

SELECTED REFERENCES

GREEN ENERGY



PROJECT NO.
A212033

COUNTRY
Denmark

PERIOD
2020 - 2022

CUSTOMER
Aalborg Portland
A/S

RECIPIENT
Aalborg Portland
A/S

CONSULTANCY
EUR 229.071

GREENCEM CARBON CAPTURE

The GreenCem project is an EUDP-supported project, with work package 1 and 2 completed in 2020-2021. The purpose of the project is to investigate the possibilities of implementing large-scale CO₂ capture at Aalborg Portland's cement factory in Aalborg and using collected CO₂ for the production of green fuels (Power to X) and/or geological storage. The project is carried out with the project partners Aalborg University (AAU), Re:Integrate, Port of Aalborg, Aalborg Forsyning Energi, DFDS and Cemtec Foundation.

COWI's role in the project is the implementation of a waste heat integration and concept study for the establishment of carbon capture and auxiliary facilities at Aalborg Portland.

Consultancy services provided:

WP1.1: Review/comment on screening carried out by Aalborg Portland regarding technology selection

WP1.2: Input for interfaces between capture plant and CO₂ transport/utilization plant

WP1.3 Input on sizes and locations of capture facilities and required infrastructure

WP2.1 In collaboration with Aalborg Portland, assess which existing facilities and systems can be integrated with the capture facility

WP2.2 Statement of waste heat potential at Aalborg Portland for use in the CO₂ capture process and proposal for an integrated solution

WP2.3: Concept study for two capacities of CO₂ capture plant (demo plant 200,000 t CO₂ per year and full-scale solution 1,000,000 t CO₂ per year) as well as auxiliary systems and CAPEX/OPEX estimates

Under WP 2.3 (concept study), the following consulting services have been provided:

The concept study is carried out for two CC plant capacities:

- Demo plant (GreenCem phase 2) with an annual capacity of approx. 200,000 t CO₂, where the flue gas is collected from the gray furnace K87.
- Full-scale CC plant (GreenCem phase 3), where the flue gas is collected from the gray furnace K87. The full-scale plant will be prepared based on a clinker production as today, but with a new/changed fuel mix.

The concept study specifically includes the use of commercially available amine-based post-combustion technologies suitable for retro-fit.

As part of the concept study, three potential options for establishing steam production are included: electric boiler, as well as gas or chip-fired boilers.

The concept study includes a liquefaction plant incl. storage facilities.

- Preparation of design basis
- Process Flow Diagrams (PFD) for facilities/processes around the CC facility. The PFD for the CC plant is based on a generic capture process, as the individual technology providers/suppliers have their own technical solutions.
- Process description of CO₂ capture and CO₂ conditioning plants
- Heat and mass balances for CC plants and auxiliary systems
- Overall layout (pipes/flue gas ducts and main components) of CC plant, heat integration/heat recovery and auxiliary plant. Visualization in 3D based on Aalborg Portland's existing 3D model of the cement factory.
- List of main components (MEL, Main equipment list)
- Calculation of electricity consumption (for use in OPEX evaluation)

- Identification of chemical consumables and waste streams
- Safety: Carry out high level HAZID together with representatives from Aalborg Portland. Incorporate HAZID summary in reporting of the concept study.
- Initial assessment of environmental consequences (emissions to air and water) from the CC facility incl. reporting thereof.
- Preparation of overall schedule for both the demo and full-scale project
- CAPEX budget for an integrated CC plant with accuracy -20/+40% and OPEX estimate

PROJECT NO.
A238397

H2DRIVEN GREEN METHANOL

COUNTRY
Portugal

H2DRIVEN has intention of establishing Green Methanol productions at 2 sites of biomass combustion facilities based on Green hydrogen from electrolyse of green electric power from solar, wind and hydropower and carbon captured from the biomass combustion flue gas. The aim is to produce 100 kton/year respectively 115 kttons/year methanol grade A.

PERIOD
2022 - 2022

The Project target is to prepare input to H2DRIVEN technology choice and prepare a of pre-feasibility report with main technological description and main economic figures (input to financial calculation), which will serve as input to H2DRIVEN Management Initial Investment Decision.

