Towards a NetZero Industry

An SNS Perspective

OEUK – October 2023

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The Problem

Green House Gas Emissions Causing Global warming

Where do they come from in the Upstream industry?

Predominantly:-

- Direct methane emissions
- CO2 from combustion
- Uncontained refrigerants

Our Challenge

The North Sea Transition Deal(NSTD) is a joint commitment on behalf of the UK Government and UK Oil and Gas (On behalf of the industry), to the delivery of the following objectives/policies, set against a 2018 baseline:-

- 10% reduction in offshore emissions by 2025;
- 25% reduction in offshore emissions by 2027;
- 50% reduction in offshore emissions by 2030;
- NetZero by 2050;

TOGETHER FOR OUR PLANET

North Sea Transition Deal

The Rt Hon Kwasi Kwarteng MP

Secretary of State for Business, Energy and Industrial Strategy

Deirdre Michie OBE
Chief Executive, OGUK

The Rt Hon Anne-Marie Trevelyan MP

Minister of State for Business, Energy and Clean Growth, and UK International Champion on Adaptation and Resilience for the COP26 Presidency

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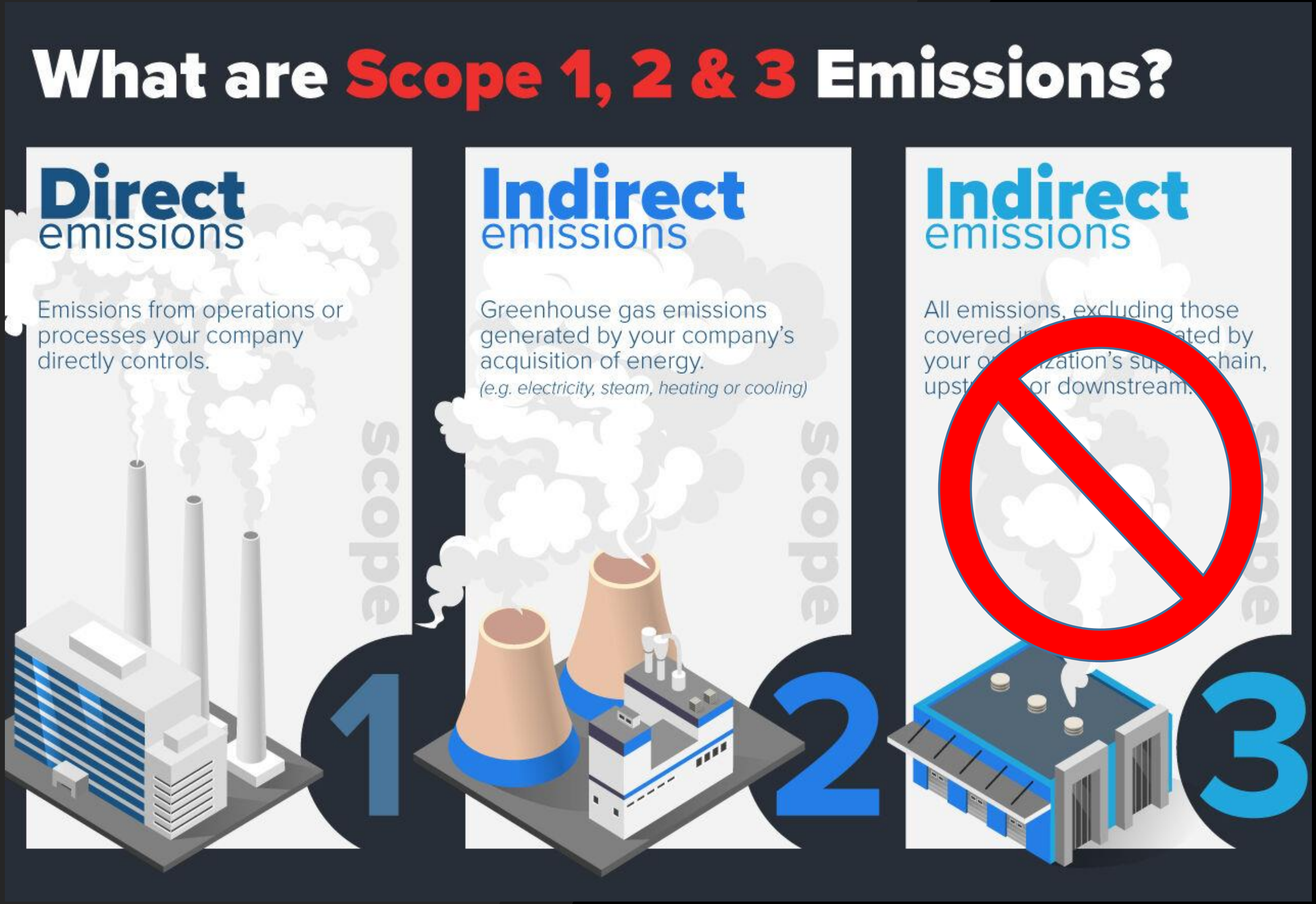
What is Included in The SNS Emissions Review?



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Where Do Our Emissions Come From?

- Marine Operations
- Aviation Operations
- Onshore/ Offshore Gas Production
- Local Power Generation/ Simplification
- Unplanned releases
- Flaring/ Venting
- Drilling activities
- Decommissioning activities

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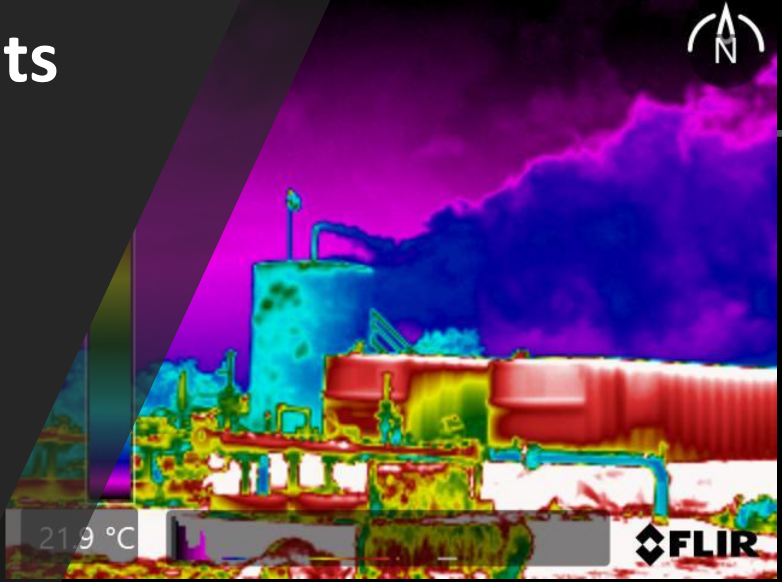
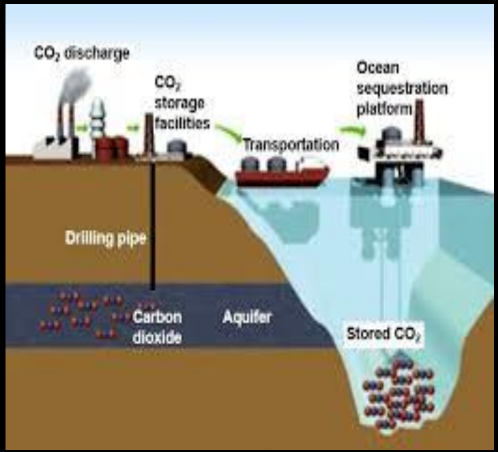
What Can We Do to Achieve Improvements

