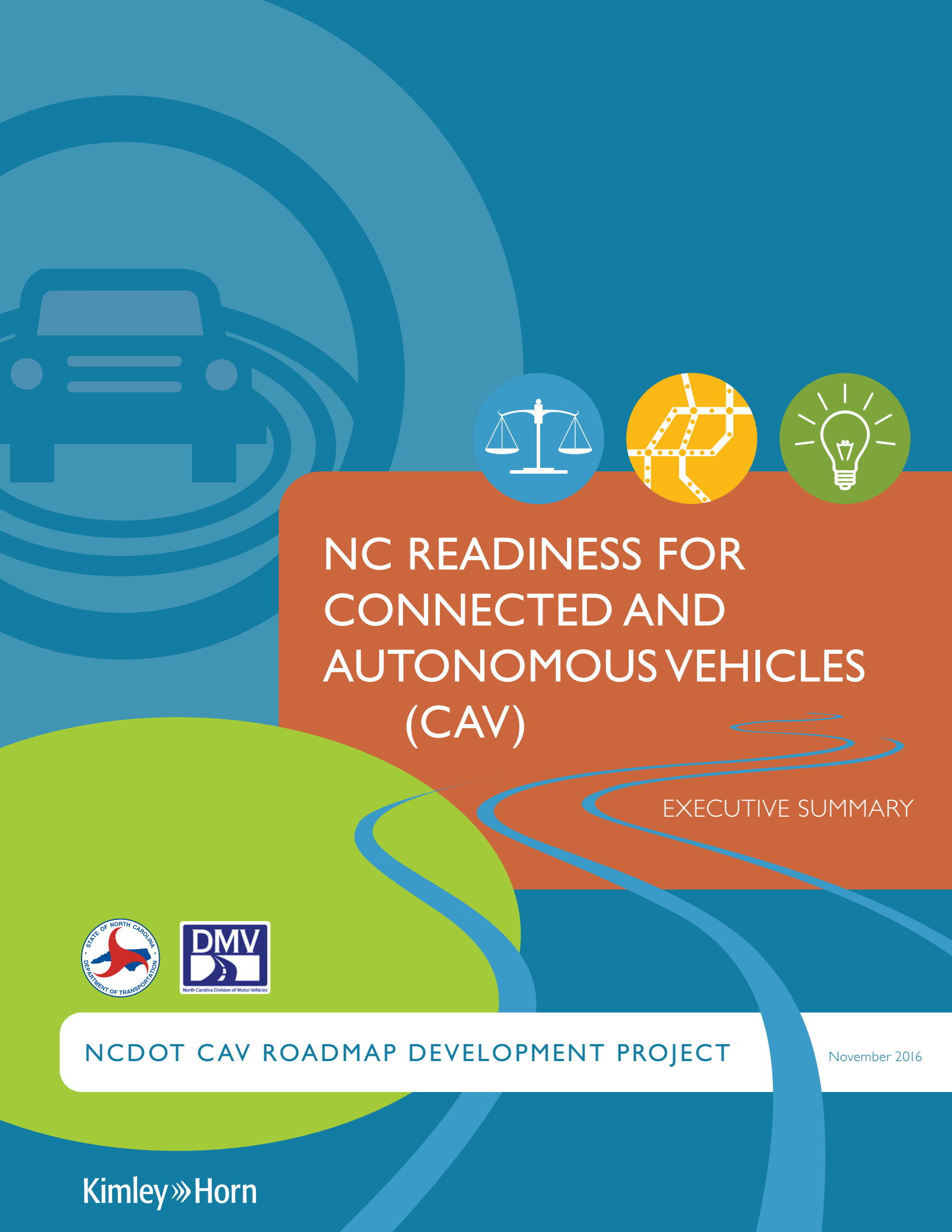


NC READINESS FOR CONNECTED AND AUTONOMOUS VEHICLES (CAV)

EXECUTIVE SUMMARY

NCDOT CAV ROADMAP DEVELOPMENT PROJECT

November 2016

Kimley»Horn

Introduction

While the impacts of some technological developments are limited to their field, there are others—like the printing press, the telephone, and the computer—that have the capacity to introduce a much more significant impact and transform the lifestyle of a generation. The introduction and advancements of connected and autonomous vehicles (CAV) is one such development.