CUSTOMER
EFACEC Power Solution

The scope comprises of the following main deliveries:

RECIPIENT
EFACEC Power Solution

CONSULTANCY
EUR 161.005

- Clarification of the project Design Basis based on input from biomass facilities
- Description of commercial ready (TRL level above 8) technologies for amine-based Carbon Capture, for Hydrogen production from electrolysis, for Methanol synthesis and distillation and for water supply-/treatment. List of main advantages/disadvantages assess TRL level and list main economic figures for each technology.
- Description of the technical concept for the chosen technology for Carbon Capture, for Hydrogen production and for Methanol synthesis and distillation for the 2 sites.
- Process flow diagrams and mass/energy balances for the 2 sites, including figures of main mass and energy flows. Aspen HYSYS® is used for the calculation of mass and energy balance
- Operating philosophy for the process plants is described, including utilization factors, operation philosophy and storages requirements.
- Description and dimension of key technical components
- Electrical Single line diagrams (HV and MV) for the 2 sites including figures of main current and energy flows
- Preliminary layouts for each sites
- CAPEX – cost of equipment, installation and civil works
- Environmental and risk assessment based on COWI's experience from similar project.

PROJECT NO.
A206710
A237192

GREEN FUELS FOR DENMARK

COUNTRY
Denmark

The project comprise the following areas: Regulatory processing; Construction maturation; Electrolysis plant; Hydrogen plant; Methanol plant; CO₂ plant; Establishment of electrical infrastructure; Water treatment plant.

PERIOD
2020 - 2023

The project is an ambitious project with the goal of establishing a 1.3 GW electrolysis plant, Carbon Capture plant and associated power-to-x plant in the greater Copenhagen area.

CUSTOMER
Ørsted Wind Power A/S

Green Fuels for Denmark can potentially supply green fuels equivalent to Denmark's total domestic consumption of aviation fuel in 2027, when the full second phase is commissioned, thus fulfilling the

RECIPIENT
Ørsted Wind
Power A/S

CONSULTANCY
EUR 3.823.878

government's ambition of 100% green domestic aviation by 2030, which is three years ahead of schedule.

COWI is technical advisor for Ørsted in the project. The project includes, so far, an initial technical analysis and advice on initial phases, which have been carried out from May to August 2020, a subsequent Feasibility phase, which has been carried out from October 2021 to April 2022, and now a concept selection phase is underway from May 2022 until October 2022.

The provided consulting services includes initial technical analysis, as well as advice on initial phases:

COWI has carried out the initial technical analysis with a view to making the initial technology choice and comparing different technological options for power-to-x. This analysis has included

- Assessment of fuel needs at DSV, Mærsk and SAS, as the most important customers
- Evaluation of quality requirements for fuel for respectively land transport, maritime use and air transport.
- Technical description of various technologies and technology choices, including description of the process plant, comprehensive electrolytic production of hydrogen, carbon capture, methanol and Fischer-Tropsch, as well as refining processes for the production of jet fuel or methanol.
- Overall mass and energy balances for the various process paths for calculating the efficiency in the conversion of energy
- The infrastructure around the plant, including distribution of fuel
- Integration with the district heating system in Copenhagen and assessment of CO₂ point sources in Copenhagen. In this connection, how will utilization of excess heat from the power-to-x plant and the carbon capture plant affect the district heating supply in Copenhagen
- Site selection and assessment of refining needs.

In addition to the technical analysis, COWI has assisted with the planning of the project's first phases, building additional partnerships around the project and preparing funding applications for the project's first phase.

Consultancy services provided, Feasibility phase:

COWI and Arkitema have prepared a feasibility report incl. project material for initial authority documentation and risk assessment regarding the plant's phases 2A and 2B, which together consist of a 250 MW electrolysis plant, which matches the amount of CO₂ collected from Avedøreværket's straw-fired block 2.

The work relates to the following partial services and professional disciplines:

- Flue gas condensation
- CO₂-capture (carbon capture)
- CO₂ for liquid form and storage
- Electrolysis plant
- Hydrogen compression and storage
- Methanol synthesis and distillation
- Methanol synthesis for the production of jet methanol
- Heat integration (Balance of plant)
- Auxiliary plant, heat pumps, steam turbine
- Water treatment plant
- Electrical system, control and instrumentation

- Plant and building disposition incl. cables in terrain, roads and constructions
- Building plant
- Port area and shipping facilities
- Project Management
- Regulatory processing
- Risk assessment

The report from the feasibility phase with associated master plan drawings disposes and specifies at an overall level the overall process and building plant.

