Scottish & Southern Electricity Networks

TRANSMISSION

Getting to Net Zero

The critical contribution from electricity generated in the north of Scotland

ssen-transmission.co.uk

Leading the way to net zero

Context for this report

In 2021 we published, "Getting to Net Zero: The critical contribution from electricity generated in the north of Scotland," which showed how the north of Scotland contributes towards meeting low-carbon electricity demand across the UK, and towards meeting the UK's net zero targets. Our previous report indicated that the region could contribute up to 10% towards the total emissions reduction required for UK net zero targets by 2050.

Since we published our previous report, there has been significant refinement to Government policy, driven by the growing urgency to establish an energy system which provides the UK with greater energy independence, whilst simultaneously accelerating progress towards net zero. This is reflected in the UK Government's publication of the British Energy Security Strategy and Net Zero Strategy.

Following on from this, the Electricity System Operator (ESO) has recently updated its Future Energy Scenarios (FES) which indicate that the projected level of low-carbon generation in the north of Scotland has increased by more than 70% compared with results in the 2021 FES.

This report revisits our 2021 analysis taking into account changes in Government policy and updated modelling of the pathway to net zero.

Key findings

Using the ESO's Consumer Transformation scenario, our analysis finds that:

- By 2030, the north of Scotland could meet more than one fifth of the UK's low-carbon electricity needs
- By 2050, nearly a third of the UK's electricity demand could be met by the north of Scotland

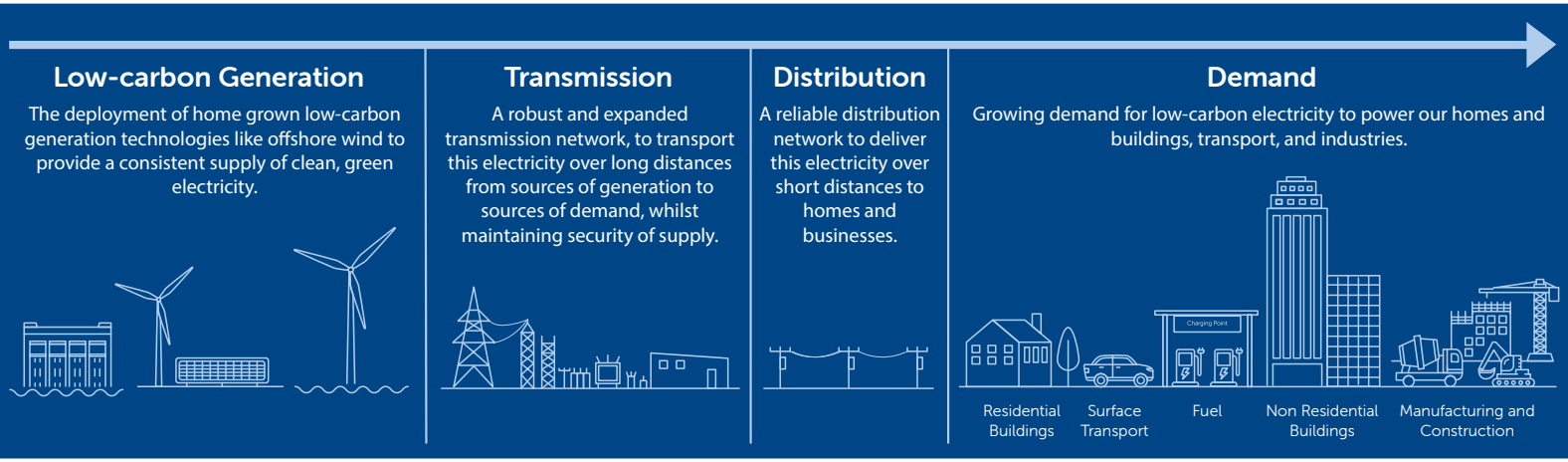
This means that if the UK follows the Climate Change Committee's (CCC) Balanced Net Zero Pathway, electricity generated in the north of Scotland has the potential to drive the following carbon reductions:

- 9% of the UK emissions reductions[1] required by 2030 (80 $MtCO_2e$)
- 16% of the UK emissions reductions[1] required by 2050 (1,580 $MtCO_2e$)

The key drivers of this transition include a significant increase in renewable electricity generation, robust transmission and distribution networks, and increasing demand. Electricity demand is set to grow by 50% by 2035 and by over 100% by 2050, driven by changes such as the switch to electric vehicles, home heat pumps, and the electrification of energy-intensive industrial processes. This is illustrated in Figure 1

This analysis shows that the north of Scotland is set to play a leading role in enabling decarbonisation and reaching net zero across the UK.

FIGURE 1: System level requirements



[1]Cumulative, relative to the UK CCC's Do Nothing Pathway.

