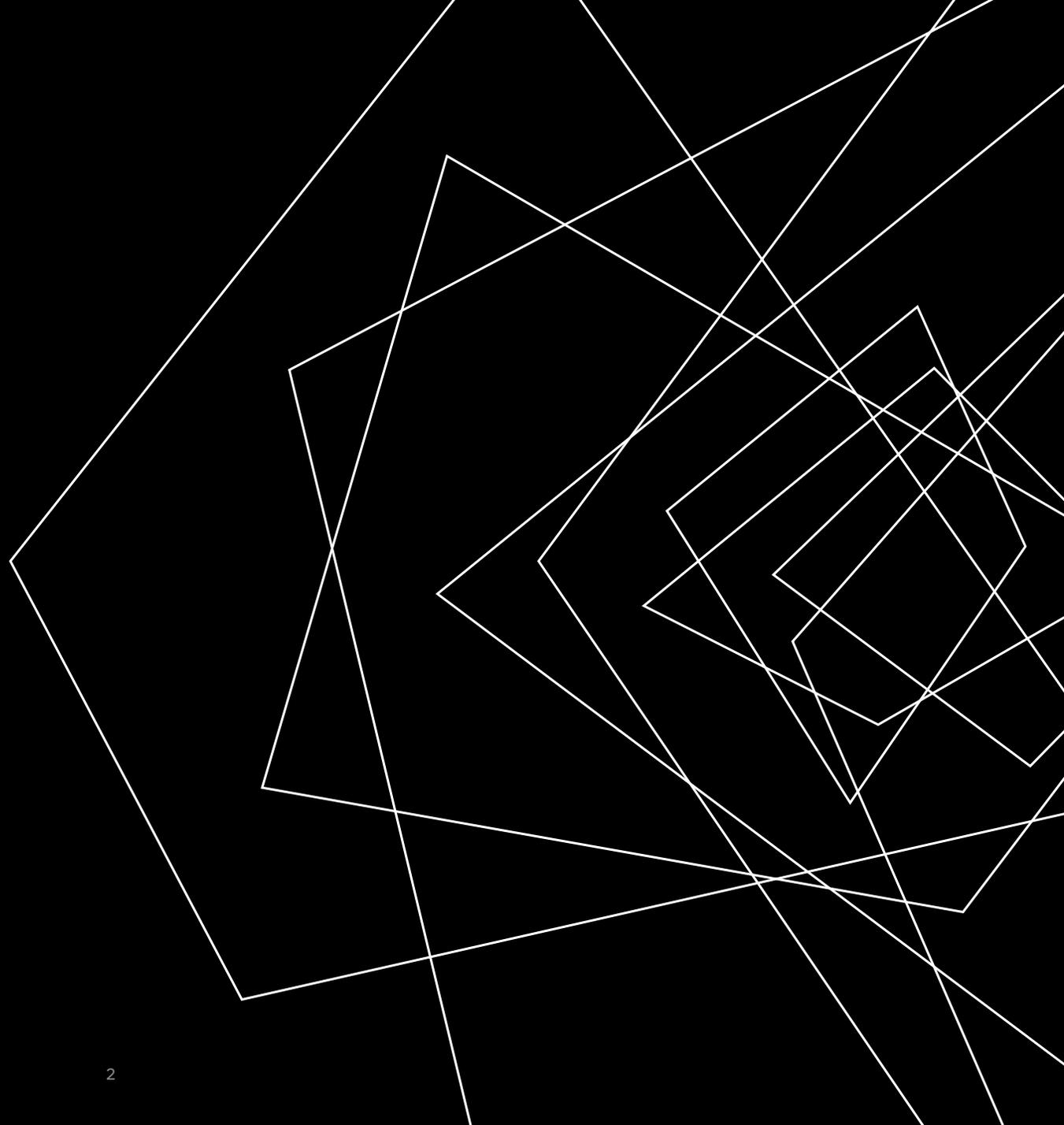
Abstract geometric lines in black on a white background, forming various overlapping shapes and polygons.

UNIVERSITY OF BATH I-SEE WEBINAR

29 4 25

Dr Russell Fowler

Why electric
cars will deliver
net-zero, if we
let them



WELCOME & THANK YOU

ABOUT ME

I am currently the Grid Connections and Strategy Manager at National Highways – supporting the rollout of EV charging on the strategic road network.

In previous roles at National Grid, E.ON and RWE Russell: led the analysis for RIIO-2, National Grid ESO's first price control, helping the ESO to be able to operate the system carbon free by 2025; led the production of the Future Energy Scenarios, electricity demand and was part of the Electricity Market Reform project setting up the first low carbon capacity and security of supply auctions before supporting National Grid's role in transport decarbonisation – from rapid EV charging to synthetic fuels for aviation. Russell also holds a PhD in mathematics from the University of Birmingham and had been a EV driver for over 4 years.

ABOUT THIS TALK

In this talk I cover both energy and electric vehicles – as such this **does not** represent the views of National Highways or National Grid but builds on analysis and discussions I have been part over the last five year.



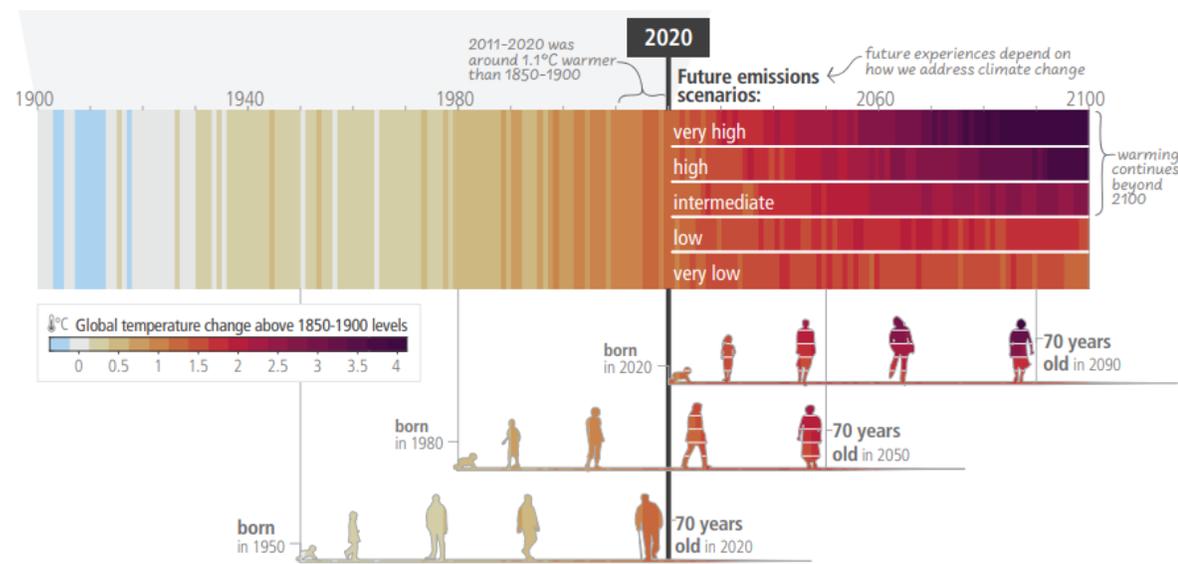
ADDRESSING CLIMATE CHANGE IS THE KEY CHALLENGE OF OUR TIME

