Shaping our electricity future

Consultation – Industry feedback summary

EIRGRID SONI

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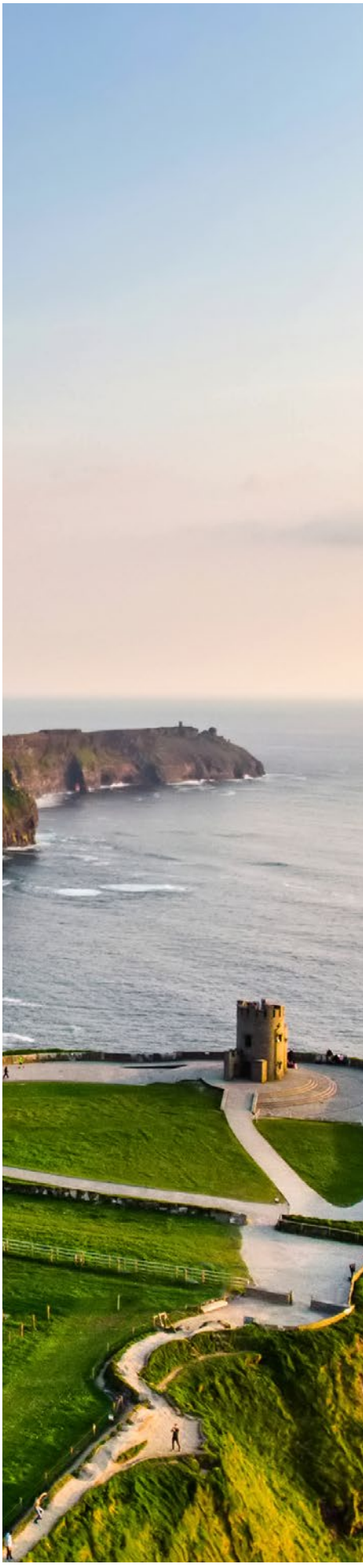


1. Introduction

The Shaping Our Electricity Future (SOEF) consultation was a step in understanding the electricity viewpoints of all stakeholders in Ireland and Northern Ireland. It is important that the TSOs are cognisant of the commentary and insights that you as energy stakeholders can provide and how we use this feedback to enhance the inputs to the final roadmap scheduled for publication in October 2021. The Irish Government has mandated a policy of 70% of electricity from renewables by 2030, and net zero Green House Gases by 2050. In Northern Ireland, the Department for the Economy is due to publish its energy strategy, which has a proposed vision of achieving net zero carbon emissions by 2050 while maintaining affordable energy for consumers. Shaping Our Electricity Future looks at the initiatives required to reach at least 70% of electricity from renewables by 2030 (referred to as the Renewable Ambition) in both Ireland and Northern Ireland. EirGrid and SONI cannot deliver on these challenging climate objectives in isolation. We need both the support and cooperation of our stakeholders to help deliver on the vast changes to electricity markets, power system operations and transmission network infrastructure that needs to be delivered in a relatively short period of time.

As the energy sector moves towards a safe, sustainable, low-carbon future there will be major changes in how and where electricity is generated, how it is connected to the grid, and in how it is bought and sold. The consultation sought feedback for the three main areas, outlined below. Interaction between these areas is shown in Figure 1.1.

Transmission Networks – four different approaches were proposed to reinforce the transmission network to address the identified needs. The purpose of the consultation was to identify the relative merits of each approach and provide meaningful feedback and information on what is the most advantageous pathway to follow when developing the transmission infrastructure network of the future.

Power System Operations – to deliver against the Renewable Ambition, it will be necessary to accommodate unprecedented penetration levels of variable non-synchronous RES such as offshore wind, onshore wind, and solar, whilst reducing the minimum number of units requirement and keeping curtailment of RES to a minimum. This will require a significant evolution of the processes and tools needed to operate the power system.

Electricity Markets – from a consumer perspective, a supply of affordable, clean low carbon energy is desired but so too is an energy system that is safe and works as expected whenever it is required. That resilience is important to the consumer and so must be implemented through an aligned markets design.

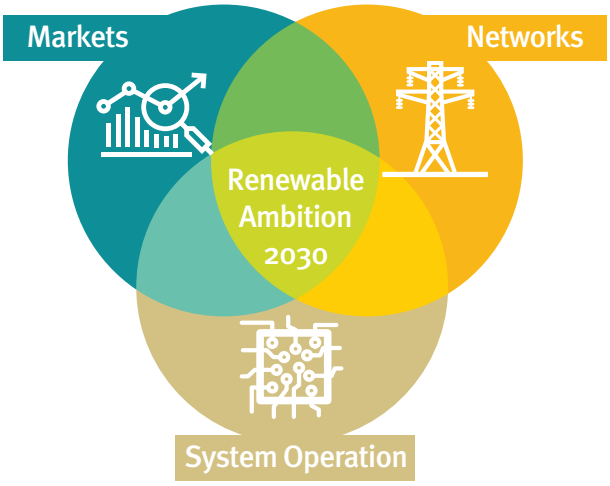


Figure 1.1: Three main areas of the Shaping Our Electricity Future consultation

2. Purpose

The purpose of this document is to provide a synopsis of the industry responses and comments received by EirGrid and SONI as part of the Shaping Our Electricity Future Consultation. An overview of the entire Shaping Our Electricity Future process is shown in Figure 2.1.

The main objective of the Shaping Our Electricity Future initiative is to outline an orderly transition to the Renewable Ambition in Ireland and Northern Ireland over the next 9 years. In consultation with governments, regulators, and stakeholders we will use a scenario-based analysis across the whole electricity system to identify an optimal roadmap to delivery of the Renewable Ambition.

Given the relatively short planning horizon to 2030, Shaping Our Electricity Future must provide a deliverable, economically feasible, dynamic, and transparent roadmap that maintains consumer affordability and delivers system reliability while meeting the Renewable Ambition.

The analysis in Shaping Our Electricity Future is based upon achieving at least 70% RES-E by 2030. However, the future evolution of the power system beyond 2030 is also implicitly considered in broader ambitions to be carbon neutral by 2050.

The consultation set out a range of credible approaches and options to meet the Renewable Ambition. Industry stakeholders provided feedback on what the optimal roadmap to achieve the Renewable Ambition should include covering areas such as:

- The optimal network investments required;
- Electricity market reforms needed; and
- Changes required to system operations.

Whilst delivering these changes, EirGrid and SONI must maintain the reliability of the electricity supply and minimise the overall cost to the electricity consumer.

The feedback we have received is being used to help validate our scenario-based models and to update assumptions, drivers and risks. The revised models will be used to produce the final Shaping Our Electricity Future Roadmap.

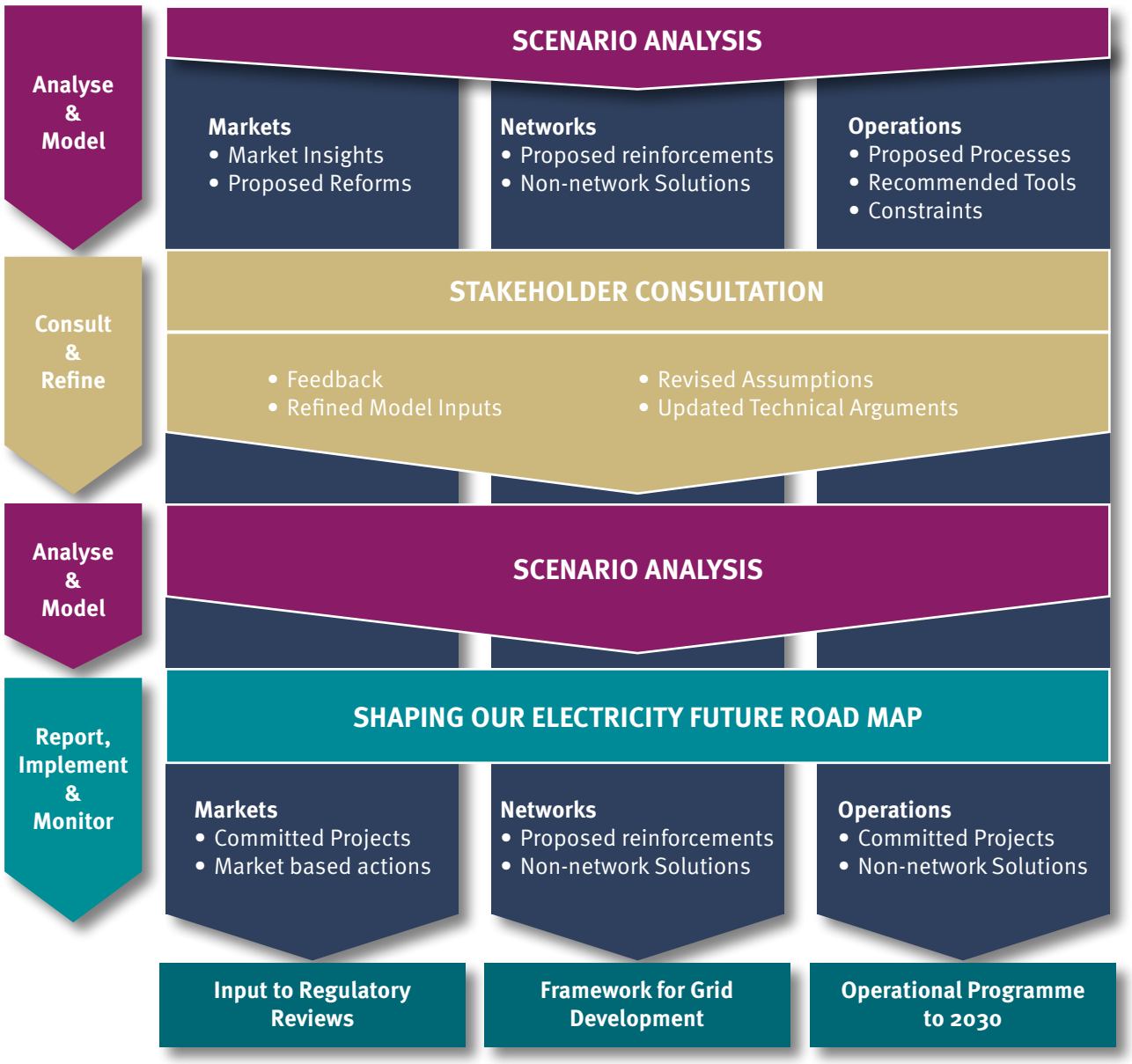


Figure 2.1: Overview of the Shaping Our Electricity Future process

3. Key Themes

Throughout the industry stakeholder engagement process, participants discussed and provided feedback on a wide range of subjects related to how best to achieve the Renewable Ambition while maintaining a safe, reliable, and affordable supply of electricity. The content and quality of the feedback was high and provided a variety of insights, suggestions and recommendations to support the Shaping Our Electricity Future roadmap.

Most of the feedback is all-island in nature, where respondents did not distinguish between the jurisdictions of Northern Ireland and Ireland when providing their commentary. We reviewed and considered all comments provided but have focussed our efforts on areas which fall under the scope of Shaping Our Electricity Future.

The consultation generated feedback from over 70 different electricity industry stakeholders and the diversity of responses ranged from regional development groups, renewable developers, energy and business associations, energy storage providers and energy Citizens. Our review of the feedback identified several key themes that we correlated and applied to the underlying assumptions and modelling inputs. The key themes are grouped under the following headings:

- **Broad feedback** – commentary relates to networks, markets, and operations
- **Transmission Networks** – feedback that relates specifically to networks
- **Power System Operations** – feedback that relates specifically to enhancement of power system operations processes and tools
- **Electricity Markets** – feedback that relates specifically to market enhancements

In these key themes it is noted where feedback is specific to Ireland or Northern Ireland alone.

3.1 Feedback common to networks, markets and operations

Many industry respondents provided feedback which is relevant to the development of the overall Shaping Our Electricity Future Roadmap rather than specifically targeted for transmission network reinforcements, electricity market and system operations enhancements. A summary of these key themes is provided below – it is noted where feedback is specific to Ireland or Northern Ireland alone:

Costings – many industry respondents noted that the cost included in the consultation report related to the capital expenditure of the transmission network cost. Respondents believed that this did not reflect the overall cost of meeting the Renewable Ambition and the corresponding impact on consumers.

> *'Costs associated with each option is an assessment of the investment required to deliver each option, and as such we believe these cost comparisons are inappropriate and in fact invalid' – Industry Respondent*

Increased renewable targets – many industry respondents stated the achievement of 70% RES-E by 2030 should be considered a step toward the goal of a net zero carbon emissions power system by 2050 and that meeting a net zero target should be the basis for the Shaping Our Electricity Future Roadmap.

> *'System Operators should not be assessing the approaches purely from the delivery of the 2030 targets, but rather the deliverability and cost impacts of meeting the 2050 target of becoming net zero, as this increases the risk associated with changing demand and increased cost of additional uprating and or reinforcement required to deliver the net zero targets' – Industry Respondent*

Shaping Our Electricity Future advisory council – many industry respondents suggested setting up of a SOEF Advisory Council like the DS3 Advisory Council. The purpose of the council is to provide a forum to discuss ideas and issues that may impact the achievement of the Renewable Ambition. Members of the council should be experts from across the power industry including representatives from academia and industry across Ireland and Northern Ireland.

> *'We propose that the System Operators establish a Grid Capacity Advisory Council (similar to the DS3 Advisory Council) as a mechanism for the System Operators, Regulators, industry and other stakeholders, including planning authorities and relevant Government Departments, to engage and work collaboratively on these matters' – Industry Respondent*

Resourcing of the Transmission System Operators (TSO) - several industry respondents stated that achieving the Renewable Ambition would result in a substantial increase in workload for EirGrid and SONI. They noted that EirGrid and SONI are currently resourced to meet their obligations as TSOs - including infrastructure planning, system operations and market operations. Respondents highlighted that it is essential that EirGrid and SONI are appropriately resourced to not only maintain the current requirements of system and market operations, but also implement the initiatives needed to achieve the Renewable Ambition.

> *'It is essential that EirGrid has the resources to progress parallel workstreams in terms of grid development, renewable connections, system operations and electricity markets.' – Industry Respondent*

Long-term security of supply - some industry respondents stressed the importance of maintaining security of supply throughout the transition to 70% renewables by 2030. Long term security of supply is viewed as critical for all electricity customers to economic activity and competitiveness.

> *'Concerns raised in recent times around security of supply, and the risk of negative impacts on customers, could have significant implications for Ireland's reputation internationally' – Industry Respondent*

Coordinated planning - some industry respondents commented that to achieve the Renewable Ambition, planning for the development of the transmission and distribution system must be coordinated between the TSOs and DSOs in Ireland and Northern Ireland. Transmission reinforcement may result in additional distribution reinforcements to ensure system reliability.

> *'[Achieving the Renewable Ambition will] require extensive cooperation and innovation in both distribution and transmission systems and particularly at the TSO/DSO interface' – Industry Respondent*

Stakeholder engagement - some industry respondents stated that ongoing cross-societal engagement will be required throughout the energy transition to ensure stakeholders are kept informed and continue to contribute to the implementation process.

> *'Historically, development of electricity infrastructure has been delayed and made more costly by issues with societal acceptance, land access and the planning application processes. Cooperation and support from across society is required to find solutions which will help to promote greater public acceptance of grid infrastructure especially with landowners and the communities directly impacted.' – Industry Respondent*

3.2 Transmission networks feedback

Maximise the use of existing grid - many industry respondents stated their support for maximising the current grid infrastructure and the build out of the network and interconnectors to allow the maximum number of renewables to be connected to the power system. These initiatives are deemed essential to facilitate firm access for projects to progress from RESS auctions to energisation.

> *'Additional implementation of new technology solutions as detailed in the Technology led approach should be incorporated as they have been shown to be effective in other jurisdictions and would maximise the use of existing grid infrastructure in the near term and would also help in minimising existing and projected future constraints whilst additional strategic infrastructure is also built out' – Industry Respondent*

Non-wire alternative technologies – several industry respondents raised the possibility of using technologies such as synchronous condensers, dynamic line rating, series compensation, and longer duration storage options. Some industry respondents advised caution of new non-wire technologies that are unproven in the field and their potential impact on system reliability is uncertain.

> *'We would like to emphasise that adapting the existing grid to mainly non-synchronous generation is possible, however technologies such as synchronous generation, demand response and storage should be recognised for their value in providing stabilisation to the grid.' – Industry Respondent*

Progression of existing and new grid projects – several industry respondents highlighted the need for a step change in pace in planning, approval, and implementation of existing and new infrastructure projects to achieve the Renewable Ambition.

> *'The pace of progress in network development needs to increase over the next decade.' – Industry Respondent*

Undergrounding cable – several industry respondents recommend the undergrounding of transmission cables where feasible to mitigate social acceptance risk and minimise environmental impact.

> *'Plan to underground any new circuits where technically feasible - avoid the process of considering overhead line (unless an underground cable is not technically feasible) options, which is long and fraught with local opposition issues.' – Industry Respondent*

Long-term proactive planning – given the scale of the Renewable Ambition, several industry respondents highlighted the need for robust long-term planning of network reinforcements.

> *'Planning networks and markets out to only 2030 risks either 'locking in' an inefficient pathway to Net Zero or leaving a shorter period to build out and finance the required infrastructure from 2030 to 2050, increasing the final cost to consumers.' – Industry Respondent*

Delivery of transmission infrastructure – given the scale of the transmission network projects needed to deliver the Renewable Ambition, several industry respondents highlighted the implementation of transmission infrastructure projects as the greatest challenge facing the Shaping Our Electricity Future initiative.

> *'Significantly more new transmission infrastructure is required to cater for the existing and planned levels of generation in the Northwest region.' – Industry Respondent*

Delivery of offshore wind in Northern Ireland – several industry respondents commented that the delivery of offshore wind capacity in Northern Ireland by 2030 was not feasible.

> *'Northern Ireland is not currently considered in the leasing rounds of the seabed for offshore wind therefore, it is unrealistic, and very much a risky strategy, to assume any offshore wind will be delivered in NI for 2030.' – Industry Respondent*

Regional development – some industry respondents stated that the development of the grid should be spread across more regions to aid regional development rather than focused in the eastern part of the country.

> *'Approach concentrates grid development in the eastern part of the country – there is a risk this could feed further demand growth in these grid constrained areas and disincentive balanced regional growth as per the ambition in the National Planning Framework.' – Industry Respondent*

System outages to accommodate reinforcements - some industry respondents questioned the operational impacts of outages needed to implement transmission system reinforcements.

> *'System operators must ensure that the system design is adequate to accommodate the outage opportunities needed for maintenance, refurbishment and end-of-life asset replacement as well as integrating reinforcements and new developments onto the Networks without undue impact on existing customers.' – Industry Respondent*

A blend of the consultation approaches in the final network development approach – many industry respondents recommended a blend of the consultation approaches in forming the final network development approach. Within their feedback, respondents set out their preferred combination of the approaches. A significant difference was noted between the feedback for Ireland and Northern Ireland:

- In Ireland, the Generation-Led approach was heavily favoured as the foundation for a blended approach.
- In Northern Ireland, the preference amongst many respondents was for the Developed-Led approach to form the foundation of a blended approach.

Relevance of Demand-Led approach to Northern Ireland– some industry respondents questioned the relevance of the Demand-Led approach to Northern Ireland given the lack of Large Energy Users in the country and the lack of strategy at governmental level to incentivise such users to develop.

> *'... deliverability of the approach would require the ability to incentivise where large users locate. This would need the Assembly, Local Government and bodies such as Invest NI for example, to develop an overall strategy to encourage and incentivise their development in particular locations.... This approach is heavily geared towards Ireland and as noted above, it is highly unlikely that NI will have the deployment of large energy users to justify this as a stand-alone approach.' – Industry Respondent*

3.3 Electricity market feedback

Holistic market design – many respondents agreed that a more holistic approach to market design is required to deliver the correct incentives and system changes to achieve 2030 targets.

> *'A holistic approach will deliver the optimal outcome, rather than focusing on separate elements.' - Industry Respondent*

Respondents highlighted that if a holistic approach was not taken that inefficiencies could occur and investment signals would be weakened.

> *'In summary, a holistic approach is absolutely critical given the complex interactions between the various markets (Long term renewable auctions, wholesale electricity, capacity, and system services). A siloed approach to each of these markets will likely result in significant inefficiencies and potentially significant associated consumer cost impacts.' - Industry Respondent*

Alignment of energy markets and operational constraints

Many respondents agreed that alignment between the markets is critical and that transparency and clarity on revenue opportunities, incentives, penalties and risk levels will be critical to ensure investment is possible and delivered in the most affordable manner.

> *'The principle of alignment is critical in order to ensure that the various markets are not incentivising investment in generation or system service provision that conflict with each other, e.g. new capacity with high start-up costs and high minimum operating levels, conflicting with RESS auctions and system service markets trying to incentivise and support very high instantaneous penetration levels of variable renewables. This likely requires some element of planning i.e., we do not want to see preferential treatment of specific technologies but we need to consider preferential treatment of certain technology characteristics.' – Industry Respondent*

A small number of industry respondents disagreed with the suggestion of ensuring alignment between market schedules, and contended that to do so would mean noncompliance with Article 13 of the Clean Energy Package.

> *'We disagree that incorporating SNSP limitations, i.e. real time system wide constraints, into the ex-ante markets should be considered. The system must facilitate the market design and market incentives – we cannot support outcomes that see the market having to react to fit to system limitations.' – Industry Respondent*

Capacity market review - Many industry respondents provided views on the current capacity market design. Some respondents have suggested there is a need to redesign the capacity market to provide better incentives and investment signals for renewable resources.