Approach to analysis

Consistent with the previous report, the analysis undertaken for this report draws on the Balanced Net Zero Pathway from the UK Climate Change Committee's (CCC) Sixth Carbon Budget and the Consumer Transformation scenario for the north of Scotland from the Electricity System Operator's (ESO) recently updated Future Energy Scenarios (FES).

The analysis sets out to demonstrate the contribution that the north of Scotland could make to meeting the UK's net zero targets. To answer this, we have applied the methodology outlined in figure 2, and described on pages 5-9

Figure 2: Methodology outline

Step 1:
What contribution does the north of Scotland make to meeting the UK's low-carbon electricity demand?

a) We examined the low-carbon electricity technologies deployed and planned in the north of Scotland, using the ESO's FES.

b) For each technology type, we then converted the generation capacity in megawatts (MW) into electricity output in terawatt hours (TWh).[2]

c) The electricity output (TWh)[2] was then compared with the total UK low-carbon electricity demand, as projected in the UK CCC's Sixth Carbon Budget.

Step 2:
What contribution does low-carbon electricity make to cut UK GHG emissions?

a) We used the Sixth Carbon Budget to calculate the potential greenhouse gas (GHG) emissions reductions achieved through the production of low-carbon electricity and its use in electrifying key sectors of the economy.

b) We then took the proportion of UK electricity demand met by the north of Scotland and applied the same percentage to the GHG emissions reductions calculated

Step 3:
What contribution does the north of Scotland make to meeting the UK's net zero targets?

a) The GHG emissions reduction from low-carbon electricity generated in the north of Scotland [Step 2] was compared against the total GHG emissions reduction required to meet net zero.

b) This determined the overall contribution of low-carbon electricity generated in the north of Scotland to UK net zero targets.

Updates to our approach

The enhanced dataset provided within this year's FES has enabled us to integrate hydrogen production into the analysis, addressing a previous gap. In addition, we have adopted a more conservative approach by excluding energy storage technologies and interconnectors, given that that their primary role is to help manage the intermittency of renewable energy sources by providing a secure supply of electricity when the wind doesn't blow, and the sun doesn't shine.

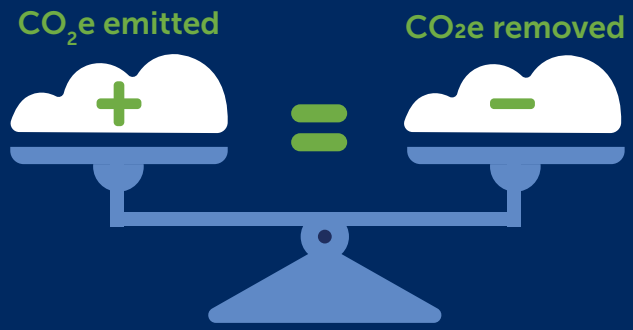
[2]We used region-specific load factors where available to convert generation capacity into electricity output. For technologies where this was not possible, national load factors were derived from the ESO FES.

The north of Scotland's role in powering net zero

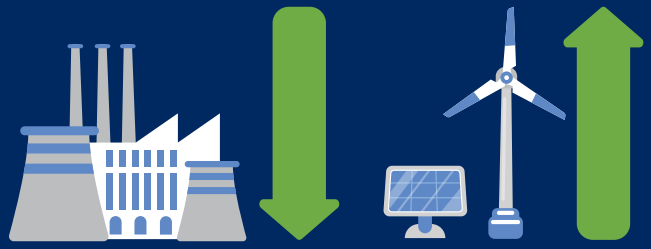
Scottish & Southern Electricity Networks
TRANSMISSION
www.ssen-transmission.co.uk

The north of Scotland plays a leading role in the UK's net zero journey to address climate change.

To tackle climate change we need to get to **"net zero"** by removing at least as much greenhouse gas emissions as we emit.



The UK Government has set a target to achieve net zero emissions by 2050, and the Scottish Government aims to do the same by 2045.



To cut the emissions we produce, we need to replace fossil fuels with renewable energy.

We need to use renewable energy to power our homes and businesses, transport, and industries.

At SSEN Transmission, we transport electricity from renewable sources in the north of Scotland to meet growing demand across the UK.

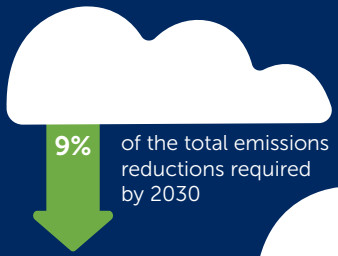
Our network is growing to help deliver even more renewable energy to homes and businesses across the UK.

Low-carbon electricity from the north of Scotland could make a significant contribution to growing electricity demand across the UK.

