NETWORKS

INNOVATION 2024: INNOVATION TO DELIVER NETWORKS FOR NET ZERO

CONSULTATION REPORT

Delivering the Electricity Network for Ireland's Clean Electric Future

DOC-110124-HVZ

esbnetworks.ie

Foreword

Innovation in ESB Networks is a key enabler to deliver on our Price Review (PR5) commitments, Climate Action Plan 24 objectives, and our Networks for Net Zero Strategy to deliver the electricity network for Ireland's clean electric future by 2040.

ESB Networks delivers an electricity network that empowers our 2.4 million customers daily and provides access to sustainable energy supplies for all. Through innovation, ESB Networks will deliver the electricity network of the future, offering customers greater choice and flexibility in how they consume and generate electricity. By investing in our technical capability and collaborating with our customers and partners, we are developing a smart and resilient electricity network. Together, we are 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.

The challenges of delivering the electricity network to support the decarbonisation of Irish society no later than 2050 require extensive and collaborative innovation. 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 to accelerate the connection of renewable generation at scale.

In support of the government's Climate Action Plan 24, our customers, and our stakeholders, we have developed our innovation strategy and portfolio of innovation projects across our three Networks for Net Zero strategic objectives.

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, are implementing new ideas, innovative concepts, and technologies.

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

Nicholas Tarrant

Nicholas Tarrant
Managing Director
ESB Networks

Executive Summary

ESB Networks ensure electricity gets to the homes and businesses of our 2.5 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 work 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 focused on delivering our Networks for Net Zero Strategy as we continuously innovate 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, are implementing new ideas, innovative concepts, and technologies that will support climate action and provide enduring benefits for our customers and communities.

Throughout this document, and 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 provided on our innovation project portfolio that spans across our three strategic objectives and reports on progress by ESB Networks over the last 12 months.

Throughout 2023, ESB Networks have 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 business as usual where there are associated demonstratable benefits.

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 how we can collaborate further to deliver our Networks for Net Zero targets together. We want to hear your views on how ESB Networks deliver innovation, our projects, and areas that ESB Networks should focus on.

Please send your comments and feedback to **innovationfeedback@esbnetworks.ie** or fill out our online survey here.

ESB Networks' Innovation KPIs

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.

- **95** innovation ideas examined in 2023.
- **28** projects currently in delivery with seven new projects initiated and two projects completed in 2023 (see section 3)
- **90+** external collaborations – ESB Networks are actively collaborating or partnering with over 90 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 450 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 see visit our website Innovation in ESB Networks

This document is split into four sections:

1. **Innovation in ESB Networks** gives an overview of our strategic objectives, our governance, and our project management processes.
2. **Looking Ahead** sets out our vision and insight into the short- and medium-term future of innovation.
3. **Our Project Portfolio** provides an update on our innovation portfolio and project progress over the last 12 months.
4. **Knowledge Sharing** gives an overview and highlights our key collaboration, engagement, and dissemination activities over the last 12 months.

Figure 1.1: ESB Networks innovation KPIs dashboard

Contents

EFQM Excellence Model Innovation Lens

1

INNOVATION IN ESB NETWORKS

1.1 ESB NETWORKS - WHO WE ARE

ESB Networks provide the electricity infrastructure that transports electricity to all customers in Ireland through both the distribution and the transmission systems. We have served our customers for over 90 years and have provided the electrical infrastructure on which our society has developed.

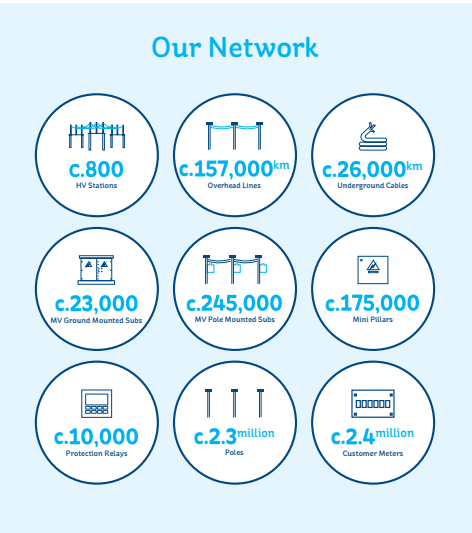
ESB Networks work to meet the needs of all Irish electricity customers, providing universal affordable access to the electricity system. We deliver and manage the performance of a network of almost 157,000 km of overhead networks, 26,000 km of underground cables, over 800 high voltage substations, significant amounts of connected generation (including renewable generation connected to the distribution and transmission systems), and 2.4 million demand customers.

To support the delivery of a safe and reliable distribution system we undertake all the functions related to asset management, planning, construction, maintenance, and operation of the high, medium, and low voltage distribution network. ESB Networks also build and maintain the high voltage transmission system.

We also deliver a range of services to the Republic of Ireland (RoI) Retail Electricity Market servicing over 2.4 million customers. We manage relationships with market participants and provide data in a timely and accurate fashion on a daily basis.

ESB Networks support the wider Irish market through the ring-fenced Meter Registration System Operator (MRSO) and Retail Market Design Service (RMDS), and supports the wholesale Single Electricity Market through the provision of aggregated meter data.

ESB Networks place customer service at the centre of our operations, providing services to all electricity customers regardless of their supplier. Our staff and approved contractors throughout the country strive for excellence in all interactions with customers, while also supporting them in participating in the energy market and transitioning towards adoption of low-carbon technologies.



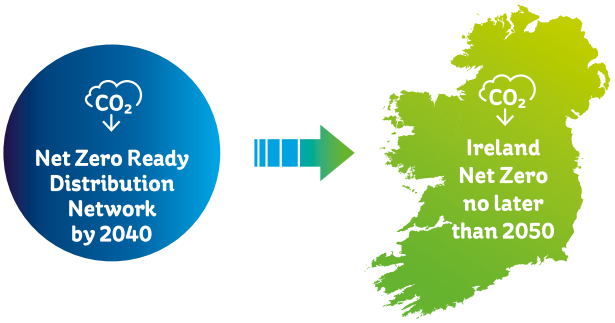
1.2 OUR NETWORKS FOR NET ZERO STRATEGY

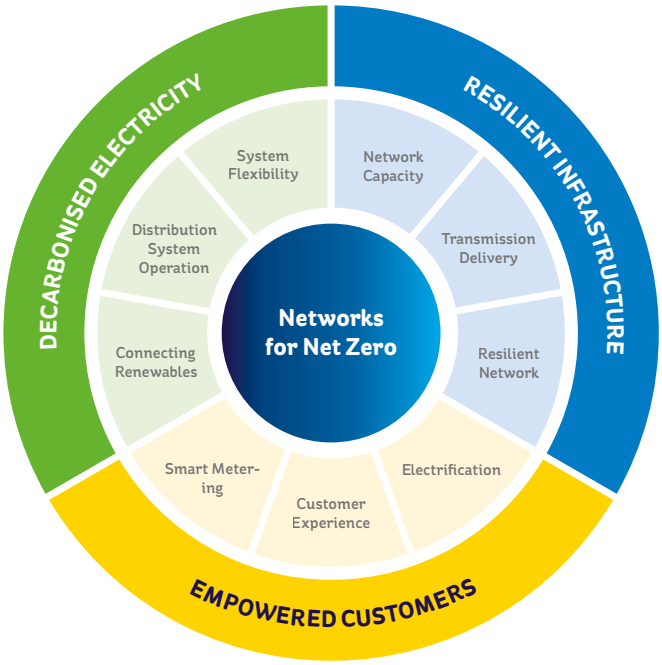
Our Networks for Net Zero Strategy outlines ESB Networks' role in facilitating the implementation of the Irish government's Climate Action Plan 2023, with a view to achieving Ireland's net zero target by 2050. The Strategy aims to develop a flexible and intelligent digital electricity network that will serve as a foundation for a clean electric future in Ireland by 2040.

ESB Networks have identified three strategic objectives which are core to the delivery of our Net Zero strategy: Decarbonised Electricity, Resilient Infrastructure and Empowered Customers. Each of the strategic objectives can be broken down into three key areas of focus, as shown in the diagram below. Realising our strategy relies upon efficient use of ESB Networks' four foundational capabilities: Our People, Digital and Data Driven, Financially Strong, and Sustainably and Socially Responsible.

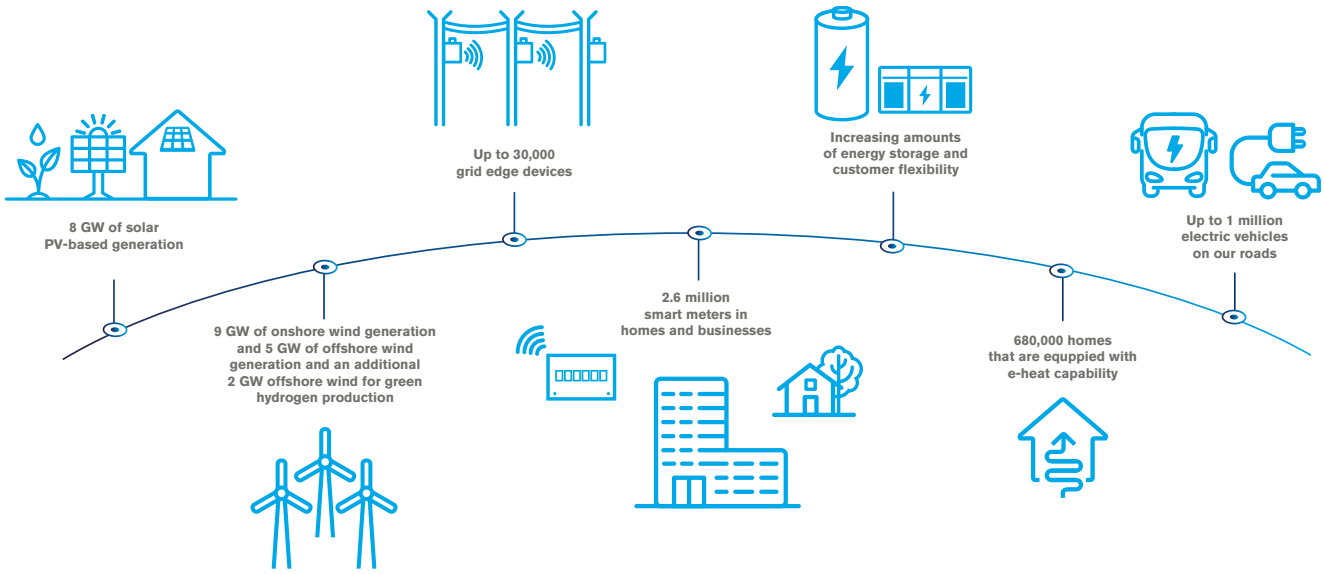
Our purpose in ESB Networks has always been to connect and distribute electricity safely, securely, and affordably. Acknowledging the significant role that electricity plays in climate action, our purpose has evolved to deliver a clean electric future through the electrification of heat, transport, and industry, as well as connecting renewable generation at scale to the electricity network.

This means delivering our role to help the targets for 2025 and 2030 as set out in Climate Action Plan 2023. The three strategic objectives supersede our innovation pillars from our previous consultations and innovation strategy. Our strategy sets out to deliver the targets defined in CAP23 for 2025 and 2030. It also sets out a clear objective to develop a digital electricity network that is flexible and smart, and will provide a foundation for a clean electric future in Ireland by 2040. This means having a net zero-ready distribution network by 2040 to enable Ireland's achievement of net zero no later than 2050. This will be an important milestone on the journey to Ireland being net zero no later than 2050. The work we do under our primary roles of Distribution System Operation (DSO), Distribution Asset Owner (DAO), and onshore Transmission Asset Owner (TAO) is essential and on the critical path to achieve this objective.





