Fiscal Note for Adoption of 15A NCAC 02D .2900

Rule Citation Number 15A NCAC 02D .2900

Rule Topic: North Carolina Advanced Clean Trucks

DEQ Division: Division of Air Quality

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Impact Summary:

State government:	Yes
Local government:	Yes
Substantial impact:	Yes
Private Sector:	Yes

Authority: G.S. 143-215.3(a)(1), (1a), (1b), (1d); G.S. 143-215.3A

Necessity: To adopt rules that establishes a North Carolina Advanced Clean Trucks Program that requires manufacturers to sell an increasing percentage of medium- and heavy-duty zero-emission vehicles as prescribed in Executive Order 271 signed by Governor Cooper on October 25, 2022.

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Acronyms

Abbreviation	Term
$	Dollars
$/kWh	dollars per kilowatt-hour
%	Percent
13 CCR	Title 13 of the California Code of Regulations
15A NCAC	Title 15A of the North Carolina Administrative Code
42 USC	Title 42 of the United States Code
AB 739	(California) Assembly Bill 739
ACT	Advanced Clean Trucks
AQC	Air Quality Committee
ASB	CARB's Airport Shuttle Bus Regulation
BAU	Business-as-usual
BEV	Battery-electric vehicle
BIL	Bipartisan Infrastructure Law
CA	California
CAA	Clean Air Act
CARB	California Air Resources Board
cents/kWh	cents per kilowatt-hour
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
CPI	Consumer Price Index
CY	Calendar Year
DA&CS	Department of Agriculture & Consumer Services
DAQ	Division of Air Quality
DEQ	Department of Environmental Quality
DMV	Department of Motor Vehicles
DOA	Department of Administration
DOT	Department of Transportation
EDF	Environmental Defense Fund
EGU	Electric Generating Unit
EIA	Energy Information Administration
EMC	Environmental Management Commission
EMFAC	California Mobile Source “Emission FACtor” model
EO	Executive Order
EPA	Environmental Protection Agency
EPA	U.S. Environmental Protection Agency
EV	electric vehicle

Abbreviation	Term
EVSE	electric vehicle supply equipment
FCEV	Fuel-cell electric vehicle
FHWA	Federal Highway Administration
GHG	greenhouse gas
GVWR	gross vehicle weight rating
HF	North Carolina Highway Fund
HTF	North Carolina Highway Trust Fund
ICE	internal combustion engine
ICT	Innovative Clean Transit
IIJA	Infrastructure Investment and Jobs Act
IRA	Inflation Reduction Act
ISOR	Initial Statement of Reason
IWG	Interagency Working Group
kWh	kilowatt-hour
lbs	pounds
MHD	medium- and heavy-duty
MOU	Memorandum of Understanding
MY	model year
NC	North Carolina
NCUC	North Carolina Utilities Commission
NOx	nitrogen oxides
NZEV	near-zero-emission vehicle
OMB	(U.S. EPA) Office of Management and Budget
OSBM	North Carolina Office of State Budget and Management
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PHEV	Plug-in hybrid electric vehicle
SC-CO_2	Social Cost of Carbon
SO_2	sulfur dioxide
VMT	vehicle miles travelled
ZEB	zero-emission bus
ZEP	zero-emission powertrain
ZEV	zero-emission vehicle

I. Executive Summary

The rules are proposed for adoption in response to Executive Order No. 271 (EO 271), *Growing North Carolina's Zero-Emission Vehicle Market*, signed by Governor Cooper on October 25, 2022[1]. EO 271 follows a series of executive actions aimed at reducing emissions and accelerating adoption of ZEVs in North Carolina, including Executive Order No. 80 (EO 80) [2], Executive Order No. 246 (EO 246)[3], and signature onto the Multi-State Medium- and Heavy-Duty (MHD) Zero Emission Vehicle (ZEV) Memorandum of Understanding (MOU)[4]. Signed in October 2018, EO 80 established goals to reduce statewide greenhouse gas (GHG) emissions to 40 percent (%) below 2005 levels and increase the number of registered ZEVs to at least 80,000 by 2025. In July 2020, Governor Cooper signed onto the Multi-State MHD ZEV MOU, in which the signatory states agreed to strive to make at least 30% of all new MHD vehicles sales zero-emission by 2030, and all new MHD vehicle sales zero-emission by 2050. Subsequently, EO 246 established goals of reducing GHG emissions by 50% below 2005 levels by 2030 and to net-zero by 2050, increasing the total number of registered ZEVs in North Carolina to at least 1.25 million by 2030, and increasing the sale of ZEVs such that at least 50% of in-state sales are zero-emission by 2030. EO 271 directs the North Carolina Department of Environmental Quality (DEQ) to establish an Advanced Clean Trucks (ACT) program requiring manufacturers to sell an increasing percentage of medium- and heavy-duty (MHD) zero-emission vehicles (ZEVs) over time and propose the ACT Rules for consideration by the Environmental Management Commission (EMC). The proposed ACT Rules were developed based on California's ACT Rules and are proposed for adoption under Section 177 of the Clean Air Act (CAA). The purpose of the ACT program is to accelerate the growth of the MHD ZEV market to support North Carolina's clean energy, environmental justice, and climate objectives by reducing greenhouse gas (GHG) and criteria air pollutant emissions from the most polluting vehicles on the road while generating local economic development and good paying jobs in a quickly growing sector.

The proposed ACT Rules would impose a ZEV sales requirement on truck manufacturers selling vehicles in North Carolina and provide compliance flexibility through credits, trading, and other features to incentivize ZEV sales. The ZEV sales requirement would apply to manufacturers that are headquartered and produce vehicles both in North Carolina and out-of-state for national and international markets. However, all of the costs and benefits associated with subject manufacturers complying with the proposed ZEV sales requirements for North Carolina are assumed to be borne in North Carolina. These costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs and benefits of the regulation in North Carolina despite the lack of a

[1] State of North Carolina, Governor Roy Cooper, Executive Order No. 246, "Growing North Carolina's Zero-Emission Vehicle Market" October 25, 2022, https://governor.nc.gov/executive-order-no-271/open.
[2] State of North Carolina, Governor Roy Cooper, Executive Order No. 80, "North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy", October 29, 2018, https://governor.nc.gov/documents/files/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition-clean-energy/open.
[3] State of North Carolina, Governor Roy Cooper, Executive Order No. 246, "North Carolina's Transformation To A Clean, Equitable Economy," January 7, 2022, https://governor.nc.gov/media/2907/open.
[4] North Carolina Department of Transportation, Multi-State Zero Emission Medium- and Heavy-Duty Vehicle Initiative - Memorandum of Understanding, https://www.ncdot.gov/initiatives-policies/environmental/climate-change/Documents/zev-memorandum-of-understanding.pdf.

specific fleet purchase requirement in North Carolina. This approach shows the full potential net impact on North Carolina's economy associated with the proposed ZEV sales requirements.

The proposed rules are expected to reduce GHG, nitrogen oxide (NOx), and particulate matter less than 2.5 microns ($PM_{2.5}$) emissions by replacing internal combustion engine (ICE) vehicles with ZEVs in North Carolina. The costs and emission reductions for the proposed rules were calculated using the cost and emission reduction data from the ACT analysis prepared by the California Air Resources Board (CARB). This was done by comparing the annual vehicle miles traveled (VMT) of MHD trucks from California and North Carolina to develop a scaling factor that was used to estimate North Carolina costs and emission reductions. This approach is consistent with the approach other states have used to estimate potential impacts associated with adopting the ACT regulations under Section 177 of the CAA.

The analysis evaluates the fiscal impacts on the State's economy by looking at the costs and savings to manufacturers, businesses, and State and local governments, along with environmental and health benefits resulting from emission reductions. Additionally, the analysis estimates potential tax credits available through two provisions of the Inflation Reduction Act (IRA). Table E-1 provides a summary of the overall incremental net impacts associated with the proposed ACT Rules and Alternative 2 relative to Alternative 1 (the "no-action" alternative). The proposed rules would require manufacturers to begin complying with ZEV sales requirements with MY 2026 MHD trucks and Alternative 2 would delay applicability of the sales requirements until MY 2027 MHD trucks. As shown in Table E-1, for the proposed Rules, the impacts for CY 2026-2049 calculated using a net present value (NPV) at a 7% discount rate were estimated to be a net benefit ranging from $175.6 million using the lower estimate of health benefits to $880.5 million using the higher estimate of health benefits. For Alternative 2, impacts calculated using a NPV at a 7% discount rate were estimated to be a net benefit ranging from $162.3 million using the lower estimate of health benefits to $865.9 million using the higher estimate of health benefits. Although the ZEV sales requirements plateau after MY 2035, this fiscal note analyzes the costs and benefits of the proposed rules through MY 2050 (CY 2049), in order to capture expected changes in some of the costs and savings throughout the life of the vehicles. It is expected that the cost of manufacturing ZEVs will decrease as the technology becomes more available and prevalent. Additionally, ZEV owners will continue to accrue savings from avoided gasoline and diesel purchases, for the life of the vehicle.

Table E-1: Summary of Net Impacts at a 7% Discount Rate

Summary of Costs (+) and Benefits (-) (million 2021$)		**NPV 7%**	
		CY 2026-2049 (Proposal)	**CY 2027-2049 (Alternative 2)**
Costs and Savings			
Manufacturers		$2,017	$1,969
North Carolina Businesses		-$368	-$370
IRA Tax Credits		-$706	-$644
North Carolina State Government		$284	$284
North Carolina Local Governments		$0	$0
Total Net of Costs (+) and Savings (-)		**$659**	**$671**
Benefits			
CO_2	SC-CO_2	-$271	-$271
NOx	Low COBRA Estimate	-$398	-$397
	High COBRA Estimate	-$895	-$894
$PM_{2.5}$	Low COBRA Estimate	-$166	-$166
	High COBRA Estimate	-$373	-$372
Total Benefits	**SC-CO_2 + Low COBRA**	**-$834.8**	**-$833.7**
	SC-CO_2 + High COBRA	**-$1,539.7**	**-$1,537.3**
Summary			
NPV	**Using Low COBRA Benefits**	**-$175.6**	**-$162.3**
	Using High COBRA Benefits	**-$880.5**	**-$865.9**

The costs, benefits, and net impacts shown in Table E-1 are estimates based on the best available data, reasonable assumptions, and forecasted projections. While there is an unknown degree of variability inherent in these estimates, the analysis indicates that the benefits will continue to accrue, likely far outpacing the costs into the future.

In summary, the analysis shows that, over time and relative to a business-as-usual baseline, the proposed ACT Rules would:

- provide North Carolina businesses and consumers with more options when buying zero-emission trucks by ensuring a supply of vehicles to the State;
- reduce maintenance, operating, and fuel costs for zero-emission truck owners as compared to owners of ICE trucks;
- reduce CO_2 emissions that cause climate change while also reducing NOx and $PM_{2.5}$ emissions to support the State's on-going efforts to maintain compliance with the existing and future National Ambient Air Quality Standards (NAAQS) for ozone and $PM_{2.5}$;
- result in benefits to the environment, public health, and North Carolina businesses far exceeding the costs to manufacturers; and

- position North Carolina to be a leader in vehicle electrification and to take advantage of future business opportunities.

This fiscal note discusses the methods used to determine these impacts, the estimated emission reductions, and uncertainties associated with the analytical approach, along with the estimated impacts using a 3% discount rate of return.

II. Background

Executive Order 271

On October 25, 2022, Governor Cooper signed EO 271, titled *Growing North Carolina's Zero-Emission Vehicle Market.* EO 271 requests the North Carolina DEQ to establish an ACT program requiring manufacturers to sell an increasing percentage of MHD ZEVs over time and propose the ACT Rules for consideration by the EMC. EO 271 directs DEQ to collaborate with local governments, environmental justice organizations, underserved communities, automobile manufacturers, motor fleet owners, electric utilities, the North Carolina Utilities Commission (NCUC), public health experts, environmental organizations, and other interested stakeholders in developing the proposed rules and the associated regulatory impact analysis. The overall goal of ACT is to develop a self-sustaining zero-emission truck market by requiring vehicle manufacturers to sell ZEVs as an increasing percentage of their annual MHD sales through 2035. The ACT program will provide vehicle manufacturers with flexibility through credits, trading, and other features to comply with the sales requirements as various segments of the MHD zero-emission vehicle market grow at different speeds. The ACT requirements would not apply to off-road vehicles, such as farm equipment or construction vehicles, and certain MHD vehicles that are specifically excluded from the rules, such as transit buses and emergency vehicles.

Clean Air Act Section 209

Except as allowed under Section 209, the CAA prohibits states from establishing their own emission standards for new motor vehicles. Under CAA Section 209, the state of California retains the unique authority as a U.S. state to set emission standards for new motor vehicles because California vehicle regulations preceded the federal CAA of 1970 with regard to managing motor vehicle-related air quality issues. As a result, under federal law, any California vehicle emissions standards must meet or exceed federal emission regulations along with other requirements specified in CAA Section 209. Under Section 209 of the CAA, the State of California is required to request and be granted a waiver from the U.S. Environmental Protection Agency (EPA) Administrator in order to enact any emission standards for new motor vehicles. Under this provision, CARB has requested and received approval of over 50 waivers. On March 30, 2023, EPA approved CARB's ACT waiver request.[5]

[5] See 88 FR 20688, April 6, 2023, California State Motor Vehicle and Engine Pollution Control Standards; Heavy-Duty Vehicle and Engine Emission Warranty and Maintenance Provisions; Advanced Clean Trucks; Zero Emission Airport Shuttle; Zero- Emission Power Train Certification; Waiver of Preemption; Notice of Decision, Notice of decision, approved by EPA on March 30, 2023.

Clean Air Act Section 177

Although States besides California are not allowed to develop their own motor vehicle emission standards, Section 177 of the CAA[6] allows other states to adopt California's motor vehicle emission standards in lieu of federal requirements without seeking EPA approval if: 1) California has requested and received from EPA a waiver for such standards under Section 209 of the CAA; and 2) the other state's adopted standards meet the requirements of Section 177, including being identical to California's standards. A summary of the four significant requirements of Section 177 and how North Carolina meets those provisions is below.[7]

1) **Applicability**: *The state is or has previously been noncompliant with federal ambient air quality standards and has plan provisions approved under Title 42 of the United States Code (42 USC), Chapter 85, Subchapter I, Part D (i.e., nonattainment plans).*

   North Carolina meets this applicability criteria. For the 1997 8-hour ozone NAAQS, North Carolina previously was designated nonattainment with the 1997 8-hour ozone NAAQS for the Charlotte, Gastonia, and Salisbury; Great Smoky Mountains National Park, Rocky Mount, and Triangle Areas and with the 2008 8-hour ozone NAAQS for the Charlotte, Gastonia, and Salisbury Area. All of these areas have been redesignated attainment with the respective ozone standards and are currently under federally approved maintenance plans to ensure on-going attainment with the standards.

2) **Identicality**: *The state's standards must be identical to the California standards for which a waiver has been granted for such model year.*

   North Carolina's proposed ACT Rules contain the same emission standards and are substantively identical to California's ACT Rules.[8]

3) **Lead Time:** *California and the other state must adopt such standards at least two years before commencement of such model year, as determined by EPA regulations.*

   California's ACT Rules became effective during calendar year 2020 and first apply the vehicle emission standards to Model Year (MY) 2024 vehicles. North Carolina's ACT Rules, if effective on or before January 1, 2024, would first apply the vehicle emission standards to MY 2027 vehicles.

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[6] Codified under United States Code, Title 42, Chapter 85, Subchapter I, Part D, subpart 1, Section 7507. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart1-sec7507.htm

[7] 42 USC 7507, New motor vehicle emission standards in nonattainment areas, https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section7507&num=0&edition=prelim

[8] Simultaneous to adopting its ACT Rules under 13 CCR, Section 1963, California also adopted a large-entity one-time reporting requirement for MHD vehicle fleets under 13 CCR, Section 2012. This information was collected to help California identify future strategies but is not needed to determine compliance with the ACT Rule requirements of 13 CCR Section 1963. The reporting requirements under Section 2012 were not part of CARB's waiver request submitted pursuant to CAA Section 209 and are not subject to the identicality provisions of CAA Section 177 for other states adopting California's ACT Rules. North Carolina is not proposing to adopt this one-time reporting requirement.

4) **Third Vehicle Prohibition:** *The state cannot use CAA Section 177 or 42 USC, Chapter 85, Subchapter II (federal emission standards for moving sources) to create a motor vehicle or motor vehicle engine different than a motor vehicle or motor vehicle engine certified in California under California standards. The state must choose either California standards or federal standards for new motor vehicles.*

   North Carolina's proposed ACT Rules do not have the effect of creating a new motor vehicle or motor vehicle engine.

California Advanced Clean Trucks (ACT) Program

The CARB ACT regulations are part of a comprehensive approach to accelerate a large-scale transition of zero-emission MHD vehicles, which ranges from Class 2b to Class 8 vehicles. The CARB ACT Rules require manufacturers who certify Class 2b-8 chassis or complete vehicles with combustion engines to sell zero-emission trucks as an increasing percentage of their annual California sales, beginning with MY 2024, when zero-emission truck/chassis sales would need to be 5% of Class 2b – 3 truck sales, 9% of Class 4 – 8 straight truck sales, and 5% of truck tractor sales. The requirements increase each year through MY 2035, when zero-emission truck/chassis sales would need to be 55% of Class 2b – 3 truck sales, 75% of Class 4 – 8 straight truck sales, and 40% of truck tractor sales. After MY 2035, the sales requirements remain in place but constant. The rules also contain components to provide manufacturers flexibility with meeting the sales targets, such as credit trading between some vehicle classes, credit trading between manufacturers, and early action credits.

III. Reason for Rule Adoption

The rules are proposed for adoption in response to EO 271, which directs the DEQ to establish an ACT program for consideration by the EMC. The proposed ACT Rules will require manufacturers to sell ZEVs as an increasing percentage of their annual MHD sales in the state through 2035. The proposed rules provide vehicle manufacturers with flexibility through credits, trading, and other features to comply with the sales requirements.

IV. Proposed Rules

As described in Section II, states proposing to adopt California's ACT program are required to meet the identicality provisions of CAA Section 177. Table 1 below shows the parallel of California's ACT regulation and North Carolina's proposed ACT Rules.

Table 1: Comparison of California and Proposed North Carolina ACT Rule Citations

California Rule Citation (13 CCR)	**North Carolina Rule Citation (15A NCAC 02D)**	**Rule Title**
1963	.2900	*Advanced Clean Trucks Purpose, Applicability, Definitions, and General Requirements*
1963.1	.2902	*Advanced Clean Trucks Deficits*
1963.2	.2903	*Advanced Clean Trucks Credit Generation, Banking, and Trading*
1963.3	.2904	*Advanced Clean Trucks Compliance Determination*
1963.4	.2905	*Advanced Clean Trucks Reporting and Recordkeeping*
1963.5	.2906	*Advanced Clean Trucks Enforcement*

Further description of each proposed Rule is provided below.

15A NCAC 02D .2901, *Advanced Clean Trucks Purpose, Applicability, Definitions, and General Requirements*

This rule is proposed for adoption to provide the purpose, applicability, definitions, and general requirements of the rules in this section. The purpose of the rule is to accelerate the market for MHD on-road vehicles in North Carolina to reduce NOx, $PM_{2.5}$, and GHG emissions. The rule applies to manufacturers that produce on-road vehicles over 8,500 pounds gross vehicle weight rating (GVWR) and sell 500 or more of these vehicles in California annually. Manufacturers of MHDs with annual sales of fewer than 500 vehicles in California are exempt from the sales requirements.[9] This threshold is commonly referred to as the "Low Volume Exemption". The rule also defines specific terms used in the Section.

15A NCAC 02D .2902, *Advanced Clean Trucks Deficits*

This rule is proposed for adoption to require each manufacturer to incur deficits, which are based on the manufacturer's annual total sales volume of MHD on-road vehicles delivered for sale in North Carolina, beginning with MY 2027. A deficit is incurred for each MHD vehicle sold in North Carolina (ICE, ZEV, or NZEV). The value of each deficit is based on the vehicle's model year and weight class group. The deficit is calculated as the product of the MY percentage requirement from Table A-1 of the proposed Rule, and the appropriate weight class modifier for each vehicle from Table A-2 of the proposed Rule. For every MY, the deficits generated by each vehicle are summed for each vehicle weight class group. Additionally, the deficits from the Class 2b-3 group and Class 4-8 group are summed, such that each model year will have one total number of Class 2b-8 (non-tractor) deficits, and one total number of Class 7-8 tractor deficits.

[9] The Low Volume Exemption for manufacturers is based on vehicle sales in California to be consistent with the definition included in the ACT regulations adopted by other states. The exception is New York, which defines the Low Volume Exemption as fewer than 500 vehicles sold in the state of New York.

Table A-1. ZEV Sales Percentage Schedule

Model Year	Class 2b-3 Group	Class 4-8 Group	Class 7-8 Tractors Group
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035 and beyond	55%	75%	40%

Table A-2. Weight Class Modifiers

	Vehicles in the Class 2b-3	Class 4-5 Vehicles in the Class 4-8 Group	Class 6-7 Vehicles in the Class 4-8 Group	Class 8 Vehicles in the Class 4-8 Group	Vehicles in the Class 7 and 8 Tractor Group
Weight Class Modifier	0.8	1	1.5	2	2.5

Table A-2 applies higher weight class modifiers to vehicles with higher emissions (i.e., larger vehicles), and lower weight class modifiers to vehicles with lower emissions (i.e., smaller vehicles).

15A NCAC 02D .2903, *Advanced Clean Trucks Credit Generation, Banking, and Trading*

Proposed Rule 02D .2903 outlines the procedures for generating, calculating, banking, and trading credits. Similar to deficits, a ZEV credit is generated for each ZEV sold, and a NZEV credit is generated for each near-zero emission vehicle (NZEV) sold. For each model year, the credits from the Class 2b-3 group and Class 4-8 group are summed (keeping ZEV and NZEV credits separate). Class 7-8 tractor credits are summed separately from those for the other vehicle class groups.

The value of a ZEV credit is equal to the weight class modifier specified in Table A-2 of the rule. The value of a NZEV credit is equal to the product of the appropriate weight class modifier in Table A-2 of proposed Rule 02D .2902 (shown above), and an "NZEV factor", which is 0.01 multiplied by the all-electric range, but limited to 0.75.

The proposed rule also allows trading and purchasing credits from other manufacturers, and banking credits, which can be used to offset deficits in later model years. Although manufacturers with fewer than 500 vehicle sales in California are exempt from the sales requirements of the Rules, exempt manufacturers may opt-in to claim ZEV or NZEV credits, which they can then sell to other manufacturers needing ACT ZEV credits. ZEV and NZEV credits are also bound by the following restrictions:

- Early action ZEV and NZEV credits (those generated for MY 2024-2026) expire at the end of MY 2030.

- ZEV and NZEV credits generated in MY 2027 or later can only be used for five model years after the model year in which they are generated.

In order to receive ZEV credit, a vehicle must be certified as compliant with California's Zero-Emission Powertrain Certification regulation.

15A NCAC 02D .2904, *Advanced Clean Trucks Compliance Determination*

To comply with the proposed rules, a manufacturer must retire enough credits to offset the deficits incurred for each MY. If a manufacturer is unable to retire credits in an amount at least equal to its deficits, the manufacturer is required to make up the deficit in the next MY; however, the carry-over deficit cannot be satisfied with NZEV credits.

As specified above, the deficits for a given model year are summed across the Class 2b-3 and Class 4-8 vehicle groups, as are the ZEV credits and NZEV credits. This approach provides flexibility for manufacturers that may have a larger market presence in one vehicle class over another. By summing the deficits across vehicle class groups, the rule effectively allows manufacturers to "trade" deficits and credits among vehicle classes, while the weight class modifiers attribute the relative level of emissions to various vehicle classes. However, to ensure ZEV tractors will be available to reduce emissions at ports and other areas with high tractor concentrations, only Class 7 and 8 tractor credits may be used to satisfy Class 7 and 8 tractor deficits, unless the manufacturer generates fewer than 25 Class 7-8 tractor deficits annually.[10]

Proposed Rule 02D .2904 also outlines a specific retirement order of credits.

15A NCAC 02D .2905, *Advanced Clean Trucks Reporting and Recordkeeping*

This rule is proposed for adoption to specify the information regulated manufacturers must report. For manufacturers selling vehicles in North Carolina, reports must be submitted starting with MY 2027. This proposed rule also details the mechanics of the reporting credit transfers and declarations, timelines, and retention requirements.

15A NCAC 02D .2906, *Advanced Clean Trucks Enforcement*

This rule is proposed for adoption to allow the DAQ to conduct an audit of the manufacturer's records of vehicle sales. If the DAQ determines that information used to obtain a credit was false, the credit will be invalidated.

V. Estimating the Fiscal Impacts

The proposed ACT Rules would introduce ZEV sales requirements for all manufacturers that certify on-road vehicles for sale in North Carolina in weight Classes 2b through 8 with a gross vehicle weight rating (GVWR) greater than 8,500 pounds. These vehicles include the following:

[10] Known as "Low Volume Tractor Flexibility", proposed Rule 02D .2904(c)(3) allows a manufacturer that generates fewer than 25 tractor deficits in a given model year and has remaining tractor deficits after following the credit retirement order set forth in the proposed Rules, to use a maximum of 25 non-tractor credits to satisfy their remaining tractor deficits.

- Class 2b-3 on-road vehicles with a GVWR that is 8,501 pounds up to 14,000 pounds;
- Class 4 on-road vehicle with a GVWR that is 14,001 pounds up to 16,000 pounds;
- Class 5 on-road vehicle with a GVWR that is 16,001 pounds up to 19,500 pounds;
- Class 6 on-road vehicle with a GVWR that is 19,501 pounds up to 26,000 pounds;
- Class 7 on-road vehicle with a GVWR that is 26,001 pounds up to 33,000 pounds;
- Class 8 on-road vehicle with a GVWR that is 33,001 pounds and above.

The sales requirements in the proposed rule 15A NCAC 02D .2902 are a percentage of the manufacturer's total annual MHD vehicle sales volume in North Carolina, varying by MY, vehicle class, and vehicle type. The MHD vehicle manufacturers will need to meet the requirements of the proposed rules starting with MY 2027 vehicles sold in North Carolina that would increase annually through MY 2035, as shown in Table 2; however, compliance is determined through a "deficit" and "credit" calculation and trading mechanism, with additional flexibilities specified in the proposed Rules and described below. The proposed Rules will also allow manufacturers to earn early compliance credits in North Carolina starting in MY 2024; credits generated in MYs 2024 through 2026 are also referred to as "early action credits."

Table 2: Proposed ZEV Sales Percentage Schedule

Model Year	Class 2b-3 Group	Class 4-8 Group	Class 7-8 Tractors Group
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035 and beyond	55%	75%	40%

A. Analysis Approach

To estimate costs, emission reductions, and benefits associated with the proposed Rules, the DAQ scaled the detailed analysis completed by CARB, based on a comparison of the VMT for MHD trucks in California with the VMT for MHD trucks in North Carolina. CARB's analysis notes that the proposed ACT Rules impose a ZEV sales mandate on ten large truck manufacturers selling vehicles in California. Although those entities are headquartered and produce vehicles entirely out of California, all of the costs associated with deploying the ZEV quantities required by the ACT Rules are assumed to be borne in California. Despite the lack of a specific fleet purchase requirement, the direct costs of the proposed ACT Rules in the analysis include incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs and savings, to show the full estimated net costs to North Carolina's economy. This approach is consistent with the approach used by

California, and subsequently used by other states to estimate potential impacts associated with adopting the ACT Rules under Section 177 of the CAA.

Vehicle mileage data from the Federal Highway Administration's (FHWA) Highway Statistics[11] for the Years 2015 to 2020 were used for the comparison. Using Tables *VM-2: Functional System Travel* and *VM-4: Distribution of Annual Vehicle Distance Traveled* from the FHWA annual statistics data, the VMT for trucks, which includes that from combination trucks and single-unit trucks (e.g., trucks with at least 2 axles and 6 tires) were summed for California and North Carolina. Using these totals, a VMT scaling factor was calculated, to scale the costs and benefits of the ACT regulation from California's analysis, to apply to North Carolina. Summaries of the VMT data for California and North Carolina from the FHWA Statistics used to calculate the VMT scaling factor are provided in Appendix A.

The DAQ applied the average VMT scaling factor from 2015 through 2020 to the costs, emission reductions, and benefits derived by CARB.[12] In their analysis, the CARB staff used models to estimate incremental costs and emissions reductions for the proposed ACT Rules compared to a business-as-usual baseline. The analysis determined reductions for GHG, NOx, and $PM_{2.5}$ emissions.

[11] Federal Highway Administration Statistics, Highway Statistics Series. 2015-2020 https://www.fhwa.dot.gov/policyinformation/statistics.cfm

[12] California Air Resources Board, Attachment C, Updated Cost and Benefit Analysis for the Proposed Clean Trucks Regulations. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/30dayattc.pdf

Table 3: VMT Scaling Factor Calculation Using FHWA Single-Unit and Combination Truck VMT Data.

Year	State	Total Truck VMT (million miles)	VMT Scaling Factor
2015	California	23,631.0	0.33
	North Carolina	7,736.1	
2016[a]	California	23,174.6	0.35
	North Carolina	8,147.6	
2017	California	22,591.3	0.37
	North Carolina	8,445.0	
2018	California	24,186.8	0.36
	North Carolina	8,741.6	
2019	California	23,991.1	0.37
	North Carolina	8,887.8	
2020	California	29,306.6	0.30
	North Carolina	8,757.1	
2015-2019 VMT Scaling Factor Average			0.36
2015-2020 VMT Scaling Factor Average			0.35

[a] The percentage of VMT by vehicle type (FHWA Table VM-4) was not available for 2016. The average vehicle percentages for 2015 and 2017 were used to estimate the percentages for 2016.

As shown in Table 3, the VMT scaling factor values are fairly consistent, with the exception of the 2020 factor, which included shutdowns as a result of the COVID pandemic. Therefore, this analysis excludes the 2020 VMT scaling factor from the average and instead uses an average VMT scaling factor of 0.36, representing FHWA VMT data from years 2015 through 2019.

B. Estimated Costs and Savings

The CARB analysis assesses costs to four categories of entities: 1) manufacturers; 2) businesses; 3) State government; and 4) local government. Similarly, this analysis evaluates these costs as they translate to North Carolina. Subsection V.B.1 quantifies the costs of North Carolina's proposed ACT Rules to MHD vehicle manufacturers that would be subject to the ZEV sales requirements. Subsection V.B.2 outlines the potential impacts to North Carolina businesses and fleets and includes both costs and savings. These entities would not be subject to the ACT Rules or any ZEV sales requirements but are potential purchasers of ZEVs and ICE MHD vehicles; therefore, it is expected that they would be impacted by the proposed ACT Rules. Since CARB's ACT analysis predates the Inflation Reduction Act (IRA) of 2022, it does not consider potential impacts from the available tax credits to MHD ZEV purchasers. Therefore, this fiscal analysis for North Carolina's proposed ACT Rules evaluates IRA tax credits separately, as discussed in Subsection V.B.3. Additionally, Subsections V.B.4 and V.B.5 contain the estimated costs to the State and local governments in North Carolina, respectively.

1. Manufacturers of MHD Vehicles

The cost analysis for vehicle manufacturers evaluates the incremental costs to produce and sell ZEVs relative to ICEs. In addition, the analysis notes that the production of ZEVs will simultaneously decrease the manufacturers' cost of complying with the EPA's Phase 2 GHG regulation for ICE vehicles[13], which requires improved fuel efficiency for MHD trucks to reduce the impacts of climate change. The CARB analysis assumes capital costs, infrastructure upgrades, and lower operating expenses and shows the full estimated cost to California for deploying the number of ZEVs required by the ACT Rules. A summary of the CARB analysis costs[14] for manufacturers is provided in Appendix B, Table B-1. Note that the cost impacts for manufacturers were developed based on estimates of total MHD vehicle sales in the state rather than sales by manufacturer. The CARB analysis identified ten MHD vehicle manufacturers as potentially subject to the ACT Rules in California. Table C-1 of Appendix C provides a list of manufacturers potentially subject to the proposed ACT Rules in North Carolina which includes 12 that manufacture EVs and ICE vehicles plus four that manufacture only EVs. The companies that manufacture only EVs would by default be in compliance with the sales requirements of the rules and would likely generate credits for trading should they choose to sell EVs in North Carolina.

This analysis assumes an effective date of January 1, 2024 for North Carolina's proposed ACT Rules; therefore, the ACT sales requirements would not be implemented until 2026, in order to comply with the 2-year lead time requirement of CAA Section 177, as explained in Section II. This lead time allows the manufacturers to adjust their operations for producing and selling ZEVs in the State. As a result, the costs associated with the adoption of the ACT Rules in North Carolina would begin in 2026, to produce and sell MY 2027 vehicles. A summary of the incremental costs is provided in Table 6 using the 2015-2019 VMT scaling factor of 0.36 provided in Table 3.

Vehicle Production

Currently, battery-electric and fuel cell electric trucks cost more to produce than their diesel or gasoline counterparts. The CARB ACT fiscal analysis used the difference in production costs between ZEVs and ICE vehicles, along with the number of ZEV sales needed to reach the proposed ACT sales requirements (as represented in Table 2), to estimate the increased costs to manufacturers for building and selling a ZEV. The incremental ZEV cost shown in Table 6 accounts for the full incremental price of the vehicles when compared to the price of an equivalent number of ICE vehicles and is treated as a cost to the manufacturer. Vehicle prices are not amortized as the manufacturer would incur the full cost in the year the vehicle is built and sold. The CARB analysis noted that it is difficult to predict how these manufacturer costs and

[13] US EPA, Final Rule for Phase 2 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-2-greenhouse-gas-emissions-standards

[14] See Table IV-8 of the California Air Resources Board, Attachment C, Updated Cost and Benefit Analysis for the Proposed Clean Trucks Regulations. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/30dayattc.pdf

cost savings from the proposed ACT regulation would be passed on to consumers. The CARB analysis assumed that the manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

The estimated ZEV sales required for each year are shown in Table 4 below. The table also shows the cumulative ZEVs resulting from the proposed ACT Rules each year, which includes the ZEVs sold in each of the prior years. Appendix C, Table C-2, provides a more detailed breakdown of the projected sales for baseline (ICE) vehicles and new ZEVs under the proposed ACT Rules, as well as the underlying assumptions used to arrive at these projected estimates.

