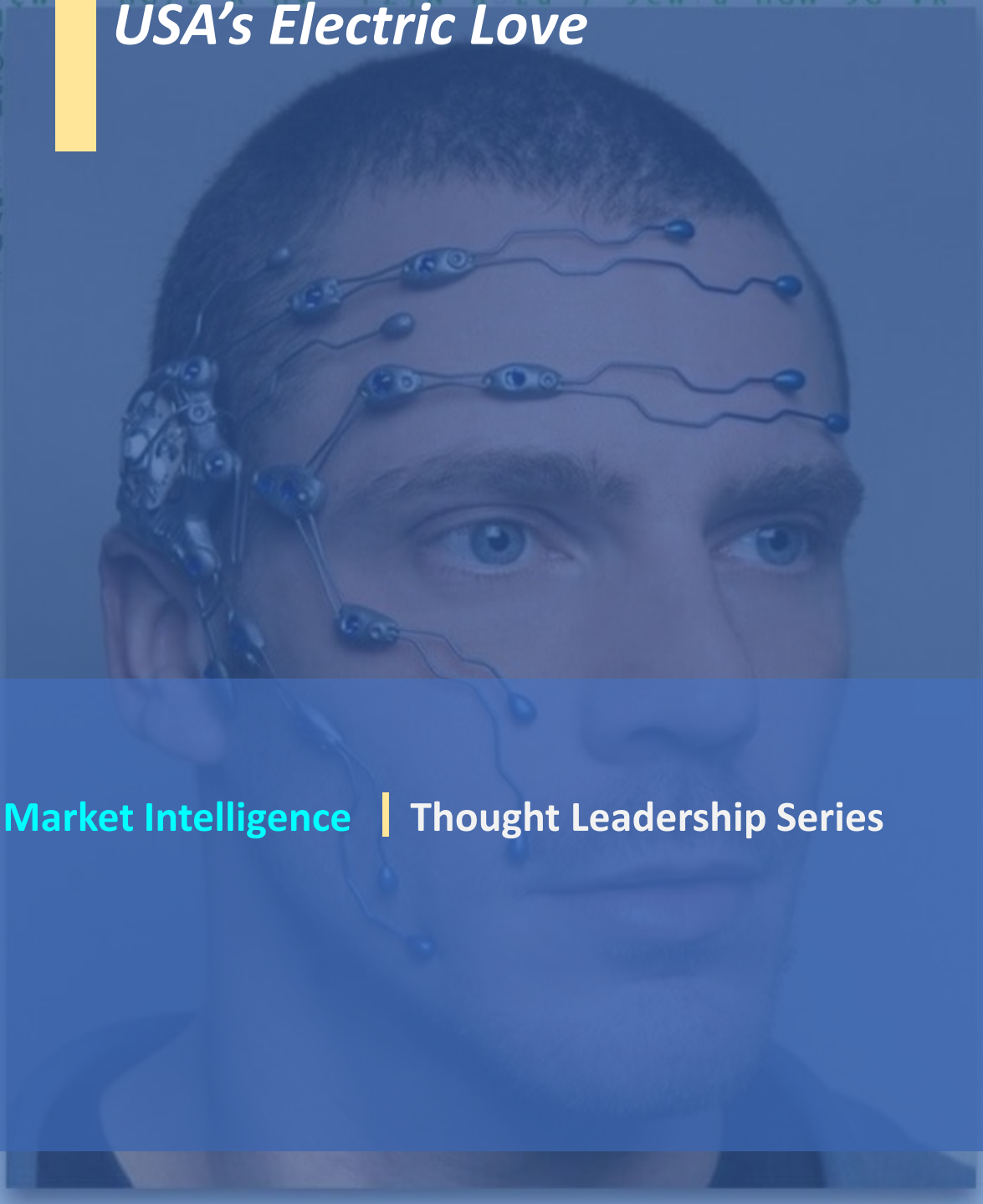
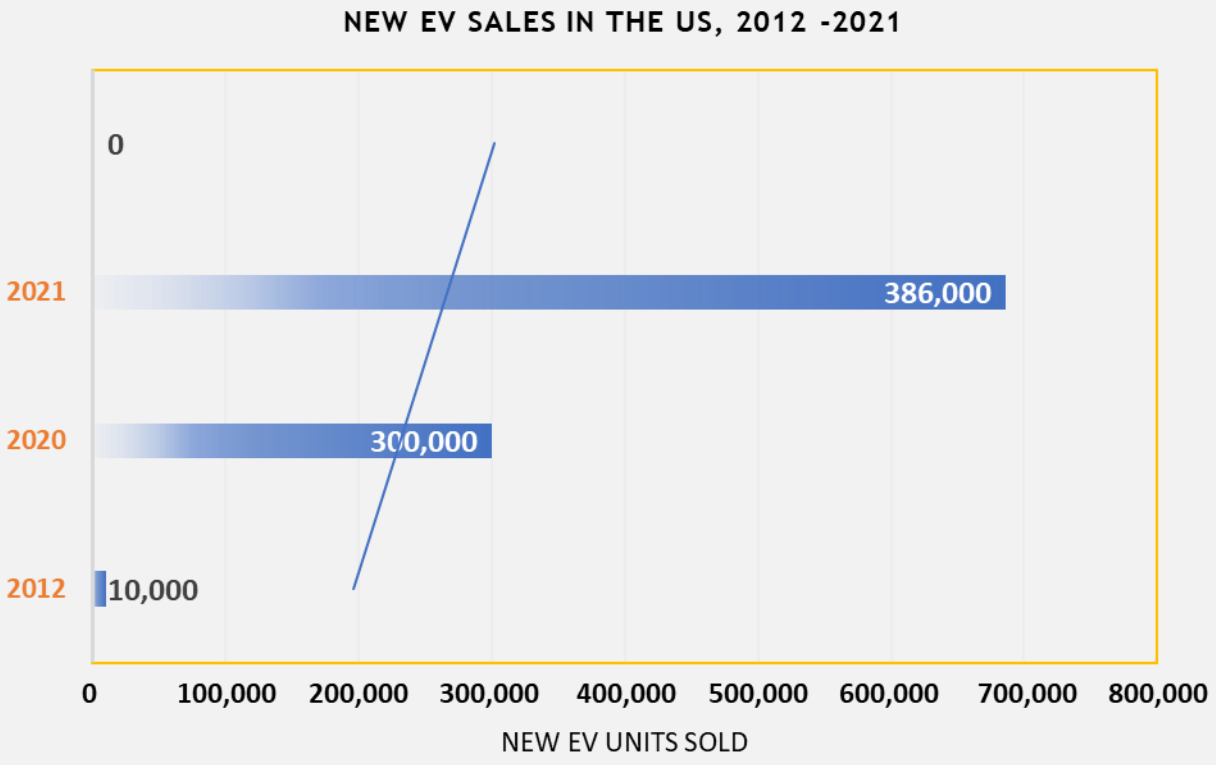
USA's Electric Love



Market Intelligence | Thought Leadership Series

EVs show strong growth in the US

Hardly 10,000 fully electric vehicles (EVs) were sold in the entire US in 2012. The country has come a long way since then as a battery electric vehicle (BEV) market, with 400,000 such vehicles sold in 2021, up from 300,000 the previous year. Include the sales numbers for plug-in hybrid electric vehicles (PHEVs) and the total sales for 2021 will cross 6.8 million units. No surprise, California, the most populous and wealthiest state, accounted for nearly 34% of all BEVs and PHEVs sold in 2021, followed by Florida (7%), New York (5%), Texas (5%), and New Jersey (4%). The top 18 states that sold a minimum of 10,000 vehicles each accounted for nearly 84% of the 6 million+ vehicles sold.



