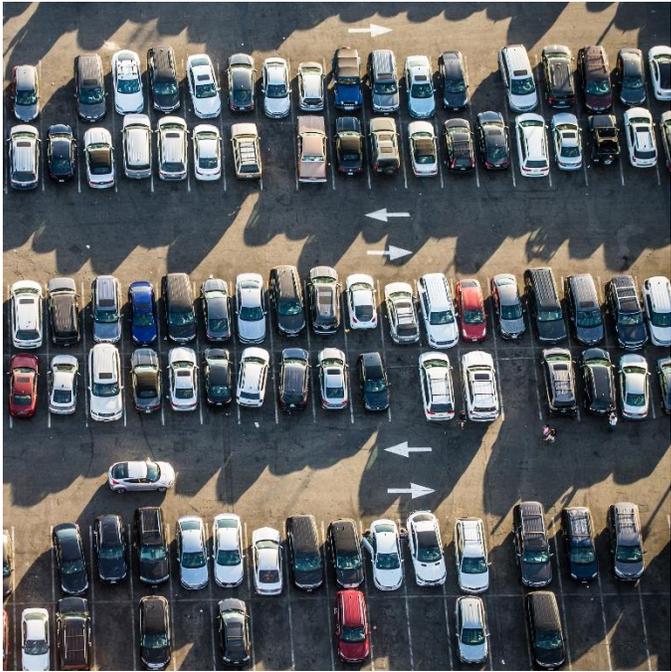


Electric Vehicle Market Status

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



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Acknowledgements

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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, 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).

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M.J. Bradley & Associates, LLC (MJB&A), founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies. Our multi-national client base includes electric and natural gas utilities, major transportation fleet operators, clean technology firms, environmental groups and government agencies. We bring insights to executives, operating managers, and advocates. We help you find opportunity in environmental markets, anticipate and respond smartly to changes in administrative law and policy at federal and state levels. We emphasize both vision and implementation and offer timely access to information along with ideas for using it to the best advantage.

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Executive Summary

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, 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 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 has said “GM believes in an all-electric future...GM is committed to driving usage and acceptance of electric vehicles...”ⁱ Similarly, in their 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.

Major findings include:

- Between 2019 and 2022, the number of battery electric (BEV) and plug-in hybrid (PHEV) models available to U.S. consumers will increase from 55 to 81. The range of vehicle types available will also increase to include sport utility vehicles (SUV), cross-overs, and pick-up trucks.
- By 2021 there will be at least five EV models available for under \$30,000 (MSRP) with a 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.
- 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.
- 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.

- Many brands are developing platforms that will exclusively cater to developing electric vehicles, like General Motors 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.
- The cost of battery packs has fallen dramatically, from approximately \$1,000/kilowatt-hour (kWh) in 2010 to approximately \$176/kWh in 2018. Most analysts project that battery pack prices will continue to fall, reaching \$100/kWh around 2025 and \$62-72/kWh by 2030. These projections have been endorsed by auto manufacturers.
- There is general industry consensus that EVs will reach price parity with ICE vehicles (based on total cost of ownership without considering any tax incentives) when battery pack prices fall below \$100/kWh. While some industry experts believe this could happen as early as 2021, most believe it will happen around 2025.

