



November 2022

Zero-Emission Vehicles Factbook

A BloombergNEF special report
prepared for COP27



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Foreword

*We are delighted to welcome the publication of BloombergNEF's Zero-Emission Vehicles Factbook, to mark the launch of the **Accelerating to Zero Coalition**. The Accelerating to Zero Coalition is a new partnership between initiatives to align activities and amplify messages to grow the group of leaders committed to an accelerated zero-emission vehicles transition.*

The Accelerating to Zero Coalition will host the ZEV declaration, through which governments, businesses, and organisations have committed to all new car and van sales being zero-emission globally by 2040 and by 2035 in leading markets.

This Factbook shows that, despite the global energy crisis, the zero-emission vehicle transition has continued to accelerate since the ZEV declaration was launched at COP26, and that the ZEV transition is key to permanently ending our dependence on oil.

We call on more actors to come forward next year and make and implement ambitious commitments to transition to ZEVs and reap the benefits of cleaner air, jobs, economic growth, and keeping our Paris Agreement goals within reach.

Alok Sharma, COP26 President

Nigel Topping, UN Climate Change High-Level Champion for the UK, COP26

Introduction and key messages

This special report has been produced by BloombergNEF in cooperation with the Accelerating to Zero Coalition and in partnership with Bloomberg Philanthropies, to coincide with COP27, the 2022 United Nations Climate Change Conference.

Since the last Conference of the Parties in 2021, global momentum towards zero-emissions road transport has continued to accelerate. Important signs of progress include:

- Annual passenger electric vehicle sales are on track for around 10.6 million units in 2022, up from 3.1m in 2020 and 6.6m in 2021. 13.2% of new cars sold globally in the first half of this year were electric, up from 4.3% in 2020 and 8.7% in 2021. Spending on clean road transport globally will exceed \$450 billion this year.
- The adoption of electric vehicles and fuel cell vehicles are expected to avoid almost 1.7 million barrels of oil use per day in 2022, up from 1.5 million barrels per day in 2021. This is about 3.8% of total demand.
- Global lithium-ion battery manufacturing capacity has increased 38% since 2021, from 540GWh to 806GWh.
- Automakers have collectively committed to sell around 43 million EVs per year by 2030, and automakers with planned phase-outs of combustion engines now account for 30% of the global auto market.

This *Zero-Emission Vehicles Factbook* documents the progress that has been made towards global net zero in the road transport sector.

While many of the indicators in this report are pointing in the right direction, most still have a long way to go before we can be confident that we are on track for net zero by mid-century.

National, regional and local governments must continue to raise ambition and implement stable, long-term policies that induce the growth of zero-emissions transport, and manage the phase-out of polluting vehicles.

Particular attention is needed to support the transition to zero-emission transport in developing economies. Stronger international collaboration and financial and technical assistance will be needed to accelerate ZEV adoption in these countries.

- In over half of the global car market, EV adoption is still below 10% of sales, and roughly 30% of the global car market is in countries where EV adoption is currently only 1-3%, or lower.
- This means over 40% of combustion cars on the road in 2035 will be located in emerging countries if no action is taken today.

This report is structured around four key elements of the zero-emission vehicles (ZEV) transition: (1) ZEV market overview, (2) market drivers, (3) corporate commitments and (4) government commitments. We hope you find this factbook valuable, and that it stimulates further debate and discussion on pathways to zero-emission transport.

Zero-Emission Vehicles Factbook

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Zero-Emission Vehicles (ZEV) Market Overview

Rapid progress,
rising momentum

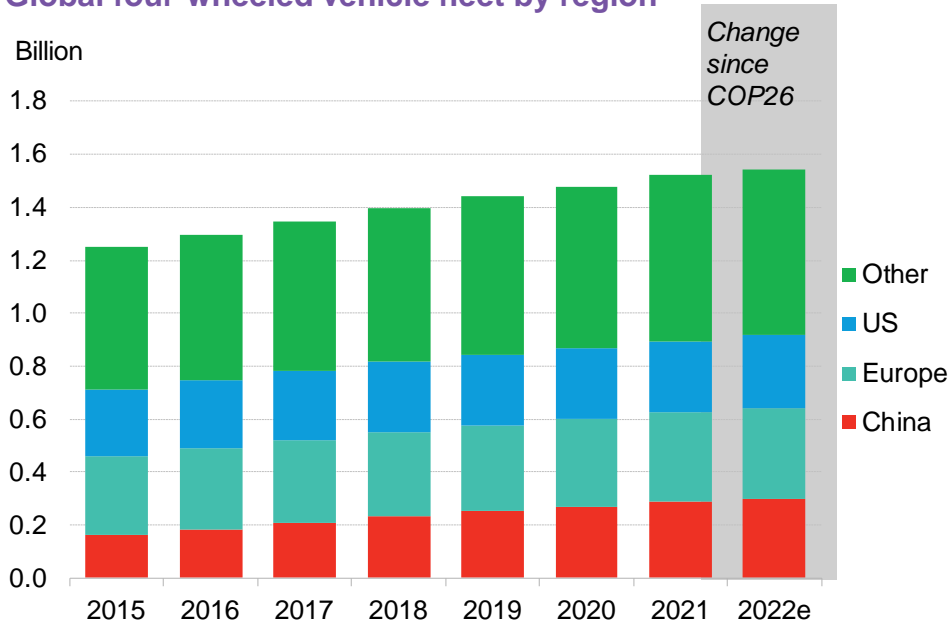


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The global road vehicle fleet continues to grow

Global four-wheeled vehicle fleet by region



The global fleet of four-wheeled road vehicles continues to rise and currently stands at over 1.54 billion vehicles, up slightly from last year.

- This total includes cars, trucks and buses.
- The growth rate is positive but slowing, with the fleet expect to grow by only 1% in 2022.
- Growth is faster in countries outside of the largest markets in the US, China and Europe – marked ‘Other’ in the chart.

About 96 million new cars, trucks and busses are expected to be added to the global fleet in 2022, with net fleet additions reaching around 63 million vehicles from 2021 through 2022.

China accounts for about 33% of the increase, representing 20% of the four-wheeled vehicle fleet globally. China surpassed the US (at 18% in 2022) as home to the largest fleet of four-wheeled vehicles globally already in 2021.

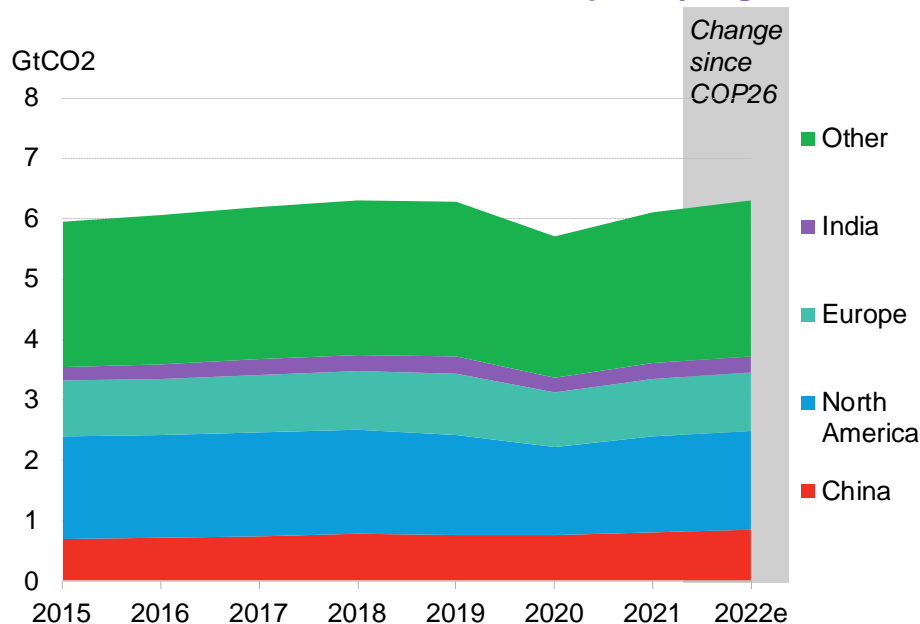
The global fleet of two- and three-wheelers is almost as big, exceeding one billion.

China, India and countries in Southeast Asia are by far the largest markets for two- and three-wheelers globally.

Source: BloombergNEF, national statistical agencies. Note: includes passenger cars, commercial vehicles and buses; excludes two- and three-wheel vehicles.

Global road transport emissions continue to rise, highlighting ZEV urgency

Global CO2 emissions from road transport by region



Global road transport emissions continue to rise as the world rebounds from the Covid-19 pandemic. 2022 road transport emissions are estimated to be 3% higher than 2021, at about 6.3GtCO₂ globally, and 1% higher than in 2019.

Zero-emission vehicles can, and have, played a role in curbing increases in road transport emissions, but there is much work to do to decarbonize the road transport sector moving forward.

North America has the highest emissions from road transport, at an estimated 1.64GtCO₂ in 2022.

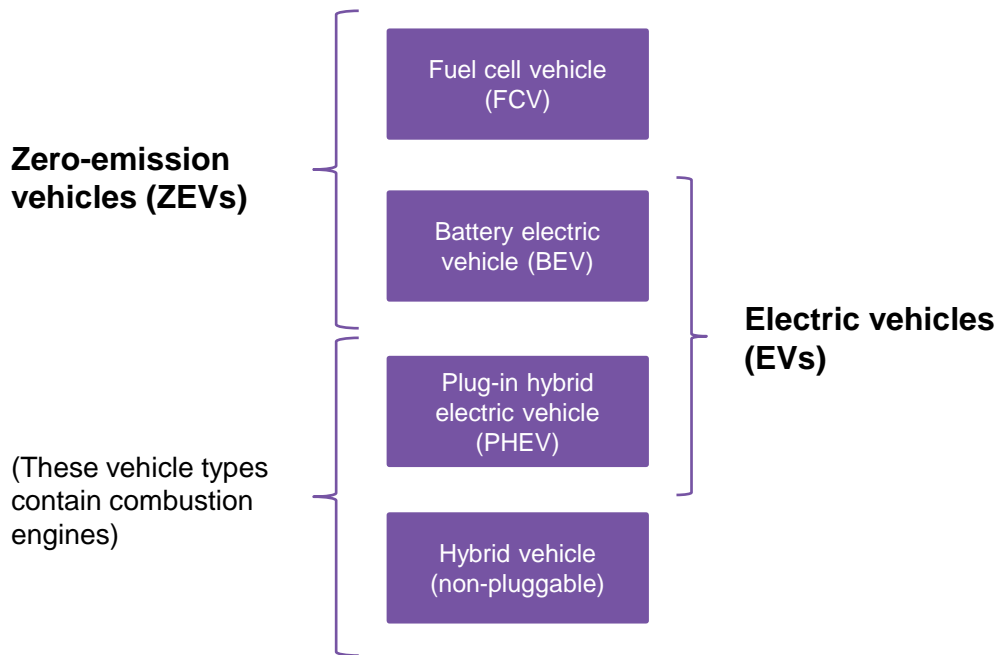
Europe and China are expected to be the next highest emitters in 2022, at 0.96GtCO₂ and 0.85GtCO₂, respectively.

India and other remaining countries made up 45% of global road transport emissions in 2022.

These regions include a broad swath of the global market from South Korea and Japan to Southeast Asia and India. Emissions continued to rise in the last two years after falling in 2020 due to the pandemic. Estimated road transport emissions for 2022 for this group are expected to hit 2.9 GtCO₂, an increase of 4% from 2021.

Source: BloombergNEF. Note: includes passenger vehicles, commercial vehicles, buses and two- and three-wheeler emissions from tailpipe, power. 2022 is estimated based on the fleet size from BloombergNEF's "Long-Term Electric Vehicle Outlook 2022."

Electric vehicles (EVs) and zero-emission vehicles (ZEVs): scope



For the purposes of this report, we define zero-emission vehicles (ZEVs) as those vehicles that never emit carbon dioxide from their tailpipes.

This means that ZEVs, in this report, only include pure BEVs and FCVs, neither of which have internal combustion engines.

It is understood that these vehicles should be fueled from clean electricity / hydrogen if they are to be truly zero-emission in operation.

Electric vehicles (EVs) as a category are commonly understood to include plug-in hybrids (PHEVs).

In this report, as in all other BNEF publications, we include PHEVs in our definition of electric vehicles (EVs), alongside pure BEVs. However, PHEVs are excluded in some pages of this report that are focused on the ZEV definition above.

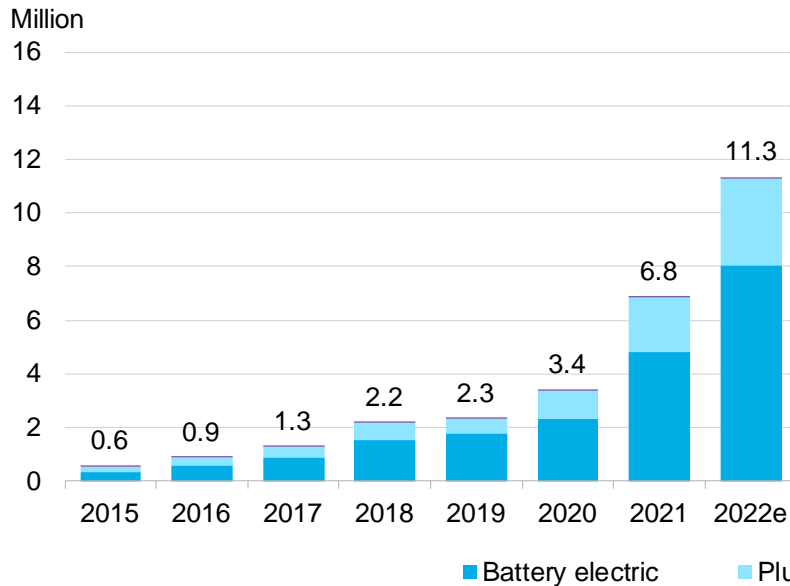
Some slides in this report focus on a wider definition “EVs and FCVs”, encompassing all of the above.

Hybrid vehicles that cannot be charged from an external power source are not included in our definitions of ZEV or EV in this report.

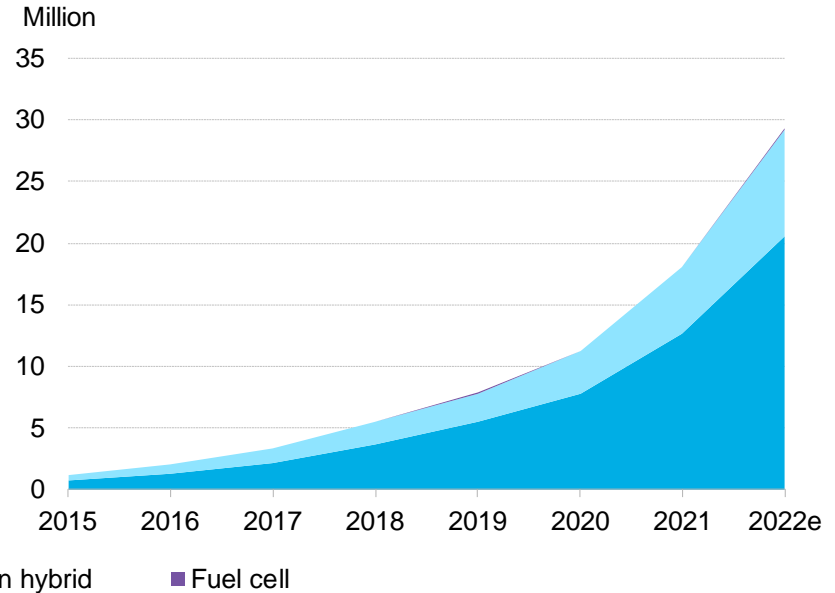
Note: categorisations are for the purpose of clarifying this report only.

Most zero-emission vehicles are battery electrics (BEVs), not FCVs

Global EV and FCV four-wheeler sales



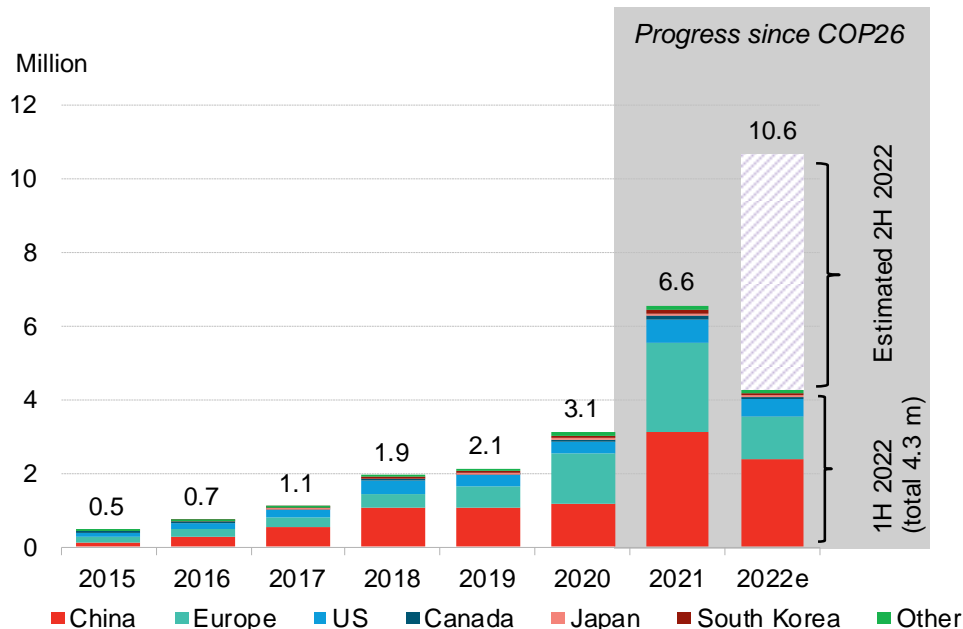
Global EV and FCV four-wheeler fleet



Source: BloombergNEF. Note: Includes passenger vehicles, commercial vehicles and buses. Excludes two-and-three wheelers. 2022e is an estimated value.

Passenger electric vehicles sales have accelerated significantly since COP26

Global electric vehicle sales by region



Global passenger EV sales grew by a record 110% in 2021, to 6.6 million.

The surge in EV sales contrasted sharply with trends in the overall passenger vehicle market, which was up only 3% that year.

The EV surge has continued into 2022.

In the first six months of 2022, nearly 4.3 million EVs were sold globally – over 70% more than in 1H 2021.

China and Europe have led the global passenger EV and FCV market since 2015, but Europe's growth has slowed in 1H 2022.

China and Europe were (respectively) responsible for 48% and 36% of global EV sales in 2021 and 56% and 28% in 1H 2022. The next largest market was the US at 11% of the global market in 1H 2022.

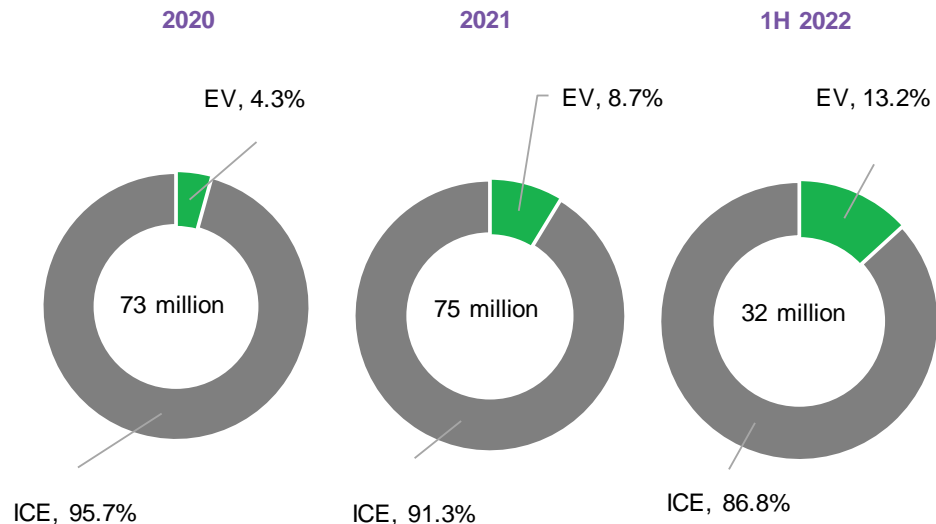
BNEF expects 2022 to be yet another record year for EV sales globally, at 10.6 million sold in total.

This would put 2022 passenger EV sales 63% higher than in 2021, and 242% higher than in 2020.

Source: BloombergNEF, Marklines, EAFU, government registration agencies. Note: Includes BEV, PHEV and FCV vehicles.

EVs are now more than 13% of the global passenger vehicle market

Global passenger vehicle sales by drivetrain



Source: BloombergNEF. Note: ICE = internal combustion engine.