The EV landscape

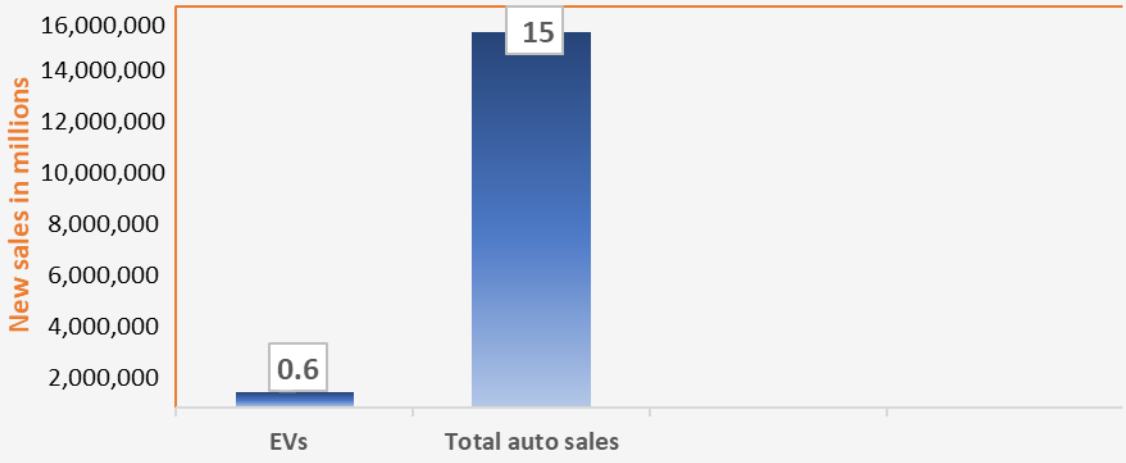
In all, 15 million new vehicles, including 3.3 million cars and 11.7 million SUVs and light-duty trucks, were reportedly sold in the US for all of 2021; BEVs, PHEVs, HCEVs taken together represented a little more than 4% of total new auto sales during the year. By 2035, nearly 44% of new car sales in the US could be electric, as per industry projections. President Joe Biden is working on an ambitious goal to make half of all new vehicles sold in 2030 electric, and that would include BEVs, PHEVs, and HCEVs. If the electrification agenda continues apace, by 2050, around half of the cars zooming along US roads are going to be electric!

Which US states sold the most EVs in 2021?

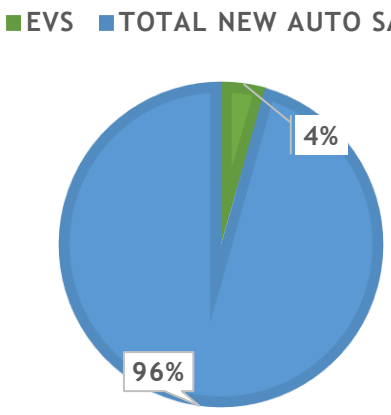
State	EVs sold (new and used)	Total	As a % of total US EV sales in 2021
California	219,800	549,100	84%
Florida	45,700		
New York	35,500		
Texas	35,200		
New Jersey	26,000		
Washington	20,800		
Massachusetts	16,900		
Illinois	16,100		
Colorado	16,000		
Arizona	14,900		
Pennsylvania	14,600		
Virginia	14,500		
Maryland	13,900		
Georgia	12,800		
Oregon	12,800		
N. Carolina	12,700		
Michigan	10,500		
Ohio	10,400		
Rest of the US states (which sold less than 10,000 units each)	98,000	98,000	15%
	647,100	647,100	100%

As in September 2022, electric vehicles accounted for close to 1% of the estimated 290 million cars, SUVs, and light-duty trucks on American roads. HCEVs numbered 15,000.

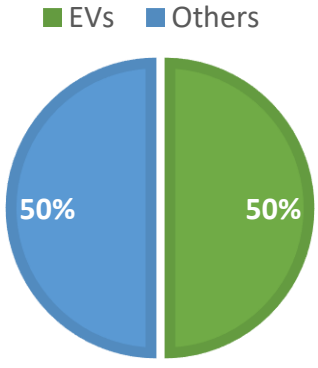
NEW EV SALES IN THE US IN MILLIONS (2021)



PERCENTAGE OF EV IN NEW AUTO SALES IN THE US (2021)

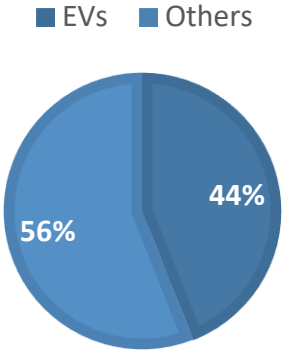


PROJECTED SHARE OF EVs IN NEW PASSENGER VEHICLES SALES IN THE US (2030)*



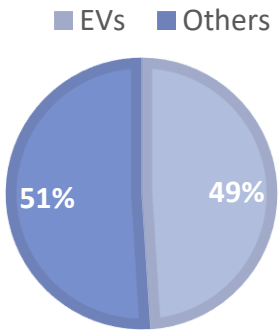
*This is a non-binding goal set by the US President

PROJECTED SHARE OF EVs IN NEW AUTO SALES IN THE US (2035)

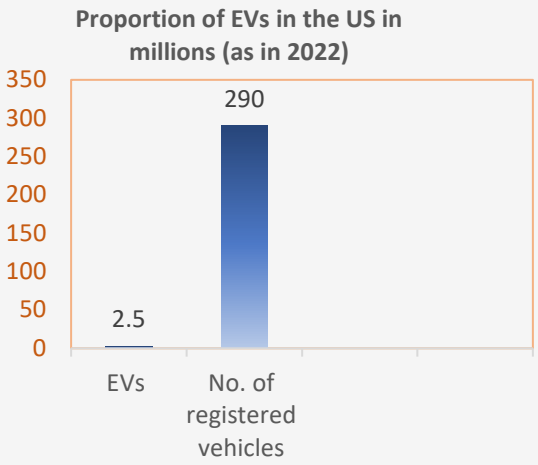


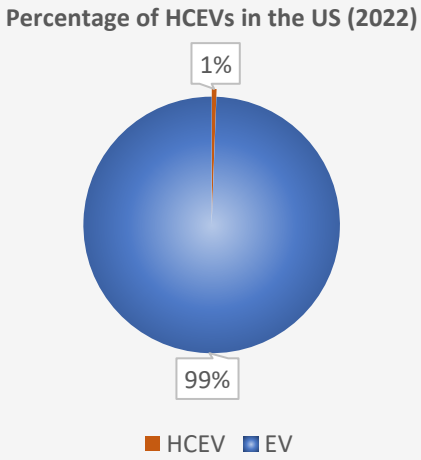
*This is an industry projection

PROJECTED SHARE OF EVs ON AMERICAN ROADS (2050)



