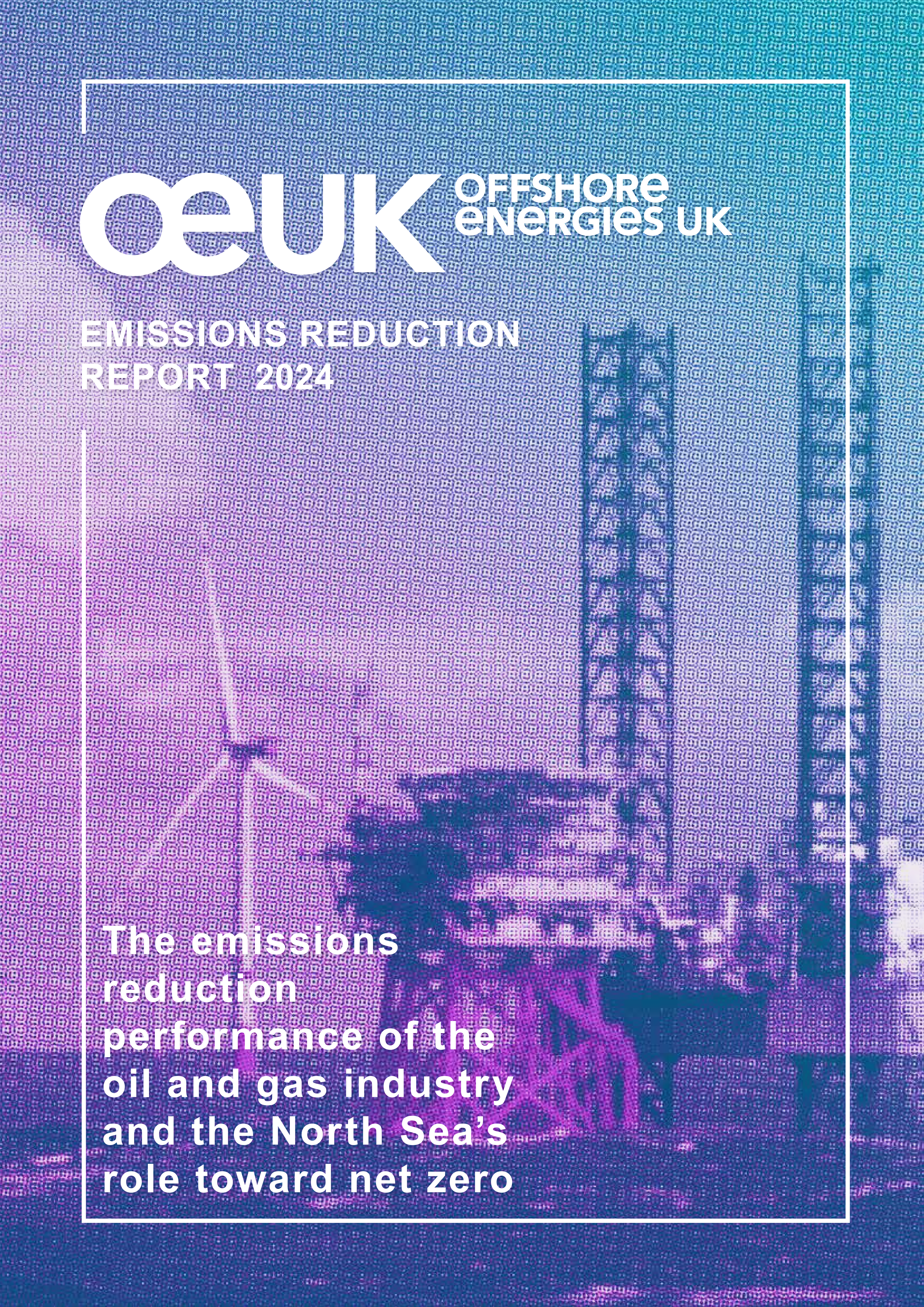

OEUK OFFSHORE ENERGIES UK

EMISSIONS REDUCTION REPORT 2024

The emissions reduction performance of the oil and gas industry and the North Sea's role toward net zero

OEUK OFFSHORE ENERGIES UK

An integrating offshore energy industry which safely provides cleaner fuel, power and products for everyone in the UK.

Working together, we are a driving force of the UK's energy security and net zero ambitions. Our innovative companies, people and communities add value to the UK economy.

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EMISSIONS REDUCTION REPORT 2024

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Foreword

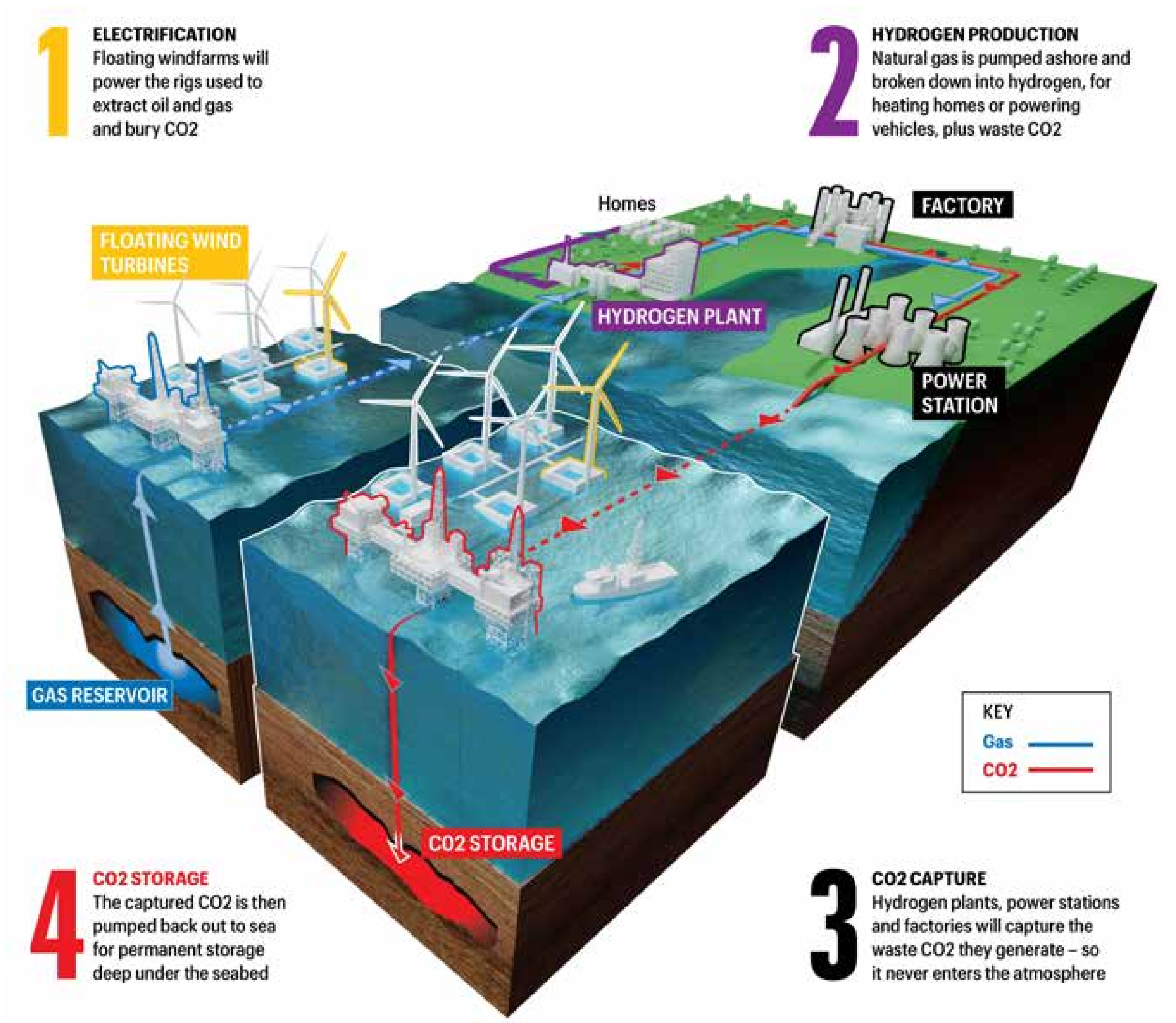
Dave Whitehouse,
Chief Executive Officer
Offshore Energies UK

Offshore Energies UK (OEUK) and our members are committed to working with the UK government, industry and regulators to help deliver net zero emissions by 2050 in an efficient and affordable manner. As a sector, we are equally committed to producing the cleaner oil and gas that the UK will continue to need in the decades to 2050 and beyond – with lower emissions than imports. Achieving this will bring huge economic and environmental benefits.

Facing a challenging policy and taxation landscape, the UK oil and gas industry has still leapt ahead of its government-agreed emissions reduction targets reflecting industry's dedication to sustainable practices and environmental stewardship. It is on track to achieve 2030 milestones and has successfully reduced upstream emissions by 28% and more than halved methane emissions since 2018. This positions the UK to achieve the North Sea Transition Deal's (NSTD) emissions reduction target of 25% by 2027, four years ahead of schedule, and the 50% methane reduction target by 2030, seven years early.

Cessation of UK oil and gas production is a big part of the emissions outlook. There is today an unnecessarily steep decline in production, which if unchecked will bring about a premature end to the life of assets that could contribute to the UK's security of supply. More hydrocarbons will be imported – particularly gas – with a larger carbon footprint than domestic reserves. Infrastructure, jobs and the economy will all suffer. By 2035, just 37 assets are forecast to be still producing, compared with 125 in 2018 – a reduction of 74%. All political parties recognise that the UK needs oil and gas for decades to come and as such we must prioritise our homegrown production over more carbon-intensive imports to support value in our economy and the highly skilled people and firms needed to build our clean energy future in such areas as carbon capture and storage, hydrogen and offshore wind.

The expertise of the UK industry's people together with private sector investment and innovation are driving these emissions reductions. We must back UK firms to continue this work with policies that keep them here in the UK and unlock further investment. In the right investment conditions, UK industry can further accelerate the homegrown energy transition as it enables our access to secure supplies of homegrown energy.



Oil & Gas | Hydrogen | CCUS | Offshore Wind

1. Report Summary

Key facts

Achieving emissions reduction targets ahead of schedule

- The UK oil and gas industry has achieved remarkable progress
- Upstream domestic production emissions have reduced 28%, surpassing 25% by 2027 target
- Methane emissions have reduced 53%, exceeding 50% by 2030 target
- The industry has an active decarbonisation plan and is on track to achieve its commitments without the need for basin-wide electrification

Operators are doing their part offshore

- Offshore installations in the North Sea have decreased annual emissions by 4.5 million tonnes since 2018. Nearly 70% of this reduction has come from operator improvements across power generation, flaring and venting

The industry is managing its methane emissions

- Total basin methane emissions associated with upstream domestic oil and gas production has reduced 53% from baseline year 2018
- Methane emissions from offshore installations specifically are also down 53% since 2018, including 12% year-on-year
- Methane emissions from venting have made the largest difference; reducing 23% year-on-year and 62% since 2018

Unlocking potential of lower carbon intensity oil and gas production

- Despite the successes, domestic production in 2023 declined 11% year-on-year, and could decline from now a further 50% over the next seven years
- Production decline increases our reliance on higher-carbon-intensive imports and reducing our energy security
- The sector has the potential to unlock 13.5 billion barrels of oil equivalent if supported with favourable fiscal and regulatory policies. Which would reduce the average carbon intensity of the oil and gas our economy consumes

Offshore wind is removing carbon dioxide from the grid on its way to net zero by 2030

- Last year offshore wind generated 49.55 TwH of electricity (14.8 GW), displacing 6.8 million tonnes of carbon dioxide of associated grid network emissions from fossil fuels
- Offshore wind installed capacity is projected to reach close to 50 GW by 2030, displacing ever more CO_2 from the grid system. Though installation needs to be accelerated, as only 40 GW will be installed at current pace

Service companies are decarbonising the supply chain

- The government committed to developing a low carbon supply chain of international repute in the NSTD
- The supply chain has achieved significant emissions reduction across a number of areas
- Integration of synthetic fuels into offshore oil and gas operations is a promising step towards decarbonisation

Energy integration will support the decarbonisation of other industries

- Over the past decade, the UK has made strides in decarbonising its industrial sector through fuel switching and improved production and operational efficiency
- However, hard-to-abate industries such as steel and cement will fail to reach net zero without the use of carbon capture and storage (CCS) and hydrogen

2. Net zero emissions

Key messages...

- **The energy supply sector has been the largest driver of reducing territorial emissions.** Compared to 1990, UK territorial emissions are now less than half the total with energy supply sectors accounting for over half of the emissions reductions. Electricity supply has been the largest emissions reducing sector with annual greenhouse gas emissions now just a quarter of the level reported in 2008. Fuel supply, which includes upstream oil and gas industry, as well as refining and coal mining, accounts for the smallest proportion of sector emissions at 8%.

- **The UK is off track to meet its first major net zero target.** The UK's Net Zero target for 2030 is not on track to be met, with only a third of the emissions reductions being covered by credible plans. 2023 saw domestic transport remaining the largest share, accounting for 29% of territorial greenhouse gas emissions.

- **Action is needed going forward.** Emissions reduction driven by the energy supply sectors has been significantly attributed to the reduction of coal and growth of renewable electricity generation. However, to achieve the UK's carbon budget targets, action is needed across all sectors of the economy, with low-carbon technologies becoming the norm.

The Paris Climate Agreement, a landmark international treaty adopted in December 2015, came into force in November 2016, committed most of the world's governments to address climate change. It is principally aimed at stopping the world's average temperature rising more than two degrees, or ideally 1.5ºC, above pre-industrial levels. Achieving this temperature goal would probably prevent the worst impacts of climate change.

Through the Climate Change Act (2008), the UK government committed to reduce net emissions by at least 100% of 1990 levels by 2050, reaching 'Net Zero'. This means that by 2050, the amount of greenhouse gas emissions produced in the UK would be equal to or less than the emissions removed from the environment.

The Act also requires the government to set legally-binding 'Carbon Budgets' which act as a regular series of stepping stone towards the 2050 target. A carbon budget is a restriction on the total amount of greenhouse gases the UK can emit over a five-year period, describing the cost-effective pathway to achieving the UK's long-term climate change objectives.