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

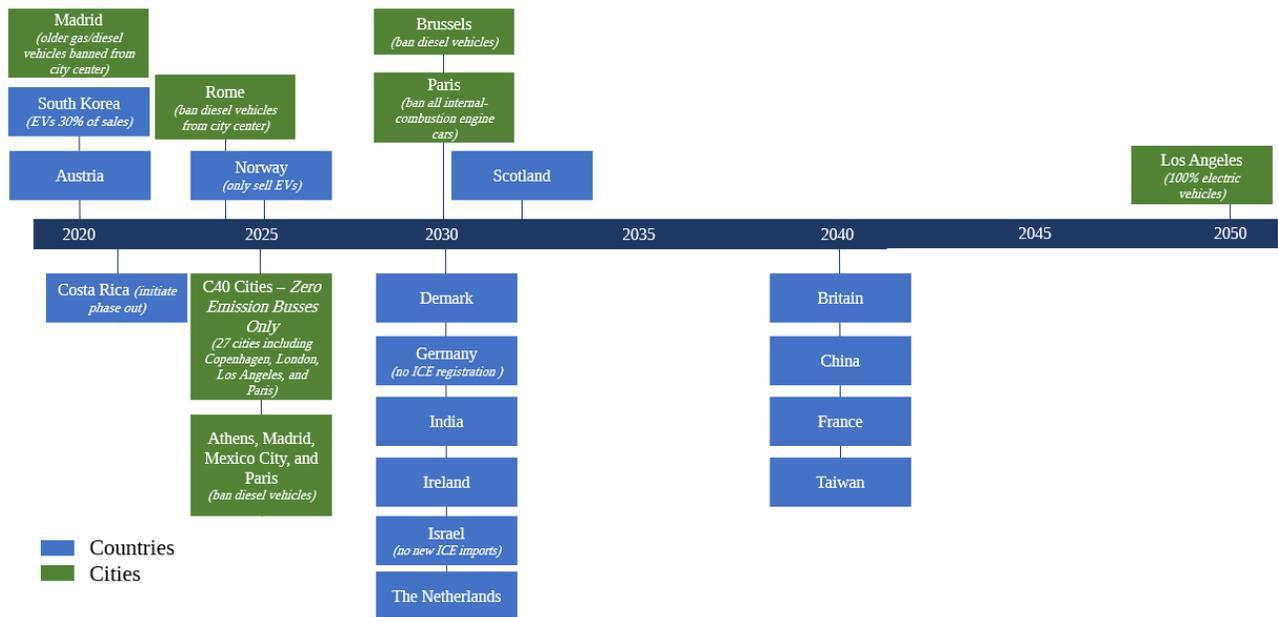
Around the world, a handful of countries have announced targets to end the sales of internal combustion engine (ICE) vehicles, ultimately hoping to transition to a cleaner, electrified transportation sector. European countries are leading this movement with Austria, Denmark, Ireland, Germany, France, 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 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 Council then turned their attention to setting the first-ever EU standards to reduce pollution from trucks.^{vii}

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.^{viii} 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.^{ix}

Globally, many cities are pledging deep decarbonization efforts as well. The Climate Mayors Electric Vehicle Purchasing Collaborative focuses on public fleet electrification, and the C40 Fossil Fuel Streets Declaration commits the 27 signatories to replacing their cities’ fossil fuel transit buses with electric alternatives by 2025 and to achieving zero-emissions in designated areas by 2030.^x 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 by 2030. 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 (Figure 1).^{xi} 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 Internal Combustion Vehicles

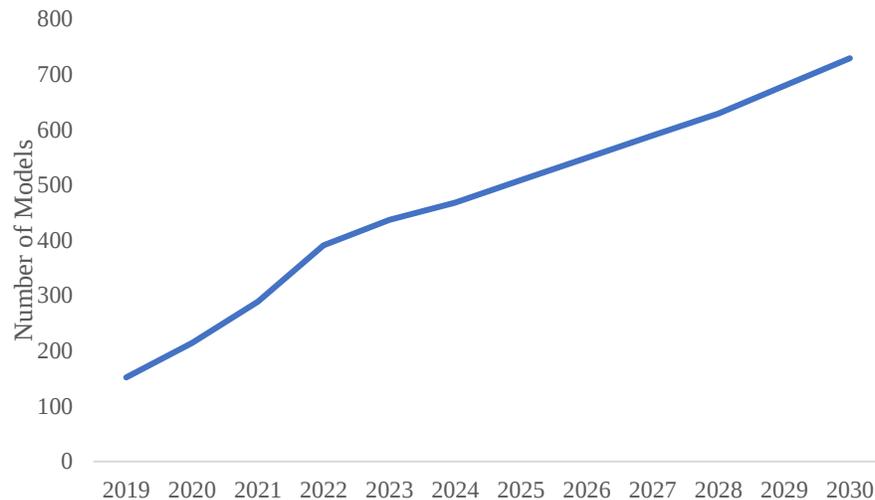


Countries have set goals targeting no new ICE vehicle sales unless otherwise indicated. Madrid aims to ban older gas (made prior to 2000) and diesel (made prior to 2006) vehicles by 2020 and join Athens, Mexico City, and Paris by banning all diesel vehicles by 2025. Paris aims to ban diesel vehicles 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.

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 700 EV models world-wide by 2030, almost five 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, Cadillac, Hyundai, Mercedes, Toyota, and VW.

