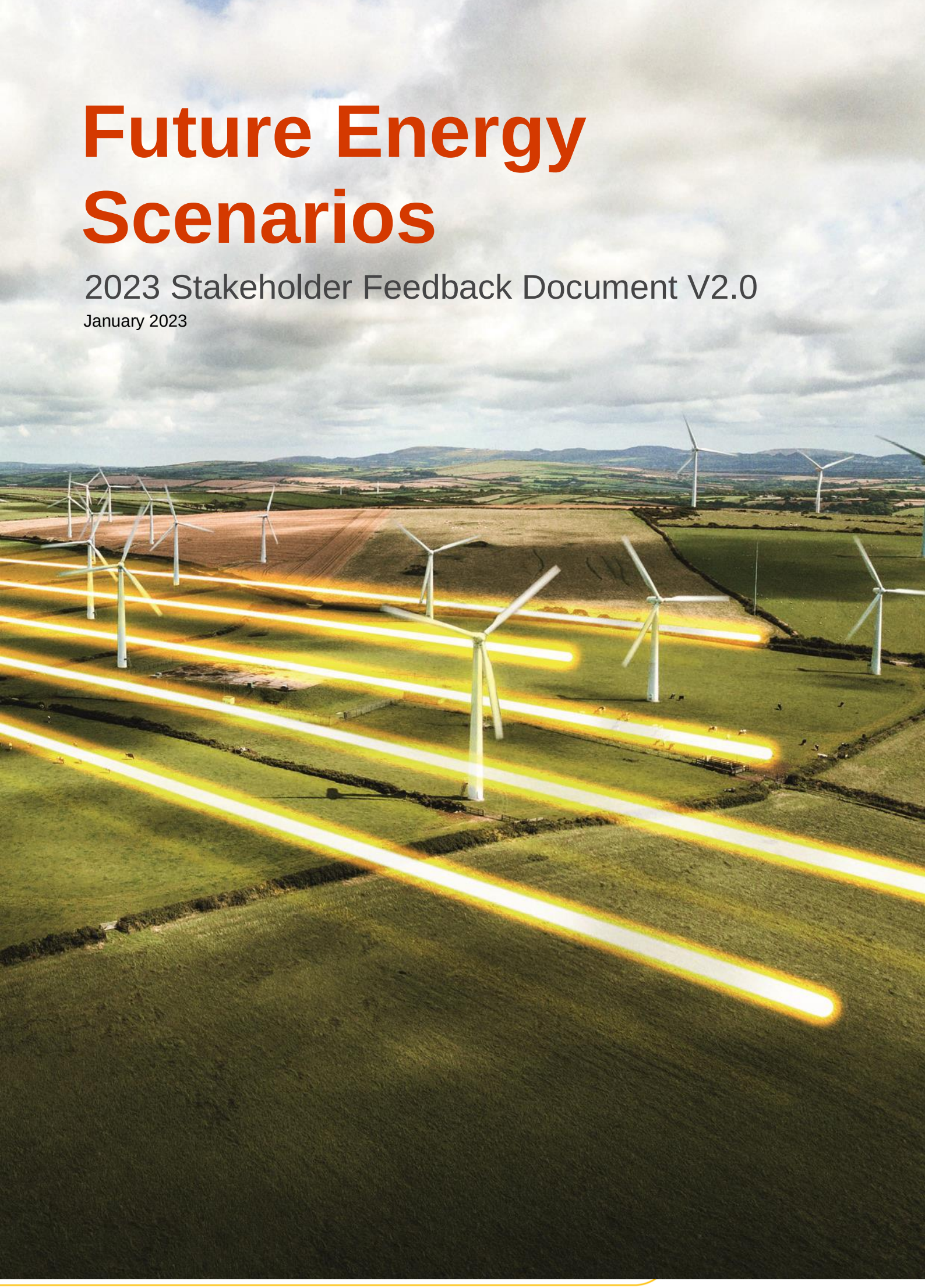
Future Energy Scenarios

2023 Stakeholder Feedback Document V2.0

January 2023



Contents

Welcome and summary

Welcome to the Stakeholder Feedback Document for 2023 Future Energy Scenarios (FES). This document sets out the proposed scenario framework and scenarios for FES 2023 and shares the detail of our engagement that took place from springtime 2022 to January 2023 and how we are taking it forward.

Engagement is fundamental to the annual FES cycle and together with our research, modelling and expertise allows us to set out the credible pathways to the future of energy. We showed in the document a summary of the views and evidence we heard from stakeholders, how we have taken these forward and the decisions at which we have arrived. Further in the document we provided a detailed breakdown of insights gathered from stakeholders and our communication and engagement activities.

We also looked back at what we said we would do for FES 2022, both from a modelling perspective as well as our engagement and communications, providing an update on those actions and improvements we set out in last year's Stakeholder Feedback Document (SFD).

Update on FES 2023 and beyond

We have monitored the market and the external environment to understand the impact on our scenario ranges and whilst longer-term uncertainty remains, we have been focussing on the near-term due to the volatility in energy markets and the cost-of-living crisis.

Our stakeholder engagement helped us understand where we are currently tracking against the scenario range and what might cause us to move within that range or fundamentally move the range in future.

The focus on the FES near-term view will be reflected in our FES 2023 publication and we will be complementing this with a range of projects and thought pieces providing additional insight on specific topics.

We are planning to publish and launch FES 2023 slightly earlier in the summer, allowing more time to transform the process for 2024, aligning with strategic network investment needs, the role of the Future System Operator (FSO) and integrating new tools for flexibility modelling.

Our engagement for FES 2023

Our engagement planning for FES 2023 followed on from the FES 2022 launch week, and during August and September we began reviewing the stakeholders and organisations from 2022. Where gaps were identified, we actively sought new stakeholders to contact, particularly in hydrogen. Engaging with new stakeholders provides fresh perspective and insight, which is essential for ensuring the scenarios remain credible and realistic. Some of the feedback received will be taken forward for consideration beyond FES 2023 as we develop the process for 2024 onwards. Engaging with these new stakeholders now provides the platform for building relationships into the future.

For FES 2023 we engaged with **1516** stakeholders across all our events from **364** different organisations. Of these organisations, **236** are new for 2023. This broad engagement continues to cover our nine stakeholder categories. The range of organisations we heard from covers local authorities, universities, distribution networks, government bodies, flexibility providers, consumer charities and interconnectors.

We are constantly seeking new organisations to engage with and welcome feedback all year round.

An overview of our main engagement activities is shared below, whilst further details can be found on pages 7 – 16.

This year (2023) following the removal of Covid-19 restrictions, we welcomed the opportunity to engage with stakeholders in person. This face-to-face engagement **Topic Table Talks** (TTT) took place in London on 12 January. We were delighted to be joined by 61 stakeholders representing a wide range of organisations from the energy industry and wider. This engagement provided the chance for rich and varied discussion to take place with our team and stakeholders.

Bilateral engagement with key stakeholders has again been an important element of our engagement cycle and allows us to seek specific feedback on a range of subjects. We heardfrom **148** stakeholders from **76** different organisations. We ensured that before each meeting stakeholders were provided with a tailored

agenda, where appropriate, setting out the areas we would like to discuss. This allowed for advanced preparation and enables productive discussion.

The **Call for Evidence** ran during October 2022. The online survey asked a range of questions on several subjects, promoted via our newsletter, website and ESO (Electricity System Operator) social media channels. We were pleased with the increase in the number of responses received compared to last year.

Our **online presence** has continued with regular newsletters to our c6.3k circulation list, updates via the ESO FES website and utilising ESO social media platforms to share information and promote our engagement. We made changes for the publication of FES 2022 to ensure the suite of documents was easy to find by adding them all to the landing page. The podcasts series that we published to explore the key themes from FES 2021 continues to attract listeners. The series assesses the energy Britain needs, examining where it could come from, how it needs to change and what this means for consumers, society, and the energy system itself. In the last 6 months 1,300 people have listened.

We continued during 2022 to engage with stakeholders to enhance our **regional insights** capability. Building on the engagement and analysis we have done over the last 12 months, we gathered additional insight from stakeholders to learn more about how we can improve and enhance our regional modelling.

We also continued to undertake a huge amount of research to understand the latest developments in technology, policy, environment, societal perceptions and economic outlook for the UK, Europe and across global energy markets.

Improvements for FES 2023:

- *Increase*: in the number of responses to the Call for Evidence
- *Increase*: in the total number of stakeholders and organisations we have heard from for 2023 compared to 2022
- *New*: in person stakeholder engagement at our Topic Table Talks, attended by over 60 stakeholders
- *New*: 236 new organisations contacted for FES 2023 – an increase from the number in FES 2022
- *New*: a series of projects and thought pieces to be completed to complement and enhance the modelling for FES 2023, providing additional insight
- *New*: focus on the FES near-term view in the FES 2023 main report
- *New*: publication for FES 2023 ‘energy background’ document providing essential information on the energy industry and thus improving the focus of the annual publication on the scenarios and updates since the previous year.

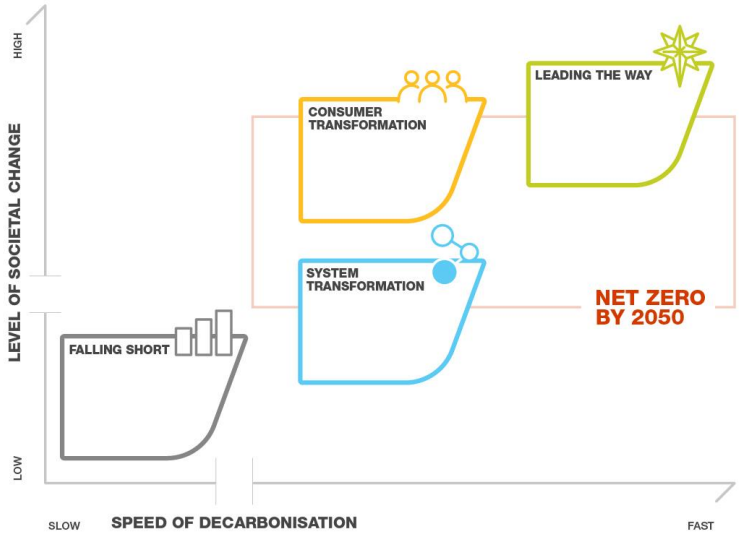
We would like to thank all our stakeholders for their continual insight, time, and advocacy of the Future Energy Scenarios

Scenario framework and scenario overview

FES sets out a range of pathways for the development of the energy sector between today and 2050. We have four scenarios arranged on a framework of 2x2 axes covering the credible range of future outcomes for the development of energy supply and demand. This framework was first introduced for FES 2020 and includes three scenarios that meet the Net Zero target, and one that does not, which was renamed ‘Falling Short’ in FES 2022.

In our Call for Evidence, we asked stakeholders whether the current framework remains fit for purpose and covers a credible range of outcomes. Overall, respondents remained happy with the framework and appreciated consistency since it enables easier year-on-year comparison. For this reason, we plan to retain the existing scenario framework for FES 2023.

The scenarios for FES 2023



We received some suggestions to consider changing the makeup of individual scenarios, but these changes would not require modification of the scenario framework and we believe the scenario framework remains fit for purpose.

Engaging across industry

We aim to reflect the breadth of stakeholder input and uncertainty within our scenario framework following our engagement across industry. Our team of experts also draw on other available sources of information to ensure our scenarios are balanced across a variety of sources to produce credible scenarios in line with the agreed framework. In making these decisions, we consider the purpose of FES in network investment both today and how decisions are likely to change in future, industry publications, conferences and related 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.

Updates to the scenario framework in the future

We always keep our scenario framework under review, and we will be considering the need for changes beyond FES 2023. This will include an appraisal of whether the scenario framework remains fit for purpose and whether the axes are still the most appropriate to explore the key uncertainties. We will engage with stakeholders to understand their views ahead of making decisions in this area and ensure any concerns can be reflected ahead of future modelling. This will include assessment of whether there are any material changes that necessitate changing the framework. The last major external change that led us to change the framework was the UK's adoption of a Net Zero target by 2050 rather than the previous 80% carbon reduction target.

One key area of focus is that we are considering the changes required to our scenarios and processes to feed into the new strategic network planning process that is currently being explored through the ETNPR (Electricity Transmission Network Planning Review). The output of the ETNPR will be a new Centralised Strategic Network Plan (CSNP) which will potentially transform how we consider network reinforcement for electricity transmission. Therefore, we are currently working to understand what the requirements will be for future supply and the demand forecasts that will be used in this process. This will ensure any changes will be fully considered, consulted with our stakeholders, tested, and implemented in time to deliver the first iteration of the CSNP.

Engaging with our stakeholders

The annual engagement cycle for the Future Energy Scenarios starts and finishes with the publication and launch event that takes place, usually during July. We combine the output from the engagement, together

with our knowledge and expertise, research, and evidence, to model and produce the credible pathways to the future of energy.

For FES 2023 we began our engagement at the FES 2022 launch, by listening to the questions asked by stakeholders during the webinars and identifying any gaps in our modelling. The planning of further engagement activities then began in summer 2022, shortly after we completed the programme of events for FES 2022. We took time to review the list of stakeholders and organisations from the previous cycle to determine those for continued engagement for FES 2023 and to identify any gaps in our stakeholder community. We looked to reach out to new organisations to begin engagement and build relationships. A key example of this is stakeholders knowledgeable in the hydrogen space where policy decisions are awaited, and large industrial and commercial end users. Bringing in new stakeholders every year ensures we are always hearing fresh views, new challenges, and ideas against existing and well-established points.

Our engagement strategy for FES 2023 covers three main approaches:

- **Online Call for Evidence** covering a range of subjects, available for all stakeholders to contribute their feedback
- **Bilateral engagement with key organisations**, asking for feedback on specific, focused topics
- **Topic Table Talks** with a range of stakeholders to discuss and debate a series of questions based around six topics

This approach, combining these different methods of engagement, together with our newsletters, website and social media interactions ensures that we are providing a variety of channels for stakeholders to be involved and inclusive for all.

Engagement comparison FES 2022 to FES 2023:

	2019 (2020 SFD)	2020 (2021 SFD)	2021 (2022 SFD)	2022 (2023 SFD)
Total number of stakeholders	**463** different stakeholders **590** stakeholders across all engagement	**1257** different stakeholders **1713** stakeholders across all engagement	**688** different stakeholders **1020** stakeholders across all engagement	**1020** different stakeholders **1516** stakeholders across all engagement
Total number of organisations	**224** different organisations **548** organisations across all engagement **109** new organisations for 2019	**460** different organisations **764** organisations across all engagement **347** new organisations for 2020	**329** different organisations **473** organisations across all engagement **204** new organisations for 2021	**364** different organisations **567** organisations across all engagement **236** new organisations for 2022 (excl. Monday FES launch and launch catch-up)
FES launch events	**248** stakeholders (London and Birmingham)	**984** stakeholders (live virtual feeds, recorded events, and catch-up sessions)	**570** stakeholders (live virtual feeds, recorded events, and catch-up sessions)	**3225** stakeholders (live virtual feeds, recorded events, and catch-up sessions)
Bilateral & regional engagement	**74** meetings	**185** stakeholders **86** organisations	**199** stakeholders **95** different organisations	**148** stakeholders **76** different organisations
Call for Evidence	**52**	**100**	**46** entered the survey; **36** provided actionable feedback	**61** entered the survey; **56** provided actionable feedback
Topic Table Talks	**n/a**	**n/a**	**n/a**	**New: 61** stakeholders from **56** organisations

	2019 (2020 SFD)	2020 (2021 SFD)	2021 (2022 SFD)	2022 (2023 SFD)
Other engagement and interactions to note	**50**	**30**	**55** stakeholders **31** organisations	**281** stakeholders **129** organisations

For our engagement monitoring, we use categories (shown in the table below) and subcategories of organisations. This ensures that as we progress through our engagement timeline, we are confident we are engaging with a broad range of companies, groups, associations, and bodies. This breadth of engagement across the energy industry is essential to ensure that scenarios are credible and plausible.

Stakeholder category	Total
Communities and their representatives	2
Consumers and consumer groups	66
Energy industry	869
Innovators	113
Non-governmental organisations	5
Other stakeholders including academics and universities	119
Political	94
Regulator	28
UK networks	220
TOTAL of 1516 stakeholders involved across all activities This does not include the 400 stakeholders that joined the FES 2022 launch executive event or the 1,984 stakeholders that have watched the launch virtual events on catch-up. We do not have the category breakdown for these stakeholders.	

Details of our communication and engagement activities

FES 2022 launch and publication: *18 July to 21 July 2022*

FES 2022 was published on 18 July 2022 on the FES website on a very hot Monday! Due to the intense heat of 40+ degrees in London on that day, our plans had to change at the eleventh hour. We had planned an in-person event at Central Hall in Westminster, with over 100 registered to attend the executive briefing. By using MS Teams, we were fortunate to be able to continue with the event online. We published a newsletter first thing on the Monday morning and updated our website to provide a link for all stakeholders to join us.

In doing this we were joined by approx. 400 stakeholders, many more than would have joined the in-person event. During the briefing, the FES 2022 key messages were presented which led to a panel discussion, followed by a Q&A session.

This event was held in conjunction with the independent think-tank Onward with Ed Birkett, Head of Energy and Climate, hosting a panel session looking at the future of the energy and what is needed to reach Net Zero.

The panel members, alongside host Ed Birkett were:

- Fintan Slye, Director, ESO
- Rt.Hon. Chris Skidmore, MP
- Lauren Stuchfield, Energy Insights and Analysis Senior Manager, ESO
- Laura Sandys CBE, Chair, Energy Digitisation Taskforce
- Maxine Frerk, Director, Grid Edge Policy

Following the executive launch event, we hosted four webinars, each focusing on one of the FES 2022 key messages:

Tuesday 20 July

- Key message 1: Policy and delivery
- Key message 2: Consumer and digitisation

Wednesday 21 July

- Key message 3: Markets and flexibility
- Key message 4: Infrastructure and whole energy system

These virtual deep dives all followed the same format; we looked at the risks, required actions and consequences for each key message. We had time for questions from attendees using sli.do, asking the most popular ones first, being transparent with the audience. A new element of the deep dives for 2022 were panel discussions with stakeholders representing different sectors of the energy industry and wider. These panels were hosted by members of the ESO and asked thought-provoking questions on what is needed to achieve Net Zero.

During the deep dive webinars, we held virtual networking sessions, providing the opportunity for stakeholders to meet each other and the FES team. These were topic based, allowing delegates to join the subject they were most interested in. These proved more successful than the previous year with over 150 stakeholders joining across all four sessions compared to 56 last year.

All the launch events were available to watch after the event via the FES website and will remain in place until the FES 2023 launch. Below we provide the viewing figures as of 18 January 2023.

Name of FES 2022 webinar	Number of video views
FES 2022 executive briefing	1131
Key message 1: Policy and delivery	261
Key message 2: Consumer and digitalisation	149
Key message 3: Markets and flexibility	276
Key message 4: Infrastructure and whole energy system	167
TOTAL	**1984**

We were delighted to be joined by 965 stakeholders across all four of the FES 2022 key message deep-dives. 536 of those were individual stakeholders.

The suite of FES 2022 documents was published on the FES website on Monday 18 July. This included the main report, FES in Five, data workbook and the scenario assumptions. We made changes to the website this year to make it easier for visitors to access the documents by making a FES 2022 landing page with the full suite of reports, executive summary, and key messages all in one place.

We received positive feedback during and after the launch events on how the presentations and documents this year noted and highlighted the 'what ifs' with clearer and more defined actions that are needed as a combined effort across the energy industry. We will continue with this approach for FES 2023.

Call for Evidence: *October 2022*

The FES 2023 Call for Evidence was published during October and remained open for 2 – 3 weeks. This online method of engagement provides all our stakeholders with the opportunity to contribute. Using MS

Forms to make responding more simple than previous years, we posed a series of questions on six different subjects. To promote the Call for Evidence we shared the survey via the FES and ESO newsletter, FES website and ESO social media channels. Following closure of the survey we published a summary of the responses through the website and FES newsletter. The summary can be found here.

The range of stakeholders represented the public, electricity storage, consumer bodies, gas networks, environmentalists, trade associations, consultants, and academia to name a few. We had 61 stakeholders in total enter the survey or provide their response direct by email. This is an increase on last year's results.

1:1 Bilateral engagement: *August to January 2023*

Our bilateral engagement with key organisations and stakeholders has again formed an integral element of our FES cycle. We began planning for this during August 2022, reviewing the list of organisations from FES 2022 and adding new ones for 2023. Bringing in new stakeholders every year is fundamental to ensuring the scenarios remain credible. New stakeholders bring new ideas with them, challenge to ideas, and fresh thinking which helps build relationships for future iterations of FES. This engagement started during September and will continue until late spring 2023. We plan to provide a further update for stakeholders on our engagement output later in 2023 via the FES newsletter and FES website.

