KPMG

The decarbonisation of transport

Putting the UK on the road to success

July 2019

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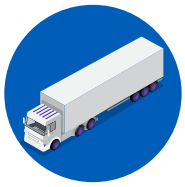
The decarbonisation of transport

4%

increase in UK transport emissions despite overall decline of 18% in greenhouse gas emissions in 2012-16. Transport is the largest emitting sector of the UK economy.[2]

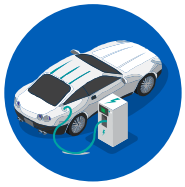
40,000

deaths each year in the UK attributable to outdoor air pollution. Cost of illness and premature death add up to more than £20 billion each year.[3]



18%

of road transport emissions are from heavy goods vehicles.[4]



44%

reduction needed in transport sector emissions in order to meet the UK's fifth carbon budget.[5]

Creating a low carbon environment to combat climate change has become one of the biggest public policy issues of our time. Central to the success of this is the decarbonisation of transport, which is the biggest single carbon-emitting sector in the UK, accounting for 28% of the country's emissions in 2017.[1]

The government's decision to accept the Committee on Climate Change's (CCC) recommendation for a net zero emissions target by 2050 is a striking development that puts the UK in a leadership position on tackling climate change. But it also raises the stakes for all parties. Concerted action will be needed across many sectors, from transport to energy to infrastructure, if we are to achieve this target.

Air pollution is considered the world's greatest environmental risk to health, accounting for 7 million global deaths annually.[6] It has been termed a global public health emergency by the WHO.[7] In the UK alone, an estimated 40,000 lives are cut short annually because of air pollution. Costs to society, business and health service add up to more than £20 billion each year. Carbon emissions, i.e. air pollution produced by internal combustion engine (ICE), including nitrogen oxides, volatile organic compounds, carbon monoxide, carbon dioxide, particulates and sulphur dioxide, therefore constitute a major public health issue.

The sale of new petrol and diesel cars and light commercial vehicles (LCVs) is already set to be banned in the UK by 2040 but the CCC has recommended bringing this forward to 2035 or even 2030, if the target of net zero emissions by 2050 is to be achieved. Increasing numbers of Ultra Low Emission Zones (ULEZs) are set to come into existence in cities around the UK between now and 2026, with London's ULEZ already in force. We can expect to see the definition of 'ultra-low' falling progressively over time, from 75g of carbon per kilometre now to perhaps 50g for cars and LCVs.[8]

Sources:

1 Committee on Climate Change. Reducing UK emissions – 2018 Progress Report to Parliament. June 2018.
2 Department for Transport. Data on energy and environment from transport. Last updated December 2018; National Statistics. Final UK greenhouse gas emissions national statistics: 1990-2016. 2018.
3 Royal College of Physicians. Every breath we take: the lifelong impact of air pollution. Report of a working party. London: RCP, 2016.
4 Department for Transport. Data on energy and environment from transport. Last updated December 2018.
5 Committee on Climate Change. 2017 Report to Parliament – Summary and recommendations. June 2017.
6 United Nations Economic Commission for Europe. Air pollution and health – Air pollution – Environmental policy. Last retrieved June 2019.
7 https://www.theguardian.com/environment/2018/nov/05/air-pollution-everything-you-should-know-about-a-public-health-emergency. Last retrieved June 2019.
8 KPMG Mobility 2030 analysis.

These are positive developments – but there is much further to go. Despite an overall fall in greenhouse gas emissions between 2012 and 2016, transport emissions have increased by 4%.[9] It has been estimated that a 44% reduction in the surface transport and residential sector is needed if the UK is to meet its 5th carbon budget.[10]

Particular action is needed on medium and heavy goods vehicles, which so far have escaped the regulatory pressure placed on cars and LCVs. The UK Government's Road to Zero strategy proposed only a voluntary reduction of 15% in greenhouse gas emissions for HGVs by 2025.[11] Even if this is achieved, it will leave a mountain to climb by 2050. However, the EU has passed new rules requiring CO2 emissions from HGVs to be reduced by 15% by 2025 and 30% by 2030.[12]

Sources:

9 Department for Transport. Data on energy and environment from transport. Last updated December 2018; National Statistics. Final UK greenhouse gas emissions national statistics: 1990-2016. 2018.