Since the plant must be located in the existing power plant area between existing buildings, tanks, piping etc., the solutions must respect existing conditions while at the same time ensuring optimal conditions for the Green Fuel plant within the given framework. This is ensured by extensive multidisciplinary coordination between the client's project organization, the power plant's operating organization, and COWI subject specialists for the above-mentioned disciplines.

Consulting services provided, Concept selection phase:

At the time of writing, at the end of August 2022, the concept selection phase including advanced procurement activities is ongoing. Thus, the carbon capture plant has been sent out to tender and the tender material for flue gas condensation, steam turbine and electrolysis plant is almost ready to be sent out.

COUNTRY

Denmark

PERIOD

2022 - 2024

CUSTOMER

CORRE ENERGY

CONSULTANCY

EUR 1.188.423

COMPRESSED AIR STORAGE - GREEN HYDROGEN HUB

Concept and FEED of Compressed Air Energy Storage (CAES) facility placed between Hobro and Viborg.

PROJECT NO.

A209494

COUNTRY

Sweden

PERIOD

2020 - 2021

CUSTOMER

Preem AB

CONSULTANCY

EUR 140.000

CINFRACAP – TRANSPORT OF CO₂

A corporation between Göteborg Energi, Nordion Energi, Preem, St1, Renova and Göteborgs Hamn AB. COWI is full-service consultant. The production of fluid carbon dioxide with the help from capture and storage of CO₂ and thereby an optimum logistical and infrastructural solution for CCS in a bigger industrial scale. The CO₂ is collected and transported to the harbour, where it will be stored shortly before it is shipped as fluid CO₂. The CO₂ is stored in underground storage facilities in the depth of 3000 metres on the bottom of the sea. The purpose is to investigate how the transport of the CO₂ can be made most cost-efficient and climate friendly.

COWI has carried through a pre-study to the planned infrastructure, which could be the first of its kind in the world. The pre-study must be ready in Q1 2021.

The COWI scope of work has focused on the following work packages:

Project management/communication:

- Coordination of the activities within the consortium group including workshops, technical meetings and project meetings.
- Coordination of the activities within the COWI team as well as ensuring that the requirements from the consortium members were met.
- Project follow up (time, economy, etc.) and administration.

- Communication (homepage, participation in conferences, press releases).

Technical pre-study:

- Investigation of logistics and distribution chain for CO₂ to get a good technical and economical solution. The following topics were addressed:
 - Technical boundaries and limitations, throughput volumes of CO₂, CO₂ quality specification.
 - System design and equipment selection. Identification of alternative system configurations, evaluation of technical and cost.
 - Different types of solution for transport of CO₂ from the capturing sites to the CO₂-terminal in the port of Gothenburg.
 - Alternatives for interim storage, tank types.
 - Optimisation of interim storage volume in relation to throughput and ship transport schemes.
 - Heat and energy balance for the full scope including transportation pipelines, interim storage, liquefaction and export. Handling of boil-off-gases from cryogenic liquid CO₂ was also addressed.

Study of location:

Investigation of location with starting point in Göteborg Hamn and participating industries to find out where and how the different parts of the distribution chains can be placed, i.e. the following must be investigated:

- Demand to physical placement (a detailed plan), underground piping and utility system rights and other questions to the groundings,
- Demand of space, proximity to unloading quay, support system and other infrastructure,
- Nearby companies and other neighbours
- Risk interests and protected areas

The overall purpose has been to recommend the best possible place. Tendering documents for budget quotes.

Risk analysis (HAZID)

In an early stage, risk identification must be carried out for the prepared facilities and transports taking the continuous work into consideration.

Cost estimate, implementation plan and time schedule

The development in the implementation plan and the cost estimate is based on technology, place and transport. Condition aspects are also included to indicate, which demands will be eligible for the facility.

COWI's team for the project includes a competent group of employees within the disciplines project management, process design, piping design/construction technology, risk, safety and condition check. A broad team who had the opportunity to take care of the entire scope.

The project was carried through in close co-operation with 6 partners in the consortium for CinfraCap. The design conditions for the respective partners gave important input for the final technical result.

