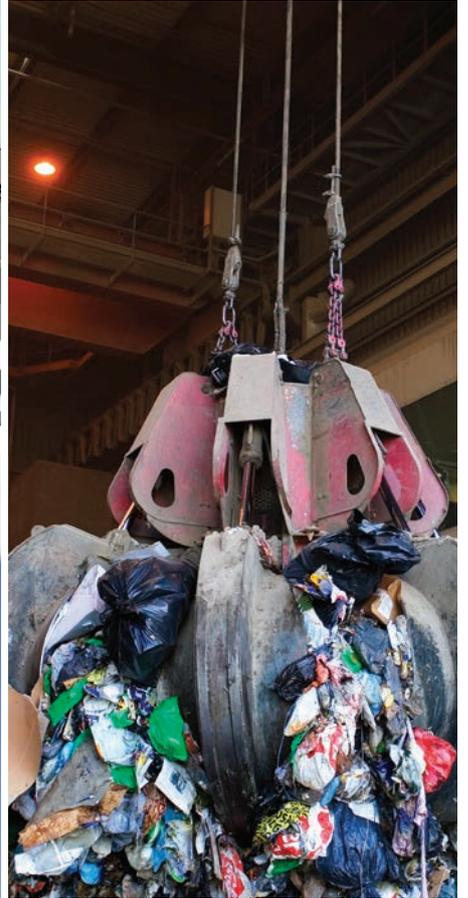


WORLD CLASS CONSULTANCY

# ENERGY FROM WASTE





### 15 TON/H WTE PLANT IN NORWAY

Municipal Solid Waste generation in the Bergen Region had been increasing for years and the capacity of the existing waste-to-energy plant serving the Region had reached its limits. The waste management company BIR in Bergen consequently decided to build 15 ton/h new plant capacity to meet the needs of the future. The new plant started operation in 2010; it meets the latest environmental standards (BAT) and is furthermore prepared for future technical standards. COWI assisted the Client as main consultant, from initial planning through design, procurement, construction, commissioning, guarantee tests, hand-over, and warranty period supervision.

## A LEADING CONSULTANT IN ENERGY FROM WASTE

The increasing focus on climate change calls for new sustainable solutions. Energy from Waste is one of them. Energy from Municipal Solid Waste (MSW) substitutes fossil fuels and thus reduces CO<sub>2</sub>-emission to the atmosphere.

COWI is a large international multidisciplinary consultancy with a worldwide staff of more than 6,000, with headquarters in Denmark and offices and operations in several countries worldwide. COWI is among the largest global waste management consultants, with complete expertise in Energy from Waste. COWI has implemented a substantial number of successful energy projects over the years.

COWI Thermal Power is a team of experts ready to assist our clients during the whole project, from planning to implementation, and throughout the entire plant life.

COWI has comprehensive experience in thermal conversion of waste. This includes combustion in traditional boilers and the most advanced systems for gasification. We have assisted Clients in numerous projects for combined heat and power plants, but also for boiler units producing steam for industrial purposes. All these plants use Municipal Solid Waste for fuel and some also burn Refuse Derived Fuels (RDF) or biomass.

COWI specialists have wide international background including working experience from a number of countries and regions in Europe, Asia, Africa and the Americas.



Architects: Friis & Moltke

## PROJECT DEVELOPMENT

The development of a Waste to Energy (WtE) project is complex and requires careful preparation. The development of the project including all necessary planning and environmental permits from the Authorities may take as much as 1-3 years depending on location, financing and procurement, so the initial costs can be quite high.

It is therefore of utmost importance to know the route to follow and the barriers and constraints that need to be managed so the final result both meets all technical requirements and is financially viable.

A conceptual plant design and a bankable feasibility study are usually the first steps before beginning the procurement. The conceptual design identifies the technical feasibility of the project and stipulates a budget for capital (CAPEX) and operational (OPEX) expenditures.

CAPEX and OPEX form the basis for preparation of the bankable feasibility study. This study evaluates the project financially and serves as the foundation for securing internal and external financing.

Projects procured under a PPP-contract (Public-Private-Partnership) require special services from your Transaction Advisor. Detailed knowledge of the market and the potential service providers must be combined with technical design and operating experience, and complemented with legal and financial acumen. COWI offers advice based on hands-on PPP experience in energy projects, e.g. from the Dublin Waste to Energy Project, a major PPP-project in the waste management sector.

