Accelerating the electric vehicle revolution

Why the UK needs a ZEV mandate

green alliance...

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By Caterina Brandmayr and Ryan Leung

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Green Alliance
40 Broadway
London SW1H 0BU

020 7233 7433
ga@green-alliance.org.uk

www.green-alliance.org.uk
@GreenAllianceUK

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Registered charity no 1045395
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(England and Wales) no 3037633

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Summary

Last November, the UK brought forward the phase out date for polluting vehicles, banning the sale of new conventional petrol and diesel cars and vans from 2030 and allowing only the sale of zero emission vehicles from 2035.

This is a significant step up in ambition and one that the UK can be rightly proud of. But that ambition needs to be translated into near term action for the UK to realise all the benefits of the transition to electric vehicles and retain leadership on this agenda.

"Ambition needs to be translated into near term action for the UK to realise all the benefits of electric vehicles."

Acting early to switch to electric cars and vans will help to maximise UK emissions reductions. This will be especially the case for battery electric vehicles, rather than plug-in hybrids, which only lead to minor emissions reductions compared to petrol and diesel cars.[1] More rapid uptake of battery electric vehicles could nearly double UK emission savings in 2030, compared to delaying widespread uptake until the 2020s. New policy to achieve this would put the UK on a stronger footing to meet its 2030 international decarbonisation target and is a crucial signal of intent ahead of the Glasgow climate summit at the end of 2021.

Fast uptake of battery electric cars will also enable lower income households to gain all the benefits from clean vehicles sooner, by increasing supply to the second hand market. Households in the bottom 40 per cent of the income range mostly buy used cars. New analysis shows that, once battery electric cars, bought new today, reach the second hand market, their owners could save between £700 and £2,300 compared to a diesel or petrol equivalent, on a total cost of ownership basis. And the savings for third hand owners would be between £3,500 and £5,600.

Another reason for the UK to capitalise early on the move to battery electric vehicles is to promote investment in domestic vehicle and battery manufacturing. This would help UK car makers to stay competitive in the European and global markets, futureproofing jobs across the country. Developing UK charging infrastructure and clean energy to underpin the shift would also support economic recovery and employment across the country.[2]

The earlier phase out date for polluting vehicles, along with consumer incentives for electric vehicle purchases and funding

for charging infrastructure, will support growth in the battery electric vehicle market, but much more is needed to speed it up. Sales are increasing but are currently only 6.6 per cent of total car sales, and there are seven times more conventional petrol and diesel models on the market than battery electric cars.

"A mandate will guarantee that more battery electric cars are sold on the UK market."

The automotive industry has shown remarkably patchy progress on decarbonisation. Rather than gradually falling, new car CO_2 tailpipe emissions actually increased between 2016 and 2019.[3] It was only in 2020, when the EU CO_2 emissions regulatory target finally came into force, that most car manufacturers focused on meeting it, ramping up sales of battery electric and plug-in hybrid vehicles.[4] As the transition to clean vehicles also depends on an adequate supply of zero emission cars and vans, effective regulation to encourage manufacturers to up their sales is, therefore, essential to enable a rapid switch.

However, the current regulatory system, based on tailpipe emission standards, will not be enough on its own. In fact, there is a risk that it will encourage the continued production and uptake of plug-in hybrids, which are incompatible with a net zero future and are more costly for owners, instead of focusing on moving to battery electric vehicles.

Our conclusion is that a mandate requiring manufacturers to sell a specific, increasing proportion of zero emission vehicles (ZEVs) over the next 15 years is the best way for the UK to meet its target phase out date. This kind of regulation will guarantee that more battery electric cars are sold on the UK market.[5] It would ensure adequate supply of a wider variety of models at more competitive prices and boost the advertising of zero emission vehicles to meet the target. It will strengthen the case for investment in net zero compatible supply chains and jobs, rather than locking in investments in incremental technologies, making UK businesses more resilient for the future.

Finally, it would support a clear public message that the future for cars and vans is zero emission, ensuring these vehicles become, as the prime minister hopes, the "most visible incarnation of our ability to simultaneously create jobs, strengthen British industry, cut emissions, and continue travelling".[6]