ESB Networks' vision for our network by 2030 is seen below



Delivering this is going to require a transformation of our network, our systems, and our approach. The sustainable social and economic development of communities, businesses, Ireland's climate action response, and transition to net zero are all dependent on ESB Networks delivering our purpose through to 2030 and beyond.

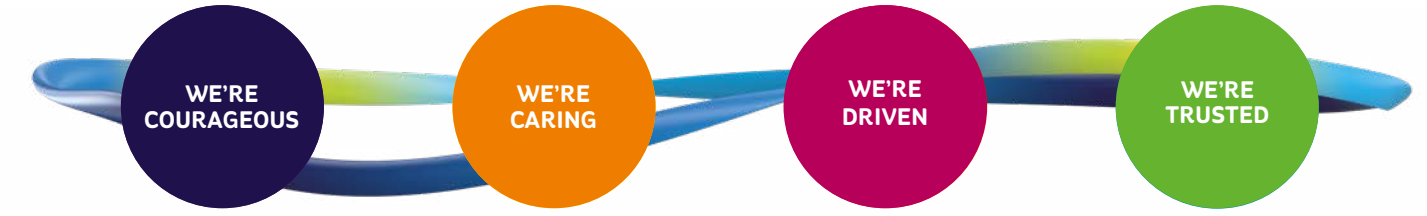
For our customers, electricity will continue to provide a safe, secure, and reliable energy source and it will also present new opportunities to take part in the energy transition through self-generation and storage, demand management, energy efficiency opportunities, and selling electricity by exporting back on to the electricity network. As customers engage with new opportunities, and as renewable energy connections increase, managing the network will become more complex.

We plan to introduce a 'Build Once for 2040' concept that will ensure that the distribution network and supporting services such as demand management are designed and developed to meet the anticipated needs of customers in 2040 and to deliver a clean electric future. This will eliminate the need for repeated, costly, and resource intensive interventions on the network. Where possible, we will deploy solutions today which are scalable to meet the needs of customers and stakeholders in 2040.

At ESB Networks, we understand that we have been entrusted with the responsibility to play a vital role in Ireland's energy future, and we know we cannot do this alone. Through delivering our Networks for Net Zero Strategy in collaboration with all our stakeholders, we will ensure that the network is prepared to meet the changing and evolving needs of our customers in a clean electric future.

Our vision is to enable the clean electric future together with our stakeholders and customers who will be at the heart of this transformation. The delivery of this is underpinned by Our Values of being Courageous, Caring, Driven, and Trusted.

Our Values



Each of us is prepared to challenge the way we've always done things, stand up for what we feel is right, and try better ways of working.

We're putting customers' current and future needs at the heart of what we do and we keep ourselves and others safe and healthy.

We bring passion and persistence to what we do every day, innovating and collaborating to meet the challenges and opportunities ahead.

We each play our part, taking ownership of our responsibilities, seeing the job through, and protecting our own health and safety, as well as others'.

1.3 INNOVATION STRATEGY AND GOVERNANCE

Our innovation strategy sets out the roadmap through which we aim to achieve our ambitions. Our annual consultation feeds into our ongoing strategy. The three innovation pillars from previous years have been replaced by the three strategic objectives of the Networks for Net Zero Strategy. We follow our strategic framework to manage every stage of the development and implementation of our initiatives, from setting the vision, project selection, and management to the transition to business as usual (BAU). Our innovation strategy cycle is illustrated in the figure below.

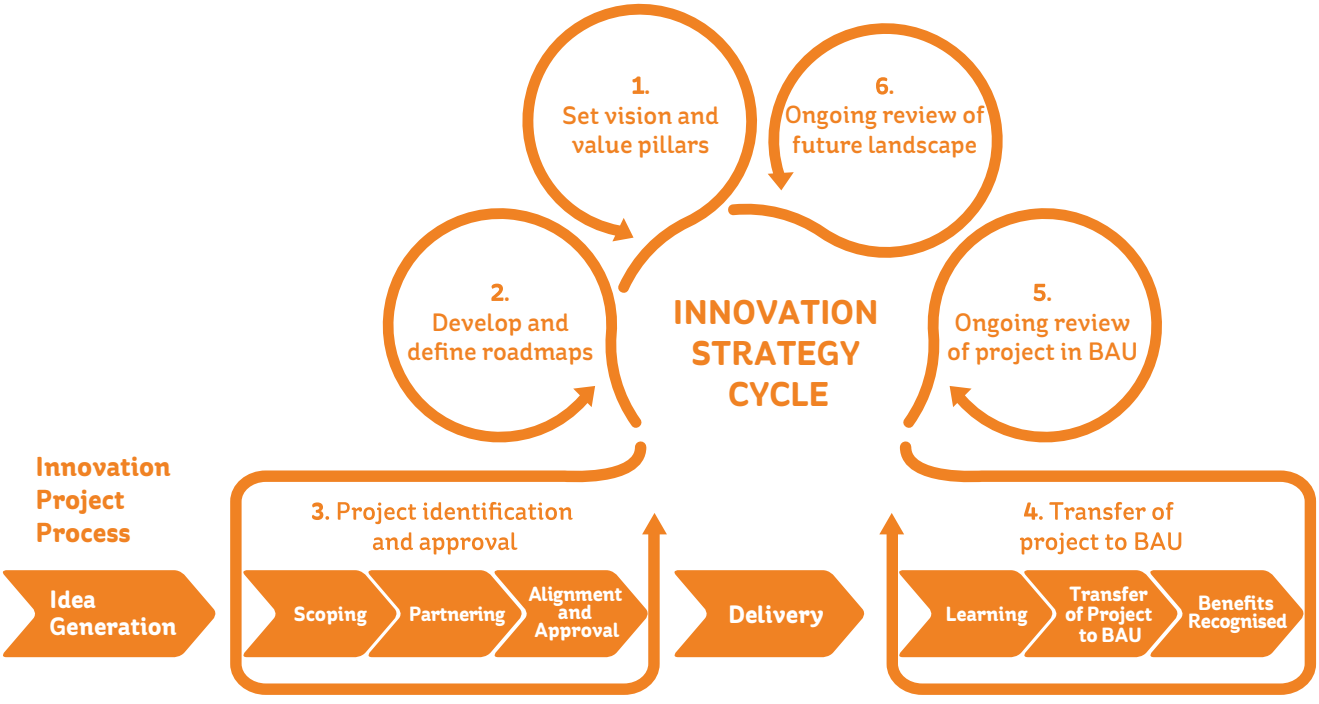


Figure 1.2: Innovation strategy cycle

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 (SLT) 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 innovation governance. The ISG has oversight of both the initiatives and processes which allow ESB Networks to effectively identify, assess, monitor, prioritise, and deliver our portfolio of innovation projects in accordance with our vision and values, for the benefits for all customers.

Further details on our key project management and governance processes are provided below in Figure 1.3.

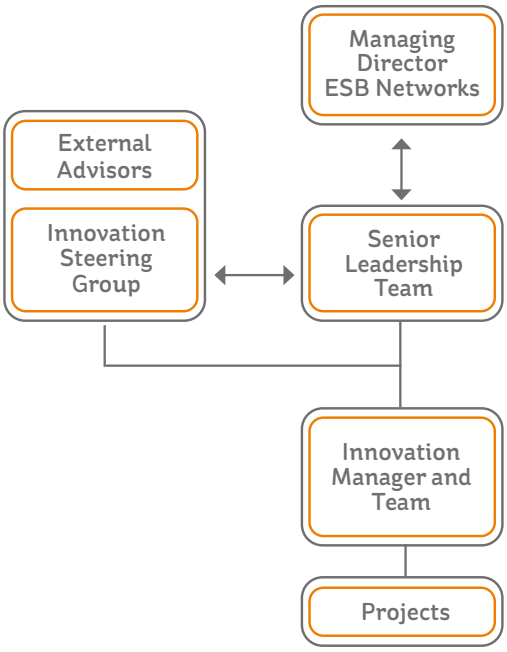


Figure 1.3: Innovation governance organisational structure

Project Identification, Evaluation, and Delivery

The process from identification of ideas to project delivery includes multiple stages as described below and shown in Figure 1.4.

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 engagement and collaboration with stakeholders and third parties.

A detailed overview of each process in our project identification, evaluation, and delivery has been published on our website here.

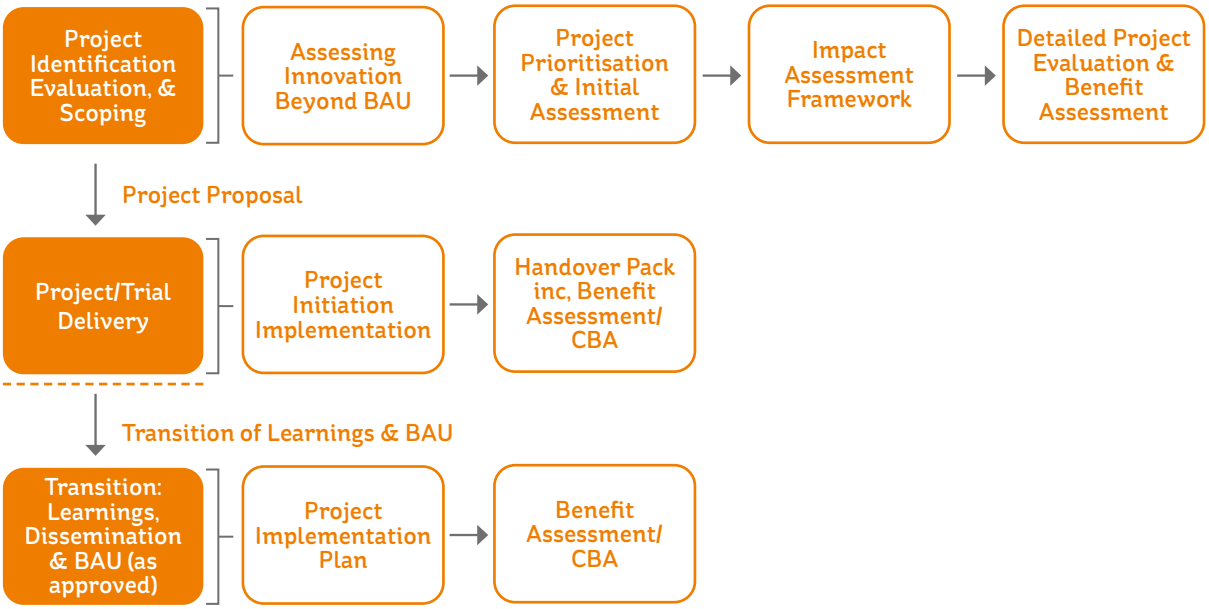


Figure 1.4: Innovation project process

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 believe it worthwhile to leverage successful innovation outcomes from others wherever possible, and that this approach should offer value for money for our customers.

ESB Networks also share learnings on innovation pilots with other utilities to enable them to leverage our learnings and fast follow our approach.

Project Trials

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.

Project Delivery

The role of the central innovation team has evolved into a 'Hub & Spoke' model, with the majority of innovation project delivery occurring within the business units across ESB Networks, where the project managers and delivery teams are intimately familiar with the subject matter area and technologies being deployed. The central innovation team manages the governance process and innovation reporting on behalf of the organisation. A small number of innovation projects are managed by members of the central innovation team, with oversight and direction provided at key stages by specialists across the wider business.

Assessment of Benefits and Costs

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 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, other types of outcomes are of course considered valuable. These include environmental and social impacts, efficiencies in connecting customers to the network, or learning opportunitiess which improve our knowledge of how to transform the network.

