



**ELECTRIC VEHICLES by REA**  
RENEWABLE ENERGY ASSOCIATION

# EV FORWARD VIEW: jobs, infrastructure, and a vision for the growth of Electric Vehicles in the UK



A to-the-point introduction for policy-makers and industry to key UK market developments and a forward view for EV deployment to 2040.

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## INTRODUCTION

The electric vehicle industry is going to develop rapidly. Already billions of pounds have been invested in R&D, manufacturing sites, new supply chains, and associated infrastructure, in the UK, Europe, and globally. The REA, the UK's largest trade association for renewable energy and clean tech, forecasts that the shift away from both diesel and petrol vehicles will be more rapid than is currently anticipated by policy-makers and analysts.

Bloomberg New Energy Finance anticipates that 50% of new car sales in the world will be EV by 2040, the year in which the UK Government has announced it will end the sale of new petrol and diesel cars and vans with no battery element<sup>1</sup>. The REA sees this forecast as the most robust that is currently publically available, but does not fully account for the step-change that is likely to take place in this sector, akin to the evolution of solar PV or uptake of mobile phones.

The shift to electric vehicles presents a range of new manufacturing and export opportunities for the UK post-Brexit, which is currently the fourth largest vehicle manufacturer in the EU<sup>2</sup>. It also presents a series of internal challenges, in particular regarding charging vehicles and upgrading electricity grid infrastructure. The two issues are fundamentally interlinked, as the ability to create export products or expand the manufacturing base requires a robust domestic market, which in turn requires the creation of a reliable, affordable, low-carbon, and extensive electric vehicle charging network.

The UK's electric vehicle and energy storage markets currently directly employ over 16,000 people, according to the annual publication REView 2017<sup>3</sup>. This number is anticipated to significantly grow, but supportive public policy, ranging from increasing grid flexibility, to strengthening building codes, is critical if these industries are to fully develop.

This analysis is informed by discussions with our network of member companies and the wider industry, both nationally and globally. It is comprised of an analysis of key anticipated market developments, followed by a projected timeline and deployment forecast to 2040.

## HOW THE EV MARKET WILL EVOLVE IN THE UK

*The REA anticipates that:*

- Total ownership costs for most Electric Vehicle owners could be lower than Internal Combustion Engine equivalents by 2020, depending on subsidies and taxations. This means the lifetime price of owning an EV, including fuel and maintenance costs, will be lower, resulting in consumer savings<sup>4</sup>.
- Bloomberg New Energy Finance's analysis (July 2017) estimating that "producing a battery [pack] in a Korean manufacturing plant in 2017 costs \$162/kWh, dropping to \$74/kWh in 2030" will be reflective of cost reductions. They estimate that battery pack prices have already fallen by 73% between 2010 and 2016.
- Some family cars will have batteries with a 350 mile range by 2019/2020<sup>5</sup>.
- A full range of electric vehicles will be available in the future, including cars, some commercial vehicles, etc..
- Different sized batteries will be used for different uses, similar to how one can currently purchase the same car model with different capacity fuel tanks.
- Other European and non-European nations may introduce a petrol and diesel vehicle ban ahead of the UK and France's confirmed timeline of 2040.
  - The Netherlands is discussing the phase-out of internal combustion engines by 2025<sup>6</sup>.
  - Germany is considering banning new petrol or diesel car sales by 2030, which would require the upgrading of the country's entire manufacturing processes and supply chain by then (Germany is the EU's largest vehicle manufacturer)<sup>7</sup>.
  - China's Government is considering a ban similar to the one being introduced by the UK, although has not yet announced a timeline<sup>8</sup>.
- Car manufacturers will have already stopped all further R&D on diesel cars this year.
- Diesel car sales will continue to fall. With lower sales volumes the cost to manufacture them will rise until a point is reached where it is no longer economic to manufacture them.
- As electric car sales volumes rise they become cheaper to produce making them cheaper than

petrol. The REA believes the opposite will be true for petrol cars with prices rising steeply in the next decade as fewer are sold and manufactured.