Electric vehicles exceeded 13% of global car sales in 1H 2022, up from just 8.7% in 2021.

Record high EV sales in 2021 kept a cap on sales of internal combustion engine (ICE) vehicles. These were down 2% globally in 2021.

China and Europe are visibly pulling ahead in market share terms, just as they are in absolute terms.

23% and 22% of cars sold in China and Europe, respectively, were electric in 1H 2022, in contrast to 2% in Japan and 7% in North America.

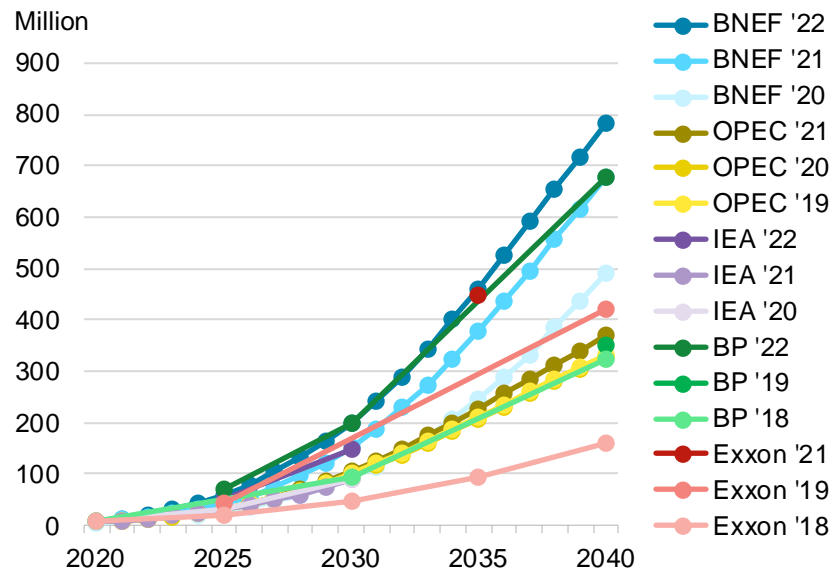
The biggest car markets in Europe have made significant progress since 2019. Between 1H 2019 and 1H 2022, the EV share of sales has increased:

- From 3% to 26% in Germany
- From 2.2% to 24% in the UK
- From 2.8% to 21% in France
- From 0.5% to 12% in Italy

Progress has also been noticeable in North America. Between 1H 2019 and 1H 2022, the EV share of sales in the region increased from 1.8% to 7%.

The outlook for zero-emission vehicles has again improved markedly

Global passenger and commercial ZEV fleet to 2040, various outlooks



Source: BloombergNEF, IEA, OPEC, BP, ExxonMobil. Note: IEA is their base-case (state policy scenario for 2020 through 2022). BNEF includes BEVs and FCVs (excl. PHEVs). OPEC includes BEV, PHEV, and FCV. IEA reports are BEVs only. All other reports include BEV and PHEV.

Long-term outlooks for battery electric (BEV) and fuel cell vehicle (FCV) adoption continue to be more bullish every year. Companies forecasting ZEV adoption now see tens of millions more BEVs on the road in the future than they expected in 2020, or 2021. The biggest reason for higher outlooks is more policy support and growing consumer acceptance.

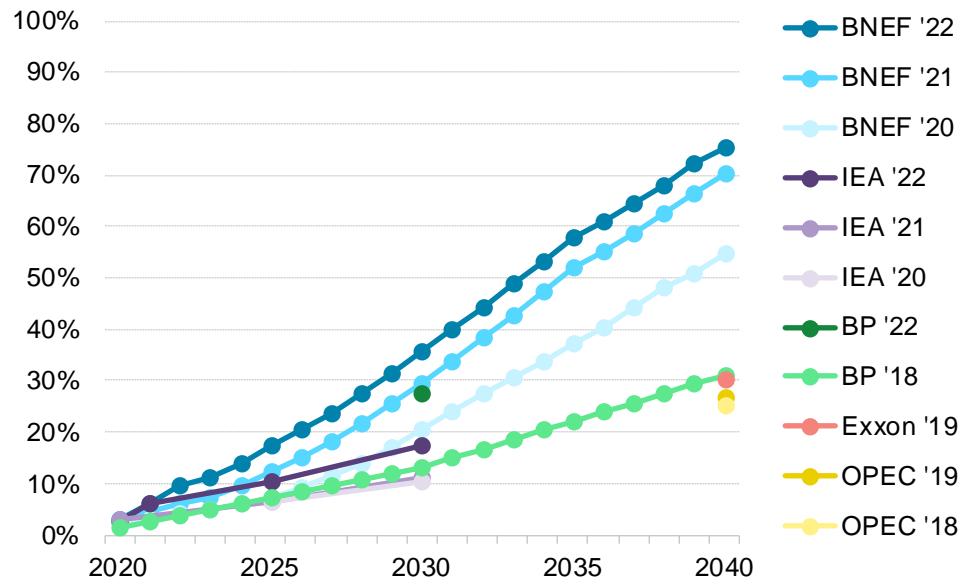
In its 2022 Long-Term Electric Vehicle Outlook, BNEF projects the global passenger and commercial ZEV fleet to hit 781 million vehicles by 2040. In 2020, this forecast had just 491 million ZEVs on the road in 2040. The latest outlook sees passenger ZEVs making up 45% of the 2040 passenger vehicle fleet, up from 39% in the 2021 report. Commercial ZEVs hit 26% of the 2040 commercial fleet, up from 24% in the 2021 report. In total, across passenger and commercial vehicles, the 2040 ZEV fleet share went from 36% in 2021 to 42% in the 2022 report.

Other organizations have also become more bullish in their most recent publications, increasing their ZEV adoption outlooks.

The IEA's 2022 Global EV Outlook increased its expected 2030 BEV fleet by 61%, to 148 million, from 92 million in the 2021 report. OPEC has revised its projected 2040 EV and FCV fleet up by 11% in its 2021 *World of Oil* publication, to 369 million EVs and FCVs on the road.

ZEVs are now expected to take more market share, sooner

Global ZEV share of passenger vehicle sales, various outlooks



Recent major reports are projecting ZEVs to capture a higher share of passenger vehicle sales, sooner than previously expected due to more policy support and consumer interest.

Share of sales is a useful metric, distinct from total ZEV sales. This is because different reports have diverging views of how overall global vehicle sales will change over time. These depend on differing views on overall car ownership trends, as well as the roles of autonomous and shared mobility technologies, and other modes of transport.

In BNEF's 2022 Long-Term Electric Vehicle Outlook, ZEVs' share of passenger vehicle sales reaches 75% globally by 2040. This is up 5 percentage points from the 2021 report.

In 2020, BNEF expected BEVs would hit only 55% of passenger vehicle sales by 2040.

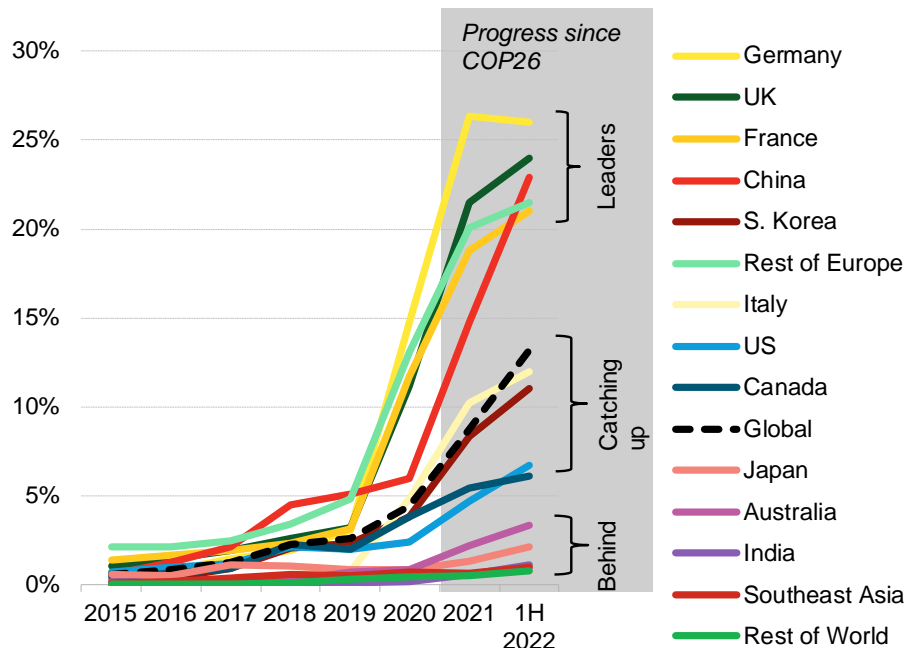
The IEA 2022 Global EV Outlook calls for an estimated 17% BEV share of passenger vehicle sales by 2030. BNEF's 2022 report calls for higher ZEV share of sales of 36% by then.

The 2020 IEA forecast was also lower, at an estimated 10% BEVs share of new passenger vehicle sales by 2030.

Source: BloombergNEF, IEA, OPEC, BP, ExxonMobil. Note: IEA is their base-case (state policy scenario for 2020 through 2022). BNEF includes BEVs and FCVs (excl. PHEVs). OPEC includes BEV, PHEV, and FCV. IEA reports are BEVs only. All other reports include BEV and PHEV.

But growth is unevenly distributed

Passenger EV share of sales



Source: BloombergNEF, Marklines, Jato. Note: Includes BEV and PHEV.

In over half of the global car market, EV adoption is still below 10% of sales. This includes countries like the US and Japan, which are still looking to catch up.

Electric vehicles' share of sales in the US reached 6.7% in 1H 2022, and only 2% in Japan. Recent regulatory changes in the US – the Inflation Reduction Act and revised fuel economy regulations – are expected to accelerate EV uptake in the country and bring it closer to the EV 'leaders'.

In Japan, recently introduced subsidies for electric kei-car purchase, together with newly released electric models addressing this car segment, can help Japan leave the 'behind' group (see chart).

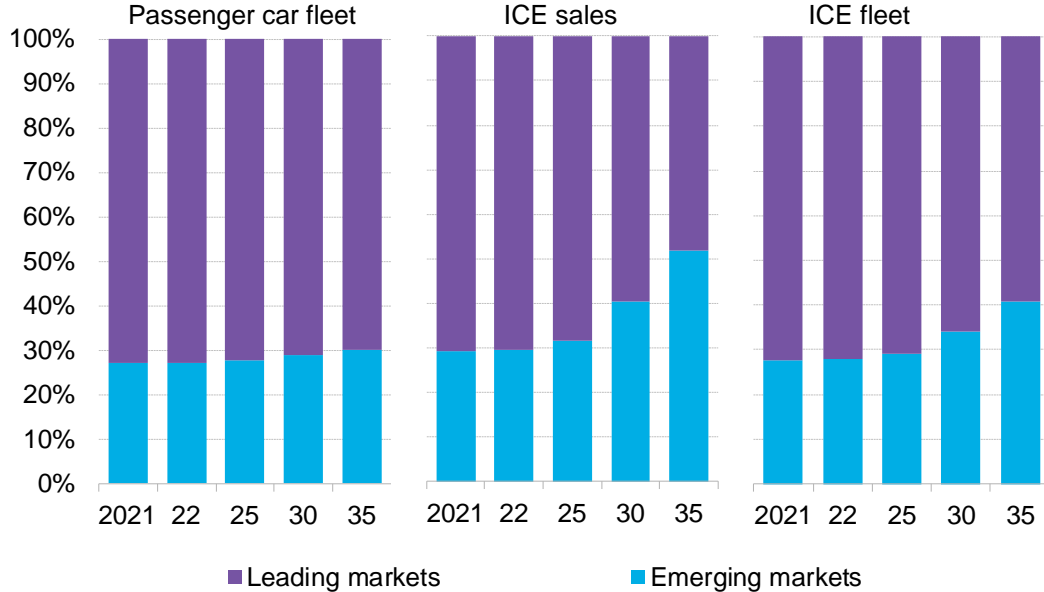
Roughly 30% of the global car market is in countries where EV adoption is currently very low.

EV adoption in India, Southeast Asia and the Rest of World category – which includes countries like Brazil or Russia – was still at or below 1% in 1H 2022.

Relatively low-priced vehicles, lack of EV model availability, underdeveloped charging infrastructure, unreliable grids and lack of policy support are some of the issues holding these countries back.

With no action, the gap will widen

Share of global passenger vehicle sales and fleet



The growing gap in EV adoption between leading and lagging countries will have serious consequences for the distribution of the legacy internal combustion vehicle fleet.

Today, 27% of the global car fleet, 30% of global internal combustion engine (ICE) vehicle sales and 28% of the ICE fleet is located in emerging EV markets.

These emerging markets are growing and will account for 30% of the global passenger vehicle fleet by 2035, according to BNEF's latest outlook.

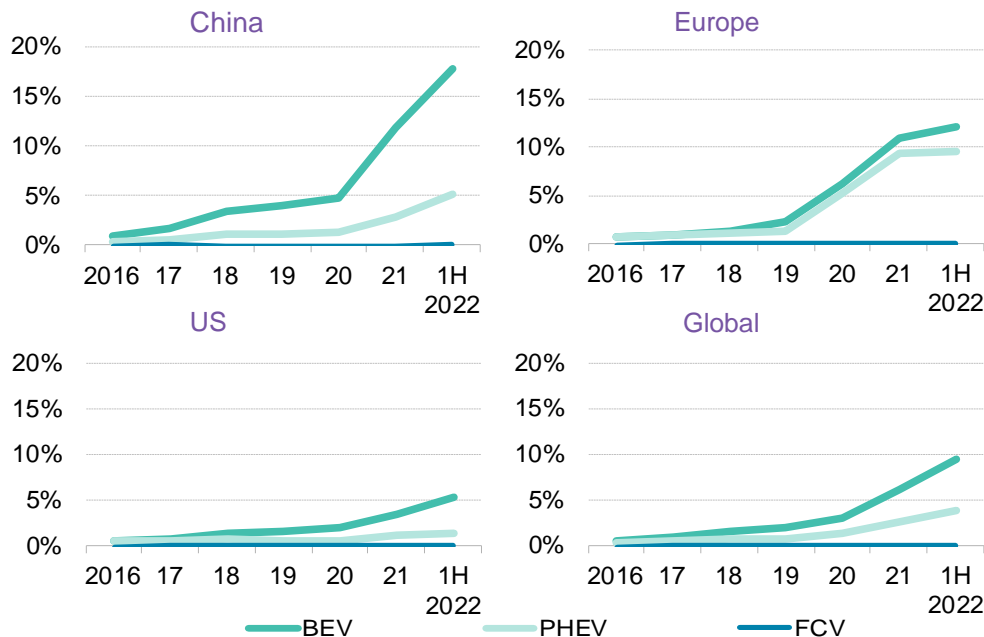
But more than half of global ICE vehicle sales will take place in emerging EV markets by 2035, as ICE vehicle sales are set to continue in emerging markets for much longer than in today's leading EV markets.

This means that, in 2035, over 40% of the world's combustion cars will be located in emerging countries if no action is taken today.

Source: BloombergNEF. Note: Includes passenger vehicles only. 'Leading markets' includes China, Europe, US, Canada, Japan, South Korea, Australia. 'Emerging markets' includes India, Southeast Asia and Rest of World countries.

Pure battery EVs are beating out plug-in hybrids

Passenger vehicle share of sales by drivetrain



Globally, sales of battery electric vehicles are outpacing those of plug-in hybrids and fuel cell vehicles.

- BEVs were 9% of 1H 2022 global passenger vehicle sales, while PHEVs were under 4%.
- FCVs are a miniscule portion of the passenger vehicle market, at around 0.1% of sales globally.

China and the US follow this same trend.

In China, BEVs' market share increased from 4% in 2019 to 18% in the first half of 2022. Meanwhile, in the US, BEVs accounted for over 5% of all vehicles sold in 1H 2022.

Plug-in hybrids (PHEVs), which are not strictly zero-emission vehicles, have fared considerably better in Europe, due to strong policy support. The growth of PHEVs in Europe is slowing, but sales in China are still growing.

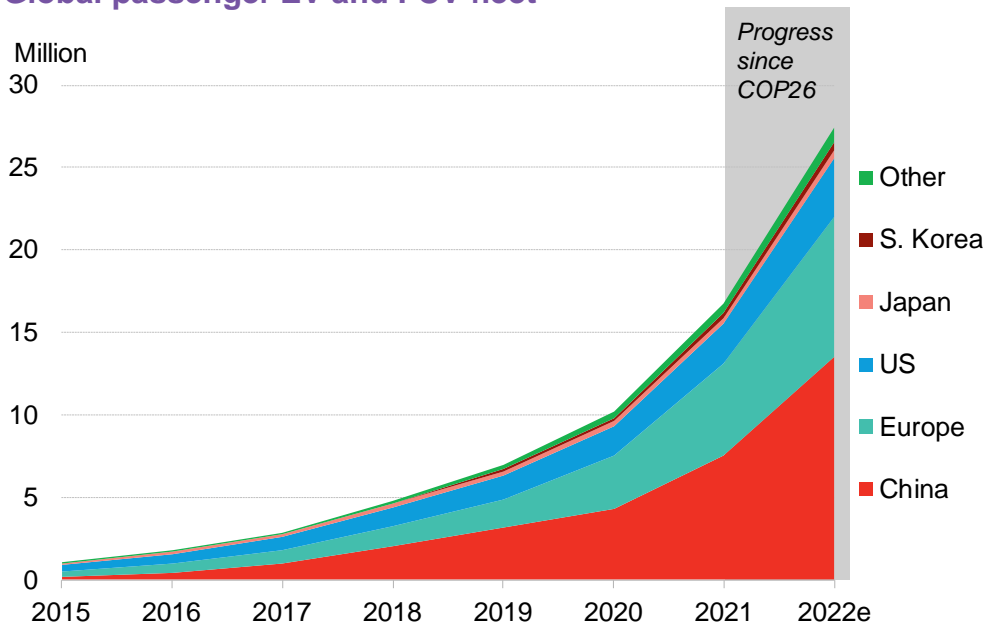
Some 44% of all EVs sold in Europe in 1H 2022 were PHEVs, down from 46% in 2021.

Europe's overall PHEV share of passenger vehicle sales stayed flat as a result, at 9.5% in 1H 2022.

Source: BloombergNEF. BEV = battery electric vehicle; PHEV = plug-in hybrid vehicle; FCV = fuel cell vehicles.

There are now almost 27 million passenger EVs and FCVs on the road....

Global passenger EV and FCV fleet



Source: BloombergNEF. Note: EV includes BEV and PHEVs.

The fleet of passenger electric and fuel cell vehicles has more than doubled in size since 2020.

A cumulative total of 27 million EVs and FCVs will have been sold by the end of 2022, up from just 10 million at the end of 2020.

99.9% of these are EVs, with FCVs playing a very limited role. Most of these vehicles are still on the road.

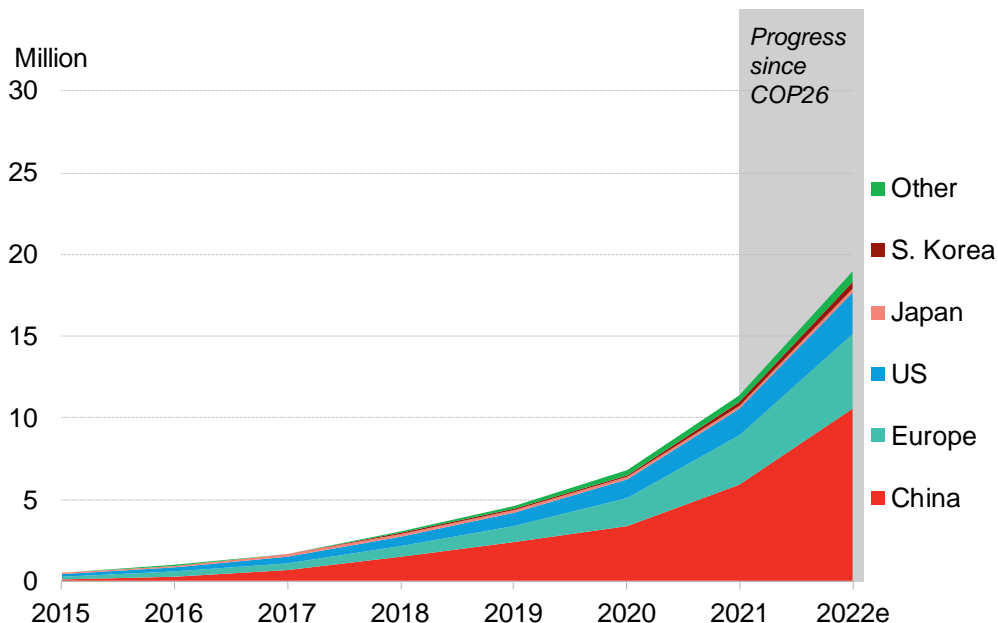
This equates to about 2% of the global fleet of passenger vehicles.