Define Scope 1 Emissions Improvement Potential

Potential areas for review:-

- Reduced venting and flaring (inventory reductions, vent purge management, improved operational practices etc.);
- Reduced fugitive emissions (improved leak detection(drones, ultrasonic detectors, FLIR) integrity systems);
- Improved power efficiency, reducing demand on local combustion(operational simplification);
- Renewable/ Efficient Energy Sources (Solar, Wind, Tidal, Hydrogen, Solid Oxide Fuel Cells(SOFC)).
- Carbon capture at source and disposal





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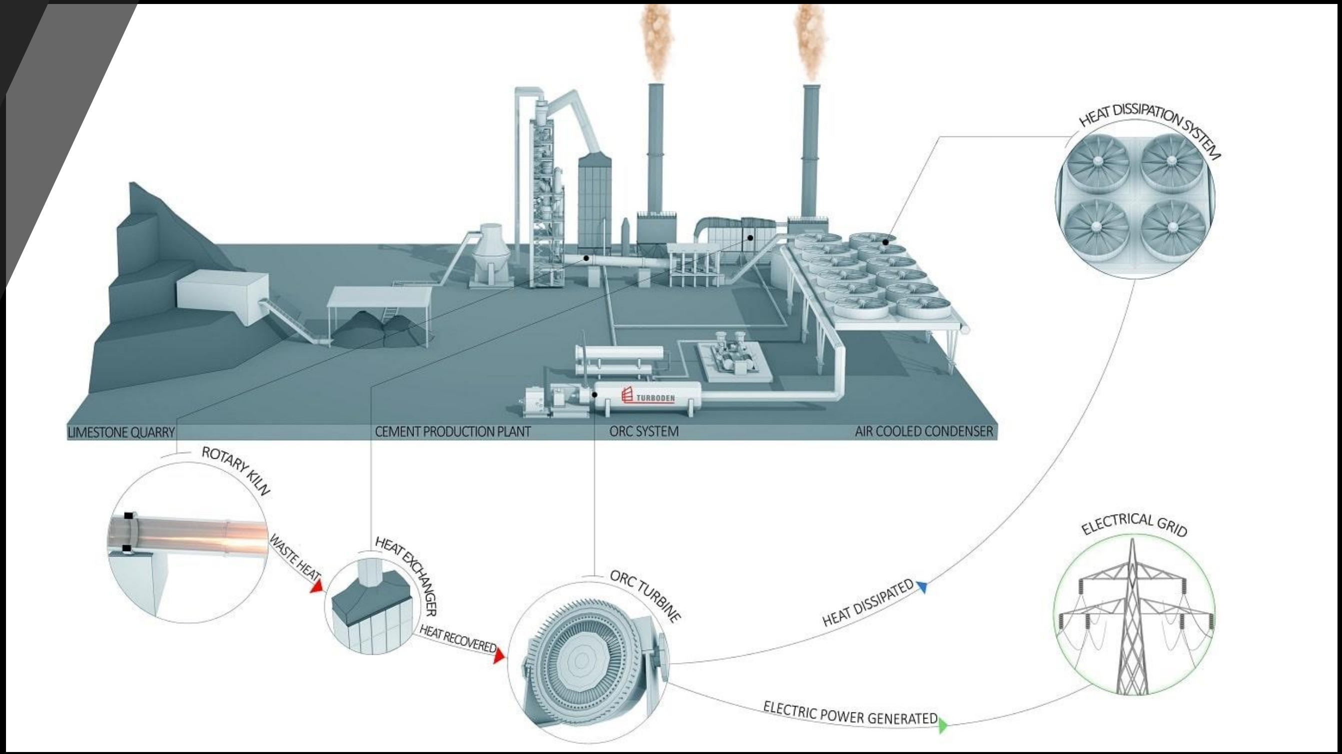
What Can We Do to Achieve Improvements

Define Scope 2 Emissions Improvement Potential

Definition:- Scope 2 emissions are indirect emissions generated from purchased energy—including electricity, steam, heating, and cooling otherwise known as **Buy Emissions**

Potential areas for review:-

- Energy/services purchased from renewable sources
- Transition to self generated renewable energy
- Waste Heat Recovery for power



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CO2 Emissions Reduction From Large Combustion Equipment

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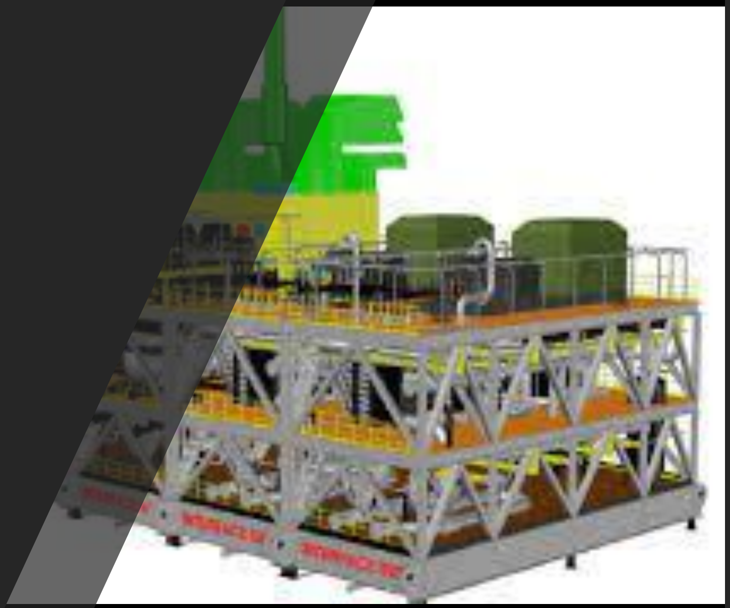
CO2 Emissions Reduction From large Combustion Equipment

- The UKCS hydrocarbon industry depends heavily upon large combustion equipment to maintain both economic and extended gas recovery.
- Typically, in the plateau and latter stages this involves the use of fired compressors to improve recovery.
- Unfortunately, this comes at a price, both in terms of CO2, other emissions and fuel gas costs. Such emissions are considered Scope One, under the universal classification system.
- The purpose of this document is to examine how the SNS can reduce CO2 emissions associated with large combustion equipment and still provide essential transition gas for business and wider society.



