10 Years of Future Energy Scenarios

The publication of the Future Energy Scenarios in July 2021 marked the 10th anniversary of FES, as it is more commonly known across the wider energy industry.

Here we take a look back at how FES has changed over the last 10 years, highlighting how the scenario frameworks, and corresponding energy supply and demand ranges, have evolved over time. We will also explore how FES has both reacted to and informed policy as well as review some case studies focusing on how the future view of solar PV, coal, offshore wind and electric vehicles has evolved with each succeeding FES publication.

What is FES?

In FES, we outline potential credible pathways for the future of energy from now to 2050 – exploring the different ways we may use and generate energy. These scenarios are not forecasts or predictions, but they do represent a credible range of likely outcomes. FES is used to inform a range of energy system activities including network operation, investment decisions and energy policy. It can also help people understand the different ways we may supply and consume energy between now and 2050.

As we reach ten years of FES, we look back at how FES has changed over the last 10 years. We'd love to hear your thoughts on the topics explored here, and more widely the role FES has played in your work to date. Please get in touch with us at FES@nationalgrideso.com, if you want to share your thoughts or questions.

Ten Years of Scenario Development

Over the last decade FES has explored what the future energy system might look like out to 2050, using between two and four scenarios to represent the credible range (see Figure 1). FES continues to inform industry, reflecting changes in energy demand and supply feeding into network developments. But how we do this work, the value it creates and the audience who use it are changing slowly over time. When the scenarios were first created in 2011 there were fewer policy-defining targets for generation capacities - there was not even the Net Zero target. Now with many more targets defined, such as for 40GW of offshore wind by 2030, the potential ranges around some of these variables have decreased. The focus is now on the growing complexity of managing such a varied system, and the changes we need to see in order to meet the Net Zero target. Stakeholder engagement has also evolved and increased with over 1200 stakeholders reached right across the industry, and wider decarbonisation community in FES 2021.

As the energy industry continues to transform to achieve Net Zero, we're actively considering how the Future Energy Scenarios work may need to continue to evolve to ensure that it continues to meet our stakeholders' needs. We're keen to hear any thoughts you have on this topic.

Figure 1 shows how the scenarios have evolved and varied since 2011. The level of decarbonisation increases moving up the vertical axis. Gone Green, Two Degrees, Low Carbon Life and Community Renewables all met the original UK Climate Change Act 2008 target of an 80% reduction in greenhouse gas emissions by 2050. However, from 2020, 3 out of the 4 scenarios (Leading the Way, Consumer Transformation and System Transformation) meet the more challenging Net Zero greenhouse gas emission target which was legislated in 2019, representing an increase in the decarbonisation ambition of FES.

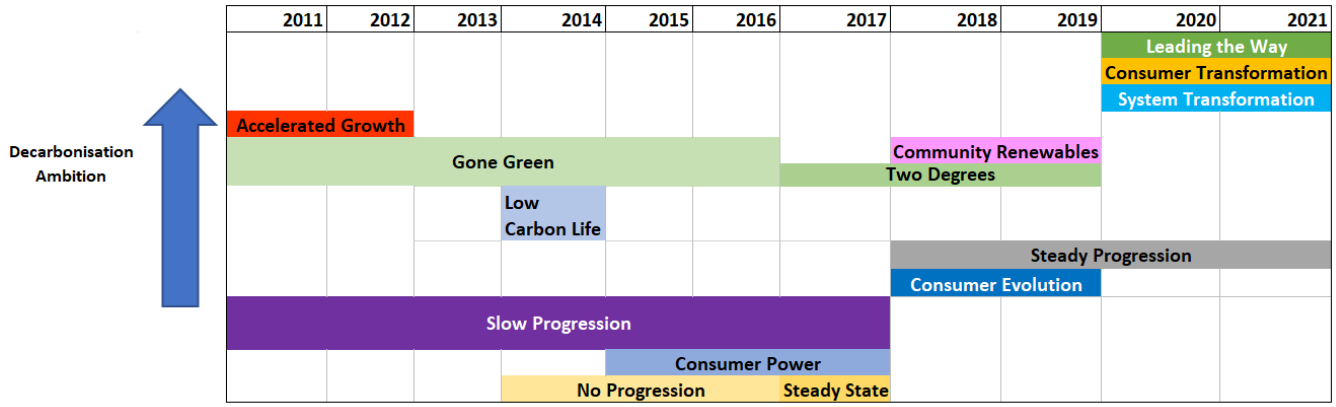

Figure 1. 10 years of FES scenarios – data taken from the FES archive

Key Insights

Between 2011 and 2012 there were 3 different scenarios, with only 2 in 2013; between 2014 and 2021 there have always been 4