NET-ZERO & CLIMATE CHANGE

Net-Zero is a much-used term and a somewhat politically charged term. When we speak about achieving net-zero or delivering a net-zero policy we are, of course, referring to emissions (carbon and other greenhouse gases) reduction ambitions. With the ultimate goal of stopping global temperature increase and “stabilising” the global climate.

IPCC

Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020.



CLIMATE CHANGE 2023 Synthesis Report Summary for Policymakers

THE COST OF INACTION WILL FAR OUTWEIGH ANY COSTS OF REACHING NET-ZERO

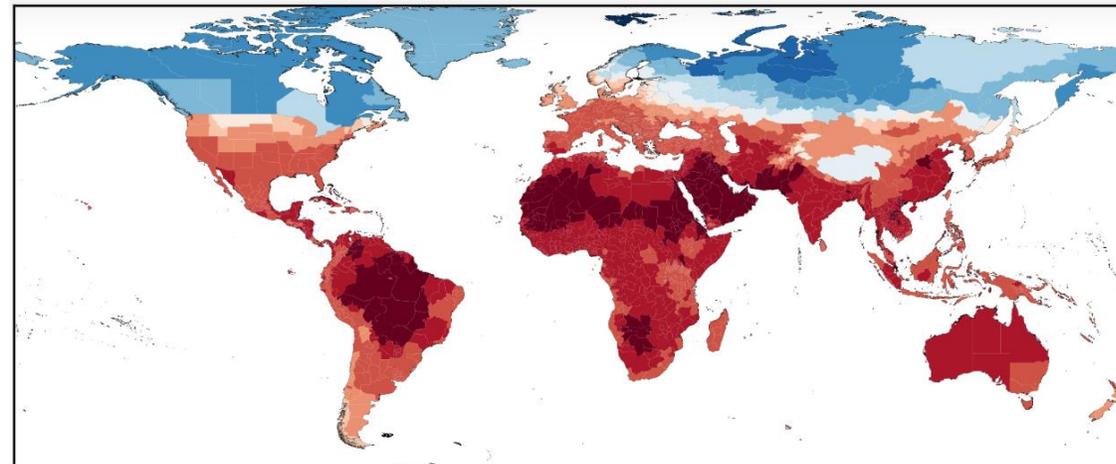
WHAT DOES IT COST?

While exact costs are hard to agree on, there are reasonable views:

The transformation of the global economy needed to achieve net-zero emissions by 2050 would be universal and significant, requiring \$9.2 trillion in annual average spending on physical assets, \$3.5 trillion more than today: McKinsey - The net-zero transition: What it would cost, what it could bring

COST OF INACTION

Again, while exact costs are hard to agree on, there are reasonable views: *\$38 trillion in damages each year. World economy already committed to damages [that] are six times larger than the mitigation costs needed to limit global warming to two degrees:*



Percentage income change
(relative to economy without climate change)

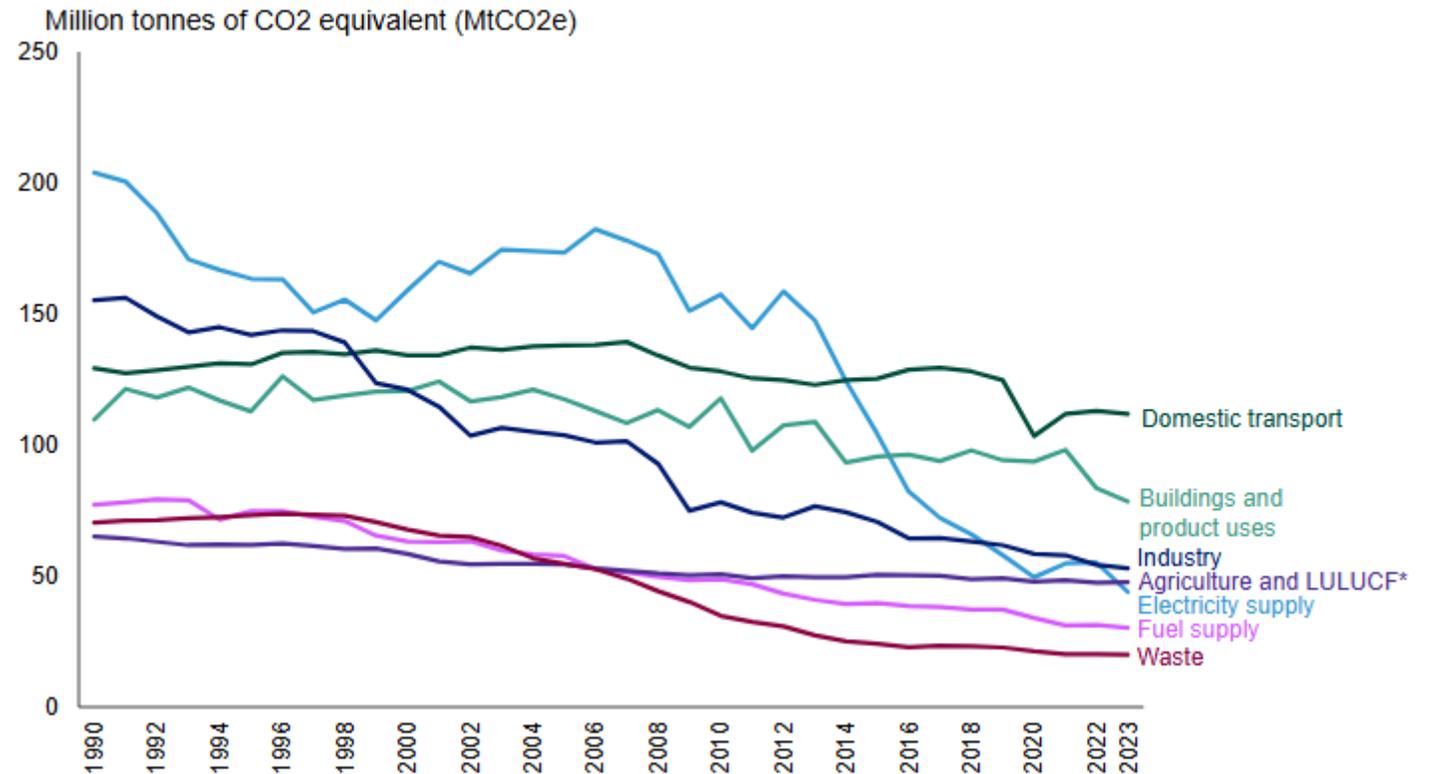
Potsdam Institute for Climate Impact Research - The economic commitment of climate change.

