



NETWORKS

# INNOVATING FOR A BRIGHTER FUTURE

ESB NETWORKS' INNOVATION STRATEGY



## INNOVATING FOR THE FUTURE OF IRELAND'S ENERGY SYSTEM

The electricity industry is undergoing unprecedented change and how electricity is produced and consumed is fundamentally altering. We must adapt to these changes while continuing to provide our customers with secure, safe and affordable electricity. This is no mean feat and in fact is often referred to as the energy trilemma. It is one of the most significant challenges ever faced by the global electricity industry.

In Ireland we are already transitioning to a low carbon electricity system. Ireland is a world leader in the adoption of renewable energy. Through the successful development of our wind farm industry we now have the third highest wind penetration worldwide. However more work is needed to further increase renewable generation and also to decarbonise our transport and heat systems.

ESB Networks is committed to supporting Ireland's target of becoming a low carbon system. We believe innovation is vital to embracing the current challenges and delivering effective solutions. Building on our history of innovation we have developed a pioneering Innovation Strategy with our stakeholders and partners. It sets out a clear vision of how we intend to deliver a world class electricity network for the future. We have worked hard to develop eight innovation roadmaps which identify opportunities across all areas of the business.

We hope you find our Innovation Strategy informative. It is through innovation that we will develop a future electricity network which empowers our customers, delivers value for money and provides a sustainable energy system for us all.

**Marguerite Sayers – Managing Director,  
ESB Networks DAC**

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# ESB NETWORKS AND IRELAND'S ENERGY FUTURE

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# INTRODUCTION

Electricity is vital to our society and we believe every citizen should have access to a secure, sustainable and affordable electricity supply. Since the Electricity Supply Board (ESB) was established in 1927, we have supplied light, heat and power to the Irish people. Today, we are proud to serve all 2.3 million industrial, commercial and domestic electricity customers in Ireland.

We are committed to enabling a brighter future for everyone, a future powered by electricity.



## A HISTORY OF INNOVATION

ESB Networks has a strong history of innovation. From the beginning we have constantly strived to improve and upgrade the electricity network. As a result we have developed one of the most progressive electricity networks in the world, one that has enabled Ireland to become a world leader in industry and technology. Innovation is part of the culture of ESB Networks and we are firmly committed to innovating into the future. In the last 15 years, ESB Networks has invested over €7bn in our network and technology, including innovative projects such as:



**Network Upgrade** - 44,000km of overhead networks converted from 10kV to 20kV, resulting in a 75% reduction in network losses



**Improved Reliability** - 72% reduction in customer minutes lost through improved network reliability and storm resilience



**Renewable Connections** - over 3,000MW of renewables connected to the network including 55% of the wind fleet connected directly to the distribution network



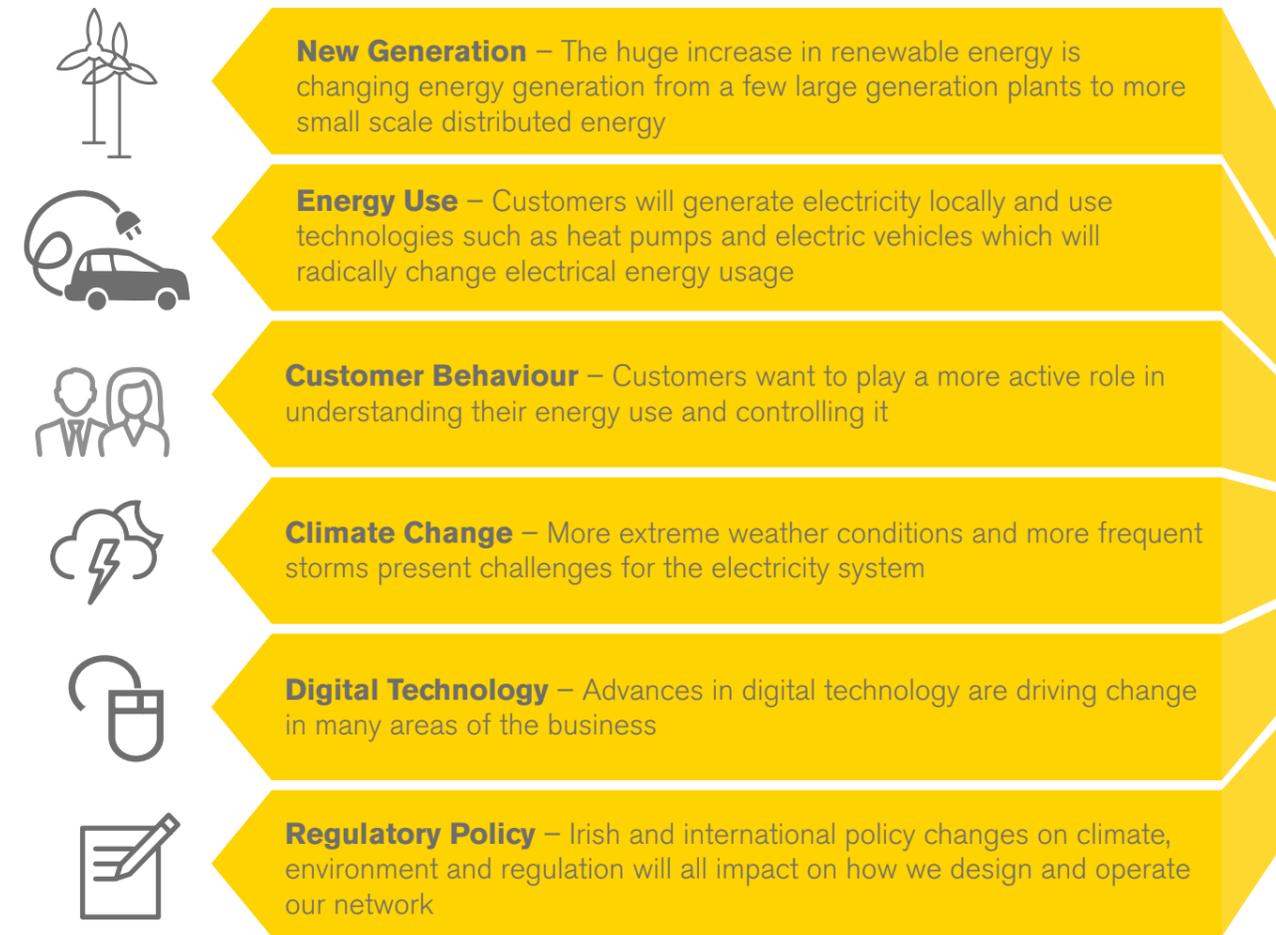
**World Class IT Platform** - this Active Distribution System Management is used to manage all aspects of the operation of the smart DSO network



**Customer Service** - improved customer satisfaction from 69% to 81%. Winner of the CCA "Contact Centre of the Year" award in 2016

## A CHANGING ENVIRONMENT

Innovation is becoming even more vital to our business as the global energy industry experiences a period of unprecedented change. In addition, the certainties and assumptions that we have used to plan and operate our networks are being challenged and will be challenged further in the future. The ability of electricity networks to adapt and innovate in this changing and uncertain environment will be crucial to their future success. There are significant external factors driving change in the energy industry in Ireland.

