

**WASTE-TO-ENERGY PLANT**

# Amager Bakke / Copenhill Copenhagen, Denmark



**Copenhagen's state of the art plant sets new standards for environmental performance, energy production and waste treatment. Innovative technology and architecture integrate to form a future in which waste-to-energy plants are welcomed in any backyard.**

In year 2017, Copenhagengers and visitors will witness a waste-to-energy plant that is not only one of the best performing European plants in terms of energy efficiency, waste treatment capacity, and environmental consideration, but also in terms of visual rendition and local acceptance.

The plant, Amager Bakke, is being constructed by Amager Ressourcecenter, owned by five Danish municipalities. Amager Bakke will be equipped with two furnace lines and a joint turbine- and generator system. The plant replaces a 45-year-old plant with four furnace lines.

By 2017 Amager Ressourcecenter will run a plant that burns 2 x 35 tonnes of waste per hour.

Altogether the plant will:

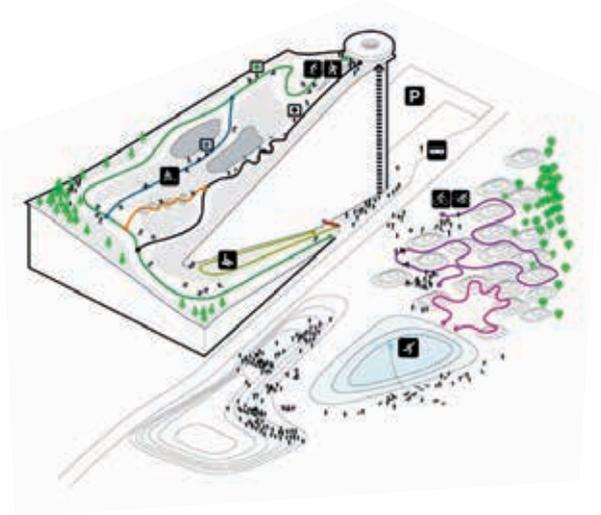
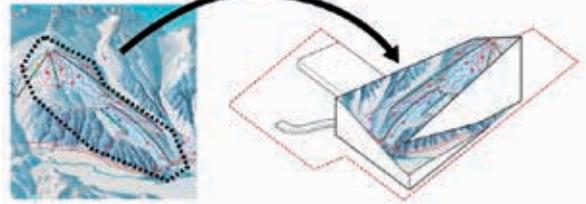
- Treat around 400,000 tonnes of waste annually produced by 500,000–700,000 inhabitants and at least 46,000 companies.
- Supply a minimum of 50,000 households with electricity and 120,000 households with district heating.
- Have steam data at 440 degrees and 70 bars which doubles the electrical efficiency compared to the former plant.

In addition to the technological merits, the plant's architecture includes a roof-wide artificial ski slope open to the public.

We have been contracted to supply the entire combustion system from crane through feeding, DynaGrate® and boiler, to ash handling, as well as a particle and NOx-reduction system.



Source: BIG



*Amager Bakke features a artificial ski slope inspired by the ski slopes in the Alps.*

## Taking technology further

"It is a multi-purpose plant that is already catching the eyes of the world because of its local appeal. The plant provides energy and waste treatment, and will be an architectural landmark and a leisure facility. The novelty of the project is the combination of ingenious technology and innovative architecture in a project dedicated local community," says Ole Hedegaard Madsen, Director of Technology and Marketing at Babcock & Wilcox Vølund.

Project Manager, Lars Juel Rasmussen, at Amager Resourcecenter also sees the future plant as a showcase for Danish innovative technology.

"The plant stands out in terms of environmental considerations, energy production, and its working environment. It is also located near the airport and just five kilometers from Copenhagen's Town Hall Square, so we're not just talking about an industrial installation, but a landmark of the Danish capital, as well," the Project Manager comments.

### Energy efficient – clean air plant

Lars Juel Rasmussen is proud to build a plant that utilizes more than 100% of the fuel's energy content, has a 28% electrical efficiency rate, reduces sulphur emissions by 99.5%, and minimizes NOx emissions to a tenth, compared to the former plant. The NOx-reduction is enabled due to a flue gas cleaning technology, Selective Catalytic Reduction (SCR), which we will install in cooperation with the catalyst manufacturer Haldor Topsøe. This is the first installation of SCR in a Danish waste-to-energy plant. Hence, ski enthusiasts need not to worry about the air quality at the slope on the operating plant.

"State of the art technology at Amager Bakke has an incredibly high environmental performance. Not least because the plant makes full and efficient use of the energy contained in the waste. It is possible to process all types of waste as fuel and still obtain a high level of energy recovery. For instance, we are able to use the organic fraction contained in the waste very efficiently," says Ole Hedegaard Madsen.

# A DynaGrate® at heart

## Water-cooled dynamics make the difference

The ever innovative technology of the DynaGrate® is unique in its fuel flexibility, optimized combustion and minimal maintenance cost. All due to the mechanical design and optimised the water-cooling system.