- The maintenance of two separate supply chains will be inefficient, and there will be attempts to bring the two more closely together, if not move to electric in full.
  - Already most new car platforms are being designed around an electric engine, rather than a petrol one, or the ability to carry an electric drivetrain (BEV or PHEV).
  - R&D will drive manufacturers to continually optimise chassis development toward electric-only power units.
- Energy storage technologies will continue to improve over the next decade, with car makers increasingly pairing with battery storage developers so as to make use of surplus or used EV batteries<sup>9</sup>.

## CHARGE INFRASTRUCTURE

- Rapid advancements will be made around the speed of charging vehicles - plans are already in place in major car companies to have a 5 minute charge. The technology now exists to do this<sup>10</sup> although the REA believes such quick charging will only have select uses due to pressures this causes on the grid.
- Around 40% of car owners will not have home charging<sup>11</sup>. Many of these will rely on public charging, potentially at work and supplemented by facilities at supermarkets, public service car parks, or other larger social spaces, but these will be supplemented by charging 'hubs' which may start to replace petrol stations.
- Infrastructure and charging networks need to be put in place now.
  - A significant proportion of parking spaces at supermarkets, multi-storey car parks and surface car parks at key locations may need charging points to meet growing demand. "Rapid" or "semi-rapid" chargers may be appropriate at supermarkets etc. to suit the 'dwell time' and enable greater throughput of vehicles.
  - All new houses should have three phase electricity supply for effective charging of Electric Vehicles.
  - Other types of new build accommodation, such as blocks of flats and communities with shared parking, should also implement effective charging solutions to meet significant demand.
  - All new workplaces should have EV charging facilities on-site or provision to install charge points.
- "Fill ups" will largely shift away from petrol stations towards shopping centres, workplaces, and public surface car parks.
- Customers at large car charging facilities, such as shopping centres, will have the opportunity to use a slow charge, for a lower price, or a fast charge, which would be more expensive for short stays.
- The renaissance of the solar PV market in the coming years will crucially support rural charging locations with weaker grid connections. On-site or near-site solar PV and battery storage will have an important role to play in providing power for charge points in remote areas.
- Service stations along major motorways will need to be rapid and plentiful with charging points at all parking spaces where practicable. Any significant queuing at motorway service stations for charging will in the end result in the Government being blamed.
- Vehicles and associated IT platforms in the early 2020's will be able to forecast and obtain real-time electricity prices, be aware of charge point locations, and will be able to identify the best available times and therefore prices at which to charge<sup>12</sup>.

## GLOBAL MANUFACTURING DEVELOPMENTS

- Volkswagen estimates that 40 Tesla-sized "gigafactories" for manufacturing batteries will be needed globally to meet EV demand by 2025<sup>13</sup>.
  - There is scope for a number of these factories to be located in the UK, creating new manufacturing jobs and inward investment, if domestic markets are created for battery products.
  - Upgrading electricity grid regulations, which would support a domestic energy storage industry, and encouraging investment in charge infrastructure and upgrading building codes would create conditions for such a battery market to develop.
  - The new factories and infrastructure would likely be built by a range of automotive and

equipment companies, not just one. Government officials should be approaching a range of companies to attract multiple sources of investment.

- Just because one player builds a battery factory in the UK this does not preclude others from doing so - the UK has five major car manufacturers building cars in the country.
- Battery manufacturing plants will be located near points of EV manufacture, as batteries are the heaviest elements of an electric car and “just-in-time” deliveries will require batteries to be readily available. Therefore, countries with battery manufacturing capabilities will attract a larger share of the future automotive manufacturing sector. For example, Tesla is rumoured to be looking to build a European car manufacturing facility and a battery gigafactory<sup>14</sup>.
- Existing UK manufacturing sites which cater to diesel, and eventually petrol vehicles should consider adapting to build batteries or EV drive trains at those sites or other sites in the UK. Government support and direction will be an important factor in the ability for many factories to adapt.
- New companies and manufacturers will need to enter the supply chain to provide the “smart” control systems and software, including for autonomous vehicles.
- China’s motor industry is already one of the largest in the world and will continue to heavily influence change in the space.
  - Their mostly domestic supply chain is now refocusing its interests outward<sup>15</sup>.
  - Chinese companies have made a number of acquisitions in the space, and a Chinese manufacturer could purchase another European auto manufacturer to establish a foothold (as they have already done with Volvo and Lotus).
- Apple, Microsoft, Google, or Amazon could move into this space by buying one of the smaller, or slower to adapt car companies, such as Chrysler, GM, or even Ford.
- Tesla, as a vehicle manufacturer, may have an approximately two year lead on vehicle technology over other international car manufactures, but the gap is closing fast<sup>16</sup>.
- Chinese auto companies see electrification as a means of growing beyond the Chinese market. Heavy investment in new electric vehicle manufacturing capacity is anticipated. Such sentiments are reflected in comments made by the Chairman of BYD in September, who said (covered by Reuters) he expected all vehicles to be “electrified” (including hybrids) in China by 2030<sup>17</sup>.

