

Where energies make tomorrow ●

Carbon Capture and Storage

Experts in low carbon energy solutions

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TECHNIP
ENERGIES

Technip Energies capabilities

About carbon capture and storage

Growing concerns over global warming is driving interest in technologies that reduce greenhouse gas emissions. Carbon capture and storage (CCS), a solution relevant to the power, oil and gas and petrochemical industries, offers the opportunity to:

- Reduce emissions of CO₂
- Avoid emission penalties
- Produce high purity CO₂ suitable for use in enhanced oil recovery (EOR)
- Demonstrate a commitment to mitigating global climate change

Technip Energies has built more than 50 installations for the removal of carbon dioxide and sulphur components from natural gases, using technologies such as membranes and physical / chemical solvents. This experience makes us well-qualified to design and execute CCS projects, particularly "post-combustion" solutions designed to capture CO₂ from the flue gas of a combustion unit usually using an amine-based process.

As well as CO₂ capture, CCS projects also involve compression and CO₂ reinjection. In both domains, we provide full support. CO₂ is usually injected in its supercritical form and we have the expertise with various optimized schemes for CO₂ treatment, compression and reinjection.

We also developed a CO₂-compatible flexible pipe that can be used whenever a project requires CO₂ reinjection into a reservoir at sea.

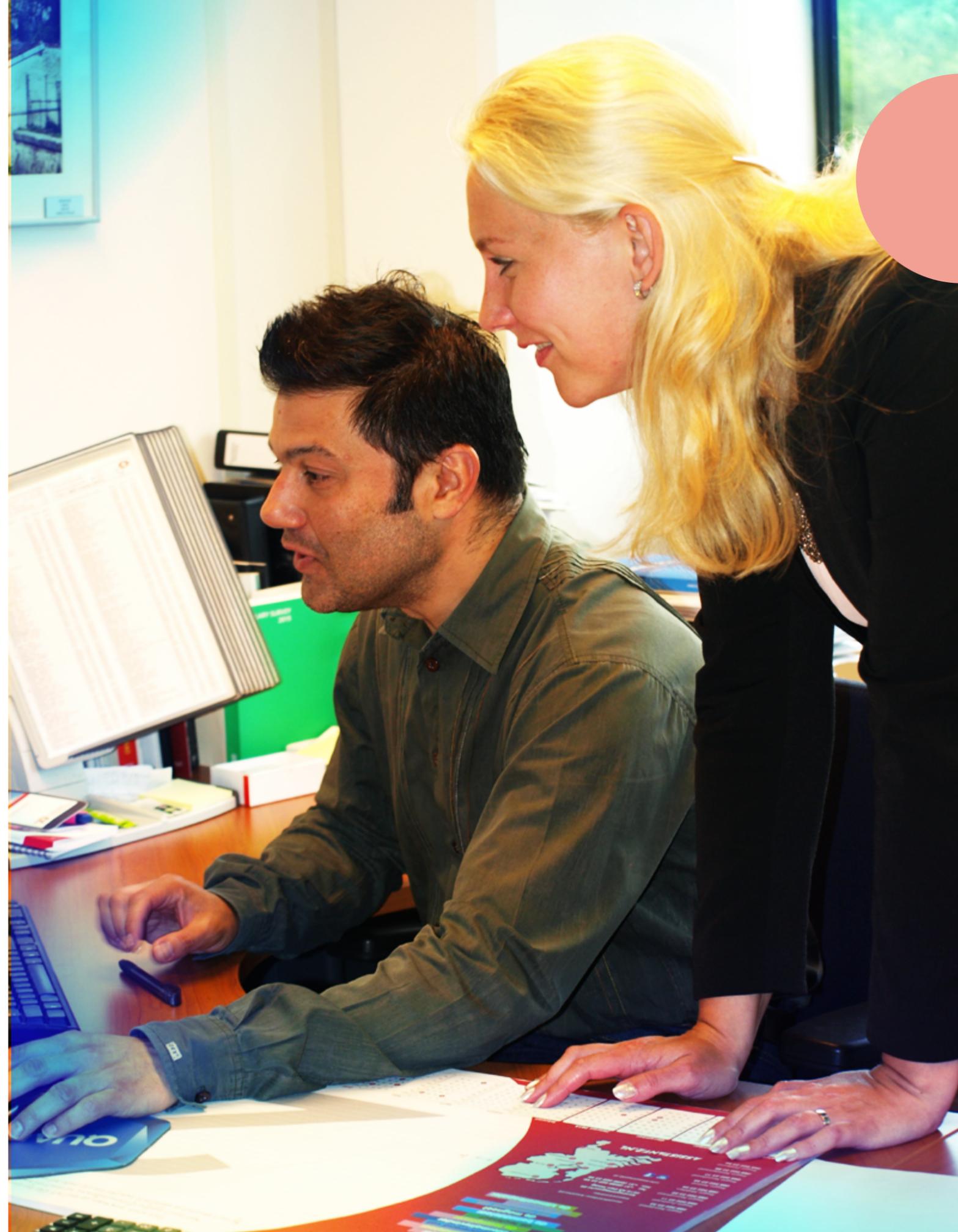
TECHNIP ENERGIES' CCS CAPABILITIES

- Consultancy (including CCS readiness studies)
- Pre-FEED, techno-economic and feasibility studies
- Front-End Engineering Design (FEED)
- Engineering, Procurement and Construction (EPC)
- Project Management Consultancy (PMC)

Our extensive experience revamping and modifying existing plants strengthens our capabilities to retrofit CCS to existing process plants and power stations.