IN THE UK TRANSPORT IS THE HIGHEST CARBON EMITTING SECTOR

TRANSPORT EMISSIONS

Since 2016 (earlier if we include a contribution from international travel) UK emission from transport have been the highest emitting sector. Emissions have been broadly flat from transport emissions since the 1990 baseline year. Only the COVID pandemic from 2020 had any significant lasting impact, with emissions around 10% lower in 2023 than in 2019. More efficient engines and lower carbon fuels had a minor effect from around 2005, but an increase in vehicle numbers reversed those savings.

EMISSIONS CHART (DESNZ)



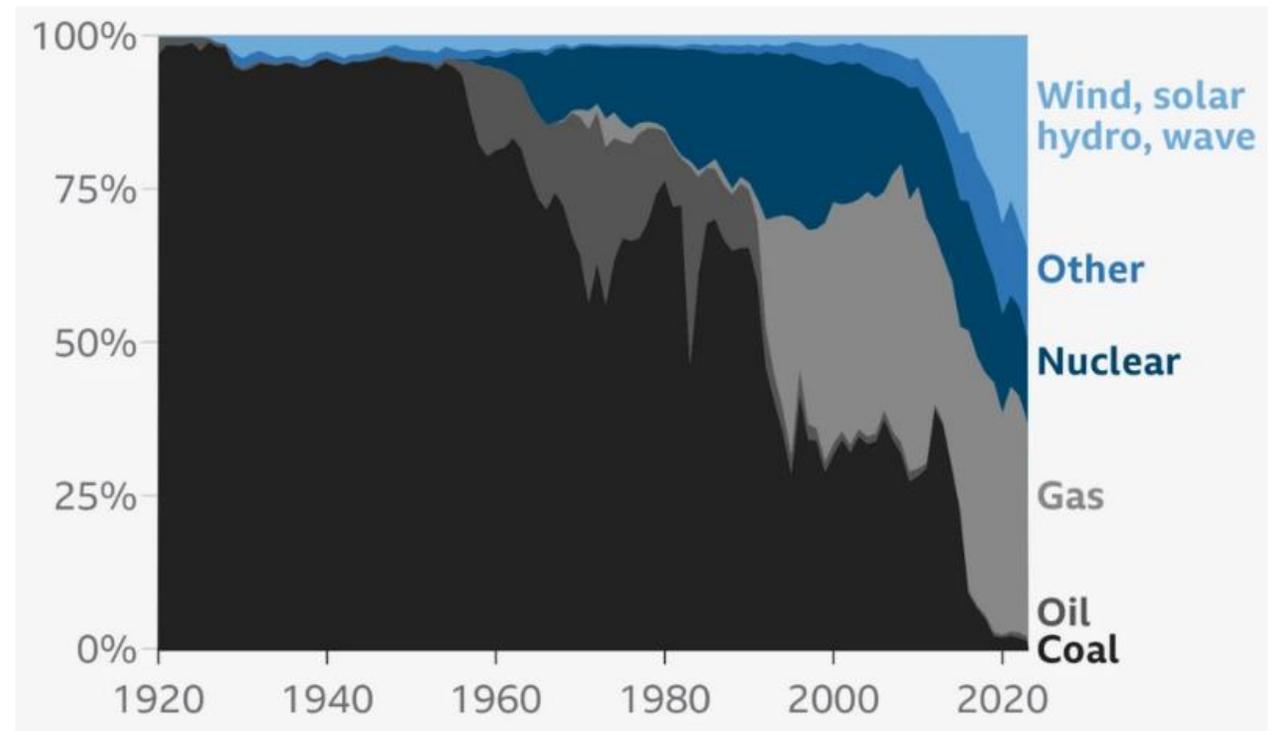
Domestic greenhouse gas emissions by sector, 1990 to 2023 (DESNZ final UK greenhouse gas emissions 2023)

HAVING OVERTAKEN ELECTRICITY IN 2016

REDUCTION IN EMISSION FROM ELECTRICITY

Transport's move to be the highest emitting sector is due to the rapid decarbonisation of the electricity sector from the mid 2010s. This decline was driven by the phasing out of coal for electricity generation, with the last coal power station being decommissioned in September 2024. Simultaneously we have seen an increase in renewable generation, in particular wind (both onshore and offshore) - this is forecast (and needed) to increase to reach net-zero and reduce gas generation.

HISTORIC ELECTRICITY GENERATION



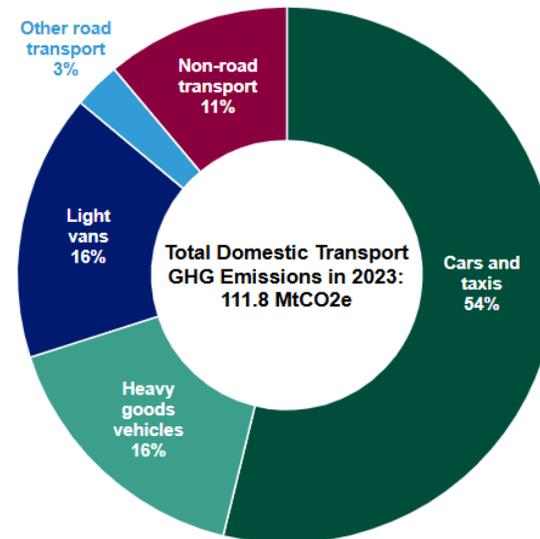
Percentage of UK electricity generated by source each year: DESNZ

TRANSPORT MUST ADDRESS THIS AND ACHIEVE A NET-ZERO THE PATHWAY

REDUCING TRANSPORT EMISSIONS

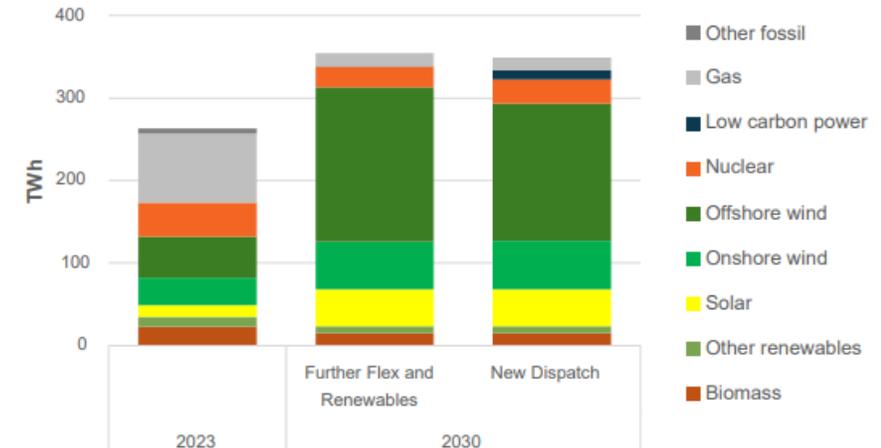
There are pathways for the electricity sector to reach net zero by 2030 - clean power 2030. Without any significant changes the transport sector could be responsible for around 50% of the UK's carbon emissions.

