ESB NETWORKS

INNOVATION TO DELIVER THE ELECTRICITY NETWORK FOR A CLEAN ELECTRIC FUTURE 2023

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FOREWORD

Innovation in ESB Networks is a key enabler to deliver on our Price Review 5 (PR5), Climate Action Plan 23 objectives and our Networks for Net Zero strategy to deliver the electricity network for Irelands clean electric future by 2040.

At ESB Networks, we're delivering an electricity network to empower our 2.4 million customers every day introducing choice and flexibility around how they consume, generate and store electricity. Through innovation, ESB Networks will deliver an electricity network for our customers which delivers value for money and provides a sustainable energy system for us all. By investing in our technical capability and collaborating with our customers and partners, we're developing a smart and resilient electricity network of the future. Together, we're paving the way for Ireland's clean electric future through the electrification of heat, transport and industry as well as connecting renewables at scale to the electricity network.

We are clear that the challenge of delivering the electricity network to support the decarbonisation of Irish society no later than 2050 requires extensive and collaborative innovation and success will not be achieved without ongoing active customer and stakeholder participation, engagement and support. We will listen to and work with our partners and stakeholders to develop innovative solutions to ensure the network is smart, flexible, resilient, safe and adaptive to support our customers adopting low carbon technologies and deliver the connection of renewable generation at scale. In support of the Governments Climate Action Plan 23, our customers and stakeholders, we have developed our innovation strategy and portfolio of innovation projects across our 3 innovation pillars of future customer, climate action and network resilience.

Our annual innovation consultation is an important opportunity for us to ask our stakeholders for their views on our innovation activities and areas of focus. This report describes how ESB Networks, working together with customers, communities, research institutions and industry partners, is implementing new ideas, innovative concepts, and technologies.

We welcome your comments and feedback to help shape how ESB Networks innovates to deliver the network for Ireland's clean, electric future and the enduring benefits for current and future generations.

Please send your comments and feedback to innovationfeedback@esbnetworks.ie

Nicholas Tarrant

Nicholas Tarrant

Managing Director
ESB Networks

EXECUTIVE SUMMARY

ESB Networks ensures electricity gets to the homes and businesses of our 2.4 million electricity customers in a safe and efficient manner. As Distribution System Operator (DSO), Distribution Asset Owner (DAO) and Transmission Asset Owner (TAO), ESB Networks works to meet the needs of all Irish electricity customers, providing universal affordable access to the electricity system. We recognise that the environment in which we operate is changing rapidly, driven by new policy and regulation, the advancement of technology, and the changing needs and expectations of our customers and stakeholders. This means the role of electricity is also changing, creating new challenges and opportunities.

Innovation in ESB Networks is a key enabler to deliver on our Price Review 5 (PR5) objectives and Networks for Net Zero strategy as we continuously innovate to deliver the electricity network for Ireland's clean electric future. This report describes how ESB Networks, working together with customers, communities, industry, the Transmission System Operator (TSO), technology providers, academics, and research institutions, is implementing new ideas, innovative concepts and technologies that will support climate action and provide enduring benefits for our customers and communities.

Throughout this document, as part of our annual consultation, we will share our approach to innovation, including our innovation framework, strategy, governance, processes, dissemination, feedback, and progress. An update is also provided on our innovation project portfolio that spans across our three innovation pillars and reports on progress by ESB Networks over the last 12 months.

ESB Networks published our last annual consultation, 'Innovation to connect a Clean Electric Future' in February 2022 and invited feedback from interested parties. We welcomed our stakeholder feedback from respondents across 8 sectors. We received positive feedback and support from the respondents in relation to many of our ideas, pipeline projects and active projects. We issued our response paper in March 2022 and the feedback fed into our agenda for our spring meeting of our Innovation stakeholder panel.

Throughout 2022, ESB Networks has extensively collaborated, engaged and disseminated the learnings and benefits of our innovation projects and activities with our stakeholders. We have also progressed projects and their learnings into BAU where there are associated demonstratable benefits.

Key highlights of 2022 include:

- Successful delivery and completion of the Dingle Project in collaboration with our community partners and ambassadors.
- Hosting our first in-person Innovation Forum in 3 years and hosting innovation webinars to engage with and share learnings with our stakeholders.
- Welcoming new members to the second cohort of our Innovation stakeholder panel.
- Successfully completing 9 Innovation Projects and sharing learnings with our partners and stakeholders across these and our ongoing projects while initiating 5 new innovation projects.
- Transition of the Modularised EGIP substation into Business as Usual as an option for Renewable customers connected at 10kV and 20kV.
- Joining and initiating new projects under the Next Generation Energy Systems (NexSys) programme and the International Community for Local Smart Grids (ICLSG) project.
- Expression of Interest for radical innovation ideas and bilateral meetings.
- Collaborating and engaging with all our stakeholders, community groups, TSO, academia, international DSO's, industry, government, CRU and international research organisations.
- Continue to develop ESB Networks Innovation Culture through Design thinking workshops, conferences and programmes.

The purpose of this consultation is to continue to encourage you, our stakeholders, to share your ideas with us, provide feedback on our innovation activities, and on how we can collaborate further to deliver the electricity network to support a clean electric future together. We want to hear your views on how ESB Networks delivers innovation, our projects and areas that ESB Networks should focus on.

Please send your comments and feedback to innovationfeedback@esbnetworks.ie

Innovation KPIs Dashboard

ESB Networks' innovation efforts are broad-ranging and involve collaboration with several organisations. In order to provide our internal strategic board and stakeholders with information about the extent of our innovation efforts, a set of KPIs has been developed. Our KPIs are updated quarterly and in response to stakeholder feedback are regularly published on our website.

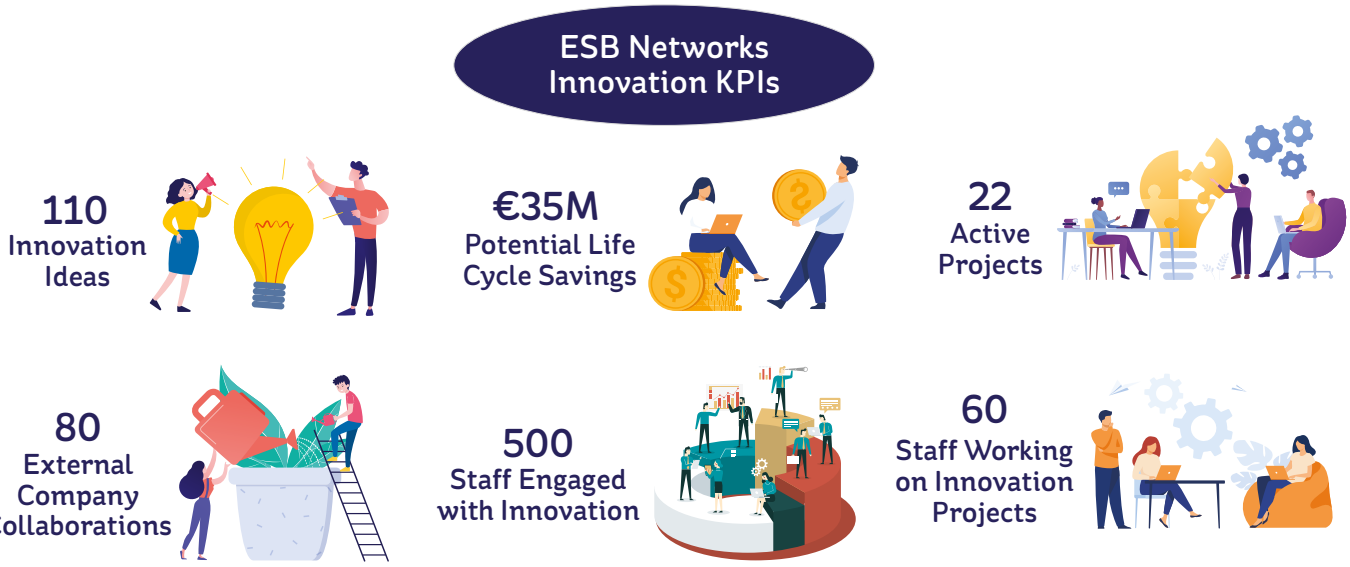


Figure 1.1: Innovation KPIs Dashboard

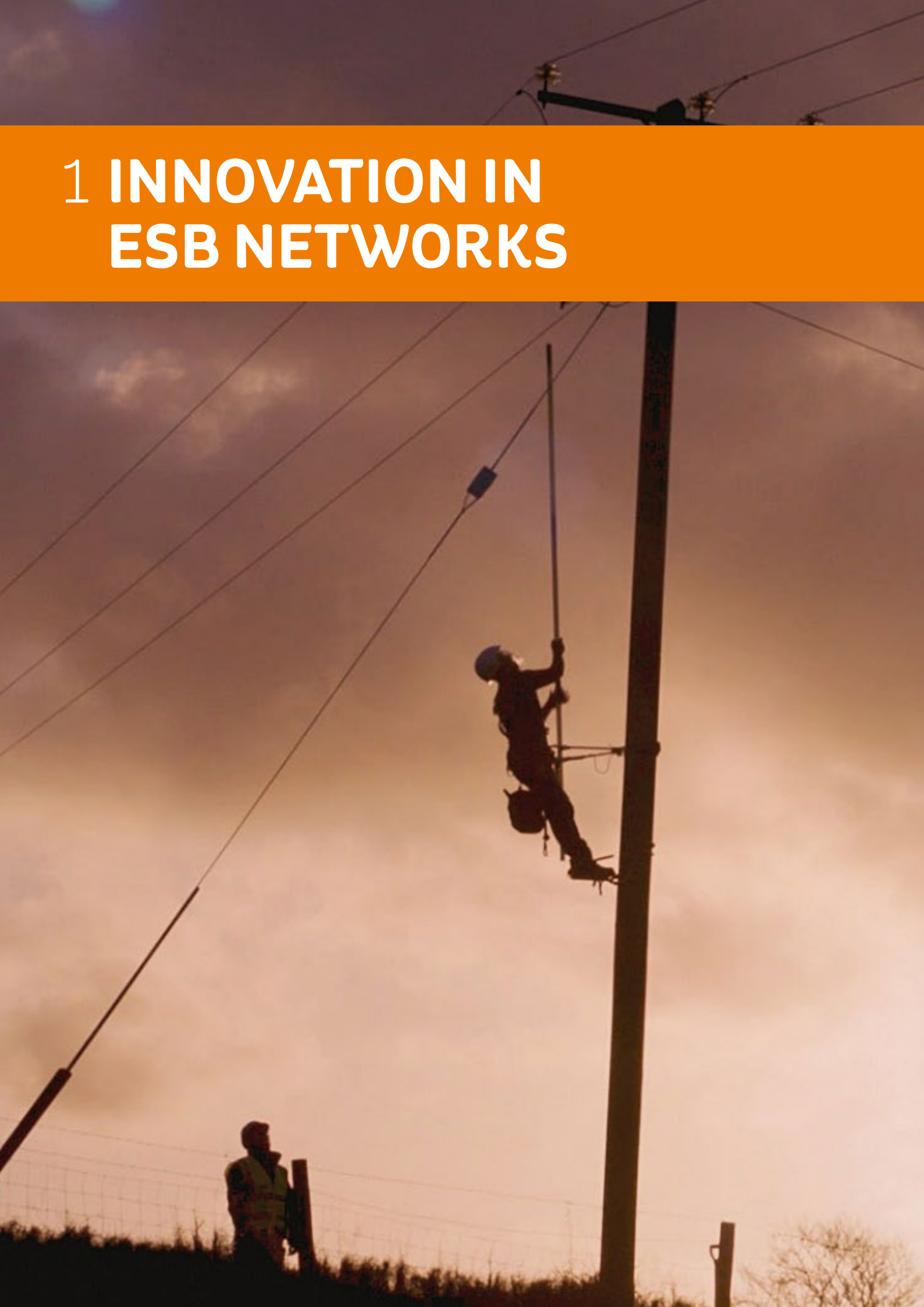
- **110** innovation ideas examined in 2022.
- **22** projects currently in delivery with 5 new projects initiated and 9 projects completed in 2022 (see section 3).
- **80+** external collaborations – ESB Networks is actively collaborating or partnering with over 80 organisations across a wide range of industry sectors and research organisations.
- **60+** staff are working on and supporting Innovation projects across ESB Networks with over 500 staff engaged across our broader internal innovation community.
- **€35m** – this figure is compiled from the potential life cycle savings calculated by each project.

For more details of our Innovation projects and activities please visit our website
Innovation in ESB Networks (www.esbnetworks.ie/who-we-are/innovation/)

This document is split into 5 sections and there are navigation tabs on the top of the page to navigate to different sections of interest.

1. **Innovation in ESB Networks** gives an overview of our Innovation Strategy, Values and Governance.
2. **How we Innovate in ESB Networks** gives an overview of our innovation processes.
3. **Innovation Project Portfolio and Delivery** is the main section of the document which give an overview of our Innovation projects.
4. **Transition of Projects and Learnings to BAU** gives an overview of our approach to transition projects and their learning to the business with a summary of project learnings to date.
5. **Collaboration, Engagement and Dissemination** gives an overview and some spotlights of our key activities during 2022.

1 INNOVATION IN ESB NETWORKS



1.1 OUR INNOVATION VISION, VALUES AND MISSION

At ESB Networks, our vision is to deliver the electricity network for Ireland's clean, electric future and our customers will be at the heart of the transformation. Our ambition is to build, maintain, operate, and develop the electricity network to meet the needs of our customers, today and into the future.

A key enabler to delivering our vision and strategy is to continuously innovate towards a sustainable low carbon energy future for our customers and for Ireland.

Our definition of innovation is to implement new ideas for the enduring benefit of our customers and business.

Our values underpin everything we do at ESB Networks and are the foundation of our innovation strategy. They will continue to guide our decisions and actions as we deliver the electricity network for Ireland's clean, electric future.

Figure 1.1: ESB Networks' Values

Our mission is to play a central role in Ireland's transition to a low-carbon economy, and to provide secure, sustainable, efficient and reliable electricity in a cost-effective manner for all customers. In support of Ireland's Climate Action Plan 2023 (CAP), the Programme for Government and the CRU's PR5 objectives, our Innovation Strategy has been developed to facilitate Ireland achieving its climate change targets for 2030 and beyond to net zero.

ESB Networks looks to embed innovation across the business and is not confining innovation to our dedicated innovation team. We're driven to continue to develop a culture of innovation which is encouraged across the organisation as we seek to challenge the status quo to find new and innovative approaches to how we carry out our business and operate our systems. This will ultimately benefit all our customers, irrespective of how or where they interact with the energy system.

The adoption of new materials, technologies and concepts, digitalisation and big data analytics have the potential to create greater efficiencies, while electrifying the heat and transport sectors will offer a range of new opportunities for our customers to engage with the energy system. Comprehensively understanding the capabilities and limitations of these new technologies and concepts, through a combination of trials and analysis, will ensure that ESB Networks will be able to deliver the electricity distribution network for our customers.

The following sections provide an overview of our Strategy, Governance and Processes to deliver innovation. We have published this in more detail for reference in our Innovation Governance and Strategy Framework document published here.

1.2 OUR INNOVATION STRATEGY FRAMEWORK AND GOVERNANCE

ESB Networks has developed its innovation strategy, in conjunction with robust governance and processes, to advance new innovative solutions to support the delivery of our PR5 programme and our Networks for Net Zero Strategy. Our strategy will enable the delivery of the Governments CAP 2023 and supports the decarbonisation of electricity by 2040, that will enable Ireland's achievement of net zero ambition no later than 2050. Our innovation strategy and approach continues to evolve, and with the publication of our Networks for Net Zero strategy, will be reviewed in 2023 to support the actions to deliver the Network for Net Zero by 2040.

The fundamental challenges posed by climate change to our society pose significant challenges for the operation of the distribution system but also present new opportunities to innovate and continually review how we plan, develop, and operate the distribution system to deliver the electricity network for Ireland's clean, electric future. By 2030, the network will support the adoption of 680,000 heat pumps, up to 1 million Electric Vehicles and the integration of up to 80% renewable electricity generation.