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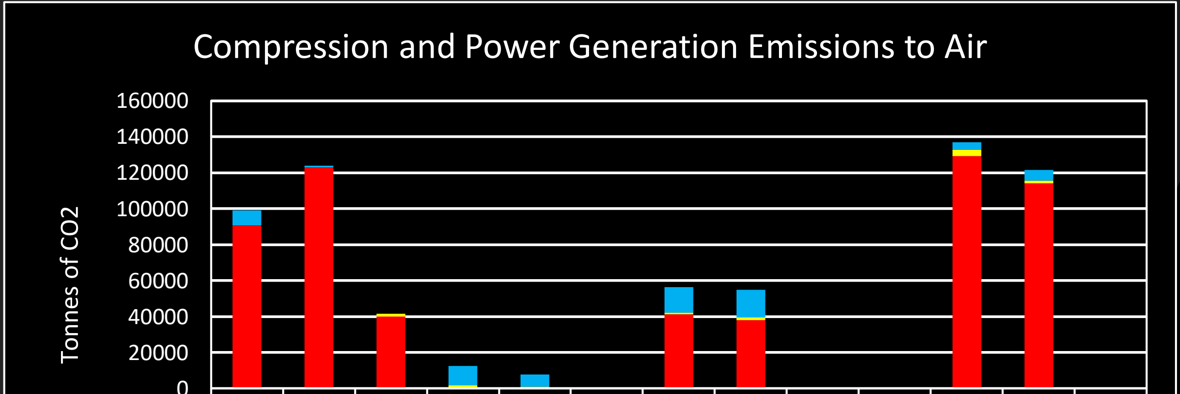
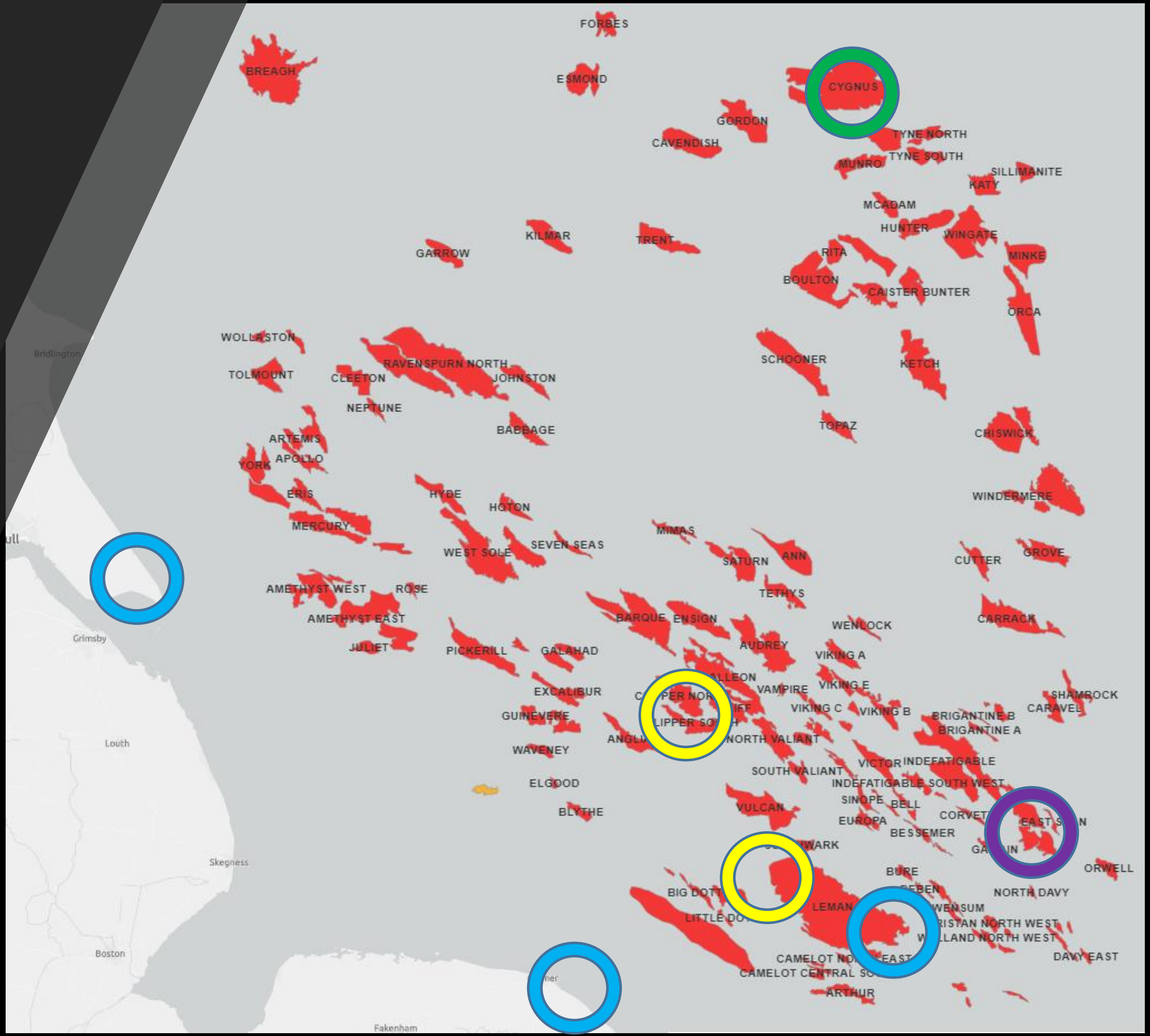
Defining the Challenge

- The SNS operates both onshore and offshore compression services.
- The emissions associated with the various installations amounts to ~580, 000T/CO2pa.
- The emissions profile is largely balanced between offshore and onshore sites.



	1	2	3	4	5	6	7	8	9	10	11	12	13
Gas	8234	867	0	10,698	6,864	0	14,077	15,376	0	0	3,998	6,055	0
Diesel	0	0	1,587	1,990	1,016	229	862	1,510	217	428	3,539	1,273	223
Compression	90800	123123	40,000	0	0	0	41,354	38,000	0	0	129,27	114,25	0



Options for Emissions Reduction – Electric Compression

- Electric Compressors are proven technology, which, when combined with renewable energy from grid or direct from offshore source, produce zero direct emissions.
- The equipment is relatively cheap and extremely reliable.
- Power demands can be very high, and sites will most likely need to upgrade power distribution infrastructure.
- Technology can be applied onshore, at most economical implementation.
- Direct renewable power can be variable (typically supplying 100% demand for 80% of time required) and a back up grid connection or high-capacity battery will be required (SOFC?).
- Full lifecycle costs need to be considered, setting CAPEX/OPEX against fuel gas, up-time and emissions savings (including social cost of carbon).

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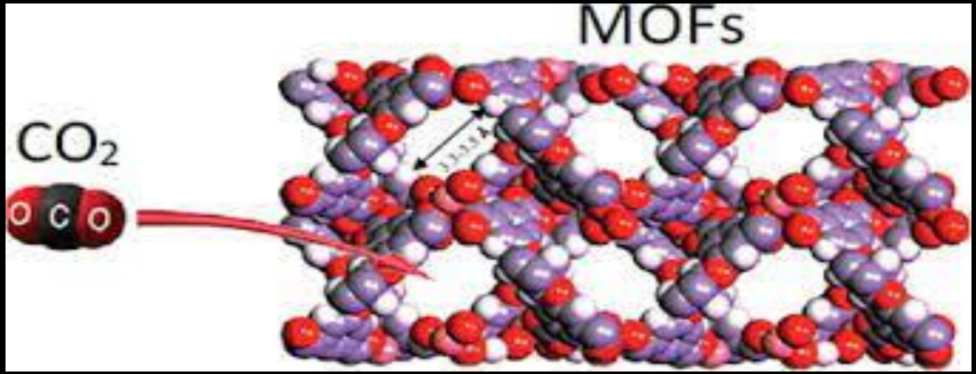
Options for Emissions Reduction – Carbon Capture

- Carbon Capture offers the opportunity to capture CO2 emissions, at source, from existing large combustion equipment.
- CC equipment can be retrofitted to existing processes, typically using proven amine technology, but also introducing new capabilities such as Molecular Organic Frameworks (MOF).
- Although large capacity CC equipment is both large and expensive, modular units are available, up to 100, 000T/CO2pa, with relatively small footprints. Such units can be used both onshore and offshore.
- Modular facilities have significant power demands ~14Mw, but this can be partially offset by process energy recovery.
- A typical fully installed 100kT/CO2pa modular unit comes in at £30m



Options for Emissions Reduction – Optimising and Sharing Resources

- The SNS is ideally situated to consider active collaboration to reduce CO_2 emissions.
- Geography and interconnectivity of assets allow for collaborative infrastructure and capacity sharing, reducing the duplication of compression assets.
- There is potential to bring onshore, difficult to abate offshore compression services.
- Operator participants could actively pursue cross SNS options for improved collaboration and infrastructure sharing.
- Work with the options to provide an optimised service to deliver emissions reduction.

