

The path to net zero

A consumer perspective and the impact of societal change

The UK’s new decarbonisation target of net zero emissions by 2050 is substantially more challenging than the previous target of an 80% reduction compared to 1990 levels. Our Future Energy Scenarios (“FES”) explore the areas of uncertainty in the future of energy; including the challenge of meeting Net Zero and the impact of this on future energy supply and demand. As our thinking develops for FES 2020, we are considering the changes which consumers – and all of society – will need to make to reach this new target, and how this will impact the energy system.

The potential pathway to Net Zero from our FES 2019 analysis is shown in Figure 1 below.

Reduction in greenhouse gas emissions (includes emissions from international and domestic aviation and shipping)

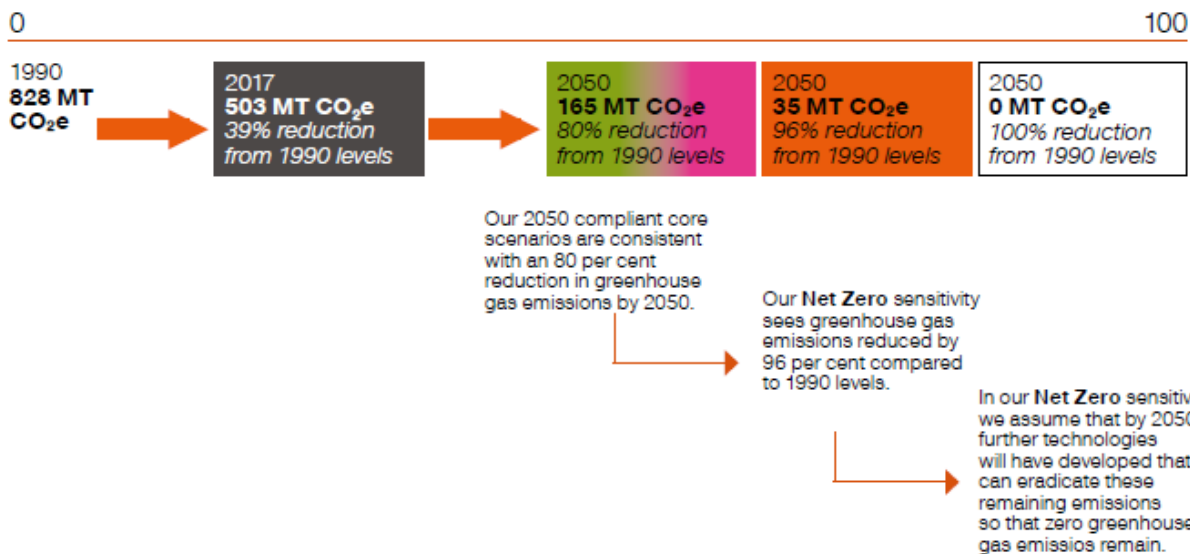


Figure 1: Changes in carbon emission levels between 1990 and 2050 in our FES 2019 scenarios and Net Zero sensitivity analysis

Significant progress has been made decarbonising the electricity system since 2010, primarily due to growth in renewable generation, the closure of coal plants and reduction in demand through greater energy efficiency. The carbon intensity of electricity is a measure of the level of CO₂ emissions produced per kilowatt hour of electricity consumed. The average carbon intensity of electricity has fallen 53% from 529 gCO₂/kWh in 2013 to 248 gCO₂/kWh in 2018. This decarbonisation has mainly taken place across the supply elements of the energy system (on the “supply-side”), with very little impact on the end consumer of electricity. Other supply-side measures include additions of small percentages of biofuels into diesel and petrol supplies or biomethane into the gas grid.

While there is further progress that can be made on the supply-side for decarbonisation, for instance transitioning from natural gas to hydrogen, decarbonisation can also be accompanied by changes on the demand-side. The “demand-side” refers to the point at which energy is consumed, and at large scale these measures will require high levels of societal change, directly impacting upon consumers’ experience of energy consumption in areas from home heating to personal vehicles to aviation. Societal change in these areas has the potential to significantly reduce energy demand and potentially also reduce carbon emissions.

