

Bloomberg's Outlook on Electric Vehicles

Electricity consumption from EVs will rise to 1,800TWh by 2040 from 6TWh in 2016. While this represents just 5% of the projected global power consumption in 2040, the 'peakiness' of fast-charging load profiles will need to be managed by utilities and regulators through the introduction of time-of-use rates to encourage off-peak charging, as well as storage solutions at the operator site which can mitigate high power demand from the grid.

Bloomberg New Energy Finance's 2017 Long Term Electric Vehicle Outlook has presented an annual analysis of how EV adoption will impact automotive and energy markets. The outlook combines the expertise of the global Advanced Transport team and draws on dozens of pieces of research and data sets published over the last year. It looks at how economics, technology, policy, and consumer behavior will impact EV adoption between now and 2040.

The report analyses five underlying factors that are expected to drive increased EV adoption over the coming years:

- Short-term regulatory support in key markets like the U.S., Europe and China
- Falling lithium-ion battery prices
- Increased EV commitments from automakers
- Growing consumer acceptance, driven by competitively priced EVs across all vehicle classes
- The growing role of car sharing, ride hailing and autonomous driving (termed 'intelligent mobility' here)

In the outlook, passenger EV adoption is treated primarily as a consumer technology diffusion problem. Most of the long-term consumer uptake modelling is driven by economics - vehicle purchase prices and total cost of ownership - but other country is also taken into account -specific vehicle market characteristics. Also the role that charging infrastructure and building stock will play in enabling or inhibiting the uptake of EVs in different countries is looked at.

In this report, a new view of lithium-ion battery price declines is integrated, a more granular analysis of the impact of intelligent mobility, as well as a more nuanced short-term view (2017-21) of EV sales based on upcoming EV model releases in key markets. The relative economics of EVs against comparable internal combustion vehicles in four different vehicle segments are looked at. The report closes by looking at the impacts of EV adoption on electricity and oil demand, as well as demand for key materials like lithium, cobalt, graphite, nickel and manganese.

The Long Term EV Outlook is not a policy forecast. It is assumed that current policies remain in place until they are set to expire, but it is not assumed for any fresh policies to be introduced. Any specific national climate targets met are not assumed. The forecast is focused on passenger vehicle markets, but the impacts of electrification on other transport segments is an area of ongoing research.

Executive Summary

EV forecast is increased when compared to last year

More aggressive EV adoption is expected than 2016 forecast, due to primarily the battery costs falling faster than expected and rising commitments from automakers.

By 2040, 54% of new car sales and 33% of the global car fleet will be electric

Falling battery prices will bring price-competitive electric vehicles to all major light-duty vehicle segments before 2030, ushering in a period of strong growth for electric power train vehicles (Figure 1 and

ELECTRIC VEHICLES

Figure 2). While EV sales to 2025 will remain relatively low, an inflection point is expected in adoption between 2025 and 2030, as EVs become economical on an unsubsidized total cost of ownership basis across mass-market vehicle classes.

China, the U.S. and Europe make up over 60% of the global EV market in 2040

The absolute size of these car markets are the primary drivers for high EV sales, though strong regulatory support in the 2015-2025 period will also spur demand that otherwise might not materialize. The medium car segment, which includes high-selling models like the Toyota Camry and Honda Accord, will account for much of this growth, given both the current size of the global midsize car market as well as the favorable switchover costs from internal combustion engines to EVs beginning in the late 2020s.

Electric vehicles become price competitive on an unsubsidized basis beginning in 2025

Some segments will take longer, but by 2029 most will have reached parity with comparable internal combustion engine (ICE) vehicles. Real mass market adoption only starts after this point in most markets (Figure 3 and Figure 4).

Battery electric vehicles (BEV) leave plug-in hybrid vehicles (PHEV) behind

While it is expected that the PHEV sales plays a role in EV adoption from now to 2025, after this the BEVs are expected to take over and account for the vast majority of EV sales. The engineering complexity of PHEV vehicle platforms, their cost and dual powertrains make BEVs more attractive over the long-run. Only in Japan it is thought that the PHEVs will continue to play an important role after 2030.