Why the UK needs a faster transition to battery electric vehicles

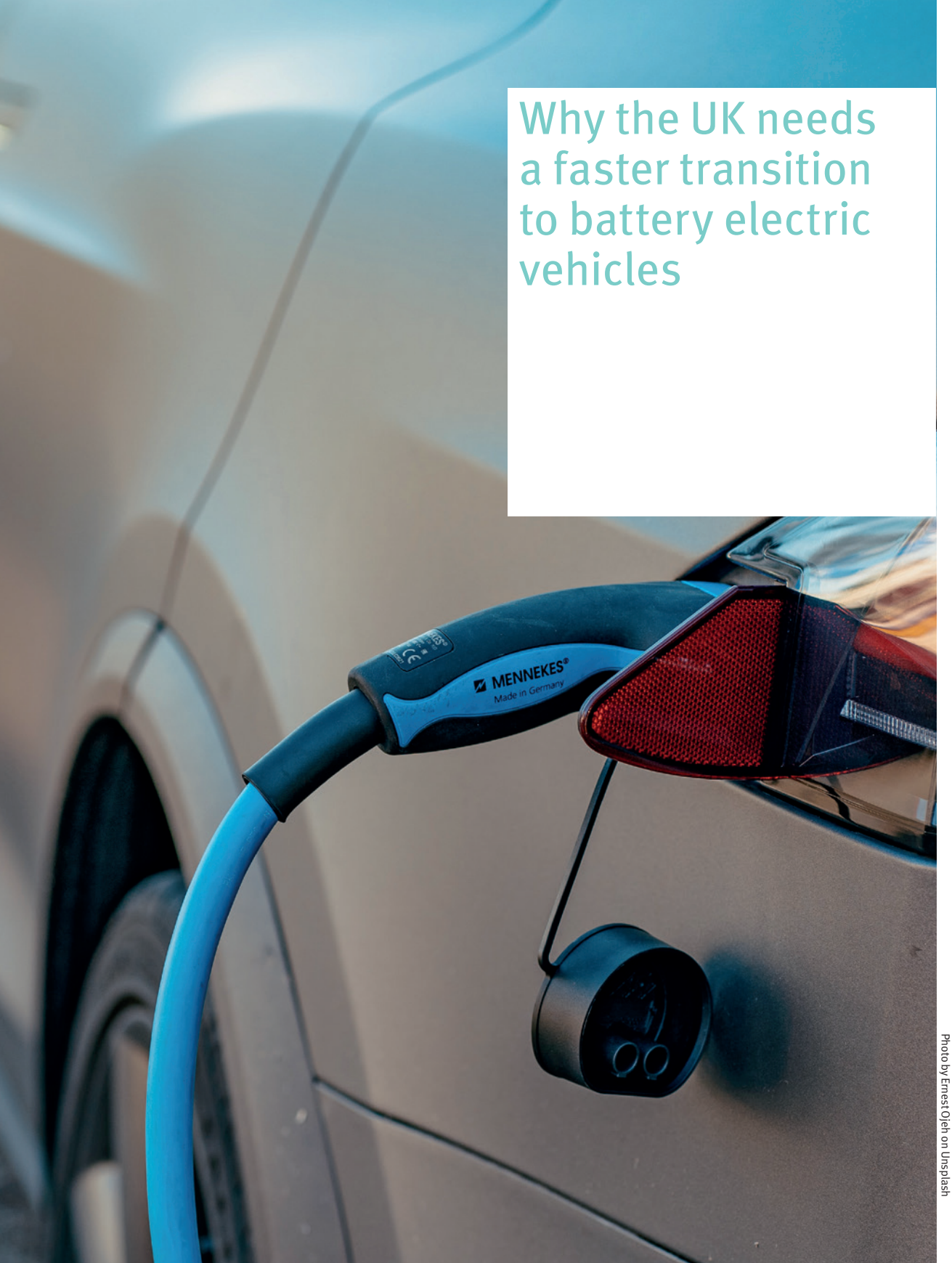


Photo by Ernest Ojeh on Unsplash

Helping to meet decarbonisation goals

Transport is the biggest emitting sector, it was responsible for 31 per cent of the UK's greenhouse gas emissions in 2019. And cars and vans account for over half of these emissions, ie 88MtCO_2e in 2019.[7]

To cut these emissions, the UK needs to promote the transition to battery electric vehicles, which avoid tailpipe emissions and have significantly lower lifecycle emissions compared to petrol, diesel and all hybrid vehicles.[8] (See annex one on page 19 for more information on plug-in hybrid vehicle emissions.)

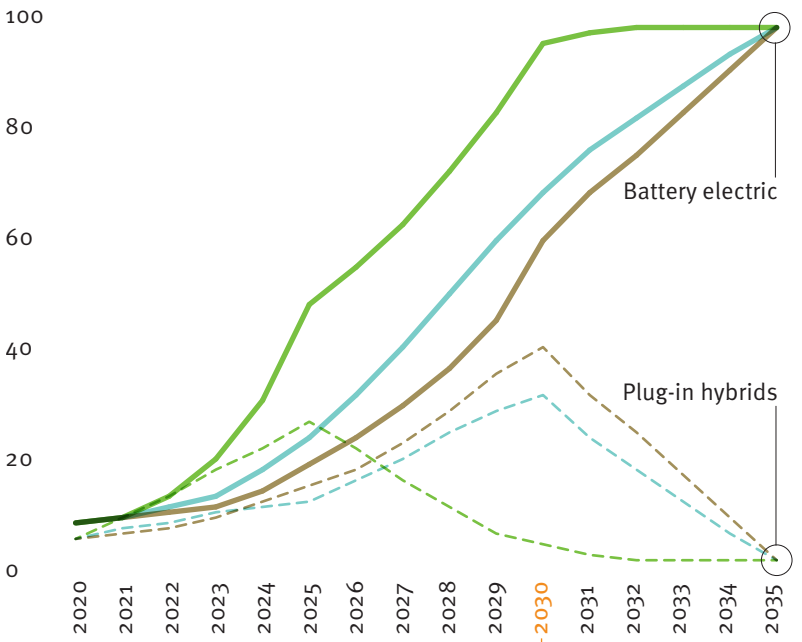
But the scale of emission cuts achieved in the near term will depend on how fast drivers switch to clean vehicles. If widespread adoption is delayed until the late 2020s, with plug-in hybrids representing a large share of the sales between 2030 and 2035, emission savings will only be just over half what could be achieved if battery electric vehicles were, instead, almost half of new vehicle sales in 2025, and the majority of sales after 2030.

