Energy for generations

NET ZERO 2040 PATHWAY REPORT

Contents

March 2024

Executive Summary

The coming decades are critical to limiting the impacts of climate change. Already, we are living through the consequences of global warming, with extreme weather events and climate-related disasters occurring with increasing frequency. As a leading energy company driven by a strong commitment to serve society, ESB has aligned its strategy to deliver the urgent action required. By decarbonising our electricity system and using that clean power to replace fossil fuels in sectors such as heat and transport, the electricity system will be a key enabler of a zero-carbon energy system.

At ESB we have committed to reach net zero by 2040 – an ambitious and challenging target, which is ten years ahead of the legally binding Government targets for Ireland, Northern Ireland (NI) and Great Britain (GB). While aware of the risks and challenges involved in delivering this, we are working hard to make it happen, continuing ESB's long tradition of responsible leadership and delivery. That said, we recognise at the outset that this journey cannot be achieved by ESB in isolation – it will require mass adoption of existing and new technologies, and close collaboration with other industry participants, key stakeholders, Governments and their agencies.

This report presents ESB's roadmap to reach net zero by 2040, along with intermediate reduction targets and Strategic Performance Initiatives (SPIs) to realise our goal. It also sets out the initiatives being undertaken by ESB to support decarbonisation across society more broadly. To frame our 2040 roadmap in Ireland, where most of our emissions currently arise, we have drawn on whole-of-energy-system modelling by MaREI Research Institute, University College Cork (UCC). This modelling predicts that by 2050, Ireland has the potential to meet close to 70% of its final energy demand directly from electricity, while a further 10% or more will be met indirectly through the production of green hydrogen using renewable electricity.

Extensive investment is required to support fundamental changes in the energy system including:

- A six-fold increase in renewable generation investment, including grid infrastructure to support increased renewable generation, increased demand and greater demand flexibility. Short-term storage solutions including batteries and pumped hydro are important, as well as green hydrogen production and long-term energy storage and dispatchable zero carbon generation.
- Investment in energy efficiency and deep electrification of society, with available technologies such as electric heat pumps providing solutions for home heating and industrial processes as well as the electrification of most of Ireland's transport fleet.

ESB will soon publish a parallel report setting out its vision of a road map for Ireland to achieve a zero-carbon, secure and resilient electricity system by 2050, also based on the MaREI modelling outputs.

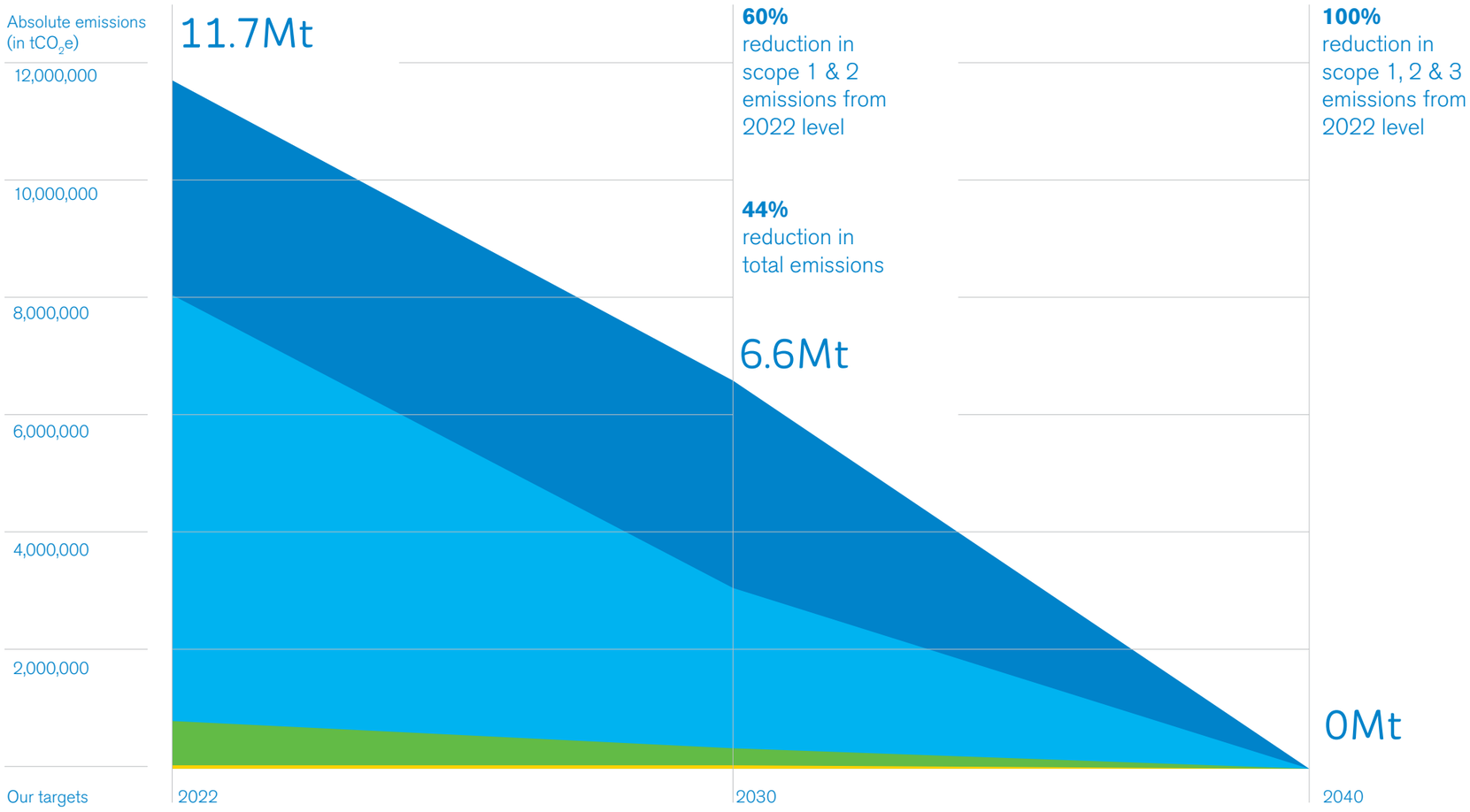
ESB's role in decarbonising society

At ESB, we recognise that through our own actions, we can enable society to reduce emissions far beyond the reaches of our own business. We rely on our customers to share our net zero vision and be partners in reaching this essential goal. The transition to net zero requires behavioural change at a large scale, and participating fully is no small ask for our customers. We are supporting them every step of the way, as they move to electric heating and transport, and transition to better insulated homes and businesses. We are undertaking several initiatives that enable our customers and wider society to reduce greenhouse gas (GHG) emissions.

- Our networks businesses are boosting low carbon technologies by connecting considerable amounts of large and small-scale renewable generation to the electricity network and facilitating the connection of heat pumps and electric vehicle charging infrastructure.
- ESB Networks is supporting the green transformation of homes and businesses through the national Smart Meter Programme in Ireland, to empower demand flexibility and greater utilisation of variable renewables. This will be bolstered by modernisation and digitisation of the network and measures to increase its resilience.
- Our generation business is building significant levels of new renewables, zero carbon-ready dispatchable generation and system services, supporting the wider decarbonisation of the electricity system.
- We are inspiring, empowering and supporting residential and business customers to achieve net zero. We are enabling consumers' move to electric forms of transport though our extensive public electric vehicle charging network, and by providing home, business and fleet charging solutions. We are empowering consumers to decarbonise the energy they use in their homes and businesses by offering energy efficiency improvements/retrofits, solar and heat pump deployment, smart time-of-use electricity tariffs and other low-carbon technologies. We are underpinning the deployment of technology solutions through our commitment to engaging and providing advice and support to consumers on their net zero journey.
- We engage in international R&D partnerships, leading innovation programmes, and strategic industry collaborations to bring forward new technologies and best practices and facilitate knowledge transfer into Ireland. Examples include our offshore wind partnerships with global experts (e.g. EDF, Orsted, Parkwind, Simply Blue), our participation in the Free Electrons programmes enabling knowledge transfer from hundreds of global start-ups, and knowledge sharing and partnerships with other global utilities (such as EDF, EON, Origin, EDP, American Electric Power, Hydro Quebec, China Light and Power). By participating in the Electric and Power Research Institute (EPRI), we are also engaged in the R&D and innovative development of net zero technologies, supporting technology transfer into Ireland.

We are and will remain at the forefront of this global transition, delivering the urgent action required to limit the drivers and impacts of climate change.

ESB's Net Zero Pathway



Increased Ambition 2028

ESB has also set an increased ambition target to achieve the 44% reduction by 2028, two years earlier than the above. This increased ambition is currently being assessed and will result in the updating of business plans over the next five years.

Executive Summary (continued)

ESB's Net Zero Pathway

Based on our most recent modelling and business plans, we expect to see, compared to 2022, a 60% reduction in our core Scope 1 and Scope 2 emissions by 2030 and a 44% total emissions reduction when taking Scope 3 emissions into account.

Across ESB, we are working towards our net zero goal through our strategy and business plans. We have examined our business activities to identify the source and scale of emissions so that we can fully eliminate GHGs by 2040 across our operations.

- We are progressively decarbonising the electricity we generate. By 2030 we aim to have 5GW of renewables connected to the electricity grid, comprising offshore wind, onshore wind, solar and hydro. Our generation portfolio will become more flexible as we grow our low-carbon system service capability through the buildout of batteries, flywheels and synchronous compensators. Over the next decade and beyond, our thermal fleet will burn ever less natural gas and will transition to green hydrogen to provide a back-up to the high levels of wind and solar. We will develop and build hydrogen storage facilities to provide a secure and resilient electricity system. We will cease coal generation at the Moneypoint power station in 2025.
- We are engaging with our suppliers to reduce supply chain emissions. Through the CDP Supply Chain initiative, ESB has contacted 60% of suppliers (by spend) in Ireland to understand their carbon footprint and decarbonisation plans. Through the initiative, we are encouraging our suppliers to move towards net zero in line with our own strategy.
- We have made great progress in electrifying our own transport fleet, starting with small and medium vehicles, and will move to electrifying larger vehicles as technologies mature. To improve the energy performance of our offices and sites, we are retrofitting our own buildings, including the opening of a new head office building in 2022 which has a heating requirement that is less than one tenth of industry norms in peer buildings.
- We are working with customers to decarbonise their energy requirements through initiatives such as Electric Ireland Superhomes, which provides a one-stop-shop solution for home retrofitting and heat pumps. Through the provision of smart tariffs, we are enabling customers to shift their energy consumption to times that help manage overall system demand and when costs are lower. ESB's Smart Energy Services and Electric Ireland work with larger commercial customers to reduce their energy use and to move to low carbon alternatives. ESB ecars has developed and operates the largest EV charging network across Ireland and is expanding and improving both network reliability and the number of charging hubs and high powered >150kW chargers – providing customers with greater convenience and faster charging times.
- As a dual fuel retailer, in addition to supplying electricity, we supply natural gas to more than half a million customers (between Ireland and the UK) with this number expected to increase (through customer growth in GB) by 2030. This would result in higher Scope 3 emissions for ESB even though the growth would primarily arise from acquiring customers with existing gas supply. We are working with customers to help transition their energy usage and emissions over time to net zero, through the provision of energy efficiency improvements and electric and other zero carbon heating solutions.

The investment required to deliver our net zero target will be significant. ESB is rated A- (BBB+ on a standalone basis) and A3 (Baa1 on a standalone basis) with S&P Global Ratings and Moody's respectively as of December 2023, and it is our intention to maintain our credit rating of BBB+/Baa1 on a standalone basis out to 2040.

Achieving net zero requires a whole-system approach. Support of all stakeholders is essential to reach our ambitious goals, underpinned by clear and bold policy from governments and implemented through adaptive, stable, and supportive regulation.

Risks to ESB's Net Zero Pathway

We have set ourselves a very ambitious target for 2040, but we do recognise that significant risks are present across our emissions landscape. We track and monitor these risks at Group level and implement mitigations as soon as it is feasible to do so.

Our generation emissions will reduce as additional renewables and zero carbon system services are added to the electricity system. It is important to note that ESB's generation emissions will be driven by the levels of running on our fossil fuelled thermal units which will be influenced by our renewables rollout and the building out of renewables by others (including contracted plants under the Irish offshore wind auction ORESS1). We are cognisant of the risk that delays in adding new renewables to the electricity system would impact on the quantum of fossil fuelled generation and emissions in the years to 2030 and to 2040. This risk is not within our control, but we will do all we can to support and encourage the achievement of Ireland's renewable targets.

We also recognise that a significant risk for 2040 lies in our Scope 3 emissions, those mainly associated with the upstream and downstream emissions of the fossil fuels we buy in wholesale markets and sell to end use customers. As explained within the report, short of exiting retail markets, we cannot easily control the downstream emissions, since they relate to gas usage by our customers and are linked to Irish and UK Government decarbonisation pathways for heating. For that reason, we recognise at the outset that there are significant challenges to eliminating these Scope 3 emissions by 2040, but we remain committed to bringing this customer base with us on the journey to net zero. We will reassess our emissions targets as part of our business planning cycle, and as policy and technology options such as hydrogen, biogas and district heat mature further and can complement our heat pump strategy.

About ESB

ESB is Ireland's leading energy utility with operations spanning electricity generation, transmission and distribution, energy supply, energy services and international consultancy. ESB operates in Ireland, Northern Ireland (NI) and Great Britain (GB). Since 1927, we have worked to bring light and energy to communities in Ireland and around the world, creating a brighter future for all. We are driven to make a difference, using our unique position as a vertically integrated utility to bring about a sustainable energy future powered by electricity. Our strategic commitment is to achieve net zero emissions by 2040. Through our portfolio of brands and JV partnerships, including ESB, ESB Networks, Electric Ireland, SO Energy, SIRO, ESB ecars, ESB's Smart Energy Services, Electric Ireland Superhomes, FuturEnergy, ESB International and Northern Ireland Electricity Networks, we are removing carbon from electricity generation, creating smarter networks capable of supporting massive growth in renewable generation, promoting electric vehicles and heat pumps to displace carbon in transport and heating, and developing customer-led solutions that will empower society to live more efficiently and sustainably.

With a shareholding of 97%, the Irish Government is our largest shareholder. All of our profits are reinvested in assets required to deliver a secure, sustainable electricity system, to paydown debt or to provide dividends to our shareholder. We currently invest over one billion euros each year to enable a secure path to net zero.

www.esb.ie

1. Introduction

1.1 Climate science and the global response

Today, the dire consequences of human-induced greenhouse gas (GHG) emissions are evident. The global surface temperature is increasing at an unprecedented rate with 2023 being the warmest year on record. We have observed a 1.09°C increase globally already in the 2011–2020-year period compared to 1850–1900[1] and extreme weather events are occurring much more frequently around the globe. The coming decades are critical to limiting the impact of climate change.

Global responses to climate change are accelerating. Internationally, 196 countries pledged in 2015 as part of the Paris Agreement[2] to hold the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels[3] . To reach this goal, the Intergovernmental Panel on Climate Change (IPCC) emphasises that global GHG emissions must peak before 2025[4]. The IPCC recognises that reducing GHG emissions across the full energy sector requires major transitions, including a substantial reduction in overall use of fossil fuels, the deployment of low-emission energy sources, switching to alternative energy carriers (such as sustainable biofuels, low-emission hydrogen), and energy efficiency[5] .

Climate Action Tracker[6] collaboratively collects data across several international research institutes to regularly publish updated predictions about the impact of national climate policy on future global warming. Figure 1 illustrates the predicted effect of two scenarios for ambitions by governments:

- The current 'Policies & action' projection is based on business-as-usual existing government policy. This projection shows a 2.6-2.9°C warming above pre-industrial levels by 2100.
- The more ambitious current 'Pledges and targets' projection includes specific targets such as the UK's and Ireland's (as a part of EU) 2050 net zero target.

Figure 1 shows that even the commitments that have been announced and taken on by Governments are not enough to reach the 1.5°C compatible projection – making it imperative that companies take a leadership role in aligning their climate targets with the 1.5°C goal. At ESB, we are actively taking on this responsibility.

What does 'net zero' mean?

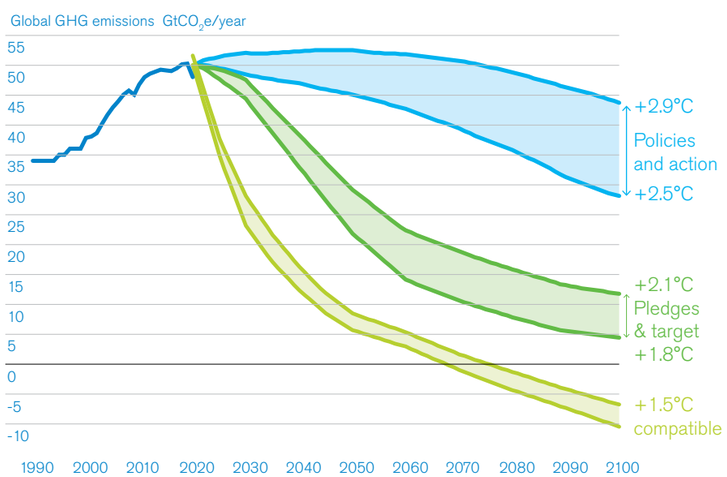
Net zero is defined by the UNFCCC Secretariat as the state where "a balance between anthropogenic GHG emissions (emissions associated with human activities) and removals is achieved[8]. This can be accomplished by ambitiously reducing and avoiding emissions in the first instance, and then implementing verified solutions to remove carbon equivalent to residual emissions.

