Changes from FES 2021 to FES 2022

18.07.22

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What are the main changes in the framework and approach when comparing *FES 2021* and *FES 2022*?

FES 2022 uses the same scenario framework as last year and 2020. 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.

Whilst the framework is the same we have listened to stakeholder feedback and changed the name of the Steady Progression scenario to **Falling Short**. Some stakeholders felt it wasn't sufficiently clear from the old name that this scenario did not meet the Net Zero target. We believe that this more accurately reflects the intent of the scenario. This is just a name change and **Falling Short** will perform the same role as Steady Progression in the FES framework (i.e. it represents the credible slowest progress towards decarbonisation).

How do the scenarios from *FES 2022* compare with the scenarios from *FES 2021*?

In FES 2022, three scenarios (**System Transformation**, **Consumer Transformation** and **Leading the Way**) reach Net Zero by 2050, just like in FES 2021. In FES 2022 decarbonisation happens at broadly the same rate, with these scenarios reaching Net Zero in the same year as in FES 2021, although there is a slightly quicker decarbonisation through the 2030's. This results in **System Transformation** meeting the 6th Carbon Budget like the other two scenarios, whereas in FES 2021 it did not. **Falling Short** doesn't meet Net Zero and emits 186 MtCO2e annually by 2050. This reduction of 78% on 1990 levels is far from achieving Net Zero but has improved on last year where Steady Progression (now **Falling Short**) in FES 2021 represented a reduction of 72% on 1990 levels.

An 80% reduction was the UK's emission target prior to Net Zero being legislated in 2019 and highlights how decarbonisation ambition has progressed in recent years.

What changes have been made to the modelling approach?

We have used the same broad modelling approach as last year but have made key changes to the way we model data centres, distribution generation, and the geographical dispersion of Electric Vehicle (EV) energy demand.

Data centres: there is a strong pipeline of new connection requests for data centres, as such we've modelled data centres explicitly for the first time in FES this year. Dedicated data centre demand could grow tenfold by 2050 but our modelling offsets this growth with a reduction in on-premises computing demand from companies outsourcing their existing computing power to these new data

centres. In future iterations of FES, we will look to improve the spatial resolution of data centre demand.

Distributed generation: we have changed the data used to set the generation backgrounds for capacity connected to the distribution network. This year we used the Embedded Capacity Register (ECR) data published by Distribution Network Operators (DNOs) to inform our view of current and planned generation capacity connected to the network below transmission voltages.

EV energy demand: we have changed how road transport spatial disaggregation works to include mileage data to capture regional differences in transport usage in addition to the differences in EV uptake. The new methodology calculates the weight based on the distribution of mileage multiplied by the fraction of vehicles that are EVs in each area. This year we increased the spatial resolution of our analysis, using Local Authority (LA) level mileage data and LA or postcode level vehicle registration data. The results are then aggregated to Grid Supply Point (GSP) level. Last year, the calculation was done at GSP level only.

In addition to this, we have also made a number of changes to our internal processes and analysis tools to help us derive further insights from the Spatial Heat model introduced for FES2021 and present our data on a regional basis.

How has the view of technologies and areas changed?

Transport

Recent government policy has committed to phase out non-zero emission Heavy Goods Vehicles, (HGVs) with all new HGVs sold in the UK to be zero emissions by 2040. This is reflected in this year's FES analysis with **Consumer Transformation**, **Leading the Way** and **System Transformation** all meeting this target. **Falling Short** achieves this slightly later, by 2045. In **Consumer Transformation** and **Leading the Way** where most zero emissions HGVs are electrified, this results in increased annual electricity demand for transport from the 2030's onwards, compared to FES 2021.

We've also updated our assumptions on how and where Electric Vehicles charge based on the improved regional modelling approach we took this year and the availability of new trial data. This has led to slight increases in peak transport electricity demand in **Consumer Transformation** and **Leading the Way** as less residential smart charging is assumed in these scenarios compared to FES 2021.

Heat

In FES 2022 **Falling Short** has around 100 TWh less natural gas demand for residential heating by 2050 compared to FES 2021. This is because post-2030 gas boilers are replaced by heat pumps and district heating more quickly than in FES 2021 due to the slightly greater decarbonisation ambition in **Falling Short** this year.

In FES 2021 **Consumer Transformation** saw a relatively small proportion of residential heating switch to hydrogen boilers through the 2030's culminating in a hydrogen demand for heating of 15 TWh by 2050. In FES 2022 **Consumer Transformation** has no hydrogen for domestic heating, this is to reflect that an almost fully electrified domestic heating system is part of the credible range of outcomes by 2050.

Electricity demand

By 2050, for all scenarios, annual electricity demands are higher than last years' results reflecting stakeholder feedback and policy announcements, specifically:

- Increased fuel switching (both electrification and hydrogen which may be produced via electrolysis) in Industrial & Commercial (I&C) sectors reflecting the Industrial Decarbonisation Strategy
- Increased electrification of HGVs
- For **Falling Short** an increased level of electrification compared to FES 2021, although without the efficiency measures seen in some of the other scenarios.

Electricity generation and flexibility

Both onshore wind and solar see increased capacities across all Net Zero scenarios by 2050 of up to 4.8 GW and 3.2 GW respectively. For offshore wind, total capacity in 2050 increases by 3.2 GW in **Falling Short** and around 2 GW in **Consumer Transformation** and **System Transformation**. It decreases by almost 3 GW in **Leading the Way** but remains high at 110 GW.

