Electric Vehicle Adoption and Impacts for the Insurance Industry

September 2023

American Property Casualty Insurance Association℠
INSURING AMERICA apci.org

EXECUTIVE SUMMARY

The electric vehicle (EV) adoption rate is increasing in the U.S. and abroad. Although many risks associated with EVs are similar to conventional vehicles, the evolving EV industry presents some unique considerations for insurers. These factors include higher upfront and repair costs for EVs than conventional vehicles, along with longer repair times and developing supply chains, and higher vehicle weight that can cause more serious injuries or damages. Advanced vehicle technologies being utilized in EVs present new risks and opportunities for risk mitigation, while EV battery technology continues to weigh down the industry with potential safety and fire-related challenges. Additionally, increasing vehicle connectivity brings data security and privacy concerns at the vehicle and charging station levels. Finally, a shifting policy and regulatory environment intended to spur EV adoption, and continued development of EV-related technologies, is changing the automotive landscape.

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BACKGROUND

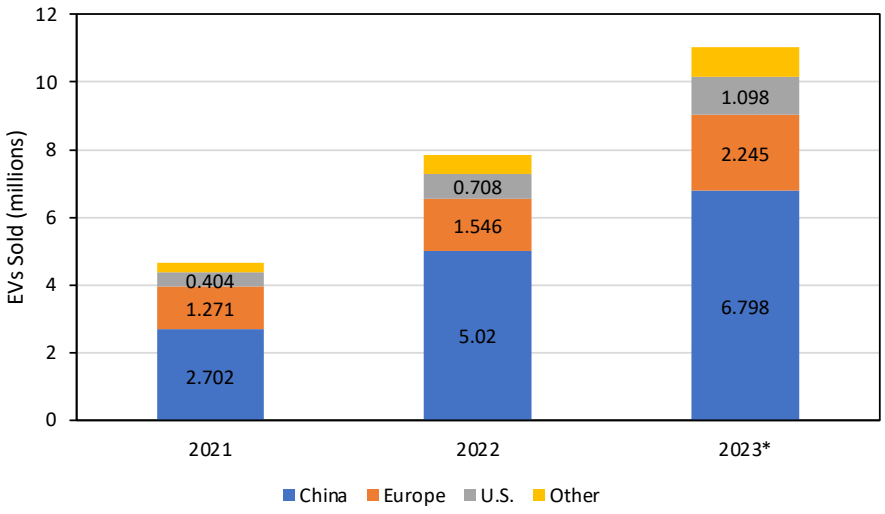
Over the past several years, momentum has been building toward the electrification of passenger vehicles in the U.S. and internationally. The adoption of electric vehicles (EVs), plug-in hybrids (PHEVs), and other low- and zero-emission vehicles has been driven partially by environmental concerns but also by shifting consumer preferences, increased battery capacity, and financial factors such as the price of gasoline.

Many vehicle manufacturers have been doubling down on EVs, with some committing to transition their lineups to electric models in the coming decades and the companies that supply necessary charging infrastructure and technologies following suit. Some large auto manufacturers have publicly committed to phasing out conventional vehicles that use internal combustion engines as early as 2035. Manufacturers acknowledge that the U.S. will continue to need a diverse range of powertrain options, and some makers are recalibrating their EV ambitions due to changing conditions.[1]

Today, EVs make up a small portion of all vehicles sold in the U.S. In 2022, auto makers sold over 807,000 EVs, or 5.8 percent of all vehicles sold, up from 3.2 percent in 2021. The U.S. EV market in 2022 was dominated by Tesla (65 percent of total sales), with Ford (7.6 percent) and Hyundai – Kia (7.1 percent) rounding out the top three manufacturers.[2] Globally, EV market share surpassed 10 percent for the first time in 2022, with 7.8 million EVs sold. Fully electric vehicles made up 19 percent of new car sales in China and 11 percent in Europe. In Germany, EVs accounted for 25 percent of new vehicles produced in 2022 and there were more EVs sold in December 2022 than conventional vehicles.[3]

Analysts estimate that EV sales in the U.S. have accounted for around 6.5 percent of new vehicle sales in the first half of 2023 and may reach cumulative sales in 2023 of over one million EVs for the first time.[4] It was estimated in early 2023 that there were over three million EVs and 130,000 public charging ports in the U.S.[5] Figure 1 shows historical and projected 2023 EVs sales for the major global markets.

Figure 1. **Global electric vehicle (EV) sales in millions by major global markets (*Projected)**



Data Source: EV-volumes.com via Wall Street Journal.[2]

1 Axios, Next roadblock for electric cars: Early adopter era is over (August 9, 2023) at **https://www.axios.com/2023/08/09/electric-cars-adoption-rates**.

2 The Wall Street Journal, U.S. EV Sales Jolted Higher in 2022 as Newcomers Target Tesla (January 6, 2023) at **https://www.wsj.com/articles/u-s-ev-sales-jolted-higher-in-2022-as-newcomers-target-tesla-11672981834**.

3 The Wall Street Journal, EVs Made up 10% of All New Cars Sold Last Year (January 16, 2023) at **https://www.wsj.com/articles/evs-made-up-10-of-all-new-cars-sold-last-year-11673818385**.

4 Axios, Unsold electric cars are piling up on dealer lots (July 10, 2023) at **https://www.axios.com/2023/07/10/unsold-electric-cars-are-piling-up-on-dealer-lots**.

5 Los Angeles Business Journal, New National Standards Emerge for EV Charging Networks (May 1, 2023) at **https://labusinessjournal.com/branded-content/new-national-standards-emerge-for-ev-charging-networks/**.

Despite recent tailwinds driving EV sales, several barriers stand in the way of more widespread adoption. The 2023 J.D. Power Electric Vehicle Consideration Study found that 42 percent of respondents were able to find an EV that suits their needs in terms of price, vehicle type, and other considerations, up from prior years.[6] The lack of public vehicle charging infrastructure and purchase price were the top two reasons for consumers rejecting the idea of buying an EV, each selected by 49 percent of respondents.

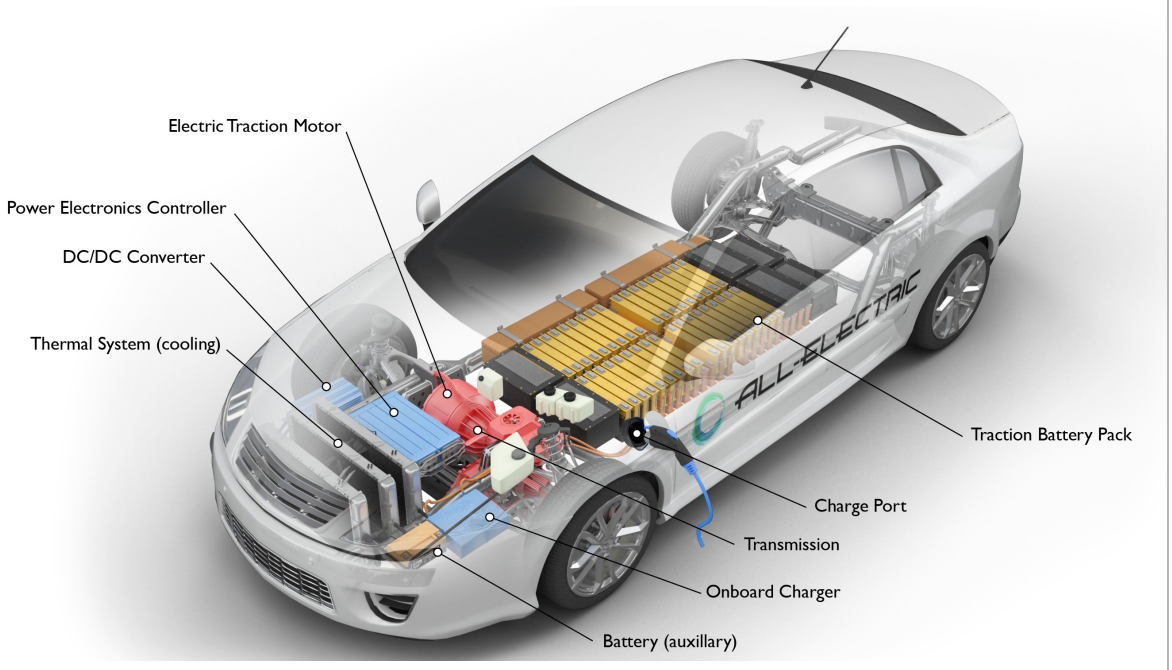
Although the large-scale adoption of EVs will take years to play out, and many of the risks associated with EVs are similar to those for conventional vehicles, insurers and their policyholders must be aware of the unique factors and risks related to this evolving industry.

SUMMARY OF EV TERMINOLOGY

The technologies associated with electric vehicles and other lower-emissions vehicles include systems and terminology that may not be familiar to some consumers. These include:

- Battery electric vehicle (BEV): Also known as a fully electric vehicle or all-electric vehicle, this type of vehicle only uses energy stored in a rechargeable battery with no secondary fuel source. The battery is used to power an electric motor rather than an internal combustion engine used in conventional gas and diesel vehicles. Cars of this type are more commonly referred to as simply an electric vehicle, or EV. Battery technology advancements in recent years have extended the total driving range to over 400 miles on a full charge and, according to the U.S. Environmental Protection Agency (EPA), translate to over 140 miles per gallon equivalent (MPGe). While Tesla is the best-known maker of BEVs, as of mid-2023, there are around 50 different models of BEVs available in the U.S., with many more expected in coming years. Figure 2 shows the basic components of a BEV.

