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ESO Response to Future System Operator supply and demand modelling

Dear Joanna Gaches,

Thank you for the opportunity to respond to your consultation on Future System Operator supply and demand modelling.

Who we are

As the Electricity System Operator (ESO) for Great Britain, we are at the heart of the energy system, balancing electricity supply and demand second by second.

Our mission, as the UK moves towards its 2050 Net-Zero target, is to drive the transformation to a fully decarbonised electricity system by 2035, one which is reliable, affordable, and fair for all. We play a central role in driving Great Britain's path to net zero and use our unique perspective and independent position to facilitate market-based solutions to the challenges posed by the trilemma.

Our transformation to a Future System Operator (FSO) is set to build on the ESO's position at the heart of the energy industry, acting as an enabler for greater industry collaboration and alignment. This will unlock value for current and future consumers through more effective strategic planning, management, and coordination across the whole energy system.

Our key messages

We broadly agree with the principles outlined in the consultation that will allow the FSO to make strategic investment recommendations to meet 2035 and 2050 targets.

We believe there is value in creating strategic pathways to Net-Zero, focused on reducing total system investment and operational costs. This is in contrast to the existing scenario approach in our future Energy Scenarios (FES) that outline credible routes to Net-Zero but does not consider the economic merits of the investment needed to meet government targets.

We broadly agree that there is value in creating a single forward view over the next 7-12 years that would allow for more clear direction for shorter-term investment decisions. However, as previously outlined to Ofgem, while it might be possible to create a single view for investment purposes, uncertainty in future supply and demand can't be eliminated. We propose that we produce a narrower range of pathways for the next FES cycle until a decision on the future of heat in the UK has been made in 2026 by the government.

We agree with Ofgem's proposal to reduce the cadence of major FES releases for the purposes of the Centralised Strategic Network Plan (CSNP) from an annual basis to a two/three yearly basis. While we would still produce minor updates in the intervening years to keep our short-term forecasts up to date, the additional time between major releases would allow for more robust pathway building with additional modelling analysis and insights.

While it was not specifically asked within the consultation questions, we would like to raise the potential conflict of license changes and FES guidance being produced in late 2023/early 2024. The production of the next FES under the new principles being consulted on will begin in July 2023, many months prior to Ofgem's proposed timescales for license and guidance changes. We would request that Ofgem is able to provide guidance in principle upon the closing of this consultation so we can deliver a changed FES 2024 on time.

Detailed responses to each question raised in the consultation can be found in Appendix 1 below.

We look forward to engaging with you further. Should you require further information on any of the points raised in our response please contact tomas.poffley@nationalgrideso.com. Our response is not confidential.

Yours sincerely

Julian Leslie

Head of Networks and Chief Engineer

Appendix 1 – Consultation Question Responses

Question 1: Do you agree that we should move towards pathways instead of scenarios, to provide greater clarity on the type of investments required under the CSNP?

We agree with the ambition to move towards the creation of “Strategic Pathways”. We believe it is important to be clear as to what this means in practice. It is also necessary to be realistic about the trade-offs of this approach when compared to Scenarios. Finally, it is important to explore what is expected when providing “Clarity” to investment processes.

Pathways vs Scenarios

The most important distinction between pathways and scenarios is their purpose. The FES scenarios present 4 credible but distinct outcomes for the evolution of the Future Energy System. This allows downstream customers to assess the risk of their plans against distinctly different yet credible outcomes and make informed decision on this basis. The scenarios are not intended to be a forecast of what is most likely to happen. Nor are they intended to provide guidance on what should happen. To this effect they do not attempt to analyse the relative merits of one scenario over another or seek ensure the scenarios represent optimal outcomes.

The general expectation of the FES scenarios is that the future will lie somewhere within the range but not necessarily resemble one of the discrete scenarios themselves. Noting however that “extreme” outcomes are not included in the scenarios.