Deep decarbonisation will require significant consumer and societal change

One of the main areas of uncertainty on the pathway to net zero is how much the behaviour and lifestyle of energy consumers, across domestic, industrial and commercial sectors, can be expected to change in the future. This includes both the appetite of these consumers to make proactive and voluntary lifestyle changes to enable a Net Zero society to be reached, and the extent that legislation can be introduced to require and encourage behavioural change.

To decarbonise heat there will be more changes required on the demand-side that will impact consumers. Heat can be thought of as having two elements – the amount of heat that a building requires to stay warm, and how that heat is provided. Improving the energy efficiency of every home and commercial premises in the country would significantly reduce the energy requirements for heating. However, retrofitting buildings with insulation causes disruption for the occupants, so there is uncertainty in the levels of energy improvements we will see and how widespread it will be.

The different options for providing clean heat also require different levels of change from the consumer; in a Net Zero world, we will no longer be able to burn natural gas in boilers in the home, so an alternative is needed. Replacing gas boilers with hydrogen boilers is unlikely to be very disruptive at end-consumer level, as they are a similar size to gas boilers, operate in a similar fashion and require less insulation than heat pumps to operate optimally. However, this relies on supply-side changes to produce sufficient amounts of hydrogen to supply this demand. An alternative heating system is more energy efficient heat appliances which run on electricity, such as heat pumps. However, these operate very differently to gas boilers and would have a more significant impact on the consumer experience; both in terms of installation and use. Insulation requires significant change for the vast majority of the population, as does electrification, whereas switching to hydrogen requires a relatively small change for most people but requires a huge change for the organisations which manage the production and delivery of energy.

Figure 2 shows the change in types of heating systems in our 2019 FES scenarios compared to today.

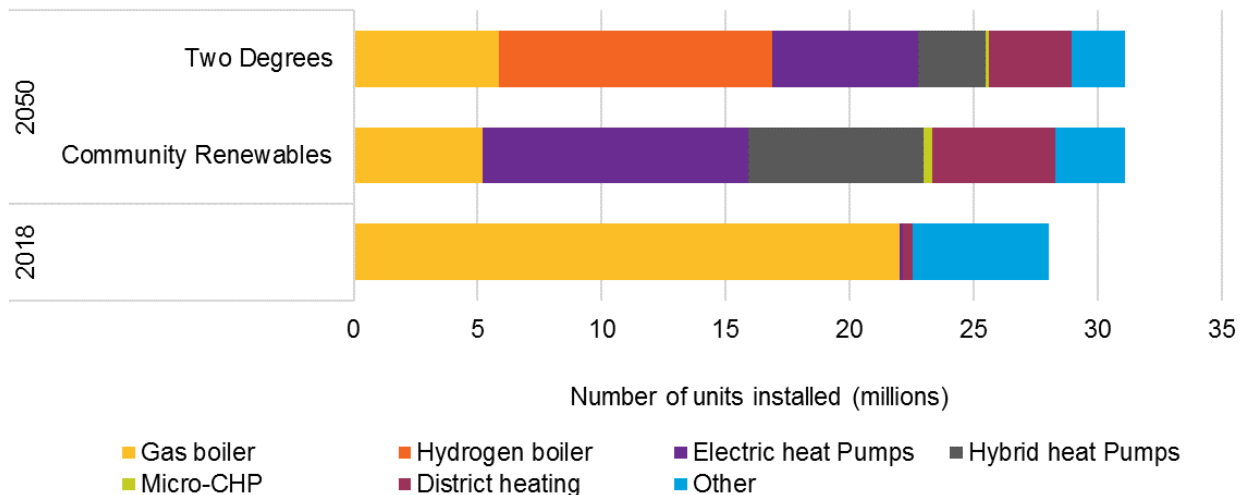


Figure 2: Installed heating systems in 2018 and the decarbonised 2050 scenarios (FES 2019)

In the transport sector, the shift towards electric vehicles is already beginning; new battery electric vehicle registrations have been increasing year on year, with an 87% increase in the year to June 2019. Use of electric vehicles will require some level of change from consumers, as recharging batteries is a different, currently longer, refuelling experience for consumers. If consumers all plug their vehicles in to charge when they return home on weekday evenings this will cause a significant spike in electricity demand that will be challenging to meet. Alternatively, if consumers plug their vehicles in and allow an automated system to optimise their charging times to benefit the electricity system, charging primarily overnight and even feeding electricity back into the grid at peak times, they could save money while reducing stresses on the network. In early December when there was record amounts of wind generation on the system some consumers on flexible electricity tariffs were paid to use excess energy, so this is already starting to happen, however there is uncertainty in how quickly this will happen and how widespread the adoption of these types of flexible tariffs will be.

