Department for Transport

From the Secretary of State
The Rt. Hon. Grant Shapps

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Huw Merriman MP
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House of Commons
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13 July 2020

Dear Huw,

I am writing to follow up on my commitment to provide more detail on Question 331 of the Committee's sitting of 24 June 2020.

The new £225 million Emergency Active Travel Fund was first announced on 9 May. On 28 May, officials wrote to transport authorities with details of the amounts they had been indicatively allocated in order to help focus development of measures that they would be able to deliver.

We designed the fund's first tranche of £45 million to be deliberately light touch so that funds could be released as soon as possible on temporary roadspace reallocation measures. Officials communicated the final tranche one allocations on 25 June so that authorities could start works in confidence of receiving the funds.

To help authorities deliver at pace, new emergency legislation came into force on 23 May 2020 to help speed up the Emergency Traffic Order process. The main change is to the means of advertising, which can now be done via digital approaches. Full details of these changes are available online here: www.gov.uk/government/publications/reallocating-road-space-in-response-to-covid-19-statutory-guidance-for-local-authorities/traffic-management-act-2004-network-management-in-response-to-covid-19

We have already seen schemes implemented across the country in cities like Brighton and Leicester where pop-up cycle lanes have proved very popular and helped newer cyclists feel safe and protected. Similar measures are being rolled out at pace across England.

I also committed in my appearance before the Committee to provide a document comparing the environmental impact of electric cars as opposed to diesel or petrol cars, as well as an up to date breakdown of the greenhouse gas emissions of the UK by transport mode. I have attached both.

Yours ever,

Rt Hon Grant Shapps MP

SECRETARY OF STATE FOR TRANSPORT

July 2020

Environmental impact of battery electric vehicles

Introduction and summary

This note compares the environmental impact of Battery Electric Vehicles (BEVs) with conventional Internal Combustion Engine (ICE) vehicles on a whole lifecycle basis.

Already, BEVs have substantially lower greenhouse gas (GHG) emissions than conventional ICE vehicles, even when taking into account the energy mix of the electricity to charge the vehicle and battery production. Between now and 2050, emissions from BEVs manufactured and driven in the UK will drop in line with our economy-wide net zero ambition.

Electricity generation

Q: Given that fossil fuels are burned to produce electricity to charge BEVs, do they have higher GHG emissions during use than ICE vehicles?

A: BEVs driven in the UK have substantially lower GHG emissions than ICE vehicles, even when accounting for the energy produced for electricity generation.

In 2018, the Department for Transport developed the Transport Energy Model (TEM) to provide a clear assessment of the relative environmental impacts of different road vehicle technologies and fuels in the UK (Annex A).[1] This showed that BEVs are highly energy efficient – a typical BEV uses a third less energy than the average petrol vehicle to move the same distance. For a typical medium car travelling at 34 km/hour, GHG emissions (from energy production and use) for a BEV were 66% lower than for a petrol car and 60% lower than for a diesel car.[a,b] In 2018, 52.5% of UK electricity generation was low carbon (33% renewables, 19.5% nuclear).[2] UK BEV emissions (from energy production and use) are expected to fall to near zero by 2050 as the electricity grid decarbonises in line with Government projections. This means the emissions of a BEV bought today will reduce over its lifetime as the grid gets cleaner.

Battery and vehicle manufacture

Q: Given they require more energy for battery production, do BEVs have higher GHG emissions over their entire lifetime than ICE vehicles?

A: BEVs driven in the UK have substantially lower GHG emissions than ICE vehicles, even when accounting for the electricity used for battery production.

Manufacturing a BEV requires more energy than an ICE, with current GHG emissions from battery production at an estimated global average of 3 tonnes CO_2 for a 39 kWh battery.[3] BEV manufacture emissions, however, are typically[a] offset over time by lower emissions during use; therefore, total lifetime emissions are lower (Annex B). This is highly dependent on the electricity mix of the country in which the vehicle is charged, and the country(/ies) in which the vehicle, battery and other parts are manufactured. To obtain their full environmental benefits, electric vehicles (EVs) and their batteries need to be manufactured using electricity from low carbon sources. Countries such as Norway, Sweden and the UK,

[a] Estimates for vehicle greenhouse gas emissions depend on multiple factors, including vehicle model and size, distance driven, and [for BEVs] the energy mix of electricity sources. Values will vary according to the assumptions made for these factors.
[b] Estimates from the 2018 TEM report were based on the 2017 UK electricity grid mix.

with their growing use of renewables, are attractive for low carbon battery manufacture. Large-scale battery manufacture (gigafactory) investment in the UK is further supported by the Government's announcement of up to £1bn to support EV supply chains.