Strengthening Innovation Culture, Expertise, and Capacity Buildings

ESB Networks continue to enhance innovation expertise and capacity through a number of different initiatives. We have a range of innovation programmes to develop and promote innovation throughout ESB Networks:

- 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 global energy utility companies.
- Innovation Connectors Group
- CIRED Ireland
- Peer DNO collaboration and engagement
- Portfolio of innovation projects

We also host a regular online Innovation Panel for external stakeholders and industry experts to discuss our portfolio and pipeline ideas. While the Innovation Panel does not have a role in governance or oversight, it provides a valuable knowledge sharing forum which gives insight into emerging technologies and future trends in the sector, as well as enabling us to develop and maintain relationships with key players.

Performance Improvement

ESB Networks are 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 around delivering innovation projects and the challenges. We carry out an assessment under the European Foundation for Quality Management (EFQM) Innovation Assessment methodology, which is an internationally recognised and certified model of excellence. At ESB Networks we continuously look for improvements across our innovation process, projects, culture, dissemination, and engagement.

2 LOOKING AHEAD

As the Distribution Asset Owner (DAO), Distribution System Operator (DSO), and onshore Transmission Asset Owner in Ireland, ESB Networks play a vital role in leading the transition to a secure and affordable low-carbon future, using clean electricity. The transition to a net zero society no later than 2050 will be enabled by a net zero ready distribution network by 2040.

Over the next 10 years, ESB Networks are poised for substantial growth and innovation driven by the electrification of heat and transport, the changing energy mix on the island, and the drive towards the target of net zero by 2040 as set out in our Networks for Net Zero Strategy. Our strategy is focused on three of the UN Sustainable Development Goals (SDGs) and SDG 9 (build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation) is one which reinforces these topics discussed below.

Throughout the period of Price Review 5 (PR5), ESB Networks continue to take the necessary preparatory steps such that in the coming decade, all customers will be able to adopt innovative technologies, products and services, changing how they generate, store, and consume electricity. As the electricity system transitions to net zero, ESB Networks need to deliver a smart and sustainable distribution system that enables smarter planning, operations, and flexibility markets, as well as providing the network capacity needed for our customers to make the transition to becoming active energy citizens.

2.1 OUTLOOK

A key enabler of our Networks for Net Zero 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, with collaboration being central to the delivery of our innovation strategy. We will need more collaborative partnerships with industry, technology providers, academia, energy providers, community agencies, and international research organisations to deliver innovation projects that realise the ambition set out in our strategy.

As society is decarbonised through electrification, our customers will depend on a robust and reliable energy supply more than ever before. Considering it is expected that in the coming years the frequency and impact of storm events will continue to worsen, ESB Networks will need to explore and employ new and innovative technologies and solutions to improve the resilience of our network, and to deliver on our target of less than 60 unplanned Customer Minutes Lost per annum. Our strategy calls out Resilient Infrastructure as a key pillar, and key to that will be ensuring we develop greater physical network resilience, but also greater cyber resilience. Our journey towards becoming a digital and data driven distribution utility naturally increases the detrimental impact that a cyber attack could have, and so continued efforts and new developments will be required in this space.

Another focal point for ESB Networks under Resilient Infrastructure will be the delivery of additional network while maintaining a growing infrastructure. Over the coming years, ESB Networks will be challenged to build new network to connect and facilitate both growing demand and increasing renewables. The magnitude of the network infrastructure to be constructed is unparalleled, spanning all voltage levels including low, medium, 38 kV, and high voltage.

Adding additional grid capacity is already a major challenge but increasing pressure for faster delivery heightens this challenge, further. Innovative approaches are required, and pilots are already underway to explore the feasibility of uprating existing 38 kV network to 110 kV to get additional capacity from existing line corridors. Rapidly evolving data analytics platforms coupled with higher quality drone footage will enable us to survey potential corridors much more quickly, automate the identification and auditing of vegetation management strategies, and prioritise maintenance works based on asset health and condition.

ESB Networks will see huge changes over the coming years as the innovative concept of renewable hubs come to fruition, accelerating the connection of new renewable projects. In parallel, the evolution of the hydrogen economy will see ESB Networks receive large scale demand connection applications to connect hydrogen electrolysers, while the applications for innovative energy storage solutions are also expected to rise.

The electrification of transport is well underway and the impacts on the distribution network are starting to materialise. Technologies such as low voltage monitoring, advanced distribution management systems, and advanced metering infrastructure in the form of smart meters will enable ESB Networks over the coming years to better monitor, and proactively plan and deliver, the low and medium voltage network upgrades required to enable our customers to adopt low-carbon technologies at scale. At the medium voltage and 38 kV level, ESB Networks are responding to the need for new and additional network capacity along the national and motorway infrastructure of the country, to deliver on the requirements s set out under the alternative fuels infrastructure regulation (AFIR) as part of the Fit for 55 package. Nevertheless, it is anticipated that there will be some challenges in the delivery of new or uprated network to enable EV charging across the country's roads infrastructure, and innovative solutions will likely be needed to deliver on the AFIR requirements, while maximising and redistributing existing capacity where possible.

Looking ahead, the future of flexibility services is poised to play a pivotal role in the evolving energy landscape. As the grid accommodates a growing influx of renewable energy sources and varying demand patterns, the ability to adapt and optimise the distribution network becomes paramount. Through our National Networks, Local Connections (NN,LC) programme ESB Networks are actively exploring and implementing innovative flexibility solutions, including demand response programs, energy storage integration, and dynamic grid management strategies. Empowering customers to actively participate in these initiatives fosters a more dynamic and responsive energy ecosystem and promotes greater sustainability and grid resilience.

In tandem, a fundamental shift toward more sustainable procurement practices and circular design principles is imperative for ESB Networks. As the demand for infrastructure expansion continues, minimising the environmental impact and promoting resource efficiency must be integral to procurement processes. Circular economy principles, encompassing the reuse and recycling of materials, can mitigate the ecological footprint of network upgrades and projects. By continuing to embed circularity into our designs, ESB Networks are contributing to a more environmentally conscious and sustainable electricity infrastructure.

Furthermore, the coming years will see the rise of energy communities as a key player in the transition to a low-carbon energy future, aligning with EU legislation advocating for decentralised energy production and consumption. ESB Networks have a pivotal role in enabling these communities and the NNLC programme published a community toolkit on the ESB Networks website in June 2023. This toolkit is our preliminary proposal, as Distribution System Operator (DSO), of the tools and supports which will support energy communities in achieving their goal of having sustainable community energy. This publication of this toolkit has started the process of actively seeking customer and community input into supporting the development, testing, and adaptation of the community toolkit. Successful collaborative efforts with energy communities can enhance grid resilience, promote local energy autonomy, and contribute significantly to the overall net zero ambition.

ESB Networks are committed to driving innovation and sustainability in its pursuit of a net zero future in line with its Networks for Net Zero Strategy and the Climate Action Plan (CAP23). The collaborative partnerships forged with industry, academia, and various stakeholders underscore the importance of collective action in achieving lasting benefits for our customers and the broader community.

As we navigate the challenges of decarbonisation, network resilience, and the evolving energy landscape, ESB Networks remain committed in its dedication to delivering a safe, secure, low-carbon electricity supply. By embracing innovative technologies and sustainable practices, we will position ourselves to help enable the energy transition for our customers.

2.2 KEY CHALLENGES

The deployment of more than 1.5 million smart meters is delivering great benefits for our customers, but data access challenges remain to be overcome so that ESB Networks can maximise the value of this data for the planning, development, and operation of the distribution network, and enable new services for our customers. For example, having greater insight into the energy needs of our customers at a localised level would enable ESB Networks to identify, prioritise, and complete medium and low voltage network upgrades where they are needed most. This data access challenge is not unique to Ireland and several peer distribution network operators across Europe are trying to overcome similar. This capability opens up a range of opportunities, especially in light of the growing complexities within low voltage networks. The electrification of heat and transport, coupled with a rising prevalence of behind-the-meter solar PV and energy storage, adds layers of complexity to the distribution network. Effectively leveraging the insights gleaned from smart meters would equip ESB Networks to proactively address challenges associated with the evolving landscape of energy consumption and generation, ultimately delivering a more resilient and adaptable electricity infrastructure for the benefit of its customers.

Transforming data into actionable information is something that is also very important when it comes to large scale electrification and the provision of capacity in the correct locations across the country. With this in mind, Charles Rivers Associates (CRA) has developed for ESB Networks a growth rate tool called PEGASUS 40 (Predicting Energy Growth and Supporting Utility Scenarios for Net Zero 2040). This tool allows ESB Networks to predict growth around the country based on differing scenarios/inputs (e.g., CAP targets, housing stock, EV charging demand, AFIR obligations etc.). PEGASUS 40 will enable us to assess and adapt peak load growth to changes in the electricity landscape and support an efficient delivery of targeted reinforcements. In addition, ESB Networks have made available a revised capacity heatmap on our website, and launched an EV charging hub screening pilot in 2023. This screening pilot has been very successful in helping charge point operators (CPOs) to select sites where capacity is more readily available. It is proposed that this screening pilot will now be extended in 2024, beyond the category of EV charging hubs, and opened to other large energy user applications.

The growth of renewable generation continues at pace and over the coming years there will be the influx of offshore renewables coming onto the grid. Given the scale of many of the new developments, large scale deep reinforcements are required on the network. These have traditionally been difficult to progress, but are key to accommodating the levels of renewables required for Ireland to decarbonise its electricity system and meet its 2030 targets outlined in the Climate Action Plan (CAP23). Finding efficient methods to connect renewables to the grid at scale will be key in line with our Networks for Net Zero Strategy to 'Build Once for 2040', We are proposing to develop renewable hubs and explore advance build network reinforcements so that increased wind, solar, and batteries (including community projects and smaller scale generation customers) can connect safely to the electricity network. A joint ESB Networks and EirGrid proposal for the implementation of a renewable hubs pilot was submitted to the CRU in June 2023 and approved in October 2023. Further information is available in our Electricity Distribution Network Capacity Pathways consultation report on our website.

2.3 INNOVATION IDEA SPOTLIGHT

Timed Connections Pilot

ESB Networks are preparing an expression of interest (EOI) for a Timed Connections pilot in 2024. It is proposed that a timed connection is a time constrained demand connection, and that it would be an interim solution until necessary reinforcement works can be completed to provide the customer with their contracted MIC on a 24-hour basis. For a customer to be considered for the pilot, their demand profile would need to be typically at its highest during lower demand periods on the electricity network and associated with the electrification of transport. They would have a specific time window in which they could utilise an agreed MIC, but would be restricted to significantly less at all other times. Implementing Timed Connections would enable faster, conditional connections for our customers while the planning and delivery of required network reinforcement works are completed. During the pilot, ESB Networks will work with the participating customers to better understand the technical, commercial, and regulatory impacts of a timed connection.

Plexigrid – Advanced Modelling, Planning, and Analysis for LV Electrification

ESB Networks are piloting an advanced modelling, planning, and analysis software platform to help plan and design the low voltage network needed to enable mass electrification for our customers. The aim of phase 1 of the pilot is to evaluate the Plexigrid software offering while exploring the benefits of using a digital twin approach for modelling the LV network, and understanding the impact of adding more low-carbon technologies behind the meter in customer homes. It is hoped that in time, ESB Networks will be able to leverage smart meter data during phase 2 of the pilot to help better understand the impact of customer loads on the LV network and the impact of the aggregated loads on the upstream transformers and distribution feeders.

Your Feedback

ESB Networks would like feedback from our stakeholders on the following questions. These will be available on our online survey which you can fill out by following this link .