Pathways will analyse, from a cost and networks perspective, what an optimal future energy system, that remains credible, might look like. These will primarily optimise on the total cost of energy to consumers in Great Britain. While it may not be possible to optimise all sources of consumer costs in our first iteration, models and capability will continually be developed to incorporate these in subsequent releases. The first iteration will focus on the cost of supply-side investment, operational and wholesale energy costs.

Uncertainty will be introduced by varying the inputs into each pathway, such as fuel and technology cost assumptions as well as demand forecasts. The modelling will then create a cost optimal pathway against this background. This will allow cost optimal pathways to be created against each set of input assumptions and will also allow the pathways to be directly compared on a cost basis.

The purpose of the pathways over the scenarios would be to provide analytical evidence as to which routes to Net-Zero are both credible and advisable. However, the FSO will not have the power to influence all the aspects of the pathways and therefore the outputs of these and the CSNP alongside the FSO’s advisory role is critical to ensuring the best outcome for end consumers. As such there would still be great uncertainty over whether the pathways would come to fruition.

To conclude we support the move to pathways over scenarios. We believe that this is a necessary step to the development of strategic network investment facilitating net zero. The pathways will help provide a strong analytical evidence based for future energy policy decisions. If used correctly they will also help reduce the range of future uncertainty by providing evidence for why one pathway is more beneficial than another.

Question 2: Do you agree that there should be a single forward view of the near term for all pathways?

In principle we agree with the idea of moving to a single forward view in the future, however we believe it is important to be clearer on the benefits vs. the risks of this approach. Since the focus of the Ofgem consultation is on electricity related network expenditure, the response to this question is focused on electricity networks.

The benefit presented in the consultation of moving to a single forward view is primarily that it will provide more certainty to the network investment process. While uncertainty to the decision-making process can be reduced, it doesn’t change the real uncertainty that the energy system faces. The high levels of uncertainty in how the future will pan out, even in the short-term, will still be there, they just won’t be presented for assessment in the network investment process. This will make it simpler to develop network plans but changes the way risk is managed in this process. It is therefore critical, if going the route of a single forward view, to agree clear principles for what the single forward view is, what version of the future it represents, and how it should be used.

The current scenario approach presents a wide envelope of credible outcomes. No indication of the likelihood of each scenario occurring is presented. As such, each scenario is treated as equally likely for the purposes of network investment planning. This can result in network investment being delayed by scenarios that aren't compliant with government policy targets. In effect, some scenarios can be a blocker to development of the electricity system since they must currently be considered within the network planning approach.

If it is decided that a single forward view is to be created for the CSNP then we need to be clear as to what this represents. One solution could be to use a view of the future which contains our "most-likely" direction of travel (akin to the Five-Year forecast currently presented in FES). This could be extended, however is not necessarily the most appropriate view to plan the networks against.

For the Holistic Network Design, Leading the Way was used as this is a scenario that is both challenging to the electricity network and represents meeting the targets of current government ambition. However, as the Five-Year Forecast shows, we are currently not on track to meet forecast in all areas. A decision therefore needs to be made as to what pathway the network should be planned to. There is a strong argument to be made for planning the electricity network against a pathway like Leading the Way that is strongly driven by meeting government targets and providing challenging network conditions in terms of high peaks and power flows. Doing this would require acceptance that some network investments could be delivered ahead of when they would be needed. However, this could be a worthwhile trade off to avoid network investment becoming a blocker to Net-Zero and running the risk of high constraint costs.

For a single-forward view to be successful, all stakeholders would have to be agreed on a detailed methodology in advance. Most critically, we would need agreement on how to treat large new supply-side connections when there is still uncertainty around their connection timing.

Given that the FES production process begins in July 2023 ahead of the 2024 release, we propose to reduce the range presented within the pathways in the short-term until a detailed methodology for the forward view has been decided. This approach will allow for more certainty in investment planning decisions made until a forward view is produced.

Can the same single forward view be used for Gas Network Planning?