Societal change will determine what our future energy system looks like

The level of societal change in our future might determine what our energy system looks like. The range of uncertainty for Great Britain's energy demand has been modelled in our more decarbonised scenarios in FES 2019. The amount of hydrogen used might change by up to ten times depending on the use of hydrogen for heating, while peak electricity demands could be 12% lower depending on how people use smart charging for their electric vehicles, and how flexibly they use electricity for heating and industrial uses.

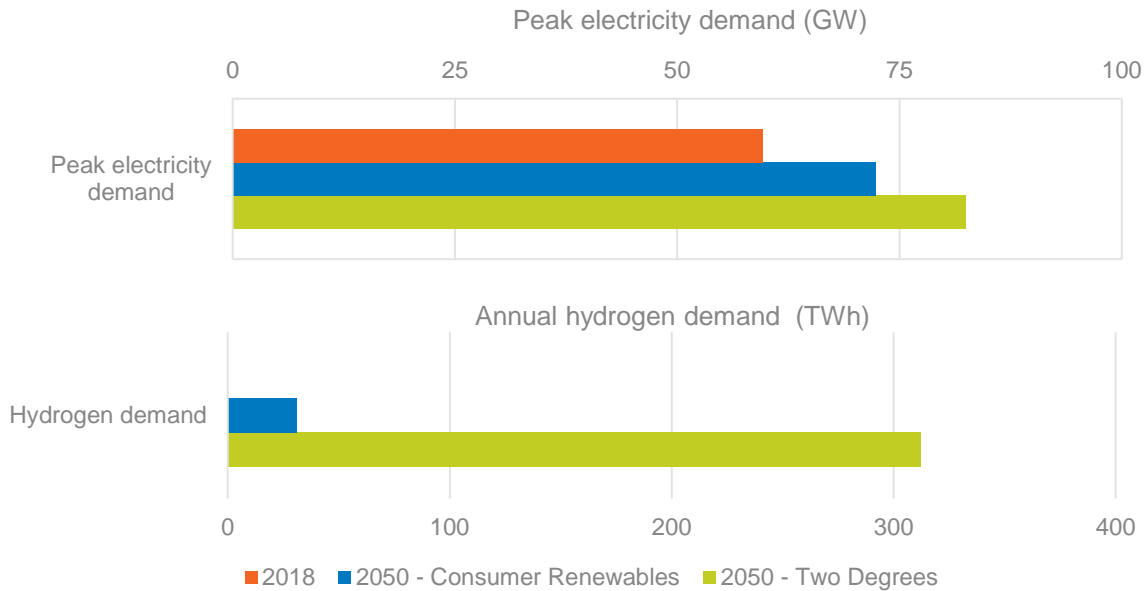


Figure 3: Hydrogen and electricity demand in FES 2019 scenarios

Other than heating and electric vehicle use, areas where changes in how we engage with energy can reduce carbon emissions include greater use of public transport, fewer flights, increased use of low-energy home appliances and greater emphasis on the carbon impact of different dietary choices.

The level of change which consumers and society undergo can be a useful lens to explore many of the biggest uncertainties which will drive the energy transformation, for example:

- **Decentralisation and the deployment of small scale distributed generators.**

The uptake of small- and medium-scale community-based generation such as wind and solar will be affected by how consumers engage with community energy schemes rather than conventional suppliers.

