

Future Energy Scenarios 2021 Stakeholder Feedback Document

March 2021

Stakeholder input to the 2021 Future Energy Scenarios



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1. Welcome and overview

We thank all stakeholders that have taken the time to join us during the year to contribute to the Future Energy Scenarios, whether that was for the 2020 launch event or via more specific engagement, during what has been a difficult period for many. We thank you for your continued support and look forward to welcoming you and engaging with you again very soon.

Introduction

The Future Energy Scenarios (FES) Stakeholder Feedback Document plays a fundamental role in the yearly FES cycle. This Document provides a summary of the feedback we have received from stakeholders since the launch of FES 2020, together with the evidence and research that has been considered to date for FES 2021.

The Document also sets out the Scenario Framework and Scenarios that will be used for FES 2021.

We have provided in the Document a summary of our engagement events and looked back at the actions we said we would take for FES 2020 to ensure we are providing full transparency.

Engaging our stakeholder community

Figure 1

Summary of stakeholder engagement



Engaging with our stakeholders has been as important as ever to the FES process throughout the recent challenging months we have all encountered. Throughout 2020 we have engaged with significantly more stakeholders than in previous years, predominantly due to the reach provided by the FES 2020 virtual event. The table below highlights the difference from 2019 to 2020.

	2019	2020
Total number of stakeholders	463 unique stakeholders 590 stakeholders across all activities	1257 unique stakeholders 1713 stakeholders across all events
Total number of organisations	224 unique organisations 548 organisations across all activities 109 new organisations for 2019	460 unique organisations 764 organisations across all activities 347 new organisations for 2020
FES launch events	248 stakeholders	790 stakeholders
FES launch on 'catch-up'	n/a	194 stakeholders

During 2020, we have engaged with a total of 1,257 individual stakeholders, representing 460 individual organisations with 347 of those being new organisations for FES 2021. Across all activities (i.e. including where stakeholders attend more than one event), we have engaged with a total of 1,713 stakeholders, including FES 2020 launch events, Call for Evidence, webinars and other meetings.

Throughout 2020 the range of new stakeholders has encompassed fuel poverty groups, charities, innovators, technology and energy data companies. This has led us to receive valuable feedback to help understand the wide range of opinions to take forward for our analysis.

We have continued to review our stakeholder base to ensure we are reaching out to a broad range of categories to allow for that wide range of feedback and opinion.

The **launch and publication programme for FES 2020** saw us taking a different approach to recent years as a result of Covid-19. During the virtual launch nearly 800 stakeholders joined us during the week, with many more joining on 'catch-up' after. We received a range of positive feedback and clear support for us to continue with this approach for FES 2021. We have identified improvements to be made for virtual launches in the future.

The autumn engagement programme saw us host an online consultation – **Call for Evidence** - to ask 6,400 stakeholders a set of questions on a range of subject. We received 100 responses and were pleased that this was around twice as many as last year. We shared a [summary of the responses](#) in our October newsletter. The Call for Evidence, importantly providing everyone the opportunity to contribute, was just one strand of the autumn engagement alongside bilateral meetings and focussed group webinars. As part of our continuous improvement approach, we have identified improvements for this type of engagement for next year to enhance the interaction and accessibility for stakeholders.

Our **bilateral engagement** has, again, been of great importance this year. We began these meetings back in September 2020 and they will continue until late spring 2021. To date we have held (or scheduled) 86 meetings with organisations spanning the energy industry and wider. We have met with 47 new organisations compared to our FES 2020 engagement. Reaching out to a wide range of organisations allows us to gain a greater understanding and knowledge of developments in the energy industry as it mobilises to meet the challenge of net zero by 2050 and associated interim targets.

The FES **Bridging the Gap engagement** began in October followed by a series of focussed webinars on three specific elements of the 'Peaks and Troughs' theme; Markets, Technology and Data & Digitisation. During the whole programme we have listened and spoken with 204 individual stakeholders from a range of organisations.

During the end of November, we hosted a FES 2020 **costing webinar** at the request of stakeholders. We had 49 people join us and received a range of questions during the event.

We have also held a small number of **specific workshops**, focusing on key subjects to engage with stakeholders who are knowledgeable and experts in their subject matter, like bio resource and negative emissions.

In addition to the activities highlighted above, we have also **hosted or attended over 30 other engagement events** to share FES 2020 or to gather evidence to take forward for FES 2021.

We have continued with the **popular FES newsletter** throughout the year as a trusted method to communicate with stakeholders; to share engagement events, thought pieces, analysis and modelling information, invitations to join variety of topics to engage and to ask for input.

The Scenario Framework and Scenarios for FES 2021

Last year we changed our Scenario Framework in order to better represent the major uncertainties in a world aiming for net zero, this involved new scenarios and a new vertical axis on our framework diagram – 'level of societal change'. FES 2020 was the first year that we modelled full scenarios meeting the 2050 net zero target. For FES 2021 we are retaining the same scenarios

and framework as used in FES 2020, as we feel they are still fit for purpose, and our stakeholders tell us they value consistency and being able to easily compare changes from year to year.

Within our Call for Evidence we asked stakeholders if they were happy for us to retain the same scenario framework for FES 2021. Many respondents supported retaining the scenarios from FES 2020 for FES 2021 with year-on-year consistency being a key theme.

Of the few respondents who didn't support this, reasons ranged from the inclusion of Steady Progression being irresponsible to Leading the Way being over-optimistic. There was no clear trend in these responses to suggest a single change for FES 2021 that would be supported across our stakeholders. Our own internal feedback suggested that no change to the framework was the most appropriate option.

Therefore, based on this feedback we are retaining the FES 2020 scenario framework for FES 2021 as it is still fit for purpose for the coming year considering recent policy decisions and announcements.

Key changes for FES 2021

For FES 2021, at this stage in our analysis we have identified the following changes from FES 2020:

- **Overall demand**
 - Impact of Covid-19 (short-term based on lockdowns and longer-term economic impact for several years) is likely to reduce industrial & commercial and transport demand
 - Changes in input data will likely reduce efficiency assumptions and increase heating energy demand – annual and unmanaged peak
 - Overall annual demands likely to be higher than FES 2020
 - Peak demands will be managed through smart charging and consumer behaviour
- **Transport**
 - Annual and peak electricity demand for EV charging will increase across the scenarios based on updated vehicle efficiency data
- **Heat**
 - Modelling developments for hybrid heating likely to show electricity demand over the peak unless actively managed. Demands for gas, electricity and hydrogen are also likely to change as a result
- **Hydrogen supply**
 - Potential inclusion of nuclear hydrogen and a change in the proportions of supply types
- **Negative emissions**
 - Potential change in the non-FES emissions used and possible inclusion of Direct Air Carbon Capture and Storage (DACCS)
- **Bioresource**
 - We are considering a potential change in the range of uses of bio energy
- **Electricity generation**
 - Following the Government's 10-point plan, we will review whether the Steady Progression scenario remains within the credible limits or whether it need include further progress towards electricity decarbonisation.

- Review when unabated gas generation should be retired and whether it is possible, particularly for smaller plant connected to the distribution networks.
- Update our storage analysis to make use of the new embedded capacity registers published by the DNOs.
- Review the offshore wind factors and profile used within our modelling as result of recent BEIS data.

Improvements identified for our continued engagement:

From our engagement we have identified improvements to take forward for FES 2021 and beyond. These are summarised below:

- Improve the stakeholder experience for future virtual launch:
 - Ensure a better audio quality and consistency for the audience
 - Allow more time for the information (slides) to be shown on screen
 - More diversity in the presenters
 - Consider changing the format and length of time of the Q&A session
- Consider publishing a more detailed comparison of FES 2020 to FES 2021
- Manage stakeholder expectations for bilateral meetings by setting out the agenda in advance
- Ensure all versions of the online documents work on all devices and interactivity works
- Be more transparent in relation to the sources and evidence used in our analysis and scenario development

We will be publishing FES 2021 in early July 2021. If you would like to contact us at any time: FES@nationalgrideso.com

2. How we engage with stakeholders

The FES cycle is an annual process that starts and finishes with the launch and publication during July. Engagement with our stakeholders takes place throughout this yearly process and is fundamental for developing the scenarios. We combine the feedback we receive together with our own insight, research findings and modelling to produce a credible range of pathways for the future of energy. We also use our expertise and knowledge that as a team we have gained from producing FES every year.

Summary of stakeholder engagement since July 2020

Figure 2

Stakeholder engagement timeline of activity.



We have continued with and increased our use of social media this year which has led to a rise in the number of responses to the Call for Evidence and to the scale of the audience during the FES 2020 launch week. We have used various platforms depending on the message and content. We have specifically used ESO LinkedIn and ESO Twitter accounts to reach out to our interested future of energy community.

Our FES 2020 social media presence continued well after the FES 2020 launch week with Twitter #FESFriday, linking industry and government announcements to FES as well as graphs and other key takeaways from the main FES report. This has ensured our FES 2020 online engagement with readers has continued.

FES 2020 launch

The virtual launch, although a change to our original plans following Covid-19 restrictions, proved a great success and we were delighted with how many stakeholders were able to join us during the week. We welcomed nearly 800 individual stakeholders attending sessions over three days

with many more joining on 'catch-up'. This number of attendees would not have been possible at a face-to-face event; however, we do recognise the benefits of networking for stakeholders and our team and will consider this when we are able to do so. We received many comments through the online event poll making it clear that many would not have been able to attend the traditional FES conference due to childcare and travel restrictions. The online alternative also reduced carbon emissions from traveling which was commented on as a positive by those that joined us.

Following a similar pattern to last year's launch programme, we held an executive summary event on the day of the publication providing a high-level overview of the analysis together with the key messages. This was then followed with a series of 'deep-dive' sessions during the Wednesday and Thursday, giving Tuesday for stakeholders to digest the suite of documents. Stakeholders were able to sign up in advance or on the day to join sessions looking at net zero, transport, residential and I&C demand, electricity generation, bioresource, system flexibility and hydrogen.

Prior to the publication, we held a briefing event for Ofgem and BEIS (Department for Business, Energy and Industrial Strategy) to share the key insight and messages from the analysis.

We ran Q&A sessions during the week and answered as many of the 480 questions that we received during the allocated time. Any questions that we did not have time for were answered during August and published in the FES 2020 Q&A document, with the final version published in early September. Whilst feedback on the format was positive, we have been able to identify improvements that we can incorporate at future events in relation to the method used and time given for questions from stakeholders.

The executive event together with the series of 'deep-dive' presentations were made available soon after the launch week on the ESO YouTube channel and the FES pages of the ESO website.

Bilateral engagement

During 2020 and into 2021 we have held (or scheduled) 86 meetings with 80 key organisations to hear from them about the future of energy. This is an increase from 2019 where we engaged with 67 organisations. We have engaged with 47 new organisations this year; including fuel poverty, heat pump association, nuclear and hydrogen groups. These meetings are an important element of FES engagement and provide us with rich insight and evidence to take forward for the analysis and scenarios.

FES: Bridging the Gap

The 'FES: Bridging the gap to net zero' programme was first launched in November 2019. Its role is to take the FES key messages each year and investigate more closely what needs to be done in the short term, to reach the UK's 2050 net zero target. We do this in close collaboration with our stakeholders, so that the subject matter, structure of the project and final report are all informed and shaped by our stakeholders' feedback and input. To enhance this approach, we work with an external partner. This year it is Laura Sandys CBE, who acts as an event chair and guest editor for the programme. While the main output from this programme is a report which is not directly part of our FES analysis, it provides a strong feedback loop into FES by clarifying areas of uncertainty and gathering more evidence for the coming year's FES cycle.

In its second year, Bridging the Gap's area of focus is the challenge to system operation associated with the increasing levels of renewable electricity generation, required for decarbonisation. With our stakeholders, from 93 new organisations including Ember Climate, EU skills and Cadent, we identified the different kinds of peaks and troughs we might see regularly on the electricity system between now and 2030. This was presented at a webinar, followed by presentations by external speakers, who gave their thoughts on how markets, technology and data and digitalisation can help manage these challenges.

Working with these speakers, we then set up workstreams, made up of stakeholder volunteers, to take a more detailed look at each of the three topics. Whilst the timeframe was short, we were able to draw on a range of expertise and insight to identify areas of consensus and to develop recommendations and next steps. Our interim findings were presented at a series of external webinars, where we canvassed the audience for their views, which will feed into our final report.