China and Europe are home to 80% of that EV fleet.

- There are now nearly 13 million EVs in China – triple the 2020 level.
- There are nearly 8 million EVs in Europe.
- The US comes in third, with an EV and FCV passenger fleet of 3.6 million vehicles – just over a quarter the size of China's fleet.

....but only around 19 million are truly zero-emission

Global passenger ZEV fleet (excludes plug-in hybrids)



Source: BloombergNEF. Note: EV includes BEV and PHEVs.

Using stricter criteria, the fleet of true zero-emission passenger vehicles (excluding PHEVs) has nearly tripled in size since 2020.

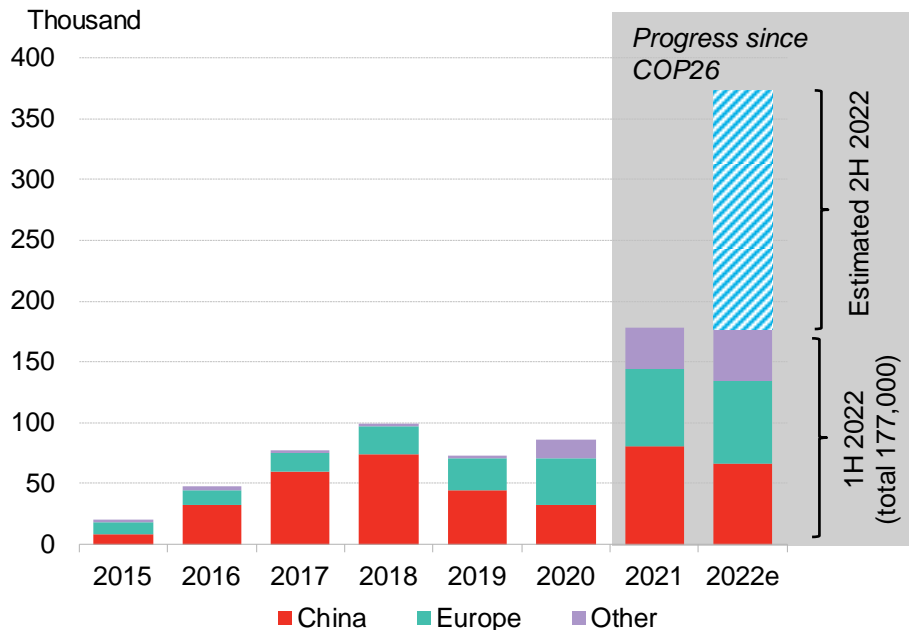
Cumulative all-time sales of zero-emission passenger vehicles reached around 19 million in 2022, up from just 6.8 million at the end of 2020.

Despite Europe's higher share of PHEVs, it is still the second biggest ZEV market globally, after China.

- There are now over 10.5 million ZEVs in China, followed by Europe at 4.6 million – more than twice the 2020 level.
- The US is in third place, with a ZEV passenger fleet around 55% of that in Europe, at 2.5 million vehicles.

Commercial ZEV adoption is beginning to take off

Global commercial ZEV sales, by region



Source: BloombergNEF, EAFO, CAIN, Korea Ministry of Transport, national registration agencies. Note: includes light- (LCV), medium- (MCV) and heavy-duty (HCV) commercial vehicles.

Sales of zero-emission commercial vehicles are growing quickly, but with large differences between countries and segments.

More than 2.5% of commercial vehicles sold globally in 1H 2022 were zero-emission models. These were almost exclusively BEVs.

Adoption was the highest for vans, as the economics of electrification are already favorable for several use cases. South Korea, China, Germany and the UK lead, with electric van penetration ranging from 8% to over 20% of sales in 1H 2022.

Sales of zero-emission heavier trucks are also growing, with China far ahead.

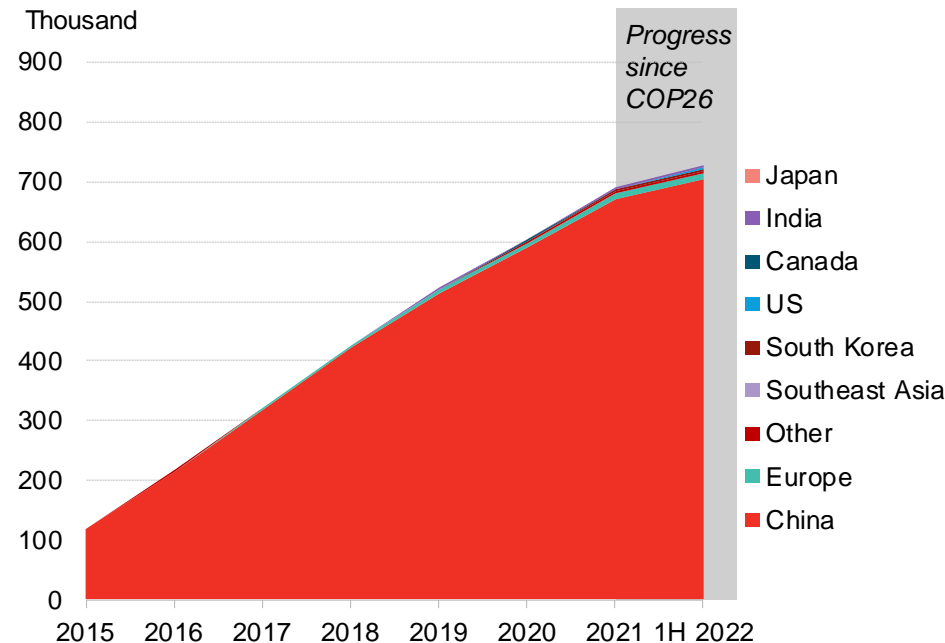
Medium- and heavy-duty electric truck sales were over 12,000 units in 1H 2022, up from about 10,000 units in all of 2021. Battery electrics again dominate ZEV sales, with vehicles used for short-distance distribution, drayage and refuse collection. Most such vehicles were sold in China, where adoption was 2.6% in 1H 2022. Sales in European countries also increased, but lag China.

Fuel cell truck sales also increased, but from a very low base.

Hydrogen-powered commercial vehicle sales were less than 1,500 units in 1H 2022, due to limited product and fuel availability. Some large manufacturers plan to increase production towards the second half of the 2020s.

The growth of the global ZEV bus fleet has slowed

Global zero-emission bus fleet by region/country



Source: BloombergNEF, various governments and trade associations.

The global zero-emission bus fleet has increased by 6% since COP26, and seven-fold since 2015.

In 2020, there were about 604,000 zero-emission buses on the road globally. By mid-2022, this number had grown to around 730,000 units. 99% of the ZEV bus fleet are electric buses (e-buses). These make up about 19% of the global bus fleet.

China continues to lead the market, making up about 97% of the global e-bus fleet.

China's zero-emission fleet is 704,000 units – 19% higher than in 2020. Cities have led the transition, with some such as Shenzhen hitting a 100% ZEV fleet in 2017.

The European zero-emission bus fleet has grown by 42% since 2020, from over 7,500 units to 10,700 units.

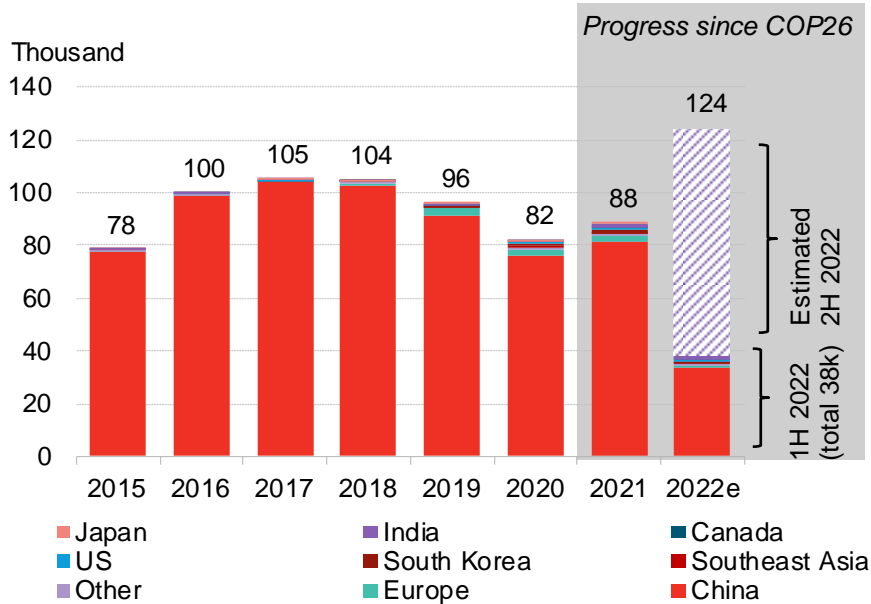
This expansion is being driven by commitments from major cities to begin procuring only zero-emission buses. Examples include London, Copenhagen, Paris and Madrid.

Clean bus deployment in the US should get a boost due to the funding from the Infrastructure Investment and Jobs Act.

The US zero-emission bus fleet sat at about 2,000 units through 1H 2022, though cities are now using additional federal funding to procure new zero-emission buses.

Zero-emission bus sales are set to increase again, driven by China

Global zero-emission bus sales by region/country



Global zero-emission bus sales are expected to rise to over 124,000 units in 2022.

This represents 41% growth from 2021, surpassing 100,000 unit sales for the first time since 2018.

The global zero-emission bus market has been propelled primarily by growth in China.

- Growth to date has been driven by national subsidies, and municipal policy to transition bus fleets to zero-emission sources. In the first half of 2022, around 34,000 zero-emission buses have been sold in China.
- China's zero-emission bus market is typically stronger in the second half of the year, and there will be a desire among buyers and manufacturers to claim subsidies before they phase out at the end of this year.

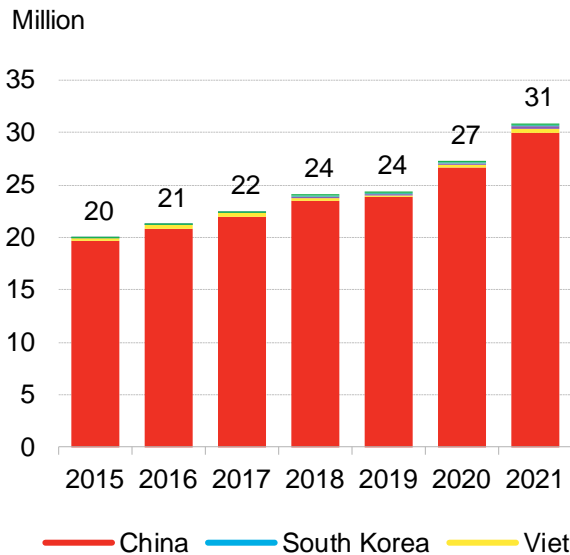
Europe's zero-emission bus sector was the second largest after China, with nearly 2,800 units sold in 2021.

Outside of the two leading areas (China and Europe), South Korea, India, the US and Latin America are all showing new growth in e-bus sales, but from a low base.

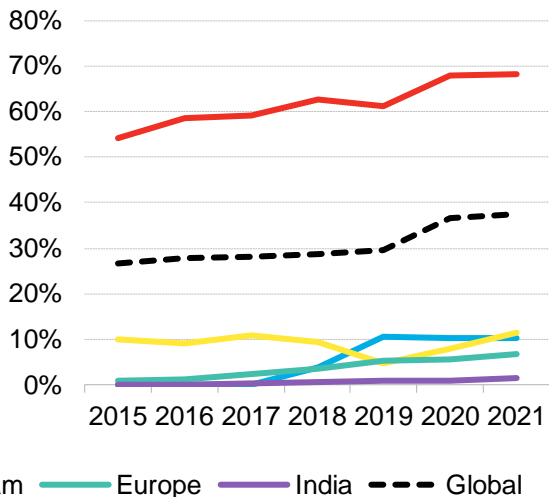
Source: BloombergNEF. Note: China includes muni and non-muni buses. 2022 sales are estimated.

Sales of electric two-wheelers were five times higher than passenger EVs in 2021

Electric two-wheeler sales



EV share of two-wheeler sales in key markets



Electric two-wheeler sales reached 31 million units in 2021, up 13% from a year earlier.

Global sales of two-wheelers grew 11% in 2021 but were still below the pre-pandemic peak.

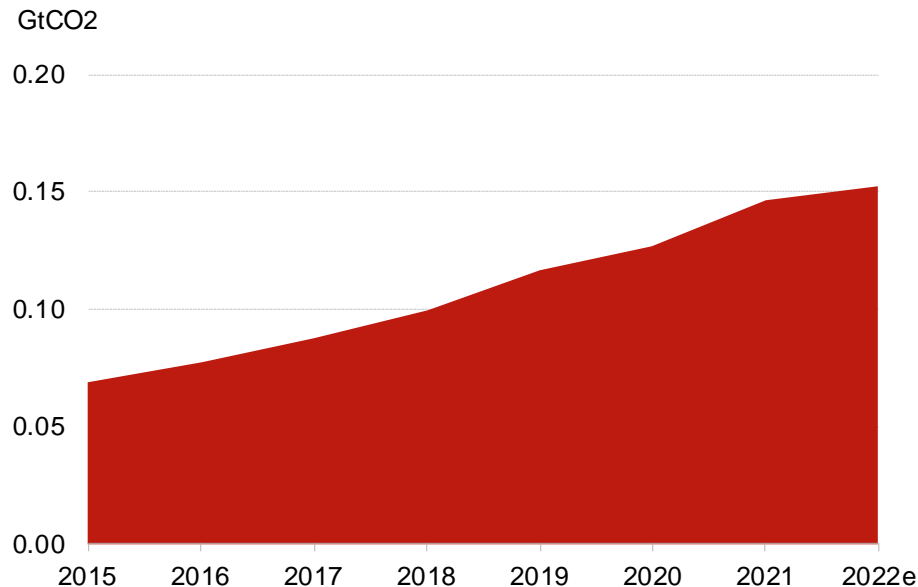
Nearly 70% of two-wheelers sold in China, and just under 40% globally, were electric in 2021.

- National standards introduced in China in 2019 require all electric bicycles and mopeds to have pedals along with an electric motor. This drove demand in China to over 30 million units.
- In Europe, the availability of purchase incentives drove electric two-wheeler sales to 106,000 vehicles in 2021, forming 7% of all two-wheeler sales in the region that year.
- Increasing model availability and the subsidies offered by federal and state governments in India also drove sales there up 75% in 2021, to 234,000 units.

Source: BloombergNEF.

EVs and FCVs are avoiding about 150 million metric tons of emissions per year

Avoided net annual emissions from road transport from EVs and FCVs



Source: BloombergNEF. Note: chart emissions includes passenger vehicles, commercial vehicles, buses and two- and three-wheeler emissions avoided from tailpipe and then subtracting power sector emissions. 2022 is estimated based on the fleet size from BloombergNEF's "Long-Term Electric Vehicle Outlook 2022."

A growing global EV and FCV fleet is already helping to avoid carbon dioxide emissions.

Electric vehicles will be eliminating about 152MtCO₂ per year of global road transport emissions by the end of 2022. This is a 'net' figure, which accounts for the small increase in power-sector emissions resulting from higher electricity demand. It will rise as more ZEVs roll out.

Avoided emissions at the end of 2022 will be up about 20% from 2020.

Net emissions avoided were just below 127MtCO₂ at the end of 2020, and have been increasing as the EV and FCV fleet grows. EVs account for over 99.9% of avoided emissions, with FCVs playing a very minor role.

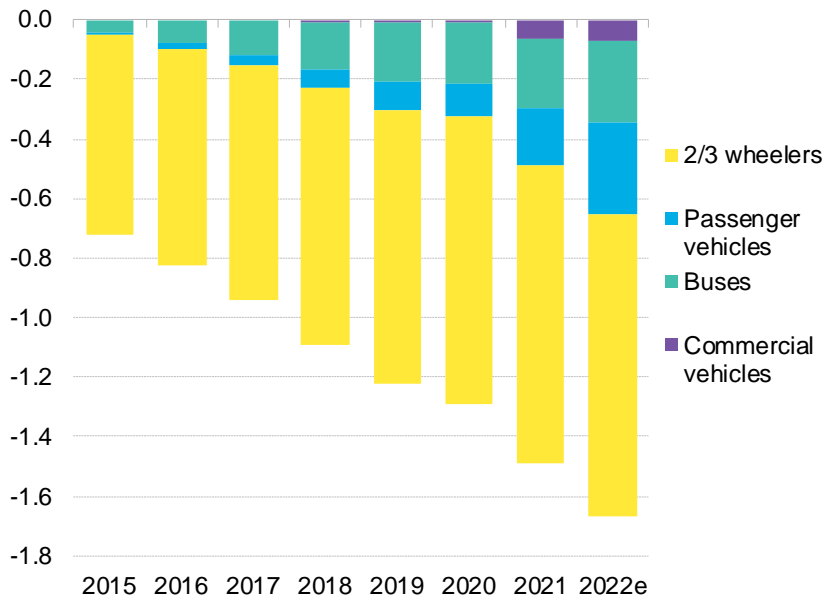
There is a long way to go – the avoided emissions estimated for 2022 are only about 2.4% of all road transport emissions.

While EV and FCV sales have risen dramatically, fleet turnover varies by country and use-type. More clean vehicles need to make their way into the fleet first to drive down emissions more steeply.

Oil use avoided by EVs has more than doubled since 2015

Oil demand avoided by EVs and FCVs

Millions of barrels of oil per day



Source: BloombergNEF, IEA.

Global oil demand in road transport is expected to reach roughly 43.9 million barrels per day in 2022, a slight increase over the past year.

The adoption of electric vehicles and fuel cell vehicles are expected to avoid almost 1.7 million barrels of oil per day in 2022, up from 1.5 million barrels per day in 2021. This is about 3.8% of total demand.

Avoided oil consumption has more than doubled from 2015-2021, up from ~725,000 barrels of oil per day in 2015. This is expected to accelerate.

Two- and three-wheeled EVs should account for 61% of the oil demand avoided in 2022 due to their rapid adoption and large fleet, particularly in Asia.

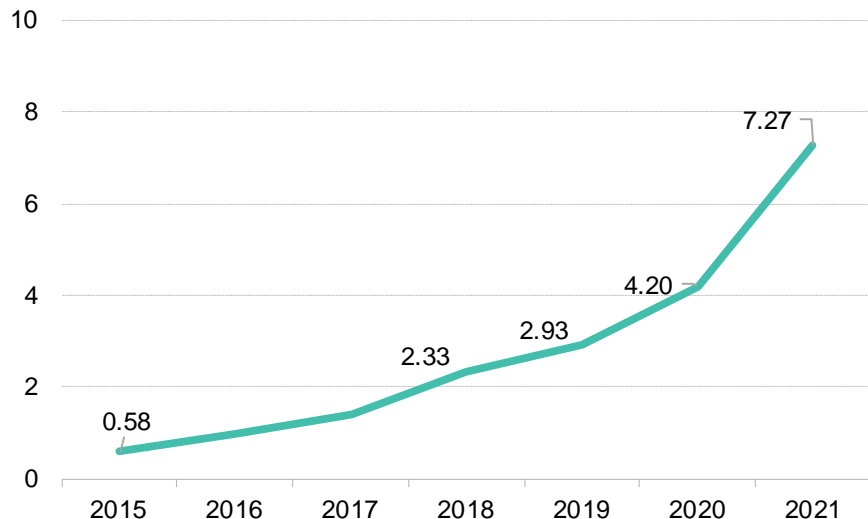
Passenger EVs are expected to surpass buses in 2022 to represent 18% of total oil demand avoided. The other two segments remain consistent with last year's data: buses with 16% and commercial vehicles accounting for just 4% of oil demand avoided in 2022.

In BNEF's Net-Zero Scenario, which achieves a zero-emission vehicle fleet globally by 2050, oil displacement increases to over 7 million barrels per day in 2030 – roughly equivalent to Russia's total oil and products exports prior to the war. This figure rises to nearly 16 million barrels per day in 2035.

Leading automakers are more committed to EVs than ever before

BNEF automaker EV exposures: industry-wide score

Volume-weighted segment scores



Source: BloombergNEF. Note: Scoring is out of 100 points in total. *qualifying automakers must have sold a minimum of 250,000 vehicles that year and have transparent financial information. In 2015-2018, only BEVs and PHEVs were scored as a part of industry scoring. FCVs were added in 2019-2021. For full criteria, see BNEF's Automaker EV Exposure Scores report.

BNEF's automaker EV exposure scores provide a quantitative measure of automakers' exposure to the passenger EV and FCV market.

