Tomorrow's Energy Scenarios 2023

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About SuperNode and Superconductors

SuperNode, headquartered in Dublin, Ireland, is a global technology development company that designs and delivers cutting-edge, superconducting cable systems for bulk electricity transmission.

Conventional transmission cables are limited in terms of current levels which in turn limit their power transfer capability. Networks based upon superconducting cable systems can move larger quantities of power over longer distances with smaller and less obtrusive infrastructure, without electrical losses and at significantly lower voltages. SuperNode's technology will connect electricity markets in a way that facilitates the integration of large-scale renewables and the achievement of a decarbonised pan-European energy system.

SuperNode was founded in 2018 by Dr. Eddie O'Connor and renewable energy developer Mainstream Renewable Power Ltd. SuperNode is jointly owned by Dr. O'Connor and Norwegian green investment group AKER Horizons.

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Introduction

SuperNode commends EirGrid for the production of this report. It is a crucial document, which will assist Ireland's journey to decarbonisation. SuperNode recognises and values the need to forecast what a decarbonised energy system in 2050 would look like. Only then can we chart a path to that future. It is particularly valuable and useful to see EirGrid comparing four distinct and comprehensive scenarios out to 2050. However, there are some areas, which SuperNode believes could be improved or expanded on, which are included in our answers below.

Purpose of Tomorrow's Energy Scenarios

1. Have we adequately explained:

   a. **Why EirGrid and SONI employ scenario planning? (Yes, No, Unsure)**

   Yes the report adequately explained the importance and value of scenario planning.

   b. The scenario development process? (Yes, No, Unsure)

   There was inadequate explanation of why each of these scenarios was chosen over any other possible scenarios. There should have been more detail provided as to why and how these four specific scenarios were chosen, which other possible scenarios were considered and the specific characteristics of each scenario. For example, there is no

scenario that surpasses government ambition. There are multiple possible scenarios, which consider futures that do not align with Government policy and targets and yet there is no scenario in this document, which surpasses Government ambition. This is an oversight and EirGrid should be considering a wider range of possible futures.

The report states that cost assessment is not included in the scope of TES. However, p17 of the report also states that scenario planning assists EirGrid to ensure "a long-term sustainable and competitive energy future". In order to review the competitiveness of each scenario, the costs should be a central factor.
The relative costs of each scenario would provide highly relevant and valuable information. It is not explained why costs were not included in the scope of the analysis. For more information on costs see Question 4.

c. How scenarios fit into our grid development process? (Yes, No, Unsure)

There is a general overview of how the scenarios fit into the grid development process but there could be more clarity given to the specifics. How will this report interact with the System Needs Assessment (SNA)? For example, how were interconnection figures reached prior to a SNA and how will these function as inputs into the SNA?

d. Where the TES publications fit in the suite of planning publications? (Yes, No, Unsure)

Yes, there is a good overview of the suite of publications, however, a more accurate timeline for the expected publication of each would be beneficial.

Scenario framework

2. Do you think the scenarios Self-Sustaining; Offshore Opportunity, Gas Evolution and Constrained Growth cover a range of credible futures for Ireland's and Northern Ireland's electricity sector? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

In each of the scenarios a net zero electricity system is achieved by at the earliest 2040 and extending out to 2050 in 'Constrained Growth'. In order to align with the carbon emissions budgets set out in the Climate Action Plan 2023, the electricity system must achieve net zero by 2035. This is one of the key signs that the Government, most notably DECC, were not sufficiently involved in the production of the TES.

EirGrid and DECC are the two organisations with most responsibility for Ireland's energy future and it's critical that there is open and comprehensive engagement between the two and that they are aligned and working towards the same goals.

The four chosen scenarios also do not capture a wide enough range of credible futures. There should be more than four scenarios analysed. As mentioned in squestion 1.b., Eirgrid have considered scenarios that do not reach Government stated goals but they have not considered an ambitious scenario where we surpass those goals. The Offshore Opportunity achieves the non-legally binding target of 37GW of offshore wind. However, Ireland has far more offshore wind potential and a scenario where Ireland develops up to 50GW would be valuable. DECC is undergoing an Offshore Renewable Energy Future Framework Economic Analysis in which they consider up to 50GW of offshore wind by 2050.

3. **Do you agree with the selection of 2035 to 2050 as the period of study for TES 2023? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

Yes. It is absolutely critical that the future out to 2050 is analysed.

4. **Do the scenarios capture the most important factors that will influence the future electricity sector in Ireland and Northern Ireland? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

As mentioned in Question 1.b. the relative costs of each scenario are not included. This is a highly important factor in assessing the competitiveness of each scenario and should be captured.

The modelling process, which undoubtedly considered costs in each scenario, should have resulted in an overall cost for each scenario. The ability to compare the relative costs of each scenario would have proven valuable and provided a more comprehensive understanding of their feasibility.