*This is an industry projection

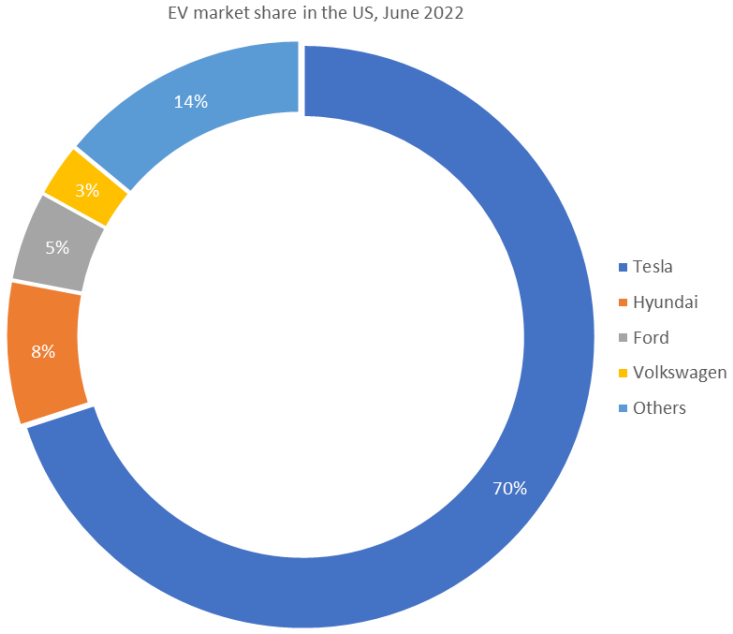




Tesla v. the rest

Tesla is to electric cars as Apple is to smartphones. Tesla dominates the US electric vehicle market with a 70% share as in June 2022. The Austin, Texas-based automotive and renewable energy company, with US$840 billion in market cap, has left all of its competitors in the dust, literally! The closest competitor, Hyundai held an 8% share, followed by Ford and Volkswagen with 5% and 3% respectively.

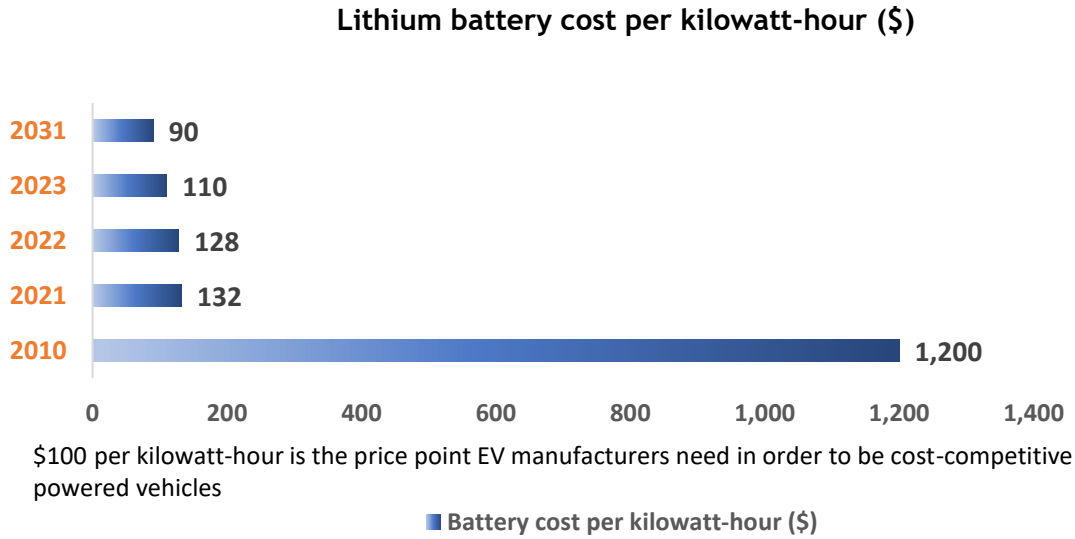
After a lot of initial dithering, many of the leading producers of fossil fuel vehicles now have a toehold in the EV circuit, which is an important face-saving point for them. However, big carmakers are still struggling to wrench themselves away from fossil fuels, their mainstay so far. Their electrification plans are also far from clear. Meanwhile, many pure-play EV businesses, free of any fossil fuel baggage from the past, are vying for a share of the EV pie.



Automaker	Timeline committed for fossil fuel phaseout / electric vehicle plans
Ford, GM, Mercedes, Volvo	Fossil fuel vehicles to be phased out in leading markets by 2035 and worldwide by 2040
Nissan	No timeline committed; half a dozen electric cars to be rolled out by end of 2023
Toyota	No timeline committed; at least a dozen all-electric vehicles to be introduced by 2025
BMW	No timeline committed; 2 million fully electric vehicles to be delivered by end of 2025
Honda	By 2030, two out of every 5 cars sold in N. America are going to be either electric or hydrogen powered; all gasoline cars to be phased out by 2040
Volkswagen	No timeline committed; 50% of US car sales will be electric by 2030
Hyundai	No timeline committed; a fifth of all cars sold in the US will be electric by 2025

What's driving EV adoption?

Factors influencing EV adoption include a dramatic drop in lithium battery prices on an annual basis from a high of $1,200 per kilowatt-hour – kWh - (2010) to $132 per kWh (2021) and further down to $128 per kWh (2022). Battery prices might stay a bit elevated in the near term because of a shortfall of nearly 26,000 tonnes in global lithium supplies. Eventually, per kWh battery price will likely stabilize around $80-$90 by 2031.



$100 per kilowatt-hour is the price point EV manufacturers need in order to be cost-competitive with gas-powered vehicles

Price / performance trade-off

Typically, electric vehicles carry a higher price tag compared to traditional vehicles in the same category. However, the higher upfront cost of the electric vehicle is more than offset by the lower cost of fuel and maintenance over the period of ownership of the vehicle (total cost of ownership). Apart from the differential pricing of fuels (electricity v. gasoline/diesel), electric vehicles don't need oil changes, air filter replacements, as well as routine engine maintenance like gasoline or diesel vehicles. The short answer to this is that electric motor and components that deliver power to the drive wheels have fewer "moving parts."

Comparison shopping	EV	Gasoline car
Model	Tesla Model Y	2022 Toyota Camry (LE)
Mileage	300-320 miles on a single charge; Cost to fully charge comes out to $13.16 (Aug 2022)	28-35 miles per gallon; Average per gallon gasoline price works out to $4.49 (Sept 2022)
Features	All-wheel drive, dual motor, 82kWh battery	All-wheel drive, 4-cylinder, 2.5L, automatic (S8)
Max. speed	150 mph	130 mph
Capacity	Up to 7 passengers plus cargo	Up to 5 passengers plus cargo
Cost per mile	$0.04 per mile	$0.11-0.16 per mile
Price	$65,990 (Sept 2022)	$25,850-$28,000 (March 2022)
Sales performance	Best-selling EV in 2022 first quarter	Best-selling gasoline car in 2022 first quarter

EV manufacturer	Vehicle type	Price range
Tesla (Austin, Texas)	Electric sedan, compact executive car, midsize luxury crossover SUV, 5-seater SUV	$48,500-$300,000
Rivian (Irvine, California)	Electric adventure vehicle, pickup truck	$73,000-$78,000
Nikola (Phoenix, Arizona)	Battery/hydrogen-powered trucks	$120,000-$150,000
Ford (Dearborn, Michigan)	Full hybrid pickup truck, plug-in hybrid SUV, all-electric truck, all-electric compact cross-over SUV, all-electric transit van, hybrid SUV	$22,200-$52,000
Ztractor (Palo Alto, California)	Autonomous small and heavy-duty electric tractors	Starting $42,000
Lucid Motors (Newark, California)	Luxury electric cars	Starting $87,400
Rad Power Bikes (Seattle, Washington)	Electric bikes	$1,200-$1,600
Canoo (Justin, Texas)	Fully electric lifestyle vehicle, multi-purpose delivery vehicle, all-electric pickup truck, electric skateboard platform	$34,800-$50,000
Levy Electric (New York City)	Electric foldable scooters	$450-$700
Proterra (Burlingame, California)	Electric transit bus	$90,000-$290,000
Faraday Future (Gardena, California)	Electric crossover	$200,000 (In production as in September 2022)
GM / Chevrolet (Detroit, Michigan)	Fully electric sub-compact all-electric hatchback, pickup; upcoming - electric truck, SUV, autonomous vehicle	$31,500-$79,900
Nissan (Franklin, Tennessee)	Fully electric hatchback; electric crossover SUV (expected in November/December 2022)	$28,000-$61,500
Toyota (Plano, Texas)	Full-size hybrid SUV, plug-in hybrid, plug-in hybrid lift back, hybrid 5-seater sedan, hybrid SUV, hybrid mid-size crossover SUV, hybrid 4-door luxury sedan, plug-in compact crossover SUV, all-electric compact crossover SUV, hybrid full-size pickup truck, fuel cell electric vehicle, hybrid minivan	$22,800-$58,300
Chrysler (Auburn Hills, Michigan)	Plug-in hybrid minivan; all electric crossover (announced in April 2022)	$46,760-$55,000