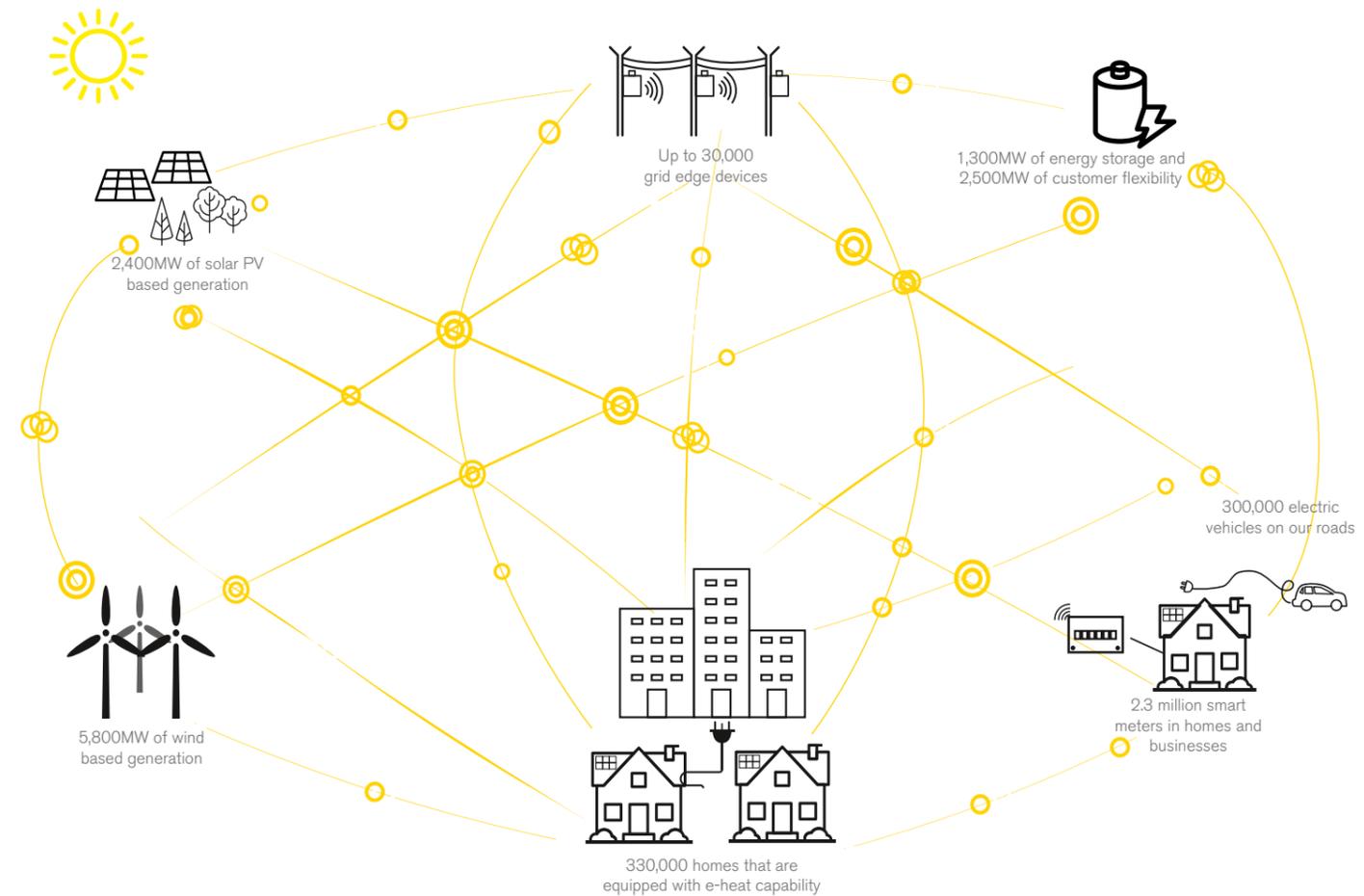


## AN ERA OF OPPORTUNITY

This changing environment provides us with challenges but also provides great opportunities for innovation. From the adoption of new materials and technologies to exploring large-scale digital applications and big data analytics. Coupling the heat and transport sectors to the electricity sector also presents a number of opportunities for our customers.

The identification of innovative opportunities for our customers and stakeholders is a key part of ESB Networks' innovation strategy. This requires us to consider the long-term landscape and identify how we see the energy system developing in the next decade and beyond. We are focusing on areas for innovative developments that will bring long-term benefits. We anticipate radical changes in electricity generation and consumption, supported by flexibility both in terms of more flexible use of electricity by our customers and energy storage.

### BY 2030, OUR NETWORK WILL SUPPORT:



**2,500MW of electricity can deliver almost half of Ireland's electricity demand on the coldest day of the year**

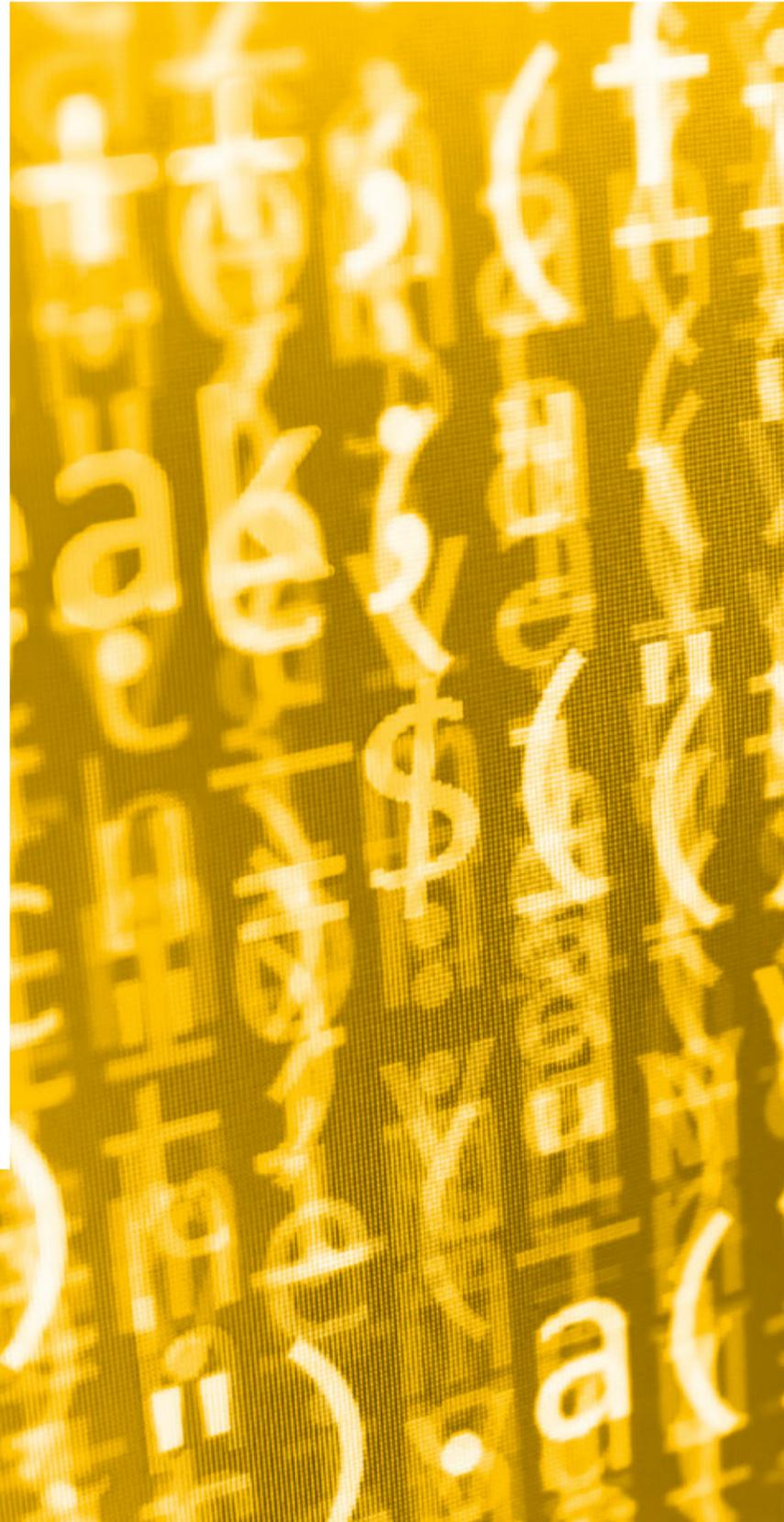
# KEY SUPPORTING ELEMENTS

Innovating in this changing environment is a complex challenge. There are three elements which support our innovation strategy and strongly influence how the strategy is implemented. The first of these is ensuring our innovation has a technology focus. The Smart Meter programme is a crucial element of our innovation strategy. Ireland's energy policy is also a key framework which guides all our innovation activity.

## TECHNOLOGY AND DATA

Our network is being enhanced today by the addition of innovative new technologies to existing assets and network components. It is our responsibility to get the most from all of our existing assets so that we can allow our customers to participate in the changing energy systems. These new technologies are allowing us to manage the operation of the network in a more controlled and precise way, freeing up additional capacity from existing assets. They are giving us real-time data about the health and performance of our assets. This innovative approach to incorporating different data sources into a real-time model of the network will allow us to plan our future investments in network assets in a more efficient and environmentally sensitive manner. We will use these new technologies to do much more in the future:

- Move further towards condition based maintenance by incorporating real-time sensor data into our maintenance management and SCADA systems
- Trial variable access management tools to allow existing embedded generators release additional capacity from the existing network connections by having more detailed control of the generator output and by deploying technology on our network that gives us real-time weather and loading information
- Safely manage the participation of our customers in importing and exporting onto the network without overloading the different components. This will involve durable low cost sensors that are easily deployable and can provide data in a secure and efficient manner to the home and to our systems
- Bi-directionally share information with EirGrid and our customers so that we can work together to maximise the efficient operation of the entire energy system



The development of new ways to collect data from our existing assets, and to incorporate this data into our systems with other data sources will unlock hidden potential for our customers. It will defer investment costs, speed up our interactions with customers, and permit customers to flexibly use our network to positively contribute to climate change targets.

## SMART METER PROGRAMME

Smart Meters will become a cornerstone of ESB Network's innovation strategy. It will involve the design, procurement and delivery of 2.3m Smart Meters and the technology to support them. The new meters will record real-time electricity usage and communicate it back to a central hub.

Smart Meters will bring many benefits. With real-time data available to customers, it will be possible to encourage changes in energy usage that facilitates the efficient operating of the system. Energy companies will be incentivised to develop new customer propositions to encourage behavioural changes and ensure that customers receive the most efficient cost reflective tariffs.

## POLICY FRAMEWORK FOR A CLEAN ENERGY FUTURE

Ireland's energy white paper "Ireland's Transition to a Low Carbon Energy Future 2015 – 2030" sets out a framework to guide policy between now and 2030. The main objective is to guide our country's transition to a low carbon energy system and provide secure supplies of competitive and affordable energy to our citizens and businesses.

