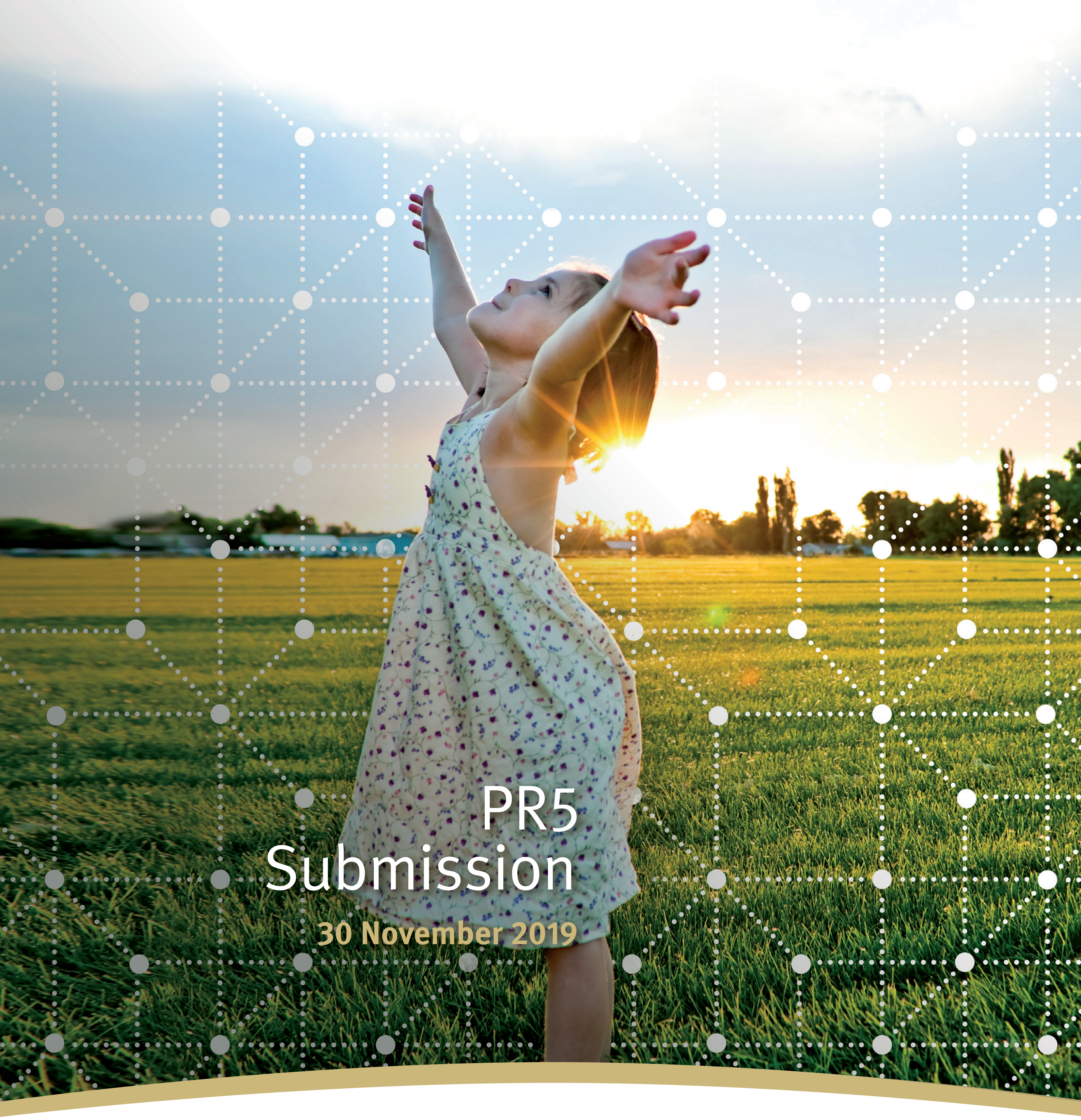

PR5 Submission

30 November 2019

EIRGRID

The current. The future.

EirGrid PR5 Submission

Executive Summary

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IMPORTANT NOTICE.

The contents contained in this paper represent a part of the information EirGrid has provided to the Commission for Regulation of Utilities (CRU) in advance of the CRU's public consultation for Price Review 5 (PR5). Given the confidential nature of some of the contents of the original EirGrid submission to the CRU, we have removed a number of aspects of our submission which we issued to the CRU on 30 November 2019. Detailed costings have been removed which could impact on the procurement of products and services by EirGrid on the behalf of electricity consumers, KPMG reports have been removed as we are bound to do so by our contract and cyber/physical security details have been removed due to security of supply reasons. Our submission seeks to leverage the benefits of a single integrated system operator to unlock benefits for all customers connected to the transmission system. Through this approach we can deliver cost savings to the Irish electricity customer. Many of the initiatives we are proposing are shared, this unlocks value through economies of scale and delivers cost savings to customers. These initiatives are outlined further in Part 3.

This document aims to provide electricity consumers and industry stakeholders with information as to EirGrid’s planned outputs as part of PR5. As part of this publication, we have included a range of output metrics and targets (Appendix S). This aims to ensure full transparency with regard to EirGrid’s performance throughout the PR5 period. The targets set out in Appendix S are conditional on the inputs being provided by the CRU as part of PR5. Without sufficient funding, EirGrid will not be capable of delivering the outputs. Given this, should the CRU reduce the inputs as requested by EirGrid, we reserve the right to recalibrate the metrics based on the level of funding.

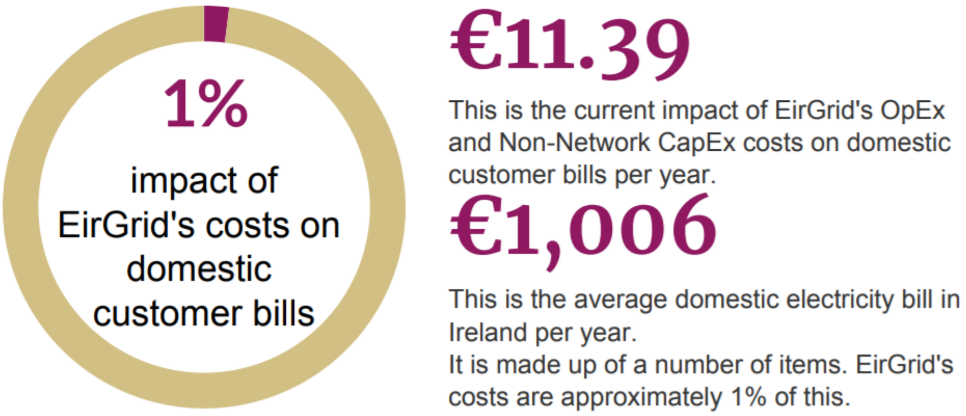
Our PR5 proposals as submitted to the CRU on 30 November 2019, aim to enhance the capability of EirGrid to deliver an improved quality of service to our customers and stakeholders. Our submission contains proposals outlining a range of new initiatives that we are proposing to deliver during PR5. We recognise, that these new initiatives will represent a small cost increase to the electricity customer, however in the context of forecast demand growth at the time of the original submission this actually resulted in a net decrease in costs to customers. These initiatives will enable the delivery of a better quality of service for all customers, providing EirGrid the resources required to operate the electricity system with unprecedented levels of intermittent renewable generation, and finally, a step change in the level of engagement EirGrid delivers to both direct customers but also members of communities that EirGrid interacts with.

Introduction

EirGrid operates, develops and maintains Ireland’s electricity transmission system.

This document sets out our business plan submission to the Commission for Regulation of Utilities, for the period from 1 January 2021 to 31 December 2025, also referred to as Price Review 5 (PR5). It also sets out at a high level our performance during the current price control period, 1 January 2016 to 31 December 2020, also referred to as Price Review 4 (PR4).

While our direct costs are approximately 1% of the typical domestic electricity bill, our actions and decisions positively influence a much larger proportion. Unlocking the value for customers in these areas is a key focus of our business plan.



€11.39

This is the current impact of EirGrid's OpEx and Non-Network CapEx costs on domestic customer bills per year.

€1,006

This is the average domestic electricity bill in Ireland per year.
It is made up of a number of items. EirGrid's costs are approximately 1% of this.

Figure 1. EirGrid Costs to Customers during PR4

This submission for PR5 has been developed against the backdrop of a strong and growing Irish economy. The expenditure proposals set out in this plan are designed to support that growth and to help ensure Ireland has a fit for purpose electricity infrastructure. Economic forecasters currently expect economic growth of 3.25[1]% per annum in the period 2020 - 2025. With increasing energy intensity and new large scale loads electricity demand is forecast to grow by 19% in the same period.

With prosperity comes a different set of challenges. Whilst EirGrid has delivered real cost savings and real reductions in input costs during PR4, we will see upward cost pressures in the PR5 period. The market for both skilled labour and Information Communication and Technology are particularly buoyant. These are key inputs to EirGrid’s business.

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[1] The ESRI estimates an annual average medium term growth rate of the economy at 3.25% in the period 2020 - 2025

The community and stakeholder environment in which we operate is also increasingly complex. We continue to invest in this important area to ensure that all voices are heard and that the projects we deliver do so taking into account stakeholder views.

This submission has been influenced and shaped by the objectives and vision set out by CRU in relation to this process on grid delivery, decarbonisation and local security of supply. In each instance these are underpinned by cost efficiency and a regulatory framework which supports the delivery of value to customers.

Grid Delivery

Our submission includes a 30%+ planned increase in grid delivery enabled through a programme of ongoing improvements in both project progression and community and stakeholder engagement

This is covered in detail in Chapter 4 and Appendix A.

Local Security of Supply

CRU have indicated that this is a key priority for PR5. EirGrid have therefore looked to prioritise a specific set of measures to help facilitate local security of supply, and Dublin in particular.

This is covered in Detail in Chapter 4 and Appendix B.

Decarbonisation

The Climate Action Plan sets an ambitious target for 70% of our electricity to come from renewable sources by 2030. Our proposed DS3+ programme is designed to connect almost 3 GW of renewable projects and deliver 95% SNSP.

This is covered in Detail in Chapter 4 and Appendix C.

Costs to Customers

We have carried out internal and external challenge of all the proposed initiatives building on real input cost efficiencies delivered by EirGrid in PR4.

This is covered in Detail in Chapter 5 and Appendix H.

Regulatory Framework

CRU requested us to make proposals to ensure our asset light framework allows us to deliver on the future transformation of the energy system. We have made a number of proposals to account for our unique position.

This is covered in Detail in Chapter 6.

Figure 2. CRU objectives and vision

The second influence has been the EirGrid strategy which was launched in September 2019. Our strategy was underpinned by extensive consultation with external stakeholders and this feedback has helped shaped what our stakeholders want and expect from us.

Figure 3. EirGrid Strategy

Our strategy will enable us to help Ireland manage the energy transition and deliver a power system fit for future generations. The regulatory framework, and the regulatory allowances provided by the CRU, are key enablers to support this transition and to ensure that the value EirGrid can deliver is unlocked for electricity consumers.

Key Achievements during PR4

There has been a significant change in the energy system during the PR4 period. By the end of this period we will have successfully enabled 40% of the electricity demand being met by renewable sources. This was in parallel with the delivering of the Integrated Single Electricity Market (I-SEM) which went live in 2018.

These changes have resulted in EirGrid managing a significant increase in volume and complexity of our day to day work, which was not envisaged during the time of the submission of the PR4 plan.

I-SEM

New market implemented whilst maintaining core activities. Three capacity auctions held to date, with the first held in December 2017.

DS3

World leading levels of System Non-Synchronous Penetration (SNSP) of 65% achieved. New System Services arrangements implemented.

Grid Delivery

At the end 2018, 17 new transmission stations, 62km of new transmission circuits, 101 km of refurbished transmission circuits and 242 km of uprated transmission circuits.

Renewable Electricity

This has increased from 27% in 2015 to 33% in 2018 to a forecast level of 40% in 2020, even in the context of significantly increasing demand.

Decarbonisation

The level of carbon produced from electricity generation has decreased 18% for the first 3 years of PR4 (464 tCO2/GWh to 379 tCO2/GWh). From 1990 to 2018 the reduction has been 57%.

Wind

Record breaking levels of wind connected over first three year. There was a 54% increase on the transmission and 46% increase on the distribution system.

Demand

This has increased by 8.8% during the first 3 years of PR4. This is mostly due to the increase in data centres. This creates additional workload for EirGrid across a number of areas.

Demand Side Units

The capacity of DSUs has increased from 240 MW in 2015 to 395 MW in 2018, with the total number of sites increasing from 201 to 417 over this period.

Resilience

System Security was maintained to a very high level during the current Price Control period. This is in the context of increased climate change activity and increased levels of variable generation.

Cost Savings

EirGrid delivered €33.5m in Imperfection Cost savings for the end consumer. This savings last for several years into the future.

Stakeholder Engagement

A step change in the level of engagement expected by members of the public and our stakeholders changed the way we carry out our engagement.

Dublin Security of Supply

Mitigation measures were implemented by EirGrid to main security of supply in the greater Dublin area due to significant and unprecedented growth in demand and the possible closures of generation stations.

Celtic Interconnector

Our partnership with RTÉ helped secure €534m in European funding for the new Celtic Interconnector. This project will increase security of supply for customers, and facilitate further competition in the market.

Facilitating Connections

Over the first 3 years we facilitated the connection of 251 MVA of new demand.We also issued 324 transmission offers. This is tracking towards an average yearly increase of 50% compared to PR3.

Incentives

EirGrid delivered against the new suite of incentives introduced by the CRU in 2018. EirGrid was awarded a score 7.14/10 by the National Stakeholder Engagement Evaluation Panel which related to areas of Quality, Implementation and Effectiveness.

Figure 4. Key PR4 Achievements for first 3 years

Financial Performance during PR4

The current regulatory framework incentivises EirGrid to operate within the allowances provided by CRU for the price control period as it bears 100% of any costs incurred over and above this.

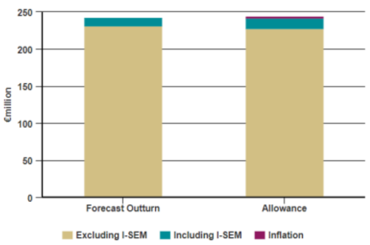
With the increased volume and complexity of the day to day work during the PR4 period EirGrid found it challenging to operate within the allowances provided by CRU. Our forecast outturn for PR4 is broadly in line with the operational allowances provided by CRU, but current expenditure is running above the allowances in the final years and cost pressure continue to increase going forward.

Even in the context of this challenge we have continued to deliver efficiencies to the benefit of customers throughout the control period. Many of these efficiencies were delivered through realising further synergies with SONI, the Transmission System Operator in Northern Ireland.

Both the transmission system and market are operated on an all island basis and with the changes in I-SEM are increasingly integrated. EirGrid bears only a proportion of the costs of delivery of all island initiatives, often as low as 50%. Customers in Ireland therefore benefit from significant economies of scale and see significantly lower costs than if EirGrid had to carry out these functions standalone.

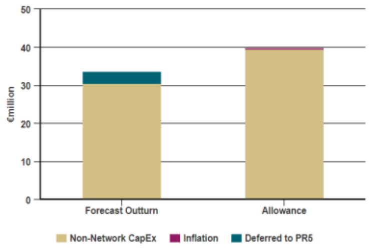
Even though our costs are a relatively modest part of the overall electricity bill, we can influence a significant portion of the overall bill. For example we have delivered in excess of €33.5m in Imperfection Cost savings during the first three years of the current price control period. Furthermore the introduction of the new Capacity Market has delivered substantial savings for Irish electricity consumers (€100m+).

OpEx



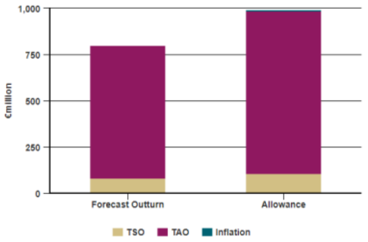
Forecast outturn of €242.8m against an adjusted allowance of €244.7m. Adjusted for I-SEM re-opener and inflation

Non-Network CapEx



Forecast outturn of €33.7m against an adjusted allowance of €39.6m. Adjusted for inflation. €3.2m deferred to PR5.

Network CapEx



Forecast outturn of €801m against an adjusted allowance of €993. Adjusted for inflation

New Initiatives for PR5

In this submission we set out the initiatives that we need to progress for a decarbonised energy system which is ready to meet the ambitious targets set out in the Climate Action Plan.

We also remain focused on our primary role to operate, develop and enhance the grid and market. This is essential if we are to ensure a safe, reliable and cost effective power system.

We understand the importance of keeping the impact on consumer bills to a minimum. We have therefore adopted a meticulous approach to challenging the new initiatives. This has involved extensive challenge at all levels of our organisation to ensure the right initiatives have been brought forward at the lowest possible costs for our customers. Furthermore we have retained KPMG as independent advisors to assist in this challenge process.

We are part of the wider EirGrid Group and therefore benefit from economies of scale as we share resources and undertake joint procurement initiatives with the Northern Ireland TSO. EirGrid contributes to the overall cost of new initiatives in line with the EirGrid Group Cost Allocation policy. This results in Irish consumers paying less for outcomes and outputs than would otherwise be the case. This is however dependent on such sharing of costs and activities on an all-island basis being permissible within the regulatory frameworks in both Ireland and Northern Ireland.

We have produced a submission to the CRU outlines a range of new initiatives for the PR5 period. These initiatives are interlinked and no one one single output or outcome can be effectively delivered in the absence of the complementary initiatives. These initiatives are linked to our new strategy and are summarised in the table below. They will deliver the following benefits:

Sustainability and Decarbonisation

- Establish effective processes and tools to operate a power system where the majority of the power comes from non-synchronous intermittent sources;
- Strengthen data and communications networks to secure better access to real-time data and the means to analyse it; and
- Promote more informed choices through an improved approach to investment appraisal and improved engagement with internal and external stakeholders.

Operate, Enhance and Develop the Grid and Market

- Deliver efficient, economic operation of the power grid for the benefit of all customers in Ireland and deliver value for money;
- Improve the resilience of the operation of the power system in Ireland;
- Secure the operation of the grid (in partnership with ESB Networks) in a manner, which is capable of addressing the latest physical and cyber security threats; and
- Meet the core remit of the TSO in a way which complies with changes to the regulatory and legal environment, adhering to emerging changes in industry standards and best practice.

Engage for Better Outcomes for All

- Continue to transform our engagement with customers, communities and the public, and build world class stakeholder relationships; and
- Improve the connection process for new and existing customers.

The total cost of these initiatives is less than €1.60 per year on the average annual domestic customer bill. This is however offset through reductions in costs elsewhere and growing overall energy demand. This will result in overall unit prices falling during the PR5 period.

Sustainability & Decarbonisation

75c

Impact to customer bills per year

No.	Initiative	Description
1	Renewable Strategy (DS3+)	This programme will ensure that the system can operate with world leading levels of renewables and new technologies.
2	Control Centre Tools	These tools will ensure that the system can operate with world leading levels of renewables and new technologies.
3	Smarter Outage Management	To manage the increased complexity of managing transmission outages.
4	Clean Energy Package	Initial funding to help scope requirements in this legislation.
5	Migration to IP Communications	To facilitate the increased volume of communications with decentralised sites.
6	Data Science	Initial funding to help scope requirements to manage increased volume of data.
7	System Planning	To manage the increased complexity associated with the new technologies and renewables.
8	Promoting Change	To build internal and external stakeholder trust.

Operate, Enhance & Develop the Grid and Market

60c

Impact to customer bills per year

No.	Initiative	Description
1	Enduring Access Planning	To manage the increased volume and complexity associated with new technologies and renewables.
2	Control Centre Training	Due to new systems and tools we need to keep pace in our training environments.
3	Physical Security	Investment is needed on the physical security of our sites.
4	Cyber Security	We need to keep pace with threats in this area.
5	European Network Codes	We need to manage increased obligations.
6	Capacity Market: Secondary Trading	To deliver on this functionality which was de-scoped for I-SEM go-live.
7	DSU Compliance with State Aid	This is required to ensure compliance with the EC state aid decision.
8	Capacity Market: Algorithm Change	This will help deliver savings for customers.
9	Capacity Market: State Aid Cross Border	To facilitate cross border participation.
10	Governance, Risk Management & Compliance	To manage increased requirements in this area.
11	Metering System	To ensure this can manage increased volume into the future.
12	Project Delivery Support	Skilled operational staff are required to support IT project delivery.
13	Electricity Balancing Guidelines	This refers to the resources required to apply the requirements of the Electricity Balancing Guidelines to current balancing practices.
14	Multi – NEMO Arrangements in the SEM	This will see the introduction of designated NEMOs into SEM.

Engage for Better Outcomes for All

24c

Impact to customer bills per year

No.	Initiative	Description
1	Education & Engagement Campaign	To increase our stakeholder engagement to help us shape an energy transition to benefit customers.
2	Customer Journey	To improve and streamline the connection process, from initial enquiry through to commissioning.
3	Framework for Development of the Grid	To continue to develop and improve the current framework, including increased engagement on the ground to support grid delivery.

Regulatory Framework

As part of this submission we have been requested by CRU to look at whether our regulatory framework is fit for purpose for the future. We retained KPMG as independent advisors to assist with this process.

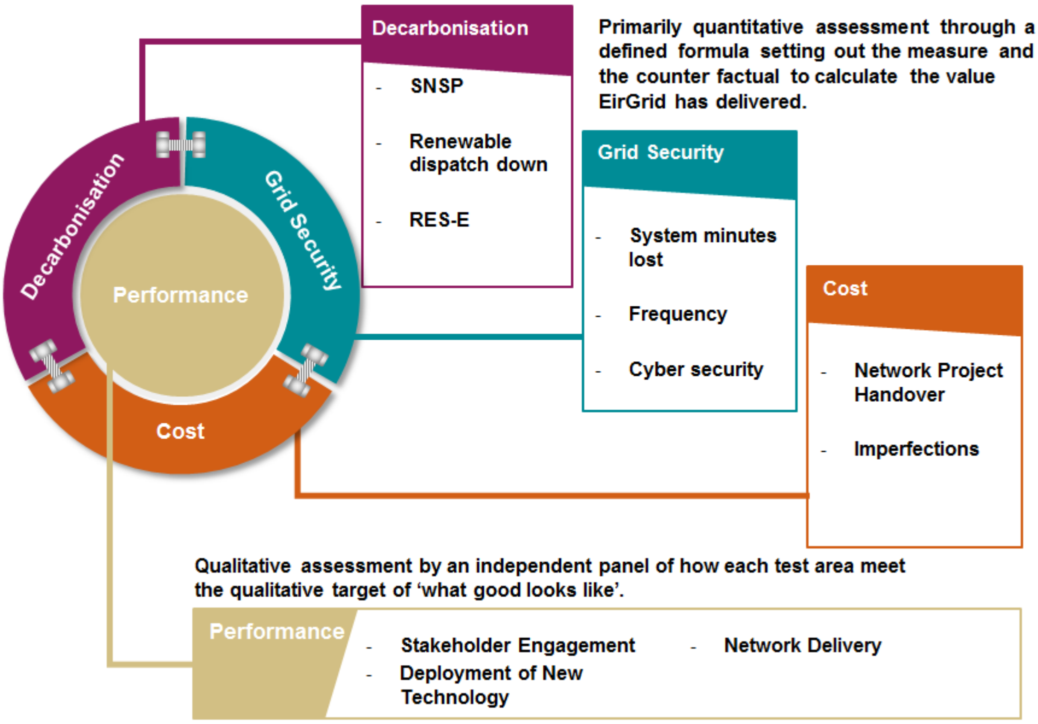
The outcome of this review is that whilst we believe that the framework is in general robust and well designed that customers would benefit from a number of modest changes to the existing framework. These changes include:

- An **Enhanced Benefit Sharing** framework which ensures customers see greater benefits through EirGrid being incentivised to deliver to stretching targets;
- A **Monitoring Committee** to deal with uncertainty and ensure customers are protected from the equally damaging risks of value adding projects not progressing or excessive allowances being provided for;
- The explicit introduction of **Real Price Effects** to help ensure those elements which EirGrid proposes be delivered, and with which CRU agrees, can actually be delivered; and
- Finally the introduction of a premium for **Asymmetric Risk** which enables the CRU to undertake a review of EirGrid's costs *ex post* without compromising its underlying financeability and protects the integrity of the regulatory framework.

Delivering Outcomes and Outputs

Our approach to this price control is focused on outputs and outcomes. The aim of the Enhanced Benefit Sharing framework proposed by us is to enhance the price control in an important way, to one where every decision made is about doing the right thing and unlocking value to the benefit of Irish customers. It also looks at the appropriate trade-off between input and output costs.

We therefore propose that a number of key areas are assessed as shown in the figure below. Appendix S contains our proposals which we submitted to CRU in February 2020.

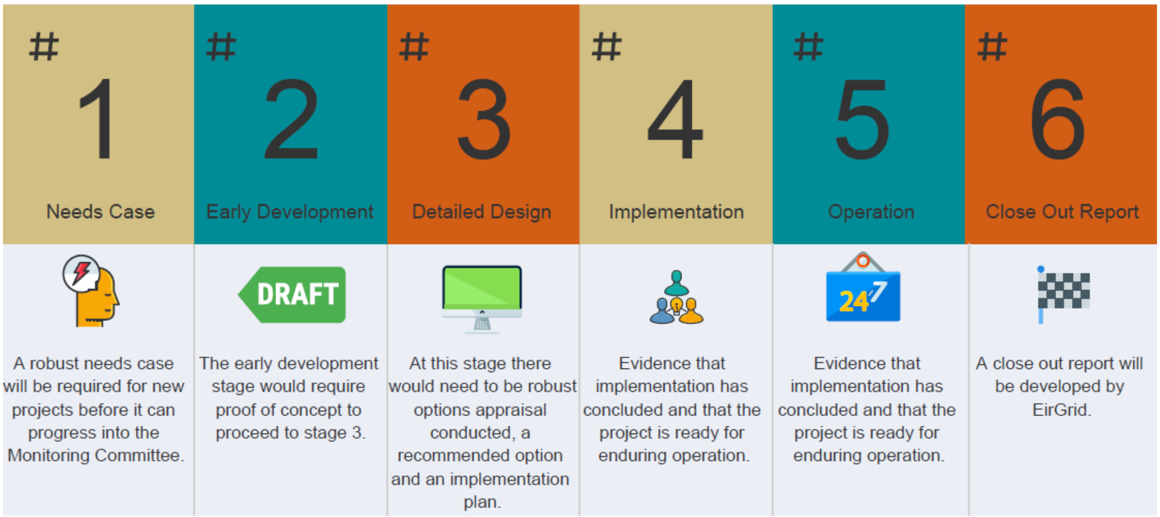


Primarily quantitative assessment through a defined formula setting out the measure and the counter factual to calculate the value EirGrid has delivered.

Qualitative assessment by an independent panel of how each test area meet the qualitative target of 'what good looks like'.

Figure 5. Enhanced Benefit Share

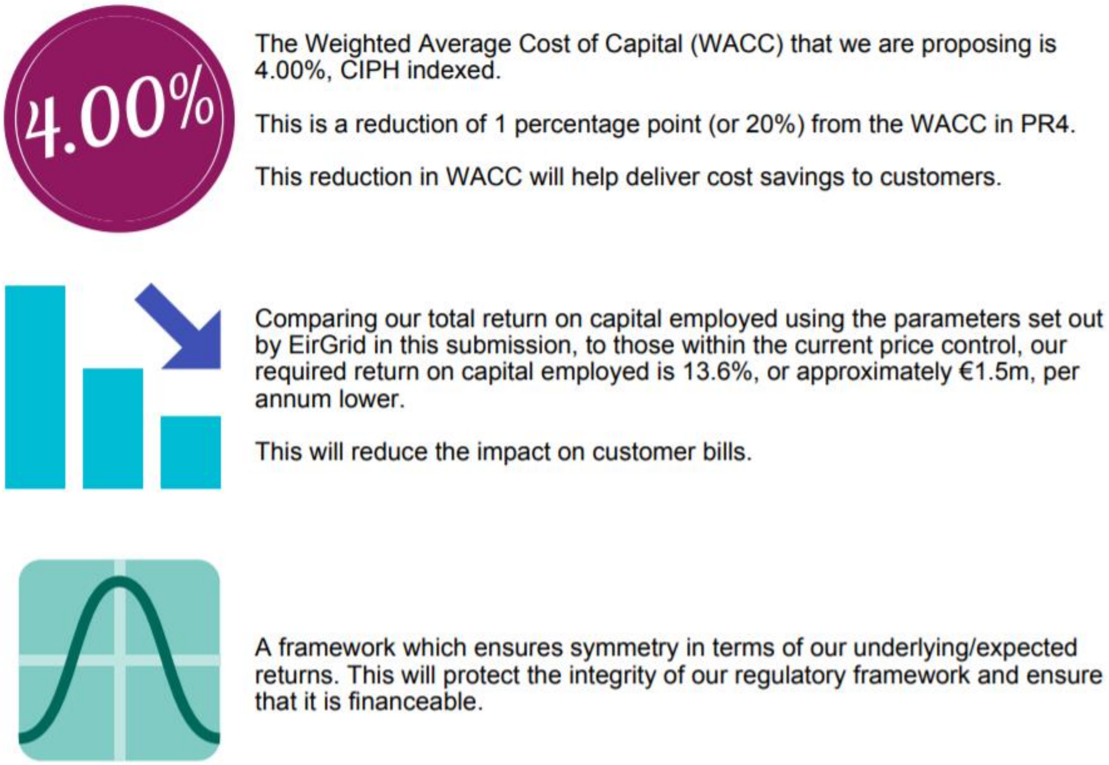
The purpose of the Monitoring Committee is to review projects that have a high degree of uncertainty. This will prevent EirGrid from being exposed to windfall gain or losses, however will allow essential projects to proceed in a timely basis. We propose that CRU, the Department of Climate Change, Communications and the Environment and EirGrid are on this monitoring committee and that it meets twice a year.



# 1	# 2	# 3	# 4	# 5	# 6
Needs Case	Early Development	Detailed Design	Implementation	Operation	Close Out Report
A robust needs case will be required for new projects before it can progress into the Monitoring Committee.	The early development stage would require proof of concept to proceed to stage 3.	At this stage there would need to be robust options appraisal conducted, a recommended option and an implementation plan.	Evidence that implementation has concluded and that the project is ready for enduring operation.	Evidence that implementation has concluded and that the project is ready for enduring operation.	A close out report will be developed by EirGrid.

Figure 6. Monitoring Committee

We have retained the existing regulatory framework for the remuneration of capital. Overall, under the proposals in this submission we will see lower returns on capital employed in the forthcoming period than for the current one. This delivers further savings and value to customers. We have sought adjustments to the framework to ensure that there is symmetry in its application. This ensures customers can continue to benefit from regulatory oversight of EirGrid's activities whilst at the same time EirGrid can continue to source finance to carry out its activities.



The Weighted Average Cost of Capital (WACC) that we are proposing is 4.00%, CIPH indexed.

This is a reduction of 1 percentage point (or 20%) from the WACC in PR4.

This reduction in WACC will help deliver cost savings to customers.

Comparing our total return on capital employed using the parameters set out by EirGrid in this submission, to those within the current price control, our required return on capital employed is 13.6%, or approximately €1.5m, per annum lower.

This will reduce the impact on customer bills.

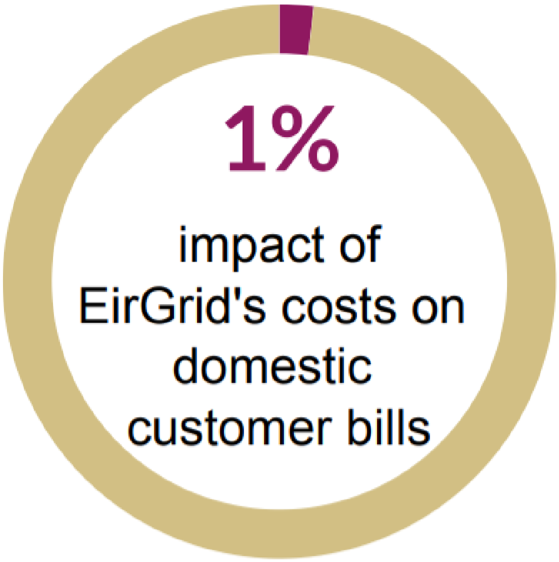
A framework which ensures symmetry in terms of our underlying/expected returns. This will protect the integrity of our regulatory framework and ensure that it is financeable.

Figure 7. Remuneration of Capital

The Cost of these Proposals

The initiatives set out in this plan, will be delivered for no additional cost per average domestic electricity customer per annum. In fact we are forecasting a reduction in the EirGrid portion of the average domestic customer bill during PR5.

The forecast Network CapEx required for PR5, which is planned by EirGrid but delivered by ESB is €1.07 billion. This represents a step change on PR4 and will see significant new network infrastructure delivered. Due to the reduction in the Cost of Capital and the forecast increase in demand, this can however be delivered at an overall reduction in the cost to the average domestic electricity customer.



€11.07

This is the forecast impact of EirGrid's OpEx and Non-Network CapEx costs on domestic customer bills per year during PR5.

-3%

This is the reduction in the EirGrid proportion of the average domestic customer bill from PR4 to PR5.

Figure 8. EirGrid Costs to Customers during PR5

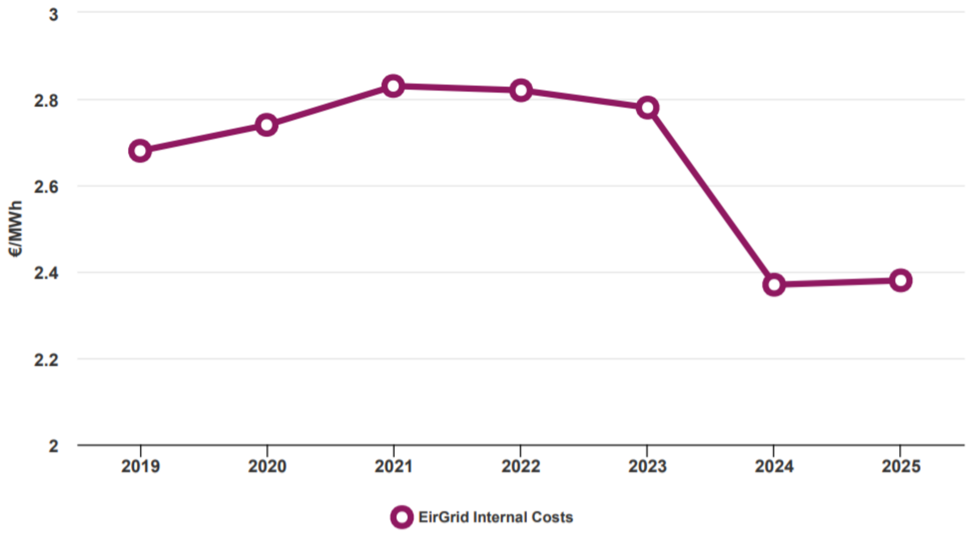


Figure 9. EirGrid Internal Costs to Customers during PR5

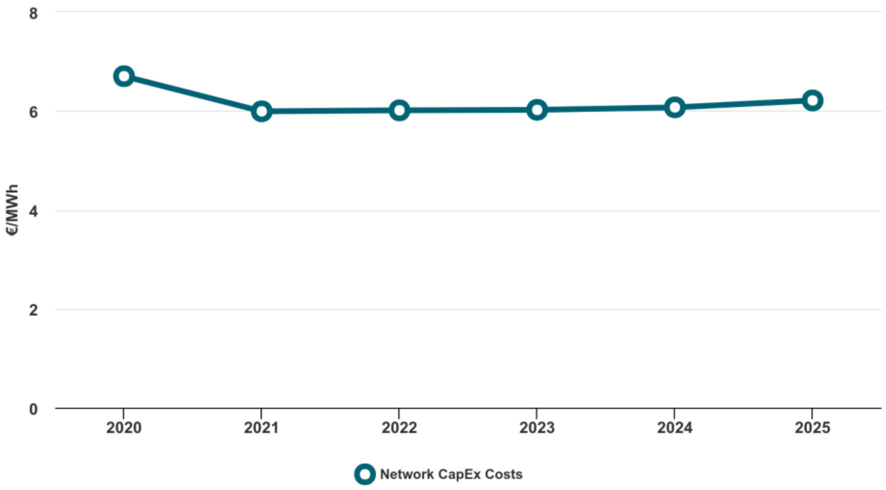


Figure 10. Estimated Network CapEx Costs to Customers during PR5

Layout of the Submission

Our PR5 submission comprises of a number of chapters and appendices, which work together as set out in the table below.

Part 1.	**A Future Energy System for Everyone**
1.	Future Trends in Energy Systems
2.	Engagement and Stakeholder Feedback
Part 2.	**Delivering Services and Outcomes**
3.	How the Past is Shaping the Future
4.	How we propose to meet this Challenge during PR5
	Appendix A. Transmission System Development & Maintenance
	Appendix B. Local Security of Supply
	Appendix C. Sustainability & Decarbonisation
	Appendix D. Operate, Develop and Enhance the Grid and Market
	Appendix E. Engage for Better Outcomes for All
	Appendix F. Non Network CapEx BAU (not published)
Part 3.	**Providing Value for Money and Managing Uncertainty**
5.	Ensuring Cost Efficiency
	Appendix G. KPMG Cost Efficiency Report (not published) *Appendix H. KPMG Business Case Challenge Report* *Appendix I. Calculation of Cost to Customers*
6.	Regulatory Framework
	Appendix J. KPMG Regulatory Framework (not published)
	Appendix K. KPMG Asymmetric Risk (not published)
Part 4.	**A Fair Balance of Risk and Return**
7.	Balance of Risk and Return
	Appendix L. KPMG Cost of Capital Report (not published)
Part 5.	**Conclusions**
8.	Conclusions
Part 6.	**Other Appendices**
	Appendix M. Securing Governance & Assurance
	Appendix N. Forecast BPQ Written (not published)
	Appendix O. Forecast BPQ Data (not published)
	Appendix P. Assumptions
	Appendix Q. Assessing Data Quality (not published)
	Appendix R. List of Abbreviations
	Appendix S. Output Metrics

1

A future energy system for everyone

Chapter 1

Future Trends in Energy Systems

Table of Contents

1.1 Overview

The electricity industry in Ireland is in a period of significant change. In the last decade, we have seen the wide-scale integration of renewables into Ireland's Transmission System, the emergence and rapid growth of the demand side management sector and the development of ever more sophisticated electricity markets. Further change is expected in the next decade. This will be driven by increasing consumer engagement and the emergence of ever more innovative technologies. Preparing for, and responding to, this change is our challenge for the next generation. Electricity demand will also increase significantly during PR5 and PR6. This entails fundamental changes that will determine our future role as Ireland's Transmission System Operator.

As we move closer towards 2030, 'accelerating' the energy transition will become increasingly important and require organisations to respond to and/or combat climate breakdown. This accelerated decarbonisation will also facilitate decarbonisation in other sectors such as transportation and heating.

Compounding the challenges above is the unpreceded level of demand increase forecast in the Generation Capacity Statement.[1] The demand forecast in Ireland continues to be heavily influenced by the expected growth of large energy users, primarily data centres. These need a lot of power and can require the same amount of energy as a large town. EirGrid's GCS shows that demand from data centres and other large energy users could account for 29% of all demand in Ireland by 2028.

EirGrid offers connections to the transmission system to parties seeking to connect in accordance with Section 34 of the Electricity Regulation Act, 1999 ("the Act"). It does so in accordance with directions from the CRU.

The number and scale of large scale data centres seeking to connect means that Ireland's electricity demand is currently expected to grow by c.38% between 2017 and 2025, equivalent in absolute terms to the growth in the 50 years between 1930 and 1980. This is occurring at the same time as societal change means that the building of new Extra High Voltage (EHV) infrastructure is taking place against an ever increasingly

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[1] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

complex backdrop and involves greater consultation and stakeholder engagement from an earlier stage.

Moreover, in the past, the long term planning of transmission infrastructure took place against the backdrop of similar long term evolution of the generation portfolio and fleet. In the context of market liberalisation and capacity auctions there is however an increasing requirement for actor co-ordination, market signals and regulatory frameworks to help ensure supply demand balance both locally and nationally.

In setting out our forecast submission for PR5, EirGrid has been cognisant of the role which we have been tasked with in the transformation of the Ireland's energy system. This chapter sets out our understanding and assumptions regarding these future trends and out how. Figure 1.1 below sets out our policy considerations for PR5.

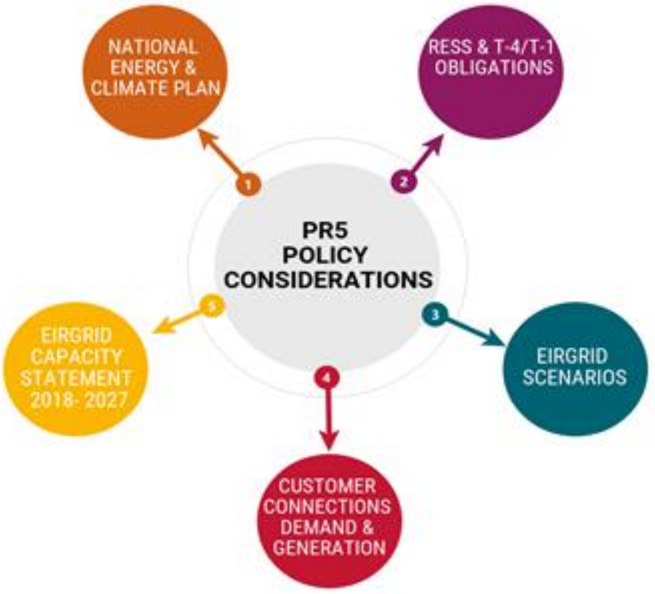


Figure 1.1 EirGrid PR5 Considerations

1.2 National Strategic Alignment

The CRU through its 2019-2021 Strategic Action Plan, the government through its recent publication of the Climate Action Plan and EirGrid through our new strategy; are all aligned in the shared goal of decarbonising our country for the benefit and wellbeing of our citizens and environment. The strategies also encourage the engagement with communities and supporting the needs of industry. To achieve these challenging common goals we will require significant investment both in infrastructure and operational and analytical systems and tools to be able to respond to the rapidly changing dynamics of the Irish electricity sector.

Climate Action Plan 2019

Rialtas na hÉireann
Government of Ireland

- Our ability to decarbonise our electricity system will be key to our ability to decouple economic growth from emissions growth
- It is important that EirGrid decarbonise the electricity that EirGrid consume by harnessing our significant renewable energy resources

CRU 2019 - 2021 Strategic Plan

CRU
An Coimisiún um Rialáil Fóntais
Commission for Regulation of Utilities

- Our strategic priority is to deliver sustainable, low-carbon solutions with Well-regulated markets and networks
- Our objective is to deliver market policies that support a low carbon future while supporting competitiveness and security of supply

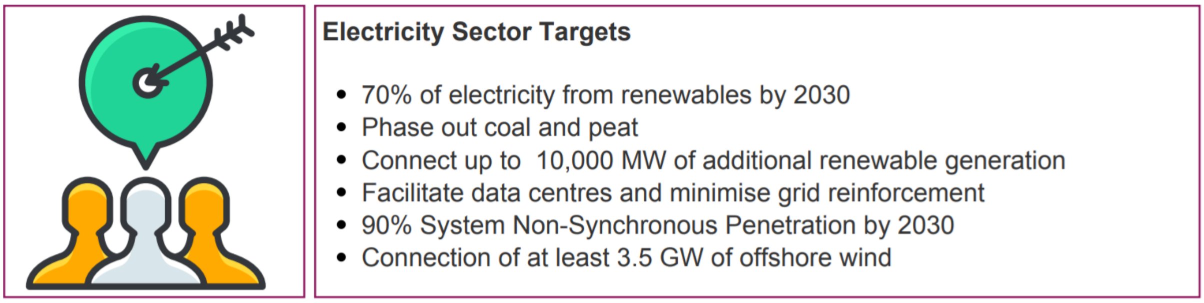
EirGrid Strategy 2020 - 25

EIRGRID GROUP

- Our primary goal is to lead the island's electricity sector on sustainability and decarbonisation
- EirGrid Group will be a beacon towards an ultimate future for electricity that is sustainable and free from carbon.

Figure 1.2 PR5 Strategic Alignment

EirGrid welcomes the breadth and ambition of the Climate Action Plan. In particular, additional measures in the transport, enterprise and citizen engagement initiatives all require the support of EirGrid.

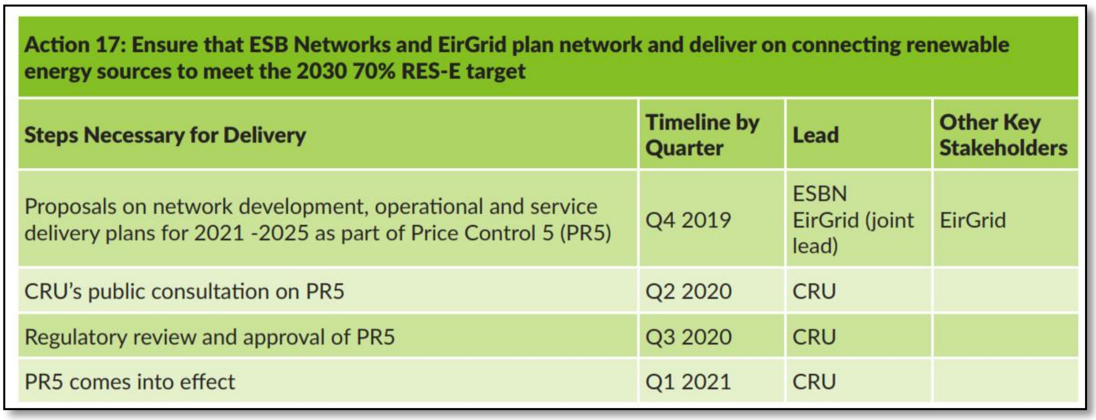


Electricity Sector Targets

- 70% of electricity from renewables by 2030
- Phase out coal and peat
- Connect up to 10,000 MW of additional renewable generation
- Facilitate data centres and minimise grid reinforcement
- 90% System Non-Synchronous Penetration by 2030
- Connection of at least 3.5 GW of offshore wind

Figure 1.3 Electricity Sector Targets

The Climate Action Plan recognises the importance of EirGrid in its delivery by specifically making PR5 a strategic action in its own right highlighting how important it is that sufficient revenue be provided to deliver their ambitious targets. This is shown in Figure 1.4.



Action 17: Ensure that ESB Networks and EirGrid plan network and deliver on connecting renewable energy sources to meet the 2030 70% RES-E target			
Steps Necessary for Delivery	**Timeline by Quarter**	**Lead**	**Other Key Stakeholders**
Proposals on network development, operational and service delivery plans for 2021 -2025 as part of Price Control 5 (PR5)	Q4 2019	ESBN EirGrid (joint lead)	EirGrid
CRU's public consultation on PR5	Q2 2020	CRU	
Regulatory review and approval of PR5	Q3 2020	CRU	
PR5 comes into effect	Q1 2021	CRU	

Figure 1.4 Extract from the Climate Action Plan Annex of Actions

The Climate Action Plan *Annex of Actions* contains 18 electricity sector actions (actions 16 to 33). Of these 18 actions[2] EirGrid has been specifically given responsibility for 19 individual deliverables. EirGrid through the Climate Action Plan has been identified as a key stakeholder responsible for jointly delivering over 60% of the electricity sector targets. A breakdown of the individual steps being led by EirGrid is outlined in Figure 1.5. It is worth noting that EirGrid is also a key stakeholder for 23 further steps. Of these 23 steps, 9 are being led by CRU and will require specific support from EirGrid to deliver.

No.	Action
17	Proposals on network development, operational and service delivery plans for 2021 -2025 as part of Price Control 5 (PR5)
20	Develop and implement flexible demand and other innovative solutions for data centres
23	Annual publication of the Transmission Development Plan, Generation Capacity Statement and Transmission Forecast Statement with input from ESBN as appropriate
23	Launch public consultation on Tomorrow's Energy Scenarios 2019 in Ireland
23	Publish Tomorrow's Energy Scenarios 2019 for Ireland
23	Publish a System Needs Assessment report to identify areas of the electricity transmission network in Ireland which will require development to cater for the envelope of scenarios in Tomorrow's Energy Scenarios 2019
23	North South Interconnector: A new interconnector connecting the electricity grids of Ireland and Northern Ireland as a project of common interest. The completion of this project will allow for a significant increase in the levels of renewables which can be deployed on the grid
23	In line with the National Policy Statement on Interconnection, develop further interconnection to increase energy security and facilitate Ireland's 70% target for renewable electricity by 2030
24	Expansion of the DS3 Qualifier Trial Programme (the trialling of new technologies on the system) into a new programme known as 'Flex Tech Integration Initiative'
24	Deliver the remaining deliverables under the DS3 Programme to enable 75% of the demand on the system to be met from variable renewable generation (75% System Non-Synchronous Penetration - SNSP)
24	Technical analysis looking at issues which need to be overcome to manage a real time operational limit of over 90% SNSP by 2030
24	Technical and market design, using findings from Flex Tech initiative, for the evolution of System

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[2] 119 steps within these 18 Actions.

	Services to enable renewable electricity targets for 2030
24	Implementation of new DS3 System Services market design, post-regulatory decision
25	Open Qualification Process for Offshore RESS Auction
25	Grid connection methods scoped, costed and connection offer(s) made to offshore wind applicants (dependent on above)
25	Development of Options Paper for Working Group on Offshore Grid Models
25	Grid connection methods scoped, costed and connection offer(s) made to offshore wind applicants that have been successful in the auction
25	Construction to commence on both (a) offshore windfarm and (b) grid connection following acceptance of offer by developer
25	Construction completed for both (a) offshore windfarm and (b) grid connection. Responsible body for grid connection dependent on decision on offshore wind delivery framework

Figure 1.5 List of Climate Action Plan actions assigned to EirGrid

In our strategy we make delivery commitments to ensure we meet the challenging targets set out in the Climate Action Plan. Furthermore this PR5 submission proposes the required regulatory framework, initiatives and revenue allowances to ensure we can successfully deliver on the Climate Action Plan targets.

1.3 Policy Environment

Energy policy action is needed to bridge between today's policies and those required to ensure climate neutrality[3], i.e. net-zero greenhouse gas (GHG) emissions. To that end, many parties, including the European Union (EU), have agreed to a long-term goal of keeping the increase in global average temperature to well below 2°C (above pre-industrial levels) and to pursue efforts to keep it to 1.5°C[4].

The EU's commitment is to reduce GHG emissions by at least 40% by 2030 compared to 1990, via its Clean Energy Package[5]. This framework includes EU-wide targets and policy objectives for the period from 2021 to 2030. The key targets for 2030 include:

- At least 40% reduction in GHG emissions from 1990 level (In 2017 Ireland was 9.6% above its 1990 level[6]).
- At least 32% renewable energy share (RES) (Ireland in 2017 was at 10.6%[7]).
- At least 32.5% improvement in energy efficiency.

The renewable energy and energy efficiency target includes a review clause by 2023 for an upward revision of the EU level target. To meet these EU targets, Member States are

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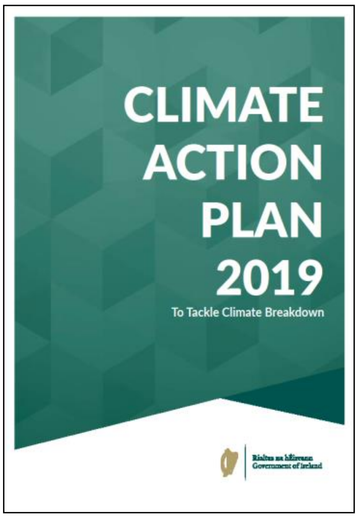
[3] European Commission, European Long-Term Vision
[4] UN, Paris Agreement
[5] EU, Clean Energy Package
[6] EPA, Ireland's Provisional GHG Emissions 1990–2017
[7] SEAI, Energy in Ireland 2018

obliged to adopt integrated National Energy and Climate Plans (NECPs) for the period 2021-2030. The European Commission has also set a long-term vision for a climate-neutral economy by 2050. Member States are required to develop national long-term strategies, and ensure consistency between their NECPs and long-term strategies.

In the delivery of renewable energy targets, we must also be cognisant of the recent Project Ireland 2040[8] initiative launched by the Irish Government.Project Ireland 2040 is informed by the Programme for a Partnership Government , which recognises that economic and social progress go hand in hand, and is made up of the National Planning Framework to 2040 and the National Development Plan.

In June 2019, DCCAE published its Climate Action Plan (CAP) to tackle Climate Breakdown.[9] The CAP's ambitious plans place specific actions on EirGrid with regard the delivery of the decarbonisation and 70% renewable penetration by 2030. The Climate Action Plan and the Project Ireland 2040 complement each other and must be considered together, not in isolation.



CLIMATE
ACTION
PLAN
2019
To Tackle Climate Breakdown

Figure 1.6. Climate Action Plan

The Annex of Actions of the CAP has designated EirGrid as Lead/Joint lead in 19 separate instances and a key stakeholder in 23 instances. CRU is leading on a total of 9 steps with input required from EirGrid.

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[8] https://www.gov.ie/en/policy/project-ireland-2040-policy/#introduction
[9] https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_Action_Plan_2019.pdf

To tackle climate change and meet our policy commitments, we believe it is important that EirGrid, DSO, TAO and CRU in our combined roles have a shared understanding of the scale of ambition needed.

The scale of ambition required to meet our obligations of 70% RES-E under the 2030 climate action targets will require an installed base equivalent to 10,000 MW of renewables during PR5 and PR6 from the current installed base of 3,768 MW. Our energy demand requirements will also likely increase from 30 TWh in 2019 to c.41 TWh by the end of PR6. Approximately 29% of this demand is being driven by data centre customers and other large energy users[10]. It is important to note that such customers have been recognised by the Irish Government as of strategic importance.[11]

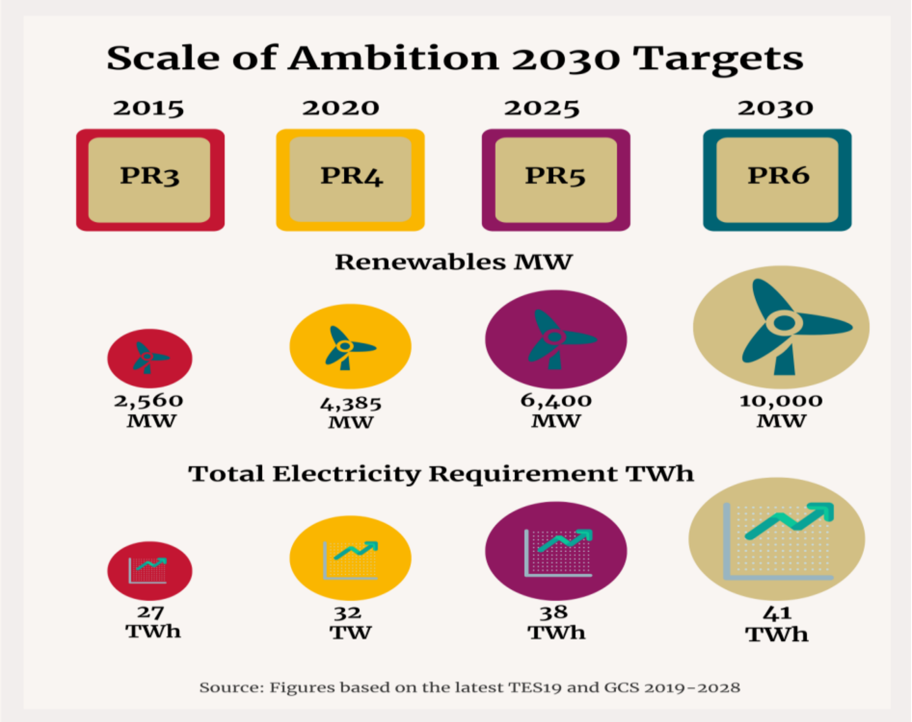

Figure 1.7 Scale of Ambition: EirGrid TES 2019 Summary to 2030

These targets in an Irish context set a 70% RES-E target for 2030[12]. It is forecast that by 2030 electricity will need to account for ~30% of final energy use for the entire economy which will equate to 70% of electricity from renewables.

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[10] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

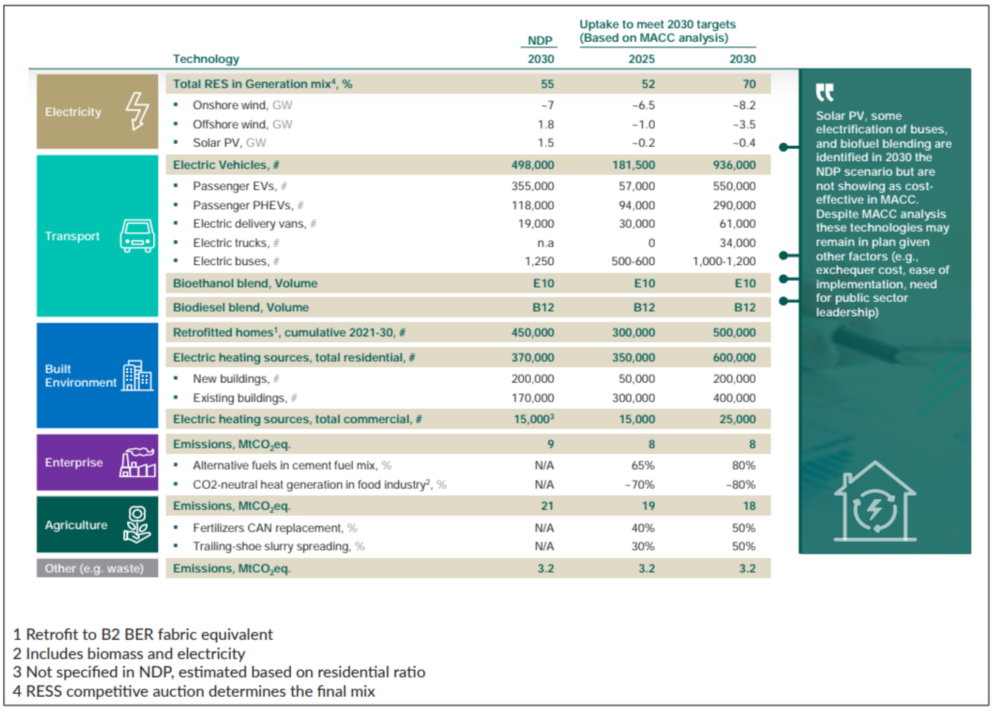
[11] https://dbei.gov.ie/en/Publications/Publication-files/Government-Statement-Data-Centres-Enterprise-Strategy.pdf

[12] Government Climate Action Plan 2019

Our PR5 forecast submission takes account of the policy requirements set out above and builds on the “EirGrid Tomorrow’s Energy Scenarios 2019” [13] to clearly set out the level of investment which is required over the period. Our Tomorrow’s Energy Scenarios (TES) aim to outline a range of credible pathways for Ireland’s energy transition, with specific focus on what this means for the electricity system over the next thirty years and beyond.

The Irish government is in the process of developing its final NECP 2021-2030, having submitted a draft[14] last year. The final NECP will incorporate aspects of the Climate Action Plan 2019[15]. The clean energy transition will have a profound effect on the electricity sector.

Ireland's Decarbonisation Pathway Dashboard[16] outlines the key electricity statistics to 2030:



		NDP	Uptake to meet 2030 targets (Based on MACC analysis)	
	Technology	2030	2025	2030
Electricity	**Total RES in Generation mix⁴, %**	**55**	**52**	**70**
	▪ Onshore wind, GW	~7	~6.5	~8.2
	▪ Offshore wind, GW	1.8	~1.0	~3.5
	▪ Solar PV, GW	1.5	~0.2	~0.4
Transport	**Electric Vehicles, #**	**498,000**	**181,500**	**936,000**
	▪ Passenger EVs, #	355,000	57,000	550,000
	▪ Passenger PHEVs, #	118,000	94,000	290,000
	▪ Electric delivery vans, #	19,000	30,000	61,000
	▪ Electric trucks, #	n.a	0	34,000
	▪ Electric buses, #	1,250	500-600	1,000-1,200
	Bioethanol blend, Volume	**E10**	**E10**	**E10**
	Biodiesel blend, Volume	**B12**	**B12**	**B12**
Built Environment	**Retrofitted homes¹, cumulative 2021-30, #**	**450,000**	**300,000**	**500,000**
	Electric heating sources, total residential, #	**370,000**	**350,000**	**600,000**
	▪ New buildings, #	200,000	50,000	200,000
	▪ Existing buildings, #	170,000	300,000	400,000
	Electric heating sources, total commercial, #	**15,000³**	**15,000**	**25,000**
Enterprise	**Emissions, $MtCO_2eq.$**	**9**	**8**	**8**
	▪ Alternative fuels in cement fuel mix, %	N/A	65%	80%
	▪ CO2-neutral heat generation in food industry², %	N/A	~70%	~80%
Agriculture	**Emissions, $MtCO_2eq.$**	**21**	**19**	**18**
	▪ Fertilizers CAN replacement, %	N/A	40%	50%
	▪ Trailing-shoe slurry spreading, %	N/A	30%	50%
Other (e.g. waste)	**Emissions, $MtCO_2eq.$**	**3.2**	**3.2**	**3.2**

Solar PV, some electrification of buses, and biofuel blending are identified in 2030 the NDP scenario but are not showing as cost-effective in MACC. Despite MACC analysis these technologies may remain in plan given other factors (e.g., exchequer cost, ease of implementation, need for public sector leadership)

1 Retrofit to B2 BER fabric equivalent
2 Includes biomass and electricity
3 Not specified in NDP, estimated based on residential ratio
4 RESS competitive auction determines the final mix

Figure 1.8 Key Electricity Statistics to 2030

1.3.1 European Harmonisation

The European Third Energy Package came into law on 3 March 2011, with the aim of enabling a greater penetration of renewables, improving security of supply and enhancing competition. Through its three regulations and two directives, it looks to do this by developing a European internal energy market through the creation of a

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[13] EirGrid Tomorrow’s Energy Scenarios 2019
[14] DCCAE, Draft NECP 2021–2030
[15] DCCAE, Climate Action Plan 2019
[16] Climate Action Plan 2019

regulatory framework to support the harmonisation and integration of European Energy Markets. This has been underpinned by the creation of the pan-European Transmission System Operators' group, ENTSO-E, and the Agency for the Cooperation of Energy Regulators (ACER) and the drafting of European Network Codes which form a legally binding set of rules and obligations for all EU member states. All of the European Network Codes have now entered into force, following a drafting process which saw ENTSO-E and ACER engage extensively with market parties and, ultimately, obtaining approval from the European Commission.

These eight European Network Codes, detailing rules relating to market trading, balancing actions, system operation and criteria for grid connections, introduce changes to domestic arrangements so as to facilitate pan-European harmonisation. Each European Network Code has its own date for entry into force and timescales for implementation. The roll-out of I-SEM presented the all-island market with an opportunity to align its trading rules with those drafted at a pan-European level.

The focus now is on ensuring that obligations relating to minimum system security, operational planning and frequency management standards are integrated into existing TSO systems and process to ensure safe and coordinated system operation on a pan-European basis. The biggest change to align system operation practices in SEM with those elsewhere in Europe will arise from the requirements of the Electricity Balancing Guideline (EBGL). The EBGL seeks to harmonise system balancing rules and facilitate the exchange of balancing resources between European TSOs; for an isolated island nation, this will inevitably require a wholesale overview of how real-time system balancing is conducted, including imbalance management, in order to implement this Code.

Looking ahead, the Clean Energy Package, adopted in May 2019, seeks to further build on the principles of the Third Energy Package. This will see the introduction of new pan-European standards and frameworks to further strengthen consumer rights and facilitate renewable connections, whilst also increasing the emphasis on centralised governance of the Energy Union, which will see the European Commission coordinate member states' National Energy and Climate Plans and issue country-specific recommendations to ensure that the overall approach is harmonised and consistent. Figure 1.9 details the Network Codes and Clean Energy Package timeline.

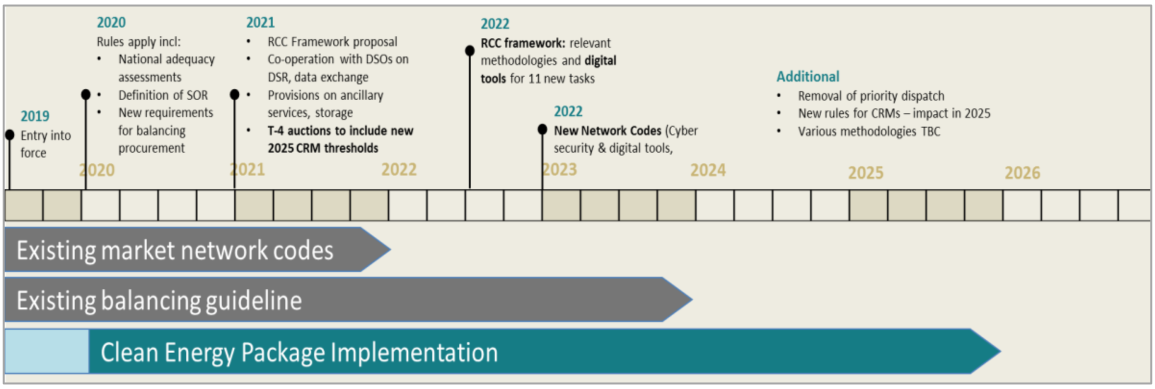

Figure 1.9 Network Codes and Clean Energy Package timeline.

1.4 Demand Growth

The Demand forecast is shown in Figure and Figure 2.[17] The demand forecast in Ireland continues to be heavily influenced by the expected growth of large energy users, primarily Data Centres. Electrification of heat and transport is also driving increase in electricity demand. Our analysis shows that demand from data centres could account for 29% of all demand in Ireland by 2028 in our Median demand scenario. In Ireland, the growth in energy demand for the next ten years varies between 23% in the low demand scenario, to 47% in the high scenario as shown Figure .

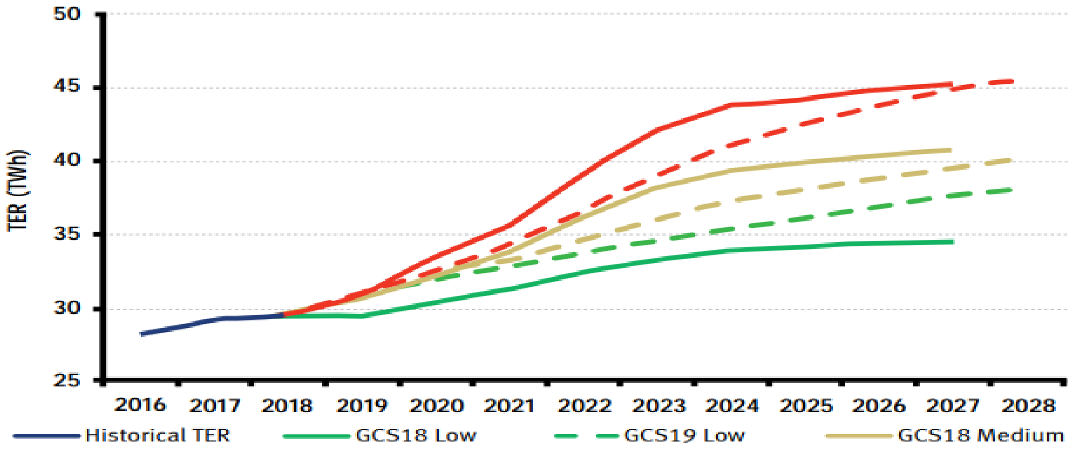

Figure 1.10 GCS 2019-2028- Total Electricity Requirement forecast for Ireland

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[17] EirGrid Generation Capacity Statement 2019- 2028

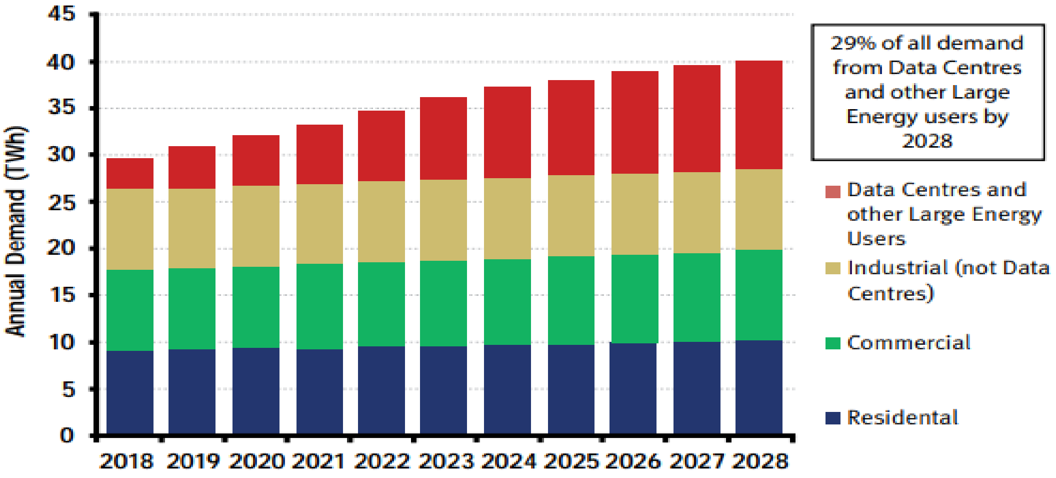

Figure 2: Median Demand scenario illustrating the split into different sectors

We are required by our statutory and licence obligations as TSO to develop the grid while maintaining security of supply. This requires that we reinforce the grid to an appropriate level which facilitates the required increased levels of renewable generation while at the same time facilitating the development of our economy and society by supporting the connection of demand and datacentre customers.

1.5 Other Considerations over PR5

- **New Connections -** It is anticipated that up to 7.5 GW of renewable generation will need to be connected to Ireland's electricity system between now and 2030.[18]
- **RESS** – RESS auctions will help drive further intergration of renewables as we move towards 2030.
- **Enduring Connections Policy 2 –** The CRU published its ECP-2 consultation (CRU/19/143) on 29 November 2019.[19] The consultation proposes three annual batches with a target of 50 offers per batch.
- **Capacity Auctions** – The ongoing capacity auctions will drive new generation connecting in Ireland over PR5 and PR6.
- **Digitalisation –** Increased data capabilities facilitate new and enhanced opportunities across the power system.
- **Democratisation:** Greater choice, transparency and market access will be typical demands in this new world. EirGrid must be ready to meet this challenge.
- **Decentralisation:** The design of power markets needs to evolve to keep pace with these rapid changes.

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[18] See Chapter 4 Appendix A.

[19] https://www.cru.ie/document_group/electricity-connection-policy-2/

Chapter 2

Engagement and Stakeholder Feedback

Table of Contents

2.1 Introduction

The previous chapter outlines the transformation that is taking place to ensure we meet our targets as outlined in the Climate Action Plan and the Clean Energy Package. In this chapter we outline how customer and stakeholder feedback has shaped the development of the EirGrid submission.

In particular, we cover:

- Ongoing customer and stakeholder engagement;
- Engagement with CRU as part of PR5; and
- Customer and stakeholder feedback received as part of the development of the EirGrid Group strategy.

We set out how this feedback feeds into strategic alignments between key stakeholders and the PR5 initiatives stemming from this work.

2.2 EirGrid's Ongoing Customer and Stakeholder Engagement

EirGrid carries out a significant amount of ongoing engagements with our customers and stakeholders. This is done through various EirGrid customer and stakeholder engagement channels e.g. industry and public consultations, industry forums, industry working groups, direct customer and public engagements, social media and general media, workshops, etc. We published a comprehensive list of such engagements in our Stakeholder Engagement Plan 2019[1] highlighting that the main purpose of a lot of this engagement is to 'ask for feedback' and to facilitate 'information sharing and learning'. Figure 2.1 show our engagement principles.

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[1] http://www.eirgridgroup.com/site-files/library/EirGrid/Stakeholder-Engagement-Plan-2019.pdf

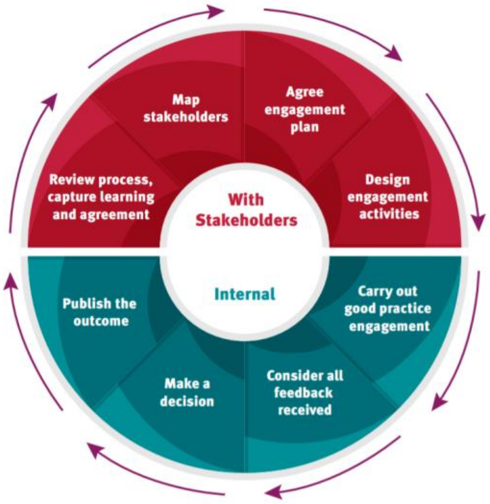

Figure 2.1: EirGrid Engagement Principles

The purpose of this annual plan is to highlight our engagements over a calendar year, identify our stakeholders and ensure they are genuinely involved in key decisions. EirGrid maintains a dedicated Customers and Stakeholders function that is continuously engaging with our customers and stakeholders and feeding their feedback into business to deliver better overall outcomes. The views of customers and stakeholders are taken on board and processes refined or developed as appropriate. The information and feedback provided from our customers and stakeholders has formed the basis for our company strategy.

During PR4, the CRU put in place the Networks Stakeholder Engagement Evaluation (NSEE) panel. The NSEE looks at the effectiveness of EirGrid's stakeholder engagement. EirGrid was pleased to achieve a score of 7.14 from the NSEE in 2018.

The 2018 NSEE Report provided positive feedback on EirGrid's performance in areas such as "Have Your Say", the "Six Step Process", and the Engagement Toolkit. The NSEE Panel members also positively noted the implementation of the EirGrid engagement process. The recommendations in the NSEE Report provided very useful feedback to EirGrid for feeding into our stakeholder plan and company strategy. This is also part of the Reporting and Incentives under PR4 (CER/18/087).

2.3 PR5 CRU Engagement

The CRU has outlined 4 strategic priorities in its 2019-2021 Strategic Plan:

1. Deliver sustainable, low-carbon solutions with well-regulated markets and networks.
2. Ensure compliance and accountability through best regulatory practice.
3. Develop effective communications to support customers and the regulatory process.
4. Foster and maintain a high-performance culture and organisation to achieve our vision.

These are broken down into further detail with specific objectives and outcomes and a number of these are specific to the electricity industry. EirGrid recognises that these are reflected and built upon in the CRU's key objectives for PR5 as outlined in the CRU's 11 July 2019 letter to EirGrid which included:

1. **Facilitating a Secure Low Carbon Future**

   CRU requested us to ensure that our plan facilitated a secure and low carbon future for both PR5 and beyond. This is one of the central pillars of our submission and is covered in further detail in the Sustainability and Decarbonisation business case which is covered in Appendix C. The building of the infrastructure required to underpin the connection of renewable generation is outlined in Appendix A.

2. **Increasing Efficiency and Protecting Consumers**

   CRU requested us to ensure that the measures outlined in our submission minimises the impact on end customer bills during PR5. We recognise the challenges associated with the transformation of Ireland's energy system and the requirements needed to secure a low carbon future. We are cognisant that this is delivered at the least cost to Irish consumers. EirGrid therefore set itself the challenge of ensuring that the cost to consumers is fair and reasonable. This was carried out through the development and challenge of the initiatives. The challenge process is covered in Appendix H, while the governance and assurance process is outlined in Appendix M.

3. **Resolving Local Security of Supply**

   Local security of supply and specifically issues in the greater Dublin region were flagged by CRU for resolution. Appendix B of our submission summarises the initiatives which we will undertake to resolve some of the current issues. Furthermore it signposts the reader to where each mitigation measure is covered in further detail.

Engagement with CRU, through the PR5 process, has also re-emphasised the continued important of grid delivery as being a priority for PR5. To cover this area we have packaged the PR5 Network CapEx requirements in Appendix A. This outlines the forecast requirements for this period and changes which are required to ensure that both EirGrid and the TAO have the capability to deliver on the ambitious requirements set out above.

Finally, the CRU's letter (D/19/16238), issued on 26 August, outlines the CRU's regulatory framework principles for PR5. EirGrid has engaged with the CRU and its advisors on what we believe a fit for purpose framework looks like, not just for PR5, but into the future. The outcome of this engagement is outlined in detail in Section 6 of this submission.

2.4 EirGrid Strategy Feedback and Engagement

EirGrid has developed a new strategy[2] to ensure we can *"Transform the Power System for Future Generations"*. This is summarised in Figure 2.2.

Figure 2.2: EirGrid Strategy

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[2] http://www.eirgridgroup.com/about/strategy-2025/

Extensive stakeholder engagement took place in developing the strategy during the situational analysis phase. This involved intensive and extensive research into specific areas, in external environment. The engagements were led by the EirGrid CE or Executive Directors as part of one-to-one meetings. Some of the stakeholders who we engaged with are shown in Figure 2.3.

Figure 2.3: Strategy Stakeholder Engagement

Through this engagement a number of common factors were identified. These are summarised in Table 2.1.

Theme	Summary of Customer and Stakeholder Feedback
Transparency	• Need for transparency in EirGrid's decision making, processes and information provided. • Better clarity required on the roles of EirGrid, ESB Networks, DCCAE and CRU, together with the importance of policy alignment between organisations. • Specific mention was made on the need to better understand the measures being taken to manage constraints, as well as the use of interconnectors.
Leadership	• As an independent body it is important for EirGrid to play a leadership role in the move towards decarbonisation. Provision of information and support to decision makers is critical. However, in undertaking a leadership role EirGrid will need to continue to consult with industry and members of the public.
Decarbonisation	• EirGrid is a key enabler to getting more low carbon energy on the system and achieving ambitious decarbonisation targets is a key policy trend. Some strategic customers actually volunteered a willingness to pay extra for a reliable, cost effective low carbon solution in Ireland.
System Operation	• Stability of the power supply is critical for many businesses. Outage planning could be improved and better planned in order to minimise disruption.

Theme	Summary of Customer and Stakeholder Feedback
Better Information & Understanding	• EirGrid needs to do more to educate people about decarbonisation and the electricity network, and how this impacts them. It will be critical that EirGrid keeps engaging with landowners and local communities in which network projects are proposed, particularly as this pertains to decarbonisation projects. • Better information provision, with more regular updates, is important. Need to provide short to long term information so that customers and market participants can make well informed decisions.
Data Analytics & Availability	• EirGrid gathers a lot of data in its role as TSO. Data analytics is becoming more important, and will be vital for EirGrid in predicting future trends for the safe and secure operation of the Transmission System. • There is a growing expectation that data will be made accessible to customers in order to allow them to better inform their decisions in relation to energy consumption.
Working with Partners	• It is important that the TSO and DSO work together to a shared vision. • Interactions between groups need to be clear and coordinated as a result. Improved relationship between EirGrid and ESB Networks, as well as European TSOs, is required. Partnership working could be broadened, e.g. universities.
Customer Journey	• Connections process could be improved and simplified; issues raised included the need to find more innovative, flexible solution, to address the requirement for multiple bonds, and the rising cost of connections. Customers highlighted their desire to see EirGrid provide feasibility studies rather than having to use external consultancy services. • Continued need for EirGrid to provide a high quality customer service.

Table 2.1: Strategy Stakeholder Feedback

2.5 New PR5 Initiatives

The new initiatives for PR5 have been grouped under five main themes. These themes align with the EirGrid Strategy as informed by the CRU's Strategic Plan and PR5 requirements, the Climate Action Plan and our customer and stakeholder engagement. These themes are:

1. Transmission System Development and Maintenace;
2. Local Security of Supply;
3. Sustainability and Decarbonisation;
4. Operate, Develop and Enhance the Grid and Market; and
5. Engage for Better Outcomes for All.

All of these new initiatives are underpinned by partnerships with our stakeholders.

Examples of customer feedback, which we have addressed in our submission include:

- Increased transparency on network outages;
- Increased provision of data;
- Improved pre-application process; and
- Increased number of project managers for transmission projects.

The new initiatives build on our existing BAU activities. Our BAU costs are outlined in Chapter 3, while the new initiatives are covered in Chapter 4. Chapter 4 notes where an initiative has been shaped based on customer and stakeholder feedback.

2

Delivering services and outcomes

Chapter 3

How the Past is Shaping the Future

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3 Introduction

This chapter sets out how the OpEx baseline for the start of the PR5 period was set.

It is important to note that EirGrid has experienced a step change in our OpEx allowance and expenditure with the introduction of I-SEM in 2018. This was not fully apparent until 2019 as I-SEM went live on 30 September 2018[1], therefore the 2018 allowance was pro-rata for 3 months in 2018. Comparison of the OpEx allowance between the entire PR4 period and PR5 is therefore not like for like. Comparisons should only be made between the final two years of PR4 (2019 and 2020) and PR5.

The current internal OpEx costs for EirGrid represent a very small portion of the average domestic customer bill. EirGrid have estimated that this is less than 1% of the bill per year and this is outlined in the PR4 Lookback submission and is also covered in Section 5 and Appendix I of this submission.

Even though our internal costs represent a small part of the overall end customer bill we recognise that there is an important requirement for us to manage our own cost base efficiently. We have applied internal and external challenge to our BAU activities and our new initiatives to ensure they provide value for money. Based on this and the level of forecast system demand over the PR5 period we have calculated that the EirGrid costs to the average domestic customer will reduce by 3% over the PR5 period.

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[1] Note that the Capacity Market went live on December 2017.

3.1 Building the Baseline

Our OpEx baseline for PR5 has been built up in the order set out in Figure 3.1.

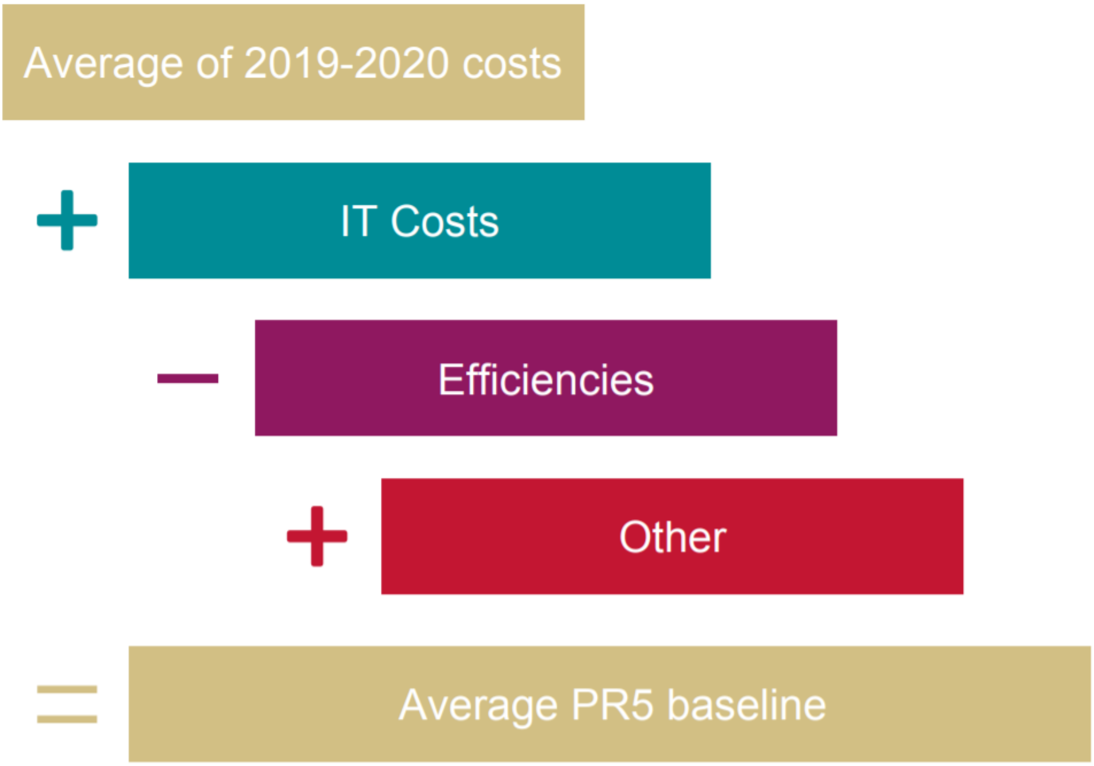

Figure 3.1: PR5 OpEx baseline

3.1.1. Average of 2019 – 2020 costs

The 2019 and 2020 calendar years are the only true comparators of EirGrid’s baseline, since these contain full years of operating under I-SEM. The starting position is therefore the average of the forecast Internal OpEx costs for the 2019 and 2020 period. This equates to €55.0m per annum.

3.1.2. IT Costs

We have included an additional €1.1m per year associated with moving certain applications to the Cloud and also for enhancements to our Operating Model. The detail around these costs are included in Appendix F.[2]

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[2] Appendix F is not published due to the confidencial nature of its contents.

3.1.3. Efficiencies

Efficiencies have been identified in our telecommunication costs. Our IT department has built up the telecoms requirements for PR5 from the bottom up. The requested allowance is less than that for PR4, even though the number of sites has increased significantly over this period. This is due to the efficiencies associated with the IP enabling works completed during PR4. This will deliver ongoing savings both in PR5 and beyond. This efficiency is a reduction of €1m per annum on the PR4 allowance.

3.1.4. Other

There are a number of other areas where we forecast a small change in costs. These are Staff Related Costs, Rates and Promotion of Research. These relate to an overall annual average reduction of €0.1m.

Professional Services have dropped resulting in a reduction of €0.5m per year. This is in part due to our ENTSO-E fees being reallocated from internal costs to external costs, since these are not directly controllable by EirGrid.

3.1.5. Average PR5 Baseline

When the changes outlined in Sections 3.2.2 to 3.2.5 are made to the starting baseline outlined in Section 3.2.1 we get a new PR5 baseline of €54.5m.

The PR5 baseline costs of €54.5m equates to a cost of €7.37 per average domestic customer in 2021.

Chapter 4

How we propose to meet this Challenge during PR5

Table of Contents

4.1. Introduction

EirGrid is continually adapting how it discharges its functions to ensure that our approach remains current and appropriate for the world around us. In this section we set out:

- The essential evolution of our business as usual activities;
- The work that we need to do to keep pace with external obligations; and
- Our response to the wider transition in Ireland's energy landscape, including the steps that we will need to take to response to the ambitious decarbonisation target set out in the Climate Action Plan.