What does 'net zero' mean to ESB?

For ESB, net zero means:

- Reducing carbon emissions from electricity generation to zero or as close to zero as practicable,
- Driving all other direct emissions (vehicle fleets and heating emissions) towards zero,
- Working through our business activities, together with our strategic and supply chain partners, to reduce our indirect emissions to or towards zero, and
- Dealing with any remaining residual emissions (maximum 10% of total baseline emissions) using a credible offset mechanism.

Figure 1 - 2100 warming projections – Emissions and expected warming based on pledges and current policies[7]



1 A.1.2, Climate Change 2021: The Physical Science Basis, Summary for Policymakers, IPCC, 2021, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf
2 Paris Agreement, United Nations, Framework Convention on Climate Change, 2015, https://unfccc.int/sites/default/files/english_paris_agreement.pdf
3 The Paris Agreement recognised that limiting the global average temperature increase to 1.5°C above pre-industrial levels would significantly reduce the risks and impacts of climate change.
4 C.1, Climate Change 2022 Mitigation of Climate Change, Summary for Policymakers, IPCC, 2022, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf
5 C.4, Climate Change 2022 Mitigation of Climate Change, Summary for Policymakers, IPCC, 2022, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf
6 Independent scientific analysis that tracks government (39 countries and the EU) climate action.
7 Climate Action Tracker, Temperatures, 2021: https://climateactiontracker.org/global/temperatures/

1.2 Energy policy in ESB's core markets

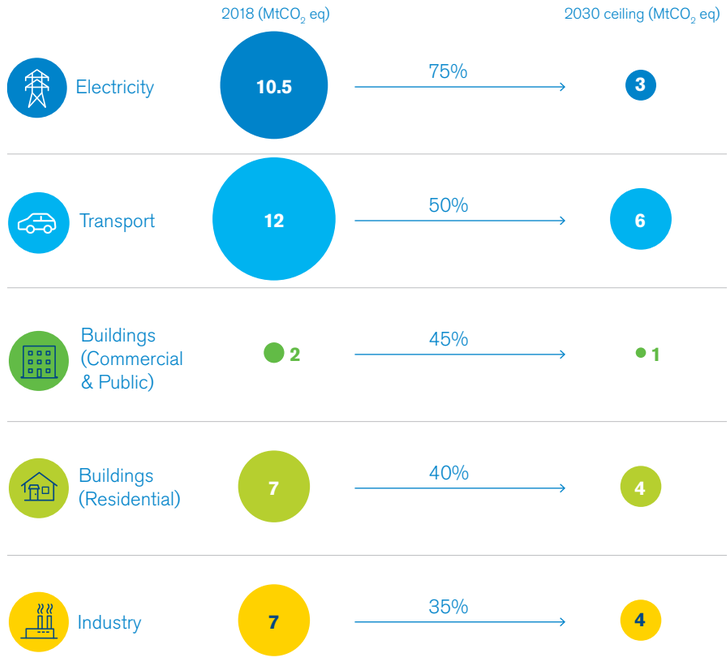
ESB operates in Ireland, Northern Ireland (NI) and Great Britain (GB). All three jurisdictions are legally committed to net zero by 2050 and have broadly aligned energy policies but differ as regards specific targets and the means of achieving them. In 2020, the EU launched the European Green Deal with the new, more ambitious net GHG emissions reduction target of at least 55% by 2030 (compared to 1990 levels)[9]. In all our operating areas, we are taking actions to support the achievement of the specific targets for the energy sector.

1.2.1 Ireland

Ireland has a 2050 net zero target. The Climate Action and Low Carbon Development (Amendment) Act 2021 (the Climate Act) sets out Ireland's national climate objective, which commits to a net zero emission target for 2050, binding five-year carbon budgets, sectoral emissions targets, the establishment of a Climate Change Advisory Council (CCAC) and a regularly updated Climate Action Plan. The most recent Climate Action Plan[10] provides a detailed roadmap to achieve a 51% reduction in overall GHG emissions from 2021 to 2030, putting Ireland on a trajectory to reach net zero by no later than 2050.

The sectoral emissions ceilings for 2030 for the key energy sectors are shown in Figure 2.

Figure 2 Ireland's sectoral emissions ceilings[11]



8 https://unfccc.int/sites/default/files/resource/CNN%20Guidelines.pdf
9 The European Green Deal - European Commission (europa.eu)
10 Climate Action Plan 2024, Government of Ireland, gov.ie - Climate Action Plan 2024 (www.gov.ie)
11 Government announces sectoral emissions ceilings, setting Ireland on a pathway to turn the tide on climate change, Department of the Taoiseach, 28 July 2022, https://www.gov.ie/en/press-release/dab6d-government-announces-sectoral-emissions-ceilings-setting-ireland-on-a-pathway-to-turn-the-tide-on-climate-change/

The 2024 Climate Action Plan highlights the significant challenges in meeting 2030 targets, citing projections from the Environmental Protection Agency (EPA). The EPA projects that Ireland will achieve a reduction of 29% in GHG emissions by 2030 compared to a target of 51%, and that almost all sectors are on a trajectory to exceed their national sectoral emissions ceilings for 2025 and 2030.

1.2 Energy policy in ESB's core markets (continued)

Ireland has one of the highest levels of penetration of wind energy in the world for a system of its size and type[12] . And the electricity sector is expected to further deliver the greatest emissions reduction this decade – driven by a rapid expansion of wind and solar generation and flexibility services, supported by increasingly decarbonised back-up generation and long duration storage. Measures to enable the achievement of the emissions ceilings by 2030 in the electricity sector are set out in Table 1.

Table 1 Ireland's 2030 targets

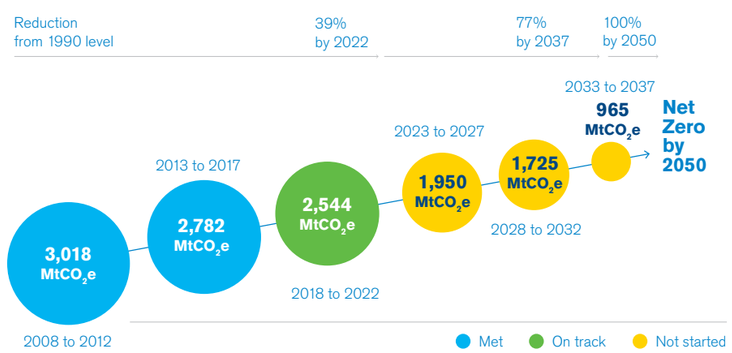
	2030 targets
Renewables	Fulfil up to 80% of demand obtained from: offshore wind: at least 5GW onshore wind: 9GW Solar: 8GW
Security of supply	Build at least 2GW of new flexible gas-fired power stations. 2GW of offshore wind in development for dedicated hydrogen production Zero-emission gas-fired generation from biomethane and hydrogen commencing by 2030
Interconnection	Build 3 new grid connections with Northern Ireland, GB and France
Demand	Make 20-30% of demand flexible. Electrification of demand: 400,000 heat pumps in existing homes and 280,000 heat pumps in new homes Required additional long-term storage (4 hour plus) in place
Transport	Deploy more than 940,000 electric vehicles

1.2.2 United Kingdom

Through the Climate Change Act, the United Kingdom became the first major economy to legislate for net zero by 2050. The act provides for a 'carbon budget' system which caps GHG emissions over five-year periods. The Climate Change Committee[13] (CCC) regularly reports on the carbon budgets and advises the government on climate strategies. In the Net Zero Strategy, the UK power sector has been set a target of reaching net zero by 2035, requiring greater efforts from the electricity industry[14]. Continuing to be a frontrunner in onshore and offshore wind, the UK has close to 30GW of wind generation capacity and more than 15GW of solar generation capacity. The UK Government also released the British Energy Security Strategy in April 2022, which outlined an increased ambition for a total of 50GW of offshore wind capacity by 2030 and emphasised the decarbonisation ambitions of the energy sector. The 2023 Net Zero Growth Plan[15] set out an update to the existing strategies, focusing on the scale up and deployment of technologies for decarbonising homes, power, industry and transport.

The CCC provides an annual assessment on whether the UK is on track to meet its carbon budgets – the first two budgets have been met, the third is on track to outperform, and the fourth, fifth and sixth are off track. The last three carbon budgets have been decided in the context of the required path to net zero by 2050.[16] In their 2023 Progress Report to Parliament, the CCC highlighted a lack of urgency in climate action and a risk of stepping back from existing climate action commitments as being key risks to reaching net zero in the UK.

Figure 3 Tracking progress of legislated carbon budgets under the Climate Change Act 2008 by the CCC (*available here*)

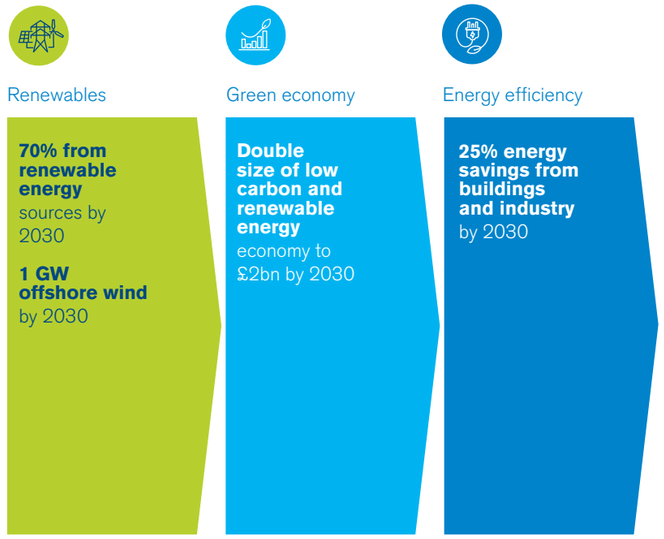


12 Ireland now number one in the world for onshore wind energy (windenergyireland.com)
13 https://www.theccc.org.uk/
14 Net Zero Strategy: Build Back Greener, UK Government, October 2021, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf
15 Powering Up Britain: Net Zero Growth Plan - GOV.UK (www.gov.uk)
16 https://www.theccc.org.uk/about/our-expertise/advice-on-reducing-the-uks-emissions/

1.2.3 Northern Ireland

Northern Ireland is bound by the UK's wider net zero commitment and has passed its own Climate Change Act. In 2021, the Northern Ireland Executive announced its *Path to Net Zero Energy*[17] which outlines a roadmap to achieve a 56% reduction in energy-related emissions by 2030, on the path to deliver its 2050 vision of net zero carbon and affordable energy. The action plan focuses on the three strategic pillars of renewables, green economy and energy efficiency. The plan and subsequent legislation are more developed for electricity decarbonisation than for heat and transport, and aims to achieve at least 80% of electricity consumption from diverse renewable sources including onshore wind and solar by 2030. The plan seeks to realise 25% energy savings from buildings and industry by 2030 and aims to develop an action plan for 1GW of offshore wind from 2030. A multi-decade Green Growth Strategy[18] will also be developed. This will be delivered through a series of Climate Action Plans, which will set out the actions to meet sector specific GHG emission targets. Important decisions are required to progress climate action in Northern Ireland. There have been consultations on the design of support schemes and the framework of offshore wind, but timely implementation is required to achieve the ambitious targets set.

Figure 4 Northern Ireland's net zero strategy targets



17 Path to Net Zero Energy, Northern Ireland Executive 2021: https://www.economy-ni.gov.uk/sites/default/files/publications/economy/energy-strategy-path-to-net-zero-action-plan.pdf
18 Green Growth Strategy, Northern Ireland Executive: https://www.daera-ni.gov.uk/articles/green-growth-strategy-northern-ireland-balancing-our-climate-environment-and-economy

1.3 ESB's net zero commitment

In ESB, we have a pivotal role to play in the decarbonisation of society. Our 2017 Brighter Future strategy placed leadership in tackling climate change at its core. In February 2022, given the increasing and urgent need for action, we launched our 2040 Strategy – Driven to Make a Difference: Net Zero by 2040. This aligns with Ireland and United Kingdom Government policy which targets net zero across the entire economies by 2050.

Our people play a critical role in delivering our purpose and strategy in line with our values. We are creating an environment that encourages creativity, commitment and ongoing learning through a safe, people-centric and inclusive experience. This underpins a high-performance, innovative, sustainable, and customer-focused culture. We are supporting this through a leadership capability that is inspiring, adaptive, empathetic and curious, and through an agile and efficient organisational design that can meet the changing needs of our customers and the business.

Our strategy is purpose led and built around three strategic objectives, underpinned by four key foundational capabilities, all of which are guided by our values.

Figure 5 ESB's Net Zero Strategic Framework

Purpose

At ESB, we're driven to make a difference. Delivering a brighter future; creating and connecting sustainable, reliable, affordable energy and supporting the customers and communities we serve to achieve net zero.

Strategic Objectives

Decarbonised Electricity
Develop and connect renewables to decarbonise the electricity system by 2040

Resilient Infrastructure
Provide resilient infrastructure for a reliable low-carbon electricity system

Empowered Customers
Empower, enable and support customers and communities to achieve net zero

Foundational Capabilities

Our People
Ensure we have the people capability to deliver our strategic objectives with a strong values-based and inclusive culture

Digital & Data Driven
Leveraging data and technology, transform ESB to a data driven digital utility

Financial Strength
Maintain the financial performance and strength required to deliver our purpose

Sustainable & Socially Responsible
Step forward on social and environmental responsibility, cultivating a safe, sound and sustainable ethos in line with our values

Our Values

WE'RE COURAGEOUS **WE'RE CARING** **WE'RE DRIVEN** **WE'RE TRUSTED**

We have developed a set of Strategic Performance Indicators (SPIs) and success metrics to ensure transparency and accountability in the delivery of our strategy. These include financial and non-financial metrics that track our progress in achieving strategic objectives and foundational capabilities. ESB took initial steps to set a Science Based Target through the Science Based Targets initiative (SBTi). Several factors have become clear since then that have resulted in ESB not being able, at this time, to achieve SBTi certification. This is discussed further in Section 4.7.

We are publishing this ESB 2040 Net Zero Pathway Report to demonstrate to stakeholders that we have a credible pathway to reducing emissions, including near-term goals to measure progress towards that 2040 ambition.

To maximise transparency, we will publish target and outturn values for key SPIs in our Annual Report, our Sustainability Report and this Net Zero Pathway Report.

Our strategy includes Sustainable and Socially Responsible as one of four foundational capabilities underpinning our strategic objectives. This report is climate focused and sets out our plans to reduce our GHG emissions to net zero by 2040. We also report on broader sustainability initiatives through our sustainability report and will publish a Sustainability Leadership Plan in 2024.

1.4 How ESB measures its carbon footprint

ESB has publicly reported on its greenhouse gas emissions since 2009[19], in line with the Greenhouse Gas Protocol methodology[20] namely:

Scope 1 – direct emissions from ESB-owned or controlled assets;

Scope 2 – indirect emissions from purchased energy used in ESB operations and electricity losses on the transmission and distribution systems; and

Scope 3 – indirect emissions - both upstream and downstream - in ESB's value chain from assets not owned or controlled by ESB.

The baseline year chosen for reporting progress on our net zero target is 2022.

Scope 1

Our Scope 1 emissions are assessed within an annual calculation process undertaken by an independent third-party verifier, as part of our emissions data submission to the EU ETS and local environmental agencies. Direct (Scope 1) GHG emissions are reported on an equity share basis for thermal assets. Emissions from buildings and vehicles are calculated based on fossil fuel consumption.

Scope 2

Scope 2 emissions associated with electricity networks transmission and distribution losses are calculated using the location-based method. The location-based rate is derived from the SEAI rate for electricity in Ireland; for NI the DEFRA factor is used.

Scope 3

During 2021, we extended the collection and estimation of Scope 3 emissions sources to all applicable Scope 3 categories. Emissions inventories are estimated using a combination of calculation methods outlined in the Scope 3 GHG Protocol Guidance. We utilise tools and methodologies as recommended by the GHG Protocol, DEFRA, Ecoinvent and SEAI to screen and calculate emissions.