Low carbon energy solutions

In 2013, Technip Energies and Shell forged a strategic alliance to market CCS projects globally, combining our Engineering, Procurement and Construction expertise with Shell's CO₂ capture technology. The alliance offers leading edge "one-stop shop" CCS projects to the power generation industry backed by the collaboration of respective experts.



The Shell CO₂ capture system

The Shell CO₂ capture system is a regenerable process that uses a proven proprietary amine technology to capture CO₂ from flue gas and release it as a pure stream.

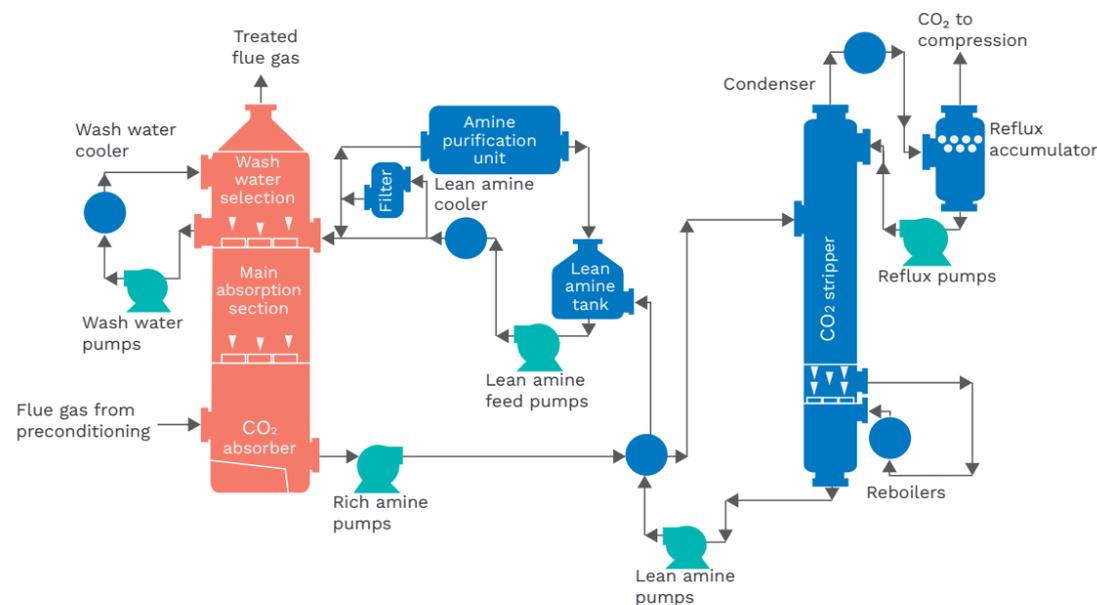
The system is ideal for retrofitting existing plants. The technology can be applied in a range of industries to lower carbon intensity and meet greenhouse gas abatement targets. An added benefit simultaneously lowers SO₂ and NO_x emissions. It is also possible to integrate CO₂ capture with Shell SO₂ removal technology which optimizes energy integration and operability.

APPLICATIONS

- Power generation (coal, gas, oil, biomass)
- Refining
- Petrochemicals
- Utility boilers
- Metallurgical industries
- Waste to energy

ADVANTAGES

- Production of high purity CO₂ suitable for EOR applications
- Low efficiency penalty meaning lower operating costs
- Minimal health, safety and environmental impact
- Simple and reliable operation
- Proven for large-scale power generation
- Constructability and operability at commercial scale
- Ability to construct modularized units



A flexible solution for CO₂ transportation

Flexible pipes, used to transport oil and gas offshore for more than 35 years, are well designed for the efficient transportation of high CO₂ content fluids. Advantages of flexible pipes, a specialty at Technip Energies, include:

- Fast installation
- Easy setup on uneven sea beds
- Ability to retrieve and reuse flexible piping
- High-pressure resistance
- Corrosion resistance