The scoring assesses automakers* on three factors: 1) EV sales, 2) EV revenue and 3) EV model count. It weights these against total unit sales and total revenue for each automaker.

The volume-weighted, industry-wide score has increased 73% since 2020.

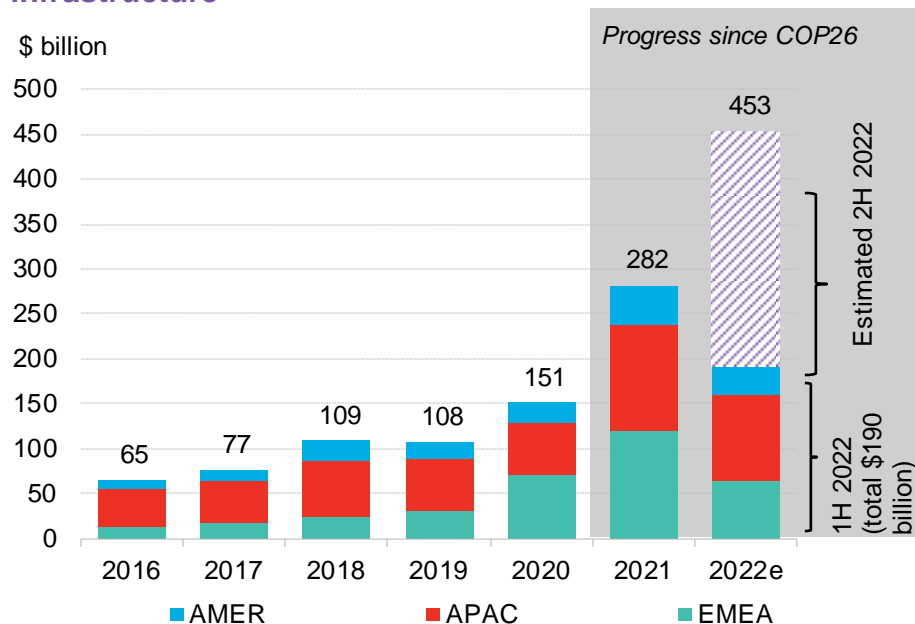
This can be understood as rising exposure, and commitment, to the EV market. The industry, while improving, only has a 2021 volume-weighted score of 7.27. In theory, an automaker could achieve a score of 100 if all their sales and revenues came from EVs.

Total EV revenues for our sample of automakers has increased by over 100% in 2021, compared to 2020.

EV revenues for qualifying automakers jumped from \$111 billion in 2020 to \$223 billion in 2021 – highlighting the increased pace of the zero-emission vehicle transition.

Clean transport spending will exceed \$450 billion in 2022

Global spending on clean road transport vehicles and infrastructure



Source: BloombergNEF. Note: includes passenger and commercial vehicles, buses, public and home charging and hydrogen refueling, and BEVs, PHEVs, FCVs.

Global spending on clean road vehicles and infrastructure – including BEVs, PHEVs and FCVs – has hit nearly \$1 trillion cumulatively from 2016 through the first half of 2022.

BNEF tracks investments across an array of subsectors, including clean passenger vehicles, commercial vehicles, buses and home and public charging infrastructure. This figure includes final purchases of vehicles and investment in infrastructure, but not investment into manufacturing plants or other supply chain steps.

In the first half of 2022, clean transport spending hit an estimated \$190 billion.

The APAC region led in the first half of 2022 with \$95 billion, with EMEA at \$65 billion and AMER at \$30 billion, respectively.

Global clean road transport spending in the first half of 2022 was greater than the total figure in 2020.

We expect the final total for 2022 to exceed \$450 billion, around 60% more than the 2021 figure.

Passenger vehicle investments far outweigh the other segments.

Passenger EVs and FCVs accounted for 84% of total expenditures in 1H 2022, less than in previous years. This highlights increased spending on commercial vehicles and infrastructure.



Market Drivers

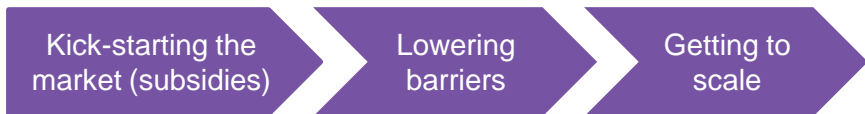
Policy, technology and
infrastructure



**Bloomberg
Philanthropies**

BloombergNEF

Policies have evolved from subsidies to market-based mechanisms



- Manufacturing subsidies
- Direct purchase subsidies
- Tax credits
- Company car allowances

- Charging infrastructure funding / public procurement
- Charging standards

- Fuel economy / emissions regulations
- EV quotas
- City restrictions on polluting vehicles
- Internal combustion engine bans



Effective, but expensive

Less expensive, competitive, scalable

Direct purchase incentives, which lower the upfront cost of an EV, are an effective tool in incentivizing early EV adoption, but are expensive for governments to support in the long term.

China has had some of the most generous subsidies in place since 2010, but has been reducing them annually, and these are now set to expire by the end of 2022. The 10% purchase tax exemption has been extended to 2023.

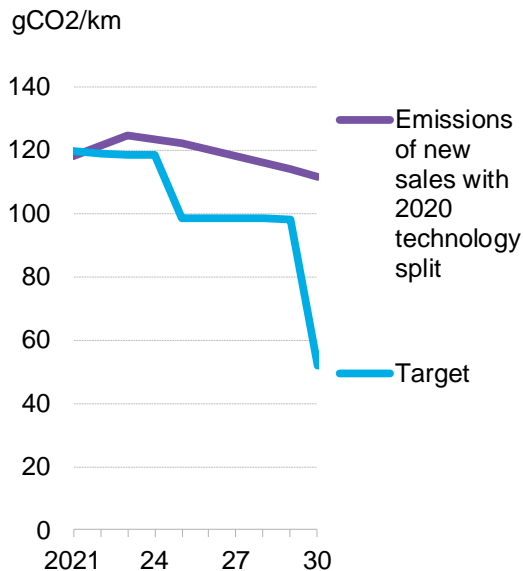
Supply side policies, like fleet-wide fuel economy targets, are gaining importance.

- Europe and China have some of the most stringent fuel economy targets in place globally, which automakers must meet. Meeting them implies significantly increasing sales of electric vehicles.
- Automakers active in these two regions are thus strongly induced to launch new EV models, and make them attractive to consumers.
- Tightened Corporate Average Fuel Economy (CAFE) standards in the US will also be difficult to meet without much higher EV sales.

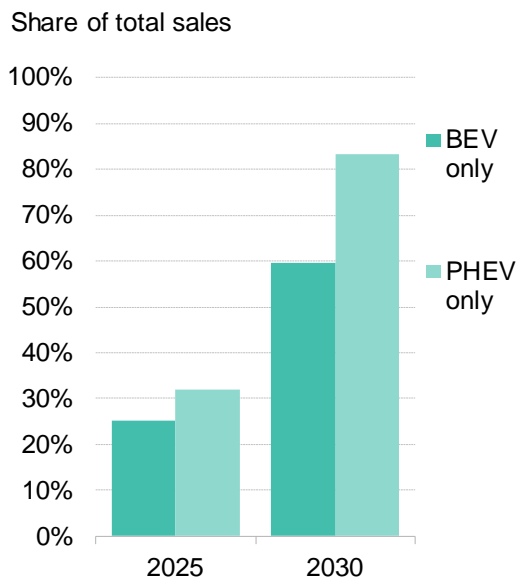
Source: BloombergNEF.

EU targets are pushing road transport CO2 emissions toward zero

Historical and target average vehicle CO2 emissions in Europe



Required EV adoption to meet new EU CO2 emission targets



Europe's new vehicle CO2 regulations effectively ban ICE car sales in 2035. As of that year new cars sold in the EU will need to reduce their CO2 emissions by 100%.

Regulations, first proposed in July 2021, were voted on and accepted in the European Parliament (June 8, 2022) and then the Council of the European Union on June 29, 2022.

On October 27, 2022 after the Council's triilogue negotiations with the European Parliament, the new targets are now confirmed.

An intermediate target of 55% reduction (compared to 2021 levels) for cars was agreed for 2030.

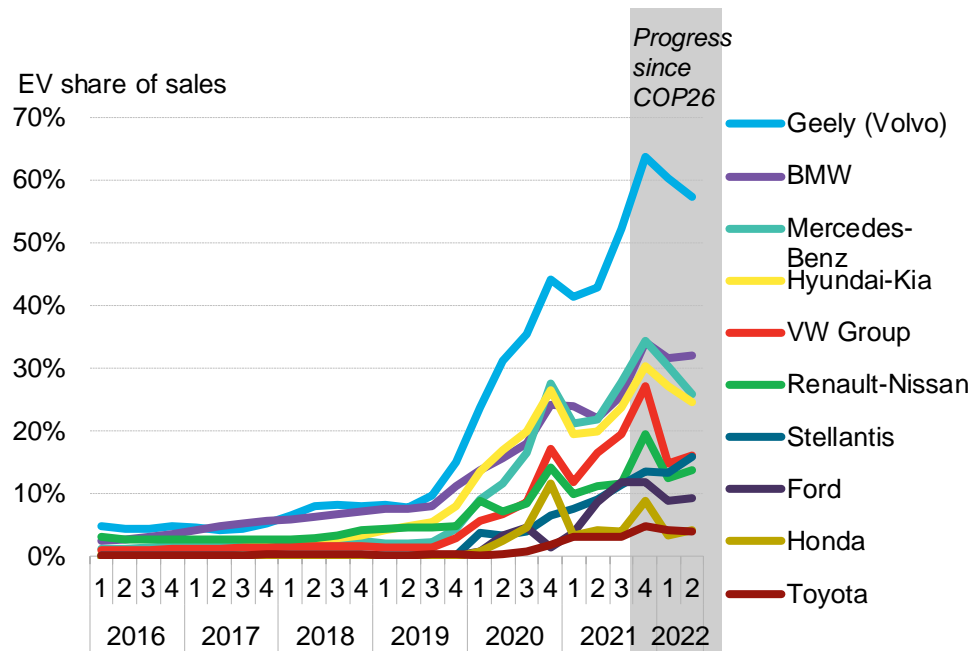
To comply with the 2030 target, at least 60% of new car sales will have to be electric in 2030. This figure assumes all of the EVs are BEVs, and increases to 80% if only PHEVs are used for compliance.

Source: BloombergNEF, European Commission. Note: The 2025 target calls for CO2 emissions to be 15% lower than in 2021; the EV share depends on the BEV-PHEV mix.



Several automakers are at or above 25% EV sales in Europe

Automakers' EV sales share in Europe



Source: BloombergNEF. Note: Includes BEV and PHEVs.

Electric vehicles are now a major component of automakers' sales portfolios in Europe.

Automakers continue to do well in Europe with their EV sales, though in the first half of 2022 many saw a slight decrease in EV share of sales due to supply chain bottlenecks, as well as seasonality of car sales.

In 2020, EVs contributed about 12% to major automakers' sales in Europe. This has leapt to an average of 21% in 1H 2022.

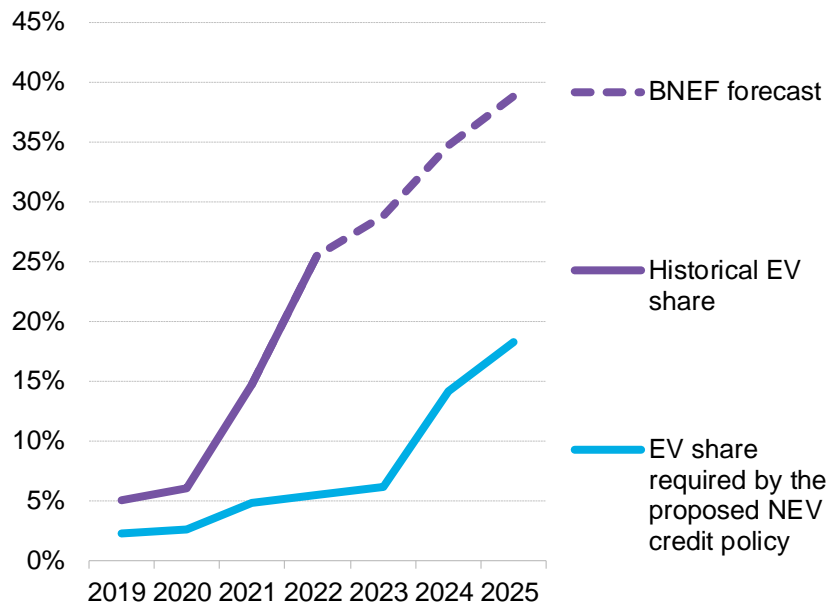
Premium brands, such as Volvo, BMW and Mercedes-Benz, have the highest EV sales share among automakers with European operations, but about 68% of their combined EV sales were still PHEVs in 2021, highlighting the challenge many automakers face in moving fully to zero-emission options.

These companies achieved the highest EV sales shares in Europe for 1H 2022:

- Geely (Volvo): 59%
- BMW: 32%
- Mercedes-Benz: 28%
- Hyundai-Kia: 26%

China's EV policies are tightening, but organic demand is taking over

Historical EV share of new car sales and required share to meet NEV targets



Since 2019, China has been promoting domestic EV sales through the New Energy Vehicle (NEV) credit and Corporate Average Fuel Consumption (CAFC) credit systems.

Under the NEV credit system, automakers are required to generate credits from the production of battery electric, plug-in hybrid and fuel cell vehicles.

To meet the current set of NEV requirements (until 2023), EVs will have to be 6% of passenger vehicle sales in 2023. The new, proposed NEV targets, announced in July 2022, call for NEV shares of 28% in 2024 and 38% in 2025. As each EV can be awarded more than one credit, BNEF estimates the actual NEV share of new car sales would need to hit 14% in 2024 and 18% in 2025.

Raising the quotas for later years reflects China's commitment to support further EV adoption, but as consumer demand grows rapidly, China looks set to exceed these targets.

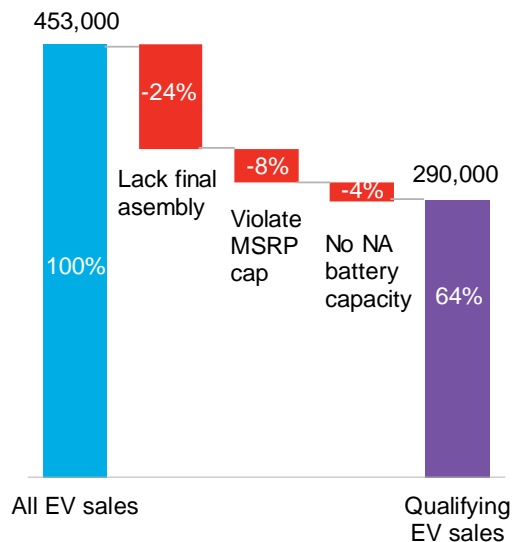
EVs already comprised 23% of new car sales in the first half of 2022 and BNEF expects them to reach 39% by 2025.

Local automakers have achieved their NEV credit requirements thus far, but some global automakers, such as Toyota and Honda, have struggled.

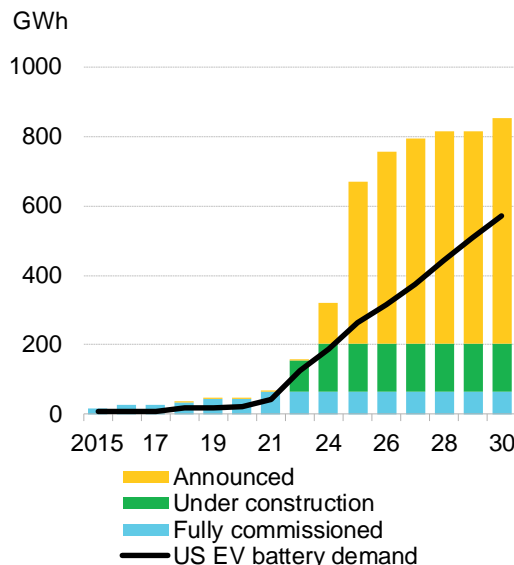
Source: BloombergNEF, Ministry of Industry and Information Technology. Note: Includes BEV and PHEV. Required EV share assumes a BEV to PHEV ratio of 8 to 2.

The US EV sector has been energized by new policy and regulation

1H 2022 EV sales that would qualify for a portion of IRA credits in 2023



North America lithium-ion cell manufacturing nameplate capacity



US EV policy has changed dramatically in the past year, with the confirmation of three major pieces of support on fuel economy standards, charging infrastructure and the Inflation Reduction Act (IRA).

The IRA in particular has energized interest in the US EV sector, with revised federal EV tax credits, a new used EV credit, incentives for commercial EVs and billions in loans and grants.

BNEF estimates that 64% of the EVs sold in 1H 2022 would qualify for a portion of the new clean car tax credit in 2023. This is compared to 31% that would receive the full credit in 2023 under the old tax credit policy.

As a result of IRA, BNEF expects the US EV fleet will be over 20% larger by 2030 than previously forecasted.

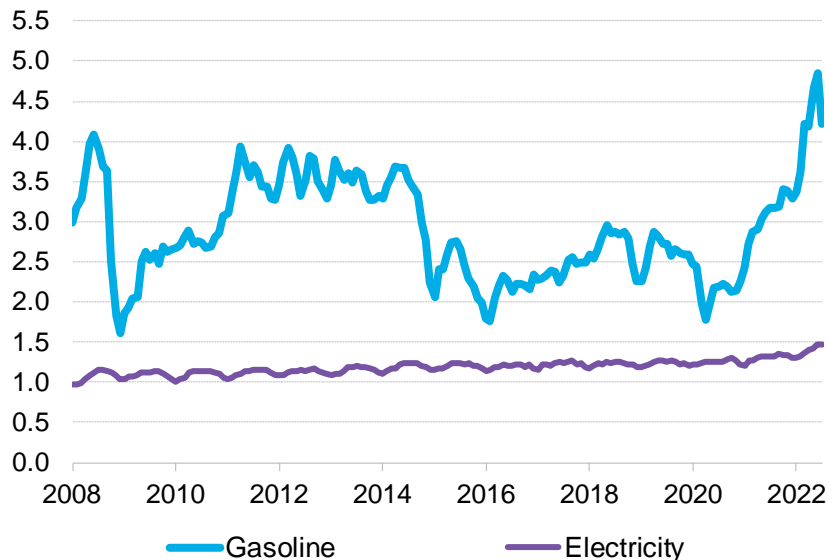
There is enough planned lithium-ion battery cell manufacturing capacity in North America to meet this demand and the IRA also has powerful incentives for battery manufacturing to speed up deployment. Raw material supply and refining are more likely to be a barrier.

Source: BloombergNEF, US Department of Energy. Note: Rules not yet finalized for battery component and raw materials requirement. Values rounded to nearest thousand unit. Figures are based on actual 1H 2022 sales and are not a forecast for future sales.

Following Russia's invasion of Ukraine, EV interest spiked in part due to higher gas prices

Average US vehicle fuel prices, 2008-July 2022

\$/gallon of gasoline equivalent (gge)



Source: BloombergNEF, EIA, Bloomberg, AAA. Note: uses gasoline and electricity data from AAA and EIA Short Term Outlook, 1H 2022 data from EIA. EIA converted electricity residential prices to dollars-per-gallon-equivalent (gge), assuming EVs are 3.5 times more efficient than internal combustion engine vehicles.

Early in 2022, the US saw increased EV interest in consumer surveys and online marketplaces as gasoline prices rose.

Edmunds highlighted that 25% of its users had searched for a “green vehicle” (hybrids and EVs) the week of March 14, 2022, compared to just 14% a month prior. 48% of consumers surveyed said gas prices were the most important, or a very important factor in a car purchasing decision.

Cars.com reported that searches on its website for electric vehicles increased by 110% on March 8 versus February 24, 2022.

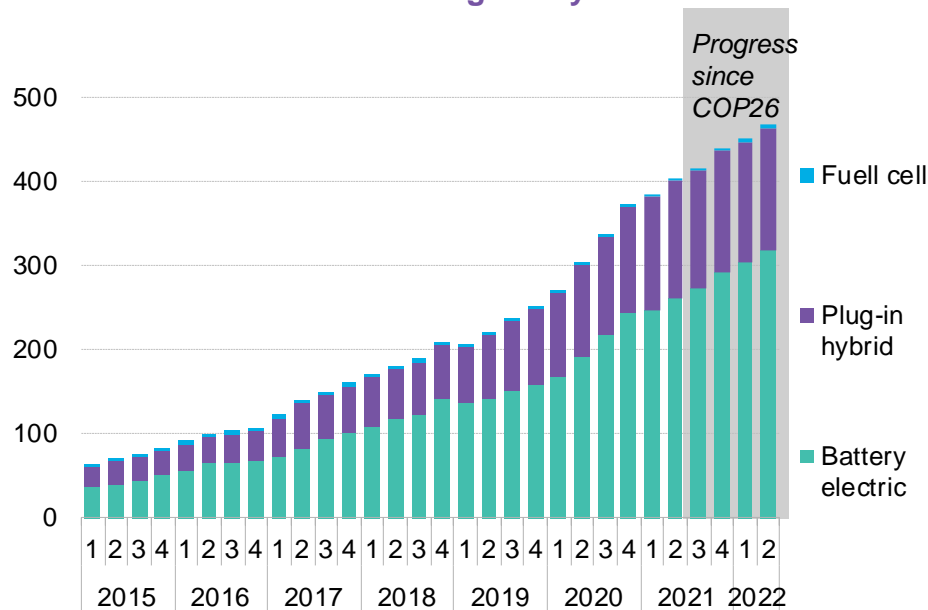
Higher gas prices make the total cost of ownership more favorable to EVs, as the delta between gas and electricity prices grows wider.

