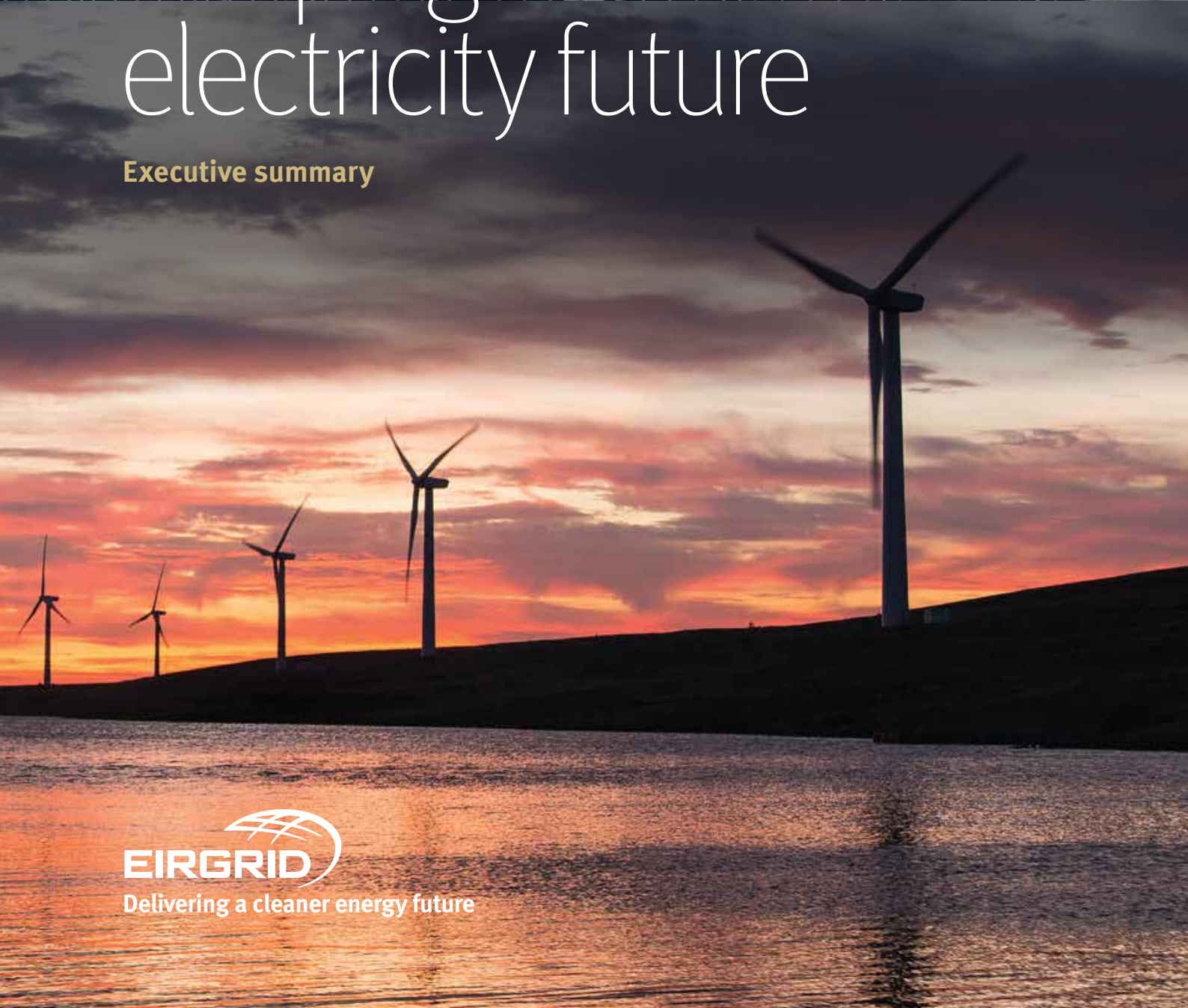




# Shaping our electricity future

**Executive summary**



Delivering a cleaner energy future





## Preface

In consultation with the Government, regulator, industry stakeholders and consumers, EirGrid will publish the inaugural *Shaping our electricity future roadmap* in Autumn 2021.

This is a watershed event both for our industry and for society and the economy in general. The proposed energy transition is a cornerstone of Ireland's response to climate breakdown.

The purpose of the roadmap is to advise and guide the Government, regulator, industry stakeholders and consumers on the optimal pathway to deliver our ultimate ambition for a renewables-based power system, while maintaining an affordable, secure, and reliable power system.

Crucially, the roadmap will help us to identify the key initiatives required to reach the next stage in this ambition, namely achieving 70% renewable energy by 2030.

This consultation report is a prequel to the roadmap and seeks to inform a consultation process with industry stakeholders. EirGrid is requesting feedback on all matters including, but not restricted to, planning scenarios, key drivers, risks and sensitivities. Feedback received from this consultation will help fine-tune the planning scenarios used to develop the final *Shaping our electricity future roadmap*.

The publication of this report triggers the start of a 10-year journey to address emissions in our industry and to support other sectors, such as heating and transport.

This will be the largest body of work that EirGrid has undertaken. The outcome will match rural electrification in terms of its long-term impact for consumers and society.

With the support of the Government and regulator, and in collaboration with our industry partners, stakeholders and consumers, we can build on the achievement of delivering an average of 40% renewable energy during 2020. This roadmap will enable the industry achieve the 70% renewable energy ambition by 2030.

Achieving this requires a whole of system approach – all areas of the electricity system, including electricity markets, network planning and system operations, need to be assessed as fit for purpose and enhanced where necessary.

We will listen and work hand-in-hand with the Government, regulator, industry stakeholders, and consumers to achieve the renewable ambition while maintaining a power system that is affordable, secure, reliable and sustainable.



Mark Foley  
Chief Executive Officer

# Shaping our electricity future

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# Executive summary

## Introduction

EirGrid Group operates and develops the electricity system in Ireland. Our 2020-25 strategy is shaped by climate change and the transition of the electricity sector to low-carbon, renewable energy. The context of climate change is well understood, and beyond scientific doubt. The only question now is how fast we as a society can respond to limit the damage, and so protect our planet for current and future generations.

The transition to low-carbon and renewable energy will have widespread consequences. There will be major changes in how electricity is generated, and in how it is bought and sold. There will also be major changes in how electricity is used, such as for transport and heat. The electricity system will carry more power than ever before and most of that power will be from renewable sources. Coal, peat and oil-based generation will be phased out in the next decade. These changes will need to be managed in a co-ordinated and cost-effective way.

The focus of the EirGrid five-year strategy is to work together, with stakeholders and our key partners, to transform the power system in Ireland and the wholesale electricity market to enable at least 70% of electricity supply from renewable sources (hereafter referred to as ‘the Renewable Ambition’) by 2030. Since the strategy launched, a 70% Renewable Energy Source – Electricity (RES-E) target has become a legal obligation for the state as part of Ireland’s National Energy and Climate Plan (NECP) 2021-2030, which is Ireland’s current contribution to the European Union’s Clean Energy Package.