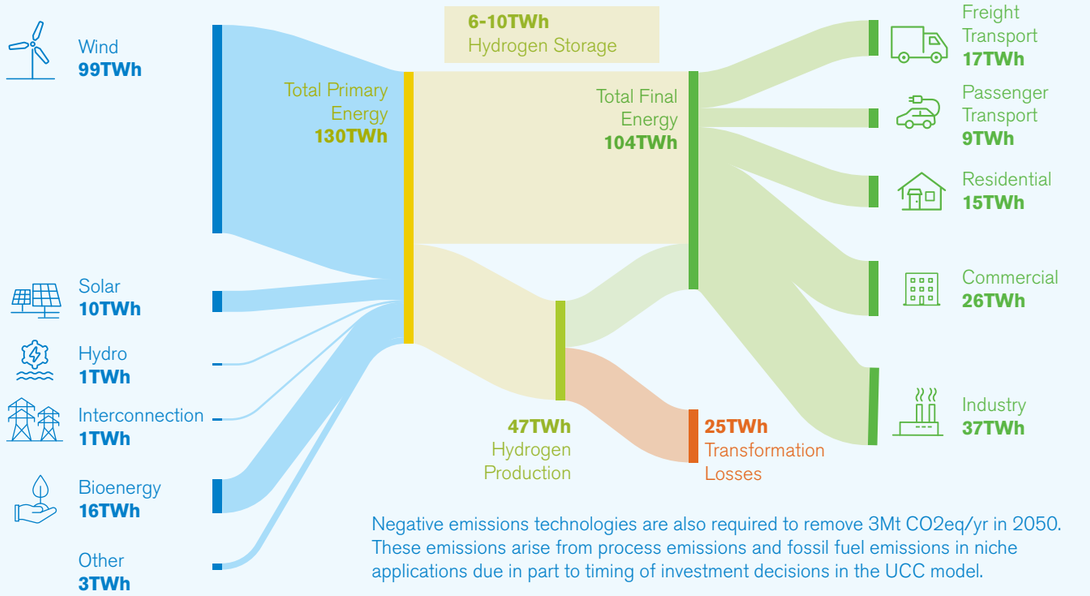
19 All Scope 1, 2 & 3 emissions are subject to annual independent third-party verification, via the EU ETS and ISO14064.
20 https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

2. ESB's vision for a 2050 net zero energy system in Ireland

Across global energy systems, a universal pathway to net zero energy systems is emerging, which relies on energy efficiency to reduce energy demand, deep electrification to switch from fossil fuels, and decarbonisation of electricity generation. It is broadly expected that the net zero transition for Ireland will also follow this pathway. The Irish Government's Climate Action Plan is putting in place the foundations for this reimagined energy system.

ESB's strategy is to reduce our net emissions to zero by 2040. It is important that we frame this commitment within Ireland's broader net zero target which is for 2050. To frame ESB's 2040 net zero pathway in Ireland, we engaged the MaREI Research Institute, University College Cork (UCC) to model Ireland's 2050 energy system[21]. We have augmented the MaREI modelling with ESB's own analysis of energy storage requirements for a resilient electricity system. MaREI's modelling shows that Ireland can deliver a resilient, secure and highly electrified energy system with greatly increased energy independence compared to the current energy system. Figure 6 shows the energy inputs and outputs for the 2050 energy system as modelled by MaREI.

Figure 6 Ireland's energy system in 2050[22]



Negative emissions technologies are also required to remove 3Mt CO2eq/yr in 2050. These emissions arise from process emissions and fossil fuel emissions in niche applications due in part to timing of investment decisions in the UCC model.

MaREI's modelling demonstrates potential for close to 70% of final energy needs to be met directly by electricity in 2050, up from around 20% today. More than 10% of final energy demand can be met indirectly by electricity through the production and use of hydrogen with the remainder coming from sources such as bioenergy. MaREI's modelling also shows that electrification will do much of the initial heavy lifting towards decarbonisation in Ireland, and that electrification should happen as early as possible on the pathway to 2050 with much of it happening by 2040.

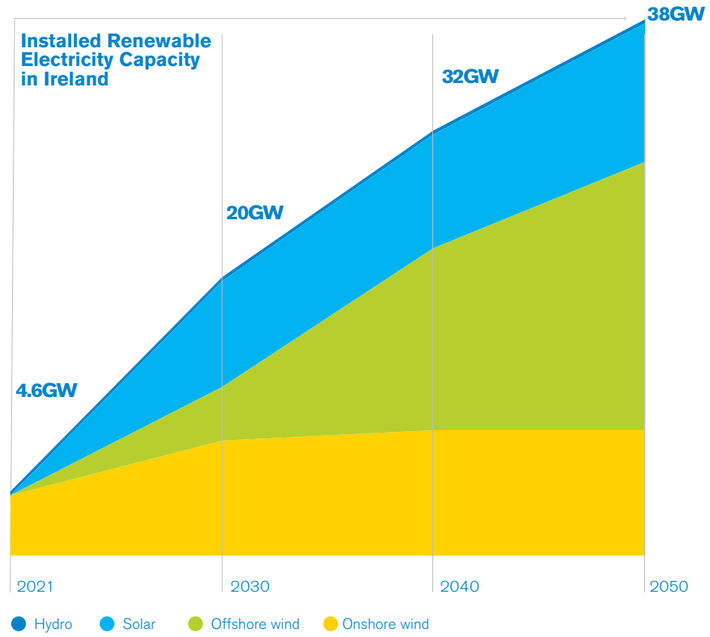
The following sections contain a sector-by-sector review of the MaREI modelling and 2050 analysis.

21 MaREI modelling was completed using the TIM Model – detailed model documentation is available here.
22 The modelling has not taken international shipping or international aviation into account. Where new demands for hydrogen or its derivatives arise in these sectors, it would represent new demand and require additional offshore wind, hydrogen production etc.

2.1 Electricity production

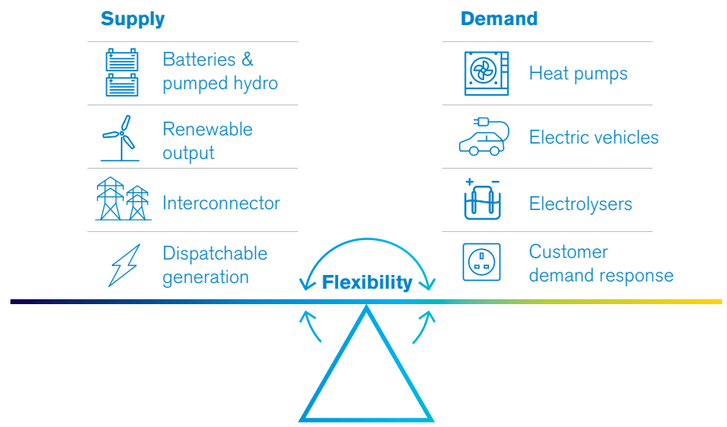
The MaREI analysis shows that electricity demand in Ireland in 2050 will be more than two and a half times greater than today, that all electricity generated will come from renewable sources and that Ireland will achieve a zero-carbon electricity system by 2040 ahead of a wider system net zero in 2050. Wind will be the main source of electricity, accompanied by solar, hydro and interconnector transfers. In the MaREI 2050 model, Ireland's electricity needs will be met by up to 19GW of offshore wind, up to 9GW of onshore wind, and 10GW of solar. Today, Ireland has over 5GW of renewables connected to the electricity grid. Transitioning to a zero-carbon electricity system presents many challenges, including planning and permitting, market design and the overall levels of investment required. ESB will examine these challenges in the soon to be published "Ireland's roadmap to a net zero energy system."

Figure 7 Evolution of Ireland's renewable mix until 2050



Flexibility will play a crucial part in the zero-carbon electricity system, balancing times of excess wind and solar output with customer demand preferences. Demand will behave differently than it does today, as electric vehicles are encouraged to charge at times of high wind and heat pumps look to operate in ways which maximise the use of renewable electricity. Batteries in homes and cars and at utility scale will provide short-term storage, as will pumped hydro and other emerging technologies. This will be supported by interconnectors with Great Britain and France and longer-duration hydrogen storage.

Figure 8 Flexibility in the electricity system

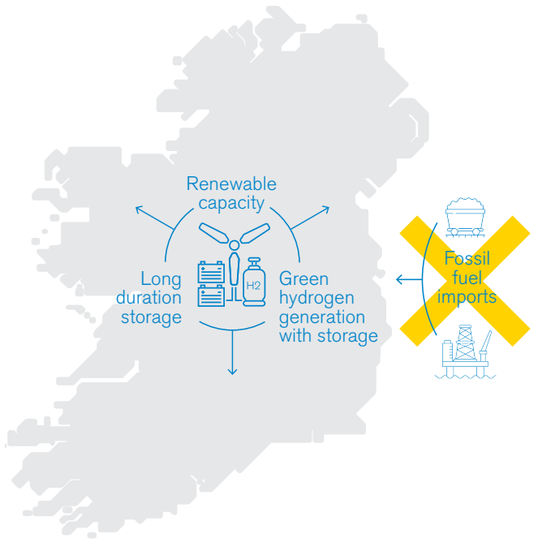


2.2 Resilience and energy security

The coming decades will see electricity become the only energy source for most households and businesses compared to today, where people use a mix of electricity, gas, oil, LPG, peat and solid fuels. Therefore, the transition to a net zero power system must go hand in hand with delivering a much more resilient electricity system than we have today. There are significant challenges and opportunities associated with this:

- Ireland will no longer import fossil fuels but rather produce much of our energy from our own renewable resources. Significant dispatchable capacity will still be required but it will run infrequently and will be powered by green hydrogen produced from renewable electricity sources.
- Long-duration renewable energy storage will be a new dimension in our energy system, with very large volumes of hydrogen stored in underground facilities. ESB analysis, complimented by MaREI modelling, suggests that the energy system will need 6-10TWh[23] [24] of hydrogen storage to ensure energy demand can be met in years to come with prolonged periods of low wind such as winter 2010/11. Additional offshore wind will also be required to ensure that there is sufficient hydrogen in storage for stress events. The level required will depend on multiple factors but is likely to be more than 4GW additional to the capacity required in Section 2.1.
- There will be a much-increased reliance on the electricity networks in the future and the number and duration of outages will need to be minimised. The network companies already have plans in place to increase the resilience of the network in areas such as cybersecurity, climate change adaptation, storm recovery and post-fault restoration.

Figure 9 Resilience of Irish energy system



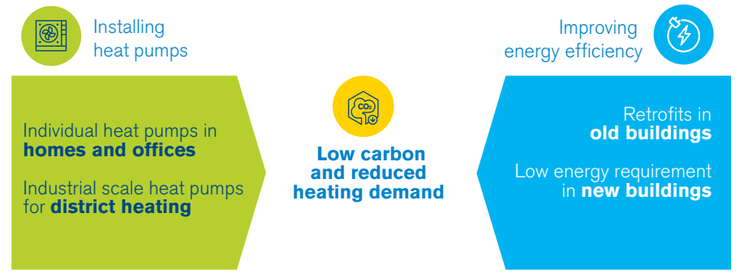
23 These numbers are influenced by the levels of interconnection, flexibility of electricity demand and applied factors of safety.
24 The former Kinsale Gas field off Ireland's south coast would store 5TWh of hydrogen.

2.3 Residential and commercial heating

It is expected that heat pumps will be the cheapest low carbon heating solution for homes and businesses in 2040[25]. With the right mix of policy choices and implementation decisions to phase out oil- and gas-fired heating, Ireland will see a predominantly electrified heating system in 2050; already more than 90% of new homes in Ireland are installing electric heating. Much of this will be individual heat pumps in homes and offices but there is potential to use industrial scale heat pumps for district heating applications. This position is in line with Government's policy for domestic and commercial heating as articulated in the 2023 Climate Action Plan[26] .

Improved energy efficiency will play a significant role in heat decarbonisation. New buildings will be constructed to meet stringent efficiency standards, while older buildings with poor energy performance will require retrofits. A notable portion of the existing housing stock can already start installing heat pumps now with low levels of efficiency measures required.

Figure 10 Twin pillars of low carbon heating solutions



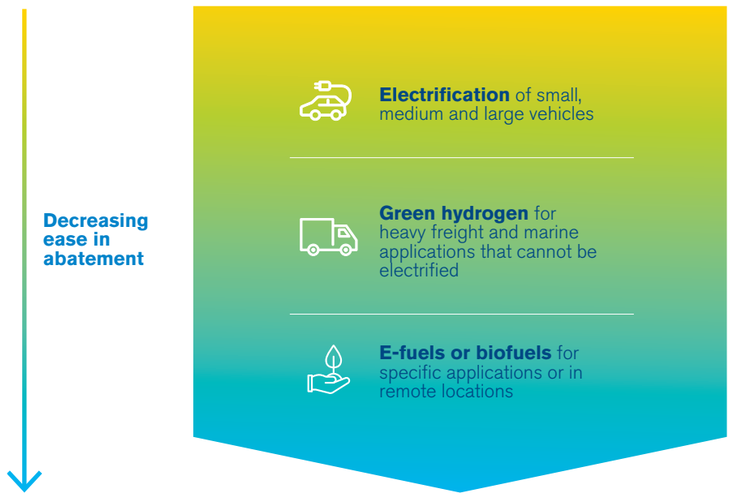
As a case in point for low carbon heating, ESB's new headquarters, opened in 2022, shows the future of zero carbon buildings and is the most efficient building of its kind in Ireland, having obtained a BREEAM Excellent certificate for its holistic approach to sustainability. The building has no fossil fuel heating and utilises geothermal energy, heat pumps, and solar PV.

25 Goodbye gas: heat pumps will be the cheapest green heating option for consumers (beuc.eu)
26 Climate Action plan 2023 – Page 162.

2.4 Transport

Transport accounts for around 35% of Ireland's energy emissions, mainly from petrol and diesel road vehicles. With the right policy choices and driven by offerings from vehicle manufacturers, electricity will provide 75% or more of the energy requirements for transport in 2050. All but the heaviest and more niche application vehicles will be electrified in line with global policy and manufacturer trends; a clearer picture will emerge in this decade as to what applications can be directly electrified. Where direct electrification cannot be employed, green hydrogen, either directly or more likely through derivatives such as methanol or ammonia, would likely play a role in heavy freight and marine applications. Green hydrogen or its derivatives should also play a role in aviation or shipping[27]. Other solutions such as biofuels could also play a niche role in very specific applications, such as aviation or in reaching remote locations.

Figure 11 Low carbon transition of various transport types

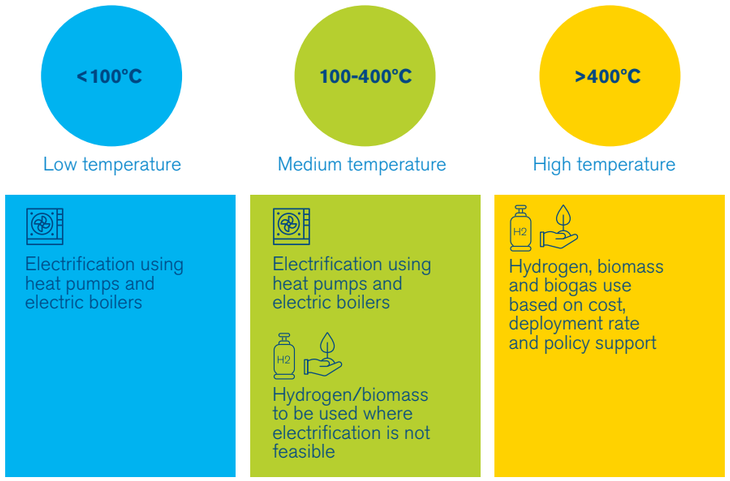


27 The modelling has not taken international shipping or international aviation into account. Where new demands for hydrogen or its derivatives arise in these sectors, it would represent new demand and require additional offshore wind, hydrogen production etc.

2.5 Industrial heat

Decarbonisation in industry is a significant challenge but can be achieved through a range of technologies and fuels. Electrification will feature prominently as temperatures achievable with heat pumps exceed 200^{0}C and technologies such as electric boilers are further deployed[28]. Hydrogen, biogas, and biomass will feature in very high temperature applications. The final share of each technology will depend on policy decisions, deployment rates, and cost. For example, the bioenergy solutions could be subject to resource constraints which will further limit their availability.

Figure 12 Decarbonisation technologies used across various temperature ranges in industrial applications



2.6 Residual GHG emissions

The MaREI modelling shows that even with significant amounts of renewable energy, energy efficiency and electrification, Ireland will still have some energy residual GHG emissions. These will arise in niche areas where fossil fuel use can't be avoided, potentially in the process emissions from cement production, and emissions from waste. Therefore, to achieve a net zero energy system in Ireland, some carbon removal technologies will be required to take carbon dioxide from the atmosphere and store it.