Budgets must be set at least 12 years in advance to allow policymakers, businesses and individuals enough time to prepare. Six carbon budgets have been developed, running up to 2037 for a total reduction figure of 78% against the baseline. We are currently in the fourth carbon budget (2023-2027), set in 2011.

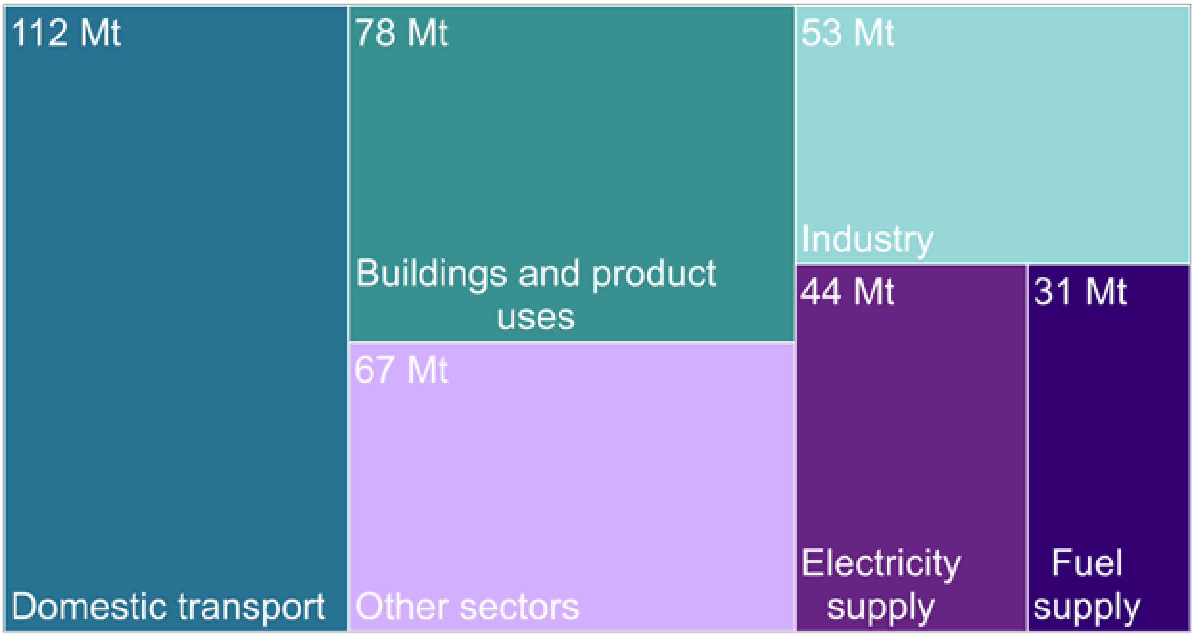
The Climate Change Committee (CCC), an independent statutory body established to advise government on emissions targets and to report to parliament on progress, recently confirmed the UK had also met its third carbon budget for the period 2018 to 2022.

UK territorial emissions are now less than half the 1990 total. Over half of the emissions reductions in these three budgets come from energy supply sectors, mainly due to the reduction of coal and growth of renewable electricity generation.

However, the CCC's 2024 Progress Report to Parliament warned the country is not on track to meet the 2030 target set in line with Net Zero, with the stark assessment that "only a third of the emissions reductions required to achieve the 2030 target are currently covered by credible plans. Action is needed across all sectors of the economy, with low-carbon technologies becoming the norm".

Budget	Carbon budget level	Reduction below 1990 levels
1st Carbon Budget (2008 to 2012)	3,018 $MtCO_2e$	26%
2nd Carbon Budget (2013 to 2017)	2,782 $MtCO_2e$	32%
3rd Carbon Budget (2018 to 2022)	2,544 $MtCO_2e$	38%
4th Carbon Budget (2023 to 2027)	1,950 $MtCO_2e$	52%
Nationally Determined Contribution (2030)	-	68%
5th Carbon Budget (2028 to 2032)	1,725 $MtCO_2e$	58%
6th Carbon Budget (2033 to 2037)	965 $MtCO_2e$	78%
7th Carbon Budget (2038 to 2042)	To be set in 2025	-

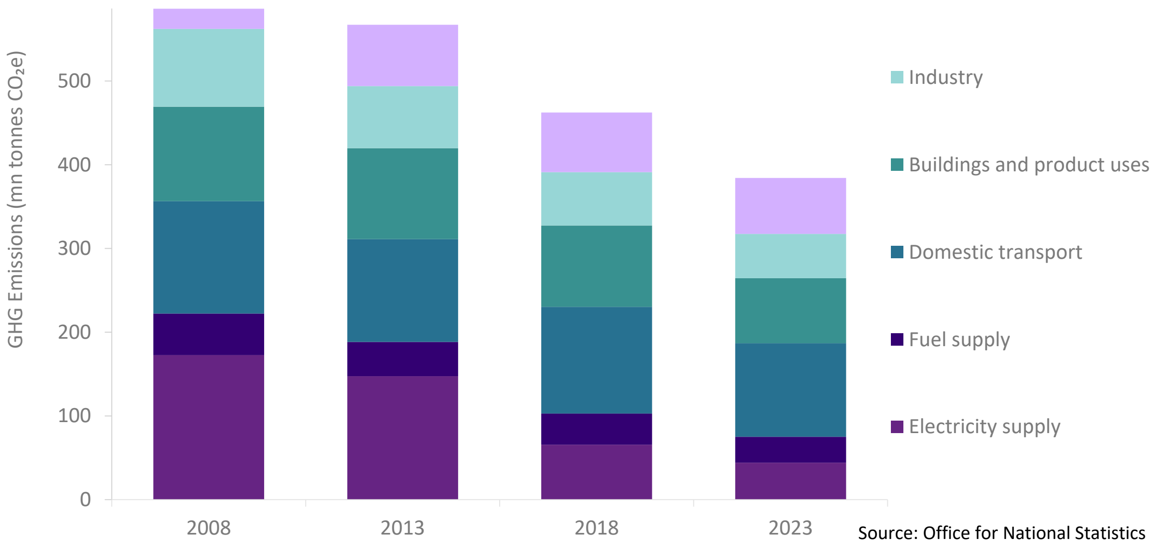
Figure 1
UK territorial emissions statistics by sector 2023



Source: Office for National Statistics

In 2023 domestic transport accounting for the largest share (29%) of greenhouse gas (GHG) emissions in the UK. Fuel supply, which includes upstream oil and gas industry as well as refining and coal mining, accounted for the smallest proportion of sector emissions at 8%. While electricity supply emissions have decreased as a proportion from 26% in 2008 to only 11% last year.

Figure 2
UK territorial emissions statistics by sector, 2008-23



Source: Office for National Statistics

Electricity supply has been the largest emissions reducing sector with annual GHG emissions now just a quarter of what it was in 2008 and a third less than they were five years ago.

Domestic transport, as the largest portion of emissions, has also fallen by the lowest percentage over the 15 years: 17% (22.5 million tonnes CO_2 equivalent).

3. UK upstream oil & gas progress

Key messages...

- **The industry is demonstrating good progress with the ability to progress and reach challenging targets.**
  In 2023, the upstream oil and gas industry emitted 13.5 million tonnes of CO_2 equivalent, representing roughly 3.5% of total UK territorial emissions. The UK's domestic oil and gas industry has now surpassed the emissions reduction target of 25% by 2027, four years earlier than was committed to through the North Sea Transition Deal, which outlines the offshore energy sector's role in delivering UK net zero goals.

- **Emissions offshore are being driven by operator improvements.**
  In the past six years since 2018, annual offshore installations emissions have decreased 4.5 million tonnes with almost 70% of this success due to operators reducing their carbon footprint across power generation, flaring and venting.

- **Methane reduction has been a key element of our progress.**
  The methane emissions associated with upstream domestic oil and gas production has reduced by 53% compared with the 2018 baseline, achieving the 50% reduction by 2030 target, seven years ahead of schedule.

- **Policy support and certainty is needed to keep the industry here and not turn further to imports.**
  Against the backdrop of an uncertain fiscal and regulatory landscape the industry continues to supply the oil and gas the country needs now and into the future while investing in emissions reduction opportunities. However, operators forecast that production beyond 2030 will be less than previously calculated as assets reach cessation of production (CoP) earlier in several cases, attributable to the unstable fiscal and regulatory climate. Near term, cessation of production could see UK output halving in six years with reliance on imports increasing as a consequence.

- **Shutting down production prematurely leads to more carbon intensive domestic production and gas imports.**
  UKCS oil and gas output in 2023 fell by 11% and 10% respectively year-on-year, resulting in an 8% increase with this decline increasing the basin's carbon intensity. The average carbon intensity of producing a unit of gas in the UK remains around a quarter of the equivalent unit of imported LNG with the UK importing 71% of total natural gas supply in 2023.

Assessment of 2023 emissions

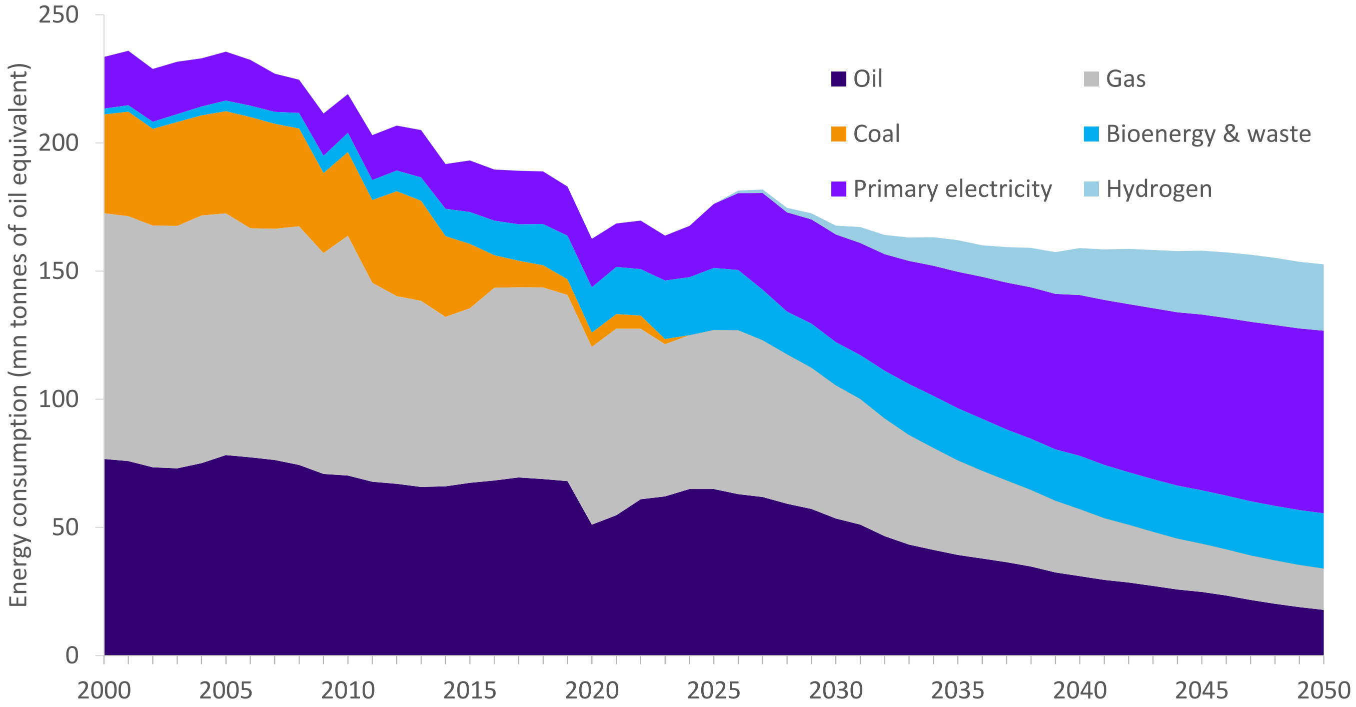
The North Sea Transition Deal (NSTD) is a strategic initiative between the oil and gas industry and government to manage the transition of the North Sea sector toward a low-carbon future in line with the UK's climate change goals. It recognises the crucial role the sector has in maintaining the UK's energy security through to net zero 2050.

The NSTD intends to support the decarbonisation using the skills and technology gained from the past 50 years of oil and gas production. It includes a commitment from industry to reduce total emissions by 10% by 2025, 25% by 2027 and 50% by 2030, relative to the 2018 baseline, and subject to progress on shared actions.

The upstream oil and gas industry emitted 13.5 million tonnes of CO_2e in 2023, 28% less than in 2018, representing roughly 3.5% of total UK territorial emissions.

Good progress is being made and the industry is demonstrating its ability to keep progressing and hitting challenging targets. Industry continues to supply the oil and gas the country needs now and into the future, investing in emissions reduction in an uncertain fiscal and regulatory landscape.