Electricity can be generated from clean RES like wind and solar power. To achieve the Renewable Ambition, RES will increasingly replace fossil fuel-based sources of electricity such as gas, coal and oil. Electricity will also be used as a replacement energy source to support other industry sectors, such as transport and heating, to help them meet their emission reduction ambitions.

To prepare for this, the electricity grid must be made stronger and more flexible. It will need to carry more power, with most of it coming from clean, RES. This change will require investment in grid infrastructure such as upgrades to the existing network and construction of new, underground cables, pylons and substations.

The transition will be complex and therefore requires extensive stakeholder engagement as well as in-depth assessments of electricity markets, network infrastructure planning and delivery, and electricity system operations. These assessments will seek to identify what changes are needed to meet the Renewable Ambition, while maintaining a reliable electricity system and providing the most economical and deliverable solution.

Consumers are our key stakeholders and we must not lose sight of your requirements for a secure, reliable and economic supply of electricity. Delivering a cleaner, more efficient and secure electricity supply for consumers is at the very heart of this project. That’s why we are seeking your views and inputs as we formulate our plans to shape our electricity future together.

## Delivering the renewable ambition – A whole system approach

Our simulations and modelling to date, across four network approaches, together with detailed reviews of market operations and system operations, suggests that the Renewable Ambition can be delivered while maintaining the stability of the power grid at the highest levels of wind penetration in the world. The scale of the transition is challenging and the current approaches to network planning and delivery, electricity system operation and electricity markets needs to be overhauled if the Renewable Ambition is to be achieved.

Ireland is a world leader in RES integration. To achieve the Renewable Ambition, we must evolve our proven practices of system operation even further to allow operation at close to 100% System Non-Synchronous Penetration (SNSP) by 2030. Enhancements to current operational policies, electricity market rules, together with support from regulators and government bodies will be needed to allow us to bring online and operate the appropriate resources on the system in a timely and efficient manner.

Our networks analysis has identified key transmission network reinforcements in Ireland that will be required irrespective of the network development approach taken. These reinforcements will now need to be progressed appropriately through our grid development frameworks in order to achieve the Renewable Ambition. In addition, we will seek to maximise the use of existing power grid infrastructure, apply proven technologies, and optimise the delivery of RES and demand connections pipeline.

Across all three dimensions of transmission networks, system operations and electricity markets we will need to work closely with our colleagues in ESB Networks. We need to develop whole of system solutions to the challenges faced by the transmission and distribution networks.

## Consultation to shape the future

This consultation report sets out a range of credible approaches and options to meet the Renewable Ambition. We are asking for your feedback on what the optimal roadmap to achieve the Renewable Ambition should include. EirGrid are seeking the optimal network investments, electricity market reforms and changes to system operations that achieve the Renewable Ambition, while maintaining the reliability of the electricity supply and minimising the overall cost to the electricity consumer.

In particular, EirGrid would like your feedback on the analysis, data and findings of reviews performed on electricity markets, networks and system operations. We will use this feedback 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* outlining steps for optimal delivery of the Renewable Ambition. The target date for publishing the final roadmap is autumn 2021.

We want to hear from a diverse range of people, groups and industries from across the country. This is essential to the success of this initiative, which at its heart is about delivering a clean, affordable, efficient and secure electricity supply to consumers by 2030. This is ‘Our’ electricity future, your grid, your network, your power supply. Help us shape it and together we can deliver a transformed power system for future generations.



## Scope and objectives

The main objective of the *Shaping our electricity future* initiative is to outline an orderly transition to the Renewable Ambition over the next 10 years. In consultation with government, regulators and stakeholders we will use scenario-based analysis across the whole electricity system to identify an optimal roadmap to delivery of the Renewable Ambition in the most economical and reliable fashion.

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.

This analysis is on achieving at least 70% RES-E by 2030. However, the future evolution of the power system beyond 2030 is also implicitly considered in delivering the EU ambition to be carbon neutral by 2050, an ambition reflected in Ireland's Programme for Government.

### Whole system approach

The parameters for the *Shaping our electricity future* initiative are the key components of the electricity system. We have utilised our whole system perspective to deliver a comprehensive analysis. It considers not only the Renewable Ambition and the retirement of older, less efficient thermal generation, but also future network reinforcements, potential deployment of demand-side resources and catering for high-demand/low-renewable generation scenarios. It takes account of the interrelationship with other business sectors such as heating and transportation.

It identifies the interrelationships and importance of synergy between the transmission and distribution networks. It also considers existing technologies that are capable of improving the performance of installed assets but are not commonly deployed on the grid in Ireland. It incorporates expansion of onshore and offshore wind, solar PV, energy storage technologies, HVDC interconnection and system services. It ensures the physical limitations and constraints of the electricity transmission and distribution grids are accurately represented, along with the technical limitations of the power system.

The challenges associated with operating the all-island system are explored, including the required changes to operational policies and tools, and the new technical capabilities required to maintain a stable and reliable power system with very high penetration of variable RES. Electricity markets are reviewed in the context of the Renewable Ambition with a focus on total market costs associated with reforms to one or many market components including energy, capacity, tariffs and system services.

The power system is complex and includes generation that provides both energy and system services; transmission infrastructure for transporting electricity at high voltages over long distances; distribution infrastructure that connects industrial, commercial and residential premises; wholesale electricity markets that are integrated with Europe; active energy citizen participation; and associated regulatory and policy components.

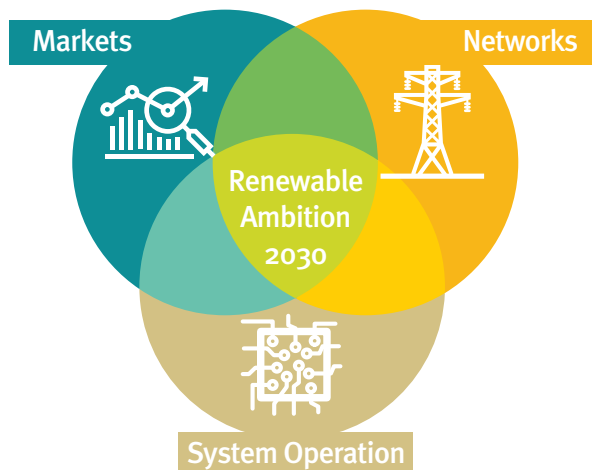


Figure 1: Three work streams



To best achieve the Renewable Ambition, the *Shaping our electricity future* initiative is considering the overall impact on these interrelated components to propose an economically viable plan that maintains the reliability of the power system in the long-term interests of consumers. To inform this consultation, we have conducted detailed reviews of current market operations, system operations and network infrastructure. The scope, methodologies and key insights of these reviews are included in the body of this report.

The insights from the reviews together with the feedback from this consultation will serve as inputs to the final *Shaping our electricity future roadmap*.

The roadmap reflects EirGrid’s duty to identify actionable reinforcements to economically meet the Renewable Ambition as well as the broader obligation of informing market participants, investors, policy decision makers and consumers of investment opportunities and proposed market and operational changes.