Figure 2. **Basic elements of a battery electric vehicle (BEV)**



Source: U.S. Department of Energy, Alternative Fuels Data Center.

6 J.D. Power, Action Needed to Keep Charging from Short Circuiting EV Purchase Consideration (June 15, 2023) at **https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-consideration-evc-study**.

- Hybrid electric vehicle (HEV): A vehicle that uses two or more power sources, most often linking a gas engine with a battery and electric motor. Depending on the driving characteristics, the vehicle switches between gas and electric power to maximize efficiency. The gas engine may turn off when the vehicle comes to a complete stop, and an electric motor may power the vehicle at low speed over short distances. The gas engine or regenerative braking may be used to recharge the hybrid battery. Traditional hybrid cars may have a driving range of more than 600 miles and be capable of achieving over 55 MPG. The most commonly recognizable hybrid auto is the Toyota Prius, in production since 1997.
- Plug-in hybrid electric vehicle (PHEV): This hybrid vehicle utilizes a hybrid system similar to a traditional hybrid but includes a larger battery pack and external charge port, allowing for greater vehicle range in all-electric mode. Some plug-in hybrids may have an all-electric range over 25 miles, a total range similar to traditional hybrids, and a combined fuel economy over 100 MPGe. The Chevrolet Volt, introduced in 2010, is one example of a PHEV.
- Zero-emission vehicle (ZEV): A vehicle that has no tailpipe pollution emissions. ZEVs include BEVs and fuel cell vehicles (FCVs) that run on hydrogen gas. There are a few FCVs available in limited markets in the U.S. The fueling infrastructure needed for widespread adoption of FCVs is not well developed.
- Electric vehicle supply equipment (EVSE): More commonly known as a charging station, this is a device used to charge electric vehicles and plug-in hybrids. Charging stations typically include multiple connectors or plugs to accommodate different vehicle charging systems and may be publicly available or privately owned at individual residences or businesses. Level 1 chargers are connected to the electrical grid through a standard 3-prong electrical outlet. Level 2 charging can operate at a higher current and voltage, allowing for faster charge times. Level 3 chargers require utility system upgrades and may be known as direct current (DC) “fast chargers.” Other charging standards have been developed by the Society of Automotive Engineers (SAE), the International Electrotechnical Commission (IEC), and Tesla, which developed the North American Charging Standard (NACS).

This paper uses the term EV to refer to any all-electric passenger automobile, for simplicity. Although some EVs may utilize advanced technology to create a software-centric driving experience, EVs should not be confused with autonomous vehicles (AVs), which can operate without a human driver. There are no fully autonomous vehicles for sale today. Additional information about EV technologies can be found at fueleconomy.gov, a website maintained by the U.S. Department of Energy (DOE), Office of Energy Efficiency & Renewable Energy.

INSURANCE CONSIDERATIONS AND POTENTIAL CHALLENGES

LIMITED VEHICLE USE AND LOSS DATA

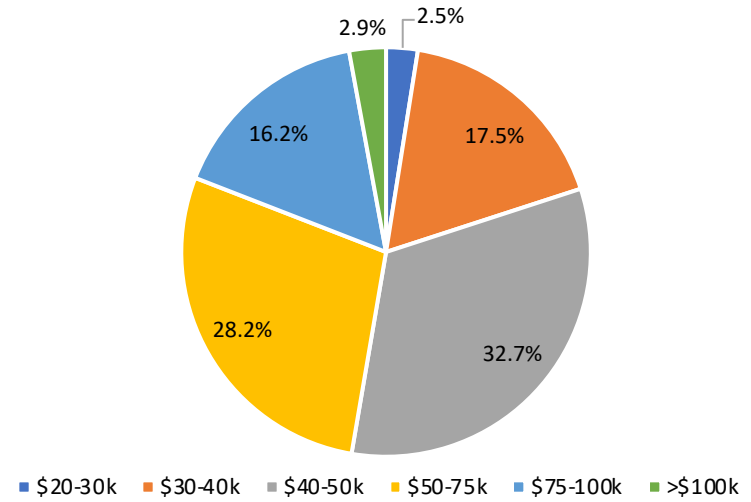
Insurers are in the business of assessing, mitigating, and transferring risk. Insurers provide personal and commercial auto policies to individuals and businesses for all types of vehicles, including conventional fossil fuel-powered cars and trucks, hybrid and fuel-efficient models, alternative fuel vehicles, and EVs. The vehicle's and driver's underlying risk characteristics ultimately drive the insurability and premium charged for auto policies.

The rapid adoption of EVs presents several challenges for insurers assessing and pricing risk. Until recently, the number of EV sales made up a very small fraction of total vehicle sales. EVs currently on the road are also skewed toward newer and higher-end models than the overall vehicle population. The relatively recent adoption of EVs means there is limited use and loss data for insurers to consider when trying to understand, accurately predict, and price risk associated with increasing numbers of EVs. In the first quarter of 2023, EV repairable claims frequency hit 1.13 percent in the U.S.[7] As a greater number of EVs are on the road for a longer period, insurers will have additional historical data to more accurately assess risks associated with EVs.

UPFRONT AND REPAIR COSTS

The high upfront cost of EVs is one barrier consumers face when considering the purchase of an EV today and is one factor affecting claims costs. To date, the EV market has focused on higher-end luxury and performance models, with the average price of an EV being $61,488 at the end of 2022 versus $49,507 for all passenger cars and trucks.[8] Figure 3 shows EV claims volume share in 2022 by the vehicle's original MSRP. Due to increasing competition and growing inventory, and to meet eligibility for tax credits, some EV manufacturers have dropped prices in recent months.[9] The introduction of additional models in coming years and maturing supply chains are also expected to exert downward pressure on EV prices over time.

Figure 3. **EV claims volume share by vehicle's original MSRP (2022)**



Source: CCC Intelligent Solutions Inc.[10]

7 PropertyCasualty360, EVs see small uptick in repairable claims frequency in Q1 (May 17, 2023) at **https://www.propertycasualty360.com/2023/05/17/evs-see-small-uptick-in-repairable-claims-frequency-in-q1/**.

8 The New York Times, Electric Vehicles Could Match Gasoline Cars on Price This Year (February 10, 2023) at **https://www.nytimes.com/2023/02/10/business/electric-vehicles-price-cost.html**.

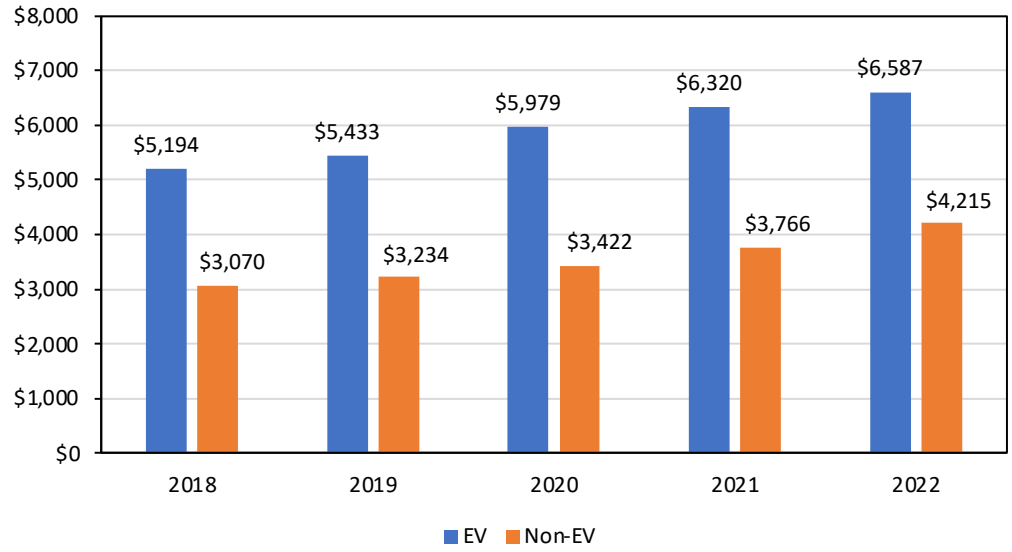
9 CNBC, Ford cuts prices on its electric F-150 Lightning pickups by as much as $10,000 (July 17, 2023) at **https://www.cnbc.com/2023/07/17/ford-f-150-lightning-ev-price-cuts.html**.

10 CCC, Will Electric Vehicle RegulaHons ConHnue to Force Change (July 11, 2023) at **https://cccis.com/news-andinsights/insights/will-electric-vehicle-regulaHons-conHnue-to-force-change/**.