PROJECT NO.
A206710

COUNTRY
Denmark

PERIOD
2020 - 2020

GREEN FUELS FOR DENMARK – TECHNICAL AND FINANCIAL ANALYSIS OF ENERGY SYSTEMS

The project is an ambitious project with the goal of establishing 1.3 GW electrolysis plants, Carbon Capture plants and associated power-to-x plants in the Greater Copenhagen area.

CUSTOMER
Ørsted Wind
Power A/S

RECIPIENT
Ørsted Wind
Power A/S

CONSULTANCY
EUR 75.136

The project is divided into several phases, and COWI has carried out the initial technical analysis in order to make the initial technology choice and compare different technological options for power-to-x. This analysis included:

- Assessment of fuel needs at DSV, Maersk and SAS as the most important customers.
- Evaluation of quality requirements for fuel for resp. land transport, maritime use and air transport.
- Technical description of various technologies and technology choices, including description of the process plant, including electrolysis production of hydrogen, Carbon Capture, methanol and Fischer-Tropsch, as well as refining processes to produce jet fuel or methanol.
- Overall mass and energy balances for the various process paths for calculating the efficiency of energy conversion.
- The infrastructure around the plant, including distribution of fuel.
- Integration with the district heating system in Copenhagen and assessment of CO₂ point sources in Copenhagen. In this connection, it is investigated how the utilisation of surplus heat from the power-to-x plant and the carbon capture plant will affect the district heating supply in Copenhagen.
- Site selection and assessment of refining needs.
- In addition to the technical analysis, COWI has assisted with the planning of the first phases of the project, building additional partnerships around the project and preparing fund applications for the first phase of the project.

The reference covers the following services:

- Analysis of energy systems and subsystems.
- Analysis of resource uses, including options for recycling resources and waste.
- Advice in connection with technology and technology selection - the technologies of the future.
- Analyses of reduction of CO₂ emissions, including Carbon Capture plants.
- Analysis of utilisation of surplus heat from industry, business, etc. and Power-to-X systems.

PROJECT NO.
A218540

COUNTRY
India

PERIOD
2020 - 2021

CUSTOMER
WB/ESMAP Team

CONSULTANCY
EUR 211.904

OFFSHORE WIND ROADMAP FOR INDIA

The objective of this assignment is to provide strategic analysis and advice on the role that offshore wind could play in India's future energy mix, analysis on the key opportunities and challenges, and recommendations on next steps in terms of policy formulation, planning and developing bankable projects. The assignment shall inform the World Bank Group's advice to the Government of India and the Government's consideration of policy and investment options for offshore wind. The analysis is expected to be shared with relevant stakeholders.

The project is only in the inception phase (Dec 2020) but have two main task a) preparation of a roadmap for offshore wind and b) desk study for a demonstration project.

PROJECT NO.
A011073

COUNTRY
China

PERIOD
2012 - 2020

CUSTOMER
Danida Business

SHANGRI-LA DISTRICT HEATING PROJECT

The Shangri-La Central Heat Supply Project is an energy and environmental project, more specifically a district heating project. The idea of the project is to extend the service area of the district heating system in Shangri-La to supply additional public buildings, commercial buildings, private homes etc. with district heating for space heating. The district heating is an alternative to wood and coal fired stoves, which are traditionally used for space heating in Shangri-La.

Finance (Danida /IFU)

RECIPIENT
DHDC

CONSULTANCY
EUR 1.464.316

PROJECT COST
EUR 20.151.131

One of the unique features of the Shangri-La Central Heat Supply Project is that it is a zero CO₂ emission project. This feature is obtained since heat to the district heating network is produced by electric power generated by hydropower, i.e. a CO₂ emission-free primary heat source. The efficiency of the use of electric power is further enhanced by using a combination of electrical boilers and air-water heat pumps.

The end user is the Dêqên Tibetan Autonomous Prefecture Heat Development Co. Ltd.

The Shangri-La project comprise five boiler houses with a total of 17 high voltage electrical (10 kV) steam boilers, each with a design capacity of 7.5 MW. Together with the electrical boilers, typically on the roof of the boiler houses, at total of 213 air-to water heat pumps have been installed, each with a capacity of 65 kW. The heat pumps are installed in a manner so that they preheat the district heating water and the electrical boilers heat the district heating water to the required supply temperature.