A No Progression scenario was introduced in 2014, but removed in 2017

There is an increase in decarbonisation ambition from 2020 to reflect Net Zero

Looking forward over 30 years into the future naturally leads to a level of uncertainty but the range of scenarios used in FES helps to account for this and explore what could happen in the case of many different outcomes. However, there have been short-term uncertainties which have the potential to have long term impacts, for example the impacts of Covid-19 and the UK's transition out of the EU ("Brexit"). The annual nature of FES means the impact of these events can be regularly updated. Based on experience to date, our modelling (for FES 2021) shows that the long-term impact of Covid-19 on energy demand (both peak and annual) is likely to be small. However, as the pandemic's impact on society becomes clearer, we will be able to reflect our observations of the post-lockdown impacts in FES 2022 and beyond.

Despite these short-term impacts, the FES scenarios have provided credible and trusted outlooks – on many occasions capturing the future well, for example in the case of offshore wind and electric vehicles. This has helped the FES publications to increasingly inform policy makers across the energy sector over the last ten years. However, we didn't always get it right with solar PV in particular an example of where FES could have been quicker to identify a trend.

FES and Policy

In addition to the Net Zero target, FES has reacted to many policy changes and key events over the last ten years.

Our FES analysis can react to policy in several ways, including:

- Technologies can be phased in or phased out.
- Where policy refers to specific projects such as the Carbon Capture Utilisation and Storage (CCUS) clusters announced in the Net Zero strategy, additional detail can be reflected. Our move to make FES more regional allows this to be done even more accurately.
- Longer term assumptions around the way energy is consumed, and the technologies which will be favoured can be based on policy ambitions and goals, with scenarios used to reflect longer term uncertainties.

Figure 2 shows a snapshot of some of the policies which were produced during each FES publication year. Examples of policies which impacted technology trajectories in FES included:

- Large Combustion Plant Directive (LCPD) & Carbon Price Floor (CPF) after which there was a significant reduction in coal power generation
- Subsidies for renewable electricity
- Electricity Market Reform which aimed to deliver low carbon energy supplies and ensure security of supply

Importantly, while FES necessarily reflects relevant policy, we do include technologies in our scenarios which we think will play an important role in the future energy system but which may not have underpinning policies or targets at the time of publication. Examples of this, discussed in more detail below, include offshore wind and electric vehicles. This ability to be independent and consider requirements ahead of current policy helps make FES a useful tool for policy makers.

