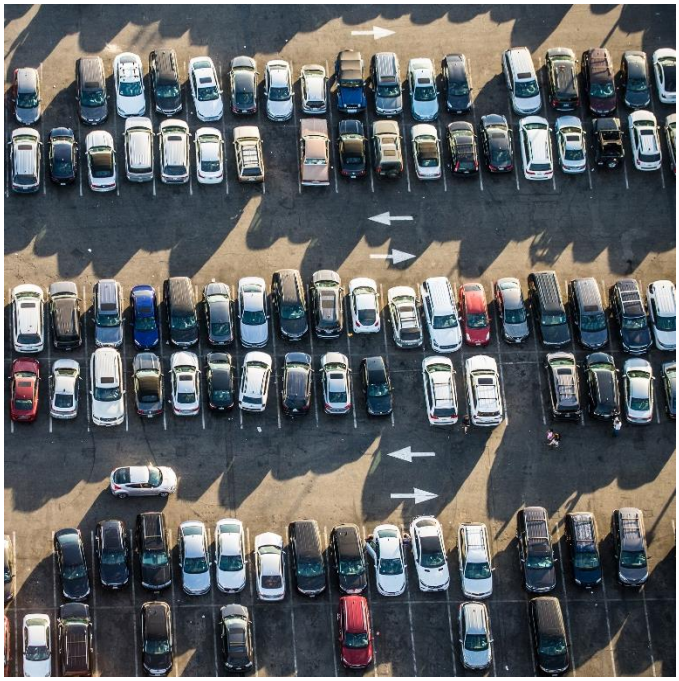
Electric Vehicle Market Status - Update

Manufacturer Commitments to Future Electric Mobility in the U.S. and Worldwide



MJB & A
an ERM Group company

September 2020

Contents

Acknowledgements 2
Executive Summary 3
Drivers of Global Electric Vehicle Growth – Global Goals to Phase out Internal Combustion Engines 6
Policy Drivers of U.S. Electric Vehicle Growth 8
Manufacturer Commitments 10
Job Creation 13
Charging Network Investments 15
Commercial Fleet Electrification Commitments 17
Sales Forecast 19
Battery Pack Cost Projections and EV Price Parity 21
Appendix – Manufacturer Commitments & Announced BEV and PHEV Models 23
Model Announcements – Light-Duty Vehicles 25
Model Announcements – Medium- and Heavy-Duty Vehicles 30
References 33

Acknowledgements

Lead Authors: Dana Lowell and Alissa Huntington

This paper summarizes the current status, and projected growth, of the U.S. electric vehicle (EV) industry over the next five to ten years. Key topics addressed include drivers of U.S. and global EV growth, auto manufacturer investments in EV development and in building a robust charging network for drivers, announced new EV model introductions, projected EV sales, projected battery pack costs, and projected date of EV "price parity" with internal combustion engine (ICE) vehicles.

This report was developed by M.J. Bradley & Associates for the Environmental Defense Fund (EDF).

About M.J. Bradley & Associates

MJB&A, an ERM Group company, provides strategic consulting services to address energy and environmental issues for the private, public, and non-profit sectors. MJB&A creates value and addresses risks with a comprehensive approach to strategy and implementation, ensuring clients have timely access to information and the tools to use it to their advantage. Our approach fuses private sector strategy with public policy in air quality, energy, climate change, environmental markets, energy efficiency, renewable energy, transportation, and advanced technologies. Our international client base includes electric and natural gas utilities, major transportation fleet operators, investors, clean technology firms, environmental groups and government agencies. Our seasoned team brings a multi-sector perspective, informed expertise, and creative solutions to each client, capitalizing on extensive experience in energy markets, environmental policy, law, engineering, economics and business. For more information we encourage you to visit our website, www.mjbradley.com.

For questions or comments, please contact:

Dana Lowell

Senior Vice President

M.J. Bradley & Associates, LLC

+1 978 369 5533

dlowell@mjbradley.com

This report is available at www.mjbradley.com.

Executive Summary

This paper is the second update to an initial report released in May 2019[1] that summarizes the current status, and projected growth, of the U.S. electric vehicle (EV) industry over the next five to ten years. Key topics addressed include drivers of U.S. and global EV growth, auto manufacturer investments in EV development and in building a robust charging network for drivers, announced new EV model introductions, projected EV sales, projected battery pack costs, and projected date of EV "price parity" with internal combustion engine (ICE) vehicles.

The data summarized here are based on formal statements and announcements by auto manufacturers, as well as analysis by the automotive press and by financial and market analysis firms that regularly cover the auto industry.

Transportation is currently the United States' largest source of greenhouse gas (GHG) emissions, and transportation-sector electrification is widely recognized as one of the best strategies for significantly reducing these emissions. The data summarized here support the conclusion that the automotive industry has embraced the vision of electrified mobility and that the EV market is on the cusp of a period of significant growth. Numerous manufacturers have publicly signaled their commitment to a future of electric vehicles. For example, the president of General Motors (GM) has said "GM believes in an all-electric future…GM is committed to driving usage and acceptance of electric vehicles…"[i] Similarly, in their 2017-2018 sustainability report Ford stated "…we aim to stay ahead of the curve in terms of electric innovation, to create cleaner, more efficient vehicles and to deliver affordable electric vehicles at scale."[ii] Volkswagen has said "the future of personal transportation is electric, and for Volkswagen, building the vehicles of the future means expanding in the United States."[iii]

These manufacturer commitments reflect heightened efforts to address the major causes of climate change, by governments world-wide, including adoption of more stringent vehicle emission standards and electric vehicle sales targets. It is likely that these government actions – and anticipation of even more stringent future standards – have been a significant driver of automaker EV commitments and investment plans, supported by dramatic reductions in the cost of batteries, which have made transportation electrification more affordable.

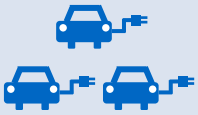
While this update now includes a discussion of medium- and heavy-duty vehicle electrification as well, the primary focus covers light-duty vehicles unless otherwise noted. Major findings of this report include:

Manufacturer Commitments

Carmakers worldwide will spend more than $185 billion through 2030 developing new electric models. Seven manufacturers have already announced plans to spend at least $11 billion to open new or renovated plants in the U.S. to build EVs in five different states. These plants will directly employ almost 20,000 workers and contribute to additional job creation for suppliers and local businesses. Most recently, Ford announced it has broken ground at its Rogue Complex in Michigan, an expansion dedicated to bringing forth the 2022 all-electric F-150. As 70 percent of plug-in EVs driven on U.S. roads in 2019 were made domestically, these manufacturing plant investments highlight continued cultivation of a strong EV workforce and robust market.

Automakers will spend **$185 billion** worldwide on light-duty vehicle **electrification through 2030** with at least **$11 billion on domestic manufacturing**

[1] The first update was released in August 2019.



Model Availability

Between 2020 and 2022, the number of battery electric (BEV) and plug-in hybrid (PHEV) passenger vehicle models available to U.S. consumers will increase from 60 to 83. The range of vehicle types available will also increase to include sport utility vehicles (SUV), cross-overs, and pick-up trucks. Since the last update, there have been notable announcements of manufacturer plans to introduce electric pick-up trucks, including those from GM, Nikola, and Lordstown Motors. The Cadillac Lyric and Lucid Motors Air have received attention as models that tout 300 and 517 miles of expected EPA-rated range, respectfully.

60 EV models in 2020 → **83** EV models in 2022

$

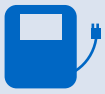
Affordability

By 2021 there will be at least six EV models available for under $30,000 (MSRP) with a driving range of up to 250 miles. There will be even more models with a net cost of under $30,000 when current federal, state, and local incentives are factored in.

EV Sales Projections

Major auto manufacturers are embracing electrification, as evidenced by the increased number and variety of electrified models offered, as well as commitments to brand electrification and sales targets. For example, Volvo anticipates BEVs will make up half of its sales in 2025 and is encouraging this transition by including an electric motor in every vehicle it launches from 2019 onwards.

Volvo anticipates battery electric vehicles will make up **half its sales by 2025**



Charging Station Investment

In addition to expanding their portfolios to include a greater range of electric and electrified models, manufacturers like Nissan and Volvo have acquired stakes in companies that specialize in charging and battery technology while Audi, Ford, Mercedes-Benz, and Volkswagen have announced they will each invest billions of dollars in electrification strategies. Manufacturers are increasingly exploring how to expand the charging network for their drivers, demonstrated through the EVgo and GM partnership to install 2,700 new fast charge plugs by 2025.

GM and **EVgo** are partnering to bring **2,700 new fast charge plugs** by 2025

Electric

EV-Specific Brand Development

Many brands are developing platforms that will exclusively cater to EVs, like GM positioning Cadillac as its lead EV brand with the BEV3 platform. By establishing unique EV-dedicated brands, automakers are sending a clear signal that EVs will increasingly make up a larger share of their portfolio and reducing emissions will be a focus going forward.

 Fleet Electrification	Electrification of medium- and heavy-duty commercial fleet vehicles is gaining traction, in part due to fleet electrification targets by major companies, with significant new developments since the last update to this report. These commitments send market signals that large entities, like Amazon, are seeking electric alternatives for their fleets, as components of their sustainability initiatives. These companies are planning to convert a range of light-, medium- and heavy-duty vehicle types to EVs, including delivery vans, commuter buses, transit buses, garbage trucks, and more. Today (2020), there are around 30 medium-duty electrified models and 21 heavy-duty models offered for sale, across a range of vehicle vocations, and this number will continue to grow in coming years. Coupled with private sector commitments, states are signaling their interest in medium- and heavy-duty electrification through recent policies such as California's Advanced Clean Truck Regulation as well as multi-state collaborations like the fifteen state Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding.	
 Declining Battery Costs	The cost of battery packs has fallen dramatically, from approximately $1,000/kilowatt-hour (kWh) in 2010 to approximately $156/kWh in 2019. Most analysts project that battery pack prices will continue to fall, reaching $100/kWh around 2025 and $61-72/kWh by 2030. Auto manufacturers have endorsed these projections.	**Battery pack prices** could fall to **$100/kWh by the mid-2020s**
 Price Parity	Many industry experts believe that passenger EVs will reach cost parity with ICE vehicles (based on total cost of ownership without considering any tax incentives) when battery pack prices fall below $100/kWh, resulting in lower up-front purchase prices. While some industry experts believe this could happen as early as 2021, most believe it will happen around 2025.	**EV life-time cost parity** with internal combustion engine vehicles will occur in 2025 or earlier due to falling battery prices

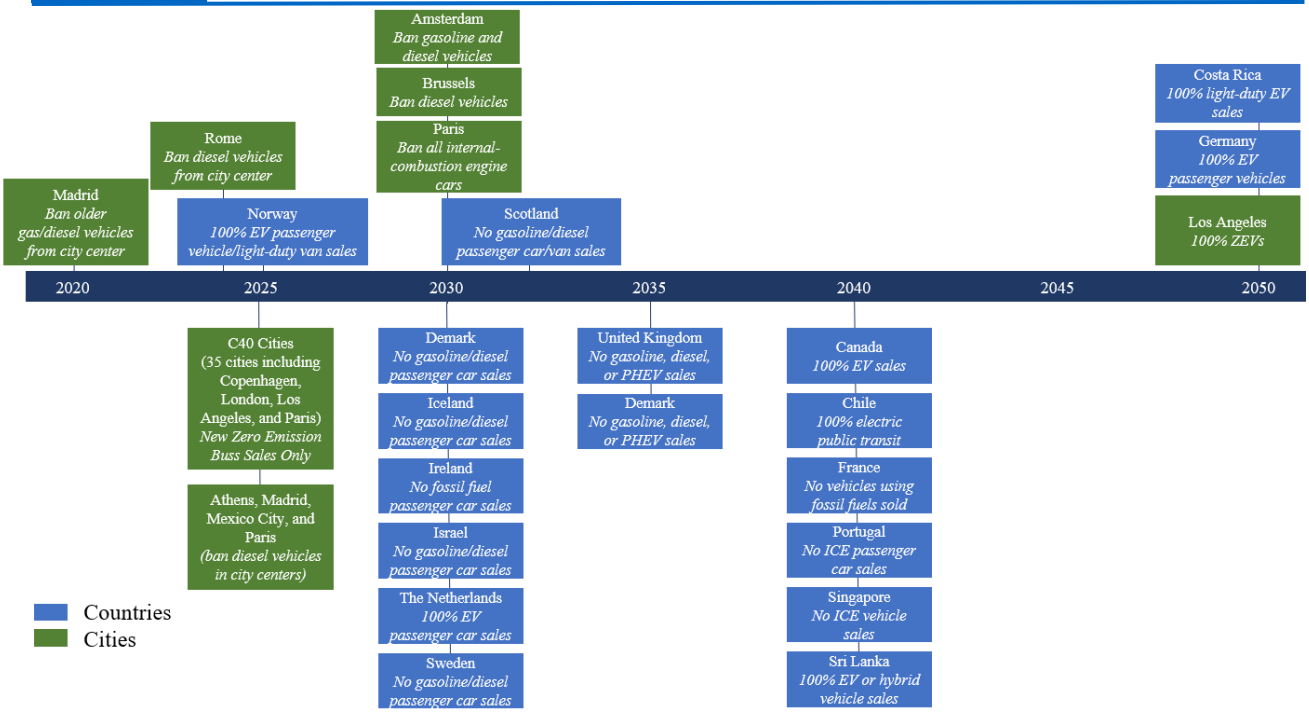
Drivers of Global Electric Vehicle Growth – Global Goals to Phase out Internal Combustion Engines

Around the world, countries have announced targets to end the sales of ICE vehicles to transition to a cleaner, electrified transportation sector. European countries are leading this movement with Denmark, Ireland, Germany, France, the Netherlands, Norway, and the U.K. aiming to only sell EVs in the coming years (Figure 1[iv]). As 2018 concluded, Norway made history as the first country where EVs made up half of all passenger vehicle sales in a year, thanks to a host of incentives: no import tax, no sales tax, no vehicle registration fees, free access to toll roads, and free parking in some city areas.[v] In addition to Norway's EV integration model, the European Union (EU) as a whole adopted more stringent fuel standards for cars and light vans for 2020 and beyond: as part of a clean mobility package, the standard will require emissions in 2030 to be 37.5 percent lower for new cars and 31 percent lower for new vans compared to 2021 levels.[vi] To capitalize on the momentum of standards for light-duty vehicles, the European Parliament and the European Council then turned their attention to setting the first-ever EU standards to reduce pollution from trucks.[vii] A Denmark-led coalition of 11 EU member states, however, believes the bloc can – and must – go further, calling for a collective ban on the sale of gasoline and diesel powered cars by 2040.[viii]

While Europe may lead in the sheer number of country commitments to phase out ICE vehicles, India and China's targets could have the most substantial impacts: if the two countries meet their targets to end ICE sales by 2030 and 2040, respectively, around 3.3. billion people, or 43 percent of the world's population, would exclusively purchase new ZEVs after 2040.[ix] Approaching this goal, China aims to sell 7 million "new-energy vehicles" annually by 2025, amounting to approximately 20 percent of its total auto market.[x]

Globally, many cities are pledging deep decarbonization efforts as well. The mayors of the Climate Mayors Electric Vehicle Purchasing Collaborative – a pledge signed by more than 175 cities and counties across the U.S. that focuses on public fleet electrification – announced they would collectively buy more than 3,500 EVs before the end of 2021 for local government fleets; Los Angeles Mayor Eric Garcetti said of the initiative, "by pooling our purchasing power, Climate Mayors are sending a powerful message to the global car market: if you build electric vehicles, we will buy them."[xi] Another coalition, the C40 Fossil Fuel Streets Declaration, commits the 35 signatories to replacing their cities' fossil fuel transit buses with electric alternatives by 2025 and to achieving zero-emissions in designated areas by 2030.[xii] Major international cities are going one step further by committing to ban diesel vehicles: Rome by 2024 (in the city center); Athens, Madrid, Mexico City, and Paris following the year after; and Brussels and Amsterdam by 2030 (Figure 1).[xiii] Los Angeles aims to increase the number of electric and zero emission vehicles operating in the city to 25 percent of all vehicles in 2025 and then to 100 percent by 2050. As indicated by recent commitments to phase out ICE vehicles and shift to lower emitting vehicles, a growing list of countries and cities are anticipating and encouraging a future supported by electrified transportation.