The *Shaping our electricity future roadmap* will identify investment opportunities, market reforms, and enhancements to operational procedures that can minimise total resource costs, and highlight those targeted transmission investments needed to meet the Renewable Ambition. The process followed in support of our reviews of transmission networks, system operations and electricity markets shown in Figure 2.

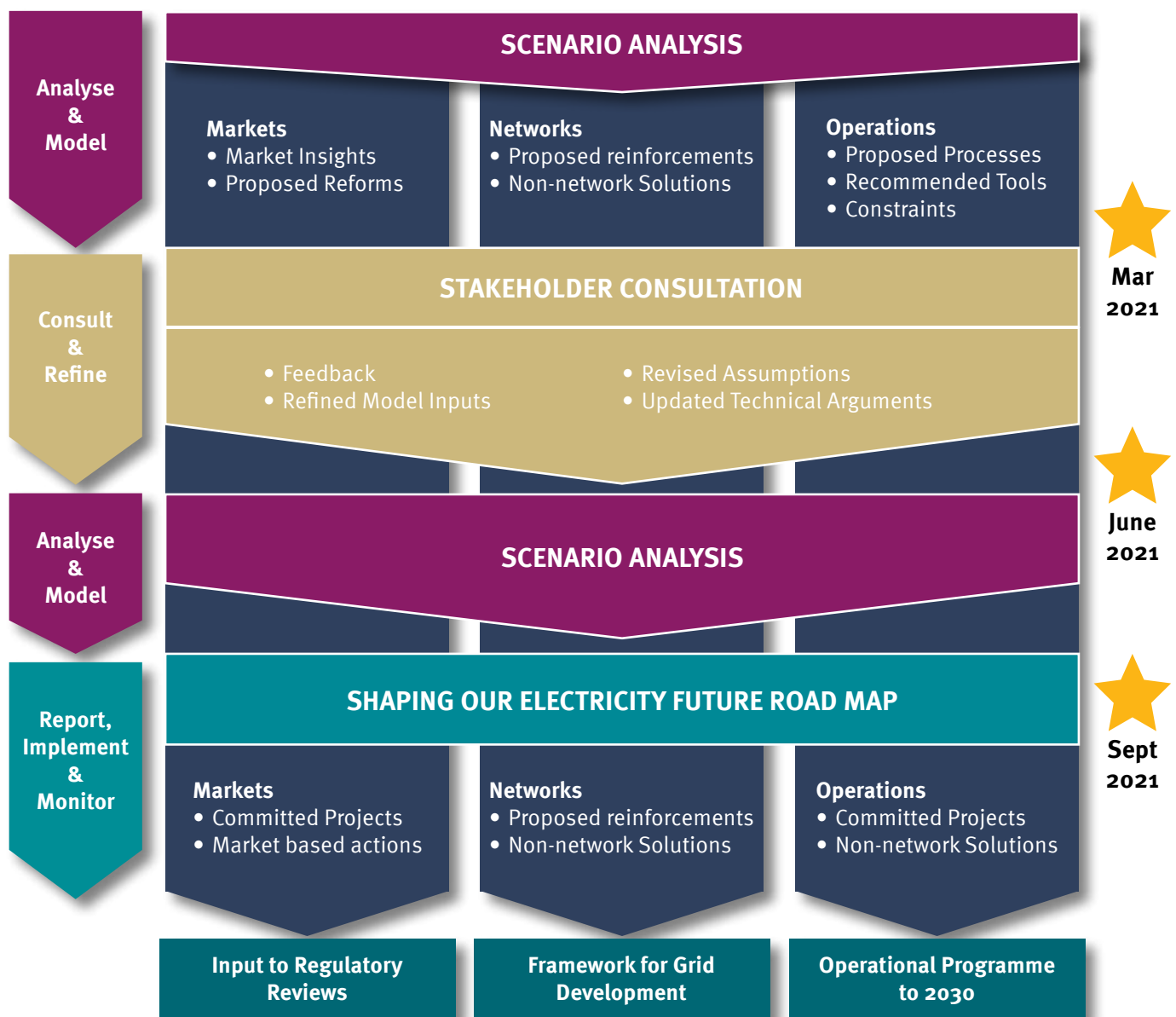


Figure 2: Shaping our electricity future process



## Transmission network review

Four separate approaches have been developed to assess how the electricity transmission network in Ireland could be developed to support the projected changes in electricity demand, generation and interconnection by 2030. These approaches describe the reinforcements needed to integrate the volume of new RES while managing demand growth in a reliable manner. The four approaches are:

- Generation-Led approach,
- Developer-Led approach,
- Technology-Led approach, and
- Demand-Led approach.

A key principle applied in each approach is minimising the need for investment in new network infrastructure. Each of the approaches, however, is characterised by a large number of network reinforcements that are necessary to meet the Renewable Ambition. By comparing the scale and quantities of transmission reinforcements required under each approach, it is possible to identify reinforcements common to all approaches and to consider what the optimal network development approach to meeting the Renewable Ambition could be. The four approaches described are not mutually exclusive and so it is likely that the optimal network development approach may be a blend of these.

## System operations review

EirGrid's *Delivering a Secure Sustainable Electricity System (DS3)* Programme has enabled the operation of the all-island power system at world-leading levels of SNSP.

The SNSP metric is a useful indicator for the capability to operate the power system safely, securely and efficiently with high levels of variable non-synchronous RES. SNSP is a real-time measure of the percentage of generation that comes from non-synchronous sources, such as wind and solar generation, relative to the system demand.

Over the course of the last decade the allowable SNSP level has been increased from 50% to 65%. In January 2021, the allowable SNSP level was further increased to 70% on a trial basis. A further trial at 75% allowable SNSP is planned for later this year.

To deliver on the 2030 Renewable Ambition, it will be necessary to accommodate even higher penetrations of variable non-synchronous RES such as offshore wind, onshore wind, and solar, while keeping curtailment levels to a minimum and maintaining system reliability.

This change in generation mix introduces unique technical and operational challenges that will require an overhaul of the current tools and processes used to operate the power system. These challenges will be addressed through four pillars, with each pillar comprising several work streams.

The pillars are outlined below:

### **Standards and services**

The objective is to reform operational standards such as the Grid Code, as well as to evolve the commercial frameworks to recognise and value the required system services and introduce new services as required.

### **Operational policies and tools**

The goal is to continue to evolve our operational policies, practices, and tools to allow the ongoing safe, secure and reliable operation of the power system at higher SNSP levels.

### **Technology enablement**

The aim is to remove barriers to entry and facilitate the development and integration of new technologies and innovations on the power system.

### **TSO-DSO collaboration**

With so much of the future generation and system service providers expected to be connected to the distribution system, we will need to partner with the Distribution System Operator (DSO) to ensure that the needs of both distribution and transmission systems, and ultimately the needs of consumers, are met.

