlines the effective dates, takes effect immediately.
- 1393 (2) The amendment of 75 Pa.C.S. § 1106(b) (Section 2) will take effect in one year from the date of approval,  
1394 specifically on November 3, 2023.
- 1395 (3) The addition of 75 Pa.C.S. § 3723 (Section 3.1) is set to take effect in 60 days from the approval date, which  
1396 is January 2, 2023.
- 1397 (4) The addition of 75 Pa.C.S. § 8510.2 (Section 9) takes effect immediately upon approval.
- 1398 (5) The remainder of the Act will take effect in 240 days from the date of approval, i.e., July 1, 2023.

1399 **3. Q: Where is Act 130 available?**

1400 **A:** Act 130 is available online and can be freely accessed at:

1401 <https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2022&sessInd=0&act=130>

1402 **4. Q: What is Act 130 about?**

1403 **A:** Act 130 includes significant amendments to the State's vehicle code (Title 75) and covers definitions, rules,  
1404 equipment standards, inspections, and other regulations concerning HAVs. This Act provides a framework for how  
1405 these vehicles should operate, focusing on areas like safety, licensing, insurance, and operations on public roads.  
1406 Additionally, Act 130 introduces new offenses, such as the theft of catalytic converters, and establishes guidelines  
1407 for the reporting and handling of vehicular accidents. It also outlines the responsibilities of different government  
1408 bodies in regulating and overseeing the use of HAVs in Pennsylvania. Act 130 includes a total of 11 sections.

**Section 1: Adding definitions in section 102 of Title 75**

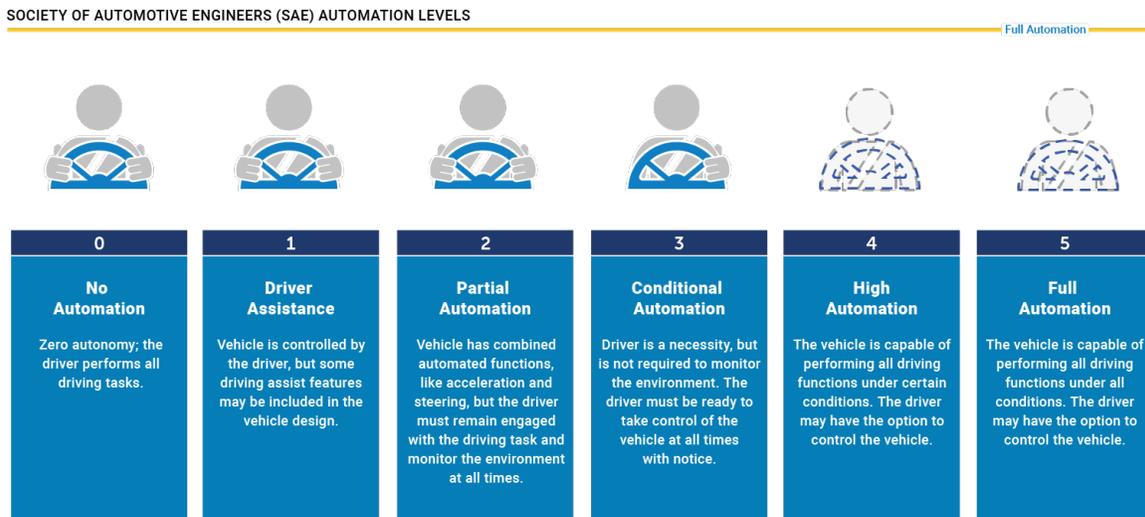
1409 **5. Q: What is an “Automated Driving System (ADS)” and how does it function?**

1410 **A:** An ADS consists of advanced hardware and software capable of handling the entire driving task independently.  
1411 It controls functions such as steering, braking, accelerating, and monitoring the vehicle’s surroundings and can  
1412 respond to road conditions without human input.

1413 In terms of driving automation levels as defined by the Society of Automotive Engineers (SAE) and adopted by the  
1414 US Department of Transportation, as shown in **Fig. 13**, ADS varies in complexity and capability:

- 1415 **1. Level 0 (No Driving Automation):** The driver performs all driving tasks.
- 1416 **2. Level 1 (Driver Assistance):** The vehicle includes systems like cruise control for acceleration or automated  
1417 steering, but not both simultaneously.

- 1418 **3. Level 2 (Partial Driving Automation):** The vehicle can automate both steering and acceleration tasks yet requires  
 1419 the driver's full engagement with the driving process and environment monitoring.
- 1420 **4. Level 3 (Conditional Driving Automation):** The ADS executes all driving functions under certain conditions;  
 1421 however, the driver must be ready to intervene if called upon.
- 1422 **5. Level 4 (High Driving Automation):** The vehicle can perform all driving operations under specific conditions  
 1423 without any human intervention, but there may be some operational constraints.
- 1424 **6. Level 5 (Full Driving Automation):** The vehicle is fully automated, capable of performing all driving operations  
 1425 under all conditions without any human input.



1426  
1427

**Figure 13 Levels of automated driving**

1428 At Levels 3 to 5, vehicles are typically referred to as HAV. Vehicles designed to operate exclusively on Level 4 or  
 1429 Level 5 automation are known as “ADS-dedicated vehicles,” meaning they do not require a human driver.

1430 **6. Q: What automation vehicles are HAVs?**

1431 **A:** HAVs refer to the vehicles with automation level 3 to 5.

1432 **7. Q: Can an individual obtain an HAVs certificate?**

1433 **A:** According to Act 130, individual persons are not typically recognized as certificate holders for HAVs. Eligible  
 1434 entities to hold such certificates include firms, partnerships, associations, corporations, or educational or research  
 1435 institutions.

1436 **8. Q: How to become an HAV driver?**

1437 **A:** To become a driver of an HAV under Act 130, the following criteria must be met:

- 1438 (1) Certificate Holder Affiliation: The individual must be an authorized employee or contractor of a certificate holder.
- 1439 (2) Dynamic Driving Task (DDT): The driver is responsible for managing all or part of the dynamic driving task,  
 1440 even if the vehicle is largely automated.

1441 (3) Monitoring Capability: The driver must be capable of monitoring and controlling the HAV either on board the  
1442 vehicle or remotely from a location within the United States.

1443 **9. Q: What is a "platoon"? What kind of vehicles can form a platoon? Can school vehicles form a platoon?**

1444 A: A platoon refers to a group of vehicles, specifically buses, military vehicles, or motor carrier vehicles, traveling  
1445 closely together at electronically coordinated speeds, which allows them to maintain shorter following distances than  
1446 typically advisable. Platoon configurations do not include school buses or school vehicles.

1447 **10. Q: Does a platoon have a maximum vehicle limit?**

1448 A: Yes, a maximum of three vehicles shall be in a platoon

1449 **11. Must each vehicle in the platoon include a driver?**

1450 A: Yes, a driver shall be present in each vehicle of a platoon, except as provided in the following: Consistent with  
1451 applicable federal or state laws and regulations, the lead vehicle may operate with a driver, and one non-lead vehicle  
1452 may operate with an Automated Driving System (ADS) engaged, with or without a driver.

