

TSO PR5 RES-E

Multi-Year Plan

2022-2026

28 October 2021



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1. Introduction

The CRU/20/154¹ Decision Paper contains direction and guidance to EirGrid as the Transmission System Operator (TSO) on Incentives and Reporting arrangements for the Price Review 5 (PR5) period, 2021-2025. The objective of the Commission for Regulation of Utilities (CRU) PR5 reporting and incentives, as per the Executive Summary of CRU/20/154, is to ensure that network companies are focused on delivering better outcomes for customers; using innovation to deliver services more efficiently; and meeting key national strategic objectives.

Section 7.2 of CRU/20/154 introduces a new incentive for RES-E, targeting an increase in RES-E to 55% by 2025. The incentive has been developed in response to the unique challenges of managing renewable electricity on the transmission system. This form of energy is generated far from where it's needed, comes from variable sources and has a different frequency to the rest of the power on the grid; thus, presenting a number of challenges for the TSO's National Control Centre (NCC). As outlined in CRU/20/154, the changes to Ireland's electricity mix shows that the TSO has been moving in the right direction in recent years, culminating in renewable generation accounting for 43% of electricity consumption in 2020.

To achieve 70% RES-E by 2030, the electricity system on the island could need up to an additional 8,400 MW of renewable generation by 2030. The exact value of additional generation will be dependent on factors such as demand growth, dispatch-down mitigation measures and the overall generation mix (including the increase in levels of storage on the system). It is currently expected that the significant growth in electricity from Renewable Energy Schemes (RES) will derive from offshore and onshore wind, solar and new technologies. This large growth of these technology types will be coupled with the phasing out of coal, oil and peat.

In that context, the CRU has set out ambitious annual RES-E targets detailed in the table below.

PR5	2021	2022	2023	2024	2025
Target RES-E %	43%	46%	49%	52%	55%

Source – Table 14: RES-E PR5 Targets, CRU/20/154

The underlying objective of this RES-E incentive is to ensure that the TSO plays its part in increasing the portion of electricity coming from renewable sources to achieve a 3% increase each year. Over the duration of the PR5 period, the TSO will seek to implement measures that ultimately contribute to the achievement of 70% renewable electricity by 2030 and lay the foundation for achieving net zero carbon emissions by 2050.

¹ <https://www.cru.ie/wp-content/uploads/2020/12/CRU20154-PR5-Regulatory-Framework-Incentives-and-Reporting-1.pdf>

This document sets out the TSO's key workstreams for the period 2022-2024 designed to facilitate the penetration of renewables, with a specific focus on the changes required to ensure that operational policies and procedures align with the wider efforts to make the electricity grid stronger and more flexible. These workstreams will enable the NCC to effectively manage the challenges associated with facilitating a low carbon future in a way that does not adversely impact system security. At the request of the CRU, high-level plans for 2025 and 2026 are also included in Section 4 of this document. The targets for subsequent years will be confirmed as part of the rolling annual submission.

2. Summary of RES-E Incentive Workstreams

In general terms, the outputs detailed in Section 3 will see the TSO complete operational studies and analysis (including trials, where appropriate) before developing operational policies and procedures in areas that will be critical in facilitating the transition to 70% RES-E by 2030. These activities will ultimately enable the TSO to:

- Identify technical scarcities and operational needs.
- Develop operational protocols, policies and procedures for new Interconnectors.
- Facilitate the transition of key operational metrics including, but not limited to, SNSP, inertia and minimum number of sets.
- Operate the power system with new system services provision capabilities and the new operational systems and tools.

The following paragraphs explain how each of the workstreams will deliver the *Success Criteria* detailed in the previous section of this document.

1. SNSP Increase

With increasing level of installed non-synchronous generation capacity (such as wind and solar) and further interconnection to the all-island power system, it is necessary to measure and limit the System Non-Synchronous Penetration (SNSP) to ensure safe and prudent operation of the system. SNSP is a measure of the non-synchronous generation on the system at an instant in time. It is the ratio of the real-time MW contribution from non-synchronous generation and net high voltage direct current (HVDC) imports to demand plus net HVDC exports.

Based on the work carried out as part of the DS3 Programme, and further power system analysis, EirGrid's Operational Policy Review Committee (OPRC) will carry out a system trial whereby SNSP will be changed in controlled phases. At the end of each phase a review and assessment will be carried out before moving to the next phase. The results of each phase will inform future operational policy and ensure the power system continues to be operated in a

secure and safe manner. The associated detail, and any relevant updates, will be communicated in a timely manner via the TSO's website and in relevant industry fora hosted by the TSO.