### 2 X 35 TON/H PPP PROJECT IN IRELAND

COWI, in a J.V. with an Irish consultant was Dublin City Council's Transaction Advisor for the development of this WtE project into a Public-Private-Partnership between the City and a major international operator. The plant will have a capacity of 550,000 TPA to be incinerated in two lines; each of 35 ton/h. Process optimisation enables a net electrical output over 60 MW with an electrical efficiency of approx. 29%, which is among the highest in the world for WtE. The Transaction Advisor assessed alternative technologies and carried out PPP procurement, contracting, complete Authority applications, and close monitoring of operator's choice of technology, acceptance of the basic design, etc. In late 2014, all statutory permits were confirmed and finance secured, allowing construction to start. Operation was commenced in 2017.



## 8 TON/H WTE PLANT IN NORWAY

COWI assisted the Client, FORUS ENERGIGJENVINNING 2 in Stavanger, in the detailed planning and procurement, follow-up and supervision during construction, commissioning, and hand-over of a new unit at the FORUS facility. The plant has a nominal capacity of 8 ton/h at a lower heating value (LHV) of 11 GJ/ton, corresponding to an annual capacity of approximately 65,000 tons. It started operation in 2013 and generates approx. 4.3 MW of electricity and up to 16 MW district heating.

# DESIGN AND PROCUREMENT

COWI will lead the design and procurement process for your new Waste to Energy project, including initial planning and design, followed by technical and commercial tender specifications. The procurement may start with a prequalification phase followed by invitation to tender, evaluation of the bids received, and negotiations and contract finishing with the preferred bidder. We will then supervise the design and construction, start-up and commissioning, followed by trial run and guarantee tests. COWI is experienced in international standards such as FIDIC.

In most cases, turnkey or EPC (Engineer-Procure-Construct) type contracts have been developed and concluded successfully. In other situations, our customers have entrusted us with carrying out the detailed design and split-package procurement for the complete plant and the attached infrastructure, such as district heating and/or cooling systems. Following the appointment of a turnkey contractor or split-package suppliers, COWI will conduct design reviews to ensure that the supplier fulfils his contractual obligations in terms of quality, time and costs.

During the manufacturer's design phase, COWI's operation and maintenance experience is a very important factor in detecting specific problems, e.g. by reviewing the supplier's layout drawings and P&I diagrams. Factory and site tests /inspections are other integral parts of our QA-system when planning new facilities.

COWI uses the well-known design tool THERMOFLEX in the plant design, establishing heat and mass balances and conducting control of suppliers' guarantee information