In February 2022, gasoline was 2.5 times more expensive (on a \$/gge basis) than electricity, highlighting the benefit of switching to EVs. In June 2022, gasoline was more than 3 times as expensive.

Still, consumers were unlikely to see this value as many of the same global market forces that led to higher gas prices also put pressure on upfront EV costs. EVs remain supply-constrained in many markets, leading to long wait times and inhibiting many consumers from purchasing an EV at an affordable upfront price.

Every year, there are more EV models to choose from

EV and FCV models available globally



The number of EV and FCV models available around the world has increased 25% since 2020.

While at the end of 2020 there were 244 battery electric and 126 plug-in hybrid vehicles models available globally, by the end of 1H 2022 this had risen to 318 and 145, respectively.

China is leading in terms of model availability.

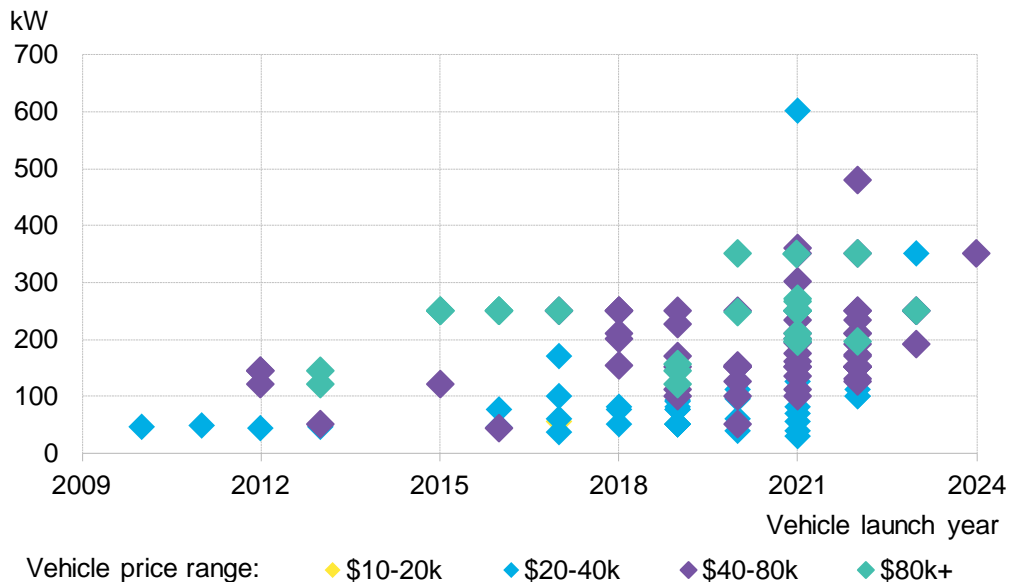
By the end of 1H 2022 there were 280 EV and FCV models available in China, compared to 206 in Europe and just 84 in the US.

The number of available EV models increased the most in the US. At the end of 2020 there were just 59 EV models available in the country. This figure had risen 43% to 84 in 1H 2022.

Source: BloombergNEF.

New BEVs can charge faster than ever...

Maximum charging capability of selected BEV models, by year of launch



Source: BloombergNEF, company press releases.

Today, the vast majority of BEVs available in the market include fast-charging capabilities in addition to the on-board charger.

This feature reduces charging times, increasing convenience and helping to encourage adoption.

Historically, the dominant charging power available in the market was 50kW, with a few luxury brands offering rates over 100kW.

While the average max-charging power of a BEV launched in 2019 was 111kW, this has increased to 195kW for models launched in 2022.

Some high-end BEV models go further, allowing for charging powers of up to 350kW.

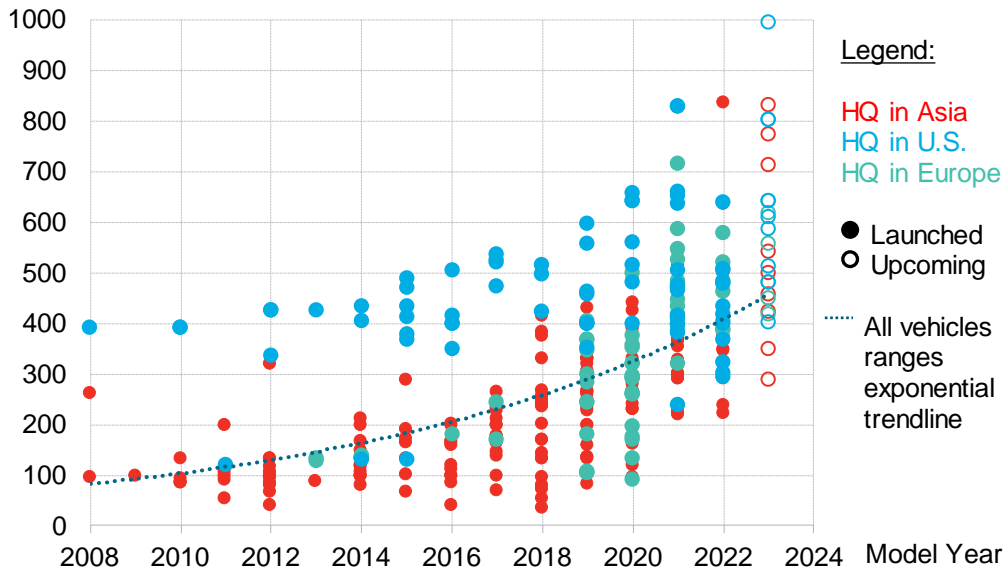
Lately, more automakers have announced implementation of 800V architectures to achieve 350kW+ in future models.

Some of the existing EV models with charging power of 350kW and up include the GM Hummer, Hyundai Genesis GV60 and the G9 from Chinese startup Xpeng.

... and drive for longer distances

Range of launched and upcoming BEV models, by launch year

EPA range in kilometers



The average range of newly launched BEV models has steadily risen over several years, exceeding 430km in 2022.

Automakers have been progressively extending the range capability of their offerings. Since 2019, average BEV range increased at a compound annual growth rate (CAGR) of 14%.

Models announced for 2023 are already hitting an all-time high of 580km on average and we expect these numbers to rise further in the future.

There is a variance across regions, with European models going slightly further in 2022 than those from US automakers.

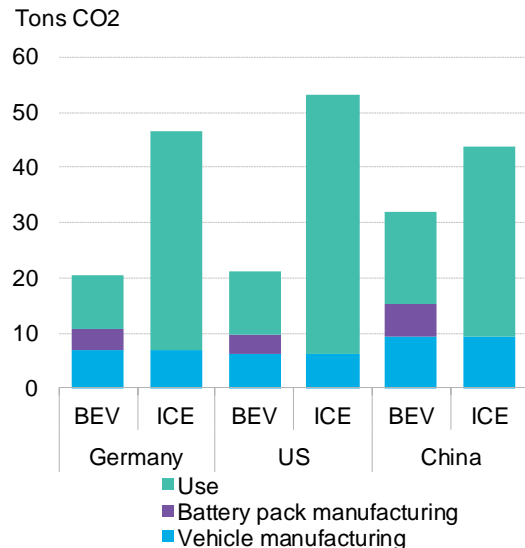
BEVs in Europe had an average range of 470km in 2022, compared to the US at 430km.

The lowest-range models are more common in the Chinese market, and in particular in the mini-car segment. However, this is changing fast, with several models introduced there in 2022 moving well beyond 500km.

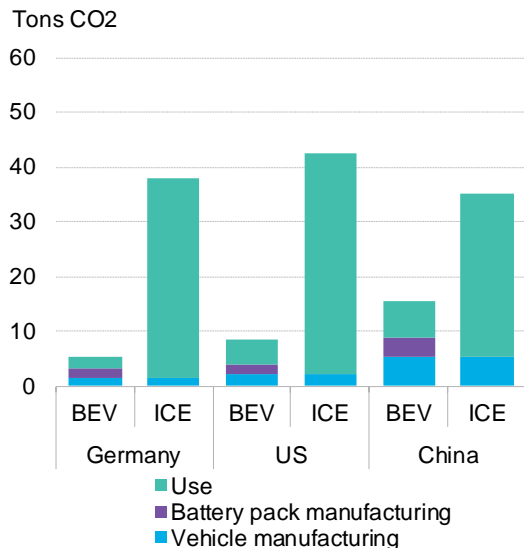
Source: BloombergNEF, EPA, Insideevs, EVCompare, Marklines, automaker's websites. Note: EPA electric range used. For models without a verified EPA range, a value was converted from the WLTP or NEDC. Regions correspond to automaker headquarters. Tesla variants of the S, X, 3 and Y are shown as individual models.

BEVs have lower lifecycle emissions than internal combustion engine vehicles

BEV and ICE vehicle lifetime CO2 emissions, 2022



BEV and ICE vehicle lifetime CO2 emissions, 2030



The lifecycle CO2 emissions of battery electric cars produced in 2022 are already lower than those of combustion cars.

The lifecycle CO2 emissions of battery cars produced in 2022 and used for 250,000km in Germany, the US and China will be 56%, 60% and 27% lower than those of ICE vehicles, respectively.

The growth of renewable energy in the power system means that manufacturing emissions will drop rapidly for both ICEs and BEVs between 2022 and 2030.

More importantly, cleaner electricity means cleaner-running BEVs. This means that the emissions advantage of BEVs against ICEs will widen further.

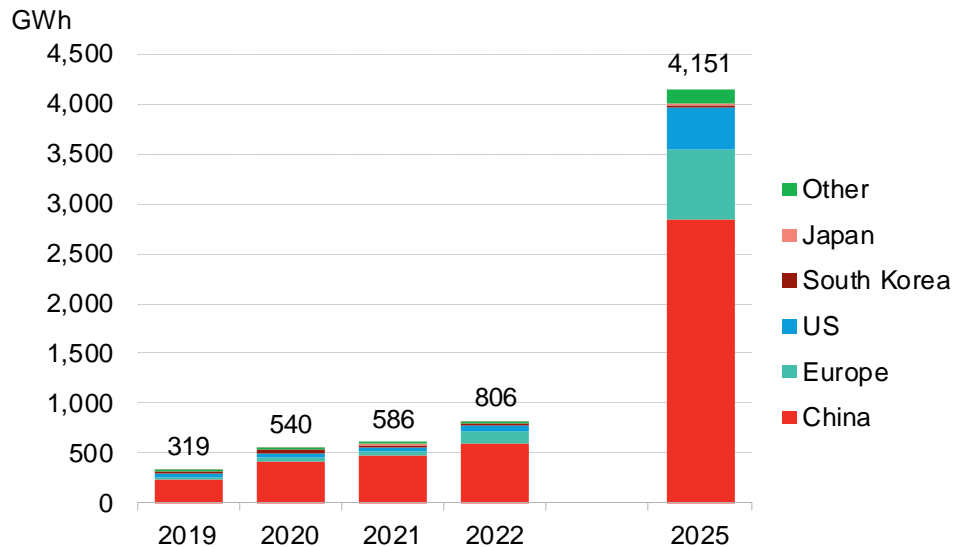
By 2030, lifecycle CO2 emissions of BEVs will be 86%, 80% and 56% lower in Germany, the US and China than for comparable ICEs.

Recycling a battery produced in Europe can lower its lifecycle emissions by 5-86%, giving a 1-17% reduction for the whole BEV.

Source: BloombergNEF, ICCT. Note: we assume that raw materials, battery cells and pack are manufactured domestically; the battery size of medium BEV is 69 kWh; end-of-life or recycling emissions are not included. Recycled battery calculations are for a NMC622 battery, and the lifecycle CO2 reduction depends on the country of manufacturing, recycling and share of recycled materials used.

Battery manufacturing capacity has increased 38% since 2021

Lithium-ion cell manufacturing capacity by plant location



Source: BloombergNEF. Note: 2022 includes facilities commissioned up to May 2022. 2025 'Other' includes capacity outside of the countries indicated. Based on current announcements without de-risking. Values have been rounded.

Battery manufacturing capacity is growing steadily to meet demand from the EV market.

There is currently 806GWh/year of commissioned lithium-ion battery-manufacturing capacity globally. This is 1.5 times the capacity that existed just two years ago.

Although China still dominates globally, Europe has tripled its battery production capacity in just two years.

By 2025, total capacity will jump fivefold, to 4,151GWh/year, if all projects planned and under construction are delivered.

China will continue to be the largest lithium-ion battery manufacturer over this time horizon, but new cell manufacturing is also planned close to demand centers in the U.S. and Europe.

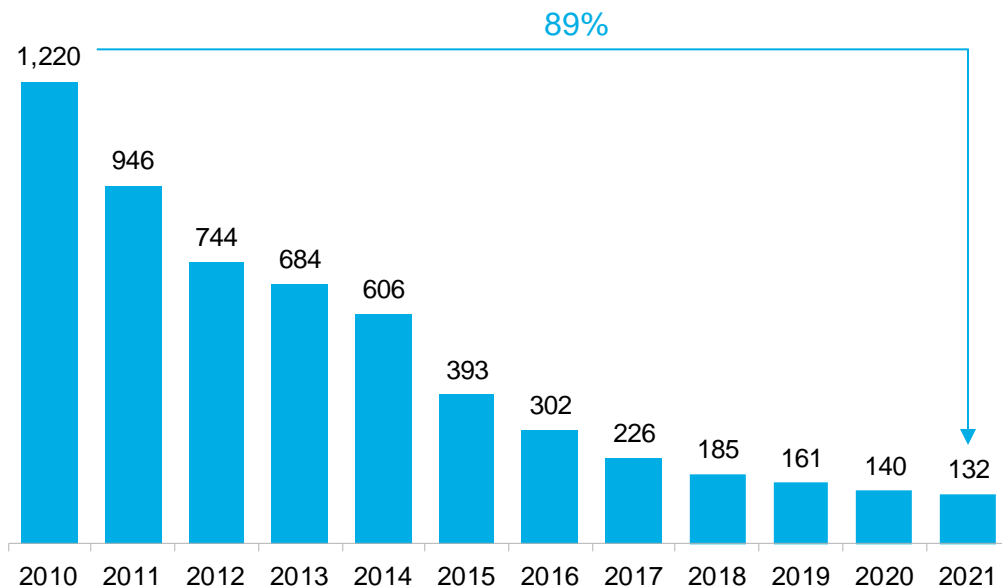
Europe's share of capacity has already grown from just 6% in 2021 to 16% in 2022.

By 2025, the US grows its share from 7% to 10%, driven by many more recent announcements.

Continued battery cost reductions are crucial for the future of EVs

Volume-weighted average lithium-ion battery pack price

Battery pack price (real 2021 \$/kWh)



Source: BloombergNEF.

The price of large-format lithium-ion batteries used in EVs has fallen dramatically over the last decade.

The volume-weighted average battery pack price in BNEF's annual survey has decreased 89% since 2010, from \$1,220 per kWh to \$132 per kWh in 2021.

In 2021, the cheapest packs delivered on a volume-weighted average basis were in China, coming in at \$111/kWh.

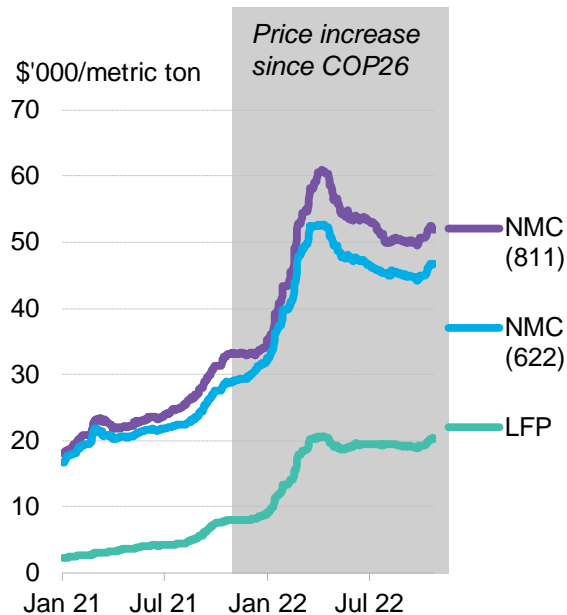
Battery prices fell for a number of reasons, including growing global manufacturing capacity, growing order sizes from leading manufacturers, increasing energy density and introduction of new cell and pack designs.

Recent material price spikes put the future trajectory in doubt. Lithium-ion battery prices are rising for the first time ever in 2022.

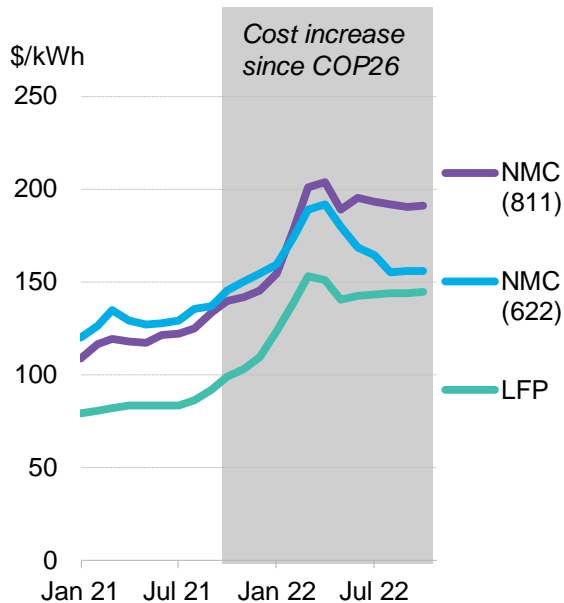
Further cost declines will depend on underlying commodity prices, as well as further advances in battery chemistry and pack design.

Raw material price increases are impacting battery prices

Lithium-ion cathode prices



Battery cell costs by chemistry



Prices for battery cells are facing an unprecedented increase in 2022.

High raw material prices led to a 56% increase in lithium iron phosphate (LFP) cell costs from October 2021 to September 2022, with a peak at \$153/kWh in March.

The cost inflation was acute for NMC (811), as a result of the Russian invasion of Ukraine, which sent nickel prices soaring in March 2022. NMC (811) cell costs rose 44% from October 2021 to March 2022, reaching a peak of \$201/kWh in March.

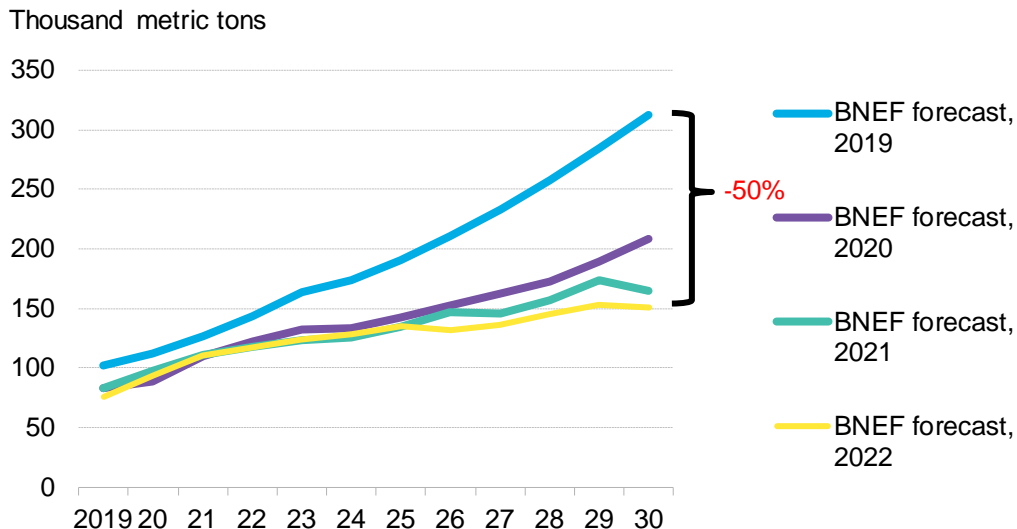
The biggest driver of cost increases is cathode prices, which are the most expensive component in a battery.