"Transport was responsible for 31 per cent of the UK's greenhouse gas emissions in 2019."

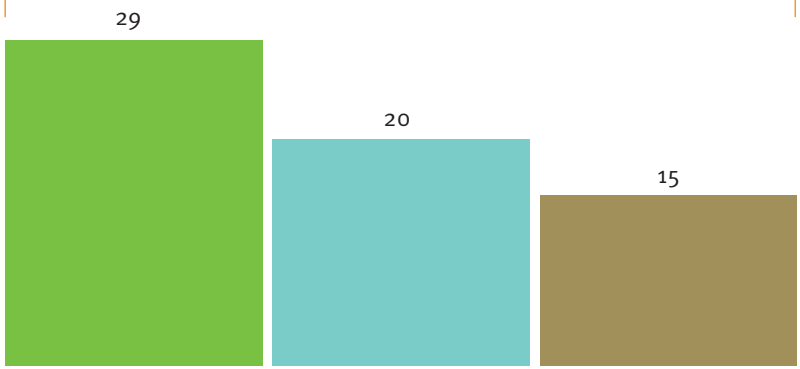
The UK has a target to reduce annual emissions, under its Nationally Determined Contribution (NDC) for the Paris climate agreement, by 68 per cent below 1990 levels by 2030. Currently, the UK is off track, with emissions in 2030 expected to be about 40 per cent higher than they should be.[9] The government urgently needs to set new policy to close this gap, preferably before it hosts the Glasgow climate summit in 2021, if it is to maintain credibility with an international audience. Policy to encourage rapid uptake of battery electric cars and vans would put the UK on a better footing to meet its target.

Fast uptake of battery electric vehicles could deliver nearly twice as many emission savings in 2030[10]

Battery and plug-in hybrid cars as a percentage of all car sales



Annual emission savings in 2030 at different levels of battery electric and plug-in hybrid car and van uptake rates ($MtCO_2e$/year)



More people can benefit sooner

New battery electric cars currently have higher upfront costs but are cheaper to run than conventional cars. This is significant for used vehicles, where depreciation leads to lower upfront prices and running costs are a relatively more important factor in overall costs. Battery electric vehicles also have fewer parts, which reduces maintenance costs.

Analysis by Element Energy, conducted for Green Alliance, shows that there are significant savings for owners of used battery electric vehicles. For a new medium sized battery electric car bought today, its subsequent second hand owner could save between £700 and £2,300 compared to the owner of a second hand diesel or petrol equivalent, on a total cost of ownership basis. Savings are even higher for the third hand owner, estimated to be between £3,500 and £5,600 compared to a diesel or petrol alternative, respectively.[11]

Households in the bottom 40 per cent of the income range mostly buy used cars.[12] The current pace of the transition to electric vehicles means they could be trapped into owning more polluting, expensive vehicles far longer than they need to be. Despite sales of new battery electric cars growing nearly 16 fold in the last six years, they were still only 6.6 per cent of new car sales in 2020.[13, 14]