2. RoCoF Limit Change

The Rate of Change of Frequency (RoCoF) relates to the amount of inertia (or kinetic energy) that is stored in the rotating masses of the synchronous machines connected to the power system. When the system inertia is high, the RoCoF following a system event is lower. Conversely, when the system inertia is low, the RoCoF following a system event is higher. An upper limit is set so that the RoCoF experienced following the loss of a generator is slow enough to permit time for frequency services to respond and contain system frequency and restore it to nominal. In addition, an upper limit on RoCoF is required to ensure that the RoCoF is tolerable for the protection settings on devices that are connected to the system. The more often the TSOs operate at or closer to the maximum limit of RoCoF the higher the renewables on the power systems.

The ongoing DS3 Programme operational trial of a reduced RoCoF limit is expected to be concluded in 2022; this will ultimately see the 1 Hz/s limit becoming enduring operational policy.

3. Operational Policy Roadmap to 2030

The accommodation of unprecedented penetrations of variable non-synchronous RES such as offshore wind, onshore wind, and solar, whilst keeping curtailment levels to a minimum, will require significant changes to the way in which the NCC manages the system. This encapsulates the way in which system services are utilised, the role of interconnection and, more broadly, challenges the TSO to facilitate the development and integration of new technologies and innovations on the power system to enable them to operate efficiently and effectively.

In Q2 2022, we intend to publish an "Operational Policy Roadmap to 2030" which will set out our plan for evolving operational policy across a range of key metrics. This roadmap will be reviewed and updated every two years. This will set out how operational policy and standards, along with operational tools, will be modified to reflect the new way in which the TSO will act as RES-E increases in Ireland.

4. Nodal Controller

The Nodal Controller is designed to take instructions from the TSO and to control the reactive power provided by participating distribution-connected wind farms based on their capabilities (subject to local constraints). The project is currently ongoing and represents the type of innovation and ambition that will be required to operate the future power system.

5. Reduce minimum number of large synchronous units

The minimum number of large synchronous units requirement needs to be reduced. However, if conventional generators can lower their minimum operating limits then the reduction in the number of units may not need to be as large. This flexible and agile approach will be crucial to the delivery of operational policy change over the next decade.

6. Reduce Inertia Floor

When reduced levels synchronous generation are running on a power system, such as on a system with increased levels of RES-E, low system inertia may require greater intervention from the system operator as frequency is more volatile when system inertia is low (which, in turn, occurs more often). Furthermore, insufficient reserve capability means that frequency varies more quickly in the case of power equilibrium incidents and is less manageable; alongside this, an increase in weather-dependent generation and associated forecast errors results in need to carry ramping capability.

Thus, the TSO is seeking to identify the optimal means of balancing these challenges whilst seeking to reduce the inertia floor, which will “free up” additional capacity for renewable generation on the network.

7. Greenlink Operational Procedures

The Greenlink interconnector is a proposed 500MW subsea link connecting the Single Electricity Market (SEM) and Great Britain (GB) transmission systems. Greenlink will deliver increased security of supply for electricity consumers, by diversifying energy sources and providing additional import and export capacity in both countries. Furthermore, it may enhance the integration of renewables in Ireland and GB supporting the growth of renewable sources of energy.

In order to take advantage of the opportunities presented by this interconnector, EirGrid will need to work extensively with the project developer and National Grid ESO as part of a comprehensive multi-year programme to design how the interconnector will operate in real-time.

8. Celtic Operational Procedures

The Celtic Interconnector, a joint project between EirGrid and RTE, the TSO in France, will deliver increased security of supply for electricity consumers, by diversifying energy sources and providing additional import and export capacity. The Celtic Interconnector will enhance the integration of renewables in Ireland by supporting the growth of renewable sources of energy

and will have strategic importance by increasing the interconnection capacity between Ireland and mainland Europe.

In the coming years, EirGrid will need to work extensively with RTE as part of a comprehensive multi-year programme to design how the interconnector will operate in real-time.

9. Enhanced Reporting of Renewable Statistics

EirGrid has committed to leveraging high quality, easily accessible data that is necessary to understand the rapidly evolving electricity industry, to improve business efficiency, to inform all short and long term decisions, and to generate business insights.

10. Detailed studies and analysis to support progress towards the 2030 targets

On-going multi-year horizon studies and analysis will need to be conducted to identify technical challenges and potential mitigations to achieve 2030 targets. Once completed, such studies will be reviewed for robustness every two years.