The report employs PLEXOS as the economic modelling software, leveraging the technologies and characteristics outlined in ENTSO-E's TYNDP 2022 Scenarios Report. The document from ENTSO-E provides insights into how the Levelised Cost of Electricity (LCOE) varies based on the renewable energy share in the system. Consequently, in the modelling process for the build-out of the most cost-effective generation, each scenario would inherently utilise a different LCOE for each technology and unit of generation and ultimately result in a different overall relative cost for each scenario.

EirGrid is the organisation best positioned to offer insights into the cost of Ireland's alternate energy pathways. While the scenario costs may be indicative, they still hold significant value in enhancing the overall credibility and applicability of the report. The document also lacks clarity on when a cost assessment will be conducted. It is not clear whether the assessment will be included in the System Needs Assessment or deferred to a later stage. Clarification on the timing of the cost assessment would be beneficial.

5. **Do you agree with our approach to carbon emissions reductions for the power system described in the scenarios? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

As mentioned in Question 1, the carbon emissions reductions for the electricity system does not align with the Government's Climate Action Plan 2023 in achieving net zero by 2035.

Electricity Demand

6. Do you agree with our overall approach to forecasting electricity demand set out in Section 5? (Yes, No, Unsure)
    a. Please provide further feedback and details on the reasons for your choice here
    b. Assumptions for Total Electricity Requirement (TER) (Yes, No, Unsure)
    c. Assumptions for peak electricity demand (Yes, No, Unsure)
    d. Assumptions for energy efficiency (Yes, No, Unsure)
    e. Assumptions for residential and tertiary sector electricity demand (Yes, No, Unsure)
    f. Assumptions for transport sector electricity demand (Yes, No, Unsure)
    g. Assumptions for industrial and New Technology Load electricity demand (Yes, No, Unsure)

Please provide further feedback and details on the reasons for your choice here

We are satisfied with the overall approach and forecasting of significantly increased electricity demand out to 2050 across each scenario.

Electricity Generation

7. **Do you agree with our overall approach to forecasting future electricity generation set out in Section 6? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

As we have mentioned in question 2, we do not agree with the forecasting for future offshore wind generation.

The onshore wind capacity limit set at 12GW is also conservative. The government targets 9GW of onshore wind by 2030. It is unrealistic to assume only 3GW more are developed in the next 20 years. This would potentially increase the overall renewable capacities for each of the scenarios.

8. **Have we considered the right balanced portfolio of generation technologies? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

As mentioned in question 7, the onshore wind capacity limit is conservative and there should have been more ambitious considerations for offshore wind.

The portfolio of generation technologies should not be considered in isolation from flexibility such as storage and interconnection. A balanced portfolio built on renewables requires sufficient storage and interconnection in order to ensure security of supply during low resource periods and a route to market for excess power in periods of high resource. The levels of interconnection are discussed further in questions 10 and 11.

9. **Do the scenarios include credible capacities and build out rates for generation technologies? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

The scenarios do for the most part include credible capacities and build out rates. As mentioned in previous answers, capacities are somewhat conservative and should be achievable with the right

policies, planning reforms and resources in place. There is, however, a concern around the very high dispatch down rates in the Self Sustaining, Offshore Opportunity and Constrained Growth scenarios. The dispatch down rates range from 16% - 22%, which does not even include curtailment or constraints. These very high levels add additional risk and costs to generation projects. The levels of interconnection and storage need to be increased from what is outlined in this report in order to ensure the market case is strong for developers looking to build in Ireland. Reducing dispatch down means more wind energy and less carbon emissions.

10. Do you agree with our overall approach to forecasting future interconnection and energy storage needs? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

We have identified some concerns and clarifications in the proposed approach, primarily in relation to the limited information provided. It is not clear in the report how the interconnection values were reached, whether there was engagement with DECC and other Irish stakeholders or other European stakeholders in relation to their future energy scenarios, weather patterns and generation profiles.

We will assess the approach on the information and interconnection values provided but more information on the approach and how these values were reached would be valuable.

Irish Stakeholder Engagement:
To what degree were DECC involved in the production of this report? The starting position of the TES scenarios is not aligned with the Department of Environment, Climate and Communications (DECC) and the stated goals in the National Policy Statement on Electricity Interconnection 2023. TES uses the endpoint of Shaping Our Electricity Future (SOEF) as the starting position for the scenarios which assumes a second Ireland-France interconnector by 2030. In DECC's Policy Statement it is stated "*we have identified the need for an additional connection to Great Britain by 2030*" with no mention of plans for a second Ireland-France interconnector. Furthermore, the supporting report by DNV to inform DECC's Policy Statement states: "*By 2030, an additional link with Great Britain is assumed as the only plausible opportunity for further interconnection beyond those projects currently operational or at an advanced stage of development".*

EirGrid and DECC are the two organisations with the most responsibility for planning Ireland's long-term energy system. It is critical that there is comprehensive engagement and alignment between these organisations and any other relevant bodies. Clarity around Ireland's future energy system is vital for the renewables and grid industry and confusion around Ireland's interconnection capacities for 2030 can undermine the industry and jeopardise Ireland's ability to achieve its goals and capitalise on our renewable resources.