> *'Market design to ensure increasingly competitive supply auctions - generators should have the right incentives to bid into RESS auctions and capacity markets at prices that reduce over time, reflecting the increasing efficiency and lowering technology costs of renewable generation.' – Industry Respondent*

Capacity market review - Many industry respondents provided views on the current capacity market design, with a comprehensive range of issues discussed. Some industry respondents supported changes to provide better incentives and investment signals for renewable resources.

> *'Stronger incentives to deliver earlier (or not rely upon the longstop date) should be considered - noting that stronger disincentives could also be applied, particularly in the event of non-delivery. ' – Industry Respondent*

Some respondents indicated that the capacity market needs support change to the Cost of New Entrant (NET CoNE) plant and enabling the market as a whole to align with the 2030 carbon budgets and eventual 2050 net zero objectives.

> *'We therefore support a review of the capacity market parameters, including the appropriate treatment of the NET CoNE calculation and also the concept of Best New Entrant plant or equivalent. ' – Industry Respondent*

> *'We agree that a review of the capacity market is needed to support new investment in low carbon technologies and avoid locking in inflexible generation for years to come. To date the capacity market has been geared towards conventional thermal plant but this focus needs to shift and a review of the market carried out to ensure investment is delivered in the technologies that can support renewables and our capacity needs over the longer-term. ' – Industry Respondent*

Several respondents requested urgent changes to the capacity market to help address concerns on the emerging security of supply issues, suggesting that the capacity market is not delivering given the current situation.

> *'It appears the capacity market is not working as intended. The recent challenges with the T4 auction and concerns about the security of supply are a sign that the capacity market is in need of immediate reform.' – Industry Respondent*

System services update - several industry respondents commented on the expanded role for system services and the need for electricity market design changes and incentives to ensure delivery of services to balance high-levels of SNSP.

> *'The system services framework and product design must be developed with a target of a zero-carbon system services model by 2030 and to get to this, more clarity is needed for investors in new zero-carbon technologies on future system service needs, investment frameworks and procurement timelines.' – Industry Respondent*

There was a high level of support for the need to increase system services and respondents requested clarification on the pace of implementation to allow them to plan their investment strategies.

> *'It is therefore recognised that an efficient outcome will not be delivered without investment and therefore the future arrangements for system services must provide sufficient investor certainty/confidence to finance and make significant capital expenditure decisions. In this regard we are concerned that daily auctions for system services will not be an efficient solution on the basis that they do not provide efficient or adequately bankable investment signals. ' – Industry Respondent*

There was some specific feedback on product design including whether there is a need for negative reserve products.

> *Negative reserve is noted as a technical scarcity in 2030 but does not appear to be highlighted as a potential future product. There are existing providers that can deliver this service such as wind and battery storage but it has not been defined as a system service and there is currently no specific remuneration in place to incentivise provision.' – Industry Respondent*

EU electricity directive - several industry respondents have suggested the full implementation of the priority dispatch and compensation under Article 12 and Article 13 of the EU electricity regulation.

> *'Full implementation of the Article 12 and Article 13 of the Electricity Regulation - including roll-out of the market interfaces to allow renewable generators to participate fully in the electricity market.' – Industry Respondent*

Network tariff review – several industry respondents recommend a review and redesign of network tariffs to better reflect charges for use of system. A broad range of suggestions on aspects requiring redesign were offered by respondents.

> *'Review of network tariffs needed - current model is largely based on capacity (levied per MW) rather than output (per MWh), which better reflects their use of the system.' – Industry Respondent*

Remove market barriers - some industry respondents recommend that the electricity market design needs to be enhanced to eliminate any barriers to new technologies entering the market.

> *'All barriers around immediate roll out and implementation of new technology solutions should be progressed as a matter of urgency.' – Industry Respondent*

Regulatory certainty - some industry respondents commented on the need for regulatory certainty to assist investors in making long-term financial commitments.

> *'The energy industry needs to have a regulatory framework that is economically and environmentally coherent.' – Industry Respondent*

Markets supporting renewable gas and hydrogen - some industry respondents have recommended that new conventional generation should be renewable gas and hydrogen ready.

> *'Future conventional generation must be flexible and capable of operating in a system with up to 100% of demand being met by renewables at any one time – New capacity should be hydrogen ready or at least 50% mix.' – Industry Respondent*

3.4 Power system operations feedback

Several industry respondents noted the need for enhanced operational processes, tools and system services to maintain security and quality of supply given that achieving 70% RES-E by 2030 will entail increasing the System Non-Synchronous Penetration (SNSP) limit up to 95%.

Reduction in minimum number of units and increase in SNSP - Many industry respondents recommended that the Shaping Our Electricity Future Roadmap should consider the ability for the power system to operate without a 'minimum generation units online' constraint on the system and at up to 100% SNSP.

> *'Call for SONI to focus on Capacity Targets - No Minimum units online by 2030.' – Industry Respondent*

Grid forming - Several consultation responses highlighted the potential of grid forming technology to support system stability and provide system restoration capability. The use of wind generation, batteries and STATCOMs as possible sources of emulated inertia was highlighted along with the potential for these technologies to provide blackstart capabilities.

> *'More emphasis should be placed on the potential for grid forming technologies such as wind turbine generators (WTGs) and combinations of batteries and STATCOMs.' – Industry Respondent*

Hydrogen - Some consultation responses highlighted the potential benefits of hydrogen technology as a renewable fuel for gas-fired generation and also as a source of energy storage. The potential to mix hydrogen with natural gas as an interim measure before transitioning to 100% hydrogen fuel was highlighted. The ability of hydrogen to store excess energy generated at wind and solar farm sites, via electrolysis, was also highlighted.

> *'Gas generators burning 100% hydrogen will be able to provide a decarbonised conventional power source - combined with significant storage capacities will enable a balanced and secure decarbonised grid.' – Industry Respondent*

Security of supply - Several consultation responses highlighted the need to maintain security of supply during the transition to 2030. The importance of maintaining a secure system from an economic and reputational point of view was highlighted. The quality of the electricity supply from a voltage stability point of view was also mentioned.

> *'Availability and security of electricity 24/7 is of paramount importance.' – Industry Respondent*

Synchronous condensers - Many consultation responses highlighted the potential benefits of synchronous condensers with their ability to provide inertia, reactive power and fault current. The ability of synchronous condensers to assist with the reduction in the minimum level of conventional generation required on the system and their potential economic benefit to the system was also highlighted.

> *'These devices provide both inertia and reactive power at a similar scale to a conventional fossil fuel plant, but with a fraction of the capital and running cost, and most importantly without burning fossil fuel, and without displacing renewables.' – Industry Respondent*

Storage - Several consultation responses highlighted the potential benefits of energy storage systems for system security and generation adequacy. The use of energy storage at variable renewable generation sites was mentioned as a potential method of reducing dispatch down at these sites. Respondents noted that this stored energy could then be used at times of low variable generation to support generation adequacy.

> *'Significant storage capacities will enable a balanced and secure decarbonised grid.' – Industry Respondent*

Renewable generation forecasting - Some consultation responses highlighted the importance of renewable generation forecasts with the potential for improved renewable generation forecasts to reduce the level of reserve and ramping services which need to be maintained by conventional units and to increase the level of renewable penetration on the all-island power system.

> *'Improved forecasting and reduced dispatch periods are the right priorities for the industry.' – Industry Respondent*

Pace of change - Several consultation responses suggested increasing the pace of change on the all-island power system beyond what is envisioned in the consultation. These respondents highlighted that the quicker changes are made, the greater potential benefits there are from a renewable generation point of view.

> *'The pace of progress in the areas of system operations needs to increase exponentially over the next decade.' – Industry Respondent*

Other - Many consultation responses highlighted technologies which have the potential to support the transition to 95% SNSP and 70% RES-E. There was also additional feedback on items which have not been discussed thus far; a non-exhaustive selection of these items is set out below:

- Development of enhanced dispatch down processes within the control centres;
- Provision of system services from distribution system-connected service providers;
- The high proportion of renewable generation connected to the distribution systems, especially in Northern Ireland, and the need to consider the impact of that on system operations;
- The potential for revision of the "over-install rule" considering the possible use of onsite storage and the high RES-E targets;
- Future decarbonisation of the power system beyond 2030; and
- Increased utilisation of hybrid projects.

4. Industry Stakeholder Responses

Responder types

The Shaping Our Electricity Future consultation generated great interest and feedback from over 71 different electricity sector stakeholders. The diversity of responses ranged from regional development groups, renewable developers, energy and business associations and energy storage providers. Figure 4.1 provides a breakdown of all the types of responders.

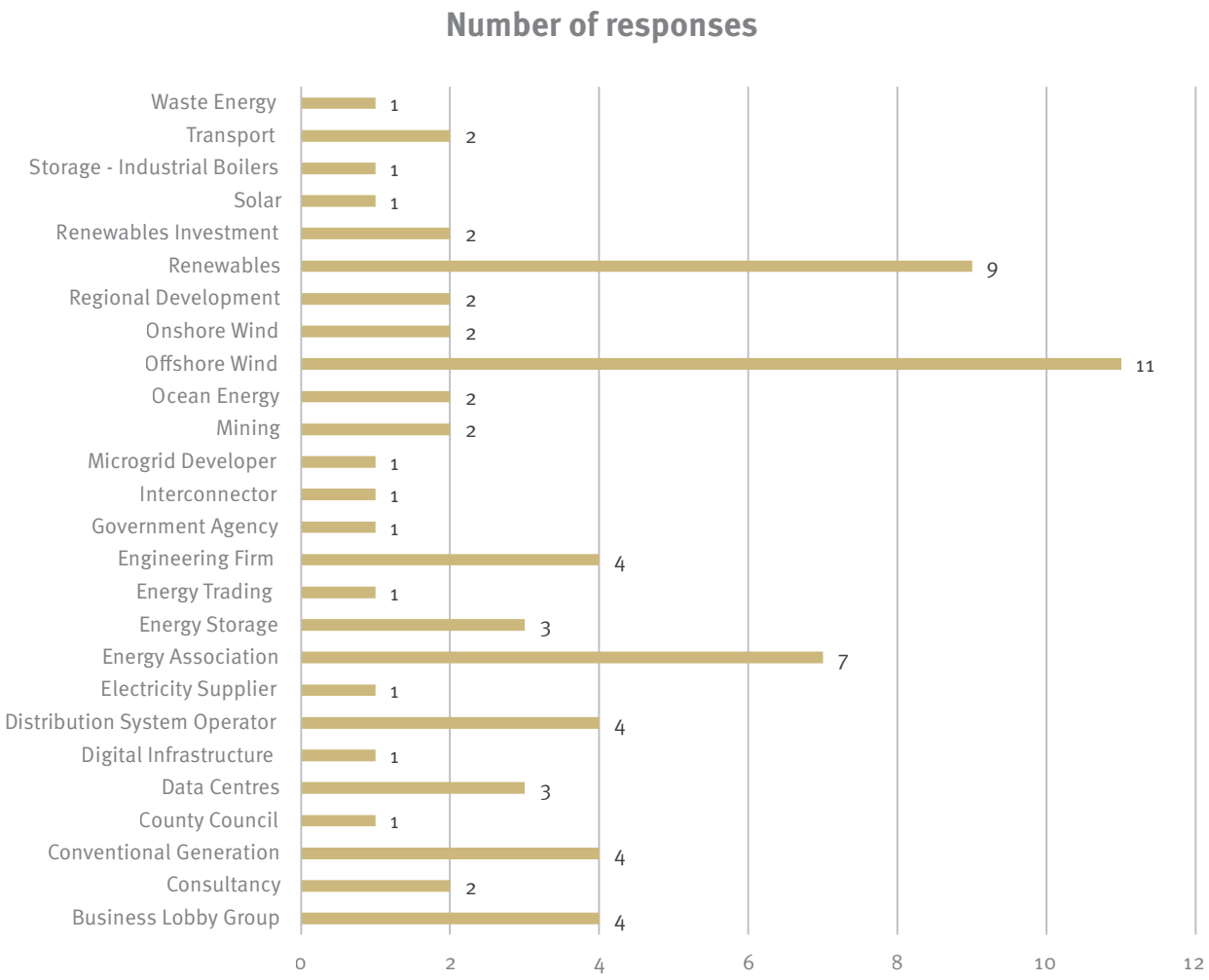


Figure 4.1: Breakdown of consultation responses by responder type

Response types

The level of detail of each of the Responders varied. In general, there were three different response types, as indicated in Figure 4.2.

Letters (1 to 3 pages)

One to three page letters that highlighted the responders concerns but did not specifically answer the questions as laid out.

Detailed response but no specific answers (3 to 25 pages)

These responders did not specifically answer the questions laid out but provided sizeable responses.

Detailed responses in the prescribed format (5 to 65 pages)

These respondents answered the questions in the prescribed format.

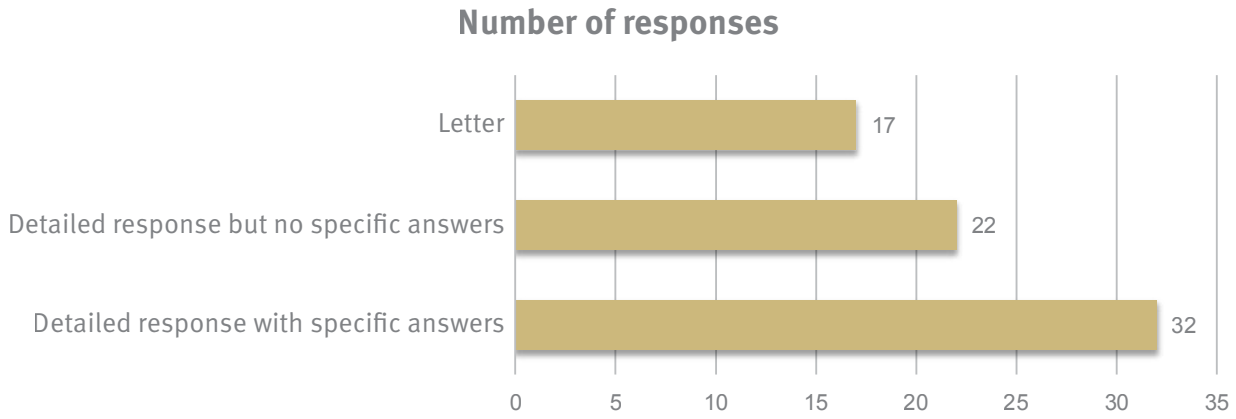


Figure 4.2: Breakdown of response types

Letters - 17 responses received

Smaller organisations tended to write one-to-three-page letters containing their feedback and highlighting their opinions and concern. They did not specifically answer the questions as set out on the portal. These unstructured responses have been reviewed and assessed and are included in our assessment of assumptions and modelling inputs where relevant.

Detailed response but no specific answers - 22 responses received

These responses contained a considerable amount of relevant information but did not align to the questions that were set out on the portal. While this unstructured information is useful it is more difficult to extract a consistent message. These unstructured responses have been reviewed and assessed and are included in our assessment of assumptions and modelling inputs where relevant.

Detailed response with specific answers - 32 responses received

These responses answered the questions as laid out in the questionnaire on the portal. While not every question was answered, the structured approach allowed the compilation of common themes and insights.

Consultancy reports

In addition, there were several consultancy reports that were submitted as attachments for additional information. These reports are most welcome and content from these reports was considered as part of our input assessment.

Jurisdictional response breakdown

Responses were jurisdictionally categorized as:

Northern Ireland (11)

A stakeholder responding with a Northern Ireland address.

Ireland (49)

A stakeholder responding with an Ireland address.

Other (11)

Where the responder had an international address or represented both jurisdications.

Responses from Northern Ireland and Ireland were generally submitted in the expected regional ratios (25:75) as shown in Figure 4.3, which indicated good engagement from both jurisdictions.

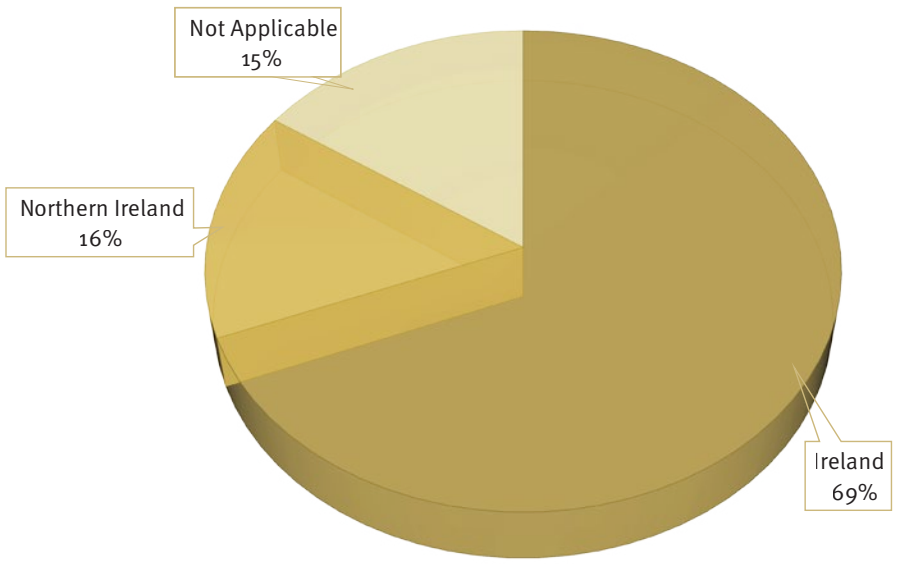
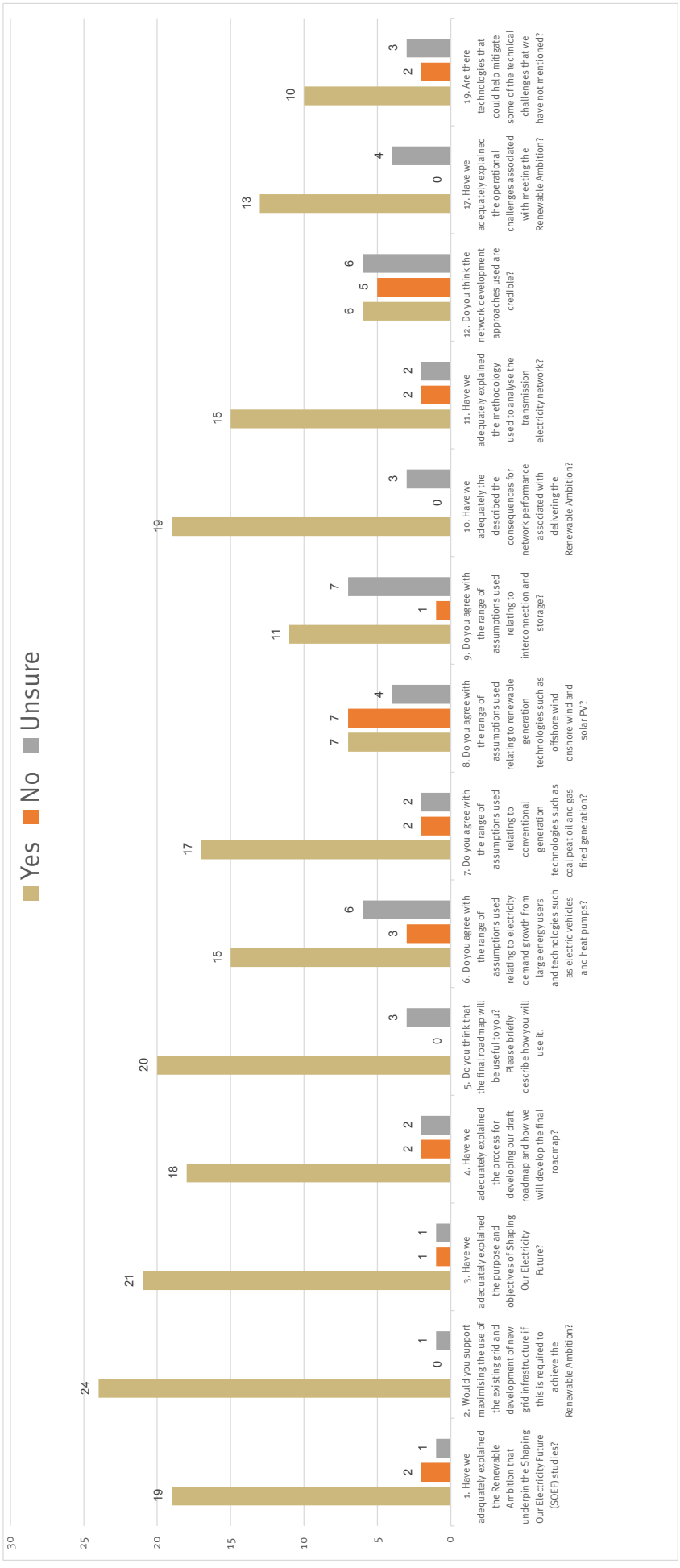


Figure 4.3: Breakdown of responses by jurisdiction

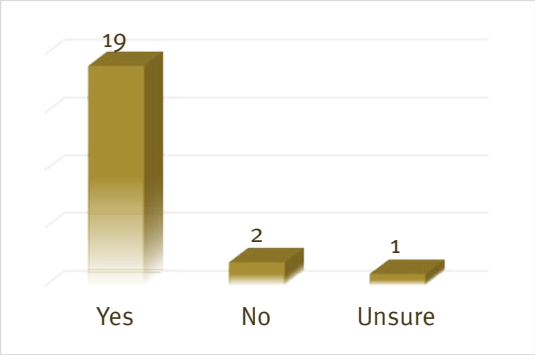
32 Structured Responses – Yes/No responses received via the portal



5. Networks Consultation Feedback

This section contains a synopsis of the consultation feedback as submitted by the industry stakeholders. This feedback will be used to shape the Shaping Our Electricity Future Roadmap that is scheduled for publication in October 2021.