Figure 3
UK future energy consumption mix



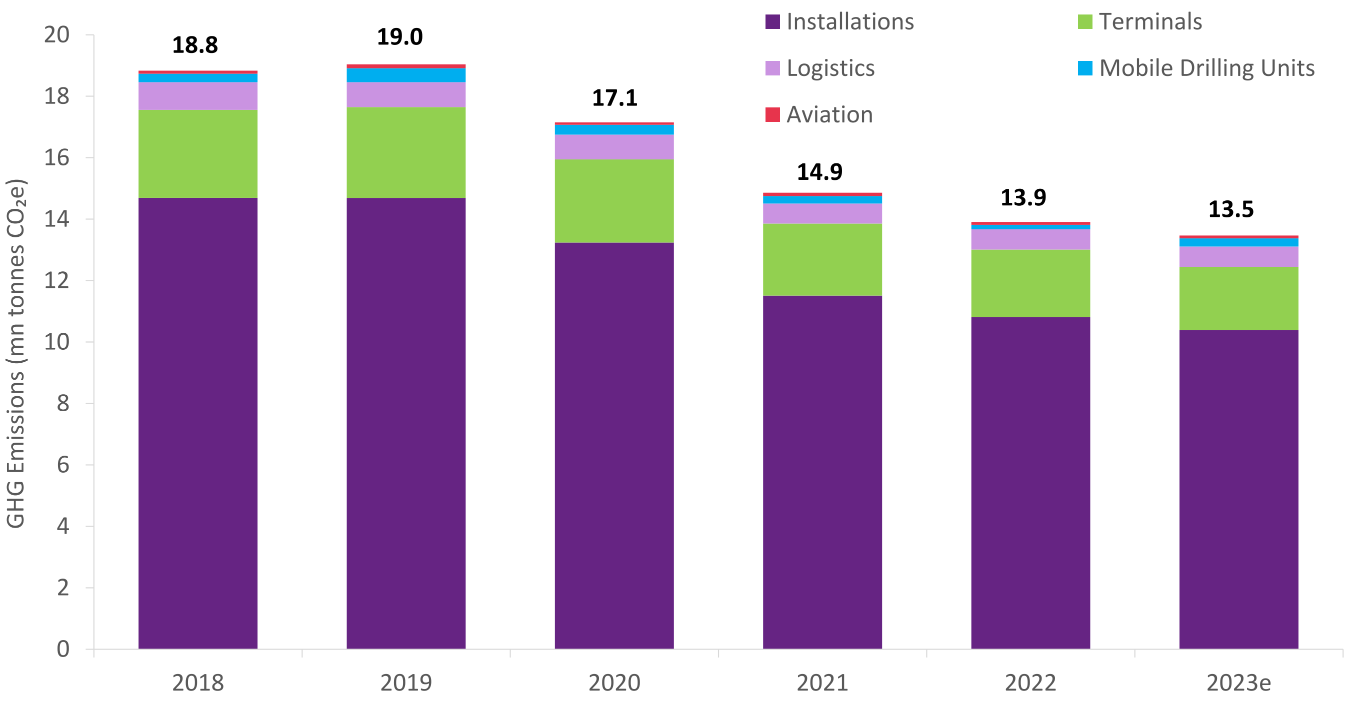
Sources: DESNZ, CCC, OEUK

The energy mix will continue to diversify, but oil and gas will still be needed, meeting over a fifth of our energy demand in 2050, as outlined in the CCC Balanced Pathway scenario. Emissions from ongoing oil and gas output will need to be abated and supplied without net emissions. Oil and gas will provide most of UK energy up to this point and will still be half of all energy consumed until 2035.

GHG emissions from offshore installations fell 4% last year, despite being forecast to remain about the same as in 2022. This means emissions from offshore installations have fallen 29% since 2018. Carbon dioxide emitted from terminals also declined by over 6% last year, bringing the total emissions down by 28% total terminal emissions since 2018.

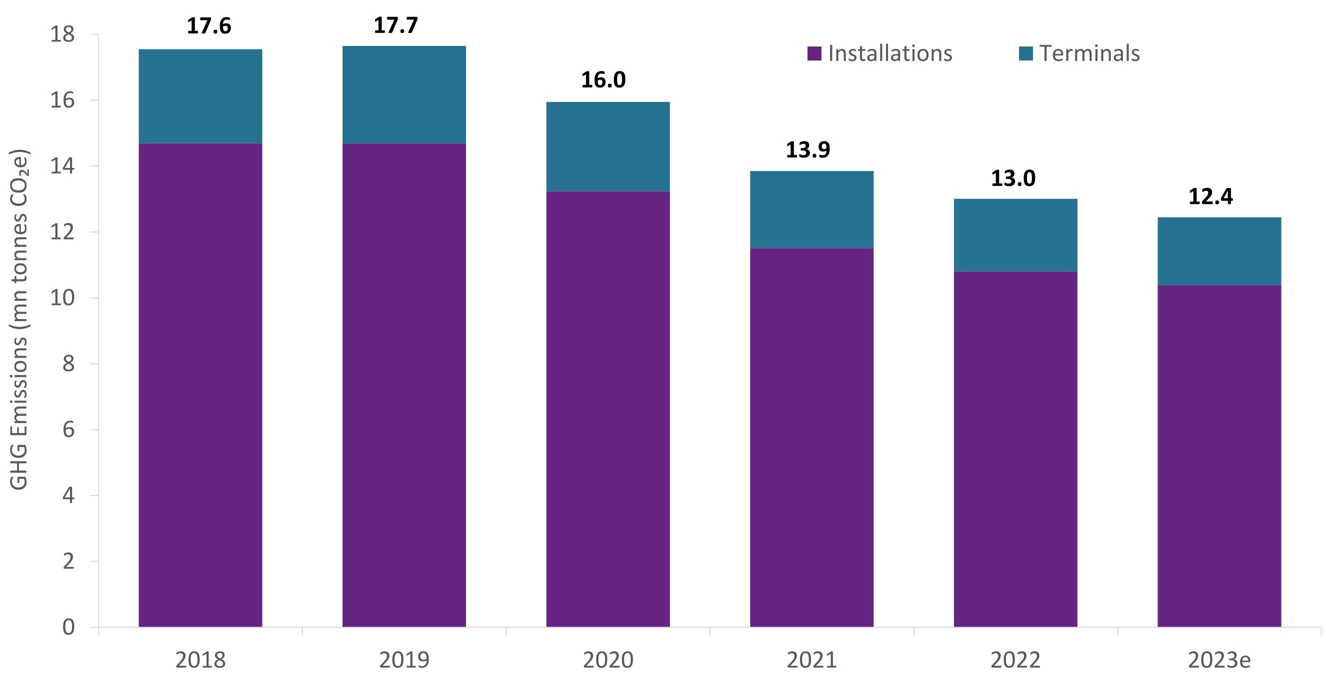
The UK's domestic oil and gas industry has now surpassed the emissions reduction target of 25% by 2027, four years earlier than was committed to through the NSTD.

Figure 4
Total UKCS associated emissions by year



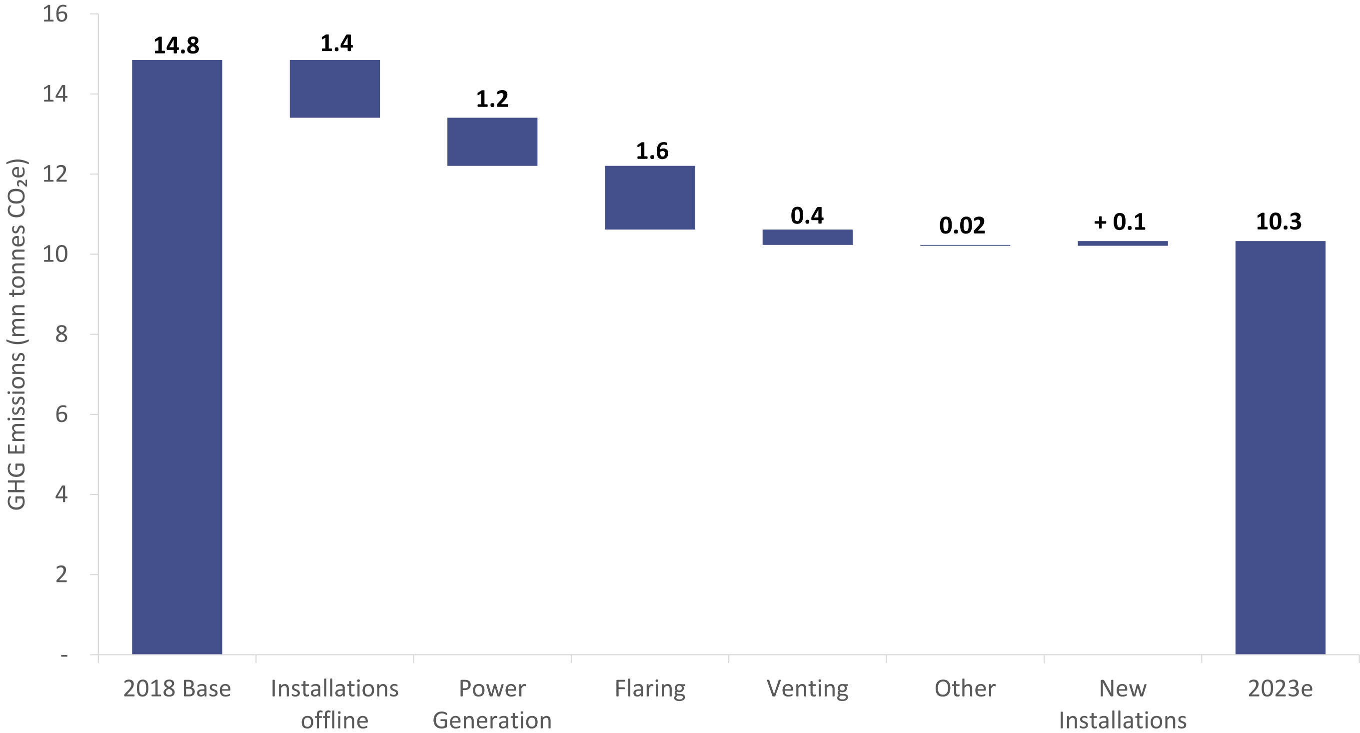
Source: ETS, EEMS, Ricardo, OEUK

Figure 5
Historic installation and terminal combined emission reduction performance alongside UK domestic production



Source: ETS, EEMS, OEUK

Figure 6
Installation emissions reduction by source



Source: EEMS

Offshore installations continue to be the driving force for the industry towards its emissions reduction targets, reducing total emissions 0.42 million tonnes CO_2e year-over-year. Coastal terminals account for a significant annual reduction in 2023 of 6%.

Total reported emissions from power generation on offshore installations fell 5% in 2023 compared with the previous year, and by 21% against 2018. However, as absolute emissions from other sources such as venting, flaring and fugitives have reduced by higher degrees, the proportion of emissions attributable to power generation have gone up from 68% in 2018 to 78% in 2023.

Annual offshore installations emissions have decreased 4.5 million tonnes over the six years since 2018. 32% of this emissions reduction figure is attributable to decommissioning.

Almost 70% of this success is due to the efforts of operators in reducing their carbon footprint across power generation, flaring and venting. By contrast, new installations which have come online since 2018 only contribute a very small proportion of current emissions.

CASE STUDY

Improving power generation efficiency

Harbour Energy has completed several projects to improve power generation efficiency across their operated assets resulting in a reduction of 46,000 tonnes CO_2 equivalent per year (tCO_2e/yr) compared to the 2018 base year, with several more opportunities in progress.

One example is the Judy platform, part of the J-Area asset, which historically operated with three-out-of-four power generation gas turbines online. Each of these is rated at 6MW; at a typical steady state demand of 9MW, this resulted in each unit operating inefficiently at approximately 50% capacity. While periods of two-out-of-four operation had been achieved through operational necessity, further work was required to ensure this could be achieved consistently without impacting plant reliability.

A dedicated technical review was carried out to overcome multiple implementation and equipment specific challenges. Modifications included the upgrade of one gas turbine control system, replacement of the liquid fuel system on another, and carrying out a power system review to optimise power consumption and demand. Harbour Energy also worked with equipment manufacturers to implement mechanical and control system upgrades to improve reliability.

Moving to two-out-of-four operation in 2023 has resulted in an approximate emissions reduction of 11,000 tCO_2e/yr. In addition to the reduced fuel gas usage, financial benefits include a reduction in maintenance costs as well as obsolescence benefits.

Several opportunities are being progressed to lower power demand further via Harbour Energy's emissions reduction action plan (ERAP) governance, reducing the risk of reverting to three-out-of-four operation under high demand.

Furthermore, the Greater Britannia Area (GBA) asset has moved from operating with three-out-of-three gas turbine power generators online to two-out-of-three, saving approximately 10,000 tCO_2e/yr.

There is an ongoing project to improve GBA power generation efficiency further by moving to one-out-of-three operation. This is more complex and requires engine upgrades as well as a reduction in power demand. One-out-of-three operation could result in a further reduction in GBA emissions by an estimated 13,000 tCO_2e/yr.

A review is underway to upgrade engine power from 15,000hp to 16,000hp at the next planned changeout, increasing output by approximately 0.6MW to 10.5MW.

In addition to this increased efficiency, power demand reduction initiatives in progress include:

- De-staging of condensate export pumps, with three oversized pumps to be sequentially reduced from nine to five stages, saving 0.5MW.
- Operating mode change to reduce circulation of TEG through offline compressor train and lower heating demand, saving 0.25MW.
- Trials to switch off a subsea field start-up pump, saving up to 0.17MW (periodic).
- Seawater system optimisation, combining the independent seawater cooling systems on the main and bridge-linked platforms to reduce the number of pumps operating, saving up to 1.0MW.

GBA power demand distribution highlights that platform demand is typically below 11MW. Following engine upgrade to 10.5MW, a further 0.5MW (or more) in power reduction is required to achieve one-out-of-three operation on a single gas turbine generator. Based on the opportunities identified above this is an achievable target.

CASE STUDY

A culture of emissions reduction - Maximising water injection while using less power

An asset was preparing to increase the rate of water injection to improve oil recovery from the reservoir. The commonly held belief was that an additional seawater lift pump (SWLP) would need to be switched on to provide enough seawater to the injection pump – this would require little effort, would guarantee sufficient water, and would provide pump redundancy in case one tripped.

However, the asset's culture of continuous emissions reduction led the team to challenge this assumption – they wanted to be sure that the additional seawater lift pump was required before accepting the increased emissions that would result – each seawater lift pump uses around 1.4 megawatts of power, equivalent to around 6,900 tonnes of CO_2e per year.

After a thorough review, engineers concluded that, in theory, a single seawater lift pump would be sufficient. However, this would add risk – if the single pump tripped then all production could be shut down as there is no way to automatically start a standby pump in this event.

Asset leadership agreed that the guaranteed reduction in emissions from the single pump was worth the potential risk of a plant shutdown. The single pump was trialed successfully for a period of three months without issue, validating the theory.