Globally, carbon capture and negative emission technologies will be important to limit global temperature rises. Our Emerging Technology and R&D teams are researching the potential uses and development of several carbon capture solutions and technologies which are currently in various stages of development[29] . Bioenergy Carbon Capture and Storage (BECCS) uses renewable biomass to create electricity and heat and captures the carbon dioxide produced, resulting in a negative carbon balance. Direct Air Carbon Capture (DACC) uses large scale fans to push air through a filter, capturing and removing the carbon dioxide already in the atmosphere. Biochar, which can be made from a wide variety of biomass, offers the potential to capture carbon and enhance soil, improving the soil's carbon content and providing habitats for beneficial microbiology. Research is also ongoing into many nature-based carbon capture solutions involving use of the land and the oceans.

Residual emissions represent the last kilometre of decarbonisation and are very important. However, there is a still a degree of uncertainty over both the quantity of residual emissions and the most effective technology for their removal, and work is ongoing at international level to define a detailed and robust removal strategy.

28 See further detail in ESB Leading Lights Paper on Industrial Heat Pumps - ESB Leading Lights
29 ESB's Emerging Technology Insights 2023 Report is available here

3. ESB's role in the broader societal enablement of net zero

ESB Group businesses and partnerships will play a critical role in decarbonising the energy emissions of broader society. The networks businesses (ESB Networks and NIE Networks) will be at the forefront of this when connecting renewables and new demand, but other businesses such as generation and customer solutions will also be important. This report contains two sets of SPIs which address our progress in supporting wider societal enablement and our own carbon emission reductions. In this section we first set out our broader enablement SPIs, and then the key Enabling Actions to be undertaken across the Group to enable this broader decarbonisation of society.

3.1 Measuring our progress – SPIs

To ensure we deliver on our commitment to achieve net zero GHG emissions by 2040 we have produced a set of SPIs to measure and monitor our broader societal enablement progress to 2030. These SPIs align with our Enabling Actions outlined in Table 2 and will be updated annually to track our progress.

Table 2 List of Enabling Actions SPIs

SPI		Metric	2022 (Actual)	2030 (Target)
1	**Scale of zero carbon electricity enabled by our networks**	RES connected to transmission and distribution networks (GW)	5.4GW in Ireland 1.8GW in NI	>22GW in Ireland >2.6GW in NI
2	**Number of smart meters installed (ESBN)**	#	1.1m	2.6m
3	**Number of low carbon technology devices connected to our networks (ESBN and NIEN)**	Electric vehicles # Heat pumps #	82k 72k	1.3m 800k
4	**Share of system demand on distribution networks that is flexible**	%	0.06%	20-30% in Ireland
5	**Electrification of transport network: public EV chargers**	Public EV chargers installed # (Ireland, NI & GB)	800 in total (40 high speed)	3,000 in total (1000 high-speed)
	Electrification of public transport: EV buses	EV buses #	16	1500 EV buses and rail electrification
6	**Customer satisfaction**	%	70-82%	>85%

3.2 Boosting low carbon technologies on our electricity networks

Enabling Action 1: ESB Networks and NIE Networks to enable renewable generation connections to fulfil up to 80% of electricity demand and additional connections thereafter (SPI 1)

Our networks businesses will connect significant renewable generation capacity in accordance with government and regulatory targets and policies. They will also enable the vast number of small-scale renewable generation connections to the distribution grid in line with customer requirements and government policies.

- In Ireland, ESB Networks will connect up to 4GW of new additional onshore wind projects and 8GW of solar as required under the Irish Government's Climate Action Plan by 2030. They will also facilitate the connection of up to 7GW of offshore wind to the onshore transmission network. This is dependent on sufficient projects being developed. ESB Networks in conjunction with EirGrid are piloting Renewable Hubs in five locations as a method of decreasing connection time for renewable generators as well as giving increased certainty in connection pricing.
- In Northern Ireland, per the Generation Capacity Statement[30], NIE Networks will connect more than 1.2GW of large-scale wind generation, most of which will be onshore. They will also connect close to 400MW of solar generation.

The two networks businesses will also develop the distribution systems to ensure that the networks are ready for very high levels of electrification and that customer requests for connections are met in a timely manner.

- ESB Networks is developing an anticipatory investment process for the distribution networks to enable 2040 electrification by developing policies which involve "touching the asset once".
- NIE Networks, through its price control process (RP7), has proposed a comprehensive programme of investment which will provide households and businesses with the infrastructure that will allow them to make use of new greener technologies.

30 EirGrid_SONI_2022_Generation_Capacity_Statement_2022-2031.pdf

3.2 Boosting low carbon technologies on our electricity networks (continued)

Enabling Action 2: Enabling electrification and flexibility markets for net zero (SPI 3 & 4)

High levels of variable renewables and significant additions of new demand such as heat pumps and electric vehicles create new challenges and opportunities in terms of system management. ESB Networks and NIE Networks will play central roles here and will enable customer participation in flexibility markets on the distribution system, to support their own decarbonisation and that of the wider energy system.

- In Ireland, ESB Networks has established the National Network, Local Connections Programme. This is creating new opportunities for customers to use and store electricity locally in a way that makes the best use of renewable energy sources. ESB Networks plans to redesign and optimise the electricity network to support renewables, customers, and community participation in providing greater flexibility.
- In Northern Ireland, NIE Networks plans to facilitate net zero through a four-step approach: namely extensive modelling and forecasting, greater monitoring, flexibility first, and touch the network once. This approach is being developed as part of the ongoing price control RP7.

ESB Networks is committed to enabling the customer on their low carbon technology (LCT) adoption journey. They have already introduced revised standards for the design of new low voltage (LV) networks, more than doubling the allocated capacity in new-build housing developments, to accommodate the requirements of these customers with respect to electrification. Approximately 50,000 new homes since 2019 have been designed to take account of and accommodate electrified heat and transport. ESB Networks continues to revise design standards to ensure that LCT load can be accommodated during any works carried out on the existing LV network, alongside developing and ensuring system improvements take place as this market grows and the momentum towards mass electrification continues.

- In PR 5 (their current price review period of 2021- 2025), ESB Networks has an investment budget of €134 million for low voltage system improvements. This budget is additionally covered by an agreed uncertainty mechanism, whereby if the uptake of LCT were to take off at an accelerated pace, or clustering of LCTs in specific areas is more concentrated, additional funds can be sought as interventions are being delivered to ensure system readiness.
- ESB Networks has developed a collaboration framework with the SEAI for future technology trials and initiatives, one example being the provision of clear guidance to the market on EV charging infrastructure connection requirements for apartment developments.
- ESB Networks is basing its approach to network readiness and the advancement and development of the distribution network on what is referred to as the FIMSS methodology: Forecast, Identify, Monitor, Smart toolkit and Strengthen the network. To cater for the increased capacity requirement on the LV network, ESB Networks has developed a new innovative 630+ kVA compact transformer, which retrofits into the existing footprint of the standard 400 kVA or 630 kVA innovation pilots for scaling of electrification and LV and MV network readiness.

3.3 Empowering low carbon living

Enabling Action 3: Inspiring, empowering and supporting customers and communities to achieve net zero

ESB's Customer Solutions Scope 3 emissions predominantly arise from the supply of gas and electricity to our customers. While our wide range of products, services and advice has a direct impact on reducing our customer-related Scope 3 emissions, it also enables the broader decarbonisation of the energy requirements of society in general.

- We provide decarbonisation of transport solutions, enabling the reduction in use of petrol and diesel, through our ESB ecars public EV charging networks, Electric Ireland and So Energy residential charging solutions and ESB's Smart Energy Services fleet charging solutions for businesses.
- We provide energy efficiency and decarbonisation of heat solutions:
  - One Stop Shop home retrofit solution through our Electric Ireland Superhomes business.
  - Heat pump solutions to residential customers in Ireland through Electric Ireland and in GB through So Energy, where deep retrofits are not required.
  - Operating within the Energy Efficiency Obligation Scheme (EEOS) and helping to fulfil Ireland's requirements under the EU Energy Efficiency Directive. Under this programme, Electric Ireland, Electric Ireland Superhomes and ESB's Smart Energy Services help residential homes and businesses improve their energy performance, reducing both running costs and environmental impacts. The EEOS has a distinct focus on assisting those experiencing fuel poverty.
  - So Energy works within the GB Energy Company Obligation (ECO) and the Great British Insulation Scheme (GBIS) to promote measures that improve the ability of low-income, fuel-poor and vulnerable households to heat their homes. This includes actions that result in reduced energy usage, such as installing insulation or upgrading heating systems. So Energy expects to spend more than £300m (between 2024 and 2030) in delivering energy efficiency measures to over 30,000 lower income homes.
- Across Ireland, Northern Ireland and GB, ESB's Smart Energy Services business serves the wider industrial and commercial sector by providing expertise in energy efficiency, energy management and low carbon technologies through long-term partnership arrangements.
- We provide inspiration and practical advice to all energy consumers through various media campaigns and our digital platforms across all our business lines.

These broad enabling actions identify where we impact on the wider decarbonisation of society – the following actions and initiatives provide greater detail and outline our targets in putting our objectives into effect.

Enabling Action 4: National Smart Meter Programme (Ireland) to empower demand flexibility and greater utilisation of variable renewables (SPI 2)

The National Smart Metering Programme was established by the Commission for the Regulation of Utilities (CRU) to roll out smart meters across Ireland. ESB Networks has been tasked with the delivery of the programme, which involves upgrading all electricity meters to smart meters. Smart meters will support Ireland's transition to a low carbon future by enabling the development of smart grids, and supporting the electrification of heat and transport, local renewable generation, and microgeneration. Electricity supply companies are now offering smart products and services, enabling customers to shift some of their consumption to times of the day when electricity is cheaper (Time of Use tariffs). As of February 2024, more than 1.6 million smart meters have been installed with a target of more than 95% coverage by 2026.

In Northern Ireland, the Department for the Economy has indicated that the cost-benefit analysis for smart metering is complete, and that work will commence urgently on the roll-out of smart metering subject to the necessary legislation[31] .

31 Energy Strategy - Path to Net Zero Energy - 2022 Action Plan Report (economy-ni.gov.uk)

3.3 Empowering low carbon living (continued)

Enabling Action 5: Supporting adoption of electric vehicles in Ireland, NI, and GB to empower reductions in petrol and diesel fuelled vehicles (SPI 5)

Most EV charging takes place in private settings such as at homes or businesses. Public EV charging gives confidence to drivers as they transition from internal combustion engine vehicles. ESB ecars operates the largest public charging network with more than 1,500 charge points across the island of Ireland. They will install 3,000 chargers in Ireland, NI and GB by 2030 with a focus on providing high powered charging hubs.

In addition to public charging, ESB's Customer Solutions businesses support customers with private charging solutions:

- Electric Ireland delivers an electric vehicle charger installation service for households via a partnership model. This is accompanied by an electric vehicle app which encourages automated off-peak charging. Electric Ireland aims to meet 10% of the market demand for home EV charging in ROI by 2030.
- So Energy will seek to develop home charging solutions alongside existing capabilities in solar and battery installation, launch a specific EV time-of-use tariff to avail of times when the grid is greener and electricity cheaper, and explore solutions where customers can avail of the ESB ecars public charging network to provide additional out-of-home charging opportunities, and promote fossil-free travel as sustainable, comfortable, and effective transport.
- ESB's Smart Energy Services offers an EV fleet charging service, offering no upfront capital costs for business. Fleet charging will be offered for cars, vans, buses, and heavy-duty vehicles.

ESB's Smart Energy Services were responsible for the design and build of what is Ireland's first ever fully electric bus depot. The project included a new depot yard which allows for the charging of up to 18 EV buses simultaneously, a new electrical substation and a dynamic load management system to optimise the energy usage on site. Within the garage, ESB's Smart Energy Services also provided a 40 kW DC mobile charger to facilitate the charging of buses that are undergoing maintenance.

Enabling Action 6: Help to build the hydrogen economy, leveraging off long duration energy storage to reduce usage of more carbon intensive energy sources

As an electricity utility, ESB is interested in hydrogen first and foremost from the perspective of back-up generation and long duration storage in the electricity system. However, there are other applications for hydrogen in the transition such as industrial feedstocks and in applications that can't be electrified. Mainland Europe will be a net importer of green hydrogen and Ireland has significant offshore wind resources with potential to produce the much-needed hydrogen.

ESB will be at the forefront of developing hydrogen export opportunities for Ireland through international engagement between now and 2040. This has already commenced through initiatives such as those in conjunction with the German Irish Hydrogen Council. Alongside this, ESB's generation business is investigating new markets for hydrogen to support Ireland's decarbonisation, such as aviation fuel, marine fuel and ammonia production.

3.4 Supporting green transformation of businesses

Enabling Action 7: Build a greener supply chain through ESB's sustainable procurement strategy

By reducing the GHG emissions (tCO2e) from ESB's supply chain through more emissions-focused procurement requirements from the suppliers and contractors we use, we can cut the GHG emissions of these entities in the goods and services they provide to others over the long term. ESB's target for reducing GHG emissions from ESB's capital goods is discussed in Section 4.

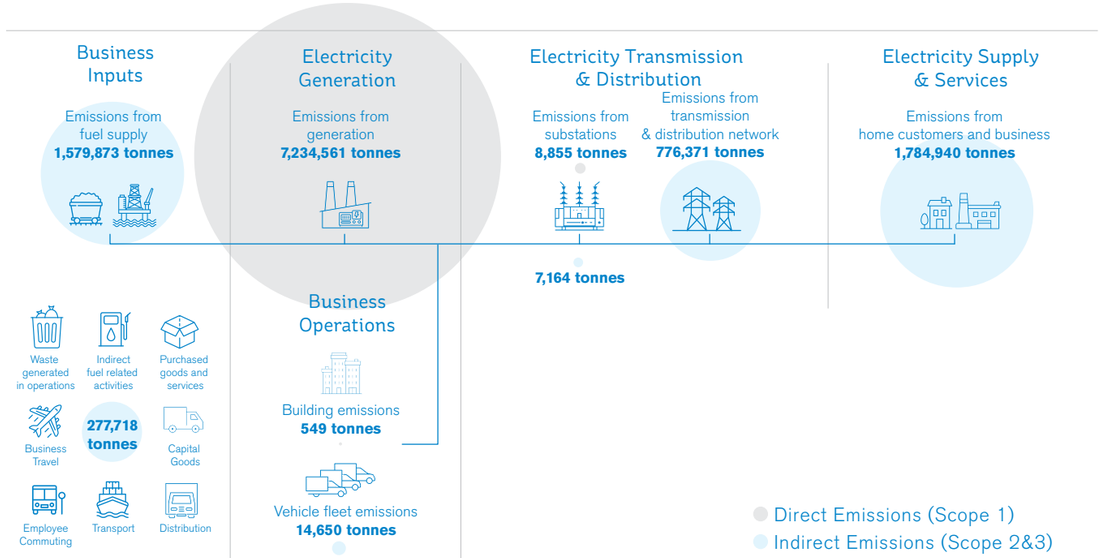
Figure 13 Enabling actions across ESB Group

4. ESB's net zero pathway

4.1 Representation of current emissions

In 2022, ESB Group had an overall GHG emissions footprint of 11.7 million tonnes CO2eq. Our emissions are reported annually in our Sustainability Report, and we disclose emissions performance via the CDP online reporting platform.

Figure 14 Representation of ESB 2022 emissions



ESB's main sources of Scope 1 & 2 emissions are:

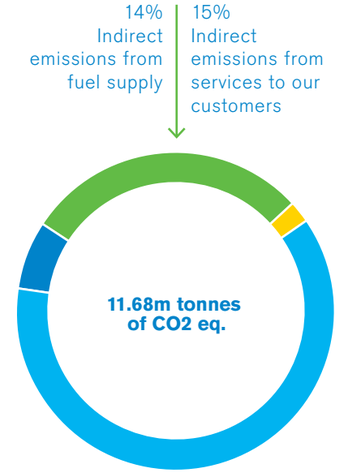
- **Electricity Generation:** ESB has 10 thermal stations across Ireland, NI and GB fuelled by a combination of ~1GW coal, 3.2GW gas, and 52MW oil. The emissions from the production of electricity by these stations contribute the greatest proportion of our GHG emissions.
- **Transmission & Distribution:** When electricity is transferred across the ESB Networks and NIE Networks transmission and distribution systems, some is dissipated in the form of heat and is 'lost'. Emissions from this 'lost' electricity contribute to ESB's overall emissions.
- **Vehicle Fleet:** ESB businesses use fossil fuel powered vehicles (cars, vans, trucks, winches, cranes, etc.) for a wide range of activities, such as maintaining networks infrastructure and constructing wind farms.
- **SF_6:** Like many other utilities, ESB's networks businesses have installed high-voltage switchgear in the past which uses sulphur hexafluoride (SF_6)[32]. Leakage of this SF_6 contributes towards our total emissions. It accounts for a small but material portion of our Scope 1 emissions.
- **Own Electricity Consumption:** ESB uses a mix of electricity including electricity from thermal as well as low carbon sources across the group businesses.
- **Buildings:** The operation (heating, cooling, appliances etc) of ESB's commercial buildings results in emissions.

