Thermal Waste Treatment in Europe

Progress in Technology and Construction of Thermal Waste Treatment Facilities in Europe

Seminar on Thermal Waste Treatment

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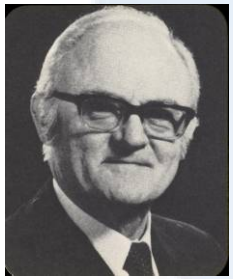
1. Introduction

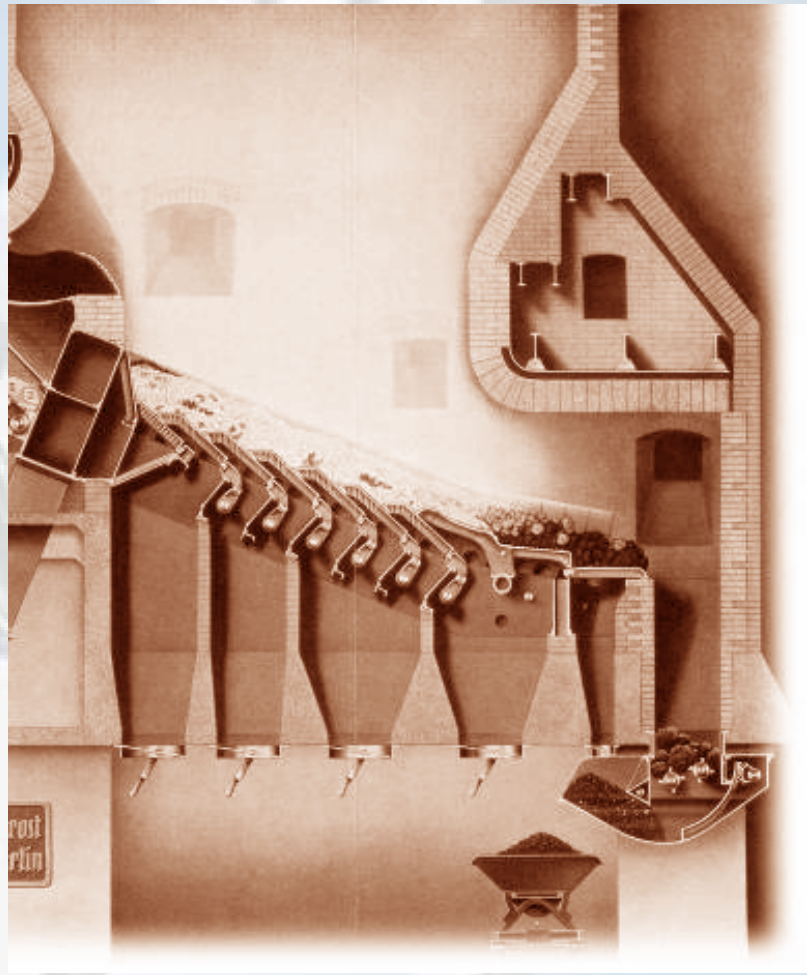
- **Building of Waste-to-Energy plants (new, extension, major overhaul) has been quite steady**
- **The center of activity though is shifting from one country to another**
- **Strong focus lately is on higher usage of the energy recovered from incineration**
- **Incineration of high-cal waste (>> 10 MJ/kg) is more in demand**
- **Many projects have been for 'large' units (> 80 MW, th)**
- **Technology choice today is dominated by well-proven grate technology**

2. MARTIN GmbH: Tradition and progress since 1925

- **Family owned in third generation**
- **Concentrated on one product**
- **From engineering provider to turnkey contractor**
- **Entirely independent**
- **Technologies proven since decades**
- **Large experience base (close to 680 lines installed)**
- **Strong development activity**
- **References and contacts worldwide**