Drivers of US Electric Vehicle Growth - ZEV Alliance

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 to enact policies that will ensure the deployment of 3.3 million ZEVs by 2025.^{xii} 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.¹ 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.”^{xiii}

As allowed by Section 177 of the Clean Air Act, all of 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.”^{xiv} This is reflected in the fact

¹ 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/>.

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.^{xv}

Manufacturer Commitments

In 2012 there were 13 battery electric (BEV) and plug-in hybrid (PHEV) models available in the U.S. The number of electrified models available in the U.S. is projected to reach 55 by the end of 2019 and 81 available models by the end of 2022 (Figure 3).² Based on these firm model announcements to date covering the short- and longer-term commitments and investment plans, many manufacturers have taken stances in support of an electric vehicle future:

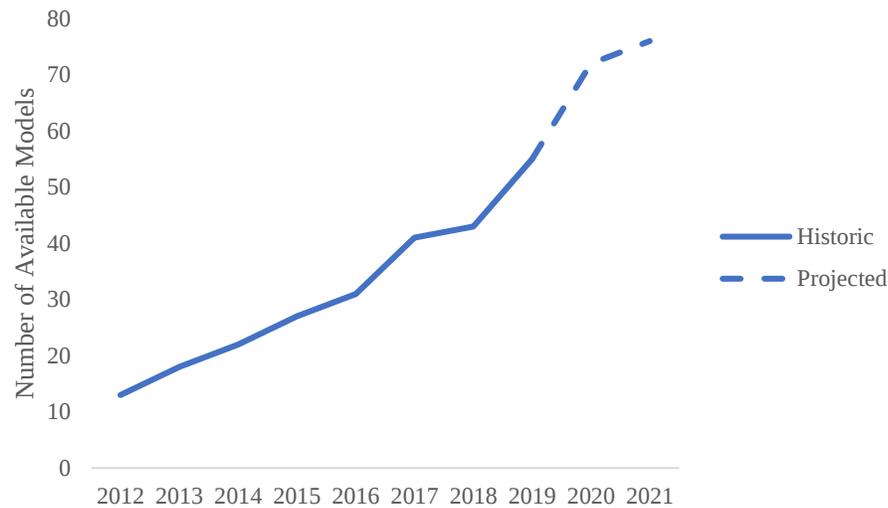
- In total, carmakers worldwide will spend more than \$135 billion through 2030 developing new electric models.³ For example, Ford, the leading brand in U.S. sales in 2017, has committed to spending \$11 billion on electrification in the five years between 2018 and 2022.^{xvi} In the five years between 2013 to 2017, Ford invested a total of \$34.9 billion in R&D.^{xvii} 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.
- A few companies have announced investments in American manufacturing plants that could benefit EV production: 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 to continue to produce existing ICE models as well as enable electrification of new Jeep models; Mercedes-Benz has committed \$1 billion to a plant in Tuscaloosa, Alabama, to set up production of EVs in the U.S.^{xviii} Audi anticipates nearly 30 percent of its U.S. customers will go electric by 2030.^{xix}
- Daimler plans to electrify the entire Mercedes-Benz portfolio by 2022.^{xx}
- 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.^{xxi}
- Ford has created Team Edison, a dedicated global EV organization “focused on bringing to market profitable, exciting electric vehicles and ownership experiences,” which will help bring some of the first PHEV and BEV pickup trucks to market.^{xxii} Ford has stated a goal of having sixteen fully electric vehicles 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.^{xxiii}
- General Motors (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.”^{xxiv} GM also announced plans to invest \$300 million in its plant in Michigan to manufacture a Chevrolet vehicle based on the battery-powered Bolt.

² 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.

³ \$125 billion corresponds to the seven announcements listed in Figure 1 in the Appendix: Audi, Daimler (Mercedes-Benz's announcement was not considered as it is owned by Daimler), FCA, Ford, Porsche, Toyota, and VW. 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.

