



REFUSE COLLECTION · ENERGY · INCINERATION · WASTE

## REFA WASTE-TO-ENERGY PLANT

FROM WASTE TO ENERGY



REFA WASTE-TO-ENERGY PLANT  
- A FACILITY FOR WASTE INCINERATION  
AND ENERGY GENERATION

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# REFA WASTE-TO-ENERGY PLANT

## - A HIGH-TECH FACILITY

REFA in Nykøbing Falster, Denmark produce energy based on waste. The Waste-to-Energy Plant is doing both electricity and hot water. The hot water is used to heat buildings in Nykøbing Falster.

The Waste-to-Energy Plant consists of two hot-water producing incinerator lines, which were commissioned in 1983 as well as a new high-tech CHP line commissioned in late-1999. The incinerator lines are subject to ongoing modernisation.

**LINE 3** – the CHP line – is operational year round – apart from one month during the summer when the facility is checked for wear and prepared for a new heating season.

**LINES 1 AND 2** – the hot-water producing furnace lines – are operational during the heating season; in addition, they have a back-up function for the CHP line in connection with emergency stoppages and repairs. The facility is under 24/7 monitoring by 2 operators.





# FROM WASTE TO ENERGY

THE THREE INCINERATOR LINES PROCESS JUST  
OVER 115,000 TONNES OF WASTE PER YEAR

Waste is delivered by REFA's partnership municipalities (Lolland Municipality and Guldborgsund Municipality) and by other Danish waste processing companies. The waste, which is delivered by more than 24,000 vehicles a year, is weighed and recorded.

The waste has been pre-sorted, so that only waste suitable for incineration is tipped into the 3,600 m<sup>3</sup> waste silo, which holds approx. 2,000 tonnes of waste. During the heating season, approx. 450 tonnes of waste is processed per day on the three incinerator lines. Annually, the total waste incineration generates 185 GWh of heat, equalling the consumption of approx. 11,000 households; in addition, 50 GWh of power is generated, equalling the consumption of approx. 10,000 households.



# PLANT DATA

POWER GENERATION CORRESPONDS TO THE ELECTRICITY CONSUMPTION OF 10,000 HOUSEHOLDS, WHILE HEAT GENERATION CORRESPONDS TO THE HEAT CONSUMPTION OF 11,000 HOUSEHOLDS

## TECHNICAL DATA - LINE 3, CHP LINE

Incinerator capacity	9 tonnes/hour
Total output	30 MW
Steam temperature, boiler	400 °C
Steam pressure, boiler	40 bar
Power output	6.7 MW
Heat output	18.9 MW
Incineration temperature	1,100 °C

## TECHNICAL DATA - LINES 1 AND 2, HOT WATER (STATED PER LINE)

Incinerator capacity	4 tonnes/hour
Total output	10 MW
Heat output	8.5 MW
Incineration temperature	1,100 °C

## HEAT AND POWER GENERATION

Power generation	50 GWh/year
Heat production	185 GWh/year



# PROCEDURE

## WASTE DELIVERY

Waste is delivered on trucks, which – after weighing and recording – go to the discharge centre, where the waste is tipped into the waste silo. A crane is used to lift the waste into the feeding funnels of the incinerators.

## INCINERATOR/BOILER SYSTEM

Lines 1 and 2 have a capacity of 4 tonnes/hour, while line 3 has a capacity for 9 tonnes/hour. When designing the incinerators, the fact that the calorific value of the waste varies considerably during daily operation has been taken into account.

All three incinerator lines feature moving grates that carry the waste through the incinerators while the waste is being incinerated. The incinerated waste remains are removed from the bottom of the incinerators in the form of incineration residue. The hot flue gas is conducted through the boiler, where the heat is released into the boiler water.

## TURBINE/ALTERNATOR SYSTEM

The scorching steam from the CHP line (Line 3 only) is conducted to the turbine system, which converts the energy at 10,200 RPM into a mechanical force; in the alternator, this force is converted into electricity. The electricity generated is sold directly to the power grid.

## CRM SYSTEM

From the control room, operating staff monitor the three lines 24/7 via an advanced control, regulation and monitoring system (CRM).