Sustainability and ethics of supply

Q: Is the mining of raw materials for BEV parts sustainable?

A: The Government is aware of the social, environmental and supply concerns surrounding the mining of raw materials for BEVs and is working to address these.

Demand for critical raw materials (such as lithium, cobalt and rare earth elements) used in batteries and electric motors is expected to increase. The Faraday Institution advise that there are more than enough global resources to supply the manufacture of EV batteries to 2050; however, annual global production levels will need to scale-up with increased demand.[4] As EV battery recycling becomes established, this could deliver significant volumes of raw materials for future production.

Some raw minerals, such as cobalt, are geographically limited with political and ethical sourcing issues. For example, the Democratic Republic of Congo (DRC) produces over 60% of the world's cobalt supply. Unregulated artisanal and small-scale mines (ASMs) in the DRC are an essential part of the supply chain and provide a livelihood for 60-80,000 people; however, ASMs can be vulnerable to abuses of power and exploitation.[5] A Government priority is to localise more of the supply chain to the UK. Many BEV manufacturers have committed to the responsible sourcing or reduction of cobalt in their supply chains. Battery cell research is optimising lithium-ion and other chemistries with reduced or zero cobalt.[6]

Mining raw minerals produces GHG emissions, unless powered by carbon-free energy, and can damage local environments through land clearance, water depletion and pollutant release. The Faraday Institution participates in the Global Battery Alliance – a World Economic Forum initiative seeking to accelerate action towards a socially responsible, environmentally sustainable and innovative battery value chain. Proposed actions to reduce environmental impact include switching to renewables, creating a circular economy to reduce primary production, and sustainable development strategies for local communities.[7]

Sustainability of disposal

Q: Can you sustainably dispose of EV batteries?

A: Technological improvements in EV battery chemistry, the reuse of batteries for stationary storage purposes, and the development of a recycling industry will lead to improvements in their sustainability.

EV batteries have performance guarantees of around 8 years or 100,000 miles, but can last longer. Once EV batteries have fulfilled their life-span for automotive applications, remaining battery storage capacity is expected to be over 70%.[8] To extract maximum economic value and minimise environmental impacts, EV batteries can be reused for second life applications, such as domestic and industrial energy storage.[9] At end-of-life, EV batteries are covered by the Waste Batteries and Accumulators Regulations 2009, which ban their disposal to landfill and incineration. The Faraday Institution is developing the technological, economic and legal infrastructure to allow close to 100% of the materials in lithium-ion batteries at the end of their first life to be reused or recycled.

List of Annexes

Annex A	The Transport Energy Model
Annex B	Greenhouse gas emissions from vehicle manufacture

Annex A – The Transport Energy Model

In 2018, DfT developed the Transport Energy Model (TEM) to provide a clear assessment of the relative environmental impacts of different road vehicle technologies and fuels. The TEM was developed with close involvement from industry, academia and environmental groups and has been subject to external analytical assurance.

The detailed methodology and outputs of the TEM are set out in the Transport Energy Model Report, which was published alongside the Road to Zero Strategy in 2018.

The model provides estimates of tailpipe emissions of air pollutants, well-to-wheel[(c)] greenhouse gas (GHG) emissions and the energy consumption of a range of fuel options for cars, both now and in 2050.

Figure 1 illustrates the GHG emissions and NO_X (oxides of nitrogen) tailpipe emissions from a medium car running on a range of energy sources. In this example, petrol cars had the highest well-to-wheel GHG emissions at 211 gCO_2e/km. Diesel (compression ignition) engines are more efficient than petrol (spark ignition) engines, so had lower emissions of 179 gCO_2e/km. A battery electric vehicle (BEV) produced the lowest well-to-wheel emissions at 73 gCO_2e/km – this was 66% lower than a petrol car and 60% lower than a diesel car.