1453 **12. Q: Should vehicles in a platoon travel only on limited-access highways or interstate highways?**

1454 A: Yes, vehicles in a platoon shall travel only on limited access highways or interstate highways, unless otherwise  
1455 permitted by the department or the Pennsylvania Turnpike Commission, as applicable.

1456 **13. Q: Can "Personal Delivery Devices" (PDDs) with an ADS be called HAVs?**

1457 A: No, PDDs equipped with ADS are not classified as HAVs under Act 130. While both utilize ADS technology,  
1458 HAVs are specifically defined as motor vehicles designed for the transportation of persons or goods, whereas PDDs  
1459 are primarily used for transporting goods on sidewalks and pathways, and are not designed to carry passengers. Act  
1460 130 explicitly excludes PDDs, which are considered as pedestrians under Pennsylvania law, from being recognized  
1461 as HAVs.

*Section 2: Amending the content and effect of certificate in section 1106 (b) (10) and (11) of Title 75*

1462 **14. Q: I want to transfer my vehicle title certificate, but I don't want to disclose that the car is an HAV. Is  
1463 that okay? What will be the consequences?**

1464 A: No, it is not permissible to transfer a vehicle title without disclosing that the vehicle is an HAV. According to Act  
1465 130, any transfer of a vehicle title must include clear notification if the vehicle has specific conditions or uses, such  
1466 as being an HAV. Failing to disclose this information violates the Act, and any person found guilty of such  
1467 nondisclosure commits a summary offense. Upon conviction, they are subject to a fine of \$200.

*Section 4: Amending Sections 3742, 3743, 3744, 3745, 3746, 4103, 4702 and 4921 of Title 75*

1468 **15. Q: What should be done when an HAV is involved in an accident?**

1469 A: When an HAV is involved in an accident, the responsible party—either a person on behalf of the certificate holder  
1470 for the HAV or an operator of the HAV itself—must immediately contact a duly authorized police department to  
1471 report the accident. They must also provide the registration details and proof of financial responsibility for the HAV  
1472 to the police department and PennDOT.

1473 **16. Q: When an HAV equipped with a rear visibility system, which functions as a traditional mirror, is**  
1474 **operating on highways of this Commonwealth, should the rear visibility system be included in the overall**  
1475 **width measurement of the vehicle for compliance with state vehicle dimension regulations?**

1476 **A:** No, according to Section 4921(e.3) of Act 130, a rear visibility system that functions as a traditional mirror in an  
1477 HAV operating on highways of this Commonwealth shall be considered equivalent to a mirror but shall be excluded  
1478 from the measurement of the width of the vehicle. This exclusion is consistent with applicable Federal and State  
1479 laws.

*Section 5: Amending Section 6109 (a) (13) of Title 75 by specific powers of department and local authorities*

1480 **17. Q: Does Act 130 affect the reasonable exercise of police powers? Are local authorities allowed to ban or**  
1481 **regulate the use of certain classes or types of traffic on particular streets, specifically targeting or**  
1482 **discriminating against HAVs? Do HAVs have equal rights with other regular driver-driven vehicles?**

1483 **A:** According to Act 130, local authorities maintain the power to prohibit or regulate the use of specific streets by  
1484 any class or kind of traffic, ensuring the reasonable exercise of police powers. However, these regulations must not  
1485 specifically target or discriminate against HAVs, ensuring HAVs are treated equally to traditional, driver-driven  
1486 vehicles on public roads.

*Section 6: Amending Section 8501 of Title 75 by adding definitions*

1487 **18. Q: What is a highly automated work zone vehicle?**

1488 **A:** A highly automated work zone vehicle is a motor vehicle that is utilized within an active work zone, managed by  
1489 either the Pennsylvania Department of Transportation or the Pennsylvania Turnpike Commission. It is specifically  
1490 used for operations related to that active work zone and is characterized by one of the following features:

- 1491 (1) Equipped with an automated driving system that enables it to operate in automated mode.  
1492 (2) Connected via wireless communication or other technologies to another vehicle, which allows for coordinated or  
1493 controlled movement within the work zone.

1494 **19. Q: What is “Dynamic Driving Task fallback”?**

1495 **A:** DDT fallback refers to the actions taken by the ADS of an HAV when there is a system failure related to the DDT  
1496 or when the vehicle exits its operational design domain. The ADS or the driver, if present, must either continue  
1497 performing the DDT or transition the vehicle to a minimal-risk condition to ensure safety.

1498 **20. Q: Can the “Dynamic Driving Task” select a destination or a waypoint? What can DDT accomplish?**  
1499 **Could you give us an example?**

1500 **A:** No, the DDT does not include strategic functions such as trip scheduling or the selection of destinations and  
1501 waypoints. It focuses on immediate operational tasks required for driving. These include, but are not limited to:

- 1502 (1) Lateral vehicle motion control via steering.  
1503 (2) Longitudinal motion control via acceleration and deceleration.

- 1504 (3) Monitoring the driving environment through the detection, recognition, classification, and preparation to respond  
1505 to objects and events.
- 1506 (4) Execution of responses to objects and events.
- 1507 (5) Maneuver planning.
- 1508 (6) Enhancing vehicle conspicuity through lighting, signaling, and gesturing.
- 1509 (7) These functions are integral to managing the vehicle's movement and ensuring safety but do not encompass  
1510 navigation to chosen destinations or waypoints.

1511 **21. Q: How do HAVs reduce the risk of collisions? What does “minimal risk condition” mean?**

1512 **A:** HAVs incorporate a ‘Minimal Risk Condition’ to significantly reduce the risk of collisions. This feature is a  
1513 safety protocol where the HAVs or its ADS brings the vehicle to a stable, stopped condition if continuing the trip  
1514 becomes unsafe or impractical. This condition is activated following a ‘DDT fallback’ scenario, where the vehicle  
1515 must manage a failure or operational issue that threatens the continuation of normal driving operations.

*Section 7: Amending Section 8502 of Title 75 by the definition of HAV*

1516 **22. Q: Which organization has the authority to grant or deploy highly automated work zone vehicles? Will**  
1517 **HAVs require driver supervision? In what areas might their work zones be involved?**

1518 **A:** PennDOT and the Pennsylvania Turnpike Commission have the authority to authorize locations on their roadways  
1519 for the deployment of highly automated work zone vehicles in Pennsylvania. These organizations decide on the  
1520 specific locations where these vehicles can be used on a periodic basis. Depending on the specific operational  
1521 requirements and safety considerations, a driver may be required in a highly automated work zone vehicle, especially  
1522 when used in active work zones. The deployment areas typically involve major roadways or areas undergoing  
1523 extensive maintenance or construction work.