Throughout the programme we have talked with and heard from 204 individual stakeholders totalling 276 across all events. The final report is published on 4 March 2021 and will be presented as an industry view about what we can do now to make sure that we can decarbonise the electricity system along the timescales outlined in FES.

FES 2020 Costing webinar

The FES 2020 costing webinar took place on 30 November and was attended by nearly 50 stakeholders from 33 organisations. During the webinar we presented the key findings from the costing project and hosted a Q&A session. Following this we published the report, slides and recording from the webinar together with the data workbook. The webinar was well received, and some stakeholders provided positive feedback when surveyed. We will consider costing the scenarios again for FES 2021 in response to feedback from stakeholders and the energy industry.

Clean heat webinar

Heat decarbonisation is identified as one area requiring urgent policy decision to drive change across the whole energy system to achieve net zero. We published a [clean heat thought piece](#) during November and followed this with a webinar on 8 December to engage with stakeholders on the future of heat decarbonisation and its implications for electricity and gas system operation. We welcomed 40 stakeholders from 33 different organisations to the webinar and received thoughtful feedback for FES 2021.

FES Network Forum

We have worked collaboratively with the electricity and gas network owners to set the agenda and purpose of the network forum meetings for FES 2021. This is to ensure that all attendees get value and benefit from this time. We contacted all representatives from the transmission, distribution, gas and electricity networks to establish what they would like from the meetings. The focus and topics of the meetings have been agreed together. The first meeting since the FES 2020 launch was held on 15 December and focussed on sharing our emerging thinking for FES 2021 followed by listening to stakeholder feedback received from the network companies. We have jointly agreed the frequency of the meetings, content and format. We will use this time to provide timely and insightful information about our analysis until time of publication.

Bio resource and negative emissions workshop

We hosted a workshop on 15 December to debate and gather insight for our bioresource modelling and analysis. We welcomed a broad range of stakeholders from government departments, innovators, suppliers and wider energy industry. The discussion was rich in content and was outside of the normal topics related to this subject. We followed this up with a thought piece on the subject, titled 'Negative emissions: the role of negative emissions in meeting net zero' bringing in analysis from aviation and shared in our January newsletter.

Spatial heat model and engagement and delivery

The Network Innovation Allowance project collaboration between NGG and ESO to develop a Spatial GB Clean Heat Pathway model has been successfully delivered. The model adds new and enhanced capabilities for understanding local solutions to decarbonising heat and the implications of those solutions to network capability at key network boundaries – offtakes for the gas networks and grid supply points for the electricity networks. The project benefited greatly from significant support from key stakeholders including GDNs, DNOs, and BEIS through a project advisory group. Insights from the model have already been used to shape the framework for FES 2021 heat modelling and the model could be the first significant test of Ofgem's focus on clear delineation of regional decarbonisation pathways. We will continue to engage with our stakeholders to build on this new modelling approach.

ENA Open Networks work

We have continued to engage with the network organisations as part of our work within the Open Networks project. In 2020 all electricity organisations shared the first set of building blocks; this

details the results of the ESO FES and the Distribution FES according to a common set of definitions.

Following this initial data transfer, we have revised the Building Blocks based on the lessons learnt and the DNOs have adopted the FES Framework for their analysis. This means that the ESO FES and Distribution FES are now based on the same set of scenarios and that we have a common data exchange that enables us to compare like for like components between each organisation.

It is anticipated that this will enable deeper engagement between the ESO and the DNOs enabling us to more easily understand the difference between modelling approaches and identify opportunities where convergence makes sense.

Ofgem and BEIS (Department for Business, Energy and Industrial Strategy) engagement

We have continued regular engagement with Ofgem, BEIS and other government departments during 2020, both at a working and senior level. This ensures they are kept informed of any changes to the scenarios and framework and have the opportunity to contribute.

Engaging internationally

We have continued to hear from stakeholders overseas and have representatives from many countries on our distribution list. We have stakeholders from Argentina, New Zealand, Chile and India in receipt of our newsletter and continue to see a growth in those joining us from other countries. We also had stakeholders join us during the FES 2020 launch week from international organisations like University of Gottingen in Germany and Iberdrola, the Spanish electricity company and Exelon, the largest electric utility and nuclear power plant in America.

Other engagement

In addition to the engagement referenced above the team have participated in a wide range of other events to share the FES messages and to bring insight back to the team for further analysis and modelling.

Stakeholder groups engaged during 2020

Stakeholder category	Total
Communities and their representatives	20
Consumers and consumer groups	183
Energy Industry	764
Innovators	198
Non-governmental organisations	33
Other stakeholders including academics and universities	233
Political	111
Regulator	46
UK Networks	125
TOTAL of 1713 stakeholders involved across all activities	

Measuring engagement satisfaction

Throughout our engagement we always measure stakeholder satisfaction and seek feedback. This helps us to continually improve, to find better ways of working with stakeholders and to improve the engagement experience for all.

The method we commonly use is the Net Promotor Score (NPS). This is an index ranging from -100 to +100 that measures the willingness of customers to recommend a company's products or services to others. It is widely recognised as a means of measuring levels of satisfaction. A positive score above 0 is considered good, +50 is excellent and above +70 is world class.

The table below provides the NPS scores from our engagement activities. Further information on all these events can be found on pages 29 onwards.

Event	Date	Net Promotor Score
FES Launch Monday	27 July 2020	+47
FES Launch Wednesday	29 July 2020	+47
FES Launch Thursday	30 July 2020	+59
FES launch post event	31 July 2020	+44
BtG initial workshop	21 October 2020	+4
BtG: Markets	27 November 2020	+63
BtG: Technology	26 November 2020	+60
BtG: Data and digitisation	25 November 2020	+25
FES 2020 costing webinar	30 November 2020	+10
Clean heat webinar	8 December 2020	-25
Network Forum	15 December 2020	+25
Bio & negative emissions	15 December 2020	+33

Engagement and communication actions and improvements identified from our events for FES 2021 and beyond:

Engagement and Communication		
You said:	We will:	Where was the feedback gathered?
You would like the audio quality and consistency to be improved to reduce time lags and stuttering's	Working with the team, IT and production company we will ensure that audio quality is improved and a better experience for stakeholders	On-the-day feedback - FES 2020 launch
You missed the networking and 1:1 aspect of a face-face event	We will investigate the options available to us for both a virtual event and one that facilitates networking and 1:1 for FES 2021 launch event. This will be reviewed and is dependent on the ongoing Covid-19 pandemic	On-the-day feedback - FES 2020 launch
You would like slower commentary for the presentations	Ensure that presentation delivery is slower by carrying out additional rehearsals beforehand	On-the-day feedback - FES 2020 launch
You would like larger slides on the web platform and on the screen for longer to digest the information	Working with IT and production teams we will ensure that slides are bigger on the screen and stay for longer to improve the experience for stakeholders	On-the-day feedback - FES 2020 launch
You would like to see presenters face separate from the slides	Working with IT and production teams we will ensure that slides are bigger on the screen and separate from the presenters to improve the experience for stakeholders	On-the-day feedback - FES 2020 launch

You would like longer time for the Q&A section of the launch event	Consider longer Q&A sessions or options to host separate Q&A events on specific topics for FES 2021	On-the-day feedback - FES 2020 launch and Call for Evidence
You would like visibility of all the questions asked by the audience	Consider the best option for sharing all the questions on the webcast (e.g. use of Sli.do) for FES 2021	On-the-day feedback - FES 2020 launch
As there are many documents that make up the suite of FES you would like to see a document overview	Consider sharing a document overview graphic during any webinar and static graphic on the webcast platform for FES 2021. This could also be published on the FES website	On-the-day feedback - FES 2020 launch
You were confused why the ESO is covering gas supply	Be clear up front why we are covering gas supply and demand – both in the documents and launch events	On-the-day feedback - FES 2020 launch
You would have liked more eye contact from the presenters during their presentation	Working with IT service and the team of presenters, we will ensure the presenters are looking at their camera to increase eye contact	On-the-day feedback - FES 2020 launch
You thought the presentations were too robotic and scripted, less pre-recorded presentations	Working with the team and investigating training options, in conjunction with the comment about speed of delivery above, we will ensure presentations appear less scripted and consider hosting all live presentations for future virtual event	On-the-day feedback - FES 2020 launch
You would have liked more diversity in the presenters	Look at all options across the team to increase range of diversity in the presenters – offering support and training for those that may not be comfortable presenting	On-the-day feedback - FES 2020 launch
You would like greater interaction between stakeholders during the launch event and other virtual engagement	Investigate other options available to us for hosting virtual engagement on a platform that allows for stakeholder interaction	Call for Evidence
You would like greater length of time in between each of the deep-dive sessions during the launch week	Look to increase the amount of time in between each session to allow more break time for future launch events	Call for Evidence
You would like the interactivity in the main FES report and FESin5 to work on all devices	Work with our service provider to ensure that interactivity of the documents works on all devices	Call for Evidence
In the FESin5 document you would like to know when each scenario will achieve net zero	Look to include this detail for the 2021 FESin5	Call for Evidence
You would like the online survey tool to be easier to navigate and complete with options to move back and to save responses	Seek to find a better alternative to ask the questions and gather feedback for any future online Call for Evidence engagement. We will also carry out a full review of the Call for Evidence to establish if it is still fit for purpose	Call for Evidence
You would like to have an agenda and questions in advance for meetings	Ensure that all stakeholders that attend meetings are sent the agenda, pre-read material and questions to be asked in advance to help manage expectations	Stakeholder satisfaction survey
You would like the meetings to be timed and structured better to allow opportunities to discuss more detailed subjects.	Ensure that all stakeholders that attend meetings are sent the agenda with timings and any pre-read in advance to help manage expectations.	Stakeholder satisfaction survey

You would us to publish our sources and supporting evidence used in the scenarios

We will consider publishing the sources we use and the contributors that have fed into the scenarios for FES 2021 – noting potential confidentiality and regulatory restrictions

Stakeholder satisfaction survey

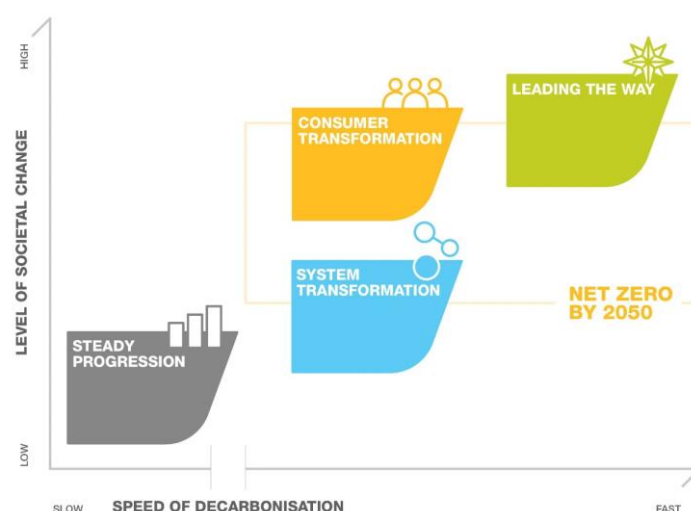
3. FES 2021 Scenario Framework and Scenarios

Our Future Energy Scenarios set out a range of pathways for the development of the energy sector between today and 2050. FES 2020 was the first year that these included full scenarios meeting the 2050 net zero target. Our stakeholders tell us that they appreciate the fact that FES explores a range of credible futures and the major uncertainties across the energy industry. Last year we changed our scenario framework in order to better represent the major uncertainties in a world aiming for net zero, this involved new scenarios and a new vertical axis on our framework diagram – ‘level of societal change’. For FES 2021 we are retaining the same scenarios and framework as used in FES 2020, as we feel they are still fit for purpose, and our stakeholders tell us they value consistency and being able to easily compare changes from year to year. In this section, we explain the choices we have made in developing the scenario framework and the stakeholder feedback we have used to inform those choices.

The scenarios for FES 2021

Figure 3

Scenario framework for FES 2021



Creating the Scenario Framework

When we develop our scenarios, we have traditionally used a structured approach that we call the Scenario Framework. This ensures that our scenarios are internally consistent while also exploring the credible range of uncertainty as a set of scenarios. Figure 4 shows the stages in creating scenarios, starting with the Scenario Matrix, where we decide how many scenarios there will be, and how they will be differentiated at the highest level. There are then stages with increasing levels of detail, culminating in the Levers, which describe how we choose the inputs into our detailed models.