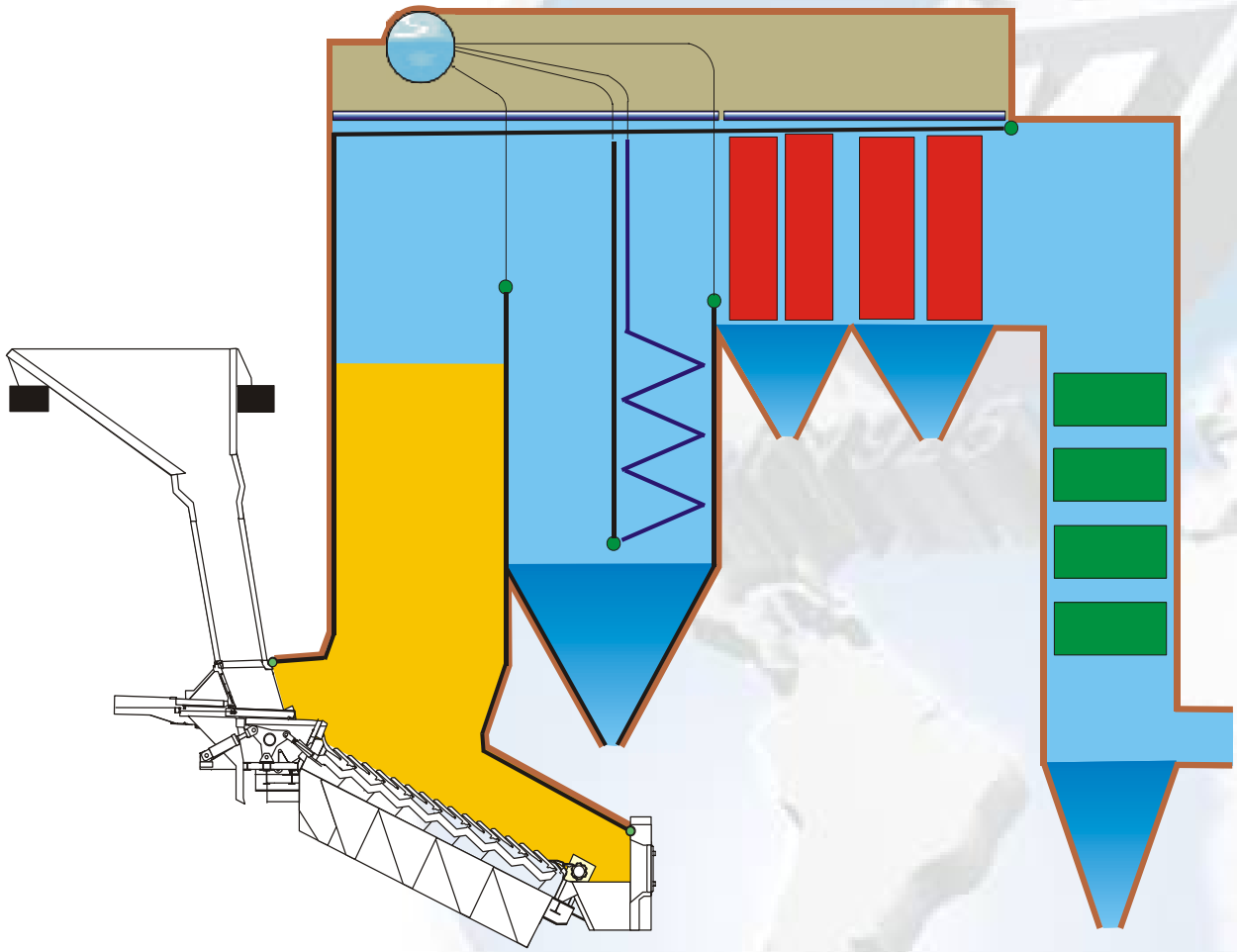


3. Combustion technology

- **As described, technology choice today is dominated by grate technology**
- **This can be forward-pushing, reverse-acting or roller type grate**
- **All these technologies have a long and successful track record**
- **They can be adapted to a great variety of waste properties (heating value, ash and water content, 'raw'or pretreated etc)**
- **Sewage sludge, medical waste and other waste fractions can be co-incinerated within certain limits**