This national energy policy framework has been developed in the context of the significant role played by European institutions in determining energy policy, markets and regulation. It also takes account of European and International climate change objectives as well as Irish social, economic and employment priorities. Our targets for 2030 are available in Energy Union and Climate Action: Driving Europe's transition to a low-carbon economy. Ireland will have to reduce its emissions by 30%, relative to its 2005 emissions. Ireland is also a party to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Paris Agreement, which provide the international legal framework for addressing climate change at a global level. Ireland ratified this on the 18th October 2016.

ESB Networks' innovation to achieve key policy objectives is fully supported by the Commission for Energy Regulation (CER). In addition to allowing funding for dedicated R&D, the CER has introduced a Strategic Innovation incentive scheme to promote innovation within ESB Networks' core activities and in the delivery of strategic projects supporting national policy objectives.

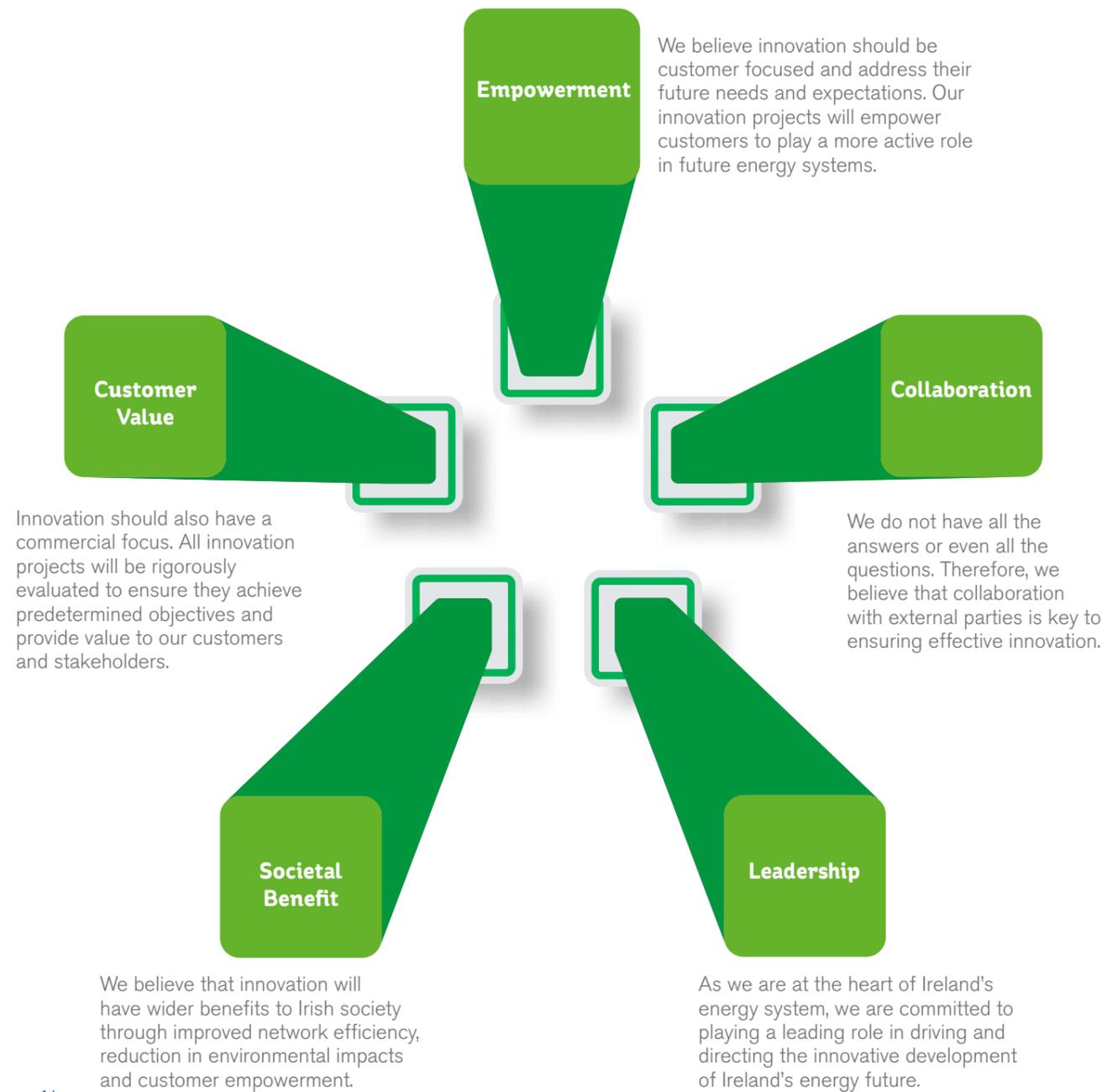
**"The EU has committed to cut CO<sup>2</sup> emissions by at least 40% by 2030".  
- 2030 Climate and Energy Package**



# VISION AND VALUE PILLARS

Our vision and value pillars are the foundation of our Innovation Strategy. These pillars are centered around the needs of our customers and other stakeholders.

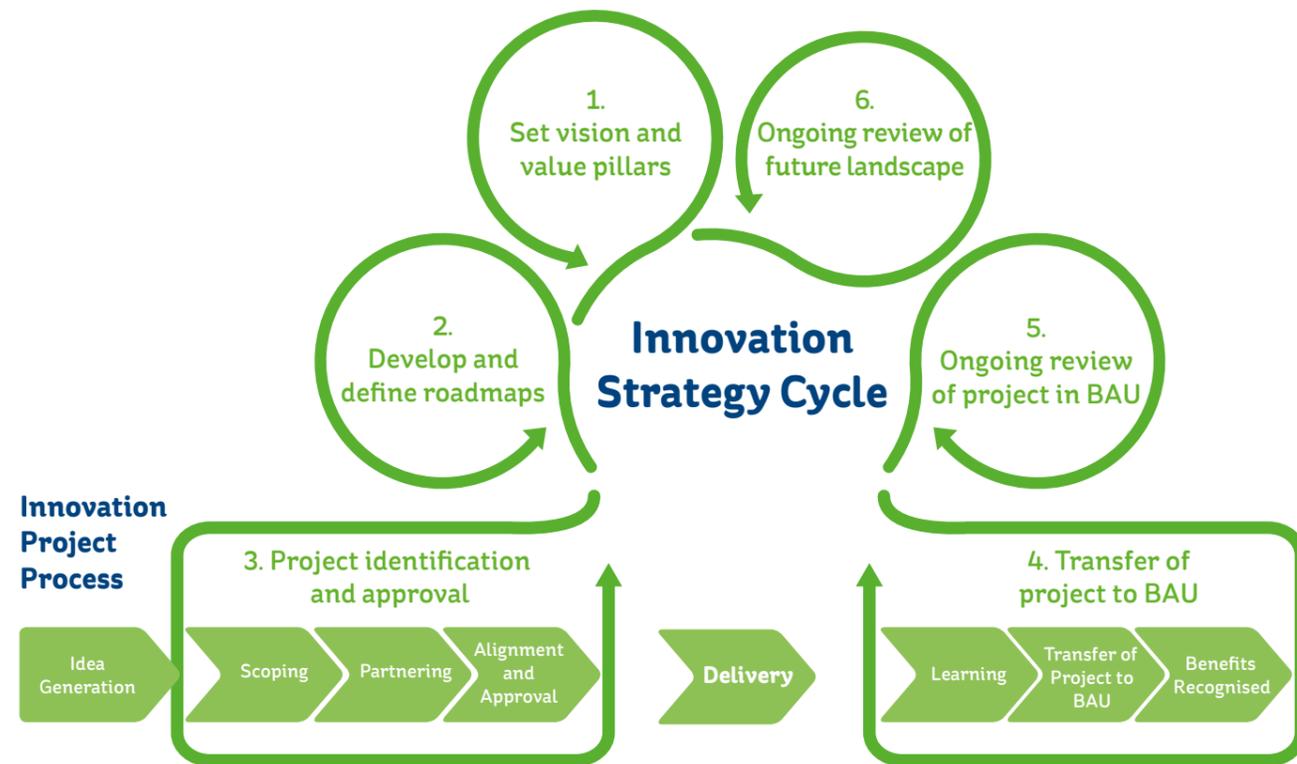
***“ESB Networks innovating towards a sustainable future for our customers and Ireland”.***