*Section 8: Amending Section 8503 (b) and (h) of Title 75 by adding a subsection about Highly Automated Vehicle Advisory Committee*

1524 **23. Q: Could Tom, who works as a regular car salesman, and his friend Jack, a teacher, be eligible to serve**  
1525 **on the Highly Automated Vehicle Advisory Committee?**

1526 **A:** Tom and Jack would only be eligible if they represent one of the specific groups mentioned in the committee  
1527 structure. These include members from educational or research institutions, technology companies, vehicle  
1528 manufacturers, and other specified stakeholders in highly automated vehicle development. Typically, the roles of a  
1529 car salesman and a teacher do not align with the specialized positions defined for committee membership unless they  
1530 have additional relevant qualifications or representational roles.

1531 The Advisory Committee shall consist of the following members:

- 1532 (1) The secretary, who shall serve as the chairperson of the advisory committee.  
1533 (2) The Secretary of Community and Economic Development.  
1534 (3) The Insurance Commissioner.  
1535 (4) The Secretary of Labor and Industry.

- 1536 (5) The Commissioner of Pennsylvania State Police.
- 1537 (6) The Chief Executive Officer of the Pennsylvania Turnpike Commission.
- 1538 (6.1) The chairperson of the Pennsylvania Public Utility Commission.
- 1539 (7) The chairperson and minority chairperson of the Transportation Committee of the Senate.
- 1540 (8) The chairperson and minority chairperson of the Transportation Committee of the House of Representatives.
- 1541 (9) The following members to be appointed by the Governor:
  - 1542 i. One member representing a transit authority located in this Commonwealth.
  - 1543 ii. One member representing [a transportation,] an educational or research institution located in this
  - 1544 Commonwealth engaged in developing highly automated vehicles.
  - 1545 iii. One member representing a technology company engaged in developing highly automated vehicles.
  - 1546 iv. One member representing a vehicle manufacturer engaged in developing highly automated vehicles.
  - 1547 v. One member representing bicyclists, pedestrians or motorcyclists in this Commonwealth.
  - 1548 vi. One member representing drivers or consumers in this Commonwealth.
  - 1549 vii. One member representing a municipality of this Commonwealth.
  - 1550 viii. One member representing platoon operations.
  - 1551 ix. One member representing an insurance company, association or exchange who is authorized to transact
  - 1552 the business of motor vehicle insurance in this Commonwealth.
  - 1553 x. Two members representing different labor organizations in this Commonwealth.
  - 1554 xi. One member representing Pennsylvanians with disabilities.
  - 1555 xii. One member representing a company engaged in the development of highly automated motor carrier
  - 1556 vehicles.

1557 **24. Q: The HAV Advisory Committee is required to submit a special annual report that evaluates the impact**  
 1558 **of HAVs on the state. What will be included in this report?**

1559 **A:** The annual report submitted by the HAV Advisory Committee under Act 130 should include several critical  
 1560 evaluations to assess the impact of HAVs on the state:

- 1561 (1) Benefits and implications for the workforce.
- 1562 (2) Economic benefits and implications.
- 1563 (3) Improvements to accessibility and mobility for persons with disabilities.
- 1564 (4) Improvements to mobility options for the general public.
- 1565 (5) Suggested changes to the laws of this Commonwealth to better integrate and regulate HAVs.

1566 **25. Q: Does the HAV Advisory Committee have the power to punish HAV drivers?**

1567 **A:** No, the Highly Automated Vehicle Advisory Committee does not have the authority to punish HAV drivers  
 1568 directly. Their powers are limited to evaluating accidents and other aspects related to the operation of HAVs. The  
 1569 committee can provide recommendations and feedback based on their evaluations, but any legal actions or penalties  
 1570 would fall under the jurisdiction of legal and regulatory bodies, not the advisory committee itself.

***Section 9: Amending Title 75 by adding Section 8504, 8505, 8506, 8507, 8508, 8509, 8510***

1571 **26. Q: Can an HAV from California enter Pennsylvania without a certificate if it intends to travel through**  
 1572 **Pennsylvania?**

1573 A: An HAV must have a valid certificate to operate in Pennsylvania, regardless of its state of origin. If an operator  
1574 holds an HAV certificate in California, it does not automatically permit operation in Pennsylvania unless there is an  
1575 existing interstate agreement or recognition of out-of-state certificates specifically allowing such an operation. As of  
1576 current regulations under Act 130, each state maintains its certification process, and there's no automatic reciprocity  
1577 for HAV operation across state lines without specific authorization.

1578 **27. Q: Tom is a driver for the public transit operator (such as SEPTA or CATA), which has a certificate for**  
1579 **operating HAVs. Can Tom legally drive an HAV on a highway?**

1580 A: Yes, Tom can legally drive an HAV on a highway as long as he is authorized by the public transit operator (such  
1581 as SEPTA or CATA) to do so. The transit operator, being a certificate holder for HAVs, must designate its drivers  
1582 who are permitted to operate these vehicles. If Tom is authorized by the transit operator, he can operate the HAV on  
1583 a highway; if not, he cannot drive the HAV without proper authorization.

1584 **28. Q: Which organization has the sole regulatory authority to operate HAVs on highways in Pennsylvania?**

1585 A: PennDOT has the sole regulatory authority to operate HAVs on highways within this Commonwealth. This  
1586 authority is consistent with the provisions of Act 130 and applicable federal laws and regulations.

1587 **29. Q: Can someone from the HAV Advisory Committee prohibit the use of an HAV on a highway?**

1588 A: No, only the secretary of PennDOT has the right to prohibit the use of an HAV on a highway. The premise is that  
1589 an HAV operate on a highway may constitute a hazard. The Advisory Committee itself does not have the authority  
1590 to prohibit the use of HAVs on highways.

1591 **30. Q: Suppose there is a serious accident involving an HAV on a highway. As the holder of the HAV**  
1592 **certificate, Tom did not report the incident to the department until 24 hours later. Is this, okay?**

1593 A: No, reporting the incident 24 hours later does not comply with the requirements set forth in Act 130. According  
1594 to the Act, PennDOT establishes the timeframe for reporting accidents involving an HAV that resulted in bodily  
1595 injury, serious bodily injury, death, or significant property damage. The timeframe established by the department is  
1596 no less than six hours from the occurrence of the accident. Therefore, Tom should have reported the accident within  
1597 the timeframe specified by PennDOT, which would be no less than six hours after the incident.

1598 **31. Q: What information of the certificate holders will be listed on PennDOT's publicly accessible Internet**  
1599 **website?**

1600 A: According to Act 130, the publicly accessible Internet website should provide comprehensive information about  
1601 HAV operations, not just the list of certificate holders. This includes:

1602 (1) Location information where the HAV is expected to operate.

1603 (2) The name and contact information for accident claims, including the registered agent for service of process.