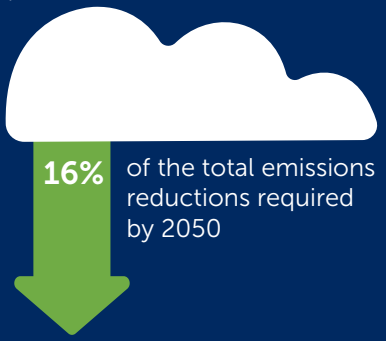
contribution to UK electricity demand in 2030

contribution to UK electricity demand in 2050

This enables crucial greenhouse gas reductions for net zero.



of the total emissions reductions required by 2030



of the total emissions reductions required by 2050

Step 1 - Contribution of north of Scotland to meeting UK low-carbon electricity demand

In order to achieve net zero UK electricity demand is set to increase, this must be met by an increase in low-carbon electricity generation.

Future energy scenarios

National Grid in its role as electricity system operator (ESO) develops Future Energy Scenarios (FES) to outline multiple electricity generation pathways out to 2050. In this report we use the ESO's Consumer Transformation scenario which would lead the UK on a pathway to net zero by 2050. This scenario is closely aligned to the CCC's Balanced Net Zero Pathway, making it a logical choice for our analysis.

In Consumer Transformation, net zero is achieved through measures which have a greater impact on consumers, driven by higher levels of consumer engagement. Homeowners make extensive changes to improve their home's energy efficiency, with a typical homeowner adopting an electric heat pump with a low temperature heating system and an electric vehicle.

The contribution from electricity generated in the north of Scotland to UK electricity demand

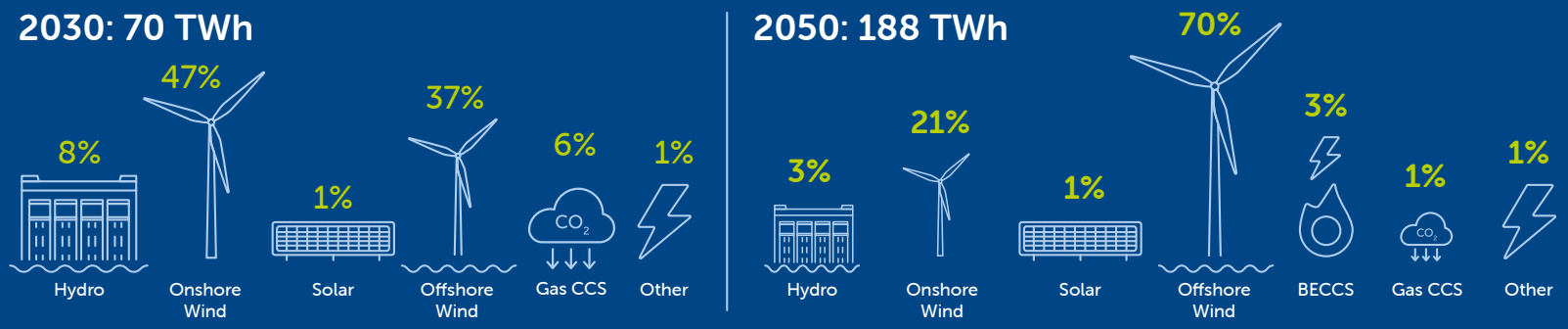
By analysing the ESO's Consumer Transformation scenario for low-carbon electricity generated in the north of Scotland, findings indicate that the region has the potential to contribute:

- **70 TWh per year by 2030, equating to a contribution of 21% towards UK low-carbon electricity demand**
- **188 TWh per year by 2050, equating to a contribution of 31% towards UK low-carbon electricity demand**

Whilst some of this electricity will be used to meet demand in the north of Scotland, the majority will be transported onwards to the rest of the UK, demonstrating the region's substantial role in the UK's energy landscape.

Figure 3 illustrates the distribution of generation output by technology type, revealing that offshore wind emerges as the dominant technology, representing 70% of total generation in the north of Scotland by 2050.