Advanced computing, sensors, and telecommunications technology are revolutionizing the world of road-based transportation. As CAV advancements expand daily and are introduced into existing transportation systems, certain questions become increasingly pertinent: Is North Carolina ready? Can we oversee safety regulations while simultaneously leveraging opportunity? Can we prepare our workforce, the legal community, and the public for this shift in how the transportation network is used? **Figure 1** captures a sampling of the opportunities and impacts that have been identified with respect to CAV.

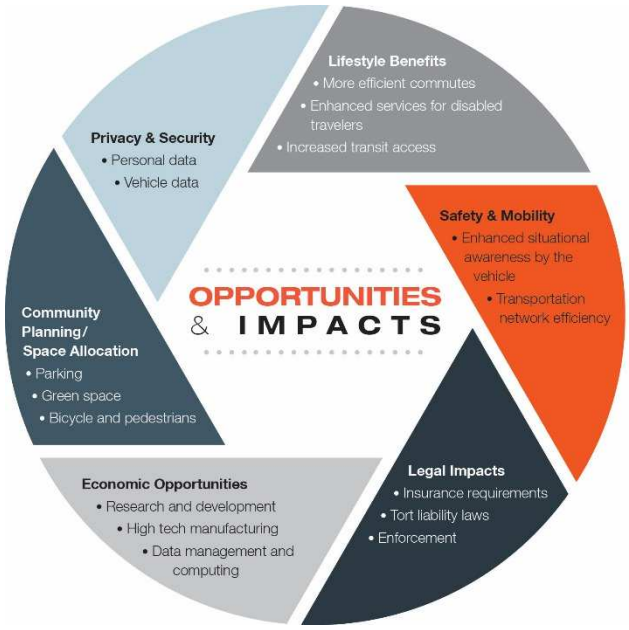


Figure 1. Opportunities and Impacts of CAV Technologies

To provide a glimpse of how this technology has progressed, **Figure 2** demonstrates how the visibility of the equipment required to provide certain levels of automation has progressed from the DARPA challenges in 1995 to the current Tesla Model S and other vehicles that are available on the market today. This document—a product of stakeholder collaboration and industry research—provides an activities roadmap that will allow North Carolina to dissect the identified questions and establish a clear way forward.

Figure 2. Progression of Autonomous Vehicle Technology from 1995 to 2016

Key Terminology

The vocabulary surrounding the CAV industry has evolved over the past few decades, and certain key terminology has become integral to following the advancements related to both connected and autonomous vehicles. **Figure 3** provides an overview and brief descriptions for a few of those key terms. In addition, **Figure 4** provides an overview of the levels of automation as defined by the Society of Automotive Engineers (SAE)—ranging from "0" indicating full driver control through "5," where the vehicle can function fully with no interaction or decision-making required from a passenger.