10 Committee on Climate Change. 2017 Report to Parliament – Summary and recommendations. June 2017.

11 Office for Low Emission Vehicles. Reducing emissions from road transport: Road to Zero Strategy. July 2018.

12 http://www.europarl.europa.eu/news/en/press-room/20190412IPR39009/meps-approve-new-co2-emissions-limits-for-trucks Last retrieved June 2019.

The journey to decarbonisation

In the rest of this article, we look at the current fuel mix across the main vehicle categories and likely path to decarbonisation of transport through 2030 and 2040. What milestones will need to be achieved that will make a 2050 target feasible?

In particular, solutions need to be found for medium and heavy commercial vehicles, where diesel is likely to remain the dominant powertrain into and beyond 2030, unless there is intervention. Without this, it is unlikely that transport decarbonisation targets will be met. All sections of the transport ecosystem have a part to play in contributing to the solutions that are urgently needed. In our view, regulation, policy and other public levers will be critical to accelerate the change that is needed.

Light-duty vehicles, including passenger cars and LCVs

Electrification of cars and LCVs (vehicles under 3.5 tonnes) is now properly underway in the UK market, even if at this stage it remains nascent: just over 2% of new sales in 2018, most of which are new car sales.

We believe a tipping point will be reached in the next two years where the penetration of passenger EVs will significantly rise. The key drivers for this include the increasing supply of affordable EV models, with 80+ 'new generation' car models due to be launched this year, and increasing investment in charging infrastructure, which helps to combat 'perceived range anxiety'.

While the number of passenger cars on the road is expected to decrease by 2030, thanks to the declining cost of on-demand mobility services, the numbers of LCVs will increase due to the growth of last-mile delivery as ever more shopping is carried out online. The level of growth is uncertain as vehicle utilisation is also set to increase substantially over the next 10 years.

Electrification of the growing LCV parc will be driven by regulatory pressure, such as the spread of urban ULEZs, while TCO parity will make electric LCVs fully commercially viable. We expect TCO parity to be achieved by 2022-2024.[14] This will significantly increase demand, and encourage the gradual development of the necessary scale production of electric LCVs.

Six electric van models are on the market currently, with around double that number set to be launched in 2019/20. However, there remain problems with supply to meet rising demand. Recently, British Gas said that plans to increase the number of electric vans in its fleet were being hampered by a shortage of available stock.[15] This constraint, in terms of production volumes, may well persist into the mid-2020s as OEMs wrestle with the decision on when to switch major production plants to EV-only production.

UK sales % by drivetrain type[13]

Passenger cars

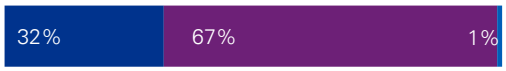
2030 Total parc: **32m**
Total sales: **2.2m**

2040 Total parc: ↓
Total sales: ↓

- ICE (incl. full hybrid)
- Electric vehicle (EV) (battery electric vehicle (BEV) and plug-in hybrid vehicle (PHEV))
- H2 fuel cell

LCV

2030 Total parc: **4m**
Total sales: **400k**



2040 Total parc: ↗
Total sales: ↗

- ICE (incl. full hybrid)
- EV (BEV & PHEV)
- H2 fuel cell

Sources:
13 KPMG Mobility 2030 analysis based on wide range of industry perspectives
14 KPMG Mobility 2030 analysis
15 https://www.thetimes.co.uk/article/shortage-of-electric-vans-thwarts-british-gas-mch6xbd7p. Last retrieved June 2019

Infrastructure is another key issue, with extensive charging networks required. The government has set up a £400m Charging Infrastructure Investment Fund, although more investment will undoubtedly be needed.

