The EV revolution: Accelerating change through tech & transformation

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zero carbon academy

Introduction to EVs and charging infrastructure

Driving change

As pressures around fossil fuel use and climate change increase, our world is shifting to become 'greener' (that is, less carbon intensive), with governments mindful of making changes that align with the concept of a green economy. The green economy, according to the UN, is defined as being: "low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services."[i]

Electric vehicles

Electric vehicles (EVs) are no longer just a futuristic concept; they are rapidly becoming a cornerstone of modern mobility. EVs can be powered using electricity from the grid, with governments and suppliers increasingly aiming to source this from renewable methods such as wind or solar energy.

Vehicles which are 100% electric are termed Battery Electric Vehicles (BEVs). For the purposes of this research, we class both PHEV (Plug-in hybrid electric vehicles) and BEV vehicles as EVs. Whilst BEVs can be classed as 'zero emissions' since they do not produce emissions and can also be charged by using 100% renewable energy (where available), PHEVs combine more traditional and polluting combustion engines with the capability to plug in and charge a battery to power an electric motor.

For the purposes of this research, we have looked specifically at the light commercial vehicles segment (private cars, small trucks-e.g. Pick-ups, and vans).

Purely electric LCVs (BEVs) have shown strong growth over the past decade, and despite a recent slowdown in some western markets, adoption will continue to increase. ZCA's latest forecasts show a Compound Annual Growth Rate (CAGR) of 8.3% globally between 2025 and 2030, with total vehicle unit sales reaching 16.5 million annually by 2030.

At present the market for both BEV and PHEV sales is fragmented, with manufacturers varying their approach to electrification. For example, Tesla only sells BEVs and Chinese car company BYD which traditionally sold ICE vehicles, switched in March 2022 to produce only full electric and heavily electrified plug-in hybrid cars. Other manufacturers, such as Toyota, are exploring not only electric, but alternative fuels such as hydrogen.

Battery technology

Battery technology is perhaps the most prominent barrier to adoption of EVs, with the present offering leading many consumers to suffer 'range anxiety'.

'Range anxiety' relates to concern around the distance an EV can travel on a single charge, alongside the worry of getting stranded during the journey should battery power run out. Other fears exist around the safety of current EV batteries, their weight, and their cost (most of these batteries presently being lithium-ion).

New developments in EV battery technology, namely All Solid-State Batteries (ASSBs) pose a significant leap forward in both EV range and

weight, offering far greater energy density than existing batteries. These technological advancements could help dispel two of the fears around EV adoption at present. To do so though, manufacturers will need to promote advantages to customers, and governments should help encourage further advancements in these technologies.

We outline the six major battery technologies currently in use or being explored for use in EVs. These are listed below:

Source: Envato

a. Lead-acid

Lead acid batteries are more commonly used in ICE vehicles to start the vehicles motor. These batteries are inexpensive and viewed as safe, however they offer poor performance in cold weather and have short lifecycles.

b. Lithium-ion

Probably the most well-known EV battery format and currently the most widely used. Lithium-ion batteries are known for their high power-to-weight ratio, as well as being efficient and offering excellent high-temperature performance. However, lithium-ion batteries have come under a lot of scrutiny due to their production and the damaging effects of lithium mining, both environmentally and humanitarianly.

c. Nickel-metal Hydride

Nickel-metal hydride batteries face high production costs and suffer from poorer performance with regards to self-discharge when compared with other battery types. This is unfortunate given their benefits, which include the fact that they are safer and more abuse tolerant, compared to both lead-acid and lithium-ion batteries.

d. Solid-state

All solid-state batteries (ASSBs) are seen by some as the future of EV batteries and a strong alternative to lithium-ion. These batteries use solid electrolytes, rather than liquid ones, which makes them less volatile than lithium-ion. In addition, they have the capacity to store more energy and offer better performance at both high and low temperatures. These batteries are cheaper, lighter, and faster to charge, as well as offering greater range.

e. Ultracapacitors

Similar to lead-acid batteries, ultracapacitors are generally used as secondary storage devices and help to level the load of lithium-ion battery packs. They basically store polarised liquid between an electrode and an electrolyte. Ultracapacitors also give EVs an extra boost of power during acceleration.

f. Na-NiCl2

Sodium Nickel Chloride batteries were originally designed to power grids, machinery, and trains; however, they have since been applied for use in

EVs. Their one considerable drawback is their temperature of operation, which sits between 275 – 350 °C.

EVs: Challenges and constraints

The major challenge in driving EV adoption relates to removing the negative perception of EVs that many consumers have. These may include concerns around industry practices, materials in use, and the products themselves. We discuss several barriers below:

a. Range anxiety & consumer opinion

Increasingly noted in discussion around consumer adoption of EVs is 'range anxiety' where concern is felt regarding the distance an EV can travel on a single charge, alongside the worry of getting stranded during the journey should battery power run out. In fact, an EY Study from May 2022 found that the top concerns inhibiting adoption included charging infrastructure and EV range anxiety. However, the study also revealed that consumers who have already purchased an EV in the past are more likely to purchase one in the future, and they have less apprehension around range distance and charging opportunities[ii].