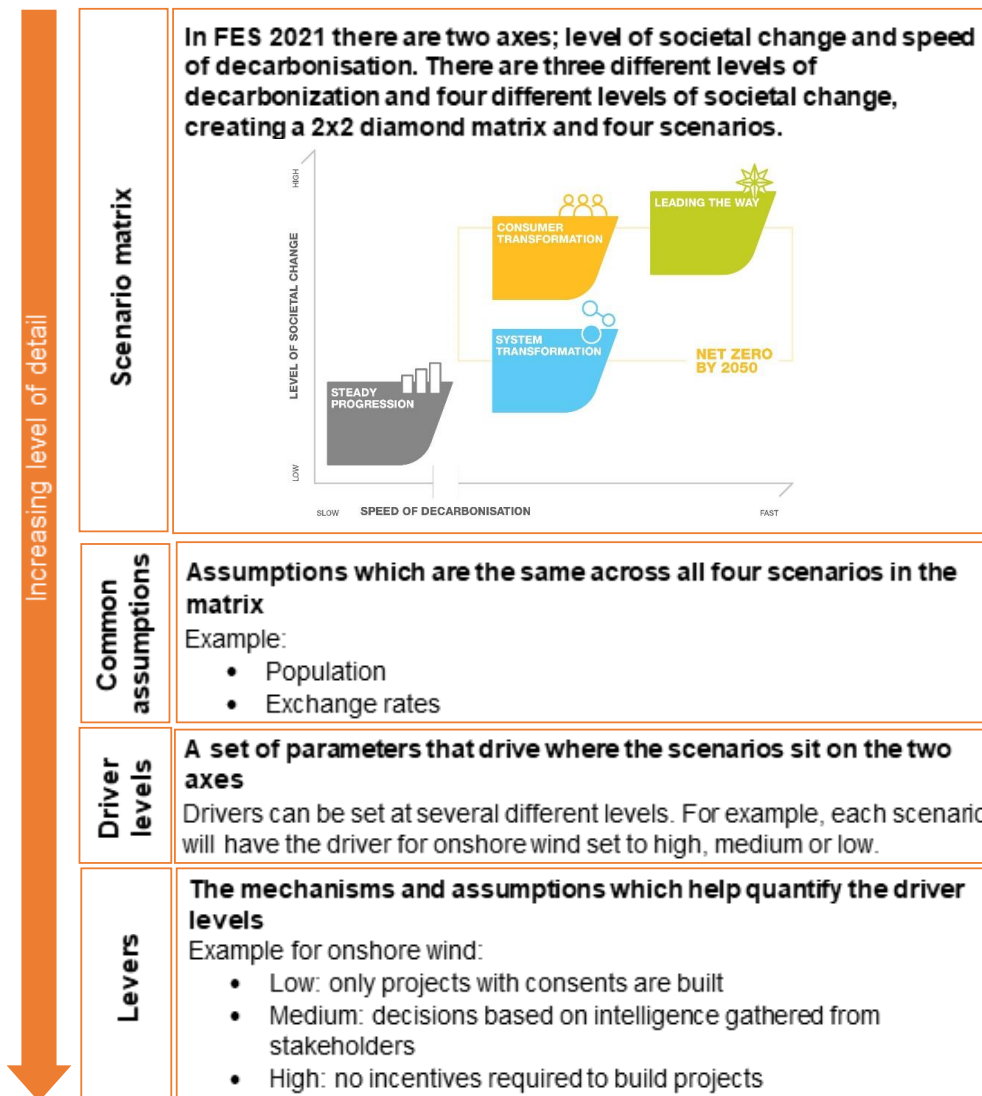


Figure 4

Creating the scenario framework

Engaging across industry

We aim to reflect the breadth of stakeholder input and uncertainty within our scenario framework. Where we haven't received clear input or direction from stakeholders on a topic, we draw on other sources of information to support our decisions. In making these decisions, we consider: the purpose of FES in network investment both today and in the future; industry publications, conferences and discussion; the direction of government policies; and the questions which we are asked by industry, government and the regulator on a day-to-day basis. Stakeholders engaged through this route are shown in Appendix B.

Feedback from stakeholders

Our engagement for the FES 2021 framework started with our FES 2021 Call for Evidence circulated to nearly 6,400 stakeholders and promoted through multiple channels. Within this we asked stakeholders if they were happy for us to retain the same Scenario Framework for FES 2021. The majority of respondents supported retaining the scenarios from FES 2020 for FES 2021 with year-on-year consistency being a key theme.

Of the few respondents who didn't support this, reasons ranged from the inclusion of Steady Progression being irresponsible to Leading the Way being over-optimistic. There was no clear trend in these responses to suggest a single change for FES 2021 that would be supported across our stakeholders.

Therefore, based on this feedback we are retaining the FES 2020 Scenario Framework for FES 2021.

Summary of stakeholder feedback for the Scenario Framework and Scenarios

Scenario Framework and Scenarios		
You said:	We will:	Evidence:
FES 2020 contains a useful set of scenarios which illustrate very different, balanced, net zero pathways. The public nature of this work, data workbook and transparency are good. FES is valued - stakeholders appreciate the insight and transparency of the publication.	Continue, and increase where possible, the public nature of our analysis, insights and data as we feel that by being as transparent as possible, we maximise the amount of valuable feedback we require to keep the scenarios as up-to-date and relevant as possible.	Stakeholders: Suppliers Networks
FES 2020 was a change, reflecting significant legislative development. Can we please have some stability for a few years to allow us to explore the implications of net zero, to allow wider industry debate, idea creation and planning?	Retain the same scenario framework and scenarios as in FES 2020 to provide stability for stakeholders and to facilitate year on year comparison. Some of the more detailed assumptions and levers with the scenarios may change to reflect feedback and external changes since FES 2020 and, as in previous years, these assumptions and levels will be published to aid transparency.	Stakeholders: Networks
Of the four scenarios, Leading the Way is the least well understood – what is it for, what is it trying to show for the energy system, what differentiates it from the others? Was it your best view? Our stakeholders grasped this scenario less well than the others	Unlike Consumer Transformation and System Transformation which were developed to show different pathways to meet net zero in 2050 (e.g. more electrification vs more hydrogen respectively), Leading the Way was designed to explore the fastest credible path to reaching net zero. It was not our best view and we will ensure this is clearer in FES 2021.	Stakeholders: Networks

4. Stakeholder input to date for FES 2021

Below we have provided a summary of the insights and evidence gathered from stakeholders during our autumn engagement, together with other input and analysis that will inform FES 2021. We have detailed the feedback received, the action and decision we will take based on this or, where we will take a different approach, the reasons why.

Summaries of the specific feedback from the FES 2021 Call for Evidence, are available on our website at: [Call for Evidence](#)

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
The impact of Covid-19	Covid-19 has had a direct impact on demands over the summer. We saw demands start to recover as lockdown lifted – and the most recent lockdown and tiering systems are less severe than the first. Covid-19 will have an impact on day to day life in the short term although the long term is harder to predict.	Continue to review data whilst we are creating FES 2021	Short term impacts to the scenarios in the short term, longer term impacts being considered	Suppliers Networks First and third-party information

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Net zero	In terms of how we flex non-energy aspects such as land use changes or aviation across the scenarios, most respondents agreed that our existing approach was appropriate.	Noting the interest in this area we held a dedicated stakeholder workshop on the subject.	The workshop involved a number of different stakeholder views. However, there was a consensus that we could consider flexing these non-energy aspects more across the scenarios and conducting sensitivity analysis where appropriate.	Call for Evidence submissions and a dedicated workshop: Industry bodies and experts Generators (including Big 6) Gas and Electricity Transmission Companies

				Industry bodies & experts including Consultancies Environmental Groups Campaign groups Other non-governmental organisations
<p>On negative emissions, there was support for the use of BECCS (whilst noting the importance of sustainable biomass and regulation of the whole carbon lifecycle) as well as other negative emission approaches. However, there was also clear feedback that FES 2020 was perhaps too reliant on BECCS.</p>	<p>Noting the divergence of views and uncertainty in this area, we held a dedicated workshop on the subject.</p>	<p>The workshop involved a number of different stakeholder views. However, there was a consensus that while BECCS in the power sector was an important element of net zero, there are other options that should also be considered and so we will review this area and provide more of a range of options across the scenarios.</p>	<p>Call for Evidence submissions and dedicated workshop: Industry bodies and experts Generators (including Big 6) Gas and Electricity Transmission Companies Industry bodies & experts including Consultancies Industry bodies and experts - trade bodies Environmental Groups Campaign groups Academics, universities and schools Local authorities Other non-governmental organisations</p>	

General
public/individual
responses

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Industrial and commercial demand	What occurs in these sectors with respect to future growth, decarbonisation and energy efficiency is directly dependent on long term, effective, policies, incentives, trade agreements and cross border markets. There is a very wide range of potential outcomes	Review the energy efficiency assumptions in FES 2021, as well as the economic modelling carried out for FES.	A range of electricity, gas, hydrogen and biofuel demands for industrial and commercial energy demand	Suppliers Networks

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Heat in buildings	Energy Efficiency: The balance of views on the level of building efficiency assumed in FES 2020 is that the high case scenarios are much higher than the current evidence supports	Continue to ground our assumptions on the latest available evidence and redouble the effort checking them with key stakeholders. We will also be using a bottom-up modelling approach to optimize uptake of insulation and storage	More balance between level building level efficiency and scenario technology mix based on cost minimization. Potentially higher fuel consumption levels	Call for Evidence Government departments NGOs Network companies Academia

Heat in buildings	Hybridization/backup heating: There is a wider variety of heat pump usage configurations in use than has been captured in FES 2020. The use of back up heaters in heat pump installation designs for example is area that could be improved	Consider wider range of heat pump configurations, including the extent to which back up heating might be required to support demand in cold winter days.	More hybrid technologies in both on-gas and off-gas dwellings	Academia Network companies Consumer advocacy groups Energy consultancies
Heat in buildings	Technology mix representativeness: Stakeholders appreciated the wide range of technologies being considered in the scenarios. They want FES to continue to be technology agnostic especially within individual technology segments e.g. heat pumps	Use more bottom-up approaches to projecting technology uptake based on whole building heat cost minimization	Changes in technology mix within the scenarios and potential impact on the range of fuel use across the scenarios	Trade associations Bridging the Gas workshop Academia
Heat in buildings	Consumer impact: Stakeholders would like FES to better demonstrate the cost impact of heat decarbonization on consumers	Use more bottom-up approaches to projecting technology uptake based on whole building heat cost minimization. Illustrate with examples average cost of the different technology options. Consumer cost of various technology types will be included in the new heat model, along with assumptions of any potential grants.	Changes in technology mix within the scenarios and potential impact on the range of fuel use across the scenarios. Using the specific consumer costs within the modelling based on varying assumptions across the scenarios.	Consumer advocacy groups Consultants
Heat in buildings	Regional approach: Mandating the end of gas boilers use will be difficult to implement and a local approach that gets consumers, communities, local authorities, GDNs, DNOs, and	Adopt a new spatial heat model recently developed as part of an NIA project to better define local variations in heat decarbonization solutions	Better delineation of regional differences in heat technology uptake	Energy producer Network companies Consumer advocacy groups Energy consultancies

DSOs working together on heat decarbonization is seen as the surest way to both get buy-in from consumers and achieve the best whole system outcomes

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Transport demand	Feedback on our uptake rates for low carbon road transport was balanced, with no strong consensus emerging on potential changes. However small changes in assumptions can significantly change energy demand, particularly levels of automation, number of vehicles and miles travelled.	In the absence of significant evidence on future driving trends and wide range of uncertainty on automation, we will leave the general themes from FES 2020 unchanged	Overall transport uptake projections will remain largely unchanged	Suppliers Network companies Government bodies
Transport Demand	<p>Energy consumption figures for road vehicles appear to be too low.</p> <p>The Department for Transport (DFT) has recently updated its EV energy consumption assumptions from 0.15kWh/mile to 0.22kWh/mile. The modelling does not appear to correctly include battery charging and discharging losses.</p>	<p>Update our energy consumption assumptions for road vehicles using the most recent DFT information</p> <p>Update our modelling to include charging and discharging losses.</p>	<p>Increased energy demands from road transport compared to FES 2020 on a like-for-like basis, both on an annual and importantly, <i>peak</i> basis. Smart charging, Vehicle to Grid and adoption of EV in the period to 2030 reduces the impact of this change</p> <p>Increased energy demand from road transport, compared to FES 2020 on a like-for-like basis</p>	Government bodies Independent stakeholders