# INNOVATION FRAMEWORK

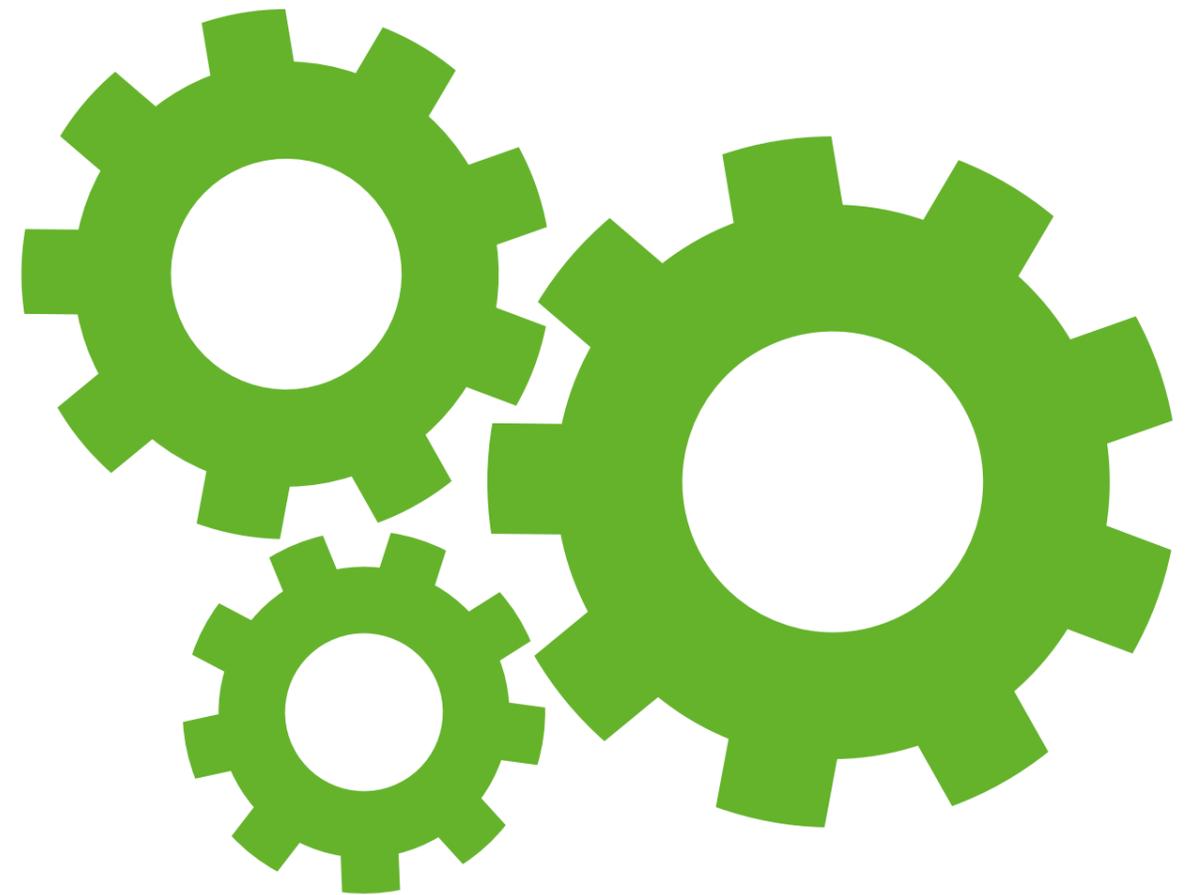
In order to embrace the increasing need to innovate in the electricity industry we have developed an Innovation Framework to help us to deliver our vision of the future. The framework builds on our history of innovation while incorporating the drivers for change. We believe it is a unique and dynamic framework while at the same time incorporating practical processes to allow innovative ideas to become a reality and add value for our customers and stakeholders.

This approach will guarantee that we remain focused on our customers and continue to develop our network in a manner that meets their needs over the short to longer-term future. This diagram shows the overall strategy cycle that we use, the process for each individual project and how they are integrated:



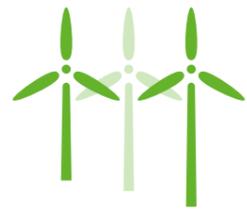
Our innovation strategy will continually evolve over time to reflect the rapidly changing energy landscape. Engagement with our partners will therefore be an ongoing feature of our strategy implementation and will continue throughout the life of this strategy. As well as our customers, our key partners include the CER, Government Departments, Local Communities, EirGrid, Industry, Academic Institutions and many more.

Strong governance is also a key part of our Innovation Framework. The governance of our innovation strategy covers not just the project process but also the delivery of the roadmaps, pillars and innovation vision. Governance is provided through our Innovation Governance Board (IGB), which includes members of the senior management team and key operational staff. The IGB owns the innovation strategy and operates to the terms of reference approved by the Managing Director of ESB Networks. This includes a comprehensive review every three years and reviews of changing drivers that may affect specific roadmaps as necessary.



# INNOVATION ROADMAPS

To ensure we have a balanced portfolio of innovation projects, eight innovation roadmaps have been developed. Each one is based on an opportunity resulting from the challenges we face. We are confident that these roadmaps will enable us to deliver an electricity system which serves the future needs of our customers and Ireland.



## Connecting Renewables

ESB Networks will facilitate the growth of renewables connected to the grid



## Customer Engagement

We are working to ensure that we listen to and respond to our customers' changing needs



## Electrification of Heat & Transport

The electrification of heat and transport is key to meeting Ireland's decarbonisation targets



## Asset Optimisation

A number of projects are underway to maximise the utilisation of assets owned by ESB Networks



## Flexibility on our Networks

Flexibility on our networks will help us to deal with future demand without major reinforcement programmes



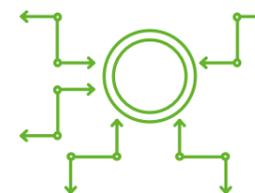
## Operational Excellence

We operate all aspects of our business to the highest standard and innovate to continually improve these standards



## Network Resilience

Resilience is key to ensuring that customers receive the best quality supply and the least amount of outages as possible



## Working with the TSO

We will continue to work closely with EirGrid to manage the emerging complexities of the system

# 03

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## EIGHT INNOVATION ROADMAPS

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# CONNECTING RENEWABLES



“ESB Networks connected the first windfarm to the grid in Bellacorick, Co. Mayo in 1992 with capacity of 6.45MW. We have now connected over 3,000MW of renewable energy and will continue to innovate to enable more renewables to connect into the future”.

ESB Networks is committed to playing a leading role in enabling Ireland's transition to a low carbon energy future, powered by clean electricity. National and EU policy continues to drive this transition, with the Clean Energy for All Europeans Package of directives and regulations in 2016 providing revised targets for Ireland.



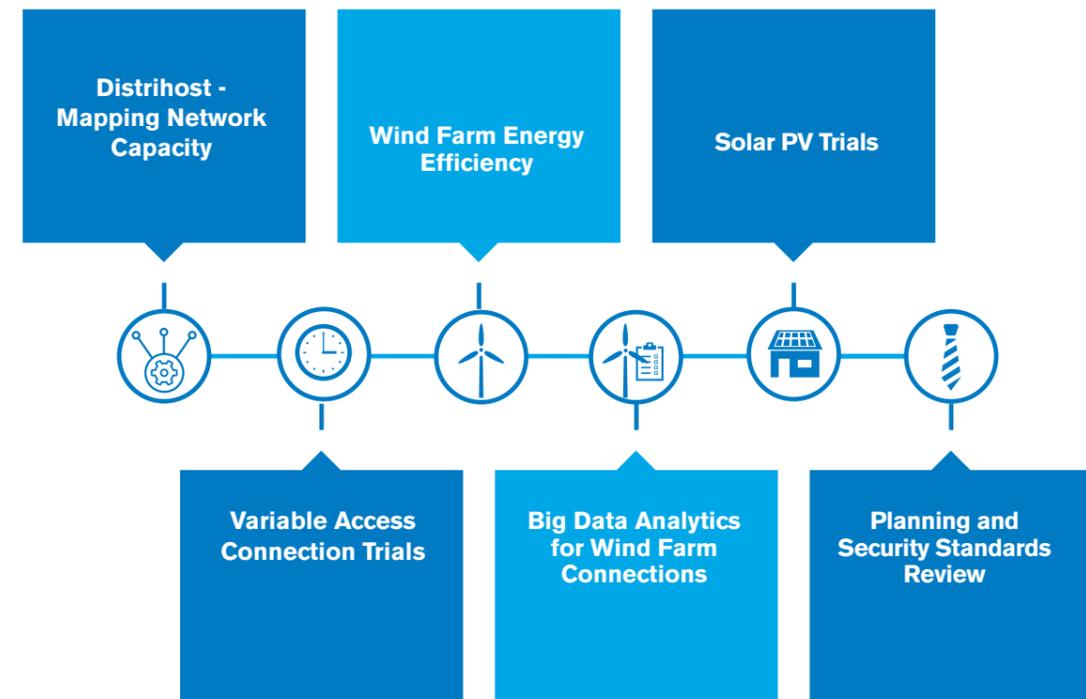
Each year sees more renewable energy sources connected to the electricity network to support the goal of minimising the amount of carbon produced. By 2030, it has been forecast that ESB Networks will have connected over 8GW of renewable generation.

Our key challenge is to support the efficient transition of these new technologies onto the electricity network while maintaining the current levels of resilience and security of network.