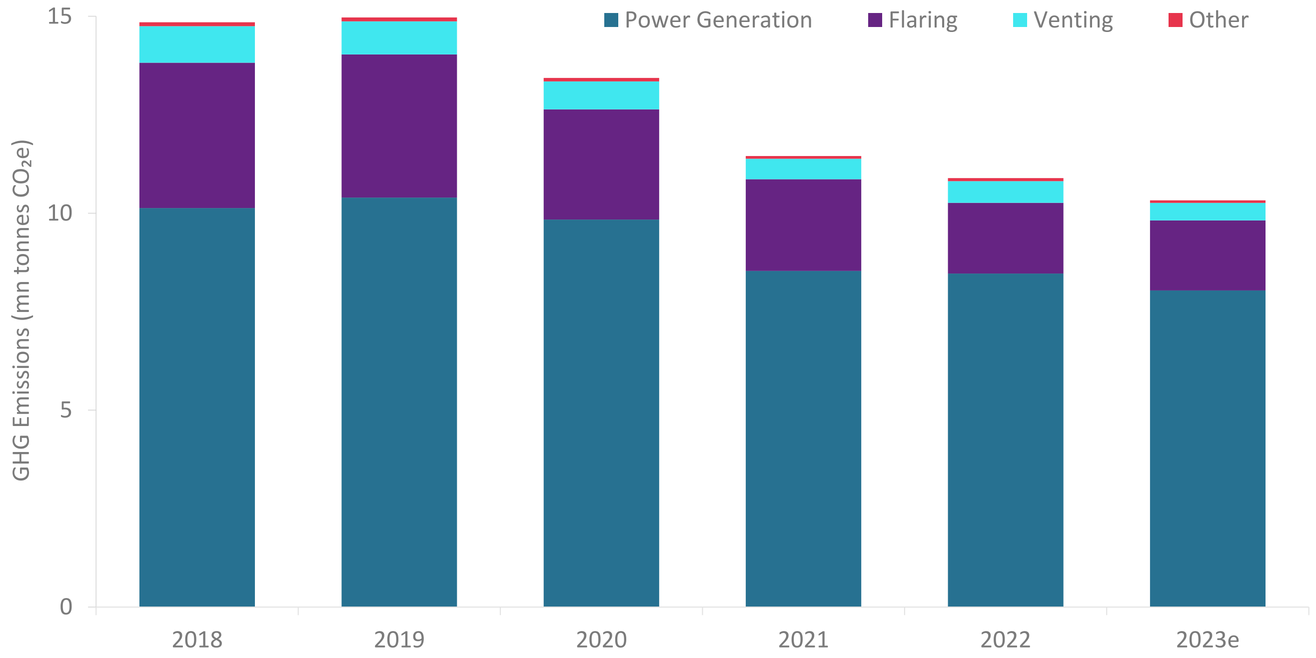
This great example of challenging every tonne of emissions shows the benefits of embedding a culture of emissions reduction, and not simply accepting the easy way, where it leads to more CO_2 being produced. There are extra benefits too; less maintenance to be done on the pumps, extra gas to be exported, and lower emissions costs.

Reductions
Power Reduction = 1.4 megawatts
Emissions Reduction = 6,900 tonnes of CO_2e per year

Efficiencies
Minimising emissions while improving hydrocarbon recovery from reservoir.

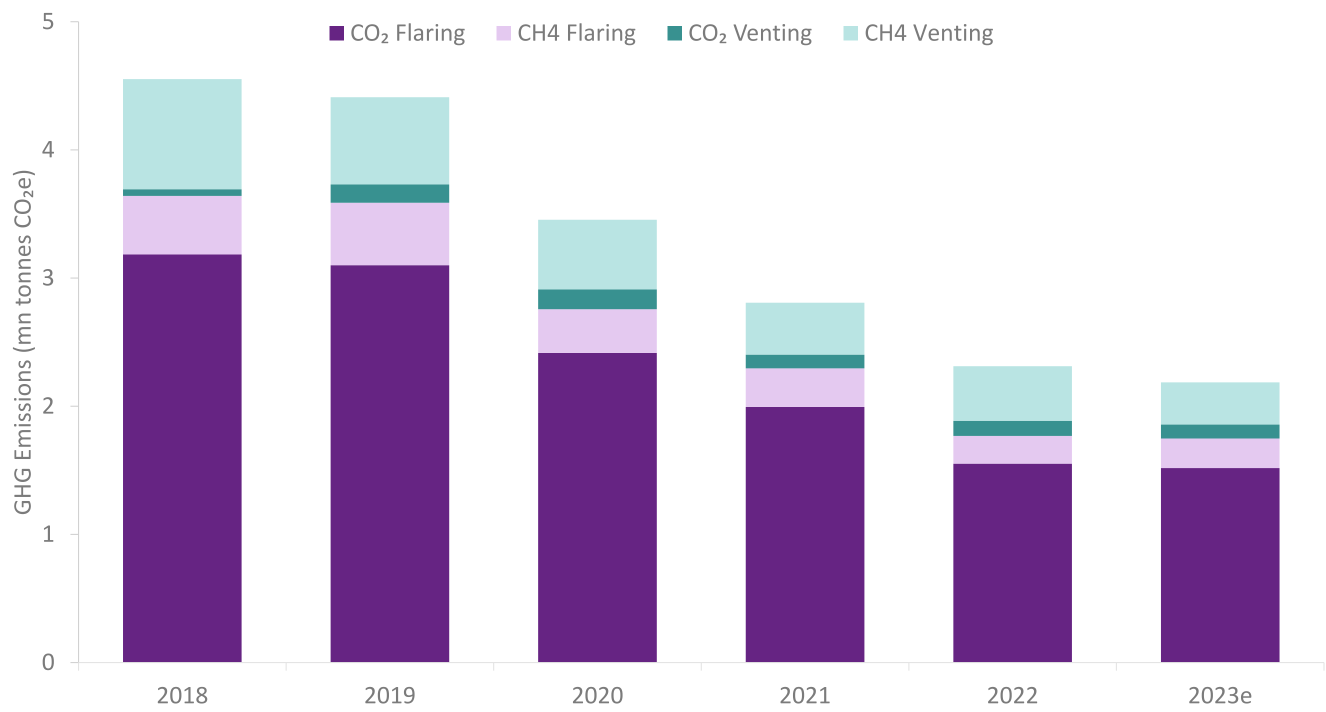
Cost Savings
Reduced Emission Trading Scheme Costs. Increased export/sales gas rates.
Reduced maintenance costs.

Figure 7
Offshore installation emissions by source



Source: EEMS

Figure 8
GHG emissions from flaring and venting



Source: EEMS

Flaring and venting are now accountable for 52% less annual emissions than in 2018. Basin-wide emissions from venting saw a significant reduction in 2023, falling 19% year-on-year.

Although CO_2 is by far the largest contributor to GHG emissions from flaring and venting, the global warming impact of methane (CH_4) is particularly important because it has over 80 times the global warming potential of CO_2 in the comparatively short twenty years or so it remains in the atmosphere before breaking down. This means that action taken to prevent methane reaching the atmosphere can have an impact on global climate in the short term. Methane does not just come from flaring and venting, but these are the primary sources.

CASE STUDY

Optimising existing asset operations through reducing produced gas flaring, gas compression projects

SERICA ENERGY

In 2020, Serica created its Emissions Reduction Group comprised of enthusiastic, skilled, and committed staff from the offshore and onshore teams. The ERG's core aim was to reduce carbon emissions from its Bruce offshore platform installation, which processes oil and gas from the Bruce, Keith and Rhum fields which equates to approximately 5% of the UK's gas production.

The group identified and assessed opportunities to reduce emissions, first by identifying the main sources of emissions and then looking at ways of reduction, be they through procedural changes, equipment modifications or process changes. The group challenged the working assumptions and reviewed production and emissions optimisation strategies to develop an emissions reduction plan.

The ERG initially focused on ways to reduce produced gas flaring, followed by options to modify process gas compression to reduce fuel gas consumption in gas turbines.

A major breakthrough came about from challenging the embedded Rhum Field start-up operations. To expedite production after a Rhum field shut down, gas would be flared to warm up the line. The team introduced changes to cold restart procedures which enabled restart with significantly less flaring, whilst still applying appropriate hydrate risk management. In addition to this, visible daily targets for flaring were introduced alongside a list of 'common culprits' which allowed targeted trouble-shooting every time the targets were exceeded. The list of culprits is a living document and updated for continuous improvement. This prevented long-term trends in increased flaring not being picked up or remedied. Overall, annual flaring was reduced by over 50%.

The ERG then turned its focus to another major source of emissions, the gas turbine driven gas compression facilities on the platform. They embarked on collaborative engineering activities with Siemens Energy to design and procure higher efficiency medium pressure and export stage compressors. The new compressors are currently being manufactured and assembled by Siemens Energy ready for delivery at the end of 2024. They will be installed offshore by the project construction team on Bruce installation in 2025, resulting in an estimated 15% improvement in emissions performance.

The completed initiatives to reduce produced gas flaring has achieved 10,000 - 20,000 tonnes per year reduction in carbon emissions.

The planned gas compression project is estimated to reduce carbon emissions by 15,000 - 20,000 tonnes per year.

The reduced produced gas flaring emissions quantities have been metered and reported through the regulator's Environmental Emissions Monitoring System and UK Emissions Trading Scheme returns.

The estimated reduction in carbon emissions from reduced fuel gas consumption operating new high efficiency compressors has been determined by compressor design modelling.

Methane management

Building on the NSTD, the sector developed a Methane Action Plan (MAP) detailing commitments to improve the monitoring and reporting of emissions and stating specific methane targets. The UK upstream oil and gas sector is an international leader in this area, being the first sector to commit to methane reduction targets as outlined in the NSTD and articulated in the 2021 industry MAP.

The MAP has 6 core commitments

1. 50% methane emission reduction by 2030
2. UKCS methane intensity below 0.2% by 2025
3. Zero routine flaring by 2030
4. Asset methane action plan
5. Measuring methane
6. International alignment

Methane is a greenhouse gas responsible for a significant portion of the global warming we are experiencing.

Methane management is a complex and global issue that requires a collaborative approach, predominantly in the accurate measurement of methane emissions. Focus on the use of technology and alignment across the areas of measurement, monitoring, reporting and verification will ensure that the 2030 targets are achieved in the most economical manner.

Methane management is becoming increasingly topical, with pressure on government to introduce a regulatory framework following moves in the EU and US.

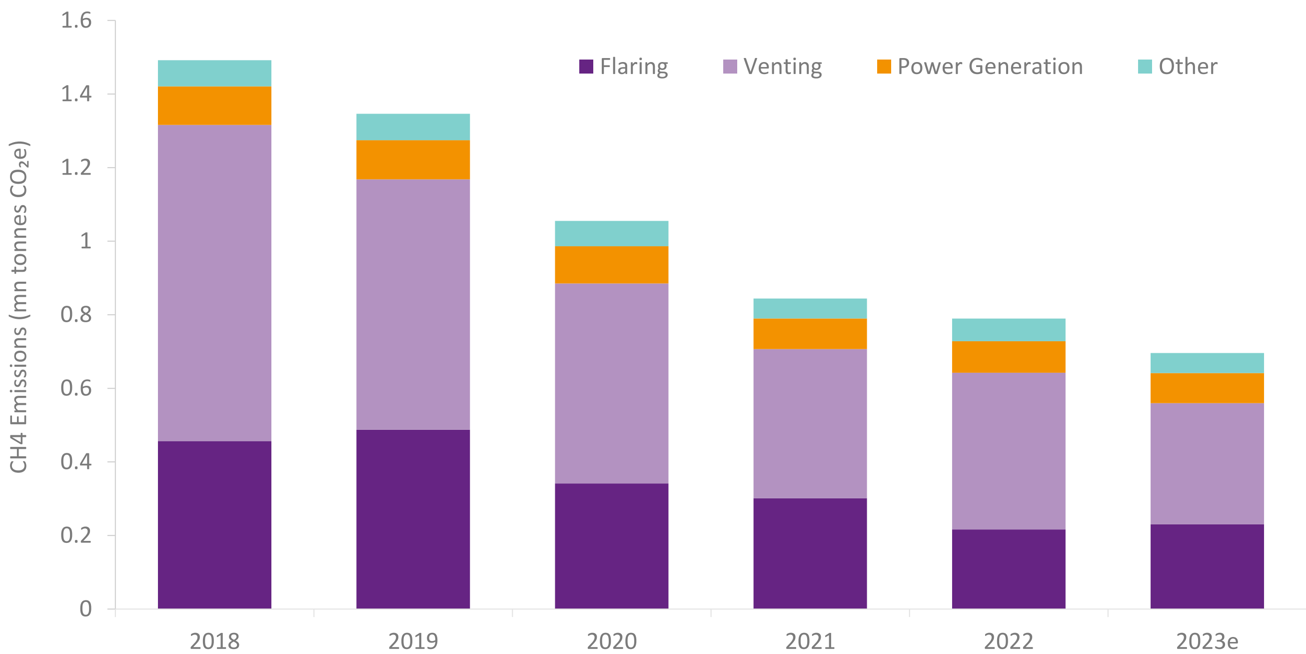
Methane reduction

Total methane emissions associated with upstream domestic oil and gas production across offshore installations, drilling rigs, aviation, logistics and onshore terminals has reduced by 53% compared with baseline year 2018; achieving the 50% reduction by 2030 target as outlined in the Methane Action Plan (MAP), seven years ahead of schedule. Industry will continue to find more ways to cut emissions.

Methane emissions from offshore installations in 2023 are down an estimated 12% year on year and 53% down overall since 2018.

Venting reductions have made the biggest difference over the last year. Total methane emissions have fallen 23% year-on-year, changing the course after the uptick in the previous reporting period.