We believe that by 2030, 70% of new car sales and 67% of LCV sales will be of electric vehicles. These will either be fully battery driven (BEVs) or plug-in hybrids that combine battery with a traditional internal combustion engine (PHEVs). Hybrid vehicles are expected to be a transition phase only, with BEVs largely taking over, other than a limited demand for long range high mileage usage applications.

Overall, we expect sales of new cars and LCVs to approach 100% electric (BEV and PHEV) by 2040, if not sooner.

Buses, coaches and Medium Commercial Vehicles (MCVs)

The greater the size and weight of vehicle, the greater the challenges of moving to low or zero emissions.

These challenges include the fact that electrification, hydrogen and bio-LNG are the only true zero-emission solutions, as well as the prohibitive cost and battery size and load or range restrictions for battery electric vehicles, and the nascent stage of hydrogen technology. Hydrogen fuel cell technology still lacks proof of concept and will require significant investment in re-fuelling infrastructure, which currently does not exist.

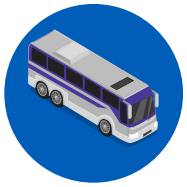
Today, suburban buses, coaches and MCVs (vehicles from 3.5 tonnes to 16 tonnes) are still predominantly diesel. Without intervention this is set to continue, although we have seen the start of EV penetration with Chinese companies Yutong and BYD launching fully electric buses/coaches in the UK.

Urban buses (of which there are around 20,000 in the UK) have high potential to be electric, zero emission vehicles. Just over 4% of sales in 2018 were zero emission and, based on new orders, this is set to double in 2019.[17]

Likewise, certain lighter MCV classes such as those with low mileage, typically urban, use cases, e.g. rubbish collection trucks, have the potential for electrification. But other MCVs and coaches that have longer duty cycles currently have markedly lower potential to move to zero emission technology.

By 2030, we expect that penetration rates of low-emission models amongst coaches and MCVs will be significantly lower than for cars and lighter vehicles, at 15% for buses and coaches and 17% for MCVs. Unless TCO parity is reached, there will be much less commercial incentive – and there is currently little regulatory push – for suburban bus and coach operators to use alternative drivetrains.

UK sales % by drivetrain type[16]



Bus & coach

2030 Total parc: **70k**
Total sales: **8k**

2040 Total parc:
Total sales: ↓

- ICE (incl. full hybrid)
- EV (BEV & PHEV)
- H2 fuel cell

MCVs

2030 Total parc: **180k**
Total sales: **14k**

2040 Total parc:
Total sales: ↗

- ICE (incl. full hybrid)
- EV (BEV & PHEV)
- H2 fuel cell

Sources:
16 KPMG Mobility 2030 analysis based on wide range of industry perspectives.
17 https://www.transportenvironment.org/press/new-electric-bus-orders-will-nearly-double-numbers-zero-emission-models-uk's-roads. Last retrieved June 2019

By 2040, we can expect to see far more significant shifts. As distribution networks change, the decline in big regional distribution centres in favour of urban or local distribution centres will see a decline in the number of MCVs. Of this smaller parc, we predict that 10% will be hydrogen fuel cell and 30% to be electric by 2040.

Likewise, hydrogen and electric urban and suburban buses will increase and we expect to see emerging solutions for coaches, even as urbanisation and the emergence of multimodal Mobility-as-a-Service transport solutions will most likely lead to lower use of mass transport and decreased mileage for buses and coaches.

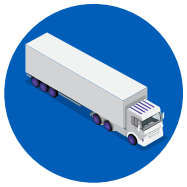
Heavy Goods Vehicles (HGVs)

For HGVs (vehicles of more than 16 tonnes), the same issues apply today as for MCVs: Electric and battery solutions are simply not there to meet the size, weight and range challenges, particularly given that most of the mileage is for long-distance duty cycle.