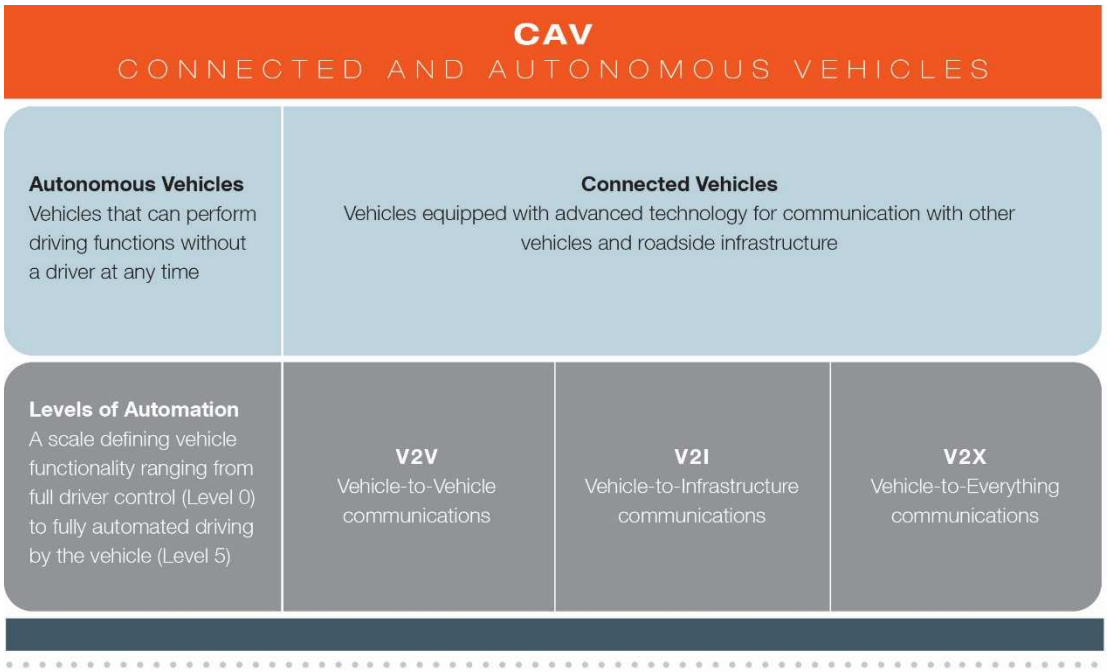
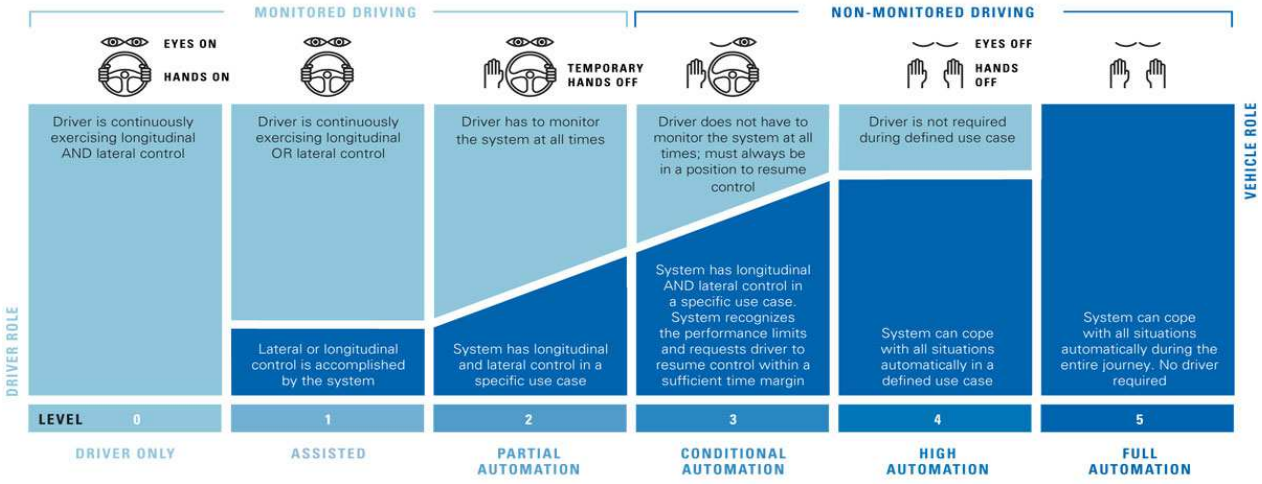


Figure 3. CAV Key Terminology



Source: http://safety.trw.com/wp-content/uploads/2016/01/AutomatedDriving_table_large.jpg

Figure 4. SAE Levels of Automation

Connected and Autonomous Vehicles in the United States

As of mid-2016, at least six states and Washington D.C. had enacted legislation to enable testing and, in some cases, operation of CAV on public roads. More recently, a few states have taken this one step further and introduced legislation that allows the testing of autonomous vehicles without requiring the presence of a human within the vehicle. More than 10 states now have significant CV pilot programs and are in the planning or implementation stages for CAV programs, projects, and deployments. Almost every major automobile manufacturer has an active AV research and development program, and a variety of third-party aftermarket suppliers are investing significant funds in the development of CAV driving technologies.

On the commercial side, passenger vehicle models including Tesla, Mercedes, and Infiniti can be purchased today with limited self-driving capabilities. A wide range of other models have foundational elements such as sensors and adaptive cruise control that will facilitate the rollout of more advanced self-driving technologies.

The daily news reports and articles related to success stories and advancements in the technology confirm the urgency to prepare. **Table 1** provides an overview of the USDOT Federal Automated Vehicles Policy (released in September 2016). This policy defines the roles and responsibilities of federal and state governments and provides a foundation to assist agencies that are looking to address the current range of questions.