Q1. Have we adequately explained the Renewable Ambition that underpin the Shaping Our Electricity Future (SOEF) studies?



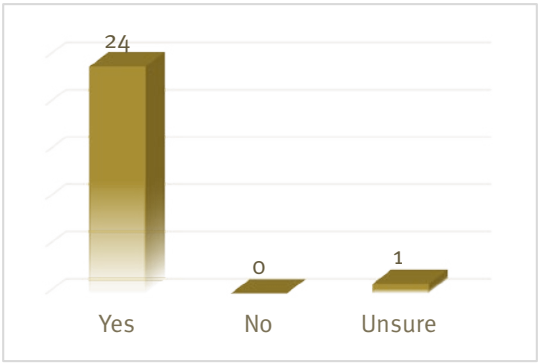
The majority of stakeholders felt that we adequately explained the Renewable Ambition that underpin the studies in Shaping Our Electricity Future (SOEF). Some respondents noted that the energy transition continues beyond 2030, and will impact both the transmission and distribution networks.

The distribution network must be included in a whole system approach in order to optimise the solution from both transmission and distribution perspectives

The consultation documentation has a relatively singular focus on achieving a renewable electricity target of 70% by 2030.

The future does not end in 2030.

Q2. Would you support maximising the use of the existing grid and development of new grid infrastructure if this is required to achieve the Renewable Ambition?



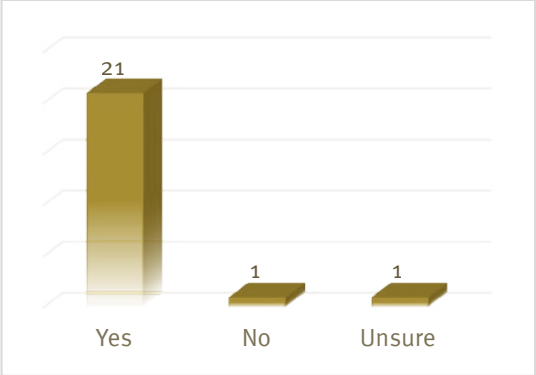
Industry stakeholders were very supportive of maximising the use of the existing grid and development of new grid infrastructure. Stakeholders believe that maximising the use of existing grid will be a critical to the delivery of the Renewable Ambition. It is also suggested that maximising the utilisation of the existing network will not be nearly sufficient.

Making the best use of existing assets is essential to being able to try to achieve the Renewable ambition.

It makes sense that existing infrastructure be optimised and made more efficient.

Maximising the use of the existing grid is only logical in terms of extracting best possible value from the sunk costs in the existing grid infrastructure.

Q3. Have we adequately explained the purpose and objectives of Shaping Our Electricity Future?



Industry stakeholders were of the opinion that we adequately explained the purpose and objectives of Shaping Our Electricity Future. Some stakeholders made the point that the purpose and objectives should be supported by a clear assessment of the costs and benefits associated with the delivery of those objectives.

We recognise that EirGrid has raised serious issues that need further consideration, some of which we expect will be brought forward by the regulators.

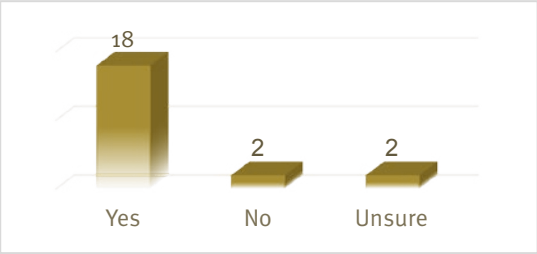
Yes – This is a welcomed consultation from the TSO's and reflects the significance of the challenge we have been set as an industry.

To deliver these changes, both TSOs need to be confident that it has the resources to progress.

One stakeholder in Ireland went further stating that

> *'The significant political ambition combined with the pending adoption of CAP 2021 provides EirGrid with both the mandate and in fact the legal obligation to think beyond 70%.' – Industry Respondent*

Q4. Have we adequately explained the process for developing our draft roadmap and how we will develop the final roadmap?



There was strong agreement among most industry stakeholders that EirGrid and SONI adequately explained the process for developing our draft roadmap and how we will develop the final roadmap.

that the delivery of the final roadmap will require further work to carry out a full cost benefit analysis, of any preferred option.

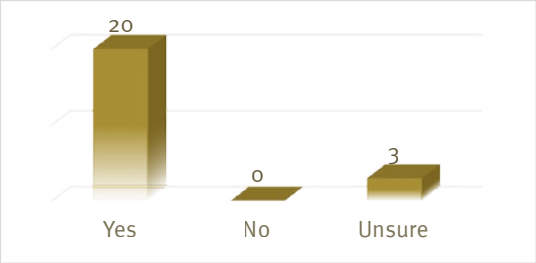
EirGrid's proposals in this Consultation around grid development have sparked a much-needed conversation and can certainly be built on to deliver outcomes that will ensure renewables targets can be met .

more information and transparency on the process should be provided with further details on how this consultation will feed into the final report.

One stakeholder however pointed out that.

> *'Although the criteria within the multi criteria analysis are outlined, the methodology for scoring the criteria and the results of the scoring of each criterion - for each outlined approach - are not present.'*

Q5. Do you think that the final roadmap will be useful to you? Please briefly describe how you will use it.



Industry Stakeholders are of the opinion that the process for developing the draft roadmap is well set out. They state that:

> *'The roadmap will provide us with much needed clarity regarding future grid reinforcements'.*

One stakeholder felt that there are some dependencies that will ultimately determine the usefulness of the Roadmap deliverable.

> *'It will depend to a large degree on the level of information contained within the roadmap, how closely the delivery of the "outcomes" will be monitored and incentivised and whether the roadmap follows and or drives the wider policy decisions required to be taken and implemented by other parties; in particular the legislative and regulatory bodies'*

EirGrid has provided useful suggestions in particular in this consultation regarding potential ways forward for network development.

Yes. It will likely inform our approach to development of new onshore wind projects in Ireland and could influence the extent to which we pursue the development of new innovations, including storage technologies.

The road map will be useful to understand so that we can have some indication as to the future actions (and timelines for such) which could impact on our current and future business.

Q6. Do you agree with the range of assumptions used relating to electricity demand growth from large energy users and technologies such as electric vehicles and heat pumps?

In general, there was strong agreement amongst Industry Stakeholders that the range of assumptions used relating to electricity demand growth from large energy users and technologies such as electric vehicles and heat pumps are correct. There were however a notable number of 'unsure' and 'no' answers in this response. Some stakeholders raised concerns about the ability to accommodate the increases in demand on the system.

> *'Whilst we have no issues with the assumptions relating to the increases in demand being adopted, we would question whether or not it is feasible for the existing infrastructure to be able to accommodate such an increase in demand.' – Industry Respondent*

Another commentator stated that.

> *'Prediction of future demand growth associated with large energy users is extremely challenging and may ultimately interact with other Government policies.' – Industry Respondent*

One respondent pointed out that.

> *'We believe the use of electrification will play the largest part in decarbonising our societies. The use of electric alternatives to everyday items today such as cars and home heating will result in an increase in the share of electricity demand of energy.' – Industry Respondent*

Several respondents in Northern Ireland noted that it would not be prudent to make assumptions around the growth of LEUs in the country given the comparative lack of interest in locating such demand there.

> *'The consultation refers to areas such as Dublin having large energy users such as data centres and that the same approach would be applicable in Northern Ireland. This is highly theoretical as Northern Ireland is not comparable in terms of large energy user interest nor development as Ireland.' – Industry Respondent*

Direct electrification is the strongest weapon we have for combating climate change.

While the assumptions appear consistent with the latest demand assumptions contained in EirGrid's generation capacity statement, much will depend on whether government policy continues to attempt to attract data centres.

Q7. Do you agree with the range of assumptions used relating to conventional generation technologies such as coal peat oil and gas fired generation?

Most industry stakeholders who responded agreed with the range of assumptions used relating to conventional generation technologies such as coal peat oil and gas fired generation. One respondent pointed out that.

> *'Gas fired generation will be needed to support the grid to ensure security of supply during prolonged periods of low wind.' – Industry Respondent*

Another industry stakeholder highlighted the energy market is likely to become much less significant while system service market, capacity market and competitive renewable auctions will become more significant.

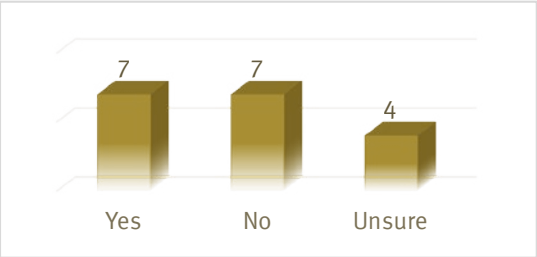
> *'As we transition away from a largely commodity-based system with significant marginal operational costs to a system that looks more like infrastructure with very low to zero marginal operating costs, the role of the energy market is likely to become much less significant and the role of system service market, capacity market and competitive renewable auctions is likely to increase greatly.' – Industry Respondent*

We agree with the assumptions but believe that any future conventional generation must be flexible and capable of operating in a system with up to 100% of demand being met by renewables at any one time.

This document assumes that a sufficient volume of RES generation can be built and commissioned before 2030, to ensure system security and to be capable of providing multi-day capacity during prolonged periods of low wind .

Yes, the range of assumptions related to conventional generation technologies that are set out in table 2 on page 9 of the technical report appear broadly correct.

Q8. Do you agree with the range of assumptions used relating to renewable generation technologies such as offshore wind onshore wind and solar PV?



This question divided opinion among industry stakeholder respondents with an equal number of **Yes** and **No** answers. There were concerns over the maturity of the technologies being proposed.

> *'All of the approaches assume that offshore wind will make varying degrees of contribution to the 2030 target. To achieve sufficient distance from shore to achieve public acceptance, it would likely rely on floating wind technology. This technology is only at the start of commercial scale deployment' – Industry Respondent*

Industry stakeholders are expressing concerns about the uncertainty surrounding the delivery of renewables projects.

> *'We see that the pipeline for new renewable energy projects faces challenges. Connection queues and uncertainty of grid costs delay project development; slow and uncertain planning permissions and grid consents are also creating headwinds for project developers. Additionally, curtailment is an increasing risk and affects the financial viability of projects.' – Industry Respondent*

Another respondent stated that.

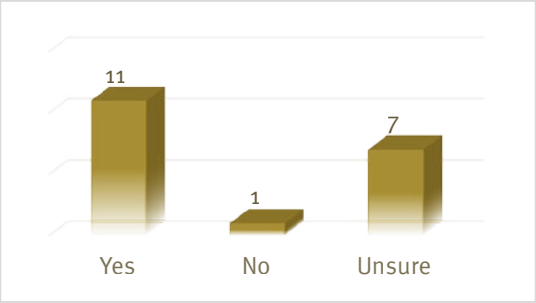
> *'Our concern with the assumptions is that none of the scenarios proposed deliver the renewable capacity targets identified in the PfG and CAP 2019 and no analysis has been carried out on the post 2030 network or further renewable capacities. It is not clear how the roadmap will deliver a network capable of supporting a net zero emissions energy system and economy, which is Ireland's ultimate end goal.' – Industry Respondent*

There is a high degree of uncertainty about the feasibility of developing new renewable resources in Northern Ireland. Offshore wind generation is a vitally important part of the 2030 mix, but at this time it seems optimistic to assume there will be significant off-shore capacity developed by 2030.

It must be reiterated here again that 2030 is not the end goal. There is no punishment for overachieving, and we should be striving towards exceeding our targets, as it is in our interest to decarbonise as quickly as possible.

It is important that the security of energy supply is considered carefully. Ireland is currently facing a number of challenges and has seen an increase in the number of amber alerts. The market must be designed to ensure the right balance of renewable and conventional generation to ensure that unexpected generation outages are kept to a minimum.

Q9. Do you agree with the range of assumptions used relating to interconnection and storage?



There is a high degree of uncertainty relating to the range of assumptions used for interconnection and storage. Whilst respondents generally strongly support the development of new interconnection technologies, concerns were raised over the timely deliverability of such projects.

> *'In relation to interconnection we would agree that the three projects listed are absolutely critical to the delivery of our decarbonisation ambitions in the sector' – Industry Respondent*

> *'Ireland has a long history of delays in delivering large infrastructure projects. We are unsure if there will be two additional interconnectors by 2030 and if they are built we are unsure if they will always be exporting in times of excess renewable generation in Ireland.' – Industry Respondent*

In relation to energy storage one respondent stated that roadmap should consider the development of energy storage.

> *'More detail on how the roadmap considers the development of energy storage to meet system needs in future would be welcome.' – Industry Respondent*

One respondent voiced strong support for Hydrogen technologies in Northern Ireland.

> *'The only credible way of solving the problems of curtailment on a large scale in NI is to convert green electricity to hydrogen and store it. The strategic siting of hydrogen infrastructure will limit the need for Grid transformation.' – Industry Respondent*

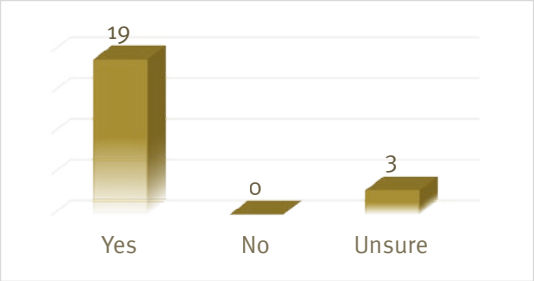
In relation to Demand Response, one respondent made the comment that.

> *'more attention needs be given to the potential for large scale demand assets, and other behind the meter technologies such as storage, to provide the necessary flexibility services and system integration required to facilitate delivery of the renewables target' – Industry Respondent*

We also welcome EirGrid's appointment as the offshore TAO and TSO, this opens up the opportunity for the development of multipurpose interconnectors post 2030. These could be hybrid with offshore wind and facilitate greater interconnection with GB and the EU.

We fully support the development of the North-South interconnector. It is also critical that the export capacity on the Moyle interconnector is increased.

Q10. Have we adequately described the consequences for network performance associated with delivering the Renewable Ambition?



Industry Stakeholder respondents strongly agreed that we adequately described the consequences for network performance associated with delivering the Renewable Ambition. Theres seems to be a general acceptance that the existing grid capacity needs to be optimised and that new grid will need to be delivered if the RES 70% ambition is to be achieved by 2030.

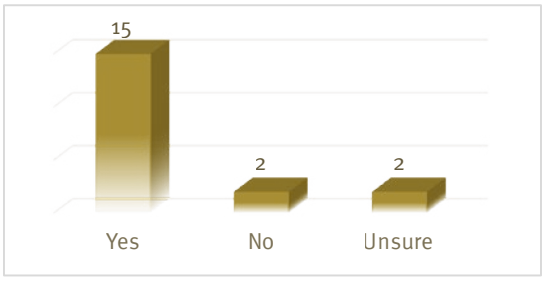
One responder stated we need to move from a grid designed for fossil fuels to a grid that accommodates increasing amounts of renewables.

> *'Our grid today was designed with the use of fossil fuel generation at its core. As we transition towards a decarbonised energy system, we must consider changes to how our electricity system operates in order to more efficiently and effectively integrate increasing levels of renewable energy.' – Industry Respondent*

It is absolutely clear that the existing network is entirely incapable of economically supporting a RES-E target of at least 70% by 2030.

Yes, we believe the network challenges and needs have been well described.

Q11. Have we adequately explained the methodology used to analyse the transmission electricity network?



Most industry stakeholder respondents agreed that we adequately explained the methodology used to analyse the transmission electricity network. Respondents did have some concerns over the cost of the grid scenarios.

> *'Yes, we believe the methodology is adequately explained. However, we believe the methods used to assess the costs of the grid scenarios have serious imitations. We do not believe the consultation provides an assessment of the overall consumer costs/benefits associated with each option, rather it is just an assessment of the network cost required to deliver each option.' – Industry Respondent*

Some respondents proposed the establishment of a Grid Capacity Advisory Council.

> *'To help deliver this we support the proposal that the System Operators establish a Grid Capacity Advisory Council (similar to the DS3 Advisory Council) as a mechanism for the System Operators, Regulators, industry and other stakeholders, including planning authorities and relevant Government Departments, to engage and work collaboratively on these matters.' – Industry Respondent*

Some respondents also pointed out that grid development costs should not be seen as a barrier but rather an investment.

> *'We support an approach that removes grid development costs as a barrier and that this should be seen instead as an investment which reduces the overall cost of renewable deployment. The cost of grid is relatively minor compared to the costs of onshore and offshore wind over the life of a RESS support scheme.' – Industry Respondent*

This point was countered by some respondents who expressed concerns about the cost to consumers.

> *'From a customer perspective cost is the key consideration' – Industry Respondent*

> *'The cost to facilitate delivery of increased renewables will ultimately be funded by customers and therefore any high-cost approaches pursued must be justifiable' – Industry Respondent*

Some respondents suggested a change in approach is required if the necessary infrastructure is to be delivered.

> *'A change in approach is needed if the necessary infrastructure is to be delivered. We believe a key part of the plan will be to outline how the infrastructure will be delivered, the resources required and detailed project programs with key interim milestones.' – Industry Respondent*

A small number of respondents questioned the validity of the assumptions used.

> *'Yes, the analysis methodology is described in sufficient detail (sections 3.1.2-3.1.5). However, the underlying assumptions regarding the locations, size and energy profile of the proposed new generators and demands are not described, nor is the process for creating those assumptions.' – Industry Respondent*

We are of the view that the cost assessment for the network investment, is overly focused on the build costs rather than carrying out a full cost benefit analysis of any such network investment.

The explanation of the approach and sources of information are clear. We welcome EirGrid's aim to make the grid stronger and more flexible and taking an approach that minimises over-build of the grid.

In order to understand the cost associated with each option it is necessary to consider a range of potential generation cost scenarios and this exercise should be conducted prior to finalising a blend.

Q12. Do you think the network development approaches used are credible?

For information, the four network approaches are summarised in Figure 5.1 below.

Generation-Led

Government policy would influence where renewable energy is generated – favouring locations where the grid is already strong

Developer-Led

In this approach, EirGrid continue to connect new sources of renewable electricity as requested in any location

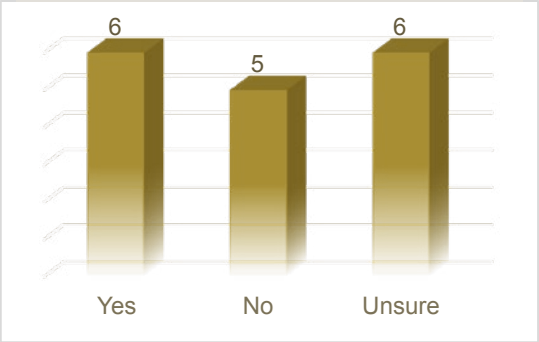
Technology-Led

This approach uses technical solutions to make the grid more resilient so it can better handle the variable nature of renewable energy.

Demand-Led

Government policy determines where large energy users locate in Ireland.

Figure 5.1: Overview of the four network development approaches



Opinion from stakeholders was split, as the **Yes**, **No** and **Unsure** responses were evenly distributed. The direct comments from respondents to question 12 includes the assertion that EirGrid and SONI are overly focused on the 2030 targets and suggest that the roadmap should consider net zero carbon emissions by 2050.

> *'The proposed network development approaches are overly focused on delivering only what is needed for 2030.' – Industry Respondent*

Some respondents in Ireland made the point that the current Developer-Led approach to network development should not continue as it may not achieve the Renewable Ambition.

> *'We answer "unsure" as while EirGrid recognises that the current developer led approach to network development cannot continue' – Industry Respondent*

Many industry respondents support a blended approach.

> *'We agree that a blended strategy is the right approach. No single scenario on its own is sufficient to plan for a cost competitive and clean energy future.' – Industry Respondent*

A small number of respondents, however, stated that none of the approaches are sufficient to meet the Renewable Ambition.

> *'we believe that none of the approaches take sufficient account of the broader policy context and that insufficient consideration has been given to the impact of different investment decisions on market competition both within and between different technology categories' – Industry Respondent*

Several industry respondents stated that while the approaches have been developed based on one specific policy, the final roadmap most likely will be a blend of all four approaches.

> *'The approaches have been developed in a way that emphasises the impact of one specific policy. It is unlikely, as identified in the technical report that the final roadmap will be made up of any one approach and will in fact be a blend of all four.' – Industry Respondent*

Several industry respondents suggested that that roadmap should go beyond 2030 to deliver net zero emissions.

> *'The perspective that the System Operators should not be assessing the approaches purely from the delivery of the 2030 targets, but rather the deliverability and cost impacts of meeting the 2050 target of becoming net zero' – Industry Respondent*

> *'our major concern is that… no analysis has been carried out on the post-2030 network and how the roadmap will deliver a net zero emissions power system, our ultimate end goal.' – Industry Respondent*

Some respondents noted that deliverability is of primary concern and that undergrounding should be promoted to speed up grid development.

