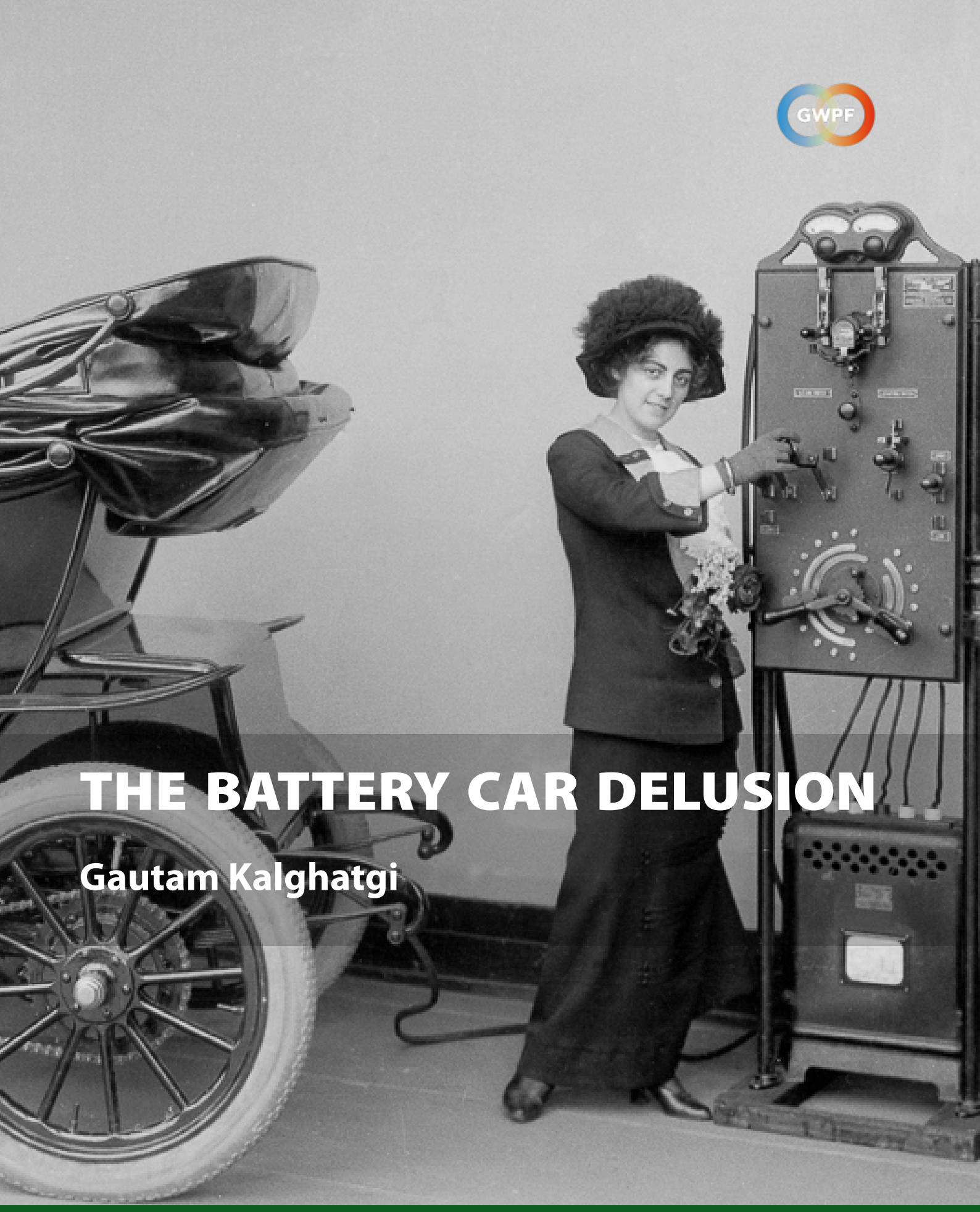

THE BATTERY CAR DELUSION

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Note 23

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Summary

Battery electric vehicles (BEVs) do not represent a significant improvement over internal combustion engine vehicles (ICEVs) in terms of their carbon dioxide footprint unless all the energy for their manufacture and use is CO_2-free. That is not likely to happen in the next ten years. A large investment in infrastructure is needed to enable wide deployment of BEVs and possibly continuing incentives to encourage people to buy them. Also, a large increase in BEV numbers will bring other problems, such as the impacts on human health of mining for the minerals, although these take place far away and are often ignored.