Figure 3

Total PHEV and BEV U.S. Models Available by Year

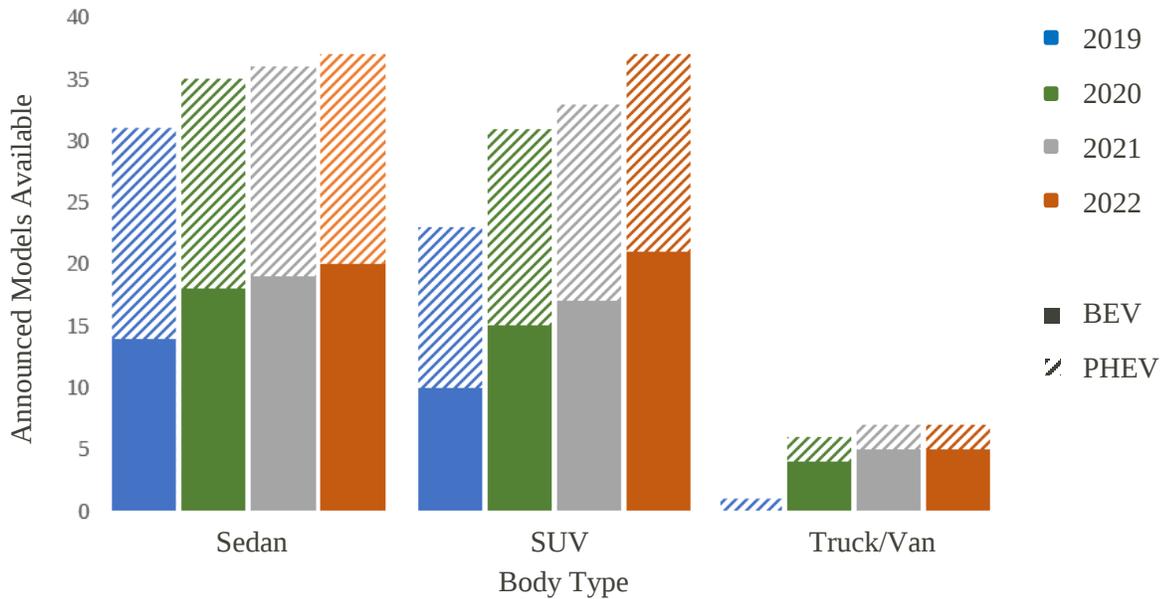


Source: 2012-2018, <https://insideevs.com/monthly-plug-in-sales-scorecard/>, 2019 models listed in the Appendix.

- Hyundai Motor Group has declared it hopes to become “one of the world’s top three EV manufacturers by 2025” through a dedicated EV platform.^{xxv}
- Porsche is offering Taycan owners 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.^{xxvi} Porsche pledged that by 2022 the company will “be investing more than six billion euros in electric mobility, and by 2025 50% of all new Porsche vehicles could have an electric drive system.”^{xxvii}
- Toyota Motor North America is collaborating with Kenworth Truck Company on zero-emission trucks powered by Toyota hydrogen fuel cell electric powertrains.^{xxviii}
- Volkswagen (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.”^{xxix}
- Ford and VW launched a global alliance to develop commercial vans and medium-sized pickups for global markets beginning as early as 2022. Additionally, the two signed a memorandum of understanding to investigate a collaboration on autonomous vehicles, mobility services, and EVs.^{xxx}
- Beyond automaker involvement, oil and gas giant Shell acquired Greenlots, an EV charging company, signaling potential increased investment in the EV realm from major oil and gas companies. According to Shell’s New Energies Executive Vice President, “it is a step towards making EV charging more accessible and more attractive to utilities, businesses and communities.”^{xxxi}
- Outside of the U.S. market, PSA group – the parent company of France’s two major automakers Peugeot and Citroen – will electrify 80 percent of its models by 2023.^{xxxii}

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 timeline of various manufacturer commitments, model introductions, and EV sales forecasts^{xxxiii}).

