Changes from FES 2020 to FES 2021

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What are the main changes in the framework and approach when comparing *FES 2020* and *FES 2021*?

FES 2021 uses the same scenario framework as last year. This is in response to stakeholder requests for consistency and because we believe it still allows us to explore the credible range of uncertainty. The 'societal change' axis combines changes in innovation, consumer understanding and behaviour to examine the ways in which our economy can decarbonise, along with how quickly this can be done, via the 'speed of decarbonisation' axis which has been part of the framework since FES 2018.

This year we've also included a dedicated section explaining the impact of the COVID-19 pandemic on our scenarios. Though we'll keep monitoring restrictions and their impacts, we have been able to provide an update on short- and long-term demand forecasts. Through the pandemic and the various changes that came with it, we have seen a great level of adaptability in society – this fits within the credible range of societal change we model, reinforcing the decision to maintain the same framework for 2021.

There are also dedicated chapters in the document on net zero and flexibility. Net zero examines the greenhouse gas emissions relating to each FES 2021 scenario and how this aligns with net zero by 2050, and Flexibility explores how supply and demand can be balanced over different timescales to ensure security of supply. Whilst much of this content was covered in FES 2020 this year is the first time its been incorporated into dedicated chapters.

To help make the whole of FES more accessible, we've implemented a new set of accessibility guidelines for all published content. This includes a new, dedicated website for FES 2021 which allows stakeholders to engage with the main content from FES without having to download the full document (although it doesn't have all the detail from the spreadsheet).

How do the scenarios from *FES 2021* compare with the scenarios from *FES 2020*?

In FES 2021, three scenarios (**System Transformation, Consumer Transformation and Leading the Way)** reach net zero by 2050, just like in FES 2020. However, in FES 2021 decarbonisation happens faster with all three scenarios reaching lower emissions in 2030 than last year. **Leading the Way** also decarbonises further with net annual emission by 2050 of -28 $MtCO_2e$ compared to 10 $MtCO_2e$ in the equivalent FES 2020 scenario. This is due to increased government ambition, highlighted by recent policies, including the acceptance of the updated, more challenging, sixth carbon budget target and the Government's Energy White Paper.

Steady Progression doesn't meet net zero and emits 243 $MtCO_2e$ annually by 2050. This reduction of 72% on 1990 levels is far from achieving net zero but has improved slightly on last year where Steady Progression in FES 2020 represented a reduction of 68% on 1990 levels.

Further information about how we developed our FES 2021 framework and scenarios can be found in our stakeholder feedback document.

What changes have been made to the modelling approach?

We have used the same broad modelling approach as last year but have replaced the heat model used in FES 2020 with our new regional heat model.

The new model is intended to enhance our understanding of the potential decarbonisation routes, their likelihood, and the impact of these on networks as well as on consumers. The improvements the model offers over our existing heat modelling capabilities include much improved spatial resolution, down to lower layer super output areas, which are small geographical areas with an average population of 1500 people. In addition, it allows detailed modelling of hydrogen infrastructure, district heating infrastructure, over 7,000 building types, thermal storage, and heat demand. We've also used the heat model as the basis to improve the modelling of the supply of hydrogen.

This regional approach, based on stakeholder feedback, has been more of a focus in FES 2021, and is an area we are putting greater resource into for the future including in FES 2022.

For more detail on changes to modelling methods and approaches, please see our FES 2021 Modelling Methods document.

How has the view of technologies and areas changed?

Transport

Recent government policy has brought forward the ban on petrol and diesel car and van sales to 2030, with a 2035 ban of Plug-in Hybrid (PHEV) cars and vans. To reflect this **Leading the Way** and **Consumer Transformation** are modelled as achieving a 2030 ban on the sale of new petrol and diesel cars and vans. **System Transformation** and **Consumer Transformation** are also modelled as achieving a 2035 ban on PHEV car and vans while **Leading the Way** achieves this much earlier in 2032.

In FES 2020 a ban on petrol, diesel and PHEV cars and vans was modelled as achieved in 2035 for **System Transformation** and **Consumer Transformation** and 2032 for **Leading the Way**.