Table 4: Estimated Number of MHD Vehicle Sales in North Carolina

Calendar Year	Model Year	Projected Total MHD Sales in NC	New MHD ZEV Sales in NC Under ACT			Cumulative New MHD ZEVs in NC
			Total	Electric Normal Range	Electric Long Range	
2026	2027	27,393	4,396	3,233	1,163	4,396
2027	2028	27,743	6,133	4,563	1,570	10,529
2028	2029	28,095	7,915	5,929	1,987	18,444
2029	2030	28,452	9,745	7,331	2,414	28,189
2030	2031	28,736	11,279	8,435	2,845	39,468
2031	2032	29,023	12,843	7,709	5,135	52,312
2032	2033	29,314	14,340	8,681	5,659	66,652
2033	2034	29,607	15,865	11,875	3,990	82,517
2034	2035	29,903	17,419	10,682	6,737	99,936
2035	2036	30,202	17,593	10,789	6,804	117,529
2036	2037	30,504	17,769	10,897	6,872	135,299
2037	2038	30,809	17,947	13,462	4,485	153,246
2038	2039	31,117	18,127	11,116	7,010	171,372
2039	2040	31,428	18,308	11,227	7,081	189,680
2040	2041	31,742	18,491	11,340	7,151	208,171
2041	2042	32,060	18,676	11,453	7,223	226,847
2042	2043	32,380	18,863	11,567	7,295	245,709
2043	2044	32,704	19,051	14,290	4,761	264,760
2044	2045	33,031	19,242	11,800	7,442	284,002
2045	2046	33,362	19,434	11,918	7,516	303,436
2046	2047	33,695	19,628	12,037	7,591	323,065
2047	2048	34,032	19,825	14,871	4,954	342,889
2048	2049	34,373	20,023	12,279	7,744	362,912
2049	2050	34,716	20,223	12,402	7,821	383,135
Total		**744,421**	**383,135**	**249,886**	**133,249**	

EPA Phase 2 GHG Regulation Compliance

The EPA Phase 2 GHG regulations[15] require manufacturers to build trucks that are more fuel efficient and have lower GHG emissions. These requirements started in MY 2021 and ramp up through MY 2027. The EPA estimated the cost per vehicle to comply with the Phase 2 GHG regulations, as shown in Table 5. Even though the costs of producing ZEVs are currently higher than other compliance options (such as improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, and more), producing ZEVs would reduce the amount of upgrades the manufacturers would need to make for their remaining ICE vehicle sales. The cost difference between Phase 2 GHG compliance costs in the business-as-usual baseline scenario and the proposed ACT Rules represents a potential cost savings to the manufacturer. By building ZEVs to comply with the proposed ACT Rules, the manufacturers are avoiding compliance costs associated with ICE vehicle upgrades needed to comply with the Phase 2 GHG regulations.

Table 5: U.S EPA Phase 2 Incremental Compliance Costs Per Vehicle[16]

Phase 2 GHG Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2b-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

[15] U.S. Environmental Protection Agency, Final Rule for Phase 2 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-2-greenhouse-gas-emissions-standards

[16] Table IX-9 of CARB's ACT Regulation Initial Statement of Reason (ISOR).

A summary of the costs and savings to manufacturers is provided in Table 6 below.

Table 6: Total Estimated Incremental Costs and Savings for Manufacturers to Produce ZEVs for North Carolina

Calendar Year	Model Year	Costs (+) and Savings (-) to Manufacturers (million 2021$)		Annual Net Impacts with ACT (Costs – Savings) (million 2021$)
		Incremental ZEV Cost	EPA Phase II GHG Regulation for ICE Vehicles (Cost Avoided/Savings)	
2026	2027	$89	-$22	$67
2027	2028	$115	-$7	$108
2028	2029	$143	-$9	$135
2029	2030	$162	-$11	$151
2030	2031	$188	-$13	$176
2031	2032	$234	-$14	$220
2032	2033	$259	-$16	$244
2033	2034	$286	-$17	$269
2034	2035	$312	-$18	$294
2035	2036	$314	-$19	$296
2036	2037	$317	-$19	$298
2037	2038	$319	-$19	$300
2038	2039	$322	-$19	$303
2039	2040	$324	-$19	$305
2040	2041	$327	-$19	$307
2041	2042	$329	-$19	$309
2042	2043	$331	-$20	$312
2043	2044	$334	-$20	$314
2044	2045	$336	-$20	$316
2045	2046	$339	-$20	$319
2046	2047	$341	-$20	$321
2047	2048	$343	-$20	$323
2048	2049	$345	-$20	$325
2049	2050	$298	-$18	$280
Total		**$6,709**	**-$417**	**$6,292**

Additionally, the CARB analysis does not include any costs to manufacturers for reporting associated with ACT compliance because manufacturers are already required to report information pursuant to the EPA Phase 2 GHG regulation, including sales per model year of every powertrain and vehicle family. Because manufacturers are already collecting and reporting this information, no significant additional reporting costs to manufacturers were attributed to the ACT Rules.

2. Businesses

For this analysis, direct impacts on businesses that purchase MHD vehicles that would be subject to the proposed ACT Rules were estimated to understand the potential impact of the proposed Rules on North Carolina's economy (despite the lack of a specific fleet purchase requirement in the ACT Rule). These impacts include sales and federal excise taxes, fuel and fueling infrastructure (electric charging and hydrogen fueling), vehicle maintenance and maintenance bay upgrades, transitional costs and workforce development, and registration fees. The impacts were developed using the impacts developed by CARB as the starting point. A summary of the California business costs estimated in the CARB analysis is shown in Appendix B, Table B-3.

Sales Tax and Federal Excise Tax

Sales and excise taxes are costs applied to the purchase of the vehicle. In the CARB analysis, a sales tax of 8.5% was used to estimate the costs for businesses. In addition, Class 8 vehicles are subject to a 12% Federal Excise tax. North Carolina applies a 3% sales tax on the purchase of vehicles in the State, which was used with the scaling factor of 0.36 to calculate the North Carolina business costs for this category.

Gasoline, Diesel, Electricity, and Hydrogen Fuel Costs / Savings

The CARB analysis calculated the gasoline, diesel, electricity, and hydrogen fuel costs using total fuel used per year and the cost of fuel per unit. The total amount of fuel used per year is based on the vehicle population per calendar year, the annual mileage (i.e., VMT) of these vehicles, and the fuel economy of the vehicles. The fuel economy assumed for each vehicle class and technology is shown in Table B-2, in units of miles per gallon (mpg) for gasoline and diesel vehicles, miles per kilowatt-hour (mi/kWh) for battery-electric vehicles, and miles per kilogram of hydrogen (mi/kg) for fuel cell electric vehicles.

Using the fuel economy data in Table B-2, the CARB analysis estimated the quantities of fuel that would be saved or be used for each of the vehicle classes and types. The analysis includes the gallons of diesel and gasoline fuel saved from replacing an ICE with ZEV, as well as the quantity of electricity and hydrogen (for fuel cell) needed to operate the ZEVs. The VMT scaling factor of 0.36 was applied to the CARB fuel quantity values to calculate the estimated fuel quantities for North Carolina. Table 7 shows the estimate of gasoline and diesel fuel saved and the estimate of electricity and hydrogen used as a result of the proposed ACT Rules. Table 8 lists the fuel prices used to calculate the gasoline and diesel fuel savings and the electricity and hydrogen costs. Gasoline, diesel, and electricity prices were obtained from the EIA Annual Energy Outlook for 2023.[17] The gasoline and diesel price projections are based on the South Atlantic region and the fuel tax portion of the price was replaced with the projected fuel sales tax estimate from the North Carolina Office of State Budget and Management (OSBM). The gasoline, diesel, and electricity fuel prices were also adjusted to 2021 dollars using Implicit Price Deflators for Gross Domestic Product from the U.S. Department of Commerce, Bureau of Economic Analysis. Hydrogen costs

[17] U.S. Energy Information Administration, Annual Energy Outlook 2023, Table 57.5. Components of Selected Petroleum Product Prices, Table 54. Electric Power Projections by Electricity Market Module Region. https://www.eia.gov/outlooks/aeo/

were obtained from the CARB analysis and are assumed to be comparable to the costs of hydrogen in North Carolina.

Table 7: Estimated Fuel Quantities Saved and Increased in North Carolina

Calendar Year	Fuel Saved from Avoided ICE Vehicles (Baseline)		Fuel (including Energy) Used for ZEVs (Proposed ACT Rules)	
	Gasoline (gal/yr)	Diesel (gal/yr)	Electricity (kWh/yr)	Hydrogen (kg/yr)
2026	1,623,451	5,356,131	74,898,104	67,456
2027	4,062,570	13,305,080	185,978,824	158,712
2028	6,970,768	23,660,318	328,940,977	274,625
2029	10,338,385	36,422,082	503,753,452	416,153
2030	14,152,597	50,681,991	699,624,804	582,416
2031	18,403,353	66,417,173	916,267,715	774,681
2032	23,077,514	83,096,364	1,146,641,422	967,825
2033	28,158,947	100,742,525	1,390,869,889	1,159,954
2034	33,628,156	119,193,151	1,646,875,785	1,349,683
2035	38,879,387	136,981,458	1,893,577,464	1,533,414
2036	43,788,776	153,969,817	2,128,572,516	1,710,045
2037	48,403,559	170,176,485	2,352,360,408	1,879,173
2038	52,749,805	185,594,123	2,564,994,010	2,039,931
2039	56,849,208	200,188,240	2,766,237,511	2,193,255
2040	60,714,596	213,874,569	2,955,090,981	2,336,196
2041	64,357,033	226,630,232	3,131,375,319	2,469,474
2042	67,784,889	238,553,383	3,296,309,668	2,593,434
2043	71,006,891	249,732,822	3,451,018,008	2,708,898
2044	74,028,551	260,180,950	3,595,642,162	2,814,799
2045	76,857,204	269,993,514	3,731,415,758	2,913,137
2046	79,499,841	279,155,910	3,858,174,812	3,002,839
2047	81,963,577	287,695,152	3,976,306,995	3,084,864
2048	84,255,885	295,656,380	4,086,421,415	3,160,226
2049	86,384,881	303,179,367	4,190,224,410	3,229,540

Table 8: Projected Fuel Prices in North Carolina, 2026-2049

Calendar Year	Projected Fuel (including Energy) Prices per Unit of Fuel			
	Gasoline (2021$/gal)	Diesel (2021$/gal)	Electricity (2021$/kWh)	Hydrogen[a] (2021$/kg)
2026	$2.93	$3.66	$0.13	$7.66
2027	$2.92	$3.56	$0.13	$7.35
2028	$2.93	$3.47	$0.13	$7.03
2029	$2.94	$3.48	$0.12	$6.71
2030	$2.96	$3.49	$0.12	$6.39
2031	$2.95	$3.52	$0.12	$6.29
2032	$2.98	$3.54	$0.12	$6.19
2033	$2.99	$3.56	$0.12	$6.10
2034	$3.00	$3.56	$0.12	$6.00
2035	$3.02	$3.60	$0.12	$5.90
2036	$3.06	$3.60	$0.12	$5.80
2037	$3.07	$3.63	$0.12	$5.70
2038	$3.08	$3.65	$0.12	$5.61
2039	$3.11	$3.66	$0.12	$5.51
2040	$3.11	$3.67	$0.12	$5.41
2041	$3.12	$3.70	$0.12	$5.31
2042	$3.13	$3.70	$0.12	$5.21
2043	$3.13	$3.73	$0.12	$5.12
2044	$3.15	$3.72	$0.12	$5.02
2045	$3.16	$3.73	$0.12	$4.92
2046	$3.20	$3.77	$0.12	$4.82
2047	$3.21	$3.78	$0.11	$4.72
2048	$3.24	$3.79	$0.11	$4.63
2049	$3.25	$3.81	$0.11	$4.53

[a]Cost of hydrogen is assumed to be the same in California and North Carolina.

The fuel quantity and fuel price estimates for North Carolina were used to calculate the fuel costs and savings as a result of the proposed ACT Rules. The results are shown in Table 9. The calculated diesel and gasoline values are fuel savings as a result of replacing ICE vehicles with ZEVs. The calculated electricity and hydrogen values are costs associated with the operation of battery-electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs), respectively. The sum of these fuel costs and savings results in overall net fuel savings.

Table 9: Estimated Fuel Savings and Costs

Calendar Year	Million 2021$				
	Savings/Avoided Costs (-) (Baseline)		Costs for ZEVs (+) (Proposal)		Total Net Fuel Costs
	Gasoline	Diesel	Electricity	Hydrogen	
2026	-$4.8	-$19.6	$9.7	$0.5	-$14.2
2027	-$11.9	-$47.3	$23.6	$1.2	-$34.4
2028	-$20.4	-$82.0	$41.1	$1.9	-$59.4
2029	-$30.4	-$126.9	$62.2	$2.8	-$92.3
2030	-$41.9	-$176.9	$85.5	$3.7	-$129.5
2031	-$54.3	-$234.0	$112.2	$4.9	-$171.2
2032	-$68.7	-$293.9	$139.8	$6.0	-$216.8
2033	-$84.2	-$358.8	$171.0	$7.1	-$265.0
2034	-$101.0	-$424.7	$204.1	$8.1	-$313.5
2035	-$117.4	-$493.1	$232.0	$9.0	-$369.4
2036	-$134.1	-$555.0	$260.1	$9.9	-$419.1
2037	-$148.5	-$617.6	$287.6	$10.7	-$467.8
2038	-$162.6	-$678.0	$314.5	$11.4	-$514.7
2039	-$176.6	-$732.4	$343.0	$12.1	-$553.9
2040	-$189.0	-$785.6	$364.2	$12.6	-$597.7
2041	-$200.6	-$837.9	$381.5	$13.1	-$643.9
2042	-$212.3	-$883.2	$400.0	$13.5	-$682.0
2043	-$222.1	-$930.6	$414.7	$13.9	-$724.2
2044	-$233.4	-$968.5	$430.1	$14.1	-$757.7
2045	-$242.7	-$1,006.5	$444.8	$14.3	-$790.1
2046	-$254.4	-$1,052.6	$450.0	$14.5	-$842.5
2047	-$262.8	-$1,086.4	$456.5	$14.6	-$878.1
2048	-$272.9	-$1,120.8	$464.1	$14.6	-$914.9
2049	-$281.1	-$1,153.7	$469.1	$14.6	-$951.1
Total 2026-2049	-$3,528.3	-$14,666.1	$6,561.6	$229.3	-$11,403.5

As described previously, the total net fuel cost to businesses reflects the net of gasoline and diesel fuel savings due to switching from gasoline or diesel vehicles to ZEVs, and the cost of electricity or hydrogen for ZEVs.

Vehicle Maintenance Costs

Vehicle maintenance costs account for the cost and labor for routine maintenance, preventive maintenance, and repairing or replacing malfunctioning components. The VMT scaling factor of 0.36 was applied to the total annual incremental maintenance costs associated with the use of ZEVs versus ICE vehicles to estimate the costs for North Carolina. The CARB analysis used several analyses to estimate a cost per mile for the different vehicle groups (see Table 10) which were applied to annual VMT for each year to estimate total maintenance costs.

Table 10: CARB Analysis Maintenance Costs for Each Vehicle Group and Technology

Vehicle Group	Gasoline/Diesel ($/mile)	Battery-Electric ($/mile)	Fuel Cell ($/mile)
Class 2b-3	$0.17	$0.128	$0.17
Class 4-5 Vocational	$0.31	$0.233	$0.31
Class 6-7 Vocational	$0.31	$0.233	$0.31
Class 8 Vocational	$0.31	$0.233	$0.31
Class 7-8 Tractor	$0.19	$0.142	$0.19

Maintenance Bay Upgrades

In addition to labor costs for maintenance on ZEVs, maintenance bays will also need to be upgraded to address the maintenance needs of the ZEV vehicles. The CARB analysis used a cost of $25,000 to upgrade a maintenance bay for ZEVs and $750,000 for fuel cell vehicles, based on transit agency cost data.[18] The number of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV. The VMT scaling factor of 0.36 from Table 3 was applied to the CARB analysis annual values to estimate the maintenance bay upgrade costs for North Carolina.

Midlife Costs

The midlife costs in the CARB analysis include the costs of rebuilding or replacing major propulsion components due to wear or deterioration. For diesel vehicles, this would be a midlife rebuild of the engine, while for BEVs this would be a battery replacement, and for a hydrogen fuel-cell vehicle this would be a fuel cell stack refurbishment. The frequency and cost of a midlife rebuild vary across technologies, and the costs are also dependent upon the time of the replacement. To estimate North Carolina midlife costs, the VMT scaling factor of 0.36 from Table 3 was applied to the CARB analysis midlife cost estimate.

Fueling Infrastructure Installation and Maintenance

The electric vehicle supply equipment (EVSE) and refueling infrastructure installation and maintenance costs estimated in the CARB analysis are derived from cost estimates from Pacific Gas and Electric and Southern California Edison as part of their Clean Energy and Pollution Act[19] applications. For electric vehicles, the CARB analysis used the charger costs and infrastructure costs shown in Table 11.

For BEVs, the two main cost components are the charging equipment hardware and the cost of upgrading the site to deliver the necessary power to the charger. Site upgrades can include trenching, cabling, laying conduit, transformer upgrades and more. Charger maintenance costs are estimated to be approximately $500 per year per charger and the baseline maintenance costs for

[18] California Air Resources Board, Appendix G Literature Review on Transit Bus Maintenance Cost. https://ww2.arb.ca.gov/sites/default/files/2020-06/Appendix G Literature Review on Transit_Bus Maintenance Cost.pdf

[19] The California Clean Energy and Pollution Reduction Act (Senate Bill 350) established clean energy, clean air, and GHG reduction goals, including reducing GHG to 40% below 1990 levels by 2030 and to 80% below 1990 levels by 2050. The bill also authorizes utilities to undertake transportation electrification.

gasoline and diesel infrastructures are assumed to be reflected in the fuel price. The EVSE costs in the CARB analysis are amortized values at 5% interest over 20 years. To estimate these costs for North Carolina, the DAQ applied the VMT-based scaling factor of 0.36 from Table 3 to CARB's EVSE and fueling infrastructure and maintenance costs.

Table 11: Electric Charger Infrastructure Costs[20]

Vehicle Group	Charger Power (kW)	Charger Cost	Infrastructure Upgrade Cost
Class 2b-3	19	$5,000	$20,000
Class 4-5	19	$5,000	$20,000
Class 6-7	40	$25,000	$27,500
Class 8	80	$50,000	$55,000
Class 7-8 Tractor	80	$50,000	$55,000

Transitional Costs and Workforce Development

Workforce development costs are associated with transitioning to the new technology. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others. While limited information is available on this type of cost, CARB notes that related discussions occurred with transit agencies during the development of their Innovative Clean Transit (ICT) rule, which led staff to assume these "other costs" associated with zero-emission bus (ZEB) deployments equal to 2.5% of bus prices for all powertrains, although the costs should go down over time for ZEBs as they become more common.[21] Therefore, the CARB ACT analysis assumed that the workforce training and transitional costs are equal to 2.5% of the incremental cost difference between a baseline (ICE) vehicle and a ZEV, until 2030, at which point the technology will have matured such that these transitional costs become business-as-usual for trucking fleets. The VMT scaling factor of 0.36 from Table 3 was applied to the CARB value of these costs to estimate the costs to North Carolina businesses.

Summary of North Carolina Business Costs and Savings

Applying the VMT scaling factor and other factors discussed previously in this section, the net impacts to North Carolina businesses are provided in Table 12.

[20] Taken from the CARB ACT Regulation ISOR, Table IX-17.

[21] The CARB ACT Regulation ISOR, page IX-25, notes that this method is based on the assumption that the Cost Subgroup used to reflect estimated soft costs for conventional internal combustion engine buses.

Table 12: Total Estimated Direct Incremental Costs and Savings for Businesses in North Carolina

Calendar Year	Model Year	Costs (+) and Savings (-) to North Carolina Businesses (million 2021$)							Annual Net Impact (Costs – Savings) (million 2021$)
		Sales & Excise Tax [a]	Fuel	Vehicle Maintenance	Maintenance Bay Upgrades	Midlife Costs	EVSE Infrastructure Installation & Maintenance	Transitional Costs & Workforce Deployment	
2026	2027	$4	-$14	-$5	$1	$0	$15	$2	$2
2027	2028	$5	-$34	-$14	$3	$0	$33	$3	-$4
2028	2029	$6	-$59	-$24	$5	$0	$58	$4	-$11
2029	2030	$7	-$92	-$37	$8	$0	$88	$4	-$22
2030	2031	$8	-$130	-$51	$11	$0	$122	$0	-$39
2031	2032	$10	-$171	-$67	$14	$9	$161	$0	-$44
2032	2033	$11	-$217	-$84	$16	$13	$204	$0	-$57
2033	2034	$12	-$265	-$102	$18	$17	$250	$0	-$70
2034	2035	$13	-$313	-$121	$20	$20	$300	$0	-$82
2035	2036	$13	-$369	-$140	$22	$24	$349	$0	-$102
2036	2037	$13	-$419	-$157	$22	$46	$397	$0	-$97
2037	2038	$13	-$468	-$174	$23	$56	$445	$0	-$104
2038	2039	$13	-$515	-$190	$23	$67	$492	$0	-$109
2039	2040	$14	-$554	-$205	$23	$77	$538	$0	-$107
2040	2041	$14	-$598	-$219	$22	$84	$584	$0	-$113
2041	2042	$14	-$644	-$232	$22	$105	$628	$0	-$108
2042	2043	$14	-$682	-$244	$21	$112	$670	$0	-$109
2043	2044	$14	-$724	-$256	$21	$114	$711	$0	-$120
2044	2045	$14	-$758	-$266	$20	$113	$751	$0	-$126
2045	2046	$14	-$790	-$276	$19	$108	$789	$0	-$136
2046	2047	$14	-$843	-$286	$18	$102	$814	$0	-$179
2047	2048	$14	-$878	-$295	$18	$98	$833	$0	-$210
2048	2049	$14	-$915	-$303	$17	$95	$845	$0	-$246
2049	2050	$13	-$951	-$310	$15	$92	$843	$0	-$299
Total		**$282**	**-$11,404**	**-$4,058**	**$403**	**$1,353**	**$10,919**	**$13**	**-$2,492**

[a] Sales tax costs for North Carolina were based on the CARB values, adjusted using the VMT scaling factor of 0.36 and a ratio of the North Carolina sales tax rate (3%) to the California sales tax rate (7.25%).

3. Inflation Reduction Act of 2022

The Inflation Reduction Act (IRA) was enacted in 2022 to curb inflation by reducing the deficit and investing in domestic energy production and clean energy. Because it predates enaction of the IRA, the CARB analysis did not include any impacts of the IRA. This fiscal analysis evaluates the direct impacts of two provisions of the IRA expected to have significant effects on the transition of the transportation sector towards zero- or lower-emitting vehicles. Each of these IRA sections and the associated impacts are outlined in this subsection.

Clean Vehicle Tax Credits

One of the provisions of the IRA includes tax credits for businesses and tax-exempt organizations to purchase commercial clean vehicles.[22] The tax credit is determined by the lesser of: 30% of the tax basis of the vehicle; or the incremental cost of the vehicle. The maximum tax credit for qualified vehicles with a GVWR of under 14,000 pounds is $7,500, and $40,000 for vehicles with a GVWR greater than 14,000 pounds. The tax credit begins in 2023 and extends through the end of 2032.

While it did not quantify impacts of the IRA, the CARB analysis did include estimates of the annual sales per vehicle group by model year, baseline MHD vehicle prices for gasoline and diesel vehicles, and price forecasts for ZEVs by vehicle group. These estimates can be found in Appendix B of this Fiscal Note. The CARB analysis based their annual new vehicle sales on new vehicle registrations in California and applied a growth factor of approximately 1% per year, based on the Emission FACtor (EMFAC)[23] inventory model truck sales forecasts. A similar analysis was performed by DAQ using North Carolina DMV registration data, which found comparable results for projected new truck registrations in North Carolina. To be consistent with the rest of the analysis in this fiscal note, the projected vehicle sales used as the basis of the CARB ACT analysis were used to estimate the number of new vehicles sold in North Carolina each year.

Estimated sales of MHD vehicles were calculated using the CARB estimated annual sales per vehicle group and the VMT scaling factor of 0.36 for model year 2027 through 2033 vehicles. These model years correspond to the start of the manufacturer sales requirements in the proposed ACT Rules in North Carolina and the end of the tax credits from the IRA, which is calendar year 2032. Table 13 provides a summary of the estimated MHD sales in North Carolina for model year 2027 through 2033 vehicles.

For the purposes of estimating the potential tax credits for businesses in North Carolina, it was assumed that the number of ZEVs that are sold in the state is equal to the sales percentages in

[22] U.S. Internal Revenue Service, Commercial Clean Vehicle Credit. https://www.irs.gov/credits-deductions/commercial-clean-vehicle-credit

[23] California Air Resources Board, EMFAC. https://arb.ca.gov/emfac/

Table 2. Table 13 shows a summary of the projected total MHD sales in North Carolina, to which the ACT ZEV sales percentages were applied.

Table 13: Estimated MHD Truck Sales by Model Year for North Carolina

Vehicle Group	ACT Rules Vehicle Class GVWR (lbs)	Number of Vehicles Sold						
		Calendar Year						
		2026	2027	2028	2029	2030	2031	2032
		Model Year						
		2027	2028	2029	2030	2031	2032	2033
Class 2b-3 Gasoline	8,501 up to 14,000	8,538	8,632	8,726	8,819	8,910	9,000	9,087
Class 2b-3 Diesel	8,501 up to 14,000	11,317	11,443	11,567	11,690	11,811	11,930	12,046
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	2,392	2,432	2,473	2,514	2,554	2,618	2,668
Class 6-7	Class 4 = 19,501 up to 26,000; Class 5 = 26,001 up to 33,000	2,808	2,855	2,903	2,951	2,998	3,073	3,132
Class 8	Class 8 = 33,001 and above	426	435	444	453	462	474	484
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	1,797	1,827	1,858	1,895	1,925	1,975	2,014
Total MHD Sales		**27,277**	**27,624**	**27,972**	**28,322**	**28,659**	**29,070**	**29,432**

The IRS tax credits are constrained at the lower of: 1) 30% of the ZEV tax basis; 2) the incremental cost between the ICE and ZEV; and 3) the maximum vehicle credit limit of $7,500 for vehicles less than 14,000 lbs or $40,000 for vehicles greater than 14,000 lbs. To determine the maximum tax credit each class of ZEV is potentially eligible for, the DAQ determined the difference between the ICE vehicle price and the ZEV price forecast from the CARB data. The lesser of the three values was determined to be the tax credit for that vehicle group and was multiplied by the estimated number of ZEVs for that vehicle group. Table 14 provides a summary of the projected vehicle prices and estimated maximum tax credits by vehicle group for each model year. Using the more detailed breakdown of electric normal- and long-range vehicles shown in Table C-2 of Appendix C, the total IRA clean vehicle tax credits were calculated for each year that they would be available, from calendar year 2026 through 2032. As shown in Table 14, the annual clean vehicle tax credits provide savings to North Carolina businesses of about $632 million over the seven-year period that the tax credit is available.

Table 14: Estimated IRA Tax Credit for North Carolina Businesses that Purchase ZEVs

CY	MY	Vehicle Group	Baseline (ICE) Vehicle Price [a]		ZEV Price Forecast [b]		30% of ZEV Tax Basis		Incremental Cost (ZEV – ICE)		Tax Credit per Vehicle (2021$) [c]		Total Tax Credits (2021$)
					Electric Range		Electric Range		Electric Range		Electric Range		
					Normal	Long	Normal	Long	Normal	Long	Normal	Long	
2026	2027	Class 2b-3	Gasoline	$50,854	$66,467	$70,052	$19,940	$21,016	$15,613	$19,198	$7,500	$7,500	$9,604,786
			Diesel	$56,505	$66,467	$70,052	$19,940	$21,016	$9,962	$13,547	$7,500	$7,500	$12,731,925
		Class 4-5	Diesel	$62,155	$79,579	$88,901	$23,874	$26,670	$17,423	$26,745	$17,423	$26,670	$8,334,247
		Class 6-7	Diesel	$96,058	$115,570	$129,912	$34,671	$38,974	$19,511	$33,854	$19,511	$33,854	$10,956,206
		Class 8	Diesel	$135,612	$155,228	$172,438	$46,568	$51,731	$19,616	$36,826	$19,616	$36,826	$1,669,981
		Class 7-8 Tractors	Diesel	$146,913	$197,590	$219,214	$59,277	$65,764	$50,678	$72,302	$40,000	$40,000	$10,784,893
		Total CY 2026 (MY 2027)											**$54,082,038**
2027	2028	Class 2b-3	Gasoline	$51,668	$65,546	$68,865	$19,664	$20,659	$13,878	$17,197	$7,500	$7,500	$12,948,668
			Diesel	$57,409	$65,546	$68,865	$19,664	$20,659	$8,137	$11,456	$7,500	$7,500	$17,164,514
		Class 4-5	Diesel	$63,150	$77,871	$86,500	$23,361	$25,950	$14,721	$23,350	$14,721	$23,350	$10,739,635
		Class 6-7	Diesel	$97,595	$113,169	$126,444	$33,951	$37,933	$15,574	$28,849	$15,574	$28,849	$13,337,752
		Class 8	Diesel	$137,781	$152,333	$168,264	$45,700	$50,479	$14,552	$30,482	$14,552	$30,482	$1,899,948
		Class 7-8 Tractors	Diesel	$149,263	$192,740	$214,435	$57,822	$64,331	$43,477	$65,172	$40,000	$40,000	$14,614,892
		Total CY 2027 (MY 2028)											**$70,705,410**
2028	2029	Class 2b-3	Gasoline	$52,495	$64,690	$67,772	$19,407	$20,332	$12,196	$15,277	$7,500	$7,500	$16,361,665
			Diesel	$58,327	$64,690	$67,772	$19,407	$20,332	$6,363	$9,445	$6,363	$7,500	$20,537,734
		Class 4-5	Diesel	$64,160	$76,322	$84,335	$22,897	$25,300	$12,162	$20,175	$12,162	$20,175	$12,030,275
		Class 6-7	Diesel	$99,157	$111,004	$123,331	$33,301	$36,999	$11,847	$24,175	$11,847	$24,175	$13,757,091
		Class 8	Diesel	$139,986	$149,724	$164,516	$44,917	$49,355	$9,738	$24,530	$9,738	$24,530	$1,730,935
		Class 7-8 Tractors	Diesel	$151,651	$188,364	$209,667	$56,509	$62,900	$36,713	$58,016	$36,713	$40,000	$18,580,878
		Total CY 2028 (MY 2029)											**$82,998,579**

CY	MY	Vehicle Group	Baseline (ICE) Vehicle Price [a]		ZEV Price Forecast [b]		30% of ZEV Tax Basis		Incremental Cost (ZEV – ICE)		Tax Credit per Vehicle (2021$) [c]		Total Tax Credits (2021$)
					Electric Range		Electric Range		Electric Range		Electric Range		
					Normal	Long	Normal	Long	Normal	Long	Normal	Long	
2029	2030	Class 2b-3	Gasoline	$53,335	$63,835	$66,679	$19,150	$20,004	$10,500	$13,345	$7,500	$7,500	$19,841,785
			Diesel	$59,261	$63,835	$66,679	$19,150	$20,004	$4,574	$7,419	$4,574	$7,419	$22,525,215
		Class 4-5	Diesel	$65,187	$74,775	$82,171	$22,433	$24,651	$9,588	$16,984	$9,588	$16,984	$12,053,060
		Class 6-7	Diesel	$100,743	$108,840	$120,219	$32,652	$36,066	$8,097	$19,476	$8,097	$19,476	$11,949,019
		Class 8	Diesel	$142,226	$147,114	$160,768	$44,134	$48,230	$4,888	$18,543	$4,888	$18,543	$1,107,457
		Class 7-8 Tractors	Diesel	$154,078	$183,988	$204,900	$55,196	$61,470	$29,910	$50,822	$29,910	$40,000	$22,736,861
		Total CY 2029 (MY 2030)											**$90,213,397**
2030	2031	Class 2b-3	Gasoline	$54,188	$63,835	$66,679	$19,150	$20,004	$9,647	$12,491	$7,500	$7,500	$23,388,331
			Diesel	$60,209	$63,835	$66,679	$19,150	$20,004	$3,626	$6,471	$3,626	$6,471	$22,631,897
		Class 4-5	Diesel	$66,230	$74,775	$82,171	$22,433	$24,651	$8,545	$15,942	$8,545	$15,942	$12,001,290
		Class 6-7	Diesel	$102,355	$108,840	$120,219	$32,652	$36,066	$6,485	$17,864	$6,485	$17,864	$10,692,357
		Class 8	Diesel	$144,501	$147,114	$160,768	$44,134	$48,230	$2,612	$16,267	$2,612	$16,267	$663,359
		Class 7-8 Tractors	Diesel	$156,543	$183,988	$204,900	$55,196	$61,470	$27,445	$48,357	$27,445	$40,000	$26,952,276
		Total CY 2030 (MY 2031)											**$96,329,510**
2031	2032	Class 2b-3	Gasoline	$55,055	$63,835	$66,679	$19,150	$20,004	$8,780	$11,624	$7,500	$7,500	$26,998,845
			Diesel	$61,172	$63,835	$66,679	$19,150	$20,004	$2,662	$5,507	$2,662	$5,507	$21,528,677
		Class 4-5	Diesel	$67,289	$74,775	$82,171	$22,433	$24,651	$7,486	$14,882	$7,486	$14,882	$17,567,438
		Class 6-7	Diesel	$103,993	$108,840	$120,219	$32,652	$36,066	$4,848	$16,227	$4,848	$16,227	$19,430,336
		Class 8	Diesel	$146,813	$147,114	$160,768	$44,134	$48,230	$300	$13,955	$300	$13,955	$2,028,042
		Class 7-8 Tractors	Diesel	$159,048	$183,988	$204,900	$55,196	$61,470	$24,941	$45,852	$24,941	$40,000	$31,596,471
		Total CY 2031 (MY 2032)											**$119,149,809**

CY	MY	Vehicle Group	Baseline (ICE) Vehicle Price [a]		ZEV Price Forecast [b]		30% of ZEV Tax Basis		Incremental Cost (ZEV – ICE)		Tax Credit per Vehicle (2021$) [c]		Total Tax Credits (2021$)
					Electric Range		Electric Range		Electric Range		Electric Range		
					Normal	Long	Normal	Long	Normal	Long	Normal	Long	
2032	2033	Class 2b-3	Gasoline	$55,936	$63,835	$66,679	$19,150	$20,004	$7,899	$10,744	$7,500	$7,500	$30,669,978
			Diesel	$62,151	$63,835	$66,679	$19,150	$20,004	$1,684	$4,528	$1,684	$4,528	$19,150,432
		Class 4-5	Diesel	$68,366	$74,775	$82,171	$22,433	$24,651	$6,409	$13,805	$6,409	$13,805	$17,530,386
		Class 6-7	Diesel	$105,657	$108,840	$120,219	$32,652	$36,066	$3,184	$14,563	$3,184	$14,563	$18,066,900
		Class 8	Diesel	$149,162	$147,114	$160,768	$44,134	$48,230	-$2,049	$11,606	$0	$11,606	$1,825,273
		Class 7-8 Tractors	Diesel	$161,593	$183,988	$204,900	$55,196	$61,470	$22,396	$43,308	$22,396	$40,000	$32,218,943
		Total CY 2032 (MY 2033)											**$119,461,913**
Cumulative Infrastructure Tax Credits for Calendar Years 2026-2032 (Model Years 2027-2033)													**$632,940,654**

[a] Baseline vehicle prices from Table IX-6 of the CARB Initial Statement of Reasons. Price adjusted by 1.61% per year based price data from the US Bureau of Labor Statistics..