LFP prices increased 149% between October 2021 and September 2022, while NMC (811) increased 55%. Prices for cobalt and nickel have come down from their highs earlier this year.

Source: BloombergNEF. Note: Analysis using BNEF Bottom-up Battery Cost Model and Cathode Cost and Prices Livesheet. These charts display adjusted costs based on metals spot prices. Full analysis and assumptions available to BNEF clients in the following report: [Energy Storage Supply Chain Disruptions Explained](#).

Automakers are switching battery chemistry to avoid cobalt

BNEF forecasts for cobalt demand from batteries, 2019-2022



Automakers continue to switch battery chemistries to reduce their reliance on metals associated with higher prices or supply concerns.

For example, over the last three years automakers have revised the battery chemistries they use to reduce their reliance on cobalt, either due to challenges pertaining to child labor in the Democratic Republic of Congo or due to rising prices.

As a result, BNEF's cobalt demand forecast has also decreased over the last three years.

Lithium iron phosphate (LFP) batteries – which use no cobalt, or nickel – benefited the most from the recent price spike.

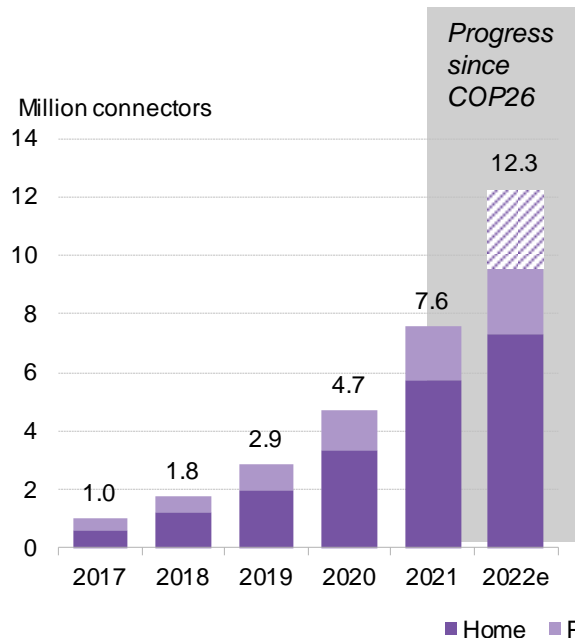
Some automakers have switched entirely to LFP batteries while others have reduced their cobalt exposure, switching to lower cobalt exposure lithium nickel manganese cobalt (NMC) batteries (eg, NMC 622 to NMC 811).

In 2022, around 40% of batteries used in passenger EVs were LFP, up from just 16% in 2020.

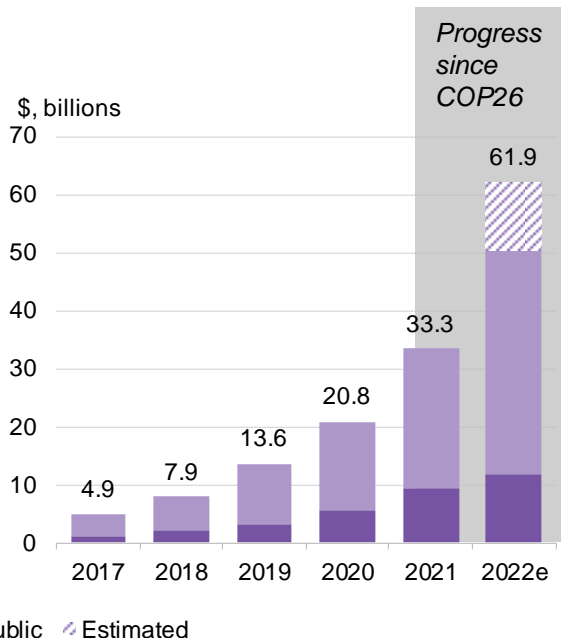
Source: BloombergNEF.

EV charging investment in 2022 equals that of the previous five years combined

Cumulative charger installations



Cumulative charger investments



BNEF estimates that there will be 9.6 million home EV chargers and 2.7 million public chargers installed globally by the end of 2022.

Despite home chargers making up 77% of the cumulative network, public chargers account for 76% of cumulative investment and will serve multiple drivers per charger.

China dominates cumulative investment in all chargers accounting for 57% of the global total, followed by Europe (24%) and the US (12%).

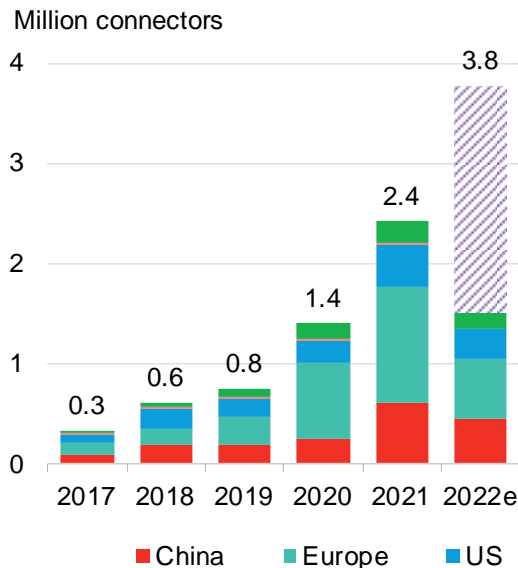
Annual investment in home and public charging in 2022 is expected to reach \$28.6 billion and cumulative investment in the sector will likely pass \$100 billion in 2023.

The industry is reaching new levels of scale in every region of the world which will lead to new efficiencies across supply chains and lower costs of capital from institutional investors.

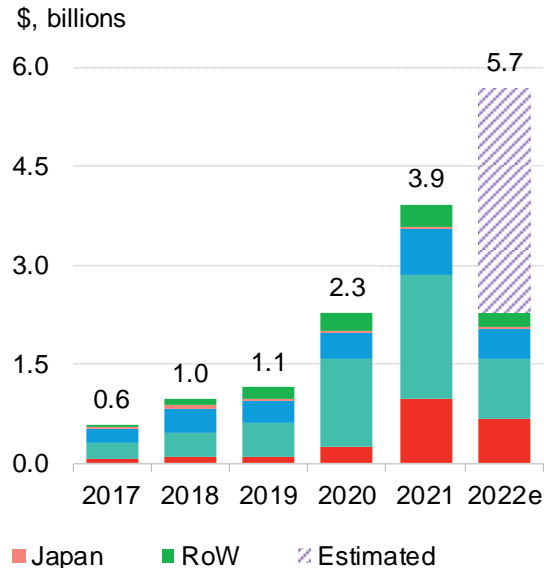
Source: BloombergNEF. Note: Excludes workplace and commercial vehicle charging installations. Includes hardware and installation investment.

European home charging companies are benefitting from high sales

Annual home charger installations



Annual home charger investments



Home charger installations are expected to top 3.8 million globally in 2022, but uptake will vary by region.

The share of BEV drivers installing a home charger is expected to remain high in Europe and the US but will fluctuate depending on the introduction and removal of subsidies. Some drivers opt to use the cable included in the car instead of purchasing a charger.

There is lower adoption of private charging in China as not everyone has an ability to get a home charger installed. This leads to a higher dependence on public charging. We expect to see more public charging across the world as lower-income drivers adopt EVs.

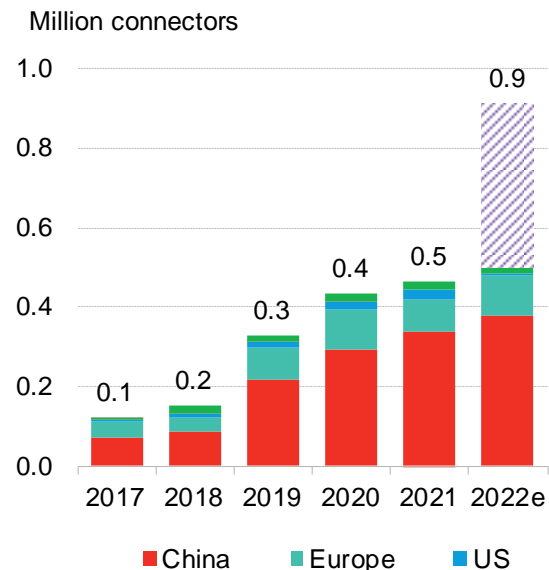
Home charger investment in Europe is expected to top \$2 billion by the end of 2022.

Europe has the highest home charger sales of any region. This could help make its charging companies competitive on the global stage.

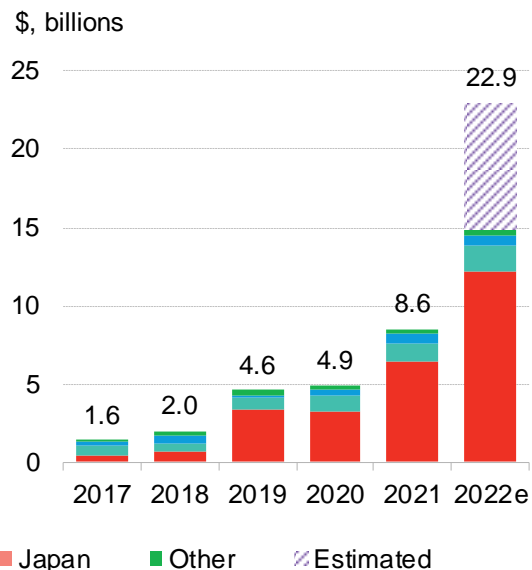
Source: BloombergNEF. Note: Home charger installations are estimated.

Public charger installations to double, investment to increase 2.6x in 2022

Annual public charger installations



Annual public charger investment



Annual public charging installations are expected to top 910,000 in 2022, up from 460,000 in 2021.

Installations have been relatively flat in the first half of the year in Europe and the US but numbers from mid-October suggest the pace of installations has hit new levels in recent months.

China is by far the leader in public charging and is expected to install 600,000 chargers in 2022, more than the rest of the world for the last three years combined. China has installed more DC fast chargers in 2022 than AC chargers, emphasizing the focus on fast charger installations there.

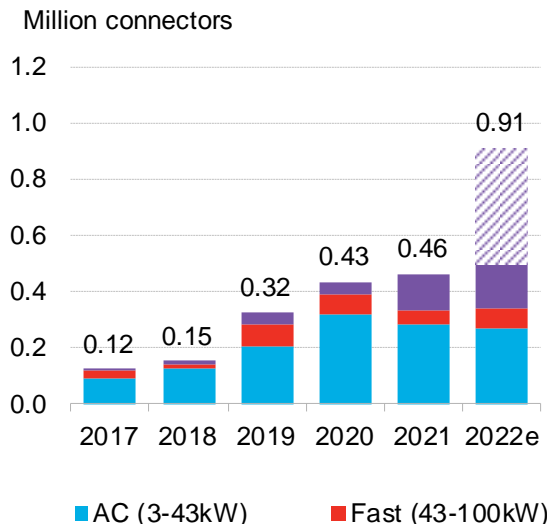
Investment in public charging is estimated to have grown 2.6x in the last year.

A spate of previous announcements in the industry is coming to fruition and investment is increasing. China is expected to invest over \$17 billion in public charging by the end of 2022, compared to \$3.3 billion in Europe and \$1.5 billion in the US.

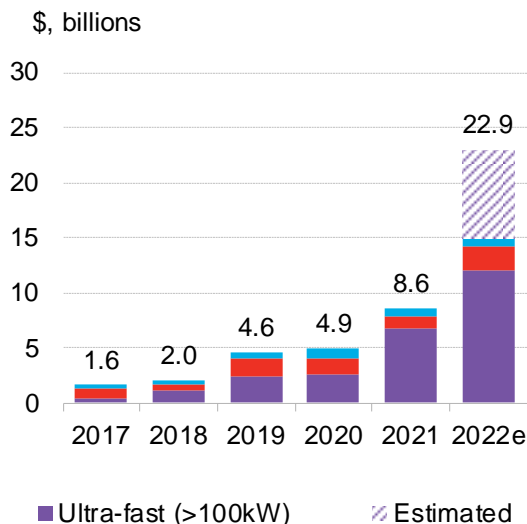
Source: BloombergNEF. Note: Investment includes hardware and local installation costs. Investment numbers are estimated.

AC (slower) charging will be just 7% of investment in public charging in 2022

Annual public charger installations by power type



Annual public charger investment by power type



Fast chargers make up 40% of annual public charger installations, but 93% of investment.

Fast chargers, particularly those over 100kW, account for the lion's share of investment in public charging. Vehicle manufacturers continue to push faster-charging vehicles to lower charging times and reduce the barriers to EV adoption.









DC charger costs are expected to decline in the long-term.

Chinese chargers can cost as little as 30% the cost of chargers produced in the rest of the world, partly due to the scale of manufacturing. China is expected to install over 390,000 DC fast chargers in 2022, six times the installs expected in the rest of the world. Over time hardware costs in other regions should fall, but installation and site costs are less transparent and may not have the same trajectory.

Source: BloombergNEF. Note: Investment includes hardware and local installation costs. Investment numbers are estimated.

Automakers are releasing vehicles with bi-directional charging capability

Automakers that have launched or announced vehicles with bi-directional functionality

Automaker	Models	Standard
	Nissan Leaf, Mitsubishi Outlander PHEV	CHAdeMO
	Kia EV6, Hyundai Ioniq 5 Hyundai	CCS
	Ford F-150 Lightning	CCS
	Vehicles from the MEB platform with 77kWh+ battery in 2023 including the ID.3, ID.4 and ID.Buzz	CCS
	Volvo EX90, Polestar 3	CCS
	BYD Atto 3	CCS
	Lucid Air	CCS
	Announced that future models will have the technology	CCS

Source: BloombergNEF. Note: Japanese versions may have CHAdeMO.

Automakers are announcing models with bi-directional capability and piloting the technology with utilities.

A number of automakers have brought vehicles with bi-directional capability to market and many more are testing the capability in pilots.

Trials are looking at both vehicle-to-home and vehicle-to-grid capability, however, commercial offerings are more focused on vehicle-to-home due to the regulatory and commercial hurdles. The CCS charging standard appears to need more work until it is signed off for full vehicle-to-grid functionality, although automakers are already using it.











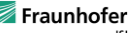

The value of bi-directional charging is unknown and uptake is hindered by high capital costs for compatible charging equipment.

Trials and research reports point to the value of bi-directional charging being in the region of \$400-1,200 per vehicle per year. The value varies depending on the region, available electricity tariffs, the time the vehicle is available and battery size.

It would currently take around five to 10 years to recoup the costs of the external equipment to enable bi-directional charging. The industry is working on reducing these costs to make the technology more attractive.

A busy year for electric truck charging as projects ramp up

High-power electric truck charging projects

Companies involved	Country /Region	# chargers / charger power/ site power	Investment	Year
DAIMLER TRUCK  		8 / not stated/ 4.5MW	Not disclosed	2021
 		Not stated	\$2 million	2022
 and 15 other partners	United States	Not stated	\$13 million	2022
WattEV (3 sites)		52MW* (site power)	Not disclosed	2022
DAIMLER TRUCK  		Not stated	\$650 million	2023
WattEV		8MW (site power)	Not disclosed	2023
DAIMLER TRUCK  	Europe	1,700 chargers	\$510 million	2022
	Spain	1MW (charger power)	Not disclosed	2022
 and 20 other partners	Germany	8** / 0.75MW	\$31 million	2022
DAIMLER TRUCK 	Germany	6 / 0.3MW	Not disclosed	2022

Source: BloombergNEF, press releases. Note: these projects are indicative and specifically target the charging of medium- and heavy-duty commercial vehicles; “Year” refers to the start of project development; *refers to all three of WattEV’s stations planned for 2022; ** refers to the project’s 8 MCS chargers, while another 8 CCS high-power chargers will also be installed.

At least 12 projects targeting commercial electric vehicle charging are now underway or set to begin construction by 2023. These projects were announced in the last 18 months and disclosed investments exceed \$1.2 billion.

For many projects the ultimate goal is to operate MW-scale chargers, once the relevant standard is finalized. Some developers plan to use CCS high-power connectors initially.

The Megawatt Charging System (MCS) – a charging connector developed for electric trucks – was demonstrated for the first time in June 2022 in Oslo, where an electric Scania truck was charged at more than 1MW.

Most of these projects are currently located in the US. Daimler Trucks and PGE were first, and in 2021 deployed eight mega chargers in Portland.

Meanwhile, the EU has set targets for commercial vehicle charging stations along the TEN-T network, setting a lower power limit of 1.4 MW per site.



Corporate Commitments

Ambition, targets and
investments

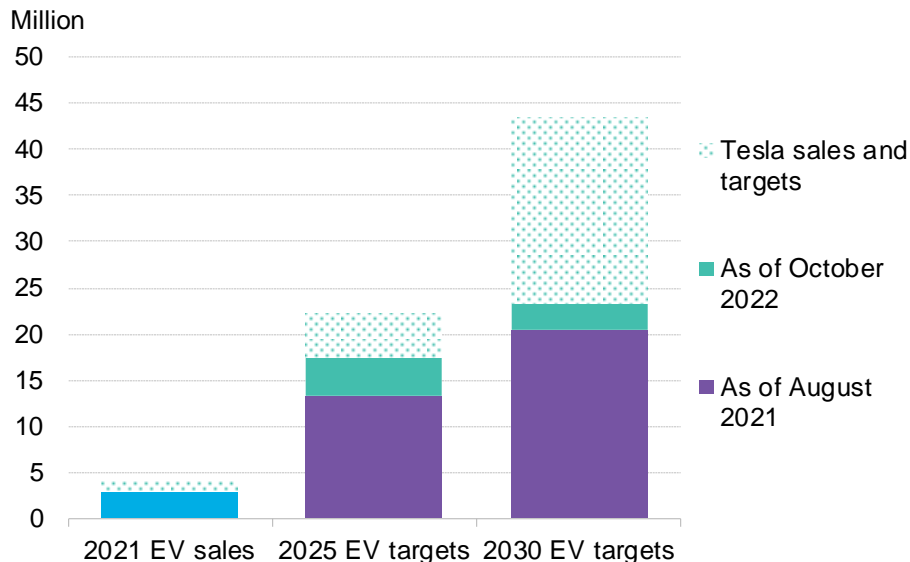


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Automakers are now targeting more than 43 million EV sales per year by 2030

2021 actual and 2025/2030 target EV sales by selected automakers



Source: BloombergNEF, various automakers. Note: EV sales estimates come from corporate statements and estimates from the BNEF EV data hub. Tesla sales and targets are in patterned green to differentiate from vehicle makers that sell ICE models.

In total, 17 automakers have set goals that could result in 22 million EV sales in 2025, including Tesla's goal of hitting an annual growth rate target of 50%.

These 2025 targets are nearly 6 times higher than the actual 2021 EV sales by these automakers, at 3.8 million.

However, in 2022, there were fewer automakers announcing specific new EV sales targets than in 2021.

Stellantis previously had a stated 2025 target but scrapped it in favor of a new 2030 target. Mercedes-Benz upped its 2025 target since last year.

For 2030, automakers have pledged to achieve 43 million in total EV sales, including Tesla's target of selling 20 million BEVs.

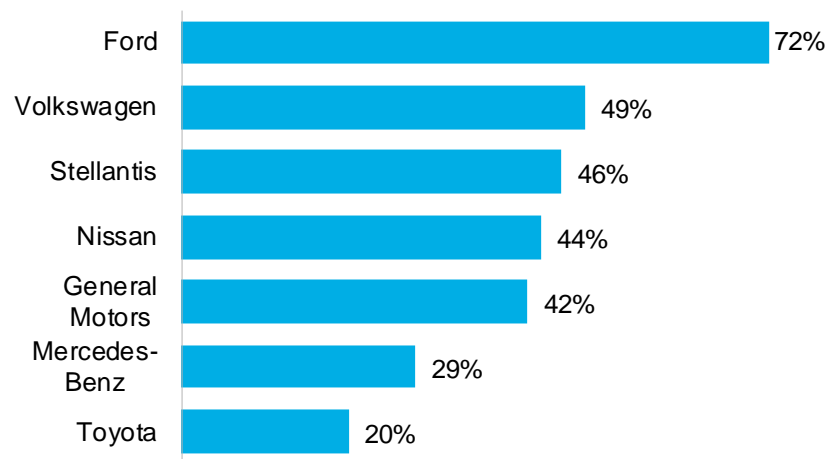
Only three automakers made major changes since COP26. Honda raised its 2030 target to 2 million EVs; Stellantis upped its 2030 target to 5 million BEVs and Mercedes-Benz has a 100% target for 2030. Other automakers' goals remained unchanged.

With few exceptions (Stellantis), most automakers' targets are still based on the catch-all category of 'electric vehicles', leaving ambiguity on the role of hybrid drivetrains.