Transport Demand	Vehicle to Grid – there is a wide range of outcomes – it could be very significant or insignificant going forwards depending on customer appetite and commercial frameworks in the energy market	Retain the range of V2G assumptions we have from FES 2020	Overall V2G assumptions will remain largely unchanged	Suppliers Networks
Transport Demand	The government has recently indicated its ambition to ban the sale of new petrol/diesel cars from 2030 – FES 2020 has a projected date between 2032 and 2040	The 2030 target will be reflected in the FES 2021 scenarios	The 2030 target will be reflected in the FES 2021 scenarios, although it should be noted that this target is not yet in law and there is a range of possibilities on what this ban will do in the second-hand vehicle market, and therefore electric vehicle uptake	Government Bodies
Transport Demand	Maritime and Aviation demand are subject to international agreements. What occurs with our nearest neighbouring countries could also be different.	Continue to monitor developments on alignment between EU and UK maritime and aviation decarbonisation policies and guidance from CCC	Overall aviation and maritime demand assumption will remain largely unchanged	Government bodies
Transport Demand	Hydrogen will play a key role in decarbonising aviation & shipping, as well as other heavy transport, including rail. Hydrogen use for transport will likely coincide with hydrogen use in other sectors e.g. industrial and building heating	We will continue to consider hydrogen use in heavy transport and aviation & shipping across the scenarios, taking guidance on demand from stakeholders such as the CCC. In addition, we will consider hydrogen use in cars	Hydrogen use in HGVs would remain largely unchanged with likely faster rate in uptake. An increase in hydrogen use for cars in scenarios with high hydrogen availability	Trade associations Government bodies

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Overall electricity demand (excl. EV's)	<p>Energy efficiency assumptions are more ambitious than those assumed by other parties – as a result energy demands are also lower than other projections.</p> <p>Whilst desirable, improved home insulation continues to be expensive and disruptive to install.</p>	<p>Review our energy efficiency assumptions in all areas – industrial and commercial processes, building insulation and heating technologies, and residential appliances</p> <p>Review our assumptions against the UK Government's "10 Point Plan" on tackling climate change</p>	We will review the data and make changes – it's too early to say what the outcome will be as the modelling is not complete	Suppliers Networks Government bodies

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Electricity generation Overall mix	<p>From our Call for Evidence it is evident that our stakeholders strongly feel that wind energy, particularly offshore wind, will be dominant by 2050. This would then be supported by solar and nuclear power.</p> <p>While storage was also seen as a key technology to support system flexibility.</p>	This feedback is broadly in keeping with our scenarios in FES 2020. We will continue with wind dominated scenarios but will look at a wider range in some of the technologies that saw less support (e.g. BECCS for power generation).	Our generation mix as presented in the FES report and the accompanying data tables.	Call for Evidence Electricity Transmission Generators Energy suppliers
Electricity generation Floating wind	Explicitly show floating offshore wind within the FES scenarios	We will look to split out floating offshore wind within the datasheets	Data tables provided alongside the FES document	Bilateral meetings Generators Industry body Consultants

Electricity generation Steady Progression	In light of recent announcements including the 10-point plan, we will review the level of ambition within the Steady Progression scenario.	The generation mix will be reviewed to see if a lower carbon intensity now reflects the edge of the credible boundary. Whilst it is too early to say exactly what changes will be made, we are considering options such as increased offshore wind and Gas CCS.	A change in the generation mix in Steady Progression and reflected within the data tables and charts published alongside FES. Lower overall carbon intensity.	Bilateral meetings Numerous companies across the industry have asked us how our scenario range is affected by new government announcements
Electricity generation CCS	A wider range of BECCS for power generation should be explored within our Net Zero scenarios. CCS could be applied to Energy from Waste (EfW) generation capacity.	We will review the range of Negative Emissions Technologies available assessing options against the scenario framework. The location of EfW sites will be reviewed and those close to proposed CCS hubs will be treated as candidates for CCS abatement.	A potential broader range of CCS within the generation mix as shown in the data tables published alongside the FES document.	Bilateral meetings Energy suppliers Public sector bodies Community stakeholders
Electricity generation Load factors	Examine the offshore wind load factors used within the FES scenarios in light of new offshore wind generation technologies	Work with offshore wind developers to improve offshore wind load factors used within the FES modelling	Improved accuracy of load factors in all scenarios.	Publication (BEIS report) Bilateral meetings Generators
Electricity generation Storage	Examine the quantity of long duration electricity storage in FES	We will look at the quantity of long duration storage to see if it is economically feasible to increase.	In scenarios that require high levels of flexibility	Bilateral meetings Generators Storage developers Energy suppliers
Electricity generation Interconnectors	We received some observations about the time required to build a new interconnector evidenced by	Update our interconnector model to use the latest project timelines and risk mitigation solutions.	With updated information our internal model should produce better estimates and require less manual adjustment.	Bilateral meetings Interconnector developers

	some of the recent long-distance interconnectors.			
Electricity generation	Stakeholder had a wide range of views on the future role for gas. It was suggested that sites that remain open will see decreased operating hours. Some felt that unabated gas should be retired as early as 2030. The CCC have suggested 2035 subject to security of supply.	Continue to review the role of gas power stations in light of net zero targets. Particular attention will be paid to the phased reduction of unabated gas as we move to a renewable dominated power sector.	Changes in our generation mix as presented in the FES report and the accompanying data tables	Call for Evidence Bilateral meetings Publication (6 th Carbon Budget)
Gas				Generators Energy suppliers Flexibility providers

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Bioresource	Should consider having a breakdown of total bio resources into different feedstock categories.	We will consider adding bio resources level for each scenario by different bio form such as wood pellet, energy crop and waste.	Additional output for each scenario including bio resources level breakdown by different bio form such as wood pellet, energy crop and waste.	FES 2020 launch event Climate Change Charity Consultancy Publication (6 th Carbon Budget)
	Should reduce the reliance on BECCS to achieve net zero	We will explore additional negative emission technologies and solutions to help reduce the reliance on BECCS and achieve net zero.	Potential for wider range of negative emission approaches across the scenarios	Call for Evidence Climate Change Charity Publication (6 th Carbon Budget)

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Gas supply Shale	Opinion is divided regarding the future of shale gas production, and whether it is consistent with net zero scenarios.	Consider the feedback carefully, and objectively assess how (UK) shale gas may contribute to the gas supply mix in each scenario.	Including indigenous shale gas production where framework assumptions make this a credible option	Call for Evidence Bilateral meetings with gas industry bodies
Gas supply Interconnectors	Interconnectors have the potential to support the growth of the UK hydrogen production industry by providing a route into the European market	Consider the possibilities of interconnectors importing and / or exporting hydrogen to and from the Continent	Potential re-purposing of existing interconnectors	Call for Evidence Industry bodies Private companies Gas network owners

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
System flexibility	Include hybrid interconnectors with the scenarios	Examine new interconnectors and consider whether they will be hybrids.	Any changes to our interconnector modelling will be set out in detail in the FES report and the accompanying data tables	Call for Evidence Offshore coordination project

Theme	Feedback and insight gathered:	We will:	Shown in scenario through:	Source and stakeholder group
Hydrogen	Should consider hydrogen from nuclear as a production method in various forms i.e. Low temperature, high temperature, thermochemical. Potential for it to be cost competitive with other production if	We will consider adding hydrogen from nuclear in varying levels to the scenarios.	Potential for one or more of the scenarios to include hydrogen from nuclear.	Academics and universities Trade association.

technology reaches maturity quick enough and there is policy support			
Policy support is one of the most important factors for any production method and across the whole industry i.e. storage, transportation, demand	We will consider bringing the importance of policy support out into the scenarios more in FES 2021	Consider spotlight on hydrogen policy	Industrial trade association Energy Consultancy Electricity TO Renewable energy company
There is opportunity for both blue and green hydrogen production in the UK. Blue is generally seen as something that could offer the short term scale up	In the scenarios a mix of blue/green hydrogen production will be considered. There will be a consideration of the timing of each technology scaling up.	Mix of sources of hydrogen across the scenarios	Industrial trade association Energy Consultancy Electricity TO Renewable energy company Gas Distribution Local Authority

5. Next steps and continuing the conversation

Over the coming months, until late spring, we will continue our engagement with the stakeholder community to gather feedback and evidence for consideration in the 2021 scenarios. Alongside this, we will progress with the detailed modelling and analysis ready to publish FES 2021 in early July. Challenge and review sessions of our analysis will take place with key stakeholders will take place during the early part of 2021.

We held the second **FES Network Forum** in late February, with further meetings planned for April and June. We will be using this time to share insight into some of the early analysis, challenge & review of our data as well as deep-dive sessions exploring hydrogen and flexibility.

Following the successful delivery of the **Spatial GB Heat Pathway model**, we will continue to engage with key stakeholders from GDN's, DNO's and BEIS to build on the new modelling approach for FES 2021. Further collaboration will help with solutions and implications to heat decarbonisation at a regional level.

We will continue our engagement with the network organisations within the **Open Networks project**. This collaborative work will enable a better understanding of the differences in modelling and identify opportunities where a joined-up approach is appropriate.

We will provide early insight and updates into some of the modelling data and results through the early part of 2021 using a variety of communication methods (e.g. the newsletter and social media) as in similar years.

In April and May, we will begin to share the dates and initial plans for the FES 2021 launch event. This will be a virtual event again to allow the high number of stakeholders to join at their convenience. We may also consider a face-to-face event later in 2021. We will seek views from stakeholders on this topic through our newsletters.

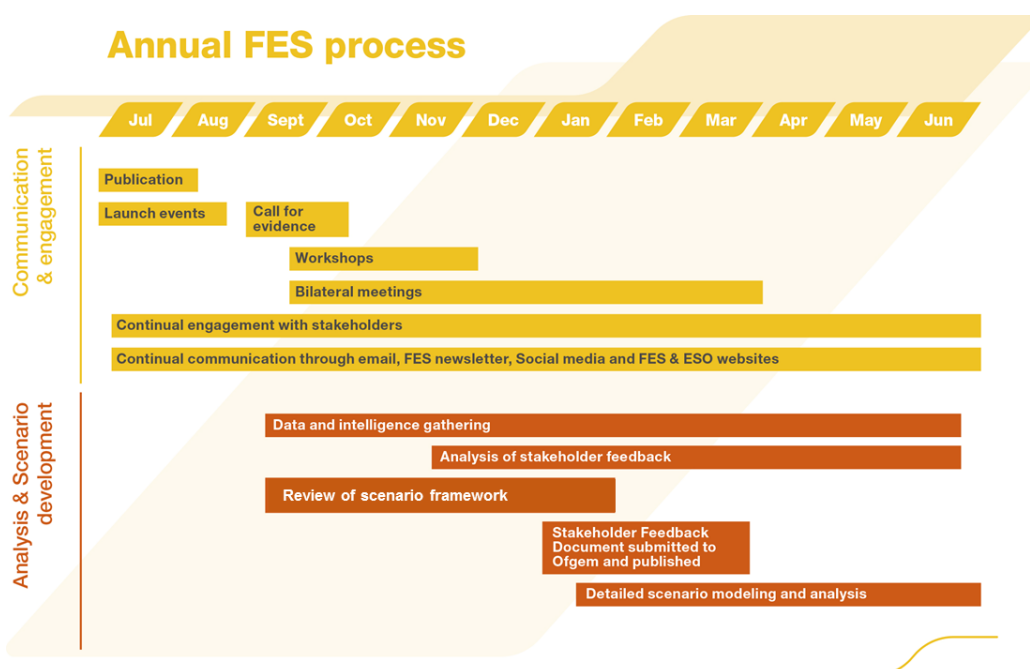
We will seek to gather continual feedback and opinion on our engagement and communications methods to ensure we find better ways of working together and meet the expectations of our stakeholder

Annual FES process

The image below shows the main steps in the FES annual process.