EV manufacturer	Vehicle type	Price range
BMW (Woodcliff Lake, New Jersey)	All-electric sports activity vehicle, sedan, luxury sedan; plug-in hybrids - sports activity vehicle, sports sedan, executive sedan, high performance SUV	$84,100 -$159, 900
Honda (Torrance, California)	Hybrid 5-seater sedan, hybrid SUV; fully electric SUV (arriving in 2024)	$26,700-$45,000
Volkswagen (Herndon, Virginia)	All-electric SUV (Vehicles are expected to reach US dealerships in October 2022); all-electric van (coming to US in 2023)	$37,500-$55,000
Hyundai (Fountain Valley, California)	Electric SUV, compact hybrid SUV, compact plug-in hybrid, 5-passenger hybrid SUV, 5-passenger plug-in hybrid SUV, electric SUV, hydrogen fuel cell SUV, compact hybrid sedan, hybrid sedan, electric sedan (coming 2023)	$24,400-$59,400
Jaguar (Manhattan, New Jersey)	All-electric SUV	$71,300
Fisker (Manhattan Beach, California)	Electric SUV	$39,000-$70,500
Hyzon Motors (Mendon, New York)	Commercial fuel cell heavy-duty truck, high-floor coach, bus, refuse collection vehicle	Starting $139,000
Lordstown Motors (Lordstown, Ohio)	Electric pickup truck (the company aims to build 50 such trucks by end of 2022)	$52,500
Cenntro Electric Group Limited (Freehold, New Jersey)	Class 4 truck, class N1 van, multi-purpose light van, multipurpose L7E electric truck, off-road-only utility task vehicle	Data not available
Mullen Technologies (Brea, California)	Class 1 cargo van, class 2 cargo van, premium compact SUV, urban commercial delivery vehicle (designed for narrow European streets); electric high-performance sports car (in production as in October 2022)	12,000 - $149,000
Xos Trucks (Los Angeles, California)	Electric class 5 to 6 medium duty trucks, class 7-8 heavy duty trucks, fully electric class 5/6 delivery van	Data not available
Arcimoto (Eugene, Oregon)	Fun utility vehicle, local delivery vehicle, rapid responder; pickup truck, camera vehicle, tilting trike (all three are in production)	Starting $17,900
B—ON, formerly Odin Automotive (Luxembourg)	Electric van	$42,400

Lower lifecycle emissions

Both gasoline and diesel vehicles spew, in varying degrees, significant amounts of hydrocarbons, carbon monoxide, carbon dioxide, nitrogen oxides, and microscopic solid/liquid droplets ("particulate matter"). The C02 emissions from fossil fuel (coal, oil, gas) combustion, along with other greenhouse gases (methane, methane nitrous oxide, hydrofluorocarbons, and ozone), trap the sun's heat in the earth's lower atmosphere like a blanket. As a result, the earth is warming faster than ever before, and temperature and weather patterns are changing almost whimsically. Left unchecked, this climate change could cause polar ice sheets to melt and, in the process, swell sea levels and cause coastal flooding. Suffice to say that climate change might potentially put all life on this planet at risk. Reducing the output of CO2 into the atmosphere (decarbonisation) by pulling away from fossil fuels toward cleaner ones (such as electricity) has become a bare necessity for humankind.

Broadly speaking, BEVs and PHEVs, when running in all-electric mode, produce zero tailpipe emissions. There could be negligible amounts of evaporative emission of gasoline from the fuel tanks of PHEVs. HEVs do release tailpipe emissions, but lower than comparable gasoline or diesel vehicles. FCEVs, for their part, only emit water vapor and warm air. Of course, the electricity used to power up EVs might emit carbon pollution if coal, natural gas, or other non-renewable resources are burnt to generate it. Even after factoring these carbon emissions, research indicates that greenhouse gas discharges associated with a typical EV are lower than those from an average gasoline car. There's something more about the EV that endears it to decarbonization enthusiasts. A typical EV is associated with lower levels of greenhouse gas emissions over its entire life cycle, from manufacturing to charging and driving, than a gasoline car in the same class.

Climate commitments

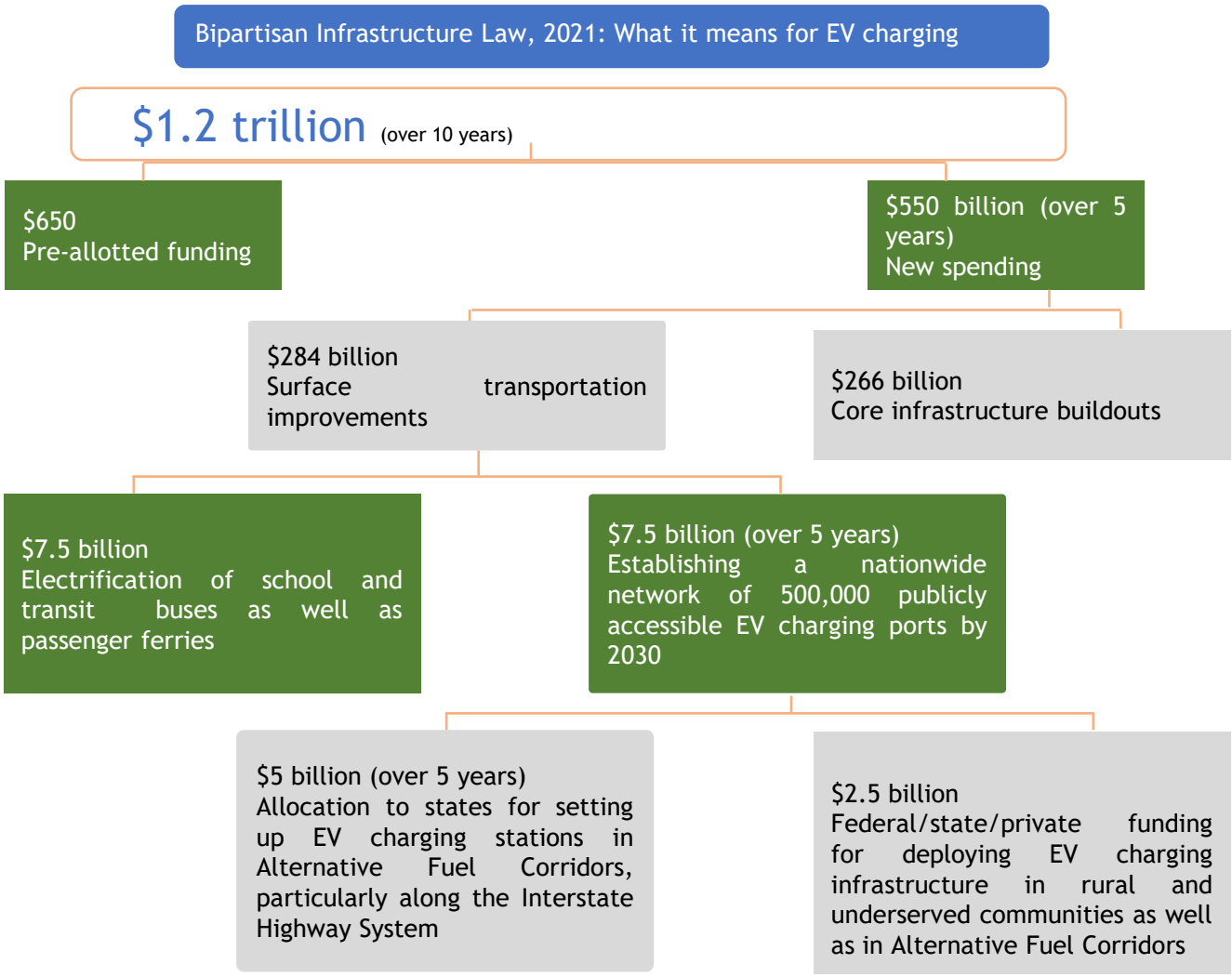
More recently, in an all-out bid to address the climate crisis, the US has set the goal of reducing the federal government's greenhouse emissions by 65% by 2030. The ambitious vision for the US is to turn into a net-zero contributor of greenhouse gases no later than 2050, a commitment it made in November 2021. Among other things, the White House plans to transform the federal fleet of 600,000 cars and trucks. All acquisitions of cars and trucks from 2035 will be 100 percent zero-emission versions. The same applies to light-duty vehicle acquisitions, albeit from 2027. New cars will be required to emit 10% less greenhouse emissions compared to the previous year. The rule, which takes effect from 2023, calls for vehicles to progressively cut emissions by 5% every year until 2026. Meanwhile, California, noted for defining America's car culture for decades, has ruled that it will ban the sale of new gasoline-powered passenger cars and trucks in the state in 2035. This effectively forces the arms of auto makers to speed the production of cleaner vehicles by 2026.