The project is a modern, high efficiency and zero emission district heating scheme, including all mechanical and electrical equipment for the boiler house, pipe networks and end user installations, e.g. boilers, heat pumps, speed controlled main pumps, valves and valve actuator, pressure holding systems, water treatment facilities, meters, instrumentation, and a state-of-the-art control and monitoring system. On the electrical side the project comprises high voltage switchers, transformers, meters, etc. In connection with the control and monitoring system also a fibre optical data communication system has been installed facilitating remote control and monitoring of each of boiler houses. The project comprises pre-insulated pipes and valves for the underground pipe network and end user installations in the form of mixing loops with energy meters (in Shangri-La this component is referred to as a "UAB – User Access Box).

The Shangri-La district heating project is development project where all required facilities and infrastructure have been constructed and commissioned during the project implementation period, i.e. the project entailed preparation of land and construction of the five new boiler houses, excavating trenches and pulling high voltage power supply cables from transformer stations up to the boiler houses, excavating trenches / crossing rivers for installation of pre-insulated district heating pipes, and installing and connecting end user installations.

The total project cost is RMB 650 million. Danida Business Finance (DBF) has supported procurement of equipment and services with RMB 150 million. COWI's services has been focused on monitoring of implementation of the project component directly linked to DBF financing, however as many issues are interconnected COWI has supported DBF with consultancy services extending into areas not directly linked to DBF financing.

The services comprised the following main deliverables and outputs:

- Project appraisal including obtaining end users comprehension of the benefits from optimal utilization of renewable energy (hydro power) in the heating system by introduction of air-water heat pumps supplementing the electrical boilers, among other benefits addressing reduction of emissions and CO₂ emission free heat production.
- Review and comments to bidding documents
- Price verification
- Formulation on requirements for model simulations (hydraulics) including requirements for introduction of for pooled operation
- On site monitoring of project implementation, system performance tests and project verification including preparation of bilingual minutes signed by all stakeholders and mission reports / debriefing of DBF
- Participation of in steering committee meetings and providing consultancy services for DBF on actions to mitigate delays, support project completion and fulfilment of loan governance

- Interpretation during monitoring missions and steering committee meeting and preparation of bi-lingual minutes
- On site sound measurement of Heat pumps
- Preparation and host for technical study tour to Denmark

PROJECT NO.
A112347

SOLAR ENERGY PROGRAMME FOR THE LOCAL GOVERNMENT OF GOTHENBURG 2018-2050

COUNTRY
Sweden

The local government of Gothenburg has an ambitious plan to generate over 60% of their electricity demand by solar energy by 2050. One sub-target is to generate more than 35 GWh in existing and new buildings in 2030. By 2050 it is estimated that about 80 % of the 2,000 buildings that the local government manages will have PV-installation on their roof or façade. The real estate portfolio contains mainly pre-schools, schools and retirement home but also some large office buildings.

PERIOD
2018 - 2021

CUSTOMER
The local government of Gothenburg

COWI is one of two consultants that are working on the realization of this project regarding pre-feasibility studies, design and economics calculations, visualization, project management and more.

PROJECT NO.
A132234

THE FUTURE DISTRICT HEATING

COUNTRY
Denmark

Today DIN Forsyning (district heating utility) purchased 50% of its district heating from Ørsted Bioenergy & Thermal Power A/S (hereafter Ørsted) which produces it at Esbjerg power plant unit 3 (ESV3). Ørsted do not wish to close ESV3 and has applied the Danish Energy Agency (DEA) not to close the power plant. The DEA has informed ESV3 must be closed down not later than 1 april 2023, with the possibility of early decommissioning if a new heat production unit is created. It is therefore necessary for DIN Forsyning to establish a new district heating production. DIN Forsyning's goal is to establish a new district heating production that is feasible for the district heating consumers in Esbjerg, Nordby and Varde, which at the same time is green and flexible.

PERIOD
2020 - 2022

CUSTOMER
Din Forsyning

CONSULTANCY
EUR 1.510.167

Furthermore, DIN Forsyning wants the new district heating production to be based on a selection of modern technologies with high supply security and with a robust market price for the consumers. Din forsyning will build the following production facilities:

- > 60 MW woodchip boiler plant with flue gas cleaning
- > 50 MW seawater-based heat pump facility
- > 30 MW electrical boiler plant
- > New pump and distribution plants

To erect these facilities a number of building and construction project shall be carried out by COWI as consultant with Arkitema (Architect) as sub-consultant

COWI prepares conceptual design, project design and main project as well as tender material for building development, climate protection, site actions, seawater intake and discharge, building for woodchip boiler, heat pump building, pumping station, woodchip storage and reception. Furthermore, a district heating project is prepared for the new pumping station with piping design, valves, pumps etc.