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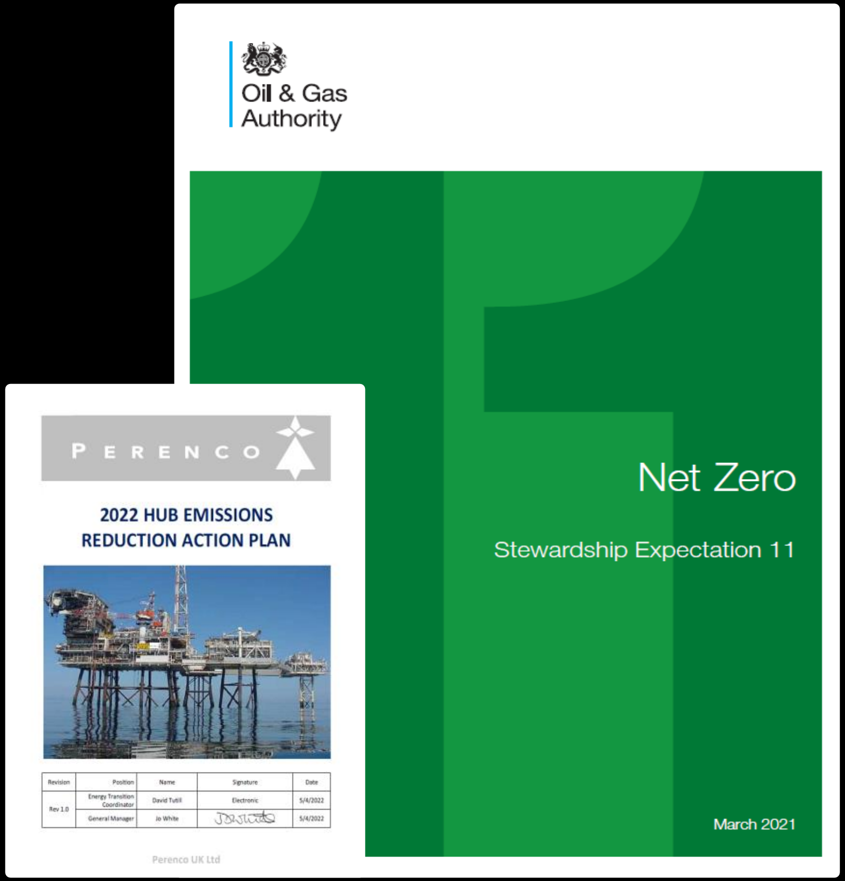
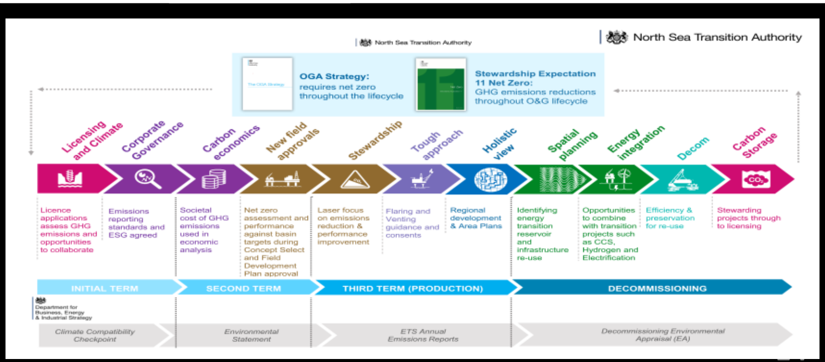
Options for Emissions Reduction – Incremental Reductions

- Compressors (convert wet seals to dry seals, address rod-packing seals, reduce emissions from gas starts).
- Improve reliability through effective preventive maintenance.
- Implement effective leak detection and repair programs.
- Reduce methane from incomplete combustion of fuel by having automated air/fuel ratio controls, minimizing the number of start-ups and increasing combustion efficiency of equipment.
- Flares (minimize flaring, improve efficiency, avoid pilot failure).
- Recompression via an electric motor-driven reciprocating compressor provides the capability to recover and capture methane leakage across seals for injection back into the process gas stream.
- Route the Dry Gas Seals primary and secondary seal vents into the turbine's inlet.
- Install a supersonic ejector system to gather fugitive emissions from Primary DGS.
- Install double opposed gas seals, to prevent leakage.





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Venting Reductions

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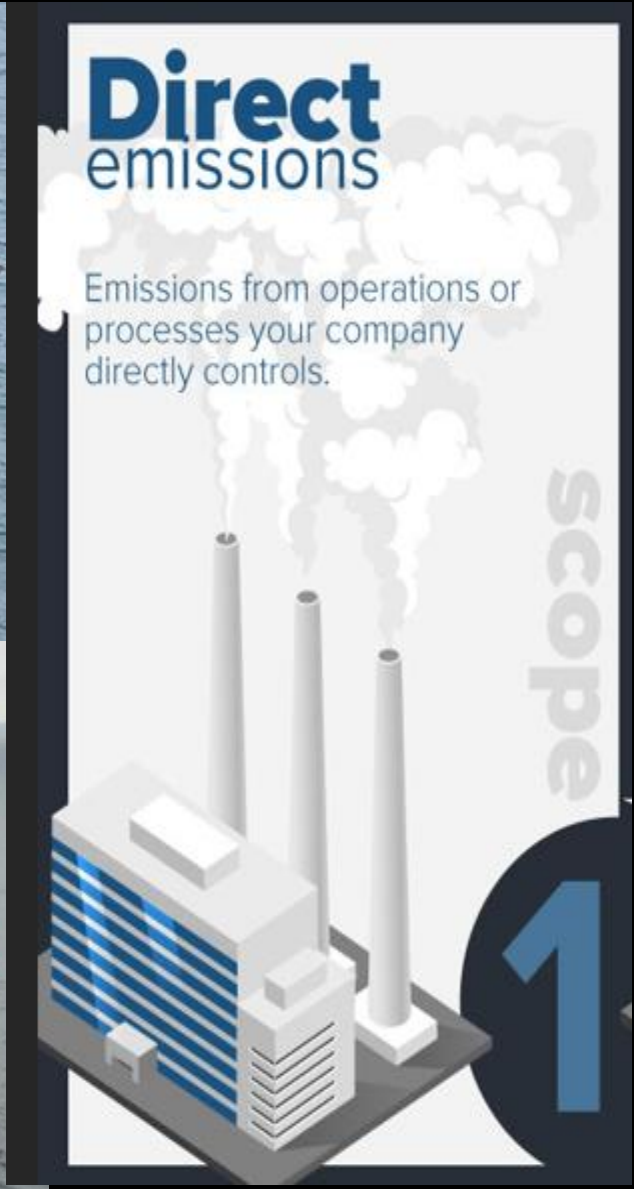
CO2 Emissions Reduction from offshore venting

- NSTA guidance* states that all operators should have, or work towards, credible plans to achieve zero routine venting by 2030 or sooner. Operators should develop a Venting Management Plan that demonstrates a credible pathway to achieving that goal, to be included as part of their Greenhouse Gas Emissions Reduction Actions Plans. This should align with the submitted annual vent consents.
- Currently venting and or flaring routinely occurs on most offshore platforms.
- In the SNS flaring is limited (and has halved in the UK North Sea in past 4 years) but venting is prevalent.