1604 **32. Q: Tom was penalized for a violation while driving an HAV a year ago. Can he now control all or part of**  
1605 **the DDT?**

1606 A: Yes, if the penalty specified under Act 130 or related regulations includes a one-year ban from driving an HAV,  
1607 and this period has elapsed, Tom would no longer be subject to this restriction. After the completion of the one-year  
1608 penalty, restrictions on controlling the DDT would no longer be imposed, allowing him to resume driving under the  
1609 terms of his certification.

1610 **33. Q: A public transit operation wants to conduct self-certification for HAVs, but the form they submit does**  
1611 **not include registered agents for legal process services related to accident claims. Will this self-certification**  
1612 **form be approved?**

1613 **A:** No, the self-certification form for HAVs must include specific information to be approved under Act 130. The  
1614 required contents of the form include the name, address, and contact information of the applicant. Crucially, it must  
1615 also include details such as a principal point-of-contact for the applicant's accident claims and a registered agent for  
1616 service of process. If these elements are missing, the form will not meet the statutory requirements and therefore will  
1617 not be approved.

1618 **34. Q: How can we ensure the safety of the HAV driver and the operation of the HAV on a highway?**

1619 **A:** To ensure the safety of the HAV driver and the operation of the HAVs on a highway, the ADS must be properly  
1620 engaged. If there is a failure in the ADS that renders it unable to perform the entire DDT within the intended  
1621 Operational Design Domain (ODD), the vehicle or the driver must transition the HAV to a minimal risk condition.  
1622 This involves taking necessary actions to reduce the risk of accidents, such as safely pulling over or stopping the  
1623 vehicle.

1624 **35. Q: Is it reasonable for a compliance certificate holder of an HAV, to notify the municipal administration**  
1625 **in writing within five days before the commencing operation of the HAVs?**

1626 **A:** No, at least 10 days.

1627 **36. Q: If there is a motor carrier HAV with a commercial driving license but without an HAV driver, is the**  
1628 **vehicle subject to federal and state laws or regulations? Are they subject to the same HAV regulations as**  
1629 **vehicles with a driver?**

1630 **A:** Yes, motor carrier HAVs without drivers are subject to both federal and state laws, similar to those with drivers.  
1631 However, the specific regulations applied may vary, particularly in areas that involve direct human oversight. Federal  
1632 and state laws ensure that all HAVs meet stringent safety and operational standards, whether they are operated with  
1633 the ADS engaged or with a human driver. Nevertheless, certain aspects of the regulations that specifically address  
1634 the human driver's responsibilities might be adjusted or replaced by requirements suited to automated operations.

1635 **37. Q: A transit operator owns two HAVs; the company has decided to use one vehicle for public welfare**  
1636 **activities, such as serving as a campus bus, and to use the other vehicle to transport hazardous materials**  
1637 **to generate revenue. Is this allowed?**

1638 **A:** Using an HAV for public welfare activities like serving as a campus bus is permissible under Act 130, as long as  
1639 it does not involve operating as a school bus or school vehicle. However, using an HAV to transport hazardous  
1640 materials is generally restricted under Act 130. The law states that HAVs may not carry hazardous materials that  
1641 require placarding according to federal regulations unless the certificate holder receives specific certification from  
1642 the department following the promulgation of regulations. Therefore, the use of an HAV to transport hazardous  
1643 materials, as described, would not be allowed unless these conditions are met.

1644 **38. Q: When an HAV is involved in a traffic accident, should it be subject to the local law or state law? How**  
1645 **should decisions be made when there is a discrepancy between local and state laws?**

1646 **A:** In the event of a traffic accident involving an HAV, both local and state laws may apply. Local authorities have  
1647 the right to exercise their police powers reasonably over HAVs, as long as these powers do not specifically  
1648 discriminate against HAVs. However, where there is a discrepancy between local and state laws concerning the

1649 operation of HAVs as a type or class of vehicle, state laws will generally take precedence. This is to ensure uniformity  
1650 in the regulation of HAV operations across the state. Therefore, in cases where local ordinances conflict with state  
1651 regulations regarding HAVs, the state regulations should be followed.

1652 **39. Q: How can a driverless HAV satisfy a police inspection by a police officer?**

1653 **A:** Under Act 130, if a driverless HAV is stopped for a police inspection and there is no human driver on board, the  
1654 vehicle is required to provide access to its vehicle registration card. This card must be either physically present within  
1655 the vehicle or electronically accessible to the police officer. This provision ensures that even without a driver, the  
1656 vehicle can still comply with typical requirements during traffic stops, such as showing a driver’s license and  
1657 registration card to an officer.

1658 **40. Q: How can we ensure that the public and stakeholders are able to adequately express their comments  
1659 and concerns before regulations and guidelines for HAVs are developed?**

1660 **A:** To ensure public and stakeholder engagement in the development of regulations and guidelines for HAVs, the  
1661 department responsible for these regulations conducts a thorough consultation process. This includes consulting with  
1662 the advisory committee in a public meeting before promulgating any regulations or publishing guidelines under this  
1663 subchapter. Additionally, there is a mandatory 10-day public comment period before any temporary regulations or  
1664 guidelines are finalized. For the final regulations, the department adheres to the public comment period stipulated  
1665 under the Regulatory Review Act, allowing ample opportunity for all concerned parties to submit their inputs.

1666 **41. Q: Would the Department, on behalf of Pennsylvania, establish an interstate agreement with another  
1667 State to allow its HAVs and platoons to operate in Pennsylvania? Once established, would it take effect  
1668 immediately?**

1669 **A:** The Department can negotiate an interstate agreement to allow the operation of another State’s HAVs and  
1670 platoons in Pennsylvania. Such an agreement would become effective only after it receives approval from the  
1671 Governor of Pennsylvania. Additionally, the agreement must comply with all relevant federal laws and regulations.  
1672 It is also required that each HAV operated under this agreement within Pennsylvania be adequately insured or self-  
1673 insured in accordance with the minimum amounts stipulated by Act 130. The immediate effect of the agreement  
1674 upon governor's approval ensures prompt enactment, provided that all legal and regulatory requirements are satisfied.

1675 **42. Q: What are the penalties for non-compliance with the regulations governing highly automated vehicles?**

1676 **A:** Under Act 130, any person who operates an HAV on a highway in a manner that is not in accordance with the  
1677 set regulations is subject to legal penalties. Specifically, if convicted for such non-compliance, the individual is liable  
1678 to pay a fine of not less than \$1,000. This stringent penalty underscores the importance of adhering to regulatory  
1679 standards to ensure the safety and efficiency of HAV operations on public roads.