We would appreciate clarification on DECC's involvement in the production of TES and encourage open and comprehensive collaboration between the two organisations for any future reports published by either entity.

European Collaboration
We would also like clarification on whether EirGrid's approach to these interconnection values has been undertaken in collaboration with our European neighbours. It is vital that we understand the future demand, generation and transmission capacities of our closest neighbours. Interconnection modelling should not be undertaken in isolation. We need to ensure the routes to market for our power are clear and optimised and that we are part of a holistic long-term strategy that considers the broader European context.

EirGrid has been involved in ENTSO-E's Offshore Network Development Plan (ONDP) for each of the 5 sea basins, along with the other EU members states with whom we would be looking to interconnect, which is due for publication on the 24th of January 2024. How much did this process contribute to EirGrid's production of this report? Did EirGrid utilise the relevant data from the other TSOs to inform credible interconnection and power flow levels between our potential trading partners.

The UK is no longer a member of ENTSO-E but it is absolutely vital to our interconnection plans and the wider holistic European energy system. National Grid ESO's Future Energy Scenario 2023 have outlined 4 scenarios with interconnection values for 2030, 2035 and 2050. In September of this year, Ireland signed an MoU with the UK to "*increase renewable energy development, electricity interconnection and security of gas supply*". Has this deal enabled greater collaboration with the UK and how much engagement was there with UK and National Grid ESO's future energy scenarios in the production of this report?

Planning and developing interconnection cannot be done in isolation. Interconnection is by its nature connected to another nation/market and we must ensure this nation/market understands our export/import needs and plans.

Interconnection also increases the likelihood of foreign interests investing in Irelands renewables industry. By providing routes to market for Irish renewables to Europe, this creates an opportunity for other nations and consumers to benefit. The EU's Renewable Energy Directive's 2018/2001 cooperation mechanism allows for Members states to collaborate on or build generation in other jurisdictions through statistical transfer and joint projects. With ample interconnection, Ireland increases the likelihood of other Member states looking to partner with Ireland on Irish renewable projects, thereby saving on cost and bolstering Ireland's renewable capacity.

Trading Partner Preference
We understand the short to medium-term preference for Continental Europe over the GB market due to a more varied generation profile and weather patterns. We would, however, like to highlight that this preference should dissipate as we approach 2050. In the long run, in a decarbonised European energy system, there will be deep interconnection moving renewable power from supply to demand across the continent, minimising the impact of local weather patterns and local trading partners.

We would also like to reiterate a clarification over whether there was engagement with the UK and EU member states over the accurate weather and generation projections used in this analysis.

System Needs Study
We require further information to understand how the need for interconnection was assessed. WEI note that the consultation document states that these are only "indicative and more detailed studies are needed to determine the optimum levels of interconnection".
WEI would also like to understand how the outputs from TES will be utilised in the System Needs Assessment (SNA). Will the interconnection values listed here act a rigid input into the SNA or will they be a flexible guiding influences with potential to change and increase according to the SNA?

11. Do the scenarios include credible capacities and build out rates for interconnection with other countries? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

More Ambition Needed
The levels of interconnection do not provide adequate export capacity to manage excess power in any of the four scenarios outlined for consultation. We compared the interconnection capacity to the total installed renewable capacity and the peak demand for each of the four scenarios, as shown in the

below tables. The result is significant levels of levels of excess power that would go to waste. In order to harness the full potential of our renewable resources we need to find a use case for this excess power. The report states that hydrogen will be produced from purpose-built, non-grid connected offshore wind turbines which are separate from the offshore wind installed capacity. This means the potential use cases for this excess power include storage, increased industrial and domestic demand but must also include significantly higher levels of interconnection than listed in these scenarios.

Furthermore, the very high levels of dispatch down outlined in Question 9 call into the question the credibility of the build out rates of generation by increasing the risk/costs to developers. In order to create the strongest business case for renewable developers, even higher levels of interconnection would be required to ensure a consistent route to market for renewable power and reduced levels of dispatch down.

The Offshore Opportunity scenario offers, by a significant margin, the lowest number of hours of demand where renewables need to be supplemented by other sources. It does, however, have the highest level of dispatch down at 22%. If the level of dispatch down can be reduced via increased interconnection and storage, it would present a very favourable scenario.

