AMENDMENT TO
7 DE ADMIN CODE 1140

Delaware Low Emission Vehicle Program

Technical Support Document

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Presented by: DNREC Division of Air Quality

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Table of Contents

Appendices

Figures

Tables

List of Acronyms

4WD	Four Wheel Drive
A/C	Air Conditioning
ACC	Advanced Clean Car Program
AFC	Alternate Fuel Corridors
AGI	Adjusted Gross Income
AQS	Air Quality System
AT PZEV	Advanced Technology Partial Zero Emission Vehicle
AWD	All Wheel Drive
BEV	Battery Electric Vehicle
BMS	Battery Management Systems
BNEF	Bloomberg New Energy Finance
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CAR	Council of Automotive Repair
CARB	California Air Resources Board
CSAPR	Cross-State Air Pollution Rule
CC4A	Clean Cars for All
CCR	California Code of Regulations
CFI	Charging and Fueling Infrastructure
CFR	Code of Federal Regulations
ch	chapter
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COBRA	Co-Benefits and Risk Assessment
COVID-19	Coronavirus Disease 2019
CVAP	Clean Vehicle Assistance Program
CVRP	Clean Vehicle Rebate Program
DAC	Disadvantage Community
DAQ	Division of Air Quality
DATDA	Delaware Automobile and Truck Dealers Association
DCCE	Division of Climate Coastal Energy
DEC	Delaware Electric Cooperative
DelDOT	Delaware Department Of Transportation
DEMEC	Delaware Electric Municipal Corporation
DMC	Direct Manufacturing Cost
DMV	Division of Motor Vehicle
DNREC	Department of Natural Resources and Environmental Control
DOE	Department of Energy

DOT	Department of Transportation
DPL	Delmarva Power
DRC	Democratic Republic of Congo
EJ	Environmental Justice
EPA	Environmental Protection Agency
ER	Emergency Room
ERCOT	Electric Reliability Council of Texas
ERG	Environmental Research Group
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
FCHEV	Fuel Cell Hydrogen Electric Vehicle
FERC	Federal Energy Regulatory Commission
FR	Federal Register
FTP	Federal Test Procedure
FV	Farm Vehicle
g/m^3	gram per meter cubed
g/mile	gram per mile
gCO_2/mi	grams of CO_2 per mile
GCWR	Gross Combined vehicle Weight Rating
GHG	Greenhouse Gas
GREET	Greenhouse gas Regulated Emissions and Energy use in Technologies
GVWR	Gross Vehicle Weight Rating
HCHO	Formaldehyde
HEV	Hybrid Electric Vehicle
HFC	Hydrofluorocarbon
HLDT	Heavy Light Duty Truck (GVWR>6000 lbs.)
I/M	Inspection and Maintenance
IAFC	International Association of Fire Chiefs
ICE	Internal Combustion Engine
ICEV	Internal Combustion Engine Vehicle
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
IRS	Internal Revenue Service
ISO	Independent System Operator
ISOR	Initial Statement Of Reasons
IVM	Intermediate Volume Manufacturer
kWh	kilowatt hours
lbs.	pounds
LDT1	Light Duty Truck with a loaded vehicle weight of 0-3750 pounds
LDT2	Light Duty Truck with a loaded vehicle weight of 3750 to 8500 pounds

LDV	Light Duty Vehicle
LEV	Low Emission Vehicle
LFCE	Low Fuel Cycle Emissions
LLC	Limited Liability Corporation
LSE	Load Serving Entity
LVM	Large Volume Manufacturer
MB	megabyte
MBUF	Mileage Based User Fee
MDPV	Medium Duty Passenger Vehicles
MDV	Medium Duty Vehicle
mg/m3	milligram per cubic meter
mg/mile	milligram per mile
MLK	Martin Luther King
MOU	Memorandum Of Understanding
MOVES	Motor Vehicle Emissions Simulator
MPG	Miles Per Gallon
MSRP	Manufacturer's Suggested Retail Price
MW	Megawatts
MY	Model Year
N_2O	Nitrous Oxide
NAA	Non-Attainment Area
NAAQS	National Ambient Air Quality Standard
NEI	National Emissions Inventory
NERC	National Electric Reliability Council
NESCAUM	Northeast States for Coordinated Air Use Management
NEVI	National Electric Vehicle Infrastructure
NHTSA	National Highway Traffic Safety Administration
NLEV	National Low Emission Vehicle
NMHC	Non Methane Hydrocarbons
NMOG	Non Methane Organic Gas
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NTSB	National Transportation Safety Board
O_3	Ozone
OFOB	Off Peak Off Bill rebate
OTC	Ozone Transport Commission
OTR	Ozone Transport Region
Pb	Lead
PC	Passenger Car

PFC	Perfluorocarbons
PFI	Port Fuel Injection
PHEV	Plug-In Hybrid Electric Vehicle
PJM	Pennsylvania New Jersey Maryland
PM	Particular Matter
pp	pages
ppb	parts per billion
ppm	parts per million
PSC	Public Service Commission
PZEV	Partial Zero Emission Vehicle
Q	Quarter
RFP	Request for Proposal
RGGI	Regional Greenhouse Gas Initiative
ROG	Reactive Organic Gases
RPE	Retail Price Equivalent
RTO	Regional Transmission Organization
SF_6	Sulfur Hexafluoride
SFH	Single Family Home
SFTP	Supplemental Federal Test Procedure
SIP	Standard Implementation Plan
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur Dioxide
SOH	State Of Health
SRIA	Standardized Regulatory Impact Assessment
STI	Sonoma Technology Incorporated
SULEV	Super-Ultra-Low-Emission Vehicles
SUV	Sport Utility Vehicle
SVM	Small Volume Manufacturer
T&D	Transmission and Distribution
TBD	To Be Determined
TCO	Total Cost of Ownership
TOU	Time Of Use
TRAP	Traffic Related Air Pollution
TSD	Technical Support Document
U.S.	United States
U.S.C.	United States Code
UDDS	Urban Dynamometer Driving Schedule
ULEV	Ultra-Low-Emission Vehicle
USCA	United States Climate Alliance
USEPA	United States Environmental Protection Agency

V2G	Vehicle to Grid
VIN	Vehicle Identification Number
VOC	Volatile Organic Compound
VTO	Vehicle Technologies Office
WMDA	Washington D.C., Maryland, Delaware service station and automotive repair Association
WTW	Well-To-Wheel
ZEV	Zero Emission Vehicle

Section 1 Introduction

In March 2022, Delaware Governor John Carney directed the Department of Natural Resources and Environmental Control (DNREC) to begin the regulatory development process for the adoption of Zero Emission Vehicle (ZEV) standards established by the California Air Resource Board (CARB) also known as the Advanced Clean Car Program (ACC).

The purpose of this action is to amend 7 DE Admin. Code 1140 – Delaware's Low Emission Vehicle Program - by updating the adoption by reference of California's Advanced Clean Car II (ACC II) as amended on August 25, 2022 and finalized on November 30, 2022. The Advanced Clean Car program is comprised of three elements – (1) low emission vehicle standards; (2) greenhouse gas emission standards and (3) zero emission standards for new vehicles weighing up to 14,000 pounds gross vehicle weight. The ACC II regulations will seek to reduce criteria and greenhouse gas emissions from new light- and medium-duty vehicles beyond the 2025 model year as well as add the new requirements for zero emission vehicles.

Delaware initially adopted the California vehicle emission standards in 2010, known as the Low Emission Vehicle Standards (LEV III), beginning with model year (MY) 2014. Additional amendments were later adopted to include the greenhouse gas standards. At that time, Delaware chose to not adopt the third element – the zero emission vehicle standards.

Incorporating the third element of ACC II known as the Zero Emission Vehicle (ZEV) standards will help Delaware to realize not only its Climate Action Goals but also produce real emission reductions from the Transportation Sector which will ensure that Delaware continues to meet the federal health-based emission standards for criteria pollution.

The following sections present technical information and a discussion these key topics:

- Delaware's Air Quality
- Overview of the Department's Regulatory Authority
- Delaware's Vehicle Emissions
- Vehicle Emission Standards
- Proposed Amendments to 7 DE Admin. Code 1140
- Vehicle Technology
- Powering Zero Emitting Technology and Grid Reliability
- Complementary Policies
- Health Impacts and Benefits
- Economic Impacts and Benefits
- Environmental Justice
- Public Participation

Section 2 Delaware's Air Quality

In 1970, Congress amended the Clean Air Act (CAA) of 1963[1] and authorized the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for criteria pollutants shown to threaten human health, welfare and the environment.

> A "criteria" air pollutant is an air pollutant that has a National Ambient Air Quality Standard (NAAQS) established for it by the U.S. EPA. There are currently seven criteria pollutants: sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). Concentrations (Table 2-1) are in either parts per million (ppm), parts per billion (ppb), or micrograms per meter cubed (g/m^3).[2]

Primary standards were set according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations (e.g., children, asthmatics, and the elderly). Secondary standards were set according to criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, buildings, etc.).

Once a NAAQS is established, states use the measured air pollution concentrations of these pollutants through their ambient air monitoring network to determine how high the pollution is in that area. Delaware's Division of Air Quality operates and maintains 11 monitoring stations throughout our state. See Figure 2-1.

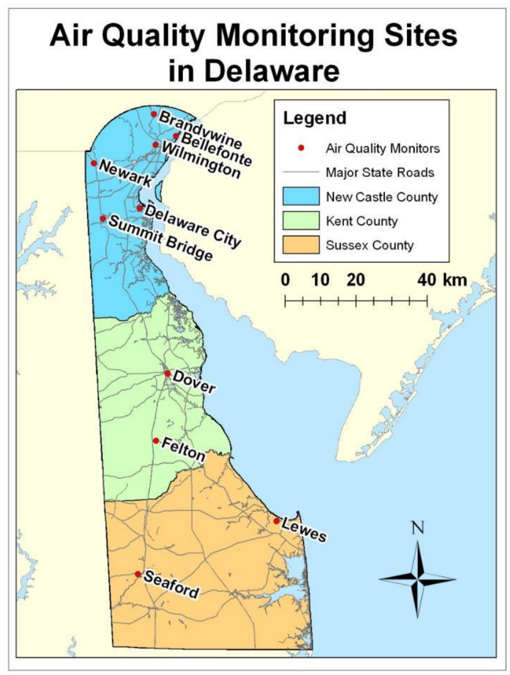

Figure 2-1. Delaware's Air Monitoring Network

Although monitoring takes place statewide, most of the stations are concentrated in the northern urban/industrial areas, which have the highest population and number of pollutant sources. Different stations also monitor different pollutants, depending on sources, population, and monitoring goals for the station. Real time data can be found on the Department's Air Monitoring website at - State of Delaware - DNREC Air Quality.

If the monitors record air pollution above the NAAQS threshold, the governor informs the EPA that the county should be classified as not meeting the health-based standard. The EPA using the data and criteria for the NAAQS classifies that county as non-attainment for the pollutant.

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[1] *Evolution of the Clean Air Act* (November 28, 2022) retrieved from https://www.epa.gov/clean-air-act-overview/evolution-clean-air-act

[2] 42 U.S.C. 7409. Pursuant to section 109 CAA, EPA has established primary national ambient air quality standards (NAAQS) for each criteria pollutant, designed to protect human health, and secondary NAAQS, intended to protect public welfare.

Table 2-2. National Ambient Air Quality Standards (NAAQS)

Pollutant (Scientific Notation)		Primary / Secondary Standard	Averaging Time	Concentration	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		Primary & Secondary	Rolling 3 month period	0.15 □g/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary & Secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)		Primary & Secondary	8 hours	0.070 ppm	Annual 4th highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year	12.0 □g/m^3	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 □g/m^3	Annual mean, averaged over 3 years
		Primary & Secondary	24 hours	35 □g/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary & Secondary	24 hours	150 □g/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Delaware has made great strides in reducing air pollution in our state since the 1970's; however, Delaware's ambient air quality monitors in 2015 showed that only New Castle County did not record pollution concentrations below the ozone standard. As a result, the state was designated non-attainment for the 2015 ozone standard and required to identify control measures that further reduce emissions from sources in Delaware. States must develop state implementation plans (SIPs) that explain the regulations and controls they will use to clean up the nonattainment areas (NAA). For all other criteria pollutants, Delaware has demonstrated attainment of the federal standards.

Delaware's ozone pollution control measures include requiring pollution control equipment on our power plants, the refinery and other industrial sources, reducing certain chemicals in the consumer products we use, and establishing standards for our vehicles to meet and for those vehicles to be inspected to show they meet the standards. Today, the largest source of ozone forming pollution in Delaware is from the cars and trucks (on-road) we drive. Transportation is also the nation's largest source of greenhouse gases, accounting for 27 percent of emissions.

EPA's NAAQS Attainment Designation Process:

EPA is required by CAA Section 107(d) to designate areas throughout the nation as attaining or not attaining the NAAQS. Section 179(c)(1) of the CAA requires EPA to determine whether a nonattainment area[3] attained the applicable standard by the applicable attainment date based on the area's air quality as of the applicable attainment date. A determination of whether an area's air quality meets applicable standards is generally based upon the most recent three years of complete, quality-assured data gathered at the established state and local air monitoring stations (SLAMS) in a nonattainment area and entered into the EPA's Air Quality System (AQS) database. Data from ambient air monitors operated by state and local agencies in compliance with EPA's monitoring requirements must be submitted to AQS. Monitoring agencies annually certify that these data are accurate to the best of their knowledge.

EPA uses the certified air monitoring data to calculate design values that are used to determine the area's status in accordance with 40 CFR 50 Appendix U. Specifically, under EPA regulations in 40 CFR 50.19 and in accordance with 40 CFR 50 Appendix U, the primary and secondary national ambient air quality standards for ozone (O_3) are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average O_3 concentration (*i.e.,* the design value) is less than or equal to 0.070 parts per million (ppm). Design values are calculated by computing the annual fourth-highest daily maximum 8-hour O_3 concentration, averaged over three years, expressed in ppm. The fourth-highest daily maximum 8-hour O_3 concentration for each year shall be determined based only on days meeting the validity criteria in 40 CRF 50 Appendix U 3(d). The 3-year average shall be computed using the three most recent, consecutive years of ambient O_3 monitoring data. Design values shall be reported in ppm to three decimal places, with additional digits to the right of the third decimal place truncated.

After EPA sets a new National Ambient Air Quality Standard or revises an existing standard for a criteria air pollutant, the Clean Air Act requires EPA to determine if areas of the country meet the new standards. Within one year of setting a new or revised national ambient air quality standard for a criteria pollutant, States and tribes submit recommendations to the EPA as to whether or not an area is attaining the standard. The states and tribes base these

[3] Delaware's New Castle county is included with the greater Philadelphia Metropolitan Statistical Area (MSA) which also includes counties in Pennsylvania, Maryland and New Jersey. For additional information on how EPA designates an area as nonattainment see EPA's Green Book - https://www.epa.gov/green-book.

recommendations on available air quality data collected from monitors at locations in urban and rural settings as well as other information characterizing air quality such as modeling. After working with the states and tribes and considering the information from air quality monitors, and/or models, EPA will "designate" an area based on whether or not it is meeting the standard.

If the air quality in a geographic area meets or is cleaner than the national standard, it is called an attainment area (designated "attainment/unclassifiable"); areas that don't meet the national standard are called nonattainment areas. A designated nonattainment area can include portions of 2, 3, or 4 states rather than falling entirely within a single state. In some cases, EPA is not able to determine an area's status after evaluating the available information and those areas are designated "unclassifiable." Once designations take effect, state and local governments with nonattainment areas must develop implementation plans outlining how areas will attain and maintain the standards by reducing air pollutant emissions.

2015 8-hour Ozone NAAQS Attainment Designation

On October 1, 2015, the EPA strengthened the primary and secondary National Ambient Air Quality Standards (NAAQS) for ground-level ozone from the 2008 NAAQS of 0.075 parts per million (ppm) over an 8-hour period to 0.070 ppm, which is equivalent to 70 ppb (US EPA 2015b). The 2015 8-hour ozone NAAQS of 0.070 ppm is expected to provide better protections of public health and environment.

Prior to EPA making the attainment or non-attainment designations, the states provide EPA their recommendations as required by CAA 107(d). Delaware submitted its ozone attainment designation recommendations on September 23, 2016. In the letter, Delaware recommended a broad non-attainment area:

"Emissions cause ozone non-attainment and Delaware believes it is necessary to establish non-attainment boundaries that encompass enough of these emissions to make attainment feasible and possible goal for the area. To this end Delaware hereby recommends that the non-attainment area borders associated with New Castle County be the borders of the States of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin…due to EPA's analysis that these states significantly impact Delaware as part of the CASPR and CASPR Update. If EPA again rejects establishing non-attainment area that is consistent with science to solve the problem, Delaware requests EPA establish New Castle County as a stand-alone non-attainment area under the 2015 8-hour ozone NAAQS."

The U.S. EPA rejected Delaware's recommendation and announced on November 16, 2017 (82 FR 54232), that New Castle County was to be designated nonattainment for ozone and associated it with the greater Philadelphia Metropolitan Area (see 40 CFR 81.15), which consists of New Castle County in Delaware and counties in Maryland, New Jersey, and Pennsylvania. The U.S. EPA designated all of these counties as marginal nonattainment for the 2015 ozone NAAQS. EPA based the designations on the most recent 3 years (2014-2016) of certified ozone air quality monitoring data and on an evaluation of factors to assess contributions to nonattainment in nearby areas. New Castle County was deemed to contribute emissions to the Philadelphia area and thereby included in the broad nonattainment area.

In a final rule dated June 4, 2018 (83 FR 25776), the EPA designated 51 areas (Figure 2-2) in the country as nonattainment for the 2015 8-hour ozone NAAQS. In the same final rule, Kent and Sussex Counties were designated as attainment (83 FR 25776). The EPA made the designations of these three counties based on their 2014-2016 design values,[4] and the effective date of the designations was August 3, 2018. Figure 2-3 provides a visual of Delaware's three counties and New Castle County as part of the Philadelphia NAA.

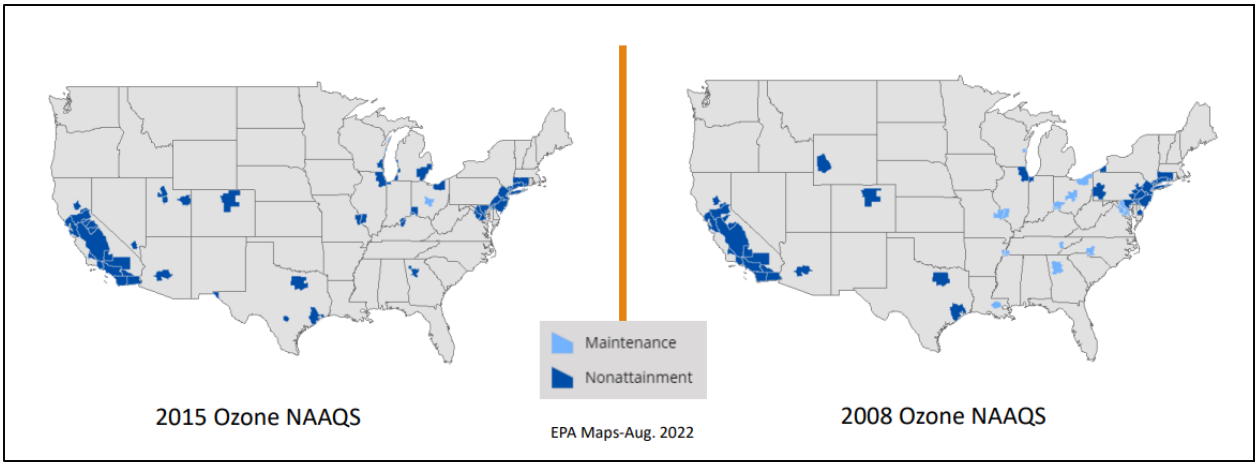

Figure 2-2. 2015 versus 2008 Ozone NAAQS Designations

The 2015 Ozone NAAQS is met at an EPA regulatory monitoring site when the design value does not exceed 0.070 parts per million (ppm). For areas classified as Marginal nonattainment for the 2015 Ozone NAAQS, the attainment deadline date was August 3, 2021. Because the design values are based on the three most recent, complete calendar years (2018-2020), attainment must occur no later than December 31 of the year prior to the attainment date (*i.e.*, December 31, 2020, in the case of Marginal nonattainment areas for the 2015 Ozone NAAQS).

Under CAA Section 107(c), within six months of the attainment deadline date (8/3/2021), the EPA is required to make a determination on the area's air quality as of the attainment date, and whether an area (PA, NJ, MD, DE) attained by that date. If the EPA determines that area failed to attain by the attainment date, EPA is required to publish that determination in the **Federal Register** per CAA section 107(c)(2). As such the EPA's proposed determinations for each area are based upon the complete, quality assured, and certified ozone monitoring data from calendar years 2018, 2019 and 2020.

[4] The air quality design value at a monitoring site is defined as the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration is also the air quality design value for the site. (40 CFR Part 50, Appendix I, Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone)

The 2018-2020 design value for the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE nonattainment area was 0.074 ppm. The attainment deadline for the marginal nonattainment areas was August 3, 2020. On October 7, 2022 (87 FR 60897), the EPA finalized actions to fulfill its statutory obligation under CAA section 181 to determine whether 31 Marginal ozone nonattainment areas attained the 2015 ozone NAAQS by August 3, 2021, the applicable attainment date for such areas.[5] Delaware's New Castle County, along with the greater Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE metropolitan statistical area was redesignated as moderate non-attainment for the 2015 Ozone NAAQS based upon the failure of the NAA to record data below the standard.

The effect of failing to attain by the applicable attainment date (August 3, 2021) requires that these areas or portions of areas to be reclassified by operation of law to ''Moderate'' nonattainment for the 2015 ozone NAAQS on November 7, 2022, the effective date of this final rule. Accordingly, the responsible state air agencies are required to submit State Implementation Plan (SIP) revisions and implement controls to satisfy the statutory and regulatory requirements for Moderate areas for the 2015 ozone NAAQS according to the deadlines established in the final rule.

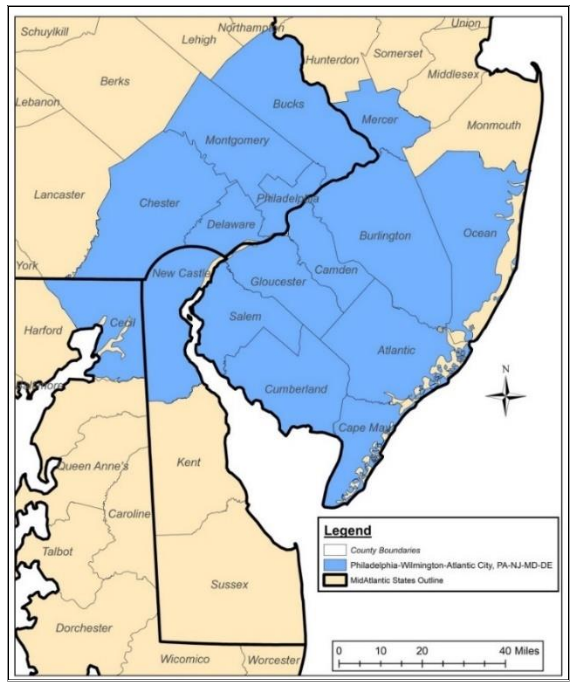

Figure 2-3. Map of the Philadelphia-Wilmington-Atlantic City Nonattainment Area Under the 2015 8-hour ozone NAAQS

Areas reclassified to Moderate face more stringent CAA requirements designed to achieve attainment of the NAAQS by no later than August 3, 2024. These requirements include stricter permitting requirements, implementing reasonably available control technology for major sources and sources covered by certain EPA guidance documents, basic vehicle inspection and maintenance (I/M) for urbanized areas, and the submission of a new plan demonstrating how the area will attain expeditiously.

Delaware's designation to Moderate nonattainment was the result of air quality monitors in the Philadelphia-Wilmington-Atlantic City recording ozone design value data for 2018-2020 above the 2015 Ozone NAAQS. Three monitors in Pennsylvania recorded design values for the 3-year period 2018-2020 that were greater than the standard (Table 2-2), thereby EPA determined that the NAA failed to meet the standard and was redesignated from marginal nonattainment to moderate nonattainment. The attainment deadline for areas designated moderate nonattainment is August 3, 2024, which requires the NAA's 3-year design value data for 2020-2023 to demonstrate attainment with the 2015 Ozone NAAQS.

[5] Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Marginal for the 2015 Ozone National Ambient Air Quality Standards. 87 FR 60897, October 7, 2022.

One key stakeholder commentor asserted that Delaware should petition EPA to remove Delaware from the greater Philadelphia nonattainment area and redesignate Delaware as attainment for the 2015 Ozone NAAQS. This commentor also suggested that based upon the more recent three-year period 2020-2022 monitoring data that EPA should consider this in their attainment decision.

As stated above, EPA is required to use the 2018-2020 data which is certified and validated. This data is the most recent data available for determining attainment for area designated as Marginal nonattainment as the deadline was August 2021. The 2022 monitoring data is not yet certified and validated by the states and cannot be used to demonstrate attainment after the August 2021 attainment deadline. EPA is further required by the CAA Section 181(b)(2) to make the attainment decision within 6 months following the applicable attainment date. In this case, EPA proposed redesignation for Delaware's New Castle county on April 13, 2022 (87 FR 21842) and finalized that decision on October 7, 2022 (87 FR 60897).[6]

As for the assertion that Delaware should petition EPA to remove Delaware from the large nonattainment area, EPA cannot remove Delaware's New Castle county because Delaware's emissions contribute to the Philadelphia-Wilmington-Atlantic City area.[7]

Table 2-2. Philadelphia-Wilmington-Atlantic City NAA 2018-2020 Design Values

State Name	County Name	Local Site Name	Valid 2018-2020 Design Value (ppm) [1,2]	2018 4th Highest Daily Max. Value (ppm)	2019 4th Highest Daily Max. Value (ppm)	2020 4th Highest Daily Max. Value (ppm)	Number of Exceedance Days in 2018	Number of Exceedance Days in 2019	Number of Exceedance Days in 2020
Delaware	New Castle	Lums Pond	0.065	0.071	0.064	0.061	4	1	0
Delaware	New Castle	Brandywine Creek State Park	0.063*	0.067	0.067	0.057	2	1	0
Delaware	New Castle	Bellevue State Park,	0.066	0.072	0.068	0.060	4	3	0
Delaware	New Castle	MLK Corner Of Mlk Blvd And Justison St	0.067	0.071	0.067	0.063	4	2	2
Maryland	Cecil	Fair Hill Natural Resource Management Area	0.068	0.073	0.068	0.064	7	3	0
New Jersey	Camden	Camden Spruce Street	0.069	0.075	0.070	0.062	5	3	0
New Jersey	Camden	Ancora State Hospital	0.064	0.068	0.067	0.059	1	3	0
New Jersey	Gloucester	Clarksboro	0.069	0.077	0.068	0.064	7	1	1
Pennsylvania	Bucks	Bristol	0.074	0.084	0.067	0.071	12	3	4

[6] 87 FR 21842. April 13, 2022. Retrieved from EPA's Green Book - https://www3.epa.gov/airquality/greenbook/jfrnrpt3.html#DE
[7] USEPA. 2023. Green Book – Ozone Designation and Classification Information. Retrieved from https://www.epa.gov/green-book/ozone-designation-and-classification-information.

State Name	County Name	Local Site Name	Valid 2018-2020 Design Value (ppm) [1,2]	2018 4th Highest Daily Max. Value (ppm)	2019 4th Highest Daily Max. Value (ppm)	2020 4th Highest Daily Max. Value (ppm)	Number of Exceedance Days in 2018	Number of Exceedance Days in 2019	Number of Exceedance Days in 2020
Pennsylvania	Chester	Chester County Transport Site Into Philadelphia	0.064	0.065	0.068	0.060	1	1	0
Pennsylvania	Delaware	A420450002lat/Lon Point Is Of Corner Of Trailer	0.068	0.073	0.069	0.062	4	3	1
Pennsylvania	Montgomery	A420910013lat/Lon Point Is Of Corner Of Trailer	0.068	0.073	0.065	0.066	7	1	0
Pennsylvania	Philadelphia	Air Management Services Laboratory	0.067*	0.071	0.067	0.064	5	3	0
Pennsylvania	Philadelphia	North East Airport (NEA)	0.073	0.079	0.071	0.070	8	4	3
Pennsylvania	Philadelphia	North East Waste (New)	0.071	0.076	0.072	0.067	9	4	2

Notes:
1. The level of the 2015 8-hour ozone NAAQS is 0.070 parts per million (ppm). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour ozone concentration. Monitors with design values less than or equal to 0.070 ppm must have 75% annual data capture and 90% 3-year average data capture in order to be considered valid.
2. The design values shown here are computed using Federal Reference Method or equivalent data reported by State, Tribal, and Local monitoring agencies to EPA's Air Quality System (AQS) as of May 5, 2021. Concentrations flagged by State, Tribal, or Local monitoring agencies as having been affected by an exceptional event (e.g., wildfire, volcanic eruption) and concurred by the associated EPA Regional Office are not included in these calculations.
Disclaimer: The information listed in this report and in these tables is intended for informational use only and does not constitute a regulatory determination by EPA as to whether an area has attained a NAAQS. The information set forth in this report has no regulatory effect. To have a regulatory effect, a final EPA determination as to whether an area has attained a NAAQS or attained a NAAQS as of its applicable attainment date can be accomplished only after rulemaking that provides an opportunity for notice and comment. No such determination for regulatory purposes exists in the absence of such a rulemaking. This report does not constitute a proposed or final rulemaking.

Ozone Pollution Trends

Trends in ozone concentrations can be difficult to discern because of meteorology. Hot, dry weather and stagnant air favor the formation of ozone, and the greatest number of exceedance days typically occur during the hottest and driest summers. Overall, Delaware ozone levels have shown a downward trend, with fewer exceedance days even as the standard has been lowered twice in the past two decades.

In Figure 2-4, the total number of statewide exceedances is shown as a bar chart in gray based on the applicable standard. The lines for each county do not necessarily correspond with the statewide count because an exceedance in a particular county may not have occurred on the same day as another county. For example, if Sussex County had two exceedances, one each on a Monday and Tuesday, Kent county had three exceedances each Wednesday to Friday, and New Castle county had one exceedance on Friday, the statewide total would be 5, but Sussex = 2, Kent = 3, and New Castle =1.

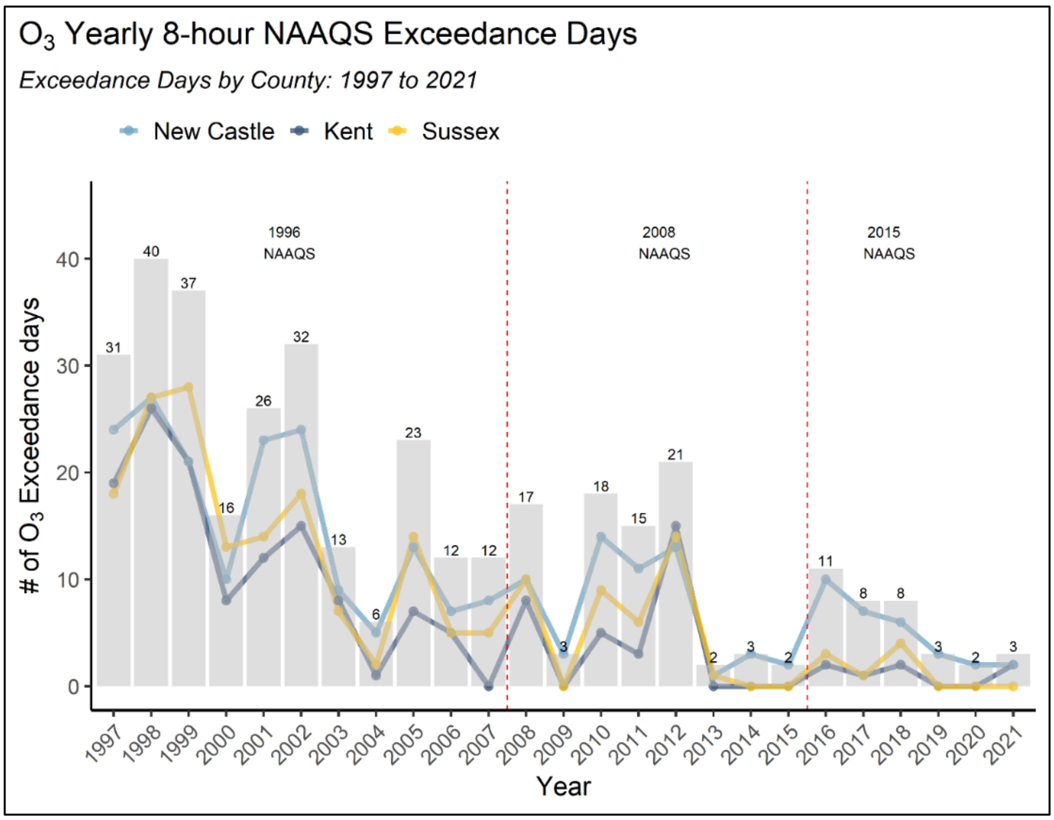

Figure 2-4: Ozone exceedance days by county from 1997 to 2021.

The design value is the statical measure used to describe the air quality status of a specific location relative to the level of the National Air Quality Standards (NAAQS). Figure 2-5 shows the "Ozone Design Value by County" for ozone from 1993 to 2021. The "Ozone Design Value by County" numbers in the chart on the following page are the annual fourth highest (4th maximum) daily 8-hour concentration, averaged over three years, referred to as the Design Value. If the Design Value is less than or equal to the standard, the 8-hour standard is achieved or met. Based on the preliminary 2019 – 2021 data, New Castle County meets the ozone 8-hour NAAQS at 0.065 ppm.

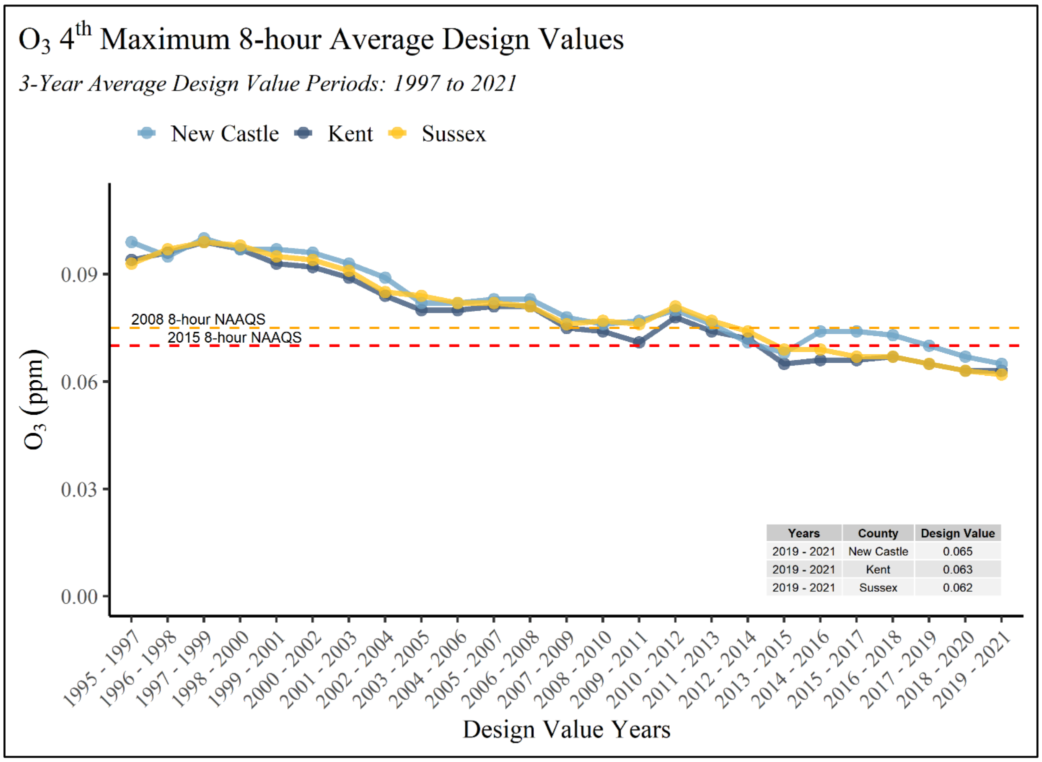

Figure 2-5: Ozone three-year average design values.

Ozone

Ozone is a colorless gas composed of three oxygen atoms. Ground level ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). This happens when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight.

It is the prime ingredient of what is commonly called “smog.” When inhaled, ozone can cause acute respiratory problems, aggravate asthma, cause inflammation of lung tissue, and even temporarily decrease the lung capacity of healthy adults. Repeated exposure may permanently scar lung tissue.

Ozone is most likely to reach unhealthy levels on hot sunny days in urban environments but can still reach high levels during colder months. Ozone can also be transported long distances by wind, so even rural areas can experience high ozone levels.

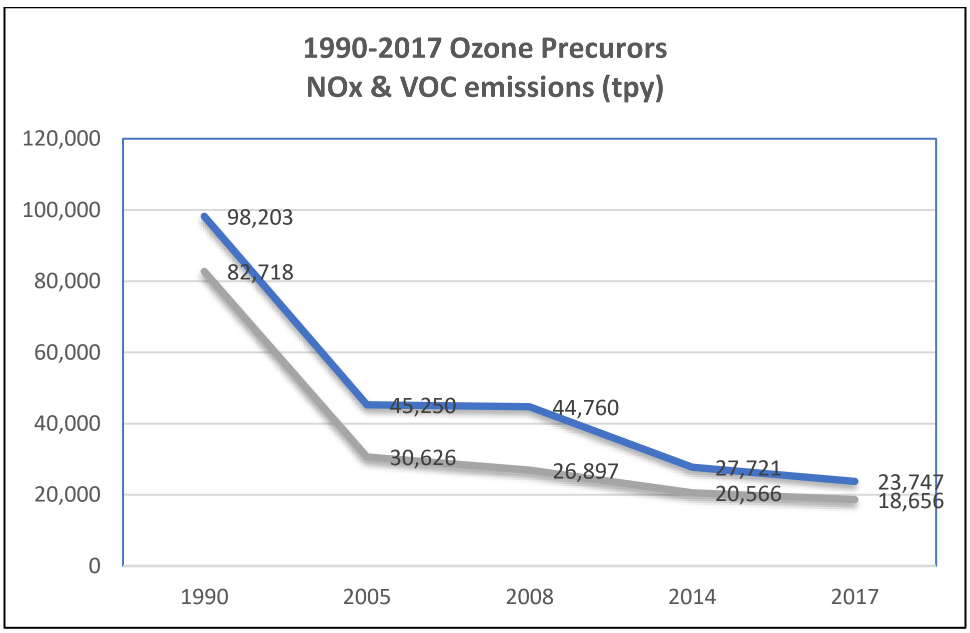

Figure 2-6. Delaware’s NOx and VOC emissions

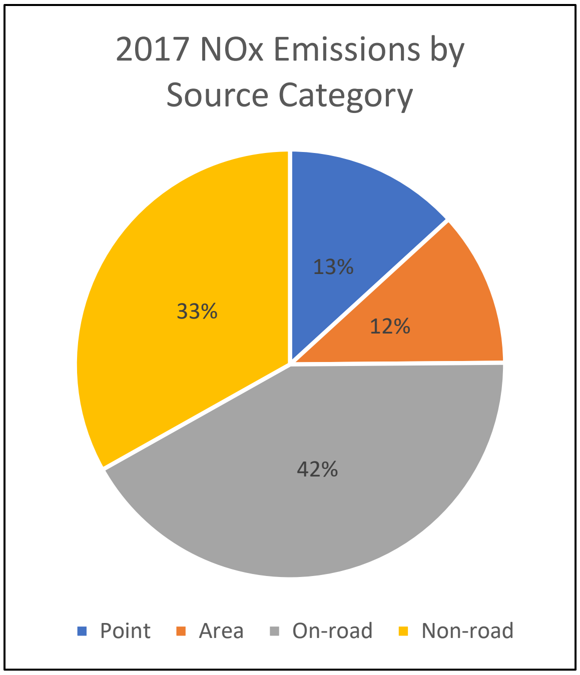

Figure 2-7. Ozone Precursor Emissions – NOx by Source Category

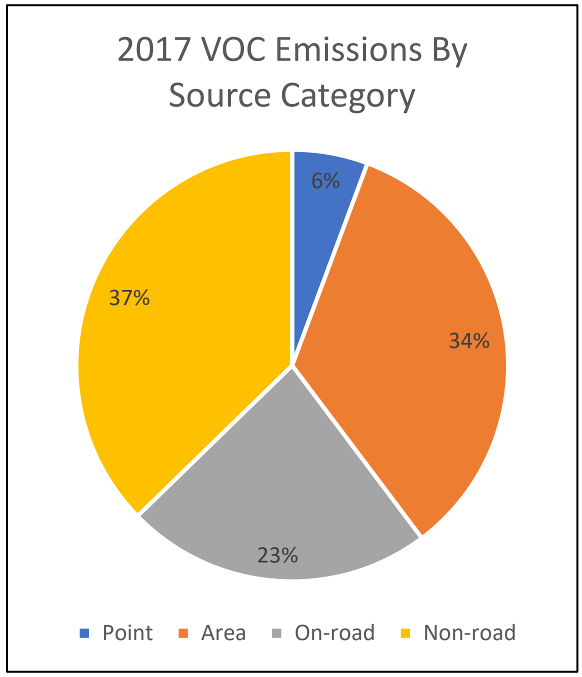

Figure 2-8. Ozone Precursor Emissions – VOC by Source Category

Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless, poisonous gas produced by incomplete combustion of fossil fuels. It reduces the blood's ability to carry oxygen. Exposure can cause fatigue, headache, and impaired judgment and reflexes at moderate concentrations; at high levels unconsciousness and death can result. People with heart disease, angina, emphysema and other lung or cardiovascular diseases are most susceptible.

Standards Primary NAAQS:

- 8-hour average = 9 ppm (10 μg/m3) (Not to be exceeded more than once per year)
- 1-hour average = 35 ppm (40 μg/m3) (Not to be exceeded more than once per year)

Sources

Carbon monoxide is formed when carbon in fuel is not completely burned. The U.S. EPA estimates that approximately 60% of all CO emissions are from motor vehicle exhaust. Other sources include incinerators, wood stoves, furnaces, and some industrial processes. Concentrations are highest along heavily traveled highways and decrease significantly with increasing distance from traffic. Therefore, CO monitors are usually located close to roadways or in urban areas.

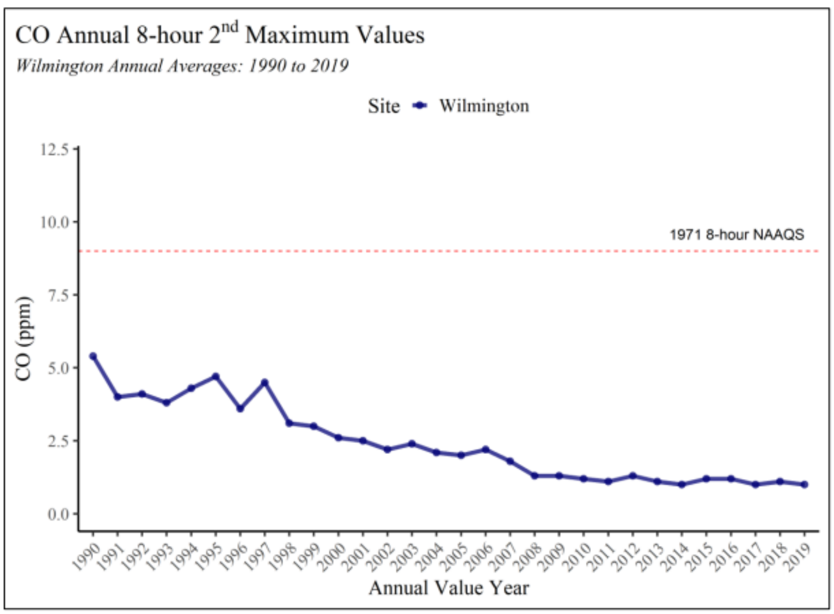

Figure 2-9. Delaware CO Trends Annual 2nd Maximum

Mobile sources cause most of the ambient CO detected by Delaware's monitoring network. There has been a slight downward trend in CO concentrations since monitoring began in the 1970s, and no violations of the ambient standards have occurred since 1977. Improvements are largely due to cleaner burning engines in cars and tighter automobile emission standards. Relatively stable low year-to-year concentrations continued in 2019.

Nitrogen Dioxide

Nitrogen dioxide (NO2) is a reddish-brown toxic gas that is part of a group of gases containing nitrogen and oxygen called oxides of nitrogen or NOX. Nitrogen dioxide irritates the lungs and upper respiratory system and lowers resistance to respiratory infections. It can be fatal in high concentrations. Nitrogen dioxide is also known to damage vegetation by stunting growth and reducing seed production. It acts to reduce visibility. Reactions between nitrogen dioxide and other compounds in the atmosphere can form nitric acid, which contributes to the acid rain problem.

Oxides of nitrogen can also have a significant impact on fine particulate matter concentrations, most notably in the western areas of the United States. One of the most important features of NOX is their ability to react with volatile organic compounds (VOCs) to form ozone. Air quality computer models have shown that control of NOX is necessary in many areas of the United States to reach attainment of the ozone standard.

Atmospheric deposition of oxides of nitrogen has recently been estimated to be a significant source of nitrogen to bodies of water such as the Chesapeake Bay and Delaware's Inland Bays. Nitrogen acts as a nutrient and contributes to excess nutrient loading and algal blooms in estuary systems.

Oxides of nitrogen are produced during high temperature burning of fuels. Sources of NOX include motor vehicles and stationary sources that burn fossil fuels such as power plants and industrial boilers.

Nitrogen dioxide levels in Delaware have remained well below the NAAQS since monitoring began. In 2019, levels continued to remain well below the standard with a slight downward trend in the Design Value. Figures 2-10 and 2-11 depict the current levels of NO2 pollution experienced in Delaware.

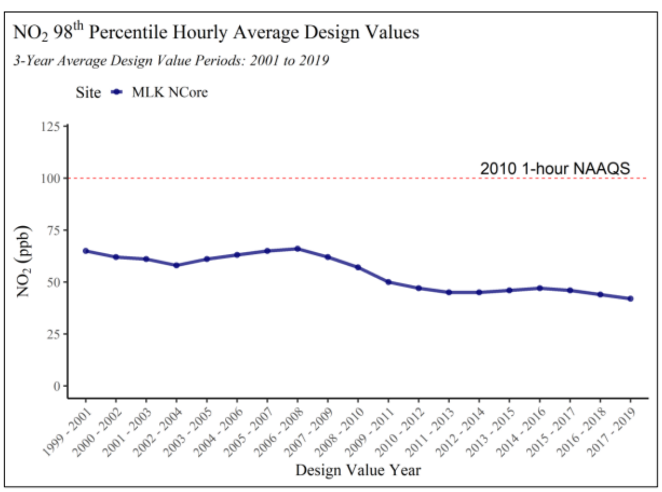

Figure 2-10. NO2 Trends, 3-year Design Values: 98th Percentile

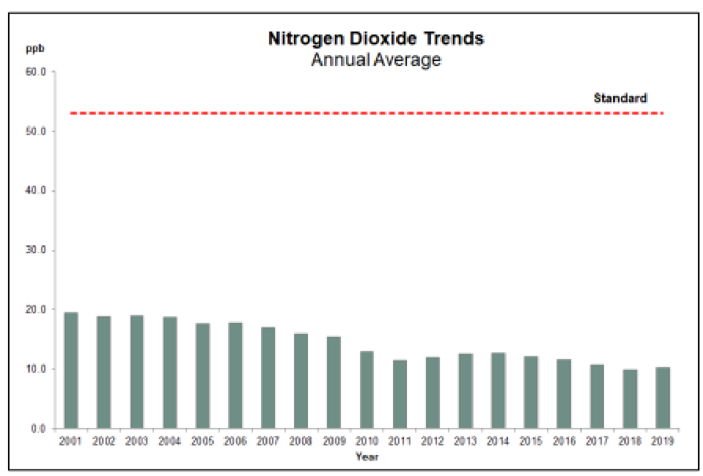

Figure 2-11. NO2 Trends, Annual Average

Particulate Matter

Tiny airborne particles found in haze, smoke and airborne dust, and known as "particulate matter" and usually abbreviated as $PM_{2.5}$, can occur year-round and can cause serious health problems.

Fine particles (those smaller than 2.5 microns) penetrate more deeply into the lungs than coarse particles those between (2.5 and 10 microns). Health studies indicate a link between fine particle concentrations in outdoor air and certain health effects. These include premature death in people with heart or lung disease, nonfatal heart attacks, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.
Particulate matter pollution can cause reduced visibility (haze) in parts of the United States, including many of our treasured national parks.

Particles can be carried over long distances by wind and settle on the ground or water. This can make lakes and streams acidic, change the nutrient balance in coastal waters and large river basins, deplete the nutrients in soil, damage sensitive forests and farm crops, and affect the diversity of ecosystems.

Particle pollution can also stain and damage stone and other materials, including culturally important objects such as statues and monuments.

Fine particles are directly released from construction sites, unpaved roads, fields, smokestacks or fires (area sources). Others form in the atmosphere by complicated reactions of chemicals such as sulfur dioxides and nitrogen oxides that are released from power plants, industries and automobiles. These particles, known as secondary particles, make up most of the fine particulate in the country.

Particulate Matter (PM) has primary and secondary standards for $PM_{2.5}$ (annual average standards with levels of 12.0 ug/m3 and 15.0 ug/m^3, respectively; 24-hour standards with 98^{th} percentile forms and levels of 35 ug/m^3) and PM10 (24-hour standards with one-expected exceedance forms and levels of 150 ug/m^3). As depicted by Figures 2-12 through 2-14 Delaware's fine particulate matter emissions are monitored below the current federal health-based emission standards and attain the standards.