Major manufacturers' investment plans highlight EV commitments

Selected automakers' R&D and capex commitments for EVs and digital tech

% of total R&D and capex



Source: Bloomberg, BloombergNEF. Note: most targets are 2021-2025, except Ford is 2022-2026 and Mercedes-Benz is over 10 years. R&D and capex commitments are the average of a 3-year period from 2019-2021.

Investment in research, development, equipment and plants for vehicle electrification is the clearest evidence of the automotive industry's rising commitment to the EV transition.

Funds deployed to develop new electric vehicles are the proof of concrete action to support long-term decarbonization goals. Automakers started announcing the expansion of EV manufacturing and partnerships to produce batteries as a part of the investments they had previously announced.

Most of these announcements were made in 2020-2021, but since COP26 certain automakers upped their investment plans in response to the more rapidly growing EV market.

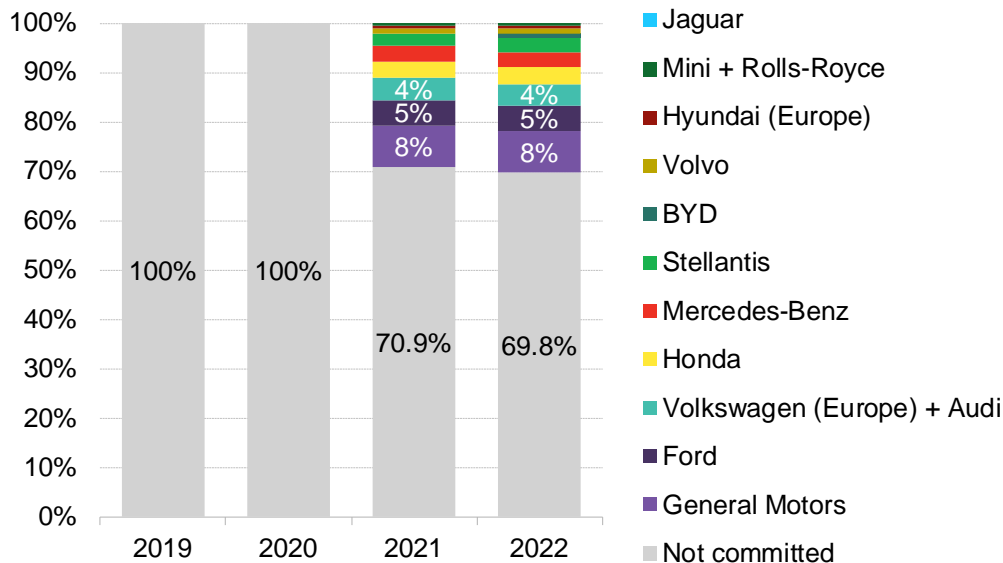
Ford has dramatically stepped up its share of spending on electrification and digital tech in 2022. Toyota has also increased its spending in the space, albeit less than other leading automakers.

The automakers in the chart sold over 38 million vehicles in 2021, representing about 51% of 2021 global sales.

Many other manufacturers, such as BYD, Volvo, Renault, SAIC and BAIC also have ambitious electrification plans and already EVs at scale.

Automakers' ICE phase-out commitments now represent 30% of the global market

Share of passenger vehicles sold by automakers with an ICE phase-out announcement



17 automotive brands have now announced global or regional ICE phase-out targets.

2022 has only seen a slight increase in these types of ambitions, with four declared new targets in the year to date. BYD announced it ended new ICE vehicle sales in 2022.

The dates of these phase-out targets range from 2030 to 2040, depending on the automaker.

Audi, Fiat, Volvo and Mercedes-Benz have chosen 2030, while GM aspires to end ICE sales in 2035. Honda has the latest target year of 2040. Other automakers like Ford, Peugeot, Hyundai and Volkswagen have announced regional ICE phase-outs for Europe specifically.

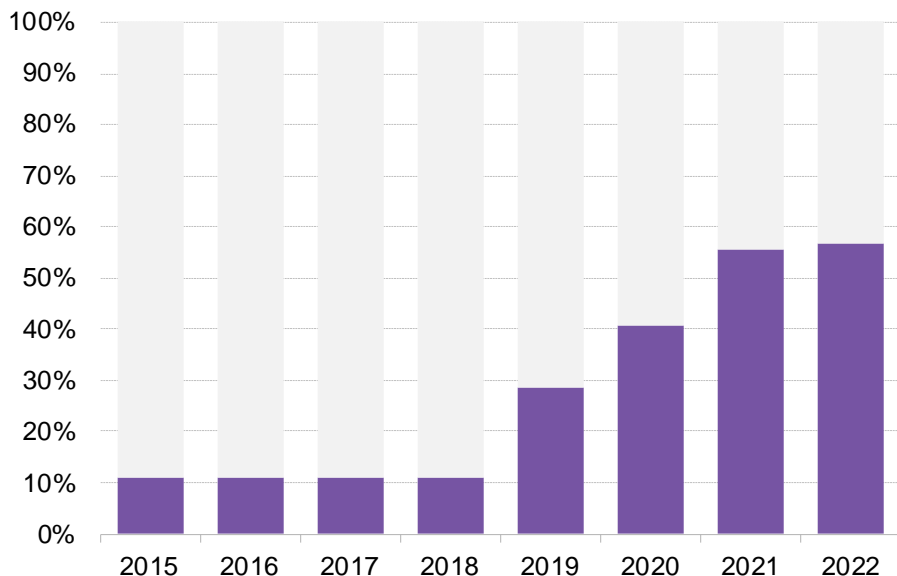
As a share of global passenger vehicle sales, these automakers represented just over 26% of all 2021 sales.

Two years ago, none of these automakers had formally made an announcement around an ICE phase-out pledge. However, around 70% of the global passenger vehicle market remains unaccounted for.

Source: BloombergNEF, Marklines, various automakers. Note: Share of 2021 passenger vehicle sales. Announcements made through October 7, 2022. Stellantis brands included: Peugeot, Fiat, Chrysler, Alfa Romeo and Maserati. Ford signed [The ZEV Declaration](#) at COP 26, indicating their willingness to go fully zero-emission by 2040 globally, but they have not repeated that commitment in reports to their investors. Ford has a confirmed 2035 target for Europe.

Manufacturers covering 57% of the auto market have set some form of net-zero target

Share of global passenger vehicle sales from automakers with a net-zero target by 2050



Source: BloombergNEF, various automakers. Note: Based on 2021 sales shares. Net-zero data comes from BNEF's Corporate Net-Zero Assessment Tool.

Vehicle manufacturers have joined the global wave of companies pledging to go net-zero by 2050.

15 automakers of various sizes have made net-zero commitments targeting 2050 or before, as of October 2022. These automakers sold over 45 million vehicles in 2021, representing 57% of the global passenger vehicle market.




Fewer automakers set net-zero targets over the past year than in 2020 and 2021. BMW, Geely Group and Mazda are notable names that have set targets since COP26

Collectively, these net-zero commitments amount to a total of 1.3GtCO₂ to be reduced globally.

This is based on our estimate of the base-year CO₂ emissions covered by the net-zero targets of these automakers. Note that some of them have only committed to scope 1 and 2 emissions, and even if a company covers all 3 scopes, it can exempt certain emission types such as customer's use of a vehicle. If these 15 automakers updated their targets to cover all the emissions in their base year, that would result in over 2.3GtCO₂ of emissions to reduce.

Truck makers are beginning to look towards a ZEV future

Selected manufacturers' targets for zero-emission commercial vehicles

Company	ZEV R&D investment	ZEV sales		
		2025	2030	2040
	"Vast majority of total" by 2025	n/a	Up to 60%	100% carbon neutral by 2039*
	n/a	n/a	>35%	"Absolute majority"
	1.6 billion euros, 2021-25	10% Scania in Europe	50% - Traton 50% - Scania 60% - MAN delivery trucks 40% - MAN long-haul trucks	Launch only battery trucks (Scania)

Source: BloombergNEF, company press releases. Note: ZEV is zero emission vehicle. * refers to some Daimler's main markets of Europe, North America and Japan.

Market activity for zero-emission commercial vehicles is gradually moving from target-setting to implementation.

Incumbent truck manufacturers have not announced updated plans since last year for zero-emission medium- and heavy-duty deployment targets.

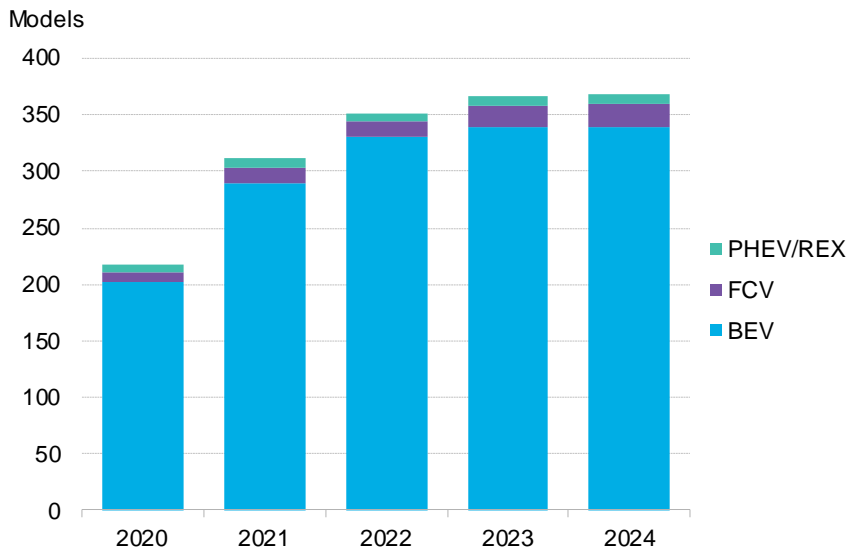
Instead, as sales start to pick up in China, Europe and the US, and large fleet owners place orders for thousands of commercial ZEVs, existing and startup truckmakers are focused on addressing their growing manufacturing needs and announcing new models.

Many manufacturers expect to deploy both battery electric and fuel cell trucks to reach decarbonization targets.

However, the Traton group is relying only on battery technology, while maintaining some hydrogen-related development activities. Several startup manufacturers also focus exclusively on battery-only trucks. The ability of manufacturers to invest in several competing technologies may be limited.

More than 350 commercial ZEVs are available in Europe and North America

Commercial ZEV models available



Battery electric vans and trucks dominate the growing suite of zero-emission commercial vehicle offerings.

Available BEVs outnumber FCVs by a ratio of 17 to one. Truck manufacturers are benefitting from advancements in battery technology taking place in the passenger car sector, and charging infrastructure – while still patchy – is also expanding. The number of models available in Europe exceeds those in North America, potentially leading to an early regional divide in zero-emission commercial vehicle adoption.

Fuel cell trucks can drive longer on a single refuelling, but BEVs are not confined to just short ranges.

Average range across FCV models is more than 500km, with some expected to exceed 1,000km. The average range of current BEV models is just over 250km, and some future vehicles may drive as far as 800km on a single charge.

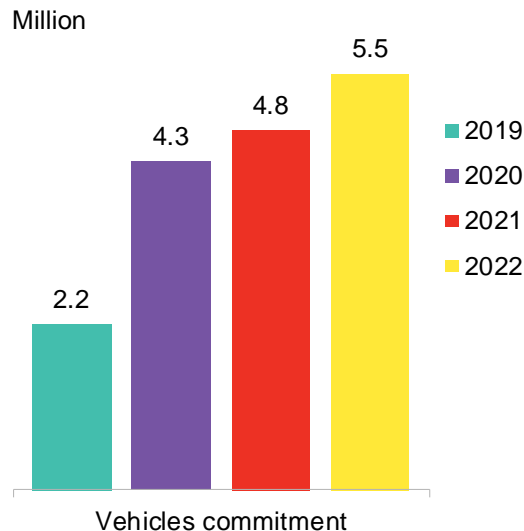
Zero-emission heavy commercial vehicles have more propulsion types, with most upcoming models being BEVs.

Heavy-duty truck models encompass a diverse array of propulsion technologies compared to lighter vehicles, with batteries, fuel cells and natural gas part of the mix.

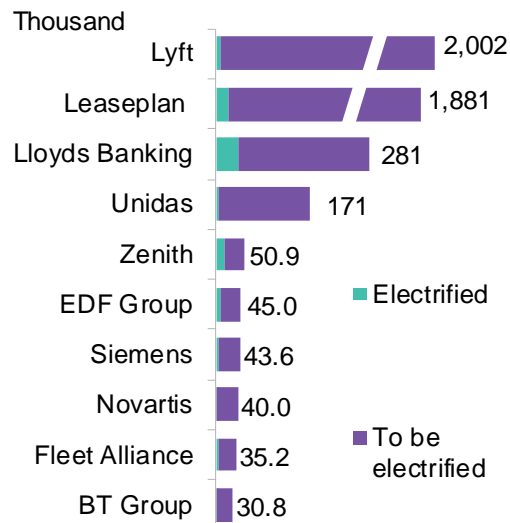
Source: BloombergNEF, company announcements, CALSTART. Note: 'BEV' is battery-electric vehicle. 'FCV' is fuel-cell vehicle. 'PHEV' is plug-in hybrid vehicle. 'REX' is range-extender vehicle. PHEV/REX are zero-emission for part of their operation relying on battery power alone.

Corporate fleet operators have joined the race to electrify

Vehicles covered by the EV100 pledge



Top 10 EV100 members by fleet size



Corporate sustainability initiatives are driving uptake of commercial EVs.

The number of vehicles covered by the Climate Group's EV100 fleet commitment, whose members pledge to electrify all of their vehicles globally by 2030, has increased 27% since 2020.

The number of EV100 members pledging to electrify their fleet increased from 53 in 2019 to 121 in 2022.

These commitments will underpin a strong source of EV demand in this decade.

So far, EV100 members have electrified just 209,654 vehicles to date, or just 3.8% of committed vehicles*.

Source: BloombergNEF, The Climate Group. Note: Based on Climate Group's March 2022 report. Data on progress towards targets is from reporting in Aug-Oct 2021



NEUTRAL

Government Commitments

National and regional
ZEV zmbition



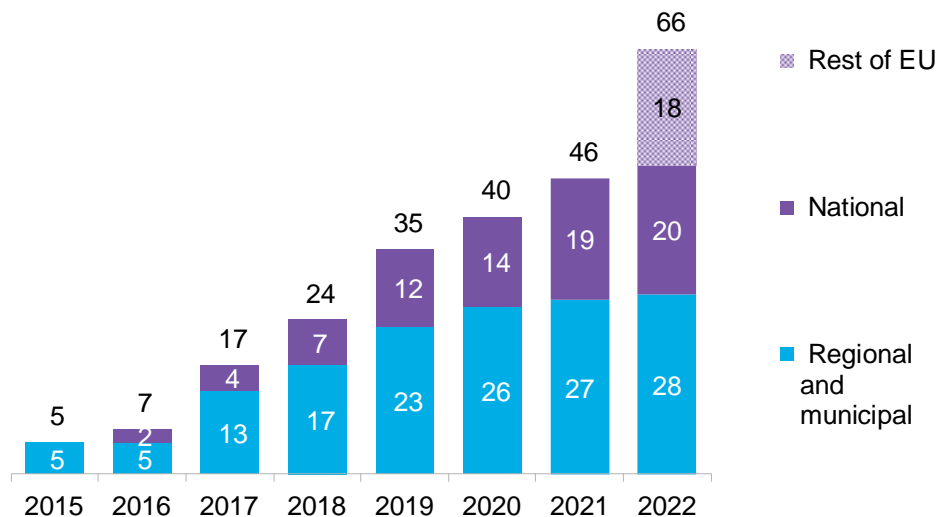
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Governments of all levels are implementing ICE phase-out targets

National and regional targets to phase out internal combustion vehicle sales

Cumulative number



There are 66 governments in total targeting a phase-out of new internal combustion vehicle (ICE) sales.

This includes 20 national governments, 28 regional and municipal authorities and an additional 18 EU countries which come under the EU's phase-out target.

These 18 countries are included in our count as of October 27, 2022, when the European Council's triilogue negotiations with the European Parliament were finalized, confirming the phase-out of ICE vehicle sales in the EU by 2035.

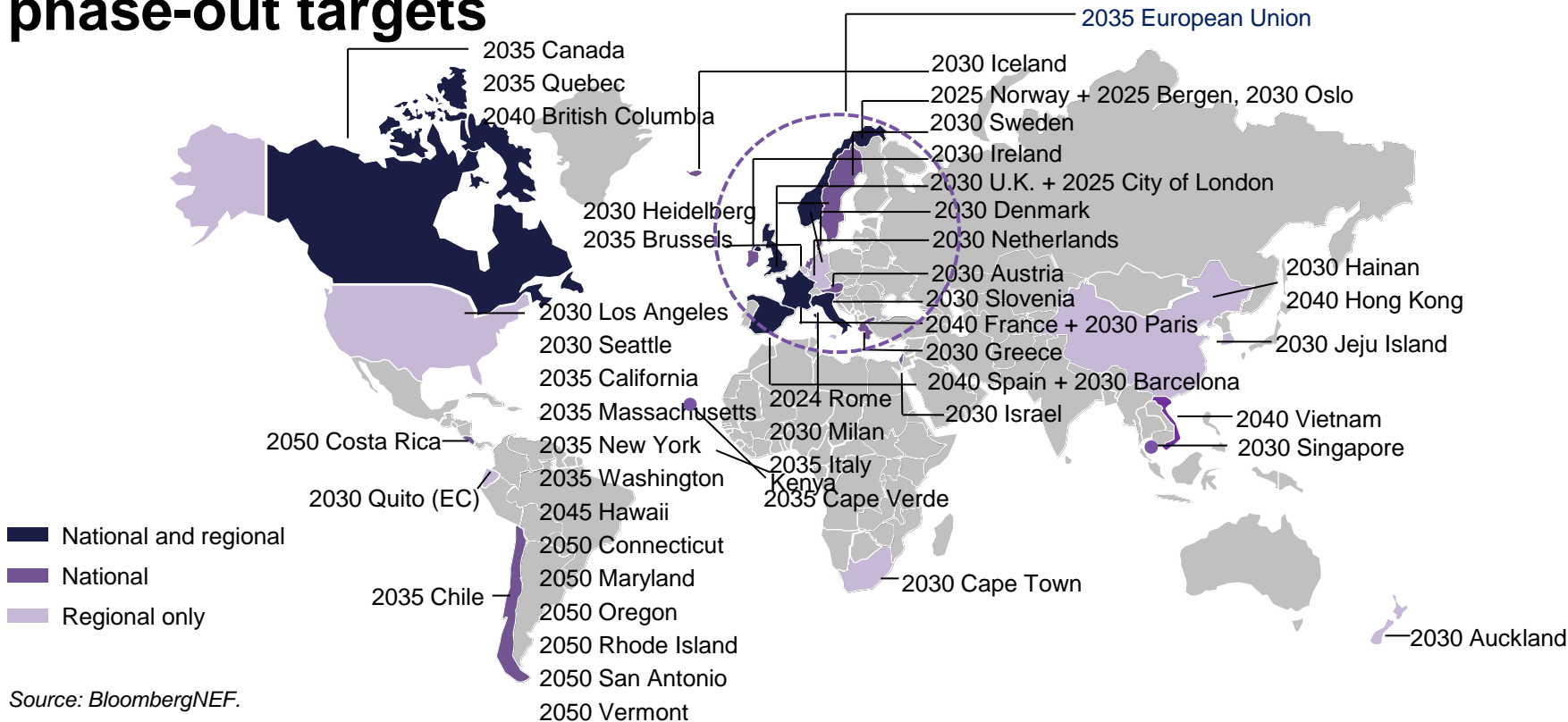
Since 2021, the list has increased by two individual countries (Greece and Vietnam) and one US state: Washington.

The importance of regional ICE phase-out targets should not be underestimated.

Sub-national targets can drive real impact, especially in countries where national mandates are yet to be implemented. For example, California (US) had led the way with an ICE phase-out set for 2035 that other states, like New York and Massachusetts, have signed onto. The US has no national ICE phase-out policy, so these states have stepped in to fill the gap. More detail on that effort is on slide [58](#).

Source: BloombergNEF. Note: covers ICE phase-out targets announced through October 27, 2022.

National and regional ICE vehicle phase-out targets



Source: BloombergNEF.

An additional 25 countries have committed to the provisions of the ZEV Declaration



The ZEV Declaration on accelerating the transition to 100% zero-emission cars and vans has been signed by 41 national governments.

25 of these (shown here) do not have a separately stated national commitment to phase out internal combustion engines.

Signatories are committed to 'work towards all sales of new cars and vans being zero-emission by 2040 or later, or no later than 2035 in leading markets.'