While it could be possible to move to a single forward view for electricity network planning, it remains unclear on how natural gas and hydrogen should be treated within this view. If it was decided that Leading the Way style pathway was used as the forward-view, this presents complications for gas network planning. Historically, the gas networks have used other scenarios as their basis for planning as these include assumptions that the gas system will be more relied upon in the transition to Net-Zero.

The gas network whilst crucial in the near term, has difficult decisions to make on maintenance and transformation as we decrease our reliance on gas and increase our production and consumption of hydrogen. The gas network must therefore still ensure security of supply via fossil fuels that is needed in the short-term whilst transforming to allow for the development of hydrogen. Ideally, electricity network development would work in perfect tandem with that of natural gas and hydrogen, but if it does not, we must be prepared. And therefore, until there is greater certainty, we believe that a scenario for natural gas is required which accepts the level of risk around the timing of our electrification journey. In time, we may also need to consider what is most appropriate for hydrogen investment.

A single forward view used for both gas and electricity planning could result in a risk to security of supply if the targets within the forward view are not met. On the other hand, by planning both systems in an uncoordinated manner, we risk over investing in network assets. We would welcome further discussion on this topic and how to best approach it when the FSO takes over the role of gas network planning in 2024.

Question 3: Do you agree with our proposal to have Net-Zero compliant pathways (number to be determined by FSO), with a separate counterfactual demonstrating the scale of activities and investment that falls short?

We agree that all pathways used for the purpose of network planning should be Net Zero compliant in order to avoid planning to fail. We also think that making this distinction when presenting the pathways to a wider audience (outside of network planning) is a positive step in changing the narrative and mindset around decarbonisation. While this pathway would not be used for network planning purposes in the CSNP, it will still be crucial for other processes that focus on assessing system adequacy.

Question 4: Do you agree that the pathways should run to 2050, and if not, why not?

We agree that the pathways should run to 2050 and no further for now. Due to the focus and challenges faced with meeting Net-Zero, there is no clarity yet on what the world may look like beyond 2050 from a technology and policy perspective.

We will closely monitor the 2050 modelling horizon with our stakeholders and in conjunction with Ofgem, agree on the triggers that would extend our modelling horizon beyond 2050.

Question 5: Do you agree that the model should develop the capacity to include extreme data ranges when requested of the FSO in its role as strategic advisory body?

We do not agree that the FES is the ideal vessel for considering extreme, low-probability events. The challenge with creating credible, coherent pathways is ensuring that each pathway creates a consistent world view. All input assumptions must align to the axioms of the specific pathway, meaning that when one such input assumption is changed, the FES creation process must be restarted to ensure all demand and supply elements are consistent with the new assumption.

This can be best understood with a specific example to understand the complexity of modelling extreme events directly within the FES. If we were to assume prolonged natural gas supply shortages within the FES, we would have to assume increased electric heat installation rates, lower levels of blue hydrogen investment, lower levels of CCGT production, earlier retirements of CCGT units and many other knock-on impacts. These combine to produce an entirely new pathway which require significant resources to create.

With the coherent worldviews presented within the FES, we believe extreme events are best studied in models with lower levels of detail, where consistency and knock-on impacts are less of a concern. Extreme, low-probability event data can still be packaged with FES models for downstream customers, but this data should only be used for short-term events that would have low impact on the wider development of the supply and demand picture in Great Britain. We believe that this type of strategic analysis will best be delivered as part of our Horizon Scanning and risk assessments, but separate to our FES detailed analysis.

We are open to the idea of exploring specific extreme events that could impact the long-term development of supply and demand, assuming that the FES moves to a schedule with more time between major releases and that the number of events studied are agreed in advance. This would allow us to create detailed insights on events of high concern and analyse how the supply and demand picture in Great Britain would evolve as a consequence.

Question 6: Do you agree with our consultation position on modelling network constraints?

We agree with Ofgem's proposal of including network constraints in FES modelling in the short-term while modelling an unconstrained network in the longer term. It will be important however to ensure that the background network used within the FES creation process assumes the highest level of potential transmission network investment to avoid pre-empting the detailed network design which will be created in the CSNP. Using this methodology, we can be certain that all new supply and demand components within the FES pathways are able to be connected to the network according to estimated network upgrade timeframes.