- **Digitalisation.**

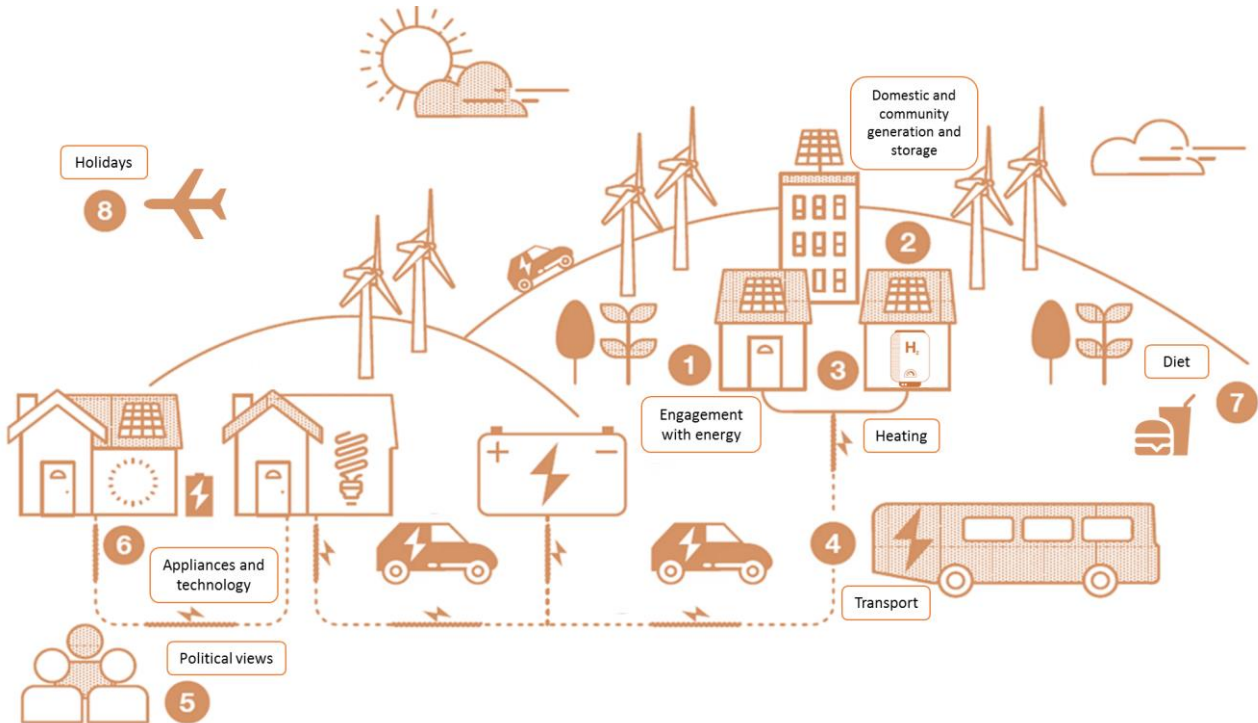
The level to which consumers embrace new technology such as smart meters could increase the data and communications available for network operation and enabling greater system flexibility. This will impact the future peak electricity demand levels and required level of network investment.

- **Future strength and consistency of climate change policy.**

The priority which voters give to decarbonisation policy in their voting preferences will directly impact policy to support decarbonisation of our energy system.

What level of societal change do you see in our future?

Societal change is a choice for each and every one of us. What are your answers to the following questions? And how do you think others – including future generations - might answer these questions?



- 1 **Engagement with energy:** Am I willing to change my energy consumption patterns, such as when I do my washing, or when my EV charges, in response to my energy tariff or savings? Where possible, do I want technology to manage this automatically on my behalf?
- 2 **Domestic and community generation and storage:** Do I want to invest in, and is there a business case for, local generation and storage in my home or local community?
- 3 **Heating:** How do I want to heat my home and what options are available for me? Would I prefer to replace my gas boiler with a hydrogen boiler, or with an electric heat pump?
- 4 **Transport:** Will I buy an electric vehicle, and how will I use it? To what degree will I use ride sharing services, autonomous vehicles, or public transport?
- 5 **Political views:** How are my political views influenced by and how do they influence energy and climate policy? Am I willing to prioritise decarbonisation in my voting preferences?
- 6 **Appliances and technology:** To what level am I willing to insulate my home? Am I willing to choose low-energy appliances and smart technology?
- 7 **Food choices:** What are the energy requirements and carbon emission impacts of my dietary choices, and will my preferences change because of these impacts?
- 8 **Holidays / aviation:** Will I change how far and how often I fly for holidays or work to minimise the carbon impact of this activity?

If you are interested in sharing your thoughts on any of the questions raised in this thought piece, please email us at box.fes@nationalgridso.com. Please also let us know if you would be interested in participating in our FES focus group in the new year, for more information please see our December newsletter.