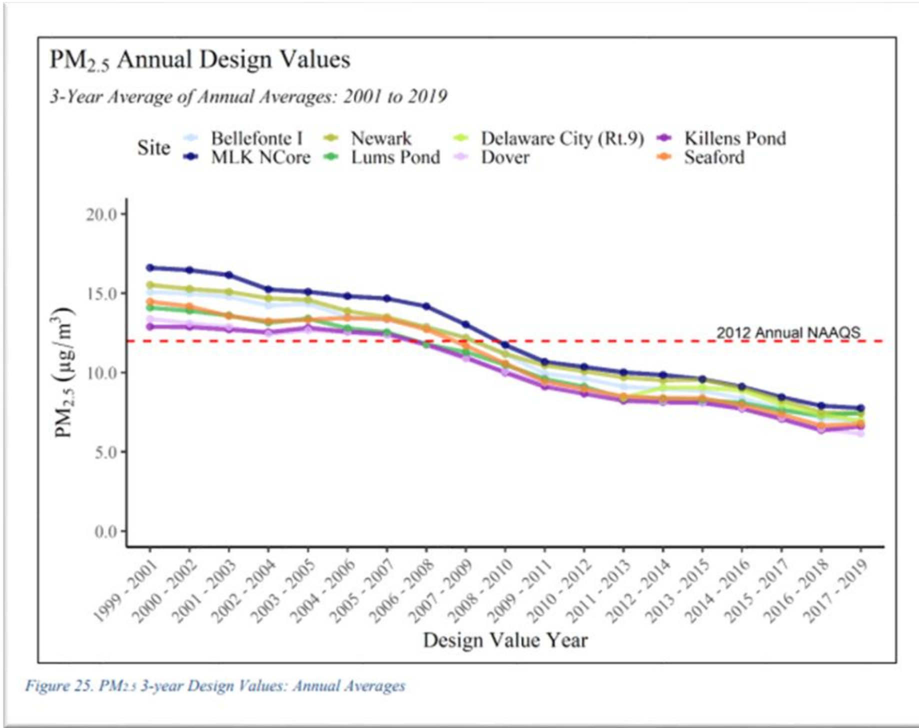

Figure 2-12. PM2.5 Annual Design Values

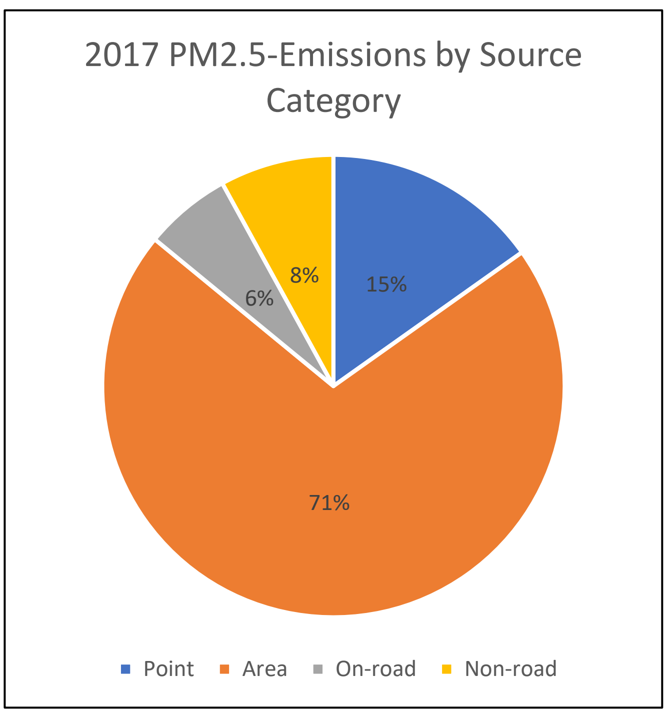

Figure 2-13. Fine Particulate Matter Emissions by Source Category

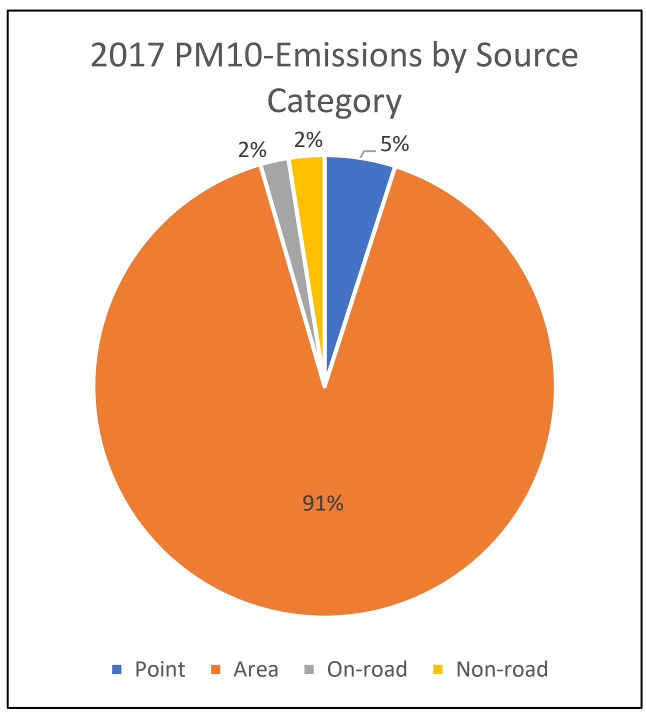

Figure 2-14. Course Particulate Matter Emissions by Source Category

Greenhouse Gas Emissions

Greenhouse gases trap heat and make the planet warmer. Human activities are responsible for almost all* of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation.

The primary sources of greenhouse gas emissions in the United States are:

- Transportation (27% of 2020 greenhouse gas emissions) – The transportation sector generates the largest share of greenhouse gas emissions. Greenhouse gas emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90% of the fuel used for transportation is petroleum based, which includes primarily gasoline and diesel.[2]
- Electricity production (25% of 2020 greenhouse gas emissions) – Electric power generates the second largest share of greenhouse gas emissions. Approximately 60% of our electricity comes from burning fossil fuels, mostly coal and natural gas.[3]
- Industry (24% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from industry primarily come from burning fossil fuels for energy, as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials.
- Commercial and Residential (13% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from businesses and homes arise primarily from fossil fuels burned for heat, the use of certain products that contain greenhouse gases, and the handling of waste.
- Agriculture (11% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from agriculture come from livestock such as cows, agricultural soils, and rice production.
- Land Use and Forestry (13% of 2020 greenhouse gas emissions) – Land areas can act as a sink (absorbing CO_2 from the atmosphere) or a source of greenhouse gas emissions. In the United States, since 1990, managed forests and other lands are a net sink, i.e., they have absorbed more CO_2 from the atmosphere than they emit.

*IPCC (2014). *Climate Change 2014: Mitigation of Climate Change (PDF)* (1454 pp, 50 MB). Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

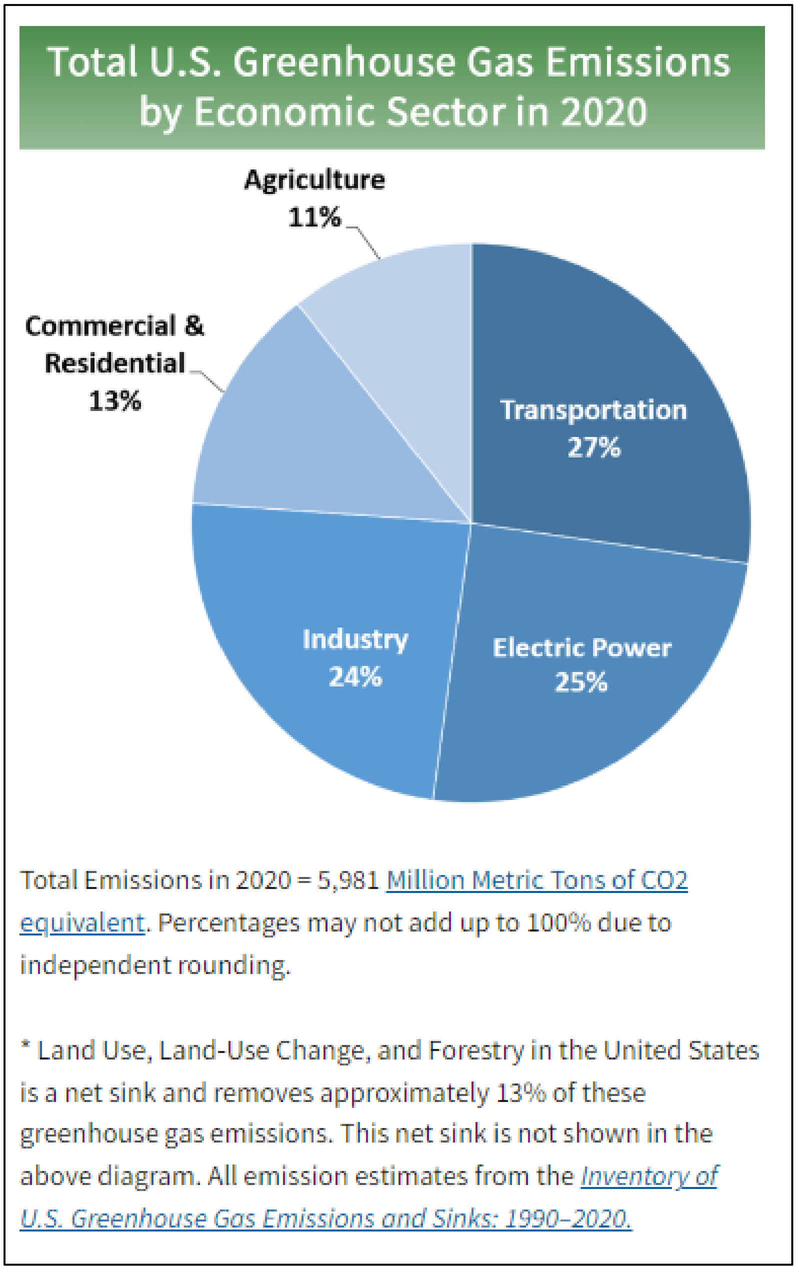

Figure 2-15. US GHG Emissions by Economic Sector

Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020.*

Since 1990, gross U.S. greenhouse gas emissions[8] have decreased by 7%. From year to year, emissions can rise and fall due to changes in the economy, the price of fuel, and other factors.

In 2020, U.S. greenhouse gas emissions decreased 11% compared to 2019 levels. The sharp decline in emissions was primarily from CO_2 emissions from fossil fuel combustion. This was largely due to the coronavirus (COVID-19) pandemic-related reductions in travel and economic activity, including a 13% decrease in transportation emissions driven by less travel.

Electric power sector emissions decreased 10% due to a slight decrease in electricity demand from the COVID-19 pandemic, and a continued shift from coal to less carbon-intensive natural gas and renewables.

Climate change is affecting Delaware and will continue to influence our state going forward. From increased temperatures and rising sea levels to heavy precipitation and flooding, our residents are experiencing the impacts of climate change in their daily lives. Acting on climate change is necessary to protect the people, places and resources loved by all residents in the First State.

The impacts of climate change look different depending on where one is located in the world. In Delaware, the most prominent climate change impacts are sea level rise, increased temperatures, and changes in precipitation patterns (including extreme weather and flooding). Delaware is already feeling these effects, which are projected to worsen in the future.

Climate action means preparing people, property and economies for climate change. By taking climate action, Delaware acknowledges that climate change impacts can negatively affect Delawareans and recognizes the benefits of proactively addressing those impacts. Maximizing resilience and adapting to climate change impacts now better prepares Delaware for extreme and unexpected events, including avoiding property damage and loss, direct and indirect business interruptions, and human deaths and injuries. Minimizing emissions now links Delaware to a worldwide effort to avoid some of the most highly damaging climate change impacts, while also allowing Delaware to reap health benefits and spur innovation for low-carbon technology development.

Recognizing the importance of proactive action, the state created Delaware's Climate Action Plan for three primary purposes:

• To help meet a commitment the state has already made: In 2017, Governor John Carney committed Delaware to reducing greenhouse gas emissions by 26% to 28% from 2005 levels by 2025 (Figure 2-16). Delaware's Climate Action Plan provides information on the state's emissions reduction progress and lays out strategies for meeting or exceeding our goal.

• To set a course for the decades ahead: Delaware's Climate Action Plan looks at past and present work and uses this work as the launching point for continued climate action.

[8] USEPA. 2020. Accessed from Sources of Greenhouse Gas Emissions | US EPA

- To integrate actions for both minimizing greenhouse gas emissions and maximizing resilience to climate change impacts: A climate action plan that specifically focuses on just reducing emissions or enhancing resilience misses out on the opportunity to link these action types to create a stronger, more effective strategy. Delaware's comprehensive response to climate change requires both minimizing emissions and maximizing resilience, as these actions are inherently interrelated.

Transportation is currently the largest in-state source of greenhouse gas emissions with light-duty passenger cars and trucks representing the majority of emissions. Delaware can reduce emissions in the transportation sector by shifting to low-carbon technologies, improving fuel efficiency and increasing opportunities for transportation choice, such as walking and biking. Adoption of the Advanced Clean Car program is one strategy the Climate Action Plan recommended.

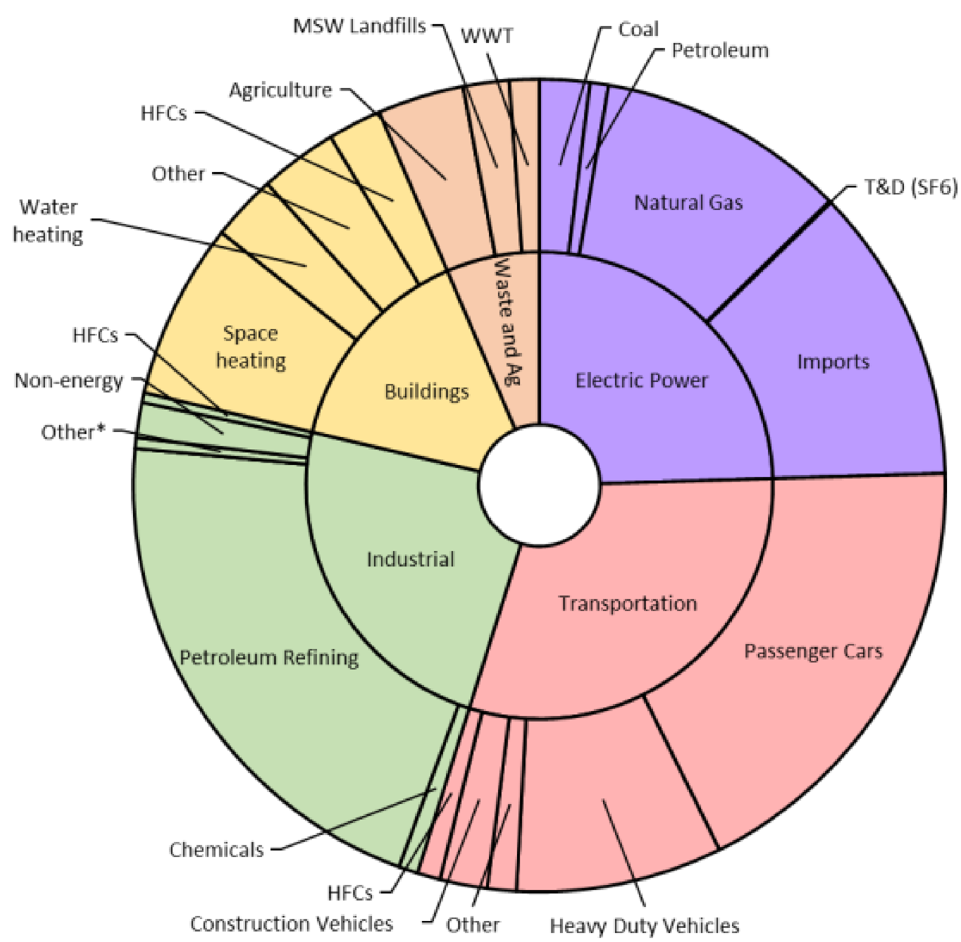

Figure 1. Gross GHG emissions in Delaware in 2018 broken out by sector and end-use (where applicable)

Figure 2-16. Delaware's 2018 Greenhouse Gas Inventory by Sector

Delaware Joins U.S. Climate Alliance to Uphold Goals of Paris Agreement

Governor Carney pledges support in fight against climate change

WILMINGTON, Del. – Governor John Carney announced on Monday, June 5, 2017, that Delaware has joined the U.S. Climate Alliance, a coalition of states committed to upholding the Paris Agreement to combat climate change, after President Trump announced last week that he would withdraw the U.S. from the agreement. The Climate Alliance now includes 13 members.

"Delaware is the country's lowest-lying state and with 381 miles of coastline, climate change is a very real threat to our future," said **Governor Carney**. "As sea levels rise, more than 17,000 Delaware homes, nearly 500 miles of roadway and thousands of acres of wildlife habitat including our critical wetlands are at risk of permanent inundation. Rising average temperatures and an increase in extreme weather events also pose health risks to Delawareans and threaten our economy. The U.S. should lead in the global fight against climate change. Delaware is proud to join this coalition of states providing that necessary leadership."

The Paris Agreement called for the U.S. to achieve a 26-28 percent reduction of emissions, from 2005 levels, by 2025. Delaware's continued commitment to reducing greenhouse gas emissions and transitioning to clean energy also will provide economic opportunity for Delawareans and offer significant public health and environmental benefits.

Delaware's greenhouse gases come from three primary sources: energy production, transportation, and industry. The state is working to reduce emissions in a number of ways, including through continued participation in the Regional Greenhouse Gas Initiative (RGGI), a nine-state program to reduce greenhouse gas emissions from power plants. Delaware also has set renewable energy targets and increased energy efficiency with building codes, weatherization and other voluntary programs.

"Reducing greenhouse gas emissions requires action at all levels – from people using less energy and driving fuel efficient cars, to the government establishing national pollutant standards," said **Shawn Garvin, Secretary of the Delaware Department of Natural Resources and Environmental Control**. "We are proud of the progress the state has made and programs that help Delawareans drive cleaner cars and improve energy efficiency in homes and businesses. There is still much work to be done to reduce Delaware's share of global greenhouse gas emissions, and I look forward to working with our sister states through the US Climate Alliance to meet Delaware's pledge for the Paris Agreement."

In the transportation sector, the state has incentivized the transition to cleaner fuels and electric vehicles, and now has a statewide network of charging stations.

"As we look to the future, it is imperative that we improve transportation resiliency to adapt to the effects of a changing climate. Incorporating the impact of climate change into our project planning and development and adding more alternative fuel vehicles to our public transportation fleet each year are just two examples of how DelDOT is responding, and we thank Governor Carney for his leadership and commitment to this effort," said **Jennifer Cohan, Secretary of Transportation**.

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https://news.delaware.gov/2017/06/05/delaware-joins-u-s-climate-alliance-to-uphold-goals-of-paris-agreement/

Figure 2-17. Governor Carney's Announcement on Zero Emission Vehicles, March 2022

Section 3 Overview of the Department's Regulatory Authority

Delaware Statute

The Department of Natural Resources and Environmental Control (DNREC) obtains its authority to regulate and reduce air pollution and air contaminants from legislation passed by the Delaware General Assembly. The following statutes in the Delaware Code establish DNREC's authority to regulate air pollution emitted in Delaware:

Title 7 Chapter 60

§ 6002. Definitions.
The following words and phrases shall have the meaning ascribed to them in this chapter unless the context clearly indicates otherwise:
(1) "Activity" means construction, or operation, or use of any facility, property, or device.
(2) "Air contaminant" means particulate matter, dust, fumes, gas, mist, smoke or vapor or any combination thereof, exclusive of uncombined water.

§ 6003. Permit — Required.
(a) No person shall, without first having obtained a permit from the Secretary, undertake any activity:
(1) In a way which may cause or contribute to the discharge of an air contaminant; or

§ 6010. Rules and regulations; plans.
(a) The Secretary may adopt, amend, modify or repeal rules or regulations, or plans, after public hearing, to effectuate the policy and purposes of this chapter. No such rule or regulation shall extend, modify or conflict with any law of this State or the reasonable implications thereof.

The Delaware General Assembly further established DNREC's authority over the regulation of vehicle emission standards:

Title 7 Chapter 67

§ 6703. Standards for vehicle emissions.

The Department shall have the power to formulate and promulgate, amend and repeal codes, rules and regulations establishing standards and requirements for the control of air contaminants from motor vehicles.

In June of 2008, the Delaware General Assembly adopted into law the Regional Greenhouse Gas Initiative (RGGI) and CO2 Emissions Trading Program, 7 *Del. C.* Subchapter II-A, §§ 6043 – 6047, which explicitly authorized and sanctioned the prior and ongoing participation of the Secretary of DNREC and the Chair of the Public Service Commission of the State of Delaware to implement and participate in the RGGI and to reduce CO_2 emissions.

In issuing regulations to reduce CO_2 emissions, the Department acts within the authority granted by 7 *Del.C.* §§6043 – 6047, 29 *Del.C.* Chapter 80, and the general authority in 7 *Del.C.* Chapter 60 with respect to air contaminants. By extension, the Department is authorized to reduce air contaminants which include CO_2 emissions.

§ 6043. Findings, purpose, and definitions.

(a) *Findings.* — The General Assembly hereby makes the following findings concerning the development, utilization and control of the air resources of the State related to impacts of carbon dioxide (CO_2) emissions:

(1) There is growing scientific consensus that the increased anthropogenic emissions of greenhouse gases are enhancing the natural greenhouse effect and causing changes in the Earth's climate.

(2) Climate change poses serious potential risks to human health and terrestrial and aquatic ecosystems globally, regionally and in the State.

(3) CO_2 is an air contaminant as defined in § 6002 of this title.

Federal Statute

The Clean Air Act initially required EPA to adopt emission limitations for motor vehicles. The 1990 Amendments require EPA to adopt regulations to achieve further reductions in emissions from motor vehicles, as well as from other mobile sources such as locomotives. States are preempted from adopting emission limitations for motor vehicles and certain other mobile sources. However, Congress provided an exception - California can adopt motor vehicle standards as described in Section 209, and standards for some --but not all-- other mobile sources, and other states can adopt the California standards as described in Section 177.

Section 209 – US Code § 7507. New motor vehicle emission standards in nonattainment areas[9]

Notwithstanding section 7543(a) of this title, any State which has plan provisions approved under this part may adopt and enforce for any model year standards relating to control of emissions from new motor vehicles or new motor vehicle engines and take such other actions as are referred to in section 7543(a) of this title respecting such vehicles if—

(1) such standards are identical to the California standards for which a waiver has been granted for such model year, and

(2) California and such State adopt such standards at least two years before commencement of such model year (as determined by regulations of the Administrator).

[9] https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart1-sec7507.htm

Nothing in this section or in subchapter II of this chapter shall be construed as authorizing any such State to prohibit or limit, directly or indirectly, the manufacture or sale of a new motor vehicle or motor vehicle engine that is certified in California as meeting California standards, or to take any action of any kind to create, or have the effect of creating, a motor vehicle or motor vehicle engine different than a motor vehicle or engine certified in California under California standards (a "third vehicle") or otherwise create such a "third vehicle".

(July 14, 1955, ch. 360, title I, §177, as added Pub. L. 95–95, title I, §129(b), Aug. 7, 1977, 91 Stat. 750; amended Pub. L. 101–549, title II, §232, Nov. 15, 1990, 104 Stat. 2529.)

Section 177 – US Code §7543. State standards[10]

(a) Prohibition

No State or any political subdivision thereof shall adopt or attempt to enforce any standard relating to the control of emissions from new motor vehicles or new motor vehicle engines subject to this part. No State shall require certification, inspection, or any other approval relating to the control of emissions from any new motor vehicle or new motor vehicle engine as condition precedent to the initial retail sale, titling (if any), or registration of such motor vehicle, motor vehicle engine, or equipment.

(b) Waiver

(1) The Administrator shall, after notice and opportunity for public hearing, waive application of this section to any State which has adopted standards (other than crankcase emission standards) for the control of emissions from new motor vehicles or new motor vehicle engines prior to March 30, 1966, if the State determines that the State standards will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards. No such waiver shall be granted if the Administrator finds that—

(A) the determination of the State is arbitrary and capricious,

(B) such State does not need such State standards to meet compelling and extraordinary conditions, or

(C) such State standards and accompanying enforcement procedures are not consistent with section 7521(a) of this title.

(2) If each State standard is at least as stringent as the comparable applicable Federal standard, such State standard shall be deemed to be at least as protective of health and welfare as such Federal standards for purposes of paragraph (1).

(3) In the case of any new motor vehicle or new motor vehicle engine to which State standards apply pursuant to a waiver granted under paragraph (1), compliance with such State standards shall be treated as compliance with applicable Federal standards for purposes of this subchapter.

(c) Certification of vehicle parts or engine parts

Whenever a regulation with respect to any motor vehicle part or motor vehicle engine part is in effect under section 7541(a)(2) of this title, no State or political subdivision thereof shall adopt or attempt to enforce any standard or any requirement of certification, inspection, or

[10] 42 USC Retrieved on March 28, 2023 from https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapII-partA-sec7543.htm

approval which relates to motor vehicle emissions and is applicable to the same aspect of such part. The preceding sentence shall not apply in the case of a State with respect to which a waiver is in effect under subsection (b) of this section.

(d) Control, regulation, or restrictions on registered or licensed motor vehicles

Nothing in this part shall preclude or deny to any State or political subdivision thereof the right otherwise to control, regulate, or restrict the use, operation, or movement of registered or licensed motor vehicles.

(e) Nonroad engines or vehicles

(1) Prohibition on certain State standards

No State or any political subdivision thereof shall adopt or attempt to enforce any standard or other requirement relating to the control of emissions from either of the following new nonroad engines or nonroad vehicles subject to regulation under this chapter—

(A) New engines which are used in construction equipment or vehicles or used in farm equipment or vehicles, and which are smaller than 175 horsepower.

(B) New locomotives or new engines used in locomotives.

Subsection (b) of this section shall not apply for purposes of this paragraph.

(2) Other nonroad engines or vehicles

(A) In the case of any nonroad vehicles or engines other than those referred to in subparagraph (A) or (B) of paragraph (1), the Administrator shall, after notice and opportunity for public hearing, authorize California to adopt and enforce standards and other requirements relating to the control of emissions from such vehicles or engines if California determines that California standards will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards. No such authorization shall be granted if the Administrator finds that—

(i) the determination of California is arbitrary and capricious,

(ii) California does not need such California standards to meet compelling and extraordinary conditions, or

(iii) California standards and accompanying enforcement procedures are not consistent with this section.

(B) Any State other than California which has plan provisions approved under part D of subchapter I of this chapter may adopt and enforce, after notice to the Administrator, for any period, standards relating to control of emissions from nonroad vehicles or engines (other than those referred to in subparagraph (A) or (B) of paragraph (1)) and take such other actions as are referred to in subparagraph (A) of this paragraph respecting such vehicles or engines if—

(i) such standards and implementation and enforcement are identical, for the period concerned, to the California standards authorized by the Administrator under subparagraph (A), and

(ii) California and such State adopt such standards at least 2 years before commencement of the period for which the standards take effect.

The Administrator shall issue regulations to implement this subsection.

A number of comments were received from the public asserting that the recent 2022 U.S. Supreme Court decision for West Virginia v. EPA [597 U.S. ___ (2022)] prohibited the Department from adopting regulations for greenhouse gas emissions and that the Delaware General Assembly would need to vote on any regulation. The major questions doctrine does not apply to state authority to legislate or regulate air pollution – GHG that authority rests with the Department as previously determined and enacted by the Delaware General Assembly in 2008 Title 7 §6043(a)(3) that carbon dioxide is an air contaminant. By defining carbon dioxide as an air contaminant, the Department may exercise its authority to regulate it.

The Department also received comments regarding the need for the General Assembly to vote on the regulation. As mentioned previously, Delaware's General Assembly delegated the Department the authority to propose and adopt regulations to reduce air pollution. Comments were also heard that the Department's proposal was unconstitutional and required legislation to be adopted. Again, the Delaware Code as established by the General Assembly in Title 7 Chapters 60 and 67 provides the Department the responsibility of proposing and adopting measures via regulations to reduce air pollution from motor vehicles.

Section 4 Delaware’s Vehicle Emissions

Since internal combustion engine (ICE) vehicles were first introduced, they have been emitting pollutants into the air. The power to move a car comes from burning fossil fuel in an engine. Pollution from cars comes from by-products of this combustion process (exhaust) and from evaporation of the fuel itself. This combined with the traffic congestion of urban areas results in a very large amount of air pollution. The emissions from the millions of vehicles on our nation's roads each day contribute substantially to our air pollution problems. Driving a private car is likely a typical citizen's most "polluting" daily activity.

While vehicles have reduced their emissions over the years due to federal standards, more action must be taken to eliminate these harsh pollutants. The primary regulated emissions from gasoline-fueled automobiles and trucks—volatile organic compounds (VOCs), nitrogen oxides (NOx), and carbon monoxide (CO)— contribute to the formation of ground-level ozone. Moreover, these mobile sources distribute ozone precursors more broadly than stationary sources.

In Delaware, vehicle emissions have become the largest contributor to emissions in the state. As seen in Figures 4-1 through 4-4, on-road vehicles are the largest source of pollution in the state for CO and NOx. They are also largest contributor to VOCs.

While most sources of emissions are well controlled due to various programs that have been implemented, transportation is still a leading cause of air pollution in Delaware. Increased pollution from vehicles can jeopardize Delaware’s ability to attain the National Ambient Air Quality Standards.

With the passage of the Clean Air Act (CAA) in 1970, the EPA began regulating nitrogen oxide (NOx) emissions from light duty vehicles. The CAA was amended in 1990, and new emission standards were set for four additional smog pollutants.

- Non-methane organic gases (NMOG)
- Carbon monoxide (CO)
- Particulate matter (PM)
- Formaldehyde (HCHO)

In addition to smog forming pollutants, vehicles also emit - Carbon Dioxide (CO_2), methane (CH4), nitrous oxide (N2O), and fluorinated gases (F-gases, which include hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], and sulfur hexafluoride [SF6] which are greenhouse gases that can remain in the atmosphere for varying lengths of time, from a few years to thousands of years. As a result, the concentration of greenhouse gases increases over time.[11]

[11] *2018 GHG Inventory Executive Summary*. DNREC Division of Air Quality. Retrieved from Regional Greenhouse Gas Initiative - DNREC Alpha (delaware.gov).

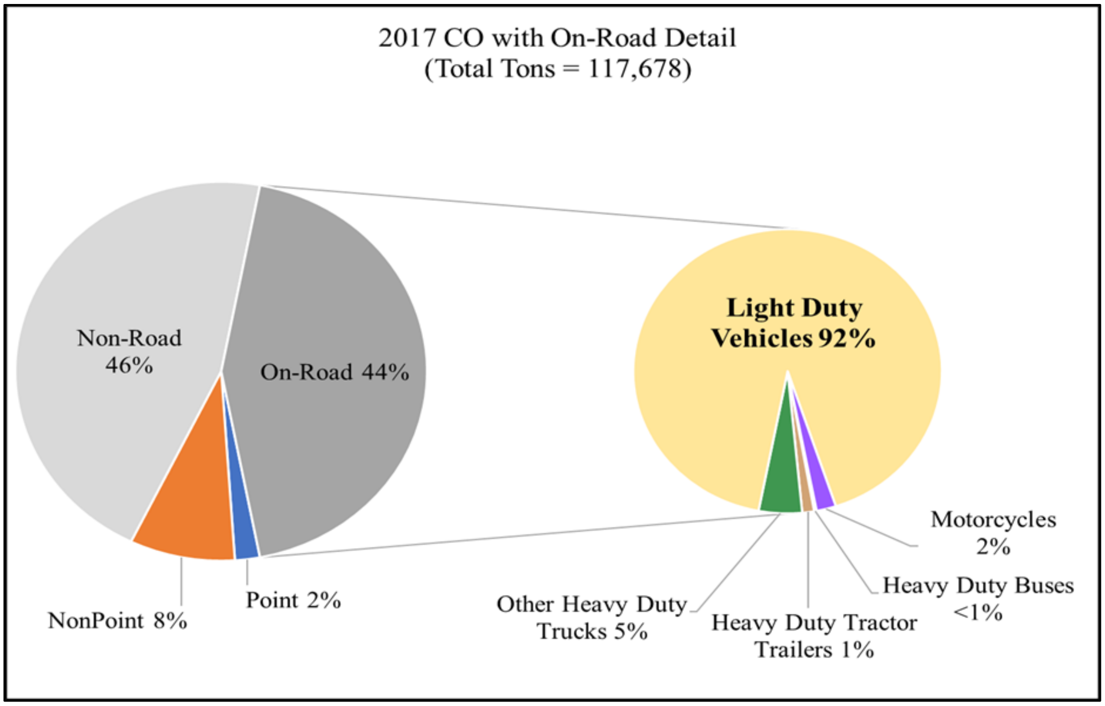

Figure 4-1. 2017 CO Total and Emissions attributed to On-Road Sources

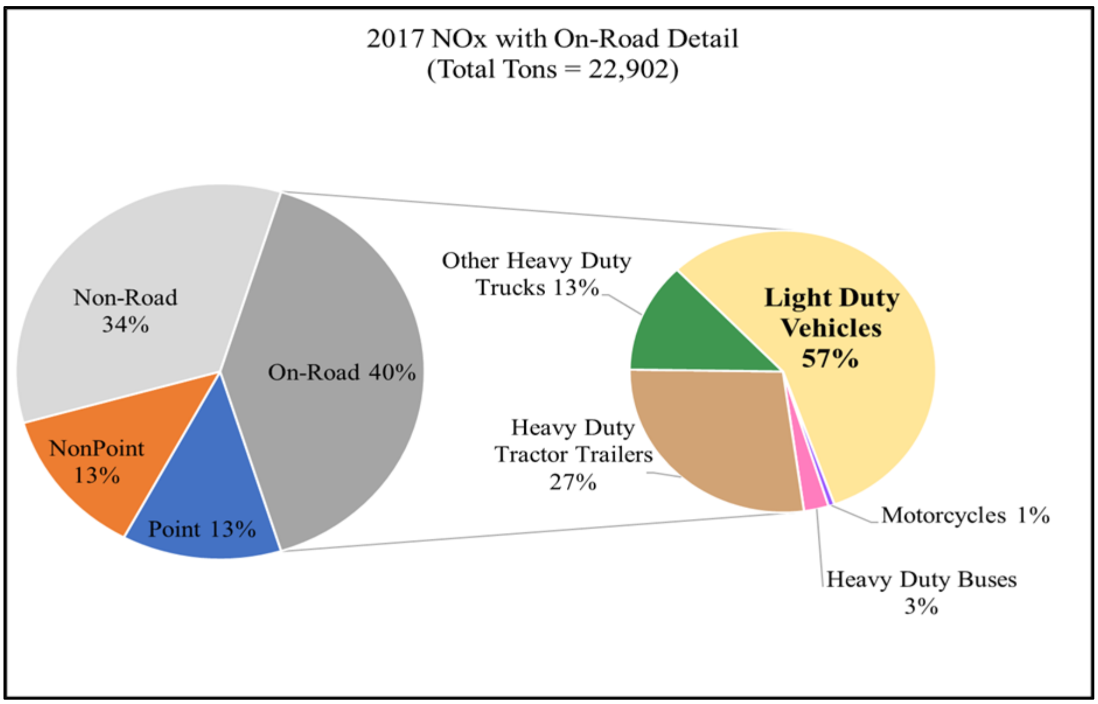

Figure 4-2. 2017 NOx Total and Emissions attributed to On-Road Sources

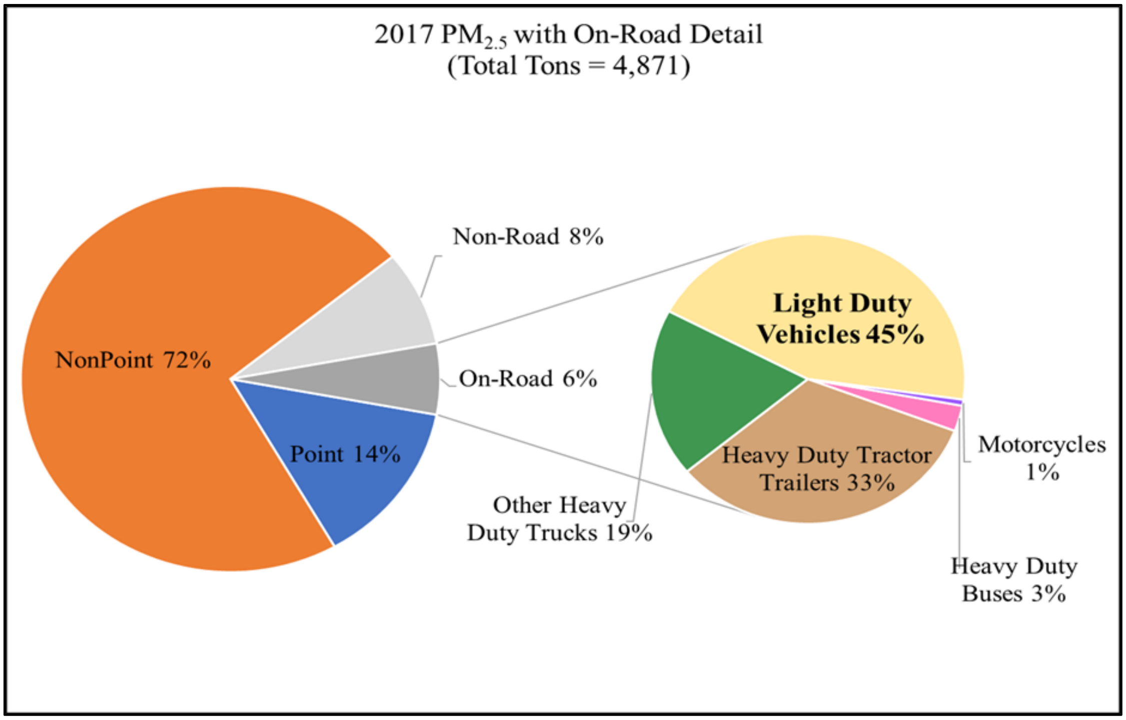

Figure 4-3. 2017 $PM_{2.5}$ Total and Emissions attributed to On-Road Sources

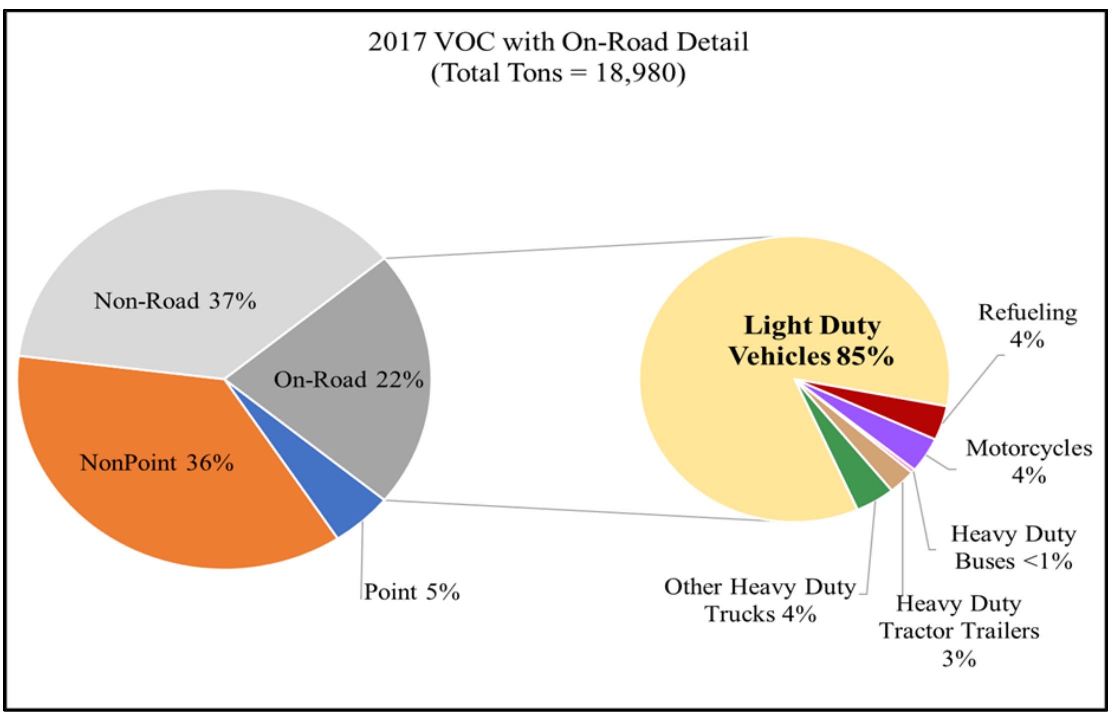

Figure 4-4. 2017 VOC Total and Emissions attributed to On-Road Sources

Section 5 Vehicle Emissions Standards

Federal Standards

By 1966, motor vehicles contributed more than 60 percent of the pollutants in the atmosphere throughout the nation. Temperature inversions in at least 27 states and the District of Columbia produced serious smog problems. The more widespread use of trucks and airplanes exacerbated the nation's air pollution problems. It became apparent during the 1960s that smog was not a local problem, but a national one, requiring the attention of the federal government. While California still led the way in emissions-control legislation, federal laws moved toward recognition of the problem. The 1963 Clean Air Act for the first time gave the federal government limited enforcement power over interstate pollution. The Motor Vehicle Air Pollution Act of 1965 produced national standards comparable to California law for the 1968 model year. In 1967, the Air Quality Act was the first piece of federal legislation designed to control lead emissions. Federal funds became available to defray part of the cost of inspection programs. Hydrocarbon emissions came under federal jurisdiction in 1968.

The 1970 Federal Clean Air Act (CAA) established the first national motor vehicle tailpipe emission standards to curb emissions of carbon monoxide (CO), volatile organic compounds (VOC) and oxides of nitrogen (NOx). The standards took effect for cars and light duty trucks in 1975. The CAA (via section 209) also granted the state of California, which has some of the worst air pollution in the nation, the authority to enact stricter standards than those adopted by the federal government.

The 1977 Federal CAA Amendments tightened the NOx standard for cars in two phases: 1977 through 1979, and 1981. The United States Environmental Protection Agency (USEPA) revised the Federal standards for light-duty trucks in 1979 and 1988 and set rules for heavier trucks in 1988. The Federal CAA (via section 177) also granted the authority for other states to adopt the California motor vehicle emission standards program, prohibiting them from setting their own standards. Thus, in the United States there are two federally sanctioned motor vehicle control programs: the Federal program and the California program.

The 1990 CAA Amendments lowered the NOx emissions standards for vehicles starting in 1994. These standards are commonly referred to as the Tier 1 standards[12], and they resulted in a 40 percent reduction in tailpipe NOx emissions from the prior Federal motor vehicle control program. Under the Amendments of 1990 ("CAA"),'[13] the USEPA was expressly prohibited from enforcing more stringent motor vehicle emissions standards until the year 2004.[14] However, Congress granted the State of California a preemption waiver permitting that state alone to adopt stricter standards.[15] Congress further granted other states the authority under the CAA to adopt any emissions standards adopted by California.[16]

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[12] The Tier 1 regulations were published as a final rule on June 5, 1991 and fully implemented in 1997. The Tier 2 standards were adopted on December 21, 1999, to be phased-in beginning in 2004.
[13] 42 U.S.C. §§ 7401-7642 (1994).
[14] 42 U.S.C. § 7521(b)(1)(C) (1994).
[15] 42 U.S.C. § 7543(b) (1994).
[16] 42 U.S.C. § 7507 (1994).

Thus, while states other than California cannot choose to implement their own vehicle emissions standards, they do have the power to adopt the California standards in place of the applicable federal standards.

In 1990, California adopted the Low-Emission Vehicle ("LEV 1") program.[17] Following its adoption, a number of states in the Northeast, as well as Texas, Michigan, Illinois, and Wisconsin, began to consider adopting California's standards. The Northeast states, empowered to act together under the CAA as the Ozone Transport Commission ("OTC"), adopted a Memorandum of Understanding agreeing to adopt the California LEV program.[18] Of these states, only Massachusetts and New York succeeded in implementing the program. Automobile manufacturers (both U.S. and foreign industry groups) protested the OTC's actions[19] and, in response, proposed an alternative to regional adoption of the California LEV program. The U.S. EPA reacted by supporting compromise negotiations between the states and the auto industry. These negotiations resulted in the development of the National Low Emission Vehicle ("NLEV") program.[20]

On December 16, 1997, EPA finalized the NLEV program [63 FR 926, 7 Jan 1998]. The NLEV was a voluntary program that came into effect through an agreement by the northeastern states and the auto manufacturers. It provided more stringent emission standards for the transitional period before the introduction of Tier 2 regulations which would take effect in 2004. Starting in the northeastern states in model year 1999 and nationally in model year 2001, new cars and light-duty trucks had to meet tailpipe standards that were more stringent than the EPA could legally mandate prior to model year 2004. However, after the NLEV program was agreed upon, these standards were enforceable in the same manner as any other federal new motor vehicle program.

The National LEV program harmonized the federal and California motor vehicle standards and provided emission reductions that were virtually equivalent to the California Low Emission Vehicle program. The program was phased-in[21] through schedules that required car manufacturers to certify a percentage of their vehicle fleets to increasingly cleaner standards (Transitional LEV, LEV, Ultra LEV). The NLEV program extended only to lighter vehicles and did not include the Heavy LDT (HLDT, GVWR>6,000 lbs) vehicle category.

In October 1999, Delaware formally adopted[22] the NLEV emissions standards via 7 DE Admin. Code 1140 to reduce emissions from mobile sources, including light duty vehicles beginning with model year 2000.

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[17] California Air Resources Bd., Res. 90-58 (September 28, 1990).
[18] MISC 94-1 RECOMMENDATION of the States of the Ozone Transport Commission dated 2/1/94 of an OTC Low Emission Vehicle Program Under Section 184(c) of the Clean Air Act Approved September 27, 1994. 59 Fed. Reg. 21720, 21722-23 (1994) (codified at 40 C.F.R. § 51.120 (1997). https://otcair.org/upload/Documents/Formal%20Actions/MISC%2094_1.pdf
[19] OTR Low Emission Vehicle Program. 1995 Retrieved from Final Rule on Ozone Transport Commission; Low Emission Vehicle Program for the Northeast Ozone Transport Region | US EPA https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-ozone-transport-commission-low-emission
[20] USEPA National Low Emission Vehicle Program. June 1997. Retrieved from Final Rule for Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines: Voluntary Standards for Light-Duty Vehicles | US EPA https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-new-motor-vehicles-1
[21] *Light-Duty Vehicles and Light-Duty Trucks: Tier 0, Tier 1, and National Low Emission Vehicle (NLEV) Implementation Schedule*. (March 2016) Retrieved from https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZN.pdf
[22] 3 DE REG 352, October 1, 1999.

In 1999, the EPA promulgated the motor vehicle Tier 2 emission standards starting with Model Year (MY) 2004 vehicles. The Tier 2 program further reduced the NOx emission standards between 77 and 86 percent in cars and between 92 and 95 percent in trucks, as compared to the NLEV program. The Tier 2 program also gave a manufacturer the flexibility to average emission reductions across its fleet to meet the emission standards. A state that did not adopt the California program would, by default, receive vehicles that met the Tier 2 (national) standards. This vehicle was commonly called the 49-state vehicle, although technically it was fewer than 49 states since other northeast states have subsequently adopted the California program. Commencing with the production of MY 2004 vehicles, the NLEV program ceased to exist. For this reason, Delaware Regulation 1140 could have been rescinded, since it had in reality attained a "sunset" status.

The latest round of federal motor vehicle emission standards further reducing NOx and VOC pollution was adopted by USEPA in 2014. The Tier 3 program[23] is part of a comprehensive approach to reducing the impacts of motor vehicles on air quality and public health. The program considers the vehicle and its fuel as an integrated system, setting new vehicle emissions standards and a new gasoline sulfur standard beginning in 2017. The vehicle emissions standards reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles. The gasoline sulfur standard enables more stringent vehicle emissions standards and makes emissions control systems more effective.

In December 2021, EPA finalized revised national greenhouse gas (GHG) emissions standards[24] for passenger cars and light trucks for MYs 2023- 2026. The final standards achieve significant GHG emissions reductions along with reductions in other criteria pollutants. The rule results in substantial public health and welfare benefits, while providing consumers with savings from lower fuel costs.

California Low Emission Vehicle Program

The California Air Resources Board (CARB) adopted the first Low-Emission Vehicle (LEV) regulations in 1990, requiring automobile manufacturers to introduce progressively cleaner light- and medium-duty vehicles with more durable emission controls from the 1994 through 2003 model years. By adopting these regulations, CARB established the most stringent criteria pollutant exhaust regulations ever for light- and medium-duty vehicles.

The regulations, now referred to as the LEV I regulations, included three primary elements: 1) tiers of exhaust emission standards for increasingly more stringent categories of low-emission vehicles, 2) a mechanism requiring each auto manufacturer to phase-in a progressively cleaner mix of vehicles from year to year with the option of credit banking and

[23] *Final Rule for Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards* (November 15, 2022). https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-motor-vehicles-tier-3

[24] *Regulations for Greenhouse Gas Emissions from Passenger Cars and Trucks* (February 16, 2023) https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-passenger-cars-and

trading, and 3) a requirement that a specified percentage of passenger cars and light-duty trucks be zero-emission vehicles (ZEVs) with no exhaust or evaporative emissions.

Building on LEV I, the second generation LEV II regulations continued to reduce criteria pollutant emissions from new light- and medium-duty vehicles starting with the 2004 model year.

In 2004, CARB approved the landmark Pavley regulations to require automakers to control greenhouse gas emissions from new vehicles for the 2009 through 2016 model years. These were the first regulations in the nation to control greenhouse gas emissions from motor vehicles. Upon adoption of federal greenhouse gas standards by the United States Environmental Protection Agency (U.S. EPA) that preserved the benefits of the Pavley regulations, the Pavley regulations were revised to accept compliance with the federal standards as compliance with California's standards in the 2012 through 2016 model years. This is referred to as the "deemed to comply" option.

California's Advanced Clean Car Program

In 2012, CARB adopted the LEV III regulations as part of the Advanced Clean Cars rulemaking package that also included the state's ZEV regulation. The LEV III regulations include increasingly stringent emission standards for criteria pollutants and greenhouse gases for new passenger vehicles through the 2025 model year. When the Air Resources Board adopted Advanced Clean Cars in 2012, they committed to conducting a comprehensive midterm review[25] of three elements of the program: 1) the ZEV regulation, 2) the 1 milligram per mile particulate matter standard, and 3) the light-duty vehicle GHG standards for 2022 and later model years. Staff's review was conducted at the same time as the U.S. EPA and National Highway Traffic Safety Administration (NHTSA) midterm evaluation of the light-duty vehicle greenhouse gas standards for 2022 through 2025 model years at the national level. The Air Resources Board concluded the following at its March 2017 hearing:

- Adopted greenhouse gas standards remain appropriate for 2022 through 2025 model years
- Continue with existing technology-forcing zero-emission vehicle requirements to develop the market
- Direct staff to immediately begin rule development for 2026 and subsequent model years
- Continue and expand complementary policies to help support an expanding ZEV market
- The particulate matter standard is feasible but further action is needed to ensure robust control

The CARB Advanced Clean Car II program builds upon many decades of regulations seeking to reduce emissions from light-duty passenger cars and trucks. Each of those regulations ultimately yielded significant public benefits.

The ZEV regulation has been adjusted numerous times since its 1990 inception to account for changes in market response and technology development. Through this timeframe,

[25] *CARB Advanced Clean Cars Mid-term Review*. 2017. Retrieved from https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-midterm-review

manufacturers continued to create technology and test pilot vehicles in limited use applications. In 2009, staff concluded that even widespread market adoption of advanced conventional technologies, like non-plug-in hybrid-electric vehicles (HEV), are inadequate for meeting GHG standards.

As proposed, ACCII will lead the sales of new cars and light-duty trucks to 100-percent zero emission vehicles (ZEVs) by the 2035 model year, including battery electric vehicles, hydrogen fuel cell electric vehicles, and the cleanest possible plug-in hybrid-electric vehicles (PHEVs), while reducing smog-forming emissions from new internal combustion engine vehicles (ICEVs). Additionally, the proposed charging and ZEV assurance measures, which set minimum warranty and durability requirements, increase serviceability, and facilitate battery labeling, will help to ensure long-lasting emissions benefits and enable consumers to successfully replace their ICEVs with new or used ZEVs and PHEVs that meet their transportation needs.[26]

The proposal builds upon the CARB's long history of controlling emissions from mobile sources. Over 30 years ago, CARB established the Low-Emission Vehicle (LEV) regulation, which contained aggressive exhaust emission regulations for light-duty passenger cars and trucks, and the first requirement for manufacturers to build ZEVs.

Continuing its leadership role in developing innovative and groundbreaking emission control programs and advancing ZEV technologies, California developed the Advanced Clean Cars (ACC) program, which the Board finalized in 2012. The ACC program incorporated three elements that combined the control of smog-causing pollutants and GHG emissions into a single coordinated package of requirements for model years 2015 through 2025, assuring the development of environmentally superior vehicles that will continue to deliver the performance, utility, and safety vehicle owners have come to expect. These three elements included the LEV III regulations to reduce criteria pollutants and GHG emissions and another phase of ZEV requirements.