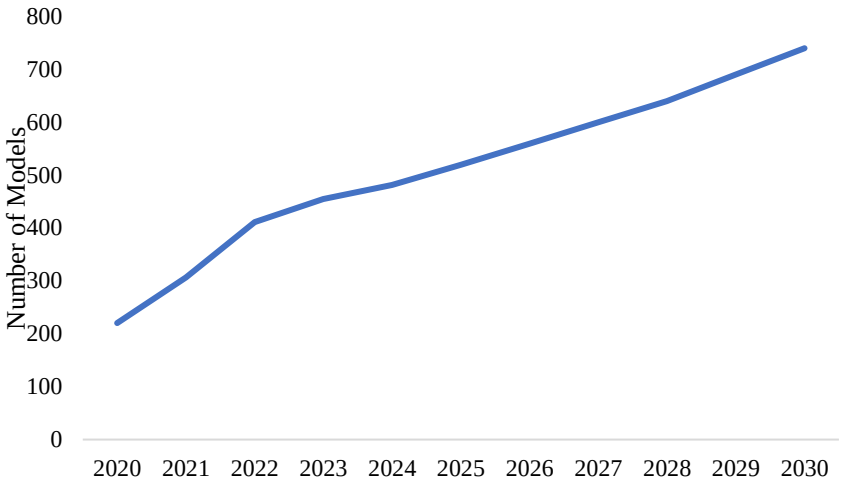
Figure 1 Timeline of Global Targets to Phase Out Sales of Internal Combustion Vehicles



Madrid aims to ban older gas (made prior to 2000) and diesel (made prior to 2006) vehicles by 2020 and join Athens, Mexico City, and Paris by banning all diesel vehicles by 2025. Paris aims to ban diesel vehicles by 2025 and all internal-combustion engines five years later. Los Angeles's Green New Deal hopes 100 percent of vehicles in the city will be electric by 2050. In February 2020, Britain announced it would move its ban from 2040 to 2035. So far, none of these targets are legally binding.

To meet these needs, auto manufacturers have announced plans to substantially increase availability of future EV models worldwide. As Figure 2 shows, auto makers have announced plans to offer about 740 EV models world-wide by 2030, more than three times the number of models currently available.

Figure 2 Global Automaker Electric Vehicle Model Commitments



See Figure 1 in Appendix for announcements used. Brand announcements considered include Audi, BMW, Daimler, FCA, Ford, GM, Hyundai, Mercedes, Toyota, and VW.

Policy Drivers of U.S. Electric Vehicle Growth

As countries around the world individually and collectively encourage the shift to EVs, the ZEV Alliance states are leading the transition within the United States. In 2013, six Northeast/Mid-Atlantic states (MD, MA, NY, CT, RI, and VT) and two Pacific coast states (CA and OR) joined in a Zero Emission Vehicle Memorandum of Understanding (ZEV MOU) to enact policies that will ensure the deployment of 3.3 million light-duty ZEVs by 2025.[xiv] These eight states – along with New Jersey, the most recent addition, who joined in 2018 – have collaborated to produce the *ZEV Task Force Multi-State ZEV Action Plan 2018-2021* and also founded the International ZEV Alliance, a global initiative between 16 North American and European national and subnational governments to accelerate the global transition to ZEVs.[2] The Task Force underscores that in the member states, light-duty passenger vehicles are the single largest contributor to GHG emissions and a significant source of local pollutants that contribute to adverse public health effects – for that reason, "transportation electrification is essential to achieving near- and long-term state GHG reduction goals, and effectively combating climate change."[xv]

Following the successful collaboration in 2013 that brought forth the light-duty ZEV MOU, fifteen states and the District of Columbia turned their attention to medium- and heavy-duty vehicles, signing another ZEV MOU in July 2020 with the goal of ensuring that 100 percent of all new medium- and heavy-duty sales be zero emission vehicles by 2050, with an interim target of 30 percent by 2030.[xvi] This commitment will help develop standards and regulations, deploy infrastructure, and drive investment in the sector. A few weeks prior to announcing participation in the multi-state collaborative, California adopted the Advanced Clean Trucks Regulation, "the first ever in the world effort to mandate the construction and deployment of zero-emission vehicles in the heavy-duty sector": under this regulation, by 2045 every new truck sold in California will be zero-emission.[xvii]

All the ZEV Alliance states have adopted the new car emission standards enacted by the California Air Resource Board (ARB), in lieu of federal standards enacted by the EPA. These ARB standards include a zero-emission vehicle (ZEV) standard, which requires that zero emission vehicles must make up a certain percentage of each manufacturer's annual new car sales in each state. Initially the ZEV standard included a "travel provision" that allowed automakers to receive credits in all other ZEV states for vehicles sold in California. This encouraged auto manufacturers to target EV sales to California only. In 2018, ARB removed the travel provision, which could lead to increased model availability and sales throughout the ZEV Alliance states. According to an analysis by the International Council on Clean Transportation, "states that adopt California's Zero Emission Vehicle regulation catalyze the market, spurring automaker marketing and expanded model availability."[xviii] This is reflected in the fact that ten states that have adopted the ZEV regulation were collectively responsible for almost 65 percent of BEV and PHEV light-duty vehicle sales between 2011 and 2018.[xix]

Under the Trump administration, the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) began rolling back Obama-era GHG standards and fuel economy standards, respectively, for light-duty vehicles for model years 2017 through 2025. In September 2019, EPA and NHTSA finalized Part One of this rollback, which purported to remove California's authority to adopt its GHG and ZEV standards and likewise prevent other states from adopting these standards. Then, in March 2020, EPA and NHTSA released Part Two, which requires automakers to decrease GHG emissions and increase the fuel economy of passenger cars by only 1.5 percent each year – a substantial relaxation compared to the five percent improvement required under the Obama-era standards.

Both Part 1 and Part 2 are in active litigation in federal court and have been challenged by two dozen states, including California and Michigan, as well as by environmental NGOs, power companies, municipal utilities, and other stakeholders. Automakers are split: in response to these federal actions, five automakers – Ford,

[2] For more information on the ZEV Action Plan, see https://newsroom.vw.com/vehicles/volkswagen-plans-to-produce-evs-in-america-starting-in-2022/. For more information on the International ZEV Alliance, see http://www.zevalliance.org/.

Honda, BMW of North America (including Rolls Royce), Volkswagen Group of America (including VW and Audi), and Volvo – signed bilateral agreements with the State of California to implement a voluntary framework that "supports continued annual reductions of vehicle [GHG] emissions through the 2026 model year . . . , encourages innovation to accelerate the transition to electric vehicles, and provides industry the certainty needed to make investments and create jobs."[xx] Through these agreements the five automakers will reduce emission 3.7 percent annually through model year 2026.[xxi] General Motors, Fiat Chrysler, and Toyota, on the other hand, sided with the Trump administration on both the rollbacks and California's authority to adopt more protective standards.

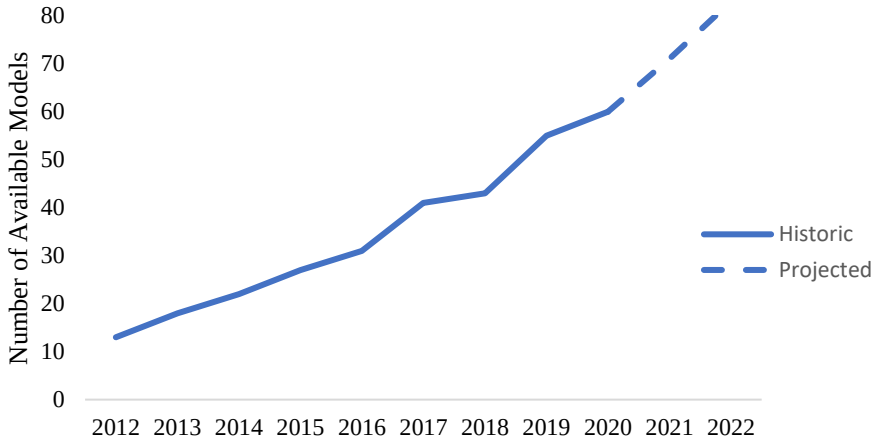
Despite the federal rollbacks of national standards, states continue to take steps to reduce transportation emissions, which surpassed emissions from the electric power sector in 2017 to now contribute the largest share of total economy-wide CO_2 emissions for the first time since the late 1970s.[xxii] One such regional strategy is the Transportation and Climate Initiative (TCI). Formed in 2010, TCI is a regional collaboration between 12 Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean energy economy, and reduce carbon emissions from the transportation sector. In December 2018, 10 of the 13 jurisdictions announced their intent to design a regional "cap-and-invest" policy that would raise funds for investing in clean transportation by imposing a fee on the GHG emissions associated with on-road motor fuels. In the draft MOU, motor gasoline and on-road diesel intended for final sale or consumption in the participating jurisdictions would be regulated. As currently envisioned, the fee would be imposed upstream at the storage facility (i.e., terminal rack). "State Fuel Suppliers" would be required to hold allowances to cover and report CO_2 emissions.

Simultaneously, California is moving forward with its Advanced Clean Cars (ACC) II regulations. The California Air Resources Board (CARB) adopted the Low-Emissions Vehicle III regulation for criteria (LEV III) and GHG (LEV III GHG emissions) as well as a technology-forcing mandate for zero-emissions vehicles (ZEV) – collectively referred to as ACC – in 2012 to control emission from passenger vehicles.[xxiii] The three regulations aim to reduce smog-forming pollution that contributes to air pollution, reduce GHG emissions, and increase the market share of ZEVs, respectively. CARB staff presented on the analysis and potential regulation modification in May and September of 2020, ultimately expecting to release the ACC II proposed regulation in the spring of 2021 in preparation for the December 2021 Board hearing. The proposal will aim to increase stringency, better-align standards with real-world reductions (e.g., better control of engine start emissions that can exceed lab test emissions), and improve the ZEV experience for consumers (e.g., standardizing fast charging ports).[xxiv]

Manufacturer Commitments

In 2012 there were 13 BEV and PHEV models available in the U.S. The number of electrified models available in the U.S. is projected to reach 60 by the end of 2020 and 83 by the end of 2022 (Figure 3).[3]

Figure 3 Total Light-Duty Vehicle PHEV and BEV U.S. Models Available by Year



Source: 2012-2018, https://insideevs.com/monthly-plug-in-sales-scorecard/, 2020-2022 models listed in the Appendix.

Based on these firm model announcements to date, as well as longer-term commitments and investment plans, many manufacturers have taken stances in support of an EV future:

$ Investment

In total, carmakers worldwide will spend more than $185 billion through 2030 developing new electric models.[4] For example, Ford has committed to spending $11 billion on electrification in the five years between 2018 and 2022.[xxv] In the five years between 2013 to 2017, Ford invested a total of $34.9 billion in R&D.[xxvi] Based on historical R&D investment, the $11 billion commitment to electrification investment could make up one third of Ford's R&D investment over the next few years. This investment could catalyze the electric truck market given Ford's announcement to produce the electric F-150. Since the last update to this report, BMW announced $30 billion in investments for "future oriented technologies," GM announced a $20 billion investment in its next generation of all-electric and autonomous vehicles, and Hyundai announced a $17 billion investment.[xxvii]

Automakers will spend **$185 billion[4]** worldwide on light-duty vehicle **electrification through 2030**

[3] Vehicles included in this figure are those available in the U.S. with MSRP below $100,000. The number of available vehicle models will be greater when considering global EV announcements and models that cost more than $100,000. Additionally, a model was only counted once although various battery sizes, ranges, and prices may be available. For example, Tesla Model S was counted once but is available in standard, long, and performance range options, same for the Leaf and Leaf e-Plus.

[4] $185 billion corresponds to the seven announcements listed in Figure 1 in the Appendix: BMW, Daimler, FCA, Ford, GM, Toyota, and VW. Investments by Audi, Bentley, and Porsche were not included as they are subsidiaries of VW Group as with Mercedes-Benz of Daimler. Other analysts have estimated a higher figure - covering additional manufacturers - of $255 billion in R&D capital by 2023 or $300 billion by 2030. See *https://www.alixpartners.com/media-center/press-releases/pile-up-awaits-auto-industry-investments-electric-autonomous-future-balloon/* and *https://www.reuters.com/article/us-volvocars-electric-margins/volvo-expects-electric-car-margins-to-match-conventional-vehicles-by-2025-idUSKCN1R12DD?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top*.

Manufacturing

Mercedes-Benz has committed $1 billion to a plant in Tuscaloosa, Alabama, to set up production of EVs in the U.S.[xxviii]

Fiat Chrysler will invest $4.5 billion in five of its existing Michigan plants in addition to building a new assembly plant in Detroit, which will both continue to produce existing ICE models as well as enable electrification of new Jeep models.[xxix]

As **70 percent of plug-in EVs** driven on U.S. roads in 2019 were **made domestically**, these manufacturing plant investments highlight continued **cultivation of a strong EV workforce** and robust market.[xxx]

Manufacturer Commitments

BMW Chairman Harald Krüger anticipates a bright future for the brand's EV line up: "by 2021, we will have doubled our sales of electrified vehicles compared with 2019…we will offer 25 electrified vehicles already in 2023 – two years earlier than originally planned. We expect to see a steep growth curve towards 2025."[xxxi]

Ford has created Team Edison, a dedicated global EV organization "focused on bringing to market profitable, exciting [EVs] and ownership experiences," which will help bring some of the first PHEV and BEV pickup trucks to market.[xxxii] Ford has stated a goal of having sixteen BEVs in their portfolio by 2022 and has announced plans to convert two of its North American plants to build plug-in models. As part of its $11 billion EV investment, Ford is investing $500 million in Rivian to develop an all-new, next-generation BEV for Ford's portfolio.[xxxiii]

GM has positioned Cadillac to be its lead electric vehicle brand going forward, highlighting the BEV3 platform and declaring that "our commitment to an all-electric, zero-emissions future is unwavering."[xxxiv] GM also announced plans to invest $300 million in its plant in Michigan to manufacture a Chevrolet vehicle based on the battery-powered Bolt.

Hyundai Motor Group has declared it hopes to become "one of the world's top three EV manufacturers by 2025" through a dedicated EV brand IONIQ.[xxxv]

Daimler aims to have a carbon-neutral passenger vehicle fleet by 2039, which will be driven by the introduction of "an entire generation of electric Mercedes models."[xxxvi]

Fiat-Chrysler has committed to producing more than 30 electrified models by 2022, 10 of which will be plug-in Jeeps and four will be all electric Jeeps.[xxxvii]

Porsche pledged that by 2022 the company will "be investing more than six billion euros in electric mobility and by 2025 50 percent of all new Porsche vehicles could have an electric drive system."[xxxviii]

VW hopes to produce 22 million electric vehicles over the next decade, an increase from its previous goal of 15 million. VW's CEO announced, "our future electric cars will be the new trademark of Volkswagen."[xxxix]

Outside of the U.S. market, PSA Groupe – the parent company of France's two major automakers Peugeot and Citroen – will electrify 80 percent of its models by 2023.[xl]

Trucking

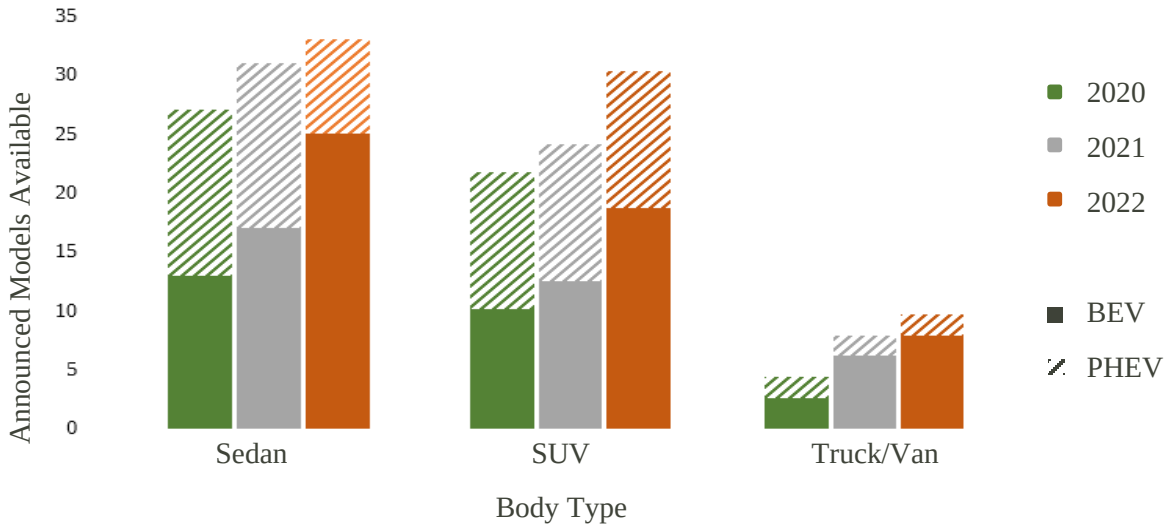
PACCAR's Kenworth and Peterbilt divisions are partnering with Dana for electric truck powertrain development. Kenworth has already developed a prototype Class 6 medium-duty electric truck and has plans to produce up to 100 of them in 2020.[xli]

In October 2019 Navistar launched their NEXT eMobility solutions business unit to focus on electrification solutions in truck and school bus markets. The company has already developed a prototype electric school bus and an electric medium-duty truck.[xlii]

Daimler Trucks has a goal of selling CO_2-nuetral commercial vehicles across all of their markets, including North America, by 2039. In North America, Daimler's Freightliner division has developed electric versions of their popular Cascadia Class 8 tractor, M2 Class 6 medium-duty chassis, and MT50 medium-duty step van. Since 2018, a 30-vehicle Freightliner Electric Innovation Fleet has been operating at customer sites, accumulating over 100,000 miles of real-world operation. In March 2020, Freightliner announced it would expand this fleet by deploying eight more electric vehicles with at least 14 different customers over the next 22 months, who collectively operate more than 150,000 Class 6 -8 vehicles.[xliii]

Figure 4 summarizes projected U.S. BEV and PHEV model availability over the next three model years (a list of models considered can be found in the Appendix as well as timelines of various manufacturer commitments, model introductions, and EV sales forecasts[xliv]). In the spring of 2020, many automakers that had anticipated near-term launches of new electric models in 2020 – including Rivian, Hummer, and Byton – revised their timelines, halted operations, and furloughed workers due to the COVID-19 pandemic. While some of these release dates have been formally pushed to 2021, others remain uncertain. The disruption of supply chains and the shift in consumer spending patterns is affecting the auto industry as a whole – not only EV offerings – leading many brands to delay model launches and less-profitable updates until 2021 or 2022 *(see* Sales Forecast *for greater detail on the effect of COVID-19 on EV sales).*[xlv]

Figure 4 Cumulative Announced U.S. Light-Duty BEV and PHEV Models 2020-2022 by Body Type



This figure only includes U.S. vehicles with an announced model name and model year introduction date and projected or announced purchase price less than $100,000. A complete list of models included in this graph can be found in the Appendix.