Combustion system / Boiler

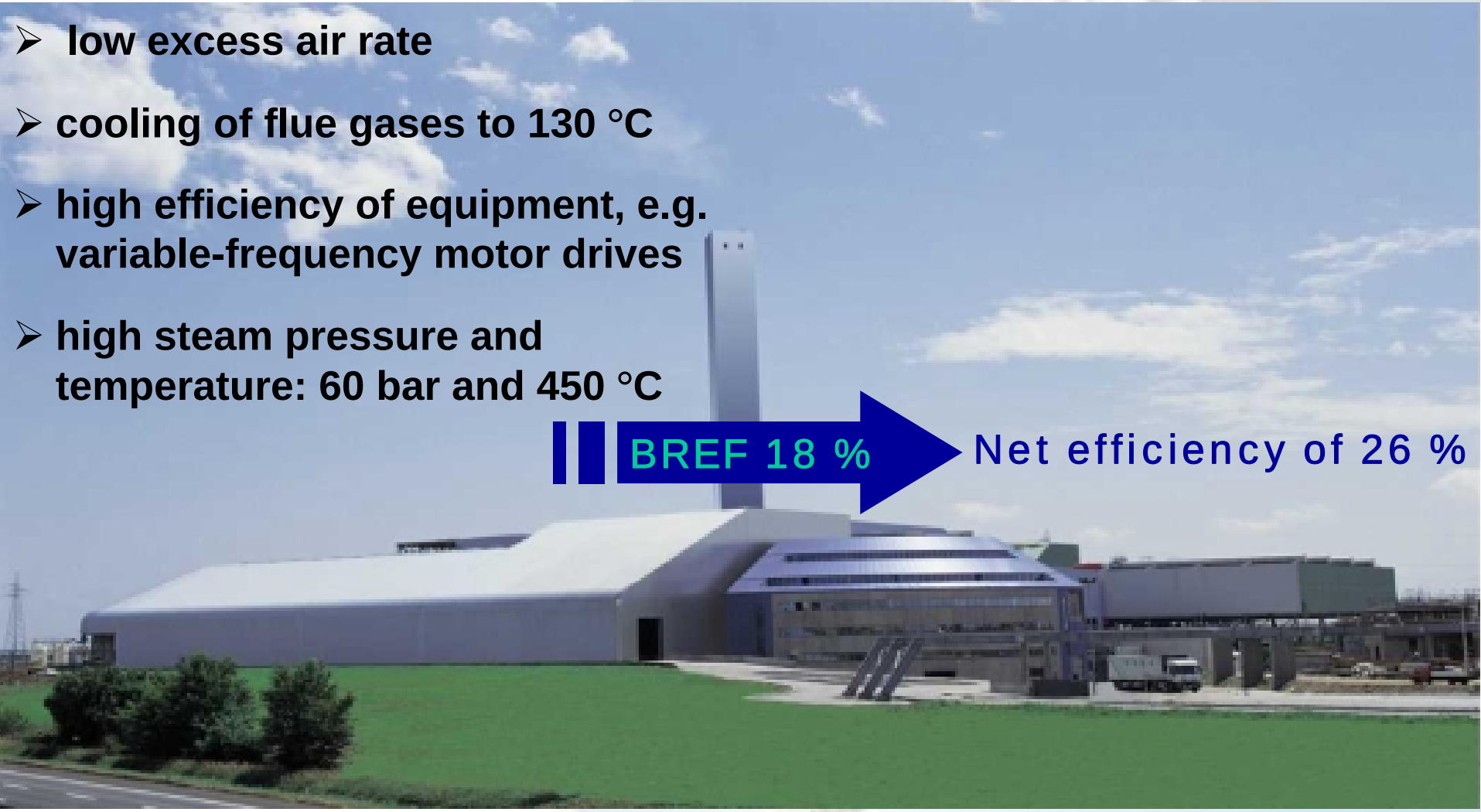


4. Increase energy efficiency

- **There is a big push to increase the usage of the energy recovered from waste incineration**
- **Waste Incineration (WI) => Waste-to-Energy (WtE) => Energy from Waste (EfW)**
- **The efficiency of electricity production can be increased**
- **Combined Heat and Power (CHP) schemes are mainly applied in northern Europe**
- **First installations for district cooling are in planning**
- **New developments are also under way**