Figure 5

Timeline of FES process



Continue to engage with us and join the conversation

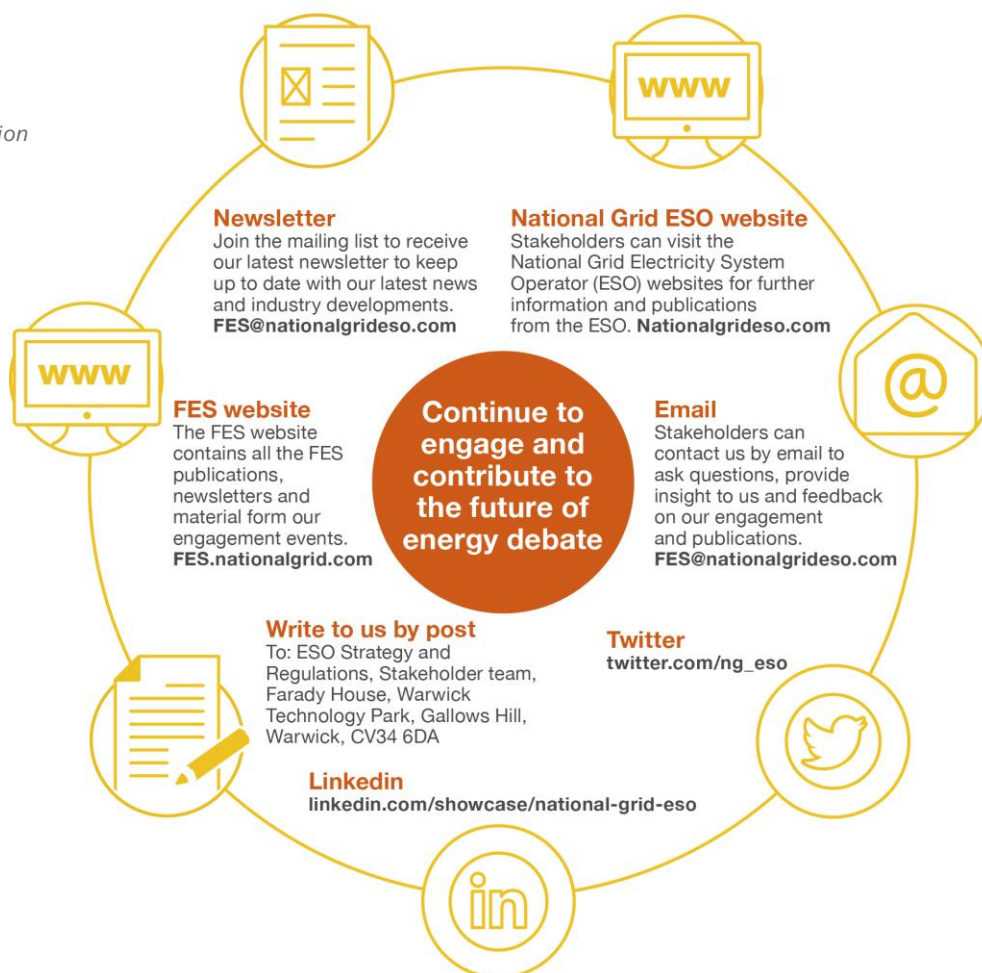
As always, we welcome everyone's feedback and opinion on the future of energy and ask that you continue to engage and contribute to the ongoing discussion and debate.

We use all methods noted below for communication, with the FES newsletter and FES website as the most popular and preferred by stakeholders. We are always open to exploring new ways to collaborate and share information.

To contact us at your convenience, please use our email: FES@nationalgrideso.com

Figure 6

Methods of
communication



6. Appendix

- A. Overview of engagement events and communication activity
- B. Stakeholder groups we have engaged with during 2020
- C. Comparison of engagement and stakeholders - 2019 to 2020
- D. Review of our engagement and communication improvements for FES 2020
- E. Review of our actions and commitments for FES 2020

A. Overview of engagement events and communication activity

FES 2020 launch event week Monday 27 July – Thursday 30 July 2020		
On-the-day satisfaction survey <ul style="list-style-type: none"> Stakeholder satisfaction score NPS: <ul style="list-style-type: none"> +47 (Monday) +47 (Wednesday) +59 (Thursday) +44 (post launch) 80% (Monday) 93% (Wednesday) 95% (Thursday) and 80% (post launch) of stakeholders said the content met their expectations 90% (Monday) 97% (Wednesday) 90% (Thursday) and 80% (post-launch) of stakeholders said the format met their expectations 790 individual stakeholders joined during the week 480 stakeholders joined on Monday 27 July 230 (average) joined per deep dive session on Wednesday 29 July and Thursday 30 July 194 (approx.) stakeholders joined on 'catch-up' <p>During the launch events we used the question function within the webcast portal and over the three days received nearly 500 questions, many of which we answered during the live events. Questions that we were unable to answer were then taken forward into the FES 2020 FAQ document, with the final version published early September. We continued to receive queries on FES 2020 via our email account.</p>	Positive feedback: <ul style="list-style-type: none"> This format allowed greater flexibility to attend and watch on catch up Carbon and transport savings from a virtual launch Good range of sessions during the week Good format used during the launch Good use of technology Openness and thought leadership evident Clear and informative content shared Ability to pick and choose the sessions during the week Good Q&A sessions Better way to launch FES than traditional conference The event was professional and informative Improvements for consideration: <ul style="list-style-type: none"> The audio quality and consistency could be improved to reduce time lags and stuttering's Lack of networking and 1:1 Slower commentary is needed for the presentation Bigger slides and having them on the screen for longer would be beneficial, separate from the presenter's face Longer time allowed for Q&A Visible stakeholder questions for the audience to see So many FES 2020 documents - would be good to see a document overview Confusion why the ESO is covering gas supply 	Summary of scenario feedback for FES 2021 <p>All feedback received in the satisfaction survey was specific to the launch event. Some feedback focusing on the analysis were received during the Q&A sessions that took place during the week; this is captured from page 16 onwards – stakeholder input for FES 2021.</p>

- Lack of eye contact from the presenters
- Too robotic and scripted, less pre-recorded presentations
- More diversity is needed in presenters

Stakeholder feedback and quotes:

- “A virtual event makes this much more accessible to a wider audience and will also have significant cost and carbon savings too”
- “Great event, engagement and well-run webinar. NGE SO continue to amaze me with their openness, engagement and thought leadership. More of the same please- Bravo!”
- “I would add only one comment and say that the one thing that I thought which could be improved would be the audio quality of the speakers”
- “Great launch event - very accessible and helpful in setting the scene. Please consider providing all presenters with headset with mic (close to mouth) for improved sound quality and consistency”

FES 2021 Call for Evidence September 2020 – open for four weeks

- The online FES 2021 Call for Evidence ran throughout September and was shared with the breadth of our stakeholder community.
- We received 100 responses (50% increase from 2019) providing feedback from a cross-section of our stakeholder audience – you can see how we have combined this feedback with other insight and taken it forward for FES 2021 on page 16 onwards.
- Our approach for 2020 was very similar to that of 2019. We produced the online survey in sections to allow stakeholders to view and answer only those questions that reflected their area of expertise.
- To increase transparency for stakeholders, we shared a summary of the feedback we received on the FES website during November and through the newsletter.
- We received some feedback on the accessibility and ease of use of the online survey tool and will look to make changes for any future Call for Evidence that we conduct.

Summary of feedback for *FES 2021*

- In October 2020 we shared a summary of the all the feedback that we received. This can be found [here](#).

FES: Bridging the gap: Peaks and troughs
21 October 2020

Overview

- 125 attendees
- Stakeholder satisfaction score NPS: +4
- Response rate of 20%

Positive feedback:

- Useful and professional event
- Topic, presentations and discussions were interesting.

For improvement:

- Need to be more specific about what will happen and how.

Summary of feedback for FES 2021

The final report for FES: Bridging the gap will be published 4 March 2021.

Stakeholder feedback and quotes:

- “It was useful and professional, I thought Slido worked well. I felt it was caught between information delivery and the interactive workshop idea, simply because of too wide a scope”

FES: Bridging the gap: Peaks and troughs
25 November 2020: Data and digitalisation

Overview

- 49 attendees
- Stakeholder satisfaction score NPS: +25
- Response rate of 24%

Positive feedback:

- Stakeholders welcomed the opportunity to be involved in the workshop
- Good to hear from a wide range of stakeholders and a lot was learnt from the event.

For improvement:

- As part of the satisfaction survey, stakeholders highlighted that the pre-event communication could have been improved.
- Asking more questions from Slido would have been beneficial
- Requests that the information is made relevant and targeted to different stakeholders during the webinar

Summary of feedback for FES 2021

The final report for FES: Bridging the gap will be published 4 March 2021.

Stakeholder feedback and quotes:

- “Really enjoyed the session and learnt a lot. Great that you had different stakeholders present (BEIS, OFGEM) and they were given time to talk (great work by the chair Laura Sandys) and a valid action taken to explore the visibility of the collaborative approach needed. It'd be great to get an update on how we have progressed with the work needed to tackle the skill set deficit in our discussions with the department of education”

**FES: Bridging the gap: Peaks and troughs
26 November 2020: Markets**

Overview

- 45 attendees
- Stakeholder satisfaction score NPS: +67
- Response rate of 7%

Positive feedback:

- Stakeholders welcomed the opportunity to be involved in the workshop

For improvement:

- No comments received

Summary of feedback for *FES 2021*

The final report for FES: Bridging the gap will be published 4 March 2021.

**FES: Bridging the gap: Peaks and troughs
27 November 2020: Technology**

Overview

- 43 attendees
- Stakeholder satisfaction score NPS: +60
- Response rate of 23%

Positive feedback:

- Stakeholders welcomed the opportunity to be involved.

For improvement:

- More opportunity for discussion and networking is needed
- Fewer acronyms, assumed an expert audience.

Summary of feedback for *FES 2021*

The final report for FES: Bridging the gap will be published 4 March 2021.

Stakeholder feedback and quotes:

- “More opportunity for participants networking and interaction. More questions captured by the ESO during registration - I'm interested in X and Y... More discussion with panellists about who should answer questions on which topics. Otherwise it was a really well-run event”.

**FES 2020 costing webinar
Monday 30 November 2020**

Overview

- 49 stakeholders joined the 90-minute event
- Stakeholder satisfaction score NPS: +10
- Response rate of 42%
- We hosted a Q&A session during the event and received 24 questions with the majority being answered during the time.

Following the webinar, we published the report, webinar slides and data workbook on the FES website. We also published a blog on Twitter and ESO website sharing the context and high-level analysis.

Positive feedback:

- Stakeholders welcomed the opportunity to join the webinar and hear the outputs from the costing project.
- Most agreed that the content and format met their expectations

For improvement:

- The process of asking questions could be improved so that those raised first are not missed
- Would be beneficial to understand and talk more about the assumptions made
- It would be helpful if the webinar took place nearer the time of the main FES publication, in particular the data workbook

Summary of feedback for *FES 2021*

No specific feedback was provided from the webinar for FES 2021.

Stakeholders would like the costing work to be completed again for FES 2021.

Stakeholder feedback and quotes:

- “Great speaker, very clear, good info on slides. Impressed with answers to questions, they really know their stuff”
- “Questions posted earlier got overtaken by later debate during the Q&A section. Frustrated that the question I posted was overtaken time and time again and never answered”

**Clean heat webinar
8 December 2020**

Overview

- 40 stakeholders joined the webinar
- 35 organisations represented
- Stakeholder satisfaction score NPS: -25
- Response rate of 9%
- Slido was used during the event and 60 posts were received, either to post a question or provide comment

Positive feedback:

- Stakeholders welcomed the opportunity to be involved and offered thanks for organising the event

For improvement:

- No comments were received
- Although the NPS score was low, no feedback was received on the reasons for this or any suggested improvements

Summary of feedback for *FES 2021*

A series of questions were put forward during the webinar to stimulate debate and to hear a range of opinions. The comments were all then taken forward for consideration.



**Network Forum
15 December 2020**

Overview

- 17 stakeholders attended the event
- 10 networks represented
- Stakeholder satisfaction score NPS: +25
- Response rate of 70%

Positive feedback:

- Stakeholders welcomed the opportunity to be involved and helping to shape the agenda of this and future forums.

For improvement:

- No comments were received

Summary of feedback for *FES 2021*

From the satisfaction survey, topics were suggested for exploring at future meetings; hydrogen and flexibility – these will be added to the agenda. The frequency of these meetings was also sought and agreed with attendees. Several questions were raised during the event which were captured and will be discussed during the next meeting in February.