## **Electricity market review**

The current market construct is designed to facilitate trading of electricity and system services on the exchange and to provide investment signals to an industry with a predominantly fossil fuel generation fleet. The market review seeks to consider how best to evolve the market construct for energy, capacity, system services, RES supports, and tariffs to accommodate the high levels of RES penetration while maintaining power system reliability. The market review considers:

- Impact of Brexit,
- Redesign of future arrangements to align to the needs of up to 100% SNSP,
- Changes required to capacity market contracts to improve market discipline,
- Changes to capacity market modelling to address bias towards conventional plant,
- Design of RES support schemes,
- Management of potential oversupply issues, and
- Role of demand-side resources in providing system services.



# Shaping our electricity future roadmap

## Electricity future insights

The combined outputs of the transmission networks, system operations and electricity markets reviews provided the following insights:

**There is sufficient planned RES capacity to meet the Renewable Ambition.** As at the date of publication, the number of RES projects in the development pipeline suggests that there is more than sufficient capacity planned and at the various stages of development than is required to meet the Renewable Ambition. Analysis of the level of network investment required to support the different development approaches provides insight into the optimal, lowest-cost and deliverable network development approach.

**Additional network capacity must be built to achieve the Renewable Ambition.** For each of the different network approaches studied as part of this work, we have identified a significant number of required network reinforcements to support the delivery of the Renewable Ambition. Building network infrastructure is complex and can take many years to deliver from planning through to energisation.

**There were a number of common reinforcements in the networks approaches analysed.** In order to achieve the Renewable Ambition, they will need to be progressed through EirGrid's framework for grid development. The network analysis for *Shaping our electricity future* is strategic in nature – each project need will be assessed in detail on an individual basis to determine the optimum path forward. At the heart of the grid development framework is engagement with industry, statutory bodies and the public. This process will commence in parallel with this consultation.

**Maximising the use of the existing power grid is key to delivering the Renewable Ambition.**

Optimising the use of the current infrastructure can help limit the scale and quantity of network reinforcements needed to achieve the Renewable Ambition. Using technologies such as active power flow controllers can help manage network congestion and maximise existing network capacities. This approach also assists in mitigating challenges associated with building new overhead lines or underground cables such as societal acceptance and prolonged outages of key infrastructure.

**The scale of network reinforcement is sensitive to the location of new renewable resource.**

Connecting large amounts of remote RES will require increased investment in network infrastructure to transfer RES to load centres. This will increase the number of network reinforcements needed to meet the Renewable Ambition. Connecting offshore wind generation close to major load centres minimises the network reinforcements needed to achieve the Renewable Ambition.

**Continued connection of large energy users in congested areas of the network in Ireland presents challenges for delivery of the Renewable Ambition.**

The all-island total electricity requirement could increase by as much as 37% by 2030. Our studies show that by connecting new large energy users in less congested areas of the network, the scale and quantity of network reinforcements needed is reduced. This approach helps increase the output of RES by limiting dispatch down caused by network congestion.

**Operating the future power system with fewer conventional synchronous generators is technically challenging.**

The large-scale integration of variable non-synchronous RES as planned is unprecedented, and will pose several technical and operational challenges which will need to be managed to ensure the continued safe, secure and reliable operation of the power system.

**System services will play a key role in managing the resilience of the power system.** System services have been key to achieving 40% RES by 2020. New system service capabilities are required to address the technical and operational challenges arising from levels of instantaneous RES increasing to close to 100% by 2030. Service providers connected to the distribution network and partnerships between the TSO and DSO are required to help release the full potential of demand-side flexibility to the electricity consumer. A demand-side management strategy is required to increase the participation of demand-side resources in energy, capacity and system services markets.

**In the short to medium-term, the system adequacy position in Ireland is going to be very challenging.** This is driven by generation capacity exiting the market (approx. 20% of portfolio) and demand increasing. A number of factors over the last 12 months have also exacerbated the adequacy position. Over and above the recent capacity auction, significant amounts of new capacity are going to be required between now and winter 2023 and winter 2024 to ensure that we have sufficient capacity to meet our demand.

**New clean dispatchable generation is required to meet demand in situations where RES is not available.** Gas-fired generation is expected to play a key role here, replacing retiring conventional plant and providing the multi-day capacity required to ensure security of supply during periods of high demand, low wind and low solar. The market design needs to attract this clean dispatchable generation. Consideration should be given to making any new gas-fired generation green hydrogen ready.

**Markets need to be more aligned to the long-term RES policy objectives of Ireland and Northern Ireland.** This is critical for ensuring investments by third party developers are appropriately targeted to solve the resultant all-island system challenges at an affordable cost to the consumer. This must be done whilst implementing evolving UK and EU policy.

## Networks stream

### Four potential approaches

Reflecting the range of potential futures, four approaches were examined as part of the networks stream.

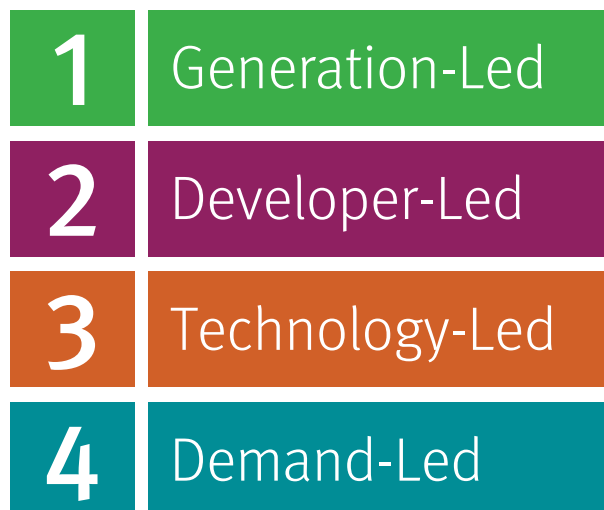


Figure 3:  
Network development approaches

It is our expectation, pending feedback from the consultation, that the final approach will be a blend of these four approaches. They are summarised in Table 1.

Table 1: Descriptions of network development approaches

Approach	Description	Likely Outcomes
<b>Generation-Led</b>	<ul style="list-style-type: none"> <li>Government policy determines the location of new generation.</li> <li>Developers build new generation in these specific locations.</li> <li>Preferred locations will consider the strength of the existing grid and the local demand for electricity.</li> <li>Approx. 4.5 GW of offshore wind, &lt; 1 GW of onshore wind and solar.</li> </ul>	<ul style="list-style-type: none"> <li>Estimated to require approx. 38 grid reinforcements.</li> <li>Highlights the pros and cons of mandating the location of new generation consistent with the current topology of the power grid.</li> <li>Most likely to lead to more offshore wind generation close to major cities, with less need for new onshore RES.</li> </ul>
<b>Developer-Led</b>	<ul style="list-style-type: none"> <li>Continue to connect new RES in developer requested locations as done today.</li> <li>Expand existing network infrastructure to connect new resources to load centres.</li> <li>Approx. 1.8 GW of offshore wind, 4 GW of onshore wind and 2 GW of solar.</li> </ul>	<ul style="list-style-type: none"> <li>Estimated to require approx. 77 grid reinforcements.</li> <li>Based on assumed capability, new infrastructure cannot be delivered in time to meet Renewable Ambition in 2030.</li> <li>New resources will connect quicker than new infrastructure will be built, constraining RES.</li> </ul>
<b>Technology-Led</b>	<ul style="list-style-type: none"> <li>Utilise proven technologies not commonly deployed on power grids.</li> <li>Utilise radially connected underground cables to carry high-voltage direct current.</li> <li>Utilises smart devices (an emerging sector of the electricity industry) to optimise flow through existing networks.</li> <li>Approx. 1.8 GW of offshore wind, 4 GW of onshore wind and 2 GW of solar.</li> </ul>	<ul style="list-style-type: none"> <li>Estimated to require approx. 46 grid reinforcements.</li> <li>Moves clean electricity from west to east in bulk, not integrated into wider transmission network.</li> <li>High-voltage underground cables are expensive, complex and therefore not often used in national power grids.</li> <li>Active power flow control technologies will improve the flow and limits on existing infrastructure.</li> </ul>
<b>Demand-Led</b>	<ul style="list-style-type: none"> <li>Government policy determines the location of new large energy users in Ireland.</li> <li>Approx. 1.8 GW of offshore wind, 4 GW of onshore wind and 2 GW of solar.</li> </ul>	<ul style="list-style-type: none"> <li>Estimated to require up to 41 grid reinforcements.</li> <li>Large energy users are located close to RES.</li> <li>May lead to more onshore RES on the west coast – less need for new offshore RES.</li> </ul>