Within transport **89% of emissions are from road transport**. From cars and vans to heavy good vehicles. Reducing emission from road transport, like we have seen from the electricity sector, will leave heat as the latest emitting sector within the UK (a topic for another session).



Domestic greenhouse gas emissions by road transport modes and non-road transport, 2023:DESNEZ

CLEAN POWER 2030



Generation mix for a clean GB power system in 2030: NESO clean power 2030

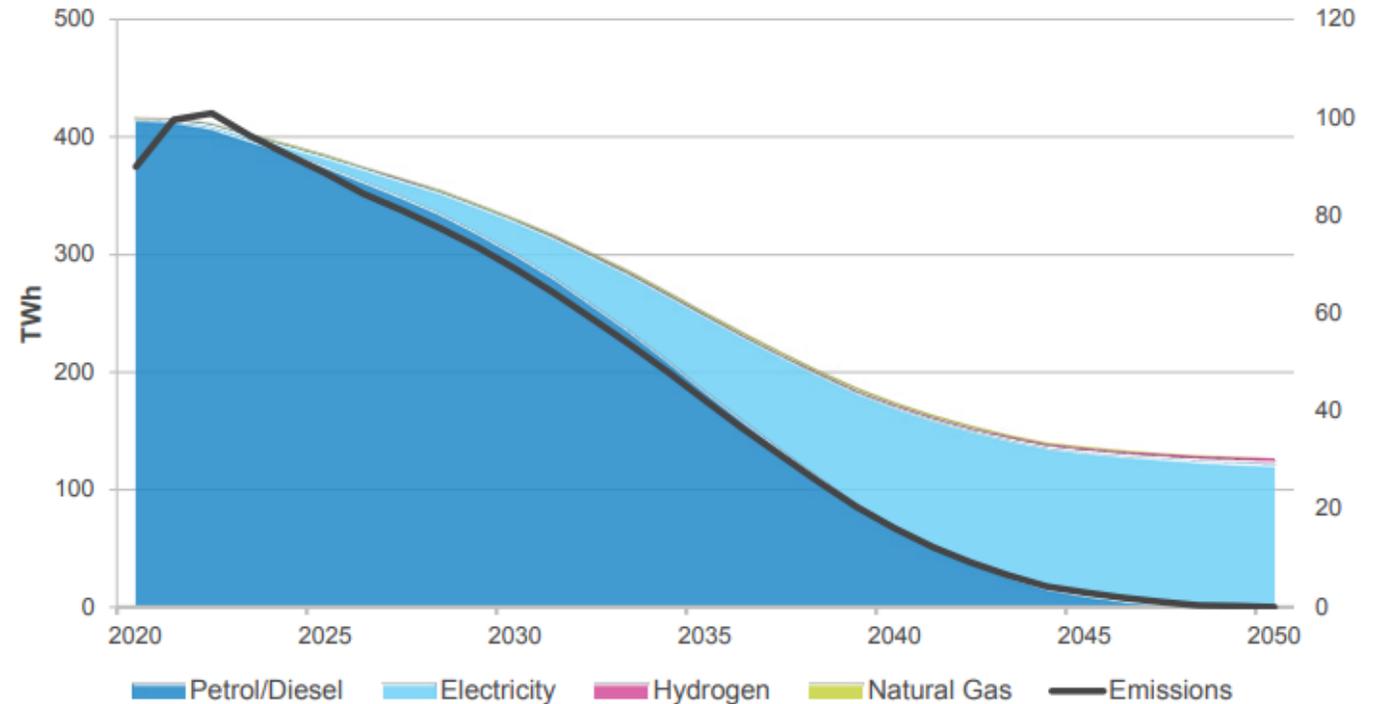
Describing clean power: We describe clean power as at least as much power being generated from clean sources as Great Britain consumes across the year, and when unabated gas generation makes up less than 5% of Great Britain's generation in a typical weather year.

IS FOR ALMOST ALL ROAD TRANSPORT TO TRANSITION TO BATTERY ELECTRIC

REDUCING ROAD TRANSPORT EMISSIONS

To achieve net-zero emission for road transport the most credible pathway (in terms of practicality and efficiency) is for almost all road transport to transition to battery electric. This both reduces emissions from petrol and diesel by switch to clean electricity but creates more efficient energy system as a battery electric motors are more efficient than a traditional internal combustion engine (ICE).

EMISSION AND ENERGY REDUCTIONS



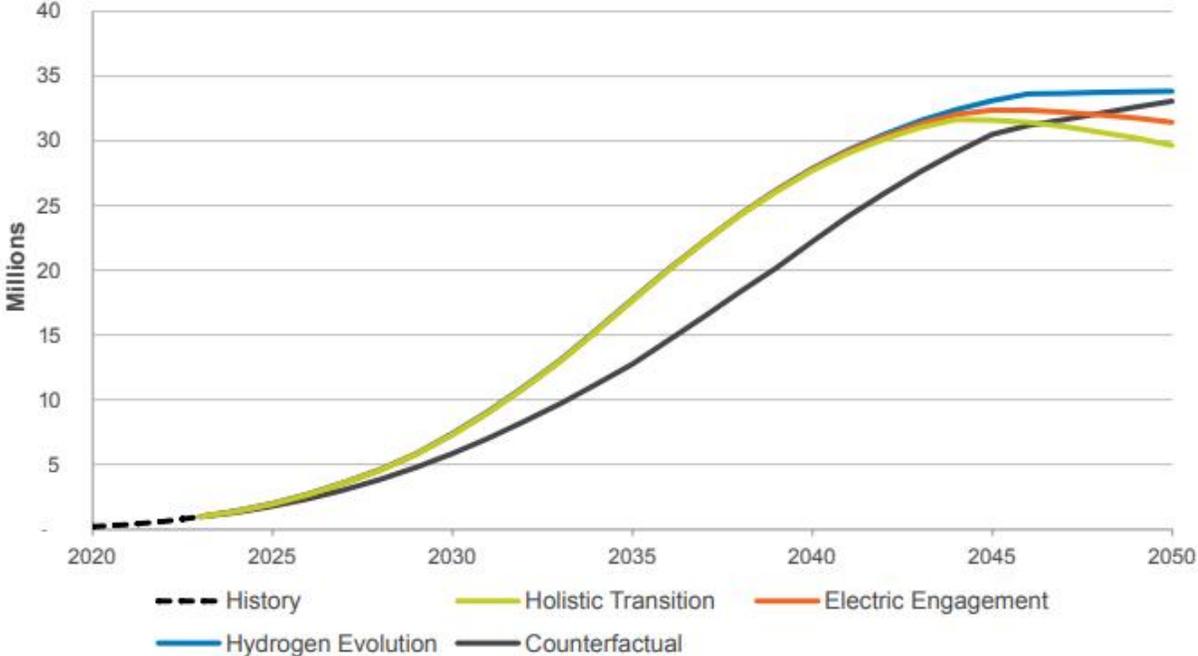
Future Energy Scenarios (FES) 2024: NESO

