Towards tomorrow's low-carbon economy.

Lloyd's Register

Our report for the OGA explores upstream opportunities in UK waters to cut greenhouse gas emissions. It also shows how the industry can be part of the nation's move to generating 'net-zero' energy by 2050, leading the Paris climate agreement pact.

Client:
Oil and Gas Authority (OGA)

Project:
Energy Integration report: Realising Cross-Sector Integration on the UKCS to Support UK's Energy Transition

Outcomes:

300
page in-depth study

6
core disciplines

5
study areas

An industry and national challenge

In May 2019, the UK became the first major economy to pass a net zero law for greenhouse gas emissions, ending the nation's contribution to global warming by 2050. Net zero means no emissions or those generated being balanced by offset schemes (from planting trees to using carbon capture and storage or other technology).

The energy industry faces significant challenges with this ambitious move. It must meet a growing demand for power more cleanly and greenly than ever before. The Oil and Gas Authority asked Lloyd's Register to explore if upstream infrastructure across the UK Continental Shelf (UKCS) could support the nation's smooth 'energy transition' from a high- to low-carbon economy, while also transforming and benefitting the sector. This work was part of a cross-regulatory study commissioned by the UK Government to consider a broad range of low-carbon initiatives.

How we helped

Our extensive, detailed technical assessment investigated numerous scenarios, focussing on three main themes:

1. Cutting CO_2 emissions of oil and gas operations with platform electrification.

2. Reducing the environmental impact of the wider energy industry by using oil and gas infrastructure with carbon capture and storage technology.

3. Exploring how the oil and gas sector could be part of the move to renewable energy by introducing:

- Hydrogen production facilities
- North Sea power hubs, potentially including gas to wire opportunities for stranded hydrocarbon resources.

For each of the areas under these themes, we:

- Considered the technical feasibility of a range of low-carbon development build-out scenarios
- Scoped the costs of each scenario
- Assessed the potential for reusing existing oil and gas infrastructure to identify market opportunities and potential cost efficiencies.

Insights and conclusions

Although a preliminary study, our report highlights several ways forward for the oil and gas business in the UKCS.

Platform electrification

This relatively straightforward concept replaces the Open Cycle Gas Turbines (OCGTs) used to generate a platform's 24/7 power and heat with an electricity supply for lower carbon emissions. Platform electrification would remove the emissions generated by OCGTs, equivalent to about 2% of all all onshore CO_2 emissions and 11% of onshore power-related emissions (with emissions forecast to drop by some 30% in 2030 and 75% in 2040).

Key insights

- Platform electrification can reduce the oil and gas carbon footprint, while extending asset and field life and improving operational economics.
- Technical solutions, including both AC and DC systems, are mature and relatively low risk.
- Commercial solutions are higher risk, as platform retrofits are typically high cost, although requirements vary between platforms and locations.
- Supply solutions should ensure that operations have a continuously stable power supply.

Conclusions

- Adoption in the UKCS generally needs to be within the next 20 years, but potentially longer in the under explored, growth area of West of Shetland (WoS).
- Platform electrification Capex may be reduced by plugging into interconnectors or working in an integrated way with offshore windfarm operators.
- Electrification has potentially long-term benefits too, supporting future offshore low-carbon projects from floating offshore wind, carbon capture and storage to hydrogen power facilities and North Sea energy hubs.

Carbon capture and storage

The idea and technology behind carbon capture and storage (CCS) are well established. CO_2 emissions – typically from the combustion of natural gas – are captured, compressed, transported and injected into permanent offshore subsurface storage sites. CCS removes the emissions generated by the power industry or industrial producers.

Key insights and conclusions

Our study focuses on compression, transportation and storage, rather than the CO_2 capture.

- CCS is important in improving the economics of UK power projects.
- The UKCS CO_2 storage capability is sufficient potentially for hundreds of years, much of this within primarily saline aquifers.
- Hydrocarbon fields are attractive options for storage as they have a well understood subsurface and offer potential capex savings by reusing oil and gas infrastructure.
- Transportation and storage costs vary significantly across the UKCS, based on store size, distance from shore and ability to reuse infrastructure.

The UK became the first major economy to pass a net zero law for greenhouse gas emissions, ending the nation's contribution to global warming by 2050.

Hydrogen production

Hydrogen's place in the UK's low-carbon economy is set to grow exponentially with the development of water electrolysis, powered by renewable electricity. This advancement will create electrical power with zero emissions through the combustion of hydrogen in gas turbines or its use in fuel cells. Currently, hydrogen is predominately generated using methane reforming technology, producing large volumes of CO_2 emissions.

Key insights

- Reusing depleted oil and gas fields for hydrogen storage is unsound due to the risk of contamination.
- Salt caverns are the best form of hydrogen storage: 60 sites have been identified and approximately 182 would be required for 11MT per year.
- Existing pipelines at low pressure can provide buffer storage and transportation to shore.

Conclusions

- At present, onshore hydrogen hubs are recommended using methane reformation and CCS technology.
- In future, hydrogen could be generated using electrolysis and renewable energy.

North Sea power hubs

UKCS integrated energy hubs are technically feasible by strategically reusing existing oil and gas facilities and combining these with some, or all, of the concepts covered in the study. The future could see large-scale electricity and hydrogen production from wind, combined with carbon capture and energy storage solutions.

Key insights

- Integrated energy hubs could benefit from cross-sector synergies and potential North Sea cross-border economies of scale.
- The potential reuse of oil and gas infrastructure is best progressed using the OGA's cessation of production (CoP) process.
- Adopting CCS technology and expanding the development of floating offshore wind farms into deeper water are essential elements.

Conclusions

- Cross-sector cooperation and integration on the UKCS are fundamental to achieving the UK's energy transition and this could be realised with a visionary integrated energy hub.
- The costs, economics and resultant commercial and cross-sector regulatory demands for such a concept need to be rigorously assessed (Phase 2 of the OGA study).

Gas to wire

A gas to wire (GTW) approach could capture undeveloped or stranded hydrocarbon resources from an appropriate hub. This is then converted into electricity (most likely using Open or Closed Cycle Gas Turbines) and transmitted into a shared, offshore power grid.

Key insights

- GTW is an opportunity to help UKCS operators maximise economic recovery (MER).
- It can combine gas and renewables infrastructure and cross-market access, as long as offshore wind farms are built close to undeveloped gas resources.
- GTW can be deployed in the short term, as it is based on proven technology.
- This concept can be combined with platform electrification in some cases.

Conclusions

- Given that capturing offshore emissions is problematic, GTW is not an end-game solution.
- The economics of both gas and renewable projects could benefit from GTW, enabling further offshore developments.

In the OGA report, GTW sits under cutting the oil and gas industry's existing emissions. That is because burning gas in a relatively inefficient, offshore turbine produces more net emissions than doing this onshore. There may be future potential elsewhere. We explored one GTW scenario where power is generated offshore by burning gas. That power is then sent to market using offshore wind farm electrical infrastructure.

What next?

Our work on behalf of the OGA – including future recommendations – will shape Phase 2 of the study. This next stage will address the economic and regulatory issues facing the sector.

The UK needs pragmatic, optimistic experts as it takes strides towards its net-zero emissions pledge. As a leading technical specialist, Lloyd's Register is committed to supporting the energy industry with its low-carbon activities.

Lloyd's Register

Get in touch

Please visit www.lr.org/oilandgas
for more information
or call +44(0)1224 398 398
email lowcarbon@lr.org

Lloyd's Register
Kingswells Causeway
Prime Four Business Park
Kingswells, Aberdeen
United Kingdom
AB15 8PU