Meanwhile, as part of the clean energy push, the latest federal rules require new light-duty vehicles (e.g., cars, SUVs, vans, light-duty trucks) sold in the US to average no less than 40 miles per gallon (mpg) of gasoline in real-world driving by 2026. The new requirement reverses the prevailing 28 mpg standard enacted by the Trump administration. The National Highway Traffic Safety Administration's latest fuel economy requirements, the strongest so far, aim to cut gasoline consumption by more than 200 billion gallons through 2050. Manufacturers must increase gas mileage for new vehicles by 8% per year in 2024 and 2025 and 10% in 2026, the model year.

Detroit's Big Three – GM, Ford, and Chrysler (now a subsidiary of Stellantis, Amsterdam) reportedly have issues meeting the tightened fuel economy standards by 2026, a market scenario that Tesla and other EV makers can potentially derive mileage from.

Tax credits and incentives

Massive funding and incentives announced by the federal administration are expected to supercharge America's electric future like never before. The Bipartisan Infrastructure Law (BIL) inked into law in November 2021 has earmarked $7.5 billion for setting up a convenient and accessible national EV charging network, comprising 500,000 charging ports by 2030. Under the plan, all fifty states will get $5 billion, over five years, to build out the EV charging network in alternative fuel corridors, particularly along interstate highways. The remaining $2.5 billion of federal, state, and private funding will ensure the charger deployment meets the administration's commitment to making EV charging more accessible and fairer for everyone, including rural, underserved, and poorer communities. Billed as the largest-ever US investment in EV charging, the network aims to make electric vehicle charging accessible to all Americans. The Build Back Better Act, also passed in November 2021, allocated $7.5 billion for the purchase of electric buses as well as electrification of existing school and transit buses.



Inflation Reduction Act, 2022
• Tax credit of up to $7,500 for buyers of all-electric cars and hybrid plugs until 2032 • A maximum tax credit of up to $4,000 for buyers of used all-electric cars and hybrid plugs until 2032 Which vehicles are eligible? • Only vehicles a certain portion of whose battery components are made or assembled in N. America qualify for full or partial tax credit • In order to access the credits, certain battery materials should be extracted or sourced from N. America or countries with free trade agreements with the US • Sedans worth up to $55,000 are eligible • SUVs and trucks priced not more than $80,000 are eligible Who qualifies for the tax credit? • Single tax filers with modified adjusted gross income of up to $150,000 • Married couples with joint income not exceeding $300,000 • An individual filing tax as "head of household" with income not exceeding $225,000

The Inflation Reduction Act (August 2022), an amendment to the Build Back Better Act, proposes to lower the upfront cost of buying an all-electric or hybrid vehicle by way of tax credits. Buyers of BEVs and PHEVs could save up to $7,500 in their income tax bill. In case of used cars, buyers might qualify for a maximum tax credit of $4,000 or 30% of the price of the vehicle. The tax credit facility, which has been around for a decade now, will continue through the end of 2032. Sedans priced $55,000 or lower are eligible, and so are SUVs and trucks worth not more than $80,000. The buyer's income ceiling is capped at $150,000 for single tax filers and $300,000 for joint filers. A ceiling of $225,000 applies in the case of household heads. So, getting the electric vehicle tax credit is no walk in the park. Further, the incentives link to two criteria and the consumer stands to lose half the tax credit (up to $3,750) if the vehicle fails to satisfy one of these criteria below:

1. *The source of the critical minerals, metals, chemicals, or other materials used in an EV battery must be either North America or nations that have free trade agreements with the US. Battery manufacturers must progressively increase the percentage of such materials extracted, processed, or recycled in the previously mentioned locations, starting at 40% in 2023 and increasing by 10% each year, up to 80% in 2026. Starting in 2025, vehicles will not qualify for the tax credit if the battery's critical minerals were extracted, processed, or recycled by a "foreign entity of concern."*

2. *The components of the EV battery must be produced or assembled in North America. Starting with 50% in 2023, manufacturers must strive to increase the percentage of components by 10% each year, reaching 100% in 2028. Starting in 2024, vehicles will not qualify for tax credit if the battery components were produced or assembled by a foreign entity of concern.*

As things stand, Australia, Chile, and China account for 55%, 26%, and 14% respectively of lithium output. Currently, Chinese companies (CATL, BYD, CALB, Guoxuan, Sunwoda, SVOLT) make up almost 56% of the EV battery market. South Korea's LG Energy Solution, SK Innovation, and Samsung SDI constituted 26% of the market. Japan's Panasonic held a 10% share. US is a miniscule player in this respect, manufacturing barely 1% of lithium products, globally.

The Inflation Reduction Act has its sights set on enhancing America's domestic processing capacity for critical minerals used in battery production. The bigger focus is on boosting the country's capabilities in advanced battery manufacturing. Alongside, the US administration hopes to reduce the country's reliance on foreign competitors for critical materials and technologies, which it perceives as a national security risk. In mid-October 2022, President Biden doled out $2.8 billion to 20 companies in 12 US states to extract and process battery materials (lithium, graphite, nickel, copper), manufacture components, and recycle various minerals.