Figure 4 Cumulative Announced U.S. BEV and PHEV Models 2019-2022 by Body Type

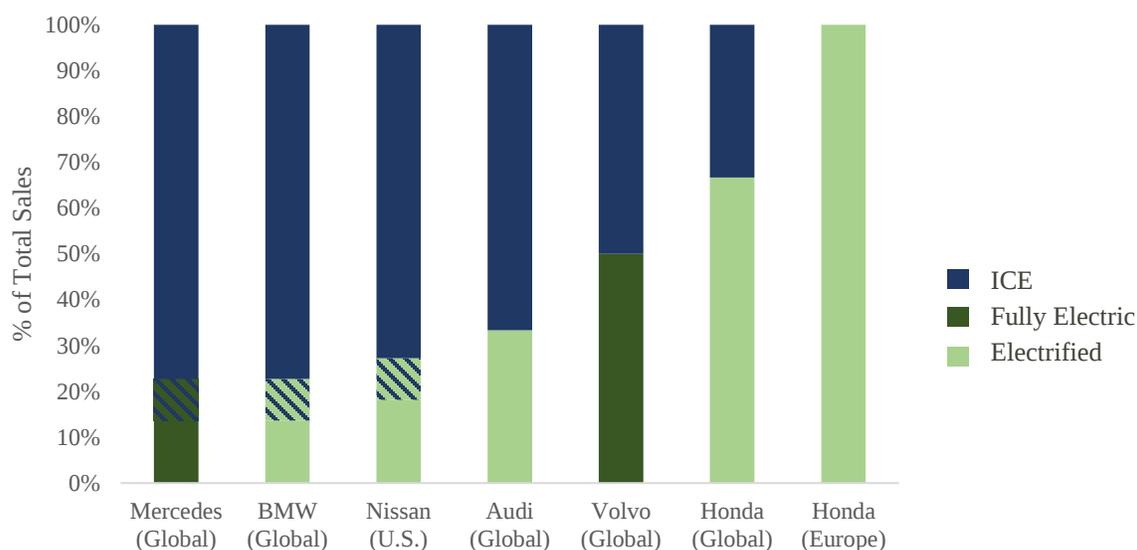


This figure only includes U.S. vehicles with an announced model name and model year introduction date and projected or announced purchase price less than \$100,000. A complete list of models included in this graph can be found in the Appendix.

Sales Forecast

According to analysts, global EV sales could rise from two million units in 2018 to 21 million in 2030.^{xxxiv} U.S. EV sales reflect these projections and have begun to accelerate in recent years, rising 26 percent in 2017 compared to 2016. The following year, sales grew 81 percent, amounting to 361,307 EVs sold in 2018.^{xxxv} While Tesla’s three models and the Toyota Prius Prime primarily contributed to this increase, many manufacturers are projecting that EVs will account for a significant share of their total sales by 2025, as illustrated in Figure 5.^{xxxvi} Audi, BMW, Mercedes Benz, and Volvo have all set global targets 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.”^{xxxvii}

Figure 5 Sales Forecast for 2025 by Manufacturer



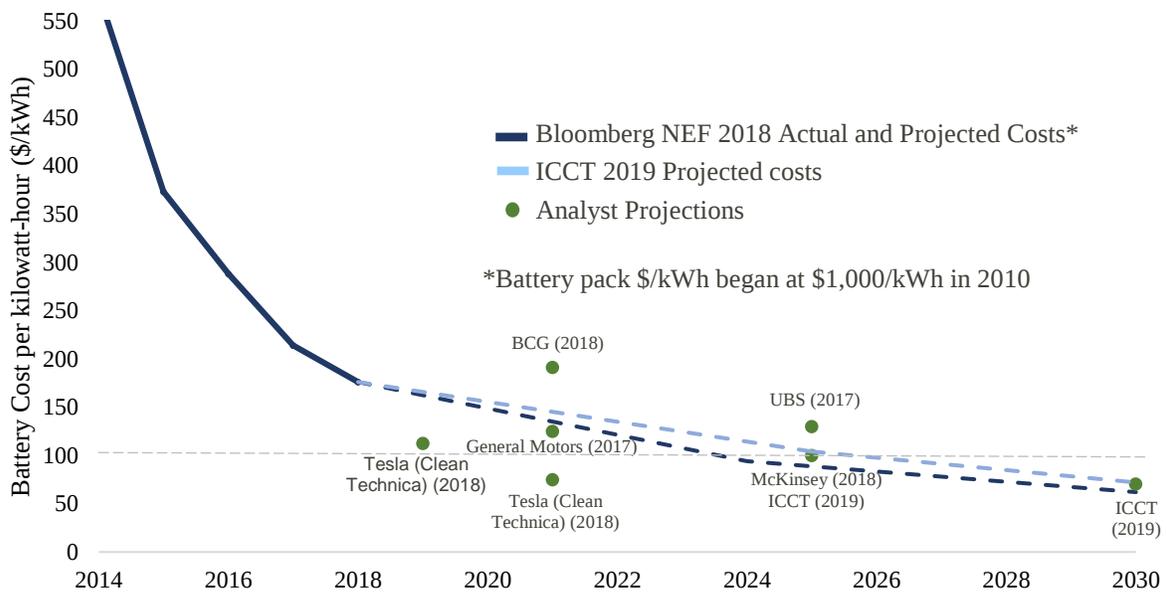
The hatched line represents a range given by the manufacturer (i.e., Mercedes expects that electrified models will make up 15 to 25 percent of sales in 2025). Electrified definitions: BMW models will have electrified drive trains, Nissan models will either be pure electric models or e-POWER powertrain 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 its sales. Audi, BMW, Mercedes, and Volvo have set global goals.