Each bilateral meeting is planned specifically for that organisation. We agree in advance what we are going to ask stakeholders, sharing this with them prior to the meeting to enable preparation. We record all our engagement in our customer and stakeholder management tool, which gives us an electronic record of the meeting, including a copy of the agenda and feedback from stakeholders. During these meetings we ask specific questions that are relevant to that party as well as strategic questions on the future of energy to organisations that can provide a view.

We have spoken with 148 stakeholders from 76 different organisations between September 2022 and January 2023, gathering their insight and evidence for FES 2023 and beyond. Of those 76, 46 organisations were new for 2023. We will continue to seek new stakeholders for engagement as we head towards spring.

Topic Table Talks (TTT): *January 2023*

We were delighted to host and welcome stakeholders to our TTT event on Thursday 12 January in London. We provided an open invite asking people to register their interest to attend as well as sending direct invitations to existing stakeholders knowledgeable in the topics being covered.

The topics were chosen based on previous feedback and continuing the themes in the 2023 Call for Evidence. We planned the topics to bring experts together to help shape our analysis and challenge our thinking in the areas where we believed this would be most beneficial. This in-person event provided our valued stakeholders with a chance to meet with our team of analysts and insight leads. At the event we provided an update on our FES 2023 plans and asked a range of strategic questions on the future of energy. This led to the detailed round table discussions focusing on:

- Energy demand
- Energy supply
- Hydrogen and whole system
- Flexibility & storage
- Regional insights
- Consumer archetypes project

Each topic had three specific questions set in advance, there to guide the conversation to ensure valuable feedback was gathered from stakeholders. These three questions were all sent to delegates in advance to allow time to prepare.

We used sli.do as the platform to ask the strategic questions to all attendees about the future of energy and as a method for any questions during the day which our team of analysts answering throughout the event.

During the day, following the network lunch we offered short 'pop-into-the-pod' slots for attendees to meet 1:1 with members of our team, to provide additional insight or simply to find out more about our work.

Regional engagement: *ongoing*

We continued to evolve how we develop our insights about the future energy system, nationally as well as regionally. As part of our analysis and engagement in FES 2022 we focussed more than ever before on understanding the regional insights for energy supply and demand through to 2050. Some of the key engagement activities we have undertaken over the past year included the development of an "explainer" document alongside an interactive webinar to explain why we are focussing on the regionalisation of FES and to understand what our stakeholders are interested in us focussing on from a regional perspective. We discussed our ambition to provide:

- **Better insights for better decisions:** Strengthen GB (Great Britain) insights with regional outputs and a coherent set of whole system scenarios, through enhancing regional assumptions and modelling (including better reflection of local factors, technological and fuel differences, increasing accuracy of models with spatial and temporal variations), to provide better information for policy and transmission investment decisions, which are a key enabler of Net Zero
- **More consistent and transparent outputs:** Providing customers with clear, consistent, and comparable scenarios, developed through cross-industry collaboration, where modelling differences will be easily understood, and the data easily compared and shared
- **Greater granularity for targeted solutions:** Be able to anticipate regional operability issues on the transmission system with enhanced regional data and provide greater support for conversations with industry stakeholders

We also published a summary of our regional insights alongside the main FES document in August – we want to use this document and other regional insights we are producing to continue the debate on regional energy, ensuring that our stakeholders can input into our assumptions.

We used FES 2022 to test some of our new regional outputs with stakeholders and the feedback we have received from these activities is being used to strengthen our regionalisation activities in the future as we focus more on providing analysis and insight on a more granular regional basis. Further regionalisation of FES is helping us to broaden our engagement to bring in new voices and perspectives, enhancing our understanding of consumer behaviour and sense checking the FES outputs so we understand what they mean on a more local level.

Network Forum: *Ongoing*

The FES Network Forum meetings continued bi-monthly throughout 2022. These are attended by stakeholders from Gas Distribution Networks, Electricity Distribution Networks Owners, and Transmission Owners. The meetings take a collaborative approach, with the agenda agreed beforehand and any suggestions for items to be included. The slides, key meeting points and a recording of the session are always provided after the meeting. We constantly seek feedback from attendees to ensure that maximum value is achieved. At the December meeting, we began the engagement for the Consumer Archetypes project in collaboration with Centre Sustainable Energy and Element Energy.

These meetings ensure that any key messages regarding FES, related projects and wider ESO subjects are shared in a consistent, timely manner with key organisations and stakeholders.

Bridging the Gap: *March 2022 to date*

Bridging the Gap to Net Zero continued its engagement with stakeholders about specific aspects of the FES key messages. The project looks at the flexibility required to achieve the 2035 target of operating a Net Zero electricity system. In March 2022, we launched a report outlining the key flexibility actions required shown on a timeline for between now and 2035. Alongside the flexibility timeline was a Day in the Life of 2035 report, walking through exactly what operating a Net Zero electricity system could look like. Both reports were based on stakeholder feedback as well as ESO expertise and the launch attracted over 500 sign-ups, with almost 350 attending on the day.

The next phase of the project is now underway, looking in detail at two key elements of flexibility: hydrogen and consumer engagement. In November 2022, we invited over 40 organisations to join us at in-person workshops to discuss the barriers to and actions needed to progress the availability of hydrogen and increased consumer engagement. This report is due to be published in March 2023 and will outline key recommendations to progress both these areas.

Consumer Archetype project engagement

As part of the drive to better understand consumer behaviour on both a national and a regional scale we commenced an innovation project to investigate the development of a set of industry standard consumer archetypes in conjunction with the other network companies. We anticipate the project, which is due to run through to May 2023, will involve extensive cross-industry engagement and will be used to enhance our modelling assumptions as well as an input into other ESO consumer initiatives.

This set of archetypes will cover both gas and electricity and are intended to benefit the further development of future energy scenarios across the whole energy system, gas and electricity, transmission, and distribution.

To ensure these archetypes reflect all areas of the network and account for localised and regional context and changes, we intend this to be a collaborative process. We therefore intend a key output of the project to be the creation of a common language with regards to consumer behaviour which will be used to aid discussions with the other network companies.

Demand Flexibility Service engagement

ESO took a collaborative approach, working with industry and wider stakeholders, to develop and launch a new Demand Flexibility Service (DFS) for the winter, which incentivises consumers and businesses to voluntarily flex the time they use electricity. This engagement ensured maximum energy retail supplier and aggregator participation in DFS and volume reduction. The engagement approach derived from concept initiation and design which commenced in July, through to service implementation in November 2022 and continued engagement as we continue to develop insights and evaluation of DFS. The expertise of suppliers, aggregators, technology providers and consumer organisations helped develop the service and ensured a strong consumer focus and better outcomes for all stakeholders.

A working group was established and chaired by Energy UK on behalf of ESO to provide a forum to feedback on the development of the new service which was brought to market at pace. We held six key industry and consumer stakeholder events including co-creation workshops, webinars and open days seeking input and feedback from a wide range of stakeholders. Circa 150 organisations directly engaged throughout these events, including suppliers, aggregators, industrial and commercial users, consumer groups, trade groups, investors and technology companies and academia; and reached an international audience with interest from Ireland, US, Poland, and Denmark. There are currently 26 providers participating in the Demand Flexibility Service including most larger domestic energy suppliers who have been engaged closely with and supported with one-to-one meetings.

This targeted engagement and market wide activity was completed in addition to our formal consultation process and BAU (Business as Usual) industry channels such as the weekly Operational Transparency Forum.

Organisations that we have directly engaged with include Advice Direct Scotland, Citizens Advice, Citizens Advice Scotland, Centre for Sustainable Energy, Data Communications Company (DCC), National Energy Action, Smart Energy GB and all the Demand Flexibility Service registered providers.

Open networks and Energy Network Association

We have continued to engage extensively and work closely with the network companies through the Open Networks project. As part of the FES and DFES (Distribution Future Energy Scenarios) alignment working group we have worked together with the DNOs (Distribution Network Operators) on several reports which were produced for the following purposes:

- To explain the purpose of the energy scenarios in DFES and FES, highlighting the benefits from the alignment between DFES and FES as well as the further standardisation of DFES across the DNOs
- To propose how the agreed “initial alignment & feedback loop model” for the DFES-FES alignment can be enhanced by focusing on information and data exchanges around the annual energy forecasts and converge, where appropriate, assumptions between DFES and FES
- To agree a consistent definition for Grid Supply Points (GSPs) and associated names across GB between the ESO and all DNOs to support the data exchange of whole system Future Energy Scenario building blocks

We also continued to engage with the Whole Energy Systems workstream within Open Networks and shared learnings from our innovation projects that have whole system benefits. Through this workgroup we also provided our feedback into how Local Area Energy Planning could be standardised and how information exchange could develop between network operators and Local Authorities.

Electricity Transmission Network Planning Review (ETNPR) engagement

As part of the ETNPR, there have been several external working groups on the potential and decision-making process that will feed into the creation of a Centralised Strategic Network Plan (CSNP). These working groups have been set up to provide input into the early thinking for the future planning process which includes consideration of the scenario development process, providing important perspectives from our external stakeholders. This feedback will help shape the future process and enable us to understand how we might need to adapt the FES going forwards. The participation at these workshops has been broad to ensure we heard from a wide cross-section of the industry as we address the challenge of identifying strategic investments on the electricity network that will enable GB to meet its Net Zero targets.

International engagement

We continued to welcome stakeholders from far and wide during 2022 with our FES newsletter reaching those in USA, Italy, Japan, UAE, Chile, and Israel. During the FES 2022 launch we were delighted to be joined by stakeholders from Denmark, Ireland, Germany, Spain, and Portugal.

BEIS (Business, Energy, and Industrial Strategy) and Ofgem engagement: *ongoing*

We have continued regular engagement with both Ofgem and BEIS since the previous publication of the Stakeholder Feedback Document. This engagement is both at a working level, occurring monthly or fortnightly, depending on the level of activity and a more strategic level, looking at the longer-term purpose of FES and the future advisory role of the FSO. We also engage with government departments on specific subjects like transport and hydrogen. Engagement will continue through 2023 as we approach the time of FES publication and launch.

Other engagement

One of the important outputs of our scenarios is a view of how the whole energy system might interact with individual technologies. For example, we were able to provide insights into a recent Parliamentary Office for Science and Technology publication on the future of nuclear in the UK and how the ambitions for nuclear deployment in the Government's energy strategy may work alongside our projections for renewable energy generation.

We continue to engage with the UK academic community to understand the current best practice in modelling and analysis of energy systems as well as technologies that may impact our scenarios. We are also keen to engage directly with undergraduate and post-graduate students who wish to continue their careers in energy. We ran a two-day student 'hackathon' at the University of Warwick where the students were tasked with predicting which areas of the country would benefit most from heat pump installations. These activities not only provide direct insights into areas of interest but also help guide how the methodology for our scenarios may evolve over the coming years.

We also attended the following events where we contributed or spoke about FES, Net Zero, hydrogen and the wider energy landscape:

- Utility Week Forum - **November**
- Aurora: The economics of importing hydrogen - **December**
- Digital dialogue on 'What is the smartest way out of the energy crisis?' the Financial Times with Patagonia - **November**
- LCP Delta: The home energy interoperability utopia - **November**
- Hydrogen APPG (All-Party Parliamentary Groups) Meeting - Carbon Intensity in Hydrogen Production - **December**
- Gas and electricity transmission infrastructure outlook 2050 - **October**

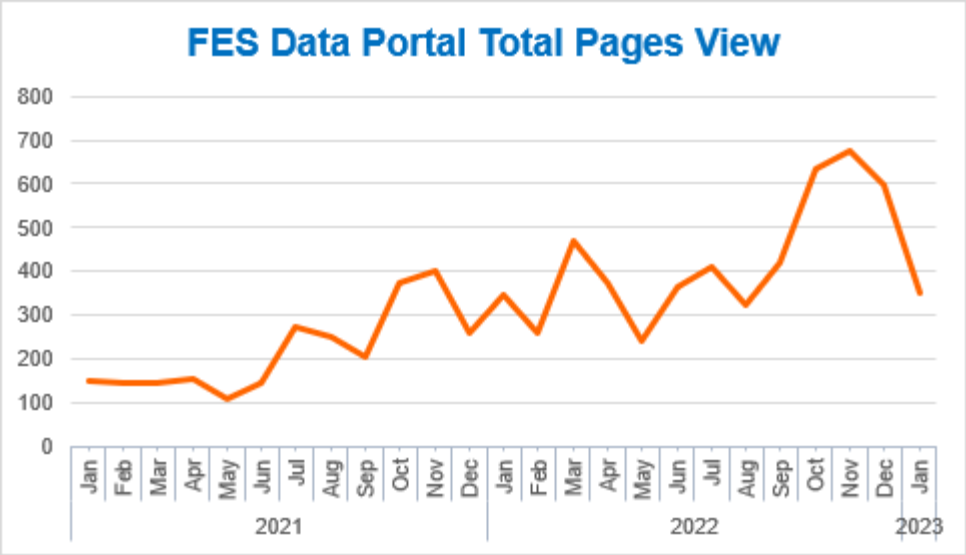
Memberships

In addition to the engagement we carry out, we are signed up to variety of energy subscription services. These provide further information, data, and research on topics such as electricity, hydrogen, and natural gas. This combination of engagement and membership directly feeds into our analysis to help shape the scenarios we produce. Examples of some of these services are Oxford Economics, Bloomberg, and Wood Mackenzie.

ESO data portal

The ESO data portal is a dedicated platform for customers and stakeholders to openly access ESO information. FES data has been added and revised throughout FES 2022. Use of the data portal continues to grow, between January 2022 and January 2023 the FES data was accessed via the data portal a total of 5,466 times which is an 85% increase on the previous year. The key data groups are building blocks, electricity supply, spatial heat model output and regional breakdown of FES, with regional data receiving the most views.

For FES 2023 we are continuing to work on the models and data availability, this should have a positive impact on future FES documents and the portal.



FES newsletter

We continued to publish, every four to six weeks, the FES newsletter to the future of energy distribution list of circa. 6,300 subscribers. The newsletter is our main method of communicating with our stakeholder community. We share information and invitations to our engagement events, publish thought pieces, request feedback, and provide updates on our plans. We published ten newsletters between February 2022 and January 2023.

FES website

For the FES 2022 publication we made changes to the website to improve accessibility and ease of use for stakeholders. We created a landing page for FES 2022 so that all documents, including executive summary, key messages, and individual chapters were all on one page. Shortly after the launch we added the recordings of virtual sessions to provide stakeholders with the opportunity to watch on catch-up.

The website is also home to our thought pieces, information on how to connect with us, regional insights, and FES publications from previous years.

We have seen an increase in the number of downloads of the main report, FES in Five, scenario framework and time spent on the website. (Data is from March 2022 to 18 January 2023).

Reports	2020	2021	2022
Total document downloads	21,687	15,120	**22,130**
Main document downloads	11,229	10,532	**10,759**
FES in Five downloads	5,138	2,542	**4,686**
Data workbook downloads	4,081	3,430	**3,397**
Scenario framework download	1,171	686	**809**
Launch webinars catch-up	n/a	n/a	**1,984**
FES page views	62,729	116,486	**109,618**
Average duration on FES pages	2m 43s	2m 22s	**2m 58s**
Latest news thought piece page views	n/a	n/a	**890**

ESO social media platforms

We continued to use the ESO social media platforms to promote FES and our work. Using these mediums allows us to reach out further than our subscribed list for our newsletter, encouraging ongoing debate about the future of energy. During the FES 2022 launch we shared the FES 2022 key messages and insights from the analysis.

March 2022 to date (FES, BtG and Regional)

- **Twitter**

Total 87,215 impressions. Most popular – 20, 757 for the day of FES 2022 launch

- **LinkedIn**

29,652 followers ESO LinkedIn

Total 84,204 impressions. Most popular 9,026 for the FES 2022 launch and links

FES email account

We have a dedicated email account for our stakeholders to contact us with queries about our engagement, modelling, and analysis. Most of our queries are answered within our set service level agreement of five working days. Some queries that require a more detailed response may take longer than five days, though we keep the stakeholder informed throughout. We have received approximately 56 queries from a range of stakeholders covering a broad spectrum of subjects since the FES 2022 launch in July.

Measuring stakeholder engagement

As well as constantly seeking feedback on how well we are doing and areas for improvement, we have metrics in place to measure what we do. This allows us to compare to previous engagement in our team and across the ESO. We always strive to improve and having these measures ensures we continue to do so.

We ask attendees to provide a score out of 10 following the event which we use to determine the Net Promotor Score (NPS). NPS is an index ranging from -100 to +100 that measures the willingness of customers and stakeholders 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. Within the ESO we have an internal target of +20 for our engagement activities.

For other satisfaction measures we use a scale of 1-10, asking stakeholders to rate the engagement based on their experience, with 10 being the highest. The table below provides the scores from our engagement activities since the FES 2022 launch. Further information on all these events can be found on page 63 onwards.

Event	Date	Measurement score
FES 2022 launch (Wed and Thu only)	July 2022	8.23 out of 10 NPS: +37
1:1 bilateral engagement	August to date	8.47 out of 10
Formal ESO satisfaction survey	September 2022	8.69 out of 10
Bridging the Gap	November 2022	8.2 out of 10 NPS +53
Electricity storage webinar	January 2023	8.34 out of 10 NPS +39
Stakeholder topic table talks	January 2023	8.72 out of 10 NPS +52

Engagement and communication improvements

From our engagement feedback we have identified the following areas to improve for the future. Whilst we cannot address every single piece of feedback without contradicting previously received feedback, our team of experts look to reach the best solution for all concerned.

Communication		
You said:	**We will:**	**Where was the feedback gathered?**
Communicate and listen to the public, bearing in mind future developments on the cost of energy to industry and the public. The objective should be to reduce the cost of energy	We already work closely with the ESO consumer team who engage with those representing consumers. For 2023 and beyond we will be working on understanding consumer behaviour through our innovation projects, the key one being the Consumer Archetypes innovation project which will give as a deeper understanding of how the public will interact with the energy system of the future. This will include consideration of factors such as cost	FES 2023 Call for Evidence
It would be good to see FES mentioned more in the national media to raise its profile with the public	We will work with ESO Corporate Affairs department as we approach the FES 2023 launch to look to bring FES into mainstream media and digital platforms: both at a local, regional, and national level	FES 2023 Call for Evidence
It might be helpful for ESO and DNOs to do some joint communication and engagement to increase understanding of the FES at local and regional levels	We will work with ESO Corporate Affairs department and the DNO's to look to bring FES into mainstream media and digital platforms; both at a local, regional, and national level	FES 2023 Call for Evidence
While FES are presently mainly directed to professionals of the energy industries, it would be good to explain the basic elements to the public who need to understand what the UK and the world needs to do to achieve Net Zero fossil carbon emissions by 2050	For FES 2023 we will be publishing a new 'energy background' document that will provide essential information on the energy industry that will help inform others	FES 2023 Call for Evidence

Communication		
You said:	**We will:**	**Where was the feedback gathered?**
Education and engagement of the general population in energy matters is slow and so far, inadequate There needs a lot more, for a long time, engagement with the general population to bring them on the path to a sustainable energy system	We will work with ESO Corporate Affairs department and others from across the energy industry and wider to bring the Net Zero journey and into mainstream media and digital platforms: both at a local, regional, and national level. This will help to inform and educate	FES 2023 Call for Evidence
FES may benefit to be presented at trade body conferences where most of its industrial stakeholders are present	For FES 2023 we have engaged with trade associations that represent many energy users. For future iterations we will look to increase our engagement with trade bodies	FES 2023 Call for Evidence
It would be good to see more regular updates post FES launch on the plan for the remainder of the year i.e., if you intend to do workshops/bilateral engagements. This would give us a heads-up to look out for further communications	We regularly share updates via the FES newsletter which is published approx. every six weeks. This is our main method of communicating with stakeholders and we always provide advance notice of any engagement. After the FES 2023 launch we will share a timeline of our engagement in our post-event newsletter	FES 2023 Call for Evidence

FES documents		
You said:	**We will:**	**Where was the feedback gathered?**
When FES updates are published (i.e., a new version of the workbook), is it possible to be notified	We will provide notification in our newsletters when any of our documents are updated. We have already started doing this for the data workbook	FES 2023 Call for Evidence