> *'Social acceptance and deliverability need to play a greater role in the multi criteria analysis that is used in [EirGrid's or SONI's] Framework for Grid Development. Support must be given to the promotion of undergrounding where possible to expedite grid development.' – Industry Respondent*

A small number of respondents noted that while the Approaches are credible that more emphasis must be placed on Power Purchase Agreements.

> *'Although the approaches are credible, we believe insufficient emphasis has been given to the role of CPPAs which must have a central role in delivering Ireland's renewable energy targets both in the medium and long-term.' – Industry Respondent*

A small number of respondents expressed concerns about deliverability.

> *'If EirGrid is to be successful in the execution of this plan, it will be critical to draw on past experiences to identify the management approaches that expedited or delayed progress on past initiatives.' – Industry Respondent*

A small number of respondents stated that the least cost, technically acceptable solution should be the ultimate goal.

> *'Overall the least cost, technically acceptable solution should be considered while taking account of deliverability of the plan' – Industry Respondent*

A small number of respondents in Ireland requested more details on the amount of generation capacity that could enabled in specific regions along with the associated costs and the likely resultant constraints.

> *'A more detailed breakdown of the investments required under each of the approaches should be provided. It would be helpful if results could be presented for each project, or combination of projects in a region, in the form of: X MW's enabled in Region A requires Projects A,B...Z and an associated investment of €Ym (noting that modest constraints <1-2% are likely acceptable and economic).' – Industry Respondent*

A small number of respondents suggested that additional information be provided in relation to the cost of reinforcing the network along with the potential impacts on tariff forecasting.

> *'With regard to the 4 approaches to network development suggested by EirGrid in their paper, it would be very useful if more information on the scale of reinforcements and costs were provided. Ongoing/operational costs of each of the approaches would also be important Additional/incremental costs can then be incorporated into supplier business planning and strategies for tariff forecasting and supplier accounting around budgets, revenues, costs, cash flows, etc.' – Industry Respondent*

Some respondents expressed concerns about how the customer will be kept informed and included as part of the process.

> *'It will be important to consider in more depth the role that the end customer will play in the energy transition. Educating and empowering customers will ensure that they are engaged throughout the process. Communications and awareness programmes and how the evolving technology landscape (IoT, microgeneration, Smart Meter roll out) can be leveraged to maximise customer engagement and benefit need careful attention' – Industry Respondent*

We note that EirGrid often adopt the tag line, "We're stepping up" and we strongly support this. The climate crisis requires all stakeholders involved to adopt improved practices and procedures to address climate change.

We welcome that EirGrid have included a scenario that clearly shows the benefits to the electricity system of connecting offshore wind generation on the east coast.

We believe that a blended approach is appropriate, and focus should not be on delivering any one of the scenarios presented alone.

The following sections explore the insights from industry respondents on the perceived strengths and weaknesses of each of the four approaches identified above.

5.1 Feedback received on the Generation-Led approach

Generation-Led Approach

Government policy would influence where renewable energy is generated – favouring locations where the grid is already strong

Section 13a and 13b explored the Strengths and Weaknesses of the Generation-Led Approach. A summary of the feedback and key themes are listed below for both Ireland and Northern Ireland.

5.1.1 Ireland

In Ireland, the Generation-Led approach was generally well received from industry respondents, however, a few respondents noted that the relatively small growth in onshore generation may not be viewed as credible, and that capacity issues present in the network today may not be addressed.

Strengths of the Generation-Led approach

Least amount of grid reinforcements	*lowest amount of grid reinforcements required, makes sense to locate new generation where it is required.*
Most economical	*this Generation-Led approach appears significantly more economic than the others.*
Least Risk	*It is clear that the Generation-Led scenario will have the lowest grid delivery risk and cost.*
Supports offshore investment	*The Generation-Led approach will support investments in offshore wind development, a valuable source of renewable energy.*
Public acceptance	*this Generation-Led approach appears significantly more economic than the others.*

Weaknesses of the Generation-Led approach

Prevents the development of the Onshore Transmission Network

By focussing on 2030, there is inadequate consideration of the direction of travel beyond that. This is particularly relevant to the 'Generation-Led' approach, which appears to reduce transmission network requirements by largely avoiding development of further onshore wind/solar. If we must develop all our resource options (including onshore) to get toward 2050, then the need to develop the transmission network to accommodate onshore has not been avoided, but merely postponed.

Risks of delays

We also recognize that the Generation-Led plan presents different risks of project delay that need to be considered.

Least Risk

the Generation-Led scenario assumes extremely minimal additional build out of onshore wind beyond the baseline which is simply not credible.

In the 'Generation-Led' approach, large offshore projects make a significant contribution to Irelands 70% RES-E by 2030 target. Whilst there may be efficiencies in focusing attention in one area, it is unlikely that this is a credible scenario as presented (very low on onshore projects).

Unknown impact on Constraints

It is unclear from the content of the report, how far the reinforcements assumed in the Generation-Led approach go towards mitigating areas of high constraint today.

5.1.2 Northern Ireland

In Northern Ireland, the Generation-Led approach was not viewed as favourably from industry respondents when compared to Ireland. This was mostly due to many respondents expressing scepticism that the offshore wind capacity set out in this approach could be delivered in Northern Ireland by 2030.

Strengths of the Generation-Led approach

The network can accommodate the required offshore wind

The grid is robust and with minimal reinforcements could accommodate up to 800MW of new offshore capacity in a location which is close to the demand centre.

Offshore wind can be deployed with relatively light reinforcements and close to load centres as proposed in the Generation Lead scenario.

An economical approach

fairly low cost of network reinforcements.

Weaknesses of the Generation-Led approach

Technology risks due to possible public acceptance issues	*It is also worth noting, to achieve sufficient distance from shore to achieve public acceptance, it would likely rely on floating wind technology. This technology is only at the start of commercial scale deployment and if being proposed in a pre 2030 context, would likely still have technology risks and higher costs than both fixed offshore and onshore wind.*
Current lack of government support	*It [development of sffshore wind] would require legislative and government policy change which will not be forthcoming in time to deliver for 2030.*
Assumptions lack credibility	*Whilst offshore wind will have a role to play in the energy mix required to reach post 2030 targets onshore wind ,and to a lesser extent solar, are the only viable technologies that can be deployed at the scale and rate required to achieve 70% RES-E in the 2030.* *there is already over 1.1GW of onshore wind in various stages of development.*
Risk of missing Renewable Ambition	*it is our view that this approach is therefore highly unlikely to deliver 70% by 2030.*

5.2 Feedback received on the Developer-Led approach

Developer-Led

EirGrid and SONI continue to connect new sources of renewable electricity as requested in any location

Section 14a and 14b explored the Strengths and Weaknesses of the Developer-Led Approach. A summary of the feedback and key themes are listed below for both Ireland and Northern Ireland.

5.2.1 Ireland

In Ireland, a number of industry respondents noted the experience to date of delivering renewable generation capacity through a Developer-Led type approach, and that continuing with such an approach would help meet the Renewable Ambition. Some respondents cautioned that the number of reinforcements required under this approach would make meeting the Renewable Ambition difficult.

Strengths of the Developer-Led approach

Developer and Grid Operator Experience

The Developer Led approach has been the dominant approach to date so there may be challenges moving away from that.

One perceived strength of the Developer Led approach is that it is the 'Business as Usual' scenario. This means that industry stakeholders are well versed in developing onshore projects and have the experience to deliver these projects. - This approach strives to meet more of the CAP installed capacity targets than the Generation Led approach and may be seen as a foundation around which more offshore wind and 'new' technology solutions from the Technology Led approach

Future Proofs the Grid

This approach develops a stronger grid with a robust level of reliability which will provide benefits for regional development.

It would seem sensible to choose an option, such as the developer led scenario, which will create a grid that is future proof in terms of the additional RES that will be required to reach the net carbon zero energy by 2050 target.

Reinforces a larger area of the network

This approach reinforces a larger area of the network than other scenarios therefore widening the catchment area for new projects to connect and contribute to 2030 onshore targets. This allows for renewable energy production to be much more distributed across the entire Island of Ireland, creates a strong grid with a robust level of reliability and creates a platform for longer-term RES growth.

Meets CAP 2019 offshore target

This is the only scenario that achieves the CAP 2019 offshore wind target of 3.5GW which is welcomed, but it's still below the PfG target of 5GW of offshore wind.

Surer Investment Signals

We are in favour of moving away from this reactive approach (EirGrid responds to ad hoc investor location decisions) to an approach that sees EirGrid signal where grid capacity is strong and weak or could be built out to utilise the network's scope, with developers investing on foot of those signals.

Accommodates shovel ready projects

This approach accommodates shovel ready projects across Ireland that can deliver both intermediate and 2030 targets.

Weaknesses of the Developer-Led approach

Doesn't deliver on 2030 targets

The Developer-Led approach is rightly recognised by EirGrid as the existing approach or business as usual which will not deliver 2030 targets and will cost ~4 times that of either the generator or demand led approaches.

It is disappointing that EirGrid has not been able to demonstrate a developer led solution that would result in the 2030 targets being delivered and would appear to indicate that this continuing on a developer led approach is not desirable going forward.

Not Deliverable

For the 'Developer Led' approach, the large number of potential reinforcements leads to this approach scoring poorly under the deliverability criterion, as one would expect.

Large Amounts of reinforcements required

The number of new circuits and uprates is almost double that of the Generation Led approach.

Weaknesses: highest amount of grid reinforcements required. To date grid reinforcement has not kept up with this approach.

This approach relies on existing and established forms of grid reinforcements only and as such fails to demonstrate how other solutions can work to delivering increased capacity onto the grid.

5.2.2 Northern Ireland

In Northern Ireland, the Developer-Led approach was viewed very favourably by many industry respondents. The maturity of the technologies and developer's experience of delivering projects were frequently cited as strengths of this approach. Many respondents stated that the Developer-Led approach represented the best approach at delivering the Renewable Ambition; however some also acknowledged the scale of network reinforcements required as presenting a risk to this.

Strengths of the Developer-Led approach

Developer and Grid Operator Experience	*Developers are well versed in site search and optimisation for maximum production, possessing a range of expertise required to determine optimum locations. There is huge experience in this approach from both the developers and the grid operators.*
Associated network reinforcement reduced curtailment	*This grid design is also likely to keep the curtailment of RES at a minimum once fully implemented. Again, this is a critical point; if curtailment can be kept to a minimum, this will maximise the running time of the RES on the grid.*
Delivers RES-E target	*[the respondent] strongly believes that the Developer Led scenario presents that best opportunity of achieving at least 70% RES-E by 2030.*
Significant capacity of planned generation	*there is already over 1.1GW of onshore wind in various stages of development.*
Supports the local green economy	*Creates the largest opportunity for the growth and sustaining of the green economy in NI and ROI (including local investors, land owners, developers, installation companies, planning/grid/ energy consultancies, traders, and training, certification & skill providers etc.)*

Weaknesses of the Developer-Led approach

Doesn't deliver on 2030 targets	*SONI's assessment that the RES-E levels that are expected to be reached are of the order of 63% compared to the ambition of 70%.*
Not Deliverable	*For the 'Developer Led' approach, the large number of potential reinforcements leads to this approach scoring poorly under the deliverability criterion, as one would expect.*
Risk of delivery of reinforcements	*It is acknowledged that there is a higher delivery risk of reinforcements for the developer led rather than the generation led scenario.*

5.3 Feedback received on the Technology-Led approach

Technology-Led

Use technical solutions to make the grid more resilient so it can better handle the variable nature of renewable energy

Section 15a and 15b explored the Strengths and Weaknesses of the Technology-Led Approach. A summary of the feedback and key themes are listed below for both Ireland and Northern Ireland. A small number of respondents made the point that the Approaches should be Technology agnostic and that transparent Market signals for investment are more important.

> ***'The system must fit the market and the signals given by market design, not the other way around. Signals for investment must furthermore remain technology agnostic. As long as the signals are framed correctly and transparently well in advance of when delivery of a product is required, the right technology mix should materialise.' – Industry Respondent***

5.3.1 Ireland

In Ireland, elements of the Technology-Led approach were viewed favourably by many industry respondents, as they could deliver some additional network capacity in advance of network reinforcement. Concerns were raised by respondents over other elements assessed in the approach, particularly regarding their deliverability by 2030.

Strengths of the Technology-Led approach

Creates new capacity and reduces bottlenecks

The main advantage that the Technology-Ledoption has over the Developer Led model is that it creates new capacity and doesn't create bottlenecks elsewhere on the network It also leaves room for more renewables to connect in the South West and frees up some capacity on the 220kV and 400kV circuits so that they can be used to reinforce the Midlands.

More widespread grid reinforcements and elements of the Technology-Led approach are required for our future grid.

No Regrets Solution

Technical Solutions - Elements of the Technology-Led scenario should be adopted as no regrets solutions and should be common across all scenarios.

Elements of the Technology-Led approach must also feature in the revised framework for network planning and development.

Faciitates increased Renewables

Strengths - The Technology-Led approach presented in the consultation shows how existing technology can be used to facilitate increased renewables onto the grid. Given the complexities in planning large scale onshore grid infrastructure, it is welcome to see the TSOs looking at other solutions. - New and innovative technologies should be considered throughout the decade and beyond.

2030-2040 Supports longer term offshore wind projects

While the Technology-Led scenario, will delay the delivery of offshore wind in the short term (route to 2030), given the time for consenting and construction, if used as a hybrid or staggered with the Generation-Led scenario being the primary approach first, then it will significantly increase the delivery of offshore wind and floating wind off the West Coast in the next time horizon 2030-2040.

Strengths of the Technology-Led approach

Near Term Technology solutions

Additional implementation of new technology solutions as detailed in the Technology-Led approach should be incorporated as they have been shown to be effective in other jurisdictions and would maximise the use of existing grid infrastructure in the near term and would also help in minimising existing and projected future constraints whilst additional strategic infrastructure is also built out. Elements of the Demand Led scenario should also be incorporated where feasible, and which are within the control and remit of EirGrid.

There is also elements of the Technology-Led scenario that should be adopted as 'no regrets' solutions and should be common across all scenarios. For instance, dynamic line rating, series compensation and even longer duration storage should be progressed to ensure that they are deployed as quickly as possible. These technologies can be deployed in the short to medium term and can help bridge the gap until new grid transmission infrastructure is built out. It will play a vital role in reducing constraints during network build out and will support early build of renewable projects.

Greater use of smart network technologies

We would have expected that greater use would have been made of internationally established smart network technologies across all scenarios. Examples of this include wider use of dynamic line ratings & smart wires which has limited use and only in the Technology-Led approach.

Undergrounding

While the Technology-Led approach is costly, there will be instances where this approach will be justified, for example undergrounding of new transmission lines in densely populated or scenic areas, assuming a cost benefit analysis can prove its viability.

Better use of Existing Assets

Consideration should also be given to better use of existing assets as well as use of storage technology as "virtual transmission" to replace some of the upgrades and new lines required to deliver the developer led approach.

Weaknesses of the Technology-Led approach

Need a clear path to firm access

We would question why there are still overloaded lines in the Technology-Led 2030 power flow map and how this aligns with any future firm access policy. It is crucial that all projects have a clear path to firmness for bidding into RESS auctions.

There are projects that EirGrid are contracted to provide firm access to already. Therefore, it is not acceptable that EirGrid would select an option that does not align with this.

Wider Network Strengthening

Technology-Led scenario Weaknesses: Investment does not strengthen the wider network as not integrated into wider grid.

More widespread grid reinforcements and elements of the Technology-Led approach (DLR etc.) are required to enable › 70% RES-E beyond 2030.

Technology not optimally placed

There does not appear to be any benefit of the technology for the area at either end of the line as the technology effectively by-passes all areas it passes through.

Market Design should not constrain the Technology

Future market design should not stifle developer innovation either in choice of technology or where to locate that technology.

Integrating HVDC and meshed grids

Weaknesses This solution includes radial HVDC links which offer no redundancy to 'tailed' renewable energy hubs. However, there is an opportunity in a blended scenario to consider how this technology may help support the existing meshed grid.

Delivery of technically more straightforward onshore UG cable connections has proved lengthy in a number of cases therefore, considering the need for extensive design and technical analysis to ascertain feasibility before considering actual delivery, this approach will be unable to deliver for 2030.

Costly, risky and Long delivery timelines

Technology-Led' approach. - This approach is somewhat akin to 'putting all our eggs in one basket'. The impact of delays to the roll out of the proposed radial HVDC links would have a significant and detrimental impact on our ability to deliver on our RES-E targets, whilst also driving up the cost of electricity due to dispatch down.

Upvoltage projects may not be feasible

The other upvoltage projects identified in the Technology Led approach would appear to be high risk. Some of the older circuits identified for potential upvoltaging may encounter spatial issues and potentially result in a complete rebuild of the tower bases, leading to planning, programme and economic impacts.

More widespread reinforements are required

More widespread grid reinforcements and elements of the 'Technology Led' approach (DLR etc.) are required to enable › 70% RES-E beyond 2030.

5.3.2 Northern Ireland

In general, industry respondents welcomed consideration of new technologies to provide increased network capacity in the short term in advance of the delivery of network reinforcements. The ability to deliver larger solutions considered in this approach by 2030 was questioned by several respondents.

Strengths of the Technology-Led approach

Helps deliver short term increase in grid capacity

Elements of the Technology-Led scenario should be adopted as no regrets solutions and should be common across all scenarios. For instance, dynamic line rating, series compensation and even longer duration storage should be progressed to ensure that they are deployed as quickly as possible. These technologies can be deployed in the short to medium term and can help bridge the gap until new grid transmission infrastructure is built out. It will play a vital role in reducing constraints during network build out and will support early build of renewable projects.

Power flow technology demonstrated in GB

National Grid Electricity Transmission has recently announced their intention to adopt power flow technology at 3 substation sites across the North of England which will unlock 1.5GW of network capacity.

Reduces constraint and production costs

minimises the levels of constraint of generation enables generators to be economically dispatched, leading to the optimal dispatch and the optimal production costs as a result.

Opportunities for learning

provides SONI and EirGrid with the opportunity to gain knowledge in HVDC systems and power flow control devices within the transmission systems – which are currently in use in other parts of the world.

Weaknesses of the Technology-Led approach

New technologies need significant trial time before deployment

these types of technologies must be suitably trialled on the transmission network … Otherwise, the risk of failure and sub optimal deployment will be considerably higher. Timing is also an important consideration as trials must be conducted in the short term to enable innovative technologies to be available for deployment well in advance of 2030.

Lack of operaitonal experience

SONI and EirGrid will need to gain knowledge in the design and use of HVDC systems and power flow control devices within the transmission systems.

Costly, risky and Long delivery timelines

However, the technology led scenario relies heavily on a 300MW HVDC "boot strap" sub sea cable around north coast connecting the north-west to the greater Belfast area. Whilst we welcome SONI's consideration of this innovative approach, we believe the technical uncertainty and timeline for delivery render it a highly risky strategy. Delivery of technically more straightforward onshore UG cable connections has proved lengthy in a number of cases therefore, considering the need for extensive design and technical analysis to ascertain feasibility before considering actual delivery, this approach will be unable to deliver for 2030.

5.4 Feedback received on the Demand-Led approach

Demand-Led

Government policy determines where large energy users locate in Ireland.

5.4.1 Ireland

In Ireland, respondents generally supported the principle of locating Large Energy Users closer to areas with large quantities of renewable energy, but many questioned how this could be achieved.

Strengths of the Demand-Led approach

Meets 2030 Targets	*Positively the Demand-Led approach is the other option that meets the 2030 targets and there is a rational spread of the expected attractive locations for LEUs across the country and a spread of generation types that does not place heavy reliance on one technology type.*
Reduced grid Reinforcemtent	*Demand-Led scenario Strengths: 2nd lowest requirement for grid reinforcement, makes sense to locate new demand next to renewable generation.*
Clearer Siting options	*The Demand-Led approach is of great importance since it suggests that our members make siting decisions based on the electricity grid.*
Business Opportunities other than data centres	*It is also essential that the Demand-Led dimension of the revised development framework does not restrict Dublin's ability to serve growing demand from businesses and consumers, including cloud computing and other digital services.* *We also see an opportunity for a properly designed Demand-Led scenario to encourage business development beyond the Dublin metro area.*
Incentivising Demand could reduce costs	*Incentivising demand to less congested areas of the grid could be progressed as a secondary option or in parallel with the overall blended approach, as it has the lowest grid development needs and many of the reinforcements in this scenario are common anyway, but this should not detract from the need to strengthen the grid to accommodate our national onshore and offshore renewable targets.* *We also recommend that the Demand-led option can be operationalized by the develop of price signals that encourage businesses to invest where generation can be located without needing additional grid capacity.*
Alleviates Grid transmission issues	*Option 4 - Demand-Led – Put Large Electricity Users Close to Sources of Clean Energy Generation). Moving them out of Dublin, closer to the source of renewable energy helps EirGrid, lessening transmission issues and reducing pressure on grid infrastructure.*
Lower Cost approach	*From a customer perspective cost is the key consideration and therefore the Generation-Led and Demand-Led approaches as outlined in the consultation paper should be favoured (purely on a cost basis).*

Weaknesses of the Demand-Led approach

Government Polcies are required to support the Demand-Led Approach

The Demand-Led model has its merits but it is unrealistic to think that EirGrid can decide where large demand are going to connect. Policies would need to be set at Governmental level for this approach to be successful and even then, the other infrastructure required to make it attractive for large demand users would also need to be in place.