EirGrid will deliver these changes in the context of greater complexity and an unprecedented rate of change within the electricity market. Our customers, partners and the whole energy system in which we operate will be cooperating closely in new ways, as part of a more active and multi-dimensional, system-wide interaction. Taking into account the views of stakeholders, EirGrid proposes the following plan with the end goal of delivering the changes needed so as to maximise the value to the end consumer.

This section summarises the six initiatives planned for the PR5 period in line with the business cases presented in Appendices A to F:

Appendix A	Transmission System Development & Maintenance
Appendix B	Local Security of Supply
Appendix C	Sustainability and Decarbonisation
Appendix D	Operate, Develop and Enhance the Grid & Market
Appendix E	Engage for Better Outcomes for All
Appendix F	Corporate Services BAU – Non Network CapEx[1]

4.2. Overview

Delivery of the PR5 Capital and Maintenance programme is vital to meeting Ireland’s climate change and renewable targets, while maintaining security of supply across the transmission grid. Over the next decade, EirGrid will be required to deliver substantial amounts of new electricity infrastructure that will be needed to meet Ireland’s Climate Action Plan (CAP) targets. In addition to new build and connections, this rapidly evolving

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[1] Not published.

system is set against a backdrop of an aging asset base which will require strategic refurbishment and replacement works. This requires a significant step change in how we develop the transmission system from that required under PR4.

For the PR5 period we are forecasting a 7% increase in the level of Network CapEx allowance needed (from €0.99bn to €1.07bn). In addition the TAO is forecasting a 14% increase in the Maintenance provision to deliver against EirGrid's maintenance policies and standards. Appendix A outlines the forecast Networks CapEx spend in greater detail and the capability measures required to enable EirGrid and the TAO to deliver on this step change in grid development and maintenance.

In recent years there has been increased focus and concerns identified in regard to local security of supply and specifically in the greater Dublin area. There are a number of contributory factors including changes to the capacity market and significant increases in demand in this region from data centres and other large scale industrial customers. EirGrid has, working in collaboration with the CRU, implemented a number of mitigation measures to date, with further long term solutions to be implemented over the coming years. This is outlined in Appendix B.

Due to the transformational change to the power system that will take place over the coming years, a step change in core activities will need to be undertaken by EirGrid. Business cases outlining these initiatives are outlined in Appendices C – E.

EirGrid operates significant and complex IT systems on a day to day basis. In addition to new tools and programmes EirGrid must ensure that its core IT infrastructure is robust and secure while evolving to provide increased flexibility and values for money. The Non-Network BAU CapEx allowance is covered in Appendix F. The requested allowance of €29.6m is less than the forecast outturn for PR4 of €33.7m.

Leveraging Experience and Competitive Markets

We recognise that many of these initiatives represent an increase over the current BAU level. As a part of the wider EirGrid Group, we are able to realise significant cost savings and other synergies related to specialist expertise. Where possible, our initiatives will be delivered jointly with SONI TSO. Ultimately, this results in substantial savings to Irish and Northern Ireland customers. In addition to reduced costs, we would expect that the quality of the solutions will benefit from this sharing of specialist knowledge.

The vast majority of the initiatives will undergo a competitive procurement exercise to ensure value for money is achieved. We have also sought to challenge and review the development of the initiatives outlined in this section. Senior level management challenge was provided to ensure robust needs, options, costs and outputs were developed for the initiatives, while we also retained KPMG to provide a level of external challenge to ensure that the best business cases could be submitted. This is outlined further in Chapter 5 of this submission.

Many of these initiatives are interrelated and have been costed accordingly i.e. you cannot deliver the Control Room Tools without the allowance for the Renewable Strategy (DS3+).

EirGrid has a proven track record in delivering complex work packages such as I-SEM and DS3. Using the experience, expertise and learning accrued during the delivery of such work packages, we will ensure that the required structures and systems are in place to deliver on the new initiatives outlined in this section.

4.3. Transmission System Development & Maintenance

EirGrid is forecasting an increased Network CapEx requirement of €1.07bn for the development of Ireland's transmission network in the PR5 period, a period which will require significant investment in the grid to ensure we are in a position to meet all of our policy and climate change commitments out to 2030. This is comparable to, but marginally higher, than the €0.99bn[2] provided for by the CRU as part of PR4.

The forecast provides a pathway over the next decade which will allow us to connect increased levels of renewables in the form of Onshore and Offshore Wind and Solar. This is within the context of also connecting new conventional generation plant which will result from the T-4 and T-1 capacity auctions in addition to meeting demand and datacentre customer connection requirements to enhance economic growth.

Challenges in deliverability, a more complex environment in terms of societal acceptance for grid infrastructure coupled with an increased acknowledgement globally of the need to move to a low carbon future characterised PR4; similar challenges will be present in PR5. Within this context EirGrid and the TAO continue to develop and implement a programme of improvements which are aimed at improving our value proposition to our customers and stakeholders. The step change required, to meet the scale of ambition to meet the challenges of achieving a low carbon future during PR5, is challenging and the Improvements and Capability requirements significant.

Summary details on these initiatives are described in Table 4.1.

Ref	Initiative Name	Description
1	Multi-Year Delivery Programme	Critical to achieving the required step change in project delivery and in turn the CAP targets is the ability to schedule and manage the transmission programme of work arising from an increased number of 2030 climate change, security of supply and demand connection projects. In addition to the ongoing projects, the Multi-Year Delivery Programme (MYDP) will contain these future projects as an iterative programme of work. EirGrid in consultation with the TAO is evolving the MYDP to drive more efficient programmes of work and improve contingency planning by using the lessons learned from the first three years of its existence (2017-2019).

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[2] This is the PR4 provision adjusted for inflation.

Ref	Initiative Name	Description
2	TSO/TAO Collaboration	EirGrid and the TAO are proposing to jointly develop and implement optimal grid delivery process improvements under the existing IA (many of which we have already trialled on existing projects) and to further enhance the collaboration and cooperation between EirGrid and the TAO to the benefit of all our customers.
3	New technology solutions to meet network problems	As set out in the PR4 Lookback Submission a number of new technologies now form part of our solution option toolbox; others are still in the trial phase. Deployment of new technologies trialled and successful under the PR4 period and ongoing development and trial of emerging solutions will be a core element of the PR5.
3	Enhanced Oversight of Contested Works	As we move into PR5 the significant scale of new connections, the majority of which at transmission level will be advanced on a contested basis, will drive a continued and potentially increased requirement for contestable build oversight and management. A number of measures are being implemented so that the improvements made in PR4 are not lost in the drive to get new plant connected.
5	Enhanced Capability – Grid Delivery	To ensure EirGrid has the capability to deliver on its roles and functions in grid development, which are central to the realisation of a sustainable and decarbonised future for Ireland, it is necessary for EirGrid to plan and augment the current resourcing model across a number of project related teams and functions: • 2 x Agriculture Liaison Officers (ALO) • 2 x Transmission Project Managers • 10 x New Connections Project Managers • 4 x Client Engineers These additional resources are included in the forecast of Network CapEx Costs.
6	Enhanced Capability – Asset Management	EirGrid and the TAO have focused on creating efficiencies in the area of asset management and maintenance, through changes to maintenance policy and standards. However, these efficiencies cannot offset the underlying growth in the asset base, continued ageing of existing assets and the resultant demand on Asset Maintenance To ensure the EirGrid has the Capability to deliver on the vital role of maintenance EirGrid have identified the need to augment the current resourcing model. The proposed additional asset management resources are included in the OpEx submission for PR5.

Table 4.1: Description of Network CapEx Initiatives

Further details are outlined in Appendix A.

4.4. Local Security of Supply

Building new grid infrastructure remains a key part of the solution in reducing constraints in a network by providing more pathways for generation to supply customers in a particular area. EirGrid has been advancing a number of projects in the Dublin region for this purpose.

Our PR5 plan builds on the work done by EirGrid to date, and the CRU request for EirGrid to proactively examine areas at risk of loss of supply under a set of credible scenarios. In line with the CRU's guidence, our PR5 submission includes a number of reinforcement projects aimed at alleviating the issues contributing to security of supply concerns in the Dublin area. These system reinforcement projects are at different stages of development. To deliver on the CRU's objectives we are proposing a programme aimed at addressing the security of supply risks that currently exist in the greater Dublin region.

During PR5, we will work to energise 33 of 40 projects currently identified as required within the greater Dublin region (See Appendix B). While these projects are primarily aimed at addressing the security of supply issue in the Dublin region, these projects will also assist in the delivery of our 2030 climate targets by facilitation the connection of further renewables onto the transmission system.

4.5. Sustainability and Decarbonisation

Sustainability and decarbonisation are driving the energy transition. The initiatives included here are focused on enabling a low carbon future through accommodating significant increases in renewable energy generation on an enhanced and changed power system in Ireland.

EirGrid's role in delivering this transition includes:

- Overseeing the strategic development of the transmission network, and facilitating the connection of new generators and demand customers.
- Supporting market participants to broaden the range of technologies that can compete in the energy, capacity and system services markets.
- Operating the system and managing the effects of renewables intermittency to maintain a high quality and security of supply for consumers at efficient cost.

EirGrid, through our DS3 programme, has delivered work leading levels of renewables onto the Irish system. This work has been carried out in partnership with SONI. We have a track record of delivering and we are committed to delivering on the ambitious targets set out in the CAP.

To meet the challenges associated with our role making the transition to a renewables-based power system, we have identified seven initiatives. The overall benefits and cost impact to customers' bills of implementation is summarised below.

Sustainability & Decarbonisation

75c

Impact to customer bills per year

No.	Initiative	Description	Cost Allocation (%)	Cost (€m)
1	Renewable Strategy (DS3+)	This programme will ensure that the system can operate with world leading levels of renewables and new technologies.	75	24.3
2	Control Centre Tools	These tools will ensure that the system can operate with world leading levels of renewables and new technologies.	50	5.1
3	Smarter Outage Management	To manage the increased complexity of managing transmission outages.	75	1.8
4	Clean Energy Package	Initial funding to help scope requirements in this legislation.	75	0.4
5	Migration to IP Communications	To facilitate the increased volume of communications with decentralised sites.	100	2.9
6	Data Science	Initial funding to help scope requirements to manage increased volume of data.	60	0.3
7	System Planning	To manage the increased complexity associated with the new technologies and renewables.	75	1.8
8	Promoting Change	To build internal and external stakeholder trust.	75	0.4

Sustainability and Decarbonisation Benefits:

- Establish effective processes and tools to operate a power system where the majority of the power comes from non-synchronous intermittent sources;
- Strengthen data and communications networks to secure better access to real-time data and the means to analyse it; and
- Promote more informed choices through an improved approach to investment appraisal and improved engagement with internal and external stakeholders.

Summary details on each of the initiatives and associated costs are described in Table 4.2 and 4.3. Appendix C describes this business case, and the associated initiatives in detail.

Ref	Initiative Name	Description
1	Renewables Strategy and Implementation	EirGrid will need to design and build the processes and tools necessary to safely maintain system resilience with high

Ref	Initiative Name	Description
	Programme (DS3+)	levels of renewables and new technologies. The challenges associated with high levels of variable non-synchronous renewable energy are widely recognised. We will need strategies to minimise the negative effects of variable renewable energy, while maximising the benefits and improving the cost-effectiveness of the power system. This initiative will help ensure that the system will be able to cope with increasing levels of RES generation without significantly increasing curtailment costs in the long run.
2	Control Centre Tools	Decentralised and low carbon technologies will fundamentally change the way the power system behaves. The development and deployment of a range of innovative tools will ensure secure operation is maintained and optimal use of renewable energy can be achieved in the most cost-effective way. The enhanced control centre functionality will ultimately facilitate the delivery of policy outcomes and lower bills for customers as the cost of renewable energy falls.
3	Smarter Outage Management	As the energy network evolves at pace and becomes more complex and more dispersed, we are finding that the challenges associated with managing outages are increasing. EirGrid has identified the potential to use new approaches and technologies to increase the smartness of our approach to outage planning. This system will result in improved functionality of the network outage management system, ensuring security of supply for the customer in an effective and efficient manner.
4	Clean Energy Package (CEP)	The costs to begin work on the CEP, which will apply from 1 January 2020. We know that the CEP will have a significant impact on TSOs and the wider energy industry. This initiative seeks an initial upfront allowance, while the full costs will be subject to progression through the proposed Monitoring Committee.
5	Migration to IP Communications	Our EMS will need additional communications functionality to allow it to integrate and control a diverse and dispersed network of power generation. Increased automation and the deployment of smart grid technologies will also trigger new bandwidth and connectivity requirements. The migration to Operational IP technology offers a more cost effective way of communicating with power system sites than using the current method. Improving the energy meter connectivity keeps the connections secure and available to support operations.
6	Data Services	The volume of data available to EirGrid will increase dramatically over the next decade. If used appropriately this can unlock great value. This initiative will define our approach

Ref	Initiative Name	Description
		to data capture, management and analysis, in the context of data security, governance and quality. This initiative will help identify areas to improve system operations by providing real or near real-time analysis and discovery and increase efficiency, delivering cost benefits to customers. This initiative seeks an initial upfront allowance, while the full costs will be subject to progression through the proposed Monitoring Committee.
7	System Planning	We need to update and enhance our appraisal processes to deal with the added complexity associated with new technologies and renewables. In particular reviewing those that require dynamic analysis. This type of analysis requires much more detailed parameters, models, tools, and a much higher skill level than equivalent steady state analysis. The increased capability here will help support further introduction of new technologies into the transmission system, which will provide new opportunities.
8	Promoting Change	We will need to build stakeholder trust by transparently communicating the challenges and opportunities associated with sustainability and decarbonisation, engaging with stakeholders to involve them in key decisions and reporting progress and risks. We also need to ensure we are leaders in sustainability internally and build best practises into day to day operational activities.

Table 4.2: Description of Sustainability and Decarbonisation Initiatives

4.6. Operate, Develop & Enhance the Grid and Market

We have a vital role in managing the electricity system and the opportunities and challenges affecting the market. We need to operate the network to provide a resilient, stable and secure supply of energy for Ireland. The way we deliver this will need to reflect the growing expectations in the energy environment including growth of renewables, the way electricity is consumed, and the demand growth forecast which impacts demand across the network.

A group of fourteen initiatives responding to specific changes in the external environment, including the TSO role in the wholesale market and requirements to meet emerging changes in the legal framework we operate in have been identified.

Whilst the proposed initiatives are driven by changes in external obligations and increased complexity in the power system, we also believe these initiatives deliver value for money for our customers and improve the quality of our services. Each initiative has been scrutinised and costs challenged to ensure value for money. Ultimately our preferred solutions have been shaped by what we believe to be in the best interests of customers. The overall benefits and cost impact to customers' bills of implementation is summarised below.

Operate, Enhance & Develop the Grid and Market

60c

Impact to customer bills per year

No.	Initiative	Description	Cost Allocation (%)	Cost (€m)
1	Enduring Access Planning	To manage the increased volume and complexity associated with new technologies and renewables.	100	1.0
2	Control Centre Training	Due to new systems and tools we need to keep pace in our training environments.	66	2.8
3	Physical Security	Investment is needed on the physical security of our sites.	100	4.1
4	Cyber Security	We need to keep pace with threats in this area.	60	4.3
5	European Network Codes	We need to manage increased obligations.	33	0.5
6	Capacity Market: Secondary Trading	To deliver on this functionality which was de-scoped for I-SEM go-live.	75	3.6
7	DSU Compliance with State Aid	This is required to ensure compliance with the EC state aid decision.	75	2.8
8	Capacity Market: Algorithm Change	This will help deliver savings for customers.	75	1.5
9	Capacity Market: State Aid Cross Border	To facilitate cross border participation.	75	2.3
10	Governance, Risk Management & Compliance	To manage increased requirements in this area.	75	0.7
11	Metering System	To ensure this can manage increased volume into the future.	75	3.3
12	Project Delivery Support	Skilled operational staff are required to support IT project delivery.	50	1.5
13	Electricity Balancing Guidelines	This refers to the resources required to apply the requirements of the Electricity Balancing Guidelines to current balancing practices.	TBC	TBC
14	Multi – NEMO Arrangements in the SEM	This will see the introduction of designated NEMOs into SEM.	TBC	TBC

Operate, Enhance and Develop the Grid and Market Benefits:

- Deliver efficient, economic operation of the power grid for the benefit of all customers in Ireland and deliver value for money;

- Improve the resilience of the operation of the power system in Ireland;
- Secure the operation of the grid (in partnership with ESB Networks) in a manner, which is capable of addressing the latest physical and cyber security threats; and
- Meet the core remit of the TSO in a way which complies with changes to the regulatory and legal environment, adhering to emerging changes in industry standards and best practice.

Summary details on each of the initiatives and associated costs are described in Table 4.4 and 4.5. Appendix D describes this business case, and the associated initiatives in detail.

Ref	Initiative Name	Description
1	Enduring Access Planning	We need to update and enhance our appraisal processes to deal with the added complexity associated with new technologies and renewables. The increased capability here will help support further introduction of new technologies into the transmission system, which will provide new opportunities.
2	Control Centre Training	By increasing and improving the functionality of our control room training, we can simulate a wider range of scenarios. These will inform real time decision making. This initiative will drive greater security of our operations.
3	Physical Security	Ongoing investment is required to ensure our people and assets are kept safe and secure.
4	Cyber Security	Cyber security threats are increasing and EirGrid will have to keep pace with developments. This programme of measures will improve our effectiveness in managing cyber security risks. This initiative will help ensure that we comply with changes to the regulatory and legal environment, i.e. NIS Directive.
5	Network Codes	Our obligations in this area are increasing. While the wider market will benefit from the standardisation and harmonisation across Europe, EirGrid will require additional staff to implement these codes and to deliver the ongoing requirements. Being compliant with the Codes will help minimise the risk of network failures, by having a consistent, efficient and coordinated approach.
6	Capacity Market Secondary Trading	We will design and implement a secondary trading platform within the Capacity Market which allows suppliers to trade between one another in the event they are not able to deliver their energy obligations, improving reliability and reducing costs in the capacity market. This will ensure orderly maintenance of the power system

Ref	Initiative Name	Description
		by ensuring participants can undertake necessary maintenance.
7	Demand Side Unit Compliance with State Aid	We will need to make changes to the treatment of DSUs in the capacity market to ensure compliance with the EC state aid decision.
8	Implementing a Mixed Integer Programming Solver	We will design and implement the next form of auction algorithm approaches to be used in the Capacity Market, which will drive customer savings.
9	State Aid Cross Border Capacity	We will need to facilitate cross border participation in the capacity market to ensure compliance with the EC state aid decision.
10	Market Related TSO Governance, Risk Management and Compliance	EirGrid needs to ensure compliance with the TSO responsibilities related to the wholesale market, the increased complexity of codes and legislation, and new European directives.
11	Metering system	EirGrid's current metering system is reaching the end of its useful life and its functionality is outdated. This will be replaced with a new metering system which automatically collects, aggregates, substitutes and validates energy metering data. This will ensure more efficient and economic operations.
12	Operational Support for IT	Skilled operational staff will be required to support the increased implementation of the IT projects, to ensure effective and efficient delivery.
13	Electricity Balancing Guideline (EBGL)	This refers to the resources required to apply the requirements of the EBGL to current balancing practices. Due to the uncertainty associated with the costs of this initiative we are proposing that this progresses through the Monitoring Committee.
14	Multi-NEMO Arrangements in the SEM	This will see the introduction of designated NEMOs into SEM. Due to the uncertainty associated with the costs of this initiative we are proposing that this progresses through the Monitoring Committee.

Table 4.4: Initiatives Under Operate, Enhance, Develop the Grid & Market

4.7. Engage for Better Outcomes for All

The need to engage for better outcomes for all is recognised in our strategy and dominates our approach to delivery of it. Appendix E covers a wide range of initiatives which we consider fundamental to overcome our greatest challenge of all, winning the hearts and minds of our customers. Our focus is not just at the level of supporting decarbonisation but in engaging, supporting and facilitating the realisation of what that change means. The overall benefits and cost impact to customers' bills of implementation is summarised below.

Engage for Better Outcomes for All

24c

Impact to customer bills per year

No.	Initiative	Description	Cost Allocation (%)	Cost (€m)
1	Education & Engagement Campaign	To increase our stakeholder engagement to help us shape an energy transition to benefit customers.	100	4.5
2	Customer Journey	To improve and streamline the connection process, from initial enquiry through to commissioning.	75	2.5
3	Framework for Development of the Grid	To continue to develop and improve the current framework, including increased engagement on the ground to support grid delivery.	100	3.7

Engage for Better Outcomes for All Benefits:

- Continue to transform our engagement with customers, communities and the public, and build world class stakeholder relationships; and
- Improve the connection process for new and existing customers.

Summary details of three initiatives and associated costs under this business case are described in Table 4.6 and 4.7.

Ref	Initiative Name	Description
1	Education & Engagement Campaign	We will engage proactively with stakeholders to ensure that our brand is known and trusted across Ireland. This initiative will help support acceptance at all levels for grid infrastructure projects; minimising delays and the cost of those delays.
2	Customer Journey	The energy transition will only be delivered if new market participants and service providers connect to the system. EirGrid proposes to improve and streamline its processes for that, to ensure an efficient and effective

Ref	Initiative Name	Description
		process from initial enquiry through to commissioning. The highest value benefits from this initiative will be derived from better decision making by potential market participants as a result of enhanced data availability, driving down costs in the wholesale and system services markets.
3	Framework for Development of the Grid	Continuing to develop and improve the Framework for Developing the Grid will be critical to enable us to deliver the required infrastructure to move towards a low carbon economy. Innovative and engaging tools for consultation and engagement, along with audience segmentation and research based insights, in relation to behavioural economics and hard data, will increase the efficacy of our consultations, build trust, transparency and public acceptance. This also involves the accreditation of our framework to ensure it aligns with best practice.

Table 4.6: Description of Engage for Better Outcomes for All Initiatives

4.8. Corporate Services BAU - Non-Network CapEx

In Appendix F, we set out our BAU investment requirements for IT and our workplace. These are broken down into a number of initiatives. A large proportion of the investment relates to ongoing refresh of systems as they reach end of life.

Ref	Initiative Name	Description
1	Replacement of end of life assets including EMS	EirGrid has reviewed the optimum useful life of its IT assets and will refresh them on this basis. This programme includes mission critical systems, such as our EMS that we use to operate the transmission system.
2	Cloud Adoption	EirGrid has reviewed its software and storage strategy and identified long term benefits from moving to cloud services for appropriate packages. This will provide the flexibility that we require to adapt to the greater digitisation of our industry.
3	IT Operating Model	A further evolution of our operating model for centralised IT services is required in order to embed efficiencies across the wider EirGrid Group, optimise our commercial management of major IT contracts and support our teams to operate as a single IT infrastructure system.
4	Standardisation of IT Solutions and Processes	We are experiencing multiple changes to our operating environment, many of which are likely to be further refreshed in advance of the next price control period, and are treated here as 'BAU' requirements. This initiative comprises updates to our systems that are necessary in order to meet these evolving demands.
5	Maintaining Cyber Security	EirGrid needs to maintain its cyber security infrastructure at the current standards; this includes the replacement of security assets that have reached the end of their life.
6	Workplace BAU	EirGrid needs to provide a secure and functional workplace, which includes maintaining our buildings.

Table 4.8: Description of BAU IT CapEx and Workplace Initiatives

Ref	Initiative Name	Total (€m)
1	Replacement of end of life assets including EMS	20.5
2	Cloud Adoption	2.5
3	IT Operating Model	0.8
4	Standardisation of IT Solutions and Processes	4.2
5	Maintaining Cyber Security	1.7
6	Workplace BAU	3.0
	Deferred from PR4 to PR5[3]	-3.2
Total		**29.6**

Table 4.9: Summary of Costs for BAU IT Capex and Telecoms Initiatives

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[3] See PR4 Lookback Submission for further details on this.

Appendix A

Appendix A

Transmission System Development & Maintenance

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A. Transmission System Development & Maintenance

A.1 Introduction

EirGrid, in accordance with its Transmission System Operator Licence and Statutory Instrument 445 of 2000 and associated Licence functions, is responsible for planning the development of a safe, secure, reliable, economical and efficient electricity transmission system with a view to ensuring all reasonable demands for electricity are met and having due regard for the environment and ensuring its ongoing management and maintenance. It does so in conjunction with ESB, in its role as Transmission Asset Owner (TAO). The respective roles of EirGrid and the TAO in the delivery of Transmission Infrastructure under this split responsibility model are set out in the Infrastructure Agreement (IA).

EirGrid is seeking to put in place development plans and advance network projects to drive the transformation of the electricity transmission; required as a result of a number of policy objectives centred on the issues of energy security, climate change and decarbonisations and economic competitiveness.

A key theme in the EirGrid 2025 strategy is to operate, develop and enhance the All Island grid and market with '***Cost effective delivery of value for society'.*** In particular to:

- Protect the delivery of our core remit in the context of changing expectations in the energy environment (including the growth of renewables and the forecast large demand increase in Ireland) and leverage this to become leaders in sustainability and decarbonisation.
- Operate the Power System securely and economically for the benefit of all customers and consumers on the island, and play our part in maintaining and improving the competitiveness and potential of both economies.
- Employ a strategic and innovative approach to asset management in the context of an asset replacement wave and a shift towards more sustainable solutions.
- Plan and develop the grid to promote and facilitate government spatial development strategies (National Planning Framework in Ireland and corresponding policy in Northern Ireland) and greater cross-border interconnection.
- Protect / enhance the environment, heritage and biodiversity as we develop an optimised grid in consultation with communities.

Delivery of the PR5 Capital and Maintenance programme is vital to meeting Ireland's climate change and renewable targets, while maintaining security of supply across the transmission grid. Over the next decade, EirGrid will be required to deliver substantial amounts of new electricity infrastructure that will be needed to meet Ireland's Climate Action Plan targets. In addition to new builds and connections, this rapidly evolving system is set against a backdrop of an aging asset base which will require strategic refurbishment and replacement works. This requires a significant step change in how we develop the transmission system from that required under PR4.

The context that frames the PR5 period is set out in further detail in Chapter 1 – Future Trends. The key drivers and enablers in regard to Transmission System Development and Maintenance include the requirement to address security of supply, support the development of both the economy and society by connecting demand customers and meeting the 2030 climate targets.

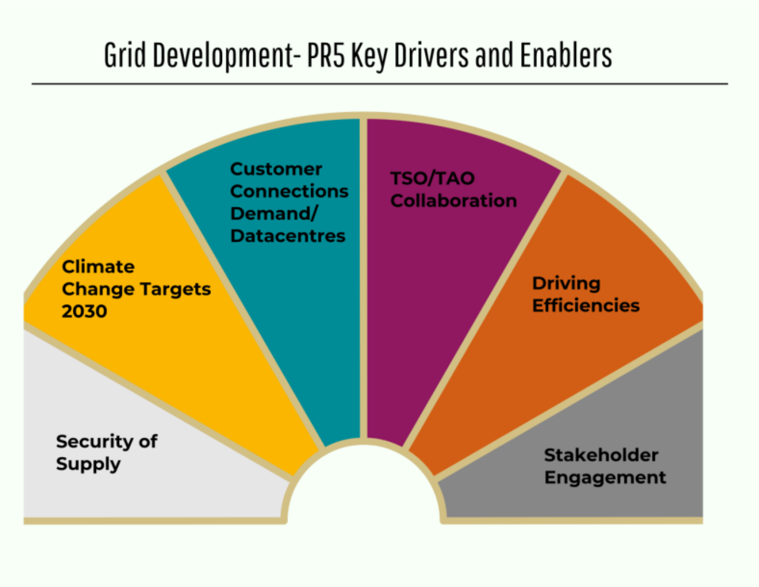

Figure A.1: PR5 Key Drivers and Enablers

EirGrid has in place processes, policies and governance structures to support the development of projects from the initial stages of solution identification through to capital approval and handover to the TAO for construction. In carrying out this work, EirGrid remains cognisant of the key role the public and industry play in the delivery of transmission projects in Ireland.

In developing the forecast for PR5 we have given consideration to the requirements emanating from various domestic and European initiatives, including:

- the Government and European policy context;
- System Needs by reference to the Transmission System Security and Planning Standards (TSSPS);

- the requirement on EirGrid to enter into contracts as a result of the RESS auctions, Capacity Auctions, ECP-1 and ECP-2 for the connection of new generation, ongoing economic growth and continued demand connection enquires and applications; and
- maintenance defined needs set against the underlying age profile of the network.

As we set about proactively anticipating how the network will change in the coming years, we have developed and published our Tomorrow Energy Scenarios document for public consultation. This explores scenarios of credible pathways for or what the power system into the future will look like, based on market players' response to the changing energy landscape in Ireland.

Through our Six Step Process[1]for grid development, EirGrid employs a range of established tools and frameworks to assess, and ultimately deliver, transmission network projects. This process is detailed in this appendix.

This paper sets out:

- An overview of Transmission Project Development in Ireland;
- The Forecast Network Capital Programme for the PR5 period;
- The Key Enablers - Capability Measures and Improvements required to be implemented so that the necessary Step Change in programme delivery can be realised and targets achieved
- The Transmission Asset Management and Maintenance requirements in the PR5 period; and
- Outcomes.

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[1] Further details on the Six Step Process to Grid Development are set out in Section A2.1

A.2 Transmission Programme Development

A.2.1 Six Step Process

Since October 2017, EirGrid has developed the transmission infrastructure projects in accordance with the new Six Step Process[2] for grid development outlined in Figure A.2. The Six Step Process has regard to EirGrid's statutory obligations which govern EirGrid's activities and processes in respect of the development of the electricity transmission grid.

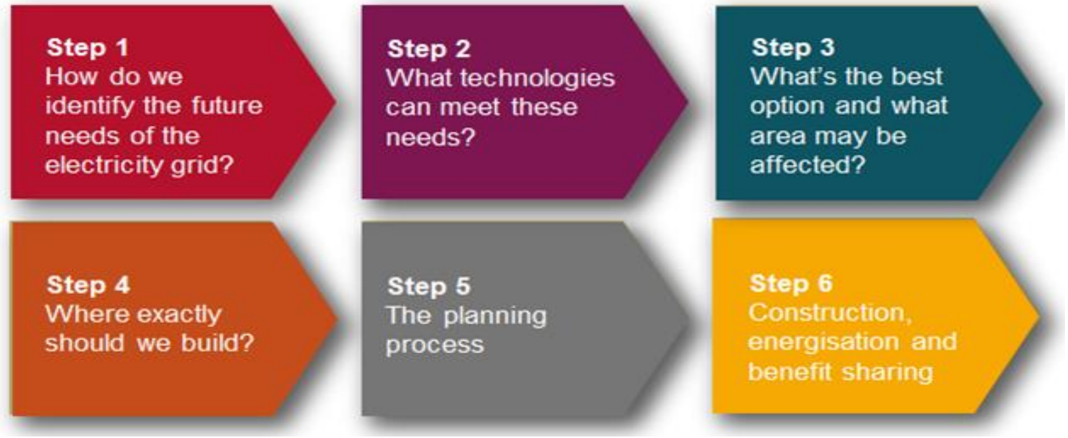

Figure A.2: EirGrid Six Step Process

Each step serves a distinct purpose based on the maturity status of the project, with Step 1 focused on the conceptual design stage and Step 6 focusing on the completion of the project and its integration into the network.

The timescales associated with each step may vary based on the scale and complexity of a project. Furthermore, in some instances activities under a number of steps may be undertaken in combination, rather than consecutively (see section on "Tiering" below).

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[2] Further details on the development of the framework was set out in the PR4 Look Back Submission

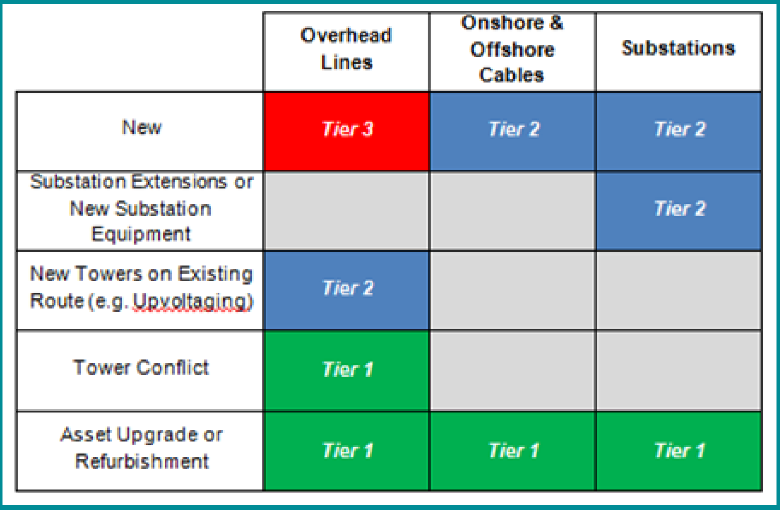
Project Tiering

It is acknowledged that not all projects are of the same scale and complexity. Three “tiers” of development project scale and/or complexity have therefore been identified in the framework.

The tier of a development project determines the corresponding level of analysis, external consultation and engagement, social impact assessment, complexity of decision-making, deliverables, gateway governance, etc. Establishing the appropriate tier for the project will therefore enable all development projects to go through the appropriate level of governance; for example smaller, and/or simpler development projects may be expedited through the framework.

Tier 1 comprises the simplest or smallest development projects and tier 3 the most complex or largest development projects. As many development projects will comprise a number of different elements, the tier will most likely be dependent on the most complex part of the development project. For example, if a new substation development project incorporates a minimal extent of new overhead line to connect in the substation, it will most likely be a tier 2 project and if it comprises a significant extent it will most likely be a tier 3 project.

As a development project progresses, if higher tier solutions are ruled out, then the development project will move to a lower tier. Also in exceptional circumstances, development projects may be moved from a lower tier into a higher tier if deemed appropriate and more analysis is required. However, as many development projects may have an overhead line option, including uprates, it would be undesirable to always default to a tier 3 project. Therefore there might be a distinction in tiering between an uncomplicated uprate of an existing line (tier 1), an uprate of an existing line which requires statutory consents (tier 2), and construction of a new line (tier 3). Moreover, an increase in the rating of an existing line, say from 220 kV to 400 kV and requiring the complete rebuilding of an existing circuit, is likely to be of such scale and complexity as to comprise a tier 3 project. As every project is unique, the decision around tiering will be a matter of consideration at a development project level which will be confirmed at each project gateway.



	Overhead Lines	Onshore & Offshore Cables	Substations
New	*Tier 3*	*Tier 2*	*Tier 2*
Substation Extensions or New Substation Equipment			*Tier 2*
New Towers on Existing Route (e.g. Upvoltaging)	*Tier 2*		
Tower Conflict	*Tier 1*		
Asset Upgrade or Refurbishment	*Tier 1*	*Tier 1*	*Tier 1*

Figure A.3: Complex Criteria Mapping to Tiers

A high level description of Six Steps is set out below

Step 1: How do we identify the future needs of the electricity grid?

The existing transmission system is assessed in line with asset maintenance standards and using scenario planning to identify and verify any issues or risks arising for the transmission grid that may result in a need to refurbish, replace or reinforce the grid. This may include high-level stakeholder engagement.

- **Gateway 1**: Endorsement of need to undertake action regarding the grid network

Toolbox

As set out in response to Question 1 – Section 1.6 (A) Smart Grids in the BPQs as part of the PR4 Look back Submission, non-established Smart Grid Technologies, a Technology Readiness Level (TRL) below 8, must first be trialled on the system. For pilot deployment of a technology, a TRL of 6 or 7 is required. If the trial is successful and the technology becomes proven it will be include in the technology toolbox.

A decision to roll out technology at scale requires capital approval, once approved a separate capital project is created and all cost are allocated to the unique capital project code. EirGrid considers technologies for widespread deployment that have achieved an EirGrid assigned Technology Readiness Level (TRL) of 8 or above.

As part of Step 1 the plausible scale of solutions is identified using the appropriate tools in the toolbox to address the identified need. The analysis in Step 1 may result in a need being addressed through operational measures (non-network solutions). In Step 2 network solutions which may comprise both the deployment of new technology (e.g. Powerline Guardians etc.) on the existing network and upgrading of the existing network (uprating or new build) are examined in detail.

Step 2: **What technologies can meet these needs?**

A long list and a subsequent short list of technology options are developed to meet the identified need, generally including medium-level stakeholder engagement.

- **Gateway 2:** Approval of a shortlist of technology options to meet the identified need, and authorisation to proceed to the next Step.

Step 3: **What's the best option and what area may be affected?**

The best performing solution (technology and corresponding study area) is identified from the short list of options. Environmental, social and other constraints occurring within that study area are identified. Public and stakeholder participation is likely to occur in this step, at as local a level as possible and/or appropriate.

It should be noted that, depending on the results from the selection process, more than one option may be taken forward to Step 4. This is in accordance with EirGrid's 'Have Your Say' publication.

- **Gateway 3:** Approval of a single best performing technology option(s) e.g. Overhead Line (OHL) or Underground Cable (UGC), and authorisation to proceed to the next Gate, including approval of estimated TSO spend up to statutory planning consenting of the project (end of Step 5); It should be noted that, in respect of a new circuit for which the best performing option is an OHL, the best performing equivalent UGC option will also be required to progress into Step 4 for detailed routing and siting. In this scenario, approval to proceed with the two options shall occur at Gateway 3.

Multi-criteria analysis framework

EirGrid employs a multi-criteria analysis framework, referred to as an enhanced performance matrix, consistently throughout the development of the investment decision. The enhanced performance matrix is to comprise five criteria (i.e. socio-economic, environmental, deliverability, technical, economic) which are expanded to sub-criteria depending on the phase of development and complexity, including the use of *Least Worst Regrets* analysis in the economic appraisal for the most complex category of projects.[3]

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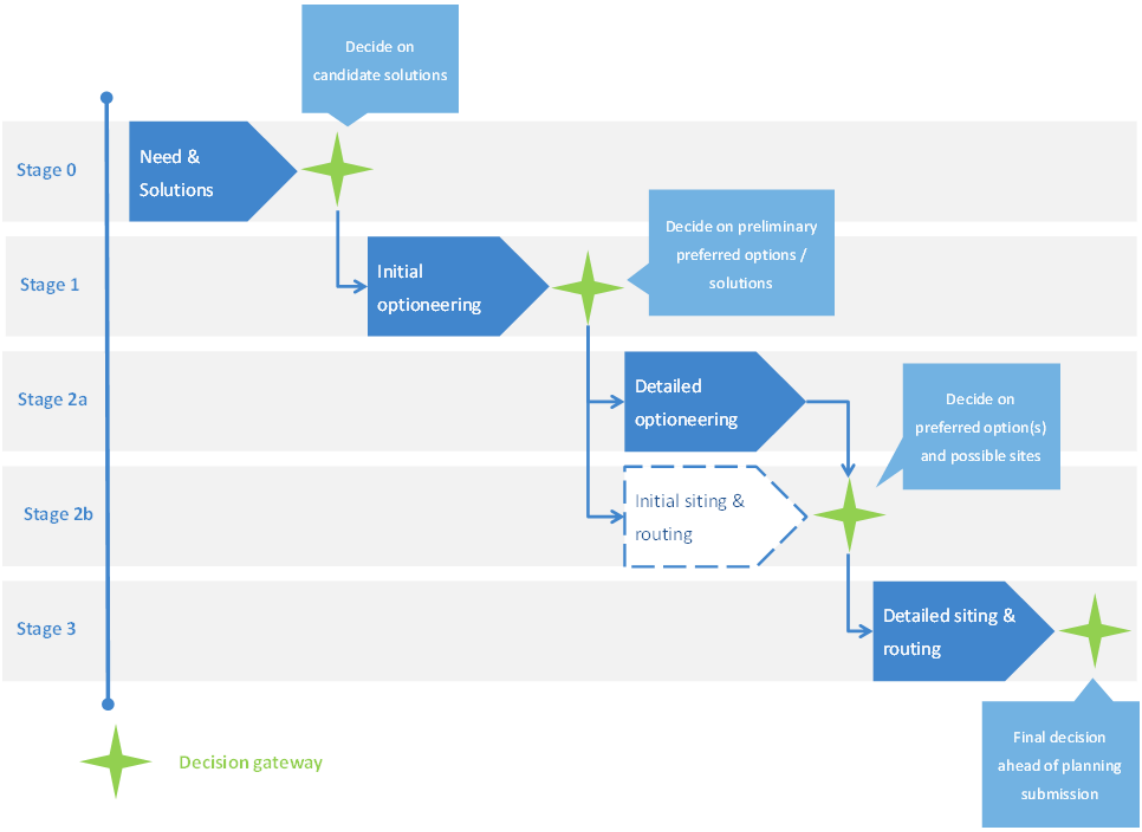
[3] As set out in our PR4 Look Back Submission, since October 2017 the recommendations from a review of our approach to developing infrastructure projects, carried out by CEPA and TNEI, have been implemented as part of our Framework for Developing the Grid



Source: CEPA and TNEI

Figure A.4: Overview of decision making process

A Scenario Planning Approach

The utilisation of scenarios is a technical planning tool applied widely across the power and utility industries. For EirGrid these represent a number of plausible possibilities for what the longer-term (unknown) future of the electricity industry might look like. The development of future scenarios allows EirGrid to understand and be better prepared for the uncertainties of the future power system.

While separate, the development of scenarios is complementary with the Framework for Grid Development project. The energy scenarios will primarily influence step 1 of the framework, they are utilised throughout the six-step framework process to constantly assess the needs of the future electricity system. They will also be used to test the viability and merits of network reinforcement options to solve any issue found. As such, they will be used to re-confirm the need for a development project in the subsequent steps, as part of the gateway process and are a key risk management tool.

Step 4: **Where exactly should we build?**

The specific nature, extent and location of the proposed development are defined. It should be noted that where more than one solution is progressed in parallel in this Step, the optimum nature, extent and location for each solution shall be identified. These are ultimately evaluated against each other, incorporating landowner, public and stakeholder consultation and engagement feedback received. The optimum project shall be identified at the end of the step.

- **Gateway 4:** Approval of the identified route and/or site for a planning application and authorisation to progress to the process of compiling the planning application (Step 5);

Step 5: **The planning process**

Statutory consent for the proposed development is obtained, or it is established that the proposed development is an exempted development. Appropriate public and stakeholder engagement is undertaken, up to and/or in parallel with any statutory public consultation process.

- **Gateway 5:** Approval to enter the statutory planning process. In the alternative that the project does not require statutory planning consent, approval of this fact, including consideration of written confirmation of same;

Step 6: Construction, energisation and benefit sharing

The project is constructed by the TAO in liaison with EirGrid PM, Client Engineer and other key personnel. Where applicable, Community Gain Funds are administered to affected communities.

- **Gateway 6**: Approval to enter Project Agreement, including approval of TSO spend up to completion of construction and energisation of the project;
- **Gateway 7:** All aspects of Project Close-out, most notably technical and financial matters.

A2.2 Customer Connections

Customer connection projects, both demand and generation, commence once a connection agreement (or a System Operator Connection Agreement (SOCA) with the Distribution System Operator) has been executed between EirGrid and the Customer. There are four categories of such projects:

1. **Non-Contested**: requiring a Customer transmission connection and which is non contested (meaning that EirGrid is responsible for acquiring planning permission and arranging construction and comissioning).

2. **Contested**: requiring a transmission connection and which is contested (meaning that the Customer is responsible for acquiring planning permission and arranging construction, excluding commissioning and energisation).
3. **DSO Contested**: Similar to the Standard Contested project, however the Customer is the Distribution System Operator (DSO) and is contesting the tranmission components
4. **Embedded generator with no transmission system works**: a subset of a standard project where the Customer only requires a RTU (Remote Terminal Unit), specification of signals and testing. These works are arranged by EirGrid.

In general Customer connection projects follow a similar process to that described in section A2.1, joining the process at Step 3. However, there are a number of additional or amended activities required to ensure the successful delivery of this type of project. EirGrid publish a customer facing document 'Guide for New Customers Getting Connected' that outlines the general process for customer connection projects[4].

Customer connections have become increasingly more challenging in recent years due to reasons such as large capacity single connections, complex connection methods and accelerated timelines. The majority of transmission connections are constructed on a contested basis and EirGrid has had considerable challenges associated with the quality of the customers' design and construction standards, with some projects having critical quality issues that would deem assets unacceptable for operation as part of the transmission system.

PR5 projections see a significant increase in the number of customer projects to be delivered in order to meet the demand for data centre connections and to reflect the 2030 targets and the scale of renewable connections required to deliver these. The resources required to manage this increase and ensure the standard of contested builds has been reflected in the PR5 forecast through the enhanced oversight of customer connections by both the EirGrid Project Managers and EirGrid Client Engineers (ref. Section A.4.4 – for further details). .

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[4] Guide for New Customer - http://www.eirgridgroup.com/site-files/library/EirGrid/2018_19-Customer-Guide.pdf . Contracted customers are also provided with a more detailed document "Getting Connected".

A.2.3 Governance Process

EirGrid has a number of internal governing bodies that are responsible for ensuring that robust governance structures are in place in respect of transmission grid infrastructure development projects, and that good governance practices are adhered to. These committees approve EirGrid project costs and the overall estimated investment costs. These committees set out in Figure A.5 below:

- Management Investment Committee (MIC)
- Transmission Investment Committee (TIC)
- EirGrid Chief Executive (CE)
- Grid Infrastructure Projects Committee (GIPC)
- EirGrid Board

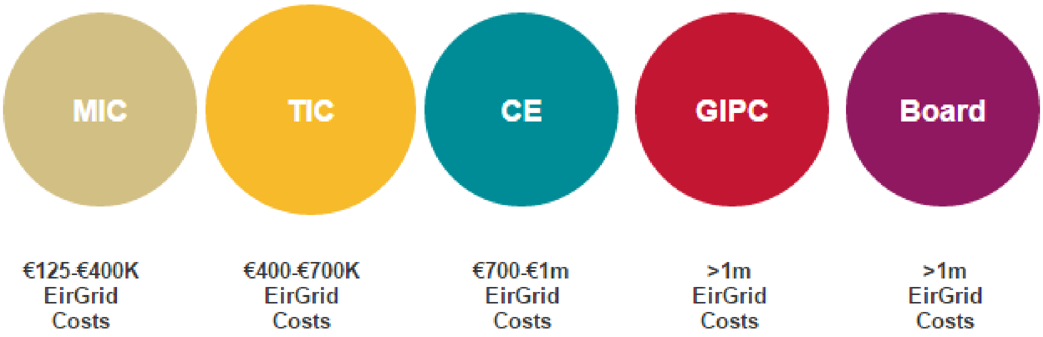


Figure A.5: EirGrid internal governing bodies for grid development projects

EirGrid's six step process provides structured governance points throughout the process, called Gateways. Each Gateway considers the following:

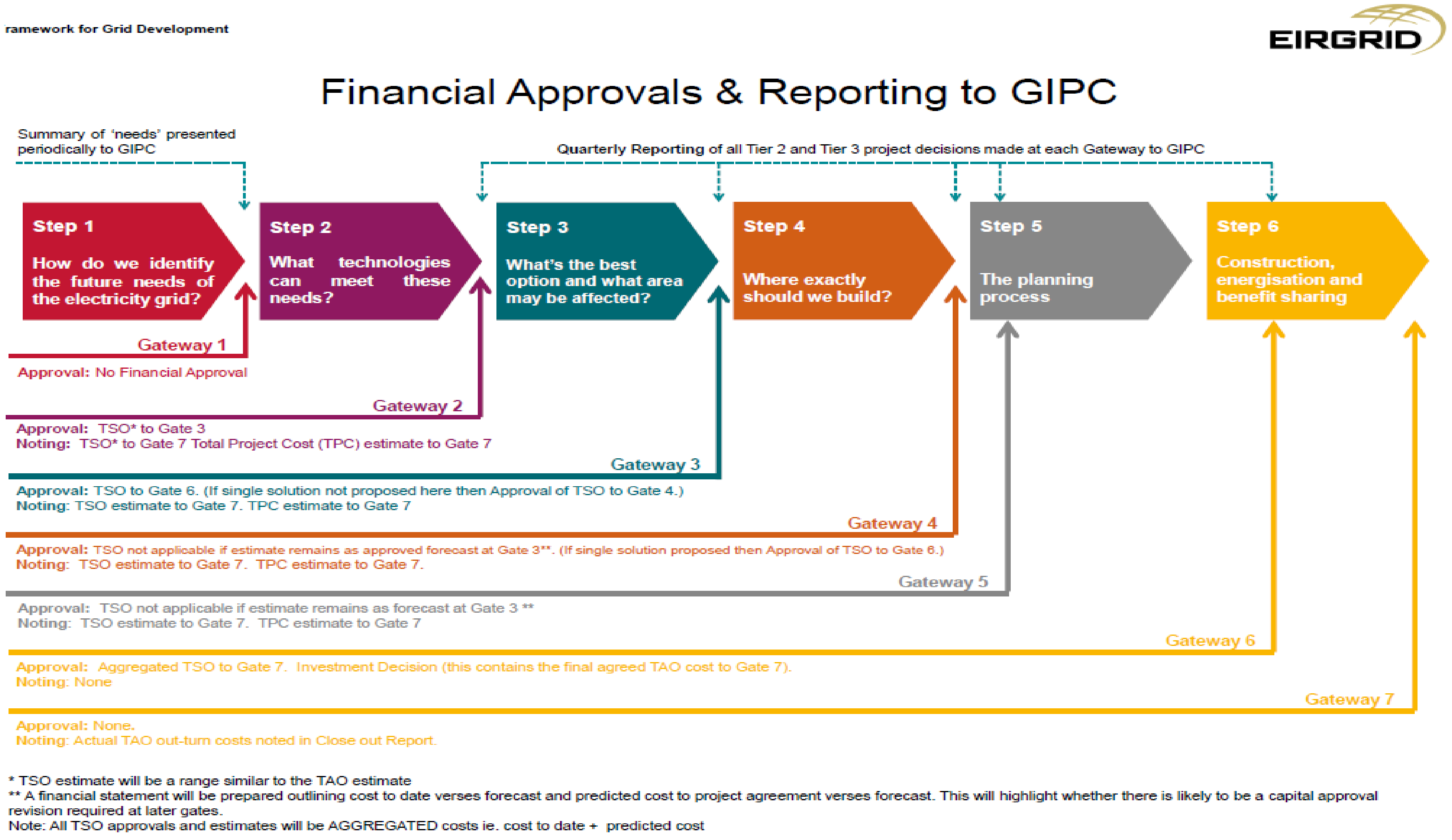
- **Process compliance:** Compliance with the framework and associated internal processes, including the extent, nature and feedback arising from public and stakeholder participation;
- **Robustness and transparency:** The rigour and outcome of any analysis or activities undertaken in the step, the level of accuracy and reliability of the data considered the transparency and robustness of the decision-making process undertaken during the step and the conclusions reached at the end of the step. Confirmation that the 'need' for the project remains valid; and
- **Scope of next step:** An outline and estimation of the activities, internal and external resources, stakeholder engagement and consultation, professional services and time required to deliver the next step. An estimate of the financial resourcing or budgeting for the next step in line with the financial control frameworks. Confirmation of the Project Manager for the next step.

The gateways are also an opportunity to consider the internal and external environment to determine whether there may be a potential impact on the project, or any impediment to advancing to the next step. This includes whether there remains a need for a project, or indeed a need for the current identified nature, location and extent of a project.

There are three possible outcomes of a governance Gateway:

- Cancel or put the project on hold;
- Amend or supplement the submission documentation and re-submit for approval; and
- Approval to proceed to the next step, with or without conditions.

The gateways generally occur at the end of a step, and sanction the project moving into the subsequent step, see Figure A.6.



ramework for Grid Development

EIRGRID

Financial Approvals & Reporting to GIPC

Summary of 'needs' presented periodically to GIPC

Quarterly Reporting of all Tier 2 and Tier 3 project decisions made at each Gateway to GIPC

Step 1
How do we identify the future needs of the electricity grid?

Step 2
What technologies can meet these needs?

Step 3
What's the best option and what area may be affected?

Step 4
Where exactly should we build?

Step 5
The planning process

Step 6
Construction, energisation and benefit sharing

Gateway 1

Approval: No Financial Approval

Gateway 2

Approval: TSO* to Gate 3
Noting: TSO* to Gate 7 Total Project Cost (TPC) estimate to Gate 7

Gateway 3

Approval: TSO to Gate 6. (If single solution not proposed here then Approval of TSO to Gate 4.)
Noting: TSO estimate to Gate 7. TPC estimate to Gate 7

Gateway 4

Approval: TSO not applicable if estimate remains as approved forecast at Gate 3**. (If single solution proposed then Approval of TSO to Gate 6.)
Noting: TSO estimate to Gate 7. TPC estimate to Gate 7.

Gateway 5

Approval: TSO not applicable if estimate remains as forecast at Gate 3 **
Noting: TSO estimate to Gate 7. TPC estimate to Gate 7

Gateway 6

Approval: Aggregated TSO to Gate 7. Investment Decision (this contains the final agreed TAO cost to Gate 7).
Noting: None

Gateway 7

Approval: None.
Noting: Actual TAO out-turn costs noted in Close out Report.

* TSO estimate will be a range similar to the TAO estimate
** A financial statement will be prepared outlining cost to date verses forecast and predicted cost to project agreement verses forecast. This will highlight whether there is likely to be a capital approval revision required at later gates.
Note: All TSO approvals and estimates will be AGGREGATED costs ie. cost to date + predicted cost

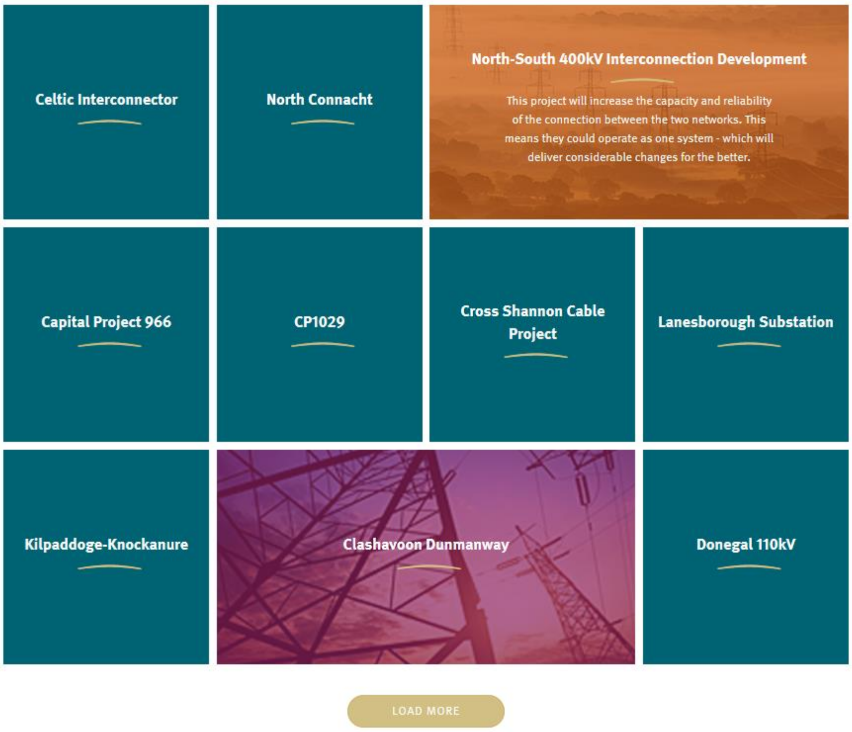
Figure A.6: Project Gateways

A.2.4 Publication of Project Information

EirGrid produces and publishes a range of documents to inform industry, stakeholders and communities of the planned developments to the transmission system. These documents include project specific documents, transmission system development document (e.g. Ten Year Development plan), and related subject specific information papers (e.g. Responding to Equine Concerns, Responding to Agricultural Concerns)

A.2.4.1 Project Specific Documents

EirGrid publishes an extensive range of project specific updates on its website. Each project page contains information on the project and why it is needed, what’s happening now, contact information and related documents.



This project will increase the capacity and reliability of the connection between the two networks. This means they could operate as one system - which will deliver considerable changes for the better.

Figure A.7: Sample landing page for transmission project information

A.2.4.2 Transmission System Development Documents

A number of the key development documents are referenced below:

Tomorrow's Energy Scenarios (TES)

During PR4, we published our consultation on Tomorrow's Energy Scenarios (TES)[5]. The aim of TES is to outline a range of credible pathways for Ireland's clean energy transition, with specific focus on what this means for the electricity transmission system over the next twenty years and beyond.

All Island Ten Year Transmission Forecast Statement

This statement is prepared each year in accordance with the provisions of Section 38 of the Electricity Regulation Act, 1999. It provides the following information:

- Network models and data of the all-island transmission system;
- Forecast generation capacity and demand growth;
- Maximum and minimum fault levels at transmission system stations;
- Predicted transmission system power flows at different points in time; and
- Demand and generation opportunities on the transmission system.

Transmission Development Plan

The Transmission Development Plan (TDP) is the plan for the development of the Irish transmission network and interconnection over the following ten years. This ten year plan presents projects that are needed for the operation of the transmission network. In addition, future needs that may drive future potential projects are also discussed. The Plan seeks to raise awareness of the specific reinforcement projects in the programme. This is consulted on annually by CRU. The final document is then approved by the CRU.

Ten-Year Network Development plan

ENTSO-E is required to adopt a Community-wide Ten-Year Network Development plan (the TYNDP) in accordance with Regulation EC 714 / 2009, in force since March 2011 whereby (According to Art. 8.3-b) "*ENTSO-E shall adopt a non-binding Community-wide 10 year network development plan, including a European generation adequacy outlook, every two years*". The Regulation set forth that the TYNDP must "*build upon national investment plans*". Irish projects of European Significance are included in ENTSO-E's TYNDP/Regional Investment Plan North Seas. According to EU Regulation 347/2013 a subset of these projects may be deemed to be Projects of Common Interest (PCIs). A

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[5] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-TES-2019-Ireland-Consultation.pdf

project may fall under the criteria of either or both of these classifications depending on its characteristics and applicable criteria.

How are Irish transmission projects included in ENTSO-E's TYNDP?

Licensed TSOs who are members of ENTSO-E and third party promoters, propose transmission projects to ENTSO-E for inclusion in ENTSO-E's Ten Year Network Development Plan (TYNDP). The technical and administrative criteria for inclusion in the TYNDP are published by ENTSO-E.

Technical criteria for inclusion in TYNDP 2020

The technical criteria and required information for inclusion of transmission projects in TYNDP 2020[6] are summarised below.

The main equipment needs to be:

- a high-voltage overhead transmission line designed for a transmission voltage of 110 kV or more in the case of direct cross-border infrastructure; or
- a high-voltage overhead transmission line designed for a transmission voltage of 220 kV or more in the case of internal infrastructure; or
- a high voltage underground/submarine transmission cable designed for a voltage of 110 kV or more.

The main equipment needs to be at least partially located in one of the countries represented within ENTSO-E.

The initial estimation of the net transfer capacity increase expressed in MW needs to be provided to ENTSO-E, where:

- for the cross-border infrastructure: no minimum limit is imposed; or
- for the internal infrastructure: no minimum limit is imposed. If the impact on the NTC is under 100 MW, projects must be planned to ensure security of supply or load growth or to allow new generation connection.

All the project characteristics necessary to model the project in the network tool used by ENTSO-E in the assessment process needs to be provided to ENTSO-E.

The following information also needs to be provided to ENTSO-E:

- Date of commissioning and status of each investment item of the project; and
- Capital and operational expenditure of each investment item of the project.

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[6] https://docstore.entsoe.eu/Documents/TYNDP%20documents/TYNDP2020/190918_ENTSO-E%20Guidance%20for%20transmission%20and%20storage%20projects%20for%20applying%20to%20the%20TYNDP%202020_FINAL.pdf

Irish Projects of Common Interest (PCIs)

The European Commission (EC) oversees the designation of Projects of Common Interest[7] (PCI). PCIs are underpinned by EU Regulation 347/2013[8]. The PCI selection is a process separate from the TYNDP process. However, to be eligible for PCI status, inclusion in the last available TYNDP is an explicit condition. PCIs are intended to help the EU achieve its energy policy and climate objectives: affordable, secure and sustainable energy for all citizens. The fourth PCI list was published by the European Commission in October 2019[9].

Figure A.8: Nesting of National and European Development Plans

A.2.4.3 Subject specific information Papers

A sample of the subject, stakeholder and community specific information papers published by EirGrid include:

- *Your Grid, Your Views, Your Tomorrow. **Responding to Equine Concerns***
    - Appendix 1 - ENTSO-E survey regarding Approach of European Grid Operators to Agricultural and Equine Land Users;
    - Appendix 2 - Review of Research on Livestock and Crops in Relation to Electric and Magnetic Fields from High Voltage Transmission Lines;
    - Appendix 3 - Equine Psychology and Behaviour; and
    - Appendix 4 - Code of Practice in Relation to Access to Land and/or Premises

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[7] https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest
[8] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:115:0039:0075:EN:PDF
[9] https://ec.europa.eu/energy/sites/ener/files/c_2019_7772_1_annex.pdf

- *Your Grid, Your Views, Your Tomorrow.* ***Responding to Agricultural Concerns***
  - Appendix 1 - ENTSO-E survey regarding Approach of European Grid Operators to Agricultural and Equine Land Users;
  - Appendix 2 - Review of Research on Livestock and Crops in Relation to Electric and Magnetic Fields from High Voltage Transmission Lines;
  - Appendix 3 - Code of Practice in Relation to Access to Land and/or Premises
- *Your Grid, Your Views, Your Tomorrow.* ***Responding to Tourism Concerns***
- ***The Electricity Grid and Your Health***

A.3 Forecast Network Capital Programme

A.3.1 Forecast Network CapEx 2021-2025

The PR5 Network Capital Programme encompasses all works, new build (customer connections and system reinforcements), uprating, and asset refurbishment at 110kV[10], 220kV, 275kV and 400kV.

EirGrid is forecasting a revenue requirement of €1.07bn for the development of Ireland's transmission network in the 2021-2025 period, a period which will require significant investment in the grid to ensure we are in a position to meet all of our policy and climate change commitments out to 2030. This is comparable to, but marginally higher, than the €0.99bn[11] provided for by the CRU as part of PR4.

The forecast provides a pathway over the next decade which will allow us to connect increased levels of renewables in the form of Onshore and Offshore Wind, and Solar. This is within the context of also connecting new conventional generation plant which will result from the T-4 and T-1 capacity auctions in addition to meeting demand and datacentre customer connection requirements to enhance economic growth.

The network CapEx forecast is designed to provide a network that can:

- facilitate economic development across the regions and one which will provide secure and reliable power supply to all its citizens while addressing security of supply in Dublin and the regions;
- facilitate an increase in the connection of and export from new generation, much of it renewable, and much of it remote from traditional load centres to meet our government policy and 2030 climate change targets; and
- facilitate the development of further interconnection.

The network CapEx forecast is first and foremost a list of individual network projects designed to meet identified needs on the grid. Each project represents a view of the optimal solution to meet the need, both current and anticipated. Of course any forecast is only a snapshot of the current expected progression of the network build programme, a point estimates from an expected probability distribution for the scenario. The reality is

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[10] It is noted that the 110kV network in Dublin city falls within the remit of ESB as Distribution System Operator.

[11] This is the PR4 provision in 2019 monies.

that EirGrid's transmission network programme, and the projects which comprise it, remain under constant review as to their requirement, and to the preferred solution.
In this it is recognised that:

- A number of the current project drivers and elements of the scenarios may ultimately not transpire;
- New project drivers not currently foreseen will arise;
- New technological solutions may come forward and reach a level of maturity that they can ultimately be adopted; and
- Projects will not always proceed along the timelines anticipated due to factors outside of EirGrid's direct control.

In Section A.2 governance through the Stage Gate review process as and when new information comes to light.

EirGrid formally reviews transmission projects at key stages in their development e.g. prior to lodging of a planning application. As part of this review we ensure that the justification for the project remains appropriate and robust in light of current facts including the most up to date cost information available to us.

Whilst EirGrid is responsible for assessing project need and solution identification, it is only responsible in terms of cost for the early stage works in achieving consents, issuing functional specification and land access (referred to as Stage 1 costs). The vast majority of the cost of the programme is construction costs (Stage 2) and is the responsibility of the TAO.

In developing the forecast we have worked closely with the TAO and have employed forecasts developed by the TAO, where the project has already been handed over to TAO, or has employed standard 2019 costs or current best judgement where such costs have not been available. It is ultimately TAO who provides actual costs associated with the delivery of the projects identified by EirGrid, however the Project Agreement signed at Gateway 6 represents an agreement between both organisations that the project need is robust and that the scope, costs and timelines are acceptable.

Each of the individual projects has been re-forecast and reassessed by EirGrid as part of this price review process. However, the purpose of the price review is not to assess the individual projects themselves, nor indeed to provide for the 'approval' of revenues associated with those projects which should ultimately progress, but rather to determine an overall provision as part of a revenue model, which can be financed by both the TAO and EirGrid for the progression, and delivery, of a network which meets Ireland's needs for the next period and beyond.

One of the strengths of the regulatory model in Ireland is that it has been designed to provide for flexibility in the determination of that which ultimately proceeds and that which is ultimately paid for by customers. During PR4 the network programme and the monies paid by customers, flexed on the basis of that which came forward. Similar flexibility will also be needed as part of PR5 and all the more so given the uncertainty as to the solution environment which will develop and indeed the generation portfolio which will emerge from RESS.

Challenges in deliverability, a more complex environment in terms of societal acceptance for grid infrastructure coupled with an increased acknowledgement globally of the need to move to a low carbon future characterised PR4; similar challenges will be present in PR5 and PR6. Part of the response to improving deliverability has been a change to the statutory and consenting framework and new requirements in terms of environmental legislation, habitats and Appropriate Assessments. This means that, quite appropriately, enhanced rigour, but also inevitably greater time and cost is expended in advancing projects to the construction stage. The funding proposal outlined in this submission provides our best forecast of how we can balance the challenges in deliverability with the need to meet our climate change targets, contractual obligations to customers and our obligations to maintain our security of supply.

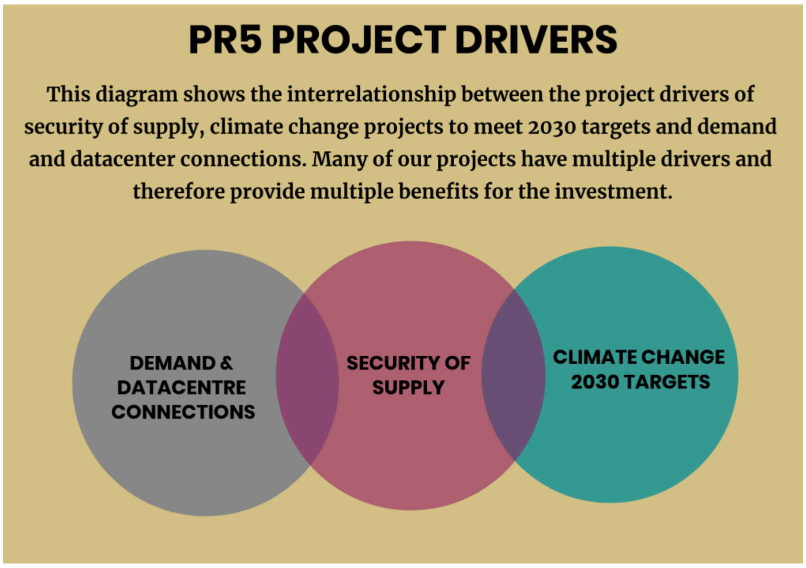
A.3.2 PR5 Project Drivers and Associated Requirements

During the development of the PR5 dataset it has become apparent that many of our projects (in both ongoing and under consideration categories) fulfil multiple drivers. That is to say, certain projects facilitate climate change and 2030 targets, while also enhancing security of supply. In some instances projects have been identified as fulfilling all 3 of the drivers identified for PR5. For the purposes of PR5 we have categorised our project drivers as follows:

Project Category

1. **Security Of Supply** – Projects required to maintain security of supply which includes asset refurbishments and system reinforcements.
2. **Datacentres and Demand Customer Connections** - Supporting Business & Society Connecting Demand Manufacturing and Datacentre connections Customer & Shallow Connections -Ongoing and Under Consideration

3. **Climate Change 2030** Renewable Targets projects required in PR5 -Ongoing and Under Consideration

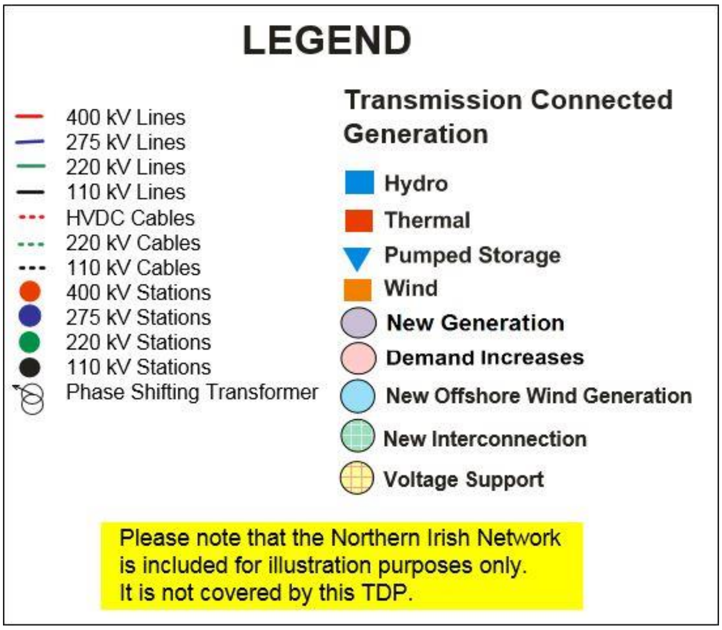


PR5 PROJECT DRIVERS

This diagram shows the interrelationship between the project drivers of security of supply, climate change projects to meet 2030 targets and demand and datacenter connections. Many of our projects have multiple drivers and therefore provide multiple benefits for the investment.

Figure A.9: PR5 Project Drivers

The transmission system graphic in Figure A.11 illustrates the areas of change driving network development in the PR5 period. The legend for the graphic is extract below in Figure A.10 for readability.



Please note that the Northern Irish Network is included for illustration purposes only. It is not covered by this TDP.

Figure A.10: Legend for Transmission System Graphic – showing drivers for network development

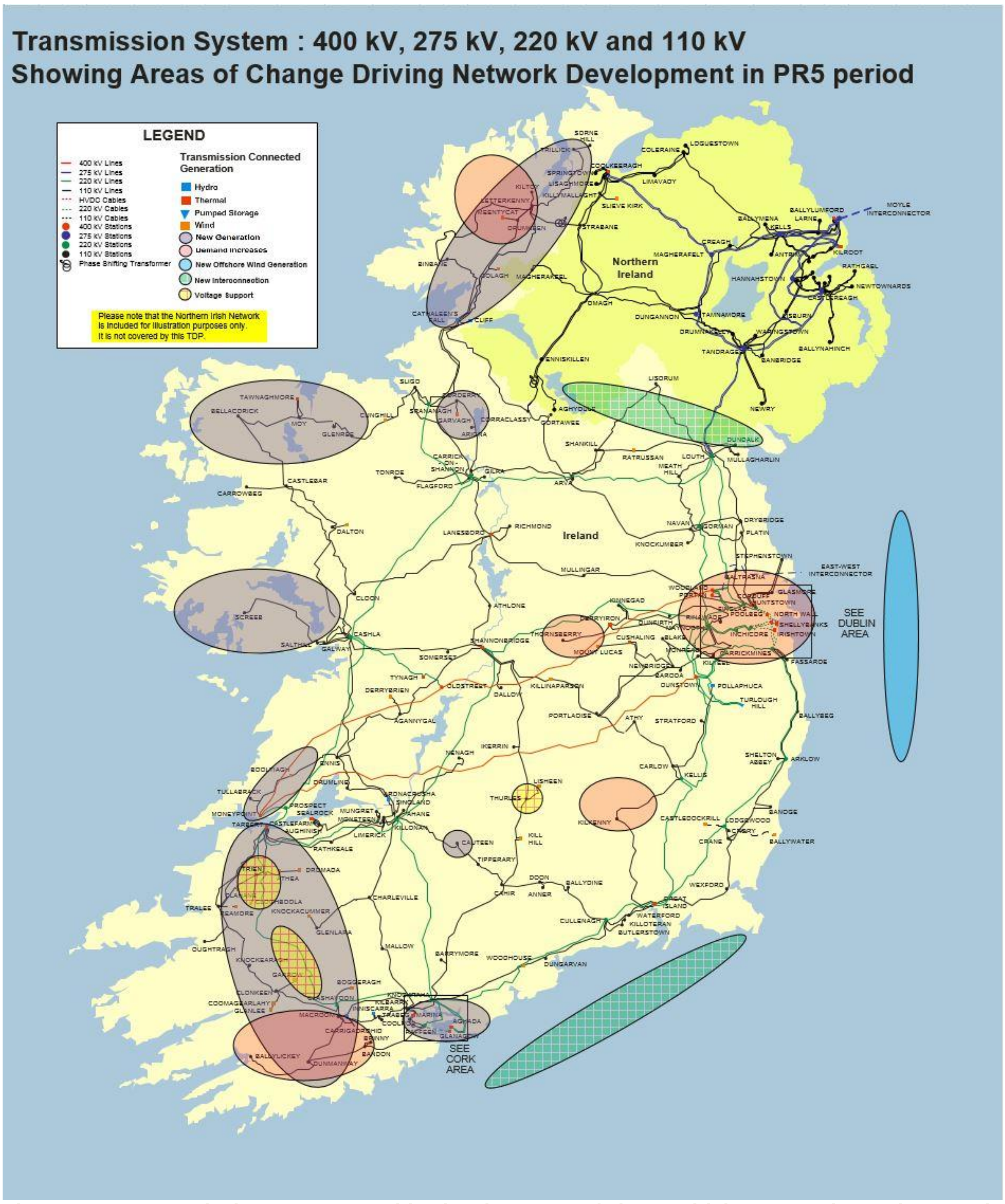


Figure A.11: Transmission System graphic showing areas of change driving Network Development in the PR5 period.

A.3.3 Developing the Forecast

In preparing the PR5 CapEx programme and associated schedule and financial profiles, EirGrid sought input from across the various arms of the business that have roles in the overall delivery of the network. The programme of projects was reviewed by the TAO programme and finance teams. Reference was also made to EirGrid's Multi-Year Delivery Programme, the EirGrid Tomorrow's Energy Scenarios (TES) and Generation Capacity Statement (GCS) publications, in addition to the programme commitments for customer connections of various types, including pipeline projects contained in the offer process. In this document the assumptions and methodologies for the various inputs are outlined.

The programme was developed by reference to the three categories of project drivers (ref Section A.3.2)

1. Security Of Supply
2. Datacentres and Demand Customer Connections
3. Climate Change 2030

A.3.3.1 Security of Supply Projects

The complete list of security of supply projects was compiled from the ongoing projects from PR4 combined with projects currently being studied by Network Planning to meet future needs, projects from System Performance to cover necessary protection upgrades, and projects from TEM to cover asset refurbishment and maintenance in line with Asset Management policy.

1. For **ongoing projects** (Post Gateway 3): the TSO cost assumptions were based on the current project financial forecasts and programmes. The TAO costs were based on the Project Implementation Plans (PIP) received, or in cases where PIPs have not yet been received, the costs were estimates based on the latest revision of the Transmission Standard Development Costs (TSDCs) provided by the TAO. In many cases the financial and schedule data was updated from that which was provided to CRU in the 2018 joint annual TSO/TAO report submitted in April 2019.
2. For **pipeline projects** (Pre Gateway 3): the project assumptions were based on inputs from EirGrid's Network Planning, Transmission Engineering and Maintenance, and System Performance teams. Pipeline Projects by their nature are in the early assessment stage with a number of potential solution options for each need. For the purposes of compiling the forecast an assumed solution has

been employed and costed as follows. These costs are thus indicative and subject to change depending on which option is selected ;

   a. The TSO costs were calculated as follows:
      - Estimates and assumptions were made for TSO costs, taking into consideration the category, type, and duration of each project, as well as with reference to recent delivery schedules for similar categories and types of projects, including assumptions as to the level of stakeholder engagement, community gains etc.
   b. The TAO costs were calculated based on the latest revision of the TSDCs provided by the TAO. For elements of projects not included in the TSDCs, figures were based on the average of similar approved projects or realised spend for projects of a similar nature and scale;
   c. The schedule durations were based on an assessment of all ongoing projects and the schedules provided include a point in time estimation for completion.

A.3.3.2 2030 Climate Change & Datacentre Projects

The list of renewable and demand customer projects was compiled based on ongoing ('live') and pipeline projects. These projects are essential to ensure further economic growth and for development and connection of renewable projects to meet Ireland's 2030 Climate Change Targets.

1. For **ongoing projects**: the TSO cost assumptions were based on the current project financial forecasts and programmes. The TAO costs were based on the PIPs received, or in cases where PIPs have not yet been received, the costs were estimates based on the latest revision of the TSDCs provided by the TAO.
2. For **pipeline projects**: the project assumptions were based on a number of categories:
   a. A number of projects currently on hold, but expected to progress within PR5; for example, projects that are awaiting a decision on planning;
   b. In the process of receiving an offer via the offer process schedule;
      i. Contracted – Customer has executed their connection agreement, the vast majority have CP Nos., a small number are in project setup and will be assigned CP Nos. in due course

        ii. Being processed – are in the offer process schedule and will be issued an offer in the near future*[12]
        iii. Live offer – Customer has been issued an offer, but have yet to execute

    c. ECP-1: Have received or will receive an ECP-1 offer for full or partial capacity of their connection under CRU/18/058;
    d. T-4: Successful connections under the T-4 process will receive an offer in due course and have fixed connection dates of 31/10/2022;
    e. Volume Capped Auctions;
    f. Group 1 Demand Connections: connection offers are being issued to Demand Customers. These Customers will be offered a flexible demand arrangement whereby EirGrid retain the right to reduce the Customer's available MIC after 2023 in the event that there are capacity issues in the Dublin region;
    g. Group 2 Demand Connections: where connection applications or enquiries have been received from Demand Customers not included in Group 1. Estimates have been included as to potential extensions of existing connections from enquiries received.

Ireland has committed to achieving 70% RES-E by 2030 (90% SNSP) as part of the "All of Government Climate Action Plan". Provisions therefore have been included in PR5 for the following:

- Offshore wind is expected to play an increasing role in the achievement of Ireland 2030 renewable energy targets. From discussions with DCCAE, CRU, DHPLG and the industry and supported by; it is expected that a number of *"legacy"* offshore projects (2-3) will progress within the PR5 period. These are projects which have varying levels of consent for offshore developments; commenced in the last decade; and
- The development of an enduring delivery model for offshore windfarm connections is also included in the "All of Government Climate Action Plan". In order to meet the plan's target of 3.5 GW of offshore wind by 2030 further development will be required. Whether this will be a de-centralised model (developer-led) or centralised

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[12] For projects which are at the "Being processed" stage in offer process the connection method is yet to be fully determined. For these projects, assumptions of the connection method have been made based on the Customer's requested connection point, the scale (MW) of the project and its geographical proximity to existing infrastructure.

model (plan-led) is still to be determined. Regardless of which direction this follows, the connection of this volume of offshore wind will result in increased onshore transmission network connection and reinforcement works. Taking into account the EirGrid Ease Cost Study provision has been made for the commencement of two (onshore) projects with the PR5 period;

- Two interconnector projects, which hold PCI status, are currently under development; Greenlink, a 500MW link to Great Britain, and Celtic, a 700MW link to France. As with onshore generation and demand connections, these projects will drive lead to wider network reinforcement projects on the transmission system.
- Developments associated with the connection of successful generators under the RESS.

In order to develop a comprehensive breakdown, the *2030 Climate Change and Datacentre category projects* was developed, underpinned by the following principles:

- The forecast TSO costs were based on the category, type, and duration of each project, with reference to recent, similar projects;
- The TAO costs were calculated based on the latest revision of the TSDCs provided by the TAO. For elements of projects not included in the TSDCs, figures were based on the of similar approved projects governance figures or realised spend for projects of a similar nature and scale;
- The schedule durations were based on an assessment of all ongoing projects within the New Connections team. The duration of the time between each Gateway in the Framework for Grid Development from each group of project was taken[13].
    - Capital Approval (CA), assumed to take place five months post issuance of offer (three months offer execution period plus two months CA preparation);
    - Project Agreement (PA), assumed to be ten months post Capital Approval;
    - Energisation, for 110 kV standard infrastructure projects circa 18 months post PA, 220 kV circa 24 months post PA.

A3.3.3 Scenario Development

In developing the investment requirement for the PR5 Period, EirGrid considered three Scenarios; (1) Unconstrained; (2) Embracing Change, Delivering Targets and (3) Business as Usual (BAU). As part of our assessment we conducted a review and

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[13] It should be noted that these are general assumptions. In some cases a subsequent review at a project level may have resulted in individual project data being updated in the dataset including schedule and/or costs.

comparison with annual CapEx spend in PR3 and PR4 in order to ensure an achievable year-on-year programme of work for the PR5 period which meets government policy, our obligations to connect customers and provides a pathway to delivering on the 2030 climate change targets.

The three scenarios are summarised in Figure A.12.

Scenario	PR5 Investment Requirement	Comment
Unconstrained	€2.02bn	Assumes no constraints in delivery, funding, resources, planning consent, land access or outages.
Embracing Change, Delivering Targets	€1.07bn	Achieves RES E target of 52% for 2025 and pathway to deliver RES E 70% by 2030. Requires changes to delivery model and Infrastructure Agreement to deliver circa €220m per annum.
Business as Usual (BAU)	€0.94bn	2025 & 2030 Climate Change Targets at Risk, assumes same delivery constraints and funding and delivery model as occurred during PR4.

Figure A.12: CapEx Funding Scenarios for PR5

EirGrid is recommending the scenario Embracing Change and Delivering Targets which drives the investment requirement of €1.07bn.

The following notes and assumptions underpin the Scenarios developed for the PR5 CapEx Programme, addressed in further detail in the sections below and included in the BPQ section 6.3/6.4 CapEx spreadsheet:

- The full PR5 list of projects represents an unfiltered/unconstrained list of all work that EirGrid and the TAO ESB would/could undertake in the absence of budget/outage/resource/external constraints.
- Reductions associated with *Customer Contributions* and *Interest During Construction* is then applied for the different scenarios.
  - Customer Contributions have been estimated on a pro-rata basis, using the PR4 forecast outturn figures for Customer Contributions (and MW to be connected) as a baseline.
  - Interest During Construction (IDC) has been applied at 5% of the forecast TAO spend for each year from 2019 to 2025.

Unconstrained Model

The full PR5 list of projects represents an unfiltered/unconstrained Ex-Ante Forecast programme of work that EirGrid and the TAO could in theory be achieved in PR5 in the absence of any constraints such as, resources, funding, planning consents, land access, outages etc.

The unconstrained scenario amounts to an investment requirement of €2.02bn (Figure A.13).

Unconstrained Model for PR5 (€ Million)	Total in the PR5 Period
EirGrid	142
TAO	1,881
Total	**2,023**

Figure A.13: Unconstrained CapEx Revenue forecast 2021-2025

The unconstrained list generates the overall total value of the identified capital works net of reductions associated with Customer Contributions and Interest during Construction:

- Customer Contributions have been estimated on a pro-rata basis, using the PR4 forecast outturn figures for Customer Contributions (and MW to be connected) as a baseline.
- Interest during Construction (IDC) has been applied at 5% of the forecast TAO spend for each year from 2019 to 2025.

The unconstrained list is the base case underpinning each of the subsequent scenarios.

Embracing Change, Delivering Targets Model

The Embracing Change, Delivering Targets scenario is a more ambitious investment profile, which will provide a pathway for delivery of the 2030 Climate Change Targets, while maintaining security of supply and meeting demand and datacentre customer connection requirements. This scenario requires us to adapt the current Industry model and embrace a transformation within EirGrid and the TAO businesses. Changes would be required to the ways in which EirGrid and the TAO collaborate to deliver projects, the adoption and application of new technologies, modifications to the current procurement models and increased levels of activity to develop community support. Further details on the improvement and capability requirements necessary to enable grid delivery are set out in Section A.4. A CapEx investment requirement of €1.07bn (Figure A.14) would be required to deliver this programme of work, after the application of Community gain, Customer contribution, Interest during construction, and other payments/deductions.

Embracing Change, Delivering Targets for PR5 (€ Million)	Total in the PR5 Period
EirGrid	81.0
TAO	985.9
Total	**1,067**

Figure A.14: Embracing Change, Delivering Targets CapEx forecast 2021-2025 (Recommend Scenario)

To arrive at the Embracing Change, Delivering Targets model, a factorisation exercise has been undertaken on the Unconstrained Scenario with factors applied on a project-by-project basis. In so doing, we are seeking to reflect that project drivers will evolve, that not all projects will ultimately progress, or progress as currently envisaged, or progress in as timely a fashion as the simple point estimates would suggest.

- This exercise takes into account the following:
    - current level of project maturity
    - outage availability
    - land access, planning, and consent risks
    - project complexity
- A factoring approach was also undertaken for PR4.
- To provide an independent check for the Embracing Change, Delivering Targets scenario, a list of projects was prepared, and a deliverability assessment undertaken by the TAO ESB, based on the following criteria:
    - Projects with CA achieved/forecast by the end of PR4;
    - New Connection projects in the offer process as of Aug 2019; and
    - Projects with Energisation forecast by the end of PR5.

The Embracing Change, Delivering Targets forecast does not represent the full cost of the individual projects, but a view as to the likely scale of investment that will be advanced in the PR5 period, as opposed to in subsequent periods, and subject, of course, to the factoring above.

Business as usual model (BAU)

The Business As Usual scenario would replicate the PR4 allowance for PR5 i.e. €0.94bn (Figure A.15), after the application of Community Gain, Customer contribution, Interest during construction, and other payments/deductions. BAU represents the partially-constrained, but achievable volume of capital projects under the existing delivery model. It is (for this scenario) assumed that network, resource and delivery constraints combined with planning, procurement, and challenges under the current Industry model will have a similar impact on the delivery of projects during PR5 as was the case during the PR4 period resulting in an annual invoice/spend in the period broadly equivalent to that in PR4. EirGrid would be of the view that our Climate Change 2030 targets would be placed at risk should we adopt this scenario.