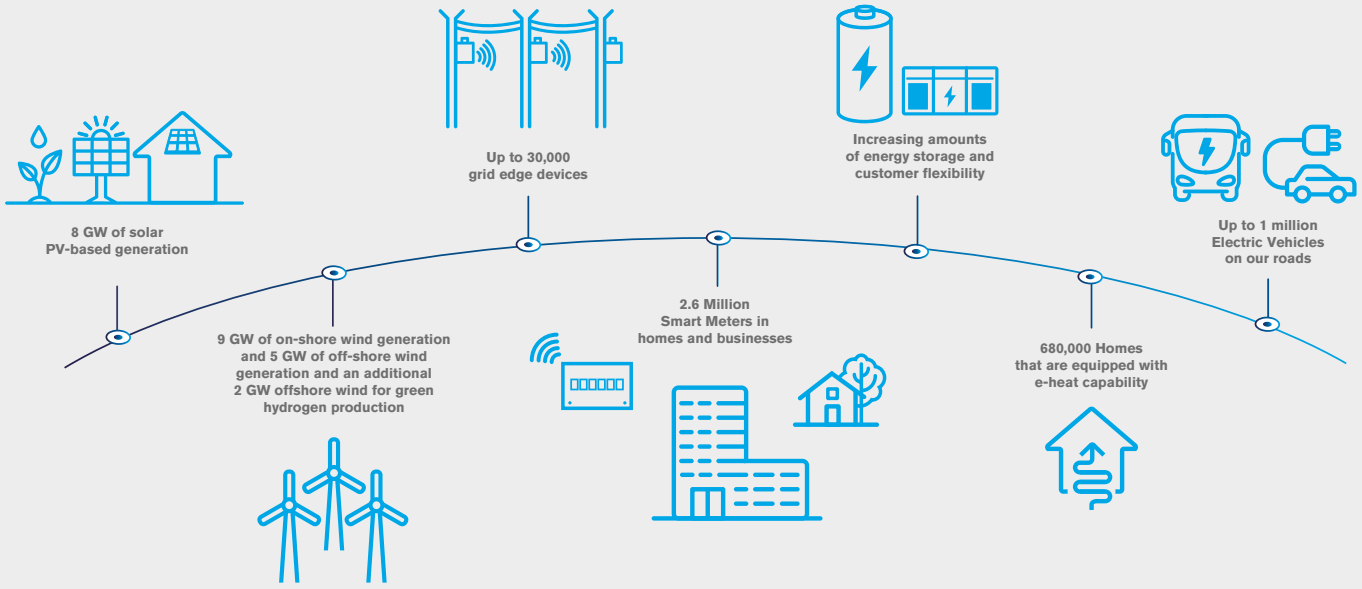


Figure 1.2: Electricity Network by 2030

1.2.1 Innovation Strategy Framework

We have developed an Innovation Strategy Framework to manage every stage of the development and implementation of our strategic initiatives, from setting the vision to the transition to Business-As-Usual (BAU) . This innovation management framework combines our governance with our processes for managing innovation across the life cycle of innovation projects. It has been designed to be flexible enough to cater for the changing requirements of our business and society. Delivering on this strategy will require us to work with our stakeholders to continue to innovative across every aspect of our business.

Robust processes associated with the identification of innovative opportunities are a key part of ESB Networks' Innovation Strategy. This framework respects that our customers, who support the cost of these projects, expect efficient and effective value from the innovation process. It recognises the risks and uncertainties inherent in investing in trialling untested innovation ideas and ensures an appropriate level of oversight.

1.2.2 Governance and risk management

An integral part of managing risk and ensuring the operational success of innovation projects is maintaining an appropriate level of governance. This is provided by ESB Networks' Senior Leadership team, sponsored by the Managing Director, and through the Connecting Futures Board (CFB) and Innovation Steering Group (ISG). The CFB is a cross-functional group of ESB Networks senior managers that provides a common governance structure for the Business and the Innovation Steering Group (ISG). The ISG is a cross functional group made up of ESB Networks Managers and external advisors with delegated authority for managing innovation.

The governance of our Innovation Strategy includes oversight of the processes which will allow ESB Networks to effectively identify, assess, monitor, prioritise and deliver the portfolio of innovation projects in accordance with our vision and values for the benefits for all customers. Our Innovation Governance Framework sets out the roles and responsibilities of individuals that are part of the innovation governance structure. The aim of our innovation governance is to ensure the collaborative implementation of new ideas that will deliver the electricity network for Ireland's clean, electric future and provide enduring benefits for our customers.

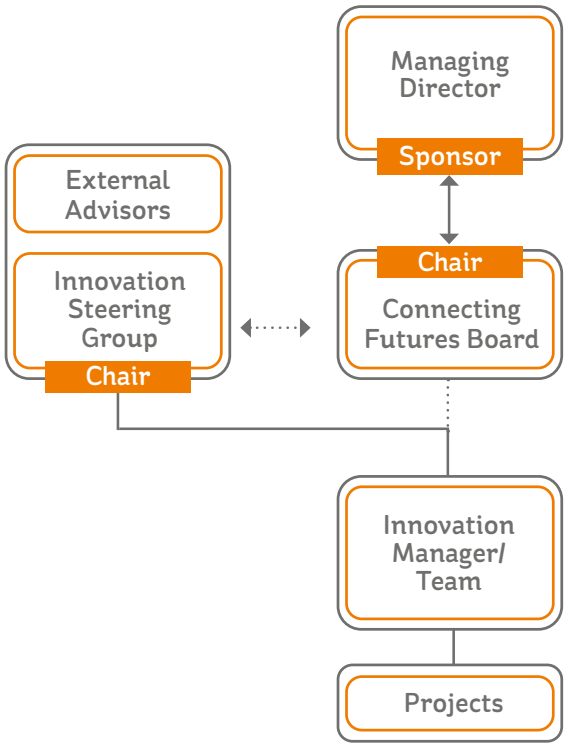


Figure 1.3: Innovation Governance Organisational Structure

1.2.3 Our Innovation Process

To effectively implement our Innovation Strategy, we have developed an end-to-end process for the management of innovation initiatives across our business areas. This process is part of our Innovation Strategy Cycle (See Figure 1.4) and has three main stages:

1. Project identification and evaluation;
2. Delivery of innovation projects;
3. Transition to BAU and dissemination of learnings.

The structure of our innovation framework and ongoing efforts in collaboration and planning allow us to identify a comprehensive number of potential projects. Proactive engagement with stakeholders and continuous monitoring of the environment we operate in have helped to determine when projects warrant cancellation, expansion or consolidation with projects of similar strategic objectives.

This reflects the dynamic nature of innovation and the fact that ESB Networks has developed a high-performing culture of innovation that values the pursuit of new ideas and opportunities. This diagram shows the overall strategy cycle that we use, the process for each individual project and how they are integrated:

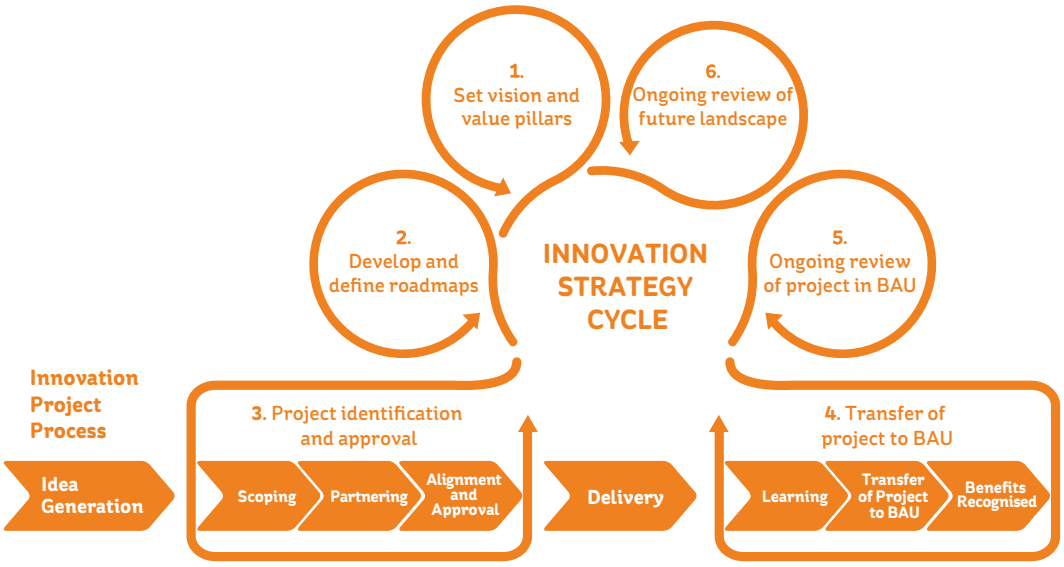


Figure 1.4: Innovation Strategy Cycle

1.2.4 Three Innovation Pillars: A Progression Plan To 2030 And Beyond

Our innovation strategy framework has been designed to be flexible enough to cater for the changing requirements of our business and society. Our people and values are at the heart of delivering on our innovation strategy which is reflected in how we implement our innovation framework. The innovation framework has been applied to a balanced portfolio of projects covering three Innovation Pillars:

Future Customer: Empowering and Supporting Customers and the Economy

Climate Action: Decarbonising Electricity, Heat and Transport

Network Resilience: Efficient, Secure, Reliable Electricity

Figure 1.5: Innovation Pillar

The innovation pillars align with our Networks for Net Zero strategy, and our PR5 objectives as agreed with the CRU. ESB Networks acknowledges the need to be flexible to address future challenges which may emerge. We expect to see refinements to the projects and areas of focus included in each innovation Pillar as policy priorities emerge, changes in customer behaviour manifest themselves and as forecasts for generation, flexibility and low-carbon load become more certain.

Our innovation activities operate across three broad horizons of innovation:

- Incremental – the innovation builds on existing systems, equipment or processes.
- Breakthrough – the innovation potentially provides new systems, equipment or processes.
- Radical – business-altering innovation.

1.3 STRENGTHENING INNOVATION CULTURE, EXPERTISE AND CAPACITY BUILDING

To ensure that the changing needs of the environment, government and society are met, ESB Networks continues to work towards the model of innovating further and innovating faster. In order to do this, we must ensure we have the people, with the right skills and expertise, in the right place, at the right time. To meet this challenge, ESB Networks continues to enhance innovation expertise and capacity building internally through a number of different initiatives. We have a range of Innovation programmes to develop and promote innovation throughout ESB Networks:

- ESB Networks Innovation Community & Culture
- Innovation Design thinking Workshops
- Innovation Forum, Conferences and Webinars
- ESB Networks Innovation Ideas Hub and Yammer
- Training and Development Programmes
- The Innovation Academy
- X_Potential - Promoting Innovation from Within
- Free Electrons Programme: International accelerator programme in partnership with 8 other DSOs.

1.4 PERFORMANCE IMPROVEMENT

ESB Networks is committed to assessing and implementing performance improvement programmes to ensure we continue to build on best practice to deliver on our Innovation strategy and projects. As part of this we engage with peer DSOs and research organisations to share learnings of delivering innovation projects and the challenges.

European Foundation for Quality Management (EFQM): We also carry out an assessment under the EFQM Innovation Assessment which is an internationally recognised and certified model of excellence. Founded in 1989, EFQM is an innovative, not-for profit, international organisation that supports leaders as they manage cultural change and transformation to deliver performance improvements and benefits for their key stakeholders.

ESB Networks was assessed in Q4 2021 under the EFQM Innovation Lens focusing on the activities, processes and culture in ESB Networks. The Innovation lens allows an organisation to assess its level of innovation maturity against a comprehensive suite of indicators and uses a weighted scoring mechanism across 7 areas under the frameworks of Direction, Execution and Results. ESB Networks is recognised as a 5-star organisation, out of a maximum of 7 stars, under the EFQM innovation lens. This achievement represents "Growth in Innovation" and demonstrates how we are integrating our innovation culture, processes, and procedures throughout the business.


2 HOW WE INNOVATE IN ESB NETWORKS






2 HOW WE INNOVATE IN ESB NETWORKS

ESB Networks have developed robust processes and procedures to assess and deliver innovation from project identification through to delivery and the dissemination of learnings and transition of projects which demonstrated benefits to BAU as per figure 2.1. Our innovation focus for projects are defined by the Oslo Manual (2018, published by the OECD and Eurostat); as a technological innovation, a business process innovation or a combination of a business process and technological change. Through our engagement and collaboration with peer DSO's we also look to leverage a fast follower approach where applicable. This approach seeks to leverage research and innovation that has already been implemented by other comparator utilities and assess their potential benefits on our network.

2.1 PROJECT IDENTIFICATION, EVALUATION & DELIVERY OVERVIEW

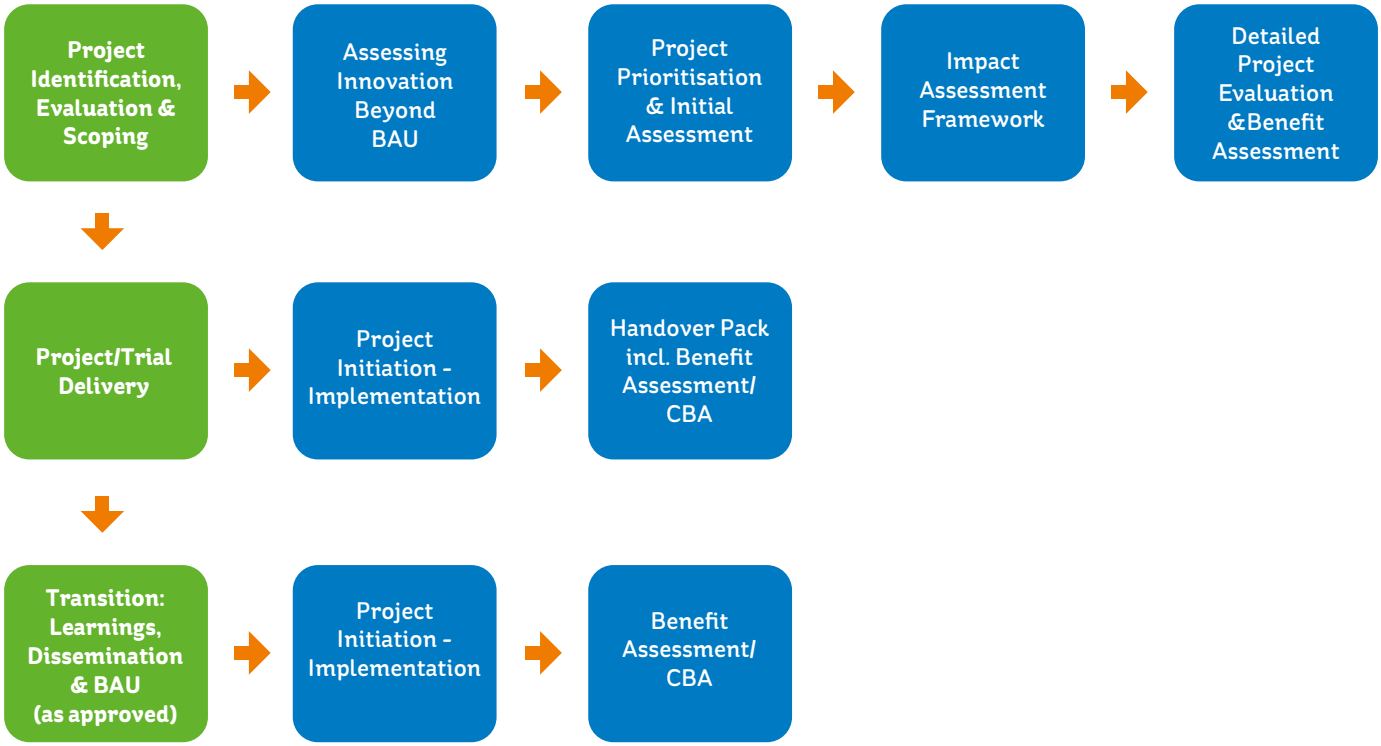


Figure 2.1: Project Identification, Evaluation & Delivery

The process from idea identification to project delivery includes project identification, evaluation, scoping and approval stages:

Figure 2.2: Project Identification and Evaluation

1. **Identifying Project Ideas Beyond Business-As-Usual**
   - Innovation ideas are initially reviewed to ensure that the scope of the idea proposed is to trial a technology or concept that is beyond BAU. If a project is deemed BAU it may proceed as a BAU pilot implementation project.
2. **Project Prioritisation and Initial Assessment**
   - Innovation ideas then go through an initial assessment and prioritisation for further investigation and scoping against five criteria: Lifecycle Savings Potential; Time Frame/Complexity; Core Competencies; Strategic Fit and Innovation Type; and Customer Need and Demand.
3. **Impact Assessment Framework**
   - As projects move from pipeline to scoping, an Impact Assessment Framework is applied to evaluate the impact across six strategic areas:
     - Safety;
     - Network Reliability and Resilience;
     - Facilitating Growth and New Connections;
     - Customer and New Market Services;
     - Environment;
     - Social and Sector Learning.
4. **Detailed Project Evaluation and Benefit Assessment**
   - Once the ideas have passed these early reviews and assessments, they are scoped out and an investment appraisal is developed for each project. The investment appraisal includes a detailed benefit analysis; this is a qualitative and a quantitative analysis where possible. If the investment appraisal deems the project viable (which may be conditional on a successful pilot project), then a project proposal is developed with clear project objectives for recommendation to the ISG for transition to project delivery stage.
5. **Strategic Validation Through Collaboration with Stakeholders and Third Parties**
   - Innovation ideas and projects are validated throughout the project lifecycle through collaboration with stakeholders and third parties.

A detailed overview of each process in our project identification, from evaluation to approval has been published on our website here.

We have also published a webinar which presents our innovation process with examples of projects at each stage of the identification, assessment, delivery, and Transition into BAU process here.

2.2 FAST FOLLOWER APPROACH

ESB Networks' 'Fast Follower' approach reviews new solutions or technologies that have been trialled by other utilities and which may feasibly be transferred for use by ESB Networks in Ireland.