[b] ZEV prices obtained from Table IX-7 of the CARB Initial Statement of Reasons.

[c] The tax credit was determined using information from the credit and deductions sections of the Inflation Reduction Act of 2022. The eligible tax credit for a vehicle is based on the lesser of 30% of the tax basis of the vehicle, or the incremental cost between an ICE and ZEV vehicle. The maximum credit is limited to $7,500 for qualified vehicles with a GVWR of 14,000 pounds or less and $40,000 for all other vehicles.

Infrastructure Tax Credits

The IRA also includes tax credits for fueling equipment, which includes electricity, that is installed before December 31, 2032. This equipment is eligible for a tax credit of 30% of the cost, not to exceed $100,000. While the CARB analysis did not include the potential credits from the IRA, it did provide the infrastructure counts for new charging stations. The infrastructure counts from the CARB analysis were multiplied by the VMT scaling factor of 0.36 to estimate the infrastructure counts for EVSE in North Carolina. The charger and infrastructure costs from the CARB analysis, as shown in Table 12, were used to determine the potential tax credit for each of the vehicle groups. A summary of the potential EVSE tax credit per charger needed for each of the vehicle groups is presented in Table 15.

Table 15: Summary of IRA EVSE Tax Credits for Vehicle Groups

Vehicle Group	*Total Charger/Infrastructure Cost (2021$)*[a]	*Potential IRA Tax Credit (2021$)*
Class 2b-3	$26,939	$8,082
Class 4-5	$26,939	$8,082
Class 6-7	$56,571	$16,971
Class 8	$113,142	$33,943
Class 7-8 Tractor	$113,142	$33,943

[a] Values from Table 12 were converted from 2018$ to 2021$ using the National Income and Product Accounts Tables, Table 1.1.9, Implicit Price Deflators for Gross Domestic Product from the US Department of Commerce, Bureau of Economic Analysis.

The potential EVSE tax credits in Table 15 were then multiplied by the estimated infrastructure counts needed in North Carolina for each of the vehicle groups. A summary of the infrastructure counts and the total potential tax credits is provided in Table 16.

Table 16: Summary of Infrastructure Counts and Potential Tax Credit by Vehicle Group

Vehicle Type	*Counts And Total Tax Credits (million 2021$)*	*Calendar Year*						
		2026	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*
		Model Year						
		2027	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*
Class 2b-3	Infrastructure Count	1,966	2,960	3,975	5,002	6,036	7,072	8,106
	Potential Tax Credit	$15.9	$23.9	$32.1	$40.4	$48.8	$57.2	$65.5
Class 4-5	Infrastructure Count	303	481	738	1,000	1,272	1,418	1,572
	Potential Tax Credit	$2.5	$3.9	$6.0	$8.1	$10.3	$11.5	$12.7
Class 6-7	Infrastructure Count	356	564	866	1,174	1,493	1,665	1,845
	Potential Tax Credit	$6.0	$9.6	$14.7	$19.9	$25.3	$28.3	$31.3
Class 8	Infrastructure Count	54	85	131	178	227	254	285
	Potential Tax Credit	$1.8	$2.9	$4.4	$6.0	$7.7	$8.6	$9.7
Class 7-8 Tractor	Infrastructure Count	177	270	364	460	560	655	762
	Potential Tax Credit	$6.0	$9.2	$12.4	$15.6	$19.0	$22.2	$25.9
Total Annual Potential Tax Credit (Million 2021$)		**$32.2**	**$49.4**	**$69.6**	**$90.1**	**$111.1**	**$127.7**	**$145.0**

As shown, the potential EVSE tax credits range from $32.2 million in 2026 to $145.0 million in 2032. These tax credits would cover roughly 30% of the EVSE costs for North Carolina businesses. Note that upon comparison of the EVSE installation and infrastructure costs in Table 12 and the estimated IRA infrastructure tax credits in Table 16, it may appear that the tax credits exceed the cost of the infrastructure during calendar years 2026 through 2029. This is because the EVSE installation and infrastructure costs shown in Table 12 are amortized costs at 5% interest using a 20-year equipment life, while the tax credits would be accrued in the year that the equipment was installed.

4. North Carolina State Government

The analysis of State Government impacts includes an estimate of staff time to implement and evaluate compliance with the proposed ACT Rules and an estimate of the share of manufacturer and business costs and savings that would impact MHD fleets owned and operated by State government.

DAQ Staffing and Resources

The CARB analysis included costs for CARB staffing and resources to set up the reporting systems, assisting stakeholders with inquiries, data analysis and auditing of information submitted by manufacturers and fleets, supporting ACT enforcement actions, and other general implementation duties. A summary of these costs in the CARB analysis for State Government is provided in Appendix B, Table B-4. For estimating costs for North Carolina, the DAQ used the CARB analysis values and applied the VMT scaling factor of 0.36 from Table 3 to the applicable impacts. Each of the State Government cost impacts is outlined in this section.

For staffing and resources, the DAQ estimated 160 hours per year for an Engineer II and 32 hours per year for an Engineering Supervisor. Annual salary costs were calculated using the total compensation calculator[24] from the North Carolina Office of State Human Resources (OSHR) with the midpoint of the salary schedules[25] for the Engineer II position (NC18) assuming 10 years of service and for the Engineering Supervisor position (NC21) assuming 15 years of state service. Hourly costs were estimated to be $60.52 for the Engineer II and $72.08 for the Engineering Supervisor. The DAQ estimated the total cost of monitoring compliance with the proposed ACT Rules to be $11,990. This analysis assumes that this monitoring will be completed by existing staff within the existing budget. No additional expenses were included for the development of compliance reporting systems as North Carolina plans to utilize the system already developed by California.

State Fleet Cost Pass-Through

The CARB's ACT analysis recognized that a portion (about 2.1%) of the MHD truck fleet is owned and operated by state government entities and passed a proportional amount of the estimated manufacturer and business costs and savings through to State government (termed "pass-through" costs). The CARB estimated this makeup of the truck fleet based on information from manufacturers and the California Department of General Services. To determine the makeup of North Carolina's truck fleet, the DAQ collected MHD truck data from the North Carolina Department of Transportation (NCDOT), North Carolina Department of Administration (NCDOA), North Carolina Department of Agriculture & Consumer Services (NCDA&CS). Based on the 2022 registration data collected, the DAQ estimated 1% of the state's MHD fleet is owned and operated by State government entities. Therefore, the state government "pass-through" costs in this analysis were calculated as 1% of the estimated North Carolina costs and savings to manufacturers (Table 6) and businesses (Table 12). Additionally, the estimated IRA tax credits represented in Subsection V.B.3 (Table 14 and Table 16) were passed through to the State in this value and contribute to the net savings shown in Table 17 during the earlier years.

[24] NC Office of State Human Resources, Total Compensation Calculator. https://oshr.nc.gov/state-employee-resources/classification-compensation/total-compensation-calculator

[25] NC Office of State Human Resources, Compensation, Salary Schedule NC. https://oshr.nc.gov/state-employee-resources/classification-compensation/compensation

Summary of State Government Costs and Savings

A summary of the estimated impacts to North Carolina State government is provided in Table 17.

Table 17: Summary of Estimated Net Fiscal Impacts on North Carolina State Government

Calendar Year	Model Year	State Government Costs (+) and Savings (-) (million 2021$)		Total Net Fiscal Impact
		DAQ Staffing and Resources	State Fleet Cost Pass-Through [a]	
2026	2027	$0.01	-$0.2	-$0.2
2027	2028	$0.01	-$0.2	-$0.1
2028	2029	$0.01	-$0.3	-$0.3
2029	2030	$0.01	-$0.5	-$0.5
2030	2031	$0.01	-$0.7	-$0.7
2031	2032	$0.01	-$0.7	-$0.7
2032	2033	$0.01	-$0.8	-$0.8
2033	2034	$0.01	$2.0	$2.0
2034	2035	$0.01	$2.1	$2.1
2035	2036	$0.01	$1.9	$2.0
2036	2037	$0.01	$2.0	$2.0
2037	2038	$0.01	$2.0	$2.0
2038	2039	$0.01	$1.9	$2.0
2039	2040	$0.01	$2.0	$2.0
2040	2041	$0.01	$1.9	$2.0
2041	2042	$0.01	$2.0	$2.0
2042	2043	$0.01	$2.0	$2.0
2043	2044	$0.01	$1.9	$2.0
2044	2045	$0.01	$1.9	$1.9
2045	2046	$0.01	$1.8	$1.8
2046	2047	$0.01	$1.4	$1.4
2047	2048	$0.01	$1.1	$1.1
2048	2049	$0.01	$0.8	$0.8
2049	2050	$0.01	-$0.2	-$0.2
Total		**$0.28**	**$25.4**	**$25.7**

[a] The State Fleet Pass-Through Costs are duplicative of a portion of the costs and savings already quantified in Subsections V.B.1, V.B.2, and V.B.3. To avoid double-counting these costs, the total State Government impacts represented in Table 17 should not be added to the total impacts represented in Table 6, Table 12, Table 14, and Table 15.

5. North Carolina Local Governments

This analysis for North Carolina's proposed ACT Rules includes an estimate of the fleet pass-through cost to local governments similar to that described for state government above.

Local Fleet Cost Pass-Through

Similar to that for State Government fleets, the CARB analysis passed 2.9% of the manufacturer and business costs through to local governments. This value was determined by CARB to be the

portion of California's fleet owned by local government entities, based on information from manufacturers and the California Department of General Services. North Carolina's analysis in this fiscal note uses the same approach, except estimating that 3.7% of North Carolina's MHD truck fleet is owned by local government entities. This percentage was based on an estimated 18,819 school buses owned by the Department of Public Instruction (DPI), and an assumption of 2 service vehicles for each of the 115 school districts in the State, resulting in an estimated 19,049, or approximately 3.7% of the total MHD vehicles registered in North Carolina at the end of calendar year 2022. Therefore, 3.7% of the estimated costs to manufacturers (Table 6) and businesses (Table 12) were passed through to local governments, to represent the portion of the MHD fleet owned by these entities. Additionally, the potential IRA tax credits represented in Subsection V.B.3 (Table 14 and Table 16) were passed through to local government fleets in this value. Note that the DAQ was unable to collect information directly from local governments on other MHD vehicles they may own or operate within the time frame for completing this analysis. Therefore, these estimates may be underestimated because they do not include other types of MHD vehicles (e.g., garbage trucks or street sweepers) that may be owned and operated by some local governments.

Summary of Local Government Costs and Savings

Table 18 below shows a summary of the estimated costs and savings to local governments in North Carolina, as outlined in this subsection.

Table 18: Summary of Estimated Net Fiscal Impacts on North Carolina Local Governments

Calendar Year	Model Year	North Carolina Local Government Costs (+) and Savings (-) (million 2021$)	
		Local Government Fleet Cost Pass-Through [a]	Total Fiscal Impact
2026	2027	-$0.6	-$0.6
2027	2028	-$0.6	-$0.6
2028	2029	-$1.1	-$1.1
2029	2030	-$1.9	-$1.9
2030	2031	-$2.6	-$2.6
2031	2032	-$2.6	-$2.6
2032	2033	-$2.9	-$2.9
2033	2034	$7.4	$7.4
2034	2035	$7.8	$7.8
2035	2036	$7.2	$7.2
2036	2037	$7.4	$7.4
2037	2038	$7.3	$7.3
2038	2039	$7.2	$7.2
2039	2040	$7.3	$7.3
2040	2041	$7.2	$7.2
2041	2042	$7.5	$7.5
2042	2043	$7.5	$7.5
2043	2044	$7.2	$7.2
2044	2045	$7.0	$7.0
2045	2046	$6.7	$6.7
2046	2047	$5.2	$5.2
2047	2048	$4.2	$4.2
2048	2049	$2.9	$2.9
2049	2050	-$0.7	-$0.7
Total		**$94.1**	**$94.1**

[a] The Local Government Fleet Pass-Through Costs are duplicative of a portion of the costs and savings already quantified in Subsections V.B.1, V.B.2, and V.B.3. To avoid double-counting these costs, the total Local Government impacts represented in Table 18 should not be added to the total impacts represented in Table 6, Table 12, Table 14, and Table 15.

C. Estimated Revenue Impacts

This section discusses the potential impacts of the proposed ACT Rules on state and local government tax revenue streams. Specifically, estimates were developed to evaluate the potential loss to the state in fuel tax revenue and increases in electricity and sales tax revenues. Note that there is considerable uncertainty associated with these estimated impacts on fuel tax revenues as discussed in Section VII.D of this fiscal note. Estimates were also developed to evaluate the potential increase in

electricity tax revenue for local governments. It is important to note that these revenue streams represent transfers of funds from a loss or gain to the state to a loss or gain for businesses. Consistent with previous fiscal analyses of proposed rules, these estimates have not been included in the overall benefit/cost estimates. However, the estimates are presented here for awareness and to further the discussion of how best to address the potential impacts of the proposed Rules on state and local government tax revenues.

1. State Government

Fuel Tax Revenue

Loss of revenue from the collection of fuel taxes was calculated using the fuel saved from avoided ICE vehicles estimated in Table 7. These estimations of gasoline and diesel fuel saved were multiplied by the fuel sales tax projections from the DOT and OSBM to calculate the loss of fuel tax revenue from the avoided gasoline and diesel usage. The DOT-OSBM projected the fuel sales tax to be 39.3 cents per gallon in 2023 and increase to 45.1 cents per gallon in 2034. A linear regression of this data was used to estimate the sales tax for the years 2035 to 2049 for this analysis. Using this approach, the fuel sales tax is projected to be 45.9 cents per gallon in 2035 and increase to 54.0 cents per gallon in 2050. A summary of the fuel tax projections used in this analysis are shown in Table 19.

Table 19: Summary of Fuel Tax Projections Used to Estimate Lost Fuel Tax Revenue

Calendar Year	Fuel Tax Projection (2021$/gal)	Projection Source
2026	0.410	DOT-OSBM Estimate
2027	0.415	
2028	0.421	
2029	0.429	
2030	0.434	
2031	0.439	
2032	0.444	
2033	0.450	
2034	0.451	
2035	0.459	DAQ Linear Regression Estimate
2036	0.465	
2037	0.470	
2038	0.476	
2039	0.481	
2040	0.486	
2041	0.492	
2042	0.497	
2043	0.502	
2044	0.508	
2045	0.513	
2046	0.519	
2047	0.524	
2048	0.529	
2049	0.535	

The fuel tax projections in Table 19 were then applied to the estimated reductions in gallons of gasoline and diesel purchased due to the proposed ACT Rules. Table 20 below shows the resulting estimation in lost fuel tax revenues to North Carolina State Government.

Table 20: Projected Fuel Tax Revenue Losses to the State

Calendar Year	Model Year	Estimated Reduction in Fuel Purchases (million gallons/year)	Projected Fuel Tax Loss (million 2021$)
2026	2027	7.0	-$2.9
2027	2028	17.4	-$7.2
2028	2029	30.6	-$12.9
2029	2030	46.8	-$20.1
2030	2031	64.8	-$28.1
2031	2032	84.8	-$37.2
2032	2033	106.2	-$47.1
2033	2034	128.9	-$58.0
2034	2035	152.8	-$68.9
2035	2036	175.9	-$80.8
2036	2037	197.8	-$91.9
2037	2038	218.6	-$102.8
2038	2039	238.3	-$113.3
2039	2040	257.0	-$123.6
2040	2041	274.6	-$133.5
2041	2042	291.0	-$143.1
2042	2043	306.3	-$152.3
2043	2044	320.7	-$161.1
2044	2045	334.2	-$169.7
2045	2046	346.9	-$178.0
2046	2047	358.7	-$186.0
2047	2048	369.7	-$193.7
2048	2049	379.9	-$201.1
2049	2050	389.6	-$208.3
Total		**5,098.4**	**-$2,521.6**

Fuel tax revenues are the North Carolina Department of Transportation's (NCDOT) largest funding source and N.C. General Statute §105-449.62 specifies how these revenues shall be used. Fuel tax revenues are deposited into two funds, the Highway Fund (HF) and the Highway Trust Fund (HTF). Fuel tax revenues support 63 percent of maintenance and operations in the HF and 36 percent of capital needs in the HTF.[26] To evaluate the impact of the estimated loss in fuel tax revenue on the total HF and HTF revenues, the DAQ compared the estimated loss in revenue in Table 20 to the total projected revenues of each Fund through 2034.[27]

[26] NC FIRST Commission, The Motor Fuels Tax,August 2020. https://www.ncdot.gov/about-us/how-we-operate/finance-budget/nc-first/Documents/nc-first-brief-edition-1.pdf

[27] May 2023 DOT-OSBM 10-Year Revenue Forecast Estimates. Projections were obtained for State Fiscal Year (SFY) 2023 – 2034. Values were provided in nominal dollars and converted to 2021 dollars using an assumption of 2.5% increase in the Implicit Price Deflator (IPD) per year.

Table 21: Comparison of Estimated Loss in State Fuel Tax Revenue with DOT Revenue Projections

Year	OSBM Projections				Estimated Loss in Fuel Tax Revenue due to ACT Rules (million 2021$)	% lost revenue (Loss in Fuel Tax/ Total Projected NCDOT Revenue)
	Motor Fuels Taxes (million nominal $)		Total NCDOT Revenue (HF + HTF)			
	HF	HTF	million nominal $	million 2021$		
2026	$1,773.5	$598.1	$5,642.1	$4,776.9	$2.86	0.06%
2027	$1,776.5	$599.1	$5,687.3	$4,697.7	$7.21	0.15%
2028	$1,783.6	$601.6	$5,748.4	$4,632.3	$12.90	0.28%
2029	$1,807.5	$609.6	$5,932.5	$4,664.1	$20.06	0.43%
2030	$1,817.0	$612.8	$6,015.2	$4,613.7	$28.14	0.61%
2031	$1,826.2	$615.9	$6,112.8	$4,574.2	$37.24	0.81%
2032	$1,838.8	$620.2	$6,192.4	$4,520.8	$47.14	1.04%
2033	$1,855.4	$625.8	$6,417.3	$4,570.7	$58.01	1.27%
2034	$1,853.6	$625.2	$6,512.2	$4,525.1	$68.92	1.52%

As shown above, the estimated loss in annual State fuel tax revenue is expected to represent approximately 0.06% to 1.52% of the projected NCDOT HF and HTF revenues through 2034. Additionally, it is important to note that the projected Motor Fuels Tax Revenues appear relatively flat, rather than increasing as they have in the past. Largely, this is due to IRA tax incentives for EVs and federal regulations that set more stringent fuel economy standards for MYs 2024-2026 Passenger Cars and Light Trucks.[28] To the extent these assumptions incorporate increased adoption of MHD ZEVs (as opposed to only light-duty EVs), some of the estimated fuel tax losses due to ACT may be already captured in these DOT-OSBM projections.

While this fiscal analysis does not attempt to analyze or recommend strategies to replace the loss in Motor Fuels Tax revenue which also can been recognized as a tax benefit to the consumer, the future of this funding stream for state government has been a topic of discussion and analysis in recent years. Additionally, while the outcomes of the various analyses of the fuel tax revenue do not necessarily converge to a uniform solution, the attention paid to this topic highlights the potential for future revenue replacement plans for the State's Motor Fuels Tax. Further discussion of this uncertainty and the recent analyses is provided in Subsection VII.C.

Electricity Tax Revenue

The CARB analysis for State impacts included revenue from an Energy Resources Fee. North Carolina does not have an Energy Resources Fee but does collect taxes of 7% from the sale of electricity. This 7% Combined Rate is comprised of the 4.75% State Rate and either 2% or 2.25% local rates, depending on the county. To estimate the amount of taxes received from the sale of electricity to charge electric ZEVs, the DAQ used the estimates of electricity used for ZEVs in Table 7. These estimates were then multiplied by 4.75% to estimate the amount of state electricity

[28] Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks, effective July 1, 2022 (87 FR 25710, May 2, 2022).

tax revenue and 2.25% to estimate the local government electricity tax revenue. The local portion of the 7% Combined Rate is addressed in Subsection V.B.5 of this fiscal note.

Sales Tax Revenue

The tax collected from the sale of MHD ZEVs was estimated using the CARB analysis value and applying the VMT scaling factor of 0.36 from Table 3. An additional sales factor of 0.41 was applied to account for the difference in sales tax on vehicles between California, which collects 7.25%, and North Carolina, which applies a 3% tax.

Summary of State Government Revenue Impacts

Table 22 below summarizes the estimated revenue impacts to North Carolina State Government from gasoline and diesel fuel taxes, electricity taxes, and state sales taxes.

Table 22: Summary of Revenue Impacts on North Carolina State Government

Calendar Year	Model Year	North Carolina State Government Revenue Impacts (million 2021$)			
		State Gasoline and Diesel Fuel Taxes (Lost Revenue)	Electricity Taxes (Increased Revenue)	State Sales Taxes (Increased Revenue)	Total Net Revenue Impact
2026	2027	$2.9	-$0.5	-$1.4	$1.0
2027	2028	$7.2	-$1.1	-$1.9	$4.2
2028	2029	$12.9	-$2.0	-$2.3	$8.6
2029	2030	$20.1	-$3.0	-$2.6	$14.5
2030	2031	$28.1	-$4.1	-$3.1	$21.0
2031	2032	$37.2	-$5.3	-$3.8	$28.1
2032	2033	$47.1	-$6.6	-$4.2	$36.3
2033	2034	$58.0	-$8.1	-$4.7	$45.2
2034	2035	$68.9	-$9.7	-$5.1	$54.1
2035	2036	$80.8	-$11.0	-$5.1	$64.7
2036	2037	$91.9	-$12.4	-$5.2	$74.4
2037	2038	$102.8	-$13.7	-$5.2	$83.9
2038	2039	$113.3	-$14.9	-$5.2	$93.2
2039	2040	$123.6	-$16.3	-$5.3	$102.0
2040	2041	$133.5	-$17.3	-$5.3	$110.9
2041	2042	$143.1	-$18.1	-$5.4	$119.6
2042	2043	$152.3	-$19.0	-$5.4	$127.9
2043	2044	$161.1	-$19.7	-$5.4	$136.0
2044	2045	$169.7	-$20.4	-$5.5	$143.8
2045	2046	$178.0	-$21.1	-$5.5	$151.3
2046	2047	$186.0	-$21.4	-$5.6	$159.0
2047	2048	$193.7	-$21.7	-$5.6	$166.4
2048	2049	$201.1	-$22.0	-$5.6	$173.4
2049	2050	$208.3	-$22.3	-$4.9	$181.1
Total		**$2,522**	**-$311.7**	**-$109.4**	**$2,100.5**

2. Local Governments

Electricity Tax Revenue

As stated in Subsection V.B.4, North Carolina electricity sales are subject to a 7% combined tax rate, of which 2% or 2.25% is imposed by the local government, dependent upon county. For the purposes of estimated the revenue to local governments from taxes on increased electricity sales due to ZEV charging, the DAQ applied the same methodology described for estimating the State-portion of utility tax revenues, except applying a 2.25% tax rate instead of the 4.75% State Rate.

Table 23: Revenue Impacts to Local Governments

Calendar Year	Model Year	Local Government Revenue Impacts Electricity Taxes (Increased Revenue)
2026	2027	-$0.2
2027	2028	-$0.5
2028	2029	-$0.9
2029	2030	-$1.4
2030	2031	-$1.9
2031	2032	-$2.5
2032	2033	-$3.1
2033	2034	-$3.8
2034	2035	-$4.6
2035	2036	-$5.2
2036	2037	-$5.9
2037	2038	-$6.5
2038	2039	-$7.1
2039	2040	-$7.7
2040	2041	-$8.2
2041	2042	-$8.6
2042	2043	-$9.0
2043	2044	-$9.3
2044	2045	-$9.7
2045	2046	-$10.0
2046	2047	-$10.1
2047	2048	-$10.3
2048	2049	-$10.4
2049	2050	-$10.6
Total		**-$147.6**

VI. Public Health and Environmental Impacts

The proposed ACT Rules would reduce emissions of CO_2, NOx and $PM_{2.5}$, resulting in environmental and public health benefits, especially for those living in communities disproportionately impacted by truck and freight emissions. These benefits include climate benefits from CO_2 reductions, and reduced mortality, hospital and emergency visits, respiratory symptoms, and fewer work loss days due to

improved health outcomes from NOx and $PM_{2.5}$ emission reductions. Subsection VI.A estimates the avoided climate damages from CO_2 emission reductions, using the Social Cost of Carbon ($SC\text{-}CO_2$). Subsection VI.B estimates the health benefits from NOx and $PM_{2.5}$ emission reductions, using the EPA's CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool.

A. Benefits from CO_2 Emission Reductions

Monetized benefits of GHG reductions are estimated using the $SC\text{-}CO_2$, which includes avoided costs as a result of mitigated climate change. Federal agencies use the $SC\text{-}CO_2$ to monetize the costs of a policy or action. The $SC\text{-}CO_2$ is the monetary value of the impacts associated with adding one ton of CO_2 into the atmosphere in a given year. These impacts include, but are not limited to, changes in net agricultural productivity, human health effects, property damage from increased flood natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystems.

The latest values for $SC\text{-}CO_2$ are the Interagency Working Group (IWG) interim values, which estimate global $SC\text{-}CO_2$ calculated at a range of discount rates.[29] The $SC\text{-}CO_2$ estimates presented below are inflation-adjusted and reported in 2021 dollars but are otherwise identical to the global $SC\text{-}CO_2$ values in the 2016 and current interim Technical Support Document.[30]

The CO_2 emission reductions in North Carolina were estimated using the well-to-wheel GHG reductions from the CARB analysis and applying the VMT scaling factor of 0.36 from Table 3. The CARB analysis provided CO_2 emission reduction estimates for calendar years 2020 through 2040. For calendar years 2041-2049, the North Carolina CO_2 emission reductions were estimated using the slope and intercept of the 2035-2040 North Carolina CO_2 emission reduction estimates. The slope of only 2035-2040 was chosen to represent the continued emission reductions beyond 2040 because the ACT ZEV sales requirements increase annually through MY 2035, after which the percentage of required ZEV sales remains constant. Therefore, the 2035-2040 slope was determined to be more representative of 2041-2049 reductions than the slope of 2026-2034, during which the sales requirements change annually. The CARB analysis provided the GHG emissions in carbon dioxide equivalents (CO_2e), which is used to measure and compare emissions from various individual GHGs based on how severely they contribute to global warming. Metrics for CO_2e would show how much a particular gas would contribute to global warming if it were CO_2. The DAQ was unable to separate the CO_2e values into the various GHG components and assumed that the CARB analysis CO_2e emissions were CO_2. Using this assumption would likely represent an upper bound of the potential CO_2 reductions associated with the proposed ACT Rules. Table 24 provides a summary of the GHG

[29] U.S. Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under Executive Order 13930. February 2021. This document also provides background on the $SC\text{-}CO_2$ history and estimation methodology. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf?ftag=MSF0951a18

[30] As noted by the IWG, global estimates recognize the diverse ways that state and national interests, businesses, and residents may be impacted by climate change beyond borders. See more discussion in the Technical Support Document pg. 14-16.

emission reductions from the CARB analysis and the estimated North Carolina CO_2 emission reductions from the proposed ACT Rules.

Table 24: Summary of CARB Analysis of GHG Emissions, Estimated North Carolina

Calendar Year	CARB Analysis			NC Analysis		
	Emission Estimates (MMT CO_2e/yr)			Emission Estimates (MMT CO_2e/yr)	Benefit Using SC-CO_2 (Million 2021$)	
	Baseline	Proposed Modifications	Reductions	Reductions	7% Discount Rate	3% Discount Rate
2026	44.77	44.77	0.00	0.00	$0.00	$0.00
2027	44.41	44.40	0.01	0.00	$0.03	$0.22
2028	43.93	43.88	0.05	0.02	$0.14	$1.12
2029	43.39	43.23	0.16	0.06	$0.45	$3.65
2030	43.04	42.73	0.31	0.11	$0.91	$7.20
2031	42.68	42.18	0.50	0.18	$1.54	$11.83
2032	42.41	41.68	0.73	0.26	$2.36	$17.58
2033	42.18	41.22	0.96	0.35	$3.24	$23.54
2034	41.99	40.76	1.23	0.44	$4.34	$30.69
2035	41.86	40.33	1.53	0.55	$5.63	$38.83
2036	41.80	39.99	1.81	0.65	$6.93	$46.71
2037	41.77	39.68	2.09	0.75	$8.31	$54.84
2038	41.79	39.42	2.37	0.85	$9.78	$63.21
2039	41.84	39.22	2.62	0.94	$11.21	$71.00
2040	41.94	39.07	2.87	1.03	$12.71	$79.01
2041	No CARB CO_2 estimates for 2041-2049			1.16	$14.75	$90.00
2042				1.26	$16.52	$99.02
2043				1.35	$18.38	$108.27
2044				1.45	$20.31	$117.76
2045				1.55	$22.33	$127.47
2046				1.64	$24.44	$137.42
2047				1.74	$26.62	$147.60
2048				1.84	$28.89	$158.01
2049				1.93	$31.24	$168.66
Total CY 2026-2049				**20.12**	**$271.1**	**$1,603.6**

As shown in Table 24, the SC-CO_2 benefits from 2026-2049 were estimated to be $271 million at a 7% discount rate and $1,604 million at a 3% discount rate. This SC-CO_2 analysis illustrates that the choice of discount rate is significant over long-time horizons and represents a significant area of uncertainty in this analysis. The IWG is working to update the SC-CO_2 values based on latest scientific and economic understanding of physical, ecological, and economic impacts of climate change as well as appropriate discounting approaches. The IWG's consensus is that the interim SC-

CO_2 values at 3% likely underestimates the avoided societal damages from reduced CO_2 emissions. See more discussion in the Technical Support Document.[31]

B. Health Benefits from NOx and $PM_{2.5}$ Reductions

NO_X are a mixture of gases composed of nitrogen and oxygen, most notably nitrogen oxide (NO) and nitrogen dioxide (NO_2). Low levels of NO_X exposure can irritate the eyes, nose, throat, and lungs, possibly causing a person to experience shortness of breath, tiredness, and nausea. Breathing high levels of NO_X can cause rapid burning, spasms, and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of body tissues, a build-up of fluid in the lungs, and death. People with asthma, as well as children and the elderly are generally at greater risk from the health effects of NO_X. NO_X is also a highly reactive gas that interacts with water, oxygen, and other chemicals in the atmosphere to form acid rain. NO_X also reacts with volatile organic compounds and sunlight to form ground-level ozone which can trap heat and particulates to form smog. Nitrates from NO_X emissions also make the air hazy and difficult to see through.

Exposure to $PM_{2.5}$ can affect health by getting deep into the lungs and bloodstream causing premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing. People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure. $PM_{2.5}$ is also the main cause of reduced visibility in national and state parks in North Carolina.

Using the NOx and $PM_{2.5}$ emission reductions from the CARB analysis, the emission reductions of these pollutants in North Carolina were estimated by applying the VMT scaling factor of 0.36 from Table 3. The CARB analysis provided NOx and $PM_{2.5}$ emission reduction estimates for calendar years 2020 through 2040. For calendar years 2041-2049, the North Carolina NOx and $PM_{2.5}$ emission reductions were estimated using the slope and intercept of the 2035-2040 North Carolina NOx and $PM_{2.5}$ emission reduction estimates, respectively. The slope of only 2035-2040 was chosen to represent the continued emission reductions beyond 2040 because the ACT ZEV sales requirements increase annually through MY 2035, after which the percentage of required ZEV sales remains constant. Therefore, the 2035-2040 slope was determined to be more representative of 2041-2049 reductions than the slope of 2026-2034, during which the sales requirements change annually. Table 25 and Table 26 show the estimated tank-to-wheel NOx and $PM_{2.5}$ emissions in North Carolina, respectively.[32] The term "tank-to-wheel" emissions generally includes those generated and released during operation of the vehicle.

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[31] U.S. Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under Executive Order 13930. February 2021. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf?ftag=MSF0951a18

[32] See Table B-7 and Table B-8 of Appendix B to this fiscal note, which summarizes the information in Tables 4 and 5 of the California Air Resources Board, Attachment D, Emission Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation Proposed Modifications, California Air Resources Board, February 28, 2020. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/30dayattd.pdf.

Table 25: North Carolina Estimated Tank-to-Wheel NOx Emission Reductions

Calendar Year	North Carolina NOx Emissions (tons/year)									
	Class 2b-3 Trucks			Class 4-8 Trucks			Class 7-8 Tractors			Total Annual NOx Reductions [a]
	Baseline	ACT Rule	Reductions	Baseline	ACT Rule	Reductions	Baseline	ACT Rule	Reductions	
2026	4,498	4,492	6	9,615	9,555	59	8,106	8,071	36	101
2027	4,032	4,023	10	9,712	9,613	99	8,090	8,027	62	171
2028	3,612	3,597	15	9,776	9,618	158	8,052	7,954	99	271
2029	3,240	3,219	22	9,797	9,558	238	8,030	7,884	147	406
2030	2,902	2,873	30	9,831	9,491	341	8,033	7,826	206	576
2031	2,602	2,564	39	9,873	9,414	459	8,045	7,767	278	775
2032	2,344	2,295	49	9,906	9,315	591	8,059	7,699	360	1,000
2033	2,116	2,056	60	9,939	9,202	737	8,081	7,635	446	1,244
2034	1,920	1,846	73	9,961	9,062	899	8,114	7,577	537	1,509
2035	1,739	1,651	87	9,985	8,912	1,073	8,156	7,528	628	1,789
2036	1,581	1,479	102	10,017	8,767	1,250	8,218	7,499	719	2,070
2037	1,434	1,319	115	10,054	8,627	1,427	8,294	7,488	806	2,348
2038	1,308	1,180	128	10,099	8,496	1,603	8,384	7,494	890	2,621
2039	1,194	1,053	141	10,152	8,375	1,777	8,483	7,515	968	2,886
2040	1,098	945	153	10,215	8,267	1,948	8,590	7,549	1,040	3,142
2041	NA	NA	168	NA	NA	2,130	NA	NA	1,130	3,428
2042	NA	NA	181	NA	NA	2,305	NA	NA	1,213	3,699
2043	NA	NA	194	NA	NA	2,480	NA	NA	1,296	3,970
2044	NA	NA	207	NA	NA	2,655	NA	NA	1,378	4,241
2045	NA	NA	220	NA	NA	2,831	NA	NA	1,461	4,512
2046	NA	NA	233	NA	NA	3,006	NA	NA	1,544	4,783
2047	NA	NA	246	NA	NA	3,181	NA	NA	1,626	5,054
2048	NA	NA	260	NA	NA	3,356	NA	NA	1,709	5,325
2049	NA	NA	273	NA	NA	3,532	NA	NA	1,792	5,596
Total			**3,012**			**38,135**			**20,370**	**61,516**

[a] Based on Table B-7 and the 0.36 VMT scaling factor from Table 3.