The full policy and fact sheets can be accessed at the following links.

- Federal Automated Vehicles Policy - September 2016
- Automated Vehicle Policy Fact Sheet Overview
- AV Fact Sheet - Vehicle Performance Guidance
- AV Fact Sheet - Model State Policy
- AV Fact Sheet - Current Regulatory Tools
- AV Fact Sheet - Modern Regulatory Tools

Table 1. Federal and State Responsibilities for CAV Readiness

Federal Responsibilities	State Responsibilities
Setting safety standards for new motor vehicles and motor vehicle equipment	Licensing (human) drivers and registering motor vehicles in their jurisdictions
Enforcing compliance with the safety standards	Enacting and enforcing traffic laws and regulations
Investigating and managing the recall and remedy of non-compliances and safety-related motor vehicle defects on a nationwide basis	Conducting safety inspections, when states choose to do so
Communicating with and educating the public about motor vehicle safety issues	Regulating motor vehicle insurance and liability
When necessary, issuing guidance to achieve national safety goals	

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Project Purpose

The North Carolina Department of Transportation (NCDOT) and North Carolina Division of Motor Vehicles (NCDMV) directed this project with two primary goals:

- Identify the wide range of questions raised by CAV technology
- Define an approach, or ***Activities Roadmap***, for how NC should prepare for CAV technology

This Activities Roadmap was guided by stakeholder involvement, industry research, and an international review of best practices. Through an iterative process of reviewing and integrating feedback, this effort guided the development of the following milestones and deliverables.

Assessment summary of the NC Motor Vehicle and Licensing Codes

Stakeholder workshop to identify key areas of focus for the State in response to CAV technology

Activities Roadmap of suggested near- and medium-term initiatives to be considered by the State in preparation for CAV technology

The process began with outreach to a diverse cross-section of stakeholders (identified to the right). Each stakeholder was invited to a day-long workshop that included an educational component about CAV and break-out sessions centered around three topics—laws and policies, infrastructure, and business. This range of input provided a holistic picture of the opportunities and impacts related to CAV within NC.

Stakeholder involvement is integral to CAV readiness, and the workshop is only the first step. Advancement of the Activities Roadmap should continue to involve multiple state agencies, public agencies, the private sector, the legal and law enforcement community, and members of the public. Collaboration with stakeholders requires the continuous support of executive leadership from the participating entities.

Stakeholders

Advocacy for the blind and visually impaired
Capital Area Metropolitan Planning Organization
Charlotte Area Transit System
Charlotte Department of Transportation
City of Raleigh
Daimler
Goldberg Segalla
Google
Governor's Highway Safety Program
MGC Law
NC Advocates for Justice
NC Association of Defense Attorneys
NC Chamber of Commerce
NC Department of Insurance
NC General Assembly
NC Office of the Governor
NC Public Transportation Division
NC Trucking Association
NC Turnpike Authority
NC Rate Bureau
NC State Highway Patrol
NC State University EcoPRT
NC State University Institute for Transportation Research and Education
Pinto Coates Kyre & Bowers, PLLC
Regional Transportation Alliance
Robocist, Inc.
SAS
Teamsters Union
Tesla Automotive
Town of Chapel Hill
GoTriangle
UNC Charlotte
UNC Highway Safety Research Center

Action Plan

With proper planning and foresight, North Carolina can leverage CAV technologies to positively impact the state in a broad range of areas. The initial stakeholder workshop revealed significant interest in moving the state forward with respect to CAV.

The input garnered from the stakeholders was distilled into an Activities Roadmap centered around seven key initiatives for CAV readiness.

A. Group Structure and Organization
B. Political Leadership Engagement
C. Changes to Laws and Motor Vehicle Codes
D. Long-Range Transportation Plans
E. Mobility and Access Improvements
F. Pilot Projects and Research
G. Outreach/In-Reach Strategy

The successful execution of this Activities Roadmap depends primarily on the first two activities: ***the development of an Executive Leadership Team (ELT) and CAV Program Manager to champion the program and the identified activities.***

In addition to the ELT, it is recommended to integrate additional stakeholders with the steering committee and existing stakeholders to form three primary working groups. These working groups would take ownership of the program, dig into the identified activities, identify additional activities, make recommendations to the CAV Program Manager that can be communicated to the legislature or other key decision makers, and measure progress against the Activities Roadmap objectives.