Through our engagement and collaboration with peer DSO's this approach seeks to leverage research and innovation that has already been implemented by other comparator utilities. It offers opportunities to adopt and/or adapt such solutions for Irish circumstances, cognisant of the fact that the Irish electricity network has characteristics that are not necessarily replicated elsewhere. These somewhat unique characteristics include the challenges associated with having almost six times as much overhead line rural network per capita as most other European countries, combined with having large amounts of non-synchronous generation on an islanded system with substantially less interconnection than the vast majority of comparable jurisdictions. As such, a simple 'Plug and Play' approach to innovation outcomes successfully achieved elsewhere may not always be applicable on our system. Nevertheless, given the size of our organisation in the context of global innovation efforts, ESB Networks believes it worthwhile to leverage successful innovation outcomes from others wherever possible, and that this approach should offer value for money for our customers. This has been echoed in previous stakeholder feedback.

ESB Networks has also shared a number of Innovation projects with peer DSO's for them to adopt as fast followers.

[2] The 'Oslo Manual, 2018' is available for download from Eurostat

2.3 PROJECT PROPOSAL TO TRIAL/PILOT

Following successful completion of the assessments outlined above, projects are presented to the ISG for review and approval. An innovation pipeline idea can make the transition to an innovation trial or pilot project with an approved scope and clear measurable deliverables. In some cases, an innovation trial or pilot project may not be required, and the 'Fast Follower' trial approach may be used. Our robust approach to project identification and evaluation enables us to deliver the optimum mix of projects that have CBRs (Cost Benefit Ratios) greater than one, provide maximum impact and deliver long-term benefits to the operation of a low-carbon electricity system powering the decarbonisation of heat and transport.

2.4 DELIVERY OF INNOVATION PROJECTS

In general, projects approved for delivery are then assigned to a Project Manager in one of two ways. Firstly, a Project Manager who becomes free after completing a previous project may be tasked to lead a new project for delivery. The project managers available to the Innovation Manager are experienced Project Managers who have completed several innovation projects. They also have a breadth of experience that includes other engineering and energy infrastructure projects. They are specialists in their fields, familiar with best-practice Project Management methodologies and are well placed to adopt the most suitable methodology and approach to deliver the designated project. Alternatively, a project may be assigned to a specific business unit for execution and delivery. In this case, the project is not delivered by the innovation team as it is deemed that the business unit is the most suitable and best-placed vehicle to do so.

2.5 QUALITATIVE AND QUANTITATIVE ASSESSMENT OF BENEFITS AGAINST COST

Projects that are approved by the ISG will have had an investment appraisal completed for them, and the benefits anticipated at completion will be identified. Project Managers report on these as the project proceeds and note their achievement, or otherwise, in regular periodic project reports.

Savings from innovations trialled and piloted in our innovation projects are tracked, and a rolling overall figure is compiled. We have estimated that the potential lifetime savings that could accrue from our current portfolio of projects underway is €35m. This figure includes:

- Projects that afford one-off savings to ESB Networks
- Projects that deliver an ongoing multi-year saving to ESB Networks
- Projects where the savings are proportional to the actual uptake of the product. On a conservative basis, low uptake assumptions have been made to determine the savings for these projects
- Projects that provide a saving to the customer (without any saving for the company)

Some projects make only a small or no financial contribution to overall monetary savings; however, these qualitative project outcomes are considered valuable for their important contributions and learning opportunities that improve our knowledge and understanding of how to transform the network to connect our customers to a clean, electric future.

3 INNOVATION PROJECT PORTFOLIO AND DELIVERY

3 INNOVATION PROJECT PORTFOLIO AND DELIVERY

ESB Networks is conducting a review of its portfolio of innovation projects and ideas for 2023 with some ideas being consolidated into new project proposals. Some of the existing, longstanding ideas from the pipeline are being rescoped in line with the new ESB Networks strategy where they address a business need. We continue to develop innovation ideas and pilots where they have the potential to help us with our electrification, decarbonisation, continuity, and network resilience challenges.

Specific areas of focus are to explore alternative methods to complete MV and LV system improvements that can be delivered fast, more cost effectively, and with less impact on the environment.. Similarly, we are looking at potential pilots to address technical limitations (e.g., voltage rise, drop and power quality) on the rural MV and LV network and increase the utilisation of existing network capacity.

Alongside the physical network reinforcement innovations, we continue to assess innovations in the area of non-wires alternatives as potential solutions to address the growing demand including that from the electrification of heat and transport. Specific challenges in this space include the impact of the EU Alternative Fuel Infrastructure Regulation (AFIR) on the distribution network with the potential for innovation pilots of new connection methods and connection types.

Data and digitalisation is a dominant innovation theme across all DSOs and we will continue to explore the potential for AI and other emerging digital technologies to improve how we work and understand our network. ESB Networks recently delivered a customer portal enabling all registered customers to access their meter data and we will continue to seek out improvements in our customer journey and support them on their low carbon transition.

3.1 INNOVATION PROJECT PORTFOLIO OVERVIEW

The ISG receives a quarterly report that outlines the status of each innovation project. The report contains graphs (See example in Figure 3.1) which allow board members to quickly see project statuses and understand how the innovation programme is progressing. Following stakeholder feedback, our 18-month Innovation Programme is published on our website bi-annually and gives our stakeholders a high-level status overview of our innovation projects. Due to the nature of innovation, ESB Networks take an agile approach to its project portfolio and pipeline assessing the project status and relevance. Projects may be cancelled, subsumed or put on hold pending further investigation to their benefits in order to maximise use of resources.

Innovation Project Portfolio and Pipeline

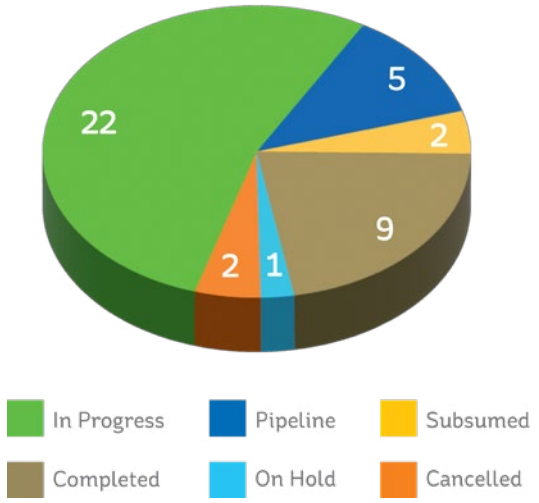


Figure 3.1: Q4, 2022 - Breakdown of Project Status

Of the 110 innovation ideas assessed across various sources in 2022, our innovation project porfolio has 22 projects in progress, including 5 new Innovation projects, and 4 pipline projects under review. 4 of the projects which were on hold in 2021 have been cancelled as they have been superceded or subsumed into developments in BAU transformation programmes.There were 9 projects succesfully completed in 2022 with the dissemination of the project learnings and outputs with some projects transitioning into BAU where the business benefits were realised, as detailed in section 3.

Projects Completed in 2022:

- Dingle Project
- Exploration of ASHP for Irelands Residential Heating Needs
- 300kVA Pole Mount Transformer
- New Core and Agregation IP Network
- Real Time State Estimation on Irish Distribution Network
- Leveraging Enhanced LV Monitoring to Optimise Targeted Network Reinforcement
- Nodal Controller
- Tesselo – LiveEO Vegitiation Survey System
- Weather Forecasting and Network Damage Prediction

A number of projects have been Subsummed/Cancelled as they have been superseeded by BAU transformation programmes or other innovation projects in 2022:

- Leveraging Fibre Infrastructure for Smart Network Management
- Data Analytics to temperature corrected loads
- Big Data Analytics for Wind Farms
- Novel LV Network Analysis Tool

The following sections detail each of our approved pipeline projects or projects in active delivery across each of our 3 Innovation pillars; Future Customer, Climate Action and Network Resilience.

3.2 FUTURE CUSTOMER PILLAR

Empowering and Supporting Customers and the Economy: This innovation pillar consists of projects that focus on enabling customers and communities to transition from a passive customer to an active energy citizen. Key activities will be enabling energy communities, facilitating the connection of microgeneration and energy storage, and investigating how we can enable customers to actively participate in the energy market and provide energy system services. The following outlines the portfolio of projects either undertaken or underway by ESB Networks and which are attributable to the Future Customer Pillar.

3.2.1 REACT Project – EU Horizon 2020

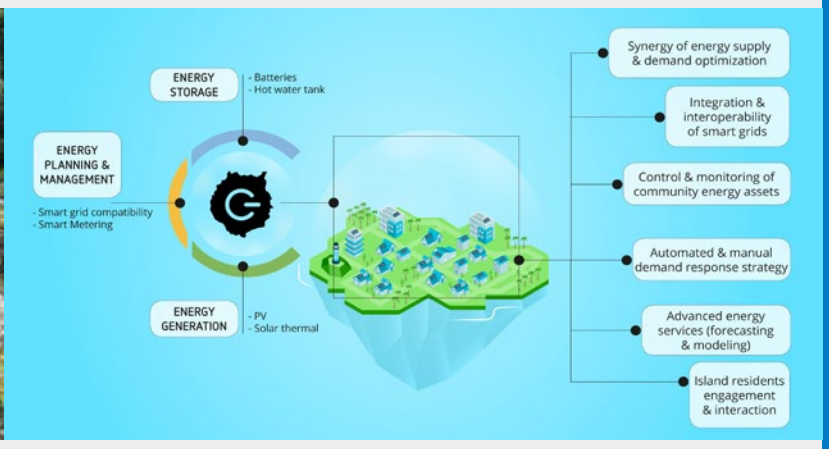
Status: In Progress **Project Timeline: Q1 '19 – Q2 '23**

Key partners / stakeholders: Údarás Na Gaeltachta, NUIG, SEAI, Veolia, Mitsubishi Electric (24 partners)

Overview: The REACT project is an EU Horizon 2020 project running from 2019 to 2023. The project aims to assess the self-sustainability of island communities that adopt renewable energy technologies. REACT consists of a consortium of 24 partners from 11 countries with island community representatives, regional authorities, DSO/ESCO, technology providers, academia and Research and Technology Organisations (RTO's). The project is aiming to develop a technical and business model to demonstrate that the large-scale deployment of distributed renewable energy sources and storage assets coupled with an ICT platform to enable an integrated and digitalised smart grid can bring economic and environmental benefits to their local island energy communities.

As part of the project, Solar PV, heat pumps and batteries have been installed on the three European pilot islands of La Graciosa (Canary Islands), San Peitro (Sardinia, Italy) and Inis Mór (Arann Islands, Ireland). There are also 5 follower islands where the aim is to replicate the approach where viable from a pilot island: Gotland Island (Sweden), Lesbos Prefecture (Greece), Isle of Wight (UK), Majorca Island (Spain), and Reunion Island (France).

Deliverable/Outputs: Inis Mór: The trials in Inis Mór have 24 participants and buildings in the project include 4 community buildings, 2 commercial buildings and 18 residential homes. The React project has installed solar PV and batteries in conjunction with the React monitoring platform and mobile app at each of the properties. The 4 community buildings have also had heat pumps installed to electrify their heating system to work with the solar and battery systems. The project aims to trial different user scenarios and flexibility services through the React platform to support the network for potential flexibility services and inform user behaviour on efficient use of their low carbon technologies.



In addition to these low carbon technologies the REACT project has installed a containerised hydrogen electrolyser at the island recycling plant which is a large energy user. It is the first containerised hydrogen electrolyser to be installed on an island and powered exclusively by the solar PV and using rainwater harvesting. The hydrogen electrolyser acts as an energy storage device by converting the electrical energy from the solar PV to hydrogen to store for use at a later time when no solar is being generated or when the power consumption from the plant is greater than that being generated. The aim of the project is to demonstrate the technology capability of using the combination of low carbon renewable generation in combination with hydrogen storage as a potential for self-sustainable energy on the island as part of a mix of renewables and storage technologies. The project is also conducting social and user research across all the pilot island participants to understand user behaviour and adoption challenges for low carbon technologies on these remote locations and environments.

To assess the possibility of the island becoming energy independent using renewable generation and electrification of heat and transport, the island's network is being modelled with a view to understanding how more widespread adoption of micro-generation would impact energy consumption, network services provision and network stability. ESB Networks has installed LV monitoring equipment on the network to capture data and support the modelling analysis as part of the project. The project has expanded to include a number of homes installed with the REACT interactive monitoring equipment and connecting to the REACT cloud system. The project has been significantly impacted by COVID 19 delaying the installation of equipment across the islands and has been granted an EU extension to Q2 2023.

Significant progress has been made in installing all the REACT systems in Inis Mór and the partner island with the participant trials taking place over 2022 and completing in 2023. The project featured on RTE's Future Island program in November 2022 and a link to the show can be viewed here. The project is supporting the Arann island self-sustainability goals and will enable its adoption of clean low carbon technologies.

3.2.2 Dingle Electrification Project

Status: Complete **Project Timeline: Q1 '18 – Q2 '22**

Partners / stakeholders: MaREI, Dingle Creativity and Innovation Hub), Dingle Ambassadors and Trial Participants

Overview: The Dingle Electrification Project's technical trials were concluded by the end of January 2022. Over the subsequent months, detailed analysis of project data was undertaken to surface insights and learnings. Stakeholder meetings were held to share these insights and learnings. Project reports were produced and are available on ESB Networks' website. The project was closed down, trial technologies were removed from the electricity network, ownership of clean energy enabling technologies was transferred to trial participants and project data was anonymized and made available for future research purposes.

Deliverables/Outputs: The project had been established with a number of core objectives. The key outcomes and learnings from each objective are summarised at a high level as follows:

Network Reliability: The deployed technologies worked effectively to support the identification of fault locations on the overhead network and to automatically restore supply on single phase circuits in instances where non-permanent faults had occurred. However, the number of faults experienced during the trial period was insufficient to enable business decisions on their wider roll-out.

Peer-to-Peer Trading: A report on project's experience to initiate a Peer-to-Peer Energy trial has been published on ESB Networks' website.

Residential Flexibility: A detailed report on the Flexibility Trial and its learnings is available on ESB Networks' website. The Flexibility Trial demonstrated that clean energy enabling technologies could be controlled to provide a range of services to the local network. The report also highlighted the challenges associated with flexibility management and how human behaviours and lifestyles can impact on the quantity of flexibility delivered.

Active Energy Citizen: A detailed report on the Dingle Project experience of consumer and community engagement and empowerment towards low carbon energy transformation is published on ESB Networks' website. This report also links to an independent assessment, carried out by MaREI, on the effectiveness of the Ambassador Programme and electric vehicle trial in the diffusion of technology and sustainable behaviours across the Dingle community.

The project has disseminated the key learnings and outcomes through public engagement, webinars, podcasts, radio, media and news outlets as well as the publication of a number of close out reports. For more information on the Dingle Electrification Project, please visit our website: ESB Networks' Dingle Project

3.2.3 Exploration of ASHP for Ireland's Residential Heating needs

Status: Complete **Project Timeline: Q1 '19 – Q2 '22**

Key partners / stakeholders: UCD/Limerick institute of Technology (LIT)/SEAI

Overview: This SEAI funded project aims to provide the basis for evidence-led policies on the electrification of heating in Ireland by conducting a field study and attitudes survey for use of Air source heat pumps (ASHP). The project looked at a longitudinal dataset of a number of houses retrofitted to improve building energy performance and Heat Pumps (as part of the Superhomes 2.0 project) and used big data techniques and approaches to gain clearer insights into the real-world performance of these Heat Pump units in situ and impacts to the network.

Deliverables/Outputs: The project found that the ASHPs underperform compared to the manufacturer's expected values. The underperformance is lower at lower temperatures. ASHPs with ratings of 8.5kW (11.2kW) underperformed against the manufacturers expected performance on average by 16 (24) % at outside temperatures of 7°C, and 3 (11) % at outside temperatures of 2°C. Despite this under performance, the heat produced over the winter heating season is deemed as renewable heat under EU definitions. The Coefficient of Performance (COP) is the ratio of heat energy produced to the electrical energy consumed.

The average or seasonal performance factor (SPF) gives a measure of the ASHP's overall performance by weighting the COP over the days of the winter heating season. The threshold for SPF considered as renewable heat is 2.83. All homes in the sample exceeded the renewable threshold, the average for the sample of retrofitted homes is SPF of 3.08. The project is successfully completed with the close out report submitted to SEAI. The project disseminated its learnings through presentations at a number of international conferences and publishing the following journal papers.

Carroll Paula (UCD), Lyons Pádraig, Chesser Mike (UCD); Air Source Heat Pumps Field Studies: A Systemic Literature Review; Elsevier – Renewable and Sustainable Energy Reviews.

Carroll Paula (UCD), Chesser Mike (UCD), Lyons Pádraig, O'Reilly Padraic (LIT); Probability Density Distributions for Household Air Source Heat Pump Electricity Demand; 10th International Conference on Sustainable Energy Information Technology (SEIT), Leuven, Belgium; Vol.175, 2020:468-475.