Table 26: North Carolina Estimated Tank-to-Wheel $PM_{2.5}$ Emission Reductions

Calendar Year	North Carolina $PM_{2.5}$ Emissions (tons/year)									
	Class 2b-3 Trucks			Class 4-8 Trucks			Class 7-8 Tractors			Total Annual $PM_{2.5}$ Reductions [a]
	Baseline	ACT Rule	Reductions	Baseline	ACT Rule	Reductions	Baseline	ACT Rule	Reductions	
2026	212	211	1	273	271	1	145	145	0	3
2027	208	207	1	277	275	2	147	146	1	4
2028	205	203	2	281	278	3	147	146	1	6
2029	202	199	3	284	279	5	148	147	1	9
2030	200	196	4	287	279	8	149	147	2	14
2031	198	194	5	290	279	11	149	147	2	18
2032	197	191	6	293	279	14	150	147	3	23
2033	196	189	6	297	279	17	151	148	3	27
2034	195	188	7	300	280	20	153	149	4	31
2035	194	186	8	302	280	23	154	150	4	35
2036	194	185	9	305	280	25	156	151	5	39
2037	193	184	10	308	280	27	157	152	5	42
2038	193	183	10	310	280	30	159	154	5	46
2039	193	182	11	313	281	32	161	156	5	49
2040	193	182	11	316	282	34	163	157	6	51
2041	NA	NA	12	NA	NA	37	NA	NA	6	55
2042	NA	NA	13	NA	NA	39	NA	NA	6	58
2043	NA	NA	13	NA	NA	42	NA	NA	7	61
2044	NA	NA	14	NA	NA	44	NA	NA	7	65
2045	NA	NA	14	NA	NA	46	NA	NA	7	68
2046	NA	NA	15	NA	NA	49	NA	NA	8	71
2047	NA	NA	15	NA	NA	51	NA	NA	8	75
2048	NA	NA	16	NA	NA	53	NA	NA	8	78
2049	NA	NA	17	NA	NA	56	NA	NA	9	81
Total			**223**			**670**			**114**	**1,007**

[a] Includes $PM_{2.5}$ emissions from brake wear.

[b] Based on Table B-8 and the VMT scaling factor of 0.36 from Table 3.

The health benefits estimated in this subsection first show those attributable to NOx and $PM_{2.5}$ separately, and then total health benefits from reductions of both pollutants. Using the estimated NOx and $PM_{2.5}$ reductions for North Carolina, the health benefits were estimated using the EPA's COBRA tool. However, there are some limitations with using this model for estimating the health benefits from this proposed rulemaking. The COBRA modeling uses meteorological data collected in 1990, which will affect the dispersion and transport of the pollutants by the model. Emissions included in the COBRA program are based on the EPA's 2016v1 platform and 2016 data from EPA Federal Reference Method (FRM) monitor sites and EPA/National Park Service Visibility Interagency Monitoring of Protected Visual Environments (IMPROVE) program monitor sites. The starting point for the 2016v1 platform is version 2 of the 2014 National Emissions Inventory (2014NEIv2). The 2016v1 platform includes a 2016 baseline emissions inventory that reflects a combination of 2014 and 2016-year emission estimates. The 2016v1 platform also includes projected emission inventories for 2023 and 2028. These inventories reflect projected changes in emissions activity levels and emission rates between 2016 and each forecast year. Projected emission rate changes include the estimated impacts of emission control programs in place at the time that the 2016v1 platform was prepared. Nonetheless, the COBRA tool remains the most appropriate method available to DAQ to perform this type of analysis for the fiscal analysis.

For this analysis, the reference year of 2023 was chosen because it is the closest date to the anticipated effective date of the proposed rules, and to decrease the potential for over- or under-estimation of the emissions inventories, population, incidence, health impact functions, and valuation functions which are based on 2016 values. Without modeling of the potential emission increases from the electric generating units (EGUs) that would experience greater load from the charging of more ZEVs and NZEVs, the COBRA values should be considered approximations of the health benefits from the proposed rules. To establish a baseline scenario against which to evaluate the proposed rules, the COBRA model was first run with the existing 2023 baseline emissions from the North Carolina highway emissions sector, which were listed as 61,155.72 tons of NOx and 2,199.97 tons of $PM_{2.5}$. The COBRA emissions were then adjusted by subtracting the NOx and $PM_{2.5}$ cumulative emission reduction estimates for the proposed rules, as represented in Table 25 and Table 26, respectively, from the North Carolina highway emissions sector 2023 baseline emissions. The baseline emissions were adjusted in this manner, and the COBRA model was run again, for each calendar year from 2026 through 2039. The difference in the annual results from each of these runs provided the health benefit estimates for that year. Table 27 shows the avoided negative health outcome incidences per year due to the estimated emission reductions of NOx and $PM_{2.5}$.

To estimate public health impacts, the COBRA model takes user-supplied inputs of sector-specific changes in emissions of primary fine particulate matter ($PM_{2.5}$) and precursors of secondary $PM_{2.5}$, including nitrogen oxides (NOx), sulfur dioxide (SO_2), ammonia (NH_3), and volatile organic compounds (VOCs); and conducts multiple modeling steps to translate changes in emissions to changes in health effects. First, COBRA uses a simplified air quality model, the Source Receptor (S-R) Matrix, to estimate changes in total annual ambient concentrations of $PM_{2.5}$, including the formation of secondary $PM_{2.5}$ from precursor pollutants. COBRA then uses a series of health impact functions, taken from the peer-reviewed epidemiological literature, to estimate how changes in outdoor air quality result in changes in the incidence of a variety of health outcomes including, premature mortality, heart attacks, asthma exacerbation, and lost workdays. Finally, COBRA

multiplies the change in incidence for each health outcome by a monetary value specific to that outcome to determine the monetized health impacts. The COBRA model provides low and high values for some health outcomes that represent uncertainties in the estimates of the health impacts of changing air quality. For avoided premature mortality, the health benefits are based on two different epidemiological studies of the impacts of $PM_{2.5}$ on mortality in the United States. The "Low" estimate represents results based on an evaluation of mortality impacts of $PM_{2.5}$ by the American Cancer Society.[33] The "High" estimate represents results based on the Harvard Six Cities mortality study.[34] Rather than average the results of these studies, EPA's standard practice has been to report the estimated change in mortality separately as Low and High values. Similarly, Low and High estimates for avoided non-fatal heart attacks are based on epidemiological studies reporting different estimates of the relationship between the risk of this health impact and $PM_{2.5}$. Most other health impacts in COBRA are reported as a single value.

For this fiscal analysis, the method described above was performed at two discount rates: 7%, as required by N.C.G.S. 150B-21.4(b1)(5); and 3%, to demonstrate the sensitivity of these results to the chosen discount rate. The difference between the monetary values resulting from the "baseline" COBRA run and the proposed ACT Rules COBRA run for each year provides the annual monetary benefit value associated with the estimated emission reductions of NOx and $PM_{2.5}$. Table 28 and Table 29 provide a valuation of the NOx and $PM_{2.5}$ emission reduction health benefits, respectively, for calendar years 2026 through 2049 at a 7% discount rate. The total health benefits associated with NOx and $PM_{2.5}$ emission reductions are estimated to range from $564 to $1,269 million (2021$) at a 7% discount rate over the years from 2026 through 2049, as shown in Table 30.

The majority of these health benefits are related to the estimated decreased mortality as a result of the emissions reductions. As noted by EPA, COBRA is a screening tool for comparing the relative impacts of emission reduction measures but should not be used to estimate the absolute impacts of specific control measures. Though simplified, the COBRA model provides useful approximations of the direction and magnitude of health effects from emission reductions.

The COBRA model was also run at a discount rate of 3% to evaluate the sensitivity of the benefits to this parameter. Table 31 and

Table 32 summarize the COBRA health benefit results for the estimated NOx and $PM_{2.5}$ reductions, respectively, for the years 2026 through 2049 at a 3% discount rate. The total health benefits associated with NOx and $PM_{2.5}$ emissions reductions are estimated to range from $631 to $1,423 million (2021$) at a 3% discount rate over the years from 2026 through 2049, as shown in Table 33.

[33] Krewski et al., Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality, May 2009. https://pubmed.ncbi.nlm.nih.gov/19627030/

[34] Lepeule et al., Chronic Exposure to Fine Particles and Mortality: An Extended Follow-up of the Harvard Six Cities Study from 1974 to 2009. March 28, 2012. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3404667/

Table 27: North Carolina Statewide Avoided Health Outcomes from $PM_{2.5}$ and NOx Reductions

Year	Annual Avoided Incidences													
	Mortality		Infant Mortality	Nonfatal Heart Attacks		Hospital Admits, All Respiratory	Hospital Admits, Cardiovascular	Acute Bronchitis	Upper Respiratory Symptoms	Lower Respiratory Symptoms	Emergency Room Visits, Asthma	Minor Restricted Activity Days	Work Loss Days	Asthma Exacerbation
	Low Estimate	High Estimate		Low Estimate	High Estimate									
2026	0.10	0.21	0.00	0.01	0.10	0.02	0.02	0.14	2.52	1.78	0.06	76.52	12.96	2.65
2027	0.16	0.37	0.00	0.02	0.16	0.04	0.04	0.23	4.18	2.94	0.10	126.88	21.50	4.41
2028	0.25	0.57	0.00	0.02	0.25	0.07	0.04	0.36	6.55	4.60	0.15	198.35	33.60	6.89
2029	0.38	0.87	0.00	0.05	0.39	0.09	0.08	0.55	9.90	6.99	0.23	300.29	50.86	10.43
2030	0.55	1.23	0.01	0.06	0.55	0.13	0.10	0.80	14.31	10.07	0.34	433.91	73.50	15.07
2031	0.72	1.64	0.01	0.08	0.74	0.18	0.14	1.05	18.91	13.31	0.43	573.37	97.13	19.91
2032	0.93	2.11	0.00	0.10	0.93	0.24	0.18	1.33	24.19	17.03	0.57	733.43	124.24	25.47
2033	1.13	2.57	0.01	0.12	1.15	0.28	0.22	1.64	29.61	20.84	0.69	897.53	152.03	31.17
2034	1.35	3.06	0.00	0.14	1.37	0.32	0.24	1.96	35.17	24.76	0.82	1,066.27	180.62	37.04
2035	1.58	3.57	0.02	0.18	1.58	0.39	0.28	2.27	41.03	28.88	0.96	1,244.07	210.72	43.20
2036	1.80	4.06	0.01	0.19	1.82	0.45	0.30	2.58	46.67	32.86	1.09	1,415.27	239.73	49.15
2037	2.01	4.56	0.02	0.22	2.02	0.49	0.34	2.91	52.32	36.83	1.22	1,586.21	268.68	55.10
2038	2.22	5.04	0.01	0.25	2.25	0.56	0.36	3.20	57.88	40.74	1.35	1,754.82	297.24	60.96
2039	2.43	5.48	0.02	0.26	2.45	0.60	0.38	3.49	63.05	44.37	1.48	1,911.44	323.78	66.38
2040	2.60	5.93	0.01	0.28	2.63	0.64	0.40	3.76	67.91	47.80	1.58	2,058.80	348.73	71.52
2041	2.84	6.40	0.03	0.31	2.87	0.70	0.42	4.08	73.55	51.75	1.71	2,229.74	377.68	77.45
2042	3.05	3.93	0.01	0.33	3.08	0.75	0.48	4.40	79.48	55.93	1.87	2,409.66	408.17	83.70
2043	3.25	7.35	0.03	0.36	3.27	0.80	0.48	4.68	84.38	59.37	1.96	2,557.90	433.28	88.87
2044	3.47	7.86	0.03	0.36	3.50	0.86	0.50	4.98	90.07	63.36	2.10	2,730.41	462.50	94.85
2045	3.66	8.30	0.02	0.41	3.70	0.91	0.54	5.28	95.36	67.09	2.23	2,890.31	489.61	100.41
2046	3.88	8.78	0.02	0.42	3.90	0.95	0.56	5.57	100.66	70.79	2.35	3,051.09	516.84	106.00
2047	4.07	9.24	0.04	0.44	4.11	1.01	0.58	5.87	105.95	74.52	2.47	3,211.40	544.00	111.58
2048	4.30	9.72	0.03	0.47	4.34	1.06	0.62	6.18	111.65	78.52	2.61	3,383.82	573.22	117.57
2049	4.50	10.20	0.03	0.50	4.54	1.11	0.64	6.47	116.94	82.31	2.73	3,545.66	600.54	123.15
Total	**51.13**	**115.84**	**0.36**	**5.57**	**51.60**	**12.63**	**7.92**	**73.64**	**1,329.72**	**935.66**	**31.04**	**40,310.63**	**6,828.20**	**1,400.28**

Table 28: North Carolina Statewide Health Benefits from NOx Reductions at a 7% Discount Rate

Year	NOx Reduction Health Benefits @ 7% Discount Rate (2021$)											
	Mortality		Infant Mortality	Nonfatal Heart Attacks		Hospital Admits, All Respiratory	Hospital Admits, Cardio-vascular	Bronchitis, Upper & Lower Respiratory Symptoms, Asthma	Minor Restricted Activity Days	Work Loss Days	Total Health Benefits	
	Low Estimate	High Estimate		Low Estimate	High Estimate						Low Estimate	High Estimate
2026	$637,406	$1,444,095	$5,499	$1,082	$10,053	$569	$870	$315	$4,464	$1,726	$651,931	$1,467,592
2027	$1,081,312	$2,449,799	$9,328	$1,835	$17,055	$966	$1,476	$534	$7,574	$2,928	$1,105,953	$2,489,659
2028	$1,716,184	$3,888,145	$14,805	$2,913	$27,068	$1,533	$2,343	$847	$12,020	$4,647	$1,755,293	$3,951,409
2029	$2,570,476	$5,823,588	$22,175	$4,363	$40,541	$2,296	$3,509	$1,268	$18,004	$6,960	$2,629,052	$5,918,342
2030	$3,644,181	$8,256,101	$31,437	$6,186	$57,475	$3,256	$4,975	$1,798	$25,524	$9,868	$3,727,225	$8,390,434
2031	$4,899,352	$11,099,691	$42,265	$8,316	$77,270	$4,377	$6,688	$2,417	$34,316	$13,267	$5,010,999	$11,280,291
2032	$6,321,436	$14,321,360	$54,533	$10,730	$99,696	$5,648	$8,630	$3,119	$44,276	$17,118	$6,465,490	$14,554,379
2033	$7,866,791	$17,822,202	$67,864	$13,353	$124,064	$7,028	$10,739	$3,882	$55,100	$21,302	$8,046,060	$18,112,182
2034	$9,542,990	$21,619,342	$82,325	$16,199	$150,494	$8,526	$13,028	$4,709	$66,840	$25,841	$9,760,457	$21,971,103
2035	$11,310,816	$25,623,886	$97,575	$19,200	$178,365	$10,105	$15,441	$5,581	$79,221	$30,628	$11,568,568	$26,040,803
2036	$13,088,685	$29,650,974	$112,913	$22,218	$206,391	$11,694	$17,869	$6,458	$91,673	$35,442	$13,386,951	$30,133,413
2037	$14,845,602	$33,630,359	$128,070	$25,200	$234,081	$13,264	$20,268	$7,325	$103,977	$40,200	$15,183,906	$34,177,545
2038	$16,570,811	$37,537,644	$142,954	$28,129	$261,267	$14,805	$22,623	$8,176	$116,060	$44,872	$16,948,430	$38,148,401
2039	$18,247,862	$41,335,547	$157,423	$30,976	$287,688	$16,304	$24,913	$9,003	$127,804	$49,413	$18,663,699	$42,008,095
2040	$19,864,106	$44,995,394	$171,367	$33,720	$313,144	$17,748	$27,120	$9,801	$139,123	$53,790	$20,316,775	$45,727,487
2041	$21,671,797	$49,088,545	$186,963	$36,789	$341,612	$19,364	$29,589	$10,693	$151,782	$58,685	$22,165,661	$49,887,233
2042	$23,385,777	$52,969,037	$201,752	$39,699	$368,596	$20,896	$31,930	$11,538	$163,784	$63,327	$23,918,701	$53,830,858
2043	$25,098,345	$56,845,915	$216,528	$42,607	$395,549	$22,426	$34,269	$12,383	$175,776	$67,964	$25,670,298	$57,770,810
2044	$26,810,756	$60,721,989	$231,303	$45,514	$422,491	$23,957	$36,608	$13,227	$187,766	$72,602	$27,421,733	$61,709,943
2045	$28,516,676	$64,582,888	$246,023	$48,411	$449,323	$25,482	$38,938	$14,069	$199,711	$77,221	$29,166,531	$65,633,654
2046	$30,235,060	$68,471,506	$260,851	$51,329	$476,341	$27,018	$41,285	$14,916	$211,742	$81,875	$30,924,076	$69,585,534
2047	$31,946,932	$72,344,839	$275,623	$54,236	$503,246	$28,548	$43,624	$15,761	$223,727	$86,511	$32,674,962	$73,521,879
2048	$33,658,603	$76,217,148	$290,394	$57,143	$530,138	$30,079	$45,963	$16,605	$235,710	$91,147	$34,674,962	$77,457,183
2049	$35,385,375	$80,166,383	$305,258	$60,064	$558,067	$31,614	$48,307	$17,460	$247,843	$95,818	$36,191,738	$81,470,748
Total	**$388,917,331**	**$880,906,377**	**$3,355,227**	**$660,213**	**$6,130,016**	**$347,503**	**$531,003**	**$191,883**	**$2,723,816**	**$1,053,152**	**$397,780,129**	**$895,238,978**

Table 29: North Carolina Statewide Health Benefits from $PM_{2.5}$ Reductions at a 7% Discount Rate

Year	$PM_{2.5}$ Reduction Health Benefits @ 7% Discount Rate (2021$)											
	Mortality		Infant Mortality	Nonfatal Heart Attacks		Hospital Admits, All Respiratory	Hospital Admits, Cardio-vascular	Bronchitis, Upper & Lower Respiratory Symptoms, Asthma	Minor Restricted Activity Days	Work Loss Days	Total Health Benefits	
	Low Estimate	High Estimate		Low Estimate	High Estimate						Low Estimate	High Estimate
2026	$402,498	$912,006	$3,569	$695	$6,456	$364	$559	$207	$2,937	$1,137	$411,965	$927,234
2027	$643,996	$1,459,206	$5,710	$1,112	$10,329	$582	$894	$331	$4,700	$1,820	$659,144	$1,483,572
2028	$982,092	$2,225,284	$8,708	$1,695	$15,752	$888	$1,363	$505	$7,167	$2,775	$1,005,193	$2,262,442
2029	$1,513,386	$3,429,113	$13,419	$2,612	$24,273	$1,368	$2,100	$778	$11,044	$4,276	$1,548,984	$3,486,372
2030	$2,253,973	$5,107,160	$19,986	$3,891	$36,151	$2,038	$3,128	$1,158	$16,449	$6,368	$2,306,991	$5,192,438
2031	$2,897,955	$6,566,296	$25,696	$5,002	$46,479	$2,620	$4,021	$1,489	$21,149	$8,188	$2,966,121	$6,675,939
2032	$3,654,626	$8,280,744	$32,406	$6,308	$58,614	$3,304	$5,071	$1,878	$26,670	$10,326	$3,740,591	$8,419,014
2033	$4,346,888	$9,849,221	$38,544	$7,503	$69,715	$3,930	$6,032	$2,234	$31,722	$12,282	$4,449,137	$10,013,681
2034	$4,974,740	$11,271,723	$44,112	$8,587	$79,783	$4,498	$6,903	$2,557	$36,304	$14,056	$5,091,757	$11,459,935
2035	$5,634,778	$12,767,113	$49,964	$9,726	$90,366	$5,095	$7,819	$2,896	$41,121	$15,921	$5,767,320	$12,980,294
2036	$6,198,205	$14,043,565	$54,961	$10,699	$99,399	$5,604	$8,601	$3,185	$45,232	$17,513	$6,344,000	$14,278,061
2037	$6,777,716	$15,356,420	$60,099	$11,699	$108,689	$6,128	$9,406	$3,483	$49,461	$19,150	$6,937,143	$15,612,836
2038	$7,357,211	$16,669,191	$65,238	$12,700	$117,978	$6,652	$10,210	$3,781	$53,690	$20,787	$7,530,269	$16,947,528
2039	$7,823,998	$17,726,555	$69,377	$13,506	$125,459	$7,074	$10,858	$4,021	$57,096	$22,106	$8,008,036	$18,022,546
2040	$8,226,376	$18,637,949	$72,946	$14,200	$131,906	$7,438	$11,416	$4,228	$60,032	$23,243	$8,419,879	$18,949,158
2041	$8,757,526	$19,841,050	$77,656	$15,117	$140,417	$7,919	$12,153	$4,501	$63,908	$24,744	$8,963,523	$20,172,347
2042	$9,497,933	$21,518,175	$84,221	$16,395	$152,282	$8,588	$13,181	$4,881	$69,310	$26,836	$9,721,346	$21,877,475
2043	$9,819,765	$22,246,936	$87,075	$16,951	$157,435	$8,879	$13,628	$5,046	$71,658	$27,745	$10,050,749	$22,618,403
2044	$10,463,537	$23,705,003	$92,784	$18,062	$167,748	$9,461	$14,521	$5,377	$76,356	$29,564	$10,709,664	$24,100,816
2045	$10,946,308	$24,798,254	$97,066	$18,896	$175,479	$9,898	$15,192	$5,625	$79,878	$30,928	$11,203,791	$25,212,320
2046	$11,429,056	$25,891,393	$101,347	$19,729	$183,208	$10,335	$15,862	$5,873	$83,400	$32,292	$11,697,895	$26,323,711
2047	$11,911,782	$26,984,416	$105,628	$20,563	$190,936	$10,771	$16,532	$6,121	$86,922	$33,656	$12,191,976	$27,434,983
2048	$12,555,449	$28,441,950	$111,336	$21,674	$201,242	$11,353	$17,425	$6,452	$91,619	$35,475	$12,850,784	$28,916,852
2049	$13,0.38,120	$29,534,695	$115,617	$22,508	$208,966	$11,790	$18,096	$6,700	$95,140	$36,839	$13,344,809	$30,027,842
Total	**$162,107,915**	**$367,263,416**	**$1,437,468**	**$279,832**	**$2,599,062**	**$146,580**	**$224,971**	**$83,309**	**$1,182,966**	**$458,028**	**$165,921,067**	**$373,395,799**

Table 30: Summary of Total Health Benefits from NOx and $PM_{2.5}$ Reductions at 7% Discount Rate

Year	Summary of NOx and $PM_{2.5}$ Reduction Health Benefits (million 2021$, 7%)					
	NOx Health Benefits (Table 28)		$PM_{2.5}$ Health Benefits (Table 29)		Total Health Benefits	
	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
2026	$0.65	$1.47	$0.41	$0.93	$1.1	$2.4
2027	$1.11	$2.49	$0.66	$1.48	$1.8	$4.0
2028	$1.76	$3.95	$1.01	$2.26	$2.8	$6.2
2029	$2.63	$5.92	$1.55	$3.49	$4.2	$9.4
2030	$3.73	$8.39	$2.31	$5.19	$6.0	$13.6
2031	$5.01	$11.28	$2.97	$6.68	$8.0	$18.0
2032	$6.47	$14.55	$3.74	$8.42	$10.2	$23.0
2033	$8.05	$18.11	$4.45	$10.01	$12.5	$28.1
2034	$9.76	$21.97	$5.09	$11.46	$14.9	$33.4
2035	$11.57	$26.04	$5.77	$12.98	$17.3	$39.0
2036	$13.39	$30.13	$6.34	$14.28	$19.7	$44.4
2037	$15.18	$34.18	$6.94	$15.61	$22.1	$49.8
2038	$16.95	$38.15	$7.53	$16.95	$24.5	$55.1
2039	$18.66	$42.01	$8.01	$18.02	$26.7	$60.0
2040	$20.32	$45.73	$8.42	$18.95	$28.7	$64.7
2041	$22.17	$49.89	$8.96	$20.17	$31.1	$70.1
2042	$23.92	$53.83	$9.72	$21.88	$33.6	$75.7
2043	$25.67	$57.77	$10.05	$22.62	$35.7	$80.4
2044	$27.42	$61.71	$10.71	$24.10	$38.1	$85.8
2045	$29.17	$65.63	$11.20	$25.21	$40.4	$90.8
2046	$30.92	$69.59	$11.70	$26.32	$42.6	$95.9
2047	$32.67	$73.52	$12.19	$27.43	$44.9	$101.0
2048	$34.43	$77.46	$12.85	$28.92	$47.3	$106.4
2049	$36.19	$81.47	$13.34	$30.03	$49.5	$111.5
Total	**$397.78**	**$895.24**	**$165.92**	**$373.40**	**$563.7**	**$1,268.6**

Table 31: North Carolina Statewide Health Benefits from NOx Reductions at a 3% Discount Rate

Year	NOx Reduction Health Benefits @ 3% Discount Rate (2021$)											
	Mortality		Infant Mortality	Nonfatal Heart Attacks		Hospital Admits, All Respiratory	Hospital Admits, Cardio-vascular	Bronchitis, Upper & Lower Respiratory Symptoms, Asthma	Minor Restricted Activity Days	Work Loss Days	Total Health Benefits	
	Low Estimate	High Estimate		Low Estimate	High Estimate						Low Estimate	High Estimate
2026	$715,636	$1,621,333	$5,499	$1,159	$10,773	$569	$870	$315	$4,464	$1,726	$730,239	$1,645,549
2027	$1,214,024	$2,750,469	$9,328	$1,967	$18,276	$966	$1,476	$534	$7,574	$2,928	$1,238,796	$2,791,550
2028	$1,926,816	$4,365,347	$14,805	$3,122	$29,006	$1,533	$2,343	$847	$12,020	$4,647	$1,966,133	$4,430,549
2029	$2,885,957	$6,538,332	$22,175	$4,676	$43,445	$2,296	$3,509	$1,268	$18,004	$6,960	$2,944,845	$6,635,989
2030	$4,091,441	$9,269,393	$31,437	$6,629	$61,591	$3,256	$4,975	$1,798	$25,524	$9,868	$4,174,927	$9,407,842
2031	$5,500,662	$12,461,984	$42,265	$8,912	$82,803	$4,377	$6,688	$2,417	$34,316	$13,267	$5,612,904	$12,648,118
2032	$7,097,282	$16,079,056	$54,533	$11,499	$106,836	$5,648	$8,630	$3,119	$44,276	$17,118	$7,242,104	$16,319,215
2033	$8,832,302	$20,009,566	$67,864	$14,310	$132,949	$7,028	$10,739	$3,882	$55,100	$21,302	$9,012,527	$20,308,431
2034	$10,714,226	$24,272,738	$82,325	$17,359	$161,271	$8,526	$13,028	$4,709	$66,840	$25,841	$10,932,852	$24,635,277
2035	$12,699,021	$28,768,770	$97,575	$20,574	$191,138	$10,105	$15,441	$5,581	$79,221	$30,628	$12,958,148	$29,198,460
2036	$14,695,092	$33,290,113	$112,913	$23,809	$221,171	$11,694	$17,869	$6,458	$91,673	$35,442	$14,994,949	$33,787,332
2037	$16,667,641	$37,757,898	$128,070	$27,005	$250,844	$13,264	$20,268	$7,325	$103,977	$40,200	$17,007,749	$38,321,846
2038	$18,604,588	$42,144,734	$142,954	$30,143	$279,977	$14,805	$22,623	$8,176	$116,060	$44,872	$18,984,222	$42,774,200
2039	$20,487,469	$46,408,763	$157,423	$33,194	$308,290	$16,304	$24,913	$9,003	$127,804	$49,413	$20,905,524	$47,101,913
2040	$22,302,078	$50,517,792	$171,367	$36,135	$335,569	$17,748	$27,120	$9,801	$139,123	$53,790	$22,757,162	$51,272,311
2041	$24,331,631	$55,113,307	$186,963	$39,423	$366,076	$19,364	$29,589	$10,693	$151,782	$58,685	$24,828,130	$55,936,457
2042	$26,255,972	$59,470,061	$201,752	$42,542	$394,991	$20,896	$31,930	$11,538	$163,784	$63,327	$26,791,740	$60,358,277
2043	$28,178,729	$63,822,758	$216,528	$45,658	$423,874	$22,426	$34,269	$12,383	$175,776	$67,964	$28,753,732	$64,775,978
2044	$30,101,307	$68,174,552	$231,303	$48,774	$452,746	$23,957	$36,608	$13,227	$187,766	$72,602	$30,715,544	$69,192,761
2045	$32,016,600	$72,509,309	$246,023	$51,878	$481,499	$25,482	$38,938	$14,069	$199,711	$77,221	$32,669,921	$73,592,251
2046	$33,945,885	$76,875,187	$260,851	$55,005	$510,452	$27,018	$41,285	$14,916	$211,742	$81,875	$34,638,577	$78,023,326
2047	$35,867,860	$81,223,904	$275,623	$58,120	$539,284	$28,548	$43,624	$15,761	$223,727	$86,511	$36,599,774	$82,436,981
2048	$37,789,609	$85,571,471	$290,394	$61,236	$568,101	$30,079	$45,963	$16,605	$235,710	$91,147	$38,560,740	$86,849,469
2049	$39,728,311	$90,005,405	$305,258	$64,365	$598,031	$31,614	$48,307	$17,460	$247,843	$95,818	$40,538,975	$91,349,736
Total	**$436,650,138**	**$989,022,243**	**$3,355,227**	**$707,492**	**$6,568,991**	**$347,503**	**$531,003**	**$191,883**	**$2,723,816**	**$1,053,152**	**$445,560,215**	**$1,003,793,819**

Table 32: North Carolina Statewide Health Benefits from $PM_{2.5}$ Reductions at a 3% Discount Rate

Year	$PM_{2.5}$ Reduction Health Benefits @ 3% Discount Rate (2021$)											
	Mortality		Infant Mortality	Nonfatal Heart Attacks		Hospital Admits, All Respiratory	Hospital Admits, Cardio-vascular	Bronchitis, Upper & Lower Respiratory Symptoms, Asthma	Minor Restricted Activity Days	Work Loss Days	Total Health Benefits	
	Low Estimate	High Estimate		Low Estimate	High Estimate						Low Estimate	High Estimate
2026	$451,897	$1,023,938	$3,569	$745	$6,922	$364	$559	$207	$2,937	$1,137	$461,415	$1,039,633
2027	$723,035	$1,638,299	$5,710	$1,192	$11,075	$582	$894	$331	$4,700	$1,820	$738,263	$1,663,410
2028	$1,102,627	$2,498,399	$8,708	$1,818	$16,889	$888	$1,363	$505	$7,167	$2,775	$1,125,850	$2,536,694
2029	$1,699,127	$3,849,977	$13,419	$2,801	$26,026	$1,368	$2,100	$778	$11,044	$4,276	$1,734,914	$3,908,989
2030	$2,530,609	$5,733,975	$19,986	$4,172	$38,761	$2,038	$3,128	$1,158	$16,449	$6,368	$2,583,908	$5,821,864
2031	$3,253,628	$7,372,194	$25,696	$5,363	$49,835	$2,620	$4,021	$1,489	$21,149	$8,188	$3,322,155	$7,485,193
2032	$4,103,168	$9,297,061	$32,406	$6,764	$62,847	$3,304	$5,071	$1,878	$26,670	$10,326	$4,189,588	$9,439,564
2033	$4,880,393	$11,058,041	$38,544	$8,045	$74,750	$3,930	$6,032	$2,234	$31,722	$12,282	$4,983,183	$11,227,535
2034	$5,585,303	$12,655,130	$44,112	$9,207	$85,545	$4,498	$6,903	$2,557	$36,304	$14,056	$5,702,939	$12,849,104
2035	$6,326,348	$14,334,053	$49,964	$10,429	$96,892	$5,095	$7,819	$2,896	$41,121	$15,921	$6,459,593	$14,553,760
2036	$6,958,926	$15,767,168	$54,961	$11,472	$106,577	$5,604	$8,601	$3,185	$45,232	$17,513	$7,105,494	$16,008,841
2037	$7,609,562	$17,241,152	$60,099	$12,544	$116,538	$6,128	$9,406	$3,483	$49,461	$19,150	$7,769,834	$17,505,418
2038	$8,260,181	$18,715,043	$65,238	$13,617	$126,498	$6,652	$10,210	$3,781	$53,690	$20,787	$8,434,156	$19,001,900
2039	$8,784,257	$19,902,180	$69,377	$14,481	$134,519	$7,074	$10,858	$4,021	$57,096	$22,106	$8,969,271	$20,207,231
2040	$9,236,020	$20,925,432	$72,946	$15,226	$141,432	$7,438	$11,416	$4,228	$60,032	$23,243	$9,430,548	$21,246,167
2041	$9,832,360	$22,276,192	$77,656	$16,209	$150,558	$7,919	$12,153	$4,501	$63,908	$24,744	$10,039,448	$22,617,630
2042	$10,663,638	$24,159,155	$84,221	$17,579	$163,280	$8,588	$13,181	$4,881	$69,310	$26,836	$10,888,235	$24,529,452
2043	$11,024,970	$24,977,358	$87,075	$18,185	$168,805	$8,879	$13,628	$5,046	$71,658	$27,745	$11,257,178	$25,360,195
2044	$11,747,754	$26,614,378	$92,784	$19,367	$179,863	$9,461	$14,521	$5,377	$76,356	$29,564	$11,995,185	$27,022,305
2045	$12,289,776	$27,841,806	$97,066	$20,261	$188,152	$9,898	$15,192	$5,625	$79,878	$30,928	$12,548,623	$28,268,545
2046	$12,831,773	$29,069,109	$101,347	$21,154	$196,439	$10,335	$15,862	$5,873	$83,400	$32,292	$13,102,037	$29,514,658
2047	$13,373,745	$30,296,281	$105,628	$22,048	$204,725	$10,771	$16,532	$6,121	$86,922	$33,656	$13,655,424	$30,760,637
2048	$14,096,411	$31,932,702	$111,336	$23,239	$215,775	$11,353	$17,425	$6,452	$91,619	$35,475	$14,393,311	$32,422,138
2049	$14,638,322	$33,159,563	$115,617	$24,133	$224,056	$11,790	$18,096	$6,700	$95,140	$36,839	$14,946,636	$33,667,800
Total	**$182,003,829**	**$412,338,583**	**$1,437,468**	**$300,041**	**$2,786,759**	**$146,580**	**$224,971**	**$83,309**	**$1,182,996**	**$458,028**	**$185,837,190**	**$418,658,663**

Table 33: Summary of Total Health Benefits from NOx and $PM_{2.5}$ Reductions at a 3% Discount Rate

Year	Summary of NOx and $PM_{2.5}$ Reduction Health Benefits (million 2021$, 3%)					
	NOx Health Benefits (Table 31)		$PM_{2.5}$ Health Benefits (Table 32)		Total Health Benefits	
	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
2026	$0.73	$1.65	$0.46	$1.04	$1.2	$2.7
2027	$1.24	$2.79	$0.74	$1.66	$2.0	$4.5
2028	$1.97	$4.43	$1.13	$2.54	$3.1	$7.0
2029	$2.94	$6.64	$1.73	$3.91	$4.7	$10.5
2030	$4.17	$9.41	$2.58	$5.82	$6.8	$15.2
2031	$5.61	$12.65	$3.32	$7.49	$8.9	$20.1
2032	$7.24	$16.32	$4.19	$9.44	$11.4	$25.8
2033	$9.01	$20.31	$4.98	$11.23	$14.0	$31.5
2034	$10.93	$24.64	$5.70	$12.85	$16.6	$37.5
2035	$12.96	$29.20	$6.46	$14.55	$19.4	$43.8
2036	$14.99	$33.79	$7.11	$16.01	$22.1	$49.8
2037	$17.01	$38.32	$7.77	$17.51	$24.8	$55.8
2038	$18.98	$42.77	$8.43	$19.00	$27.4	$61.8
2039	$20.91	$47.10	$8.97	$20.21	$29.9	$67.3
2040	$22.76	$51.27	$9.43	$21.25	$32.2	$72.5
2041	$24.83	$55.94	$10.04	$22.62	$34.9	$78.6
2042	$26.79	$60.36	$10.89	$24.53	$37.7	$84.9
2043	$28.75	$64.78	$11.26	$25.36	$40.0	$90.1
2044	$30.72	$69.19	$12.00	$27.02	$42.7	$96.2
2045	$32.67	$73.59	$12.55	$28.27	$45.2	$101.9
2046	$34.64	$78.02	$13.10	$29.51	$47.7	$107.5
2047	$36.60	$82.44	$13.66	$30.76	$50.3	$113.2
2048	$38.56	$86.85	$14.39	$32.42	$53.0	$119.3
2049	$40.54	$91.35	$14.95	$33.67	$55.5	$125.0
Total	**$445.56**	**$1,003.79**	**$185.84**	**$418.66**	**$631.4**	**$1,422.5**

VII. Cost and Benefit Summary

This section provides a summary of the costs and benefits from the proposed ACT regulation for the State of North Carolina. These include the impacts to manufacturers, businesses in North Carolina, State government, and local governments, as well as the health and environmental benefits associated with the reduction of $PM_{2.5}$, NOx, and CO_2 emissions. The DAQ estimated impacts for the proposed ACT Rules for each year beginning in calendar year 2026, which is two years after the effective date of the proposed rules and the first year of implementation, through 2049, which is the last year for which CARB estimated costs in their analysis. While the proposed ACT Rules apply the last increase in ZEV sales requirements in 2035 (after which the sales requirements remain constant), the analysis was performed through 2049 to capture the expected significant changes in ZEV costs, and potential for cost parity over time. This section summarizes the costs, savings, and benefits described throughout this fiscal analysis. Subsection VII.B contains a summary of the costs and savings to the entities outlined in Section V, while Subsection VII.B contains the present value net costs, savings, and benefits. Finally, Subsection VII.C describes the primary uncertainties associated with the results of this analysis.