FES documents		
You said:	**We will:**	**Where was the feedback gathered?**
Moving from one year's FES to the next appears to result in inconsistencies in the datasets being presented – both in terms of what data is being presented and how it is presented, which makes tracking metrics more difficult	We continue to provide more data via the data workbook and try to keep formatting and standards etc. consistent within this document	FES 2023 Call for Evidence
More detail around flexibility modelling and how balance of technologies across scenarios are determined	Flexibility is an area we continue to focus on, and this will continue over the coming year. The need for more focus on this has led to specific presentations and chapters within our FES analysis	1:1 engagement
Long for a return of the small book, packed with data and easy to read, I'm not a fan of web-based documents	For FES 2023 we will look to provide a print version of FES-in-Five making it easier to print at home and office. We do not intend to return to providing hard copies of our documents as we consider our carbon footprint and the expense	FES 2023 Call for Evidence
Would like to understand the audit process for FES, for example based on the experience from last 7-8 years how accurate have the scenarios been	We would recommend that this stakeholder speak to us directly on this subject so we can describe our processes and understand their needs better	FES 2023 Call for Evidence
More can be done to explain how the different pieces of modelling and FES puzzle fit together to produce its scenarios. This can be in the form of a simple flow diagram showing the relationships between the different models	Some of this is included in the modelling methods document published alongside the main FES document. For FES 2023 we will consider how best to show the interactions between the models	1:1 engagement

FES documents		
You said:	**We will:**	**Where was the feedback gathered?**
The quantity and detail of free to download data makes FES an extremely valuable resource. FES could do more to help educate its stakeholders on how to make best use of this data and the importance of performing detailed analysis	For FES 2023 we will consider how best to present this.	1:1 engagement

FES launch event		
You said:	**We will:**	**Where was the feedback gathered?**
Ensure that all questions from the Q&A are addressed regardless of popularity, as some of the answers to these questions will have implications for the DFES modelling that we do	As we did during the FES 2022, we will endeavour to answer as many questions as we can during the live webinars for 2023. Using sli.do provides the ability to 'up-vote' questions, we then start with the most popular. Due to the volume of questions raised we may not be able to cover them all. We always provide the FES email account for stakeholders to contact us after events	FES 2022 launch webinars
It would be good to share a version of the slides in advance to help with questions/following along	We will consider how this is possible. Timescales are short between getting the analysis finalised and our launch. Currently, this is a limiting factor	FES 2022 launch webinars

FES launch event		
You said:	**We will:**	**Where was the feedback gathered?**
It would be useful to leave more time for participants to go through FES reports ahead of the launch of webinars and sessions. With the market, and the energy industry getting more complex, FES reports are also getting denser. Thus, allowing more time for participants to digest the information in the report would enable a more valuable and active engagement	For FES 2023 we will consider the timing of the publication together with the programme of launch events, allowing sufficient timing for the reports to be digested and to suit most stakeholders	FES 2022 launch webinars
Spreading out the Deep Dive sessions would be useful. These could take place within a week rather than 2 days to allow more time for reflection and more valuable Q&A sessions	For FES 2023 we will consider the timing of the publication together with the programme of launch events, allowing sufficient timing for the reports to be digested	FES 2022 launch webinars

Engagement		
You said:	**We will:**	**Where was the feedback gathered?**
It might be helpful to add some structure or even some pre-work to ensure maximum value for time spent like a pre-survey to the stakeholder to list the 5 main topic areas you'd like to cover in the session?	For our 1:1 engagement we send an agenda to those invited to help prepare for the meeting. In addition to this, for future meetings, where appropriate, we will look to send pre-read with more explanation about what the session will cover	1:1 engagement

Engagement		
You said:	**We will:**	**Where was the feedback gathered?**
Earlier sight of the agenda would benefit all	For our 1:1 engagement we send an agenda to those invited to help prepare for the meeting. For future meetings we will look to send this at least a week in advance to provide more time	1:1 engagement
It would have been useful for the ESO team to have a shared a bit more information on what they are working on	For our future meetings we will look to factor in some time to the meeting to provide an update on FES and what we are working on	1:1 engagement
Ensure that stakeholders are approached each year	This is fundamental to our FES process, and we do this in a wide range of ways to ensure we are accessible to a variety of stakeholders. We will continue to do this	1:1 engagement

Summary of engagement output for FES 2023

Energy Demand

Transport

Summary of views expressed

- Consensus that our range is broadly correct with exceptions stated below. The Government Zero Emissions Mandate Consultation's minimum forecast is within the FES 2022 scenario range, but a significant source (ICCT LCA Paper) differs from FES assumptions
- Wide range of views on V2G (Vehicle-to-Grid) levels although there are views are that our higher boundaries are too ambitious
- There has not been any significant market or policy changes for transport since FES 2022 modelling was done. The consensus is that main FES scenarios remain credible for transport demand and EV (Electric Vehicles) uptake although there is now more uncertainty about when and where this demand will occur on the network. Though they are a significant and growing source of potential demand flexibility, we do not have certainty over the mechanisms to harness that flexibility.
- Hydrogen and electrification both play a role for HGVs with electric road systems being more likely in scenarios with more electric HGVs

Decisions made, impact and rationale

- We will not update any transport demand data for FES 2023. This decision is based on stakeholder consultation, the absence of any significant changes in transport policy and confirmation by the government Zero Emissions Mandate Consultation results
- V2G will be an important part of our modelling in our new dispatch model exploring whole system flexibility. This is supported by more focussed innovation projects to better understand V2G deployment and operability. We are also considering commissioning similar projects to understand changing demand for HGVs. Any review of our HGV technology mixes will focus in the first instance on whether the mix of BEVs (Battery Electric Vehicle) and hydrogen HGVs is credible
- We will continue to test our assumptions with stakeholders, understand differences where they arise and update future FES numbers accordingly

Key areas of uncertainty

- Amount of flexibility delivered through V2G, as well as general routes to implementation for V2G. Range of stakeholder views have been wide since we started exploring this in 2020
- When and where transport demand will occur on the network including charging hubs and electric HGV demand

To be taken forward for future consideration

- We will review V2G views again for future analysis beyond FES 23 and intend to update scenarios to reflect any new insight and outputs from our new dispatch model
- We are working on a Network Innovation Allowance (NIA) innovation project which has the potential to represent a significant step forward in our capability to understand what would motivate consumers to engage and to model V2G and rapid charging hubs going forward. We will look to implement these findings into our modelling methods beyond FES 23.

Sources, research, policy, and evidence used

- Our approach this year is to engage with transport stakeholders throughout the year to enhance our relationships with them further and ensure rich insight is feeding into our future analysis. The stakeholders we're reaching out to represent a cross section of experts from political organisations, energy industry analysts, trade bodies, aggregators etc. Currently stakeholders seem broadly comfortable that our vehicle uptakes cover the credible range of uncertainty. As a result, we will be

seeking their feedback on what the key uncertainties are in the modelling which they would like us to focus our efforts on. We will be placing more emphasis on seeking views of experts on the elements of our modelling which impact the within day shape of demand. With this in mind, we are also reviewing studies on electric van charging and on-street smart charging to assess the impacts

- We have so far spoken to electricity networks, and they have highlighted that the key uncertainties in the transport sector include the scale of V2G and the charging profiles of electric HGVs. We plan to address these in FES through an innovation project on V2G which is underway and a proposed project to understand HGV charging profiles

Industrial & Commercial

Summary of views expressed

- Our stakeholders have provided their views of future energy prices, economic output, and data centre connection capacities
- The FES 2022 Consumer Transformation and System Transformation I&C demand scenarios were deemed to be credible boundaries for an electrified or hydrogen economy by a trade association.
- The impact of high energy prices and a slowing economy will lead to a range of different energy demand responses, according to the industrial or commercial sub-sector
- Opportunities for large industries to participate in flexibility are limited
- Scottish plans for the role of hydrogen in its energy system are especially detailed and ambitious.
- There is reduced demand in the next year compared to FES 2022 5 Year Forecast
- Industrial clusters will act as catalysts for demand – particularly of decarbonised hydrogen

Decisions made, impact and rationale

- We will use updated data on data centres, economic output, and energy prices to update our five-year forecast and confirm that the FES 2022 scenarios remain appropriate
- We will complete our assessment of the industrial and commercial energy demand scenarios once the stakeholder feedback is fully assessed and incorporated into our modelling
- We will continue to monitor the economic environment in relation to how this may affect future industrial and commercial energy demand
- We will review our fuel switching data considering Scotland's new hydrogen action plan (Dec 2022)

Key areas of uncertainty

- Exact energy demand responses to high prices and slowing economy
- Whether there will be more or less investment in energy efficiency – smaller capex budgets vs. increasing energy costs
- Whether the drop in demand is temporary (1-3 years) or long term (3-30 years)
- Locations of electrolysis capacity
- Industrial decarbonisation pathways

To be taken forward for future consideration

We have learned more about how industry hedges prices risk to protect against high prices. This will be considered when we update our industrial and commercial demand model.

Sources, research, policy, and evidence used

- We spoke to several industrial manufacturers and a trade association which represents large energy consumers. We also spoke to two electricity network organisations and an economics consultancy
- We are anticipating a significant downturn in the economy over the coming few years, as well as continuing high energy prices. From the stakeholders that we have spoken to, we are told that changes to the economy will have an impact on energy demand. The impact will vary from sub-sector to sub-sector. Similarly, high energy prices will affect certain sub-sectors more than others

- Our engagement with the electricity network organisations will ensure our forecasts of data centre capacities and demands are appropriate
- We have learnt more about the various hedging strategies adopted by industrial and commercial organisations, to protect against variations in energy prices. This will be taken on board when updating our industrial and commercial energy demand model
- We anticipate that there maybe a few remaining stakeholder bilateral engagements for industrial & commercial energy demand after the publication of this Stakeholder Feedback Document

Heat and Appliances

Summary of views expressed

- FES 2022 Leading the Way and Consumer Transformation heat pump uptake are much higher than the current uptake. Some baselines of heat pump installations looked at this year are below those given in Falling Short. The Boiler Upgrade Scheme alone is likely to be insufficient to meet required number installations. It was also noted that GSHPs now receive significantly less funding than they did under the RHI (Renewable Heat Incentive) scheme
- There is a lot of scope for further developing the analysis on hydrogen for heating and its logistics in FES, particularly around cost analysis. More information is needed, weighing up cost and performance of heating technologies against each other for homes, e.g., heat pumps, DH (District Heating), and hydrogen for a typical home. Some suggested that the hydrogen demand in Falling Short is too low. Majority of stakeholders do not believe hydrogen for heat is economical or efficient and that there are many infrastructure challenges. A minority believe it is preferable, citing the large amount of energy the gas grid can carry compared to the electricity grid and the investment needed in the electricity network
- Fundamental to the transition to Net Zero for heating will be policy. More policy is needed to encourage the uptake of Net Zero heating technologies. Significant transition to heat pumps and high energy efficiency in new builds is unlikely without regulation. We would like to know more about preparations for capacity – how will grid/network capacity be prepared for an increase in distributed generation, heat pumps and EVs, so that this is not a blocker for uptake?
- Regional data, on where heat networks would be cheapest and most effective, would be highly valuable in helping to socialise knowledge and analysis for where funding can best be targeted.
- Heat pumps with thermal storage offer significant demand flexibility opportunity – not just by flattening the peak, but by *overheating* and storing ahead of peak demand periods. Phase change storage suggested

Key areas of uncertainty

- What incentives there will be for residential decarbonisation and efficiency improvements
- How much infrastructure affects uptake of different heating technologies?
- Better understand the drivers of electrification in heat
- GB policy on hydrogen for heat (expected 2026)

Decisions made, impact and rationale

- Where relevant, these updates will be incorporated into the central forecast for FES 2023
- We will need to make reasonable assumptions about likely policy for the FES near-term view and the specific outcomes of the hydrogen for heat decision due in 2026

To be taken forward for future consideration

- A review of assumptions for the other scenarios will form part of future modelling. Though we now have updated insight on likely heat pump numbers, that mostly applies to the near-term, so an update to the central forecast remains the preferred way to reflect this
- We will explore the integrated roles of heat pumps, thermal storage, and cooling demand. We note the potential for demand flexibility and inverting peak heating demand

- One stakeholder suggested that increasing heat pump efficiency by 50% would yield an equivalent demand reduction as insulating every solid wall in GB homes. We intend to explore this further in future

Sources, research, policy, and evidence used

- Our stakeholders include the heat pump industry, heat network and gas networks, electricity networks, housebuilders, consumer advice and consumer representative bodies
- Our written sources include a wide range of articles from different points of view, published policy, intended policy, economic data, and official government numbers for 2022 (DUKES)

Overall demand

Summary of views expressed

- Giving consumers choice at the individual level for heat decarbonisation would lead to a very expensive network. To minimise network cost, consumer choice may be limited e.g., gas grid connection to new homes ending
- Heat is the main elastic energy demand on the consumer side which people expect to fall, largely due to consumer response to high energy process
- Monthly gas throughput reports show significant demand reduction through the monthly trends on overall gas demands
- Stakeholders confirmed there is a variety of energy demand responses in relation to high prices – each sector is sensitive to different degrees. Similarly, there are a variety of responses to GDP, although this may be more significant to the trade association members. Individual consumer behaviour is generally expected to be more conscious of energy use, but many people will not be able to invest in residential decarbonisation without support
- Stakeholders are not expecting a major effect on I&C demand from the financial crisis besides short-term shocks
- Long term decarbonisation in I&C is very dependent on the location and strategy for hydrogen roll-out. Decarbonisation through use of hydrogen will be very difficult for organisations not close to hydrogen production and industrial clusters
- Unanimous position: stakeholders would like clearer messages comparing electricity and hydrogen for residential heat costs, albeit not necessarily from FES
- Hydrogen vs. electrification won't just be about which technology is superior, it will be about which one is easier to implement, as well as its net whole system benefits
- There is general agreement that new hydrogen demand would be seen around industrial clusters first
- Some consumers are rejecting hydrogen boilers in favour of heat pumps (because they have an electricity supply, but not a hydrogen supply)
- Some stakeholders believe that our heat pump numbers are too high in the near term. This will be reflected in the FES near-term view. Bilateral stakeholder engagements show a consensus that the scenarios show the correct range for the longer term i.e., with more financial support for them
- Multiple stakeholders stressed the importance of not waiting for perfect solutions and remembering that cumulative emissions must be minimised to slow climate change, which may often mean deploying an imperfect solution earlier

Decisions made, impact and rationale, key areas of uncertainty, to be taken forward for consideration for FES 2023/2024 and sources, research, policy, and evidence used.

These areas have been covered under each sector specific section above.

Regional Insights

Summary of views expressed

- Our stakeholders have continued to be supportive of further regionalisation of the Future Energy Scenarios. We have heard that our stakeholders would like us to continue to focus on the aim to enhance the interaction and the alignment between the FES and the DFES as well as further using the specific customer intelligence we receive directly from customers or via the network companies. Through this, there will be a need to ensure there is a consistency of assumptions and narratives between regions as well as making sure local ambitions are balanced with national considerations
- We have also heard that we need to continue to be as transparent as possible as well as broadening our engagement as we seek to add more granularity to our modelling and insights. This will include sharing data in an open and accessible way as well as making the assumptions that currently underpin our regional breakdown available and explaining how those assumptions will change over time
- Views have been expressed on how we should incorporate the outputs from Local Area Energy Plans as they develop and that we should look to make use of the high granularity data about local areas

Decisions made, impact and rationale

- We are committed to provide more granular data in the future. This year we have published full spatial outputs from our heat model, and we intend on publishing additional spatial data alongside additional regional insights during the FES 2023 cycle and further into the future. We will also be adding additional data to our visualisation platform, including the visualisation of our spatial heat model outputs and the building blocks data – these are the common building blocks that ensure the results of the GB FES and DFES are published to a consistent template making comparison easier
- We want to continue to ensure there is increased alignment between FES and other regional scenario projections and are working on agreeing common definitions for Grid Supply Points (GSPs) as part of the ENA (Energy Networks Association) Open Networks project and we are also agreeing focus areas following a comparison of the building block data
- Our modelling includes consideration down to individual project level for our electricity supply analysis. We are currently assessing any relevant project level changes between FES 2022 and FES 2023 which could mean there will be changes in dates and locations on an individual site basis which may not have a material impact on the aggregated technology levels we publish in our data workbook when comparing FES 2022 with FES 2023

Key areas of uncertainty

- The likelihood of individual region carbon abatement targets being reached
- The potential move to a nodal market structure and the impact of the location of future energy supply and demand
- Uncertainty around the role of hydrogen and where assets could be in the future is one of the main obstacles to planning strategic investment across the whole energy system

To be taken forward for consideration for FES 2023 and beyond

- We intend to work with the Gas Distribution Networks to explore a more granular view of gas scenario projections that can be shared with industry to help understand actions needed to decarbonise the gas network
- One of our next steps is also to create a common language and consumer segmentation with both gas and electricity network companies. We aim to understand how consumer behaviour will vary with time and across geographical locations to then apply to future scenario development for both distribution and transmission network planning. To address this, a “Consumer Building Blocks” project has kicked off and will run in parallel to our FES 2023 cycle. As part of this we want to better understand how demographics will influence outcomes on the energy system, investigating what drives outputs at a regional level. We

intend on publishing a series of thought pieces on this topic and investigating this further as part of the Consumer Building Blocks project

- We want to ensure there is coordination between local and/or regional energy plans and national policies. We do not intend on duplicating effort, but rather to understand how the feedback loop between local area energy plans, DFES and the FES works in practice. Furthermore, we recognise we need to work closely with, and through, the regional network operators who have established relationships and data exchange processes with the local authorities

Sources, research, policy, and evidence used

- Distribution future energy scenarios
- FES 2023 Call for Evidence
- Industry webinar on regionalisation (May 2022)
- Bilateral engagement
- Scottish whole energy system scenarios
- Guidance on creating a Local Area Energy Plan (Energy Systems Catapult)
- Welsh Future Energy Grid for Net Zero (Energy Systems Catapult)

Whole energy system, gas supply and hydrogen

Summary of views expressed

Stakeholder engagement for Whole System and Gas Supply continues beyond the publication date of this document. This is partly due to the analysis in this area beginning later in the overall FES cycle, but also due to the increasing level of activity concerning the whole GB energy system and the transition to low and zero carbon fuels. If the team were to conclude engagement by early January, then there may be the risk of missing out on timely developments and information that would otherwise inform our modelling.

- Whilst the rate of **UKCS** (UK Continental Shelf) is declining, there is likely to be little impact on new gas fields starting production in the near term, and in fact projects could speed up if the Government's Net Zero targets begin to significantly impact the gas market
- Transition of **interconnectors** to hydrogen - a key question stakeholders are considering but don't have a firm answer to is how to transition their pipeline from natural gas to hydrogen with all the modification work required to the infrastructure, outages and therefore lost revenue, and timing and therefore when it becomes economic. Current thinking is that a gradual transition could be the way with a natural gas and hydrogen blend using the existing infrastructure
- 2022 saw strong **LNG** (Liquefied Natural Gas) shipments to the UK, and stakeholders believe this trend will continue in 2023, particularly whilst demand from China remains relatively low. 2024 looks uncertain, and it's very difficult to predict, however much will depend on demand from China and the continued development of FSRU's (Floating Storage and Regasification Unit) that are coming online in Europe which have the potential to take shipments away from the UK. As is usually the case, market prices will dictate where the LNG will go
- Desktop research has shown that **biomethane** production can support security of supply and support industries who are reliant on natural gas use. Stakeholders we have spoken to also agree with this view. Emissions could be reduced by up to 30 percent by 2030 if we can increase production
- Despite the decision by the current Government to re-impose the moratorium on fracking, market participants still believe there is a case for **shale** gas production in the UK, and their views remain similar to last year. Stakeholders told us that 2030 is the cut-off point, after which the case for shale becomes much weaker
- **Gas prices** at the NBP (Notional Balancing Point) continued to trade higher in 2022 as the ongoing conflict between Russia and Ukraine continued to intensify concerns over gas supplies in

Europe, particularly over the winter period. Whilst prices have softened over the past few weeks as the weather has been relatively mild so far this winter, there remains caution that this could still change, whilst worries over supplies of gas next winter remain high

- The issue of **hydrogen for domestic heating** is a point of major debate for stakeholders. There was passionate support for the use of the fuel from some quarters, most notably representatives of network owners. However, the majority of those engaged with have indicated that expansion into the domestic sector is not a high priority compared to the demand for industrial or transport-based consumers. A cause for concern was the extended period (2026) before a decision on domestic heating is currently expected from the Government
- Regarding network development for the **transportation of hydrogen**, engagement participants indicated that it was most likely that links would begin in clusters, built around industrial hydrogen demand zones. Production would be distributed in local areas as a priority, but ultimately clusters could link up to create larger production and transportation zones. This contrasted with views expressed by small number of asset developers that indicate the need for a transmission network to connect local hubs

Decisions made, impact and rationale

All stakeholder feedback has given support to our approach of not updating the scenarios for FES 2023.

Key areas of uncertainty

Significant uncertainty remains in the areas of:

- Energy prices
- Natural gas global availability and transportation
- Hydrogen demand, production, transportation, storage, and related UK strategy
- The viability of bioenergy to contribute to negative emissions

To be taken forward for further consideration

Engagement and research will continue for all areas of natural gas, hydrogen, and bioenergy because these areas are later than others in the process and there are many stakeholders to cover.