Chesser Mike (UCD), Pádraig Lyons, O'Reilly Padraic (LIT); , Carroll Paula (UCD),) Air source heat pump in-situ performance - ScienceDirect; Energy and Buildings Volume 251, 15 November 2021, 111365

3.2.4 +CityxChange (Positive City Exchange)

Status: In Progress **Project Timeline: Q4 '18 – Q4 '23**

Key partners / stakeholders: Limerick City and County Council, Trondheim Municipality, IES and MPower

Overview: Through active citizen engagement, the +CityxChange (Positive City Exchange) Project is developing a series of demonstration projects on how today's cities can become smart, positive energy cities of the future. +CityxChange is a European Union (EU) Horizon 2020 Smart City Lighthouse project. The consortium consists of 32 partners, led by the Lighthouse cities Limerick and Trondheim in Norway and five other follower cities, Alba Iulia (Romania), Pisek (Czech Republic), Sestao (Spain), Smolyan (Bulgaria) and Voru (Estonia). This is the first such award to an Irish city.

Deliverables/Outputs: In Limerick, a community energy concept proposed to trial the use of intelligent meters, innovative new renewable generators (including hydrokinetic energy), electrical energy storage, digital tools and citizen participation to create a Distributed Positive Energy Block (DPEB) and District. ESB Networks' proposed focus was to support the integration of the DPEB into the distribution network and provide technical advice and support on concepts such as peer-to-peer energy trading and the Energy Community Utility (ECU) to be trialled. COVID-19 has had a significant impact on the progress of the project during 2020 and 2021. A project-wide change request has been submitted to the European project office requesting that elements of scope associated with energy trading and flexibility at a community level, transition from physical trials to computerised simulations due to the challenges associated with recruiting prosumers and the installation of renewable generation within the footprint of the project.

Progress has been made during 2022 on the testing of the tidal turbine. The foreshore licensing and planning permission consents process is ongoing with the intention to connect a 30kW demonstration plant in the Shannon River during 2023. In that regard, the mini-gen and small-scale generation connection application process, currently under trial by ESB Networks, may support connection of this plant prior to conclusion of the project.

3.2.5 300 kVA Pole Mounted Transformer

Status: Complete **Project Timeline: Q1 '19 – Q2 '22**

Key partners / stakeholders: Kyte Powertech/ABB

Overview: The project aim was to develop and test a novel, larger capacity, 300 kVA, pole mounted transformer as a potential option to uprate our 200 kVA pole mounted unit and support the electrification of heat and transport. The technical challenge for the transformer development has been to optimise the size and weight of transformer that can be pole mounted in line with the physical and mechanical limitations of the strength of the pole itself. Any changes or increase to the size and weight of a transformer must ensure that the physical loading limits on the pole and equipment dimensions are not exceeded.

Deliverables/Outputs: The project has successfully developed, type-tested and installed a 300 kVA transformer with our supply partners in 2022. The project has developed initial specifications, policy and procedures for installation as part of the trial. The project is being evaluated through our materials introduction process for BAU assessment against alternative options to support capacity growth from the electrification of heat and transport.

Transition of Learnings & BAU: The project was presented and discussed with stakeholders at our November Innovation Forum in 2022. There has also been interest in this project from other DNO's who we have shared our learnings through bilateral meetings and engagements. A project close report has been published with the successful completion of the trial here.

3.2.6 Optimise Eheat: Optimal Heat pump scheduling to improve hosting capacity for DERs

Status: In Progress **Project Timeline: Q1 '23 – Q1 '25**

Partners: Nexsys Programme

Overview: This project is part of the Next Generation Energy System – Nexsys Programme, is an all-island multidisciplinary energy research programme hosted by the UCD energy institute in partnership with 8 other leading research institutions and 9 co-funding industry partners. As part of the Nexsys programme, the project will research the use of heat pump scheduling, with a focus on industrial heat pumps and the impact on the network capacity and capabilities to optimise capacity to support other LCTs and DERs. To decarbonise heat, larger industrial heat pumps are being adopted and installed by businesses and industry which have increased loads and changing in energy profiles by these customers. Adopters of heat pumps are also adopting other LCTs such as EV charging but also Solar PV and Batteries. This research project will investigate the impacts of heat pumps on the network and the impacts on the network in conjunction with optimising and scheduling load use in combination with other LCTs.

3.2.7 Artificial Intelligence (AI) in Smart Metering Applications

Status: In Progress **Project Timeline: Q1 '21 – Q4 '24**

Outputs: The Smart Metering program is replacing every electricity meter in Ireland, to assist the country to manage its energy usage more efficiently. Smart meter auditing is carried out to ensure quality and standards are maintained and improves safety. The auditing process is resource intensive.

As part of the auditing process, we have developed and are using innovative AI technology to assist with the checking and auditing of images taken at every install. There were over 1,000,000 smart meter installations completed by the end of 2022 and there will be 2.4 million-meter replacements by end of 2024. There will be over 10 million images to check and audit over the programme and the AI enables ESB Networks to do this with significant efficiency and cost savings as part of our audit process of the smart meter program.

Benefits/Deliverables: The AI has developed and improved image quality capture providing ESB Networks with a national database of cut-out fuses, and performing 5 key audit checks on every smart meter installation. The AI tool supports us to maintain our high-quality standards with our installers and contractor staff. The AI and its use cases is being developed and improved for use in the smart meter programme.

The use of AI has brought significant benefits to the Quality Assurance Audit function of the smart meter programme;

- Saves cost in terms of auditing time
- Reduces the audit time by up to 10%
- Improves ESB Networks asset infrastructure database
- Is a key safety and quality anchor on the project by alerting us to 40% of quality assurance issues
- Ensures quality standards are kept high with staff and contractors maintaining a >99% pass rate
- Provides security through automation and reduces costs without which the audit budget would need increasing by 400%

3.2.8 International Community for Local Smart Grids (ICLSG)

Status: In Progress **Project Timeline: Q4 '22 – Q4 '27**

Key partners / stakeholders: Oxford University; Ausgrid, Australia; Corena, Enel Foundation, Italy; Low Carbon Hub, UK; SSE Networks, UK; Tepco Power Grid, Japan; Wel Networks, New Zealand.

Overview: The International Community for Local Smart Grids is an ambitious 5-year knowledge sharing programme to promote, support and advance the critical role of smart grids in securing a fair transition to net zero. The project is a partnership of innovative electricity distribution network operators, community groups and research partners. Convened by the University of Oxford, the partnership puts smart grids at the centre of this transition to bridge the gap between international targets, local ambition and decarbonisation, whilst maintaining network resilience.

Deliverables/Outputs: Led by the University of Oxford and supported by the Enel Foundation as research partner, the research being undertaken identifies how challenges can be addressed and opportunities shared to support decarbonisation efforts. This is done by bringing together the learnings from smart grid trials run by our partners. The research addresses the intersecting themes of community, planning, and operation and is addressed through the following four lenses: current state of play, a just transition, community opportunities, policy and regulation. The project has been carrying out research into network resilience in 2022 and will publish its report in 2023 to its partners.

3.3 CLIMATE ACTION PILLAR

Decarbonising Electricity, Heat and Transport: This innovation pillar focuses on delivering the innovations that will ensure that ESB Networks cost-effectively delivers the right infrastructure at the right time for a decarbonised energy system, supporting the integration of significantly increased levels of renewables and electrified heat and transport on the system. The following outlines the portfolio of projects undertaken by ESB Networks under the Climate Action Pillar.

3.3.1 Development of Modularised Metering and Control for RES Connections

Status: In Progress **Project Timeline: Q1 '19 – Q4 '23**

Key Partners/Stakeholders: Central, Independent Power Providers, Maxol, Ecars, Circle K

Overview: There are two parts to the project which support faster connection of customers renewable generation and EV charging hubs.

Project 1: The development of the MV Embedded Generation Interface Protection (EGIP) Standard Modular Substation project supports the connection of further renewable generation to the network by facilitating a faster connection of embedded generation, including solar, to the distribution system. The solution will allow for generation connections of between 1 and 20 MVA (subject to local system capacity) to ESB Networks' MV System. We have designed and developed new standardised prefabricated substation modules that can be deployed readymade to site, allowing for faster renewable connections to the system.

Stakeholder Engagement: Introducing an alternative connection option for MV customers requires significant stakeholder consultation. The project published its MV EGIP Standard Module Connection public consultation. ESB Networks installed a demonstration unit at its National Training Centre, Portlaoise and held over 20 showcase events to promote the innovative design to MV customers and provide the opportunity for visitors to ask questions about the module and assess its suitability as a new, alternative option. ESB Networks hosted informative events to share the detailed specifications and requirements, as well as being discussed with a wider audience at one of its Innovation Webinars.

Deliverables/Transition to BAU. This solution has been progressed to business-as-usual for 2022 as an option for MV customers for connections between 1 and 20 MVA. ESB Networks have developed the specification, procedures and processes for installing, testing, and commissioning the module. The module is now a standardised option for customers to enable faster connections to the network to include in their planning application. The project has delivered a BAU solution, with Reduced MV Substation construction time on site; reduced requirement for commissioning work on-site, thereby removing conflict with civil works stage of project that can regularly occur; reduced footprint of MV Substation; Standardised Modular design providing the industry with certainty on design and build requirements for MV EGIP connections.

Project 2: The Compact Standard Modules for Electric Vehicle Charging Infrastructure Connections project aims to evaluate new and innovative approaches to MV substation design where larger EV chargers (200kVA to 2mVA) are expected to connect to the network. The aim of the project is to explore the use of modular solutions to increase the efficiency and speed of larger EV charger connections to the MV network. The project is trialling a standard approach to new MV modular substation design for large EV charging substations that are expected to connect. The project is piloting the use of modular solutions with 3 partners to increase the efficiency and speed of (large) EV charger connections to the MV network. This approach will reduce the overall footprint of the substation and reduce construction effort when compared to a conventional MV block-built substation building. The design specification developed also enables flexibility for our customers design for their Modular substation whilst ensuring ESB Networks' standards for connection are met.

Stakeholder Engagement: ESB Networks undertook a public consultation with stakeholders to inform the design and look for partners. We hosted informative sessions and an innovation webinar was held to update stakeholders on the proposed designs and trial site partners. As a result of these engagements, we have selected proposed trials with 3 partners who expressed their interest as part of our consultation and engagements.

Deliverables/Outputs: In 2022 the trial sites have progressed and we have collaborated with the trial partners on the designs of their modules for the trials. However, supply chain issues have delayed the first installations in 2022. The first installations are now expected in early 2023. We have had strong interest and positive feedback on this proposed solution with EV charging providers planning to adopt the solution for their future EV charging hub sites.

3.3.2 Introduction of Sidewalk Transformer

Status: In Progress **Project timeline: Q3 '17 – Q4 '23**

Key partners / stakeholders: Kyte Power Tech

Overview: The electrification of heat and transport will lead to increased demand loads and potential congestion on LV networks with the proliferation of LCT. The aim of the project is to develop a prototype and trial a miniature secondary substation, known as a sidewalk transformer, as an alternative to conventional reinforcement. The project aims to benefit customers by providing a solution to the anticipated increase in loads from electrification of heat and transport, particularly in urban settings where space is limited, by providing a viable option to uprate the network, as cost effectively as possible.

Deliverables/Outputs: Sidewalk transformers are a potential solution to such spatial restrictions, allowing transformers to be located on narrow streets in densely populated city areas. ESB Networks is developing an Irish trial of these units to increase capacity for our residential customers in situations where the use of LCT is anticipated. A 10kV 200kVA prototype sidewalk transformer has been designed, type tested, and installed in ESB Networks' Training Centre in Portlaoise. Following design and operational assessment a number of required modifications and improvements have been identified to meet protection and operational requirements. The project has been extended to propose the development a "version 2 unit" in 2023 and install in our test centre for assessment to develop the standards, processes and procedures for a potential future trial on the network and operational use.

3.3.3 Investigate Statistical Contributions from Distribution Generation - F-Factor

Status: In Progress **Project Timeline: Q1 22 – Q1 24**

Overview: Traditionally, distribution network security has relied on conventional network assets such as transformers and circuits to supply energy to consumers from the upstream grid. In recent years, there has been an increasing interest in utilising non-network assets to improve cost efficiency and increase security of supply. The existing ESB Networks' security of supply standard is a deterministic standard that focuses on ensuring that sufficient network redundancy is available to secure demand during peak demand conditions and that loss of supply is recovered within defined timeframes.

F-factors are a statistical means to account for the contribution of embedded generation to system security and have been utilised in the UK by some DNO's. F-factors are used in planning studies to propose a basis for setting assumed generation output in order to show a reduced requirement for network assets to meet demand but are applied differently depending on whether a generator is not in control of its fuel source (intermittent generation) or whether a generator can control its fuel source (non-intermittent). This project adopts a Fast Follower approach to consider methodologies in other jurisdictions and how ESB Networks' security of supply standard might be enhanced to include the contribution from embedded generation connected to the network. The project is currently engaging with other DSO/DNO's and carrying out an investigative study on certain parts of the network to understand the potential use of F-Factors on our system and standards.

Deliverables/Outputs: The contribution of embedded generation to distribution security of supply should be accounted for statistically in the development of medium and long-term network development plans and in Load Indices calculations. The projects' aim is to determine an appropriate contribution of embedded generation to be considered when determining distribution system security.

3.3.4 Introduction of MV/LV Tap Changing Transformers

Status: In Progress **Project Timeline: Q3 '17 – Q3 '23**

Overview: The LV network is designed so that voltage drop of no more than 5% of nominal voltage (230V) occurs. However, the increased loading on the system, due to the electrification of heat and transport, challenges our design assumptions and this increased loading could result in some LV networks exceeding this 5% limit. There is in addition to voltage drop, the added complexity of voltage rise during the daytime where large amounts of Solar PV is installed.

The aim of this project is to develop and trial an On Load Tap Changing Transformer for our secondary substations to adapt to potential voltage issues from increasing LCTs on our network. With a tap changing transformer, the voltage level can be monitored by a relay, which can control an On Load Tap Changer (OLTC). Thus, the LV voltage level can be maintained across a wide range of loading conditions. The transformer has been designed to have 10 raise taps and 7 lower taps and the allocation of upstream voltage drop for 38kV and MV infrastructure can effectively be reallocated downstream to the LV network by using a tap changer to regulate the voltage at the LV busbar to 244V. This means that a larger voltage drop can then be used in the design of the LV network.

Deliverables/Outputs: A prototype transformer has been successfully developed, type tested and installed for trial on the network. The project was extended to accommodate issues and delays raised during initial type testing of the prototype, but improvements were implemented and the unit successfully passed. In Q3 2022 the unit was successfully installed at a trial location on our network and is currently being monitored as part of the trial. The project is expected to be completed in 2023 and its benefits assessed as a potential option for implementation on the network.

3.3.5 Climate-Adapted Alternatives to Creosote Wood Poles

Status: In Progress **Project Timeline: Q3 '16 – Q4 '25**

Description/Scope: This materials science innovation project requires that improved, if not new, products are needed to replace wood poles currently in use under Irish climatic conditions and to substitute any hazardous components of the chemicals currently in use. The sale of creosote has been banned to the general public and although business users are entitled to continue to use it under certain conditions, an EU-wide end of use of new creosote poles is to be implemented from Oct 2029. The recommended solutions must be adaptable to and reliable in the Irish climate cognisant of the forecasted impacts of future climate change. Not only are non-hazardous products needed but replacement processes must also be introduced to install, maintain, operate as well as to uninstall the products.

There are over 2.2 million creosote-treated wooden poles installed countrywide on the LV, MV and HV networks. The Irish climate challenges and impacts the decay of wooden poles. Untreated wooden poles decay at an increased rate, with consequential risks to safety, continuity and reliability. Therefore, alternatives to the creosote treated pole need to be trialled and evaluated. Substitute pole preservatives have been trialled as an alternative to creosote however to date have not satisfied the performance requirements but will continue to be assessed. Any substitute for the existing stock of wooden poles must be robust and reliable or risk inconvenience for the customer and reputational damage to ESB Networks.

Composite Poles: The project has been researching and trialling alternative material poles from different composite manufacturers to adapt for use on our network. Following a detailed market research and engagement with DSOs we have trialled both a Modular and Singular Composite pole designs. We have installed 160 composite poles on three overhead line sites and at our National Training Centre. Additional installations took place in 2022 including an urgent pole replacement due to storm damage of wooden poles in November 2022. These are being monitored for signs of wear, degradation and weather effects. The timelines of this innovation project have been extended to reflect the need to monitor the trial poles for a more appropriate time (more than 10 years) to better reflect their long-term performance in the Irish context. No adverse effects are reported on the trial pole sets from initial audits in 2022 and final performance comparison stress tests will be required at the end of the trial. In conjunction with trialling new pole technologies, new processes, tools, equipment will need to be introduced to maintain and operate the successful alternative pole which will require a significant training and change program for our Staff. ESB Networks is also monitoring developments in other jurisdictions and DSO's.

Benefits / Deliverables: A cost increase is anticipated as creosote poles are retired and other pole types, such as composite poles, are introduced. The project will deliver a set of procedure documents that will facilitate the introduction of new pole types – detailing the different installation, training, maintenance, and handling needed and identify the most cost-effective substitute.