The ACC II proposal provides a critical tool to meet climate and public health goals and to attain and maintain federal air quality standards. Like California, Section 177 states have set ambitious greenhouse gas (GHG) emission reduction targets for 2050 and interim targets that require aggressive emissions reductions by as soon as 2030. In the Northeast and Mid-Atlantic, the transportation sector is the largest source of GHG emissions, with cars and light-duty trucks accounting for more than a quarter of all emissions. The rapid electrification of these vehicles is urgently needed to mitigate the worst effects of climate change. [27]

[26] California Air Resources Board – Advanced Clean Cars II Initial Statement of Reasons https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

[27] U.S. Environmental Protection Agency, State Inventory and Projection Tool (2022), https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool ; U.S. Energy Information Administration, Energy-Related CO2 Emission Data Tables, https://www.eia.gov/environment/emissions/state/.

The proposed amendments will result in reduced NOx, PM2.5 and GHG emissions. Each of these pollutants presents a distinct set of challenges and risks to public health and the environment.

Reducing emissions of criteria and other toxic air pollutants (non-methane hydrocarbons, nitrogen oxides, particulate matter, carbon monoxide, benzene, 1-3 butadiene, and formaldehyde) to improve air quality is one of the key objectives of the Advanced Clean Cars Program. By MY 2027, new vehicles in Delaware will emit 75% less smog-forming pollution (mainly non-methane hydrocarbons and nitrogen oxides) than the average new car sold today. The proposed ACCII standards would decrease Delaware's greenhouse gas emissions and control smog-causing pollutants beginning with MY 2027. The Advanced Clean Cars Program II has many benefits, including consumer savings and reductions in smog-forming emissions and greenhouse gases. Reducing GHG emissions from vehicles is the second key objective of the Advanced Clean Cars II Program.

Delaware is required to act on its emissions issue and targeting the largest source (on road vehicles) is the first step in lowering harmful emissions in the state. As stated later in this document, lowering emissions is beneficial to the health of all Delawareans. The main goal of the Division of Air Quality is to provide clean air to all Delaware residents.

ACC II is critical to meeting Delaware's public health and climate goals and meeting state and federal air quality standards. Mobile sources are the greatest contributor to emissions of criteria pollutants and greenhouse gases (GHG) in Delaware. The National Ambient Air Quality Standards (NAAQS) for two of these criteria pollutants—ozone (sometimes referred to as smog) and fine particulate matter (PM2.5, sometimes referred to as soot)—can both be found in the air in Delaware.

CAA 177 States Adopting the California Motor Vehicle Emission Standards

The following states have chosen to adopt the California motor vehicle emission standards. Pennsylvania has announced that it is considering adoption of the ZEV requirements and has also signed on the Medium-Heavy Duty Memorandum of Understanding that commits them to adopt the California regulations for the heavy-duty fleet.

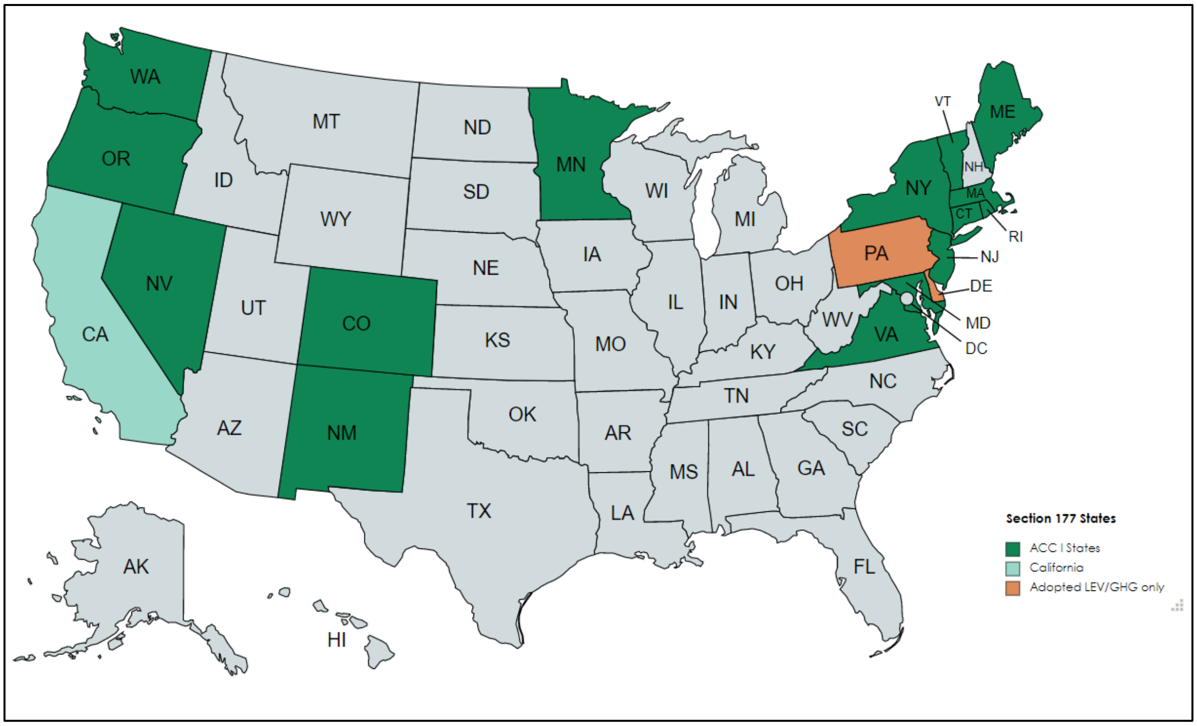

Figure 5-1. California and the Section 177 States

Section 6 Proposed Amendments to 7 DE Admin Code 1140 – Delaware's Low Emission Vehicle Program

This regulation as currently adopted and as proposed is applicable to on-road vehicles with a GVRW up to 14,00 pounds, but it does contain exemptions for certain vehicles that may fall within these parameters. 7 DE Admin. Code 1140 Section 2.2 describes the vehicles that would not be impacted by this amendment. Two types of vehicles noteworthy of being mentioned are emergency vehicles and vehicles registered as farm vehicles.

Emergency vehicles are specifically exempt from the regulation in Section 2.0:

> 2.3.2 *Test vehicles and emergency vehicles;*

The definition of emergency vehicles is contained in section 3.0 Definitions:

> *"Emergency vehicle" means any publicly owned vehicle operated by a peace officer in the performance of their duties, any authorized emergency vehicle used for fighting fires or responding to emergency fire calls and any publicly owned authorized emergency vehicle used by an emergency medical technician or –paramedic or any ambulance used by a private entity under contract with a public agency.*

Off-highway use vehicles, are also specifically exempted in section 2.0:

> 2.3.9 *Sold exclusively for off-highway use;*

Title 21 DE Code, Motor Vehicle, **Registration, Title and License**, Chapter 21. **Registration of Vehicles** provides for the registration of farm vehicles, §2113, **Special farm vehicle registration**. Provides the Division of Motor Vehicle (DMV) the authority to register vehicles that are used exclusively for farm activities as a "Farm Vehicle" and issue an "FV" tag. Vehicles with an "FV" tag are currently exempt from inspections and emission testing, Vehicles, that are registered in Delaware, as a "Farm Vehicle" and having an "FV" tag are considered off highway and would not be subject to the requirements of this regulation.

The Department is not proposing any changes to the exemptions currently adopted and listed in Section 2 of the regulation.

Some commentors opined that the regulations for Zero Emitting Vehicles should only apply to New Castle County. Because many Delawareans commute between all three counties daily, purchase vehicles in any of the three counties and may reside in one county and commute to another, restricting the emission requirements to vehicles sold in one county and not all three would be impractical, difficult to enforce and limit the emission reduction benefits.

As mentioned previously, Section 177 of the Clean Air Act allows California to adopt their own motor vehicle emission standards:

- •States can adopt California emission standards, but must do so identically.
- •Provide two years' advance notice before the start of the model year; and

•Delaware has adopted California's emission vehicle rules since 2010. Emission standards are in place through the 2025 model year.

The following provides a summary of the proposed changes that are recommended to be adopted and incorporated to Delaware's Low Emission Vehicle Program 7 DE Admin Code 1140:

Zero Emission Vehicles

California adopted the Advanced Clean Cars II Rule, which will result in greenhouse gas and tailpipe emissions reductions. The emission standards will drive the sales of zero-emission vehicles (ZEV) to 100 percent in Delaware by the 2035 model year, including battery electric vehicles, fuel cell vehicles, and the cleanest possible plug-in hybrid-electric vehicles. The program also amends the low-emission vehicle regulations to include increasingly stringent standards for gasoline cars and heavier passenger trucks to continue to reduce smog-forming emissions while the sector transitions toward 100 percent zero emitting vehicles by 2035. Figure 6-1 provides the required annual sales requirements for manufacturers over the 2026-2035 model years:

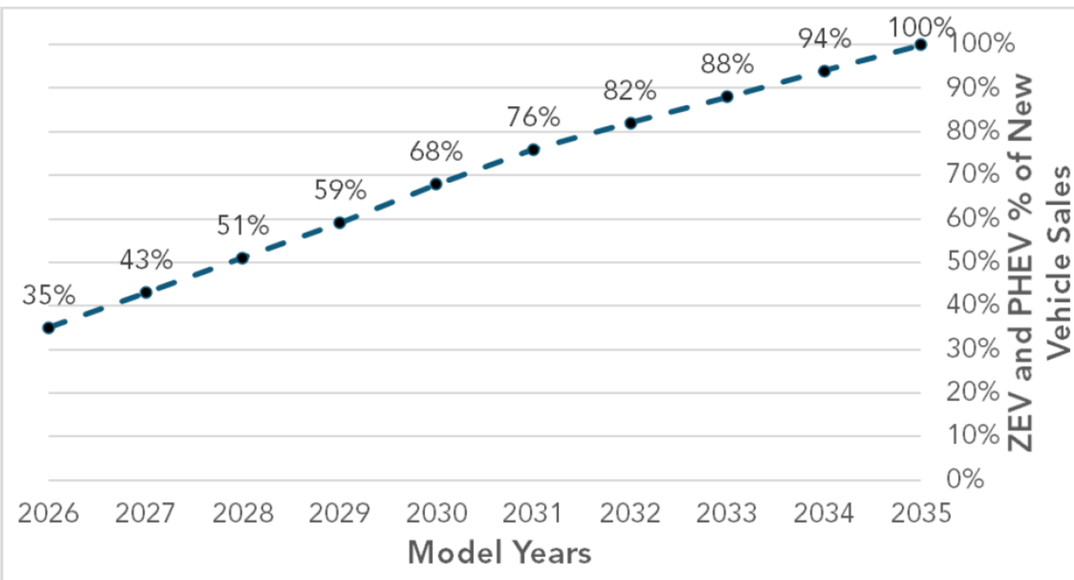

Figure 6-1. New Vehicle Sales Targets for Zero Emitting Vehicles

The program includes zero-emission vehicle durability requirements, which include minimum warranties for batteries and parts, increase serviceability, and facilitate charging and battery labeling. These provisions will help ensure all electric vehicle owners can successfully replace their gasoline vehicles with new or used vehicles that meet their needs. These measures are particularly important for consumers in lower-income and underserved communities where used vehicle sales are a critical step in the transition to cleaner vehicles. Giving consumers additional assurance that their used zero-emission vehicle purchase meets minimum requirements is key for broader market uptake.

Meeting the ZEV compliance targets in 2021, ZEV sales in Delaware made up almost 5 percent of the total new car sales. The Alliance for Automotive Innovation reports that electric vehicle sales have tripled from 2020 (2020-2022).[28] Over the past few years this percentage has been accelerating. Most vehicle manufacturers have announced plans to shift production to all or mostly zero emissions technologies by 2035 to 2040, and California and the manufacturers have been in close communication about the feasibility of meeting the ACC-2 requirements.

Advances in battery technology and compliance flexibilities will help manufacturers meet their obligations. The industry has rapidly responded to evolving market pressures, consumer demands, and regulatory requirements across the United States and around the globe. Overall, these improvements have reduced costs for batteries, the main driver of battery electric vehicle and plug-in hybrid electric vehicle costs. Based on public announcements, it is expected that nearly 120 ZEV and plug-in hybrid electric vehicle models will be available to consumers before the 2026 model year.

Table 6-1. CARB Initial Statement of Reasons – Summary of ZEV Proposals[29]

Proposal Category	Description of Proposal
ZEV minimum requirements	150-mile label range, propulsion-related parts warranty, battery warranty, data standardization, charging cord, battery label, service information
PHEV minimum requirements	50-mile label range, 40-mile US06 range, SULEV, 15- year emissions warranty, battery warranty, charging cord, battery label
ZEV and PHEV Vehicle Values and Life	Counted as One Vehicle Value, 5-year value life
PHEV Phase in 2026-2028	30-mile label range, partial vehicle value
PHEV Cap	20% of annual requirement
Environmental Justice (EJ) Vehicle Values	5% of annual requirement through 2031 MY 0.5 value for ZEVs and 0.4 value for 6-passenger PHEVs offered at 25% price discount to car share community programs 0.1 value for off-lease (<$40k MSRP) ZEV and PHEVs delivered to CC4A and CVAP dealers 0.1 value for low MSRP ZEVs and PHEVs (<$20k Cars, <$27K Trucks)
Early Compliance Values	15% of annual requirement through 2028 MY OEMs with >20% EV market share in 2024 and 2025 can generate ACC II credits early
Historical Credit Treatment (ACC I)	2025 MY Balance / 4 = Converted ZEV Values 2025 MY Balance / 1.1 = Converted PHEV Values
Converted ZEV and PHEV Values	15% of annual requirement (if shortfall) through 2030 MY
Pooling	Excess values can count toward compliance, up to 25% (2026) down to 5% (2030) of annual requirement (if shortfall) in CA or Section 177
Allowed Deficit	Can carry forward deficit for 3 years
Small Volume Manufacturers (SVM)	Must comply 2035+ MYs

[28]Alliance for Automotive Innovation. 2023. Retrieved from Get Connected 2022 Q4 Electric Vehicle Report.pdf https://www.autosinnovate.org/.
[29] CARB. 2022. "Initial Statement of Reasons – ES-0-1: Summary of ZEV Proposals" https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

Table 6-2. Summary of ZEV Assurance Proposals[30]

Proposal	**Description**	**Applicable Vehicles for 2026 MY, unless noted**
Data Standardization	Required data parameters, including battery state of health	ZEVs and PHEVs*
Durability	80% of Certified Range Value for 10 years / 150,000 miles	ZEVs and PHEVs*
Propulsion-Related Parts Warranty	3 years / 50,000 miles 7 years / 70,000 miles for high priced parts	ZEVs and PHEVs*
Battery Warranty	8 years / 100,000 miles, 70% or 75% Battery State of Health	ZEVs and PHEVs
Service Information	Disclose repair information to independent repair shops	ZEVs (2011 MY+) and PHEVs*
Battery Labeling	Label all traction batteries for recyclability and repurposing	ZEVs, PHEVs, hybrid electric vehicles (HEVs), and 48V HEVs

*PHEVs are proposed to be required to comply with staff's battery state of health standardization and charge rate requirements, both of which must be accessible to the driver. PHEV are already required to comply with (1) California Code of Regulations (CCR), title 13, section 1968.2 (On-Board Diagnostics), which covers most other data metrics proposed for ZEVs, (2) CCR, Title 13, sections 1961.2 and 1961.4 which requires vehicles to meet GHG and criteria exhaust emission standards over useful life (15 years or 150,000 miles, (3) CCR, title 13, section 2037 ad 2038, which requires emissions related parts warranty coverage for PHEVs, and (4) CCR, title 13, section 1969, which requires the disclosure of service information.

Low-Emission Vehicle requirements for gasoline vehicles

While the regulations move the vehicle fleet to all electric vehicles by 2035, many of the gasoline vehicles sold before that model year will continue to be utilized well beyond 2035. The proposed Advanced Clean Cars II rule includes emissions requirements, known as low-emission vehicle requirements on gasoline vehicles.

These include new standards to address the increased emissions associated with aggressive driving and cold-starts, require more stringent exhaust and evaporative emissions standards, and changes to the fleet average requirements.

[30] CARB. 2022. "Initial Statement of Reasons – ES-0-2: Summary of ZEV Assurance Proposals" https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

Table 6-3. Summary of LEV Proposals for Light-Duty Vehicles[31]

Proposal Category	Description of Proposal
NMOG+NOx Fleet Average	Maintain NMOG+NOx fleet average at 0.030 g/mile Phase-out ZEVs from NMOG+NOx fleet average Phase-out NMOG+NOx emission credits given to PHEVs for electric driving Eliminate dirtiest emission certification bins (ULEV125 and LEV160) Add new lower emission bins (SULEV15, SULEV25, ULEV40, ULEV60)
SFTP Emission Standards	Eliminate composite SFTP certification option Require all light-duty vehicles to meet FTP NMOG+NOx emission levels on the aggressive driving US06 cycle Require attestation that vehicles will meet FTP NMOG+NOx emission levels on the SC03 cycle
Particulate Matter (PM) Emission Standards	Reduce US06 PM emission standard from 6 to 3 mg/mile
Cold-start Emission Control	Establish new FTP emission standards to improve cold- start emission control following partial soaks of 10 minutes to 12 hours New emission standards to improve cold-start emission control during quick drive-aways on an 8 second initial idle FTP test.
Plug-in Hybrid Electric Vehicles	Establish new cold-start US06 emission certification test to demonstrate compliance with new high-power cold-start emission standards
Evaporative Emission Control	Reduce running loss emission standard from 0.05 to 0.01 g/mile to reduce evaporative emissions during driving.

Table 6-4. Summary of LEV Proposals for Medium-Duty Vehicles[32]

Proposal Category	Description of Proposal
NMOG+NOx Fleet Average	Reduce fleet average to 150 mg/mile for class 2b and 175 mg/mile for class 3 Remove ZEVs from the fleet average calculation Eliminate dirtiest emission certification bins for class 2b (ULEV250, ULEV200) and class 3 (ULEV400, ULEV270)
	Add new lower emission certification bins for class 2b (SULEV150, SULEV100, SULEV85, SULEV75) and for class 3 (SULEV175, SULEV150, SULEV125, SULEV100).
SFTP Emission Standards	Eliminate composite SFTP certification standards Require all Class 2b MDVs to meet FTP NMOG+NOx emission levels on the US06 cycle Require all Class 3 MDVs to meet FTP NMOG+NOx emission levels on the UC cycle Require attestation that SC03 emissions will be lower than FTP certification bin standard
Particulate Matter (PM) Emission Standards	Eliminate composite SFTP certification option Require all medium-duty vehicles to meet stand-alone PM standards for aggressive driving cycles: 8 mg/mile for class 2b on full US06 cycle, 6 mg/mile for class 2b on bag 2 US06 cycle, and 5 mg/mile for class 3 on UC cycle
Moving Average Window In-Use Standards	Establish new PEMS standards for MDVs over 14,000-pound Gross Combined Weight Rating for better emission control during towing

[31] CARB. 2022. "Initial Statement of Reasons – ES-0-3: Summary of LEV Proposals for Light Duty Vehicles" https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf
[32] CARB. 2022. "Initial Statement of Reasons – ES-0-4: Summary of LEV Proposals for Medium Duty Vehicles " https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

Equity considerations

The pollution reductions from the proposed rule, considering the cleaner gasoline vehicles as well as greater availability of ZEVs, will reduce exposure to vehicle pollution in communities throughout Delaware, including in low income and disadvantaged communities that are often disproportionately exposed to vehicular pollution. Additionally, the durability and warranty requirements support more reliable ZEVs in the used vehicle market, which makes the cost of ZEVs become more affordable to lower-income households.

The proposed rules encourage manufacturers to take actions that improve access to ZEVs for disadvantaged, low-income, and other frontline communities, including investments in community car share programs, producing affordable ZEVs, and keeping used vehicles in Delaware to support the existing Clean Fuel and Transportation Initiatives.

Equitably transitioning to a zero-emission transportation system requires a coordinated and collaborative approach. This involves the development of a comprehensive recharging and refueling network and implementation of a suite of incentive programs for clean cars, funding for charging, and fueling options.

DNREC is working closely with the Delaware Department of Transportation to ensure public charging is accessible for everyone, particularly those who do not have access to home charging.

Section 7 Vehicle Technology

The American automobile industry has evolved significantly over the last one hundred years - from the 1908 Ford Model T to TESLA's battery electric vehicles. The Model T's four-cylinder engine had a top speed of 45 miles per hour and a 10-gallon fuel tank whereas the Tesla Model 3 gets from 0 to 60 mph in 3.1 seconds. America and the global automobile market is transitioning away from fossil fuels to cleaner zero emitting technologies with investments in the billions of dollars. These investments are coming to market with an increasing number of new products announced each model year.[33]

By definition, Zero Emitting Vehicles (ZEV) produce no exhaust emissions under any possible operational mode. Battery Electric Vehicles (BEV) and Fuel Cell Electric Vehicles (FCEV) are the most common examples of ZEVs and are the foundation of CARB's proposal. BEVs utilize batteries with an on-board charger to store energy from the electrical grid to power electric motors. These electric vehicles have instant torque response, low noise, regenerative braking from energy recovered by the motor that greatly reduces brake wear and associated emissions, and generally have a simplified mechanical drivetrain, often without a transmission.[34]

FCEVs are full electric drive vehicles where the propulsion energy is supplied by hydrogen stored on board and a fuel cell stack that transforms the chemical energy stored in hydrogen into electricity for the drive motor. The electrochemical process for the fuel cell stack is fed by oxygen (retrieved from ambient air) and hydrogen (stored on board in pressurized tanks), with the byproducts being electricity, water, and heat (although it does not combust the hydrogen). The major components of the fuel cell system include the fuel cell stack, necessary associated equipment (e.g., fuel valves, air compressor, coolant fluid sub-system, etc.), and a battery pack. FCEVs are able to travel long distances between refueling events due to the large quantity of energy in the hydrogen stored in the on-board tanks and are able to refill with hydrogen in times similar to gasoline vehicles.[35]

Although not a ZEV by definition because of its internal combustion engine emissions, PHEVs also use battery packs to power electric motors. In addition to their battery pack with grid-supplied electricity, these vehicles use another fuel, typically gasoline, to power an internal combustion engine. PHEV powertrains can be categorized into two different groups – blended and non-blended. Blended PHEVs do not have an electric drive powertrain that can meet all the motive power requirements of the vehicles on electric power only; they require the combustion engines to meet the higher power demands of the vehicles even when the batteries have not been depleted. On the other hand, non-blended PHEVs are capable of driving on electric power for the majority of driving conditions until the batteries have been depleted. Non-blended PHEVs require electric motors that can deliver power levels roughly equal to that of the internal combustion engines (ICEs).[36]

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[33] *"The Future is Electric: Let's Drive Together." Global Alliance. January 2023. Retrieved from https://www.autosinnovate.org/*
[34] *All-Electric Vehicles* U.S. Department of Energy (U.S. DOE) here: https://afdc.energy.gov/vehicles/electric_basics_ev.html
[35] *Fuel Cell Electric Vehicles* U.S. DOE: https://afdc.energy.gov/vehicles/fuel_cell.html
[36] *Plug-In Hybrid Electric Vehicles* U.S. DOE: https://afdc.energy.gov/vehicles/electric_basics_phev.html

Much of the market growth of ZEVs is attributed to improvements in ZEV technology. The industry has rapidly responded to evolving market pressures, consumer demands, and regulatory requirements in California, across the U.S., and around the globe. Overall, these improvements have reduced costs for batteries - the main driver of BEV and PHEV costs - as well as for non-battery components. This has enabled manufacturers to accelerate plans to bring to market more long-range ZEVs and highly capable PHEVs in more market segments. Looking to the future of electric drive technologies in the 2026 to 2035 timeframe, it is anticipated there will be even greater efficiency improvements, longer ranges, and comparable vehicle offerings and capabilities across all passenger car and truck categories and comparable costs to ICE vehicles as summarized further in California's Initial Statement of Reasons - Appendix G.[37]

Zero emitting technology that the automobile industry is currently bringing to market are either battery electric or fuel cell vehicles. The majority of manufacturers are developing battery electric products, though Toyota is one manufacturer developing an impressive fuel cell vehicle – the Toyota Mirai.[38] Sales growth in 2022 for battery electric vehicles and plug-in electric vehicles (PEV) has grown over 2021 to 7.3% for new U.S. sales (up from 4.4%) and for 177 states 8.1% (up from 4.9%). Data for each quarter in 2022 shows increases from one quarter to the next.

Table 7-1 PEV Sales in the U.S.

	Q1	**Q2**	**Q3**	**Q4**	**2022**
BEVs	4.8%	5.5%	6.0%	7.1%	5.9%
PHEVs	1.4%	1.5%	1.3%	1.6%	1.4%
Total PEVs	6.2%	7.0%	7.3%	8.7%	7.3%

Table 7-2 PEV Sales in the 177 States*

	Q1	**Q2**	**Q3**	**Q4**	**2022**
BEVs	4.8%	5.9%	6.2%	7.9%	6.2%
PHEVs	1.9%	2.0%	1.7%	2.2%	1.9%
Total PEVs	6.7%	7.9%	7.9%	10.1%	8.1%

*Section 177 ZEV States include: CO, CT, MA, MD, ME, MN, NJ, NM, NV, NY, OR, RI, VA, VT, WA

This section will present an overview of current zero emitting vehicle technology and provide information to dispel many of the concerns raised by the public at the November and December public workshops held by the Department which include range anxiety, battery costs and disposal as well as vehicle costs compared to gasoline or diesel fueled products.

Additional information on ZEV technology, market trends, batteries, durability, and technology costs are found in Attachment A – CARB Initial Statement of Reasons Appendix G.

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[37] *Initial Statement of Reasons – Appendix G*. CARB 2022. Retrieved from https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/appg.pdf
[38] When fully fueled with hydrogen, the 2023 Mirai XLE has an impressive manufacturer-estimated 402-mile driving range rating and the 2023 Mirai Limited has a 357-mile driving range rating. Toyota Marai. 2023. Retrieved from https://www.toyota.com/mirai/

Vehicle Availability and Market Trends

ZEV and PHEV technology continues to change rapidly as the industry responds to evolving market pressures, consumer demands, and California, U.S., and other global regulatory requirements. Manufacturers are now accelerating plans to bring more ZEVs and highly capable PHEVs to the market while indicating plans to phase out new ICE vehicles. These electrified vehicles utilize various technologies that continue to improve with ongoing development. There have been several broader trends in ZEV technology taking place within the industry: battery packs with increased energy capacity, vehicles with more electric range, and expanding electric vehicle technology into various vehicle segments. These technology improvements are leading to a wider range of ZEV and PHEV models that offer customers more utility.

The electric vehicle market has seen a significant increase in available models since the Nissan Leaf and Chevrolet Volt 2010 market introductions. Currently, the market has increased from one [39]to 60 models offered through 2021.[40] This rapid market growth and expansion of product offerings over the past decade is expected to accelerate significantly in the next five years.

Consumers have different needs and expectations, especially when it comes to vehicles. Vehicle choice and model availability across market segments is a critical decision-making factor for new car shoppers, and a diverse selection of makes and models is an indicator for market growth. According to research by the International Council on Clean Transportation (ICCT), cities with more ZEV models available to consumers had higher electric vehicle registrations.[41] Table 7-3 lists the 2021 model year ZEVs and PHEVs available by technology type across different vehicle classes in the U.S. market.

Table 7-3. Electric Vehicles Available by Manufacturer, Model Year 2021[42]

Make	Model	Vehicle Type	Electric Range	EPA Size Class
Audi	e-tron	BEV	222	Standard SUV 4WD
Audi	e-tron Sportback	BEV	218	Standard SUV 4WD
BMW	I3/i3s	BEV	153	Subcompact Car
Chevrolet	Bolt EV	BEV	259	Small Station Wagon
Ford	Mustang Mach-E	BEV	211-305	Small Station Wagon
Hyundai	Ioniq Electric	BEV	170	Midsize Car
Hyundai	Kona Electric	BEV	258	Small SUV 2WD
Jaguar	I-Pace EV400	BEV	234	Small SUV 4WD
Kandi	K27	BEV	59	Compact Car
Kia	Niro Electric	BEV	239	Small Station Wagon

[39] One model from a manufacturer subject to the ZEV regulation in 2010
[40] Models here are defined as a unique vehicle offering, excluding trim versions of that model. For example, the Nissan Leaf is offered in the S, SV, and SL trims, but the Leaf is only counted as one model.
[41] International Council on Clean Transportation. 2019. *The surge of electric vehicles in United States cities.* International Council on Clean Transportation. June. Accessed March 1, 2022. https://theicct.org/sites/default/files/publications/ICCT_EV_surge_US_cities_20190610.pdf
[42] U.S. Department of Energy and U.S. Environmental Protection Agency. 2022. *Fuel Economy Guide: Model Year 2021*. March 2. Accessed March 4, 2022. https://www.fueleconomy.gov/feg/pdfs/guides/FEG2021.pdf

Make	Model	Vehicle Type	Electric Range	EPA Size Class
MINI	Cooper SE Hardtop 2 door	BEV	110	Subcompact Car
Nissan	Leaf (S/SV/SL)	BEV	149-226	Midsize Car
Polestar	2	BEV	233	Midsize Car
Porsche	Taycan (4/4S/Turbo/Perf)	BEV	199-227	Large Car
Tesla	Model 3	BEV	263-353	Midsize Car
Tesla	Model S	BEV	334-405	Large Car
Tesla	Model X	BEV	300-371	Standard SUV 4WD
Tesla	Model Y	BEV	244-326	Small SUV 4WD
Volkswagen	ID.4	BEV	240-260	Small SUV 2WD
Volvo	XC40 AWD BEV	BEV	208	Small SUV 4WD
BMW	I3/i3s with Range Extender	BEVx	126	Subcompact Car
Honda	Clarity Fuel Cell	FCEV	360	Midsize Car
Hyundai	Nexo/Blue	FCEV	354 , 380	Standard SUV FWD
Toyota	Mirai Limited / XLE	FCEV	357	Compact Car
Audi	A7 Quattro	PHEV	24	Midsize Car
Audi	A8 L	PHEV	18	Large Car
BMW	330e	PHEV	23	Compact Car
BMW	330e xDrive	PHEV	20	Compact Car
BMW	530e	PHEV	21	Compact Car
BMW	530e xDrive	PHEV	19	Compact Cars
BMW	745e xDrive	PHEV	17	Large Car
BMW	X3 xDrive30e	PHEV	18	Small SUV 4WD
BMW	X5 xDrive45e	PHEV	31	Standard SUV 4WD
Bentley	Bentayga	PHEV	18	Standard SUV 4WD
Chrysler	Pacifica Hybrid	PHEV	32	Minivan - 2WD
Ferrari	SF90 Stradale Coupe	PHEV	9	Two-Seater
Ford	Escape FWD PHEV	PHEV	37	Small SUV 2WD
Honda	Clarity Plug-in Hybrid	PHEV	48	Midsize Car
Hyundai	Ioniq Plug-in Hybrid	PHEV	29	Midsize Car
Jeep	Wrangler 4dr 4xe	PHEV	22	Small SUV 4WD
Karma	GS-6	PHEV	54, 61	Subcompact Car
Karma	GT	PHEV	54, 61	Subcompact Car
Kia	Niro Plug-in Hybrid	PHEV	26	Small Station Wagon
Land	Rover / Range Rover / Sport PHEV	PHEV	19	Standard SUV 4WD
Lincoln	Aviator PHEV AWD	PHEV	21	Standard SUV 4WD
Lincoln	Corsair AWD PHEV	PHEV	28	Small SUV 4WD
MINI	Cooper SE Countryman All4	PHEV	18	Midsize Car
Mitsubishi	Outlander PHEV	PHEV	24	Small SUV 4WD
Polestar	1	PHEV	52	Minicompact Car
Porsche	Cayenne	PHEV	15, 17	Standard SUV 4WD
Porsche	Panamera 4 e-Hybrid	PHEV	17, 19	Large Car
Subaru	Crosstrek Hybrid AWD	PHEV	17	Small SUV 4WD

Make	Model	Vehicle Type	Electric Range	EPA Size Class
Toyota	Prius Prime	PHEV	25	Midsize Car
Toyota	RAV4 Prime 4WD	PHEV	42	Small SUV 4WD
Volvo	S60 AWD PHEV	PHEV	22	Compact Car
Volvo	S90 AWD PHEV	PHEV	21	Midsize Car
Volvo	V60 AWD PHEV	PHEV	22	Small Station Wagon
Volvo	XC60 AWD PHEV	PHEV	19	Small SUV 4WD
Volvo	XC90 AWD PHEV	PHEV	18	Standard SUV 4WD

Vehicle Cost & Affordability

EV adoption is growing rapidly in the U.S. and globally for both the consumer and commercial vehicles. Numerous trade journals and websites have projected EVs will replace traditional internal combustion engine vehicles (ICEV) by 2035. This adoption is driven by the availability of more vehicles at reduced costs, increased availability of charging, favorable economic incentives, a growing interest in EVs, and a growing awareness of the environmental benefits.[43] [44] [45] [46]

In 2021, when California began the development of second phase of Advanced Clean Car program, they identified 60 available ZEVs and PHEVs for model year 2021, which spanned across ten EPA vehicle size classes, and many with all-wheel drive capabilities. Since that time, auto manufacturers have announced more choices in larger vehicle categories like large SUVs and pick-up trucks that are needed to attract more consumers, and for ZEVs and PHEVs to become more competitive with the ICEV market. Appendix G of California's Initial Statement of Reasons (ISOR) states – *"This is critical in the United States where crossovers, sport utility vehicles and light pickup trucks and vans (collectively defined as light-duty trucks) represent over 76 percent of new sales in 2020 and 2021."*[47]

California provided a table in their Appendix G of the ISOR listing the anticipated new ZEVs and PHEVs projected to be introduced in model years 2022-2025 (Table 7-4)

Table 7-4. Anticipated New ZEVs and PHEVs Introduced in Model Years 2022 to 2025

Make	Model	Vehicle	Electric Range Type	EPA Size Class
Alfa Romeo	Tonale[i]	PHEV	50	Midsize

[43] *"Preparing for an Electric Vehicle Future: How Utilities can Succeed." Smart Electric Alliance. October 2019. https://sepapower.org/resource/preparing-for-an-electric-vehicle-future-how-utilities-can-succeed/*

[44] *Cheapest New Electric Car Is Even Cheaper in 2023*, Motorbiscuit 2023 https://www.motorbiscuit.com/cheapest-new-electric-car-cheaper-2023/

[45] *Best Electric Cars - Top Rated Electric Car Models*, Motortrend 2023 https://www.motortrend.com/style/electric/

[46] *Best Hybrids & EVs Reviews* - Consumer Reports 2023 https://www.consumerreports.org/cars/hybrids-evs/

[47] CARB. *ISOR Appendix G - ACC II ZEV Technology Assessment*. April 2022. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

Make	Model	Vehicle	Electric Range Type	EPA Size Class
Aston Martin	DBX PHEV[ii]	PHEV	TBD	Standard SUV
Aston Martin	Sportscar (DBS/DB11/Vantage)[ii]	BEV	372+	Two Seaters
Audi	A6 e-tron[iv]	BEV	400 (WLTP)	Large
Audi	e-tron GT[v]	BEV	238	Standard SUV
Audi	e-tron S (20, 21, 22in)[v]	BEV	181, 208	Standard SUV
Audi	e-tron S Sportback (20, 21, 22in wheels)[v]	BEV	185, 212	Standard SUV
Audi	Q4 e-tron & sportback quattro[v]	BEV	241	Small SUV
Audi	RS e-tron GT[v]	BEV	232	Midsize
Audi	A4 e-tron[vi]	BEV	TBD	Large
Automobili	Battista hyper GT[vii]	BEV	310 (WLTP)	Two Seaters
Bentley	Flying Spur[viii]	PHEV	25	Compact
BMW	i4 (4 Series)[v]	BEV	227-301	Large
BMW	iX xDrive50[v]	BEV	305-324	Standard SUV
BMW	iX3[ix]	BEV	286 (WLTP)	Standard SUV
BMW	X5 (Hydrogen NEXT)[x]	FCEV	311	Small SUV
BMW	i5[xi]	BEV	250	Midsize
BMW	i7[xii]	BEV	380	Large
BMW	i8 M[xiii]	PHEV	TBD	Two Seaters
Buick	Electra[xiv]	BEV	300	Standard SUV
Cadillac	Lyriq SUV[xv]	BEV	300	Standard SUV
Cadillac	Celestiq sedan[xvi]	BEV	400+	Large
Cadillac	Escalade[xvii]	BEV	400+	Standard SUV
Canoo	Lifestyle Vehicle[xviii]	BEV	230	Large
Canoo	Electric AWD Pickup Truck[xix]	BEV	200	Standard Pickup
Canoo	Electric Van[xix]	BEV	250	Standard Pickup
Chevrolet	Blazer[xx]	BEV	300	Standard SUV
Chevrolet	Equinox[xxi]	BEV	200	Small SUV
Chevrolet	Silverado[xxii]	BEV	400	Standard Pickup
Chrysler	Airflow Concept[xxiii]	BEV	350+	Large
Dodge	eMuscle[xxiv]	BEV	500	TBD
Faraday Future	FF 91[xxv]	BEV	378	Large
Fisker	Ocean Crossover[xxvi]	BEV	250, 340, 350+	Small SUV
Ford	E-Transit[xxvii]	BEV	125	Cargo Van
Ford	F-150 Lightning[xxviii]	BEV	230, 300	Standard Pickup
Ford	Explorer SUV[xxix]	BEV	TBD	Standard SUV
Genesis	Electrified G80[xxx]	BEV	265-310	Large
Genesis	Electrified GV70[xxxi]	BEV	249 (Korean)	Small SUV
Genesis	GV60[xxxii]	BEV	229, 249, 280	Small SUV
GMC	Hummer EV Edition 1[xxxiii]	BEV	329	Standard Pickup
GMC	Sierra Denali[xxxiv]	BEV	400	Standard Pickup

Make	Model	Vehicle	Electric Range Type	EPA Size Class
GMC	Sierra SUV[xxxv]	BEV	400	Standard Pickup
GMC	Hummer EV SUV[xxxvi]	BEV	300	Standard SUV
Honda	Acura ADX SUV[xxxvii]	BEV	TBD	Small SUV
Honda	Prologue SUV[xxxviii]	BEV	300	Small SUV
Hyundai	Ioniq5SUV[v]	BEV	220, 256, 303	Small SUV
Hyundai	Ioniq6Sedan[xxxix]	BEV	300	Midsize
Hyundai	SantaFePlug-inHybrid[v]	PHEV	31	Small SUV
Hyundai	Tucson Plug-in Hybrid[v]	PHEV	33	Small SUV
Hyundai	Ioniq 7 SUV[xl]	BEV	300+	Standard SUV
Infiniti	QX Inspiration SUV	BEV	TBD	Small SUV
Jaguar Land	Range Rover P440e[xlii]	PHEV	48	Standard SUV
Jeep	Compass 4xe PHEV[xliii]	PHEV	29-30 (WLTP)	Small SUV
Jeep	Grand Cherokee PHEV[v]	PHEV	26	Small SUV
Jeep	Renegade 4xe PHEV[xliv]	PHEV	26 (WLTP)	Small SUV
Jeep	Wrangler Magneto[xlv]	BEV	250	Small SUV
Kandi	K32[xlvi]	BEV	60, 150	Standard Pickup
Karma	GSe-6[xlvii]	BEV	230	Midsize
Kia	EV6[v]	BEV	232, 274, 310	Midsize
Kia	Sorento Plug-in Hybrid[v]	PHEV	32	Small SUV
KIA	EV9[xlviii]	BEV	300	Standard SUV
Lamborghini	Urus PHEV[xlix]	PHEV	TBD	Standard SUV
Lamborghini	Aventador[l]	PHEV	TBD	Two Seaters
Lamborghini	Huracan[li]	PHEV	TBD	Two Seaters
Land Rover	Range Rover[lii]	BEV	300	Standard SUV
Lexus	NX 450h Plus AWD[v]	PHEV	37	Small SUV
Lexus	RZ450e[liii]	BEV	250	Small SUV
Lincoln	MarkE[liv]	BEV	300-350	Standard SUV
Lordstown	Endurance[lv]	BEV	250	Standard Pickup
Lordstown	Van Concept[lvi]	BEV	350	Minivan
Lotus	Evija Hypercar[lvii]	BEV	250 (WLTP)	Two Seaters
Lotus	Type 132[lviii]	BEV	TBD	Standard SUV
Lotus	Unnamed Coupe-Sedan[lix]	BEV	TBD	Compact
Lotus	Unnamed Smaller SUV[lx]	BEV	TBD	Small SUV
Lucid	Air Dream (all trims)[v]	BEV	451-520	Large
Lucid	Air Grand Touring (all trims)[v]	BEV	469, 516	Large
Lucid	Air Pure[lxi]	BEV	406	Large
Maserati	Grecale PHEV SUV[lxii]	PHEV	TBD	Small SUV
Maserati	Levante GT PHEV SUV[lxiii]	PHEV	33	Small SUV
Maserati	GranCabriolet[lxiv]	BEV	TBD	Compact
Maserati	GranTurismo[lxv]	BEV	TBD	Compact
Maserati	Grecale EV[lxvi]	BEV	TBD	Standard SUV

Make	Model	Vehicle	Electric Range Type	EPA Size Class
Maserati	Levante SUV[lxvii]	BEV	TBD	Standard SUV
Maserati	MC20[lxviii]	BEV	TBD	Two Seaters
Mazda	MX-30[v]	BEV	100	Small SUV
Mazda	MX-30 PHEV[lxix]	PHEV	TBD	Small SUV
Mercedes-Benz	EQA(GLAclass)[lxx]	BEV	200-250	Small SUV
Mercedes-Benz	EQB(GLBclass)[lxxi]	BEV	240	Small SUV
Mercedes-Benz	EQE (C class)[lxxii]	BEV	370	Midsize
Mercedes-Benz	EQS450Plus[v]	BEV	350	Large
Mercedes-Benz	EQS 580 4matic[v]	BEV	340	Large
Mercedes-Benz	EQG[lxxiii]	BEV	400	Small SUV
Mercedes-Benz	Vision EQXX[lxxiv]	BEV	620	Large
Mercedes-Benz	EQC (GLC class)[lxxv]	BEV	272 (WLTP)	Small SUV
Nissan	Ariya crossover[lxxvi]	BEV	210, 300	Small SUV
Polestar	3[lxxvii]	BEV	310	Standard SUV
Polestar	4[lxxviii]	BEV	300	Small SUV
Polestar	5[lxxix]	BEV	TBD	Standard SUV
Porsche	Macan EV[lxxx]	BEV	227	Small SUV
Ram	1500 Electric[lxxxi]	BEV	500	Standard Pickup
Rivian	R1S[v]	BEV	316	Standard SUV
Rivian	R1T[v]	BEV	314	Standard Pickup
Rolls-Royce	Spectre[lxxxii]	BEV	TBD	TBD
Subaru	SolterraCUV[lxxxiii]	BEV	220	Small Station
Tesla	Cybertruck[lxxxiv]	BEV	250, 300, 500	Standard Pickup
Tesla	Roadster[lxxxv]	BEV	620	Midsize
Toyota	bZ4X[lxxxvi]	BEV	250	Small SUV
VinFast	VF 8[lxxxvii]	BEV	313 (WLTP)	Small SUV
VinFast	VF 9[lxxxvii]	BEV	342 (WLTP)	Midsize
Volkswagen	ID. 5[lxxxviii]	BEV	320	Small SUV
Volkswagen	I.D. Buzz[lxxxix]	BEV	300+	Minivan
Volkswagen	ID. Space Vizzion[xc]	BEV	300	Small Station
Volkswagen	ID. Vizzion[xci]	BEV	413	Small Station
Volkswagen	ID.6 Crozz / ID.6 X[xcii]	BEV	270, 365 (NEDC)	Standard SUV
Volkswagen	ID Life[xciii]	BEV	200	Compact
Volvo	C40 Recharge twin[v]	BEV	226	Small SUV
Volvo	Embla (XC90	BEV	TBD	Small SUV
Volvo	Polestar 2 Single, Dual[v] Motor[xcv]	BEV	249, 270	Small SUV
Volvo	XC60[xcvi]	BEV	TBD	Standard SUV

Additional expansion of the vehicle models is expected after 2025 based on the manufacturers announced longer-term, broad-reaching electrification plans that will affect model years 2025 and beyond. Many auto manufacturers have announced commitments to become completely electric.

- Ford announced over $22 billion in investments for electrification through 2024 as it moves to electrify its most iconic products such as the Mustang, F-150 and Transit.[48]

- General Motors is investing $27 billion to develop electric and autonomous vehicles by the end of 2025.

- Cadillac is planning to have all electric vehicles and is transforming its Spring Hill Tennessee facility to produce them.[49]

- Stellanis, representing Chrysler, Dodge and Jeep[50] products, has pledged to electrify 50% of their brands by 2030[51] [52].

These announcements continue a pattern from the past several years of many manufacturers taking steps to introduce a wide range of zero-emission technologies while reducing their reliance on the ICE in various markets around the globe[53].

Table 7-5. Future Vehicle Availability

2025	2028	2030	2033	2035
Jaguar[54]	Lotus Stellanis[55] - Chrysler,[56] Dodge, Jeep	Bentley Cadillac Genesis Lexus Mercedes-Benz[57] Mini Rolls Royce Volvo[58]	Audi	Chevrolet, GMC, Buick[60]

[48] *The Ford Electric Vehicle Strategy*. Ford. 2021. Accessed on March 8, 2022 from Ford Electric Vehicles | Charging, Range, Technology & More | https://media.ford.com/content/fordmedia/fna/us/en/news/2021/05/19/the-ford-electric-vehicle-strategy--what-you-need-to-know.html
[49] General Motors. 2022 Accessed on March 8, 2023 from *GM Reveals Ultium-Powered LYRIQ* | General Motors https://www.gm.com/stories
[50] Jeep. 2023. Accessed on March 8, 2023 from *4xe Electric SUV Lineup | Jeep® Recon & Wagoneer S Reveal https://www.jeep.com/ev.html*
[51] Stellanis. 2023. Accessed on March 8, 2023 from *Electrification* | Stellantis https://www.stellantis.com/en/technology/electrification
[52] Autowise. July, 8 2021. Accessed on March 8, 2023 from Stellantis to *Launch 55 Electric Vehicles by 2025* – Autowise . https://autowise.com/stellantis-to-launch-55-electric-vehicles/ .
[53] ERM/MJ Bradley. 2021. Electric Vehicle Report. Accessed on March 8, 2023 from *MJB&A publishes updated report on electric vehicle market over next 5-10 years* https://www.erm.com/news/mjba-publishes-updated-report-on-electric-vehicle-market-over-next-5-10-years/
[54] Jaguar 2021. Accessed on March 8, 2023 from *JAGUAR LAND ROVER REIMAGINES THE FUTURE OF MODERN LUXURY BY DESIGN* | Jaguar Media Newsroom https://media.jaguarlandrover.com/news/2021/02/jaguar-land-rover-reimagines-future-modern-luxury-design
[55] Forbes, "*Every Automaker's EV Plans*." 2021. Accessed on March 8, 2023 from https://www.forbes.com/wheels/news/automaker-ev-plans/
[56] Chrysler. 2022. Accessed on March 8, 2023 from *The Future of Chrysler* | Chrysler Innovation https://www.chrysler.com/chrysler-innovation/future-of-chrysler.html
[57] Mercedes-Benz AG. 2021. "Mercedes-Benz prepares to go all-electric." July 22. Accessed March 4, 2022. https://mercedes-benz-media.co.uk/en-gb/releases/1431
[58] Volvo Car USA. 2021. "Volvo Cars to be fully electric by 2030." Volvo Newsroom. March 2. Accessed March 8, 2023. https://www.media.volvocars.com/us/en-us/media/pressreleases/277409/volvo-cars-to-be-fully-electricby-2030
[60] General Motors. 2021. "General Motors, the Largest U.S. Automaker, Plans to be Carbon Neutral by 2040." GM Corporate Newsroom. January 28. Accessed March 8, 2023. https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2021/jan/0128-

		VW[59]		

Vehicle Range and Fuel Economy

Much has been said about the miles or range an electric vehicle can achieve on a single charge. As previously stated, the Ford Model T had a 10-gallon fuel tank and an approximate fuel economy of 7.5 mpg.[61] Automobile manufacturers are developing and delivering products that meet the needs of its customers with improved fuel efficiency and longer vehicle range on a single charge. The 2000 introduction of the Toyota Prius, a hybrid electric vehicle, combined the internal combustion engine with an electric motor for an overall fuel efficiency of approximately 40 miles per gallon. The Toyota Prius which achieved a fuel economy of 60 miles per gallon (mpg) was the most fuel-efficient vehicle in America until the Chevrolet VOLT was introduced in 2010.[62]

A few comments were received claiming that electric vehicles were simply less efficient than their gasoline counterparts. EPA's Fuel Economy webpage[63] states that gasoline powered vehicles only convert about 12-30 percent of the energy stored in gasoline to power the wheels whereas, an electric vehicle converts over 77 percent of the electric energy from the grid to power the vehicles wheels. An August 2022 MotorTrend article further discusses the overall fuel efficiency of electric vehicles compared to an ICE vehicle. *"The vast majority of energy wasted in an ICE vehicle is through the heat the engine produces, which you can literally feel radiating from under the hood."*[64]

Federal Fuel Economy Standards

Looking back in time to the 1973 oil embargo, which prompted the US Congress to act and establish fuel economy standard for conventional vehicles with the 1975 adoption of the Corporate Average Fuel Economy Standards (CAFE) through the Energy Policy and Conservation Act. Beginning with model year 1978, all new passenger cars would be designed to meet the 27.5 miles per gallon average fuel economy. This standard was almost double what the average car achieved in the early 1970s. Though the CAFE standards were designed to conserve fuel and limit the consumer impact on the high cost and price variability of fuel, vehicle range has become an expectation with the American consumer.

Over the next 25 years, the American vehicle owner drove more and more miles per year in less fuel-efficient SUVs and light-duty trucks. The 1975 CAFE standards remained in place until 2007, when Congress passed legislation (Energy Independence and Security Act of 2007) to raise the standard by 20% to 35 mpg by 2020. Following the US Supreme Court's decision in *Massachusetts v. EPA,* an agreement between the federal government (NHTSA and

carbon.html .
[59] Volkswagen. 2021. "Strategy update at Volkswagen: The transformation to electromobility was only the beginning." Volkswagen Newsroom. March 5. Accessed March 8, 2023. https://www.volkswagennewsroom.com/en/stories/strategy-update-at-volkswagen-the-transformation-to-electromobility-was-only-thebeginning-6875
[61] Ford Model T mpg. Fuelly.com. 2023. Retrieved from *Ford Model T MPG - Actual MPG from 15 Ford Model T* owners https://www.fuelly.com/car/ford/model_t
[62] Fuel Economy Guide. USDOE. 2023. Retrieved from Fuel Economy. https://www.fueleconomy.gov/feg/pdfs/guides/feg2023.pdf
[63] USEPA. 2023. Fuel Economy. Retrieved from https://www.fueleconomy.gov/feg/evtech.shtml#:~:text=Energy%20efficient.,to%20power%20at%20the%20wheels
[64] MotorTrend. 2022. Electric Vehicles are Way, Way More Energy-Efficient Than Internal Combustion Vehicles. Retrieved from https://www.motortrend.com/news/evs-more-efficient-than-internal-combustion-engines/

EPA), state regulators (California) and the automobile industry, it established a national program to harmonize fuel efficiency standards with standards to reduce greenhouse gas pollution from light-duty vehicles.[65]

With the advent of stronger federal fuel economy standards coupled with the emission reduction standards set by EPA, the automobile manufacturers have invested in battery technology that will deliver and meet consumers' expectations. The range varies from manufacturer to manufacturer with typical mile ranges from 85 up to 250 miles. Some manufacturers offer extended mile ranges up to 400 miles per charge.[66]

The median driving range of 2021 model year BEVs has increased to 234 miles, but that still trails the median range of a gasoline vehicle of 403 miles. The increase in electric range is necessary for market development as consumers are looking for EVs that can go 300 to 500 or more miles on a single charge, and EVs that cost about the same as their gasoline counterparts.[67] [68] [69] There are already BEV models in the process of becoming certified for the 2022 model year achieving a maximum range of 520 miles, including the Lucid Air. As more long-range BEVs become available, the discrepancy in range between gasoline-powered vehicles and BEVs is likely to continue to narrow.[70]

PHEVs with increased ranges are also anticipated due in part to consumer demand for a more all-electric driving experience. Second generation PHEVs that are currently in the market offer more range than earlier generation vehicles. The maximum PHEV all-electric range in model year 2021 and 2022 is attributed to the Karma GS-6 (61 all-electric miles). While the maximum PHEV all-electric range increased in a stepwise pattern from 35 miles in 2011 to 61 miles in 2022, the median range for PHEVs has decreased from 35 miles to 23 miles in the last 11 years due to an increase in PHEV model availability.