3. Incentive Deliverables/Actions

The following pages outline the deliverables of each TSO's ten workstreams which will be progressed and tracked as part of the RES-E multi-year plan. These workstreams reflect the efforts to be made by the TSO in supporting the achievement of the annual RES-E targets set by the CRU. Supplementary details on each of these ten workstreams can be found in Section 2 of this document.

It should be noted that, while EirGrid is committed to progressing these workstreams in accordance with the timelines detailed in this document, factors beyond EirGrid's control may impact on EirGrid's ability to meet these targets. In evaluating performance, recognising that not all factors affecting the achievement of the RES-E targets are within EirGrid's control, CRU/20/154 states that EirGrid's proposals should allow for the evaluation of areas within its control and not.

Workstream	Success Criteria	2022 Outputs	2023 Outputs	2024 Outputs
1. SNSP Increase	Safely and securely increase the instantaneous amount of renewable generation that can be accommodated on the power system to 85% by 2025. Across this timeline, the TSOs will gain more operational experience which feeds into policy reviews and updates. Hence the TSOs expect an incremental approach similar to the DS3 programme bringing benefits to end consumers with more renewables on the system being accommodated safely and securely.	Complete 75% SNSP trial and transition to enduring operational policy.	Further studies and analysis on technical issues and potential solutions. Improving operational standards, including Grid Codes and system services protocols.	Complete final studies and checks prior to the increase in the SNSP limit to 85%.
2. RoCoF Limit Change	Operate more frequently at, or just below, 1Hz/s (i.e. with minimal levels of conventional generation being required). For full transparency, the Operational Constraints Update will detail the RoCoF levels being adhered to.	Complete the 1 Hz/s RoCoF Trial and its transition to enduring operational policy.	N/A	N/A
3. Operational Policy Roadmap to 2030	Develop a holistic approach to system operation in the context of increased renewable penetration. Effective execution of this workstream will combine TSO expertise with industry	Following completion of key operational initiatives, including the SNSP and	Continually review the <i>Operational Policy Roadmap to</i>	Review and update the <i>Operational Policy Roadmap to</i>

Workstream	Success Criteria	2022 Outputs	2023 Outputs	2024 Outputs
	feedback on potential solutions, ultimately helping Ireland to meet renewable targets while maintaining system security.	RoCoF Trials, draft the <i>Operational Policy Roadmap to 2030</i> , setting out the plan for evolving operational policy in areas such as SNSP, minimum number of units, minimum inertia and reserve requirements. Publish, the <i>Operational Policy Roadmap to 2030</i>	2030 based on changes to operational practises and expected changes.	2030
4.Nodal Controller	Access system services from distribution connected wind farms, thus creating higher levels of system resilience.	Complete the on-going Nodal Controller Trial in Ireland and its transition to enduring operational policy.	N/A	N/A
5.Reduce minimum number of large synchronous units	Operate the power system with fewer conventional generators to accommodate large amounts of non-synchronous RES and keeping curtailment levels to a minimum.	Undertake suite of studies to identify the capabilities needed to reduce the minimum number of large synchronous units from 8 to 7. Develop interim operational policy for operation with a minimum of 7 large	Conduct operational trials with a minimum number of 7 large synchronous units.	Implement enduring operational policy for operation with a minimum of 7 large synchronous units.

Workstream	Success Criteria	2022 Outputs	2023 Outputs	2024 Outputs
		synchronous units.		
6.Reduce inertia floor	Obtain inertia from sources other than conventional generators, such as from synchronous condensers.	Undertake suite of studies to identify the capabilities needed to reduce inertia floor from 23,000 MWs to 20,000 MWs. Develop operational policy for operation with an inertia floor of 20,000 MWs.	Conduct operational trials of 20,000 MW inertia floor. Implement enduring operational policy for operation with an inertia floor of 20,000 MWs.	N/A
7.Greenlink Operating Procedures	Ensure that Greenlink's integration into the network is done in a way that facilitates renewable penetration in Ireland.	Agree key operating principles with Greenlink and National Grid ESO (e.g. ramping approach, TSO services provision).	Develop TSO-specific and joint detailed processes and operating procedures (Interconnector Operating Protocol) for Greenlink.	Finalise TSO-specific and joint detailed processes and operating procedures (Interconnector Operating Protocol) for Greenlink. Support commissioning of Greenlink interconnector.
8.Celtic Operating Procedures	Ensure that the development of the Celtic interconnector effectively facilitates renewable penetration in Ireland.	Develop RTE-EirGrid Joint Operating Agreement (JOA) for the Celtic Interconnector.	Develop TSO processes and procedures related to the operation of the Celtic Interconnector (e.g. ramping approach, inter-TSO service provision).	
9.Enhanced Reporting on renewables	The Data Strategy will support openness and transparency by default to build trust to customers and the public, meet	Implementation of new company wide data strategy	Establish the tools that will enable enhanced	Advanced Operational & Power Quality Analytics,