However, there have been some encouraging signs recently with manufacturers investing significantly in R&D around HGV electrification and fuel cell technology, with forecasts for TCO parity in the late 2020s. A string of OEMs have announced new or forthcoming models.

In 2030, we predict that ICE drivetrains will still dominate, despite the likely initial impact of the first generation of commercially manufactured hydrogen fuel cells and Bio-LNG. An easier early win will be to increase investment in aerodynamics, telematics and digital freight brokerage to reduce fuel consumption and increase operating efficiencies and vehicle utilisation, thereby lowering carbon emissions.

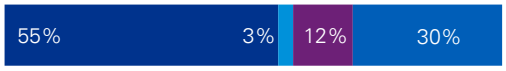
UK sales % by drivetrain type[18]



HGVs

2030 Total parc: **375k**
Total sales: **39k**

2040 Total parc:
Total sales:



- ICE (incl. full hybrid)
- Bio-LNG
- EV (BEV & PHEV)
- H2 fuel cell

Nevertheless, while such improved ICE vehicles might largely address the required 15% reduction in CO2 by 2025, and contribute significantly to the 2030 target of 30%, they are only supporting measures and not a long term solution to an overall carbon neutral economy.

Accelerating progress is expected to be made after 2030, however. TCO is a critical factor in the potential demand for alternative powertrain over and above diesel. We anticipate TCO parity for alternatives to Diesel will be achieved in the mid 2030's, and this will drive significantly increased demand for Hydrogen HGVs, and for EV HGVs where use cases allow.

The growth of hydrogen in transport could be significantly facilitated if hydrogen also becomes the method of choice for powering and heating homes. Supply of hydrogen at scale will be needed, with refuelling points along major long haul corridors. Other economies such as Japan are investing in hydrogen as the likely future of transport and power.

Sources:
18 KPMG Mobility 2030 analysis based on wide range of industry perspectives.

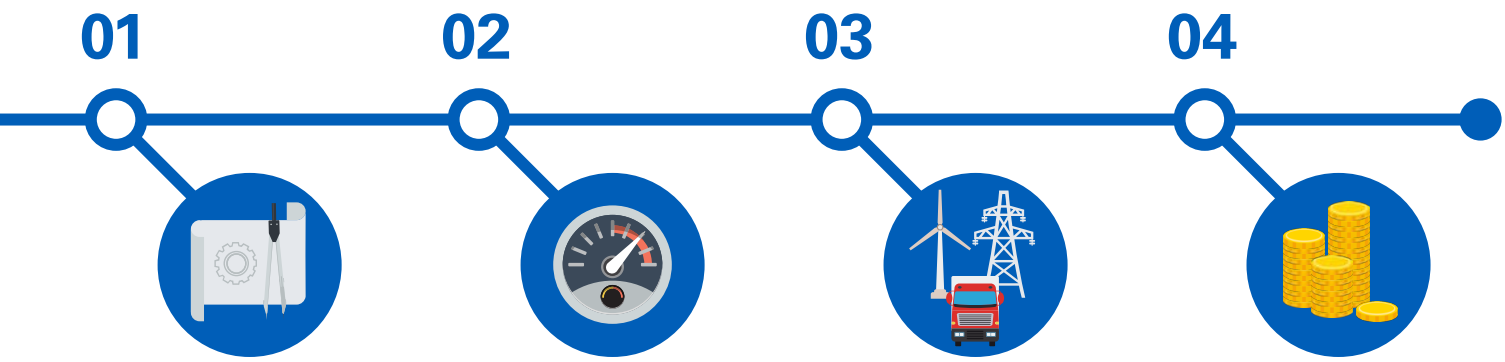
The fact is, however, that in 2040 ICE drivetrains are expected to still be in the majority across even sales of new HGVs, just as with coaches and MCVs, and disproportionately greater as a proportion of the fleet. Furthermore, HGV numbers are expected to rise, as they increasingly travel from central consolidation centres to the local distribution centres, bypassing the need for MCVs.