Lithium – Key Points
• Lithium-ion cells make up nearly 77% of an average battery pack • Global lithium reserves stood at 22m tonnes in 2021 • Chile, Australia, Argentina, and China hold 8m, 2.7m, 2m and 1m respectively in reserves • Worldwide lithium production reached 100,000 tonnes in 2021 • Australia, Chile, and China were responsible for 55%, 26%, and 14% respectively of this output • Battery production is the major end-use market for lithium, consuming as much as 74 percent of all lithium produced • 14 percent is used in ceramics and glass, and 3 percent in lubricating greases • There is a deficit of 26,000 tonnes in worldwide lithium supplies currently • This might shoot up to 1.1 million tonnes by 2030

More power needed to charge EVs

In level 1 charging, the slowest available charging method, the BEV or PHEV is plugged into a 120-volt household power outlet. The AC power from the grid feeds the EV on-board charger, which converts the same into DC output and proceeds to charge the battery. Level 1 charging – aptly called "trickle charging" - adds no more than 3 to 5 miles of range per hour of charging. Level 1 chargers are featured generally in residences and parking garages.

Level 2 chargers, often seen in parking lots, supermarkets, hotels, offices, and residences, provide 12 to 80 miles of range for every hour they are connected to an EV, which makes them 4-16x faster than their level 1 counterparts. The power source in this case is 208-240 volt.

The advent of level 3 chargers (direct current fast-charging technology /DC fast charging) has shrunk EV charging times from 20 hours, previously, to just 15-45 minutes. Level 3 chargers deliver a 400 to 900-volt direct current to the EV battery. Such fast chargers give 3 to 20 miles of range per minute of charging and can charge 80 percent of the battery in under 20 minutes for most cars. This kind of charging cuts back charging time drastically by eliminating any need to convert AC power to DC before charging the EV battery.

Features	Level 3 charging (DC fast charging)	Level 2 charging	Level 1 charging
Time to fully charge battery pack	15-45 minutes	5-8 hours	20+ hours
Volt	480+	208-240	120
Average output	50kW-350kW	6.2 kW-19.2 kW	1kW-1.8 kW

Features	Level 3 charging (DC fast charging)	Level 2 charging	Level 1 charging
Miles per hour/minute of charging	3-20 miles per minute	12-80 miles per hour	3-5 miles per hour
Typical locations	Public charging stations along major highways	Parking garages, supermarkets, malls, hotels, offices, residences	Residences and occasionally in parking garages
AC or DC charging	The charging station directly delivers DC power to the EV battery, and this is faster	The charging station delivers AC power to the EV's on-board charger, which converts the same into DC power and then proceeds to charge the EV battery. This is time consuming	

No. of EV charging ports in the US segmented by charging speed (July 2022)

States	No. of level 3 (DC fast charging) ports	Total	
California	7,800	11,700	26,200
Florida	1,500		
Texas	1,300		
New York	1,100		
States with less than 1,000 DC fast charging ports each		14,500	
Total no. of DC fast charging ports in the US		26,200	

States	No. of level 2 charging ports	Total	
California	28,900	83,700	
New York	7,300		
Florida	5,000		
Massachusetts	4,700		
Texas	4,300		
Colorado	2,900		
Washington	2,900		
Georgia	2,900		
Maryland	2,700		
Pennsylvania	2,200		

States	No. of level 2 charging ports	Total	
Ohio	2,000		
Virginia	2,000		
Illinois	1,900		
N. Carolina	1,900		
Arizona	1,800		
Missouri	1,800		
Michigan	1,800		
Oregon	1,600		
Utah	1,500		
N. Jersey	1,500		
Tennessee	1,100		
Minnesota	1,000		
States with less than 1,000 level 2 charging ports each		12,200	
Total no. of level 2 charging ports in the US		95,900	95,900

States	No. of level 1 charging ports	Total	
Georgia	200	620	920
California	200		
Washington	80		
Colorado	60		
Virginia	50		
Oregon	30		
States with less than 30 level 1 charging ports each		300	
Total no. of level 1 charging ports in the US		920	
Total no. of EV charging ports in the US			123,020

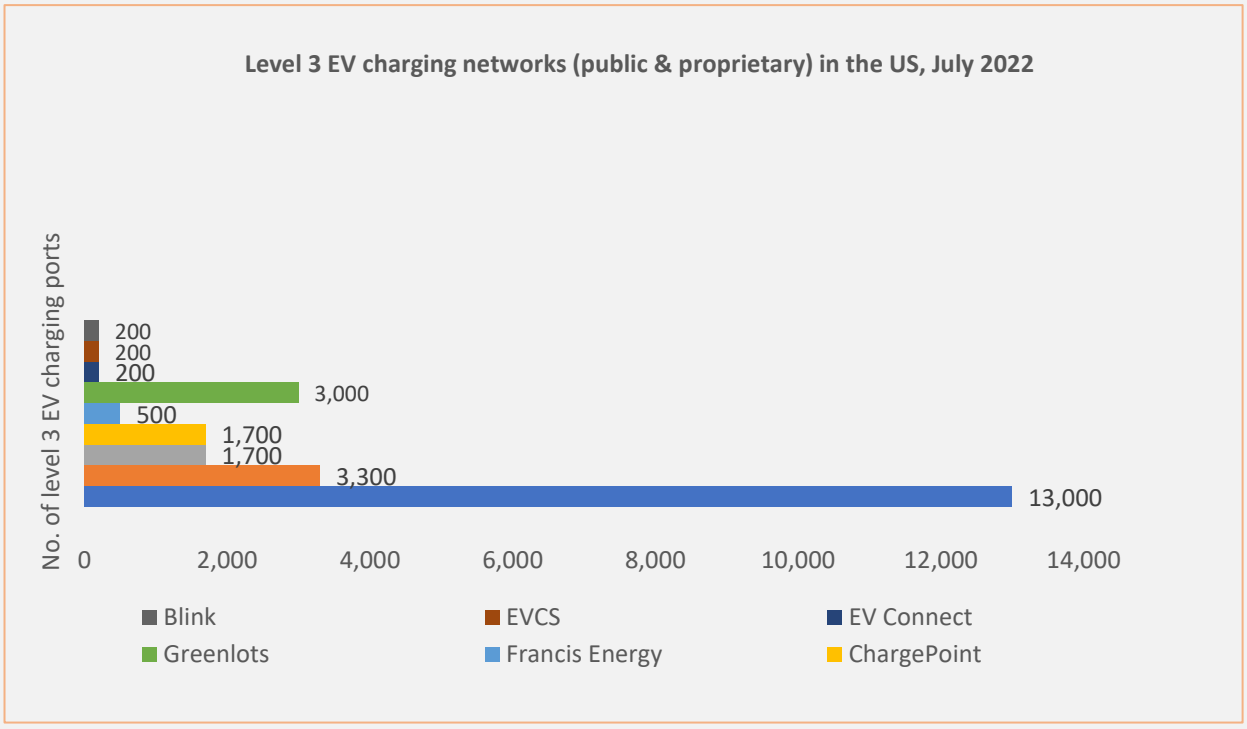
No. of EV charging ports in the US by top states (2021)

States	No. of EV charging ports	Total no. of EV charging ports	As a % of total EV charging ports	Approx. no. of gas stations in the US
California	38,700	107,600	89%	150,000 (each with multiple gas pumps)
New York	7,600			
Florida	6,200			
Texas	5,000			
Massachusetts	4,600			
Washington	3,900			
Colorado	3,700			
Georgia	3,700			
Maryland	3,200			
Virginia	3,200			
N. Carolina	2,600			
Illinois	2,600			
Pennsylvania	2,500			
Oregon	2,200			
Missouri	2,100			
Ohio	2,100			
Arizona	2,000			
New Jersey	1,800			
Michigan	1,700			
Utah	1,700			
Tennessee	1,500			
Connecticut	1,400			
Nevada	1,300			
Minnesota	1,300			
Oklahoma	1,000			
Other states (with less than 1,000 charging ports each)	13,000	13,000	11%	
		120,600	100%	