A. Summary of Costs and Savings to Manufacturers, Businesses, State/Local Government (Undiscounted)

The impacts of the proposed ACT Rules were calculated using the VMT scaling approach with the costs and benefits calculated in the CARB analysis. Table 34 provides a summary of these impacts in North Carolina. Most costs are to manufacturers for the development and manufacture of ZEVs. Some of these costs are offset by savings associated with the GHG requirements in the EPA ICE Phase 2 Regulations which allows averaging, banking, and trading compliance provisions for the engine and vehicle standards. This provision allows manufacturers to trade credits, bank credits for future years, and average credits, which in turn allows manufacturers to certify engines or vehicles that do not perform up to the standard and offset them with engines or vehicles, such as ZEVs, that perform better than the standard. For North Carolina businesses, the analysis shows that cost savings from fuel and vehicle maintenance outweigh the additional costs of installing the infrastructure for charging and maintaining ZEVs, and the midlife costs of the ZEV. Loss-of-revenue from the sale of gasoline and diesel fuel is the main impact for North Carolina government; however, these losses are transferred as savings to businesses. In addition, the losses are offset somewhat by ZEV registration fees which are an added cost to businesses.

Table 34: Summary of Costs and Savings to Manufacturers, Businesses, and Government, Undiscounted

Calendar Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Model Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Cost Impacts to Manufacturers (Million 2021$), Undiscounted (Table 6)														
Incremental ZEV Price	$88	$115	$143	$162	$188	$234	$260	$286	$312	$315	$317	$319	$322	$324
ICE Phase 2 GHG	-$22	-$7	-$9	-$11	-$12	-$14	-$16	-$17	-$19	-$19	-$19	-$19	-$19	-$19
Total Impacts to Manufacturers	**$67**	**$108**	**$134**	**$151**	**$176**	**$220**	**$244**	**$269**	**$293**	**$296**	**$298**	**$300**	**$303**	**$305**
Cost Impacts to North Carolina Businesses (Million 2021$), Undiscounted (Table 12)														
Sales & Excise Tax	$4	$5	$6	$7	$8	$10	$11	$12	$13	$13	$13	$13	$13	$13
Fuel	-$14	-$34	-$59	-$92	-$130	-$171	-$217	-$265	-$313	-$369	-$419	-$468	-$515	-$554
Vehicle Maintenance	-$5	-$14	-$24	-$37	-$51	-$67	-$84	-$102	-$121	-$140	-$157	-$174	-$190	-$205
Maintenance Bay Upgrades	$1	$3	$5	$8	$11	$14	$16	$18	$20	$22	$22	$23	$23	$23
Midlife	$0	$0	$0	$0	$0	$9	$13	$17	$20	$24	$46	$56	$67	$77
EVSE Infrastructure	$15	$33	$58	$88	$122	$161	$204	$250	$300	$349	$397	$445	$492	$538
Workforce Transition	$2	$3	$4	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Impacts to NC Businesses	**$2**	**-$4**	**-$11**	**-$22**	**-$39**	**-$44**	**-$57**	**-$70**	**-$82**	**-$102**	**-$97**	**-$104**	**-$109**	**-$107**
Potential IRA Tax Credits (Million 2021$), Undiscounted (Table 14 and Table 16)														
Vehicle Tax Credits	-$54	-$71	-$83	-$90	-$96	-$119	-$119	$0	$0	$0	$0	$0	$0	$0
Infrastructure Tax Credits	-$32	-$49	-$70	-$90	-$111	-$128	-$145	$0	$0	$0	$0	$0	$0	$0
Total IRA Tax Credits	**-$86**	**-$120**	**-$153**	**-$180**	**-$207**	**-$247**	**-$265**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Cost Impacts to North Carolina State Government (Million 2021$), Undiscounted (Table 17)														
DAQ Compliance Costs	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Total Impacts to NC State Government	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**
Cost Impacts to North Carolina Local Governments (Million 2021$), Undiscounted (Table 18)														
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Net Impacts to NC Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Costs Impacts (Million 2021$), Undiscounted														
Total Net Costs (Undiscounted)	**-$17**	**-$16**	**-$29**	**-$51**	**-$71**	**-$71**	**-$78**	**$199**	**$212**	**$194**	**$201**	**$196**	**$194**	**$198**

Calendar Year	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	Total (CY 2026-2049) (MY 2027-2050)
Model Year	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	
Cost Impacts to Manufacturers (Million 2021$), Undiscounted (Table 6)											
Incremental ZEV Price	$327	$329	$331	$334	$336	$339	$341	$343	$345	$298	$6,709
ICE Phase 2 GHG	-$19	-$19	-$20	-$20	-$20	-$20	-$20	-$20	-$20	-$18	-$417
Total Impacts to Manufacturers	**$307**	**$309**	**$312**	**$314**	**$316**	**$319**	**$321**	**$323**	**$325**	**$280**	**$6,292**
Cost Impacts to North Carolina Businesses (Million 2021$), Undiscounted (Table 12)											
Sales & Excise Tax	$14	$14	$14	$14	$14	$14	$14	$14	$14	$13	$282
Fuel	-$598	-$644	-$682	-$724	-$758	-$790	-$843	-$878	-$915	-$951	-$11,404
Vehicle Maintenance	-$219	-$232	-$244	-$256	-$266	-$276	-$286	-$295	-$303	-$310	-$4,058
Maintenance Bay Upgrades	$22	$22	$21	$21	$20	$19	$18	$18	$17	$15	$403
Midlife	$84	$105	$112	$114	$113	$108	$102	$98	$95	$92	$1,353
EVSE Infrastructure	$584	$628	$670	$711	$751	$789	$814	$833	$845	$843	$10,919
Workforce Transition	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13
Total Impacts to NC Businesses	**-$113**	**-$108**	**-$109**	**-$120**	**-$126**	**-$136**	**-$179**	**-$210**	**-$246**	**-$299**	**-$2,492**
Potential IRA Tax Credits (Million 2021$), Undiscounted (Table 14 and Table 16)											
Vehicle Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$633
Infrastructure Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$625
Total IRA Tax Credits	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**-$1,258**
Cost Impacts to North Carolina State Government (Million 2021$), Undiscounted (Table 17)											
DAQ Compliance Costs	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.28
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Total Impacts to NC State Government	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.28**
Cost Impacts to North Carolina Local Governments (Million 2021$), Undiscounted (Table 18)											
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Net Impacts to NC Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Costs Impacts (Million 2021$), Undiscounted											
Total Net Costs (Undiscounted)	**$194**	**$201**	**$203**	**$194**	**$190**	**$182**	**$141**	**$113**	**$79**	**-$19**	**$2,542**

B. Net Present Value Impacts

Discounting is a way of adjusting costs and benefits occurring at different points in time into a common period so that they can be compared equivalently. Future year costs and benefits are converted into present day values using a 7% discount rate as directed by N.C.G.S. 150B-21.4(b1)(5), as well as a 3% discount rate, which is the central point estimate from the IWG interim guidance.[35] These year-by-year impacts are then summed to determine the net present value (NPV) of all costs and benefits at each rate. Scientific consensus around the appropriate discount rate for the social cost of carbon continues to evolve, and it has been indicated that a discount rate below 3% may be appropriate.[36]

The impacts include the costs and savings to manufacturers, businesses, and governments, as outlined in Section V, as well as associated emission reduction benefits, as outlined in Section VI. In this analysis, a positive NPV indicates that the quantified costs outweigh the quantified benefits, while a negative NPV indicates that the quantified benefits outweigh the quantified costs.

Table 35 summarizes the present value costs (and savings) for manufacturers, North Carolina Businesses, and North Carolina Government at a 7% discount rate, while Table 36 adds in the present value health and environmental benefits at a 7% discount rate, as outlined in Section VI. Table 35 and Table 36 contain the same costs, savings, and health/environmental benefits listed in Table 34, converted to present value equivalents.

[35] U.S. Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under Executive Order 13930. February 2021. Technical Support Document: Social Cost of Carbon, Methane, (whitehouse.gov)

[36] *Ibid*

Table 35: Summary of Costs and Savings to Manufacturers, Businesses, and Government at a 7% Discount Rate

Calendar Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Model Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Cost Impacts to Manufacturers (Million 2021$ @7% Discount Rate)														
Incremental ZEV Price	$63	$77	$89	$94	$102	$119	$123	$127	$129	$122	$115	$108	$102	$96
ICE Phase 2 GHG	-$15	-$4	-$6	-$6	-$7	-$7	-$7	-$8	-$8	-$7	-$7	-$6	-$6	-$6
Total Impacts to Manufacturers	**$48**	**$72**	**$84**	**$88**	**$96**	**$112**	**$116**	**$120**	**$122**	**$115**	**$108**	**$102**	**$96**	**$90**
Cost Impacts to North Carolina Businesses (Million 2021$ @ 7% Discount Rate)														
Sales & Excise Tax	$3	$3	$4	$4	$4	$5	$5	$5	$5	$5	$5	$5	$4	$4
Fuel	-$10	-$23	-$37	-$54	-$70	-$87	-$103	-$118	-$130	-$143	-$152	-$158	-$163	-$164
Vehicle Maintenance	-$4	-$9	-$15	-$22	-$28	-$34	-$40	-$45	-$50	-$54	-$57	-$59	-$60	-$61
Maintenance Bay Upgrades	$1	$2	$3	$5	$6	$7	$8	$8	$8	$8	$8	$8	$7	$7
Midlife	$0	$0	$0	$0	$0	$5	$6	$7	$8	$9	$17	$19	$21	$23
EVSE Infrastructure	$10	$22	$36	$51	$67	$82	$97	$111	$124	$135	$144	$151	$156	$159
Workforce Transition	$2	$2	$2	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Impacts to NC Businesses	**$2**	**-$2**	**-$7**	**-$13**	**-$21**	**-$22**	**-$27**	**-$31**	**-$34**	**-$39**	**-$35**	**-$35**	**-$34**	**-$32**
Potential IRA Tax Credits (Million 2021$, @ 7% Discount Rate)														
Vehicle Tax Credits	-$39	-$47	-$52	-$53	-$52	-$61	-$57	$0	$0	$0	$0	$0	$0	$0
Infrastructure Tax Credits	-$23	-$33	-$43	-$52	-$60	-$65	-$69	$0	$0	$0	$0	$0	$0	$0
Total IRA Tax Credits	**-$62**	**-$80**	**-$95**	**-$105**	**-$113**	**-$125**	**-$126**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Cost Impacts to North Carolina State Government (Million 2021$ @ 7% Discount Rate)														
DAQ Compliance Costs	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Total Impacts to NC State Government	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Cost Impacts to North Carolina Local Governments (Million 2021$ @ 7% Discount Rate)														
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Net Impacts to NC Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Cost Impacts (Million 2021$ @ 7% Discount Rate)														
Total Net Costs (7% Discount Rate)	**-$12**	**-$10**	**-$18**	**-$30**	**-$39**	**-$36**	**-$37**	**$88**	**$88**	**$75**	**$73**	**$67**	**$61**	**$59**

Table 35: Summary of Costs and Savings to Manufacturers, Businesses, and Government at a 7% Discount Rate (continued)

											Totals
Calendar Year	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**CY 2026-2049**
Model Year	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**MY 2027-2050**
Cost Impacts to Manufacturers (Million 2021$ @7% Discount Rate)											
Incremental ZEV Price	$90	$85	$80	$75	$71	$67	$63	$59	$56	$45	$2,158
ICE Phase 2 GHG	-$5	-$5	-$5	-$4	-$4	-$4	-$4	-$3	-$3	-$3	-$141
Total Impacts to Manufacturers	**$85**	**$80**	**$75**	**$71**	**$67**	**$63**	**$59**	**$56**	**$52**	**$42**	$2,017
Cost Impacts to North Carolina Businesses (Million 2021$ @ 7% Discount Rate)											
Sales & Excise Tax	$4	$4	$3	$3	$3	$3	$3	$2	$2	$2	$91
Fuel	-$165	-$166	-$165	-$163	-$160	-$156	-$155	-$151	-$147	-$143	-$2,985
Vehicle Maintenance	-$60	-$60	-$59	-$58	-$56	-$54	-$53	-$51	-$49	-$47	-$1,085
Maintenance Bay Upgrades	$6	$6	$5	$5	$4	$4	$3	$3	$3	$2	$127
Midlife	$23	$27	$27	$26	$24	$21	$19	$17	$15	$14	$329
EVSE Infrastructure	$161	$162	$162	$161	$158	$156	$150	$143	$136	$127	$2,861
Workforce Transition	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$8
Total Impacts to NC Businesses	**-$31**	**-$28**	**-$26**	**-$27**	**-$27**	**-$27**	**-$33**	**-$36**	**-$40**	**-$45**	**-$652**
Potential IRA Tax Credits (Million 2021$, @7% Discount Rate)											
Vehicle Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$360
Infrastructure Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$346
Total IRA Tax Credits	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	-$706
Cost Impacts to North Carolina State Government (Million 2021$ @ 7% Discount Rate)											
DAQ Compliance Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Total Impacts to NC State Government	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.10**
Cost Impacts to North Carolina Local Governments (Million 2021$ @ 7% Discount Rate)											
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Net Impacts to NC Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Cost Impacts (Million 2021$ @ 7% Discount Rate)											
Total Net Costs (7% Discount Rate)	**$54**	**$52**	**$49**	**$44**	**$40**	**$36**	**$26**	**$19**	**$13**	**-$3**	**$659**

Table 36: Summary of Net Impacts (Costs minus Savings and Benefits) at a 7% Discount Rate

Calendar Year			2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Model Year			**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Net Costs (Million 2021$ @ 7% Discount Rate)																
Total Net Costs			**-$12**	**-$10**	**-$18**	**-$30**	**-$39**	**-$36**	**-$37**	**$88**	**$88**	**$75**	**$73**	**$67**	**$61**	**$59**
North Carolina Environmental and Health Benefits (Million 2021$ @ 7% Discount Rate)																
7%	CO_2 (SC-CO_2)		$0.0	$0.0	-$0.1	-$0.5	-$0.9	-$1.5	-$2.4	-$3.2	-$4.3	-$5.6	-$6.9	-$8.3	-$9.8	-$11.2
	NOx (COBRA)	Low Estimate	-$0.7	-$1.1	-$1.8	-$2.6	-$3.7	-$5.0	-$6.5	-$8.0	-$9.8	-$11.6	-$13.4	-$15.2	-$16.9	-$18.7
		High Estimate	-$1.5	-$2.5	-$4.0	-$5.9	-$8.4	-$11.3	-$14.6	-$18.1	-$22.0	-$26.0	-$30.1	-$34.2	-$38.1	-$42.0
	$PM_{2.5}$ (COBRA)	Low Estimate	-$0.4	-$0.7	-$1.0	-$1.5	-$2.3	-$3.0	-$3.7	-$4.4	-$5.1	-$5.8	-$6.3	-$6.9	-$7.5	-$8.0
		High Estimate	-$0.9	-$1.5	-$2.3	-$3.5	-$5.2	-$6.7	-$8.4	-$10.0	-$11.5	-$13.0	-$14.3	-$15.6	-$16.9	-$18.0
Total Benefits		**SC-CO_2 + Low COBRA**	**-$1.1**	**-$1.8**	**-$2.9**	**-$4.6**	**-$6.9**	**-$9.5**	**-$12.6**	**-$15.7**	**-$19.2**	**-$23.0**	**-$26.7**	**-$30.4**	**-$34.3**	**-$37.9**
		SC-CO_2 + High COBRA	**-$2.4**	**-$4.0**	**-$6.4**	**-$9.9**	**-$14.5**	**-$19.5**	**-$25.3**	**-$31.4**	**-$37.8**	**-$44.6**	**-$51.3**	**-$58.1**	**-$64.9**	**-$71.2**

Table 36: Summary of Net Impacts (Costs minus Savings and Benefits) at a 7% Discount Rate (continued)

Calendar Year			2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	Totals CY 2026-2049
Model Year			**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**MY 2027-2050**
Total Net Costs (Million 2021$ @ 7% Discount Rate)													
Total Net Costs			**$54**	**$52**	**$49**	**$44**	**$40**	**$36**	**$26**	**$19**	**$13**	**-$3**	**$659**
North Carolina Health Benefits (Million 2021$ @ 7% Discount Rate)													
7%	CO_2 (SC-CO_2)		-$12.7	-$14.8	-$16.5	-$18.4	-$20.3	-$22.3	-$24.4	-$26.6	-$28.9	-$31.2	-$271
	NOx (COBRA)	Low Estimate	-$20.3	-$22.2	-$23.9	-$25.7	-$27.4	-$29.2	-$30.9	-$32.7	-$34.4	-$36.2	-$398
		High Estimate	-$45.7	-$49.9	-$53.8	-$57.8	-$61.7	-$65.6	-$69.6	-$73.5	-$77.5	-$81.5	-$895
	$PM_{2.5}$ (COBRA)	Low Estimate	-$8.4	-$9.0	-$9.7	-$10.1	-$10.7	-$11.2	-$11.7	-$12.2	-$12.9	-$13.3	-$166
		High Estimate	-$18.9	-$20.2	-$21.9	-$22.6	-$24.1	-$25.2	-$26.3	-$27.4	-$28.9	-$30.0	-$373
Total Benefits		**SC-CO_2 + Low COBRA**	**-$41.4**	**-$45.9**	**-$50.2**	**-$54.1**	**-$58.4**	**-$62.7**	**-$67.1**	**-$71.5**	**-$76.2**	**-$80.8**	**-$835**
		SC-CO_2 + High COBRA	**-$77.4**	**-$84.8**	**-$92.2**	**-$98.8**	**-$106.1**	**-$113.2**	**-$120.3**	**-$127.6**	**-$135.3**	**-$142.7**	**-$1,540**
NPV of Quantified Impacts (million 2021$, 7% Discount Rate)										**Using low COBRA benefits**			**-$175.6**
										Using high COBRA benefits			**-$880.5**

At a 7% discount rate, the NPV of the costs, savings, and benefits from 2026 through 2049 was calculated as a net benefit ranging from $175.6 million using the lower estimate of COBRA health benefits to $880.5 million when using the higher estimate of COBRA health benefits.

To evaluate the effect of discount rate, the present value costs and benefits were also summarized at a discount rate of 3%. Table 37 summarizes the present value costs for manufacturers, North Carolina Businesses, and North Carolina Government at a 3% discount rate, while

Table 38 adds in the present value benefits at a 3% discount rate, as outlined in Section VI, to determine the net present value of all quantified costs and benefits.

Table 37: Summary of Net Impacts to Manufacturers, Businesses, and Government at a 3% Discount Rate

Calendar Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Model Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Costs and Savings to Manufacturers (Million 2021$ @3% Discount Rate)														
Incremental ZEV Price	$76	$96	$116	$128	$144	$174	$187	$201	$212	$208	$203	$199	$195	$190
ICE Phase 2 GHG	-$19	-$6	-$7	-$9	-$10	-$11	-$11	-$12	-$13	-$12	-$12	-$12	-$12	-$11
Net Impacts to Manufacturers	**$58**	**$91**	**$109**	**$119**	**$135**	**$164**	**$176**	**$189**	**$200**	**$196**	**$191**	**$187**	**$183**	**$179**
Costs and Savings to North Carolina Businesses (Million 2021$ @ 3% Discount Rate)														
Sales & Excise Tax	$3	$4	$5	$6	$6	$8	$8	$8	$9	$9	$8	$8	$8	$8
Fuel	-$12	-$29	-$48	-$73	-$99	-$127	-$157	-$186	-$213	-$244	-$269	-$292	-$311	-$325
Vehicle Maintenance	-$5	-$11	-$20	-$29	-$39	-$50	-$61	-$72	-$83	-$92	-$101	-$108	-$115	-$120
Maintenance Bay Upgrades	$1	$3	$4	$6	$9	$10	$12	$13	$14	$14	$14	$14	$14	$13
Midlife	$0	$0	$0	$0	$0	$7	$9	$12	$14	$16	$30	$35	$41	$45
EVSE Infrastructure	$13	$28	$47	$69	$94	$120	$147	$175	$204	$230	$255	$277	$298	$316
Workforce Transition	$2	$2	$3	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Impacts to NC Businesses	**$2**	**-$3**	**-$9**	**-$18**	**-$30**	**-$33**	**-$41**	**-$49**	**-$56**	**-$67**	**-$63**	**-$65**	**-$66**	**-$63**
Potential IRA Tax Credits (Million 2021$, @ 3% Discount Rate)														
Vehicle Tax Credits	-$47	-$59	-$67	-$71	-$74	-$89	-$86	$0	$0	$0	$0	$0	$0	$0
Infrastructure Tax Credits	-$28	-$41	-$57	-$71	-$85	-$95	-$105	$0	$0	$0	$0	$0	$0	$0
Total IRA Tax Credits	**-$74**	**-$101**	**-$124**	**-$142**	**-$159**	**-$184**	**-$191**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Costs and Savings to North Carolina State Government (Million 2021$ @ 3% Discount Rate)														
DAQ Compliance Costs	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Net Impacts to State Government	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**
Costs and Savings to North Carolina Local Governments (Million 2021$ @ 3% Discount Rate)														
Fleet Pass-Through	*already included in costs to manufacturers and businesses*													
Net Impacts to Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Cost Impacts (Million 2021$ @ 3% Discount Rate)														
Total Net Costs (3% Discount Rate)	**-$15**	**-$13**	**-$23**	**-$40**	**-$54**	**-$53**	**-$56**	**$139**	**$144**	**$128**	**$129**	**$122**	**$117**	**$117**

Table 37: Summary of Net Impacts to Manufacturers, Businesses, and Government at a 3% Discount Rate (continued)

Calendar Year	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	Totals (CY 2026-2049) (MY 2027-2050)
Model Year	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	
Costs and Savings to Manufacturers (Million 2021$ @3% Discount Rate)											
Incremental ZEV Price	$186	$182	$178	$174	$170	$167	$163	$159	$156	$130	$3,997
ICE Phase 2 GHG	-$11	-$11	-$11	-$10	-$10	-$10	-$10	-$9	-$9	-$8	-$254
Net Impacts to Manufacturers	**$175**	**$171**	**$168**	**$164**	**$160**	**$157**	**$153**	**$150**	**$146**	**$123**	**$3,744**
Costs and Savings to North Carolina Businesses (Million 2021$ @ 3% Discount Rate)											
Sales & Excise Tax	$8	$8	$7	$7	$7	$7	$7	$7	$7	$6	$168
Fuel	-$341	-$356	-$367	-$378	-$384	-$389	-$402	-$407	-$412	-$416	-$6,238
Vehicle Maintenance	-$125	-$128	-$131	-$133	-$135	-$136	-$136	-$137	-$136	-$136	-$2,240
Maintenance Bay Upgrades	$13	$12	$11	$11	$10	$9	$9	$8	$8	$7	$239
Midlife	$48	$58	$60	$59	$57	$53	$49	$45	$43	$40	$722
EVSE Infrastructure	$333	$347	$360	$371	$380	$388	$389	$386	$381	$368	$5,978
Workforce Transition	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10
Net Impacts to NC Businesses	**-$64**	**-$60**	**-$58**	**-$63**	**-$64**	**-$67**	**-$86**	**-$97**	**-$111**	**-$131**	**-$1,360**
Potential IRA Tax Credits (Million 2021$, @ 3% Discount Rate)											
Vehicle Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$493
Infrastructure Tax Credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$482
Total IRA Tax Credits	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**-$975**
Costs and Savings to North Carolina State Government (Million 2021$ @ 3% Discount Rate)											
DAQ Compliance Costs	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.18
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Net Impacts to State Government	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.01**	**$0.18**
Costs and Savings to North Carolina Local Governments (Million 2021$ @ 3% Discount Rate)											
Fleet Pass-Through	*already included in costs to manufacturers and businesses*										
Net Impacts to Local Governments	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Net Cost Impacts (Million 2021$ @ 3% Discount Rate)											
Total Net Costs (3% Discount Rate)	**$111**	**$112**	**$109**	**$101**	**$96**	**$90**	**$68**	**$52**	**$36**	**-$8**	**$1,409**

Table 38: Summary of Net Impacts and Health Benefits at a 3% Discount Rate

Calendar Year			2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Model Year			**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Total Net Costs (Million 2021$ @ 3% Discount Rate)																
Total Net Costs			**-$15**	**-$13**	**-$23**	**-$40**	**-$54**	**-$53**	**-$56**	**$139**	**$144**	**$128**	**$129**	**$122**	**$117**	**$117**
North Carolina Health Benefits (Million 2021$ @ 3% Discount Rate)																
3%	CO_2 (SC-CO_2)		$0.0	-$0.2	-$1.1	-$3.7	-$7.2	-$11.8	-$17.6	-$23.5	-$30.7	-$38.8	-$46.7	-$54.8	-$63.2	-$71.0
	NOx (COBRA)	Low Estimate	-$0.7	-$1.2	-$2.0	-$2.9	-$4.2	-$5.6	-$7.2	-$9.0	-$10.9	-$13.0	-$15.0	-$17.0	-$19.0	-$20.9
		High Estimate	-$1.6	-$2.8	-$4.4	-$6.6	-$9.4	-$12.6	-$16.3	-$20.3	-$24.6	-$29.2	-$33.8	-$38.3	-$42.8	-$47.1
	$PM_{2.5}$ (COBRA)	Low Estimate	-$0.5	-$0.7	-$1.1	-$1.7	-$2.6	-$3.3	-$4.2	-$5.0	-$5.7	-$6.5	-$7.1	-$7.8	-$8.4	-$9.0
		High Estimate	-$1.0	-$1.7	-$2.5	-$3.9	-$5.8	-$7.5	-$9.4	-$11.2	-$12.8	-$14.6	-$16.0	-$17.5	-$19.0	-$20.2
Total Benefits		**SC-CO_2 + Low COBRA**	**-$1.2**	**-$2.2**	**-$4.2**	**-$8.3**	**-$14.0**	**-$20.8**	**-$29.0**	**-$37.5**	**-$47.3**	**-$58.2**	**-$68.8**	**-$79.6**	**-$90.6**	**-$100.9**
		SC-CO_2 + High COBRA	**-$2.7**	**-$4.7**	**-$8.1**	**-$14.2**	**-$22.4**	**-$32.0**	**-$43.3**	**-$55.1**	**-$68.2**	**-$82.6**	**-$96.5**	**-$110.7**	**-$125.0**	**-$138.3**

Table 38: Summary of Net Impacts and Health Benefits at a 3% Discount Rate (continued)

												Totals
Calendar Year			**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**CY 2026-2049**
Model Year			**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**MY 2027-2050**
Total Net Costs (Million 2021$ @ 3% Discount Rate)													
Total Net Costs			**$111**	**$112**	**$109**	**$101**	**$96**	**$90**	**$68**	**$52**	**$36**	**-$8**	**$1,409**
North Carolina Health Benefits (Million 2021$ @ 3% Discount Rate)													
3%	CO_2 (SC-CO_2)		-$79.0	-$90.0	-$99.0	-$108.3	-$117.8	-$127.5	-$137.4	-$147.6	-$158.0	-$168.7	-$1,604
	NOx (COBRA)	Low Estimate	-$22.8	-$24.8	-$26.8	-$28.8	-$30.7	-$32.7	-$34.6	-$36.6	-$38.6	-$40.5	-$446
		High Estimate	-$51.3	-$55.9	-$60.4	-$64.8	-$69.2	-$73.6	-$78.0	-$82.4	-$86.8	-$91.3	-$1,004
	$PM_{2.5}$ (COBRA)	Low Estimate	-$9.4	-$10.0	-$10.9	-$11.3	-$12.0	-$12.5	-$13.1	-$13.7	-$14.4	-$14.9	-$186
		High Estimate	-$21.2	-$22.6	-$24.5	-$25.4	-$27.0	-$28.3	-$29.5	-$30.8	-$32.4	-$33.7	-$419
Total Benefits		**SC-CO_2 + Low COBRA**	**-$111.2**	**-$124.9**	**-$136.7**	**-$148.3**	**-$160.5**	**-$172.7**	**-$185.2**	**-$197.9**	**-$211.0**	**-$224.1**	**-$2,235**
		SC-CO_2 + High COBRA	**-$151.5**	**-$168.6**	**-$183.9**	**-$198.4**	**-$214.0**	**-$229.3**	**-$245.0**	**-$260.8**	**-$277.3**	**-$293.7**	**-$3,026**
NPV of Quantified Impacts (million 2021$, 3% Discount Rate)										**Using low COBRA benefits**			**-$826.5**
										Using high COBRA benefits			**-$1,617.5**

The NPV at a 3% discount rate was calculated as a net benefit ranging from $826.5 million using the lower COBRA health benefits to $1,617.5 million using the higher COBRA health benefits, as shown in

Table 38.

The magnitude of the costs and benefits summarized in this section are highly uncertain due to the method for estimating costs and the uncertainties described in Subsection VII.C below. While there are uncertainties with the estimated costs and benefits, the magnitude of the costs relative to the magnitude of the benefits provide a reasonable indicator that the benefits will outweigh the costs of the proposed rules, especially over the long term.

C. Uncertainties and Limitations

There are a number of uncertainties associated with the fiscal analysis, including those associated with the CARB's analysis (and therefore inherent in this analysis), the VMT scaling approach used for many of the costs, savings, and benefits outlined in this fiscal analysis, and the ongoing transition of the transportation and electricity sectors. This section provides a summary of the primary uncertainties associated with this analysis.

CARB Analysis

The CARB analysis was developed from 2018-2021 and at that time used the best available data for estimating costs of implementing the ACT Rules. Uncertainties in the CARB's analysis of future impacts of the rules, which then become inherent uncertainties in the costs, savings, and benefits to North Carolina that are based on scaled values from the CARB's analysis. For the CARB analysis, these uncertainties include manufacturer investment into the production of ZEVs, projected costs of diesel, gasoline, hydrogen, and electricity, and socioeconomic impacts of businesses purchasing ZEVs.

To address the uncertainty in the fuel savings between California and North Carolina, the DAQ used the estimates of fuel quantities to estimate the potential fuel savings for North Carolina rather than scaling the total fuel cost in the CARB analysis. The CARB analysis included the quantity of gasoline and diesel fuel savings, as well as increased demand for electricity and hydrogen. These quantities were scaled using the VMT scaling factor and multiplied by the fuel price. The EIA end user price projections for gasoline, diesel, and electricity prices for the South Atlantic region were used to calculate the fuel costs or savings. The gasoline and diesel prices were adjusted using OSBM projections for fuel sales tax. The cost of hydrogen used in the CARB analysis was used to estimate the fuel costs for fuel cell vehicles.

While there are numerous tools available to predict future fuel and electricity prices to estimate reasonable costs and savings, it is difficult to predict how manufacturers and businesses will respond to the implementation of the ACT Rules. If business demand for ZEVs is high, then costs are more likely dependent on the supply of these vehicles from manufacturers (i.e., supply-limited). Conversely, if manufacturers produce many of these ZEVs, vehicle costs will be more driven by

businesses' demand for these vehicles. These factors will affect the cost of the vehicles, which is one of the significant costs in this analysis.