This analysis identifies the number of grid reinforcements for each approach on a project component basis. A number of these project components will naturally aggregate into one project – for example a new station and two new transformers in that station would be progressed as one project.

## Common reinforcements

The analysis based on the four approaches identifies a number of reinforcements that are common to all approaches.

Each of these reinforcements will now be assessed in significantly more detail on an individual basis using the framework for grid development process. At the heart of these frameworks is engagement with industry, statutory bodies and the public. A summary of the common reinforcements is provided in Table 2.

Table 2: Summary of common reinforcements

Reinforcement type	Count
Upgrading of Existing Circuits	8
Upvoltage Existing Circuits	2
New Circuits	0
New Substation Equipment	4
<b>Total</b>	<b>14</b>





# 1

## Generation-Led approach

Under the Generation-Led approach, government policy may determine the optimal location for new RES. The high-level methodology is to assess the new RES pipeline and assign a higher priority to resources close to the major load or growth centres. The objective is to minimise the need to invest in new transmission infrastructure. The Generation-Led approach supports Ireland in achieving the Renewable Ambition. The effect of this approach is that less onshore generation is required to achieve the Renewable Ambition by 2030.

The Generation-Led approach assumes that the offshore pipeline delivers along policy objectives (approx. 4.5 GW) with the need for less than 1 GW of additional onshore renewable generation (wind and solar).

Based on this generation mix, it is estimated that 24 reinforcements, in addition to the common reinforcements, will be required to meet the Renewable Ambition.

A breakdown of reinforcements required under the Generation-Led approach is provided in Table 3.

Table 3: Reinforcements required in the Generation-Led approach by type

Reinforcement type	Count
Upgrading of Existing Circuits	22
Upvoltage Existing Circuits	2
New Circuits	5
New Substation Equipment	9
<b>Total</b>	<b>38</b>
Percentage of Total that are Common Reinforcements	37%

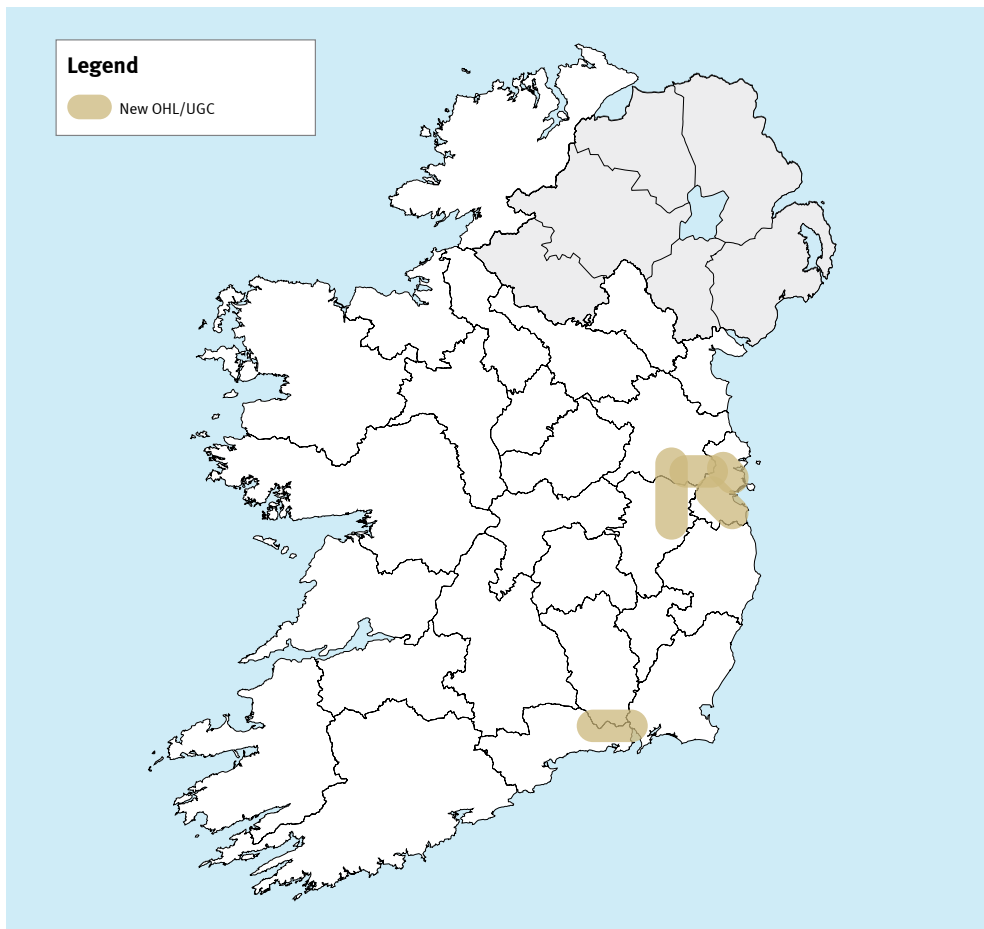


Figure 4: Additional circuits required for the Generation-Led approach

# 2

## Developer-Led approach

The Developer-Led approach, utilises a status quo type scenario where new RES are connected to the power grid in the locations proposed by the developers. The high-level methodology assumes that developers can locate anywhere on the power grid and network reinforcements will be built to accommodate bringing the electricity to the load centres. The objective is to allow the market to incentivise new RES and augment the power grid as needed to optimise the power flows. This is consistent with current grid connection procedures where typically smaller volumes of capacity are added to the system over a ten-year horizon. Implicit in this approach is that offshore wind connections are delayed (only approx. 1.8 GW materialise by 2030) and there is an increased dependency on onshore wind and solar.

The Developer-Led approach forecasts the need for 1.8GW of new offshore wind resources, 2GW of Solar Photovoltaic (PV) and 4GW of new onshore wind resources.