1. **What potential areas of innovation do you feel that ESB Networks should focus on as part of PR6?**
2. **What innovation pilot would you propose/prioritise from your sector?**
3. **How can ESB Networks do more to enable and empower community energy projects?**
4. **What innovative solutions are you aware of that ESB Networks should be piloting to assist our customers on their application journey for demand/generation connections or to connect quicker to the network?**
5. **How can ESB Networks enhance customer engagement and education to promote energy efficiency and demand-side management, and what incentives or tools should be provided to customers?**
6. **Given the expected growth of energy storage, hydrogen, and alternative-fuel technologies, what collaborative initiatives would you propose be undertaken with technology providers to explore the potential of these technologies while ensuring grid resilience and reliability?**
7. **How do you envision the potential benefits or opportunities of open access to data and models in the electricity distribution system, and how could such transparency enhance collaboration, innovation, and efficiency within the industry? Please specify data that would be beneficial.**

3

OUR PROJECT PORTFOLIO

3.1 OVERVIEW

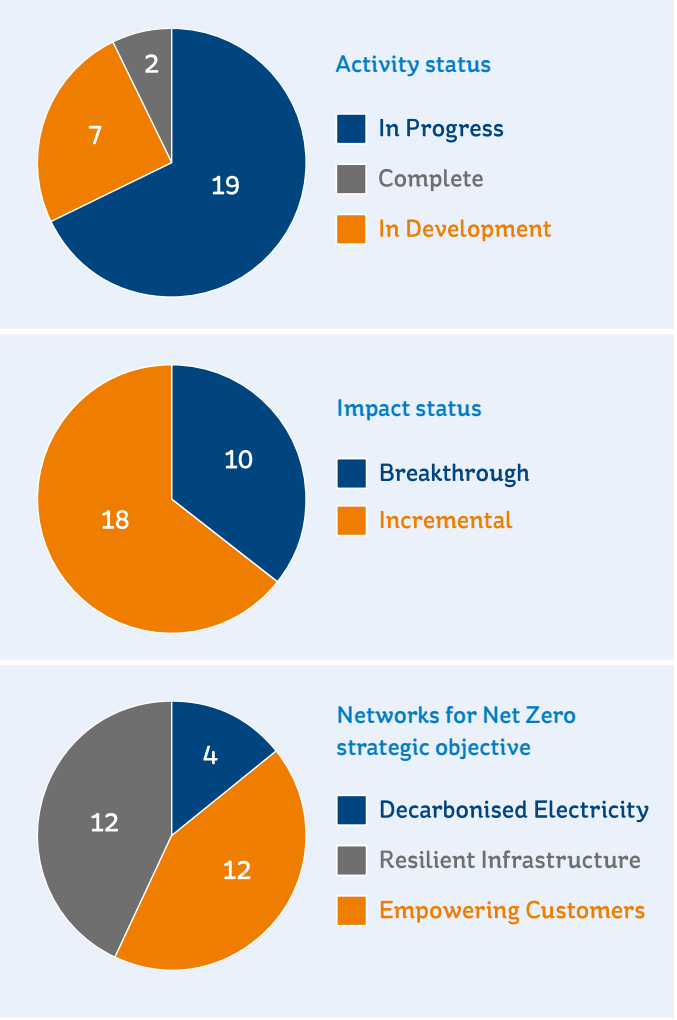
Each project in the ESB Networks innovation portfolio has three classification statuses:

1. **Activity status:** either In Development, In Progress or Complete;
2. **Impact status**: either Incremental or Breakthrough;
3. **Networks for Net Zero strategic objective:** the project is most pertinent to either Decarbonised Electricity, Resilient Infrastructure or Empowering Customers.

We continuously develop new innovation ideas and pilots, which may then progress to the In Progress stage when approved by the Innovation Steering Group. Due to the nature of innovation, ESB Networks take an agile approach to our 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.

Of the 95 innovation ideas assessed across various sources in 2023, our innovation project portfolio has 28 active projects, including seven new projects in development. There were two projects successfully completed in 2023 and 19 are in progress.

Referring to the Networks for Net Zero strategic objectives, four projects in the innovation portfolio relate most directly to Decarbonised Electricity, 12 to Resilient Infrastructure, and 12 to Empowered Customers. 10 Projects are classified as Breakthrough and 18 as Incremental.



3.2 IN DEVELOPMENT

	NAME	IMPACT STATUS	NETWORKS FOR NET ZERO STRATEGIC OBJECTIVE
1	Sustainable Backup Power Solutions	Breakthrough	Decarbonised Electricity
2	Island Decarbonisation	Breakthrough	Decarbonised Electricity
3	Analysing Impacts of Behind-the-Meter Innovative Solutions	Breakthrough	Resilient Infrastructure
4	Timed Connections	Incremental	Empowering Customers
5	Industrial Heat Pump Network Impacts	Incremental	Empowering Customers
6	E-Fleet – Decarbonisation of the Fleet	Incremental	Empowering Customers
7	Resilient Charging Solutions	Incremental	Empowering Customers

1: Sustainable Backup Power Solutions	**STATUS:** In Development, Breakthrough, Decarbonised Electricity	**TIMELINE:** Q2 2023 - Q2 2025
Scope	ESB Networks deploy diesel generation for temporary and emergency backup scenarios. Diesel generation has been used over the last 50 years to provide temporary generation during substation maintenance, upgrade works, and for continuity purposes during network outages. In addition, emergency diesel generation is installed at over 50 ESB Networks depots to provide backup power in the event of grid blackouts.	
Key Partners	Consultancy and technology providers offering expertise in the providing sustainable technology solutions.	
Benefits	Decarbonisation of diesel generation to meet Net Zero 2040.	
Impacts	Process and infrastructure changes to accommodate new technologies.	
Outputs	Comprehensive report evaluating technologies for backup and emergency generation. New technical standards for incorporating into electricity network.	
Next steps	Expression of linterest for pilot(s) for Sustainable Backup Power Solutions (BESS, H2, Hybrid, HVO, Other).	

2: Island Decarbonisation	**STATUS:** In Development, Breakthrough, Decarbonised Electricity	**TIMELINE:** Q2 2023 - Q2 2025
Scope	The islands Inishturk and Tory do not have an interconnection with the distribution network on the mainland and rely on diesel generators as their primary source of electricity. With the increasing uptake of low-carbon technologies, there are challenges for such small island networks powered by diesel generators. High penetration levels of behind-the-meter solar PV can cause operational issues in small island networks with low levels of demand and innovative solutions will be needed. This project aims to reduce the use of and reliance on diesel-based generation by assessing and trialling alternatives sources of generation, while also aiming to find an innovative solution where diesel generators are deployed to areas which high penetrations of behind-the-meter solar PV.	
Key Partners	Consultancy and technology providers offering expertise in providing sustainable technology solutions.	
Benefits	Greater resilience, safe and secure supply of energy for the islands by diversifying generation. Allowing for more solar to be installed on the islands and decarbonisation of diesel generation.	
Impacts	Support ESB Networks Assets in replacement of diesel generation with decarbonised alternatives on the islands. Reinforcement of ESB Networks' Networks for Net Zero Strategy.	
Outputs	Comprehensive report evaluating technologies for decarbonising islands. Evaluation and determination of best technologies for specific application.	
Next steps	Engagement with islands (Inishturk and Tory). Further analysis of electrical requirements and determination of suitable solutions for the islands.	

3: Analysing Impacts of Behind-the-Meter Innovative Solutions	**STATUS:** In Development, Breakthrough, Resilient Infrastructure	**TIMELINE:** Q3 2023 - Q2 2025
Scope	ESB Networks are exploring participation in a project focusing on addressing challenges posed by the EU's Alternative Fuels Infrastructure Regulation (AFIR) in Ireland, aiming to meet electrification targets for both light- and heavy-duty vehicles on the core and comprehensive road networks. The proposed solution involves strategically deploying modular battery energy storage systems (BESS) to augment grid connections behind the meter. ESB Networks could gain learnings which would be applied across electrifying sectors. The specific challenge is the surge in electric vehicle (EV) adoption, causing a substantial increase in demand for new and upgraded connections.	
Key Partners	To be confirmed in 2024.	
Benefits	Alleviating pressure on the distribution network from electrifying sectors by optimising grid upgrades and enhancing grid resilience.	
Impacts	Mitigating the pressure on the electricity network while supporting compliance with AFIR and national policies.	
Outputs	Comprehensive analysis of the impacts of behind-the-meter innovations on grid connections.	
Next steps	Collaborate with key partners for project learnings.	

4: Timed Connections	**STATUS:** In Development, Incremental, Empowering Customers	**TIMELINE:** Q3 2023 - Q2 2025
Scope	It is proposed that a Timed Connection is a time constrained demand connection and that it would be an interim solution until necessary network reinforcement works can be completed to provide the customer with their contracted MIC on a 24-hour basis. For a customer to be considered for the pilot, their demand profile would need to suit a Timed Connection and they also need to be enabling the electrification of transport. ESB Networks will work with the participating customers during the pilot to better understand the technical, commercial, and regulatory impacts of a Timed Connection.	
Key Partners	To be confirmed in 2024.	
Benefits	Supports the electrification of transport by enabling ESB Networks to deliver faster demand connections as an interim measure until network reinforcement works are completed to deliver the contracted MIC on a 24-hour basis.	
Impacts	Potential to enable new demand connections or increase connection capacity while network reinforcement works are planned and delivered.	
Outputs	Comprehensive report outlining any impacts of Timed Connections on the electricity distribution network and the benefits for our customers.	
Next steps	Expression of interest.	

5: Industrial Heat Pump Network Impacts	**STATUS:** In Development, Incremental, Empowering Customers	**TIMELINE:** Q2 2023 - Q1 2025
Scope	The NEXSYS heat pump project aims to comprehensively analyse the implications of incorporating an industrial heat pump into the electricity network. The scope includes a detailed assessment of the impact on the electricity network, considering factors such as load curves, peak demand, power losses, voltage drop, power quality, and reactive power requirements. The broader analysis encompasses the examination of the industrial heat pump, its size, industry applicability, and interactions with other systems like storage, supplementary heating, and waste-heat systems. Additionally, the project involves a review of relevant industry standards and an in-depth analysis of heat pump performance and load capacity scheduling.	
Key Partners	NEXSYS partners.	
Benefits	Enhanced understanding of the implications of industrial heat pumps on the electricity network. Optimisation of heat pump utilisation without compromising the stability of the electricity distribution system. Compliance with industry standards, mitigating potential issues related to power quality, harmonics, and technical considerations.	
Impacts	Identification of early adopters and insights into the scale of installations. Consideration of on-site integration solutions and its impact on the electricity network. Addressing concerns such as voltage drop, power quality, power factor correction, and cleaning cycle management.	
Outputs	Comprehensive analysis report detailing the impact of industrial heat pumps on the electricity network. Heat pump performance and load capacity scheduling insights.	
Next steps	Collaborate with industry partners to gather knowledge on heat pump installations in Ireland. Conduct a detailed analysis of the industrial heat pump and its interactions with other systems.	

6: E-Fleet – Decarbonising and Electrification of our Fleet	**STATUS:** In Development, Incremental, Empowering Customers	**TIMELINE:** Q2 2022 - Q4 2025
Scope	ESB Networks are 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 (NTs) and teams leverage the fleet when restoring the network following adverse weather conditions and storms. Delivering solutions that work for our experienced NTs 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. The aim of the project is to meet our decarbonisation of our fleet and transport in line with our 2030 targets and beyond to Net Zero by 2040.	
Key Partners	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.	
Benefits	We will implement 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 personal EV as they are adopted. We will deliver a modularised fit out 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, in support of our circular economy goals.	
Impacts	The project will deliver a framework for new electric fleet vehicles and associated new telemetric data for managing our fleet of EVs and related charging requirements.	
Outputs	Ideas developed to date, include home charging units and modular van fit-out.	
Next steps	Trial of solutions.	