Electricity Price Projections

Future electricity prices were projected to estimate three of the fiscal impact values summarized in Subsections V.B and V.C: 1) the cost of electricity to businesses for charging EVs; 2) the State revenue from electricity taxes; and 3) the revenue to local governments from electricity taxes. The electricity prices used to estimate the cost of electricity to businesses for charging EVs were obtained from EIA AEO 2023[37], which were provided as "end-use prices" (i.e., including taxes). The AEO provides these values in both nominal cents per kilowatt-hour, and in 2022 cents per kilowatt-hour (which was converted to 2021 dollars per kilowatt-hour as shown in Table 8 to estimate the total cost of EV charging to businesses). Table 39 shows the electricity price projections from EIA AEO 2030 for the Southeast Region and the values converted to 2021 dollars presented in Table 8.

[37] EIA AEO 2023, Table 54 (Electric Power Projections by Electricity Market Module Region) SERC Reliability Corporation (Southeastern) Region, transportation sector,

Table 39: Electricity Price Projections used to Estimate EV Charging Costs

	EIA AEO 2023 End-Use Price, SERC/Southeast Region, Transportation			
Calendar Year	**nominal cents per kWh**	**2022 cents per kWh**	**2021 cents per kWh**	**2021$/kWh (Table 8)**
2026	15.2	13.8	12.9	$0.13
2027	15.5	13.6	12.7	$0.13
2028	15.8	13.4	12.5	$0.13
2029	16.1	13.2	12.4	$0.12
2030	16.5	13.1	12.2	$0.12
2031	16.9	13.1	12.2	$0.12
2032	17.4	13.0	12.2	$0.12
2033	18.0	13.2	12.3	$0.12
2034	18.6	13.3	12.4	$0.12
2035	19.1	13.1	12.3	$0.12
2036	19.5	13.1	12.2	$0.12
2037	20.1	13.1	12.2	$0.12
2038	20.7	13.1	12.3	$0.12
2039	21.4	13.3	12.4	$0.12
2040	22.0	13.2	12.3	$0.12
2041	22.6	13.0	12.2	$0.12
2042	23.1	13.0	12.1	$0.12
2043	23.6	12.9	12.0	$0.12
2044	24.1	12.8	12.0	$0.12
2045	24.7	12.8	11.9	$0.12
2046	25.4	12.5	11.7	$0.12
2047	25.9	12.3	11.5	$0.11
2048	26.5	12.2	11.4	$0.11
2049	26.8	12.0	11.2	$0.11
2050	27.3	11.8	11.0	$0.11
Average Annual Growth 2026-2050	2.48%			

The prices were also carried through to ultimately affect the electricity tax revenue to the State (Table 22) and to local governments (Table 23). While the DAQ believes that use of these prices is the best available approach for the estimations in this fiscal analysis, the values carry some uncertainty for the following reasons:

- The values represent "Reference Case" projections. The EIA's AEO 2023 narrative notes that reference case represents the "best guess under nominal conditions, which presumes no new policy or laws over the modeled time horizon," also noting that only current laws and regulations are considered. Therefore, any possible changes in electricity prices reflected in recent filings with the NCUC would not be captured in these projections or the resulting cost and savings estimations.

- The "end-use prices" represent an average across the Southeast U.S. Specifically, the SERC Reliability Corporation (Southeastern) Region. The SERC region includes 8 states and portions of an additional 8 states. Thus, they would not incorporate the effects of North Carolina-specific requirements such as Session Law 2021-165 (House Bill 951)[38] that authorizes the NCUC to:
    - Take all reasonable steps to achieve a 70% reduction in CO_2 emissions emitted in the State from electric public utilities from 2005 levels by the year 2030, and carbon neutrality by the year 2050,
    - Authorize performance-based regulation of electric public utilities,
    - Proceed with rulemaking on securitization of certain costs and other matters, and
    - Allow potential modification of certain existing power purchase agreements with eligible small power producers.

IRA and IIJA Impacts

The federal Infrastructure Investment and Jobs Act (IIJA) (Public Law 117-58, also known as the "Bipartisan Infrastructure Law" or BIL) was adopted November 15, 2021 and the federal IRA (Public Law 117-169) was adopted August 16, 2022. Both of these federal laws provide billions of dollars of funding to state and local agencies, businesses, and citizens of North Carolina to invest in ZEV technology and infrastructure to facilitate economic growth and reduce CO_2 and health impacts associated with criteria air pollutant emissions. The IRA includes a maximum commercial clean vehicle tax credit of $7,500 for qualified vehicles with GVWR under 14,000 pounds, and up to $40,000 for all other qualifying vehicles. Additionally, the advanced energy projects section of the IRA provides $10 billion of tax credits allocated to clean energy projects, including projects involving charging and refueling infrastructure for MHD electric or fuel cell vehicles. These tax credits, which provide up to 30% of the cost of a charging station (not to exceed $100,000), would potentially reduce the EVSE infrastructure costs for North Carolina businesses. Subsection V.B.3 of this fiscal note includes estimations of these two potential IRA tax credits; however, these estimations are based on the ZEV adoption rates in line with the proposed ACT Rules sales requirements and do not capture the additional acceleration in ZEV adoption expected to result from the IRA or IIJA.

Further, the IRA and IIJA provide billions of dollars of additional federal funding opportunities related to MHD ZEVs that could not be quantified in this analysis which DAQ believes will further reduce the costs associated with this transition of the transportation sector toward the adoption of ZEVs. Table C-3 of Appendix C lists the additional funding opportunities under the IRA and IIJA related to MDH ZEVs.

The IRA/IIJA tax credits will support ZEV adoption for businesses in North Carolina. The tax credits will lower the impacts on businesses in North Carolina and accelerate the replacement of older gasoline and diesel trucks with ZEVs. The proposed ACT Rules will help secure an adequate supply of MHD ZEVs in North Carolina to smooth the transition and, in combination with the tax credits, further accelerate the transition to ZEVs in NC.

[38] General Assembly of North Carolina, Session 2021, Session Law 2021-165, House Bill 951, https://ncleg.gov/Sessions/2021/Bills/House/PDF/H951v6.pdf.

EGU Emissions

The CARB analysis did not quantify any emission increases associated with the electricity generation required to charge the ZEVs and NZEVs required by the proposed ACT Rules. Therefore, these EGU emissions were not included in this Fiscal Note analysis for North Carolina. However, the CARB analysis does include fuel economy data for electric, gasoline, and diesel vehicles; therefore, the increased electricity usage required to charge California's required number of ZEVs and NZEVs can be estimated. This increased electricity usage for California can then be scaled to North Carolina using the VMT scaling factor of 0.36. EGU emission factors developed by the EPA[39] were used to estimate the EGU emissions from the increased electricity needed to charge electric vehicles. These emission factors have been adjusted to take into account impacts of the IRA and decrease over time as higher-emitting power generation technologies like coal and natural gas combustion are phased out in favor of renewable sources. A summary of the EGU emission increases and the estimated ACT emission reductions for CO_2, NOx, and $PM_{2.5}$ for the years 2026 through 2049 are shown in Table 40 below. Table 40 shows the range of CO_2, $PM_{2.5}$ and NOx emission factors for the years 2035, 2040, 2045, and 2050. To estimate the EGU emissions, a linear regression was performed using the EPA data to determine emission factors for each of the years 2026 through 2049. The emission factors were then multiplied by the increased electricity usage for North Carolina to estimate the EGU emissions for that year.

Table 40: Estimated Potential Net Emissions Impact from EGUs

EPA IRA-Adjusted EGU Emission Factors 2035-2050 Annual Average Output Emission Rate ***(lb/MWh)***			
Projection Year	**CO_2**	**NOx**	**$PM_{2.5}$**
2035	273	0.035	0.015
2040	175	0.027	0.012
2045	100	0.013	0.006
2050	60	0.004	0.004
Emission Estimates (Cumulative, 2026-2049)			
Scenario	**CO_2 (million metric tons/yr)**	**NOx (tons/yr)**	**$PM_{2.5}$ (tons/yr)**
ACT Reductions (Table 24, Table 25, Table 26)	**20**	**61,516**	**1,007**
Estimated EGU Increases from ACT	**4**	**582**	**264**
ACT – EGU Difference	**16**	**60,934**	**743**

As shown in the emission estimates, the increases in EGU emissions are expected to be significantly lower than the projected ACT emission reductions. However, this would reduce the environmental

[39] U.S. EPA, EPA Greenhouse Gas Emissions for Heavy-Duty Vehicles: Phase 3 Draft Regulatory Impact Analysis (EPA-420-D-23-001), Table 4-8, April 2023. https://www.epa.gov/system/files/documents/2023-05/420d23004.pdf

and health benefits as a result of the CO_2, $PM_{2.5}$, and NOx emission reductions achieved from the implementation of the ACT rules and quantified in Section VI and Subsection VII.B.

VMT Scaling Factor

Another uncertainty of scaling the California data to North Carolina is differences in the economies of each State. California has an economy that is driven, in large part, by the import and export of goods to and from the United States. California has a total of 12 ports, eleven of which are publicly owned, and one of which is privately owned. These ports process about 40% of all containerized imports and 30% of all exports in the United States. MHD trucks are used to move these goods to and from various locations in the State for distribution. North Carolina has two major ports that import and export goods, Wilmington and Morehead City. These goods are moved between these ports and locations in and out of the State. Since some of these imported goods are moved out of the State, the associated MHD mileage may not be captured in the FHWA statistics as occurring within North Carolina.

North Carolina is also known as a pass-through State, meaning MHD trucks travel through North Carolina to destinations along the east coast. These trucks do not originate from or deliver goods to North Carolina, but rather just travel through the State to their ultimate destination. These truck miles are included in the FHWA mileage statistics, but the owners of the trucks may not be subject to these proposed ACT Rules because they are not registered in the State.

As a result, the scaling of truck mileage may not represent the true impacts that North Carolina may experience, relative to California's estimated ACT Rules impacts. There is some uncertainty associated with the MHD mileage by companies in North Carolina in the FHWA statistics, which could potentially decrease or increase the VMT scaling factor. A lower mileage estimate for North Carolina (relative to California) would lower the VMT scaling factor, which would in turn lower the costs and savings (to all entities), as well as environmental and health benefits estimated in this analysis. A higher mileage estimate would increase the business costs and cost benefits. However, the DAQ believes that the VMT scaling approach provides the best estimate of costs and benefits of North Carolina's proposed ACT Rules within the timeframe for developing this fiscal note.

Vehicle Production Cost and Price Parity

One of the largest cost components to manufacturers in the CARB analysis was the incremental cost of producing a ZEV in comparison to an ICE vehicle. The CARB analysis estimated the cost of building a ZEV by using the cost of a conventional glider vehicle and adding electric components, fuel cell components, and energy storage costs, and applied a 10% markup to cover costs for research, development, retooling and overhead. The CARB analysis used cost data for battery electric vehicle components from an ICCT white paper.[40] Fuel cell components were obtained from the ICCT white paper and other sources. In calculating the incremental cost, the CARB analysis kept the cost of the ICE vehicle constant and adjusted the cost of the ZEV based on declining battery storage costs. However, there was never a vehicle cost parity achieved between the ZEV and ICE vehicles in the

[40] International Council on Clean Transportation, Transitioning to Zero-Emission Heavy-Duty Freight Vehicles, September 26, 2017. https://theicct.org/publication/transitioning-to-zero-emission-heavy-duty-freight-vehicles/

CARB analysis. Since the publication of the CARB analysis, several studies have looked at MHD cost parity for ZEVs compared in ICE vehicles and include adjustments based on the IRA.

Table 41 shows EPA's estimates of the average incremental cost per vehicle (aggregated by regulatory group) of HDVs relative to ICEs for 2027 and 2032 developed to support its proposed rulemaking to strengthen GHG standards for HDVs. The estimates were developed for 101 truck sizes and applications for battery and fuel cell electric vehicles, and include direct manufacturing costs that reflect learning effects, indirect costs, and the IRA Section 13502 Advanced Manufacturing Production Credit. The results imply that for light- and medium-heavy duty vocational vehicles and day cab tractors, the incremental cost of a ZEV vehicle would reach cost parity during the 5-year analysis period. However, for heavy-heavy duty vocational vehicles, the average incremental costs between ZEVs and ICEs may increase due to complying with the proposed standards, which become increasingly more stringent over time.

Overall, it is expected that cost parity between ZEVs and ICEs will occur for several types of MHD vehicles indicating that the incremental ZEV manufacturer costs estimated in this fiscal note are overstated.

Table 41: EPA Estimates of Manufacturer Incremental ZEV Cost Per Vehicle (2021$) for Proposed Phase III GHG Emissions Standards[41]

Vehicle Type	Year	Incremental Cost Per Vehicle [a]
Light-Heavy Duty Vocational	2027	$1,750
Light-Heavy Duty Vocational	2032	-$9,515
Medium-Heavy Duty Vocational	2027	$15,816
Medium-Heavy Duty Vocational	2032	$1,358
Heavy-Heavy Duty Vocational	2027	-$505
Heavy-Heavy Duty Vocational	2032	$8,146
Day Cab Tractors	2027	$64,121
Day Cab Tractors	2032	$26,364
Sleeper Cab Tractors	2027	N/A
Sleeper Cab Tractors	2032	$54,712

Other Pollutant Impacts

This fiscal analysis includes the health impacts associated with reductions of pollutants addressed in the CARB's ACT Rule analysis (CO_2, NOx, and $PM_{2.5}$). However, there may be additional pollutant impacts not included in the analyses, as described below.

[41] Tables 2-96 and 2-97 of Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3, Draft Regulatory Impact Analysis, Assessment and Standards Division Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-D-23-001, April 2023. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10178RN.pdf

One pollutant not included in the health impacts quantified in Section VI and Subsection VII.B is sulfur dioxide (SO_2). Exposure to SO_2 can have harmful effects on the human respiratory system and cause difficulty breathing, especially affecting people with asthma, particularly children.[42] As described previously in this fiscal note, the proposed ACT Rules would decrease the number of diesel MHD ICE vehicles on the road in North Carolina, thus reducing the amount of diesel burned. Since diesel contains a small amount of sulfur, there are expected decreases in SO_2 emissions, which result from the combustion of sulfur-containing diesel in ICE vehicles. However, the CARB's ACT analysis did not include estimated emission reductions of SO_2 from which the North Carolina's emission reductions could be scaled with the approach utilized for other pollutants. Further, the sulfur content of diesel is very low, primarily due to the phase-in of EPA regulations lowering the amount of sulfur in diesel fuel. From 2006 to 2010, EPA regulations phased-in requirements for ultra-low sulfur diesel (ULSD), which is defined as containing no more than 15 parts per million (ppm) sulfur, for diesel fuel used in on-road highway vehicles.[43] Today, all highway diesel fuel supplied to the U.S. market is required to be ULSD, and all highway diesel vehicles are required to use ULSD.[44] Due to the low sulfur content of diesel fuel, the resulting SO_2 reductions and associated health benefits from the proposed ACT Rules are expected to be minor in comparison to the health impacts from reductions of CO_2, NOx, and $PM_{2.5}$ quantified in this fiscal note.

Another pollutant not quantified in this analysis is ground-level ozone (O_3). While the COBRA results in Subsection VI.B of this fiscal note include the expected health benefits from estimated NOx reductions resulting from the proposed ACT Rules, COBRA does not evaluate impacts associated with O_3, which is formed from a photochemical reaction of VOC and NOx in the presence of sunlight. Along with the direct health impacts outlined in Subsection VI.B, reductions in NOx emissions may also lead to reductions in O_3 formation, since there would be less NOx with which VOCs could react. The potential implications of this are twofold. Firstly, ozone is a federally regulated pollutant with a National Ambient Air Quality Standard (NAAQS) that is currently under review by EPA. Ozone reductions from on-road vehicles would help to ensure North Carolina remains in attainment of the ozone NAAQS, if the standard is lowered following the conclusion of EPA's ongoing review. Secondly, ground-level ozone has its own health impacts, outside of those attributable to its precursor pollutants. Ozone can cause coughing, sore or scratchy throat, difficulty or pain associated with breathing deeply and vigorously, inflamed and damaged airways, increased susceptibility to lung infection, aggravation of lung diseases such as asthma, emphysema, and chronic bronchitis, and increased frequency of asthma attacks. Although these effects can happen in healthy people, they are more serious in people with lung diseases (such as asthma), and may lead to increased school absences, medication use, visits to doctors, emergency rooms, and hospitals.[45] The inclusion of benefits from the two additional pollutants described above (SO_2 and O_3) would add to

[42] Sulfur Dioxide Basics, U.S. EPA, https://www.epa.gov/so2-pollution/sulfur-dioxide-basics

[43] Diesel Fuel Standards and Rulemakings, Overview of Diesel Standards, U.S. EPA, https://www.epa.gov/diesel-fuel-standards/diesel-fuel-standards-and-rulemakings

[44] Diesel Fuel Standards and Rulemakings, Onroad (Highway) Diesel Fuel Standards, U.S. EPA, https://www.epa.gov/diesel-fuel-standards/diesel-fuel-standards-and-rulemakings

[45] Health Effects of Ozone Pollution, U.S. EPA, https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

the benefits quantified in Subsection VII.B, furthering the conclusion of this analysis that the benefits from the proposed ACT Rules are understated across the evaluation period (2026-2049).

Health Benefits from Reductions to NOx and $PM_{2.5}$

As explained in Subsection VI.B, the health benefits associated with emission reductions resulting from the proposed ACT Rules were estimated using EPA's COBRA tool. This is consistent with DAQ's practices for other rulemaking fiscal analyses, and some other states that have adopted rules to implement California's ACT program. On April 12, 2023, the EPA announced a proposal[46] for more stringent standards to reduce greenhouse gas emissions from heavy-duty (HD) vehicles beginning in MY 2027. In their analysis of the health benefits for the proposed rule, the EPA estimated the health impacts and associated economic value of those impacts using the Environmental Benefits Mapping and Analysis Program (BenMAP)[47]. BenMAP is an open-source computer program developed by the EPA that calculates the incidence number and economic value of air pollution-related deaths and illnesses. The software incorporates a database that includes many of the concentration-response relationships, population files, and health and economic data needed to quantify these impacts. The two current versions of this tool are BenMAP in the Cloud, which operates via a webpage, and BenMAP-Community Edition (BenMAP-CE) v1.5.

Using BenMAP health benefits and emission reductions for NOx and $PM_{2.5}$, a benefit per ton of emission reductions was calculated from the data in the Regulatory Impact Analysis[48] for the proposed EPA rule. These BenMAP benefit per ton of emission reduction values were then used to calculate the benefits for the ACT reductions estimated in this fiscal note. The results were compared to the benefit per ton of emission reduction calculated using the COBRA program for the proposed ACT rules. The COBRA benefits calculated for the proposed ACT rules, from CY 2026-2049, ranged from $564 to $1,269 million at a 7% discount rate. The health benefits calculated using the same emission reductions from the proposed ACT rules, but with the benefit per ton values calculated from the BenMAP results for the proposed EPA rules, ranged from $1,064 to $2,104 million at a 7% discount rate. Table 42 below shows a comparison of the annual and total benefits estimated using the two methodologies at a 7% discount rate.

[46] U.S. EPA, Proposed Rule: Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles – Phase 3. https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-greenhouse-gas-emissions-standards-heavy

[47] Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE), U.S. EPA, https://www.epa.gov/benmap

[48] U.S. EPA, Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3, Draft Regulatory Impact Analysis, April 2023. See Tables 7-10 and 7-11. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10178RN.pdf

Table 42: Comparison of Health Benefits Estimation Methodologies at a 7% Discount Rate

Calendar Year	Present Value at 7% Discount Rate (million 2021$)			
	Benefits Using COBRA (Table 30)		Benefits using EPA Rule Methodology	
	Low Estimate	High Estimate	Low Estimate	High Estimate
2026	$1.1	$2.4	$1.6	$3.4
2027	$1.8	$4.0	$2.6	$5.4
2028	$2.8	$6.2	$4.3	$9.0
2029	$4.2	$9.4	$6.5	$13.8
2030	$6.0	$13.6	$9.9	$20.0
2031	$8.0	$18.0	$13.2	$27.4
2032	$10.2	$23.0	$17.3	$35.3
2033	$12.5	$28.1	$21.4	$43.3
2034	$14.9	$33.4	$26.1	$52.1
2035	$17.3	$39.0	$30.0	$61.7
2036	$19.7	$44.4	$34.4	$69.5
2037	$22.1	$49.8	$40.2	$79.2
2038	$24.5	$55.1	$44.3	$89.0
2039	$26.7	$60.0	$48.8	$97.5
2040	$28.7	$64.7	$53.4	$105.1
2041	$31.1	$70.1	$59.1	$115.9
2042	$33.6	$75.7	$62.6	$124.2
2043	$35.7	$80.4	$68.3	$133.2
2044	$38.1	$85.8	$74.1	$146.3
2045	$40.4	$90.8	$78.6	$155.6
2046	$42.6	$95.9	$84.0	$164.6
2047	$44.9	$101.0	$90.1	$174.7
2048	$47.3	$106.4	$95.9	$187.5
2049	$49.5	$111.5	$98.1	$190.6
Total NPV	**$563.7**	**$1,268.6**	**$1,064**	**$2,104**

At a 3% discount rate, the COBRA health benefits ranged from $631 to $1,423 million. The proposed ACT health benefits at a 3% discount rate ranged from $1,183 to $2,333 million when the EPA BenMAP benefit per ton values were used. These benefits calculated using the Ben-MAP benefit per ton values would significantly increase the potential health benefits of the proposed ACT Rules and would improve the net present value of the quantified impacts of the proposed ACT Rules. Table 43 below shows a comparison of the annual and total benefits estimated using the two methodologies and a 3% discount rate.

Table 43: Comparison of Health Benefits Estimation Methodologies at a 3% Discount Rate

Calendar Year	Present Value at 3% Discount Rate (million 2021$)			
	COBRA Benefits (Table 33)		Benefits using EPA Rule Methodology	
	Low Estimate	High Estimate	Low Estimate	High Estimate
2026	$1.2	$2.7	$1.8	$3.8
2027	$2.0	$4.5	$2.9	$6.2
2028	$3.1	$7.0	$4.8	$9.9
2029	$4.7	$10.5	$7.3	$15.1
2030	$6.8	$15.2	$10.8	$22.7
2031	$8.9	$20.1	$15.0	$30.2
2032	$11.4	$25.8	$19.5	$39.1
2033	$14.0	$31.5	$23.7	$48.5
2034	$16.6	$37.5	$28.6	$58.3
2035	$19.4	$43.8	$33.5	$68.3
2036	$22.1	$49.8	$38.3	$77.6
2037	$24.8	$55.8	$43.7	$88.7
2038	$27.4	$61.8	$49.7	$98.7
2039	$29.9	$67.3	$54.5	$106.4
2040	$32.2	$72.5	$59.6	$116.4
2041	$34.9	$78.6	$65.1	$127.6
2042	$37.7	$84.9	$69.2	$137.3
2043	$40.0	$90.1	$76.0	$150.9
2044	$42.7	$96.2	$82.8	$161.4
2045	$45.2	$101.9	$87.0	$168.5
2046	$47.7	$107.5	$93.7	$184.2
2047	$50.3	$113.2	$99.5	$195.7
2048	$53.0	$119.3	$106.5	$204.6
2049	$55.5	$125.0	$109.2	$213.3
Total NPV	**$631.4**	**$1,422.5**	**$1,183**	**$2,333**

There are several differences between the health benefit estimates using COBRA and BenMAP. The COBRA program contains detailed emission estimates of $PM_{2.5}$, SO_2, NOx, NH_3, and VOCs for the year 2016, and detailed projections for 2023 and 2028 as developed by the U.S. EPA. For this fiscal note analysis, the 2023 COBRA projections were used to estimate the health benefits of the proposed ACT rules. The EPA BenMAP provided health benefit estimates for 2027 through 2055 and these values were used to calculate the potential heal benefits of the estimated reductions for that respective year. Therefore, the potential health benefits are greater when using the BenMAP health benefit per ton values in comparison to the health benefits from COBRA. The health benefit estimates have also been updated in the BenMAP using new risk analysis studies that reflect more recent data. The BenMAP health benefit estimates include a longer follow-up period that includes more recent $PM_{2.5}$ concentrations and is more representative of the U.S. population with respect to the distribution of individuals by race, ethnicity, income and education.

Future of Fuel Tax Revenue Stream

A 2020 NC FIRST Commission[49] brief highlighted the expected future decline in gas tax revenues, as vehicle fuel economy improves, and alternative fuel vehicles become more prevalent. The brief also identified higher growth in diesel sales than gasoline sales in recent years, indicating a shift from personal gasoline consumption towards e-commerce transactions resulting in transportation of goods by truck.[50] The following year in 2021, the NC FIRST Commission published a final report[51] of their modernization study indicating that North Carolina relies too heavily on motor fuels taxes, and that motor fuel tax revenues will decline. The report recommended an array of possible solutions to aid in stabilizing revenues, including replacement of the Motor Fuel Tax with a Mileage-Based User Fee by 2030.

Additionally, the North Carolina General Assembly has recently taken, or is considering actions with impacts to the current transportation revenue structure. Session Law (S.L.) 2022-74 transferred $193.1 million, or 2%, of sales tax revenue to the Highway Fund. By 2024, the Highway Fund and Highway Trust Fund will receive a combined total of 6% of sales tax revenues (S.L. 2022-74, Section 42.3.(a)).[52] Senate Bill 354 would increase the annual add-on registration fee for EVs from $140.25 to $180.00 (both subject to CPI increases every 4 years, as described in Subsection V.B.4), require a new, additional, annual registration fee for plug-in hybrid vehicles of $90.00, and make other changes to increase revenue for roads.[53] House Bill (HB) 128, entitled *An Act To Enact the Electric Vehicle Highway Use Equalization Tax*, would add a new tax to electric vehicles and fuel cell electric vehicles that is based on the miles traveled by the vehicle each year.[54] HB 128 would set the EV VMT tax to 1.2 cents per mile traveled, subject to a percentage increase that is based on changes in population and CPI.[55]

The topic of Mileage-Based User Fees also had its own breakout session at the 2023 N.C. Transportation Summit,[56] and the Access User Fee concept continues to be championed by the NC Chamber as a sustainable option to replace the gas tax. The Access User Fee would charge all passenger vehicles the same rate (whether electric, gasoline, or hybrid), equal to what the owner of a

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[49] The NC Future Investment Resources for Sustainable Transportation (FIRST) Commission was created in 2019 to advise the Secretary of Transportation in the formation of a sustainable long-range transportation investment strategy.

[50] NC FIRST Commission, The Motor Fuels Tax,August 2020. https://www.ncdot.gov/about-us/how-we-operate/finance-budget/nc-first/Documents/nc-first-brief-edition-1.pdf

[51] NC FIRST Commission, Final Commission Report, January 2021, https://www.ncdot.gov/about-us/how-we-operate/finance-budget/nc-first/Documents/2021-01-08-final-report.pdf

[52] Session Law 2022-74, North Carolina General Assembly, https://www.ncleg.gov/EnactedLegislation/SessionLaws/PDF/2021-2022/SL2022-74.pdf

[53] General Assembly of North Carolina, Session 2023, Senate Bill 354, Section 1.1, March 23, 2023, https://www.ncleg.gov/Sessions/2023/Bills/Senate/PDF/S354v1.pdf

[54] General Assembly of North Carolina, Session 2023, House Bill 128, An Act to Enact the Electric Vehicle Highway Use Equalization Tax, Section 1, https://www.ncleg.gov/Sessions/2023/Bills/House/PDF/H128v1.pdf

[55] N.C.G.S. 105-449.80, Tax Rate, https://www.ncleg.gov/EnactedLegislation/Statutes/PDF/BySection/Chapter_105/GS_105-449.80.pdf

[56] 2023 N.C. Transportation Summit, North Carolina Department of Transportation, January 18-19, 2023, https://www.ncdot.gov/news/nc-transportation-summit/Pages/default.aspx

typical gasoline-powered vehicle pays in gas taxes annually, allow payment in different frequencies, and eliminate all state gas taxes.[57]

As stated previously, this fiscal note does not attempt to conclude or presume the future of NCDOT Revenues or the Motor Fuel Tax. Rather, this discussion is presented to highlight the uncertainty associated with the estimated Fuel Tax and its impact on the Highway Fund and Highway Trust Fund values presented in Subsection V.C.1, and note the possibility that the Motor Fuel Tax may be fully removed from the State's revenue structure within the time period of this analysis (i.e., before 2050).

VIII. Rule Alternatives

In accordance with N.C.G.S. 150B-21.4(b2)(5), the fiscal note for a proposed rulemaking with a substantial economic impact is required to contain a description of at least two alternatives to the proposed rules. As defined in N.C.G.S. 150B-21.4(b1), "substantial economic impact" means an aggregate financial impact on all persons affected of at least one million dollars ($1,000,000) in a 12-month period. As shown in Section V of this fiscal note, the proposed rules are expected to have a substantial economic impact. Therefore, two alternatives have been evaluated in this section.

A. Alternative 1: Business-as-Usual

The first alternative to the proposed ACT Rules would be a business-as-usual or no action approach. Under the business-as-usual alternative, meeting North Carolina's MHD ZEV transition and emissions reductions goals would be heavily reliant on factors like societal demand, fuel costs, or the IRA. As noted in the uncertainties section, the IRA provides tax credits to businesses that purchase MHD ZEVs and tax credits for the installation of ZEV charging stations. The purchase price of MHD ZEVs appears to be a potential obstacle to their uptake by businesses (despite the lower maintenance and fuel costs). As such, it is expected that these tax credits will influence some businesses in North Carolina to consider replacing their gasoline and diesel trucks with ZEVs. While these tax credits will lower the upfront cost of purchasing MHD ZEVs, it is highly uncertain whether the tax credits on their own would increase adoption of ZEVs such that North Carolina will reach its GHG emissions reduction goals outlined in the MHD ZEV Memorandum of Understanding (MOU) and Executive Order No. 246 (EO 246).[58] In July 2020, North Carolina signed onto the Multi-State MHD ZEV MOU,[59] which established goals for 30% of all new MHD vehicle sales to be ZEVs by 2030, and 100% of all new MHD vehicle sales to be ZEVs by 2050. In January 2022, EO 246 established both emission reduction and ZEV adoption goals, including: 1) a 50% reduction in statewide GHG emissions from 2005 levels by 2030; 2) net-zero GHG emissions by 2050; 3) an increase in the total

[57] The Charlotte Observer, Ed-Op, *NC business leaders: The state gas tax is the wrong way to fund roads*, Accessed June 23, 2023, https://www.charlotteobserver.com/opinion/article269075477.html

[58] State of North Carolina, Governor Roy Cooper, Executive Order No. 246, "North Carolina's Transformation To A Clean, Equitable Economy," January 7, 2022, https://governor.nc.gov/media/2907/open.

[59] North Carolina Department of Transportation (NCDOT), Multi-State Zero Emission Medium- and Heavy-Duty Vehicle Initiative - Memorandum of Understanding, July 15, 2020, https://www.ncdot.gov/initiatives-policies/environmental/climate-change/Documents/zev-memorandum-of-understanding.pdf

number of registered ZEVs to at least 1,250,000 by 2030; and 4) an increase in ZEV sales such that at least 50% of in-state new vehicle sales are zero-emission by 2030.

Under this business-as-usual alternative, it is highly unlikely that the emission reductions and associated environmental and health benefits described in Section VI would be achieved. The ACT Rules will require an increasing percentage of the MHD vehicles sold in North Carolina to be zero-emission, thus ensuring that an inventory of these vehicles is available for businesses, the State, and local governments in the State. For these reasons, the business-as-usual alternative was rejected.

B. Alternative 2: 2027 Implementation Date

The second alternative evaluated was delay of the implementation of the ACT Rules until Calendar Year 2027 (MY 2028). While this alternative would provide an additional year for manufacturers to ramp up production of MHD ZEVs for sale in North Carolina, it would also mean a higher ZEV sales percentage requirement in the first year of implementation, since North Carolina would enter at the MY 2028 sales requirements. The analysis in this fiscal note thus far assumes a Rule effective date of January 1, 2024, with implementation beginning on January 1, 2026, which would first apply the ZEV sales requirements for MY 2027 vehicles (15% for Class 2b-3 vehicles, 20% for Class 4-8 vehicles, and 15% for Class 7-8 tractors). Delaying the implementation date to January 1, 2027, would first apply the ZEV sales requirements for MY 2028 vehicles (25% for Class 2b-3 vehicles, 40% for Class 4-8 vehicles, and 25% for Class 7-8 tractors). This would result in a steeper incline for manufacturers and dealers to sell ZEVs to businesses in the first year of implementation to reach these sale requirements.

In addition, delaying the implementation date to January 1, 2027 (applying to MY 2028 vehicles) would have a small effect on the costs to manufacturers. The total impacts to manufacturers from 2026 through 2049 are $6,292 million, whereas the impacts to manufacturers for 2027 to 2049 is $6,225 million. Delaying the implementation date to MY 2028 vehicles could potentially save manufacturers $67 million. However, this would require more ZEVs to be sold in the first year of implementation (CY 2027), in comparison to 2026 implementation. Truck manufacturers are already developing and selling ZEVs as other states have been adopting and preparing to implement the ACT Rules. In addition, manufacturers would have less time to promote the IRA tax credit for ZEV vehicles, since these credits expire at the end of calendar year 2032. This fiscal note estimates a total of $86 million (undiscounted) in available IRA tax credits for clean vehicle purchases and infrastructure in North Carolina in 2026. Overall, the fiscal note shows a net benefit ranging from $13 million to $15 million for CY 2026. Without the CY 2026 impacts, the fiscal analysis shows the following net impacts: 1) a net cost to manufacturers, businesses, state government, and local governments of $2,560 million (undiscounted); 2) an overall NPV (after considering environmental and health benefits) at a 7% discount rate as a net benefit ranging from a $162.3million to $865.9 million; and 3) an overall NPV at a 3% discount rate as a net benefit ranging from $810.5 million to-$1,600 million. Table 44 presents a more detailed breakdown of the estimated impacts under Alternative 2.

Table 44: Summary of Net Impacts under Alternative 2

Summary of Costs (+) and Benefits (-) under Alternative 2 (million 2021$)		NPV CY 2027-2049	
		7%	3%
Costs and Savings			
Manufacturers		$1,969	$3,686
Businesses		-$370	-$726
IRA Tax Credits		-$644	-$901
NC State Government		-$284	-$636
NC Local Governments		$0	$0
Total Net of Costs (+) and Savings (-)		**$671**	**$1,423**
Benefits			
CO_2	$SC\text{-}CO_2$	-$271	-$1,604
NOx	Low COBRA Estimate	-$397	-$445
	High COBRA Estimate	-$894	-$1,002
$PM_{2.5}$	Low COBRA Estimate	-$166	-$185
	High COBRA Estimate	-$372	-$418
Total Benefits	**$SC\text{-}CO_2$ + Low COBRA**	**-$833.7**	**-$2,233.9**
	$SC\text{-}CO_2$ + High COBRA	**-$1,537.3**	**-$3,023.4**
Summary			
Total NPV of Costs, Savings and Benefits	**Using Low COBRA Benefits**	**-$162.3**	**-$810.5**
	Using High COBRA Benefits	**-$865.9**	**-$1,600.0**

As shown in Table 44 above, the estimated impacts under Alternative 2 result in less net benefits, primarily due to the loss of CY 2026 IRA tax credits. Therefore, the DAQ rejected this alternative and recommends that the implementation of the rule begin in CY 2026.