BAU for PR5 (€ Million)	Total in the PR5 Period
EirGrid	74
TAO	870
Total	944

Figure A.15: BAU CapEx Revenue forecast 2021-2025

The BAU forecast does not represent the full cost of the individual projects, but only that likely to be advanced in the PR5 period, as opposed to in subsequent periods, and subject, of course, to the factoring for the above reference constraints.

A.3.4 Stage 1 Spend

In relation to Stage 1 spend, the advancement of the early stage works, EirGrid incurs and carries the associated project cost until such time as the project reached Project Agreement (PA) with the TAO at which point the project specific costs are invoiced to the TAO and added to the Network RAB in accordance with the arrangements under the IA. The overall profile of the Stage 1 spend and receipt is presented below.

TSO Stage 1 Forecast Spend and Receipts (€ Million)	2025
Opening Asset Value (OAV)	**27.4**
Spend	7.6
Invoiced	-8.9
Closing Asset Value (CAV)	**26.1**

Figure A.16: Profile of Stage 1 Spend and Receipts

A.4 Enablers - Capability Measures Grid Delivery

We have outlined a forecast Network CapEx Requirement of €1.07bn for PR5 which represents an increase of €266m on the €801m outturn for PR4. This forecast requires the TSO/TAO delivery to increase to on average €213m per annum in terms of spend[14] during the period, from the average of €160m per annum of spend during PR4.

As described in Section A.1 and Chapter 1 – Future Trends, the scale of ambition needed and challenges which need to be overcome to deliver on our Climate Change 2030 targets and Customer connections while maintaining security of supply is significant and complex. The scale of the challenge in our view requires a step change in the combined approaches of both EirGrid and the TAO, alongside an increased level of collaboration between EirGrid, the TAO, Developers and the CRU.

The Industry deployment times for the development of renewable infrastructure will need to increase six fold to transition to a low carbon economy.[15] The RESS and T-4 capacity auctions by design set an expectation of delivery of the grid connection within 2 to 4 years of the auction award year, placing grid connections on the critical path for these projects.

Within this context EirGrid and the TAO continue to develop and implement a programme of improvements which are aimed at improving our value proposition to our customers and stakeholders. The step change required to meet the scale of ambition in achieving a low carbon future during PR5 and into PR6 is challenging significant and the improvements and capability requirements described here to enable same significant.

A.4.1 Multi-Year Delivery Programme (MYDP)

Critical to achieving the required step change in project delivery and in turn the Climate Action Plan targets is the ability to schedule and manage the transmission programme of work arising from an increased number of 2030 climate change, security of supply and demand connection projects. In addition to the ongoing projects, the MYDP will contain these future projects as an iterative programme of work.

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[14] Spend is the sum of the TSO Invoiced Spend and TAO Spend. i.e. the costs added to the Transmission RAB

[15] Global Energy Transformation Report Roadmap to 2050 IRENA 2018

The current transmission system outage season consists of approximately 190 working days between the end of February and the end of November. The ability to scale the outage programme to accommodate the projected increased transmission programme of work will be a key enabler for delivery against targets in PR5 and PR6. EirGrid in consultation with the TAO is evolving the MYDP to drive more efficient programmes of work and improve contingency planning by using the lessons learned from the first three years of its existence (2017-2019).

The following examples from the MYDP in 2018 are provided to illustrate these improvements:

1. Earlier project sequencing facilitating the identification of comprehensive project plans.
    - The detailed project sequencing of the Killonan 220 kV and Knockraha 220 kV station projects identified when a transformer would be available in Knockraha 220 kV for re-use in the Killonan 220 kV station, thus introducing an early saving/efficiency and a reduction of 9 months of transmission outages. This is a critical outage saving in the SW region which is currently heavily constrained.
2. Earlier programme sequencing facilitating the identification of logical outage overlaps and regional dependencies,
    - The MYDP provides a platform to carry out an impact assessment when new high priority projects are required to be added to the programme and delivered in the near timeframe.
    - After the issuance of MYDP 2020 – 2024 in July 2019, we will be moving towards quarterly sequencing workshops to re-sequence projects which have had programme changes to assess the impacts to the wider multi-year programme of works.
3. Earlier shadow planning[16] facilitating the identification of realistic outage plans and specific outage conflicts,
    - The earlier identification of outage constraints has been implemented in the first 3 years of the MYDP. A recent example being at Kilpaddoge 220 kV station. In 2018, a conflict between the outages required for two high

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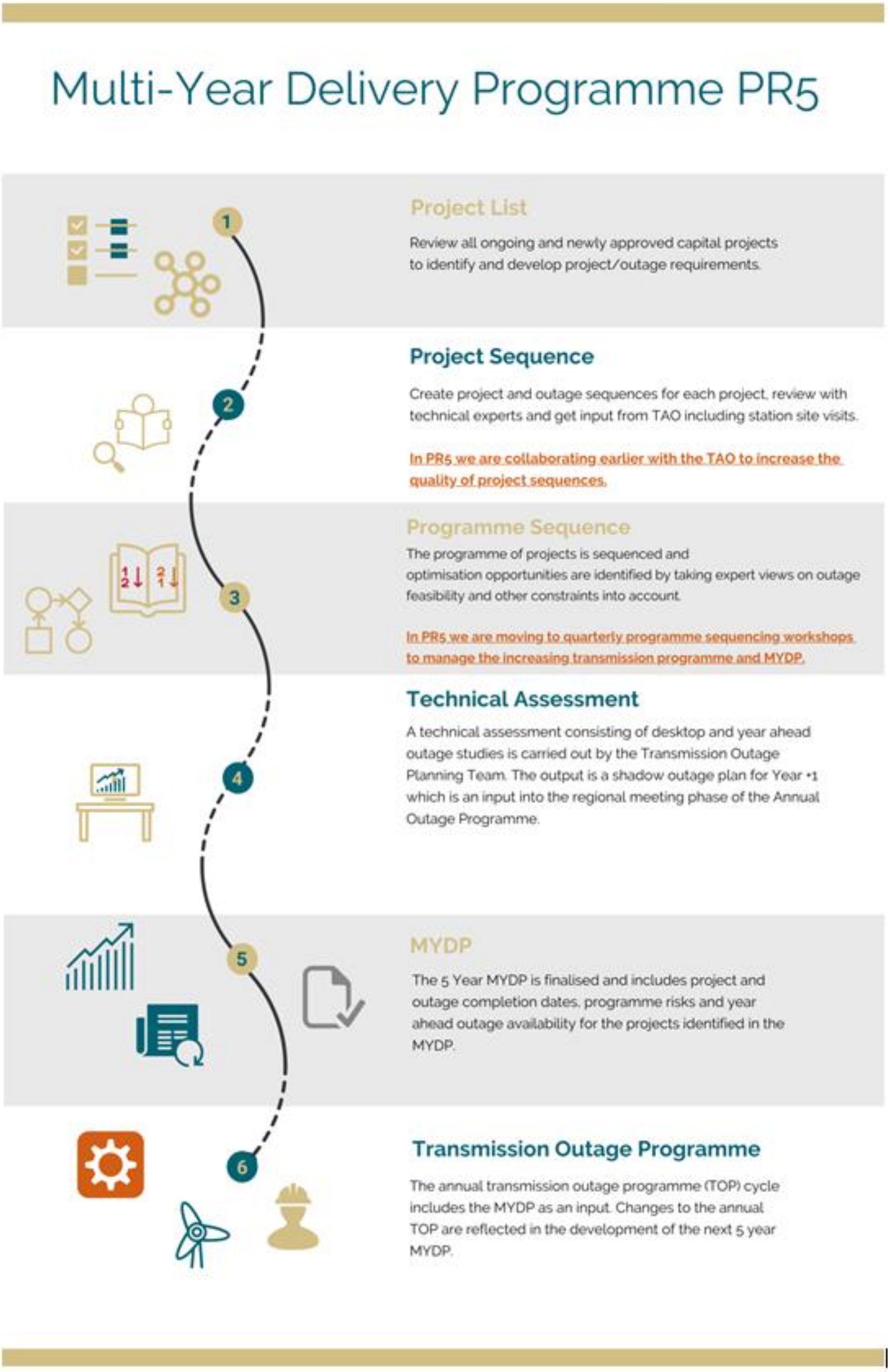
[16] Outage shadow planning is a desktop technical study and model of the Y+1 outage plan yielding a programme of feasible and infeasible outages, thus providing earlier opportunity to intervene and re-sequence project activities where required, resulting in a more efficient outage programme in Y. The actual outcome in Y is dependent on a) the quality of the information provided in the shadow plan and b) meeting the planned outage slots forecast in the MYDP.

priority projects (Kilpaddoge 220 kV station and Ballynahulla – Knockanure 220 kV) was identified in the shadow plan assessment for the 2019 outage season. The early identification allowed time to engage and work collaboratively with TAO to re-sequence the Kilpaddoge 220 kV project to enable other Kilpaddoge project works that were originally to take place in 2020, to take place in 2019 instead, thus making efficient use of the 2019 outage season. This demonstrates the significant benefits of having a MYDP in place allowing both TSO and TAO to plan for delivery in a thorough and coordinated manner.

In the 2018 outage programme we progressed and completed 40 transmission projects including the connection of 183 MW of TSO wind and 171 MW of DSO wind generation. On average the number of outage weeks per project was c.10 weeks in 2018. The increased programme of work required under PR5 places additional importance on the quality and accuracy of a MYDP. It also places additional responsibility on EirGrid and the TAO to plan, and meet the project and outage schedules identified at an early stage in the project lifecycle. This responsibility also extends to customers connecting to the system to give accurate connection dates in order to meet specific future planned outage slots or windows.

Further improvements identified for the cross-functional MYDP team includes the use of contingency plan projects which can be put in place as mitigation against a situation where a project is postponed or cancelled at short notice, thus utilising the outage slot i.e. working with the TAO to identify projects which can have materials or designs readily available for quick mobilisation to site in the case where an outage slot becomes available.



Multi-Year Delivery Programme PR5

Project List

Review all ongoing and newly approved capital projects to identify and develop project/outage requirements.

Project Sequence

Create project and outage sequences for each project, review with technical experts and get input from TAO including station site visits.

In PR5 we are collaborating earlier with the TAO to increase the quality of project sequences.

Programme Sequence

The programme of projects is sequenced and optimisation opportunities are identified by taking expert views on outage feasibility and other constraints into account.

In PR5 we are moving to quarterly programme sequencing workshops to manage the increasing transmission programme and MYDP.

Technical Assessment

A technical assessment consisting of desktop and year ahead outage studies is carried out by the Transmission Outage Planning Team. The output is a shadow outage plan for Year +1 which is an input into the regional meeting phase of the Annual Outage Programme.

MYDP

The 5 Year MYDP is finalised and includes project and outage completion dates, programme risks and year ahead outage availability for the projects identified in the MYDP.

Transmission Outage Programme

The annual transmission outage programme (TOP) cycle includes the MYDP as an input. Changes to the annual TOP are reflected in the development of the next 5 year MYDP.

Figure A.17: Multi-Year Delivery Programme in PR5

A.4.2 TSO/TAO Collaboration

The scale of CapEx required in PR5 and PR6 to meet the development needs of Ireland's transmission network and our national 2030 climate change targets is significant and will require innovation in the way we work individually and together if it is to be achieved.

A joint working group was set up to carry out a detailed review of the Infrastructure Agreement (IA) that sets out how the relationship between our two organisations should work and to determine if this required any change to enable the innovations required. This review has been completed and EirGrid and the TAO share the view that amendments to the IA are not necessary. We have embarked on a full review of the operational working relationships between the two companies. This we believe can be achieved within the CRU approved principles of the current IA.

The group consists of senior managers from EirGrid and the TAO. The progress of the group is overseen by a joint executive level working groups comprising executives from the project and operational sides of both businesses. This Executive group reports directly to the EirGrid CE and the ESBN Managing Director.

The working group meets as required and is currently meeting weekly. A total of twelve (12) meetings have taken place at senior manager level with a further six (6) at Executive and CE/MD level.

We are proposing to jointly develop and implement optimal grid delivery process improvements under the existing IA (many of which we have already trialled on existing projects) and to further enhance the collaboration and cooperation between EirGrid and the TAO to the benefit of all our customers. These changes will support the delivery of the transformation of our national energy infrastructure called for under the government's Climate Action Strategy – delivering low carbon energy to all our customers while enhancing security of supply and supporting economic growth across the country.

A.4.3 New technology solutions to meet network problems

A key strategy during the PR4 period was to examine new and better ways of doing work and this resulted in the development of projects of a technology type new to the Irish transmission system.[17] These technologies include:

- Deployment of STATCOMs
- Distributed Series Reactors (DSR)
- Power Flow Controller - Static Synchronous Series Compensation (SSSC)
- Composite Poles
- Tower Voltage Uprates

As set out in the PR4 Lookback Submission some of these technologies now form part of our solution option toolbox while others are still in the trial phase. Deployment of these technologies and ongoing development and trial of emerging solutions will be a core element of the PR5.

A.4.4 Enhanced Oversight of Contested Works

During PR4 serious concerns were identified in regard to the standard of work on contestable builds, which was impacting negatively on the delivery of all projects including:

- Customer's proceeding with installation prior to design review being completed;
- Concern for Earthing & Cable Duct installation quality issues;
- Concerns regarding quality of pre-commissioning;
- Very large commissioning snag lists;
- Numerous electricians remedying snags during Commissioning; and
- At pre-commissioning handover, EirGrid and the TAO are regularly handed plant that is unfit for handover to commissioning phase.

These issues lead to programme delays, impact on commissioning schedules and ultimately the energisation of connections. In addition and more significantly the issues identified have the potential to put both the transmission system and those engaged in the commissioning and operation of such contestably built assets at risk.

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[17] As set out in Section 7.4 of the PR4 Lookback Submission

In December 2016 EirGrid and the TAO called an all industry briefing to highlight the issues and set in process a series of changes to the project oversight. These changes focused on Enhancing Stage Gate reviews in the Contestable build programme at the design and pre-commissioning stage and putting in place a requirement for Formal Notifications required to progress between Stage Gates as illustrated in Figure A.18 below.

Figure A.18: Contestable Build Projects – Stage Gate Review Process

A formal Derogation Request procedure was established whereby a customer may seek a derogation from a specific functional design specification requirement where they consider that compliance with the obligation is impractical in its particular circumstance. Such circumstances would need to be exceptional and industry is conscious of same.

The number of design review workshops and customer meetings were increased. In addition increased oversight on Construction Inspections on contestable projects was rolled out.

These changes have led to an increase in quality of contestable builds which has enabled projects advance to commissioning and energisation more readily and in turn enable EirGrid and the TAO to have better certainty over the commission windows and likely connection dates of projects.

As we move into PR5 the significant scale of new connections, the majority of which at transmission level will be advanced on a contested basis, will drive a continued and potentially increased requirement for contestable build oversight and management.

A number of measures are being implemented so that the improvements made in PR4 are not lost in the drive to get new plant connected, these include:

- The roll out of revised external facing documentation, functional specifications etc., taking on board industry feedback and learning during the PR4 period, to limit where possible the scope for ambiguity or misinterpretation of requirements. The roll out of Transmission Designer Certification and Authorisations

  - EirGrid and the TAO shall check competence and resources of all appointees and that Customers only appoint designers who are competent to carry out their Safety, Health & Welfare at Work (Construction) Regulations 2013 duties.
  - Such Authorisations are considered an appropriate mechanism for satisfying the Construction Regulation requirements for competency.
- Continued high-levels of technical support in customer clinics and on site through an increased number of Client Engineers (Ref. Section A.4.4.4)
- Continued customer project management, ensuring that appropriate project controls and effective and proactive communication are in place through an increased number of New Connection Project Managers (Ref. Section A.4.4.3)

A.4.5 Providing additional Capability for Grid Delivery

To ensure EirGrid has the capability to deliver on its roles and functions in grid development, which are central to the realisation of a sustainable and decarbonised future for Ireland, it is necessary for EirGrid to plan and augment the current resourcing model across a number of project related teams and functions. In the sections below EirGrid has outline four key areas where additional resourcing requirements have been identified:

- 2 x Agriculture Liaison Officers (ALO)
- 2 x Transmission Project Managers
- 10 x New Connections Project Managers
- 4 x Client Engineers

These additional resources will be recovered as part of the Network CapEx Programme, taking into account, where applicable, customer contributions from connection charges. This is consistent with the current framework for their recovery. These additional resources are included in the forecast of Network CapEx Costs as set out in Section A.3.

The scale of ambition required to meet the 2030 targets including that required in the PR5 period is shown in Figure A.19 below. The breadth of connection works; renewables, batteries, thermal and demand, that would be required to be facilitate is significant and a notable step change from that facilitated in the PR4 period.

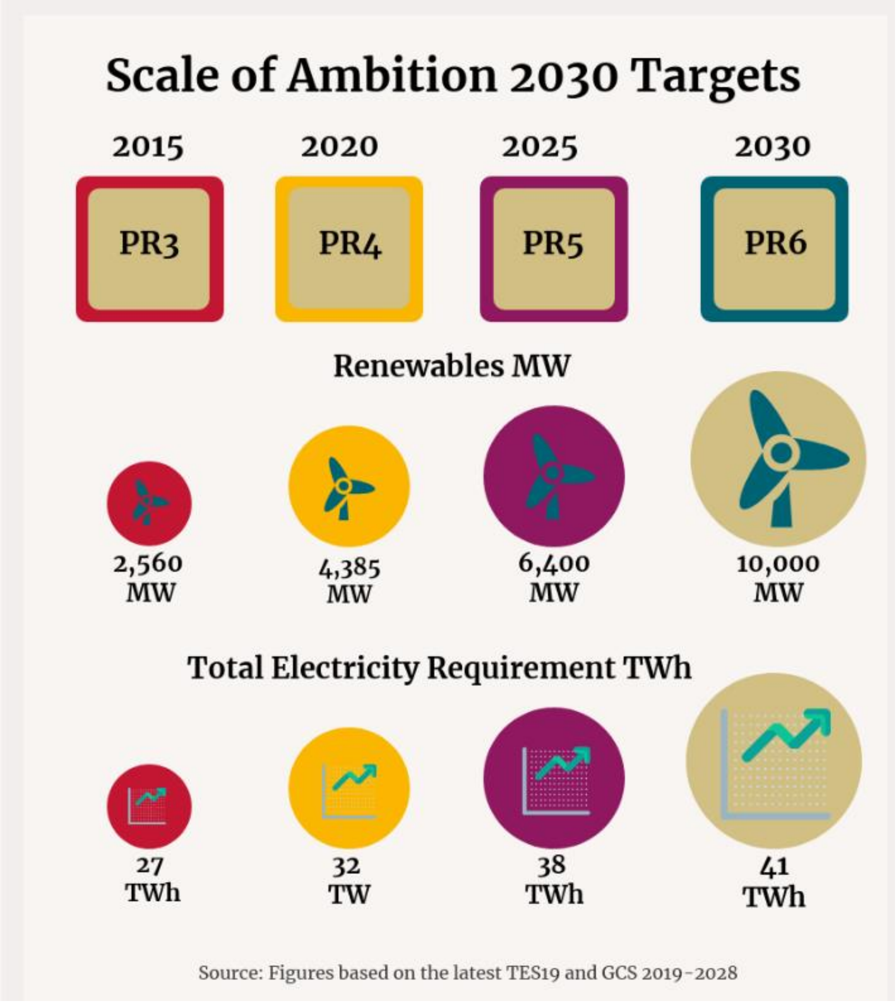

Figure A.19: Scale of Ambition 2030 Targets

Benefits & Outcomes

Mobilisation of additional resources in the Grid Delivery teams will ensure EirGrid has the capability to:

- Deliver the new infrastructure required to allow the connection of generation, demand and interconnection connections;
- Deliver on the Sustainability and Decarbonisation Targets provided by Government Climate Action Plan;
- To meet customers' expectations with respect to time, cost and quality – these customers include some of the largest companies in the world (Amazon, Intel, Google, Facebook, SSE, Statkraft);
- Ensure high voltage equipment is designed and installed to minimise the risks to the safety of personnel (EirGrid, ESB, public and third parties) and to minimise the impact of transmission system faults which could result in the injury or death of members of staff or public and/or result in a partial or complete power system collapse and in severe damage to transmission system assets;

  - Work with ESB Networks to continue to improve upon the existing relationships within the respective organisations with the aim of delivering more effectively
  - Innovate and embed new grid development strategies in how we do business; and
  - Focus on engaging in an appropriate and effective manner with communities to ensure our messages are delivered and the concerns of communities are understood.

Failure to provide for increased capacity and capability across the grid development teams would led to the following risks:

- Less effective engagement and reduced opportunities to influence landowners on the need for grid infrastructure;
- Increased likelihood of delays to delivery of consents for grid development infrastructure, meaning we are unable to progress to construction in a timely fashion;
- Increased likelihood of delays to project delivery and energisation of not only to individual projects but across wider project programme;
- Increased costs associated with the delays – impact to consumers, developers, the economy and environment; and
- Increases the risk of failure of Ireland to meet its 2030 targets set under the Climate Action Plan.

A.4.5.1 Agriculture Liaison Officers (ALO)

Introduction and Context

The EirGrid grid development strategy seeks to balance the energy needs of the country with the impact on landowners and communities. The implementation of the Six Step Process saw the introduction of ALOs which gave EirGrid a dedicated presence on the ground for the first time. The role of an ALO is to engage with those landowners who are impacted or may be impacted by our projects. Our ALOs are located regionally and liaise with landowners on all agricultural matters. ALOs involvement throughout the project is essential for:

- providing landowners with a comprehensive knowledge of a project in a timely manner;
- giving landowners an opportunity to influence decisions being made by EirGrid in each step in the Framework process;
- Discussing the siting of new lines and cables, land access, and also providing information on community funds and proximity payments.

Figure A.20: ALO Role in EirGrid

We have outlined the need for two additional ALO resources for PR5. These resources will support the additional work required under PR5 and complement the requirement for an additional Community Liaison Officer (CLO)[18] ensure continued development of projects to a consistently high standard, by providing transparency and building trust with communities in accordance with our strategic objectives.

We need to continue investing in our landowner engagement efforts to assist in the development of social acceptance for projects in PR5. The provision of regional staff who understand local concerns are able to listen and take into consideration any concerns raised by landowners is vital in this regard. They are also able to provide landowners with targeted, accessible information.

Identification of Need

When reviewing our progress in building out projects over the last two price review periods, we see that delays are very rarely for technical or design reasons. In the vast majority of cases our projects are delayed on grounds of social acceptance, be that expressed via local communities or indeed by individual landowners. Those projects suffering the longest delays are those where the ability for meaningful input from the public came too late in the development process, i.e. at a point when decisions on routing and technology had already been made.

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[18] It should be noted that Community Liaison Officers (CLOs) based in the Customers and Stakeholders team work hand in hand with ALOs, to be the presence on the ground for grid development projects. The ramp up in project activity forecast for PR5 will also drive a need for an additional CLO resource (in addition to 2 ALOs) which is the subject of a separate Business Case being developed by External Affairs.

Our new approach to consultation provides the opportunity for this engagement at a much earlier opportunity and the success of this is beginning to be evident in the early stages of newer projects which have embraced it from the start. The introduction of ALOs has served as the bedrock for our new approach. Positive feedback has been received in relation to engagement on the North Connaught and CP1029.

A team of four ALOs currently manage landowner engagement activities for all capital projects in PR4. However over the PR5 period and into PR6 there will need to be a large ramp up in project activity to deliver on our objects and challenging 2030 energy targets. To support continued landowner engagement on existing projects, as well as deliver the same level of engagement on pipeline projects such as Capital Project 966 and Capital Project 1029, we have identified the need for two additional ALO resources.

Benefits & Outcomes

The success of our new Six Step Process is beginning to be evident with the positive feedback we are getting in relation to our engagement on projects which have embraced the new approach from initiation. With landowner engagement, and the role of the ALO in particular, at the forefront, the key benefit of increasing the number of ALOs for grid development is that we will be able to sustain an increased level of engagement across a larger number of projects.

The importance of the role of the EirGrid ALOs was recognised in the planning decision for the North South Interconnection (NSI) from An Bord Pleanala. A condition of grant is that an ALO shall be appointed and shall be responsible for liaison with landowners, prior to and during the construction phase of the project to ensure the satisfactory completion and operation of the development in the context of agricultural activities.

Delivery of the PR5 programme is vital to meeting Ireland’s climate change targets, and investment in data centres by large multinationals, while maintaining security of supply across the transmission grid. Over the next 5 years, EirGrid will be required to deliver substantial amounts of new electricity infrastructure that will be needed to meet Ireland’s Climate Action Plan targets.

ALOs, together with CLOs will be EirGrid’s face in the community for grid development during PR5. An additional two ALO resources will support engagement on existing projects as well as delivering the same level of engagement on pipeline projects.

Investing in our ALO team supports the principles of greater and more meaningful engagement which is a key tenet of the Framework. EirGrid needs to continue developing this new approach to landowner engagement as we move towards an unprecedented rise in project activity during PR5.

We have seen that this approach assists in reducing opposition to grid development projects. The net effect of this is that there is more certainty during the construction phase of the project, reducing the likelihood of lengthy and expensive delays.

A.4.5.2 Transmission Project Managers

Introduction and Context

Transmission Projects encompass system reinforcements and refurbishment projects. These projects ensure continued security of supply by strengthening the network so that it has the capacity to transmit the power from conventional generation, renewable generators to demand customers and on to the distribution system and all consumers. The Transmission Projects (TP) team is responsible for new 400 kV, 220 kV and 110 kV station and overhead line development projects as well as upgrade and refurbishment projects in Ireland.

The scale of reinforcements being driven from the connecting parties both generation and demand is significant and growing in complexity. This complexity will only likely increase as the Government’s Climate Action Plan is implemented.

We have outlined the need for two additional Project Managers for Transmission Projects. They are to facilitate and assist in delivering on-going and the additional forecasted significant ramp up of transmission projects (grid reinforcement and asset management projects) associated with the development and maintenance of the grid.

Identification of Need

Projects managed by the Transmission Projects Team are almost entirely for the purposes of grid reinforcement, and range from new greenfield substations, cable and overhead line projects, new developments within existing substations, uprating of existing circuits to substations, and overhead line refurbishment projects.

Transmission Project Managers carry out the following activities:

- Primary responsibility for managing a range of technical projects through the public planning process in order to achieve planning consent. Projects include both the redevelopment of existing high voltage assets (substations and overhead lines) and the development of new high voltage projects ensuring that appropriate project controls are in place having regard to budgets, schedule, quality, risk and activity monitoring.

- Managing stakeholder interface including progress meetings, reporting, relationship management, coordination and general communication.
- Ensuring not only are the deliverables under the IA process managed with the TAO but that as the project promoter and working in partnership with the TAO that site works are managed in such a way that landowners and local community requirements are appropriately taken into account.
- Using established project management techniques, coordinating a wide range of activities and inputs from other professionals including technical & engineering, environmental management, communications, public & stakeholder relations, vendor management, finance and procurement.

Currently eight Transmission Project Managers (PM) are actively managing 58 live transmission projects, c.7 projects per PM. With careful management this is just sufficient to meet current business requirements. All team members manage a mix of large and long-term projects and smaller but still essential projects. There is no capacity within the existing team to accommodate any significant increase, particularly of large scale projects.

There is significant ramp up in the both the number and complexity, from a technical and stakeholder management perspective, of projects required over the PR5 period to deliver on our, the Government's and the CRU's stated ambitions for decarbonisations, and system security.

The key areas which drive the increase in workload:

- Pipeline projects driven by known system requirements in EirGrid GCS and TES 2019 publications and
- Current projects which will need to be completed and energised over the next number of years. The programme for a number of these projects covers both PR5 and PR6 periods.
- Asset Management projects
- Relay replacement projects from identified by the Protection team in Operations. There are circa 600 relays to be replaced in the PR5/6 period and the estimated capital cost for these projects will range from €80m to €100m. This is a significant volume of work and will require the full application of the IA process to groups of these relays.
- There is a pipeline of up to 7 cable replacement projects in the greater Dublin area forecast to begin in the PR5 period. Each of these would carry significant

PM resourcing due to the levels of planning and stakeholder engagement needed in addition to the full application of the IA process.

- Reinforcements emanating from the drive for offshore wind, solar and other projects resulting from the Government 2030 Climate Action Plan. All of these coming at a time when EirGrid will need to deliver an unprecedented level of additional renewable connections under this plan.

Project management resources ensure delivery of complex transmission projects to an appropriate quality level. This is particularly important at a time when there are significant issues with public opposition, land access, public planning requirements, construction of cable connections, and the introduction of new technologies.

A.4.5.3 New Connections Project Managers

Introduction and Context

The New Connections team is responsible for the delivery of electricity generation, demand and interconnection customer connections to the transmission system – from initial offer process engagement, through customer connection agreements, to energisation and asset ownership transfer. This also includes the delivery of transmission works for power generation and demand customer connections at distribution voltage levels.

Programme Managers with responsibility for overseeing the work of a team of Project Managers work to meet the expectations of our customers by managing the issues and risks on the projects while ensuring the required level of budget and schedule control are in place.

Currently eleven (11) Customer Connection Project Managers actively manage a rolling project workload of 90-100 projects, c.9 projects per PM. All team members manage a mix of large and complex projects and smaller modification projects. Given the increasing requirement for project oversight of contested builds[19] and the scale of connections envisaged in the PR5 period there is no capacity within the existing team to accommodate any significant increase, particularly of large scale projects.

Project Managers manage the customer connections and engagements on a day to day basis by

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[19] The majority of transmission connections are built on a contested basis

- Project management of a portfolio of customer projects, ensuring that appropriate project controls are in place having regard to budgets, schedule, quality, risk and activity monitoring.
- Communicating effectively to customers and business stakeholders, (including senior management team), via meetings, presentations and reports.
- Within the team, supporting a proactive customer and stakeholder engagement approach and high performance capabilities and behaviours.

In this business case we have identified the need for an additional Programme Manager and nine (9) Project Managers, a total of ten (10) FTEs, in the New Connections Team to meet the needs of generation and demand customers to facilitate government policy.

Identification of Need

To deliver this scale of connections requires an enhanced New Connections team and increased number of Project Managers. Further to leverage upon the lessons learned in relation to delivering large Demand projects for customers during PR4 such as Intel, Facebook and Amazon, an additional Programme Manager / Team Lead with responsibility for overseeing the work of a team of Project Managers is required. This model has ensured in the past that we can meet the expectations of our customers by managing the issues and risks on the projects while ensuring the required level of budget and schedule control are in place.

A.4.5.4 Client Engineers

Introduction and Context

The Client Engineering function is responsible for ensuring technical compliance with EirGrid Functional Specifications for all new connections and system reinforcements to the Transmission system.

Under the IA the Client Engineer is responsible for reviewing the detailed designs and specifications for all projects meets the requirements of the TSO Development Plan, its functional specifications, outline designs, generic standards and the detailed designs and procurement requirements.

Where customers opt to contestably construct their projects, they are required under Schedule 10 of the Connection Agreement to, ‘*Construct the Customer’s Connection Works in accordance with the requirements of the Company (EirGrid) as set out in the Company’s specifications and in the Customers approved design’*.

The role of the Client Engineer includes the provision of functional specifications and outline designs to Customers which allows them to prepare their detailed designs and technical submissions for review by the Client Engineer. During the construction phase the Client Engineer attends site to inspect the works to ensure that they are being completed in accordance with the agreed design.

This technical quality assurance role provides added value to the TUoS (Transmission Use of System) customer in:

- Providing quality assurance to ensure projects are constructed to a high standard for safe, secure and reliable operation for the intended lifecycle;
- Supporting customers in solving complex problems efficiently to provide timely delivery of their grid connections;
- Supporting customers in achieving compliance to Transmission Standards to safeguard subsequent asset transfer to the TAO, who will ultimately assume responsibility for the future maintenance and associated costs of the asset for the remainder of its lifecycle.

The role of the Client Engineer has evolved and intensified during PR4 with the scale and complexity of customer connection projects, together with accelerated delivery timelines, requiring increased technical engineering support resulting in additional design review workshops and customer support meetings. The time available for Client Engineers to support and oversee customer connection often competes with the Client Engineers commitments to wider system development and reinforcement projects.

During PR4 the customer projects were mainly large demand connections (Datacentres) resulting from IDA supported Foreign Direct Investment (FDI) and renewable energy generation connections via windfarms. A significant number of the new connections expected during PR5 will involve new technologies such as Battery Storage, Solar and Offshore wind, and this will create new challenges and complexities that will require additional technical expertise for efficient delivery. It is important that EirGrid have the technical resources available to allocate the necessary time to these challenges as they arise.

In addition the growth in renewable connections has increased the number of asynchronous and intermittent technologies on the transmission system and has as a result impacted the stability of the grid. Investment in new complex power electronic system reinforcements (also known as FACTS[20] devices) is required to increase power transfer capability and stability and mitigate other detrimental effects caused from the introduction of renewables. These evolving technologies require specialised technical resources within the Client Engineer team to ensure timely delivery.

There is currently a total of seven (7) FTEs delivering the Client Engineering role. To meet the forecast requirements in PR5 in terms of system development, a significant increase in customer connections and continued increased complicity the requirement for an additional four (4) Client Engineers has been identified.

Identification of Need

The Client Engineering role can vary in scale depending on the project, with some projects requiring greater technical input, quality assurance and support than others.

Projects which include new stations and associated overhead lines or underground cable construction typically require more Client Engineering time, as opposed to 'less complex' projects which may include a new bay in an existing station or a line upgrade/ refurbishment.

Without investing in new resources to increase the capability of the team we will simply not have the capability to provide Client Engineering Services to the forecast project pipeline or meet our customer and stakeholder expectation in terms of project delivery.

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[20] Flexible AC Transmission System (FACTs): A flexible alternating current transmission system is a system composed of static equipment used for the AC transmission of electrical energy.

A.5 Transmission Asset Management & Maintenance

In accordance with obligations set out under S.I. 445/2000 EirGrid is responsible for setting maintenance policy and standards which comprise of policies for maintenance, replacement and refurbishment of the assets forming part of the transmission system; including frequency of tests, services and condition assessments. The physical maintenance work is then carried out by the TAO.

The arrangements governing the interactions and respective roles of EirGrid and the TAO in respect to the maintenance of the transmission system are further detailed in the Infrastructure Agreement[21].

High Level Asset Management roles for EirGrid and the TAO are outlined in Figure A.21 below.

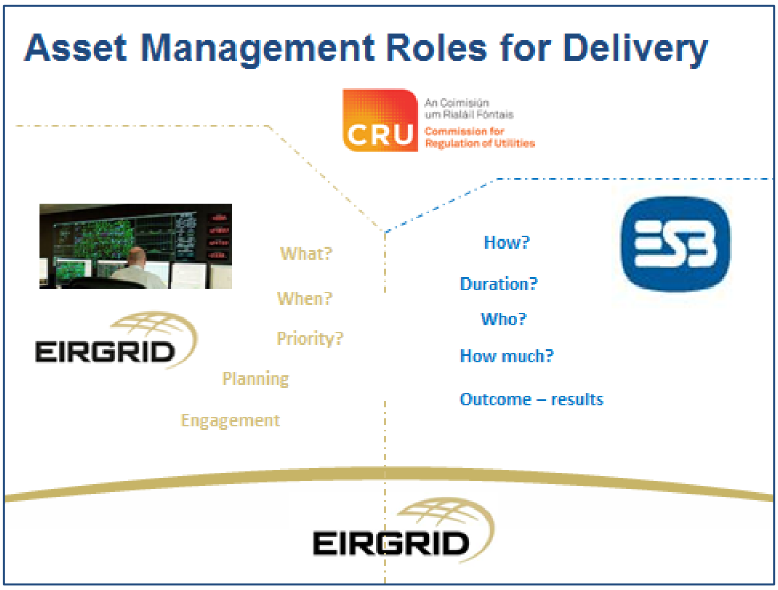

Figure A.21: Asset Management Roles EirGrid and ESB Networks

EirGrid and the TAO work closely to develop, maintain, and manage the transmission system and ensure that EirGrid can continue to operate the transmission system in a safe, secure, and reliable manner.

ISO 55001 is the international standard for Asset Management Systems and was first published in 2014. Asset Management is defined within the ISO standard as being, ‘the coordinated activity of an organisation to realize value from assets’. Asset Management

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[21] CER/11/084 – Infrastructure Agreement - https://www.cru.ie/wp-content/uploads/2011/07/cer11084.pdf

supports the realisation of value from the use of assets, while being able to demonstrably achieve an agreed balance of the likely cost, the resultant risk and expected asset performance over its whole life.

The Institute of Asset Management Conceptual Model is shown in Figure A.22, the intention of the model is to describe the overall scope of asset management and the groups of activity that are included within the discipline, maintenance is represented as one element of the life cycle delivery stage.

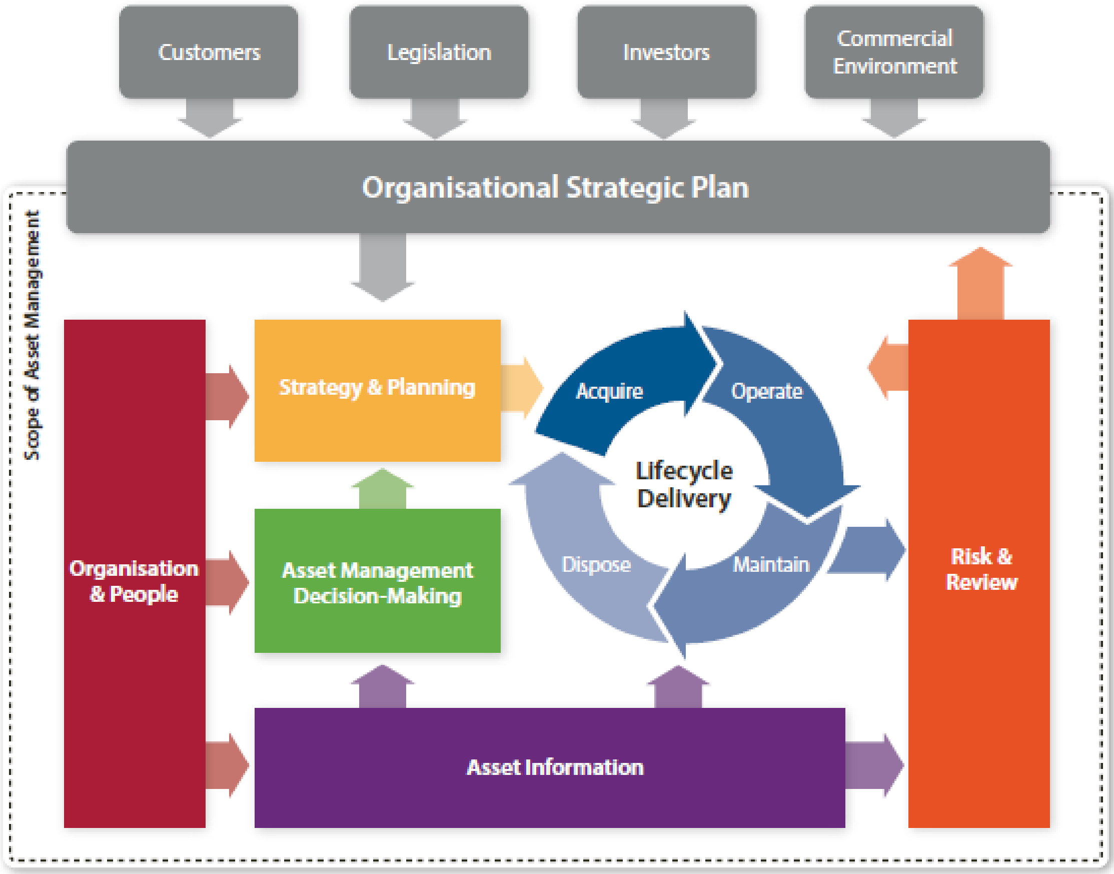

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Figure A.22: IAM Conceptual Model

Further details on the following Maintenance areas are set out in response to the following queries in Appendix 1 *BPQ Historical Narrative*, Section 1.1 Question 11v, vi, and vii; Section 1.2 Question 5; and Section 1.5 Question 10i and ii.

- Asset risk management practice ISO certification
- Inspection and Maintenance standards and frequencies
- Maintenance Benchmarking and Policy Changes
- Asset Management Benchmarking and Policy Changes
- Condition monitoring practices and equipment health

- Climate Change Risk Assessment and Adaption

EirGrid Asset Management Team

The responsibilities for the team can be outlined under the following areas:

Asset Management

- Management of an ageing Asset Base
- ISO 55001 Implementation
- Life Cycle Costing and Planning
- Risk Management
- Asset Investment Decision Making – Capital Projects Major and Minor
- Condition Monitoring and Asset Health

Maintenance

- Annual Maintenance Planning
- Annual Maintenance Implementation and Coordination
- Auditing of Annual Maintenance Activities
- Responding to equipment / plant failures
- Fault Investigation
- Customer Engagement

Policies and Standards

- Maintaining, review and benchmarking of Asset Management and Maintenance Policies and Standards
- Management of the Maintenance Policies and Standards Committee with ESB Networks
- Joint Technical Working Groups for Lines, Cables and Stations with ESB and ESB E&MP
- Maintaining involvement and relationships with other European TSO's through ENTSO-E and other forums

Information

- Custodians of Asset Information and Data for EirGrid
- Management of Maintenance Management System
- Management of Geographic Information System (GIS)
- Asset Management and Maintenance Document Management

ESB Networks Asset Teams

The EirGrid Asset Management Team interact and conduct business with many different teams and individuals within the TAO on a day to day basis from Station and Lines Supervisors and Outage Coordinators who are regionally based to the ESB Networks Asset Management Department of lines, cables and stations teams.

The TAO has established four (4) specific regions each with a dedicated Outage Coordinator whom the EirGrid Asset Management Team interact with on a daily basis.

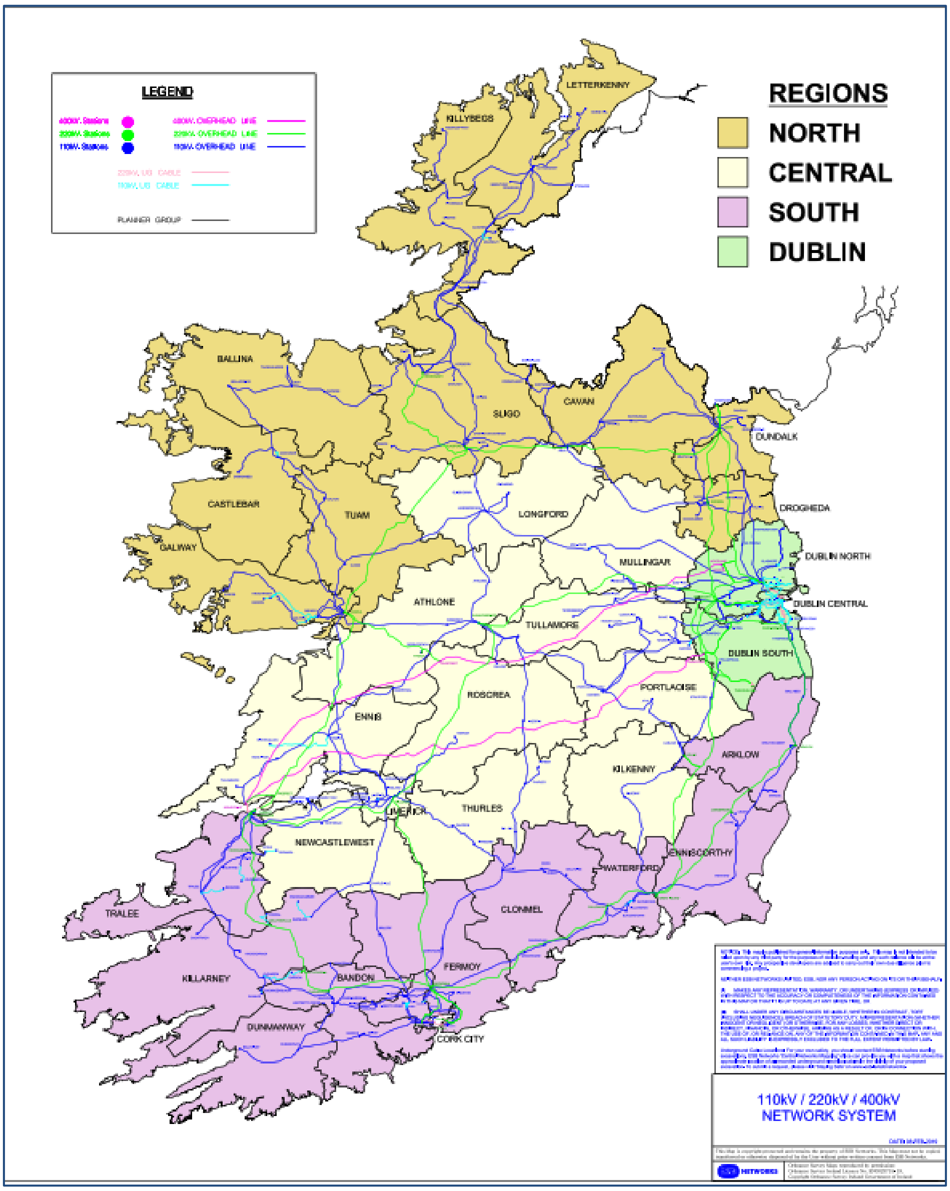

Figure A.23: The TAO Maintenance Regions

Similarly the ESB Networks Asset Management Department have dedicated Overhead Lines, Cables and Stations Teams that the EirGrid AM Team interact with on a daily basis.

A.5.1 Enablers - Capability Measures Asset Management

Introduction and Context

Over the PR4 period the transmission system has undergone significant development to accommodate the connection of renewable and conventional generation and transmission customer demand. This has necessitated the uprating of many existing assets and the construction of additional transmission stations and circuits. The total number of assets has increased during the period and will continue to increase through PR5 therefore the quantity of maintenance required has increased significantly.

In addition, the existing transmission system asset base continues to age (sample Figure A.24 and Figure A.25). EirGrid expect the quantity of maintenance to increase substantially as a result and in some cases as the existing equipment is becoming obsolete and is no longer being supported by the Original Equipment Manufacturer (OEM) there will be an increased need for asset replacement works to be carried out.

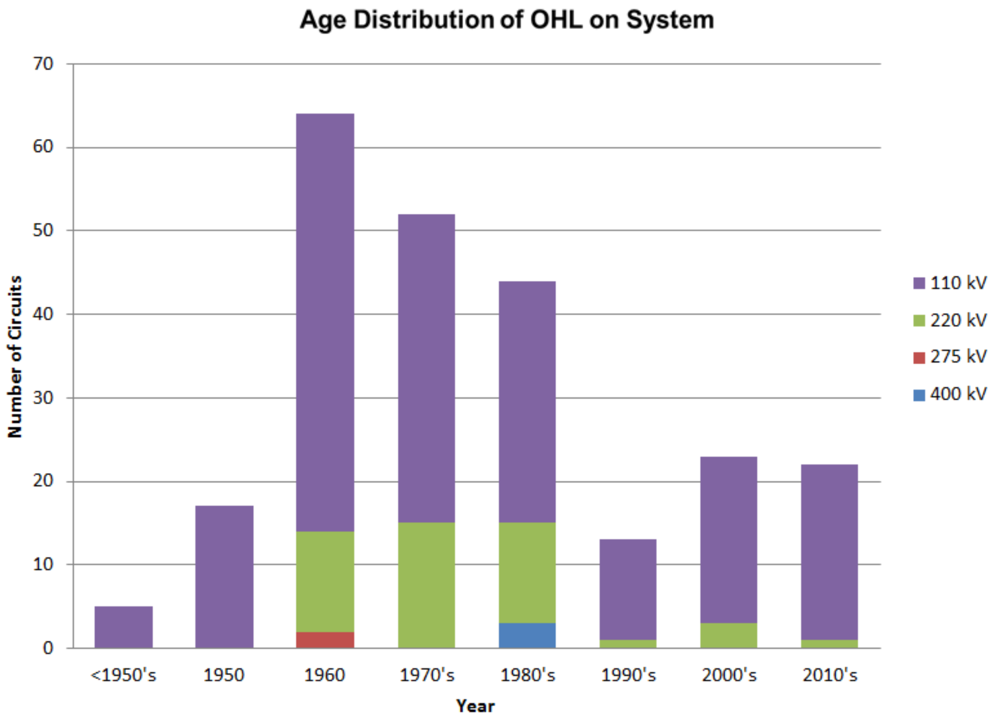

Figure A.24: Age Distribution of Overhead Lines – Number of Circuits

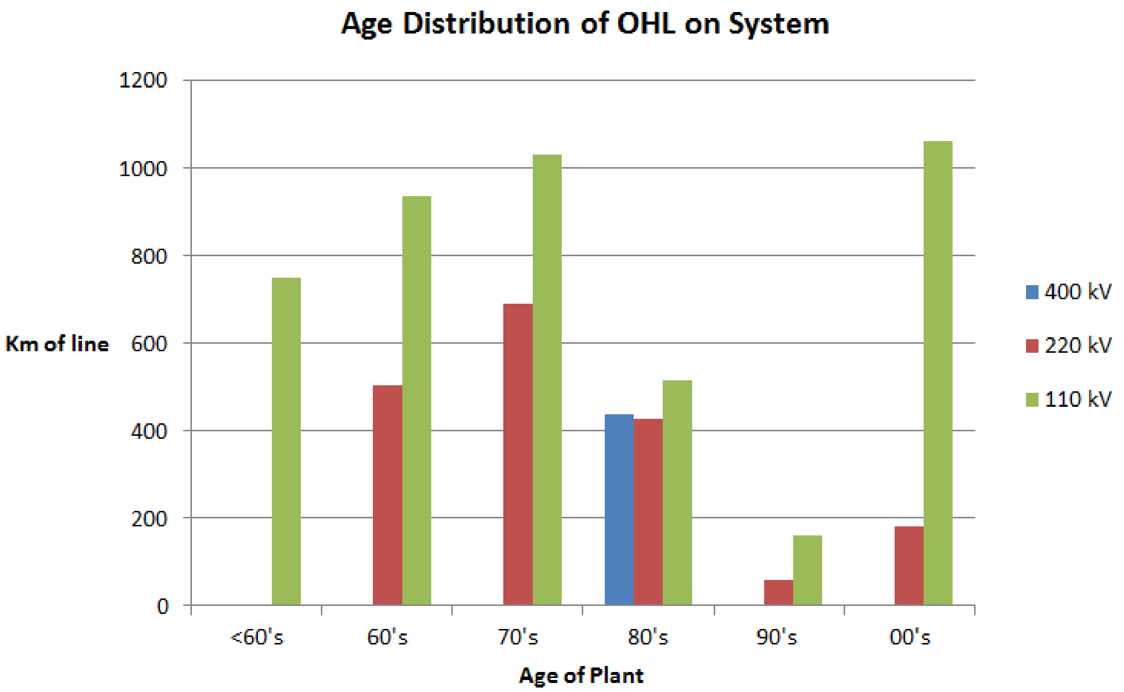

Figure A.25: Age Distribution of Overhead Lines – Km of Lines

The PR4 Maintenance Allowance, provided as part of the TAO OpEx approved by the CRU was €88.5m.

EirGrid and the TAO through the maintenance policy have focused on creating efficiencies in this area, and this can be demonstrated in the policy changes. However, these efficiencies cannot offset the underlying growth in the asset base, continued ageing of existing assets and the resultant demand on Asset Maintenance as reflected in the TAO maintenance forecast and the need for additional capacity in the EirGrid Asset Management Team.

To ensure the EirGrid has the Capability to deliver on the vital role of maintenance EirGrid have identified the need to augment the current resourcing model. The proposed additional asset management resources would be recovered through EirGrid's OpEx provision and are included in the forecast cost submission.

Identification of Need

We have identified the need for three additional FTE's in the Asset Management function to ensure delivery of our licence obligations, meet the objectives applicable to the TSO/TAO Partnership identified as part of the Strategic Review completed earlier in 2019 and for delivery on our commitments to PR5 including:

Information Management Systems for Optimal Decision Making: EirGrid and the TAO should explore opportunities to better share information, systems and data management, which would offer considerable mutual benefits and enhance the relationship between the companies.

- **Management of all EirGrid Asset Management and Maintenance Policies and Standards:** The Transmission Asset Base is ageing and maintenance is becoming increasingly challenging. Maintenance targets need to be improved upon and new approaches need to be developed with the TAO.

ISO 55001: The implementation plan for ISO 55001 requires commitment and dedicated resources to ensure successful delivery.

Co-ordination of Planning, Maintenance and Expansion of the Network: Independent TSOs need to undertake efficient co-ordination of planning, maintenance and expansion of the network with all relevant stakeholders but particularly TAO representatives, in both mid/long term timelines to achieve optimal grid infrastructure delivery.

- **Management of Capital Refurbishment and Replacement Projects -** There are a significant number of capital approvals required for the replacement of existing underground cables in the Dublin urban area which will be resource intensive over the coming years in terms of identifying alternative routes and engaging with multiple stakeholders including Dublin City Council and business owners along any proposed routes.
  In addition a recent failure in 2019 of a 220/400 kV transformer at Moneypoint Generating Station, which has caused significant constraints on wind generation in the South West of the country has highlighted the need for the development and procurement of a stock of strategic spares which have long lead times, e.g. the typical lead time for a power transformer is circa 2 years.
  As a result of their generation output being constrained – generation customers in this region have incurred significant losses in revenue.
  This work (equipment identification and procurement) is becoming more urgent due to the ageing of the existing asset base.

Information Management and Decision Support Tools: A joint information management strategy will support information exchange between EirGrid and the TAO and the integration of technological advancements to maximise our knowledge of the grid to enhance decision-making and grid utilisation. As part of the research for the Strategy Work stream, a workshop was held with Gas Networks Ireland (GNI). GNI advised they have a team of 4 staff deployed to 'data analytics' associated with asset information. This team works to make use of the data to better inform investment decisions and to assist in determining when maintenance/ refurbishment/ replacement is due on equipment. Similarly ESB Networks have also begun to develop their capability in the use of data analytics.

- **Asset Health and Data Analytics:** Development of Asset Health Indices and the use of data analytics to optimise investment decision making for all major plant and equipment on the transmission network. Other utility companies such as Bord Gais Networks and Thames Water (UK) have adopted the use of these 'tools'. A key part of this works includes component sampling and testing to increase asset knowledge base in order to make more informed Asset Management decisions earlier to determine whether components should be maintained or replaced prior to project scoping. As the asset base grows this will also increase in importance as the efficient scoping of Capital projects will be a key focus in the capital expenditure timelines.

Benefits & Outcomes

Mobilisation of additional resources in the Asset Management team will ensure EirGrid has the capability to

- Provide the necessary resourcing for the Asset Management team to meet our commitments under PR5 and objectives of 2019 Strategic Review as applicable to the TSO/TAO Partnership Work stream
- Value for money will be achieved for the TUoS customer through improved maintenance delivery, the availability of better information to optimise investment decisions in relation to Asset Management.
- Improved information will enable more efficient planning of the annual maintenance programme thus in turn making more efficient use of available outages on the transmission network.
- Improved information will also support investment decisions of when to undertake maintenance/ refurbishment or replacement of existing assets to ensure value to the TUoS customer. Historically asset maintenance would have been time based (age), however due to the growth in the asset base, alternative approaches are now required including condition based.

Enable EirGrid, working with the TAO, to establish a single source of asset health rating available for assets on the transmission network; no single source is currently available. Other European TSO's such as Fingrid (Finland's TSO) have invested heavily in the use of data tools and can access 'real-time' information on their network assets.

A.6 Conclusion

EirGrid is putting in place development plans and advance network projects to drive the transformation of the electricity transmission required as a result of a number of policy objectives centred on the issues of energy security, climate change and decarbonisations and economic competitiveness.

Through our recommended scenario for network development in the PR5 period, *Embracing Change, Delivering Targets*, we are forecasting an investment requirement of €1.07bn. This represents an ambitious investment profile, which will provide a pathway for delivery of the 2030 Climate Change Targets, while maintaining security of supply and meeting demand and datacentre customer connection requirements.

The network CapEx forecast is designed to provide a network that can:

- facilitate economic development across the regions and one which will provide secure and reliable power supply to all its citizens while addressing security of supply in Dublin and the regions;
    - that can support a forecast increase in Demand of c.6 TWh including the connection of c.700 MVA of data centre and large demand customer load;[22]
- facilitate an increase in the connection of and export from c.2900MW of new renewable generation,in the form of Onshore and Offshore Wind, and Solar, much of it remote from traditional load centres to meet our government policy and 2030 climate change targets;
- facilitate an increase in the connection of conventional generation and emerging technologies resulting from the T-4 and T-1 capacity auctions and system services procurement requirements against ambitions timelines; and
- facilitate the development of further interconnection.

Each of these is necessary if we are to realise our ambitions and each requires a step change and continuous improvement in our capability and delivery.

The network CapEx forecast is first and foremost a list of individual network projects designed to meet identified needs on the grid. Each project represents a view of the optimal solution to meet the need, both current and anticipated. Of course any forecast is

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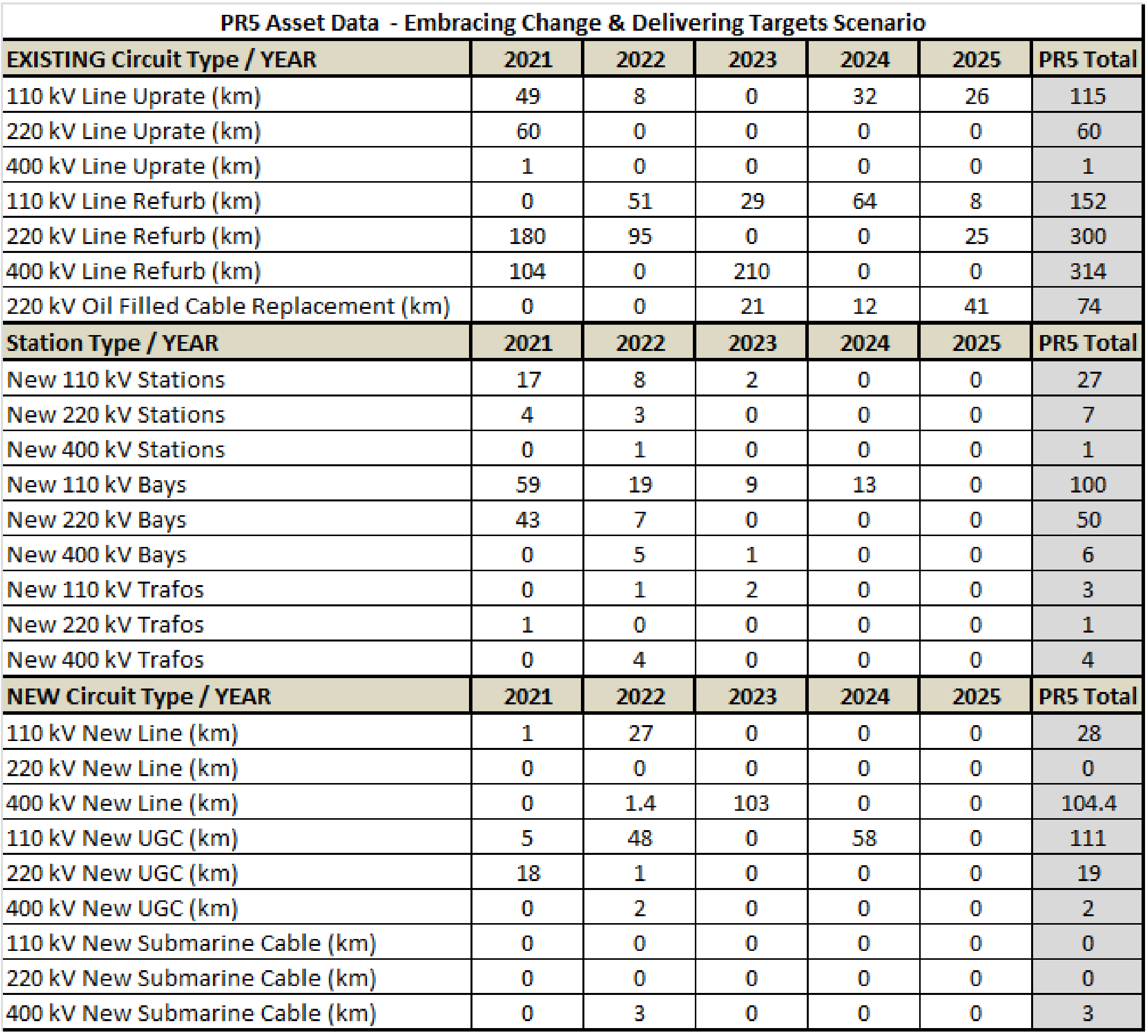
[22] All-Island Generation Capacity Statement 2019-2028, Figures 7 and 8 (pages 23 and 24). Median Scenarios.

only a snapshot of the current expected progression of the network build programme, a point estimates from an expected probability distribution for the scenario. The reality is that EirGrid's transmission network programme, and the projects which comprise it, remain under constant review as to their requirement, and to the preferred solution.

At this time EirGrid's *Embracing Change, Delivering Targets* scenario would see the delivery of significant transmission assets to enable the outcomes outlined above. The potential scale of assets is set out in Figure A.26 below.



PR5 Asset Data - Embracing Change & Delivering Targets Scenario

EXISTING Circuit Type / YEAR	**2021**	**2022**	**2023**	**2024**	**2025**	**PR5 Total**
110 kV Line Uprate (km)	49	8	0	32	26	115
220 kV Line Uprate (km)	60	0	0	0	0	60
400 kV Line Uprate (km)	1	0	0	0	0	1
110 kV Line Refurb (km)	0	51	29	64	8	152
220 kV Line Refurb (km)	180	95	0	0	25	300
400 kV Line Refurb (km)	104	0	210	0	0	314
220 kV Oil Filled Cable Replacement (km)	0	0	21	12	41	74
Station Type / YEAR	**2021**	**2022**	**2023**	**2024**	**2025**	**PR5 Total**
New 110 kV Stations	17	8	2	0	0	27
New 220 kV Stations	4	3	0	0	0	7
New 400 kV Stations	0	1	0	0	0	1
New 110 kV Bays	59	19	9	13	0	100
New 220 kV Bays	43	7	0	0	0	50
New 400 kV Bays	0	5	1	0	0	6
New 110 kV Trafos	0	1	2	0	0	3
New 220 kV Trafos	1	0	0	0	0	1
New 400 kV Trafos	0	4	0	0	0	4
NEW Circuit Type / YEAR	**2021**	**2022**	**2023**	**2024**	**2025**	**PR5 Total**
110 kV New Line (km)	1	27	0	0	0	28
220 kV New Line (km)	0	0	0	0	0	0
400 kV New Line (km)	0	1.4	103	0	0	104.4
110 kV New UGC (km)	5	48	0	58	0	111
220 kV New UGC (km)	18	1	0	0	0	19
400 kV New UGC (km)	0	2	0	0	0	2
110 kV New Submarine Cable (km)	0	0	0	0	0	0
220 kV New Submarine Cable (km)	0	0	0	0	0	0
400 kV New Submarine Cable (km)	0	3	0	0	0	3

Figure A.26: Forecast scale of PR5 Asset delivery

As part of the PR5 framework EirGrid believes it is important to have an established set of metrics at the outset against which network delivery is measured. In the period from this submission to final determination in 2020 current ongoing projects and pipelines projects set out in the programme will evolve. It is essential that the PR5 period has a defined baseline for project development and that such a baseline is formed to capture and record progress against set metrics that can then be reported to the CRU and wider stakeholders. Such metrics could also be incorporated in the CRU's proposed Balanced Score Card for Investment planning and delivery.

EirGrid is committed to providing such a baseline and an updated project forecast asset list as at January 01 2021 and would welcome clarity from the CRU as to the output metrics it wants reported in order for these to be incorporated.

Appendix B

Local Security of Supply

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B.1 Planning and Maintenance of Local Security of Supply

The electricity industry in Ireland is in a period of significant change. This in turn leads to challenges for EirGrid in relation to planning, developing and operating the system. EirGrid is obliged to ensure the economic and efficient delivery of the Transmission System in accordance with Regulation 8(1) of SI 445 of 2000, as amended[1],

> *"(a) to operate and ensure the maintenance of and, if necessary, develop a safe, secure, reliable, economical and efficient electricity transmission system [], in all cases with a view to ensuring that all reasonable demands for electricity are met and having due regard for the environment; []*
>
> *(c) to plan the long term ability of the transmission system to meet reasonable demands for the transmission of electricity; [and]*
>
> *(ca) to contribute to security of supply through adequate planning and operation of transmission capacity and system reliability;"*

In planning and operating the system we work to ensure a safe and reliable supply of electricity to all regions, whilst at the same time balancing this with the overall cost of doing so. Furthermore, we now need to decarbonise the energy system, which can introduce conflicting requirements. This difficult choice among three competing or conflicting options is often referred to as the Energy trilemma (ref. Figure B 1).

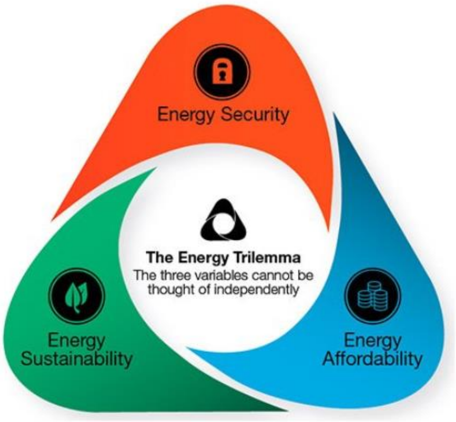

Figure B 1: The Energy Trilemma

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[1] As amended by SI 60 of 2005

Ensuring that the long term needs of the transmission system are met is a complex task. The planning process involves the application of technical reliability criteria, economics, consideration of transmission operations, maintenance and protection, co-ordination with generation and distribution functions, information technology, strategic considerations and new technologies and environmental aspects. EirGrid's Transmission System Security Planning Standards (TSSPS)[2] set out the basis for assessing and planning the transmission network. The standards for day-to-day operation of the system are set out in the Grid Code[3] and the EirGrid's Operating Security Standards (OSS)[4]. Each of these standards and the code has been approved by the CRU.

This suite of planning and operational standards seeks to ensure the integrity of the transmission system and provision of security of supply against a range of probable risks/contingencies but not all possible risks/contingencies that could materialise. This ensures that the overall cost to the end users is minimised. To design a system that could withstand all possible risks/contingencies and all permutations of future requirements would be uneconomic.

The overall system could be previously described as steady state. EirGrid had several years' notice for new generation connecting or closing. This generation was also centrally located, as it consisted of large producers of power often near the major load centres. The growth or decline of demand was also relatively easy to predict.

We are now in a world where the pace of change is much more rapid. The generation portfolio is expected to change profoundly over the next decade. The new market arrangements and wider policy drivers towards decarbonisation are, as intended, leading to the closure of older or inefficient generation units. We have already seen units submit closure notices and look to close in less than the three years' notice set out in the Grid Code. We are also seeing ever increasing decentralisation and dispersion of generation with a trend towards smaller scale sources of generation compared to the traditional large scale CCGT type units, a larger portion of which will be connected to the Distribution System. The new capacity market auctions in SEM have successfully reduced costs for customers by increasing competition however this creates more uncertainty on what the future system will look like.

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[2] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016-APPROVED.pdf

[3] http://www.eirgridgroup.com/customer-and-industry/general-customer-information/grid-code-info/

[4] http://www.eirgridgroup.com/site-files/library/EirGrid/Operating-Security-Standards-December-2011.pdf

Coupled with an evolving generation portfolio, efficient planning of the network is also determined in the context of the Loss of Load Expectation (LOLE) standard for Ireland. The LOLE is an estimate of the number of hours in an average year where there will be insufficient generation to cover demand. The LOLE has been set at eight (8) hours by the SEM Committee. This level of LOLE is relatively high, in comparison to other European networks and in reaching its decision[5] the SEMC acknowledged the potential trade-off between increased security of supply, by moving to a lower, three (3) hour, LOLE, and an increased cost of capacity by retaining a large number of units.

In the last decade, we have seen the wide-scale integration of renewables onto Ireland's Transmission System, the emergence and rapid growth of the demand side management sector, the development of ever more sophisticated electricity markets and the development of hyper scale energy intensive data centres. As noted in Chapter 1 we are seeing significant growth in demand, predominately driven by data centres. Much of it is clustering in a specific part of the network around Dublin with connections to both the Transmission and Distribution 110kV network. These users can go from initial investigation to energisiation in a very short period of time. They can then ramp to full production very quickly once energised at a pace that far exceeds the planning and delivery timeframes for system reinforcement works. This type of load growth in itself presents challenges, and EirGrid is conscious that this is not the only driver of increased demand with the intention for Ireland to switch to electric heating and transport, a cornerstone in reaching decarbonisation targets, potentially adding to further significant growth.

Providing a secure system for customers at an efficient cost with increases in load is achieved through a multi-faceted approach. Building new infrastructure has and remains a key part of the solution. However, lead times to build new infrastructure have increased in recent times. Societal acceptance for new large scale infrastructure is increasingly challenging and requires careful and comprehensive engagement to achieve the best outcomes for all.

All of this means that the management of security of supply requirements is a much more active endeavour for EirGrid, the Distribution System Operator[6], the CRU and the

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[5] https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-15-103%20CRM%20Decision%201_0.pdf

[6] See FBPQ Tab 1.1 Q19 for info regarding TSO DSO interactions.

wider industry than has traditionally been the case and requires both innovative and interim solutions to address these challenges as the arise in the short to medium term. This includes procuring new and existing generation at an efficient cost, managing speculative demand requests, providing the right locational signals to generation and demand.

EirGrid in considering and planning for the evolution of the networks is also cognisant of the implementation of the European Network Codes (ENCs)[7], one of the significant changes that underpin system operation in the PR5 period. Whilst all of the European Network Codes interact to drive holistic changes to how the system is run, we note the specific roles of the Connection Code and the System Operation Code families.

The former includes the Demand Connection Code, which will mandate requirements relating to demand side response, and the Requirements for Generators Network Code, which drives a change in the technical capabilities of generator plant. The System Operation Code family has a more direct influence on the activities which EirGrid will need to undertake going forward, with the System Operation Guideline setting minimum system security, operational planning and frequency management standards and the Emergency & Restoration Network Code creating harmonised standards and procedures to be applied in the Emergency, Blackout and Restoration states. EirGrid's compliance with these ENCs, and the future requirements of the Clean Energy Package, will underpin our approach to ensuring Security of Supply within Ireland.

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[7] As we note in Chapter 1, these derive from The Third Energy Package, which came into law on 3 March 2011

B.2 Background to Dublin Security of Supply Concerns

While EirGrid is focused on maintaining a high level of system security across Ireland; Dublin presents a specific set of circumstances that warrants particular attention. Throughout PR4, EirGrid has been managing a significant increase in demand within the greater Dublin Region. This demand increase has been driven primarily by data centres and other large energy users with relatively short construction times when compared to the construction times associated with large electricity infrastructure or generation plant. A snapshot of the particular challenge posed by connecting large amounts of data centres is illustrated by Figure B 2. Power requirements are expected to rise by c.38% between 2017 and 2025 which is equivalent, in absolute terms, to the total load growth in the 50 years between 1930 and 1980. This is occurring at the same time as societal change means that the building of new electricity infrastructure is taking place against an ever increasingly complex backdrop and involves greater consultation and stakeholder engagement from an earlier stage.

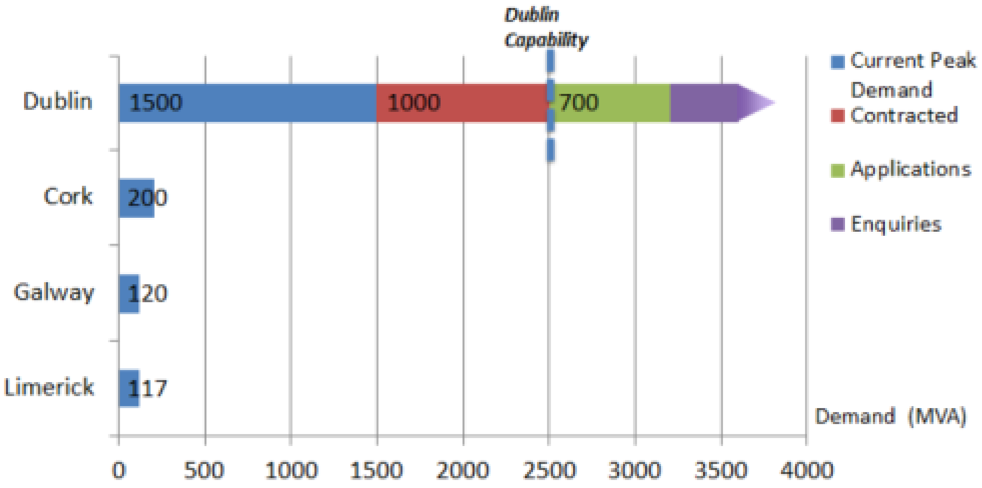

Figure B 2 Scale of contracted demand and data centre enquires

Naturally, this has created challenges for EirGrid, particularly with regard to network planning. To compound this challenge; during 2017, two large, co-located, generation sets in Dublin, Huntstown Unit 1 and Huntstown Unit 2 signalled their intention to exit from the generation market and not serve out the three year Closure Notice Period as set out in the Grid Code. In January 2018, the CRU determined that the “Demonstrable, Material and Imminent Likelihood (DMIL) of Closure” test set out in CRU/17/346 had been passed by the units. Analysis carried out at the time indicated that such a closure would result in almost immediate non-compliance with the CRU's approved TSSPS. The ability to adequately maintain the power system would be severely restricted including providing outages for new customer connections as well as facilitating system reinforcements. Operating the power system much closer to the stability margin also increases the likelihood of a significant system security event.

EirGrid was asked to prepare a Mitigant Measures Report by the CRU in the context of the principles and objectives outlined in CRU/17/346 and the risk of disorderly exit. In May 2018 EirGrid submitted to the CRU the Report. In the Mitigant Measures Report, EirGrid considered and set out a range of potential solutions, including where those options represented a technically feasible option and were or were not an available option in a c. 3 year period and prior to the delivery of envisaged new capacity under the T-4 capacity auctions under the new SEM arrangements.

The focus of any mitigant measure was the need to provide the suite of services which are required for the operation of the system, including both active and reactive power support. These services are by their nature geographic specific as the power system is carefully designed to balance the flows upon the system across the topology of the network. This by its nature limited the options.

EirGrid worked closely with the CRU in this period to identify, develop and implement the necessary measures to maintain Dublin security of supply. The CRU issued directions reference CRU/18/228 and D/18/10646 to give effect to these measures which are discussed in detail below.

B.3 Meeting the Dublin Security of Supply Challenge

The CRU's direction, CRU/18/228, set out a number of measures to address security of supply concerns in Dublin. For ease of reference EirGrid has summarised them in Figure B 3 along with how EirGrid has supported their implementation.

CRU Security of Supply Measure	EirGrid Implementation
Local Reserve Service Agreements (LRSA)	EirGrid has entered into a number of LRSAs to ensure ongoing security of supply.
Locational Scalars for System Services	EirGrid has supported the development of a new locational scalar mechanism as set out in Section B.3.3
Financial Reporting to mitigate future disorderly exit	EirGrid responded to the CRU consultation in support of the CRU's initiative
TSO operational measures to maintain security of supply	EirGrid developed a number of short term operational measures to implement in the event of the Huntstown Units closing in 2018. This is set out in Section B.3.4
Facilitating generators connecting	EirGrid has worked with the CRU and developers in facilitating the participation of new generation in the T-4 capacity auctions. EirGrid is currently working on the delivery of connections for the successful new generators. This is set out in Section B.3.5
Accelerated transmission reinforcement	EirGrid is advancing a range of transmission reinforcements in the Dublin region improving the capability of the Dublin network to efficiently meet new load requirements as set out in Section B.3.6 against an accelerated programme.
Flexible Demand Contracts	EirGrid has implemented a flexible demand arrangement for new Dublin data centre customers along with a range of other measures. These are set out in Section B.3.7

Figure B 3 Mitigant Measures in CRU/18/228

B.3.1 Local Reserve Service Agreements

As part of extensive consideration of potential measures that could mitigate the impact of the closure of units at Huntstown, EirGrid entered into detailed negotiations with the owners of the units. The purpose of this engagement was to ascertain if terms consistent with the principles set out in CRU/17/346 could be agreed that could result in a contract with either of the Huntstown Units being an available mitigant option. Proposed LRSA terms were ultimately agreed between the parties and endorsed by the CRU. Further to a direction from the CRU to EirGrid, EirGrid entered into an LRSA with Huntstown Power Company Limited and Viridian Power Limited for the continued operation of Huntstown

Unit 1 and Huntstown Unit 2 respectively for a four (4) year period, until the end of September 2022[8].

B.3.3 Locational Scalars for System Services in the Dublin Region

CRU considers that there is a need for locational signals for the Dublin Region to incentivise generation which provides system support. In February 2019[9], the CRU proposed to direct EirGrid to adjust the DS3 System Services Locational Scarcity Scalar for the Dublin Region and sought stakeholders' views on its proposals. The CRU's proposals can be summarised as follows:

- The Locational Scarcity Scalars will be adjusted above one for all services providers in the Dublin Region for the services TOR2, RRS, RRD, RM1, RM3 and SSRP. This will only apply to the DS3 System Services Standard (Volume Uncapped) Contracts.
- €12.5m will be allocated on an annual basis to cover the costs of adjusting the DS3 System Services Locational Scarcity Scalars in the Dublin Region. This amount will be reviewed annually.
- In the first year, the Locational Scarcity Scalars will be set for five years from their initial adjustment, i.e. the period 2019 - 2024. In subsequent years, the Scalar values will be set five years in advance on an annual basis. For instance, in 2020 the scalar values will be set for the year 2025 and so on, one year at a time.
- The Locational Scarcity Scalars will be applied to payments for the relevant technologies and System Services in line with the payment rules for the Temporal Scarcity Scalar as set out in the DS3 System Services Market Ruleset.

EirGrid understands that CRU is currently finalising its decision on same.

B.3.4 TSO Operational measures to maintain system security

EirGrid operates the transmission system in line with the Operational Security Standards and adheres to published Operational Constraints when scheduling the power system. EirGrid implements system operational constraints, in conjunction with SONI the TSO in

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[8] Further details are set out in the CRU paper CRU/18/228

[9] https://www.cru.ie/wp-content/uploads/2019/02/CRU19011-Consultation-Paper-on-Locational-Scalars-in-the-Dublin-Region-updated.pdf

Northern Ireland, in order to maintain acceptable levels of system stability and voltage levels to enable efficient operation of the system. EirGrid publishes updates to the Operational Constraints monthly and as required if any changes are made. Actions have to be taken by EirGrid when events occur on the power system, e.g. units/circuits being unavailable through forced outages, to maintain the security of the network and supply to customers. EirGrid considered the potential operational measures that could be implemented in the event of the loss of the two Huntstown units in a sudden disorderly exit. These included measures around the operation of the East West Interconnector, voltage control, Distribution System measures and around outage management.

B.3.5 Facilitating generators connecting in the Dublin Region

In line with CRU/17/058, in October 2018, the CRU directed EirGrid to issue a connection offer to any generator located within the Dublin Level 2 region that was successful in the CY 2022/23 T-4 Capacity Auction. EirGrid engaged with a large number of projects prior to the auction to address connection related queries. This resulted in up to 2,000MW of new capacity applying to qualify for the auction. The CY 2022/23 T-4 Capacity Auction completed successfully in April 2019 and resulted in 446 MW of new flexible gas-fired generation, 155 MW of new battery storage and 500 MW of offshore wind. This new capacity is primarily located in the Dublin area. Intensive work is underway with these customers in completing connection offers and delivering grid connections in time for the 2022 capacity year.

However, it is recognised that there are risks of existing plant closure or forecast generation not connecting. On 3 October 2019, the CRU issued a further direction to EirGrid to issue a connection offer to any generator located within the Dublin Level 2 region that is successful in the CY 2023/24 T-4 Capacity Auction. This has resulted in over 2,000MW of new capacity seeking to qualify for the auction. EirGrid will work with these applicants on the same basis as the CY 2022/23 T-4 Capacity Auction and seek to deliver any required connections for this and future capacity auctions during the PR5 timeframe.

EirGrid will also be working with new renewable generation locating in or close to the Dublin network, which is likely to include substantial amounts of offshore wind, as part of the overall decarbonisation of the system. Renewable generation locating close to large load centres or other strong parts of the network minimises the amount of new transmission infrastructure required to transport power to where it is needed. This is an effective and efficient way to decarbonise the electricity system and EirGrid has been encouraging policy makers to recognise this opportunity. The proximity of East coast offshore wind to the large Dublin load and the increasing requirements from large energy users is a clear example of this. EirGrid welcomes the opportunity to work closely with the CRU in further exploring this opportunity.

B.3.6 Accelerated transmission reinforcement of the Dublin Region

Building new grid infrastructure remains a key part of the solution in reducing constraints in a network by providing more pathways for generation to supply customers in a particular area. EirGrid has been advancing a number of projects in the Dublin region for this purpose. Our PR5 plan builds on the work done by EirGrid to date, and the CRU request for EirGrid to proactively examine areas at risk of loss of supply under a set of credible scenarios. While a number of wide ranging measures discussed in this appendix, and as identified by the CRU, will be required to address the security of supply risk in the Greater Dublin region; the accelerated transmission reinforcement of the Dublin region forms a central element in the PR5 Grid Delivery Plan.

In line with the CRU’s guidance, our PR5 submission includes a number of reinforcement projects aimed at alleviating the issues contributing to security of supply concerns in the Dublin area. These system reinforcement projects are at different stages of development. To deliver on the CRU’s objectives we are proposing a programme aimed at addressing the security of supply risks that currently exist in the greater Dublin region.

During PR5, we will work to energise 33 of 40 projects currently identified as required within the greater Dublin region (a list of these projects are included in Section B.4). While these projects are primarily aimed at addressing the security of supply issue in the Dublin region, these projects will also assist in the delivery of our 2030 climate targets by facilitation the connection of further renewables onto the transmission system.

We are also accelerating works to connect Woodland and Dunstown 400 kV (CP0966) stations. This project will require public planning consent and if successful the project will contribute to a reduction of dependence on generation in Dublin and accommodate the output of renewable generation transmitted from the South West to Dublin while also providing additional reactive support in Dublin. EirGrid is targeting Project Agreement and handover to the TAO in 2022.

Furthermore, we are also accelerating the North Dublin reinforcement project (CP1021) on a similar basis. This is a major project to reinforce the North Dublin area where increasing large scale new demand is expected. Project agreement and handover to TAO is expected in 2023.

Our PR5 submission also includes system reinforcement substation redevelopment projects to support the Leixlip, Inchicore, Maynooth, and Finglas greater Dublin areas. Together these works require careful scheduling into EirGrid's multi-year Outage Plan as they are dependent on certain generation availabilities to manage secure and safe power system operation during their development.

B.3.7 Flexible Demand Contracts

Ireland has seen a paradigm shift in the scale of large data centres seeking to connect to the Irish electricity system. EirGrid has committed to meeting the challenge of maintaining Ireland's high standards in security of supply while maximising the opportunities presented by this new sector. While the connection of a large number of data centres presents a new challenge to EirGrid, we recognise the important role that data centres will play in the future as outlined in the Government paper on The Role of Data centres in Ireland's Enterprise Strategy ("Data Centre Strategy")[10].

In August 2018, EirGrid developed a paper "Accommodating Ireland's Increased Electricity Demands in the Context of the Data Centre Paradigm" (the "Paradigm Paper"). The Paradigm Paper highlighted that the increases in electricity demand present new challenges for EirGrid in terms of how best to facilitate the connection of this unprecedented load growth on the Irish electricity system. Key points of the Paradigm Paper are as follows:

- Ireland is facing into a rapid growth in electricity demand;
- The majority of this demand increase is being driven by data centres;
- These data centres mostly intend on connecting in the greater Dublin region;
- This rapid increase in demand, located in a specific area has the potential to result in capacity constraint issues for the valuable commodity that is the transmission network;

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[10] https://dbei.gov.ie/en/Publications/Publication-files/Government-Statement-Data-Centres-Enterprise-Strategy.pdf

- EirGrid is now faced with the challenge of offering contracts for connection in the greater Dublin region potentially above the power capability of the greater Dublin region;
- Set out a range of short term measures in response to the issues identified above; and,
- Proposed potential longer term solutions that may be considered.

To ensure that data centres can continue to connect to Ireland's transmission system and deliver the benefits as outlined in the Data Centre Strategy, and in response to the challenges highlighted above, EirGrid has since developed a specific Data Centre Connection Offer Policy and Process (DC-COPP) paper. The DC-COPP was issued to data centre customers and stakeholders in June 2019 outlining the new policy with regard to the connection of data centre customers to the transmission network. In advance of circulating the updated policy to data centre customers, EirGrid hosted data centre fora in September 2018 and April 2019 where customers were provided with information on the treatment of the connection of data centres to the transmission network.

The DC-COPP includes detail about the implementation of flexible demand policy for new data centre customers. This is an innovative new approach which allows EirGrid to reduce the load of a data centre a specific number at times when there is more demand for power that can be met by the system. This measure protects existing customers, allows data centres to continue to connect, while managing the potential for over procurement of new generation capacity. Other measures contained within the DC-COPP are:

- Implementing a new two stage process whereby connection methods and capacity are only contracted with data centres once they receive planning permission for their facility. Their facility also must receive planning permission for a project size consistent with their power requirements.
- Facilitating the use of on-site generation to offset the requirement for flexible demand. This initiative provides data centres with the opportunity to allow their on-site generation to be dispatched by EirGrid at times of system need.
- Providing more flexibility on ramping requirements. This allows data centres more ramping of their load over an extended period of time which facilitates more realistic forecasting of load requirements enabling EirGrid to plan more effectively.