THE INCREASE IN BATTERY ELECTRIC CARS (ELECTRIC VEHICLES OR EVS)

INCREASE IN ELECTRIC VEHICLES (EVS)

In order to meet emission reduction targets in 2050 there are legislative targets for the transition to EVs. Most significantly the Zero Emission Vehicle (ZEV) mandate, which sets targets for the sale of new zero emission vehicles (the majority will be electric). Within this between 2030 and 2035 they will be no new (pure) petrol or diesel cars sold, given the average life span of an ICE car is around 12 years this will lead to a minimal number of ICE vehicles remaining by 2050.

NUMBER OF EVS ON THE ROAD



Future Energy Scenarios (FES) 2024: NESO

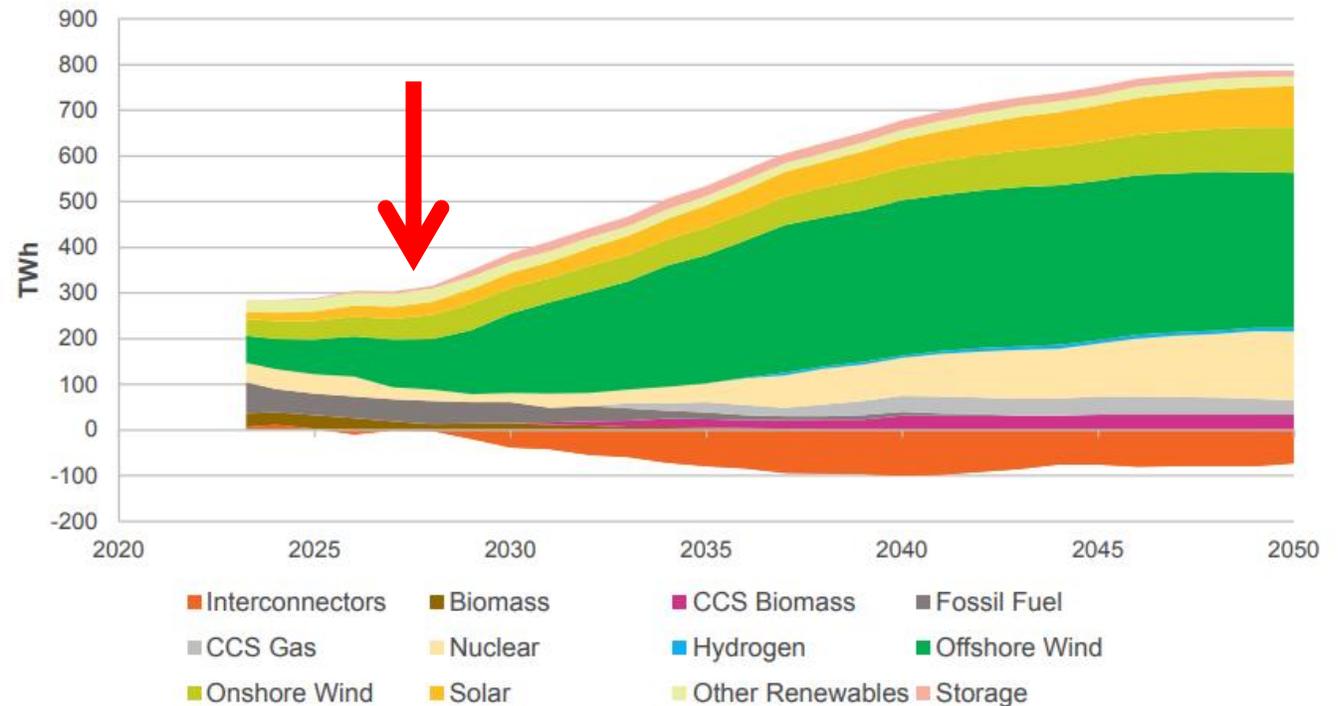
**34 Million
vehicles on UK
roads in 2024**

THIS WILL INCREASE ELECTRICITY DEMAND FROM THE LATE 2020S

INCREASE IN DEMAND FOR ELECTRICITY

The increase in EVs will lead to an increase in demand for electricity – but this has to be taken the context of what is happening to the wider demand for electricity, which had been declining for almost 20 years, due to increased energy efficiency (LED lights etc...) and the move towards a more service-based economy. However, by the late 2020s the increase in EVs will outgrow the efficiencies from the wider economy