Based on this generation mix, it is estimated that 63 reinforcements, in addition to the common reinforcements, will be required to meet the Renewable Ambition.

This quantum of reinforcements cannot be delivered in a decade and the Developer-Led approach on its own will not deliver the Renewable Ambition by 2030.

A breakdown of reinforcements required under the Developer-Led approach is provided in Table 4.

Table 4: Reinforcements required in the Developer-Led approach by type

Reinforcement type	Count
Upgrading of Existing Circuits	52
Upvoltage Existing Circuits	2
New Circuits	7
New Substation Equipment	16
<b>Total</b>	<b>77</b>
Percentage of Total that are Common Reinforcements	18%

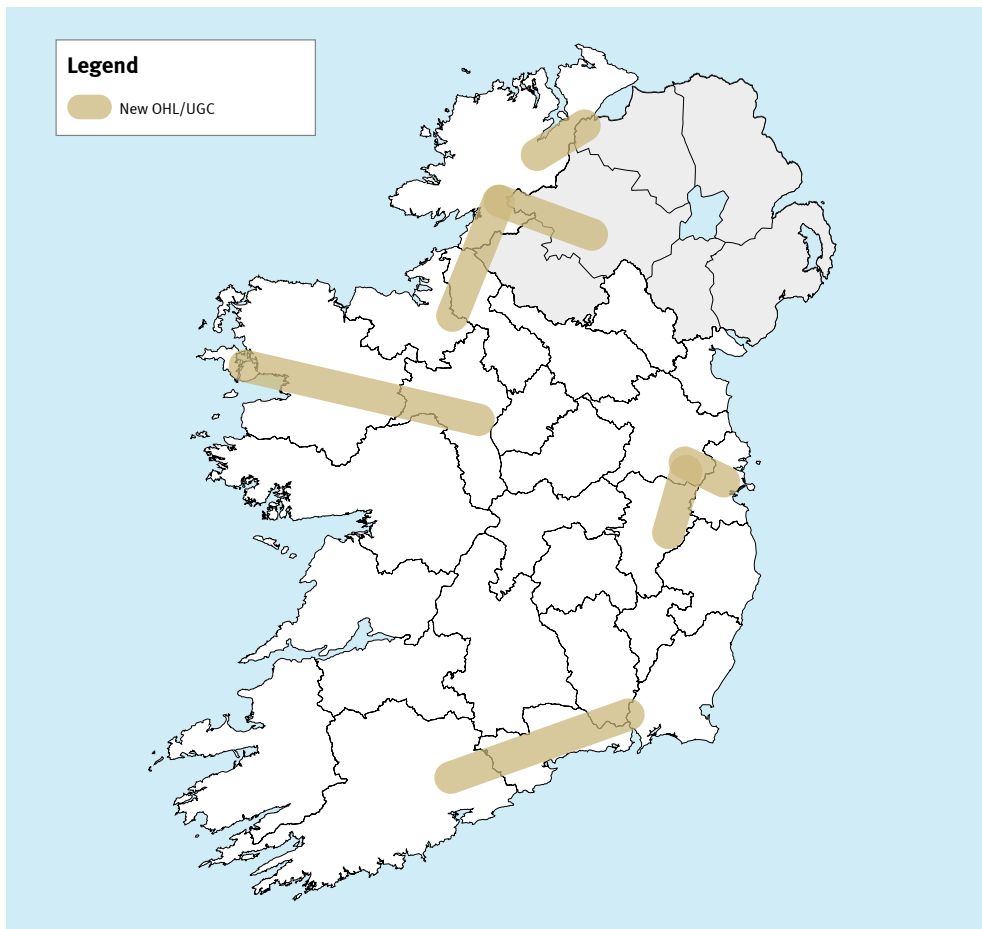


Figure 5: Additional circuits required for the Developer-Led approach

# 3

## Technology-Led approach

The Technology-Led approach, seeks to utilise proven technologies that are not commonly deployed on the power grid. The goal is to assess their feasibility in contributing to the Renewable Ambition by 2030 in a cost-effective and reliable manner. The generation portfolio is per the Developer-Led approach, i.e. offshore wind connections are delayed (only approx. 1.8 GW materialise by 2030) and there is an increased dependency on onshore wind and solar. The high-level methodology is to assume the utilisation of underground high-voltage direct current (HVDC) cables and active power flow control technologies. The objective is to install these technologies to move clean electricity from the west to the east, while minimising disruption to the existing power grid. The HVDC links are designed to evacuate renewable generation from remote parts of the grid to the major urban centres. They are “non-embedded” within the AC grid, which means that if there is a contingency on a HVDC link the sources of power are tripped/run back instead of this being transferred to other nearby circuits on the wider meshed AC grid.

The disadvantage of underground HVDC projects is they tend to be expensive and complex to implement.

The Technology-Led approach forecasts the need for 1.8GW of new offshore wind resources, 2.5GW of Solar Photovoltaic (PV) and 4GW of new onshore wind resources.

Based on this generation mix, it is estimated that 32 reinforcements, in addition to the common reinforcements, will be required to meet the Renewable Ambition. A breakdown of reinforcements required under the Technology-Led approach is provided in Table 5.

Table 5: Reinforcements required in the Technology-Led approach by type

Reinforcement type	Count
Upgrading of Existing Circuits	30
Upvoltage Existing Circuits	4
New Circuits	4
New Substation Equipment	8
<b>Total</b>	<b>46</b>
Percentage of Total that are Common Reinforcements	30%