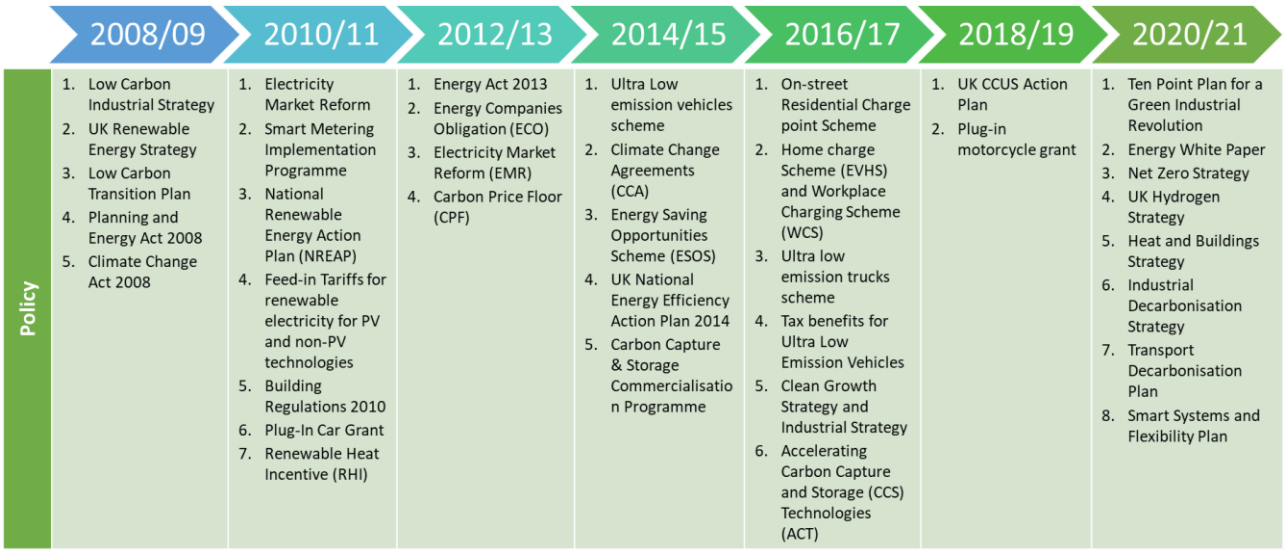

Figure 2 Key UK energy policies with potential impacts on FES

One area where FES has increasingly played an important role over the last decade is to inform UK energy policy. It has been cited in key areas of energy policy, major UK policy papers such as the Net Zero and Hydrogen strategies produced by the Department for Business, Energy & Industrial Strategy (BEIS) in 2021, and broader policy debates. Figure 3 highlights several key policy and regulatory milestones that have cited FES.

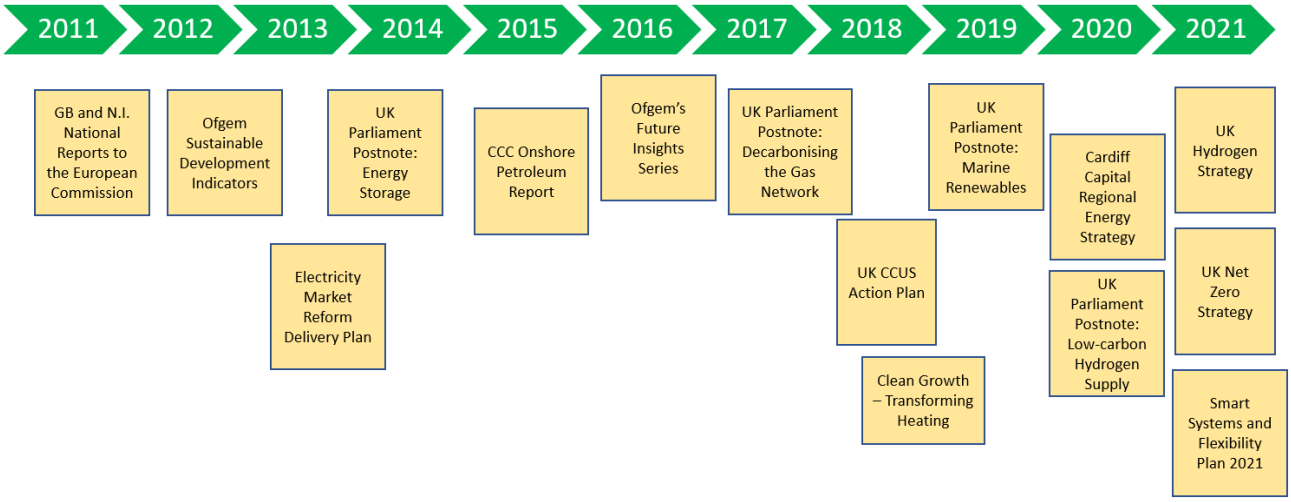

Figure 3. Example of FES supporting UK energy policy

If FES has helped you, we'd love to hear from you. Please get in touch with us at FES@nationalgrideso.com, if you want to share your thoughts or questions.

Stakeholder involvement

Each year our FES team review changes to Government policy and engage with an increasing number of stakeholders to ensure FES is up to date and reflects the latest developments in the energy sector. Stakeholder engagement has become an increasingly important part of the FES process since 2012 when over 150 stakeholders were engaged, to FES 2021 where we reached over 1200 stakeholders, as detailed in our associated Stakeholder Feedback Document. Figure 4 highlights some of the key stakeholders for FES 2021, as well as some of the regulated energy system activities it is used for.