In addition to higher upfront costs, some studies have shown that EVs take longer to repair and are more expensive to repair than conventional vehicles. Several factors contribute to these trends, including the necessary retooling of auto parts manufacturers, assembly plants, and repair shops, required training of repair technicians, and the adaptation of supply chains for new components. Since many EV models are relatively new, there are few options for aftermarket replacement parts; it is estimated that original equipment manufacturer (OEM) parts account for over 90 percent of the parts used in EV repairs.[11] Additionally, fewer repair shops are qualified to repair EVs, particularly for newer and smaller EV startups that have yet to achieve the scale of larger manufacturers.[12] For instance, EV startup Rivian has about 200 certified collision shops in North America, compared to 2,800 for Ford.[13]

According to CCC Intelligent Solutions, the total average cost of repair (TCOR) for EVs in 2022 was $6,587, compared to $4,215 for all non-EVs (Figure 4).[14] However, some of the observed higher repair costs for EVs are due to the EV population skewing toward newer, higher-end models. In comparing vehicles of the same age, the TCOR for current year model EVs is $1,600 more than for non-EVs. Other factors that contribute to higher EV repair costs include a greater average number of parts per estimate, which can be 33 to 50 percent greater than a non-EV, and labor costs that can be double the non-EV rate.[15]

Figure 4. **Total cost of repair for EVs and non-EVs (2018 – 2022)**



Source: CCC Intelligent Solutions Inc.[16]

Data suggests that the difference in repair costs between EVs and conventional vehicles is less pronounced for vehicles of both similar age and price. Repairing a mainstream, non-luxury brand EV costs about $800 more than a similar gas-powered vehicle and roughly the same when comparing premium EVs and premium conventional cars.[17] According to the Highway Loss Data Institute, for vehicle models with both an EV and gasoline version, EV repair costs were only 2 percent higher.[18]

11 PropertyCasualty360, EVs see small upHck in repairable claims frequency in Q1 (May 17, 2023).

12 The New York Times, Why Car Repairs Have Become So Expensive (July 3, 2023) at **https://www.nyHmes.com/2023/07/03/business/car-repairs-electric-vehicles.html**.

13 *Ibid.*

14 CCC, Will Electric Vehicle RegulaHons ConHnue to Force Change (July 11, 2023).

15 *Ibid.*

16 *Ibid.*

17 The New York Times, Why Car Repairs Have Become So Expensive (July 3, 2023).

18 *Ibid.*

New vehicles, including EVs, have increasingly complex systems and components, leading to higher repair costs for insurance companies when cars are damaged in an accident. Digital and EV battery systems that may not have visual damage still need to be inspected and, in some cases, recalibrated following a collision. The average cost of repairing a damaged car has increased 36 percent since 2018, according to data company Mitchell.[19] Factors contributing to higher auto repair costs in general include the rapid increase in overall economic inflation starting in 2020 due to the COVID-19 pandemic, supply chain disruptions, among others. Auto insurance claims inflation has continued to increase more quickly than the underlying consumer price index, far outpacing the increase in auto insurance premiums.[20,21]

To the extent that EVs cost more upfront and to repair, consumers may see these factors reflected in higher insurance premiums for an EV than for a lower value, mainstream car. When shopping for a new car, consumers should contact their insurance company to receive a quote for the vehicle they are considering.

VEHICLE TECHNOLOGY

Although all light duty cars and trucks sold in the U.S. must meet Federal Motor Vehicle Safety Standards, some features of EVs pose unique safety considerations for consumers and insurers. EVs can deliver instantaneous high torque from a stop, resulting in much faster acceleration than many conventional vehicles. Depending on the driver's familiarity with EVs and how aggressively the vehicle is driven, this enhanced performance of many EVs could either be a safety concern or benefit that allows a driver to avoid a collision. A survey of 1,200 EV owners by insurer AXA in Belgium found that drivers of EVs caused 50 percent more collisions than conventional vehicles, which was attributed to misjudgment of accelerations.[22] Claims data compiled in China, where EV adoption is further along than the U.S., suggest is takes new EV drivers about three years to learn to drive an EV as safely as a conventional vehicle.[22a]

Risk mitigation factors for EVs, and newer cars in general, include advanced driver assistance systems (ADAS) and other features that make cars safer in collisions or able to avoid accidents. Like many new vehicles produced in recent years, EVs may utilize technology and digital controls to enhance the driving experience and improve vehicle safety. Some manufacturers use radar, light detection and ranging (LiDAR), digital cameras, and artificial intelligence to detect obstacles and hazards while driving, enabling semi-autonomous driving and other advanced features.

Other vehicle technologies such as automatic emergency braking (AEB), adaptive cruise control and driver assist features, lane departure warnings, and blind spot monitoring are increasingly common in both new EVs and conventional vehicles. In May 2023, the National Highway Transportation and Safety Administration (NHTSA) announced plans to make AEB and pedestrian automatic emergency braking (PAEB) required components on all new passenger cars and light trucks.[23] To address concerns that pedestrians may not hear approaching EVs, which operate quietly at lower speeds, electric and hybrid vehicles under 10,000 pounds are required to emit a sound when driving below about 20 miles per hour in the U.S. and Europe.[24]

A challenge for insurers is being able to know which cars they insure have advanced features such as driver assistance since it is no longer the case that a vehicle identification number (VIN) or the make, model, and year reveals everything insurers need to know about a vehicle's risk characteristics. There is also inconsistency in the terminology manufacturers use to describe advanced driving or safety features. It is especially important for insurers to have this type of information to assess risk as vehicle systems assume a larger role.

19 *Ibid.*

20 Insurance Business, New APCIA study examines rising challenges for the auto insurance space (July 21, 2023) at **https://www.insurancebusinessmag.com/us/news/auto-motor/new-apcia-study-examines-rising-challenges-for-the-auto-insurance-space-453558.aspx**.

21 Money, Car Insurance Rates Are Rising Faster Than Anything Else in the Economy (August 2, 2023) at **https://money.com/car-insurance-inflation-2023/**.

22 The Brussels Times, Electric cars involved in more accidents than regular vehicles, study shows (September 11, 2022) at **https://www.brusselstimes.com/287315/electric-cars-involved-in-more-accidents-than-regular-vehicles-study-shows**.

22a PropertyCasualty360, What lessons can U.S. insurers learn from China's experience with EVs? (September 11, 2023) at **https://www.propertycasualty360.com/2023/09/11/what-lessons-can-u-s-insurers-learn-from-chinas-experience-with-evs/**.

23 NHTSA, NHTSA Proposes Automatic Emergency Braking Requirements for New Vehicles (May 31, 2023) at **https://www.nhtsa.gov/press-releases/automatic-emergency-braking-proposed-rule**.

24 Green Car Reports, EVs and hybrids get an extension to meet US noise-making requirements (September 1, 2020) at **https://www.greencarreports.com/news/1129448_evs-and-hybrids-get-an-extension-to-meet-us-noise-making-requirements**.

To support innovation in transportation, insurers need to be able to identify a vehicle equipped with advanced driving systems, the type of technology on board an individual vehicle (when presented as a risk to be insured), and anonymized loss history data. Insurers need this information to develop products and underwriting methods to meet the needs presented by the changing nature of the driving risk and to obtain regulatory approval to bring those products to market. The ability to identify vehicles with automated driving technology is also critical for safety researchers to determine the effectiveness of the technology in reducing crashes and differentiating the performance of different automated driving systems.

BATTERY TECHNOLOGY

The majority of EVs and PHEVs built today use lithium-ion battery packs, but there is no standard design across different EV manufacturers. Some battery packs use assemblages of cylindrical cells, while others use rectangular prismatic batteries or pouch-like batteries that have a more flexible shape. Each design has its own advantages and disadvantages, including different risk factors. Many battery packs are housed at the bottom of the EV, lowering the vehicle's center of gravity and reducing the risk of a rollover, while also making the battery pack difficult to access and susceptible to damage from road debris.

Each design has its own advantages and disadvantages, including different risk factors.

COST AND ACCESSIBILITY: In some instances, the battery pack design or integration into the structure of the EV means they are expensive or impossible to service or remove. Battery packs can cost tens of thousands of dollars and account for up to half of an EV's price, making replacement of the battery following some accidents uneconomical.[25] A lack of available diagnostics to determine battery condition after an accident, along with high cost, leads some EVs to be scrapped after an accident. A 2023 study found that battery replacement can sometimes cost more than a used EV that is one year old.[26] A lack of transparent battery health information for buyers of used EVs is another hurdle for wider EV adoption. Internationally, the U.K. government and E.U. are exploring possible regulation that would mandate battery state of health (SOH) monitors on all new EVs to aid consumer confidence.[27]

EV batteries reach the end of their lifetimes when they retain less than around 70 or 75 percent of their original capacity.[28] Auto recyclers extract the valuable metals inside the batteries, including lithium, nickel, cobalt, manganese, aluminum, which may then be used to make new batteries. Automakers that use EV battery materials that have been recycled in the U.S. qualify for EV production incentives.[29]

WEIGHT: The battery in an EV can account for as much as one-third of the total vehicle weight, and EVs are considerably heavier than conventional cars. The average vehicle weighed about 4,300 pounds in mid-2023, and some larger EVs can weigh thousands of pounds more. At the extreme end, the GMC Hummer EV weighs over 9,000 pounds, with a battery that weighs as much as some conventional vehicles.[30]

25 Reuters, Insight: Scratched EV battery? Your insurer may have to junk the whole car (March 20, 2023) at **https://www.reuters.com/business/autos-transportation/scratched-ev-battery-your-insurer-may-have-junk-whole-car-2023-03-20/**.

26 Reuters, EV Batteries remain major challenge for insurers, Thatcham Research says (July 5, 2023) at **https://www.reuters.com/business/autos-transportation/ev-batteries-remain-major-challenge-insurers-uks-thatcham-2023-07-04/**.

27 Fleetworld, UK government explores compulsory battery state of health monitors for EVs (May 2023) at **https://fleetworld.co.uk/uk-government-explores-compulsory-battery-state-of-health-monitors-for-evs/**.

28 Car and Driver, Everything You Need to Know about EV Battery Disposal (June 10, 2023) at **https://www.caranddriver.com/features/a44022888/electric-car-battery-recycling/**.