## REA FORWARD VIEW - KEY MILESTONES EVERY 5 YEARS

Looking ahead as to what could happen in the new car market, the charging infrastructure market and the energy market over the next couple of decades:

### 2017-2020

- New vehicle platforms are introduced, providing a full range of EV ready vehicles that are increasingly capable of being ICE, PHEV or EV throughout the product lifecycle.
- 200-mile range EVs are increasingly common from major manufacturers. An increasing number of well-known manufacturers are going to enter the EV market. PHEVs remain popular with some large employers due to favourable Benefit-in-Kind rates. Company car tax will begin to favour PHEVs instead of diesel or petrol vehicles, creating another early market.
- Lack of progress in the development of strategic (rapid charge) infrastructure hampers the adoption of BEV.
- A growing number of multinational companies will publically back widespread EV adoption in order to be seen as leaders of this positive change<sup>18</sup>.
- Concerns grow over uncontrolled home charging and its potential impact on the grid. To address the issue, OLEV (in conjunction with vehicle manufacturers) incentivises home charging points with units that only charge at off-peak times.
- Lithium-ion cells reach ever higher energy density and lower cost per kWh through increased production of cells, bringing economies of scale benefiting stationary energy storage too.
- Total ownership costs for most electric cars are lower than ICE equivalents by 2020<sup>19</sup>.
- 10% of new vehicles sales are EV/PHEV by 2020 in the UK.

### 2020-2025

- EV models gain significant ground with 300-mile range becoming practical and affordable as family

cars with purchase prices achieving near parity with ICE versions.

- PHEV and 'Range Extender' EV models offer greater electric range (130 mile+) and consumers enjoy a greatly reduced fuel usage. The continuation of fossil engines in these vehicles brings the benefits of batteries while allowing for "hassle-free" flexibility for long journeys.
- New Benefit-in-Kind rates for vehicles with long electric range grow this 'long range' PHEV/REx market. Premium brands re-positioning BEV as their standard offering and move away from ICE and PHEV altogether.
- Domestic charging mandates smart control and more cost-reflective time of use tariffs to push charging into 'off peak' periods based on local and national constraints (not necessarily just overnight) and periods of high renewable generation.
- Significant number of EVs involved in Demand Side Response (DSR), Enhanced Frequency Response (EFR) and Vehicle to Grid (V2G) services with innovative ownership/usage models developed by new entrants and utilities in conjunction with vehicle manufacturers and finance houses.
- Significant push by employers for workplace EV charging, which will encourage buyers without off-street parking. This is a development that can be incentivised by Government. Rapid Chargers will be used for weekly charging of vehicles where there is modest daily usage.
- Strategic charging infrastructure (e.g. service stations along motorways and trunk routes - MSAs/TRSAs) commonly now use multiple 150kW connections to provide an 80% charge in 20 minutes (60 kWh battery), which is good for 150-200 miles at motorway speeds.
- 50% of new vehicle sales are EV/PHEV.