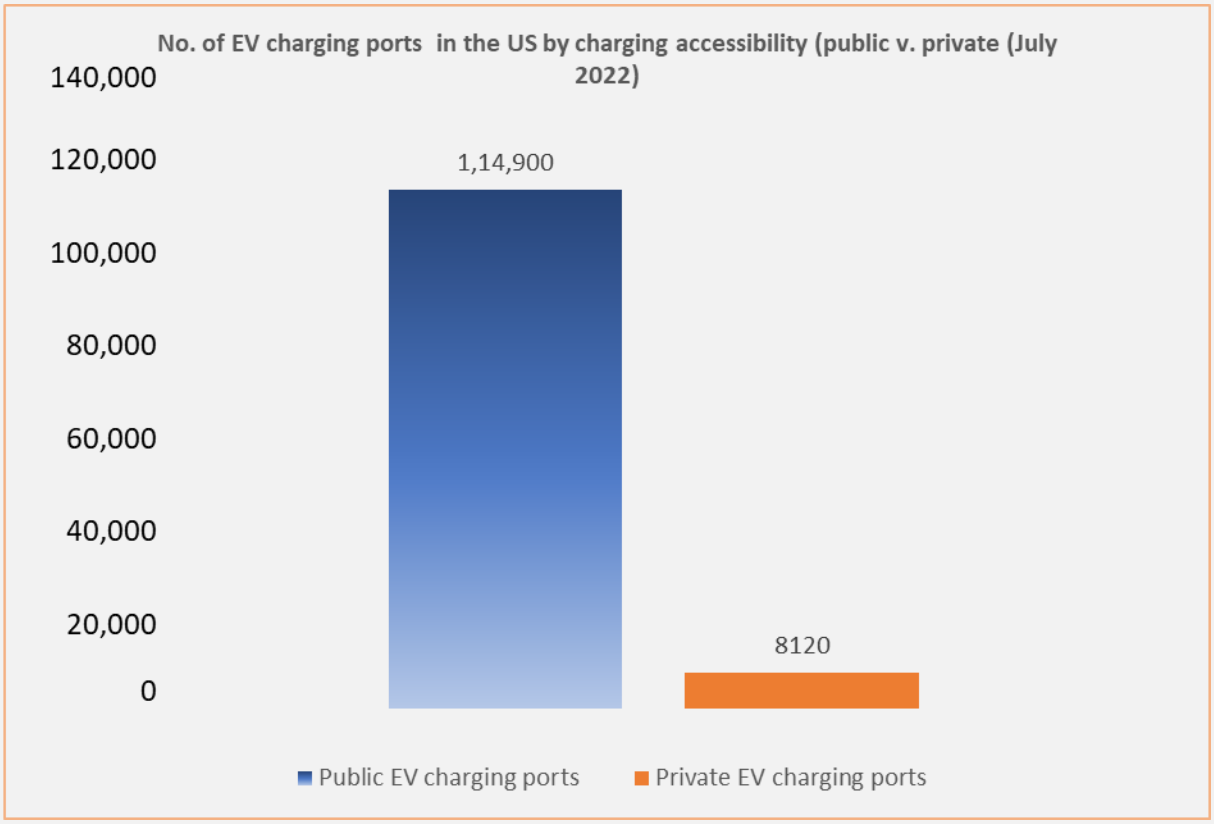
DC fast chargers are hugely expensive to install and, therefore, beyond the scope of most residential locations. So, DC fast chargers are mostly seen in public spots. As in July 2022, the US had a total of 26,200 level 3 charging ports. California accounted for nearly 30% of these ports. Florida came a distant second with a 6% share, while Texas and New York held a 5% and 4% share respectively. The other states had fewer than 1,000 DC fast charging ports each.

41% of the more than 26,000 level 3 EV charging ports were publicly accessible ones run by charging networks like Blink, Greenlots (owned by Royal Dutch Shell), EVgo, EVCS, Francis Energy, Volkswagen-owned Electrify America, EV Connect, and ChargePoint. At least 50% of these ports were proprietary, mostly operated by the Tesla Supercharger network. Overall, Tesla had 13,000 level 3 ports in the US as in July 2022. Greenlots operated 3,000 ports and Electrify America 3,300. EVgo and ChargePoint each had 1,700 ports to their credit.

Total no. of level 3 EV charging ports in the US	26,200
Public level 3 ports	10, 800
Proprietary level 3 ports	13,000



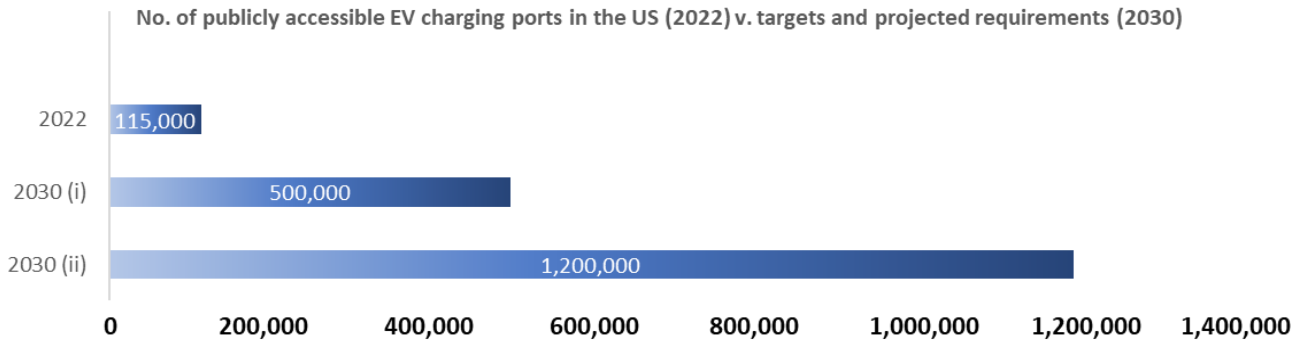
- *Tesla Supercharger network is a proprietary one open to Tesla owners only.*
- *Greenlots is owned by Royal Dutch Shell since 2019.*
- *Electrify America is Volkswagen-owned.*



- *Private EV charging port = A charging port, such as one run by an office or multi-unit dwelling, access to which is limited to employees or residents*
- *Public EV charging port = A charging port that is accessible to the general public regardless of where it located, i.e., in a workplace or a multi-unit dwelling*

In all, the US had 95,900 level 2 charging ports as well as 920 level 1 charging ports for EVs. Of the total 123,020 ports, 93% were accessible to the general public (publicly accessible charging ports) while the rest were private. The access to the latter is limited to, say, employees of an office or residents of a multi-unit dwelling.

The number of public charging ports have been on the rise, from 96,536 (2020) to 114,900 (July 2022), but as electric vehicles gain popularity and market share, this is not nearly enough. Under BIL, a network of 500,000 public EV charging ports is planned to be built by 2030. However, according to industry experts, that can only scratch the surface of the charging station shortage, the single biggest roadblock to EV adoption. America needs more than a million public charging ports, besides private chargers, by 2030, as per various industry estimates.



2030 (i) = No. of charging ports targeted under the Bipartisan Infrastructure Law
2030 (ii) = No. of charging ports required to meet demand as per industry projections

Rapid EV adoption in the US has spawned an entire supporting ecosystem consisting of EV battery manufacturers, power inverter makers, battery management systems, and various software providers. Wait, there's more, like vehicle electrification services, charging networks, vehicle rentals and shared services, as well as providers of commercial and domestic charging infrastructure. The renewed push by the US administration in the direction of cleaner and more efficient energy is putting new life into this ecosystem partners and promises to uplift their prospects.