FORECAST INCREASE IN ELECTRICITY DEMAND



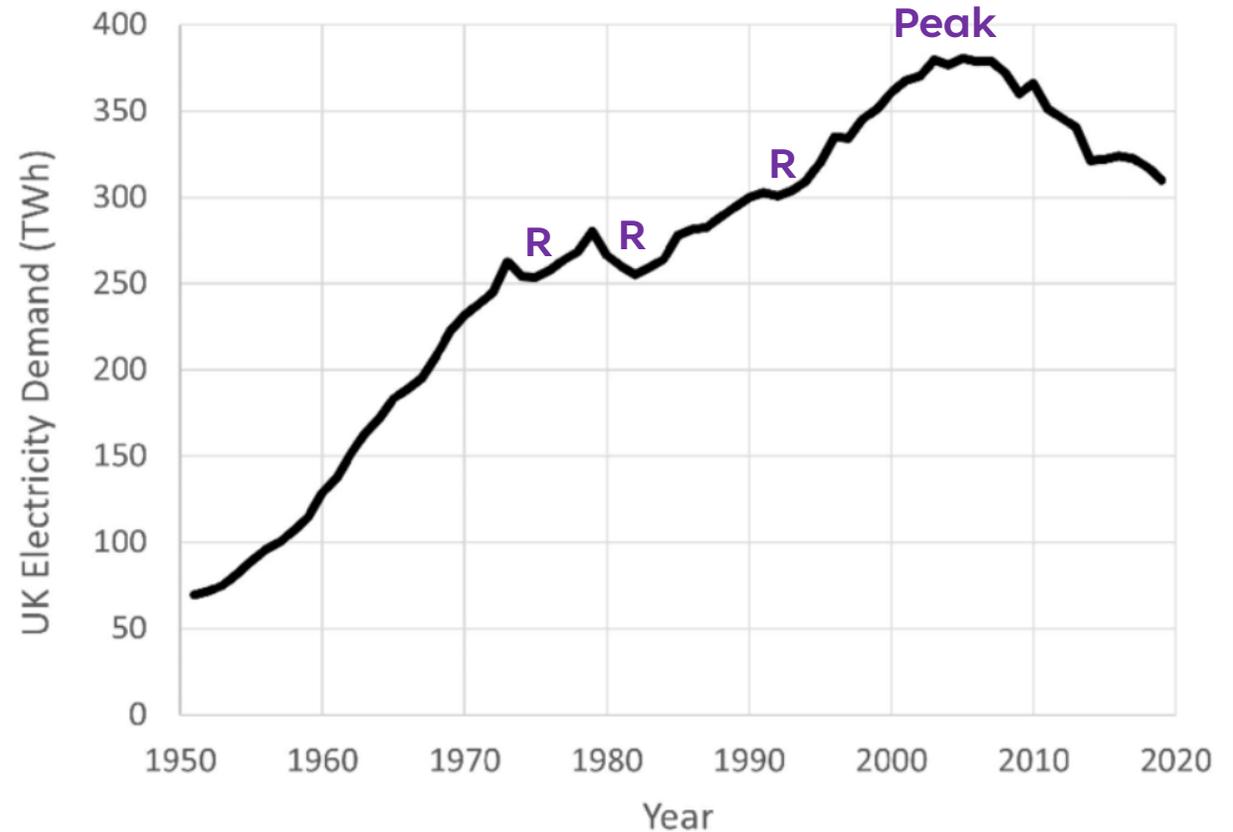
Future Energy Scenarios (FES) 2024: NESO (Electric Engagement scenario)

AFTER MORE THAN 20 YEARS OF DECLINING ELECTRICITY DEMAND

ELECTRICITY DEMAND HAS BEEN FALLING FOR 20 YEARS

Post World War 2 economic growth increased electricity demand, with reductions coinciding with economic rescissions in the Mid 1970s, early 1980s and 1990s (**Rs** on the chart). Electricity demand peaked in 2005. The move towards a more service-based economy and energy efficacy measures have broken the historic link between electricity demand and economic growth in the UK.

HISTORIC ELECTRICITY DEMAND



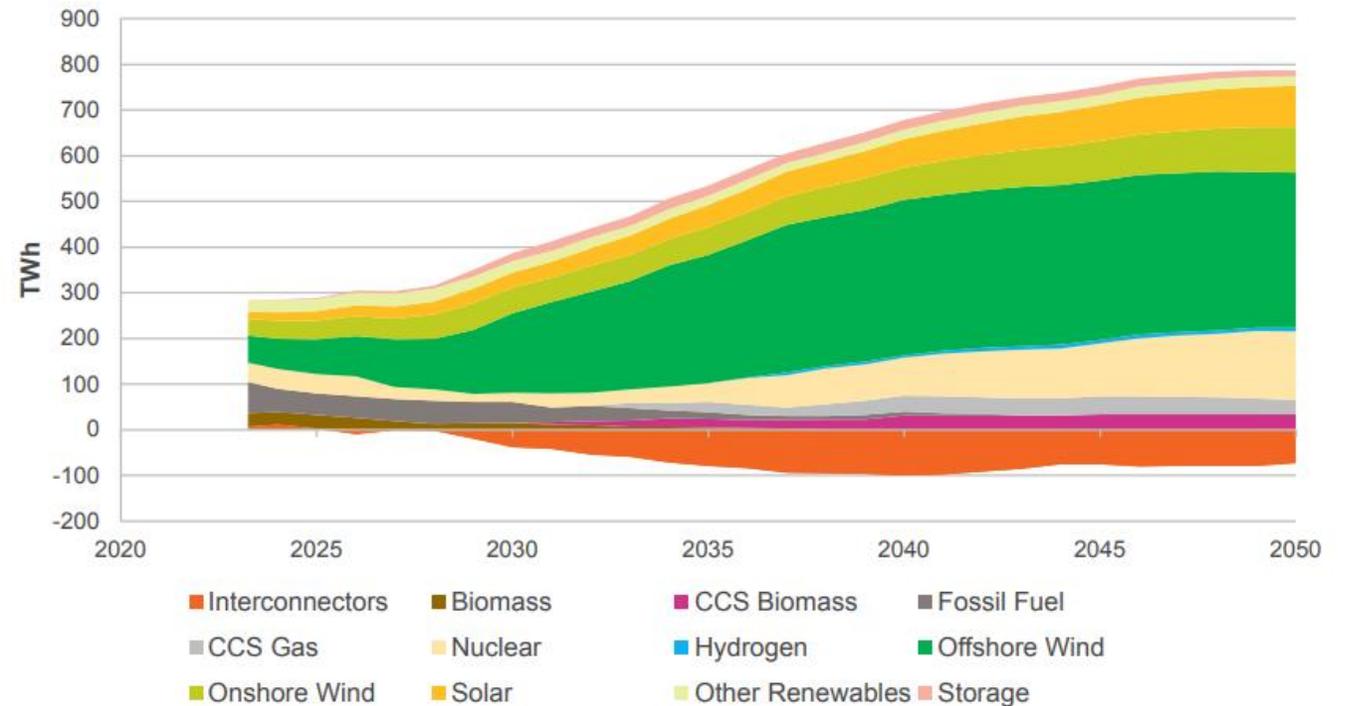
Historic electricity demand: Statista

THIS INCREASE NEEDS TO BE MET BY NEW CLEAN POWER (RENEWABLE AND NUCLEAR)

CLEAN POWER REPLACING FOSSIL FUELS

Additionally, to new generation for the increasing demand, to meet clean power 2030 policy objectives existing fossil fuel power station (now gas after the closure of the last coal power plant). The majority of this new capacity will be from renewable generation, particularly Offshore wind power.

