
Sustainable energy solutions



COWI



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Introduction

The ambition is clear; to support our customers in accelerating the green transition while doing what we are good at: offshore renewables, green fuels and carbon capture. By combining these measures, we can get closer to net-zero than ever before. We work with all aspects of sustainable energy planning, production and distribution while enabling sector coupling and reducing the cost of decarbonisation.

Offshore renewables are one of the fastest growing areas of sustainable energy and under continuous development. Thanks to our long global history within offshore renewables, we can offer our customers competencies that span all offshore typologies, including energy islands, floating offshore wind farms, and floating solar photovoltaics (PV) solutions. In other words, making the most of the green power potential off the coastlines.

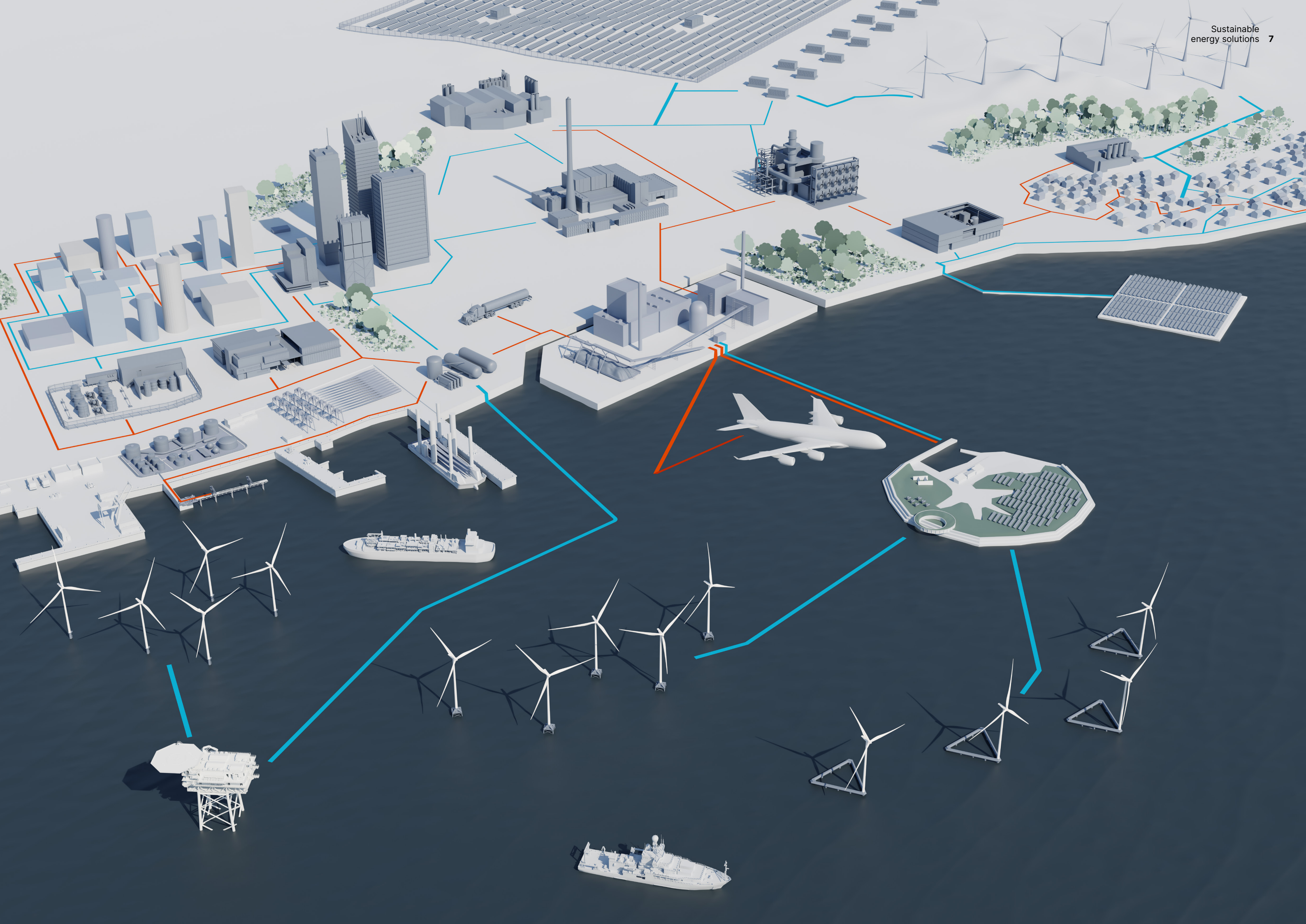
Offshore renewables are also where it all starts. The electricity produced from sustainable offshore energy sources can, in turn, be connected to the grid and be used as electricity, or be utilised to produce **green hydrogen**. Green hydrogen is key for sectors where it is not enough to decarbonise with electricity alone, e.g., hydrotreatment in refineries, steel and ammonia production, and heavy transportation. This way, we can solve the challenge of intermittency and unleash the full potential of renewable energy.