FIGURE 3: North of Scotland low-carbon generation by technology type and percentage of total share



Step 2 – Context: The UK's GHG emissions targets

The net zero target

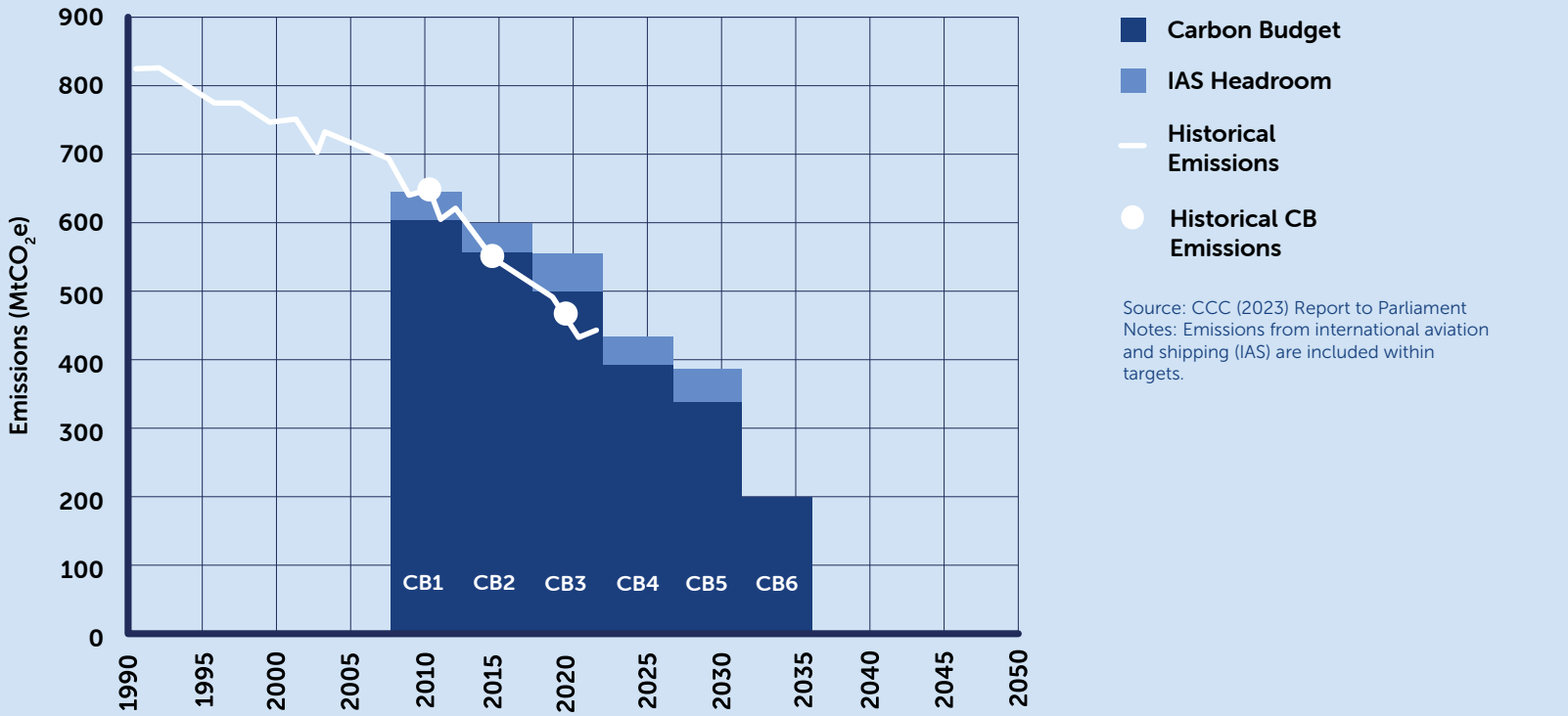
Through the Climate Change Act 2008, the UK government set stringent national greenhouse gas emissions reduction targets. The 2019 amendment further increased the commitment to net zero greenhouse gas (GHG) emissions by 2050. This ambitious target involves reducing net emissions by at least 100% compared to 1990 levels and is applicable to all sectors of the economy. Additionally, the Scottish government has set its own ambitious target, aiming to achieve net zero GHG emissions by 2045. More recently, the UK Government made a commitment to achieve a fully decarbonised electricity sector by 2035, recognising the critical role of clean energy in enabling the net zero transition.

Carbon budgets

The UK CCC provides guidance on the GHG emissions reductions required for net zero. This is primarily achieved through the development of carbon budgets (CB) which outline the allowable level of GHG emissions in the UK over a five-year period. As illustrated in Figure 4 the UK has achieved its historical carbon budgets and future carbon budgets have been put into law up to 2037.

FIGURE 4:

UK carbon budgets and historical emissions



Source: CCC (2023) Report to Parliament
Notes: Emissions from international aviation and shipping (IAS) are included within targets.