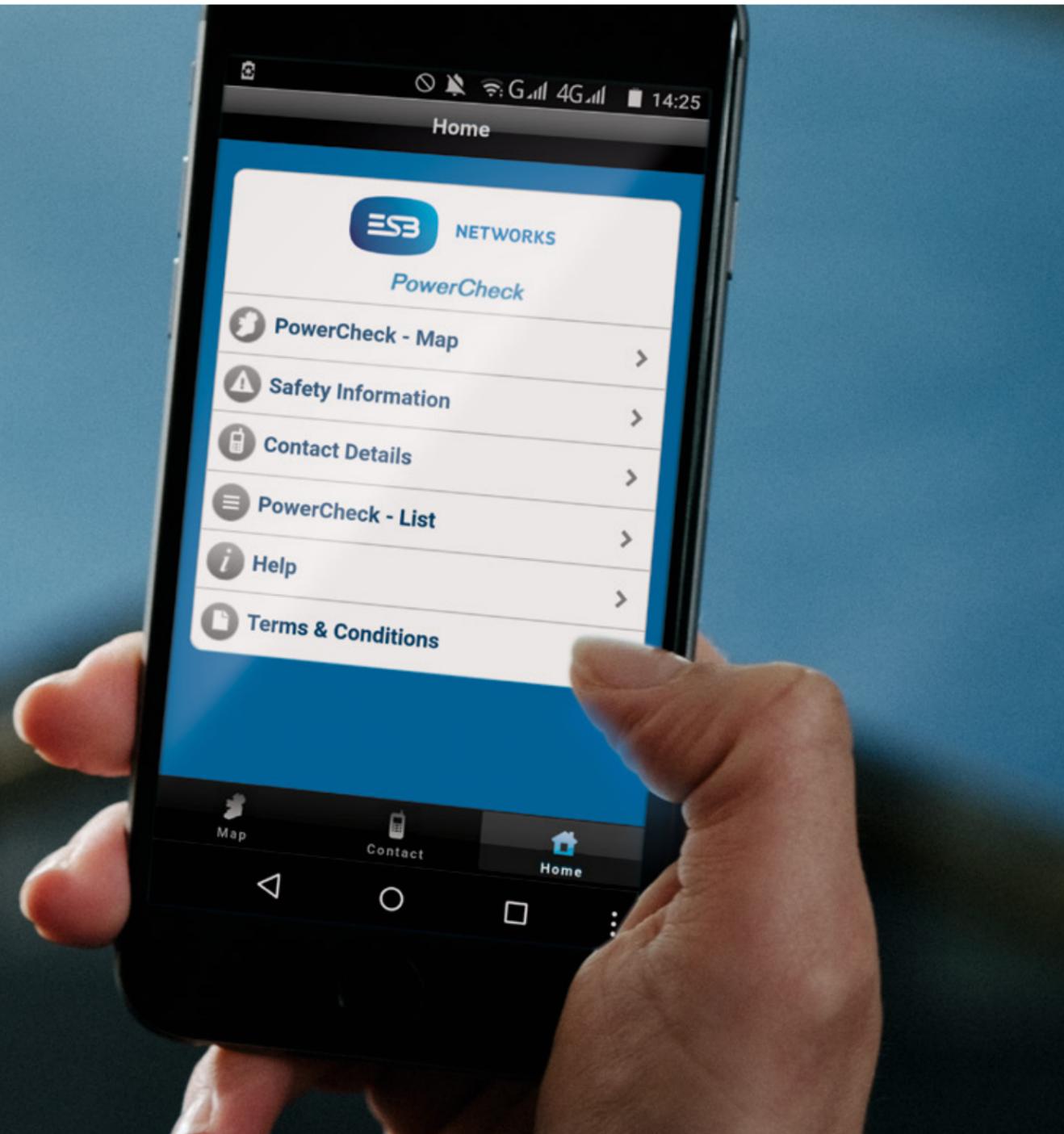
To date large-scale onshore windfarms have provided the main source of renewable generation. Over recent years we have also seen new Distributed Energy Resources (DER) apply for and connect to our network. These new technologies include grid-scale solar Photo Voltaic (PV), Combined Heat and Power (CHP) and biomass. These technologies are now developing market momentum.

We aim to examine the impact of increased connection of non-domestic DER and renewables on our future electricity system, and establish how our planning standards and policies need to evolve to support their connection, in the most economic method possible.

## ROADMAP PROJECTS



# CUSTOMER ENGAGEMENT



“As we look to a low carbon future powered by a smart electricity grid, we continue to serve our 2.3 million industrial, commercial and domestic electricity customers with pride.” - Marguerite Sayers, MD, ESB Networks

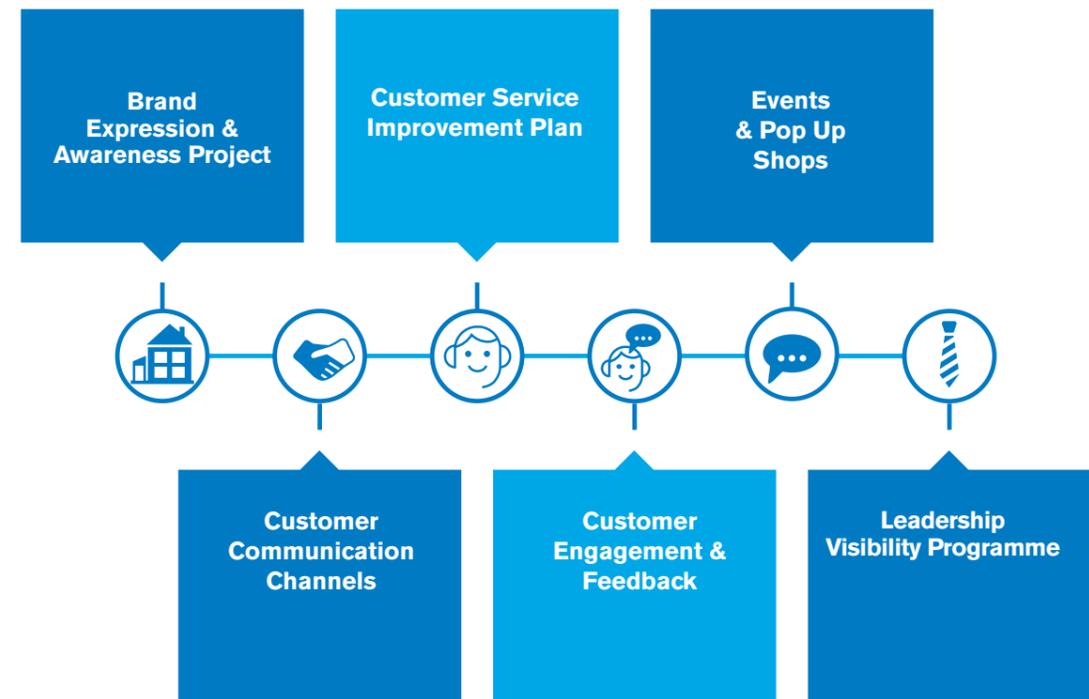
ESB Networks is proud to serve all 2.3 million industrial, commercial and domestic customers in Ireland and to provide them with safe and reliable electricity to power their homes, businesses and communities. We have a proud tradition of serving our customers and the community for over 90 years, and as the energy industry changes and transitions to a low carbon future, ESB Networks will ensure our customers remain at the centre of everything we do.



ESB Networks' staff have thousands of daily touchpoints with our customers. We have over 2,000 field staff who work in the community on a daily basis and our 24 hour National Customer Contact Centre deals with over 1.8 million customer contacts annually. We understand that customers want to communicate with us in different ways and at times that suit them. We aim to support our customers' desire to quickly access our services and we will continue to use new technologies and digital channels to improve the customer experience.

ESB Networks is also working to improve our profile and engagement with our customers. This has initially focused on safety and in 2015 an integrated Public Safety Campaign was developed based on customer involvement and feedback. The Customer Engagement innovation roadmap includes development of new communication channels, more active customer engagement and development of a more visible brand.

## ROADMAP PROJECTS



# ELECTRIFICATION OF HEAT & TRANSPORT



With electricity becoming an increasingly low carbon fuel, the electrification of heat and transport will prove one of the most economic and practical ways to meet Irish decarbonisation targets.

The Irish electricity distribution network has been installed over generations – greater use of these assets in substituting fossil fuels in transport and heat will prove societally cost effective.

The bulk of the network already exists, and with ESB Networks delivering innovative solutions, only limited modification is likely to be required to use it more intensively and to meet the demands of heat and transport electrification on the network.