Battery Pack Cost Projections and EV Price Parity

For EVs to become cost competitive with internal combustion engine vehicles (without considering tax or other incentives or emissions externalities), virtually all analysts agree that battery pack prices must continue to drop from \$195/kWh in 2018 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 Figures 6^{xxxviii} and Figure 7^{xxxix}, most analysts agree that price parity between EVs and ICE vehicles will occur sometime between 2020 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.^{xl}

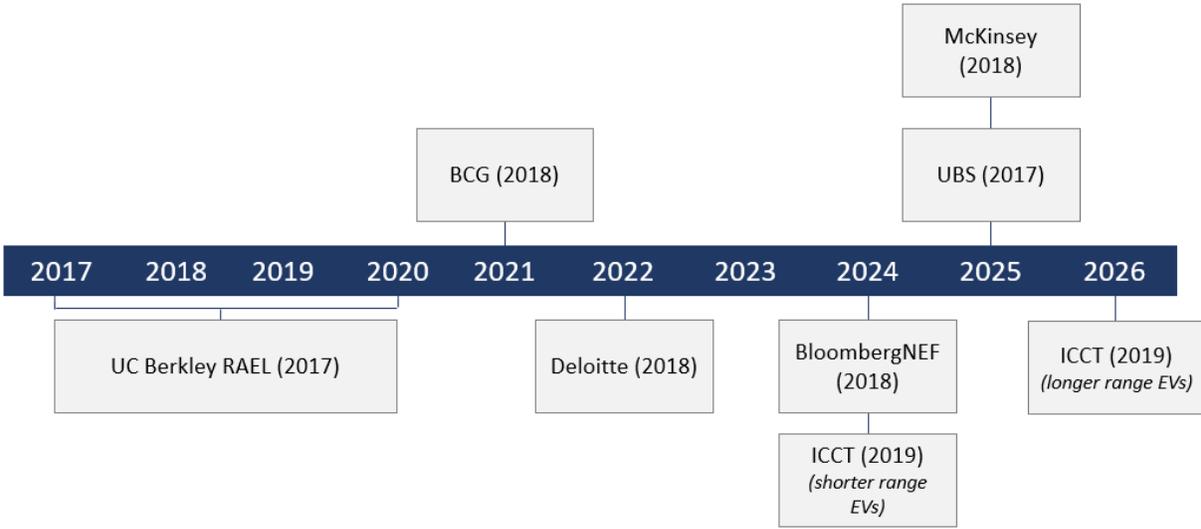
Figure 6 Actual and Projected Battery Pack Costs



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 7

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



Appendix – Manufacturer Commitments & Announced BEV and PHEV Models

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

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
						\$15.5 billion for electric mobility, digitization and AI		20 electrified models	800,000 EVs annually (1/3 total sales)				
								All model have electrified version					
		500,000 e-vehicles		5 BEV models				25 electrified models (at least 12 BEVs)	15-25% of sales are electric				
		\$22.5 billion battery cell purchase		Smart brand: only selling cars with electric systems in Europe/N. America		10 BEV models							
				Phase out all-diesel passenger car production in Europe		More than 30 electrified models (Jeep: at least 10 PHEV and 4 BEVs)							
						\$10.5 billion for electrification		40 electrified (16 BEV 24 PHEV)					
		\$300 million MI EV manufacturing plant		Cadillac will introduce new model every 6 months through 2021			20 all electric models		1 million EV units globally				

Green – Model announcements
 Orange – Investments (converted to USD\$) or acquisitions
 Blue – EV sales forecast

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

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
 HYUNDAI								44 electrified models					
 Mercedes-Benz		\$1 billion U.S. production plant			130 electrified variants			15-25% of new vehicles are electric					
 NISSAN		\$11 billion in fleet electrification, \$1.18 billion in battery tech			1 million electrified vehicles			Electrified vehicles make up 20-30% of US sales					
 PORSCHE		\$70 million DCFC investment at dealerships			\$6.7 billion in electrification			50% of new vehicles "could have an electric drive system"					
 TOYOTA			10 BEVs in early 2020s					Every model is dedicated electric or has electric option					\$13 billion for battery technology 5.5 million electrified vehicles (1 million BEV/FCEV)
 VW		\$50 billion in EV/autonomous vehicle development						80 electrified models (50 BEV) Up to 3 million EV sales annually					22 million e-cars produced Electric version for entire brand (300 models)
 VOLVO		Every future car will have electric motor		Invest 5% of annual revenue annually (~\$1 billion) in the next few years to develop and build EVs				BEVs make up 50% of sales					
		Acquired Freewire Technologies		Invested in Momentum Dynamics									

Model Announcements

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.