7: Charge Fleet – Resilient Charging Solutions for Electrification of our Fleet and Transport	**STATUS:** In Development, Incremental, Empowering Customers	**TIMELINE:** Q2 2022 - Q4 2025
Scope	The aim of the project is to develop new and resilient charging solutions to support the electrification of our fleet and transport across our depots, substations, and sites in conjunction with public charging infrastructure. This will involve trialling new en-route 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.	
Key Partners	To be confirmed in 2024.	
Benefits	Resilient charging solutions for our fleet.	
Impacts	Charging solutions will be delivered and new on-site and in-field charging solutions will be trialled.	
Outputs	None to date.	
Next steps	An assessment across sites and stations of the charging requirements and solutions for our expanding fleet of EV vans.	

3.3 IN PROGRESS

	NAME	IMPACT STATUS	NETWORKS FOR NET ZERO STRATEGIC OBJECTIVE
1	Investigate Statistical Contributions from Distribution Generation: F-Factors	Incremental	Decarbonised Electricity
2	Plexigrid - Advanced Modeling, Planning, and analysis for LV Electrification	Breakthrough	Decarbonised Electricity
3	Development of Dynamic Line Ratings (DLR)	Incremental	Resilient Infrastructure
4	Sidewalk Transformers	Incremental	Resilient Infrastructure
5	Novel Use of Drones and AI for Line Patrolling and Fault Location	Incremental	Resilient Infrastructure
6	MV Planning Assist Tool	Incremental	Resilient Infrastructure
7	Alternatives to Creosote Wood Poles	Incremental	Resilient Infrastructure
8	Wildlife OHL Contact Prevention	Incremental	Resilient Infrastructure
9	Inspection of OHLs Using Drones and Image Processing Analytics	Incremental	Resilient Infrastructure
10	Developing 400MHz Spectrum Ue for Smart Grid Applications	Breakthrough	Resilient Infrastructure
11	AI Synthetic Analyses of 110 kV Composite Insulators	Breakthrough	Resilient Infrastructure
12	GridVision AI for Condition Assessment of Tower Corrosion	Breakthrough	Resilient Infrastructure
13	Innovation Feasibility Study for Uprating of Existing 38 kV Overhead Lines to 110 kV	Breakthrough	Resilient Infrastructure
14	CSS Voltage Quality Dashboard	Incremental	Empowering Customers
15	Composite Street Light	Incremental	Empowering Customers
16	Low-Carbon Technologies Register	Incremental	Empowering Customers
17	EV Charge Point Database and Capacity Mapping	Incremental	Empowering Customers
18	International Community for Local Smart Grid	Incremental	Empowering Customers
19	AI in Smart Metering Applications	Breakthrough	Empowering Customers

1: Investigate Statistical Contributions from Distribution Generation: F-Factors	**STATUS:** In Progress, Incremental, Decarbonised Electricity	**TIMELINE:** Q1 2022 - Q1 2024
Scope	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 DNOs. 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.	
Key Partners	Azorom.	
Benefits	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 project's aim is to determine an appropriate contribution of embedded generation to be considered when determining distribution system security.	
Impacts	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.	
Outputs	None to date.	
Next steps	We are carrying out a study with partners Azorom on specific parts of the network to understand the potential use of F-factors on our system and with our standards.	

2: Plexigrid - Advanced Modelling, Planning, and Analysis for LV Electrification - (AMP-LV)	**STATUS:** In Progress, Breakthrough, Decarbonised Electricity	**TIMELINE:** Q2 2023 - Q4 2024
Scope	The Plexigrid pilot is an initiative in the LV system development team to implement an advanced LV grid management solution on ESB Networks asset data. This project encompasses implementation and evaluation of Plexigrid's platform over two stages. This opportunity arose through the Free Electrons programme. The first stage, 'Grid Planning and Analytics', focuses on evaluating current grid structures and data formats, ensuring effective data integration into the Plexigrid platform. This involves collaboration between Plexigrid and ESB to align on data formats and exchange methods. Once the data is exchanged, Plexigrid will engage in data cleaning and structuring to create a model of the LV network. This stage includes developing a digital twin for grid analytics and capacity assessments, detecting and addressing any data quality issues. The second stage, 'Advanced Analytics', aims to build upon the first by incorporating smart meter data and available secondary substation monitoring data. This stage aims to leverage historical data for improved insights into grid performance, loss reduction, and power quality enhancement. It will enable ESB to analyse past network issues and devise potential remedies through advanced data analytics.	
Key Partners	Plexigrid, Free Electrons.	
Benefits	Data-driven network planning: The pilot will provide insights for future network planning, particularly in accommodating new low-carbon technologies and managing the growing demand for electric vehicle chargers and other emerging technologies. Enhanced data quality: The pilot will indicate the quality and reliability of LV grid data, providing ESB with a more accurate and detailed understanding of the current state and future needs. Capital expenditure optimisation: By utilising analytics, ESB can better identify where investments are most needed, potentially reducing unnecessary capital expenditures and focusing on areas that yield the most significant benefit.	
Impacts	The Plexigrid pilot will enable ESB to understand how LV asset data can be used more intelligently to make data-driven decisions for grid reinforcements and new connections. By leveraging advanced analytics and simulation, the project will facilitate better understanding and management of the network's capacity and performance.	
Outputs	Intended outputs: • Stage 1: Data model, digital twin for grid analytics, capacity assessment tools • Stage 2: Advanced analytics using smart meter and substation data	
Next steps	Stage 1 development by Plexigrid to begin in Q1 2023.	

3: Development of Dynamic Line Ratings (DLR)	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q1 2017 - Q4 2025
Scope	At present, 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 exceed the winter ratings on rare occasions. This project represents a fundamental shift in the way the capacity available on the circuits (on which this new technology is deployed) 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.	
Key Partners	Eirgrid (TSO).	
Benefits	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. 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.	
Impacts	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.	
Outputs	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 and have successfully installed 10 dynamic line rating sensors on the first trial location site. The trial is being monitored and learnings from the first installation are being reviewed. A second trial site has been identified and installation of sensors is expected to be completed in Q1 2024. 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 the next phase of deployments on other trial locations.	
Next steps	This project will move to BAU after the first two successful installations, once they start to feed back to the TSO systems.	

4: Sidewalk Transformers	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q3 2017 - Q2 2024
Scope	The electrification of heat and transport, and the proliferation of LCT, will lead to increased demand loads and potential congestion on LV networks. The aim of the project is to develop a prototype miniature secondary substation, known as a sidewalk transformer, as an alternative to conventional reinforcement, particularly for urban centres where space to construct traditional substations is limited, and then to trial that solution.	
Key Partners	Kyte Power Tech.	
Benefits	The project aims to benefit customers by offering a potential network capacity solution for the anticipated increase in loads arising from electrification of heat and transport, particularly in urban settings, through trialling a viable option to uprate the network, as cost effectively as possible.	
Impacts	This solution will allow additional transformers to be located on narrow streets in densely populated city areas, where spatial restrictions limit the opportunity for construction of traditional substations with larger footprints, thereby enabling increased network capacity for residential customers in those urban centres where increased network load arising from LCT take-up and use is anticipated.	
Outputs	ESB Networks are conducting a trial in Ireland of these units. A 10 kV 200 kVA prototype sidewalk transformer has been designed, type tested, and installed in ESB Networks' training centre in Portlaoise.	
Next steps	Following design and operational assessment, a number of required modifications and improvements were identified to meet protection and operational requirements. Supply chain issues have delayed delivery by the manufacturer of a key termination joint for MV cables within the unit. Initial discussions with operations and protections teams have taken place to consider methods to connect the sidewalk transformer to the existing MV infrastructure, but these will not be finalised until version 2 of the unit is delivered, which is now expected to be during 2024.	

5: Novel Use of Drones and AI For Line Patrolling and Fault Location	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q1 2021 - Q4 2025
Scope	ESB Networks have 150,000 km 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 NTs 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 were 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 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.	
Key Partners	IAA, University of Limerick.	
Benefits	The project has successfully used drones for line patrols, to audit vegetation management, and to 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 one 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.	
Impacts	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.	
Outputs	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 to share learnings from the advanced image analysis features which UL are working on as part of their research. During 2023, documentation was updated in line with new European standards and ESB Networks now have seven pilots with A2 category licence. These pilots will now proceed with training to go to specific category A3, which will enable them to operate at beyond visual line of sight (BVLOS) for certain areas of the country. During 2023, ESB Networks shared learnings with UKPN in relation to the development of internal process, procedures, training, and approvals and certification.	
Next steps	For 2024, the focus is to schedule and complete further training with the pilots, with quarterly CPD to be put in place for all ESB Networks pilots. More advanced pilots are to be scoped and developed to enable further use cases, such as hazard patrols, while ESB Networks plan to add an additional 15 trained pilots in 2024. It is planned that a centralised specialist team for the country will be setup while works are underway to transition the learnings to business as usual, with the aim to embed the use of drones into everyday use.	

6: MV Planning Assist Tool	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q1 2023 - Q1 2025
Scope	Medium voltage (MV) network planners in ESB Networks rely on many sources of data to complete network studies when assessing the impacts of new demand and renewable generation connections. The setup and completion of these studies take time and often many applications do not proceed. This project set out to try and design a software tool that would gather GIS network data and MV feeder capacity data into a single interface. The tool was intended to be a ready reckoner for users to be able to make faster, high-level assessments of new demand connections, including an estimated connection cost for the customer based on their location and required connection capacity.	
Key Partners	Internal ESB Networks project.	
Benefits	The tool could be used as a ready reckoner to enable users make faster, high-level assessments for new demand connections, including an estimated connection cost for the customer based on their location and required connection capacity. It provides additional benefits for training and onboarding of new staff.	
Impacts	Assists the network planner in determining estimated network capacity.	
Outputs	A proof of concept has been completed in 2023 with data from two ESB Networks planner groups. Several internal workshops have been completed to gather user feedback.	
Next steps	Additional use cases have been proposed with development work to expand and continue the existing proof of concept while exploring the market for commercially available tools that may offer similar capabilities.	



7: Introduction of Alternatives to Creosote Wood Poles	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q3 2016 - Q4 2025
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 the 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 October 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 store, transport, handle, install, access, maintain, and operate as well as to uninstall, the products. There are over 2.2 million creosote-treated wooden poles installed countrywide on the LV, MV, 38 kV, and HV networks. The Irish climate accelerates 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 and 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.	
Key Partners	Regarding composite poles, ESB Networks Assets have networked with Vattenfall (Swedish utility), who have used composite poles for nearly 15 years, and continue to seek further networking with other Nordic utilities who similarly use composite poles. ESB Networks Assets are in advanced technical development with Jerol (Sweden), with a substantial pole order in progress. ESB Networks Assets are also in ongoing development/ discussions with RS (Canada), Comrod (Norway), and Creative Composites (USA). ESB Networks Assets continue to work with internal stakeholders to facilitate the introduction of composite poles to ESB Networks' overhead network. ESB Networks are exploring alternative wood types to treat, to provide diversity in supply and continues to research what chemical alternatives are available to use in the treatment. No other partners are currently involved in this work.	