## EXECUTION AND COMMISSIONING

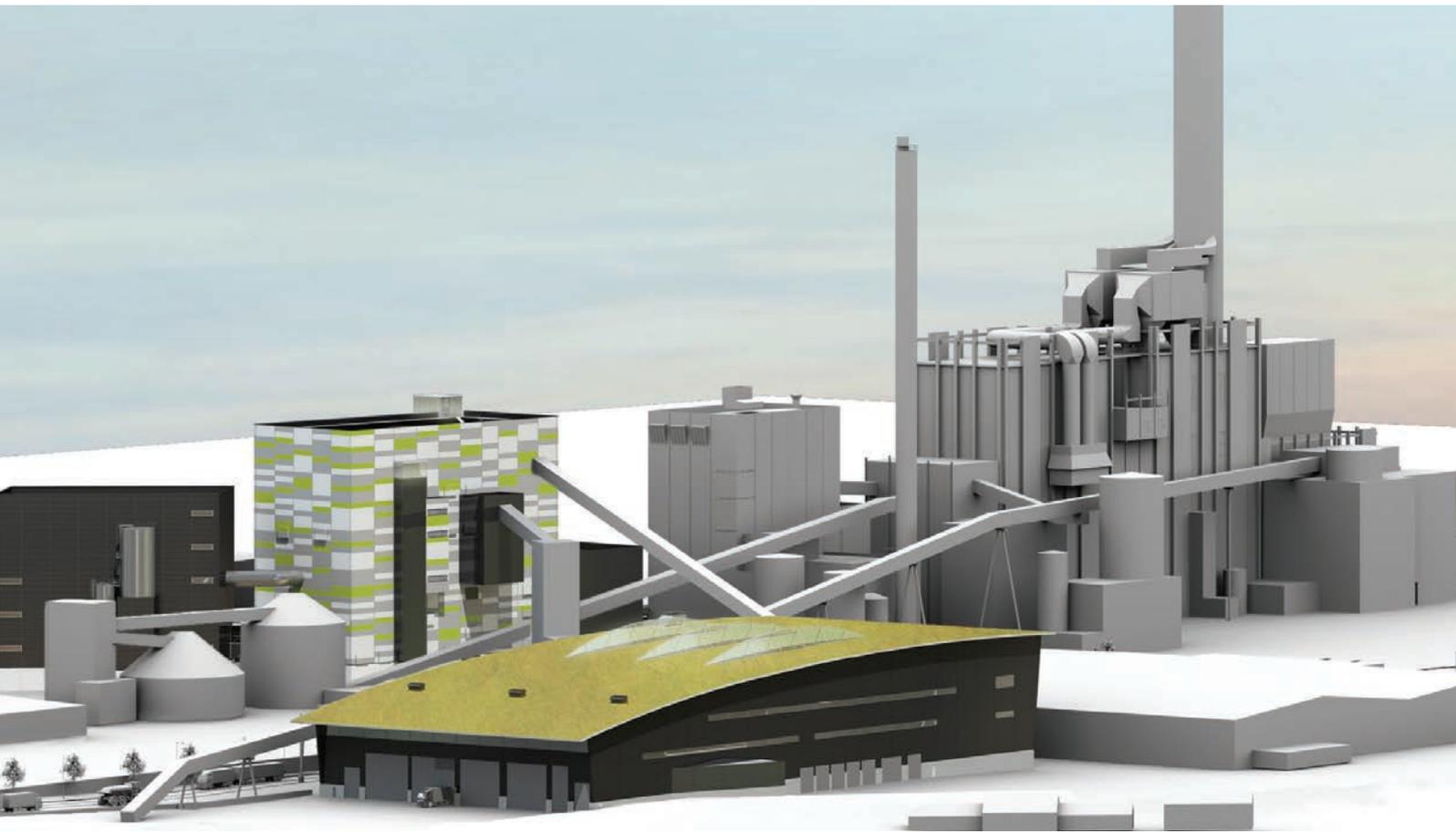
Plant commissioning, including training the staff and giving it ownership of the project, are very important factors for the future success of the plant. It is COWI's experience that energy plants need special consideration during this phase.

One of COWI's unique services is to provide experienced engineers for planning and supervision of the plant commissioning and to work hand-in-hand with the future staff and the original equipment suppliers during training and commissioning.

In this way, the project benefits from lessons learned in other projects. Furthermore, the temporary employment of one or more experienced operating engineers from COWI can mitigate the need for increased staff during the plant's early operation.

### REFURBISHMENT OF VESTFORBRÆNDING WTE PLANT IN COPENHAGEN

Vestforbrænding in Copenhagen is Denmark's largest WtE plant, treating annually 600,000 tons of MSW. In 2013, COWI as general consultant, assisted Vestforbrænding in the planning and procurement for a major overhaul and upgrading of the 32 ton/h Line 5, commissioned in 1998. This included new Inconel membrane walls, new water-cooled wear zone above the grate, new bottom ash system and fly ash conveying system, and new bag-house filter system. In 2014, COWI again assisted Vestforbrænding in the planning and procurement for a major boiler repair and improvement for Line 6, commissioned in 2004. This included replacement of a large part of the first boiler pass with new Inconel membrane walls.



### 167 MW RDF AND BIOMASS CFB PLANT IN SWEDEN

The MälärEnergi Utility in Västerås near Stockholm has installed the world's largest circulating fluidised bed (CFB) boiler for waste to burn approx. 400,000 TPA. The main fuel is RDF (refuse derived fuel), supplemented with biomass (peat and wood chips) as necessary. The new boiler produces approx. 135 MW energy as 75 bar/470 °C high-pressure steam that drives a 48 MW turbine/generator. Low-pressure steam is extracted to supply hot water district heating. COWI assisted MälärEnergi as overall project manager and carried out detailed design for buildings, boiler plant, turbine/generator plant, fuel preparation, and storage and handling systems. The new unit started operation in late 2014.