FORECAST INCREASE IN CLEAN POWER



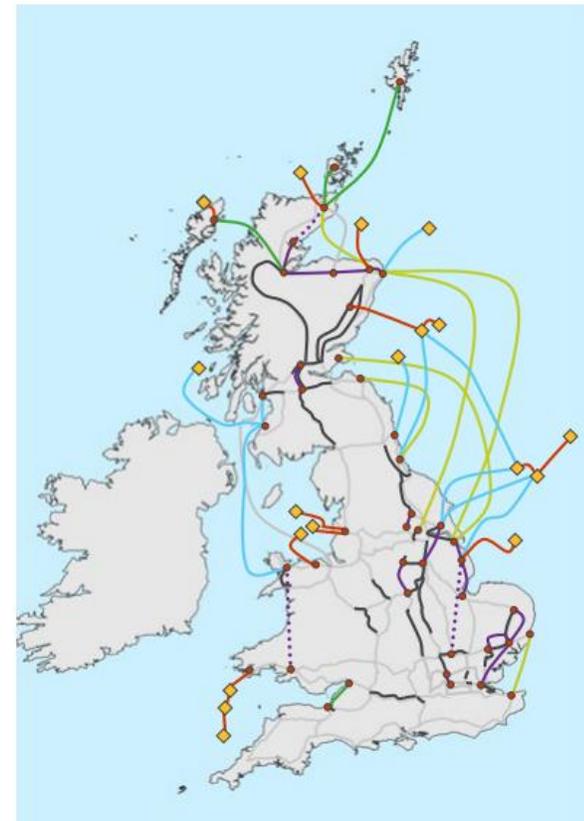
Future Energy Scenarios (FES) 2024: NESO (Electric Engagement scenario)

THIS CREATES A DOUBLE CHALLENGE FOR THE ELECTRICITY SYSTEM

THE DOUBLE CHALLENGE

Firstly, managing the increasing demand. While demand will still be below the 2005 historic peak, generation is now located offshore with new infrastructure required to be built to transport this to demand centres. Secondly, generation is now weather dependant meaning forecasting of both demand and supply is key as well as both flexible generation and demand.

NEW INFRASTRUCTURE REQUIRED FOR OFFSHORE WIND



Legend	
Existing network	—
Existing network upgrade	—
New onshore network infrastructure	—
New network need	••••
New subsea network reinforcement	—
Other works	—
New offshore HVAC	—
New offshore HVDC	—
HND offshore wind farm	◆
Onshore substation to connect new infrastructure	●
All option routes and locations are for illustrative purposes only.	

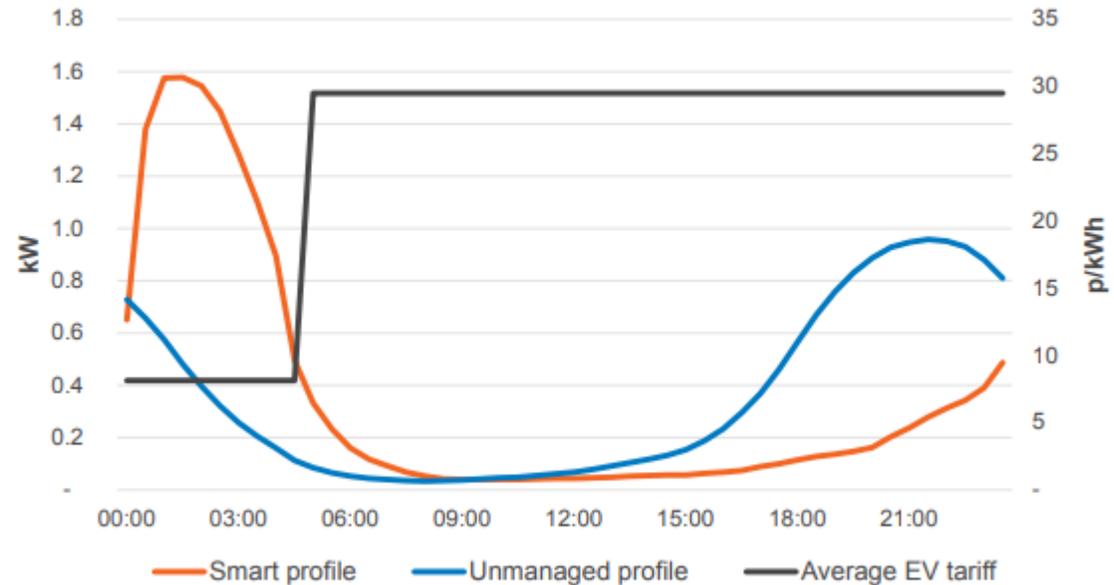
A holistic network design to support offshore wind deployment for net zero: NESO 2022

ON THE FACE OF IT EVS PROVIDE AN IDEAL SOLUTION

FLEXIBLE DEMAND FROM EVS

As EVs can be charged flexibly, that is when charging at home or a destination (such as a workplace) the EV will be parked for longer than the charging cycle required, in particular when EVs are parked at home overnight. This flexible charging behaviour can be aligned with generation from renewable generations. When combined with other forms of flexible demand and generation, allows renewable generation to be more efficiently deployed to reach net-zero.

FLEXIBLE CHARGING PROFILE



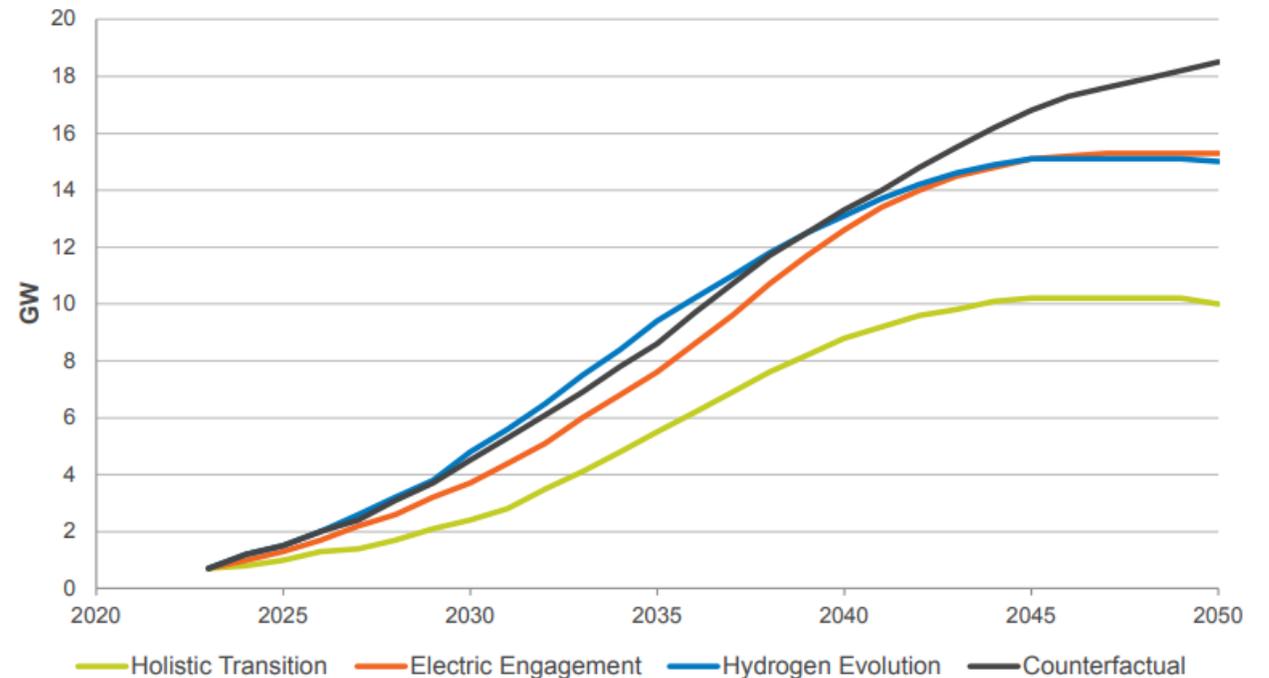
EV charging profiles - ev.energy, Average EV tariff- Money Saving Expert: NESO