Commentors raised questions regarding the ability of ZEVs to operate in a weather emergency or evacuation order. The concern was attributed to vehicle range anxiety and the inability to charge the battery or accessing convenient charging stations while on Delaware highways. With the advent of modern meteorology forecasting[71], weather emergencies are typically forecasted days in advance, providing the impacted population time to prepare. The Delaware Emergency Management Agency (DEMA) has resources for citizens to prepare and

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[65] The EPA established global warming pollution standards of 250 grams per mile, on average, for model year (MY) 2016 vehicles. NHTSA set fuel efficiency standards which target a new vehicle average of 34.1 miles per gallon in MY2016. These two standards reflect a harmonized level of stringency. CARB agreed to accept compliance with the National Program as compliance with its standards even though the federal standards were weaker until 2016.

[66] *Model S Long Range Plus: Building the First 400-Mile Electric Vehicle. June 15, 2020. Retrieved from Model S Long Range Plus: Building the First 400-Mile Electric Vehicle | Tesla* https://www.tesla.com/blog/model-s-long-range-plus-building-first-400-mile-electric-vehicle

[67] Consumer Reports 2020. Consumer Reports, "*Consumer Interest and Knowledge of Electric Vehicles: 2020 Survey Results*", Published December 2020 https://advocacy.consumerreports.org/wp-content/uploads/2020/12/CR-National-EV-Survey-December-2020-2.pdf

[68] Cox 2021a. Cox Automotive, "*2021 Cox Automotive Path to EV Adoption Study*", Conducted June/July 2021 https://www.coxautoinc.com/wp-content/uploads/2021/11/2021-Cox-Automotive-Path-to-EV-Adoption-Study-Highlights.pdf

[69] Deloitte 2022, Deloitte "*2022 Global Automotive Consumer Study*", Published January 2022. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Consumer-Business/us-2022-global-automotive-consumer-study-global-focus-final.pdf

[70] DOE 2022a. US Department of Energy. Accessed February 11, 2022 Fact of the week #1221. "January 17, 2022: Model Year 2021 All-Electric Vehicles Had a Median Driving Range about 60% That of Gasoline Powered Vehicles" https://www.energy.gov/eere/vehicles/articles/fotw-1221-january-17-2022-model-year-2021-all-electric-vehicles-had-median

[71] National Weather Service. 2023. Retrieved from National Weather Service https://www.weather.gov/

plan for these events.[72] DEMA recommends everyone prepare a plan in advance and stay informed about emerging dangers, hazards and risks in our area.

Truck Towing Capacity

Many comments were received regarding the ability of battery electric trucks to tow and haul heavy loads. Towing does impact electric vehicle's range as it does for similarly equipped gasoline or diesel-powered vehicles. Studies by MotorTrend have shown the towing range for the Ford F-150 Lightning's Platinum model with an estimated range of 300 miles in mixed driving conditions is rated 8,500 pounds[73]. Towing a small travel trailer weighing 3,140 pounds the trucks range dropped to 115 mile. When pulling a medium weight 5,260-pound camper, the range dropped to 100 miles and towing a heavier 7,218 pound camper the range was only 90 miles. MotorTrend still proclaimed the model year 2023 Ford F-150 Lightning the MotorTrend Truck of the Year.[74]

MotorTrend acknowledges the towing limitations for the current technology but praises the trucks performance as better than any other F-150 model. *"It drives better both empty and loaded down with cargo, it's more efficient, and it's significantly cheaper to charge on home or business 240-volt power than a gas-powered truck is to fuel. It has significantly more lockable storage and can export 25 percent more power through its 120-volt and 240-volt outlets than any other F-150. When not loaded down, its range and charging speed are as good as the competition, and its route planner for road-trip charging is excellent."*

Other manufacturers such as General Motor Silverado, Rivian R1T and Tesla's Cybertruck are all rated with towing capacities at 10,000 pounds or more. Stellanis (formerly Chrysler) recently announced the RAM Revolution which is expected to have a 500-mile range and a towing capacity of 14,000 pounds.

Battery Durability and Lifespan

Another concern voiced by consumers is product durability or the expected lifespan for the batteries before it requires replacement or a new vehicle. BEVs currently rely on lithium-ion batteries to operate; however, these batteries do not have an unlimited lifespan. The ACC2 regulations require automobile manufacturers to submit at the time of certification, data on the expected degradation of the battery's State of Health (SOH) over the vehicle's useful life. Beginning with model year 2026, California's ACC II will require battery electric vehicles to be designed to maintain 80 percent of the certified Urban Dynamometer Driving Schedule (UDDS) range for 15 years or 150,000 miles. Fuel Cell vehicles must be designed to maintain at least 90 percent fuel cell system output power after 4,000 hours of operation.

To measure the lifespan of these batteries, battery durability is considered for assessing

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[72] DEMA. 2023. Emergencies & Preparedness. Retrieved from Emergencies & Preparedness - Delaware Emergency Management Agency https://www.dema.delaware.gov/
[73] Ford's XLT model is rated with a 10,000 maximum towing capacity. Retrieved from https://www.ford.com/trucks/f150/f150-lightning/
[74] MotorTrend. December 2022. MotorTrend Awards – The Ford F-150 Lightning the 2023 Truck of the Year. Retrieved from https://www.motortrend.com/news/ford-f-150-lightning-2023-truck-of-the-year/

the useful life of a battery, and how different elements impact the battery degradation process. The US Department of Energy Vehicle Technologies Office (VTO) has put forth electric vehicle targets and goals for batteries at the pack and cell level including: 15 years of calendar life, 1,000 cycles of deep discharge cycle life, and greater than 70 percent of useable energy for nominal capacity discharged over three hours at –20 degrees Celsius (C) for low temperature performance.[75] In comparison, on average the typical life span of a conventional internal combustion engine vehicle is 12 years or 150,000 miles.[76]

BEV batteries also degrade due to temperature, cycles and time, much like all technology. However, BEV batteries utilize complex battery management systems (BMS) that regulate how the batteries are charged and discharged to prolong their life (Figure 7-1). The BMS, which manages the electronics of a rechargeable battery, whether a cell or a battery pack, thus becomes a crucial factor in ensuring electric vehicle safety. It safeguards both the user and the battery by ensuring that the cell operates within its safe operating parameters. BMS monitors the state of health (SOH) of the battery, collects data, controls environmental factors that affect the cell, and balances them to ensure the same voltage across cells.[77]

Batteries are not expected to need replacement even after the warranty expires. Batteries are expected to maintain a useful life of more than 10 years. A study by Recurrent[78] notes that the "*Nissan Leaf is the oldest mass-produced electric vehicle on the road, has seen the most battery replacements. However, many of the replacements for early model year LEAFs were covered by Nissan after they found that their original battery chemistry lost charge quickly in hot environments. However, they quickly changed to more hearty battery that has seen great success. In fact, in response to a question about how the company planned to use old LEAF batteries, Nic Thomas, Nissan's marketing director for the UK, told Forbes, "Almost all of the batteries we've ever made are still in cars, and we've been selling electric cars for 12 years. We haven't got a great big stock of batteries that we can convert into something else." Other comments from the company include one from 2019 by managing director of Renault-Nissan Energy Services, Francisco Carranza, who estimated that the batteries may last 22 years."*

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[75] U.S. Department of Energy. 2020. "Batteries: 2020 Annual Progress Report." Office of Energy Efficiency & Renewable Energy Vehicle Technologies Office. Retrieved from https://www1.eere.energy.gov/vehiclesandfuels/downloads/VTO_2020_APR_Batteries_compliant_.pdf
[76] Average Age of Automobiles and Trucks in Operation in the United States. US Bureau of Transportation Statistics. 2022. Retrieved from https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states.
[77] Keerthi, S. K. (2022, March 29). Battery Management System in electric vehicles. Engineering, Manufacturing, Digital Transformation Solutions. Retrieved February 14, 2023, from https://www.cyient.com/blog/battery-management-system-in-electric-vehicles#:~:text=A%20Battery%20Management%20System%20(BMS,within%20its%20safe%20operating%20parameters.
[78] Recurrent. 2023. "New Study: How Long do Electric Car Batteries Last?" Retrieved from https://www.recurrentauto.com/research/how-long-do-ev-batteries-last

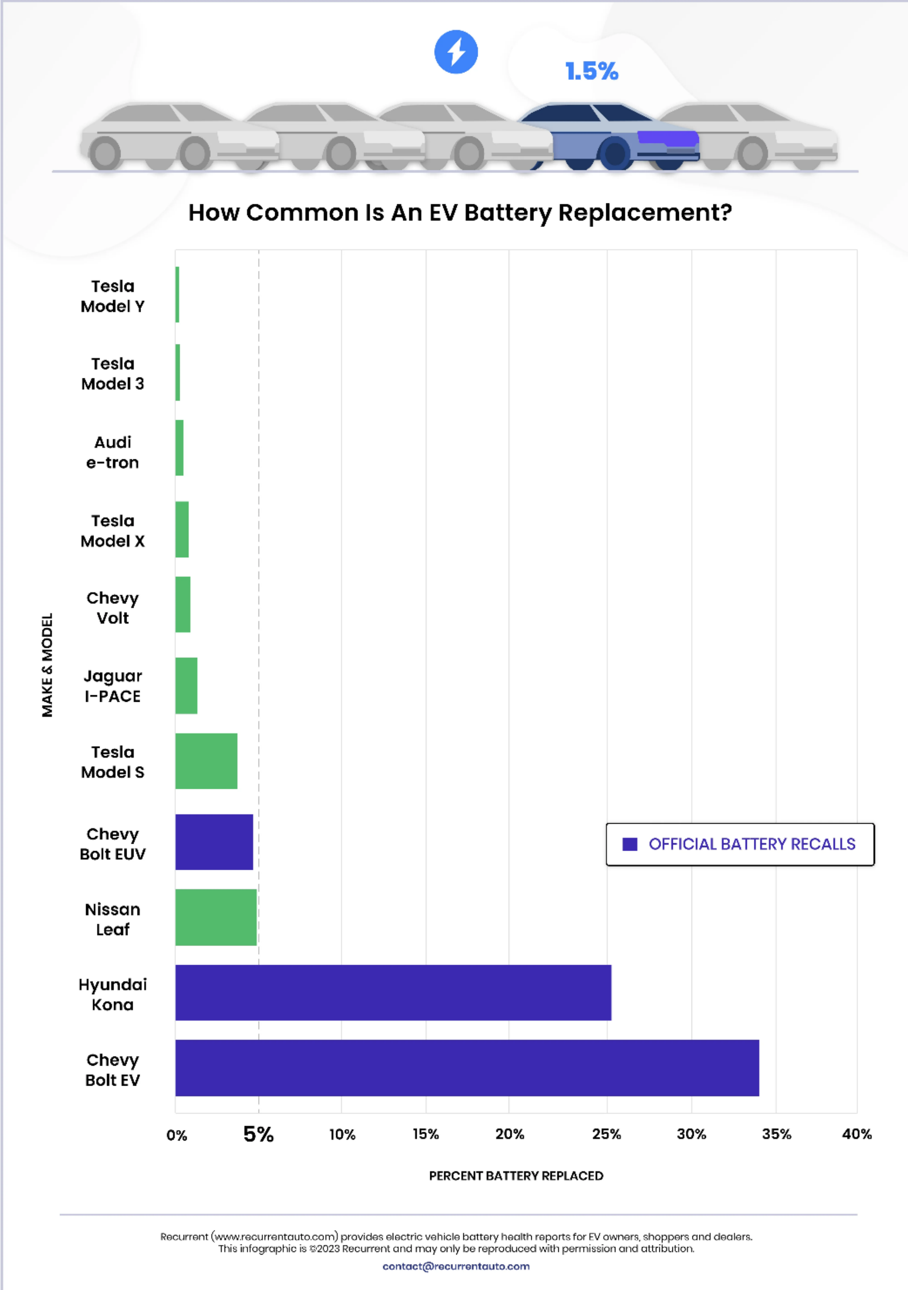

Figure 7-1. Recurrent Battery Replacement

Electric vehicles on the road today are already able to maintain 80 percent of the vehicle's original battery capacity for 10 years or 150,000 miles. When looking at the United States Advanced Battery Consortium electric vehicle battery goals for a battery life of 15 years, an analysis conducted on lithium-ion cells of battery model Panasonic NCR18650PD revealed capacity loss was well within the 80 percent benchmark, even at different temperatures.[79] Tesla's

[79] Keil et al., "Aging of Lithium-Ion Batteries in Electric Vehicles" https://mediatum.ub.tum.de/doc/1355829/document.pdf

fleet of over 1 million Tesla Model S and X vehicles have also shown less than 15 percent battery degradation for vehicles that drove between 150,000 and 200,000 miles.[80] Tesloop, which is a Tesla rental company in Southern California, operated a Tesla Model X 90D with 350,000 miles on an original battery, while only experiencing a 13 percent capacity fade, which translated to a range reduction from 247 miles to 215 miles at 95 percent charge.[81]

The California Air Resources Board (CARB) Initial Statement of Reasons (ISOR) – Appendix G provides more details on the state of battery technology and future trends.

Battery Warranty

Battery warranty is important to purchasers because the battery is the most expensive part of the vehicle and the most expensive to repair and replace. Failure or undue degradation of the battery pack can affect the usefulness and drivability of a BEV and cause individual drivers to stop using the vehicle, revert to gasoline vehicles, or avoid initial or subsequent purchase of the technology for fear of future failure. With the battery warranty defined in subsection 1968.2 of the California Code of Regulations, the manufacturer is liable to honor claims that fall below the threshold of 70% state of battery health in the timeframe, 8 years or 100,000 miles for 2026 through 2030 model years, and 75% state of health for 2031 and subsequent model years. This will bolster consumer confidence in ZEVs and help sustain and expand ZEV market growth.

By adopting Section 1962.8 of the California Code of Regulations (CCR), the regulation will require a minimum warranty for batteries on battery electric vehicles and plug-in hybrid vehicles. The manufacturer shall warrant to the purchaser a battery free of defects in materials and workmanship which causes deterioration of the battery state of health to be less than 70% for 2026 through 2030 model years, and 75% for 2031 and subsequent model years, for a period of 8 years or 100,000 miles, whichever comes first.

Additional sections in the California Code of Regulations provide additional warranty coverage and protect consumers from future costly repairs. One requirement requires vehicle manufacturers to provide a prescribed ZEV warranty statement with each new vehicle. This standard is necessary to inform the consumer of the manufacturer's obligations with respect to the warranty coverage, and of the consumer's rights to have repairs made for conditions covered by the warranty at no cost to the consumer. This subsection is included to mimic the emission warranty statement for internal combustion engine vehicles (ICEVs) as provided in CCR, title 13, section 2039, but modified to be appropriate for ZEVs. This maintains consistency across warranty requirements, ensures consumers are aware of the vehicle's warranty coverage, and avoids undue burden on the regulated entities.

The automobile manufacturers are to provide a warranty for the vehicle's power train and emission controls for 8 years or 100,000 miles, while California requirements extend that warranty to 10 years or 150,000 miles. As EV battery packs become cheaper to manufacture,

[80] Tesla. 2019. Impact Report. Tesla. https://www.tesla.com/ns_videos/2019-tesla-impact-report.pdf
[81] Kane, Mark. 2019. Insideevs.com - Tesloop Explains Various Causes For Tesla Battery Degradation. April 22. Accessed March 2, 2022. https://insideevs.com/news/345589/tesloop-reasons-cause-battery-degradation/

companies like Tesla and GM can create larger batteries with more energy potential, which in turn increases their mile-range and also lowers the overall cost of the vehicle. Additionally, the improved technology reduces the degradation of batteries, meaning that over time the maximum potential stays closer to the new battery. In addition, newer batteries have greatly increased in mileage range. As they degrade, they will still maintain a longer mileage range than batteries from just a few years ago. Lithium-ion batteries can be repaired by replacing dead cells.[82]

Battery and Vehicle Costs

Advancements in battery capacity, computing power, and efficient power electronics continue to reduce costs and increase the performance of EV models across all market segments. Coupled with steady increases in energy density, this translates directly into growing set of vehicle applications and duty cycles that can be electrified cost-effectively. While consumer adoption relies on individual preferences, commercial and public fleet adoption depends more on financial considerations, in particular the low total cost of ownership. The increase in EV volume production, along with the decrease in battery cost, increases the likelihood of a viable solution for all market segments.[83]

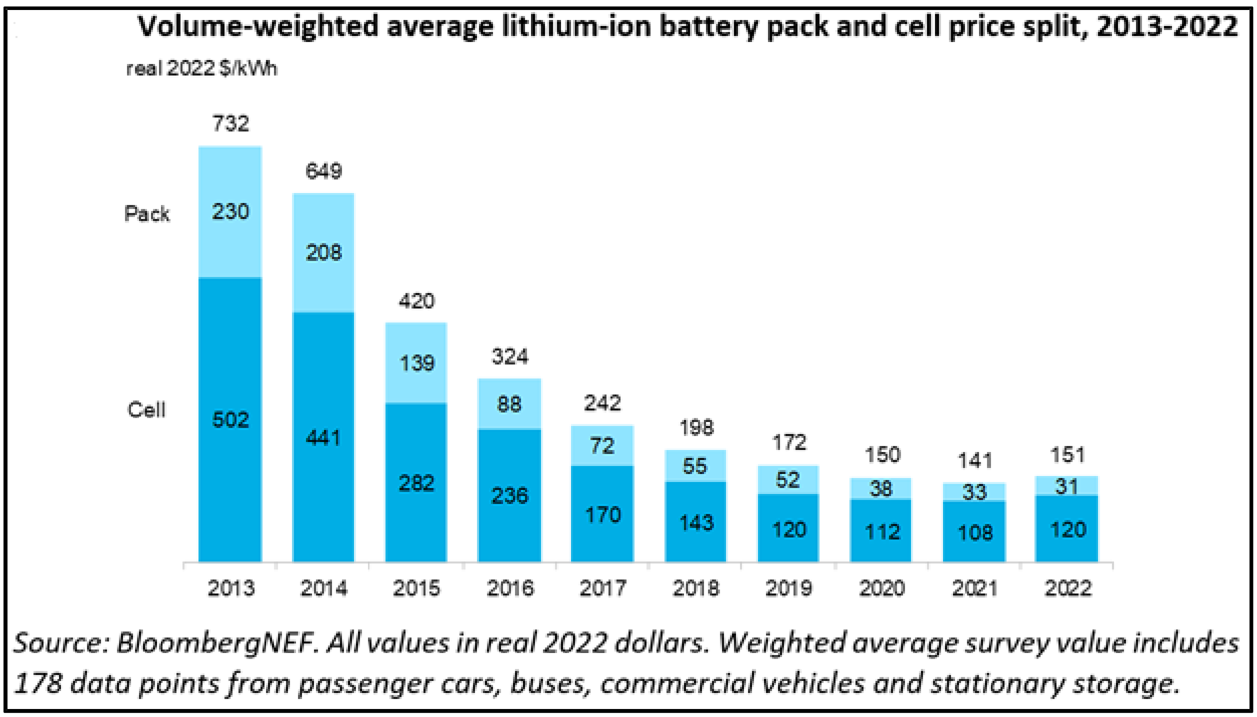

Figure 7-2. Volume-weighted average lithium-ion battery pack and cell price split, 2013-2022[72]

[82] EV Connect. (2021, December 30). How long does an electric car battery last?: Ev Connect. EV Connect. Retrieved January 17, 2023, from https://www.evconnect.com/blog/how-long-does-an-electric-car-battery-last#:~:text=On%20average%2C%20EV%20batteries%20only,longer%20than%20ICE%20drivetrain%20components.

[83] Smart Electric Power Alliance. "Preparing for an Electric Vehicle Future: How Utilities can Succeed". October 2019. https://dor.mo.gov/motor-vehicle/documents/SEPAOverview.pdf

While prices for key battery metals like lithium, nickel and cobalt have moderated slightly in recent months, Bloomberg New Energy Finance (BNEF) expects average battery pack prices to remain elevated in 2023 at $152/kWh (in real 2022 dollars). BNEF expects battery price to start dropping again in 2024, when lithium prices are expected to ease as more extraction and refining capacity comes online. Based on the updated observed learning rate, BNEF's 2022 Battery Price Survey predicts that average pack prices should fall below $100/kWh by 2026. This is two years later than previously expected and will negatively impact the ability for automakers to produce and sell mass-market EVs in areas without subsidies or other forms of support. Higher battery prices could also hurt the economics of energy storage projects.[84]

Battery Safety

Ever since the first electric car was made available, there have been questions about its safety as compared to traditional forms of transportation. There was a major concern about electric cars being vulnerable to electric fires. The main risk that is posed by electric cars stems from the battery pack. In most cases, these battery packs provide an extra layer of protection for the electric car. However, if the battery pack is exposed to severe external damage it could lead to an electrical short, which could start a fire.

However, this does not make electric cars more likely to catch fire than conventional vehicles. On the contrary, there are still more car fires that are attributed to gasoline-powered vehicles over electric vehicles. Lithium-ion batteries have a much lower risk of fire explosions than gasoline in conventional vehicles. To prevent external damage or short- circuiting, a protective cooling shroud filled with coolant liquid surrounds electric vehicle batteries. In addition, in spite of external cooling, all electric vehicles are installed in an array rather than one huge lithium-ion battery pack to prevent damage from malfunction.[85] Research using *National Transportation Safety Board* (NTSB) data showed hybrid-powered cars were involved in about 3,475 fires per every 100,000 sold. Gasoline-powered cars were involved in about 1,530 fires per every 100,000 sold. Electric vehicles (EVs) were involved in only 25 fires per 100,000 sold.[86]

A few commentors mentioned concern about electric vehicles catching fire after Hurricane Ian flooded communities in Florida. Florida reported eleven electric vehicle fires attributed to the flooding following the hurricane. In a small number of cases when an EV is submerged in water, contaminants or salt in the water can cause short-circuiting, especially after the water drains from the battery, and result in a fire. Commentors were also concerned about the methods used to extinguish these fires.

Emergency response for electric-drive vehicles is not significantly different from that of conventional vehicles. Electric-drive vehicles are designed with cutoff switches to isolate the battery and disable the electric system, and all high-voltage power lines are clearly designated

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[84] BNEF. "Lithium-ion Battery Pack Prices Rise for First Time to Average of $151/kWh". Accessed on March 9, 2023 from https://about.bnef.com/blog/lithium-ion-battery-pack-prices-rise-for-first-time-to-an-average-of-151-kwh/

[85] Kia. (2023). Are Electric Cars Dangerous? Kia British Dominica. Retrieved January 17, 2023, from https://www.kia.com/dm/discover-kia/ask/are-electric-cars-dangerous.html

[86] Tucker, S. (2022, January 1). Study: Electric vehicles involved in fewest car fires. Kelley Blue Book. Retrieved February 15, 2023, from https://www.kbb.com/car-news/study-electric-vehicles-involved-in-fewest-car-fires/

with orange coloring. The NTSB has issued guidance for "*Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles.*"[87] In addition to the guidance provided by the NTSB, the National Fire Protection Association has developed training for firefighting electric vehicle fires.[88]

As stated by NHTSA, the likelihood of an electrical fire in an EV battery is as likely or less likely than a gasoline fire in an ICE vehicle. According to the International Association of Fire Chiefs (IAFC), "adapting our response plans through training, research, and experience is critical in the fire service. As sales of electric and hybrid vehicles increase, the fire service must continue to modify our tactics to properly respond and protect firefighters."[89] Firefighters are preparing for a ZEV future and should a vehicle fire occur, they will be prepared to handle it safely. NHTSA has also provided guidance for handling electric vehicle fires that occur because of saltwater flooding.[90]

Electric cars also undergo intense and rigorous safety testing in order to make sure that they meet the basic safety standards that are desired for traditional vehicles. In addition to this, these vehicles must also undergo specific safety tests that help limit chemical battery spills, keep the battery secure during an accident and prevent electric shortages. For any electric cars to be sold, manufacturers comply with NHTSA standards to ensure that their vehicles are safe.

With batteries that can now handle 300-500 miles of range, their weights are making EVs heavier than ICE vehicles. Battery research is in progress to reduce weights and keep the higher range capabilities. According to a NHTSA report about Lithium-ion Battery Safety Issues for Electric and Plug-in Hybrid Vehicles, "*Substantial research and development is in progress to achieve greater Li-ion battery performance at lighter weight and lower cost. Researchers are exploring higher performance chemistries and are expanding the operating range of batteries through electrochemical modeling.*"[91]

Overall, battery technology is improving, and the safety and reliability of batteries is very similar to that of an ICE vehicle if not safer.

Battery Critical Minerals

Many commentors at the public workshops expressed concerns about the labor practices used in foreign countries for the mining of the minerals mentioned. While Delaware has no ability to regulate the labor practices used overseas for mining, the United States is taking steps to reduce human rights violations seen in the mines and to minimizing dependence on foreign supplies of these essential minerals. Globally, China controls most of the market for processing and refining cobalt, lithium, rare earths and other critical minerals.

[87] NTSB. 2020. "Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles". Retrieved from https://www.ntsb.gov/safety/safety-studies/Documents/SR2001.pdf
[88] National Fire Protection Association. 2022. Retrieved from Alternative Fuel Vehicle (AFV) Safety Training | NFPA https://www.nfpa.org/EV
[89] Fire Department Response to Electrical Vehicle Fires, IAFC, (10/15/2021), Accessed (2/8/2023) https://www.iafc.org/docs/default-source/1haz/respondingtoelectricalvehiclefires.pdf
[90] Responding to Electric Vehicle Fires Caused by Salt Water Flooding, FEMA (10/20/2022), Accessed (2/8/2023) https://www.usfa.fema.gov/blog/ig-102022.html
[91] NHTSA, Lithium-ion Battery Safety Issues for Electric and Plug-in Hybrid Vehicles (2017). https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/12848-lithiumionsafetyhybrids_101217-v3-tag.pdf

Recently, United States President Biden signed Executive Order 14017[92] "America's Supply Chains" to review and report on vulnerabilities in our critical mineral and material supply chains and to work with partners and allies to diversify sustainable sources, expand domestic mining, production, processing and recycling of critical minerals and materials – all with the intent to focus on boosting strong labor, environmental and environmental justice community engagement and Tribal consultation standards.

Auto makers are moving to directly source battery raw materials from mines with safety rules and protections for workers – GM investing in California mine, BMW buying lithium from an Australian mine, Volkswagen signing contracts with a German one.[93] This past year, Ford Motor Company and Rio Tinto signed a non-binding global memorandum of understanding (MOU) to jointly develop more sustainable and secure supply chains for battery and low-carbon materials used in Ford vehicles.[94] "*Under the agreement, Ford will explore becoming the foundation customer for Rio Tinto's Rincon lithium project in Argentina. Rio Tinto is currently progressing detailed planning to bring Rincon into production and will work with Ford toward a significant lithium off-take agreement to support its production of electric vehicles.*"

The practice of artisanal mining (mining performed by regular people and sometimes children) as opposed to industrial miners is a common practice in the Democratic Republic of Congo (DRC) where 60 percent of the world's cobalt originates. The U.S. State Department[95] is working with the government of Congo to stop the practice which can be dangerous, especially when deep tunnels collapse. Artisanal mining is estimated to represent 30 percent of Congo's cobalt production.

In addition to the work of the U.S. State Department, the Department of Labor - Bureau of International Labor Affair's COTEECO project works to address child labor in the DRC's cobalt supply chain, with a focus on artisanal and small-scale mining. The project supports key stakeholders to develop and implement strategies to reduce child labor and improve working conditions in artisanal and small-scale mines, as well as in the broader cobalt supply chain.[96]

Battery Disposal and Recycling

Automakers in the U.S. market typically warrant traction[97] or high-voltage batteries for

[92] FACT SHEET: Securing a Made in America Supply Chain for Critical Minerals, The White House (2/22/2022) Accessed (2/8/2023) https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/22/fact-sheet-securing-a-made-in-america-supply-chain-for-critical-minerals/
[93] Automakers partner with mines as electric cars rely on raw materials for batteries : NPR March 11, 2022 https://www.npr.org/2022/03/11/1085670133/automakers-partner-with-mines-as-electric-cars-rely-on-raw-materials-for-batteri#:~:text=Automakers%20partner%20with%20mines%20as,raw%20materials%20for%20batteries%20%3A%20NPR&text=Press,Automakers%20partner%20with%20mines%20as%20electric%20cars%20rely%20on%20raw,are%20being%20mined%20for%20batteries.
[94] *Ford Signs MOU for Battery and Low Carbon Materials Supply* - Smart Energy Decisions July 25,2022 https://www.smartenergydecisions.com/energy-management/2022/07/25/ford-signs-mou-for-battery-and-low-carbon-materials-supply
[95] *Democratic Republic of the Congo* - United States Department of State 2023 https://www.state.gov/countries-areas/democratic-republic-of-the-congo/
[96] Combatting Child Labor in the Democratic Republic of the Congo's Cobalt Industry (COTECCO) | U.S. Department of Labor https://www.dol.gov/agencies/ilab/combatting-child-labor-democratic-republic-congos-cobalt-industry-cotecco
[97] An EV traction battery is rechargeable energy storage that supplies power to the electric motor.

BEVs for 8 years or 100,000 miles.[98] Meanwhile, the batteries on PHEVs certified to California's transitional ZEV standard are warranted for 10 years or 150,000 miles. As battery technology progresses, and to maximize BEV benefits, increasing the battery warranty on these vehicles to cover more vehicle mileage for an extended period ensures the vehicles have a reliable battery for a longer period of the vehicles' lifespan. Once battery capacity drops below 70 percent of the initial range, or if the vehicle is out of warranty and the battery pack or individual modules are replaced, those batteries would enter end of life management processes. Retired traction batteries can be reused, repurposed, recycled, or ultimately discarded in a hazardous waste landfill. Because the electric vehicle battery is expected to retain much of its capacity, waste disposal is unlikely and recycling the battery for other uses is more cost effective – similar to lead acid batteries are recycled rather than disposed of in a landfill.

When BEV batteries reach the end of their life span, they can either be replaced or recycled if the vehicle is no longer intended to be in use. After use in a vehicle, lithium battery packs could deliver an additional 5-8 years of service in a stationary application. Given the growing market for electric vehicles, second-life batteries could represent an important resource for stationary energy storage applications. Examples of stationary energy storage applications include backup power for homes or cellular tower, or in larger arrays, for large buildings like arenas or even in utility grid applications.[99]

The ACCII proposed amendments provide language for warranties on the vehicles and batteries.[100] If a battery is damaged or defective, the warranty language in ACCII acts as a safeguard for consumers. However, even fully functional batteries are perishable along the span of their useful life and do not last forever.

EV battery recycling is happening in facilities around the United States. The materials recovered, including cobalt, nickel, lithium, and manganese, can be used in the manufacturing of new batteries. While the recycling market is growing, there is still no federal or state law or policy that requires it. This is expected to change as more EVs are sold. In turn, this could ensure higher recycling rates and increased efficiency.[101]

Widespread battery recycling will keep hazardous materials from entering the waste stream, both at the end of a battery's useful life and during its production. The material recovery from recycling would also reintroduce critical materials back into the supply chain and would increase the domestic sources for such materials.

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[98] Office of Energy Efficiency & Renewable Energy, 2016. "Fact #913: February 22, 2016 The Most Common Warranty for Plug-In Vehicle Batteries is 8 Years/100,000 Miles". Posted February 22, 2016

[99] Wentworth, Adam. 2018. Amsterdam Arena installs major new battery storage. ClimateAction. July 02. Accessed March 1, 2022. https://www.climateaction.org/news/amsterdam-arena-installs-major-new-battery-storage

[100] Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response, CARB (8/25/2022) Accessed (2/9/2023) https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/fsor.pdf

[101] Analyst, J. D. S., Dunn, J., Analyst, S., Analyst, J. D. S., Analyst, S. H. S. V., Houston, S., Analyst, S. V., Analyst, D. C. S. V., & Cooke, D. (2022, September 20). California's progress toward recycling policy for EV Batteries. The Equation. Retrieved February 8, 2023, from https://blog.ucsusa.org/jessica-dunn/californias-progress-toward-recycling-policy-for-ev-batteries/

Work is now underway to develop battery-recycling processes that minimize the life cycle impacts of using lithium-ion and other kinds of batteries in vehicles. Efforts to improve battery recycling are also underway at the U.S. Department of Energy's ReCell Center[102], a collaboration with national labs and universities launched in 2019. There, researchers are working to scale up what's called "direct recycling." This method aims to recapture the cathode material — a carefully manufactured powder — without melting or dissolving the whole battery and destroying the powder in the process.

However, not all recycling processes are the same, and require different methods of separation for material recovery[103] - some examples include:

Smelting: Smelting processes recover basic elements or salts. These processes are operational on a large scale and can accept multiple kinds of batteries, including lithium-ion and nickel-metal hydride. Smelting takes place at high temperatures where organic materials, including the electrolyte and carbon anodes, are burned as fuel or reductant. The valuable metals are recovered and sent to refining so that the product is suitable for any use. The other materials, including lithium, are contained in the slag, which is used as an additive in concrete.

Direct recycling / recovery: Some recycling processes directly recover battery-grade materials. Components are separated by a variety of physical and chemical processes, and all active materials and metals can be recovered. Direct recovery is a low-temperature process with minimal energy requirement.

Intermediate processes: The third type of process is between the two extremes of smelting and direct recovery. Such processes may accept multiple kinds of batteries, unlike direct recovery, but recover materials further along the production chain than smelting does.

Separating the different kinds of battery materials is often a stumbling block in recovering high-value materials. Therefore, battery design that considers disassembly and recycling is important in order for electric-drive vehicles to succeed from a sustainability standpoint. Standardizing batteries, materials, and cell design would also make recycling easier and more cost-effective.

A number of automakers have formed business partnerships with companies to recycle and reuse electric vehicle batteries. One of these companies that has formed a partnership with several car companies is Redwood Materials.[104] Partnerships with Redwood Materials have been forged with Ford, Toyota, Volkswagen, Audi and Volvo to collect and recycle end-of-life

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[102] U.S. Department of Energy. 2023. Retrieved from ReCell Center https://recellcenter.org/newsroom/recell-in-the-news-2023/
[103] Batteries and Electric Vehicles, US Department of Energy (2023), Accessed (2/13/2023) https://afdc.energy.gov/vehicles/electric_batteries.html
[104] Redwood Materials. 2023. Retrieved from Redwood Materials | Circular Supply Chain for Lithium-ion Batteries https://www.redwoodmaterials.com/

batteries from their electric vehicles with the goal of making electric cars more sustainable and affordable.

Ultium Cells LLC[105] (a joint venture between General Motors and LG Chem) has contracted with Canadian firm Li-Cycle to handle the recycling of waste materials created at Ultium's Lordstown manufacturing facility in Detroit which is producing batteries for GM electric vehicles. American Honda Motor Company has partnered with Ascend Elements Inc.[106] to recycle its end-of-life lithium-ion batteries from its electric vehicles. Hyundai is working with UL Solutions[107] to create second-life battery energy storage systems from its expended EV batteries. Meanwhile, Mercedes-Benz[108] has announced plans to build its own battery recycling plant in Kuppenheim, Germany. Tesla also recycles batteries on its own, claiming the ability to recover 92 percent of the battery's raw materials.

Parts and Maintenance

Aside from just the battery, electric vehicles have a similar design to ICE vehicles with regard to brakes, and wheels, however many of the other parts of the vehicle are not the same. From the battery to the drivetrain, EVs are not similar to ICE vehicles in many ways. The lack of extra moving parts provides consumers with fewer chances of technological failures, as well as less routine maintenance. Nearly 100 traditional ICE components will be eliminated in the shift to EVs, and only a handful will survive the transition unaltered. No fuel systems or exhausts are needed. EVs will require 41 new components. Most will be electrical or electronic with no moving parts. Most parts for vehicle suspension and steering systems will transition to EVs with no changes required.[109]

Electric vehicles also typically require less maintenance because the battery, motor, and associated electronics require little to no regular upkeep. All-electric vehicles typically require less maintenance than conventional vehicles because: The battery, motor, and associated electronics require little to no regular maintenance

- There are fewer fluids, such as engine oil, that require regular maintenance
- Brake wear is significantly reduced due to regenerative braking
- There are far fewer moving parts relative to a conventional fuel engine.

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[105] Ultium. Retrieved from Ultium Battery Powered Electric Vehicles | General Motors https://www.gm.com/ultium?ppc=GOOGLE_700000001980004_71700000090550494_58700007661457492_p69332716386&d_src=313715&d_adsrc=4137267&d_campaign=71700000090550494&d_site=GOOGLE&d_adgroup=58700007661457492&d_keyword=ultium&gclick=Cj0KCQjwuLShBhC_ARIsAFod4fJQQUsIkfNZ98tLtjCwuhuF2cfjHCzWW7JOXnQ0l6W-9yZWifSJuaMaAilhEALw_wcB&gclid=Cj0KCQjwuLShBhC_ARIsAFod4fJQQUsIkfNZ98tLtjCwuhuF2cfjHCzWW7JOXnQ0l6W-9yZWifSJuaMaAilhEALw_wcB&gclsrc=aw.ds
[106] American Honda. 2023. Retrieved from https://global.honda/newsroom/news/2023/c230227aeng.html
[107] UL Solutions. 2021. Retrieved from UL and Hyundai Join Forces to Advance Second Life Battery Energy Storage System Safety and Performance | UL Solutions https://www.ul.com/news/ul-and-hyundai-join-forces-advance-second-life-battery-energy-storage-system-safety-and-0
[108] Mercedes-Benz. 2022. Retrieved from Mercedes-Benz establishes sustainable battery recycling: Own recycling plant to start in 2023 - Mercedes-Benz Group Media. https://group-media.mercedes-benz.com/marsMediaSite/en/instance/ko/Mercedes-Benz-establishes-sustainable-battery-recycling-Own-recycling-plant-to-start-in-2023.xhtml?oid=52769309
[109] Ice vs. EV. Automotive News. (2022, February 21). Retrieved February 15, 2023, from https://www.autonews.com/ice-vs-ev

Section 8 Powering Zero Emitting Technology and Grid Reliability

Introduction

The fueling infrastructure for future zero emitting vehicles will transition from the current fossil fuel dependent – gasoline and diesel fuel - to other cleaner alternatives. The alternative fuels will depend on the choice of zero emitting technology favored by the automotive industry and the consumer. Currently, the automotive industry has chosen to develop and produce electric or fuel cell technology to replace gasoline and diesel powered light and medium duty vehicles. Over 80 new electric vehicles have been announced and are expected to be available to consumers in 2023.

Comments received during the Department's public engagement identified concerns regarding the supply of electricity, the ability to deliver that electricity without straining the transmission and distribution system (aka the grid) as well as issues associated with weather emergencies that may hinder the ability to charge a vehicle.

This section will address the anticipated impacts to electricity power generation, transmission, and distribution system as well as those associated with fuel cell vehicles.

Electricity Generation

Delaware's electricity comes from electric generating units located throughout the state and the Mid-Atlantic region. The fuels these units use to generate electricity is either natural gas, coal, nuclear or renewable energy[110]. The Delaware General Assembly passed legislation in 2005 – *The Renewable Portfolio Act*[111]- requiring electricity providers to source and deliver power generated from renewable energy:

> *"The General Assembly finds and declares that the benefits of electricity from renewable energy resources accrue to the public at large, and that electric suppliers and consumers share an obligation to develop a minimum level of these resources in the electricity supply portfolio of the state. These benefits include improved regional and local air quality, improved public health, increased electric supply diversity, increased protection against price volatility and supply disruption, improved transmission and distribution performance, and new economic development opportunities…It is therefore the purpose and intent of the General Assembly in enacting the Renewable Energy Portfolio Standards Act to establish a market for electricity from these resources in Delaware, and to lower the cost to consumers of electricity from these resources".*

The Renewable Portfolio Standard as amended in 2021[112] requires that by 2040, up to forty percent of the state's electricity supplied to customers is generated from renewable sources which include wind, solar, geothermal, ocean energy and fuel cells. As Delaware's electricity is generated from more and more zero emitting resources, shifting vehicles to electric power will further reduce air pollution.

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[110] PJM System Mix by Fuel.1/1/2022-12/1/2022. https://gats.pjm-eis.com/GATS2/PublicReports/PJMSystemMix/Filter
[111] 26 Del Code 351 – Renewable Portfolio Standards Act. https://delcode.delaware.gov/title26/c001/sc03a/index.html
[112] 83 Del. Laws, c. 3, § 1; AN ACT TO AMEND TITLE 26 OF THE DELAWARE CODE RELATING TO RENEWABLE ENERGY PORTFOLIO STANDARDS. 2021.

Delaware's municipalities are developing and deploying renewable energy and energy efficiency programs in the communities they serve. The Delaware Electric Municipal Corporation (DEMEC) has supported green energy initiatives with its members since 2004, well before the Delaware Renewable Portfolio Standard became law. DEMEC has agreements for wind power from the Laurel Hill Wind Farm in Lycoming, Pennsylvania, and solar power from the Dover Sun Park, the Milford Solar Farm, and the Smyrna Solar Facility. In addition, DEMEC supports the Municipal Green Energy Grants Program to provide assistance for residents utilizing renewable energy for their homes.

DEMEC has made significant long-term investments in renewable energy and has invested over $100 million in the development of a large portfolio of qualifying renewable energy generation resources to achieve the lowest possible compliance cost. DEMEC's goal is to install community solar energy in each of its nine member communities."[113]

Electric Transmission & Distribution System

The electric transmission & distribution system, also known as the electric grid,[114] is one of the most significant achievements of the 20th century. It powers homes, businesses, hospitals, schools, traffic lights and more. It is also the most reliable system in the world. Yet with more people needing more electricity to power their televisions, phones, computers, tablet computers and air conditioners, demand has skyrocketed, and the current grid struggles to keep up. An electrical grid is an interconnected network for electricity delivery from producers to consumers. Electrical grids vary in size and can cover whole countries or continents. It consists of:

- Power stations, often located near fuel supplies and away from heavily populated areas,
- Electrical substations to step voltage up or down,
- Electric power transmission to carry power long distances, and
- Electric power distribution to individual customers, where voltage is stepped down again to the required service voltage(s).[115]

The electrical grid is a complex network of electrical generators (i.e., power plants) and transmission and distribution lines that dynamically responds to shifts in electrical supply and demand to make sure electricity is always supplied reliably.

[113] Sustainability Commitment. Sustainability Commitment " Delaware Municipal Electric Corporation. Retrieved February 3, 2023, from https://www.demecinc.net/sustainability/commitment/
[114] Electrical grid - An electrical grid is an interconnected network for electricity delivery from producers to consumers.
[115] Kaplan, S. M. (2009) Smart Grid: Electrical Power Transmission: Background and Policy Issues. Congressional Research Service, CRS Report for Congress, R40511.

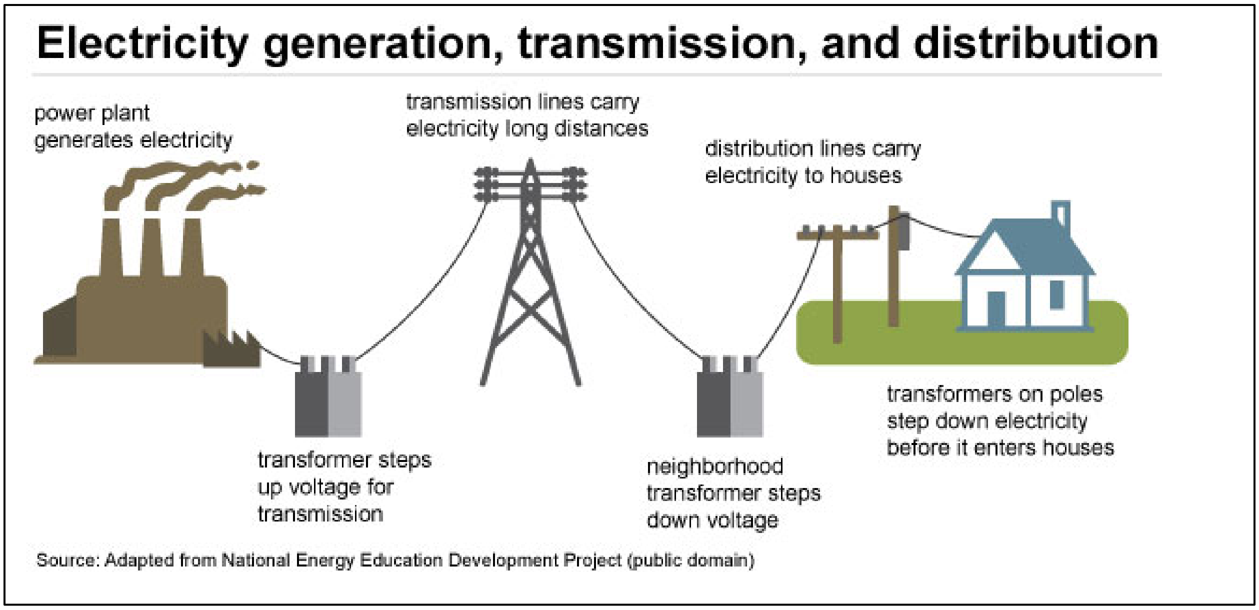

Figure 8-1. Electricity Grid[116]

In the US, the electric grid is split into three sections in the contiguous states: the Eastern Interconnect, the Western Interconnect and the Electric Reliability Council of Texas (ERCOT). The Eastern and Western Interconnects even extend into neighboring Canada. For example, if one lives in Delaware, that person is electrically connected to people as far away as Florida. In fact, transmission line or generator outages in one part of an interconnect can cause cascading blackouts to occur hundreds or thousands of miles away, one instance of which occurred during the 2003 Northeast blackout.[117]

The National Electric Reliability Council (NERC) was formed on June 1, 1968. Its purpose increased industry coordination and cooperation between the 12 regional and area utility organizations that work together, promoted coordinated operations and planning, issued reliability guidelines, and exchanged best practices with each other. "*Since its formation, NERC has continued to adapt to industry and market changes, including the introduction of wholesale and retail electricity competition and the changing economics and policies that are driving the current shift to natural gas, renewable, and distributed energy resources. In the face of these many changes, NERC's constant mission has been to assure that the North American bulk power system (BPS) remains highly reliable*."[118]

The U.S. electric power system is divided into three major grids: the Western Interconnection, the Eastern Interconnection, and the Texas interconnection (overseen by the Electric Reliability Council of Texas, or ERCOT) (Figure 8-2) These three grids operate almost

[116] Electricity explained - How electricity is delivered to consumers. EIA 2022. Retrieved February 6, 2023 from https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php
[117] Understanding the electrical grid. EnergySage. (2020, March 17). Retrieved February 3, 2023, from https://www.energysage.com/electricity/understanding-electrical-grid/
[118] *The History of the North American Reliability Corporation.* David Nevious. 2018. History book (nerc.com) https://www.nerc.com/AboutNERC/Resource%20Documents/NERCHistoryBook.pdf

independently of one another and share little power because of limited electricity transfer capacity.

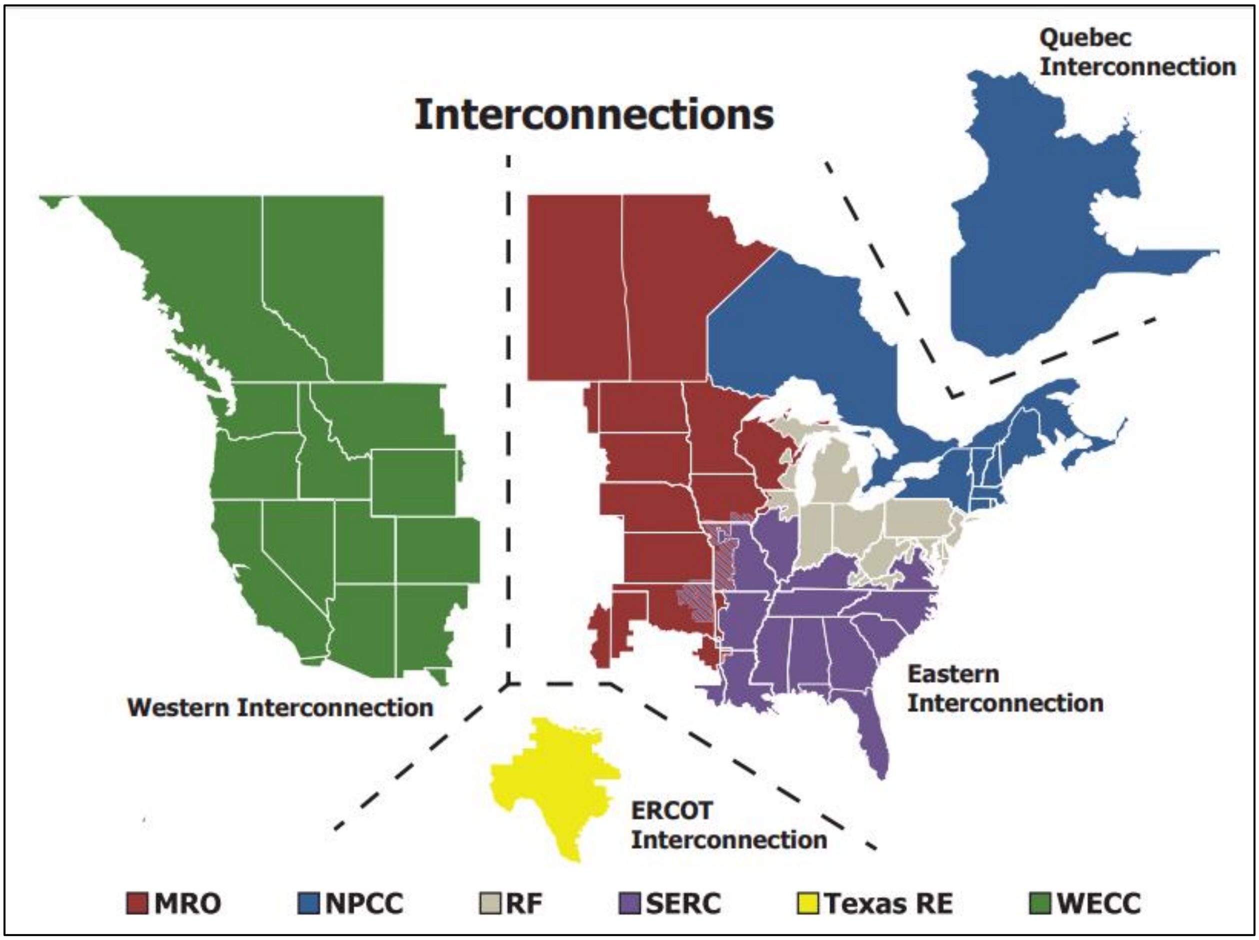

Figure 8-2. US Electric Grid Interconnections. Source – NERC.[119]

PJM is Delaware's regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia (Figure 8-3). PJM ensures the reliability of the high-voltage electric power system serving 61 million people in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. PJM coordinates and directs the operation of the region's transmission grid, which includes 62,556 miles of transmission lines.