Learnings: Further experience of conducting maintenance and repairs to the composite poles is emerging – specifically understanding the equipment and tools needed. The singular pole design has been identified as more adaptable to ESB Networks operational and delivery needs.

3.3.6 Wildlife OHL Contact Prevention (Ref: 77)

Status: In Progress **Project Timeline: Q1 '19 – Q4 '23**

Key partners / stakeholders: Lancaster University

Overview: The project aims to identify and trial novel measures to prevent wildlife from coming into contact with live conductors and overhead line (OHL) network equipment in general. It is intended to use technology to allow technicians to report bird strikes and other issues caused by wildlife, and the use of mobile technology can allow workable solutions to be shared. The benefit to the customer will be an improved service (reduced Customer Minutes Lost) through a reduction in wildlife-caused interruptions to supply, while the primary benefit will be to wildlife, who will be deterred from harming themselves. Project outputs will feed into line design, incorporating any measures at the outset, informing upgrades and alterations to account for local conditions. Another project benefit relates to how existing standard materials can be cost-effectively modified to incorporate risk mitigation during manufacturing.

The project has trialled and demonstrated positive results from a particular design of 'diverter' to deter contact between birds and overhead lines. Collaboration with Lancaster University has yielded a better understanding of how birds visually detect obstacles and which colours and shapes work best to highlight them. ESB Networks' aerial warning devices specification has now been updated to include a variety of solutions intended to reduce wildlife interaction with overhead network, these devices include anti-perching devices, bushing guards, larger spiral diverters and dynamic bird flight diverters.

Benefits / Deliverables: The project aim is to bring about a reduction in bird strikes to the network to reduce CI's/CMLs. The success of the project is in the delivering and fielding of deterrents (diverters) that can be shown to be reliable and effective to protect wildlife and the Networks. The benefits will also accrue to wildlife, who will be deterred from harming themselves. Given the objective to protect wildlife, Innovative deterrents will be deployed where appropriate irrespective of the cost benefit analysis.

Project outputs will feed into line design incorporating any measures at the outset, informing upgrades and alterations to account for local conditions. Another project benefit relates to how existing standard materials can be cost-effectively modified to potentially incorporate deterrents during manufacture. The project is transitioning new bird 'diverters' and methods into BAU and is continuing to assess and trial new methods.

3.3.7 Developing 400MHz Spectrum Use for Smart Grid Applications

Status: In Progress **Project Timeline: Q1 '21 to Q4 '25**

Key partners / stakeholders: Lancaster University

Overview: The electricity industry is undergoing unprecedented change, and the methods by which electricity is produced and consumed are fundamentally altering. Secure telecommunications are fundamental to this change and to the safe and efficient operation of the electrical grid.

ESB Networks' existing telecoms infrastructure is fully managed and maintained by ESB Networks Telecoms. ESB Networks Telecoms supports connectivity to primary substations down to 38kV substations. Connectivity beyond the 38kV substation is currently supported by third-party mobile networks. Third party networks are not suitable to meet predicted growth in sensors and line equipment on MV feeders and substations primarily due to coverage, availability, and insufficient power backup. Cyber security weaknesses are also a key limiting factor of third-party solutions. Existing private telecoms solutions deployed by Networks Telecoms are not viable on a large-scale basis.

Benefits / Deliverables: ESB Networks acquired a radio spectrum licence from ComReg in November 2019 to support the deployment of a Smart Grid telecommunications network. This radio network is being procured, designed and rolled out for use by ESB Networks with EirGrid and Ervia (Gas Networks Ireland and Irish Water) having the ability to utilise the radio network. This Smart Grid network will deliver a wide range of benefits for ESB Networks and wider society; primarily a more environmentally friendly electrical network, integrating more renewable energy, enabling electrification of heat and transport, and less electrical outages with speedier fault resolution times to name some of the benefits.

ESB Networks have successfully completed the initial procurement process and with this the successful tenderer we are designing the network, with rollout of radio base stations and services beginning in Q4 2022 and due to conclude in 2025. The first site is planned for installation in Dublin in Q1 2023. This network will be deployed for at least 13 years, with the potential for the equipment to be upgraded and continue in use for even longer. The project was presented and discussed at our innovation forum in 2022 as part of ESB Networks telecoms strategic technologies.

3.3.8 AI Vegetation Survey System (Tesselo)

Status: Complete **Project Timeline: Q4 '20 to Q2 '22**

Overview: ESB Networks use LiDAR to assess the clearance distance available between trees and overhead lines as part of our vegetation management programme. The project trialed an approach by Tesselo, from the Free Electrons programme, which uses satellite imagery in conjunction with LiDAR data to produce additional information on vegetation growth to help inform vegetation risk classification. Over 2021 and 2022, a proof-of-concept trial for vegetation management assessment and analysis was undertaken on a sample of the overhead transmission line network. Following a review of the data and results, the project identified further work required for validation of the Tesselo model using LiDAR contractor-identified vegetation risk sites. This was completed with the final steps associated with the original scope of the trial being closed out. A final assessment of the data and overall results from the trial was completed in 2022.

Benefits / Deliverables: The results of the trial demonstrated the capability to identify vegetation, however, due to the absence of height information (wires or vegetation) it proved difficult to reliably identify spans highlighted as being at risk. While the results across the trial network show that the overall trend would appear to match the lidar, individual variation on lines was too large to use this approach alone as a risk classification tool for lidar capture prioritisation. The project identified that the cloud cover over Ireland to trend and capture information over a period of time represents additional challenges to the use of this approach in vegetation management. This proof-of-concept project was completed in 2022 and the learnings are being disseminated and transitioned into the business..

3.3.9 E-Fleet – Decarbonising and Electrification our Fleet of Yellow Vans

Status: In Progress **Project Timeline: Q2 '22 to Q4 '25**

Overview: ESB Networks is trialling and developing innovative solutions to decarbonise and electrify our transport fleet in line with our Networks for Net Zero Strategy. We operate an extensive fleet of vehicles to maintain and operate the network. As well as the day-to-day operations and maintenance of the network, our experienced Network Technicians (NT's) and teams leverage the fleet when restoring the network following adverse weather conditions and storms. We recognise our role in leading the decarbonisation and electrification of our fleet and equipment and have developed a strategy to deliver on our targets in line with our Networks for Net Zero strategy. Delivering solutions that work for our experienced NT's is at the core of this project. In line with our Networks for Net Zero strategy, for vehicles that an electrification option is not yet available we will electrify systems that can be electrified.

Benefits / Deliverables: The first area of this project is to develop a home charging solution for our NTs which will enable them to charge at home efficiently and easily through a technology solution which can differentiate the NT E-Van charging and their own personnel EV as they are adopted. The end user experience is at the heart of this project, and we are working with technology partners to trial charging and payment methods which are efficient and easy for the end user.

The second area of this project is to develop a new re-usable modular design fit out for our medium-sized Yellow Van that meets the needs of our Network Technicians. A circular economy re-use approach is at the core of its design with the modular design able to be swapped and re-used across the lifetime of vans. The aim of this project will deliver a modularised fit for our yellow van fleet which can support lower carbon emissions from our existing fleet and be re-used on our new fleet of electric vans as they are delivered to ESB Networks.

3.3.10 Charge Fleet – Resilient Charging solutions for electrification of our Fleet & Transport

Status: In Progress **Project Timeline: Q2 '22 – Q4 '25**

Overview: The aim of this project is to develop new and resilient charging solutions to support the electrification of our fleet and transport across our depots, substations and sites. This will involve trialling new enroute charging solutions at depots, substations and in field charging to enable NTs to charge safely while working on site or at remote locations. The project will also use the advanced telemetry systems on our fleet to assess the needs of our users and the areas and roles that are most suitable for early EV Fleet adoption.

Benefits / Deliverables: The project will carry out an assessment across sites and stations to assess the charging requirements and solutions required for our expanding fleet of EV Vans. As part of this project new charging solutions will be delivered and new on site and in field charging solutions will be trialled for use at our stations and substations to enable our staff to charge in a safe and secure way while carrying out works to the network. The project is delivering a number of smart charging solutions to our depots in 2022 and 2023 and new innovative charging solutions have been identified to trial at our stations and substations in 2023 as our new fleet of EV Vans are delivered.

3.4 NETWORK RESILIENCE PILLAR

Efficient, Secure, Reliable Electricity: This innovation pillar focuses on the evaluation of innovations to provide an efficient, resilient and reliable future network that can support a low-carbon future. The following outlines the portfolio of projects undertaken by ESB Networks under the Network Resilience Pillar.

3.4.1 Inspection of Overhead Lines Using Drones and Image Processing Analytics

Status: In Progress **Project Timeline: Q3 '16 – Q4 '25**
Key partners / stakeholders: TSO

Overview: Currently, line inspections on ESB Networks' overhead transmission lines are carried out manually. To carry out these inspections, the HV lines need to be switched out before inspectors are deployed to carry out visual inspections on all structures and equipment associated with the HV line by climbing its structures. Information on the condition of the HV line is then manually transcribed onto line assessment sheets which are then compiled into an overall report. Disadvantages associated with this approach include: limited range of ability to undertake inspections due to outages, dependence on accessible locations on the structures, and data collected can vary in quality and subject to human error.

By using new drone and AI systems, this project is developing a solution as an innovative alternative to the traditional line inspection. This will enable reduced time and resources spent on overhead line inspections, improve safety, reduce or eliminate the need for outages and optimise the use of materials and resources. A specification has been developed and procurement is in progress to inspect transmission lines using drones. The drone provider will collect visual and location data through visual inspection of structures, insulators, hardware and conductor. The AI service provider will assess the data through automation, at a basic level, to produce an automated report detailing the necessary requirements for line refurbishment. Once procured, the project will move into the capture and data analysis phase of the project using AI and comparing systems and solutions.

The use of AI/machine learning to routinely screen collected inspection images for anomalies, could also allow human experts to focus on high-value-adding analysis of identified anomalies, such anomalies may include installation/design anomalies. AI can aid in building of network models that can be used for asset health assessment, asset recording, maintenance planning and future analysis. The technology trialled in this innovation project supports that ambition by potentially reducing scheduled outages and providing a reliable means to identify asset faults before they result in unscheduled outages.

Benefits: The key objective of the project and trials will be to:

- Demonstrate a saving versus the current average line patrol.
- Evaluate the risks associated with the interaction of drones and network components such as insulators and to establish clearance distances and no-fly zones, if necessary, around live and/or delicate equipment.
- Certain inspections would no longer need lines to be switched out, thus improving system security and customer continuity. Additionally, physical line maintenance can be scheduled for regular maintenance outages when works identified by data analyses/AI software can also be conducted. In the event the project proves successful, significant saving (millions €'s) may be realised over a number of years from avoided market adjustments and customer inconvenience that result from scheduled line outages.
- The potential to reduce exposure of personnel to working-at-height hazard is also of significant benefit.

Deliverables: The project has developed and delivered a new Unmanned Arial Vehicle (UAV) inspection framework for programmed UAV inspection and condition assessment of hardware and steelwork on Overhead Line transmission network. This framework should reduce requirement for costly, higher risk, outage-depending climbing inspections while providing high quality, verifiable asset condition imagery and data/indicators. This framework includes options for additional innovative proposals in the areas of asset health and AI inspection tools. This framework is due to be awarded to contractors who submitted to the tender process in early 2023. This delivers on the initial benefits of the project. The next phase of this project use of AI inspection tools will be assessed and developed in the next phase of the project starting in 2023.

The project is currently undertaking proof of concept project trials of two AI systems to assess their capabilities and use under the UAV (Drone) Framework for Towers and Overhead line assets health.

3.4.2 Gridvision AI for condition assessment of tower corrosion

Status: In Progress **Project Timeline: Q2 '22 – Q4 '23**
Partner: GridVision

Overview: This project will test and assess the Gridvision software tool as a proof of concept which was developed to use machine learning for automated condition assessment on overhead lines. GridVision and their innovative AI tools were identified for a POC trial as part of the free electrons programme. An interesting aspect of this tool is a methodology to highlight and quantify corrosion levels on lattice steel tower members. This could provide a useful objective and rapid means to undertake an initial assessment of the relative levels of corrosion on towers to help decide if full detailed manual steelwork inspections on at individual bar-level are needed on some or all of the towers on a given circuit.

3.4.3 AI synthetic analyses of 110kv composite insulators

Status: In Progress **Project Timeline: Q4 '22 – Q1 '24**
Partner: Simerse AI

Overview: This project selected from the 2022 Free Electrons portfolio will assess the capabilities and use cases for Simerse AI. The project is developing massive (100K+) synthetic images of two types of 110 kV composite insulators by different manufacturers to see whether synthetic imagery can be used to train an AI algorithm to accurately identify different types of insulators. It is also intended to further develop synthetic imagery of typical defects that can arise on composite insulators with a view to using the tool to automate defect detection. Where visible differences between insulator supply batches may be present it is hoped this tool may be able to detect these differences also. If the first stages of this project are successful it is planned to trial the system on a sample line or lines captured under the new UAV framework in 2023.

3.4.4 Development of High Voltage Stations Health Index

Status: Complete **Project Timeline: Q1 '18 – Q4 '22**

Overview: The project aims to enhance the knowledge of our network assets through near-to-real-time status information and by enabling field technicians to report and carry out maintenance activities using new software applications developed for smart mobile devices. This will allow for an up-to-date status of network assets to be supplied to asset owners, planners, operators and others; arming them with information to make better decisions about more timely maintenance and an understanding of operational limitations. This, in turn, supports the connection of increasing DER on our network.

This project has developed the first phase of a functioning Health Index for all HV substations and their components. The project has adopted an Asset Health Index methodology in use in other DSOs and DNOs called 'Common Network Asset Indices Methodology' (CNAIM). A mobile application was developed for capturing asset information onsite to input into the asset health database. The project has been progressed into the BAU transformation powering ahead programme led by network assets.

3.4.5 Nodal Controller for Reactive Power

Status: Complete **Project Timeline: Q1 '16 – Q1 '22**
Partner: TSO

Overview: To facilitate the transfer of reactive power to the transmission system, ESB Networks has developed a sophisticated control system called a Nodal Controller. The Nodal Controller is a new concept and seeks, for larger DSO-connected wind farms, to use centralised and automated intelligence, allowing as much reactive power support as possible to be delivered to the TSO-DSO interface, respecting voltage and thermal capabilities of the distribution network. DSO-connected wind farms can be used to provide valuable reactive power support to the transmission network, and in some cases obviating, reducing or deferring investment in transmission infrastructure such as STATCOMs and capacitor banks.

Benefits/Deliverables: To test this concept, a pilot of this technology was carried out at the Cauteen wind cluster in Co. Tipperary, on Topology 2 wind farms. The project has overcome a number of technical challenges and developments to successfully install and trial the Nodal controller, communications equipment and develop the control algorithm. As part of the trials, the project further developed the algorithm from initial learnings and a successful trial was implemented at the trial location over the winter period of 2021 – 2022. The project and trials have been successfully completed with the learnings and outputs from the trials being reviewed by the project stakeholders.

3.4.6 Novel use of Drone Technology for Fault Location and Line Patrolling

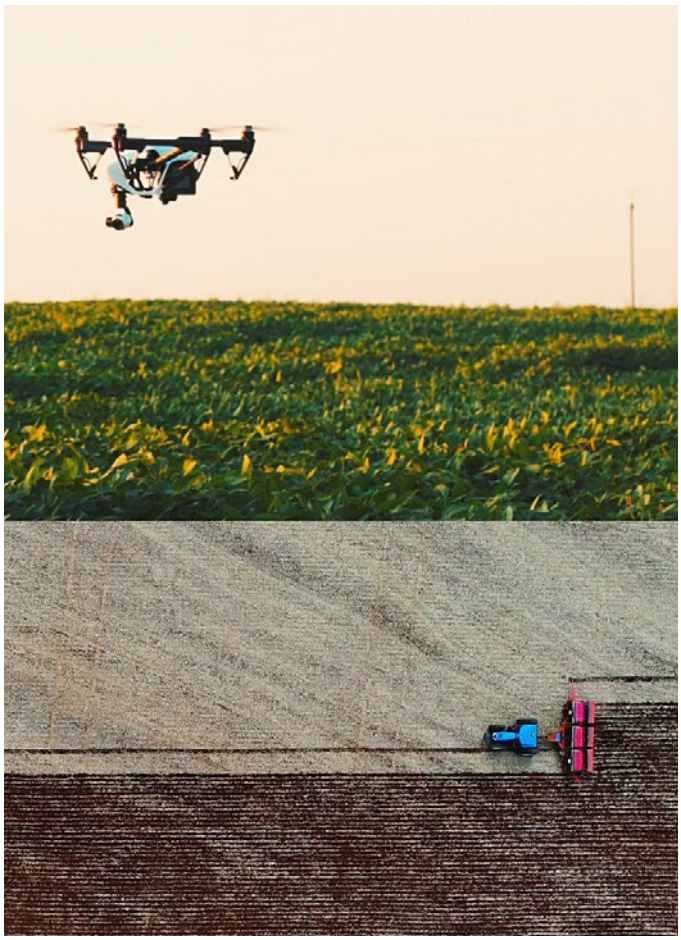
Status: In Progress **Project Timeline: Q1 '21 – Q3 '23**
Key Partners/Stakeholders: IAA & UL

Overview: This ESB Networks have 150,000km of overhead distribution lines on our network. To manage and maintain the network we carry out preventative maintenance such as our vegetation management programme and line patrols where NT's walk the route to identify potential faults or issues on the distribution network through often challenging rural and forest terrain.