Lithium-ion battery demand from EVs will grow from 21GWh in 2016 to 1,300GWh in 2030. It is expected that 270GWh of large format battery cell

production to be online globally by 2021, led by global suppliers including LG Chem, Samsung SDI, Lishen, CATL, Tesla and others. The supply chain will need to scale up further in the 2020s to meet demand.

Electricity consumption from EVs will rise to 1,800TWh by 2040 from 6TWh in 2016. While this represents just 5% of the projected global power consumption in 2040, the 'peakiness' of fast-charging load profiles will need to be managed by utilities and regulators through the introduction of time-of-use rates to encourage off-peak charging, as well as storage solutions at the operator site which can mitigate high power demand from the grid.

Fossil fuel demand will be displaced by the growing fleet of EVs.

It is projected as 34% of cars on the road will be EVs by 2040 - 530 million EVs in total - which will displace up to 8m barrels of transportation fuel per day.

Charging infrastructure is still not solved

The amount of public EV chargers has grown significantly in the last five years, but more is needed. Even when EVs have reached cost parity with internal combustion engine vehicles, lack of home charging will be a significant barrier to adoption and will restrict EV sales from reaching 100%. In the models, many countries that grab an early lead in EV adoption (China, U.S., parts of Europe) hit this 'infrastructure cap' in the mid-2030s and sales growth slows significantly.

The impact of autonomous driving is limited for the next 10 years, but ride hailing and car sharing services will have an impact sooner. It is believed that autonomous vehicles will be primarily shared and will begin to replace existing human-driven shared and hailed cars starting in 2030. This will start to impact vehicle sales and increase the average distance travelled per vehicle. It is

expected that expect 80% of all autonomous vehicles in shared applications to be electric by 2040 due to lower operating costs.

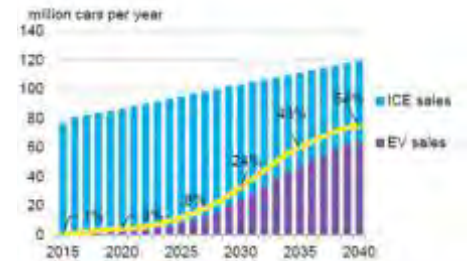


Figure 1: Annual global light duty vehicle sales

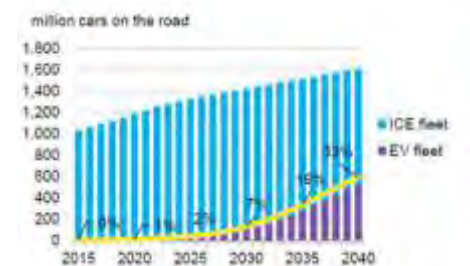


Figure 2: Global light duty vehicle fleet

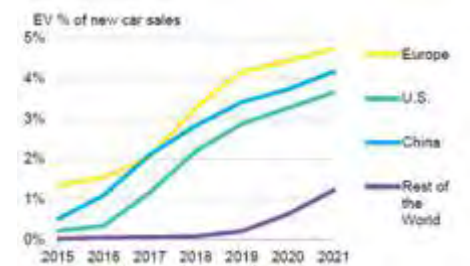


Figure 3: Short-term EV sales penetration by country

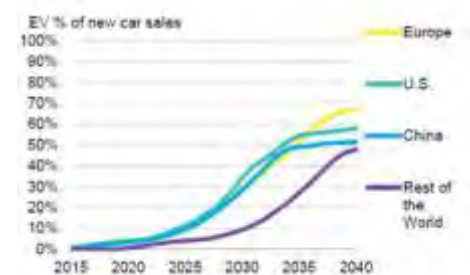


Figure 4: Long-term EV sales penetration by country

Source: "Electric Vehicle Outlook 2017"; Bloomberg New Energy Finance