*Section 10: Amending Chapter 85 of Title 75 by adding a subchapter D named other automated vehicles*

1680 **43. Q: What kind of vehicle can be the leader of a platoon on Pennsylvania? And can one nonlead vehicle  
1681 operate without a driver via an ADS?**

1682 **A:** According to Act 130, the lead vehicle in a platoon must be operated with a driver. However, one or more nonlead  
1683 vehicles in the platoon may operate with an ADS engaged, and these vehicles may operate either with or without a  
1684 driver, consistent with applicable federal and state laws and regulations. This allows for flexibility in the

1685 configuration of platoons, enhancing the potential benefits of automated driving technology while ensuring safety  
1686 and regulatory compliance.

1687 **44. Q: For the general platoon operations program, what procedures and standards apply to operating a fleet**  
1688 **on the highways of this Commonwealth?**

1689 **A:** Under Act 130, the following procedures and standards apply to operating a platoon fleet on the highways of  
1690 Pennsylvania:

1691 (1) A person or entity may operate a platoon on state highways if they submit a plan for general platoon operations  
1692 to the Department of Transportation. This submission must be made in consultation with the Pennsylvania State  
1693 Police and the Pennsylvania Turnpike Commission, as applicable.

1694 (2) The department has 30 days to review the submitted plan. If the plan is neither explicitly approved nor rejected,  
1695 nor is additional information requested within this period, the plan is deemed approved automatically, allowing the  
1696 person or entity to commence platoon operations.

1697 **45. Q: Where can I find out more about the policies around platooning operations?**

1698 **A:** The [vehicle platooning policy](#) could be found here:

1699 [https://www.penndot.pa.gov/ProjectAndPrograms/ResearchandTesting/Automated%20\\_Vehicles/Documents/Vehi](https://www.penndot.pa.gov/ProjectAndPrograms/ResearchandTesting/Automated%20_Vehicles/Documents/Vehi)  
1700 [cle%20Platooning%20Policy.pdf](https://www.penndot.pa.gov/ProjectAndPrograms/ResearchandTesting/Automated%20_Vehicles/Documents/Vehicle%20Platooning%20Policy.pdf)

*Section 11: Amended the effective time of this Act 130*

1701

1702 **Appendix B Interviewer Script for Workforce and Economic Impact Analysis**

1703 **Specific Questions:**

1704 **0. Icebreaker**

- 1705 a) Introduce yourself (set the context). Please share your name, your organization, and describe your  
1706 experience in workforce and economic development within your professional setting.
- 1707 b) When did you first encounter the concept of HAV, and how has HAV impacted your work?
- 1708 c) What’s the first word that comes to mind when you hear “HAV coming to Pennsylvania”?
- 1709 1. What specific changes in workforce demand have you observed in your industry, organization, or company due  
1710 to HAV technology? Have these changes increased or decreased workforce demand?
- 1711 2. Can you identify any new job roles or occupations that have emerged (or will emerge) as a result of HAV  
1712 technology in Pennsylvania, either currently or in the future? (e.g., mechanical shops, inspection, car washing,  
1713 remote operators)
- 1714 3. Have you observed, or do you foresee, any reduction in operational costs in your organization due to HAV  
1715 technology? If so, how? (Specifically related to levels 3 and above, not automation in general)
- 1716 4. What new skills or training do you think are necessary to adapt to HAV technology in your field? Which trainings  
1717 are most important or needed?
- 1718 5. How do you think Act 130 will impact the workforce in Pennsylvania? You can use your organization as an  
1719 example or discuss PA in general.
- 1720 6. How do you think Act 130 will impact economic development in Pennsylvania? You can use your organization  
1721 as an example or discuss PA in general (e.g., sales, tax, job creation, faster traffic and goods delivery).
- 1722 7. In your opinion, how might vehicle inspection, repair, and maintenance businesses adapt to the development of  
1723 HAV technology? Have you heard of any discussions or news on potential changes?
- 1724 8. How will Act 130 impact economic development in PA? You can use your organization as an example, or in  
1725 general PA. (sales, tax, job positions, faster traffic and good delivery?)
- 1726 9. In your opinion, how may the vehicle inspection, repair and maintenance businesses/shops adapt to the  
1727 development of HAV technology? Have you heard of any discussions/news on some potential changes?
- 1728 10. What market growth opportunities, such as vehicle purchases, sensors, data analytics, and others, do you foresee  
1729 as a result of HAV technology?

1730 **Closing Questions:**

- 1731 1. What are some opportunities and challenges you foresee for fleet-based HAVs (Levels 3, 4, and 5) in Pennsylvania?

1732

1733

1734 **Appendix C Interviewer Script for Accessibility and Mobility Impact Analysis**

1735 **Specific Questions:**

1736 **0. Icebreaker**

- 1737 a) Introduce yourself (set the context). Please share your name, your organization, and describe your experience  
1738 with accessibility and mobility-based analysis in your professional setting.
- 1739 b) When did you first encounter the concept of Highly Automated Vehicles, and how has HAV impacted your  
1740 work?
- 1741 c) What's the first word that comes to mind when you hear "HAVs coming to Pennsylvania"?
- 1742 1. Do you believe HAVs will enhance accessibility and mobility in Pennsylvania? Please share your thoughts to  
1743 support your answer.
- 1744 2. How well does HAVs technology meet the needs of individuals requiring special accommodations? What areas  
1745 do you think need improvement?  
1746
- 1747 3. What roles should HAVs play in public transportation? Do you see HAVs complementing or replacing existing  
1748 transit systems? Considering Pennsylvania's rural nature, how do you foresee HAVs impacting transit services?
- 1749 4. What existing infrastructure do you think needs improvement to better support HAVs technology?
- 1750 5. What improvements have you seen, or do you foresee, in public transportation services due to HAVs technology  
1751 in Pennsylvania?
- 1752 6. Do you believe that HAVs technology has the potential to enhance safety for vulnerable road users, marginalized  
1753 communities, and disabled travelers? In your experience, have you seen such measures implemented in  
1754 Pennsylvania?
- 1755 7. What is your overall experience or opinion on HAVs shared mobility services, such as Waymo's robotaxi? Do  
1756 you believe these services can enhance accessibility and mobility?
- 1757 8. How can Pennsylvania DOT better utilize HAVs technology or support its deployment to improve overall  
1758 accessibility and mobility in Pennsylvania?
- 1759 9. If you could only choose one, would you prioritize HAVs investment in urban or non-urban (suburban & rural)  
1760 areas, from the perspective of enhancing accessibility and mobility?

1761 **Closing Questions:**

- 1762 1. What are some opportunities and challenges you foresee for fleet-based HAVs (Levels 3, 4, and 5) in Pennsylvania?