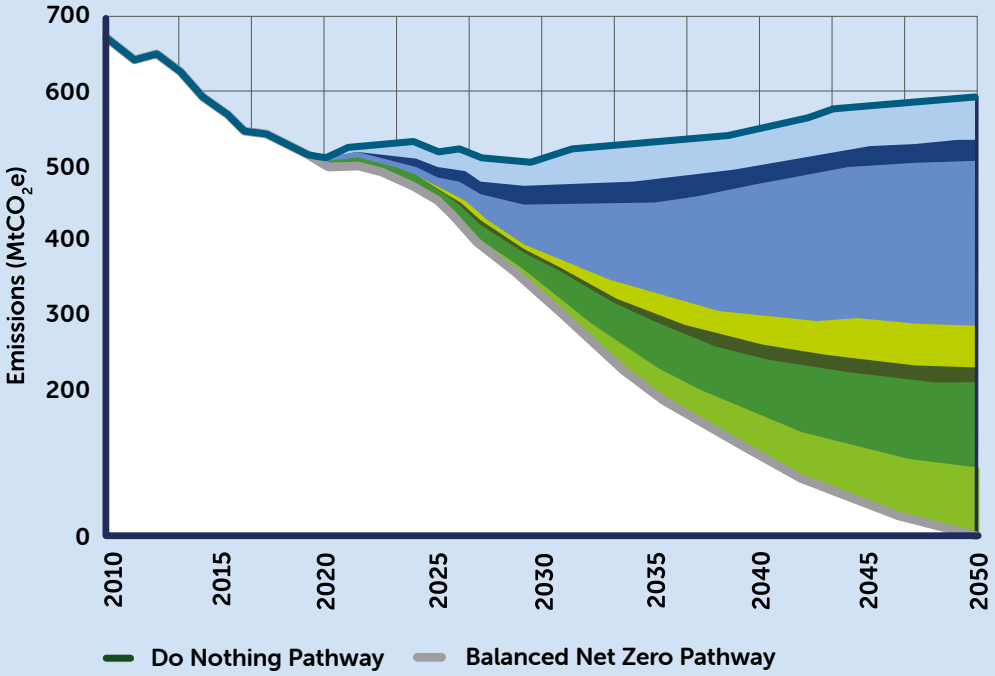
Step 2 – Context: The UK's pathway to Net Zero

The Balanced Net Zero Pathway

In its Sixth Carbon Budget, the CCC provides a set of scenarios showing different ways that the UK could achieve its short-term carbon budgets and long-term net zero target. These scenarios define the actions required in each sector of the economy and the corresponding emissions reduction over time. **This report uses the "Balanced Net Zero Pathway" scenario which represents the CCC's recommended pathway to meet the Sixth Carbon Budget.**

Figure 5 compares the emissions trajectory under the Balanced Net Zero Pathway (in the grey line) against a Do Nothing Pathway (in the blue line at the top), which represents historic emissions reductions up until 2020 and the expected growth in emissions beyond this year if no further climate action is taken. The different coloured areas between the two pathways illustrates the emissions reductions required by different abatement actions. In total, the difference between the baseline Do Nothing Pathway and the Balanced Net Zero Pathway is 9,700 $MtCO_2e$ from 2023 to 2050.

FIGURE 5:
Types of abatement in the Balanced Net Zero Pathway



Actions	Share of total cumulative emissions reductions
Reduce demand	13%
Improve efficiency	7%
Electrification	37%
Hydrogen and other low-carbon technologies	8%
CO_2 capture from fossil fuels & industry	3%
Produce low-carbon energy	19%
Offset emissions using land and GHG removals	13%

Source: BEIS (2020) Provisional UK greenhouse gas emissions national statistics 2019, CCC analysis

Step 2 – Contribution of low-carbon electricity to cut UK GHG emissions

Achieving net zero depends on transitioning away from fossil fuels and adopting low-carbon technologies for both electricity generation and demand. Figure 5 shows how the majority of emissions reductions associated with this transition come from two key actions – **producing low-carbon energy, and electrification. Together, they account for 56% of emissions cuts.**

Producing low-carbon energy

This action cuts emissions by decarbonising the UK's electricity supply. This is achieved by replacing fossil fuel-powered electricity generation technologies (like combined cycle gas turbines) with low-carbon alternatives (like offshore wind farms). Low-carbon energy generation **contributes 19% of the cumulative emissions reductions required by 2050.**

In the Balanced Net Zero Pathway, the low carbon share of electricity is projected to reach **100% by 2035**

Electrification

This action cuts emissions by using low-carbon electricity to decarbonise other sectors of the economy. The success of this action depends on the adoption of technologies like electric vehicles and heat pumps to replace fossil fuelled technologies like petrol and diesel cars and gas boilers. Making these changes may require further policy changes, incentives, and support programmes, but if successful, electrification could **contribute 37% of the cumulative emissions reductions required by 2050.**

Impact on UK electricity demand

As a result of electrification, annual **electricity demand in the Balanced Net Zero Pathway is projected to double from around 300 TWh today to 612 TWh by 2050.** Figure 7 illustrates the expected growth in electricity demand across sectors. Currently, around 30% of this electricity demand is being met by electricity generated from fossil fuels, however we will only achieve net zero targets if all demand is met by electricity generated from low-carbon sources. This is why rapid decarbonisation of the UK's electricity supply is essential to reducing emissions in other sectors of the economy.