Most recently, a survey by McKinsey discovered that 42% of hesitant EV buyers said that they will not purchase an EV until battery capacity and driving range improve[iii]. The study also revealed that consumer requirements for battery range continue to rise drastically.

b. Energy consumption & grid pressures

Increasingly favoured and encouraged is the charging of vehicles during times of low demand, such as overnight, to reduce pressure on the electricity grid and incentivise the use of EVs by charging when energy prices are typically lower. There is also the draw of Vehicle to Grid (V2G), where EVs can export their stored energy back to the grid, thus effectively acting as a network of batteries to store surplus energy which can then be used at peak times: "Connecting millions of EVs and coordinating their charging and discharging would minimise the costs of EV charging while allowing the grid to balance the integration of high levels of variable renewable energy sources"[iv].

c. Environmental impact & recycling

EV batteries are made from a combination of raw materials, including so-called 'base' metals such as aluminium, copper and iron, as well as more expensive 'precious metals' such as cobalt, nickel and manganese. Other key elements include graphite and, of course, lithium[v]. The process of creating EV batteries themselves is both environmentally and socially troublesome.

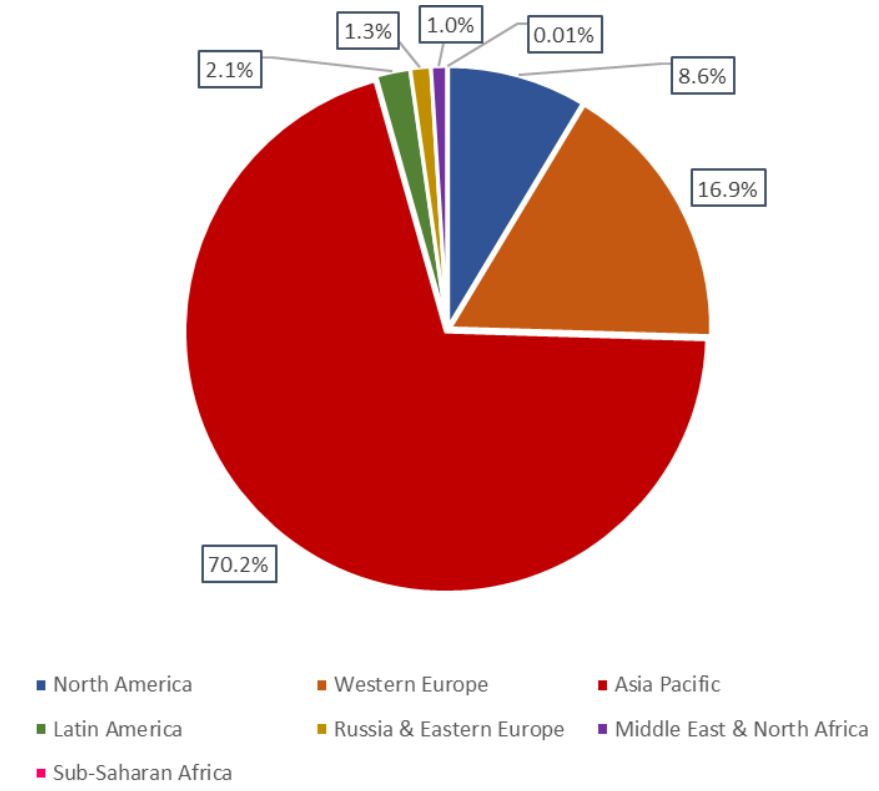
Whereas more traditional alkaline car batteries can and often are recycled[vi], EV batteries face several challenges. They are much larger and heavier than traditional batteries; the materials used are also hazardous to human health and can explode if disassembled incorrectly.

Forecast summary

EV market set to continue growth despite recent BEV sales slowdown

- We forecast that the total number of LCVs in use and on the road will be higher in 2028 than previously expected, and whilst North America and Westen Europe will see lower totals than in our previous study, numbers from Asia Pacific will be much larger.
- PHEV registrations are expected to slow significantly towards the end of our forecast period; PHEVs remain popular in emerging markets (compared to BEVs) having been somewhat of a 'gateway' vehicle for consumers to experience electrification. They provide the opportunity to use charging services and offer the benefits that provides, whilst still allowing consumers some security in being able to use petrol or diesel should they require.
- Asia Pacific, specifically China, will dominate sales of EVs throughout the forecast period.
- However, recent data has also shown a notable slowdown in BEV sales in the West. Taking into consideration 2024 data and future sales projections, ZCA's BEV forecasts have been lowered, with global sales set to be almost 3 million units less in 2028 than previously expected.
- We expect the slowdown in BEV sales to be temporary, with EV numbers continuing to increase to 2030.

Total annual EV sales globally in 2030: 24.4 million, split by region



Source: Zero Carbon Academy

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For in-depth analysis, including our full suite of market forecasts, industry-specific trends and recommendations, vendor leaderboards, as well as insight into country-specific policy, ZCA's full research can be purchased here: Electric vehicles & charging infrastructure (zerocarbonacademy.com)

References

[i] Green Economy | UNEP – UN Environment Programme.
[ii] EY Mobility Consumer Index reveals US lags behind global counterparts in electric vehicle adoption | EY - US
[iii] Exploring consumer sentiment on electric-vehicle charging | McKinsey
[iv] V2GB-Public-Report.pdf (esc-production-2021.s3.eu-west-2.amazonaws.com)
[v] EV battery guide: what are electric car batteries made of? | RAC Drive
[vi] Electric cars: What will happen to all the dead batteries? - BBC News