New approach to grid planning

A new approach to interconnection must also be deployed. We can no longer view interconnectors as individual projects but instead as parts of a wider transmission network. We must also move away from primarily focussing on point-to-point interconnectors. This approach will not deliver an optimal decarbonised energy system. A new approach to grid planning must be implemented based around meshed grids with multiple routes to market. The Ostend North Seas Energy Summit Declaration of Energy Ministers outlined plans to develop 'a meshed offshore grid' to incorporate offshore wind targets and Ireland's interconnection policy should set out plans for this meshed grid today. The European Commission has also published an EU Action Plan for Grids on the 28th of November which stated that "Offshore networks will be composed of radial and hybrid transmission projects evolving towards a future meshed grid".

In the short-term, hybrid offshore projects can offer some benefits over point-to-point by providing direct routes to market for offshore wind power. This would also help alleviate onshore network constraints which are proving challenging for Ireland. However, they are not a long-term solution and must ultimately become part of a meshed grid approach. It is still unclear how hybrid/multi-purpose interconnectors are defined in Ireland and a clear and accurate definition is required.

DECC plan to publish an Offshore Transmission Strategy in Q1 2024 and it is crucial that EirGrid are involved in the development of this strategy to ensure it is aligned with TES, the SNA and EirGrids view of the future of Ireland's energy system.

Accelerated Interconnector Development

Facilitating the level of interconnection stated in the report and aiming beyond it, as this response is recommending, will be extremely challenging. The Celtic interconnector is likely to take ~15 years to build 700 MW. If we look at the Offshore Opportunity Scenario, we will have 17 years from today to build 12,000 MW and 27 years to build 16,000 MW. The planning, permitting and development of interconnectors must be vastly accelerated from today. Achieving this level of interconnection in this time frame will require significant effort, innovative approaches and added support and resources for EirGrid.

Need for clear, forward thinking planning

We also recommend the development of a clear plan as soon as possible for early engagement with the supply chain. Proactive planning is essential to avoid potential delays or cost escalations. TenneT, the German TSO, has procured 14 2GW HVDC stations and 10 cable systems out to 2030, securing the majority of the limited HVDC supply chain. If Ireland is not proactive in planning its offshore transmission system early and engaging with the supply chain early, it will be left out in the cold with limited supply, delayed projects or excessive costs. It is SuperNode's understanding that the lead time for HVDC electrical equipment is approximately 6 years. This will impact projects in the medium and long term but will significantly impact any projects needed to achieve 2030 targets.

We must also reiterate the need for open and frequent engagement with European neighbours to better understand their needs and their development plans to ensure clarity for Irelands own plans.

12. Do the scenarios include credible capacities and build out rates for energy storage? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

SuperNode support the consideration of various storage technologies from 8 hours duration, 100 hours duration, hydro and vehicle to grid.

There could be more detail provided on the breakdown of storage technologies across the scenarios and the assumptions behind them.

13. Is there any aspect of electricity generation that you disagree with, or any aspect that you believe we have not considered, or any further aspect that you would like us to include in the final publication? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

As mentioned in Question 5 the consideration of the relative cost of each scenario is absent. There would have been different marginal cost for electricity generation for each technology across the scenarios. This would have been relevant information and added significant value to the report.

14. Do you agree with our overall approach to modelling decarbonisation for a net zero power system? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here

We would like to better understand the modelling approach for dispatch down (figure 6.5) and for hours of demand where wind and solar were supported by other sources (figure 6.6).

Figure 6.5: The dispatch down figures are very high. Is it correct that this does not include any curtailment or constraints? What assumptions are made on import and export? Is optimal interconnection assumed?

Figure 6.6: Why are energy storage, and interconnection classified as other sources in the same bracket as thermal capacity. Storage and interconnection are key elements of a decarbonised energy system and do not emit carbon. It would be more meaningful for this model to show how reliant the scenarios are on thermal capacity alone.

15. **Do you think the pathways presented for emissions reduction are credible? (Yes, No, Unsure) Please provide further feedback and details on the reasons for your choice here**

As mentioned in Question 2, the timelines for achieving a net zero power system do not align with the Climate Action Plan 2023 which targets 2035.

Other

16. **Is there any other information not referred to above that you would like us to provide in our final publication? Please provide further feedback and details on the reasons for your choice here**

As mentioned in Question 5 the relative cost of each scenario should be included in the final publication.

More details on how these scenarios will move forward would be valuable. What is the process of engagement with DECC and CRU for future decision making based on TES.

17. Have you any other comments on the consultation or on TES? Please provide further feedback and details on the reasons for your choice here

SuperNode would again like to commend EirGrid for the production of this report and appreciates the opportunity to respond. SuperNode is always open to participate in any further consultations or engagements with EirGrid