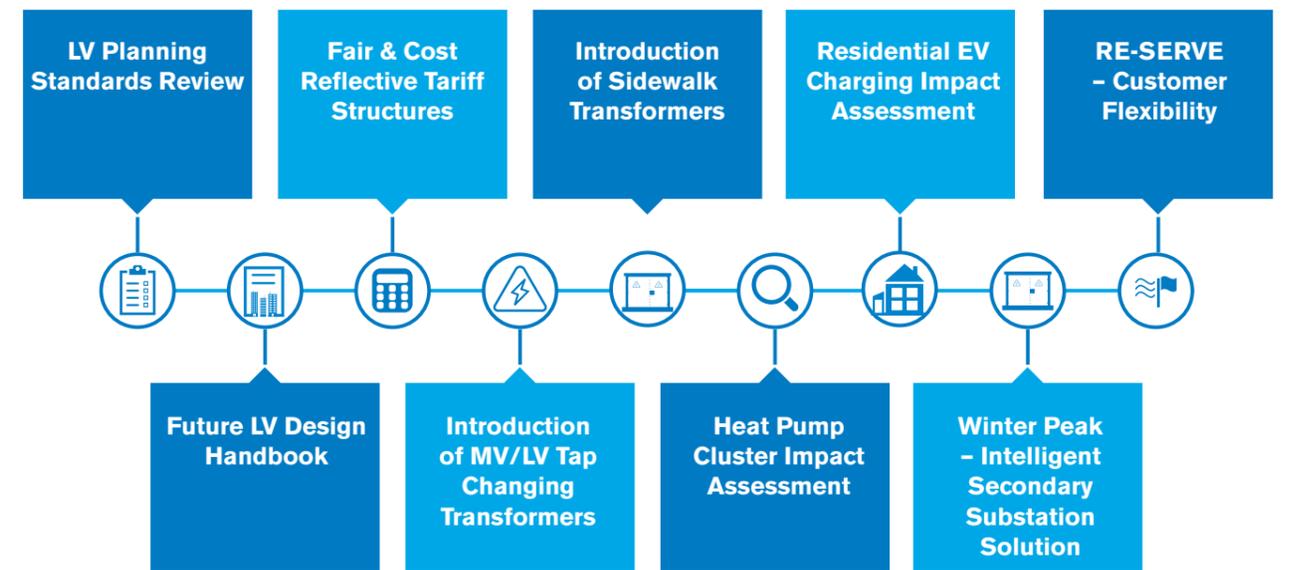
The Electrification of Heat & Transport innovation roadmap addresses network planning and operation, to meet these new demands without compromising our customers' comfort, security or quality of supply at an economic cost reflecting our customers' needs and values.

ESB Networks has undertaken R&D to facilitate these new demands for a number of years. Now we need to deliver strategies allowing the fastest connection at minimum long-term cost – resilient, cost effective technical solutions which can be deployed within 1-2 years. We continue to investigate and develop strategic new solutions for even greater levels of electrification of heat and transport longer-term.

The projects in this roadmap focus on LV networks where the greatest impact is expected, beginning with short-term tactical solutions and moving to those longer term strategies. They range from final stage materials introduction for smart technologies, to active system management pilots, to analytical research into uptake uncertainty and technological risk, informing strategic investment decisions in future.

As we move towards a low carbon society, this innovation roadmap will help us to deliver the secure, reliable and efficient network our customers need, as they choose the heat and transport solutions that are right for their homes, businesses and lifestyles.

## ROADMAP PROJECTS



*“The challenge of decarbonising heat can be met with increased electrification of heat. The additionality of the R&D, innovation and support from ESB Networks to ensure the development of e-Heat can deliver decarbonisation to Ireland’s heat sector in the most cost effective manner for Ireland. It’s clear from our European work that ESB Networks is at the forefront of smart grid R&D in a European context.”*

- Paul Kenny, Chief Executive Officer, Tipperary Energy Agency

# ASSET OPTIMISATION



ESB Networks manages a network of assets ranging from the 2.3 million meters in every house and business in Ireland, to the 400kV substations connecting hundreds of megawatts of generation. Developed over decades, these assets are located in all corners of the country, serving the needs of all Irish electricity customers.



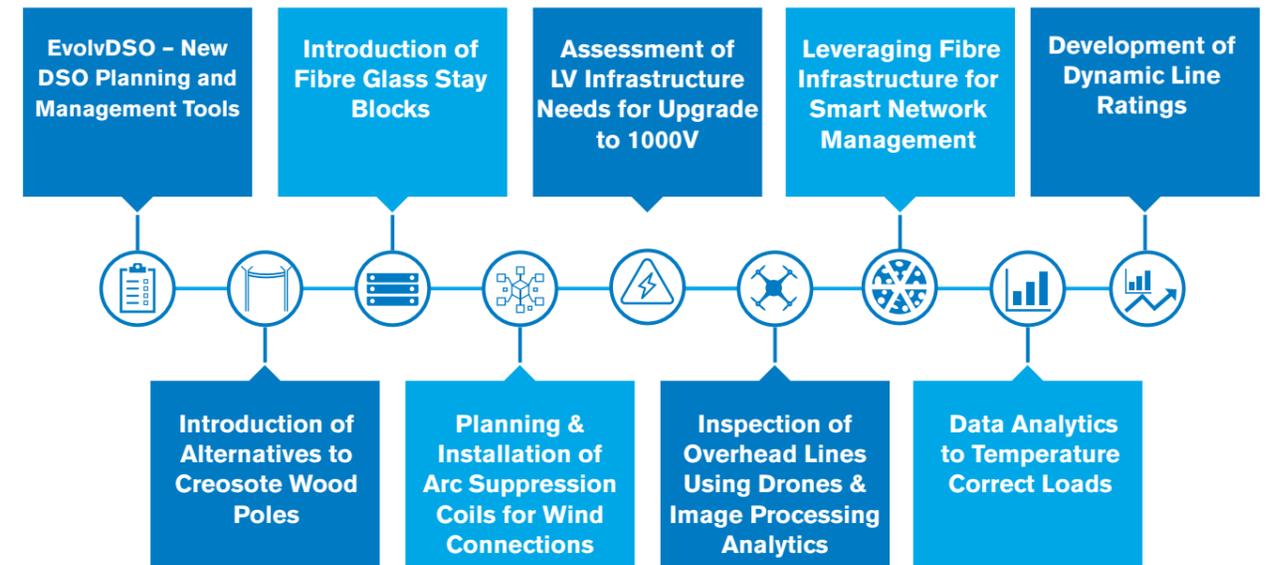
We manage these assets in line with best utility practices to deliver reliable and reasonably priced electricity. As these assets age, and as our customers' needs change over time, we are working to extend our assets' useful lives, improve their reliability and maximise the capacity they can provide.

Technological developments are creating new opportunities in how we manage our assets, improving:

1. **Efficiency:** Sensing and analytics on our fixed assets will allow us to optimise maintenance interventions, more efficiently focus our resources and improve asset performance. The Use of Condition assessment rankings (health indices), as part of risk management, will improve our maintenance processes and lifecycle management of assets. This means ESB Networks will optimise the value from all investments made.
2. **Environmental impact:** New materials will ensure that all future network investment in connecting customers, increasing capacity to support economic development and upgrading failing assets will be delivered in an environmentally aware way. Innovative products and techniques will help us limit the impact on our country's natural landscape and work in partnership with landowners and residents to better balance local environmental and economic values.
3. **Reliability:** Innovative control and protection technologies will allow us to safely improve the quality and reliability that our assets deliver.

The Asset Optimisation innovation roadmap is designed to ensure that ESB Networks take value of advances in asset management technologies, materials and practices to develop a network that provides the services customers want.

## ROADMAP PROJECTS



“Since 1927, through rural electrification in the 1940s and 1950s, ESB Networks has been managing the electricity infrastructure to support Irish social and economic development. Through innovation, now we can ensure that this 170,000km of networks and 2.2 million poles delivers greater value, evolving and developing with society today.”

# FLEXIBILITY ON OUR NETWORKS



We have developed our network over the last 90 years to facilitate our customers using electricity in ways to support their lifestyles. We are committed to continual development of our network to allow our customers to use electricity in varied ways in response to changing environmental, technological and commercial incentives. Over the last 20 years we have changed the nature of how the electricity network works by connecting large numbers of generators to the distribution system. We have built assets and control systems to ensure that the network works safely and efficiently for all customers while facilitating the increased penetration of renewables in an affordable way.



