



The Firth of Forth:

net zero at the heart of Scotland

August 2021



Global energy transition activity has accelerated as countries strive to meet their Paris Agreement commitments and achieve a net zero economy. The UK was the first major economy to commit to a net zero target, with progress towards this largely driven by the rapid growth in the wind sector.

The UK's offshore installed capacity passed 10 GW in 2020 and is on track to meet the target of 40 GW by 2030. Whilst the UK has committed to net zero by 2050, Scotland has a 2045 target. The transformation of the power sector has been an early success, with Scottish emissions from power down 85% from 1990 levels. To sustain this momentum, some of the more intractable emissions challenges – including industrial emissions - need to be met head on.

The Firth of Forth area is Scotland's major industrial cluster. The area is responsible for more than 10% of Scotland's emissions but is critical to the Scottish economy. A diverse industrial base with refining and petrochemicals at its core, the area sustains thousands of jobs and produces multiple products and feedstocks essential to other industries, modern living and to the sustainable future society strives for. The challenge is to navigate a path to net zero while supporting economic growth and job creation. Closing industries and offshoring emissions would achieve the headline objective of national emissions reduction. But it would also have severe economic consequences, and would not reduce global emissions. With 24 years to achieve net zero in Scotland, it is time to address this challenge at the heart of the Scottish economy.

A valuable industrial ecosystem has developed in the Firth of Forth area, built on more than 250 years of international energy and trading activity. The industry, innovation and deep skill sets within this part of Scotland are vital to tackle the many technical and commercial challenges that must be faced to achieve net zero, whether in Scotland, the UK or globally. Managing and supporting the transition of the Firth of Forth area should be a priority.

Across the UK we have seen a number of net zero hubs develop around major industrial clusters, including Net Zero Teeside, Zero Carbon Humber and HyNet North West. These have attracted investment, which has spurred on net zero collaboration and initiatives that are helping to transform the industrial base of the UK. Glasgow is hosting the United Nations Climate Change Conference (COP26) in November. With the eyes of the world trained on Scotland, there is a great opportunity to launch a net zero hub for the Firth of Forth. Such an initiative for Scotland's major industrial area would be wholly complementary to the development of the Scottish cluster and Scotland's Net Zero Roadmap (SNZR). This is not about one area competing against another, but about a national effort to deliver net zero.

This paper makes the case for the Firth of Forth Net Zero Hub.



Climate change and Scotland's role

The 2016 Paris Agreement, ratified by the UK in the same year, set out the ambition to keep the rise in average global temperature to below 2 degrees Celsius, ideally limiting warming to 1.5 degrees Celsius, compared to pre-industrial levels. In 2019 the Climate Change Committee (CCC), the UK's independent climate advisory body, recommended the UK bring its greenhouse gas emissions to net zero by 2050. Furthermore, the CCC recommended Scotland achieves net zero by 2045. These targets were enshrined in law by the respective parliaments later that year. Up to 2019, average annual declines in total UK greenhouse gas (GHG) emissions had been 2.6%. In 2020, the Covid-19 pandemic saw emissions fall 8.9% to 414.1 million tonnes of carbon dioxide equivalent (MtCO₂e), a 48.8% drop from 1990 levels¹. However, this came with the economic cost of a 9.9% fall in GDP². Reducing emissions whilst sustaining the economy is fundamental to delivering energy transition and net zero.

The UK was the first major economy to commit to net zero. The country had a running start due to the success of the offshore wind sector, which had 10 GW of installed capacity by 2020 and is on course for 40 GW by 2030. This impressive growth has made the UK the global leader in offshore wind capacity. On the other hand, the UK currently has no carbon capture utilisation and storage (CCUS) operational today, but an ambitious government target of 10 MtCO₂ installed capacity by 2030. Similarly, the UK's low-carbon hydrogen production is in a nascent stage of development, but together with renewables and CCUS, is a key pillar of the future energy system. The contrasting progress of offshore wind versus CCUS and hydrogen underlines a fundamental challenge in the development of the integrated low-carbon energy system. It also highlights the need for coordinated industrial policy and a clear strategy that incorporates:

- sustained investment in new technologies, national infrastructure and industrial hubs;
- a regulatory environment fit for an integrated energy system;
- and fiscal and industrial policies that create the markets to allow the low carbon economy to flourish.