Table 2. Proposed CAV Working Groups

Working Group	Primary Responsibility
Laws and Policies	Identify possible changes or additions to the laws, regulations, and policies
Infrastructure	Reevaluate the planning and design of transportation facilities and systems (e.g., vehicle fleets, pavement markings, signing, etc.)
Business	Facilitate partnerships and technology development with third parties from the private sector and universities

Table 3 presents a summary of the Activities Roadmap. The table is categorized by initiative and identifies the working group(s) involved, the activity owner responsible, and a high-level schedule and budget. This table is the foundation of the Activities Roadmap. It is expected that the list of activities will continue to grow as the ELT, working groups, and State executive leadership continue to promote and expand NC's readiness for CAV.

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Table 3. Activities Roadmap Summary

	Working Group	Activity Owner	Schedule	Budget
A. Group Structure and Organization				
A-1: Develop CAV Oversight Structure		NCDOT	<1 month	Internal
A-2: Identify CAV Program Manager		ELT	< 2 months	Internal
A-3: Develop Business Plan		ELT, CAV PM	< 4 months	Internal
B. Political Leadership Engagement				
B-1: Present Activities Roadmap to Leadership (including political groups)		CAV PM	3 months from Activities Roadmap Approval	Internal
B-2: Present Findings and Updates to Leadership (including political groups)		CAV PM	Biannual	Internal
B-3: Present Findings and Updates to Major Business and Industry Associations		CAV PM	Biannual	Internal
C. Changes to Laws and Motor Vehicle Code				
C-1: Modifications to Laws and MVC for AV Testing		NCDMV	1 year	Internal
C-2: Modifications to Laws and MVC for AV Operations		NCDMV	2 years	Internal
C-3: Engage AAMVA/NHTSA AV Model Policy Group		NCDMV	1 year	Internal
C-4: Conduct an Insurance Expo Workshop		NCDOI	< 6 months	$50K
C-5: Define Advanced Driver Education Programs		NCDMV	1 year	Internal
D. Long-Range Transportation Plans				
D-1: Monitor and Participate in LRTP Research		NCDOT TPB	1 year	$100K
D-2: Review and Revise NCDOT 2040 Plan		NCDOT TPB	< 6 months	$100K (review); $300K (revision)
D-3: Develop Guidance for MPOs' 2040 Plans		NCDOT TPB	< 6 months after NCDOT 2040 Plan	$200K

	Working Group	Activity Owner	Schedule	Budget
E. Mobility and Access Improvements				
E-1: Modify Laws and Regulations regarding Holistic Transportation Services		NCDOT with NCHHS	2 years after AV testing legislation	Internal effort
E-2: Conduct Workshop Focused on Opportunities for Disabled Traveler Services		Disadvantaged Sub-Committee Chair	< 1 year	$50K
E-3: Develop Partnerships with Department of VA, Hospitals, Advocacy Groups, and Transit/Paratransit Operators for Funding		Disadvantaged Sub-Committee Chair	< 6 months (sub-committee); < 1 year (grants apps)	$100K ($10K per grant app)
F. Pilot Projects and Research				
F-1: Conduct Workshop on Potential Opportunities		CAV PM	< 6 months	$25K
F-2: Join CV Pooled Fund Study		CAV PM	< 6 months	$50K per year
F-3: Develop Statewide Consortium for CAV Research		CAV PM, Business Working Group Chair	TBD (> 1 year)	TBD
F-4: Engage NASCAR		CAV PM	TBD (> 2 years)	$15M+
G. Outreach/In-Reach Strategy				
G-1: Develop an Outreach/In-Reach Strategy		CAV PM	< 6 months from start of regulatory actions	$100K
G-2: Conduct Webinars for Activities Roadmap Intro		CAV PM	< 6 months from initiation	$25K
G-3: NCAV.org for the Public		CAV PM	< 6 months from initiation	$25K
G-4: NCAV.org Content Expansion		CAV PM	< 6 months from initiation	$50K
G-5: Participation in National Organizations and Conferences		CAV PM	Ongoing	$15K
G-6: Highlight the Ability of Toll Roads to Leverage CV Technology		CAV PM	Within 1 year	Internal effort