29 Reuters, Dead EV batteries turn to gold with US incentives (July 21, 2023) at **https://www.reuters.com/business/autos-transportation/dead-ev-batteries-turn-gold-with-us-incentives-2023-07-21/**.

30 Business Insider, The electric Hummer isn't as great for the environment as you might think – and it proves not all EVs are created equal (December 2, 2022) at **https://www.businessinsider.com/gmc-hummer-ev-efficiency-weight-electric-vehicles-pickup-trucks-2022-12**.

Heavier vehicles can cause more damage to road surfaces, as well as other vehicles, people, or property involved in an accident. In some instances, older parking garages or infrastructure may be susceptible to damage or collapse from the combination of consumer preference for larger vehicles and the additional weight of EVs.[31] While every vehicle has its own safety characteristics, a 2018 study by the Insurance Institute for Highway Safety (IIHS) found that the likely injuries sustained by the driver of a lighter sedan were more serious than those sustained by the driver of a heavier SUV. A 2011 study by the National Bureau of Economic Research found that a 1,000-pound difference between vehicles in a crash increases the likelihood of a fatality by 47 percent.[32]

PERFORMANCE AND FIRE RISK: Early EV batteries posed fire risks if they were punctured or charged improperly, were sensitive to temperature, and experienced degraded performance over time.[33] While advances in battery technology have increased the range of EVs and decreased recharging times, there are still risks of battery failure and degraded performance under certain circumstances. How a vehicle is driven and the driving conditions, including ambient temperature, can affect the range of EV batteries. While many conditions result in only modest range reductions, a study by AAA found that the range of an EV could decrease up to about 40 percent in cold temperatures and when utilizing the car's heater.[34]

Although newer lithium-ion technologies have made the batteries more resistant to fire, EV batteries still face a risk of fire through self-ignition and reignition following an accident since the liquid electrolyte in lithium-ion batteries is highly flammable. A battery fire may spark a chain reaction between cells known as thermal runaway.[35] Such chemical battery fires burn hotter and take considerably more water and time to extinguish than a conventional car that catches fire, particularly when an encased battery pack is located at the bottom of the vehicle.[36] Fires that would normally take one hour to extinguish for a conventional vehicle have taken five or six hours for EVs and required as much as 12,000 gallons of water, more than 10 times the volume needed to extinguish a conventional vehicle fire.[37]

With a lack of readily available fire extinguishing agents for EVs, some fire services have reportedly taken to partial or complete submersion of a burning EV in water to control the fire.[38] Vehicle manufacturers and some states, including Virginia, are providing information to public safety, fire and emergency management services on how to handle situations involving EVs, such as how to disengage or isolate an EV battery.[39] This type of information is critical to first responders as well as towing and vehicle service professionals that come into contact with EVs after they have been involved in an accident. The uniqueness of EV designs and lack of common EV standards means that no single method works to extinguish an EV fire.

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31 CBS, NYC launches investigation on Lower Manhattan parking garage collapse (April 19, 2023) at **https://www.cbsnews.com/newyork/news/nyc-launches-investigation-on-lower-manhattan-parking-garage-collapse/**.

32 CBS, As electric vehicles become more common, experts worry they could pose a safety risk for other drivers (June 13, 2023) at **https://www.cbsnews.com/news/electric-vehicle-safety-heavy-battery/**.

33 NFPA, Lithium ion batteries hazard and use assessment (November 2016) at **https://www.nfpa.org/News-and-Research/Data-research-and-tools/Hazardous-Materials/Lithium-ion-batteries-hazard-and-use-assessment**.

34 AAA, AAA Electric Vehicle Range Testing (February 2019) at **https://www.aaa.com/AAA/common/AAR/files/AAA-Electric-Vehicle-Range-Testing-Report.pdf**.

35 NBC News, Ford F-150 Lightning electric truck fire highlights a growing EV risk (April 20, 2023) at **https://www.nbcnews.com/business/consumer/ford-f-150-lightning-electric-truck-fire-highlights-growing-ev-risk-rcna80611**.

36 The Hill, Firefighters have to blast 40 times more water at burning Tesla than other cars (August 17, 2021) at **https://thehill.com/changing-america/enrichment/arts-culture/568255-firefighters-have-to-blast-40-times-more-water-at/**.

37 ABC News, Hurricane Ian flood damage to EVs creating ticking time bombs in Florida (October 21, 2022) at **https://abc7.com/hurricane-ian-ev-car-fires-electric-cars-damaged-florida-flood-damage/12356326/**.

38 CTIF, Up to 150,000 liters of water needed to put out a fire in an electric car (September 18, 2022) at **https://www.ctif.org/news/150-000-liters-water-needed-put-out-fire-electric-car**.

39 NBC News, Ford F-150 Lightning electric truck fire highlights a growing EV risk (April 20, 2023).

The risk of EV battery fires has direct implications for personal and commercial lines, including auto and property insurance and other types of insurance depending on where the fire occurs. EVs that catch fire inside a home garage, in a public parking garage, or at a dealer or repair facility can damage these structures or any adjacent or nearby property. There have also been examples of EVs catching fire after flooding by saltwater and EV fires on cargo ships (see Spotlights below). As with conventional vehicles, attempting to drive a vehicle after it has sustained significant damage or been submerged in water is not advisable. Guidance from some manufacturers also recommends outdoor storage of EVs that have been in an accident or experienced flooding and keeping the vehicle at least 50 feet away from other objects.

Some auto manufacturers are working to create so-called 'solid state' batteries for EVs that hold the promise of mitigating some of the challenges with current lithium-ion battery technology. Solid state batteries may be safer because they use a solid-state electrolyte rather than a flammable liquid, do not get as hot when charging, and are lighter. They also may perform better, including increased vehicle range and lower charging time and cost.[40] The technology is still under development and is not expected to be commercially available for at least several years.

Spotlight: EV Fires Following Hurricane Ian

In the days and weeks following Hurricane Ian in September 2022, reports from Florida confirm numerous instances where EVs caught fire spontaneously.[41] Saltwater intrusion was cited by NHTSA as the main factor behind the fires. Although flooding is primarily blamed, it is unclear what initially sparks the fire. There have been instances when flooded vehicles picked up by tow trucks caught fire while being towed or after being brought to a lot. In some instances, flooded EVs from Florida that were resold have caught fire in other states. With increasingly severe weather occurring across the country, experts warn that EV fires due to flooding may become more common.

Recommendations for mitigating the risks of fire include:

- ***Educating** consumers about the risks of EVs damaged or flooded by saltwater.*
- ***Moving** EVs away from a potential flood area before a storm.*
- ***Parking** damaged or flooded EVs at least 50 feet away from other vehicles, structures, or combustible materials.*
- ***Unplugging** damaged or flooded EVs from electrical outlets before power is restored to an area.*

Spotlight: EV-related Fires on Cargo Ships

There have been several recent examples of fires occurring on ships that are transporting EVs, possibly impacting marine and cargo insurance lines. A vessel carrying over 3,700 cars, including nearly 500 EVs, caught fire off the coast of the Netherlands in July 2023. An EV was the suspected source of the fire, in which one person died.[42] In February 2022, a cargo ship carrying around 4,000 luxury vehicles, including some EVs, caught fire off the coast of Portugal. The ship sank with all cars onboard, resulting in an estimated $500 million loss to the shipping company.[43] The cause of the fire was still unknown one year after the fire, but EVs have been suspected, resulting in some shipping companies refusing to transport used EVs.

40 Financial Times, Between hope and hype for Toyota's 'solid-state' EV batteries (July 4, 2023) at **https://www.ft.com/content/457269a7-9500-43ed-bfb7-f729d19de5ee**.

41 ABC News, Hurricane Ian flood damage to EVs creating ticking time bombs in Florida (October 21, 2022).

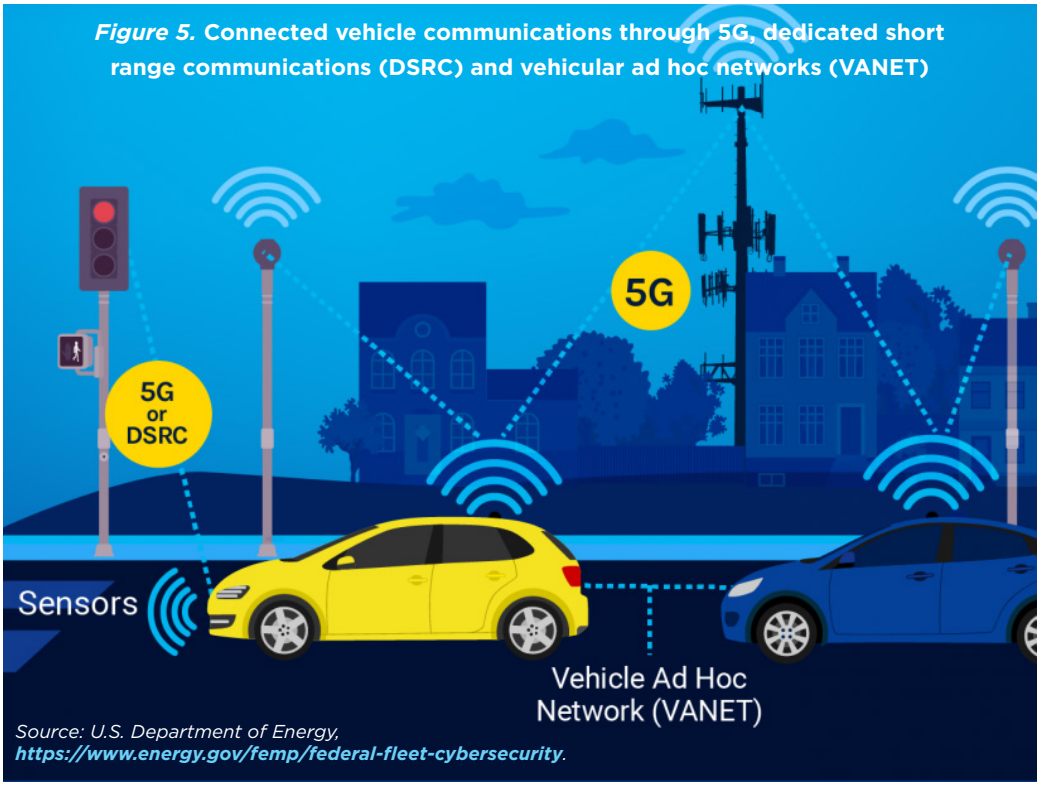
42 Reuters, One dead in cargo ship fire, electric car suspected source, Dutch coastguard says (July 26, 2023) at **https://www.reuters.com/world/europe/one-dead-several-wounded-after-fire-cargo-ship-dutch-coast-guard-2023-07-26/**.