Job Creation

The EV industry employed nearly 130,000 individuals across the U.S. in 2019, with jobs surpassing 266,000 when also including jobs associated with hybrid, natural gas, hydrogen, and fuel cell vehicles.[xlvi] This includes jobs associated with creating an expansive charging network as well. California, Michigan, and Texas are the top three states supplying these clean vehicle jobs, respectively. These jobs contributed to 42 states and the District of Columbia employing more clean energy than fossil fuel workers in 2019. In expanding BEV and PHEV offerings, auto makers understand the economic impact they can have through enhanced production capacity:

Assembly Plant Production

Light-Duty Vehicles

Ford plans to invest more than $1.45 billion in Michigan production, which could result in approximately 3,000 new jobs. This includes 900 jobs through a $900 million expansion at its Flat Rock plant as well as those created by a $700 million investment at the Rouge Complex for production of the electric F-150.[xlvii]

GM will invest $300 million in its Orion Township, Michigan, assembly plant to produce a new Chevrolet EV. These 400 new jobs will contribute to GM's ultimate goal to create 700 new jobs and support 28,000 jobs across six states.[xlviii]

In November 2019, VW started the expansion of its Chattanooga, Tennessee, assembly plant, which aims to add 1,000 jobs that will support its new EV line-up.[xlix]

According to an IHS Markit report from May 2018, Tesla's operations have supported over 51,000 jobs in California (20,189 directly, 31,424 indirectly through local supply chain purchases and employee consumer activity).[l]

Tesla is currently undergoing discussions with Travis County, Texas, for creation of a $1 billion EV manufacturing plant that could support 5,000 direct jobs and more than 4,000 indirect jobs due to secondary effects.[li]

Toyota and Mazda have announced a joint venture in Alabama. Targeting 4,000 new jobs, the plant has hired approximately 600 employees to date.[lii]

Mercedes-Benz has committed $1 billion to a plant in Tuscaloosa, Alabama, to set up production of EVs in the U.S. and expects this will create 600 new jobs.[liii]

Fiat Chrysler will invest $4.5 billion in five of its existing Michigan plants, which could create nearly 6,500 jobs.[liv]

Medium- and Heavy-Duty Vehicles

Assembly Plant Production

Volvo Trucks announced plans to invest $400 million over six years to upgrade its New River Valley, Virginia plant, which produces all Volvo trucks sold in North America. The investment could result in over 775 new jobs.[lv]

Tesla selected Austin, Texas, as the site of its next Gigafactory, where it will invest $1 billion to produce a range of EVs, including the Tesla Semi Truck – an effort that will be supported by 5,000 new jobs.[lvi]

Daimler Trucks North America expects to start production of the eCascadia and eM2 trucks in Portland, Oregon, in 2021 after announcing plans in 2019 to convert the plant to produce electric Freightliners.[lvii]

In 2020, Navistar broke ground on a $250 million San Antonio plant that will produce both diesel and electric trucks, through which it expects to support 600 new jobs. It also announced a new facility outside of Detroit that will be the lead location for its NEXT eMobility solutions platform, employing 50 eMobility specialists.[lviii]

Battery Production

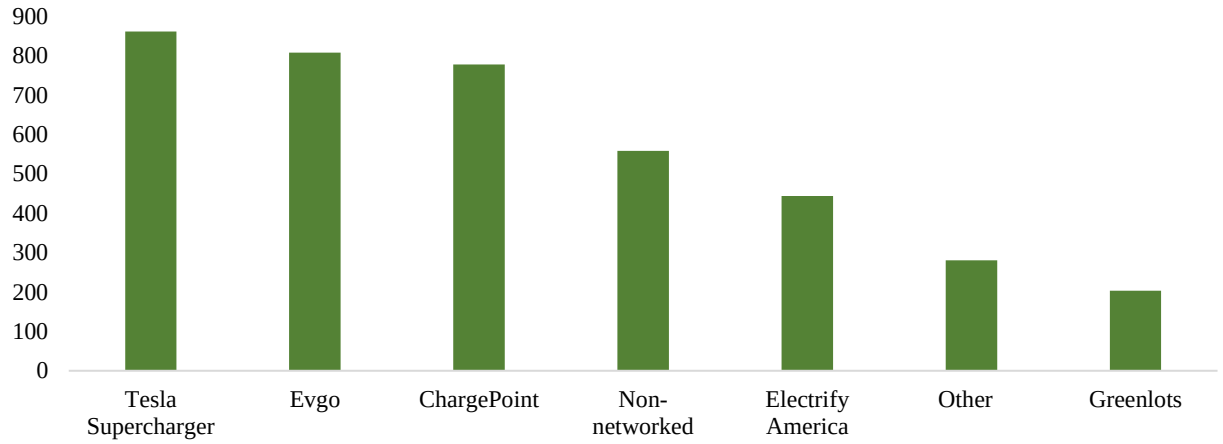
GM is investing $2.3 billion into a joint venture with LG Chemical to produce its Ultium battery at a plant in northeastern Ohio – a partnership that could bring over 1,100 jobs to the area.[lix]

Charging Network Investments

Creating an accessible public charging network will be essential to achieving wide-spread EV adoption. Although most drivers are expected to charge at home overnight due to convenience and discounted off-peak rates offered by utilities, public charging is vital for EV drivers who live in multi-unit complexes or those without a private driveway. Additionally, drivers will need charging along highways and interstates to feel confident in their ability to drive longer distances and charge along the way. Expected future battery improvements will increase EV range, thus reducing but not eliminating the need for public charging networks to support long-distance travel

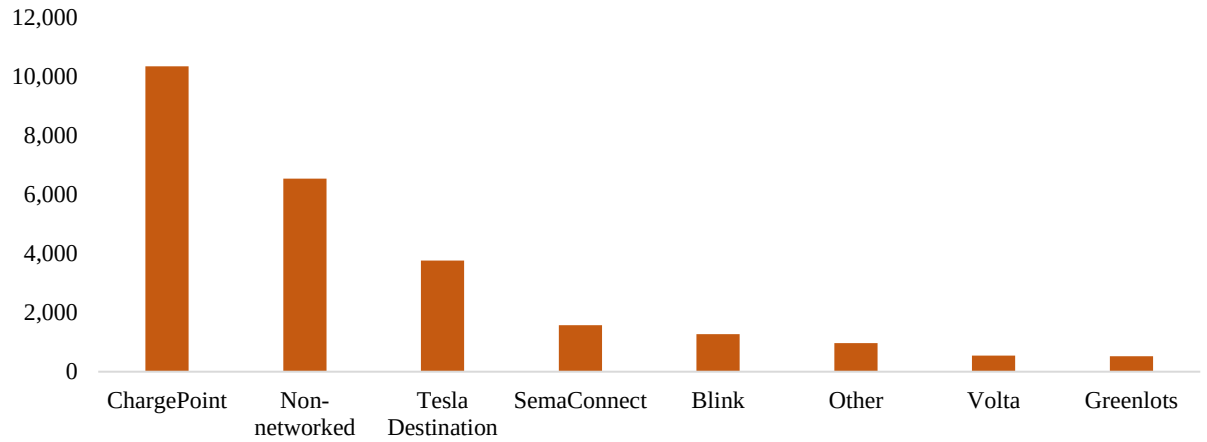
Today, four networks make up 75 percent of public Direct Current Fast Chargers (DCFC) (Figure 5) while one company – ChargePoint – dominates the public Level 2 market (Figure 6).

Figure 5 Number of Public Direct Current Fast Charging Stations by Network



Other includes Francis, Blink, Webasto, EV Connect, OpConnect, and Volta. Source: Alternative Fuels Data Center, August 24, 2020, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC&country=US&ev_levels=dc_fast

Figure 6 Number of Public Level 2 Charging Stations by Network



Other includes EVgo, FLO, GE WattStation, Electrify America, OpConnect, Webasto, EV Connect, and Francis. Source: Alternative Fuels Data Center, August 24, 2020, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC&country=US&ev_levels=dc_fast

As automakers prepare to bring more electrified models to market, they are also recognizing the need for a robust, well-developed charging ecosystem to support drivers. Notable milestones include:

- Marry Barra, the Chairman and CEO of GM, said "we are moving quickly to bring new EVs to market that customers will love. We know how important the charging ecosystem is for drivers, one that includes access to convenient and reliable public fast charging" when announcing GM and EVgo's partnership to bring 2,700 new fast charge plugs to drivers over the next five years.[lx]
- Porsche is offering owners of its first EV model, the Taycan, three years of free charging through a partnership with Electrify America – total investment will reach $70 million to install chargers at the automaker's 191 U.S. dealerships.[lxi]

While these investments reflect automakers' understanding of the need for an expansive and reliable charging network, they are not alone in investing in widespread deployment of charging infrastructure. Utilities offer expertise, rebates, and unique charging rates while local and state governments provide funding and sometimes free or discounted charging at certain locations.

Major oil and gas companies are also exploring investments to adapt to an electric future. According to Shell's New Energies Executive Vice President, Shell's acquisition of Greenlots, an EV charging company, "is a step towards making EV charging more accessible and more attractive to utilities, businesses and communities."[lxii] Chevron also made headlines as the first major oil and gas company in the U.S. to announce that it will offer a dozen EV charging plugs at five of its gas stations in California.[lxiii]

Commercial Fleet Electrification Commitments

While cars and light-duty trucks account for the majority share of transportation GHG emissions, medium- and heavy-duty vehicles are responsible for nearly a quarter, with this percentage projected to increase in the future.[lxiv]

Full-sized (40-ft.) electric transit buses have been commercially available in North America for 10 years, and their use has been steadily growing; as of early 2020, approximately 180 U.S. transit agencies are operating a total of more than 850 electric transit buses, with more than 1,000 additional electric buses on order for delivery in the next two years. This is almost three percent of the national transit bus fleet.[lxv] This is the only medium- or heavy-duty vehicle segment with significant EV penetration to-date.

Since the last update to this report, however, there has been increased activity related to electrification of medium- and heavy-duty vehicles, with a focus on other types of commercial fleets. A few years ago, the only large EVs commercially available in the U.S were transit buses. Today (2020), there are nearly 30 medium-duty electrified models and 21 heavy-duty models offered for sale, across a range of vehicle vocations (*see* Appendix *for greater detail*). Companies that operate large fleets are taking note: Amazon has ordered 100,000 electric delivery vans from Rivian; Republic Services, Inc. ordered 2,500 electric garbage trucks from Nikola (with the option to increase to 5,000); FedEx ordered 1,000 electric vans from Chanje; UPS and DHL ordered 950 electric trucks and 63 delivery vans, respectively, from Workhorse; and Walmart and PepsiCo are looking to Tesla for its electric semi-truck plans.[lxvi] With these commitments, the number of electric trucks in use could skyrocket in the near-future from 2,000 in 2019 to 54,000 by 2025.[lxvii] These investments will continue to grow in the coming years thanks to corporate fleet electrification commitments (Table 1).[lxviii] For example, EV100 is a global initiative bringing together 82 companies committed to accelerating the transition to EVs and making electric transport the new normal by 2030.

Walmart and PepsiCo ordered 45 and 100 electric semi-trucks, respectively, from Tesla	DHL ordered 63 electric delivery vans from Workhorse	FedEx ordered 1,000 electric delivery vans from Chanje
UPS ordered 950 electric trucks from Workhorse	Republic Services, Inc. ordered, 2,500 electric garbage trucks from Nikola	Amazon ordered 100,000 electric delivery vans from Rivian

Fleet electrification goals will exert pressure on auto manufacturers to keep pace. After receiving nearly $45 million in grant funding from the California Air Resources Board, Volvo launched Volvo LIGHTS, a three-year demonstration project to test the ability for heavy-duty, battery electric trucks and equipment to reliably move freight between ports and warehouses in Southern California.[lxix] The initiative focuses on providing a range of vehicle, charging, and workforce development innovations. The focus includes new lithium ion battery chemistries that increase energy density by more than 20 percent and prevent premature degradation to reduce cost, as well as multiple truck configurations with all-electric ranges of up to 250 miles.

Table 1 Sample of Fleet Electrification Commitments

Sector	Company	Electric Fleet Plans
Retail	Ikea Group*	2020: Electrify deliveries in Amsterdam, Los Angeles, New York, Paris, and Shanghai (25% global of deliveries) 2025: 100% EV or other zero-emissions solutions for deliveries and services through suppliers
	Amazon	2022: 10,000 electric delivery vans (short-term goal) 2030: 100,000 electric delivery vans total (long-term goal)
	Clif Bar & Company*	2030: 100% fleet electrification
	Unilever	2030: 100% fleet electrification (11,000 vehicles)
	Walmart	2040: Zero emission vehicle fleet, including long-haul (6,000 trucks)
Power	Consumers Energy	2025: Buy or lease 100% of EVs for fleet
	Schneider Electric*	2030: 100% electric fleet (14,000 vehicles)
	Southern California Edison	2030: 100% electric passenger car and small-to-midsize SUV, 30% medium-duty vehicles and pickup trucks, 8% heavy-duty trucks, 60% forklifts
	Xcel Energy	2023: 100% electric sedan portion of fleet 2030: 100% electric light-duty fleet; 30% medium- and heavy-duty
Transportation	Antelope Valley Transit	2018: Convert all the agency's aging diesel buses to a 100% battery electric bus fleet with up to 85 new all-electric buses
	Lyft**	2026: 100% new vehicles for Express Drive (driver rental program) are electric 2030: 100% EVs on platform
	King County Metro	2030: 100% zero-emissions fleet
	Lime*	2030: 100% conversion of operations fleet
	Uber**	2030: 100% of rides take place in EVs in U.S., Canadian, and European cities 2040: 100% of rides take place in zero-emission vehicles, on public transit or with micromobility
Delivery	DHL	2025: 70% of first- and last-mile delivery services with clean transport modes 2050: Reduce logistics-related emissions to zero
Biotech	Genentech	2030: 100% electrification of sales fleet (1,300 vehicles) and commuter buses
Municipal	New York City, New York	2017: Only purchase PHEVs for non-emergency sedans going forward 2025: Add 2,000 EVs to NYC sedan fleet 2040: 100% electric MTA bus fleet
	Los Angeles, California	2028: 100% ZEV vehicle conversions "where technically feasible" (2028: taxi fleet, school buses; 2035: urban delivery vehicles) 2035: 100% electrification of sanitation fleet through LA Department of Sanitation Commitment
	Houston, Texas	2030: 100% EV non-emergency, light-duty municipal fleet

*Member companies of EV100
**Drivers for Lyft and Uber are contractors rather than employees, so it may be difficult to convince drivers to switch to EVs. Lyft does not intend to remove drivers from platform who do not drive electric or provide financial incentives to drivers for the transition. Instead, much of the plan revolves around exerting pressure on competitors, lawmakers, and automakers. Uber will pay BEV and hybrid drivers an incentive of $1.50 and $0.50 per trip, respectively, and GM and Renault-Nissan will offer discounts to EVs. While Uber has not explicitly stated they will not remove non-electric drivers, they may be in a similar position as Lyft.