32 SF6 is highly stable, non-toxic, non-flammable and electronegative (will not form other compounds that will alter its state and effectiveness) making it a valuable substance in keeping networks running safely and reliably. Electricity networks are one of the few places where SF6 is still used today due to the technical challenges of replacing it. Monitoring, repairing and replacing equipment prevents SF6 leakage, however, deterioration of SF6 containing equipment and use overtime will result in some leakage. SF6 is a much more potent GHG than CO_2, by 23,500 times according to the IPCC (fifth assessment report).

Across ESB's operations in Ireland, NI and GB, the largest source of Scope 1 emissions comes from our thermal generation, accounting for 62% of total emissions in 2022. Transmission and distribution losses are the largest source of Scope 2 emissions, accounting for 7% of ESB's total emissions in 2022.

Our Scope 3 emissions are largely made up of the upstream (extraction and transport) emissions associated with fossil fuels we purchase, the downstream emissions associated with the use of the natural gas we sell to customers, and the emissions in our purchased goods supply chain.

Figure 15 Split of ESB's emissions in 2022



Note: 'Other' refers to other scope 1 & 2 emissions including SF6, employee commuting, own electricity consumption, and accounts for 2% of total emissions

Across our three core business areas (Generation and Trading, Networks Businesses, and Customer Solutions) we have initiated, implemented, and completed several initiatives to radically reduce our carbon footprint:

We have grown our renewable generation portfolio, invested in new battery and flywheel technology, invested in the thermal fleet to make it more flexible, and retired peat stations and legacy thermal stations.

We have undertaken deep retrofit of three key administrative buildings, and built a new head office in Dublin, achieving at least 50% improvement in energy efficiency. This has been complimented by a move to electric heating.

ESB Networks is electrifying vans within their vehicle fleet.

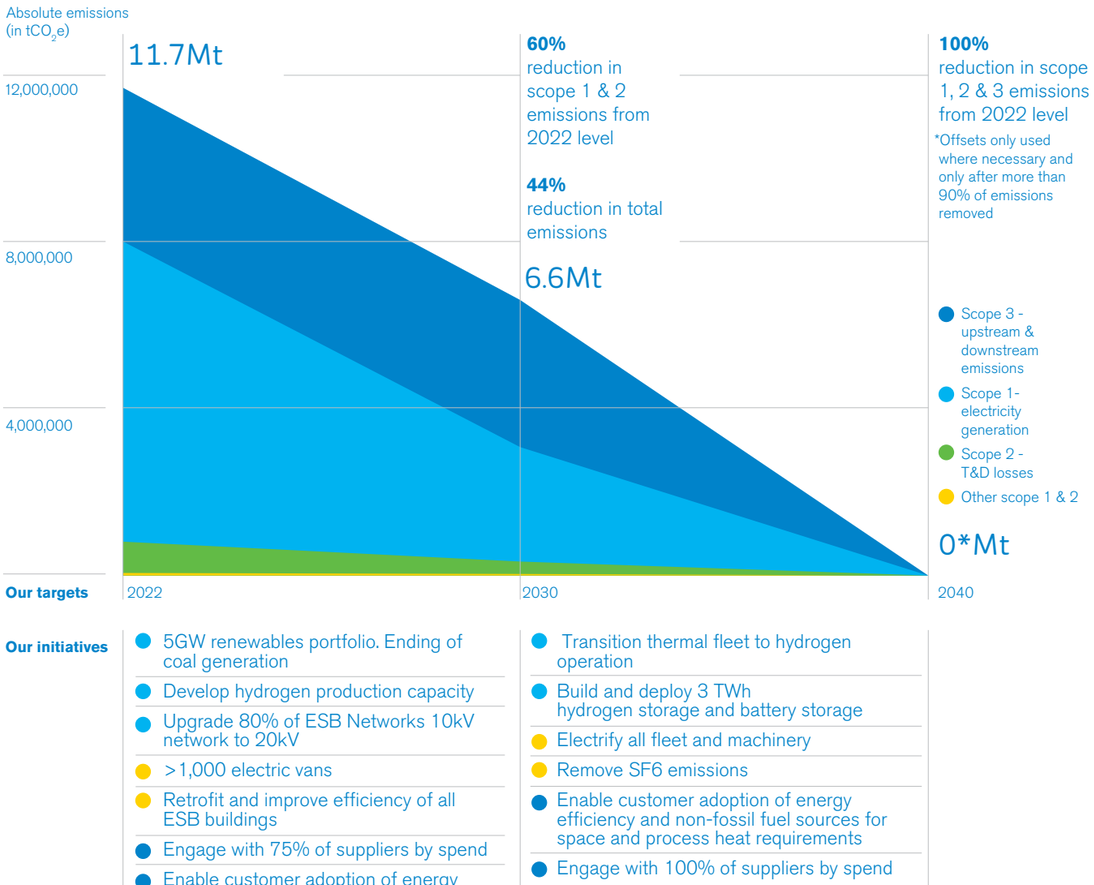
We have established a new JV – Electric Ireland SuperHomes to provide a one-stop-shop to facilitate deep retrofit and conversion of customers' heating systems to electricity.

These are only a few examples of our successful initiatives to date. We are expanding on our existing initiatives and instigating new initiatives to achieve net zero by 2040. Our planned initiatives are discussed in the following chapters.

4.2 ESB's net zero roadmap

The energy sector accounts for approximately 70% of global GHG emissions. As a major utility operating in Ireland and the UK, we have a significant role to play in the societal transition to net zero across all areas of our business. To this end, we are taking urgent and focused action through the development of an incredibly ambitious roadmap to achieve net zero GHG emissions by 2040. We will do this through the wide-ranging initiatives outlined in the following sections.

Figure 16 Net zero roadmap



Increased ambition 2028

ESB's core emission trajectory set out above targets a 44% reduction in total emissions (on 2022 levels) across all scopes by 2030. ESB has also set an increased ambition target to achieve the 44% reduction by 2028, two years earlier than the above. This increased ambition is currently being assessed and will result in the updating of business plans over the next five years. Meeting this increased ambition will require the assessment of current carbon emitting businesses and examination of new low carbon business opportunities.

4.3 Measuring our progress to net zero – ESB Group

To ensure we deliver on our commitment to achieve net zero GHG emissions by 2040 we have produced a set of internally focussed SPIs to measure and monitor our progress to 2030. These SPIs align with our initiatives outlined below and will be updated annually to track our progress.

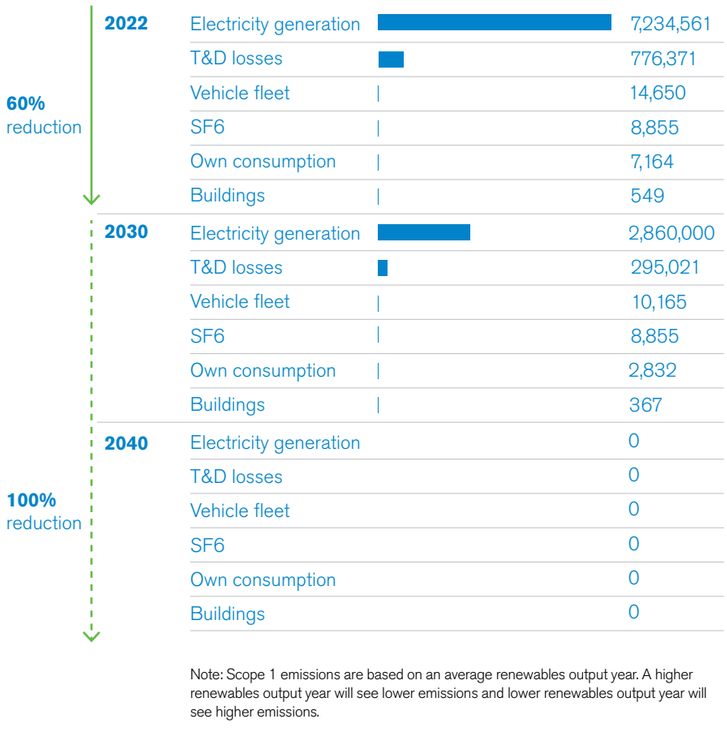
Table 3 List of ESB Group SPIs

SPI		Metric	2022 (Actual)	2030 (Target)
1	**Increase our renewable generation portfolio**	MW of operational renewables (GW)	923MW	>5GW
2	**Reduce carbon intensity of electricity ESB produces**	Carbon intensity of the electricity ESB produces (gCO_2/kWh)	419gCO_2/kWh	140gCO_2/kWh
3	**Decarbonisation of our electricity output**	Share of ESB generation output from zero carbon sources (%)	15%	63%
4	**Energy storage and system balancing**	Number of ESB hydrogen/large-scale storage projects	JV in place with dCarbonX	2 or more lighthouse projects active / operational
5	**Digital maturity**	Digital maturity (independently assessed across a range of criteria)	Foundational/ Mainstream	Mainstream/ Leader
6	**Smart tariffs**	% of Electric Ireland residential customers availing of smart tariff plans	17%	80%
7	**Internal ESB carbon footprint**	Emissions from buildings and vehicle fleet (tCO_2)	18.3ktCO_2	50% reduction in absolute emissions
8	**Electric Ireland Superhomes**	Number of deep retrofits completed since business established	308	35,000

4.4 Scope 1 and 2 emissions reductions

ESB's trajectory from 8m tonnes of Scope 1 and Scope 2 CO2e emissions in 2022 to net zero GHG emissions in 2040 is ambitious and is set out in Figure 17. To guide this pathway, we have developed wide-ranging and purposeful initiatives to transition from the way our business operates today to our ambitious goal in 2040.

Figure 17 Scope 1 and 2 - current and projected emissions (in tCO_2e)



2022	Electricity generation	7,234,561
	T&D losses	776,371
	Vehicle fleet	14,650
	SF6	8,855
	Own consumption	7,164
	Buildings	549
2030	Electricity generation	2,860,000
	T&D losses	295,021
	Vehicle fleet	10,165
	SF6	8,855
	Own consumption	2,832
	Buildings	367
2040	Electricity generation	0
	T&D losses	0
	Vehicle fleet	0
	SF6	0
	Own consumption	0
	Buildings	0

Note: Scope 1 emissions are based on an average renewables output year. A higher renewables output year will see lower emissions and lower renewables output year will see higher emissions.

4.4.1 Our net zero initiatives

This section presents ESB's targets for reducing Scope 1 & 2 GHG emissions to ensure our achievement of net zero by 2040, as well as outlining the initiatives we will take to make progress towards achieving our target.

4.4.1.1 Generation

All of ESB's energy generation will come from zero carbon sources by 2040. Generation will transition to a combination of renewables comprising primarily wind and solar and other energy carriers such as hydrogen. This will be supported by a portfolio of short-, medium- and long-term storage assets to underpin a resilient power system. Fossil fuel-fired thermal generation will provide a back-up role before being retired or fully decarbonised by 2040.

Initiative 1: Five-fold increase in renewable generation to 5GW by 2030 (SPI 1, 2 & 3)

ESB's generation business is targeting a 5GW renewable electricity portfolio across Ireland, Northern Ireland, and Great Britain by 2030, to be made up of onshore wind, offshore wind, and solar generation.

ESB has nearly 800MW of operational onshore and offshore wind as well as over 200MW of hydro generation. Further capacity has been successful in renewable auctions and is at various stages of development. For example, Oweninny 2 windfarm in Co Mayo recently commenced commercial operations; the Neart na Gaoithe offshore wind farm in Scotland is under construction, while the Inch Cape offshore windfarm in Scotland is close to financial close. Construction is well underway at the ESB and Bord Na Móna 70MW solar farm in Timahoe, Co Kildare and the wholly owned Bullstown solar farm (8MW) in Co Meath has started its build programme. These projects are in addition to over 500MW of contracted solar and onshore wind projects.

The generation business is also building a strong pipeline of new onshore and offshore projects. The Oriel offshore wind farm, while unsuccessful in Ireland's first offshore wind auction, is exploring alternative routes to market, and there are close to 6GW of further potential offshore projects at design stage.

FuturEnergy Ireland, of which ESB is a 50 per cent shareholder with Coillte, intends to build 1GW of onshore wind across Ireland by 2030. Finally, ESB is in joint venture arrangements with Harmony Solar and Bord Na Móna to deliver 1.3GW of solar generation – and is constantly looking for additional renewable generation opportunities.

4.4 Scope 1 and 2 emissions reductions (continued)

Initiative 2: System services and storage

Low carbon system services are key to delivering a renewables-based electricity system[33]. We are developing and building a pipeline of large-scale battery projects in Ireland, and in 2024 we will have at least 300MW of utility scale battery projects in place in Dublin and Cork. Our synchronous compensator at Moneypoint went operational in 2023. This asset will provide valuable system services to a power grid with a high level of renewables. ESB will also maximise the provision of system services across the existing generation fleet to support the transition to more variable renewables. This will involve investments in thermal plants to make them more flexible.

ESB is also developing a pipeline of new development flexibility projects including batteries and synchronous compensators for delivery by 2030.

Initiative 3: Ending of coal operation at Moneypoint

ESB's strategy places a particular emphasis on reducing the carbon intensity of its generation fleet. The Moneypoint power station has traditionally operated with three coal fired units. Looking towards the future of the plant, ESB has strategically taken the decision to cease coal burning in Moneypoint in 2025 – marking a positive step in our net zero journey. In response to a security of electricity supply need identified by EirGrid and the Commission for Regulation of Utilities (CRU), ESB and EirGrid have entered into a targeted contracting mechanism (TCM) agreement to make the station output available as a generator of last resort. Subject to planning and environmental approvals, ESB will convert Moneypoint to run on heavy fuel oil for the period of the TCM contract. The station will not be active in the wholesale electricity market but will be available to operate, at the instruction of EirGrid, as a back-up in the event that a shortage of generation capacity in the market threatens the security of electricity supply to customers.

This is a temporary arrangement to meet the security of supply needs of the system and will not impede ESB's multi-billion-euro redevelopment of Moneypoint – the Green Atlantic @ Moneypoint project – into a renewable energy hub, helping Ireland to become a leader in green energy production.

33 The electricity network needs to balance generation and demand at all times and there are different technologies which can provide the necessary flexibility to ensure grid stability. Different technologies are better suited to providing different flexibility services, e.g., batteries can store electricity when demand is low and/or wind generation is high and then supply electricity at times when demand is high and/or wind generation is low. A flywheel/ synchronous compensator does not generate electricity but is a large electric motor that can provide grid stability.

Initiative 4: Green hydrogen for power generation (SPI 4)

An electricity system with a high percentage of wind and solar generation will require a backbone of dispatchable generators. ESB is already a major provider of dispatchable power, and we will transition our thermal generation fleet to zero carbon operation using hydrogen or hydrogen derivatives such as ammonia or e-fuels. To enable this, we will develop and invest in large scale hydrogen production using offshore wind and electrolysis. We are already starting to make this happen through the early-stage development of regional clean energy clusters. We plan to develop a Cork Energy Hub to leverage offshore wind to produce zero-carbon energy products such as hydrogen. The hydrogen fuelled zero-carbon electricity will help attract green industrial investment, and the hub will promote emerging technologies. It will bring scale to hydrogen use, and the proximity of large-scale green energy storage will open up opportunities in Ireland and beyond.

Green Atlantic @ Moneypoint will harness offshore wind to produce green hydrogen and hydrogen derivatives, store it, and use it in back-up generation. We plan to develop further similar initiatives across the island of Ireland to support the transition to net zero.

We are already exploring how we will use hydrogen in our power stations. Our Carrington power station in Manchester is part of HyNet, the UK's leading industrial decarbonisation cluster. HyNet is an initiative to help industry and other applications decarbonise by switching how they power their operations, moving from fossil fuels to low carbon hydrogen. HyNet will allow ESB to gain valuable experience in hydrogen transport and combustion in gas turbines. As well as building early expertise in this important technology, it also enables ESB to bring similar clustered solutions to Ireland, accelerating the energy transition.

Initiative 5: Commission hydrogen storage capacity by 2040 (SPI 4)

Seasonal and strategic energy storage will be required to support a resilient zero carbon power system, and ESB will play a key role in enabling this.

ESB is focusing on three specific green hydrogen storage opportunities based around proposed decarbonisation clusters – east of Dublin's Poolbeg, west of ESB's Green Atlantic @ Moneypoint project supporting the Shannon Estuary cluster, and south of Aghada in Cork. ESB is partnering with dCarbonX and Bord Gáis Energy in Project Kestrel (www.h2kestrel.ie), which is focused on the proposed re-development of the decommissioned gas reservoirs in the offshore Kinsale area gas fields for large-scale energy storage. Initial work involves using the depleted gas fields at Kinsale and Ballycotton for natural gas storage, and then transitioning this to hydrogen storage when there is surplus renewable gas and green hydrogen production. On the west coast, where there is limited capability to store energy as hydrogen, we are progressing the use of green hydrogen as an energy vector, produced from the potential vast supply of Atlantic offshore wind, stored as ammonia, and used for electricity generation when zero carbon baseload or backup power is needed. On the east coast and in the UK, ESB is exploring the development of hydrogen storage in sub-sea salt caverns.