Figure 9
Offshore installation methane (CH_4) emissions by source

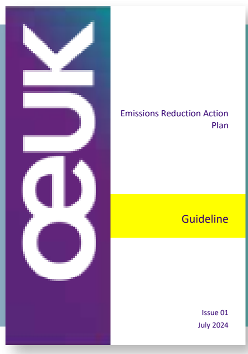


Source: EEMS

Offshore Energies UK Guidelines

We are the definitive source of information on the UK offshore oil and gas industry, producing a range of publications that are essential reading.

oeuk.org.uk/product/emissions-reduction-action-plan-erap/

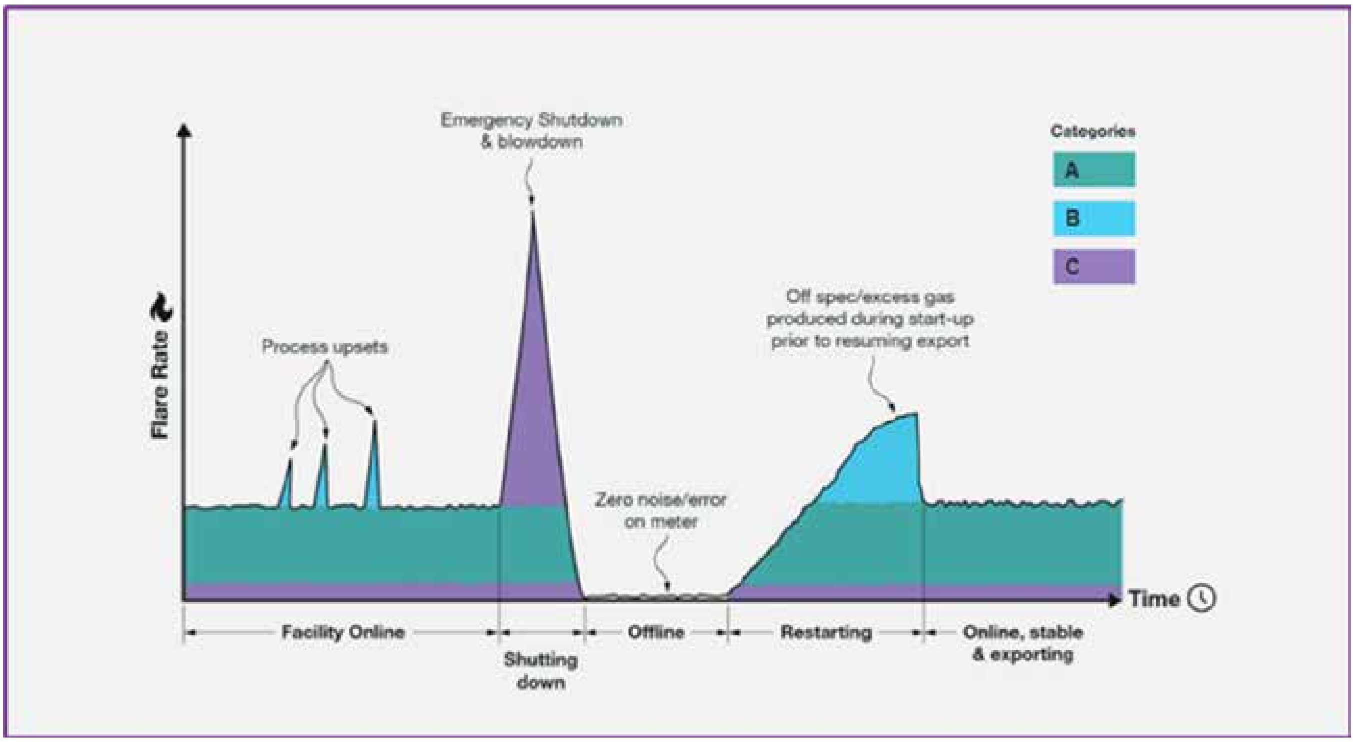


Zero routine flaring

Approximately 80% of total methane emissions from oil and gas infrastructure come from flaring and venting. NSTA estimates that around half of this is "routine flaring", defined as the regular ignition of unwanted or uneconomical natural gas released during the extraction process.

As the 2030 deadline approaches, operators are focusing on their plan to deliver zero routine flaring. For some, this will mean a focus on changes to operational practices. For those with engineering solutions, a limited number of planned shutdowns before the end of the decade remain to conduct the work.

Some operators planning to produce post-2030 have a focus on flare gas recovery with the intention to export or utilise it as fuel gas. Using it as fuel gas means modifying engines and turbines to run on dual fuel, so that power generation is continuous. Operators examining options to export recovered gas have identified additional areas of work to understand and address the impact on gas composition.



Illustrative flaring and venting profile with gas stream category allocations *Source: NSTA*

Category A:
Streams for the safe operation of the asset based on its current design and operating at optimum efficiency (excluding Category C). Reductions to flaring and venting allocated to this category generally require facility modifications.

Category B:
Flaring and venting occurring during normal operations beyond levels optimum for the installation. Reduction in flaring and venting in this category can be achieved through operational changes.

Category C:
Emergency disposal and gas streams required specifically for the operation of safety critical equipment/elements.

The industry is committed to the 2030 zero routine flaring target and is working to ensure that technical modifications are made to existing installations remaining in production beyond 2030. In some cases, the modifications of an asset can be upward of £60 million, so the economic benefit of adopting technology is dependent on the specific asset that will include the volume of gas recovered and the availability of export routes offset against the cost of asset modification.

Flare and vent systems on offshore installations are a category of equipment termed safety and environment critical elements (SECE), which means that they have to meet strict performance standards. Any material change to a flare and vent system has to be managed within the installation's safety case, which means that once an engineering approach has been developed and risk assessed, it must then also be submitted to the Health & Safety Executive (HSE) for review and acceptance. Careful planning is required to ensure that the overall risk profile of the installation is not increased by the redesign, and that in an emergency, the new design is demonstrably as reliable as its existing version. The concept of risk being "as low as reasonably practicable" means in practice that no change to a SECE can be made that would increase the risk levels to personnel on board.

CASE STUDY

Installation of a flare gas recovery system on Elgin

Operating 30% of the UK's gas production, TotalEnergies, in partnership with Wood, will implement the first flare gas recovery system (FGRS) in 2025 on Elgin - the UK's largest producing installation. Led by Wood's team in Aberdeen, this project will create 40 new positions on and offshore.

The recovery process involves capturing the gas from the low-pressure flare and compressing it, allowing the gas to be recovered, processed, and exported to market whilst reducing emissions.

The design benefited from TotalEnergies industrialisation scheme, a task force to standardise FGRS designs from TotalEnergies global portfolio, tapping into expertise that allowed for knowledge transfer, realised in optimised project time and cost.

The FGRS will eliminate routine gas flaring on Elgin, as well as majority of routine hydrocarbon venting, and it will reduce overall flaring by ~35%. The project is expected to save around 40 kt of CO_2e per year.

Elgin / Franklin came into production in 2001 and it is one of the largest HPHT (high pressure, high temperature) installations in the world. Elgin consists of central processing facilities located on a Process, Utilities and Quarters (PUQ) platform bridge-linked to two wellhead platforms (WHP); Elgin WHP A and Elgin WHP B. The PUQ is, in effect, a gas refinery with a sophisticated process plant onboard to produce commercial quality gas.

Gas from Elgin/Franklin is exported to the Bacton terminal in Norfolk via the 468km Shearwater Elgin Area Line (SEAL) pipeline.

Liquids from Elgin/Franklin are exported to Cruden Bay on the northeast coast of Scotland via the Graben Area Export Line (GAEL) pipeline and Forties Pipeline System (FPS). Liquids are piped onwards to Kinneil for tanker export.

The field is operated by TotalEnergies, with ENI, Harbour Energy, Ithaca Energy, NEO Energy and ONE-Dyas holding non-operated interests.

CASE STUDY

Ithaca Energy, Accelerated execution of remediate unlit flaring

Maintaining a lit flare is crucial for the safe operation of a facility and for minimising the environmental impact of hydrocarbon gases. Unburnt hydrocarbon gas can be approximately 34 times more harmful to the environment than burnt gas, underscoring the importance of ensuring the flare remains lit. In 2023, operations on one of our facilities, faced increasing challenges in keeping the flare alight, particularly during periods of strong winds.

Through data collected during a UAV inspection, it was discovered that the flare's pilot system, which is vital for maintaining the flare, was not functioning on the windward side. This issue was clearly visible in thermal images of the flare, where the right-hand pilot nozzle appeared cold in contrast to the left-hand nozzle. The malfunction created a high likelihood of the flame being extinguished if strong winds blew it too far horizontally, away from the operational pilot.

Given the significant safety concerns associated with unburnt hydrocarbons and the environmental ramifications, the operations and engineering teams prioritised resolving the issue swiftly. A planned shutdown during the summer provided an ideal opportunity to address the flare's malfunction. However, the shutdown was only three months away, and the asset already had a fully defined scope for the shutdown.

Ithaca engaged the flare vendor, initiating the manufacturing of a new pilot system within two weeks.

The goal was to deliver the new pilot system ahead of the scheduled shutdown, with a tight deadline of just eight weeks. In parallel with the manufacturing process, extensive planning and engineering work were required to prepare for the replacement of the pilot system, all of which needed to be completed within the same timeframe to ensure readiness for the shutdown.

While the engineering and manufacturing efforts were underway, the operations team worked diligently to minimise the impact of the malfunctioning flare until the new pilots could be installed. They determined that increasing the amount of gas sent to the flare would help keep it lit. Although this approach resulted in burning more gas than usual, it was deemed preferable from an absolute emissions perspective to burn excess gas rather than vent unburnt hydrocarbons into the atmosphere. In close collaboration with the NSTA, the flare and vent consent regulator, these adjustments were implemented, allowing the flare to remain lit for significantly longer periods.

Following a successful shutdown, during which the faulty pilots were replaced, the flare maintained its stability and remained lit at normal rates, even during the high winds of Storm Babet, October 2023. This successful outcome highlighted the effectiveness of the team's efforts together with great support from the vendors, and ensured continued safety and environmental performance of the facility.

UK oil and gas industry

The offshore energy industry is meeting the demands of the North Sea Transition Deal, including scope 1 and 2 emissions reductions which requires collective and individual effort across industry and government to meet the targets. Over the past few years, various high-level emissions forecasts derived from projecting forward historic performance have been created for the UKCS as a whole. These forecasts explain some of the national targets such as those in the NSTD and the development of the recent Oil and Gas Authority (OGA) plan to reduce GHG emissions, published March 2024.

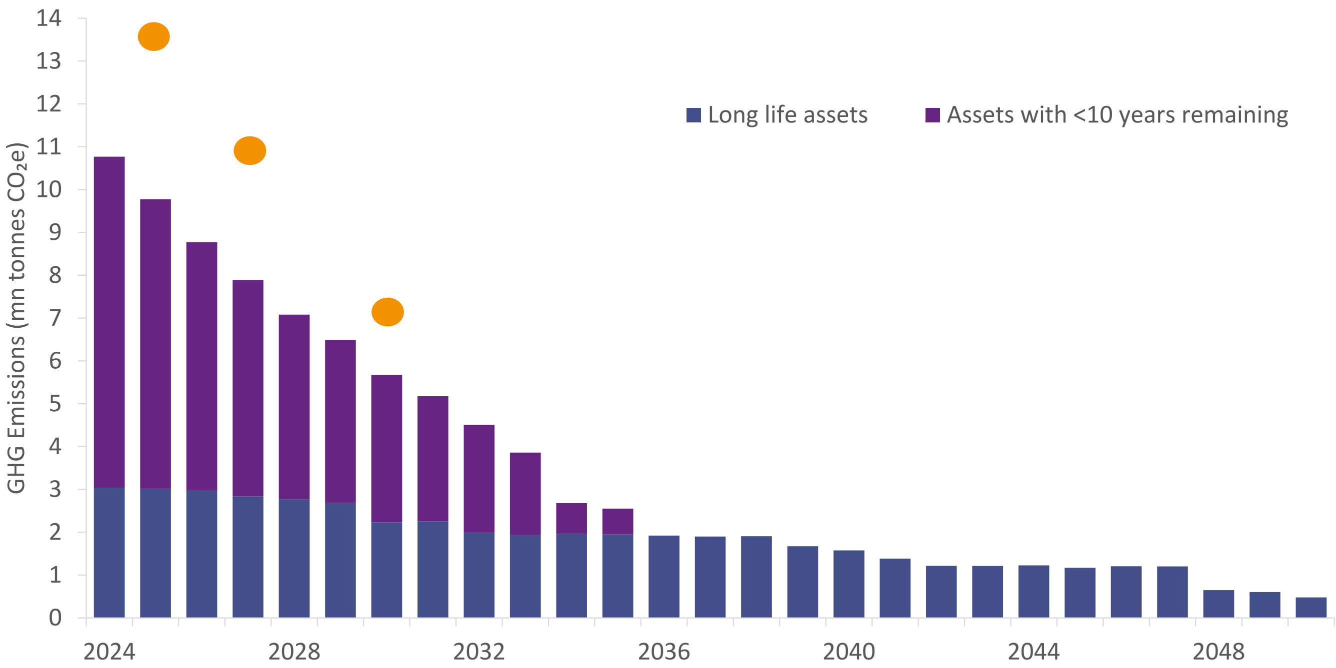
OEUK developed a comprehensive overview of industry decarbonisation efforts prepared instead with forward-looking operator submitted data. This analysis can be utilised by industry to collate, validate and analyse operator data and provide forecasts without breaking any confidentiality of commercially sensitive information.

To achieve this outcome, annual surveys of stewardship expectations for production and emissions, and emission reduction action plans (ERAP) were leveraged to form the data for the analysis supported with operator discussions. The analysis looks back to emissions reduction performance from 2018, looks forward in detail across the next 10 years, and as far ahead as 2050 where data is available.

The results demonstrate that industry is providing the approach to decarbonisation performance and reporting. As outlined, demonstrable progress is being made and operators have the plans and budgets to carry out material decarbonisation projects that meet the near-term NSTD targets.

Beyond 2030, absolute emissions associated with oil and gas production are predicted to fall steeply along with output, but also due to the reduction in flaring and venting, and lower-emission installations taking over from older and more energy-intensive installations.

Figure 10
Medium to long-term emission outlook from existing and sanctioned fields



Source: Asset Stewardship, OEUK

Operators forecast that production beyond 2030 will be less than previously calculated as assets reach cessation of production (CoP) earlier in several cases, attributable to the unstable fiscal and regulatory climate.

The industry has an active decarbonisation plan and is on track to surpass its commitments without the need for basin-wide electrification.