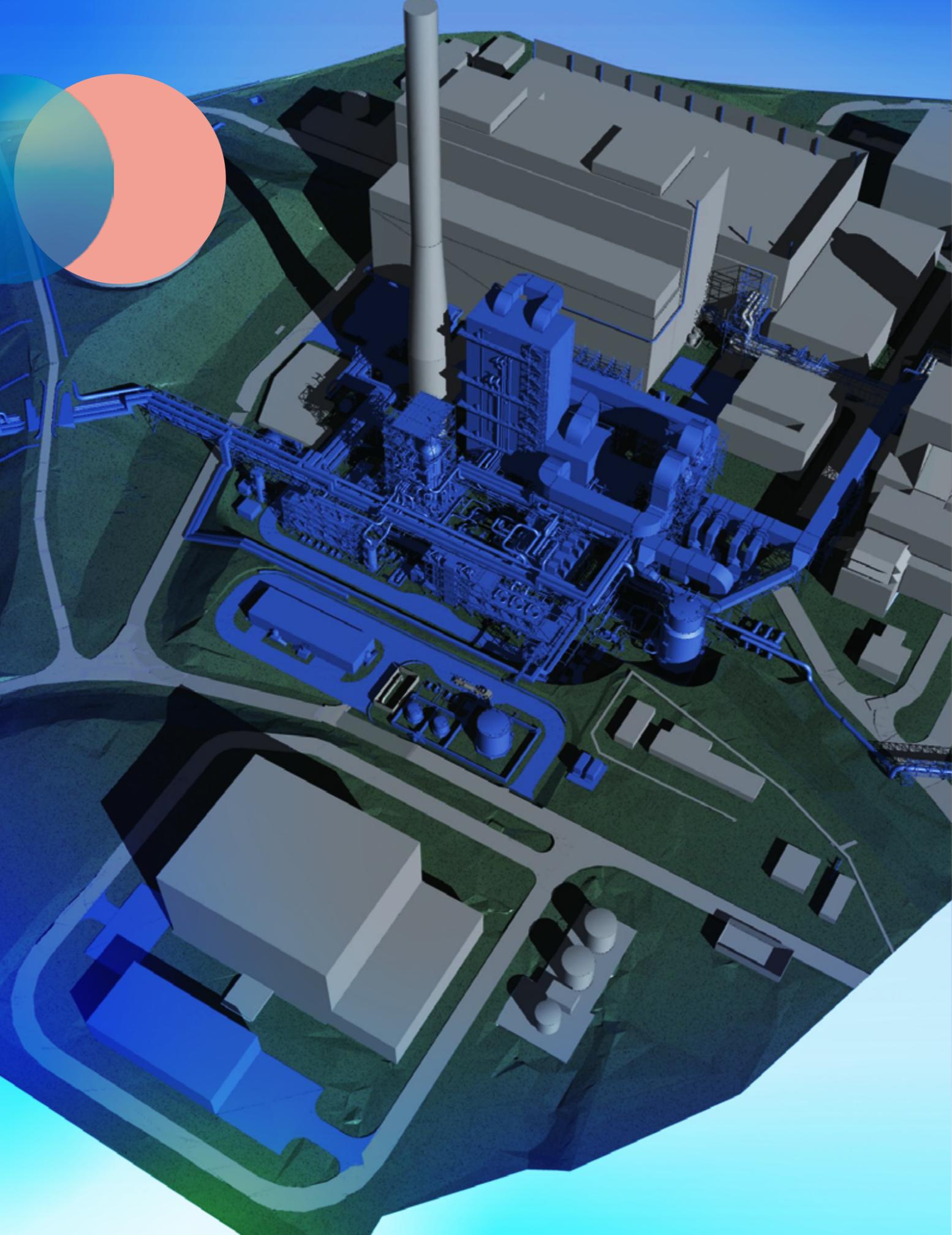
An engineered solution via extensive testing

The CO₂ content in flexible pipe transport applications can be higher than 90 percent, much higher than standard applications of 15 percent content or less. CO₂ behaves as a supercritical fluid above 31.1°C, and 72.8 atm, so compatibility between pipe materials and the CO₂ rich fluid had to be tested and verified.

Technip Energies has worked intensively on the qualification of several thermoplastic materials used for flexible pipe pressure sheaths and stainless steel grades for the inner carcass. Our tests covered applications as high as 90°C/600bar/100% CO₂. Different materials were tested for their ability to withstand rapid gas decompression in CO₂ rich gas mixtures and long-term exposure to CO₂, with special attention to the plasticizer effect of CO₂. The impact of supercritical CO₂ on the hydrolysis degradation mode also was assessed and verified.



Standard TechnipFMC Flexible Pipe Structure



The Peterhead carbon capture and storage project

Technip Energies worked with Shell UK Limited and SSE Generation on the FEED work for the Peterhead Carbon Capture Project which was cancelled following withdrawal of funding for the UK CCS Commercialization Competition, in which the Peterhead project was one of the final contenders.

About one million metric tons per year of CO₂ emissions was to have been captured from the power station, transported

by pipeline, and stored about 100 kilometers offshore in the depleted Goldeneye gas reservoir at a depth of more than two kilometers below the floor of the North Sea.

Following the 2012 completion of a pre-FEED study, Technip Energies' operating center in the UK completed the onshore FEED for the project in 2015 in conjunction with Shell. Our FEED scope included the carbon capture using the Shell CANSOLV capture

technology, CO₂ conditioning and compression plant and modifications to the existing combined cycle gas turbine power plant and site utilities.

During the Peterhead project, Technip Energies gained extensive experience in equipment design, costing and CCS plant design optimization. Today our UK office serves as a center of excellence for the development of end-to-end CCS solutions.



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