For bioenergy, we will continue to further understand how best biomass can be used in reaching Net Zero, mainly focusing on how it can be used (and to what extent) as a negative emissions technology.

A database of hydrogen knowledge for hydrogen assets is currently being built. This will allow a bottom-up approach to modelling hydrogen, based on current progress. The database will include current and planned hydrogen production assets, including their scale, location, technology, and transportation links.

We will also continue to watch the very uncertain global energy market, to help shape the near-term view of gas supply, although the longer-term scenarios already cover a wide range of credible uncertainty.

For hydrogen modelling this year, we are particularly interested in broadening our knowledge and understanding three main areas:

- Firstly, regarding the development of the hydrogen / industrial clusters, we would like to get a better understanding of how the key components of these clusters interact with one another and when they are likely to come online. This will give us a better understanding of how and when we can expect to see the scaling up of hydrogen demand and supply. This is expected to also touch on hydrogen storage and CCUS (Carbon Capture, Usage and Storage). As the FSO, we will look at the optimal locations for hydrogen on a whole energy basis as well as information coming from government and developing locations
- Secondly, the transportation of hydrogen from production to consumption. It will be key to our modelling to know what infrastructure is likely to be operational and by when, to inform the regional modelling work

we're doing around hydrogen production. We expect this to also include hydrogen blending in the networks, and the repurposing of existing natural gas infrastructure with the potential of having a 100% hydrogen network in the future

- Thirdly, when considering GB as a whole and the total supply and demand for hydrogen, it will be key to understand how we connect with Europe, the rest of the world, and how we interact in the global hydrogen economy; at a simplified level, the extent to which we import and export hydrogen

Sources, research, policy, and evidence used

The groups approached for engagement included:

- Network owners
- Energy suppliers
- Asset developers
- Engineering groups
- Consulting companies
- Educational bodies
- Industrial users and
- Trade groups

The ESO EIA team regularly uses contacts, news sites, and general web searches. The following is a list of some of the main reports which helped develop our thinking regarding hydrogen in the last year.

- Hydrogen Sector Development Action Plan, BEIS
- Proposals for hydrogen transport and storage business models, BEIS
- Energy Transition Outlook 2022, DNV
- The Clean Hydrogen Opportunity: Growth and Climate Benefits Within Reach if UK Acts Now, Boston Consulting Group
- What 18 independent studies all concluded about the use of hydrogen for heating, Recharge news
- On the feasibility of direct hydrogen utilisation in a fossil-free Europe, International Journal of Hydrogen Energy
- The economics of hydrogen imports: Better to stay local?, Aurora
- Hydrogen infrastructure requirements up to 2035, BEIS
- Industrial Hydrogen Accelerator Programme: successful projects, BEIS
- The role of hydrogen in achieving Net Zero, Science and Technology Committee
- Hydrogen Storage: Delivering on the UK's Energy Needs, Hydrogen UK
- Opportunities and challenges associated with hydrogen's role in the delivery of future energy systems, Scottish Science Advisory Council

Hydrogen and electrification

We asked stakeholders whether they believed the future energy system would be dominated by hydrogen use or electrification. We received a range of responses about the future makeup of the energy system. Most stakeholders agreed that currently hydrogen is unlikely to be the best solution for domestic heating or small passenger vehicle transport, but it should see use in HGV (Heavy Goods Vehicles), grid balancing through electrolysis from renewables and power-to-gas hydrogen peaking (replacing fossil fuel generation). Other applications include industrial processes that cannot easily be electrified. It is more likely that electrification of

heat will continue to develop with heat pumps, smart thermal stores and heat networks providing heat to buildings and flexibility to the power grid.

Stakeholders supported the view of greater weight on electrification over hydrogen in FES 2022, but still thought System Transformation remained credible and was a pathway that should be considered due to the uncertainties involved (e.g., in relation to the decision hydrogen boilers for residential heating taking place in 2026).

Electricity supply

Summary of views expressed

Energy Storage & Flexibility

We engaged with a wide range of stakeholders this year including industry experts, network operators, and developers of existing and developing technologies. Many stakeholders agree with the importance of the role that energy storage will play in a future Net Zero energy system. However, there is still considerable uncertainty over what technologies will be deployed and where, and the roles that they will play. There is agreement across some stakeholders that the FES 2022 scenarios and framework do a good job at capturing this uncertainty via credible future pathways towards a Net Zero energy system.

Many stakeholders agree that the current energy markets do not provide the right signals to help incentivise the rollout of LDES (Long Duration Energy Storage). Furthermore, they believe that a support mechanism is needed to help fund the build out of LDES technologies. It is suggested by some stakeholders, however, that some technologies will be able to be built without support mechanisms, such as a cap and floor scheme, and these will be able to operate on a merchant basis. There is some debate whether LDES technologies will be needed. Some stakeholders suggest that batteries will be able to perform within day flexibility and that hydrogen and electrolysis will be able to cover the needs of longer duration and seasonal storage.

Nuclear Fusion Development

Most responses were generally favourable, and that nuclear fusion is something that is worth pursuing, however stakeholders recognised the high levels of risk involved and that nuclear fusion is unlikely to be delivered by 2040. They suggest 2050 and beyond is more realistic. Some responses were favourable to fusion, however, they stated we should focus more on the technologies we have available today and that more effort should be spent on optimising our demand profile, building system resilience, and building homes that have low energy consumption.

A small number of responses were highly critical of fusion, claiming it was not feasible by 2040 and that the government announcement of a prototype fusion reactor by 2040 was largely a political move. These responses also say that investing heavily in fusion will be a waste of money and that this money should go towards other technologies.

The role of nuclear (fission) in the future energy system (or in FES)

The consensus was that nuclear power stations have an important role to play within the future energy system, specifically by serving to provide a stable baseload. Most responses distinguished between large-scale nuclear power stations, and Small Modular Reactors (SMR).

It was widely agreed that a push for more localised energy systems was necessary, and SMR technology suited this far better than large scale reactors. This would have the added benefits of providing jobs for different localities and more opportunities for industrial clusters to utilise heat from power stations.
It was highlighted during engagement that one of the major benefits of implementing nuclear through an SMR approach is the opportunity to drive down costs. Large scale nuclear power stations require bespoke designs and significant build time, whereas there seems to be potential to reduce costs of SMR through developing production-lines. For these reasons, most responses were optimistic about localised SMR and had little confidence in the future of large-scale nuclear power stations.

Some of the challenges highlighted include high costs of current technology, social acceptance, and speed of deployment. The issue of licensed sites and new sites was also discussed. It seemed apparent that although

licensed sites are currently more palatable, to maximise benefit from SMR stations, new sites near industrial clusters would need to be explored.

Sources of firm energy

Most stakeholders agreed factors that will drive sources of firm energy in the future will depend on political will to set up:

- the right policy and financial frameworks to encourage low carbon technologies into the market
- cost of technology and lead time to build and connect to the system
- consumer appetite to change for security of supply and decarbonisation
- the volume of firm energy will be dependent on level of demand that can be offset by DSR

There were discussions on effectiveness of existing methods of revenue generation such as capacity markets and the implications on various low carbon technologies. There is capacity in the pipeline from other low carbon technologies such as hydro, however action from government is needed to make it available in the market. Some stakeholders hold the view that the capacity market is working for wind and interconnectors and would like to see similar success for other low carbon technologies. There was broad consensus that mechanisms could be established that paid for aggregated services provided by a single technology.

Stakeholders also shared their views on potential sources of firm technology such as nuclear, SMR, hydrogen with storage, some form of unabated gas with CCUS, tidal, hydro and interconnection. There was still uncertainty with respect to what the future mix of firm energy would look like in the future.

Renewables

One of our stakeholders viewed that the Government target of 50 GW of offshore wind by 2030 is unachievable under the current planning permission timescales.

Another stakeholder shared that they would like to understand from our perspective what would need to happen to increase the development of solar schemes in Scotland and how this might be considered in the FES scenarios.

Decisions made, impact and rationale

The following changes will be made to storage modelling for our analysis following FES 2023:

- Adopt the Afry definition for Short, Medium and Long Duration Energy Storage in our scenario framework and modelling (Short: 1 to 4 hours, Medium: 4 to 12 hours, Long: 12 to 100 hours, ultra-long: greater than 100 hours) instead of the old BEIS definition (Short: 1-2 hours, Medium: 3-4 hours, Long: >4 hours), as this more accurately reflects the different roles that electricity storage technologies will play on a Net Zero system
- Revisit the assumptions regarding domestic storage deployment towards 2050. We will carry out further investigation to determine if we need to adjust our long-term domestic storage forecasts and by how much.
- Model and communicate Medium Duration Energy Storage (MDES) and Long Duration Energy Storage (LDES) technologies as generic “black box” categories instead of explicitly referring to Liquid Air Energy Storage (LAES) and Compressed Air Energy Storage (CAES). This is based on feedback that there remains significant uncertainty over which technologies will play these roles in the future and that this new approach will help reflect this uncertainty whilst allowing us to focus on how to model system need. We will continue to model PHS (Pumped Hydro Storage) in the same way as previous years as this is a mature technology with a significant pipeline
- We have received feedback that there remains considerable uncertainty over the levels of the flexibility needs of the future Net Zero system. We are currently carrying out a flexibility project,

involving the use of additional dispatch modelling software to perform further flexibility this will transform the way we model flexibility and move to a more economic and system led basis

- Based upon stakeholder feedback we will continue to exclude fusion as a commercial source of energy before 2050. This will be kept under review
- Nuclear fission
    - Large scale will be limited in deployment
    - We will include more small-scale units than large-scale units to reflect stakeholder feedback
- We currently have 3 scenarios that do not reach 50 GW of offshore wind by 2030 and we are confident that this currently reflects the range of uncertainty. Therefore, we are going to keep the offshore wind scenario range in FES 2023 broadly the same as it was in FES 2022. We will continue to focus on specific site-level offshore wind intelligence, working closely together with our stakeholders that use our scenarios in network planning through the transitional CSNP and the Holistic Network Design processes
- We have not seen any significant change in the pipeline of solar connections in Scotland hence our scenarios remain unchanged for now. This will be kept under review
- We will maintain a wide variety of firm energy technologies within the FES scenarios
- Our effort is focussed on understanding the uncertainty in the near term and therefore which individual generation locations and connection dates are likely to change in FES 2023. This is due to the use of the scenarios in network investment recommendations and where we have seen changes since FES 2022

Key areas of uncertainty

- **Storage**: How much LDES will be required, which technologies will be developed and the policies that will be put in place to drive change
- **Nuclear***:* The role that nuclear will have on the future system, the level of capacity needed, location on the system and which technologies will be used
- **Energy Sources:** Sources of firm energy, how much will be dispatchable and the need for baseload generation.
- **Hydrogen***:* The role of hydrogen for generation in the future

To be taken forward for consideration for FES 2023

- We will continue to review our language used to represent various technology types
- We will continue to improve our modelling of spatially disaggregated generation
- As regionalisation becomes increasingly important, we will continue to work with our stakeholders to deliver regional information that they have expressed an interest in

Sources, research, policy, and evidence used

- FES 2023 Call For Evidence
- Bilateral engagements
- “Benefits of Long Duration Electricity Storage” an Afry report to BEIS, Aurora Global Energy Market Forecast October 2022
- Aurora GBR Power Market Forecast Data October 2022, Oxford Economics - Prices and Baseline Data November 2022
- UK Gov - Autumn Statement 2022

- Carbon pricing, Baringa - Commodity Carbon Assumptions
- Resource Adequacy in the 2030s an Afry report to EMR
- EnergyPulse insights report by Renewables UK
- British Energy Security Strategy by BEIS (07 April 2022)
- Net Zero Strategy: Build Back Greener by BEIS (last updated 5 April 2022), DNO Embedded Capacity Registers

Next steps for FES 2023 and future

We will continue with our engagement as well as our modelling and analysis for FES 2023. This will continue until the time of the publication and programme of launch events. As we have referenced in earlier pages in this document, some of the valuable feedback we gather from engagement will be taken forward for future analysis and so may not be seen in FES 2023. We balance our priorities with the information which results in the largest impact on the scenarios and our need to develop our processes to meet the changing needs of scenarios and the energy market. We plan to share a further update on our engagement and output towards the end of spring next year.

We will continue to publish the FES newsletter for our stakeholder community, sharing updates about our engagement, the launch events and thought pieces providing additional insight to our readers. We will also regularly update the FES website.

Engagement

Regional insights

We are planning on producing additional insights during FES 2023 to provide whole system regional insights, the first of which will be focussed on how we currently use demographics in our analysis and how we are looking to improve in this area.

Consumer Building Blocks

We hope to include some insights from the Consumer Building Blocks innovation project within FES 2023 and will look to integrate outcomes from the project in future modelling This will help us to model where consumers are on the network, how they use energy, and how they behave with respect to Net Zero.

Network Forum

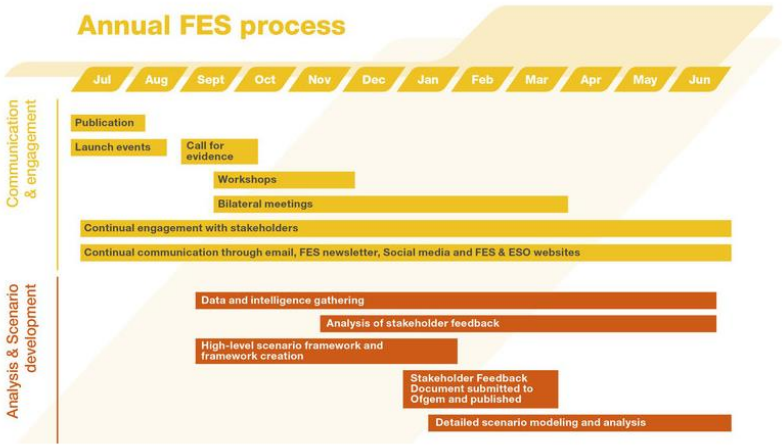
We will be holding the next forum meeting in February 2023, continuing bi-monthly thereafter. We will share early insight into the FES 2023 analysis and hold challenge and review sessions with stakeholders from the distribution and transmission organisations. We will continue to encourage active participation at these meetings, promoting discussion and debate with those that attend.

Bridging the Gap

The next Bridging the Gap report and findings will be published in March 2023, outlining the key recommendations to flexibility (e.g., hydrogen and consumer engagement) and the actions needed to progress both these areas.

Annual cycle of FES and continuing the conversation

We welcome feedback, insight, and evidence from stakeholders all year round in addition to the more structured elements of our engagement cycle that occur from late summer till early spring. The figure below shows a typical FES year with the start and finish point being the FES publication.



We welcome your contribution and discussion throughout the year and encourage everyone to join the ongoing dialogue about the future of energy; never before has it been so important. You can contact the team at any time via email: FES@nationalgrideso.com.

If you would like to subscribe to receive our FES newsletter, then please contact FES@nationalgrideso.com to be added to the distribution list.

We also promote our work and share updates on our engagement and thought pieces through the ESO social media platforms. The figure below provides further information as well as other methods to contact us and the ESO.

Contribute to the future of energy debate

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Email FES

Contact us if you have a question, want to share some insight or have feedback on any part of FES.

FES publications

Access all FES publications for this year and previous years.

ESO Publications

Access further insight from the National Grid Electricity System Operator.

Call Us

Tel: +44 (0) 1926 653000

Write To Us

National Grid ESO, Faraday House Warwick Technology Park, Gallows Hill, Warwick. CV34 6DA

Appendices

A. Breakdown of engagement output
B. Breakdown of stakeholders and stakeholder categories
C. Breakdown of engagement and communications
D. Comparison FES 2022 to FES 2022
E. Review of FES 2022: You Said: We Will

Appendix A. Breakdown of engagement output for FES 2023 and future

Industrial & Commercial Energy demand

We anticipated there will be a few remaining stakeholder bilateral engagements for Industrial & Commercial energy demand after the publication of the Stakeholder Feedback Document

Feedback and insight gathered:	We will:	How is this reflected	Source
Forecasts of energy prices and economic output for I&C sectors	Incorporate this data into our overall I&C energy demand forecasts	Will be incorporated into FES 2023 modelling	Energy industry
Existing & anticipated data centre connection capacities on GB transmission network	Incorporate this data in our data centre demand model	Will be incorporated into FES 2023 modelling	UK Networks
FES 22 CT & ST energy demand scenarios seemed acceptable still as credible boundaries for an electrified or hydrogen economy for I&C for FES 23 In general terms it's important to take an objective view of the practicality of government policies before arriving at credible FES pathways Stakeholder confirmed there would be a variety of energy demand responses in relation to high prices – each sector is sensitive to different degrees. Similarly, there would be a variety of responses within a slowing economy, although this the economic downturn maybe more significant to the trade association's own members There are limited opportunities for large industries to participate in flexibility in electricity and gas demand currently	Review how appropriate it is to use the FES 22 I&C CT & ST scenarios for FES 23 Continue to take an objective view towards new announcements around Net Zero Continue to implement different energy price/GDP sensitivities per sub-sector within our energy demand model Be aware of limited scope for large industry users to contribute to demand side response	Will be reviewed during FES 2023 modelling	Energy industry
FES 22 took account of the various Net Zero policy announcements in a reasonable way	Continue to implement different energy price/GDP sensitivities per	Will be implemented during FES 2023 modelling	Large business

Feedback and insight gathered:	We will:	How is this reflected	Source
For food manufacturers, their output and energy demand are not expected to drop significantly in the near term due to a downturn in the economy	sub-sector within our energy demand model		
We learnt that the manufacturer of petrochemicals is seeing reduced demand for its products, although energy demand will be impacted less (as much energy is generated from feedstock) We learnt about the long-term decarbonisation pathway for a large chemicals manufacturer, including various dependencies and needs	Use the insights to better understand the requirements for decarbonisation of the chemicals sector	Will be considered during FES 2023 and future modelling	Large business

Transport

Feedback and insight gathered:	We will:	How is this reflected	Source
One of the key uncertainties in transport moving forward is still V2G – high levels seem ambitious Note that this feedback on the uncertainty surrounding V2G, both upside and down, is congruent with feedback dating as far back as Bridging the Gap 2020	We are working on an NIA innovation project which has the potential to represent a significant step forward in our capability to understand what would motivate consumers to engage and to model this going forward. We will look to implement these findings into our future modelling methods Implement use of a new dispatch model beyond FES 2023 with different V2G capabilities. We also have projects underway looking at how V2G is behaving in our dispatch model as part of the whole system of flexibility. We will use these to inform our V2G assumptions across	Taken forward for future consideration	Electricity Network(s)

Feedback and insight gathered:	We will:	How is this reflected	Source
	scenarios to ensure we're testing the credible range of system impacts		
The FES ranges for uptake are credible. The uncertainty is shifting to when are where this demand will occur on the network. This includes rapid charging hubs and electric HGVs	We will continue testing whether this is the view of broader stakeholders. We will look at how we can place more focus on reducing the uncertainty on the within day profiles from different charger types Regarding rapid hubs, these profiles are being looked at as part of the NIA V2G innovation project. We will build on these findings, including reviewing the suitability of our existing profiles Regarding electric HGVs, we are actively seeking how to reduce this uncertainty, including scoping a potential innovation project in this area	Taken forward for future consideration	Electricity network(s)
HGVs: It is likely that both electric and Hydrogen HGVs will play a role. While Electric Road Systems have not received government funding for demonstrator trials, it could become a technology in the later years in a scenario with a high prevalence of BEV HGVs	We committed last year to further exploring Electric Road Systems, however this assumed it would pass the government funded feasibility stages for a demonstrator trial. We currently view this as less credible. Therefore, any review of our HGV technology mixes will focus in the first instance on whether the mix of BEVs and Hydrogen HGVs is credible	Taken forward for future consideration	Electricity Network(s) (ZERFT) Demonstration programme
Governments Zero Emission Mandate Consultation. This sets out a proposed minimum proportion of car and van sales (that	We have reviewed the proposal and believe that uptakes to these proposals lie within our scenario range (the exact position is highly	Taken forward for future consideration	ZEV mandate

Feedback and insight gathered:	We will:	How is this reflected	Source
occur in a given year) which must be zero emission	dependent on the overall forecast for vehicle sales per year) While awaiting the final decision we will test with stakeholders whether this impacts the credibility of our ULEV car and van ranges out to 2035		
ICCT LCA paper – Efficiency assumptions for e.g., PHEVs	This is a comprehensive study into vehicle life cycle assessments. As part of this they form a view on PHEV car electricity usage from real world data. The result differs from current FES assumptions. We will review the evidence base for these assumptions as a result	Taken forward for future consideration	ICCT LCA paper