EV ecosystem

EV battery manufacturers	• Top manufacturers: CATL, BYD, CALB, Guoxuan, Sunwoda, SVOLT (China); LG Energy Solution, SK Innovation, Samsung SDI (South Korea); Panasonic (Japan) • Global market share: China - 56%, South Korea - 26%, Japan - 10% • The Inflation Reduction Act 2022 and tax credits for manufacturers are expected to boost battery production in the US • LG Energy Solution, SK Innovation, Panasonic and Samsung SDI are investing more than $38 billion, 2022 through 2026, to bolster US EV production
EV power inverter manufacturers	• Top manufacturers: Aptiv, Continental AG, Denso corporation, Hitachi Astemo, Lear Corporation, Marelli Holdings, Meidensha Corporation, Mitsubishi Electric, Nissan Motors, Robert Bosch, Siemens, Sungchang, Toyota Industries Corporation, Valeo, Vitesco Technologies, BYD, CWB Automotive Electronics
EV battery management systems	• Top players: Bosch, Continental AG, Panasonic, Intel, Denso, Tesla • Others: BYD, CATL, Leclanche, Texas Instruments, Hyundai, Ion Energy, Titan Advanced Energy Solutions, Eatron Technologies, Ficosa, Hella, Maxim Integrated Products, Lithium Balance, Analog Devices, Visteon, Ricardo, Orient Technology, Sensata Technology, Bird Global, Idneo Engineering Services, BorgWarner, Infineon Technologies, Ewert Energy Systems, Battrixx, Endurance Tech, On.Energy, Eberspaecher, Nuvation Energy, LG Energy Solution, Britishvolt
Vehicle electrification services	• Top players: Bosch, Continental, Aisin, Johnson Controls, Delphi Technologies, Mitsubishi Electric, Magna, Denso • Others: Eaton, Stellantis, Lightning eMotors, Romeo Power, Hyliion, Open Motors
EV rentals and sharing services	• Hertz, Kingbee, Enterprise Holdings, Avis, Turo, Envoy, Revel
Charging networks	• Tesla, EV Connect, ChargePoint, Electrify America • Francis Energy, EVCS, EVgo, Greenlots, Blink, FLO, Volta
Home EV chargers	• ChargePoint, Juicebox, Grizzl-E Classic, Blink, Electrify America , Phoenix Motorcars, WiTricity, Ohme, EO charging, Wallbox, EVBox, Andersen, Zappi, BP Pulse, Rolec
Commercial charging infrastructure providers	• Black & Veatch, Tata Power, Burns & McDonnell, Tetra Tech, KBR Inc, HDR Inc, CDM Smith, Siemens, Delta Electronics, ABB, BP Mobility

America has hit the right track, namely electric mobility, albeit a tad bit late in relation to China. Even so, to wean away a gas-guzzling nation from fossil fuels there is need for millions of charging ports, public and private, and more by way of tax credits and all-electric vehicle choices. The country also needs to step up domestication of battery manufacturing and mineral production.

Types of electric vehicles - BEV / PHEV / HEV / FCEV

	Battery electric vehicle (BEV)	Plug-in hybrid electric vehicle (PHEV)	Hybrid electric vehicle (HEV) - "regular hybrids"	Fuel cell electric vehicle (FCEV)
Presence of internal combustion engine	• No gasoline engine	• Has both an engine and electric motor	• Has both a gas-powered engine and a small electric motor	• Runs on electric motor powered by liquid hydrogen held in a compressed storage tank
	• Fully electric vehicle with rechargeable batteries	• Can plug into the grid to recharge • Most PHEVs don't support fast charging	• Cannot plug into the grid to recharge • Recoups energy, otherwise lost in braking, to charge the battery • Uses the energy, thus stored, to assist the gasoline engine during acceleration	• Hydrogen tank acts as a source of chemical energy

Types of electric vehicles – BEV / PHEV / HEV / FCEV

Emission level	• Does not generate any of the harmful tailpipe emissions associated with gasoline-powered vehicles ("Zero emission" vehicle)	• Emits CO2 when the internal combustion engine is in operation • Considered a low-emission vehicle	• Emits CO2 when the internal combustion engine is in operation	• Emits only water vapor ("Zero emission" vehicle)
Mileage	• Covers 75-402 miles on a single charge • The miles per charge varies between models	• Can go anywhere from 10-40 miles on electric power • Beyond that distance, it's a normal gasoline car	• Travels 1-2 miles before the gasoline engine turns on • Consumes only electric power under light load and during acceleration • Petrol/diesel engine needs to kick in for the car to go any faster	• The latest generation cars can go up to 400 km on a single tank of hydrogen

Types of electric vehicles - BEV / PHEV / HEV / FCEV

	Battery electric vehicle (BEV)	Plug-in hybrid electric vehicle (PHEV)	Hybrid electric vehicle (HEV) - "regular hybrids"	Fuel cell electric vehicle (FCEV)
Charging level – level 1 / level 2 / level 3	• AC level 1 charging • AC level 2 charging • DC fast charging	• AC level 1 charging • AC level 2 charging • DC fast charging	• Not applicable	• Takes about 10 mins to refuel the hydrogen tank • Buyers face a key issue: there are only 86 hydrogen refilling stations in the US; 60 in California and one in Hawaii (October 2022)
Models	• Hyundai Ioniq 5, Tesla Model 3, Polestar 2, Volkswagen ID.4, Kia EV6, Mini Electric, MG ZS EV, Tesla Model Y, Renault Zoe, Hyundai Kona Electric, Kia e-Niro	• Mitsubishi Outlander, Volvo XC60 Twin Engine, BMW 225xe, Volkswagen Golf GTE, Toyota Prius Plug-in, Mercedes-Benz E350 e SE	• Toyota Corolla Hybrid, Toyota Yaris Hybrid, Lexus RX450h, Ford Mondeo Hybrid, Honda NSX	• Hyundai Nexo SUV, Toyota Mirai

Types of electric vehicles - BEV / PHEV / HEV / FCEV

US prices	• $20,875 to $181,450 (Feb 2022)	• $27845-$507000 • (Base prices, Feb 2022)	• $20,200-$40,000 (Starting prices, May 2022)	• $50,000-$58,000 (May 2022; available only in California) • Lease prices (California only) work out to $379/month

About Infiniti's Market Intelligence Services

At Infiniti Research, we share your passion to drive market intelligence. We develop insights that help business professionals get the right information in the right format, without any unnecessary frills. Our solution coverage extends across crucial processes of your strategy planning process, so that you achieve more. Our services are aligned to the needs of your organization and are aimed at helping you extract hidden values out of your teams, suppliers, contracts, and processes. Our researchers have extensive experience in delivering deep dive custom research and consulting assignments for over 45 Fortune 500 companies and numerous small and medium-sized companies across several industry verticals.

North America

110 E. Schiller, #208 Elmhurst, IL 60126 U.S.A.

Email: americas@infinitiresearch.com

Tel: +1 630 530 7340 Fax: +1 630 833 2171

Europe

8 Wimpole Street W1G 9SP London United Kingdom

Email: emea@infinitiresearch.com

Tel: +44 207 637 2456 Fax: +44 845 280 2825

Asia-Pacific

1st Floor - Left Wing, Embassy Signet, Cessna Business Park, Kadubeesanahalli Outer Ring Road, Bangalore - 560 103

Email: asia@infinitiresearch.com

Tel: +91 934 254 0560 Fax: +91 80 4080 6070