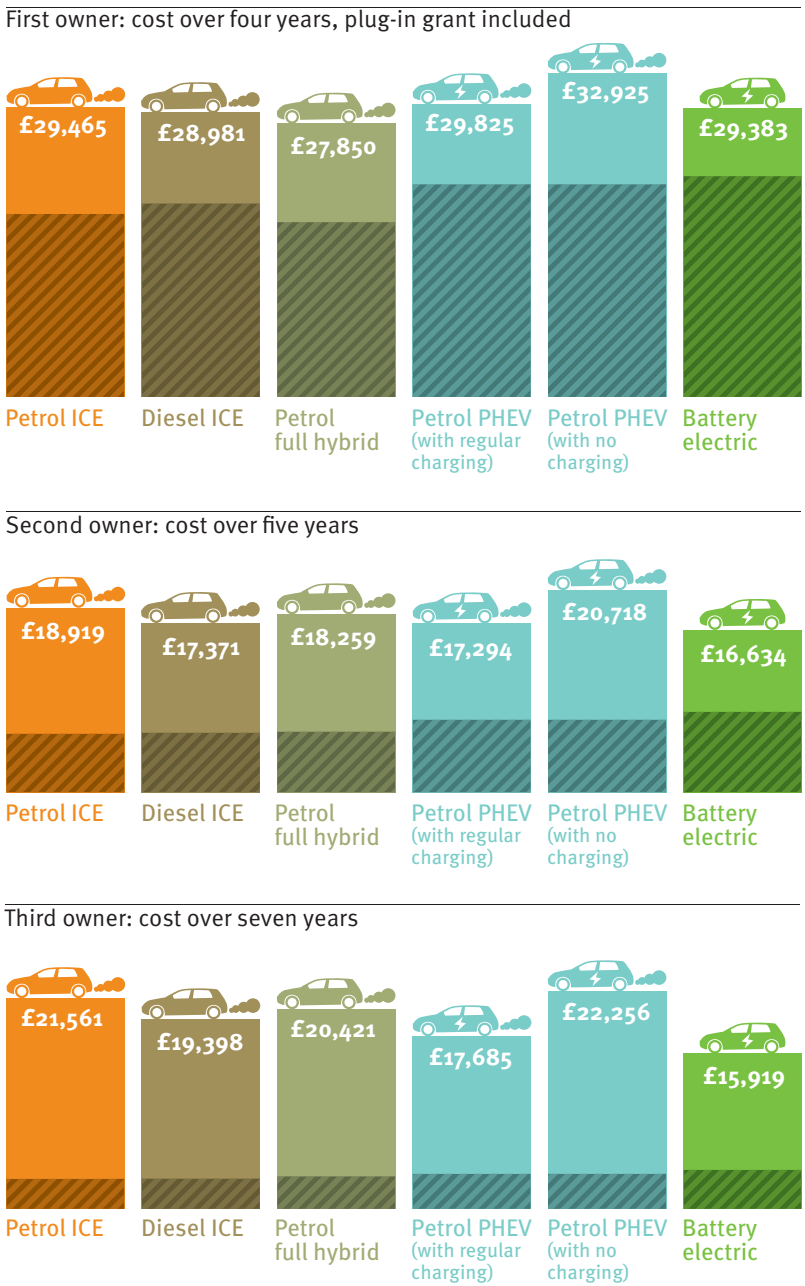
Notably, plug-in hybrids are not only more expensive than battery electric cars, but they could also be the most expensive type of car, if used without charging. As consumers are not always aware of the difference between types of hybrid and electric vehicle technologies, there is a risk that they will purchase them, either as a new or used vehicle, without full awareness of these cost implications.[15, 16] And, if plug-in hybrids represent a significant share of vehicle sales up to 2035, it would limit the cost benefits to consumers.

Speeding up the market for new battery electric cars, including by ensuring sufficient supply, will help to bring down costs and increase the flow of them onto the second hand market.

Boosting the battery electric vehicle market will save used car owners thousands[17]

"There are significant savings for owners of used battery electric vehicles."

Total cost of ownership of a medium size car, bought new in 2021



Good for the economy and businesses

Increasing sales of battery electric vehicle now will contribute to economic recovery from Covid. Investment in charging infrastructure will create jobs in both the short and the medium term. The necessary expansion of electricity generation will support new jobs in the power sector. And lower running costs will free up cash to increase consumer spending in other parts of the economy.[18]

Furthermore, securing the long term resilience of UK industries means investing in solutions that will make them competitive in future. With the global market for battery electric vehicles set to grow quickly, the UK has a good starting point: in 2018, it built a quarter of the battery electric cars in Europe.[19,20] But the global race is now on. The EU is moving in on the market, though its growth is only expected to pick up significantly later in the 2020s.[21] The UK can either capitalise on its early mover advantage in the first half of the 2020s, to secure and bolster its position in both the domestic and EU markets, or wait and risk falling behind.

"A more concerted effort to establish more battery electric vehicle manufacturing will require immediate steps to grow the domestic supply chain."

Rules of origin, which require a certain share of a vehicle to be made in the EU or UK (if the vehicle is to be exported to the EU), will also become stricter later in the 2020s.[22] A more concerted effort to establish more battery electric vehicle manufacturing, including battery production, early will therefore be essential and will require immediate steps to grow the domestic supply chain.

Research by Cambridge Econometrics compared the benefits of a 2030 and a 2035 phase out of all conventional petrol, diesel and hybrid (including plug-in hybrid) new vehicles. Its analysis finds that ramping up battery electric vehicle uptake to nearly all new sales in 2030 could grow the UK's GDP by as much as 0.6 per cent by 2030, compared to a slower transition, if UK industry were able to capture a greater share of domestic demand. There will be further benefits if it also corners the EU market. Investment in UK electric vehicle manufacturing will also help to futureproof jobs in the automotive sector and support new employment in battery production.[23]