Heat & Appliances

Feedback and insight gathered:	We will:	How is this reflected	Source
Current heat pump uptakes are modest, a large increase was seen early 2022 before the RHI scheme ended but levels have fallen back since. FES22 LW and CT uptake are much higher than current uptake. The Boiler Upgrade Scheme alone is likely to be insufficient, GSHPs now receive significantly less funding than they did under the RHI scheme	Reflect this in heat pump uptake numbers for FES 2023 near-term view	FES 2023 near-term view	Heat Pump Industry
FES needs more analysis on hydrogen for heating and its logistics, particularly around cost analysis. More information is needed weighing up cost and performance of heating technologies against each		Taken forward for future consideration	A range of stakeholders

other for homes, e.g., heat pumps, DH and hydrogen for a typical home			
Fundamental in the transition to Net Zero for heating will be policy. More policy is needed for encouraging Net Zero heating technologies. For heat pumps this would require a reduction in electricity price (through either redistribution of levies or decoupling electricity price from gas), scalability in heat pump installation and the Future Homes Standard	For commentary	FES 2023 commentary	Heat Pump Industry
Would like to know from FES a cost analysis of District Heat Networks. Does the cost reduce through time, where, when and by how much? Regional data on where heat networks would be cheapest and most effective would be highly valuable in helping to spread knowledge on where funding can be targeted. Outlining heat zones (zones with a particular heat system which is optimal – DH, Heat Pumps Hydrogen) would be helpful	Though we do consider general economic factors and commercial readiness, we do not currently fully cost our scenarios.	Taken forward for future consideration	Heat Network and Heat Pump parties
Some baselines looked at this year are below those given in Falling Short – Heat pump numbers. Baselines are different in FES BB dis-aggregated areas compared to their data. Would like to see a focus on heat pumps with and without thermal storage and the effect on demand	We will reflect this in future peak demand reduction options	Taken forward for future consideration, though we may be able to include some early analysis in FES 2023.	General Energy Demand Stakeholder group
FES needs more analysis on hydrogen – its cost compared to other heating systems and more regional analysis on where hydrogen (incl. for heat) is likely to go. It was suggested that the hydrogen demand in FS is too low. Would like a "most likely" scenario	We will explore an improvement in modelling capability to accurately reflect this	Taken forward for future consideration	Gas stakeholders

Significant transition to heat pumps and high energy efficiency in new builds is unlikely without regulation.	This aligns with our existing key message on Policy and Delivery (KM1) and will be reflected in our analysis for FES 2023.	FES 2023	Housebuilding Industry
Would like to know more about preparations for capacity – how will grid/network capacity be prepared for an increase in distributed generation, heat pumps and EVs, so that this is not a blocker for uptake	This is out of the core scope for FES. We do have high level commentary about the evolution of energy networks within FES but this level of detail would be found in ETYS and NOA publications for networks and the Operability Strategy Report and Outlook documents for operability	Not in scope for FES	Housebuilding Industry

Regional

We asked our stakeholders about how the feedback loop and interaction between ESO scenario projections and regional projections produced by regional network companies as well as the interaction with Local Authority led Local Area Energy Plans should work in practice:

Feedback and insight gathered:	We will:	How is this reflected	Source
Add up the DFES projections (for relevant technologies) and see how close they come to the national FES projections	We are regularly meeting with the DNOs as part of regular FES and DFES engagement. We are comparing a subset and priority of technology groups at grid supply point level We have used the Embedded Capacity Register to form our Baseline for embedded generation within the FES projections. We are working with the DNOs on improving the data quality and usefulness of the ECRs in our	Shown in FES 2023 (we will be updating the baseline year using the latest ECR data for both embedded storage and generation) and taken forward for future consideration	Call for Evidence - Electricity Network(s)

Feedback and insight gathered:	We will:	How is this reflected	Source
	scenario projections – this is an ongoing process		
Drive the data flow to local authorities about plans and programmes since they may not have the bandwidth to be forthcoming (due to understaffing / budget cuts etc) As more local areas develop LAEPs, FES should use as much of this high quality, high granularity data about local areas as possible	We regularly engage with the network companies on local plans and will continue to address how we reflect new high granularity regional data such as the data provided by local authorities in their LAEPs. We are also planning on building on engagement with organisations such as ADEPT and UK100 to begin to build relationships with local authorities and understand the usefulness to them of the regional data we are producing We will be looking to use this feedback to enhance our outputs, as we develop our modelling further to enable a more “bottom-up” approach	Taken forward for future consideration	Call for Evidence – Local Authorities
Be as transparent as possible, contact and include major players in the regional schemes Sharing of assumptions / data sources would be useful to the regional network companies	We are expanding our stakeholder base each year and our process is open for any stakeholders to get involved in. We transparently share our modelling methods, assumptions and data sources each year. We also share our assumptions and data sources with our network colleagues via our bilateral engagement and the Network Forum we hold throughout the year. We would welcome any further suggestions	Ongoing consideration	Call for Evidence – Local Authorities
We also asked about how we currently publish regional electricity data via our regional breakdown of FES data workbook and FES visualisation platform. We want to explore enhancing this data and information as well as agreeing a similar dataset for our gas and hydrogen pathways.	FES includes national level projections and may not exactly reflect local council plans – as part of investigating the feedback loop with the Local Area Energy Plans, we will investigate how the data will feed into and be informed by our scenario development process The default view of the visualisation has been set to the NUTS1 regions as we have	Taken forward for future consideration	Call for Evidence – Local Authorities

Feedback and insight gathered:	We will:	How is this reflected	Source
It is useful to drill through FES projections in the local area, and then compare this to local council plans, however we would prefer if the visualisation defaulted to grid supply points rather than regions	stakeholders that are interested in the non-network perspective. We have made the visualisation as user-friendly as possible so users can select the view they are most interested in		
The inclusion of the number of heat pumps, EVs etc in the regional breakdowns would complement the demand values (MW)	This will be added into our data visualisation platform. We are adding two separate new visualisations, one focussed on the outputs from our Spatial Heat model and one to display the Building Blocks data that we exchange with the DNOs. Available here: Future Energy Scenarios 2022	New visualisations will enrich the platform during this cycle and the development of the platform further will be taken forward for future consideration	Call for Evidence – various industry stakeholders
Show the difference between gross demand as 'incurred' by the user and net demand as seen by the networks and perhaps savings / reductions from a net demand approach	We already publish Building Block data showing regional views of demand, and present both underlying demand and embedded generation which is offset against this. We intend to provide further commentary on how we take the data at GB level and how this is then transformed into our regional datasets	We intend on providing this commentary during the FES 2023 cycle	Call for Evidence – various industry stakeholders
It would be interesting to add trendlines and compare current generation and demand mix to FES projections from 2016 onwards	Although this activity would produce an interesting comparison, it would be difficult to gain any meaningful insight due to the number of changes in policy that have caused us to make step changes in our assumptions over the last few years		Call for Evidence
We asked our stakeholders what the top three elements are where they believe their local region or area may see a different pathway compared to the main FES predictions. We received a range of responses, across many regions in GB and ideas for areas that we have not yet considered	This is very valuable feedback and the insight we would like to gain on a local level. We will continue to use this to feed into our discussions with our regional stakeholders to further develop industry understanding and our modelling		Call for Evidence

Feedback and insight gathered:	We will:	How is this reflected	Source
Are individual region or local authority carbon targets going to be an input into this modelling, and if so when choosing to incorporate them will you be assessing how likely they are to be reached?	As we build more bottom-up modelling, we will have more flexibility to reflect local climate change targets within our analysis and, we will be able to assess the appropriateness of different local policies that will drive action	Ongoing consideration	Regional Explainer Webinar Not for profit energy organisation
You mention an aim to enhance the interaction/alignment between this new FES regional analysis and other regional scenario assessments (i.e., DFES). How/what form will that enhanced interaction take place and at what point(s) in the FES timeline do you see that happening?	As part of the ENA Open Networks project, we have agreed to further enhance the feedback loop with the distribution network operators - this has started with alignment of GSP assumptions, and we will prioritise specific areas of our analysis (or "Building Blocks") where we will agree to assess any further opportunities to align. It is anticipated that there will be key points in our annual cycles where a comparison and improvement actions are agreed between the ESO and the DNOs – more detail is provided here: https://www.energynetworks.org/industry-hub/resource-library/on22-ws1b-p2-fes-and-dfes-purpose-of-energy-scenarios-(30-may-2022).pdf	Ongoing process	Regional Explainer Webinar Not for profit energy centre of expertise
How will this regional FES fit with consideration of a potential move to nodal market structure for the electricity market?	As we begin to consider alternative market arrangements within our modelling, regional data will form a key component of building our future view. Insights into local supply and demand patterns are crucial in understanding the impacts of nodal market arrangements on investment signals in the market. Regional insights will provide additional confidence in the assumptions at a nodal level and hence better assess future supply and demand growth through locational price signals.	Ongoing consideration	Regional Explainer Webinar Energy Supplier
A question about the direction of travel for your geographical granularity – for scenario	Our ambition is for our modelling to start at regional level, down to GSP (electricity) /	Ongoing consideration	Regional Explainer Webinar

Feedback and insight gathered:	We will:	How is this reflected	Source
projections (published or otherwise), do you foresee going any 'deeper' than i.e., Grid Supply Point or local authority boundary level in your regional analysis in the next FES round or in the future?	Offtake (gas) level or individual supply point depending on the model. We also intend to be able to map our outputs from this level of granularity to Local Authority boundary level. We don't intend on going deeper than this. We work closely with the GDNs and the DNOs who provide this deeper level of insight		Energy Consultancy
Can you explain to what granularity within-region you will be modelling supply, demand, and transmission? i.e., will you be modelling nodal?	As above	Ongoing consideration	Regional Explainer Webinar Network Company
We currently share specific customer intelligence which you use to differing extents. Will you be looking to utilise the outputs from GDN's demand forecasts within the FES regional analysis modelling?	We will continue to balance how different datasets inform our work. Our analysts consider all information gained and carefully assess which elements become inputs to our modelling. We intend to enhance the level of granularity within our modelling to make better use of the granular data that is provided to us by our stakeholders. This may include detailed demand forecast data down to an individual site level and it may also include the use of detailed data output from Local Area Energy Plans.	Ongoing consideration	Regional Explainer Webinar Network Company
How will a shift to a bottom-up, regionalised approach ensures consistency of assumptions and narrative between regions? How will it link with national policies e.g., on renewables or heat pump deployment targets? And will local ambitions be balanced against economics e.g., regarding wind in Scotland?	We intend to establish a feedback loop between our national level analysis and regional analysis and to do this from a whole system perspective. We want to be able to highlight where there may be opportunities to adapt and introduce policies that are applicable for specific parts of GB and that also compliment the broader GB decarbonisation journey. The scenario framework allows us to	Ongoing consideration	Regional Explainer Webinar Energy Supplier

Feedback and insight gathered:	We will:	How is this reflected	Source
	test this and highlight where there might be discrepancies that need further investigation. We are engaged with both regional governments and local authority groups in providing feedback on their plans		
There is a desire to see more of a regional breakdown of information in energy supply, especially of wind	We are exploring how we split our current supply data so we can provide a more meaningful breakdown whilst maintaining confidentiality of our customers' information	Ongoing consideration	Non-governmental organisations

Energy supply

Feedback and insight gathered:	We will:	How is this reflected	Source
Distributed generation - DNOs are considering how best to account for transmission constraints when previously the DFES has been unconstrained. This is due connection constraints. They want to know, when considering the DG in ECR and building our forecasts, whether ESO account for it in any way	Currently scenarios for distributed generation are based on an unconstrained system and modelled at TO level and then disaggregated to GSP/DNO using split based on sites currently connected to the system. As regional insights are becoming increasingly important, we are currently exploring how we can use more granular data from the ECR and other sources for future iterations. We will be continuing this conversation through the ENA DFES/FES alignment working group to ensure assumptions are applied consistently	Our Distributed generation modelling has seen significant improvements in recent FES cycles, and we will consider how ECR data is used in our modelling going forwards. We have a separate process for our transmission generation modelling which considers contracted capacity dates from the TEC register as a starting point	DNO
Through this analysis, we see the gaps between FES and DNO data, and there needs to be better alignment of this in the future. For example, considering the DNO's data on existing, operational sites and sites with a connection offer	We are holding bilateral engagements with owners of ECR data and DFES to understand what is driving the gap and developing a plan to align on baseline and forecast where it makes sense to do so. We are constantly	We will continue our bilateral engagement with the DNOs to improve the alignment between FES and DFES. This will involve collectively agreeing the areas that require attention and	DNOs

Feedback and insight gathered:	We will:	How is this reflected	Source
	developing and aligning our data. This will be a continuous process which is progressing.	prioritising when modelling updates can be completed in time for inclusion in future iterations of the FES and the DFES	
Can FES move away from the “Baseload” and “Intermittent” terminology and use to something less emotive	We recognise the importance of this and will be making eb FES 2022 document we used weather dependent/variable instead of intermittent	Ongoing consideration	Manufacturers and Technologists
There is a desire to see a neutral description of the different generation technologies, their pros and cons, features and benefits of the technology	As part of FES 2023 we will be producing a standalone energy background document, which will contain a short description of the technologies considered in our analysis. We can describe the role that they play in our scenarios. Pros and cons are subjective and subject to change over time therefore this would be a complex picture to present and may detract from the scenarios themselves. We consider many different aspects for each technology including how advanced/established the technology is, the services it can provide and the economics. This is at a technology level and then further detailed assessment is conducted for individual projects in the nearer term	The energy background document will be standalone and published alongside FES 23.	Industry bodies & experts including Consultancies, Trade bodies
FES should include new or innovative technologies	We continue to investigate new or innovative technologies for FES with a view to assess their readiness to deployment at scale	Ongoing consideration	Manufacturers and Technologists

Storage and flexibility

The various insights from flexibility have been incorporated into the relevant energy supply and demand sections; please see the relevant sections above for further information.

Feedback and insight gathered:	We will:	How is this reflected	Source
Most stakeholders are happy with the scenario framework and levels of capacities/volumes assumed in FES. They also believe that it captures the range of uncertainty well in terms of what technologies will be deployed in a Net Zero future. We have received positive feedback on the consistency of the scenarios in recent years	We are keeping the scenario framework the same for FES 2023	Shown in FES 2023	Industry bodies, Developers
The importance of duration for energy storage has been mentioned a couple of times since an energy storage system has a power but also an energy element	Continue to communicate the volume of storage we assume in FES as well as the capacity	Shown in FES 2023	Developers
Some stakeholders suggest we should show Vehicle-to-Grid, hydrogen and electricity storage on the same graph in the main FES document	Review how we show storage in the final charts published in the final FES document	Shown in FES 2023	Developers
It is suggested by some stakeholders that FES is underestimating the value and quantity of capacity needed for a Net Zero future and that FES is not sufficiently reflecting the current pipeline of projects. It is suggested that once an appropriate funding mechanism is in place, it is possible for a large amount of the UK LDES pipeline to be delivered	We are working on a project which aims to develop an approach to undertake more detailed flexibility analysis to determine what levels of which LDES technologies will be needed and when. We will also monitor and follow closely all BEIS updates regarding relevant funding mechanisms	Taken forward for future consideration	Consultancies, Developers
High capital expenditure, lead times, and lack of in-house engineering expertise will play a significant barrier in deployment of the UK pumped hydro storage pipeline. The addition of pumping capability to existing hydro plants is currently investigated	We will explore how we model pumping capacity being added to conventional hydro plants. We will explore how much additional capacity can be added to the UK pumped hydro storage fleet using this method	Taken forward for future consideration	Industry bodies, developers

Feedback and insight gathered:	We will:	How is this reflected	Source
Different storage technologies and durations will provide distinct roles on the future system. It is crucial for a market to be designed for long-duration energy storage which rewards capacity since these projects will be sitting idle for large portions of the year and have lower utilisation rates	We take these considerations on board when modelling long-duration energy storage	Shown in FES 2023	Industry bodies, developers
Synchronous properties of many long-duration energy storage technologies mean they will provide additional services to the grid such as inertia, short-circuit and reactive power services	We plan to examine and take these considerations on board when modelling long-duration energy storage	Taken forward for future consideration	Developers
It is suggested that the use of the capacity registers (TEC, Embedded and ECRs) as input data is missing a significant amount of behind the meter storage that would not be listed in the registers due to them sharing connections with their existing co-located assets	We undertake engagement with specific developers and network operators to gather additional data of sites which may be missing from the registers	Taken forward for future consideration	Developers
Many stakeholders agree that the current pipeline for storage projects with connection agreements – mostly batteries – is overinflated and that a large amount of it will not materialise on the network	We will take these considerations on board when producing our storage forecasts. We are carrying out a project which aims to develop a more detailed analysis to determine what levels of types of flexibility will be needed and where	Taken forward for future consideration	Developers
It is suggested that FES might overestimate the battery capacity forecasts however provides a good benchmark for strategic planning	We are carrying out a project which aims to develop a more detailed analysis to determine what levels of types of flexibility will be needed and where. The project will help us re-evaluate all storage assumptions taken so far	Taken forward for future consideration	Battery developer
Some stakeholders suggest that the system might not need significant levels of long-duration energy storage technology capacities (pumped hydro, compressed air, liquid air) and that batteries will perform the within day flexibility and longer duration and seasonal flexibility could	We will take these comments onboard when modelling flexibility. We are currently working on a	Taken forward for future consideration	Developers, industry bodies

Feedback and insight gathered:	We will:	How is this reflected	Source
be performed by hydrogen and electrolysis. However, some other stakeholders question the suitability of hydrogen for electricity purposes and recommend its use primarily for transport purposes due to lower round-trip efficiency and high cost. They also mentioned overreliance in some scenarios	project to improve how we model flexibility		
BEIS definition of storage durations (threshold of 4 hours for long-duration energy storage) is no longer fit for purpose in identifying the different types of storage needed and hinders the development of diverse solutions for different time periods	Will review the FES definitions of storage durations and adopt the AFRY definition (short, medium, long duration storage, ultra-long) in the sub-sequent year (out of scope for FES 2023)	Taken forward for future consideration	Developers, industry bodies
Lithium Ion is currently the dominant form of battery storage technology however this is likely to be replaced by other battery chemistries as they develop further, like iron-air or solid-state lithium batteries. We have also discussed the separation of lithium-based and flow batteries with our stakeholders, since the latter can play the role of LDES and needs to become a succinct technology	Currently our view of batteries is limited by the quality of input data however are keen to begin modelling alternative battery chemistries and the role they can play on the system when this picture becomes clearer	Taken forward for future consideration	Developers, industry bodies
Extreme weather events, such as Dunkelflaute, are recognised as a real risk to a future decarbonised energy system and it is not yet clear what the best way and mix of technologies is to secure the system against these events. More work needs to be done in this area	There is currently work being done to assess how the system responds to Dunkelflaute periods. We are aiming to publish the findings in a thought piece later in the year. Our Bridging the Gap work has investigated this as well through the Day in the Life 2035 project and we are investigating this further considering longer periods with no gas generation on the network. Further details will be published later in the year	Shown in FES 2023	Industry bodies, developers

Feedback and insight gathered:	We will:	How is this reflected	Source
Grid connections were discussed as a common point of concern to ensure energy storage deployment. Strictly speaking, some technologies have long lead times and if we want to achieve certain storage targets by 2035, these technologies should start being built soon	We have taken comments on the impact of delayed grid connections on board. There is currently work being carried out by our Connections Team as part of a broader review into the Connections process	Taken forward for future consideration	Developers, network operators,
Location of storage is also important and was highlighted by some stakeholders	We have taken these comments on board. We are carrying out a project which aims to develop a more detailed analysis to determine what levels of types of flexibility will be needed and where	Taken forward for future consideration	Developers
There is no single long-duration energy storage technology that is most suitable for a net-zero power system and its role will be carried out by a wide range of different technologies	There is discussion taking place about modelling distinct “black box” medium- and long-term energy storage technologies instead of referring directly to e.g., compressed air and liquid air energy storage technologies to reflect the uncertainty around these technologies	Taken forward for future consideration	Developers, industry bodies
Long-duration energy storage will be crucial for the future system however is currently heavily hindered by lack of investment and appropriate route to market. Some stakeholders suggest reform of the capacity market and that a funding mechanism is needed to incentivise the development of long-duration energy storage. Some developers suggest that a funding mechanism isn’t needed for these long-duration energy storage technologies. Reference was made to the cap & floor scheme for interconnectors, albeit being trickier for energy storage since the revenue stream stacking is more uncertain. Another important comment was made around	We have taken these comments on board for how we model flexibility. We currently try to reflect the uncertainty around the future of long-duration energy storage in our scenario range for FES	Shown in FES 2023	Developers