Near term, CoP could see UKCS output halving in six years. Our reliance on imports will increase as a consequence, reducing our energy security as the country becomes more vulnerable to the effects of external supply shocks.

Producing more from the UKCS, with a lower carbon intensity would benefit the country if the current downward trajectory can be slowed, but this needs supportive fiscal and regulatory policies. This would be a game-changer, particularly for small developments and help avoid lost opportunities.

CASE STUDY

Armada late life compression

The Armada late life compression (LLC) project is currently being matured to reconfigure and re-wheel the existing gas export compression train, presenting a material decarbonisation opportunity in line with Harbour Energy's commitment to achieve net zero Scope 1 and 2 greenhouse gas emissions (GHG) by 2035, as well as an enabler for asset life extension.

The initial project premise was to re-wheel the production gas booster and export compressors, retaining the existing two-stage operation driven by two separate gas-powered turbines. This would provide an approximate emission reduction of 13,000 tonnes CO_2 equivalent (tCO_2e) per year, through improved compression operation and efficiency.

However, through utilisation of the new joint venture (JV) hub strategy good practice template and integration of our emissions reduction action plan (ERAP) governance to enact our GHG reduction commitments, an alternative concept was identified to realise further emissions reduction potential. This option comprises reconfiguration and moving to a single compressor casing design, allowing a single gas-powered turbine driving both the production gas booster and export compressors. By moving to a single gas turbine, this project will reduce emissions on Armada by >40,000 tonnes CO_2e per year, an approximate 30% reduction compared to 2023 emissions, improving the emissions intensity performance.

This reconfiguration concept will require substantially more CAPEX and will be more complex from an engineering, procurement and execution point of view to achieve the additional emissions reduction potential, versus the initial re-wheel only approach.

As well as reducing OPEX spend and fuel gas usage, this decarbonisation project aims to maximise economic recovery, potentially extending the asset cessation of production timing to 2030+ and unlocking further resource maturation opportunities.

The intent of the Armada LLC project demonstrates Harbour Energy's commitment to achieve the maximum emissions reduction possible with a more capital intensive and complex project from an engineering, procurement and execution perspective. Furthermore, this is a leading example that late life assets provide material opportunities for cost effective emissions reduction, despite their lifecycle stage.

Moving to a single gas turbine in 2026 will reduce emissions on Armada by >40,000 tonnes CO_2e per year, an approximate 30% reduction compared to 2023 emissions and improving the emissions intensity performance. All figures are based on preliminary output from concept select stage studies, and are subject to change prior to making a final investment decision.

Carbon intensity

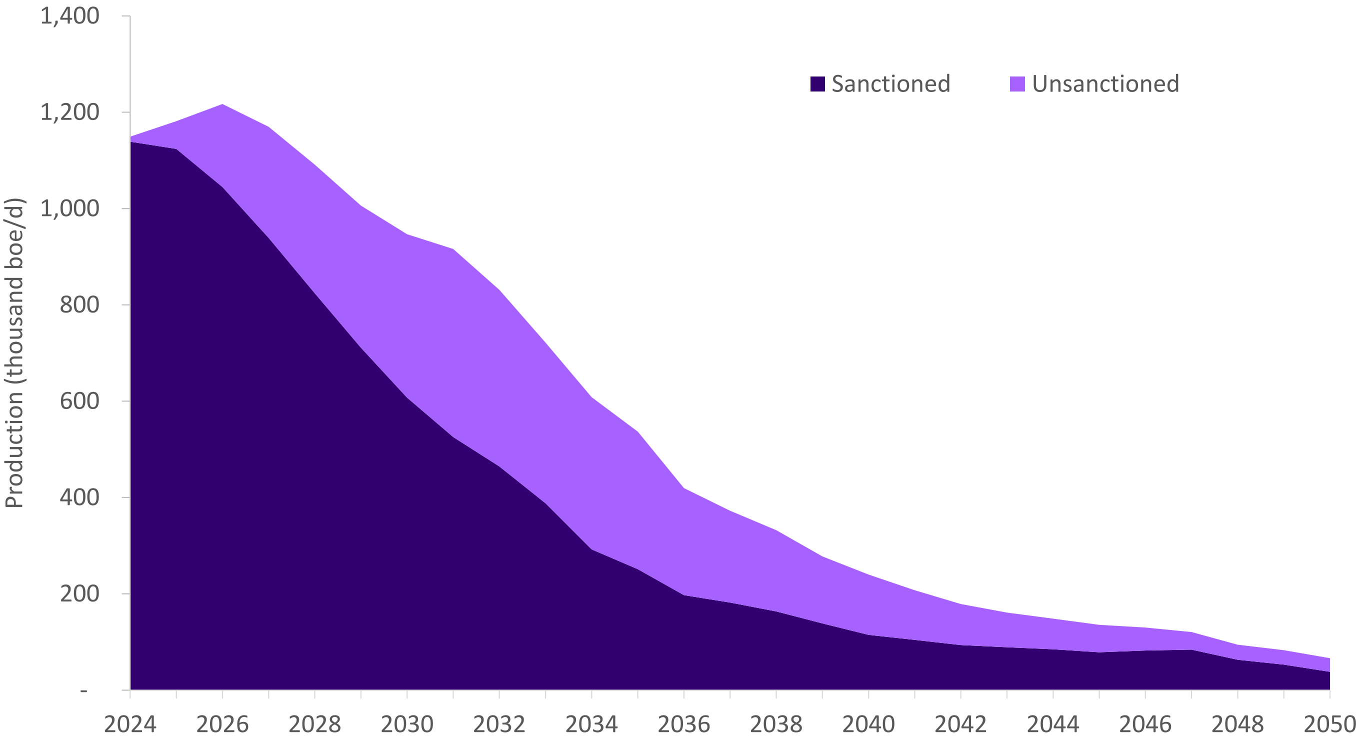
UKCS oil and gas output in 2023 fell by 11% and 10% respectively year-on-year. This rapid decline saw an increase in the basin's carbon intensity – the quantity of GHG emitted in the full value chain for a barrel of production. Infrastructure needs a similar amount of energy all the time, irrespective of declining throughput.

So, while the net emissions attributable to the UK fall, the overall emissions emitted into the atmosphere go up and this ultimately defeats the wider purpose of climate action.

New developments unlocked in the UKCS would be focused on extending the life of existing infrastructure and could cut basin emission intensity as new production with low emissions bring down the average.

Despite the relatively small increase in average carbon intensity in the North Sea of 21.40 kg/boe in 2023, up from 19.67 kg/boe in 2022, the UK direct and indirect carbon intensity of producing a unit of gas in the UK remains around a quarter that of the equivalent unit of imported LNG. The UK imported 71% of total natural gas supply in 2023.

Figure 11
UKCS production outlook, sanctioned versus unsanctioned



Source: Asset Stewardship, OEUK

4. Reaching net zero

Key messages...

- **Offshore energy integration will have a deep and lasting impact on the country's overall net zero target.**
  Achieving the net zero targets will primarily be achieved through the development of carbon capture and storage technology and hydrogen, along with the addition of offshore renewables – particularly offshore wind. Co-ordinated and integrated effort, along with a streamlining of planning processes, is required to ensure a sufficient pipeline of projects across the sector that will deliver net zero targets.

- **Accelerating installed offshore wind capacity has a key role to play in decarbonising the grid and the wider economy.**
  With nearly 15 GW of capacity operational in 2023, 6.8 million tonnes of CO_2 has been displaced from the UK power system. The government aim is to quadruple offshore wind by 2030, with the expectation that this will be the fastest growing source of renewable energy in the coming decade. Long term, it is expected that 100 GW will be in place by 2050 and beyond that, the UK has vast resources of offshore wind that could be exported as electricity or hydrogen.

- **Grid connections and pace of installation pose challenges to achieving the country's targets.**
  Around 6 GW of grid connection agreements need to be brought forward to 2030 to allow time for required network enabling works. At current pace, only 40 GW of offshore wind capacity is expected to be installed by 2040; to be on track to achieve the aim, 7.6 GW needs to enter the planning system in 2024. There are about 80 GW of offshore wind projects in the pipeline, but offshore wind can take over 10 years to be fully operational from the award of the seabed lease.

- **The UK has the largest CO_2 storage capacity in Europe, far beyond our own needs.**
  The UK is estimated to possess the largest carbon storage capability in Europe at 78 Gt, with projected installed capacity at least 50 million tonnes of storage by 2035. Developing cross-border networks between the UK and EU will allow other countries to decarbonise faster while capitalising on UK potential.

- **Emerging technologies such as CCS and hydrogen are fundamental to a just energy transition.**
  Hard to abate industries such as steel and cement will fail to decarbonise without the use of CCS or hydrogen, which is key to safeguarding the transition at the lowest environment cost while retaining local content.

Decarbonising the grid: Power generation

Ahead of the 2024 general election, the Labour party published a policy document on energy that aimed for a ‘zero-carbon electricity system by 2030’, accelerating the former government’s power system ambition by five years. The original 2035 national grid decarbonisation target was determined as realistic by the CCC but has since downgraded this view based on the current pace of change.

To understand the scale and pace of development needed to realise a decarbonised grid by 2030, OEUK commissioned independent analysis (AFRY, 2024). The findings show that deployment rates for established renewable technologies would need to match or exceed historical annual deployment rates until 2030. It would also require new technologies to be deployed at scale. Table 1 shows the size of additions needed above existing capacity and how this compares to current government targets.

Table 1: comparing 2030 Government ambition versus AFRY NZ 2030 (GW)

	Installed capacity	Government ambition 2030	AFRY NZ 2030
Onshore wind	13	30	28
Solar	16	48	44
Offshore wind	15	50	51
Total	44	128	123

Fast, effective and co-ordinated effort in several targeted areas is required to achieve the scale needed, with little contingency available. Planning processes will need to be streamlined to ensure a sufficient pipeline of projects, and support schemes will need to be scaled up or implemented.

Existing policy levers can be built on the legal framework and required policies are already in place and the government can extend or accelerate their implementation. Sufficient revenue support and greater resources for consenting and grid connections need to be committed to enable the necessary scale up.

Offshore Energies UK Guidelines

We are the definitive source of information on the UK offshore oil and gas industry, producing a range of publications that are essential reading.

oeuk.org.uk/product/analysis-for-achieving-a-net-zero-power-grid-by-2030/

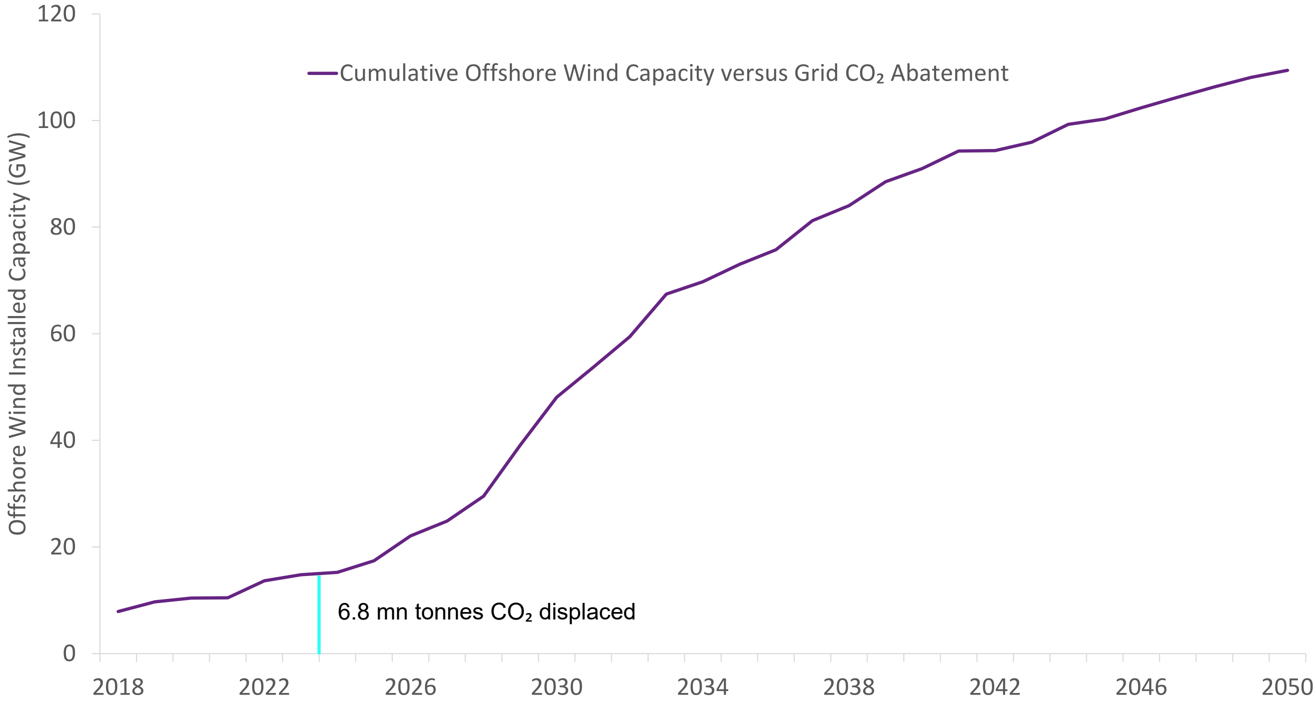
Offshore wind

Offshore wind is expected to be the fastest growing source of renewable energy in the coming decade. Offshore wind has similar installed capacity to onshore wind and solar in the UK, each standing at around 15 GW, which is enough electricity to power 18 million households. The government aims to double onshore wind, triple solar and quadruple offshore wind by 2030.

At the current pace of deployment, only 40 GW of offshore wind capacity is expected to have been installed by 2030. To be on track to achieve targets, 7.6 GW needs to enter the planning system in 2024. Grid connections are also a significant challenge: around 6 GW of grid connection agreements need to be brought forward to 2030 to allow time for required network enabling works. An additional 36 GW must be operational by 2030. There are about 80 GW of offshore wind projects in the pipeline, but offshore wind can take over 10 years to be fully operational from the award of the seabed lease.