- Granting ‘Autoproduction Status’ to offset flexible demand. This is a newer initiative that is being worked on between EirGrid, CRU and developers. One project has been approved in principle and at least one more project is being considered.

EirGrid will continue to review and enhance policy measures to appropriately support data centre development for the rest of PR4 and in PR5 through engagement with the CRU, the data centre industry and other stakeholders. EirGrid is keen to examine further locational signals for new connections through charging, tariffing or other policy measures and looks forward to working with the CRU on these areas early in the PR5 period.

The proposed expansion of the Intel facility in Leixlip is one of the largest ever investments in the Irish state. The customer’s required timeline for connection is very challenging which has, and will, require EirGrid to deliver in an unprecedented manner. The power demand is also unprecedented and will eclipse existing and planned customer requirements. On 21 November Intel welcomed planning approval for the facility and EirGrid welcomed receipt of planning permission from an Bord Pleanála for the new 220kV connection associated with Intel connection and projected load increased. Delivery of this project will be a significant achievement for EirGrid in the PR5 period and therefore has been noted here accordingly.

B.4 Project List

CP number	Project Name	Security of Supply Driver	Security of Supply	2030 Climate Change Targets	Datacentres and Demand Customers	Forecast Energisation
CP0437	Belcamp 220 kV GIS Station	North Dublin Network Reinforcement / Amazon	X		X	2020
CP1043	Gafney (Temporary) Gas Flexgen	New Dublin Generation for SOS	X	X		2020
CP1017	400 kV Voltage Uprate Trial	Innovation - Future SOS in Dublin Region	X			2021
CP0646	Finglas 110 kV GIS Station Redevelopment	North Dublin Network Reinforcement	X			2021
CP0872	Castlebagot 220 kV GIS Station	West Dublin Network Reinforcement	X		X	2021
CP0984	Shellybanks Belcamp 220kV Cable	North Dublin Network Reinforcement	X		X	2021
CP1050	Gafney (Permanent) Gas Flexgen	New Dublin Generation for SOS	X	X		2021
CP0668	Corduff - Ryebrook 110 kV Line Uprate	West Dublin Network Reinforcement / Intel	X			2021
CP0869	Maynooth - Woodland 220kV Line refurbishment	West Dublin Network Reinforcement / Intel	X			2022
Pipeline Project	Porterstown Battery Storage Facility	New Dublin Generation for SOS	X	X		2022
CP0823	Maynooth - Turlough Hill 220kV Line refurbishment	West Dublin Network Reinforcement / Asset Life Extension	X			2022
CP0968	Dunstown 400kV Series Compensation	West Dublin Network Reinforcement	X	X		2022
Pipeline Project	Corduff Gas Flexgen	New Dublin Generation for SOS	X	X		2022
Pipeline Project	Inchicore 2hr Battery Storage	New Dublin Generation for SOS	X	X		2022
Pipeline Project	North Wall 4 Gas Turbine	New Dublin Generation for SOS	X	X		2022
Pipeline Project	North Wall 5 Gas Turbine	New Dublin Generation for SOS	X	X		2022
Pipeline Project	Poolbeg 2hr Battery Storage	New Dublin Generation for SOS	X	X		2022
Pipeline Project	Poolbeg Gas Flexgen	New Dublin Generation for SOS	X	X		2022
Pipeline Project	Ringsend Gas Flexgen	New Dublin Generation for SOS	X	X		2022
Pipeline Project	Southwall 2hr Battery Storage	New Dublin Generation for SOS	X	X		2022
Pipeline Project - Cable	Dunstown-Maynooth-Turlough Hill Cable Replacement	West / South Dublin Network Reinforcement / Asset Life Extension	X			2023
Pipeline Project - Cable	Northwall Poolbeg - Cable Replacement	North Dublin Network Reinforcement / Asset Life Extension	X			2023
CP0808	Maynooth 220kV Station Reconfiguration	West / South Dublin Network Reinforcement	X		X	2023
CP0792	Finglas 220kV Busbar Reconfiguration	North Dublin Network Reinforcement	X		X	2023
CP0580	Carrickmines 220 kV GIS Development	South Dublin Network Reinforcement	X			2023
Pipeline Project - Cable	Inchicore Poolbeg 1 - Cable Replacement	West / South Dublin Network Reinforcement / Asset Life Extension	X			2023
Pipeline Project - Cable	Inchicore Poolbeg 2 - Cable Replacement	West / South Dublin Network Reinforcement / Asset Life Extension	X			2024
CP1001a	Corduff Finglas Line Refurbishment 1	North Dublin Network Reinforcement	X			2025
CP1001b	Corduff Finglas Line Refurbishment 2	North Dublin Network Reinforcement	X			2025
Pipeline Project - Cable	Finglas Northwall - Cable Replacement	North Dublin Network Reinforcement / Asset Life Extension	X			2025
Pipeline Project	Woodland Circuit Breakers	North Dublin Network Reinforcement	X			2025
CP0692	Inchicore 220kV GIS Station Upgrade	West / South Network Reinforcement	X		X	2025
Pipeline Project - Cable	Carrickmines Poolbeg - Cable Replacement	West / South Dublin Network Reinforcement / Asset Life Extension	X			2025
Pipeline Project	Northwall station life extension	North Dublin Network Reinforcement	X			2026
CP0966	Dunstown - Woodland	Dublin Network Reinforcement	X			2027
Pipeline Project	Protection Projects Pipeline - Cumulative	Dublin Network Protection System Upgrades SOS	X			2028
CP1021	North Dublin Reinforcement	North Dublin Network Reinforcement / East Coast Studies	X			2028
Pipeline Project	Station Busbar Uprate 1 - Dublin 110 kV Macetown	West / South Network Reinforcement	X			2030
Pipeline Project	Another Reinforcement in Dublin	Dublin Network Reinforcement / East Coast Studies	X		X	2030+
Pipeline Project	South Dublin	Dublin Network Reinforcement / East Coast Studies	X			2030+

Figure B 4 Dublin Specific Projects

Appendix C

Appendix C

Sustainability and Decarbonisation

Table of Contents

C. Introduction

Note that all detailed costs have been removed from this published version as they could prejudice future procurement exercises

This business case sets out our initiatives to enable a low carbon future that can accommodate an increase in renewable energy generation and drive significant change to the power system in Ireland.

The CAP sets out a policy of having 70% of our electricity being generated from renewable sources by 2030 is ambitious. EirGrid has already delivered world leading levels of renewable penetration. We are therefore uniquely placed to continue to meet the challenging targets, since we have a track record of delivering on current policy targets. A step change is however required during PR5 to ensure that we have the processes, system, tools and infrastructure required to meet the 2030 challenge.

Our role in delivering the 2030 targets includes:

- Overseeing the strategic development of the transmission network, and facilitating the connection of new generators and demand customers.
- Supporting market participants to broaden the range of technologies that can compete in the energy, capacity and system services markets.
- Operating the system and managing the effects of renewables intermittency to maintain a high quality and security of supply for customers at efficient cost.

To meet the challenges associated with our role making the transition to a renewables-based power system, we have identified eight initiatives, outlined in Figure C.1. As outlined in Chapter 5 these initiatives are all on top of our business as usual activities. EirGrid has reviewed and challenged these to ensure that this is the case.

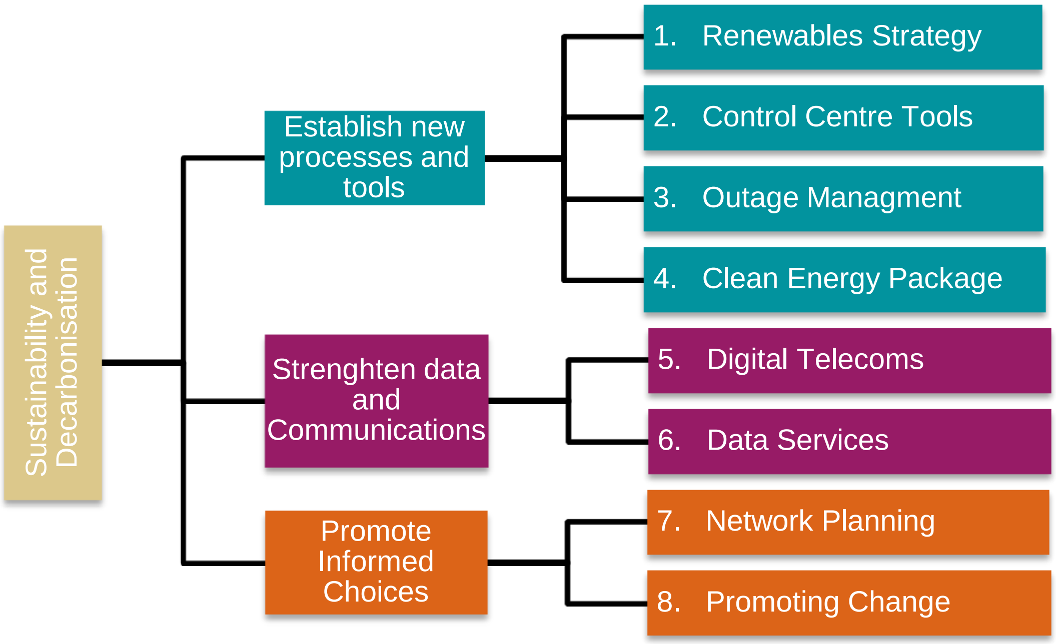

Figure C.1: Sustainability and Decarbonisation Initiatives

These eight initiatives work together to support the overall aim of efficient, economic operation of the transmission system for the benefit of all customers in Ireland. As part of this they specifically will work together to:

- Establish effective processes and tools to operate a power system where the majority of the power comes from non-synchronous intermittent sources;
- Strengthen data and communications networks to secure better access to real-time data and the means to analyse it;
- Promote more informed choices through an improved approach to investment appraisal and improved engagement with internal and external stakeholders; and
- They have been designed to ensure value for money.

We will start the programme of work by undertaking a range of research and development activity to support the delivery of an increasingly renewables-based power system via an overarching strategy. This will support the development of new processes and control centre tools to manage higher levels of non-synchronous RES generation and demand-side response technologies. It will also support proposals for smarter outage management. At the same time, we will invest in the modernisation of our communications and data systems. This will increase the flexibility and responsiveness of the system to adapt to change. Finally, we will review and enhance our approach to investment appraisal to promote cost effective system development.

Our initiatives fully align with Irish Government policy objectives. EirGrid's statutory duties can be summarised as:

- Ensuring the security of electricity supply through system reliability;
- Ensuring that the transmission system is developed in an efficient, co-ordinated and economic way;
- Facilitate competition in the market.

Our initiatives also respond to the drivers of investment identified by the CRU in their PR5 vision and objectives and in their *2019-2021 Strategic Plan* which outlines their commitment to deliver a secure, low carbon future at least cost.

The total cost of the business case is €37m over the control period, with a breakdown of the cost by initiative set out in the Table C.1. These costs have been developed through market review, evidence from previously procured services and a robust internal review process. As set out in Section 5 the overall cost of the activities undertaken by EirGrid, to the end consumer, will reduce by 3% from PR4 to PR5. This is even in the context of the new initiatives outlined below.

Initiative	Total (€m)	Notes
1. Renewables Strategy (DS3+)	24.3	Subject to review through Monitoring Committee
2. Control Centre Tools	5.1	Subject to review through Monitoring Committee
3. Outage Management	1.8	-
4. Clean Energy Package	0.4	Initial allowance. Remainder subject to re-opener through Monitoring Committee
5. IP Migration	2.9	-
6. Data Science	0.3	Initial allowance. Remainder subject to re-opener through Monitoring Committee
7. Network Planning	1.8	-
8. Promoting Change	0.4	-
Total	**37.0**	

Table C.1: Sustainability and decarbonisation estimated costs

These initiatives work collectively to deliver the overall outcome of sustainability and decarbonisation and have been costed accordingly. Failure to secure the full allowance for one of these initiatives may impact on the successful delivery of others e.g. failure to secure the full allowance for Control Centre Tools will mean that the Renewable Strategy (DS3+) initiative will not deliver on the proposed outcomes and outputs.

Furthermore EirGrid achieves significant efficiencies through its EirGrid Group operating model. All of these initiatives are being delivered in conjunction with SONI. The costs have been allocated per our Cost Allocation Policy. This means that Irish consumers are benefiting from significant economies of scale.

C.1. Renewables Strategy and Implementation Programme (DS3+)

C.1.1. Introduction and Context

The indigenous renewable resources available in Ireland fall into the following categories:

- Intermittent, non-synchronous technologies, namely wind and solar PV;
- One pumped storage plant;
- A small number of hydroelectricity plants; and
- Two waste to energy plants.

Large volumes of small scale biomass generation, CHP and anaerobic digestion facilities are installed on the Distribution System, however these are not dispatchable. The majority of Ireland’s current RES contribution is provided in the form of onshore wind. Presently there is only one connected offshore windfarm. The connection of offshore windfarms are likely to increase significantly towards the end of the PR5 period and especially during the PR6 period.

Ireland also has AC interconnection to Ireland and DC interconnection to Wales, with a further DC interconnector planned to France. Further interconnection will help to facilitate the increasing volumes of wind and solar resources, however the nonsynchronous nature of DC interconnection does not resolve some of the technical constraints introduced through large volumes of non-synchronous generation. While further AC interconnection is currently being progressed to Ireland and DC connection between Ireland and France, there are no plans to connect the island of Ireland to another synchronous system though AC interconnection.

The combination of the variability and non-synchronous nature of the wind and solar resources coupled with the increasing volumes of non dispatchable small scale RES introduces challenges for EirGrid.

Delivery of a power system that uses Ireland’s indigenous renewable energy resources will require extensive planning and preparation. We will need to design and build the processes and tools necessary to safely maintain system resilience with high levels of renewables and new technologies.

The challenges associated with high levels of variable non-synchronous renewable energy are widely recognised. We will need strategies to minimise the challenging effects of variable renewable energy, while maximising the benefits and improving the cost-effectiveness of the power system[1].

The Irish power system has characteristics that mean the impacts of the energy transition are experienced more quickly here than elsewhere. Operating a small transmission system with limited interconnection, and very high levels of non-synchronous intermittent generation over significant periods of time, has not been done before to this scale. This means that EirGrid will encounter and have to manage these impacts before other TSOs.

C.1.2. Progress to Date

A significant energy transition is already underway in Ireland, with more than 33% of total electricity consumption in 2018 coming from renewable generation. We forecast that we will successfully meet the 2020 target of 40%.

1219 MW of controllable wind generation was added between 2015 and 2018. The addition of this level of wind, whilst keeping wind curtailment to a minimum has been successfully facilitated by our DS3 programme. In total by 2020 there is expected to be 4,250 MW of wind capacity installed in Ireland. To put this in context, the Ireland system has a peak demand of c. 5100 MW.

Over the last price control period, significant progress was made via the Delivering a Secure, Sustainable Electricity System (DS3) programme to support the 2020 renewable electricity target. As part of this programme, EirGrid, working with SONI, has been able to support increased levels of instantaneous, non-synchronous renewable generation on the all-island system, from 50% to 65% with the aim to increase this to 75% by 2020.

This programme is one of the elements of Ireland's response to the 2020 target of achieving a 40% RES target. Alongside work by ESB Networks, CRU and market participants, the DS3 programme has facilitated achievement of Ireland's renewable target. One of the benefits of this programme is that by increasing the level of non-synchronous generation which can be accommodated onto the systems means a reduction in wind curtailment.

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[1] IRENA, OECD/IEA and REN21, 2018, Renewable Energy Policies in a Time of Transition

Stakeholder engagement has supported our renewables strategy to date. This has included an Advisory Council comprised of experts that was established to ensure that industry views are represented and acted upon.

Using the lessons learnt to date, our renewable strategy will seek to keep pace with binding targets and continued policy developments and will enable us to be prepared to facilitate continued increased levels of renewables.

C.1.3. Identification of Need

The Climate Action Plan sets out a clear target of 70% of our electricity to come from renewable sources by 2030. This is a significant step change on the 2020 target of 40%. The necessary steps must be taken during PR5 to ensure that we can ultimately deliver on the 2030 target.

To meet these challenges we need to prepare a programme of work to solve the operational challenges associated with maintaining reliability and cost-efficient supply with an increasing share of energy from distributed, non-synchronous RES generation and market participation from demand side resources.

Without further progress to support the transition, it is possible the market will become less competitive and unable to fulfil the Government's targets, especially if investors become less certain of future ability to generate or provide services without significant constraints.

This initiative will support the delivery of the CRU's strategic themes of enabling security of supply and a low carbon future that are set out in its corporate strategy.

The continued increase of non-synchronous renewable generation will present new challenges that EirGrid will need to overcome, if it is to be able to continue to maintain, both system security and fulfil its priority dispatch obligations.

C.1.4. Stakeholder Engagement

Delivering increased levels of renewables and new technologies requires close engagement with a range of stakeholder groups. This is to ensure knowledge sharing, targeting of resources and validation of approaches. It is also vital to ensure that the market develops to provide competitive and business driven outcomes.

As part of the DS3 programme a range of stakeholder activities were undertaken and the insights from these have also helped to inform this initiative. This includes the use of, and engagement through:

- DS3 Advisory Council, comprised of industry experts;
- Industry Workshops;
- System Services Industry Forums and Updates;
- Multiple Industry consultations.

The DS3 Advisory Council was established in 2011 to provide a forum to discuss issues associated with achieving 40% of our electricity coming from RES-E. It consisted of experts from across the power industry. This includes representatives from academia and industry across Northern Ireland, Ireland and Europe. Meetings were held approximately every four months. The DS3 Programme also provides regular updates to the wider power industry on the recent findings and developments through workshops. These were held approximately every six months. The DS3 System Services programme also provided regular communications to the wider industry through the publication of quarterly updates and industry forums. The insights gained through this approach helped to develop our approaches to DS3 and provided informed views on future challenges.

EirGrid is a leading member of the EU Sysflex project. This project is made up of 34 members comprising of transmission and distribution system operators, aggregators, technology providers, research and academic institutions as well as consultancies. This is a Horizon 2020 funded project which aims to address the challenges from renewable energy sources, by demonstrating new types of system and flexibility services. We lead on the Sysflex Work Package 4 which aims to develop tools and procedures to equip system operators with the new operating practices as required by the introduction of new system services. Our engagement with experts across Europe has helped to inform this initiative.

Interaction between DS3+ and FlexTech

The EirGrid FlexTech initiative is an all-island project that is directly associated with the EU funded SysFlex Project.

Under the EU-SysFlex Project, EirGrid and SONI are responsible for identifying key barriers and solutions to renewable integration. In delivering this task, co-operation and engagement with the DSOs (ESB Networks and NIE Networks) is essential – hence the Flex Tech Initiative. This initiative is our answer to address this need by providing a structured platform of engagement with our stakeholders.

One of the key outputs of the Flex Tech initiative is to inform future Qualification Trial Processes (QTP), which determines what technologies should be tested and which prove capable of providing the required flexibility. While the QTP process is operated and governed under the DS3+ programme, its learning the outcomes will provide key insights to the EU-SysFlex Project.

The EirGrid Flex Tech initiative will remain within the EU-SysFlex Programme until completion in November 2021, at which time it will fall under the scope of the DS3+ programme.

C.1.5 Option Appraisal

There are two options in order to deliver the 2030 targets set out in the Climate Action Plan:

1. Do nothing: No further work to integrate RES.
2. Develop a renewables strategy and the tools necessary to implement it.

Option 1: Do Nothing

If we do not continue with and accelerate this programme of work then we will not be able to meet 2030 targets, and the operational constraints which exist today will remain unchanged. That means that:

- With increasing levels of RES generation on the system, curtailment of RES will increase significantly, as there is reduced capability to manage exceptional levels of non-synchronous generation.
- The overall volume of electricity generated from RES will not increase sufficiently to meet public policy objectives.
- Increased participation on the system, including in the provision of System Services, will not be provided by new technologies resulting in significant inefficiencies and barriers to market entry.

- Significant levels of thermal generation will continue to be required (as minimum synchronous generation is not decreased), which will then bring additional technical, cost and environmental challenges, as plant reaches the end of its economic life.
- Ireland will fall behind other jurisdictions with a diminished reputation within the area of renewable energy and fighting climate change.

For these reasons, EirGrid does not believe that the “do nothing” option is consistent with either its or the CRU’s statutory duties.

Option 2: Develop a Renewables Strategy and the associated tools

Meeting market and policy requirements for a renewables-based power system will require investment in people and assets. We will therefore need to research and evaluate potential solutions to unlock Ireland’s low carbon future.

It is clear that a range of different processes, services, and tools can all contribute to commercial and public policy objectives with each responding to different external drivers. The challenge lies in determining which investments to take forward to maximise value to the Irish customer, which is the purpose of this initiative.

It is clear that without the right type of investment, the connection of further RES generation will undermine system performance and likely result in excessive levels of curtailment from renewable sources. This would impede progress towards renewable energy targets; reduce the value delivered by the system; and damage investor confidence.

As part of the development of the new strategy, we will need to invest in additional staff and also a range of tools along with external validation of these. This option has been developed based on experience to date, engagement with stakeholders and review of publically available information. The nature of research and development means that there is a degree of uncertainty around the optimal solution currently; however as this initiative progress the strategy is expected to become clearer.

C.1.6 Proposed Initiative

Because there is limited scope to simply follow developments elsewhere, we will need a programme to research, develop, innovate and test the robustness of new policies, processes and tools, which will allow us to integrate high levels of RES into the electricity system in a safe and secure manner.

The policies, processes and tools will be developed over the PR5 period, reflecting the need to continue to accommodate renewable generation in the connection queue and to work towards the targets set out in the Climate Action Plan.

The programme will look at all aspects of renewables integration, from the connections process to operations and balancing. Specifically, it will:

- Identify operational challenges associated with operating the power system with very high levels of RES generation.
- Develop a set of feasible solutions to solve the operational challenges including the development of new policies, processes and tools;
- Undertake a review of System Services, to be completed by the end of 2022 to be available for operation in 2023;
- Bring together the Regulator, TAO as asset owner and DSO to develop and agree a fit for purpose connection process; and
- Ensure that the market remains competitive and investment is encouraged.

In doing this, EirGrid will need to invest in both additional staff and tools to support research and development, undertake policy reviews and appraisal as well as stakeholder engagement. Based on our work to date, we have identified an obvious need for additional tools to cover the following:

- Scheduling of reserves from new technologies;
- New digital performance monitoring system;
- New digital communications infrastructure;
- System Services at residential level;
- New TSO-DSO interface; and
- A new System Services settlement system.

These tools are a mixture of evolution of existing tools as well as the introduction of new tools and systems. Through this programme of research and development as well as extensive stakeholder engagement we will look to continue to establish a detailed set of plans for the efficient and effective delivery of a renewables-based power system. The work will construct a view of evolving market needs across a diverse customer-base and establish a set of solutions to meet those needs, appraising each solution to make sure that we deliver value for money.

The initiative is central to EirGrid's ability to promote outcomes that deliver value for money for customers. It will determine strategic priorities for investment and define the approach to network design and planning for the subsequent price control. It will also improve trust in delivery through customer and stakeholder engagement.

This initiative and the investment in new tools seeks to drive value for money over the long run, through making upfront investment in the tools and resources to deliver against renewable targets, rather than incurring larger facilitation costs later. The shift to renewables is a key uncertainty which we have a responsibility to manage and develop cost efficient solutions to meet.

C.1.7 Delivery of Preferred Approach

The initiative will involve extensive planning and preparation, to design and build the processes and tools, necessary to safely maintain system resilience with high levels of renewables. As such it requires investment in additional staff and improved tools.

We have a clear understanding of the future scenarios for the power system through the Tomorrow's Energy Scenarios initiative.

We need to continue to engage with a broad range of stakeholders to monitor market trends and continually re-evaluate strategy. With that in mind, we will engage with:

- CRU and the TSO in Northern Ireland to contribute to the evolution of regulatory policy and strategy.
- The TAO and the DSO in Ireland to ensure assets and resources are efficiently managed and system resilience is improved, as well as ongoing issues on the Distribution Network.
- SEM Committee to ensure the effective delivery of both joint and separate statutory remits.
- European institutions and agencies to participate in relevant meetings at ENTSO-E and other European organisations, with direct contact with European Commission undertaken to promote renewable facilitation in Ireland.

In addition, we will maintain the existing Advisory Council, with representatives from across industry invited to provide feedback. We will also establish a customer forum with ongoing and intensive stakeholder engagement across industry, engaging with stakeholders from particular sectors on their individual needs. We will engage with the SEM Committee and DSOs to establish a joint vision for the system. This vision will recognise the needs of the local network and the broader system and will be vital in further designing and delivering a renewables-based power system.

We have a track record in the safe and efficient delivery of system changes over the current control period. We propose to apply that successful approach to developing plans for the coming control period.

We will therefore require additional staff resources for:

- **Research and development**: Technical studies to identify challenges, review and refresh the Grid Code, enhance system services and improve congestion management.
- **Policy review and appraisal**: New operational policies, TSO-DSO operational coordination and training.
- **Stakeholder engagement**: Continued consultation and engagement with national and European policymakers, technical engagement with suppliers and other operators, and consultation with key customers.

In delivering the key tools we need to provide the following:

- **Scheduling of Reserves from New Technologies**: Increased scarcities of System Services are observable on the system when there are increased levels of renewables. As such, we need to be able to schedule and dispatch services from wind, solar, batteries and Demand Side Units (DSUs), meaning there also need to be efficiencies in wind dispatch. This will require augmentation of our existing systems.
- **Digital Performance Monitoring Systems (DPMS)**: To efficiently monitor performance and subsequently remunerate the providers of these System Services, the performance monitoring system needs to be automated to review the performance for the 14 existing System Services and any future System Services. The DPMS will compare the declared availability of each individual site vs what their actual response was to a system event and determine a pass/fail rating. This may require a new bespoke system if it is not possible for augmentation of our existing systems.

- **RES Telecommunications Lab**: To support DPMS there is a need for communications infrastructure to interact with Phasor Measurement Units (PMU). PMU are devices that record power system data when the power system is operating outside of normal operational limits. Data processing software that processes the data, collected from the PMU, and labels and sorts the data will be required. This will require augmentation of our existing systems.
- **System Services at residential level, pilot and roll out**: The need for new and enhanced System Services has been established through the DS3 programme. These System Services are required from a range of new technologies and providing units by 2020. Further expansion of these System Services is likely as a result of policy objectives for facilitating increased levels of RES. The residential customer has significant potential to provide these services when engaged effectively and given the correct incentives. This will provide long term competitive pressure on the cost of System Services. However, to date, there has been no appropriate incentive to stimulate this market, nor complementary enabling mechanisms to credibly and prudently procure residential System Services. A pilot project is required to explore the potential approaches, mechanisms and systems required to facilitate this and a rollout is needed to reflect upon the findings. The absence of smart metering is likely to impact energy services being provided at scale by residential customers in the period, however should not be a barrier to the provision of System Services product(s).
- **TSO-DSO Interface**: Unique challenges with embedded renewables and capability are set to increase significantly, as the system becomes more geographically diverse with a wider array of technologies creating, not only local, but also system challenges. This places a greater emphasis on how the TSOs and DSOs work together, a key part of the TSO-DSO partnership is the exchange of information. An updated TSO-DSO interface is therefore required.
- **Settlement System**: New System Services products and new incentives structures will need to be put in place to meet future obligations. A new settlement system is required in order to manage the increased complexities. The settlement system will be an augmentation of the DS3 settlement system.

C.1.8 Costs Estimation and Efficient Cost

As part of DS3 we undertook a range of research and development activities and worked closely with our stakeholder to ensure effective processes were delivered efficiently. Based on our experience in driving change we have developed an understanding of the associated costs with this type of programme. The estimated costs of each element of this initiative, along with our method of estimation, are set out in Table C.2.

Based on our experience and estimates of future activities we will expect to require an increase in headcount of 13.5 FTEs across a multi-disciplinary team with a focus on supporting research and development activities. Overall OpEx spend includes an allowance for supporting professional services, IT development and research.

We also expect to need CapEx investment for developing tools and systems through the following:

- Scheduling of System Services from new technologies.
- New digital performance monitoring system.
- New digital communications infrastructure.
- System Services at residential level.
- New TSO-DSO interface.
- A new settlement system.

Combining the operating and capital expenditure we estimate total costs for EirGrid of €37.0m across the next control period. The costs set out in this submission represent only 75% of the cost of this programme, as a result of the synergies available by approaching this as part of the wider EirGrid Group.

Cost type	Methodology	Source of cost data	Cost data validation	Costs (€m)
Payroll (OpEx)	Bottom up cost assessment	Standardised FTE costs	Internal SME review	
Professional fees (OpEx)	Bottom up cost assessment	Previous experience	Internal SME review	
IT Development costs (OpEx)	Top down cost assessment	Previous experience	Internal SME review	
Research (OpEx)	Top down cost assessment	Previous experience	Internal SME review	
Total (OpEx)				
Scheduling of System Services from new technologies (CapEx)	Top down cost assessment	Previous experience (I-SEM) & vendor engagement	Internal SME review	
Digital Performance Monitoring (CapEx)	Top down cost assessment	Previous experience (ESMS1)	Internal SME review	
RES Telecommunications Lab (CapEx)	Top down cost assessment	Previous experience (metering comms lab)	Internal SME review	
DSM at residential level – Pilot (CapEx)	Bottom up cost assessment	Market data on PMUs, customer participation & infrastructure	Internal SME review	
DSM at residential level – Roll out (CapEx)	Bottom up cost assessment	Market data on PMUs, customer participation & infrastructure	Internal SME review	
TSO-DSO Interface (CapEx)	Top down cost assessment	Previous experience (MOIP)	Internal SME review	
Settlement System (CapEx)	Top down cost assessment	Previous experience (DS3)	Internal SME review	
Total (CapEx)				

Table C.2: Initiative 1 Estimated costs

In developing these cost estimates we have relied on the following evidence:

- **Scheduling of System Services from new technologies:** Experience of change requests generated during I-SEM implementation, through engagement with specialist software vendors on the changing or addition of functionality to the bespoke IT systems such as the Electronic Dispatch Instruction Logger (EDIL) and the MMS. There is a small pool of vendors that are capable of delivering this project. The cost estimation is based on the general scale of change in the I-SEM project.
- **Digital Performance Monitoring (DPMS):** Learnings from previous performance monitoring systems and the importance of establishing the appropriate data source. Cost expected to at least be the same as the previous system. Simple data mapping now available from the System Services settlement system, more consistent and there are PMU at a centralised location and increased complexities are not anticipated.
- **RES Telecommunications Lab:** Experience of the metering communications lab that is currently in place. Based on discussions with the Head of System Performance - Costs comprise of licence costs and additional hardware to support.
- **DSM at residential level – pilot and roll out:** Bottom up assessment based on estimated number of meters, customer participation and infrastructure development costs.
- **TSO-DSO Interface:** Experience of the Market Opening Implementation Programme (DSO had to redesign the retail market and open up to other suppliers) at the time we had to put in an interface. We have engaged with the DSO to ensure that their PR5 submission includes a provision for this interface also.
- **Settlement System:** Experience of change requests implemented to the existing DS3 settlement system. The costs estimation is based on similar change requests that have been implemented on the existing system.

C.1.9 Benefits

The initiative will crystallise the vison for a renewables-based power system, establish a framework for its delivery, and monitor progress through the control period and beyond.

The work will help us to evaluate the efficiency and effectiveness of alternative solutions to support our transition to a renewables-based power system. This ultimately means that:

- The system will be able to cope with increasing levels of RES generation without significantly increasing curtailment costs in the long run, building on the management of curtailment over the last control period.
- Cost efficiencies for customers and businesses as the benefits from renewable energy are maximised.
- The market will have capacity to facilitate market entry and increased participation.
- Significant levels of thermal generation will no longer to be required, reducing the need for thermal generation as existing plant reaches the end of its economic life, therefore reducing greenhouse gas emissions.

The programme of work will facilitate the safe and efficient operation of increased levels of renewables on the system, enabling us to reduce costs to customers without reducing service quality. At the same time, the programme will also make a significant contribution to the delivery of wider environmental policy aims.

The proposed output metrics for this are included in Appendix S.

We will be happy to engage with the CRU to agree upon metrics which would support its role in the delivery of decarbonisation. This is further explored in Section 6.

C.1.10 Risks and Mitigations

This programme of work requires a range of integrated and coordinated activities to ensure that it is delivered effectively. In terms of the activities undertaken the key risks include:

- The developed vision does not meet needs of stakeholders, and as such is unable to identify appropriate solutions.
- There is an inability to recruit the right skill sets to support the delivery of this activity leading to overall delays.

- Appropriate solutions are not fully scoped and lead to outputs which do not fully meet needs.

Specific risks and mitigations associated with the delivery of this strategy and the associated capital investments are presented below.

Risk	Probability	Impact	Mitigation
There are insufficient skills to perform the solution analysis and design.	Low	High	The current team has developed a range of complex skills as part of DS3 and understand the challenges that need to be addressed.
There are challenges in identifying the appropriate skills in the recruitment for additional staff.	Medium	Low	We have experience in recruitment for targeted skill sets and will work with hiring managers to ensure we get the most effective people.
Procurement for developing tools takes longer than expected leading to delays and additional costs for the project.	Low	Low	We have significant experience in the procurement of solutions, and are obliged to procure these services through a public tendering exercise. We will need to create a realistic and achievable project plan that includes the time needed to complete the procurement exercise.
The solutions may prove more complex than expected leading to delays and additional costs for the project.	Medium	Medium	We will validate the proposed new processes in advance of the project starting through robust business case evaluation, agile development and small-scale prototyping where possible.
The operation of the solutions may prove complex, introducing the need for additional resources and costs into its operation and use.	Low	High	We have significant experience in the management and operation of large complex solutions. We will include the management processes and procedures into the design of the solution.
The expected benefits from the changes are not achieved leading to wasted investment.	Low	Medium	We have significant experience in the delivery and project management of solutions and the achievement of benefits. We will create a realistic benefits management plan as part of the overall project delivery plan to ensure that benefits are identified and that they are achieved.
The projects explored by EirGrid are not ambitious enough to keep pace with the rapid pace of change in the energy system and deliver the quality of service that customer’s will demand in future.	Low	Medium	We have a proven track record in pursuing innovation approaches to the challenges presented by the energy transition. We will outline our approach to innovation to ensure we continue to leverage high risk/high reward projects where appropriate.

Table C.3: Initiative 1 Delivery risks and mitigations

C.2. Control Centre Tools

C.2.1 Introduction and Context

One of the key objectives of the PR5 period will be paving the way for the transition to a decentralised, low-carbon electricity system. This will require the development of a suite of control centre tools to oversee, control and optimally manage the system at the National Control Centre (NCC).

New functionality will be required to facilitate both further integration of RES generation as well as range of new technologies. These new technologies will range from grid-scale down to aggregated domestic level.

These will fundamentally change the way the power system behaves. The development and deployment of a range of innovative tools will ensure secure operation is maintained and optimal use of renewable energy can be achieved in the most cost-effective way.

This builds upon previous experiences we have with improving control centre tools, including the integration of the Wind Dispatch Tool in the control centre. The Wind Dispatch Tool enables EirGrid to manage wind installed across Ireland, including embedded sites at distribution level. It also enables the accurate monitoring and tracking of the renewables energy production as well as the dispatch down volumes, which feed into renewables reporting for Ireland.

C.2.2 Proposed Initiative

Control centre tools and applications will need to adapt and respond to changes in energy technology, grid technology and regulatory compliance. There will be an initial task to design and identify specifics, although at this stage we anticipate significant enhancements are required for:

- Demand forecasting: new demand forecasting to capture the impact of embedded generation.
- RES forecasting: forecasting RES output, particularly when embedded in the distribution system.
- Demand Side Unit (DSU) dispatch: effective dispatch and control of a wide range of DSU.

- RES dispatch: a new tool designed to facilitate the dispatch of small-scale RES down to 1 MW.
- Storage controller: tool/ functionality to manage storage and the System Services it will collectively provide to the TSO.
- System services scheduling for RES and new technologies: the optimisation of the provision of System Services from technologies such as wind, solar, battery storage and DSM.

The following diagram (removed due to cyber security risks) shows the scope of the Energy Transition Control Centre Tools and the interfaces that either currently exist with other solutions or that must be put in place to achieve the overall solution.

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C.2.3 Identification of Need

The power system in Ireland is undergoing a period of rapid change in terms of the technologies connecting to the system, and how they interact and impact on the operation of the system as a whole.

To deliver value to customers, it is essential that the NCC is equipped with the systems, tools and applications to optimise the system. The NCC will need to facilitate significant increase in demand-side participation, including at residential level, it will need to integrate increased levels of new generation that is predominantly embedded in the Distribution Network and needs to be more agile to quickly incorporate new small-scale embedded generation.

During PR4, we have already invested in new tools to enable Grid Controllers to operate the power system with ever increasing levels of RES and new technologies up to 2020. The DS3 Control Centre Tools project will deliver enhanced frequency control, enhanced voltage control and enhanced stability analysis capability to the NCC by 2020. In addition we propose to undertake a full refresh of the EMS commencing in 2019 and this is covered in a separate business case (please see Appendix F).

The NCC plays a key role in enabling EirGrid to meet its obligations under our transmission system operation licence. In particular, EirGrid is required to plan, operate, coordinate and direct the flow of electricity onto and over the transmission system in an efficient, economic, and coordinated manner. Given the transformation of the system, the NCC will need to be adaptable to accommodate new challenges and ways of working under rapidly changing conditions.

However, there will be a need to develop additional functionality to respond to the technology drivers identified and not all of the functionality can or will be captured in the EMS. The core function of the EMS is to provide oversight and control over the Transmission System; other functionality to support decision-making in the Control Centres will need be developed as tools which are separate to the EMS.

NCC systems, tools and applications will need to respond to a range of technological and market drivers of investment including:

- Energy technology drivers including dynamic data centre demand, distributed storage, the emergence of hybrid sites, electrification of new sectors and its impact on demand, residential demand-side participation and grid scale RES offshore/ tidal; and
- Non-energy drivers including EMS platform refresh, data feeds for Market Management System (MMS) and other systems/tools, and Control Room redesign.

C.2.4 Stakeholder Engagement

This initiative has been informed by our ongoing stakeholder engagement for the DS3 programme. This includes the use of and engagement through:

- Advisory Council.
- Industry Workshops.
- System Services industry fora, consultations and updates.

One of the specific themes covered in the stakeholder engagement element of DS3 was the systems tools with control centre tools being a key element of this. As such stakeholders have been engaged specifically on this topic, to ensure that tools develop to meet the needs of the market and customers. This is also to understand the challenges of both integrating new technologies and operating the power system with these new technologies.

The primary mechanism at present for continuing to engage with stakeholders in the evolution of the control centre functionality is through the customer forum (see Initiative 1). It is only by understanding both the barriers to new technologies—connecting the system and the operational challenges of integrating these new technologies and their impact on the system, that we will be able to develop the roadmap for the control centre. A key element of this will be understanding the pace of development of new technologies and how quickly they will want to connect the power system and operate in the energy and System Service markets. As we transition to more distributed RES power system, the reducing size of the connecting parties means that the connection time becomes shorter and any systems (and supporting business processes), that EirGrid develops will need to meet those new timelines.

In addition, it will be essential to understand how other TSOs are meeting these challenges – we will do this through our engagement with vendors in the marketplace and our involvement in ENSTO-E, in particular: the Research, Development and Innovation Committee and the Digital Committee.

C.2.5 Option Appraisal

The licence conditions of EirGrid as TSO require us to operate the power systems of Ireland. Failure to prudently and appropriately develop the NCC functionality to meet the challenges of operating the evolving power system for the benefit of customers may act as a barrier to integrating renewables which would increase costs to customers.

We have identified two options, a ‘Do Nothing’ and a ‘Do Something’.

The option to ‘Do Nothing’ exists where the control centre tools are retained as they currently are, however a range of challenges have been identified with relation to this including:

- Inability to effectively integrate new technologies into NCC operation leading to potentially missing the decarbonisation target and increased curtailment.
- Inability to effectively integrate increasing levels of existing renewable technologies into NCC operation, leading to potentially missing the decarbonisation target and increased curtailment.
- Inability to capture the benefit of dynamic data centre demand thus potentially increased System Services needs from other providers and potentially a barrier to transitioning to higher levels of System Non-Synchronous Penetration (SNSP).

- Suboptimal usage of distributed storage, which could lead to unnecessary levels of local or regional congestion.
- Uncertainty regarding the impact of the electrification of new sectors and hence increased error in demand forecasting, leading to increased Dispatch Balancing Costs (DBC).
- Inability to engage customer in the journey towards a sustainable decarbonised energy future by not addressing barrier to residential level system services provision, via an aggregator.

The ‘Do Nothing’ scenario would effectively result in a stall in further renewable integration. In absence of the appropriate control centre tools and resources the System Operators would not be able to further increase non synchronous penetration levels. This will in turn increase the level of curtailment experienced by renewables resulting in a stall in renewable investment. Coupled with this, the ‘Do nothing’ scenario, would result in the System Operator being unable to effectively utilise the inherent flexibility of new Service providers including storage , DSM along with renewables such as wind and solar, resulting in non-optimised scheduling and increased costs.

Our ‘Do Something’ scenario, reflects on the challenges we face currently and drivers of change, as such, it requires the updating of a range of systems to deliver effective outcomes and mitigates the challenges above. In terms of developing our approach for each of the solutions we explored the following questions:

- Could the functionality be provided by an off-the-shelf solution by a trusted vendor?
- How complex is the functionality?
- How much interaction/ interfacing is there to other systems?
- How scalable does the solution need to be?

The ‘Do Something’ scenario is built on our experience and knowledge of the areas of the NCC that need to be improved. These tools will need to work together and provide support across the changes that are occurring within the market.

C.2.6 Delivery of Preferred Approach

Our delivery approach includes investment in a range of control centre tools including:

- Common Dispatch Mechanism and Communications Design and Implementation, covering renewable energy sources (RES), demand side unit (DSU), small scale generation (SSG) and storage control management.
- Control centre data store.
- System services scheduling for RES, DSU and storage.
- Enhanced demand forecasting.
- Enhanced RES forecasting.
- Additional forecasting data sources.

Within each of these there will be a need to undertake scoping, design, development, testing, implementation and roll-out. There will also need to be ongoing support for operation.

The case for investment in these tools is underpinned by the following assumptions:

- A roadmap, informed by internal engagement and external engagement with industry, regulators and policy makers, will inform the sequencing and prioritisation of the deployment of new functionality and capability.
- Engagement with Grid Controllers and sister TSO organisations will be essential to ensure the benefits of new functionalities can be delivered – this will be supported by business process alignment and policy change.
- Off-the-shelf solutions are favoured from a cost and enduring support perspective – the more bespoke the application, the greater the cost and the enduring support can be complex, costly and resource intensive.
- In some cases, the required additional functionality can only be delivered via modifications to other commercial-facing systems in the NCC– this can be more complex and lower priority when weighted against other changes.
- Due to the integrated all-island operations and all-island EMS platform and suite of supporting tools, all the assumptions here are on the basis of delivery for the control centres in Ireland and Northern Ireland.

C.2.7 Costs Estimation and Efficient Cost

The OpEx and CapEx estimates for spend are based on our experience in developing and delivering solutions within the control centre, such as the wind penetration secure level assessment tool (WSAT) and the DSA tool.

For each of the proposed control centre tools we have undertaken a bottom-up approach to identify the costs associated with the requirement including labour input, vendor costs, technical support and license costs. These have been estimated based on a review of market solutions costs and standardised maintenance benchmarks.

Table C.5 provides a summary of the costs for the initiative. These represent EirGrid's share of the total project costs, which include savings obtained from developing these tools as part of a group.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
Payroll (OpEx)	Bottom up cost assessment	Standardised FTE costs	Internal SME review	
Ongoing license support (OpEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Total (OpEx)				
Overall Programme Design and High Level Solution Design and Component Identification (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Common Dispatch Mechanism and Communications Design and Implementation (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Control Centre Data Store (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
RES (Renewable Energy Sources) Dispatch (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
SSG (Small Scale Generation) Aggregation/ Dispatch (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
DSU (Demand Side Unit) Dispatch (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Storage Control Management (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
System Services Scheduling for RES	Bottom up cost assessment	Review of market solutions	Internal SME review	

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
(Renewable Energy Sources) (CapEx)				
Enhanced RES Forecasting (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Enhanced Demand Forecasting (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Additional Forecasting Data Sources (CapEx)	Bottom up cost assessment	Review of market solutions	Internal SME review	
Total (CapEx)				

Table C.5: Initiative 2 Estimated costs

C.2.8 Benefits

The benefits of developing the control centre capability include enhanced ability to:

- Manage the power system of Ireland as it evolves and changes and to manage new technologies, such as solar PV and offshore RES, in the most effective way.
- Support the understanding of the potential impact of the electrification of new sectors, leading to reduced Dispatch Balancing Costs (DBC).
- Capture the benefit of dynamic data centre demand reducing System Services needs from other providers and lowering barriers to transitioning to higher levels of SNSP.
- Increase the benefits of Demand Side Management (DSM), from industrial-scale DSU to residential-scale DSM schemes, which enable end customers to actively participate in the energy transition and keeps cost at a minimum.
- There may also be benefits to Ireland of increased level of fuel independence.

The enhanced control centre functionality will ultimately facilitate the delivery of policy outcomes and lower bills for customers as the cost of renewable energy falls.

The proposed output metrics for this are included in Appendix S.

C.2.9 Risks and mitigations

There are a range of risks and uncertainties associated with delivering additional functionality in the control centre:

- Uncertainty regarding the pace of development and new connections in Ireland – this means that the timescale for the tools to manage new technologies or to support the management of the power system with these new technologies is unknown.

- Due to the innovative nature of the solutions required to manage the power system of the future, the development and deployment will require internal Subject Matter Expertise (SME), both from a software development and system operations viewpoint, and external vendor SME. All will need to work in close partnership and this will continue to a focus in vendor management to ensure knowledge retention of bespoke tools is a high priority.
- Due to the introduction of other large, transformational projects e.g. market changes, Real-Time operations will continue to experience significant change. This will need to be carefully managed to ensure there are no unintended negative impacts, due to overly complex tools, or, too much information provided, that would impact on decision making.
- The successful deployment of any new functionality depends heavily on the underlying communication infrastructure being available in a timely manner. Consideration regarding the required communications infrastructure, from a TSO, DSO and User point of view is essential. Failure to deliver the required communications infrastructure could result in tools being unable to monitor/schedule/dispatch Users, ultimately resulting in real-time operations not being changed to deliver value to the customer.
- Experience has shown that in order to develop and deploy a new tool successfully, it is essential to engage the end user i.e. the Grid Controllers, at each stage of the process. This must be balanced with need not to have an overly customised or bespoke solution which can be costly to support on an enduring basis.

Specific risks and mitigations associated with the delivery of the Control Centre Tools are presented below.

Risk	Probability	Impact	Mitigation
There are challenges in identifying the appropriate solutions needed to deliver the control centre tools	Medium	High	We have experience in developing and delivering a range of complex solutions including control centre tools although we will need to develop a detailed delivery plan.
Procurement for developing tools takes longer than expected leading to delays and additional costs for the project.	Low	Low	We have significant experience in the procurement of solutions, and are obliged to procure these services through a public tendering exercise. We will need to create a realistic and achievable project plan that

Risk	Probability	Impact	Mitigation
			includes the time needed to complete the procurement exercise.
Challenges in ensuring that enduring support is provided for the tools developed.	Low	Medium	Engagement with external vendors will be important to ensure that effective solutions with long term support solutions are identified.
Licensing and support costs are higher than expected due to unknown factors.	Low	Low	We have ongoing discussions with vendors and as such a detailed knowledge of expected costs. Further engagement will be need and a robust procurement process.
Developing new tools proves more technically challenging than expected, leading to delays, cost increases or even non-delivery of the solutions	Medium	Medium	We will learn from international experience to identify potential technical hurdles, conduct detailed due diligence on vendors and explore technical requirements through initial low risk feasibility studies.

Table C.6: Initiative 2 Delivery risks and mitigations

C.3 Smarter Outage Management

C.3.1 Introduction and Context

Outage management systems provide the capability to plan for outages associated with:

- The development and commissioning of new transmission infrastructure and generation connections.
- Planned activity on the network and at generators that require the assets to be de-powered, for example in order to undertake routine maintenance.
- Unplanned events such as unexpected transmission and generation failures.

These outages need to be scheduled and coordinated at a system level to avoid or minimise any interruptions to supply and minimise costs, such as Dispatch Balancing Costs (DBCs).

We are responsible for the management of generation outages in Ireland from 3 years ahead to 1 day ahead and transmission outages from 1 year ahead. This includes production of the Transmission Outage Programme (TOP), a Generation Outage Programme (GOP) and the co-ordination of business and participant requirements for both.

The TSO is required under Grid code to facilitate and manage outages of Generators and Power System Equipment.

As the energy network evolves at pace and becomes more complex and more dispersed, we are finding that the challenges associated with managing outages are increasing. In addition to these added challenges, the introduction of a new Capacity Market has also added an additional dynamic to the traditional outage management approach.

While the market itself is designed to deliver the volume of Capacity required by the TSOs to cover peak loads, and incentivises generators to be available during times of scarcity, this at the same time adds an incentive for generators to perhaps not be as flexible as they would otherwise have been with regards scheduled outages. While the impact of this with regards to margins across the year is not yet fully settled it adds an additional dynamic input into the outage management process.

EirGrid has identified the potential to use new approaches and technologies to increase the smartness of our approach to outage planning. In this initiative we set out the case of need for this step change in approach, the associated costs and the benefits of this initiative.

C.3.2 Identification of Need

Developments in technology have created the potential for us to improve the service that we offer to customers.

An enterprise Outage Management System (OMS) will allow the effective tracking, management and reporting on transmission and generation outages. It will enable effective management of outage requests, outage changes, unplanned outages and overall outage programme management for both generation and transmission. This enterprise solution should also provide the capability for ESB Networks to input their outage information relating the transmission system in Ireland. This enterprise OMS will have real-time information on system outages which it will be able to share effectively with other systems. This will ensure that the system stability as well as the associated costs can be determined when outages change.

Where generation and transmission outages are not aligned, generators are compensated for lost revenue through the imperfections charge. Smarter outage management will allow us to assess the impact of transmission outages on the DBC element of that charge.

Since I-SEM Go-Live, the prediction of DBC has become increasingly difficult with outturn DBC coming in 42% higher than that provided for in the tariff. This has led to additional costs being incurred in credit cover and associated interest accruals.

By implementing a better approach to outage planning, we will be able to more accurately predict the impact of outages on DBC budgets prior to approving requests. It may also be able to reschedule those outages to reduce adverse economic impacts.

C.3.3 Proposed Initiative

We propose to develop a new approach to outage management to reduce the total costs associated with planned and unplanned outages. The approach will involve the development of a decision-support system based on the estimated costs of outage under alternative system conditions. It will include new systems, tools and skills.

This new smart outage management process will provide decision-makers with information on the total cost of granting outage requests, taking account of possible interactions and dependencies across the system.

An enterprise OMS will be deployed as an initial step. This will allow the effective tracking, management and reporting on transmission and generation outages. Complementary CBA tools will use the same data sets to manage associated constraint costs. This optimisation will provide benefits to the industry as their requests may be granted with better evidence-based CBAs while EirGrid can meet incentivised targets to deliver more economic solutions for the benefit of customers.

We will need additional resource to support the development and delivery of the new enterprise OMS. This will involve working with internal and external stakeholders to scope the project, design the system and integrate the components within the business.

Figure C.3 below provides an overview of the architecture of the smart outage management solution (removed due to cyber security risks).

C.3.4 Option Appraisal

We have identified three options for outage management as follows

- Option 1: Do nothing and continue to react to unexpected DBC variances, acknowledge their financial costs and accrue financial penalties for failure to meet incentivisation targets.
- Option 2: Develop a smart outage management approach with use of predictive financial and power flow models to establish the potential impact of each outage from a cost, system resilience and stability perspective. To make informed and sometimes automated decisions on outage coordination. As part of collaboration with Regulatory Authorities to establish a new incentives mechanisms and/or seek significant upward revisions of the DBC forecasts each year.
- Option 3: Incorporate stochastic methods and reliability-based assessments into the smart OMS to further mitigate the risk of unexpected variances.

We have discounted Option 1 as it is at odds to the grid code obligation “to minimise so far as possible” the impact of outages because developments in technology introduce possibilities that were not present before. Option 3 is attractive in terms of advanced analytics but these benefits are offset by high computational costs.

Option 2 is the preferred option. This involves development of a smart outage management approach, employing informed decision-making that incorporates financial, enhanced security and reliability considerations along with the current feasibility criteria and operational security standards. The main benefits of this approach include:

- Enhanced assessment of risks.
- Consistent application of procedures to establish priorities.
- Enhanced learning from improved feedback between DBC forecasts and outturns.
- Use of consistent data to create a single source.

In addition, by implementing a new enterprise OMS alongside related tools we anticipate synergies that will improve value for money for the Irish consumer.

C.3.5 Delivery of Preferred Approach

Delivery of the preferred approach will involve the following stages:

- Stage 1: Analysis and solution specification. We will document existing outage management processes and identify desired target processes including interface requirements. This will be used to create a tender specification document.
- Stage 2: Procurement and supplier selection. We will engage the market and publish the tender specification. Following evaluation of tender responses we will select the supplier providing the best overall value.
- Stage 3: Solution implementation and validation. We will work with our preferred supplier to implement and validate a new OMS. This will involve:
    - Acquisition, installation and configuration of new system
    - Integration of the new system with existing external systems including: MMS, EMS, IGM/CGM and PSSE.
    - Development of analytical and reporting functions, with supporting documentation.

    - Engagement with customers and other stakeholders to inform them of the new outage management process.
    - Training of staff in the operation of the new system.
- Stage 4: System support. We work with our preferred supplier to provide intensive post-deployment support to facilitate a smooth transition from deployment to ongoing operations.

C.3.6 Costs Estimation and Efficient Cost

We have developed a bottom-up cost estimate based on estimated resource, software and hardware costs based on the activities described above. As part of this we have relied on existing external resource rate cards, expected benchmarked maintenance levels and license costs.

Total costs for the new smart OMS are shown in Table C.8.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
Solution Implementation and Validation (OpEx)	Bottom up cost assessment	Standardised costs	Internal SME review	
Total (OpEx)				
Payroll (CapEx)	Bottom up cost assessment	Standardised costs	Internal SME review	
Analysis and Solution Specification (CapEx)	Bottom up cost assessment	Standardised costs	Internal SME review	
Procurement and Supplier Selection (CapEx)	Bottom up cost assessment	Standardised costs	Internal SME review	
Solution Implementation and Validation (CapEx)	Bottom up cost assessment	Standardised costs	Internal SME review	
Hypercare During Initial Period of Operation (CapEx	Bottom up cost assessment	Standardised costs	Internal SME review	
Total (CapEx)				

Table C.8: Initiative 3 Estimated costs

In determining costs, we have analysed advanced/smart outage management solutions from a number of potential suppliers including: ABB, ACS Power, CGI Group, Daffron, ETAP, Futura, GE, Hexagon, Intergraph, IPS Energy, Kaihen, Landis and Gyr, Milsoft, National Information Solutions Cooperative, OATI, Oracle, OSII, Power System Engineering, Prometheus, Ripley Power & Light Company, Schneider Electric, Sedata, Sensus, Siemens, Survalent, and Versify.

We have also used our substantial experience in outage management and in the design and acquisition and development of technology solutions in validating the cost estimates.

C.3.7 Benefits

The proposed solution optimises the coordination of transmission and generation outages in line with priorities for safe, secure, reliable, economical and efficient operation. Each outage will be managed in real-time through the Near-Time team using the OMS.

The benefits of a new smart outage management process include:

- Overall improved functionality of the network outage management system ensuring security of supply for the customer in an effective and efficient manner.
- Greater understanding of the impact of particular outages may be ascertained prior to commencement and appropriate risk management and alleviation may be established.
- Effectively identifying, monitoring and tracking our performance against core obligations in relation to outage management.
- Escalating dispatch balancing costs may be mitigated.
- Enhanced feedback between DBC forecasting and actuals resulting from outage occurrences.
- Facilitating decision making using the same data sets and single source of truth across all associated teams (Near Time Outage Management, Near Time Office, Real Time Control Centres, System Support, Grid Development Programme Management Office) meaning that consistent information is available.

- Considering all pertinent factors when determining the outage programme including financial aspects along with potential impact on system security and stability.
- The implementation and operation of consistent, reproducible and auditable process with intuitive outcomes.
- Enabling enhanced output from resource set or alleviating resource requirements in the longer term.

The proposed output metrics for this are included in Appendix S.

C.3.8 Risks and Mitigations

Specific risks and mitigations associated with the delivery of a new smart OMS are presented in Table C.9.

Risk	Probability	Impact	Mitigation
There are insufficient skills in EirGrid to perform the solution analysis and design.	Low	Medium	There are external consulting organisations that can provide skills and experienced resources if necessary.
The solutions have been installed in EirGrid for so long that detailed knowledge of the operation and use is not available as staff have left.	Low	Medium	There are external consulting organisations that can provide skills and experienced resources if necessary.
The selected vendor cannot deliver the project within the expected times and costs.	Low	High	EirGrid has significant experience in the procurement of large information technology infrastructure solutions. EirGrid is obliged to procure these services through a public tendering exercise. EirGrid will create a realistic and achievable project plan that includes the time needed to complete the procurement exercise. EirGrid will validate vendor skills, experiences, references and technology capability prior to selection.
The cost estimates in	Low	Medium	EirGrid has validated the costs with reference

Risk	Probability	Impact	Mitigation
the business plan are inaccurate and underestimate the actual cost			to existing systems and with providers of these solutions.
The users in the production, generation, consumption and transmission units do not use the new solution.	Medium	Medium	The introduction of any new processes to external stakeholders is always complex. EirGrid already has skills and experience in major change projects such as I-SEM that affected external stakeholders. EirGrid will manage the communication process carefully to maximise project success.
The procurement exercise does not identify satisfactory solutions leading to delays and additional costs for the project.	Low	Medium	EirGrid has significant experience in the procurement of large information technology infrastructure solutions. EirGrid is obliged to procure these services through a public tendering exercise. EirGrid will create a realistic and achievable project plan that includes the time needed to complete the procurement exercise. EirGrid will contact all vendors in advance to inform them of the tender. One possible mitigation is to use section 49 (1) d of S.I. No. 286/2016 - European Union (Award of Contracts by Utility Undertakings) Regulations 2016 to allow EirGrid to use the negotiated procedure without prior call for competition.
The operation of the outage management processes proves more complex leading to delays and additional costs for the project.	Low	Medium	EirGrid will validate the proposed new processes in advance of the project starting.
The operation of the new configuration proves complex, introducing the need for additional resources and costs into its operation and use.	Low	High	EirGrid has significant experience in the management and operation of large complex information technology infrastructure solutions. EirGrid will include the management processes and procedures into the design of the solution.
The expected benefits from the changes are not achieved leading to wasted investment.	Low	Medium	EirGrid has significant experience in the delivery and project management of large information technology infrastructure solutions and the achievement of benefits. EirGrid will create a realistic benefits management plan as part of the overall

Risk	Probability	Impact	Mitigation
			project delivery plan to ensure that benefits are identified and that they are achieved.
The interfaces required by the outage management system prove complex to implement and operate.	Medium	Medium	EirGrid has significant experience in developing system interfaces. The I-SEM project introduced over 140 new interfaces. EirGrid has an effective interface management technology infrastructure. Nonetheless interfaces can be complex. EirGrid will analyse and specify their requirements in detail to avoid problems during implementation.

Table C.9: Initiative 3 Delivery risks and mitigations

C.4. Clean energy package

C.4.1 Introduction and Context

The Clean Energy Package (CEP)aims to set the right balance between making decision at EU, national and local level. In doing so, efficiency gains at European level will be established that otherwise could not be found if each country acted alone. The new measures provide greater opportunity for citizens and businesses.

Through improved market efficiency and reinforced customer rights, citizens will have influence over their energy footprint. TSOs and market operators have a key role to play in the development and realisation of a low carbon energy future and EirGrid, working with our partners, are committed to supporting and delivering Ireland's low carbon economy objectives.

The European Commission presented a legislative package on 30 November 2016 – the largest release of proposed European energy policy since the Third Energy Package in 2009. Negotiations have now been concluded on all aspects of the framework – the Clean Energy for All Europeans package – and the new rules were formally adopted by member states in May 2019. This marks a significant step towards the creation of the Energy Union and delivering on the EU's Paris Agreement commitments.

An assessment is underway to identify areas of work and resource requirements for implementation and as such it is too early to provide a detailed analysis of expected budget and resource requirements.

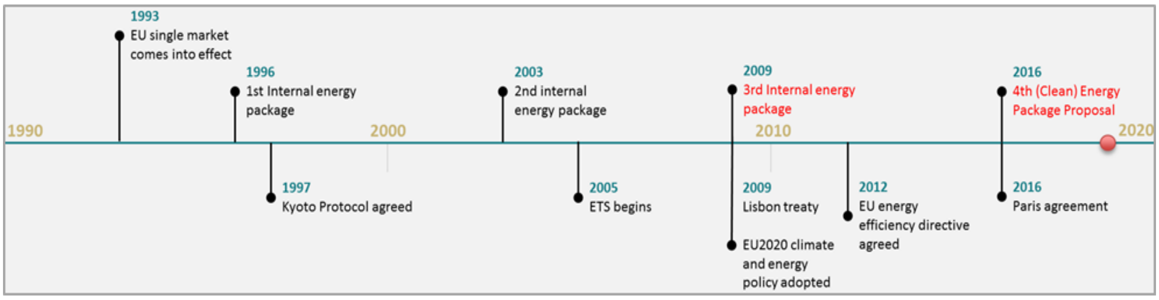

Figure C.2: Timeline of EU energy policy

C.4.2 Proposed Initiative

The implementation of the Clean Energy Package will be delivered on EU, National and at local level. EirGrid Group will provide support to ENTSO-E for the development of EU level tasks and also shall be responsible to deliver local TSO obligations. There is a focus on six key areas:

1. **Provisions for regional cooperation (RCCs)**

The CEP foresees an enhanced framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs). These have to be formally started by 1 July 2022, including the 10 new tasks for the RCCs where relevant. ENTSO-E has to develop a proposal for those new RCC tasks that are not covered by existing network codes or guidelines. ENTSO-E can decide how to deliver these new tasks in the most efficient manner, e.g. through a new methodology, an amendment to a NC or GL (Guideline), or an alternative arrangement at regional level. A legal review is ongoing regarding the need for new methodologies. Those ENTSO-E methodologies would be subject to ACER approval and will be executed by RCCs, whose obligations and liabilities will also be applicable as of 1 July 2022.

In addition, further assessment looks at potentially needed new IT tools, or the update of existing ones able to support the new RCC tasks at pan-European level, and to fulfil ENTSO-E's obligations to promote cooperation between TSOs at regional level and ensure interoperability, communication and monitoring of regional performance.

2. **European resource adequacy assessment**

The CEP requirements for the pan-European adequacy assessment include the development of five new methodologies within 6 to 12 months after entry into force. The future European adequacy assessment sees a major extension of its scope compared to the current Mid-term Adequacy Forecast as it will need to cover new requirements such as yearly granularity for a ten-year horizon, flow-based calculations, sectoral integration, sensitivities with/without CRM, among others. There are different scenarios for implementation with differing impacts on ENTSO-E and member resourcing, depending on the choice of speed of implementation, tool optimisation and allocation of resources between ENTSO-E Secretariat and TSO experts.

The preferred scenario shall offer the best balance between resources needed and timely delivery however some delays are unavoidable and require a pro-active communication with the EC and ACER, as to successfully manage risks and expectations. The European resource adequacy assessment also requires an efficient stakeholder interaction.

3. Bidding Zone methodologies (BZ), review & reporting on structural congestions

The CEP defines a new framework to conduct the bidding zone review. Every three years ENTSO-E has to develop a technical report on structural congestions and assessment of capacity calculation thresholds. The BZ methodologies and scenarios must be delivered three months after entry into force while the subsequent review is to be done by the relevant TSOs within 12 months after approval of the methodologies and scenarios.

Developing the methodologies and scenario configurations should be considered as an All-TSOs task, with a role of ENTSO-E to coordinate and facilitate the work, while the actual review is to be seen as a Member State responsibility and should be conducted at that level by the relevant TSO.

4. Capacity mechanisms registry and provisions for foreign capacity participation

The CEP grants ENTSO-E new mandates to develop methodologies, and common rules and tools for the participation of foreign providers to capacity mechanisms, all due within 12 months after entry into force. Further to this, ENTSO-E has to develop a registry of foreign capacity providers within 24 months after entry into force.

Additionally, new restrictions on revenue available to high carbon emitters will impact the local Capacity Mechanism on the island of Ireland. These new rules will have to be considered.

5. Risk preparedness framework and methodologies

The CEP sets a new framework for the enhanced and better coordinated approach to risk preparedness at the regional level which will be delivered through key methodologies for short-term adequacy assessments and crisis scenarios. This has to be developed by ENTSO-E within six months after entry into force.

6. **TSO-DSO cooperation on new tasks through the future EU DSO entity, future Network Codes (NC) drafting process, legal implications and penalties**

There are likely to be significant resource implications related to these new provisions on ENTSO-E members as the CEP puts into place a new process for future New Network Codes and guidelines drafting and adoption, as well as on cooperation with the future EU DSO entity on NCs and other tasks related to system planning and operation. Additional considerations to be taken into account include the possibility for potential new network codes in the areas of cybersecurity, demand response, interoperability, etc. as well as the impacts of upcoming processes to amend existing NCs/GLs to reflect the new CEP requirements.

Last but not least, the CEP impacts on ENTSO-E and the TSOs should be seen in the context of the future greater role and the oversight of ACER vis-à-vis ENTSO-E and the RCCs, and the new requirements for transparency, data provision and compliance. In addition, if ENTSO-E or the RCCs are deemed to be non-compliant with their obligations under the CEP, they may face financial penalties. Liabilities, risk of delays, and options for ENTSO-E and TSOs to deliver with respect to delivering timely on its obligations and avoiding penalties shall be reviewed.

C.4.3 Identification of need

The Clean Energy Package is EU law and includes eight legislative documents focusing on energy efficiency, energy market reform, renewable energy and governance. Three directives and one Regulation have already been published in the Official Journal of the European Union. The remaining four texts have been agreed and will be published in the coming weeks.

Energy Performance in Buildings Directive	Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0075.01.ENG

Renewable Energy Directive	Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG
Energy Efficiency Directive	Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency (Text with EEA relevance.)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0210.01.ENG
Governance Regulation	Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (Text with EEA relevance.)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0001.01.ENG
Electricity Directive	Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast) (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN
Electricity Regulation	Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast) (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN
Risk-Preparedness Regulation	Regulation (EU) 2019/941 OF THE EUROPEAN Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0941&from=EN
Rules for the regulator ACER	Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators (recast) (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0942&from=EN

Table C.10: Legislative documents of the Clean Energy Package

The Electricity Directive and Electricity Regulation will impact EirGrid Group and will be applicable from 1st January 2020. Work to implement the package has already begun and will likely continue for the extent of the price review period (until 2026). The existing

European Network Codes may also be amended during this period and also require additional effort for any change or new proposals.

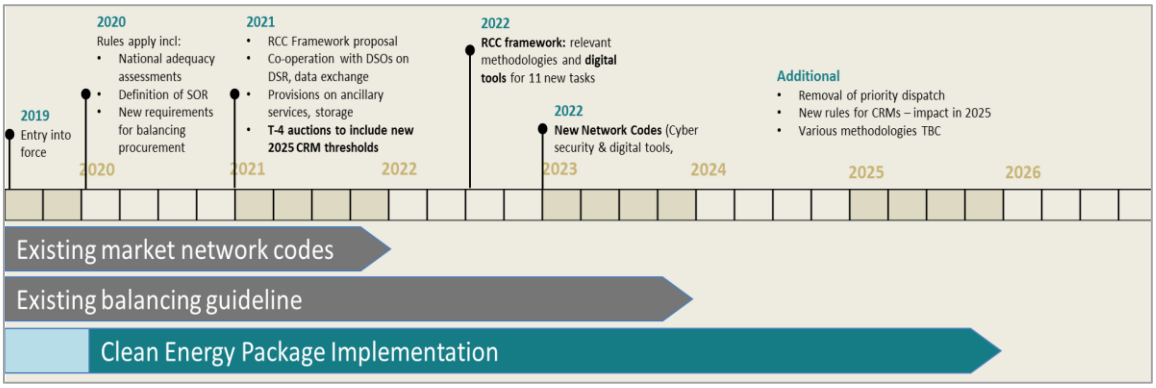

Figure C.3: Implementation timeline of Network Codes and the Clean Energy Package

C.4.4 Option Appraisal

Non-compliance: it is not possible to estimate potential fines levied on Ireland for not implementing the obligations under the Regulation and Directives. We assume these could be significant. It should be noted that new articles on penalties are now included.

We have reviewed two options for implementation including:

- Stepwise and minimum requirements; and
- Go fast & ambitious

The first (stepwise) approach (with strong risk monitoring) is a preferred approach which will deliver a gradual ramp-up of resources, testing and learning whilst managing risk of incurring some delay. The second approach would require a high resource requirement and contingency without gradual testing or learning.

EirGrid will consider the new obligations and will pursue a path for implementation that allows for effective and efficient use of resources. The implementation programme is to be drafted later this year and will require consultation and agreement with the UR. In our business plan, we have included EirGrid's share of the cost of initial preparatory work here only.

C.4.5 Delivery of Preferred Approach

At present, we do not have a detailed breakdown with respect to expected costs resulting from implementation of the Clean Energy Package. The Electricity Regulation and Directive became EU law in the Summer 2019 and an impact assessment is currently underway. An uncertainty mechanism will therefore be required once there is clarity on final obligations and agreement on the approach for implementation.

C.4.6 Costs Estimation and Efficient Cost

It should be noted that implementation will be a cross-functional process and tasks such as the drafting of methodologies, the introduction of new network codes and subsequent legal and regulatory reviews and implementation of new tools and processes, may be substantial in terms of resource commitment. It is estimated that EirGrid's share of the initial cost for professional fees for high-level design analysis and design will be approximately €0.4m. This excludes implementation costs. We propose that the enduring allowance required for this goes through the Monitoring Committee as discussed further in Chapter 6.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
External consultancy	Bottom up cost assessment	Standardised costs	Internal SME review	

Table C.11: Initiative 4 Estimated costs

C.4.7 Benefits

The Clean Energy Package aims to set the right balance between making decision at EU, national and local level. In doing so, efficiency gains at European level will be established that otherwise could not be found if each country acted alone.

The new measures provide greater opportunity for citizens and businesses and through improved market efficiency and reinforced customer rights, citizens will have influence over their energy footprint. TSOs and market operators have a key role to play in the development and realisation of our low carbon energy future and EirGrid Group, working with our partners, is committed to supporting and delivering Ireland and Northern Ireland’s climate objectives.

C.4.8 Risks and Mitigations

There remains significant uncertainty with respect to the cost of implementation including any capital expenditure or resultant resource expectations. Depending on the level of required change to current systems, operational tools and other arrangements, the costs could decrease or increase relative to expectations.

Because of the magnitude of the uncertainty around the cost of implementing this legislation, EirGrid proposes the use of the Monitoring Committee, as discussed in Chapter 6, to recover the majority of the cost, with only the initial exploratory works funded through the price control revenues.

C.5. Migration to IP technology

C.5.1 Introduction and Context

Telecommunications services are critical to core functions of EirGrid and are depicted in Figure C.6 as Corporate Services and Operational Services. Corporate Services comprise corporate telephony, mobile services and Internet connectivity. Operational Services are more specific to a transmission system provider and comprise SCADA (Supervisory Control and Data Acquisition), operational telephony, meter data collection and communications systems required to protect transmission lines.

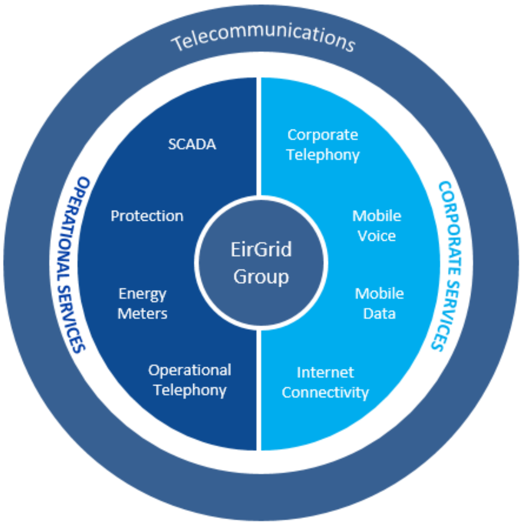

Figure C.4:Portfolio of Telecom Services

In Ireland the telecommunications network is owned by ESB and is designed to provide wide geographical coverage and continuity in the event of a local or widespread power outage. Commercial telecommunications providers would not be in a position to provide the required coverage or service resilience. The development of a separate telecommunications network would be prohibitively expensive. EirGrid's telecommunications services are largely provided by ESB Networks Telecoms under a service level agreement (SLA) which is built on the Infrastructure Agreement (IA) between EirGrid and ESB.

ESB Networks Telecoms have developed a new IP based network with 16 nodes currently in place. This network, known as the Operational IP Network, is a dedicated network for EirGrid's operational telecommunications requirements.

C.5.2 Proposed Initiative

The current model for delivering telecommunications services is based on providing individual point to point circuits to power system sites. These circuits are costly to implement and incur a rental charge for operational use. The profile of new connections to the power system has changed in recent years from a small number of large connections to a large number of small connections, making the current solution unsustainable. However the proposal to migrate to an Operational IP model is expected to facilitate a larger number of small connections at a lower per-site cost.

This initiative will utilise the new IP network which has been developed and migrate sites from the old connections to the new IP network.

C.5.3 Identification of Need

In order to meet current and future system requirements, EirGrid needs to provide appropriate telecommunication services to its core businesses. The EirGrid Group Telecommunication Strategy, which was developed with the assistance of an external consultant, identified the key business drivers that will have a major impact on the future requirement for telecommunications services across the EirGrid Group. This is shown below.

Business driver/Functional Need		Drivers for Telecommunications Solutions and Services
	**Power System Operation** Requires reliable voice and data Telecom services with appropriate connectivity between remote sites and control centres	• SCADA network requirements • System Performance network requirements • System Services • Control Centres • Telephony requirements
	Power System Growth Requires a scalable telecoms network to cater for the ongoing growth of the power system	• SCADA network requirements • System Performance network requirements • System Services • Support for Energy Metering • Control Centres

Business driver/Functional Need	Drivers for Telecommunications Solutions and Services
	• Telephony requirements
DS3/Small Scale Generation (SSG) Requires a flexible telecoms network to meet the needs of increasing levels of renewable energy and new system services	• SCADA network requirements • System Performance network requirements • System Services
Increased automation and the deployment of smart grid technologies Requires a telecoms network that will support the deployment of new technologies, potentially with new bandwidth and connectivity requirements .	• SCADA network requirements • System Performance network requirements • System Services • Support for Energy Metering • Control Centres • Telephony requirements
Single Electricity Market Operator (SEM) The operation of the SEM will require a telecommunications solution that supports the remote reading of meters and can scale to meet future growth	• Support for Energy Metering

Existing (non IP) telecommunications technologies are limited in terms of agility, capacity and longevity and are being phased out by manufacturers, so their continued use will become problematic within the next 5-8 years.

C.5.4 Options Appraisal

There are no alternative options available to EirGrid. The IP network was developed by ESB Networks Telecoms to help support the future needs of the transmission and distribution system. There are no other third parties that have such a system in place. Furthermore, the physical network is divided into two separate networks with one dedicated for EirGrid’s use.

C.5.5 Delivery of Preferred Approach

The telecommunications services initiatives can be summarised as follows:

- Migration to IP technology for data and telephony requirements, both for corporate and operational services
- Provision of robust shared inter connectivity between EirGrid sites and the consolidation of Internet connections in order to support critical business functions cost effectively

We are targeting 40 sites per annum to be migrated from old communication technologies to IP.

C.5.6 Costs Estimation and Efficient Cost

Over the next control period, EirGrid will upgrade and replace its current analogue services. The package of work includes capital expenditure to support IP migration.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
System IP Migration (CapEx)	Bottom up cost assessment	Standardised costs	Internal SME review	

Table C.12: Initiative 4 Estimated costs

C.5.7 Benefits

The benefits associated with migrating to IP telecommunications are as follows:

All- Island Power System Operation

Reliable telecommunication services with appropriate connectivity between remote sites and control centres to facilitate continued all-island power system operation.

Power System Growth

Scalable telecommunication services in response to a growing power system with changing needs in terms of monitoring, control and data volumes.

DS3/Small Scale Generation (SSG)

Flexible telecommunication services to meet the needs of increasing levels of renewable energy and in particular to cater for a large number of small generation sites and new system services.

Increased automation and the deployment of smart grid technologies

Adaptable and geographically diverse telecommunication services capable of supporting multiple interface standards, speeds and protocols in order to facilitate the deployment of smart grid technologies.

Single Electricity Market Operator (SEMO)

Reliable telecommunication connectivity between the central market operator sites in Dublin and Belfast and to multiple Internet Service Providers to support market participants.

C.5.8 Risks and Mitigations

Table C.13 explores delivery risks and potential mitigations.

Risk	Probability	Impact	Mitigation
EirGrid cannot secure the appropriate expertise to manage the delivery of this initiative	Low	Medium	We have experience in recruitment for targeted skill sets and will work with hiring managers to ensure we get the most effective people.
Operational IP Technology provides the most cost effective method of data and telephony communication, so the lack of its adoption would present the risk of escalation of operational costs	Low	Medium	The transfer of sites will be kept under close observation by our HRCS function with corrective action taken in a timely fashion.
Delays to this initiative will hamper the delivery of other strategic initiatives including data analytics, cloud computing, data centre co-location and cyber security	Low	High	The transfer of sites will be kept under close observation by our HRCS function with corrective action taken in a timely fashion.
The integration and ongoing usage of Operational IP services can be achieved without cyber security threats compromising the power system	Low	High	The cyber security requirements for this have been captured elsewhere in this PR5 submission.

Table C.13: Initiative 5 Delivery risks and mitigations

C.6. Data Services

C.6.1 Introduction and Context

Changes in electricity markets, generation, demand and supply, create challenges and opportunities for network planning and operation. At the same time, increased use of digital communications in the delivery and use of energy networks, presents an opportunity to develop a better understanding of demand and supply through better data capture, data management and data analytics.

At this stage this initiative seeks to provide additional support, to undertake a scoping activity, to identify key data analytics requirements and assessments for improving overall functionality. This reflects on lessons learnt to ensure that efforts are focused at the onset to maximise effect. Once specifics have been identified we will then be in a position to better engage on delivery of the data services.

C.6.2 Identification of Need

The volume and complexity of data is increasing for a variety of reasons including: the operation of the new trading arrangements, multiple new connections in generation and generators, additional transmission resources, growth in renewables, increased use of IP-enabled control devices, and increased numbers of data requests from stakeholders.

There are an increasing number of smart features across the network and this is set to continue to grow. At the same time there is increasing requirements around data security and sensitivity which need to be accounted for in our approaches.

Improving our data services should enable continued progress towards greater levels of efficiency and accuracy throughout the business. This is driven by enabling decision makers, system planners and technical staff to be able to take more informed actions and decisions. We also have requirements to ensure commercially sensitive data is protected effectively.

The solutions that the improved levels of data analytics supports should also help to manage the increased levels of uncertainty due to higher levels of renewables as well as providing the necessary data for enhanced performance monitoring and better record historic information for reporting purposes.

Enhanced data services and the introduction of advanced analytics will also become a key enabler to support the continued growth of demand side management and in particular, demand side participation at a residential level.

Timely access to reliable, up-to-date data is required to assist with rapid decision-making and operational adjustments needed to support the strategic objectives of the business. It will also improve our ability to provide data more widely to customers and stakeholders.

Over recent years there has been a significant increase in customers, regulators and other bodies requesting access to more data at a higher level of granularity. The involvement of stakeholders is therefore central to the development of enhanced data services.

External parties will have questions on grid development, systems operations including DBC and other areas. We need to be in a position to respond to external events. The data warehouse platform can only be built in a collaborative environment and the structures and models developed need to be responsive to all stakeholder needs.

In understanding potential solutions we have ongoing discussions with our suppliers to understand existing data service offerings available and how these can support our business. This insight helps us to formulate effective strategies.

We will also need to arrange workshops on data services and deliver solutions that work for a wide range of stakeholders and customers.

C.6.3 Proposed Initiative

We will develop and implement a strategy to support the realisation of benefits of data services. The data strategy will:

- Define our approach to data capture, management and analysis.
- Identify issues and gaps with existing approaches.
- Review future data service requirements.
- Define an approach to data security, governance and quality.

The focus of the strategy will be to inform investment decisions, by providing the right signals to developers and market participants to make sure we get the right developments in the right places.

The initiative will link different data initiatives. It will look to ensure that common data tools are developed so that costs can be reduced and increasing re-use across the organisation. It will improve data security and quality and allow us to extract value from our extensive data assets.

As part of the initiative to create a scalable data architecture solution, there will be activity to:

- Document business data requirements including data landscape, supply chain view, model view and lifecycle view.
- Design of data warehouses and data extraction tools.
- Assessment of analytics tools across all parts of the organisation.

The overall aim from this process will be to have a detailed strategy and specifically developed solutions to support, the creation of a more advanced data analysis system.

C.6.4 Option appraisal

In order to support the take-up of renewables as well as drive efficiency and effectiveness across our business we need to invest in data services to make this feasible.

There are a range of potential data analytical solutions and options available and we have reviewed public evidence from a range of potential suppliers. Through this we have determined that the most appropriate option at this stage, is to devote resources to scope potential solutions and approaches.

At a later date further specific investments will need to be procured in a competitive and transparent manner, however, as there is too much uncertainty about potential solutions it does not seem feasible to justify expenditure on these unknowns at this point.

The key first step is therefore the development of a data strategy to finalise the required service inputs. Following this there will need to be a review of potential next steps reflecting actions. This will likely include taking forward either some, or all of the recommendations, from the strategy. We propose that this then gets progressed through the Monitoring Committee which is outlined in Section 6.

C.6.5 Delivery of Preferred Approach

It should be noted that we are proposing that this initiative is progressed through the Monitoring Committee as set out in Chapter 6. This section outlines what the overall enduring process would entail.

Our delivery plan for the data and analytics work package includes preparing a multi-year plan for the development of a strategic data analysis through detailed investigation. Details of this are set out below.

Data strategy development

The purpose of the strategy will be to place the various data-related initiatives in a wider context to ensure that they are consistent, make certain that effort is not duplicated and to contribute to the achievement of the wider information technology and business strategies of EirGrid.

It is important to link the different data initiatives to this strategy. It will ensure that common data tools are used, reducing cost and increasing re-use across the organisation. It will improve data security and quality. It will allow us to extract value from its extensive data assets.

The data strategy work will include the following activities to:

- Document current data assets across the organisation – data stores, data processing, data integration and exchanges.
- Identify issues and gaps with current data processing, both primary – core applications – and secondary ones.
- Define planned future data processing requirements that incorporates both data storage infrastructure and data process.
- Define an approach to data security and information classification.
- Define an approach to data governance.
- Describe an approach to data quality.

The data strategy will be developed in a structured way across the following capabilities, competencies, subject areas, processes and supporting technologies:

- Data Governance.

- Data Architecture.
- Data Modelling and Design.
- Data Storage and Operations.
- Data Security.
- Data Quality.
- Data Integration and Interoperability.
- Reference and Master Data.
- Data Warehousing and Business Intelligence.
- Document and Content.
- Metadata.

Detailed business requirements documented

The analysis and design of business requirements will look to understand the current and known (or likely future) data management systems, structures and processes and the requirements to access and process this data. The work will gather and present information in a number of views:

- Data landscape view - describe the entities and functional units within and outside the organisation and their interactions in terms of data flows.
- Data supply chain view - describe in-bound and out-bound data paths, within and outside the organisation, in terms of the applications and the data that flows along the data paths.
- Data model view – define data specifications that reflect data requirements and designs and defines the critical data produced and consumed across the organisation.
- Data lifecycle view – describe data across its stages of creation, consumption, use, retention, archival and deletion.
- Current data management view - analyse how data management processes and capabilities are designed and operated.

Data warehouse design and data extraction tools analysis

The Extract Transformer and Load engine (ETL) tool extracts data from operational data stores, performs operations on it to transform it and then loads the resulting data into time-oriented data warehouse for reporting and analysis. As part of this the following is required:

- ETL operations and requirements need to be defined.
- The source data needs to be specified.
- The nature of the transformations needs to be described.
- The target data stores will be defined.
- The capabilities of the ETL facility will be defined and documented.
- The ETL tool need to be able to accommodate new data feeds easily.

The data warehouse is the central store of integrated data from one or more disparate sources. It provides the foundation of data reporting and analysis for an organisation. The data warehouse platform can only be built in a collaborative environment and the structures and models developed need to be responsive to all stakeholder needs. It needs to be designed to allow it to grow and be extended easily. During this investigation stage all stakeholder needs will be identified and analysed.

Analytics Tool Assessment

The analytics component will need to make a suite of toolsets available to allow business users to process a wide variety of data types and perform a wide range of analyses. These tools include data mining that identifies patterns, aids understanding and provides predictive analysis.

This investigative stage will enable a full analysis of the tools available to be completed to ensure the most suitable ones are selected. This phase will need to include an element of trialling and piloting of the available tools. There is a very rich and functional set of open source tools available.

C.6.6 Costs Estimation and Efficient Cost

Delivery of this programme will entail spending approximately €0.3m. In terms of input required to deliver our data strategy, we have relied on a mix of evidence from:

- Experience of provision of data solutions and pilots within the business.
- Market studies and review of public pricing provided by external parties.
- Existing contracts with a number of vendors providing services.