1763

1764 **Appendix D Information of Identified Stakeholders**

1765 **(1) Benefits and Implications to the Commonwealth’s workforce**

1766 **TABLE 6 IDENTIFIED STAKEHOLDERS FOR THE WORKFORCE IMPACT ANALYSIS**

<b>Organization</b>	<b>Category</b>
SAE International	Professional Organization
PA. Public Utility Commission	State/Municipal Government
Pennsylvania Department of Education	State/Municipal Government
City of Pittsburgh - Department of Mobility & Infrastructure	State/Municipal Government
City of Philadelphia	State/Municipal Government
Pennsylvania Department of Labor and Industry	State/Municipal Government
Carnegie Mellon University	Academics/Education
Michael Baker International	Consultant
Partners for Automated Vehicle Education (PAVE)	Non Profit
Centre Area Transportation Authority (CATA)	Transit Agency
Buchanan Ingersoll & Rooney	Law Firm
Conference of Minority Transportation Officials (COMTO)	Work Force Organization
DOL Women's Bureau	Work Force Organization
Royal Truck & Equipment	Private Industry
Perrone Robotics	Private Industry
RoboTire	Private Industry
FedEx Ground Package System, Inc.	Private Industry
Aurora	Private Industry
PA Motor Truck Association	State/Municipal Government

Motor Carrier Safety Advisory Committee	State/Municipal Government
PA Department of Labor & Industry	State/Municipal Government
PA Department of Agriculture	State/Municipal Government
Southwestern Pennsylvania Commission	State/Municipal Government
Motional	Private Industry
TechNet: The Voice of the Innovation Economy	Non Profit
Waymo	Private Industry

1767 **(2) Economic Benefits and Implications to the Commonwealth**

1768 **Table 7 Identified stakeholders for the economic impact analysis**

<b>Organization</b>	<b>Category</b>
Carnegie Mellon	Academics/Education
SAE International	Professional Organization
PA Department of Community & Economic Development	Planning & Economic Development
Pittsburgh Regional Alliance	Planning & Economic Development
PA Turnpike Commission	State/Municipal Government
PA Department of Community and Economic Development	State/Municipal Government
Southwestern Pennsylvania Commission	State/Municipal Government
Drive Engineering	Consultant
DCED-Governor's Action Team	Planning & Economic Development
Pittsburgh Regional Alliance	Planning & Economic Development
Regional Industrial Development Corporation (RIDC)	Planning & Economic Development
Skyline Technology Solutions	Private Industry
Royal Truck & Equipment	Private Industry

Royal Truck & Equipment	Private Industry
Perrone Robotics	Private Industry
Allegheny Conference on Community Development	Non Profit
Pittsburgh Downtown Partnership	Non Profit
Aurora	Private Industry
PA Chamber of Business & Industry	State/Municipal Government
PA Department of Community & Economic Development	State/Municipal Government

1769 **(3) Improvements to Accessibility for Persons with Disabilities**

1770 **Table 8 Identified stakeholders for the accessibility impact analysis**

<b>Organization</b>	<b>Category</b>
University of Pittsburgh School of Medicine	Academics/Education
University of Pittsburgh	Academics/Education
Carnegie Mellon	Academics/Education
SAE International	Professional Organization
Southwestern Pennsylvania Commission	State/Municipal Government
Centre Area Transportation Authority (CATA)	Transit Agency
Rabbit Transit	Transit Agency
Automated Vehicle Industry Association	Law Firm
Aurora	Private Industry
Aurora	Private Industry
Royal Truck & Equipment	Private Industry
Locomation	Private Industry
Cubic Transportation	Private Industry

Koop Technologies	Private Industry
ABATE (motorcyclists)	State/Municipal Government
Statewide Independent Living Council	State/Municipal Government
Pedalcycle and Pedestrian Advisory Committee	State/Municipal Government
Pennsylvania Driving Under the Influence Association	State/Municipal Government
PA Department of Aging	State/Municipal Government
Delaware Valley Regional Planning Commission	Planning & Economic Development

1771 **(4) Improvements to Mobility Options for the General Public**

1772 **Table 9 Identified stakeholders for the mobility impact analysis**

<b>Organization</b>	<b>Category</b>
Carnegie Mellon	Academics/Education
University of Pittsburgh	Academics/Education
Kittelson & Associates, Inc.	Consultant
Kittelson & Associates, Inc.	Consultant
Imperial Traffic & Data Collection, LLC.	Consultant
Michael Baker International	Consultant
Southwestern Pennsylvania Commission	State/Municipal Government
City of Pittsburgh Dept of Mobility & Infrastructure	State/Municipal Government
City of Pittsburgh Department of Mobility and Infrastructure	State/Municipal Government
Royal Truck & Equipment	Private Industry
Perrone Robotics	Private Industry
Reflex AI	Private Industry
Ford Motor Company	Private Industry

Pittsburgh Regional Transit	State/Municipal Government
Southeastern Pennsylvania Transportation Authority (SEPTA)	State/Municipal Government
Latitude AI	Private Industry
Stack AV	Private Industry
PA Public Transportation Association	State/Municipal Government
PA School Bus Association	State/Municipal Government
Public Utility Commission	State/Municipal Government
Centre Regional Planning Agency	State/Municipal Government

1773

1774

1775 **Appendix E Information of Final Focus Groups Participants**

1776 Thirty-five individuals from the 29 listed organizations agreed to participate in the focus group sessions. They were  
1777 divided into five focus group sessions. Additionally, three shorter one-on-one sessions were organized to  
1778 accommodate participants with scheduling conflicts.

- 1779 1. Aurora
- 1780 2. Motional
- 1781 3. Latitude AI
- 1782 4. Ford Motor
- 1783 5. StackAV
- 1784 6. PA Motor Truck Association
- 1785 7. Autonomous Vehicle Industry Association
- 1786 8. TechNet: The Voice of the Innovation Economy
- 1787 9. SAE International
- 1788 10. Regional Industrial Development Corporation (RIDC)
- 1789 11. Pennsylvania Driving Under the Influence Association
- 1790 12. Motor Carrier Safety Advisory Committee
- 1791 13. Conference of Minority Transportation Officials (COMTO)
- 1792 14. Centre Area Transportation Authority (CATA)
- 1793 15. Southeastern Pennsylvania Transportation Authority (SEPTA)
- 1794 16. Rabbit Transit
- 1795 17. Executive Deputy Secretary of Policy & Planning, Office of Governor Josh Shapiro
- 1796 18. PA Department of Aging
- 1797 19. PA Turnpike Commission
- 1798 20. Delaware Valley Regional Planning Commission
- 1799 21. Centre Regional Planning Agency
- 1800 22. Southwestern Pennsylvania Commission
- 1801 23. City of Pittsburgh, Department of Mobility and Infrastructure
- 1802 24. City of Philadelphia
- 1803 25. Carnegie Mellon University
- 1804 26. University of Pittsburgh
- 1805 27. Michael Baker International
- 1806 28. Kittelson & Associates, Inc.