Estimates of tailpipe emissions from petrol and diesel ICE cars included nitrogen oxides, at 0.05 g/km and < 0.01 g/km, respectively, and particulate matter, at 0.0019 and 0.0016 g/km, respectively.[(d)] BEVs have zero tailpipe emissions.

[c] Well-to-wheel describes the greenhouse gas emissions per kilometre driven, including those emitted at the tailpipe and those associated with producing the fuel/electricity used by the vehicle.
[d] Values are for pre-2017 Euro 6 cars.

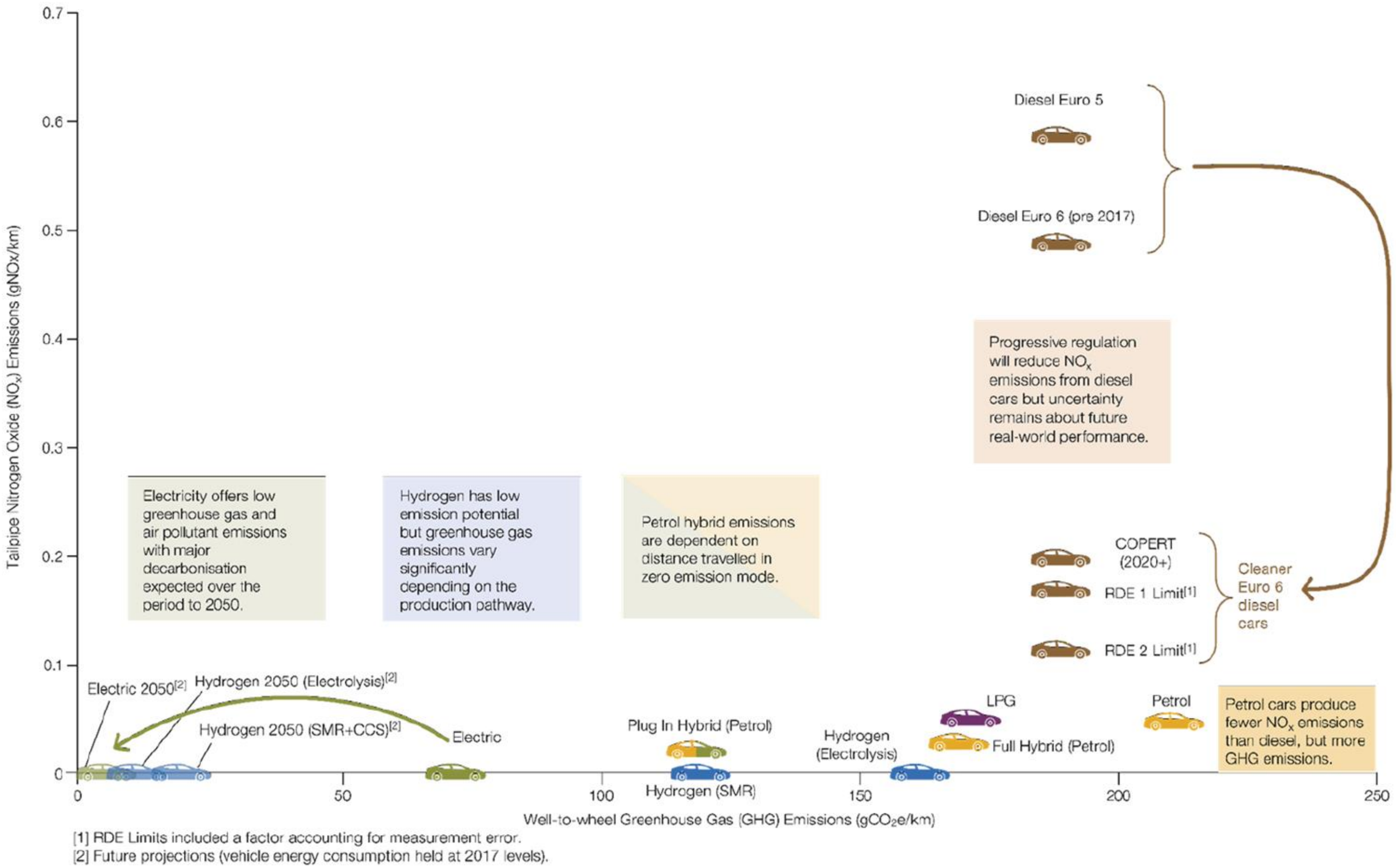

Figure 1: Estimated greenhouse gas (GHG) and oxides of nitrogen (NO_x) emissions for a typical medium car on a mixed urban/extra-urban duty cycle (average speed 34 km/hr). For fossil fuels the GHG impact includes current average biofuel blend levels. For electricity the GHG impact is based on 2017 UK marginal grid electricity.