Longer term, it is expected that 100 GW will be in place by 2050 and beyond that, the UK has vast resources of offshore wind that could be exported via interconnector or hydrogen. Progression in wind technology has moved from onshore to offshore with floating wind, an emerging technology, enabling deployment in ever deeper water. This technology has a higher load factor, meaning higher operational efficiency and power output.

Figure 12
Growing offshore wind capacity removing carbon emissions from the grid



Source: Rystad, Crown Estate, OEUK

Offshore wind generated 49.55 TWh (14.8 GW) of electricity in 2023, displacing 6.8 million tonnes CO_2 of associated grid network emissions from fossil fuels. As installed offshore wind capacity grows toward the mid-century, more CO_2 will be removed from the grid as it decarbonises.

The Innovation and Targeted Oil & Gas (INTOG) offshore wind round has been designed to tackle the offshore oil and gas power generation via platform electrification. It has the dual advantage of directly reducing emissions from platforms and displacing emissions from power generation. Up to 5.5 GW (a third of current capacity) of floating wind could be deployed to electrify the UKCS platform with the surplus going to the grid. Furthermore, INTOG is the most promising route for the UK to build 5 GW of offshore wind by 2030.

CASE STUDY

Culzean floating wind

TotalEnergies (TEPUK's parent company), is targeting installation of 35 Gigawatts (GW) of renewables by 2025 and 100 GW by 2030 worldwide. TotalEnergies is developing a portfolio of offshore wind projects in the UK through TotalEnergies Renewables UK Limited (TRUK). TEPUK and TRUK are both based in Aberdeen and work closely together.

TEPUK is proposing to demonstrate the possibility of electrifying existing oil and gas assets in the North Sea via the installation of a floating turbine, which would connect to the existing oil and gas platform (Culzean Field).

The rationale of the project is twofold; to trial mooring system technologies and a new floater technology, the first of this type of hull design in combination with using a readily available 3MW turbine design. The semi-submersible light floater hull is modular, allowing for fast assembly and optimised costs; whilst the pioneering project is focused on testing the technology, hybridisation of the Culzean offshore installation is a direct outcome, expecting to save approximately 40kt CO_2e emissions related to power supplied.

Overall, the new floater technology will deliver opportunities for significant cost savings, industrialisation of larger projects, and provide TEPUK with valuable experience in the hybridisation of assets; with the Culzean Field providing an additional opportunity to pilot the integration with an oil and gas installation for the provision of power.

When operational, expected in late 2025, the 3MW floating wind turbine will supply around 20% of Culzean's current power requirement, thereby reducing its emissions.

The current Culzean Field comprises a Well Head Platform (WHP [A]), a Central Processing Facility Platform (CPF [B]) and a separate Utilities and Living Quarter Platform (ULQ [C]). It is proposed that the floating turbine will be linked to the CPF via a 2 km export cable.

Low carbon dispatchable power

An overreliance on intermittent energy sources such as wind and solar without the ability to store excess power generation, will result in imports from overseas, potentially at a price and environmental premium.

Having access to low-carbon dispatchable power generation domestically reduces the cost to the end-consumer and the sector's overall emissions.

Hydrogen to power – and vice-versa

More electricity demand and renewable electricity generation requires a network with flexible and dispatchable technologies embedded in it. Hydrogen to power can be a flexible decarbonisation method for power generation, where low carbon hydrogen is used to generate electricity through turbines, boilers or combustion engines. Conversely, at times of over-generation especially during summer, excess power supply can be diverted to hydrolysis projects, avoiding constraint costs.

If implemented correctly, hydrogen to power offers flexibility and security to the system. It offers somewhere for excess renewable energy to be diverted to, rather than curtailing production. For example, this principle is in operation using pumped hydropower.

Power carbon capture and storage

A solution that would make use of the existing strengths of the domestic power market is power carbon capture and storage (CCS), which combines the power generation capabilities of the existing domestic gas and bioenergy power plants and decarbonises them through carbon capture technologies. Capturing the CO_2 and injecting it into depleted gas fields reduces the emissions of the existing generation fleet.

Power CCS is fundamental to the scale up of low carbon dispatchable power while the hydrogen sector is developing. Gas will therefore be a part of the UK energy mix for years to come.

Ongoing research and development are aimed at overcoming challenges related to cost and efficiency. Current forecasts envisage 10 GW of power CCS capacity needs to be in position by 2030.

Decarbonising other industries

Over the past few decades, the UK has made positive strides in decarbonising its industrial sector, through fuel switching and improved production and operational efficiency. However, the largest decline in gross emissions has come from a loss of industrial and manufacturing plants to overseas.

Domestically produced goods are in demand in numerous sectors and as the UK bolsters its industrial and manufacturing ambitions, emissions must fall further. Hard-to-abate industries such as steel and cement will fail to reach net zero without the use of CCS or hydrogen.

Decarbonising cement and steel, and a low-carbon goods market will be key to safeguarding the transition at the lowest possible environmental cost and promoting local content for the transition.

As an example, the production of cement involves process emissions, emissions released through the chemical transformation of raw materials, that would not be affected by the electrification of the fuel source. During the calcination process limestone, calcium carbonate ($CaCO_3$), is heated in a cement kiln to form lime (CaO) releasing CO_2. The only means of reducing process emissions is to capture the CO_2 at source.

Steelmaking demands high temperatures for the refining and the reduction of iron ore to iron, and both processes produce emissions. Steel manufacturers must first decarbonise their furnaces by electrifying their fuel source. Then they decarbonise the reduction, either using a non-carbon-based reduction agent such as hydrogen or by capturing the emissions associated with the process. This enables high-quality steel production to continue but without the associated emissions. The Morecambe Net Zero case study highlights the importance of CCS in protecting the UK's industrial sector.

To make sure that the decarbonisation of domestic industry is economically viable and sustainable, the UK is considering measures similar to the EU's Carbon Border Adjustment Mechanism (CBAM), which imposes tariffs on imported goods depending on the amount of carbon their production emitted. The aim is to level the playing field for domestic industries and reduce the incentives to relocate. The UK CBAM will place a carbon price on some of the heaviest emitting manufacturing sectors: aluminium, cement, ceramics, fertiliser, glass, hydrogen, iron and steel sectors.

The UK CBAM will work cohesively with the UK Emission Trading Scheme (ETS), including free allowances, to ensure imported products are subject to a carbon price comparable to that incurred by UK production, mitigating the risk of carbon leakage.

As the key market-based mechanism for driving industrial decarbonisation, the UK ETS enables businesses to make economically rational decarbonisation investment decisions, by placing a market value on their CO_2 emissions. This UK-wide cap-and-trade system covers around a third of the UK's greenhouse gas emissions, mainly from power generation and industry sectors.

In 2022, the UK ETS Authority started public consultations on the future of the scheme, proposing expanding it to new sectors and including more greenhouse gases, along with other changes to how the scheme functions. This was intended to develop a long-term pathway for the scheme and to enhance its role as a foundation for a thriving, decarbonised economy through 2050 and beyond. A well-designed scheme would extend the market integrity and commercial drive towards decarbonisation across more of the economy, and support delivery of the energy transition.

Along with the proposed CBAM, the UK ETS scope extension is a critical opportunity to enable the delivery of net zero goals while ensuring that emissions are not simply outsourced to other countries. Addressed through a combination of domestic policies and international cooperation, the UK can be well placed to meet its climate goals without sacrificing economic growth and industrial competitiveness.

CASE STUDY

Morecambe Net Zero MNZ project

Spirit Energy's MNZ project will provide a permanent decarbonisation solution, converting the depleted South and North Morecambe Bay gas fields off the coast of Barrow-in-Furness to provide permanent, safe and secure carbon storage.

The Morecambe Bay gas fields have been a cornerstone of the UK's energy security for decades, and at one stage provided 30% of all domestic natural gas supply (at today's volumes).

MNZ has partnered with the Peak Cluster to capture, transport and permanently store CO_2 emissions from neighbouring industries and across Derbyshire, Staffordshire and Cheshire with a focus on the cement and lime industry. 40% of the UK's cement and lime industry to be decarbonised on the route to capturing over 25 million tonnes per year.

The project has the capacity to be the largest carbon store in Europe and could hold 10 years' worth of all UK industrial emissions whilst safeguarding thousands of jobs across the UK's industrial heartlands and bring vital investment to the North West of England.

Beyond this, by connecting additional industrial sites and by importing CO_2 from further afield by ship and rail, it is projected that 25 million tonnes of CO_2 can be stored at the site each year by the end of the next decade. This scale will allow rapid commercialisation of the project with rising UK ETS prices and become a net revenue generator for the UK moving forward given the scale of opportunity there is to export CO_2 storage services.

To do this, the MNZ-Peak Cluster will work in three simple stages:

Capture: CO_2 will be captured in specialist equipment installed at the industrial plants of Peak Cluster in Derbyshire and Staffordshire, with the potential to subsequently connect further industries to the transport infrastructure.

Transport: CO_2 will be transported via newly built buried pipeline across to the coast, before being transported offshore to the storage site.

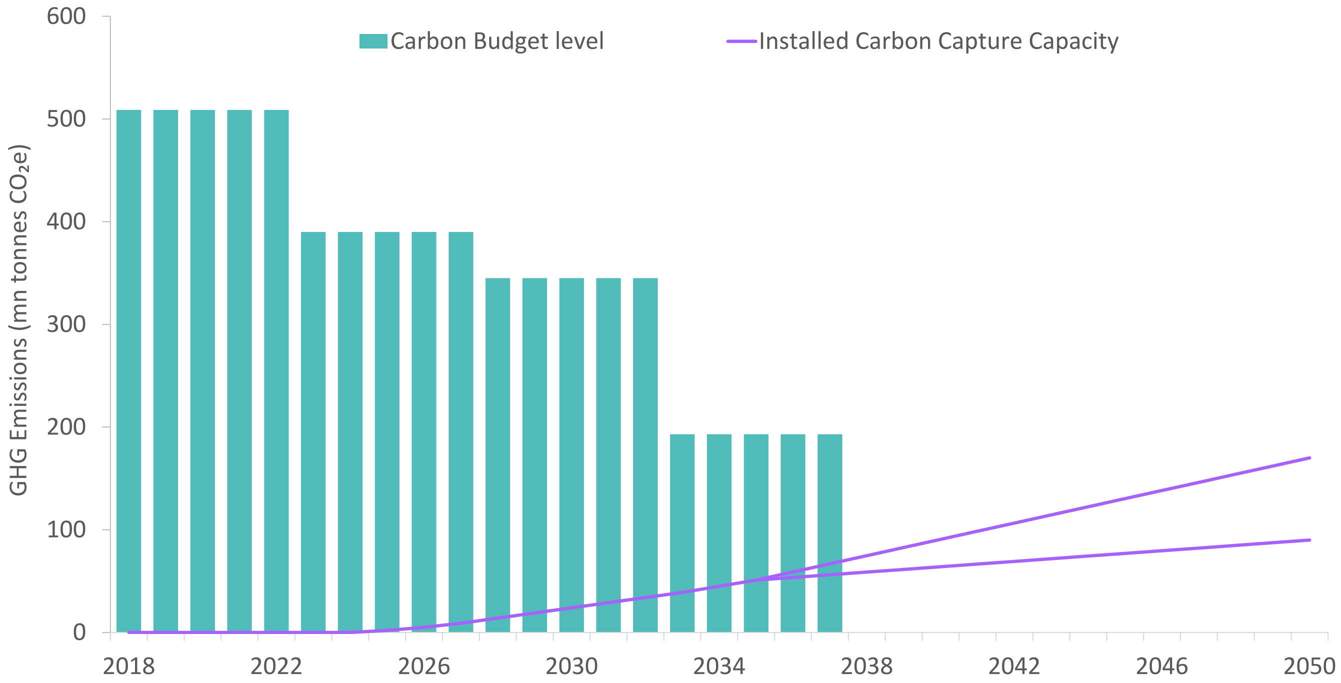
Storage: CO_2 will be injected into rock formations deep beneath the East Irish Sea for permanent storage.

A total storage capacity of 78 billion tonnes; enough carbon storage to hold two centuries' worth of the UK's current emissions

Key facts:

- Four million tonnes of industrial CO_2 emissions from the Peak Cluster will be stored in MNZ each year from 2030
- A pipeline of projects capable of capturing approximately 94 million tonnes per annum of CO_2
- The creation and safeguarding of more than 13,000 jobs
- An annual increase of £154m in skills uplift and wage increases
- Attract around £5bn of UK investment in construction and operations
- It will generate the equivalent of £1.8bn GVA
- Between £34.6bn and £104.0bn will be saved by industry in ETS non-payments

Figure 13
Carbon budget level against projected CCS installed capacity to 2050



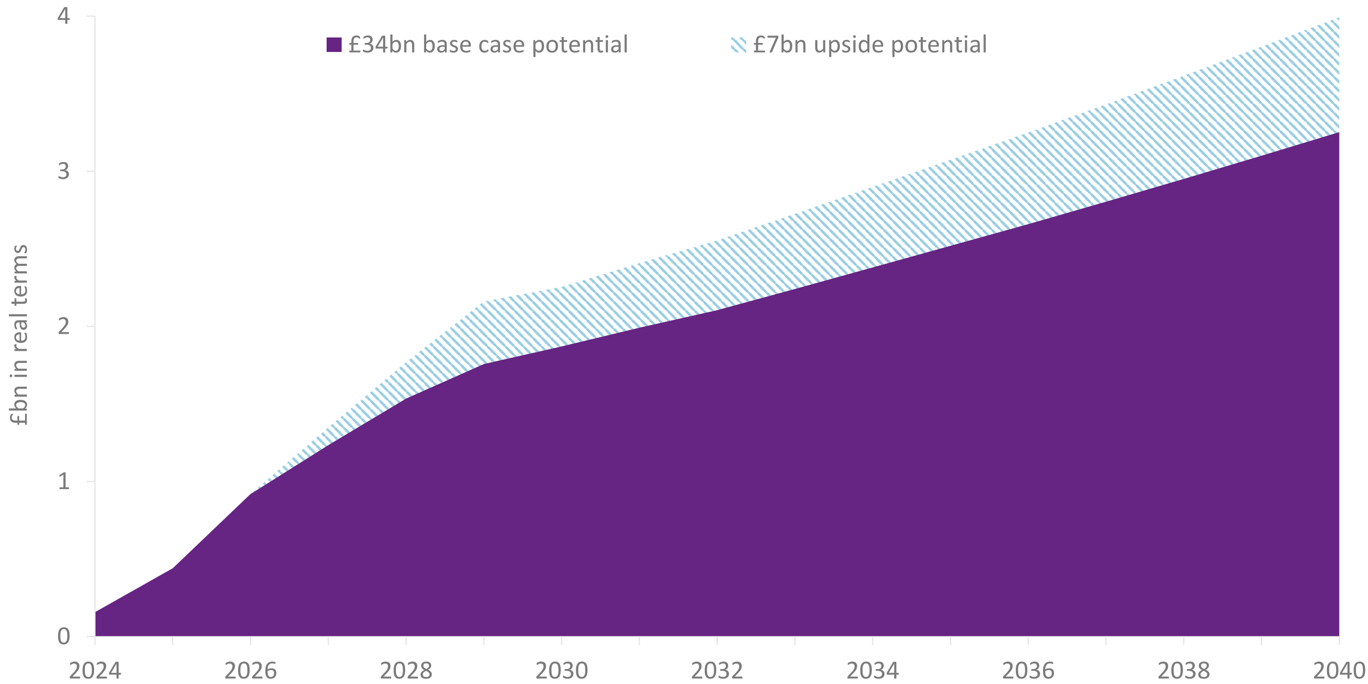
Source: CCC, Rystad, OEUK

The UK is projected to have installed at least 50 million tonnes of carbon storage by 2035, offsetting more than a quarter of the annual sixth Carbon Budget level for that period. By 2050, this capture capacity is projected between 90 and 170 million tonnes.