1807 29. Drive Engineering

1808 **Table 10 Identified information for the participants**

Organization	Name	Email
Michael Baker International	Jim Katsafanas	jkatsafanas@mbakerintl.com
Motor Carrier Safety Advisory Committee	Robert Pento	rpento@pa.gov
Regional Industrial Development Corporation (RIDC)	Tim White	twhite@ridc.org
PA Motor Truck Association	Rebecca Oyler	royler@pmta.org
Michael Baker International	Jeffrey Kupko	jeffrey.kupko@mbakerintl.com
Kittelson & Associates, Inc.	Glenn Rowe	growe@kittelson.com
Centre Area Transportation Authority (CATA)	Kimberly Fragola	kfragola@catabus.com
Delaware Valley Regional Planning Commission	Fang Yuan	fyuan@dvrpc.org
Centre Regional Planning Agency	Gregory M. Kausch	gkausch@crcog.net
Southwestern Pennsylvania Commission	Evan Schoss	eschoss@spcregion.org
University of Pittsburgh	Sivashankar Sivakanthan	sis65@pitt.edu
Pennsylvania Driving Under the Influence Association	Leo Hegarty	lhegarty@padui.org
Southeastern Pennsylvania Transportation Authority (SEPTA)	Pat Breen	PBreen@septa.org
Rabbit Transit	Richard Farr	rfarr@rabbittransit.org
Motional	Sam Wempe	samuel.wempe@motional.com
Executive Deputy Secretary of Policy & Planning, Office of Governor Josh Shapiro	Stephen D'Ettorre	SDETTORRE@PA.GOV
PA Department of Aging	David Miles	davimiles@pa.gov
SAE International	Renoll Erin	erin.renoll@sae.org
Autonomous Vehicle Industry Association	Katie Marshall Timmons	kmarshall@venable.com
Latitude AI	Catherine Johnsmeyer	cjohnsmeyer@lat.ai
City of Pittsburgh, Department of Mobility and Infrastructure	Michael Bethune	Michael.Bethune@pittsburghpa.gov
Southeastern Pennsylvania Transportation Authority (SEPTA)	Emily Yates	eyates@septa.org
Aurora	Matt Blackburn	mblackburn@aurora.tech
City of Philadelphia	Akshay Malik	akshay.malik@phila.gov

Carnegie Mellon	Karen Lightman	karenlightman@cmu.edu
TechNet: The Voice of the Innovation Economy	Margaret Durkin	mdurkin@technet.org
Ford Motor	Tony Reinhart	treinha1@ford.com
Ford Motor	Stephanie Fries	sfries8@ford.com
Ford Motor	Michelle Elder	melder7@ford.com
StackAV	Elizabeth Fishback	liz@stackav.com
Drive Engineering	Gabby Benson	gabby@driveengineering.com

1809

1810

1811 **References**

1812 [1] Litman, T. (2020, January 9). *Autonomous vehicle implementation predictions: Implications for transport*  
1813 *planning*.

1814 [2] Nikitas, A., Vitel, A.-E., & Cotet, C. (2021). Autonomous vehicles and employment: An urban futures revolution  
1815 or catastrophe? *Cities*, 114, 103203. <https://doi.org/10.1016/j.cities.2021.103203>

1816 [3] Clements, L. M., & Kockelman, K. M. (2017). Economic Effects of Automated Vehicles. *Transportation*  
1817 *Research Record: Journal of the Transportation Research Board*, 2606(1), 106–114. [https://doi.org/10.3141/2606-](https://doi.org/10.3141/2606-14)  
1818 [14](https://doi.org/10.3141/2606-14)

1819 [4] Bardaka, E., C. Frey, A. Hajbabaie, G. List, N. Roupail, B. Williams, and M. Cummings, Impacts of  
1820 Autonomous Vehicle Technology on Transportation Systems. 2019, NCDOT Project.

1821 [5] Park, J.E., W. Byun, Y. Kim, H. Ahn, and D.K. Shin, The Impact of Automated Vehicles on Traffic Flow and  
1822 Road Capacity on Urban Road Networks. *Journal of Advanced Transportation*, 2021. **2021**: p. 8404951.

1823 [6] Massar, M., I. Reza, S.M. Rahman, S.M.H. Abdullah, A. Jamal, and F.S. Al-Ismail, Impacts of Autonomous  
1824 Vehicles on Greenhouse Gas Emissions—Positive or Negative? *International Journal of Environmental*  
1825 *Research and Public Health*, 2021. **18**(11): p. 5567.

1826 [7] Beede, D., & Powers, R. (2017). *The Employment Impact of Autonomous Vehicles*.

1827 [8] Groshen, E. L., Helper, S., MacDuffie, J. P., & Carson, C. (2018). *Preparing U.S. Workers and Employers for*  
1828 *an Autonomous Vehicle Future*. W.E. Upjohn Institute. <https://doi.org/10.17848/tr19-036>

1829 [9] US DOT. (2021). *Driving Automation Systems in Long-Haul Trucking and Bus Transit: Preliminary Analysis of*  
1830 *Potential Workforce Impacts*.

1831 [10] Waschik, R. (2021). *Evaluating the impact of autonomous long-haul trucking deployment in California using*  
1832 *USAGE-Hwy*.

1833 [11] Brogan, P. (2018). *Autonomous Vehicle Development in Michigan*.

1834 [12] Yankelevich, A., Rikard, R. V., Kadylak, T., Hall, M. J., Mack, E. A., Verboncoeur, J. P., Cotten, S. R., Lukuc,  
1835 M. R., Seymour, E., & Poe, C. (2018). *Preparing the Workforce for Automated Vehicles*.

1836 [13] Securing America’s Future Energy (SAFE). (2018). *America’s workforce and the self-driving future Realizing*  
1837 *productivity gains and spurring economic growth.pdf*.

1838 [14] Chamber of Progress. (2024). *Opportunity AV How Many and What Types of Jobs Will Be Created by*  
1839 *Autonomous Vehicles.pdf*.

1840 [15] Shapiro, R., & Yoder, I. (2023). Innovation Highway: Unlocking the Social and Economic Benefits of  
1841 Autonomous Vehicles.  
1842 [https://www.uschamber.com/assets/documents/CTEC\\_InnovationHighwayReport\\_July23.pdf](https://www.uschamber.com/assets/documents/CTEC_InnovationHighwayReport_July23.pdf)

1843 [16] Clements, L. M., & Kockelman, K. M. (2017). Economic effects of automated vehicles. *Transportation*  
1844 *research record*, 2606(1), 106-114. Available from:  
1845 [https://www.cae.utexas.edu/prof/kockelman/public\\_html/trb17economiceffectsofavs.pdf](https://www.cae.utexas.edu/prof/kockelman/public_html/trb17economiceffectsofavs.pdf)