Manufacturer	Vehicle Type	EV type	Model Name	Planned Availability	Battery Size (kWh)	Range (miles)	Price (\$)
Audi	SUV	BEV	e-tron Premium Plus	2019	95	248	\$74,800
Audi	Sedan	PHEV	A3 sportback e-tron	2019	9	16	\$39,500
BMW	Sedan	PHEV	MINI Countryman	2019	7.6	12	\$36,900
BMW	Sedan	BEV	i3	2019	42.2	153	\$44,450
BMW	Sedan	PHEV	330e	2019	7.6	14	\$45,600
BMW	Sedan	PHEV	330e iPerformance	2019	12	37	\$46,595
BMW	Sedan	PHEV	i3 REX	2019	42.2	153	\$48,300
BMW	Sedan	PHEV	530e iPerformance	2019	9.2	28.5	\$53,400
BMW	SUV	PHEV	X5	2019	9	14	\$63,750
BMW	Sedan	PHEV	740e iPerformance	2019	9.2	28	\$91,250
BMW	SUV	PHEV	X5 xdrive 40e	2019	9	14	\$64,000
BMW	SUV	PHEV	X5 iPerformance	2020			\$63,750
BMW	SUV	BEV	iX3	2020	70	248	
BMW	Sedan	BEV	i4	2021	80	373	
BMW	SUV	BEV	Vision iNEXT	2021			
Bollinger	Truck/ Van	BEV	B1	2020	120	200	
Bollinger	Truck/ Van	BEV	B2	2020	120	200	
BYD	SUV	BEV	e6	2019	61	186	\$35,000
Byton	SUV	BEV	M-Byte (AI)	2020	71	250	\$45,000
Byton	Sedan	BEV	K-Byte (AI)	2020			
Cadillac	Sedan	PHEV	CT6	2019	18.4	31	\$75,095

Manufacturer	Vehicle Type	EV type	Model Name	Planned Availability	Battery Size (kWh)	Range (miles)	Price (\$)
Chevrolet	Sedan	BEV	Bolt	2019	60	238	\$36,620
Chrysler	Truck/ Van	PHEV	Pacifica Hybrid	2019	16	33	\$39,995
Chrysler	Truck/ Van	BEV	Portal	2020	100	250	
DS	SUV	BEV	DS 3 Crossback	2019	50	185	\$28,000
Fiat	Sedan	BEV	500e	2019	24	84	\$33,210
Ford	Sedan	BEV	Focus	2019	33.5	115	\$29,120
Ford	Sedan	PHEV	Fusion Energi	2019	9	26	\$34,595
Ford	SUV	PHEV	Escape	2020	14.4	30	\$25,200
Ford	SUV	BEV	Mach 1	2020		300	<\$40,000
Ford	Truck/ Van	PHEV	Hybrid F150	2020			
Ford	Truck/ Van	BEV	F 150	2021			
Honda	Sedan	PHEV	Clarity	2019	17	48	\$33,400
Honda	Sedan	BEV	Clarity EV	2019	22.5	89	(lease only)
Hyundai	Sedan	PHEV	IONIQ Plug-In Hybrid	2019	8.9	29	\$29,350
Hyundai	Sedan	BEV	IONIQ Electric	2019	28	124	\$30,315
Hyundai	Sedan	PHEV	Sonata	2019	9.8	28	\$33,400
Hyundai	SUV	BEV	Kona Electric	2019	64	258	\$37,495
Jaguar	SUV	BEV	I-Pace	2019	90	234	\$69,500
Jaguar	Sedan	BEV	XJ	2019		300	
Jeep	SUV	PHEV	Wrangler	2020			
Kia	SUV	BEV	Niro	2019	64	239	\$37,495
Kia	SUV	PHEV	Niro	2019	8.9	26	\$28,200
Kia	SUV	BEV	Soul EV	2019	30	111	\$36,495
Kia	Sedan	PHEV	Optima	2019	9.8	29	\$35,390
Land Rover	SUV	PHEV	Range Rover Sport	2019	13.1	31	\$78,600
Land Rover	SUV	PHEV	Land Rover	2019	13.1	31	\$78,600
Lincoln	SUV	PHEV	Aviator	2019			\$88,895
Lucid Motors	Sedan	BEV	Air	2020		400	\$60,000