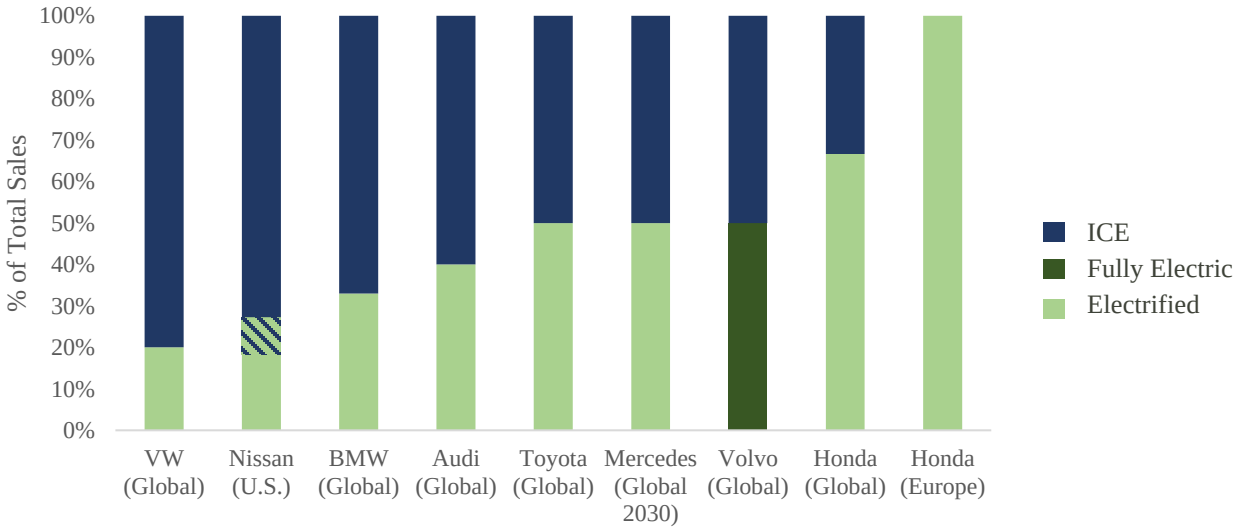
Sales Forecast

According to analysts, global EV sales could rise from 2.1 million units in 2019 to 26 million in 2030 and 54 million in 2040.[lxx]

U.S. EV sales accelerated in recent years, rising 26 percent in 2017 compared to 2016. The following year, sales grew 81 percent – amounting to over 361,000 EVs sold in 2018 - then contracted slightly to 325,000 in 2019.[lxxi]

While Tesla's three models and the Toyota Prius Prime were responsible for most of the increase in EV sales in 2018 and 2019 in the U.S., many of the top manufacturers are projecting that EVs will account for a significant share of their total sales by 2025, as illustrated in Figure 7.[lxxii] Audi, BMW, Honda, Toyota, VW, and Volvo have all set global targets and announced projections for 2025, while Nissan has set a target specifically for U.S. sales. Honda is the most ambitious: the manufacturer hopes to electrify one hundred percent of its European vehicle sales by 2025, noting that "…since we made that first pledge in March 2017 [to electrify two-thirds of sales], the shift towards electrification has gathered pace considerably. Environmental challenges continue to drive demand for cleaner mobility. Technology marches on unrelenting and people are starting to shift their view of the car itself."[lxxiii] The International Council on Clean Transportation (ICCT) estimates that auto manufacturers are collectively targeting global production of 13 million EVs annually by 2025.[lxxiv]

Figure 7 Sales Forecast for 2025 by Manufacturer



The hatched line represents a range given by the manufacturer (e.g., Nissan expects that electrified models will make up 20 to 30 percent of U.S. sales in 2025). Electrified definitions: BMW models will have electrified drive trains (BEV or PHEV), Nissan models will either be pure electric models or e-POWER powertrain models, and Audi does not define electrified. Nissan has set a goal for its U.S. sales. Honda announced in March 2019 its ambition of making one hundred percent of its European sales electrified, building upon the brand's 2017 goal of electrifying two-thirds of global sales. Audi, BMW, Mercedes, Toyota, VW, and Volvo have set global goals.

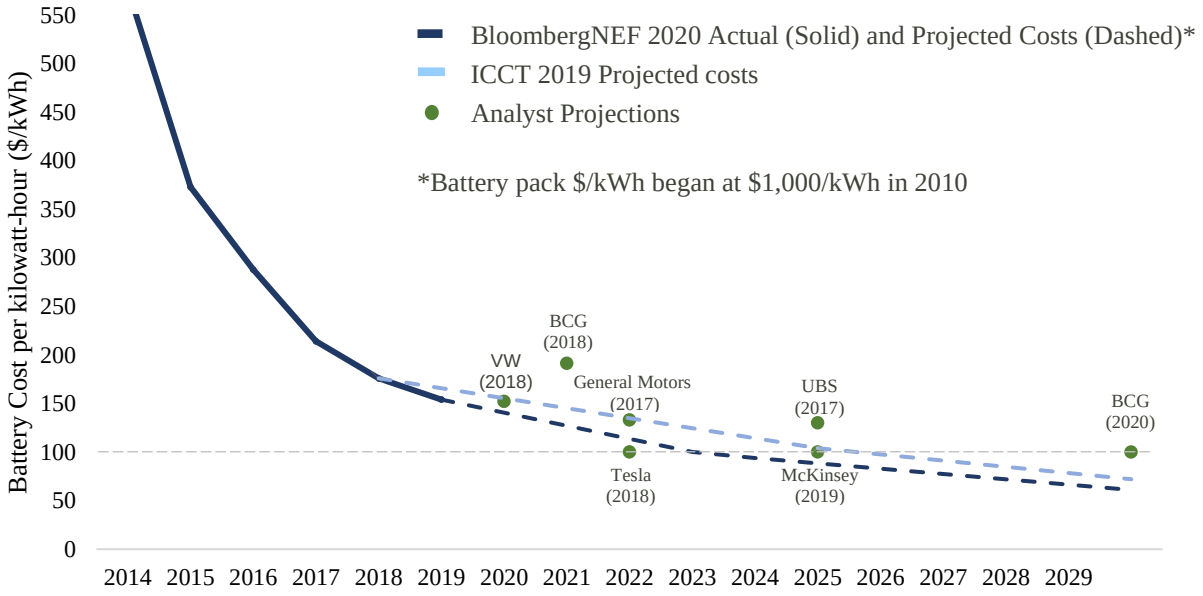
Effects of the COVID-19 pandemic on vehicle sales – both ICE and EV – vary across industry expert opinions. Early analyst reports projected that EV sales globally will fall in 2020 relative to 2019 – by between 18 and 43 percent – due to the global recession, supply chain disruptions, and changes in consumer behavior, regaining momentum by the mid- to late-2020s as prices fall, charging becomes more abundant, and auto makers offer greater variety.[lxxv] As the pandemic has progressed, however, auto sales industry-wide have begun to rebound despite months of production shut downs, with the International Energy Agency (IEA) claiming that although total global passenger car sales are set to decline 15 percent for 2020, "electric car sales are expected to fare better than the overall passenger car market, with EV sales this year to broadly match the 2.1 million sold in 2019." [lxxvi] The report cautions that "second waves of the pandemic and slower-than-expected economic recovery could lead to different outcomes." Sales rebounds will also depend on government actions: in the U.K., new gasoline and diesel vehicle registrations were down around 90 percent in May 2020 compared to the previous year while BEV registrations were up 21.5 percent, a trend that may have been influenced by a tax break for corporate buyers that began the month prior.[lxxvii] Similarly, Germany doubled its EV incentive as part of its COVID-19 stimulus plan, with combined incentives totaling €9,000 for new vehicles costing less than €45,000. The U.S., on the other hand, has not included EV related measures in its stimulus packages.

Battery Pack Cost Projections and EV Price Parity

For EVs to become cost competitive with ICE vehicles (without considering tax or other incentives or emissions externalities), virtually all analysts agree that battery pack prices must continue to drop from $156/kWh in 2019 to around $100/kWh. When battery prices cross this threshold, EVs will achieve price parity on a total cost of ownership basis.

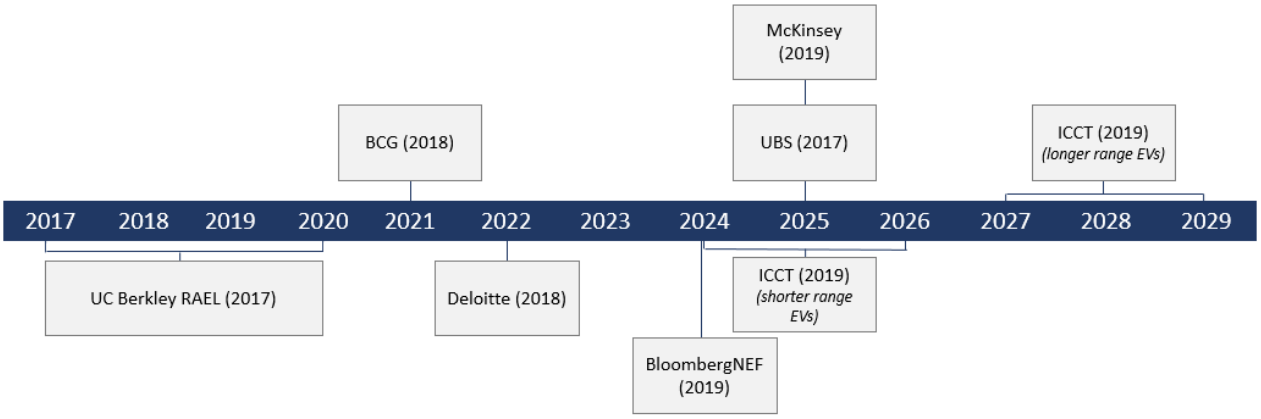
As illustrated in Figure 8[lxxviii] and Figure 9[lxxix], most analysts agree that price parity between EVs and ICE vehicles will occur sometime between 2023 and 2025. Working in parallel with the price parity projections for batteries, Volvo expects its margins on electric cars to match those of vehicles with combustion engines by 2025.[lxxx] With the advent of price parity on the horizon, some analysts expect the sales of conventional gas cars to peak in 2030 and decline thereafter.[lxxxi]

Figure 8 Actual and Projected Battery Pack Costs



Cost projection shown are for battery packs. Several of the listed sources estimated battery cell costs; for these estimates the value shown includes a 25 percent mark-up to estimate pack costs.

Figure 9 Industry Expert Price Parity Timeline – Based on Total Cost of Ownership



Continued improvements in batteries are key to achieving ICE cost parity via reductions in upfront purchase cost, increased EV range, and increased battery life. While EVs are still more expensive to purchase, they are already providing significant fuel cost savings: as highlighted by a recent National Renewable Energy Laboratory (NREL) and Idaho National Laboratory (INL) study, EVs could save drivers as much as $14,500 in fuel costs over 15 years compared to ICE vehicles.[lxxxii]

To push forward battery innovation, automakers have announced a host of research and production partnerships. GM is investing $2.3 billion into a joint venture with LG Chemical to produce its Ultium battery at a plant in northeastern Ohio. GM is also developing a next-generation, one million mile battery – compared to current batteries that are projected to last 100,000-200,000 miles.[lxxxiii] Tesla is simultaniously developing its own million mile battery, which could come as early as the end of 2020; exploring improvements in energy density for next-generation batteries through partnerships with Panasonic; and testing alternative chemistries to lithium ion batteries with researchers at Dalhousie University.[lxxxiv] Mercedes-Benz has forged research partnerships with CATL in China, particularly on its cell-to-pack design, and with Hydro-Quebec's Center for Excellence in Transportation Electrification and Energy Storage in Canada to develop solid-state battery technologies.[lxxxv] According to Hydro-Quebec, solid-state lithium metal batteries could mark a new era in EV battery development as they have "a very high energy density, are long lasting, and very light [and are] considered to be a safer alternative to regular lithium-ion batteries."[lxxxvi]

Beyond automaker involvement, research insitutions like Georgia Tech, ETH Zürich, and Oak Ridge National Laboratory are collaborating on solutions that would increase energy density without reducing the battery liftetime through structures created during charge-discharge cycles.[lxxxvii]

`

Appendix – Manufacturer Commitments & Announced BEV and PHEV Models

Figure 1A Manufacturer Commitments: Model Announcements, Investments, and Sales Forecasts

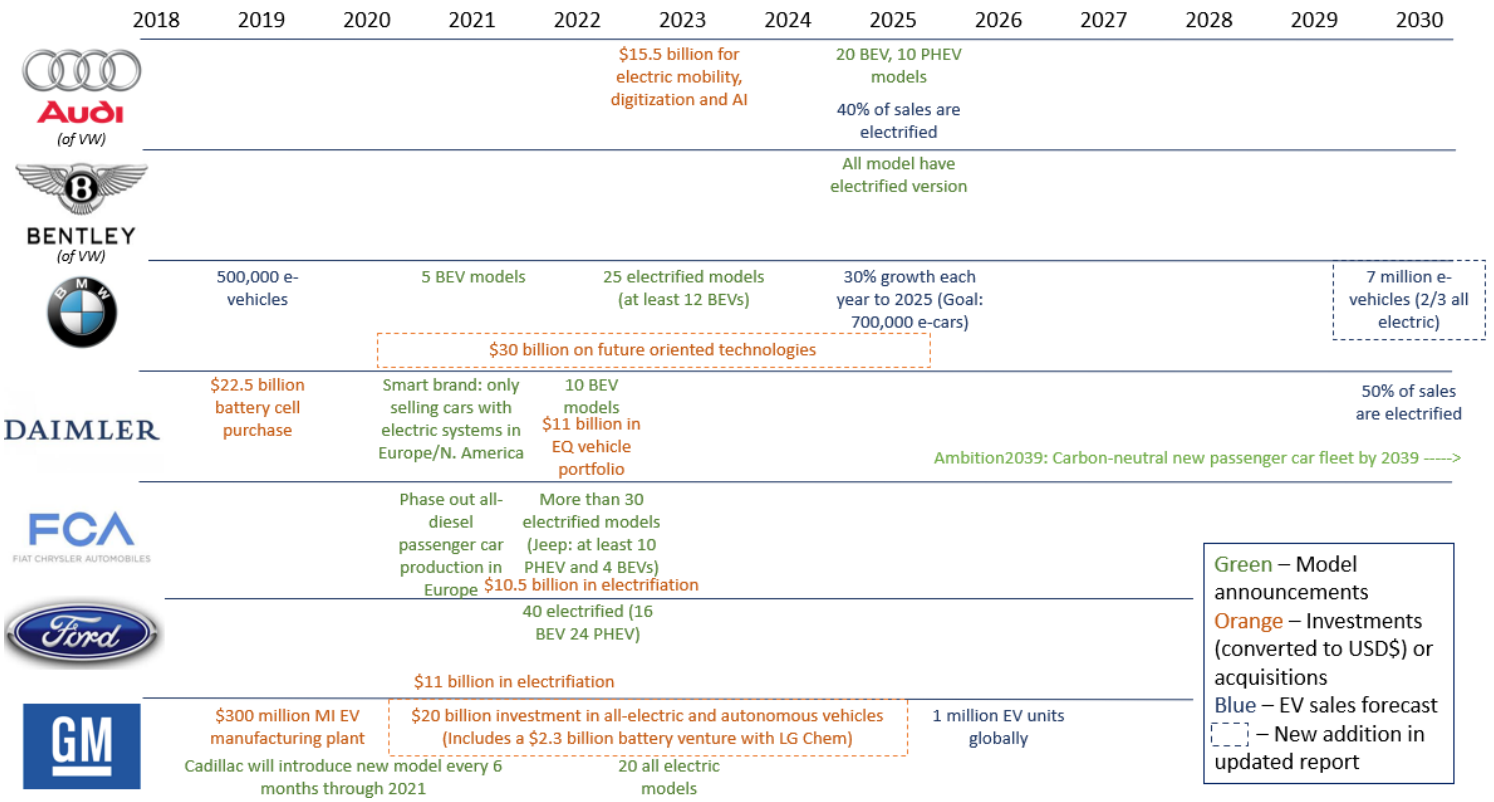
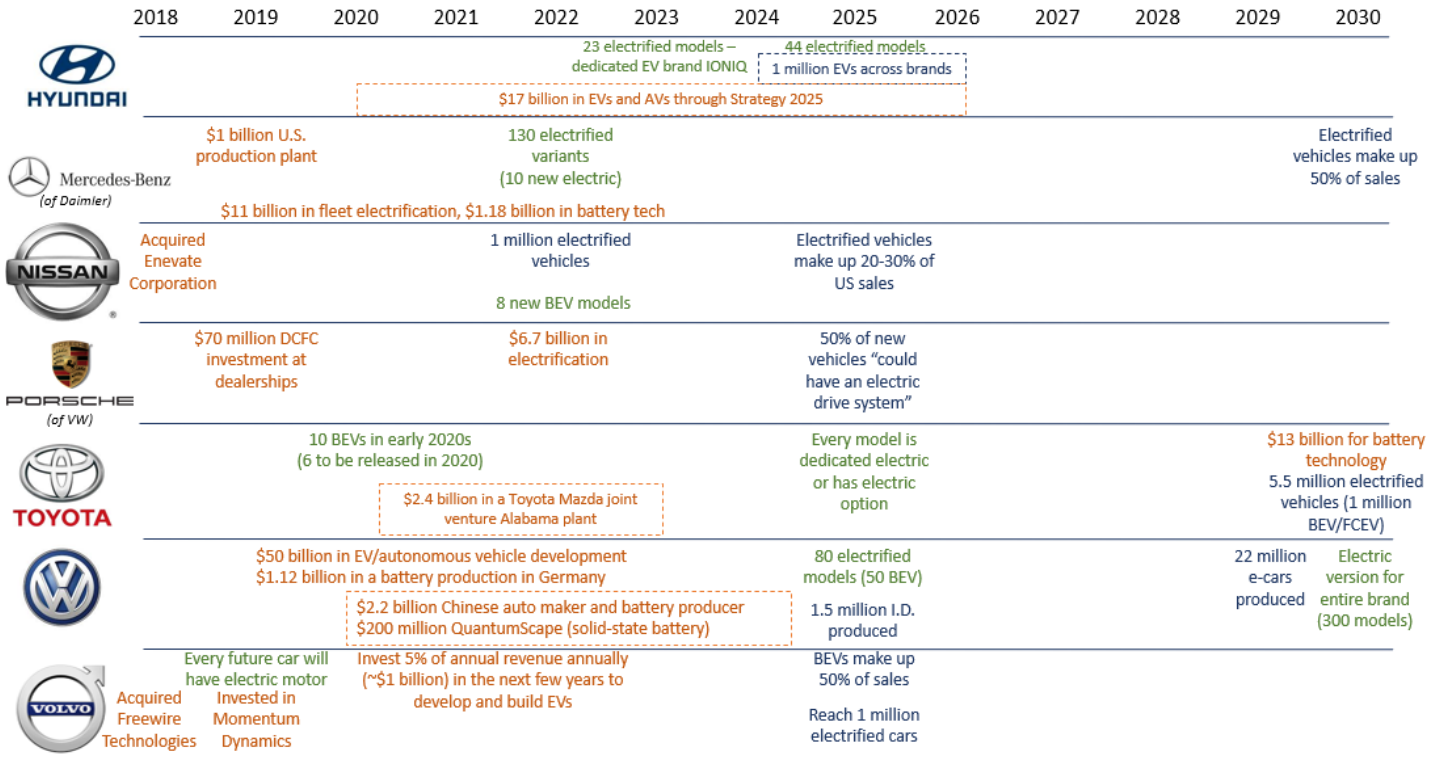


Figure 1A (cont.) Manufacturer Commitments: Model Announcements, Investments, and Sales Forecasts



Model Announcements – Light-Duty Vehicles

This table includes only models with an announced model name and model year introduction date for models less than $100,000. Other data is included if available; blank cells indicate that the data is not available from the manufacturer. Range is range per charge as stated by the manufacturer; for PHEVs this is electric mode range. Price is MSRP for base model, as stated by the manufacturer, and does not include any federal or state tax incentives. Concept cars not included.