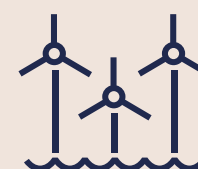
Finally, by combining **biogenic or captured carbon** with green hydrogen, we can create other **green fuels** such as e-methanol and e-kerosine, which can be used in shipping and aviation, ultimately closing the carbon cycle. Alternatively, captured carbon can be permanently stored in natural reservoirs.

We work with all the building blocks of the value chain – from planning to sustainable energy production, through energy transition to green fuels production via electrolysis. Our knowledge covers the latest technologies within offshore renewables, green fuels and carbon capture, enabling tailored sustainable solutions to even the most challenging scenarios.

Moreover, waste or surplus heat from green fuels production from power plants or waste incineration facilities can be utilised in **district heating**, which is a highly sustainable and efficient means of heat supply. We support our customers throughout the value chain here as well, from planning and establishment of new district energy systems to optimisation and extension of existing networks.

Together, we shape a sustainable and liveable world.





Offshore renewables:

• Early-phase support:

- Site selection
- Pre-feasibility studies
- Levelised cost of energy (LCOE) estimations

• Front-end engineering design (FEED)

• Detailed design:

- Monopiles
- Jackets
- Gravity-based foundations
- Floating structures

• Electrical design

• Owner's engineer services



Green fuels and carbon capture and storage:

• Early-phase support:

- Site selection
- Environmental permitting
- Planning
- Pre-feasibility studies
- Feasibility studies
- Conceptual studies
- Pre-FEED
- Financial assessments
- Cost estimation
- Techno-economic modelling for optimizing energy system design
- Risk management

• Front-end engineering design (FEED)

• Detailed engineering

• Procurement support

• Construction supervision

• Commissioning

• Owner's engineer or knowledge partner services



Energy island

Wind conditions in the North Sea are hardly ideal for many things, but they are more than optimal for green energy production. Located 100 kilometres off the Danish west coast, in 25- to 30-metre-deep water, the world's first energy island is expected to produce 10 GW of electricity from ten surrounding offshore wind farms, enough to power ten million households in Europe.

This offshore power hub, set to collect, store, convert and distribute green electricity from hundreds of offshore wind turbines will be the first of its kind, and mark a new era for sustainable energy production and a significant step in the green transition – in Denmark and abroad.

Our services have included location screening and cost-benefit analysis in the pre-feasibility stage of the project, as well as owner's engineer services for Copenhagen Infrastructure Partners.

Period
2022-ongoing

Client
Copenhagen
Infrastructure
Partners (CIP)

Country
Denmark

The illustration shows only one of the many possible outcomes. The final design concept and island configuration will be decided at a later stage.



Green Fuels for Denmark

Thanks to the development of ground-breaking green fuel and hydrogen production facilities, trucks, ships and airplanes will be fuelled by green alternatives such as hydrogen, e-methanol and e-kerosene, which will result in significant carbon emission reductions.

This endeavour may radically change the transportation industry and there is an extraordinary team behind it. This unique partnership includes A.P. Moller – Maersk, SAS, Ørsted, Copenhagen Airports, DSV and DFDS, all devoted to pushing the green transition in their industries.

Green Fuels for Denmark utilises renewable electricity to create hydrogen, which can be turned into e-methanol and e-kerosene by adding captured carbon from a pre-existing power plant. The challenge is to integrate all the different production methods seamlessly at a scale that has not been done before, while keeping efficiency and sustainability in mind.

When finalised, the facilities will turn energy from offshore wind into 250,000 tonnes of green fuels per year, with a 1.3 GW production capacity. Our services include concept and feasibility studies, basic engineering, cost estimates, handling of environmental impact as well as risk and safety.