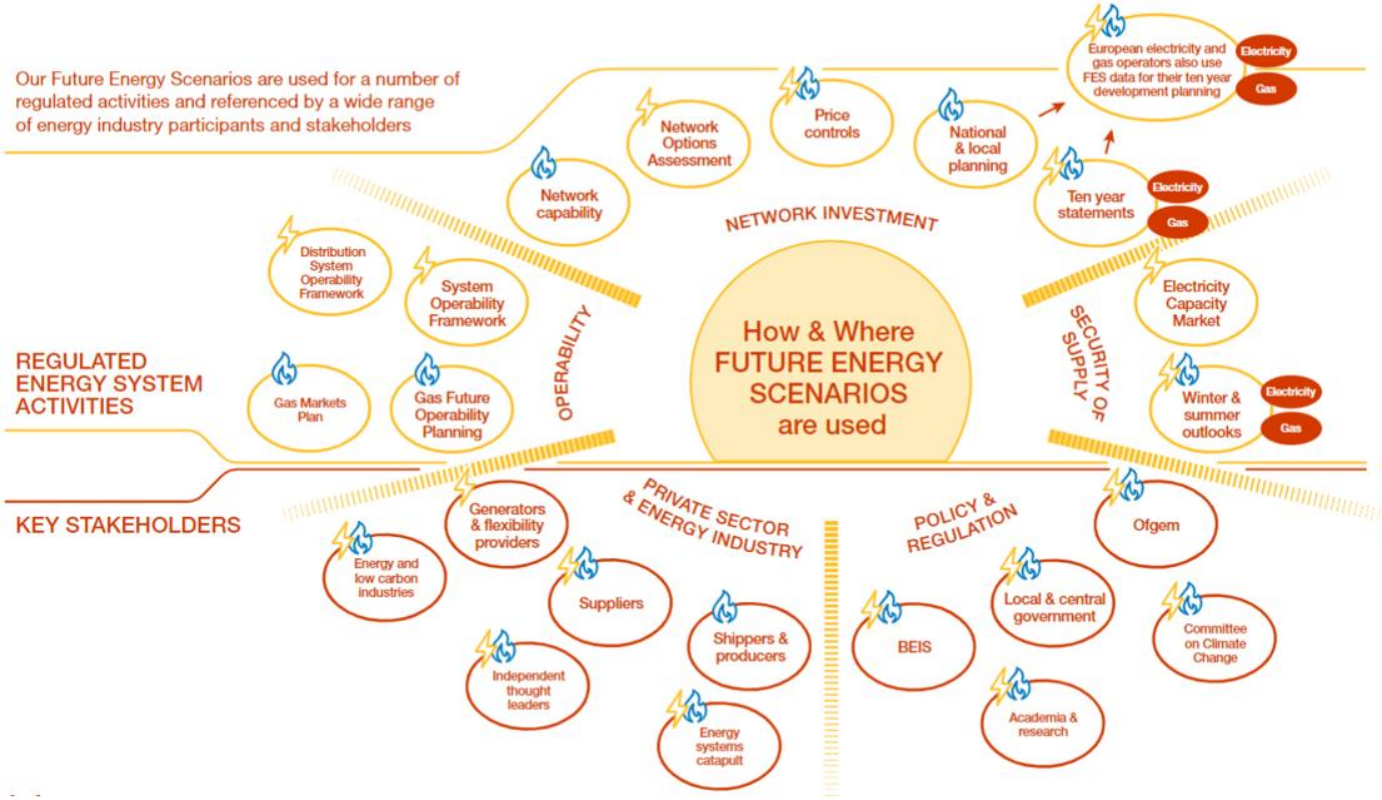

Figure 4. Stakeholders and regulated system activities relating to FES 2021

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Case studies: learning from rapid changes in the energy sector

Since the Climate Change Act in 2008, we have seen radical, sometimes unprecedented, transformations across the energy system. We have continually sought to learn from these transformations, and enhance how we produce our Future Energy Scenarios.

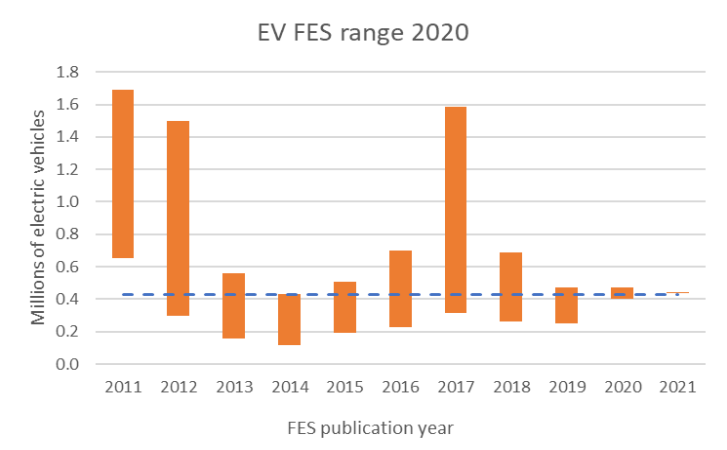
The following section looks at four case studies: two where FES was slightly slow to react to policy; and two where FES was ahead of and helped inform policy. In each case the difference between the range of scenario results (shown by the orange bars) in each FES publication and what we actually saw in 2020 (shown as a dashed blue line) is given. We also describe the reasons which contributed to the difference and, where appropriate, the lessons that we can learn. In Case Study 4 on offshore wind, the range of scenario results are described for 2030 and compared to the 2030 target of 40GW.