To support our net zero ambitions, ESB plans to have projects at final investment decision stage this decade, with a view to construct and commission in the next decade.

4.4 Scope 1 and 2 emissions reductions (continued)

4.4.1.2 Networks

ESB Networks and NIE Networks have emissions arising from losses on their respective transmission and distribution networks, in their buildings, and in their fleets. Emissions from networks losses will reduce as the underlying sources of generation decarbonise, while transition to electric vehicles and retrofitting buildings will remove other emissions. NIE Networks has committed to reaching net zero by 2050 or sooner.

Both ESB Networks and NIE Networks have their own published strategies, which include measures for reducing emissions and related reporting mechanisms.

Initiative 6: Reduction of emissions from losses

Transmission and distribution losses are the biggest source of emissions in the networks' businesses. As the carbon intensity of the electricity transported across the networks reduces, so will the volume of emissions arising from losses. ESB Networks and NIE Networks expect emissions on the transmission and distribution network to reduce as the electricity system decarbonises on the island.

As the amount of electricity transported across the networks grows – whether through increased economic activity or the adoption of electric vehicles and heat pumps – energy losses will increase. Initiatives can be undertaken to mitigate this; for example, ESB Networks is upgrading 80% of the 10kV medium voltage network to 20kV network, increasing network capacity by a factor of two while reducing losses.

Initiative 7: Transition to zero carbon fleets (SPI 7)

The networks' businesses have commenced decarbonisation of their fleets and will build on this to achieve zero-carbon fleets in 2040.

- ESB Networks has a fleet of over 2,000 vehicles comprising 300 small vans, 1,200 larger vans and pick-ups, and 500 bespoke built utility heavy goods vehicles (HGVs). They are targeting 1,000 electric vehicles in the fleet by 2030, with an expectation that all two-wheel drive vehicles in the fleet will be electric. Any remaining vans in the fleet will be electrified by 2035. They will also oversee the replacement of the internal combustion engine forklift fleet with electric forklifts by 2030, and will continually electrify the fleet as technology becomes available (e.g. winches, cranes). The transition of the heavy-duty fleet to zero carbon solutions is more challenging and will progress as viable offerings from original equipment manufacturers (OEMs) become available. It is expected that by 2030, 15% of the heavy-duty vehicles purchased will be low emission.
- NIE Networks has commenced fleet electrification, with 2022 marking a significant milestone as they transitioned 18 fleet vans (5% of their fleet) to fully electric models. As part of the roll out of fleet EVs, they are supplying and fitting both home (7.2kW) and depot (22kW) charge points. Home charging costs are reimbursed to staff.

4.4 Scope 1 and 2 emissions reductions (continued)

Initiative 8: Decarbonisation of network company buildings (SPI 7)

ESB Networks and NIE Networks will transition to zero carbon office buildings and depots in their respective net zero pathways. Significant emissions savings will be achieved through energy efficiency measures:

- ESB Networks will refurbish all buildings to achieve a B energy rating by 2030, furthered by installing heat pump technologies and other low carbon solutions such as solar PV.
- NIE Networks has commenced upgrades to its building stock. For example, extensive refurbishment works were carried out in 2022 at its Belfast Dargan Depot with fabric improvements and PV panel installations, improving the energy efficiency of the building.

Initiative 9: SF6 emissions reduction

Group wide SF6 emissions have reduced significantly in recent years. Over the past four years, the networks businesses have reduced SF6 leakage by over 60% and continue to work to contain, reduce, and minimise the use of SF6. This will be further reduced as substation management is improved, and eventually eliminated as SF6 is removed from the network. The EU and UK both have strategies to eliminate these gases and the networks businesses will need to work within legislative parameters. To this end, replacements for SF6 will be adopted as they become available and are proven to be reliable.

4.4.1.3 Other cross group emissions

Other Scope 1 & 2 emissions include those from our own electricity consumption (Scope 2), group level vehicle fleet (Scope 1), and buildings (Scope 1). GHG emissions from our own electricity consumption will reduce by 60% (compared to 2022) by 2030, predominately due to the increased proportion of renewable generation as outlined under Target 1. Emissions from our vehicle fleet at ESB Group level will reduce by more than 30% (compared to 2022) by 2030, as fleets become electrified, starting with small and medium vehicles, and moving into larger vehicles as technologies mature. Emissions from our buildings will reduce by more than 30% (compared to 2022) by 2030, as the buildings we own are refurbished to move away from fossil fuels. Rented and leased properties will need to be either refurbished or alternative locations found.

Additionally, we will complete the transition to paperless operations enabled by a comprehensive digital transformation. Insofar as we can within customer preferences, we will shift to paperless based billing and move to digital communications. We will decarbonise our footprint at marketing events such as energy shows, alongside decarbonising the production and delivery of all our advertising, television, radio, and online presence. We are also evaluating ESB's sponsorships to ensure that sponsorship provision aligns with our net zero strategic ambition. These actions are reflected in our ESB Group SPI 7.

4.5 ESB's Scope 3 emissions

Scope 3 GHG reductions in 2030 are inherently more challenging to determine than Scope 1 and 2, as Scope 3 are indirect emissions arising from activities carried out by assets not owned or controlled by ESB. Upstream Scope 3 emissions from purchased fuel will reduce as we reduce the amount of fossil fuels used in our power stations, but some areas within Scope 3 will increase first before reducing. Total emissions from natural gas sales will increase in line with an increase in customer numbers before 2030, while emissions from concrete and steel used in the construction of onshore and offshore wind farms and networks assets will increase, given the amount of new investment needed in these areas to achieve net zero. These increases will be offset somewhat by the emissions reduction initiatives outlined later in this chapter, as illustrated in Figure 18.

Figure 18 Scope 3 - Current and projected emissions (in tCO_2e)

2022	Upstream emissions from fuel supply	1,579,873
	Downstream emissions from supply & services	1,784,940
	Capital goods	266,639
	Other scope 3	11,079
2030	Upstream emissions from fuel supply	1,131,074
	Downstream emissions from supply & services	1,888,203
	Capital goods	373,295
	Other scope 3	8,863
2040	Upstream emissions from fuel supply	0
	Downstream emissions from supply & services	0
	Capital goods	0
	Other scope 3	0

The next sections describe ESB's Scope 3 emissions, their trajectory and the initiatives we will employ to reduce them.

4.5.1 Upstream emissions from fuel purchases

These emissions include "well to tank"[34] upstream emissions from the fuels consumed by ESB's thermal generation fleet. This forms a large portion of ESB's supply chain emissions and will naturally reduce as the generation fleet is decarbonised (see Initiative 1). GHG emissions from ESB upstream fuel supply will decrease by 28% between 2022 and 2030, before achieving net zero by 2040. ESB's upstream fuel supply emissions will decrease as we reduce the amount of fossil fuels we purchase.

The second largest upstream source is the well to tank upstream emissions from gas sales in Ireland, NI, and GB. These will increase before 2030 as we grow our supply business in GB and acquire new gas customers, after which they will steadily fall to zero by 2040.

Other smaller sources included are the well to tank upstream GHG emissions from fuels consumed by ESB fleet vehicles, and well to tank upstream emissions from gas consumption from ESB Group buildings.

Our upstream emissions will decline in line with reduction in purchase and use of fossil fuels, as we move towards renewables and other forms of low carbon generation.

34 Well to tank refers to the emissions associated with extracting fossil fuels from the ground and transporting them to their point of use. It does not refer to the emissions associated with combusting the fuel at the point of use.

4.5 ESB's Scope 3 emissions (continued)

4.5.2 Downstream emissions from fuel sales

Reducing gas sales and displacing customers' fossil-based energy requirements with renewable electricity will be a key component in reducing our Scope 3 emissions. While providing consumers with the products and services to enable them to achieve net zero will be key in this respect, we will also progressively shift our focus from the sale and marketing of natural gas to the utilisation of electricity.

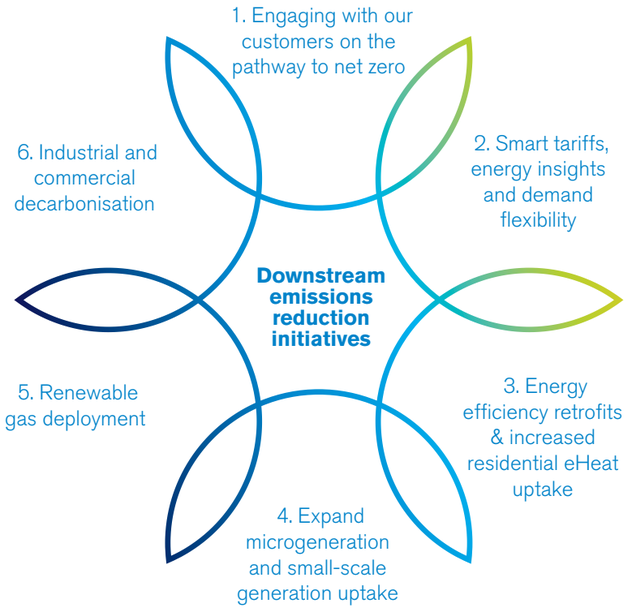
In Ireland, over the period 2022 to 2030, Electric Ireland will reduce the gas volume sold by 9%. We will also aim to have 10% of the gas we sell come from renewable sources by 2030.

In GB, we have ambitious plans to grow our majority owned retail business So Energy, bringing high standards of service to customers there. The GB market is such that most customers bundle their gas and electricity together with a single supplier, meaning we will increase our number of gas customers – resulting in higher Scope 3 emissions for ESB, although there will be no aggregate increase in emissions as the customer has simply moved from another supplier. We will onboard these customers in the knowledge that we will work with them to transition to zero carbon energy. Even though we expect to grow our gas customer base by 80% over the period 2022 to 2030, we will work to limit the increase in overall gas consumption to 37% over the same period, through an increased focus on energy efficiency, electrification of heat and reduction in average customer gas consumption as set out in Section 4.5.3.

The period from 2030 to 2040 will see a step change in decarbonisation activity as the impacts of wider Ireland and UK Government net zero initiatives kick in, in tandem with ESB's own initiatives – resulting in a steady fall to zero emissions by 2040. In line with our vision of the future energy system, we expect solutions such as increased industrial electrification, mass rollout of heat pumps, wide scale energy efficiency, and renewable gas (biomethane & hydrogen) for high temperature demand to feature very strongly in this period.

4.5.3 Scope 3 downstream emissions reduction initiatives

Initiatives will be delivered across the customers solutions businesses to reduce Scope 3 emissions arising from the energy we sell to customers.



Initiative 10: Engaging with our customers on the pathway to net zero

At every level in ESB, we look to put the customer at the heart of what we do. Our Customer Solutions businesses will build on their direct relationships with customers to be a trusted partner on the journey to net zero.

Electric Ireland has established a Net Zero Hub to provide advice to residential customers on decarbonising their energy usage. This brings together in one convenient location all advice, tariffs, products and services in relation to home energy audits, energy efficiency measures, retrofits, smart meter plans, EV and heat pump tariffs, servicing, solar panel, battery storage and more – guiding the customer through their decisions on their own journey towards net zero.

Electric Ireland Business Markets provide small and medium businesses with a range of tools to understand, monitor and make positive changes associated with their energy usage. For example, we have partnered with DCSix Technologies to introduce Wattrics to our business customers, which enables customers to understand their energy usage with real-time energy audits and feasibility studies. This information helps businesses to discover opportunities to reduce energy usage and build awareness about energy efficiency.

Electric Ireland's "Your world, brighter" advertising campaign helps lead customers towards a cleaner, greener and smarter future. Although most customers understand the importance of net zero, getting there involves new ideas, new products, new services and new thinking. "Your world, brighter" means everything Electric Ireland does has the ambition to make customers' world that little bit better and brighter. This comes to life across the product range and services offered such as smart meter plans, home charging for electric vehicles, and solar panels installation. Our target is that by 2030, over 50% of customers associate Electric Ireland with "offering a range of products and services to help customers live a more sustainable life".

4.5 ESB's Scope 3 emissions (continued)

Initiative 11: Smart tariffs, energy insights and demand flexibility

Electric Ireland offers a range of smart electricity tariffs to customers, tailored to meet their individual circumstances. All smart Home Electric+ plans come with advanced analytics providing customers with detailed information on energy usage, down to the level of understanding which home appliances are using the most energy and when. As the customer builds up an energy usage profile for their home, Electric Ireland provides personalised advice on how better to utilise their energy and if suitable will suggest moving to a more appropriate time of use smart tariff based on their circumstances. As an example: for homes with a heat pump and a smart meter, the Home Electric+ Night Boost tariff offers cheaper electricity at night (11pm – 8am) and includes a cheaper boost period from 2am–4am, ideal for heating water and potentially reducing those costs by up to 70%. Electric Ireland aims to have 80% of its residential and SME customers utilising the most appropriate smart tariffs by 2030.

As we approach 2030, Electric Ireland will further expand on the capability of both our Net Zero Hub and smart tariff energy insights by developing an Energy Insights Audit tool and Home Energy Management (HEM) platform, integrating real time energy data and insights with a tailored suite of net zero products and propositions. Our HEM platform will provide customers with access and control to various products such as heat pumps, microgeneration and EV charging, further enabling active customers to participate fully in renewable energy and demand flexibility markets.

In GB we will support the Energy System Operator (ESO) in the Demand Flexibility Scheme through the launch of So Rewarding. This programme provides an incentive for customers to reduce electricity usage during peak demand periods, with incentives including vouchers, free electricity, and a free solar/battery installation. So Rewarding sets a framework to enable collective action when demand exceeds supply, encouraging a community mindset that enables renewables to become a greater contributor to our grid while reducing reliance on traditional carbon-based generators.

Initiative 12: Energy efficiency retrofits and increased residential eHeat uptake

Electric Ireland Superhomes is a One Stop Shop which looks after all the key stages of a home energy retrofit, from retrofit design through to project completion and management of grant funding. Electric Ireland Superhomes has delivered a large number of deep retrofits to date and has committed to a target of delivering 35,000 retrofits by 2030. Electric Ireland Superhomes promotes the benefits of eHeat solutions to customers as part of overall home energy retrofits. In the context of Ireland's 'Just Transition Fund', Electric Ireland Superhomes plans to open an office in the Midlands which will hire locally and work collaboratively with relevant stakeholders to build contractor capacity to deliver retrofits. Electric Ireland Superhomes also works with approved housing bodies to retrofit multiple housing projects, enabling economies of scale and increased emissions reduction.

Understanding that not all customers are able or ready to take the step of a full home retrofit we will expand our offering in the wider provision of eHeat solutions for residential customers, providing a pathway for incremental changes on the journey to net zero. We will further develop direct relationships and partner with OEMs (with in-country service) to provide solutions such as heat pumps for homes that require minimal or no fabric upgrades, direct electric and heat storage technologies. Electric Ireland aims to meet 10% of the market demand for heat pump deployment in existing homes by 2030.

In GB, So Energy is participating in a trial for heat pump installations in the Northwest of England, which provides learning around customer demands for heat pumps. We will explore additional partnerships that will open-up wider national coverage for heat-pump installation, to investigate how time-of-use or behind-the-meter tariffs can reduce heat anxiety and provide cost predictability, and to promote heat pumps as a step towards reduction (if not removal) of a household's reliance on gas – paving the way for eventual decommissioning of individual household gas appliances.

To further support these initiatives, we will continue to expand on and improve our smart tariff offerings for customers with electric heating. We will develop finance solutions to minimise this key barrier for customers, work with major OEMs and heating contracting companies in Ireland and GB to improve supply chain efficiencies, and influence policy and regulation to further minimise the cost for the homeowner in electrifying their home heating and hot water solutions.

4.5 ESB's Scope 3 emissions (continued)

Initiative 13: Expand microgeneration and small-scale generation uptake

ESB's Customer Solutions businesses will work with customers to deploy zero carbon small-scale generation.

We will build upon current offerings of solar PV and energy storage from Electric Ireland, So Energy and successful commercial deployments by ESB's Smart Energy Services. Products will incorporate technology specification and installation, purchasing excess generation, affordable finance solutions, and storage solutions including batteries and hot water tank diverters to maximise the use of onsite generation from a peak demand and cost perspective. There is already significant interest in solar PV deployment at residential and commercial levels and we will work to maximise this in support of decarbonisation targets. Electric Ireland aims to meet 10% of the market demand for solar PV deployment in existing homes by 2030.