Based on the Assumption that the system Operator can influence LEU

Some of the development approaches are more realistic than others. Demand-Led scenario for instance is based on the assumption that the system operator has [by means of the grid connection process] a possibility to influence strongly the location of major demand infrastructure like data centres.

This approach Assumes Demand is willing to relocate outside Dublin

The Demand-Led approach in Ireland, is presented as an option which avoids €1.6billion of investment. This looks attractive, however given the fact that the data centre industry is booming and recognising other locational requirements, it is likely that there will be data centre growth in Dublin (the GCS scenarios include an additional 800 / 1320 MW in the median / high scenarios respectively). It could be interpreted that for the benefits presented in the 'Demand Led' approach to materialise, little or no further data centre demand can be accommodated in the Dublin.

Regionlaistion Strategy is complicated by legal and regulatory issues

It could be interpreted that for the benefits presented in the 'Demand-Led' approach to materialise, little or no further data centre demand can be accommodated in the Dublin region. Given that this is unlikely, the TSO's may need to develop many of the projects in the Dublin region, which reduces the overall benefit of a regionalisation strategy. - It is not clear how such a regionalisation strategy would be achieved or indeed what legal or regulatory issues would need to be addressed.

The Demand-Led approach is not practical or credible

All the scenarios except the demand led scenario are credible but don't go far enough to meet the targets in the Climate Action Plan and Programme for Government.

This approach focuses on location of generation where the grid is strong and demand is high near more densely populated areas. It also presumes delivery of the majority (700MW) of clean energy required to achieve 70% from offshore wind. This approach is impractical at best as it does not take account of wider policy and environmental constraints of siting generation close to populations. It would require legislative and government policy change which will not be forthcoming in time to deliver for 2030.

Not feasible BUT could be effective in relieving constraints

On the Demand-Led approach, we would query whether it is feasible for Data Centres to move outside Dublin and to what extent there has been engagement between EirGrid and these large demand customers in relation to this option. From a network constraint perspective this option has potential to be extremely effective but we would suggest it requires extensive engagement with these large demand customers to determine feasibility before relying on this as a solution in a final roadmap.

5.4.2 Northern Ireland

In Northern Ireland many industry respondents, whilst supportive of the principle of the approach, felt that there is a lack of interest from developers and a lack of support and incentives to deliver see the approach succeed.

Strengths of the Demand-Led approach

Relieve network congestion and constraints

In principle, the location of large energy users closer to RES generation instead of locating in an already congested area of the grid has many benefits such as reduced renewable constraints, alleviation of network pressure in areas of high demand growth and increased supply of renewable energy to large demand customers.

There are benefits to be gained in co-locating demand and generation including better economic development, more efficient use of assets, less constraints and lower system losses. There may be region specific opportunities in the west of the province where generation is more likely to be located.

Low cost of approach

Relatively low cost of approach in comparison to other 3.

Delivers network and minimises constraint

This approach provides an appropriate level of security of supply and is readily expandable with headroom to accommodate further demand or generation.

Assuming that the generation connects as expected, and that the reinforcements are in place by 2030, this grid design – once implemented – seems to be able to keep the curtailment of RES at a minimum.

Weaknesses of the Demand-Led approach

Lack of strategic approach, incentives and infrastructure

However, locating data centres and other large energy users to the West of Northern Ireland would require a broad national strategic approach with investment in infrastructure (e.g. fibre, transport, water) outside of the transmission network and SONI's remit.

The Demand-Led approach considers influencing new Large Energy Users to locate at stations across the transmission network where capacity exists. But how will these LEU's be "influenced"? Is this through economic incentives?

This approach doesn't consider the availability and adequacy of the fibre network at the area where they assume that new large power users will relocate.

Introduces new risks

This approach would create an additional level of risk as it relies on the development of large energy users such as data centres being situated close to high volumes of renewable generation capacity. Siting of such large users would require significant Government incentive and circumstances can change over time, requiring a large users demand to drop or indeed, need to move elsewhere.

Applicability to Northern Ireland

The consultation refers to areas such as Dublin having large energy users such as data centres and that the same approach would be applicable in Northern Ireland. This is highly theoretical as Northern Ireland is not comparable in terms of large energy user interest nor development as Ireland.

Requiement to connect demand

there is] a duty to connect customers (if feasible) wherever they choose to locate.

Might limit generation opportunities

This approach geographically confines renewable generation to a small number of areas (including onshore).

5.5 Recommendations for a blended approach

Many industry respondents suggested the final network development approach should consist of a blend of two or more of the approaches set out in the SOEF consultation. Respondents suggested their preferred combination of the approaches, and these are discussed below. Several respondents stated that if none the individual approaches were capable of delivering the Renewable Ambition then a combination of the approaches may be a more successful delivery model.

A small number of respondents provided the following summary as to why a blended scenario is the best approach, stating that such an approach would:

- Achieve or exceed the current Climate Action Plan targets and enable an effective grid development pathway towards 2050;
- Optimise the use of the existing infrastructure, while developing new additional grid infrastructure in tandem, protecting projects from unsustainable levels of dispatch down;
- Use smart technology to maximise the use of existing infrastructure;
- Future proof the network so that it is readily capable of being expanded in the future;
- Minimise constraints and curtailments;
- Reduce, or ideally remove, the need for minimum generation units online;
- Be mindful of social acceptance and the impact on local communities and support the promotion of undergrounding where possible to expedite grid development in this regard; and
- Consider the overall future cost of generation and focus less on the actual grid development costs.

Further feedback from industry respondents on a blended approach included:

> *'We believe that a blended approach is appropriate, and the focus should not be on delivering any one of the scenarios presented alone. Island wide network development which delivers all the reinforcements credible within the 2030 timeframe will ensure we meet our medium- and longer-term targets. It's crucial that the design and development of network reinforcements required for post 2030 projects are also progressed as soon as possible.' – Industry Respondent*

> *'We agree that a blended strategy is the right approach. No single scenario on its own is sufficient to plan for a cost competitive and clean energy future.' – Industry Respondent*

> *'We propose that this blended approach should focus on the strengths of each scenario and that a phased approach could be adopted which progresses all the reinforcements credible within the timeframe for 2030 as a first phase. This phased approach could begin design and development of options for delivery later in the decade and post-2030, including options in scenarios such as the Demand and Technology led approaches, as a second phase.' – Industry Respondent*

One respondent requested a further brief consultation period is held on a final, blended approach.

> *'We would also suggest that, given the relatively polarised nature of the options being consulted upon and the fact that it has been widely acknowledged that the final roadmap will consider a blend of network development options, a further round of consultation on the emerging blended plan is necessary prior to finalisation. Given the extensive nature of the initial consultation, this could likely be successfully implemented utilising a shorter 4 week consultation period.' – Industry Respondent*

Several respondents suggested a blended approach should contain technology elements from either the technology toolbox or the TechnologyLed approach.

> *''Consideration needs to be given to the technology toolbox and the process for developing grid projects to help deliver on these objectives.' – Industry Respondent*

> *'A blended scenario should work to maximizing the existing grid through existing and innovative solutions (as mentioned in Technology Led scenario).' – Industry Respondent*

> *'A blended scenario should work to maximising the existing grid through existing and innovative solutions (e.g., HTLS/ DLRs /Series Compensation/ Virtual Battery Networks etc.).' – Industry Respondent*

> *'We believe that many of the technology solutions identified in this approach should be adopted in a blended solution.' – Industry Respondent*

One respondent recommended the inclusion of demand side response in a final blended approach.

> *We view demand side response from residential customers as part of a blended approach and note that there are already significant volumes of battery storage, large-scale DSM and wind generators operational today that can provide these services.' – Industry Respondent*

5.5.1 Ireland

In Ireland, various combinations of approaches were suggested by respondents. A common theme across the majority of suggestions offered was a reliance on the Generation-Led approach as the foundation to an overall blended approach.

> *'All in all, when looking at public acceptance and deliverability the credibility of generation led option is significantly higher than the rest, and it should be the base for the blended approach required that will deliver 5GW+ of offshore wind by 2030 in phases 1&2.' – Industry Respondent*

Generation, Technology and Developer-Led – Several respondents in Ireland suggested this combination of approaches to meet the Renewable Ambition and reinforce the transmission network in congested areas.

> *'This blended solution combines the best elements of the Generator Led and Technology Led options with some suggested Developer Led reinforcements to strengthen further the North Connacht, Donegal and Midlands regions.' – Industry Respondent*

> *'A blended solution of the four scenarios presented by EirGrid could look something like this This blended solution combines the best elements of the Generator Led and Technology Led options with some suggested Developer Led reinforcements to strengthen further the North Connacht, Donegal and Midlands regions. This solution has the potential to deliver 8.2GW of Onshore and 5GW of Offshore.' – Industry Respondent*

Generation and Demand-Led – Several respondents in Ireland suggested this combination of approaches to meet the Renewable Ambition and reinforce the transmission network in congested areas.

> *'The Generation-Led and Demand-Led options would, respectively, be clearly preferable on their own to a generator investor or demand investor.' – Industry Respondent*

> *'Elements of the Demand Led scenario should also be incorporated where feasible, and which are within the control and remit of EirGrid.' – Industry Respondent*

> *'The Generation-Led and Demand-Led options would, respectively, be clearly preferable on their own to a generator investor or demand investor. But is either on its own the right outcome for the delivery of grid capacity to meet 2030 aims and the right outcome for the consumer? We do not believe any one option on its own will facilitate meeting 2030 targets at least cost to the consumer.'– Industry Respondent*

'A combination of the Generation-Led and Demand-Led scenarios will work best minimising required grid reinforcements. It is increasingly challenging to do business in Ireland: Infrastructure projects are difficult to implement. The current uncertain and delayed timeline of planning and environmental approvals processes risk not matching the rate of change required at Industry level to achieve decarbonisation.' – Industry Respondent

'Therefore, we are responding to the four questions above in one complete answer, with specific emphasis on the Generation and Demand-Led scenarios. We agree that a blended strategy is the right approach. No single scenario on its own is sufficient to plan for a cost competitive and clean energy future. It is also hard to favor any particular scenario based on the data presented by EirGrid.' – Industry Respondent

Generation and Technology-Led – Several respondents in Ireland suggested this combination of approaches to meet the Renewable Ambition and transport power across the country where required.

'It is submitted, the primary scenario that should ideally be adopted is the Generation Led, scenario, but a hybrid or secondary implementation so the Technology Led, scenario with the implementation of underground cables to carry high voltage(HVDC) to connect the West Coast to the east coast, and significantly the major demand centre on the east coast and export opportunity to UK, France and Europe on the east coast and therefor unlocking the potential for offshore and floating wind off the west coast of Ireland.' – Industry Respondent

'It is submitted, the primary scenario that should ideally be adopted is the Generation Led, scenario, but a hybrid or secondary implementation so the Technology Led, scenario with the implementation of underground cables to carry high voltage (HVDC) to connect the West Coast to the east coast.' – Industry Respondent

Blended but predominantly Developer-Led – Whilst many responses recommended the generation-led approach as the predominant approach in any final scenario, some respondents suggested it should be built around the Developer-Led approach.

'We believe that a blended approach is appropriate. Within the final SOEF we believe there needs to be strong elements of the developer led approach. There is substantial capacity of onshore wind generation that is in advanced stages of development in the North-Connacht region that can make a material contribution to the interim 2025 and the 2030 RES-E targets.' – Industry Respondent

'As noted above, in order to achieve 2030 targets and indeed, Net Zero, new and innovative approaches are required by all stakeholders. It is noted that this is essentially an extension of, and builds on, the Developer led approach.' – Industry Respondent

'We strongly believe that the Developer Led scenario should be considered as the foundation approach. Additional implementation of new technology solutions as detailed in the Technology led approach should be incorporated as they have been shown to be effective in other jurisdictions and would maximise the use of existing grid infrastructure in the near term and would also help in minimising existing and projected future constraints whilst additional strategic infrastructure is also built out.' – Industry Respondent

'As noted in the previous section we believe a blended approach is needed, including strong elements of the developer led approach.' – Industry Respondent

All four approaches – A number of respondents suggested a blend of all four approaches should inform the final network development approach.

'The cost to facilitate delivery of increased renewables will ultimately be funded by customers and therefore any high-cost approaches pursued must be justifiable. We believe that a blend of the four potential approaches set out by EirGrid is likely to be optimal.' – Industry Respondent

'We need to adapt, knowing that the business-as-usual approach (Developer Led) will fail in both the 2030 and 2050 timeframes. For this reason, the question is, how can elements of each approach support the transition?' – Industry Respondent

'The approaches have been developed in a way that emphasises the impact of one specific policy. It is unlikely, as identified in the technical report, that the final roadmap will be made up of any one approach and will in fact be a blend of all four.' – Industry Respondent

'A blended plan that identifies and selects the best possible aspects of all four approaches is essential. The final plan should prioritise a grid that can reliably, and cost effectively support 70% renewable energy by 2030; be delivered at pace with minimal risks of delays from permitting; rely on market signals to encourage customer behaviour; and allow continued opportunities for business growth - from both demand side customers and renewable energy developers.'. – Industry Respondent

5.5.2 Northern Ireland

Like in Ireland, various combinations of approaches were suggested by respondents in Northern Ireland. Unlike in Ireland, a reliance on the Developer-Led approach was generally favoured as the foundation to an overall blended approach.

> *'[the respondent] strongly believes that the Developer-Led scenario presents that best opportunity of achieving at least 70% RES-E by 2030. From 2030 it is expected that offshore wind generation will start connecting and provide the renewable capacity in the next steps to a zero-carbon electricity system. Aspects of the other approaches can be blended with the Developer led approach.' – Industry Respondent*

Developer and Generation-Led – One respondent suggested a combination of these two approaches would be best for delivering the required renewable generation capacity for achieving the Renewable Ambition by 20390, and further capacity beyond that.

> *'[the respondent] believes that the Developer Led scenario blended with the Generation Led approach presents that best opportunity of achieving at least 70% RES-E by 2030 as we believe that offshore wind can form a key part of the solution up to 2030 and the key component in the overall de-carbonisation strategy beyond that.' – Industry Respondent*

Developer and Technology-Led – One respondent, whilst stressing a strong preference for the Developer-Led approach, recommended adopting elements of the Technology-Led approach to deliver network capacity in advance of the delivery of reinforcement projects.

> *'[the respondent] strongly believes that the Developer Led scenario presents that best opportunity of achieving at least 70% RES-E by 2030… Elements of the Technology-Led scenario should be adopted as no regrets solutions and should be common across all scenarios. For instance, dynamic line rating, series compensation and even longer duration storage should be progressed to ensure that they are deployed as quickly as possible. These technologies can be deployed in the short to medium term and can help bridge the gap until new grid transmission infrastructure is built out. It will play a vital role in reducing constraints during network build out and will support early build of renewable projects.' – Industry Respondent*

Generation and Demand-Led – One respondent considered a blend of the Generation-Led and Demand-Led approaches as the most effective approach for Northern Ireland.

> *'[the respondent] considers that Demand-Led and Generation-Led approaches would be most effective if combined. There are benefits to be gained in co-locating demand and generation including better economic development, more efficient use of assets, less constraints and lower system losses. There may be region specific opportunities in the west of the province where generation is more likely to be located.' – Industry Respondent*

6. Power System Operations

In order to achieve the Renewable Ambition, it will be necessary to operate with a high level of variable non-synchronous RES such as offshore wind, onshore wind and solar, whilst keeping curtailment levels to a minimum. This will require enhancements to power system operational processes, tools and system services to enable EirGrid and SONI to deal with unique challenges that will not be faced on larger power systems for years to come.

Q17. Have we adequately explained the operational challenges associated with meeting the Renewable Ambition?

Several industry respondents agreed that the operational challenges associated with meeting the Renewable Ambition were adequately explained. Respondents were encouraged by the System Operators' ambition to increase SNSP to at least 95% by 2030.

> ***'this interim step to facilitate SNSP to at least 95% by 2030 will be a major achievement' – Industry Respondent***

> ***'We applaud the aim to increase SNSP to at least 95% by 2030, we believe the electricity system must be capable of operating at any one time with zero carbon system services by 2030 (i.e. 100% SNSP).' – Industry Respondent***

A small number of respondents expressed concern in relation to the number of units required to facilitate the requisite reduction in synchronous generation while also maintaining security of supply.

> ***'Our concern however is that, notwithstanding that EirGrid has not yet specified the specific inertia floor and minimum number of units requirement needed to facilitate the requisite reduction in the minimum synchronous generation level, it is unclear how a balance will be achieved in attaining these two technical aims with maintaining security of supply.' – Industry Respondent***

A small number of respondents pointed out that there are considerable challenges to overcome to deliver a stable power supply.

> ***'You have clearly listed the challenges of increasing the amount of intermittent non-synchronous generation on the grid: Frequency Stability, Voltage Stability, Transient Stability, Power Quality and Generation Adequacy. All challenges must be overcome, and these parameters must be maintained for the grid and to ensure a stable power supply' – Industry Respondent***

A small number of respondents raised the following point about operational constraints.

> *'It is now widely recognised that the removal of existing operational constraints is the single most important measure that needs to be implemented if we are to deliver on our decarbonisation targets in the power sector.' – Industry Respondent*

A small number of respondents stated that delivery of Grid Infrastructure was a key operational enabler.

> *'Grid infrastructure is a key enabler to addressing the key challenge of achieving an SNSP of "close to 100%" while balancing the grid with a new system demand and generation profile.' – Industry Respondent*

A small number of respondents noted that the TSOs need to provide greater levels of reporting on energy and non-energy market emissions and costs.

> *'The TSOs need to start measuring and reporting on energy market and non-energy market (non-energy action) emissions and the cost of the constrained run' – Industry Respondent*

Some respondents acknowledged that there are considerable challenges to operating a Control Centre with the proposed levels of RES-E.

> *'This will require new practices and procedures in the control centre to grow confidence and experience in operating with large amounts of renewables and new system support technologies.' – Industry Respondent*

Q18. Do you have any comments in relation to the technical scarcities and operational challenges identified? Are there challenges that you foresee that we have not discussed?

Some respondents made the following comments about synchronous inertia.

> *'The operational challenges presented in relation to synchronous inertia are well understood and we welcome the development of the fixed contracts procurement framework for new low carbon sources of inertia and other new services that will be required in the coming years.' – Industry Respondent*

A small number of respondents commented on behind the meter CHP.

> *'We fear that industrial sites who have low carbon CHP installations will decide to shut down their CHP and return to traditional consumption of grid power… EirGrid should be mindful of the potential loss of some 100's of MW of behind the meter CHP generation. Because this is behind the meter it will appear as increased demand.' – Industry Respondent*

A small number of respondents questioned EirGrid's and SONIs deterministic modelling approach.

> *'Our understanding is that EirGrid's deterministic modelling approach does not apply a forecast error in PLEXOS which therefore does not capture the extent of ramping events that could materialise.' – Industry Respondent*

Several respondents commented on the future DS3 system services arrangements.

> *'The existing capacity allocation for DS3 services no longer meets the short-term targets of further increase in required system services to meet technical scarcities and operational challenges' – Industry Respondent*

> *'The anticipated high levels of curtailment and inability to meet 2030 targets will be of particular concern to stakeholders. The current uncertainty around the future of DS3 and its subsequent replacement are compounding this problem.' – Industry Respondent*

> *'We would strongly support urgency around the implementation of new DS3 System Services Arrangements. Detailed design should commence as soon as possible, following on from the high-level consultation earlier this year.' – Industry Respondent*

Several respondents stated that zero carbon system services should be in place by 2030.

> *'The operational challenges are clear and while we applaud the aim to increase SNSP to at least 95% by 2030 we believe the electricity system must be capable of operating at any one time with zero carbon system services by 2030' – Industry Respondent*

A small number of respondents suggested the development of alternatives to synchronous inertia.

> *'A significant focus was put on synchronous inertia in this section. However, little information was given on alternatives for inertia/inertia like services such as grid forming from wind farms or storage systems' – Industry Respondent*

Q19. Are there technologies that could help mitigate some of the technical challenges that we have not mentioned?

A large range of technologies were referenced by industry stakeholders in their responses to the consultation. A summary of the technologies is listed below.