43 The Drive, It's Been Exactly One Year Since the Felicity Ace Caught Fire With Nearly 4,000 Cars Onboard (February 16, 2023) at **https://www.thedrive.com/news/its-been-exactly-one-year-since-the-felicity-ace-caught-fire-with-nearly-4000-cars-onboard**.

DATA SECURITY AND PRIVACY

All newer vehicles, including EVs, are more connected than ever before and rely on increasing numbers of automotive chips and software to run them.[44] As EV technologies continue to evolve, vehicles will increasingly communicate with each other, known as vehicle to vehicle (V2V) communication, and with nearby infrastructure (V2I or V2X) to navigate their surroundings (Figure 5). These communications have the potential to increase the safety of our roads by reducing the frequency or severity of accidents and to increase the mobility of disabled or aging populations.

Figure 5. **Connected vehicle communications through 5G, dedicated short range communications (DSRC) and vehicular ad hoc networks (VANET)**



Source: U.S. Department of Energy, ***https://www.energy.gov/femp/federal-fleet-cybersecurity****.*

The digital systems that operate newer vehicles generate large amounts of data about their operation via built in apps, sensors, and cameras, including data or digital images showing how the vehicle was driven leading up to an accident. This data may provide critical information for the parties involved in an accident, insurance companies, authorized third parties, federal and state regulators, and law enforcement. Insurance companies have offered voluntary telematics systems for years that collect data on mileage and driving habits, and in turn provide discounts to the safest drivers. Some insurers have forged partnerships with auto manufacturers to provide seamless data sharing.[45]

44 The Wall Street Journal, Cars and Chips Will Only Get Closer (November 18, 2021) at **https://www.wsj.com/articles/cars-and-chips-will-only-get-closer-11637263396**.

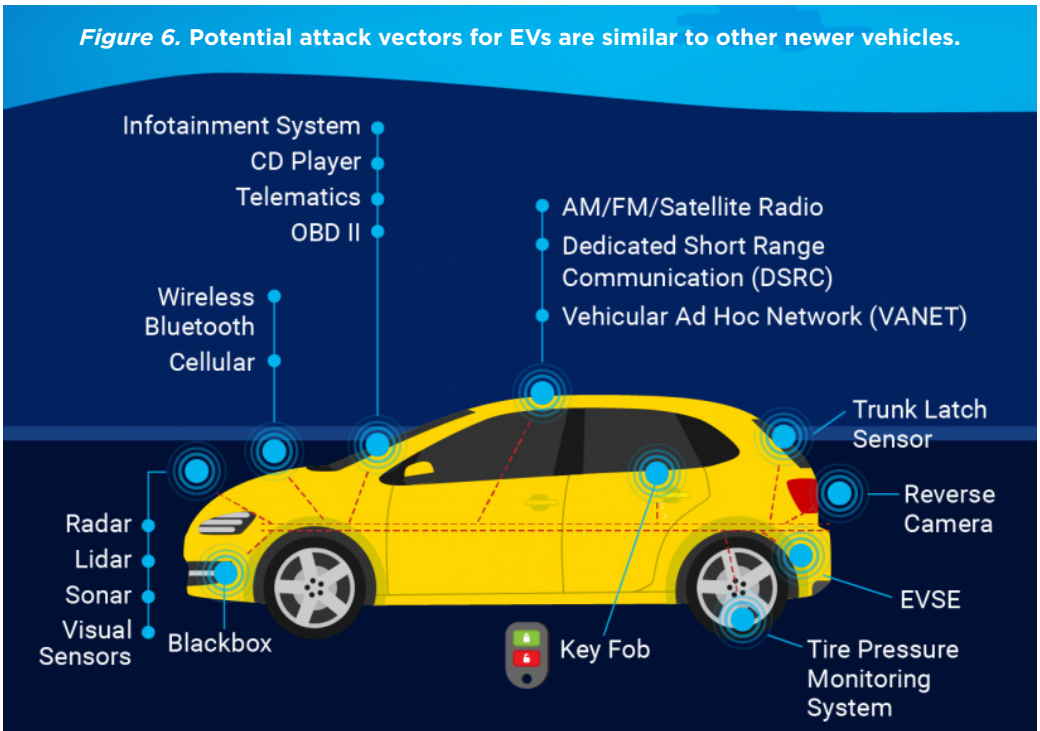
45 The Wall Street Journal, Car Insurers Struggle to Track Driving Behavior. GM May Have a Better Way to Do It. (November 19, 2020) at **https://www.wsj.com/articles/car-insurers-struggle-to-track-driving-behavior-gm-may-have-a-better-way-to-do-it-11605791475**.

The control over vast amounts of data generated by vehicles is the subject of ongoing debate in the U.S. and E.U., and has repercussions for the insurance industry.[46,47] There are privacy issues, questions regarding who owns the data, and the intellectual property rights of those who develop advanced vehicle technology. It is important to balance these considerations with the goals of improving safety and insuring this new risk profile. At a minimum, vehicle owners and lessees should have control over and the ability to authorize access to vehicle data for third parties with whom they wish to share data for any reason, including insurers for underwriting and claims purposes. The data should also be available on reasonable terms to allow for prompt accident investigation and resolution of claims for damage and injury resulting from the accident.

Along with the potential for improved safety and mobility stemming from connected vehicle features, there are cybersecurity risks associated with data leaks or hacking (Figure 6). A 2021 study found that vehicle cyberattacks increased by 225 percent from 2018 to 2021.[48] Some newer cars connect to a smartphone via an app that can lock or unlock and start the vehicle remotely. In addition to the potential for theft of unattended vehicles, a vehicle that is hacked while operating could result in serious safety concerns for the driver and others.

Auto manufacturers take precautions to avoid cyberattack vulnerabilities and security concerns. Security precautions for vehicle operators should include using encrypted communications when connecting to wireless networks, using multifactor authentication, and maintaining up-to-date vehicle firmware and software. The DOE and other organizations maintain resources on mitigating vehicle cybersecurity threats.[49] For any vehicle, an alarm system, motion sensor, or GPS tracking device can help deter theft or increase the chances of a stolen vehicle being recovered.

Figure 6. **Potential attack vectors for EVs are similar to other newer vehicles.**



Source: U.S. Department of Energy, ***https://www.energy.gov/femp/federal-fleet-cybersecurity****.*

46 Automotive News, U.S. lawmakers forming congressional caucus on vehicle data access (September 20, 2022) at **https://www.autonews.com/regulation-safety/us-lawmaker-forming-congressional-caucus-vehicle-data-access**.

47 Reuters, EU car data access rules in progress but no timeline (April 3, 2023) at **https://www.reuters.com/business/autos-transportation/eu-car-data-access-rules-progress-no-timeline-2023-04-03/**.

48 Israel21c, Cyberattacks on cars increased 225% in last three years (February 24, 2022) at **https://www.israel21c.org/cyberattacks-on-cars-increased-225-in-last-three-years**/.