[119] ERO Enterprise | Regional Entities (nerc.com) https://www.nerc.com/AboutNERC/keyplayers/Pages/default.aspx

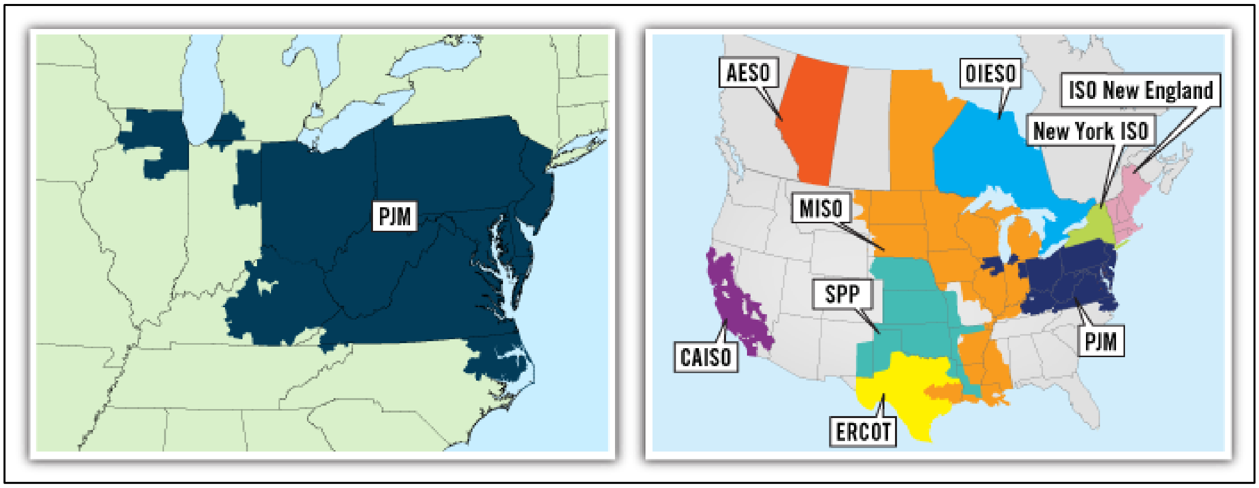

Figure 8-3. PJM Service Area. Source – PJM.[120]

To keep the grid functioning requires a delicate balance between supply and demand, as well as a highly integrated series of components throughout the country. Delaware's grid operator (PJM) maintains this balance through a mix of market awareness and insights, plus forecasts of weather, demand, and supply, with a goal of providing low-cost and reliable electricity service. As can be seen in Figure 8-3, PJM shares borders and coordinates with other regional grid operators, including the Midcontinent Independent System Operator (ISO) and the New York ISO. Both regional transmission organizations and independent system operators (such as the New York ISO) were formed to ensure the efficient and reliable delivery of power.[121]

In the United States, the way electricity is bought and sold varies by region. While many cities are served by municipally owned utilities (DEMEC), and some rural areas are served by customer-owned rural cooperatives (DEC), most electricity customers are served by utilities that are owned by investors (Delmarva Power). These investor-owned electric utilities can be either regulated and operate as vertically integrated monopolies with oversight from public utility commissions, or they can operate in deregulated markets, where electric energy prices are set by the market with some federal oversight of wholesale market operations. These regulatory constructs determine how retail and wholesale electricity prices are set and how power plants are procured.

Delaware's Public Service Commission (PSC) was created in 1949 to regulate investor-owned public utilities. The Commission works to ensure safe, reliable and reasonably priced cable, electric, natural gas, wastewater, water and telecommunications services for Delaware consumers. For services that are moving toward competitive markets, the Commission makes rules to level the playing field between competing providers and resolves disputes between those providers.

The PSC is made up of five part-time Commissioners, appointed by the Governor and confirmed by the Senate. The Commissioners are supported and assisted by a staff of full-time

[120] PJM. 2023. https://learn.pjm.com/who-is-pjm/where-we-operate
[121] Ibid.

state employees. The Commission makes its decisions at formal meetings that are open to the public. PSC holds public hearings throughout the year regarding rate changes, rulemakings, and complaints.

In 1999, the General Assembly passed legislation restructuring the electric industry in Delaware. Prior to restructuring, the generation, transmission, and distribution of electric power by investor-owned utilities was fully regulated by the PSC. With restructuring, the generation of electric power became deregulated, leaving only distribution services under the regulatory control of the PSC. The pricing of electric transmission is regulated by the Federal Energy Regulatory Commission (FERC).[122]

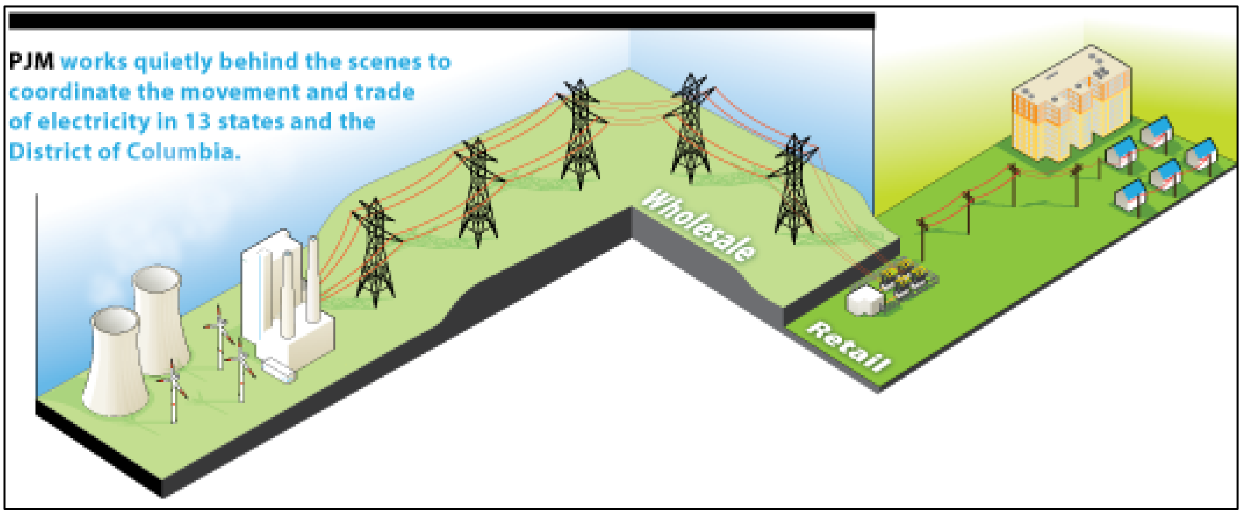

Figure 8-4. PJM Wholesale Electricity Transmission. Source – PJM.

Delmarva Power (an Exelon Company), an investor-owned utility, and other Delaware electricity providers deliver and distribute electricity to retail customers. Delmarva Power is a regulated public utility company serving a 5,000 square mile service area located on the Delmarva Peninsula. It provides electricity to over 300,000 customers in Delaware and to over 200,000 customers in Maryland.[123] Other electricity providers in Delaware include the Delaware Electric Cooperative (DEC)[124], as well as members of the Delaware Municipal Electric Corporation (DEMEC)[125].

[122] Electricity Restructuring – 26 Del. Code 1001-1020. See https://delcode.delaware.gov/title26/c010/index.html.
[123] Delmarva Power (an Exelon Company). 2023. Delmarva | Delmarva Power - An Exelon Company https://www.delmarva.com/Pages/default.aspx
[124] Delaware Electric Cooperative. 2023. Delaware Electric Cooperative | We keep the lights on https://www.delaware.coop/
[125] Delaware Municipal Electric Corporation. 2023. About » Delaware Municipal Electric Corporation (demecinc.net) https://www.demecinc.net/

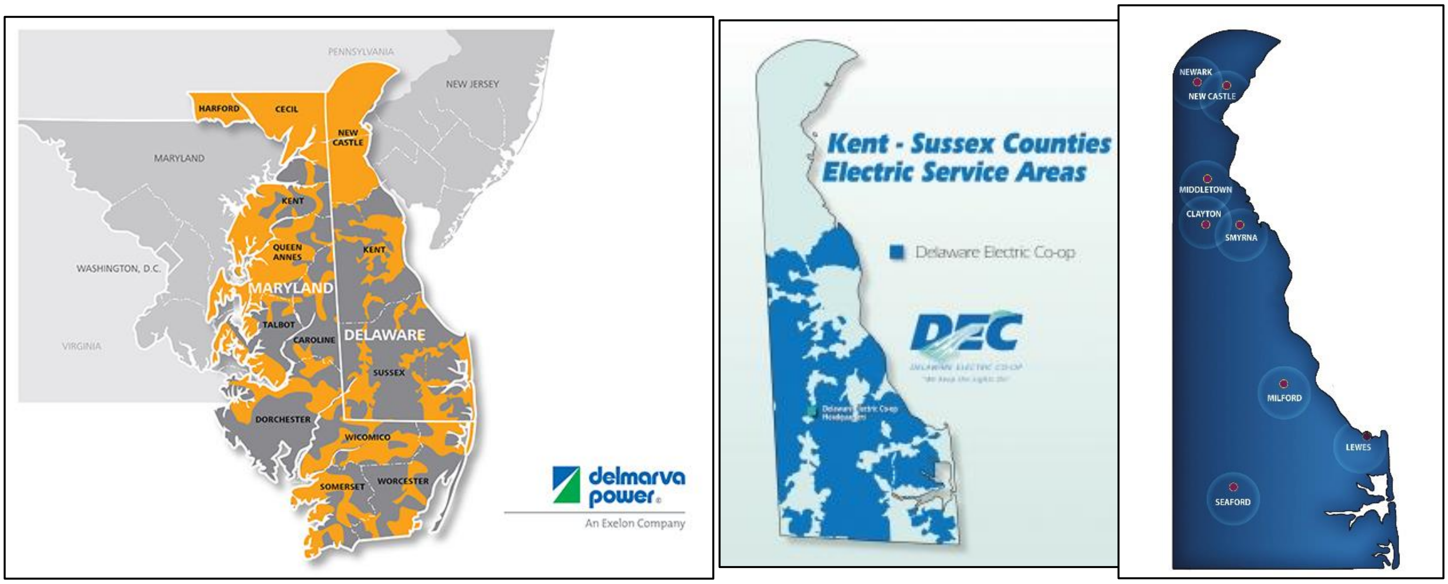

Figure 8-5. Delaware Electricity Providers. Source – Delmarva power. DEC, DEMEC**.**

Delaware Electric Cooperative (DEC) was founded by a group of farmers in 1936 to bring electricity to rural Delaware. As a non-profit electric utility, the Co-op serves over 100,000 members (or customers) across Kent and Sussex Counties. Unlike investor-owned utilities, as members sign up for new electricity service, they become part-owners of the Co-op. When they pay their electric bills each month, they are investing in the continued development, growth and maintenance of the equipment and technology used to power their communities. Eventually, the money invested by members in the Co-op is returned to them in the form of capital credits. Members elect representatives to DEC's board of directors, ensuring that their voices and interests are heard.[126]

DEMEC was incorporated in 1979 as a public corporation constituted as a Joint Action Agency and a wholesale electric utility. DEMEC represents and serves municipal electric distribution utilities located in the State of Delaware. Members include the City of Newark, the City of New Castle, the Town of Middletown, the Town of Clayton, the Town of Smyrna, the City of Milford, the Lewes Board of Public Works and the City of Seaford. Collectively, the members serve over 99,000 residents and businesses in their communities. In total, DEMEC's members have a peak load over 300 megawatts. DEMEC is also a generation owner[127] of the PJM Load Serving Entity ("LSE") for its municipal member utilities and provides 100% of their wholesale power supply requirements.[128]

The distribution of electricity in Delaware is primarily provided by Delmarva Power and the Delaware Electric Cooperative (Figure 8-5). These two entities work to ensure the supply of electricity to their customers is reliably met at a reasonable cost. The Delaware General

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[126] Delaware Electric Cooperative. 2023. Delaware Electric Cooperative | We keep the lights on https://www.delaware.coop/
[127] DEMEC owns and operates renewable energy (solar) and the Warren Beasley Power Station (natural gas).
[128] Ibid.

Assembly requires Delmarva Power to develop a 10-year plan called an Integrated Resource Plan that addresses how the utility will meet demand and supply obligations.[129] The plan covers the period 2016-2026 and considers projected load forecast, prices, environmental emissions and supply of electricity from renewable resources. The plan also outlines the measures and actions Delmarva Power recommends for the 10-year period.

Grid Reliability

Each year, Delaware's electric utilities develop numerous projects to modernize and strengthen the electric grid to better serve their customers. These projects include installation of stronger utility poles to the installation of new, state-of-the art equipment. These upgrades continue to improve system reliability and further reduce the frequency and duration of outages. Much of the work is focused on hardening the infrastructure against more damaging winds and extreme flooding. Across Delaware, the electric grid continues to see the impacts of more frequent and severe weather driven by climate change. Delaware's electric utilities are continually analyzing the local energy grid to identify critical infrastructure projects and to help communities become more resilient to the impacts of storms and hurricanes.

In addition to addressing the impacts of climate change, Delaware's electric utilities, as well as the PSC, review and forecast the demand or need for more and more electricity by residential, commercial, and industrial consumers. Electric vehicles will rely on the electric grid to provide consistent, on-demand power to charge vehicles. With the light duty market described in this proposal, the electric grid will have to expand and as electric vehicle fleet penetration and charging requirements increase.

The state's electric grid has expanded and evolved as consumer demand for electricity services has grown, including with the recent emergence of plug-in electric vehicles. Electrification of Delaware's transportation sector, particularly when combined with increased electrification of the state's building stock, will require further investments in transmission and local distribution systems as well as coordinated grid planning efforts. In the long term, transitioning to 100% passenger vehicle electrification is achievable with a gradual build out of clean energy resources - more gradual than during times of peak electricity sector growth in the past, given that electric vehicle loads can be distributed over nonpeak hourly periods.

Over the next four years, Exelon, Delmarva Power's parent company, has pledged to invest almost $29 billion on infrastructure to modernize the Transmission & Distribution (T&D) system with new technologies. These technologies will enable increased levels of electrification, integrate renewable energy into the grid system and enhance reliability and resilience in the face of climate change and cyber security threats.[130] Exelon further states "*each of our utilities invests in infrastructure to support safe, reliable and resilient service for customers, while advancing clean and affordable energy choices and more equitable outcomes for communities…Where we deliver electricity, our utilities are advancing electrification, infrastructure and controls to*

[129] Delmarva Power & Light 2016 Integrated Resource Plan. See https://depsc.delaware.gov/wp-content/uploads/sites/54/2017/03/DPL-Public-IRP-113016.pdf
[130] Exelon – Sustainability Report 2021. Retrieved from Exelon www.exeloncorp.com

effectively and reliably manage increased loads, distributed resource and power flow management."[131]

Delmarva Power's website states that the utility "*anticipates rapid adoption of new electric loads that support decarbonization such as electric vehicle charging infrastructure and converting to electric heat sources. In order to help guide large scale electrification Delmarva Power has developed a load capacity map to represent areas on the distribution grid where there is reasonable capacity to accommodate electric vehicle charging infrastructure and other load sources with lower probability of necessitating extensive equipment upgrades or line extensions that would add cost or time to projects*."[132]

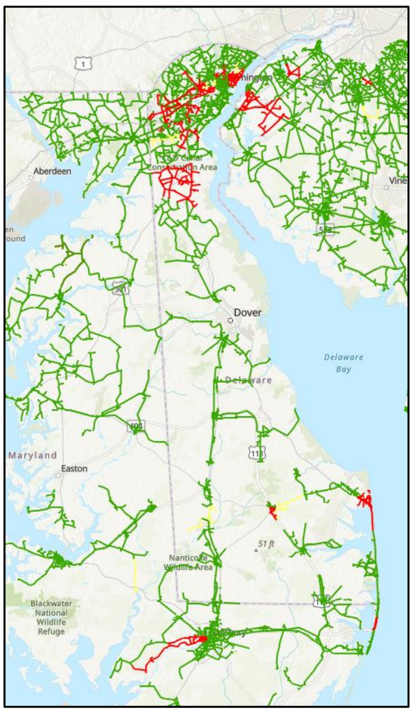

Figure 8-6 provides different levels of available load capacity on a circuit by color (green is greater than 1 MW, yellow is 0.5 MW to 1 MW, and red is less than 0.5 MW). The map identifies general areas where load capacity may be constrained and could require a system upgrade scope to accommodate new load project connections.

Delmarva Power's ongoing investments in grid reliability and strengthening are focused on ensuring customers have the power they require to meet future demand. In 2019, DPL received approval from the PSC to offer an electric vehicle charging rate for residential customers who charge their EVs at home. The new rate is called the "Plug-In Vehicle Rate."[133] This new rate provides DPL residential customers a special time of use rate specific to charging electric vehicles at home during off-peak hours (8:00 pm – 12:00 pm on weekdays and all hours during the weekend). In order to take advantage of the special rate, residential customers are required to install a second utility meter next to their existing home meter.

Figure 8-6. DPL – EV Load Capacity Map.

The Delaware Electric Cooperative also offers incentives for residential customers' electric vehicle charging. Members of the Co-op can earn a one-time $200 billing credit and an additional $5 monthly billing credit during the summer by not charging their electric vehicles during the "Beat the Peak" alerts. The "Beat the Peak" program issues alerts to its members to conserve energy during high-demand periods. Members conserve energy by delaying the use of major appliances like dishwashers and dryers, and by turning up the thermostat a few degrees in

[131] Ibid.
[132] Delmarva Power & Light – EV Load. 2023. See EV Load Capacity Map | Delmarva Power - An Exelon Company https://www.delmarva.com/SmartEnergy/InnovationTechnology/Pages/EVLoadCapacityMap.aspx
[133] DPL Plug-In Vehicle Rate. Electric Vehicle Program | Delmarva Power - An Exelon Company https://www.delmarva.com/SmartEnergy/InnovationTechnology/Pages/ElectricVehicles/DE/ElectricVehicleProgram.aspx

the summer and down a few in the winter. The program has saved members more than $38 million since 2008.[134]

Programs like these offered by Delaware's utilities will help to ensure that Delaware's grid continues to meet the need for the increasing EV charging demand. Other improvements such as Delmarva's smart grid are seen by experts as necessary not only to prevent power outages from high demand, but also to help Delaware meet its climate goals by further reducing energy demand by energy efficient technology deployment.

The US Department of Energy's website Smartgrid.gov defines a smart grid as leveraging digital technology that allows for two-way communication between the utility and its customers, as well as sensing along the transmission lines. A smart grid is composed of controls, computers, automation systems and new technologies and equipment working together, with the electric grid to respond digitally to changing electric demand. A smart grid will result in more reliable and efficient transmission and distribution of electricity, provide more efficient restoration of power after a power outage, help to reduce peak demand, integrate customer-owned solar energy, and provide large-scale renewable energy.[135]

Delmarva has installed smart meters throughout its service territory to enhance the two-way communications between the consumer and the utility. These improved communications will further ensure grid reliability by identifying outages, re-routing power around failed equipment and preventing service disruptions by detecting and dealing with potential issues before they cause problems. Customers also gain greater control over their own power use. Armed with electricity cost data , consumers can make choices to change their habits and further save money.

The biggest cost savings in using a smart grid is in improved efficiency of electricity delivery. Historically, utility companies supplied extra voltage into the grid to cover potential dips somewhere on that grid. With a smart grid, utility companies can supply the minimum amount of voltage to address identified voltage drops on the grid, which will result in greater efficiency and cost savings.[136]

The University of Delaware's Dr. Willet Kempton has developed the vehicle to grid (V2G) concept that leverages the stored energy in electric vehicles as a demand side electricity resource.[137] *"Electric-drive vehicles, whether powered by batteries, fuel cells, or gasoline hybrids, have within them the energy source and power electronics capable of producing the 60 Hz AC electricity that powers our homes and offices. When connections are added to allow this electricity to flow from cars to power lines, we call it "vehicle to grid" power, or V2G. Cars pack a lot of power. One properly designed electric-drive vehicle can put out over 10kW, the average draw of 10 houses. The key to realizing economic value from V2G are grid-integrated vehicle*

[134] DEC – Beat the Peak. Beat the Peak | Delaware Electric Cooperative https://www.delaware.coop/btp

[135] USDOE. 2015. Smart Grid: The Smart Grid | www.SmartGrid.gov
[136] Delmarva Power - an exelon company. Smart Grid 101 | Delmarva Power - An Exelon Company. (n.d.). Retrieved February 3, 2023, from https://www.delmarva.com/SmartEnergy/SmartGridAndSmartMeter/Pages/SmartGrid101.aspx
[137] University of Delaware. 2023. The Grid-Integrated Vehicle with Vehicle to Grid Technology. Retrieved from V2G Home www.udel.edu

controls to dispatch according to power system needs." By drawing the stored energy from the vehicles battery to power other devices, homes or commercial entities, the vehicle becomes a demand side resource that can provide electricity during emergency events.

Comments were concerned that the electric vehicle would not be able to charge during a power outage or other emergency event and thereby become inoperable. Though this is a similar concern for vehicle owners that fail to have a full tank of gasoline at the time of the emergency, electric vehicles become more important during a power outage as their stored energy can be used to provide backup power.

Delaware Municipalities Prepare for Electric Vehicles

In 2019, Newark City Council gave its staff direction to begin investigating the feasibility of integrating electric vehicles (EVs) into the City's fleet, and to replace current vehicles with EVs wherever possible.[138] The City recently received a grant from Energize Delaware to purchase electric vehicles and lawn care equipment, and to install electric vehicle charging infrastructure.[139]

In 2014, the Rehoboth City passed an ordinance 92-42 "*Parking for Electric Vehicles,"* designating four electric vehicle charging parking spaces near the Convention Center parking lot.[140]

Most electric vehicle owners will meet their driving needs by plugging in only at home. Most electric vehicles (EVs) can be charged with a standard 120 V (Level 1) outlet. To charge the vehicle more quickly, a dedicated 240 V (Level 2) outlet or charging system can be installed. For those who live in apartments or condominiums, on-site EV charging stations are becoming more common.

Workplace charging is also becoming more widely available, and there are growing numbers of public charging stations. These stations can be found along highways, at grocery stores or other retail locations, and in public garages. Many more are on the way in Delaware.

The reliability of Delaware's electric grid is paramount for supporting a ZEV fleet. Outages must be minimal if the state's infrastructure is to support thousands of new EVs on Delaware's roads. Delmarva Power and the Co-op are committed to reliability and want to ensure that customers have the power they will need today and in the future.

[138] City of Newark letter from the City Manager to the Mayor and City Council. Recommendation to Waive the Bid Process in Accordance with the Code of the City of Newark for the Procurement of Electric Vehicles. April 14, 2021. Retrieved from 7C www.newarkde.gov

[139] City of Newark letter from the City Manager to the Mayor and City Council Recommendation to Amend the 2023-2027 Capital Improvement Program to Incorporate Grant Funding and Authorization to Enter into a Contract with Energize Delaware. Feb 6, 2023. Retrieved from 6B www.newarkde.gov

[140] Rehoboth Beach City Ordinance 92-42. Parking for Electric Vehicles. Retrieved from https://ecode360.com/29672967#29672967

Section 9 Complementary Policies

During the public workshops and in comments received by the Department, many people voiced concerns about vehicle price, availability of fueling infrastructure and access for people in multi-unit dwellings or downtown areas. This section outlines complementary policies that in part address these concerns.

Planning and policy development for the transition to zero-emission vehicles has been underway in the state of Delaware for at least a decade. This includes statewide legislation and policy, local level ordinances and funding and incentives. Significant federal funding through the Bipartisan Infrastructure Bill and the Inflation Reduction Act are also helping to accelerate deployment of zero-emissions vehicles and fueling stations.

In addition to the programs below, the Delaware Department of Transportation and the DNREC Division of Climate, Coastal and Energy are developing a Delaware Statewide EV Charging Infrastructure Plan. The statewide plan will help guide charging station locations and feasibility with special interest in serving rural communities, disadvantaged communities, and those who live in multi-unit dwellings. The plan[141] will bolster areas that have high EV adoption as well as prepare areas with low adoption to be ready and secure in the alternative fuel transition.

State and Municipal Policies for Zero-Emission Vehicle Fueling Stations

Changes to policies and practices is necessary to facilitate the adoption of zero-emission vehicles. Several foundations policies are outlined below.

Public Service Commission

In 2019, Delaware's Public Service Commission approved an order deregulating electric vehicles charging stations and electric vehicle service providers from regulation. This ruling (docket number 19-0377) helps to facilitate the long-term expansion of charging stations by eliminating permitting uncertainty and delays.

State regulators across the country have determined that companies purchasing electricity at retail from regulated utilities and using it to provide charging service to electric vehicles are not performing the role of an electric utility or supplier and should not be subject to regulation. At least 32 other states, along with the District of Columbia exempt electric vehicle charging from regulatory jurisdiction.

State Legislation

[141] The State of Delaware - Department Of Transportation. (n.d.). Delaware's Vehicle Electrification Future. Delaware Department of Transportation. Retrieved 2023, from https://deldot.gov/Programs/NEVI/index.shtml?dc=statewidePlan

Two recent bills have addressed the facilitation and expansion of electric vehicle charging stations in the state. These two bills provide the foundation for expansion of charging stations on state property and in municipal settings.

HB 177, passed in 2019, allows state agencies to charge a reasonable fee to public for the use of charging stations operated by state agencies. This is to allow the state agency to recoup associated costs of installing or operating charging stations for public use.

SB 187, passed in XX, requires that municipalities with more than 30,000 residents develop and a procedure to allow residents to obtain a permit to install a charging station for residential use on property that abuts a residential street. This will facilitate access to charging by those without off-street parking.

County ordinances

In 2021, New Castle County passed Ordinance No. 21-116 [142], requiring that all new construction including parking lots, residential housing, and commercial buildings be "EV-Capable," meaning that they are built to support the use of electric vehicle charging equipment. 10% of parking spaces at each new site will have the capacity for this support. This ordinance means that costly retrofits will not be necessary later in the zero-emission vehicle transition.

State Incentives for Zero-Emission Vehicles

The State of Delaware has made available consumer and business incentive for the purchase or lease of alternative fuel vehicles since 2015. Included in these incentives were electric, propane and natural gas fueled vehicles. Recently, the Sustainable Energy Utility launched a program to specifically assist municipal governments deploy electric vehicles.

DNREC Clean Vehicle Rebate Program

The Clean Vehicle Rebate Program, administered by DNREC, offers cash rebates to Delaware residents and businesses who purchase or lease qualifying electric vehicles. The rebates help offset the upfront premium of purchasing an electric vehicle over a traditional combustion engine vehicle, though lifetime ownership of electric vehicles provides consumers with savings on fuel and repairs. More than 1,600 rebates for electric vehicles have been issued since July 2021.

Sustainable Utility Grants for Local Government EV Fleets

Municipal government fleets and charging infrastructure of special value in the transition to zero emission vehicles. In recognition of the importance of municipal partnership in this effort, Delaware's Sustainable Energy Utility[143] has recently launched a program targeted assisting Delaware municipalities transition their fleets to zero emissions. This program, Grants for Local Government EV Fleets,[144] provides funding for electric cars, trucks, vans, motorcycles

[142] 21-116 www.newcastlede.gov
[143] Delaware Sustainable Energy Utility – Energize Delaware. 2023. Retrieved from https://www.energizedelaware.org/
[144] Grants for Local Government EV Fleets. Retrieved from https://www.energizedelaware.org/ev-fleets/

and lawn equipment. Funds are available for the vehicles and costs of charging stations including installation and utility upgrades. Each municipality that applies can receive grants of up to $500,000. In addition, this program will also fund feasibility studies for municipal governments. Starting the process with a feasibility study can help a local government understand upfront costs, long term benefits, available equipment, as well as establish a phased approach for conversions.

Federal Incentives for Zero-Emissions Vehicles

Under the Inflation Reduction Act (IRA)[145], federal incentives for purchasing a new or used electric vehicle can provide consumers with up to $7,500 or $4,000 respectively in federal tax credits. Changes made to these incentives in 2023 allow all manufacturers to qualify without the previously limiting sales cap of 200,000 vehicles per manufacturer. The IRA restricts those making a gross income of greater than $150,000 from receiving the credit, with higher income limits set for the head of household and joint filers.

Vehicle eligibility is primarily based on the Manufacturer's Suggested Retail Price (MSRP) (not including destination charges, taxes, and fees), setting an $80,000 limit for vans, SUVs, and pickup trucks, and $55,000 for other passenger vehicles. Credit eligibility is also decided based on manufacturing requirements in the IRA designed to boost American manufacturing. Eligible vehicles require that the final assembly of the EV take place in North America, which includes the United States, Puerto Rico, Canada, and Mexico. Consumers can use the U.S. Department of Energy's "VIN Decoder" which ensures that the vehicle they are buying meet these requirements. In accordance with increasing domestic manufacturing, the IRA will also phase in rules requiring manufacturers to mine critical battery components in the US or from major trade.

Until the Treasury Department and the IRS issue further guidance on critical mineral and battery components, the credit is calculated as a $2,500 base amount, with additional credits available for battery capacity of at least 5 kilowatt hours (kWh). For each kilowatt hour of battery capacity beyond 5kWh, up to an additional $5,000 beyond the base amount can be awarded. When in effect, the critical minerals requirement and battery component requirement will each offer $3,750 in credit, for up to $7,500 total. In 2024, car dealerships will be allowed to offer an upfront discount of up to $7,500 for vehicles that meet new requirements.

Previously owned electric vehicle owners can receive up to $4,000 in tax credits if the vehicles are $25,000 or less and have more stringent income requirements than the limitations placed on new vehicle buyers.

State Incentives for Zero-Emission Vehicle Fueling Stations

[145] Inflation reduction act of 2022. Internal Revenue Service. Retrieved 2023, from https://www.irs.gov/inflation-reduction-act-of-2022

In addition to rebates on vehicles, the state of Delaware works with a variety of entities to provide education, technical assistance, and funding for charging stations. Several of these programs are outlined below.

DNREC Electric Vehicle Charging Equipment Rebates

DNREC offers cash rebates to entities that purchase Level 2 electric vehicle charging stations for public access, workplace, fleet or multi-family uses. The rebate covers up to 90% of the purchase cost of a charging station up to $3,500 per charging port. Since July 2021, 126 charging station projects have been funded through the program.

In recognition of the critical need to deploy charging stations at apartment complexes and other homes without access to designated off street parking, DNREC will offer enhanced rebates for multi-family dwellings starting in Spring 2023.

VW Mitigation Settlement

Through the Volkswagen Mitigation Settlement, Delaware was awarded $9.6 million for emissions reductions programs. Recipient states were able to use 15% of those funds for electric vehicle charging and Delaware chose to allocate $1.4 million to expand the state's fast charging network. Through a competitive RFP process, the state received $8 million in funding requests. Ultimately, 14 locations (32 charging ports) were chosen for the funding of DC fast charging stations (DCFC), including downtown areas, hotels, and traditional gas stations. These locations help bolster the upcoming statewide electric vehicle infrastructure plan which will aim to place chargers where they are most needed.

Federal Incentives for Zero-Emission Vehicle Infrastructure Funding

Significant federal funding is now available through numerous programs to accelerate fueling stations for a variety of alternative fuels. The descriptions below highlight the most prominent programs but is not inclusive of all federal funding opportunities.

National Electric Vehicle Infrastructure Program

Under the National Electric Vehicle Infrastructure (NEVI) Formula Funding[146], a program included in the Bipartisan Infrastructure Law[147], Delaware will receive $18 million over fiscal years 2022 to 2026 for the installation of DC fast charging stations along the state's alternative fuel corridors (AFCs), including Routes 1, 13, 113, and I-95. AFCs[148] are federally

[146] Bipartisan Infrastructure Law - National Electric Vehicle Infrastructure (NEVI) formula program fact sheet: Federal Highway Administration. Bipartisan Infrastructure Law - National Electric Vehicle Infrastructure (NEVI) Formula Program Fact Sheet | Federal Highway Administration. Retrieved 2023, from https://www.fhwa.dot.gov/bipartisan-infrastructure-law/nevi_formula_program.cfm
[147] The United States Government. (2023, February 21). Building a better America. The White House. Retrieved 2023, from https://www.whitehouse.gov/bipartisan-infrastructure-law/
[148] Alternative fuel corridors. FHWA. Retrieved 2023, from https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/

designated routes on major highways that allow for inter-city, regional, and national travel via motor vehicles. Charging stations funded through this program will include at least four ultra-fast charging ports and will be no less than 50 miles apart and less than 1 mile off the highway. Since Delaware can reach NEVI goals relatively quickly due to the small size of the state, fast charging stations are planned every 25 miles[149]. This increase in access to public charging along heavily trafficked routes will provide security and confidence to drivers that they can quickly recharge at a convenient location while traveling away from home.

Charging and Fueling Infrastructure (CFI) Discretionary Grant Program

The U.S. Department of Transportation's Charging and Fueling Infrastructure (CFI) Discretionary Grant Program, established by the Bipartisan Infrastructure Law, will provide $2.5 billion over five years to a wide range of applicants, including cities, counties, local governments, and Tribes. $700 million is available in fiscal years 2022 and 2023 to strategically deploy EV charging and other alternative vehicle-fueling infrastructure projects in publicly accessible locations in urban and rural communities, as well as along designated Alternative Fuel Corridors (AFCs).

The CFI Program has two distinct grant funding categories. The **Community Program** will provide $1.25 billion to strategically deploy publicly accessible EV charging infrastructure, and hydrogen, propane, or natural gas fueling infrastructure in communities. Infrastructure may be located on any public road or in other publicly accessible locations such as parking facilities at public buildings, public schools, and public parks, or in publicly accessible parking facilities owned or managed by a private entity. The **Corridor Program** will provide $1.25 billion to strategically deploy publicly accessible EV charging infrastructure and hydrogen, propane, and natural gas fueling infrastructure along designated alternative fuel corridors (AFCs).

[149] Map of planned DC Fast Charging Station Locations https://arcg.is/zfTWW

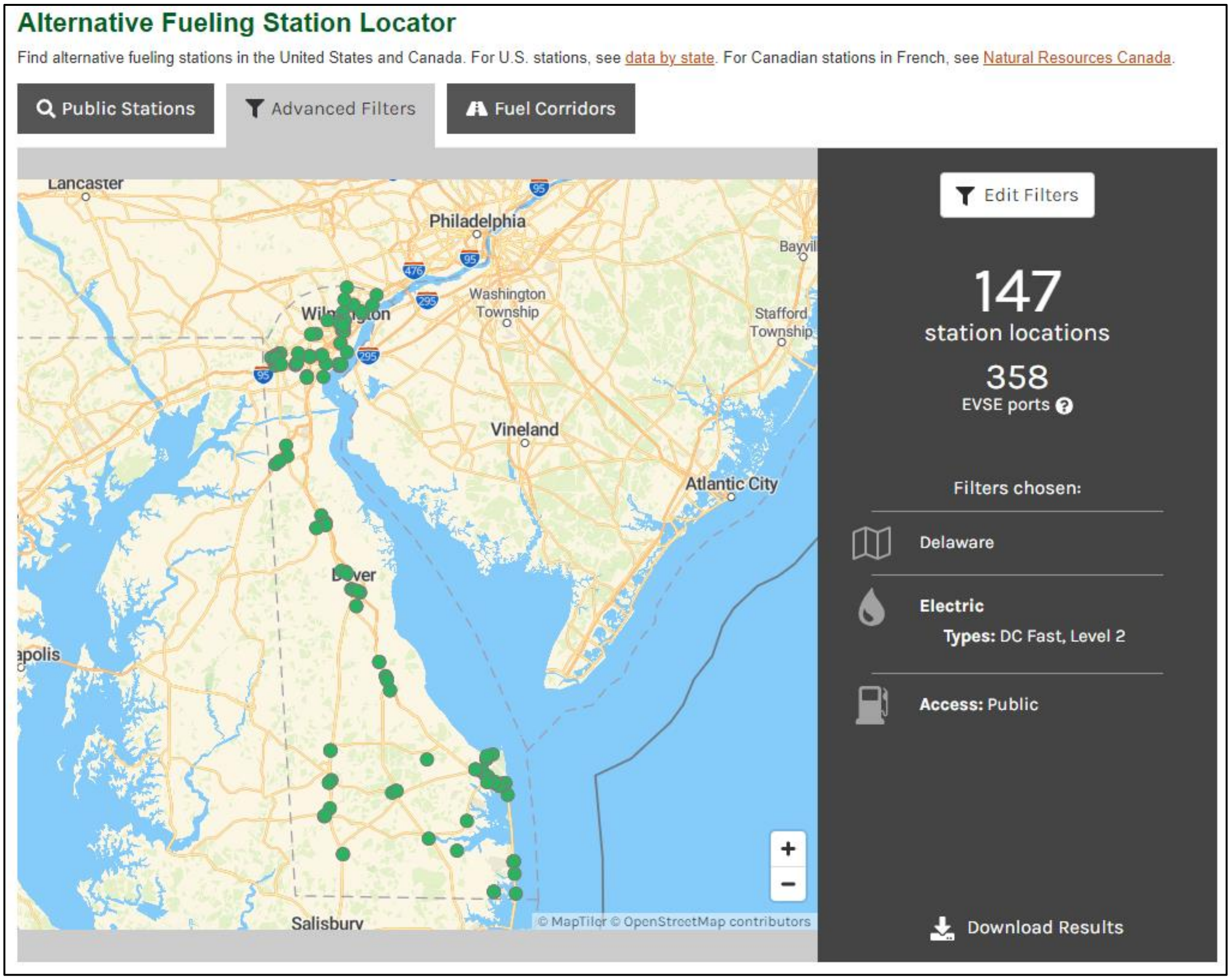

Figure 9-1. Electric Vehicle Charging Stations in Delaware. Source U.S. Dep. Of Energy

Inflation Reduction Act

Under the Inflation Reduction Act (IRA)[150], federal incentives for purchasing an electric vehicle can provide consumers with up to $7,500 in federal tax credits. Changes made to these incentives in 2023 allow all manufacturers to qualify without the previously limiting sales cap of 200,000 vehicles per manufacturer and opt to impose income limits on the consumer level instead. The IRA restricts those making a gross income of greater than $150,000 from receiving the credit, with higher income limits set for the head of household and joint filers.

Vehicle eligibility is primarily based on the Manufacturer's Suggested Retail Price (MSRP) (not including destination charges, taxes, and fees), setting an $80,000 limit for vans, SUVs, and pickup trucks, and $55,000 for other passenger vehicles. Credit eligibility is also decided based on manufacturing requirements in the IRA designed to boost American manufacturing. Eligible vehicles require that the final assembly of the EV take place in North

[150] Inflation reduction act of 2022. Internal Revenue Service. Retrieved 2023, from https://www.irs.gov/inflation-reduction-act-of-2022

America, which includes the United States, Puerto Rico, Canada, and Mexico. Consumers can use the U.S. Department of Energy's "VIN Decoder" which ensures that the vehicle they are buying meet these requirements. In accordance with increasing domestic manufacturing, the IRA will also phase in rules requiring manufacturers to mine critical battery components in the US or from major trade.

Until the Treasury Department and the IRS issue further guidance on critical mineral and battery components, the credit is calculated as a $2,500 base amount, with additional credits available for battery capacity of at least 5 kilowatt hours (kWh). For each kilowatt hour of battery capacity beyond 5kWh, up to an additional $5,000 beyond the base amount can be awarded. When in effect, the critical minerals requirement and battery component requirement will each offer $3,750 in credit, for up to $7,500 total. In 2024, car dealerships will be allowed to offer an upfront discount of up to $7,500 for vehicles that meet new requirements. Previously owned electric vehicle owners can receive up to $4,000 in tax credits if the vehicles are $25,000 or less and have more stringent income requirements than the limitations placed on new vehicle buyers.

Utility Incentives for Zero-Emission Vehicle Fueling Infrastructure

Utility programs, especially those that incentive charging vehicles at off-peak hours, are essential for promoting zero-emissions vehicles as well as ensuring long term grid stability. Examples of utility programs in Delaware are outlined below.

Delmarva Power

Delmarva Power[151] has an electric vehicle program in which customers can receive a time-of-use rate specific to EV charging. The rate provides the benefit of reduced electric bills for customers when they charge their vehicle during off-peak hours. The Off Peak – Off Bill Rebate (OPOB) will provide Delmarva customers with a rebate based on how much electricity (kWh) they use each quarter to charge their EVs during off-peak hours. On-peak hours are defined as noon to 8 pm weekdays, excluding holidays, and all other hours are off-peak. Based on actual charging session data, Delmarva will calculate the rebate amount by subtracting any on-peak charging from total off-peak charging, at 3 cents per kWh.

Delaware Electric Cooperative

Delaware Electric Cooperative[152] has created a program for customers who install a ChargePoint Home Charger at their residence, in which they can receive a billing credit of $200 plus a $5 discount on their bill during months of peak energy usage. Through this program, the

[151] Delmarva Power - an exelon company. Electric Vehicle Program | Delmarva Power - An Exelon Company. (2019, July). Retrieved 2023, from https://www.delmarva.com/SmartEnergy/InnovationTechnology/Pages/ElectricVehicles/DE/ElectricVehicleProgram.aspx
[152] Beat the peak with electric vehicles. Delaware Electric Coop. Retrieved 2023, from https://www.delaware.coop/btp/electric-vehicles

utility can help homeowners with energy management for EV charging as well as helping to inform the cooperative's preparations for greater EV adoption soon.

Section 10 Health Benefits

ACCII will benefit Delawareans not only for their health but also economically. Currently, internal combustion engine vehicles (ICE) emit harmful pollutants into Delaware's air. As outlined in this section, the pollutants can cause adverse health effects as well as harmful economic impacts to the state. ZEVs such as electric vehicles (EV) and fuel cell hydrogen electric vehicles (FCHEV) will act in similar ways toward the reduction of traffic related air pollution. Both technologies release zero harmful pollutants into the air while in operation. In some cases, health and cost savings go hand in hand. Delaware teamed up with Northeast States for Coordinated Air Use Management (NESCAUM) and the US Climate Alliance (USCA) to provide modeling and data for health and economic benefits to Delaware. USCA also assisted Delaware with environmental justice benefits that ACCII can provide to residents of the state.

Health Benefits

ACCII provides benefits to Delawarean's health through the reduction of harmful pollutants in the form of NOx, greenhouse gases, and other tailpipe emissions. The proposed regulation reduces NOx and PM2.5 emissions, resulting in health benefits for individuals in Delaware. The California Air Resources Board (CARB) analyzed the value of health benefits associated with four health outcomes under the proposed regulation and potential alternatives: cardiopulmonary mortality, hospitalizations for cardiovascular illness, hospitalizations for respiratory illness, and emergency room (ER) visits for asthma.

The American Lung Association's 2022 State of the Air annual air quality report continues to report that millions of Americans live with unhealthy air quality. The annual "*State of the Air"* report looks at two of the most widespread and dangerous pollutants from this group, fine particulate matter and ozone.[153] Delaware's New Castle County fails for ozone pollution as the result of continuing to record days where the air was deemed unhealthy to breathe for those with underlying health conditions or other sensitivities.

DELAWARE

American Lung Association in Delaware

	HIGH OZONE DAYS 2018–2020					HIGH PARTICLE POLLUTION DAYS 2018–2020							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Kent	2	0	0	0.7	B	0	0	0	0	0.0	A	INC	INC
New Castle	11	0	0	3.7	F	0	0	0	0	0.0	A	7.6	Pass
Sussex	4	0	0	1.3	C	0	0	0	0	0.0	A	7.0	Pass

Figure 10-1. American Lung Association 2022 State of the Air – Delaware.

[153] State of the Air Report. American Lung Association. 2022. Accessed March 8, 2023 from https://www.lung.org/getmedia/74b3d3d3-88d1-4335-95d8-c4e47d0282c1/sota-2022

ACCII will help lead to fewer cardiopulmonary deaths; fewer hospital admissions for cardiovascular illness; fewer hospital admissions for respiratory illness; and fewer emergency room visits for asthma. These and other health impacts have been identified by U.S. EPA[154] as having a causal or likely causal relationship with exposure to PM2.5 based on a substantial body of scientific evidence. U.S. EPA has determined that both long-term and short-term exposure to PM2.5 plays a causal role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between PM2.5 exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty and other factors are taken into account. U.S. EPA has also determined a causal relationship between nonmorality cardiovascular effects and short- and long-term exposure to PM2.5, and a likely causal relationship between non-mortality respiratory effects (including worsening asthma) and short- and long-term PM2.5 exposure.[155] Delawareans will see benefits to their health as the penetration of ZEVs into the fleet increases throughout ACCII's timeframe and vehicular air pollution decreases.

The American Lung association[156] has invested heavily into ZEV research and has asserted that the transition to ZEVs will be very beneficial to Delawareans. Specifically due to Delaware being upwind of high polluting urban areas like Philadelphia and Chester, PA. Delaware has conducted its own modeling for health and economic benefits to the state.

According to the American Lung Association, "*The transition to zero-emission transportation will benefit the health of children riding school buses, daily commuters and transit riders, truckers and local delivery drivers and especially those residents nearest major roadways, warehouse distribution centers and other pollution hotspots. People who live downwind of major urban areas will also benefit. Further, the transition away from burning harmful fossil fuels in the power sector to non-combustion renewable energy, including wind and solar, is critical to addressing the impacts on communities most burdened by emissions generated at fossil-fueled power plants. The transportation sector must move comprehensively to zero-emission solutions, including both electric vehicles and their fuels, as rapidly as possible*." [157]

[154] Initial Statement of Reasons, CARB (2022) Accessed (2/15/2023) https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf
[155] Ibid
[156] American Lung Association. (2020). (rep.). Zeroing in on Healthy Air. Accessed (2/15/2023) https://www.lung.org/clean-air/electric-vehicle-report
[157] Ibid

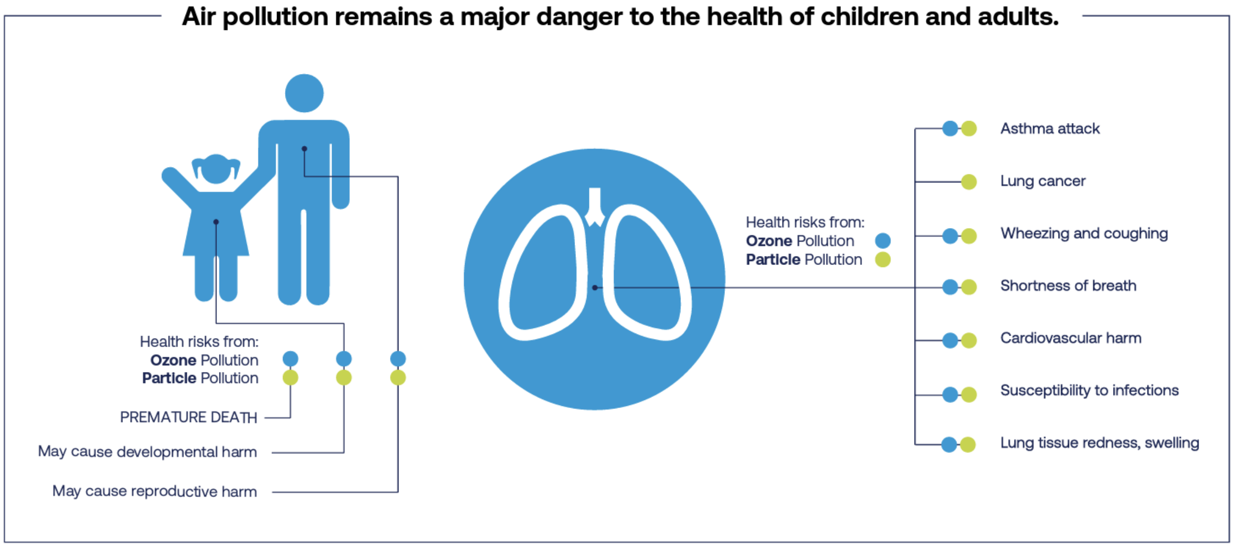

Figure 10-2. Air Pollution Effects[158] (American Lung Association (2020))

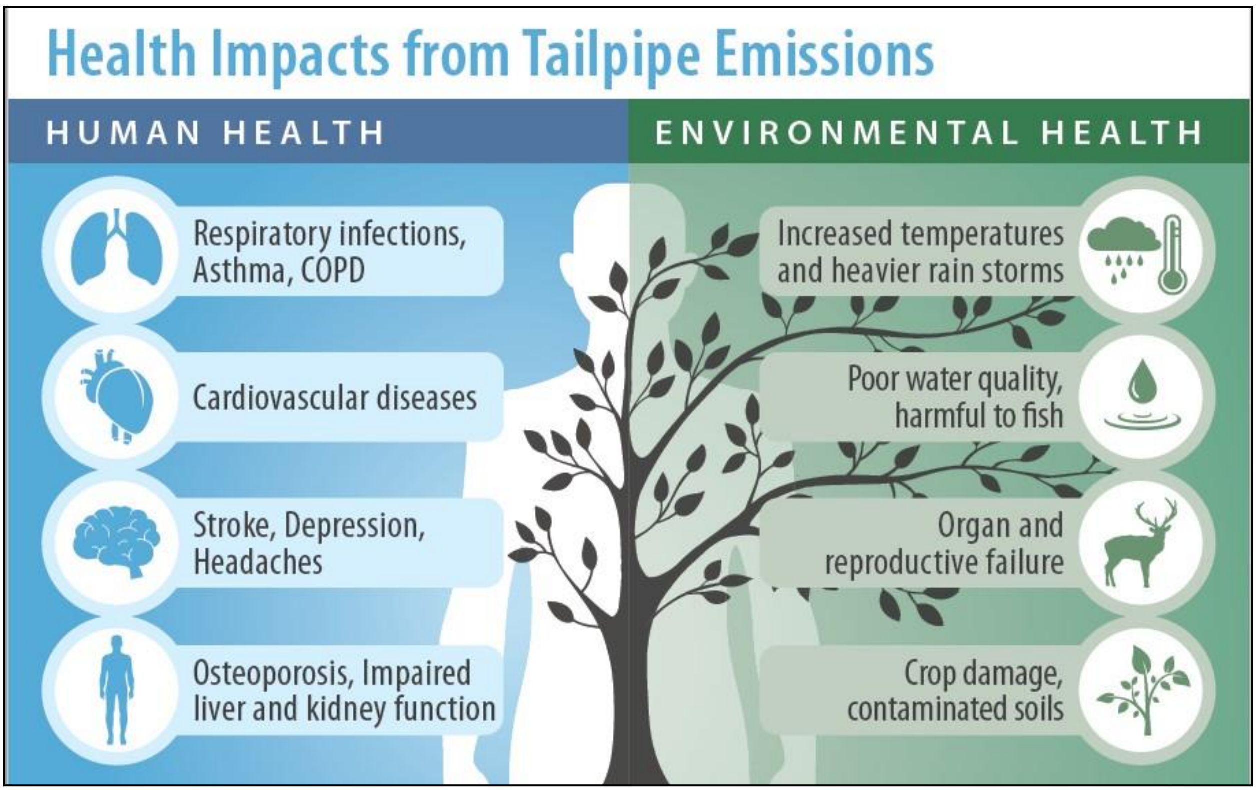

Figure 10-3. Health Impacts from Tailpipe Emissions

Passenger vehicles impact health through their tailpipe emissions and their fuel production

[158] Ibid

process, or "upstream" emissions. Tailpipes emit harmful emissions (Figure 10-3) that create ozone and particulate matter pollution, as well as greenhouse gases, which cause climate change. Many states have adopted and are moving forward with ACCII to increase consumer awareness and adoption of ZEV technologies. Implementing a rapid phase-in of renewable energy sources (e.g., wind and solar) will couple the tailpipe-free emissions on the road with reduced power plant emissions and an increasing amount of emission-free renewable power.