Case Study 1: Electric vehicles

Scenarios vs Reality: There were just over 400,000 Electric Vehicles (EVs) in the UK by the end of 2020. This was within the expected range of outcomes for each FES publication since 2012. FES recognised the future importance of EVs from 2011. The potential trajectory reflected the UK Government's 2030 ban on new petrol and diesel cars, before the ban was announced. The "Two Degrees" scenario in 2017 assumed a large uptake of hybrid electric vehicles which extended the range of results.

Reasons: Over the last decade consecutive UK Governments have supported EV uptake through a mixture of different policies, targets and grants. This consistent support has led to an increasing deployment of EV's year on year for the last decade.

Summary: FES recognised the importance of EV's from its first publication. This aligned with Government policy and preceded the petrol/diesel vehicle ban.

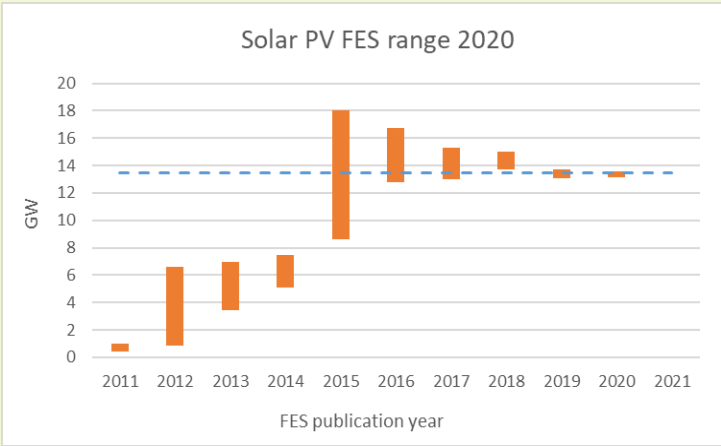


Case study 2: Solar PV

Scenarios vs Reality: In 2011 we expected to have ~1 GW of solar power capacity in GB by 2020; we now have over 13 GW.

Reasons: Feed-in tariffs for small scale generation introduced in 2010 incentivised the deployment of smaller renewable installations including solar photovoltaics (PV). The cost of Solar is estimated to have reduced by 50% from 2010-2012. It also has the highest public approval of renewable technologies (85%). The scenario "Accelerated Growth", which saw an increasing trend in Solar PV capacity from 2011 to 2012 was dropped in 2013 following stakeholder engagement.

Lessons learnt: A combination of new subsidies, reducing technology costs, and policy support can lead to fast deployment of new technologies. For solar this was recognised relatively late. Continuing to include a high growth and innovation scenario (i.e. similar to "Accelerated Growth") may have recognised the potential increase in solar capacity sooner.

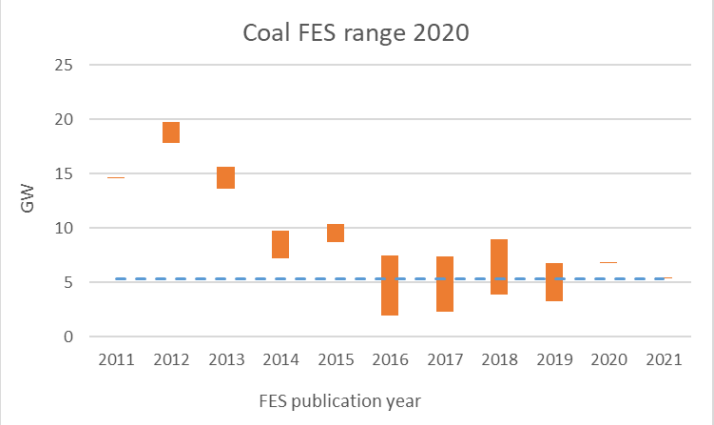


Case Study 3: Coal

Scenarios vs Reality: Coal started being phased out early in the Last decade with only 6GW remaining by 2020. All coal plants are to be phased out by 2024. FES was slow to predict the reduction in coal.