By modelling network constraints within our pathway approach, we will have the capability to advise on future generation and demand connection locations as part of the new FSO advisory role.

The exact timeframes and background network assumptions would have to be agreed in advance with Ofgem, TO's and other key stakeholders.

Question 7: Do you agree with our consultation position, and do you have a view on which data principles should be possible to adopt for the first FES?

We thank Ofgem for recognising that this process of change and improvements will take time to develop in order to deliver everything we would like to. We have not yet made a decision on the best prioritisation on data principles. We will be outlining our options and minded-to position soon.

Question 8: Are there specific stakeholder needs cases for publication of data, including the format of outputs?

We welcome stakeholder feedback on specific needs for the format and publication of data outputs.

Question 9: Are there specific data outputs associated with the FES that we should mandate?

As part of the FES documentation, we currently include a data workbook that includes all of the outputs. We would welcome greater clarity from Ofgem on what it believes currently isn't included that could be of value. We question the value in publishing all of our models since making these suitable for public release would require significant resources to ensure they are suitable for public use, have associated documentation and

are cleansed of sensitive data. For any specific models, we would propose discussing the costs and benefits of delivering public releases. An additional complication is that some of our models are built in third-party software which require commercial licenses to use.

Question 10: Do you agree that regional and/or industrial hub pathways should be included in the FES?

We are broadly agreed that including some regional/industrial pathway modelling in the FES would be beneficial. An enhanced understanding of regional requirements of the future energy system will play an important part in identifying network requirements across all energy vectors.

FES already provides a regional breakdown, and we will be continually enhancing this regional information by adopting a more “bottom up” approach where it is relevant and material to do so. It is important however to ensure that this activity doesn’t duplicate efforts that are already undertaken by DNOs and TOs. By adopting more granular assumptions the FES can ensure that regional plans are aligned across Great Britain to support delivery of government policy targets.

Any changes made to the FES methodology will need to complement and align with the broader changes that will be introduced through the regional system planner role.

Question 11: Do you agree with our proposal for a ‘major’ FES in the year prior to the main CSNP publication, with smaller annual updates in the intervening years?

We agree that there could be benefit in moving towards a less frequent “major” FES publication schedule in line with the new CSNP. However, it is important to note that the FES serves multiple customers, many of which currently rely on annual updates.

In order to serve these customers best, it may be better to produce annual short-term updates with less frequency long-term forecast updates. This would allow customers that rely on short-term data to receive the latest industry information, while also giving us additional time to produce detailed economically optimised long-term pathways every 2 or 3 years.

Depending on the agreed upon timescales and approach, it will be important to agree upon the thresholds that will trigger an update to the long-term pathways in intervening years. With a more complex modelling approach to produce the pathways, it is unlikely to be possible to produce a full FES refresh upon request, so these updates would be best served as separate single pathway sensitivities. We will consult with stakeholders to agree upon the criteria that would trigger additional sensitivity analysis when updated industry information becomes available.

Question 12: Do you consider that longer-term evolution of energy supply and demand modelling should head in the direction outlined above and if so how?

We broadly agree that FES supply and demand modelling should evolve in the direction that allows for co-optimisation of multiple energy vectors and to be able to advise on the optimal placement of future supply, demand and network investment.

While the full breadth of the scope of FSO responsibilities is still being discussed, the changes set out in this consultation give the FES a platform from which to be able to advise on whole system interactions. While direct system investments (generation, storage, network) are simpler to optimise from a cost reduction perspective, environmental and social value will be more difficult to advise on until new capability is developed.

In order to analyse further variations in assumptions and deep uncertainties, we would need significant resource increases and technology upgrades to ensure the modelling complexity could be achieved. For each additional component to be considered within FES analysis, it would be necessary to understand if the additional costs incurred would provide value to stakeholders, customers and consumers.