### **2025-2030**

- All major car brands have a long-range EV offering in their most popular car and light commercial vehicle segments with PHEV in all other segments.
- Cost reductions in EV powertrains and batteries mean that PHEV are less appealing due to their complexity. New platforms are being designed as BEV only.
- By the end of the decade 75% of new car and light commercial vehicle sales are BEV. Virtually all of the rest are (long range) PHEV.
- Fuel stations are increasingly scarce in towns, confined to trunk routes. Charging rates of up to 350kW (800V systems) at major MSAs/TRSAs offer recharge times in the order of 10 minutes per 150 miles on some vehicles.

### **2030-2035**

- Most brands have applied EV across their entire range, down to the smallest vehicles that are typically least profitable.
- 90+% of new vehicle sales are BEV with the rest long-range PHEV. Half of the vehicle population is BEV.
- 2033: No new vehicle platform launched without a BEV as part of the line-up since platform will continue through 2040 and a typical model manufacturing lifetime is seven years.

### **2035-2040**

- Virtually no light vehicles sold new have any liquid fuel source, any PHEV vehicles that do are 'run out' from launches from late 2020s/2030s.
- Liquid fuel filling stations are by this time only located on major routes to support existing vehicles. Petrol prices are high so recharging still more attractive where vehicle is PHEV<sup>20</sup>.
- Government ban on the sale of new petrol and diesel-only cars and vans comes into force in 2040.
- Electric vehicles will make up the majority of vehicles on the road.

### **Debunking false narratives over combustion engines phase out**

The fear over a 'cliff edge' death to combustion engine vehicles, as cited by certain consumer-oriented campaigns, seems to be unfounded and is predicated on there being little market development towards increasingly electrified drivetrains in the meantime. With most manufacturers already planning increasingly hybridised and electric models anyway, in part to meet ever more stringent CO<sup>2</sup> targets, this is not the case as investment is starting now. It is unlikely that purely Internal Combustion Engine (ICE) vehicle models will continue to be available beyond the 2020s.

## CONCLUSIONS AND RECOMMENDATIONS

- The EV shift is happening faster than most understand. Most new car sales will be electric well before the 2040 diesel and petrol vehicle sales ban, with our “Forward View” being that **75% of new car and light-commercial sales are all-electric or PHEV by 2030**.
- **DNOs** should be given clear direction as to their future role in the electricity system, as active participants rather than passive infrastructure owners.
- EV charging, solar, and energy storage should be required in **building codes** for all new homes, offices, shopping centres, public buildings, coffee shops (over a certain size) and retail with car parking spaces.
- Government should encourage **battery manufacturing** in the UK.
- It is critical that electric vehicles are charged primarily, or entirely, with **clean electricity**. The renewable energy sector will be vital in making sure the clean power is available to make sure electric miles are carbon free.
- **Solar carports** and canopies can help address rural grid issues, as can onsite electricity storage technologies (projects in the UK, Belgium and Germany already repurpose used EV batteries as on-site storage to ease grid pressure)<sup>21</sup>.
- Delivery of the Government’s recently launched **Smart Systems and Flexibility Plan** will support the growth of the battery storage sector, which is a key market for the growing battery and EV industry<sup>22</sup>.
- Government needs to act as an enabler to the automotive industry so the UK can at the very least maintain its current R&D/manufacturing share but should aim to significantly increase it as well as manufacturing capacity, as the rapid shift to electrification of transport unfolds. The forthcoming **Industrial Strategy** is a good opportunity to do this.
- Central Government, in collaboration with Local Authorities, should **launch an EV roll-out strategy** that looks at everything from Building Regulations to manufacturing, power generation and charging infrastructure so barriers can be minimized and electric vehicles become an obvious choice for consumers.
- **It is essential that the Government plays its part in this rapid transition** and assists by steering and encouraging investment as fossil fuel reliant companies disappear or are forced to adapt. This includes job training to move workers from older industries to newer ones.