Our review from external parties includes consideration of information from Gartner Research, Oracle, Dell, Version 1, CPL and Eolas

The enduring costs for this initiative will be agreed through the Monitoring Committee as discussed in Chapter 6.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
Data Strategy Development (CapEx)	Bottom up cost assessment	Review of market solutions and experience	Internal SME review	
Detailed Business & Data Requirements Documented (CapEx)	Bottom up cost assessment	Review of market solutions and experience	Internal SME review	
Data Warehouse Design & Data Extraction Tools Analysis (CapEx)	Bottom up cost assessment	Review of market solutions and experience	Internal SME review	
Analytic Tools Assessment (CapEx)	Bottom up cost assessment	Review of market solutions and experience	Internal SME review	

Table C.14: Initiative 6 Estimated costs

C.6.7 Benefits

There is a need for an enterprise-wide data and analytics capability that provides for intelligence-led planning, prioritisation and decision-making.

The initiative will provide a return on investment by:

- Providing more effective use of resources: We will identify areas to improve IT solutions performance by reducing operational cost over time and targeting scarce IT skills to value-adding activities. This will eliminate or reduce duplication, data errors, and lack of visibility or reporting.

- Enhancing operational efficiency: We will identify areas to improve system operations by providing real or near real-time analysis and discovery and increase efficiency, delivering cost benefits to customers. This will facilitate system development by maintaining the security of supply with a high level of renewables.
- Refining network planning: We will identify new tools for improved discovery, reporting, visualisation, analysis, modelling and potential publication. This will be used to better understand the business and provide predictive and even prescriptive analysis.
- Improving data security. We will identify areas to reduce commercial and reputational risks associated with poor data management. Our approach will set out an approach for an effective data governance framework that protects our interests and those of our stakeholders. This will aid internal and external communications by providing high quality responses for information or clarification.

Once the strategy is developed there will be a need to revisit the metrics monitored.

C.6.8 Risks and mitigations

Table C.15 explores delivery risks and potential mitigations.

Risk	Probability	Impact	Mitigation
Inability to identify an effective data strategy to be pursued.	Low	Medium	Wide range of existing data analytics packages exist which are widely deployed.
Costs of implementation of data strategy are significant.	Medium	Medium	The data strategy will need to review costs of alternative options and prioritise based on business needs.

Table C.15: Initiative 6 Delivery risks and mitigations

C.7 System Planning

C.7.1 Introduction and Context

Changing market conditions and the rapid introduction of renewable generation and new technologies will exert pressure on system planning processes and resources. For example, the greater range of potential future scenarios driven by renewables creates uncertainty, and we are seeing an increase in the speed for access to be provided to the transmission system.

At the same time society is demanding much greater justification and transparency to support proposed developments and the introduction of new technologies that are being considered.

Our planning team needs to be able to meet both the analytical challenges associated with new technologies and also the increased stakeholder requirements. Methods should be evolved and adjusted to become more agile to be able to meet these challenges over the next price control period.

C.7.2 Proposed Initiative

We will undertake an ongoing review of the needs of the Transmission System with reference to ongoing market requirements, our licence conditions as well as the nature of the renewables and technologies expected in the price control. Where this requires system reinforcements we will undertake consultation with stakeholders and planning authorities.

We need to update and enhance our appraisal processes to deal with the added complexity associated with new technologies and renewables. In particular reviewing those that require dynamic analysis (e.g. transient/frequency/voltage stability, harmonics, temporary overvoltage, transitory recovery, switching studies). This type of analysis requires much more detailed parameters, models, tools, and a much higher skill level of the operator than equivalent steady state analysis.

As these technologies are more susceptible to changes occurring in the system in both the short term (hourly, daily) or long term (years) they also require scenarios and contingencies to be evaluated.

This means that not only is there an impact to the time taken and skill required of analytical teams, but also that of data acquisition teams, models and their developers, and communications. As many of these analyses require different models to be adequately completed the overhead of new tools and support teams is also required.

In this we will also need to develop approaches we use for stakeholder engagement within the system planning process to ensure we use the improved analytical methods to demonstrate value.

C.7.3 Identification of Need

We need to ensure that the network planning team has the appropriate resources and skill set to meet the challenges it faces in supporting the delivery of renewables based energy market.

Historically standard power system analysis has required the use of simplified steady state (load flow, fault level) analysis to undertake the assessment of the network. However due to the changes occurring in user's plant and equipment, coupled with the types of analysis required to test new dynamic technologies, nearly all system studies going forward are going to require dynamic analysis.

Dynamic analysis including transient/frequency/voltage stability, harmonics, temporary overvoltage, transitory recovery and switching studies require much more detailed parameters, models, tools, and a much higher skill level of the analyst. The current Network Planning team has limited experience in elements of these and indeed would likely require external support without additional resources.

The current systems are also more susceptible to changes occurring in the short term (hourly, daily) or long term (years), which require more scenarios and contingencies to be evaluated. This increases the work load of the Network Planning team.

Furthermore, the more power electronic equipment that is utilised in our system the more analysis will have to be carried out in relation to control system interactions. The latter is an area which Network Planning currently has no experience.

As there are significant unknowns regarding the complexity of the system under very high levels of renewable generation these activities are likely to evolve and become more challenging. We need to ensure that we take appropriate actions to mitigate this risk and be able to plan the system effectively to deliver value to customers.

A range of new technologies are becoming operational on the system and require more detailed and frequent analysis. This means in the PR5 Price Control period we need to be able to understand the challenges of:

- Traditional technical phenomena such as power flow and voltage.
- A range of a complex issues, such as harmonic analysis, transient over voltages, dynamic stability, and sub-synchronous interactions.
- Additional issues around cabling and HVDC technologies.

The existing team has experience with some elements of these challenges. There is also need to undertake more scenario testing to reflect the challenges associated with renewables.

Failure to provide sufficient support to correctly and adequately assess these challenges may result in:

- Risk to security of supply.
- Poor investments (that risk being stranded);
- Failure to obtain the necessary permissions from planning bodies; and/or
- Public and political acceptance enabling development to be completed.

As such ensuring the Network Planning team has the appropriate resources is important.

As set out in Appendix E, we are aware that we will need to be able to ramp up our early engagement with stakeholders that are potentially impacted by network investment projects. This initiative does not overlap with the scope of that mechanism.

C.7.4 Option Appraisal

In terms of options considered we have reviewed a ‘Do Nothing’ and a ‘Do Something’ scenario.

The ‘Do Nothing’ scenario would mean we do not invest in our people or resources and as such are less able to cope with the increased levels of complexity and stakeholder requests that are forecast over the regulatory period. This would result in sub-optimal outcomes for grid users and end customers.

The ‘Do Something’ scenario would mean we invest in the required resources for system planning given the expected future complexity of power system analysis based on known phenomena and their propagation in transmission systems.

The transmission system in Ireland is small relative to other transmission systems and more exposed to changes and new phenomena occurring. As one of the fastest developing systems to decarbonisation in relative terms, Irish system can be expected to encounter previously unknown phenomena or growth in phenomena.

As Ireland is ‘ahead of the curve’ in this area it is hard to obtain material evidence to back up our estimated resource requirements specifically. The prudent and risk adverse approach is to have appropriate resources available to deal with estimated additional analytical burden and meet stakeholder demands.

In the past, much of the work associated with the planning of the system has been outsourced to consultants at a premium rate. This approach has become increasingly more difficult to justify as the cost of this work has increased. It is also hindered by the fact that the availability of skilled resources to undertake this type of work are scarce.

Given the volume of analysis needed to undertake annual assessments of the system and to review new projects as they come on-stream, the current approach to using external resources is becoming unsustainable both practically and financially. There is also a need to ensure that resources are located in jurisdictions they operate in and have a detailed understanding of the stakeholder environment.

In this additional resources have been identified as the key importance to support the management of the increased workload rather than investment in additional tools.

C.7.5 Delivery of Preferred Approach

Our preferred approach is to employ additional skilled staff to supplement our existing network planning resources. The skill set of these individuals will need to reflect the increased level of technical complexity expected over the next price control period.

C.7.6 Costs Estimation and Efficient Cost

We estimate that given the expected volume of work we would need to budget for €1.9m over the 5 year control period. This covers the support of 3.75 FTE to provide support across System, Access and Scenario Planning.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
Payroll (OpEx)	Standardised FTE costs	Standardised FTE costs	Internal SME review	

Table C.16: Initiative 7 Estimated costs

C.7.7 Benefits

As a result of investing in network planning, we will be able to better assess how market developments and new technologies will impact on the performance and efficiency of the system. Failure to do so could be in breach of our statutory and licence requirements and could result in increased risk of system wide problems.

The ability to support further introduction of new technologies into the transmission system will provide new opportunities. Many of the new technologies which are driving this change in the business as usual work in planning the development of the system are controllable and/or tuned devices. They therefore offer the opportunity to change their controls and/or be re-tuned to deal with changing needs of the power system.

As a result they provide a potential opportunity to find viable alternatives to capitally intensive new developments in the long run. For example the deferment of the need to develop a standard new transmission line of c.20km in length would offer savings in of circa. €20m.

Overall this will mean that we will be able to provide robust, timely, efficient and defendable investment decisions that will ultimately lead to better value to customers. We will measure the benefits from the success rate and turnaround of the necessary developments of the transmission systems.

C.7.8 Risks and Mitigations

Risk	Probability	Impact	Mitigation
Failure to comply with legislative and licence requirements, and to meet customer and stakeholder expectations.	Low	High	License requirements for network planning must continue to be met, it will be vital to ensure that where specific issues arise these are identified and targeted in discussion with stakeholders.
Increased costs to customers due to challenges to or unsuccessful achievement of planning submissions and/or political intervention	Medium	Medium	Engaging closely with customers and stakeholders to understand issues and challenges and where possible make appropriate responses to these.
Stranded assets and/or irreparable damage to plant and equipment	Medium	Medium	All assets and equipment should be reviewed to ensure value and continued monitoring of this over time.

Table C.17: Initiative 7 Delivery risks and mitigations

C.8 Promoting Change

C.8.1 Introduction and context

The delivery of a renewables-based energy system will involve a concerted effort across all internal and external stakeholders. This will not only require the development and delivery of a clear strategy, it will also require clear articulation of the strategy to establish and maintain stakeholder support.

We will need to build internal and external stakeholder trust by transparently communicating the challenges and opportunities associated with sustainability and decarbonisation, engaging with stakeholders to involve them in key decisions and reporting progress and risks. We also need to ensure we are leaders in sustainability internally and build best practises into day to day operational activities.

In doing this we need to leverage our current internal and external affairs capabilities and ensure we have a dedicated focus on sustainability.

C.8.2 Proposed Initiative

We will establish a specific Policy and Sustainability role to develop and execute an organisation-wide strategic sustainability initiative, integrating sustainability throughout the company based on industry best practice as well as key national and international guidelines in the area of sustainability. This initiative will be designed to enhance business performance and support the long term strategic objectives of EirGrid.

The role will require the identification and prioritisation of areas for sustainability efforts, including the initial four areas highlighted in the strategic review of sustainability where we have a role:

- Projects: environmental initiatives in conjunction with grid projects.
- Facilities: energy saving and environmental initiatives in conjunction with our offices/business.
- Employees: educating employees and facilitating them to carry out environmental initiatives at home in addition to at work.

- Communities: educating the wider community and supporting environmental initiatives through CSR initiatives.

This Policy and Sustainability function will liaise with colleagues to ensure effective outcomes.

C.8.3 Identification of Need

The drive towards greater use of renewables, increased diversity in energy demand and supply, and the rapid development of new technologies means that investment case-making is both more complex and more urgent.

As we move to a system fit for the 21st Century, there is a need to be a leader in sustainability within Ireland to meet the needs of our customers and stakeholders. In doing this resources are required to lead initiatives and engagement across the organisation. This involves developing strategy, policy, communications and implementations plans as well as collaborating internally and externally with stakeholders.

Our experience is that investment case-making is becoming more complex, and policy-makers, suppliers and customers are all demanding much greater transparency and justification to support decisions on infrastructure proposals. Based on this engaging with our stakeholder internally and externally needs to evolve and become more agile during the course of the next control period.

C.8.4 Option Appraisal

We need to support the sustainability initiative via undertaking a range of internal and external activities. Consideration of options has been undertaken to understand the scale of resources required to ensure that tasks are completed accurately and efficiently.

Alternative options were considered including:

- Do nothing: This is not an option as to proceed with EirGrid having little focus on sustainability would mean that the organisation is not aligned with national and international sustainability development goals. With responsibility for planning and operating the transmission system to deliver safe reliable and economic electricity now and for future generations for Ireland, sustainability needs to be at the heart of how the organisation does business.

- Option 2: Implement sustainability initiatives within the organisation, but do not provide leadership in sustainability externally. This option has not been selected, as it would be a missed opportunity. Our role is to deliver a sustainable electricity system for future generations – education and accessible engagement with stakeholders and communities will enable us to deliver this more effectively and efficiently, increasing overall benefits for Ireland.
- Option 3: Implement sustainability initiatives within the organisation and externally. Using this approach it was identified that a modest level of increase, equivalent to 1 FTE was deemed viable to be shared between SONI and EirGrid to deliver the required activities. This was seen as the minimum level of input required. The overall resource requirement was based on a review of existing activities and identification of existing gaps and additional tasks required. In supporting this we have reviewed a range of job specifications from other relevant organisations.

C.8.5 Delivery of Preferred Approach

We will create a Policy and Sustainability function in 2020 to develop and execute an organisation-wide strategic sustainability initiative. The function will identify and prioritise areas for sustainability efforts across the organisation. This will provide support across both SONI and EirGrid.

C.8.6 Costs Estimation and Efficient Cost

One FTE has been identified as required for this function across SONI and EirGrid, with the cost shared. In developing the resource requirement and brief we have reviewed sustainability roles at other organisations, as well as used benchmarked FTE costs.

This means that EirGrid will require 0.75 FTE support over the PR5 period.

Cost type	Methodology	Source of cost data	Cost data validation	Cost (€m)
Payroll (OpEx)	Standardised FTE costs	Standardised FTE costs	Internal SME review	

Table C.18: Initiative 8 Estimated costs

C.8.7 Benefits

The benefits are likely to be improvements in engagement on sustainability issues with stakeholders and becoming a recognised leader in this area. This has the ability to encourage energy saving and benefit the environment in a holistic manner.

The expected benefits from building stakeholder trust will enable EirGrid to more easily work with communities to deliver the infrastructure needed to meet the renewables targets and deliver affordable, reliable and sustainable electricity for customers into the future.

Build name recognition for EirGrid associated with positive action, such as developing and sponsoring events and initiatives that educate the general public on climate change and their part in helping to alleviate it and making sustainability part of how we operate.

Talk with and learn from stakeholders, reinforcing EirGrid's accessible engagement with stakeholders and communities. Increased visibility, understanding and trust will help to reduce opposition to infrastructure and allow focus on the important issues.

The proposed output metrics for this are included in Appendix S.

C.8.8 Risks and Mitigations

The risks associated with not promoting change are set out in Table C.19.

Risk	Probability	Impact	Mitigation
EirGrid cannot secure the appropriate expertise to manage the delivery of this initiative	Low	Medium	We have experience in recruitment for targeted skill sets and will work with hiring managers to ensure we get the most effective people.

Operational IP Technology provides the most cost effective method of data and telephony communication, so the lack of its adoption would present the risk of escalation of operational costs	Low	Medium	The transfer of sites will be kept under close observation by our HRCS function with corrective action taken in a timely fashion.
Delays to this initiative will hamper the delivery of other strategic initiatives including data analytics, cloud computing, data centre co-location and cyber security	Low	High	The transfer of sites will be kept under close observation by our HRCS function with corrective action taken in a timely fashion.
The integration and ongoing usage of Operational IP services can be achieved without cyber security threats compromising the power system	Low	High	The cyber security requirements for this have been captured elsewhere in this PR5 submission.

Table C.19: Initiative 8 Delivery risks and mitigations

Appendix D

Appendix D

Operate, Develop and Enhance the Grid & Market

Table of Contents

D.1. Introduction

Note that all detailed costs have been removed from this published version as they could prejudice future procurement exercises

As Transmission System Operator (TSO) we have a vital role in managing the electricity system and the opportunities and challenges affecting the market. We need to operate the grid to provide a resilient, stable and secure supply of energy for Ireland. The way we deliver this will need to reflect the growing expectations in the energy environment including growth of renewables, the way electricity is consumed, and the demand growth forecast which impacts demand across the network.

This group of initiatives respond to specific changes in the external environment, including the TSO role in the wholesale market and requirements to meet emerging changes in the legal framework we operate in.

Delivering against this background will be challenging and will require us to implement a strategy to operate, develop and enhance the Grid and Market. Through an extensive market engagement process, have identified four key outcomes this theme aims to address:

- Outcome 1 – deliver **efficient, economic operation of the power grid** for the benefit of all customers and consumers in Ireland and deliver value for money;
- Outcome 2 – improve the resilience of the operation of the power system across Ireland;
- Outcome 3 – **secure the operation of the grid** in a manner, which is capable of addressing the latest physical and cyber security threats; and
- Outcome 4 – meet the core remit of the TSO in a way which **complies with changes to the regulatory and legal environment,** adhering to emerging changes in industry standards and best practice.

In developing this strategy we identified a series of initiatives which, in alignment with our strategy for PR5, drive value for money by improving the quality of our service and delivering efficiencies in our operations.

We have developed an integrated package of initiatives, which collectively deliver the changes necessary and align them under the strategic theme of "Operate, Develop and Enhance the Grid & Market". Collectively, these initiatives deliver an incremental increase in levels of service above existing business as usual operations for the PR5 period.

Whilst the proposed initiatives are driven by changes in external obligations and increased complexity in the power system, we also believe these initiatives deliver value for money for our customers and improve the quality of our services. Each initiative has been scrutinised and costs challenged to ensure value for money. Ultimately our preferred solutions have been shaped by what we believe to be in the best interests of customers.

The initiatives we have identified are as follows:

- **Initiative 1: Enduring Access Planning & Connection Management** covers how we will manage the increase in activity required to facilitate new connections.
- **Initiative 2: Control Centre Training** comprises the resources and software required to provide updated control centre training.
- **Initiative 3: Physical Security** will involve the ongoing refresh of our physical security systems to keep our people and assets safe**Initiative 4: Cyber Security** comprises a programme of measures which will improve our effectiveness in managing cyber risks.
- **Initiative 5: European Network Codes** comprises additional resources to ensure our legal obligations are met.
- **Initiative 6: Capacity Market Secondary Trading** will design and implement a secondary trading platform within the Capacity Market which allows suppliers to trade between one another in the event they are not able to deliver their energy obligations.
- **Initiative 7: Demand Side Unit (DSU) Compliance with State Aid** will support our preparation for the changes of the fundamental treatment of DSUs in the energy market.
- **Initiative 8: Mixed Integer Programming (MIP) Solver** will design and implement the next form of auction algorithm approaches to be used in the Capacity Market to drive customer savings.
- **Initiative 9: State Aid Cross Border Capacity** will provide us with the sufficient resources to prepare for the participation of cross-border generation in interconnected capacity markets by 2024.
- **Initiative 10: Market Related TSO Governance, Risk Management and Compliance** comprises additional compliance resources to address shifts in TSO compliance responsibilities related to the wholesale market, the increased complexity of codes and legislation, and new European directives.
- **Initiative 11: Metering system** comprises a new metering system which automatically collects, aggregates, substitutes and validates energy metering data.

- **Initiative 12: Operational support for IT (Information Technology) Projects** encompasses the time and resources necessary to support IT project delivery whose contributions will be spread across a portfolio of projects, rather than get attributed to and capitalised by one specific project.
- **Initiative 13: Electricity Balancing Guideline (EBGL)** refers to the resources required to apply the requirements of the EBGL to current balancing practices. EirGrid is proposing that this will be treated as part of the uncertainty mechanism.
- **Initiative 14: Multi-NEMO (Nominated Electricity Market Operators) Arrangements in the SEM** will see the introduction of designated NEMOs into SEM. EirGrid is proposing that this will be treated as part of the uncertainty mechanism.

We believe these initiatives are effective as a package and integrated with one another to collectively strike the right balance between achieving the necessary outcomes in this investment area and delivering value for money to customers.

The table below summarises the overall resource requirements for this investment area including the total capital and operating costs for each of the initiatives, as well as whether the initiative is subject to a re-opener.

Initiative		Total(€ m)	Notes
1	Enduring Access Planning & Connection Management	1.0	-
2	Control Centre Training	2.8	-
3	Physical Security	4.1	
4	Cyber Security	4.3	-
5	European Network Codes	0.5	-
6	Capacity Market Secondary Trading	3.6	-
7	DSU Compliance	2.8	-
8	MIP Solver	1.5	-
9	State Aid Cross Border Capacity	2.3	-
10	Governance, Risk Management and Compliance	0.7	-
11	Metering system	3.3	-

12	Operational Support for IT Projects	1.5	-
13	Electricity Balancing Guideline	TBC	Subject to re-opener
14	Multi-NEMO Arrangements in the SEM	TBC	Subject to re-opener
Total		**28.2**	

Table D.1: Operate, Enhance, Develop the Grid and Market estimated costs

In order to demonstrate these initiatives deliver value for money, we need to consider the benefits of each initiative and how we will measure the benefits throughout the price control period. For each of the initiatives we summarise the benefits at three levels:

- **Primary outcomes** reflect the core purpose of the initiative. This links to the four key enablers this theme aims to address.
- **Secondary outcomes** reflect more detailed, qualitative outcomes achieved as a result of the initiative.
- **Potential metrics** reflect the metrics we will be using to quantitatively measure the primary and secondary outcomes. Many of these mirror what is presented in Chapter 11 of the submission, the Benefit Sharing Framework, as well as metrics we already monitor (e.g. SEMO KPIs report, EirGrid Group All-Island Transmission System Performance Report).

Table D.2 maps out where each initiative supports a particular strategic enabler of change.

Theme Outcomes		1	2	3	4
Initiatives		Supporting the efficient, economic operation of the power grid	Supporting improved resilience of operation of the power system	Provide a secure operation of the grid	Comply with changes to the regulatory and legal environment
1	Enduring Access Planning & Connection Management	Y	Y	Y	Y
2	Control Centre Training	Y	Y	Y	

Theme Outcomes		1	2	3	4
Initiatives		Supporting the efficient, economic operation of the power grid	Supporting improved resilience of operation of the power system	Provide a secure operation of the grid	Comply with changes to the regulatory and legal environment
3	Physical Security			Y	Y
4	Cyber Security		Y	Y	Y
5	European Network Codes	Y	Y		Y
6	Capacity Market Secondary Trading	Y			Y
7	DSU State Aid Compliance	Y			Y
8	MIP Solver	Y			Y
9	State Aid Cross Border Capacity	Y			Y
10	Market Operations Governance, Risk Management and Compliance		Y		Y
11	Metering system	Y			Y
12	Operational Support for IT Projects		Y	Y	
13	Electricity Balancing Guideline		Y		Y
14	Multi-NEMO Arrangements in the SEM	Y			Y

Table D.2: Operate, Enhance, Develop the Grid and Market enablers

Throughout the price control period, we will scrutinise and challenge costs and measure our progress on key metrics to ensure we are continuously delivering value for money for customers.

In the remainder of this appendix we provide a summary of the supporting initiatives that sit within this business case. For each, we describe:

- The background to the requirement and the area of our operation to which the initiative relates;
- The proposed initiative and related ask for the Price Control;
- The identification of need for the initiative;
- The options that were considered and how the initiative was identified as the preferred solution;
- How the initiative will be delivered;
- The estimated operating and capital expenditure required to deliver the initiative over price control period, and underlying assumptions;
- The primary outcomes, secondary outcomes and potential metrics to measure the benefits of the initiative; and
- Risks associated with delivering the initiative.

Note that as Initiatives 13 (Electricity Balancing Guideline) and 14 (Multi-NEMO Arrangements in the SEM) will be subject to a re-opener, descriptions of each have been included at this stage, however there is still uncertainty around the exact detail and costs at this stage. We would expect to provide information relating to these initiatives at such time that the parameters for implementation are clearer (such as post-Brexit market arrangements and access to pan-European platforms). These projects will then process through the proposed Monitoring Committee.

As outlined in Chapter 5 these initiatives are all on top of our business as usual activities. EirGrid has reviewed and challenged these to ensure that this is the case.

D.2. Initiative 1: Enduring Access Planning & Connection Management

D.2.1 Introduction and context

The transition to low-carbon and renewable energy will have widespread consequences. There will be major changes in how electricity is generated, with most power being sourced from renewable technology, and the electricity system needing to carry more power than ever before.

The Irish government has set ambitious Climate Action targets for 2030. The target for electricity would see 70% of consumption generated from renewable plants, representing an increase of 30% on the 2020 target.

It is likely that the current renewable capacity will almost double by 2030 to meet this target. Connection offers for the associated plants will need to be completed within the next price period in order for the capacity to be installed by 2030; this will require significant connection activity work, which would exceed the levels currently experienced by EirGrid.

The transitioning away from coal, peat and oil-based generation represents a fundamental step-change in the way in which the network will be run on a day-to-day basis; we can currently operate the grid with up to 65% SNSP, but by 2030, this must increase to 95%.

Furthermore, EirGrid notes the evolution of the electricity market during the current price control period, which included the introduction of the capacity market, which sought to achieve the required generation capacity at the most efficient cost to the consumer. As part of this evolution, we have seen a significant change in the generation fleet, with multiple connection offers required for the new plants and the impact of plant closures, needing to be analysed in response.

This initiative focuses on the need to revise EirGrid's approach to connections, including the associated modelling and network planning activities, as connecting parties respond to the policy intervention schemes, introduced as part of the aforementioned Climate Action targets.

D.2.2 Identification of Need

EirGrid is required to meet all reasonable requests for demand and to offer terms for connection to the transmission system. Everyone applying to connect to the transmission system will submit a formal application to EirGrid. Applications are advanced through a connection offer process that is designed to ensure fairness, provide transparency and facilitate timely delivery of connection offers. This process has been approved by the Commission for Regulation of Utilities (CRU).

The connection offers that progress through this process will require EirGrid to undertake analysis, as part of its obligations under the National Transmission System Security and Planning Standards, and to coordinate planning with the DSO. This enables us to understand the impact on the transmission system of connection applications to the DSO.

D.2.3 Options appraisal

Three options were considered for this business case:

1) **Do nothing.** Under the Do Nothing option, we would make no changes and continue to rely on the existing resources and approach to connect parties to the network. It is EirGrid's view that undertaking this approach will lead to a suboptimal connection process, including inaccurate network models, based on the anticipated increased workload.
2) **Outsource system studies activities.** An alternative approach could be to enter into agreements with an external service provider, meaning that the studies would be completed by specialist consultants. We note that that the skillset and experience required to undertake this analysis is limited and costly, with day rates exceeding €1500 (excluding any necessary travel costs and expenses), whilst we are also concerned with the risk associated with providing an external organisation with commercially-sensitive system security information.
3) **Recruit resources into the EirGrid Group to manage the increase in workload.** Under this option, two permanent resources would be recruited by EirGrid TSOs to undertake the additional work expected during the PR5 period. These resources would need to complement the existing teams' skillset and should enable EirGrid to enhance its understanding of the evolving energy landscape and its impacts on system operation.

D.2.4 Proposed initiative

EirGrid proposes to recruit two new resources to manage the increase in workload. We believe that there is significant value to the end consumer in building an internal capability that will ensure we can fully understand the changes to the grid and market, meaning that we can continuously review, and improve, our contribution to the 2030 Climate Action targets.

At present EirGrid employs four resources to process generation connections in Ireland. This would, therefore, see our team increase to six FTEs.

D.2.5 Delivery of preferred approach

This initiative involves the recruitment of staff to fulfil the increased obligations. This recruitment will be managed by the EirGrid HR function.

D.2.6 Costs estimation and efficient costs

The cost takes the form of increased operational expenditure, relating to payroll costs for the new FTEs required to deliver the initiative. It is assumed that the existing Talent & Acquisition team would be used to support the recruitment process, meaning that there would be no capital expenditure associated with identifying and recruiting these new resources.

Our approach to estimating the cost is summarised in Table D.3.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Average FTE cost in EirGrid	EirGrid internal costs	Internally validated	

Table D.3: Enduring Access Planning & Connection Management

D.2.7 Benefits

Primary outcome	**Facilitate the transition toward 70% renewable energy by 2030, whilst operating a secure network.** EirGrid remains committed to its obligations relating to the connection of new plant to the network. Without this initiative, it is our view that our compliance obligations would be at risk, placing doubt on Ireland’s ability to hit its climate change targets.
Secondary outcomes	**Increased network analysis capability.** EirGrid’s activities remain at the heart of the changing energy market. As such, we must ensure that we are well-positioned to fully understand how the market might evolve and, hence, how we must adapt to continue to facilitate decarbonisation.
Relevant metrics	**Connection Offers.** Existing KPIs are in place to reflect EirGrid’s performance in the development of connection applications. Successfully implementing this initiative will enable us to maintain our strong performance in this field.

Table D.4 summarises the benefits of this initiative.

D.2.8 Risks and mitigations

Table D.5 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
Due to the rare skillset required to undertake this work, EirGrid is unable to find talent within the market place.	Medium	High	We will draw on the expertise of our Talent & Acquisition team and our internal training catalogue to ensure that the job description attracts candidates with key core skills.
Preferred candidates will demand higher salaries, in response to a limited candidate pool.	Low	Medium	We have endeavoured to benchmark our compensation and benefits package and believe that we should be able to attract candidates based on our current payroll structure.
The start-to-finish recruitment process takes longer than anticipated to complete	Medium	Medium	We will engage recruitment partners, as well as advertising these roles on EirGrid's Careers website, in order to expedite the process.

Table D.5. Enduring Access Planning & Connection Management risks and mitigations

D.3. Initiative 2: Control Centre Training

D.3.1 Introduction and context

The main purpose of a transmission network control centre is to match electricity generation to customer demand and ensure a safe, secure and efficient transmission system. To make sure the lights stay on throughout Ireland, a team of our staff operate the grid from the EirGrid National Control Centre (NCC) located in Dublin. The main objective is to operate the transmission system in the most economical manner, consistent with safety, security, continuity, quality and environmental standards.

Staff training for the NCC tools is necessary to ensure our people can perform their role well, and is a specific requirement under several regulations (detailed later in this section).

Our control centre is evolving with new tools and systems, and we therefore need to ensure that the training environment keeps pace. This initiative sets out the reasons why EirGrid needs to invest in additional control centre training, examines the options available and details the delivery of our preferred solution.

D.3.2 Identification of Need

According to Commission Regulation (EU) 2017/1485 (March 2019), Article 58, our training programs should include

“the knowledge of the transmission system elements, the operation of the transmission system, use of the on-the-job systems and processes, inter-TSO operations, market arrangements, recognising of and responding to exceptional situations in system operation, operational planning activities and tools”.

Our offline training program in particular is expected to be, “carried out in an environment which simulates the [actual] control room.”

With new investments to our NCC tools, we will require our training environment to be regularly updated to reflect the evolving market and the changing behaviours of market participants. Failure to invest sufficiently in the training environment could considerably impact the efficiency with which control room operators can utilise the tools at their disposal.

Table D.6 (removed due to cyber security risks) compares the software tools that are used in the NCC and what is available at the Dispatcher Training Simulator (DTS).

D.3.3 Options appraisal

The following options were considered:

1) **Do Nothing.** Under this option, we would not take on additional staff and we would not update our training environment to reflect new tools and systems at the NCC. There is a risk that staff cannot utilise these tools effectively. We would also be in breach of our legal obligations.

2) **Training programmes on system operation offered by third party providers.** Under this option, we would purchase a training service from a specialist provider. These services are becoming known in Europe although they are focussed on heavily interconnected systems. We do not believe there is third party training service available that is targeted at the island environment in which we operate. Additionally, such a service would not reflect the specific control software we have in place at the NCC so would be less relevant to our staff. There would be overhead costs in sending our staff abroad to receive the training and further training would still be needed to be provided in-house.

3) **New in-house training tools (preferred option).** Under this option, new training tools would be provided covering the new tools and systems in place at the NCC. These would be of the same quality as those already deployed for pre-existing tools.

D.3.4 Delivery of preferred approach

The following steps would be undertaken to implement the preferred option:

1. Develop detailed business requirements to capture what will need to be included in the offline versions of the software for use in DTS;
2. Engage with the relevant software vendors to procure the required offline versions of the software;
3. Commission and test the implementation of these test environments in the DTS; and
4. Undertake enhanced training with all NCC Grid Controllers.

D.3.5 Costs estimation and efficient costs

Implementation (capital costs) comprise the professional fees, hardware and software, and systems costs. Operating costs reflect the average FTE cost.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Based on comparable costs of similar software already in use	EirGrid internal costs estimates	Internally validated	

Table D.7: Control Centre Training – Cost Estimates

D.3.6 Benefits

Table D.8 summarises the benefits of this initiative.

Primary outcome	**Improve the resilience of the operation of the power system across the island of Ireland.** This initiative will deliver a training environment which is reflective of the latest systems and tools of the NCC. This will better prepare our staff for their critical role of matching electricity generation to customer demand; ultimately making the power system in Ireland more resilient. **Secure the operation of the grid.** This initiative will drive greater security of our operations, as the updated training environment will better prepare our staff in the event of a physical or cyber attack.
Secondary outcomes	**Improved capabilities of our simulator.** The simulator used for training purposes will match what is seen in the NCC. **Improved competency of control centre staff.** Through a better training environment, staff will be more competent on the control centre that is bespoke to EirGrid.
Relevant metrics	**System frequency.** This metric is the percentage of time that the system frequency is kept within a set target range, which we anticipate will improve with better-trained control centre staff. **System minutes lost.** This metric represents the cumulative total of system minutes lost due to system quality. We anticipate this metric will be reduced with better-trained control centre staff. **Number of new control centre staff trained per year.** We anticipate this metric will increase with a more effective training environment.

Table D.8: Control Centre Training – Benefits

D.3.7 Risks and mitigations

Table D.9 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
System non-synchronous penetration (SNSP) increases are limited	Medium	High	Policies will be introduced into the control centre with increases in SNSP clearly stating the measures taken to ensure system consistency.

Table D.9: Control Centre Training – Risks and mitigations

D.4. Initiative 3: Physical Security

Please note the contents within this initiative are confidential and have been removed.

D.5. Initiative 4: Cyber Security

Please note the contents within this initiative are confidential and have been removed.

D.6. Initiative 5: European Network Codes

D.6.1 Introduction and context

Europe’s electricity networks are currently operated according to national rules that govern the actions of operators and determine how access is given to users. The European Union is adopting a common set of rules, commonly known as European Network Codes, which enable electricity network operators, generators, suppliers and consumers to operate more effectively in the pan-European electricity market. The harmonisation of national rules will promote the efficient use of cross-border interconnection between countries and will provide a more secure and reliable electricity system with an increased level of renewable generation.

Over the past several years EirGrid, together with other members of ENTSO-E, has been working hard to develop the European Network Codes. The final rules are being proposed by the European Commission and adopted by the European Parliament before becoming binding into European law. Our focus now is to identify what necessary changes are required in Ireland to ensure that EirGrid is compliant to these new rules when they begin to enter into force.

A substantial amount of work has already been achieved to prepare for these new rules, including the new design of the Integrated Single Electricity Market (I-SEM). However, work remains to be done during the PR5 period. EirGrid continues to work with its regulators, governments and key stakeholders to ensure timely delivery.

Please note, that outlined below does not include the work required to implement the Electricity Balancing Guideline, because the scope of the work required is still extremely uncertain. As set out at the beginning of this appendix, EirGrid proposed that the implementation of that code is included in an uncertainty mechanism.

D.6.2 Identification of Need

EirGrid’s requirement is to fulfil the enduring roles that are driven by both the System Operation and Connection Network Codes. These roles vary hugely, and may be daily, weekly, monthly, annual or event driven tasks. Examples of these enduring tasks include, but are not limited to:

- Additional compliance testing;
- Coordinated capacity calculation;
- Outage planning co-ordination;

- Review and amendment of the system defence and system restoration plans;
- Review and development of the Grid Code to reflect the European Network Code requirements; and
- Additional new European Network Codes which are planned for development and implementation during the price control period.

The existing EU legislation that relates to System Operation and Connection Network Codes includes:

Connection Codes. These Codes specify procedures for connecting to the transmission system during both normal and exceptional circumstances.

- Commission Regulation (EU) 2016/631 of 14 April 2016 established a network code on requirements for grid connection of generators – ‘Requirements for Generators (RfG)’;
- Commission Regulation (EU) 2016/1388 of 17 August 2016 established a Network Code on Demand Connection - ‘Demand Connection Code (DCC); and
- Commission Regulation (EU) 2016/1447 of 26 August 2016 established a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules - ‘HVDC Connection Code (HVDC)’.

System Operation. These Codes specify procedures for planning and operating the transmission system during both normal and exceptional circumstances.

- Commission Regulation (EU) 2017/1485 of 2 August 2017 established a guideline on electricity transmission system operation – ‘System Operation Guidelines (SOGL), and
- Commission Regulation (EU) 2017/2196 of 24 November 2017 established a network code on electricity emergency and restoration - ‘Emergency Restoration Code (ER)’.

Additional members of staff are required to manage increased complexity associated with changes to all elements within Network Codes, alongside administering the enduring roles for the specific Network Codes listed above.

Currently EirGrid has five FTEs shared between SONI and EirGrid, who are responsible for addressing the enduring roles following the implementation of the System Operation and Connection Network Codes. EirGrid concluded that these resources are insufficient for the level of work now required to monitor, shape and implement the developing European Network Codes.

D.6.3 Options appraisal

Three options were considered as part of this business case:

1) **Do nothing.** This option would entail utilising EirGrid's existing resources to review, update, develop and ensure compliance with the European Network Codes. EirGrid does not believe the existing resources are able to meet this task due to a significant increase in our workload. Therefore EirGrid would be at risk of a compliance breach, resulting in infraction proceedings, which is clearly not acceptable.

2) **Separate the European Network Code team into two separate functions; one for SONI and one for EirGrid**. If EirGrid resources were to work completely independently from SONI, we estimate that 5 FTEs would be required for EirGrid only. This figure would essentially replicate the current structure and workings of the current team, while removing any overlap between the two teams. The current structure was designed to avoid any duplication of works between EirGrid and SONI, and maximise the use of available expertise at each stage of the European Network Code implementation project. Hence this option was not selected.

3) **An additional FTE for the existing team (preferred option).** An additional resource (1 FTEs) would be introduced to the team to carry out the EirGrid-related activities on European Network Codes. For context, additional resources are also required and being sought for EirGrid-related activities. Under this option, we continue with the combined SONI-EirGrid team, thus maintaining lowest cost for the consumer by avoiding duplication of work. This initiative will provide necessary resources to ensure EirGrid is compliant with the European Network Codes.

D.6.4 Proposed initiative

EirGrid proposes introduction of one additional FTE who will be responsible for reviewing, updating, developing and ensuring compliance within these European Network Codes. The additional resource will provide support to:

- Continuously work with our regulators, governments and key stakeholders to resolve potential issues with the code parameters;
- Regularly review and update the codes to ensure they are fit for purpose as technology and system requirements develop;
- Develop additional European Network Codes over the next price control period to cover technologies / issues not addressed at present (e.g. storage);
- Update the Ireland Grid Codes to reflect changes or new European Network Code requirements;
- Ensure compliance across the entirety of the codes to make sure Ireland legal obligations are met; and
- Submit information, as necessary, to ENTSO-E as part of their monitoring role.

These staff members will work with colleagues in SONI to ensure a coordinated, consistent and efficient path to compliance for both parts of the synchronous system on the island of Ireland.

D.6.5 Delivery of preferred approach

We anticipate recruiting the FTE by the start of the PR5 period. The recruited FTE would need a number of different competencies, including knowledge of the European Network Codes, Grid Code, electricity industry knowledge, e.g. technical, operational and/or market and project management.

The options of both internal recruitment and external recruitment should be considered; however, it is important to note that, in either case, it is likely that the recruited individual would require some form of training in order to develop the knowledge and expertise to successfully carry out their role.

It is also important to note that this is an enduring role which will be required during the price control period and beyond. Hence, it is essential that EirGrid fosters and develops the necessary expertise internally, rather than relying on the availability of external expertise.

D.6.6 Costs estimation and efficient costs

Our requirement for one additional FTE was based on a number of factors, including:

- Our experience to date regarding the implementation of the codes;
- EirGrid's ongoing legal obligations in relation to compliance with the entirety of the European Network Codes.

Our approach to estimating the cost is summarised in Table D.17.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Average FTE cost in EirGrid	EirGrid internal costs	Internally validated	

Table D.17: European Network Codes – Estimated Costs

D.6.7 Benefits

Primary outcome	**Complying with changes to the regulatory and legal environment.** With the increased complexity associated with changes to all elements within European Network Codes, EirGrid does not believe it will be able to be continuously compliant with the current resource levels. This initiative will deliver one FTE that will give EirGrid the capacity and capabilities required to comply with the European Network Codes in a timely manner.
Secondary outcomes	**Consistency in power system operations between Ireland and the rest of Europe.** Compliance to the European Network Codes will ensure there is a more consistent approach to connection requirements, operational practices, and testing procedures across Ireland and the rest of Europe. **Minimising risk of network failures.** Having a consistent, efficient and coordinated cross-border approach through compliance with the European Network Codes will also minimise the risk of network failures on the Irish system in the event of other transmission systems failures across Europe. It also reduces the likelihood of a generation shortfall on the Irish system.
Relevant metrics	**Compliance register.** EirGrid will use a compliance register which will objectively validate our compliance to the European Network Codes.

Table D.18: European Network Codes – Benefits

D.6.8 Risks and mitigations

Table D.19 summarises the risks associated with delivering this initiative and EirGrid's proposed approach mitigating these risks:

Risk	Probability occurring	Impact	Mitigation
Inability to recruit suitably skilled staff leading to delays.	Low	Low	In the event of recruiting less suitably skilled staff, EirGrid will provide sufficient training in order to develop the knowledge and expertise to successfully carry out their role.
Cost overruns	Low	Low	EirGrid have used benchmarked salaries and have a high degree of confidence in the cost estimates.

Table D.19: European Network Codes – Risks and Mitigations

D.7. Initiative 6: Capacity Market Secondary Trading

D.7.1 Introduction and context

Operating the Capacity Market was one of the new roles allocated to EirGrid as a TSO, in the context of the new I-SEM. In the Capacity Market, participants enter into an auction, setting out the cost for generating or alleviating capacity to the market. Successful capacity auction participants are paid Capacity Payments and, in return, must deliver on their capacity market obligations, i.e. they should be available to the provide energy they set out to deliver in the auction, especially at times of high demand or system stress. Participants with Awarded Capacity are also subject to Difference Charges to the TSO in the event the market/reference price exceeds the strike price. The converse is also true: where the TSO is subject to Difference Payments to the Participant in the event the market/reference price is below the strike price.

All cash flows in the Capacity Market take place in a single Socialisation Fund. Figure D.1 demonstrates the cash inflows and outflows of the Socialisation Fund. For simplicity, we focus on how Capacity Payments, Difference Charges and Difference Payments impact the Socialisation Fund (rather than showing all potential cash inflows and outflows).

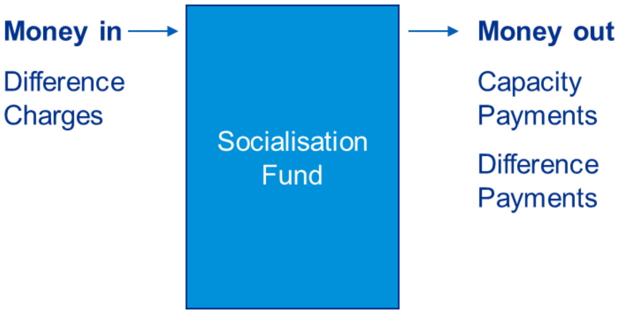

Figure D.1: Capacity Market – Socialisation Fund

If there are insufficient funds in the Socialisation Fund, the Difference Payments are suspended and accrued until funds are available.

Capacity Market auctions happen well in advance of energy delivery. Specifically, these are held four years before the delivery Capacity Year (also known as T-4 auctions). In addition, EirGrid holds a further T-1 auctions for incremental capacity. Since these auctions are held so far in advance, there are situations where generators may not be able to provide energy they have contracted to deliver; e.g. due to maintenance which requires scheduled outages.

Currently, when this occurs, participants can submit an ‘Active’ Interim Secondary Trading Notification (ISTN) to the System Operators, indicating a negative quantity of Awarded Capacity. EirGrid can then add a register entry to the Capacity and Trade Register with the quantity specified in the ISTN at the Capacity Auction Price of the primary auction for the relevant period. The participants loose Capacity Payment quantum pro-rata for the period of the scheduled outage and, thus, would not be exposed to pay Difference Charges or receive Difference Payments. Ultimately the risk of non-delivery that rests with the participant is moved to the market, as a whole. In addition, the non-payment of Difference Charges reduces the Socialisation Fund and increases the risk of EirGrid’s Difference Payments being suspended and accrued.

During the design of the Capacity Market, it was envisaged that a more comprehensive set of Secondary Trading arrangements would be developed over time to address these issues and the rules of this would be written into the Capacity Market Code under Section H. These enduring Secondary Trading arrangements would involve the running of regular secondary trading auctions for secondary products covering part of the Capacity Year (e.g. weekly or monthly). Thus the current interim process is not aligned to the originally-proposed Capacity Market model.

The purpose of this initiative is to design and implement a market for secondary trading that allows generators to trade between one another in the event they are not able to deliver the energy they have contracted for a specified time. The participant whose Generator Unit is going on outage would trade the Awarded Capacity to another unit. The latter would then receive Capacity Payments based on the price cleared in the Secondary Trading Auctions and would be exposed to Difference Charges for the quantity traded.

D.7.2 Identification of Need

As noted earlier, it was expected at the time of introducing the Capacity Market that enduring secondary trading arrangements would be developed over time. Bringing forward these arrangements in order to deliver a better functioning, more efficient market is consistent with EirGrid's general obligations to deliver value for money to its consumers, customers and other stakeholders.

The figure below shows the sum of generation outages on the Irish and Northern Irish systems for 2019. The forecasted months based on previous averages. This is an indication of the quantity of capacity that may be interested in entering into a secondary trade.

Figure D.2 demonstrates planned outages of generation units and/or associated connection assets which tend to take place over the summer when electricity demand is lower. Capacities associated with Forced outages resulting from unforeseen circumstances are out of our control and, therefore, can occur at any given time in a year.

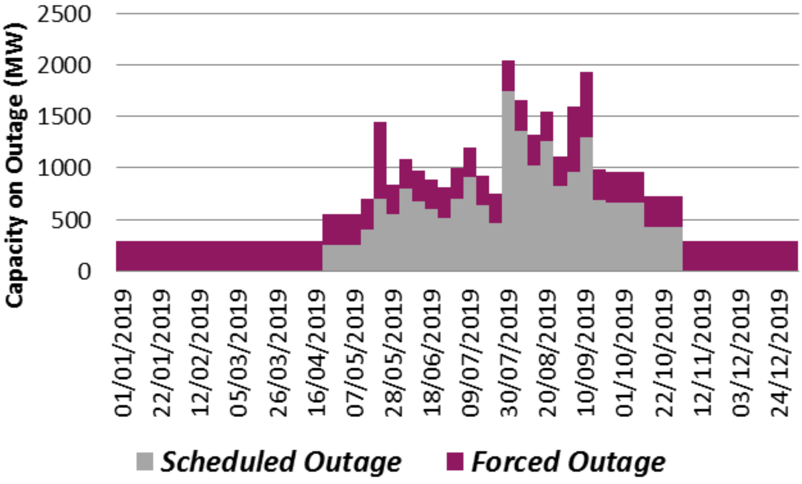

Figure D.2: Capacity Market – Generator Outages

D.7.3 Options appraisal

Three options were considered as part of this business case:

1) **Do Nothing.** In this scenario, we would continue using the ISTN arrangements. The market bears the risk of non-delivery from the original participant and funds to the Socialisation Fund are reduced. This is leading to higher consumer costs overall and is also not consistent with the SEM Committee's original design of the Capacity Market.

2) **Manual Secondary Trading.** An alternative option is where participants would contact each other (or perhaps through a broker) to enter into a secondary trade at

an agreed price. The two participants would then request a transfer of Awarded Capacity under B. 21 of the Capacity Market Code (CMC) from one Generating Unit to another for the agreed period. This would require regulatory approval on the basis that the trade is for the purpose of covering a scheduled outage and where any other conditions specified are met. Once the approval is received, the parties would need to sign a deed, specifying the agreed price and quantity to the System Operators. The System Operators would verify that the unit taking on the obligation has sufficient capacity to cover the obligations and, where satisfied, would approve the trade and enter into the Capacity and Trade Register in a similar manner to how Interim Secondary Trades are given effect to at present. Option 2 is a time consuming approach which does not provide Generating Units the flexibility and ease of transfer of its obligations.

3) **Implement an online platform for a Secondary Trading Market (preferred option).** This option is to design and implement a secondary trading market which is consistent with the original design of the Capacity Market by the SEM Committee. This will require detailed design and options consideration of how the secondary market would operate. The decision whether to implement a Secondary Trading Market under a centralised auction or via the bilateral trade approach has yet to be decided. Implementing an online platform for a Secondary Trading Market will give Generating Units the flexibility and ease to transfer of its obligations in the event of a planned or forced outage in a timely and efficient manner.

D.7.4 Delivery of preferred approach

The preferred option is to proceed with designing, implementing and operating an online secondary trading market. The following are the key actions required to deliver the preferred option:

- Develop high level design options (i.e. auction or bilateral);
- Consultation with key stakeholders to discuss the design of the secondary market (i.e. the approach, products, frequency of auctions);
- Develop the detailed design of the secondary market;
- Undertake rules modifications once the design has been decided;
- Develop and implement the requirements in new processes & systems;
- Conduct testing and trials of the new system;

- Train staff and customers of the new system; and
- Secondary Trading Go-Live.

Following implementation, there will be ongoing operational requirements of the trading market, rendering requirement of appropriate IT development costs.

D.7.5 Costs estimation and efficient costs

The following assumptions were made to estimate the costs of the preferred option:

- The rules will not require substantial modification from those contained in Chapter H of the Capacity Market Code.
- Solution can be implemented in CMP under current vendor arrangements.
- Appropriate expert resources are in place in TSOs, RAs, vendors and certification.
- Both options of the design of the Capacity Market (i.e. auction or bilateral) are consistent with the Capacity Market State Aid approval.

As part of implementation costs, professional fees have been compiled by estimating levels of effort required to deliver each activity and applying the associated day rates. Day rates and levels of effort are based on experience from the I-SEM project and other recently completed Capacity Market activities (e.g. certification). Table D.20 presents the estimated level of effort to implement a Market for Secondary Trading.

Implementation Steps	FTEs	Days
High level design and detailed design		
Rules modification		
Process and system implementation		
Stakeholder management and training		

Table D.20: Secondary Trading – Estimates of Effort

Implementation costs also include the cost of the systems themselves and licensing costs.

Operating costs comprise ongoing IT development costs. We also assume we will require four FTE per annum to operate the Secondary Trading Market, which will be a shared resource between SONI and EirGrid, as set out in the allocation in Section 4.

Our approach to estimating the cost is summarised in the Table D.21.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Based on experience from the I-SEM project and other recently completed Capacity Market activities	EirGrid internal costs estimates	Internally validated	
OpEx	Based on experience from the I-SEM project and other recently completed Capacity Market activities	EirGrid internal costs estimates	Internally validated	

Table D.21: Secondary Trading – Cost Estimates

D.7.6 Benefits

Table D.22 summarises the benefits of this initiative.

Primary outcome	**Complying with changes to the regulatory and legal environment.** In the design of the Capacity Market it was envisaged that a more comprehensive set of Secondary Trading arrangements would ultimately be put in place. This initiative would deliver what is part of the original I-SEM design.
Secondary outcomes	**Orderly maintenance of the power system.** It is not beneficial to the power system for Generating Units to avoid taking scheduled maintenance out of fear of the consequences of not meeting their obligations. The introduction of a Secondary Market will allow Generating Units to undertake necessary maintenance, as well as manage their risks more effectively. **Improved financial resilience of the Capacity Market.** Delivering this initiative will ensure there are sufficient funds consistently in the Socialisation Fund.
Relevant metrics	**Volume of trades.** EirGrid will monitor the number of trades that take place in the Secondary Market and how much (in MW) of capacity is traded. **Availability statistics.** EirGrid anticipates less forced outages will take place, given this initiative will improve Generating Units' ability to undertake maintenance regularly. This should improve overall availability in the Capacity Market, which will be monitored through availability statistics.

Table D.22: Secondary Trading – Benefits

D.7.7 Risks and mitigations

Table D.23 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
There is a risk that Secondary Trading Auction outcomes are incorrect caused by an incorrectly implemented solution resulting in reputational damage to the market and deterioration in market sentiment.	Low	High	EirGrid has significant experience in the specification and detailed design of complex information technology solutions. EirGrid will validate the design with stakeholders before implementation. EirGrid will simulate and validate the trading algorithms before implementation.
There is a risk that Secondary Trading Auction liquidity is low caused by an overly complex auction process resulting in poor price discovery and low market confidence.	Low	Medium	EirGrid will ensure that the solution is only as complex, as necessary. EirGrid will validate the design with stakeholders before implementation. EirGrid will simulate and validate the trading algorithms before implementation.

Table D.23: Secondary Trading – Risks and Mitigations

D.8. Initiative 7: Demand Side Unit (DSU) Compliance with State Aid

D.8.1 Introduction and context

DSUs are third-party companies that specialise in demand side management. DSUs contract with a number of high-demand users (e.g. data centres, factories, grocery stores) and aggregate them together to operate as a single Demand Side Unit.

As mentioned in Initiative 6, EirGrid is responsible for operating the Capacity Market. If successful in the auction, Capacity Market participants are awarded a Reliability Option (RO) which entitles them to Difference Charges (Payments) in the event the market reference price rises below (above) the strike price. DSUs participate in Capacity Market auctions, with an agreement to alleviate energy demand, especially at times of high demand or system stress. When necessary, we issue instructions to DSUs to reduce demand at an aggregate level. The DSU is then responsible for co-ordinating the energy reduction from all of its demand sites. Demand sites typically use on-site generation, plant shutdown or storage technology to deliver the demand reduction.

In the initial design of the Capacity Market, the SEM Committee determined that DSUs, unlike other market participants, would initially be exempt from Difference Charges where the contracted demand reduction is delivered. In other words, DSUs would only be subject to Difference Charges in the event its demand reduction is not delivered. This decision was made on the basis that DSUs did not have access to energy revenue which is used to offset Difference Charges and DSUs would therefore be placed at a disadvantage compared to other capacity providers. However, the SEM Committee also noted that in the medium to longer term it may be necessary to review this decision.

In their recent State Aid decision, the European Commission accepted this approach as a transitional measure given the practical difficulties of treating DSUs in the same manner, as other capacity providers in the time available. However, State Aid approval was granted following a commitment by the Regulatory Authorities (RAs) "to end the exemption from payback obligations for DSUs as of the delivery period starting in October 2020".

D.8.2 Identification of Need

Removal of DSUs from exemption of difference charges is therefore required as a condition of State Aid approval.

The final component, Calculation of Metered Quantities for DSUs (i.e. Step 3 of the RAs requirements to implement this decision), relates to the requirement to calculate a more accurate metered value for DSUs. In the 2019/2020 T-1 Capacity Auction, 426 MW of de-rated capacity cleared. In the 22/23 T-4 Capacity Auction, 415 MW of de-rated capacity cleared. We foresee this approaching 1GW in the near future, and we currently do not have the capability to measure beyond this amount.

D.8.3 Options appraisal

Two options were considered for this business case:

1) **Do nothing.** Under this option, we would continue to exempt DSUs from Difference Charges and would be in breach of State Aid rules.
2) **Prepare for changes of the treatment of DSUs (preferred option).** The preferred approach is based on guidance provided by the RAs to implement this decision. No other options were considered since this is aligned to RA guidance.

D.8.4 Proposed initiative

The purpose of this initiative is to prepare for the changes of the fundamental treatment of DSUs in the energy market. The RAs have advised on the three steps required to implement this decision:

1. **Removal of exemption from difference charges** involves making changes to the Trading and Settlement Code and implementing these changes in the Settlement Systems.
2. **Accounting for procurement of energy reduced** concerns the fundamental treatment of DSUs energy in the market. The RAs proposed an enduring approach which involves the DSU getting paid for Metered Quantity, but the trading site supplier unit (TSSU) does not have to pay back for energy from the wholesale market in the imbalance settlement. The RAs propose to adjust the Metered Quantities of a Supplier Unit by the proportion of the DSU Metered Quantity associated with the Individual Demand Sites (IDSs) that form part of their Supplier Unit.

3. **Calculation of Metered Quantities for DSUs** relates to the requirement to calculate a more accurate metered value for DSUs based on the difference between the DSU's demand sites' metered quantities and a calculated baseline profile. Delivering the enduring requirement would involve significant systems to be implementation. There is a need to commence work on the development of settlement grade metering to ensure the appropriate performance incentives can be applied and operational security can be preserved.

D.8.5 Delivery of preferred approach

The project will follow the model for governance of market development projects.

D.8.6 Costs estimation and efficient costs

The following assumptions were made to estimate the costs of the preferred option:

- Required Meter Data Providers (MDPs), TSO and MO solutions are technically feasible and can be implemented under current vendor arrangements.
- Appropriate expert resources are in place in TSOs, MO, MDPs, RAs and vendors.
- Metering solution to be developed on all island basis by EirGrid and SONI working with other MDPs.

Implementation costs of removing exemption from difference charges comprise:

- Project Management;
- Software Development; and
- Testing.

Implementation cost of accounting for procurement of DSU energy reduced:

- Capital Equipment;
- Project Management Staff;
- Developer contractor;
- Software Development; and
- Licences.

Implementation cost of metering calculation:

- Capital Equipment;
- Project Management Staff;
- Developer contractor;
- Software Development; and
- Licences.

Our approach to estimating the cost is summarised in Table D.24.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Benchmarked against the Enhanced Performance Management System) Phase 1 project	EirGrid internal costs estimates	Internally validated	

Table D.24: DSU State Aid – Cost Estimates

D.8.7 Benefits

Table D.25 summarises the benefits of this initiative.

Primary outcome	**Complying with changes to the regulatory and legal environment.** The removal of DSUs' exemption from Difference Charges is required as a new condition for the State Aid approval. Therefore, the initiative comprises steps needed in order to adhere to the State Aid rules, as per the guidance of the RAs.
Secondary outcomes	**Improved metering capabilities.** EirGrid currently does not have the capability to meter quantities delivered by the DSUs. This initiative will provide this capability, which is particularly helpful given the capacity cleared for DSUs is expected to increase over time.
Relevant metrics	**Number of DSUs monitored.** EirGrid anticipates this initiative will allow to increase the number of DSUs monitored over time. **Compliance register.** EirGrid will use a compliance register, which will objectively validate our consistent and timely compliance to our State Aid Requirements.

Table D.25: DSU State Aid – Benefits

D.8.8 Risks and mitigations

Table D.26 summarises the risks associated with delivering this initiative and EirGrid's proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
Not maintaining stability of existing market during the implementation phase	Low	High	EirGrid has significant experience in the management and operation of large complex information technology solutions. EirGrid will include the transition, cutover and readiness processes and procedures into the design and delivery of the solution to minimise the risk on instability.

Table D.26: DSU State Aid – Risks and Mitigations

D.9. Initiative 8: Implementing a Mixed Integer Programming Solver

D.9.1 Introduction and context

As previously mentioned, one of EirGrid's major roles as a TSO is operating the Capacity Market. This includes administering the Capacity Market auctions in order to secure sufficient generating capacity to meet expected demand. Capacity providers who are successful in the auction are awarded capacity agreements, which define their obligation to generate a certain level of electricity and capacity payments they will be entitled to receive.

During the detailed design of the Capacity Market, the Regulated Authorities (RAs) considered a number of auction algorithm approaches to be applied to the Capacity Auctions. Previously, EirGrid used an approach called Auction Format B. Auction Format B is a heuristic approach (i.e. a process or set of rules to be followed in calculations) that would clear all offers in merit in the price setting stage, except for any inflexible price setting offers that are not fully cleared. Following this, the capacity auction software would consider a subset of inflexible offers that had not cleared to ensure that all Locational Capacity Constraints are satisfied. Where the Locational Capacity Constraints are not satisfied by the offers cleared from the price setting stage, additional quantities are cleared. This approach limits the number of inflexible offers that can be considered to satisfy the Locational Capacity Constraints to ensure that the problem is tractable and can be solved within the Allowed Timeframe.

To address the constraints of Auction Format B, Auction Format C was implemented and applied for the first T-4 auction (Capacity Year 2022/2023). Auction Format C is a heuristic approach that clears offers with the objective of maximising Net Social Welfare (i.e. minimising the Awarded Capacity above the estimated demand curve), subject to constraints including Locational Capacity Constraints. Auction Format C differs from B in that it does not automatically clear offers that are in merit from price setting stage. Instead, it includes those that are out-of-merit that are required for Locational Capacity Constraints and may result in in-merit offers from the price setting stage not clearing where they are surpluses to requirements as expressed in the Demand Curve. This approach also limits the number of inflexible offers that can be considered above and below the price-setting offer to satisfy the Locational Capacity Constraints.

D.9.2 Identification of Need

During the detailed design of the Capacity Market, the Regulatory Authorities (RAs) considered a number of auction algorithm approaches to be applied in the Capacity Auctions. The use of Auction Format B in 2018/19 and 2019/20 T-1 capacity auctions was seen as a transitional measure, with the intent to move to Auction Format D on an enduring basis.

In a recent (May 2019) SEM Committee Consultation Paper the RAs stated “[f]or the 2023/24 T-4 capacity auction, the SEM Committee proposes to progress if possible to the Enduring Auction Solution Methodology i.e. Auction Format D.” Whilst it is not yet a State Aid requirement, it is our understanding that the RAs wish to proceed with Auction Format D as soon as is possible.

It is believed by the RAs, EirGrid and SONI that Auction Format D has the potential to achieve a more optimal solution than the current approach, which would, in turn, lead to more efficient selection of capacity from a net social welfare perspective.

D.9.3 Options appraisal

Two options were considered for this business case:

1) **Do nothing - continue using Auction Format C.** Under this option we would continue to administer Capacity Market auctions using Auction Format C. This option is viable, subject to it being State Aid compliant. However, it is not consistent with the long term target design of the Capacity Market and may not produce the most efficient solutions from a Net Social Welfare perspective.
2) **Develop and implement Auction Format D (preferred option).** Under this option, we would develop and implement a Mixed Integer Programming Solver approach. This approach is consistent with the long term target design for the Capacity Market and has the potential to produce more optimal solutions from a Net Social Welfare perspective. We also understand that this approach is the preferred option of the RAs. Given the movement of the market, and the time it

will take to implement this new auction format, we aim to be ahead of curve in developing a tool that is compliant to State Aid changes.

D.9.4 Proposed initiative

This aim of this initiative is to design and implement the next form of auction algorithm approaches to be used in the Capacity Market: Auction Format D, or a Mixed Integer Programming (MIP) optimisation approach. The MIP optimisation approach clears offers with the objective of maximising Net Social Welfare, subject to constraints including Locational Capacity Constraints. Net Social Welfare (or, consumer surplus) reflects the difference between the price that consumers pay and the price that they are willing to pay, at the point supply meets demand. Figure D.3 demonstrates how Net Social Welfare is calculated in the context of the Capacity Market.

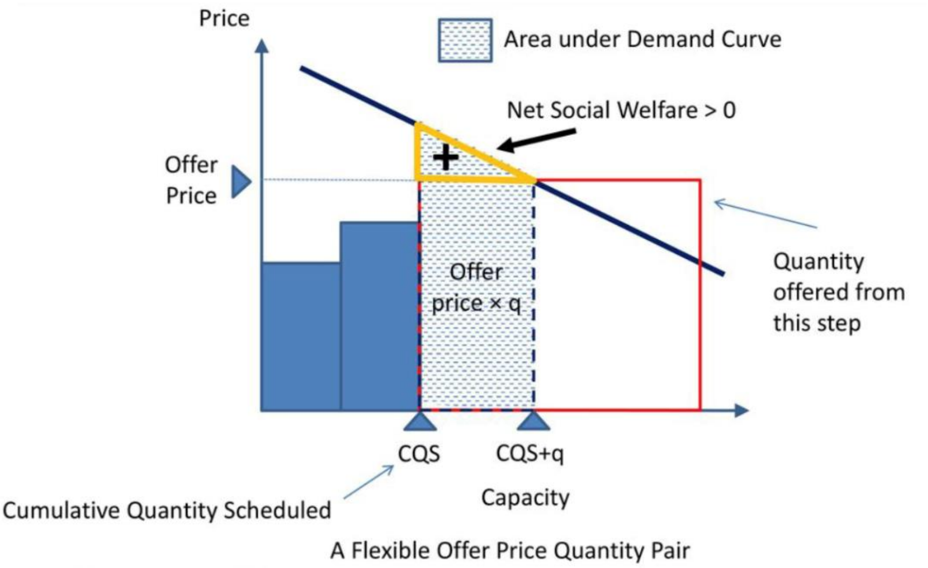

Figure D.3: Capacity Market – Net Social Welfare1

Auction Format D differs from Auction Format C in that it does not limit the number of inflexible offers to be considered when maximising Net Social Welfare subject to constraints. Auction Format D therefore may potentially achieve a more optimal solution than Auction Format C. MIP optimisation can find solutions that are optimal or more optimal than heuristic based approaches B and C (although this is not guaranteed in the Allowed Timeframe).

D.9.5 Delivery of preferred approach

The preferred option is to proceed with designing, implementing and operating Auction Format D, the MIP solver. The following are the key actions required to deliver and implement the preferred option:

- Selecting a suitable delivery partner, following public procurement procedures, to design and develop the MIP solver.
- Working with our delivery partner to:
  - Set out the user requirements of the new auction format;
  - Develop the detailed application design;
  - Develop the MIP capacity auction algorithm;
  - Conduct testing of the MIP solver and developing testing reports; and
  - Develop certification reports.
- Ongoing project management with our delivery partner to ensure the initiative is delivered to the agreed timescales and budget.

Following implementation of the MIP solver we would require ongoing support and licencing, continuous development, and further certification.

D.9.6 Costs estimation and efficient costs

The estimated costs of the project are under the assumption that the vendor has expertise to implement the MIP solver. We also assume appropriate expert resources are in place in TSOs, RAs, vendors and certification.

Professional fees, as part of implementation costs have been compiled by estimating levels of effort required to deliver each activity and applying the associated day rates. Day rates and levels of effort are based on experience from the I-SEM project and other recently completed Capacity Market activities (e.g. certification). Table D.27 presents the estimated level of effort to implement the MIP solver.

Implementation Steps	FTEs	Days
User requirements		
Application design		
Testing		
Certification		

Table D.27: MIP Solver – Estimate of Effort

Implementation costs also comprise the cost of the systems itself. Operating costs comprise ongoing licence support. Our approach to estimating the cost is summarised in Table D.28.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Based on experience from the I-SEM project and other recently completed Capacity Market activities	EirGrid internal costs estimates	Internally validated	
OpEx	Based on experience from the I-SEM project and other recently completed Capacity Market activities	EirGrid internal costs estimates	Internally validated	

Table D.28: MIP Solver – Cost Estimates

D.9.7 Benefits

Table D.29 summarises the benefits of this initiative.

Primary outcome	**Complying with changes to the regulatory and legal environment.** In the vision of the Capacity Market it was envisaged that the MIP solver would ultimately be used. This initiative would deliver what is required by the Regulated Authorities.
Secondary outcomes	**More efficient outcomes for consumers.** It is anticipated that the initiative may potentially achieve a more optimal solution when matching energy demand to energy supply.
Relevant metrics	**Net social welfare.** The difference between the unconstrained price setting outcomes and the constrained outcome in the 2022/2023 T-4 Capacity Auction was approx. €664,687 or 0.08% of unconstrained Net Social Welfare. This represents the maximum increase in Net Social Welfare that could have been achieved by a MIP solver in this particular auction. This is considered indicative of

	the potential Net Social Welfare increases achievable through the use of Auction Format D in future auctions.

Table D.28: MIP Solver – Benefits

D.9.8 Risks and mitigations

Table D.29 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
Capacity Auction outcomes are incorrect caused by an incorrectly implemented algorithm resulting in reputational damage to the market and deterioration in market sentiment.	Low	High	We will engage in a comprehensive design, certification and testing process as outlined in our delivery section
Capacity Auction outcomes are correct, but not intuitive (e.g. the low priced offer does not clear in favour of a higher priced offer) caused by maximisation of Net Social Welfare, resulting in reputational damage and questions regarding fairness of the outcome.	n/a	n/a	This is highly dependent on the set of participating Capacity Market Units and the profile of price-quantity pairs submitted by Participants in a given Capacity Auction. While the list of Capacity Market Units eligible to participate in a given Capacity Auction is known at final qualification stage, the profile of submitted price-quantity pairs is not known until gate closure on the day of the Capacity Auction. There is therefore a degree of uncertainty in attempting to assess the likelihood and severity of these risks prior to the execution of a given Capacity Auction.
Capacity Auction does not solve in the Allowed Timeframe caused by the complexity of the problem resulting lower Net Social Welfare than Auction Format C.	n/a	n/a	Same as above
The current software vendors cannot implement a MIP solution caused by the lack of expert developers resulting in delays to the implementation and further costs.	Low	Low	EirGrid will engage with current vendors at early stages of implementation to confirm whether they have the capabilities to implement MIP solution
Clean or renewable offers that are deep	n/a	n/a	There is a degree of

Risk	Probability	Impact	Mitigation
in-merit are displaced by out-of-merit carbon intensive offers caused by the exhaustive nature of the MIP optimisation of Net Social Welfare resulting in reputational damage to market, TSOs and RAs.			uncertainty in attempting to assess the likelihood and severity of these risks prior to the execution of a given Capacity Auction.

Table D.29: MIP Solver – Risks and Mitigations

D.10. Initiative 9: State Aid Cross Border Capacity

D.10.1 Introduction and context

As the operator of the Capacity Market in Ireland, we are subject to the European Commission’s State Aid requirements. EU legislation is bringing together energy markets across Europe with the aim of creating a fully liberalised internal energy market.

The Commission has acknowledged the complexity of direct participation of foreign capacity in its decision on the market-wide capacity mechanism:

> *“Whilst the direct participation of foreign capacity providers is the preferred model, there are important technical and regulatory hurdles which prevent direct auction. In practice, direct cross-border participation entails first and foremost effective cooperation with the various actors in the neighbouring market of Great Britain (TSOs, regulatory authority and market operator).”*

Given the complexity of direct participation in cross border Capacity Market, alongside Brexit, implementation has not progressed as fast as initially envisaged and the RAs have not issued any consultations on the development of this area. Therefore, realistically speaking, we expect to implement participation of foreign capacity in the Capacity Market towards the end of the price control period.

This aim of this initiative is to have the sufficient resources to support EirGrid in the implementation of the necessary frameworks to facilitate cross-border capacity market participation by 2024.

D.10.2 Identification of Need

Article 26 of the recast electricity regulation as part of the Clean Energy Package contains overarching regulations in respect of treatment of cross border capacity in Capacity Markets:

> *“Capacity mechanisms other than strategic reserves and, where technically feasible, strategic reserves shall be open to direct cross-border participation of capacity providers located in another Member State, subject to the conditions laid down in this Article.*

> *In the case of capacity mechanisms in operation on … [the date of entry into force of this Regulation], Member States may allow interconnectors to participate directly in the same competitive process as foreign capacity for a maximum of four years from … [the date of entry into force of this Regulation] or two years after the date of approval of the methodologies referred to in paragraph 11, whichever is earlier."*

Member States may require foreign capacity to be located in a Member State that has a direct network connection with the Member State applying the mechanism. We are subject to these State Aid requirements.

Article 26 of the recast electricity regulation as part of the Clean Energy Package also includes a methodology that should be deployed for implementation. By 12 months after the date of entry into force of this Regulation, the ENTSO-E is required to submit to ACER:

- A methodology for calculating the maximum entry capacity for cross-border participation;
- A methodology for sharing the revenues;
- Common rules for the carrying out of availability checks;
- Common rules for determining when a non-availability payment is due;
- Terms of the operation of the registry; and
- Common rules for identifying capacity eligible to participate in the capacity mechanism.

Based on these requirements, we need the resources to prepare for participation in the foreign capacity market. The estimated resources we need are based on the recent I-SEM project as a benchmark.

D.10.3 Options appraisal

The preferred option is to have the resources and capabilities to prepare and implement participation in the foreign capacity market. The key actions required to deliver the preferred option are:

- Calculate the maximum entry capacity for cross-border participation;
- Determine the process for sharing of revenues;
- Determine the process for carrying out of availability checks;
- Determine the process for determining when a non-availability payment is due;

- Determine the process for operation of the qualification registry of capacity for foreign capacity markets; and
- Determine the process for identifying capacity eligible to participate in the Capacity Market.

Implementation will require detailed design, rules modification, process and systems implementation, stakeholder management and training, and systems costs. Following implementation, ongoing operations of direct participation of foreign capacity will be required.

D.10.5 Costs estimation and efficient costs

In developing the cost estimates, EirGrid made the following assumptions:

- Required TSO, MO & MDP solutions are technically implementable.
- Appropriate expert resources are in place in TSOs, MO, MDPs, RAs and vendors.
- Requirements of Clean Energy Package will apply post-Brexit.
- Cross border capacity is limited to SEM – GB (but should consider SEM – FR to accommodate the proposed new Celtic Interconnector between France and Ireland)
- Number of participants seeking qualification could exceed SEM by 10 (i.e. there could be thousands of applications for qualification).

Professional fees, as part of implementation costs, have been compiled by estimating levels of effort required to deliver each activity and applying the associated day rates. Day rates and levels of effort are based on experience from the I-SEM project. Table D.30 presents the estimated level of effort to implement the preferred option.

Implementation Steps	FTEs	Days
High level design and detailed design		
Rules modification		
Process and system implementation		
Stakeholder management and training		

Table D.30: Cross Border State Aid – Estimate of Effort

Implementation costs also comprise the cost of the systems itself. Operating costs comprise an additional four FTEs to provide ongoing support. Our approach to estimating the cost is summarised in Table D.31.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Based on experience on the I-SEM project	EirGrid internal costs estimates	Internally validated	
OpEx	Based on experience on the I-SEM project	EirGrid internal costs estimates	Internally validated	

Table D.31: Cross Border State Aid – Cost Estimate

D.10.6 Benefits

Table D.32 summarises the benefits of this initiative.

Primary outcome	**Complying with changes to the regulatory and legal environment.** It is a State Aid requirement that EirGrid be prepared for integration into this cross-border Capacity Market by 2024. This initiative addresses this State Aid requirement.
Secondary outcomes	**Increase in participants in the Capacity Market.** Through participation in the foreign Capacity Market we will be able to access more energy market participants with a more diverse generation mix to select from.
Relevant metrics	**Compliance register.** EirGrid will use a compliance register which will objectively validate consistent and timely compliance to the State Aid Requirements.

Table D.32: Cross Border State Aid – Benefits

D.10.7 Risks and mitigations

Table D.33 summarises the risks associated with delivering this initiative and EirGrid's proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
Insufficient cooperation from the GB RAs in developing the detailed solution, meaning that implementing the participation of foreign capacity either fails or is delayed.	Medium	Low/ Medium	Implementation of the participation of foreign capacity is subject to the satisfactory co-operation of the actors in GB. Therefore EirGrid would not be in breach of the regulatory requirements if failure were

Risk	Probability	Impact	Mitigation
			caused by GB actors. EirGrid will further seek to reduce the risk by seeking effective dialogue with its GB counterparts.

Table D.33: Cross Border State Aid – Risks and Mitigations

D.11. Initiative 10: Market Related TSO Governance, Risk Management and Compliance

D.11.1 Introduction and context

As a TSO, EirGrid is obliged to comply with European Network Codes, SEM Committee and regulatory decisions, Trading & Settlement Codes (T&SC), alongside other relevant codes. This requires EirGrid to manage its governance, risk management & compliance, activities in comprehensive and coordinated fashion.

Governance, risk management and compliance (GRC) are three separate, but important disciplines which are essential to ensuring a high standard of delivery and compliance is achieved. GRC is the umbrella term covering activities, such as corporate governance, enterprise risk management (ERM) and corporate compliance with applicable laws and regulations.

Governance can be considered to be the senior executive framework used to govern an organisation and ensure it creates policies and procedures appropriate to adequately monitor and control regulated organisational activities. SONI and EirGrid share responsibility for this governance activity to reduce duplication and maximise efficiencies.

As a result of I-SEM, the new compliance management and reporting activities have been established. This initiative assumes synergies will be obtained by delivery alongside similar market operator requirements, using existing operational processes and tools where possible.

D.11.2 Identification of Need

In the context of new TSO responsibilities and increasingly complex codes/legislation, the operational compliance team will be responsible for new activities, including:

- Compliance of additional capacity auctions;
- Operational compliance;
- Pan-European TSO compliance initiatives (e.g. REMIT changes);
- Code specific operational audits (i.e. GSFs & GCFs);

- The establishment, population and operation of a TSO audit and compliance library and reporting; and
- Managing and supporting the TSO operational compliance areas within the wider Group COSO framework program.

D.11.3 Options appraisal

Two options were considered for this business case:

1) **Do nothing.** Under the Do Nothing option the market compliance team continues to operate as is, with no resource overseeing EirGrid TSO's compliance with its market related obligations. This puts EirGrid at risk of not conforming to its stated requirements, given new responsibilities and increasingly complex legislation and its application to regulatory frameworks.
2) **Enhance our GRC capability (preferred option).** Based on the additional activities required EirGrid believes this will require hiring an additional two FTEs, who would share these tasks across SONI and EirGrid to avoid duplication.

D.11.4 Delivery of preferred approach

It is anticipated that the two additional FTEs will be hired at the beginning of the price control period. These resources will be shared by both SONI and EirGrid, with EirGrid funding 75% of the cost.

D.11.5 Costs estimation and efficient costs

The two resources will be at an average EirGrid FTE cost.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Based on an average EirGrid FTE cost	EirGrid internal costs	Internally validated	

Table D.34: Governance/Risk Management – Cost Estimates

D.11.6 Benefits

Table D.35 summarises the benefits of this initiative.

Primary outcome	**Complying with changes to the regulatory and legal environment.** Hiring additional staff will ensure greater compliance with the Capacity Market Code, as well as compliance to the current obligations and related codes. This is in addition to European legislation and code requirements.
Secondary outcomes	**Efficient operation.** This initiative will allow EirGrid to deliver our compliance reports more efficiently; implement changes to the code more quickly; and make decisions more effectively.
Relevant metrics	**Compliance register.** EirGrid will use a compliance register which will objectively validate our consistent and timely compliance to existing codes/legislation and upcoming European directives.

Table D.35: Governance/Risk Management – Benefits

D.11.7 Risks and mitigations

Table D.36 summarises the risks associated with delivering this initiative and EirGrid's proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
Inability to recruit suitably skilled staff leading to delays.	Low	Low	In the event of recruiting less suitably skilled staff, EirGrid will provide sufficient training in order to develop the knowledge and expertise to successfully carry out their role.
Cost overruns	Low	Low	EirGrid have used benchmarked salaries and have a high degree of confidence in our cost estimates.

Table D.36: Governance/Risk Management – Risks and Mitigation

D.12.Initiative 11: Metering system

D.12.1 Introduction and context

EirGrid is responsible for ensuring system adequacy, from the planning stage where cost effective energy providers are selected through the Capacity Market, to real-time balancing supply and demand. As part of ensuring system adequacy, EirGrid collects high-accuracy meter data for billing and revenue purpose for generators, demand customers and interconnectors.

The Metering Code for the Single Electricity Market (approved by the RAs), requires High Accurate Revenue Class Energy Meters to be installed for connection points to the Transmission System. The purpose of the metering system is to remotely collect, validate, substitute and aggregate Revenue Meter Data for provision of the SEM (imbalance market), Transmission Use of System (TUoS), and System Services for billing and revenue purposes.

Revenue Meter Data is a fundamental requirement for the operation of the following Settlement and Billing Systems:

- **SEM**. EirGrid is responsible for providing meter data for all transmission connected generating units. Our Commercial & Settlement team provides data feeds to SEMO on a daily basis.
- **Transmission Use of System Charges (TUoS).** EirGrid charges for the use of the transmission system infrastructure and for the transportation of electricity. Use of the network occurs by users importing from the system (Supplier TUoS) and by users exporting to the system (Generation TUoS).
- **System Services**. EirGrid charges for the recovery of the costs arising from the operation and security of the transmission system.

EirGrid is obliged under the Trading and Settlement Code to collect and validate meter data for a defined set of metering points. EirGrid is also responsible for operating and providing for the installation, testing and calibration of a defined set of metering points. The collection, validation, substitution and aggregation of meter data for the provision of Revenue Meter Data is currently done using three major applications and a number of other support tools across SONI and EirGrid.

D.12.2 Identification of Need

In the context of the increases in the number of connections on the transmission system requiring revenue metering, and increasing complexity due to new types of generation connection and configurations (e.g. hybrid sites with different forms of generation) our current metering system is unsustainable in the long term.

EirGrid is the Transmission Meter Data Provider (MDP) under the Trading and Settlement Code. This means that we have to collect and validate meter data for a defined set of metering points. It is important that we can do this part of our job in the most cost efficient matter and drive value to our customers and energy consumers in Ireland.

One of the major changes we face in the next price control period is the shift from the majority of generation coming from a small number of large, centrally dispatched generators, to a larger number of small, renewable energy sources. This shift requires more connection points to the transmission system. Without certain automation processes, the current system is not equipped to handle these increased connections, particularly with data substitution where there are multiple databases that are required to be streamlined into various settlement systems like TUoS and System Services.

Along with the energy metering data, the graphical comparisons required for the I-SEM Imbalance Market on generator availability instruction and generator dispatch validation are based on the accuracy of data supplied to the Market. With the increase in the number of generator connections, our current approach of creating Excel graphs would not be adequate.

In addition, the increase in generation connections to the transmission system is coming from hybrid connections, which include multiple renewable generations (e.g. solar and wind, wind and battery, or thermal generation and battery connections). This leads to more complex metering arrangements and more onerous requirements for additional meter data aggregation to separate the generation types for market and settlement purposes. The current systems are limited in their ability to further aggregate automatically and require manual calculations.

The output of the metering system impacts our billing and revenue generated from the Imbalanced Market, transmission use of system and system services.

D.12.3 Option appraisal

A number of options were considered:

1) **Do nothing (business as usual).** Under this option we continue with existing systems and processes. We do not believe this is a sustainable option for our long run operations due to the increasing quantity and complexity of the data we need to manage as the electricity system changes.
2) **Modification of current Ireland metering systems and process**. The existing products/systems have been in use many years (some since the late 1990s). At this stage in their life cycle, we do not think extensive modification, redevelopment and replication of the current system will provide value for money and meet our long term business needs.
3) **Tender for new Metering System (preferred option).** Under this option, we would secure synergies by implementing one system across SONI and EirGrid that does data collection, validation and aggregation. In comparison to Options 1 and 2, this new metering system would give us the following capabilities:
    - Full automation of processes and procedures;
    - Full audit and traceability;
    - Full meter data substitution (obligates manual intervention);
    - Standardisation of meter data systems on an all-island basis;
    - Standardisation of processes and procedures;
    - Streamlining of resources; and
    - Reduced vendor support and maintenance costs

D.12.4 Proposed initiative

In this business case EirGrid proposes decommissioning the existing metering system and investing in a new All-Island metering system for both SONI and EirGrid. The following diagram presents the existing energy solution in EirGrid. The scope of the upgrade or replacement is shown in the shaded area in Figure D.4 (removed due to cyber security risks).

D.12.5 Delivery of preferred approach

The detailed solution to our preferred option has yet to be decided upon detailed design and analysis. Broadly, there are four potential metering solutions we are considering:

a) Separate Meter Data Collection System and Meter Aggregation and Substitution System installed individually in each jurisdiction. The high-level design of this solution is outlined in Figure D.5 (removed due to cyber security risks)..

b) Separate Meter Data Collection System and Meter Aggregation and Substitution System installed across both jurisdictions. The high-level design of this solution is outlined in Figure D.6 (removed due to cyber security risks).:

c) Common Meter Data Collection System and Meter Aggregation and Substitution System installed individually in each jurisdictions. The high-level design of this solution is outlined in Figure D.7 (removed due to cyber security risks)..

d) Common Meter Data Collection System and Meter Aggregation and Substitution System installed across both jurisdictions. The high-level design of this solution is outlined in Figure D.8 (removed due to cyber security risks).:

Delivering the preferred option will require the following steps:

- **Analysis and Solution Specification** – the existing energy data processes are documented and the desired target processes are defined and agreed. This information will be used to create the tender document.
- **Procurement and Supplier Selection** – the tender will be published, submissions will be received and the most suitable supplier will be selected.
- **Solution Implementation and Validation** – the selected solution is implemented and its operation validated. The underlying technology infrastructure is acquired,

installed and configured. EirGrid users are trained in its use. The new processes are implemented. Reporting and analysis facilities will be developed.

- **Migration of Existing Energy Meters Data Feeds** – the data feeds from the existing energy meters will be migrated to the new solution.
- **Parallel Operation** – the new and old solutions may be operated in parallel for some time. During this phase, data feeds from the energy meters will need to be directed to both the old and new solutions in parallel.
- **Historical Data Migration** – historical energy meter data may be migrated to the new solution to provide a common interface to responding to both current and historic queries.
- **Decommissioning** – at the end of the project, the existing Meter Data Collection System and Meter Aggregation and Substitution System in EirGrid will be decommissioned.

D.12.6 Costs estimation and efficient costs

The cost estimates are based on the following assumptions:

- Existing energy meters will not be replaced (i.e. the cost of new energy meters is not included in this project);
- The existing communications links between energy meters and the EirGrid and SONI sites will be used; and
- No new communications links will be required.

Cost estimates were derived based on previous experience within EirGrid of installing and replacing other data management systems e.g. the previous All Island EMS systems. We analysed Meter Data Collection System and Meter Aggregation and Substitution System solutions from a number of vendors.

We also reviewed agreed contracts in other jurisdictions for similar metering systems. The estimated costs have been received internal approvals within OPI and HRCS.