Period
2020-ongoing

Client
Ørsted

Country
Denmark



Green e-fuels for shipping



Heavy transportation, including the maritime sector, cannot rely on direct electrification. To decarbonise shipping, we need green fuels. COWI supports A.P. Moller – Maersk in developing what might be the largest scale of e-methanol production based on renewable power and biogenic CO₂ sources. The project runs in parallel in multiple locations and, once fully operational, will have a total capacity exceeding 20 GW.

As engineering partners, we are responsible for pre-feasibility, design and techno-economic optimisation. Our work covers the complete end-to-end value chain: wind and solar power, transmission, hydrogen production, carbon capture, methanol synthesis, plant, pipelines and storage design, and terminals for export of finished products.

This is a truly multidisciplinary project, also including commercial and technical management services including certification, regulatory and permitting aspects.

Period
2022-ongoing

Client
A.P. Moller – Maersk

Country
Multiple locations



North Irish Sea Array



The North Irish Sea Array (NISA) offshore wind farm is a part of the first offshore competition under the Renewable Electricity Support Scheme (ORESS-1) in Ireland.

Once operational, the NISA development will have the capacity to power over 500,000 homes with clean energy, playing an important role in helping Ireland meet its ambitions of reaching 80 per cent renewable energy by 2030.

We have been selected as owner’s engineer, supporting Statkraft in preparing an auction application with a broad scope of work ranging from foundation concept design, electrical design, construction, operation and maintenance (O&M) port assessment to cost model development. Working against challenges in the marketplace, such as rising materials costs and pressures to increase renewable energy capacity, keeping the levelised cost of energy (LCOE) at the forefront of the application will be central to all work on the project.

Period
2022-ongoing

Client
Statkraft

Country
Ireland



Empire Wind

Situated off the coast of Long Island, New York, Empire Offshore Wind has an anticipated generation capacity of more than 2 GW of renewable power and the development will utilise 15 MW wind turbines. As one of the largest offshore wind projects in the US, it is expected to play a major role in meeting New York State's goal of reaching 70 per cent renewable energy by 2030.

The development spans 80,000 acres and is in water depths ranging from 65 to 131 feet. The project calls for the detailed engineering of 138 foundations with diameters of approximately 30 feet and lengths up to 330 feet.

Over 100 experts from COWI are working on all aspects of the wind turbine foundation design, from the tower interface to the seabed fastening – including steel, geotechnical and electrical design for the project as well as engineering support for fabrication, transportation and installation.

Period
2022-ongoing

Client
Equinor and bp

Country
USA



Arcadis Ost 1

The Arcadis Ost 1 offshore wind farm – showcasing the largest monopiles ever installed in Europe – is located in the Baltic Sea, north-east of the German island Rügen.

The next-generation XXL monopiles will support 27 wind turbines, generating approximately 257 MW of power at full capacity, enough to provide electricity for 300,000 households. Working in the area has its unique challenges, as it requires special considerations for ice loads, chalk, glacial till and soft soil, and a water depth that varies between 42 and 46 metres, requiring a floating installation of monopiles and wind turbines.

We have delivered the detailed design of monopile foundations for the wind turbines and offshore substation, including geotechnical, electrical and mechanical engineering and lifetime optimisation.

Period
2019 – 2023

Client
Parkwind Ost GmbH

Country
Germany



Firefly



The Firefly offshore floating wind farm is our first project under our master service agreement (MSA) with Equinor. Consisting of low draft semi-submersible turbines, the wind farm will be located 70 kilometres off the shore of Ulsan, in more than 60 metres deep water to harness the strongest winds on the sea.