ESB's Smart Energy Services has recently completed the largest behind-the-meter solar installation in Ireland – providing a 7.3MW ground mounted solar PV array to support the customer in significantly reducing its carbon footprint. It is estimated that the system will generate approximately 7.9GWh of clean renewable electricity, meeting 20% of the site's energy requirements.

Initiative 14: Renewable gas deployment

ESB's Customer Solutions businesses will procure renewable gas in increasing quantities. Electric Ireland will purchase biomethane under a new renewable heat obligation scheme being implemented in Ireland. The precise method of procuring the gas will be decided upon in the next two years. While biomethane will be a scarce resource, it will play a role in decarbonisation – at first blended with the natural gas supply system, and later targeted at hard to electrify applications. Electric Ireland aims to increase the share of renewable gas it supplies to customers as a percentage of overall natural gas to 2% by 2026 and 10% by 2030.

Initiative 15: Industrial and commercial decarbonisation

ESB's Smart Energy Services supports industrial and commercial customers in Ireland, Northern Ireland and Great Britain through energy efficiency solutions and low carbon technology deployment, including corporate power purchase agreements (CPPAs). Energy efficiency measures include energy management systems, low energy lighting and waste heat recovery. Low carbon technology deployment is expected to be driven by industrial heat pumps for existing and new businesses, moving from fossil fuel-based heat solutions, and providing large-scale on-premises solar solutions. This has already started through ESB's SES €75m fund to help large businesses reduce their carbon footprint while making energy cost savings. Up-front capital is provided by ESB for these energy-saving infrastructural projects, and repayments are financed by the savings delivered. Once the initial capital expenditure cost is repaid, the client receives 100 per cent of the savings. Over the period to 2030, ESB's Smart Energy Services aim to deliver a cumulative reduction in industrial and commercial customers' carbon emissions by 75k tonnes, progressively increasing our ambition as we head towards 2040.

ESB Energy provides low-carbon heat solution for a world-first greenhouse project in the UK

4.5.4 Emissions associated with capital goods purchases.

Scope 3 supply chain emissions includes all upstream emissions from the production of capital goods and services purchased by ESB, such as steel and cement in the construction of wind turbines, or upstream freight. ESB monitors and reports on the carbon footprint of the capital goods we purchase[35] . These are different from Scope 1 emissions in that the emissions are directly controlled by the entity ESB purchases the goods from – meaning we must work with our supply chain partners to reduce these emissions.

In doing this, we aim to reduce the carbon emissions in our supply chain to achieve net zero by 2040. ESB is already engaging with suppliers through the CDP Supply Chain initiative. We have engaged 60% of our largest suppliers (by spend) to understand their carbon footprint and decarbonisation plans. By 2030 this will be 75%. Through the initiative, we will encourage our suppliers to move towards net zero in line with our own plans. We will focus on reducing emissions from the largest suppliers first, gradually expanding in a phased manner.

ESB is a founding member of the Supply Chain Sustainability School. The initiative is a collaboration between industry stakeholders, including customers, contractors and supply chain members who have a mutual interest in building the skills of the sector's supply chain.

Given the levels of investment in generation and network infrastructure required to reach net zero by 2040, we expect that our emissions from capital goods will increase before 2030 – arising from steel used in networks and generation assets, or concrete in new wind farms, for example.

We will pursue specific initiatives either at Group or business level to drive supply chain decarbonisation. These will involve reviewing and updating procurement policies to reflect ESB's net zero ambition, auditing high-spend vendors for corporate social responsibility, and continuing to work with the CDP Supply Chain initiative.

SUPPLY CHAIN SUSTAINABILITY SCHOOL

35 Emissions from ESB's capital goods are calculated differently to the emissions from ESB's other activities. Here emissions are calculated by spend rather than examining the carbon content of each item purchased.

4.5 ESB's Scope 3 emissions (continued)

4.5.5 Emissions from day-to-day operations

ESB's day-to-day business activities generate indirect emissions. Across our businesses, we will work to reduce these by 20% between 2022 and 2030 before achieving net zero by 2040.

- ESB has developed a comprehensive smart working policy which affords employees the opportunity to work remotely in a way that matches business needs with individual preferences – resulting in a vast reduction in employee commuting. This has been enabled by rapidly increasing digital capabilities across the organisation through integrated document management and video conferencing.
- ESB calculates emissions from our people commuting to and from offices through staff surveys. We encourage low carbon commuting by providing high quality facilities for cyclists and taking part in schemes such as cycle to work and annual public transport commuter tickets. Most offices have EV charging facilities which encourages a low carbon option where car travel is unavoidable.
- We maximise use of online facilities for meetings and seminars where we can. Over 95% of learning and development programmes are now online. We are also investigating the use of Augmented Reality technology to reduce the need to spend time on site for training purposes. This approach recognises that in-person training is still required and seeks to ensure the most engagement and meaningful interaction when we do bring people together.
- ESB's ambitious strategy will be delivered through our people. We will recruit significant numbers of new staff this decade and beyond, and in 2022 announced plans to recruit more than 1,000 people. Our interview process has moved online: in 2023 over 7,700 interviews were carried out online, resulting in less travel for applicants and lower emissions.
- The way our people travel when working can result in emissions and we will take actions to address this. We encourage people to take public transport when possible if travelling for work and we will seek to use offsite meeting venues that are accessible by public transport or have charge points. Over time, we will examine our travel and expenses policies to ensure that they encourage low carbon travel. We recognise that international travel is required on occasion, but we will seek to ensure that air transport is justified.

ESB is also embedding sustainability in its learning and development framework. In 2024 we will roll out a suite of training modules in Environmental and Social Sustainability, GHG Emissions: Calculation and Measurement, Energy Pathway to Net Zero, Biodiversity and Nature Net Positivity, Circularity & Waste, and Sustainable Supply Chain Management. All staff will complete foundation training in sustainability and climate change, and a Sustainability Navigators programme has been established with volunteers from right across the Group.

'Sustainability Navigator Group - Biodiversity Workshop with Dr. Aoibhinn Ní Shúilleabháin, chair of Citizen's Assembly on Biodiversity Loss'

4.6 ESB residual emissions

We will decarbonise well over 90% of our long-term emissions in line with the SBTi Net Zero guidance[36]. However, we recognise that there may be some residual emissions – emissions that are truly 'hard-to-decarbonise' or emissions that are not under our control.

Negative carbon technologies and offsets can play a small yet important role in this regard. ESB is committed to only using offsets obtained through credible and certified mechanisms. Only to be used when absolutely necessary, these could include carbon removal technologies such as bioenergy with carbon capture and storage (BECCS) and direct air carbon capture and storage (DACCS), or local initiatives such as peatland rewetting or forestry expansion. Moreover, we will limit the use of external offsets, only utilising them if no internal mechanism is feasible and if they can deliver real cuts to our emissions. ESB's Emerging Technology team is investigating negative emission technologies and actively seeking to be involved in pilot projects.

4.7 Governance, risk and financial frameworks

4.7.1 Governance framework

ESB must align the entire organisation around our purpose and our strategy to reach net zero by 2040. This includes our financial planning and business development, which must ensure that social and environmental aspects are considered and assessed. The Group has already made good progress here. We have raised three green bonds to date, attracting sustainable investors to our bond issuances. ESB has also put a Sustainability-Linked Revolving Credit Facility in place with a group of 13 international banks – enabled by the proactive approach we have taken to climate and environmental governance.

ESB has governance structures in place for environment and sustainability, and our net zero transition will sit within those structures. In addition, we have established a comprehensive programme to implement enhanced reporting standards, systems, processes, resourcing, organisation, and governance arrangements to enable the Group to deliver leading ESG performance and transparency, and to meet all external requirements. We will report regularly on our net zero transition progress including updating this document at regular intervals.

Climate risk and opportunity is integrated into the strategic review process in ESB. It is also linked to the Enterprise Risk Management (ERM) process through a Principal Risk on climate. The Safety, Sustainability and Culture Committee of the Board monitors the management of safety, environment and climate risk and climate opportunities. The Audit and Risk Committee oversees the overall ERM process for ESB Group. The Committee reviews risks throughout the year as well as having a 'deep dive' day on risk, including climate risk. The Environment and Sustainability Leadership Team, a group of senior managers from across the Group, receive regular updates on environmental, sustainability and climate issues. The Group Safety, Health and Environment Manager and the Environment and Sustainability Manager are members of this group. The Environment and Sustainability Managers group provide day-to-day updates on environment and sustainability and pool knowledge across the Group. This governance structure is illustrated below.

Governance for Environment and Sustainability

36 The SBTi Net-Zero Manual & Criteria 2021, SBTi: https://sciencebasedtargets.org/resources/files/SBTi-Corporate-Net-Zero-Manual-Criteria_Pre-Launch-Public-Consultation.pdf

4.7 Governance, risk and financial frameworks (continued)

4.7.2 Risk management framework

Approach to risk management
The effective management of risks and the pursuit of opportunities supports the development and implementation of ESB's strategy while protecting the interests of its stakeholders and stockholders. ESB is exposed to a number of risks and opportunities which could have a material impact on its performance and long-term development. The effective identification, management and mitigation of these risks and opportunities is a core focus of ESB Group.

How ESB manages risk
The Board has overall responsibility and accountability for risk management and internal control. The Board must also ensure that an appropriate culture has been embedded throughout the organisation to ensure that risks are assessed and managed effectively. The Board ensures that the Group's risk exposure is proportional to the pursuit of its strategic objectives and creation of longer-term stockholder value. It has adopted a Risk Management Policy to support its oversight of risk throughout the Group.

Effective risk management is critical to ESB achieving net zero by 2040, and to the long-term sustainable growth of our business. The rapid changes taking place in ESB, the market and the regulatory and operating environment in which we operate, make it essential to continuously reassess risks and have clear strategies and controls to manage them and, as appropriate, leverage any opportunities they present.

ESB has a dynamic risk management approach that enables the Group to identify, analyse and manage risks to help identify potential exposures as soon as possible. Our Strategy Framework informs (and is informed by) the ESB ERM process, including the ESB Group Risk Appetite Statement as well as the processes to identify Group Principal and Emerging Risks.

Right across ESB Group, we are significantly reliant on the policy and regulatory landscape being supportive of the investments and changes needed to implement our strategy. We face risks in delivering net zero by 2040. The key risks are documented below and are comprehensively captured within ESB's ERM. ESB reports in detail on its approach to risk management, including Group Principal Risks, in its Annual Report.

Scope 1 Risks

1 Delay to decarbonisation of electricity systems
ESB's Scope 1 emissions reduction relies on our own actions in building more renewable and flexible assets, but also in the wider decarbonisation of electricity systems.

Against the backdrop of year-on-year increases in electricity demand to 2030, a significant acceleration of renewables across the markets we operate in is required, to reduce the required operation of our thermal plant.

Otherwise, our total emissions will likely not reduce in line with our projections.

2 Delay to rollout of system services in SEM
The rollout of new system services will play a significant role in enabling increased levels of non-synchronous penetration on the system.

Further delays in implementing the new system service framework in SEM places upward pressure on our emissions in 2030 and beyond.

3 Lack of progress in hydrogen policy, regulatory framework and investment
ESB has a large dispatchable generation portfolio across Ireland, NI and GB. The transition of these units to hydrogen forms a key part of our net zero strategy. If we do not see progress on the policy, investment and regulatory framework for hydrogen and hydrogen storage at a national level, we may not be able to transition from fossil fuels in the 2030s in line with our strategy.

4 Lack of alternatives to SF_6 usage
Across the group, ESB uses SF_6 gas in various switchgear installations. Although it forms a small portion of total GHG emissions, clarity is still lacking on alternatives or on the legislative timeline for its elimination. ESB may be limited in its ability to pivot from SF_6 absent a broader industry solution.

5 Delay in transitioning heavy goods vehicles
Our Networks businesses have bespoke built utility Heavy Goods Vehicles (HGVs) in their fleets. These will transition to zero carbon fuel sources, but this transition will be subject to the offerings from vehicle manufacturers. If there are delays in vehicle offerings, then a knock-on impact on our net zero target is possible.

Scope 2 Risks

6 Delay to decarbonisation of national electricity systems
As the owners of electricity transmission and distribution systems, ESB accounts for the losses on these networks in our inventory. The reduction in emissions from these losses is tied to the decarbonisation of the underlying electricity system. If decarbonisation is delayed, ESB could struggle to meet our interim 2030 or final 2040 targets.

Scope 3 Risks

7 Lack of ambitious policy and regulation to drive electrification of heating
Emissions from products sold will form an increasing portion of our emissions on the pathway to net zero in 2040, as customer numbers increase, and other Scope 1 and 2 emissions reduce.

While ESB has initiatives to support customers in their transition to low carbon solutions, there is a significant reliance on Government policy and the regulatory environment. If significant progress isn't seen in heat decarbonisation policy in the coming years, our ability to stay on a 2040 net zero trajectory becomes very challenging. There is a further challenge here where Governments are targeting 2050 for net zero heating while ESB is targeting 2040.

8 Developing renewable gas production capacity
Decarbonisation of high temperature process heat in industrial and commercial applications will require solutions beyond electrification. The provision of renewable gas either in the form of biomethane or hydrogen provides a means of decarbonising this sector. The development of an indigenous biomethane production capacity to meet the ambitious policy targets set in the Climate Action Plan for Ireland will require support that is not in place yet.

9 Supply chain targets of net zero 2050
Although small overall, the capital goods purchases by ESB have associated emissions which are accounted for in our emissions inventory. These are expected to increase before 2030 given additional net zero investments required in generation and networks.

To reach net zero we will rely on the manufacturers of the products we purchase to deliver zero carbon products. We will work with our suppliers to ensure we get access to low and zero carbon products, but there are risks for ESB where these manufacturers are working to a 2050 net zero target while we have more ambitious 2040 target.

The risks set out above are those observed at the time of preparing this report. ESB reports in detail on its approach to risk management, including Group Principal Risks, in its Annual Report.

4.7 Governance, risk and financial frameworks (continued)

4.7.3 Financial framework

The investment required to achieve our net zero target will be significant, and one of our key priorities will be to maintain the financial strength required to deliver on our strategic commitments. We are committed to maintaining consistently strong financial performance, underpinned by efficiency and investment discipline, to ensure that we can maintain a strong investment grade credit rating and secure optimal long-term funding to match investment plans for our net zero future.

ESB is rated A- (BBB+ on a standalone basis) and A3 (Baa1 on a standalone basis) with S&P Global Ratings and Moody's respectively as of December 2023, and it is our intention to maintain our credit rating of BBB+/Baa1 on a standalone basis out to 2040.

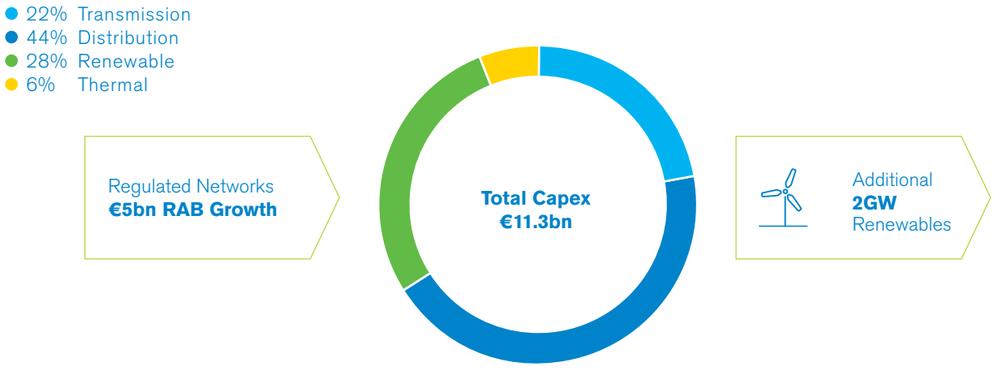
ESB conducts an annual five-year integrated business planning process which is aligned to our net zero strategy. In November 2023, the ESB Board approved plans for the period 2024-2028, which commits ESB to deliver an additional 2GW of renewable generation by 2028 together with significant investment in our networks. This will enable us to reach our key objectives of generating and connecting renewable generation, providing resilient, reliable infrastructure, and enabling our customers and communities to achieve net zero.

A high-level summary of the output of our five-year planning process (2024-2028) is outlined below. We anticipate that both Capital Expenditure (Capex) and Earnings Before Interest, Taxes, Depreciation and Amortisation (EBITDA) will grow further throughout the period to 2040, enabling us to deliver the investment required to deliver our net zero strategy while maintaining our financial strength.