Battery Electric Vehicle (BEV) uptake rates have increased across all scenarios, this is based on strong sales despite the Covid-19 pandemic and increased policy ambition. A key difference compared to FES 2020 is a reduction in BEV efficiency assumptions which results in higher electricity demand. This is due to increased real-world data and stakeholder feedback.

Heat

Our new regional heat model (used for the first time in FES 2021) has given us a more granular view of residential heat and the opportunities for moving heat demand within the home. This analysis, combined with more conservative insulation assumptions across our scenarios this year, has led to higher annual and peak electricity demands in our modelling and increased the importance of domestic heat flexibility. Combined with stakeholder feedback, use of the new model also increased the relative share of electrification over hydrogen for heating in the commercial sector.

Electricity demand

Compared to FES 2020, we see higher annual demands by 2050 across all scenarios. There are four main reasons for this:

1) Changes in fuel switching and thermal or appliance efficiency assumptions in the industrial and commercial sectors
2) Changes to thermal efficiency assumptions accompanied by increases in the use of heat pumps of all types
3) Changes to the use of thermal storage devices at times of peak demand in homes and businesses

4) Reductions in Battery Electric Vehicle (BEV) efficiency assumptions

Electricity generation and flexibility

Increased electricity peak demands compared to FES 2020 mean we will need more generation capacity, particularly renewables, as well as flexible technologies and demand side response. This includes offshore wind, where across all sectors a minimum of 31 GW is now expected by 2030 compared to 25 GW in FES 2020, and solar where there is an additional 17 GW by 2050 in **Leading the Way**. This also leads to higher Bioenergy with Carbon Capture and Storage (BECCS) capacities, as well as gas CCUS (Carbon Capture Usage and Storage) in **System Transformation** and **Consumer Transformation** compared to FES 2020.

To meet net zero gas cannot be used without capturing its emissions, and the Climate Change Committee has called for a complete end to unabated gas for power generation by 2035, subject to security of supply. **Leading the Way** has been adjusted to reflect this, however, it requires immediate action on the deployment of CCUS to be used in BECCS, hydrogen and other types of long duration storage. Additionally, gas CCUS is now deployed in Steady Progression from the mid-2030's for the first time.

Flexibility is provided by a range of technologies as in FES 2020. This year there are lower electrolysis capacities across scenarios as higher load factors for each electrolyser are assumed, reflecting that electrolysis is not just powered by renewables that would otherwise be curtailed.

Hydrogen storage by 2050 in **System Transformation** has over double the hydrogen storage capacity than in FES 2020. Methane reforming plant run more often throughout the year, rather than mainly in winter, so more seasonal storage is required. Hydrogen storage in the other two net zero scenarios is largely unchanged.

Natural Gas supply and demand

There is minimal change in natural gas supply and demand in FES 2021, compared to FES 2020. Natural gas is an important component of today's energy mix, primarily for heating and cooking, and remains so into the 2030's. This year, moving through the 2030's and beyond, natural gas supply varies between the scenarios, primarily due to the differences in hydrogen production. **System Transformation** has 60% of today's demand levels (almost 50 bcm annual demand), while **Leading the Way** has just 2 bcm annual demand in 2050. This range illustrates the difference between a blue hydrogen net zero scenario, where hydrogen is produced from natural gas, and a more electrified, green hydrogen net zero scenario where hydrogen is produced from electricity.

Bioenergy

In **Leading the Way** there are no biomass imports unlike in FES 2020. It is assumed that changes to land use, partly because of dietary changes, allow for more energy crops to be grown in the UK. **System Transformation** has gone from having the lowest demand for bioenergy last year to the greatest in FES 2021; this is largely because of a 40 TWh increase in in bioenergy demand for hydrogen production by 2050.

Hydrogen

This year additional methods of hydrogen production have been incorporated into our net zero scenarios. Hydrogen production using dedicated nuclear for electrolysis is deployed from 2030 in **System Transformation** and 2035 in **Consumer Transformation**. Biomass gasification combined

with CCUS is deployed in **System Transformation** from 2031 like last year, but this year it is also present in **Leading the Way**, again from 2031.

The maximum amount of hydrogen required in 2050 has reduced in **System Transformation** since FES 2020 due to increased electrification of heat.

More detail of all areas and technologies can be found in the FES 2020 Data Workbook A high-level summary of key statistics can also be found here.

For any queries, please contact fes.nationalgrideso.com

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