PROJECT NO.
P-072200

MAABJERG BIOENERGY

COUNTRY
Denmark

Manure from farming produces energy for households

PERIOD
2012 - 2014

The plant annually ferments 550,000 tons of manure from local farms, producing 18 million cubic meters of biogas per year. The biogas is used as fuel in gas engines, generating electricity for 12,500 households and district heating for 5,000 house-holds. The digested manure is used as fertilizer on

CUSTOMER
Maabjerg
BioEnergy

CONSULTANCY
EUR 280.000

PROJECT COST
EUR 53.000.000

the farms with increased fertilizing effect. The addition of concentrated whey from dairies, potato starch residues, and stable litter enhances the fermentation process.

Sludge from city waste water

Sewage sludge from Holstebro City wastewater treatment plant is treated in separate fermenters at the plant. The digested sludge is dewatered and the wastewater is returned to the wastewater plant for final treatment. The plant annually removes 300 tons of organic nitrogen and 300 tons of phosphorus. This protects the water quality in the streams and lakes in the surrounding environment. In addition, the plant reduces CO₂-emission to the atmosphere. Plant operation is fully automatic and a special logistics program ensures the most effective use of transport capacity for all transport of manure, fertilizer and sludge. The project was divided into fourteen separate contracts, including concrete storage tanks, steel fermenting tanks, piping, gas engines, electrical work and control system.

COWI services included project management, procurement, design and engineering, testing and commissioning of the control system for the complete plant. This work comprised the operation coordination of all fourteen contracts and the final commissioning and optimisation of the process.

COWI prepared detailed programming descriptions for the automation of all activities, layout of process pictures used for operating and monitoring, alarm handling, and design of reports for plant efficiency recording.

COWI services also comprised detailed engineering of piping and auxiliary systems.

PROJECT NO.
A118022

COUNTRY
Malta

PERIOD
2019 - 2024

CUSTOMER
Wasteserv Malta
Ltd

CONSULTANCY
EUR 3.150.147

PROJECT COST
EUR
180.000.000

NEW WASTE-TO-ENERGY FACILITY IN MALTA

Investment value -180,000,000 EUR

The international consultancy firm COWI A/S has been awarded a contract as Owners Engineer from Government owned Wasteserv Malta Ltd. The Project consists of the construction of a Waste-to-Energy Facility on the Maltese Islands with an expected annual capacity more than 100,000 tonnes. COWI's Consultancy Services comprises for the Preliminary Design, Engineering, Permitting, Procurement and Construction of a Waste to Energy Facility in Malta.

SPECIFICATION OF WASTE-TO-ENERGY PLANT

Waste incineration pr. year:	190,000 tonnes
Power production:	20 MW
Heat production:	0 MW
Flue gas system:	Semi dry

COWI will provide the full services for the preparation and completion of the specifications, tender documents and the Design, Build, Finance and Operate (DBFO) Contract as a result of COWI elaborated Public Private Partnership (PPP) schemes. Further, COWI provides overall procurement process facilitation, legal backing and assistance in the evaluation and contract award for the DBFO Contract financed through the PPP scheme. The ultimate aim of the procurement process is that the preferred bidder shall then become the private partner within the PPP.

The overall objective of this infrastructure investment project is to oversee and manage the construction of a Waste to Energy Treatment Facility, covering the preparation of the necessary studies, documentation and supervision of the said construction of a state of the art Waste-to-Energy Treatment Facility for the treatment of a wide range of waste fuels and ensure its adequate integration in the municipal waste management system in Malta contributing towards Malta's climate change obligations. COWI is also to provide consultation and supervision during the detailed design, construction & commissioning works as well as during the operations monitoring period.