Feedback and insight gathered:	We will:	How is this reflected	Source
the pathfinders, which although very successful in their deployment, are not enough only themselves as a route to market			
Due to the uncertainty over future technologies which will provide long-duration energy storage, many stakeholders suggested modelling this as a non-technology specific “black box”, instead of referring directly to compressed or liquid air technologies	We have taken this feedback on board and will review how we model long-duration energy storage technologies	Taken forward for future consideration	Developers, industry bodies
It has been highlighted by a wide range of stakeholders that the connections processes for both transmission and distribution is a significant barrier for reaching the storage capacities forecasted in FES	Work is currently being carried out by the Connections Team and DNOs to reform the Connections process. When we conduct our stakeholder engagement, we always ensure that feedback is passed to the relevant teams	N/A	Developers, industry bodies
It has been commented that long-term domestic storage forecasts are overambitious for LW and CT (up to 8 GW by 2050 in LW), and the gap is too large between LW / CT and ST / FS	Review our long-term domestic storage assumptions and carry out further investigation to determine if we need adjust our forecasts and by how much	Taken forward for future consideration	Developers, industry bodies
Some battery developers suggest that ancillary service markets will start to become saturated post 2024 and that trading in the wholesale market will become the dominant revenue stream for batteries. 2-hour batteries will become the dominant battery duration after this point. Unlikely that Lithium battery durations will exceed the 4-hour duration	Review battery durations in the medium to long-term in our scenarios. We currently assume 2-hour batteries will become the dominant duration in the medium term, with 4-hour duration batteries appearing on the system in the longer term. We are currently limited by the availability of reliable duration data for a large amount of the battery pipeline however we are continually working on how we can improve this	Shown in FES 2023	Developers

Feedback and insight gathered:	We will:	How is this reflected	Source
Government policy is critical to the deployment of the required levels of long-duration energy storage for a Net Zero system	We agree and have taken these comments on board for how we model flexibility. We currently try to reflect the uncertainty around the future of long-duration energy storage in our scenario range for FES and we will always consult government policy for this purpose	Shown in FES 2023	Developers, industry bodies
Some feedback suggests that FES currently has the wrong approach to designing a system which greatly underestimates the amount of flexibility available, particularly from the demand side. It has been suggested to start with the question "what is the potential for flexibility as a system" and build up from there	We are currently reforming our flexibility modelling process to greater understand the potential for flexibility in the GB Net Zero system across all technologies	Taken forward for future consideration	Local authorities, industry bodies

Whole System and Gas Supply

Feedback and insight gathered:	We will:	How is this reflected	Source
Interconnectors In the short term, operators started to see a change in behaviour of shippers, particularly after Beast from the East, which saw shippers book a lot of long-term capacity, but due to mild weather, this capacity was not utilised. This has seen shippers move away from long term capacity bookings to make more bookings on the shorter-term market.	Include this in our FES near-term view	Include this in our FES near-term view	Interconnector operators
Confirmation of max pipeline flows, both import and export, was gained, which feeds into the FES analysis Life expectancy of the import/export gas pipelines - Operators are confident of the continued life of these for natural gas, they continuously review this	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Interconnector operators

Feedback and insight gathered:	We will:	How is this reflected	Source
Transition to Hydrogen - A key question stakeholders are considering but don't have a firm answer to is how to transition their pipeline from natural gas to Hydrogen with all the modification work required to the infrastructure, outages and therefore lost revenue, and timing and therefore when it becomes economic. Current thinking is that a gradual transition could be the way with a natural gas and hydrogen blend using the existing infrastructure For the time being, they still believe natural gas is a key fuel and is difficult to transition away from it as it is used so widely			
UKCS Whilst the rate of UKCS is declining, there is likely to be little impact on new gas fields starting production in the short term, and in fact projects could speed up if the government's Net Zero targets begin to significantly impact the gas market Post 2040 may see very small levels of gas as no new investment taking place this far out at the moment. If they become too small, it may become uneconomical to operate gas terminals. Much more investment needed to keep the gas market going beyond 2050 Continued high prices could see an increase in investment in the industry Large oil and gas companies are still very much interested in the natural gas market; however, they are beginning to take an interest in the energy transition and how gas can play a part Blue hydrogen is likely to lead the way for the hydrogen market in the shorter term, so there is still a market for natural gas	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Shippers

Feedback and insight gathered:	We will:	How is this reflected	Source
LNG			
2022 saw strong LNG shipments to the UK, and stakeholders believe this trend will continue in 2023, particularly whilst demand from China remains relatively low. 2024 looks uncertain, and it'**s** very difficult to predict, however much will depend on demand from China and the continued development of FSRU's that are coming online in Europe which have the potential to take shipments away from the UK. As is usually the case, market prices will dictate where the LNG will go	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Market reports
Stakeholders agreed with the latest market intelligence that suggest a tightening of the LNG supply market until the mid-2020's. This can be mainly attributed to an expected recovery in Chinese demand and lower pipeline flows from Russia to Europe. Russia supplies around 130bcm per annum to Europe which will need to be replaced			
The current energy crisis has prompted a shift in focus – before the crisis, there was some concern over falling gas demand as we head in o the 2030's, however there is less worry over this			
When asked over potential for LNG terminals to repurpose to hydrogen in the future, stakeholders stated they are looking into the ammonia market and believe there is a strong case to import ammonia. The UK has space for Ammonia storage and believe Saudi Arabi and the US will be key exporters of the fuel. Currently, they see ammonia development alongside the continued regasification of natural gas			

Feedback and insight gathered:	We will:	How is this reflected	Source
Gas market update			
Gas prices at the NBP continued to trade higher in 2022 as the ongoing conflict between Russia and Ukraine continued to intensify concerns over gas supplies in Europe, particularly over the winter period. Whilst prices have softened over the past few weeks as the weather has been relatively mild so far this winter, there remains caution that this could still change, whilst worries over supplies of gas next winter remain high	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Market reports
Green Gas			
Desktop research has shown that biomethane production can support security of supply and support industries who are reliant on natural gas use. Stakeholders that we have spoken to also agree with this view. Emissions could be reduced by up to 30 percent by 2030 if we can increase production Biomethane also has a role to play in transport, with a growing number of users moving towards this, while use in agriculture vehicles, such as tractors is also increasing Bringing in household food waste collection in the UK would increase feedstock and help to increase production, but stakeholders are unsure whether the food waste collections will happen Green Gas Support Scheme has had relatively low impact so far, with a small number of projects having applied for the scheme. The impact of the scheme is likely to be in the industrial waste sector as domestic waste collections yet to take place. In addition, rising costs, political uncertainty**,** and the length of time it takes to get permits have also had an impact on the scheme	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Market reports Gas producers

Feedback and insight gathered:	We will:	How is this reflected	Source
Shale			
Despite the decision by the current government to re-impose the moratorium on fracking, market participants still believe there is a case for Shale gas production in the UK, and their views remain like last year Stakeholders believe the UK will still be relying on natural gas out to 2050 and beyond, and imports of natural gas from LNG and pipeline imports are more carbon intensive than domestic shale Investment decisions in the sector have become very difficult in the past 12 months due to changes in government and a looming general election. Market participants also believe it would be very difficult to get the current government to overturn the moratorium before the next general election Last year, stakeholders told us that 2030 is the cut-off point, whereby the case for shale becomes much weaker after this point in time. Stakeholders this year believed this was still the case If Shale gas production was to develop in this country, the UK could become self-sufficient in gas in a high shale scenario, when combined with UKCS	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Market reports Gas producers
Hydrogen			
The issue of hydrogen application in domestic heating is a point of major debate among those we engaged with. There was passionate support for the use of the fuel from some quarters, most notably representatives of Network Owners. However, the majority of those engaged with have indicated that expansion into the domestic sector is not a high priority compared to the demand which could be met among industrial or transport-based consumers. The costs and logistics of moving into domestic heating	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Network owners Developers Industry bodies

Feedback and insight gathered:	We will:	How is this reflected	Source
are also a cause to pause, according to most in the industry, a matter not helped by the extended period (2026) before any form of decision on domestic heating is currently expected from the Government While domestic heating with hydrogen is not considered a priority by the majority of those we engaged with, this does not mean that the resulting assumption is a full deployment of heat pumps. Rather, just under half of those asked felt the UK would see a mix of the two technologies. The nature of the technology to be deployed would be dependent on the regional characteristics of housing stock/demand and the nature of the infrastructure in the region. This position is supported by similar comments from the Government's Science and Technology Committee in its report, 'The role of hydrogen in achieving Net Zero' A similar 'mixed' picture was expressed for production technology developments. Around 2/3rd of those spoken to either had no response to or were neutral on the focus of any production. However, the remainder indicated that there was a preference for blue hydrogen developments i.e**.,** gas feedstock with CCUS. Energy Suppliers and Asset Developers were those showing this preference, potentially linked to their own planned portfolio Even though there was no real preference on the technology amongst the majority, there was an acknowledgement that development on scale would be more likely to come from blue hydrogen production over green production. This reflects the maturity and nature of the technology, providing a more reliable level of output, although is still precluded on the development of CCUS on a commercial scale In the interim, the smaller green hydrogen product developments are being considered by the industry as a			

Feedback and insight gathered:	We will:	How is this reflected	Source
method of electricity system support. The placement and use of electrolysers at points of potential system constraints were included in the forecasts applied in FES 2020. The engagement indicates that this should remain the case Regarding network development for the transportation of hydrogen, engagement participants indicated that it was most likely that links would begin in clusters, built around industrial hydrogen demand zones. Production would be distributed in local areas as a priority, but ultimately clusters could link up to create larger production and transportation zones This contrasts with views expressed by small number of Asset Developers that indicate the need for a transmission network to connect local hubs. It should be noted that those who have indicated such a position are developing projects where there is limited local demand and such a transmission link would be needed to increase its viability. This has a direct impact on FES scenarios where a hydrogen transmission system such as being developed through Project Union is brought to fruition Finally, the engagement on hydrogen often discussed the Government plans and targets for hydrogen. The UK's hydrogen road map is aiming for 10GW of installed hydrogen production by 2030, notional split 50/50 between blue and green production. Most parties asked felt that this target was ambitious, particularly regarding green hydrogen production. Moreover, those polled indicated that it was a lack of timely and clear Government support for hydrogen production, which was delaying progress, putting the Government's own targets at risk			

Feedback and insight gathered:	We will:	How is this reflected	Source
Emissions and CCUS			
BEIS is now in phase 2 of its direct air and carbon capture programme (Direct Air Capture and other Greenhouse Gas Removal technologies competition - GOV.UK (www.gov.uk)). Time has been spent better understanding these technologies in terms of costs/energy usage/energy type (electricity, hydrogen, natural)/scales and how they fit into the overall landscape of the governments ambition to reach Net Zero by 2050. This is further complemented via desktop research and stakeholder engagement about other carbon dioxide removal technologies such as enhanced weathering, trying to better understand the process and any potential risks Progress report from the CCC last year highlights that more action is needed from government if we are to keep on track with carbon budgets Other work focuses on CCUS, speaking to the relevant stakeholders how GB can deploy this technology to meet climate targets. This has involved getting an understanding of the total capacity of CO2 storage in the UK, where storage sites are being leased, how companies will begin the process of CCUS and the potential for the UK to store CO2 of other countries if market conditions are favourable. BEIS have recently confirmed they have no objection to the OGA/NSTA to start awarding leasing licenses in the East Irish Sea and the North Sea (10 sites in total) which builds on the 3 locations which are currently under license. Using this information, we hope to produce visuals showing the locations of carbon storage sites and how these locations fit into the overall energy system. (1st Carbon Dioxide Storage Licensing Round (publishing.service.gov.uk))	Include this in our FES near-term view and ensure the FES 2023 ranges cover this	Include this in our FES near-term view and commentary	Market reports Government Developers Producers

Feedback and insight gathered:	We will:	How is this reflected	Source
Bioenergy			
Looking at the split of where and how best to grow biomass within the UK, BEIS are currently running a biomass feedstock programme to help develop domestic feedstocks (Biomass Feedstocks Innovation Programme: successful projects - GOV.UK (www.gov.uk)) we will keep up to date with the progress these projects have made Additionally, BEIS are running a BECCS h2 programme: Hydrogen BECCS Innovation Programme: Phase 2 - GOV.UK (www.gov.uk) We will be speaking to BEIS as part of our stakeholder engagement to get an update on their latest views on biomass, when they will publish their next biomass paper (and what implications this might have) as well as any other innovation programmes they might have	Ensure the FES 2023 ranges cover this	Include this in our commentary	Market reports BEIS

Appendix B. Breakdown of stakeholder categories

We use the categories below to monitor the sectors that we have engaged with. We used the same categories as last year to allow for comparison.

The numbers below are the total number (1,516) of stakeholders involved across all our engagement activities. Some have taken part in more than one event during this time and the total number of individual stakeholders is 1,020.

Main category	Sub-category	Count
Communities and their representatives	Impacted Local Communities and Residents	0
	Parish councils	0
	Local Campaign Groups and advocacy groups	2
Consumers and consumer groups	General public/individual responses	32
	Consumer groups and charities	34
Energy Industry	Energy Suppliers	72
	European and International Networks	21
	European TSO	15
	Generators (including Big 6)	168
	Industry bodies & experts including Consultancies, Trade bodies	331
	Interconnectors	10
	Offshore Gas Companies	27
	Offshore Transmission Owners	0
	Operating Margin Providers	0
	National Grid ESO	115
	Shippers	8
	Small Generators	8
	Small Renewables	27
	Storage and Flexibility	50
	Terminal Operators	7
	Transmission directly connected demand	10
Innovators	Environmentalists	5
	Manufacturers and Technologists	75
	Infrastructure providers	33
Non-governmental organisations	Environmental Groups	1
	Other non-governmental organisations	4
Other stakeholders	Academics, Universities and Schools	47
	Finance and investment community	45
	Small businesses	15
	Other including media	0
Political	Devolved Administrations	12
	European administration	17
	Members of European Parliament	0
	Members of Parliament	0
	Local Authorities	2
	UK Government Bodies	19
Regulator	Regulatory bodies	56
UK Networks	Distribution Network Operators	28
	Gas and Electricity Transmission Companies	113
	Gas Distribution Networks	74
	Other UK networks - water, communications	1
	Total	**1516**

Appendix C. Breakdown of communications and online activities

<table>
<tr><th colspan="2">FES 2022 Launch week - July 18 – 21 2022</th></tr>
<tr><td>Overview
FES 2022 launch took place Monday 18th July till 21st July. Events took place on the 18th, 20th and 21st with the 19th being used a read and digest day for stakeholders. The FES documents were published on Monday 18th
Overall NPS for the week: +37
c.400 stakeholders joined the virtual executive launch on the Monday
c.43 questions via sli.do during Monday event
c. 265 questions via sli.do during Wednesday and Thursday sessions
c.965 stakeholders in total joined the Wednesday and Thursday deep-dive sessions
c.160 joined the virtual networking sessions on Wednesday and Thursday
c.1984 watched the virtual events on catch-up to date</td><td>On-the-day satisfaction survey

Positive feedback:
Well organised and planned event.
Great summaries and engaging
Good Q&A session hearing from the team
On-the-day satisfaction survey

Improvements for consideration:
Share a version of the slides in advance of the event
Would be good to ensure all questions are addressed regardless of popularity</td></tr>
<tr><td colspan="2">Stakeholder quotes:
“Appreciate the long Q&A sessions” “Really enjoyed it and find it engaging”
“Well conducted event, great summaries, unfortunately I was expecting more visibility of how NGESO will facilitate/enable and innovate to promote Net Zero ambitions”
“The FES is such an important vision of the future and shows credible paths to how we can reach Net Zero. As it is informed by the best data from the industry, I regard it as (alongside the CCC's work) the gold standard for energy system modelling. This year I have been very impressed with the focus on consumer and heat as these are some of the key areas of challenge and where progress is needed this decade.”
“Happy with the changes made in FES 2022 and should continue in the direction of making recommendations to industry due to the level of influence FES has”.</td></tr>
</table>

Call for Evidence - October 2022

- FES 2023 online Call for Evidence ran for over 2-3 weeks during October 2022
- Range of questions asked for 6 different subjects
- MS Forms used to ensure an easy and quick experience for stakeholders
- Published via the FES and ESO newsletter, FES website and ESO social media channels
- Range of stakeholders responded - public, electricity storage, consumer bodies, gas networks, environmentalists, trade associations, consultations, and academia
- We had 61 different stakeholders in total enter the survey or provide their response direct by email. This is an increase on last year's results

Summary of feedback

- Following closure of the survey we published a summary of the responses through the FES website and newsletter. The summary can be found here. The feedback is also referenced above on pages 35 to 60.

1:1 bilateral engagement (ESO and one other organisation) for FES 2023 - August 2022 to January 2023

Overview:

- We have met with 148 stakeholders from 76 organisations
- We have heard from 8 stakeholder categories during this engagement
- All meetings have taken place virtually using MS Teams
- Engagement is planned and co-ordinated across the FES team and wider ESO where appropriate
- Each meeting is tailored to that organisation; an agenda is sent in advance to help all prepare for the engagement
- Current stakeholder satisfaction measure is 8.47 out of 10 from 17 responses
- 1:1 engagement will continue through till late spring

Positive feedback:

- Useful engagement
- Highly engaged and open team
- Followed up on points post meeting
- Friendly and easy to communicate with

Improvements for consideration:

- More could be done in terms of material shared before the engagement
- Regular contact throughout the year
- Share more information on current plans and FES

Feedback for FES 2023:

The feedback gathered from these meetings and how we are taking it forward is shown in pages 35 to 60.

For reference, we have received input on:

- Industrial and commercial
- Heat
- Transport
- Regional Insights
- Whole system and gas supply
- Energy supply
- Storage and flexibility

Stakeholder quotes:

- "I find the report an interesting read, and it's a great way of communicating the various future scenarios."
- "The team are easy to communicate with and are friendly. Questions were provided in advance which was useful."

1:1 bilateral engagement (ESO and one other organisation) for FES 2023 - August 2022 to January 2023
• "It was a good introduction to the ESO team, although we felt that it would have been useful for the ESO team to have a shared a bit more information on what they are working on."

Regional Insights engagement - 19 May 2022
Overview • Webinar held after publishing an explainer document showing the steps we are taking to provide a deeper regional focus to our scenarios • Approx. 65 stakeholders joined for this webinar • Approx. 10 questions received in the meeting chat
Areas Stakeholders are interested in: • How are individual region or local authority targets are going to inform the modelling in the future • Ensuring there is a consistency in assumptions and narrative between regions • Balancing local ambitions against economics

Electricity storage webinar - 16 January 2023
Overview • Webinar held after publishing the thought piece focusing on electricity storage, exploring the current landscape and the potential future credible pathways of electricity storage to 2050 • 8 stakeholders provided feedback to the thought piece • Approx. 85 stakeholders joined for this webinar – including those from the ESO • Stakeholder satisfaction score: NPS +39 and 8.34 out of day • Approx. 15 questions received in the meeting chat
Positive feedback: • Great session and very useful • Appreciate the time given to deliver the session **Stakeholder quotes:** • "Useful follow-up to the original blog post, thank you" • "Communication is key"

Stakeholder Topic Table Talks - 12 January 2023	
• Thursday 12 January – The Pullman Hotel, central London • 110 stakeholders invited • C.70 attended – broad range of stakeholders and organisations represented • 6 topics discussed with 3 questions asked for each subject • Opportunity to meet 1:1 with the team through 'pop-into-the-pod' slots during the afternoon • Stakeholder satisfaction scores: 8.72 out of 10 NPS +52	**On-the-day satisfaction survey** Positive feedback: • Well organised, effective, and structured event • Fast-paced, interesting, and different • Good facilitation during the day
	On-the-day satisfaction survey Improvements for consideration: • Allow more time for discussion • Some conversations were difficult to hear due to noise in the room • Opportunity to switch tables for each subject question so that you can talk to more people
Stakeholder quotes: • "Altogether excellent" • "Great event, well run, appreciated pre-read material, thanks." • "Probably could do with longer for the conference. More upfront presentations would be interesting too" • "Well led discussion by a really good set of facilitators" • "Very good sessions, possibly 5 mins longer on some of them table sessions" • "Would have been nice to have had more time on each topic"	

FES Network Forum - February 2022 to date (Online)
• Network Forum meetings held Feb 2022, Arp 2022, Jun 2022, Oct 2022, Dec 2022, and Feb 2023 being planned. All held virtually • Average of 32 attendees per meeting including those from the ESO • Representatives from gas and electricity distribution and transmission organisations • Also attended by other teams from the ESO • Various subjects discussed including FES 2022 launch and publication, engagement updates, FES 2023 plans, scenario framework and scenarios, Consumer Archetypes project, modelling insights, fuel prices and Bridging the Gap Agenda is shared in advance of the meeting and any other items are requested. Following the meeting, key action points, slides and a recording of the meetings is shared with attendees and wider distribution list for this group. Attendees have provided valuable feedback on the range of subjects including our analysis and modelling, FES 2023 plans and associated framework.