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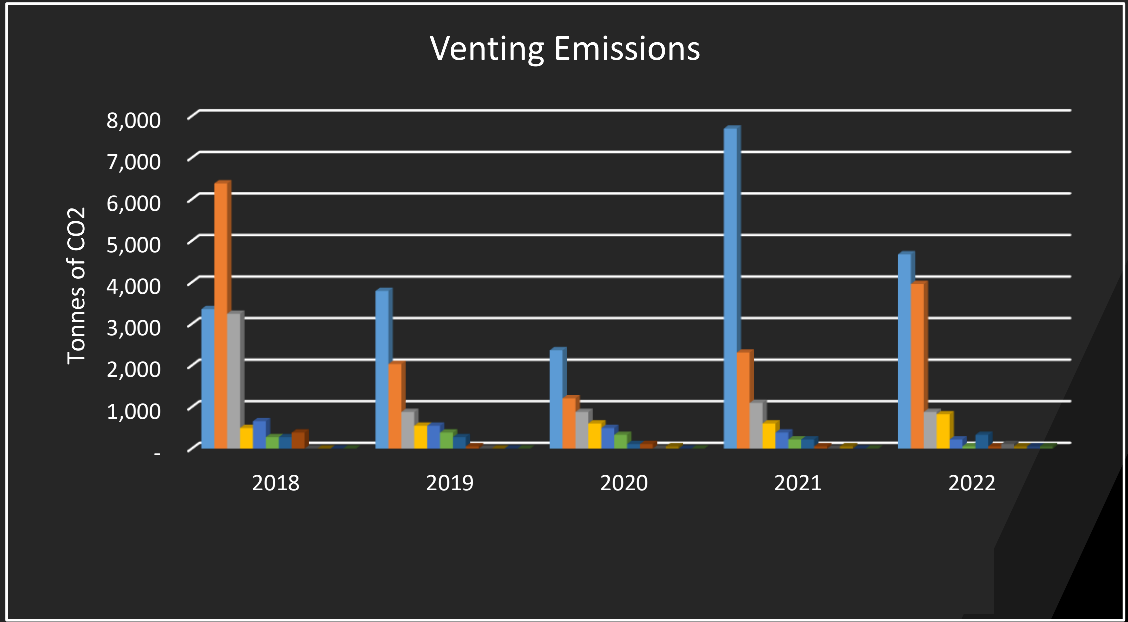
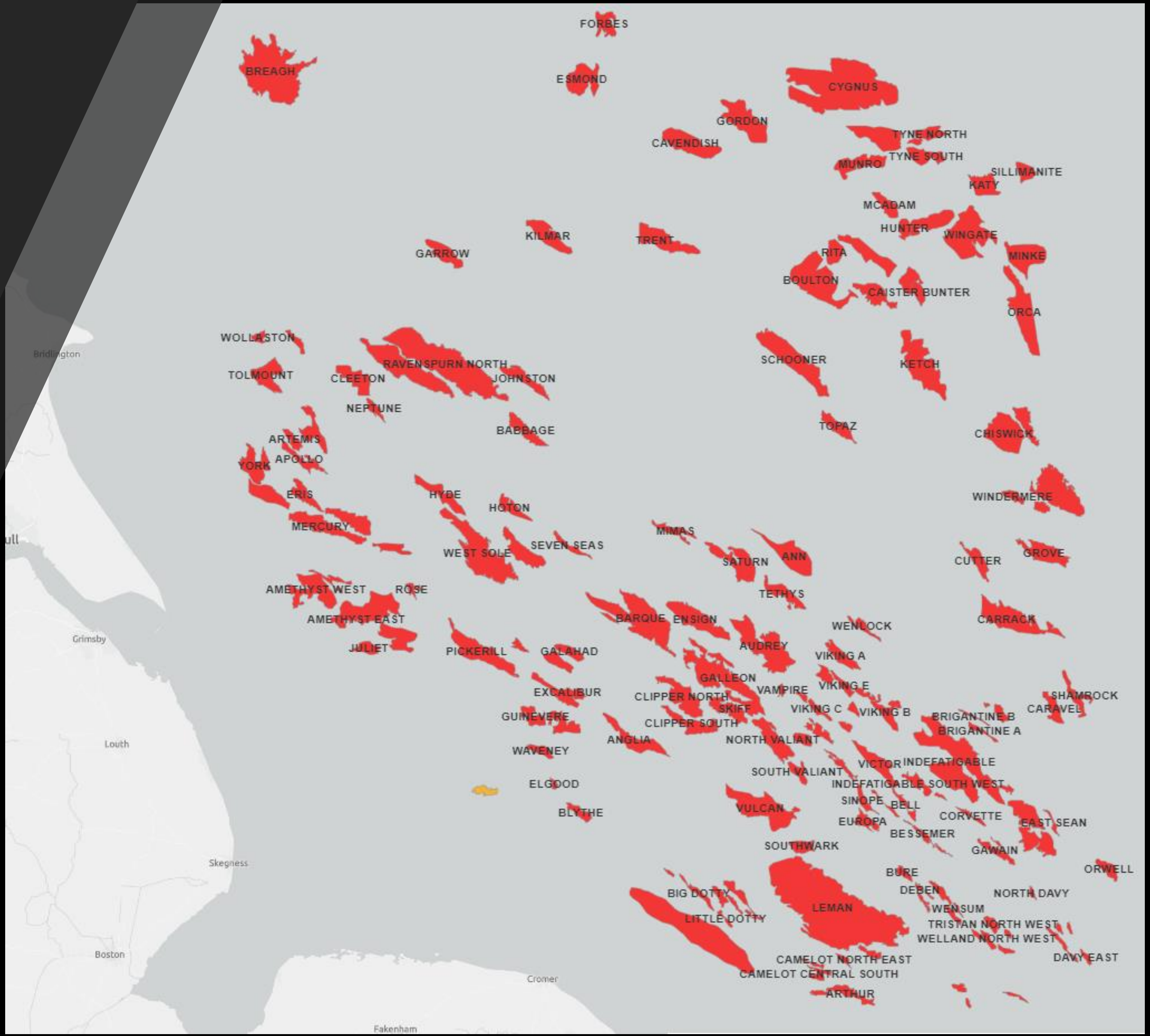
*www.nstauthority.co.uk/media/7647/flaring-and-venting-guidance_june-2021-final.pdf

Defining the Challenge

- SNS offshore venting typically accounts for over 10,000 tonnes of CO_2 equivalent per annum
- Venting volumes broadly correlate with the size of the operator in terms of their presence in the SNS



	2018	2019	2020	2021	2022	Average
tCO2	15,070	8,525	6,160	12,650	11,275	10,736



*Source: NSTA Data Centre
Conversion factor used: 55 tons CO2 eq. per MMscf vented natural gas

Venting Measurement and Detection

Measurement:

- Vent stack meters
  - Direct vent emissions measurement – accuracy challenges
- Drone surveys
  - Wide range emissions mapping – correlation challenges

Detection:

- Acoustic emission [AE] sensor
  - Quantifies valve leakages by examining the very high frequency noise a leaking fluid generates
- Forward-looking infrared camera [FLIR]
  - Visualise fugitive emissions

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Options for Venting Reduction

- Quick overhaul / replacement of passing vent valves
- N_2 skids to replace natural gas blanket gas and purge
- Monitoring program using FLIR, AE and drones to detect fugitive emissions so they can be addressed
  - Joint industry drone program?
- Operational methodology changes to reduce blowdown inventory
- Decomplexing or segregation of plant to reduce blowdown inventory
- Instil culture change in operations teams to consider methane emission impact in decision making
- Venting Emissions to be considered throughout the lifecycle of the asset.
- All new projects to be engineered on the basis of zero routine flaring and venting.