Manufacturer	Vehicle Type	EV type	Model Name	Planned Availability	Battery Size (kWh)	Range (miles)	Price (\$)
Mercedes Benz	Sedan	PHEV	C350e	2019	6.4	9	\$47,900
Mercedes Benz	SUV	PHEV	GLC350e	2019	8.7	15	\$50,650
Mercedes Benz	SUV	BEV	EQC 400	2019	80	279	\$75,000
Mercedes Benz	SUV	PHEV	GLE550e	2019	9	10	\$67,000
Mitsubishi	SUV	PHEV	Outlander	2019	12	22	\$34,595
Nissan	Sedan	BEV	Leaf	2019	40	150	\$29,990
Nissan	Sedan	BEV	Leaf E-Plus	2019	60	220	\$37,445
Porsche	Sedan	BEV	Taycan	2019	90	300	\$75,000
Porsche	SUV	PHEV	Cayenne	2019	14	27	\$79,900
Porsche	SUV	BEV	Macan	2022			
Rivian	Truck/Van	BEV	R1T	2020	105	250	\$69,000
Rivian	SUV	BEV	R1S	2021	105	240	\$72,500
SMART	Sedan	BEV	Smart ForTwo	2019	17.6	57	\$23,900
Subaru	SUV	PHEV	Crosstrek	2019	8.8	17	\$34,995
Tesla	Sedan	BEV	Model 3	2019	50	220	\$35,000
Tesla	Sedan	BEV	Model S 75D	2019		259	\$75,700
Tesla	SUV	BEV	Model X 75D	2019		238	\$79,500
Tesla	SUV	BEV	Model Y	2020			\$40,000
Toyota	Sedan	PHEV	Prius Prime	2019	8.8	25	\$27,100
Volkswagen	Sedan	BEV	e-Golf	2019	35.8	125	\$30,495
Volkswagen	Sedan	BEV	I.D.	2020	48	205	\$29,400
Volkswagen	SUV	BEV	I.D. Crozz	2020	83	300	
Volkswagen	Sedan	BEV	I.D. Vizzion	2022	111	400	
Volkswagen	SUV	BEV	I.D. Buzz	2022	111	270	
Volkswagen	SUV	BEV	I.D. Buzz Cargo	2022	111	205	
Volvo	SUV	BEV	XC40 EV	2019		310	\$50,000
Volvo	SUV	PHEV	XC60	2019	10.4	18	\$52,900

Manufacturer	Vehicle Type	EV type	Model Name	Planned Availability	Battery Size (kWh)	Range (miles)	Price (\$)
Volvo	Sedan	PHEV	S60 T8 (Polestar)	2019	10.4	21	\$54,400
Volvo	Sedan	PHEV	S90	2019	10.4	21	\$63,650
Volvo	SUV	PHEV	XC90	2019	10.4	19	\$64,950
Volvo	Sedan	BEV	Polestar 2	2020		350	\$45,600
Volvo	SUV	BEV	XC90	2022			

Figure 2A

Price-Range Matrix: BEV Models Available in 2021

		Price (\$)			
		0-30,000	30,000-40,000	40,000 – 70,000	70,000+
Range (Miles)	0-150	Smart For Two Ford Focus	Fiat 500e Kia Soul EV Huyundai IONIQ Volkswagen e-Golf		
	150-250	DS 3 Crossback Volkswagen I.D. Nissan Leaf	Kia Niro EV BYD 36 Nissan Leaf e-plus Chevrolet Bolt Tesla Model 3	BMW i3 Jaguar I-Pace	Audi e-tron Rivian R1S
	250+		Hyundai Kona Electric	Byton M-Byte Rivian R1T Volvo Polestar 2 Volvo XC 40 Lucid Air	Mercedes EQC 400 Porsche Taycan Tesla Model S Tesla Model X

Note: There are more models announced through 2021 but some have not announced both the range and the price and were therefore not included in the matrix. Only includes models with announced purchase price less than \$100,000 and does not include any federal or state tax incentives.

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