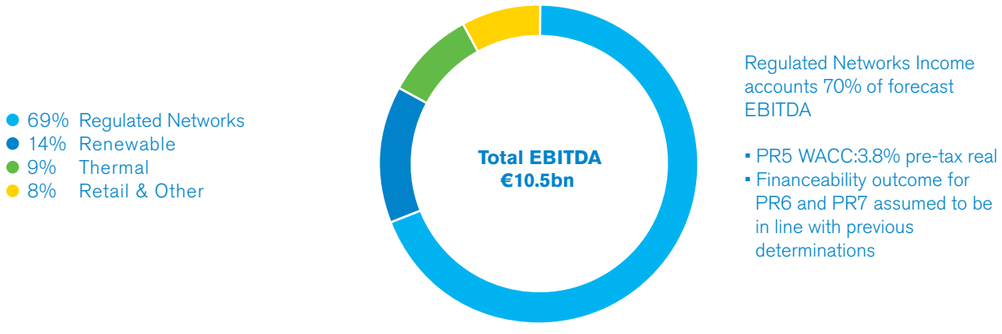
This investment plan will be funded by a combination of earnings and external debt. If credit rating metrics come under pressure at any point in the plan, ESB may choose to implement one or more financial flexibility options identified internally to ensure existing ratings are retained.

It is anticipated that gearing will remain below 60% for the life of the plan.

Graphic - 5 Year Capex Plan 2024 – 2028



Graphic - 5 Year EBITDA Plan 2024 – 2028



4.7.4 Science-based targets accreditation

As part of our *Driven to make a Difference: Net Zero by 2040* strategy, ESB committed to setting and achieving a science-based emissions target (SBT) for 2030. SBTs are used by companies to complement net zero commitments by setting nearer term targets, to show that they are on track to meet the longer-term goals.

ESB has been working to establish whether it is still feasible to achieve certification of a target under the Science Based Targets Initiative (SBTi) methodology. Since ESB first committed to SBTi, the required emissions reduction has become more stringent, moving from a "well below 2°C" requirement to a "1.5°C" requirement. Coupled with delays in the pace of offshore wind deployment in Ireland and in Great Britain (GB) and continued demand growth, this has increased uncertainty over ESB's Scope 1 emissions in 2030. If offshore wind deployment and output in these markets is lower than originally expected in 2030, it is likely that ESB's thermal plant will run more to maintain security of supply – increasing ESB's Scope 1 emissions. Similarly for Scope 2 emissions arising in the networks businesses, uncertainty over the expected carbon intensity of the power system in 2030, driven by the same factors affecting Scope 1 emissions, will impact the level of ESB's Scope 2 emissions and the assurance that targets can be achieved by 2030.

For Scope 3 emissions, setting an SBT requires an explicit reduction target in line with a 1.5°C reduction pathway. ESB has observed that decarbonisation of the heating sector is expected to greatly accelerate after 2030 as capacity and capability builds towards the end of this decade. ESB's Customer Solutions business sells natural gas in Ireland and the UK, and the decarbonisation trajectory of these customers is not in line with setting an SBT target.

Given these medium-term uncertainties, in many cases beyond ESB's direct control, we are not at this time in a position to set an SBTi accredited science-based target for 2030.

While it is a serious finding that our expected position in 2030 does not currently fit with an accreditation within the SBTi framework, this does not mean that ESB's net zero ambitions for 2040 cannot be met. This is because governments in both jurisdictions have legislated for net zero and have policies to support the same. In Ireland, for example, it is projected that significant offshore wind will connect to the system and further initiatives for zero carbon dispatchable generation will come forward which will support ESB's net zero trajectory.

During 2024, ESB will undertake a strategic review of options for a science-based plan to assess how a science-based target (SBTi or otherwise) could be achieved. This may require changes to ESB's plans and will be dependent on a supporting policy and regulatory framework from the relevant authorities.

ESB is publishing this 2040 Net Zero Pathway Report to demonstrate to stakeholders that it has a credible pathway to reducing emissions including near-term goals to measure progress towards that 2040 ambition.

5. ESB within a society-wide coordinated response

We are now working towards net zero by 2040 through our strategy and business plans. We know we cannot do this alone and that achieving net zero in Ireland and the UK requires a whole-system approach.

We need the support of our stakeholders to reach our ambitious goals. We need continued clear and bold policy from Governments, implemented through adaptive, stable and supportive regulation.

As the countries we operate in move towards their national goals of net zero, all energy providers must act in unison. We need our fellow energy companies, as well as the companies we work with, to implement their own robust net zero targets. Furthermore, our suppliers will need to move towards net zero as we take our Scope 3 emissions into account in our 2040 objectives.

We will rely on our customers to share our net zero vision and be partners in reaching this essential goal. We appreciate that this is no small ask, as participating fully in the national transition to net zero requires behavioural change at a large scale. We will be there to support our customers at every step along the way as they move to electric heating and transport and as they transition to better insulated dwellings and businesses.

At ESB, we are ready to collaborate with all involved to ensure we are all pulling in the same direction. This and the coming decades are critical to limiting the impact of climate change and we need to be aligned on the action required.

To achieve our ambitious goals, we have important asks of Governments and regulators. These are linked to our three Strategic Objectives in areas where the regulatory and policy landscape is not complete or where further improvements are required. ESB is also publishing a report “Ireland’s 2050 Net Zero Roadmap”, which sets out the detailed actions required to deliver a secure and resilient electricity system as the backbone of a 2050 net zero economy in Ireland.

5.1 Decarbonised electricity

Our greatest impact will be decarbonising electricity, ensuring that our networks businesses connect the required generators to decarbonise the system, and that the power we produce ourselves is clean.

- **Electricity grid expansion** – Our decarbonisation plans rely on the expansion and reinforcement of the electricity grid, through the addition of lines, substations, and new technologies. Our networks businesses need a regulatory and network planning framework that supports this expansion at a rate which stays ahead of customer demands. As more transport and heating energy requirements move to the electricity grid, revenue controls will likely become more complex and charging arrangements become more important. The regulatory framework must continually evolve to meet the needs of the net zero goal.
- **Renewable electricity framework** – To achieve carbon reduction targets, Ireland will need to connect very significant amounts of new renewable generation each year. To do this, there needs to be a planning, policy and regulatory framework in place for renewables which supports this ambition and adapts to the changing requirements of the energy system. This involves ensuring that relevant Government agencies and local authorities are mandated and resourced, and that regulatory issues are addressed – such as increasing onshore wind, unlocking hybrid connections and bringing forward floating offshore wind projects. In this context, policy makers in Ireland should set the objective of a net zero electricity system by 2040 in order to achieve an overall net zero energy system by 2050.
- **System services framework** – Incorporating increasing amounts of renewable electricity generation requires far more system services, ensuring the safe operation of the network. These include voltage control, inertial response, reserve provision, and ramping margin provision. ESB will be a major player in facilitating and providing these services, making it important to complete the underlying framework. In Ireland and Northern Ireland, the System Services Future Arrangements must be implemented in a timely manner to ensure that 2030 targets can be met, putting us on an achievable pathway to net zero.
- **Market design** – The current electricity market design will need to change to transition to net zero. While incremental changes will be made for 2030, more fundamental changes will be required to ensure that new zero carbon generation can build a business case, that existing generation is remunerated appropriately, and that customers get the best value for money. This discussion has started in GB and at EU level, and it is vital that Ireland and Northern Ireland stay involved in shaping discussions and acting early to ensure the new arrangements are developed in a timely manner.

Floating offshore wind will be key to delivering a net zero electricity system and economy and has been identified in the Programme for Government. The development of port infrastructure, such as the proposed port development at Green Atlantic @Moneypoint, will be critical to the construction and deployment of floating offshore wind. Specific support will be required to deliver these technologies. This could be a dedicated payment for a first-of-a-kind installation or a specific category in an auction. This technology is ready and ESB is aware of various projects which could be advanced.

5.2 Resilient infrastructure

Electricity will make up close to 70% of final energy demand in a net zero energy system in 2050, up from 20% at present. Resilience is important today, but it takes on an added significance as more and more of our everyday energy requirements rely on electricity. The net zero electricity system needs to be accompanied by security of supply and resilient policies and actions. To incorporate the increasing volumes of renewable generation, other technologies also need to develop to ensure the system is sufficiently robust to cater for a range of potential further unknowns. This resilient infrastructure is essential for ESB to achieve net zero by 2040, and it requires others to take the following actions:

- **Long-term strategy on greenhouse gas emissions reduction** – Planning the net zero energy system requires a long-term system outlook to facilitate long lead time investments and to avoid building new fossil fuel assets that will ultimately be stranded. It is important, for Ireland in particular, that the long-term emissions reduction strategy is regularly updated and reviewed to reflect evolving scientific consensus and technological developments.

- **Zero carbon dispatchable generation** – There must be sufficient zero carbon dispatchable generation in the SEM and GB to provide backup when renewables are not available. Policies are needed to enable companies such as ESB to plan new zero carbon generation or to retrofit existing plants where feasible, and to move away from current market arrangements which continue to incentivise fossil fuel generation for back-up.

- **Security of supply and energy storage framework** – The island of Ireland has an opportunity to achieve energy independence, and possibly export energy. This is in stark contrast to our high import dependency today. Clear, long-term strategies and policies are required to achieve this, including mandating levels of operational and strategic storage to cover prolonged periods with low levels of renewables output. A strategic storage framework needs to unlock development of multiple seasonal energy storage projects. It should also include targets for large scale renewable energy storage, accelerate a licensing process to enable them, and establish the commercial incentives to promote them. Ireland has published an energy security package for 2030. It will be important that this is implemented and that further iterations of the strategy take the longer-term 2050 net zero requirements into account.

- **Hydrogen strategies** – Hydrogen will play a key role in long duration energy storage – and this storage will likely be the largest hydrogen application on the island. Hydrogen will be used in hard-to-electrify sectors and it also offers export opportunities given the expected supply deficit of hydrogen in major economies in Europe. ESB believes that identifying and designating specific renewable energy and hydrogen clusters can help promote hydrogen production and demand in tandem. Given this, it is important that published hydrogen strategies are implemented to support development of this emerging industry.

- **Smart and reliable networks for electrification** – A highly resilient electricity network is key to enabling a net zero energy system. The distribution system will transfer much greater volumes of electricity and will need to cater for different customer preferences and distributed generation. As the system decarbonises and we see greater electrification of demand, it is crucial that network companies are supported in staying ahead of demand and flexibility requirements, through revenue controls, system services and the planning system. Cybersecurity will be increasingly important, given the significant reliance on the electricity networks, and policies and procedures will need to evolve to address growing cyber threats.

5.3 Empowered customers

Customers must be at the heart of the transition to a net zero energy system since their choices and actions will drive decarbonisation. We will ask customers to significantly change how they consume electricity. We know this will be challenging, for some more than others. While ESB believes there is appetite for this, the right empowering frameworks need to be put in place to support this shift.

- **Digitisation and electrification strategy** – In the transition to net zero, digitisation and electrification go hand in hand. Smart meters are already unlocking new benefits to customers, but we must build upon this. We must unlock barriers to electrification such as charging structures and planning requirements, and we must ensure that greater digitisation of the energy sector is enabled and encouraged. A stakeholder forum should be established to gather evidence and best practices for customer engagement in the transition and the findings from this should be used to inform propositions to customers. Collaboration will be required here between network companies and energy suppliers, as well as support from Governments, regulators, and consumer organisations. All of this should come together in an electrification and digitisation strategy.

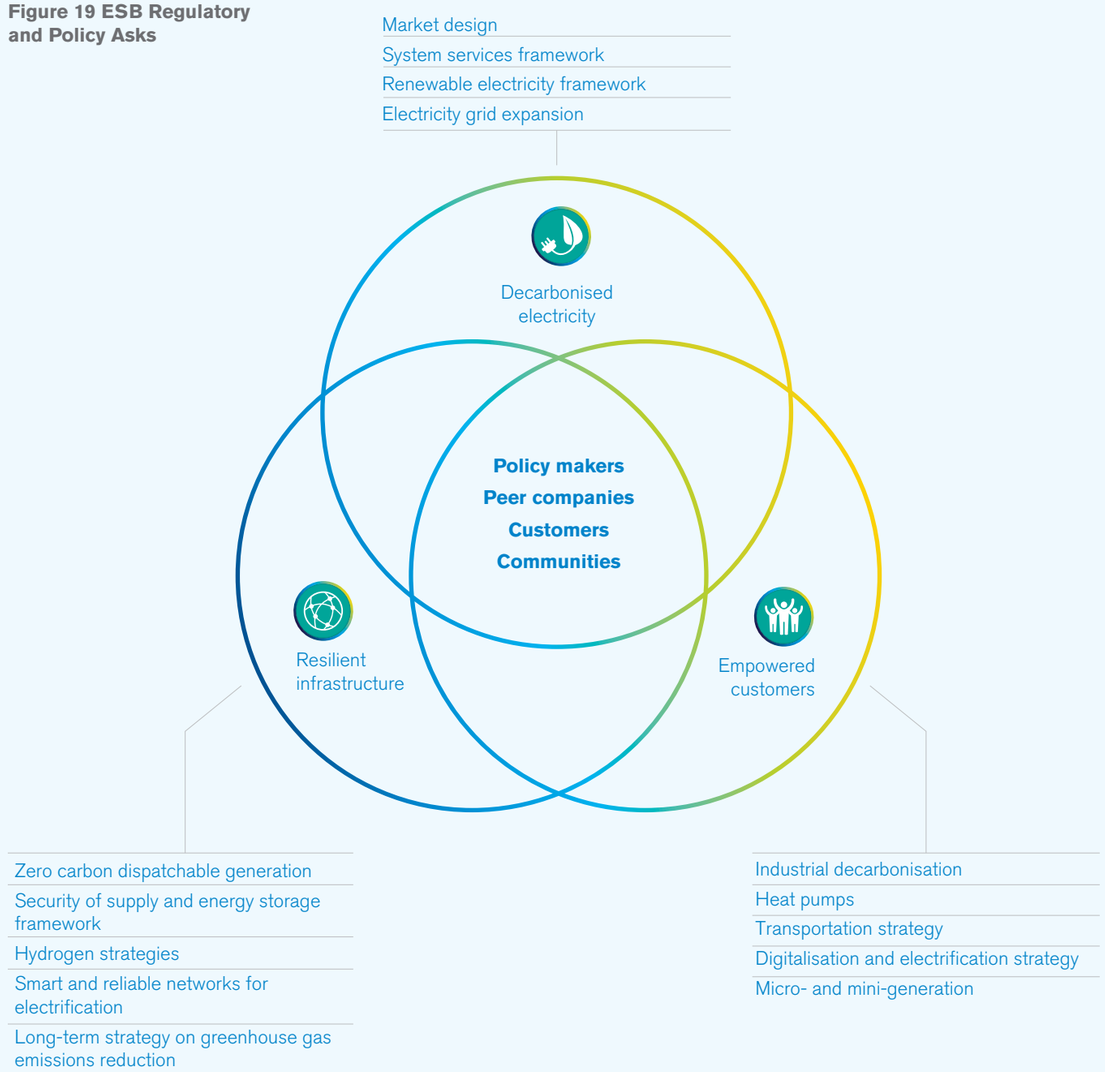
- **Transportation strategy** – A modal shift, alongside electrification, must play a role in our transition to a low carbon transport system. If we do not see this modal shift, the roads will need to be reinforced and duplicated at great expense to the public purse, while at the same time we will endure crippling congestion costs. To this end, significant focus must be placed on transitioning to greater use of active travel, public transport, shared mobility and new transport forms like e-scooters and e-bikes. Nonetheless, road vehicles will still be required and where possible these should be electrified. Transport strategies with appropriate resourcing need to be in place to map out the transition to zero carbon transport, and to identify charging and refuelling requirements and need for monetary or regulatory support.

- **Micro- and mini-generation** – Small-scale generation will play a key role in the transition. As solar costs reduce, an increasing number of panels will be installed as citizens become more personally involved in the transition. It is important that customers and communities are supported in this and that strategies for small generation are finalised, involving connection processes and availability of required installers and appropriate supports.

- **Heat pumps** – The mass deployment of heat pumps is crucial to achieving net zero in Ireland and needs to accelerate rapidly. Installing fossil fuelled boilers in new buildings is not compatible with our net zero ambition and we must stop doing this immediately. In addition, there are large parts of the domestic and commercial building stock that are ready for heat pumps today with minimal energy efficiency upgrades, while others will require varying levels of retrofits. Building regulations need to prohibit fossil fuelled boilers in new builds and strategies are needed for rapid deployment of heat pumps in existing buildings. Where district heating can be made to work, it should be rolled out with zero carbon electric heating sources where no sustainable waste heat is available.

- **Industrial decarbonisation** – Industrial decarbonisation requires specific attention from policy makers and regulators. High temperature heat pumps will play a major role, as will other technologies such as hydrogen and bioenergy. A Contracts for Difference (CfD) support mechanism should be developed and made available to accelerate the uptake of zero emission technologies in industry.

Figure 19 ESB Regulatory and Policy Asks



As outlined above, there are many wider infrastructure requirements for ESB to achieve net zero GHG emissions by 2040. We are not alone in this journey. Collectively through cooperation with all stakeholders, we can accomplish the change needed to deliver our net zero ambition alongside the Irish and UK Governments' national goals.

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