Within this context and with its globally significant renewable resources, Scotland has a critical role to play in supporting the UK's net zero ambitions. With a vast offshore renewable resource potential combined with a rich oil and gas legacy, including industry leading offshore engineering and subsurface expertise, and extensive oil and gas infrastructure, the transition from a oil and gas province into a low carbon integrated energy hub has global significance. The influential role the North Sea has played in the international oil and gas sector demonstrates the outsized impact a small region can have on a global industry.

¹<https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2020>

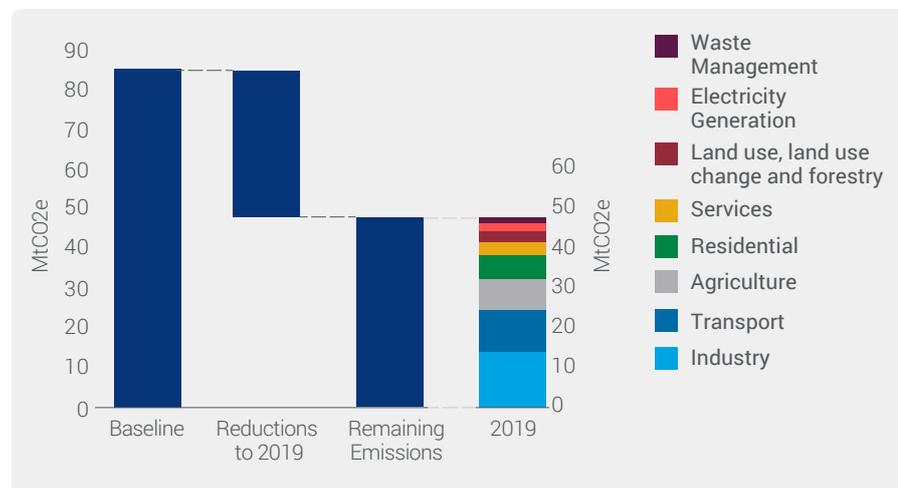
²<https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/gdpmonthlyestimateuk/december2020#:~:text=Annual%20average%20GDP%20fell%20by,production%20fell%20by%208.6%25>

³In 2020 the CCC recommended a new method of reporting emissions (the GHG Account). On this basis Scotland has achieved a 51.5% reduction.



From 1990 to 2019 Scotland reduced GHG emissions by 43.8% from 1990 levels³. This has principally been driven by the shift away from coal to renewables, but also by the decline of heavy industry. On the way to reaching a 2045 net zero target, the Scottish Parliament has committed to ambitious emissions reduction targets: 75% by 2030 and 90% by 2040. The Scottish government also set a target of 5 GW of low-carbon hydrogen production by 2030. These are major tasks and will require sustained focus and strategic investment in critical areas of the economy to ensure a sustainable and just transition. With the continuing success of the renewables sector, attention must turn to the harder-to-abate sectors, in particular transport, industry, agriculture and residential.

Figure 1: Scottish Greenhouse Gas Emissions (using Climate Change Plan emissions categories) MtCO₂e



The challenge will be to navigate a path to net zero while supporting economic growth and job creation. Shutting down industries or offshoring emissions would further the objective of national emissions reduction, but have severe economic consequences and not reduce net global emissions. Instead there need to be intense efforts to support industry's transition to a sustainable footing. This must be a just transition which protects jobs and maintains a secure supply of affordable energy. Scotland's impressive track record in reducing emissions from electricity generation by more than 85% since 1990 has shown what can be achieved. Scotland's last remaining major industrial cluster sits in and around the Firth of Forth, which stretches from the Port of Leith, on the north side of Edinburgh, to the Port of Grangemouth, 20 miles upstream to the west. A diverse industrial base with refining and petrochemicals at its core, the area is a material emitter of greenhouse gases, but it is also a vital part of the economy, sustaining thousands of jobs and producing multiple products and feedstocks essential to modern living. The Firth of Forth neatly encapsulates the challenge the UK, Scotland and other industrial economies face - a challenge that needs to be met head on. With 24 years until net zero in Scotland, it is time to address this challenge at the heart of the Scottish economy.