PROJECT NO.
A090455
COUNTRY
Denmark
PERIOD
2017 - 2020
CUSTOMER
EU Horizon 2020
CONSULTANCY
EUR 5.291.186

COOL DH

No investment value. The objective of COOL DH action is to support cities in their endeavor to plan and deploy new, efficient district heating and cooling (DHC) systems and extend, refurbish existing ones to higher standards. Thus allowing greater uptake of renewables, recovering of excess heat or cold while improving the overall efficiency of the systems. COOL DH is an abbreviation of Cool ways of using low grade Heat Sources from Cooling and Surplus Heat for heating of Energy Efficient Buildings with new Low Temperature District Heating (LTDH) Solutions. The project is funded by Horizon 2020. The COOL DH consortium consists of the utilities and municipalities of the two cities (Lund in Sweden) and Høje-Taastrup in Denmark where the full scale demonstration takes place, together with leading DH energy specialists as well as leading industrial manufacturers.

The COOL DH project will:

- > Innovate, design and build cooling and heat recovery process systems, enabling heat recovery to a local LTDH grid. They will mainly be driven by renewables. Design work will start in 2017 and heat recovery will start in 2019.
- > Design and build a LTDH grid with non-conventional pipe materials. The project will also test new innovative pipe components to make the pipes easier to transport and more cost-efficient.
- > Innovate and design suitable heating systems and controls inside buildings that combine LTDH with distributed integration of local produced renewable energy. Erection of new buildings in Lund will start in 2018 and continue throughout the project. LTDH in Høje-Taastrup will mainly apply to existing buildings that are being refurbished, including modification of the heating system.
- > Develop viable business models and new pricing systems. As well as ensuring a good (low) return temperature and provide the building companies with maximum flexibility regarding the choice of heating systems.
- > Demonstrate a full system with all needed components suitable for low DH temperatures (40-65 oC), including demonstration of systems for heating of DHW (Domestic Hot Water) without risk of legionella.
- > The results from the project will be disseminated locally, nationally and internationally for future replication of the projects results.

COWI is leading the joint venture and is in charge of planning, design and reporting of the EU project.

PROJECT NO.
A124748
COUNTRY
France
PERIOD
2019 - 2022
CUSTOMER
Eiffage Métal SAS
RECIPIENT
Eiffage Métal SAS
CONSULTANCY
EUR 2.863.884
PROJECT COST

SAINT NAZAIRE OWF DETAILED DESIGN

The Saint Nazaire offshore wind farm will be located between 12km and 20 km of the coast in the Northern part of the Bay of Biscay and cover an area of 78 km². The site was selected due to strong and steady winds, and a shallow water depth between 12 and 25 meters. The 480 MW wind farm will ultimately generate the equivalent of 20% of the Loire-Atlantique's electricity consumption needs.

The Saint Nazaire offshore wind farm project is developed by Parc du Banc de Guérande, a consortium of EDF Renouvelables and Enbridge, and was awarded in 2012 by the French Government. Construction and operating permits were given in 2017 with the final decision from the Conseil d'Etat in June 2019. The wind farm is due for commissioning in 2022.

The project is being developed as a part of the French government's aim to increase the country's renewable energy share of total consumption to 32% by 2030.

GE Renewable Energy HAL 150 6MW.

COWI has been part of the project since the tender design in 2016 and was awarded the detailed design of the monopile foundations in 2019. COWI's HSE tasks included:

- Identification, risk evaluation, mitigating and reporting HSE hazards

- Planning, conduction and reporting HSE design risk assessment workshop
- Preparation of escape, rescue and evacuation drawings and related report
- Prepare technical notes on ATEX classification

PROJECT NO.
A073635

TECHNICAL ASSISTANCE FOR SETTING UP THE FIRST OFFSHORE WINDFARM PROJECT IN INDIA (FOWPI)

COUNTRY
India

PERIOD
2016 - 2019

CUSTOMER
EU Delegation to
India

CONSULTANCY
EUR 1.724.083

The First Offshore Wind Farm Project of India (FOWPI) is part of the "Clean Energy Cooperation with India (CECI) ", which aims at enhancing India's capacity to deploy low carbon energy production and improve energy efficiency, thereby contributing to the mitigation of global climate change. Project activities will support India's efforts to secure the energy supply security, within a well-established framework for strategic energy cooperation between the EU and India. FOWPI objective is to plan and preliminary prepare a first 200MW offshore wind farm near the coast of Gujarat, 25km off Jafarabad. The Project will bring the vast experience of offshore wind from the European market to India and will set up a knowledge centre in the country. FOWPI will be led by COWI A/S (Denmark) with key support from WinDForce Management Ltd. (India). The project is prepared in cooperation with the European Union (EU), the Ministry of New and Renewable Energy of India (MNRE) and the National Institute of Wind Energy- India (NIWE). The project is awarded under the Indo-European co-operation on Renewable Energy Program and funded through the European Union. Contract: No 2015/368469.