## Fuel flexibility

The mechanical design of the DynaGrate® is developed in response to the general waste-to-energy plant vulnerability to e.g. metal contents in waste. Today, plant operation is not interrupted by melting metals. Further, the mechanical break-up of the waste layer on the grate results in thorough agitation and superior combustion conditions. The water-cooling system allows high heating values that are vital to fuel flexibility. Together, the water-cooling and mechanics result in high plant efficiency and excellent burnout of the waste, evident for example from very low TOC values (around 0.2%) in bottom ash.

## Optimized combustion

Since the water-cooled optimised DynaGrate® is not dependent on air cooling, full control of the primary combustion air is reached. This means that the combustion process can be optimised in order to e.g. reduce the NO<sub>x</sub> formation at the source. B&W Vølund tests operating at oxygen levels around 4.5 – 5% show NO levels in the range of 200–250 mg/Nm<sup>3</sup>. This is before the flue gas reaches the SCR filter. Moreover, low excess air result in less flue gases thereby reducing the stack loss and power consumption for the fans.

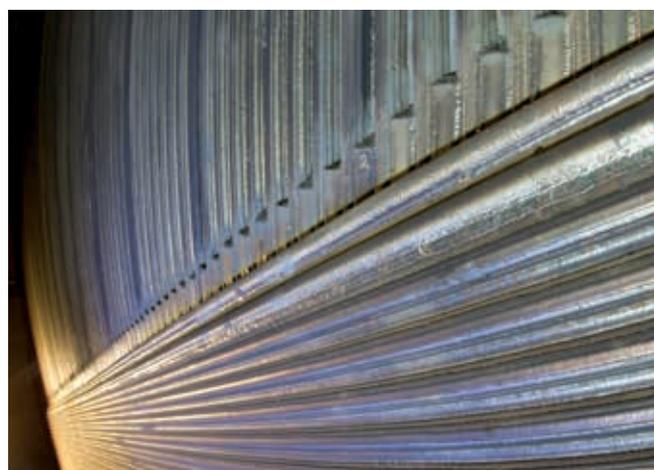
Besides low raw NO<sub>x</sub> emission, our CFD designed over-fire system VoluMix™ reduces CO and TOC to a minimum. Volumix™ injects secondary air into the combustion zone – with a complete burnout in the gas phase.

## Minimised maintenance cost

The DynaGrate® reduces maintenance cost because the entire cooling system is well integrated and protected in the steel shaft. There are no sensitive hose connections inside the furnace. Damages due to grate siftings, melting tin, aluminium, and the like are efficiently prevented. The driving mechanism is situated outside the furnace which means that the mechanism is not exposed to an aggressive environment and offers easy access for maintenance. Finally, the mechanical set-up secures that movable grate parts are not in contact, thereby reducing wear and tear of the grate.



DynaGrate®



*The water-cooled wear zone consists of a number of heavy steel tubes covered with Inconel®. The cold surfaces prevent build-up of slag and thereby operation problems.*

*The new wear zone is connected in natural circulation with the boiler drum and constitutes an integrated part of the boiler. This coupling increases the overall efficiency of the plant.*

**The Babcock & Wilcox Vølund contribution to Amager Bakke:**

- Crane
- Feeding system with hopper
- DynaGrate® with water-cooled wear zone
- Boiler
- Ash system
- Electrical system
- Electrostatic precipitator (ESP) for the reduction of particles in the flue gas
- Selective catalytic reduction (SCR) for reduction of NOx emissions
- Economiser for cooling of flue gas
- Combustion control system

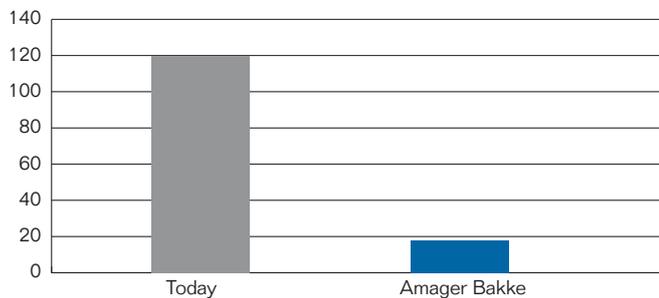
Amager Ressourcecenter is owned by the Danish municipalities of Dragør, Frederiksberg, Hvidovre, Copenhagen, and Tårnby.



Picture from the contract signing. From left: Ulla Röttger, CEO at Amager Ressourcecenter, Mogens Lønborg, Chariman of the board at Amager Ressourcecenter, and John Veje Olesen, CEO at B&W Vølund.

## Clean air plant

Reducing emissions by 85–99.9%



NOx emissions reduction (mg/m3)

Plant design data (per line)		
Process parameters	Guaranteed Values*	Units
Waste capacity	35	t/h
Heat value, lower	11.5	MJ/kg
Steam output	141.1	t/h
Steam temperature	440	°C
Steam pressure	70	bar
Boiler outlet flue gas temp.	160	°C
Feed water temperature	130	°C

Flue gas values: After cleaning	Guaranteed Values*	Units
NOx**	15	mg/ Nm <sup>3</sup>
CO***	50	mg/ Nm <sup>3</sup>
NH3**	3	mg/ Nm <sup>3</sup>
TOC	5	mg/ Nm <sup>3</sup>

\* All values refer to 11% O2 dry gas

\*\* 24-hour average

\*\*\* Half-hour average

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