ALLOWING DEMAND INCREASES AND WEATHER DEPENDENCY TO BE MANAGED

SHIFTING DEMAND

This flexibility allows demand to be shifted to not only when clean power is abundant, but also to reduce unnecessary strain on the Grid. By moving demand from times of system peak the increase in overall demand from EVs can be better accommodated.

INCREASE IN PEAK DEMAND FROM EVS



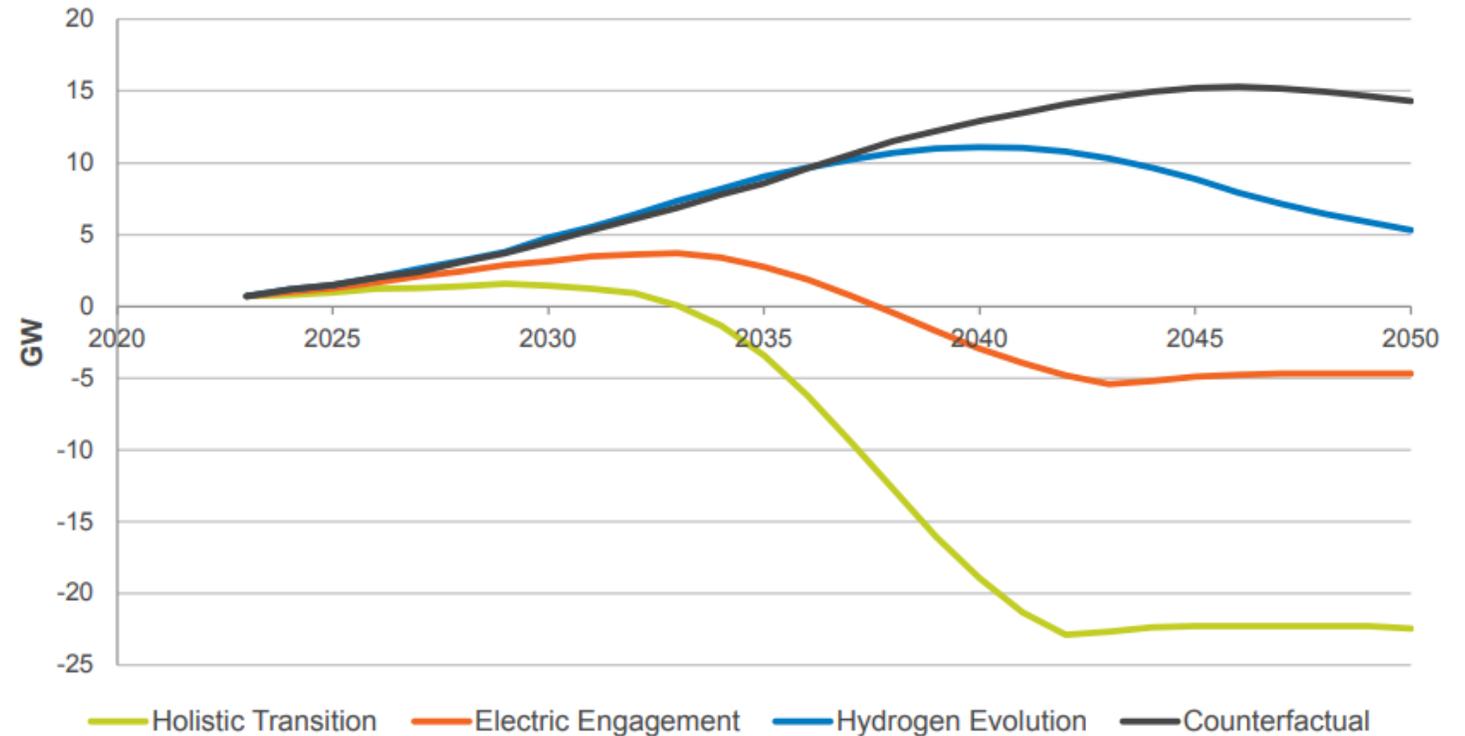
Future Energy Scenarios (FES) 2024: NESO

NOT CAUSING STRAIN ON THE GRID

VEHICLE TO GRID

From just shifting demand EVs can send power back onto the grid (V2G), with some scenarios actually reducing peak demand from EVs – this allows more integration of renewable generation and a greater shift toward electrification of wider transport and heating.

INCREASE IN PEAK DEMAND FROM EVS WITH V2G



Future Energy Scenarios (FES) 2024: NESO

HOWEVER, THERE ARE COMMERCIAL, TECHNICAL, SOCIAL AND POLITICAL BARRIERS THAT WE NEED TO OVERCOME...

UNCERTAIN POLITICS CREATE UNCERTAIN MARKETS

The D

Net zero blamed for blackout chaos

CONSUMERS NEED TO BE LEADING NOT FOLLOWING

Top 10 reasons UK drivers are not considering an EV for their next vehicle

Lack of suitable charging points and range anxiety continue to be the biggest turn-offs for the EV revolution.



IT NEEDS TO BE WORTHWHILE FOR CONSUMERS



TECHNOLOGY NEEDS TO BE “RIGHT” AND EASY TO USE

NAO: Smart meter rollout is going slow and over budget



THANK YOU

ANY QUESTIONS?



Russell Fowler

Energy and clean transport