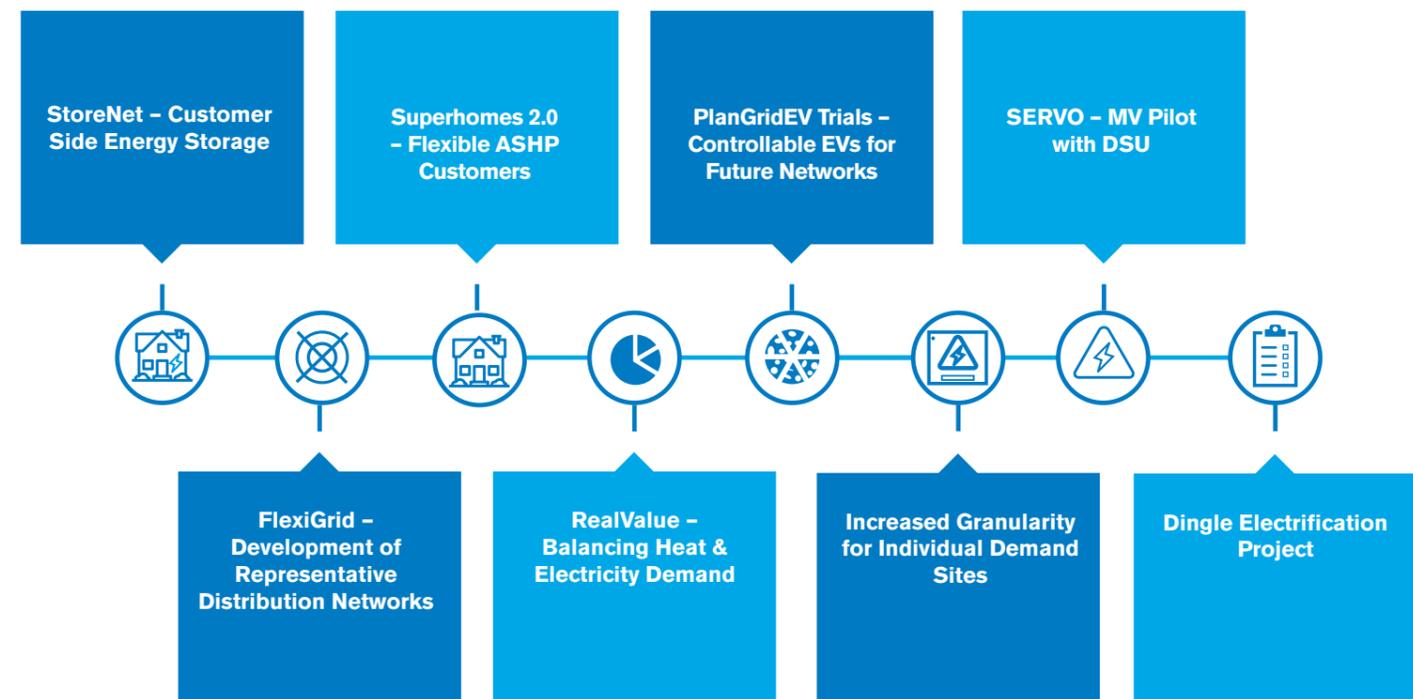
Our vision for the future is to maximise the capacity of our existing network to allow all of our customers the maximum level of flexibility in terms of how much, how often and when they use electricity at the lowest possible cost. We will build new network to serve new customers to a standard that allows full flexibility in an efficient and timely manner.

Our customers will engage with technologies such as e-heat, e-transport, domestic storage, and domestic level generation. We will work to ensure that our network can support the wide range of customer requirements as efficiently as possible. These technologies will enable our customers to partake in an energy market where they can contribute to managing climate change by decarbonising our energy system, and they can share in the commercial benefits of this participation. It is our role to facilitate flexible customer behaviours by ensuring that the network has sufficient capacity and is as safe and reliable as possible.

ESB Networks will take a leadership role in Demand Side Management in Ireland. We will develop our network to facilitate participation of all customers in future Demand Response services or markets. It is forecast that there will be 2,500MW of demand side response capability in our customers' premises by 2030. We will invest in new control systems and assets to allow all of this capability to offer needed services to the energy system in Ireland.

Smart Metering and other domestic and network level control technologies will be vital in delivering a network with sufficient capacity and visibility to facilitate customer flexibility. The projects set out in this roadmap are trialling and implementing these technologies. These projects will provide us with the data and systems that we need to optimise our investment plans and meet the changing needs of our customers.

## ROADMAP PROJECTS



“ESB Networks participation with EPRI is consistent with the continued strong ESB Networks leadership in the area of innovation for the entire power industry. We appreciate the opportunity to be associated with the innovative ideas and demonstrations at ESB Networks”  
 - Mark F. McGranaghan, Vice President, Distribution & Utilization, EPRI

# OPERATIONAL EXCELLENCE



“ESB Networks commissioned our first remote control substation in 1991. Today all 650 HV substations are controlled remotely from our operations centres in Dublin and Cork.”

We use a range of modern systems and technologies to keep our network safe and operating efficiently for all our employees, contractors and customers. These have evolved over time and are now embedded as core parts of how we manage our assets and deliver all of our work programmes.

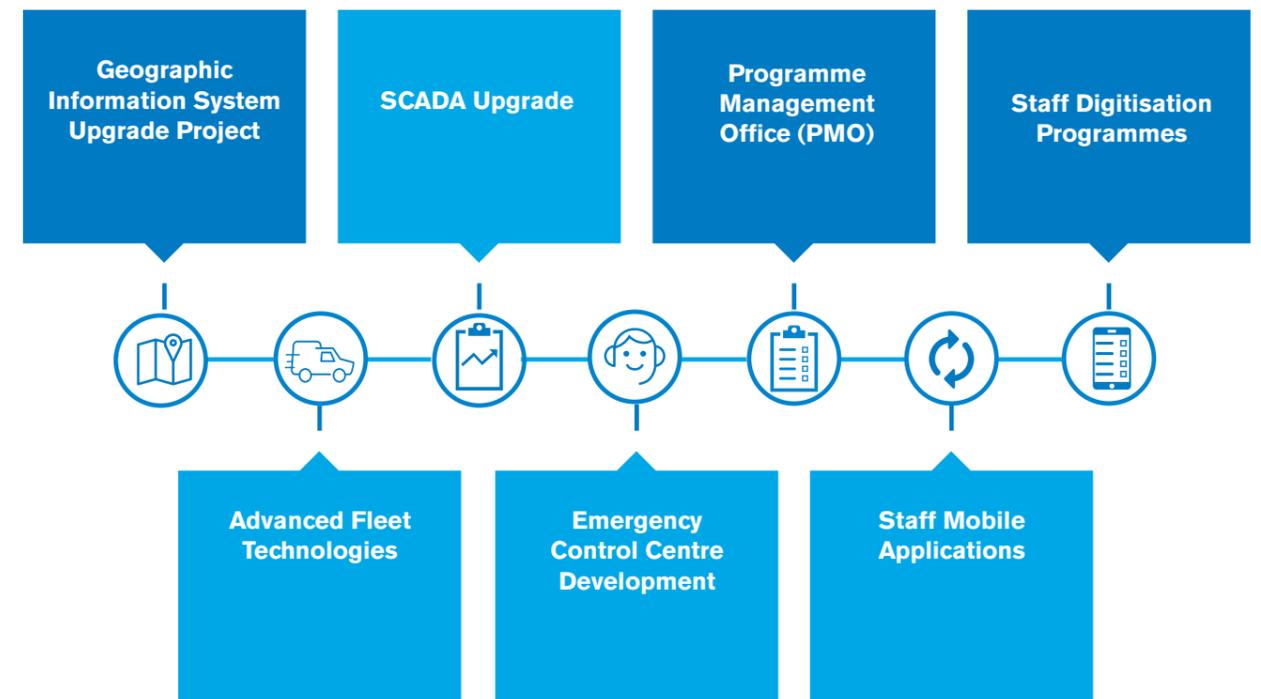
We continually challenge ourselves to improve these systems and processes and to embrace developing technologies to increase efficiency and deliver value to our customers. We strive to be as responsive as possible to the demands of the network and to individual needs of our customers. This means being faster to respond and focussed on anticipating customer needs.

While we improve our systems and processes through the deployment of technology, the delivery of a safe network for our customers and staff, and the safe management of all who work on or near to the electricity network will always underpin our activities.

We will continue to deploy mobile technology to make work delivery faster and safer, and we will ensure that the systems that monitor and control our network are developed to the highest international standards to support our customer needs in particular to deliver flexibility, resilience and enhanced public safety.



## ROADMAP PROJECTS



# NETWORK RESILIENCE



*“As the potential gravity of the situation emerged on the morning of January 14th, the decision was taken to convene a National Co-Ordination Group. Through the course of the day, the information ESB Networks provided and their measured and accurate advice was vital to the decision making process and in providing authoritative messages to the media, that in turn provided reassurance to the public.”*

- John McCarthy, Secretary General, Dept of Housing, Community and Local Government