Even with a hundred-fold increase in BEV numbers to 10 million by 2030, over 85% of transport in the UK will still run on internal combustion engines. There is, however, great scope for improving ICEVs in terms of their efficiency and emissions impact. This will require no new infrastructure, but will require sustained research effort. Even if the government want to promote BEVs, banning the sale of new ICEVs will effectively stop R&D in this area well before such a ban comes into force, thus removing the easiest way to bring about big improvements in the environmental impact of transport. A ban would also have a serious impact on employment in a critical sector of UK industry. All available technologies, including BEVs, ICEVs and novel fuels, where they make sense, need to be deployed to mitigate the impact of transport.

About the author

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Introduction

The UK government is considering banning the sale of any new vehicle carrying an internal combustion engine (ICE) starting from 2035. The Committee on Climate Change wants this date brought forward to 2032 or even 2030. The ban would include hybrid electric vehicles (HEVs) and even plug-in hybrid electric vehicles (PHEVs). Thus, from this date, only fully electric vehicles – battery electric vehicles (BEVs) and vehicles equipped with fuel cells and running on hydrogen – will be on sale.

This note argues that such a ban will not make much difference to the greenhouse gas (GHG) emissions from transport in the UK by 2030 and will require very significant expenditure on new infrastructure. Even with a 100-fold increase in the number of BEVs to 10 million, around 85% of transport energy will still be delivered by ICEs. This large increase will at best save about 4% of the GHGs associated with transport in the UK. However, even a 5% reduction in the fuel consumption of ICEs will deliver a greater reduction in GHGs, and this, moreover, while using existing infrastructure. In fact, there is great scope for reducing the fuel consumption of ICEs by very much more than 5%, as well as to reduce their exhaust pollution to negligible levels through the use of better combustion, control and after-treatment systems along with partial electrification and reductions in weight. This will require continuous development. but R&D in this area will stop much before the proposed ban is implemented as manufacturers move out of ICEV. This will shut off the most practical way of mitigating the effect of transport on the environment while there will have been very little impact on GHG via BEVs but at great cost.

The battery car delusion

The prize is small

BEVs are not zero-emission; it takes more energy to manufacture a BEV than an ICEV, because the manufacture of batteries is very energy intensive. In addition, end-of-life recycling cost is higher for a BEV than for an ICEV. As a result, in the UK, only BEVs with small batteries have lower lifetime emissions than ICEVs. As battery size increases, to enable bigger cars and longer range, the CO_2 footprint of BEVs surpasses that of equivalent ICEVs, even if the electricity used is increasingly carbon-free. Therefore, even converting all of the UK's 37 million[1] light duty vehicles (LDVs; that is, cars and vans, accounting for about 55% of UK's transport energy use[2]) to battery power would not decarbonise the transport system to any great extent. A recent IEA study suggests that, on average, for a mid-sized car, greenhouse gas (GHG) emissions are around 25% lower for a BEV compared to its ICE equivalent[3] so, allowing for various uncertainties, we might expect an overall GHG saving of just 15–20% if the whole LDV fleet was converted.

The task is gargantuan

At the end of 2019, the UK had around 100,000 BEVs, representing about 0.3% of the LDV fleet.[4] In other words, BEV numbers have to increase at least 300-fold if the government is to replace all LDVs. To electrify bigger cars and give longer ranges, available battery capacity has to increase by a factor much greater than 300. If we assume a 100-fold increase in BEV numbers by 2030 to 10 million, it would represent only 27% of the LDV fleet and 85% of transport would still rely on ICEVs. Incidentally, in 2019, 37,800 BEVs were sold; at this rate it would take 263 years to reach 10 million.

Moreover, heavy-duty commercial transport and aviation, which account for around 45% of transport energy use in the UK, cannot/should not be electrified because of the size of the batteries needed. For example, a medium-range jet like the Airbus A320 carries 266 MWh of energy in the form of aviation fuel. A battery storing an equivalent amount of energy would weigh 19 times the maximum take-off weight of the aircraft.[5] In fact the only way of fully decarbonising aviation is to shut it down.

The costs are vast

Mass conversion to BEVs will require huge spending on CO_2-free electricity generation and the necessary public infrastructure for charging. In the UK, around 16 million LDVs (43% of the total) park on the street.[6,8] Over 2 million public charging points, placed near where people usually park rather than at more remote charging areas, will be needed to overcome 'charging anxiety' and persuade people to buy BEVs. Subsidies to encourage people to buy BEVs will continue to be necesary until their up-front costs come down sufficiently. A recent paper by Toyota concluded that even in the most optimistic scenarios BEVs would not reach purchase price parity with ICEVs by 2030.[7]

To make things worse, at some point in the future, the government will need to tax electricity in order to recoup lost fuel tax on fossil fuels and the associated VAT, which together currently contribute over £32 billion to the public purse.