## GLOSSARY OF TERMS

**Benefit-in-Kind (BIK)** - benefit received by an employee in lieu of salary, e.g. company car, attracting lower rate of taxation for low emission vehicles

**BEV** - Battery Electric Vehicle

**DNO** - Distribution Network Operator

**DSO** - Distribution Service Operator

**DSR** - Demand-Side Response

**EFR** - Enhanced Frequency Response

**EV** - Electric Vehicle

**Gigafactory** - Tesla-style high capacity battery manufacturing facility

**ICE** - Internal Combustion Engine

**PHEV** - Plug-in Hybrid Electric Vehicle

**REx** - Range Extender

**TRSAs** - Trunk Road Service Area

**MSAs** - Motorway Service Areas

**V2G** - Vehicle to Grid

## ABOUT THE REA

The Renewable Energy Association (REA) represents a wide variety of organisations, operating in the decarbonisation of heat, power, and transport, including generators, project developers, fuel and power suppliers, investors, equipment producers and service providers. Around 650 companies are members of the REA, ranging in size, from major multinationals to sole traders, making it the largest renewable energy trade association in the UK. This includes over 100 companies operating in energy storage and electric vehicle charge infrastructure.

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- <sup>2</sup> European Automotive Manufacturing Association "EU Production" - <http://www.acea.be/statistics/tag/category/eu-production>
- <sup>3</sup> REView 2017 Press Release - R-E-A.net, July 2017: <https://www.r-e-a.net/news/new-report-shows-nearly-126000-employed-in-growing-renewables-industry-but-growth-slowing>
- <sup>4</sup> "UBS Evidence Lab Electric Car Teardown - Disruption Ahead?" - UBS Research featured on AdvantageLithium.com, May 2017: [http://www.advantagelithium.com/\\_resources/pdf/UBS-Article.pdf](http://www.advantagelithium.com/_resources/pdf/UBS-Article.pdf)
- <sup>5</sup> REA analysis
- <sup>6</sup> "Netherlands closes in on 2025 petrol and diesel car ban" - Autocar.com, August 2016: <https://www.autocar.co.uk/car-news/new-cars/netherlands-closes-2025-petrol-and-diesel-car-ban>
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- <sup>9</sup> "Nissan and Eaton power ahead with second-life battery system" Nissan Newsroom Europe, December 2015: <http://newsroom.nissan-europe.com/eu/en-gb/media/pressreleases/140285/nissan-and-eaton-power-ahead-with-second-life-battery-system1>
- <sup>10</sup> "StoreDot demos EV battery that reaches a full charge in 5 minutes" - Engadget.com, May 2017: <https://www.engadget.com/2017/05/12/storedot-ev-battery-demo/>
- <sup>11</sup> "Forecourt thoughts: Mass fast charging of electric vehicles" - National Grid, August 2017: <http://fes.nationalgrid.com/insights/forecourt-thoughts-mass-fast-charging-of-electric-vehicles/>
- <sup>12</sup> REA analysis following discussion with industry
- <sup>13</sup> "Elon Musk says 2 or 3 more Tesla Gigafactories are coming to the US" - Electrek.co, July 2017: <https://electrek.co/2017/07/15/elon-musk-tesla-gigafactory-us/>
- <sup>14</sup> "Tesla announces new gigafactory in European expansion" - The Guardian, November 2016: <https://www.theguardian.com/technology/2016/nov/08/tesla-adds-german-firm-grohmann-to-european-operations>
- <sup>15</sup> REA analysis
- <sup>16</sup> REA analysis
- <sup>17</sup> BYD predicts ambitious China shift to electric cars by 2030" - Reuters, September 2017: <http://www.reuters.com/article/us-byd-autos/byd-predicts-ambitious-china-shift-to-electric-cars-by-2030-idUSKCN1BW0BQ>
- <sup>18</sup> See EV100 Campaign led by Climate Group, here: <https://www.theclimategroup.org/electro-mobility>
- <sup>19</sup> REA analysis
- <sup>20</sup> UK Government 2016 Fossil Fuel Price Forecast anticipates in the "central scenario" a steadily increasing oil price of \$80/bbl by 2040. REA analysis indicates that petrol prices at the pump would correspondingly increase during that time. "BEIS 2016 FOSSIL FUEL PRICE ASSUMPTIONS" – Gov.UK, November 2016: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/576542/BEIS\\_2016\\_Fossil\\_Fuel\\_Price\\_Assumptions.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576542/BEIS_2016_Fossil_Fuel_Price_Assumptions.pdf)
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