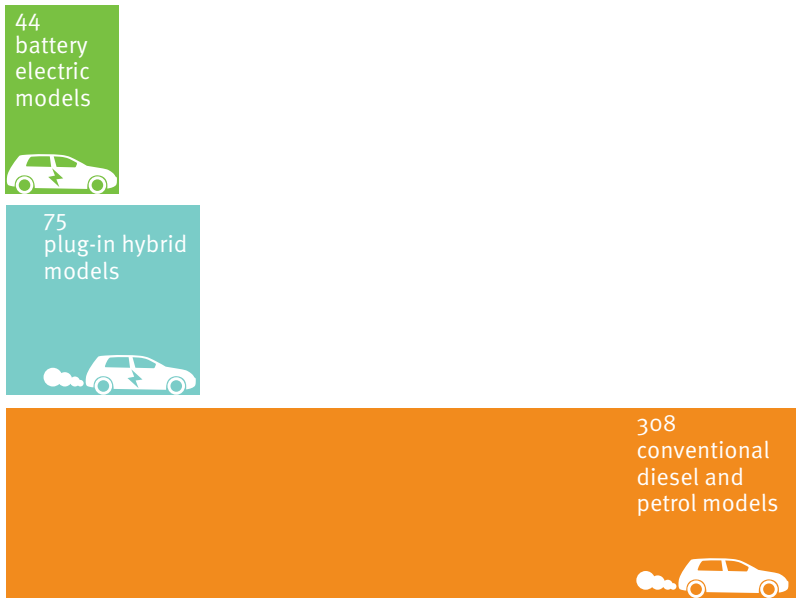
Speeding up clean vehicle sales

Photo by Alexunder Hess on Unsplash

Progress is still limited

Sales of battery electric cars are increasing but from a very low base, and the range of battery electric vehicle models on the market is currently small, making it hard for some consumers to find an option that matches their needs and preferences.[24] As of March 2021, there were seven times as many petrol and diesel only car models and 1.7 times as many plug-in hybrid car models available on the UK market.[25]

There is a limited choice of battery electric vehicle models on the UK market (at March 2021)[26]



Regulation is essential

The government's 2030 phase out date for petrol and diesel vehicles is a strong signal of intent. Consumer incentives, as well as funding and policy to scale up charging infrastructure, can help overcome some of the main barriers to electric vehicle uptake. But the pace of change also depends on adequate supply. The car industry's track record so far, in relation to meeting the EU's CO_2 tailpipe regulations, suggests it may not be in any rush to bring cleaner vehicles to market and promote them, in the absence of effective regulation to drive change.[27]

Under the government's CO_2 regulations, the average emissions of new cars sold by a company cannot exceed a certain amount of CO_2 per kilometre. To bring down average emissions, car companies can improve fuel efficiency and sell lower emitting vehicles, such as plug-in hybrid and battery electric vehicles.

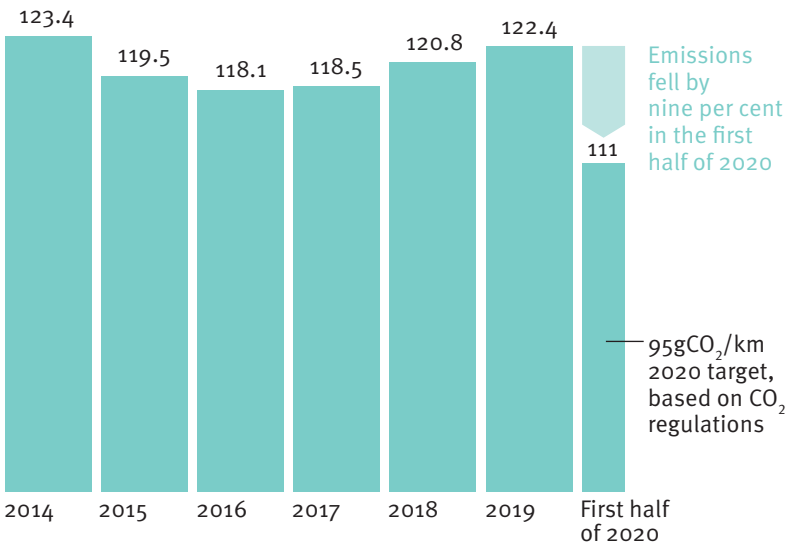
"A push to grow sales of SUVs led to CO_2 emissions from new cars actually increasing between 2016 and 2019."

The industry showed very poor progress in reducing emissions ahead of the EU's 2020 CO_2 target coming into force. A push to grow sales of SUVs led to CO_2 emissions from new cars actually increasing between 2016 and 2019, rather than falling to meet the 2020 target of 95gCO_2 per km.

It was only in 2020, when the new target came into effect, that most car manufacturers launched many more new electric vehicle models and ramped up the sales of battery electric and plug-in hybrid vehicles to meet the tighter CO_2 regulation. Research by Transport & Environment shows this resulted in an average reduction in CO_2 emissions from new cars of nine per cent in just six months in the first half of 2020, the largest drop ever recorded.[28]

Manufacturers delayed action until they were forced[29]

Average carbon dioxide emissions from newly registered passenger cars in Europe (gCO2/km)



A mandate to accelerate the electric vehicle transition

Why a ZEV mandate is needed

The UK's post-Brexit approach to tailpipe emissions regulations is still to be determined but the government has so far adopted regulation to retain emission standards that are at least as ambitious as the EU's. The effective EU target for average emissions from new cars is set at 95gCO_2 per km in 2020 and 2021, with a 15 per cent reduction from 2021 levels by 2025 and a 37.5 per cent reduction by 2030.[30] While this is encouraging, going forward the targets would have to be considerably tighter to enable the fast transition the UK needs to maximise the benefits we have discussed.[31] There are also issues with the complexity and transparency of the CO_2 tailpipe standards.