Online communications - Website, email, social media, newsletter

Website

For FES 2022 we made changes to the website to make the landing page the home for the full suite of documents, executive summary, and key messages. This has ensured an easier search path to find all the relevant documents.

There were 21,592 downloads of FES 2022 documents, broken down as followed:

- Full report interactive version: 9,651
- Full report non-interactive: 1,108
- FES in Five interactive: 508
- FES in Five non interactive: 4,178
- Data workbook: 3,397
- Scenario assumptions: 809
- How we do our modelling for FES 2022: 229
- Regional breakdown of FES data (workbook): 557
- Key changes from FES 2021 to 2022: 316
- FES 2023 Call for Evidence summary of responses: 528
- Future Energy Scenarios 2022 Stakeholder Feedback Document: 311

A few days after the launch programme finished, we uploaded recordings of all the virtual sessions to provide continual viewing opportunities for stakeholders. These have been watched by our stakeholder community nearly 2,000 times.

Email

Approx. *60 queries* received from July to date. Queries received are from a wide range of stakeholders, including public, suppliers, industry experts, storage & flexibility providers, academics & universities, and local authorities. Queries cover a broad range of topics from FES data and graphs to requests to join the mailing list and research projects. Most are replied to within five working days with complex queries or those that require further information taking longer.

ESO social media

We have utilised all ESO social media platforms to promote FES and the work we do. We shared key updates on the FES 2022 launch and key messages. Key statistics below:

Twitter

Total 87,215 impressions – March 2022 to date (FES, BtG and Regional)

Most popular – 20,757 for the day of FES 2022 launch

LinkedIn

29,652 followers ESO LinkedIn

Total 84,204 impressions - March 2022 to date (FES, BtG and Regional)

Most popular 9,026 for the FES 2022 launch and links

Newsletter

Online communications - Website, email, social media, newsletter
From February 2022 to January 2023, we published *10* newsletters to the future of energy *distribution list of c.6,300*. The FES newsletters are our main method of communication with stakeholders. The average open rate is 33.3%. The most read newsletters were relating to the launch and publication of FES 2022. The top four countries receiving the newsletter are UK, USA, Netherlands, and Germany. Other countries include Israel, Qatar, Spain and Japan.

Appendix D. Comparison of FES 2022 to FES 2023 stakeholder engagement

	2020	2021	2022
Total number of stakeholders	1257 different stakeholders 1713 stakeholders across all events	642 different stakeholders 1020 stakeholders across all events	**1020** different stakeholders **1516** stakeholders across events
Total number of organisations	460 different organisations 762 organisations across all activities 347 new organisations for 2020	329 different organisations 473 organisations across all activities 204 new organisations for 2021	**364** different organisations **567** organisations across all activities **236** new organisations for 2022
Bilateral & regional meetings	80 organisations 185 stakeholders	95 organisations 199 stakeholders	**76** organisations **145** stakeholders
FES launch events **FES launch on 'catch-up'**	790 stakeholders 194 stakeholders	428 stakeholders 142 stakeholders	**1365** stakeholders **1984** stakeholders
Call for Evidence	100 responses 62 organisations 21 as individuals	46 entered the survey 36 provided a response 33 different organisations	**61** responses **56** provided actionable feedback **45** different organisations
Workshops (webinars for 2020)	116 stakeholders 68 organisations	n/a	**63** stakeholders Topic Table Talks

Stakeholder category	2020 Total	2021 Total	2022 Total
Communities and their representatives	20	6	2
Consumers and consumer groups	183	27	66
Energy Industry	764	486	869
Innovators	198	81	113
Non-governmental organisations	33	16	5
Other stakeholders	233	146	119
Political	111	43	94
Regulator	46	12	28
UK Networks	125	203	220
	Total 1713	**Total 1020**	**Total 1516**

Below is a breakdown of stakeholder groups for each engagement event for FES 2023:

Stakeholder category	FES 2022 launch event	Call for evidence	1:1 engagement	Topic Table Talks	Network Forum	Consumer Archetypes Project	Electricity Storage Webinar	Bridging the Gap
Communities and their representatives	0	1	0	0	N/A	0	1	0
Consumers and consumer groups	16	23	2	2	N/A	17	2	5
Energy Industry	628	23	85	31	N/A	22	51	25
Innovators	73	4	15	11	N/A	3	3	7
Non-governmental organisations	0	1	2	1	N/A	0	0	1
Other stakeholders	100	2	5	3	N/A	0	4	5
Political	44	4	24	3	N/A	7	2	10
Regulator	13	0	1	3	N/A	9	0	2
UK Networks	91	3	14	9	93	0	5	5
TOTAL	**965**[1]	**61**	**148**	**63**	**93**	**58**	**68**	**60**

[1] This total does *not* include the c.400 that attended the executive brief or the 1984 that have watched on catch-up – stakeholder categories unknown

Appendix E. Review of FES 2022: YouSaid:WeWill

Summaries of the specific feedback from the FES 2022 Call for Evidence, are available on our website at: Call for Evidence:

Regional Insights

1. **We asked our stakeholders to provide their views on what aspects of the whole energy system would benefit from a more bottom-up regional modelling approach. Several areas were put forward by our stakeholders:**

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	Updated: What we did for FES 2022:
Hydrogen for heat and more broadly deployment of hydrogen across the whole energy system	Ensure that this feedback is central to our longer-term strategy for the regionalisation of FES. Some elements will be explored as part of FES 2022, but others will materialise in later publications (e.g., as modelling development and data collection will take time) In the near term we are exploring improvements to our regional heat, road transport and distributed generation modelling	Where relevant, we will use regional insights to inform the GB aspects of FES 2022 (as well as publishing more granular regional results and visualisations)	We updated our spatial heat model for FES 2022 with specific improvements made to the way that housing stock is processed regionally to enhance the quality of the outputs. We also updated policies based on information from the Heat and Buildings strategy and other publications.
Electricity Generation: topics included how technologies alter over time, more information on distribution-connected technologies and the inclusion of large tidal projects and schemes			For distributed generation we have used the Embedded Capacity Register (ECR) data, published by Distribution Network Operators, to inform our view of current and planned generation capacity connected to the network below transmission voltages
Heat decarbonisation: how heat networks, solar heating and heat storage technologies will develop			We have published additional regional results alongside FES 2022 to increase the transparency of our outputs. This can be found on the ESO data portal

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	Updated: What we did for FES 2022:
Electric Vehicles: The uptake of EVs based on recharging availability and urban and remote uptake comparisons	Ensure that this feedback is central to our longer-term strategy for the regionalisation of FES. Some elements will be explored as part of FES 2022, but others will materialise in later publications (e.g., as modelling development and data collection will take time) In the near term we are exploring improvements to our regional heat, road transport and distributed generation modelling	Where relevant, we will use regional insights to inform the GB aspects of FES 2022 (as well as publishing more granular regional results and visualisations)	For our transport modelling we have incorporated mileage data from the Department for Transport when splitting GB level demands into regional components as well as the number of registered vehicles This has enabled us to switch from just looking at numbers of EVs and where they are in the country, to looking at where the EVs are now being driven
Consumer engagement	On consumer engagement modelling, we intend on kicking off a project looking into consumer building blocks, jointly created with network companies We will also be broadening our engagement to bring in new voices and perspectives, such as Local Authorities We are working closely with the network companies through the ENA to continue to simplify and optimise the interface with the more bottom-up scenarios currently developed by gas and electricity network companies such as the DFES		On consumer engagement modelling we have kicked off an innovation project to enhance consumer behaviour modelling, which is seeking to adopt a common approach and language to be used across the industry. We intend on further broadening our engagement through this project by bringing in new voices and perspectives We have worked closely with the DNOs throughout the ENA to ensure that this transition is smooth not only for us but also for them. We will continue to work closely with the DNOs to further improve our distributed generation modelling as well as other areas in our process

2. **We also asked our stakeholders how we can improve our new visualisation of our regional breakdown of FES electricity data:**

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	Updated: What we did for FES 2022:
Our stakeholders informed us that it would be helpful if the FES document shows a regional breakdown of potential future emissions considering all types of current and future generation technologies We were also asked to consider who the end user of the visualisation is, to ensure it meets the needs of stakeholders and benefits them			We have enhanced our regional visualisation platform by adding outputs from our spatial heat model and our Building Blocks data

3. **We asked our stakeholders what they would like to see us change, focus on, or prioritise as we develop the regional whole energy system scenarios. Again, several areas were put forward by our stakeholders, although granularity of data was flagged by several:**

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	Updated: What we did for FES 2022:
• Electricity generation: role of nuclear power in regional decarbonisation • Planning longer term with no fossil fuel generation • Tidal stream resource • Hydrogen production using nuclear energy • Interaction with DFES: More sharing of datasets; Assumptions being made clearer; Bringing together modelling assumptions of FES and DFES • Focus on where granular regional modelling can improve accuracy of forecasts for what FES is used for • Include a more granular view of gas scenario projections • CO2 storage and CCUS deployment • Top to bottom communications and interfaces • FES toolkit for local deployment • Different spatial scenarios in terms of economic, demographic, transport demands and infrastructure	In terms of how we publish the regional data, as well as constantly increasing the amount of regional granularity we can provide, we are also exploring how best to provide stakeholders with the ability to configure the data to the granularity they require		We will be using feedback from users of our visualisation tool to feed into the further development of a user configurable FES view We will also be seeking feedback on the additional regional data we have published and asking our stakeholders what further datasets and to what level of granularity would bring them benefit

Net Zero

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
There was feedback that rapid action is needed to meet Net Zero, this included feedback that FES scenarios should focus more on 2030 and 2035. No feedback suggested that progress on Net Zero should be slower	Investigate how we can provide more emphasis on near term decarbonisation while still focusing on the 2050 Net Zero target	Ensuring all Net Zero compliant scenarios meet the 6th Carbon Budget (in 2035) as well as greater focus being provided on all other relevant interim milestones	We retained the Steady Progression scenario but renamed it 'Falling Short' to make it clearer that this scenario would not meet the legally binding net zero target. On balance we consider it credible to include a scenario that doesn't meet the net zero target but will keep this under review. Many milestones and targets are particularly challenging, and in some areas, we consider it credible that they could be missed in some of our net zero scenarios. This helps highlight the need for further action to meet net zero.
There was mixed feedback on whether all scenarios should meet the Net Zero target	Maintain Steady Progression as a scenario that doesn't reach Net Zero but rename it to more clearly acknowledge that it misses Net Zero	Steady Progression misses Net Zero by 2050	
Whilst there was support for bioenergy, there was feedback on the importance of ensuring sustainable biomass is used and the carbon accounting of bioenergy (including BECCS) is appropriate	There is uncertainty around emissions from bioenergy which relate to how sustainable the processes used to grow and harvest the feedstock are. Therefore, we will continue to engage with relevant stakeholders such as BEIS and CCC to ensure we are modelling emissions of bioenergy correctly	We will continue to review this area and use the scenarios to show an appropriate range of options for bioenergy deployment	

Industrial and Commercial

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Policy changes from I&C decarbonisation strategy, Net Zero strategy, hydrogen strategy I&C fuel switching rates to electricity and hydrogen	Adjust our fuel switching assumptions in line with policy incentives and industry feedback	Changes in energy demands for different fuels in the I&C sector, increased electricity and hydrogen demands in some scenarios	Completed as planned
Views on future likely I&C cluster development	Model planned I&C clusters in greater detail	Greater medium-term certainty in industrial and hydrogen demand in cluster locations	Completed as planned
Fuel Prices			
Volatility in energy prices and future projections	Adjust our models to take account of economic growth and I&C energy retail prices	Price spikes impacting short term demand forecasts	Completed as planned
Data Centres			
Feedback on future demand from data centres and insights into the viability of efficiency improvements in data centres	Model planned additional demand forecast for Data Centre connections in greater detail	Increased energy demands for data centres in all scenarios	Completed as planned
Feedback on the drivers of future data centre demand Feedback regarding the current UK data centre landscape; what types of data centres, how many, and where.	Adjust our forecasting models to recognise the impact of efficiency improvements in the years to come.	Varying rate of growth across scenarios	Completed as planned

Heat in buildings

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Policy document and landscape changes	Reflect publications such as the Heat and Buildings strategy	Lower bound of heat pump uptake	Completed as planned
Specific feedback on some of our initial regional heat outputs	Develop and improve our regional heat modelling capabilities	Improved regional modelling outputs, granularity, and accuracy	Completed as planned
Policy changes and low carbon technology support, heat pump grants	Incorporate impact of subsidy changes and HP price forecasts to heat modelling	Central assumptions on heat pump uptake rates	Completed as planned

Transport demand

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Policy developments affecting HGV, Bus and Motorcycle uptake. Data on baseline bus and HGV kWh/mile efficiencies	Broaden the range of zero emission technologies considered for use in heavy duty HGVs across the scenarios.	Faster uptake of zero emission HGVs in our Net Zero scenarios than modelled previously A greater role for BEV HGVs in the scenarios due to the increased uptake rate required to meet the 2035 target	Completed as planned
Feedback on smart charging, vehicle to grid engagement rates and demand per charge-point archetype assumptions	Develop and update our smart charging and V2G engagement assumptions Adjust demand per charge-point archetype	Changes in peak demand impact from V2G and smart charging	Completed as planned

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Innovation and behaviour change for charging for households without off street parking	Adjust range of outcomes for charging for households without off street parking	Varying outcomes between destination charging, near-home rapid hubs and on-street charging solutions	Completed as planned

Overall electricity demand (excluding EVs)

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Feedback on main drivers of demand and translation into peak demands	Review and adjust demand annual/peak ratios	Changes to peak demand across scenarios	Completed as planned
Impact of grid code modifications change to Triads	Improve understanding of embedded benefits and impact of their removal on peak demand	Changes to demand side response assumptions across scenarios	Reviewed grid code modification with charging team for primary and possible secondary effects

Electricity generation

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Overall mix			
The proportions and amounts in the 2021 scenarios are broadly correct but timings are heavily dependent on technical and commercial readiness. Even for high technical readiness, investment decisions will be deferred until the business case is clear for a given technology. Clear policy, routes to funding and revenue generation will all help to narrow the margin of uncertainty. This is especially true for technologies with a high capital cost like nuclear or tidal range. These insights align with Key Messages 1 and 3 from FES 2021	FES focusses on technologies which have both commercial and technical viability between now and 2050, which we will continue to do. We will continue to pay attention to changes in the market and reflect that in our publications	We will adjust timings in line with insight gathered on for readiness of specific technologies and markets	Completed as planned
Onshore and Offshore Wind			
Weather dependency means low load factors likely, meaning higher installed capacity. There needs to be a clear business case to build the extra capacity required We received updated numbers for installed wind capacity including specific forecasts for likely floating wind capacities in the Celtic Sea by 2035 and total capacity for all Scottish waters by 2050	Consider the complexities and enablers to reaching government target for installed wind capacity	Our narrative will explore the relationship between load factors, capacity, and commercial viability of large-scale wind and what may happen in times of excess	We explored curtailments and flexibility products in relation to high wind output

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Offshore Wind			
There is a specific request for a breakdown of installed offshore wind capacity, by region, by scenario	This is now a question we ask all wind development stakeholders	Our modelling will reflect updated estimates of installed capacity and a regional breakdown where possible	Explored in our regional insights
Tidal and Marine Sources			
Tidal energy and marine resources in general may be underdeveloped or under-represented in national policy and, consequently, FES The industry believes that there is increasing government backing for tidal range generation. Capacity in Wales could be tripled and by 2034, there could be up to 10GW available, providing up to 20TWh per year There is seen to be minimal detrimental impact to the marine environment, especially when compared to potential destruction from climate change There is a high up-front cost for Tidal Range but also a long (120 year) life span. Under a RAV model, such as the one for Sizewell C Nuclear Plant, we could expect a cost of c.£45/MWh	Explore the potential for greater installation of tidal generation capacity (tidal steam and tidal range)	Our modelling will reflect technologies which are deemed credible based on their technical and commercial readiness. The latter is sometimes based largely on government policy positions for certain technologies We will ensure that explanations are provided for why any specific technologies have been left out of scenarios as part of the narrative. This may be in the form of a separate publication	Completed as planned

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Load factors			
Confirmation that increasing diversity and flexibility in the generation mix is likely to lead to lower load factors and higher installed capacities. There may be new business cases emerging to harness the increased capacity that comes with low load factors to use surplus energy in ways that may seem inefficient in isolation, but are good compromises when the wider energy efficiency, cost, environmental impacts, and public support is considered	This reflects our current understanding, but we will continue to explain it in the report	No change – this is already modelled	No change – already modelled
Storage			
It was noted by several stakeholders that there is significant battery capacity in the pipeline although not all of it will be developed. There was also an acknowledgement from some stakeholders that there was scope for another pumped hydro storage site post 2035. Feedback generally agreed with the range of storage capacities (GW) and volumes (GWh) for other electricity storage technologies across the FES scenarios	Battery deployment will be increased slightly in Leading the Way. We will review the opportunity for additional pumped hydro storage particularly in the post 2035 period in Leading the Way. No significant changes to the range of capacities and volumes for other electricity storage technologies will be made to the FES scenarios	Increased battery and PHS capacity in Leading the Way. All scenarios but especially those that require high levels of flexibility	We increased battery capacity across all scenarios to reflect vast increase in pipeline Brought forward LDES capacity closer to pre 2035 and increased in all scenarios but FS
In terms of energy storage, the volume stored (e.g., GWh) is as important as the power rating (e.g., GW)	Although we do model volume and power, we will look to make it clearer in the report		GWh figures stated more clearly in report

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Storage			
It would be helpful to define different categories of storage i.e., short, long, inter-seasonal as organisations seem to use different definitions	We will consider if this makes the report clearer and if so, add relevant definitions. BEIS currently define long duration storage as >4hrs and have a power capacity of at least 100 MW		Duration definitions kept the same and in line with BEIS definitions. Graphic included in report to illustrate the roles those different durations of storage will play and, on the system, and volumes of storage required
Interconnectors			
The time needed to develop and build an interconnector can vary significantly from project to project as each one has different characteristics (i.e., cable length, routes). There is also increased regulatory uncertainty and therefore risk for projects connecting to some countries	Continue to engage with interconnector developers and update our interconnector model to incorporate the latest project timelines and uncertainty	The updated information on timelines and uncertainty has resulted in a reduction in the interconnector capacity in 2030 and 2050 across the scenarios, compared to FES 2021	Our published range reflects the changes in scenarios we said we would make. I.e., lower interconnector capacity overall and a wider range created by a lower bottom end in our Falling Short Scenario. It is important to note that this range is intended to highlight the increased uncertainty around interconnector project mainly driven by political factors in connecting countries. The change in range should not be seen as a decrease in the need for interconnection between FES21 and 22. For a view on the level on interconnection expected to be needed stakeholders should refer to the NOA IC

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Interconnectors As well as "point to point" interconnectors, some developers are considering multi-purpose interconnectors (MPI's) to the UK. Some stakeholders felt that FES should include these options. However, others also acknowledged that there was uncertainty around what configuration an MPI would take, as well as when they would first be developed, although they are expected to become a reality	We will consider how MPI's could be modelled in FES 2023. For FES 2022 we will discuss the potential impact of MPI's as a future technology, but it may not be possible to explicitly include it in the modelling	This may change the characteristics of interconnectors in some scenarios, for example different load factors	MPI interconnectors are still expected to be part of the energy mix in the future but were not explicitly model due to uncertainty around their configuration
Interconnectors There was also a relatively small amount of feedback that longer distance interconnectors linked to remote generation would help to provide security of supply to the system and should be considered	We will continue to engage with relevant developers and follow the development of this technology	No direct action taken in the absence of specific information	No direct action taken in the absence of specific information
Gas The ESO must ensure that FES is technologically agnostic – the branding suggests a preference towards electricity No significant changes to gas generation predictions	We have included this feedback in our early storyboarding activity for FES 2022 and will continue to find and action opportunities to demonstrate the "whole energy system" nature of FES	No change – our editorial governance processes regularly challenge us to remain neutral in our analysis and commentary. This is because, despite being the ESO, FES is a whole energy system document and so this is how we treat our analysis and engagement	No change

Bioenergy and BECCS

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
BECCS could provide a greater source of baseload generation, especially in winter to help reduce overall emissions because of an expectation that BECCS plants will respond to a carbon price more than to an electricity price	We will engage further with diverse stakeholders and conduct our own research into lifecycle sustainability of Biomass generation feedstock to ensure a balanced view in FES	We will ultimately continue to base our carbon accounting on the standard set by the IPCC (and BEIS/CCC)	Carbon accounting was based on IPCC standard
While no concerns have been raised around any supply constraint for Biomass in the numbers being modelled in FES, there is debate about how sustainable the feedstock is. There is concern that the nuance around bioenergy feedstock is hard to convey. There is a real risk that biomass (and, to a lesser extent, BECCS) could turn **out to be a net** carbon emitter depending on how it is deployed and could take the focus away from other decarbonisation activity	Explore other means of carbon abatement including greater societal change We will continue to explore the whole supply chain and wider environmental impacts of BECCS	We will ultimately continue to base our carbon accounting on the standard set by the IPCC We will continue to model based on credible levels of societal change but will explain the changes needed in some of the hard to abate sectors	Carbon accounting was based on IPCC standard