Higher electrical efficiency

Optimized conventional type
- Brescia concept -



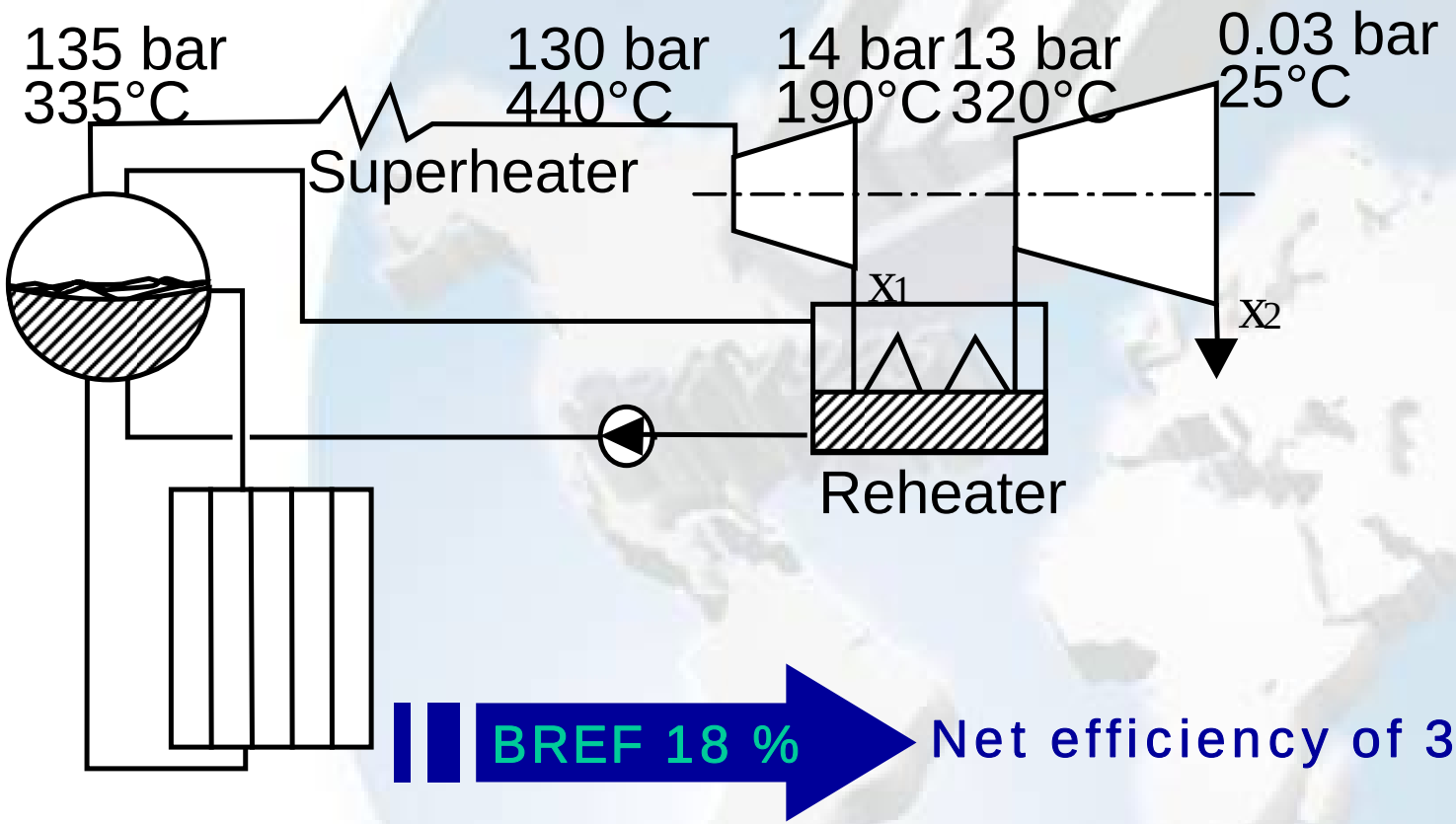
- **low excess air rate**
- **cooling of flue gases to 130 °C**
- **high efficiency of equipment, e.g. variable-frequency motor drives**
- **high steam pressure and temperature: 60 bar and 450 °C**