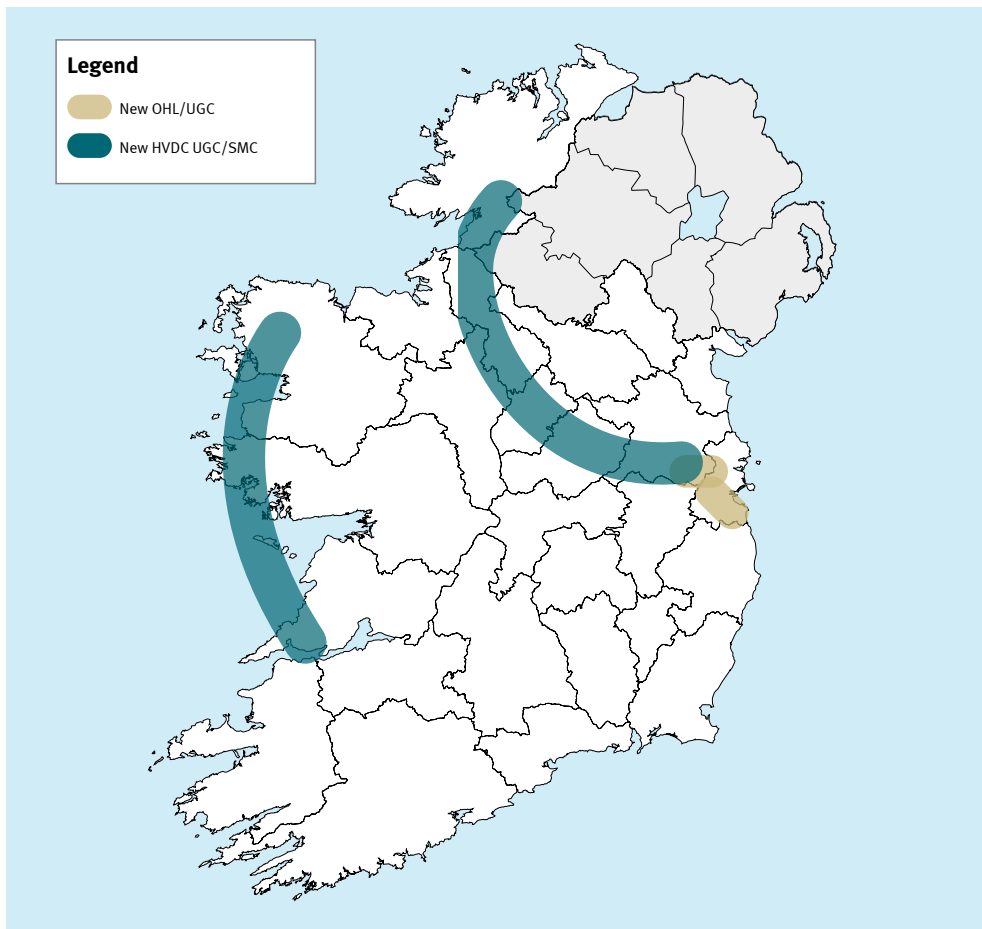


Figure 6: Additional circuits required for the Technology-Led approach

# 4

## Demand-Led approach

Under the Demand-Led approach, government policy may determine the optimal location for new large-scale loads in Ireland. Reflecting the fact there is a large pipeline of new large energy user projects in the Dublin area, the Demand-Led approach looks at moving demand to other regions of Ireland. The generation portfolio is per the Developer-Led approach, i.e. offshore wind connections are delayed (only approx. 1.8 GW materialise by 2030) and there is an increased dependency on onshore wind and solar.

The objective is to minimise the need to invest in new transmission infrastructure by moving planned large-scale loads away from load centres, so they are closer to sources of clean, RES in the west and south. The consequence of this approach is that less offshore generation and more onshore resources on the west coast is required to achieve the Renewable Ambition by 2030.

The Demand-Led approach forecasts the need for 1.8GW of new offshore wind resources, 2GW of Solar Photovoltaic (PV) and 4GW of new onshore wind resources.

Based on this generation mix, it is estimated that 27 reinforcements, in addition to the common reinforcements, will be required to meet the Renewable Ambition. A breakdown of reinforcements required under the Demand-Led approach is provided in Table 6.

Table 6: Reinforcements required in the Demand-Led approach by type

Reinforcement type	Count
Upgrading of Existing Circuits	29
Upvoltage Existing Circuits	2
New Circuits	4
New Substation Equipment	6
<b>Total</b>	<b>41</b>
Percentage of Total that are Common Reinforcements	34%

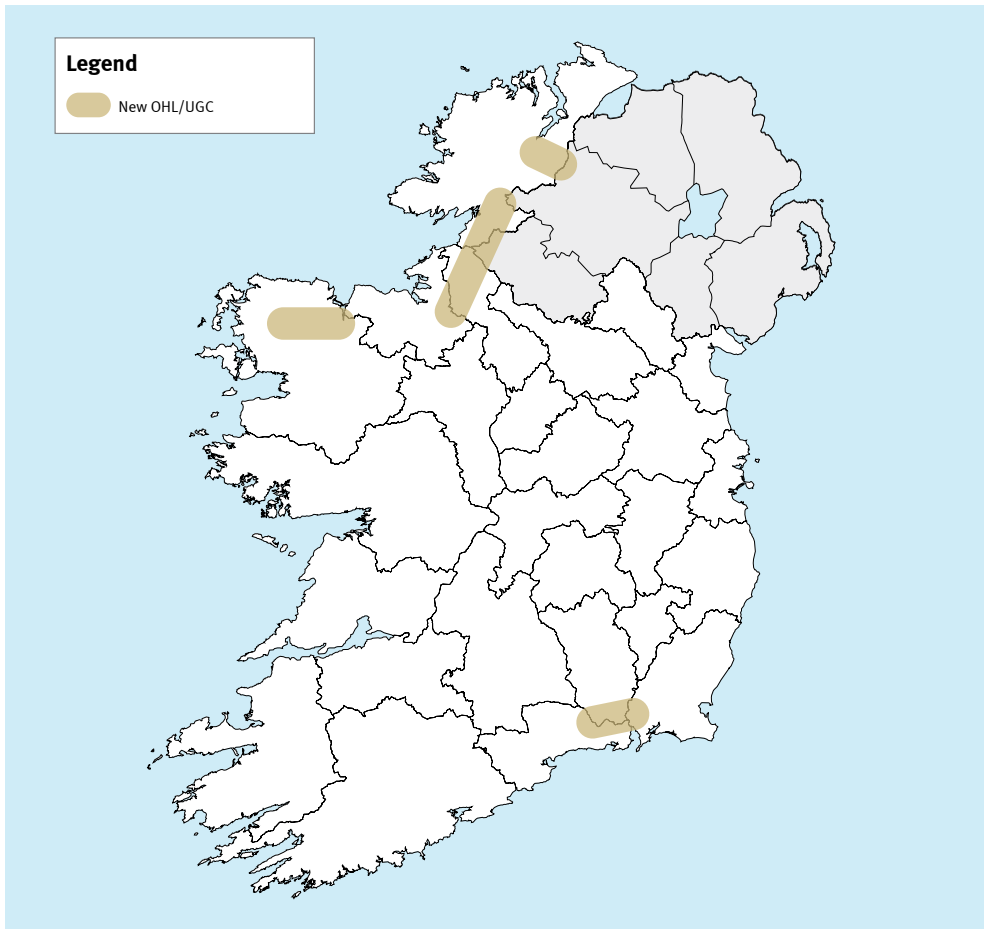


Figure 7: Additional circuits required for the Demand-Led approach

## Operations stream

In order to deliver the Renewable Ambition, it will be necessary to accommodate unprecedented levels of RES on the power system in real time whilst maintaining security of supply. This will require a significant evolution of power system operations, and for EirGrid to deal with unique challenges that will not be faced in larger power systems for years to come.

By 2030, we are planning to operate at SNSP levels up to 95%; to have a reduced inertia floor; to have implemented a secure Rate of Change of Frequency (RoCoF) limit of 1Hz/s (an operational trial is currently underway); and to have a significantly reduced minimum number of large synchronous units requirement (the current requirement is to keep eight large conventional synchronous units synchronised across the island).

These operational changes will facilitate reductions in the minimum level of conventional synchronous generation required on the system. Operating the future power system with fewer synchronous generation units relative to today, allied to the large-scale integration of variable non-synchronous RES, will pose several technical and operational challenges, the scale of which have not been experienced by other power systems to date.

These technical challenges will drive the need to significantly enhance our system operational capability. Our review findings reinforce the need for an all-island programme of work to enhance our system operations capability out to 2030. There are four key pillars underpinning the Operational Pathways to 2030 Programme:

- Standards and services,
- Operational policies and tools,
- Technology enablement, and
- TSO-DSO.