FIGURE 6: Examples of technology replacements across sectors

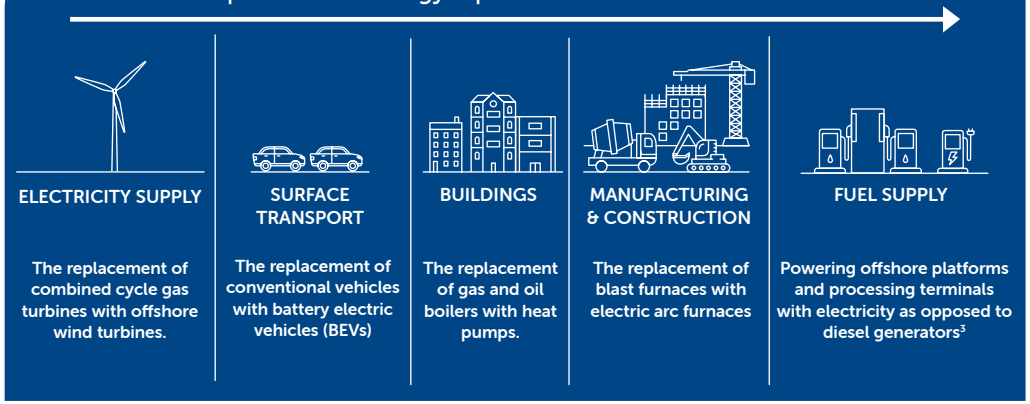
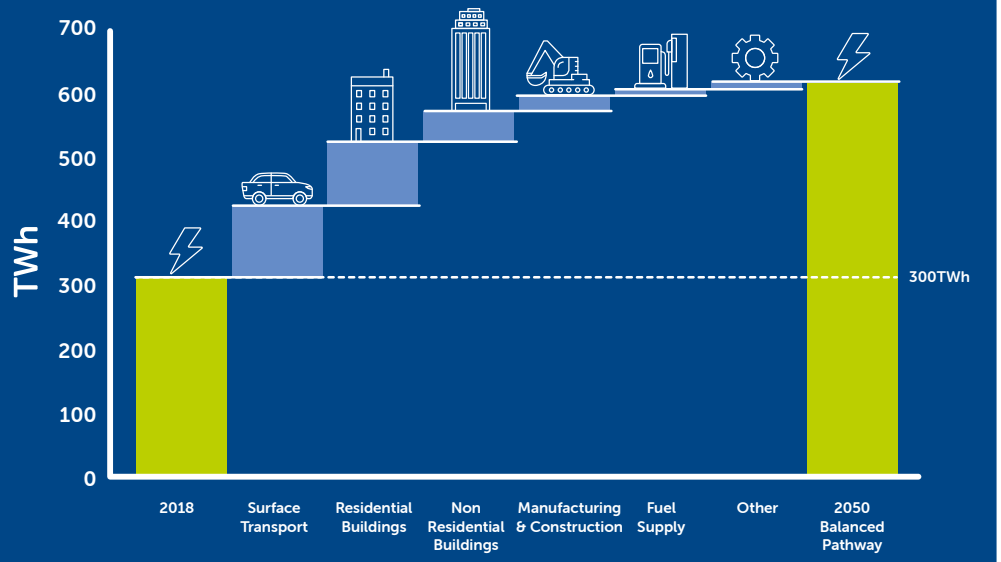


FIGURE 7: Contribution by sectors to increased electricity demand in the Balanced Net Zero Pathway



Source: CCC analysis

[3]Whilst this report focuses on decarbonising the economy to reach net zero, the oil and gas industry is likely to continue to exist in some form for some time to come. CCC analysis suggests that switching from diesel generators to electricity to power offshore platforms and processing terminals can make a meaningful contribution to the production emissions reduction efforts.

Step 3 - Contribution of north of Scotland to meet net zero targets

We have established that low-carbon generation is central to achieving 56% of the total emissions reduction required in the Balanced Net Zero Pathway, through its role in decarbonising the UK's electricity supply and reducing emissions in other sectors through electrification.

By 2030, over one fifth of the UK's low-carbon electricity demand could be met by electricity generated in the north of Scotland, increasing to almost one third by 2050.