BREF 18 % → Net efficiency of 26 %

ASM Brescia, Italy

Intermediate superheating

- Amsterdam concept -

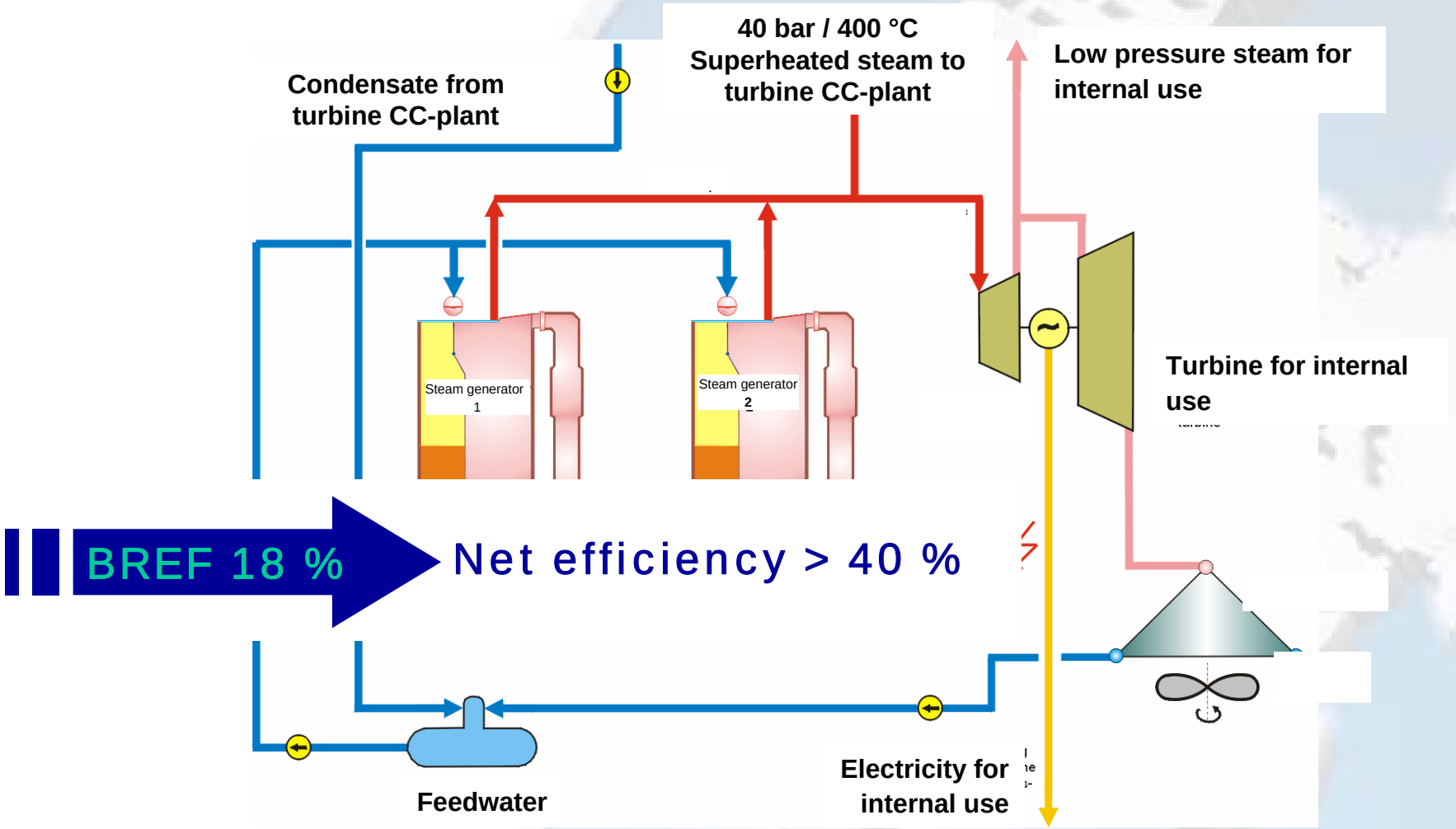