Battery Electric Vehicles

Manufacturer	Vehicle Type	Model Name	Planned Availability	Battery Size (kWh)	Range (mi)	Cost
Audi	SUV	e-tron Sportback	2020	95	218	$77,400
BMW	Hatchback	i3	2020	42.2	153	$44,450
BMW	Hatchback	i4	2021	80	310	
BMW	SUV	Vision iNEXT	2022			
Bollinger	Truck/Van	B1	2020	120	200	
Bollinger	Truck/Van	B2	2020	120	200	
BYD	SUV	e6	2020	80	250	$35,000
Cadillac	SUV	LYRIQ	2022		300	$60,000
Chevrolet	Hatchback	Bolt	2020	66	259	$36,620
Chevrolet	SUV	Bolt EUV	2021			
Chrysler	Truck/Van	Portal	2020	100	250	
Fiat	Hatchback	500e	2020	24	84	$33,460
Fisker	SUV	Ocean	2022		250	
Ford	SUV	Mach-e	2020		300	$40,000
Ford	Truck/Van	F 150	2022			
GMC	Truck/Van	Hummer SUT	2021		400	
GMC	SUV	Hummer SUV	2022		400	
Hyundai	Hatchback	IONIQ Electric	2020	38.3	170	$33,045
Hyundai	SUV	Kona Electric	2020	64	258	$37,190
Hyundai	Hatchback	Ioniq 5	2021			
Hyundai	Hatchback	Ioniq 6	2022			
Jaguar	SUV	I-Pace	2020	90	234	$69,850
Jaguar	Hatchback	XJ	2021		300	
Kandi	Hatchback	K27	2020	17	100	$21,500
Kandi	Hatchback	K23	2020	42	188	$30,000
Kia	SUV	Soul EV	2020	64	111	$33,950
Kia	SUV	Niro	2020	64	239	$38,500
Lordstown Motors	Truck/Van	Endurance	2021		250	$52,500
Lucid Motors	Hatchback	Air	2022		517	$80,000

Manufacturer	Vehicle Type	Model Name	Planned Availability	Battery Size (kWh)	Range (mi)	Cost
Mercedes Benz	SUV	EQC	2020	80	200	$68,895
MINI	Hatchback	Mini Cooper SE Electric	2020	32	110	$29,900
Nikola	Truck/Van	Badger	2021		300	$60,000
Nissan	Hatchback	Leaf	2020	40	150	$29,990
Nissan	SUV	Ariya	2021	63	300	$40,000
Porsche	SUV	Macan	2022			
Rivian	Truck/Van	R1T	2021	105	250	$69,000
Rivian	SUV	R1S	2021	105	240	$72,500
Tesla	Hatchback	Model 3	2020	54	240	$39,490
Tesla	SUV	Model Y	2020	75	316	$51,190
Tesla	Hatchback	Model S	2020		402	$74,990
Tesla	SUV	Model X	2020	100	351	$79,990
Tesla	Truck/Van	Cybertruck	2022		250	$39,990
Volkswagen	Hatchback	I.D.	2020	48	205	$29,400
Volkswagen	Hatchback	e-Golf	2020	35.8	125	$31,895
Volkswagen	SUV	I.D Crozz	2020	83	300	
Volkswagen	Hatchback	I.D. Vizzion	2022	111	400	
Volkswagen	SUV	I.D. Buzz	2022	111	270	
Volkswagen	SUV	I.D. Buzz Cargo	2022	111	205	
Volvo	SUV	XC40 EV	2020	78	200	$50,000
Volvo	Hatchback	Polestar 2	2020	78	275	$59,990
Volvo	SUV	XC 90	2022			

Plug-In Hybrid Electric Vehicles

Manufacturer	Vehicle Type	Model Name	Planned Availability	Battery Size (kWh)	Range (mi)	Cost
Audi	SUV	Q5	2020	14.1	20	$52,900
Audi	Hatchback	A7	2020		26	$75,900
Audi	Hatchback	A8	2020		17	$94,995
BMW	Hatchback	330e	2020	7.6	14	$44,550
BMW	SUV	X3	2020	12	18	$48,550
BMW	Hatchback	530e	2020	9.2	16	$53,900
BMW	SUV	X5	2020	9	14	$65,440
BMW	Hatchback	745e	2020	9.2	14	$95,550
Chrysler	Truck/Van	Pacifica Hybrid	2020	16	33	$40,245
Ford	SUV	Escape	2020	14.4	30	$25,200
Ford	Hatchback	Fusion Energi	2020	9	26	$34,595

Manufacturer	Vehicle Type	Model Name	Planned Availability	Battery Size (kWh)	Range (mi)	Cost
Ford	Truck/Van	Hybrid F150	2020			
Honda	Hatchback	Clarity	2020	17	48	$33,400
Hyundai	Hatchback	IONIQ Plug-In Hybrid	2020	8.9	29	$26,500
Hyundai	Hatchback	Sonata	2020	9.8	28	$31,400
Jeep	SUV	Wrangler 4x3	2020			
Kia	SUV	Niro	2020	8.9	26	$28,200
Kia	Hatchback	Optima	2020	9.8	29	$36,090
Land Rover	SUV	Land Rover	2020	13.1	31	$78,600
Land Rover	SUV	Range Rover Sport	2020	13.1	19	$79,000
Lincoln	SUV	Aviator	2020		21	$68,000
Mercedes Benz	SUV	GLC350e	2020	13.5	22	$51,900
MINI	Hatchback	MINI Countryman	2020	7.6	12	$36,900
Mitsubishi	SUV	Outlander	2020	12	22	$35,000
Porsche	SUV	Cayenne	2020	14	13	$81,100
Subaru	SUV	Crosstrek	2020	8.8	17	$35,145
Toyota	Hatchback	Prius Prime	2020	8.8	25	$27,750
Toyota	SUV	RAV4 Prime	2020		42	$38,100
Volvo	Hatchback	S60 T8 (Polestar)	2020	10.4	21	$54,400
Volvo	Hatchback	S90	2020	10.4	21	$63,200
Volvo	SUV	XC90	2020	10.4	19	$64,950
Volvo	SUV	XC60	2020	10.4	18	$67,000

Unconfirmed Models and Soft Announcements

Concept cars and announcements unconfirmed by the manufacturer (i.e., models that have been discussed by automotive press but OEMs have not confirmed a launch date or details) are not included in the charts throughout the report but are included here for reference. OEM soft commitments have also been included when possible.

Manufacturer	Vehicle Type	EV Type	Model Name	Planned Availability
Audi	SUV	BEV	Q4 e-tron	Unconfirmed for U.S. – concept
Bentley		BEV		2025
BMW	SUV Hatchback	BEV	X1 5-series	Announced will offer electrified versions, did not confirm specs or other information
Byton	Hatchback SUV	BEV	K-Byte M-Byte	Unclear due to COVID and unconfirmed for U.S.
GM	Truck/Van			Chevy 2025 pickup
Honda		BEV	Fit/Jazz	
Hyundai	SUV	BEV	Ioniq 7	2024 concept
Jeep	SUV	PHEV	Renegade Compass	Unconfirmed for U.S.
Kia	SUV	BEV	Stonic	
Mercedes Benz		PHEV	*Unconfirmed for U.S.:* GLBe A250e	Announced 10 new electric models by 2022
Mercedes Benz		BEV	*Unconfirmed for U.S.:* EQA (2020) EQB (2021) EQE (2022) Vision EQS	Announced 10 new electric models by 2022
Toyota	3 SUVs* (*one would be a Subaru collaboration)* 2 Trucks/Vans* 1 Hatchback*	BEV	*Unnamed*	Announced June 2019 for 2020-2025
Workhorse^	Truck/Van	PHEV	W-15	Production on hold as of March 2020

^Workhorse announced a model but has not announced details or launch dates due to production delays.
*Toyota announced six new vehicles will launch in 2020 but did not provide further details. These are speculations based on https://www.caranddriver.com/news/a27887943/toyota-ev-rollout-plans/.

Figure 2A Price-Range Matrix: BEV Models Available in 2021

Range (Miles) \ Price ($)	0-30,000	30,000-40,000	40,000 – 70,000	70,000+
0-150	Kandi K27 Kandi K23 Ford Focus Mini Cooper SE	Fiat 500e Kia Soul EV Volkswagen e-Gof		
150-250	Volkswagen I.D. Nissan Leaf	Huyundai IONIQ Kia Niro EV BYD e6 Chevrolet Bolt Tesla Model 3	BMW i3 Jaguar I-Pace Volvo XC 40	Rivian R1S
250+		Hyundai Kona	Nissan Ariya Nikola Badger Ford Mach-e Rivian R1T Volvo Polestar 2 Mercedes EQC 400 Tesla Model Y Lordstown Endurance GM Lyriq	Audi e-tron Tesla Model S Tesla Model X

Model Announcements – Medium- and Heavy-Duty Vehicles

This table includes only models with an announced model name and model year introduction date. Other data is included if available; blank cells indicate that the data is not available from the manufacturer.

Medium-Duty Vehicles

Vehicle Type	Manufacturer	Model	Weight Class	Availability	Battery Size (kWh)	Stated Range (mi)
Passenger Van	Lightening Systems	Ford Transit	3	2020	43-86	60-120
Delivery Van	EVT Motors	EVT Motors Logistics Van	4	2020	106	108-173
Delivery Van	Chanje	V8100	4	2020	100	150
Delivery Van	EVT Motors	Electric Van Cuttaway	5	2020	106	173
Delivery Van	Rivian	Amazon Van	3	2021 *Amazon Only*		
Delivery Van	Ford	Transit		2021		
Delivery Truck	EVT Motors	Urban Electric Class 3 Truck	3	2020	92	173
Delivery Truck	SEA Electric	Ford Repower: T350HD; E350; E450; F53; F59	3-6	2020		220
Delivery Truck	SEA Electric	Isuzu Repower	3-6	2020		
Delivery Truck	SEA Electric	Hino Repower	4-7	2020		
Delivery Truck	BYD	6F	6	2020	221	124
Delivery Truck	Xos	Medium Duty	6	2020		200
Delivery Truck	UES	Repower International P1000	6	2020		
Delivery Truck	BYD	8TT	8	2020	409	125
Delivery Truck	Freightliner	eM2	6	2021	325	230
Work Truck	Phoenix Motor Cars	Ford Repower: E450	4	2020	70-150	
Work Truck	Motiv	Ford Repower: E450; F53; F59	4-6	2020	127	
Work Truck	Peterbilt (Paccar)	Model 220EV	6	2020	140-348	250
Work Truck	Navistar	eMV	6	2021	321	250
Shuttle Bus	GreenPower	EV Star	3	2020	118	150

Vehicle Type	Manufacturer	Model	Weight Class	Availability	Battery Size (kWh)	Stated Range (mi)
Shuttle Bus	Motiv	EPIC Ford E-450 Shuttle Bus	4	2020	106	85
Shuttle Bus	Phoenix Motor Cars	Zeus 400	4	2020	70-140	80-150
Shuttle Bus	Lightening Systems	Ford Repower: E450; F-550	4-5	2020	86-129	80-100
Shuttle Bus	Lion Electric	Lion M	7	2020	NA	75-150
Shuttle Bus	GreenPower	Synapse Shuttle Bus	8	2020	100-200	75-140
Shuttle Bus	Proterra	Catalyst E2	8	2020	440-660	161-328
School Bus	Blue Bird	Micro Bird G5	3	2020	88	100
School Bus	Phoenix Motor Cars	Zeus 600	4	2020	70-140	80-150
School Bus	Motiv	EPIC Ford E-450 Type A	4	2020	106	85
School Bus	Lion Electric	Lion A	6	2020	80-160	75-150
School Bus	Motiv	EPIC Ford F-59 Type C	6	2020	127	100

Heavy-Duty Vehicles

Vehicle Type	Manufacturer	Model	Weight Class	Availability	Battery Size (kWh)	Stated Range (mi)
School Bus	Blue Bird	All American	7	2020	160	120
School Bus	Blue Bird	Vision	7	2020	160	120
School Bus	Lion Electric	Lion C	7	2020	88-220	65-155
School Bus	Thomas Built	Saf-T-Liner C2 Jouley	7	2020	220	120
School Bus	GreenPower	Synapse 72	7	2020	100-200	75-140
School Bus	IC (Navistar)	chargE	7	2020	260	120
Transit bus	BYD	30-ft, 35-ft, 40-ft, 60-ft	8	2020	324	Varies
Transit bus	Gillig	40-ft	8	2020	148 - 444	Varies
Transit bus	Green Power	30-ft, 35-ft, 40-ft, 60-ft	8	2020	NA	Varies
Transit bus	Complete Coach	40-ft remanufactured	8	2020	NA	Varies
Transit bus	New Flyer	35-ft, 40-ft, 60-ft	8	2020	160 - 466	Varies

Vehicle Type	Manufacturer	Model	Weight Class	Availability	Battery Size (kWh)	Stated Range (mi)
Transit bus	Nova Bus	40-ft	8	2020	150	Varies
Transit bus	Proterra	35-ft, 40-ft	8	2020	220 - 660	Varies
Coach Bus	Van Hool	CX45E	8	2020		
Refuse Truck	BYD	6R	6	2020		
Refuse Truck	Peterbilt (Paccar)	Model 520EV	8	2020	308-420	60-90
Refuse Truck	BYD	8R	8	2020		
Refuse Truck	Mack	LR	8	2021		
Refuse Truck	Lion Electric	Lion 8	8	Pre-order only	160-480	
Tractor Truck	Kalmar Ottawa	T2E Port Tractor	8	2020		
Tractor Truck	Orange EV	T-Seires Repower Terminal	8	2020		
Tractor Truck	BYD	8TT	8	2020	409	125
Tractor Truck	Peterbilt (Paccar)	Model 579EV	8	2020	264-420	110-200
Tractor Truck	Xos	ET One	8	Demonstration		300
Tractor Truck	Freightliner	eCascadia	8	2021	550	250
Tractor Truck	Tesla	Semi	8	2021		300-500
Tractor Truck	Nikola	Nikola One	8	2022		75
Tractor Truck	Nikola	Nikola Two	8	2022		400
Tractor Truck	Nikola	Nikola Tre	8	2022		
Delivery Truck	Lion Electric	Lion 8	8	Pre-order only	160-320	

Unconfirmed Models and Soft Announcements

Vehicle Type	Manufacturer	Model	Availability	Battery Size (kWh)	Stated Range (mi)
Delivery Van	GMC	BV1-*unconfirmed*	2021		
Delivery Van	Mercedes Benz	eSprinter	Currently only in Europe	41	
Delivery Van	Mercedes Benz	Vito	Currently only in Europe		
Delivery Van	Workhorse	C1000	TBD	70	125
Delivery Van	Workhorse	UPS Delivery Van	TBD - UPS only		

References

[i] General Motors. "GM Outlines All-Electric Path to Zero Emissions." *GM Corporate Newsroom*, 2 Oct. 2017, https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2017/oct/1002-electric.html.