By applying these contributions to the GHG emissions reductions achieved through the production of low-carbon energy and subsequently, its role in the electrification of other sectors, results indicate that electricity generated in the north of Scotland has the potential to achieve the following carbon reductions[4]:

80 $MtCO_2e$ or 9% of the UK emissions reductions required by 2030

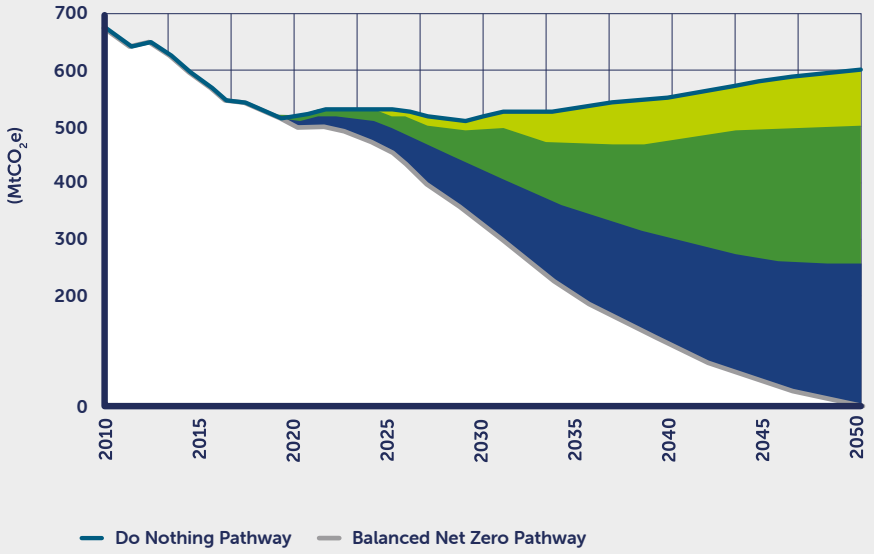
1,580 $MtCO_2e$ or 16% of the UK emissions reductions required by 2050

Figure 8 shows how low-carbon generation connected in the north of Scotland, dominated by offshore wind by 2050, compares to low-carbon generation connected in other parts of the UK, as well as other sources of decarbonisation which do not rely on low-carbon generation (see Figure 5).

By 2050 the north of Scotland's contribution to net zero is expected to be equivalent to the UK's projected emissions reductions associated with reforestation, nature restoration and carbon capture and storage (CCS).

FIGURE 8:

The contribution of low-carbon electricity generated in the north of Scotland relative to the total emissions reduction required for net zero



Actions	Share of total cumulative emissions reductions
Low-carbon electricity generated in the north of Scotland	16%
Low-carbon electricity generated elswhere in the UK	40%
Other types of abatement	44%

[4]Cumulative, relative to the UK CCC's Do Nothing Pathway.

The role of north of Scotland transmission network

Net zero targets for the North of Scotland electricity sector

As the owner and operator of the electricity transmission system in the north of Scotland, SSEN Transmission has a core responsibility to provide a robust and secure transmission network that is capable of connecting increasing levels of low-carbon generation and transporting it to sources of demand.

As illustrated in figure 9, low-carbon electricity production in the north of Scotland is projected to reach 70 TWh by 2030 and 188 TWh by 2050. For context, the region generates around 16 TWh of low-carbon generation today.

Project-level analysis: A 2030 view

The scale of efforts required to establish an electricity network capable of accommodating the output from 70 TWh of low-carbon generation is substantial. To demonstrate this, figure 9 illustrates the design of the north of Scotland electricity transmission network in 2030.

The Pathway to 2030 Programme was established from the ESO's Pathway to 2030 Holistic Network Design (HND) and includes a package of projects which form part of a major upgrade of the electricity transmission networks across Great Britain. These projects are key to enabling the connection of ScotWind offshore wind projects. We are also progressing significant new infrastructure to provide additional capacity for Skye, Argyll, Orkney and Shetland.

By comparing the annual projected low-carbon generation output associated with each project against the north of Scotland electricity sector's net zero targets, we can effectively assess each project's contribution to achieving these targets, results of which are illustrated on figure 9.

Findings suggest that the combined generation output from each of these projects, along with the region's existing generation output, holds the potential to achieve 38% of the progress required to reach the 2050 target.

Whilst this analysis has focussed on our major investment packages, it is important to note that there will also be smaller-scale projects which will enable the connection of additional renewable generation onto the north of Scotland electricity network during this decade.