- 1846 [17] Winston, C., & Karpilow, Q. (2020). *Autonomous vehicles: The road to economic growth?*. Brookings  
1847 Institution Press.
- 1848 [18] Raposo, M. A., Grosso, M., Mourtzouchou, A., Krause, J., Duboz, A., & Ciuffo, B. (2022). Economic  
1849 implications of a connected and automated mobility in Europe. *Research in transportation economics*, 92, 101072.  
1850 Available from: <https://www.sciencedirect.com/science/article/pii/S0739885921000445>
- 1851 [19] Alonso, E., Arpón, C., González, M., Fernández, R. Á., & Nieto, M. (2020). Economic impact of autonomous  
1852 vehicles in Spain. *European transport research review*, 12, 1-17. Available from:  
1853 <https://etr.springeropen.com/articles/10.1186/s12544-020-00452-4>
- 1854 [20] Clements, L. M., & Kockelman, K. M. (2017). Economic Effects of Automated Vehicles. *Transportation*  
1855 *Research Record: Journal of the Transportation Research Board*, 2606(1), 106–114. [https://doi.org/10.3141/2606-](https://doi.org/10.3141/2606-14)  
1856 14
- 1857 [21] Securing America’s Future Energy (SAFE). (2018). *America’s workforce and the self-driving future Realizing*  
1858 *productivity gains and spurring economic growth.pdf*.
- 1859 [22] Shapiro, R., & Yoder, I. (2023). *Innovation Highway: Unlocking the Social and Economic Benefits of*  
1860 *Autonomous Vehicles Robert*.
- 1861 [23] Visich, D. (2019). *Autonomous Vehicles—Impact and Who Is Winning The Technology Race*.
- 1862 [24] Waschik, R. (2021). *Evaluating the impact of autonomous long-haul trucking deployment in California using*  
1863 *USAGE-Hwy*.
- 1864 [25] Dicianno, B.E., S. Sivakanthan, S.A. Sundaram, S. Satpute, H. Kulich, E. Powers, N. Deepak, R. Russell, R.  
1865 Cooper, and R.A. Cooper, Systematic review: Automated vehicles and services for people with disabilities.  
1866 *Neuroscience Letters*, 2021. 761: p. 136103.
- 1867 [26] Kassens-Noor, E., Cai, M., Kotval-Karamchandani, Z., & Decaminada, T. (2021). Autonomous vehicles and  
1868 mobility for people with special needs. *Transportation research part A: policy and practice*, 150, 385-397.
- 1869 [27] Bhuiya, M. M. R., & Liu, J. (2022). Autonomous Vehicle-Heaven or Hell for People with Disability: A Study  
1870 from Literature. *Available at SSRN 4441972*.
- 1871 [28] Bayless, S. H., & Davidson, S. (2019). Driverless cars and accessibility: Designing the future of transportation  
1872 for people with disabilities.
- 1873 [29] Claypool, H., Bin-Nun, A., & Gerlach, J. (2017). Self-driving cars: The impact on people with  
1874 disabilities. *Newton, MA: Ruderman Family Foundation*. Available from: [https://rudermanfoundation.org/wp-](https://rudermanfoundation.org/wp-content/uploads/2017/08/Self-Driving-Cars-The-Impact-on-People-with-Disabilities_FINAL.pdf)  
1875 [content/uploads/2017/08/Self-Driving-Cars-The-Impact-on-People-with-Disabilities\\_FINAL.pdf](https://rudermanfoundation.org/wp-content/uploads/2017/08/Self-Driving-Cars-The-Impact-on-People-with-Disabilities_FINAL.pdf)
- 1876 [30] Kassens-Noor, E., Cai, M., Kotval-Karamchandani, Z., & Decaminada, T. (2021). Autonomous vehicles and  
1877 mobility for people with special needs. *Transportation Research Part A: Policy and Practice*, 150, 385–397.  
1878 <https://doi.org/10.1016/j.tra.2021.06.014>.
- 1879 [31] Dunmoyer, D. (2024). *Responsibly Ushering in Autonomous Vehicles in Texas*.
- 1880 [32] Bayless, S. H., & Davidson, S. (2019). Driverless cars and accessibility: Designing the future of transportation  
1881 for people with disabilities.

- 1882 [33] Dicianno, B. E., Sivakanthan, S., Sundaram, S. A., Satpute, S., Kulich, H., Powers, E., Deepak, N., Russell, R.,  
1883 Cooper, R., & Cooper, R. A. (2021). Systematic review: Automated vehicles and services for people with disabilities.  
1884 *Neuroscience Letters*, 761, 136103. <https://doi.org/10.1016/j.neulet.2021.136103>
- 1885 [34] Sivakanthan, S., Cooper, R., Lopes, C., Kulich, H., Deepak, N., Lee, C. D., Wang, H., Candiotti, J. L., Dicianno,  
1886 B. E., Koontz, A., & Cooper, R. A. (2023). Accessible autonomous transportation and services: A focus group study.  
1887 *Disability and Rehabilitation: Assistive Technology*, 1–8. <https://doi.org/10.1080/17483107.2023.2242898>
- 1888 [35] Simpson, C., Kemp, E., Ataii, E., & Zhang, Y. (2019). Mobility 2030: Transforming the mobility  
1889 landscape. *KPMG Int.*
- 1890 Available from: [https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-](https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf)  
1891 [mobility-landscape.pdf](https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2019/02/mobility-2030-transforming-the-mobility-landscape.pdf)
- 1892 [36] Preparing for the Future of Transportation
- 1893 Available from: [https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-](https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf)  
1894 [vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf](https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf)
- 1895 [37] Park, J. E., Byun, W., Kim, Y., Ahn, H., & Shin, D. K. (2021). The Impact of Automated Vehicles on Traffic  
1896 Flow and Road Capacity on Urban Road Networks. *Journal of Advanced Transportation*, 2021, 1–10.  
1897 <https://doi.org/10.1155/2021/8404951>
- 1898 [38] Llorca, C., Moreno, A., Ammar, G., & Moeckel, R. (2022). Impact of autonomous vehicles on household  
1899 relocation: An agent-based simulation. *Cities*, 126, 103692. <https://doi.org/10.1016/j.cities.2022.103692>
- 1900 [39] Bardaka, E., C. Frey, A. Hajbabaie, G. List, N. Roupail, B. Williams, and M. Cummings, Impacts of  
1901 Autonomous Vehicle Technology on Transportation Systems. 2019, NCDOT Project.
- 1902 [40] Autonomous Vehicles.  
1903 [https://css.umich.edu/sites/default/files/2023-10/Autonomous%20Vehicles\\_CSS16-18.pdf](https://css.umich.edu/sites/default/files/2023-10/Autonomous%20Vehicles_CSS16-18.pdf)
- 1904 [41] Economic Impacts of Autonomous Delivery Services in the US  
1905 [https://steergroup.com/sites/default/files/2020-09/200910\\_%20Nuro\\_Final\\_Report\\_Public.pdf](https://steergroup.com/sites/default/files/2020-09/200910_%20Nuro_Final_Report_Public.pdf)
- 1906 [42] FOREFRONT: Securing Pittsburgh’s Break-out Position in Autonomous Mobile Systems.  
1907 <https://ridc.org/wp-content/uploads/2021/09/PGH-Autonomous-Systems-Full-Report-1.pdf>