Crucially, CO_2 regulations only set an upper limit on the emissions allowed, rather than setting explicit requirements for a share of the vehicles sold to have zero tailpipe emissions. Therefore, there is a risk that they will promote continued production and uptake of hybrid and plug-in hybrid cars, which are incompatible with the net zero goal, instead of ensuring a focus on zero emission alternatives.

"A ZEV mandate would secure an adequate supply of battery electric vehicles to the UK market"

The government also plans to consult on which types of vehicles can be sold between 2030 and 2035, ie once the sale of new petrol and diesel vehicles is banned, but before only zero emission vehicles can be sold.[32] Setting strict criteria to ban the sale of hybrid vehicles and only allow the sale of plug-in hybrids that can be driven in electric mode for the vast majority of their trips, will ensure significant uptake of battery electric cars after 2030. But, even if these strict criteria were put in place beyond 2030, it is unlikely to have a significant impact in the near term.

A new form of regulation, known as a Zero Emissions Vehicle (ZEV) mandate, is the answer. Already in force in California and nine other US states, China and some Canadian provinces, this would require car and van manufacturers to sell an increasing number of zero emission vehicles, such as battery electric vehicles, as a share of their overall sales on the UK market.[33] Sales targets can be set under a credits scheme, where manufacturers would be able to trade ZEV credits between one another in a given year, to allow for some flexibility in the market. Sales targets would progressively increase to reach 100 per cent by 2035, the phase out date for all vehicles with tailpipe emissions. (For more information about California's ZEV mandate see annex two on page 20)

A ZEV mandate is an effective measure for the following reasons:

It secures an adequate supply of battery electric vehicles to the UK market. The Climate Change Committee (CCC) recommends that battery electric cars should be nearly half of new vehicles sales in 2025. While more ambitious CO_2 regulations could promote a greater supply of lower emission vehicles than projected under current regulations, they are still unlikely to guarantee the higher sales of zero

emission cars needed to meet the CCC's recommendation. There is also a risk that supply to the UK market might be limited, if demand for battery electric vehicles grows significantly in other EU nations, driven for instance by more generous purchase subsidies, currently offered in Germany and France.[34] By introducing a ZEV mandate, the UK would secure adequate supply without having to increase purchase subsidies to the level of its EU counterparts. The mandate would also help to accelerate cost reductions, as car makers will compete for sales to meet the target.

"A ZEV mandate would encourage producers to advertise battery electric vehicles to ensure sales targets were met."

It will promote clear public messaging. There is strong public support for action on climate change.[35] But clear messaging about solutions is essential to secure long term shifts in behaviour. Rather than using CO_2 regulations to support continued uptake of lower carbon vehicles with only marginal emission improvements, some of which, as in the case of plug-in hybrids, are much less green than claimed, a ZEV mandate would help to focus on the need to switch to zero tailpipe emission cars. This is especially important, given that many consumers are not clear about the difference between hybrid and battery electric cars.[36] Advertising is one of the areas where it is likely to have an impact. According to a report by the New Weather Institute and Possible, car manufacturers spent £1.2 billion in 2019 advertising SUVs, which are responsible for significant emissions. This increased SUVs' share of the market to 40 per cent in that year.[37] A ZEV mandate would encourage producers to advertise battery electric vehicles specifically to ensure sales targets were met and accelerate efforts to train up related dealerships and maintenance providers.

It will help to futureproof UK industry. With CO_2 regulations alone, UK manufacturers might continue to invest in producing conventional vehicles, as well as hybrids and plug-in hybrids, potentially locking jobs into high carbon supply chains. Earlier investment in battery electric vehicle manufacturing will improve the long term resilience of the UK automotive industry.[38] A ZEV mandate will strengthen the case for this investment along supply chains and in green jobs. It would also help to attract inward investment from manufacturers specialised in zero emission vehicles.

Putting the UK at the forefront of the electric vehicle revolution

As highlighted in the prime minister's ten point plan, "zero emission vehicles can be our most visible incarnation of our ability to simultaneously create jobs, strengthen British industry, cut emissions, and continue travelling".[39]

The UK has demonstrated leadership by setting an ambitious earlier target to phase out polluting cars. Building on existing policy to promote the uptake of electric vehicles, the Department for Transport now needs to ensure that regulation supports this move.

A ZEV mandate, with ambitious interim targets over the 2020s, in line with the CCC's recommended uptake levels for battery electric vehicles, of nearly 50 per cent by 2025 and over 70 per cent in 2028, should be introduced, under a credits scheme, to maximise climate benefits and cost savings to consumers. It will set a clear incentive for car manufacturers to capitalise on the transition to zero emission vehicles, promoting investment in futureproof supply chains, boosting battery electric vehicle sales and ensuring there is a wider range of clean vehicles on offer.