[ii] Ford. "Sustainability Report 2017/2018." https://corporate.ford.com/microsites/sustainability-report-2017-18/driving-change/electrification.html.

[iii] Volkswagen. "Volkswagen plans to produce EVs in America starting in 2022." *Volkswagen* Newsroom, 14 Jan. 2019, https://newsroom.vw.com/vehicles/volkswagen-plans-to-produce-evs-in-america-starting-in-2022/,

[iv] Burch, Isabella, and Jock Gilchrist. "Survey of Global Activity to Phase Out Internal Combustion Engine Vehicles." *Center for Climate Protection*, Sept. 2018, https://climateprotection.org/wp-content/uploads/2018/10/Survey-on-Global-Activities-to-Phase-Out-ICE-Vehicles-FINAL-Oct-3-2018.pdf ; Deign, Jason. "How Internal Combustion Engines Will Die Out in Eurasia." *Green Tech Media*, 11 Oct. 2018, https://www.greentechmedia.com/articles/read/how-internal-combustion-engines-will-die-out-in-eurasia#gs.UvEz9Aql https://www.roadtraffic-technology.com/features/european-countries-banning-fossil-fuel-cars/ ; Cohen, Michael J. "Nine countries say they'll ban internal combustion engines. So far, it's just words." *Quartz*, 7 Aug. 2018, https://qz.com/1341155/nine-countries-say-they-will-ban-internal-combustion-engines-none-have-a-law-to-do-so/ ; Dzikiy, Phil. "Electric buses surging in Latin America, Chile adding to fleet as it aims for all-electric by 2040." *Electrek*, 24 May 2019, https://electrek.co/2019/05/24/electric-buses-latin-america/; Plautz, Jason. "British Columbia law requires 100% clean vehicle sales by 2040." *Utility Dive*, 3 June 2019, https://www.smartcitiesdive.com/news/british-columbia-law-requires-100-clean-vehicle-sales-by-2040/555965/ Meijer, Bart. "City of Amsterdam to ban polluting cars from 2030." *Reuters*, 2 May 2019, https://www.reuters.com/article/us-netherlands-pollution-amsterdam/city-of-amsterdam-to-ban-polluting-cars-from-2030-idUSKCN1S81XV.

[v] Rathi, Akshat. "Half of all cars sold in Norway in 2018 were electric." *Quartz*, 3 Jan. 2019, https://qz.com/1514111/half-of-all-cars-sold-in-norway-in-2018-were-electric/.

[vi] European Commission. "Europe accelerates the transition to clean mobility: Co-legislators agree on strong rules for the modernization of the mobility sector." 18 Dec. 2018, https://ec.europa.eu/clima/news/europe-accelerates-transition-clean-mobility-co-legislators-agree-strong-rules-modernisation_en.

[vii] European Commission. "Clean mobility: Putting an end to polluting trucks. Commission welcomes first-ever EU standards to reduce pollution from trucks." 18 Feb. 2019, http://europa.eu/rapid/press-release_IP-19-1071_en.htm.

[viii] Ekblom, Jonas. "CORRECTED-Denmark calls for EU ban on sale of all diesel and petrol cars by 2040." *Reuters*, 4 Oct. 2019, https://uk.reuters.com/article/eu-autos-denmark/corrected-denmark-calls-for-eu-ban-on-sale-of-all-diesel-and-petrol-cars-by-2040-idUKL2N26P09C.

[ix] Deign, Jason. "How Internal Combustion Engines Will Die Out in Eurasia." *Green Tech Media*, 11 Oct. 2018, https://www.greentechmedia.com/articles/read/how-internal-combustion-engines-will-die-out-in-eurasia#gs.UvEz9Aql https://www.roadtraffic-technology.com/features/european-countries-banning-fossil-fuel-cars/.

[x] Tian, Ying, Yan Zhang, and Jie Ma. "The $18 Billion Electric-Car Bubble at Risk of Burstin in China." *Bloomberg News*, 14 Apr. 2019, https://www.bloomberg.com/news/articles/2019-04-14/the-18-billion-electric-car-bubble-at-risk-of-bursting-in-china?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top.

[xi] Climate Mayors. https://driveevfleets.org/ ; Beitsch, Rebecca. "Mayors across the country commit to buying electric vehicles." *The Hill*, 29 June 2019, https://thehill.com/policy/energy-environment/450892-mayors-across-country-commit-to-buying-electric-vehicles.

[xii] C40 Cities. https://www.c40.org/networks/zero-emission-vehicles.

[xiii] Ramey, Jay. "Rome to ban diesel cars from city center by 2024." *Auto Week*, 2 Mar. 2018, https://autoweek.com/article/diesel/rome-ban-diesel-cars-city-center-2024 ; City of Los Angeles. "L.A.'s Green New Deal." Apr. 2019, http://plan.lamayor.org/sites/default/files/pLAn_2019_final.pdf ; BBC News. "Petrol and diesel car sales ban brought forward to 2035." 4 Feb. 2020, https://www.bbc.com/news/science-environment-51366123 ; Cui, Hongyang; Dale Hall, and Nic Lutsey. "Update on the global transition to electric vehicles through 2019." *The International Council on Clean Transportation*, Jul. 2020, https://theicct.org/sites/default/files/publications/update-global-EV-stats-20200713-EN.pdf.

[xiv] Multi-State ZEV Task Force. "About the ZEV Task Force." https://www.zevstates.us/about-us/.

[xv] NESCAUM. "Multi-State ZEV Action Plan 2018-2021." https://www.nescaum.org/documents/2018-zev-action-plan.pdf.

[xvi] NESCAUM. "Multi-State Medium-and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding." 14 July 2020, http://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf.

[xvii] California Air Resources Board (CARB). "California takes bold step to reduce truck pollution." 25 June 2020, https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution ; CARB. "Meeting State of California Air Resources Board." 12 Dec. 2019, https://ww3.arb.ca.gov/board/mt/2019/mt121219.pdf?_ga=2.151518330.275037154.1588616184-1935873982.1585329253c.

[xviii] Slowik, Peter, and Nic Lutsey. "The Continued Transition to Electric Vehicles in U.S. Cities." *The International Council on Clean* Transportation, Jul. 2018, https://www.theicct.org/sites/default/files/publications/Transition_EV_US_Cities_20180724.pdf.

[xix] Auto Alliance. "U.S. Light-Duty Advanced Technology Vehicle (ATV) Sales (2011-2018)." Last updated 5 Nov 2018. https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/.

[xx] California Air Resources Board. "California and major automakers reach groundbreaking framework agreement on clean emissions standards." 25 July 2019, https://ww2.arb.ca.gov/news/california-and-major-automakers-reach-groundbreaking-framework-agreement-clean-emission.

[xxi] California Air Resources Board (CARB). "Settlement Agreements with BMW, Ford, Honda, Volvo, and VW." 17 Aug. 2020, https://ww2.arb.ca.gov/resources/documents/framework-agreements-clean-cars?source=email.

[xxii] U.S. Energy Information Administration. "Power sector carbon dioxide emissions fall below transportation sector emissions." 19 Dec. 2017, https://www.eia.gov/todayinenergy/detail.php?id=34192.

[xxiii] California Air Resources Board. "Advanced Clean Cars." https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-cars.

[xxiv] California Air Resouces Board. "Advanced Clean Cars II Regulations. Informational Update." 28 May 2020. https://ww3.arb.ca.gov/board/books/2020/052820/20-5-3pres.pdf ; California Air Resources Board. "Advanced Clean Cars (ACC II) Workshop." 16 Sept. 2020, https://ww2.arb.ca.gov/sites/default/files/2020-09/ACC_II_Sept_2020_Workshop_Presentation.pdf.

[xxv] Statista. "Leading car brands in the United States in 2017, based on vehicle sales (in units)." https://www.statista.com/statistics/264362/leading-car-brands-in-the-us-based-on-vehicle-sales/ ; Ford Motor Company. "2017 Annual Report." https://s22.q4cdn.com/857684434/files/doc_financials/2017/annual/Final-Annual-Report-2017.pdf.

[xxvi] Ford Motor Company. "2017 Annual Report." https://s22.q4cdn.com/857684434/files/doc_financials/2017/annual/Final-Annual-Report-2017.pdf ; Ford Motor Company. "2015 Annual Report." https://s22.q4cdn.com/857684434/files/doc_financials/2015/annual/2015-annual-report.pdf.

[xxvii] BMW Group. "Innovation leadership: BMW Group plans over 30 billion euros on future-oriented technologies up to 2025." 18 Mar. 2020, https://www.press.bmwgroup.com/global/article/detail/T0306823EN/innovation-leadership:-bmw-group-plans-over-30-billion-euros-on-future-oriented-technologies-up-to-2025?language=en ; Wayland, Michael. "General Motors to spend $20 billion through 2025 on new electric, autonomous vehicles." *CNBC*, 4 Mar. 2020, https://www.cnbc.com/2020/03/04/gm-to-spend-20-billion-on-new-electric-autonomous-vehicles.html ; Park, Ju-min, and Heekyong Yang. "Hyundai Motor eyes thrust on electric vehicles in $52 billion investment plant." *Reuters*, 3 Dec. 2019, https://www.reuters.com/article/us-hyundai-motor-investment-idUSKBN1Y8054.

[xxviii] Daimler. "Global electric offensive: Mercedes-Benz invests $1 billion in Tuscaloosa, creates 600 new jobs." https://www.daimler.com/company/locations/tuscaloosa/.

[xxix] FCA. "FCA to Expand Production Capacity in Michigan to Grow Core Brands, Electrify Jeep." 26 Feb. 2019, http://media.fcanorthamerica.com/newsrelease.do?id=20661&mid=1

[xxx] Office of Energy Efficiency and Renewable Energy. "FOTW #1146, August 10, 2020: Nearly 70% of Light-Duty Plug-in Electric Vehicles in the United States Were Assembled Domestically." 10 Aug 2020, https://www.energy.gov/eere/vehicles/articles/fotw-1146-august-10-2020-nearly-70-light-duty-plug-electric-vehicles-united.

[xxxi] Evarts, Eric C. "BMW pulls ahead its electrification plan by two years." *Green Car* Reports, 26 June 2019, https://www.greencarreports.com/news/1123785_bmw-pulls-ahead-its-electrification-plans-by-two-years.

[xxxii] Ford Motor Company. "2017 Annual Report." https://s22.q4cdn.com/857684434/files/doc_financials/2017/annual/Final-Annual-Report-2017.pdf.

[xxxiii] Ford Motor Company. "Rivian announces $500 million investment from Ford; partnership to deliver all-new Ford battery electric vehicle." 24 Apr. 2019, https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/24/rivian-500-million-investment-ford.html.

[xxxiv] General Motors. "2019 Outlook: General Motors Strengthens Core Business and Future Mobility." 11 Jan. 2019, https://media.gm.com/content/dam/Media/gmcom/investor/2019/jan/Press-Release-1-11-19.pdf ; General Motors. "GM's Path to an All-Electric, Zero Emissions Future." *GM Corporate Newsroom*, 7 Mar. 2018, https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2018/mar/0307-barra-speech.html.

[xxxv] Hyundai Motor Company. "Hyundai Motor Unveils Long-term Plans for Maximizing Shareholder Value, Securing Sustainable Growth." 28 Feb. 2019, https://www.hyundaimotorgroup.com/MediaCenter/News/Press-Releases/hmc-growth-190228.hub#.XILVeShKiM8.

[xxxvi] Daimler. "Ambition2039. Our path to sustainable mobility." 22 Mar. 2019, https://www.daimler.com/company/corporate-governance/board-of-management/kaellenius/linkedin/ambition-2039.html.

[xxxvii] Automotive News. "FCA's 5-year plan led by new Jeep, Ram, luxury products; company hits financial milestone." 1 Jun 2018, https://www.autonews.com/article/20180601/BLOG06/180539956/fca-s-5-year-plan-led-by-new-jeep-ram-luxury-products-company-hits-financial-milestone.

[xxxviii] Porsche. "The next generation of the Porsche Macan will be electric." 26 Feb. 2019, https://newsroom.porsche.com/fallback/en/2019/products/porsche-macan-next-generation-elektric-leipzig-17067.html.

[xxxix] Einstein. Paul. "Volkswagen boosts electric vehicle production by 50% with 22 million BEVs by 2029."*CNET*, 13 Mar. 2019, https://www.cnbc.com/2019/03/12/vw-boosts-electric-production-by-50percent-with-22-million-bevs-by-2029.html ; Teale. "Volkswagen proposes 'paradigm shift' by opening EV platform to competitors." *Utility Dive*, 4 Feb. 2019, https://www.utilitydive.com/news/volkswagen-ev-platform-competitors/547454/.

[xl] Einstein, Paul. "These Countries Want to Ban All Vehicles That Run On Gas or Diesel." *NBC* News, 10 Jul. 2017, https://www.nbcnews.com/business/autos/these-countries-want-ban-all-vehicles-run-gas-or-diesel-n78143.

[xli] Kane, Mark. "PACCAR's Kenworth and Peterbilt Partner on EVs with Dana." *Inside EVs*, 11 Jan. 2020, https://insideevs.com/news/391832/paccar-kenworth-peterbilt-evs-dana/.

[xlii] Navistar. "Navistar Launches New Business Unit, NEXT eMobility Solutions." 28 Oct. 2019, https://news.navistar.com/2019-10-28-Navistar-Launches-New-Business-Unit-NEXT-eMobility-Solutions.

[xliii] Daimler. "CO_2-neutral commercial vehicle fleet by 2039." 25 Oct. 2019, https://www.daimler.com/sustainability/co2-neutral-commercial-vehicle-fleet-until-2039.html.

[xliv] Audi: Audi. "Audi returns to electrify the Big Game on Feb. 3 with a 60-second spot." *Audi Newsroom*, 4 Jan 2019, https://media.audiusa.com/en-us/releases/290; Lambert, Fred. "Audi announces €14 billion investment with focus on electric vehicles." *Electrek*, 4 Dec. 2018, https://electrek.co/2018/12/04/audi-investment-electric-vehicles/ ; Schot, Bram, Alexander Seitz, and Stefan Niemand. "Audi Investor & Analyst Meeting Presentation." *Audi Investor Presentations*, 17 Sep. 2018, https://www.volkswagenag.com/presence/investorrelation/publications/presentations/2018/09_september/20180917_INVESTOR_MEETING_THE_CHARGE.pdf ; Tomich, Jeffrey. "Midwest 'roadmap' aims to unlock EV emissions benefits." *Energy Wire*, 24 Jan 2019, https://www.eenews.net/energywire/2019/01/24/stories/1060118433 ; Kane, Mark. "Audi's Accelerated E-Roadmap Envisions 30 Plug-Ins By 2025." *Inside EVs*, 1 June, 2019, https://insideevs.com/news/352474/audi-envisions-30-plugins-2025/.

Bentley: Elliot, Hannah. "When marketing luxury vehicles, 'electric' is no longer a bad word." *Automotive News*, 11 Apr 2018, https://www.autonews.com/article/20180411/OEM05/180419941/when-marketing-luxury-vehicles-electric-is-no-longer-a-bad-word.

BMW: Dilanni, Phil. "BMW Group delivers over 140,000 electrified vehicles in 2018." *BMW USA News*¸ 10 Jan 2019, http://www.bmwusanews.com/newsrelease.do?id=3355&mid= ; Sachgau, Oliver. "BMW Steps Up E-Car Target to 700,000 by 2025 as Fines Loom." *Bloomberg*, 25 June 2019, https://www.bloomberg.com/news/articles/2019-06-25/bmw-steps-up-electric-sales-target-as-regulation-and-fines-loom ; Evarts, Eric C. "BMW pulls ahead its electrification plan by two years." *Green Car* Reports, 26 June 2019, https://www.greencarreports.com/news/1123785_bmw-pulls-ahead-its-electrification-plans-by-two-years ; Taylor, Chloe. "BMW set to double electric vehicle sales by 2021." *CNBC*, 25 Jun. 2019, https://www.cnbc.com/2019/06/25/bmw-set-to-double-electric-vehicle-sales-by-2021.html ; BMW Group. "More than seven million vehicles with all-electric or plug-in hybrid drive systems by the year 2030." 12. Aug. 2020, https://www.press.bmwgroup.com/global/article/detail/T0313566EN/more-than-seven-million-vehicles-with-all-electric-or-plug-in-hybrid-drive-systems-by-the-year-2030?language=en ; BMW Group. "Innovation leadership: BMW Group plans over 30 billion euros on future-oriented technologies up to 2025." 18 Mar. 2020. https://www.press.bmwgroup.com/global/article/detail/T0306823EN/innovation-leadership:-bmw-group-plans-over-30-billion-euros-on-future-oriented-technologies-up-to-2025?language=en.