The following submissions were made in relation to possible technologies:

Hydrogen

> *'We broadly agree with the range of technologies identified to mitigate the technical challenges listed. However, we believe more consideration needs to be given to large scale energy storage through hydrogen' – Industry Respondent*

> *'Our expectation is that hydrogen would be blended with natural gas on-site to begin with as capacity grows, but eventually there will be dedicated hydrogen pipelines and large-scale shared storage infrastructure.' – Industry Respondent*

> *'At a global level there is a growing realisation of the central role hydrogen will play in the energy market due to the associated energy storage capabilities and the various methods of deploying hydrogen as a fuel in terms of heat and transport. In local terms, Northern Ireland is well-placed to be a world leader in the hydrogen economy due to several inherent strengths of the local economy, our infrastructure and the natural environment.' – Industry Respondent*

High voltage electrode boilers

> *'Option of combined hot water and steam in one unit. These units will reduce curtailment of wind turbines on the island.' – Industry Respondent*

> *'Electrode boilers are proven technology available off the shelf from 5MW to 60MW delivering 7 to 90 tonnes of carbon free steam per hour. This can offset imported fossil fuels in industrial heat applications. Electrode boilers can be ramped up in times of high wind and alternated with existing gas boilers in times of low wind.' – Industry Respondent*

Batteries

> *'We believe that limited mention of batteries is made throughout this section which is unusual considering they could alleviate many issues if designed and deployed appropriately. For example batteries could help solve frequency stability and control issues (reserves, ramping, frequency balancing); voltage support issues (static voltage support); congestion; restoration' – Industry Respondent*

Smart grid technologies

> *'We also see the potential for several smart grid technologies and big data to support the energy transition and help optimize the energy system. Advancements in sensors, data processing and complex algorithms are playing a greater role in supporting grid operators' decision making in managing the grid.' – Industry Respondent*

Demand side units

> *'It is our view that demand side units in the short term will be better placed to respond to distribution-level constraint issues as a congestion service provider.' – Industry Respondent*

Interconnectors

> *'We support the development of the North-South, Greenlink and Celtic interconnectors and welcome the planned expansion of the Moyle interconnector and see future interconnection as crucial' – Industry Respondent*

Wave energy

> *'Ireland has, arguably, the world's most energy intensive waves with a resource estimated by the first Offshore Renewable Energy Development Plan (OREDP 1) at up to 31 GW, most of which is located off the Atlantic coast.' – Industry Respondent*

Q20. Do you have any comments on the approach we are taking to system services product design?

Several industry respondents commented that that the approach to system services product design was both appropriate and pragmatic.

> *'The approach being taken to system services product design is pragmatic in our view. Identifying first the technical and operational challenges of realising 70% RES-E by 2030 is appropriate before developing a suite of products that can mitigate these challenges.' – Industry Respondent*

Several industry respondents expressed concerns about the design of the new system services arrangements. One respondent stated that it is important that the new system services design does not hamper innovation or introduce barriers to market entry.

> *'The existing framework for procurement of system services is coming to an end and is unlikely to support long-term investment without a clear understanding of how any new products will be delivered in future. It is important that the system services regime does not hamper innovation, and we would encourage the TSO's to remove barriers to entry for new technologies that could provide system services going forward' – Industry Respondent*

A small number of respondents highlighted the need for clarification on the increased need for system services and clarity on how these services are to be procured and used in the near term.

> *'SONI outlines the need for increased service provision to be 2025 for each class of service. SNSP was 60% in 2017, 70% in 2020, and is around 75% in 2021, with it being forecast to grow to 85% by 2025 (in SONI's pathway to 2030). It is logical that the concomitant need for system services has been rising in relation with the rising SNSP, so why is it stated within the consultation that the need for increased service provision only due to increase in 2025?' – Industry Respondent*

A small number of respondents noted that system services products must be developed with the primary goal of delivering of zero carbon system services and provide clarity to investors.

> *'The approach to model potential technical scarcities and then design and review of system service products to address these certainties makes sense. We have commented previously that this system services framework and product design must be developed with a target of a of zero-carbon system services model by 2030 and to get to this, more clarity is needed for investors in new zero-carbon technologies on future system service needs, investment frameworks, procurement timelines and volume needs.' – Industry Respondent*

Some industry respondents stated that low carbon technologies should play a greater role in the provision of system services.

> *'Low carbon technologies have the potential to be at the core of system services and system restoration strategies. Recent research into the needs of systems with high penetration of renewables such as EU-SysFlex have highlighted the benefits of including renewable generation into restoration strategies of countries around Europe.' – Industry Respondent*

A small number of industry respondents welcomed the assertion that transmission connected wind farms will have a role to play in service provision particularly during high SNSP situations.

> *'The approach is very much welcomed, particularly with regards to the explicit recognition of transmission connected wind power as a mainstream provider of ancillary services to system operators. We particularly welcome explicit mentions of services in the seconds-hours range which may be available in high SNSP situations' – Industry Respondent*

A small number of industry respondents expressed a desire to see additional information on the approach to the design and delivery of congestion products.

> *'It would be useful to get details of the process planned to create a "Congestion" product. The document says that the challenge of designing the congestion products will be tackled in the Operational Pathways to 2030 programme but there is no indication of the timeframe.' – Industry Respondent*

> *'More detail is needed on the congestion product that could be used to alleviate network constraints. There are a number of potential providers that could deliver this service but clarity is needed on issues such as the type of duration(s) for such a product, locations on the network that it would be required and whether from the network perspective it is on the demand side or generation side (or both).' – Industry Respondent*

One industry respondent requested clarification on the likelihood of Negative Reserve being introduced as a system services product.

> *'Negative reserve is noted as a technical scarcity in 2030 but does not appear to be highlighted as a potential future product. There are existing providers that can deliver this service such as wind and battery storage but it has not been defined as a system service and there is currently no specific remuneration in place to incentivise provision.' – Industry Respondent*

One industry respondent enquired about the future role of demand side resources in both the provision of transient stability and voltage support.

> *'We consider the approach taken to system services product design to be thorough, comprehensive and systematic, however, we also emphasise the need for a more comprehensive examination of whether demand side resources (behind-the-meter batteries and generators) can have a greater role in providing for transient stability and perhaps even voltage support in the future.' – Industry Respondent*

A small number of industry respondents requested that the roadmap should provide clarity on grid forming technologies and the role they could play in providing system stability.

> *'In the final roadmap, we believe more emphasis should be placed on the potential for grid forming technologies (such as wind turbine generators (WTGs) and combinations of batteries and STATCOMs) and how these can contribute to system stability for 2030.' – Industry Respondent*

A small number of industry respondents requested clarity on the progress of the Nodal Controller trial and the potential future deployment of the Nodal Controller.

> *'The nodal controller has been in trial development for many years now without being opened up to the wider industry so clarity is required urgently on its future use and how renewable projects can utilise it' – Industry Respondent*

> *'The consultation mentions the potential for distribution connected wind farms to provide reactive power to the TSOs and the nodal controller is highlighted as an enabler for this, but it would be beneficial for the final roadmap to set out a plan for wider rollout of this technology following the trial phase and how this potential from distribution connected wind farms will be unlocked.' – Industry Respondent*

A small number of industry respondents stressed the need for consultation and engagement on the design of the future system services products and associated arrangements to ensure that they are delivered in a timely manner.

> *'It is extremely important that an overarching design decision is reached early in 2021. It is also very important [system services product design] that this is produced for participants to consult on in a timely manner – as it is essential that the final design is appropriate and allowed to be shaped by those who will be using it.' – Industry Respondent*

One industry respondent stated that volume forecasting must be matched with volume reporting as investment cannot be made against uncertainty.

> *'Volume rather than price regulation is mentioned as the way forward in the system services workstream - volume forecasting must be matched with volume reporting if there is to be any merit in this. Volume forecasts for the short and long term are needed for all products, old and new, else investment cannot be made against uncertainty.' – Industry Respondent*

Q21. Do you have any comments in relation to the evolution of operational policy out to 2030?

A small number of industry respondents commented on the evolution of operational policy out to 2030 stating that there is a lot of content detailing the '*why*' but very little in the way of '*how*' we will achieve it.

> *'There is a lot of detail on the current problems and challenges we face and what we need to do as we head towards 2030 (the "why") and also the benefits that will accrue when we get there but there is not enough detail on "how" we will achieve it – we appreciate there is more to come in this process and look forward to seeing more detail on specific market designs, liquidity incentives, participant interface designs, data structures etc.' – Industry Respondent*

Several industry respondents expressed the view that the TSOs need to place emphasis on reducing the minimum level of conventional generation required on the system as well as on increasing SNSP limits.

> *'We welcome the substantial progress being made by EirGrid and SONI in increasing the SNSP limit to 75% and the plans to achieve even higher limits over the coming years. However, it is noted from the TSOs' dispatch down reports that the majority of curtailment is due to the minimum level of conventional generation on the system rather than SNSP limits.' – Industry Respondent*

> *'The ability to operate the system at higher levels of renewable penetration, beyond the current SNSP level of 75% is to be commended. However, the increasing levels of dispatch down, including constraints and curtailment need to be addressed.' – Industry Respondent*

'It's noted from EirGrid's dispatch down reports that the majority of curtailment is due to the minimum level of conventional generation on the system rather than SNSP limits. It is clear that curtailment levels can only be reduced by both increasing SNSP and reducing minimum conventional generation (Min Gen) levels. Reducing Min Gen levels to zero through the development of zero carbon system services and increasing the SNSP to 100% will be the most effective mitigation to reducing curtailment in 2030.' – Industry Respondent

'There has been improvement over the last decade in Min Gen levels. and the recent EirGrid innovation to allow wind farms to provide negative reserve from Q4 2020 does appear to be showing further reductions in these levels. However, the progress in reducing Min Gen levels has not matched the progress being made in increasing SNSP levels' – Industry Respondent

A small number of respondents suggested that the TSOs should report on Min Gen levels during curtailment events suggesting that only through measurement and reporting can improvements be made.

'To monitor progress as we progress to 2030, we request that EirGrid and SONI start reporting on Min Gen levels during curtailment events. Currently the TSOs' dispatch down reports do not report on either the actual levels of Min Gen or the improvements being made in reducing these levels. By measuring and reporting on this we can start to see improvements in operation constraints and the benefits this is having in terms of reducing renewable curtailment'. – Industry Respondent

A small number of respondents referenced the need to evolve operational policy out to 2030 to support market enhancements.

'In general, we concur with the approach to the evolution of operational policy out to 2030. We do feel that there are several very important points that must be effectively and timely delivered. - The Technology Enablement pillar which aims at breaking down barriers to entry and enabling the integration of new grid technologies at scale. - The new framework to replace the existing arrangements is required by 1 May 2023 - Prior to the launch of the new system services arrangements, the technical specification of the system services products required to deliver on the objectives will be published.' – Industry Respondent

A small number of respondents highlighted the shortfalls in the current market processes and systems for batteries that will need to be addressed as part of the roadmap.

> *'The key limitations involve IT and market systems as follows: - There is no capability for current market interfaces (MPI) to accept and process 'negative' Physical Notifications (PNs) into central scheduling, for charging of batteries. - Standard dispatch tools (EDIL) do not have the capability to relay 'negative' MW instructions for charging (even if negative PN actions could be submitted as envisaged under the TSC) – although the TSOs note the possibility to use telephone instructions here. - The lack of an appropriate battery storage market model, which results in storage units being registered and setup as 'Multi-Fuel Generator' Units, which do not support a full operating range of export/ import and preclude operation in the balancing market for charging.' – Industry Respondent*

A small number of respondents maintained that gas generation continues to provide a vital reliability service and will continue to have a role until variability of renewable generation supply can be suitably managed.

> *'Section 4.4.2.7. Generation adequacy. This is vital to a reliable grid. Gas units for generation adequacy will be required until sufficient renewable generation is available and the issue of intermittent supply is overcome.' – Industry Respondent*

A small number of respondents emphasised that large-scale demand assets such as DSUs should have a role in supporting frequency stability and addressing issues such as congestion.

> *'The highlights the proficiency of large-scale demand assets such as DSUs in providing frequency stability and addressing issues such as congestion and resource adequacy. Members argue that 'Reserve' should be added to the list of key operational metrics. We also consider that in the categorisation of technical challenges, the emphasis should be on 'Resource Adequacy' rather than 'Generation Adequacy' - Industry Respondent*

Q22. Do you have any comments on the Operational Pathways to 2030 objectives, programme or key milestones?

Some industry respondents expressed the preference that solutions should be delivered incrementally rather than waiting for an overarching solution.

> *'The approach in Ireland seems to have been to try to develop a comprehensive program and then try to deliver it all together. This should be combined with a more incremental approach where specific problems are identified, and solutions developed and delivered without waiting for an overarching solution.' - Industry Respondent*

Many industry respondents stated that the TSOs should be sufficiently resourced to deliver all the necessary change associated with the roadmap. They expressed concern that insufficient resources could put the Renewable Ambition at risk.

> *'The energy industry has concerns that without additional resourcing on the part of the TSOs it will not be possible to deliver all the necessary changes over the coming decade. We request that as part of the final SOEF roadmap that a clear strategy or plan is provided in relation to how the TSOs plan to resource and support the various work areas outlined in the roadmap.' - Industry Respondent*

A small number of respondents stated their ambition that the all-island power system should become the first synchronous power system in the world capable of running in a safe secure and stable manner with no conventional fossil fuel plant on the system.

> *'As the electricity system must be capable of operating at any one time with zero carbon system services by 2030 (i.e. 100% SNSP), we support the proposal that a roadmap needs to be set out to deliver this, including the ability for the power system to operate without a 'minimum generation units online' constraint on the system. Ireland can and should aim to become the first synchronous power system in the world capable of running in a safe secure and stable manner with no conventional fossil fuel plant operating on the system.' - Industry Respondent*

> *'we would suggest that the objective should be the complete removal of operational constraints from the system utilising full zero carbon system services.' - Industry Respondent*

A small number of respondents suggested that lessons learned from prior experience should be implemented.

> *'If EirGrid is to be successful in the execution of this plan, it will be critical to draw on past experiences to identify the management approaches that expedited or delayed progress on past initiatives.' - Industry Respondent*

A small number of respondents stated that the design, implementation and optimisation of new control centre systems and tools will require investment and should be prioritised as part of the roadmap.

> *'A weighting on the design, implementation and optimisation of new control Centre systems and tools would be viewed as a necessity to operate unprecedented levels of non-synchronous generation on the grid, and the associated details provided within the paper do not reflect the challenge and required investment. There are existing issues with the operation of these control systems in relation to the wind dispatch tool that have been previously highlighted, which require resolution and significant re-design to meet the 2030 RES-E target.' - Industry Respondent*

Some industry stakeholders highlighted the need for continued open and transparent collaboration with all stakeholders.

> *'We would therefore encourage the TSOs to collaborate with stakeholders in an open and transparent manner to ensure that the key milestones can be delivered in a timely fashion' - Industry Respondent*

A small number of respondents suggested that the indicated timeline for development of changes to the Grid Codes and associated standards is too ambitious.

> *'The consultation emphasises the role that the development of grid codes and associated standards and legislation will have in facilitating the fulfilment of the grid connection of the Renewable Ambition in the island of Ireland. The consultation sets a key milestone on having Grid Code modifications approved by 2022, which seems a bit too ambitious bearing in mind the dynamics of both, grid code modifications and transmission connected big infrastructure projects. The time that would be available for a proper development, industry review and implementation of code changes looks too tight' - Industry Respondent*

A small number of industry respondents stressed the importance of the new DS3 System Services arrangements proceeding in a timely manner and the need for extensive stakeholder engagement on the Operational Pathway to 2030 programme.

> *'We agree broadly with the operational pathways to 2030 objectives, programme and key milestones. However, we would stress: - The importance of no further delays to the Go-Live of new DS3 System Services Arrangements - The inclusion of a milestone for the delivery of the technical specifications of system services products being provided to the market, and, - That stakeholder engagement on the Operational Pathways to 2030 Programme must be advertised and made accessible as widely as possible to receive the full spectrum of possible responses' - Industry Respondent*

A small number of industry respondents encouraged a holistic approach to market design across energy, system services and capacity to maintain security of supply and emphasised the need for investment signals to be provided in a timely manner.

> *'The timeline for the go-live of the new system services has been confirmed recently by the RAs as being 1 May 2024. While this pushes out draft milestone timelines we believe that the time can be best spent by ensuring a holistic approach to market design across energy, system services and capacity is followed to ensure that not only the MWs needed to maintain security of supply including during dunkelflaute periods will be installed in suitable volumes but that signals for investment in capabilities of technologies is given on time under the new systems services arrangements.' - Industry Respondent*

A small number of industry respondents highlighted that electrical thermal storage can provide system services at times of high SNSP while helping to decarbonise industrial heat.

> *'Dispatchable electrode boilers or electrical thermal storage can help provide system services in times of high SNSP while decarbonising industrial heat and helping achieve government renewable electricity targets.' - Industry Respondent*

A small number of industry respondents emphasised the need to prioritise the delivery of proposed developments in modelling, forecasting and real-time systems to ensure that there is sufficient operational capability in line with additional SNSP increases and system services increases.

> *'Modelling, forecasting and real-time systems will provide further capability in managing scarcities and operational challenges. It is a welcomed level of detail outlined as a key pillar in the operational pathways program through section 4.6.5.1, however due to known timelines of system deployment it should be highlighted that this project should be priorities to ensure sufficient operational capability in line with additional SNSP increases and system services increase.' - Industry Respondent*

A small number of industry respondents emphasised the importance of removing barriers to new technology and stated that engagement by the TSOs with industry on the FlexTech initiative to date has not been to the level needed.

> *'An example of this would be FlexTech where engagement between the TSOs and industry has been slow and often not forthcoming, leading to a degree of frustration in industry and much delayed start to the roll out and delivery of the project. It is therefore welcome to see FlexTech highlighted as one of the four key pillars underpinning the Operational Pathways to 2030 programme and we look forward to working with the System Operators and removing the barriers to the integration of these important technologies.' - Industry Respondent*

7. Electricity Market Design

Q23. Do you agree a holistic approach in incentivising timely and affordable investments via markets is required?

Many industry respondents agreed that the holistic approach will deliver the optimal outcome to achieve the Renewable Ambition and some identified this approach as key to the success of Shaping Our Electricity Future.

> *'A holistic approach will deliver the optimal outcome, rather than focusing on separate elements.' - Industry Respondent*

A small number of industry respondents suggested that a siloed approach will likely result in inefficiencies and potentially result in negative consumer cost impacts.

> *'In summary, a holistic approach is absolutely critical given the complex interactions between the various markets (Long term renewable auctions, wholesale electricity, capacity, and system services). A siloed approach to each of these markets will likely result in significant inefficiencies and potentially significant associated consumer cost impacts.' - Industry Respondent*

Some industry respondents agreed with the holistic approach and stated that energy, system services and capacity markets must operate coherently and seamlessly and that units connected to the distribution system can compete fairly with those connected to the transmission system.

> *'Yes, we agree a holistic approach is required. The energy, system services and capacity markets must operate coherently and seamlessly to provide confidence for developers to invest, to provide a level playing field for units to compete in and deliver the programme for government and deliver a fair price to the end consumer. There must be no barriers to entry or competition for technologies in these markets as there is today for renewables and other low carbon technologies in the capacity market. It is essential that units connected to the distribution system can compete on a fair and equal basis to those connected to the transmission system.' - Industry Respondent*

A small number of industry respondents highlighted that new incentives are required as conventional load generation operates with increasingly lower Load Factors.

> *'New incentives will be needed to attract new and keep existing (clean) gas-fired generation which may in the future have to operate with increasingly lower Load Factors.' - Industry Respondent*

A small number of industry respondents suggested that the holistic approach should provide investor certainty with the appropriate allocation of risk.

> *'We agree that in order to secure the level and type of investment required to achieve the 2030 and 2050 targets, a holistic approach which provides investors with a high degree of certainty in relation to market rules and design is required. A market design which appropriately allocates risk is also crucial. ' - Industry Respondent*

A small number of industry respondents suggested that the electricity markets should provide support and incentives for conventional generation.

> *'Consideration needs to be given to the role of conventional generation in an environment of increasing intermittent renewable electricity generation and how the market can be designed to incentivise the necessary conventional generation to back intermittent renewables.' - Industry Respondent*

A small number of industry respondents recommended that the future market design should be developed by considering all market types and outcomes and must allow revenue stacking of services – also any new market design needs to provide the right investment signals in a timely manner.

> *'The market design must allow revenue stacking of services e.g. system services, congestion products, energy market and capacity market. This is critical for the build out of new zero-carbon technologies. The market design also needs to developed for the 2030 context with 70%+ RES-E and a system capable of operating at 100% SNSP for multiple hours of the year.' - Industry Respondent*

> *'It is critical that the wholesale energy, capacity and ancillary service markets are designed holistically to ensure the right investment signals can be made in a timely manner. We are therefore very supportive of proposals to reform the capacity market and ancillary services market based on ensuring coherent investment and behavioural signals can be provided. The future market design must allow revenue stacking of services e.g., system services, congestion products, energy market and capacity market.' - Industry Respondent*

A small number of industry respondents stated that demand side technologies should be further considered in future market enhancements and integrated in the market services.

> *'In our opinion the electricity market systems need to evolve to fully integrate demand side technologies and effective signals need to be created in the form of payment categories or revenue streams for energy, capacity, and system services.'*

A small number of industry respondents suggested that due to the high level of capital investment in generation projects that it is imperative that energy, system services and capacity markets should ensure that effective and efficient signals are sent to the market – also energy signals should not undermine system security and reliability.

> *'There are challenges that will need to be addressed to ensure that the high capital costs associated with future investment can continue to earn sufficient returns where there is an increasing proportion of generation with relatively low marginal operating costs. It is therefore imperative that the energy, system services and capacity markets work in a cohesive manner to ensure that effective and efficient signals are sent to the market. The market needs to ensure that the changes to energy prices resulting from increasing renewable generation do not undermine system security and stability. Therefore, the market design has to ensure that market participants are able to earn a reasonable return for their assets from all of the available revenue streams.'*

Some industry respondents expressed concerned that investors will need to understand all the risks associated with their offshore wind projects given the amount of capital investment required.

> *'Yes, we agree with the merits of a holistic approach to incentivise timely and affordable private investment into all-island electricity market. Bearing in mind the volume of the capital investment required by offshore wind power plants, investors will need to understand all the risks associated with their offshore wind projects. Support and innovative approaches by EirGrid and SONI will be very welcome to develop ways of helping industry to identify, quantify and manage those risks. The impact of uncertainty on interest rates and capital costs is clear, and these are ultimately transferred to consumers if market design is insufficient.' – Industry Respondent*

A small number of industry respondents disagreed with aligning the electricity market with the system operational limits and further contended that to do so would mean noncompliance with Article 13 of the Clean Energy Package.