Implementing ACCII, coupled with state and local renewable power goals, are critical steps in protecting public health, preserving a sustainable climate and bringing the transportation sector to a truly zero emission future. Existing state and national renewable energy policies are already resulting in changes to the electricity grid that are curbing dependence on harmful fossil fuels in favor of cleaner technologies. Ongoing efforts will be needed to ensure that clean, non-combustion renewable energy is the dominant source of power going forward.[159]

A full-scale transition to ZEVs will require continued careful coordination between state and federal leadership, utilities, energy regulators and the public in order to protect against increases in "upstream" emissions at power plants that threaten the health of other communities far from roadways. Utilities play an important role here in cleaning up the power grid. They also play an important role in supporting the ZEV market, including by providing special electricity rates for plug-in vehicle customers, investing in charging infrastructure and promoting the benefits of ZEVs to customers.[160]

Delaware Health Benefit modeling:

The analysis of program benefits was conducted by Sonoma Technology, Inc. (STI), with technical input on data and methods from the International Council on Clean Transportation (ICCT) and Northeast States for Coordinated Air Use Management (NESCAUM).

The annual health outcomes of Delaware's adoption of ACC II were estimated with U.S. EPA's Co-Benefits and Risk Assessment Health Impacts Screening and Mapping Tool (COBRA).[161] COBRA estimates the change in number of cases of illnesses caused by $PM_{2.5}$[162] and their economic values for $PM_{2.5}$-associated health effects. The aggregated economic values combining all health effects are summarized in Table 10-1.

In general, adopting ACC II reduces on-road mobile source emissions and gasoline production/distribution emissions, but would increase electric generation emissions. Due to lower emissions over the course of ACCII's timeline, Delawareans are expected to spend less on health issues caused by vehicle emissions. The net health benefit of these emission changes in Delaware is $95.7 million dollars. The overall analysis approach is summarized below:

[159] Clean Air Future Health and Climate Benefits of Zero Emission Vehicles. American Lung Association in California (October 2016) Accessed (2/16/2023) https://www.lung.org/getmedia/b4231b57-878c-4263-8c2b-8c4cb80d86ca/2016zeroemissions.pdf.pdf
[160] Ibid
[161] USEPA. COBRA Model retrieved from CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) | US EPA. https://www.epa.gov/cobra/what-cobra#:~:text=EPA's%20CO%E2%80%93Benefits%20Risk%20Assessment,%2C%20regional%2C%20or%20national%20levels.
[162] Particulate matter 2.5 (PM2.5) measures the number of particles that are 2.5 microns or smaller in the air and is a standard measure of air quality.

1) Baseline emissions modeling using EPA's MOVES3[163] model was conducted. MOVES was run at the County scale for the representative county in Delaware used in EPA's National Emissions Inventory (NEI). MOVES input data and growth rates relevant to the analysis were provided by Delaware, and these were used along with NEI input data. Emissions modeling was conducted for a 2017 base year, 2030, and 2040. Results for the representative county were scaled to the statewide level using apportionment factors developed for the NEI.
2) The baseline MOVES output was adjusted in post-processing to account for the benefits of ACC II. The adjustment factors for NO_x, $PM_{2.5}$, VOCs and CO_2 were developed using baseline and proposed rule emissions inventories provided by CARB. Adjustment factors for SO_2 and NH_3 were calculated from the in-use ZEV fractions resulting from the proposed rule. The adjustments used in the health benefits analysis (below) assume that the program starts with model year 2026, but an emissions scenario representing a model year 2027 start was also developed.
3) The in-use ZEV fractions were used to calculate ZEV electricity consumption, and emissions factors from the U.S. Department of Energy's GREET 2021 model were used to calculate grid emissions associated with ZEVs. In turn, the changes in LDV energy consumption and GREET CO_2e emissions were used to calculate net (well-to-wheel, or WTW) CO_2e emissions.
4) Projections of light-duty ZEV population over time were generated using Delaware's current in-use ZEV population, and CARB estimates of in-use ZEV increases due to the proposed rule.
5) EPA's COBRA[164] model was used to estimate the health benefits associated with implementation of the ACC II program in Delaware.

Table 10-1. Annual COBRA-estimated economic values of Delaware adopting ACC II, in millions of US dollars

Analysis Year	Total NO_x Reduction (TPY)*	Total $PM_{2.5}$ Reduction (TPY)*	In-State Benefit**	Out-Of-State Benefit**	In-State Burden***	Out-Of-State Burden***	Net Benefit****
2040	-158	-10	$37.1	$74.6	$-3.2	$-12.8	$95.7

* Emissions reduction in tons per year
** The benefit of reduced on-road emissions
*** The burden of increased electric generation emissions
**** The sum of in-state and out-of-state benefits and burdens

The annual health outcomes of Delaware's adoption of ACC II were estimated with EPA's CO–Benefits Risk Assessment (COBRA) screening model. COBRA is tool that helps state and local governments estimate the health benefits associated with clean energy policies and programs to compare against program costs.

[163] EPA's MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.
[164] CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) | US EPA https://www.epa.gov/cobra/what-cobra#:~:text=EPA's%20CO%E2%80%93Benefits%20Risk%20Assessment,%2C%20regional%2C%20or%20national%20levels

Table 10-2: Cumulative ACC II Emissions Benefits Compared to the Business-as-Usual Scenario, 2025-2040 (Model Year 2027 implementation)

	NOx	**$PM_{2.5}$**	**WTW CO_2e**
By 2030	123 US tons	8 US tons	1.2 million metric tons
By 2035	502 US tons	38 US tons	5.3 million metric tons
By 2040	1,169 US tons	85 US tons	11.9 million metric tons

In addition, in June 2022, the Health Effects Institute conducted an extensive review of the health effects of long-term exposure to Traffic-Related air pollution: "Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution"[165] The study concluded – "*In light of the large number of people exposed to traffic related air pollution (TRAP) — both in and beyond the near-road environment—the Panel concluded that the overall high or moderate-to-high level of confidence in the evidence for an association between long-term exposure to TRAP and several adverse health outcomes indicates that exposures to TRAP remain an important public health concern and deserve greater attention from the public and from policymakers."*

[165] "Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution." Health Effects Institute. No. 23. June 2022 https://www.healtheffects.org/system/files/hei-special-report-23_4.pdf

Section 11 Economic Cost-Benefit Analysis

The following details the methods, sources, and limited results for the support of the economic analysis of ACC II in the state of Delaware for the U.S. Climate Alliance. For this work, Environmental Research Group (ERG)[166] recreated many of the analyses in the California Air Resources Board (CARB) ACC II Standardized Regulatory Impact Assessment (SRIA)[167] for the state of Delaware. The specific tasks are aligned with the CARB SRIA's Chapter 3, Direct Costs, and Chapter 4, Fiscal Impacts.

Methods

In this section, we describe the scenarios that formed the economic impact of the ACC II rule on the state of Delaware. The baseline scenario maps a projection of vehicles sold between 2026 and 2040 in the absence of the ACC II rule, while the ACC II scenario outlines the increased zero-emission vehicle (ZEV) production necessary to meet the regulations in the ACC II.

Baseline

Table 4 of the CARB SRIA records the baseline scenario for vehicles sales in California and divides vehicle sales into internal combustion engine vehicles (ICEVs), plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs), and fuel cell electric vehicles (FCEVs). ERG applied the proportions of each vehicle category to data from Delaware to recreate this table. We took the number and proportion of BEV sales in Delaware in 2019 to calculate the total number of vehicles sold in Delaware in 2019. From there, we applied linear trends to match the 2019 proportion of each category to the 2026 proportions. For example, in 2019, approximately 1.25 percent of vehicles sold in Delaware were BEVs. The CARB report shows the proportion of BEV sales in 2026 would be 6.7 percent; therefore, we applied a linear increase in BEV sales of 0.78 percent each year between 2020 and 2026. Table 11-1 shows the baseline scenario of vehicle sales in Delaware.

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[166] ERG is an environmental research company who partnered with the U.S. Climate Alliance to assist Delaware with analyzing the economic impacts of the Advanced Clean Car II program. about us https://www.envrg.com/

[167] California Air Resources Board (CARB) ACC II Standardized Regulatory Impact Assessment (SRIA). Retrieved from https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/appc1.pdf

Table 11-1. Baseline Vehicle Sales

	ICEV		PHEV		BEV		FCEV		
Year	**ICEV sales**	**Sales Percentage**	**PHEV Sales**	**Sales Percentage**	**BEV Sales**	**Sales Percentage**	**FCEV Sales**	**Sales Percentage**	**Total**
2019	45,500	98.2%	241	0.5%	579	1.3%	–	0.0%	46,320
2020	44,787	97.0%	422	0.9%	938	2.0%	–	0.0%	46,195
2021	44,077	95.7%	602	1.3%	1,295	2.8%	–	0.0%	46,070
2022	43,371	94.4%	781	1.7%	1,649	3.6%	67	0.1%	45,945
2023	42,668	93.1%	959	2.1%	2,002	4.4%	133	0.3%	45,820
2024	41,968	91.8%	1,136	2.5%	2,353	5.2%	200	0.4%	45,694
2025	41,271	90.6%	1,312	2.9%	2,702	5.9%	265	0.6%	45,569
2026	40,577	89.3%	1,487	3.3%	3,049	6.7%	331	0.7%	45,444
2027	40,642	89.0%	1,521	3.3%	3,181	7.0%	340	0.7%	45,684
2028	40,700	88.6%	1,543	3.4%	3,322	7.2%	351	0.8%	45,917
2029	40,769	88.4%	1,563	3.4%	3,450	7.5%	360	0.8%	46,142
2030	40,780	88.0%	1,585	3.4%	3,623	7.8%	374	0.8%	46,362
2031	40,966	88.0%	1,592	3.4%	3,640	7.8%	375	0.8%	46,573
2032	41,147	88.0%	1,599	3.4%	3,656	7.8%	377	0.8%	46,778
2033	41,321	88.0%	1,606	3.4%	3,671	7.8%	379	0.8%	46,977
2034	41,489	88.0%	1,612	3.4%	3,686	7.8%	380	0.8%	47,168
2035	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351
2036	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351
2037	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351
2038	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351
2039	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351
2040	41,651	88.0%	1,618	3.4%	3,701	7.8%	382	0.8%	47,351

ACC II Scenario

Alternatively to the baseline scenario, the ACC II scenario calls for a proportion of vehicles produced to be ZEV until 2035, when all vehicle sales will be ZEVs. The CARB SRIA reflects this in tables 2, 8, and 43. Table 11-2 shows the rule requirements, while also estimating the proportion of BEVs plus FCEVs and PHEVs sold by year.

Table 11-2. Percentage Requirements for the ACC II Rule

Model Year	BEV+FCEV	PHEV	Percentage Requirement
2026	22.2%	3.3%	25.5%
2027	30.7%	3.3%	34.0%
2028	39.1%	3.4%	42.5%
2029	47.6%	3.4%	51.0%
2030	56.1%	3.4%	59.5%
2031	72.6%	3.4%	76.0%
2032	78.6%	3.4%	82.0%
2033	81.3%	6.7%	88.0%
2034	82.7%	11.3%	94.0%
2035	82.7%	17.3%	100.0%

Similar to the baseline scenario, we used the number of BEVs sold in Delaware in 2019 and scaled that according to the vehicle sales growth in California throughout the study period to estimate the proportion of vehicles sold in the Table 11-2 vehicle categories. We used these estimates throughout the rest of the analyses.

Direct Costs

This section outlines the direct costs to the state of Delaware.

Direct Costs for Vehicle Manufacturers

ZEV Regulation Costs

The ZEV regulation would negatively impact vehicle manufacturers by requiring them to alter their manufacturing practices for the switch from ICEVs to ZEVs. The majority of these costs would remain the same between California and Delaware, though the net change in vehicle sales by technology type would change. Based on the baseline and ACC II scenarios outlined above, the change in vehicle sales is shown in Figure 11-1. ICEVs are phased out in the baseline scenario, as manufacturers increase production of BEVs, PHEVs, and FCEVs to achieve ZEV requirement.

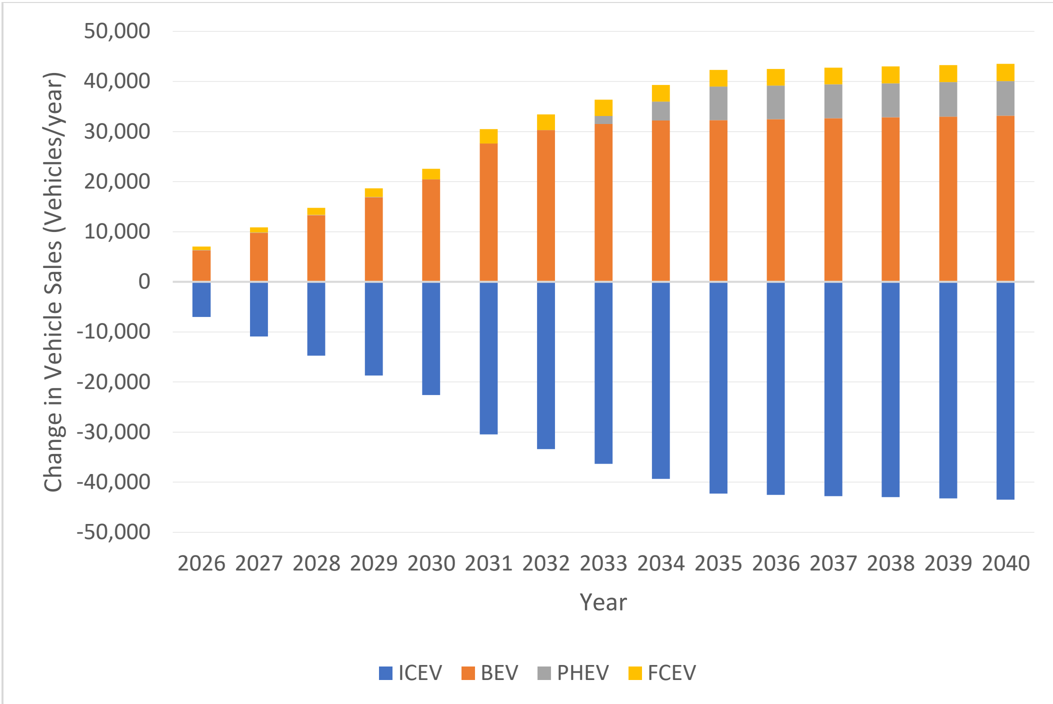

Figure 11-1. Net Change in Vehicle Sales by Technology Type (2026–2040)

The direct costs section (section 3) of the CARB SRIA also presents average incremental costs by technology type and calendar year. ERG updated these values by taking the proportions of vehicles outlined in Table 29 of the CARB SRIA and mapping the incremental costs in Appendix A to each vehicle type. ERG then calculated the number of vehicles sold within each category and applied the incremental costs to calculate the total cost of the ZEV proposal.

Cost to Comply with Low Emissions Vehicles Amendments

The Low Emissions Vehicles (LEV) amendments in the ACC II set regulatory benchmarks for light-duty vehicles (LDVs) and medium-duty vehicles (MDVs). According to the CARB SRIA, approximately 6.9 percent of new ICEVs purchased currently exceed the US06 emission standards for NMOG (Non-Methane Organic Gases) + NOx (nitric acid and nitrogen oxide). In the absence of data relevant to Delaware, we opted to use the California proportion of 6.9 percent and applied this value to our estimates of ICEVs sold during the study period of 2026–2040. To update the 6.9 percent of ICEVs sold that do not comply with the standard, vehicles would need calibration work and upgrades to the emission control hardware, mainly the catalyst system, requiring $77 on average (in 2021). These costs would likely decrease over time due to advances in technology, so we applied a 3 percent year-over-year decrease.

Table 11-3 shows the number of vehicles impacted over the study period along with the incremental cost to each vehicle and the total costs for the upgrade. Notably, there are no costs until 2028. This regulation would be phased in and applied during 2028; therefore, no costs are accrued before then.

Table 11-3. Total Cost to Comply with the Proposed US06 NMOG + NOx Standards

Model Year	Total ICEVs Sold	Vehicles Affected	Upgrade Costs (Catalyst System)	Annual Cost ($2021)
2021	42,445	2,929	$77.00	$0
2022	40,913	2,823	$74.69	$0
2023	39,377	2,717	$72.45	$0
2024	37,839	2,611	$70.28	$0
2025	36,297	2,504	$68.17	$0
2026	34,752	2,398	$66.12	$0
2027	30,905	2,132	$64.14	$0
2028	27,023	1,865	$62.21	$116,005
2029	23,108	1,594	$60.35	$96,222
2030	19,163	1,322	$58.54	$77,401
2031	11,391	786	$56.78	$44,629
2032	8,568	591	$55.08	$32,562
2033	5,728	395	$53.43	$21,116
2034	2,871	198	$51.82	$10,266

To estimate the number of MDVs impacted by the regulations, we scaled the CARB SRIA data to the Delaware data based on the proportion of vehicles sold in each state. Delaware sells 2.3 percent the vehicles of California.

Table 11-4 shows the projected sales of MDVs throughout the study period.

Table 11-4. Projected Sales for Medium-Duty Vehicles by GCWR

	Greater than 14k lbs.		Less than 14k lbs.		
Model Year	**Diesel**	**Gasoline**	**Gasoline**	**Diesel**	**Total**
2026	543	413	246	0	1,204
2027	516	392	234	0	1,143
2028	488	371	221	0	1,081
2029	460	350	209	0	1,018
2030	431	328	196	0	955
2031	402	306	182	0	891
2032	373	284	169	0	826
2033	343	261	156	0	760
2034	313	238	142	0	694
2035	283	215	128	0	627

ERG calculated the incremental costs over time for the three vehicle categories impacted in Table 11-5: diesel and gasoline vehicles greater than 14,000 pounds and gasoline vehicles under 14,000 pounds. ERG used the incremental costs for each of the three vehicle types found in tables 37 and 38 of the CARB SRIA and tapered them over time to align with the California data. ERG then applied these incremental costs each year to the number of vehicles sold to calculate the total compliance costs and per vehicle, as shown in Table 11-5.

Table 11-5. Total Cost of Compliance with MDV Proposals

	Greater than 14k lbs.		Less than 14k lbs.		
Year	**Diesel**	**Gasoline**	**Gasoline**	**Total cost**	**Cost per Vehicle**
2026	$565,700	$198,797	$35,247	$799,744	$665
2027	$441,264	$177,353	$33,465	$652,083	$571
2028	$406,407	$166,504	$31,658	$604,570	$560
2029	$372,933	$155,664	$29,826	$558,423	$548
2030	$340,631	$144,845	$0	$485,475	$508
2031	$309,620	$134,188	$0	$443,809	$498
2032	$279,700	$123,552	$0	$403,252	$488
2033	$250,695	$112,929	$0	$363,625	$478
2034	$222,626	$102,362	$0	$324,988	$468
2035	$195,544	$91,833	$0	$287,377	$458

Total costs to comply with the LEV amendments are outlined in Table 11-6.

Table 11-6. Total Cost to Comply with the LEV Proposals

Year	LEV LDV Costs for US06 Standards	LEV MDV Costs	Total LEV Costs
2026	$0	$799,744	$799,744
2027	$0	$652,083	$652,083
2028	$116,005	$604,570	$720,574
2029	$96,222	$558,423	$654,646
2030	$77,401	$485,475	$562,877
2031	$44,629	$443,809	$488,438
2032	$32,562	$403,252	$435,814
2033	$21,116	$363,625	$384,740
2034	$10,266	$324,988	$335,254
2035	$0	$287,377	$287,377

Total Incremental Vehicle Cost and Pricing

This section summarizes the costs of the ACC II regulations on manufacturers. The annual costs of the regulations are shown in Table 11-7, which shows the direct manufacturing costs (DMC) as well as the retail price equivalent (RPE), which is the DMC multiplied by 1.5. ERG did not account for cold-start compliance costs in this analysis.

Table 11-7. Annual Costs of ACC II Regulations

Year	ZEV Costs	LEV Costs	Total Direct Cost (DMC)	Total Costs (RPE)
2026	$38,156,338	$799,744	$38,956,082	$58,434,123
2027	$51,209,898	$652,083	$51,861,981	$77,792,971
2028	$59,424,653	$720,574	$60,145,227	$90,217,841
2029	$63,307,205	$654,646	$63,961,851	$95,942,776
2030	$65,139,888	$562,877	$65,702,765	$98,554,147
2031	$76,019,593	$488,438	$76,508,031	$114,762,046
2032	$70,910,392	$435,814	$71,346,206	$107,019,309
2033	$66,584,003	$384,740	$66,968,743	$100,453,115
2034	$62,573,607	$335,254	$62,908,861	$94,363,291
2035	$59,448,410	$287,377	$59,735,787	$89,603,680

The total costs from all vehicle sales are shown in Table 11-8. ERG created these estimates by taking the incremental vehicle costs necessary to meet the standards in Table 11-2 and applying these to the projected vehicle sales in Delaware. The incremental vehicle cost was applied across all vehicle sales to find the average incremental cost per vehicle.

Table 11-8. Total Costs Across All New Vehicle Sales

Model Year	Total Sales	Total Costs	Average Incremental Cost ($/vehicle)
2026	46,648	$58,434,123	$1,253
2027	46,827	$77,792,971	$1,661
2028	46,998	$90,217,841	$1,920
2029	47,161	$95,942,776	$2,034
2030	47,317	$98,554,147	$2,083
2031	47,463	$114,762,046	$2,418
2032	47,604	$107,019,309	$2,248
2033	47,737	$100,453,115	$2,104
2034	47,862	$94,363,291	$1,972
2035	47,979	$89,603,680	$1,868
Average Annual	**47,359**	**$92,714,330**	**$1,958**
Total	**473,594**	**$927,143,300**	

Direct Costs for Vehicle Ownership

Insurance and Registration Costs

The state of Delaware requires annual $40 registration fees for all vehicle owners residing in the state.[168] According to the CARB SRIA, insurance fees are estimated to be 5 percent of the incremental cost of the vehicle.[169]

Statewide Total Cost of Ownership for Vehicle Owners

ERG calculated the statewide total cost of ownership (TCO), which calculates the changes in costs between the ACC II scenario and the baseline scenario over the entire state. The price and plug analysis integrates vehicle sales and the cost to purchase home chargers. For this analysis, we assumed 85.5 percent as the proportion of electric vehicle purchasers would install home charging units.[170] The sales tax is actually a document fee to the state of Delaware since Delaware does not have a statewide sales tax on vehicles. The gasoline and electricity calculations are based on the consumption or reduced consumption relative to the baseline of each fuel type. These calculations involved taking the number of vehicles sold in the last 12 years (assuming a 12-year vehicle lifespan) and multiplying by the proportional vehicle efficiency for the vehicle type. The analyses can be found under the subsection titled Fiscal Impact.

The hydrogen analysis was performed similarly to the other fuel consumptions methods and can be found on the state TCO tab of the Excel Spreadsheet data tables. The maintenance and repair analysis used a weighted mean of relative maintenance costs for each vehicle type multiplied by the number of vehicles and annual mileage. The insurance analysis multiplied the incremental cost of vehicles by 5 percent and multiplied this by all vehicles sold. The state of Delaware has a $40 registration fee. ERG estimated the annual registrations based on the change in vehicle sales to estimate the difference in registrations between the baseline and ACC II scenarios and multiplied by the annual registration fee. The vehicle-to-grid (V2G) analysis sought to estimate the value of using a vehicle to power a home during peak electricity price hours. The analysis assumed 6 kilowatt-hours of electricity were used during peak pricing each day from the vehicle instead of the grid. The vehicle was then replenished from the grid overnight during off-peak hours. ERG used the Delaware Electric Cooperative's data that identified prices for peak and off-peak hours.[171]

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[168] Title 21 Accessed September 26, 2022 https://delcode.delaware.gov/title21/c021/sc04/index.html

[169] *Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective* Fulton, 2018. https://www.mdpi.com/2076-3417/8/9/1487/htm

[170] Idaho National Laboratory. (n.d.). Retrieved 2023, from https://avt.inl.gov/sites/default/files/pdf/arra/PluggedInSummaryReport.pdf

[171] Delaware Electric Cooperative, inc.. leaf no. – 53. Retrieved 2023, from https://www.delaware.coop/sites/default/files/R-TOU.pdf

Table 11-9. Statewide TCO for the Proposed Regulations, Relative to Baseline, from 2026–2040 (Millions of 2020 U.S. Dollars)

Year	Price and Plug	Sales Tax	Gasoline	Electricity	Hydrogen	Maintenance and Repair	Insurance	Registration	V2G	Total Cost	Total Savings	Net Cost
2026	$17.81	$0.0641	-$32.41	$18.56	$1.17	-$6.18	$2.92	$0.05	-$0.04	$40.57	-$38.62	$1.95
2027	$37.98	$0.0807	-$46.61	$25.88	$2.77	-$8.51	$3.89	$0.05	-$0.09	$70.64	-$55.22	$15.42
2028	$60.94	$0.0882	-$66.74	$35.72	$4.55	-$10.85	$4.51	$0.04	-$0.34	$105.85	-$77.92	$27.92
2029	$85.27	$0.0880	-$92.80	$47.94	$6.29	-$13.23	$4.80	$0.04	-$0.53	$144.43	-$106.56	$37.87
2030	$110.18	$0.0845	-$127.07	$62.46	$7.57	-$15.62	$4.93	$0.04	-$0.76	$185.25	-$143.45	$41.80
2031	$128.14	$0.0915	-$173.01	$83.15	$8.77	-$20.23	$5.74	$0.04	-$5.39	$225.92	-$198.63	$27.29
2032	$136.69	$0.0789	-$223.03	$104.57	$9.61	-$21.95	$5.35	$0.03	-$7.12	$256.34	-$252.10	$4.24
2033	$139.92	$0.0680	-$274.68	$129.61	$9.70	-$22.94	$5.02	$0.03	-$13.39	$284.35	-$311.00	-$26.65
2034	$140.06	$0.0582	-$329.29	$155.96	$9.96	-$23.64	$4.72	$0.03	-$21.54	$310.78	-$374.46	-$63.69
2035	$138.08	$0.0498	-$384.04	$179.24	$10.20	-$24.02	$4.48	$0.03	-$31.53	$332.08	-$439.60	-$107.52
2036	$132.62	$0.0688	-$439.50	$204.44	$11.42	-$24.14	$4.50	$0.03	-$43.41	$353.08	-$507.05	-$153.96
2037	$129.01	$0.0879	-$494.05	$229.08	$12.60	-$24.27	$4.53	$0.04	-$57.17	$375.35	-$575.48	-$200.14
2038	$126.99	$0.1072	-$549.73	$250.14	$13.28	-$24.39	$4.55	$0.05	-$71.40	$395.12	-$645.52	-$250.40
2039	$126.45	$0.1265	-$594.49	$276.26	$14.22	-$24.51	$4.57	$0.06	-$86.30	$421.70	-$705.29	-$283.59
2040	$127.10	$0.1459	-$637.71	$296.82	$14.63	-$24.63	$4.59	$0.07	-$101.57	$443.36	-$763.91	-$320.55

Direct Costs on Typical Businesses

According to the U.S. census, there are currently no vehicle manufacturers in Delaware. Passenger car rental businesses, however, will be impacted by the ACC II rule, as they will need to spend more on vehicle purchases. There are an estimated 12 car rental establishments in the state of Delaware.[172] ERG created an analysis to estimate the potential costs to a car rental business over the course of the regulatory period. The rental car sector typically carries around 1 percent of state vehicles.[173] For this analysis, we assumed that a car rental facility in Delaware would purchase 40 vehicles per year. The costs associated with the ACC II rule on a car rental business are incremental vehicle costs, document fees when purchasing the vehicles, insurance, and registration costs. One category, maintenance and repair costs, would likely result in savings since these costs are typically lower for ZEVs compared to ICEVs.[174]

[172] NAICS 532111 https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables
[173] California Energy Commission. Light-duty ZEV uptake in government and rental segments. California Energy Commission. Retrieved 2023, from https://www.energy.ca.gov/media/5889
[174] Argonne Scientific Publications | Argonne National Laboratory. Retrieved 2023, from https://publications.anl.gov/anlpubs/2021/05/167399.pdf

Table 11-10. Potential Costs for a Typical Car Rental Business

Year	Vehicle Costs	Document Fee	Maintenance & Repair	Insurance	Total Cost	Total Savings	Net Cost
2026	$49,905	$2,121	-$20,214	$2,495	$54,522	-$20,214	$34,308
2027	$66,185	$2,813	-$41,659	$3,309	$72,307	-$41,659	$30,648
2028	$76,477	$3,250	-$63,485	$3,824	$83,551	-$63,485	$20,066
2029	$81,049	$3,445	-$85,705	$4,052	$88,546	-$85,705	$2,841
2030	$82,980	$3,527	-$108,096	$4,149	$90,656	-$108,096	-$17,440
2031	$96,328	$4,094	-$131,083	$4,816	$105,238	-$131,083	-$25,844
2032	$89,563	$3,806	-$153,351	$4,478	$97,848	-$153,351	-$55,503
2033	$83,834	$3,563	-$170,163	$4,192	$91,589	-$170,163	-$78,574
2034	$78,547	$3,338	-$184,145	$3,927	$85,812	-$184,145	-$98,333
2035	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624
2036	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624
2037	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624
2038	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624
2039	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624
2040	$74,403	$3,162	-$194,909	$3,720	$81,285	-$194,909	-$113,624

Direct Costs on Small Businesses

As of the 2017 U.S. census, there are no vehicle manufacturing facilities in Delaware that would fit the small business definition[175] of a vehicle manufacturer.[176]

Typical small businesses throughout Delaware would only be impacted by the ACC II rule if they purchased a vehicle. To address how the rule might impact small businesses, we conducted a TCO analysis of a light-duty truck (LDT2) and then compared these costs for a BEV (with and without a home charger) and PHEV to an ICEV. This TCO also included, the incremental cost of the vehicle, and interest on the incremental cost of the vehicle, as well as incremental fuel, maintenance, and insurance costs.

Table 11-11, shows the results of our analysis. ERG performed similar analyses in subsection titled Direct Costs on Individuals.

[175] U. S. small business administration - sba.gov. Retrieved April 5, 2023, from https://www.sba.gov/sites/default/files/2022-09/Table%20of%20Size%20Standards_NAICS%202022%20Final%20Rule_Effective%20October%201%2C%202022.pdf

[176] SOURCE: 2017 County Business Patterns and Economic Census. https://www.census.gov/data/tables/2017/econ/susb/2017-susb-annual.html

Table 11-11. TCO Over 10 Years for Electric LDT2 Compared to Baseline ICEV, Purchased in 2028

	BEV		PHEV
Cost Category	**With Home Charger**	**No Home Charger**	**With Home Charger**
Incremental vehicle price	$4,514	$4,514	$4,592
Home level 2 charging cost	$850		$850
Finance costs (document fee for titles and interest payments)	$789	$789	$803
Incremental fuel costs	-$8,804	-$698	-$5,070
Incremental maintenance costs	-$8,239	-$8,239	-$1,088
Incremental insurance	$2,257	$2,257	$2,296
Total (10 years)	**-$8,633**	**-$1,377**	**$2,382**
Payback period	**4.2**	**7.9**	**NEVER**

Direct Costs on Individuals

ERG performed a 10-year TCO analysis comparing BEVs and PHEVs to ICEVs. This TCO included the same categories as in the section above. There are currently no government incentives for installing home charging, in contrast to California, so our values for charger installation are higher. ERG calculated incremental insurance as 5 percent of the incremental vehicle costs.[177]

Table 11-12 shows the TCO over 10 years for a 2026 model year (MY) vehicle and Table 11-13 shows the TCO over 10 years for a 2035 MY vehicle. The TCO analysis estimates that it is more costly to purchase a PHEV than an ICEV at any point during the study period. Over the course of the study period, the break-even point for purchasing a BEV compared to an ICEV will decrease.

Table 11-12. TCO Over 10 Years for Individual ZEV and PHEV Buyer Compared to Baseline ICEV, 2026 MY Passenger Car in Single-Family Home

	BEV		PHEV
Cost Category	**With Home Charger**	**No Home Charger**	**With Home Charger**
Incremental vehicle price	$4,978	$4,978	$5,012
Home level 2 charging cost	$850		$850
Finance costs (document fee for Titles and interest payments)	$870	$870	$876
Incremental fuel costs	-$6,944	$335	-$4,212
Incremental maintenance costs	-$6,528	-$6,528	-$1,142
Incremental insurance	$2,489	$2,489	$2,506
Total (10 years)	**-$4,285**	**$2,144**	**$3,890**
Payback period	**6.1**	**15.8**	**NEVER**

[177] *Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective* Fulton, 2018. https://www.mdpi.com/2076-3417/8/9/1487/htm

Table 11-13. TCO Over 10 Years for Individual ZEV and PHEV Buyer Compared to Baseline ICEV, 2035 MY Passenger Car in Single-Family Home

	BEV		PHEV
Cost Category	**With Home Charger**	**No Home Charger**	**With Home Charger**
Incremental vehicle price	$1,364	$1,364	$3,640
Home level 2 charging cost	$850		$850
Finance costs (document fee for Titles and interest payments)	$238	$238	$636
Incremental fuel costs	-$7,589	-$83	-$4,772
Incremental maintenance costs	-$6,451	-$6,451	-$1,129
Incremental insurance	$682	$682	$1,820
Total (10 years)	**-$10,906**	**-$4,250**	**$1,046**
Payback period	**1.8**	**2.7**	**NEVER**

Delaware also has a slate of incentives to offset vehicle purchase costs to consumers. The Delaware Clean Vehicle Rebate Program[178] provides cash rebates for vehicles purchased before December 31, 2022. The program offers a $2,500 cash rebate for a new BEV, $1,000 for a new PHEV, $1,500 for a propane or natural gas vehicle, and $1,350 for a bi-fuel propane or natural gas vehicle. The state also offers incentives for heavy-duty vehicles, $20,000 for new qualifying heavy-duty compressed natural gas class 7 or 8 vehicles to commercial entities, nonprofits, individuals, or businesses in Delaware through the Heavy-Duty Vehicle Rebate Program.[179] Through the Clean Vehicle Rebate Program, the state offers rebates for chargers purchased between July 1, 2021, and December 31, 2022. Table 11-14 provides details on the programs.

Table 11-14. Rebate and Limit Amounts for Electric Vehicle Charging Station Incentives

	Rebate Amount		Charging Port Limit per Location	
Location	**Commercial**	**Government and Nonprofit**	**Commercial**	**Government and Nonprofit**
Public Access	75%	90%	6	6
Workplace	75%	90%	6	6
Fleet	75%	90%	6	10
Multi-Family	90%	90%	10	10

[178]The Delaware Clean Vehicle Rebate program. DNREC Alpha. (2023, March 16). Retrieved April 5, 2023, from https://dnrec.alpha.delaware.gov/climate-coastal-energy/clean-transportation/vehicle-rebates/
[179] Heavy-duty vehicle rebate program. DNREC Alpha. (2022, December 27). Retrieved April 5, 2023, from https://dnrec.alpha.delaware.gov/climate-coastal-energy/clean-transportation/heavy-duty-vehicle-rebates/

Fiscal Impacts

This section covers the state-level fiscal impacts of the ACC II rule on the state of Delaware.

Local Government

ERG has assessed the different fiscal impacts as combined state and local impacts. Clear information on the split between local and state government taxes or the allocation of these funds is not available. Below, ERG describes the methods for calculating fiscal impacts throughout the state and show all fiscal impacts in Table 11-15.

State Government

State Fleet Cost Pass-Through

The state vehicle fleet comprised 2,356 vehicles in 2017[180], with an average of 350 vehicle purchased each year. This covers 0.76 percent of all vehicles sold in Delaware each year. Therefore, the state would realize around 0.76 percent of the statewide vehicle cost and operational savings from the rule.

State Sales Taxes from Vehicle Sales

The state of Delaware does not have a sales tax on vehicles, though they do have a 4.25 percent document fee that operates in a similar manner. This fee is applied to all new vehicles sales in the state. The resulting change in fiscal impact is due to the incremental cost of ZEVs and the change in the number of vehicles sold between 2026 and 2040. The vehicle sales tax revenue is reflected in Table 11-15.

Vehicle Registration Fees

Between 2016 and 2021, annual vehicle registrations in Delaware increased from 779,000 to 832,700. ERG took the annual change in vehicle purchases for both the baseline and the ACC II scenarios to estimate the number of vehicle registrations between 2026 and 2040. ERG calculated the difference in the number of vehicles between the baseline and ACC II scenarios and scaled this up to the number of historical registrations. ERG then applied the annual registrations cost of $40 in Delaware. This calculation, depicted below, resulted in nearly $7.7 million in additional state revenue between 2026 and 2040. The registration fee revenue is reflected in Table 11-15.

$$\left(\begin{array}{c} Estimated\ Registrations\ ACC\ II\ Scenario - \\ Estimated\ Registrations\ Baseline\ Scenario \end{array}\right) * \ Registration\ Cost\ (\$40) = \ Revenue$$

Gasoline Taxes

To calculate the incremental gasoline consumption in the state, we took the difference in the number of vehicles sold in the baseline and ACC II scenarios over time. ERG then calculated the cumulative number of vehicles under the assumption that vehicles had a lifespan of 12 years. ERG used the average annual mileage for passenger cars and the average vehicle efficiency for

[180] The State Of Delaware. . Government and services. OMB. Retrieved April 5, 2023, from https://gss.omb.delaware.gov/fleet/

ICEVs to calculate the number of gallons not consumed under the ACC II scenario that would have been consumed under the baseline scenario. ERG applied the gasoline tax in the state, which is $0.23 per gallon, to calculate lost revenue from the ACC II scenario, which totals $317.6 million between 2026 and 2040. The lost gasoline sales tax revenue is reflected in Table 11-15.

Energy Resource Fee

Electric utilities are taxed at 4.25 percent in Delaware. ERG estimated that these taxes would be passed onto utility customers. To estimate increased energy consumption, we used the number of BEVs in the ACC II scenario and subtracted the number of BEVs in the baseline scenario. ERG summed this difference over the last 12 years under the assumption that the average vehicle life is 12 years. Next, ERG multiplied the number of vehicles by the average annual mileage in the CARB SRIA for a passenger car and calculated the energy consumption for those miles based on the average number of miles per kilowatt-hour. Finally, ERG used the projected electricity rates[181] and multiplied by the 4.25 percent tax to estimate a total revenue of $89.2 million between 2026 and 2040. The utility user fee revenue is reflected in Table 11-15.

Fiscal Impacts on State Government

Table 11-15 shows the total fiscal impacts of the ACC II rule on the state of Delaware.

Table 11-15. Estimated Fiscal Impacts on State Governments

Year	Vehicle Cost	Operational Cost	Operational Savings	Registration Fee Revenue	Utility User Fee Revenue	Vehicle Sales Tax Revenue	Gasoline Sales Tax Revenue	Total Fiscal Impact
2026	$729,755	$83,429	($125,847)	$620,275	$788,859	$64,074	($2,541,160)	($1,755,290)
2027	$868,428	$153,802	($297,522)	$575,304	$1,099,792	$80,677	($3,614,320)	($2,583,254)
2028	$955,214	$237,538	($515,665)	$529,755	$1,517,893	$88,186	($5,120,537)	($3,661,790)
2029	$996,904	$333,462	($779,842)	$483,650	$2,037,482	$88,049	($7,067,340)	($5,008,684)
2030	$1,029,884	$442,490	($1,103,240)	$436,996	$2,654,441	$84,537	($9,451,844)	($6,645,003)
2031	$1,163,496	$592,508	($1,514,106)	$389,825	$3,533,771	$91,542	($12,714,816)	($8,941,574)
2032	$1,098,308	$692,314	($1,829,385)	$342,170	$4,444,290	$78,916	($16,219,923)	($11,315,786)
2033	$1,029,213	$804,912	($2,123,046)	$294,026	$5,508,430	$68,000	($19,870,221)	($13,710,844)
2034	$960,338	$916,264	($2,403,171)	$245,409	$6,628,136	$58,154	($23,627,128)	($16,168,860)
2035	$897,517	$1,004,817	($2,655,905)	$196,388	$7,617,665	$49,774	($27,448,715)	($18,831,318)
2036	$897,517	$1,093,713	($2,870,885)	$368,543	$8,688,739	$68,814	($31,175,737)	($21,169,985)
2037	$897,517	$1,151,071	($2,995,738)	$541,551	$9,736,041	$87,950	($34,807,562)	($23,494,870)
2038	$897,517	$1,182,760	($3,095,768)	$715,447	$10,630,857	$107,183	($38,343,558)	($25,874,581)
2039	$897,517	$1,234,666	($3,147,529)	$890,195	$11,741,236	$126,510	($41,443,410)	($27,670,122)
2040	$897,517	$1,257,275	($3,189,613)	$1,065,813	$12,614,686	$145,934	($44,107,580)	($29,246,326)
Total	**$14,216,642**	**$11,181,022**	**($28,647,261)**	**$7,695,348**	**$89,242,317**	**$1,288,300**	**($317,553,850)**	**($216,078,288)**

[181] U.S. Energy Information Administration - EIA - independent statistics and analysis. Homepage - U.S. Energy Information Administration (EIA). (2022). Retrieved April 5, 2023, from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2022&region=1-2&cases=ref2022&start=2020&end=2045&f=A&linechart=ref2022-d011222a.13-3-AEO2022.1-2&map=ref2022-d011222a.4-3-AEO2022.1-2&ctype=linechart&sourcekey=0

Assumptions

ERG used numerous assumptions throughout the analyses.

Vehicle Lifespan

ERG assumed a 12-year vehicle lifespan for analyses where prior year vehicle sales would impact the current year.[182] For example, when conducting the statewide TCO analysis, specifically the gas consumption portion, ERG used the difference in the number of ICEVs purchased each year between the baseline and ACC II scenarios. ERG then calculated the cumulative number of vehicles by taking that difference in vehicles purchased over the past 12 years. From there, we multiplied by the reciprocal of vehicle efficiency and annual mileage to get the number of gallons consumed each year.

Annual Mileage

The CARB SRIA used a matrix of annual mileages for each purchase year and age of the vehicle, found in Tables A5–A7 of the report. While ERG incorporated these matrices for the individual TCO analyses, they opted to use the average value for passenger vehicles for many of the analyses.

Amortized Payments

The majority of vehicles are purchased with loans,[183] which we simulated by assuming that cars were purchased with loans with 5 percent annual interest rates and 5-year payment schedules paid monthly. These payments were used in all TCO analyses except the vehicle rental company analysis and the state vehicle purchase cost analysis. We used the following formula to calculate annual payments:

$$P_a = 12 * C/(\frac{((1+i)^n)-1}{i*(1+i)^n})$$

Where P_a is the monthly payment, C is the incremental purchase price, i is the annual interest rate divided by twelve months (5%/12 = 0.4167%), and n is the number of payments (5 years * 12 months = 60 payments).

Conclusions

Based on the direct cost analyses, the costs of the ACC II rule would increase the average cost of a vehicle by $1,253 in 2026, and up to $2,418 in 2031, before costs would begin to decrease. The statewide TCO would result in a net cost of $1.95 million in 2026, increasing to $41.8 million in 2030. Cost savings begin in 2033 at $26.7 million, increasing to $320.6 million saved in 2040. Cost savings are largely due to the fuel switching from gasoline to electricity and

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[182] Average age of automobiles and trucks in operation in the United States. Average Age of Automobiles and Trucks in Operation in the United States | Bureau of Transportation Statistics. (n.d.). Retrieved April 5, 2023, from https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states

[183] Car loan statistics that will make you want a bicycle. Fortunly. (2022, March 7). Retrieved from https://fortunly.com/statistics/car-loan-statistics/#gref

hydrogen. Savings on fuel would account for $340.9 million in savings in 2040 alone for drivers in Delaware, while the rest of the impacts on the state would cost nearly $20 million.

For individuals in Delaware, buying a PHEV instead of a ICEV in 2026 will cost an additional $3,890 over 10 years of ownership. A BEV without a home charger will cost an additional $2,144 over an ICEV over the first 10 years of ownership, and a BEV with a home charger will result in savings of $4,285 over 10 years. In 2035, the same comparisons will result in an additional $1,046 for a PHEV, $4,250 saved for a BEV without a home charger, and $10,906 saved for a BEV with a home charger.

Fiscal changes due to the ACC II rule will decrease state revenue, beginning in the first year of implementation. The lost revenue will increase over time and is entirely due to the reduced revenue from the gasoline tax. While this decrease would cause reduced revenue to the state of Delaware, the benefits of reduced gasoline consumption are not demonstrated here, such as the benefits of reduced pollution. Between 2026 and 2040, the government would potentially lose $216 million in revenue if other revenue sources are not found to replace the motor fuel tax losses.

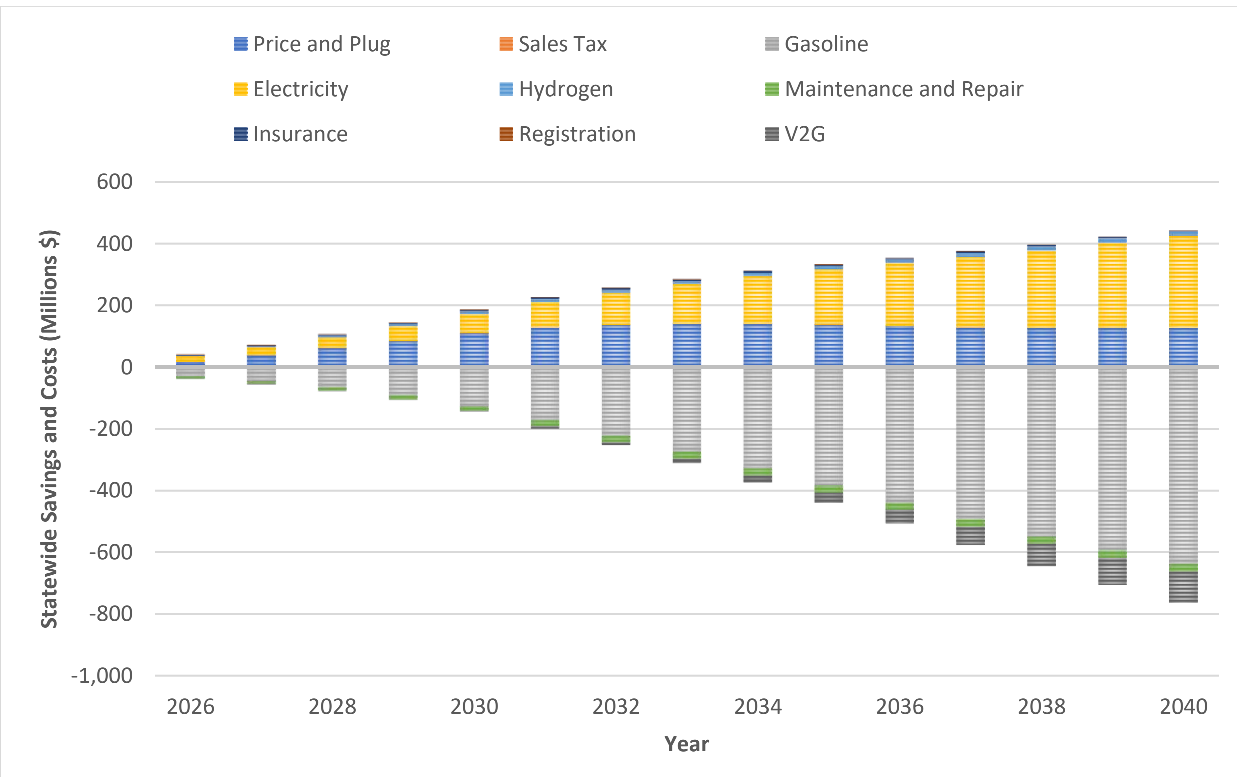

Figure 11-2 Delaware Statewide Savings and Costs.

The following is an analysis of the economic costs and benefits of implementing ACCII. This section focuses on the costs-benefits of electric vehicles to both manufacturers and owners of electric vehicles. On November 30, 2022, the California Air Resources Board (CARB) adopted ACCII. CARB completed a detailed economic analysis as part of the regulatory development process of ACCII. Delaware is utilizing the CARB economic cost-benefit analysis in this Technical Support Document (TSD) to demonstrate the economic costs and benefits of ACCII. Unless otherwise noted, details of this analysis can be found in CARB's "Standardized Regulatory Impact Assessment" (CARB SRIA) (Appendix X)[184].

Battery Costs

Battery costs represent the largest portion of BEV technology and a significant portion of PHEV and FCEV technology costs for vehicle manufacturers. As shown in Table 10-1 below, battery costs are expected to decrease over time, for the following reasons[185 186]:

- Improved and simplified battery cell and pack designs
- Introduction of new battery chemistries
- New manufacturing techniques in addition to increasing production volumes

Table 11-16 – Battery Costs. CARB SRIA, Table 19, Page 53.

Table 19. Battery Pack Costs in ($/kWh) for BEVs, PHEVs, and FCEVs for Model Years 2026 through 2035

	Model Year									
Technology	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
BEV	95.3	88.7	82.4	76.7	72.5	68.9	65.4	62.2	59.1	56.1
PHEV	133.5	124.1	115.4	107.3	101.5	96.4	91.6	87.0	82.7	78.5
FCEV*	832.8	824.5	816.2	808.1	800.0	792.0	784.1	776.2	768.5	760.8

A more detailed analysis of battery costs can be found in the CARB SRIA pages 51-53.

Non-Battery Costs/Cost Reductions

An analysis of "non-battery" economic costs and benefits are detailed in the CARB SIA, ages 53-61. Costs include, but are not limited to electric motors, gearboxes, fuel cells, and hydrogen storage tanks. Because of the less complex assembly process of ZEVs, assembly costs reductions can result in cost savings.

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[184] "Advanced Clean Cars II Proposed Amendments to the Low Emission, Zero Emission, and Associated Vehicle Regulations, Standardized Regulatory Impact Assessment (SRIA)". CARB. March 29, 2022. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/appc1.pdf

[185] Bloomberg New Energy Finance (BloombergNEF) 2020 EV Outlook and Battery Price Survey. https://about.bnef.com/electric-vehicle-outlook-2020/

[186] National Academies of Sciences, Engineering, and Medicine. 2021. Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy—2025-2035. Washington, DC: The National Academies Press. https://doi.org/10.17226/26092.

Capital Cost of Installation of Home Charging Units

One potential cost to owning an EV is the purchase and installation of a home charging station. The "Level 1" 120-volt chargers provided by vehicle manufacturers have relatively slow charging capabilities[187]. Therefore, many EV/PHEV owners choose to install a "Level 2", 220-volt charger in their residence. By installing a home charger, EV owners can have access to lower cost electricity and the convenience of home charging.

Table 11-3 shows the costs for the installation of a home charger, taken from July 2021 report from the International Council on Clean Transportation, "Charging Up America: Assessing the Growing need for U.S. Charging Infrastructure Through 2030"[188].

Table 11-17 – Installation of Home Charging Unit Costs. CARB SRIA, Table 46, Page 92

Table 46: Cost of installing home Level 2 Circuit and Wiring

Housing Type	*Receptacle Upgrade**	*EVSE Unit ***	*Total/home*
Single Family Home (SFH) - Detached	$680	---	$680
SFH - Attached, Duplex, Triplex, Quad	$2,000	---	$2,000

** Costs are constant over regulation period*
*** No direct costs assumed given convenience cord requirement*

Owners may be able to offset these costs if state or federal rebates and/or incentive programs are available. Specifically, the DNREC Division of Climate, Coastal and Energy implemented the Clean Vehicle Rebate Program (CVRP) in 2015. Currently, CVRP provides rebates for commercial level 2 charging stations and stations in multi-unit dwellings, up to $3,500 for single port and $7,000 for dual port chargers. These rebates help address both the greater need for public charging infrastructure and the lack of at-home charging that can be a barrier to EV adoption.