Daimler: Daimler. "Daimler buys battery cells in a total volume of 20 billion euros." *Daimler Media*, 11 Dec 2018, https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-buys-battery-cells-in-a-total-volume-of-20-billion-euros.xhtml?oid=42042973 ; Daimler. "Plans for more than ten different all-electric vehicles by 2022: All systems are go." *Daimler Media*, https://media.daimler.com/marsMediaSite/en/instance/ko/Plans-for-more-than-ten-different-all-electric-vehicles-by-2022-All-systems-are-go.xhtml?oid=29779739 ; Daimler. "Annual Report 2017." https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2017.pdf ; Daimler. "Ambition2039: Out path to sustainable mobility." 13 May 2019, https://blog.daimler.com/en/2019/05/13/mercedes-carbon-neutral-e-mobility/ ; Daimler. "Ambition2039. Our path to sustainable mobility." 22 Mar. 2019, https://www.daimler.com/company/corporate-governance/board-of-management/kaellenius/linkedin/ambition-2039.html..

FCA: Fingas, Jon. "Fiat Chrysler will launch over 30 EVs and hybrids by 2022." *Engadget*, 2 Jun 2018, https://www.engadget.com/2018/06/02/fiat-chrysler-launching-over-30-electric-and-hybrid-cars-by-2022/. Automotive News. "FCA's 5-year plan led by new Jeep, Ram, luxury products; company hits financial milestone." 1 Jun 2018, https://www.autonews.com/article/20180601/BLOG06/180539956/fca-s-5-year-plan-led-by-new-jeep-ram-luxury-products-company-hits-financial-milestone.

Ford: Ford Motor Company. "2017 Annual Report." https://s22.q4cdn.com/857684434/files/doc_financials/2017/annual/Final-Annual-Report-2017.pdf

GM: GM. "GM Outlines All-Electric Path to Zero Emissions." *GM Newsroom*, 2 Oct 2017, https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2017/oct/1002-electric.html ; Harder, Amy. "GM's emerging electric strategy." *Axios*, 14 Jan 2019, https://www.axios.com/newsletters/axios-generate-ab96b41b-4160-450b-8ac9-c9a8abd42b88.html?chunk=5&utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top#story5 ; Muller, Joann. "How GM Plans To Bury Tesla With Onslaught Of Electric Vehicles That Will – Gasp! – Make A Profit." *Forbes*, 15 Nov 2017, https://www.forbes.com/sites/joannmuller/2017/11/15/how-gm-plans-to-bury-tesla-with-onslaught-of-electric-vehicles-that-will-gasp-make-a-profit/#6cb349542341; Green Wire. "GM announces electric vehicle plant, jobs after Trump tweet." 22 Mar. 2019, https://www.eenews.net/greenwire/2019/03/22/stories/1060128047 ; Chappell, Bill. "GM And LG Chem Plan $2.3 Billion Electric Battery Venture In Ohio." NPR, 5 Dec. 2019, https://www.npr.org/2019/12/05/785156805/gm-and-lg-chem-plan-2-3-billion-electric-battery-venture-in-ohio ; Wayland, Michael. "General Motors to spend $20 billion through 2025 on new electric, autonomous vehicles." *CNBC*, 4 Mar. 2020, https://www.cnbc.com/2020/03/04/gm-to-spend-20-billion-on-new-electric-autonomous-vehicles.html.

Hyundai Kia: Hyundai Motor Company. "Hyundai Motor Unveils Long-term Plans for Maximizing Shareholder Value, Securing Sustainable Growth." 28 Feb. 2019, https://www.hyundaimotorgroup.com/MediaCenter/News/Press-Releases/hmc-growth-190228.hub#.XILVeShKiM8 ; Park, Ju-min, and Heekyong Yang. "Hyundai Motor eyes thrust on electric vehicles in $52

billion investment plan." *Reuters*, 3 Dec. 2019, https://www.reuters.com/article/us-hyundai-motor-investment-idUSKBN1Y8054 ; Hyundai Motor Group. "Hyundai Motor Announces IONIQ Brand Dedicated to EVs, Opening New Chapter for Customer-Centric EV Experiences." https://tech.hyundaimotorgroup.com/press-release/hyundai-motor-announces-ioniq-brand-dedicated-to-evs-opening-new-chapter-for-customer-centric-ev-experiences/.

Mercedes-Benz: Daimler. "At a glance: Electric initiative at Mercedes-Benz Cars." *Daimler Media*, 29 Jan 2018, https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2017.pdf ; Daimler. "Global electric offensive Mercedes-Benz invests $1 billion in Tuscaloosa, creates 600 new jobs." *Daimler Media*, 13 Mar 2018, https://www.daimler.com/company/locations/tuscaloosa/ ; Daimler. "Annual Report 2017." https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2017.pdf ; Daimler. "Daimler buys battery cells in a total volume of 20 billion euros." *Daimler Media*, 11 Dec. 2018, https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-buys-battery-cells-in-a-total-volume-of-20-billion-euros.xhtml?oid=42042973.

Nissan: Nissan Motor Company. "Nissan aims to sell 1 million electrified vehicles a year by FY2022." *Nissan Global Newsroom*, 23 Mar 2018, https://newsroom.nissan-global.com/releases/release-487297034c80023008bd9722aa05f858-180323-01-j ; Nissan USA. "Alliance Ventures invests in Enevate to advance Li-ion battery technology for electric vehicles." 13 Nov 2018, https://nissannews.com/en-US/nissan/usa/releases/alliance-ventures-invests-in-enevate-to-advance-li-ion-battery-technology-for-electric-vehicles?page=2&query.

Porsche: Kane, Mark. "Porsche Taycan Owners Get 3 Years Of Free Electrify America Charging." *Inside EVs*, 28 Jan 2019, https://insideevs.com/porsche-taycan-3-years-free-charging/; Porsche. "The next generation of the Porsche Macan will be electric." 26 Feb. 2019, https://newsroom.porsche.com/fallback/en/2019/products/porsche-macan-next-generation-elektric-leipzig-17067.html.

Toyota: Tajitsu, Naomi. "Toyota to make over 10 battery EV models in early 2020s." *Reuters*, 18 Dec 2017, https://www.reuters.com/article/us-toyota-electric-vehicle/toyota-to-market-over-10-battery-ev-models-in-early-2020s-idUSKBN1EC0EB ; Toyota. "Toyota aims for sales of More Than 5.5 Million Electrified Vehicles Including 1 Million Zero-Emission Vehicles per Year by 2030." *Toyota Global Newsroom*,18 Dec 2017, https://newsroom.toyota.co.jp/en/corporate/20353243.html. Tajitsu, Naomi. "Toyota to market over 10 battery EV models in early 2020s." *Reuters*, 18 Dec. 2017, https://www.reuters.com/article/us-toyota-electric-vehicle/toyota-to-make-over-10-battery-ev-models-in-early-2020s-idUSKBN1EC0EB ; Shepardson, David. "Toyota, Mazda joint venture Alabama plant will now cost $2.3 billion." *Reuters*, 13 Aug. 2020, https://www.reuters.com/article/us-toyota-mazda-plant/toyota-mazda-joint-venture-alabama-plant-will-now-cost-2-3-billion-idUSKCN2592V0.

Volkswagen: Kottasova, Ivana. "Volkswagen to spend $50 billion on electric car 'offensive.'" *CNN Business*, 16 Nov 2018, https://www.cnn.com/2018/11/16/business/volkswagen-electric-cars/index.html ; Volkswagen. "Shaping the transformation together. Annual report 2017." https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2018/volkswagen/en/Y_2017_e.pdf ; Volkswagen. "E-mobility." https://www.volkswagenag.com/content/onkomm/brands/corporate/world/presence/en/group/e-mobility.html; Energywire. "Volkswagen vows to build 22M e-cars over the next decade." 13 Mar. 2019, https://www.eenews.net/energywire/2019/03/13/stories/1060127083 ; Energy Wire. "Volkswagen to invest $1B in battery production plant." 15 May 2019, https://www.eenews.net/energywire/2019/05/15/stories/1060333135 ; Volkswagen. "Volkswagen significantly raises electric car production forecast for 2025." 27 Dec. 2019, https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-significantly-raises-electric-car-production-forecast-for-2025-5696 ; Moss, Trefor, and Martin Mou. "Volkswagen Pours More Than $2 Billion Into China's Electric-Car Industry." *The Wall Street Journal*, 29 May 2020, https://www.wsj.com/articles/volkswagen-pours-more-than-2-billion-into-chinas-electric-car-industry-11590736755?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top ; Korosec, Kristen. "Volkswagen sinks another $200 million into solid-state battery company QuantumScape." *MSN TechCrunch*, 16 June 2020, https://www.msn.com/en-us/news/technology/volkswagen-sinks-another-dollar200-million-into-solid-state-battery-company-quantumscape/ar-BB15zF65.

Volvo: Volvo. "Volvo Cars aims for 50 per cent of sales to be electric by 2025." 25 Apr. 2018, https://www.media.volvocars.com/global/en-gb/media/pressreleases/227602/volvo-cars-aims-for-50-per-cent-of-sales-to-be-electric-by-2025 ; Volvo. "Volvo Cars goes all electric." 5 Jul 2017, https://www.media.volvocars.com/global/en-gb/media/pressreleases/210058/volvo-cars-to-go-all-electric; Volvo. "Volvo Cars Tech Fund invests in electric car charging company FreeWire." 24 Oct 2018, https://www.media.volvocars.com/global/en-gb/media/pressreleases/239948/volvo-cars-tech-fund-invests-in-electric-car-charging-company-freewire ; Volvo Group. "Volvo Group Venture Capital invests in wireless electric charging." 15 Jan 2019, https://www.volvogroup.com/en-en/news/2019/jan/news-3177831.html; Vaish, Esha. "Volvo expects electric car margins to match conventional vehicles by 2025." *Reuters*, 20 Mar. 2019, https://www.reuters.com/article/us-volvocars-electric-margins/volvo-expects-electric-car-margins-to-match-conventional-vehicles-by-2025-idUSKCN1R12DD?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenera ; Volvo Cars Global Newsroom. "Volvo Cars announces new target of 1 million electrified cars sold by 2025"21 Apr. 2016. https://www.media.volvocars.com/global/en-gb/media/pressreleases/189874/volvo-cars-announces-new-target-of-1-million-electrified-cars-sold-by-2025 .

[xlv] Wayland, Michael. "GM's profitable SUVs remain on-track for 2020; coronavirus delays other vehicles." *CNBC*, 29 Apr. 2020, https://www.cnbc.com/2020/04/29/gms-profitable-suvs-on-track-for-20-covid-19-delays-crossovers.html.

[xlvi] E2. "Clean Jobs America 2019." 15 Apr. 2020, https://e2.org/wp-content/uploads/2020/04/E2-Clean-Jobs-America-2020.pdf.

[xlvii] Ford. "Ford adds 2nd North American site to build battery electrics; Michigan workers to make first autonomous vehicles." 20 Mar. 2019, https://media.ford.com/content/fordmedia/fna/us/en/news/2019/03/20/ford-adds-2nd-north-american-site-to-build-battery-electrics.html ; Ford. "Ford Deepens Commitment to American Manufacturing, Celebrates Production Start of All-New F-150, Breaks Ground on New Electric F-150 Plant at Historic Rouge Center." 17 Sept. 2020, https://media.ford.com/content/fordmedia/fna/us/en/news/2020/09/17/ford-deepens-commitment-to-american-manufacturing.html.

[xlviii] General Motors. "GM to Invest $300 Million, Add 400 Jobs at Michigan Plant for New Chevrolet Electric Vehicle." 12 Mar. 2019, https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2019/mar/0322-orion.html#:~:text=%E2%80%94%20General%20Motors%20is%20investing%20%24300,jobs%20to%20the%20Orion%20plant.

[xlix] Gaines, Jim. "Chattanooga Volkswagen plant breaks ground on electric SUV expansion, to add 1,000 jobs." *Knox News*, 13 Nov. 2019, https://www.knoxnews.com/story/money/2019/11/13/volkswagen-build-electric-suv-chattanooga-add-1-000-jobs/4159279002/.

[l] Levesque, Leslie, and Bob Flanagan. "The Economic Contribution of Tesla in California." *IHS Markit*, May 2018, https://cdn.ihs.com/www/pdf/TeslaEconomicFootprintReport-51518.pdf.

[li] Travis County Commissioners Court Voting Session Agenda Request. "Travis County Economic Development Performance Agreement." 23 Jun. 2020, https://www.kxan.com/wp-content/uploads/sites/40/2020/06/Item-18-Backup-6-23-2020.pdf.

[lii] Shepardson, David. "Toyota, Mazda joint venture Alabama plant will now cost $2.3 billion." *Reuters*, 13 Aug. 2020, https://www.reuters.com/article/us-toyota-mazda-plant/toyota-mazda-joint-venture-alabama-plant-will-now-cost-2-3-billion-idUSKCN2592V0.

[liii] Daimler. "Global electric offensive: Mercedes-Benz invests $1 billion in Tuscaloosa, creates 600 new jobs." https://www.daimler.com/company/locations/tuscaloosa/.

[liv] FCA. "FCA to Expand Production Capacity in Michigan to Grow Core Brands, Electrify Jeep." 26 Feb. 2019, http://media.fcanorthamerica.com/newsrelease.do?id=20661&mid=1.

[lv] Volvo Group. "$400 million NRV plant investment to boost quality for Volvo trucks customers." 8 Aug. 2020, https://www.volvogroup.com/en-en/news/2019/aug/nrv-plant-investment.html.

[lvi] Hennes, Rebecca. "Tesla's new $1b "Gigafactory" will open near Austin, with Musk calling it an 'ecological paradise.'" *Houston Chronicle*, 23 Jul. 2020, https://www.houstonchronicle.com/news/houston-texas/article/Tesla-Texas-gigafactory-Austin-Abbott-Musk-15428792.php.

[lvii] Daimler. "DTNA CEO Declares Path to Zero-Emission Commercial Transport to be Driven by Battery-Electric Vehicles." 24 Apr. 2019, https://daimler-trucksnorthamerica.com/company/newsroom/PressDetail/dtna-ceo-declares-path-to-zero-emission-2019-04-24.

[lviii] Corso, Jessica. "Navistar's first SA-made truck will be electric." *San Antonio Business Journal*, 14 Sept. 2020, https://www.bizjournals.com/sanantonio/news/2020/09/14/navistar-making-electric-vehicles-in-sa.html.

[lix] Chappell, Bill. "GM and LG Chem Plan $2.3 Billion Electric Battery Venture in Ohio." *NPR*, 5 Dec. 2019, https://www.npr.org/2019/12/05/785156805/gm-and-lg-chem-plan-2-3-billion-electric-battery-venture-in-ohio.

[lx] General Motors, "General Motors and EVgo aim to accelerate widespread EV adoption by adding fast chargers nationwide." 31 July 2020, https://investor.gm.com/news-releases/news-release-details/general-motors-and-evgo-aim-accelerate-widespread-ev-adoption.

[lxi] Trop, Jaclyn. "Porsche to Offer Free Charging on Its First Fully Electric Vehicle." *Fortune*, 29 Jan. 2019, http://fortune.com/2019/01/29/porsche-electric-vehicle-taycan/.

[lxii] Greenlots. "Greenlots announces acquisition by Shell, one of the world's leading energy providers." 30 Jan. 2019, https://greenlots.com/greenlots-announces-acquisition-by-shell-one-of-the-worlds-leading-energy-providers/.

[lxiii] Ferris, David. "Chevron makes landmark investment in chargers." *Energy Wire*, 21 May 2019, https://www.eenews.net/energywire/2019/05/21/stories/1060369775.

[lxiv] Center for Climate and Energy Solutions (C2ES). "Federal Vehicle Standards." https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/.

[lxv] CalStart, https://calstart.org/ ; American Public Transportation Association. https://www.apta.com/ ; and MJB&A research.

[lxvi] Hawkins, Andrew J. "Amazon will order 100,000 electric delivery vans from EV startup Rivian, Jeff Bezos says." *The Verge*, 19 Sept. 2019, https://www.theverge.com/2019/9/19/20873947/amazon-electric-delivery-van-rivian-jeff-bezos-order ; Wayland, Michael. "Nikola shares surge 22% on garbage truck order for Republic Services." *CNBC*, 10 Aug. 2020, https://www.cnbc.com/2020/08/10/nikola-shares-surge-more-than-22percent-on-garbage-truck-order-for-republic-services.html ; Reuters. "FedEx expands fleet to add 1,000 Chanje electric vans." 20 Nov. 2018 https://www.reuters.com/article/us-fedex-chanje-vans/fedex-expands-fleet-to-add-1000-chanje-electric-vans-idUSKCN1NP1C3 ; Hanley, Steve, "UPS Places Order For 950 Workhorse N-GEN Electric Delivery Vans." *CleanTechnica*, 20 June 2018, https://cleantechnica.com/2018/06/20/ups-places-order-for-950-workhorse-n-gen-electric-delivery-vans/#:~:text=UPS%20Places%20Order%20For%20950%20Workhorse%20N-GEN%20Electric,to%20UPS%2C%20bringing%20the%20total%20order%20to%201%2C000. ; DHL. "DHL Expands Green Fleet with Addition of New Electric Delivery Vans." 7 Feb 2019, https://www.dhl.com/us-en/home/press/press-

archive/2019/dhl-expands-green-fleet-with-addition-of-new-electric-delivery-vans.html ; Lambert, Fred. "Tesla Semi receives order of 30 more electric trucks from Walmart." *Electrek*, 6 Sept. 2018, https://electrek.co/2018/09/06/tesla-semi-new-order-electric-truck-walmart/ ; PepsiCo. "2019 Sustainability Report: Focus Areas." https://www.pepsico.com/sustainability/focus-areas/climate.