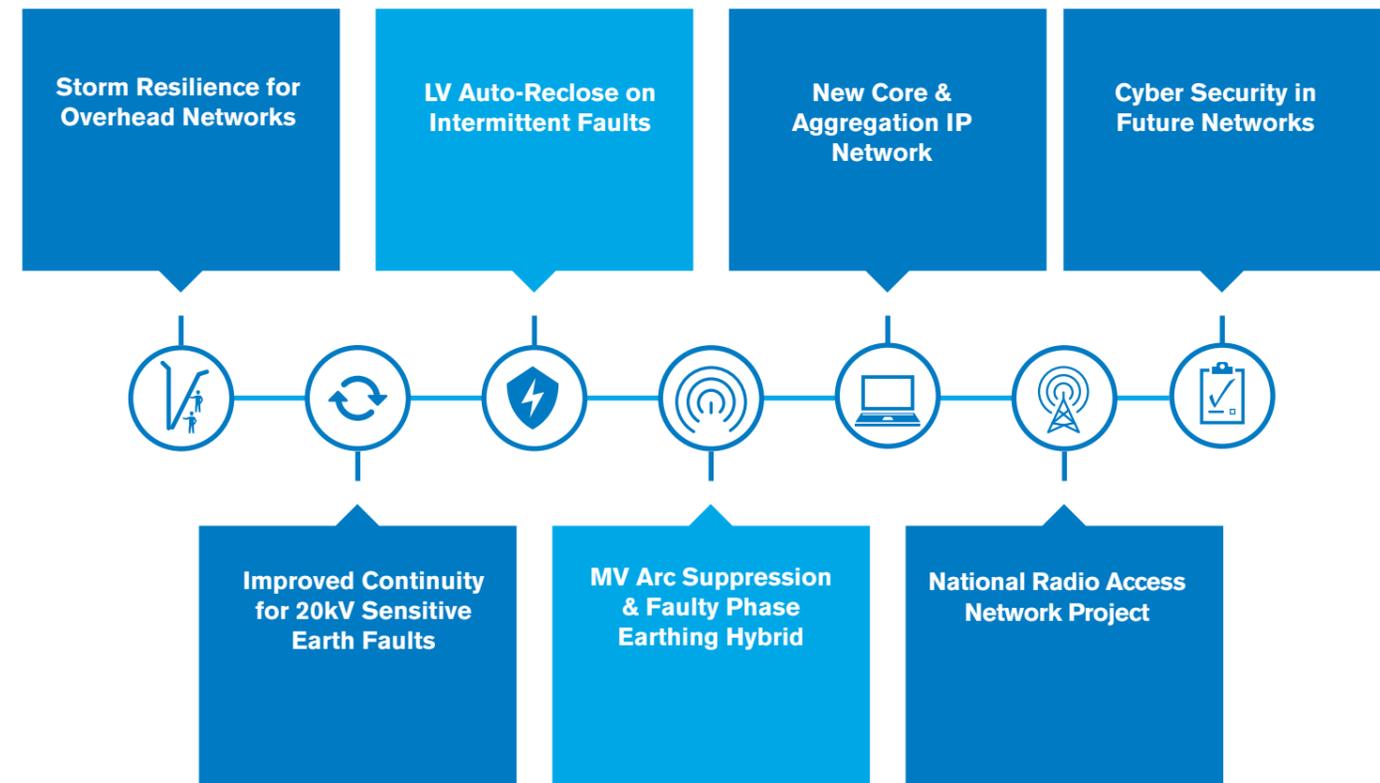
The investment in our network over the last 20 years has resulted in continuity of supply to our customers improving by more than 60%. As our climate continues to change we must ensure that we continue to invest in making our network resilient to the changing weather patterns and more intense storms that we have seen over recent years.

We must also ensure that our network is resilient enough to support our customers who will be using more electricity as they electrify heat and transport in their personal lives to support Ireland's journey towards a clean energy system. Our network must be reliable and have enough capacity to enable this customer transition to a more electrified lifestyle.

This will require that we continue to build and maintain our network to high standards. We will also have to invest in more monitoring and sensing technology to provide us with detailed data about the performance of our assets. This data allows us to make decisions and to create data and business intelligence platforms which will use this rich data asset to help us keep the network strong and reliable. Sharing our focus between fixed assets and sensing and data assets needs a new competence and focus on keeping the data and IT systems resilient to failure and intrusion.

Delivery of a resilient network across all of our assets and component parts is an exciting challenge for ESB Networks. We are working to to achieve this across a range of projects.

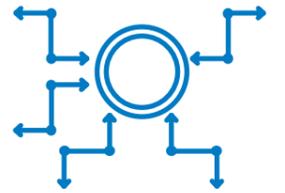
## ROADMAP PROJECTS



# WORKING WITH THE TSO



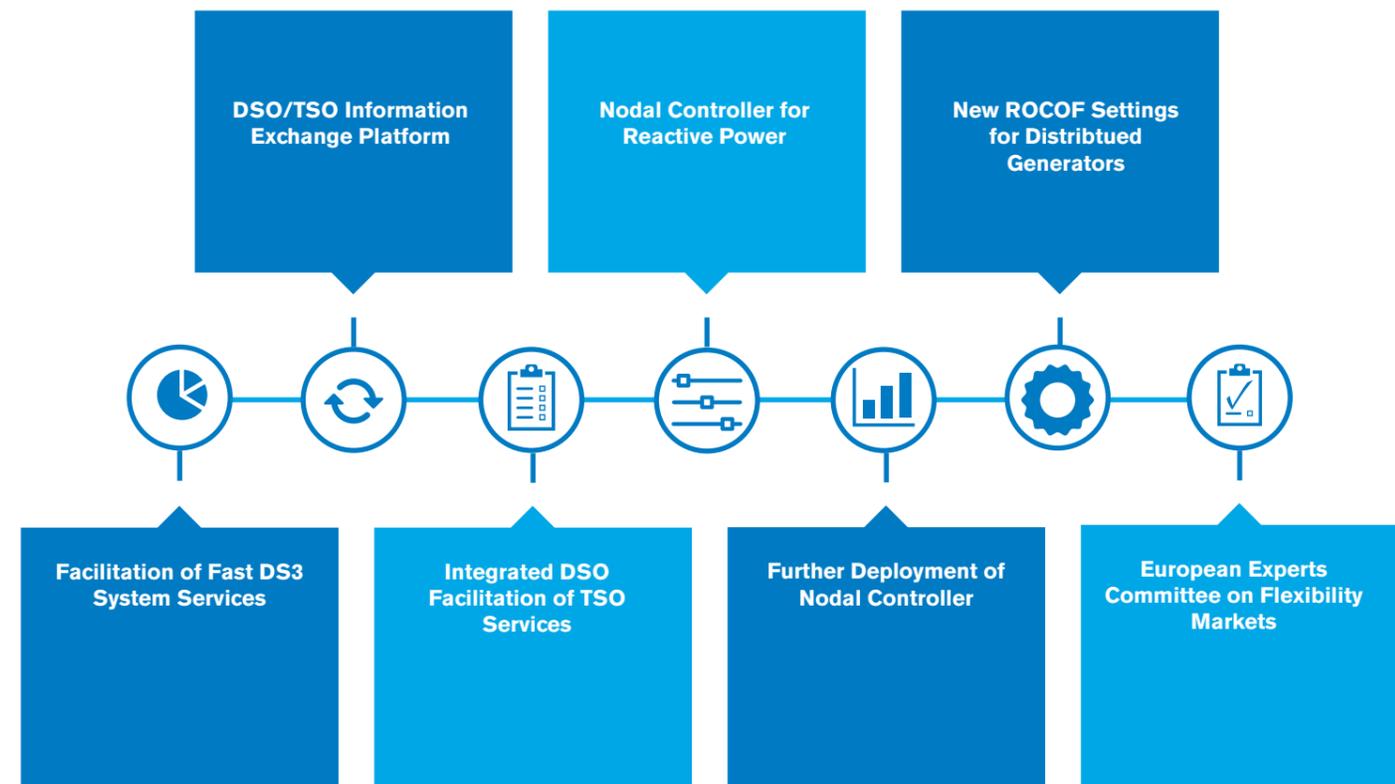
Safe operation of the electricity network in Ireland means that the distribution system and transmission system work together in a coordinated way so that the needs of all customers are met. The two systems will host over 8GW of renewable intermittent generation by 2030 which will require even stronger coordination between ourselves, the Distribution System Operator (DSO), and the Transmission System Operator (TSO). Part of this will be the use of sophisticated ICT platforms and flexibility to deliver secure, sustainable and cost effective energy to all our customers. To do this the TSO, EirGrid, requires support services from generation customers and from demand customers, most of whom are connected to the distribution system.



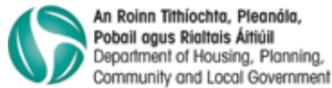
ESB Networks is already facilitating our customers to provide these services under EirGrid's "Delivering a Secure Sustainable Electricity System (DS3)" programme. The number of service providers on the distribution network is currently low but the requirements for flexibility, in the form of flexible generation, Demand Side Response (DSR) and energy storage, will see an increase in the amount of these service providers on the distribution network. In addition to active power management we are also working to facilitate provision of reactive power from the distribution system to the transmission system in response to network, customer and TSO requirements. This is being achieved by installing sophisticated control systems in existing HV substations and managing these systems from our Distribution Control Centres.

These challenges and opportunities will require us to work ever more closely with our flexibility and TSO partners to deliver appropriate solutions. The aim of this roadmap is to develop relationships, processes and tools that facilitate the development of a future zero carbon electrical energy system here in Ireland.

## ROADMAP PROJECTS



We have a large and diverse group of external partners and stakeholders and we believe that only through collaboration can we achieve our goals.



**We also work closely with:**

- Energy Suppliers
- Energy Generators
- Environmental Groups
- Charitable Organisations
- Local Authorities
- Academic Institutions

ESB Networks is committed to supporting Ireland's goal of becoming a low carbon economy. Our future electricity network will require innovative technologies and business models to engage customers in energy system planning and operation. This in turn drives challenges around the provision of advanced information communication systems, big data analytics and cyber security. We are also striving to provide greater flexibility in the type of services we provide to our customers.

We believe that through our innovation framework and resulting eight roadmaps we have set out a clear vision of how we intend to deliver a world class electricity network for the future. As we look to a brighter future powered by a smart electricity grid, we continue to serve our 2.3 million industrial, commercial and domestic electricity customers with pride.





NETWORKS