This essential work will keep power flowing will while we develop our electricity future and the key milestones within it will be delivered in support of the Renewable Ambition.



Figure 8: Operational pathways to 2030

## Markets stream

We consider that well-functioning markets are going to be critical to achieving the Renewable Ambition and doing so at a reasonable cost to the consumer. In principle, the financial mechanisms which bring forward the generation and demand reduction resources that will be necessary to meet the Renewable Ambition do not directly matter. In practice, the way that such resources are primarily made available today is through a series of market mechanisms – the energy and capacity markets and well-designed auctions for the provision of various system services. In general, these market mechanisms are considered to be more desirable than other alternatives, such as centrally planned solutions, as market mechanisms can provide greater diversity, facilitate innovation and allow industry and market dynamics to select the most cost-efficient outcome.



However, where market design does not align with operational requirements this can lead to market outcomes not matching actual requirements and increased TSO intervention to ensure security of supply at increased cost to the consumer. Our view is that the primary mechanisms by which the technical and operational challenges of the transition to the 2030 targets (and beyond) should be met is through the use of existing market mechanisms (energy, capacity and system services), acknowledging that there will need to be significant modifications to the market arrangements. We also consider that we need to ensure key enablers are reviewed and developed to ensure potential barriers to delivery of the market and operational changes required are removed.

Our review of electricity markets has identified critical enablers that we consider are key to delivering cohesive market design changes and ensuring alignment with operational requirements. The critical enablers are as follows:

- Flexible network approach leading to portfolio arrangements,
- Demand side, and
- Enhanced market systems and communication platforms.

Through consideration of the critical enablers we have developed a draft roadmap for electricity markets which reflects the actions needed to ensure that the required market design changes are implemented in support of the Renewable Ambition.

## Roadmaps

The results of our review of transmission networks, system operations and electricity markets provides an initial assessment of the actions needed to meet the Renewable Ambition by 2030 in a manner which achieves lowest cost for the electricity consumer whilst ensuring a safe, secure and reliable electricity transmission grid.

The draft roadmap outlines a number of network reinforcements, energy market enhancements and system operations milestones that are required to meet the Renewable Ambition. We are now seeking feedback on draft roadmap as part of the *Shaping our electricity future* consultation. Feedback received will be used to produce a final roadmap which we will publish in Autumn 2021.

EirGrid has launched a new consultation portal to make it easier for you to give your feedback. You can access the portal at: [consult.eirgrid.ie](https://consult.eirgrid.ie)

Here you can access more information about the project, fill out a survey or make a detailed submission.

## Guiding Principles

- 70 % electricity from renewable sources
- Customer centric - transparent engagement
- Economically meet the Renewable Ambition and maintain power system reliability
- Collaborative support from government and regulators is a key success factor
- Maximise the use of the existing grid
- New infrastructure investment is needed
- New clean conventional generation is needed
- TSO and DSO collaboration is a key success factor
- Considers beyond 2030 to 2050

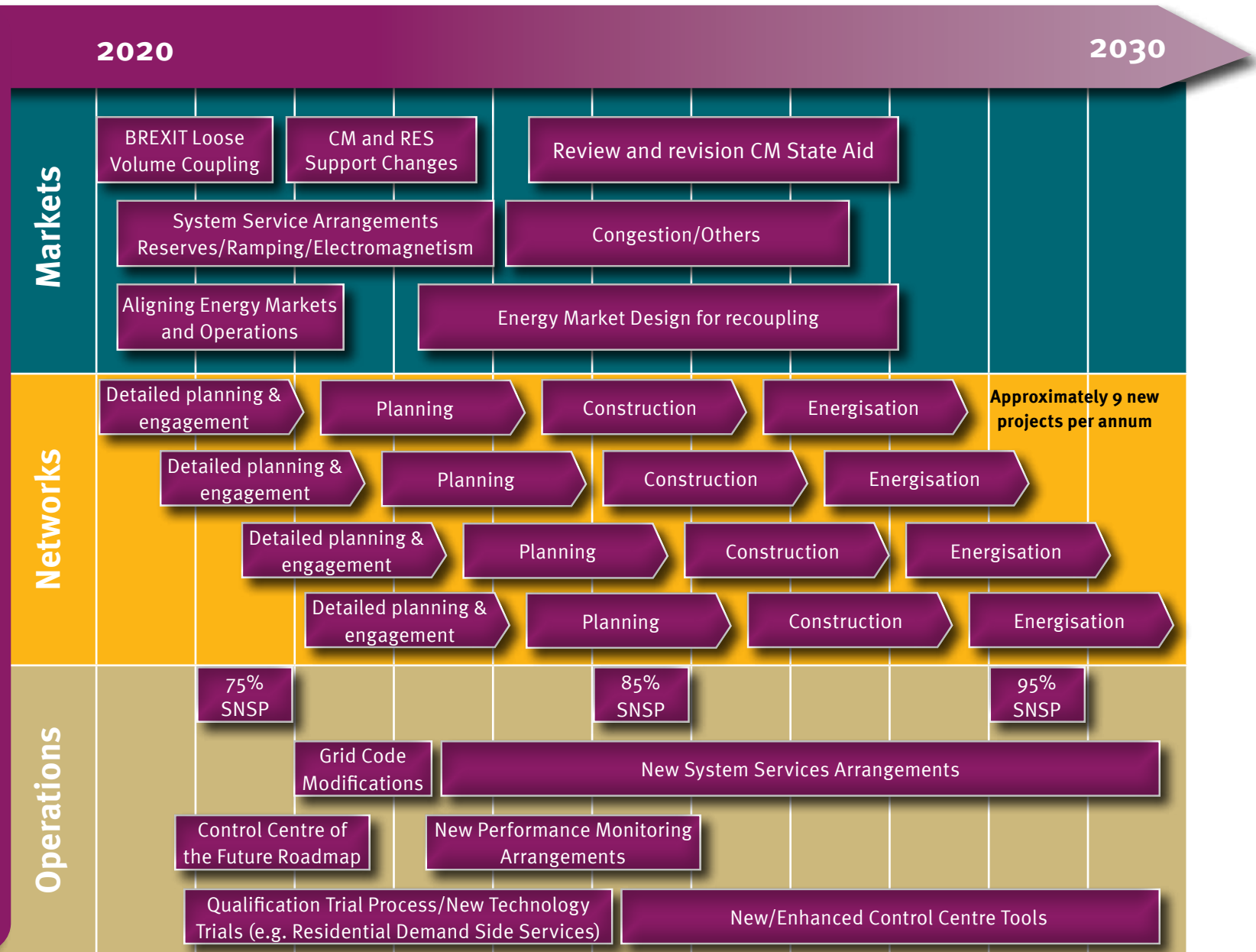


Figure 9: Draft roadmap to 2030







The Oval, 160 Shelbourne Road, Ballsbridge, Dublin D04 FW28 • Telephone: 01 677 1700 • [www.eirgrid.com](http://www.eirgrid.com)