Implementation (capital) costs comprise licenses, hardware and software, and professional fees to the vendor. Operating costs comprise ongoing licence support.
Our approach to estimating the cost is summarised in Table D.38.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Based on our review of Meter Data Collection System and Meter Aggregation and Substitution System solutions from a number of vendors.	EirGrid internal costs estimates	Internally validated	
OpEx	Based on previous experience within EirGrid of installing and replacing other data management systems e.g. the previous All Island EMS systems.	SONI internal costs estimates	Internally validated	

Table D.38: Metering System – Cost Estimates

D.12.7 Benefits

The following table summarises the benefits of this initiative.

Primary outcome	**Efficient, economic operation of the power grid.** The key issue with our metering systems is their limited automation capabilities. This initiative will allow us to automate the outputs of our metering systems and avoid using manual intervention. This ultimately contributes to the efficient and economic operation of power grid; especially in the wake of more generation coming from small, renewable energy sources, with more complex metering arrangements.
Secondary outcomes	**Improved customer satisfaction.** The improved auditability and traceability of the metering systems will bring benefits to our customers by enabling faster responses to market resettlement and minimising customer queries and disputes. **Improved data integrity**. Through more automation and less manual intervention in our metering systems, this initiative will improve the quality of the data required for our settlement and billing systems.
Relevant metrics	**Number of metering points.** We anticipate this initiative will increase the number of meters used for the system. **Customer Disputes.** We anticipate this initiative will reduce the number and/or duration of customer queries and disputes due to inaccurate meter readings.

Table D.39: Metering System - Benefits

D.12.8 Risks and mitigations

Table D.40 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation
There are insufficient skills in EirGrid to perform the solution analysis and design.	Low	Medium	There are external consulting organisations that can provide skills and experienced resources if necessary.
The solutions have been installed in EirGrid for so long that detailed knowledge of the operation and use is not available as staff have left.	Low	Medium	There are external consulting organisations that can provide skills and experienced resources if necessary.
The procurement exercise takes longer than expected leading to delays and additional costs for the project.	Low	Low	We will create a realistic and achievable project plan that includes the time needed to complete the procurement exercise.
The selected vendor cannot deliver the project within the expected times and costs.	Low	High	We will validate vendor skills, experiences, references and technology capability prior to selection to ensure the vendor is able to deliver the solution within expected timeframes.
The cost estimates in the business plan are inaccurate and underestimate the actual cost	Low	Medium	We have validated the costs with reference to the costs for existing systems and with providers of these solutions.
The amount of information technology infrastructure due to additional energy meters being added.	Low	Low	We will monitor any changes in the energy meter infrastructure to ensure that any changes in scope are identified early and incorporated into the solution delivery plan.
The procurement exercise does not identify satisfactory solutions leading to delays and additional costs for the project.	Low	Medium	We will contact all vendors in advance to inform them of the tender. One possible mitigation is to use section 49 (1) d of S.I. No. 286/2016 - European Union (Award of Contracts by Utility Undertakings) Regulations 2016 to allow us to use the negotiated procedure without prior call for competition.
The operation of the new and existing meter data collection processes in parallel proves to be more complex leading to delays and additional costs for the	Low	Medium	We will validate the requirement for the operation of the new and existing meter data collection processes in parallel with the selected vendor prior to starting the project.

Risk	Probability	Impact	Mitigation
project.			
The operation of the new configuration proves complex, introducing the need for additional resources and costs into its operation and use.	Low	High	We have extensive experience in the management and operation of large complex information technology infrastructure solutions. We will include the management processes and procedures into the design of the solution.
The expected benefits from the changes are not achieved leading to wasted investment.	Low	Medium	We will create a realistic benefits management plan as part of the overall project delivery plan to ensure that benefits are identified and that they are achieved.

Table D.40: Metering System – Risks and Mitigations

D.13. Initiative 12: Operational Support for IT Projects

D.13.1 Introduction and context

The initiatives listed elsewhere in our business plan cover the direct delivery costs of the associated IT projects. Whilst these include the time and resources of the team directly sponsoring the work, they do not always include the time and resource of other functions. The reason for this is that a number of other teams may need to provide input on an ad-hoc basis. It is unlikely that these staff might meet the threshold for capitalisation to a project of spending more than 50% of their time on it, because they will be working on multiple other activities in parallel with the capital project.

This input has therefore not been included within each of the initiatives submitted in this business plan, and is summarised in this initiative.

As explained in our PR4 Lookback submission, diverting key resources during PR4 impacted delivery of our CapEx programme over the PR4 period. We are keen to ensure that we have sufficient resources within the teams that sponsor the projects. This will improve the specification and acceptance of solutions, delivering more successful outcomes overall.

These additional resources are only needed to support the project delivery over the PR5 period and are not enduring roles.

D.13.2 Identification of Need

These projects will be delivered on an all-island basis, with EirGrid contributing in line with our cost allocation policy (see HBPQ). Over the entire TSO CapEx programme, it is expected that an equivalent of six resources would be required across the island to inform and support the IT CapEx programme.

This level of support will be vital for the successful delivery of these essential investments and is not included within our baseline, because dedicated teams were established to provide this role on the large CapEx projects in the current price control (I-SEM and DS3).

The projects that will require the most support from the sponsoring teams are:

- Metering System;
- Control Centre Training; and
- EMS Upgrade.

For the other initiatives there is likely to be an indirect impact the sponsoring teams which will require additional resources to ensure successful outcomes form the projects. In particular:

- Cloud Adoption;
- Cyber Security;
- Data Services; and
- IP Telecommunications Migration.

There will be a change in the IT solutions that are offered to our operational staff, which will result in them having to review and revise operational business processes.

Hence, while these staff are not be required to deliver the IT product outlined in the initiatives identified in this submission, there will be an impact on teams who are already occupied with full time roles and who will need to provide staff to the project team in order to support the effective integration of the new product into the organisation.

D.13.3 Option appraisal

Two options were considered for this business case:

1) **Do nothing.** Under this scenario, operational expertise necessary to deliver the projects would either be provided in a sporadic and piecemeal manner or the investment projects would be delayed, or not delivered in the most optimal fashion, due to lack of resource in the team sponsoring the work.

2) **Ensure sufficient staff available to support IT projects (preferred option).** Under this option, EirGrid would increase the resources available to the supporting teams to free up key staff to support the efficient and effective delivery of IT solutions that relate to their area of expertise.

D.13.4 Delivery of preferred approach

It is anticipated that the additional FTEs will be hired at the beginning of the price control period. These resources will be shared by both SONI and EirGrid, with EirGrid funding 75% of the cost.

D.13.5 Costs estimation and efficient costs

The two resources will be at an average EirGrid FTE costs.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Based on an average EirGrid FTE costs	SONI internal costs	Internally validated	

Table D.41: Operational Support for IT Projects – Cost Estimate

D.13.6 Benefits

Table D.42 summarises the benefits of this initiative.

Primary outcome	**Supporting the efficient, economic operation of the power grid.** Projects will be delivered much more effectively if the end user has adequate time to support the development of functional specifications and to test the proposed deliverable. For the larger projects, this burden on operational staff time will be considerable, but will ensure that the outcome is most effective delivering long term value.
Secondary outcomes	**Comply with changes to the regulatory and legal environment.** Implement changes to the code more quickly; and make decisions more effectively.
Relevant metrics	**Project Delivery.** Project functionality and user interface meets system operation needs and is delivered in an efficient manner.

Table D.42: Operational Support for IT Projects – Benefits

D.13.7 Risks and mitigations

Table D.43 summarises the risks associated with delivering this initiative and our proposed approach mitigating these risks:

Risk	Probability	Impact	Mitigation

Risk	Probability	Impact	Mitigation
Inability to recruit suitably skilled staff leading to delays.	Low	Low	In the event of recruiting less suitably skilled staff, we will provide sufficient training in order to develop the knowledge and expertise to successfully carry out their role.
Cost overruns	Low	Low	We have used benchmarked salaries and have a high degree of confidence in our cost estimates.

Table D.43. Operational Support for IT Projects – Risks and Mitigations

D.14. Initiative 13: Electricity Balancing Guideline

D.14.1 Introduction and context

The Electricity Balancing Guideline (EBGL) was drafted as one of the Priority European Network Codes and entered into force on 18 December 2017. The Guideline instructs the development of a number of detailed and complex methodologies, plus the integration of a number of new internal market systems, to be implemented over a period of six years following entry into force (excluding any derogations introduced at Member State level).

The EBGL sets out the rules for the integration of Balancing Markets in Europe, with the long-term objective of enhancing security of supply across the Internal Energy Market (IEM). The EBGL aims to do this through harmonisation of electricity balancing rules and facilitating the exchange of balancing resources between European TSOs.

The Guideline contains numerous obligations for most players across the energy industry; Balance Responsible Parties (BSRPs), Balancing Service Providers (BSPs), TSOs and Interconnector owners are all impacted by the EBGL. Areas for consideration as part of implementing the EBGL include (but are not limited to):

- Requirements with respect to how imbalances prices in the market are calculated;
- Detailed requirements with respect to additional data the TSO is required to publish;
- Provisions with respect to reserving capacity on interconnectors to use for balancing purposes; and
- The introduction of regional and European Balancing Platforms.

Although the long-term aims of the EBGL are in line with the core principles on which the SEM is predicated, namely increasing the participation of demand side and renewable technology in Balancing Markets and improving price signals based on transparent competition, it must be acknowledged that the move towards pan-European balancing principles represents a significant change from how real-time balancing is currently carried out in our isolated market.

In addition to changes relating to settlement and imbalance management, which will not only impact the economics of system operation, but also the investment cases of new generation units, the development of pan-European balancing platforms, underpinned by common balancing products, represent perhaps the biggest change to how EirGrid will need to operate the network. The purpose of these Balancing Platforms is to enable:

- TSOs, when balancing the system in real time, to access service provision from a wider market than just their own immediate area (i.e. wider than the SEM for SONI/EirGrid), and
- Balancing Service Providers (BSPs) to offer balancing services into a wider market than their own immediate market/TSO.

The Balancing Platforms will be set up with a central platform, into which TSOs submit their needs for balancing energy, as well submit bids from BSPs in their area. The central platform will then determine the bids that will be activated to meet the TSO's need.

In acknowledgement of the challenges faced with implementing the EBGL, derogations have been issued by CRU to EirGrid covering a number of the Guideline's requirements.

D.14.2 Identification of Need

Whilst EirGrid accepts the significant challenges of a move towards pan-European balancing principles, we remain fully focussed on honouring Ireland's commitments to the implementation of all IEM-based legislation.

We note that Ireland may not realise benefits deriving from the implementation of the EBGL in the near-term given the financial impact of systems development coupled with potential changes to market players' behaviour (including traders and investors in newly-connecting plant). That being said, it is anticipated that future pan-European arrangements will be predicated on the principles and systems architecture, that derives from the EBGL.

D.14.3 Options Appraised

1) Continue existing approach, without reopener. This option would entail utilising our existing resources to review, update, develop and ensure compliance with the EBGL, endeavouring to implement the Guideline to avoid infraction proceedings following non-compliance. We consider, however, that the uncertainties surround this guideline could

result in sunk costs, if suboptimal balancing practises are transposed on to the existing arrangements in SEM. Furthermore, with continued uncertainty regarding the United Kingdom's participation in the IEM, it might mean that resources and capital expenditure is applied to an initiative which cannot be used by Irish participants.

2) Continue to work with Regulatory Authorities to identify, and implement, an EBGL-compliant solution that is optimised to deliver benefits to the SEM. Given the aforementioned significant changes that will result from implementing the EBGL, our preferred approach would be to continue our collaborative engagement with key SEM stakeholders to ensure that all parties understand, and are committed to, the new balancing principles that would be in place. Once the end goal is commonly understood, the implementation costs can be quantified and considered against the consumer benefit that this may derive. Hence, a reopener approach is proposed.

D.14.4 Delivery of Approach

The outcomes of this project will be that Ireland will have implemented the necessary components of the Electricity Balancing Guideline by the end of price control period. This specifically includes:

- Implementation of the cross-border MARI and TERRE platforms, including:
    - Conversion of local bids and submission to the platforms;
    - Dispatch units, as per the results of those platforms, and coordinating associated operational processes;
    - Pricing and settling all actions, such that market participants are correctly paid and the TSO remains financially neutral.
- Implementation of required changes to imbalance settlement methodology in the SEM;
- Implementation of any required settlement changes in the SEM;
- Implementation of additional data feeds/transparency publications required, specifically to the European Transparency Platform; and
- Submission of methodologies, both on a domestic level and as part of a regional European coordination.

D.14.5 Costs estimation and efficient costs

We note that the costs published by National Grid with respect to implementation of one of the pan-European platforms required by the EBGL. The named costs for the TERRE platform were outlined to be approximately £25 million. The Proposer confirmed that £13 million of this constituted the current costs of the TERRE algorithms and that the remainder costs were to address any wider network impacts.

As such, we foresee a significant OpEx and CapEx cost, covering short-term and enduring resource requirements and capital investment. A provisional estimate could see costs estimated in the region of €27.9m covering systems, professional fees, certification, platform joining fees, interfacing and audits. The OpEx costs are estimated at €1.4m, while the CapEx costs are estimated at €26.5m. The joining fee alone is estimated at €19.5m (this is included in the CapEx estimates of €26.5m) and this is benchmarked based on the National Grid information.

It is worth reiterating that, in the event of the UK leaving the EU without a deal, market players in GB, including the onshore system operator and interconnectors, would not have access to the proposed pan-European balancing platforms. In this scenario, this would also prevent SEM participants from using the TERRE and MARI platforms and EirGrid from using cross-border balancing products that are developed through the implementation of the EBGL.

D.15. Initiative 14: Multi-NEMO Arrangements

D.15.1 Introduction and context

The guideline for allocating cross-zonal capacity and congestion management (CACM) entered into force on the 14 August 2015. CACM introduced the concept of multi-regional market coupling, through which cross-border power flows are instructed based on price differentials between wholesale electricity markets throughout Europe. Increased levels of market coupling reduce the price differential between EU member states and, therefore, ultimately reduce electricity prices for EU consumers.

Ireland has benefitted from the implementation of multi-regional coupling at the Day-Ahead stage after this was introduced as part of I-SEM implementation in October 2018. Looking ahead, as this principle is extended into the intraday timeframe, via the implementation of the XBID concept, market liquidity should further increase, facilitating the rising proportion of intermittent renewables in the electricity generation mix.

In order to facilitate the sale of the associated power flows through the implicit auctions, CACM established the mechanism through which designated electricity market operators can participate in Day Ahead or Intraday market coupling. Such Nominated Electricity Market Operators (NEMOs) are now designated in each country by the relevant regulatory authority. Multi-NEMO arrangements are frameworks that allow multiple NEMOs to operate in the same jurisdiction, with the ultimate view of preventing monopolisation of the NEMO role.

A number of potential models exists, which could be used for the implementation of a Multi-NEMO approach in I-SEM. Initial analysis highlights the wide variety of possible design options for Multi-NEMO arrangements (covering questions such as timelines, hub arrangements and shipping arrangements). Implementing any of them in a small market will involve significant cost, in light of the complexities of each individual party's implementation project.

D.15.2 Identification of Need

EirGrid remains fully focussed on honouring Ireland’s commitments to the implementation of all IEM-based legislation. We note that the Multi-NEMO arrangements are a requirement of CACM and, therefore, want to find the best solution for their implementation into the SEM.

We wish to ensure that this is done in the most optimal way for all stakeholders, so as to feel confident that the end solution will be of most benefit to the consumer. As such, we highlight that efforts must still be made to work with all impacts stakeholders to finalise the optimal solution in order that the relevant regulatory authorities can balance providing NEMOs with an opportunity to participate in these markets, whilst simultaneously managing the associated costs with implementing the necessary changes.

D.15.3 Options Appraised

1) Continue existing approach, without reopener. This option would entail utilising our existing resources to review, update, develop and ensure compliance with CACM, endeavouring to implement the Guideline to avoid infraction proceedings following non-compliance. We consider, however, that the uncertainties surround the Multi-NEMO approach could result in an inaccurate forecast cost submission. Furthermore, with continued uncertainty regarding the United Kingdom’s participation in the IEM, it might mean that resources and capital expenditure is applied to an initiative which cannot be used by Irish participants.

2) Continue to work with Regulatory Authorities to identify, and implement, a Multi-NEMO solution that is optimised to deliver benefits to the SEM. Given the aforementioned significant changes that will be required to move to a Multi-NEMO arrangement, our preferred approach would be to continue our collaborative engagement with key SEM stakeholders to ensure that all parties can adhere to their respective roles under the Multi-NEMO approach and that costs can, therefore, be assessed appropriately. Hence, a reopener approach is proposed.

D.14.4 Delivery of Approach

The outcomes of this project will be that Ireland will have implemented the necessary requirements of the Multi-NEMO arrangements. This work relates to the development and maintenance of the algorithms, systems and procedures for markets coupled under a Multi-NEMO framework, any changes to processing input data on cross-zonal capacity and allocation constraints (including interaction with coordinated capacity calculators) and supporting the result management process.

As such, we foresee a significant OpEx and CapEx cost, covering short-term and enduring resource requirements and capital investment. A provisional estimate could see costs estimated in the region of €11.9m covering systems, professional fees and certification. The OpEx cost is estimated at €1.7m, while the CapEx costs are estimated at €10.5m

It is worth reiterating that, in the event of the UK leaving the EU without a deal, market players in GB, including the onshore system operator and interconnectors, would not have access to the proposed pan-European balancing platforms. In this scenario, this could change the legal status of certain obligations relating to Multi-NEMO arrangements which, in turn, could mean that any investment before the UK leaves the EU is sunk.

Appendix E

Appendix E

Engage For Better Outcomes

Table of Contents

E.1. Overview of the strategic theme

Note that all detailed costs have been removed from this published version as they could prejudice future procurement exercises

The need to engage for better outcomes for all is recognised in our strategy and is central in our approach to its delivery. This appendix covers three initiatives which we consider fundamental to overcome our greatest challenge of all; winning the hearts and minds of the public and ensuring the country is fully engaged in the decarbonisation movement and cognisant of our role in that process. Our focus is not just at the level of supporting climate change targets but in engaging, supporting and facilitating the realisation of what that change means.

In terms of EirGrid's core remit, we recognise that customers must be at the heart of our decisions. They will need to host grid infrastructure and be fully supportive of cleaner energy technologies. We are committed to challenging ourselves in the field of customer and stakeholder satisfaction, proactively seeking out new and effective ways to ensure that their complex needs can be met.

During this paradigm shift in the energy industry, we will fail to gain acceptance for grid projects from a broad range of stakeholders if we do not engage and educate them directly. This means making efforts to reach out to people via the channels they each are accustomed to garner their news, be that locally, nationally or online. As we seek to integrate more renewable technology into the energy mix in Ireland to meet our national targets to address the climate emergency, clear and relevant information must be made available to those who need it, in a way that empowers those stakeholders with a clear call to action. The timelines to connect 70% renewable energy by 2030 will require more proactive support of society and the onus falls to EirGrid and the Government to ensure that we are doing our utmost to engage and educate society about the need to develop the grid to connect renewable energy. Through the development of our strategy, multiple stakeholders provided feedback as to how they felt it was EirGrid's role to educate society and do more to communicate this.

The Irish electricity system relies on an intricate mesh of grid infrastructure. Advances in technology are increasingly helping us to find less intrusive ways to move large amounts of power around the grid. However, all electricity grids, in any country, depend on a backbone of large-scale infrastructure. This means we still rely on pylons, substations, and overhead wires. Asking landowners and local communities to accept new infrastructure has never been an easy task. We never take these decisions lightly, or without first investigating all alternative solutions, but where new infrastructure is essential, it is imperative to gain public trust and acceptance to minimise opposition and support project delivery.

In recent years, we have transformed our public and stakeholder engagement. We are committed to further improvements where required. Our increased focus on accommodating even more renewable energy is a significant evolution. It will lead to major changes in how we operate the electricity system and the wholesale market. Many of these proposals are based on feedback received from our stakeholders. This feedback is summarised in Chapter 2.

The three initiatives that make up this theme are:

- Initiative 1: Education & Engagement;
- Initiative 2: Enhanced Customer Journey;
- Initiative 3: Developing the Grid Framework.

As outlined in Chapter 5 these initiatives are all on top of our business as usual activities. EirGrid has reviewed and challenged these to ensure that this is the case.

E.2 Initiative 1: Education & Engagement

E.2.1 Introduction and context

Climate change and decarbonisation are at the forefront of policy discussion in Ireland, with the public more engaged in efforts to transition towards a greener economy.

EirGrid has a critical role to play in this transition. Appendix C covers some of the ways in which EirGrid will have to adapt in order to ensure that renewable technology can penetrate the network so as to ensure that the Irish Government's 2019 Climate Action Plan can be realised.

As important a role as EirGrid has in the decarbonisation movement, we fully understand the need to engage with a wide range of stakeholders in carrying out our core remit. This may take the form of asking landowners or local communities to accept new infrastructure, or encouraging different consumption patterns to alleviate system stress.

In order for this to be done effectively, we have developed an Education & Engagement initiative that will enhance the public's understanding of our role and, more generally, the move towards decarbonisation. This initiative will improve the public's levels of acceptance and trust which extensive research has shown will facilitate a more collaborative dialogue with those involved in supporting the integration of renewables.

E.2.2 Identification of Need

In recent years, we have changed how we operate, with significant effort applied to increasing stakeholder engagement.

It is important we are seen as a trusted partner, creating a platform from which to share our vision for a sustainable future with all our stakeholders.

We know from our ongoing market research over the last number of years that when people are aware of and understand the role of EirGrid they are twice as likely to trust us and the work we do. We also know that when the role of EirGrid is accurately explained to the public it transforms their point of view and they then compare it to other essential government services.

Previously there was little brand awareness and that what people presumed about EirGrid was factually inaccurate. In 2014 we found that those who were aware of us and also able to accurately describe what we do was just at 16%.

Our most recent research in 2019 highlights the steady improvement in the public's understanding of EirGrid , which had grown to 31% of respondents able to accurately describe what we do. We have seen ongoing growth in understanding in line with our education campaign over the course of the last number of years in particular with the launch of an awareness and understanding TV campaign 2018.

The need for communities and local authorities to be aware of, and trust in, EirGrid's contribution towards the development of grid infrastructure, was outlined in several key research strands. These include *Spark* brand research and The Chartered Institute of Arbitrators' report[1] into EirGrid's consultation approach.

The reviews and research also highlighted that Transmission System Operators are modifying their behaviour and behaving more like strategic brands, with clearly defined engagement objectives. They are communicating to segmented audiences with tailored content across fully integrated digitalised channels. As traditional newsrooms decline, the 'corporate newsroom' is emerging to deliver this bespoke, packaged content with a 'personalised' story-telling approach.

We note that Transmission System Operators are significantly increasing their stakeholder engagement to prepare their partners and the public for the energy transition and to ensure they and their goals remain credible and beneficial.

We must also grow our stakeholder engagement and education programmes; we will build on the existing work that is undertaken by our internal teams by on-boarding a resource to support the anticipated increase in workload.

E.2.3 Option appraisal

Two options have been considered to enhance engagement and education to communities, and the public. These are:

> **Option 1:** Continue with the current levels of investment in education and engagement. This option would maintain the status quo, but qualitative and quantitative research has revealed this will continue to delay the delivery of infrastructure projects resulting in higher costs than necessary for end customers.
>
> **Option 2:** Invest in a targeted and modern education, information and engagement programme. This option would see EirGrid using a range of

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[1] http://www.eirgridgroup.com/site-files/library/EirGrid/Appendix-6-Arbitrators-Report-Updated.pdf

channels through which to engage with the Irish public. This would help inform a wide audience of the role that we play in society and how we are supporting the decarbonisation movement. Activities would include a media advertising campaign, combined with website improvements and a 3D modelling initiative to enable the public visualise projects, and provide feedback based on fact, not merely sentiment.

E.2.4 Delivery of preferred approach

Option 2 has been identified as the preferred option, to ensure that EirGrid's Education & Engagement initiative is fully effective. It is anticipated that this will be delivered through:

- Annual enhancements to the CRM system which is planned for roll out in the PR4 period;
- Improvements to the online SmartGrid Dashboard;
- The development of a 3D modelling tool, to support public consultations;
- A review of EirGrid's approach to online data publication, to ensure that frequently-sought information is easily accessible;
- The development of a mobile-friendly website, which will convey information about the electricity system using comparisons and graphics; and
- An integrated multi-platform education campaign – which would include TV, digital and radio advertising.

The resource required to support this initiative is 1 FTE; this resource will enable the existing team to realign their individual work portfolios to their core business activities.

E.2.5 Cost estimation and efficient costs

The breakdown of costs associated with our preferred option are set out in Table E.1.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Based on an internal market benchmark costing exercise.	EirGrid internal costs estimates	Internally and externally validated External validation via public relations and advertising agency experts procured via competitive tendering process.	Professional fees: Council Partnership Engagement: Activation of Council Partnerships: Industry publications: Corporate Newsroom: Focus Groups: Payroll: **Total:**

Table E.1: Education & Engagement Campaign – Cost Estimates

E.2.6 Benefits

Successful delivery of this initiative will see acceptance and support at all levels for grid infrastructure projects; minimising delays and the associated cost of those delays. It will also drive wider buy-in to the decarbonisation agenda.

The essential transformation of the energy supply chain in Ireland will only come when customers understand the link between climate change and the urgent need to address it, and their relationship with energy. The education campaign will inform customers on the benefits of the green energy transition. This education will help support attempts to drive customer behavioural change by other bodies. Our information and education campaign will align with messaging from our partners and statutory bodies to create a pathway for customers through the energy transition. It will aim to empower customers while addressing fears and concerns.

The proposed output metrics for this are included in Appendix S.

E.2.7 Risks and mitigations

The risks of not delivering on this initiative are that EirGrid faces uninformed pushback from key stakeholders when undertaking its activities. This could extend to key grid projects being delayed, resulting in increased costs to customers.

The risk associated with delivering this initiative is outlined in Table E.3, alongside measures for mitigation.

Risk	Probability	Impact	Mitigation
Risk that initiative does not deliver the benefits expected	Low	Low	Experienced media consultancy to be used to support the investment

Table E.3: Education & Engagement Campaign – Risks and Mitigations

E.3 Initiative 2: Enhanced customer journey

E.3.1 Introduction and context

Customer engagement for EirGrid commences in advance of applications for new demand or generation connections and evolves over the full lifetime as a customer. To address evolving customer needs, a number of activities are being undertaken to foster a more collaborative relationship with our existing and future customers, with the end goal of enhancing the customer experience and providing quality customer service for all generation and demand customers. These activities are based on feedback received from our customers.

As well as active customers, we want to ensure that prospective connecting parties, and other external stakeholders, can easily find relevant information relating to the planning, development and operation of the transmission system.

The nature and complexity of connections is changing, in keeping with the evolution of the energy market. With that in mind, our experience, combined with customer feedback, suggests that our existing approach to new connections will not be fit for purpose going forward.

As part of this response to industry changes, a balance must be struck between ensuring consistency and transparency in our processes and responding to the bespoke needs of our stakeholders. We need to ensure that our connection processes are working efficiently and are delivering the level of service that our direct customers expect.

The increasing digitalisation of the electricity sector is in turn increasing the demand from active and prospective customers to access the data we can provide about use of the network. Data provision is a key part of the service we provide to customers and warrants review to ensure this too remains fit for purpose and can facilitate the transformation in the system.

E.3.2 Proposed initiative

The five improvements identified as part of this initiative are detailed below:

Pre-application Process

A structured pre-application process for new and existing customers will be introduced. This is to ensure a consistent, transparent process for customer engagement from early engagement up to the submission of a connection application. This will involve the development, implementation and publication of a defined pre-application process for customers. It will provide transparency around the process for prospective customers considering connecting to the transmission system and ensure consistency of treatment of customers. This will be more efficient for the customer, the TSO and the TAO from the earliest stages of entry point into the pre-application process.

Early customer feasibility studies

This is an assessment of the practicality of a customer's proposed plan or method of connection prior to submitting a formal application.

Sprint Approach to Offer Process for Strategic Connections

This will see EirGrid trial the use of a Sprint Approach to prepare connection offers in a more efficient way. This will only be possible for strategic or high priority projects initially; we propose to ramp up to having one sprint session every month by 2023.

Improved system information for future connections

To improve the information available to customers, heat maps with up to date information on system capacity and location, will be developed and made available online for customers. This will provide a more transparent customer service to connecting parties.

Customer Relationship Management (CRM) Tool

A Customer Relationship Management (CRM) tool for the management of enhanced customer experience and the provision of high quality customer service will be rolled out across the EirGrid Group. As part of EirGrid's current strategic milestone, a CRM system was piloted (with a small group of staff) according to our requirements in Q4 2019. The next stage is to roll out an enhanced CRM tool across the organisation, implementing the learning and efficiencies from the CRM pilot so that all staff members are recording customer details and interactions using the same tool. This will be a major companywide change initiative that will occur during the PR5 period.

E.3.3 Identification of Need

This section addresses the need for each improvement.

Pre-application Process: Currently there are no formal parameters for pre-application engagement with customers. It is done on an ad-hoc basis via meetings or through third party introductions. Needs vary from customer to customer but a clear time commitment should be outlined to optimise both parties' time and resources. Customer feedback indicated enhanced pre-application engagement such as providing a structured forum for pre-application queries would be very beneficial. Identification of trends from other TSOs show that many other European TSOs provide this service.

Early customer feasibility studies: This service is not currently available for EirGrid customers. Both demand and generation customers have expressed interest in this service. Customers have repeatedly requested that EirGrid provides assessment of the practicality of customer's proposed plan to connect prior to submitting formal application. This is necessary to facilitate bankability of projects for customers to them to move to the next stage, including the connection application. Feasibility studies or a variation of these are currently both provided by other European TSOs.

Sprint Approach to Offer Process for Strategic Connections: This initiative is in response to feedback on best practice elsewhere in Europe in relation to customer connection processes. Customers highlighted that the current time taken to receive a connection offer once their application has been accepted (90 business days) is one of the longer timelines for connection to a transmission system. As key customers have fed back, the quicker turnaround of connection offers to customers allows them to make informed decisions and assists with strategic planning in a timely manner.

Improved system information for future connections: Improvements in technology and greater access to up to date information are needed to assist customers make strategic decisions. Customers have requested that the latest information is available in easily accessible format on generation and demand capacity at each node around the transmission system. Feedback has been received from customers that the Generation

Capacity and the Transmission Forecast Statements are not providing sufficiently up to date information. The current information becomes outdated as soon as any new connections are being processed, possibly as early as the release date of the statements due to the data freeze for their development. Other TSOs already provide this information, meaning customers can access heat maps detailing where capacity is available and it is expected that this will grow further.

Customer Relationship Management (CRM) Tool: The CRM tool will provide transparency internally on customer interactions across the breadth of the organisation's functions and provide a more seamless customer service. The tool will allow better relationship management across the organisation based on informed and consistent communications. This will drive efficiencies for both the customers and EirGrid, as interactions will be recorded and can be accessed with ease.

E.3.4 Option appraisal

This initiative is comprised of two components; the first relates to the pre-application process that we provide and the second relates to the accessibility of up-to-date data relevant to the connection application process.

Three options have been considered. These are explored below in turn:

> **Option 1:** Do nothing (continue with current approach). Under this option, we would continue to operate with the current arrangements. Engagement will continue to be bespoke and may not meet the requests of customers to embed improvements in light of their changing requirements. Customers may face challenges relating to project funding as a result, which in turn may impact the achievability of Ireland's renewables targets. In response, it is common practise for connecting parties to engage external consultants who, in turn, may need to request large volumes of data from EirGrid to support their studies, which currently require resources to fulfil the requests. The current application processing timelines will also persist.
>
> **Option 2:** Develop and provide customer journey improvements in the aforementioned areas without charging customer for the services. This option has the potential to meet customers' needs and improve the efficiency of the pre-application process. Because we would not charge customers for this service,

this option would not give rise to the complexity and expectations that comes with a service that customers are charged for (Option 3).

Option 3: Develop and provide a formal pre-application process, charging customers for this service. This option entails the same measures as Option 2 but also charges customers for the cost of providing the service. This option has the potential to improve outcomes for customers as per Option 2, however we consider there are potential downsides that it could give rise to. Specifically, we envisage that the information we provide in the pre-application stage would be limited to that which we are readily able to provide and it would be non-binding. Nonetheless, if customers are paying for such information, it will drive an expectation of specific detailed information and commitments that we are not in a position to provide without significant additional resources for detailed studies.

E.3.5 Delivery of preferred approach

Option 2 has been identified as our preferred approach for an enhanced customer journey. To deliver the aforementioned customer journey improvements, we are looking to recruit five FTEs, to be tasked with running the formal pre-application process, engaging with prospective customers and updating and publishing data on a regular basis. Maintaining and updating of detailed transmission system data and connection information and undertaking regular comprehensive system studies for multiple nodes around the transmission system will be required to provide up to date system information on grid capacity for prospective customers. This will be a recurring cost over the course of the price control and beyond.

Furthermore, an external consultant will be appointed, following a competitive procurement process, to support the development and improvement of the pre-application process (carried out on an all Island basis). EirGrid will incur 75% of the total cost of the consultancy fees[2].

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[2] Please refer to the cost allocation table for the initiatives in Section 4 for further detail.

E3.6 Cost estimation and efficient costs

The costs associated with this initiative have been set out in Table E.4.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
OpEx	Average FTE cost in EirGrid	EirGrid internal costs	Internally validated	
OpEx	Application Process – External Consultant Support	EirGrid market research	Validated thorough external benchmarking exercise	

Table E.4: Customer Journey – Cost Estimates

E.3.7 Benefits

The highest value benefits from this initiative will be derived from better decision making by potential market participants, driving down costs in the wholesale and system services markets.

Further benefits will accrue through the optimisation of both customers' and EirGrid's resources in the connections process, delivering a more effective and efficient process. The proposed output metrics for this are included in Appendix S.

E.3.8 Risks and mitigations

Risks to the delivery of this initiative principally relate to the chance of cost overruns, the chance of delays to the initiative and the chance that the initiative does not realise the intended benefits. These risks are outlined in Table E.6, alongside measures for mitigation.

Risk	Probability	Impact	Mitigation
Risk that costs overrun	Low	Low	Minimal external costs
Risk that initiative does not run to time, delaying benefits	Low	Low	The delivery of this initiative is not complex and there is a wide pool of potential suppliers

Risk	Probability	Impact	Mitigation
Risk that initiative does not deliver the benefits expected	Low	Low	Engage with customers in advance of embedding the new processes to ensure we understand what they want from them

Table E.6: Pre-Application Process – Risks and Mitigations

E.4 Initiative 3: Developing the Grid Framework

E.4.1 Introduction and context

A six-step framework for developing the Grid has been established by EirGrid[3], with a view to facilitating an increased level of stakeholder engagement from the outset. This framework is outlined in Section 7.3 of the PR4 Lookback Submission. This framework includes increased efforts to develop, and maintain, long term relationships in local areas, whilst simultaneously improving the transparency of the consultation and decision-making processes. This framework also addresses the culture and processes internally within the organisation to:

i. put in place the guiding principles for consultation;
ii. ensure consistency of information; and
iii. manage and investigate complaints or feedback.

We believe that continuing to improve the Developing the Grid Framework will be critical as EirGrid seeks to deliver the required infrastructure to enable Ireland to move towards a low carbon economy and continue to integrate renewables into the electricity network. Significant volumes of offshore wind generation, and further on-shore wind and solar generation across the island creates a need for EirGrid to consider the best way to facilitate the connection of renewables to the grid.

E.4.2 Proposed initiative

This initiative will see EirGrid continue to develop and improve its framework for grid development by undertaking the following activities:

1. **Developing 'Next Generation Tools':** EirGrid will develop Next Generation Tools for improving community engagement throughout the process for each capital project. This will include a modern project stakeholder relationship management tool. The new tool will have superior security and processes. It will incorporate spatial mapping of stakeholders on line routes and also allow for digitalisation of information at point of capture using tablets or smart phones.

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[3] See page 17 of Stakeholder Engagement Plan 2019 Report for further detail on the 6-step framework. http://www.eirgridgroup.com/site-files/library/EirGrid/Stakeholder-Engagement-Plan-2019.pdf

A suite of Next Generation Tools will be developed to improve our consultation and engagement processes with our customers. These include:

- Segmentation studies: identifying the audiences where EirGrid can and needs to increase sentiment most dramatically will enable content to be tailored accordingly. Forward-looking engagement strategies can then be based on these results.

- Investing in resources for a ‘Corporate Newsroom’ to ensure key messages reach a wide range of stakeholders through packaged multi-channel communications. Investing in digital content and rolling out consultations to include innovations in digital mapping, live-chat and virtual reality will provide citizens a greater understanding of our work and foster greater increased social acceptance.

- Tests incorporating behavioural economics framing will allow innovations such as ‘power-off and save’ to proactively educate and include customers in actions which change their behaviour and by which EirGrid can use data to evidence the benefit of that behaviour change to the customer.

- Embedding data-driven insight from market research and opinions of key influencers.

- Consultations considering a wide range of stakeholders, segmenting, targeting and tailoring the approach to the specific needs of the group where appropriate. This will be achieved by combining a variety of methods such as face to face meetings, deliberative workshops, and digital tools.

- Harnessing more modern methods of engagement through the use of digital technology such as, but not limited to apps, online engagement tools, virtual reality, 3D illustrations, live chats and digital mapping.

- Developing new data streams across the website that allows data to be easily translated into easily understandable information for a wider, more diverse audience.

2. **Securing framework accreditation and undergoing annual certification:** Accreditation of the framework demonstrates EirGrid Group's commitment to ensure we are maintaining a best practise approach to community and stakeholder engagement in our activities when developing the grid. This initiative will involve identifying a suitable international accreditation for the EirGrid Group Framework, achieving this certification and maintaining it.

   Development and implementation of an annual certification programme will ensure staff are continually trained and learnings maintained and improved. It will reinforce EirGrid Group's commitment to a community focused approach to developing the Grid. Enduring training tools and an annual certification structure will be developed and implemented within the organisation to ensure maintenance of the best practise approach.

3. **Increasing Levels of Local Engagement:** With more grid development being undertaken, greater levels of support for engagement on large and small Capital Projects will be required. Additional resources are necessary to ensure the organisation can continue to support framework engagements to the standards set out in the Framework for this increasing number of projects.

E.4.3 Identification of Need

The existing 'Developing the Grid Framework' has already transformed how EirGrid Group works with communities and stakeholders and has delivered positive benefits to date. This initiative will ensure that the standards that have been set thus far are adhered to and built upon. In doing so, we seek to continue to provide transparency around what we do and, therefore, build trust with communities.

Society's expectations of green energy and decarbonisation have evolved, with an emphasis now on organisations using innovative and engaging tools for consultation and engagement so as to ensure that any interested party can be involved in shaping the way in which things are done. Failure to match these expectations is synonymous with EirGrid missing opportunities to consult effectively and increase our public acceptance.

EirGrid has commissioned a review of consultation and engagement best practice trends and tools techniques to understand if there were any new approaches to engagement that have evolved since the EirGrid review to consultation which took place in 2014. Among the key findings, it was observed that the digital transformation means consumers and stakeholders expect a seamless experience when interacting with a brand; this is a fundamental sentiment of the Developing the Grid framework.

“Best in class” TSOs have moved away from blanket communications and seek to segment their audience and tailor content to increase impact. A number of TSOs appear to be segmenting their audience into niche groups and targeting them with pertinent communications, thus ensuring that relevant stakeholders are always presented with opportunities to engage.

EirGrid has followed National Grid ESO (NGESO) as it has sought to improve its stakeholder engagement techniques during the current RIIO Price Control and in anticipation of increased focus in this area during its next price control. In our interactions with NGESO, including during Ofgem’s recent “Electricity System Operator Mid Year Review”, we have noted the challenges associated with building transparency whilst simultaneously endeavouring to exceed stakeholders’ expectations.

As we seek to validate and create assurance that our own framework is robust, we believe that accreditation and annual certification will build trust, recognition and credibility for the EirGrid Group around how we develop the Grid which will be critical to deliver the requirements to meet Ireland’s 2030 targets. It will also provide an opportunity for continuous improvement through external review of the ‘Developing the Grid Framework’.

The success of the existing ‘Developing the Grid Framework’ is evidenced with the positive feedback we have received in relation to our engagement on the Celtic Interconnector and North Connacht projects. We would wish to take the levels of engagement on these projects as a baseline and apply increased efforts to future schemes.

E.4.4 Option Appraisal

In developing this initiative, two options have been considered:

Option 1: Continue current ways of working. As highlighted above, there is currently a Developing the Grid Framework in place, which has seen EirGrid improve its external engagement and the way in which stakeholder interaction is treated within the organisation. This would result in no further investments in further improvement opportunities, including technology and resources used in EirGrid' interaction with customers and interested parties. This could pose risks in relation to delivering the level of grid build required during PR5 and in delivering on the Climate Action Plan.

Option 2: Continue to improve EirGrid's Developing the Grid framework. This option would see EirGrid build on the success of the existing framework by developing 'Next Generation Tools', achieving accreditation for its framework and further increasing its level of engagement within local communities.

E.4.5 Delivery of preferred approach

To ensure that EirGrid can deliver a holistic and relevant stakeholder engagement programme, it is proposed that Option 2 is progressed, to continue to grow and build on the success of EirGrid's existing grid development framework.

The following activities will be delivered through this initiative:

- **Developing 'Next Generation Tools'**: A suite of tools will be developed, including a 'Corporate Newsroom', a sentiment studies tool and improved consultation software.
- **Securing framework accreditation and undergoing annual certification**: The accreditation process and associated certification will be conducted by a third party.
- **Increasing levels of local engagement**: This will be enabled by recruitment of two additional members of staff, whose remit would focus on local engagement.

E.4.6 Cost estimation and efficient costs

The costs captured under this initiative relate to the recruitment of two FTEs, who will support the improvements. Capital Expenditure associated with developing Next Generation Tools is captured in Appendix F.

Cost type	Methodology	Source of cost data	Cost data validation	Cost calculation
CapEx	Internal market benchmarking exercise	EirGrid benchmarking exercises costs	Internally validated	

Table E.7: Grid Development Framework – Cost Estimates

E.4.7 Benefits

By effectively enhancing the Grid Development Framework, we expect to create an environment whereby stakeholders can contribute towards the decarbonisation movement easily, thus resulting in a joined-up approach that is universally subscribed to.

The proposed output metrics for this are included in Appendix S.

E.4.8 Risks and mitigations

Risks to the delivery of this initiative principally relate to the chance of cost overruns, the chance of delays to the initiative and the chance that the initiative does not realise the intended benefits. These risks are outlined in Table E.8, alongside measures for mitigation.

Risk	Probability	Impact	Mitigation
Risk that initiative does not run to time, delaying benefits	Low	Low	The delivery of this initiative is not complex and there is a wide pool of potential suppliers
Risk that our partnership targets prove difficult to	Low	Low	Build relationships with individuals at the target at different levels

Risk	Probability	Impact	Mitigation
engage with			

Table E.8: Grid Development Framework – Risks and Mitigations

3

Providing value for money and managing uncertainty

Chapter 5

Ensuring Cost Efficiency

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5.1. Purpose and Scope

This section covers all aspects of efficiency related to our submission, from quantitative benchmarking through to the decisions made by EirGrid that impact the efficiency of the wider transmission system. In particular, it focuses on:

- EirGrid's approach to ensuring that its business plan reflects only the efficient cost of delivery;
- The efficiency that is embedded in our business plan because we are part of the wider EirGrid Group;
- The wider efficiency that EirGrid can influence through delivering outcomes and outputs; and
- Econometric benchmarking of EirGrid's efficiency.

Efficiency has been at the forefront while we have been preparing our business plan. One of our first pieces of work was to retain an independent consultant (KPMG) to critically examine our current levels of efficiency. Their report can be found at Appendix G.

We have also been conscious of the duty upon us to ensure that we play our part in developing an efficient, economic and coordinated transmission system. This requires us to strike a balance between our internal cost efficiencies and that of the wider transmission system. We requested KPMG to challenge our plans. This involved KPMG challenging the EirGrid business in developing the initiatives and the costs associated with these. This process was to ensure that our proposed initiatives have a robust need, making sure that that all possible options were thoroughly assessed. Our stakeholder needs, additional costs and confirmation that no duplication of projects were also challenged. As part of this, KPMG developed a cost tool that has been used to ensure the integrity of the cost data that has populated our financial model and BPQ data tables. KPMG have produced a report outlining this role which can be found in Appendix H.

5.2. Our Approach to Developing an Efficient Business Plan

As part of our PR5 submission we wanted to ensure that our initiatives covered all expected needs out to 2025. Our approach was that these initiatives were essentially a 5 year business plan. We therefore started by developing initiatives bottom up. These initial initiatives were then rationalised and refined through a concerted process of engagement and challenge at senior levels within EirGrid. The engagements and challenge included the following:

- “Dragons’ Den” sessions: where the sponsor of each of the initial initiatives presented it to a panel of senior staff from KPMG and EirGrid management. This was subject to robust challenge on the case of need, choice of solution and cost estimate. See Figure 5.1. for pictures taken during 2 of these sessions. Formal feedback was provided by KPMG to the business following these sessions.

Figure 5.1. EirGrid “Dragons’ Den” sessions

- Once the feedback from the first phase of challenge had been processed, the remaining initiatives were subject to an iterative challenge process from KPMG experts. This included focused interviews and ongoing engagement to challenge the underlying evidence.

- Each initiative was recorded in the cost tool, where challenge was applied to ensure that the data being used was consistent and that each initiative was unique and that there was no double counting between BAU and the new initiatives.

- Deep dives of the initiatives were given to the EirGrid Executive Directors over a number of sessions. KPMG also provided feedback on each initiative and the costs of each of these initiatives.

- From the start of the PR5 planning process we have been cognisant of the overall impact to customer bills. This was further reinforced following engagement with CRU July 2019, which had protecting customers as one of the key objectives for PR5.

EirGrid set an ambitious target of ensuring a minimal impact in €/MWh terms over the course of the price control. At each stage of the PR5 planning process the Executive Directors were cognisant of the cost of these new initiatives to end customers. We therefore presented the impact to customer bills as part of this process.

- Based on the above a final decision was made on which initiatives would be included in the submission. A number of initiatives were dropped as it was determined that these should be absorbed through our existing BAU allowance as part of our ongoing efficiencies.
- Where an initiative did not meet the standard which we were applying it was not allowed to be included in the *ex-ante* revenue allowance request. The small number of initiatives that fell into this category has been earmarked as re-openers through our proposed new uncertainty mechanism, as set out in the next chapter.

As part of this role, KPMG also robustly challenged the assumptions behind the costs that we have based our business plan upon. These are also listed in Appendix H, along with some examples of the challenges that they applied to our proposals.

5.3. Efficiency from Scale / Group Synergies

5.3.1. Background

When SONI was acquired by EirGrid, the SEM Committee acknowledged in its consultation paper SEM-08-176[1], that “nothing within the applicable general duty of independence shall act so as to constrain EirGrid and SONI, as separate businesses, from harnessing beneficial economies of scale and other synergies (such as costs saving on shared services) for the betterment of customers.”

EirGrid has been able to secure material efficiencies in its specialist areas as part of the EirGrid group. These are outlined as follows:

- Sharing the cost of bespoke software solutions;
- Sharing expertise and knowledge; and
- Bulk discounts on IT systems.

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[1] https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-08-176.PDF

5.3.2. Sharing the Cost of Bespoke Software Solutions

EirGrid has a very similar role to SONI, and requires the same specialist IT solutions to fulfil its obligations in Ireland as SONI has in Northern Ireland. By developing and purchasing together the bespoke software that is needed to schedule and dispatch the system, we are able to pool resources and costs. Both control centre sites act as back-up for each other, reducing the physical infrastructure that would otherwise be required by both companies. This is not only more cost effective but also importantly increases system resilience.

The cost of these IT solutions is shared on the basis of our cost allocation principles that are set out in the PR4 Lookback submission. If EirGrid was operating on a stand-alone basis, it would have to incur the full cost of development and also have to purchase additional back-up infrastructure.

The savings available to EirGrid through the joint development and procurement of our bespoke systems is embedded into our business plan, and we have not undertaken a specific exercise to determine indicative additional costs that would be incurred if we were required to undertake these essential investments on a standalone basis.

Since the majority of the initiatives are developed on an EirGrid Group wide basis and in many instances are indivisible, it is clear that the cost of the relevant initiatives if pursued by EirGrid in isolation would be more expensive.

EirGrid is also able to leverage additional services as part of a wider group; this includes aspects of stakeholder engagement, materials and services related to advice and governance. These synergies are also reflected in our plan.

5.3.3. Sharing expertise and knowledge

As part of the wider EirGrid Group which is focused on delivering the same services, staff in EirGrid can share expertise with SONI and specialist knowledge can be pooled.

This delivers benefits through both lower costs and higher quality of outputs. This is particularly visible in areas such as cyber security, where EirGrid and SONI are both responding to the same external threats, and in renewable integration, where we see specialist skill sets are deployed. Pooling expertise and services in this area provides greater security at a lower cost.

The synergies from pooled expertise and shared services are reflected throughout this business plan.

5.3.4. Bulk Discount on IT systems

Due to the significant overlap in our duties, EirGrid and SONI both require a very similar suite of IT services. These are the type of purchases where discounts are available based on the scale of purchase.

While EirGrid would be able to obtain a level of discount against list price if it was purchasing these on a stand-alone basis, significantly greater discounts are available as part of a larger group whereby EirGrid can take advantage of the greater purchasing power.

5.4. BAU Efficiencies

We have carried out a robust challenge of our BAU activities as part of this price control process. Efficiencies have been identified in our telecommunication costs. Our IT department have built up the telecoms requirements for PR5 from the bottom up. The requested allowance is less than that for PR4, even though the number of sites has increased significantly over this period. This is due to the efficiencies associated with the IP enabling works completed during PR4. This will deliver ongoing savings both in PR5 and beyond. This efficiency is a reduction of €1m per annum on the PR4 allowance.

5.4.1. EirGrid Controllable Costs

We developed a simple model to determine the impact of EirGrid's OpEx and Non-Network CapEx, to the average domestic customer bills, over the PR5 period. Appendix I outlines the data sources and workings of this model. The model shows that the average cost to consumers for the activities undertaken by EirGrid for PR4[2] was €2.71/MWh. Over the PR5 period this reduces to an average of €2.64/MWh, which equates to a 3% reduction on average. By the end of PR5 EirGrid's controllable costs in total will be almost 12% lower €/MWh than today's figure of €2.71/MWh. This analysis also shows that the EirGrid costs only make up approximately 1% of the overall average domestic consumer bill. Figure 5.4 shows the current impact of EirGrid's OpEx and Non-Network CapEx on the average domestic electricity bills, while Figure 5.5 shows the evolution of these costs over the PR5 period.

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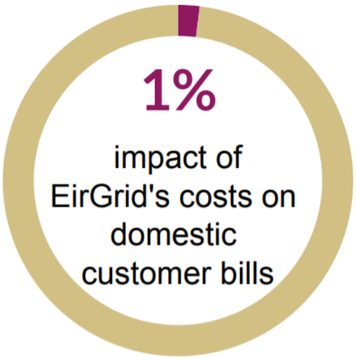
[2] For PR4 we only use 2019 and 2020 figures as these are the only years which have OpEx and Non-Network CapEx associated with I-SEM. To use previous years would not provide a like for like comparison.



€11.07

This is the forecast impact of EirGrid's OpEx and Non-Network CapEx costs on domestic customer bills per year during PR5.

-3%

This is the reduction in the EirGrid proportion of the average domestic customer bill from PR4 to PR5.

Figure 5.4. Impact of EirGrid's costs on the average domestic electricity bills

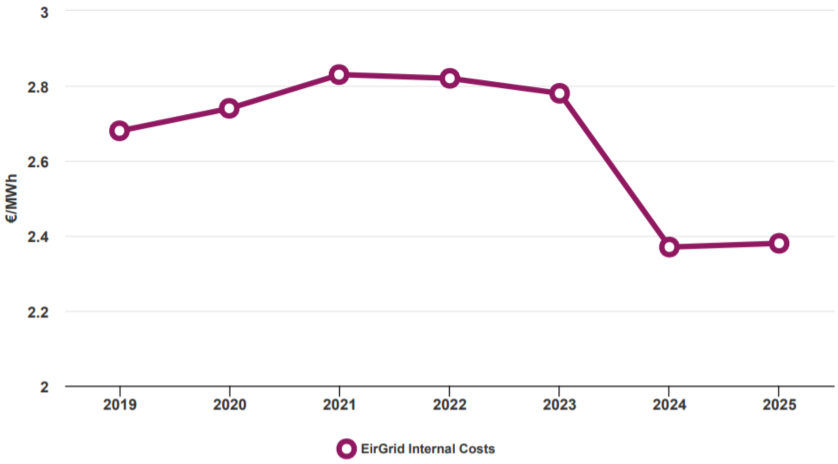


Figure 5.5. Evolution of EirGrid's costs on the average domestic electricity bills

5.4.2. Sensitivity Analysis on EirGrid Controllable Costs

There are a small number of projects which we are proposing are not included as part of the ex-ante revenue allowance, due to the level of uncertainty associated with these. These projects are:

1. Data Science
2. Electricity Balancing Guidelines
3. Multi-Nemo Arrangements in the SEM

To ensure transparency we have estimated costs for these projects resulting in a best estimate of €47.8m (OpEx and Non-Network CapEx) over the 5 years of PR5. We have carried out sensitivity analysis of the impact on the average domestic electricity bill if these projects proceed at these costs. The impact is that the average cost to consumers for the activities undertaken by EirGrid increase by 5% to €2.83/MWh as shown in Figure 5.6. However, even when all of these are included EirGrid's controllable costs per MWh are still forecast to fall by nearly 2% by the end of the period. EirGrid has developed an uncertainty mechanism for use in PR5 and we propose that these projects are progressed through this framework. This is outlined in Chapter 6.

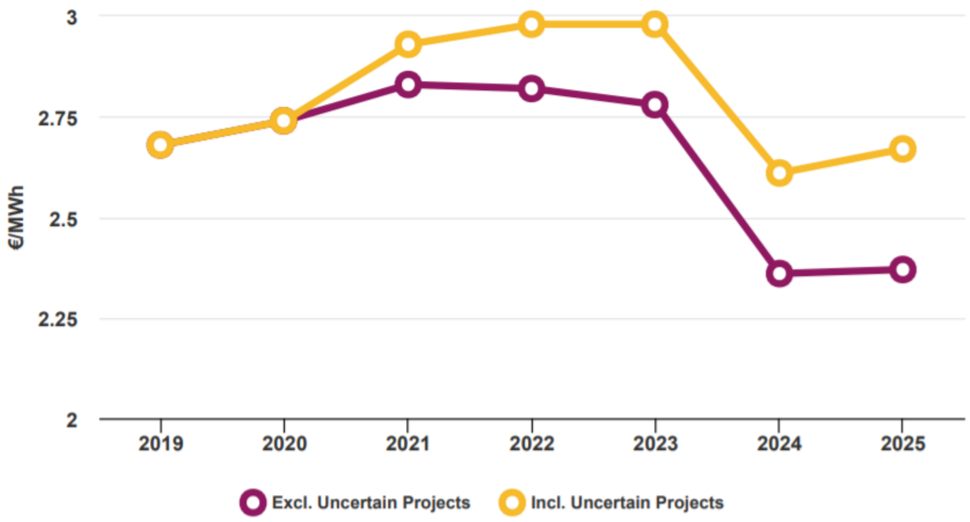


Figure 5.6. Sensitivity analysis with uncertain project costs included

5.4.3. Network CapEx

The model developed by EirGrid also includes analysis of the impact of the forecast Network CapEx requirement as this will impact on customer bills. EirGrid looked at both the impact of this cost and that outlined in Chapter 4 holistically as part of our target of keeping the €/MWh constant. The impact of this on the average domestic electricity bill is shown in figure 5.7.

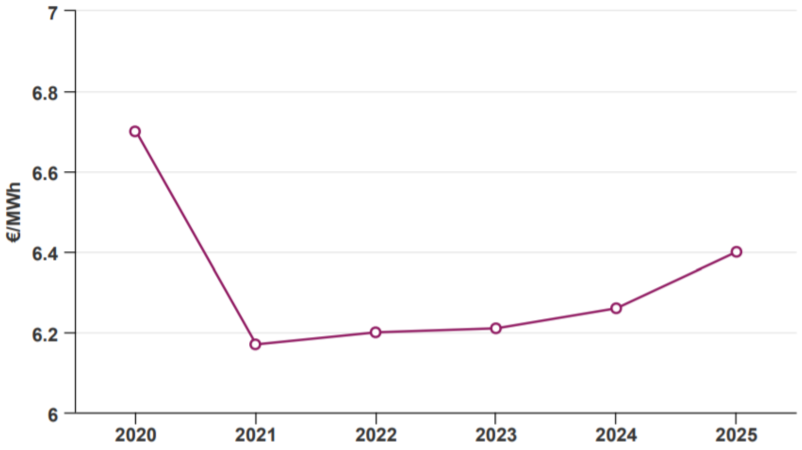


Figure 5.7. Evolution of Network CapEx costs on the average domestic electricity bills

5.4.4. Delivery of Further Efficiencies through Enhanced Outputs

The above examines efficiencies in our internal cost base, in particular leveraging economies of scale and careful managing of our direct costs. Almost all of our activities are mandatory under statute, licence or codes, therefore options to drive internal efficiency through a reduction in our activities are limited. We have absorbed significant additional complexity and volume in the PR4 Price Control period.

Real value and efficiencies for customers is delivered through output delivery. The analysis presented above shows how the controllable costs of EirGrid represented a very small portion of the end cost to the average electricity customers. We have outlined to the CRU the value which EirGrid can deliver as part of the overall value chain to customers. For example, EirGrid saved €33.5m for Irish customers during the first 3 years of PR4. The efficiencies that EirGrid can deliver for customers through the changes and initiatives that it implements can deliver a greater magnitude of efficiency within the wider electricity system than any saving we could make on our internal costs. For example:

- **The I-SEM Project:** the new trading arrangements went live in October 2018, and have resulted in lower average prices for customers. This includes a reduction in the cost of generation capacity of approximately €150 million per year for Irish customers. It is EirGrid that runs the capacity auctions, and manages the scheduling and dispatch of generators in its control room;

- **DS3 Programme**: this has seen a world leading approach to the integration of non-synchronous intermittent renewable generation that has been an essential part of Ireland's achievement of its target of 40% renewable electricity by 2020 and has placed significant downward pressure on prices in the wholesale market; and
- **DBC**: over the first three years of the PR4 price control, EirGrid saved €33.5 million for Irish customers by reducing system constraints.

The above examples however are industry wider initiatives. EirGrid has also delivered benefits through:

- New means of system services delivery and system services contracting;
- Facilitating the introduction of contestable connections;
- Increased system resilience;
- Introduction of new industry wide publications such as the Transmission Development Plan and Tomorrow's Energy Scenarios; and
- Ensured the network was developed only where appropriate, stepping back from the development of projects where the need was no longer justified.

All of these have given rise to increased efficiency within the electricity system.

We are however cognisant of the importance of efficiency in the wider system that we can unlock by challenging ourselves. This has shaped the formation of this business plan submission. In the next chapter we set out proposals that we believe will unlock considerable value for customers, while maintaining a balance between our internal costs and wider priorities.

5.5. Costs of an Efficient TSO

5.5.1. Background to the Efficiency Assessment

EirGrid retained KPMG as independent economic advisors to examine the potential evolution of the costs of an efficient electricity TSO in Ireland for the five year period 2021 to 2025. Their report assesses the potential for improvements in cost efficiency rather than the efficiency of the costs proposed by EirGrid as part of its business plan submission.

Historically, regulators have assessed the potential for improvements in cost efficiency for regulated sectors based on a combination of:

- **Relative efficiency:** the process by which less efficient firms learn from and 'catch-up' to the most efficient firms in a given sector. For a regulated monopoly such as EirGrid, regulators will set catch-up efficiency targets to try and mimic the competitive pressure that would otherwise drive efficiency gains in a competitive market. A firm's catch-up efficiency is typically estimated using historical trends of costs against outputs which are benchmarked across comparable companies or industries.
- **Ongoing productivity gains**: capture the rate at which the most efficient company in the sector can improve its productivity over time. The underlying rationale is that one might expect EirGrid to be able to improve its cost efficiency at a similar rate to other comparable companies, or sectors, in the economy.
- **Real price effects (RPEs):** capture the difference between input price inflation (e.g. wage growth) and the price index used to index the revenues during the control period. The scope for EirGrid to improve its cost efficiency will be offset by growth in the cost of its inputs. RPEs incorporate the genuine cost pressures faced by EirGrid based on the inputs of its business rather than the more general movement of goods and services which make up inflation indices.

The total scope for cost efficiency improvements is the aggregate impact of ongoing productivity gains, RPEs and catch-up efficiency. Assessing the scope for efficiency gains requires one to establish a comparator against which EirGrid can be measured. KPMG's report assesses the evidence for determining the scope for cost efficiency gains from a top-down perspective and considers whether evidence is sufficiently robust for use in a regulatory setting for the PR5 period.

5.5.2. Ongoing Productivity

The available evidence supports a range for ongoing productivity gains of between -0.26% and 1.0% per annum for a company operating in similar sectors of the economy as EirGrid. This is based on an assessment of:

- Independent forecasts for productivity in the Irish economy
- An independent estimate for productivity based on EU KLEMS
- Precedents from previous regulatory determinations

Given the range of uncertainty around Irish productivity data, the point estimate recommended by KPMG was based on the average of four sources as outlined in detail in their report. The recommendation is for an ongoing productivity of 0.3% per annum. This equates to €3.6 million in internal OpEx over the PR5 period. This point estimate provides equal weighting to the range of estimates from different sources that cover both long and short term trends in productivity. This is outlined in the KPMG report which can be found in Appendix G.

5.5.3. Real Price Effects RPEs

The inputs that make up EirGrid’s cost base are not proportionate to the items which make up the Consumer Price Inflation (CPIH) which will be used to index EirGrid’s revenues. This creates a risk that the efficient costs for a TSO are increasing more quickly (or slowly) than EirGrid’s revenue allowance. In the presence of positive RPEs, EirGrid may be unable to cover its costs with its revenue allowance which could have knock-on impacts on the company’s ability to finance its activities and carry out its statutory functions.

To estimate an RPE that could be applied to EirGrid’s costs, trends in price indices related to EirGrid’s inputs were compared to CIPH inflation.

5.5.4. Relative Efficiency

Relative efficiency accounts for the process by which less efficient firms learn from and ‘catch-up’ to the most efficient firms in a given sector. The total of relative efficiency and ongoing productivity equal the potential level of efficiency that a firm in a sector could achieve over a period of time.

A range of evidence for potential comparator companies (other SOs) and publicly available independent sources (e.g. wage indices, survey data and other benchmarking exercises) was assessed to determine if a robust benchmark for determining the scope for catch-up efficiency in EirGrid’s cost base could be established. This analysis considered the activities which EirGrid undertakes, characteristics of the industry in which it operates, and how EirGrid could be compared against publicly available data sources.

There are a range of issues and challenges that affect the ability to establish comparator companies for EirGrid. This limits the ability to undertake meaningful and robust benchmarking analysis to estimate catch-up efficiency for EirGrid. This is primarily because:

- EirGrid operates in a different industry structure to other SOs which is more suitable to the system it operates, and is designed for the SO to fit licence and legislated requirements; and
- Each transmission system differs in terms of the requirements it must satisfy, the geography in which it is located, the size of the system and the generators connected, all of which result in TSOs undertaking a different mixture of activities.

The available information for other SOs is not sufficiently comparable to EirGrid to allow robust cross-sectional comparisons to be made. This finding is consistent with previous independent studies, in particular pan-European TSO benchmarking studies commissioned by the Council of European Energy Regulators ('CEER') Unbundling, Reporting and Benchmarking Task Force, which concluded that robust benchmarks for system operations costs could not be established.

KPMG did however examine trends in EirGrid's efficiency over time. This showed that overall, over the past five years EirGrid has faced additional challenges managing increased volume and complexity of workload while continuing to improve some of its key service quality metrics.

5.6. Summary

In preparing this submission EirGrid has ensured that its base level of input costs are efficient, that it has incorporated ongoing productivity improvements but most importantly it is equipped to deliver output efficiency to the benefit of customers.

EirGrid continues to challenge itself in delivering efficiencies. The synergies achieved by sharing key IT systems with SONI on an all-island basis allows EirGrid to achieve lower costs in manner that would not be possible if purchasing as a standalone entity.

In addition, by sharing knowledge and expertise between SONI and EirGrid, EirGrid benefits from a pool of specialist industry experts, which to do so in isolation would be particularly challenging in the current competitive employment industry.

For EirGrid and its customers to benefit from further efficiencies during PR5 it is vitally important the regulatory framework supports this output delivery and unlocks the value for customers. A key aspect of this submission, the enhanced benefit sharing framework, is outlined in the next chapter.

Appendix H

KPMG review of EirGrid's business cases for PR5

November 2019

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Introduction and context- development of EirGrid business cases

1. Initial development of business cases

EirGrid's business cases were developed by business teams based on EirGrid's strategy for the 2021-25 (PR5) price control. EirGrid developed these business cases as part of its PR5 business plan to evidence and justify funding for additional expenditure to deliver key outcomes for customers and license obligations in line with EirGrid's strategy and the CRU's objectives for PR5

2. EirGrid Governance and Executive Director challenge

The cases developed by EirGrid business teams were challenged by a 'Dragons Den' panel, the EirGrid Regulation Governance Board and through peer review across multiple iterations of each business case.

3. KPMG review

EirGrid engaged KPMG to provide an independent critical friend review of the business cases, through review of the underlying business case documentation and evidence, participation in the Dragons Den process and workshops.

4. KPMG's process and methodology

This report sets out KPMG's process and methodology for reviewing the EirGrid business cases, and a summary of key conclusions including implications for overall costs.

Our scope and limitations of scope

This report sets our process and methodology for challenging the business cases proposed by EirGrid for delivery in PC 2021-25.

Scope – independent review of business cases

- We have carried out an independent review of the business cases developed by EirGrid, CRU's expectations, and our experience and best practice from across regulated utilities. This report sets out the process of our review and the framework and criteria applied.
- We have focussed on what we see as the key issues and provided an independent perspective. Our review focused on the justification of each business case across multiple criteria, including needs case, options appraisal and the strength of the evidence supporting cost estimates.

Limitations of our scope

- Our review does not cover all business cases developed by EirGrid. For example, we did not review all cases which could be subject to uncertainty mechanisms.
- We provided a number of comments and recommendations to EirGrid as part of our review. The report does not set out the comments provided on each case and we have not reviewed whether all comments provided have been addressed in the final cases included in the EirGrid business plan.
- We have not performed any management functions or made any judgements or decisions for EirGrid. While we have in the course of performing the scope provided advice to EirGrid on matters relevant to EirGrid decision making, responsibility for all EirGrid decisions, for any results arising from its decisions and for management of any consequences rest solely with EirGrid.
- Our review does not constitute a complete value for money or cost benefit analysis in support of any particular spend.

Process for our review (1/2)

We provided initial challenge to the EirGrid business cases at an early stage of their development through the Dragons Den process; thereafter we reviewed a number of the business cases in detail and provided comments on the needs case, options appraisal and the strength of evidence underpinning cost estimates.

Dragon's Den review

The Dragon's Den was a panel consisting of KPMG and the representatives from key business functions (IT, HR, Regulation and Finance). The panel challenged the EirGrid business case owners on the strength of the evidence available to support cost estimates, options appraisal and the needs case.

The panel agreed next steps and actions with business case owners, including adjustments to cost estimates, considering alternative options and development of outputs to allow robust monitoring of delivery. For example on costs, owners were advised to obtain market evidence to support cost estimates.

KPMG cost tool

We developed a tool to capture costs associated with the business cases. The tool captured and standardized cost data across cases to allow and identify key areas of challenge e.g. consistency of assumptions between cases, different categorisation of spend, or duplication of costs between cases.

The tool facilitated quality control of business case costs; it identified where the composition of costs was not clear, inconsistencies with supporting documentation and ensured a robust change control process. Periodic updates to the tool enabled the business to quantify the impact of ongoing challenge to costs and supported decision making.

Ongoing feedback loop

Review of each business case

KPMG teams were deployed to carry out initial reviews of the business cases, assessing the the strength of the evidence available to support cost estimates, options appraisal and the needs case. This included focused interviews and ongoing engagement to challenge underlying evidence.

We provided a Red Amber Green (RAG) status for each case on a regular basis as the business updated and developed the cases; as a result of this iterative process the status of the business cases (reflected in the RAG assessment) improved over time. Where our challenge led the business to changes in costs, this was reflected in the KPMG cost tool on an iterative basis.

Process for our review (2/2)

We provided initial challenge to the EirGrid business cases at an early stage of their development through the Dragons Den process; thereafter we reviewed a number of the business cases in detail and provided comments on the needs case, options appraisal and the strength of evidence underpinning cost estimates.

Validation guidelines

We provided validation guidelines to allow the business teams to test and strengthen the evidence of the underlying cost base. Validation guidelines set recommended standards of evidence across the EirGrid cases on cost estimation, options appraisal and deliverability across cases.

The validation guidelines incorporate our business case experience and ~~bestgood~~ practice observed across regulated utilities. These guidelines contained tests/questions to check the robustness of cases and ensure consistency and informed the calibration of our RAG assessment.

Final business case review

The work performed by KPMG informed the EirGrid Regulation Governance Board challenge of business cases. The KPMG teams provided comments on several iterations of the cases developed by the business, and the final review was premised to supplement any remaining areas of weakness with solutions feasible within the time available.

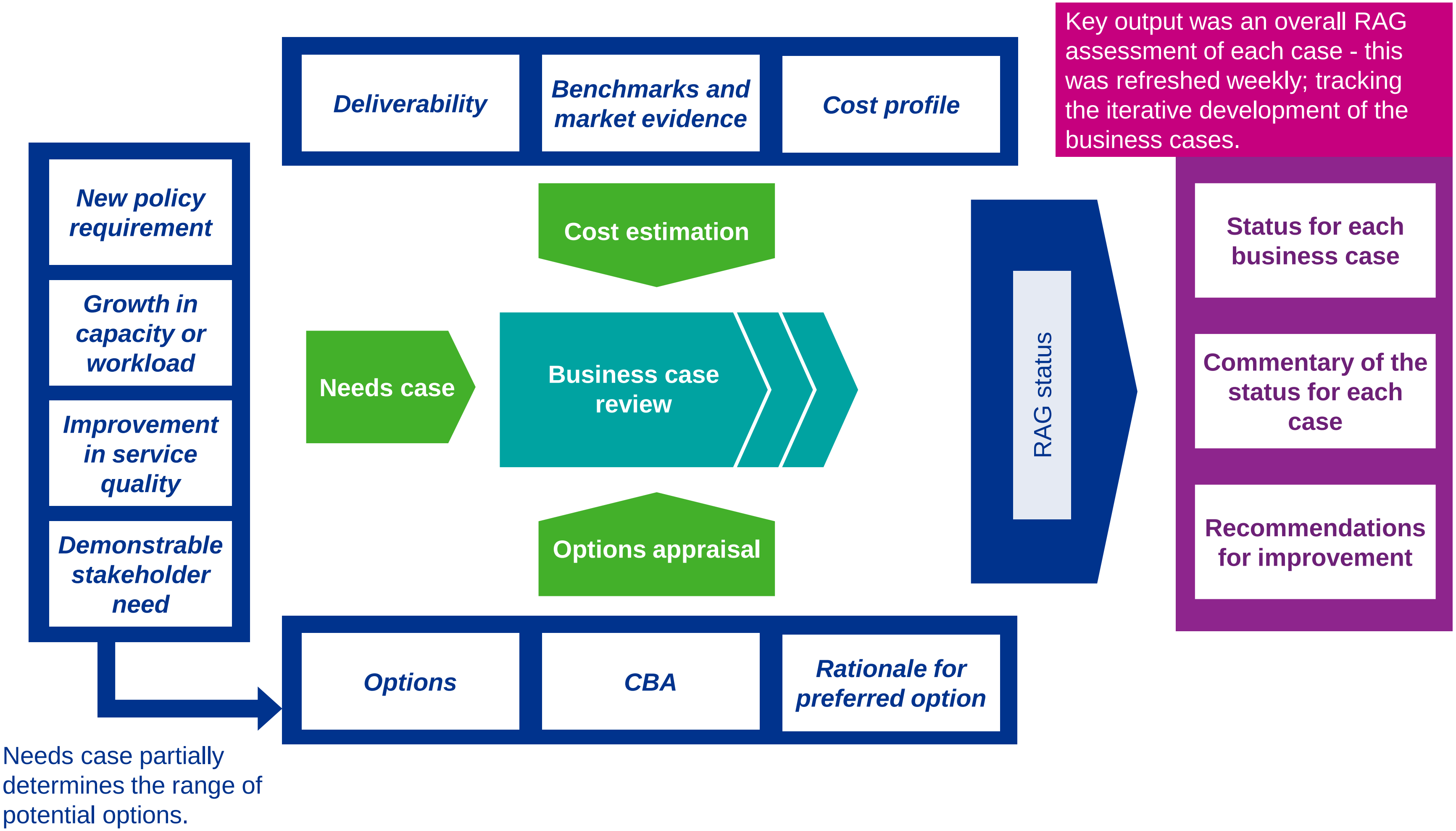
KPMG's role

KPMG's role was to serve as a critical friend to EirGrid, to review the business cases and to provide challenge to improve the quality of the business cases. We worked with the business to highlight areas where cases could be strengthened and refined through an iterative process and an ongoing feedback loop.

Our review and recommendations informed EirGrid governance processes and decision making regarding the business cases.

Framework for our review (1/2)

Our approach to the assessment of business cases was structured around three critical areas of assessment consistent with the regulator's priorities; (1) the needs case; (2) options appraisal; and (3) strength of evidence supporting cost estimates.



Key output was an overall RAG assessment of each case - this was refreshed weekly; tracking the iterative development of the business cases.

New policy requirement

Growth in capacity or workload

Improvement in service quality

Demonstrable stakeholder need

Deliverability

Benchmarks and market evidence

Cost profile

Cost estimation

Needs case

Business case review

Options appraisal

Options

CBA

Rationale for preferred option

RAG status

Status for each business case

Commentary of the status for each case

Recommendations for improvement

Needs case partially determines the range of potential options.

KPMG

Framework for our review (2/2)

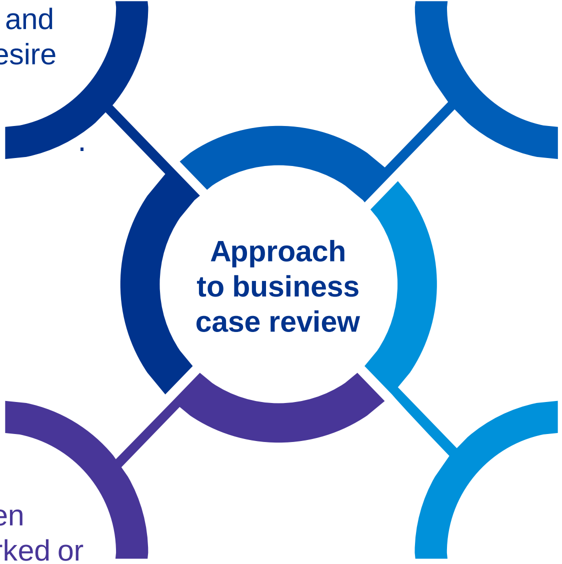
The needs case, options appraisal and robustness of costs are assessed separately for each case and are used as inputs to determine the RAG status on materiality for each case.

1. Needs case

This considers whether the needs case is clear and driven by a) a (new) statutory or policy requirement, b) growth in capacity or workload, c) quality improvement (i.e. quality improvement to customers) or d) clear and demonstrable stakeholder/customer desire for the investment.

2. Options appraisal

This assesses whether there is a clear review of different options to meet the need identified and a conclusion around the best option for customers. This could be supported by Cost Benefit Analysis, which would include quantitative assessment of benefits to customers through avoided costs, service improvement, efficiency or risk reduction.



3. Strength of evidence to support cost estimates

This considers how the costs have been estimated, whether they are benchmarked or supported by robust evidence, whether they take into account expected efficiencies and input cost pressures.

4. Materiality status

The materiality status principally is based on the % of totex the respective case represents and encompasses (1),(2) and (3). Where a case is not material it may require lower levels of supporting evidence or EirGrid should evaluate whether these should be aggregated with other cases.

Key messages from our business case review

We reviewed approximately 30 business cases for the EirGrid business as part of the Dragons Den sessions and subsequent iterative development process. This slide sets out a number of key findings from our review of the business cases presented to the Dragons Den panel and the subsequent RAG assessment we carried out for each business case, which highlighted a number of areas where business cases could be refined and strengthened:

Engagement from business teams- The Dragons Den sessions were well attended by senior level management staff and presentations supplemented the information provided in the business cases with good engagement from staff.

Needs case- Overall across business cases the needs case was relatively strong. Most of the cases emerged either from a new statutory requirement or from growth/change on the system driven by a strong regulatory or policy imperative. Several cases relate to operational improvements, where a strong case was made that they deliver a tangible efficiency, service improvement or reduce risk/increase resilience.

Options appraisal- Initial cases contained limited options appraisal. We recommended that alternative options were considered to demonstrate that the right option has been selected.

Strength of evidence supporting cost estimates- On some cases we challenged the strength of the evidence base to support cost estimates, in particular where the business case involves new systems and approaches or capital expenditure which cannot easily be benchmarked, and suggested (through our cost validation guidelines) approaches to strengthen the evidence supporting the estimates of costs. In other cases we found that the underlying evidence was supported by robust market benchmarking and evidence.

Our review identified a number of internal inconsistencies in cost assumptions across cases (which resulted in some decreases and some increases in costs across cases), duplication with baseline expenditure and cases where cost estimates could be refined based on available data and evidence. Duplication was removed from the business cases where identified. Several business cases were dropped where there was sufficient uncertainty around the scope and cost estimates for the case; the scale of uncertainty around some cases, which could not be included in ex ante allowances, highlighted the importance of uncertainty mechanisms for recovery of efficient costs.

In response to our review EirGrid developed further iterations of all cases, which resulted in changes to cost estimates across almost all cases (including a reduction in costs for 16 business cases and several cases being dropped), additional optioneering in business case documentation and inclusion of output metrics and measures to allow ongoing monitoring of the business cases.

Appendix 1 - Business case cost sources

Business case cost sources

This section provides an overview of the key components of and available evidence supporting the cost estimates for each business case reviewed as part of the Dragons Den sessions and subsequent iterative development process.

Business case	Cost sources
Control Centre Training	Implementation (capital costs) consist of professional fees, hardware and software, and systems costs. Operating costs reflect average FTE costs. Both reflect internal management estimates and have been internally validated.
Physical Security Technology Replacement and Enhancement	Cost estimates are based upon current (2019) market pricing for physical security protective products. All costs have been market tested; with estimated costs based on like-for-like purchasing of security technology and equipment within the Irish marketplace.
Cyber Security	Capex costs have been developed based on a internal review of published material of costings for similar initiatives by companies in the Power and Utilities sector and have been externally validated by EirGrid strategic cyber business partners. Opex is mostly comprised of system tools, which EirGrid is at advanced stages of procurement and as such is externally validated by the market.
Network Codes	Case consists of 1 FTE (sized based on EirGrid’s previous experience).
Capacity Market Secondary Trading	Opex consists of new FTEs and IT development costs; these are based on from the I-SEM project and other recently completed Capacity Market activities which are have been internally validated. Capex estimates has been primarily built up using day rates and effort required on similar projects to develop systems.
Demand Side Unit Compliance with State Aid	Costs have been benchmarked against a similar project (the Enhanced Performance Management System Phase 1 project)
Implementing a Mixed Integer Programming Solver	Opex is based on the I-SEM project and other recently completed Capacity Market activities. Capex estimates has been primarily built up using day rates and effort required on similar projects to develop systems.

Business case cost sources

Business case	Cost sources
State Aid Cross Border Capacity	Opex relates to FTEs; these are based on from the I-SEM project and other recently completed Capacity Market activities. Capex estimates have been primarily built up using day rates and effort required on similar projects to develop systems.
Market Operations Governance, Risk Management and Compliance	Two FTE based on EirGrid rates.
All-island Metering System	Capex is based on an internal review of Meter Data Collection System and Meter Aggregation and Substitution System solutions from a number of vendors. Opex is based on previous experience within EirGrid of installing and replacing other data management systems e.g. the previous All Island EMS systems
Customer Journey	Costs consist of 5 FTEs; the cost of which is based on centralised internal pay assumptions.
Renewables Strategy	Costs have been informed by (1) Previous experience, adjusted for management expectations (2) Market data (3) Vendor engagement, using either top down and bottom up assessment. These have been validated by internal SME.
Control Centre Tools	Estimates for spend are based on previous experience in developing and delivering solutions within the control centre. For each cost centre tool EirGrid has undertaken a bottom-up approach to identify the costs associated with the requirement including labour input, vendor costs, technical support and license costs. These have been estimated based on a internal review of market solutions costs and standardised maintenance benchmarks.
Outage Management	Bottom-up cost estimate based on estimated resource, software and hardware costs. As part of this EirGrid has relied on existing external resource rate cards from a number of suppliers, expected benchmarked maintenance levels and license costs. These have been internally validated.

Business case cost sources

Business case	Cost sources
Telecoms	Opex costs relate to new FTEs. The capex for system IT migration has been constructed bottom-up using standardised costs; and validated by an internal SME.
Data Services	Costs estimates are underpinned by evidence including: (1) Experience of provision of data solutions and pilots within the business (2) Market studies and review of public pricing provided by external parties (3) Existing contracts with a number of vendors providing services (4) Internal review from external parties (such as Gartner, Oracle, Dell and others). Costs have additionally undergone internal SME validation.
System Planning	c. 5 FTE based on EirGrid rates.
Promoting Change	c. 1 FTE based on EirGrid rates.
Building the Network	23 FTE based on EirGrid rates.
Engagement and Education	1 FTE based on EirGrid rates. Costs predominantly relate to agency and professional fees for increasing brand awareness across stakeholder groups.
Access Planning	2 FTE based on EirGrid rates.
Framework for the Development of the Grid	3.5 FTE based on EirGrid rates. Other costs predominantly relate to licence and software costs relating to stakeholder management systems (including using new technologies such as VR).

Appendix I

Appendix I

Cost to the Consumer

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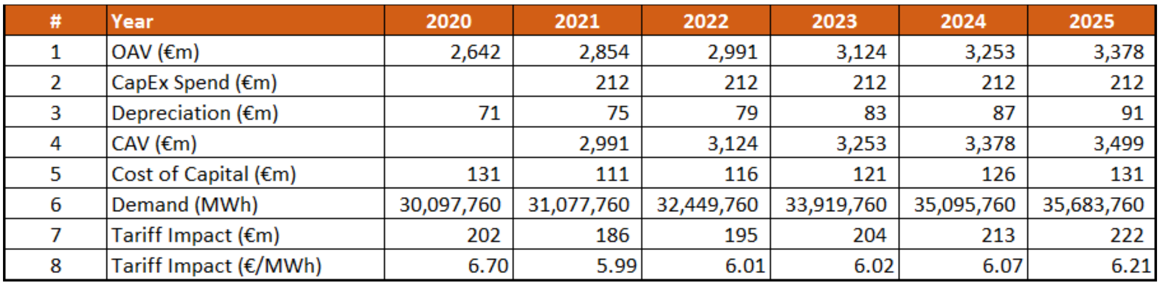
I. Introduction

This appendix sets out how we have calculated the cost impacts of our PR5 submission on customers. The purpose of this appendix is to ensure transparency around these numbers, to clarify the assumptions made and outline the source of the data.

The costs have been presented based on the average domestic electricity customer for illustrative purposes.

I.1 Impact of Network CapEx

This section outlines the cost to customers based on the forecast Network CapEx requirements for PR5 of €1.07bn.



#	Year	2020	2021	2022	2023	2024	2025
1	OAV (€m)	2,642	2,854	2,991	3,124	3,253	3,378
2	CapEx Spend (€m)		212	212	212	212	212
3	Depreciation (€m)	71	75	79	83	87	91
4	CAV (€m)		2,991	3,124	3,253	3,378	3,499
5	Cost of Capital (€m)	131	111	116	121	126	131
6	Demand (MWh)	30,097,760	31,077,760	32,449,760	33,919,760	35,095,760	35,683,760
7	Tariff Impact (€m)	202	186	195	204	213	222
8	Tariff Impact (€/MWh)	6.70	5.99	6.01	6.02	6.07	6.21

Table I. 1: Impact of Network CapEx

#	Line Item	Description	Data Source
1	Opening Asset Value (OAV)	Year 2020 is based on data from CRU model. For other OAVs this is set equal to the previous year's CAV.	https://www.cru.ie/wp-content/uploads/2015/07/CER15296-Decision-on-TSO-and-TAO-Transmission-Revenue-for-2016-to-2020-1.pdf
2	CapEx	This is the forecast PR5 Network Capex requirement of €1.07bn spread evenly over the 5 years.	Forecast BQP has a different spending profile but for example purposes here it has been assumed to be an even spread of the projected sum across the five years.
3	Deprecation	Transmission Assets that are assumed to be depreciated over 50 years.	Additional depreciation of €4m per year assumed, based on the average annual increase from the previous CRU model. Opening Deprecation figure obtained from CRU. See link: https://www.cru.ie/wp-content/uploads/2015/07/CER15296-Decision-on-TSO-and-TAO-

			Transmission-Revenue-for-2016-to-2020-1.pdf
4	Closing Asset Value (CAV)	OAV + CapEx – Deprecation	NA
5	Cost of Capital	Year 2020 = OAV * 4.95% PR5: ((OAV+CAV)/2) * 3.80%	Return based off actual WACC for 2020 and for assumed WACC of 3.8% for PR5. Consistent with EirGrid's estimates of an asset based business.
6	Demand	This is the forecast demand for the relevant years	Median demand from the 2019 - 2028 Generation Capacity Statement[1]. It was then adjusted to account for Non I-SEM traded energy (1.588 TWh) and losses of 2% applied. This is consistent with the approach for the 2019 tariff calculations.
7	Tariff Impact (€m)	Depreciation + Return	NA
8	Tariff Impact (€/MWh)	Tariff Impact (#7)/ Demand (#6)	NA

Table I.2: Explanation of Data Sources in Table I.1

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[1] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

I.2 Impact of EirGrid’s Controllable Costs

This section outlines the cost to customers based on the forecast OpEx and Non-Network CapEx.