We will need to see significant progress in the 2040-2050 decade, with winning commercially viable zero emission solutions emerging and being adopted at scale, if the transport sector is to decarbonise and play the role it needs to in helping the UK meet its 2050 ambition.

We must also bear in mind that all of our 2040 figures are for new sales: there are still likely to remain significant numbers of 'old' ICE vehicles on our roads for many years beyond that, unless regulatory action is taken to remove them (or tax them significantly more highly to incentivise trade-ins). Furthermore, a lot of the HGV miles driven in UK are by vehicles registered in other European countries, so a co-ordinated international approach is also important to reducing overall pollution from HGVs driven in the UK.

The winning milestones for decarbonisation

The winning fuel for each vehicle type will need to achieve the following four milestones:



Technology proof of concepts:

At the first stage technology proof of concepts need to be established to ensure that the fuel can be produced at scale and that it will be fit for each vehicle type.

Increased take up:

This will further drive commercial viability and incentive to produce at scale. Take up will be driven by TCO parity and mitigation of perceived anxieties, such as around EV range.

Sufficient infrastructure in place:

Significant investment in infrastructure will be required in order for these alternative fuel types to be used at scale and for EVs to become transport of choice.

Network constraints are managed

Finally, whichever the fuel of choice for each vehicle type, businesses will need to be incentivised to invest in a network that supplies demand in line with the grid's capabilities, forming a wider, seamless network that works for consumers, businesses, as well as the power networks.

For decarbonisation to become a reality, and meet national aspirations, a number of complex interplaying factors need to align. Policy and regulation, charging and fuelling infrastructure, OEM investment, energy and fuel supply including battery and alternative technology, and customer demand all need to work together to drive change at the pace needed.

Putting the UK on the road to success

If the UK is to achieve the level of transport decarbonisation that we envisage for 2040 – and then become net zero by 2050 – we will need to see increased action across the transport ecosystem. In particular:

Public policy

Regulators and transport authorities will need to think in particular about introducing specific timelines and targets for larger commercial vehicles. Frameworks are needed that encourage trials and promote innovation. Regulatory sticks may be needed to drive the levels of change required. There is also the need for international co-operation to drive availability of ULEV vehicles and accelerate adoption across the fleet that will in practice contribute to emissions on UK roads.

OEMs

The automotive sector today faces many challenges and the big players are being disrupted by start-ups such as Tesla, Nikola and others. This only increases the need for them to increase the urgency of their investments in new models and technologies. Manufacturers are taking the challenge seriously – but a further step change is needed.

Energy

Transport decarbonisation must go hand in hand with decarbonisation of energy. Otherwise, it will fall short. If 'dirty power' goes into vehicles, dirty emissions will come out. The energy and power sector has an instrumental role to play in developing green technologies that can be integrated into transport modes.

We have seen some genuine strides taken – probably more in the last two years than in the previous ten. ULEZs, for example, would have been unthinkable just a few years ago. Consumer perceptions have changed. The political will exists to put the UK in the driving seat globally towards a zero emission future.

To translate this into reality, the whole ecosystem will need to come together and collaborate on viable solutions. No single part of the ecosystem can achieve this on its own. The government's adoption of the 2050 zero emission target fires the starting gun for what must be a new phase of increased investment, determination and coordination of efforts.

Contact us

Natasha Patel

Associate Director, Mobility 2030
KPMG in the UK

T: +44 7824 605 340
E: natasha.patel@kpmg.co.uk

Graham Armitage

Partner, Co-Head of Mobility 2030
KPMG in the UK

T: +44 7710 808 936
E: graham.armitage@kpmg.co.uk

Sarah Owen-Vandersluis

Partner, Strategy Lead for
Infrastructure and Mobility
KPMG in the UK

T: +44 7789 032 546
E: sarah.ov@kpmg.co.uk

Simon Virley

Partner, Head of Energy
KPMG in the UK

T: +44 7825 052 194
E: simon.virley@kpmg.co.uk

kpmg.com/uk/mobility2030

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