Benefits	The project has been researching and trialling alternative material poles from different composite manufacturers to adapt for use on our network. Following detailed market research and engagement with suppliers, ESB Networks have trialled both a modular and singular composite pole type. ESB Networks have also trialled poles from three different suppliers at its national training centre.
Impacts	Further experience of conducting maintenance and repairs to the composite poles is emerging, specifically the understanding of the equipment and tools needed. The singular pole design has been identified as more adaptable to ESB Networks operational and delivery needs at distribution voltages. A cost increase is anticipated as creosote poles are retired and other pole types, such as composite poles, are introduced. These costs are mitigated by a longer lifespan, reduced crew mobilisations for pole replacements, increased storm resilience, reduced risk of wildlife damage, more agile supply chain, and higher materials consistency.
Outputs	ESB Networks have installed approximately 20 no. modular composite poles (2017) and five no. singular poles (2022) across LV, MV, and 38 kV voltages on the overhead network. These installations included urgent pole replacements due to storm damage of wooden poles in November 2022. These are being monitored for signs of wear, degradation, and weather effects. A five year audit was carried out on the poles installed in 2017 and all are performing well. The project will deliver a technical material specification, company standard, and 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.
Next steps	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. Next steps include the finalisation of the technical material specification and company standard. ESB Networks staff will also need an introduction and to attend training workshops in relation to correct handling, tooling, erecting, etc. of composite poles. ESB Networks are expecting to receive an order of 1400 no. composite poles procured to aid in critical shortage of wood pole supply, while a tender for the framework supply of composite poles to ESB Networks is also required for modular and singular poles – LV, MV, 38 kV, and HV duties. It is also planned to erect more than 170 poles treated with alternative treatments and species diversity, although getting test sites continues to be a challenge.

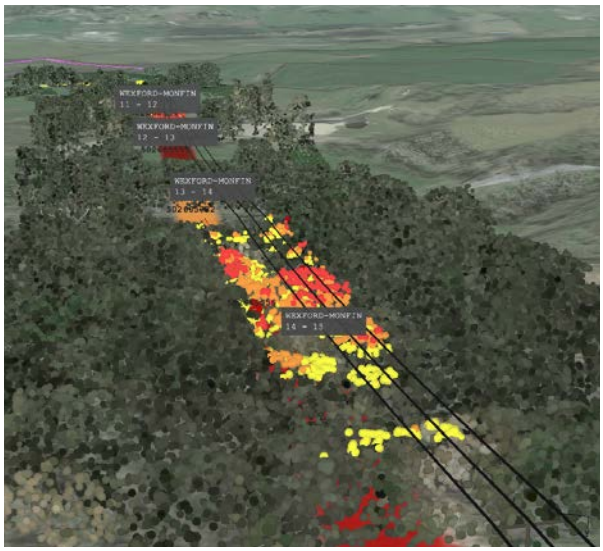
8: Wildlife OHL Contact Prevention	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q1 2019 - Q4 2023
Scope	The project aims to identify and trial novel measures to prevent wildlife from coming into contact with live conductors and overhead line (OHL) network equipment in 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 project aim is to bring about a reduction in bird strikes to the network to reduce CIs/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 network.	
Key Partners	Lancaster University, EA Technology.	
Benefits	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. However, they will still be deployed at locations where deterrents are needed to protect wildlife, irrespective of whether there is a cost benefit, given the objective to protect wildlife.	
Impacts	The project reports positive results from a particular design of diverter which has been trialled in ESB Networks' northern region to deter contact between birds and overhead lines.	
Outputs	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. 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.	
Next steps	Several anti-perching devices and spiral diverters were installed during 2023 and feedback is now required on their continued effectiveness and the longevity of the units installed.	

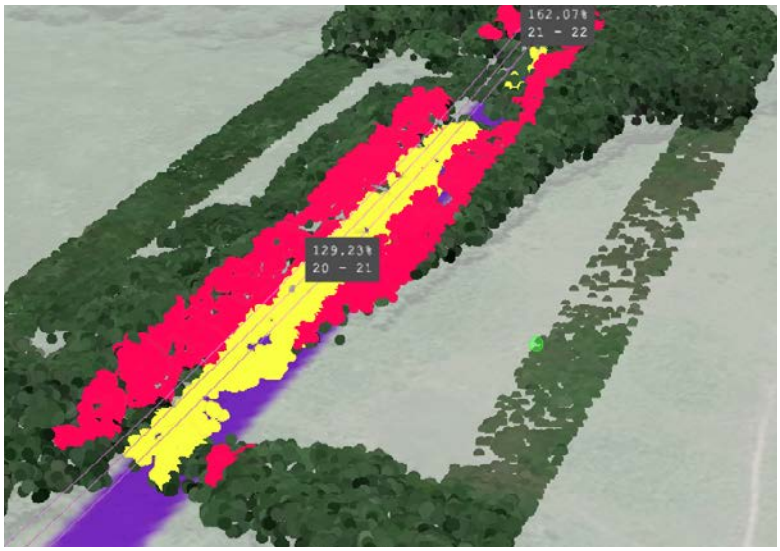
9: Inspection of OHLs Using Drones and Image Processing Analytics	**STATUS:** In Progress, Incremental, Resilient Infrastructure	**TIMELINE:** Q3 2016 - Q4 2025
Scope	Line inspections on ESB Networks' overhead transmission lines (OHL) and towers are currently carried out manually. To carry out these 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. • data collected can vary in quality and subject to 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 conductors. 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 using AI and comparing systems and solutions. The key objective of the project and trials will be to: • Demonstrate a saving over 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.	
Key Partners	TSO (Transmission System Operator).	
Benefits	By using new drone and AI systems, 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. 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 several 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.	
Impacts	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, which may include installation/design anomalies. AI can aid in the 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.	
Outputs	The project has developed and delivered a new unmanned aerial vehicle (UAV) inspection framework for the 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. The framework was awarded in early 2023 and is currently being utilised for image capture as business as usual and as part of further pilot projects.	
Next steps	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, and it is expected that the outputs of these pilots will transition to business as usual very quickly.	

10: Developing 400 MHz Spectrum Use for Smart Grid Applications	**STATUS:** In Progress, Breakthrough, Resilient Infrastructure	**TIMELINE:** Q1 2021 - Q4 2026
Scope	The electricity industry is undergoing unprecedented change, and the methods by which electricity is produced and consumed are fundamentally changing. 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 400 kV substations down to 38 kV substations. Connectivity beyond the 38 kV 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. Services at an MV level will become increasingly critical to operation of the electrical grid. ESB Networks Telecoms is developing a private LTE network to deliver a dedicated, secure, and robust solution that is appropriate to the scale of new connections. ESB Networks acquired a radio spectrum licence from ComReg in November 2019 to deploy a smart grid telecommunications network.	
Key Partners	This radio network is being procured, designed, and rolled out by ESB Networks Telecoms for use by ESB. Sigma Wireless and Nokia are the primary delivery partners.	
Benefits	This Smart Grid network will deliver a wide range of benefits for ESB Networks and wider society, including integrating more renewable energy, enabling electrification of heat and transport, and reducing electrical outages with faster fault resolution times. This network will be used to deliver services essential to the grid with the potential to be upgraded and leveraged for emerging smart grid services.	
Impacts	Having a private mobile network to meet predicted growth in sensors and line equipment on MV network that also has the coverage, availability, and necessary cyber resilience is a key enabler to delivering of ESB Networks' Networks for Net Zero Strategy.	
Outputs	ESB Networks have awarded a contract for delivery. Design is at an advanced stage and enabling works are in progress. Rollout of radio base stations will commence in 2024 with build-out due for completion in 2026.	
Next steps	Completion of the network rollout and transition of existing critical applications over onto the new network. Discussions are also ongoing with other third-party utilities for use of the network.	

11: AI Synthetic Analyses of 110 kV Composite Insulators	**STATUS:** In Progress, Breakthrough, Resilient Infrastructure	**TIMELINE:** Q4 2022 - Q1 2024
Scope	Selected from the 2022 Free Electrons portfolio, this project 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.	
Key Partners	Simerse AI.	
Benefits	Where visible differences between insulator supply batches may be present, it is hoped this tool may be able to detect these differences.	
Impacts	The tool is intended to provide a system that can be utilised for the automated identification of insulator type differences (Stage 1), within type batch differences (Stage 2a) and defect identification (Stage 2b), based on UAV imagery provided by any vendor on the current ESB Networks CON 819 UAV inspection framework.	
Outputs	If the first stages of this project (Stages 1 and 2) are successful, it is planned to trial the system on a sample line or lines captured under the new UAV framework in 2023 (Stage 3).	
Next steps	Stages 1 and 2 completed successfully. Data capture by UAV contractor nearly complete to permit work on Stage 3 pilot line (Louth-Woodland 220 kV) for identification of polymeric insulator batch differences.	

12: GridVision AI for Condition Assessment of Tower Corrosion	**STATUS:** In Progress, Breakthrough, Resilient Infrastructure	**TIMELINE:** Q2 2022 - Q4 2023
Scope	This project will test and assess the GridVision software tool as a proof of concept which was developed to use machine learning for the 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.	
Key Partners	GridVision.	
Benefits	This could provide a useful objective and rapid means to undertake an initial assessment of the relative levels of corrosion (Grade 4+ on the UK NG Scale) on towers, to help decide if full detailed manual steelwork inspections on an individual bar level are needed on some or all of the towers on a given circuit.	
Impacts	Using automated image capture on towers provides a repeatable means of capturing identical sets of imagery over time (e.g. every five years). A machine learning corrosion detection tool then also provides a repeatable, objective means of assessing corrosion on bars/bolts at Grade 4+ at each time point, and allows for comparison of corrosion development over time.	
Outputs	Outputs from the corrosion detection system consist of a relative percentage measure of corrosion at Grade 4+ on each tower, such that towers above a set percentage (e.g. greater than 2-3%, or several bars), may be selected for detailed manual image inspections and identification of individual bars and their specific corrosion levels.	
Next steps	Following completion of the proof of concept in Q4 2023, eSmart Systems will deploy the tool on 200 towers on the Louth-Woodland 220 kV line, on which they are undertaking the UAV assessment as part of their work on the ESB Networks UAV framework contract CON 819. It is anticipated that if this further test is successful, the tool can be deployed on any line dataset captured by any of the three UAV contractors on the framework.	





13: Innovation Feasibility Study for Uprating of Existing 38 kV Overhead Lines to 110 kV	**STATUS:** In Progress, Breakthrough, Resilient Infrastructure	**TIMELINE:** Q3 2023 - Q3 2024
Scope	The 38 kV overhead line network is a key element of the distribution system, comprising some 6,000 km overhead network, and is similar in length to the full transmission network. Much of the existing 38 kV network is comprised of relatively small conductors, some of which have been installed for several decades. The 38 kV network did not undergo the significant upgrades during the MV network renewal programme, nor has it seen the level of upgrades/uprates completed in the past decade on the 110 kV network. Capacity requirements for the period through to 2040 will be driven by the electrification of heat and transport, economic growth, and distributed generation. To accommodate the anticipated growth in demand, the capacity of the 38 kV network needs to be assessed. This project will seek to develop an innovative solution for the up-voltage of existing 38 kV overhead network to 110 kV to support the increased capacity requirements for our network. Additionally, a software platform is also being evaluated to assess the benefits of Lidar processing software to quantify the impact on vegetation and ground clearances associated with upgrading a 38 kV circuit to 110 kV.	
Key Partners	ESB Engineering and Major Projects, Neara.	
Benefits	The LV system is currently being future proofed for electrification with new after diversification maximum demand (ADMD) standards approved for LV designs, while similarly much of the 10 kV network is being upgraded to 20 kV. This will increase the load carrying capability of MV feeders, but to unlock the additional capacity on the MV network, the 38 kV system needs to be upgraded to facilitate the additional demand requirements.	
Impacts	While capacity is the primary driver for evaluating the options for the 38 kV network, other factors also need to be considered, including ageing of the existing 38 kV infrastructure which will require significant investment in structure replacement and suitable conductor replacement. A further challenge will be to design whatever upgrade option may be selected to enhance network resiliency in the face of climate change, particularly considering the potential for increasingly frequent storm events and periods of exceptional summer temperatures.	