**Bio and negative emissions workshop
15 December 2020**

Overview

- 10 stakeholders joined the webinar
- 7 organisations represented
- Stakeholder satisfaction score NPS: +33
- Response rate of 60%

Positive feedback:

- Stakeholders welcomed the opportunity to be involved

For improvement:

- No comments were received

Summary of feedback for *FES 2021*

Views from stakeholders suggested that it makes sense to flex the bio usages across different scenarios especially bio import and that the FES 2020 range looks reasonable but could go higher. There are uncertainties around DACCS and BECCS for hydrogen production. Land use sector should be considered alongside BECCS as natural carbon sink.

**Bilateral meetings (involving ESO and one other organisation) for FES 2021
September 2020 to April 2021**

Overview

- 86 online bilateral meetings held or scheduled with a wide range of organisations from across the energy industry
- 185 stakeholders involved in the 86 meetings
- Bilateral engagement will continue into the spring with insight and evidence being gathered for FES 2021
- Stakeholder satisfaction score NPS: +38

Positive feedback:

- Stakeholders welcomed the opportunity to meet with the team to provide their insight
- The engagement was open and transparent
- Good work by the team who are professional, helpful and friendly
- ESO are well placed to model the scenarios and engage with relevant stakeholders
- Stakeholders felt that the information provided was welcomed and valid

Improvements for consideration:

- Some stakeholders would have liked to have been given more data and information that sits behind the current scenarios and to greater gain understanding on the assumptions and constraints
- Stakeholders would have welcomed questions and key issues put forward before the meeting to maximise feedback
- Having an agenda for the meeting would have been beneficial
- Using a template to capture standardised information would be helpful to allow information to be gathered from across the business in advance of the meeting. Wider engagement with membership organisations would be good

High-level summary of key feedback for FES 2021

Regarding electricity supply, many stakeholders noted that wind is likely to dominate but that there is still uncertainty around the technologies that will support this. A range is required including for BECCS as this was narrow in FES 2020. There was an increasing interest in the decarbonised scenarios in light on recent government announcements. This will lead to a review of Steady Progression in FES 2021.

Feedback indicated that an increased focus on hydrogen would be appreciated while looking at increasing the range of supply sources.

Further reduction of emissions should be considered for non-FES emissions reducing the requirement for negative emissions.

Stakeholders agreed with us that the power sector will be renewables led with a strong focus on Wind. They value the data we publish and the range across technologies where substantial uncertainties remain.

The increased focus on hydrogen has been well received.

The amount of demand using each fuel for Leading the Way scenario was included in the feedback, along with a request for further clarity of assumptions of the scenario.

The levels of buildings efficiency (insulation) from FES 2020 was described and very ambitious, as was the electric vehicle efficiency input for the transport modelling.

Consider a wider range of emission abatement technologies

Consider a wider range BECCS or power generation with the net zero scenarios.

Stakeholder feedback and quotes:

- “The current level of engagement, dialogue and approach to working has been good”
- “Schedule and structure the meetings to tailor suit the client but otherwise engagement is perfect”
- “The NG colleagues I engaged with were very open and keen to learn in a new area”
- “I felt that NG was open and transparent”

FES 2020 online communication

■ FES website

We made significant changes to the FES website by moving from a microsite to the main ESO site. This took place on the 2 June and has improved navigation and accessibility for readers and provided better analytics for us to monitor. Since this change and the FES 2020 publication the FES website audience has grown. Below are some key statistics:

- Combined **21,687 downloads of all FES publications**
- 11,229 downloads of the main FES report
- **4, 081 downloads of the data workbook**
- 1,171 downloads of the scenario framework
- **62,729 views of FES pages**
- The FES pages accounted for **18% of all visits to the ESO site** during July and on launch day the documents page was the most visited page of the website that week.

■ Newsletter

We have continued during 2020 to publish the FES newsletter to share our insight, invitations and ask for input.

Positive feedback:

- Continue with the most popular methods of communication; email, social media, FES newsletter and website.

Improvements for consideration:

- Provide a clear and shareable link to the launch webpages and ensure it is covered by relevant media publications
- Continue with face-to-face interactions where possible
- Continue hosting webinars
- Look to specifically use YouTube and LinkedIn as methods of communication with stakeholders.

- Distribution list of **6,400 stakeholders**
- Published **11 newsletters** (March to January)
- Average of **25% recipients open each publication**
- Top four countries receiving are UK, USA, Ireland and Germany
- Other countries reached include **Australia, Japan, Poland, China, India, UAE, Brazil and Argentina**
- The most read articles and links were:
 - FES 2020 suite of documents
 - Bridging the Gap final report
 - Launch of the FES 2021 Call for Evidence

▪ **Email queries**

01.02.20 – 21.01.21: during this period, we have received 227 queries

We have continued to receive and respond to a range of queries via our dedicated email account. Queries received are from a wide range of stakeholders; including general public, suppliers, industry experts, storage & flexibility providers, academics & universities and local authorities. Queries cover a broad range of topics. Over 120 queries were received relating to the launch, publication and analysis for FES 2020. We have responded to most of the queries within our agreed standard of service of five days. Some queries that have been more complex in nature have taken longer to investigate and to provide a response to the stakeholder.

▪ **Social media and media**

Before the FES 2020 launch we shared a press release under embargo to trusted contacts which resulted in national media coverage in the Guardian, Times and Independent newspapers. There were 193 articles written about FES which equated to a media reach of 1,747,689,000

• **Twitter:**

- The FES 2020 launch post was one of the most successful tweets posted
- 140,916 Twitter impressions

B. Stakeholder groups we have engaged with during 2020

Stakeholder categories

We use the categories below to inform us and other interested parties' which sectors across the energy industry and wider we have engaged with. These are the same categories that we used last year and so can provide a comparison against the previous year which is found on page 43.

Stakeholder category	Subcategory
Communities and their representatives	Impacted Local Communities and Residents Parish Councils Local Campaign Groups and advocacy groups
Consumers and consumer groups	General public/individual responses Consumer groups and charities
Energy industry	Energy Suppliers European and International networks European TSO Generators (including Big 6) Industry bodies & experts including Consultancies, Trade bodies Interconnectors Offshore Gas Companies Offshore Transmission Owners Operating Margin Providers National Grid ESO Shippers Small Generators Small Renewables Storage and Flexibility Terminal Operators Transmission directly connected demand
Innovators	Environmentalists Manufacturers and Technologists Infrastructure providers
Non-governmental organisations	Environmental Groups Other non-governmental organisations
Other stakeholders	Academics, Universities and Schools Finance and investment community Small businesses Other including media
Political	Devolved Administrations European Administration Members of European Parliament Members of Parliament Local Authorities UK Government Bodies
Regulators	Regulatory bodies
UK Networks	Distribution Network Operators Gas and Electricity Transmission Companies Other UK networks – water, communications Gas Distribution Networks

Below is a breakdown of stakeholder groups and organisations engaged with during the year of 2020

The numbers shown in the table below are the total amount of stakeholders that have been involved across all our engagement activities. Some may have taken part in more than one event during this time. The total number of individual stakeholders is 1,257 and this relates to the 1,713 number below.

Stakeholder breakdown for all engagement activities during 2020

Stakeholder category	Total
Communities and their representatives	20
Consumers and consumer groups	183
Energy Industry	764
Innovators	198
Non-governmental organisations	33
Other stakeholders including academics and universities	233
Political	111
Regulator	46
UK Networks	125
TOTAL	1713

Below is a further breakdown of the stakeholders we have engaged with to provide transparency

Main category	Sub-category	Count
Communities and their representatives	Local Campaign Groups and advocacy groups	20
Consumers and consumer groups	General public/individual responses	164
	Consumer groups and charities	19
Energy Industry	Energy Suppliers	39
	European and International Networks	34
	European TSO	9
	Generators (including Big 6)	152
	Industry bodies & experts including Consultancies, Trade bodies	255
	Interconnectors	8
	Offshore Gas Companies	8
	National Grid ESO	160
	Shippers	7
	Small Generators	4
	Small Renewables	21
	Storage and Flexibility	43
	Terminal Operators	2
	Transmission directly connected demand	26
Innovators	Environmentalists	9
	Manufacturers and Technologists	149
	Infrastructure providers	43
Non-governmental organisations	Environmental Groups	17
	Other non-governmental organisations	16
Other stakeholders	Academics, Universities and Schools	109
	Finance and investment community	59
	Small businesses	19
	Other including media	39
Political	Devolved Administrations	12
	Members of Parliament	1
	Local Authorities	24
	UK Government Bodies	74
Regulator	Regulatory bodies	29
UK Networks	Distribution Network Operators	55
	Gas and Electricity Transmission Companies	41
	Gas Distribution Networks	44
	Other UK networks - water, communications	2
		Total 1713

Below is a breakdown of stakeholder groups for each engagement event:

Stakeholder breakdown for the FES 2020 launch event

Stakeholder category	Total
Communities and their representatives	13
Consumers and consumer groups	79
Energy Industry	371
Innovators	81
Non-governmental organisations	14
Other stakeholders	131
Political	43
Regulator	11
UK Networks	47
TOTAL	790

Stakeholder breakdown for the FES 2020 launch event – ‘catch-up’

Stakeholder category	Total
Communities and their representatives	1
Consumers and consumer groups	14
Energy Industry	98
Innovators	19
Non-governmental organisations	1
Other stakeholders	35
Political	7
Regulator	2
UK Networks	17
TOTAL	194

Stakeholder breakdown for FES 2021 Call for Evidence

Stakeholder category	Total
Communities and their representatives	2
Consumers and consumer groups	24
Energy Industry	41
Innovators	9
Non-governmental organisations	1
Other	15
Political	4
Regulators	0
UK Networks	4
TOTAL	100

Stakeholder breakdown for FES 2020 costing webinar

Stakeholder category	Total
Communities and their representatives	0
Consumers and consumer groups	11
Energy Industry	21
Innovators	1
Non-governmental organisations	1
Other stakeholders	5

Political	2
Regulator	3
UK Networks	5
TOTAL	49

Stakeholder breakdown for Clean Heat webinar

Stakeholder category	Total
Communities and their representatives	0
Consumers and consumer groups	4
Energy Industry	18
Innovators	5
Non-governmental organisations	1
Other stakeholders	10
Political	0
Regulator	0
UK Networks	2
TOTAL	40

Stakeholder breakdown for FES 2021 Network Forum (December)

Stakeholder category	Total
UK Networks	17
TOTAL	17

Stakeholder breakdown for Bio and negative emissions

Stakeholder category	Total
Communities and their representatives	0
Consumers and consumer groups	2
Energy Industry	3
Innovators	0
Non-governmental organisations	1
Other stakeholders	0
Political	4
Regulator	0
UK Networks	0
TOTAL	10

Stakeholder breakdown for FES 2021 Bridging the Gap programme

Stakeholder category	Total
Communities and their representatives	4
Consumers and consumer groups	42
Energy Industry	80
Innovators	61
Non-governmental organisations	2
Other stakeholders	25
Political	34
Regulator	10
UK Networks	18
TOTAL	276

Stakeholder breakdown for FES 2021 bilateral meetings

Stakeholder category	Total
Communities and their representatives	0
Consumers and consumer groups	3
Energy Industry	118
Innovators	21
Non-governmental organisations	5
Other stakeholders	9
Political	10
Regulator	0
UK Networks	19
TOTAL	185 stakeholders at 86 meetings

C. Comparison of engagement and stakeholders - 2019 to 2020

	2019	2020
Total number of stakeholders	463 unique stakeholders 590 stakeholders across all activities	1257 unique stakeholders 1713 stakeholders across all events
Total number of organisations	224 unique organisations 548 organisations across all activities 109 new organisations for 2019	460 unique organisations 762 organisations across all activities 347 new organisations for 2020
FES launch events	248 stakeholders	790 stakeholders
FES launch on 'catch-up'	n/a	194 stakeholders
Call for Evidence	52 responses 28 organisations 19 as individuals	100 responses 62 organisations 21 as individuals
Workshops (webinars for 2020)	86 stakeholders 73 organisations	116 stakeholders 68 organisations
Bilateral meetings	67 organisations 128 stakeholders	80 organisations 185 stakeholders

Stakeholder category	2019 Total	2020 Total
Communities and their representatives	7	20
Consumers and consumer groups	44	183
Energy Industry	280	764
Innovators	48	198
Non-governmental organisations	13	33
Other stakeholders	32	233
Political	49	111
Regulator	11	46
UK Networks	106	125
Total	590	1713

D. Review of our engagement and communication improvements for FES 2020

Below we have provided a review of the actions that we said we would deliver for *FES 2020* (as set out in the 2020 Stakeholder Feedback Document), together with an update on how we have delivered against those actions or, where we have not taken forward an action, the reason why.