> *'The consultation discusses aligning the electricity market with system operational limits i.e., introducing the SNSP limit in the ex-ante market. We do not agree with this proposal and have submitted a letter to the RAs in this regard. The proposal is not compliant with Article 13 of the CEP, it discriminates against wind generation and places the risk of dispatch down on the generator rather than the party best placed to manage this, the TSO. The TSOs are best placed to develop and introduce the solutions such as DS3 or network solutions to minimise dispatch down.' – Industry Respondent*

> *'We disagree that incorporating SNSP limitations, i.e. real time system wide constraints, into the ex-ante markets should be considered. The system must facilitate the market design and market incentives – we cannot support outcomes that see the market having to react to fit to system limitations.' – Industry Respondent*

A small number of industry respondents expressed concerns about the current electricity market including issue with ex ante market revenues, flagging and tagging and future EU market developments.

> *'Increased RES in ex ante markets is driving down energy prices for consumers, as expected. It also means though that conventional capacity (and RES) can rely less on the ex-ante market for revenues. - A review of flagging and tagging in the balancing market (BM) is necessary to ultimately benefit consumers whereby actions on units are taken and recognised sequentially and not on a "net" basis. - Urgent review of investment signals necessary to mitigate security of supply concerns must occur to ensure we do not need further local reserve service agreements (LRSA) type contracts in future. - We believe all market revisions occurring this decade need to bear in mind EU market developments. The platforms of MARI 21and TERRE22 in particular are expected to be the biggest influencers on close to real time market design, alongside future market coupling arrangements.' – Industry Respondent*

Some industry responders suggested that the future market design must be capable of both delivering 70%+ RES-E by 2030 and a power system capable of operating at 100% SNSP.

> *'The market design needs to developed for the 2030 context with 70%+ RES-E and a system capable of operating at 100% SNSP for multiple hours of the year. This means bringing together multiple stakeholder such as the System Operators, Market Operator, the Regulatory Authorities, Government as well as industry to work on these issues. This also means full implementation of the Article 12 and Article 13 of the Electricity Regulation as well as the introduction of measures such as SIDC to allow more efficient use of the interconnectors and frameworks to incentivise build out of system support technologies such as synchronous condensers and storage. Constraint and curtailment risk also needs to be managed.' – Industry Respondent*

Q24. Do you agree that the concepts of alignment, clarity and commitment we have outlined are important to enable markets to effectively deliver investment to meet the long-term policy objectives?

Many industry respondents agreed with the principle of alignment to ensure that investment signals in the various markets do not conflict with each other and that there should not be preferential treatment of specific technologies.

> *'The principle of alignment is critical in order to ensure that the various markets are not incentivising investment in generation or system service provision that conflict with each other, e.g. new capacity with high start-up costs and high minimum operating levels, conflicting with RESS auctions and system service markets trying to incentivise and support very high instantaneous penetration levels of variable renewables. This likely requires some element of planning i.e., we do not want to see preferential treatment of specific technologies but we need to consider preferential treatment of certain technology characteristics.' – Industry Respondent*

Some industry respondents highlighted that system services and capacity markets need to be designed to ensure that future investment can earn sufficient returns.

> *'There are challenges that will need to be addressed to ensure that the high capital costs associated with future investment can continue to earn sufficient returns where there is an increasing proportion of generation with relatively low marginal operating costs. It is therefore imperative that the energy, system services and capacity markets work in a cohesive manner to ensure that effective and efficient signals are sent to the market.' – Industry Respondent*

A small number of industry respondents disagreed with this concept of alignment suggesting that a balanced mix of technology types are required to ensure security of supply.

> *'EirGrid's view on the alignment principle, 24 appears to be to mix signals of capacity and system services markets and align markets with system limitations all of which we disagree with. For us, the aim and effect of alignment should be to ensure the respective revenue streams of energy, capacity, RESS and system services enable a balanced mix of technology types to materialise that complement each other and simultaneously ensure security of supply including during dunkelflaute events and to facilitate integration of RES onto the system.' – Industry Respondent*

Many industry respondents suggested that renewables auctions, capacity contracts, and system service contracts will be required to support the attributes of the future power system of low marginal operational cost and high capital investment costs.

> *'In summary we expect to be building a system that will have extremely low marginal operating costs and relatively high upfront capital costs. We will still need a well functioning wholesale electricity market to minimise the short run marginal cost of any remaining fossil fuel plant and to support efficient interconnector trading & flows, but the majority of the required investment in the system is likely to be supported through long term competitive renewable auctions, long term capacity contracts and potentially longer term system service contracts. Examining all of this in terms of the specific question asked.' – Industry Respondent*

A small number of industry respondents stated that markets will need to change as the generation mix becomes dominated by renewables, and the electricity system needs to evolve in conjunction with the market evolution.

> *'Our members fully recognise the need for alignment across each of the markets to procure an optimum balance of services from all market participants in each market. We also recognise that over the decade the relationship between the markets will change as the generation mix becomes increasingly dominated by renewables. For instance, the market rules underpinning today's markets, which are largely driven to the goal of achieving the lowest possible price, are unlikely to encourage the levels of investment required to support the transition to a low carbon system. Consequently, the markets need to evolve to provide signals to fund the development of technical solutions to maintain the resilience of the electricity system.' – Industry Respondent*

A small number of industry respondents questioned how customer demand is to be hedged and what measures were in place to prevent the consumer paying for electricity that could not be utilised.

> *'One of the key questions for suppliers will be how customer demand will be hedged in a system that is predominantly based on non-dispatchable renewable generation. Additionally, where there is excess renewable electricity (particularly wind) within the market it is imperative that customers do not end up paying for renewable electricity that cannot be utilised due to system constraints.' – Industry Respondent*

A small number of industry respondents stressed the need for market design stability and that a stable trajectory was required to reduce investment risk.

> *'We are of the view that in order to deliver the level of investment needed to achieve long-term policy objectives such as 2030 and 2050 targets, a stable market design is required. Operation of the grid, in terms of system tolerances must likewise follow a stable trajectory to reduce investment risk. Sudden market changes with major commercial implications will unnerve investors, inflate the risk profile associated with new technology investments and thus will result in a higher overall cost of the transition to the end consumer.'– Industry Respondent*

A small number of industry respondents pointed out that engagement by the TSO with other key stakeholders is necessary to achieve the Renewable Ambition.

> *'We do not believe this is all within the gift of EirGrid / SONI and it is crucial that wider engagement with the regulatory authorities that considers all of the known changes (either required as a result of the recent changes through the Clean Energy Package, the Northern Ireland energy strategy, net zero carbon ambitions and likely increased renewables / decarbonisation targets following the EU proposals for "Fit for 55".' – Industry Respondent*

A small number of industry respondents commented that although physical interconnection with the EU is a longer-term goal, the process of designing, planning, and resourcing for interconnection with the EU should be expedited.

> *'In terms of European alignment RES agrees that without physical interconnection with Europe, that alignment may be a longer-term goal, however if we be clear on what changes need to happen and under what timescales, we can make the necessary system upgrades in an orderly and clear way. Experience from other European countries, such as GB have shown that implementation of European regulations can be resource intensive and require significant industry expertise. EirGrid and SONI need to dedicate space to planning and reviewing exactly what changes are necessary and under what timescales so industry can have foresight in order to resource plan.' – Industry Respondent*

A small number of industry respondents stated the importance of all parties honouring their contractual commitments including the delivery of new generation, shallow connection works and deep reinforcements.

> *'Commitment is critical to ensure reliability / predictability of outcomes. Contracting parties need to honour contractual commitments and appropriate performance incentives and penalties should be in place such that each party can rely on the commitments of the other. This principle should apply widely across the sector incorporating commitments from generators in relation to delivery of new capacity, and from SOs in relation to delivery of non-contestable shallow connection works and necessary deep reinforcements.' – Industry Respondent*

A small number of industry respondents expressed concern at the pace of the consultation process needed to approve market design changes in a timely manner.

> *'We also welcome the recognition that "It is important that a design for the future arrangements is agreed as soon as possible to ensure that appropriate arrangements can be implemented to ensure that there is no break in the investment that is needed to meet 2030 targets." We note that the intention is that the high level design will be approved by the Regulatory Authorities by the end of this year. This will require a significant speeding up of the consultation process compared to the rate of progress made to date.' – Industry Respondent*

Q25. Do you have any comments on our findings and recommendations in relation to the energy markets component of our review?

Many industry responders want to further engagement on the market roadmap and believe the focus should broader than the delivery of the future EU trading model post reconnection.

> *We would ask that meaningful and timely stakeholder engagement takes place during the significant review of the existing Market Roadmap. We believe this is extremely important so that the future design of the energy market does not focus on the future pan-EU trading after reconnection to Europe to the detriment of the current and future participants within the all-island market.' – Industry Respondent*

A small number of industry respondents expressed concern about the commercial implications of Multi Regional Loose Volume Coupling (MRLVC) and Single Day Ahead Coupling (SDAC) post Celtic interconnection.

> *'Careful consideration should be placed on the technical and commercial implication of Ireland's situation of potentially having the requirement to trade in both Multi Regional Loose Volume Coupling (MRLVC) and Single Day Ahead Coupling (SDAC) post the implementation of the Celtic Interconnector, given the scale of the interconnector capacity relative to system demand.' – Industry Respondent*

Several industry respondents stated the need to fully implement of Article 12 and Article 13 of the EU the Electricity Regulation.

> *'Adopting a market design to further renewable integration means full implementation of the Article 12 and Article 13 of the Electricity Regulation and the development of a roadmap for implementation, including roll-out of the market interfaces to allow renewable generators to participate fully in the electricity market.' – Industry Respondent*

A small number of industry respondents recommended a review of the electricity market to ensure all generation will be adequately compensated.

> *'We recommend a fundamental review of the electricity market to ensure that each type of plant can earn sufficient revenues to be economical. This will include every type of plant from new flexible synchronous generation to long duration storage.' – Industry Respondent*

A small number of industry respondents stated that key policy and regulatory changes along with government funding are required to ensure the power system can support decarbonisation in other sectors.

> *'This roadmap must outline the key policy and regulatory changes required expected timeframes and be in alignment with wider policy decisions (such as firm access, connections policy, locational charging, development of hydrogen strategy etc). It will also need to align to the future Carbon Budgets to ensure that the power system can decarbonise in time to facilitate the wider decarbonisation of other sectors (including supporting decarbonisation of transport via the roll out of EV's and the decarbonisation of heat through electrification)' – Industry Respondent*

A small number of industry respondents expressed concern about the pace at which the Regulatory and SEM Committee can make decisions to support the Renewable Ambition.

> *'The paper notes the importance of key regulatory design decisions being made early, for example many of the market timeframes appear contingent on SEM Committee decisions being made this year. It would be helpful to see a comparable degree of urgency from the SEM Committee.' – Industry Respondent*

Some industry respondents highlighted that if regulators were to allow greater access to the wholesale market prices - consumers could invest in technology that could ultimately help deliver the net zero carbon goal.

> *'Low electricity prices and negative electricity prices are not a bad thing. Currently these price signals are not available to consumers of power due to network tariffs and levies. If the Regulators allowed access to the wholesale market price, then flexible consumers could invest in the technology needed to achieve our 2030 targets and aim for net zero carbon in the future.' – Industry Respondent*

> *'Negative prices are not necessarily a bad thing. Negative price can develop investment opportunities in technology needed for a low carbon future. Power-to-heat, energy storage, power-to-gas, domestic demand side management all benefit from access to low and negative power prices. Unfortunately, other charges are more flat in nature and are less aligned to the needs of energy market. This result in distorted price signals. In an efficient market without the distortion of other charges would self-stabilize as new technology is built to utilise the excess of energy available in times of high RES-E delivery.' – Industry Respondent*

A small number of industry respondents expressed concerns that the current market design is built around principles of scarcity and marginal pricing and central dispatch of thermal assets which does not adequately accommodate renewables.

> *'We strongly support the proposed review of the existing Market Roadmap. The current market design is built around principles of scarcity and marginal pricing which reflect an older philosophy of centrally dispatching thermal assets. In a renewables' world, the power is generated when the sun shines and the wind blows, and the challenge is matching that to demand. More simply, we are likely to see high volumes of cheap (essentially free at the margin) green power on our system, which challenge that market design heuristic.' – Industry Respondent*

Some industry respondents recommended a review network tariffs as they are largely based on capacity rather than output.

> *'Review of network tariffs needs to be undertaken with urgency. We have longstanding concerns with the current model where they are largely based on capacity (levied per MW) rather than output (per MWh), which better reflects their use of the system and does not discriminate on the basis of capacity factor.' – Industry Respondent*

A small number of industry respondents expressed concern that the proposals to grandfather constraints was inappropriate, as this could have a negative impact on renewable electricity projects.

> *'Proposals to grandfather constraints will have a detrimental impact on renewable electricity projects, as they will be asked to carry a disproportionate level of the impact of constraint when compared to existing generators. Pro-rating constraints is the preferred option. We would support anything that can be done to establish the functional liquid futures markets so as to support diversification of technologies that will help increase penetration of renewables e.g. green hydrogen. ' – Industry Respondent*

Q26. Do you have any comments on our findings and recommendations in relation to the capacity market component of our review?

Many industry respondents provided views on the current capacity market design, providing a substantial amount of feedback.

Some industry respondents stated that the energy market may become less relevant as an entry signal for new generation and the capacity market is now becoming more relevant.

> *'It is likely that the energy market will become less relevant as an entry signal for new capacity over time and that the importance of the capacity market will increase substantially. It is important that the capacity market evolves in a manner that ensures appropriately strong entry signals exist to meet the capacity requirements of the system and that contracted capacity delivers within the agreed timelines.' – Industry Respondent*

Some industry respondents expressed concern that the current capacity market design and suggested that it needs immediate reform to prioritize facilitating growth, not constraining it and that any design should deliver security of supply.

> *'It appears the capacity market is not working as intended. The recent challenges with the T4 auction and concerns about the security of supply are a sign that the capacity market is in need of immediate reform. The capacity market should be designed around two pillars: 1) incentivise supply to allow for demand growth and investment, and 2) flexible technologies for system ramping and peaking. Right now, it appears that the priority is flexible technologies. The market should prioritize facilitating growth, not constraining it. The results of this focus solely on flexibility are being seen in the market today and need to be addressed quickly. We encourage fast action to address these issues because of the importance of the capacity market and the near-term challenges with security of supply.' – Industry Respondent*

A small number of industry respondents stated that very little new capacity has been delivered through the current capacity mechanism and that there is now a capacity gap.

> *'Further work is required to ensure that the capacity market is well defined and able to deliver on its objectives. There has been little new capacity delivered through the capacity mechanism to date and there is a capacity gap that needs to still be filled. A review of how the capacity market can effectively deliver new capacity may be required.' – Industry Respondent*

Some industry respondents expressed concern regarding the NET CoNE calculation and the concept of Best New Entrant plant.

> *'We therefore support a review of the capacity market parameters, including the appropriate treatment of the NET CoNE calculation and also the concept of Best New Entrant plant or equivalent. Members also emphasise the capacity market cannot be treated in isolation and that there needs to be better alignment with the energy and system services market.' – Industry Respondent*

A small number of industry respondents requested clarity on the future capacity market development and more specifically de-rating factors.

> *'Clarity on the forward-looking approach in the capacity market would be welcome, as well as de-rating factors aligned with state-of-the-art bigger offshore wind power plants.' – Industry Respondent*

A small number of industry respondents agreed that a review of the capacity market is needed to support investment in low carbon technologies and that this market should more accurately reflect the potential contributions of next generation energy technologies.

> *'We agree that a review of the capacity market is needed to support new investment in low carbon technologies and avoid locking in inflexible generation for years to come. To date the capacity market has been geared towards conventional thermal plant but this focus needs to shift and a review of the market carried out to ensure investment is delivered in the technologies that can support renewables and our capacity needs over the longer-term. We agree an approach that more accurately models and reflects the potential contributions of providers like energy storage to capacity requirements is needed. Strict emissions limits could be considered here for new build contracts in future capacity auctions to support new zero carbon technologies.' – Industry Respondent*

A small number of industry respondents expressed concerns that existing and new generation have been undervalued.

> *'Capacity of existing and new generation has been undervalued. This has resulted in premature exit signals and low investment in new capacity.' – Industry Respondent*

A small number of industry respondents stated that any new contracted capacity should be sufficiently flexible, and that new technology (namely hydrogen) should be utilized to decarbonize conventional power.

> *'We believe any new contracted capacity should be required to be sufficiently flexible, low minimum operating levels and should be hydrogen ready (or at least capable of a high hydrogen blend >50%). Gas generators burning 100% hydrogen will be able to provide a decarbonised 'conventional' power source, this combined with significant storage capacities will enable a balanced and secure decarbonised grid. In addition, electrolyser technology used for producing hydrogen can act as system service provider to the grid.' – Industry Respondent*

Some industry respondents provided recommendations into improvements to the Capacity Auction process, providing detailed feedback.

> *'We recommend the following - More careful vetting of qualification applications, particularly for new capacity with greater delivery risks - Procurement of adequate capacity, taking into account the risks of non-delivery of new capacity and the greater impact of generator outages in our relatively small, isolated, and highly constrained power system with a high penetration of renewables - Reduced capacity withholding by the RAs in T-4 auctions, which has the effect of suppressing the clearing price and putting security of supply at risk, particularly in constrained areas. - Review of the TSO's modelling methodology underpinning capacity requirement calculations to ensure it reflects system stress events more directly and is informed by recent operational experience recognizing that average conditions do not result in system stress events (e.g. average wind conditions do apply in real time, DSU availability tends to be significantly less than battery storage). - Review of bid limits for existing capacity, - Cessation of netting DS3 revenues from the BNE calculation process as it removes the incentive to invest capital in the provision of system services necessary to decarbonise the power system.' – Industry Respondent*

> *'With regards to the recommendations included within this capacity market review, we agree that: - Ensuring the "missing money" issue associated with ensuring generation adequacy at likely times of system stress can be resolved through the capacity market if the wholesale market and or system services market cannot deliver the revenues required to ensure enough capacity to meet the designated LOLE. - Ensuring the best modelling of locational capacity constraints and the future interaction of RES, storage and DSU should be facilitated (through PLEXOS) if that is the information most likely to deliver more reliable assessments of the adequacy provided by new technologies. Given the complexities of the future SEM market and the high RES penetration, we recommend that this option be progressed and adequately resourced so that the best information is available before any significant redesign of the Capacity Market is underway. - Stronger incentives to deliver earlier (or not rely upon the longstop date) should be considered - noting that stronger disincentives could also be applied, particularly in the event of non-delivery - We note that the potential increase in performance security requirement is used in other markets (including GB) and should be a relatively simple change to implement. - An urgent re-evaluation of the NET CONE must take place to set the appropriate price caps in line with existing and future EU emissions limits (i.e. not based on an OCGT using distillate fuel in N. Ireland) and that as part of the calculation, the necessity to ensure alignment with the 2030 carbon budgets and eventual 2050 net zero objectives, which should ensure if new gas generation is required, it must be fitted with CCUS or run on zero emissions gas, be capable of running flexibly, to support the variable power sector and be designed to run at low minimum load. - Ensuring the Capacity Market meets the basic compliance requirement (e.g. ensuring DSU can participate is also a known issue that must be resolved urgently). We would also emphasise the need to ensure the market framework, rules and processes can enable participation from other member States, and how this might work in conjunction with the Celtic interconnector. Clarifying the treatment of third countries in this regard (i.e. the UK) will be also be required.' – Industry Respondent*

A small number of industry respondents are of the opinion that the current de-rating process needed to be improved and should be regularly consulted on.

> *'We also think that the current de-rating process needs improvement to ensure that more accurate de-rating factors are applied to particular technologies and run times. We would like all future modelling and possible changes to be communicated with, and consulted on by stakeholders. ' – Industry Respondent*

A small number of industry respondents commented that capacity payments should vary depending on the scale of plant emissions.

> *'There is a proposal that there would be no capacity payments if plant emissions exceeded some threshold. Rather than such a binary approach, it might be better for capacity payments to vary with CO_2 emissions. This would provide a continuing incentive to reduce emissions further below that threshold. ' – Industry Respondent*

A small number of industry respondents stated that adequate incentives are needed for long duration storage technologies.

> *'Consideration should also be given to incentivising investment in longer duration storage technologies which could have multiple system benefits including congestion management, reduced system & oversupply curtailment and provision of energy volumes at better efficiencies than hydrogen.' – Industry Respondent*

A small number of industry respondents stated the need for adequacy modelling to replace less efficient DSU technologies.

> *'We believe that adequacy modelling to enhance the provision of efficient entry of newer more efficient or flexible technologies needs to be undertaken to enable these technologies to enter and replace older less efficient DSU technologies.' – Industry Respondent*

Q27. Do you have any comments on our findings and recommendations in relation to the system services component of our review?

Several industry respondents commented on the expanded role for system services and the need for electricity market design changes and incentives to ensure delivery of system services to balance high levels of renewables. Within this feedback, a broad range of opinions were provided.

A small number of industry respondents supported the System Service ambitions outlined but requested that the Go Live date of May 1st, 2024, be adhered to and be procured through auctions where pragmatic.