Maintenance and Repair

The average maintenance costs for EVs are lower than that of an equivalent ICEV. For example, BEVs will not need oil changes, spark plugs, or air filter replacement. The Argonne National Laboratory has provided estimates of incremental maintenance costs that are below that of an ICEV based on vehicle technology type and miles driven (See Table 10-4 below). [189]

Table 10-4 – Maintenance Costs. CARB SRIA, Table 47, Page 94.

[187] A "Level 1" charging unit represents 120-volt charging using a common household outlet. Level 1 chargers are generally provided with a vehicle purchase and typically provides 3-5 miles of range for every hour they are connected to an EV or PHEV.

[188] Gordon Bauer, Chih-Wei Hsu, Mike Nicholas, and Nic Lutsey. Charging Up America: Assessing the Growing need for U.S. Charging Infrastructure Through 2030. International Council on Clean Transportation. July 2021. Accessed March 10, 2022. https://theicct.org/wp-content/uploads/2021/12/charging-up-america-jul2021.pdf

[189] Argonne National Laboratory. "Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains". April mai2021. https://publications.anl.gov/anlpubs/2021/05/167399.pdf

Table 47: Estimated incremental maintenance costs for each vehicle classification and powertrain type, in dollars per mile (values in parentheses are negative values, indicating savings relative to a comparable internal combustion engine vehicle)

Vehicle Types	2026 - 2035
BEV-PC	$ (0.040)
BEV-LT1	$ (0.039)
BEV-LT2	$ (0.053)
BEV-MDV	$ (0.091)
PHEV-PC	$ (0.007)
PHEV-LT1	$ (0.009)
PHEV-LT2	$ (0.007)
PHEV-MDV	$ (0.007)
FCEV-PC	$ (0.007)
FCEV-LT1	$ (0.008)
FCEV-LT2	$ (0.007)
FCEV-MDV	$ (0.010)

The Department heard concerns about the ability of our automotive repair sector to adapt and learn how to repair zero emitting vehicles as well as concerns about the impacts to traditional repair shops. The Big 3 Auto Makers (Ford, General Motors and Stellanis NV) have all developed and offered to their dealerships training for service professionals on the advancements in vehicle technology service and repairs. Across the nation vocational-technical community colleges have been introducing new curriculum to prepare the next generation of repair technicians for electric vehicles. Delaware's Technical Community College is considering introducing curriculum for electric vehicle repair.[190]

Employment Impacts

While a transition to electric vehicles will likely result in a decrease in some jobs/industries such as automotive repair and maintenance, other industries are expected to increase as a result of the transition. Examples include electric power generation, transmission, and distribution, and chemical manufacturing. Additional jobs involving charger installation and maintenance are expected to be generated.

Comments were received regarding the impact increased numbers of electric vehicles would have on local gasoline stations and convenience stores such as Wawa and Royal Farms. The concern was the need for these stations and stores to adapt to provide charging stations and the necessary infrastructure to power the vehicles. Both Wawa and Royal Farms have been actively engaged in providing both liquid fuel pumps and charging stations at their new builds throughout Delaware and the Philadelphia region.[191] The Inflation Reduction Act and the

[190] Bay to Bay News. 2023. "Vo-techs preparing for zero-emission vehicle mandate in Delaware." Retrieved from Vo-techs preparing for zero-emission vehicle mandate in Delaware | Bay to Bay News on March 22, 2023. https://baytobaynews.com/delaware/stories/vo-techs-preparing-for-zero-emission-vehicle-mandate-in-delaware,103654

[191] Wawa. 2022. Wawa Reaches 2 Million Charging Milestone and Cuts Ribbon on First EVgo Station in Philadelphia. Retrieved from Convenience Stores & Gas Stations | Wawa. https://www.wawa.com/social-purpose/march-2022/wawa-reaches-2-million-charging-milestone-and-cuts

Bipartisan Infrastructure Law both contain opportunities for supporting commercial business to build electric vehicle charging stations and the necessary infrastructure to support it.[192]

Comments were received regarding the impact the proposed amendments might have on Delaware's tourism. The Department acknowledges the importance of the tourism industry in Delaware, the jobs created, and incomes derived from it. However, no negative impacts are anticipated. The proposed amendments to 7 DE Admin. Code 1140 apply to vehicles sold in state and do not ban the sale of gasoline. As the charging network is expanded (see Complementary Policies) intrastate and interstate tourism may grow as many early adopters will develop greater confidence traveling to and in an EV ready state. Significant numbers of gasoline and diesel vehicles are expected to continue to operate in Delaware post 2035.

Motor Fuel Tax Impacts

States are facing a number of challenges funding their transportation programs. Revenues are not keeping pace with needs as vital infrastructure asses reach the end of their designed life cycle and populations grow and shift. Traditionally, states have relied on a variety of revenue sources for transportation funding under a "user pays, user benefits" principle that roughly approximates a "user fee" which includes vehicle registration fees, tolls and state and federal gas and diesel taxes also known as "motor fuel taxes". Motor fuel taxes are the predominant source of transportation funding, but a number of variables has diminished the value of these taxes over time. These include rising fuel efficiency for vehicles, a shifting federal-state cost share on infrastructure investments and inflation. Motor fuel taxes have remained at 1993 levels further reducing the value of revenue received for transportation funding.

As more and more electric or zero emitting vehicles come to market, states are examining how to advance their policy goals to support transportation electrification and meet transportation funding needs. The National Governors Association have prepared a white paper – *"State Transportation Revenue in a Coming Era of Electric Vehicles".*[193] This paper presented a variety of funding methods and highlights best practices from across the country – which include increasing existing motor fuel tax rates, indexing motor fuels to inflation, implementing mileage-based user fees and studying fuel-neutral fees, based on energy consumption.

Beginning in 2018, Delaware's Department of Transportation (DelDOT) partnered with the Eastern Transportation Coalition, a partnership of 17 Eastern U.S. states and Washington, D.C. to explore the feasibility of a mileage-based user fee (MBUF) as a replacement for the pay-

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[192] White House. 2023. Fact Sheet: Biden-Harris Administration Announces New Standards and Major Progress for Made-in-America National Network of Electric Vehicle Chargers. Retrieved from FACT SHEET: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicle Chargers | The White House. https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/

[193] National Governors Association. 2022. Retrieved from White-Paper-Planning-for-State-Transportation-Revenue-in-a-Coming-Era-of-Electric-Vehicles.pdf (nga.org) https://www.nga.org/publications/planning-for-state-transportation-revenue-in-a-coming-era-of-electric-vehicles/

at-the-pump tax. Through a series of demonstration pilots, surveys and analyses, DelDOT and the coalition determined that MBUF can be a viable alternative for the motor fuel tax.[194]

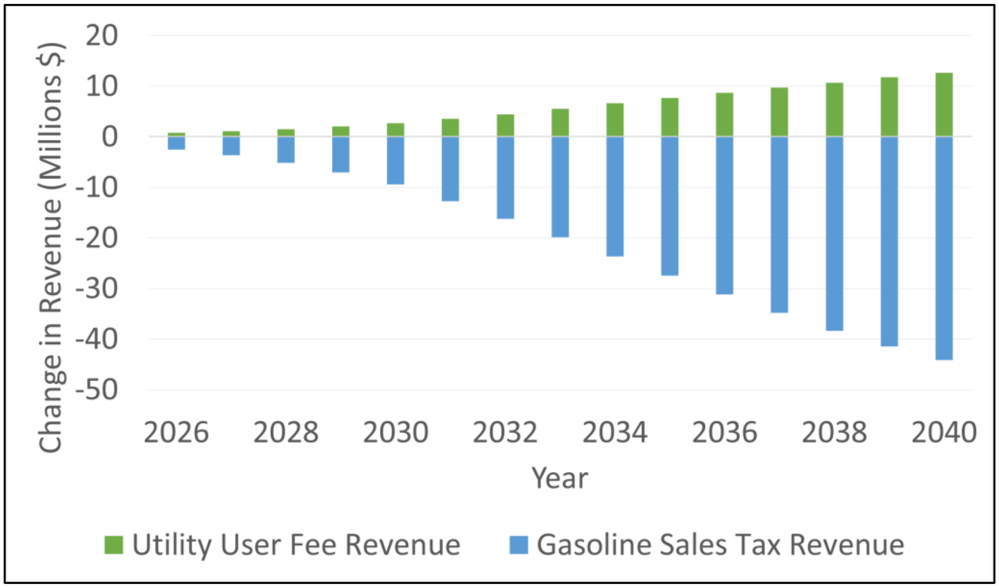

Figure 11-3. Change in Government Revenue from Vehicle Fuel

Many states are already working to adopt measures to address the loss in revenues attributed to inflation, fuel economy gains and the increased number of electric vehicles through specific vehicle registration fees for electric vehicles. The National Conference of State Legislators has identified five states that have adopted the California Zero Emitting Vehicle standards have increased vehicle registration fees for electric vehicles.[195]

Table 11-19. Electric Vehicle Registration Fees by State.

STATE	Electric Vehicle Registration Fees
Alabama	$200 annual fee for EVs.
Arkansas	$200 annual fee for EVs.
California:	$100 annual fee for a zero-emissions vehicle. Starting in January 2021, annual increases will be indexed to the consumer price index.
Colorado:	$50 annual fee for full-electric and plug-in hybrid (PHEV) vehicles.

[194] Eastern Transportation Coalition. 2022. Exploration of Mileage-based User Fee Approaches for All Users. Retrieved from Findings / Reports - The Eastern Transportation Coalition MBUF Pilot (tetcoalitionmbuf.org). https://tetcoalitionmbuf.org/wp-content/uploads/2022/02/Exploration-of-Mileage-Based-User-Fee-Approaches-for-All-Users_Condensed-1.pdf

[195] NCSL. 2023. Special Fees on Plug-in Hybrids and Electric Vehicles. Retrieved from https://www.ncsl.org/energy/special-fees-on-plug-in-hybrid-and-electric-vehicles#:~:text=%24150%20additional%20annual%20fee%20for,as%20the%20motor%20fuel%20tax

STATE	Electric Vehicle Registration Fees
Georgia:	$200 annual license fee for “noncommercial alternative fueled vehicles,” including EVs, but not PHEVs (unless the owner requests an alt-fuel license plate). The fee is automatically adjusted on an annual basis.
Hawaii:	$50 annual fee for full-electric and plug-in hybrid (PHEV) vehicles.
Idaho:	$140 annual fee for EVs; it’s $75 for PHEVs. 2.5 cents per mile fee that drivers can pay in lieu of the $300 fee
Illinois:	$100 annual fee for EVs beginning July 1, 2019.
Indiana:	$150 annual fee for EVs; it’s $50 for hybrids and PHEVs.
Iowa:	$65 additional annual fee for battery electric vehicles (BEVs). $32 additional annual fee for plug-in hybrid electric motor vehicles (PHEVs). In 2021, the fee increases to $97 for BEVs and $48.75 for PHEVs. In 2022, the fee increases to $130 for BEVs and $65 for PHEVs.
Kansas:	$100 total annual registration fee for all-electric vehicles. $50 total annual registration fee for electric hybrid and plug-in electric hybrid vehicles. Because the state’s EV fees are total, not additional, electric and hybrid vehicles are not charged a separate or passenger vehicle registration fee, but instead are charged an increased fee of $100 for all-electric vehicles and $50 for hybrid electric vehicles.
Louisiana:	$110 fee for EVs and a $60 fee for plug-in hybrids, which is effective starting in 2023
Michigan:	$135 annual fee for non-hybrid electric vehicles weighing less than 8,000 pounds; it’s $235 for those weighing more than 8,000 pounds. The state charges hybrid owners an extra $47.50 and PHEV drivers an added $117.50. These fees are indexed to the state gas tax and would rise incrementally if it is increased.
Minnesota:	$75 annual fee on EVs.
Mississippi:	$150 fee on EVs and a $75 fee on hybrids. Beginning July 1, 2021, these fees will be indexed to the inflation rate.
Missouri:	$75 annual fee on EVs, and $37.50 on PHEVs.
Montana:	$50 for EVs; hybrids and plug-in vehicles.
Nebraska:	$75 annual fee on alternative-fuel vehicles, including EVs.

STATE	Electric Vehicle Registration Fees
North Carolina:	$130 on plug-in vehicles, including EVs.
North Dakota:	Annual fees of $143 for plug-in hybrids, which varies depending on vehicle weight and year of registration. Annual fees of $213 for electric vehicles, which varies depending on vehicle weight and year of registration.
Ohio:	Annual fees of $231 for plug-in electrics. Annual fees of $131 for hybrid vehicles.
Oklahoma:	tiered EV fees based on vehicle weight, with a $110 fee for EVs under 6,000 pounds
Oregon:	$110 annual fee on PHEVs beginning on January 1, 2020.
South Carolina:	$120 biennial fee for EVs; it's a $60 biennial fee for hybrids.
South Dakota:	$50 annual fee for full-electric and plug-in hybrid (PHEV) vehicles.
Tennessee:	$100 annual fee for EVs.
Utah:	$60 annual fee for EVs; it increases to $90 in 2020 and $120 in 2021. Hybrids are assessed a $10 fee that rises to $15 in 2020 and $20 in 2021. It's currently a $26 annual fee for PHEVs that jumps to $39 in 2020 and $52 in 2021. In 2022 increases will be indexed to the consumer price index.
Virginia:	$64 annual license for EVs.
Washington:	$225 annual fee for EVs.
Wisconsin:	$100 annual fee for EVs.
Wyoming:	$200 annual fee for EVs.

The Department received comments concerning what is perceived as higher insurance cost for electric vehicles. Insurance costs are typically based on the cost and value of a vehicle. EV and ICE vehicles with higher values will likely incur a greater cost to insure. For example, premium EVs such as the Mercedes EQS and Porsche Taycan have higher insurance costs due to the complexity of the parts, and the luxury interior and exterior of the vehicle. As repair shops and dealerships become better equipped to handle ZEV repairs, insurance costs are expected to decrease.[196]

[196] Electric car insurance: Is it more expensive? Progressive. (2023). Retrieved April 4, 2023, from https://www.progressive.com/answers/car-insurance-electric-vehicles/

Section 12 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no population bears a disproportionate share of negative environmental consequences resulting from industrial, municipal, and commercial operations or from the execution of federal, state, and local laws, regulations, and policies. Meaningful involvement requires effective access to decision makers for all, and the ability in all communities to make informed decisions and take positive actions to produce environmental justice for themselves.[197]

Improving access to clean transportation and mobility options for low-income households and communities most impacted by pollution supports equity and environmental justice and is key in achieving emission reductions. The significant pollution reductions from the proposed amendments to Delaware's Low Emission Vehicle Program as a whole, when accounting for cleaner ICEVs as well as ZEVs, will reduce exposure to vehicle pollution in communities throughout Delaware, including in low-income and disadvantaged communities that are often disproportionately exposed to vehicular pollution.

Further, the proposed ZEV assurance measures, presented in the proposed amendments (13 CCR 1962.4(e)), will ensure these emissions benefits are realized and long-lasting, while supporting more reliable ZEVs in the used vehicle market, where the cost of ZEVs become more affordable to lower-income households.

The proposed amendments also provide opportunities for manufacturers to take actions that improve access to ZEVs for disadvantaged, low-income, and other frontline communities, including investments in community car share programs, producing affordable ZEVs, and keeping used vehicles in Delaware.

In addition to meeting health-based air quality standards and climate change goals, emission reductions are particularly necessary in areas most vulnerable to, and that have been disproportionately impacted by, pollution. In many overburdened and underserved communities, the pollution and public health impacts from on-road vehicle emissions are especially significant and greater than in other communities.

These impacts are often compounded by the proximity of nearby industrial sources, including upstream, midstream, and downstream fuel production sources. Underserved communities are also especially vulnerable to the economic impacts and health burdens associated with climate change, as the most severe harms from climate change fall disproportionately upon these underserved communities who are least able to prepare for and

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[197] What is environmental justice? Energy.gov. (2022). Retrieved June 14, 2022, from https://www.energy.gov/lm/services/environmental-justice/what-environmental-justice

recover from associated impacts.[198] [199] [200]

Environmental Justice communities in Delaware also see rising vehicle counts nearly every year. This is due to the communities being close to high traffic roadways like I295 and I495. As of now most of these vehicles are ICE vehicles that are emitting harmful pollutants near these communities.[201] With ACCII these communities will face a smaller burden of harmful pollutants due to fewer tailpipe emissions from vehicles.

The impacts of climate change and air pollution affect all Delawareans, but residents in disadvantaged and low-income communities are especially vulnerable and often face the most severe impacts. By increasing the number of ZEVs on the road and continuing to clean up conventional internal combustion vehicles, the ACC II regulatory proposals will reduce exposure to vehicle pollution in communities throughout Delaware, including in frontline communities that are disproportionately exposed to vehicular pollution.

Making access to ZEVs and clean mobility in low-income and frontline communities is of importance. The proposed ACC II regulations will reduce vehicle pollution in communities that are often adversely impacted by motor vehicle pollution, such as near roadway communities, by reducing emissions from ICEVs and accelerating the transition to ZEVs. Further, the proposed ZEV assurance measures will ensure these emissions benefits are long lasting and support the development of a robustly used ZEV market. In addition, the ZEV regulation incentivizes automakers to invest in community carshare programs, produce more affordable ZEVs, and ensure that more used ZEVs are available. While the proposed ACC II regulations will advance equity, a whole-of-government approach is needed to maximize access, ensure affordability, and direct benefits to low-income and frontline communities. Thus, other policies and programs beyond ACC II will be needed in California and Section 177 of the CAA states to ensure these communities benefit from and have direct access to ZEVs. Low-income communities will see a large increase in the number of ZEVs available at more affordable price points.

Considering Equity in Advanced Clean Cars

Improving access to clean transportation and mobility options for low-income households and communities most impacted by pollution supports equity and environmental justice and is key in achieving emission reductions. Delaware's statewide strategy to address these goals includes ACC II in helping to reduce exposure to criteria pollutants and toxic air contaminants in burdened communities. The significant pollution reductions from the proposal as a whole, when accounting for cleaner ICEVs as well as ZEVs, will reduce exposure to vehicle pollution in communities

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[198] EPA 2021c. United States Environmental Protection Agency. Climate Change and Social Vulnerability in the United States: A Focus on Six Impact Sectors. September 2021. Accessed January 31, 2022. 73 IPCC 2021. (EPA 430-R-21-003) https://www.epa.gov/cira/social-vulnerabilityreport

[199] Petkova 2016. Elisaveta Petkova. The Disproportionate Consequences of Climate Change. February 12, 2016. Accessed January 31, 2022. https://ncdp.columbia.edu/ncdp-perspectives/the-disproportionate-consequences-of-climate-change/

[200] *Delaware Climate + Health Conference Summary Report. DNREC 2017. Accessed on March 8, 2023 - https://documents.dnrec.delaware.gov/energy/Documents/Climate%20Health%20Conference/DE%20Climate%20+%20Health%20Report.pdf*

[201] The State of Delaware - Department of Transportation. (2021). DelDOT gateway. Delaware Department of Transportation. Retrieved February 28, 2023, from https://deldot.gov/Programs/gate/index.shtml

throughout Delaware, including in low-income and disadvantaged communities that are often disproportionately exposed to vehicular pollution.

Under the Inflation Reduction Act[202], the Bipartisan Infrastructure Law[203], and additional programs, Delaware is in the position to access opportunities for federal funding that support and amplify the goals of Advanced Clean Cars II and the Clean Air Act. For example, many of these grant programs can be used to support infrastructure, transportation accessibility, air quality improvement, and the adoption of electric vehicles on the road. It is important to note that not all funding opportunities are currently available and may vary by the needs of the state, program funding priorities, and budget constraints of the relevant federal agencies. However, the State of Delaware is tracking these programs and preparing to apply for these funds when they become available. Through proactive monitoring and preparation, the state is better equipped to take advantage of funds to support clean air and clean transportation goals.

In addition, the zero-emission vehicle assurance measures, such as minimum warranty and durability requirements, increased serviceability, and facilitate charging and battery labeling, will help ensure all consumers can successfully replace their higher polluting vehicles with new or used vehicles that meet their needs for transportation and protect the emission benefits of the program. These measures are particularly important for consumers in lower-income and underserved communities where used vehicle sales are significant. Giving consumers additional assurance that their used zero-emission vehicle purchase meets minimum requirements is key for broader market uptake.

The proposed changes to converted ZEV and PHEV values provisions also incentivize automakers to participate in ACC II's environmental justice programs. By placing more ZEVs and PHEVs in community-based clean mobility programs and selling more affordable ZEVs and PHEVs below the manufacturer's suggested retail price, automakers can unlock full usage of the cumulative allowance option for compliance. Car manufacturers can receive EJ credits for increasing affordability of ZEVs for Delaware's undeserved communities.

Finally, the regulations offer automakers additional compliance opportunities for actions to improve access to zero-emission vehicles in overburdened and lower-income communities, such as providing reduced price zero-emission vehicles for community mobility programs, producing affordable zero-emission vehicles, and retaining used vehicles in Delaware to support the state's complimentary policies and incentives.[204]

Improving access to clean transportation and mobility options for low-income households and communities most impacted by pollution supports equity and environmental justice and is key in achieving emission reductions. The Department's Division of Climate, Coastal and Energy is working to develop additional programs to promote clean transportation across all

[202] Inflation reduction act of 2022. Internal Revenue Service. (2022). Retrieved February 28, 2023, from https://www.irs.gov/inflation-reduction-act-of-2022
[203] The United States Government. (2023, February 21). Building a better america. The White House. Retrieved February 28, 2023, from https://www.whitehouse.gov/bipartisan-infrastructure-law/
[204] Advanced Clean Cars II Regulations: All New Passenger Vehicles Sold in California to be Zero Emissions by 2035, CARB (2021) Accessed (3/1/2023) https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii

Delaware economic sectors.

Through ACCII's requirements, funding opportunities, and incentives, Delaware is determined to provide opportunities to Environmental Justice communities throughout the rollout of ACCII.

Section 13 Public Participation

After the Start Action Notice was issued in July 2022, DNREC held a series of workshops to provide information on the ACCII program and gather input and comments from key stakeholders and the general public regarding the proposed amendments to 7 **DE Admin. Code** 1140. The sections below describe DNREC's public participation process leading up to the public hearing, to be held on April 26, 2023.

Key Stakeholder Workshops

DNREC held two virtual Key Stakeholder Workshops on October 13, 2022, and October 26, 2022. The workshops had the following number of public participants, with some stakeholders attending both workshops: 33 (10/13/22) and 26 (10/26/22). The workshop agenda included the following topics/items:

- Overview of Advanced Clean Cars II Program
  - Low Emission Vehicle Requirements
  - Greenhouse Gas Requirements
  - Zero Emission Vehicle Requirements
- Proposed Regulatory Language Review (7 **DE Admin. Code** 1140)
- Complementary Policies and Programs
- Implementation
- Open Discussion
- Next Steps

Key stakeholders included, but were not limited to:

- Alliance for Automotive Innovation
- Builders & Remodelers Associations of Delaware
- Caesar Rodney Institute
- ChargePoint
- Clean Air Council
- Climate and Environmental Justice Committee, Central DE NAACP
- Delaware Automobile Dealers Association
- Delaware Automobile and Truck Dealers Association (DATDA)
- Delaware Concerned Residents for Environmental Justice
- Delaware Environmental Justice Community Partnership
- Delaware Electric Cooperative
- Delaware Electric Vehicle Association
- Delaware Lung Association
- Delaware Nature Society
- Delmarva Power
- DELDOT
- Delaware Municipal Electric Corporation
- Healthy Communities Delaware
- Hyundai

- League of Women Voters
- Members of the Delaware General Assembly
- Mid Atlantic Alliance for Climate and Health
- Mid-Atlantic Petroleum Fuel Distributors
- National Resources Defense Council
- Public Service Commission
- Rivian
- Ruggerio, Willson, and Watson Lobbyists
- Sierra Club
- Tesla
- Wilmington Area Planning Council
- Washington, Maryland, Delaware Service Station and Automotive Repair Association/ The Council of Automotive Repair (WMDA/CAR)

Public Workshops

DNREC subsequently held five virtual Public Workshops on the following dates, with attendance numbers listed:

- November 15, 2022 (38 Public Participants)
- November 16, 2022 (42 Public Participants)
- November 17, 2022 (29 Public Participants)
- December 13, 2022 (113 Public Participants)
- December 15, 2022 (246 Public Participants)

The Agendas for these Public Workshops were similar to the Key Stakeholder Workshops Agendas.

Public Comments

Over 700 public comments were received on the proposed amendments as of March 31, 2023. Please find in Table 12-1 the summary of the public comments received from October 3, 2022, to March 31, 2023 for consideration for the proposed amended regulation, prior to the public hearing. The table also identifies the Section of this Technical Support Document in which each general comment is addressed, if applicable.

Public Electric Vehicle Survey

The Department's Division of Climate, Coastal and Energy contracted with the University of Delaware to conduct a survey – *"Delaware Resident's Opinions on Electric Vehicles and Climate Change"*. The survey results are provided in the Appendices.

Table 13-1 – Summarization of Public Comments Received

General Comment	TSD Section
Delaware does not need additional emission reductions; our air quality is ok/meets the standards	Section 2.0 – Delaware's Air Quality
Pollution is caused by non-Delaware registered vehicles	Section 3.0 – Delaware's Vehicle Emissions
Department lacks authority to adopt vehicle emission standards	Section 4.0 – Vehicle Emission Standards
Department has overstepped its authority and this proposal is unconstitutional	Section 4.0 – Vehicle Emission Standards
Proposal will ban gasoline vehicles in Delaware	Section 5.0 – Proposed Amendments
Delawareans will be forced to buy electric vehicles	Section 5.0 – Proposed Amendments
Will impact farm equipment	Section 5.0 – Proposed Amendments
Large Diesel trucks will be affected	Section 5.0 – Proposed Amendments
Delivery and work trucks will be affected	Section 5.0 – Proposed Amendments
Impact to tourism, access to gasoline will decrease, prohibit tourism	Section 5.0 – Proposed Amendments
Pollution resulting from lithium mining	Section 6.0 – Vehicle Technology
Vehicle range anxiety: battery range insufficient, need to charge too frequently	Section 6.0 – Vehicle Technology
Vehicle charging infrastructure: charger availability, public charging, multi-unit dwelling charging	Section 8.0 – Complementary Policies
Vehicle charging infrastructure maintenance	Section 6.0 – Vehicle Technology
Public vehicle charging infrastructure security	Section 6.0 – Vehicle Technology
Concerns regarding battery safety (fires) and disposal	Section 6.0 – Vehicle Technology
Battery life low	Section 6.0 – Vehicle Technology
Concerns regarding battery raw materials mined in Africa	Section 6.0 – Vehicle Technology
Vehicle availability: technology is not ready	Section 6.0 – Vehicle Technology
Fossil fuels are used to produce batteries	Section 6.0 – Vehicle Technology
Battery disposal will hurt environment	Section 6.0 – Vehicle Technology
Electric companies don't want people to install solar	Section 7.0 – Grid Resiliency and Impacts
Impacts to the electricity grid/power outages/blackouts etc.	Section 7.0 – Grid Resiliency and Impacts
Shifting creation of carbon monoxide from several locations (mobile sources) to power plants	Section 7.0 – Grid Resiliency and Impacts
Not enough green energy to support electric vehicles	Section 7.0 – Grid Resiliency and Impacts
Most electricity comes from fossil fuels	Section 7.0 – Grid Resiliency and Impacts
High costs of electric vehicles	Section 11.0 – Economic Benefits/Analysis Section 8.0 – Complementary Policies
Vehicle costs/impacts to low-income consumers	Section 11.0 – Economic Benefits/Analysis

	Section 8.0 – Complementary Policies
Support batteries being made in the US	Section 11.0 – Economic Benefits/Analysis
Cost of upgrades to homes for chargers	Section 11.0 – Economic Benefits/Analysis
Batteries expensive to replace	Section 11.0 – Economic Benefits/Analysis
Economic impact on car dealerships and mechanics	Section 11.0 – Economic Benefits/Analysis
Should charge gas tax on EVs	Section 11.0 – Economic Benefits/Analysis
Will shut down gas stations and put people out of work	Section 11.0 – Economic Benefits/Analysis
Insurance costs are higher for ZEVs	Section 11.0 – Economic Benefits/Analysis
Generally oppose adoption of amended regulation	NA

Public Hearing

The proposed amendments and public hearing announcement will be published in the Delaware Register of Regulations on April 1, 2023. A public hearing is scheduled for April 26, 2023. The public hearing will provide an opportunity for the public to submit verbal comments. In addition, written comments will be accepted until May 26, 2023.

Public Participation Documentation

Hearing exhibits, presentation slides, supporting documents, and comments received following the workshops are posted on the Department's Public Hearing website, under Docket # 2022-R-A-0011, for the April 26, 2023 hearing: https://dnrec.alpha.delaware.gov/public-hearings/.

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21-116 www.newcastlede.gov

26 Del Code 351 – Renewable Portfolio Standards Act. https://delcode.delaware.gov/title26/c001/sc03a/index.html

3 DE REG 352, October 1, 1999.

42 U.S.C. § 7507 (1994).

42 U.S.C. § 7521(b)(1)(C) (1994).

42 U.S.C. § 7543(b) (1994).

42 U.S.C. §§ 7401-7642 (1994).

42 U.S.C. 7409. Pursuant to section 109 CAA, EPA has established primary national ambient air quality standards (NAAQS) for each criteria pollutant, designed to protect human health, and secondary NAAQS, intended to protect public welfare.

42 USC Retrieved on March 28, 2023 from https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapII-partA-sec7543.htm

83 Del. Laws, c. 3, § 1; AN ACT TO AMEND TITLE 26 OF THE DELAWARE CODE RELATING TO RENEWABLE ENERGY PORTFOLIO STANDARDS. 2021.

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Appendix A – NESCAUM ACCII Modeling for Delaware

Link - https://documents.dnrec.delaware.gov/Admin/Hearings/2022-R-A-0011/Exhibits/DE-ACC-II-Emissions-Summary-Revised-020223-Locked.xlsx

Appendix B – ERG ACCII Modeling for Delaware

Link - https://documents.dnrec.delaware.gov/Admin/Hearings/2022-R-A-0011/Exhibits/ERG-Delaware-Final-Locked.xlsx

Appendix C - Delaware Residents' Opinions on Electric Vehicles and Climate Change 2022 Survey - Full Report of Results

Delaware Residents' Opinions on Electric Vehicles and Climate Change

2022 Survey

Full Report of Results

Prepared by

Paul Brewer, James Bingaman, Wyatt Dawson, and Aysha Siddika
University of Delaware

for the

Delaware Department of Natural Resources and Environmental Control
Division of Climate, Coastal and Energy

ABOUT THE DIVISION OF CLIMATE, COASTAL, & ENERGY

The Division of Climate, Coastal and Energy, housed within the Delaware Department of Natural Resources and Environmental Control, uses an integrated approach of applied science, education, policy development, and incentives to address Delaware's climate, energy, and coastal challenges. With a mission of providing leadership towards sustainable communities and environments now and for future generations, the Division works towards fostering clean energy, sustainable coasts, and a livable climate for all Delawareans.

ABOUT THE UNIVERSITY OF DELAWARE

The University of Delaware exists to cultivate learning, develop knowledge, and foster the free exchange of ideas. State-assisted yet privately governed, the University has a strong tradition of distinguished scholarship, which is manifested in its research and creative activities, teaching, and service, in line with its commitment to increasing and disseminating scientific, humanistic, artistic, and social knowledge for the benefit of the larger society. Founded in 1743 and chartered by the state in 1833, the University of Delaware today is a land-grant, sea-grant, and space-grant university.

The University of Delaware is a major research university with extensive graduate programs that is also dedicated to outstanding undergraduate and professional education. UD faculty are committed to the intellectual, cultural, and ethical development of students as citizens, scholars and professionals. UD graduates are prepared to contribute to a global and diverse society that requires leaders with creativity, integrity and a dedication to service.

The University of Delaware promotes an environment in which all people are inspired to learn, and encourages intellectual curiosity, critical thinking, free inquiry, and respect for the views and values of an increasingly diverse population.

An institution engaged in addressing the critical needs of the state, nation, and global community, the University of Delaware carries out its mission with the support of alumni who span the globe and in partnership with public, private, and nonprofit institutions in Delaware and beyond.

PROJECT TEAM

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INTRODUCTION

In Delaware, the transportation sector is the largest producer of greenhouse gas emissions. Over half of the transportation-related emissions in this sector come from passenger cars. Gasoline-burning vehicles also contribute to other forms of air pollution, such as nitrogen oxides, particulate matter, and ozone-forming volatile organic compounds (VOCs). Transitioning away from traditional gas cars, toward electric and alternative fuel vehicles, is a crucial strategy for meeting Delaware's climate change mitigation goals. However, purchasing a vehicle is a major investment. People naturally want to choose the option that is right for them, their families, their budget, and their daily needs. In light of this, it is important to understand both the opportunities and perceived barriers posed by electric vehicle adoption.

Recognizing the need to understand the public's attitudes about electric vehicles and to collect updated measures of the public's attitudes about climate change, the Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Climate, Coastal and Energy commissioned a 2022 survey aimed at gauging how Delawareans perceive electric vehicles and climate change and how strongly they support implementing actions to encourage electric vehicle use in Delaware. The survey was supervised by Dr. Paul Brewer, a professor in the Department of Communication at the University of Delaware.

The results indicate that most Delawareans are familiar with electric vehicles and that one in three are very or somewhat likely to choose an electric vehicle as their next vehicle. Most Delawareans say that they would be more likely to choose an electric vehicle if its price matched that of a traditional vehicle, if there more charging stations, and if there were financial incentives from the government. At the same time, majorities say that concerns about running out of power, costs, wait times for charging, and charging availability make them less likely to choose an electric vehicle.

Most Delawareans support a range of key strategies to encourage electric vehicle use and believe that increasing the use of electric vehicles would be effective in helping to reduce climate change. Most Delawareans are also convinced that climate change is happening and that the state should act now to reduce the impacts of climate change. A majority say they have personally experienced or observed the effects of climate change.

The results of the survey reveal gender gaps and differences across counties in attitudes about electric vehicles and climate change. Compared to men, women tend to express more support for actions to encourage electric vehicle use and greater belief that increasing electric vehicle use will help reduce climate change. In addition, New Castle County residents are more likely than Kent and Sussex County residents to support actions to encourage electric vehicle use and to believe that increasing electric vehicle use will help reduce climate change.

Delawareans tend to trust consumer sources, vehicle manufacturers, and their state government as sources of information about electric vehicles. They are divided on whether to trust the federal government and less trusting of car dealerships or the news media.

Appendix A includes a topline with the full questionnaire and results. Appendix B includes detailed demographic tables for results by gender, county of residence, and age cohort.

METHODOLOGY

This survey was conducted by Standage Market Research from August 17 to September 14, 2022, under a sub-contract agreement with the University of Delaware. A representative sample of 1001 Delaware residents were interviewed for the study either by telephone (500 respondents) or online (501 respondents). Interviewees were selected through random sampling. Statistical results are weighted by demographic factors to reflect the general population of Delaware. The margin of sampling error for the complete set of weighted data is ± 3.2 percentage points.

While Standage Market Research fielded the survey and weighted the results, the University of Delaware research team prepared all written summaries of the survey results in this report.

Two coders from the research team categorized open-ended responses into common themes. To establish intercoder reliability, the two coders independently analyzed a 20% sample, with all categories attaining acceptable reliability. Discrepancies between coders were resolved through discussion. The results in the report reflect the coders' consensus judgments.

All demographic differences presented in the report are statistically significant at the .05 level.

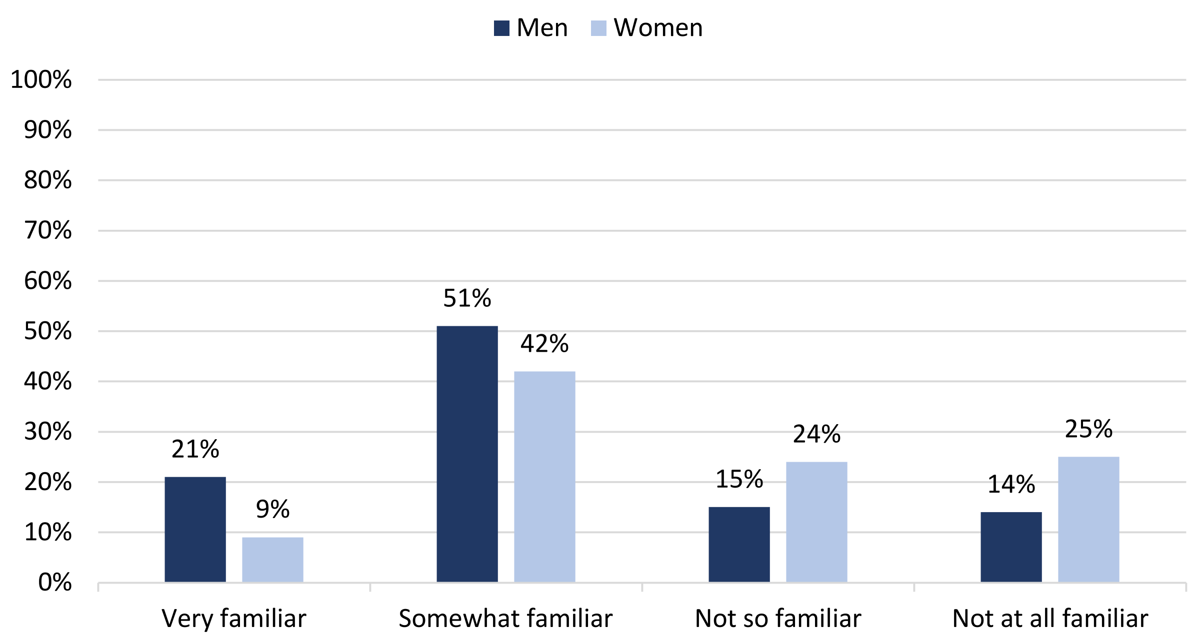
Due to rounding, not all percentages presented in the report sum to the subtotals and totals reported.

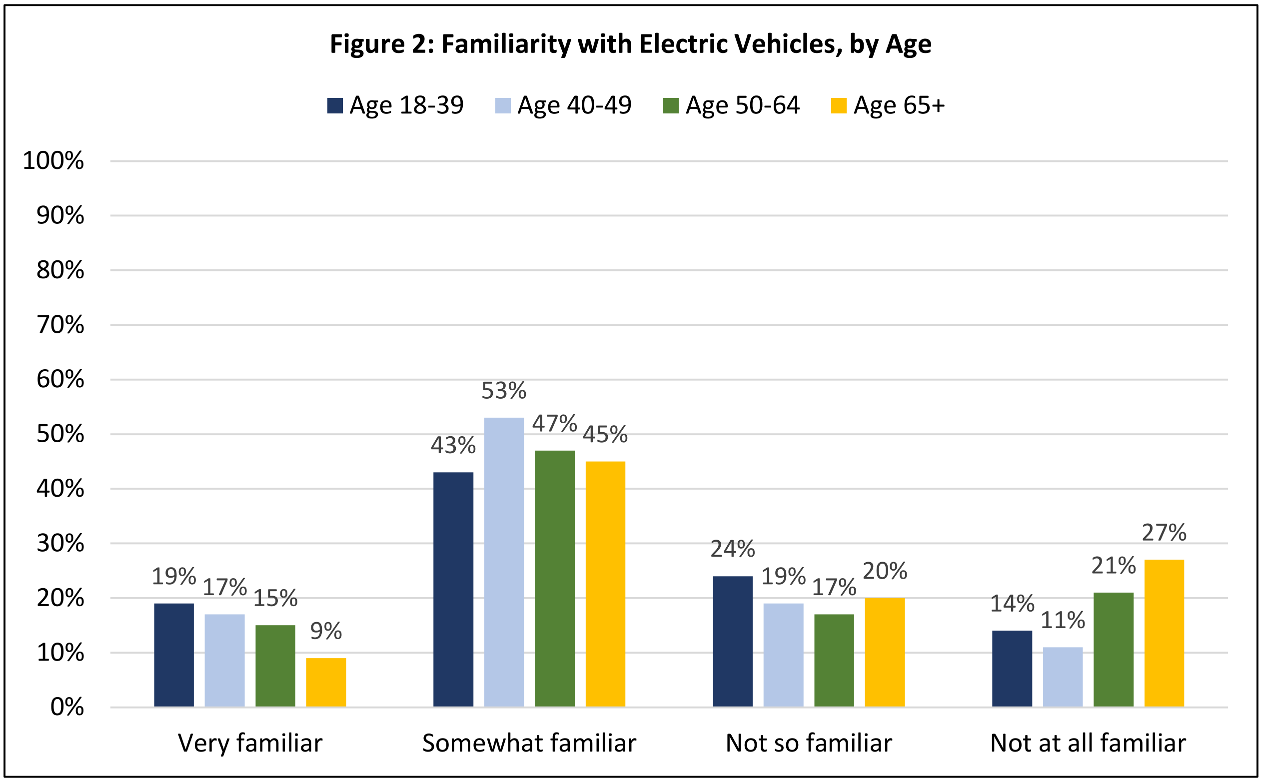
RESULTS

FAMILIARITY WITH ELECTRIC VEHICLES

The survey found that a majority of Delawareans (61%) reported being very familiar (15%) or somewhat familiar (46%) with electric vehicles. The results also reveal gender and age gaps in self-reported familiarity with electric vehicles. Compared to women, men are more likely to report familiarity with electric vehicles (71% versus 51%). In terms of age differences, Delawareans between the ages of 40 and 49 report the greatest familiarity with electric vehicles (70%), followed by those between 18 and 39 (62%) and those between 50 and 64 (62%). Those 65 years of age or older report the lowest level of familiarity (54%). Only 4% of all Delawareans say they currently own an electric vehicle.

Figure 1: Familiarity with Electric Vehicles, by Gender

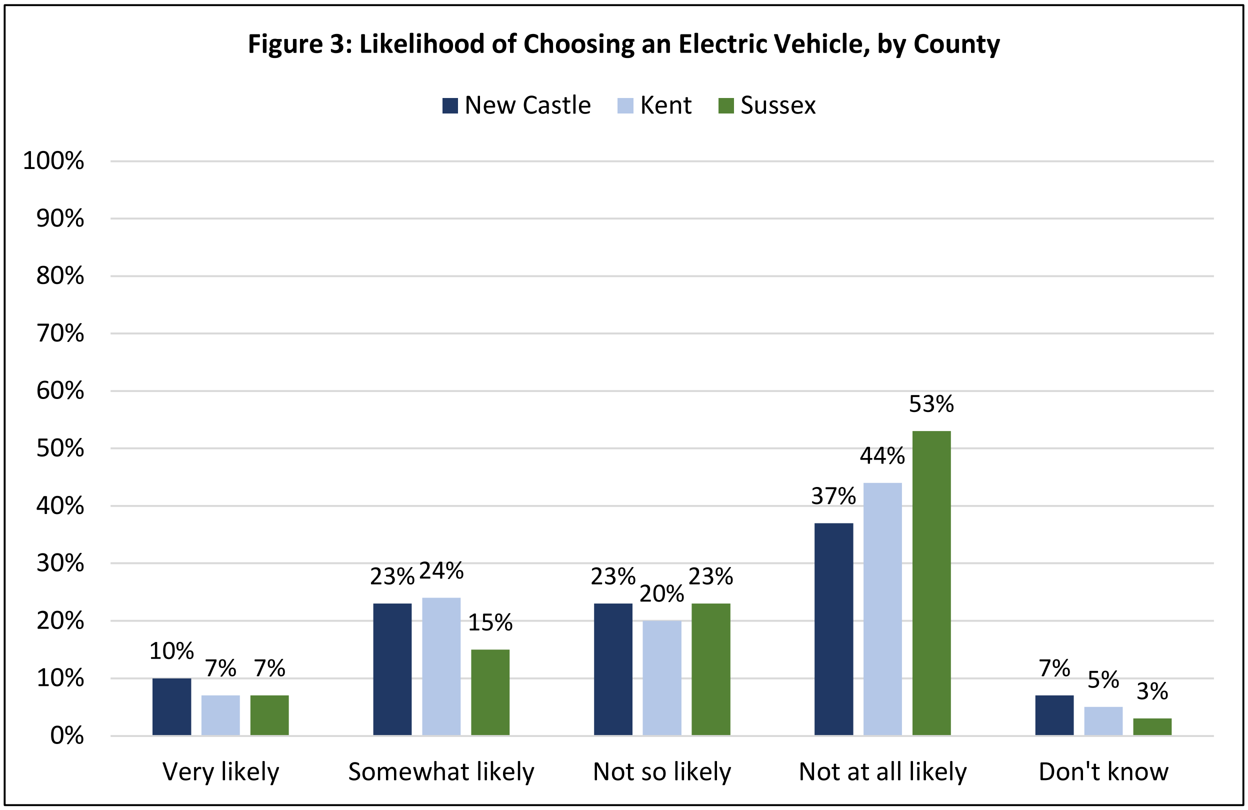




CHOICES REGARDING ELECTRIC VEHICLES

Slightly less than one in three Delawareans (30%) say they will be very likely (9%) or somewhat likely (22%) to choose an electric vehicle the next time they purchase or lease a vehicle. More than twice as many (65%) say they are not so likely (22%) or not at all likely (42%) to choose an electric vehicle.

The survey results also reveal differences in choices by county. Residents of New Castle County (33%) and Kent County (31%) are more likely than residents of Sussex County (22%) to say they may choose an electric vehicle.



When Delawareans who say that they are very are somewhat likely to choose an electric vehicle are asked to provide their top reason for doing so, around one in five (19%) mention environmental reasons such as reducing emissions. A similar percentage (19%) cite features of electric vehicles such as their need for less gas. Another 15% offer responses related to potential costs. Smaller percentages cite specific examples such as Tesla (4%) or broader concepts of progress (2%).

When Delawareans who say they are unlikely to choose an electric vehicle are asked to provide their top reason for not doing so, more than one in three (38%) mention potential vehicle or maintenance costs. Another 22% cite feasibility concerns such as a lack of infrastructure. Around one in five (20%) mention performance concerns such as a lack of range or battery life. Smaller percentages cite environmental issues such as battery disposal and mining (10%), lack of knowledge about electric vehicles (6%), safety issues such as data hacking or potential fire hazards (3%), or political principles (3%).

Table 1. Top reasons for choosing or not choosing an electric vehicle

	%	Most common words within category
Reasons for choosing		
Environment	19%	Environment(al), better, gas, climate, change
Features	19%	Gas, cost(s), maintenance, fuel, environment(al)
Costs	15%	Gas, cost(s), price(s), save, environment(al)
Reasons for not choosing		
Costs	38%	Cost(s), expense(s)/expensive, price(s), battery/batteries, charge/charging
Feasibility	22%	Charge/charging, electric(ity), station(s), cost(s), grid
Performance	20%	Charge/charging, cost(s), range, battery/batteries, expense(s)/expensive
Environment	10%	Battery/batteries, electric(ity), environment(al), gas, fossil

ACTIONS, CONCERNS, AND CHOICES ABOUT ELECTRIC VEHICLES

Almost two-thirds of Delawareans (64%) say that they would be much more or somewhat more likely to choose an electric vehicle if its price matched that of a traditional vehicle. Majorities of Delawareans also say that they would be more likely to choose an electric vehicle if provided with more charging stations (62%) or financial incentives from the government (59%). However, most Delawareans say that matching the style of traditional vehicles (58%) or providing extended test drives from dealerships (59%) would not make them more likely to choose an electric vehicle.

Nearly three in four Delawareans (73%) say that concerns about running out of power make them much less likely or somewhat less likely to choose an electric vehicle. Similarly, majorities of Delawareans say that concerns about initial cost (71%), long wait times for charging (69%), the availability of public charging stations (68%), the cost of service and repairs (66%), and lack of charging at home (63%), make them less likely to choose an electric vehicle. Around half of Delawareans say that concerns about vehicle availability (54%) and vehicle performance (52%) make them less likely to choose an electric vehicle, while fewer than half say the same for concerns about variety in models (43%) and the use of new technology (34%).

OPINIONS ABOUT CHARGING ELECTRIC VEHICLES

A majority of Delawareans (62%) say that they have seen an electric vehicle charging station in their community. Around half (49%) say that they would be willing to wait less than 15 minutes to charge an electric vehicle to add 100 miles of driving range. Another one in three (30%) say that they would be willing to wait 30 minutes to an hour. Relatively few Delawareans say that they would be willing to wait 30 minutes to an hour (7%) or more than an hour (4%) to charge an electric vehicle.

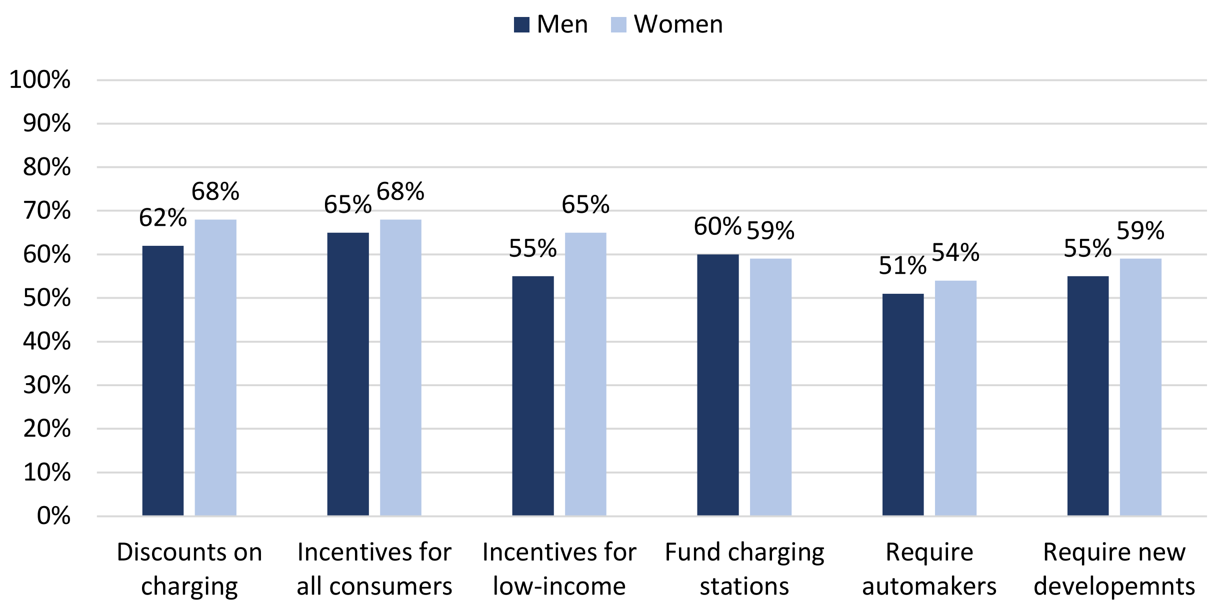
When asked about potential amenities near charging stations, most Delawareans (79%) say that having a restroom would be very or somewhat important to them. Majorities also say that having a coffee shop or restaurant (68%), an indoor seating area (54%), and free wifi (54%) would be important to them. Fewer Delawareans say that having shopping options (49%) or a recreation area or fitness facility (32%) would be important.