It can be introduced alongside more stringent CO_2 regulations for vehicles, to ensure that, as well as promoting earlier sales of zero emission vehicles, there is continuous improvement in the performance and efficiency of petrol, diesel and hybrid vehicles up to the phase out date. A strict set of criteria should also be introduced to limit the sales of all types of hybrids between 2030 and 2035 (except plug-in hybrids that can be driven in electric mode for the vast majority of trips), to accelerate the move to zero emission vehicles.

The UK can either lead in this global transition, and become a hub for battery electric vehicle manufacturing, or lose its place in the market for the foreseeable future. As the country prepares to host the Glasgow climate summit in November 2021, it has the chance to set the bar for this industry, follow through on its own carbon cutting commitments and help to raise the ambitions of the rest of the world to move faster to electric transport.

Annexes

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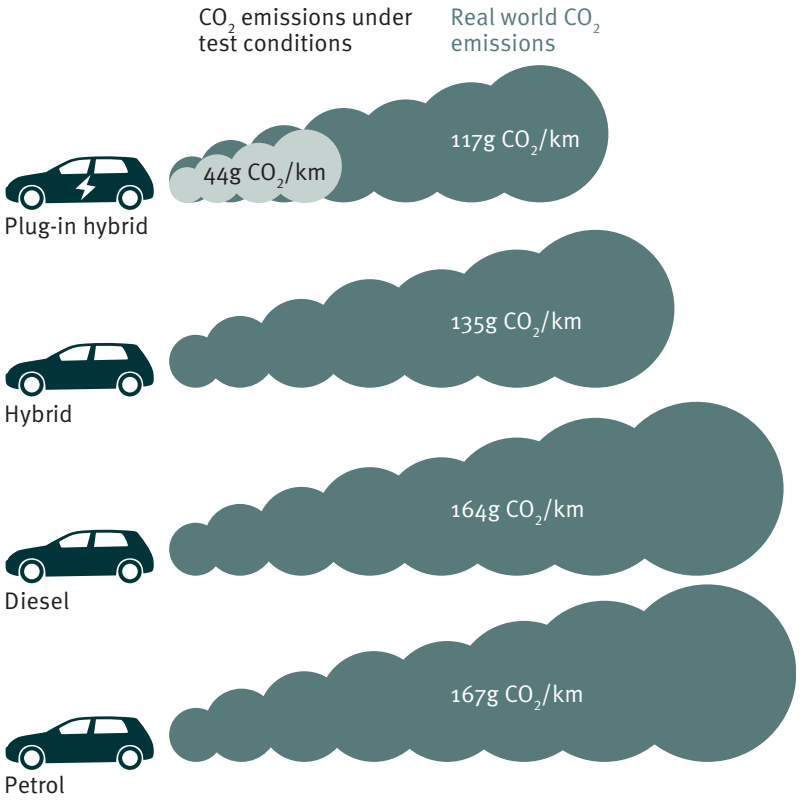
Annex one

Why plug-in hybrids are not the solution

While plug-in hybrid cars are presented as a green alternative to conventional petrol and diesel vehicles, their real world emissions are often significantly higher than those generated under test conditions and they are only marginally better than those from conventional vehicles.[40] This is because owners frequently do not charge their cars or the car does not drive using the battery and electric motor only, even when supposedly running in zero emission mode.

Car buyers are at risk of being misled about the green credentials of plug-in hybrids and might choose to purchase them believing them to be better than they are, instead of opting for a truly zero emission vehicle.

Real world emissions from plug-in hybrids are higher than predicted[41]



Annex two

California's ZEV mandate: leading the way in the US

A mandate on manufacturers, under a credit trading system, has already been implemented in California.[42] Manufacturers are required to sell a growing proportion of zero emission vehicles and, if they fail to meet the target, they must purchase ZEV credits from other producers that exceed their mandate.

With a target for sales of pure zero emission vehicles of six per cent in 2020, the mandate has helped to increase the share of battery electric vehicle sales nearly fourfold since 2015 to reach 6.4 per cent in 2020, which is over three times the US average that year.[43, 44] California alone accounted for nearly half of all new US battery electric vehicle sales in 2020.[45] Battery electric vehicles are forecast to reach over a quarter of all sales in California by 2025 and up to nearly 60 per cent by 2030, while estimates for US wide adoption suggest less than 10 per cent of new sales will be EVs in 2025, and just over 20 per cent in 2030.[46]

The mandate, first introduced in 1990, has also driven technology improvements, thanks to the early focus on low carbon vehicles and its ZEV credit system. Under this, manufacturers that are more advanced in ZEV technology can sell their excess ZEV credits to other manufacturers, stimulating investment in innovation. It also provided an incentive for the early entry of specialised ZEV manufacturers.[47, 48]

As a testimony of the effectiveness of this scheme so far, California is also planning to extend it to medium duty and large trucks, from 2024.[49]

California battery electric vehicle sales are three times the US average, as a percentage of overall car sales[50]

Endnotes

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[3] European Environment Agency, 2020, 'Average CO2 emissions from newly registered motor vehicles in Europe'; figure 1: 'Average carbon dioxide emissions from new passenger cars'. Average CO2 emissions from new passenger cars increased from 118.1 gCO2/km in 2016 to 122.4 gCO2/km in 2019, rather than gradually decreasing towards the 2020 target of 95 gCO2/km.