Gas supply

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
UKCS UKCS decline rate may be faster than expected, though it would likely be a small difference. This may be a correction of previous optimism. Once the decline of gas starts, it is expected to be rapid Assumptions on UKCS supply into specific terminals unduly pessimistic Government ambition for no unabated gas generation on the electricity system past 2035	We must balance the feedback that is received here on UKCS. Assumptions in Leading the Way may be extended to other scenarios	2035 ambition for no unabated gas for power is currently targeted in Leading the Way but may be reflected in other scenarios	2035 ambition for no unabated gas for power was targeted in Leading the Way
Shale The closer we get to 2030 without progress on shale gas, the less chance we have of shale developing in this country	Some stakeholders believe that shale gas should not appear in the scenarios at all, and others feel that it provides a means to reduce import dependency and could potentially be lower in terms of emissions that other supplies (e.g., LNG)	Currently we have shale gas supply in Falling Short only. This may be pushed back to later in the period to reflect latest position. New exploration appears less likely in general since FES 2021 but, equally, until this is explicitly ruled out, it is credible to retain it in Falling Short	Shale gas remained in the open non-compliant scenario in FES 2022, Falling Short, after the government opened the door to the possibility of fracking
Interconnectors / LNG / Norway No changes suggested for gas interconnectors	N/A	N/A	

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Biogas and Green Gas Biomethane is seen as a key transitional technology until mid-2030s for heat while hydrogen or electric heating scale up Green gas use (and corresponding reduction of natural gas demand) seen as essential to meet target for no unabated gas generation by 2035 We received updated projections for operational CHP plants using biomethane and updated collection rates	We will revisit our underlying assumptions for biomethane production and will update where necessary The general stance in FES is that bioenergy supply in general should be targeted towards areas where there is no viable decarbonised alternative or to produce negative emissions. However, there is a caveat for biogas particularly when it can be produced from waste in other sectors and reduce e.g., landfill gas escaping into the environment	Update biomethane production capacities and implementation timings as appropriate	Capacities updated
Biogas and Green Gas FES currently sees 28TWh as a credible biomethane production capacity. Industry is divided on whether this is ambitions or conservative. Some sources suggest there is a potential for at least 54.5TWh to 73TWh by 2030 of biomethane	We may need to engage stakeholders further where conflicting points of view cannot be reconciled	Our models will ultimately represent what we can justify as a credible range	Bio usage for biomethane ranges from 0Twh in 2050 up to 50Twh across the 4 scenarios

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Biogas and Green Gas Carbon price likely to influence growth in anaerobic digestion (AD). Global Methane Pledge can't be met without dealing with emissions from rotting waste. AD is a decarbonisation technology which offers energy as a by-product rather than the other way around. Sequestered carbon from AD may then be combined with hydrogen to make more biomethane Circa 45 AD plants expected to be built within 4 years under the green gas support scheme leading to projected growth in the short to medium term. Leading developers are starting to commission plants without subsidy, basing the business model on the value of decarbonisation technology	We already model the influence of changing market incentives such as carbon prices through our societal change axis. This is reviewed regularly to ensure that it reflects updated stakeholder feedback	Continued reflection of the influence of carbon prices in our models	Carbon process updated

System constraints

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Most comments recognised the value of the current FES modelling related to flexibility. There has been some feedback that alongside the unconstrained network modelled in FES, it would be useful to see results in the short term for a constrained network. This is to reflect the real-world impact that constraining off renewables for network constraints has on power system intensity and wind load factors. The National Infrastructure Commission have also recognised that the location of increased renewable deployment on the network (I.e., where resource is high) can add challenges to managing the network. These challenges can lead to increased network constraints	Assess how we can incorporate constrained network modelling into the current suite of FES results. This could be an additional near-term (e.g., 5 year) sensitivity analysis on the existing scenarios	Improved accuracy of load factors and carbon emissions in the short term and better alignment with historical out-turn. It may also allow the requirement for energy storage to mitigate constraints to be modelled	We presented greater detail on transmission network flows today and in the future, and the varying requirements on networks across the country, We also highlighted the regional variation in carbon intensity of electricity and how this is affected by changes in the generation mix. We will keep this under review as work is done to reform how Transmission network planning is done

Hydrogen

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
General Role of Hydrogen Green hydrogen is unanimously the preferred option for end use but there is debate about how we transition to it and the role of blue hydrogen in this transition	This feedback generally aligns with the underlying assumptions behind FES 2021 with some caveats (e.g., around System Transformation and whether green hydrogen could be scaled up quickly enough to meet required demand)	Updated figures and increased clarity within commentary	Updated figures and increased clarity within commentary

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
General Role of Hydrogen Policy is unclear about whether hydrogen generation should be used for flexibility or baseload and what the commercial incentives will be	We aim to provide greater clarity on the ways we may transition to hydrogen and its role in the whole energy system	Updated figures and increased clarity within commentary	Updated figures and increased clarity within commentary
Stakeholders see hydrogen as a transformative source of flexibility, the value of which is expected to rise dramatically as the electricity generation mix becomes more diverse	We will explore the relative energy efficiency and economic efficiencies for different technologies with respect to heating as an indicative end use (and potentially other applications)	We will consider including this in scenarios depending on how credible the added insight would be	Relative efficiencies included
Cheap electricity can change the way we deploy hydrogen and may make the use of hydrogen-based storage preferable over more efficient vectors due to its potential for overall best business case		Commentary on relative energy efficiency and economic efficiency of hydrogen compared to other vectors	Commentary added
Deployment of Hydrogen Clusters are emerging as key to leading the transition to hydrogen	Ensure this is considered in current modelling – especially regarding the role of the National [Gas] Transmission System	Changes reflected in modelling as appropriate (including locational detail)	Changes included
Demand and Storage There may be potential for government subsidies for commercial diesel to transfer to Hydrogen to stimulate demand	We will explore this further with relevant stakeholders and monitor the likelihood of this	We will model based on credibility, which typically comes from a policy commitment	Completed as planned

Feedback and insight gathered:	We said we would for FES 2022:	Shown in scenario through:	*Updated: What we did for FES 2022:*
Demand and Storage			
Blending into the NTS would provide a reliable demand and an incentive for people to invest in hydrogen generation – but this limited capacity could curtail hydrogen production unless there is also investment in inter-seasonal geological storage. This also allows for hydrogen production in times of excess renewable generation, for sale back to the network to cover low renewable periods	We will seek greater clarity on the likelihood of large scale inter-seasonal storage being available and commercially viable	To be included in modelling as appropriate	Modelling updated
Electrolysis and Electricity Generation			
Large scale storage improves the commercial viability of mass hydrogen production Manufacturing capacity for electrolysers likely to be stronger than demand and there are good economies of scale i.e., not a constraint to deployment – rather the opposite No change in assumptions for how electrolysers will operate but co-located sites may be likely Mid 2030's expectations for electrolysis deployment at scale updated Efficiency improvements: £400 per kW possible by 2025 as is a 50% increase in generation capacity for the same footprint	We will seek greater clarity on the likelihood of large scale inter-seasonal storage being available and commercially viable. However, this feedback aligns with the comments on the importance of hydrogen storage in FES 2021 Seek wider views on electrolysis estimates	It is likely that we will increase the amount of electrolysis capacity that we model in at least the LW and ST scenarios	Storage updated

Review of our engagement and communication actions from FES 2022

Below we have provided a review of the actions that we said we would deliver for FES 2022 (as set out in the 2022 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

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
Communication			
Making our newsletters and email more interesting by including more graphics	We will look to add in graphics and images into our newsletters and other communications	Call for Evidence	We have started to add images to our newsletter but recognise that we can add more to make the articles more interesting and engaging. We will look to improve on this further during 2023
Consider hosting short interactive webinars on specific topics	During 2022 we will look to host webinars for our stakeholder community based on the subject of thought pieces that we write and publish. We will look to invite stakeholders with specific knowledge on this subject together with an open invite for all	Call for Evidence	We have run several webinars alongside published articles. Most recently we published an article on electricity storage and hosted a webinar shortly after. This was attended by 85 stakeholders and received excellent feedback. We also ran a webinar to discuss our plans to enhance our regional insights which was attended by over 60 stakeholders alongside an explainer document. We will continue to do this.
Using more accurate icons for FES 2022	Working with the design agency we will ensure all graphics used in the documents and presentations are fit for purpose and are an accurate representation	Call for Evidence	We worked closely with the design agency for the suite of FES 2022 documents to ensure all images and graphics provided an accurate representation

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
Utilising an API for accessing data in the workbook	We will continue to add and expand on the FES data that is made available in machine readable format and via API in future cycles. We have been increasing the data made available in machine readable format via the ESO Data Portal (link) over the past FES cycles. Currently we have: Data in "Building Block" format, The Energy Supply data table from the data workbook, The Electricity Ten Year Statement regional data, including GSP shapefiles. Plus, data from other areas of the ESO. These files can be accessed via API - more details can be found here	Call for Evidence	The use of the data portal continues to grow, between January 2022 on January 2023 the FES data was accessed via the data portal a total of 5466 times this is a 85% increase on the previous year. The key groups are building blocks data, electricity supply data, spatial heat model output and regional breakdown of FES data, with regional data receiving the most views. For FES 2023 we are continuing to work on the models and the data availability, this should have a positive impact on future FES documents and the portal
Providing engagement updates for the rest of the year post FES launch	We will continue to share updates and early FES insight through our newsletter and via the ESO newsletter – Plugged In. In the December and January FES newsletter we will be sharing thought pieces looking at our new regional heat model and a 10 year look back at FES	Call for Evidence	We have shared insights with stakeholders through our stakeholder engagement programme, including bilateral meetings and events, as well as through our thought pieces and newsletters
Clarity on who to talk to in the team and to understand who deals with what together with a management structure	We will look to share a team structure with key areas of focus in a future newsletter and website	September 2021 Stakeholder Satisfaction Survey	During the Topic Table Talks event we shared a breakdown of our teams in the stakeholder pre-read material
Website			

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
Include some headline findings rather than broad key messages; analysis snapshots would be welcome	We will look to include more of our "key insights" (which contain more direct analysis snapshots) from each of the main sections of the document onto the website	Call for Evidence	For FES 2022 we used the landing page to host all the documents as well as the Key Messages and executive summary. For each Key Message, we listed recommendations for action needed based on our analysis. For each chapter and sub chapters, we listed the key findings on web pages
There are numerous ways to access the same information, the website could be simplified with better use of navigation	We will provide clearer navigation on the website and better signposting to the suite of documents	Call for Evidence	For the FES 2022 suite of documents, we made changes to the website to ensure the landing page contained all documents, as well as the key messages, executive summary, and individual chapters. We will continue with this for 2023
FES documents			
Ensure the non-interactive version is available at time of launch as the interactive version does not allow for copy and paste	For FES 2022 we will ensure that all versions of the main report are available on the day of publishing	Call for Evidence	Due to tight timescales, we were unable to publish the print, non-interactive version of the main report on the day. This was available a couple of days after. For FES 2023 we will endeavour to publish all documents at the same time
Be clear that the main report is an interactive version	For FES 2022 we will explicitly set out if the documents are interactive, printable, or other at the time of publishing. This will be visible both	Call for Evidence	For FES 2022, on the website, each document was clearly labelled if it was print or interactive. We will continue with this for FES 2023

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
	on the website and within the relevant documents		
Provide varying levels of granularity for varying audiences	While it may not be possible to provide narrative for all levels of granularity, we plan to make the granularity of our data and visualisations more configurable to ensure that it meets the needs of our stakeholder base	Call for Evidence	We provided varying levels of detail of our analysis to meet the needs of our stakeholders. We did this by publishing FES in Five which is a summary of the main report with the accompanying data workbook providing the detailed analysis. We also provided more granular data through the regional building blocks. The website provides the key insight and recommendations at a high level
Improve the navigation of the main document as it can be difficult to follow, current perception is that it is full of links and jargon	We will work with our design team to improve the navigation of the main document, looking to other sources for best practice and seeking to further reduce any jargon	Call for Evidence	We made changes to the interactive document for FES to improve the navigation and structure of the document and ensure each section follows a similar structure. We have also included more pop-ups with background context and an extended document glossary
Provide more detail regarding nuclear energy and how its role varies in scenarios	We will build on FES 2021 insights in terms of how nuclear energy may have a potentially broader role in the energy industry across the scenarios. For instance, production of hydrogen and heat in addition to electricity generation as well as more insight into its contribution to flexibility	Call for Evidence	The potential role of nuclear power for wider applications was included in FES 2022 (e.g., System Transformation included nuclear power for hydrogen produced by electrolysis.)

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
Consider numbering the scenarios in the future if they remain unchanged (for example CT20, CT21) to enable referencing aspects that have changed since last year	Where references to scenarios from previous publications are made in FES 2022, we will ensure that this is clear (i.e., potentially via some form of numbering)	Call for Evidence	In the FES 2022 we made comparisons with the previous year clear by referencing FES 2021 scenarios in the text. It was not deemed necessary to number the scenarios due to the way they were presented. We also renamed one of our scenarios (Falling Short)
Could FES be split by technology like the CCC's 6th Carbon Budget – to provide more technology specific analysis	Where appropriate, we split FES by technology (e.g., different types of generation or heating system). We will explore the extent to which we can expand on this in FES 2022 whilst retaining other relevant splits such as sectors, fuels etc. As in previous years, our data and analysis will be able to be broken down by technology using the data workbook	Call for Evidence	In our suite of documents for FES 2022 we carefully considered how insights would be presented. The document was presented in a similar format to FES 2021, on a top level by sector with different technology at lower level, to allow easier year on year comparison. Scenario projections for major technologies are presented in the document with further detail signposted to the data workbook.
FES launch event			
More advance notice of the launch event – 3-6 months in advance would be ideal	We will share the launch date for FES 2022 no later than April (i.e., 3 months prior)	Call for Evidence	For the launch and publication of FES 2022 we shared the date approximately 12 weeks in advance via the newsletter and on social media
Ensure links are sent out after the event for viewing the presentations	As soon as possible after the launch event has concluded, we will share links to view the presentations. This can be via the website or newsletter, over social	Call for Evidence	The recordings of all the virtual events from the FES launch were posted on the website a few days after the event. We shared these via the FES 2022 wrap-up email

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
	media and directly to those that attended		
Spread the sessions out more so it is easier to attend all of them	While we make recordings of the sessions available for people who missed them, we are keen to maximise numbers at the sessions themselves. As such we will seek further feedback on how best to achieve this (noting that other stakeholders have previously expressed a preference for sessions to be compressed into single days)	Call for Evidence	A few days after the completion of the FES 2022 launch, we published recordings of all the virtual events. Regarding timings of the virtual sessions, we continued to host these over two days as we believe this meets the requirements of most stakeholders
Launch sessions to include more analysis insight rather than repeating FES – explain more of the implications and modelling	Presentations for FES 2022 to include more content on the aspects and implications of the modelling and less duplication of content from the main FES report	Call for Evidence	We made significant changes to the content for the deep-dive presentations for FES 2022, focusing more on the actions needed, consequences and risks rather than repeating content from the report. This approach was welcomed by stakeholders; we will continue for FES 2023
Host breakout sessions on specific topics	For FES 2022 we will consider altering the format of the breakout sessions to focus on specific subjects	Call for Evidence	As we did for FES 2021, we offered virtual breakout sessions during the deep-dives presentations for 2022. We altered the format by setting the subject in advance. We saw an increase in the number of attendees joining and will continue with this format in the future
Some attendees commented that the questions weren't answered sufficiently	As in other forums, it is not always possible to provide a yes or no	On the day satisfaction survey	As we do in all our Q&A sessions, we do our best to answer all the

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
and needed more of a yes or no – the question was a challenge to the assumptions	answer to questions on complex topics – especially when exchanges are recorded as caveats can be very important. However, we are always keen to receive challenges to our assumptions and will ensure that answers to questions are as helpful as possible. This includes any responses included in FAQ documentation		questions to the best of our ability within the time allowed. We used Sli.do for FE 2022 for the Q&A asking those questions that were the most popular. We always offer our email address if stakeholders wish to contact us further
Stakeholders would like more in depth information into the modelling and assumptions and less of a summary of what is already published in the FES report	We will consider providing more information on the assumptions and modelling that is not covered in the main report. This could be a specific deep dive. Also, we will include better signposting to the modelling and assumptions document in the full suite	On the day satisfaction survey	We changed the format of the virtual deep-dives session for FES 2022 by focussing more on our assumptions, risk, actions, and consequences for each Key Message – this approach was well received by stakeholders
Comments received focused on the quality of the recorded presentations – how they need to be more engaging, less rushed**,** and scripted. Some stakeholders said it was difficult to stay engaged	We will look to improve the quality of the presentations by using a different format for recording them and streaming through the platform. We will also look at training requirements for the team as well as incorporating graphics on screen to make them more engaging	On the day satisfaction survey	We made significant changes to the software and platform used for the FES 2022 launch. We moved to MS Teams Webinar, improving the quality of the presentations and functionality. All presentations were live
Some stakeholders experienced issues with WTV's virtual conference software, particularly those using Microsoft edge. In some instances, the streaming platform was blocked by company firewalls	In event pre-read we will continue to highlight any potential issues with using different browsers and, when links are sent, advise attendees to test them in advance	On the day satisfaction survey	For FES 2022 we used MS Teams Webinar rather than a third-party conference platform. This ensured that attendees did not experience any connection, streaming, joining or firewall issues. We did not

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
			receive any comments regarding these issues this time
Several attendees requested access to the presentation slides before or at the same time as the presentation	For future events, we will consider whether sharing some or all the slides in advance of the presentation may improve engagement. However, more generally we will share slides as soon as possible after the presentations	On the day satisfaction survey	After consideration, we did not share any slides in advance of the presentations. We published these very soon after the launch programme
Comments were received about the registration process and how it could be improved by sending calendar invites for selected sessions	For future events we will work with the conference provider, seeking to send calendar invites for the separate sessions	On the day satisfaction survey	We used MS Teams webinar allowing us to send direct calendar invites for each individual Key Message session to all those that registered to attend
Several stakeholders requested earlier joining instructions, agenda, timings for the day and other information	In addition to the information shared via the FES newsletter we will look to provide further information via the website and directly to those that have registered	On the day satisfaction survey	We used MS Teams Webinar for FE 2022, giving more control and flexibility to the organising team – this ensured that we were able to connect directly with attendees for agendas and timings etc rather than through a third party. Using MS Teams also removed the need for any detailed joining instructions
Some attendees commented that having a higher character letter limit in the Sli.do Q&A would have been useful	We will look to increase the capacity in the Q&A function to raise longer questions whilst also noting the risk that this could be detrimental to the broader Q&A process for all attendees	On the day satisfaction survey	For the Q&A sessions for 2022 we used Sli.do – this allowed longer questions to be raised. We did not receive any negative feedback regarding this.

You said:	We said we would for FES 2022:	Where was the feedback gathered?	*Updated: What we did for FES 2022:*
Some stakeholders have requested to have a session on some of the modelling methods used, for those interested in data science and modelling	We will consider hosting a session specifically on modelling methods	On the day satisfaction survey	We did not offer a separate session on our modelling as this is only requested by very small minority of stakeholders. We did update our document our 'How we do our modelling' document and renamed the document to make to clearer to stakeholders
Bilateral engagement			
Some stakeholders provided feedback that they would like more frequent sessions and regular contact throughout the year	We will look to offer further opportunities for engagement throughout the year via the FES newsletter	Bilateral satisfaction survey	In addition to the 1:1 engagement we also ran the Call for Evidence. This online engagement provides all with the opportunity to contribute. We also hosted the Topic Tale Talks event in early January for stakeholders to come together, with the team to discuss a range of subjects. We welcome feedback throughout the year via our newsletter, email, and social media platforms
Feedback was received that we should consider if one hour is long enough for adequate discussions	When planning our engagement and understanding what we need to discuss with stakeholders we will look to schedule time longer than an hour where appropriate	Bilateral satisfaction survey	Following a review of our engagement meetings we felt that one hour was the right amount of time for most stakeholders, allowing sufficient time for discussion
For specific questions and points to discuss, sending these in advance would help structure the session	For future bilateral meetings, where possible, we will send stakeholders questions to advance for awareness	Bilateral satisfaction survey	For our focused 1:1 engagement we send an agenda, where appropriate, in advance of the meeting to attendees to help them prepare, this ensures the time spent is valuable to all

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