	#	Year	PR4		PR5				
			2019	2020	2021	2022	2023	2024	2025
Non-Network CapEx	1	Non-Network Capex Spend (€m)	79.84	11.0	14.32	14.32	14.32	14.32	14.32
	2	OAV (€m)	28.6	88.1	77.9	69.2	58.6	46.1	46.8
	3	Depreciation (€m)	20.3	21.3	23.0	24.9	26.8	13.7	14.3
	4	CAV (€m)	88.1	77.9	69.2	58.6	46.1	46.8	46.8
	5	Cost of Capital (€m)	2.9	4.2	2.9	2.6	2.1	1.9	1.9
	6	Demand (MWh)	28,431,760	30,097,760	31,077,760	32,449,760	33,919,760	35,095,760	35,683,760
	7	Tariff Impact (€m)	23.2	25.4	26.0	27.5	28.9	15.5	16.2
	8	Tariff Impact (€/MWh)	0.82	0.85	0.84	0.85	0.85	0.44	0.45
OpEx	9	OpEx (€m)	53.1	57.0	61.9	64.2	65.5	67.6	68.6
Totex	10	Tariff Impact (€m)	76.33	82.41	87.88	91.61	94.34	83.13	84.78
	11	Tariff Impact (€/MWh)	2.68	2.74	2.83	2.82	2.78	2.37	2.38
	12	Cost per average customer (€/yr)	11.28	11.50	11.88	11.86	11.68	9.95	9.98
Bill Impact	13	Average Price to households per €/KWh	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	14	Use (MWh)	4.2	4.2	4.2	4.2	4.2	4.2	4.2
	15	Cost (€)	1006	1006.00	1006.00	1006.00	1006.00	1006.00	1006.00
	16	% of bill	1.12%	1.14%	1.18%	1.18%	1.16%	0.99%	0.99%

Table I.3: Impact of EirGrid’s Controllable Costs

#	Line Item	Description	Data Source
1	Non Network Capex Spend	This is the forecast Non-Network CapEx spend. For PR5 this is spread evenly over the 5 years. RPEs are included in these figures.	Years 2019 and 2020 comes from Tab 7.1 Row 21 of the FBPQ. The €3.2m deferred from PR4 to PR5 has been added to each year during PR5 at a rate of €0.64m per year. For PR5 this is from the business cases. The €3.2m deferred from PR4 to PR5 has been subtracted from each year at a rate of €0.64m per year.
2	OAV	Year 2019 is based on data from the FBPQ. Equal to the previous year’s CAV thereafter.	Year 2019 comes from Tab 7.1 Cell T19 of the FBPQ.
3	Deprecation	We assume that all CapEx is depreciated over 5 years, therefore 20% deprecation each year.	E.g. 2024’s deprecation is 20% of 2019 + 20% of 2020 + 20% of 2021+ 20% of 2022 + 20% of 2023 based on the Non-Network CapEx.
4	CAV	OAV + Non-Network Capex Spend – Deprecation	
5	Cost of Capital	Years 2019 and 2020 = OAV * 4.95% PR5: ((OAV+CAV)/2) * 4.00%	Return based off actual WACC for 2020 and for assumed WACC of 4% for PR5 for an asset light business.
6	Demand	This is the forecast demand for the relevant years	Median demand from the 2019 - 2028 Generation Capacity Statement[2]. It was then adjusted to account for Non I-SEM traded energy (1.588 TWh) and losses

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[2] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-All-Island-Generation-Capacity-Statement-2019-2028.pdf

			of 2% applied. This is consistent with the approach for the 2019 tariff calculations.
7	Tariff Impact (€m)	Depreciation (#3) + Return (#5)	NA
8	Tariff Impact (€/MWh)	This is the tariff impact of the Non-Network CapEx and is calculated as follows: Tariff Impact (#7)/Demand (#6).	NA
9	OpEx	This is the forecast OpEx spend. RPEs are included in these figures.	This is taken from the FBPQ as follow: (Tab 3.1 row 201) – (Tab 3.1 row 188) Note that RPEs for OpEx are then added to this.
10	Tariff Impact (€m)	This is the Totex tariff impact and is obtained from the Non-Network CapEx Tariff Impact (#7) + OpEx (#9)	NA
11	Tariff Impact (€/MWh)	This is the Totex tariff impact as follows: Tariff Impact (#10)/Demand (#6).	NA
12	Cost Per Average Customer (€/yr)	This is the Totex Tariff Impact (#10) * Use (#13)	NA
13	Average Price to Households per €/kWh	This is the average unit rate for the domestic electric bill	SEAI Data[3].
14	Average Household Use (MWh)	4.2 MWh	Bonkers.ie data[4].
15	Cost (€)	This is the average domestic customer electric bill	NA
16	% of Bill	Cost Per Average Customer (#12) / Cost (#15)	NA

Table I.4: Explanation of Data Sources in Table I.3

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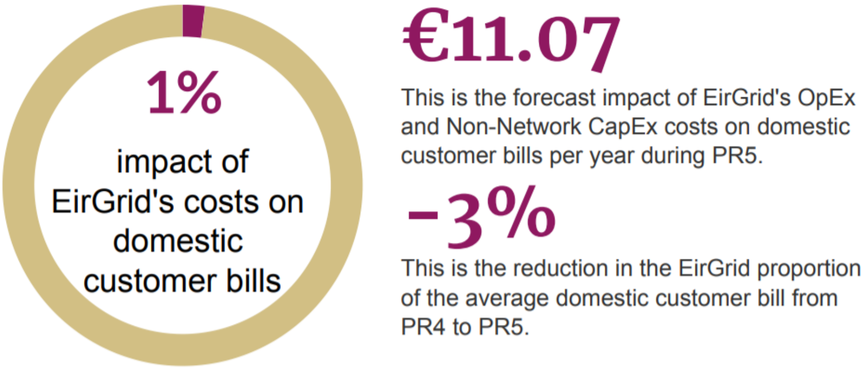
[3] https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/prices/

[4] https://www.bonkers.ie/blog/gas-electricity/new-average-energy-consumption-figures-revealed/



1%

impact of EirGrid's costs on domestic customer bills

€11.07

This is the forecast impact of EirGrid's OpEx and Non-Network CapEx costs on domestic customer bills per year during PR5.

-3%

This is the reduction in the EirGrid proportion of the average domestic customer bill from PR4 to PR5.

Figure I.1: EirGrid's cost on customer bill.

Figure I.2 and I.3 show the variation in internal costs for EirGrid and Network Capex Costs respectively.

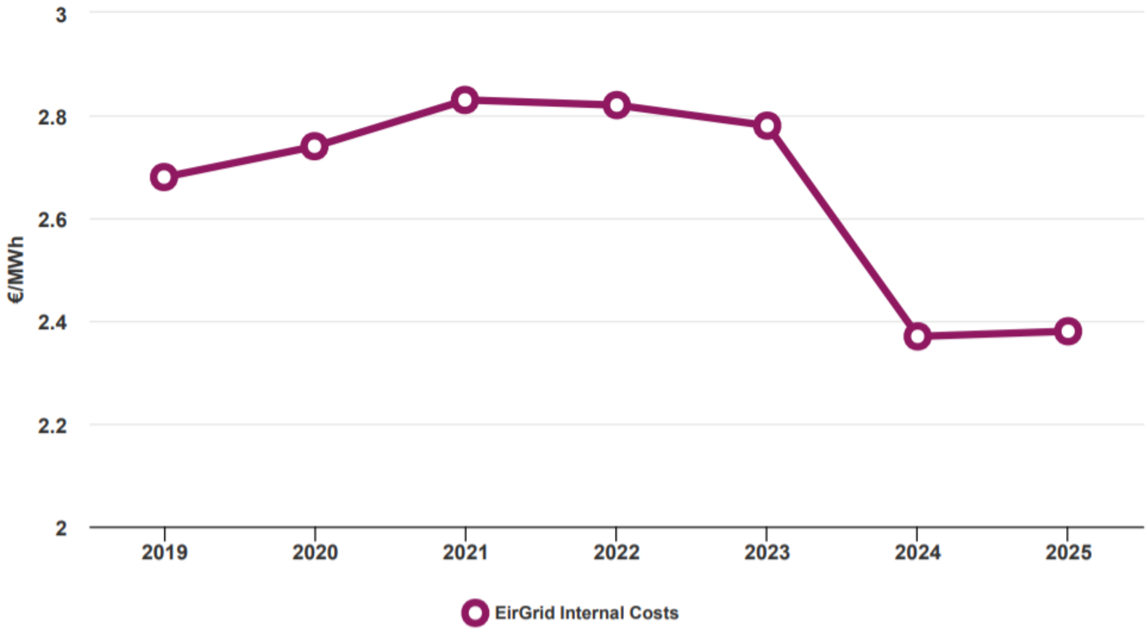


Figure I.2 EirGrid Internal Costs.

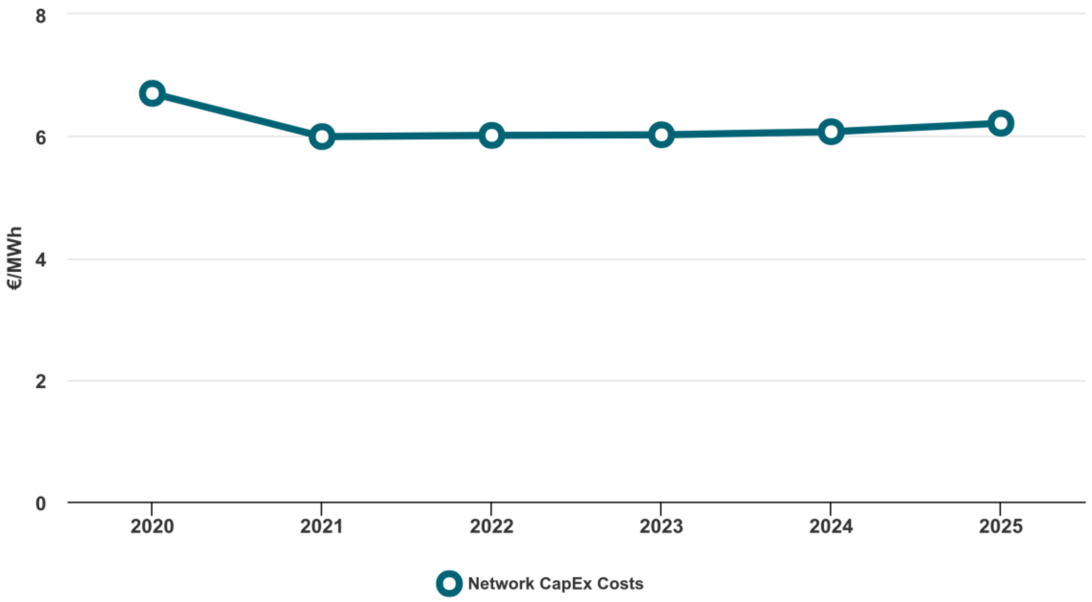


Figure I.3 Network CapEx Costs.

I.3 Sensitivity Analysis – EirGrid Costs

There are 3 projects have not been accounted for within costs outlined in Section 3.

Table I.5: Uncertain Projects for PR5

When these are added to the cost model the following is the tariff impact

	PR4		PR5				
	2019	2020	2021	2022	2023	2024	2025
Tariff Impact (€/MWh)	2.68	2.74	2.93	2.98	2.98	2.61	2.67

Table I.6: Impact of EirGrid Controllable Costs with Sensitivity Analysis

Chapter 6

Regulatory Framework

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6.1. Introduction

If the transformation of Ireland's electricity sector set out in this submission is to be delivered it is vital it is supported and underpinned by an appropriate regulatory framework.

EirGrid has particular characteristics by virtue of its asset light nature. As a result it is exposed to much greater levels of operational gearing than a traditional network based utility and must manage cashflow differentials significantly greater than its underlying tangible Regulatory Asset Base. It is important the regulatory framework supports these unique characteristics.

In addition, by virtue of its role in the industry, EirGrid is able to deliver significantly greater value through the enhanced outputs and outcomes that it can deliver for consumers than simply through the efficient management of its own internal cost base. A well designed regulatory framework will enable these additional benefits to be unlocked and will encourage and incentivise EirGrid to invest in and seek out these additional sources of value.

6.2. The Current Regulatory Framework

The regulatory framework for EirGrid is built upon the foundation of the traditional framework of *ex ante* revenue cap. This provides that where the company outperforms the revenue cap it can retain the savings for a period of time before seeing the benefits passed through to customers. The converse equally applies. This has served customers well and significant efficiencies have been passed on to customers in the almost two decades since its introduction.

The current framework, set out as far back as 2001 (CER/01/131)[1], is based on a five year rolling retention of savings thus ensuring the company has the same incentive to deliver cost efficiencies throughout the regulatory cycle. In our view this represents best practice regulation and the regulatory commitment, and regulatory certainty, brought through consistency in its application helps provide a stable regulatory framework whereby investment can take place and where regulatory risk around the cost of

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[1] https://www.cru.ie/wp-content/uploads/2001/07/cer01131.pdf

financing is minimised. It is customers who ultimately benefit. This is shown graphically in Figure 6.1.

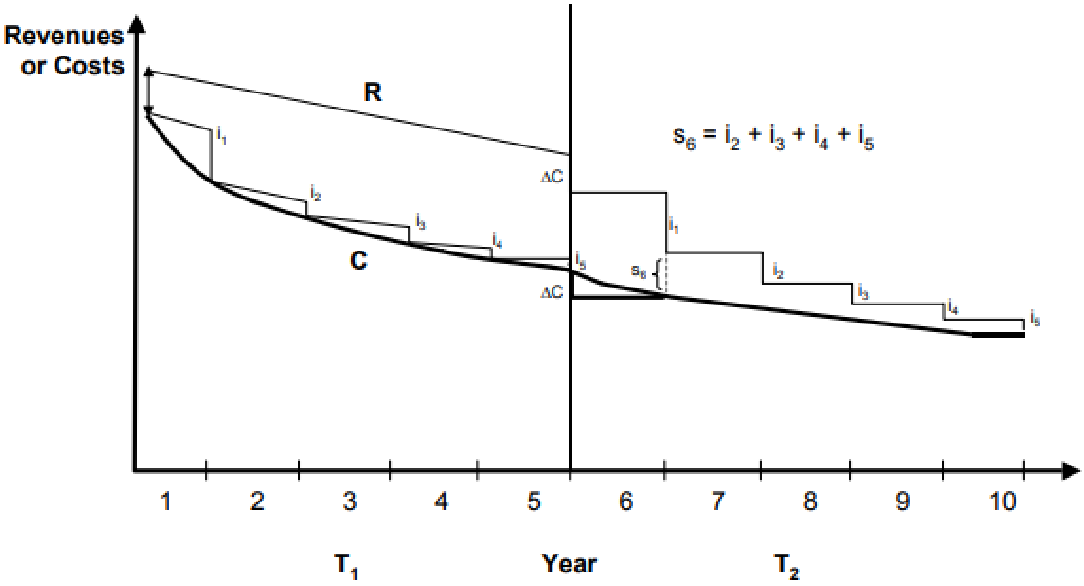

Figure 6.1: Illustration of rolling retention. Source CRU[2]

This revenue cap framework applies equally to both operating costs and non-network capital costs (largely investment in Information Technology) incurred by EirGrid. This helps ensure EirGrid faces the correct incentives to make OpEx and CapEx trade-offs and to ultimately do the right thing.

The revenue cap is supported through a framework of remuneration for the layers of capital employed and risks faced by the EirGrid business. This framework, which is largely unique to the EirGrid business reflecting EirGrid's unique characteristics, has been built up and developed by the CRU over time as the capital employed by EirGrid and the risks it faces have in themselves continued to evolve.

The fair pricing of this capital, and ensuring that ultimately a fair balance of risk and return for its remuneration, is further set out in the next chapter. However in summary the framework comprises:

- Weighted Average Cost of Capital (WACC) remuneration on the tangible asset base (RAB) and on the early stage network development costs (Side RAB);

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[2] https://www.cru.ie/wp-content/uploads/2001/07/cer01131.pdf

- Remuneration calibrated to the WACC on 20% of the external costs managed by EirGrid to help support the working and contingent capital required for their management; and
- A margin of 0.5% of Transmission Use of System (TUoS) reflecting EirGrid's higher operational gearing and wider collection agent activities.

At the time of Price Review 4 there was considerable debate as to how the wider Enterprise Value (EV) of the EirGrid business, which ultimately reflects the capital employed within the business, should be remunerated and at the same time how the regulator and regulatory framework should best assess, and ensure, the financeability of the EirGrid business. Ultimately a number of these questions were left for consideration by CRU as part of this price review, PR5.

EirGrid has given careful consideration to the framework which will help support this price review and which will help ensure customers ultimately see the benefit which can be delivered through the energy transition. We have also received expert economic advice from KPMG to assist both us, and CRU, in this process.

As part of this we considered whether a fundamental re-think was required and whether an entirely different form of incentive based framework and margin based approach was more appropriate. Ultimately we concluded it is not.

What instead we set out below is very much enhancement to the existing framework to take account of the changed and changing circumstances for the next period; it represents a form of evolution not revolution. In particular:

- Introduction of a Monitoring Committee, as part of a wider suite of uncertainty mechanisms, to help both CRU and EirGrid manage the inherent uncertainty that this next period will bring;
- Rather than addition of a specific layer of capital to reflect the Enterprise Value in the EirGrid business an enhanced framework of incentives to drive value for customers in terms of better outputs and outcomes; and
- A specific provision to handle and manage any asymmetric risk within the regulatory framework which may arise by virtue of either its design or application.

The remainder of this chapter sets out EirGrid's proposals for each in turn.

6.3. Managing Uncertainty – the Monitoring Committee

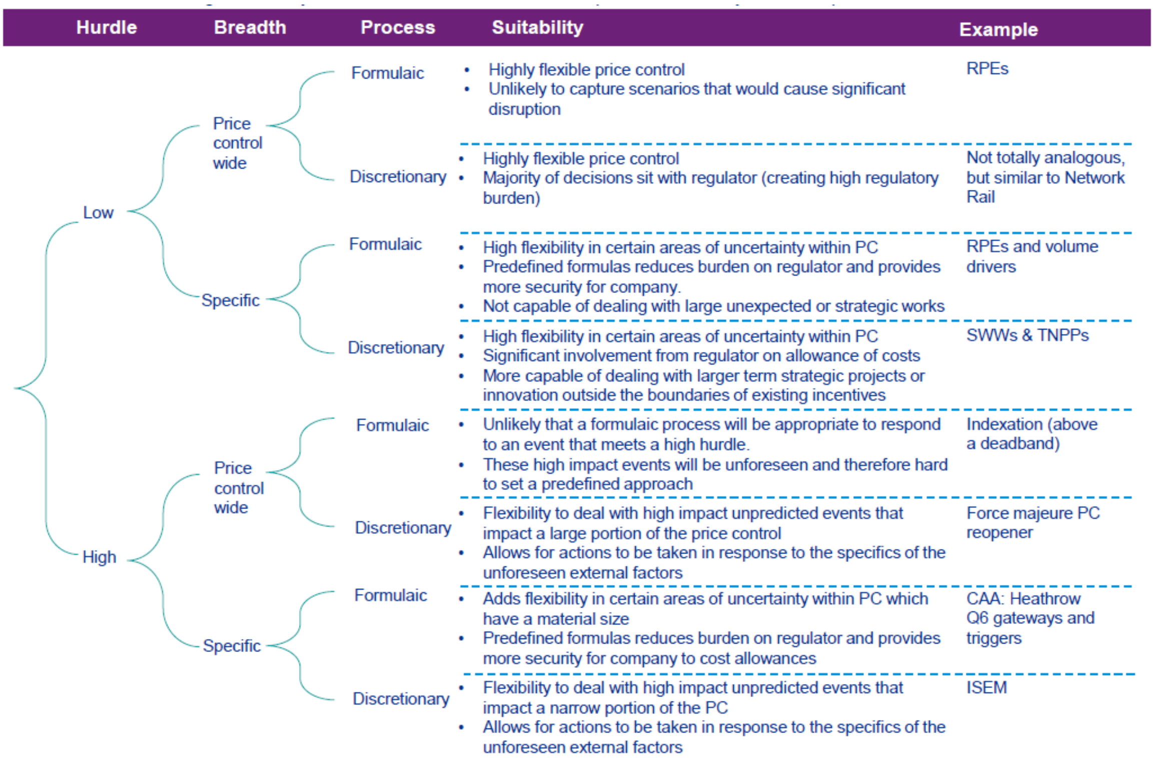
Ex ante incentive based regulation has served customers well. It effectively passes cost management risk from customers to company where it is the company who can best mange such risks and remunerates investors for the taking of these risks either in the form of return on capital or a margin on operating activities.

The alternative, an *ex post* regime, means it is customers who bear these risks, that any incentive for the company to manage costs is effectively removed and the regime effectively becomes one of pass through. Moreover, as discussed below, the underlying framework may be subject to asymmetry and explicit provision would be required to counteract this.

However what is faced in the forthcoming period is a situation whereby the level of uncertainty, and therefore risk, *ex ante* is much more significant than in the past. In that sense the level of certainty necessary for the regulated entity to be able to take the risk associated with adverse outcomes eventuating does not ultimately exist.

Even more importantly left simply to an *ex ante* mechanism there is a risk that customers suffer either under-investment or simply pay too much to ensure investment is delivered. Neither is desirable. In addition for any *ex ante* risk taken by the company customers will have to pay a heavy premium in the form of higher levels of return to compensate investors for taking that risk.

We set out below in Figure 6.2 a decision tree terms of categorisation of the different types of uncertainty which may be faced. This is taken from the independently prepared accompanying KPMG paper, Appendix J which accompanies this plan.



Hurdle	Breadth	Process	Suitability	Example
Low	Price control wide	Formulaic	• Highly flexible price control • Unlikely to capture scenarios that would cause significant disruption	RPEs
		Discretionary	• Highly flexible price control • Majority of decisions sit with regulator (creating high regulatory burden)	Not totally analogous, but similar to Network Rail
	Specific	Formulaic	• High flexibility in certain areas of uncertainty within PC • Predefined formulas reduces burden on regulator and provides more security for company. • Not capable of dealing with large unexpected or strategic works	RPEs and volume drivers
		Discretionary	• High flexibility in certain areas of uncertainty within PC • Significant involvement from regulator on allowance of costs • More capable of dealing with larger term strategic projects or innovation outside the boundaries of existing incentives	SWWs & TNPPs
High	Price control wide	Formulaic	• Unlikely that a formulaic process will be appropriate to respond to an event that meets a high hurdle. • These high impact events will be unforeseen and therefore hard to set a predefined approach	Indexation (above a deadband)
		Discretionary	• Flexibility to deal with high impact unpredicted events that impact a large portion of the price control • Allows for actions to be taken in response to the specifics of the unforeseen external factors	Force majeure PC reopener
	Specific	Formulaic	• Adds flexibility in certain areas of uncertainty within PC which have a material size • Predefined formulas reduces burden on regulator and provides more security for company to cost allowances	CAA: Heathrow Q6 gateways and triggers
		Discretionary	• Flexibility to deal with high impact unpredicted events that impact a narrow portion of the PC • Allows for actions to be taken in response to the specifics of the unforeseen external factors	ISEM

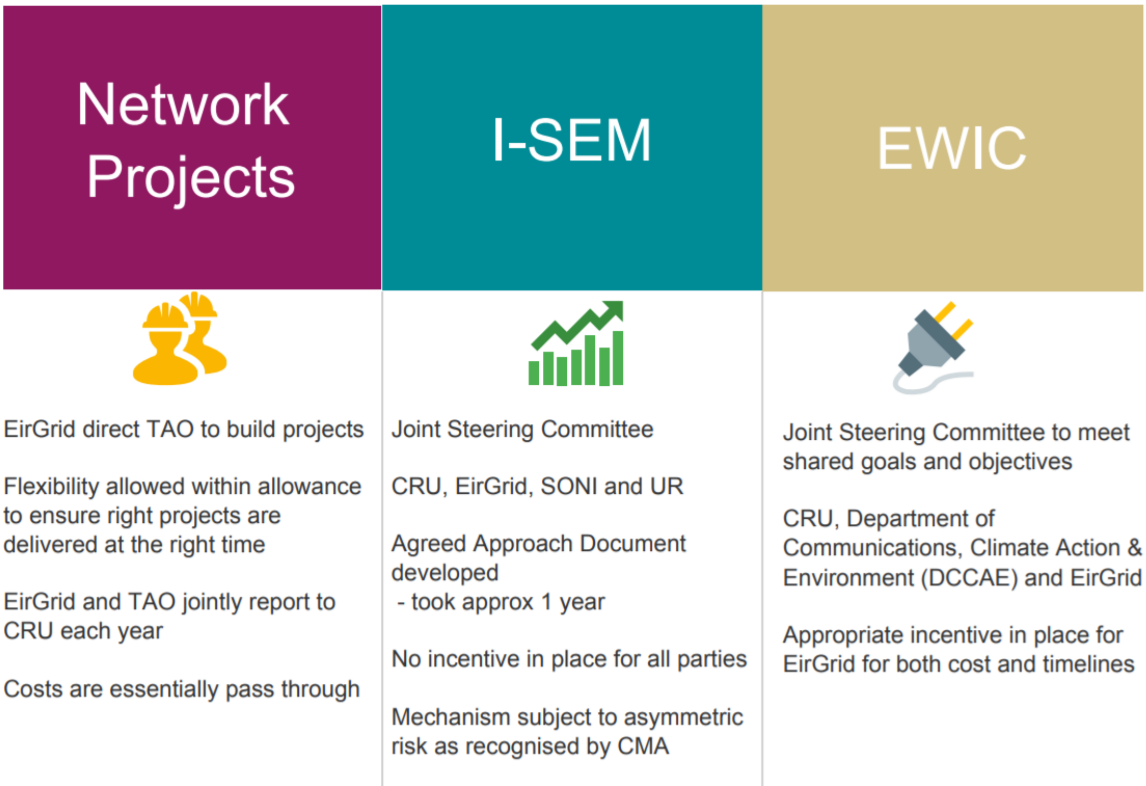
Figure 6.2: KPMG Decision Tree for Types of Uncertainty

The decision tree sets out a wide variety of paths whereby uncertainty can be managed or addressed. In some instances trigger mechanisms may be appropriate; in other cases *ex post* true ups or automatic adjustments may be more beneficial and in their report KPMG has set out a possible *ex post* true up framework to handle potential forecast error in terms of the application of Real Price Effects. However, in the case of the nature and type of uncertainty likely to be faced in the PR5 period - high hurdle, specific and discretionary - a broader scoped and more tailored mechanism is going to be necessary.

The need for and application of such a mechanism is not new. There exists a largely *ex post* pass through mechanism for the advancement of network projects and network delivery. This has operated successfully, but carries no cost management incentive properties and is subject to asymmetric risk. In addition, because the activities are very different and distinguishable from those carried out by EirGrid under the *ex ante* revenue cap the impact of edge effects, and consequentially potential unwelcome or perverse incentives, is minimised. This is not the case for the activities in PR5 for which uncertainty mechanisms need to be derived.

Equally, during PR4, both the I-SEM implementation and DS3 System Services implementation costs were recovered through bespoke arrangements which were put in place for their recovery. However, these mechanisms, whilst potentially appropriate for these projects, particularly I-SEM, were cumbersome. Each took almost a year to put in place. They were also costly, subject to ongoing audit and verification by both TSO and regulator, and were subject to an asymmetric risk profile as confirmed in the case of SONI by the Competition and Markets Authority in terms of the application of the very same mechanisms.

In the past, where there were shared policy objectives, a wider oversight body came together comprising CRU, DCCAE and EirGrid[3] to oversee and manage regulatory recovery in respect of the East West Interconnector (EWIC). This wider body helped ensure the policy objectives were delivered and oversaw the cost of that delivery with an appropriate incentive framework.



Network Projects	I-SEM	EWIC
EirGrid direct TAO to build projects Flexibility allowed within allowance to ensure right projects are delivered at the right time EirGrid and TAO jointly report to CRU each year Costs are essentially pass through	Joint Steering Committee CRU, EirGrid, SONI and UR Agreed Approach Document developed - took approx 1 year No incentive in place for all parties Mechanism subject to asymmetric risk as recognised by CMA	Joint Steering Committee to meet shared goals and objectives CRU, Department of Communications, Climate Action & Environment (DCCAE) and EirGrid Appropriate incentive in place for EirGrid for both cost and timelines

Figure 6.3: Examples of Uncertainty Mechanisms used by CRU

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[3] At the time CER, DCENR and EirGrid

During the preparation of this business plan EirGrid engaged with CRU and the CRU's consultants CEPA and GHD in order to consider what form of uncertainty mechanism might ultimately be most appropriate. These discussions, and the framework and taxonomy set out by CEPA and GHD were extremely useful and we believe all parties ultimately came to the common view that there is no suitable 'off the shelf' type mechanism applied elsewhere available. EirGrid would like to acknowledge the input of both CRU, CEPA and GHD in assisting its consideration prior to presenting the proposals as set out in this plan.

Each of the mechanisms previously employed by the CRU for EirGrid could potentially be employed, however the mechanism best suited to both the uncertainty faced and the broader shared policy objectives is that akin to EWIC and the putting in place of a Monitoring Committee to oversee the progression and management of expenditure in respect of important projects around decarbonisation, including DS3+, European Network Code delivery and future legislative change coming from Europe around the Clean Energy Package.

The Monitoring Committee, which would be designed and framed to respect the statutory roles and responsibilities of each of the parties, would operate a stage gate process in respect of projects and would enable both monitoring of project delivery and amendment to the necessary revenue streams to enable cost recovery.[4]

The stylised operation of this stage gate based approach is set out diagrammatically in Figure 6.4.

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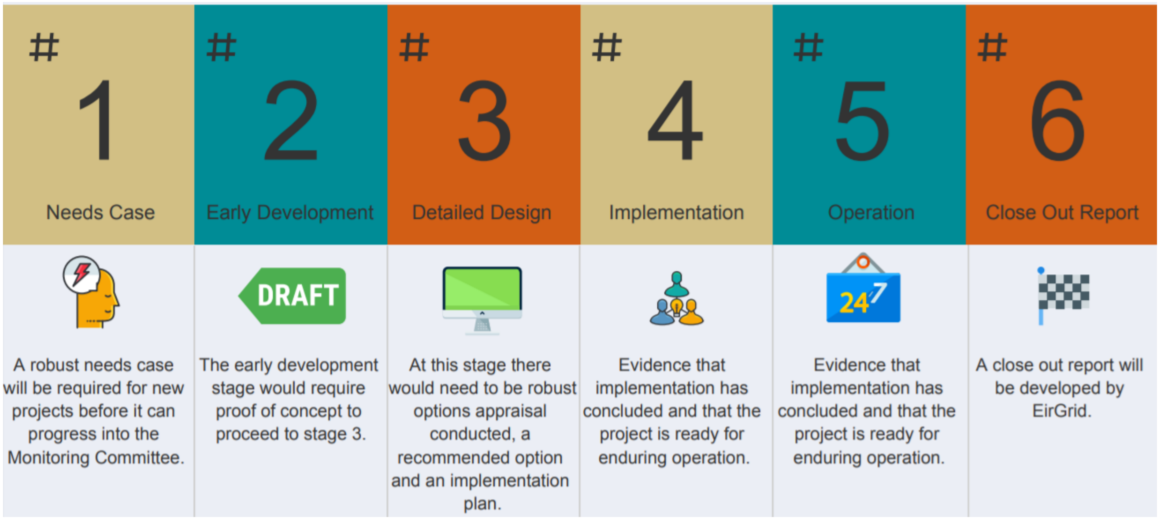
[4] Including remuneration for any risks taken in delivery/ cost recovery.



1 Needs Case

A robust needs case will be required for new projects before it can progress into the Monitoring Committee.

2 Early Development

The early development stage would require proof of concept to proceed to stage 3.

3 Detailed Design

At this stage there would need to be robust options appraisal conducted, a recommended option and an implementation plan.

4 Implementation

Evidence that implementation has concluded and that the project is ready for enduring operation.

5 Operation

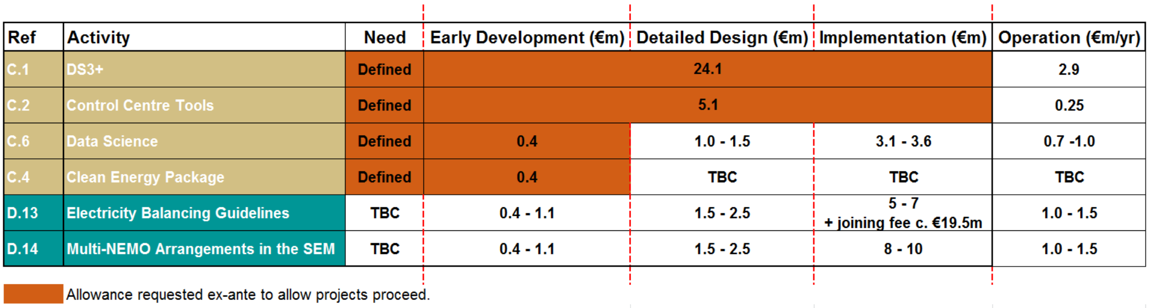
Evidence that implementation has concluded and that the project is ready for enduring operation.

6 Close Out Report

A close out report will be developed by EirGrid.

Figure 6.4: Stage Gates of Monitoring Committee

Within this there is a taxonomy of projects concerning the level of uncertainty concerning need, timing, cost or benefit. A number of the projects are set out against this taxonomy, as shown in figure 6.5.



Ref	Activity	Need	Early Development (€m)	Detailed Design (€m)	Implementation (€m)	Operation (€m/yr)
C.1	DS3+	Defined	24.1			2.9
C.2	Control Centre Tools	Defined	5.1			0.25
C.6	Data Science	Defined	0.4	1.0 - 1.5	3.1 - 3.6	0.7 -1.0
C.4	Clean Energy Package	Defined	0.4	TBC	TBC	TBC
D.13	Electricity Balancing Guidelines	TBC	0.4 - 1.1	1.5 - 2.5	5 - 7 + joining fee c. €19.5m	1.0 - 1.5
D.14	Multi-NEMO Arrangements in the SEM	TBC	0.4 - 1.1	1.5 - 2.5	8 - 10	1.0 - 1.5

🟧 Allowance requested ex-ante to allow projects proceed.

Figure 6.5: Projects to proceed through Monitoring Committee

Therefore for some projects, DS3+ and Control Centre Tools, there is clear need, clear benefits and a clear desire to proceed as soon as possible. Failure to do so would give rise to delays and ultimately cost customers. An *ex ante* allowance should be included for these projects against a pre-defined scope and the role of the Monitoring Committee is simply to monitor progress and to agree adjustments concerning scope change.

In other instances it is important to commence works now but simply for customers to provide *ex ante* funding consistent with the advancement of 'proof of concept' or early stage works until such point as greater certainty emerges in respect of either timing of need or the overall scope and costing of the requirements. This is the case in respect of Data Science and the Clean Energy Package.

Finally there are ‘known unknowns’, areas of work where the precise scope has not yet been established and any cost estimate is particularly uncertain. This includes projects in respect of the Electricity Balancing Guidelines and Multi-NEMO Arrangements in the SEM. In the case of these projects the requirement would be kept under review and they could later be brought to the Monitoring Committee for either early stage or full development. A draft outline Terms of Reference for the Committee is annexed to this paper. EirGrid looks forward to discussing and agreeing this with both the CRU and DCCAE.

6.4. Unlocking Value for Customers – Enhanced Benefit Share

EirGrid's current regulatory framework has in place a number of performance incentives or KPIs. As discussed above, consideration was given at the close of PR4 as to how best recognise and remunerate EirGrid's full Enterprise Value, including the contribution from intangible assets, human and intellectual capital. In parallel, during PR4 CRU continued to refine and enhance the existing performance incentive framework.

EirGrid continues to believe that this framework can be enhanced further to benefit customers more and if calibrated appropriately can at the same time address the outstanding issues of remuneration for Enterprise Value whilst at the same time ensuring consumers continue to benefit from EirGrid's actions. In developing this enhanced benefit share framework, EirGrid has drawn on the report prepared by its independent economic consultants, KPMG, as set out in Appendix J.

To identify the areas of value potential in its activities EirGrid applied a bottom up approach facilitated by KPMG through a number of workshops with EirGrid managers and staff. This started from the EirGrid activities, assessed the value that can be created for customers in these activities when we go above and beyond what is expected and delivered a list of benefit levers that, when incentivised, can provide a powerful benefit sharing mechanism.

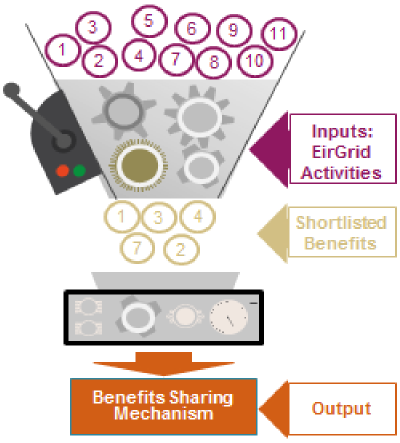


Figure 6.6: Process to identify areas of EirGrid Enhanced Benefit Share

The KPMG report outlines the process that was undertaken in more detail, but this is summarised below.

- **Stage 1:** High level analysis mapping the activities to the quadrants in the benefit sharing framework based on effort and value potential. "Filtering out" activities where the trade-off between additional cost and benefit does not justify the incremental effort.
- **Stage 2:** Identify value areas that are most impacted by the shortlisted EirGrid activities. Define long list of metrics and to measure the value created by EirGrid activities for customers.
- **Mechanism design:** The selected benefit areas move on to the next stage where the design of benefit sharing mechanism for each will be considered:
    - Constraint 1: value accreted > value of the incentive payment; and
    - Constraint 2: value of benefit sharing payment > cost of investment.

As a result of this involved and process driven approach, EirGrid narrowed down the areas where greatest value is expected to be deliverable:

- **Decarbonisation:** The decarbonisation of the electricity system is of great importance to customers and a vital component of the energy transition.
- **Grid Security:** A secure and reliable electricity network that is fit for the future of the electricity systems needs is vital to customers and market participants.
- **Cost:** Ensuring customers get value for money and benefit from cost efficiency should be paramount. However the costs for customers should be viewed holistically.

It was evident when undertaking the assessment process that EirGrid's value to customers often comes not only from what we do but by how we do it. Therefore, in addition to the three value areas above, a fourth component needs to be at the centre of our framework:

- **Performance:** Whilst delivering on decarbonisation, grid security and cost, EirGrid will also need to meet the expectations of its stakeholders. Creating a transparent information sharing environment accompanied by the timely completion of our tasks will create frictionless and efficient working relationships between the parties acting in the market.

The inclusion of a specific performance element also helped balance the mechanistic and evaluative based approaches.

In terms of the overall design of the incentive package EirGrid remains of the view that a balance is appropriate; for example between a wholly evaluative or wholly mechanistic approach, or between fully discrete (narrower measures more directly in EirGrid’s control) or fully system wide activities (wider measures over which EirGrid has less direct influence and may involve other industry participants).

EirGrid is however clear that it is important that the package is a holistic one and that application of a small number of disparate incentives would be much less likely to deliver benefits and would have the potential to give rise to perverse incentives. EirGrid is also clear that given the need to invest discretionary capital in achieving the desired outputs and outcomes that greater application of financial incentives would be expected to be more beneficial.

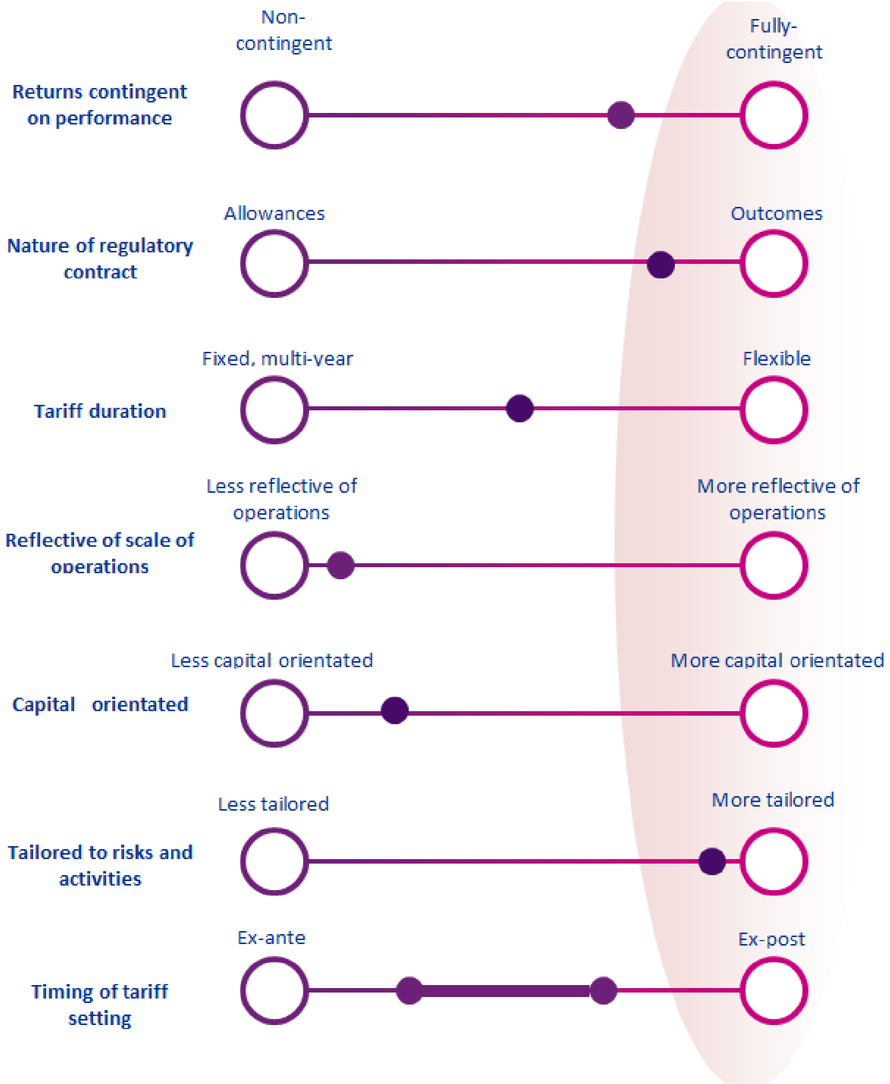


Figure 6.7: Balance of Framework Considerations

EirGrid therefore believes that a framework based on these benefit components creates a holistic package bringing together all the things that are important to consumers. These benefit components are in natural tension to each other so by bolting all of the components together in the framework we will be incentivised to look at the benefits to customers as a whole rather than focusing on one component to the detriment of another.

Regulatory incentive design incentive packages have often been an additional element to the overall regulatory framework. It is EirGrid's intention with this proposed framework to build the incentives into the very foundation of the regulatory design.

As a result, this changes the price control in an important way to one where every decision made is about doing the right thing for customers. In so doing, and in applying a holistic package, it complements the revenue cap framework. Creating value for customers is no longer an optional extra but integral to the overall framework.

EirGrid is proposing using a combination of quantitative and qualitative assessments to determine the additional value to customers. The assessment of decarbonisation, grid security and costs should be through quantitative assessment, through a defined formula setting out the measure and the counter factual to calculate the value we have delivered.

The assessment of EirGrid's overall performance could be through qualitative assessment by an independent panel of how each test area meet the qualitative target of 'what good looks like'. Metrics can also be evaluated with a combination of quantitative and qualitative assessments, for example, where the assessment is initially formulaic a qualitative approach can be used to account for changing circumstances and to ensure the target is still appropriate.

If the enhanced benefit share is further aligned in terms of inputs and outputs then it ensures EirGrid is always and everywhere incentivised through the regulatory framework to make the most appropriate choices and to do the right thing.

The current benefit sharing framework is significantly misaligned in terms of the management of inputs versus the delivery of outputs. This can be seen most clearly on page 12 of the independent KPMG report whereby KPMG illustrate a ratio of over 100:1 between the benefit derived by EirGrid through the management of input costs as compared to delivering of output and outcome value.

Whilst EirGrid is not necessarily suggesting the benefit sharing factor should be a common one this level of divergence has the potential for significant value which could otherwise be unlocked for customers to be left on the table. For example, under today's regulatory framework it would not pay EirGrid to invest €100,000 of discretionary capital to unlock consumer savings in terms of DBC of €20m[5]. This ultimately doesn't feel right.

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[5] This is based on the approved allowance of €271.33m for 2019/2020 which was approved by SEM Committee. Due to the deadband it would take €21m in savings before EirGrid could get €100,000 in incentive payments. Each additional €1m saved for customers thereafter would result

As a result EirGrid is proposing a closer alignment of benefit sharing factors through this process and as a result a greater focus on outputs and outcomes.

As discussed in KPMG’s report, there is a balance to be struck when choosing metrics to incentivise. To strike this balance, the metrics that are suggested below are a combination of both macro and granular measures with each incentive element having a macro measure plus a small group of metric what are more in the our control.

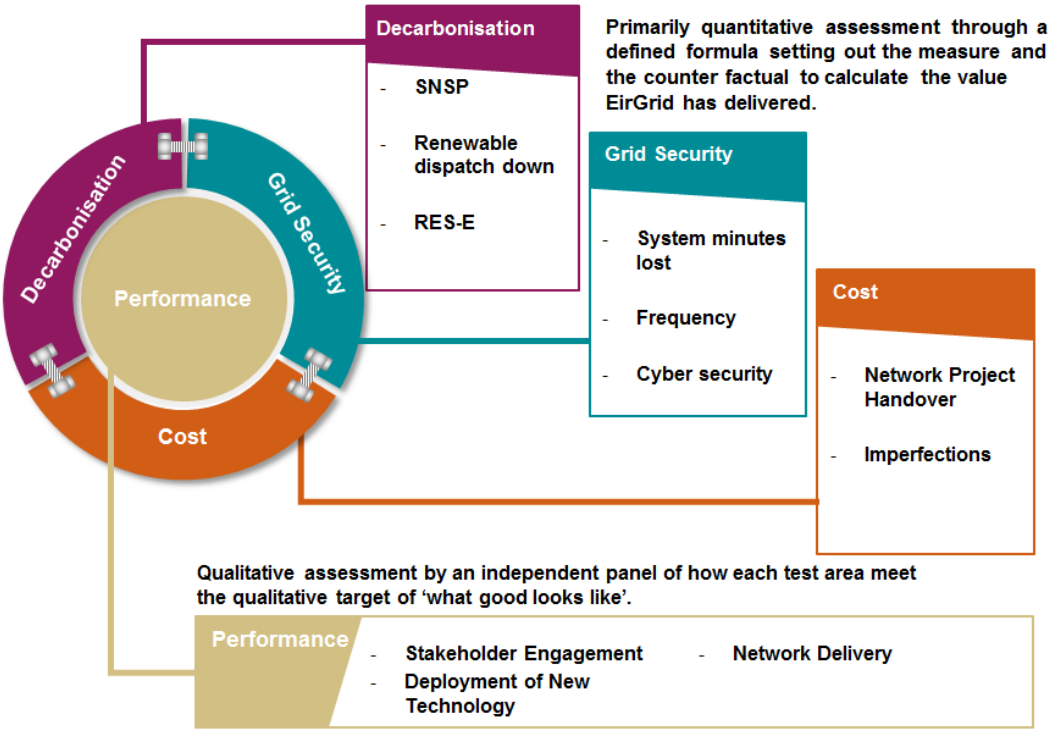

Figure 6.7: Holistic Incentive Design Package

Through the proposed value sharing framework we are working to deliver the best result for customers.

When calibrating the package the incentive levels will need to be meaningful and powerful whilst also ensuring financeability. A floor to the overall package is required to ensure that there is a limit to downside exposure and is important to ensure the company is financeable.

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in an additional €100,000 in incentive payments. This would then max out at the cap of €61m savings for customers, where EirGrid would receive an max incentive payment of €4m.

A cap to the overall package is required to ensure that there is a limit to the level of exposure for customers. This cap however needs to be meaningful enough for the company to be encouraged to take on the high value adding activities for customers.

To create a strong and material incentive for EirGrid to create value whilst maintaining our financeability a collar of -€3m per annum from this package is proposed. The calibration of this collar is further discussed in the next chapter on the balance of risk and return.

To create a stretch target for EirGrid to realise the benefits which remain largely untapped EirGrid is proposing a cap of +€7m per annum. This ratio of upside to downside of just over 2:1 provides a powerful incentive to EirGrid to drive out customer value, while the customer exposure is still low (a maximum payout of €0.91 per domestic customer per annum for the benefits delivered) in absolute terms. The overall ratio is broadly consistent with the existing incentive framework applied by the CRU.

As the framework comprises of four distinct areas, decarbonisation, grid stability, cost and performance, each of these areas will need to be individually meaningful as well. To further enable this, the sum of the individual caps and floors for the areas are greater than the total cap and floor on the overall package. A €10.5m on the upside and -€4.5m on the downside is proposed to deliver this.

Based on the above framework EirGrid proposed metrics and targets for each of the four main areas. These were developed and challenged by senior management in EirGrid to ensure that the targets are strectching. Furthermore we were requested by CRU to progress some joint incentives with both the TAO and the DSO. Appenix S includes a detailed overview around our proposals. As outlined in this appendix these outputs are premised on the input costs being approved. Table C.1 below provides a summary of the output metrics and targets which we propose.

Metric	2021	2022	2023	2024	2025	Summary of Proposed Target Mechanism	Upside (€m)	Downside (€m)
3.1. Sustainability & Decarbonisation								
1 RES-E (%)	41	43	46	49	52	This will measure the portion of electricity from renewable sources for each year. Items outside of the TSOs control will be adjusted on an annual basis. Every 1% outside of target will equate to 20% of the upside/downside.	1.00	-0.33
2 SNSP (%)	75	75	75	75	85	This will measure the System Non Synchronous Penetration (SNSP) for each year. The target for 2030 is 95% to ensure that we can achieve the RES-E target of 70%. Every 5% outside of the target will equate to 50% of the upside/downside. This is based on a target SNSP of 95% required by 2030, therefore an increase of 10% (95% - 85%) required to get there.	1.00	-0.33
3 Renewable Dispatch Down (%)	≤8	≤9	≤10	≤10	≤10	This measures the level of dispatch down of renewables to ensure this is minimised. A deadband of ±1% is proposed to account for variables outside of the TSOs control such as demand and renewable connections. The TSO does reserve the right to account for High Impact Low Probability (HILP) events outside of our control. Every 1% outside of the deadband will equate to 25% of the upside/downside.	1.00	-0.33
3.2. Grid Security								
1 System Minutes Lost (SML)	1.5 – 3.0					This will measure the number of system minutes lost due to faults on the Transmission System, for which the TSO has control over. This is normalised against the peak system demand. There is a deadband between 1.5 and 3.0 system minutes. Every 0.1 system minutes outside of this deadband equates to 20% of the upside/downside. The upside is limited at 1.0 SML and the downside is limited at 3.5 SML. This is consistent with the current framework.	0.5	-0.5
2 System Frequency (%)	96	96	96	96	96	This measures the performance of the system frequency against the nominal frequency of 50 Hz. A target frequency range of 50 ±0.1 Hz is applied (grid code notes a range of 50 ±0.2 Hz for the TSO to operate within. An annual target of 96% is proposed and this is consistent with the current framework.	0.5	-0.5

3	Cyber Security (Maturity)	Confidential					This measures the maturity of the EirGrid Group cyber security.	0.5	-0.5
3.3.	**Cost**								
1	Network Project Handover (€)	Assessed annually with a true up at the end of PR5					It is proposed to assess TSO/TAO outturn performance against a baseline PR5 invoicing/spend profile that will be agreed with CRU in 2020. This measure will assess timely handover from the TSO to the TAO. An ex-post annual adjustment will be required to account for issues outside the control of the TSO and TAO that lead to projects not being progressed as planned such as land access issues, changes in customer preferences, customer consenting issues, customer delays etc.	2.5	-1.0
2	Imperfections (€)	Assessed annually					This measures the Imperfections outturn, on an annual basis, against the allowance. Items outside of the TSOs control (e.g. fuel costs) are adjusted ex-post. The majority of the existing design is retained; however we propose a recalibration of the variables to unlock further value for customers. On the upside the deadband is changed from 7.5% to 2.5% and the sharing factor is changed from 10% to 25%.	2.5	-1.0
3.4.	**Performance**								
1	Stakeholder Engagement	7.5	7.75	8.0	8.25	8.5	A CRU established Stakeholder Panel will assess and score EirGrid on the quality (20%), implementation (40%) and effectiveness (40%) of their stakeholder engagement strategy in the previous year. The panel will be chaired by CRU and will consist of representatives from a range of stakeholders. EirGrid will publish a report for consultation on the effectiveness of their stakeholder engagement in the preceding year. The panel will assess EirGrid's performance, drawing on this report, the consultation responses and the final submission from EirGrid to the panel. EirGrid will receive a score of between 1 and 10.	0.75	0

2	Investment Planning (Optioneering)	Assessed annually	The purpose of this metric is to ensure that we are making robust and quality investment decisions in a timely manner in order to ensure the grid is safe, secure, and reliable and is able to economically deliver/enable our climate action targets (i.e. 70% RES-E by 2030). This would be a qualitative metric. An annual independent ex-post audit of our investment planning process and we will provide evidence to the auditors of any applicable process improvements and lessons learned implemented during the relevant period. This would be assessed on a 3 point scale of Average or below average (0%), Above standard (50%), Significantly above standard (100%).	0.50	0
3	Deployment of New Technology	Assessed annually	The purpose of the metric is to ensure our processes are effective in enabling the trialling, piloting, deployment and use of new technology on the grid and in our operations. Removing barriers to the deployment of new technology is vital to delivering the transition to a low carbon power system. Each year the TSO would produce/update a rolling two year plan setting out planned activities to enable the deployment of new technology. At the end of the year, the TSO would compile a report on the effectiveness of our approach to 'Enabling New Technology' over the previous calendar year. This would be assessed on a 3 point scale of Average (0%), Above standard (50%), Significantly above standard (100%).	0.50	0
4	Infrastructure Delivery	Assessed annually with a true up at the end of PR5	The deliverable that the metric refers to is the delivery aspect of the Investment Planning and Delivery Balanced Scorecard framework for PR4, in particular steps 4-6 of this process. The five year baseline programme for PR5 (currently expected to contain of the order of 230 Capex projects and a combined TSO/TAO spend of €1.07bn) will be submitted to CRU in 2020 (to commence on 01/01/2021). This metric will track deliverables and process improvements against the agreed PR5 baseline.	0.50	0
			Capped at	7.0	-3.0

Table C.1 EirGrid Metrics and Output Proposals.

6.5. Framework to Manage Asymmetric Risk

As set out in the next chapter, EirGrid has based the determination of its rate of return on capital employed on calculations using the Capital Asset Pricing Model (CAPM). CAPM is based on symmetry in the distribution of expected returns, and the regulatory contract is based on the “fair bet” principle.

The current regulatory framework is based on an *ex ante* provision of revenues to EirGrid to carry out its functions. In the preparation of this control the CRU indicated it was intending to undertake *ex post* review of EirGrid’s performance and expenditure.

If as part of the *ex post* review EirGrid can at best recover its efficiently incurred costs but has the potential for disallowance in their recovery, then on average EirGrid will not recover its costs and will not earn the expected returns assessed using the CAPM framework; even more importantly the CAPM framework used to calculate those returns will no longer hold.

EirGrid asked its independent economic advisors KPMG to analyse EirGrid’s exposure to asymmetric risk in PR5. Their report is included at Appendix K. KPMG point to the discussions of asymmetry in the SONI appeal to the Competition and Markets Authority (CMA). Effectively due to the nature of the SONI framework on network pre-construction projects, which is almost identical to that applied by the CRU to EirGrid, the underlying distribution was not only asymmetric but in fact fully truncated. The effect of this truncated distribution, when combined with SONI’s other asset light characteristics which are again akin to EirGrid’s, meant the CMA ultimately determined SONI should be compensated for the asymmetry present through application of a margin to the costs concerned of 3%.

The 3% was calibrated by CMA based on that which it felt to be reasonable, including by reference to CRU’s previous disallowance of EirGrid’s costs in Price Review 4. The uplift was limited to 3% on the basis that Utility Regulator made clear any such disallowance was limited to Demonstrably Inefficient and Wasteful Expenditure (DIWE) and that clear guidance was published by Utility Regulator on its application.

This truncated distribution applies to early stage network project costs, to significant projects such as I-SEM delivery which was advanced under the Agreed Approach

Document (AAD) and to any other areas where the *ex post* review provides that EirGrid can at best recover its costs.

EirGrid understands the CRU's desire to reserve the right to review costs *ex post* in customers' interests. It also reflects the CRU's practice in both setting and during PR4 and the CRU's stated intention as part of this PR5 process. This in itself may provide a level of protection to customers through the regulatory framework. As a result however it passes a level of risk from customers to the regulated entity concerning cost recovery. It is therefore appropriate customers compensate or pay for that transfer of risk.

The ultimate scale of the necessary adjustment for the asymmetry this creates however depends somewhat on CRU's own actions and the clarity of the guidance and decision making it employs. The greater the discretion afforded the CRU to apply asymmetric adjustments to EirGrid's recovery, the greater the necessary asymmetric risk premium. This premium can be minimised by being clear that any *ex post* adjustment is limited simply to finding of DIWE; it can be further reduced in the case that the CRU consults on and publishes clear DIWE guidance.

In terms of adjustment for this PR5 period this could either take the form of:

- Application of an asymmetric risk premium of 6% to both early stage network projects and non-network capital projects; or
- Application of an asymmetric risk premium of 3% to both early stage network projects and non-network capital projects and publication of a paper of clear guidance as to the CRU's proposed application of such review and clear confirmation that any such review shall be limited to DIWE.

EirGrid proposes the second approach and that a lower premium is applied in tandem with the publication by the CRU of clear guidance. The revenue provisions based upon application of the second approach are set out in the table below

€m	**2021**	**2022**	**2023**	**2024**	**2025**
Non-Network Capital Projects (€m)	19.1	19.4	19.7	20.1	20.4
Early Stage Network Projects (€m)	22.1	17.1	11.2	8.7	7.7
3% compensation for asymmetry (€m)	1.2	1.1	0.9	0.9	0.8

6.6 Conclusion on the Regulatory Framework

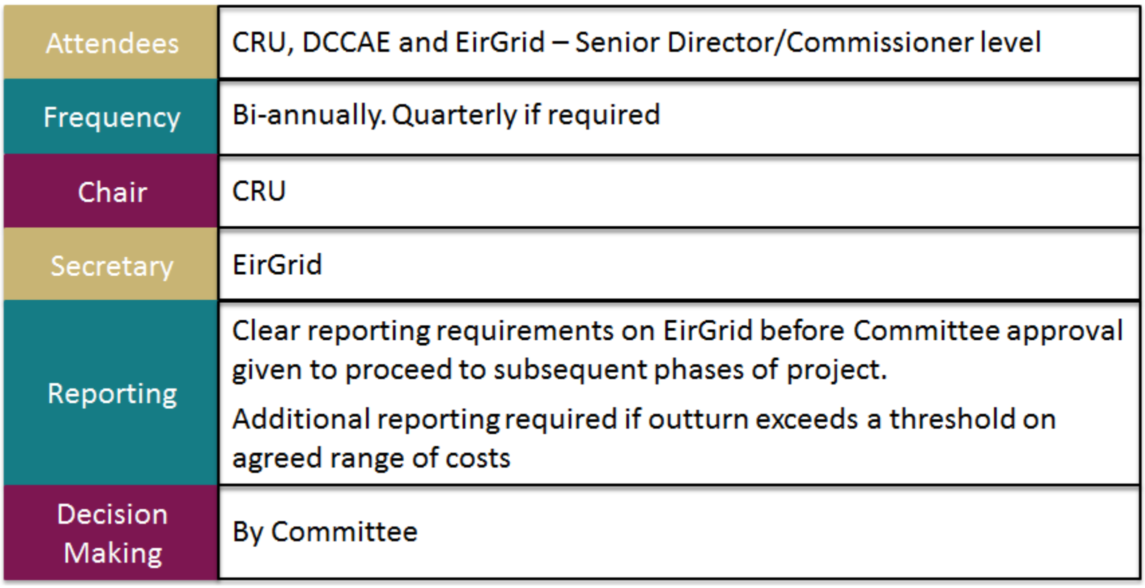
The regulatory framework for EirGrid has been developed over a number of price control cycles. It effectively operates as a series of individual policy targeted instruments reflecting the largely unique characteristics of the EirGrid business. It has served customers well.

In this chapter EirGrid confirms its view that the basic framework remains fit for purpose, but that there are 3 areas where it ought to be adapted and refined to take account of its ongoing evolution and challenges for the future.

- The *ex ante* framework should be complemented by the introduction of a Monitoring Committee to enable timely progression of projects where there is insufficient certainty for them to be included in the *ex ante*;
- Additional customer value should be unlocked and the full Enterprise Value within the EirGrid business recognised through an enhanced performance incentive framework, subject to a cap and collar to ensure ongoing impact on customer bills is modest and EirGrid's financeability protected; and
- A framework to address the asymmetric risk within the regulatory framework, and to do so in a manner which best protects customers' interests.

In the next chapter we turn our attention to the appropriate remuneration for the capital employed and risks faced by the business to ensure an appropriate balance of risk and return.

Annex – Draft Terms of Reference for Monitoring Committee



Attendees	CRU, DCCAE and EirGrid – Senior Director/Commissioner level
Frequency	Bi-annually. Quarterly if required
Chair	CRU
Secretary	EirGrid
Reporting	Clear reporting requirements on EirGrid before Committee approval given to proceed to subsequent phases of project. Additional reporting required if outturn exceeds a threshold on agreed range of costs
Decision Making	By Committee

EirGrid Roles & Responsibilities

- The TSO will be responsible for the administration of the Monitoring Committee
- The TSO will need to submit a 'Needs Case' to Monitoring Committee to progress a project into the Monitoring Committee
- The TSO will need to submit a 'Progress Update' prior to each Monitoring Committee one month in advance of the scheduled meeting. This should contain progress and outturn to date for the current phase and updated costs and plan for future stages
- The TSO will need to respond to queries raised by members in relation to the 'Progress Update' prior to Monitoring Committee
- The TSO to document actions and decisions made during Monitoring Committee and circulate within two weeks following meeting

Monitoring Committee Roles & Responsibilities

- Monitoring Committee to approve or reject the ‘Needs Case’ and outline rationale for decision to accept or reject
- Monitoring Committee to issue questions on EirGrid’s ‘Progress Update’ two weeks following receipt of this i.e. two weeks prior to the scheduled Monitoring Committee
- Monitoring Committee will approve or deny any requests from EirGrid (contained within the ‘Progress Report’) to move from one stage to the next as part of the project lifecycle. Reasons to be provided if request is approved or rejected

Scope of Needs Case

- A project summary
- Key aims of the project
- Expected completion date
- Expected outputs and outcomes (Project Impact) for consumers
- Clearly state which of the strategic aims that CRU has outlined for PR5 the project will target and how it will achieve delivery
- Which part of the project lifecycle (Early Development, Detailed Design, Implementation, Operation) the request will start at
- Costing estimates for the various stages of the project lifecycle (Early Development, Detailed Design, Implementation, Operation)
- What are they key milestones in the project (i.e. in year 1 we will complete x, in year 2 we will complete y
- Identification of challenges
- Decarbonisation, removal of constraints in the Dublin region, ensuring cost efficiency for customers.

Scope of Progress Report

- Current spend of project
- Evidence that spend has been efficiently incurred in the stage of the project lifecycle that the project is currently in
- Evidence of the cost estimates for future stages of the project lifecycle and that these have been appropriately sized and benchmarked
- Formal request to move from one stage to the next with the associated justification
- Evidence that agreed outcomes/outputs have been delivered. Where not detailed justification to be provided.

4

A fair balance of risk and return

Chapter 7

Balance of Risk and Return

Table of Contents

7.1 Introduction

In the last chapter EirGrid reviewed the regulatory framework. We set out how the current framework remains broadly fit for purpose but would benefit from enhancement in terms of application of a revised and enhanced performance incentive sharing framework, the introduction of more tailored uncertainty mechanisms and the appropriate calibration of a mechanism to address the presence of asymmetric risk.

In this chapter, we set out EirGrid's remuneration requirement for the layers of capital employed by EirGrid to handle the complex risks involved in operating the transmission system and which seeks to ensure that risk and return are appropriately balanced in the ultimate interest of customers.

As we have already outlined in this plan EirGrid is tangible asset light and a largely human and intellectual capital business. This means that the risks it is exposed to are in large part unconnected with its own assets and the capital it requires to finance those assets. Moreover, the services EirGrid provides have implications for its working capital and financial risks that are disproportionate to its conventionally recognised regulatory assets.

In its January 2015 advice to the CRU, Europe Economics confirmed that "*EirGrid has very significantly lower Return on Capital to Operating Expenditure and Return on Capital to Total Revenue ratios*" relative to typical utilities and that the RAB-WACC approach would by itself provide inadequate remuneration. It noted that "*the EirGrid RAB … is unlikely to be an adequate representation of EirGrid's true enterprise value*".

The remuneration framework for EirGrid's TSO business has evolved over the last decade. The layered framework put in place recognises that the risk and financing of EirGrid's various business activities have implications for EirGrid's remuneration requirements that go beyond the tangible asset base.

In light of our shared strategic objectives and the implications for our incentive regime set out in Chapter 6, we consider the remuneration framework adopted for PR4 remains an appropriate and robust foundation. Suitably updated, we believe this remuneration framework can provide the necessary resources for us to deliver what our customers and society requires from us, whilst at the same time maintaining EirGrid's financeability.

It does however depend on the framework remaining well-calibrated to the evolving and increasing risk environment post I-SEM and the ongoing development of the performance incentive regime which will help counteract downward pressures and therefore increased vulnerability elsewhere in the model.

Of particular relevance is that a level of asymmetric risk in the regulatory framework, not fully recognised at the time of PR4, has become evident. Its presence became clear through the disallowance in PR4 in relation to the PR3 period and the CRU's stated position on the conduct of *ex post* review. The need to recognise asymmetric risk as a component of required remuneration was elsewhere confirmed by the CMA in its 2017 final determination for SONI.

We set out in the remainder of this chapter how we update and benchmark EirGrid's remuneration requirements.

7.2 Structure of the PR4 remuneration framework

What the CRU, our customers and indeed wider society expect from EirGrid is evolving, as are our regulatory and financial market environments. Our remuneration framework must therefore evolve to reflect the consequent changes in our working capital requirements and exposure to risk.

The PR4 remuneration framework provided for return allowances on EirGrid's capital in three components. These relate to:

(i) A return on the company's fixed assets, accounted for as its RAB and for the carrying of early stage network projects;

(ii) Provision to manage both working and contingent capital; and

(iii) A margin to adjust for operational risk and EirGrid's operational gearing which is much higher than that faced by traditional network utilities.

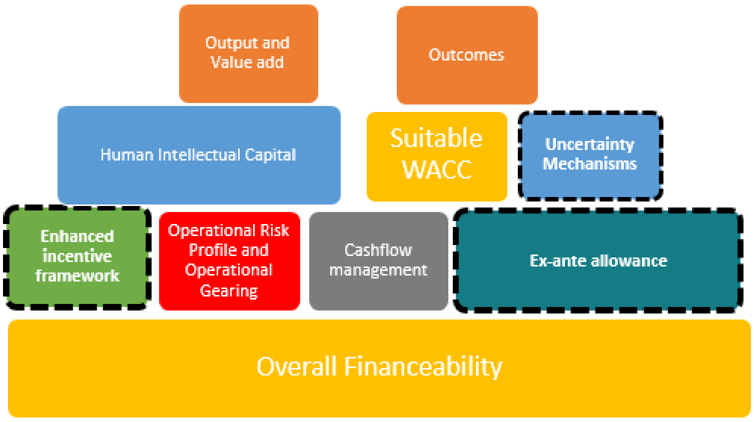


Figure 7.1: Elements within the EirGrid Regulatory Framework

We believe that the underlying structure of the PR4 remuneration framework remains appropriate. As we explain further in this chapter, the continued relevance of the PR4 remuneration framework is in large part a reflection of its conceptual coherence.

The framework was, and is, effectively a form of tailored policy instrument based approach with each layer, or element, relating to a particular business characteristic whilst at the same time being calibrated to an overall financeable business benchmark as a whole. No element can or should be looked at in isolation, without reference to the whole; nor can the whole simply be looked at without proper consideration of each individual element.

The components of the current framework of allowed returns are illustrated below; the missing or additional elements necessary to respond to the challenging transition environment for the future are also set out.

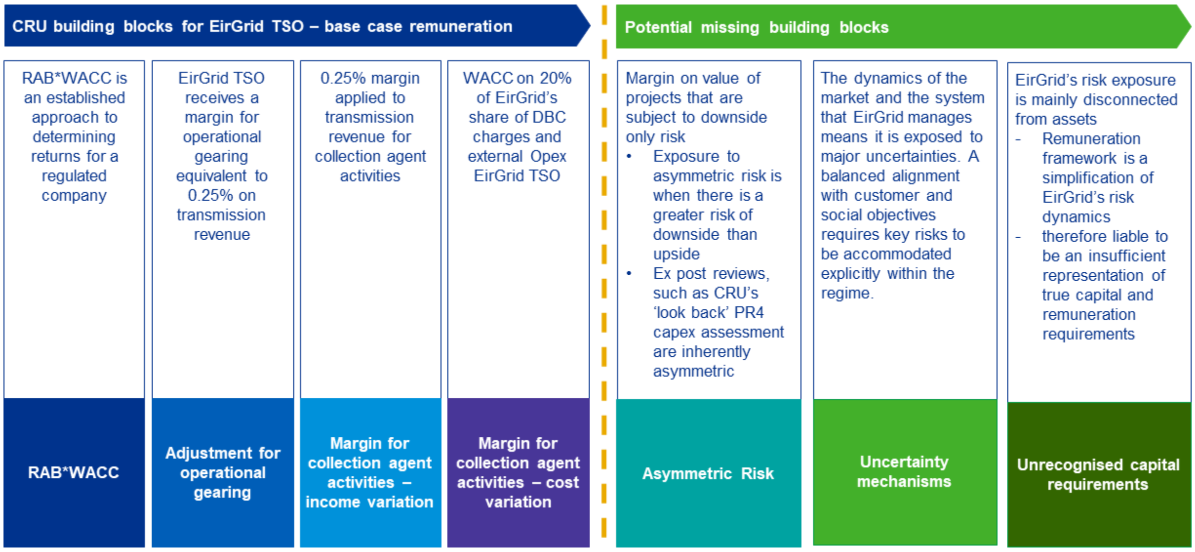


Figure 7.2: Components of allowed returns

7.3 Capital Structure and the EirGrid Business

The nature of the business and the segmentation of its layers of capital into physical, contingent, working, human, intellectual and operational mean that understanding and having a full appreciation of the EirGrid capital structure is complex.

In relation to tangible, or RAB, capital on which the traditional WACC is applied a notional gearing of 55% debt: 45% equity is assumed and has been applied. This has been employed to enable us to derive our WACC estimates below. In relation to RAB alone, results in part from the fact that EirGrid commences this PR5 period at zero gearing; EirGrid is however targeting a 30% gearing in relation to the RAB for the PR5 period. This capital structure 'mismatch' between notional WACC gearing and target actual gearing means that EirGrid has to hold additional equity in terms of RAB assets to support its overall capital structure than the notional gearing in relation to RAB would imply.

The overall capital structure of the business is significantly affected by the presence of contingent and working capital. As a result the overall financial structure of the business can vary significantly depending on the scale of adverse imbalances in the cashflow differentials which are managed by EirGrid and the precise funding structures employed to finance them. EirGrid holds a very significant Revolving Credit Facility (RCF) of

€150m (more than twice the size of it average RAB) to help manage these. The overall gearing of the business depends on the extent to which such facilities are drawn.

In addition, and to support the raising of the necessary debt facilities, EirGrid also carries significant equity or cash on balance sheet to help ensure its ongoing financeability and ensure customer and market resilience. This equity employed, and implicit additional equity call, is not specifically recognised within the regulatory framework. It is however a vital component of the EirGrid capital structure. Customers, and market participants, rely on it.

7.4 Return on the RAB and Stage 1 Network Expenditure (Side RAB)

Return for capital employed is required in respect of investment in EirGrid's tangible assets. These relate to its fixed assets accounted for in its RAB, principally IT-related, and un-invoiced early stage network works.

For PR4, required returns were determined by applying a Weighted Average Cost of Capital (WACC) to these assets. CRU determined the WACC drawing from conventional regulatory approaches for infrastructure-based businesses and did not specifically adjust the WACC applied to RAB based capital for EirGrid's specific business characteristics or higher operational gearing. We propose to continue this approach and have done so based on an assumed notionally efficient gearing structure of 55%.

We estimate that on this basis the real pre-tax cost of RAB capital to be 4.0% (HICP indexed)[1]. This is just below the mid-point (4.06%) of the range set out in the accompanying KPMG report 'Estimation of the allowed return on EirGrid RAB' included in Appendix L. This is set out in Figure 7.1.

This represents a significant reduction of 1.5 percentage points in nominal terms, or over 20% reduction, relative to that set as part of PR4.

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[11] This is based on an assumed forecast for HICP of 1.5% as compared to a 2% forecast for PR4. HICP has actually averaged 0.3% over the past 5 years (2013-2018)

This estimate includes 22bps relating to the higher costs relative to asset heavy businesses of raising debt for EirGrid as a small company. Should the CRU wish to apply a consistent measure of the WACC across the sector i.e. to EirGrid and ESB as TAO and DSO, it may be appropriate to remunerate this cost through a separate allowance in fixed € terms and to adopt a marginally lower WACC. EirGrid is open to such an approach[2].

After taking account of this cost of debt difference, we consider our WACC estimate broadly comparable with the CAR's recent determination for DAA and is (coincidentally) the same as the 2017 CRU decision for Gas Networks Ireland. The CRU estimated a significantly lower WACC for Irish Water, driven principally by its relatively low asset beta estimate.

The reduction since the last review is mainly driven by two factors:

i) our adoption of a policy shift by regulators to reflect a current market view of the risk-free rate in estimating the cost of equity, and
ii) a similar scale of shift in our estimate of the cost of debt.

Our estimates of the total equity market return (TMR), with a mid-point estimate of 6.5%, are closely in line with the generality of recent decisions and proposals by regulators in the UK and Ireland.

The exception to the fairly tight range of estimates is the CRU's for Irish Water in its July 2019 consultation paper where it adopts two approaches. In its IRC2 approach, it uses a TMR range that broadly aligns with other regulators but uses a current market conditions approach to derive a relatively high point estimate of 7.5%.

Our mid-point estimate for the asset beta, at 0.4, is in line with that for our current control and broadly in the middle of the range for other regulatory estimates in Ireland and the UK for network industries, and electricity networks in particular.

It is important to recognise that historical measures of TMR embed historical risk-free rates. Therefore, an application of the forward-looking risk-free rate to a purely historical

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[2] Under this approach the WACC would be 3.84% and the average fixed allowance for EirGrid's small company status is €366k per annum.

TMR when deriving the ERP risks underestimating the risk-free rate embedded in the TMR and hence overestimating the resulting ERP. There will likely be a partial downward bias in the cost of capital given that the beta is less than 1.

In order to address this issue, when deriving the cost of capital estimate at the low end of the range, we decompose the TMR into the risk-free rate and the ERP by using a risk-free rate more closely aligned to that observed historically (0.5%). This approach reduces the downwards bias of the high ERP compared to the risk-free rate for the same TMR which would otherwise result in a lower estimated WACC. This adjustment results in an estimate of real risk-free of -0.03% as compared to a purely forward looking estimate of -0.55%.

To estimate a cost of debt on a notional gearing basis, we assumed that the notional company would have periodically issued fixed rate debt over the last seven years. On this basis, we estimate a real cost of debt of 1.88%, practically a full 1% lower than that assumed for our current control. This reduction reflects the persistent period of low market interest rates since the financial crisis.

Parameter	CRU EirGrid PR4	Ofgem RIIO-2 2019	CRU GNI 2017	CRU Irish Water 2020-24	CAR DAA 2020-24	Point Estimate EirGrid PR5
Measure of inflation	HICP	CPIH	HICP	HICP	HICP	HICP
Risk-free rate	1.90	-0.75	1.90	Ref: Decision	-0.14	-0.03
Cost of debt	2.9	1.93	2.50	2.00	0.85	1.88
Cost of equity						
Risk-free rate	1.90	-0.75	1.90	Ref: Decision	-0.14	-0.03
TMR	6.65	6.50	6.65	Ref: Decision	6.43	6.50
ERP	4.75	7.25	4.75	Ref: Decision	6.57	6.53
Ba	0.40	0.38	0.42	0.32	0.45	0.40
Be	0.89	0.75	0.93	0.64	0.84	0.89
Cost of equity (pre-tax)	7.00	5.78	7.24	5.71	6.15	5.89
Gearing	55%	60%	55%	50%	50%	55%
WACC (pre-tax)	4.74%	3.47%	4.63%	3.86%	3.50%	4.06%

Table 7.1: Comparison of WACC

Overall the lower proposed WACC in terms of its application to the RAB and Side RAB will save customers over €4m across the PR5 period.

7.5 Treatment of Contingent Capital, Working Capital, Collection Agent Activities and Operational Gearing

The EirGrid regulatory framework is premised on a targeted policy instrument based approach which remunerates EirGrid for the specific contingent capital, working capital, collection agent activities and operational gearing characteristics faced by the EirGrid business.

This was calculated for PR4 as follows:

(i) 20% x (external costs + 75% x imperfections charges) x WACC

(ii) 0.5% x transmission revenue

In relation to the first element the volatility of external costs, particularly Dispatch Balancing Costs (DBC), has continued to increase in the light of I-SEM. The reduction in WACC from 4.95% to 4.00% will see remuneration for the balance sheet support to support these activities fall by c.20% in the PR5 period. In the case of DBC this represents a reduction in the effective margin from 1% to an effective margin of 0.8%. This is below the necessary benchmarked margin on turnover (1% - 1.8%) and as DBC costs grow this therefore erodes EirGrid's overall financeability.

By applying a WACC estimate to the deemed working capital value we are reflecting in full the reduction in the risk-free rate to the remuneration for this layer while the potentially more relevant premium attributed to risk in equity markets (TMR) has remained largely unchanged and with the increased volatility beta may in fact have increased.

Overall returns are expected to decrease by over €3m during the PR5 period as a result.

In relation to the second element, the relative operational gearing of EirGrid to TAO continues to increase, and equally EirGrid is forecast to have greater collection agent revenue activities relative to underlying equity returns than was the case in the PR4 period. The margin of 0.5% for PR4 derived from a base transmission revenue margin of 0.25% and an adjustment for operational leverage of a further 0.25%.

Ultimately operational gearing is equally affected not only by transmission revenue but by Dispatch Balancing Costs. As a result as part of this price review EirGrid believes the margin formula should potentially be amended to include not only transmission revenue but also DBC. This change has not been included in the base figures set out in the forecast BPQ. As set out in Table 7.2 the analysis would suggest a level of upwards recalibration may be required.

Approach to estimating margin	Estimated range from analysis	Point estimate of analysis range	Assessment of the approach for remuneration
Top-down approach	0.26%	0.26%	This high-level approach is consistent with the CMA. The estimated adjustment does not suggest a material change in remuneration from the current framework.
Bottom-up approach: market comparator benchmarks	0.36% - 0.42%	0.38%	The bottom-up analysis is more tailored to EirGrid's operational gearing than the top-down approach. The results suggest a small upwards adjustment to current remuneration. The range reflects the sensitivity of results to the comparators selected.
Europe Economics beta adjustment	1.21% – 1.85%	n/a	ESBN is the only comparator under Europe Economics' approach and early stage network costs are excluded.

Source: KPMG analysis

Table 7.2: Summary of operational gearing adjustment

The approach adopted by the CRU is also reconcilable to the more risk-based approach in the UK's CMA determination for SONI.

The principal component of the allowances determined by the CMA that corresponds to the activities above is the collection agent margin. The CMA applied a margin to the relevant revenues [3] defined as imperfections charges, TUoS (equivalent to TAO revenues) and other systems services (equivalent to external opex). The CMA provided for a margin allowance of 0.5%[4],[5].

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[3] See paragraph 12.140 of the November 2017 CMA final determination

[4] Paragraph 12.152

[5] In its 2020-25 business plan submission to the Utility Regulator, SONI has recalibrated this margin allowance to 0.6% in light of the increased level of risk anticipated by the CMA following the introduction of the I-SEM.

The CMA also provided for two other components: an allowance for the parent company guarantee and an uplift to the WACC for operational leverage. SONI's parent company guarantee represents contingent capital which, for EirGrid, is a role played by its need to retain higher levels of equity to support contingent and working capital requirements.

The uplift to the WACC for operational leverage in SONI's regime is consistent in concept to the operational gearing adjustment to the transmission revenues margin for EirGrid. The projected value of SONI's uplift depends on the projected value of its RAB. Nevertheless, calculated consistently with the CMA final determination, its value to SONI is similar or higher as a percentage of its non-internal revenues to the 0.25% adjustment made for EirGrid in PR4.

7.6 Calibrating the Framework for Asymmetric Risk and Enhanced Benefit Share

7.6.1 Asymmetric risk

The principal financial economic models adopted by regulators, in particular CAPM consider measures of expected returns. By default, the remuneration framework makes explicit provision for the cost of capital (or for required margins where there is no clear capital base attaching to the risky activities involved). These models do not account for any asymmetries in the risk profile which could mean that reasonable expectations of returns and margins will depart from the allowances provided.

The underlying regulatory principle involved is that price controls should constitute a 'fair bet'. The fair bet principle, for example as articulated by Ofcom, is that *"an investment is a 'fair bet' if, at the time of investment, expected return is equal to the cost of capital".* This works if the potential upside and downside risks are symmetric and, on balance, no out- or under-performance would be expected relative to the regulatory framework.

By contrast, if a company is exposed to asymmetric downside risk, it will achieve on a mean expected basis a lower outturn return than the required return. In such circumstances, it would be appropriate to provide for additional allowances to ensure the control remains a 'fair bet'. The regulatory precedent for this includes the explicit allowance for asymmetry provided for SONI in the CMA's November 2017 final determination.

Of particular concern in EirGrid's regime is the CRU's proposed *ex post* review, the scope for disallowance of expenditure it deems inefficient and the experience in PR4 of disallowances in respect of the PR3 period. In addition the underlying cost distributions are in themselves asymmetric and would be expected to be subject to positive skew.
The affected projects are dominated by large and complex IT projects and pre-construction activities for network projects.

These projects are by their nature complex and non-routine, difficult to forecast and prone to unanticipated issues that can lead to cost overruns. These characteristics mean it is not always straightforward to prove that costs were efficient and necessary as there can be a sparsity of evidence about what was known and knowable at the time. This sparsity of evidence could readily be subjectively misinterpreted as a deficiency. These issues were noted in the CMA final determination, paragraph 7.98.

The downside nature of the risk is aggravated further by an inherent information asymmetry. When making decisions, EirGrid does not have the benefit of hindsight, while CRU does have that benefit when it carries out any *ex post* review.

An allowance of 3% of relevant expenditure would normally be appropriate where there is clear structured guidance in the application of the 'Demonstrably Inefficient and/or Wasteful Expenditure' (DIWE) principle, an associated commitment that future *ex post* review will follow it and an inclusion of appropriate contingencies in *ex ante* budgets. This would be consistent with the CMA determination for SONI. Without these being in place, a significantly greater allowance, as we outlined in the last chapter, 6%, would be expected to be required.

While the allowance is generally made for the prospective period, the situation for EirGrid is complicated by the fact that the *ex post* review in respect of a period takes place in the subsequent period. CRU has indicated it will initiate such a review in respect of PR4. Since it will be effected in PR5, and related remuneration was not provided for in PR4, a retrospective adjustment should be recognised as part of this PR5 review.

7.6.2 Enhanced Benefit Share

EirGrid's TSO business plays a central role in the management of physical and market dimensions of a complex system. The financial risks it is exposed to are naturally also complex. As we discuss above, our starting point is a remuneration framework jointly evolved over time by CRU and EirGrid, but we should recognise that the framework reflects a rough approximation or simulation of the business's total capital requirements (analogous to its Enterprise Value) and associated costs.

The Enterprise Value of a company would typically equal the present value of cashflows of the RAB, in EirGrid's case it may be necessary to adjust for its high proportion of intangibles to provide an accurate measure.

The RAB under the building blocks model is always equal to present value of the future stream of cashflows. Under corporate finance theory the EV of the firm is equal to the present value of all cashflows and consequentially the RAB. However, EirGrid as an asset-light utility has low tangible assets (primarily IT) as most of the value it provides are service and expertise based, and as a result not all Enterprise Value and potential value of the business to customers is likely to be captured in the RAB.

An important example that highlights this is the uncertainties attaching to the company's incentive regime. EirGrid sees it as central to its purpose that it has a strong economic interest in the performance of the system as a whole. Its incentives should, and broadly do, align the interests of the company with those of its customers and broader society. As a complex and multi-dimensional system that plays an essential role in the Irish economy, those uncertainties will naturally have a market-covariant, or systemic risk, component. As well as the form of the incentives and the dynamics of the system's behaviours, the level of this risk will relate to the scale of the company's incentive exposure. Meanwhile, remuneration for beta risk is recognised as a component of the WACC which is applied to the RAB. The potential misalignment arises because the value of the RAB is largely disconnected from the scale of the company's incentive exposure.