Engagement and Communication		
Stakeholders said for FES 2020:	We said we would for FES 2020:	Updated: What we did for FES 2020:
You prefer the locations of London, Birmingham and Manchester for our engagement events.	Consider the top three favourable locations for our launch venues for 2020 and further events during our autumn engagement programme.	As a result of Covid-19 we changed our plans and moved to a virtual launch for FES 2020. Our original plans were focussing on London followed by a series of roadshow events in other major cities.
You prefer communicating by email with ESO & FES websites being favourable with social media and LinkedIn having less importance.	Continue to publish bi-monthly or more regular newsletters to inform stakeholders as well as asking for feedback on key decisions we are making. Make enhancements to the FES site to ensure it remains fit for purpose and meets stakeholder needs. We will continue to use social media as a means of engagement but not be fully reliant on this for getting our messages out.	We continued to publish regular newsletters to the future of energy distribution list during 2020 as a means of sharing our updates, providing invitations for engagements and asking for input into our processes. We made significant changes to the FES website ahead of the FES publication by bring the pages back 'in-house'. This has ensured consistency with the ESO, better navigation and accessibility for FES.
You like having a week to read and digest the suite of FES documents before attending the main launch event; this is adequate time and is a positive change from last year.	Publish the suite of FES documents at least a week before holding the main FES launch conference.	As our plans changed in light of the ongoing pandemic and we turned to a virtual launch we hosted a high-level briefing on the first day and then a provided a 'stakeholder digest' day to allow time for the FES 2020 content to be absorbed before

		the deep-dive sessions later in the week.
You would prefer if we continue with a similar format for the <i>FES 2020</i> launch events that allows adequate time for Q&A, discussion and networking and with senior ESO leaders.	Hold two events to meet the needs of our wide stakeholder base for our launch programme of events for <i>FES 2020</i> . During each event, we will ensure that delegates have plenty of opportunity for networking and Q&A time with the ESO leaders and our team of analysts.	The virtual launch followed a similar format to the face-to-face events for FES 2019. We held a high-level summary session on the Monday, providing the key messages and overview of the analysis. We then followed this by two days of deep dive sessions on specific subjects. During each session we had time for Q&A with the questions answered by the analysts.
You would like us to be clear in the scope and purpose of each launch event through the invitation and introduction.	Be explicit in the scope, purpose and aim of the differing launch events as part of the invitation process for the launch events.	We ensured that our communication regarding the virtual launch week was clear noting exactly what each session will include. We shared this through our newsletter and social media platforms.
You believe we should ensure diversity in presenters at engagement events.	Ensure that our presenters and representatives at events represent a range of diversity.	During the week we had presenters from a range of backgrounds and ethnicity. However, we recognise that there is more we can do to increase the range of diversity of our presenters for future events.
You think we need to be clearer on the use of Sli-do.	Provide clear instructions on how to use Sli-do as part of the pre-read material and also during the event introduction.	For the FES 2020 launch event we used the question function on the platform for Q&A. We provided guidance on how to use this during the week's events.
You would like better planning & allocation of delegates to individual topics sessions during the conference.	Look at the options available for planning and allocation of delegates for attending any smaller specific sessions that we may host during the main conference for <i>FES 2020</i> .	As our plans changed for the FES 2020 launch and we moved to a virtual event, we were able to allow all

		stakeholders that wished to join the specific sessions to do so.
<p>You value the full range of publications that make up FES. You especially appreciate having a concise summary, in the form of FES-in-5 alongside the main FES document and data workbook.</p> <p>You would like the documentation to be as comprehensive as possible.</p>	Continue to provide the full suite of FES documents, including FES-in-5, and ensure they meet our stakeholder's needs by considering a range of perspectives.	For FES 2020 we published the full suite of documents that included the main report, FES-in-5, data workbook, modelling methods, key changes from FES 2019, regional breakdown and the FAQ document.
<p>You strongly supported our proposal to discontinue the printed copies of the full FES document, and move towards the interactive online style used in our Market Outlook publications.</p>	Continue to provide printed copies of FES-in-5. However, based on your support for reducing our carbon footprint, we no longer intend to print the main FES document.	Considering stakeholder feedback and our own review we chose not to print the main FES report and instead just printed FES-in-5 which we offered to post to stakeholders upon their request.
<p>You would like the document to be more concise.</p>	Aim to make the online document more accessible and concise to read via the introduction of interactive features.	For FES 2020 we published different versions of the main report and FES-in-5 on the FES website. This included versions suitable for printing as well as online interactive copies. We also structured the document differently for 2020 into System View and Consume View chapters and used more interactivity to help make the information more concise.
<p>You would appreciate greater transparency of the assumptions made within the scenarios.</p>	<p>Explore ways of bringing key assumptions into the core narrative so that they are clearer and more transparent when developing the main FES document.</p> <p>Continue to provide the full details of our scenario assumptions in the associated Scenario Framework document.</p> <p>Look to share the key assumptions in the presentations that we give during <i>FES 2020</i> launch programme and subsequently share online.</p>	<p>As in previous years, as part of the FES 2020 suite of documents we published our full list of scenario assumptions and levers.</p> <p>The key assumptions were then highlighted in the narrative for each scenario element (often using pop-ups)</p>

		in the main document as well as referenced in the launch presentations.
You would like us to provide more visible comparisons to the previous year's FES.	Look to provide comparison information that will enable stakeholders to compare & contrast with the <i>FES 2019</i> scenario range as the scenarios will not be directly comparable since the framework and scenarios will be changing for <i>FES 2020</i> .	For FES 2020 we produced a short FES 2019 to FES 2020 comparison which we published as part of the suite of documents detailing the main changes from year on year. We will continue with this for FES 2020 to FES 2021.
You have asked for increased granularity of data at a consistent level across the outputs, and for more sensitivity work to be included in the publication.	<p>Publish as much of our data and assumptions as possible, to ensure that they can be externally ratified via challenge and review. We will expand on the data set we provide in our Data Workbook every year as we develop our analysis and receive requests for additional data. We will publish the data related to the building blocks agreed with the DNOs.</p> <p>Continue to do this, and extend the data sets where possible, however there are certain areas where we must aggregate data items for confidentiality reasons.</p>	<p>Following positive feedback in FES 2019, we continued the approach of including additional data in dedicated data tables in the Data Workbook that can be filtered as appropriate by users. The Data Workbook also now contains "building block" data to facilitate greater comparison of FES data with data produced by other networks. We also incorporated the FES data with other data published on the ESO Data Portal.</p>
You would like more information relating to relative costs and consumer benefits across the scenarios.	<p>Endeavour to include more qualitative information in the main narrative to improve comparison of scenarios based on cost where relevant.</p> <p>Look to analyse the scenario costs in a similar way to our scenario costing in <i>FES 2018</i>, and publish these as a standalone document.</p>	We carried out a FES 2020 costing project so compare the costs of the scenarios. We hosted a webinar on 30 November and then published the report, webinar slides and data workbook. We also shared via social media and produced a blog to highlight the key messages.

E. Review of our actions and commitments for FES 2020

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	<i>Updated: What we did for FES 2020:</i>
Electricity market modelling Storage	Storage is expected to see short term growth followed by a period of stability. Growth will pick up again when more renewables have been deployed and wholesale prices are spikier.	Continue to assess the need for storage within our analysis and will track the build out of projects via our engagement with the network companies and via registers such as the Capacity Market register.	The impact by scenario will be determined through our analysis and the FES levers.	We reviewed the amount of storage required in light of the new scenario framework. As the scenarios included more variable renewable generation than in previous years, the amount of storage was increased to support system flexibility. We then tested our results within a pan-European dispatch model.
Electricity market modelling Hydrogen	Under certain circumstances (e.g. lower cost of offshore wind) hydrogen from electrolysis may be price comparable to hydrogen from stream methane reforming (SMR). This may result in additional growth in offshore wind.	Assess the need for hydrogen and the different production options as part of our whole system analysis. If hydrogen from electrolysis is included, we will ensure that the required power generation is included within the scenarios to meet this.	If we include hydrogen production from large scale electrolysis, it is likely that we include this in a limited number of scenarios. There is still much uncertainty as to how hydrogen will be produced (electrolysis, methane reformation or imports). We will aim to explore this uncertainty across the scenarios.	Our scenarios capture a range of hydrogen production with System Transformation and Consumer Transformation both with a mix of blue and green hydrogen. With the former favouring methane reforming and the latter favouring electrolysis. In Leading the Way, the focus is on 100% green hydrogen. Hydrogen

import is also included in Leading the Way.

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	<i>Updated: What we did for FES 2020:</i>
Electricity market modelling Charges	<p>The Targeted Charging Review and review of network charging are policies which may shift the balance between growth of distributed generation and growth of transmission connected generation.</p> <p>Some distributed generation sites may start to close before end of life following changes to the embedded benefits and as a result of emissions regulations.</p>	<p>Update our analysis to include the November 2019 decision Ofgem published on the Targeted Charging Review.</p> <p>Monitor the case for earlier closure of these sites whilst we undertake our analysis and through further stakeholder engagement. Based on early results we are minded to include earlier closures than in <i>FES 2019</i>.</p>	<p>Although we have removed the decentralisation axis from the FES Framework, it is likely that the scenarios with higher degrees of societal change will see the higher levels of distributed generation.</p> <p>Earlier closure of unabated thermal generation typically occurs in the scenarios that decarbonise quickest.</p>	<p>We introduced a closure profile for unabated thermal generation in the net zero compliant scenarios. This takes effect from the early 2030s.</p>
Electricity market modelling Interconnectors	<p>We are likely to have significantly more than 20GW of interconnection by 2050.</p> <p>In <i>FES 2019</i> interconnection flatlines after the 2020s. You should consider interconnector connections outside of current listed projects.</p>	<p>Investigate the option of adding additional post-2030 projects within the scenarios. We will examine the consumer benefit off additional interconnectors to other countries.</p>	<p>The level of interconnection is likely to vary in line with the amount of renewable generation.</p>	<p>Supported by the analysis from NOA IC, we increased the level of interconnection from 2030 onwards in the net zero scenarios as these have the highest need for system flexibility to support the high level of variable renewable generation.</p>

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	Updated: What we did for FES 2020:
Electricity market modelling Technology	We should consider higher ranges for several technologies, in particular: thermal, Carbon Capture, Utilization & Storage (CCUS), wind and nuclear.	Assess the need for all types of generation in light on the new net zero targets. This may result in higher ranges than in previous <i>FES</i> .	The amount of installed generation will depend on the total demand for electricity. In cases where hydrogen is produced by electrolysis it is likely that we will see higher capacities than in previous <i>FES</i> .	In light of the scenarios and the net zero target, we reviewed all forms of generation and produced a generation mix that meets the required demand, security of supply standards and carbon targets. In many cases this resulted in large increases in wind and CCUS. We continue to explore a range of nuclear outcomes.
Electricity market modelling Renewable generation	Respondents generally expressed a very weak outlook for small scale wind (sites of less than 1MW total capacity) due to high capex costs and planning restrictions. Respondents were more positive around solar Photovoltaic (PV), with typical ranges being within the 20 – 65 GW bracket for a net zero compliant scenario.	Reflect the weak outlook for the smallest scale wind turbines within our scenarios particularly in light of the removal of the decentralisation axis.	The highest level of small-scale wind was previously within the Community Renewables scenario. For <i>FES 2020</i> we will align this to the level of societal change.	We cut the projection for the smallest scale onshore wind turbines. The pipeline of wind projects less than 1MW was reduced such that by 2050 the maximum installed capacity is 2.3 GW, down from 3.6 GW. We increased the level of solar PV compared to FES 2019.
Gas supply LNG	There is general oversupply in the Liquefied Natural Gas (LNG) market at present but demand, particularly from developing countries, will continue to increase.	Maintain relatively high levels of LNG in the short term as we expect prices to stay relatively low.	Keeping LNG in the scenario that is non-compliant with net zero. Reviewing the appropriateness and acceptable volume of LNG imports in the decarbonised scenarios.	In the short term, LNG remains high compared to imports from the Continent, although still reducing from 2019 levels. In the longer term, the flexibility afforded by LNG means that where demand exceeds supply from other sources such as UKCS and Norway, imports will make up the shortfall.