# FLUE GAS PURIFICATION SYSTEM

## ENERGY AND CLEAN AIR

When the flue gas has released its heat to the boiler water, it is conducted to the flue gas purification system for removal of a number of air-pollutants generated in the waste incineration process.

The gas from the CHP line is first conducted to a reactor tank (GSA) in which lime is injected. The lime reacts with the acidic gases of the flue gas (sulphuric acid, hydrochloric acid, etc.). Ash, reaction powder and excess lime are sorted out into a subsequent bag filter. Following purification, the flue gas is conducted to the chimney.

The gas from lines 1 and 2 is also conducted to a reactor tank in which lime is injected; however, in this system the ashes, excess lime, etc., are sorted out into an electronic filter, following which the flue gas is conducted to the chimney. Annually, 900 tonnes of lime and 20 tonnes of active carbon are used to purify and neutralise flue gases.



# ENVIRONMENT

## THE THREE INCINERATOR LINES ALL COMPLY WITH APPLICABLE ENVIRONMENTAL REQUIREMENTS

REFA has no problems about living up to the joint European emission requirements. Consequently, we are in compliance with requirements concerning flue gas purification in regard to dust, dioxin, sulphur compounds, acids, mercury and other heavy metals.

With advanced flue gas purification, the flue gas is clean – very clean – and much cleaner, e.g. than the smoke coming from oil burners or wood-burning stoves. If only three households burn their household waste in a barrel in their backyard, the dioxin emission is just as high as from REFA's Waste-to-Energy Plant – a plant that processes the waste of the 55,000 households in the area. The total discharge of dioxin from the plant is around one hundredth of a gram (0.01 grams) – in a whole year. To minimise water use in the plant, rain water is collected in a basin for subsequent use in the process.

The Waste-to-Energy Plant's environmental impact is monitored continuously by means of three separate environmental measuring stations. For every ten seconds – round the clock, all year – eight parameters are measured that are significant in regard to emissions. These measurements are subject to a special quality system to ensure the reliability of the continuous measuring results. In addition, a number of samples are taken each year by impartial, accredited environmental laboratories

**DIOXIN EMISSIONS**  
THE BURNING OF WASTE  
FROM THREE HOUSEHOLDS  
IN THEIR BACKYARD = THE SAME  
EMISSION AS THE BURNING OF WASTE  
FROM 55,000 HOUSEHOLDS  
AT THE CHP PLANT





REFA IS OWNED BY LOLLAND MUNICIPALITY AND GULDBORGSUND MUNICIPALITY. REFA OPERATES A WASTE-TO-ENERGY PLANT, A BIOMASS PLANT, ENVIRONMENTAL CENTRES, BIOLOGICAL COMPOSTING STATIONS, A RELOAD STATION AND RECYCLING STATIONS ON THE ISLANDS OF LOLLAND AND FALSTER

# REFUSE COLLECTION, ENERGY, INCINERATION, WASTE

REFA IS AN INTER-MUNICIPAL WASTE COMPANY OWNED BY THE TWO MUNICIPALITIES IN THE ISLANDS OF LOLLAND-FALSTER.

## REFA OWNS AND OPERATES:

- Waste-to-Energy Plant (waste incineration, energy generation)
- Reloading station (collection point for refuse collection services)
- Environmental centre Hasselø (deposit and sorting venue)
- Environmental centre Gerringe (deposit and sorting venue)
- Bio-compost facility (composting of straw, branch waste and sludge)
- Biomass facility (production of energy from biomass)
- Collection scheme for refuse collection and bulky waste
- Recycling sites
- In addition, a number of collection schemes for special waste

REFA processes approx. 300,000 tonnes of waste per year and employs 115 people. The Waste-to-Energy Plant alone employs 24 people. REFA is co-owner of Special Waste System A/S, which owns such facilities as a special incineration facility in Nørre Alslev for the processing of chemical waste and hazardous clinical waste from much of Denmark.



# REFA WASTE-TO-ENERGY PLANT

LINE 3, CHP LINE  
CROSS-SECTION OF THE BUILDING





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