The aim of this project is to investigate the use of drone patrols by our staff where drones will be flown Beyond Visual Line of Sight (BVLOS) and AI will be used to assess the data captured to optimise the patrolling process. ESB Networks was granted authorisation to operate at an Extended Visual Line of Site (EVLOS) licence from the Irish Aviation Authority to trial and operate the drones. In 2022 standards, procedures and training were approved in ESB Networks on use of Drones across ESB Networks using certifications granted by the IAA.

With the current EU regulation changes we are investigating the possibility to move to a BVLOS certification using our own Light UAS operator certification in 2022. The project has successfully used Drones for line patrol, audit vegetation management and assess vegetation encroachment on our overhead lines. The drones have proven to reduce patrol times by 80% with one drone able to assess as much as 60km of lines in 1 day. The drones can also patrol inaccessible lines due to flooding or inaccessible ground. The project plans to further develop the use of drones and image capture capabilities to audit and assess our network under several use cases.

The use of AI can further enhance the use of this data across a range of use cases from vegetation management audits to line patrols following storms or issues relating to intermittent faults on our network. In 2022 the project undertook a trial demonstration on our network in conjunction with University of Limerick (UL) to assess the capabilities of larger drones with higher payload capacity for use with Lidar and advanced cameras on our network as well as share learnings from the advanced image analysis features which UL are working on as part of their research. The project and work to date was presented and discussed with stakeholders at our Innovation Forum 22.



3.4.7 Smart Network - New Core and Aggregation IP Network

Status: Complete **Project Timeline: Q3 '16 – Q4 '22**

Overview: ESB Networks' telecommunications network consists of multiple hardware platforms using a number of manufacturers and is the main means of providing communications and control connectivity for system critical services on the electricity network. To accommodate the introduction of a smart grid equipped with smart devices, the range of critical and non-critical services that will require connectivity on the electricity network is predicted to grow significantly, with the bandwidth requirements per service also increasing.

Deliverable/Transition to BAU: ESB Networks is investing in the installation of a scalable new fibre-optics-based core and aggregation network, spanning ten core sites (HV stations) and four aggregation sites. This new core and aggregation IP network is a fundamental building block in fulfilling the existing and future communications requirements of the electricity network and will act as a key enabler of smart network operations by the DSO and TSO. The project has delivered a total of 10 core nodes and 115 aggregation nodes, across the TSO and DSO has been delivered. The project has progressed from innovation into BAU implementation with the management migrated to the Network Management Centre for 24/7 operations. The final additional 63 aggregation nodes will be delivered in 2023 as part of continual expansions of the network.

3.4.8 Weather Forecasting and Network Damage Prediction

Status: Completed **Project Timeline: Q4 '17 – Q4 '22**
Key Partners/stakeholders: DTN

Overview: Forecasting damage and required response through storm damage prediction is a new and innovative way of managing resources and restoring customers' supply quickly following storm damage to the network. The project is supporting ESB Networks' ability to reinstate safe conditions in the system following storms.

Deliverables/Outputs: The project has introduced a system incorporating a localised multi-day-ahead weather forecast with a set of ESB Networks-customised and specified weather metrics (wind, lightning, rain, snow etc.). This system supplements the existing Met Éireann system – on a national and regional basis – for forecasting general weather impacts. Weather forecast is broken down into geographical areas corresponding to ESB Networks customer delivery regional boundaries in the form of a customised daily report. The forecast tool enables network operations and regional management to have a clear view of the upcoming weather patterns to guide decisions on required readiness and response. Over the last two years this has been used successfully and proven to be of great benefit. It has been successfully transitioned and embedded into BAU. It often provides the earliest indication to trigger the consideration of a requirement for additional resources.

Phase 2 of the project developed a proof of concept (POC) network damage/fault forecasting prediction service. Our project partner developed a model by combining ESB Networks historical network fault data and historical weather events. The prototype tool provided a multi-network fault prediction as part a first-cut model using localised forecasts and asset damage data to predict vulnerable parts of the network during weather events. The trial period did not demonstrate the accuracy required with the data available for real-life events when cross checked from post event data. Further analysis in 2022 of the nature of storm events in Ireland and the results of the initial trial of the POC tool did not demonstrate subsequent sufficient benefit for further development. The project has come to a successful completion in 2022 with the advanced weather reports providing valuable actionable information for our National Control Centre and staff.

3.4.9 Optimal voltage Allocation for the MV LV distribution networks

Status: In progress **Project Timeline: Q1 '23 – Q2 '24**

Key partners / stakeholders: Nexsys Programme

Overview: This project is part of the Next Generation Energy System – Nexsys Programme, is an all-island multidisciplinary energy research programme host by the UCD energy institute in partnership with 8 other leading research institutions and 9 co-funding industry partners. Network reinforcement is required when the voltage drops below standard, with the level of voltage drop being proportional to the load. This means that adding additional load such as EVs and Heat Pumps will cause greater voltage drop and hence drive a need for more reinforcement. However, an alternative approach to reinforcement on the LV system would be, instead, to improve voltage regulation on the MV system which could be more cost-effective. Following on from initial research in the area this project will look at the possibilities of using MV voltage regulators to more tightly manage MV voltage excursions and hence allow greater increased LV voltage regulation, with less need for reinforcement.

3.4.10 Development of Dynamic Line Ratings

Status: Ongoing **Project Timeline: Q1 '17 – Q4 '25**

Key partners / stakeholders: Eirgrid (TSO)

Description/Scope: Currently conductors on the overhead distribution and transmission network are assigned static seasonal based ratings. The daily capacity on the network is determined by the conductor size deployed on the circuit and the current season, i.e. Autumn, Winter, Spring, Summer. The use of blanket seasonal temperatures (i.e. summer 24°C) for determining the ratings is thought to be very conservative as daily temperatures rarely meet these in summer, however in winter, due to climate change there is an elevated risk that daily temperatures can on rare occasions exceed the winter ratings. This project represents a fundamental shift in the way the capacity available on the circuits with this new technology is deployed on is determined. Factors such as meteorological parameters (ambient temperature, wind-speed, wind direction) and the current state of the conductor on the circuit (ground clearance, sag, conductor temperature) will determine the allowable capacity on the circuit on an hourly/forecast day ahead basis. As the current seasonal capacity ratings of circuits are considered very conservative, it is expected that the circuits the technology is deployed on will realise an increase in capacity. However, this new technology also comes with the additional control, that in the rare event a circuit is exceeding the allowable maximum conductor temperatures (due to high ambient temperatures and low wind speeds), it will be possible to reduce the capacity of the infrastructure to ensure optimum life of the conductors.

Benefits/Deliverables: In certain cases, it is expected that this technology will provide:

- An alternative solution to uprating some circuits where it is expected that the increase in capacity is only required during high wind conditions.
- Operational resource improvements.
- Avoided outages – any consequential inconvenience or costs are avoided by not requiring a line outage to increase its capacity

In collaboration with the TSO the functional specifications for dynamic line ratings are completed and approved. The tender documentation was issued in 2022 for procurement with a successful vendor selected in the procurement tender for trial. The project has developed the policy, processes and procedures to successfully installed 10 Dynamic Line rating sensors on the first trial location site and the trial is being monitored and learnings from the first installation being reviewed. This is a long-term strategic project in partnership with the TSO and the timelines are extended to learn from the initial deployment and deliver next phase of deployments on other trial locations.

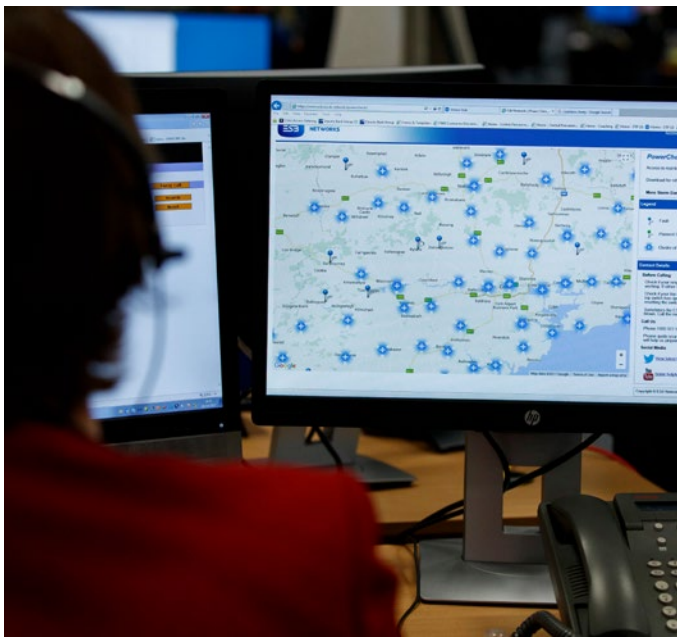
3.4.11 Real Time State Estimation on Irish Distribution Network

Status: Complete **Project Timeline: Q2 '20 – Q2 '22**

Key partners / stakeholders: NovoGrid, SEAI

Overview: Led by Novogrid and supported by ESB Networks this SEAI funded project involved research and innovation targeted at the development of a software platform to provide real-time insight into distribution network power flows and voltages. Over the course of the project the estimation capability expanded to accommodate the entirety of the Irish MV distribution network. The project platform presents estimates of network states in real-time, where measurements have been made available to the platform.

Benefits/Deliverables: The project developed hardware solutions to communicate to the cloud platform, and having proven assumptions on desktop studies, took in measurements in the field in order to pilot the real-time estimation capability. ESB Networks provided access to a network model for use on this project. Additionally, 3 months of data has been provided from over 100 MV/LV transformer monitors, installed under another innovation project, for use in validating the state estimator. Validation of the platform was achieved in collaboration with ESB Networks where pilot measurement locations were established and estimations by the platform were verified. The project successfully completed in 2022 with Novogrid having developed the Grid Vis platform and trialled the model using data provided by ESB Networks. The project close out report was issued to SEAI and the learnings disseminated into the business and presented to international conferences by Novo Grid such as the Enlit Europe utility conference in November 2021.



3.4.12 Leveraging Enhanced LV Monitoring to Optimise Targeted Network Reinforcement

Status: Complete **Project Timeline: Q3 '20 – Q2 '22**

Overview: ESB Networks must ensure LV network readiness for increased uptake of low-carbon technology to support decarbonisation and enhance customer continuity. Smart solutions to provide additional capability to the distribution network must be considered as options, as well as conventional reinforcement to provide this capability.

Based on forecasts of areas of the LV network that may require additional capability, the project will focus on the targeted deployment of enhanced monitoring equipment on MV/LV substations. This will validate forecasts and ensure that additional capability is added to the distribution system in a cost-effective and timely manner. Average demands of customers on substations in different social demographic areas is being used to provide more accurate forecasts of MV/LV substation load taking into account the propensity of customers to buy EVs and heat pumps.

This project has leveraged data from multiple sources of data including sensors installed under the project "Use of Temperature Sensors with Sigfox to Assess Substation Loading."

Benefits/Deliverables: The project developed a network forecasting tool which integrated data sources such as socio-economic data from the Central Statistics Office (CSO) with our own network data. This was used to determine the targeted installations of our LV monitoring equipment on highly loaded substations, or EV friendly locations, where increases in load due to electrification is likely in the near term. The project overview was presented to stakeholders as part of the 2021 webinar series and at our Innovation Forum November 2022.

The project has transitioned into BAU under our LV network allowance team in electrification who are delivering system improvements and solutions to address issues developing on the network, such as overload and voltage, from the adoption of LCTs as customers electrify their heat and transport. An advanced data analytics dashboard incorporating the LV monitoring data with additional Network and system data was developed and enhanced over the course of the project. This has successfully been transitioned into BAU and in use to identify issues developing on the network, such as load and voltage from the adoptions of LCT's such as EVs, heat pumps and solar PV. This advanced warning of issues developing on the network is enabling ESB Networks to proactively deliver system improvements to network. The project has published two papers and presented at international conference to Cigré 2022 and Cired 2022 (see section 5.2.3)

4 TRANSITION TO BUSINESS: PROJECTS AND LEARNINGS

ESB Networks' innovation projects deliver quantifiable benefits by successfully embedding the new knowledge, processes, solutions and technologies into our BAU practices to improve the ways in which we work and serve our customers. ESB Networks continues to reap the benefits of projects that have previously closed, as they are embedded in the organisation.

4.1 TRANSITION TO BAU

A culture of innovation is fostered across every level of ESB Networks' business. We have clear innovation objectives and a centralised innovation function that identifies and trials innovation projects before transitioning to BAU. A dedicated Innovation Portfolio and Transition manager continues to focus on improving the transition process and enhance how we disseminate learnings.

The ISG, established in 2019, has enhanced our governance and Innovation Strategy Framework. The internal and external ISG members bring a wide range of experience, expertise and knowledge to the decision-making process. This ensures that the most appropriate innovation projects, which also give the greatest benefits to our customers, will make their way through the innovation process and transition into the business. We have found that one of the keys to a successful transition to BAU is to engage the business owners early and ensure engagement and buy-in throughout the project lifecycle.

The Innovation Portfolio and Transition Team use a systematic methodology and implementation process (see Figure 4.1 below) to ensure that a consistent approach to project transition and dissemination is maintained.

Figure 4.1 : Transition Methodology and Implementation Process

Once an innovation project is complete and it is recommended by the project team and business owners for transition to the business with approval by the Innovation Steering Group, the project delivery team compiles a handover document for the business owner. Projects at this point may reveal further innovation opportunities which, once passed the appropriate approvals, may then be followed through within the scope of an existing project or as a new project.

A workshop with the delivery team and Innovation Portfolio and Transition Team is held where a draft implementation plan is developed using a standard checklist (See Table 5.1) as a guide. Subsequent workshops are then held with the Innovation Delivery Team, the Business Owner and the Innovation transition manager to finalise the implementation plan and allocate roles, responsibilities and timelines to actions.

Checklist Items	Checklist Sub-Items
Scope of Transition	• Scope/Objectives/Measure of Success
Ownership and Stakeholders	• Business/Solution Owner • Business/Solution User • Key Stakeholders
BAU CBA/Benefit Assessment	• Cost Benefit Analysis for BAU • Benefit Assessment for BAU
Business/Systems Transition	• IT Systems • Policies/Standards/Legal Docs • Processes
Resource Transition	• Training • Internal Dissemination
Asset Transition/Procurement	• Tender Requirement: - Specification - Evaluation
External Dissemination	Publications (Consultations/Papers/Reports), Webinars, Workshops, Presentations, Videos, Bilateral Meetins with Stakeholders, etc.

Table 4.1: Transition to BAU Checklist

Once the implementation plan has been delivered and the innovation project has been embedded into the business, the outputs and benefits are monitored and tracked by the business owner. This enables ESB Networks to demonstrate true integration of the innovation projects' outputs to BAU and the realisation of the expected benefits.

A dissemination plan is developed for all projects, whether they transition to BAU or not, and whether the trials or research outcomes/findings were successful or not. The purpose of the dissemination plan is to ensure all learnings from our innovation activities are disseminated internally in ESB Networks and externally to the wider industry.

The innovation team continue to engage with other organisations and jurisdictions to investigate best practice and potential improvements for transitioning innovation project portfolio outcomes to BAU. This has enabled shared learnings in relation to the innovation process, governance, project reporting, transitioning projects to BAU, assessing benefits, measuring success and the dissemination of learnings.

4.2 PROJECT LEARNINGS, BENEFITS AND TRANSITION TO BAU

One of the key priorities of our strategy is ongoing communication of project results and insights with stakeholders who are impacted by, interested in, or have influence on our innovation activities.

In 2022, our engagements were varied and ranged from soliciting feedback and suggestions, to sharing updates on project progress and disseminating project learnings via a range of online industry events, ESB Networks' website, webinars and engaging with research groups in Ireland and abroad.