[lxvii] Wood Mackenzie. "Electric heavy-duty trucks and charging infrastructure: A grid edge case study." 4 Aug. Aug. 2020, https://www.woodmac.com/reports/power-markets-electric-heavy-duty-trucks-and-charging-infrastructure-a-grid-edge-case-study-428638/#utm_source=gtm&utm_medium=article&utm_campaign=pandr&utm_content=wmpr_evtruck2020.

[lxviii] The Climate Group. "EV 100." https://www.theclimategroup.org/ev100-members ; IKEA. "Zero emissions for home deliveries." https://about.ikea.com/en/sustainability/becoming-climate-positive/zero-emissions-for-home-deliveries ; Coyle, Meg. "Go behind the scenes as Amazon develops a new electric vehicle." *The Amazon Blog*, 4 Feb. 2020, https://blog.aboutamazon.com/sustainability/go-behind-the-scenes-as-amazon-develops-a-new-electric-vehicle ; Clif Bar. "Start Global Cooling." https://www.clifbar.com/stories/climate-action/ ; Unilever. "Unilever commits to 100% electric vehicles by 2030." https://www.unilever.com/news/news-and-features/Feature-article/2017/unilever-commits-to-100-percent-electric-vehicles-by-2030.html ; Walmart. "Walmart Sets Goal to Become a Regenerative Company." 21 Sept. 2020, https://corporate.walmart.com/newsroom/2020/09/21/walmart-sets-goal-to-become-a-regenerative-company ; Consumers Energy. "An Electric Vehicles Story." https://www.consumersenergy.com/community/sustainability/our-hometown-stories/ev-story ; Schneider Electric. "Schneider Electric joins The Climate Group EV100 initiative to fast-track shift of 100% fleet to electric mobility." 6 Feb. 2020, https://www.se.com/ww/en/assets/564/document/117928/release-climate-group-EV100-initiative.pdf ; Southern California Edison. "SCE Announces 2030 Goals for Electrifying Its Vehicle Fleet." https://energized.edison.com/stories/sce-announces-2030-goals-for-electrifying-its-vehicle-fleet ; Antelope Valley Transit Authority. "Electric Bus Fleet Conversion." https://www.avta.com/electric-bus-fleet-conversion.php ; Lyft. "Leading the Transition to Zero Emissions: Our Commitment to 100% Electric Vehicles by 2030." 17 June 2020, https://www.lyft.com/blog/posts/leading-the-transition-to-zero-emissions?mc_cid=9de7a585ad&mc_eid=f28238facf ; King County Metro. "Transitioning to a zero-emissions bus fleet." https://kingcounty.gov/depts/transportation/metro/programs-projects/innovation-technology/zero-emission-fleet.aspx ; Lime. "Lime Commits To 100% Zero-Emissions Operations Fleet Vehicles." 6 Feb. 2020, https://www.li.me/second-street/lime-commits-to-100-zero-emissions-operations-fleet-vehicles ; Uber. "Driving a Green Recovery." 8 Sept. 2020. https://www.uber.com/newsroom/driving-a-green-recovery/ ; DHL. "DHL Expands Green Fleet with Addition of New Electric Delivery Vans." 7 Feb. 20219, https://www.dhl.com/us-en/home/press/press-archive/2019/dhl-expands-green-fleet-with-addition-of-new-electric-delivery-vans.html ; Los Angeles County Electric Truck & Bus Coalition. "LA Sanitation Announces Public Commitment to 100% Electric Refuse Truck Fleet as Los Angeles Leaders Discuss Zero-Emissions Plans."23 Jan. 2020, https://laelectrictruckandbus.org/press-releases-1/2020/1/23/la-sanitation-announces-public-commitment-to-100-electric-refuse-truck-fleet-as-los-angeles-leaders-discuss-zero-emissions-plans ; Genentech. "Step Up Declaration." https://stepupdeclaration.org/genentech ; MTA. "MTA Deploys First All-Electric Articulated Bus Fleet to 14th Street Busway." 15 Dec. 2019, http://www.mta.info/press-release/nyc-transit/mta-deploys-first-all-electric-articulated-bus-fleet-14th-street-busway ; New York City. "New York City's Roadmap to 80x50." https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/New%20York%20City's%20Roadmap%20to%2080%20x%2050.pdf ; City of Los Angeles. "L.A.'s Green New Deal: Sustainable City pLAn 2019." 29 Apr. 2019, https://plan.lamayor.org/sites/default/files/pLAn_2019_final.pdf ; City of Houston. "Houston Climate Action Plan." Apr. 2020, http://greenhoustontx.gov/climateactionplan/CAP-April2020.pdf.

[lxix] Volvo LIGHTS, https://www.lightsproject.com/about/.

[lxx] BloombergNEF. "Electric Vehicle Outlook 2020." 19 May 2020, https://about.bnef.com/electric-vehicle-outlook/.

[lxxi] Pyper, Julia. "US Electric Vehicle Sales Increased 81% in 2018." *Green Tech Media*, 7 Jan. 2019, https://www.greentechmedia.com/articles/read/us-electric-vehicle-sales-increase-by-81-in-2018#gs.v2SiFXA7 ; McDonald, Loren. "2019 US EV Sales Decreased an Estimated 7% to 9% - 6 Reasons Why." *EVAdoption*, 20 Jan. 2020, https://evadoption.com/2019-us-ev-sales-decreased-an-estimated-7-to-9-6-reasons-why/.

[lxxii] Kane, Mark. "Audi's Accelerated E-Roadmap Envisions 30 Plug-Ins By 2025." *Inside EVs*, 1 June, 2019, https://insideevs.com/news/352474/audi-envisions-30-plugins-2025/ ; Keating, Dave. "Mercedes-Benz Will Make Entire Car Fleet Carbon-Neutral by 2039." *Forbes*, 13 May 2019, https://www.forbes.com/sites/davekeating/2019/05/13/mercedes-benz-will-make-entire-car-fleet-carbon-neutral-by-2039/#596ff0174bd4 ; Nissan Motor Company. "Nissan aims to sell 1 million electrified vehicles a year by FY2022." *Nissan Global Newsroom*, 23 Mar 2018, https://global.nissannews.com/en/releases/180323-01-e ; Winton, Neil. "BMW 50% Electrification Target for 2030 is Ambitious, but is it Achievable?" *Forbes*, 14 Aug. 2020, https://www.forbes.com/sites/neilwinton/2020/08/14/bmw-50-electrification-target-for-2030-is-ambitious-but-is-it-achievable/#631df428201f ; Volvo. "Volvo Cars aims for 50 per cent of sales to be electric by 2025." 25 Apr 2018, https://www.media.volvocars.com/global/en-gb/media/pressreleases/227602/volvo-cars-aims-for-50-per-cent-of-sales-to-be-electric-by-2025 ; Honda. "Honda Commits to Total Electrification in Europe by 2025." 5 Mar. 2019, https://global.honda/newsroom/news/2019/4190305eng.html ; Ellfeldt, Avery. "Toyota to roll out 6 all-electric models in 2020."*EE News*, 24 June 2019, https://www.eenews.net/greenwire/2019/06/24/stories/1060650517 ; Taylor, Chloe. "BMW set to double electric vehicle sales by 2021." *CNBC*, 25 Jun. 2019, https://www.cnbc.com/2019/06/25/bmw-set-to-double-electric-vehicle-sales-by-2021.html ; Kane, Mark. "VW Group Expects EVs To Account For 20% Of Its Total Sales By 2025" *InsideEVs*, 7 Dec. 2019, https://insideevs.com/news/386651/vw-group-to-quadruple-bev-share/.

[lxxiii] Honda. "Honda Commits to Total Electrification in Europe by 2025." 5 Mar. 2019, https://global.honda/newsroom/news/2019/4190305eng.html.

[lxxiv] Lutsey, Nic, Mikahil Grant, Sandra Wappelhorst, and Huan Zhou. "Power Play: How Governments are Spurring the Electric Vehicle Industry." *The International Council on Clean Transportation (ICCT)*, May 2018, https://theicct.org/sites/default/files/publications/EV_Government_WhitePaper_20180514.pdf.

[lxxv] BloombergNEF. "Electric Vehicle Outlook 2020." 19 May 2020, https://about.bnef.com/electric-vehicle-outlook/ ; Wood Mackenzie. "Global electric vehicle sales to drop 43% in 2020."8 Apr. 2020, https://www.woodmac.com/press-releases/global-electric-vehicle-sales-to-drop-43-in-2020/.

[lxxvi] International Energy Agency (IEA). "Electric car sales this year resist Covid-19's blow to global car market." 15 Jun. 2020, https://www.iea.org/news/electric-car-sales-this-year-resist-covid-19-s-blow-to-global-car-market.

[lxxvii] Parnell, John. "Europe's Demand for Electric Cars May Get a Jolt From COVID-19 Response." *Green Tech Media*, 3 Jul. 2020, https://www.greentechmedia.com/articles/read/covid-19-response-to-accelerate-european-ev-demand.

[lxxviii] Kupper, Daniel, et al. "The Future of Battery Production for Electric Vehicles." *Boston Consulting Group*, 11 Sept. 2018, https://www.bcg.com/en-us/publications/2018/future-battery-production-electric-vehicles.aspx ; Holland, Maximillian. "$100/kWh Tesla Battery Cells This Year, $100/kWh Tesla Battery Packs in 2020." *Clean Technica*, 9 Jul. 2018, https://cleantechnica.com/2018/06/09/100-kwh-tesla-battery-cells-this-year-100-kwh-tesla-battery-packs-in-2020/ ; Ganter, Rolf, Carl Berrisford, Kevin Dennean, and Sally Dessloch. "Longer Term Investments: Smart Mobility." *UBS*, 19 Oct. 2017, https://www.ubs.com/content/dam/WealthManagementAmericas/documents/smart-mobility.pdf ; Baik, Yeon, Russell Hensley, Patrick Hertzke, and Stefan Knupfer. "Making electric vehicles profitable." *McKinsey & Company*, 8 Mar. 2019, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable ; Muller, Joann. "How GM Plans To Bury Tesla With Onslaught Of Electric Vehicles That Will – Gasp! – Make A Profit." *Forbes*, 15 Nov. 2017, https://www.forbes.com/sites/joannmuller/2017/11/15/how-gm-plans-to-bury-tesla-with-onslaught-of-electric-vehicles-that-will-gasp-make-a-profit/#6f11652b2341 ; Ford. "Investor Day." 14 Sept. 2016, https://corporate.ford.com/content/dam/corporate/en/investors/investor-events/Press%20Releases/2016/september-2016-ford-investor-deck-for-web.pdf ; Lutsey, Nic, and Michael Nicholas. "Update on electric vehicle costs in the United States through 2030." *The International Council on Clean Transportation (ICCT)*, 2 Apr. 2019, https://www.theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf ; BloombergNEF. "Battery Pack Prices Fall As Market Ramps Up With Market Average At $156/kWh In 2019." 3 Dec. 2019, https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/ ; Mosquet, Xavier, Akash Arora, Alex Xie, and Matt Renner. "Who Will Drive Electric Cars to the Tipping Point?" *Boston Consulting Group*, 2 Jan. 2020, https://www.bcg.com/publications/2020/drive-electric-cars-to-the-tipping-point.

[lxxix] Spector, Julian. "Study: We're Still Underestimating Battery Cost Improvements." *Green Tech Media*, 17 Aug. 2017, https://www.greentechmedia.com/articles/read/were-still-underestimating-cost-improvements-for-batteries#gs.LiuymJmj ; BloombergNEF. "Battery Pack Prices Fall As Market Ramps Up With Market Average At $156/kWh In 2019." 3 Dec. 2019, https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/ ; Kupper, Daniel, et al. "The Future of Battery Production for Electric Vehicles." *Boston Consulting Group*, 11 Sept. 2018, https://www.bcg.com/en-us/publications/2018/future-battery-production-electric-vehicles.aspx ; Wu, Hao, Genevieve Alberts, and James Hooper. "Battery Electric Vehicles." *Deloitte*, Feb 2019 https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/manufacturing/deloitte-uk-battery-electric-vehicles.pdf?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top Ganter, Rolf, Carl Berrisford, Kevin Dennean, and Sally Dessloch. "Longer Term Investments: Smart Mobility." *UBS*, 19 Oct. 2017, https://www.ubs.com/content/dam/WealthManagementAmericas/documents/smart-mobility.pdf ; Baik, Yeon, Russell Hensley, Patrick Hertzke, and Stefan Knupfer. "Making electric vehicles profitable." *McKinsey & Company*, 8 Mar. 2019, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable ; Lutsey, Nic, and Michael Nicholas. "Update on electric vehicle costs in the United States through 2030." *The International Council on Clean Transportation (ICCT)*, 2 Apr. 2019, https://www.theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf.

[lxxx] Vaish, Esha. "Volvo expects electric car margins to match conventional vehicles by 2025." *Reuters*, 20 Mar. 2019, https://www.reuters.com/article/us-volvocars-electric-margins/volvo-expects-electric-car-margins-to-match-conventional-vehicles-by-2025-idUSKCN1R12DD?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenera.

[lxxxi] Iaconangelo, David. "'Stark' outlook for gasoline-powered cars – report." *EE News*, 15 May 2019, https://www.eenews.net/energywire/2019/05/15/stories/1060334183.

[lxxxii] National Renewable Energy Laboratory (NREL). "News Release: Research Determines Financial Benefit from Driving Electric Vehicles." 22 Jun. 2020, https://www.nrel.gov/news/press/2020/research-determines-financial-benefit-from-driving-electric-vehicles.html.

[lxxxiii] Lienert, Paul. "GM says it is 'almost there' on million-mile electric vehicle battery." *Reuters*, 19 May 2020, https://www.reuters.com/article/us-gm-batteries/gm-says-it-is-almost-there-on-million-mile-electric-vehicle-battery-idUSKBN22V2FS?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=top ; Chappell, Bill. "GM and LG Chem Plan $2.3 Billion Electric Battery Venture in Ohio." *NPR*, 5 Dec. 2019, https://www.npr.org/2019/12/05/785156805/gm-and-lg-chem-plan-2-3-billion-electric-battery-venture-in-ohio.

[lxxxiv] Szymkowski, Sean. "Tesla poised to reveal 'million-mile' battery as soon as this year, report says." *CNET Road Show*, 14 May 2020, https://www.cnet.com/roadshow/news/tesla-million-mile-battery-performance-charging/ ; Yamazaki, Makiko. "Exclusive: Panasonic aims to boost energy density in Tesla batteries by 20% - executive." *Reuters*, 30 July 2020, https://www.reuters.com/article/us-panasonic-tesla-exclusive/exclusive-panasonic-aims-to-boost-energy-density-in-tesla-batteries-by-20-executive-idUSKCN24V1GB ; Louli, A.J., et. al. "Diagnosing and correcting anode-free cell failure via electrolyte and morphological analysis." *Nature Energy*, 10 Aug. 2020, https://www.nature.com/articles/s41560-020-0668-8.

[lxxxv] Daimler. "High-volume battery supply supports "Electric First" strategy: Mercedes-Benz and CATL as a major supplier team up for leadership in future battery technology." 5 Aug. 2020, https://media.daimler.com/marsMediaSite/en/instance/ko/High-volume-battery-supply-supports-Electric-First-strategy-Mercedes-Benz-and-CATL-as-a-major-supplier-team-up-for-leadership-in-future-battery-technology.xhtml?rs=4&ls=L2VuL2luc3RhbmNlL2tvLnhodG1sP29pZD00ODM2MjU4JnJlbElkPTYwODI5JmZyb21PaWQ9NDgzNjI1OCZib3JkZXJzPXRydWUmcmVzdWx0SW5mb1R5cGVJZD00MDYyNiZ2aWV3VHlwZT10aHVtYnMmZnJvbUluZm9UeXBlSWQ9NDEwMTI!&oid=47008688.

[lxxxvi] Hydro-Quebec. "Hydro-Québec partners with Mercedes-Benz on Development of Solid-State Battery Technologies." 4 Feb. 2020, https://news.hydroquebec.com/press-releases/1580/hydro-quebec-partners-with-mercedes-benz-on-development-of-solid-state-battery-technologies/.

[lxxxvii] Georgia Tech Institute for Electronics and Nanotechnology. "Spontaneous Formation of Nanoscale Hollow Structures Could Boost Battery Storage." 13 Jun. 2020, http://dev.ien.gatech.edu/news/spontaneous-formation-nanoscale-hollow-structures-could-boost-battery-storage.