The resources are beyond us

There are also challenges associated with providing additional electric power to a large number of BEVs both at the micro and macro level.[6,8] For example, the electricity distribution network will need to be significantly altered. There are serious questions about the availability of materials needed for battery production. For instance, to replace all LDVs in the UK with BEVs would require twice the total annual world cobalt production, nearly the entire world production of neodymium, three quarters the world's lithium production and at least half of the world's copper production during 2018.[9]

There are costs beyond money

Both BEVs and ICEVs have impacts on human health. The impact of BEVs – mainly from the extraction of the minerals required – is three to five times worse than the impacts of ICEVs, which arise mainly from exhaust pollutants.[10]

There are also environmental concerns. Mining of minerals required for BEVs also has significant adverse impacts on freshwater.[10,12,13] Currently these environmental impacts of BEVs are ignored because the number of BEVs is relatively low and the harm occurs in faraway places. This is morally unjustifiable, and will be even less supportable if the demand for these materials increases many hundredfold.

ICEs to the rescue

The big savings can be made in the big numbers

After we spend the many tens of billions necessary to deliver a 100-fold increase in BEV numbers, as noted above, 85% of UK transport energy will still be delivered by ICEs. If each BEV delivers a 25% saving in greenhouse gas emissions, the overall reduction for the UK would be less than 4%.[11] A larger reduction emissions could be delivered with a minor improvement in fuel consumption of ICEVs of just 5%. It is highly unlikely that technology would fail to deliver such modest progress by 2030.[14] Moreover, this would not require any investment in new infrastructure. In fact there is scope for far greater reductions in fuel consumption.[14] Better combustion and control systems, partial electrification and reductions in weight could conceivably deliver reductions of 50%.

Killing the golden goose

A ban on new ICEV sales will ensure that the UK will be denied the benefits of any improvements in ICEV technology that later emerge, even though transport will largely be run on ICEs for decades to come; well before such a ban comes into force, research and development in this area will cease in the UK as manufacturers pull out of the technology. The possibility of making large and – relatively speaking – very cheap impacts on the sustainability of transport will be thrown away in favour of BEVs, an expensive and largely futile exercise. Moreover, many scientists and engineers working in world-renowned groups in the UK will lose their jobs. In fact, if the general public is not persuaded to buy BEVs in large numbers by 2030, because of charging anxiety and high up-front costs, car manufacturers will be in real trouble and an important sector of UK industry will be destroyed, with dire implications for employment.

A word on air quality

Although BEVs are widely seen as being beneficial in terms of air quality, modern ICEs with exhaust after-treatment sys-

tems are comfortably capable of beating the most stringent NOx requirements, and modern filters for diesel exhausts can deliver near-zero particulate levels.[14,15] In fact, in some polluted cities, such as Delhi or Los Angeles, the exhausts of modern ICEVs may have lower pollutant levels than the intakes.[14,16] At this point, other sources of particulates such as tyre wear become more important. Here, BEVs perform rather badly; they are heavier than ICEVs because of the weight of the batteries and tyre wear is consequently worse.

BEVs can play an important role in improving local air quality, although they represent little improvement over the most modern ICEVs. But if BEVs are being promoted because they can help with urban air quality, different policies need to be instituted. Banning polluting vehicles from city centres, as happens in the many low emissions zones, is a much better approach than arguing on the basis of greenhouse gas emissions. As we have seen, by 2030, the introduction of BEVs will have made little difference on this score.

Conclusions

All available technologies, including ICEVs, BEVs, fuel-cell vehicles and alternative fuels are required to improve the sustainability of transport. Banning the most common of these technologies, and the one with the most potential for improvement, namely ICEVs, is not sensible. All of these technologies need to be assessed on an honest life-cycle basis to ensure that they deliver what they promise and do not have unintended counterproductive consequences. Policies instituted on environmental arguments have often proved to be either ineffective or counterproductive or have other unwanted[1] consequences. The warnings are there.[5]

Notes

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About the Global Warming Policy Foundation

The Global Warming Policy Foundation is an all-party and non-party think tank and a registered educational charity which, while openminded on the contested science of global warming, is deeply concerned about the costs and other implications of many of the policies currently being advocated.

Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

The key to the success of the GWPF is the trust and credibility that we have earned in the eyes of a growing number of policy makers, journalists and the interested public. The GWPF is funded overwhelmingly by voluntary donations from a number of private individuals and charitable trusts. In order to make clear its complete independence, it does not accept gifts from either energy companies or anyone with a significant interest in an energy company.

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