Annex B – Greenhouse gas emissions from vehicle manufacture

Greenhouse gas (GHG) emissions from battery production:

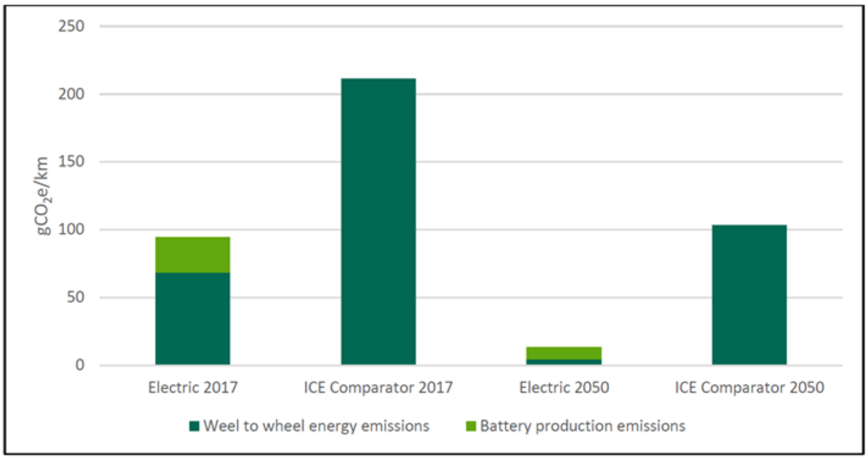

Figure 2: Estimated BEV well-to-wheel (energy production and use) and battery production GHG emissions for a medium car in 2017 and 2050, compared to an Internal Combustion Engine (ICE) car. Note this was published before the government's commitment to net zero by 2050 was announced; we now expect zero well to wheel emissions for a BEV in 2050. Other (non-battery) emissions from vehicle manufacture are not included. Source: Department for Transport, 2018. Transport Energy Model

GHG lifecycle emission benefits for EVs compared to ICE across vehicle size and geography:

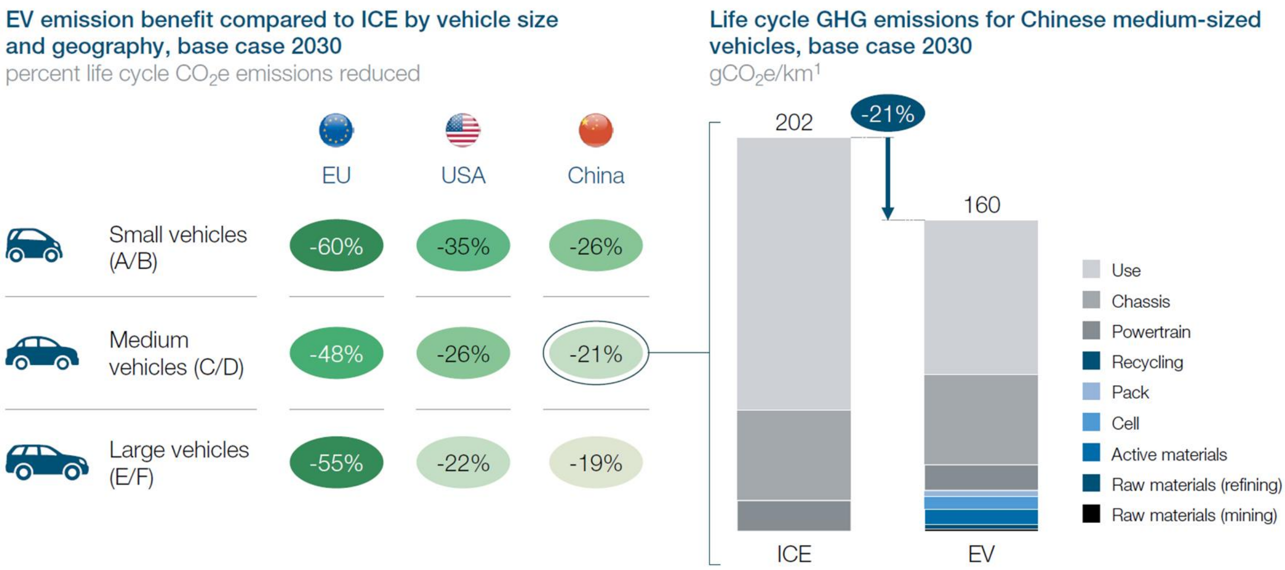

Figure 3: BEV emission benefit compared to ICE in base case 2030 by vehicle size and geography. Source: Global Battery Alliance, 2019. A Vision for a Sustainable Battery Value Chain in 2030

References

[1] Department for Transport, 2018. Transport Energy Model Report.
[2] Department for Business, Energy & Industrial Strategy, 2019. Digest of UK Energy Statistics
[3] IVL, 2019. Lithium-ion vehicle battery production – estimate calculated from mean of 61-106 CO_2eq/kWh battery capacity (83.5 CO_2eq/kWh) x typical battery capacity (39 kWh). Typical battery capacity of 39 kWh taken from 2018 EU Joint Research Centre report referenced in Faraday Report - High-energy battery technologies.
[4] Faraday Institution. 2020. Faraday Insights - Issue 6: Lithium, Cobalt and Nickel: The Gold Rush of the 21st Century
[5] Faraday Institution. 2020. Faraday Insights - Issue 7: Building a Responsible Cobalt Supply Chain
[6] Faraday Institution. 2020. Faraday Insights - Issue 6: Lithium, Cobalt and Nickel: The Gold Rush of the 21st Century
[7] Global Battery Alliance, 2019. A Vision for a Sustainable Battery Value Chain in 2030
[8] University of Warwick, 2020. Used Nissan LEAF batteries given “second life” thanks to WMG, University of Warwick
[9] Harper et al., 2019. Recycling lithium-ion batteries from electric vehicles

Greenhouse gas emissions by transport mode: United Kingdom, 1990-2018

By source			2018 MtCO$_2$e[1]	*% domestic transport emissions 2018*
Domestic transport	**Road transport**	Cars and taxis	68.5	*55%*
		Heavy goods vehicles	20.7	*17%*
		Light vans	19.4	*16%*
		Buses and coaches	3.2	*3%*
		Motorcycles & mopeds	0.5	*0%*
		Other road transport emissions	0.6	*0%*
		Total	**112.9**	***91%***
	Other transport	Rail	1.8	*1%*
		Domestic aviation	1.5	*1%*
		Domestic shipping	5.9	*5%*
		Other	2.2	*2%*
		Total	**11.4**	***9%***
	Total domestic transport		**124.4**	***100%***
Net domestic emissions all sources			**451.5**	**.**
Transport as a % of Net Domestic Emissions			**28%**	**.**
International emissions (Memo items)		International aviation	36.7	.
		International shipping	7.9	.

[1] MtCO$_2$e = Million tonnes of carbon dioxide equivalent.

Sources
Ricardo-AEA/BEIS (NAEI);

Notes

- The 'by source' figures for transport only include direct emissions from transport and exclude emissions from energy generation for electric trains and road vehicles.
- 'Other road transport emissions' consist of emissions from road vehicles running on liquified petroleum gas (propane and butane), emissions from the evaporation of engine lubricants and urea as well as urea use, and biofuel use.
- ‘Other transport – other’ mainly consists of 'military aircraft and shipping' & 'aircraft support vehicles'.
- International aviation and international shipping emissions are not included in the national total reported to the UNFCCC, since there is no internationally agreed way of allocating these emissions to individual nation states (see notes and definitions).