[4] Transport & Environment, 2020b, *Mission (almost) accomplished*

[5] The mandate would require sales of zero emission vehicles, of which battery electric cars and vans are expected to be the most widespread type of technology.

[6] HM Government, 2020, *The ten point plan for a green industrial revolution*

[7] The total emissions for the UK in 2019 were 520 MtCO2e, in which the transport sector (including international aviation and shipping) contributed 169 MtCO2e, where 88 MtCO2e were from cars and vans. CCC, 2020, *Sixth carbon budget*

[8] Transport & Environment, 2020a, op cit

[9] Green Alliance, 2021, *Net zero policy tracker: April 2021 update*

[10] For more information about the analysis, see methodology available on Green Alliance's website at www.green-alliance.org.uk/resources/Accelerating_EV_revolution_Methodology.pdf

[11] For more information on this analysis, see our methodology online at www.green-alliance.org.uk/resources/Accelerating_EV_revolution_Methodology.pdf

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[16] Note that evidence shows that plug-in hybrids are not charged regularly. P Plötz, C Moll et al, 2020, *Real-world usage of plug-in hybrid electric vehicles: Fuel consumption, electric driving, and CO2 emissions*

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[21] Transport & Environment, 2020b, op cit.; Transport & Environment, 2021, *Cars CO2 review: Europe's chance to win the e-mobility race*

[22] B Hancke and L Mathei, 25 January 2021, 'Brexit, batteries and the fate of the British car industry', *LSE blogs* which says: "The threshold for so-called originating content will climb to 45% from 2023 until the end of 2026, and to 55% from 2027. This is particularly challenging for EV production because the batteries alone, which are currently mainly imported from Asia or the US, often make up 50% of the total value of a car."

[23] Cambridge Econometrics, 2020, op cit; Faraday Institute, 2020, *UK electric vehicle and battery production potential to 2040*; crucially, the majority of existing employment in the automotive sector can be directly transformed into green jobs through electrification, based on WWF, 2018, *Accelerating the EV transition – environmental and economic impacts*

[24] J Attwood, 6 January 2021, 'Analysis: 2020 UK car sales hit 28-year low, EV market grows rapidly', *Autocar*

[25] SMMT, 2021, *Delivering the triple bottom line: a blueprint for the electric vehicle revolution*

[26] Ibid

[27] Transport & Environment, 2020b, op cit; this is also the case for vans, as highlighted by Transport & Environment, 2021, *European van market unplugged: how weak regulation is failing electrification*

[28] Ibid

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[39] HM Government, 2020, op cit

[40] Transport & Environment, 2020a, op cit

[41] Ibid

[42] California Air Resources Board, Zero-Emission Vehicle Program, ww2.arb.ca.gov

[43] California Code of Regulations. 'Zero-Emission Vehicle Standards for 2018 and subsequent model years for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles', 13 CA ADC § 1962.2, govt.westlaw.com, accessed on 1 May 2021. Note that there is an upper target of 9.5 per cent in 2020 and 22 per cent in 2025 which can be met through sales of plug-in hybrids, alongside battery electric cars and fuels cell electric vehicles. However, the mandate sets a minimum level that needs to be met by vehicles with zero tailpipe emissions.

[44] Alliance for automotive innovation, 'Electric vehicle sales dashboard', http://www.autosinnovate.org, accessed on 14 May 2021

[45] A Bui, P Slowik N Lutsey, 2020, *Update on electric vehicle adoption across U.S. cities*; note that, alongside a ZEV mandate, electric vehicle uptake in California has also been enabled by the availability of charging infrastructure and other supportive policies.

[46] L McDonald, 2021, 'EV sales forecast', evadoption.com; Bloomberg New Energy Finance, 2020, Electric vehicle outlook 2020; note however that there is considerable uncertainty in the US forecast, given the recent change in administration, as highlighted in K Adler, 19 January 2021, 'IHS Markit forecasts global EV sales to rise by 70% in 2021', IHS Markit

[47] Note that the set of technologies that qualified for the ZEV mandate has evolved over time. Since 2018, only battery electric vehicles, fuel cell electric vehicles and plug-in hybrids are eligible to receive ZEV credits.

[48] V McConnell, B Leard and F Kardos, 2019, *California's evolving zero emission vehicle program: pulling new technology into the market*

[49] D Shepardson and N Groom, 25 June 2020, 'California passes landmark mandate for zero emission trucks', *Reuters*

[50] Alliance for automotive innovation, 'Electric vehicle sales dashboard', www.autosinnovate.org, accessed 14 May 2021

Green Alliance
40 Broadway
London SW1H 0BU

020 7233 7433
ga@green-alliance.org.uk

www.green-alliance.org.uk
@GreenAllianceUK

The Green Alliance Trust
Registered charity no. 1045395
Company limited by guarantee
(England and Wales) no. 3037633
Registered at the above address