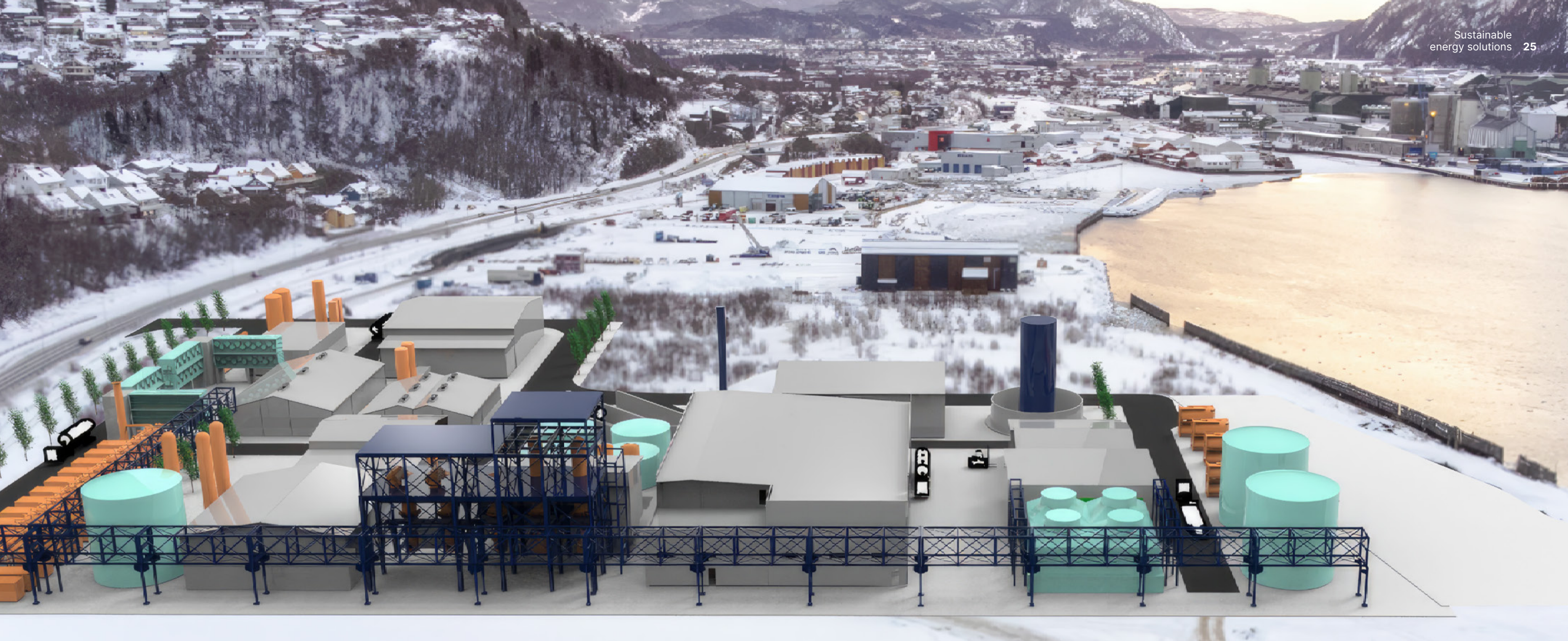
Once fully operational, Firefly will produce 800 MW of electricity of Equinor’s prospective 12-16 GW renewables portfolio planned to be achieved by 2030.

As part of the MSA, we support Equinor’s offshore wind projects and low-carbon solutions by delivering independent studies, reviews and verifications; and engineering scopes of work.

Period
2022-ongoing

Client
Equinor

Country
South Korea



Norsk e-Fuel

Norsk e-Fuel AS is a Norwegian project developer driving the transition to renewable aviation by producing sustainable fuels. The company is backed by a strong network of industrial partners and investors with experience

in the Power-to-Liquid industry. The company's first plant will be constructed in Mosjøen, Norway, and will have a production capacity of up to 50 million litres of e-fuel.

The innovative production pathway is optimised to produce e-kerosene by using renewable electricity to turn captured carbon and water into sustainable aviation fuel. The e-fuel seamlessly fits the existing infrastructure and can be used without aircraft adaptation.

We are owner's engineer in the project, supporting the consortium with technical advisory services in pre-FEED and FEED design, civil design, and permitting.

Period
2022-ongoing

Client
Norsk e-Fuel AS

Country
Norway



H2DRIVEN

H2DRIVEN aims to decarbonise the chemical and the maritime industries by producing green methanol based on renewable energy and carbon captured from two biomass combustion facilities in Portugal.

This project implements a state-of-the-art value chain where green hydrogen is produced from recovered and purified water and green electricity – from solar radiation, wind and water energy. Then, by adding biogenic CO₂, captured in forest biomass boilers, it is turned into green methanol.

We prepared a pre-feasibility study for the two sites that will produce 100 kton and 115 kton of methanol respectively.

Period
2022 – 2023

Client
Dourogás,
The Navigator
Company, Bondalti
and Capwatt

Country
Portugal



HØST PtX Esbjerg

HØST PtX Esbjerg is a ground-breaking new green fuels plant being developed by CIP in partnership with market leaders in agriculture (Arla, Danish Crown, DLG) and shipping (A.P. Moller – Maersk and DFDS) to produce green ammonia by harnessing renewable powered electrolysis. The ammonia will be used both as fertilizer and as a clean shipping fuel and will play an important role in the decarbonisation of the agricultural and shipping industries in Denmark.