Reasons: The Large Combustion Plant Directive (2008) limited the amount of CO_2 which could be produced by large carbon emitters (including coal plants), with non-compliant units closing by 2015. The 2012 UK Electricity Market Reform, which aimed to drive uptake of "reliable, diverse and low-carbon power", included increasingly stringent climate regulation such as the Carbon Price Floor (2013), and a reduction in cost of low carbon alternatives has also made coal less attractive.

Lessons learnt: FES scenarios were revised as policy changed but it was arguably too slow. As well as the impact of policy, the speed of impact also has to be considered.

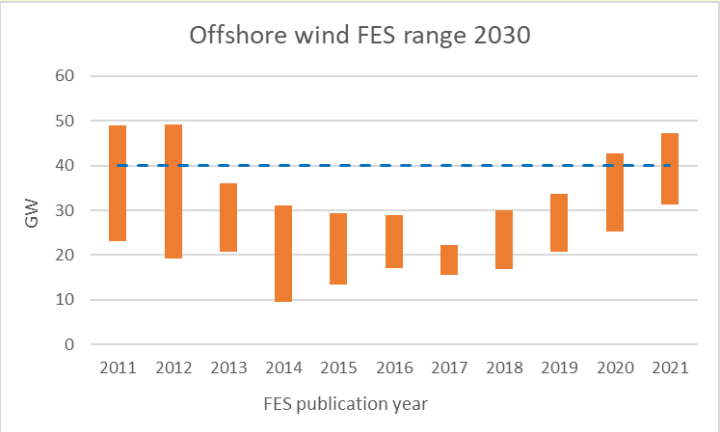


Case Study 4: Offshore wind

Scenarios vs Reality: FES 2021 suggests between 31-47 GW of offshore wind deployed by 2030, increasing to 71-130 GW in 2050. After early optimism, the expected range of capacity has remained broadly constant, steadily increasing from 2017. At the time of publishing FES 2021 we had 10.4GW of offshore wind installed, with 10's of GW's at various stages in the pipeline. In October 2020, the UK Government set a target of 40 GW by 2030.

Reasons: Long term, stable subsidy schemes (first through the Renewable Obligation, and then Contracts for Difference via the EMR), regular seabed leasing rounds, and Government and industry collaboration has reduced cost and led to the UK having one of the largest global installed capacities of offshore wind.

Summary: Consistent policy signals, reducing costs, a strong deployment track record and healthy pipeline of future projects, allowed FES to recognise the importance of offshore wind as an enabler of decarbonisation and increase its share of the generation mix as a result.



Continuing to evolve FES

We are continuing to develop our capabilities alongside the energy industry. We recognise that the decarbonisation of the energy sector will support broader parts of the economy, which is why we have continued to focus on more whole system outputs This is driven by Net Zero targets being across wider sectors than the traditional networked energy sector we have previously considered. We have needed to increasingly consider emissions from other sectors as well as the multi-vector nature of heat, transport and storage in the context of the challenges facing the whole energy system now and in the future.

We also believe that there are aspects of decarbonising the whole energy system that are driven by local factors that cannot be fully understood using only a top-down assessment framework, so we are increasingly focusing on more granular regional outputs. For example, in FES 2021 we used our new spatial heat model to provide a bottom-up modelling approach that considers regional variations. For FES 2022 we have focused more on the regional outputs of the heat model and are improving the regional disaggregation of our transport model. In future FES publications we will expand this regional approach to include other vectors so that, ultimately, we will be able to clearly articulate a whole system view that, where material and relevant, is informed by bottom-up regional assumptions that are well understood and prioritised. To find out more about Regional Future Energy Scenarios, see our RIIO2 Business Plan.

We have valued your feedback and insights which have helped us to shape the FES publications so far, and we look forward to working closely with you to define the energy scenarios of the future.

For more information on our current and past FES documents, and to see our other FES thought pieces go to: https://www.nationalgrideso.com/future-energy/future-energy-scenarios.