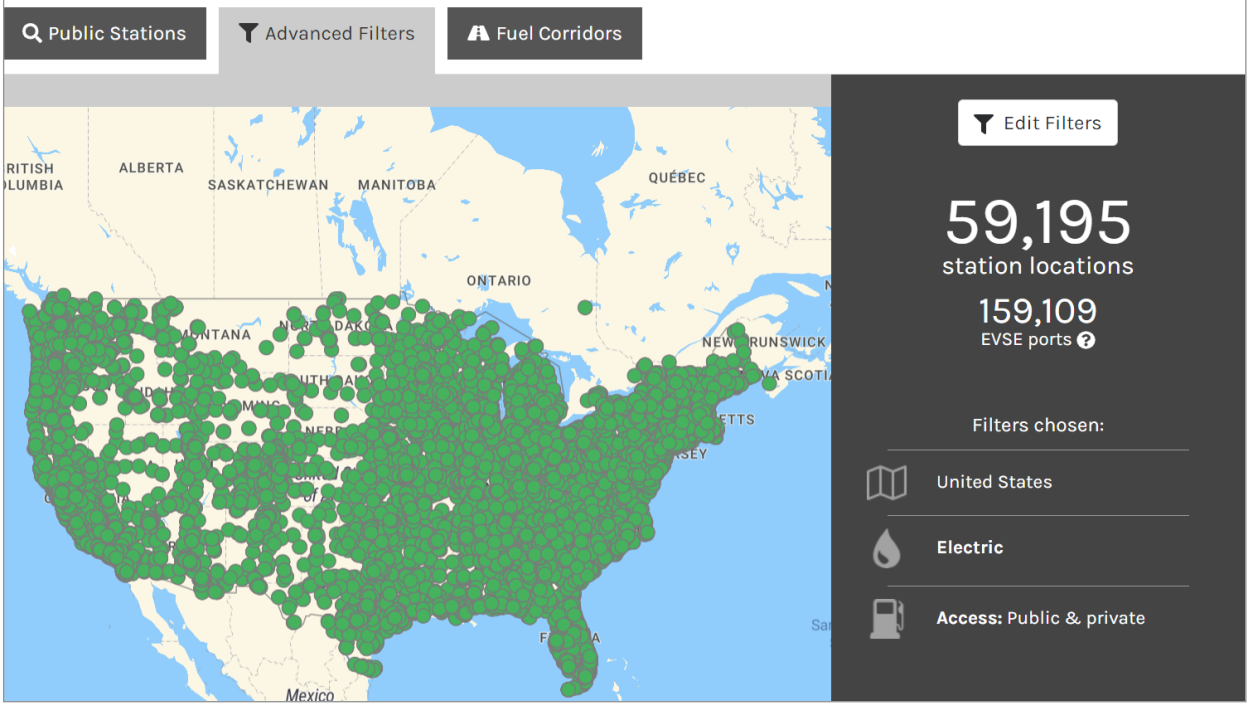
49 NREL, Vehicle Cybersecurity Threats and Mitigation Approaches (August 2019) at **https://www.nrel.gov/docs/fy19osti/74247.pdf**.

INFRASTRUCTURE

According to the 2023 J.D. Power Electric Vehicle Consideration Study, the lack of public vehicle charging infrastructure was the top reason (49 percent) cited by consumers rejecting the idea of buying an EV today. The confusing terminology and lack of a single charging standard further complicates the picture. As described below, recent U.S. policy is incentivizing the development of charging infrastructure across the country to quell consumer's fears of EV's limited range, and new partnerships are expanding and unifying the charging landscape.

As of August 2023, the DOE's Alternative Fueling Station Locator includes the locations of nearly 60,000 public and private EV charging stations in the U.S., which include 160,000 EV ports (Figure 7).[50] Tesla currently operates about 60 percent of the nation's 32,000 existing fast chargers. In 2023, Tesla reached agreements with Ford, GM, and EV startup Rivian to utilize the Tesla charger network and incorporate Tesla's North American Charging Standard (NACS) style charging ports on their vehicles starting in 2025.[51] The other major charging standard, known as the Combined Charging System (CCS), is used by nearly all non-Tesla EV manufacturers in the U.S.

Figure 7. **Existing EV charging stations in the U.S., as of August 2023.**



Source: U.S. Department of Energy, ***https://afdc.energy.gov/stations/#/analyze****.*

50 U.S. DOE AFDC, Alternative Fueling Station Locator at **https://afdc.energy.gov/stations/#/analyze**.

51 The Wall Street Journal, Tesla Recruits Another Rival to Use Its Supercharger Network (June 20, 2023) at **https://www.wsj.com/articles/rivian-to-use-teslas-ev-charging-standard-f04eae51?mod=article_inline**.

In July 2023, a new joint venture among auto manufacturers was reported that will take advantage of government incentives to install as many as 30,000 fast chargers in metropolitan areas and along major highways beginning in 2024, and that will compete with Tesla's Supercharger and other charging networks.[52] Outside of the Tesla network, many of the existing charger stations are operated by third parties, and some are privately owned and operated by the site's owner.

While most vehicle charging takes place at home, J.D. Power reported that 20.8 percent of EV drivers experienced charging failures or equipment malfunctions while trying to use public charging stations in the first quarter of 2023.[53] Problems have included user errors by those unfamiliar with the technology, broken screens, plugs, and cords, network connection failures, and difficulties connecting to certain brands of EVs. With charge times of around 30 minutes, there have also been reports of consumers having to wait for hours to charge their vehicles.

A potential risk of using public charging stations is their vulnerability to being hacked. Researchers with the University of Oxford and Armasuisse, a government agency in Switzerland, reported that the CCS fast chargers used in Europe and the U.S. can be attacked with off-the-shelf radio hardware.[54] The attack, known as Brokenwire, involves sending malicious signals to the EV to cause electromagnetic interference and disrupt the charging. However, this does not permanently damage the EV or charging system. Other attacks could pose different threats to the vehicle or infrastructure, or potentially expose driver or vehicle data. For instance, hackers could disable vehicle chargers and disrupt business operations until a ransom is paid.

There are several electric vehicle supply equipment (EVSE) communication standards meant to help ensure security between the charging unit, central system, web server, FTP server, and EV (Figure 8). Some recommended mitigation techniques to physical and remote threats to EV charging infrastructure include:[55]

- **Removing all jacks** that are externally accessible from the EVSE unit.
- **Incorporating strong encryption** of the EVSE controller boards.
- **Including tampering alarms** or signals to the service provider.
- **Employing secure coding practices** and auditing the source code.
- **Using code-signing techniques** for firmware updates.
- **Utilizing hypertext transfer protocol secure (HTTPS)** communication with web servers.

Addition research is underway to help address some of the charger station vulnerabilities to cyberattack.[56]

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52 The Wall Street Journal, Big Automakers Plan Thousands of EV Chargers in $1 Billion U.S. Push (July 26, 2023) at **https://www.wsj.com/articles/big-automakers-plan-thousands-of-ev-chargers-in-1-billion-u-s-push-af748d19**.

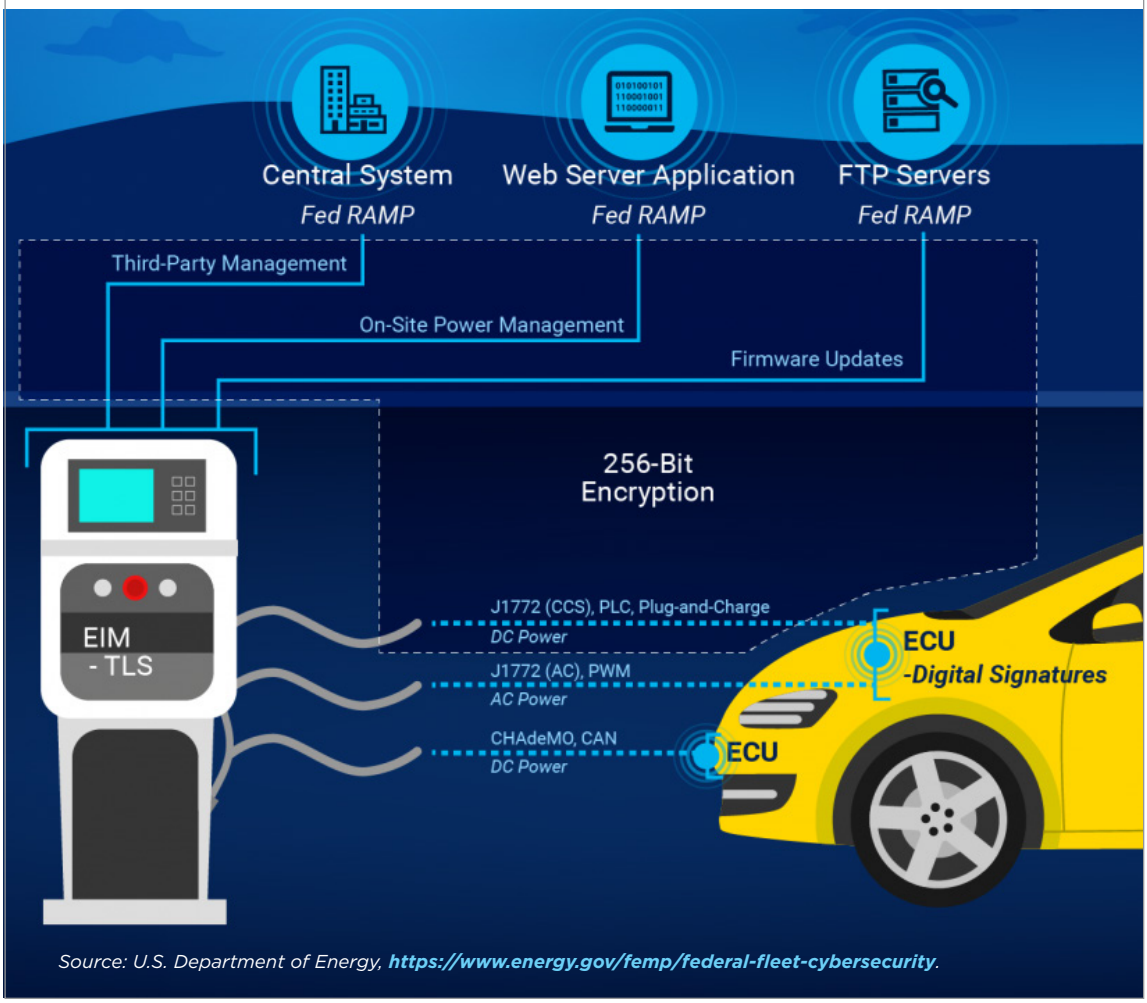
53 USA Today, How reliable are public EV charging stations? Report shows many EV drivers have issues (June 14, 2023) at **https://www.usatoday.com/story/money/cars/2023/06/14/public-ev-chargers-jd-power-reliability-study/70279294007/**.