More notable for offshore wind is an earlier deployment of offshore wind capacity across the scenarios, driven by the increases in the pipeline and the governments increased target of 50 GW by 2030. By 2035 there is between 2.7 GW (**Leading the Way**) and 13.5 GW (**System Transformation**) of additional capacity compared to FES 2021.

For nuclear power plants, **Consumer Transformation** and **Leading the Way** have seen small reductions in capacity by 2050 compared to FES 2021 whilst **Falling Short** and **System Transformation** have seen small increases. This has had the effect of reducing the range of nuclear capacity across our scenarios in 2050 from 5.5 GW to 17.1 GW in FES 2021, to between 8.1 GW to 15.3 GW in FES 2022.

Bioenergy with Carbon Capture and Storage (BECCS) capacities are generally lower in FES 22 than FES 21 with the exception of **Falling Short** which had no BECCS capacity last year. This year, with an increased decarbonisation ambition, **Falling Short** has a BECCS capacity of 5.2 GW by 2050.

Gas CCUS (Carbon Capture Usage and Storage) is deployed at slightly greater levels in FES 2022 across all scenarios, with **Falling Short** having the greatest capacity by 2050 of 23.1 GW compared to 21.5 GW in FES 2021.

To meet Net Zero, gas cannot be used without capturing its emissions, and the UK Government in its Net Zero strategy has committed to a Net Zero power sector by 2035, subject to Security of Supply (SoS). **Leading the Way** now better reflects this, with all unabated gas capacity (at both transmission and distribution level) phased out by the end of 2035. However, it requires immediate action on the deployment of CCUS, hydrogen and other types of long duration storage. The other Net Zero scenarios retain unabated gas generation capacity for longer but the load factors reduce significantly year on year.

Flexibility is provided by a range of technologies as in FES 2021. This year there are lower electrolysis capacities across scenarios except **System Transformation** as total hydrogen demand has reduced. For **System Transformation**, total hydrogen demand has also reduced compared to

FES 2021 but a greater proportion comes from electrolysis; in part due to the benefit it provides by reducing energy curtailment.

The Industrial & Commercial sectors are expected to offer increased levels of demand side flexibility in the future. However, this has been reduced compared to last year's results by as much as 2.3 GW in 2035 and 4.9 GW in 2050, as last year relatively high proportions of industrial peak demand were being shifted using demand side flexibility.

Natural gas supply and demand

In FES 2022 natural gas supply and demand are lower by 2050 in all scenarios except **Leading the Way**, when compared to FES 2021. For **Leading the Way**, whilst demand is still low it has increased as this year we have some hydrogen production coming from Steam Methane Reformation (SMR) to reflect the 1 GW target by 2025 in the British Energy Security Strategy.

Bioenergy

Compared to FES 2021, bioenergy demand in FES 2022 has increased in all scenarios except for **Leading the Way**, by as much as 45TWh by 2050 (**Falling Short**). Compared to FES 2021, bioenergy demand in **Leading the Way** has reduced by 23 TWh in 2050, with less use of BECCS for power generation in this scenario. This reduction is mainly due to less need for negative emissions provided by BECCS in **Leading the Way,** as other options such as Direct Air Carbon Capture and Storage (DACCS) are more widely deployed. This widening of the range across the Net Zero scenarios highlights the degree of uncertainty around the role of bioenergy in the energy system.

Hydrogen

Hydrogen demand by 2050 is lower for all scenarios in FES 2022 compared to FES 2021 with a reduction in annual hydrogen demand of between 35 TWh to 53 TWh. The reasons for this reduction are scenario specific but include:

- A reduction in hydrogen demand from road transport for **Consumer Transformation** and **Leading the Way** (corresponding to the greater electrification of the HGV sector mentioned earlier)
- A reduction in hydrogen demand for residential heat in **System Transformation**
- A removal of hydrogen for residential heating in **Consumer Transformation**
- A removal of hydrogen blending in **Falling Short**.

In terms of hydrogen production, the proportion of hydrogen produced from electrolysis compared to methane reformation has increased in FES 2022. This takes account of the government target that at least 50% of hydrogen production should be from electrolysis by 2030 as well as a recognition of the wider whole energy system benefits of electrolysis (e.g. provision of flexible demand in the power sector).

As noted above, in Leading the Way there is now some hydrogen produced from methane reformation (in FES 2021 there was none in Leading the Way). This reflects the fact that there are now dedicated subsidy arrangements for this technology.

Unlike in FES 2021, blending of hydrogen into the existing gas system now takes place in System Transformation and Leading the Way as part of the transition to a 100% hydrogen system and as a

demand of last resort. However, as this is not listed as a preferred use case under the hydrogen supply subsidy rules wholesale blending is no longer assumed in Falling Short (like it was in Steady Progression in FES 2021).

Finally, hydrogen exports are included for the first time in System Transformation and Leading the Way (this scenario also includes imports and the net position is imports).

More detail of all areas and technologies can be found in the FES 2022 Data Workbook. A high-level summary of key statistics can also be found in FES in Five. These documents can be found on the FES section of the ESO website - https://www.nationalgrideso.com/future-energy/future-energy-scenarios

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