Outputs	It is expected that the output of this study will shape the strategy to transform and upgrade the existing 38 kV network in line with ESB Networks' Networks for Net Zero Strategy and its principle of 'Build Once for 2040'. Outputs shall include the following main elements: • Proposed design solution including suite of structures for voltages up to 110 kV to replace existing 38 kV structures on any given line. • Line rating and conductor solutions (conventional and composite core HTLS for min. 100 MVA capacity, including fibre optic requirements). • Sample line design assessments for three 38 kV lines (40 km total) to assess planning and clearance requirements to vegetation and buildings. • Constructability and cost review of proposed solution based on sample line assessments. • Recommendations for further studies to support implementation phase, including indicative costs and programme. • Evaluation of Neara Lidar processing software platform providing learnings for ESB Networks regarding the use of such data and technologies.
Next steps	Feasibility study is in progress in parallel with clearance and vegetation assessments using the Lidar processing software platform. The recommended follow-on studies may include: • Electrical and earthing studies, including Insulation Coordination (underway). • Composite core HTLS conductor assessment and installation trial. • Lattice steel angle tower design and procurement/testing (including line/cable I/F design). • Braced steel angle pole design and procurement/testing. • Composite pole designs for intermediate structures (single and portal). • 110 kV post insulator design and procurement/testing. • Pilot Project(s) development for planning submission. • Neara phase 2 Free Electrons project to support pilot project.

14: CSS Voltage Quality Dashboard	**STATUS:** In Progress, Incremental, Empowering Customers	**TIMELINE:** Q1 2023 - Q4 2025
Scope	The scope of the project is to develop a Power BI dashboard to enable customer service supervisors (CSS) to validate customer reported voltage issues without site visits. Currently several site visits are required to install and uninstall voltage recorders. This project aims to give CSSs access to suitable smart meter data to facilitate remote validation of issues and fast tracking of rectification order creation.	
Key Partners	ESB Networks customer delivery, Powering Ahead programme, smart metering.	
Benefits	Improved efficiencies on voltage complaints. This product will enable faster assessment of voltage issues; local area teams will be able to articulate issues to customers and initiate the system improvements more effectively. Empowerment of CSSs and wider team with enhanced visibility of customers voltage quality. This will also support and enhance investment and system improvements. Enables efficient use of resources including staff and voltage recorder devices which are limited.	
Impacts	Shortening of duration of many customer journeys from original phone call to construction. Reduction in number of site visits required by network technicians. Increased access to voltage recorder equipment due to reduction in number of site visits.	
Outputs	Data engineering solution including database architecture and data pipelines to extract, transform, and load (ETL) data from various sources to a suitable central datahub. Data analytics reporting tool to be developed in Power BI to visualise data and apply fast tracking logic to automatically validate confirmed issues to CSS.	
Next steps	Solution and architecture planning Q4 2023.	

15: Composite Street Light	**STATUS:** In Progress, Incremental, Empowering Customers	**TIMELINE:** Q2 2023 - Q1 2024
Scope	Local authorities contacted ESB Networks to collaborate on the development and trial of an EV charging solution powered from public lighting supplies. The solution was required to accommodate the simultaneous charging of two electric vehicles per street.	
Key Partners	Electric Skyline (a public lighting maintenance contractor) local authorities, ZEVI, Department for Transport.	
Benefits	This solution will provide a means for EV drivers without private driveways to charge their electric vehicles in the vicinity of their homes. The design of the solution will integrate the public light, the EV chargers, and the ESB Networks interface cabinet all within the one column, thereby reducing street furniture from three items to one. The solution design also adheres to government's accessibility standards for mobility impaired users, by enabling 360-degree access around the device. Payment for use of the charging service will also be facilitated by "tap and go" charging for customers.	

Impacts	This facility can be provided at those public lighting points that are directly connected to the distribution network. The solution design will accommodate charging of four electric vehicles per street, double that requested by the local authorities.
Outputs	A physical mock-up of the solution was used for demonstration purposes and to ensure stakeholders understood the design features of the solution. A physical mould of the solution has been developed by Electric Skyline and is being used as a basis for manufacturing. The solution design incorporates ESB Networks' standard equipment, such as cut-out switches, isolator devices, and metering, thereby removing the need for testing of those components.
Next steps	Electric Skyline has ordered new integrated public lighting and EV charging columns from its supplier. It is anticipated that the first devices will be ready for installation during Q1 2004.

16: Low-Carbon Technology Register	**STATUS:** In Progress, Incremental, Empowering Customers	**TIMELINE:** Q3 2023 - Q4 2024
Scope	The LCT (low-carbon technology) register project involves the following: • Establishment of a list of LCT compliant equipment; • Appointment of LCT compliance agency; • Population of an LCT database; • Modification of connection application processes to capture data on LCT equipment to be connected to the network.	
Key Partners	While this is an internal ESB Networks project, the support of third parties in the provision of data to populate the LCT database will be key to its development.	
Benefits	Establishing a list of LCT compliant equipment that may only be connected to the distribution network will improve safety for ESB Networks customers and the electrical network itself. Knowing where LCT devices have been connected to the network will, among other things, better support management of the electrification programme, aid with design of flexibility procurement, inform technical studies for new connections, support investigation of power quality issues, and enable reporting on LCT take-up across society.	
Impacts	Minor change to a number of connection application processes to capture additional details on the types of LCT devices proposed to be installed.	
Outputs	The LCT database will identify where known low-carbon technologies (generation, electric vehicle chargers, and heat pumps) are connected to the low voltage network.	
Next steps	Initial population of LCT database with data available across ESB Networks. Procurement of LCT compliance agency services and establishment of baseline LCT register. Engagement with third parties to explore how data essential to the population of the LCT database may be sourced.	

17: EV Charge Point Database and Capacity Mapping	**STATUS:** In Progress, Incremental, Empowering Customers	**TIMELINE:** Q2 2023 - Q4 2024
Scope	The scope of this project is to develop a comprehensive database to aggregate and report on the public electric vehicle (EV) charging capacity across Ireland, in order to comply with new EU regulations and reporting requirements. This includes identifying and cataloguing various types of EV charge points and their locations, as well as evaluating the associated charging capacities for different plug types. The project aims to identify a partner through the ESB Eco Partners platform. The partner will be responsible for defining suitable datasets that meet the reporting requirements. The partner will also be responsible for developing the required data engineering pipelines to gather and automatically update the data. This will first be delivered in a proof of concept model, within a budget of €30k. Additionally, there is potential for collaboration in creating a dashboard for data aggregation and reporting.	
Key Partners	Delivery partner (to be confirmed upon completion of Eco Partners evaluation process), Zero Emissions Vehicles Ireland (ZEVI), Transport Infrastructure Ireland (TII), EV charge point operators will likely be engaged as part of the project.	
Benefits	Regulatory compliance: The project will assist in regulatory reporting and adherence to new EU regulations regarding the reporting of public EV charging infrastructure. Market insight: Understanding the current EV charging landscape in Ireland provides valuable insights into market trends and needs. This knowledge can guide future investments and innovations in the EV charging sector and distribution network. Stakeholder engagement: The project fosters collaboration among ESB Networks' stakeholders, including charge point operators and EV partners. This collaboration can lead to stronger relationships and better alignment of goals and strategies within the industry Network planning: Enables strategic network development planning for PR6 for developing additional capacity in accordance with AFIR requirements and ZEVI's en-route charging plans.	
Impacts	This project will provide ESB Networks with a clear and accessible overview of EV charging stations. By employing robust data management and analysis, the project will assist regulatory reporting and promote technological innovation. By being able to identify charging station locations in relation to the distribution network, it will also assist in planning and asset management functions.	
Outputs	Intended outputs: Database of EV charging stations, interactive dashboard displaying key reporting metrics.	
Next steps	Six partners have outlined proposals on the ESB Eco Systems platform. The next step is to meet and evaluate the proposals before deciding on a suitable partner to complete a proof of concept.	

18: International Community for Local Smart Grids (ICLSG)	**STATUS:** In Progress, Incremental, Empowering Customers	**TIMELINE:** Q4 2022 - Q4 2027
Scope	A five 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, while maintaining network resilience. The project objectives and themes are aligned with our own areas of focus and innovation pillars. We recognise the benefits of being a partner in the ICLSG project for our customers and communities by leveraging the knowledge and experience of the international partners, peer DSO's, and the on ongoing research through the duration of the project. 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 the project partners.	
Key Partners	Oxford University; Ausgrid, Australia; Corena, Enel Foundation, Italy; Low Carbon Hub, UK; SSE Networks, UK; TEPCO Power Grid, Japan; WEL Networks, New Zealand.	
Benefits	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 aim of the partnership is to promote the critical relationship between communities and smart grids in securing a fair transition to net zero that shares the ideas, innovations, and opportunities that a low carbon future creates. The themes of the project partnership are: • A fair transition to net zero - ensuring that as we take action to decarbonise, people and communities are not left behind and the policy environment supports this transition. • A resilient transition - undertaking adaptation and mitigation measures to continue delivering a secure supply of electricity. • A smart and local transition - exploring innovative ways to support engagement between communities and smart grids and the lessons that can be learnt from the partners' projects.	
Impacts	ESB Networks have presented to the group based on our Dingle project, and the community impact that it had. The partners will take this experience and apply to their own innovation endeavours, just as we will do for the projects we learn about from the partners.	
Outputs	The network resilience report was published in 2023 to the project partners and stakeholders. The project partners are carrying out research focused on distributed energy resources (DER) and the network in 2023 in the DSO regions, to share insights and learnings into the technical, behavioural, and regulatory challenges in the different partner regions.	
Next steps	New focus areas will be decided on based on the partners' experience, for 2024 and beyond.	

19: AI in Smart Metering Applications	**STATUS:** In Progress, Breakthrough, Empowering Customers	**TIMELINE:** Q1 2021 - Q4 2024
Scope	Ongoing auditing of smart metering installations is carried out to ensure quality and standards are maintained and to improve safety. This project involves the use of artificial intelligence (AI) to review images of smart metering installations in order to maintain high quality standards.	
Key Partners	This solution was developed internally by ESB.	
Benefits	The use of AI has brought significant benefits to the quality assurance audit function of the smart meter programme. By performing five key audit checks on every smart meter installation, the AI tool supports ESB Networks in maintaining its high quality standards with smart meter installers and contractor staff.	
Impacts	The auditing process is resource intensive and involves the review of images taken at every install. By the end of 2024 the smart metering programme will have completed the installation of over 2.4m smart meters, with in excess of 10 million images to be checked and reviewed over the duration of the programme. Using AI enables ESB Networks to do this with significant efficiency and cost savings. Integrated use of AI within the auditing process is a key safety and quality anchor of the smart metering programme, which alerts ESB Networks to 40% of quality assurance issues, thereby helping to ensure that quality standards are kept high, with staff and contractors maintaining a >99% pass rate. A secondary result of the use of AI has been in the development of a national database of cut-out fuses.	
Outputs	Auditing time per installation has been reduced by up to 10% with associated cost savings. In the absence of AI, it is anticipated that the audit budget would need to be increased by 400% with a larger team performing the assessments.	
Next steps	As the roll-out of three-phase smart meters commences, the opportunity to integrate other QA/auditing tests will be explored.	