Firth of Forth: connecting domestic and international markets

For more than two centuries the Firth of Forth has played an important role in the global energy business. Less than 30 miles from Glasgow and Edinburgh, the Port of Grangemouth was established in 1768 as a trading hub with exports including coal, grain, flax, iron and timber. By the second half of the 19th century oil retorted from locally mined oil shales saw multiple oil refining works spring up across the area.

With a strong regional legacy in oil refining and access to domestic and international markets, the Anglo-Persian Oil Company (now bp) established the Grangemouth refinery in 1924. By the mid-20th century, Grangemouth had developed into a refining and petrochemical hub, importing oil cargoes from the Middle East through the port or by the newly established pipeline from Finnart on the west coast. With first oil from the North Sea in the early 1970s, the Forties Pipeline System was built to transport oil to the Firth of Forth, establishing it as a major logistical and trading hub for the oil business. Since 1975, the Forties Pipeline System has delivered more than 9 billion barrels of oil to the Firth of Forth, either refined at Grangemouth or loaded onto tankers at the deep-water loading facility at Hound Point for the international market.

As well as the Grangemouth refinery and petrochemical facilities, ExxonMobil and Shell opened a processing and petrochemical hub at Mossmorran on the north side of the Firth of Forth. The two plants opened in 1985 to process North Sea natural gas liquids and for the manufacture of ethylene. The Firth of Forth refining and petrochemical industry has supported the growth of businesses across the energy value chain, forming a critical part of the Scottish economy. Beyond the hydrocarbon sector, the Firth of Forth's natural harbour, multiple port facilities and access to international markets has attracted a wide range of industries including ship-building, biomass, oilfield equipment manufacture, and logistical hubs for the food and drinks sectors. The most recent addition is the Leith renewables energy hub which launched earlier this year to develop the Port of Leith into an operations and manufacturing hub for the burgeoning offshore renewables sector creating long-term, high quality jobs.

The Firth of Forth's unique characteristics

The Firth of Forth captures both the challenges the UK and Scotland face to decarbonise, but also the enormous opportunities that will emerge in a low-carbon economy both domestically and internationally. Scottish industry currently emits about 10.7 Mt of CO₂ per year, of which the Grangemouth and Mossmorran cluster accounts for about 40% of this total, or approximately 10% of Scotland's total emissions. By some margin this is Scotland's largest industrial cluster – and represents a material part of the Scottish economy. With only 24 years until net zero 2045, tackling these emissions will be fundamental to achieving this ambition. Whatever pathway the energy transition follows, refined products and chemicals will remain vital to the economy for many decades to come. Adapting and evolving their production is critical to meeting the twin goals of economic growth and net zero emissions. The Firth of Forth industrial cluster has developed over two centuries with a strong history of innovation, adapting to changing markets and consumer demands. It has powered the national economy, produced the building blocks for the pharmaceutical industry, as well as multiple materials and products essential

to modern life. The transition to a low-carbon economy is not about switching old industries off but about adapting, innovating and transitioning them to sustainable operations. The Firth of Forth industrial hub should play a central role in Scotland's net zero strategy and continue to be a driver of economic growth and job creation.

The Firth of Forth area has compelling geographic and socio-economic characteristics that make it a globally attractive industrial hub. The sheltered waters and deep-water loading provide year-round access for dry bulk and bulk liquid loading, reliably maintaining access to international markets. As North Sea oil production declines over the coming years and a low-carbon integrated energy system emerges, the bulk liquids will shift to low-carbon alternatives but trade will continue. With an abundance of renewable power on- and offshore, and the extensive sub-surface storage potential in the North Sea, Scotland's role in the global energy industry will evolve with the potential to develop hydrogen production and export, and the import and long-term storage of carbon dioxide (CCUS). With the European Union long on emissions and short of hydrogen and CCUS projects there is a major market on the doorstep. As well as the Firth of Forth's favourable physical geography, the Grangemouth industrial area and its port sit at the heart of Scotland. Less than 40 miles from 70% of the Scottish population and less than 30 miles from the centres of Edinburgh and Glasgow, Grangemouth's strategic location makes it the perfect distribution hub for today's petroleum products and for future low-carbon fuels and products. Rail and motorway facilitate local and national connections. The international airports of Edinburgh and Glasgow provide global connectivity.