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Platform Simplification

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NUI Operations – The Problem

- Oversized and overly complex
- Energy intensive in relative to production
- Highly complex, and increasingly unsupported, control systems
- Deteriorating infrastructure
- High levels of maintenance and integrity support

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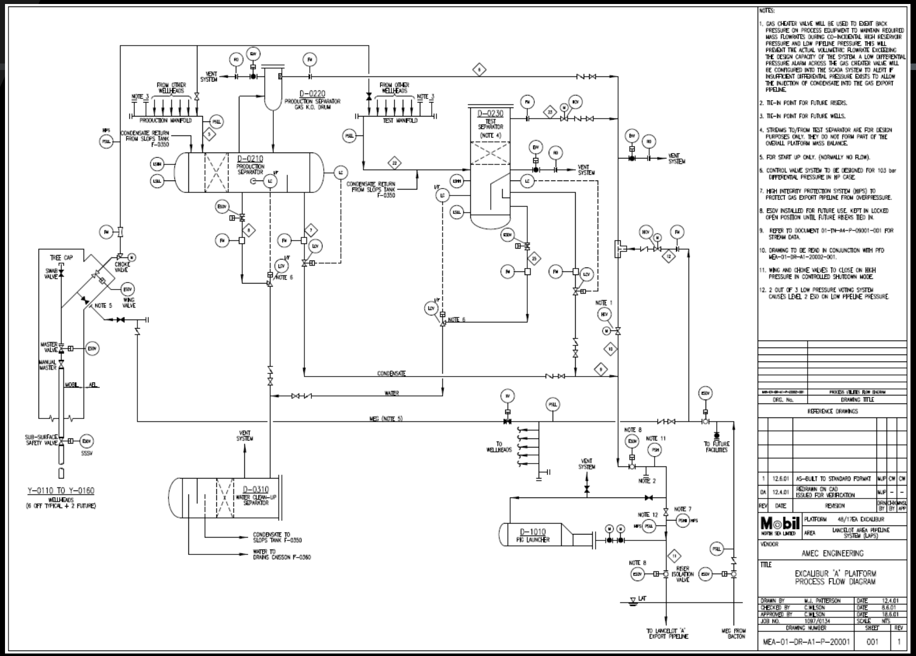
NUI Operations – The Solution

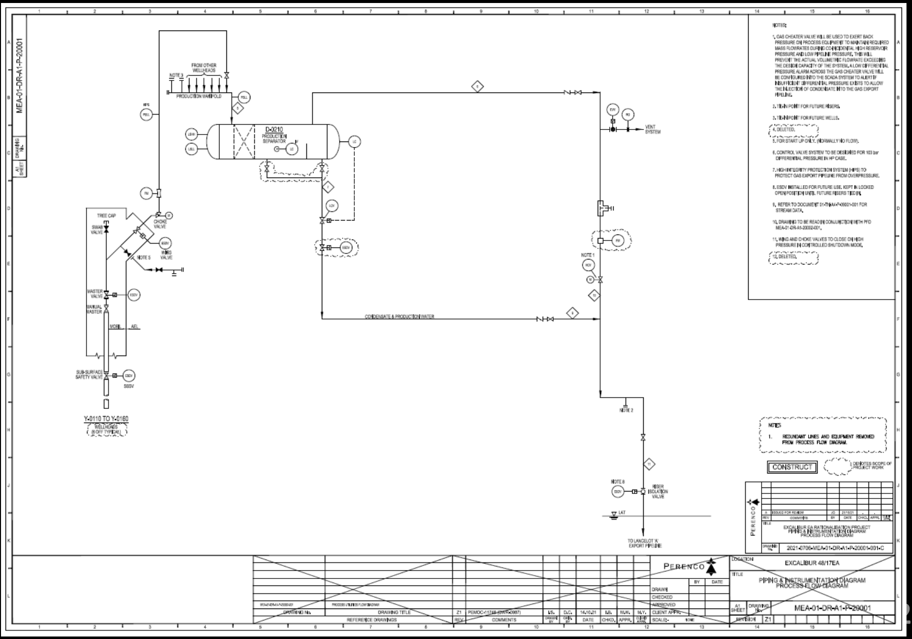
Simplify!

Simplify!

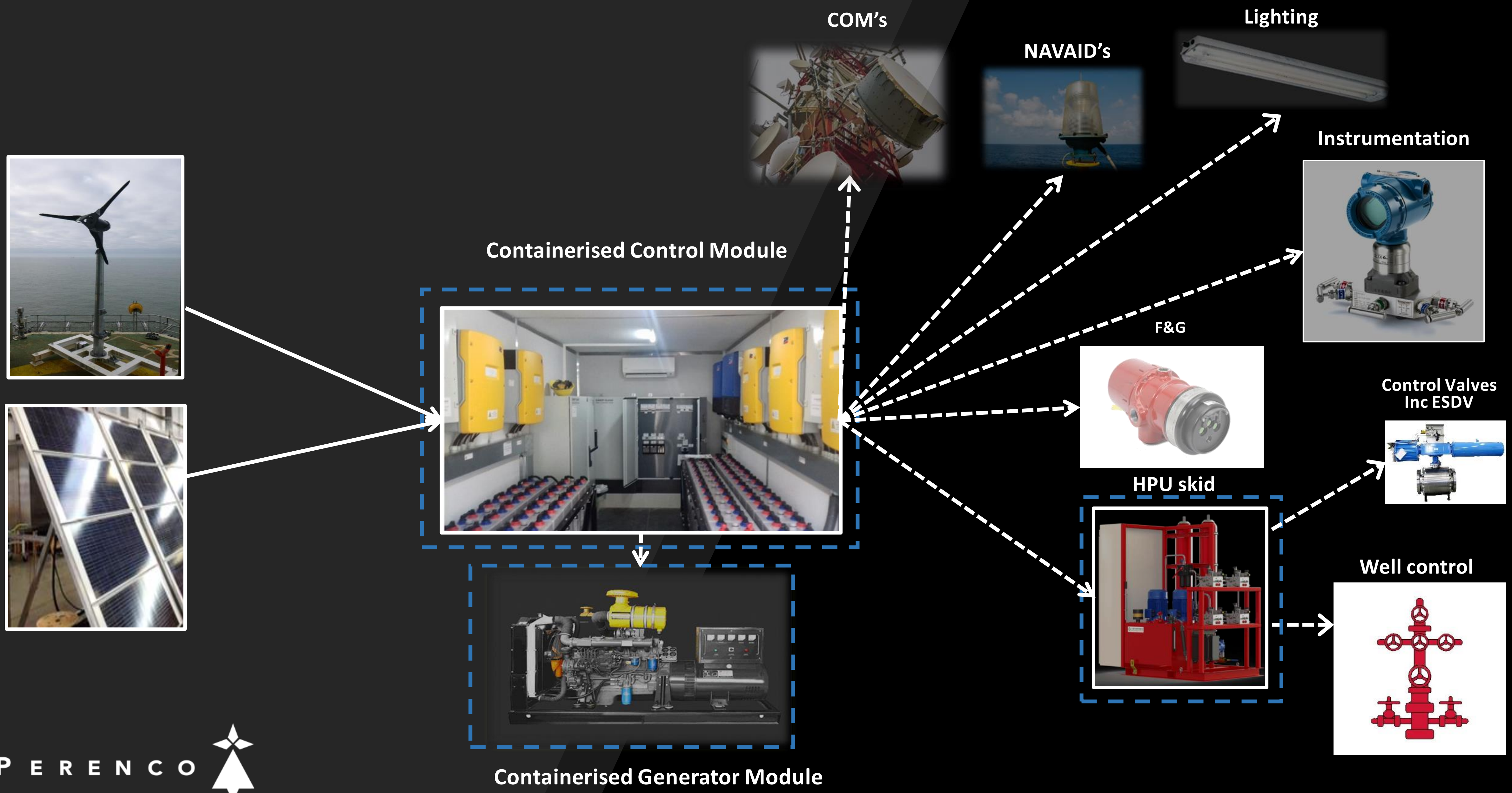
Simplify!