3.4 COMPLETE

	NAME	IMPACT STATUS	NETWORKS FOR NET ZERO STRATEGIC OBJECTIVE
1	On-Street Charging Customer Interface	Incremental	Empowering Customers
2	Positive City Exchange (+CityxChange)	Breakthrough	Empowering Customers

1: On-Street Charging Customer Interface	**STATUS:** Complete, Incremental, Empowering Customers	**TIMELINE:** Q1 2023 - Q3 2023
Scope	This project was focused on producing a method for EV charging for on-street locations that complied with Irish legislation.	
Key Partners	The partners in this project were charge point operator Easy Go, and manufacturer of electrical busbars and equipment enclosures Ensto Renley.	
Benefits	This method enables ESB Networks to electrically connect on-street fast EV charging facilities while complying with all regulations.	
Impacts	EV drivers can recharge quickly at publicly accessible on-street locations. ESB Networks have moved the customer interface point for on-street infrastructure to comply with regulations. A new design document has been briefed out across all design managers in ESB Networks.	
Outputs	A prototype of this connection method has been deployed and is live at multiple sites. This change of work practice has been introduced across ESB Networks. A guide to accompany the code of practice for customer interface has been developed for internal ESB Networks use and is registered within the One Source repository. A version of this guide is published on ESB Networks' website for customer use.	
Next steps	This project is now live, and the connection method has been briefed to all ESB Networks design managers. The connection of fast EV chargers to the electricity network in public locations will be carried out nationally in accordance with these new design standards.	

2: +CityxChange	**STATUS:** Complete, Breakthrough, Empowering Customers	**TIMELINE:** Q4 2018 - Q4 2023
Scope	+CityxChange (Positive City Exchange) is a European Union (EU) Horizon 2020 Smart City Lighthouse project consisting 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). +CxC is conducting a series of demonstration projects on how today's cities can become smart, positive energy cities of the future. In Limerick, a community energy concept proposed to trial the use of intelligent meters, new innovative tidal renewable generators (hydrokinetic energy), electrical energy storage, digital tools, and citizen participation to create a distributed positive energy block (DPEB) and district. ESB Networks' focus in this project 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 local energy community utility (ECU).	
Key Partners	Limerick City and County Council, Trondheim Municipality, IES, and MPower.	
Benefits	The project anticipated the following benefits: • Connecting increased renewable energy in urban centres. • Establishment of local energy markets. • Demonstrating how digital technologies can make cities more climate-friendly.	
Impacts	The project's experience will document, for follower cities, the building blocks necessary to establish a positive energy block and district, and how energy consumers can be engaged to actively participate in those energy services maximising local renewable energy.	
Outputs	Further progress has been made during 2023 on the testing of the tidal turbine. Planning permission has been secured, although the foreshore licence is still pending, which has delayed the application to connect the turbine to the distribution network beyond the timeline of the project. The establishment of an energy community of scale, and investment in renewable energy by its members, did not occur to a level necessary to support a trial of P2P trading or flexibility services in the city.	
Next steps	All project learnings and deliverables will be published on the +CxC website and the Horizon Europe results platform.	


VERSALIFT
VOE 36 MHI
70

4 KNOWLEDGE SHARING

4.1 COLLABORATION, ENGAGEMENT, AND DISSEMINATION

Stakeholder collaboration and engagement are essential parts of our innovation strategy and take place at each step of our innovation process. ESB Networks collaborate and engage 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 collaborate with a wide range of stakeholders, including academic institutions, government entities and organisations, industry trade associations, electricity suppliers and generators, as well as newer energy actors such as demand-side units (DSUs) and battery storage providers. The challenges posed by the transition to Net Zero are substantial, and a collaborative approach to addressing these challenges is essential. We have a role to work together with our external partners on research and innovation activities that are aligned with our strategic objectives and our CAP targets for the network. To achieve our 2030 CAP targets, including the connection of significantly greater levels of renewables, the electrification of heat and transport, and the enabling of active energy citizens, we must collaborate and engage 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. In January 2023, we published ESB Networks' Stakeholder Engagement Strategy & Plan 2023 describing our approach, methodology, and key areas of engagement focus, and listing our engagement activities for the year ahead.

Engagement in innovation is guided by ESB Networks' strategic stakeholder engagement framework, which sets out our enduring engagement strategy to enable an open and ongoing dialogue with all our stakeholders. It provides opportunities for our stakeholders to contribute to projects and programmes, have their issues heard, and inform the decision-making process. We continually seek feedback from our stakeholders to contribute to all our projects and programmes, and to activities that inform our decision-making process as appropriate.
We value the feedback we receive, particularly on our annual publications and consultation, and this document offers examples of how we have acted on it.

ESB Networks undertake 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. 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 provide letters of support for relevant projects of theirs that align to the role of the DSO.

Throughout 2023, 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 1.5: Infographic of ESB Networks stakeholder engagement in 2023

4.2 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	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 Project dissemination events, modular substation showcase events
Industry Lobby Groups, Suppliers, Generator Owners, and Academics	Bilateral meetings	Range of bilateral meetings, workshops, and conferences
IEEE	Conference and committee meetings	Attending IEEE conferences and committee meetings
Safe Electric and Engineers Ireland	Briefing	Electrification of heat and transport, microgeneration, community energy, and standards
NSAI	Standards and committee	Supporting the development of standards
IERC	Committee	Attending committee meetings and related project workshops
Zevi	Board membership	Regular board meetings
Zevi	Webinars	ESB Networks screening process for EV charging hubs
EPRI	Membership, project and Innovation workshops	ESB Networks are a member of EPRI and work with other utility members on a range of projects and programmes
EPRI	Membership, project and innovation workshops	ESB Networks are a member of EPRI and work with other utility members on a range of projects and programmes

Organisation	Type	Topic
450 MHz Alliance, EU Joint Research Council, EUTC, and Tech UK	Meetings and conference	Shared learnings from 'National Radio Access Network' project and 400 MHz smart grid delivery
Smart Dublin	Workshop	Knowledge sharing event - innovation strategy and process
Engineers Ireland Lecture Series & National Recovery Event	Lecture series and conference	Disseminate and share learnings with stakeholders on electrification and network developments in ESB Networks
ABB	Presentation and panel	Energy storage for network resilience, novel fault isolation, EVs and the grid
Eurelectric	Workshop and committee	DSO development
CIGRE	Conference, workshops, and 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 having established an Irish committee, submitted papers, and presented at CIRED 2023 conference, Rome
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
INMR World Congress	Annual conference	Attendance and presentation

Publications

In 2023, ESB Networks personnel authored or co-authored several 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**; Connecting Renewables to the Grid, *Teagasc Webinar April 2023*
4. **Anthony Walsh**; Voltage Uprating of the Distribution Grid for Net Zero, *INMR World Congress Bangkok 2023*
5. **Anthony Walsh**; Effective Investment Planning for Asset Management, *DSO Forum Barcelona 2023*
6. **Pádraig Coughlan, Francisco Romo, Tara Ní Reachtagáin, Dan Catanase, Jack Herring, Clem Power**; A NOVEL DSO APPROACH IN PROACTIVELY UPGRADING THE LV DISTRIBUTION NETWORK FOR ELECTRIFICATION OF HEAT AND TRANSPORT; *CIRED Rome 2023*
7. **Jack Herring, Clem Power, Tara Ní Reachtagáin**; LOW CARBON CUSTOMERS: ANALYSIS OF LOADING OF DOMESTIC HEAT PUMP TRANSFORMERS IN IRELAND; *CIRED Rome 2023*
8. **Ciaran Geaney, Fergal Egan;** A DSO VIEW ON IMPLEMENTING RESIDENTIAL CUSTOMER FLEXIBILITY IN RURAL COMMUNITIES; *CIRED Rome 2023*

ESB Networks' Website and Social Media

The innovation section of ESB Networks' website continues to be a valuable channel to share information and updates with our stakeholders as it continues to be ranked highly as a preferred channel. We regularly update the website with information on innovation projects and innovation consultation documentation. A newly revamped website is being designed for launch in 2024, to improve our engagement and interaction with all customers and stakeholders.

4.3 SPOTLIGHT: UTILITY WORKSHOP 2023

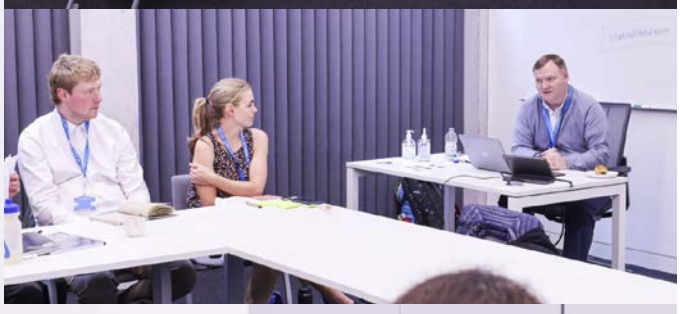
In 2023 we arranged a workshop with invited Distribution System Operators (DSOs) from other jurisdictions. In May, six utilities including NIE, Hydro Quebec, China Light and Power, EDP, and E.ON met in person and online to discuss their experiences of innovating to meet their customers changing needs and the needs of their networks. As well as listening to their specific stories, we posed questions to the group on areas of network resilience and preparation for net zero, and discussed their varied approaches and answers.

Specific questions included:

- What have been the biggest challenges you have faced in ensuring resilience of the distribution system, and how have you addressed them?
- Given the emerging trends you see in the energy sector that will impact the resilience of the distribution system, which tools do you see being applied to which issues (e.g. advances in technology, such as machine learning and artificial intelligence)?
- What are the main challenges you foresee in upgrading the electrical network to reach net zero, and how do you plan to overcome them?
- What measures are you taking to ensure that the upgrade of the electrical network is cost-effective and does not cause undue disruption to customers (including improved delivery process)?

The DSOs engaged with the issues raised and gave us great food for thought with their diversity of answers – many face similar challenges to ESB Networks and have used technically similar solutions. ESB Networks 'Fast Follower' approach to Innovation, where technologies that have been trialled by other utilities can sometimes be quickly transferred for use by ESB Networks in Ireland without as lengthy a trial/project process, may be suitably applied to these solutions.

The workshop was a remarkable success and a useful opportunity to engage with other DSOs, share challenges, and benchmark ESB Networks' innovative solutions against theirs, while building lasting networks and connections.



4.4 WORK WITH US ON THE INNOVATION JOURNEY

The transition to a low-carbon Ireland cannot be delivered without extensive and collaborative innovation. ESB Networks are committed to leading the transition, and know we must continue to innovate further and faster to increase the volume of renewable generation connected. We must increase the speed with which new generation is connected where possible, and support the timely implementation of the national Climate Action Plan and the European Clean Energy Package. We are facilitating the wholesale electrification of transport and heat, while also improving network resilience. We must continue to manage intermittency, to support energy communities, microgeneration, and active customers, and to move the dial on the many fronts required to make an increasingly low-carbon grid a reality.

We must build on our history of innovation, maintaining an agile mindset and ensuring the processes we have in place and the solutions we implement can respond to a rapidly changing world. This report has summarised how ESB Networks are 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 invite you to collaborate with us on this transition to the network for the future by sharing your ideas, challenging our approach, and holding us to account. We want to hear your views on how ESB Networks deliver innovation, and whether we are focusing on the right innovation projects to connect our customers to a clean electric future.

Please send your comments and feedback to **innovationfeedback@esbnetworks.ie** or fill out our online survey here.

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

ESB NETWORKS
Three Gateway,
East Wall Road,
Dublin 3,
DO3 R583

Tel 1800 372 757 or +353 21 2386555
Email esbnetworks@esb.ie

esbnetworks.ie