Appendix A: Federal Highway Administration Statistics

Appendix A List of Tables

Table A-1: Summary of FHWA Statistics - Functional System Travel

Year	State	ANNUAL VEHICLE MILES (MILLIONS) [a]		
		Rural Total	Urban Total	Rural and Urban Total
2015	California	53,679.7	281,858.8	335,538.6
	North Carolina	37,633.1	74,245.5	111,878.6
2016	California	52,995.0	287,120.0	340,114.9
	North Carolina	39,293.6	77,455.0	116,748.7
2017	California	54,701.6	289,160.5	343,862.1
	North Carolina	40,128.6	79,047.7	119,176.4
2018	California	58,432.2	290,363.5	348,795.7
	North Carolina	41,165.7	79,961.5	121,127.2
2019	California	56,480.5	284,355.8	340,836.3
	North Carolina	41,618.1	80,856.6	122,474.7
2020	California	55,380.9	244,430.7	299,811.7
	North Carolina	36,857.0	69,485.3	106,342.4

[a] Data from Federal Highway Administration Highway Statistics, Table VM-2.

Table A-2: Summary of FHWA Statistics - Percent Distribution of Annual Vehicle Distance Traveled, Buses

Year	State	PERCENT DISTRIBUTION OF ANNUAL VEHICLE DISTANCE TRAVELED[a]					
		Rural			Urban		
		Interstate System - Buses	Other Arterials - Buses	Other - Buses	Interstate System - Buses	Other Arterials - Buses	Other - Buses
2015	California	0.36	0.50	0.75	0.30	0.72	0.52
	North Carolina	0.54	0.63	0.67	0.48	0.50	0.91
2016	California	0.38	0.53	0.76	0.30	0.67	0.51
	North Carolina	0.55	0.66	0.69	0.48	0.52	0.90
2017	California	0.39	0.55	0.76	0.29	0.62	0.49
	North Carolina	0.56	0.69	0.71	0.48	0.53	0.89
2018	California	0.42	0.58	0.79	0.33	0.72	0.57
	North Carolina	0.56	0.70	0.71	0.49	0.54	0.89
2019	California	0.42	0.58	0.79	0.33	0.72	0.57
	North Carolina	0.54	0.71	0.73	0.47	0.55	0.94
2020	California	0.75	0.59	0.62	0.23	0.82	0.49
	North Carolina	0.61	0.77	0.86	0.57	0.62	0.82

[a] Data from Federal Highway Administration Highway Statistics Table VM-4.

[b] Data for 2016 was unavailable. 2016 values based on average of 2015 and 2017 percentages.

Table A-3: Summary of FHWA Statistics - Percent Distribution of Annual Vehicle Distance Traveled, Trucks

Year	State	PERCENT DISTRIBUTION OF ANNUAL VEHICLE DISTANCE TRAVELED[a]											
		Rural						Urban					
		Interstate System - Single Unit Truck	Interstate System - Combination Truck	Other Arterials - Single Unit Truck	Other Arterials - Combination Truck	Other - Single Unit Truck	Other - Combination Truck	Interstate System - Single Unit Truck	Interstate System - Combination Truck	Other Arterials - Single Unit Truck	Other Arterials - Combination Truck	Other - Single Unit Truck	Other - Combination Truck
2015	California	4.28	17.12	4.90	6.12	4.40	3.95	3.02	5.61	3.07	2.25	2.50	0.95
	North Carolina	2.59	12.16	3.45	5.22	3.84	3.80	2.39	6.45	2.79	2.21	3.00	1.51
2016[b]	California	4.26	17.13	4.91	5.95	4.23	2.75	3.13	5.12	3.08	2.08	2.33	1.24
	North Carolina	2.69	12.53	3.57	5.26	3.90	3.78	2.38	6.49	2.86	2.20	2.99	1.48
2017	California	4.23	17.13	4.91	5.77	4.05	1.55	3.23	4.63	3.09	1.91	2.16	1.52
	North Carolina	2.78	12.90	3.68	5.29	3.96	3.75	2.36	6.53	2.92	2.18	2.98	1.44
2018	California	4.43	17.35	4.70	5.08	4.05	1.71	3.46	5.65	3.30	1.92	2.21	1.29
	North Carolina	2.78	12.90	3.78	5.34	4.08	3.77	2.41	7.03	2.95	2.10	2.98	1.44
2019	California	4.43	17.35	4.70	5.08	4.05	1.71	3.46	5.65	3.30	1.92	2.21	1.29
	North Carolina	2.66	13.61	4.02	5.17	4.26	3.95	2.31	6.12	3.03	2.19	3.17	1.54
2020	California	5.59	18.80	6.73	9.93	2.56	2.09	4.45	7.50	4.67	3.26	2.35	1.36
	North Carolina	3.05	14.95	4.43	5.11	4.91	4.75	2.84	7.44	3.41	2.45	3.45	1.72

Note: Percent trucks include: buses, combination trucks, and single-unit trucks (with at least 2 axles and 6 tires).

[a] Data from Federal Highway Administration Highway Statistics Table VM-4.

[b] Data for 2016 was unavailable. 2016 values based on average of 2015 and 2017 percentages.

Appendix B: CARB ACT Regulation Analysis Tables

Appendix B List of Tables

Table B-1: Total Estimated Direct Incremental Costs for Manufacturers from CARB Analysis[60]

Calendar Year	Costs to Manufacturers (million 2021$)[a]			Annual Cost (million 2021$)
	Incremental ZEV Price	ICE Phase 2 GHG (Cost Avoided)	ZEP Certification	
2020	$0	$0	$0.00	$0
2021	$0	$0	$0.00	$0
2022	$0	$0	$0.00	$0
2023	$0	$0	$0.00	$0
2024	$112	($24)	$0.19	$89
2025	$138	($29)	$0.04	$109
2026	$173	($37)	$0.04	$137
2027	$246	($60)	$0.04	$185
2028	$319	($18)	$0.04	$301
2029	$398	($25)	$0.04	$373
2030	$450	($30)	$0.04	$420
2031	$523	($34)	$0.04	$488
2032	$651	($40)	$0.04	$611
2033	$721	($43)	$0.04	$678
2034	$795	($47)	$0.04	$748
2035	$866	($52)	$0.04	$815
2036	$874	($52)	$0.04	$822
2037	$880	($52)	$0.04	$829
2038	$887	($53)	$0.04	$834
2039	$893	($53)	$0.04	$841
2040	$901	($53)	$0.04	$848
Grand Total	**$9,828**	**($701)**	**$1.08**	**$9,128**

[a] Manufacturer's costs were converted from 2018$ to 2021$ using the National Income and Product Accounts Tables, Table 1.1.9, Implicit Price Deflators for Gross Domestic Product from the US Department of Commerce, Bureau of Economic Analysis.

[60] One cost to manufacturers that is included in the CARB ACT fiscal analysis but not included as a cost to North Carolina manufacturers in this fiscal note is that for Zero-emission Powertrain (ZEP) certification. Beginning with MY 2024, the ACT Regulation requires manufacturers to certify their MHD vehicles using the ZEP Certification procedure in order to earn ZEV credits. The DAQ assumed that there will be no additional ZEP certification costs for manufacturers to comply with ACT adoption in North Carolina since it is likely that manufacturers needing this certification will obtain it pursuant to CARB's ACT Regulation; therefore, this cost is not included in the manufacturer costs of North Carolina's analysis.

Table B-2: Fuel Economy for Each Vehicle Group and Technology[61]

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and Beyond	Units
Class 2b-3	Gasoline	10.9	11.7	mpg
	Diesel	23.0	24.8	mpg
	Battery-Electric	2.0	2.1	mi/kWh
Class 4-5	Diesel	13.8	14.3	mpg
	Battery-Electric	1.3	1.3	mi/kWh
Class 6-7	Diesel	9.6	9.9	mpg
	Battery-Electric	0.8	0.8	mi/kWh
Class 8	Diesel	7.7	8.1	mpg
	Battery-Electric	0.6	0.7	mi/kWh
Class 7-8 Tractor	Diesel	8.8	9.2	mpg
	Battery-Electric	0.6	0.6	mi/kWh
	Fuel Cell Electric	16.6	17.5	mi/kg

[61] Taken from Table IX-11 of CARB's ISOR.

Table B-3: Total Estimated Direct Incremental Costs for Businesses from CARB Analysis

Calendar Year	Costs to California Businesses (million 2021$)[a]										Annual Cost (million 2021$)
	Large Entity Reporting	Sales & Excise Tax	Fuel Costs	Low Carbon Fuel Standard (LCFS) Revenue	Vehicle Maintenance Costs	Maintenance Bay Upgrades	Midlife Costs	EVSE Infrastructure Installation & Maintenance	Transitional Costs & Workforce Deployment	Registration Fees	
2020	$16	$0	$0	$0	$0	$0	$0	$0	$0	$0	$16
2021	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2024	$0	$12	($18)	($12)	($5)	$1	$0	$14	$3	$0	($5)
2025	$0	$15	($46)	($27)	($13)	$3	$0	$32	$3	$0	($32)
2026	$0	$18	($84)	($46)	($24)	$5	$0	$57	$4	($1)	($70)
2027	$0	$26	($141)	($73)	($39)	$9	$0	$94	$6	($2)	($121)
2028	$0	$33	($222)	($112)	($60)	$14	$0	$147	$8	($3)	($196)
2029	$0	$42	($332)	($161)	($88)	$18	$9	$214	$10	($6)	($294)
2030	$0	$47	($478)	($220)	($123)	$25	$12	$297	$11	($9)	($437)
2031	$0	$55	($636)	($290)	($162)	$31	$17	$393	$0	($12)	($602)
2032	$0	$68	($808)	($367)	($204)	$38	$27	$501	$0	($16)	($762)
2033	$0	$74	($1,003)	($449)	($250)	$44	$37	$620	$0	($19)	($947)
2034	$0	$81	($1,218)	($536)	($300)	$51	$67	$748	$0	($23)	($1,129)
2035	$0	$87	($1,441)	($626)	($351)	$56	$82	$886	$0	($27)	($1,334)
2036	$0	$88	($1,660)	($713)	($402)	$59	$98	$1,022	$0	($31)	($1,540)
2037	$0	$88	($1,901)	($796)	($449)	$62	$126	$1,156	$0	($36)	($1,749)
2038	$0	$89	($2,116)	($875)	($495)	$64	$157	$1,290	$0	($41)	($1,927)
2039	$0	$91	($2,327)	($950)	($538)	$65	$189	$1,420	$0	($45)	($2,097)
2040	$0	$91	($2,535)	($1,022)	($578)	$64	$219	$1,550	$0	($51)	($2,263)
Grand Total	**$16**	**$1,006**	**($16,968)**	**($7,276)**	**($4,080)**	**$609**	**$1,039**	**$10,440**	**$45**	**($322)**	**($15,490)**

Table B-4: Summary of Estimated Fiscal Impacts on State Government from the CARB Analysis

Model Year	CARB Analysis (million 2021$)						
	CARB Staffing and Resources	State Gasoline and Diesel Fuel Taxes	Energy Resources Fee	Registration Fee	State Sales Taxes	State Fleet Cost Pass-Through	Fiscal Impact
2020	($0.6)	$0	$0	$0	$0	$0	($0.6)
2021	($0.4)	$0	$0	$0	$0	$0	($0.4)
2022	($0.4)	$0	$0	$0	$0	$0	($0.4)
2023	($0.4)	$0	$0	$0	$0	$0	($0.4)
2024	($0.4)	($5)	$0	$0	$4	($2)	($3)
2025	($0.4)	($13)	$0	$0	$5	($1)	($10)
2026	($0.4)	($22)	$0	($1)	$6	($1)	($17)
2027	($0.4)	($36)	$0	($2)	$10	($1)	($29)
2028	($0.4)	($56)	$0	($3)	$13	($2)	($48)
2029	($0.4)	($82)	$0	($6)	$16	($2)	($73)
2030	($0.4)	($114)	$1	($9)	$17	$0	($106)
2031	($0.4)	($151)	$1	($12)	$20	$2	($140)
2032	($0.4)	($192)	$1	($16)	$26	$3	($178)
2033	($0.4)	($235)	$1	($19)	$28	$5	($220)
2034	($0.4)	($282)	$1	($23)	$31	$8	($265)
2035	($0.4)	($331)	$1	($27)	$34	$11	($312)
2036	($0.4)	($378)	$2	($31)	$34	$15	($359)
2037	($0.4)	($426)	$2	($36)	$34	$19	($406)
2038	($0.4)	($469)	$2	($41)	$34	$23	($450)
2039	($0.4)	($511)	$2	($45)	$36	$26	($492)
2040	($0.4)	($550)	$2	($51)	$36	$30	($532)
Total	**($9)**	**($3,852)**	**$18**	**($321)**	**$387**	**$134**	**($3,643)**

Table B-5: Estimated Number of Annual MHD Vehicle Sales per Vehicle Group from the CARB Analysis

Vehicle Group	ACT Rule Vehicle Class GVWR (lbs)	Model Year 2024	Model Year 2025	Model Year 2026	Model Year 2027	Model Year 2028	Model Year 2029	Model Year 2030
Class 2b-3 - Gasoline [a]	8,501 up to 14,000	23,117	23,313	23,544	23,715	23,979	24,240	24,496
Class 2b-3 - Diesel [a]	8,501 up to 14,000	30,644	30,904	31,209	31,437	31,786	32,131	32,472
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	6,436	6,531	6,649	6,786	6,904	7,024	7,147
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	7,556	7,667	7,806	7,966	8,105	8,246	8,390
Class 8	Class 8 = 33,001 and above	1,119	1,137	1,177	1,194	1,216	1,239	1,264
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	4,686	4,769	4,918	4,993	5,075	5,161	5,263
Grand Total		**73,558**	**74,321**	**75,303**	**76,091**	**77,065**	**78,041**	**79,032**

[a] Class 2b-3 vehicles broken into fuel type using the CARB baseline assumptions of 43% gasoline and 57% diesel.

Table B-6: Estimated Price of ICE and ZEVs from the CARB Analysis

Vehicle Group	ACT Rule Vehicle Class GVWR (lbs)	ICE Vehicle Price [a] (2018$)	CARB ZEV Price Forecast (2018$) [b]	
			Electric Normal Range	Electric Long Range
2024 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$45,000	$64,896	$69,241
Class 2b-3 - Diesel	8,501 up to 14,000	$50,000	$64,896	$69,241
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$55,000	$80,127	$91,424
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$85,000	$116,174	$133,554
Class 8	Class 8 = 33,001 and above	$120,000	$154,799	$175,655
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$130,000	$201,351	$216,931
2025 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$45,725	$63,635	$67,568
Class 2b-3 - Diesel	8,501 up to 14,000	$50,805	$63,635	$67,568
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$55,886	$77,616	$87,841
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$86,369	$112,591	$128,321
Class 8	Class 8 = 33,001 and above	$121,932	$150,486	$169,362
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$132,093	$194,134	$212,353
2026 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$46,461	$62,599	$66,201
Class 2b-3 - Diesel	8,501 up to 14,000	$51,623	$62,599	$66,201
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$56,785	$75,585	$84,952
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$87,759	$109,702	$124,112
Class 8	Class 8 = 33,001 and above	$123,895	$147,007	$164,299
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$134,220	$188,312	$207,885
2027 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$47,209	$61,684	$65,011
Class 2b-3 - Diesel	8,501 up to 14,000	$52,454	$61,684	$65,011
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$57,699	$73,852	$82,503
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$89,172	$107,253	$120,563
Class 8	Class 8 = 33,001 and above	$125,890	$144,057	$160,029
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$136,381	$183,371	$203,439

Table B-6: Estimated Price of ICE and ZEVs from the CARB Analysis (continued)

2028 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$47,969	$60,829	$63,909
Class 2b-3 - Diesel	8,501 up to 14,000	$53,299	$60,829	$63,909
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$58,628	$72,267	$80,275
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$90,608	$105,025	$117,345
Class 8	Class 8 = 33,001 and above	$127,917	$141,371	$156,155
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$138,576	$178,870	$199,004
2029 Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$48,741	$60,035	$62,895
Class 2b-3 - Diesel	8,501 up to 14,000	$54,157	$60,035	$62,895
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$59,572	$70,830	$78,266
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$92,066	$103,016	$114,456
Class 8	Class 8 = 33,001 and above	$129,976	$138,949	$152,677
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$140,807	$174,809	$194,579
2030+ Model Year				
Class 2b-3 - Gasoline	8,501 up to 14,000	$49,526	$59,241	$61,881
Class 2b-3 - Diesel	8,501 up to 14,000	$55,029	$59,241	$61,881
Class 4-5	Class 4 = 14,001 up to 16,000; Class 5 = 16,001 up to 19,500	$60,531	$69,394	$76,258
Class 6-7	Class 6 = 19,501 up to 26,000; Class 7 = 26,001 up to 33,000	$93,549	$101,008	$111,568
Class 8	Class 8 = 33,001 and above	$132,069	$136,527	$149,199
Class 7-8 Tractors	Class 7 = 26,001 up to 33,000; Class 8 = 33,001 and above	$143,074	$170,748	$190,155

[a] Baseline vehicle prices from Table IX-6 of the CARB Initial Statement of Reasons.

Price adjusted by 1.61% per year based price data from the US Bureau of Labor Statistics.

[b] ZEV prices obtained from Table IX-7 of the CARB Initial Statement of Reasons.

Table B-7: CARB ACT Regulation Analysis Estimated NOx Emission Reductions[62]

	California NOx Emissions (tons/year)									
	Class 2b-3 Trucks			Class 4-8 Trucks			Class 7-8 Tractors			
Year	Baseline	Proposed Modifications	Reductions	Baseline	Proposed Modifications	Reductions	Baseline	Proposed Modifications	Reductions	Total CA NOx Reductions (Tons/yr)
2020	23,205	23,205	0	44,439	44,439	0	32,766	32,766	0	0
2021	21,089	21,089	0	40,270	40,270	0	30,460	30,460	0	0
2022	19,094	19,094	0	33,248	33,248	0	27,095	27,095	0	0
2023	17,239	17,239	0	25,387	25,382	5	22,360	22,356	4	9
2024	15,517	15,514	3	26,020	25,977	43	22,602	22,579	23	69
2025	13,944	13,936	8	26,412	26,317	95	22,580	22,528	52	155
2026	12,495	12,479	16	26,708	26,543	165	22,518	22,419	99	280
2027	11,201	11,174	27	26,979	26,704	275	22,471	22,298	173	475
2028	10,034	9,993	41	27,156	26,717	439	22,368	22,094	274	754
2029	9,001	8,941	60	27,213	26,551	662	22,306	21,899	407	1,129
2030	8,062	7,980	82	27,309	26,363	946	22,313	21,740	573	1,601
2031	7,228	7,121	107	27,424	26,150	1,274	22,347	21,576	771	2,152
2032	6,510	6,374	136	27,517	25,876	1,641	22,385	21,385	1,000	2,777
2033	5,879	5,711	168	27,608	25,560	2,048	22,448	21,208	1,240	3,456
2034	5,333	5,129	204	27,670	25,173	2,497	22,538	21,047	1,491	4,192
2035	4,830	4,587	243	27,736	24,755	2,981	22,655	20,910	1,745	4,969
2036	4,391	4,108	283	27,824	24,353	3,471	22,827	20,831	1,996	5,750
2037	3,984	3,664	320	27,927	23,964	3,963	23,039	20,800	2,239	6,522
2038	3,633	3,277	356	28,052	23,600	4,452	23,288	20,816	2,472	7,280
2039	3,317	2,925	392	28,199	23,263	4,936	23,564	20,875	2,689	8,017
2040	3,050	2,625	425	28,375	22,963	5,412	23,860	20,970	2,890	8,727

[62] Taken from Table 4 of CARB's ACT Regulation Analysis, Attachment D, Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation Proposed Modifications

Table B-8: CARB ACT Regulation Analysis Estimated $PM_{2.5}$ Emission Reductions[63]

	$PM_{2.5}$ Emissions (tons/yr)									
	Class 2b-3 Trucks			Class 4-8 Trucks			Class 7-8 Trucks			
Year	Baseline	Proposed Modifications	Reductions	Baseline	Proposed Modifications	Reductions	Baseline	Proposed Modifications	Reductions	Total CA $PM_{2.5}$ Reductions (Tons/yr)
2020	669	669	0	1,370	1,370	0	636	636	0	0
2021	654	654	0	1,253	1,253	0	585	585	0	0
2022	639	639	0	948	948	0	440	440	0	0
2023	624	624	0	715	715	0	393	393	0	0
2024	611	611	0	732	731	1	399	398	1	2
2025	599	598	1	745	743	2	401	401	0	3
2026	588	586	2	757	753	4	404	403	1	7
2027	578	575	3	770	764	6	407	405	2	11
2028	570	564	6	780	771	9	408	406	2	17
2029	562	554	8	789	774	15	410	407	3	26
2030	556	545	11	798	775	23	413	408	5	39
2031	551	538	13	806	775	31	414	408	6	50
2032	547	531	16	815	776	39	417	409	8	63
2033	544	526	18	824	776	48	420	411	9	75
2034	541	521	20	832	777	55	424	413	11	86
2035	539	516	23	840	777	63	427	416	11	97
2036	538	513	25	847	778	69	432	419	13	107
2037	537	510	27	855	779	76	437	423	14	117
2038	537	508	29	862	779	83	442	427	15	127
2039	536	506	30	870	780	90	447	432	15	135
2040	536	505	31	877	782	95	453	437	16	142

[63] Taken from Table 5 of CARB's ACT Regulation Analysis, Attachment D, Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation Proposed Modifications

Appendix C: Additional Reference Tables

Appendix C List of Tables

Table C-1: MHD Vehicle Manufacturers Potentially Subject to Proposed ACT Rules in NC

Manufacturer	US Headquarters Location	Vehicle Class Manufactured	Fuel Type
Arrival Ltd	Charlotte, NC	2b-3	Electric Vehicle (EV) only
Rivian Automotive	Irvine, CA	2b	EV only
Tesla	Austin, TX	8	EV Only
Nikola Motors	Coolidge, AZ	8	EV only
Navistar / International	Lisle, IL	4-8	EV and gas/diesel
Volvo Group North America (Mack Truck brand)	Greensboro, NC	3-8	EV and gas/diesel
Stellantis (previously Fiat-Chrysler Automobiles (FCA)) (Ram Truck brand)	Auburn Hills, MI	2b-5	EV and gas/diesel
PACCAR (Kenworth, Peterbilt, and DAF brands)	Kirkland, WA	5-8	EV and gas/diesel
Daimler Truck North America LLC (formerly Freightliner Corporation) (Thomas Built, Mercedes-Benz, and Western Star brands)	Portland, OR Cleveland, NC	2b-8	EV and gas/diesel
Isuzu Commercial Truck of America, Inc	Anaheim, CA	3-6	EV and gas/diesel
Ford Motor Company	Dearborn, MI	2b-8	EV and gas/diesel
General Motors Corporation/Chevrolet	Detroit, MI	2b-6	EV and gas/diesel
Isuzu	Anaheim, CA	3-6	EV and gas/diesel
Nissan	Franklin, TN	2b	EV and gas/diesel
Hino Motors Manufacturing / Toyota	Novi, MI	4-8	ZEV and diesel
Blue Bird	Fort Valley, GA	4-7	EV and gas/diesel

Table C-2: Detailed Vehicle Count and Fuel Assumptions for Baseline and Policy

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2026	2027	Class 2b-3	19,855	43%	Gasoline	8,538	Class 2b-3	15%	2,978	70%	2,085	30%	893
				57%	Diesel	11,317							
		Class 4-5	2,392	100%	Diesel	2,392	Class 4-5	20%	478	100%	478	0%	0
		Class 6-7	2,808	100%	Diesel	2,808	Class 6-7		562	100%	562	0%	0
		Class 8	426	100%	Diesel	426	Class 8		85	100%	85	0%	0
		Class 7-8 Tractors	1,797	100%	Diesel	1,797	Class 7-8 Tractors	15%	270	0%	0	100%	270
		Total				**27,277**	**Total**		**4,373**				
2027	2028	Class 2b-3	20,075	43%	Gasoline	8,632	Class 2b-3	20%	4,015	35%	1,405	65%	2,610
				57%	Diesel	11,443							
		Class 4-5	2,432	100%	Diesel	2,432	Class 4-5	30%	730	100%	730	0%	0
		Class 6-7	2,855	100%	Diesel	2,855	Class 6-7		856	100%	856	0%	0
		Class 8	435	100%	Diesel	435	Class 8		131	100%	131	0%	0
		Class 7-8 Tractors	1,827	100%	Diesel	1,827	Class 7-8 Tractors	20%	365	0%	0	100%	365
		Total				**27,624**	**Total**		**6,097**				
2028	2029	Class 2b-3	20,294	43%	Gasoline	8,726	Class 2b-3	25%	5,073	35%	1,776	65%	3,298
				57%	Diesel	11,567							
		Class 4-5	2,473	100%	Diesel	2,473	Class 4-5	40%	989	100%	989	0%	0
		Class 6-7	2,903	100%	Diesel	2,903	Class 6-7		1,161	100%	1,161	0%	0
		Class 8	444	100%	Diesel	444	Class 8		178	100%	178	0%	0
		Class 7-8 Tractors	1,858	100%	Diesel	1,858	Class 7-8 Tractors	25%	465	0%	0	100%	465
		Total				**27,972**	**Total**		**7,866**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2029	2030	Class 2b-3	20,508	43%	Gasoline	8,819	Class 2b-3	30%	6,152	35%	2,153	65%	3,999
				57%	Diesel	11,690							
		Class 4-5	2,514	100%	Diesel	2,514	Class 4-5	50%	1,257	100%	1,257	0%	0
		Class 6-7	2,951	100%	Diesel	2,951	Class 6-7		1,476	100%	1,476	0%	0
		Class 8	453	100%	Diesel	453	Class 8		227	100%	227	0%	0
		Class 7-8 Tractors	1,895	100%	Diesel	1,895	Class 7-8 Tractors	30%	568	0%	0	100%	568
		Total				**28,322**	**Total**		**9,680**				
2030	2031	Class 2b-3	20,721	43%	Gasoline	8,910	Class 2b-3	35%	7,252	35%	2,538	65%	4,714
				57%	Diesel	11,811							
		Class 4-5	2,554	100%	Diesel	2,554	Class 4-5	55%	1,404	100%	1,404	0%	0
		Class 6-7	2,998	100%	Diesel	2,998	Class 6-7	55%	1,649	100%	1,649	0%	0
		Class 8	462	100%	Diesel	462	Class 8	55%	254	100%	254	0%	0
		Class 7-8 Tractors	1,925	100%	Diesel	1,925	Class 7-8 Tractors	35%	674	0%	0	100%	674
		Total				**28,659**	**Total**		**11,233**				
2031	2032	Class 2b-3	20,929	43%	Gasoline	9,000	Class 2b-3	40%	8,372	35%	2,930	65%	5,442
				57%	Diesel	11,930							
		Class 4-5	2,618	100%	Diesel	2,618	Class 4-5	60%	1,571	50%	785	50%	785
		Class 6-7	3,073	100%	Diesel	3,073	Class 6-7		1,844	50%	922	50%	922
		Class 8	474	100%	Diesel	474	Class 8		285	50%	142	50%	142
		Class 7-8 Tractors	1,975	100%	Diesel	1,975	Class 7-8 Tractors	40%	790	0%	0	100%	790
		Total				**29,070**	**Total**		**12,861**				
2032	2033	Class 2b-3	21,133	43%	Gasoline	9,087	Class 2b-3	45%	9,510	35%	3,329	65%	6,182
				57%	Diesel	12,046							
		Class 4-5	2,668	100%	Diesel	2,668	Class 4-5	65%	1,734	50%	867	50%	867
		Class 6-7	3,132	100%	Diesel	3,132	Class 6-7		2,036	50%	1,018	50%	1,018
		Class 8	484	100%	Diesel	484	Class 8		315	50%	157	50%	157
		Class 7-8 Tractors	2,014	100%	Diesel	2,014	Class 7-8 Tractors	40%	805	0%	0	100%	805
		Total				**29,432**	**Total**		**14,401**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2033	2034	Class 2b-3	21,334	43%	Gasoline	9,174	Class 2b-3	50%	10,667	35%	3,734	65%	6,934
				57%	Diesel	12,161							
		Class 4-5	2,742	100%	Diesel	2,742	Class 4-5	70%	1,920	50%	960	50%	960
		Class 6-7	3,219	100%	Diesel	3,219	Class 6-7		2,253	50%	1,127	50%	1,127
		Class 8	499	100%	Diesel	499	Class 8		349	50%	175	50%	175
		Class 7-8 Tractors	2,076	100%	Diesel	2,076	Class 7-8 Tractors	40%	830	0%	0	100%	830
		Total				**29,871**	**Total**		**16,020**				
2034	2035	Class 2b-3	21,532	43%	Gasoline	9,259	Class 2b-3	55%	11,843	35%	4,145	65%	7,698
				57%	Diesel	12,273							
		Class 4-5	2,791	100%	Diesel	2,791	Class 4-5	75%	2,093	50%	1,046	50%	1,046
		Class 6-7	3,276	100%	Diesel	3,276	Class 6-7		2,457	50%	1,228	50%	1,228
		Class 8	505	100%	Diesel	505	Class 8		379	50%	189	50%	189
		Class 7-8 Tractors	2,103	100%	Diesel	2,103	Class 7-8 Tractors	40%	841	0%	0	100%	841
		Total				**30,206**	**Total**		**17,612**				
2035	2036	Class 2b-3	21,727	43%	Gasoline	9,352	Class 2b-3	55%	11,950	35%	4,182	65%	7,767
				57%	Diesel	12,384							
		Class 4-5	2,806	100%	Diesel	2,806	Class 4-5	75%	2,105	50%	1,052	50%	1,052
		Class 6-7	3,294	100%	Diesel	3,294	Class 6-7		2,471	50%	1,235	50%	1,235
		Class 8	506	100%	Diesel	506	Class 8		380	50%	190	50%	190
		Class 7-8 Tractors	2,108	100%	Diesel	2,108	Class 7-8 Tractors	40%	843	0%	0	100%	843
		Total				**30,442**	**Total**		**17,748**				
2036	2037	Class 2b-3	21,917	43%	Gasoline	9,424	Class 2b-3	55%	12,054	35%	4,219	65%	7,835
				57%	Diesel	12,5493							
		Class 4-5	2,825	100%	Diesel	2,825	Class 4-5	75%	2,119	50%	1,059	50%	1,059
		Class 6-7	3,317	100%	Diesel	3,317	Class 6-7		2,487	50%	1,244	50%	1,244
		Class 8	509	100%	Diesel	509	Class 8		382	50%	191	50%	191
		Class 7-8 Tractors	2,120	100%	Diesel	2,120	Class 7-8 Tractors	40%	848	0%	0	100%	848
		Total				**30,687**	**Total**		**17,890**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2037	2038	Class 2b-3	22,102	43%	Gasoline	9,504	Class 2b-3	55%	12,156	35%	4,255	65%	7,901
				57%	Diesel	12,598							
		Class 4-5	2,846	100%	Diesel	2,846	Class 4-5	75%	2,135	50%	1,067	50%	1,067
		Class 6-7	3,342	100%	Diesel	3,342	Class 6-7		2,506	50%	1,253	50%	1,253
		Class 8	513	100%	Diesel	513	Class 8		385	50%	192	50%	192
		Class 7-8 Tractors	2,136	100%	Diesel	2,136	Class 7-8 Tractors	40%	854	0%	0	100%	854
		Total				**30,938**	**Total**		**18,036**				
2038	2039	Class 2b-3	22,283	43%	Gasoline	9,582	Class 2b-3	55%	12,256	35%	44,290	65%	7,966
				57%	Diesel	12,702							
		Class 4-5	2,868	100%	Diesel	2,868	Class 4-5	75%	2,151	50%	1,075	50%	1,075
		Class 6-7	3,366	100%	Diesel	3,366	Class 6-7		2,525	50%	1,262	50%	1,262
		Class 8	517	100%	Diesel	517	Class 8		388	50%	194	50%	194
		Class 7-8 Tractors	2,152	100%	Diesel	2,152	Class 7-8 Tractors	40%	861	0%	0	100%	861
		Total				**31,186**	**Total**		**18,180**				
2039	2040	Class 2b-3	22,460	43%	Gasoline	9,658	Class 2b-3	55%	12,353	35%	4,324	65%	8,030
				57%	Diesel	12,802							
		Class 4-5	2,890	100%	Diesel	2,890	Class 4-5	75%	2,167	50%	1,084	50%	1,084
		Class 6-7	3,392	100%	Diesel	3,392	Class 6-7		2,544	50%	1,272	50%	1,272
		Class 8	523	100%	Diesel	523	Class 8		392	50%	196	50%	196
		Class 7-8 Tractors	2,176	100%	Diesel	2,176	Class 7-8 Tractors	40%	871	0%	0	100%	871
		Total				**31,442**	**Total**		**18,327**				
2040	2041	Class 2b-3	22,632	43%	Gasoline	9,732	Class 2b-3	55%	12,448	35%	4,357	65%	8,091
				57%	Diesel	12,900							
		Class 4-5	2,911	100%	Diesel	2,911	Class 4-5	75%	2,183	50%	1,092	50%	1,092
		Class 6-7	3,417	100%	Diesel	3,417	Class 6-7		2,563	50%	1,281	50%	1,281
		Class 8	526	100%	Diesel	526	Class 8		394	50%	197	50%	197
		Class 7-8 Tractors	2,188	100%	Diesel	2,188	Class 7-8 Tractors	40%	875	0%	0	100%	875
		Total				**31,674**	**Total**		**18,463**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2041	2042	Class 2b-3	22,800	43%	Gasoline	9,804	Class 2b-3	55%	12,540	35%	4,389	65%	8,151
				57%	Diesel	12,996							
		Class 4-5	2,933	100%	Diesel	2,933	Class 4-5	75%	2,200	50%	1,100	50%	1,100
		Class 6-7	3,443	100%	Diesel	3,443	Class 6-7		2,583	50%	1,291	50%	1,291
		Class 8	529	100%	Diesel	529	Class 8		397	50%	198	50%	198
		Class 7-8 Tractors	2,203	100%	Diesel	2,203	Class 7-8 Tractors	40%	881	0%	0	100%	881
		Total				**31,908**	**Total**		**18,600**				
2042	2043	Class 2b-3	22,964	43%	Gasoline	9,874	Class 2b-3	55%	12,630	35%	4,421	65%	8,210
				57%	Diesel	13,089							
		Class 4-5	2,955	100%	Diesel	2,955	Class 4-5	75%	2,216	50%	1,108	50%	1,108
		Class 6-7	3,469	100%	Diesel	3,469	Class 6-7		2,602	50%	1,301	50%	1,301
		Class 8	534	100%	Diesel	534	Class 8		400	50%	200	50%	200
		Class 7-8 Tractors	2,221	100%	Diesel	2,221	Class 7-8 Tractors	40%	889	0%	0	100%	889
		Total				**32,143**	**Total**		**18,737**				
2043	2044	Class 2b-3	23,123	43%	Gasoline	9,943	Class 2b-3	55%	12,718	35%	4,451	65%	8,266
				57%	Diesel	13,180							
		Class 4-5	2,980	100%	Diesel	2,980	Class 4-5	75%	2,235	100%	1,118	0%	1,118
		Class 6-7	3,499	100%	Diesel	3,499	Class 6-7		2,624	100%	1,312	0%	1,312
		Class 8	541	100%	Diesel	541	Class 8		405	100%	203	0%	203
		Class 7-8 Tractors	2,248	100%	Diesel	2,248	Class 7-8 Tractors	40%	889	0%	0	100%	871
		Total				**32,391**	**Total**		**18,881**				
2044	2045	Class 2b-3	23,279	43%	Gasoline	10,010	Class 2b-3	55%	12,803	35%	4,481	65%	8,322
				57%	Diesel	13,269							
		Class 4-5	3,002	100%	Diesel	3,002	Class 4-5	75%	2,251	50%	1,126	50%	1,126
		Class 6-7	3,524	100%	Diesel	3,524	Class 6-7		2,643	50%	1,321	50%	1,321
		Class 8	543	100%	Diesel	543	Class 8		407	50%	204	50%	204
		Class 7-8 Tractors	2,260	100%	Diesel	2,260	Class 7-8 Tractors	40%	904	0%	0	100%	904
		Total				**32,608**	**Total**		**19,009**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2045	2046	Class 2b-3	23,430	43%	Gasoline	10,075	Class 2b-3	55%	12,886	35%	4,510	65%	8,376
				57%	Diesel	13,355							
		Class 4-5	3,025	100%	Diesel	3,025	Class 4-5	75%	2,269	50%	1,134	50%	1,134
		Class 6-7	3,551	100%	Diesel	3,551	Class 6-7		2,664	50%	1,332	50%	1,332
		Class 8	549	100%	Diesel	549	Class 8		412	50%	206	50%	206
		Class 7-8 Tractors	2,284	100%	Diesel	2,284	Class 7-8 Tractors	40%	914	0%	0	100%	914
		Total				**32,839**	**Total**		**19,144**				
2046	2047	Class 2b-3	23,578	43%	Gasoline	10,139	Class 2b-3	55%	12,968	35%	4,539	65%	8,429
				57%	Diesel	13,440							
		Class 4-5	3,047	100%	Diesel	3,047	Class 4-5	75%	2,285	50%	1,143	50%	1,143
		Class 6-7	3,577	100%	Diesel	3,577	Class 6-7		2,683	50%	1,341	50%	1,341
		Class 8	552	100%	Diesel	552	Class 8		414	50%	207	50%	207
		Class 7-8 Tractors	2,298	100%	Diesel	2,298	Class 7-8 Tractors	40%	919	0%	0	100%	919
		Total				**33,053**	**Total**		**19,270**				
2047	2048	Class 2b-3	23,274	43%	Gasoline	10,201	Class 2b-3	55%	13,048	35%	4,567	65%	8,481
				57%	Diesel	13,522							
		Class 4-5	3,069	100%	Diesel	3,069	Class 4-5	75%	2,302	50%	1,151	50%	1,151
		Class 6-7	3,603	100%	Diesel	3,603	Class 6-7		2,702	50%	1,351	50%	1,351
		Class 8	555	100%	Diesel	555	Class 8		416	50%	208	50%	208
		Class 7-8 Tractors	2,309	100%	Diesel	2,309	Class 7-8 Tractors	40%	924	0%	0	100%	924
		Total				**33,260**	**Total**		**19,392**				
2048	2049	Class 2b-3	23,865	43%	Gasoline	10,262	Class 2b-3	55%	13,126	35%	4,594	65%	8,532
				57%	Diesel	13,603							
		Class 4-5	3,092	100%	Diesel	3,092	Class 4-5	75%	2,319	50%	1,159	50%	1,159
		Class 6-7	3,629	100%	Diesel	3,629	Class 6-7		2,722	50%	1,361	50%	1,361
		Class 8	559	100%	Diesel	559	Class 8		419	50%	210	50%	210
		Class 7-8 Tractors	2,328	100%	Diesel	2,328	Class 7-8 Tractors	40%	931	0%	0	100%	931
		Total				**33,473**	**Total**		**19,517**				