## OPERATION, MAINTENANCE AND OPTIMISATION

COWI staff has extensive experience in the commissioning and operation of energy plants and we are able to assist you in planning of maintenance and in the improvement of existing facilities with new flue gas cleaning or heat recovery systems.

Flue gases from a Waste to Energy plant contain substantial heat in the form of hot vapours. COWI has realised additional heat recovery based on flue gas condensation and heat pumps in several plants. This extra energy substantially increases the district heating output of the facility. Based on this experience, we can assist you in selecting the most suitable solution for your plant configuration.

Integrating a heat recovery system may improve the thermal efficiency to nearly 100% based on the lower heating value (LHV) of the fuel.

When environmental standards are intensified, COWI can assist the plant owners in meeting the new demands. We are very experienced in refurbishing existing facilities with new Air Pollution Control equipment and we have hands-on experience with all major flue gas cleaning technologies, heat recovery and emission measuring systems.



## ADVANCED TECHNOLOGIES

In addition to our experience in mass burning of waste, COWI offers a unique experience in other waste-to-energy technologies, such as gasification. We show a few examples below.

COWI assists the Danish Maabjerg Energy Concept Consortium (MEC) in developing its integrated energy system. This project comprises 2nd generation bioethanol production, based on 250,000 TPA wheat straw, production of biogas based on molasses from the ethanol production, and energy production in a refurbished CHP plant. The CHP plant will burn lignin pellets, also a by-product from the ethanol production. The project finally includes gasification of municipal solid waste using the DONG Energy REnescience technology.

MEC is a consortium of five partners: Two local utilities (Vestforsyning and Struer Forsyning), a waste handling company (NOMI), Novozymes (provider of enzymes), and DONG Energy (national energy utility).

COWI assisted MälarEnergi in Sweden in the implementation of the world's largest fluidised boiler for Refuse Derived Fuel (RDF). The boiler has a thermal capacity of 167 MW and started operation in 2014.

Furthermore, COWI has been involved in the gasification of biomass, e.g. a 20 MW project in Denmark with gasification of wood pellets and a project in South Africa involving small scale gasification.

### 115.000 TPA WASTE MANAGEMENT PROJECT IN SRI LANKA

COWI provided consulting services for a waste management project in Colombo in Sri Lanka. The project includes a waste segregation/sorting plant, a biogas plant to handle the organic part of the waste and a 16 ton/hour Waste-to-Energy plant. COWI assisted with strategic advice on financial, commercial and technical aspects in the development and implementation phase of the project. The plant is expected to enter into commercial operation in 2020.

## OUR SERVICES COVER:

### PROJECT DEVELOPMENT

- › Pre-feasibility and Feasibility study
- › Environmental Impact Assessment (EIA)
- › Conceptual design and specification
- › Technology evaluation
- › BAT (Best Available Technology) assessment
- › Procurement plan
- › Technical, environmental and economic due diligence
- › Statutory process
- › Economy, finance and organisational set-up

### DESIGN AND IMPLEMENTATION

- › Design of mechanical, electrical, and civil works – at turnkey or detail level
- › Pre-qualification
- › Procurement including technical specification according to FIDIC and other international standards
- › Bid evaluation and contract negotiation
- › Progress monitoring
- › Quality control including shop inspections
- › Construction management and supervision
- › Commissioning, including start-up, guarantee testing and handover

### OPERATION AND MAINTENANCE

- › Support during the guarantee period
- › Optimisation of existing plants
- › Support for operation and maintenance
- › Education and training of operation and maintenance staff
- › Planning of scheduled maintenance

### SPECIAL CONSULTING SERVICES

- › Handling, treatment and disposal of residual products
- › Optimisation and improvement of monitoring and control instruments and systems (DCS/SCADA)
- › Environmental management including 'Green Reports'
- › Life cycle and climate analyses
- › Energy planning
- › District heating and cooling systems
- › Waste Management

# COWI OFFERS YOU STATE-OF-THE-ART EXPERTISE IN ALL ASPECTS OF WASTE TO ENERGY



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