Rationalise the Process and Plant





NUI Operations – Simplification Strategy



NUI Simplification – What will POEMS Achieve

OPEX improvement by

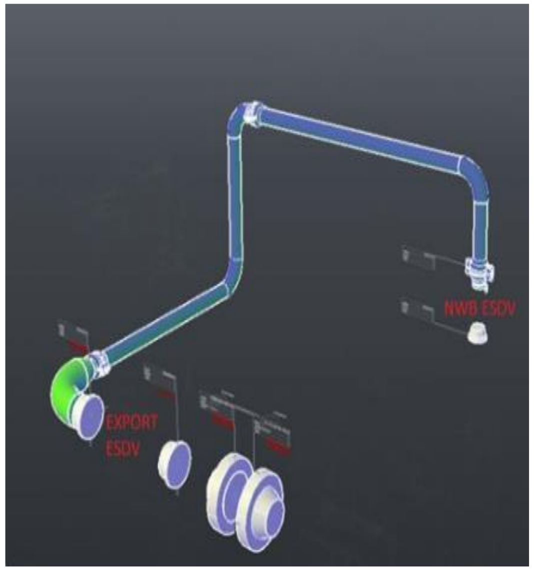
- A reduction in running costs
- An average reduction in visits from 14 weeks to 4 weeks

Improve reliability / reduce interventions / Improve production

- Simplification of platform production processes
  - Reduction in topsides pipework
  - Simplified control systems
  - Simplified Navigation Aid systems
- Modifications to reduce load requirements and incorporate solar and wind power. Diesel only as back-up

Reduce environmental impact

- Reduction of emissions through the increased use of solar and wind power
- Reduction in visits reduces emissions associated with aviation and vessel attendances
- Reduction in platform venting frequency due to control systems improvements <u>**and**</u> reduction in inventory



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Carbon Capture and Storage

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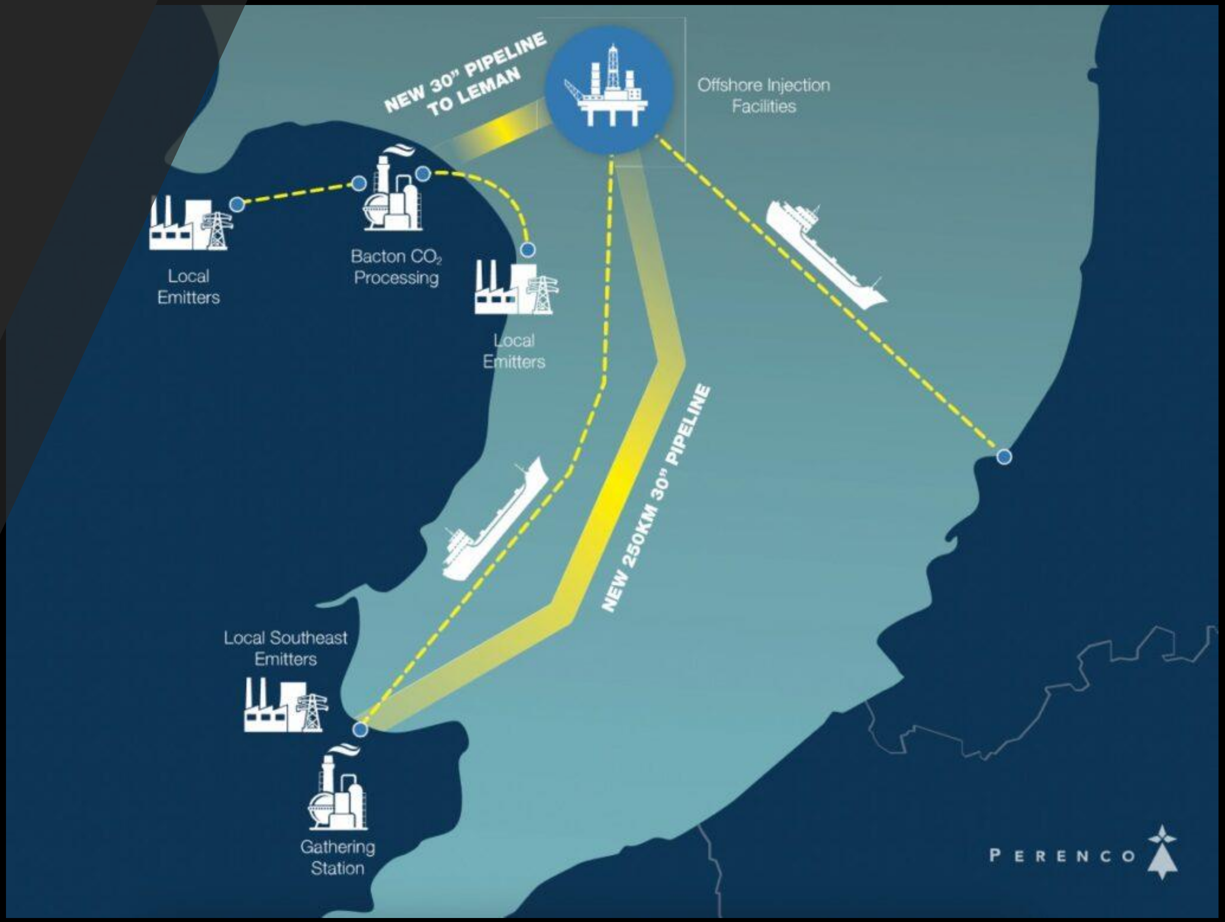
Project Poseidon – A World Class CCS Project

- Project Poseidon represents one of the most strategic and capable CCS projects in the world.
- At peak it will inject ~45Mtpa into a mixture of depleted gas reservoirs and the BC9 aquifer. Injection will commence ~ end 2029.
- The project has the potential to not only service local East Anglia emitters, but also, indeed principally, key emitters in the Southeast of England and worldwide.
- The project will be facilitated by both dedicated CO2 pipelines and tanker shipping capability.
- Bacton Terminal will be the main local onshore distribution point, with a further facility located on the Medway estuary.
- The project will be operational for nominally 50 years, at which point it will be decommissioned, monitored and after 20 years returned to the state.