Workstream	Success Criteria	2022 Outputs	2023 Outputs	2024 Outputs
statistics	regulatory commitments and drive new business models and partnerships focused on decarbonisation. Reporting and data allow stakeholders to make informed decisions and/or challenges the TSOs decisions and approach which all helps.	that will establish tools, standards, policies and procedures in line with emerging technology.	Renewable Forecasting Analysis, Demand Forecasts, Performance Monitoring, Anomaly Detection, faster resolution of market queries etc.	Dynamic Network Model Management.
10. Detailed studies and analysis to support progress towards the 2030 targets	Ensure that system changes continue to be accurately reflected in TSO assumptions.	On-going multi-year: Conduct long horizon studies and analysis to identify technical challenges and potential mitigations to achieve 2030 targets. The studies completed will be reviewed for robustness every two years. Conduct short-term operational studies to ensure a secure transition with increasing levels of renewables as we transition to 2030.		

4. High-Level Plans 2025 – 2026

The high-level plans for 2025 and 2026 will be dependent on the outcome of the work undertaken in 2022 to 2024; hence, more detail on the proposed plans for these years will be provided in future years as part of the rolling annual submission.

It is expected, however, that work in these years may shift away from some of the workstreams currently detailed in this incentive and towards new challenges. These new challenges include:

- Developing operational policy for operation at 85% SNSP.
- Conducting an operational trial with a SNSP limit of 85%.
- Reviewing and implementing of operational policy changes related to the new North-South Tie-Line.

5. Interdependencies/Assumptions

By 2030, EirGrid hopes to be able to operate at SNSP levels up to 95%, to have a reduced Inertia Floor (reduction from the current floor of 23,000 MWs), to have implemented a secure RoCoF limit of 1Hz/s) 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). The purpose of evolving these, and other, operational metrics is to facilitate a reduction in the minimum level of conventional synchronous generation (in MW terms) required on the system. By reducing the minimum required level of conventional synchronous generation, increased levels of non-synchronous RES can be facilitated; operating the future power system with fewer synchronous 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.

In that context, the successful fulfilment of the RES-E annual targets set out by the CRU is heavily reliant on interdependencies and assumptions relating to the actions undertaken by stakeholders. Furthermore, in the specific context of operational trials, it should be noted that successful completion of a trial is contingent upon experiencing the necessary system conditions that will enable the TSO to conclude such a trial. It is assumed, for any deliverables which are reliant on a pilot, regulatory decision or statutory decision in advance, that the necessary pre-requisite or dependency has been successfully achieved in a timeframe allowing for any required subsequent action by EirGrid for their delivery.

6. Performance Assessment for 2022

EirGrid propose that the incentive should be split evenly across the ten initiatives with deliverables to be achieved in each calendar year. For each of the initiatives proposed above, the outcome is clear. In EirGrid's outturn performance report to CRU each year we will evidence how we have performed against the multi-year plan.

The potential allowed upside in each calendar year is €0.4 million. We propose that the allowed upside be calculated on a linear basis with the quantum of deliverables achieved per calendar year directly related in percentage terms to the allowed upside.

7. Next Steps

The consultation period will run for four weeks, beginning on 28 October 2021, and closing on 26 November 2021.

Stakeholders are invited to respond outlining their views on the proposed structure of and approach to the proposals in this RES-E multi-year plan.

Consultation responses are invited until COB on 26 November 2021 and can be sent to info@eirgrid.com

If you do not wish for your consultation response to be published post submission, please mark it as confidential. Please note that all responses will be shared with the CRU in any case.

8. Appendix – Acronyms

CRU	Commission for Regulation of Utilities
DS3	Delivering a Secure Sustainable Electricity System
DSO	Distribution System Operator
GB	Great Britain
HVDC	High Voltage Direct Current
JOA	Joint Operating Agreement
MW	Megawatts
NCC	National Control Centre
OPRC	Operation Policy Review Committee
PR5	Price Review 5
RES	Renewable Energy Schemes
RES-E	Electricity produced from Renewable Energy Sources
RESS	Renewable Electricity Support Scheme
RoCoF	Rate of Change of Frequency
SEM	Single Electricity Market
SNSP	System Non Synchronous Penetration
TCG	Transmission Constraint Group
TSO	Transmission System Operator