The FOWPI project will provide technical assistance for preparation of the first offshore windfarm through design and technical specification of the wind farm including foundations, electrical network, wind turbines etc. This will also include specific technical studies for the selected site, including coastal surveys, environmental assessments, cost-benefit analysis, transmission layouts, monitoring systems, safety measures, and other relevant technical studies as identified. All to be used as advisory material by a wind farm developer considering investing in the project.

PROJECT NO.
A095757

ASSESSMENT OF BIOMASS-TO-ENERGY OPPORTUNITIES IN SUB-SAHARAN AFRICA

COUNTRY
Kenya, South
Africa, Ivory
Coast (region d)

PERIOD
2017 - 2017

CUSTOMER
World Bank/IFC

CONSULTANCY
EUR 238.058

This study assessed the potential to use agriculture, forest, and agri-industry biomass for bioenergy production (thermal and gaseous) in Kenya, South Africa and Côte d'Ivoire. The project was part of the overall IFC project on Energy & Resource Efficiency Solutions in Sub-Saharan Africa (ENRES). ENRES works with companies as well as sector-level aggregators to catalyze the uptake and use of resource efficiency and clean energy solutions that will help reduce the use of energy, water as well as other resources, thereby increasing the competitiveness and performance of companies in the manufacturing, agribusiness and services sectors, while also leading to reduced greenhouse gas (GHG) emissions.

The objective of the assessment was to identify the potential use of agricultural biomass for thermal and electricity generation in three Sub-Saharan African countries at the country level and at the agricultural clusters level. The assessment sought to:

1. Identify the major biomass types, quantities, and current and potential uses;
2. Identify key industry players, anchor companies and major clusters within priority countries, their energy consumption, produce output, energy supply shortfalls and the size of the energy demand gap; and
3. Identify conversion technologies (appropriate to Sub-Saharan Africa) that can be used to utilize the available biomass resources for thermal and/or electricity generation and indicative costs associated with these conversion technologies.

Biomass categories to be considered under this assessment included residues from agricultural crops, food and crop processing wastes, livestock manures, orchard and vineyard residues and forestry

residues (including mill and wood processing residues). For purposes of this assessment, no municipal wastes or dedicated biomass energy crops were to be considered.

COWI's services comprised overall project management, including:

- i. Identification of the major agricultural biomass clusters within the selected countries;
- ii. Review and characterization of the biomass resources available in these clusters;
- iii. Estimation of the gross, technical and economic agricultural biomass potential;
- iv. Identification of feasible biomass conversion technologies and economic/cost evaluation of these technologies;
- v. Field interviews with industry stakeholders and anchor companies to validate biomass potential and conversion technologies findings and options;
- vi. Identification of potential business or project development opportunities; and
- vii. Identification of any technical, institutional and, regulatory barriers (deficiencies) for the development and implementation of biomass-to-energy projects and realization of the identified economic potential.

PROJECT NO.
A099193

COUNTRY
Sweden

PERIOD
2017 - 2021

CUSTOMER
Mälarenergi AB

CONSULTANCY
EUR 2.600.000

NEW BIOMASS FIRED PLANT - BLOCK 7

The project comprised establishment of a new CHP plant (Block 7) for Mälarenergi - a regional utility company.

THERMAL INPUT: 165 MW

FLUE GAS OUTPUT: 30 MWheat

DISTRICT HEATING OUTPUT: 97 MWheat

POWER OUTPUT: 53 MWpower

FUEL: Recycled wood as main fuel with possibility for forest residues and wood by-products

INCINERATOR TYPE: Circulating fluidized bed

THROUGHPUT: 220 000 t/a

As owner's engineer COWI's services comprised:

- Civil & Structural detail design of all foundation work and all concrete structures, including pre-studies

- Assistance in project management and technical advice on preparation of a project definition brief, tender document, contract and follow-up during construction.