		Baseline					Policy						
							ZEV Sales Requirements			ZEV Breakdown			
CY	MY	Vehicle Class	Projected Sales	Fuel Assumptions		Projected Sales	Vehicle Class	%	#	Electric Normal Range		Electric Long Range	
2049	2050	Class 2b-3	17,761	43%	Gasoline	7,637	Class 2b-3	55%	9,768	35%	3,419	65%	6,350
				57%	Diesel	10,124							
		Class 4-5	3,114	100%	Diesel	3,114	Class 4-5	75%	2,336	50%	1,168	50%	1,168
		Class 6-7	3,656	100%	Diesel	3,656	Class 6-7		2,742	50%	1,371	50%	1,371
		Class 8	564	100%	Diesel	564	Class 8		423	50%	211	50%	211
		Class 7-8 Tractors	2,348	100%	Diesel	2,348	Class 7-8 Tractors	40%	939	0%	0	100%	939
		Total				**34,716**	**Total**		**16,208**				
Cumulative Sales Calendar Years 2026-2049 (MY 2027-2050 Vehicles)													
2026-2049	**2027-2050**	**Cumulative Total**				**733,920**	**Cumulative Total**		**377,547**				

Table C-3: Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA) Funding Opportunities Supporting MHD ZEV Adoption not Included in the Fiscal Note Analysis

Federal Agency	Program	Source	Funding Amount and Type	Program Description	Eligible Entities
FTA	Low or No Emission Vehicle Program, Buses and Bus Facilities Program [64] Funded: $7.25B, 10/1/2021–9/30/2026 Federal share: up to 85 % for transit buses, up to 90% for EVSE Stackable: Yes, if criteria are met	IIJA § 30018, Div. J, Tit. VIII	7,250,000,000 (Grant - Competitive)	Two programs that provide competitive grants for: - Purchase/lease of low- and zero-emission vehicles and related infrastructure; and - Capital projects to construct or modify bus facilities for low- and zero-emission vehicles. Percentage of funding is allocated to rural projects and workforce development activities.	Recipients that allocate funds to fixed bus route operators, state or local governments, tribes, and private nonprofits engaged in public transportation (e.g., State Dept. of Transportation Agencies)
EPA	Clean School Bus Program[65] Funded: $5B, 10/1/2021–9/30/2026 Federal share: 100% Stackable: TBD	IIJA § 71101	5,000,000,000 (Rebate Grant - Competitive)	Rebates to replace diesel school buses with ZEBs and associated infrastructure. Technical assistance is also available. Initial round disbursed as rebates; future funding likely to be disbursed via competitive grants.	States, local governments, and school districts that provide school bus service, contractors, nonprofit school transportation associations, and tribes (e.g., States that provide school bus service)

[64] https://www.transit.dot.gov/notices-funding/low-or-no-emission-and-grants-buses-and-bus-facilities-competitive-programs-fy2023
[65] https://www.epa.gov/cleanschoolbus

Federal Agency	Program	Source	Funding Amount and Type	Program Description	Eligible Entities
EPA	Clean Ports Program[66] Funded: $3B, 10/1/2022–9/30/2027 Federal share: TBD Stackable: TBD	IRA § 60102	3,000,000,000 (Rebate Grant - Competitive)	Rebates and grants on a competitive basis to purchase or install zero-emission port equipment or technology; conduct relevant planning or permitting in connection with installation of zero-emission equipment or technology; and develop qualified climate action plans. $750M is set aside for ports in nonattainment areas.	Port authorities; state, regional, local, or tribal agencies with jurisdiction over ports; APCAs; entities that own/operate/uses port facilities in partnership with the above (e.g., States, Air Agencies, and Port Authorities)
FHWA	Charging and Fueling Infrastructure Discretionary Grant Program[67] Funded: $2.5B, 10/1/2022–9/30/2026 Federal share: TBD Stackable: TBD	IIJA § 11401	2,500,000,000 (Grant - Competitive)	Includes two programs: $1.25B to complement ZEV infrastructure build-out along alternative fuel corridors; $1.25B for community grants, with priority for rural areas, low- and middle-income areas, and areas with a high ratio of multi-unit dwellings to single-family homes. Infrastructure must be located on a public road or be publicly accessible, e.g., public buildings, schools, and parks, or privately-owned, publicly accessible parking.	States, local governments, MPOs, transportation and port authorities, tribes, and groups of the above (e.g., States, transportation and Port Authorities)

[66] https://www.epa.gov/inflation-reduction-act/clean-ports-program
[67] https://www.fhwa.dot.gov/environment/cfi/

Federal Agency	Program	Source	Funding Amount and Type	Program Description	Eligible Entities
EPA	Clean Heavy Duty Vehicle Program[68] Funded: $1B ($400M for nonattainment areas), 12/14/2022–9/30/2031 Federal share: up to 100% Stackable: TBD	IRA § 60101	1,000,000,000 (Rebate Grant - Competitive)	Rebates for up to 100% of the following costs for Class 6-7 HD ZEVs and infrastructure: - Incremental costs of replacing an eligible vehicle with a ZEV; - Purchase, installation, operation, and maintenance of infrastructure; - Workforce development and training to support ZEV maintenance, charging, fueling, and operation; and - Planning and technical activities to support ZEV adoption and deployment.	States, local governments, tribes, and nonprofit school transportation associations (e.g., States)
EPA	Diesel Emissions Reduction Act (DERA)[69] Funded: $60M, 10/1/2022–9/30/2031 Federal share: varies; additional funding available if state matches base allocation Stackable: No; states can use VW Trust funds to match base allocation and receive additional funding	IRA § 60104	60,000,000 (Formula Grant – Non-competitive)	Funding for grants, rebates, and loans to identify and reduce diesel emissions resulting from goods movement facilities, and vehicles servicing goods movement facilities, in low-income and disadvantaged communities. Eligible diesel vehicles, engines and equipment include: school buses; class 5–8 HD on-road vehicles; locomotive engines; marine engines; and onroad engines, equipment or vehicles used in construction, cargo handling, agriculture, mining, or energy production.	Regional, state, local, and tribal agencies/consortia; port authorities; qualifying nonprofits; and MPOs, municipalities, and school districts if they meet certain project requirements

[68] https://www.epa.gov/inflation-reduction-act/clean-heavy-duty-vehicle-program
[69] https://www.epa.gov/dera

Federal Agency	Program	Source	Funding Amount and Type	Program Description	Eligible Entities
FHWA	Congestion Mitigation and Air Quality Improvement (CMAQ)[70] Funded: $13.2B, 10/1/2021–9/30/2026 Federal share: typically 80% Stackable: Up to 50% of allocation can be moved to other federal-aid highway programs, and vice versa	IIJA § 11115	13,200,000,000 (Formula Grant – Non-competitive)	Flexible funding for projects that reduce congestion and improve air quality in ozone, carbon monoxide, or particulate matter nonattainment/maintenance areas. IIJA adds eligibility for MHD ZEVs and EVSE, and infrastructure to reduce emissions from nonroad vehicles and engines used in construction or port-related freight operations.	States, local governments, and transit agencies in nonattainment/maintenance areas
EPA	Greenhouse Gas Reduction Fund[71] Funded: $7B, until 9/20/2024 Federal share: TBD Stackable: TBD	IRA § 60103(a)	7,000,000,000 (Grant - Competitive	Three major funding streams: - $7B competitive grants to states, municipalities, tribal governments, and other eligible recipients to enable low-income and disadvantaged communities to deploy or benefit from zero-emission technologies. - $12B competitive grants (via green banks) to provide financial and technical assistance to eligible projects that reduce or avoid greenhouse gas emissions. - $8B competitive grants to eligible entities in low-income and disadvantaged communities to provide financial and technical assistance to projects that reduce or avoid greenhouse gas emissions.	States, municipalities, tribes, green banks, and nonprofits serving low-income and disadvantaged communities

[70] https://www.fhwa.dot.gov/environment/air_quality/cmaq/

[71] https://www.epa.gov/inflation-reduction-act/greenhouse-gas-reduction-fund

Federal Agency	Program	Source	Funding Amount and Type	Program Description	Eligible Entities
FHWA	Carbon Reduction Program (CRP)[72] Funded: $6.2B, 10/1/2021–9/30/2026 Federal share: typically 80% Stackable: Yes, with other federal-aid highway funding	IIJA § 11403	6,200,000,000 (Grant – Non-competitive)	Each state must submit a Carbon Reduction Strategy (CRS) developed in consultation with an MPO. Eligible projects must reduce emissions from on-road highway sources. CRS development, efforts to reduce environmental and community impacts of freight movement, EV and EVSE acquisition and installation, and projects to reduce emissions from ports all qualify for funding.	States
EPA	Climate Pollution Reduction Grants (CPRG), Implementation[73] Funding: $4.75B, 10/1/2022–9/30/2031 Federal share: TBD Stackable: TBD	IRA § 60114(b)	4,750,000,000 (Grant – Competitive)	Competitive funding for grants to implement GHG reduction plans.	States, APCAs, municipalities, Indian Tribes, or groups of these entities, that are covered by a plan developed with funding awarded under § 60114(a)
FHWA	Reduction of Truck Emissions at Port Facilities[74] Funding: $250M, 10/1/2022–9/30/2026 Federal share: up to 80% Stackable: TBD	IIJA § 11402	250,000,000 (Formula Grant – Non-competitive)	Grant funding to test, evaluate, and deploy projects to reduce idling truck emissions, including port electrification and efficiency improvements particularly from HD vehicles. Awards will be treated as federal-aid highway projects.	States

[72] https://www.fhwa.dot.gov/bipartisan-infrastructure-law/crp_fact_sheet.cfm

[73] https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants

[74] https://www.fhwa.dot.gov/bipartisan-infrastructure-law/rtep.cfm

15A NCAC 02D .2901 is proposed for adoption as follows:

SECTION .2900 - ADVANCED CLEAN TRUCKS

15A NCAC 02D .2901 ADVANCED CLEAN TRUCKS PURPOSE, APPLICABILITY, DEFINITIONS, AND GENERAL REQUIREMENTS

(a) Purpose. The purpose of rules 15A NCAC 02D .2901, .2902, .2903, .2904, .2905, and .2906 is to accelerate the market for on-road zero-emission vehicles and to reduce emissions of oxides of nitrogen (NOx), fine particulate matter (PM), other criteria pollutants, toxic air contaminants, and greenhouse gases (GHG) from medium- and heavy-duty on-road vehicles.

(b) Scope and Applicability. Any manufacturer that certifies on-road vehicles over 8,500 pounds gross vehicle weight rating for sale in North Carolina is subject to 15A NCAC 02D .2901, .2902, .2903, .2904, .2905, and .2906 except as specified in Paragraph (e) of this Rule.

(c) Definitions. The following definitions apply for this Rule and 15A NCAC 02D .2902 through .2906:

(1) "All-electric range" means the number of miles a vehicle can travel using electricity stored on-board the vehicle as tested pursuant to the requirements of 17 CCR section 95663(d) for on-road vehicles with a gross vehicle weight rating (GVWR) over 8,500 pounds.

(2) “CCR” means the California Code of Regulations.

(3) "Class 2b-3" means an on-road vehicle with a GVWR that is 8,501 pounds up to 14,000 pounds.

(4) "Class 2b-3 group" means the group of all on-road vehicles with a GVWR that is 8,501 pounds up to 14,000 pounds.

(5) "Class 4" means an on-road vehicle with a GVWR that is 14,001 pounds up to 16,000 pounds.

(6) "Class 4-8 group" means the group of all on-road vehicles with a GVWR that is 14,001 pounds and above, including “yard tractors” as defined in Subparagraph (c)(23) of this Rule, except for a “tractor” as defined in Subparagraph (c)(20) of this Rule.

(7) "Class 5" means an on-road vehicle with a GVWR that is 16,001 pounds up to 19,500 pounds.

(8) "Class 6" means an on-road vehicle with a GVWR that is 19,501 pounds up to 26,000 pounds.

(9) "Class 7" means an on-road vehicle with a GVWR that is 26,001 pounds up to 33,000 pounds.

(10) "Class 7-8 tractor group" means a group of on-road vehicles, that have a GVWR 26,001 pounds and above, including all vehicles that meet the definition of "tractor" as defined in Subparagraph (c)(20) of this Rule, except "yard tractors" as defined in Subparagraph (c)(23) of this Rule.

(11) "Class 8" means an on-road vehicle with a GVWR that is 33,001 pounds and above.

(12) "Cutaway vehicle" or “cutaway bus” means a vehicle in which a bus body designed to transport passengers is mounted on the chassis of a van or light- or medium-duty truck chassis, and that has a GVWR greater than 14,000 pounds but not more than 26,000 pounds. The original van or light- or medium- duty truck chassis may be reinforced or extended. A cutaway vehicle may accommodate some standing passengers.

(13) "Excluded bus" means a vehicle that meets the following conditions:

(A) A passenger-carrying vehicle with a GVWR that is 14,001 pounds or more;

(B) Has a load capacity of 15 or more passengers;

(C) Is not a cutaway vehicle as defined in Subparagraph (c)(12) of this Rule; and

(D) Is not a school bus as defined in the California Vehicle Code section 545.

(14) "Director" means the Director of the North Carolina Division of Air Quality or his or her authorized representative.

(15) "Gross vehicle weight rating" or "GVWR" means the weight specified by the manufacturer as the loaded weight of a single vehicle.

(16) "Manufacturer" means any person who assembles new on-road motor vehicles, or imports such vehicles for resale, or who acts for and is under the control of any such person in connection with the distribution of new motor vehicles, but shall not include any dealer with respect to new motor vehicles received in commerce. In general, this term includes any person who manufactures or assembles an on-road vehicle or other incomplete on-road vehicle for sale in North Carolina or otherwise introduces a new on- road motor vehicle into commerce in North Carolina. This includes importers who import on-road vehicles for resale and persons that assemble glider vehicles. This does not include persons who supply parts to the importer or vehicle manufacturer of record.

(17) "Model year" means, for tractors and vocational vehicles with a date of manufacture on or after January 1, 2021, the calendar year corresponding to the date of manufacture; however, the vehicle's model year may be designated to be the year before the calendar year corresponding to the date of manufacture if the engine's model year is also from an earlier year. Requirements in 40 CFR 1037.601(a)(2), as amended October 25, 2016, limit the extent to which vehicle manufacturers may install engines built in earlier calendar years. Manufacturers may have other model year designations for the same vehicle for compliance with other requirements or for other purposes.

(18) “Near-zero-emission vehicle” or “NZEV” means one of the following:

(A) An on-road plug-in hybrid electric vehicle which has the same definition in 40 CFR 86.1803-01, amended on July 1, 2011, incorporated by reference herein, including subsequent amendments, that achieves all-electric range as defined in Subparagraph (c)(1) of this Rule; or

(B) An on-road hybrid electric vehicle that has the capability to charge the battery from an off-vehicle conductive or inductive electric source and achieves all-electric range as defined in Subparagraph (c)(1) of this Rule.

A copy of 40 CFR 86.1803-01 may be obtained pursuant to 15A NCAC 02D .0103.

(19) "NZEV credit" means a credit generated by producing, and selling a NZEV in North Carolina.

(20) "Tractor" means an on-road vehicle meeting one of the following:

(A) The definition of ‘‘tractor’’ in 40 CFR 1037.801; or

(B) the definition of ‘‘vocational tractor’’ in Subparagraph (c)(22) of this Rule.

(21) "Vehicle" or “on-road vehicle” means new equipment that meets the following criteria:

(A) Has a GVWR that is 8,501 pounds and above;

(B) Is equipment intended for use on highways, and meets the definition set forth in 40 CFR 1037.801;

(C) Is not a trailer as defined in 40 CFR 1037.801; and

(D) Is not an excluded bus as defined in Subparagraph (c)(13) of this Rule.

(22) “Vocational tractor” means a vehicle classified as a vocational tractor under 40 CFR 1037.630, as amended October 25, 2016.

(23) “Yard tractor” means a vehicle that was originally designed to be operated on-road and has a movable fifth wheel that can be elevated and is used in moving and spotting trailers and containers at a location or facility. Yard tractors are also commonly known as yard goats, hostlers, yard dogs, trailer spotters, or jockeys.

(24) "Zero-emission vehicle" or "ZEV" means an on-road vehicle with a drivetrain that produces zero exhaust emission of any criteria pollutant, precursor pollutant, or greenhouse gas under any possible operational modes or conditions.

(25) "ZEV credit" means a credit generated by producing and selling a ZEV into North Carolina.

(d) General Requirements. Except as provided in Paragraph (e) of this Rule, a manufacturer shall retire a number of ZEV or NZEV credits that equals or exceeds their total annual deficits each model year, subject to the provisions of 15A NCAC 02D .2904.

(e) Low Volume Exemption. Each model year, starting in 2027, manufacturers that do not exceed 500 average annual sales of on-road vehicles produced and delivered for sale in California for the three prior model years are exempt from the requirements of 15A NCAC 02D .2901 through .2906. Manufacturers that meet this exemption as of 2024 but subsequently exceed 500 average annual vehicle sales in any model year become subject to the requirements of 15A NCAC 02D .2901 through .2906 starting the second model year after the average annual sales exceeded the threshold.

(f) Voluntary Credit Generation. Any manufacturer that is exempt may elect to generate ZEV or NZEV credits pursuant to 15A NCAC 02D .2903. If a manufacturer chooses to generate ZEV or NZEV credits, it shall comply with the credit generation, banking, and trading provisions of 15A NCAC 02D .2903, the reporting and recordkeeping requirements of 15A NCAC 02D .2905, and the enforcement provisions of 15A NCAC 02D .2906.

(g) Referenced Regulations. For the purposes of this Section, Title 13, Section 1956.8, and Title 17, Section 95663, of the California Code of Regulation are incorporated by reference, including subsequent amendments and editions. Copies of Title 13 of the California Code of Regulations, Section 1956.8, and Title 17 of the California Code of Regulations, Section 95663, may be obtained free of charge via the internet from the Office of Administrative Law California Code of Regulations website at http://ccr.oal.ca.gov/.

History Note: *Authority G.S. 143-215.3(a)(1); 143-215.107(a)(1), (3), (6); 143-215.107(b);*
Eff.

15A NCAC 02D .2902 is proposed for adoption as follows:

15A NCAC 02D .2902 ADVANCED CLEAN TRUCKS DEFICITS

Basic Requirement. Beginning with the applicable effective dates, a manufacturer shall comply with the following requirements:

(1) Deficit Generation. Starting with the 2027 model year, a manufacturer shall annually incur deficits based on the manufacturer's annual sales volume of on-road vehicles produced, and delivered for sale in North Carolina. Deficits are incurred when the on-road vehicle is sold to the ultimate purchaser in North Carolina.

(2) Deficit Calculation. Deficits shall be calculated each model year. For each on- road vehicle, the deficit is calculated as the product of the model year percentage requirement from Table A-1, and the appropriate weight class modifier for each vehicle from Table A-2. Every model year, the deficits generated by each vehicle are summed for each vehicle group.

Table A-1. ZEV Sales Percentage Schedule

Model Year	Class 2b-3 Group	Class 4-8 Group	Class 7-8 Tractors Group
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035 and beyond	55%	75%	40%

Table A-2. Weight Class Modifiers

	Vehicles in the Class 2b-3	Class 4-5 Vehicles in the Class 4-8 Group	Class 6-7 Vehicles in the Class 4-8 Group	Class 8 Vehicles in the Class 4-8 Group	Vehicles in the Class 7 and 8 Tractor Group
Weight Class Modifier	0.8	1	1.5	2	2.5

(3) Deficit Rounding. If the sum of deficits generated in a model year for a vehicle group is not equal to a whole number, the sum of deficits shall round up to the nearest tenth when the fractional part is equal to or greater than 0.05, and round down to the nearest tenth if less than 0.05.

(4) Deficit Accounting. Deficits generated from vehicles in the Class 7-8 tractor group shall be accounted separate from other deficits.

History Note: *Authority G.S. 143-215.3(a)(1); 143-215.107(a)(1), (3), (6); 143-215.107(b);*
Eff. _____

15A NCAC 02D .2903 is proposed for adoption as follows:

15A NCAC 02D .2903 ADVANCED CLEAN TRUCKS CREDIT GENERATION, BANKING, AND TRADING

Beginning with the 2024 model year, the following requirements apply:

(1) ZEV Credit Calculation. A manufacturer may generate ZEV credits for each ZEV produced, and delivered for sale in North Carolina, for the manufacturer-designated model year. ZEV credits are earned when a new on-road vehicle is sold to the ultimate purchaser in North Carolina. The ZEV credit generated for each vehicle sold is equal to the value of the appropriate weight class modifier in Table A-2 of 15A NCAC 02D .2902.

(2) NZEV Credit Calculation. Until the end of the 2035 model year, a manufacturer may generate NZEV credits for each NZEV produced, and delivered for sale in North Carolina, for the manufacturer-designated model year. NZEV credits are earned when a new on-road vehicle is sold to the ultimate purchaser in North Carolina. The NZEV credit generated for each vehicle sold is calculated as the product of the appropriate weight class modifier in Table A-2 of 15A NCAC 02D .2902, and the NZEV factor value as calculated in Subitem (2)(a) of this Rule.

(a) NZEV Factor Value. The NZEV factor used to calculate NZEV credits shall be calculated as 0.01 multiplied by the all-electric range, and is not to exceed 0.75.

(b) Minimum All-Electric Range. To earn credit, NZEVs must have an all-electric range that equals or exceeds the criteria specified in 17 CCR section 95663(d) until the end of the 2029 model year and an all-electric range that equals or exceeds 75 miles or greater starting with the 2030 model year.

(3) Credit Rounding. If the calculated number of summed ZEV or NZEV credits generated in a model year for a vehicle group is not equal to a whole number, the summed number shall round up to the nearest tenth when the fractional part is equal to or greater than 0.05, and round down to the nearest tenth if less than 0.05.

(4) Credit Banking. ZEV and NZEV credits may be banked for future use. Banked credits may be used to satisfy deficits in 15A NCAC 02D .2904 and have limited lifetimes pursuant to Item (7) of this Rule.

(5) Credit Trading and Transfer. ZEV and NZEV credits may be traded, sold, or otherwise transferred between manufacturers. ZEV or NZEV credits transferred in this manner may be used to satisfy deficits in 15A NCAC 02D .2904 and have limited lifetimes pursuant to Item (7) of this Rule, and shall be reported to the Director in accordance with 15A NCAC 02D .2905.

(6) Credit Accounting. ZEV and NZEV credits shall be separately accounted for based on model year generated. NZEV credits shall be accounted for separately from ZEV credits. Class 7-8 tractor group credits shall be accounted for separately from other credits.

(7) Limited Credit Lifetime. ZEV and NZEV credits have limited lifetimes as follows:

(a) 2024 to 2026 Model Year. ZEV or NZEV credits generated in the 2024, 2025 and 2026 model years expire at of the end of the 2030 model year, and are no longer available to be used to meet compliance for 2031 and later model years. For example, ZEV or NZEV credits generated during the 2025 model year may be used to meet compliance requirements until the end of the 2030 model year, and may not be used to meet 2031 model year compliance requirements.

(b) 2027 Model Year and Beyond. ZEV or NZEV credits generated in 2027 and subsequent model years may be used only for five model years after the model year in which they are generated. For example, ZEV or NZEV credits generated for the 2024 model year may be used to meet compliance requirements until the end of the 2029 model year, and may not be used to meet 2030 model year compliance requirements.

(8) Zero-Emission Powertrain Certification for ZEVs. Beginning with the 2027 model year, on-road ZEVs over 14,000 pounds GVWR and incomplete medium-duty ZEVs from 8,501 through 14,000 pounds GVWR produced, and delivered for sale in North Carolina, shall meet the requirements of 13 CCR 1956.8 and 17 CCR 95663 as amended by the Zero-Emission Powertrain Certification regulation to receive ZEV credit.

History Note: *Authority G.S. 143-215.3(a)(1); 143-215.107(a)(1), (3), (6); 143-215.107(b);*
Eff.

15A NCAC 02D .2904 is proposed for adoption as follows:

15A NCAC 02D .2904 ADVANCED CLEAN TRUCKS COMPLIANCE DETERMINATION

(a) Annual Compliance Determination. For each model year, compliance is achieved when the manufacturer's Class 7-8 tractor credits retired offset their Class 7-8 tractor deficits except as specified in Subparagraph (c)(3) of this Rule and when the manufacturer's total credits retired offset their total deficits.

(b) Requirement to Make Up a Deficit. A manufacturer that retires fewer ZEV or NZEV credits than required to meet its credit obligation in a given model year shall make up the deficit by the end of the next model year by submitting a commensurate number of ZEV credits to satisfy the deficiency. Deficits carried over to the following model year shall not be made up with NZEV credits.

(c) Credit Retirement Order. Credit accounts are debited using the following conventions, except as provided in Subparagraph (3) of this Paragraph:

(1) First, credits shall be retired by order of model year expiration, starting with the earliest expiring credit.

(2) Second, credits shall be retired in the following order by credit type and weight class group:

(A) First, Class 7-8 tractor group NZEV credits to meet Class 7-8 tractor group deficits up to the cap specified in Paragraph (d) of this Rule;

(B) Second, Class 2b-3 group and Class 4-8 group NZEV credits to meet Class 2b-3 group and Class 4-8 group deficits up to the cap specified in Paragraph (d) of this Rule;

(C) Third, Class 7-8 tractor group NZEV credits to meet Class 2b-3 group and Class 4-8 group deficits;

(D) Fourth, Class 7-8 tractor group ZEV credits to meet Class 7-8 tractor group deficits;

(E) Fifth, Class 2b-3 group and Class 4-8 group ZEV credits to meet Class 2b-3 and Class 4-8 group deficits; and

(F) Sixth, Class 7-8 tractor group ZEV credits to meet Class 2b-3 group and Class 4-8 group deficits.

(3) Low Tractor Volume Flexibility. A manufacturer who generates 25 or fewer Class 7-8 tractor deficits in a model year and has tractor deficits remaining after retiring credits pursuant to the credit retirement order in Subparagraphs (1) and (2) of this Paragraph may use a maximum of 25 Class 2b-3 or Class 4-8 group ZEV credits, starting with the earliest expiring credits, to satisfy their Class 7-8 tractor group deficits.

(d) NZEV Credit Limit. A manufacturer may use NZEV credits to satisfy, at maximum, 50 percent of the annual summed deficits for the Class 2b-3 group and the Class 4-8 group, and may use Class 7-8 tractor NZEV credits to satisfy, at maximum, 50 percent of the annual summed deficits for the Class 7-8 tractor group.

(e) Tractor Deficits Shall Be Met With Tractor Credits. Annual deficits accrued in the Class 7-8 tractor group may only be met with Class 7-8 tractor credits, except as described in Subparagraph(c)(3) of this Rule.

History Note: *Authority G.S. 143-215.3(a)(1); 143-215.107(a)(1), (3), (6); 143-215.107(b);*
Eff.

15A NCAC 02D .2905 is proposed for adoption as follows:

15A NCAC 02D .2905 ADVANCED CLEAN TRUCKS REPORTING AND RECORDKEEPING

(a) Sales Reporting. Beginning with the 2024 model year, and no later than 90 days following the end of each model year, a manufacturer shall report the following information to the Division for each on-road vehicle produced and delivered for sale in North Carolina for each model year, except as provided in Paragraph (e) of this Rule:

(1) Vehicle Identification Number (VIN) for each vehicle;

(2) Vehicle weight class;

(3) Whether the vehicle type is a tractor, yard tractor, or is another vehicle type;

(4) Fuel and drivetrain type;

(5) The volume produced and delivered for sale in North Carolina for the vehicle type; and

(6) If the vehicle is a NZEV, the tested all-electric range of the vehicle.

(b) Credit Transfer Reporting. A manufacturer that transfers to or receives ZEV or NZEV added credits from another manufacturer shall submit to the Director an annual report of all credit trades, transfers, and transactions. The Division will not recognize any credit transfers until the report is received.

(1) Transfer Reporting Deadline. Reports shall be submitted no later than 90 days following the end of each model year to demonstrate compliance.

(2) Required Credit Transfer Information. Manufacturers that transfer or receive ZEV or NZEV credits shall submit a letter or document signed by authorized agents of both parties to the transaction summarizing the transfer, which shall include the following:

(A) Corporate name of credit transferor;

(B) Corporate name of credit transferee;

(C) Number of ZEV credits transferred for each model year, rounded to the nearest tenth per 15A NCAC 02D .2903(3);

(D) Number of NZEV credits transferred for each model year, rounded to the nearest tenth per 15A NCAC 02D .2903(3); and

(E) Indicate whether the ZEV or NZEV credits are Class 7-8 Tractor credits, or other credits.

(c) Retention of Records. Records of reported information required in this Rule and documentation showing vehicle delivery to the ultimate purchaser at a location in North Carolina shall be kept by manufacturers for the Division to audit for a period of eight (8) years from the end of the model year the vehicles were produced.

(d) Grouped Sales Reporting. Manufacturers may optionally submit information required in Paragraph (a) of this Rule grouped by categories for vehicles that are not ZEVs or NZEVs without providing individual VINs. If exercising this option, manufacturers shall still retain records available for the Division to audit, including the individual VINs, pursuant to Paragraph (c) of this Rule.

History Note: Authority G.S. 143-215.3(a)(1); 143-215.107(a)(1), (3), (6); 143-215.107(b);

Eff. _____

15A NCAC 02D .2906 is proposed for adoption as follows:

15A NCAC 02D .2906 ADVANCED CLEAN TRUCKS ENFORCEMENT

Enforcement of Requirements. A manufacturer is subject to the following:

(1) Audit of Records. A manufacturer shall make records of vehicle sales into North Carolina available to the Director within 30 days of a request for audit to verify the accuracy of the reported information. Submitting false information is a violation of this Section.

(2) Authority to Suspend, Revoke, or Modify. If the Director finds that any ZEV or NZEV credit was obtained based on false information, the credit will be deemed invalid.

(3) Public Disclosure. Records in the Division's possession for the manufacturers subject to this Section shall be subject to disclosure pursuant to G.S. 132 and G.S. 143-215.3C.

History Note; Authority G.S.143-215.3(a)(1); 143-215.107(a)(1), (3) (6); 143-215.107(b); 143-215.114A; Eff.