54 Security Week, Remote 'Brokenwire' Hack Prevents Charging of Electric Vehicles (March 30, 2022) at **https://www.securityweek.com/remote-brokenwire-hack-prevents-charging-electric-vehicles/**.

55 U.S. DOE FEMP, Federal Fleet Cybersecurity at **https://www.energy.gov/femp/federal-fleet-cybersecurity**.

56 CleanTechnica, Intern Develops Technology To Find EV Charging Vulnerabilities (July 19, 2023) at **https://cleantechnica.com/2023/07/19/intern-develops-technology-to-find-ev-charging-vulnerabilities/**.

Figure 8. **Cybersecurity measures for EVSE connections.**



Source: U.S. Department of Energy, ***https://www.energy.gov/femp/federal-fleet-cybersecurity****.*

The electrification of vehicles is expected to increase electricity demand and place additional strain on already stressed and vulnerable electricity systems. Some experts in recent years have warned of potential reliability problems with the U.S. power grid, particularly during peak summertime demand or resulting from extreme weather and natural disasters.[57] This issue highlights the importance of ensuring grid stability by maintaining diverse energy supplies, storage capacity, and backup facilities, as well as building new and maintaining existing energy and electrical infrastructure to help maintain a safe and stable electricity grid. EVs can be charged overnight when electricity demand is lower, and they can also serve as storage devices, delivering energy back to the grid from the EV battery in what is known as vehicle-to-grid (V2G) charging.

ENVIRONMENTAL CONSIDERATIONS

The transportation sector accounts for the largest share of U.S. greenhouse gas (GHG) emissions (28 percent), followed by power generation (25 percent).[58] Vehicle manufacturers face increasingly stringent tailpipe and fuel economy standards to improve air quality and reduce the country's GHG emissions. While EVs and other ZEVs do not have direct tailpipe emissions, there are still environmental impacts from their production and operation.

57 Business Insider, A potential 'black swan' for US oil prices is being overlooked: unreliable electricity grids (July 3, 2022) at **https://markets.businessinsider.com/news/commodities/oil-prices-energy-market-electricity-power-grid-black-swan-cornerstone-2022-7**.

58 U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks at **https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks**.

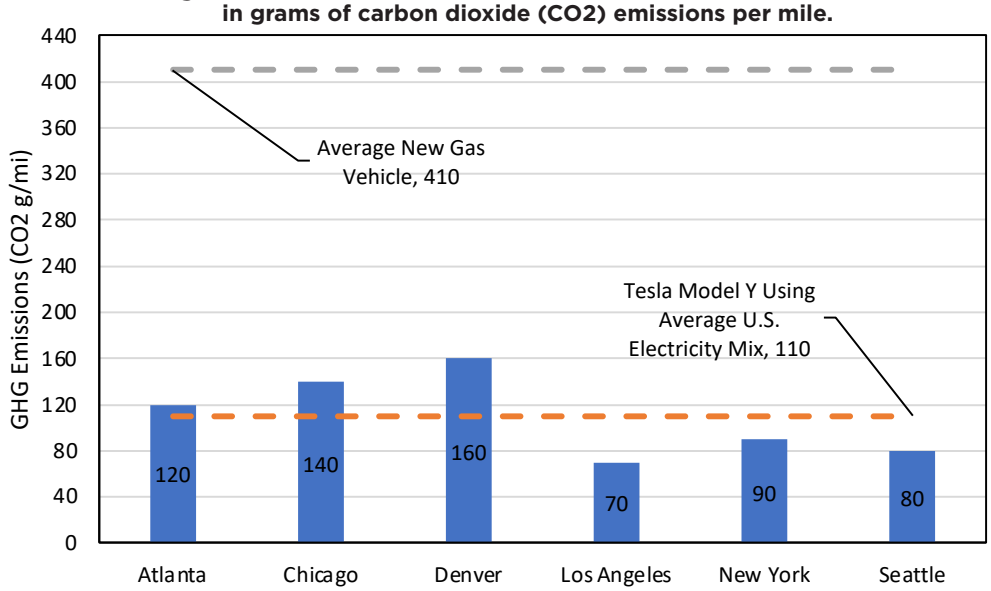
Many considerations[59] affect the fuel economy, GHG emissions, and lifecycle environmental impacts of vehicle production and operation. In 2020, Argonne National Laboratory conducted a lifecycle GHG assessment for a conventional gasoline car and an EV with a 300-mile electric range. The EV had higher initial manufacturing emissions and end-of-life emissions associated with the battery, as well as higher feedstock or fuel emissions from the electricity used to charge the battery, but lower overall emissions over the lifetime of the vehicle due to zero in-use emissions while driving.[60] By some estimates, an EV only has a lower environmental footprint than a conventional vehicle after it has reached 50,000 miles.[61]

The calculation of GHG emissions for an EV is also dependent upon two major factors:

- **The carbon dioxide (CO2) emissions associated with different types of fuel**: Different fuels emit different amounts of CO2 when burned to generate the same amount of energy. For instance, natural gas emits around 115 pounds of CO2 versus 155 pounds of CO2 for gasoline and 230 pounds of CO2 for coal to generate the same amount of energy.
- **The energy mix that is used to generate electricity in a particular location**: Different locations also have a different mix of fuel sources to generate electricity. Several tools are available to calculate the mix of fuels used to generate electricity in different regions of the U.S., such as: **https://www.epa.gov/egrid/power-profiler#/**. A separate tool calculates the emissions of any given vehicle is a particular location: **https://www.fueleconomy.gov/feg/Find.do?action=bt2**.

Figure 9 shows the GHG emissions for a Tesla Model Y, the world's best-selling car for the first half of 2023, in major U.S. cities compared to the same vehicle powered by the average electricity mix in the U.S. and an average new gasoline vehicle.

Figure 9. GHG emissions for Tesla Model Y in different U.S. cities in grams of carbon dioxide (CO2) emissions per mile.



*Data Source: U.S. Department of Energy, **https://www.fueleconomy.gov/feg/Find.do?action=bt2**.*

59 Reuters, Analysis: When do electric vehicles become cleaner than gasoline cars? (July 7, 2021) at **https://www.reuters.com/business/autos-transportation/when-do-electric-vehicles-become-cleaner-than-gasoline-cars-2021-06-29/**.

60 Caveat: the GHG comparison of a conventional vehicle to an EV includes assumptions for vehicle lifetime, miles driven, and other factors.

61 The Times, Electric cars only greener than petrol after 50,000 miles (November 26, 2020) at **https://www.thetimes.co.uk/article/electric-cars-have-to-do-50-000-miles-before-they-are-greener-than-fossil-fuel-vehicles-8hb5m0dm7**.

Environmental considerations surround the use of chemical fire suppressants and the use of large quantities of water needed to put out EV battery fires, particularly in drought-prone regions. There are other potential environmental, social, and political impacts for extracting lithium and other critical metals and materials needed for battery and EV components that are beyond the scope of this paper.[62]

Insurers are under pressure by regulators and other stakeholders to disclose and reduce the carbon emissions associated with their internal operations and their underwriting and investment portfolios to meet climate change or environmental, social, and governance (ESG) objectives. The Greenhouse Gas Protocol developed methodologies to calculate direct and indirect sources of GHG emissions for businesses, including scope 3 emissions for investments. Other groups, including the Partnership for Carbon Accounting Financials (PCAF), have developed a methodology for insurance-associated emissions from underwriting portfolios for limited business lines, including personal auto lines.[63]

Over time, insurers may face additional pressure to align their portfolios with lower carbon emissions. This places insurers in a difficult position since they do not choose their customers, cannot control the vehicle purchase decisions of their customers, and are subject to anti-discrimination regulations at the state level. There are also unique issues and complications for the U.S. market, which serves rural communities, small businesses, and diverse socioeconomic populations that may lack the resources to purchase EVs or easily access EV charging infrastructure.

EVs present additional considerations for public health, as they transfer the air pollution sources from internal combustion engines in vehicles, which are very effectively controlled via advanced emissions controls and catalytic converters, to the power plants that generate electricity used to charge EVs. In some instances, the electricity could come from low- or zero-emission renewable energy sources. In other instances, electricity could be generated from fossil fuel plants that may be located near vulnerable or disadvantaged communities, raising additional considerations.

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62 The Guardian, Revealed: how US transition to electric cars threatens environmental havoc (January 24, 2023) at **https://www.theguardian.com/us-news/2023/jan/24/us-electric-vehicles-lithium-consequences-research**.

63 Partnership for Carbon Accounting Financials, Insurance-Associated Emissions (November 2022) at **https://carbonaccountingfinancials.com/files/downloads/pcaf-standard-part-c-insurance-associated-emissions-nov-2022.pdf**.