Another key priority is to realise the benefits of innovation to our customers by disseminating and transitioning successful projects into BAU. A number of projects that delivered benefits and learnings in 2022 and which are transitioning into the business are summarised in the following table.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Future Customer** **React Project (ref. 220)** Close out report	The project has enabled 3 island communities, in Ireland (Inis Mór), Spain (La Graciosa), and Italy (San Pietro) to install renewable energy, storage assets and energy management systems to learn the user behaviour on the adoption and use of these systems to support a pathway to self-sustainability. With 24 participants on Inis Mór, the participants are benefiting from decarbonisation of their energy needs and the project is developing social learnings on the adoption and usage of the technology for island communities. Due to the remoteness of the islands a key learning from all 3 islands has been the challenge and access to skilled and trusted installers for these LCT's and the future maintenance challenges for island communities. To support the island, a model to develop local expertise and support is being explored by the Irish consortium partners led by NUIG for Inis Mór. Significant learnings on the installation and operation of the hydrogen electrolyser have been identified from the rainwater harvesting system use to the low levels of PV generation during the winter periods to maintain hydrogen production and storage.	The React project as an EU H2020 project has had significant dissemination of learnings throughout the project by the partners. There project has a dedicated partner to support the dissemination and shared learnings from the project partners with a dedicated News & Media and publications section and use of social media: REACT 2020. Project partners have participated in the Bridge programme which is an EU programme across EU projects to encourage shared learnings and development. The partners have input into a wide variety of working groups across policy, standards, regulation, technology, and system. Publication & Results - REACT 2020: The project partners have published 9 papers to date and presented at international conferences. The project partners continue to share and disseminate learnings regularly through each work package and 6 monthly project meetings. The Inis Mór trial has held a number of community engagement events with international partners presenting to and engaging with the community. The Irish consortium has also had an opportunity to learn from the partner islands in 2022 with a visit to La Garciosa during the biannual general assembly meeting. Inis Mór also featured on RTE's Future Island program in November 2022 and a link to the show can be viewed here.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Future Customer** **Dingle Electrification Project (59)** -EV Trials -Flexibility trials -Diffusion of learnings -Network Resilience Dingle Electrification Project Website Close Out Report	The Dingle Project provided insights and learnings on the adoption and use by citizens and communities of Low Carbon Technologies. The project explored mechanisms to contribute to a greater diffusion and take-up of these technologies across communities and what is needed to activate the energy citizen. Flexibility – demonstrated that clean energy enabling technologies could be operated and controlled to provide a range of flexibility services to the local network however some challenges were identified. EV Trials – provided evidence on the suitability of electric vehicles, when coupled with home charging solutions, to people living in rural communities. This trial also demonstrated the potential of V2G services. Network Resilience – demonstrated technologies to support identification of the location of faults on the overhead network and, to restore power on single phase circuits sub sequent to transient faults.	ESB Networks' Dingle Project has enabled and supported diffusion and dissemination of learnings in collaboration with the Dingle community, ambassadors and partners with details published on our website (section 4.4). ESB Networks Dingle Project – A report on Active Energy Citizenship & Community Engagement has been published to share learnings and insights. Stakeholder visits to Dingle, enabled by the Dingle community and Ambassadors, to share their lived experience and the community wide interest in low carbon transformation. The community engagement and empowerment model, developed as part of the Dingle Project, has been shared with stakeholders in other communities. Customer Flexibility Trial report - details the learnings from the Flexibility Trial and our EV Trials. Trial learnings were shared nationally & internationally and have helped inform the National Networks, Local Connections (NN,LC) Programme. EV Trial learnings have been shared with policy makers and bodies such as SEAI and Department of Transport to help inform policy, communications and enablers of electric vehicle diffusion. Network Resilience trials learnings have been shared with stakeholders and internally with ESB Networks stakeholders with the development of internal standards and policy for use. The learnings have been presented at webinars to stakeholders and partners. Further trials of these technologies may be necessary in order to validate technology performance under additional fault scenarios. ESB Networks' Dingle Project Webinar Series: can be viewed back and presents 4 detailed webinars cover all aspects and topics of the dingle project including: objectives and policy drives, EV trials and flexibility, Active Energy Citizen and Network Resilience.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Future Customer** **Exploration of ASHP for Ireland Residential Needs (ref.74)**	The project found that the ASHPs underperform compared to the manufacturer's expected values. The underperformance is lower at lower temperatures. ASHPs with ratings of 8.5kW (11.2kW) underperformed against the manufacturers expected performance on average by 16 (24) % at outside temperatures of 7°C, and 3 (11) % at outside temperatures of 2°C. Despite this underperformance, the heat produced over the winter heating season is deemed as renewable heat under EU definitions. The threshold for SPF considered as renewable heat is 2.83. All homes in the sample exceeded the renewable threshold, the average for the sample of retrofitted homes is SPF of 3.08.	The project published the project close out report to the SEAI National Energy RD&D Funding Programme. Learnings and outcomes were disseminated through presentations at a number of international conferences and webinars. The project also published the following peer reviewed journal papers: Carroll, Paula (UCD); Lyons, Pádraig; Chesser, Mike (UCD); Air Source Heat Pumps Field Studies: A Systemic Literature Review; Elsevier – Renewable and Sustainable Energy Reviews. Carroll, Paula (UCD); Chesser, Mike (UCD); Lyons, Pádraig; O'Reilly, Padraic (LIT); Probability Density Distributions for Household Air Source Heat Pump Electricity Demand; 10th International Conference on Sustainable Energy Information Technology (SEIT), Leuven, Belgium; Vol.175, 2020:468-475. Chesser, Mike (UCD); Lyons, Pádraig; O'Reilly, Padraic (LIT); Carroll, Paula (UCD); Air source heat pump in-situ performance - ScienceDirect; Energy and Buildings Volume 251, 15 November 2021, 111365
Innovation Pillar: **Future Customer** **300 kVA Pole Mounted Transformer (ref: 98)** Project Close Out Report	The project successfully developed, type tested and trialled on the live network, a 300 kVA pole mounted transformer as a replacement for a 200 kVA pole mount transformer which is the largest BAU unit currently used. This successfully expedited the uprating of the trial circuit compared to the traditional reinforcement of splitting the network. As part of the trial the project has developed the specification, policy and standards for the 300 kVA pole mount transformer to be trialled on the network.	The project has published a close out report on our website here. The project was presented to the Materials introduction Board for review to assess for potential to transition into BAU. The project was presented as part of webinars on the Electrification of heat and transport in 2021. The project was presented and discussed at the in-person Innovation Forum in November 2022.
Innovation Pillar: **Future Customer** **Artificial Intelligence (AI) in Smart Metering Applications (211)**	The AI tool supports us to maintain our high-quality standards with our installers and contractor staff. The AI and its use cases is being developed and improved for use in the smart meter programme. The use of AI has brought significant benefits to the Quality Assurance Audit function of the smart meter programme; • Saves cost in terms of auditing time • Reduces the audit time by up to 10% • Improves ESB Networks asset infrastructure database • Is a key safety and quality anchor on the project by alerting us to 40% of quality assurance issues • Ensures quality standards are kept high with staff and contractors maintaining a >99% pass rate • Provides security through automation and reduces costs without which the audit budget would need increasing by 400%.	The mobile application and AI tool is in BAU and being used by all meter installers to capture every installation and feed the information back to our quality and audit team. Incremental improvements have been implemented in 2022. The project has been presented to stakeholders as part of our innovation webinar series and has been highlighted at Ireland AI awards in 2021.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Climate Action** **Development of Modularised Metering and Control for RES Connections (ref:81)** **MV EGIP Standard Modular Substation**	The MV EGIP Standard Modular Substation project has been progressed to business-as-usual for 2022 as an option for MV customers for connections between 1 to 20 MVA. ESB Networks have developed the specification, procedures, and processes for installing, testing, and commissioning the module. The module is now a standardised option for customers to enable faster connections to the network to include in their planning application. The project has delivered a BAU solution, with reduced MV Substation construction time on site, reduced requirement for commissioning work on-site (thereby removing conflict with civil works stage of project that can regularly occur), reduced footprint of MV Substation; Standardised Modular design providing the industry with certainty on design and build requirements for MV EGIP connections.	Engagement and input from stakeholders were central to the project development. The project hosted a number of stakeholder bilateral meetings, webinars and held a public consultation for stakeholders to inform and finalise the design specification. The project developed the productionised module and hosted 20 stakeholder showcase events with industry stakeholders at ESB Networks' Portloaise training centre. Our planning and connections teams have engaged with developers throughout 2022 to inform and enable applicants to include the specification designs and planning drawings in their development plans. These specification designs and planning drawings are published and available on our website. - Planning Drawing for MV EGIP Modular Substation Building - Planning Drawing for MV EGIP Modular Substation Foundation
Innovation Pillar: **Climate Action** **The Compact Standard Modules for Electric Vehicle Charging Infrastructure Connections (ref, 81)** Close Out Report	The project has developed a standardised design specification for EV charge point operators to incorporate into a modular substation for trial. This will increase the efficiency and speed of larger EV charger connections to the MV network. The charge point operators will design and supply the module ensuring the ESB Networks part of the cabinet satisfy the design specifications.	The project has been disseminated through a range of channels from webinars, industry bi-lateral meetings, conferences and consultations to inform stakeholders and get feedback on the design while also seeking partners to trial. The trials have progressed in 2022 and will be installed and commissioned in 2023. The intention is that the EV Module design standard will be reviewed and transition into BAU following the successful trial of the modules.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Network Resilience** **Smart Network - New Core and Aggregation IP Network (ref: 49)** Close Out Report	With increasing deployment and reliance on network automation and intelligence on the network, future proofing the telecoms network is fundamental to ensuring a secure and resilient electricity network. The project has increased the resilience, security and bandwidth with the installation of a new scalable fibre-optic core and aggregation network for secure communications for the DSO and TSO operations.	The network is now fully integrated into BAU with management migrated to the Network Management Centre for 24/7 operations. The project was disseminated as part of our innovation forum in 2022 and is a fundamental building block supporting ESB Networks Telecoms strategy for secure and resilient telecommunications for network operations.

Innovation Projects	Benefits and Learnings	Dissemination and Transition to BAU
Innovation Pillar: **Network Resilience** **Weather Forecasting – Network Damage Prediction (ref: 54)**	The project supports the use of improved weather prediction to improve our ability in forecasting damage to the network and required resource response through storm damage prediction in a new and innovative way.	The project developed a new improved daily weather forecasting notification tool to our control room. The notification tool developed has been embedded into BAU as it proved successful over the last two years and often provides the earliest indication to trigger the consideration of a requirement for additional resources due to weather events.
Innovation Pillar: **Network Resilience** **Inspection of Overhead Lines Using Drones and Image Processing Analytics (ref: 19)**	By using new drone and AI systems, this project has developed a solution as an innovative alternative to the traditional line inspections. This will enable reduced time and resources spent on overhead line inspections, improve safety, reduce or eliminate the need for outages and optimise the use of materials and resources.	The project has developed the policy, standards and specifications for the use of drones on our network for HV asset assessment. The project has developed an Unmanned Arial Vehicle (UAV - drone) inspection framework agreement and is finalising the procurement of the Drone provider to use as an alternative to traditional line inspections as BAU. The next phase of the project will aim to develop and train AI models.
Innovation Pillar: **Network Resilience** **Leveraging Enhanced LV Monitoring to Optimise Targeted Network Reinforcement (ref.151)**	An advanced data analytics tool and dashboard was developed to integrate the data from 1000 LV monitors deployed on the network with other network data sources to proactively identify issues developing on the network.	This is transitioned into BAU for use by the LV network allowance team within electrification to identify LV system improvement needs and proactively deploy system improvements to the network. The project has been disseminated via webinars and was highlighted and discussed as part of our Innovation forum in 2022. The project has also had a number of papers published and presented at international conferences including CIRED 2022 and Cigré 2022.

Table 4.2: Innovation Projects Dissemination and Transition

5 COLLABORATION, ENGAGEMENT AND DISSEMINATION

5.1 COLLABORATION AND ENGAGEMENT

Stakeholder collaboration and engagement are essential parts of our Innovation Strategy and take place at each step of our innovation process. ESB Networks collaborates and engages with our stakeholders and customers to better understand the impacts of the challenges facing them, to identify and prioritise the issues to be addressed, and to help inform and validate the design of our projects. ESB Networks collaborates with a wide range of stakeholders including academic institutions, government entities and organisations, industry trade associations, electricity suppliers and generators, as well as new energy actors such as Demand-Side Units (DSUs) and battery storage providers. We acknowledge that the challenges posed by the transition to Net Zero are substantial, and a collaborative approach to addressing these challenges is essential. We understand we have a role to work together with our external partners' research and innovation activities that are aligned with our innovation pillars and our CAP targets for the network. Furthermore, to achieve our 2030 CAP targets we acknowledge that delivering the connection of greater levels of renewables, electrification of heat and transport and enabling active energy citizens can only be achieved by collaborating and engaging with our external partners, stakeholders and customers.

We are committed to continuously improving our approach to engagement to deliver meaningful outcomes for all our customers, stakeholders, and our business. Each year, ESB Networks publish a 'Stakeholder Engagement Strategy & Plan' providing stakeholders with pathways to engage as well as setting out our engagement priorities for the year ahead. In January 2022, we published ESB Networks Stakeholder Engagement Strategy & Plan 2022 describing our approach, methodology and key areas of engagement focus and listing our engagement activities for the year ahead. We continually seek feedback from our stakeholders to contribute to all our projects and programmes, and activities and to have their issues heard which informs our decision-making process. Our annual publications and consultations give our stakeholders a better understanding of our priorities, increased ownership of outcomes and greater capacity to engage in how energy will be used in the future. We value the feedback we receive and this document offers examples of how we have acted on it.

5.2 COLLABORATION AND ENGAGEMENT PARTNERS

ESB Networks undertakes significant engagement with our stakeholders across Ireland and internationally. We engage and collaborate with Irish electricity suppliers, generators and other international parties/companies to support their research and development. It can be said that, as standard, the majority of our projects feature an element of industry involvement and various levels of collaboration. We also engage with research and academic institutions to identify potential opportunities for projects and collaboration and also provide letters of support for relevant projects of theirs that align to the role of the DSO. Through 2022 we actively engaged and collaborated with a wide range of stakeholders and partners through our projects and regular meetings with representative bodies and organisations. Figure 5.1 gives an overview of our partner and engagements across 2022.

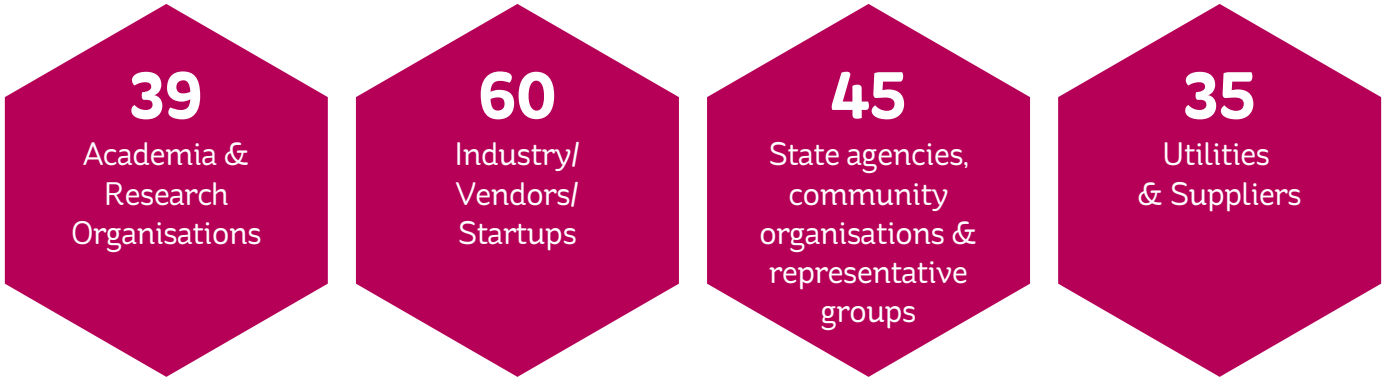


Figure 5.1 Infographic of ESB Networks stakeholder engagement in 2022

5.2.1 Presentations, Conferences and Workshops

ESB Networks personnel attended and presented at meetings, conferences and workshops during the year with a view to sharing innovation project learnings and strategy:

Organisation(s)	Type	Topic
Government Departments, Industry representative, Groups, Suppliers, Generator Owners and Academics	Webinars Meetings Showcase events	Series of innovation topics Direct Bi-Lateral Meetings and presentations to working groups Innovation Forum, Dingle dissemination events, Modular substation showcase events
Industry Lobby Groups, Suppliers, Generator Owners and Academics	Bi Lateral meetings	Range of bilateral meetings, workshops and conferences
Zevi	Board Membership	Regular Board meetings
Safe Electric and Engineers Ireland	Briefing	Electrification of heat and transport, microgeneration, community energy & standards
NSAI	Standards and Committee	Supporting the development of standards
IERC	Committee	Attending committee meetings and related project workshops
IEEE	Conference and Committee Meetings	Attending IEEE conferences and committee meetings
UCC MaREI – Shaping the Future of Marine & Maritime Communities	Workshop	Presentation on Community Engagement – Dingle Project
EPRI	Membership, project and Innovation workshops	ESB Networks is a member of EPRI and work with other utility members on a range of projects and programmes ESB Networks presented at the Utility innovation workshop in September 2022
EPRI	Workshops	Attendance at the European Workshop Week
450 MHz Alliance, EU Joint Research Council, EUTC and Tech UK	Meetings/Conference	Shared learnings from 'National Radio Access Network' Project and 400MHz smart grid delivery
Smart Dublin	Workshop	Knowledge sharing event - Innovation Strategy and Process
Engineers Ireland Lecture Series & National Recovery Event	Lecture Series Conference	Dingle Project Lecture Disseminate and share learnings with stakeholders on Electrification and Network Developments in ESB Networks
ABB	Presentation/Panel	Energy Storage for Network Resilience, Novel Fault Isolation, EVs and the Grid
Eurelectric	Workshop and committee	DSO development
CIGRE	Conference/Workshops / Seminars	Presentations and participation in a range of working groups and panel discussions
CIRED	Conference Establishment of Irish Branch	Paper publications, presentations and participation in panel discussions ESB Networks staff have established an Irish committee and submitted papers for Cired 2023 conference Rome