Figure 2: Strategic location - Grangemouth and the Firth of Forth at the heart of Scotland



Source: Wood Mackenzie; Esri

One thing that cannot be over-stated and is a critical differentiator for the Firth of Forth, and of significant value to the Scottish economy, is the legacy of refining and petrochemical operations across the area. From the early days of refining shale oil to the modern petrochemical era, the deep technical expertise in mechanical, chemical and process engineering and the commercial experience in the oil, fuels and chemicals businesses has created a valuable pool of knowledge and expertise. World-leading universities, including Edinburgh, Glasgow, Heriot Watt, Stirling and Strathclyde, provide local companies with highly-trained engineering and business graduates, as well as leading research and development resources. This valuable ecosystem has developed over many decades and is vital to tackling the multiple technical and commercial challenges that must be faced to achieve net zero, whether in Scotland, the UK or globally. Managing and supporting the transition of the Firth of Forth area should be a national priority.

The Firth of Forth – the Forth industrial revolution

Across the UK, a number of net zero hubs have formed around the major industrial clusters such as Net Zero Teeside, Zero Carbon Humber and HyNet North West. These hubs have galvanised around their net zero identities supporting the transformation from old industrial sites to the integrated energy and industrial hubs of the future. CCUS, blue and green hydrogen production, biofuels production, renewables equipment manufacturing, offshore wind servicing and much more, developing alongside traditional industries such as steel, cement, refining and petrochemicals, supporting their transition with clean power and emission mitigation technologies. Each of these hubs has developed their own identity, creating a net zero vision and plan, and in doing so attracting investment from government and industry. Transforming these sites is complex and expensive, but essential if the UK is to maintain its industrial base and lay the foundation of the green industrial revolution. Running down and ultimately offshoring high-emissions sectors would help to meet the UK's emissions objectives, but, in the process, destroy the country's industrial base and for no net global reduction in emissions. For core industries that are vital to the economy, the UK must resolve how to cut emissions and mitigate the remainder. It is a tough line to walk but success will reinvigorate the industrial base securing jobs and the foundations of the national economy.