This helps explain the adjustment for operational gearing adjustment as a margin on revenues rather than as an uplift to the WACC. By itself, however, it only partially addresses the overall issue.

While much of EirGrid's risk exposure is not connected to assets on its balance sheet, it does have implications for EirGrid's capital base. For assets on the balance sheet, EirGrid has a basis to procure debt capital, but must otherwise rely on equity capital. Its other dimensions of risk exposure would translate into a requirement for equity capital, and in large part explains EirGrid's relatively high level of retained equity.

The simplification that is necessary in structuring a remuneration framework does mean there is a danger that some of EirGrid's capital requirements go unrecognised and under-remunerated. This danger is amplified by the increasing complexity of the system that EirGrid is managing and the desirable progression towards incentives that are better aligned with the interests of our customers, of society and of the broader Irish economy. In our view the risk that the total Enterprise Value is not captured under the current framework is best addressed in a manner that supports through enhancing and evolving the incentive framework. The incentives framework must be strong enough to incentivise EirGrid to invest for the benefit of customers while reducing costs and without risking EirGrid's ability to finance itself.

Increasing the strength of the incentives framework whilst securing financeability and resilience could be achieved by introducing a collar to reduce downside financial risk. The calibration of the collar would be critical to ensure that EirGrid is exposed to meaningful risk while remaining financeable as a business.

7.6.3 Considering overall financeability

To help us consider EirGrid's financial sustainability under different economic, business performance and regulatory outcomes, we have undertaken analysis of key financial metrics using a financial model of EirGrid over the PR5 period. We have reflected on a range of debt, equity and margin metrics.

Our financial model is capable of modelling a range of scenarios and reflects the regulatory treatment of outturns for PR5. Downside scenarios, and therefore financial resilience, modelled would be driven by incentive and cost underperformance and the scope for ex-post disallowances. The financial model also allows us to model the effects of liquidity risk from our revenue collection activities and macroeconomic risk from inflation and interest rates.

Drawing from Moody's published rating methodologies for the Business and Consumer Service Industry and Diversified Technology, regulatory precedents and margins observed in comparable energy businesses such as energy retailers and GB's DCC, our advisers consider benchmarks of 10-13% for margins over controllable revenue and 1-1.8% for margins over total revenues (including collection activities) as being appropriate. We consider that EirGrid's base case margins compare reasonably against these benchmarks[6], as summarised in the Table 7.3.

Metric	Benchmark	EirGrid base case forecast	Evidence
EBIT margin for controllable revenues	10 – 13%	9.92%[7]	Moody's, comparable companies, regulatory precedent
EBIT margin for total revenues plus DBC	1 – 1.8%	1.34%	Regulatory precedent, bottom-up assessment of total required profitability

Source: KPMG analysis

Note: The margin above excludes the indexation of depreciation. [8]

Table 7.3: Summary of base case return metrics

Key debt metrics in the base case are set out below based on the notional company. EirGrid's base case credit metrics will naturally be substantially above normal thresholds since, in that base case, it is only borrowing against one component of its capital requirement, its RAB.

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[6] Our advisers also assembled a database of margins from financial information on a population of comparable asset-light businesses across the economy. These margin-revenue ratios are affected by the balance of activities of comparator companies – asset-dependent activities naturally have higher margin ratios than pure collection agent activities. Taking into account EirGrid's balance of activities, we are satisfied that EirGrid's margins, relative to both its total revenues and its controllable revenues, compare reasonably.

[7] The margins here are calculated based on projections that include a downwards adjustment mirroring and offsetting the additional revenue allowance for the mean-expected disallowance with respect to asymmetric risk. The margins in tables 7.7 and 7.7 are calculated on the basis of the allowed revenue and do not reflect the mean-expected disallowance with respect to asymmetric risk.

[8] Should the returns be adjusted by the difference between nominal and real depreciation as a proxy for a more accurate representation of the fully nominal return, the resulting margins will be higher. The margin on controllable revenue after applying this adjustment would be 11.0% and on total revenue (including DBC), 1.5%.

	2021	2022	2023	2024	2025	*Average*	Threshold
AICR	3.8x	4.2x	4.4x	4.6x	4.7x	**4.3x**	**1.8x**
FFO / Debt	50%	61%	71%	44%	50%	**55%**	**12%**
Debt / RAB	55%	55%	55%	55%	55%	**55%**	**55%**

Source: EirGrid financial model

Table 7.4: Summary of base case debt metrics

Conventional debt metric benchmarks, which are suitable for infrastructure-based businesses, are less directly applicable to a business such as EirGrid. Its cashflow uncertainties require it to maintain facilities that go beyond the notional gearing ratio and maintain levels of retained equity to provide headroom in the event of adverse financial circumstances.

As we explain in Chapter 6, it is appropriate for EirGrid to have an incentive regime that aligns its interests with wider sector, CRU, social and customer objectives. This means that it is exposed to potential incentive downsides and, in those circumstances, it must still be ready to manage its continuing cash flow uncertainties. Its ability to support its revolving credit facility (RCF) in the event that it is fully drawn is an important condition for the company’s and the industry’s ongoing sustainability. With this in mind, we have carefully considered the level of downside incentive risk that remains consistent with our ability to support the RCF.

In normal circumstances, EirGrid’s revenue structure means that it has significant levels of Funds From Operations (FFO) from activities that are not supported by conventional debt. This means that conventional debt metrics are liable to appear strong. This is because the capital implications of the cashflow risks involved are not reflected in actual debt levels when those circumstances prevail. Those metrics are more relevant when we consider scenarios when the RCF is fully drawn.

When the RCF is fully drawn, a key metric, the adjusted interest cover ratio used by Moody’s (comparable to the Post Maintenance Interest Cover Ratio used by Fitch), falls to levels close to the threshold level our advisers consider is necessary to maintain credit quality equivalent to investment grade. This means any significant downside incentive outcomes could take the company below these levels.

	Benchmark	Base case	€3m downside	€3m downside + full RCF	Combined downside[9]
RAB gearing:		*Notional*	*Notional*	*Notional*	*Notional*
Return metrics					
EBIT margin (controllable revenue)	10 - 13%	9.92%	6.77%	6.68%	2.54%
EBIT margin (total + DBC)	1 - 1.8%	1.34%	0.92%	0.90%	0.35%
Debt metrics					
AICR	1.8x	4.3x	2.9x	2.2x	0.8x
FFO / Debt	12%	55%	49%	12%	10%
Debt / RAB	55%	55%	55%	220%	220%

Source: KPMG analysis

Table 7.5: Downside scenario metrics

7.6.4 Calibration of the cap and collar

Investor confidence ultimately requires a sustainable regime that provides fair risk-adjusted returns and deals appropriately with exceptional or severe downside outcomes. Confidence is also supported if exceptional upsides are limited and handled in structured ways.

The collar and cap mechanisms provide centrally important support for this objective. The purpose of the collar and cap mechanisms would be to provide protections for both upsides and downsides and, at the same time, attenuate risk exposure in a way that helps (together with the cap) bring fair risk-adjusted returns into alignment with an acceptable level of regulatory allowances.

In light of our financeability analysis, we assess that a collar mechanism set at -€3 million annually, which is at the limit of what we can withstand, would ensure the quality of our customer-aligned risk exposure is substantially preserved and so maximise the potential value for customers. It would provide the necessary comfort to investors that

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[9] The scenario combines a 5% non-recoverable element on controllable opex, a fully disallowed 5% early stage network project and €3m p.a. incentive penalty with a fully drawn down RCF across the price control.

the consequent poor metrics will not deteriorate further while ensuring the quality of our incentives for better customer outcomes is substantially preserved.

We also protect customers from an increase in the revenue requirement that would otherwise follow from a change in our risk exposure, by limiting the potential amplitude and shape of that risk exposure. A cap calibrated at €7 million would limit the upside risk tail as the collar limits the downside tail. As outlined in Chapter 6 this ratio of just over 2:1 upside to downside in terms of application of the cap collar mechanism is broadly consistent with that currently applied by the CRU.

We see the collar and cap mechanisms as necessary to allow a sector-aligned regime to work. It would provide a proportionate modification to the risk profile to preserve both the strategic incentive properties for EirGrid, which better align its interests with the sector and wider society, and EirGrid's ability to finance its activities in this new risk context.
We believe our collar/cap proposal is necessary to maintain the company's financial sustainability. It provides protections consistent with longer term financial sustainability. By providing a balance to the change in the quality of risk exposure, it avoids a potentially unwelcome increase in the WACC or other margins while helping to drive desirable customer upsides.

It is important however that the mean expected payout from the benefit sharing package is also calibrated appropriately in the context of meeting overall financeability metrics.

7.7 Conclusion

The calibration of parameters within this submission deliver annual average EBIT margins of 1.45% on total turnover (including DBC). This compares to the *ex ante* assumption of EBIT margins of 1.7% on a like for like basis provided by CRU in PR4, a significant reduction. This significantly affects our financeability and importantly also significantly reduces our ability to bear downside risk and reduces our financial resilience to unexpected shocks at the very time when uncertainty both in terms of our own activities, and in the management of liquidity risks, is in fact increasing.

Metric	PR4	PR5
EBIT margin for controllable revenues	13.54%	10.77%
EBIT margin for total revenues plus DBC	1.68%	1.45%

Source: KPMG analysis

Note: The margin above excludes the indexation of depreciation.

Table 7.6: Ex-ante margins for PR4 and PR5

We recognise that our proposals for a new benefit sharing framework will significantly transform our business as we prepare for a significantly transformed energy sector. We think it is important, for our stakeholders and in particular for consumers and the wider interests of the sector, for us to introduce better-aligned incentives at this review and to propose proportionate collar and cap mechanisms to ensure the business remains financially sustainable and financially affordable for our customers.

We wish to maximise the strategic benefits for society from the system we are operating while remaining within current acceptable levels of return requirements. Our carefully balanced proposals make it possible for us to deliver this ambition. It is important that the overall framework is calibrated to deliver the necessary financial resilience for the challenges ahead. An expected annual payout of over €2m per annum year on year would be necessary to restore to EirGrid the same financial ratios the CRU provided for in PR4. Any outperformance would need to be on top of this.

In this chapter we have drawn out the remuneration for the layers of capital employed by the business. In summary, these are as follows:

- Application of a 4.0%[10] real pre-tax WACC to capital invested in the RAB, including the capital deployed in early stage network development – a saving of excess of €4m to customers relative to the application of the current WACC;
- Continued application of the existing framework to working capital and margins with calibration as per PR4; a saving of over €3m to customers relative to today's arrangements;
- A potential amendment to the formula in respect of the application of margin to include DBC costs to correct the anomalous situation to date whereby these have been excluded;
- *Ex ante* revenue provision of 3% to early stage network spend and non-network capex costs to cover the asymmetry in the regulatory framework; and
- Introduction of the revised benefit share framework, calibrated to deliver overall benchmarked returns consistent with those previously provided by the CRU under PR4. This requires a mean expected annual performance payment of over €2m under that framework.

Finally, we wish to emphasise the importance of our collar and cap calibration. We have calibrated them so that they will work with our business plan assumptions. They bring together our objectives of a regime that drives us to better customer outcomes while allowing us to remain within our current remuneration framework, and the lower costs for customers that entails. Changes in those assumptions would necessitate changes in the levels of the collar and the cap. Significant reductions in those levels would start to compromise the quality of alignment with better customer outcomes, and diminish the strength of our incentive regime.

The balance of risk and return is precisely that, a balance. The business plan, and the remuneration framework must ultimately be considered in the round. The package we have set out not only provides the potential to unlock additional value for customers but does so at lower overall cost to customers through reduced investor returns. It manages and balances the risk profile between EirGrid and customers with a view to securing financeability and ensuring that the regulatory package and framework is designed such that customers are ultimately significantly better off.

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[10] We have also suggested the possibility if a sectoral wide WACC was to be employed that EirGrid be separately accorded the monies associated with the cost of fundraising for its small company status. This equates to a reduction in WACC of 22bps and separate provision of revenues averaging €366k per annum.

Overall the average domestic customer will save €7.6m over the PR5 period as a result of the lower returns on capital relative to those which applied in PR4. This is significant.

In the scale and context of the EirGrid business this is significant.

5

Conclusions

Chapter 8

Conclusions

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8. Conclusion

8.1 What this submission will deliver

This PR5 submission has set out the investment and regulatory framework which will not only delivery significant outputs in the PR5 period (2021-2025) but that which will enable the establishment of a clear pathway for meeting the ambitious targets set out in the Climate Action Plan for 2030.

In particular we will:

- Continue to transform our engagement with customers, communities and the public;
    - Improving the connection process for new and existing customers, increasing transparency and clarity on connection requirements before, during and following connection.
- Deliver on ambitious sustainability and decarbonisation targets - enabling a low carbon future by accommodating significant increases in renewable energy generation on an enhanced and changed power system in Ireland on sustainable basis:
    - Establishing effective processes and tools to operate a power system where the majority of the power comes from non-synchronous intermittent sources;
    - Strengthening data and communication networks to secure better access to real-time data and the means to analyse it; and
    - Promoting more informed choices through an improved approach to investment appraisal and improved engagement with internal and external stakeholders.
- Ensure the continued operation of the network to provide a resilient, stable and secure supply of energy for Ireland:
    - Delivering efficient, economic operation of the power grid for the benefit of all customers in Ireland and deliver value for money;
    - Improving the resilience of the operation of the power system in Ireland;
    - Securing the operation of the grid (in partnership with ESB Networks) in a manner, which is capable of addressing the latest physical and cyber security threats; and

    - Meeting the core remit of the TSO in a way which complies with changes to the regulatory and legal environment, adhering to emerging changes in industry standards and best practice.
- Deliver on an ambitious Network Development programme (in partnership with ESB Networks):
    - Facilitating economic development across the regions and provide secure and reliable power supply to all citizens. We will also address security of supply in Dublin and the regions, including supporting a forecast increase in Demand of c.6 TWh. This includes the connection of c.700 MVA of data centre and large demand customer load;
    - Facilitating an increase in the connection of and export from c.2900 MW of new renewable generation, in the form of onshore and offshore wind, and solar;
    - Facilitating an increase in the connection of conventional generation and emerging technologies resulting from the T-4 and T-1 capacity auctions and system services procurement requirements against ambitions timelines;
    - Facilitating the development of further interconnection; and
    - Deploying new technology solutions to meet network problems.

8.2. What we need to deliver on this submission

8.2.1 Regulatory Framework

4.00%

The Weighted Average Cost of Capital (WACC) that we are proposing is 4.00%, CIPH indexed.

This is a reduction of 1 percentage point (or 20%) from the WACC in PR4.

This reduction in WACC will help deliver cost savings to customers. This is estimated as €7.6m over the PR5 period.

Due to the level of uncertainty, which is universally recognised over the PR5 period, we are proposed that a Monitoring Committee should be introduced.

This will consist of CRU, DCCAE and EirGrid.

It will allow projects to proceed, ensuring that EirGrid can deliver on its obligations set out in the Climate Action Plan.

Price pressures are increasing on EirGrid's costs

We have proposed the application of a blended Real Price Effect of 1.3% per annum.

An ongoing productivity improvement of 0.3% has also been applied.

The net change is therefore 1.0% per annum.

We require a framework which ensures symmetry in terms of our underlying/expected returns. This will protect the integrity of our regulatory framework and ensure that it is financeable.

To ensure this we are proposing an asymmetric risk premium of 3% on early stage network projects and on our Non-Network CapEx

This equates to an estimated premium of €0.9m per annum.

We are proposing an Enhanced Benefit Sharing Framework that unlocks further value for customers, but which at the same time ensures that EirGrid is in a financeable position.

An overall cap of +€7m and a collar of -€3m are applied.

8.2.2 Costs of this submission

Table 8.1 provides a summary of these, including the BAU element.

	Description	Units	2021	2022	2023	2024	2025	Total
OpEx	OpEx BAU	€m	54.4	55.1	55.4	56.2	56.7	**277.8**
	Sustainability & Decarbonisation	€m	2.1	2.7	3.1	3.8	3.7	**15.4**
	Operate, Develop & Enhance the Grid and Market	€m	2.6	3.0	3.0	2.9	2.9	**14.3**
	Engage for Better Outcomes for All	€m	1.4	1.4	1.4	1.4	1.4	**7.0**
	Network Development & Maintenance	€m	0.3	0.3	0.3	0.3	0.3	**1.5**
	Real Price Effects	€m	1.1	1.7	2.3	3.0	3.6	**11.7**
Non - Network CapEx	Non-Network CapEx BAU	€m	5.1	5.7	6.7	6.5	5.6	**29.6**
	Sustainability & Decarbonisation	€m	3.7	4.9	5.4	5.6	2.0	**21.6**
	Operate, Develop & Enhance the Grid and Market	€m	3.5	4.4	3.7	1.2	1.1	**13.9**
	Engage for Better Outcomes for All	€m	0.7	0.7	0.7	0.7	0.7	**3.7**
	Real Price Effects	€m	0.3	0.5	0.7	0.7	0.6	**2.8**

Figure 8.1: Summary of PR5 Internal Costs

Even though there is an increase in the allowance being sought by EirGrid for PR5 we have calculated that the overall cost to the average domestic customer will reduce during PR5. This is due to the challenge by EirGrid provided on the BAU and new initiatives, the forecast increase in demand and the reduction in the WACC. Figure 8.2 shows the impact on customer bills.

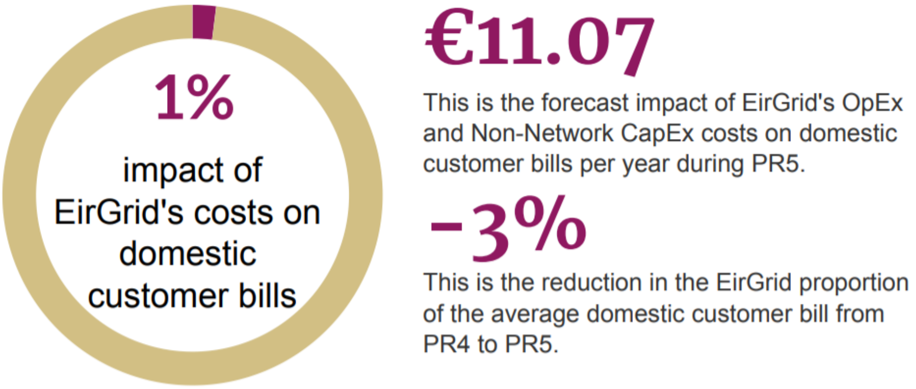

Figure 8.2: EirGrid Internal Costs to Customers

Appendix M

Appendix M

Securing Governance & Assurance

Table of Contents

M.1 Introduction

As the TSO for Ireland, EirGrid provides a critical public service for a wide range of customers. Consequently, it is essential that we abide by a comprehensive assurance and governance framework that acts in the interest of all Irish consumers and enables control, resilience and innovation to be embedded within all areas of operation and delivery.

Our customers and stakeholders require confidence in the work that we do and the robustness of all the decisions that we make. EirGrid has aimed to deliver our submission in a transparent manner highlighting the quality of the work that has been done while recognising where improvements can be made in the future.

It is essential that we can provide confidence and assurance in the methodology we have applied in developing our business plan. We are able to demonstrate the application of a range of assurance steps, specifically:

- **Assurance Framework** – the application of the 3 Lines of Assurance Model;
- **Ownership & Accountability** – business cases have defined owners and Executive Sponsors;
- **Technical Expertise & Challenge** – third party assurance partners were engaged to provide support, challenge and technical expertise throughout the process;
- **Executive Oversight & Challenge** – regular Executive challenge provided to assumptions through the Regulatory Governance Board (RGB); and
- **Embedded Governance Framework** – regular Board reporting enabling critical challenge throughout the process and incorporation of the wider Group governance processes.

M.2 Assurance Framework

For the PR5 business plan development process we applied a structured three lines of assurance model as presented in Figure M.1

M2.1 First Line of Assurance: enabling robust and high quality business case development

The first line of assurance involved ensuring that the most appropriate resources were allocated to the development and review of individual business cases. First line activities included:

- Appointment of workstream experts;
- Consistent application of data templates;
- Quality checks and review;
- Continual assessment of needs/expectations; and
- Management and Executive oversight.

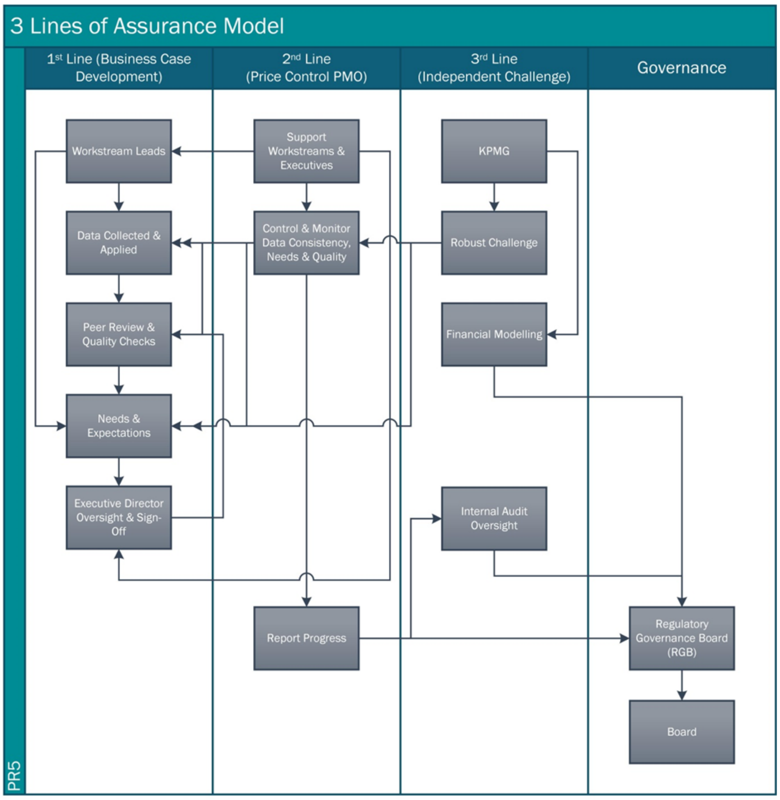

Figure M.1: Price Control Governance & Assurance

M.2.2 Second Line of Assurance: ensuring application of first line through independent challenge processes

The Price Control Project Management Office (PCPMO) acted as the second line of assurance predominantly in an oversight role in relation to the quality of data and robustness of assumptions made with key responsibilities for:

- Supporting individual Workstream Leads and Executives;
- Providing data collection templates to ensure consistency;
- Monitoring the quality of data collected and assumptions made;
- Ensuring business cases are clearly linked to needs and expectations; and
- Reporting progress at workstream and project level.

Additionally a robust Change Management Process was applied, enabling directorates to take ownership of their data and proposals; thereby ensuring that any changes took place in a controlled manner that is consistent and maintains the integrity of the work or data in question.

The PCPMO issued standard templates for the collection of information and data throughout the development of the business plan, which the business completed. These were signed off by the appropriate Executive Director prior to submission to the PCPMO. Once submitted, the templates were reviewed by the PCPMO for consistency and completeness and questions were raised where appropriate.

M.2.3 Third Line of Assurance: enabling independent challenge of assumptions, robustness of data and business case quality

Our third line of assurance was provided through two channels, by KPMG acting as our third party independent experts who provided technical challenge to the submissions and by our embedded independent Internal Audit function.

The role of KPMG included:

- Supporting individual Workstream Leads and Executives;
- Robust technical challenge to business case data and assumptions;
- Performing financial modelling and risk analysis; and

- Reporting to the RGB.

The role of Internal Audit included:

- Oversight of the governance processes being applied; and
- Monitoring the application of change management controls.

M.2.4 Governance

A change control process was put in place across the business. This process was enforced following final submissions from the business, and included strict control over the data tables to prevent unauthorised or unexplained changes. Where changes occurred as part of this process, they were reviewed by the PCPMO, Executive Director and/or RGB for sign-off as appropriate relative to the significance of the change. Changes were recorded and monitored by the PCPMO.

Executive Board members representing EirGrid met with the PCPMO regularly to ensure progress against milestones and to approve key principles and activities across the business.

M.3 Ownership and Accountability

In order to ensure the most robust business case development, the PR5 PCPMO identified workstream leads, data owners and Executive Director sponsors to ensure clear accountability for each deliverable.

Consequently, each Executive Director was responsible for the management, risk assessment and assurance of their suite of deliverables.

M.4 Technical Expertise

Whilst in-depth technical knowledge and expertise exists within the company, it is essential that external guidance is utilised during the process to ensure that benchmarking against best practice and robust technical challenge occurs. Consequently we partnered with KPMG to deliver such expertise.

Examples of the technical expertise provided by KPMG, as part of EirGrid's assurance processes, included:

- Challenging EirGrid's methodologies and underlying assumptions;
- Assurance of data flows through financial model to data tables; and
- Reviewing the business cases, data tables and supporting information for consistency.

M.5 Executive Oversight and Challenge

Through the RGB, the Executive Directors have participated throughout the development of EirGrid’s PR5 submission for 2021-25. They have set the objectives for the PR5 period, which are ambitious but also reflects achievable outcomes with regards to service and performance. The scale of the submission reflects well justified business cases, which have received thorough oversight and challenge from the Executive to ensure they represent efficient means of delivering on our ambitions. EirGrid’s business cases have been robustly challenged by both internal and external specialists, to a level commensurate with the scale of the proposals (See Appendix H for further details).

Appendix P

Appendix P

Assumptions

EIRGRID

This submission is premised upon the following core assumptions. Changes to these assumptions would result in changes to the required revenues to EirGrid for the period.

1. That the plan is based on EirGrid TSO Licence in effect as of November 2019; any changes to EirGrid's licence obligations will require a corresponding change in revenues.
2. That the following cost categories are specifically excluded from the forecast and would require a corresponding allowance be provided:
    a. Any change of law from that in place as at November 2019;
    b. Changes to the Capacity Market Code, the Grid Code or the Trading and Settlement Code; and
    c. Any costs identified as being excluded under EirGrid's proposals in respect of the Monitoring Committee.
3. That the United Kingdom's proposed exit from the European Union in accordance with Article 50 does not give rise to any significant changes in the operation of the all island transmission system or in the operation of the Integrated Single Electricity Market.
4. EirGrid operates an integrated business model, as part of the wider EirGrid Group, which delivers significant benefits for customers. The baseline costs and business cases as set out in this submission are to a significant extent based on an allocation of costs for Group wide solutions. It is assumed that nothing in the regulatory architecture in either Ireland or Northern Ireland inhibits or curtails this.
5. That the application of the parameters and initiative/ business cases as set out in this control are considered in totality and should not be considered in isolation. Any adjustment or amendment to individual parameters will require re-calibration of other aspects of the plan. Any adjustment or amendment to individual initiatives may result in others being undeliverable.
6. The Network CapEx forecast includes provision for onshore works to facilitate the connection of offshore windfarms. The cost of any offshore works are assumed for the purposes of this submission to be fully payable by the connecting party.
7. That any costs associated with fulfilment of the direction received from the CRU in July 2018 concerning the mitigation of Dublin security of supply are recoverable separately from the Price Control, including their capitalisation and recovery over a suitable period on an NPV neutral basis by reference to the regulated WACC, as appropriate.

8. That the current Ongoing Service Charge arrangements will cease as of 31 December 2020.
9. That the costs of any network projects which do not proceed to handover to ESB are recoverable on an NPV neutral basis, as provided for under Clause 2.2, Schedule 7 of the IA. This is consistent with the approach approved in CER/11/167.
10. The following cost categories are excluded and assumed to be treated on a pass through basis:
    a. Cost of provision of System Services;
    b. Inter TSO Compensation Costs;
    c. ENTSO-E fees;
    d. Standby Debt arrangement and commitment fees provided consistent with the requirements of the Trading & Settlement Code;
    e. Costs associated with Guarantees of Origin;
    f. CORESO/Regional Control Centres.

11. The following are assumed to be separately recoverable:
    a. PSO Costs;
    b. PSO (including RESS) Administration costs; and
    c. Costs associated with the provision of, or modification of, connection offers subject to the return to TUoS of the first €250k received per annum.

12. That EirGrid faces no cash flow mismatch, or liquidity risk by virtue of its administration of the PSO arrangements,

Appendix R

Appendix R

List of Abbreviations

Abbreviations	**Term**
AAD	Agreed Approach Document
ABP	An Bord Pleanála
AC	Alternating Current
ACCC	Aluminium Conductor Composite Core
ACE	ATM Control-Effectiveness
ACER	Agency for the Cooperation of Energy Regulators
ACS	Average Cold Spell
ACSR	Aluminium Core Steel Reinforced
AI	Artificial Intelligence
AICR	Adjusted Interest Cover Ratio
ALF	Annual Load Factor
ALO	Agricultural Liaison Officer
AM	Asset Management
APR	Annual Performance Report
ATCO	Air Traffic Control Office
AV	Audio Visual
BAU	Business As Usual
BEPS	Base Erosion and Profit Shifting
BER	Building Energy Rating
BPQ	Business Plan Questionnaire
BSPs	Balancing Service Providers
BZ	Bidding Zone
CA	Capital Approval
CAA	Civil Aviation Authority (UK)
CACM	Capacity Allocation and Congestion Management
CAP	Climate Action Plan
CapEx	Capital Expenditure
CAPM	Capital Asset Pricing Model
CAR	Commission for Aviation Regulation (UK)
CAV	Closing Asset Value
CBA	Cost Benefit Analysis
CC	Competition Commission
CCGT	Combined Cycle Gas Turbines
CCT	Control Centre Tools
CDGU	Centrally Dispatched Generating Unit
CDS	Credit Default Swaps
CEER	Council of European Energy Regulators
CEP	Clean Energy Package
CEPA	Cambridge Economic Policy Associates
CGM	Common Grid Model
CHP	Combined Heat and Power
CIM	Common Information Model
CJEU	Court of Justice of the European Union
CLO	Community Liaison Officer
CM	Capital Maintenance

CM	Customer Management
CMA	Competition and Markets Authority
CMC	Capacity Market Code
CMP	Capacity Market Platform
CNI	Critical National Infrastructure
COP21	Conference of the parties
COSO	Committee of Sponsoring Organisations of the Treadway Commission
CPCM	Customer Preferred Connection Method
CPI	Consumer Price Index
CPNI	Centre for Protection of National Infrastructure
CRM	Customer Relationship Management
CRU	Commission for Regulation of Utilities
CSA	Control Self-Assessment
CSB	Counterparty Settlement & Billing system
CSO	Central Statistics Office
CSR	Corporate Social Responsibility
CY	Capacity Year
DAA	Dublin Airport Authority
DAC	Designated Activity Company
DBC	Dispatch Balancing Costs
DC	Direct Current
DCC	Demand Connection Code
DCCAE	Department of Communications, Climate Action and the Environment
DCCAEWG	Climate Change Adaptation Working Group
DC-COPP	Data Centre Connection Offer Policy and Process
DDM	Dividend Discount Model
DDOS	Distributed Denial of Service protection
DHPLG	Department of Housing, Planning and Local Government
DIWE	Demonstrably Inefficient and Wasteful Expenditure
DLP	Data Loss Prevention
DO	Distillate Oil
DoF	Department of Finance
DPMS	Digital Performance Monitoring Systems
DRR	Dynamic Reactive Response
DS3	Delivering a Secure Sustainable Power System
DS3+	Next Phase of DS3
DSM	Demand Side Management
DSO	Distribution System Operator
DSR	Distributed Series Reactors
DSU	Demand Side Unit
DTS	Dispatcher Training Simulator
E&MP	Engineering and Major Projects (Team in ESBN)
EA	External Affairs
EBGL	Electricity Balancing Guideline
EBIT	Earnings before interest and taxes
EC	European Commission
ECB	European Central Bank

ECP	Enduring Connection Policy
EDIL	Electronic Dispatch Instruction Logger
EEA	European Economic Area
EG	EirGrid
EHECS	Earnings, Hours and Employment Costs Survey (Ireland)
EHV	Extra High Voltage
EI	Emulated Inertia
EIDAC	EirGrid Interconnector Designated Activity Company
EMS	Energy Management System
EN	Enhancement
ENSTO-E	European Network of Transmission System Operators for Electricity
EPRG	Energy Policy Research Group (Ofgem)
EPRI	Electric Power Research Institute
ER	Emergency Restoration
ERM	Enterprise Risk Management
ERP	Equity Risk Premium
ESB	Electricity Supply Board
ESBN	Electricity Supply Board Networks
ESCO	Energy Service Company
ESIPP	The Energy Systems Integration Partnership Programme
ESRI	Economic and Social Research Institute
ESU	Energy Storage Unit
ETL	Extract Transformer and Load engine
EU	European Union
EU KLEMS	EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs
EV	Enterprise Value
EVs	Electric Vehicles
EWIC	East West Interconnector
F&L	Finance and Legal
FACTs	Flexible AC Transmission System
FBPQ	Forecast Business Plan Questionnaire
FDI	Foreign Direct Investment
FFO	Funds from operations
FFR	Fast Frequency Response
FOI	Freedom of Information
FPFAPR	Fast Post Fault Active Power Recovery
FR	France (used in the context of SEM-FR)
FTE	Full-time equivalent
GB	Great Britain
GCFs	General Communication Failures
GCS	Generation Capacity Statement
GD3	Network Control Centre tool providing real-time and historical generation data
GDI	Grid Development and Interconnection
GDN	Gas Distribution Network
GDP	Gross Domestic Product

GDPR	General Data Protection Regulation
GDX	Group Data eXchange
GFC	Gross Final Consumption
GHG	Greenhouse Gas
GIPC	Grid Infrastructure Projects Committee
GIS	Geographic Information System
GL	Guidelines
GNI	Gas Networks Ireland
GNI	Gross National Income
GNP	Gross National Product
GO	Gross Output
GO	Guarantees of Origin
GOP	Generation Outage Programme
GRC	Governance, Risk Management and Compliance
GSFs	General System Failures
GVA	Gross Value Added
GW	Gigawatts
GWh	Gigawatt-hours
HBPQ	Historic Business Plan Questionnaire
HFO	Heavy Fuel Oil
HIAC	Head of Internal Audit & Compliance
HICP	Harmonised Index of Consumer Prices
HPFF	High Pressure Fluid Filled
HR	Human Resources
HRCS	Human Resources and Corporate Services
HSE	Health Service Executive
HTLS	High Tension Low Sag
HV	High Voltage
HVDC	High Voltage Direct Current
IA	Infrastructure Agreement
IAA	Irish Aviation Authority
IaaS	Infrastructure as a Service
IAM	Institute of Asset Management
IAS	Indicative Actual Schedule
iBoxx	Index of Investment Grade Bonds
ICMP	Internet Control Message Protocol
ICMP	Interconnector Management Platform
ICT	Information and Communications Technology
IDC	Interest During Construction
IDOK	Interim Determination of K
IDS	Intrusion Detection Systems
IDS	Individual Demand Sites
IE	Ireland
IEM	Internal Energy Market
IFRS	International Financial Reporting Standards
IGM	Individual Grid Model

IOT	Internet of Things
IP	Internet Protocol
IPCC	Intergovernmental Panel on Climate Change
IPS	Intrusion Prevention Systems
IR	Infra-Red
IRC2	Irish Water Revenue Control
IRDG	Industry Research and Development Group
IS	Information Systems
I-SEM	Integrated Single Electricity Market
ISO	Independent System Operator
ISO	International Organisation for Standardisation
ISTN	Interim Secondary Trading Notification
IT	Information Technology
IT&T	Information Technology and Telecoms
ITO	Independent Transmission System Operator
JAO	Joint Allocation Office
K	Regulatory Precedent for applying an adjustment
KPI	Key Performance Indicators
kV	Kilovolt
LCCCM	Least Cost Chargeable Connection Method
LFG	Landfill Gas
LiDar	Surveying Method (laser Scanner for 3D Scan giving location of Line)
LSAT	Look-ahead Stability Assessment Tool
MaREI	Centre for Marine and Renewable Energy
MARI	Manually Activated Reserves Initiative
MASS	Meter Aggregation and Substitution System
MDM	Master Data Management
MDP	Meter Data Provider
MFP	Multi-factor productivity
MIC	Management Investment Committee
MIP	Mixed Integer Programming
MMS	Market Management System
MO	Market Operator
MOIP	Messaging Over Internet Protocol
MPSC	Maintenance Policy and Standards Committee
$MtCO_2$ Eq	Metric tons of carbon dioxide equivalent
MV90	Meter Data Collection Tool
MVA	Mega Volt Amp
MW	Megawatt
MWh	Megawatt hour
MYDP	Multi-Year Delivery Programme
NACE	Nomenclature génerale des Activités économiques dans les Communautés Européennes (European industrial activity classification)
NATS	National Air Traffic Services (UK)
NC	Network Codes
NCC	National Competitiveness Council
NCC	National Control Centre

NCSC - IE	National Cyber Security Centre Ireland
NDP	National Development Plan
NECP	National Energy and Climate Plan
NEMO	Nominated Electricity Market Operator
NESS	Non-energy Settlement System
NG	National Grid (UK)
NGESO	National Grid Electricity System Operator (UK)
NHS	National Health Service (UK)
NI	Northern Ireland
NIE	Northern Ireland Electricity Networks Limited
NIS	Network and Information Systems
NOA	Network Options Assessment
NOM	Network Output Measures
NPV	Net Present Value
NREAP	National Renewable Energy Action Plan
NSEE	National Stakeholder Engagement Evaluation
NSI	North South Interconnection
NTMA	National Treasury Management Agency
OAV	Opening Asset Value
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OES	Operator of Essential Services
OGSC	Ongoing Service Charge
OHL	Overhead Line
OJEU	Official Journal of the European Union
OMS	Outage Management System
OPDE	Operational Planning Data Environment
OpEx	Operational Expenditure
OPI	Operations, Planning and Innovation
ORR	Office of Rail and Road (UK)
OSB	Oracle Service Bus
OSS	Operating Security Standards
OT	Operational Technology
OU	Ownership Unbundling
PA	Project Agreement
PaaS	Platform as a Service
PC	Price Control
PCIs	Projects of Common Interest
PCN	Private Communications Network
PCNP	Pre-construction Network Planning
PCPMO	Price Control Project Management Office
PD	Potential Discharge
PHEV	Plug-in Hybrid Electric Vehicle
PIP	Project Implementation Plan
PLC	Public Limited Company
PM	Project Managers

PMO	Project Management Office
PMU	Phasor Measurement Units
POR	Primary Operating Reserve
PP&E	Property, Plant and Equipment
PPI	Producer Price Index
PR4	Price Review 4 (2016 – 2020)
PR5	Price Review 5 (2021 – 2025)
PR6	Price Review 6 (2026 – 2030)
PSO	Public Service Obligation
PSSE	Power System Simulation for Engineers
PV	Photovoltaic
QE	Quantitative Easing
QTP	Qualification Trial Process
RAB	Regulatory Asset Bases
RAG	Red Amber Green Status
RAs	Regulatory Authorities
RBS	Royal Bank of Scotland
RCC	Regional Coordination Centres
RCF	Revolving Credit Facility
RCV	Regulatory Capital Value
REFIT	Renewable Energy Feed-in Tariff
RES	Renewable energy sources
RES - E	Renewable Energy Source - Electricity
RES – H	Renewable Energy Source – Heat
RES - T	Renewable Energy Source - Transport
RESS	Renewable Energy Support Scheme
RfG	Requirements for Generators
RfR	Risk free rate
RGB	Regulation Governance Board
RIIO	Revenue = Incentives + innovation + outputs
RIIO-GD1	Ofgem’s current Price Control for Gas Distribution Networks (UK)
RIIO-T1	Ofgem’s current Price Control for Gas and Electricity Transmission (UK_
RM1	Ramping Margin 1
RM3	Ramping Margin 3
RM8	Ramping Margin 8
RO	Reliability Option
RoCoF	Rate of Change of Frequency
RPE	Real Price Effects
RRD	Replacement Reserve – Desynchronised
RRS	Replacement Reserve – Synchronised
RTÉ	Réseau de Transport d’Électricité (the French TSO)
RTUs	Remote Terminal Units
SaaS	Software as a Service
SAN	Storage Area Networks
SAS	Statistical Analysis Software
SCADA	Supervisory Control and Data Acquisition

SCS	Substation Control System
SDR	System Disturbance Reports
SDW	Standing Data Workbook
SEAI	Sustainable Energy Authority of Ireland
SEM	Single Electricity Market
SEMO	Single Electricity Markey Operator
SG	Stage Gate
SIEM	Security Monitoring Tool
SIR	Synchronous Inertial Response
SLA	Service Level Agreement
SME	Subject Matter Expert
SML	System Minutes Lost
SNSP	System Non-Synchronous Penetration
SO	System Operator
SOC	Outsourced Security Operations Centre
SOCA	System Operator Connection Agreement
SOGL	System Operation Guideline
SONI	System Operator Northern Ireland
SOPCM	System Operator Preferred Connection Method
SOR	Secondary Operating Reserve
SoS	Security of Supply
SP	Scottish Power
SPPI	Services Producer Price Indices
SPS	Special Protection Schemes
SPV	Special Purpose Vehicle
SQL	Structured Query Language
SSG	Small Scale Generation
SSRH	Support Scheme for Renewable Heat
SSRP	Steady State Reactive Power
SSSC	Static Synchronous Series Compensation
STATCOM	Static Synchronous Compensator
SvK	Svenska Kraftnat
SWW	Strategic Wider Works
T&SC	Trading and Settlement Codes
TAO	Transmission Asset Owner
TCO	Total Cost of Ownership
TDP	Transmission Development Plan (Ireland)
TE	Phase to Group Fault
TER	Total Electricity Requirement
TERRA	Trans European Replacement Reserves Exchange
TES	Tomorrow’s Energy Scenarios
TFP	Total Factor Productivity
TFPgo	Gross Output TFP
TFPva	Value Added TFP
TIC	Transmission Investment Committee
TIM	Translation Interface Module

TIPS	Treasury Inflation-Protected Securities
TMR	Total Market Return
TNDP	Transmission Network Development Plan (Northern Ireland)
TNEI	The Northern Energy Initiative
TNPP	Transmission Network Pre-Construction Projects (Northern Ireland)
TO	Transmission Owner
TOP	Transmission Outage Programme
ToR	Terms of Reference
TOR	Tertiary Operating Reserve
TOR1	Tertiary Operating Reserve 1
TOR2	Tertiary Operating Reserve 2
TP	Transmission Projects
TPC	Total Project Cost
TRL	Technology Readiness Level
TSDCs	Transmission Standard Development Costs
TSO	Transmission System Operator
TSSPS	Transmission System Security and Planning Standards
TSSU	Trading Site Supplier Unit
TUoS	Transmission Use of System
TVM	Threat and Vulnerability Management
TW	Terawatt
TWh	Terawatt-hour
TYNDP	Ten Year Network Development Plan
UGC	Underground Cable
UHF	Ultra High Frequency
UK	United Kingdom
UKRN	UK Regulators Network
UR	Utility Regulator Northern Ireland
VA	Value Added
VR	Virtual Reality
WACC	Weighted Average Cost of Capital
WaSC	Water and Sewage Companies (UK)
WEF	Wind Energy Forecast
WFC	Wind Farm Controller
WLA	Wholesale Local Access
WoC	Water Only Companies (UK)
WSAT	Wind Security Assessment Tool
XBID	European Cross-Border Intraday
XLPE	Cross Linked Polyethylene

Appendix S

EirGrid PR5 Submission

Enhanced Benefit Sharing Mechanism Output Metrics and Targets

Revision No.	Comments	Date
3	TSO Joint Incentives	15/05/2020

1. Executive Summary

The CRU has outlined its principles for the regulatory framework in a letter to EirGrid on 26 August 2019. In this letter there was an increased focus on outputs and outcomes required to achieve the CRU's objectives and vision for PR5. EirGrid supports an output and outcomes based approach.

In this document we aim to build on the existing suite of incentives, the proposed PR4 Balanced Scorecard and on the CRU's principles for the regulatory framework.

In line with 'Reporting and Incentives under Price Review 4' Decision Paper (CER/18/087), our metrics are output focused and not input focused. Our PR5 submission which was provided to the CRU on 30 November 2019 outlines the input processes that EirGrid will use to deliver the output metrics outlined in this report. Any reduction in funding for the inputs outlined in our PR5 submission will impact on EirGrid's ability to deliver the outputs that the CRU has targeted for PR5 and this outputs framework is dependent on and conditional on these inputs.

This paper outlines the metrics and targets which deliver a holistic package that will deliver clear benefits over the price control cycle. In summary these are:

Decarbonisation

1. RES-E (%) – To increase the percentage of electricity from renewable sources in Ireland.
2. SNSP (%) – To increase the maximum level of System Non-Synchronous Penetration (SNSP) that the TSOs in Ireland and Northern Ireland will allow on the system at any point in time.
3. Renewable Dispatch Down (%) – to keep the average level of curtailment and constraint in Ireland below a certain level.

Grid Security

1. System Minutes Lost – to keep this below a certain threshold each year.
2. System Frequency – to ensure that EirGrid manages the system frequency within Grid Code requirements.
3. Cyber Security – to ensure that our cyber security maturity improves over the course of the price control.

Costs

1. Network Project Handover (€) - It will incentivise EirGrid to ensure timely progress of projects but will be so designed that it will discourage unnecessary expenditure.

2. Imperfections (€) – we propose to maintain the current incentive design but to recalibrate some of the parameters. This is currently a joint incentive with SONI due to the all-island nature of the balancing market. A similar submission has been made by SONI to UR.

Performance

1. Stakeholder Engagement – this will assesses our stakeholder engagement plan each year.
2. Investment Planning – The purpose of this metric is to ensure that we are making robust and quality investment decisions in a timely manner. Part of this metric includes a joint incentive with the TAO.
3. Deployment of New Technologies - The purpose of the metric is to ensure our processes are effective in enabling the trialling, piloting, deployment and use of new technology on the grid and in our operations.
4. Network Delivery - The deliverable that the metric refers to is the delivery aspect of the Investment Planning and Delivery Balanced Scorecard framework for PR4, in particular steps 4-6 of this process. Part of this metric includes a joint incentive with the TAO.

The proposed metrics and targets have been designed to incentivise performance and have been baselined against our ambitious price control submission i.e. EirGrid receives no incentive payment for delivering on the baseline targets but will receive an incentive payment for exceeding the already ambitious targets, while an incentive penalty will be applied if the targets are not met.

EirGrid welcomes further engagement with CRU in further developing these proposals in advance of the commencement of the PR5 period.

2. Background

EirGrid's current regulatory framework has in place a number of performance incentives or KPIs. CRU is currently refining and enhancing the existing performance incentive framework through the PR4 balance scorecard. EirGrid continues to believe that this framework can be enhanced further to benefit customers. Furthermore if calibrated appropriately they can also address the outstanding issues of appropriately remunerating Enterprise Value whilst at the same time ensuring consumers continue to benefit from actions taken by EirGrid. In developing this enhanced benefit share framework, EirGrid has drawn on the report prepared by its independent economic consultants KPMG, as set out in Appendix J of our PR5 forecast submission.

To identify the areas of value potential in its activities EirGrid applied a bottom up approach facilitated by KPMG through a number of workshops with EirGrid managers and staff. This started from the EirGrid activities, assessed the value that can be created for customers in these activities when we go above and beyond what is expected and delivered a list of benefit levers that, when incentivised, can provide a powerful benefit sharing mechanism.

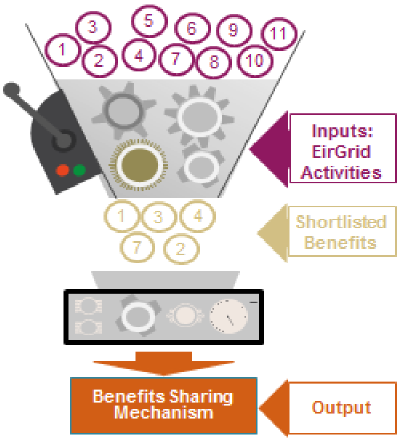

Figure S-1: Process to identify areas of EirGrid Enhanced Benefit Share

The KPMG report outlines the process that was undertaken in more detail, this is summarised below.

- **Stage 1:** High level analysis mapping the activities to the quadrants in the benefit sharing framework based on effort and value potential. "Filtering out" activities where the trade-off between additional cost and benefit does not justify the incremental effort.
- **Stage 2:** Identify value areas that are most impacted by the shortlisted EirGrid activities. Define long list of metrics and to measure the value created by EirGrid activities for customers.

- **Mechanism design:** The selected benefit areas move on to the next stage where the design of benefit sharing mechanism for each will be considered:
    - Constraint 1: value accreted > value of the incentive payment; and
    - Constraint 2: value of benefit sharing payment > cost of investment.

As a result of this involved and process driven approach, EirGrid narrowed down the areas where greatest value is expected to be deliverable:

- **Decarbonisation:** The decarbonisation of the electricity system is of great importance to customers and a vital component of the energy transition.
- **Grid Security:** A secure and reliable electricity network that is fit for the future of the electricity systems needs is vital to customers and market participants.
- **Cost:** Ensuring customers get value for money and benefit from cost efficiency should be paramount. However the costs for customers should be viewed holistically.

It was evident when undertaking the assessment process that EirGrid's value to customers often comes not only from what we do but by how we do it. Therefore, in addition to the three value areas above, a fourth component needs to be at the centre of our framework:

- **Performance:** Whilst delivering on decarbonisation, grid security and cost, EirGrid will also need to meet the expectations of its stakeholders. Creating a transparent information sharing environment accompanied by the timely completion of our tasks will create frictionless and efficient working relationships between the parties acting in the market.

The inclusion of a specific performance element also helped balance the mechanistic and evaluative based approaches. This is shown graphically in the figure below.

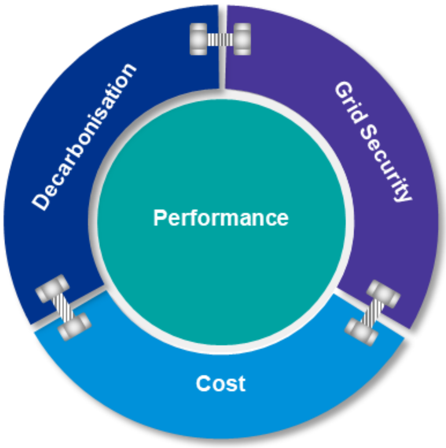

Figure S-2: EirGrid Enhanced Benefit Share Framework

In terms of the overall design of the incentive package, EirGrid remains of the view that a balance is required, for example between a wholly evaluative or wholly mechanistic approach, or between fully discrete (narrower measures more directly in EirGrid's control) or fully system wide activities (wider measures over which EirGrid has less direct influence and may involve other industry participants).

EirGrid is however clear that it is important that the package is a holistic one and that application of a small number of disparate incentives would be much less likely to deliver benefits and would have the potential to give rise to perverse incentives. EirGrid is also clear that given the need to invest discretionary capital in achieving the desired outputs and outcomes that greater application of financial incentives would be expected to be more beneficial.

EirGrid believes that a framework based on these benefit components creates a holistic package bringing together all the things that are important to consumers. These benefit components are in natural tension to each other so by bolting all of the components together in the framework we will be incentivised to look at the benefits to customers as a whole rather than focusing on one component to the detriment of another.

Regulatory incentive design packages have often been an additional element to the overall regulatory framework. It is EirGrid's intention with this proposed framework to build the incentives into the very foundation of the regulatory design. As a result, this changes the price control in an important way to one where every decision made is about doing the right thing for customers. In so doing, and in applying a holistic package, it complements the revenue cap framework. Creating value for customers is not an optional extra but integral to the overall framework.

EirGrid is proposing using a combination of quantitative and qualitative assessments to determine the additional value to customers. The assessment of decarbonisation, grid security and costs should be through quantitative assessment, through a defined formula setting out the measure and the counter factual to calculate the value we have delivered.

When calibrating the package the incentive levels will need to be meaningful and powerful whilst also ensuring financeability. A floor to the overall package is required to ensure that there is a limit to downside exposure and is important to ensure the company is financeable.

To create a strong and material incentive for EirGrid to create value whilst maintaining our financeability a collar of -€3m per annum from this package is proposed. This is discussed in more detail in the PR5 forecast submission. To create a stretch target for EirGrid to realise additional benefits for consumers and industry participants, which to date remain largely untapped, EirGrid is proposing a cap of +€7m per annum. This ratio of upside to downside of just over 2:1 provides a powerful incentive to EirGrid to drive out customer value, while the customer exposure is still low

As the framework comprises of four distinct areas, decarbonisation, grid stability, cost and performance, each of these areas will need to be individually meaningful as well. To further enable this, the sum of the individual caps and floors for the areas are greater than the total cap and floor on the overall package. €11.75m on the upside and -€4.50m on the downside is proposed to deliver this.

Area	Total Upside per annum (€m)	Total Downside per annum (€m)
Sustainability & Decarbonisation	3.00	-1.00
Grid Security	1.50	-1.50
Cost	5.00	-2.00
Performance	2.25	0.00
Capped at	**7.00**	**-3.00**

Table S 1

EirGrid would also welcome discussion with CRU on the development of a metric and target for the ECP-2 process. This important process is due to be completed during the PR5 period. This could take the form of a metric similar to that currently in place for ECP-1. Due to the specific project nature of ECP-2 we propose that this should be separate to the cap of +€7m per annum and collar of -€3m per annum.

3. Output Metrics

This section outlines the approach which we have undertaken to develop the metrics and targets, how we propose to recover the cost of reporting and in relation to confidentiality of certain metrics.

Approach

1. We have used the existing incentives and the proposed PR4 Balanced Scorecard (Reporting and Incentives CER/18/087) as the basis for the metrics outlined in this submission. These form a good basis on which to make enhancements.
2. The proposed metrics and targets are dependent on the provision of the revenues sought in relation to the inputs, as part of our price control submission. Any reduction in funding for the inputs outlined in our PR5 submission will impact on EirGrid's ability to deliver the outputs that the CRU has targeted for PR5 and this outputs framework is dependent on and conditional on these inputs.
3. All of the proposed targets have been designed to be stretching for the TSO to achieve. Our Executive Directors have challenged these to ensure this. The deliverables set out in our PR5 submission are ambitious and require a culture of innovation and flexibility within the TSO and for us to engage in partnerships, in order to be successful. The targets set out in this document are based on our PR5 submission. If EirGrid receives an incentive payment, this cost is more than offset by the incremental value returned to consumers, e.g. consumers are always better off when the targets are met or outperformed.
4. When designing the metrics we have focused on what we believe is important for customers and where EirGrid can unlock further value by investing discretionary capital.
5. When designing the metrics we have aimed to keep these simple to limit the analysis and reporting burden for both EirGrid and the CRU. Many of the new incentives are quantitative and the SMART (Specific, Measurable, Agreed, Realistic, Timely).
6. EirGrid believe that the targets should be flexible to adapt to the increasing pace of change in the energy industry. We have made a number of assumptions in the development of the targets such as demand, renewable connections, RESS actions, etc. Is it therefore prudent to re-baseline the targets to ensure that we

are appropriately incentivised to deliver on the right things. Furthermore areas outside of EirGrid's control should be allowed to be accounted for ex-post.

7. The targets should be in tension with each other e.g. we should not be incentivised to exceed Grid Security targets at the detriment of costs to the customer, therefore we have a metric for Imperfection Costs. It should also be noted that many of the metrics not under the 'Cost' category can lead to indirect cost benefits. For example enabling RES-E will ensure that Ireland complies with European legalisation and therefore that we do not incur penalties for failing to reach legally binding targets.

TSO Audit Fees

We have proposed that a number of the metrics are assessed annually through an independent audit. The terms of reference of the audit will be agreed between EirGrid and the CRU and the cost of the audit should be fully recoverable by EirGrid. The audits will be managed by the Head of Internal Audit and Compliance who reports to the Audit Committee on the EirGrid plc Board. The audit reports will be shared with CRU.

Confidentiality

Reporting of certain metrics may be required to be confidential and not available to the general public. Examples include cyber security.

The proposed metrics and targets are outlined in the following sections under the headings of Sustainability and Decarbonisation, Grid Security, Cost and Performance.

Metric		2021	2022	2023	2024	2025	Summary of Proposed Target Mechanism	Upside (€m)	Downside (€m)
3.1. Sustainability & Decarbonisation									
1	RES-E (%)	41	43	46	49	52	This will measure the portion of electricity from renewable sources for each year. Items outside of the TSOs control will be adjusted on an annual basis. Every 1% outside of target will equate to 20% of the upside/downside.	1.00	-0.33
2	SNSP (%)	75	75	75	75	85	This will measure the System Non Synchronous Penetration (SNSP) for each year. The target for 2030 is 95% to ensure that we can achieve the RES-E target of 70%. Every 5% outside of the target will equate to 50% of the upside/downside. This is based on a target SNSP of 95% required by 2030, therefore an increase of 15% (95% - 85%) required to get there.	1.00	-0.33
3	Renewable Dispatch Down (%)	8	9	10	10	10	This measures the level of dispatch down of renewables to ensure this is minimised. A deadband of ±1% is proposed to account for variables outside of the TSOs control such as demand and renewable connections. The TSO does reserve the right to account for High Impact Low Probability (HILP) events outside of our control. Every 1% outside of the deadband will equate to 25% of the upside/downside.	1.00	-0.33
3.2. Grid Security									
1	System Minutes Lost (SML)	1.5 – 3.0					This will measure the number of system minutes lost due to faults on the Transmission System, for which the TSO has control over. This is normalised against the peak system demand. There is a deadband between 1.5 and 3.0 system minutes. Every 0.1 system minutes outside of this deadband equates to 20% of the upside/downside. The upside is limited at 1.0 SML and the downside is limited at 3.5 SML. This is consistent with the current framework.	0.5	-0.5
2	System Frequency (%)	96	96	96	96	96	This measures the performance of the system frequency against the nominal frequency of 50 Hz. A target frequency range of 50 ±0.1 Hz is applied (grid code notes a range of 50 ±0.2 Hz for the TSO to operate within. An annual target of 96% is proposed and this is consistent with the current framework.	0.5	-0.5

3	Cyber Security (Maturity)	2.8	3.2	3.2	3.4	3.5	This measures the maturity of the EirGrid Group cyber security. The current maturity is 2.5 and this compares well to a Power and Utility average score of 2.2. The assessment is carried out annual by an independent auditor (currently EY). It is proposed that 0.1 outside of the target will equate to 20% of the upside/downside.	0.5	-0.5
3.3.	**Cost**								
1	Network Project Handover (€)	Assessed annually with a true up at the end of PR5					It is proposed to assess TSO/TAO outturn performance against a baseline PR5 invoicing/spend profile that will be agreed with CRU in 2020. This measure will assess timely handover from the TSO to the TAO. An ex-post annual adjustment will be required to account for issues outside the control of the TSO and TAO that lead to projects not being progressed as planned such as land access issues, changes in customer preferences, customer consenting issues, customer delays etc.	2.5	-1.0
2	Imperfections (€)	Assessed annually					This measures the Imperfections outturn, on an annual basis, against the allowance. Items outside of the TSOs control (e.g. fuel costs) are adjusted ex-post. The majority of the existing design is retained; however we propose a recalibration of the variables to unlock further value for customers. On the upside the deadband is changed from 7.5% to 2.5% and the sharing factor is changed from 10% to 25%.	2.5	-1.0
3.4.	**Performance**								
1	Stakeholder Engagement	7.5	7.75	8.0	8.25	8.5	A CRU established Stakeholder Panel will assess and score EirGrid on the quality (20%), implementation (40%) and effectiveness (40%) of their stakeholder engagement strategy in the previous year. The panel will be chaired by CRU and will consist of representatives from a range of stakeholders. EirGrid will publish a report for consultation on the effectiveness of their stakeholder engagement in the preceding year. The panel will assess EirGrid's performance, drawing on this report, the consultation responses and the final submission from EirGrid to the panel. EirGrid will receive a score of between 1 and 10.	0.75	0

2	Investment Planning (Optioneering)	Assessed annually	The purpose of this metric is to ensure that we are making robust and quality investment decisions in a timely manner in order to ensure the grid is safe, secure, and reliable and is able to economically deliver/enable our climate action targets (i.e. 70% RES-E by 2030). This would be a qualitative metric. An annual independent ex-post audit of our investment planning process and we will provide evidence to the auditors of any applicable process improvements and lessons learned implemented during the relevant period. This would be assessed on a 3 point scale of Average or below average (0%), Above standard (50%), Significantly above standard (100%).	0.50	0
3	Deployment of New Technology	Assessed annually	The purpose of the metric is to ensure our processes are effective in enabling the trialling, piloting, deployment and use of new technology on the grid and in our operations. Removing barriers to the deployment of new technology is vital to delivering the transition to a low carbon power system. Each year the TSO would produce/update a rolling two year plan setting out planned activities to enable the deployment of new technology. At the end of the year, the TSO would compile a report on the effectiveness of our approach to ‘Enabling New Technology’ over the previous calendar year. This would be assessed on a 3 point scale of Average (0%), Above standard (50%), Significantly above standard (100%).	0.50	0
4	Infrastructure Delivery	Assessed annually with a true up at the end of PR5	The deliverable that the metric refers to is the delivery aspect of the Investment Planning and Delivery Balanced Scorecard framework for PR4, in particular steps 4-6 of this process. The five year baseline programme for PR5 (currently expected to contain of the order of 230 Capex projects and a combined TSO/TAO spend of €1.07bn) will be submitted to CRU in 2020 (to commence on 01/01/2021). This metric will track deliverables and process improvements against the agreed PR5 baseline.	0.50	0
			Capped at	7.0	-3.0

Table S 2

3.1. Sustainability & Decarbonisation

<table>
<tr><td>Metric</td><td>3.1.1. RES-E (%)</td></tr>
<tr><td>Assessment</td><td>Quantitative</td></tr>
<tr><td>Purpose of the metric</td><td>This is a new metric. It is designed to incentive us to maximise penetration of electricity generated by RES sources in line with Ireland’s Climate Action Plan 2019. This aims to achieve 70% renewable electricity by 2030 and lay the foundations for achieving net zero carbon emissions by 2050. The 2025 target is based on the 52% RES-E projection for 2025 detailed in the Climate Action Plan[1].</td></tr>
<tr><td>Approach to measurement</td><td>The target should be re-baselined annually as the RES-E trajectory is dependent on market mechanisms driven by policy – in particular the MW capacity and regularity of RESS auctions.

The target for each year is set based on a forecast level of demand, renewable connections, availability of renewable generation, etc. The actual target should be assessed ex-post and any factors outside of the control of the TSO should be adjusted to ensure an accurate reflection of performance. RES-E (%) is calculated on a quarterly basis one month following the end of each quarter. An annual report will be submitted at the end of Q1 of the following year.</td></tr>
<tr><td>Upside/Downside</td><td>The actual RES-E for the last number of years is found below:

<table>
<tr><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th></tr>
<tr><td>13%</td><td>20%</td><td>19%</td><td>20%</td><td>23%</td><td>27%</td><td>26%</td><td>30%</td><td>33%</td><td>36%</td></tr>
</table>

Increasing beyond this level becomes increasingly more challenging due to network congestion and operational challenges into the future.

The inputs required to meet the targets outlined below have been included in the Price Control submission. We propose that every 1% away from the target should equate to 25% of the incentive payment or penalty, as applicable.

Upside: €1.00m
Downside: €0.33m</td></tr>
<tr><td>Target per Year</td><td></td></tr>
<tr><td>2021</td><td>41%</td></tr>
<tr><td>2022</td><td>43%</td></tr>
<tr><td>2023</td><td>46%</td></tr>
<tr><td>2024</td><td>49%</td></tr>
<tr><td>2025</td><td>52%</td></tr>
</table>

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[1] See Figure 4.4. of Climate Action Plan

<table>
<tr><td>Metric</td><td>3.1.2. SNSP (%)</td></tr>
<tr><td>Assessment</td><td>Quantitative</td></tr>
<tr><td>Purpose of the metric</td><td>This is a new metric. System Non Synchronous Penetration (SNSP) is an important enabler for increasing the level of renewable sources of electricity generation on the power system. New tools and processes are required by the TSO to allow increases in the SNSP metric, therefore this is determined to be a good measure for progress to enable decarbonisation of the electricity system to achieve net zero carbon emissions by 2050.</td></tr>
<tr><td>Approach to measurement</td><td>The SNSP level is published on our website on a monthly basis in the Operational Constraints update document. At first any increase will be first trialled before it is implemented on a permanent basis.

At times the SNSP limit may be temporarily decreased during certain weather warnings. Any such instances should be excluded from the assessment.

The SNSP as of 31 December each year will be used to assess the performance of the TSO.</td></tr>
<tr><td>Upside/Downside</td><td>The actual SNSP limit over the last several years is as follows:

<table>
<tr><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>50%</td><td>55%</td><td>60%</td><td>65%</td><td>65%</td></tr>
</table>

The allowances required to meet the targets outlined below have been included in the Price Control submission. We propose that every 5% away from the target should equate to 33% of the incentive payment or penalty, as applicable.

Upside: €1.00m
Downside: €0.33m</td></tr>
<tr><td>Target per Year</td><td></td></tr>
<tr><td>2021</td><td>75%</td></tr>
<tr><td>2022</td><td>75%</td></tr>
<tr><td>2023</td><td>75%</td></tr>
<tr><td>2024</td><td>75%</td></tr>
<tr><td>2025</td><td>85%</td></tr>
</table>

Table S 3

<table>
<tr><td>Metric</td><td>3.1.3. Renewable Dispatch Down (%)</td></tr>
<tr><td>Assessment</td><td>Quantitative</td></tr>
<tr><td>Purpose of the metric</td><td>This is a new metric. This incentive is to minimise the dispatch down of renewable generation. There are two categories of dispatch down; constraints (due to localised network issues) and curtailment (due to system wide issues).

Renewable generation receives priority dispatch within the scheduling and dispatch algorithms in the Control Centres. However, there will be times when it is not possible to accommodate all priority dispatch generation while maintaining the safe, secure operation of the power system. Security-based limits have to be imposed due to both local network and system-wide security issues. Local network issues may arise due to lack of grid infrastructure to accommodate the renewable generation or due to transmission outages required to facilitate the delivery of new infrastructure.

Excessive dispatch down of renewable generation may result in projects becoming unfinanceable, therefore it is important to ensure this is minimised.</td></tr>
<tr><td>Approach to measurement</td><td>Renewable Dispatch Down (%) is calculated on a quarterly basis one month following the end of each quarter. Annual figures are available one month following the end of the year.

Some dispatch down is outside of the control of the TSO e.g. windfarm testing and DSO constraints. Dispatch down associated with these areas will be excluded from the assessment.

A deadband of ±1% is proposed to account for variables outside of the TSO’s control such as demand and renewable connections. The TSO does reserve the right to account for High Impact Low Probability (HILP) events outside of our control e.g. forced outage of a transmission transformer.</td></tr>
<tr><td>Upside/Downside</td><td>The actual dispatch down for the last number of years is as follows:

<table>
<tr><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>2.4%</td><td>2.5%</td><td>3.3%</td><td>4.4%</td><td>5.1%</td><td>2.8%</td><td>3.7%</td><td>5.0%</td><td>6.9%</td></tr>
</table>

Minimising dispatch down over the coming years will become more challenging due to the rapid growth of renewable sources on the system. Analysis is currently being carried out on the ECP-1 process and the level of dispatch down associated with these connections. Some of these have been published on the EirGrid website (http://www.eirgridgroup.com/customer-and-industry/general-customer-information/constraint-reports-solar/). We propose that the targets are aligned with the overall Ireland levels for dispatch down.</td></tr>
</table>

	We propose that every 1% away from the deadband should equate to 25% of the incentive payment or penalty, as applicable. Upside: €1.00m Downside: €0.33m
Target per Year	
2021	8%
2022	9%
2023	10%
2024	10%
2025	10%

Table S 4

3.2. Grid Security

Metric	3.2.1. System Minutes Lost
Assessment	Quantitative
Purpose of the metric	This is an existing metric. The international benchmark for transmission system performance and reliability is the System Minute. The System Minute is an index that measures the severity of each system disturbance relative to the size of the system. It is determined by calculating the ratio of unsupplied energy during an outage to the energy that would be supplied during one minute, if the supplied energy was at its peak value.
Approach to measurement	For each event on the transmission system that is within the control of the TSO the following formula will be used to assess the impact: System Minutes Lost = (load not supplied x duration in minutes) / (system peak) Note that a Power Factor of 0.9 will be used for the load not supplied Examples of areas outside of our control include Red Level Weather events, capacity shortfall, ice accretion on transmission system, gas emergencies / fuel shortages etc. This is consistent with the existing design of this current metric.
Upside/Downside	The mean System Minutes Lost from 2004 to 2018 is 1.109 SML. We propose that there is a deadband between 1.5 and 3.0 SML, where there is neither a penalty nor incentive payment. We propose that every 0.1 SML between 1.5 SML and 1.0 SML will equate to 20% of the upside payment and that every 0.1 SML between 3.0 SML and 3.5 SML will equate to 20% of the downside penalty. Upside: €0.50m Downside: €0.50m
Target per Year	
2021	1.5 – 3.0 SML
2022	1.5 – 3.0 SML
2023	1.5 – 3.0 SML
2024	1.5 – 3.0 SML
2025	1.5 – 3.0 SML

Table S 5

Metric	3.2.2. System Frequency (%)
Assessment	Quantitative
Purpose of the metric	This is an existing metric and we propose a change to some of the parameters. The Grid Code requires that the frequency is kept within the normal operating limits of 50 Hz ± 0.2. This is to protect equipment and ensure a quality supply of electricity to end users. Assessing the percentage of time the TSO operates within this window is considered a good measure of the performance against the Grid Code requirement. Certain events outside of the control of the TSO, such as generator trippings, will result in the frequency falling outside of these normal operating limits. Management of frequency will also become more challenging due to increasing levels of non-synchronous generation on the system. It should also be noted that there needs to be a balance in relation to this metric as to not create a perverse incentive i.e. to maintain the frequency within the target range 100% of the time would require the TSO to hold additional dynamic operating reserve at an additional cost to consumers. The TSO therefore proposes that a normal operating target of 50 Hz ± 0.1 Hz is assessed on an annual basis. It should be noted that this target window is more onerous than that outlined in the Grid Code. The target percentage of time that the frequency should be in this window is outlined below. The TSO believes that this strikes the best balance to ensure quality of supply but which minimise costs.
Approach to measurement	The percentage of time that the frequency is within the range of 50 Hz ± 0.1 Hz will be assessed at the start of each year for the previous year. A report will be prepared by the TSO, with the supporting data accompanying the report.
Upside/Downside	The actual performance was 99.6% in 2017 and 99.65% in 2018. Frequency control will become increasing challenging with the rapid decarbonisation of the electricity system with fewer conventional sources of frequency control and stability. It should also be noted that aiming for frequency control within the proposed limits close to 100% would present a perverse incentive on the TSO to have an increased volume of system services, which would ultimately be borne by the end customer. A tolerance of ±2% is proposed around the central target. A linear payment/penalty is proposed between the central target and the outer band i.e. for every 0.1% away from the outer target will equate to 5% of the incentive payment or penalty, as applicable. Upside: €0.50m Downside: €0.50m

Target per Year	
2021	96%
2022	96%
2023	96%
2024	96%
2025	96%

Table S 6

<table>
<tr><td>Metric</td><td>3.2.3. Cyber Security Maturity</td></tr>
<tr><td>Assessment</td><td>Quantitative</td></tr>
<tr><td>Purpose of the metric</td><td>This is a new metric. Cyber risks do not stand still and the security programme needs to continuously evolve to keep pace with an ever changing global threat landscape. As the sophistication of cyber-attacks increase, the security function will need to adapt to manage the existing and emerging risks.

This metric will measure the maturity of the TSOs cyber security tools and processes.

The Power and Utilities average maturity using the EY framework is currently 2.2.</td></tr>
<tr><td>Approach to measurement</td><td>It is an independently assessed score which comprises NIST and ISO best practices. This proposal is currently based on the EY Cybersecurity Programme Assessment (CPA). The assessment benchmarks and scores the following areas:
<table>
<tr><th>NIST Domain</th><th>Category</th></tr>
<tr><td rowspan="5">IDENTIFY</td><td>Asset Management</td></tr>
<tr><td>Business Environment</td></tr>
<tr><td>Governance</td></tr>
<tr><td>Risk Assessment</td></tr>
<tr><td>Risk Management Strategy</td></tr>
<tr><td rowspan="6">PROTECT</td><td>Access Control</td></tr>
<tr><td>Awareness and Training</td></tr>
<tr><td>Data Security</td></tr>
<tr><td>Information Protection Processes and Procedures</td></tr>
<tr><td>Maintenance</td></tr>
<tr><td>Protective Technology</td></tr>
<tr><td rowspan="3">DETECT</td><td>Anomalies and Events</td></tr>
<tr><td>Detection Process</td></tr>
<tr><td>Security Continuous Monitoring</td></tr>
<tr><td rowspan="5">RESPOND</td><td>Analysis</td></tr>
<tr><td>Communications</td></tr>
<tr><td>Improvements</td></tr>
<tr><td>Mitigation</td></tr>
<tr><td>Response Planning</td></tr>
<tr><td rowspan="3">RECOVER</td><td>Communications</td></tr>
<tr><td>Improvements</td></tr>
<tr><td>Recovery Planning</td></tr>
</table>
This will require an annual audit of our cyber security processes and tools. This independent audit will be provided.</td></tr>
</table>

Upside/Downside	EirGrid first assessed our maturity in 2018 and received a score of 1.8. A concerted effort was undertaken to increase this and it 2019 we received a score of 2.5, which is now above the industry benchmark. The allowances required to meet the targets outlined below have been included in the Price Control submission. We propose that every 0.1 away from the target should equate to 20% of the incentive payment or penalty, as applicable. It is proposed that for all instances that the cost of the independent audit will be recoverable by the TSO. Upside: €0.50m Downside: €0.50m
Target per Year	
2021	2.8
2022	3.2
2023	3.2
2024	3.4
2025	3.5

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3.3. Cost

Metric	3.3.1. Network Project Handover (€)
Assessment	Quantitative and Qualitative
Purpose of the metric	This metric is based on the proposed PR4 Balance Scorecard with some refinements to reflect the overall new holistic incentive framework. The TSO/TAO has committed to delivering increased transmission CapEx programmes of work in PR5 and into PR6 to achieve the 2030 Climate Action Plan targets. The TSO/TAO 5 Year CapEx outturn needs to be robust over PR5 to deliver on these targets. This metric will measure the timely transfer of projects from the TSO to the TAO.
Approach to measurement	This metric is measuring TSO transmission CapEx and the TAO outturn in PR5. The five year baseline programme for PR5 will be submitted to CRU in 2020, assessment of the metric will be on an ex-post and ex-ante basis at the end of PR5 The TSO and TAO PR5 outturn is expected to be €1.07bn (TSO €81m/TAO €986m) subject to the PR5 regulatory decision in 2020. It is proposed that the metric is a 5 year delivery metric which is agreed ex-ante as per the TSO/TAO PR5 transmission CapEx baseline which will be agreed in 2020 (to commence on 01/01/2021). An annual outturn report will be provided and a final true up report at the end of the PR5 period. An ex-post annual adjustment will be required to account for issues outside the control of the TSO and TAO that lead to projects not being progressed as planned such as land access issues, changes in customer preferences, customer consenting issues, customer delays etc.
Upside/Downside	This would be assessed on a 5 point scale of Significantly below standard (-100%), Below standard (-50%), Average (0%), Above standard (50%), Significantly above standard (100%). Upside: €2.5m Downside: €1.0m
Target per Year	
2021	Annual report. Final true up at the end of PR5
2022	Annual report. Final true up at the end of PR5
2023	Annual report. Final true up at the end of PR5
2024	Annual report. Final true up at the end of PR5
2025	Annual report. Final true up at the end of PR5

Table S 8

Metric	3.3.2. Imperfections (€)
Assessment	Quantitative
Purpose of the metric	This is an existing metric where we have proposed a change to some of the parameters. The aim of this incentive is to minimise constraints costs (which arise due to the difference between the ex-post market schedule and the real-time dispatch); these costs are passed onto the end electricity consumer. Since 2012 there has been a regulatory approved incentive for the TSOs to reduce imperfections costs. Since the establishment of this incentive process the TSOs, through the introduction of operational initiatives, have reduced Imperfection Costs (excluding Make Whole Payments) by €117.1 million. These savings are not only realised in the year in question but also create savings in the following years as they become normal operational standards. This continues to be relevant under the revised SEM arrangements.
Approach to measurement	The method of assessment will remain unchanged, however it is proposed that the design of the upside payment/downside penalty is recalibrated to ensure that it can unlock further value for customers.
Upside/Downside	On the upside the deadband is changed from 7.5% to 2.5% and the sharing factor is changed from 10% to 25%. This is a linear payment between 2.5% and 25% i.e. if the TSO reduces Imperfections by 25% then we can retain 25% of the overall savings. The existing downside design remains unchanged. Upside: This calculation is dependent on the annual imperfections allowance which is adjusted ex-post. Downside: This calculation is dependent on the annual imperfections allowance which is adjusted ex-post.
Target per Year	
2021	Determined annually ex-post
2022	Determined annually ex-post
2023	Determined annually ex-post
2024	Determined annually ex-post
2025	Determined annually ex-post

EirGrid also have an existing incentive to manage our internal OpEx allowance with a 100/0 cost sharing i.e. for every €1 outturn below our allowance we get to retain this, whereas for every €1 outturn above our allowance we must absorb this under provision.

3.4. Performance

Metric	3.4.1. Stakeholder Engagement
Assessment	Qualitative
Purpose of the metric	This is an existing metric. This metric is designed to measure our Stakeholder Engagement.
Approach to measurement	A CRU established Stakeholder Panel will assess and score EirGrid on the quality (20%), implementation (40%) and effectiveness (40%) of their stakeholder engagement strategy in the previous year. The panel will be chaired by CRU and will consist of representatives from a range of stakeholders including generators, suppliers, energy communities and Large Energy Users. EirGrid will publish a report for consultation on the effectiveness of their stakeholder engagement in the preceding year. The panel will assess EirGrid's performance, drawing on this report, the consultation responses and the final submission from EirGrid to the panel. EirGrid will receive a score of between 1 and 10. The incentive payment will be based on this score.
Upside/Downside	EirGrid received a score of 7.14 in 2019. The 2019 assessment will commence in May 2020. This Stakeholder Engagement metric is dependent on the investment that is forecast by EirGrid in Engagement and Education, Enhanced Customer Journey and the Framework for Development of the Grid. This investment is necessary to continue to build and improve stakeholder engagement across the organisation and deliver on the feedback received from stakeholders and the NSEE Panel to date. A score of: 0 – 1: no incentive 1 – 2: no incentive 2 – 3: no incentive 3 – 4: no incentive 4 – 5: no incentive 5 – 6: 20% upside 6 – 7: 40% upside 7 – 8: 60% upside 8 – 9: 80% upside 9 – 10: 100% upside

	Upside: €0.75m Downside: €0.00m
Target per Year	
2021	7.50
2022	7.75
2023	8.00
2024	8.25
2025	8.50

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Metric	3.4.2. Investment Planning
Assessment	Qualitative
Purpose of the metric	This metric is based on the proposed PR4 Balance Scorecard with some refinements to reflect the overall new holistic incentive framework. The purpose of this metric is to ensure that we are making robust and quality investment decisions in a timely manner in order to ensure the grid is safe, secure, and reliable and is able to economically deliver/enable our climate action targets (i.e. 70% RES-E by 2030). The CRU has indicated that there is a need to demonstrate that we are identifying appropriate investments in a timely manner.
Approach to measurement	We propose to use the same approach as the equivalent PR4 incentive: • The metric is qualitative in nature; • An annual independent ex-post audit of our investment planning process would be conducted based on the guiding principles and methodology set out further below; • Performance across the three steps of the Framework for Grid Development would be weighted as follows: o Step no. 1 – 20%; o Step no. 2 – 20%; o Step no. 3 – 60% • Projects for inclusion in the incentive would be assessed on an ex-post basis. Entry criteria for inclusion in the ex-post assessment would be limited to the following: o Investment Planning Projects in Steps 1 - 3: Decision documentation and supporting documentation for investment decisions made at Gateways 1 - 3, for all projects in Ireland, with an estimated (or forecast) total capital cost of greater than €10m (TSO and TAO combined); o The ex-post analysis would be limited to projects that have completed Gateways 1 - 3 in the calendar year in question. • We would also provide evidence to the auditors of any applicable process improvements and lessons learned implemented during the relevant period. **Audit Guiding Principles** 1. Identifying the need for network investment at different network locations. 2. Approving the network investments required to connect new Demand or Renewable customers to the transmission system (Gateway 3 only). 3. Determining the range of technologies which can meet a particular quantified need. 4. Demonstrating that the full range of stakeholder concerns

	have been considered, including environmental, socio-economic, technical performance, cost and deliverability. 5. Choosing the right solution to deploy – and how analysis of costs, benefits, technical considerations, and other impacts feature in that choice. **Audit Methodology** 1. The investments identified under Steps 1-3 of the six step process are brought forward in order to maintain supply in accordance with the TSO licence requirements. These investments are set out in the annual publication of the Transmission Development Plan. 2. The quality of decision-making in the option selection process, which ensures best value for the Transmission Use of System (TUoS) customer, is demonstrated in the documentation provided at gateways 1-3. 3. Performance to be measured as an outcome of the review of a sample of gateway 1-3 documentation within a calendar year. The quality of the documentation is under review. 4. Proposed scoring or grading system as per proposed in Upside/Downside section below (or equivalent audit assessment scale). 5. The annual decisions will be confirmed on an ex-post basis from the full register of decisions made in the applicable calendar year. 6. Projects to be assessed include those with an estimated or forecast total capital cost of greater than €10m (combined TSO and TAO). 7. An ex-post adjustment principle is in place for third party driven delays outside of the TSO's control and this will be taken into account when confirming the projects applicable for the annual audit process.
Upside/Downside	The TSO performance would be assessed on a 3 point scale of Average or below (0%), Above standard (50%), Significantly above standard (100%). It is proposed that for all instances that the cost of the independent audit will be recoverable by the TSO. Upside: €0.50m Downside: €0.00m Note that part of this assessment will include a joint metric with the TAO called 'Project Initiation to CPP Agreed Phase'. This is detailed in Section 3.2 of the supplementary document included in Annex 1. The TSO is proposing that the following upside and downside is utilised for this joint incentive per annum: Upside: €0.10m

	Downside: €0.00m For the avoidance of doubt the overall Investment Planning assessment will be capped and collared at +€0.5m/-€0.0m per annum.
Target per Year	
2021	Determined annually ex-post
2022	Determined annually ex-post
2023	Determined annually ex-post
2024	Determined annually ex-post
2025	Determined annually ex-post

Table S 10

Metric	3.4.3. Deployment of new Technology
Assessment	Qualitative
Purpose of the metric	This metric is based on the proposed PR4 Balance Scorecard with some refinements to reflect the overall new holistic incentive framework. The Enabling New Technology metric has the following aims: • Ensure our processes (internally and with the TAO and DSO) are effective in enabling the trialling, piloting, deployment and use of new technologies on the grid and in our operations. • Ensure that we are optimising the existing grid to minimise the need for new infrastructure through increasing the capacity of existing infrastructure or by using new technologies, where appropriate This is essential towards the overall goal of decarbonising the power system. New technology encompasses technology used by transmission and distribution connected customers, as well as technology used by the TSO on the transmission system, in the Control Centres, or in our interactions with the DSO with respect to the provision of system services by distribution connected service providers.
Approach to measurement	We propose the following approach to measurement: • Each year (timing to be determined), we would produce/update a rolling two year plan setting out planned activities to enable the deployment of new technology • At the end of the year, we would compile a report on the effectiveness of our approach to ‘Enabling New Technology’ over the previous calendar year

Upside/Downside	The TSO performance would be assessed on a 3 point scale of Average or below (0%), Above standard (50%) and Significantly above standard (100%). Upside: €0.50m Downside: €0.00m
Target per Year	
2021	Determined annually ex-post
2022	Determined annually ex-post
2023	Determined annually ex-post
2024	Determined annually ex-post
2025	Determined annually ex-post

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Metric	3.4.4. Infrastructure Delivery
Assessment	Quantitative and Qualitative
Purpose of the metric	This metric is based on the proposed PR4 Balance Scorecard with some refinements to reflect the overall new holistic framework. CRU has requested the TSO/TAO to deliver the PR5 programme with an emphasis on speed and delivery. The most appropriate incentive to assess this metric would be a five year incentive against the PR5 baseline of projects which will be agreed in 2020 with CRU. In order to deliver the step change outlined under our shared ambition, in the PR5 embracing change and delivering targets scenario of €1.07bn, the TSO/TAO will be required to employ a wide variety of process innovations and improvements.
Approach to measurement	The deliverable that the metric refers to is the delivery aspect of the Investment Planning and Delivery Balanced Scorecard framework for PR4, in particular steps 4-6 of this process. There are Quantitative and Qualitative aspects to the metric. • Quantitative – As per agreed PR5 baseline • Qualitative – Demonstrated process improvements It is proposed that the metric is a 5 year delivery metric which is agreed ex-ante as per the TSO/TAO PR5 transmission CapEx baseline which will be agreed in 2020 (to commence on 01/01/2021). A final outturn report will be provided at the end of PR5. Areas outside of the TSOs control should be excluded as part of any ex-post review.
Upside/Downside	The TSO performance would be assessed on a 3 point scale of

	Average or below (0%), Above standard (50%), Significantly above standard (100%). Upside: €0.50m Downside: €0.00m Note that part of this assessment will include two joint metrics with the TAO called 'Joint Process Improvement' and 'Asset and Programme Data Exchange'. These are detailed in Section 3.3 and 3.4 respectively of the supplementary document included in Annex 1. The TSO is proposing that the following upside and downside is utilised for each of these joint incentive per annum: Upside: €0.10m Downside: €0.00m For the avoidance of doubt the overall Network Delivery assessment will be capped and collared at +€0.5m/-€0.0m per annum.
Target per Year	
2021	Annual report. Final true up at the end of PR5
2022	Annual report. Final true up at the end of PR5
2023	Annual report. Final true up at the end of PR5
2024	Annual report. Final true up at the end of PR5
2025	Annual report. Final true up at the end of PR5

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