Amsterdam, Netherlands

Status: Summer 2007

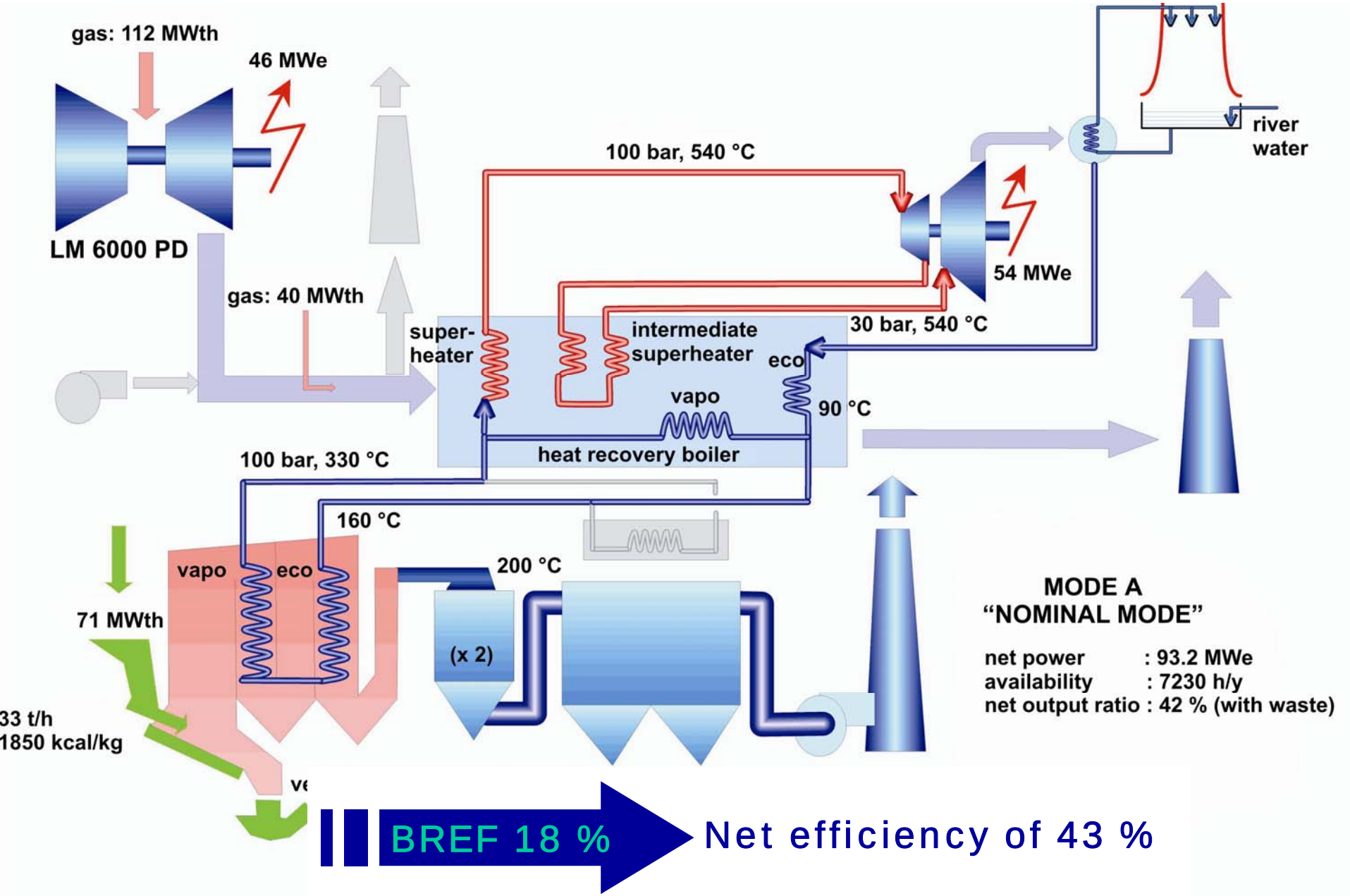
Combination with gas turbine

- Mainz concept -



Mainz, Germany