Table 5.1: Presentations, Conferences and Workshops

Organisation(s)	Type	Topic
Distribution Code Review Panel (DCRP)	Presentations	Regular presentations on innovation projects at the quarterly DCRP meetings
ENA – Innovation summit	Conference Committee and Working groups	Attendance at the ENA's Innovation Summit Engagement and input into cross purpose working groups with UK DSO/DNO peers - Review Policy, Standards practices across a range of working groups
E.DSO Stakeholder and Innovation Council	Meetings and workshops	Attendance and participation on a range of policy and standards

Table 5.1: Presentations, Conferences and Workshops

5.2.2 Publications

In 2022, ESB Networks personnel authored or co-authored a number of peer-reviewed, published papers and articles. A number of related papers to innovation areas are listed below with the ESB Networks staff highlighted in bold:

1. Cigré C2.40 working group - **Tony Hearne** (co-author);. Cigré publications
2. Cigré study committee A2 Transformers - **Transformer and Reactor Procurement** book, (chapter author on Transformer losses & efficiency) – viz. Khayakazi Dioka, Prof Paul Jarman, John Lapworth, Asgeir Mjelve, Santhiago Montenegro, Prof Alvaro Portillo, Adesh Singh, Craig Swindermann, **Anthony Walsh**, Ross Willoughby, and Bert Wouter
3. **Anthony Walsh, Clem Power**; Development of Retrofit MV/LV Transformer Designs to accommodate increased Electrification (Electric Vehicles / Heat Pumps); Cired Porto Workshop 2022
4. **Anthony Walsh**; Doubling the ADMD in Housing Schemes to cater for future EV loads; Cired Porto Workshop 2022
5. Zarko Janis, **Anthony Walsh,** Adesh Singh, Yorda Botec; Power Transformer Efficiency—Survey Results and Assessment of Efficiency Implementation; 5th International Colloqium on Transformer Research and Asset Management.
6. **Ken Atkinson**, Robert Southey, Measuring the Resistivity of Crushed Rock in Existing HV Stations; CEATI 2022
7. Jack Herring; **John Fitzgerald, Dan Catanase, Emma Silke**, Francois Pienaar, **Clem Power**, Hugh Cunningham; Online Monitoring and Data Analytics Enabling LV Network Investment Optimisation for a Low Carbon Future in Ireland, Cigré Session 2022, Paper 639, B3: substations and electrical Installations.
8. Jack Herring: **John Fitzgerald, Emma Silke**, Francois Pienaar, **Clem Power**, Hugh Cunningham, **Dan Catanase** SMART LV NETWORK PLANNING TO ACCOMMODATE E-MOBILITY AND LOW CARBON TECHNOLOGIES; CIRED workshop on E-mobility and power distribution systems, Paper No.1164 Porto June 22

5.2.3 Publications & Public Consultations

ESB Networks is committed to consulting publicly about its innovation activities annually. We are also committed to informing our stakeholders on their feedback through response papers and strategy documents which are published on our website publications. We also look for partners and participation through Expressions of Interest (EOI) calls.

Last year we published the following public consultations documents and EOI calls:

1. Innovation to Connect a Clean Electric Future – Innovation Consultation 2022
   a. Innovation Consultation - Response Paper
2. ESB Networks Expression of Interest for Radical Innovation Project Ideas
3. Innovation Stakeholder Panel - Terms of Reference (TOR).

5.3 INNOVATION STAKEHOLDER PANEL

In 2022 we issued a new call for expressions of interest for the Innovation Stakeholder Panel that was established in 2020, to renew and refresh the membership and external organisations representation in line with our Terms of Reference (TOR). The purpose of the panel is to provide early engagement on the selection, prioritisation, and timeline planning of innovation projects, by gaining a collaborative understanding of potential benefits and impacts of proposed projects to both internal and external stakeholders, as well as an opportunity to listen to and discuss the issues of importance to the various stakeholders and their organisations, which might be resolved or improved with networks innovations. We received a great response to our call and would like to thank all that expressed interest and have now met with the newly reconstituted panel. ESB Networks would like to acknowledge their ongoing contributions and input into our innovation activities and areas of focus. The panel currently has representation from 11 sectors, and in addition to receiving topical presentations and briefings, is also asked to bring any issues of particular relevance to their industry or members, to the group for discussion.

5.4 COLLABORATION, ENGAGEMENT & DISSEMINATION CASE STUDY: DINGLE ELECTRIFICATION PROJECT

From its launch in 2018, until conclusion in early 2022, collaboration has been critical to the operation of and the success of the Dingle Electrification Project (Dingle Project). The project was centred around the implementation of a range of low carbon technologies within a local community setting to help ESB Networks explore the potential services that these technologies could provide and to give us a better understanding of energy consumer behaviours and motivations, assessed through how the day-to-day use of these technologies can alter their impact on the network.

Collaboration: The Dingle Electrification Project was founded upon collaboration. Central to this were the five Ambassadors, together with the electric vehicle and solar PV trial participants. Without the support of these individuals, many of the project's learnings and trial outcomes would not have emerged. The deployment of technologies in a real community setting identified challenges, required solutions and provided learnings that a technical simulation in a laboratory environment would not have provided.

Other effective collaborations throughout the project involved those with the Dingle Hub, MaREI and North East West Kerry Development, as part of the Corca Dhuibhne 2030 Group, which provided ESB Networks with access channels to many local communities and groups, enabling the objectives of the Dingle Project to be widely communicated and understood, and to enable participation in low carbon capability-building initiatives that will support diffusion of these behaviours and technology adoption beyond the timeline of the Dingle Project.

Working closely with MaREI as it conducted social research into the effectiveness of the Ambassador programme and the EV trial also helped ESB Networks understand some of the active energy citizen learnings throughout the project and the potential for replication in other communities.

Throughout the early months of 2022, **engagement** with trial participants was for the purposes of completing the technical trials and to support a number of stakeholder visits to the project. Ambassadors continued to share their experiences of how a transition to low carbon energy has positively impacted their day-to-day lives and the continued community-wide interest in those experiences.

Dissemination of the project's learnings and insights have occurred, and continue to occur with interested parties, through the December 2021 webinar series videos and project reports published on ESB Networks' website and through meetings held with senior stakeholders such as CRU, the local MEP, representatives of Department of Transport and a number of County Councils. Various webinars have been held and others are scheduled, with applications submitted to share project insights at international utility conferences.

An event was hosted for the Ambassadors, trial participants and collaboration partners, subsequent to completion of the technical trials, to share the key insights and learnings from ESB Networks' perspective, and to hear from those involved across the community what they had learned throughout the project.

ESB Networks intends to monitor, with the collaboration of the Dingle Hub, the level of low-carbon and clean energy enabling technology adoption across the Dingle peninsula over the coming years to further assess the effectiveness of some of the initiatives undertaken as part of the project.

5.5 DISSEMINATION OF KNOWLEDGE AND LEARNINGS

The electricity network and distribution system is evolving to support Ireland's transition to a low-carbon future. Throughout this transition, ESB Networks will ensure that customers and stakeholders remain at the centre of our business. Listening to and engaging with customers is key to understanding their needs and preferences as to how we develop the network and deliver services to our customers.

In response to stakeholder feedback to our 2021 consultation for increased visibility of the innovation programme portfolio we published our 18 Month Innovation programme on our website. This was published and updated on our website since 2021 and we will continue to update and publish this report biannually in 2023.

At a range of industry events throughout 2022 and through a variety of channels, ESB Networks focused on engaging with our stakeholders who were either impacted by our innovation activities, or who may have had an influence on them. The purpose was varied, ranging from seeking feedback to informing terms of references and project approaches, to sharing updates on project progress and plans, to disseminating knowledge and learnings from projects to the wider industry. These channels of engagement included bilateral meetings, our website, public consultations, Innovation Stakeholder Panel, Innovation Webinars and our innovation forum.

5.5.1 EOI on Ideas for Radical Innovation projects

ESB Networks manages a balanced portfolio of projects across our 3 innovation pillars and assesses them across the innovation horizons of incremental, breakthrough and radical. Our proportional split of innovation projects are balanced across Incremental (75) and breakthrough (25) and this represents our focus on innovation projects of TRL7 and above for a DSO of our size and scale.

However following feedback from stakeholders in 2022 we held an expression of interest for radical innovation project ideas in 2022 to encourage our stakeholders to provide input and ideas in the radical space to potentially add to our existing portfolio of innovation projects. The EOI garnered feedback and ideas from 15 stakeholders across range of sectors and areas including electrification, IT sustainability, Network monitoring and Network Resilience. We would like to acknowledge and thank all respondents for their ideas and feedback. While none of the proposed ideas were in the radical space, we held a number of bilateral meetings with respondents to further assess their ideas. We are continuing to engage with some respondents on some of their developments and will assess if these should be considered further to develop a trial project in 2023.

5.5.2 Bilateral Meetings with Stakeholders

As part of our ongoing engagement with stakeholders throughout 2022, we held various bilateral meetings and workshops with the renewable electricity sector, academia/research, e-heat, e-transport, professional institutions, energy agencies/authorities, equipment/systems manufacturers, utility/TSO, industry & large energy users, electricity suppliers, industry consultants and international organisations. We received stakeholder feedback from respondents across 8 sectors to our Innovation Consultation, Innovating to Transform the Electricity Network which had been published in February 2022. As part of our response to this feedback, we offered bilateral meetings to each of the respondents and extended the offer to additional interested stakeholders. As a result of this, we held several interactive sessions with stakeholders including, MaREI, Electricity Association of Ireland (EAI), and UCD Energy Institute.

Throughout 2022 we held engagement and diffusion events with community and industry stakeholders such as our Dingle stakeholder events and additional show case events as part of our Modular MV EGIP substation project team held a at the NTC in Portlaoise. In 2022 we have held bilateral meetings with Peer DSO's and industry research organisations such as Cigré and CIRED, with ESB Networks staff from Innovation and Electrification establishing an Irish branch of CIRED in 2022.

5.5.3 ESB Networks' Website & social media

The innovation section of ESB Networks' website continues to be a valuable channel to share and disseminate with our stakeholders as it continues to be ranked highly as a preferred channel. We continuously update the website with project close out reports and in 2022 significantly updated Dingle section to disseminate the valuable learnings outputs from the project. A new 'Innovation Stakeholder' section is under development for the website to disseminate and share the recordings of our innovation webinars and details from our Innovation Stakeholder Panel meetings. Through our social media channels, such as LinkedIn, ESB Networks continues to inform stakeholders with regular posts of updates on our innovation projects and activities and value user comments and input. For more information on our innovation projects and activities please visit Innovation in ESB Networks.

5.6 ENGAGEMENT & DISSEMINATION OF LEARNINGS CASE STUDY: INNOVATION FORUM 2022

In 2022 we have moved to provide information on our Innovation activities, and the outcome of projects, through a mixture of online webinars and in-person events. While our online webinars continue to be a welcome addition to our engagement channels and have enabled a more agile approach to stakeholder engagement, the sharing of information on our innovation activities and the dissemination of project learnings and outcomes, the Innovation team also had a strong presence at the SEAI Energy show in March, which was an opportunity to speak face-to-face with stakeholders and some representative organisations.

Based partly on feedback from our external Stakeholder Panel indicating comfort with face-to-face meetings, we hosted an in-person Innovation Forum in Pairc Ui Chaoimh, Cork, on Tuesday 29th November. A mixture of Innovation stakeholders, including representatives of industry, academia and technical experts, listened to presentations and joined in with panel discussions and interactive sessions.

Our webinar series covered a range of topics across our Innovation projects such as supporting the connection of renewable generation, electrification of heat and transport, community engagement, network resilience and the transition of flexibility projects and trials into our newly launched NNLC Programme.

Our innovation webinars continue to encourage interaction through open discussions via an online platform and were attended by a diverse group of stakeholders across government, industry, academia and representative associations. We had strong engagement with our stakeholders with an average attendance of 90 stakeholders for each webinar. All our webinar recordings have been made available to our stakeholders for reference and can be viewed at www.esbnetworks.ie/who-we-are/innovation/ . We look forward to continuing the Innovation Webinar series in 2023, to share our innovation progress, discuss feedback we have received, and collaboratively consider how we tackle the transition to the network of the future.

5.

The opportunity of the Innovation Forum in Cork was to directly have a two-way communication between ESB Networks Innovation, the wider Networks business and our stakeholders. We invited representatives from government and policy influencers, energy industry representative groups, universities and research groups and energy and technology suppliers with a well-represented cross-section of stakeholders present on the day.

A number of showcases were used to present newer technologies and demonstrate their potential, such as our use of drones for inspection and maintenance, Virtual Reality headsets and environments for hands-on exercises in conjunction with the National Training Centre in Portlaoise, and a new electric light van from the ESB Networks fleet.

The day provided opportunities for formal and organic networking and discussion (commencing with a shared breakfast and concluding with a "Meet the Teams" session), with many attendees pleased to engage face to face to tease out the challenges facing their industry or area, benefits of Innovation projects and technologies, or to explore future developments and plans. There was a presentation from the ESB Networks Electrification Team on the reasons for, and technology to support, **Low Voltage Networks Updates** to enable Low Carbon Technologies. This was followed by a presentation from ESB Networks Fleet & Equipment, on their **Fleet Developments and Decarbonisation,** demonstrating how they are playing a role in electrifying their own fleet while working on the enablers for other people to do the same. A panel discussion with the speakers and guest panellist Dr Paul Deane of MAREI research centre followed, during which our guests could ask and "upvote" questions using an online tool.

Further presentations on **Networks Flexibility** and the National Networks, Local Connections Programme; **Renewable Connections** to the network; and **Latest Developments in Networks Telecoms** followed, with a further panel discussion (joined by guest panellist Dr Pádraig Lyons of the International Energy Research Centre) and opportunity for questions and comments. The forum was extremely successful, with attendees enjoying the opportunity to hear about the why as well as the what of our Innovation activities, and ESB Networks receiving direct feedback, being challenged and hearing first-hand from our internal and external stakeholders.

5.7 WORK WITH US ON THE INNOVATION JOURNEY

We are clear that the challenge of delivering the electricity network to support the decarbonisation of Irish society no later than 2050 requires extensive and collaborative innovation and success will not be achieved without ongoing active customer and stakeholder participation, engagement and support. We will listen to and work with our partners and stakeholders to develop innovative solutions to ensure the network is smart, flexible, resilient, safe and adaptive to support our customers adopting low carbon technologies and deliver the connection of renewable generation at scale.

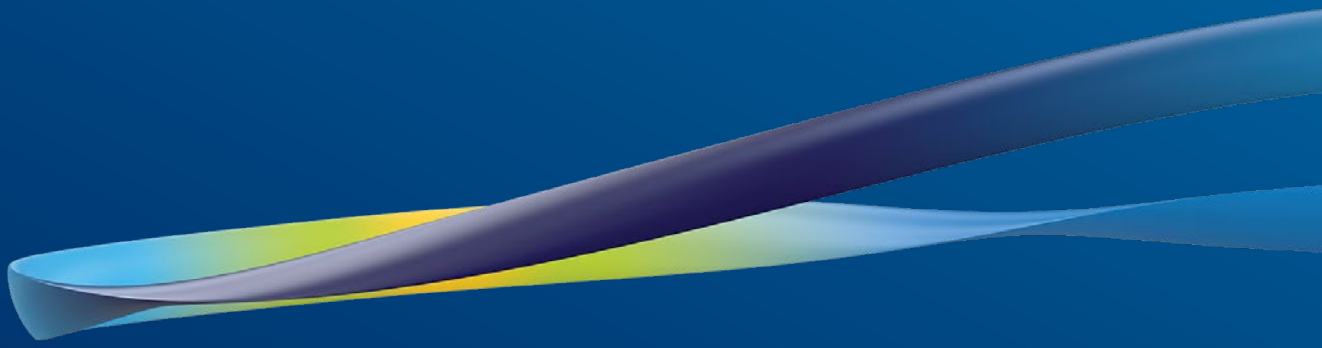
We must build on our history of innovation, maintain an agile mindset and ensure the processes we have in place and the solutions we implement are capable of responding to a rapidly changing world. This report has summarised how ESB Networks is collaboratively implementing new ideas, innovative concepts and technologies that will provide enduring benefits for our customers. We have shared our approach to innovation including our overall framework, strategy, governance, processes, dissemination, feedback and progress.

We welcome your comments and feedback to help shape how ESB Networks innovates to deliver the network for Ireland's clean, electric future and the enduring benefits for current and future generations.

Please send your comments and feedback to innovationfeedback@esbnetworks.ie

For more details of our Innovation projects and activities please visit our website: Innovation in ESB Networks

NETWORKS



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