Figure 3: Shared characteristics of net zero hubs and the Firth of Forth





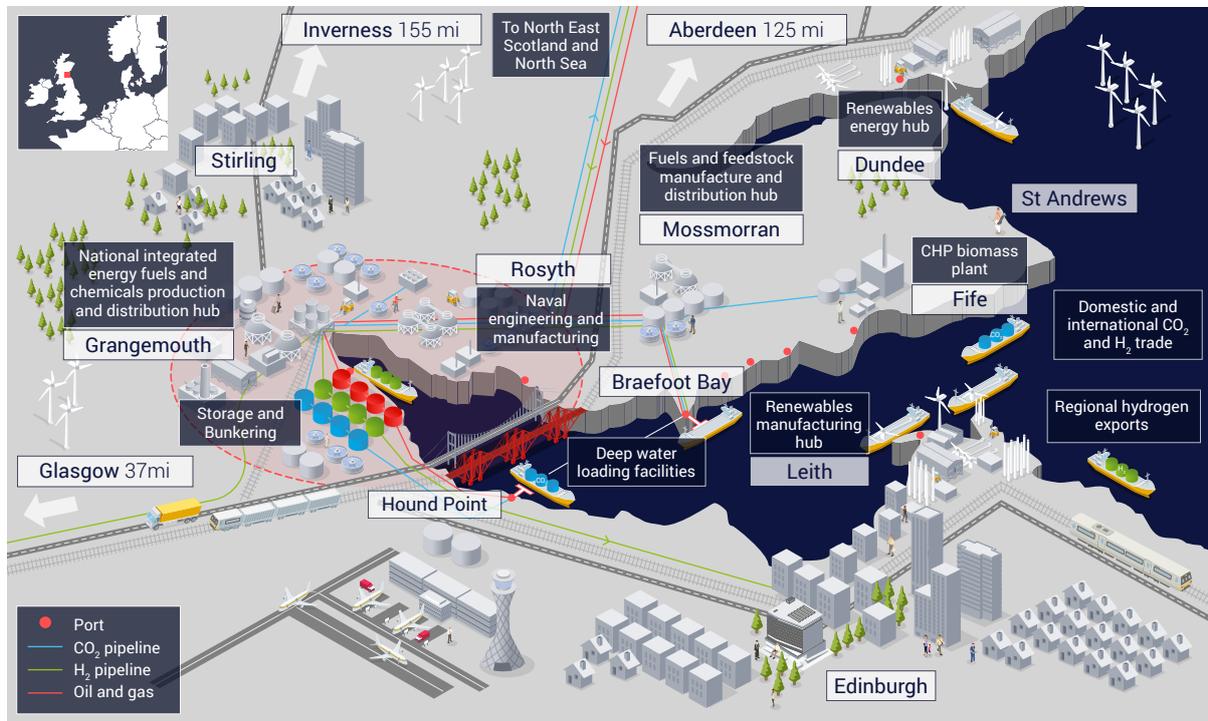
Scotland's Firth of Forth industrial hub is critical to the Scottish economy, providing employment, tax revenues, fuels, and the chemical feedstocks for industries in domestic and international markets. It is also an area responsible for more than 10% of Scotland's CO2 emissions but at the same time a centre of expertise with the skills necessary to address the multiple technical and commercial challenges faced in delivering net zero. It is a significant part of the net zero challenge but a major part of the solution and a cornerstone of the current and future economy.

Creating a Firth of Forth Net Zero Hub would acknowledge the challenge head on. It is an economically important industrial cluster that needs to tackle its emissions and fulfil its role as an important agent in the national energy transition and delivery of net zero. Developing a net zero vision for the Firth of Forth area would highlight the strategic importance of the region, draw attention to the many attractive characteristics of the area that make it such a compelling industrial and trading hub, and lead to the long-term creation of high quality jobs. Raising the profile of the area under a net zero banner will increase focus, build momentum, spark ideas and seed initiatives. As has been the case with other net zero hubs, such an ambitious project will require government support. Attracting funding requires a clear plan that defines the ambitions, lays out the challenges and identifies projects that will help to deliver on net zero. The plan must also highlight the strategic, economic and social benefits. Within the area, initiatives are already underway, but by bringing them under one globally recognisable partnership it will raise the profile, build momentum and help attract investment.

The Firth of Forth Net Zero Hub would be complementary to other Scottish energy transition initiatives. This is not about one area competing against another, but about a national effort to deliver net zero. The work being done through NECCUS on Scotland's Net Zero Roadmap (SNZR) is examining how the industrial emissions from the Central Belt to the North East of Scotland can be decarbonised. SNZR incorporates the Firth of Forth area but given that this is the largest industrial cluster in Scotland, developing its own initiative and net zero identity would only strengthen this broader national effort. The central location of the Firth of Forth, its connectedness to population and markets, and the critical industrial infrastructure and knowledge base put the Firth of Forth at the nexus of the energy transition. Creating the Firth of Forth Net Zero Hub will be an important step towards tackling the emissions challenge within the locality and also vital to the successful decarbonisation of the Scottish and UK economies.

This paper identifies the need for the Firth of Forth Net Zero Hub; however, Wood Mackenzie sees this within the global context of the energy transition. Globally, industrial clusters and ports must assess their future through the lens of the energy transition to ensure they secure the opportunities to grow their business whilst also mitigating future threats.

Figure 4: The Firth of Forth Net Zero Hub - conceptual



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