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	Updated: What we did for FES 2020:
Gas supply Shale	Environmental and public concerns, on top of regulatory tightness is, or could be, holding back development on shale gas and as such opposing views were received on whether shale gas should be developed further. Some believe it should be supported fully to achieve security of supply, and at least one net zero scenario in <i>FES 2020</i> should include UK shale.	Continue to monitor closely the environmental and political developments surrounding shale gas and incorporate these into our modelling.	The uncertainty around UK shale gas production will be captured by providing a range of plausible outcomes across the scenarios.	We included shale gas in Steady Progression as this is the scenario with the highest demand for natural gas. We are not aware of any substantial progress in the development of shale gas production in the UK since a moratorium was put in place by government and so have not included it in the net zero compliant scenarios. Equally, there has been no official statement made to rule out domestic shale gas production in the future, so we believe that to include it in one scenario is justified.
Gas supply Storage	A support mechanism would be required for new storage to be viable.	<p>Consider storage when modelling flows at times of peak demand.</p> <p>There will be many aspects of our scenarios that will require or benefit from support or legislation. We aim to make these assumptions clear in the document.</p> <p>However, we will not model in detail future storage capacity in the scenarios because from a gas supply perspective, storage essentially nets off to zero.</p>	Where there is existing storage or a new facility comes on-line, this will be considered in the modelling, but we do not make assumptions regarding future projects.	We have not made any assumptions regarding future storage projects coming on-line. Any changes in the capacity of existing infrastructure since the last FES have been accounted for in the detailed analysis that underpins the scenarios.

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	Updated: What we did for FES 2020:
Whole system Hydrogen	You would like to see hydrogen in power generation included in one of the scenarios.	Consider including H2 in the power generation mix	H2 power generation will be considered in our modelling and the volume will be determined by the economic case.	In FES 2020 we captured a range of hydrogen in power generation, with System Transformation having as high as 28TWh of hydrogen produced from methane reforming with CCUS and Consumer Transformation and Leading the Way having 20TWh of hydrogen in power generation produced from electrolysis.
Whole system Hydrogen	There is some but little support for hydrogen imports.	Consider hydrogen imports but only in one of our scenarios as hydrogen imports could change the scenario significantly.	Some level of hydrogen import will be used to meet demand in one of the scenarios	We have included imports in FES 2020 Leading the Way scenario, where we are trying to decarbonise as fast as possible. The imports allow for a flexible source of hydrogen potentially reducing the volume of storage required as well.
Whole system Net zero	You would like to see the trajectory of the net zero pathway to 2050.	Include the trajectory of the net zero pathway to 2050	This will be reflected in all our net zero scenarios	In FES 2020 we have System Transformation and Consumer Transformation scenarios showing the trajectory of net zero pathway to 2050. We also have Leading the Way scenario showing trajectory of achieving net zero before 2050.
Energy Demand Industrial & Commercial (I&C)	In a low carbon environment, there will be a mix of electricity for low temperature processes and hydrogen for high temperatures.	Include a wide range of lower carbon technologies in the scenarios – to reflect the uncertainty of technologies, fuel use and regional variations where possible.	Different combinations of pathways in the scenarios	In FES 2020, System Transformation showcased a world where significant volumes of hydrogen are produced, and used in heat, transport and industrial processes, with heat

pumps in a proportion of homes. Consumer Transformation showed an electrified world, with small volumes of hydrogen produced via electrolysis from renewables. Most heating is via heat pumps but with a proportion of buildings on hydrogen or hydrogen hybrid heat. Leading the Way and Steady Progression showed other possible scenarios.

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	Updated: What we did for FES 2020:
Energy Demand I&C	Energy efficiency or Zero Carbon in this sector is difficult and requires policy or incentivisation	Consider the impact that current and new policy would have on our scenarios. This will be captured as part of our assumptions needed to ensure we meet net zero across a range of scenarios. Reflect a range of I&C efficiency assumptions in the scenarios, based on the spring 2019 BEIS consultation on I&C energy efficiency	Reflect a range of I&C efficiency assumptions in the scenarios	We modelled a range of outcomes, using Industrial Clean Growth Strategy target of 20% by 2030 in Consumer Transformation. Leading the Way goes further and achieves 25% by the same year. System Transformation reaches 20% by 2050, whereas Steady Progression has minimal improvement by 2050.
Energy Demand Residential efficiency	The existing government targets for energy efficiency are already challenging and the UK has missed every target it has set to date.	Assume a continuation (or reduction) of past performance in this area for Steady Progression scenario. The other scenarios specifically consider what is necessary to achieve the net zero target and so will necessarily be more optimistic.	Reflect a range of assumptions in the scenarios, around the EU 2030 32% target	Steady Progression assumed a slow rate of improvement. System Transformation has a high rate of improvement but does not achieve the target. Consumer Transformation achieves the target, and Leading the Way achieves 40% by 2030.

Energy Demand Heat	You would like to see more granular data on the number and type of heating appliances in the <i>FES</i> data workbook (storage/resistive heaters; oil/wood/lpg boilers; etc.)	Include more disaggregated data on building level technologies and expand the sourcing of primary data in our analysis.	Range in uptake rate of low carbon technologies.	We published the full breakdown of residential technologies and data in the <i>FES</i> Data Workbook, table ED3.
Energy Demand Heat	You would like to see more evidence of how seasonal variation in heat pump performance has been used in modelling of peak demand.	Update the heat pump performance curves in our heat pump modelling and ensure seasonal impacts are captured in calculation of winter peak demand.	Range of electricity demand for heating at peak.	We developed a new methodology for calculating heat pump peak demand that makes explicit use of heat pump performance data at peak conditions.

Theme	Stakeholders said for <i>FES</i> 2020:	We said we would for <i>FES</i> 2020:	Shown in scenario through:	<i>Updated: What we did for FES 2020:</i>
Energy Demand Heat	You would like to see clearer definition of regional approach to heat decarbonisation.	Continue to reflect the regional segmentation of heat decarbonisation, especially around hydrogen and district heating where appropriate. We have started an NIA innovation project to build a platform for assessing the regional drivers of heat decarbonisation and how that might impact technology uptake. The project is not going to be completed until September 2020 and would therefore be too late to make it into <i>FES</i> 2020.	Range in fuel consumption across regions.	Regional segmentation of heating was reflected in the Consumer Transformation and to smaller extent Leading the Way scenarios. In these scenarios, considerations of economics and locational features will drive availability of hydrogen networks that serve homes with hybrid heating systems.
Energy Demand Heat	You would like to see clearer mapping of technologies to building types based on connection to the gas grid or whether they're in new or existing stock.	Provide future projections of heating technology uptake that are grouped according to whether the buildings are new builds or existing stock on the gas grid or not.	Range in energy consumption by fuel type; better scenario narratives	This is reflected in the <i>FES</i> 2020 data workbook – table ED3.

Energy Demand Heat	You would like to see clear indication of the level of decentralisation in scenarios now that the decentralisation axis has been replaced	Explore, through sector-specific assumptions and the document narrative, how level of decentralisation can be best manifested in the scenarios	Range in heat technology uptake in scenarios e.g. more decentralised scenarios will show higher levels of district heating	We have used the level of district heating in the scenarios to reflect the level of decentralisation in the scenarios and aligned with the societal change axis. This is also aligned to the level of embedded generation.
Energy Demand Transport	The deployment of Vehicle-to-grid (V2G) could start to happen anywhere from imminently to within the next 10 years.	Not be modelling any significant engagement in V2G before 2025. Currently the most popular charging standard for European manufacturers, Combined Charging System (CCS), is not due to offer V2G capability until 2025 on their product roadmap. Given this and other barriers which still exist, we don't think any earlier would be credible at this stage.	Different V2G adoption rates in the scenarios.	Detailed on page 13 of the FES methodology document. Steady Progression assumes V2G from 2035, System Transformation from 2030, and all other scenarios assume V2G from 2025. Uptake rates (as a %age of EV owners) differs in all scenarios.
Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	<i>Updated: What we did for FES 2020:</i>
Energy Demand Transport	The capacity of V2G available in 2050 in a Net-zero world could be anywhere from 0-20GW, but on average you expect the capacity available to be lower than that modelled for <i>FES 2019</i> . You also expect this capacity to be lower in a scenario where we do not meet net-zero.	Include a wide range of V2G assumptions to reflect this uncertainty and we will make these assumptions clear in the scenarios. The Steady Progression scenario will likely have a very low use of V2G, whereas a higher rate of V2G, may be necessary to achieve net zero.	Different V2G adoption rates in the scenarios.	We adopted a range of uptake among EV owners between 11% and 45% by 2050. The lower end of this range reflects the lower range from FES 2019 and the upper range models a world with widespread V2G uptake.

Energy Demand Transport	To see significant uptake, V2G needs a strong commercial offering to domestic users. One key barrier to this is the increased cost of the V2G charger, and this may or may not come down substantially in price.	Include a wide range of V2G assumptions to reflect this uncertainty and we will make these assumptions clear in the scenarios. In Steady Progression, for instance, we may consider the uptake of domestic solar or other similar technologies with a similar payback period.	Different V2G adoption rates in the scenarios.	We adopted a range of uptake among EV owners between 11% and 45% by 2050. The lower end of this range reflects the lower range from FES 2019 and the upper range models a world with widespread V2G uptake.
Energy Demand Transport	You expect to see a significant number of biofuel heavy goods vehicles (HGVs) on the road from the early 2020s - 2035, 5-10 years before we see a significant number of hydrogen HGVs on the road.	Be unable to model considerable uptake of biogas road transport in net-zero scenarios without first modelling the other sectors to better understand the resources available. The range of uptake dates suggested broadly align with the results of our <i>FES 2019</i> modelling. In <i>FES 2019</i> we had different technologies in different scenarios.	Different gas and hydrogen adoption rates in the scenarios	Comprehensive information is in FES Workbook table ED5. For instance, by 2050, the range of HGVs is: Hydrogen 10,000-400,000. Battery 20,000-250,000 and only in Steady Progression there are 300,000 running on natural gas.

Theme	Stakeholders said for FES 2020:	We said we would for FES 2020:	Shown in scenario through:	Updated: What we did for FES 2020:
Energy Demand Transport	You think our smart charging engagement levels in <i>FES 2019</i> could be too optimistic (e.g. when considering historic consumer engagement in economy 7) or could be more optimistic.	Review the evidence base for smart charging engagement and consider whether its credible to widen this range of engagement across scenarios.	Different smart charging adoption rates in the scenarios	Feedback on this area continues to vary across our stakeholders with no overall consensus. Our range was slightly widened for FES 2020.
Energy Demand Transport	You think as different consumer segments adopt electric vehicles, the charging profile will change and so we should account for this when using our historic charging	Consider scoping a further study to investigate whether and how this profile could change over time. However, we do not intend to change our methodology this year as we do not currently have the evidence base to do so.	N/A - The charging profile is used across all scenarios	For now, the current charging profiles are appropriate and there is a lack of significant data on the behaviour of mass market EV owners. We will continue to monitor and gather data as it becomes available.

	profile from our NIA study to model peak demand.			
Energy Demand Transport	You think when we're modelling autonomous vehicles, that we're missing the energy demand from the external infrastructure and communications equipment required.	Continue to explore this with stakeholders with expertise in this area to understand how we could take account of this	N/A - This is a comment on methodology	Concepts for the infrastructure around autonomous vehicles are still being developed globally and will probably differ from country to country. The UK has a choice on what concept could be adopted (e.g. on-board autonomy, or remote journey optimisation using computer centres). We will continue to monitor developments in this space and determine energy demands when more data becomes available.
Energy Demand Transport	Low and zero carbon technologies will become available for maritime and aviation in the period 2030 - 2050, using electricity, hydrogen, biofuel and hybrids.	We do not currently model these in our bottom up forecasting and don't currently have sufficient evidence base to do so. We will therefore use other published figures in FES 2020. We will continue engaging with industry and exploring the potential to flex these across scenarios in future years	Assumptions on aviation and maritime fuel usage will remain fixed across all scenarios	FES 2020 was based around the most recent projections published by the Committee for Climate Change.

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