> *'We support EirGrid's ambitions in the systems services (SS) space – future system services arrangements will play a key role in facilitating the volume of renewables required to be on the system to meet 2030 targets. The go-live date of the new arrangements of 1 May 2024 must be achieved. SS should wherever possible and pragmatic be procured via auctions.' – Industry Respondent*

Several industry respondents stated that the any new system services should incentivise zero-carbon technologies.

> *'It is critical that the System Services framework supports investment in new zero-carbon technologies that can provide System Services and reduce our reliance on conventional fossil fuel generation for service provision. grid-forming wind turbines and combinations of batteries and STATCOMs can provide a range of ancillary services including being Black-Start capable. This will provide EirGrid with additional capabilities to manage the grid in increasing levels of renewable penetration. Gas generators burning 100% hydrogen will be able to provide a decarbonised 'conventional' power source, this combined with significant storage capacities will enable a balanced and secure decarbonised grid.' – Industry Respondent*

A small number of industry respondents stated that the system services design needs to deliver solutions that are unique to island of Ireland, and that daily auctions alone will not deliver the required solutions.

> *'Ireland is a pioneer in integrating variable renewables, EirGrid and SONI are facing challenges not seen anywhere else in the world. System service design needs to deliver for Irish solutions. Irish investors in zero carbon system service technology need certainty. Daily auctions do not provide this on their own.' – Industry Respondent*

A small number of industry respondents stated that power system of Ireland and Northern Ireland is uniquely different and that concepts that may be efficient for other EU countries may not work in an Irish context.

> *'The power system of Ireland and Northern Ireland differs from Europe as it is a highly constrained, small, synchronously isolated power system with ultra-high renewable targets for a small synchronous system. In addition, system services revenue is relatively more important to investment decisions / revenue adequacy compared to Europe, given the higher wind penetration. It is important to take account of these characteristics and to recognise that a solution based on concepts that may be efficient for other EU countries may not be workably efficient, or attract the required investment, in an Irish context.' – Industry Respondent*

A small number of industry respondents stated that the auctions would help with unconstrained DAM running decisions.

> *'Holding System Services auctions after DAM results enables market participants to make unconstrained DAM running decisions, in line with the original intent of the SEM design.' – Industry Respondent*

A small number of industry respondents sought clarity on how System Services is to be reformed to operate with 70% renewable generation.

> *'It is not clear from the report nor from the consultation how the system services sector is going to be reformed to ensure a fully functioning electricity grid, with 70%+ levels of weather dependent renewable generation.' – Industry Respondent*

A small number of industry respondents disagreed with an ex-post approach to system service procurement as it could possibly undermine the incentives market participants have to provide.

> *'We do not support an "ex post" approach to System Services procurement whereby System Services are "procured" after the balancing market closes, i.e. System Services volumes are determined after the fact based on how the unit acted in real time. An ex post approach in our view would undermine the incentives market participants have to actually provide System Services and perform in line with their technology's capability.' – Industry Respondent*

A small number of industry respondents stated that investor certainty is crucial when making significant capital expenditure decisions and were that the daily auctions do not provide efficient or adequately bankable investment signals.

> *'It is therefore recognised that an efficient outcome will not be delivered without investment and therefore the future arrangements for system services must provide sufficient investor certainty/confidence to finance and make significant capital expenditure decisions. In this regard we are concerned that daily auctions for system services will not be an efficient solution on the basis that they do not provide efficient or adequately bankable investment signals. ' – Industry Respondent*

Some industry respondents expressed concerned about the timelines identified for system service implementations and that action needs to be forthcoming.

> *'We note that all four of the Classes of System Services are noted as needing increased service provision from 2025. However, only 2 of the 4 are judged to be likely to have their product design implemented in 2023, creating time for the required investment by 2025. One of these classes (congestion) is judged likely to be ready by 2027, and the other (Electromagnetism and Inertia) has no expected date outlined. While it is good to have this understood and outlined, based on this there will be a deficit in required system services in 2025. Actions need to be taken to address this.' – Industry Respondent*

> *'Timely investment in system services is required to ensure emission reduction targets in both Ireland and Northern Ireland can be achieved. The issue for investors under the current DS3 market arrangements however is revenue risk.' – Industry Respondent*

Several industry respondents highlighted that market mechanisms which are outside the control of the investor increases risk and therefore erodes investor confidence.

> *'In the absence of volume controls and guaranteed budget increases, investment will result in lower market pricing, and therefore reduced returns. The market is also a monopsony – i.e. the TSOs act as the sole buyer of services - and therefore affords little opportunity for product differentiation – i.e. there are limited mechanisms to protect market share as the provision of services increases. Investment under the current DS3 arrangements is therefore subject to significant risk that manifests in a myriad of forms, including system SNSP levels, budget caps and wider regulatory risk. Over time these market dynamics, which are outside the control of the investor, are likely to significantly erode investor confidence in the market.' – Industry Respondent*

Several industry respondents stated if price caps are to be used then there needs to be a corresponding price floor for any potential downside risk uncertainty.

> *'The TSOs have proposed that price caps may be a feature of the future DS3 market but while this places a cap on the upside there needs to be a corresponding floor on the downside risk. The ongoing TSO consultation on DS3 system services expenditure highlights the risk that new investment faces without longer term price certainty.' – Industry Respondent*

A small number of industry respondents supported the merits of procuring zero carbon inertia but added but this requires sufficient funding.

> *'We welcome the intent (as outlined in the SEM decision paper 21021 to require the TSOs to consider the merits of procuring zero carbon inertia via a future fixed contract auction, and it remains critical that the budget for this service (if required) must be additional to the existing capped budget.' – Industry Respondent*

A small number of industry respondents stated that the market design must cater for the revenue stacking of services.

> *'The market design must allow revenue stacking of services e.g. system services, congestion products, energy market and capacity market. This is critical for the build out of new zero-carbon technologies.' – Industry Respondent*

A small number of industry respondents expressed concern that the focus should not be predominately compliance driven but should also be guided by the ultimate goal of decarbonisation.

> *'We are concerned that the approach being developed is focused too much on compliance and putting in place a competitive framework rather than what the framework should be helping to deliver as its ultimate goal, which is the decarbonisation of the power system. We do not believe these are mutually exclusive. A framework that is compliant and delivers value to consumers while helping deliver on our national decarbonisation aims can be developed.' – Industry Respondent*

A small number of industry respondents supported the shorter-term procurement of energy-based reserve services.

> *'We support moving to, where possible, shorter-term procurement of energy-based reserve services in line with energy market procurement. This does not necessarily mean daily auctions – some or all of the reserves.' – Industry Respondent*

A small number of industry respondents commented that Article 6 creates issues for the energy storage sector and that and new system service framework may need new types of support schemes.

> *'We understand that the EU Commission and national regulators (currently discussing with policymakers from Greece, for example) appreciate that Article 6 creates a lot of issues for the storage sector because it prevents any long-term certainty on revenues. They are looking into different programmes/payments/ support schemes to allow some long-term payments for storage. This needs further consideration in Ireland as well, to ensure that a sustainable market for system services, which will increasingly be provided by energy storage, is set up. If the redesigned system services framework doesn't actually result in new investment, then it falls at the first hurdle, could be procured closer to real time facilitating variable renewables and demand response certainty in their committed volumes, reducing costs for the consumer.' – Industry Respondent*

Q28. Do you have any comments on our findings and recommendations in relation to the renewable supports component of our review?

For this question, a number of detailed and specific responses were provided by industry respondents. One respondent mentioned that while they welcomed priority dispatch of RES generation in the Energy Market that a similar priority of dispatch status should also be applied in the services market.

> *'In relation to non-financial support mechanisms, we very much welcome the guaranteed access for RES generation to the Energy Market, i.e. priority of dispatch. Moreover, bearing in mind that in the 2030s the Irish power system is going to run at 95% SNSP for significant periods of time it would make sense to consider the possibility of setting up a similar priority of dispatch for RES in the services market.' – Industry Respondent*

Many respondents mentioned that extending RESS contract period from 15 to say 25 years would substantially reduce risks.

> *'Extending the contract periods in RESS from 15 years (towards 25+) would greatly reduce the risk of very low merchant tail pricing thus lowering auction bid prices and the costs of renewable deployment over the longer-term.' – Industry Respondent*

Another responder was concerned about the lack of control they had in relation to levels of constraint, curtailment, or energy balancing actions. Also, developers have no way of reacting to locational signals driven by changes to TLAFs or TUoS costs.

> *'Once a generator becomes operational following a successful RESS auction, the developer of that generator has no control over the levels of constraint, curtailment, or energy balancing which the generator will absorb. Similarly, the developer has no ability to respond to varying locational signals driven by changes to TLAFs or TUoS as the decision regarding the location of the generator has already been made - with the locational signals at that point in time, such as TLAF and TUoS costs, having fed into this decision.' – Industry Respondent*

Several respondents mentioned five volatile factors which introduce RESS project uncertainty. They contended that a greater level of certainty around these factors should be offered prior to any RESS auction.

> *There is substantial difficulty in predicting each of the five volatile factors (constraint, curtailment, energy balancing, TLAF and TUoS) over a 35-year project lifetime. This creates a very wide-ranging band of uncertainty which the developer must take account of in advance of submitting a RESS auction bid. There is merit to minimising or removing the risk and volatility associated with these factors to the RESS bidder. A greater level of certainty around these factors should be offered to developers in advance of the auction taking place' – Industry Respondent*

Some contributors were concerned about the affordability of the decarbonisation transition and that it should put the 2030 ambition at risk.

> *'We agree that the affordability of the decarbonisation transition over this decade is a critical factor, but it should not risk under-delivering the volume of RES needed for 2030 aims. The suggestion by EirGrid that future support design should factor in the ability of the system to utilise the RES generation is not supported as again we cannot support proposals that sees market design reacting to system limitations.' – Industry Respondent*

One contributor was concerned about the revenues that are earnable based on the various interdependencies built into the market designs.

> *'Regarding the discussion around what revenue streams should RES be assumed to earn, the capacity market currently de-rates all RES to a low percentage. Their participation in the capacity market is therefore not incentivised by the capacity market itself. Both the REFIT and RESS schemes "claw back" capacity revenue earned, effectively negating any revenue a unit interested in entering the capacity market may earn and saving the PSO customer money. Whether a RES supported unit should be assumed to earn capacity or system service revenue therefore depends on the design of the market from which revenues are assumed earnable in the first instance.' – Industry Respondent*

Contributors mentioned that encouraging the use of CPPAs needs to remain at the forefront of any consideration of oversupply issues from renewable energy.

> *'As an active participant in the CPPA market, we see that challenges with connection agreements, risks of future curtailment, and timelines for grid planning are all hindering the renewable energy market. We are also concerned about EirGrid's statement about the risks of oversupply from renewable energy. We caution against EirGrid taking steps that could devalue CPPAs or discourage participation in the CPPA market at a time when the government policy is to encourage CPPAs. CPPAs deploy private capital to invest in the development of renewable energy on the Irish grid and this mechanism offsets the need for public support for renewable energy projects. Encouraging CPPAs needs to remain at the forefront of any consideration of oversupply issues.' – Industry Respondent*

Another contributor stressed the importance of renewable support schemes and the there may be opportunities to further leverage existing renewable assets and connections where infrastructure already exists.

> *'Renewable support schemes have played a pivotal role in delivering the renewable deployment successes observed in both jurisdictions on the Island of Ireland to date. With an abundance of natural resource, RESS support will continue to be the catalyst and enabler to help realise the challenging targets Industry has been asked to deliver. Whilst support schemes will provide the stimulus for future growth, there may be opportunities to leverage existing renewable assets and connections to realise their full potential, particularly where investments have already been made and infrastructure already exists.' – Industry Respondent*

Some contributors mentioned that the removing of Priority Dispatch status for new renewable generation risks disincentivising investment in RESS and these projects may therefore require additional supports.

> *'We note that priority dispatch (an important non-financial support mechanism) may not be a component of future renewables support due to the Clean Energy Package (EU Regulation 2019/943), as the Clean Energy Package is removing priority dispatch status for new renewable generation within Europe. This will likely assist TSOs and DNOs in handling (potentially reducing their costs) the increased level of RES that will be required up to 2030 and beyond. But it will also disincentive the investment in RES, so the levels of financial support may need to increase to compensate for this.' – Industry Respondent*

Another contributor highlighted the unique challenges that renewables developers face in Northern Ireland.

> *'We believe there are a number of areas that should be considered in this review: NI remains the only part of these islands whereby developers do not have access to a market mechanism to deliver a fixed price for renewable electricity. We support the proposed extension of the UK Contracts for Difference (CfD) scheme as outlined in the DfE Energy Strategy consultation. For this to deliver the required increase in renewable electricity generation capacity it is essential that future CfD auction rounds included an NI only competition. As outlined in AFRY's Power of Renewables analysis, NI projects face a number of competitive disadvantages in comparison with projects in GB, including:*
>
> - *Higher grid connection costs*
> - *Significantly longer planning timelines*
> - *Typically, smaller turbine sizes (it is vital NI is included in Auction Round 5?)' ' – Industry Respondent*

More specifically, one contributor was concerned about the how the NI government proposes to implement a CfD regime for onshore wind, solar and hybrid projects.

> *'We are supportive of alignment of renewable support schemes across both jurisdictions and would particularly like to see the Northern Irish Government progress its proposals in the Energy Strategy to implement a CfD regime for onshore wind, solar and hybrid projects.' – Industry Respondent*

Other respondents were concerned about how and when the revised market framework would be delivered (Evolution Vs. Revolution).

> *'We also acknowledge that delivering a fully revised market framework would be a revolution rather than evolution and we note the concerns that if the SOs were to: "seek to change too much it is unlikely to be implementable in a timely fashion with adverse impact on necessary investment. However, if [the SOs] do not make sufficient changes to existing market systems then delivery of the long-term renewable objectives will be unlikely.' – Industry Respondent*

Finally, one contributor was concerned about a possible conflict between the support schemes and the target of having 15% of electricity consumed by CPPAs by 2030.

> *'While there may be good coordination between support schemes, there is clear conflict between the RESS and the target of having 15% of electricity consumed by CPPAs by 2030. Unless steps are taken to resolve this conflict, the RESS will continue to inhibit a functioning CPPA market and regulators need to find a solution. This important factor is overlooked in the recommendations.' – Industry Respondent*

Q29. Do you have any comments on our findings and recommendations in relation to network tariffs component of our review?

One contributor commented that the tariff review process should be transparent, evidence-based and have an over-arching objective of cost reflectivity.

> *'We recognise the challenges the 2030 and ultimately 2050 targets pose and accept that network tariffs will have to adapt and evolve from being a 'route to market' to becoming an enabler and active driver of system change, as alluded to in the paper. As part of this evolution, it is important the tariff review process is transparent, evidence-based and has an over-arching objective of cost reflectivity.' – Industry Respondent*

There were concerns expressed that locational charging would hinder the 2030+ Renewable Ambition.

> *'Given that there will be a requirement for generation to locate at sites away from the main centres of demand (predominantly on the Dublin area), there is a clear risk that the introduction of locational charging would hinder rather than support the development of sufficient grid to meet the 2030+ requirements.' – Industry Respondent*

Another contributor pointed out that the current network tariffs are acting as a disincentive to new technology investment.

> *'Current network tariffs are a disincentive to industrial power-to-heat. They are a barrier to industrial sites using electrode boilers to reduce their fossil fuel usage and they are a barrier to this new technology which will reduce dispatch down of wind turbines.' – Industry Respondent*

One respondent welcomed the tariff review and hoped the review would take into account a broader view of the energy storage sector capabilities.

> *'We welcome a network tariffs reviews and from the perspective of energy storage stress that this review takes into account the developing use cases for storage, particularly longer-duration storage that we will need for 2030 and beyond. There is the risk that focusing on a narrow use case for storage will have a significant distortionary impact on the development of the storage sector in Ireland in the medium to long term by disincentivising investment in longer duration systems. This would reduce the wider benefits that can be offered by storage technologies that are critical for integrating world leading levels of renewable generation on a small, heavily constrained, island system.'*
>
> *'A further consideration is alignment of jurisdictional network charging structures for storage.' – Industry Respondent*

A respondent had a particular concern at the possibility of assets being stranded and is seeking regulatory clarity as to the arrangements for charging for storage.

> *'There must be policy certainty at the point that generators commit to the grid connection (in line with their contractual responsibility under RESS or a CPPA), to remove the risk of stranded assets and therefore the risk of higher costs for consumers. As a priority we would welcome clarity from the regulator as to the arrangements for charging for storage and ensuring the approach will be consistent across both Ireland and N. Ireland to avoid any market distortion.' – Industry Respondent*

Another mentioned that tariffs should reflect the actual cost of network development.

> *'Penal network tariffs should not be used as a locational signal where it does not reflect the actual cost of network development. – Industry Respondent*

A respondent pointed out that locational signals are too volatile and provide no long-term investment signal.

> *'The issues with generator tariffs currently are that the locational signal is too volatile and provides no long-term investment signal. Network tariff locational signals should only be relevant up to the point of operation and should be fixed afterwards for a period of time. Existing generators cannot react to these after they have built. Some element of cap and floor may be appropriate and this should also apply to existing sites.' – Industry Respondent*

In relation to TUoS charges one respondent made the following points.

> *'We would strongly support preserving certain key TUoS design principles, in particular that TUoS charges should:*
>
> - *Be cost reflective*
> - *Promote fairness and avoid undue discrimination*
> - *Provide reasonable stability and predictability*
>
> *Any proposal to strengthen the locational signals provided through TUoS should respect these principles and shouldn't be penal. The issue with existing generator tariffs is that the locational signal is too volatile and provides no long-term investment signal. Network tariff locational signals should only be relevant up to the point of operation and should only be index linked to Consumer price index afterwards. Existing generators cannot react to these volatile TUoS charges after they have built.' – Industry Respondent*

Another contributor communicated that any review should consider Transmission/Distribution Loss Adjustment Factor as the they believe them to be ineffective.

> *'A review of the Transmission/Distribution Loss Adjustment Factor should also be considered. They are ineffective at influencing where generation is located. It could be repurposed to incentivise the location of large demand users such as power-to-heat, data centres or power-to-gas.' – Industry Respondent*

Another contributor mentioned that the Demand Turn Up (DTU) service in the UK is worth investigating.

> *'The Demand Turn Up (DTU) service in the UK encourages large energy users and generators to either increase demand or reduce generation at times of high renewable output and low national demand. This service provides an out of market support for potential consumers of flexible power to help the wind industry.' – Industry Respondent*

Another responder provided the following content in relation to the charging base, locational signals and whole system interactions.

> ***Consideration of the charging base**: we accept the need to review the concern that the tariff structures in Ireland and Northern Ireland have a significant energy-based component but there is the emergence of technologies which can avoid an energy-based charge. The suggested review seems pragmatic and fair.*
>
> ***Locational signals:** We do not support the use of network tariffs for more stringent signalling of locational investment or locational grid use. The current approach to TLAFs has led to investors facing increasingly negative TLAF effects year on year long after investments have been made. Our preference is for signals to be given for locating investment from the very outset of a project such that the project is not exposed to subsequent unpredictable investment risk and cost.*

> ***Whole system interactions:*** *we support the concept of taking a holistic "whole of system" approach and to review the transmission and distribution charging arrangements together in order to minimise perverse incentives driven by inconsistencies between network voltages. Such a holistic approach should also ensure the networks function effectively and deliver for consumers. The reference to the need to consider how charges relating to system services are determined as between Ireland and NI is noted too – it may be prudent for EirGrid to work with the RAs to develop this concern and work out possible solutions through the future system services arrangements consultation process*

Another respondent highlighted that cross-jurisdictional considerations should form an important part of the tariff review to ensure tariffs are transparent and cost reflective.

> ***'Cross-jurisdictional considerations will also form an important part of the review process, both in the context of NI and RoI as well as neighbouring interconnected markets. Currently NI and RoI have different charging methodologies, different policy drivers and ultimately different needs and demands for network upgrades and investments. The recovery of these costs relative to the jurisdiction they are incurred in has the potential to result in disruptive outcomes if tariffs are not transparent and cost reflective.' – Industry Respondent***

Concern was raised about SONI becoming a more active driver of system change.

> ***'SONI states that it may be necessary for the setting of new Tariffs to go beyond facilitation and become a more active driver of system change. This is a departure, and may mean that the cost reflectivity of future tariff arrangements may be reduced – focusing on the best interests of medium to long-term sector transition, potentially at the expense of short to medium-term network cost minimisation.' – Industry Respondent***

And finally one respondent was concerned that the system operator resources may be insufficient to progress many different parallel workstreams.

> ***'TSO Resourcing To deliver all this is it essential that the TSOs have the resources to progress parallel workstreams in terms of grid development, renewable connections, system operations and electricity markets. We have concerns that without additional resourcing on the part of the TSOs it will not be possible to deliver all the necessary changes over the coming decade. It is our view that existing TSO resources are already stretched to deliver their current work activities and this problem will only be exacerbated with a growing remit in areas like offshore connections and grid infrastructure, electrification and data centre growth. The lack of progress in areas such as FlexTech is evidence that if resources are not properly assigned to a project or initiative then the work will not progress and what the SOEF roadmap is proposing is multiple new workstreams on top of the TSOs existing activities. We request that as part of the final SOEF roadmap that a clear strategy or plan is provided in relation to how the TSOs plan to resource and support the various work areas outlined in the roadmap.' – Industry Respondent***

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