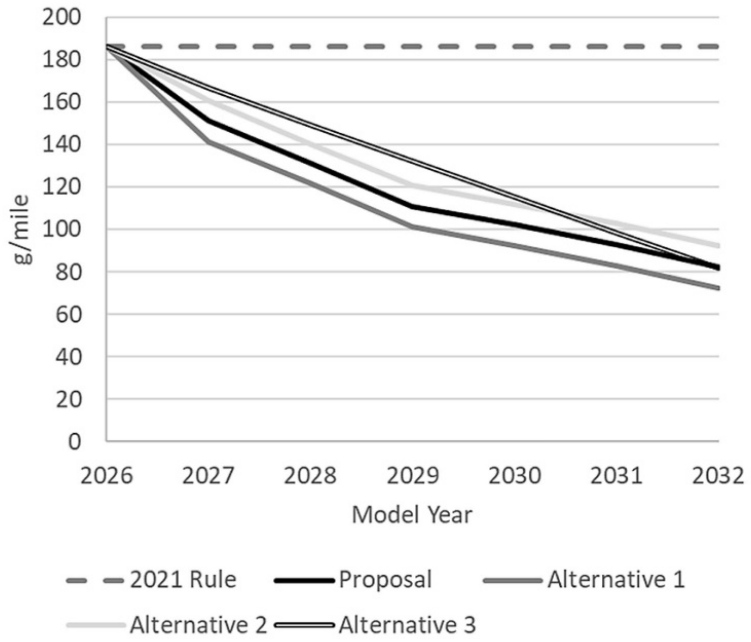
POLICY AND REGULATION

FEDERAL

In 2021, President Biden signed an executive order establishing a goal of having 50 percent of all new passenger vehicles sold in 2030 to be ZEVs, including EVs, PHEVs, and fuel cell vehicles. The order also directed the U.S. Environmental Protection Agency (EPA) and Department of Transportation (DOT) to establish new emissions and fuel efficiency standards for vehicles beginning with model year 2027. In March 2022, President Biden invoked the Defense Production Act to increase the country's supply of metals and materials used in EV production.[64]

In April 2023, the EPA released a proposed rule entitled Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, which includes more stringent tailpipe emissions standards to be phased in over a six-year period.[65] The proposal does not mandate a particular vehicle technology, but rather requires reducing fleet average emissions of CO2 by 56 percent by 2032 relative to current model year 2026 standards. Figure 10 shows the proposed tailpipe emissions standards for light-duty vehicles and several alternatives. The proposed targets for medium-duty vehicles represent a 44 percent reduction in CO2 emissions over the same period. One possible compliance pathway for light-duty vehicles would require over fifty percent of new vehicles sold to be EVs by 2030 and roughly two thirds by 2032.

Figure 10. Proposed light-duty vehicle tailpipe emissions standards in grams of carbon dioxide (CO2) emissions per mile.



Source: U.S. EPA

64 The White House, Fact Sheet; Biden-Harris Administration Driving U.S. Battery Manufacturing and Good-Paying Jobs (October 19, 2022) at **https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/19/fact-sheet-biden-harris-administration-driving-u-s-battery-manufacturing-and-good-paying-jobs/**.

65 U.S. EPA, Proposed Rule: Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles (April 2023) at **https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-multi-pollutant-emissions-standards-model**.

NHTSA administers the nation's Corporate Average Fuel Economy (CAFE) standards. CAFE standards for passenger cars and light duty trucks are 44.2 and 49.1 miles per gallon for model years 2024 and 2026, respectively. In July 2023, NHTSA proposed new CAFE standards for model years 2027 and later, requiring a fleet-wide average of 58 miles per gallon in 2032.[66] Under the standards, manufacturers receive credits for EVs sold in each model year. While CAFE standards can vary by vehicle manufacturer depending on several factors, the new standards reflect ambitious targets for the adoption of EVs and are intended to align with the EPA's proposed tailpipe emission standards.

Through funding provided by the Bipartisan Infrastructure Law, the current Administration aims to have a national network of 500,000 EV chargers by 2030.[67] The law provides $7.5 billion to help install charging infrastructure. Recent federal legislation has also provided funding for EV components and critical materials, and support for domestic manufacturing and tax credits for new and used EVs. Tax credits of up to $7,500 for new EVs and $4,000 for the purchase of a used EV are intended to make EV purchases more affordable on a mass scale. Some states or utility companies may provide additional financial incentives for purchasing an EV or installing a home charger.

Several other federal agencies have taken action that will affect the adoption of EVs. The Department of Transportation (DOT) and DOE recently finalized new EV charging standards. The rule establishes minimum technical standards for charging stations, including required numbers of charging ports, connector types, power level, availability, payment methods, uptime/reliability, EV charger infrastructure network connectivity, and interoperability, among other standards and requirements.[68] DOT also announced the National Electric Vehicle Infrastructure (NEVI) Formula Program, a plan to create a network of charging stations along major highways.[69]

The Federal Highway Administration has put in place requirements for assembly and manufacturing processes and temporary waivers through the Build America, Buy America (BABA) Implementation Plan to Enhance Buy America for EV Chargers.[70] Over the next decade, the DOE's Build a Better Grid Initiative will provide over $13 billion toward improving the reliability and efficiency of the power grid.[71] The plan is intended to enhance transmission planning, facilitate efficient, and conduct research of new technologies.[72]

STATE LEVEL

At the state level, the 2023 State Transportation Electrification Scorecard from the American Council for an Energy-Efficient Economy reports that California has the strongest state policies in the U.S. for encouraging EV adoption.[73] According to the study, California scores highly because of its commitment to vehicle electrification and the state's plan to update its electricity grid to accommodate more EVs. EVs made up 15.1% of all passenger vehicles sold in California during the first half of 2022, according to the California Auto Dealers Association, compared to 5% for the nation.

66 NHTSA, Corporate Average Fuel Economy at **https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy**.

67 The White House, Fact Sheet: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicles Chargers (February 15, 2023) at **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/**.

68 U.S. DOT, Charger Types and Speeds at **https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds**.

69 U.S. DOE AFDC, National Electric Vehicle Infrastructure (NEVI) Formula Program at **https://afdc.energy.gov/laws/12744**.

70 U.S. DOT FHA, Q&A for Build America, Buy America (BABA) Implementation Plan to Enhance Buy America for Electric Vehicle (EV) Charters (July 11, 2023) at **https://www.fhwa.dot.gov/construction/contracts/buyam_qaev/**.

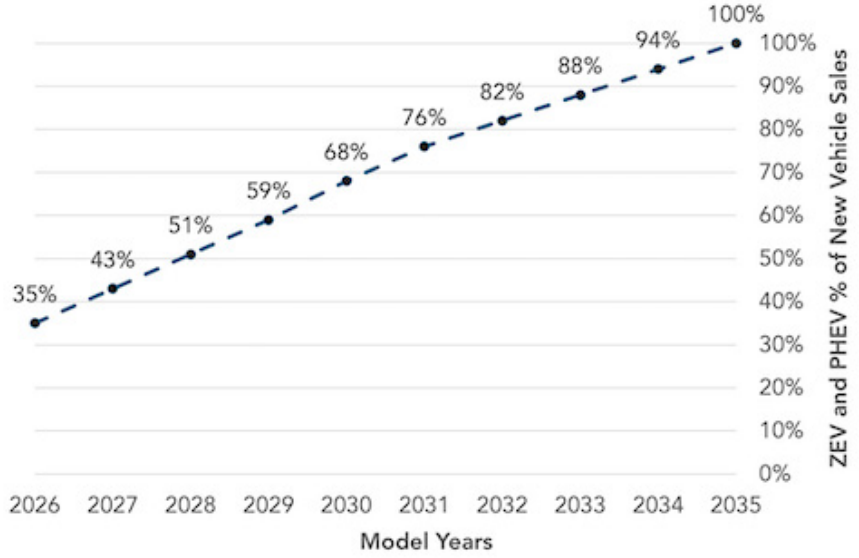
71 U.S. DOE, Biden-Harris Administration Announces $13 Billion to Modernize And Expand America's Power Grid (November 18, 2022) at **https://www.energy.gov/articles/biden-harris-administration-announces-13-billion-modernize-and-expand-americas-power-grid**.

72 U.S. DOE, Building a Better Grid Initiative (January 12, 2022) at https://www.energy.gov/oe/articles/building-better-grid-initiative.

73 Insurance Journal, California Sits Far atop National EV Policy Scorecard List (June 28, 2023) at **https://www.insurancejournal.com/news/west/2023/06/28/727376.htm**.

California recently adopted the Advanced Clean Cars II rule, requiring all light-duty cars sold after 2035 to be ZEVs, and the Advanced Clean Trucks rule, which established ZEV sales requirements for manufacturers of heavy-duty trucks.[74,75] Figure 11 shows the compliance pathway for California's Advanced Clean Cars II rule. To date, 17 other states have adopted all or part of California's low-emission vehicle (LEV) and ZEV regulations under section 177 of the federal Clean Air Act. Those states include NY, MA, VT, ME, PA, CT, RI, WA, OR, NJ, MD, DE, CO, MN, NV, VA, and NM.

Figure 11. **California zero-emission vehicle (ZEV) requirements under the Advanced Clean Cars II rule.**



Source: California Air Resources Board

CONCLUSION

The automotive sector is undergoing a significant shift toward vehicle electrification. In many ways, EVs present similar risks to conventional vehicles, and insurers will continue to utilize appropriate factors to assess and price the risks associated with these vehicles. However, EVs also present unique risk factors that merit consideration by insurers, policyholders, and other stakeholders. As EV adoption plays out over the coming years, insurers will continue to assess and respond to the insurance needs of consumers and businesses in the transportation sector.

74 CARB, Advanced Clean Cars II Regulations: All New Passenger Vehicles Sold in California to be Zero Emissions by 2035 at **https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii**.

75 CARB, Advanced Clean Trucks at **https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks**.

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