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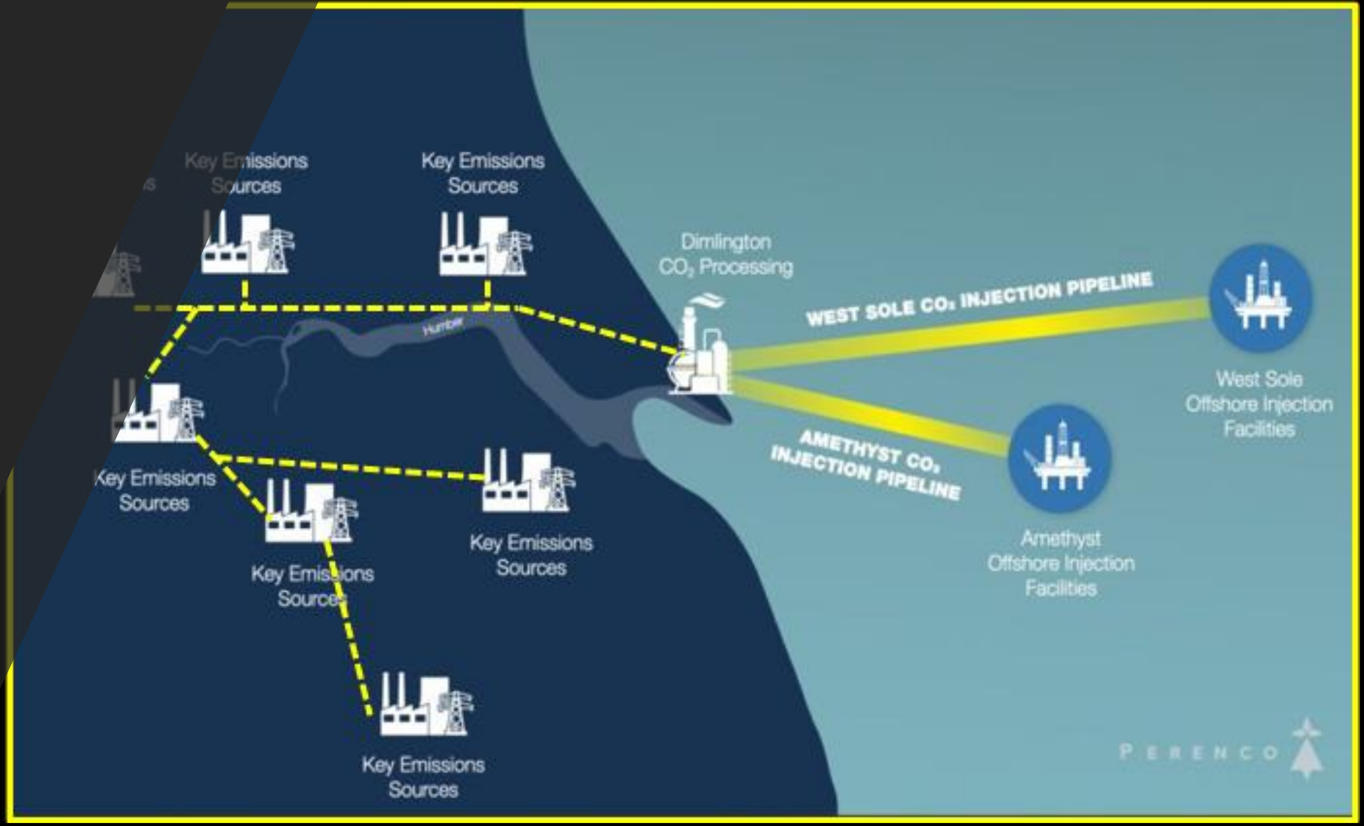
Project Orion – Smaller but Very Significant

- Designed to deliver a significant Carbon Capture and Underground Storage capacity, with an initial injection capacity of 0.75Mtpa rising to 6Mtpa and commencing injection in 2031.
- The full project encompasses both the decommissioned Amethyst field and currently producing West Sole field, utilising depleted gas reservoirs, in which to permanently store captured CO2 within geological formations.
- Orion will complement other CCS projects currently in development, providing additional capacity for the decarbonisation of Humberside and adjacent areas, for a 30-year period.



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Bacton Energy Hub

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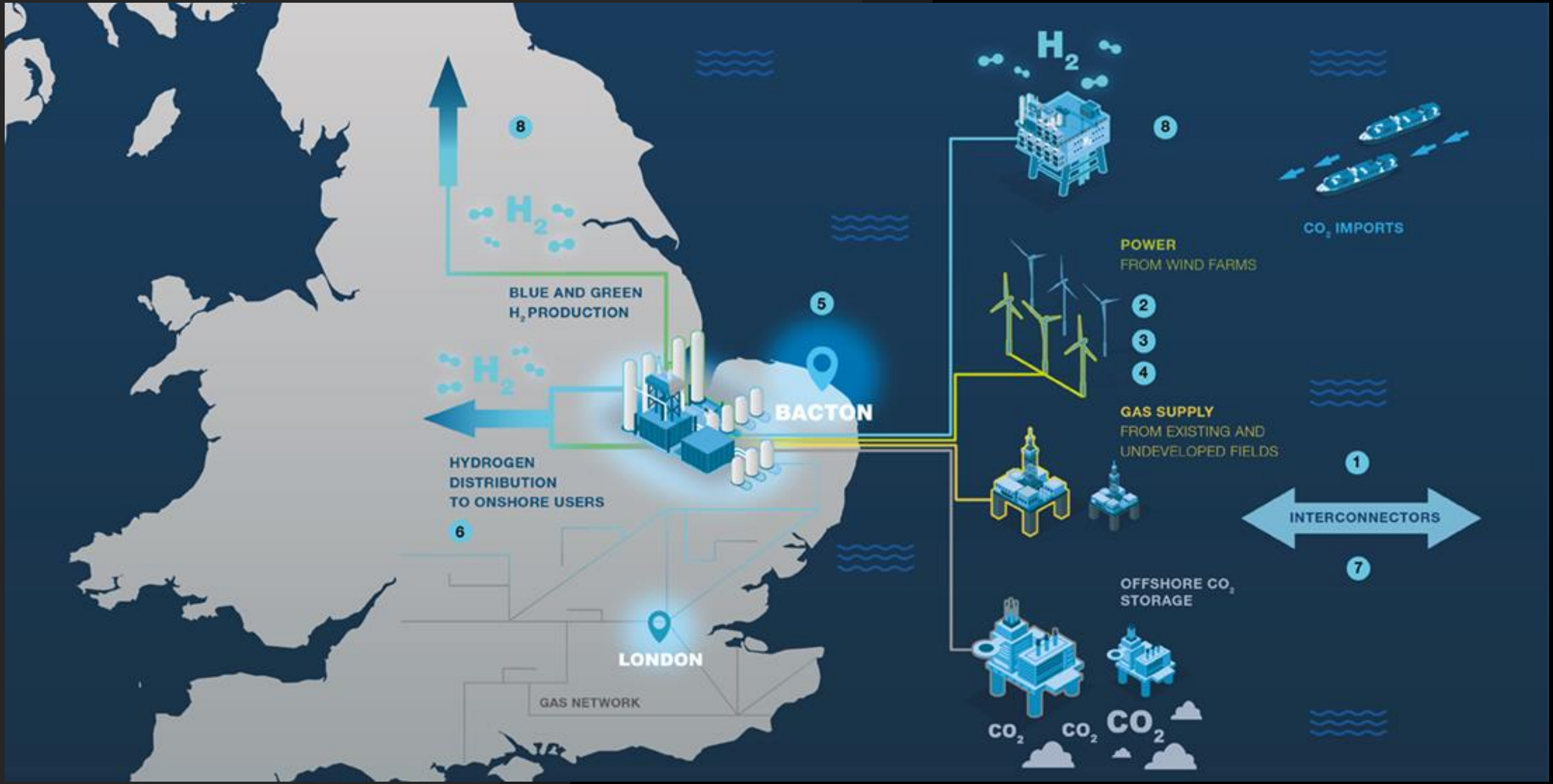
The Bacton Energy Hub



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