Once in operation, the 1 GW plant will be one of Europe's largest green fuels facilities and will provide a number of additional advantages beyond a plentiful supply of green ammonia. For instance, excess heat from the plant will supply emission-free district heating to 15,000 households in the surrounding municipalities, and the entire project will contribute to reducing annual emissions by 1.5 million tonnes.

We are assisting CIP with spatial planning, risk analysis, safety and environmental assessments, planning and early project maturation.

Period
2022-ongoing

Client
Copenhagen
Infrastructure
Partners (CIP)

Country
Denmark



Vestforbrænding



Vestforbrænding owns and operates Denmark’s largest waste incineration plant where this carbon capture project aims to capture 400,000 tonnes of CO₂ per year and sequester it in the underground instead of releasing it to the atmosphere.

After the flue gas is cleaned of hazardous compounds, the remaining CO₂ is captured and transferred to a sequestration site. There, the CO₂ is pumped into the underground for permanent storage.

Surplus heat from the carbon capture plant will be used for district heating, supplying 30,000 homes with carbon-free heating, thereby further decreasing CO₂ emissions.

As owner’s engineer, we have contributed to the project development, procurement of a carbon capture plant for an energy-from-waste plant including energy supply systems and civil works. Furthermore, we assisted with preparing a funding application to the Danish Energy Agency (Energistyrelsen) for the project.

Period
2022-ongoing

Client
I/S Vestforbrænding

Country
Denmark



Aalborg Portland

As part of the GreenCem project, Aalborg Portland, Denmark's sole cement producer, was investigating carbon capture, storage and utilisation (CCSU) strategies in an effort to reduce the significant carbon emissions associated with cement production.

The project involved life-cycle analyses and an assessment of the technical, financial and sustainability aspects of possible CCSU solutions. The key outcome of the project is a technical and economic decision basis for Aalborg Portland and the project partners for considering next steps in terms of establishing a test facility and, in due course, a large-scale facility.

Our role involved investigating the establishment of a carbon capture facility at the factory and assessing how the captured carbon can best be converted into green fuels. Additionally, we prepared a conceptual study for two carbon capture test facilities – one with an annual capacity of 200,000 tonnes of captured carbon, and a larger one with an annual capacity of 800,000 tonnes.

Period
2020 – 2022

Client
Aalborg Portland

Country
Denmark



Runcorn CCS

The Runcorn CCS Project marks our first carbon capture project in the UK and is one of the first energy-from-waste (EfW) facilities in the world to have the technology fitted. Once operational, the facility will capture around 900,000 tonnes of CO₂ each year, 50 per cent of which includes biogenic CO₂, removing 450,000 tonnes from the atmosphere annually.

As owner's engineer for renewable energy and waste management company, Viridor, we worked with project stakeholders to develop the basis of design for the carbon capture plant as well as project timelines and risk register. We also reviewed cost and specifications from vendors for the installation of carbon capture technology at the UK's largest energy-from-waste (EfW) facility near Liverpool.

Period
2022-ongoing

Client
Viridor

Country
United Kingdom



Tårnby district heating

Connecting more households to the district heating system is vital to the green transition, as a new district heating installation typically replaces an existing boiler using oil or fossil gas. Moreover, district heating is increasingly generated by large electrically-powered heat pumps that can be configured to operate when the power is greenest.

Tårnby Forsyning has embarked on a large-scale expansion of the district heating system in the area. COWI will provide assistance under a framework agreement and contribute to accelerating the roll-out. A permanent team of our consultants will assist Tårnby Forsyning in planning and design, as well as construction management services once the construction starts.

Period
2023-ongoing

Client
Tårnby Forsyning

Country
Denmark

Together with customers, partners and colleagues, we shape a future where people and societies grow and flourish. We do that by co-creating sustainable and beautiful solutions that improve the quality of life for people today and many generations ahead.

Our starting point is gaining a deep understanding of our customers, their aspirations and concerns. This is what sets us apart and how we deliver long-term value.

Primarily located in Scandinavia, the UK, North America and India, we are currently 7,500 people, who offer our expertise in engineering, architecture, energy and environment.

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