The British Geological Survey estimates the UK possesses around 78 Gt of CO_2 storage, the largest in Europe and far beyond our needs as a nation. Developing cross-border networks between the UK and the European Union will benefit all parties involved, as the UK can capitalise on its vast CO_2 storage potential and countries can also access these facilities and so decarbonise faster.

OEUK commissioned Rystad Energy to write a report on the supply chain earlier this year. It outlines the financial opportunities for the UK supply chain from the expansion of domestic CO_2 storage to include injecting emissions from Europe. The analysis shows that the upside potential for UK supply chain companies could be in the region of £7 billion over the course of the next 15 years if 30% of emissions from European emitters were stored in the UK.

Figure 14
UK CCS capital and operational expenditure per year with imports



Source: Rystad

With the annual upside potential reaching £1 billion/year by 2040, any delay to cross-border transport would greatly reduce our ability to compete with countries such as Denmark, Norway and the Netherlands. Failing to attract European emissions would also reduce the economies of scale for storage sites, hence lower earnings for supply chain and transportation and storage companies. The government would also collect lower taxes.

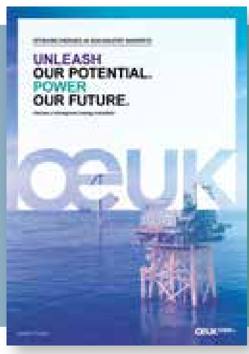
The final investment decision (FID) for the Track-1 clusters (Hynet and East Coast Cluster) is expected later this year, with the Track-2 clusters (Viking CCS and Acorn CCS) following in 2025.

Choosing an energy transition which is homegrown instead of imported will grow the economy, support jobs, create value for the UK's world class supply chain and deliver reliable supplies of cleaner energy.

Offshore Energies UK Guidelines

We are the definitive source of information on the UK offshore oil and gas industry, producing a range of publications that are essential reading.

https://oeuk.org.uk/product/oeuk-2024-industry-manifesto/



5. Further decarbonisation opportunities

Key messages...

- **Significant emissions reduction efforts have been delivered not only by operators.**
  The supply chain plays a pivotal role in servicing the industry to generate opportunities to support further decarbonisation across the full supply chain. Service companies have demonstrated their commitment to emissions reduction through various actions and decarbonisation projects.

- **The integration of synthetic fuels into offshore oil and gas operations is a promising step forward.**
  Technology has a key role to play in the delivery of emission reduction targets and such things as synthetic fuels and can help decarbonise hard-to-abate sectors without the need to decommission offshore installations early.

Decarbonising the supply chain

As part of the NSTD, the government committed to developing a 'low carbon supply chain of international repute', working alongside the sector to identify opportunities to support low-carbon propositions across the UK.

This commitment also included support for the sector's supply chain review to identify the UK's capability to deliver technology and services across the energy transition.

Significant emissions reduction efforts have not only come from operators, but the supply chain servicing our sector has also put forth high efforts to support further decarbonisation across the full supply chain.

CASE STUDY

Supply Chain Decarbonisation Approach

SLB is committed to creating value and fostering resource consciousness for a balanced planet,aiming to enhance cooperation among stakeholders within and beyond their value chain.

SLB take an intrapreneurial approach to pilot and scale a range of responsible supply chain initiatives, supported by a central governance structure, and implemented locally across 100+ geographies including the UK.

By understanding and influencing their value chain, SLB are working to proactively address sustainability challenges and drive culture change.

The impact of initiatives is reflected in 2023 achievements:

- CDP Supplier Engagement Rating of A
- Ecovadis Sustainable Procurement Score of 70/100
- Ranked 11th on Gartner's Supply Chain Industrial Top 25
- Upskilled 4000+ employees on sustainability
- 850M$+ and 1100+ projects tendered with climate weightage.

Europe and the UK in particular are at the forefront of SLB's decarbonisation efforts, with several local and regional initiatives supporting a global plan, some of which are cited below:

Upskilling
SLB partnered with the University of Exeter to train 300 internal supply chain leaders to date on Circularity. Along with company-wide sustainability training for all employees, collaborating with Climate Fresk to deliver baseline training to 80%+ of supply chain team (4000+) by end of 2024.

CDP Supply Chain Focus
In 2021, SLB partnered with CDP to request standardized climate disclosures from priority suppliers to gain insights into their environmental performance. In just two years, this achieved visibility of over 80% of CDP requested vendors, and in 2023, the second largest CDP disclosure program worldwide was conducted. SLB co-developed a framework with CDP – the SLB Horizon Analysis – which provides insights on tangible climate-related actions that each supplier should take, helping them advance to the next level of maturity through training and webinars covering topics such as reporting, an action strategy, and the risks and opportunities associated with climate change. In 2023, SLB were recognized with an "A" CDP Supplier Engagement Rating, moving from a D to an A rating in just three years.

Sourcing Focus
In 2023, SLB embedded climate action into their sourcing strategy for high-emission product categories, setting a minimum 10% climate weightage in tenders as evaluation criteria, utilising suppliers' CDP scores or SLB Climate Action Request questionnaires.

Others
Climate Action Integration in Contracts: SLB implemented an Environmental Sustainability Exhibit in supplier contracts, formailising minimum climate action expectations for key suppliers.

Product Carbon Footprint: This initiative Improves granularity of Scope 3.1 to define emissions reduction levers, focus on chemicals and manufacturing categories, while being aligned with the World Business Council for Sustainable Development and the Partnership for Carbon Transparency.

This comprehensive approach has resulted in significant improvements in decarbonizing the company supply chain.

CASE STUDY

Shore Power

After mapping out its emissions, Montrose Port Authority (MPA) identified that 96% belonged to Scope 3, predominantly from visiting vessels. In response, MPA committed to implementing shore power to reduce 80% of these emissions by 2035, as per its Net Zero strategy.

The shore power facility, named Plug Montrose, is a pioneering £1mn self-funded joint venture with Plug, a leading Norwegian company that specialises in shore power. Plug Montrose launched in April 2024, making Montrose the first port in Scotland to provide shore power to offshore energy supply vessels.

Typically, berthed ships use diesel-fuelled auxiliary engines to power onboard functions such as lighting, heating and cooling. Plug Montrose provides an alternative power supply, allowing vessels to connect to the port's electrical grid, powered by 100% renewable power with a renewable energy guarantee of origin (REGO). This enables vessels to switch off their diesel generators, significantly reducing emissions, fuel consumption and noise pollution.

The shore power facility offers numerous benefits, including better air for the local community and lower greenhouse gas emissions. Additionally, ship owners benefit from lower fuel and operating costs. Onboard personnel experience a quieter, safer environment, relying less on ear defenders when working. Maintenance tasks, such as air leak inspections, are also more efficient.

Currently installed on Berths 1 and 2, Plug Montrose will be installed next on Berth 3, with plans to expand it to all berths. The facility allows energy supply-chain vessels, in both traditional and renewable energy sectors, to decarbonise their operations while in port. Many vessels can already connect and others are being retrofitted for shore power compatibility.

The installation process, completed in 12 months, involved constructing a new substation and transformer system, housed in a shipping container, with cabling extending to quayside connection cabinets. MPA was fortunate to have sufficient grid capacity, ensuring a smooth installation process. And the Plug team was experienced in installing similar plant, in Norwegian ports.

Lessons from Norwegian installations were very useful, bearing in mind the constraints on vessels operating using shore power in those ports. The Plug team adapted the system specifically for Montrose, enabling vessels to perform quayside operations while connected to shore power. Although this was a first-time project in the UK for some stakeholders they successfully adapted to local differences, completing the project on schedule.

Plug Montrose represents a significant step towards sustainable maritime operations. By leveraging shore power, MPA not only reduces its Scope 3 emissions but also sets a benchmark for other UK ports. This initiative demonstrates the potential for significant environmental and operational benefits through innovative and collaborative approaches to emission reductions in complex maritime environments.
Since April 2024, connections by energy supply-chain vessels have consumed 253.64 MWh of energy. Based on pure CO_2 emissions, 187.7 tonnes have been saved. First-year conservative projections estimate savings of 400 tonnes.

Montrose Port Authority tracks shore power energy consumption and the cut in emissions using specialist proprietary software called Plug Insights used by Norwegian ports since 2018. It is not just a system for the port to use; vessel operators can also access it to see how much power their fleet is using when plugged in and how many tonnes of CO_2 they are avoiding.

The engineer responsible for decarbonising Montrose Port has calculated that if one Viking vessel supply ship, such as the Magne or Njord Viking, were plugged into shore power for 24 hours, that would save as much CO_2 as would be emitted by a car circumnavigating the globe.

CASE STUDY

Alternative Fuels: An Alternative to Electrification

There are several isolated assets situated far from the shore where electrification is not a feasible option for decarbonising power generation. For these assets, an alternative method to decarbonise power generation is required.

Summary
This study is part of the Net Zero Technology Centre's Alternative Fuel Gas Turbine (AFGT) project, part of the Net Zero Technology Transition Programme (NZTTP). Power generation accounts for approximately 79% of greenhouse gas (GHG) emissions from the oil and gas industry, making decarbonising of offshore power generation essential to meet the emission reduction targets of the North Sea Transition Deal (NSTD).
Apollo, in collaboration with EnQuest and Bumi Armada, explored fuel change-out options and their implications on the Armada Kraken FPSO in the UKCS. The primary focus was to reduce onboard emissions to align with net zero and energy transition targets.

Phase 1: This phase centered on understanding the key differences between alternative and traditional fuels, including OEM offerings around generator sets and boilers. The knowledge gained provided the foundation for Phase 2.

Phase 2: This phase is built on Phase 1 findings, developing feasible options for adopting alternative fuels on the FPSO.

Scope of Work
The study aimed to understand the technical, regulatory, and technology implications of using alternative fuels instead of gas and/or diesel on an offshore production asset. Four alternative fuels were considered: alternative diesel, methanol, ammonia, and hydrogen.
Phase 1: Focused on understanding the differences between alternative and traditional fuels, consolidating existing work to determine the current status, and developing a range of options for adopting alternative fuels on the FPSO.

Phase 2: Built on Phase 1 findings, involving detailed discussions with OEMs to gather more information on changing to an alternative fuel. A detailed assessment of the remaining options was conducted.
Outcome

The study assessed the four alternative fuels for the Armada Kraken FPSO—alternative diesel, methanol, ammonia, and hydrogen—in terms of cost, technology readiness, and emissions reduction impact. Alternative diesel was found to be the only practical and economically feasible option, requiring no significant modifications or changes to operating procedures. Apollo presented the findings, recommendations, and a technology roadmap in a study report.

Read the full report here – https://www.netzerotc.com/wp-content/uploads/2023/09/1130-REP-044-R1-AFGT-Kraken-Case-Study-Report-Public-Summary.pdf

Synthetic fuels

Synthetic fuels, also known as synfuels or e-fuels, are a synthetic alternative to fossil fuels and can help decarbonise hard-to-abate sectors decommission ahead of time/early.

Electrofuels (e-fuels) are produced by combining electrolytic (green) hydrogen, with captured carbon or nitrogen. An e-fuel can be considered carbon neutral if the emissions released into the atmosphere during its combustion are equal to (or less than) the captured CO_2 used to produce it.

Offshore installations rely on fossil fuels for power generation and operations. Adopting synthetic fuels for existing infrastructure requires minimal modifications and can significantly reduce a platform's carbon footprint.

The energy transition requires synthetic fuels, first though must come mature technologies that are still nascent and expensive, such as green hydrogen and CO_2 capture.

The integration of synthetic fuels into offshore oil and gas operations would be another promising step towards decarbonising the industry.

Glossary	
Mt	Million tonnes
$MtCO_2e$	Million tonnes of carbon dioxide-equivalent
Gt	Gigatonne (1,000 million tonnes)
NSTD	North Sea Transition Deal
GW	Gigawatt (1,000 Megawatts)
TWh	Terawatt hours
CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
CoP	Cessation of production
Carbon leakage	The movement of production and associated emissions from one country to another owing to more favourable conditions for energy-intensive industries as well as lower standards for emissions and health and safety.
GHG	Greenhouse gases
CCC	Climate Change Committee
OGA	Oil and Gas Authority
ERAP	Emissions Reduction Action Plan
CBAM	Carbon Border Adjustment Mechanism
CCS	Carbon Capture and Storage
ETS	Emissions Trading Scheme
CaO	Calcium oxide
$CaCO_3$	Calcium carbonate

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