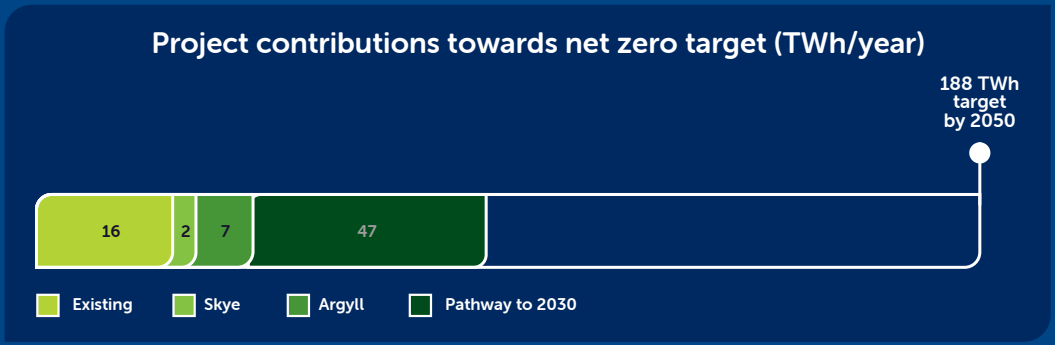
Beyond 2030

Although a considerable amount of work is planned to be delivered by 2030, Figure 9 confirms that further efforts are necessary beyond this timeframe as the UK's demand for low-carbon electricity continues to grow.

In response, work is underway to develop the HND Follow-up Exercise (FUE), a successor to the Pathway to 2030 (HND) which aims to connect even more offshore wind generation which was not in scope for the original. This work is being lead by the ESO and is expected to be published before the end of 2023.

For SSEN Transmission, this represents a second major investment package opportunity for for the 2030s, signifying the ongoing growth of our project portfolio to establish a robust electricity network fit for the future. **We remain committed to embracing the opportunities and challenges ahead as we strive to deliver a network for net zero.**

FIGURE 9



PATHWAY TO 2030

In-flight Investments

1. Argyll 275kV strategy
2. Fort Augustus to Skye 132kV upgrade
3. Orkney 220kV AC subsea link*
4. Shetland subsea link*

Pathway to 2030 Investments

1a. Beauly to Loch Buidhe 400kV reinforcement
1b. Loch Buidhe to Spittal 400kV reinforcement
2a. Beauly to Blackhillock 400kV double circuit
2b. Blackhillock and Peterhead 400kV double circuit
3. Beauly to Denny 275kV circuit to 400kV
4. East Coast Onshore 400kV Phase 2 reinforcement
5. Spittal to Peterhead 2GW HVDC subsea link
6. Peterhead to Drax 2GW HVDC subsea link
7. Peterhead to South Humber 2GW HVDC subsea link
8. Arnish to Beauly 1.8GW HVDC link
9. Aquila Pathfinder

New Infrastructure (Routes shown here are for illustrative purposes)

Upgrade/Replacement of Existing Infrastructure

Existing Network

*We are currently in the process of developing local FES for both the Orkney and Shetland projects. Once this information becomes available, we will update our analysis accordingly.

About us

SSEN Transmission is responsible for the electricity transmission network in the north of Scotland. Our responsibilities include the maintenance and investment in the high voltage 132kV, 220kV, 275kV and 400kV electricity transmission network.

Our extensive network consists of underground and subsea cables, as well as overhead lines supported by wooden poles or steel towers, and electricity substations. It extends over a quarter of the UK's landmass, navigating some of the most challenging terrains and powering our communities by providing a safe and reliable supply of electricity.

Home to vast renewable energy sources, the north of Scotland transmission network has a strategic role to play in supporting the delivery of the UK's net zero target. We're already a mass exporter of renewable energy, with around two-thirds of power generated in our network area exported south. This renewable energy is key to reducing the emissions intensity of the national electricity grid and meeting the increasing electricity demand required for net zero.

By powering homes and business throughout the UK with clean, green electricity the north of Scotland is enabling the electrification of other sectors, which is essential for emissions reduction.

Beyond this core function, we have a portfolio of commitments to reduce our own greenhouse gas (GHG) emissions. These emissions reduction targets have been externally validated by the Science Based Targets Initiative (SBTi) in line with a 1.5°C global warming pathway. A full breakdown of our emissions categories, along with the extent of progress made towards these targets can be viewed in our Annual Sustainability Report.

.

Following a minority stake sale completed in November 2022, SSEN Transmission is now owned 75% by SSE plc and 25% by Ontario Teachers' Pension Plan Board.

Scottish & Southern Electricity Networks

TRANSMISSION

If you would like a printed copy of this document or require it in an adapted format, such as large print, please get in touch so that we can accommodate your preferences.

If you are unable to access our website or reach us via email and require information about Sustainability please call our Sustainability team on +44 (0) 7827 039 550 or write to:

SSEN Transmission | Grampian House | 200 Dunkeld Road
Perth, PH1 3AQ

@SSETransmission

@SSENCommunity

Fair Tax

SSEN TRANSMISSION
AA1000 STAKEHOLDER
ENGAGEMENT PERFORMANCE
ADVANCED 2022