OPINIONS ABOUT ACTIONS ON ELECTRIC VEHICLES

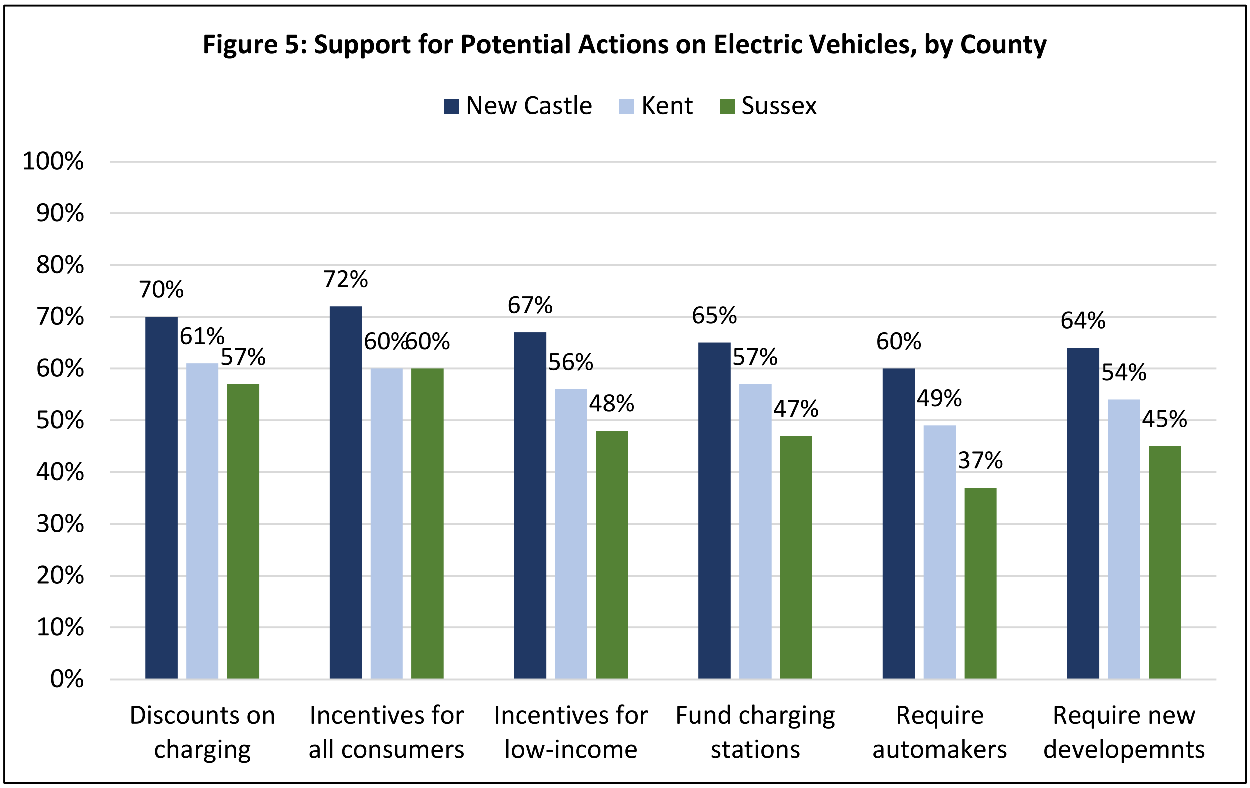
Delawareans support multiple actions to encourage the adoption of electric vehicles. Fully two-thirds (67%) support offering discounts on electricity to charge electric vehicles at times when demand is low. Most Delawareans also support providing incentives and tax rebates for electric vehicles to all consumers (66%), providing incentives and tax rebates to low-income consumers (60%), providing funding to increase the availability of charging stations (59%), and requiring new residential and commercial developments to include plugs for electric vehicle chargers (57%). Around half of Delawareans favor requiring automakers to offer more electric vehicle options in the state (52%).

The survey results reveal differences in support for these actions across gender and county of residency. Compared to men, women are more likely to support discounts on charging, incentives for all consumes, incentives for low-income consumers, requirements for automakers, and requirements for new developments. Furthermore, men are particularly likely to *strongly* oppose each of these actions along with funding for charging stations.

Figure 4: Support for Potential Actions on Electric Vehicles, by Gender



Across all six actions, New Castle residents report higher levels of support than do residents of Kent and Sussex counties. In addition, Kent County residents are more likely than Sussex County residents to support incentives for low-income consumers, funding for charging stations, requirements for automakers, and requirements for new developments.



TRUST IN SOURCES OF INFORMATION ABOUT ELECTRIC VEHICLES

Four in five Delawareans (80%) trust consumer sources such as Kelly Blue Book and Edmunds a great deal or a fair amount as sources information about electric vehicles. Majorities also trust vehicle manufacturers (65%) and the Delaware state government (57%) as sources of information about electric vehicles. Around half of Delawareans (51%) trust the federal government when it comes to electric vehicles, whereas fewer than half trust car dealerships (46%) or the news media (40%).

BELEIFS ABOUT ELECTRIC VEHICLES AND CLIMATE CHANGE

Most Delawareans (64%) believe that increasing the use of electric vehicles would be very or somewhat effective in helping to reduce climate change, though women are more likely than men to believe so (67% to 60%). Additionally, New Castle County residents (70%) are more likely than Kent County (61%) and Sussex County (51%) residents to believe that increasing the use of electric vehicles would be effective in reducing climate change.

Most Delawareans are completely or mostly convinced that climate change is happening (71%), more than half (60%) say they have personally experienced or observed local impacts of climate change, and two-thirds (67%) agree that we should take immediate action to reduce the impacts of climate change. Compared to men, women are more likely to believe that climate change is happening (76% to 67%), more likely to report having personally experienced or observed the impacts of climate change (66% to 53%), and more likely to favor immediate action on climate change (72% to 61%). In terms of patterns across counties, New Castle County (75%) and Kent County (73%) residents are more likely than Sussex County residents (62%) to believe that climate change is happening. In addition, New Castle County residents (70%) are more likely than residents of Kent County (65%) and Sussex County (61%) to favor immediate action on climate change.

Figure 6: Opinion on Use of Electric Vehicles to Reduce Climate Change, by Gender

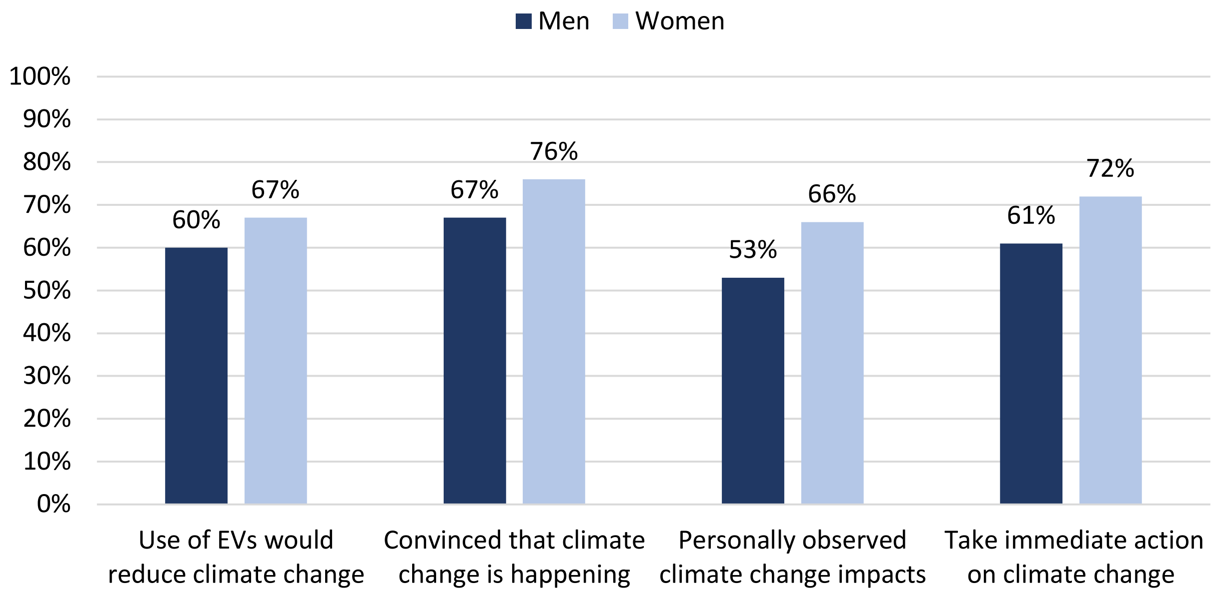
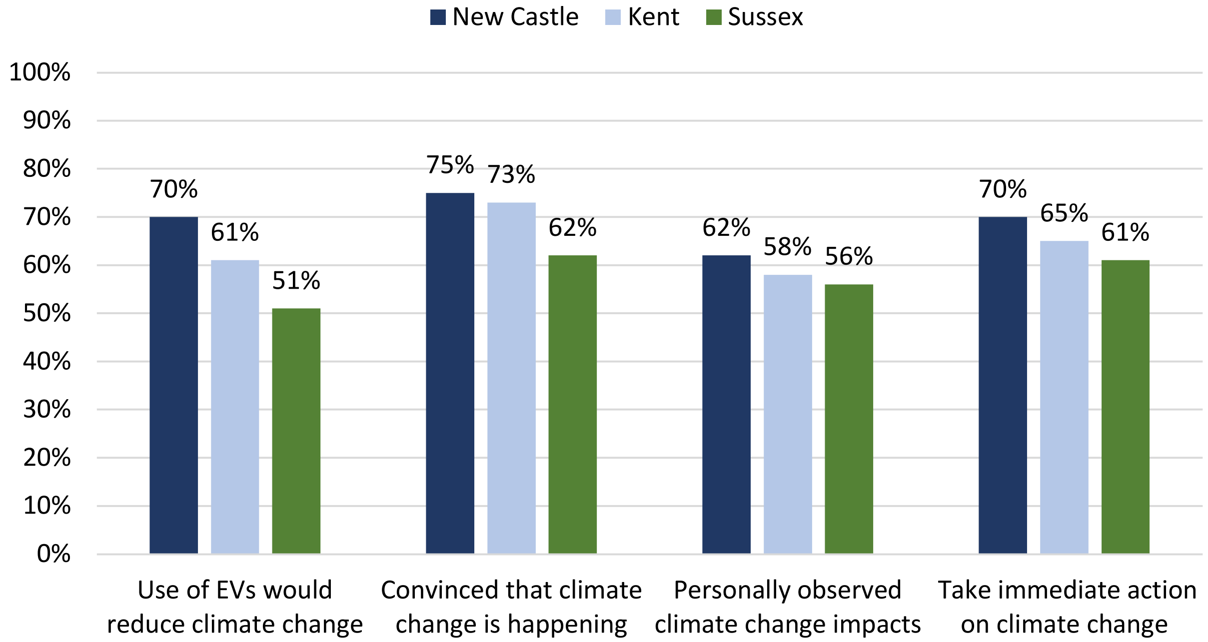


Figure 7: Opinion on Use of Electric Vehicles to Reduce Climate Change, by County



Delawareans support multiple strategies for reducing climate change. More than four-fifths (83%) favor increasing conservation of forested and agricultural lands. Majorities also support requiring stronger air pollution control for business and industry (78%), requiring that an increasing percentage of electricity used in Delaware come from renewable sources (69%), and requiring stronger energy efficiency standards on household appliances (69%). Fewer Delawareans favor requiring that an increasing percentage of vehicles sold in Delaware be powered by electricity, but a plurality still support this strategy (41% versus 36% opposed).

FOR MORE INFORMATION

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Appendix A: Survey Topline

Delaware Residents' Opinions on Electric Vehicle and Climate Change
Delaware Department of Natural Resources and Environmental Control and
University of Delaware Center for Political Communication
August 17 – September 14, 2022
N = 1,001

Results are weighted by demographic factors to reflect the general population of Delaware. Not all percentages sum to 100% due to rounding. In addition, not all results below sum to totals included in the text of the report due to rounding.

Q1. How familiar are you with electric vehicles–are you very familiar, somewhat familiar, not so familiar, or not at all familiar with them?

Very familiar	15%
Somewhat familiar	46%
Not so familiar	20%
Not at all familiar	19%

Q2. Do you currently own or lease an electric vehicle?

Yes	4%
No	96%

Q3. The next time you purchase or lease a vehicle, how likely are you to choose an electric vehicle–are you very likely, somewhat likely, not so likely, or not at all likely to do so?

Very likely	9%
Somewhat likely	22%
Not so likely	22%
Not at all likely	42%
(Do not read) Don't know	5%

Q4. IF Q3 = "VERY LIKELY" OR "SOMEWHAT LIKELY" ASK: "What is your top reason for choosing an electric vehicle?" [Open-ended answer; see text of report for results]

Q5. IF Q3 = "NOT SO LIKELY" OR "NOT AT ALL LIKELY" ASK: "What is your top reason for not choosing an electric vehicle?" [Open-ended answer; see text of report for results]

Q6. Next, I am going to read a list of potential actions to make it easier to choose an electric vehicle, and I would like for you to tell me whether each action would make you MORE likely to choose an electric vehicle. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - would this make you much more likely, somewhat more likely, or no more likely to choose an electric vehicle? (NEXT ITEM; IF NECESSARY: much more likely, somewhat more likely, or no more likely?

a. Providing more charging stations

Much more likely	35%
Somewhat more likely	27%
No more likely	35%
(Do not read) Don't know	3%

b. Matching the price of traditional vehicles

Much more likely	37%
Somewhat more likely	27%
No more likely	32%
(Do not read) Don't know	4%

c. Matching the style of traditional vehicles

Much more likely	15%
Somewhat more likely	25%
No more likely	58%
(Do not read) Don't know	3%

d. Providing government financial incentives

Much more likely	31%
Somewhat more likely	28%
No more likely	38%
(Do not read) Don't know	3%

e. Providing extended test drives from dealerships

Much more likely	14%
Somewhat more likely	24%
No more likely	59%
(Do not read) Don't know	3%

Q7. Now, I am going to read a list of potential concerns about electric vehicles, and I would like for you to tell me whether each concern makes you LESS likely to choose an electric vehicle. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - does this make you much less likely, somewhat less likely, or no less likely to choose an electric vehicle? (NEXT ITEM; IF NECESSARY: much less likely, somewhat less likely, or no less likely?)

a. Running out of power

Much less likely	52%
Somewhat less likely	21%
No less likely	24%
(Do not read) Don't know	2%

b. Availability of public charging stations

Much less likely	35%
Somewhat less likely	33%
No less likely	28%
(Do not read) Don't know	3%

c. Availability of vehicles

Much less likely	25%
Somewhat less likely	29%
No less likely	41%
(Do not read) Don't know	5%

d. Initial cost

Much less likely	44%
Somewhat less likely	27%
No less likely	25%
(Do not read) Don't know	3%

e. Cost of service and repairs

Much less likely	43%
Somewhat less likely	23%
No less likely	25%
(Do not read) Don't know	9%

f. Not enough variety in models

Much less likely	20%
Somewhat less likely	23%
No less likely	53%
(Do not read) Don't know	4%

g. Using new technology

Much less likely	14%
Somewhat less likely	20%
No less likely	62%
(Do not read) Don't know	4%

h. Vehicle performance

Much less likely	26%
Somewhat less likely	26%
No less likely	41%
(Do not read) Don't know	7%

i. Long wait while charging

Much less likely	43%
Somewhat less likely	26%
No less likely	26%
(Do not read) Don't know	5%

j. Lack of charging at home

Much less likely	46%
Somewhat less likely	17%
No less likely	33%
(Do not read) Don't know	3%

Q8. Have you seen a public electric vehicle charging station in your community?

Yes	62%
No	36%
(Do not read) Don't know/refused	2%

Q9. How long would you be willing to charge an electric vehicle in a public location to add 100 miles of driving range? (READ LIST)

Less than 15 minutes	49%
15 to 30 minutes	30%
30 minutes to an hour	7%
More than an hour	4%
(Do not read) Don't know	10%

Q10. Next, I am going to read a list of amenities that charging stations could be placed near, and I would like for you to tell me how important each amenity would be to you if you were charging for at least 15 minutes. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - would this be very important, somewhat important, not so important, or not important at all? (NEXT ITEM; IF NECESSARY: very important, somewhat important, not so important, or not important at all?)

a. A restroom

Very important	55%
Somewhat important	24%
Not so important	7%
Not important at all	13%
(Do not read) Don't know	0%

b. A coffee shop or restaurant

Very important	31%
Somewhat important	36%
Not so important	13%
Not important at all	19%
(Do not read) Don't know	1%

c. Free wifi

Very important	31%
Somewhat important	24%
Not so important	19%
Not important at all	27%
(Do not read) Don't know	0%

d. A recreation area or fitness facility

Very important	14%
Somewhat important	18%
Not so important	29%
Not important at all	39%
(Do not read) Don't know	1%

e. Shopping options

Very important	19%
Somewhat important	30%
Not so important	21%
Not important at all	28%
(Do not read) Don't know	1%

f. An indoor seating area

Very important	24%
Somewhat important	30%
Not so important	20%
Not important at all	26%
(Do not read) Don't know	0%

Q11. Next, I am going to read a list of potential actions that could be taken regarding electric vehicles, and I would like for you to tell me if you support or oppose each one. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this? (NEXT ITEM; IF NECESSARY: strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this?)

a. Offer discounts on electricity to charge electric vehicles at times when demand is low

Strongly support	41%
Moderately support	25%
Neither support nor oppose	14%
Moderately oppose	5%
Strongly oppose	14%
(Do not read) Don't know	1%

b. Provide incentives and tax rebates for electric vehicles to all consumers

Strongly support	43%
Moderately support	23%
Neither support nor oppose	10%
Moderately oppose	5%
Strongly oppose	17%
(Do not read) Don't know	1%

c. Provide incentives and tax rebates for electric vehicles for low-income consumers

Strongly support	41%
Moderately support	19%
Neither support nor oppose	12%
Moderately oppose	5%
Strongly oppose	21%
(Do not read) Don't know	1%

d. Provide funding to increase the availability of electric vehicle charging stations

Strongly support	37%
Moderately support	22%
Neither support nor oppose	13%
Moderately oppose	7%
Strongly oppose	19%
(Do not read) Don't know	1%

e. Require automakers to offer more electric vehicle options in Delaware

Strongly support	29%
Moderately support	23%
Neither support nor oppose	25%
Moderately oppose	6%
Strongly oppose	17%
(Do not read) Don't know	1%

f. Require new residential and commercial developments to include plugs for electric vehicle chargers

Strongly support	33%
Moderately support	24%
Neither support nor oppose	17%
Moderately oppose	6%
Strongly oppose	19%
(Do not read) Don't know	1%

Q12. Next, I am going to read a list of information sources, and I would like you to tell me how much you trust each as a source of information about electric vehicles. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you trust it a great deal, somewhat, not much, or not at all? (NEXT ITEM; IF NECESSARY: a great deal, somewhat, not so much, or not at all?)

a. The federal government

A great deal	14%
Somewhat	37%
Not so much	18%
Not at all	30%
(Do not read) Don't know	1%

b. The Delaware state government

A great deal	13%
Somewhat	44%
Not so much	16%
Not at all	25%
(Do not read) Don't know	1%

c. Vehicle manufacturers

A great deal	11%
Somewhat	54%
Not so much	19%
Not at all	14%
(Do not read) Don't know	1%

d. Car dealerships

A great deal	4%
Somewhat	42%
Not so much	29%
Not at all	24%
(Do not read) Don’t know	1%

e. Consumer sources such as Kelly Blue Book and Edmunds

A great deal	24%
Somewhat	56%
Not so much	9%
Not at all	9%
(Do not read) Don’t know	3%

f. The news media

A great deal	2%
Somewhat	38%
Not so much	25%
Not at all	33%
(Do not read) Don’t know	2%

Q13. Do you think that increasing the use of electric vehicles would be very effective, somewhat effective, not so effective, or not at all effective in helping to reduce climate change?

Very effective	33%
Somewhat effective	31%
Not so effective	11%
Not at all effective	21%
(Do not read) Don't know	5%

Q14. How convinced are you that climate change is happening? Would you say you are completely convinced, mostly convinced, not so convinced, or not at all convinced?

Completely convinced	51%
Mostly convinced	20%
Not so convinced	13%
Not at all convinced	13%
(Do not read) Don't know	3%

Q15. Now, please tell me how strongly you AGREE or DISAGREE with each of the following statements. The first one is: (INSERT ITEM) - do you strongly agree, somewhat agree, neither agree nor disagree, somewhat DISagree, or strongly DISagree with this statement? (NEXT ITEM; IF NECESSARY: Do you strongly agree, somewhat agree, neither agree, nor disagree, somewhat DISagree, or strongly DISagree?)

a. I have personally experienced or observed local impacts of climate change.

Strongly agree	36%
Somewhat agree	24%
Neither agree nor disagree	16%
Somewhat disagree	8%
Strongly disagree	15%
(Do not read) Don't know	1%

b. We should take immediate action to reduce the impacts of climate change.

Strongly agree	48%
Somewhat agree	19%
Neither agree nor disagree	12%
Somewhat disagree	7%
Strongly disagree	14%
(Do not read) Don't know	1%

Q16. Next, I am going to read a list of potential actions that could be taken to reduce climate change, and I would like for you to tell me if you support or oppose each one. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this? (NEXT ITEM; IF NECESSARY: strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this?)

a. Require that an increasing percentage of electricity used in Delaware come from renewable sources

Strongly support	44%
Moderately support	25%
Neither support nor oppose	15%
Moderately oppose	5%
Strongly oppose	10%
(Do not read) Don't know	2%

b. Require that an increasing percentage of vehicles sold in Delaware be powered by electricity

Strongly support	20%
Moderately support	21%
Neither support nor oppose	19%
Moderately oppose	12%
Strongly oppose	24%
(Do not read) Don't know	3%

c. Require stronger energy efficiency standards on household appliances

Strongly support	41%
Moderately support	28%
Neither support nor oppose	15%
Moderately oppose	5%
Strongly oppose	9%
(Do not read) Don't know	1%

d. Require stronger air pollution control for business and industry

Strongly support	57%
Moderately support	21%
Neither support nor oppose	10%
Moderately oppose	4%
Strongly oppose	7%
(Do not read) Don't know	1%

e. Increase conservation of forested and agricultural lands

Strongly support	63%
Moderately support	20%
Neither support nor oppose	10%
Moderately oppose	3%
Strongly oppose	3%
(Do not read) Don't know	1%

Appendix B: Detailed Demographic Tables

Q1. How familiar are you with electric vehicles–are you very familiar, somewhat familiar, not so familiar, or not at all familiar with them?

	Men	Women	New Castle	Kent	Sussex
Very	21%	9%	14%	15%	15%
Somewhat	51%	42%	46%	41%	51%
Not so	15%	24%	22%	19%	14%
Not at all	14%	25%	18%	25%	19%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	19%	17%	15%	9%	15%
Somewhat	43%	53%	47%	45%	46%
Not so	24%	19%	17%	20%	20%
Not at all	14%	11%	21%	27%	19%

Q2. Do you currently own or lease an electric vehicle?

	Men	Women	New Castle	Kent	Sussex
Yes	6%	2%	5%	3%	2%
No	94%	98%	95%	97%	98%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Yes	6%	4%	2%	3%	4%
No	94%	96%	98%	97%	96%

Q3. The next time you purchase or lease a vehicle, how likely are you to choose an electric vehicle–are you very likely, somewhat likely, not so likely, or not at all likely to do so?

	Men	Women	New Castle	Kent	Sussex
Very likely	9%	8%	10%	7%	7%
Somewhat likely	21%	22%	23%	24%	15%
Not so likely	20%	25%	23%	20%	23%
Not at all likely	45%	39%	37%	44%	53%
Don't know (VOL)	4%	7%	7%	5%	3%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very likely	11%	8%	7%	9%	9%
Somewhat likely	26%	22%	18%	21%	22%
Not so likely	25%	25%	25%	17%	22%
Not at all likely	32%	41%	44%	49%	42%
Don't know (VOL)	6%	5%	6%	4%	5%

Q6. Next, I am going to read a list of potential actions to make it easier to choose an electric vehicle, and I would like for you to tell me whether each action would make you MORE likely to choose an electric vehicle. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - would this make you much more likely, somewhat more likely, or no more likely to choose an electric vehicle? (NEXT ITEM; IF NECESSARY: much more likely, somewhat more likely, or no more likely?)

a. Providing more charging stations

	Men	Women	New Castle	Kent	Sussex
Much more likely	35%	36%	39%	37%	24%
Somewhat likely	26%	29%	29%	25%	27%
No more likely	37%	32%	29%	38%	47%
Don't know (VOL)	2%	4%	4%	1%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much more likely	42%	31%	28%	39%	35%
Somewhat likely	28%	32%	29%	22%	27%
No more likely	25%	34%	40%	37%	35%
Don't know (VOL)	4%	3%	3%	2%	3%

b. Matching the price of traditional vehicles

	Men	Women	New Castle	Kent	Sussex
Much more likely	38%	37%	42%	38%	25%
Somewhat likely	25%	28%	27%	27%	27%
No more likely	34%	30%	27%	33%	43%
Don’t know (VOL)	3%	5%	4%	3%	5%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much more likely	47%	37%	35%	32%	37%
Somewhat likely	24%	29%	25%	30%	27%
No more likely	25%	30%	38%	33%	32%
Don’t know (VOL)	4%	5%	3%	5%	4%

c. Matching the style of traditional vehicles

	Men	Women	New Castle	Kent	Sussex
Much more likely	12%	17%	18%	11%	9%
Somewhat likely	23%	27%	27%	25%	20%
No more likely	63%	53%	52%	60%	69%
Don’t know (VOL)	2%	4%	3%	4%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much more likely	13%	19%	17%	11%	15%
Somewhat likely	30%	24%	24%	23%	25%
No more likely	54%	54%	56%	64%	58%
Don’t know (VOL)	3%	3%	3%	3%	3%

d. Providing government financial incentives

	Men	Women	New Castle	Kent	Sussex
Much more likely	35%	28%	35%	27%	23%
Somewhat likely	24%	32%	30%	25%	27%
No more likely	39%	36%	32%	47%	44%
Don’t know (VOL)	2%	5%	3%	1%	6%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much more likely	36%	31%	32%	27%	31%
Somewhat likely	28%	29%	26%	30%	28%
No more likely	31%	35%	41%	41%	38%
Don’t know (VOL)	5%	6%	2%	2%	3%

e. Providing extended test drives from dealerships

	Men	Women	New Castle	Kent	Sussex
Much more likely	14%	14%	16%	8%	13%
Somewhat likely	21%	27%	25%	27%	19%
No more likely	64%	54%	55%	63%	66%
Don't know (VOL)	1%	4%	3%	2%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much more likely	20%	12%	13%	12%	14%
Somewhat likely	24%	26%	21%	27%	24%
No more likely	54%	59%	64%	58%	59%
Don't know (VOL)	2%	3%	2%	4%	3%

Q7. Now, I am going to read a list of potential concerns about electric vehicles, and I would like for you to tell me whether each concern makes you LESS likely to choose an electric vehicle. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - does this make you much less likely, somewhat less likely, or no less likely to choose an electric vehicle? (NEXT ITEM; IF NECESSARY: much less likely, somewhat less likely, or no less likely?)

a. Running out of power

	Men	Women	New Castle	Kent	Sussex
Much less likely	54%	51%	53%	54%	50%
Somewhat likely	19%	24%	22%	21%	21%
Not less likely	26%	22%	23%	24%	27%
Don't know (VOL)	1%	3%	2%	2%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	45%	50%	57%	55%	52%
Somewhat likely	30%	23%	17%	18%	21%
Not less likely	22%	25%	25%	24%	24%
Don't know (VOL)	3%	2%	1%	2%	2%

b. Availability of public charging stations

	Men	Women	New Castle	Kent	Sussex
Much less likely	36%	35%	35%	39%	34%
Somewhat likely	33%	34%	35%	36%	27%
Not less likely	29%	27%	26%	22%	36%
Don’t know (VOL)	2%	5%	4%	3%	3%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	33%	32%	36%	38%	35%
Somewhat likely	40%	37%	33%	26%	33%
Not less likely	21%	28%	29%	31%	28%
Don’t know (VOL)	5%	3%	1%	4%	3%

c. Availability of vehicles

	Men	Women	New Castle	Kent	Sussex
Much less likely	25%	25%	24%	23%	27%
Somewhat likely	31%	27%	31%	35%	21%
Not less likely	40%	41%	39%	39%	48%
Don’t know (VOL)	3%	7%	6%	4%	4%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	26%	23%	28%	22%	25%
Somewhat likely	25%	36%	27%	30%	29%
Not less likely	40%	37%	42%	43%	41%
Don’t know (VOL)	9%	3%	2%	6%	5%

d. Initial cost

	Men	Women	New Castle	Kent	Sussex
Much less likely	45%	43%	45%	49%	40%
Somewhat likely	26%	28%	31%	25%	20%
Not less likely	27%	24%	22%	23%	36%
Don’t know (VOL)	2%	5%	3%	2%	5%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	41%	44%	49%	43%	44%
Somewhat likely	28%	33%	24%	26%	27%
Not less likely	27%	21%	25%	27%	25%
Don’t know (VOL)	4%	1%	3%	5%	3%

e. Cost of service and repairs

	Men	Women	New Castle	Kent	Sussex
Much less likely	42%	45%	45%	43%	41%
Somewhat likely	25%	21%	26%	26%	15%
Not less likely	23%	25%	22%	23%	33%
Don't know (VOL)	9%	8%	8%	8%	12%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	43%	50%	46%	37%	43%
Somewhat likely	22%	27%	20%	25%	23%
Not less likely	27%	19%	25%	26%	25%
Don't know (VOL)	8%	4%	9%	12%	9%

f. Not enough variety in models

	Men	Women	New Castle	Kent	Sussex
Much less likely	20%	20%	21%	22%	18%
Somewhat likely	23%	22%	28%	15%	16%
Not less likely	54%	52%	49%	57%	59%
Don't know (VOL)	3%	6%	2%	7%	8%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	20%	28%	20%	16%	20%
Somewhat likely	20%	27%	27%	18%	23%
Not less likely	54%	40%	52%	59%	53%
Don't know (VOL)	6%	5%	2%	6%	4%

g. Using new technology

	Men	Women	New Castle	Kent	Sussex
Much less likely	15%	13%	16%	12%	9%
Somewhat likely	17%	23%	21%	19%	18%
Not less likely	67%	58%	58%	68%	67%
Don't know (VOL)	2%	6%	4%	1%	6%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	11%	13%	15%	15%	14%
Somewhat likely	14%	21%	21%	23%	20%
Not less likely	68%	63%	61%	59%	62%
Don't know (VOL)	7%	3%	2%	4%	4%

h. Vehicle performance

	Men	Women	New Castle	Kent	Sussex
Much less likely	26%	26%	27%	25%	24%
Somewhat likely	22%	29%	27%	29%	21%
Not less likely	48%	35%	40%	40%	46%
Don’t know (VOL)	4%	10%	7%	5%	8%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	27%	24%	33%	19%	26%
Somewhat likely	24%	32%	20%	28%	26%
Not less likely	41%	41%	42%	42%	41%
Don’t know (VOL)	8%	3%	5%	11%	7%

i. Long wait while charging

	Men	Women	New Castle	Kent	Sussex
Much less likely	43%	43%	42%	43%	43%
Somewhat likely	28%	24%	29%	28%	18%
Not less likely	25%	26%	24%	24%	31%
Don’t know (VOL)	3%	7%	4%	6%	7%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	32%	47%	44%	46%	43%
Somewhat likely	32%	28%	22%	25%	26%
Not less likely	26%	20%	30%	25%	26%
Don’t know (VOL)	10%	5%	4%	4%	5%

j. Lack of charging at home

	Men	Women	New Castle	Kent	Sussex
Much less likely	43%	50%	49%	48%	39%
Somewhat likely	16%	18%	18%	17%	15%
Not less likely	39%	28%	29%	33%	43%
Don’t know (VOL)	2%	4%	3%	2%	4%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Much less likely	50%	48%	46%	44%	46%
Somewhat likely	13%	23%	17%	17%	17%
Not less likely	32%	28%	35%	36%	33%
Don’t know (VOL)	6%	1%	2%	4%	3%

Q8. Have you seen a public electric vehicle charging station in your community?

	Men	Women	New Castle	Kent	Sussex
Yes	65%	59%	65%	52%	62%
No	34%	38%	33%	45%	35%
Don't know (VOL)	1%	3%	2%	4%	3%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Yes	67%	62%	63%	57%	62%
No	28%	37%	36%	40%	36%
Don't know (VOL)	5%	1%	1%	3%	2%

Q9. How long would you be willing to charge an electric vehicle in a public location to add 100 miles of driving range? (READ LIST)

	Men	Women	New Castle	Kent	Sussex
< 15 minutes	52%	45%	47%	49%	53%
15 to 30 minutes	33%	27%	32%	27%	27%
30 min. to an hour	5%	9%	8%	9%	4%
More than an hour	4%	4%	4%	3%	4%
Don't know (VOL)	7%	13%	9%	12%	11%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
< 15 minutes	33%	56%	51%	54%	49%
15 to 30 minutes	40%	28%	28%	26%	30%
30 min. to an hour	10%	7%	7%	6%	7%
More than an hour	4%	4%	4%	4%	4%
Don't know (VOL)	13%	6%	10%	10%	10%

Q10. Next, I am going to read a list of amenities that charging stations could be placed near, and I would like for you to tell me how important each amenity would be to you if you were charging for at least 15 minutes. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - would this be very important, somewhat important, not so important, or not important at all? (NEXT ITEM; IF NECESSARY: very important, somewhat important, not so important, or not important at all?)

a. A restroom

	Men	Women	New Castle	Kent	Sussex
Very	50%	60%	55%	56%	53%
Somewhat	26%	23%	24%	26%	23%
Not so	6%	8%	9%	7%	5%
Not at all	17%	8%	11%	10%	19%
Don't know (VOL)	1%	0%	0%	1%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	54%	46%	61%	56%	55%
Somewhat	25%	28%	21%	24%	24%
Not so	8%	8%	8%	6%	7%
Not at all	14%	17%	10%	13%	13%
Don't know (VOL)	0%	1%	0%	1%	0%

b. A coffee shop or restaurant

	Men	Women	New Castle	Kent	Sussex
Very	30%	33%	34%	27%	28%
Somewhat	34%	39%	35%	43%	34%
Not so	13%	12%	13%	12%	12%
Not at all	23%	16%	17%	18%	26%
Don't know (VOL)	1%	0%	0%	1%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	31%	30%	35%	29%	31%
Somewhat	40%	37%	32%	37%	36%
Not so	11%	15%	11%	13%	13%
Not at all	17%	17%	21%	20%	19%
Don't know (VOL)	0%	1%	0%	1%	1%

c. Free wifi

	Men	Women	New Castle	Kent	Sussex
Very	27%	34%	33%	25%	28%
Somewhat	20%	28%	26%	22%	20%
Not so	19%	19%	20%	20%	16%
Not at all	34%	19%	21%	32%	35%
Don't know (VOL)	1%	0%	0%	1%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	41%	25%	30%	27%	31%
Somewhat	21%	29%	24%	21%	24%
Not so	18%	22%	19%	17%	19%
Not at all	20%	23%	26%	34%	27%
Don't know (VOL)	0%	1%	0%	1%	0%

d. A recreation area or fitness facility

	Men	Women	New Castle	Kent	Sussex
Very	14%	14%	15%	15%	9%
Somewhat	17%	19%	19%	17%	18%
Not so	25%	32%	31%	29%	22%
Not at all	43%	35%	34%	39%	50%
Don't know (VOL)	1%	0%	1%	1%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	15%	17%	13%	11%	14%
Somewhat	29%	17%	11%	17%	18%
Not so	35%	33%	25%	24%	29%
Not at all	21%	32%	50%	47%	39%
Don't know (VOL)	0%	1%	0%	1%	1%

e. Shopping options

	Men	Women	New Castle	Kent	Sussex
Very	16%	23%	19%	23%	17%
Somewhat	29%	31%	35%	25%	23%
Not so	22%	20%	22%	18%	22%
Not at all	32%	25%	23%	32%	38%
Don't know (VOL)	1%	1%	0%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	19%	21%	20%	19%	19%
Somewhat	31%	37%	24%	30%	30%
Not so	22%	21%	20%	22%	21%
Not at all	28%	20%	35%	27%	28%
Don't know (VOL)	0%	1%	0%	2%	1%

f. An indoor seating area

	Men	Women	New Castle	Kent	Sussex
Very	21%	27%	26%	27%	17%
Somewhat	26%	34%	32%	29%	26%
Not so	19%	20%	19%	20%	22%
Not at all	33%	18%	23%	23%	35%
Don't know (VOL)	0%	1%	0%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	18%	25%	28%	25%	24%
Somewhat	33%	30%	25%	32%	30%
Not so	23%	17%	22%	17%	20%
Not at all	27%	27%	24%	26%	26%
Don't know (VOL)	0%	1%	0%	1%	0%

Q11. Next, I am going to read a list of potential actions that could be taken regarding electric vehicles, and I would like for you to tell me if you support or oppose each one. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this? (NEXT ITEM; IF NECESSARY: strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this?)

a. Offer discounts on electricity to charge electric vehicles at times when demand is low

	Men	Women	New Castle	Kent	Sussex
Strongly support	40%	41%	44%	39%	33%
Moderately support	22%	27%	26%	22%	24%
Neither	13%	16%	14%	18%	14%
Moderately oppose	4%	5%	4%	3%	7%
Strongly oppose	19%	9%	11%	16%	21%
Don’t know (VOL)	1%	1%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	35%	43%	41%	42%	41%
Moderately support	34%	25%	22%	21%	25%
Neither	18%	13%	14%	13%	14%
Moderately oppose	3%	2%	5%	8%	5%
Strongly oppose	10%	16%	15%	15%	14%
Don’t know (VOL)	1%	1%	2%	1%	1%

b. Provide incentives and tax rebates for electric vehicles to all consumers

	Men	Women	New Castle	Kent	Sussex
Strongly support	43%	43%	48%	44%	31%
Moderately support	22%	25%	24%	16%	29%
Neither	7%	13%	8%	14%	12%
Moderately oppose	6%	5%	6%	4%	5%
Strongly oppose	21%	13%	14%	21%	23%
Don’t know (VOL)	0%	1%	1%	2%	0%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	41%	43%	44%	44%	43%
Moderately support	30%	26%	19%	21%	23%
Neither	13%	6%	12%	9%	10%
Moderately oppose	4%	4%	3%	8%	5%
Strongly oppose	11%	20%	20%	17%	17%
Don’t know (VOL)	1%	0%	1%	1%	1%

c. Provide incentives and tax rebates for electric vehicles to low-income consumers

	Men	Women	New Castle	Kent	Sussex
Strongly support	39%	43%	47%	40%	28%
Moderately support	17%	22%	20%	16%	20%
Neither	9%	15%	8%	15%	19%
Moderately oppose	6%	5%	5%	4%	8%
Strongly oppose	29%	13%	19%	22%	25%
Don't know (VOL)	1%	1%	1%	3%	0%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	38%	40%	42%	43%	41%
Moderately support	20%	22%	19%	18%	19%
Neither	20%	16%	9%	8%	12%
Moderately oppose	3%	3%	6%	9%	5%
Strongly oppose	19%	19%	23%	21%	21%
Don't know (VOL)	1%	0%	1%	2%	1%

d. Provide funding to increase the availability of electric vehicle charging stations

	Men	Women	New Castle	Kent	Sussex
Strongly support	37%	37%	42%	35%	26%
Moderately support	23%	22%	23%	22%	21%
Neither	8%	17%	13%	13%	14%
Moderately oppose	7%	8%	8%	6%	8%
Strongly oppose	24%	14%	14%	21%	29%
Don't know (VOL)	1%	1%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	40%	30%	36%	38%	37%
Moderately support	21%	31%	22%	20%	22%
Neither	18%	12%	12%	11%	13%
Moderately oppose	7%	7%	9%	7%	7%
Strongly oppose	14%	20%	20%	21%	19%
Don't know (VOL)	0%	1%	1%	2%	1%

e. Require automakers to offer more electric vehicle options in Delaware

	Men	Women	New Castle	Kent	Sussex
Strongly support	28%	30%	31%	29%	24%
Moderately support	23%	24%	29%	20%	13%
Neither	22%	27%	21%	24%	35%
Moderately oppose	7%	4%	6%	5%	6%
Strongly oppose	20%	13%	13%	20%	22%
Don't know (VOL)	1%	1%	1%	2%	0%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	26%	25%	30%	33%	29%
Moderately support	21%	26%	26%	21%	23%
Neither	36%	29%	19%	18%	25%
Moderately oppose	2%	4%	5%	9%	6%
Strongly oppose	13%	17%	20%	16%	17%
Don't know (VOL)	0%	0%	0%	3%	1%

f. Require new residential and commercial developments to include plugs for electric vehicle chargers

	Men	Women	New Castle	Kent	Sussex
Strongly support	32%	34%	37%	30%	25%
Moderately support	23%	25%	26%	25%	20%
Neither	14%	20%	16%	17%	19%
Moderately oppose	8%	4%	6%	6%	7%
Strongly oppose	21%	16%	14%	20%	29%
Don't know (VOL)	1%	1%	1%	2%	0%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	35%	30%	32%	34%	33%
Moderately support	25%	24%	21%	27%	24%
Neither	17%	21%	20%	12%	17%
Moderately oppose	3%	4%	7%	9%	6%
Strongly oppose	20%	21%	19%	16%	19%
Don't know (VOL)	0%	0%	1%	2%	1%

Q12. Next, I am going to read a list of information sources, and I would like you to tell me how much you trust each as a source of information about electric vehicles. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you trust it a great deal, somewhat, not much, or not at all? (NEXT ITEM; IF NECESSARY: a great deal, somewhat, not so much, or not at all?)

a. The federal government

	Men	Women	New Castle	Kent	Sussex
A great deal	14%	14%	15%	12%	13%
Somewhat	34%	40%	40%	33%	34%
Not so much	15%	21%	19%	21%	13%
Not at all	35%	25%	25%	32%	38%
Don't know (VOL)	2%	0%	1%	1%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	7%	13%	12%	22%	14%
Somewhat	48%	43%	34%	29%	37%
Not so much	26%	16%	17%	15%	18%
Not at all	20%	28%	36%	32%	30%
Don't know (VOL)	0%	0%	1%	2%	1%

b. The Delaware state government

	Men	Women	New Castle	Kent	Sussex
A great deal	12%	15%	12%	17%	13%
Somewhat	43%	45%	48%	38%	40%
Not so much	14%	18%	17%	16%	13%
Not at all	29%	21%	22%	28%	32%
Don't know (VOL)	2%	1%	1%	1%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	8%	8%	13%	21%	13%
Somewhat	56%	47%	38%	39%	44%
Not so much	18%	14%	19%	12%	16%
Not at all	17%	31%	28%	25%	25%
Don't know (VOL)	0%	1%	2%	3%	1%

c. Vehicle manufacturers

	Men	Women	New Castle	Kent	Sussex
A great deal	10%	12%	9%	17%	11%
Somewhat	53%	56%	61%	45%	48%
Not so much	20%	18%	17%	21%	21%
Not at all	16%	12%	13%	14%	17%
Don't know (VOL)	1%	1%	1%	2%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	20%	12%	10%	6%	11%
Somewhat	57%	58%	52%	53%	54%
Not so much	13%	20%	20%	21%	19%
Not at all	10%	9%	17%	17%	14%
Don't know (VOL)	0%	1%	1%	2%	1%

d. Car dealerships

	Men	Women	New Castle	Kent	Sussex
A great deal	3%	5%	5%	6%	3%
Somewhat	38%	45%	45%	43%	32%
Not so much	28%	30%	28%	22%	34%
Not at all	30%	18%	21%	27%	29%
Don't know (VOL)	2%	1%	1%	2%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	6%	3%	2%	6%	4%
Somewhat	48%	41%	41%	38%	42%
Not so much	25%	30%	31%	28%	29%
Not at all	21%	25%	26%	24%	24%
Don't know (VOL)	0%	1%	0%	4%	1%

e. Consumer sources such as Kelly Blue Book and Edmunds

	Men	Women	New Castle	Kent	Sussex
A great deal	25%	23%	22%	29%	24%
Somewhat	54%	57%	59%	51%	52%
Not so much	8%	10%	8%	8%	12%
Not at all	12%	6%	8%	9%	10%
Don't know (VOL)	2%	4%	2%	3%	3%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	16%	25%	25%	27%	24%
Somewhat	63%	60%	56%	47%	56%
Not so much	13%	8%	8%	9%	9%
Not at all	7%	7%	9%	10%	9%
Don't know (VOL)	0%	0%	2%	6%	3%

f. The news media

	Men	Women	New Castle	Kent	Sussex
A great deal	3%	1%	2%	3%	1%
Somewhat	36%	39%	41%	36%	32%
Not so much	20%	30%	26%	24%	24%
Not at all	37%	29%	29%	36%	40%
Don't know (VOL)	3%	1%	1%	1%	3%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
A great deal	1%	1%	2%	4%	2%
Somewhat	45%	33%	37%	37%	38%
Not so much	26%	30%	23%	24%	25%
Not at all	27%	37%	36%	32%	33%
Don't know (VOL)	1%	0%	2%	3%	2%

Q13. Do you think that increasing the use of electric vehicles would be very effective, somewhat effective, not so effective, or not at all effective in helping to reduce climate change?

	Men	Women	New Castle	Kent	Sussex
Very	34%	32%	35%	36%	25%
Somewhat	26%	36%	35%	25%	27%
Not so	9%	12%	9%	11%	15%
Not at all	27%	14%	17%	22%	30%
Don't know (VOL)	4%	6%	5%	6%	4%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Very	35%	24%	32%	37%	33%
Somewhat	31%	40%	28%	29%	31%
Not so	16%	12%	12%	6%	11%
Not at all	16%	22%	22%	22%	21%
Don't know (VOL)	3%	3%	6%	6%	5%

Q14. How convinced are you that climate change is happening? Would you say you are completely convinced, mostly convinced, not so convinced, or not at all convinced?

	Men	Women	New Castle	Kent	Sussex
Completely	47%	55%	56%	46%	44%
Mostly	20%	21%	19%	27%	18%
Not so	12%	13%	11%	11%	18%
Not at all	18%	8%	12%	12%	18%
Don't know (VOL)	2%	3%	3%	3%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Completely	44%	57%	51%	53%	51%
Mostly	27%	16%	20%	19%	20%
Not so	17%	12%	12%	12%	13%
Not at all	10%	12%	15%	14%	13%
Don't know (VOL)	2%	4%	2%	3%	3%

Q15. Now, please tell me how strongly you AGREE or DISAGREE with each of the following statements. The first one is: (INSERT ITEM) - do you strongly agree, somewhat agree, neither agree nor disagree, somewhat DISagree, or strongly DISagree with this statement?

a. I have personally experienced or observed local impacts of climate change.

	Men	Women	New Castle	Kent	Sussex
Strongly agree	32%	40%	39%	35%	30%
Moderately agree	21%	26%	23%	23%	26%
Neither	16%	17%	16%	23%	13%
Somewhat disagree	11%	6%	9%	5%	9%
Strongly disagree	19%	10%	13%	12%	21%
Don't know (VOL)	1%	1%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly agree	33%	36%	38%	36%	36%
Moderately agree	20%	29%	20%	26%	24%
Neither	27%	14%	17%	11%	16%
Somewhat disagree	7%	5%	8%	10%	8%
Strongly disagree	12%	17%	16%	14%	15%
Don't know (VOL)	0%	0%	2%	2%	1%

b. We should take immediate action to reduce the impacts of climate change.

	Men	Women	New Castle	Kent	Sussex
Strongly agree	45%	51%	53%	44%	38%
Moderately agree	16%	21%	16%	21%	22%
Neither	9%	14%	12%	14%	9%
Somewhat disagree	9%	5%	6%	6%	9%
Strongly disagree	20%	9%	11%	14%	21%
Don't know (VOL)	1%	1%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly agree	47%	48%	48%	49%	48%
Moderately agree	18%	20%	17%	20%	19%
Neither	17%	9%	12%	9%	12%
Somewhat disagree	7%	6%	6%	7%	7%
Strongly disagree	11%	17%	16%	13%	14%
Don't know (VOL)	0%	0%	2%	2%	1%

Q16. Next, I am going to read a list of potential actions that could be taken to reduce climate change, and I would like for you to tell me if you support or oppose each one. The first one is: (INSERT ITEM; RANDOMIZE ORDER) - do you strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this? (NEXT ITEM; IF NECESSARY: strongly support, moderately support, neither support nor oppose, moderately oppose, or strongly oppose this?)

a. Require that an increasing percentage of electricity used in Delaware come from renewable sources

	Men	Women	New Castle	Kent	Sussex
Strongly support	39%	48%	45%	46%	38%
Moderately support	23%	27%	25%	25%	25%
Neither	16%	13%	15%	12%	15%
Moderately oppose	7%	4%	5%	5%	6%
Strongly oppose	12%	7%	8%	9%	13%
Don’t know (VOL)	2%	1%	1%	3%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	43%	41%	50%	41%	44%
Moderately support	26%	29%	18%	29%	25%
Neither	19%	12%	15%	12%	15%
Moderately oppose	5%	4%	6%	5%	5%
Strongly oppose	6%	13%	10%	9%	10%
Don’t know (VOL)	0%	1%	1%	3%	2%

b. Require that an increasing percentage of vehicles sold in Delaware be powered by electricity

	Men	Women	New Castle	Kent	Sussex
Strongly support	19%	21%	23%	19%	13%
Moderately support	20%	22%	23%	23%	16%
Neither	17%	21%	20%	19%	18%
Moderately oppose	12%	13%	12%	9%	15%
Strongly oppose	29%	20%	19%	26%	35%
Don't know (VOL)	3%	3%	3%	4%	2%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	15%	19%	23%	21%	20%
Moderately support	24%	20%	22%	19%	21%
Neither	29%	20%	16%	15%	19%
Moderately oppose	13%	9%	13%	13%	12%
Strongly oppose	16%	30%	25%	26%	24%
Don't know (VOL)	3%	1%	2%	5%	3%

c. Require stronger energy efficiency standards on household appliances

	Men	Women	New Castle	Kent	Sussex
Strongly support	37%	45%	45%	43%	32%
Moderately support	27%	28%	27%	24%	31%
Neither	15%	16%	15%	17%	16%
Moderately oppose	7%	4%	5%	5%	7%
Strongly oppose	11%	7%	8%	9%	13%
Don't know (VOL)	2%	0%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	34%	35%	48%	43%	41%
Moderately support	29%	33%	19%	31%	28%
Neither	22%	16%	16%	10%	15%
Moderately oppose	5%	5%	5%	6%	5%
Strongly oppose	7%	11%	10%	8%	9%
Don't know (VOL)	3%	0%	1%	2%	1%

d. Require stronger air pollution control for business and industry

	Men	Women	New Castle	Kent	Sussex
Strongly support	50%	63%	60%	50%	55%
Moderately support	23%	20%	19%	25%	23%
Neither	8%	11%	10%	11%	8%
Moderately oppose	6%	3%	5%	2%	5%
Strongly oppose	10%	4%	6%	9%	8%
Don’t know (VOL)	2%	0%	1%	2%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	53%	52%	58%	60%	57%
Moderately support	25%	25%	18%	20%	21%
Neither	11%	8%	13%	7%	10%
Moderately oppose	4%	5%	4%	5%	4%
Strongly oppose	5%	11%	6%	7%	7%
Don’t know (VOL)	3%	0%	1%	1%	1%

e. Increase conservation of forested and agricultural lands

	Men	Women	New Castle	Kent	Sussex
Strongly support	58%	67%	62%	66%	65%
Moderately support	23%	17%	20%	19%	18%
Neither	10%	11%	12%	5%	11%
Moderately oppose	3%	2%	3%	2%	3%
Strongly oppose	3%	2%	2%	6%	1%
Don’t know (VOL)	2%	1%	1%	3%	1%

	Age 18-39	Age 40-49	Age 50-64	Age 65+	Overall
Strongly support	55%	71%	65%	63%	63%
Moderately support	21%	23%	17%	19%	20%
Neither	20%	4%	10%	8%	10%
Moderately oppose	3%	0%	4%	3%	3%
Strongly oppose	2%	2%	2%	4%	3%
Don’t know (VOL)	0%	0%	2%	3%	1%