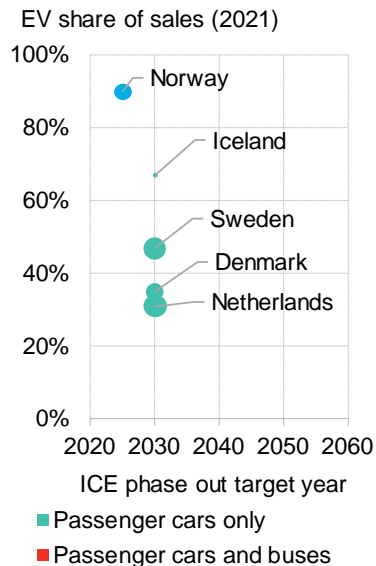
A number of emerging markets countries, such as India and Mexico, have committed to 'work intensely towards accelerated proliferation and adoption of zero emission vehicles'.

Source: BloombergNEF. Note: includes only countries that signed the ZEV Declaration at COP26, but do not have an announced ICE phase-out target. Signatories were grouped into 'Governments' and 'Governments in Emerging Markets and Developing Economies'.

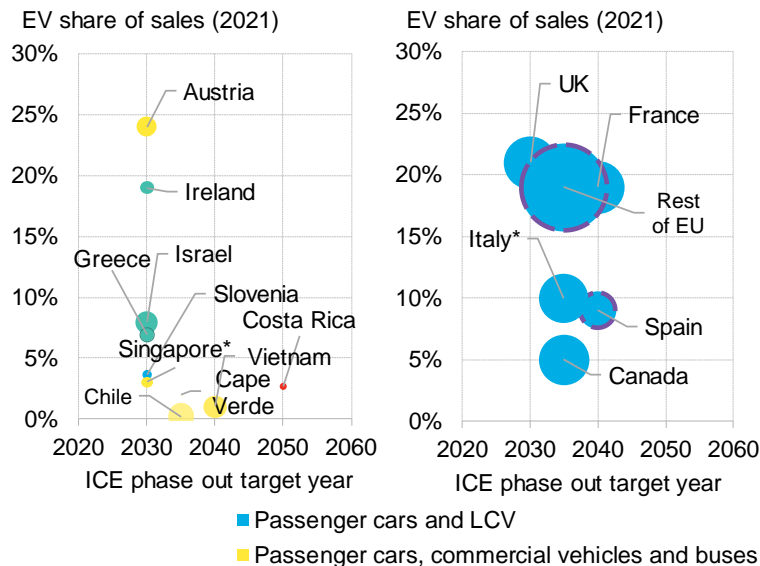
38 countries are targeting complete phase-outs of conventional cars

National targets to phase out internal combustion vehicle sales

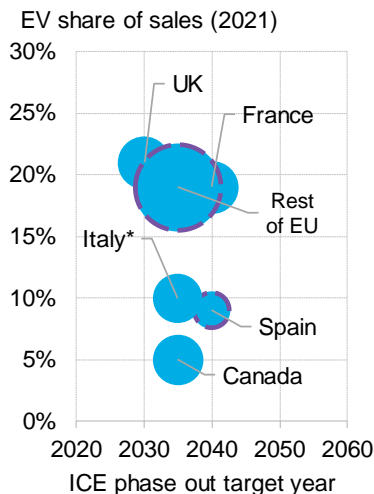
Nordics+



Small car markets



Major car markets



There are 20 national-level targets to phase out sales of internal combustion vehicles (ICE), and 18 additional EU countries that are now obliged to stop selling ICE cars by 2035.

The 18 additional EU countries, added this year, represent 4.6 million in 2021 car sales.

The list already included many European countries, but Canada, Singapore, Costa Rica and Chile have also committed to phasing out ICE sales.

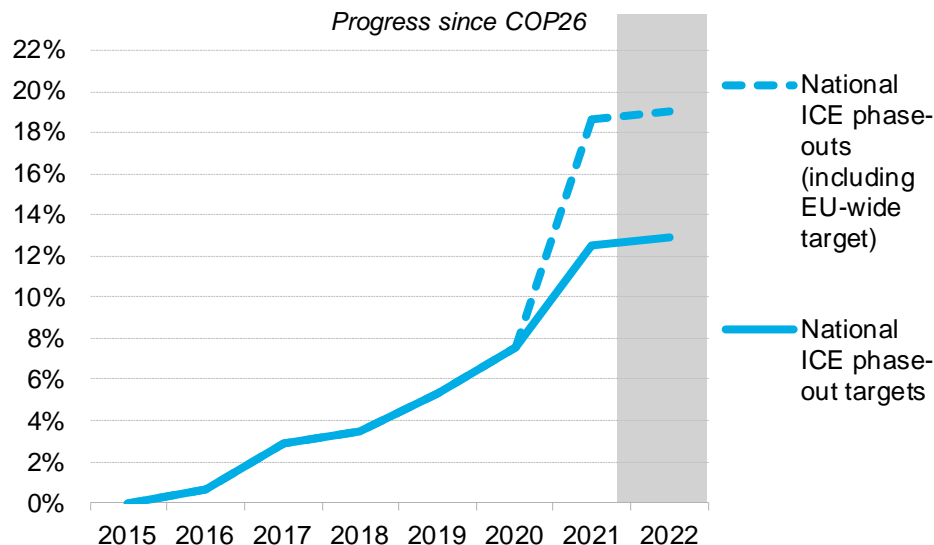
Only two individual countries joined the list since COP26 and only one announcement – Vietnam – was made in 2022.

In November 2021, **Greece** announced it would ban new sales of combustion cars from 2030. Only 7% of cars sold in Greece in 2021 were electric, significantly less than in other countries – Iceland (67%), Sweden (47%) or Denmark (35%) – targeting the same date.

Source: BloombergNEF. Note: Includes BEVs and PHEVs. Size of the bubble represents the size of the overall passenger vehicles market in 2021; the color of a bubble represents vehicle segments included in the target. Singapore calls for all newly registered cars to be cleaner-energy models from 2030.

Countries with phase-out targets account for 19% of the passenger vehicle market

Share of global passenger vehicle sales covered by national and EU ICE phase-out targets



19% of 2021 passenger vehicles sales were in countries that now have an internal combustion engine (ICE) phase-out date.

While there was strong growth of countries announcing ICE phase-outs from 2019 to 2021, where the covered global market share (based on 2021 sales) more than doubled, 2022 has seen a slowdown in new national additions. Only Vietnam has announced a national ICE phase-out in 2022.

The EU's recent agreement on its ICE phase-out policy provides a significant boost. Without it, only 13% of global passenger vehicle sales would be covered as of this year.

The first country with a national ICE phase-out policy was Norway in 2016. That year, less than 1% of global passenger vehicle sales were covered by these policies.

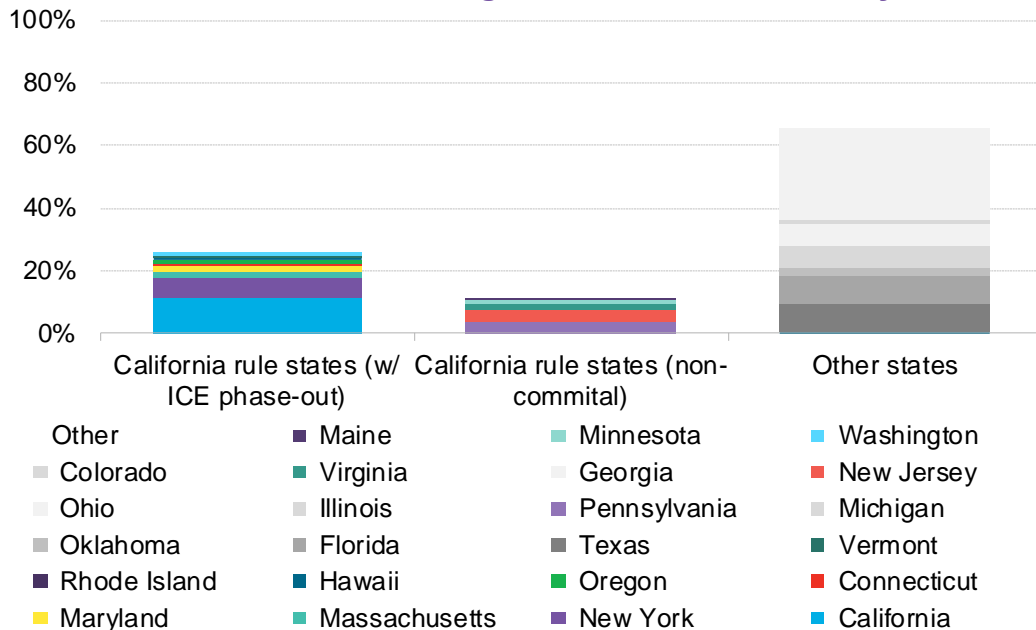
By 2020, 6% of global passenger vehicles sales occurred in countries with an ICE phase-out. This included markets like Canada, France, Spain and the UK.

Other markets outside of EMEA have announced targets. The largest are Canada, Chile and Vietnam, though Singapore and Cape Verde have also put policies in place.

Source: BloombergNEF, Marklines, Bloomberg Intelligence. Note: share of 2021 global passenger vehicle sales by announcement year of ICE sales phase-out. European Union has finalized its 2035 CO2 emission regulation. Covers ICE phase-outs through October 27, 2022.

In the US, states are leading the transition, representing up to 40% of the national market

Share of US EV market following California's fuel economy standards



Source: BloombergNEF, CARB, NADA. Note: chart considers states that follow California's fuel economy standards – including LEV and GHG regulation programs, not only ZEV states.

California has now finalized its Advanced Clean Cars II policy, which puts the state on a path to phasing out ICE vehicle sales by 2035.

The policy calls for EVs and FCVs to rise to 35% of new passenger car sales by 2025, 68% by 2030 and 100% by 2035. In that year, PHEVs that meet necessary requirements can make up to 20% of new sales.

17 states have adopted California's Low-Emission Vehicle and greenhouse gas emission regulations.

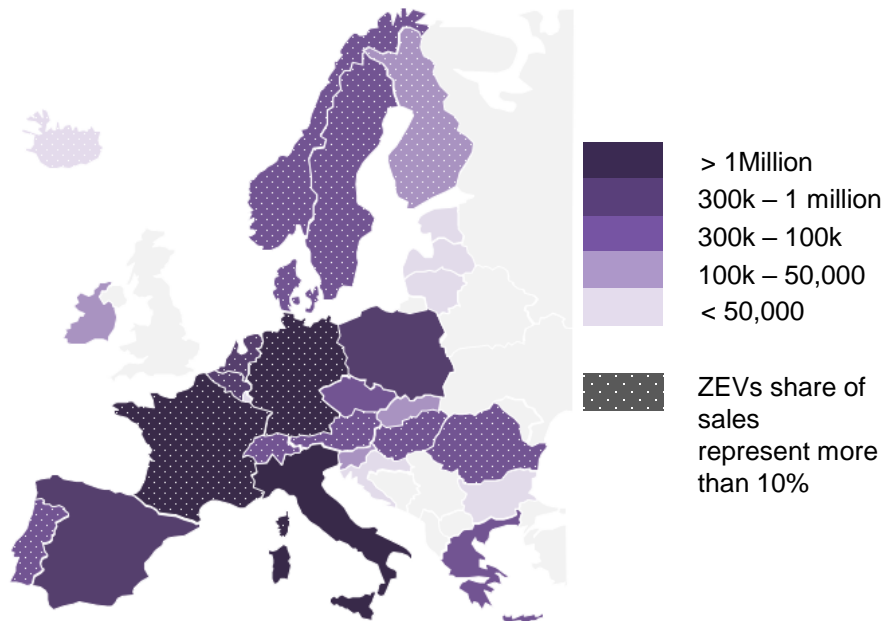
These markets comprise nearly 40% of the entire US auto market for new passenger car sales in 2021. Of the 17 states, though, only 10 previously or recently indicated that they were comfortable with phasing out ICE vehicle sales by 2035.

While a national ICE phase-out policy in the US is unlikely, California has previously pushed the automaker forward by adopting more stringent standards.

15 states have also adopted California's Zero-Emission Vehicle (ZEV) standard.

The EU's agreed ICE phase-out covers 13% of the global auto market

European passenger vehicle sales, 2021



The EU's plan to effectively phase out new ICE vehicle sales by 2035 covers over 13% of the global vehicle market.

The proposal, agreed in October 2022, aims to hit a fleet-wide emissions target of 0gCO₂ per km by 2035 for all new car sales, effectively banning PHEVs, as well as conventional vehicles.

Collectively, the EU together with Norway, Switzerland and Iceland, countries that also have set ICE phase-out targets, recorded 10.1 million passenger vehicle sales in 2021, which is 13% of the global total.

Some EU countries are making early strides towards the 2035 target.

In the first half of 2022, Sweden stands out with a 28% ZEV market share, followed by the Netherlands (20%) and Denmark (17%).

Countries still below 10% ZEV share of sales are now a minority of the market, at just 1.6 million passenger vehicle sales in 1H 2022. This is down from 3.6 million in 1H 2021.

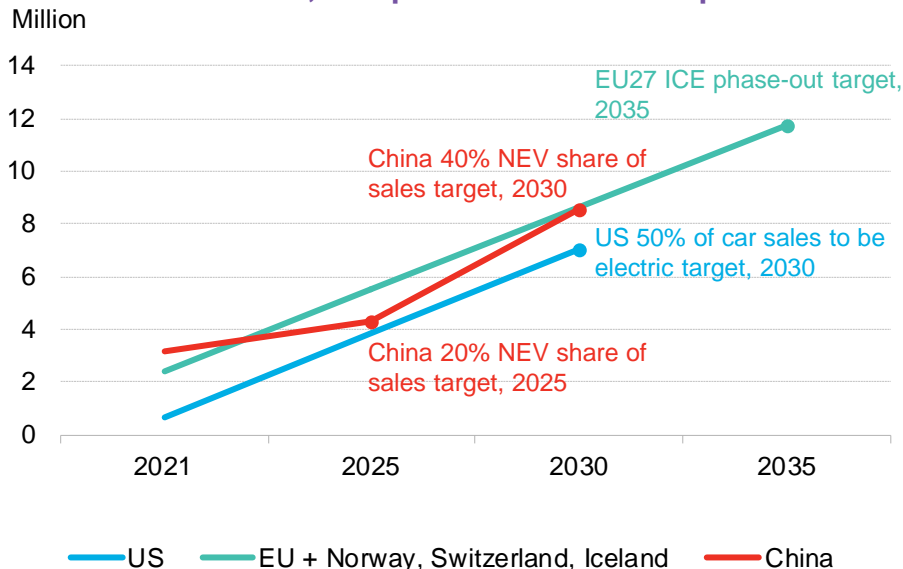
Italy, Spain and Poland are the biggest European car markets where ZEV adoption is still below the 10% mark (as of 1H 2022).

France has recently breached the 10% threshold, reaching 12% ZEV share of sales in the first half of 2022.

Source: BloombergNEF. Note: The map includes data for EU27 countries, Norway, Switzerland and Iceland. Data from ZEV share of sales is for the first half of 2022; total passenger vehicle sales is full year 2021.

The US and China have substantial EV targets, despite no phase-out policy

Estimated EV and FCV sales based on interim policy targets in China and the US, compared to the EU ICE phase-out



Source: BloombergNEF, various governments. Note: uses 2021 passenger vehicle sales for country to estimate impact of interim targets in the chart. The US 2030 target is non-binding, and it includes PHEVs. The EU 2035 target is a full ICE phase-out, while the US and China targets are interim targets. Values between target dates are extrapolated.

Though China and the US do not have national ICE phase-out targets, they do have interim targets that could play a vital role in accelerating EV adoption. These targets are unchanged from last year but are more likely given recent market developments.

China's target is part of its NEV program, and includes three drivetrain types – BEV, PHEV and FCV. Its interim goal calls for 40% NEV share of sales across passenger and commercial vehicles and buses by 2030. This could amount to 8.5 million passenger EVs and FCVs sold by 2030, more than 2.5 times higher than in 2021. China also has a 20% NEV target for 2025.

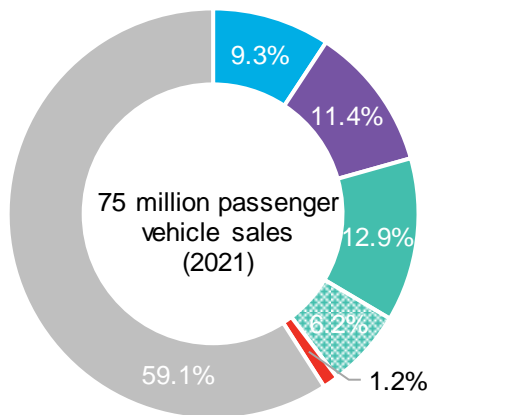
The US has an interim target for 2030, set under an executive order by President Biden, calling for 50% of passenger vehicle sales to be electric.

Over the past year, the US has seen strengthening federal and state policy that makes hitting the target much more likely, including long-term subsidies via the Inflation Reduction Act, enhanced fuel economy standards and state ICE phase-outs led by California.

Both interim targets, if achieved, will have a significant impact on global passenger vehicle sales.

Combined national targets cover 41% of the global passenger vehicle market

Share of 2021 passenger vehicle market covered by ICE phase-out commitments and interim / partial targets



- US (2030 target)
- China (2030 target)
- ICE phase-out (in place)
- Rest of EU
- India (2030 target)
- Not committed

Source: BloombergNEF, various governments. Note: uses 2021 passenger vehicle sales for country to estimate impact of interim targets in the chart. The U.S. 2030 target is non-binding, and it includes PHEVs. China's targets is for new energy vehicles. India's target includes PHEVs. ICE phase-outs vary by country/region.

Aggregating ICE phase-outs and interim sales targets reveals that nearly 41% of the passenger vehicle market is now targeted for transition to EVs or ZEVs. This is up from just 8% in 2019, but largely unchanged since last year.

As discussed on previous slides, ICE phase-outs represent over 19% of the global car market. Interim / partial targets – including China, the US and India – add another 21%.

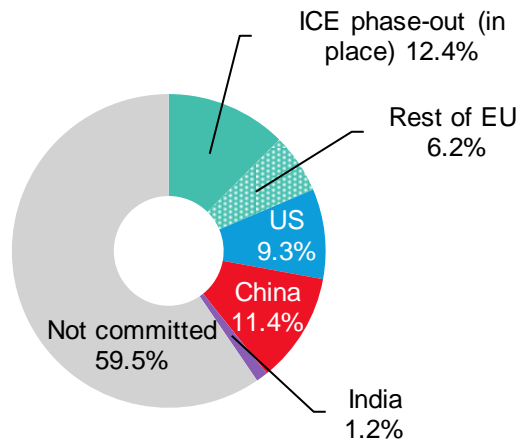
Combined, these targets covered about 31 million passenger vehicle sales in 2021.

There remains about 59% of the market not covered by any type of ZEV commitment.

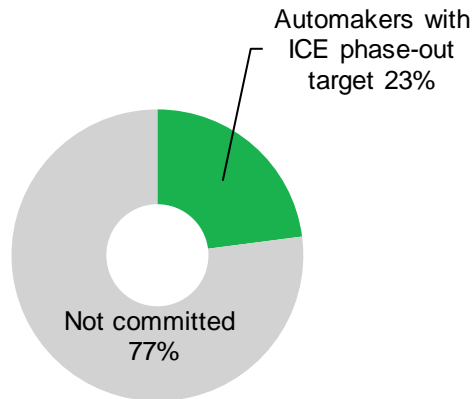
Large auto markets without a current ICE phase-out policy include South Korea, Japan, Russia and Brazil – as well as remaining portions of the three large markets with interim targets (the US, China and India).

Automakers' 2035 ambitions do not match up to country targets

Country ICE phase-out targets and interim / partial ZEV targets by 2035



Automakers' ICE phase-out targets by 2035



Source: BloombergNEF.

Source: BloombergNEF.

Automotive manufacturers' ICE phase-out targets by 2035 are currently less ambitious than the targets set by governments.

Automakers accounting for 23% of the 2021 global passenger vehicle market have stated their intentions to stop selling internal combustion engine vehicles by 2035. This is considerably less than the 40% of the global market covered by national and EU targets (including interim ones), as shown on the previous two slides.

However, a like-for-like comparison to strict ICE phase-outs looks more balanced, with national targets of this type accounting for only 19% of the global market.

Some automakers have phase-out targets for 2040; including these lifts the share of the market covered by automakers' ICE phase-out commitments to 30%.

Honda has set a 2040 ICE phase-out target, and Ford has a similar commitment under the ZEV Declaration, but most other automakers have set targets between 2027 and 2035. Fewer automakers set targets in 2022 than in the past two years.

Most Chinese automakers have not announced ICE phase-out targets despite strong EV sales.

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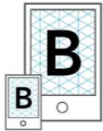
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