Combined waste-to-energy / natural gas
- Bilbao plant realized by CNIM -



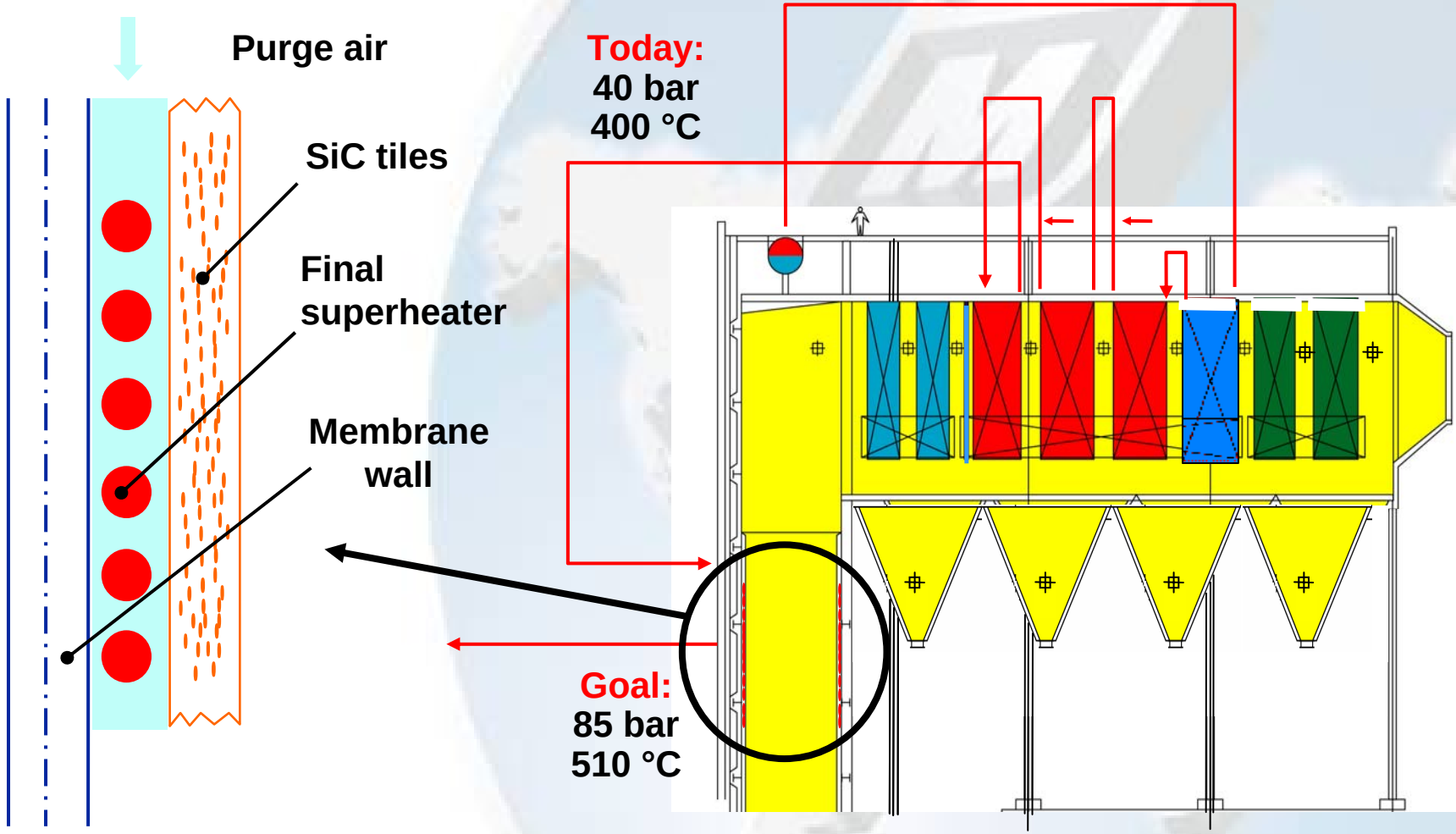
Bilbao, Spain

New WTE plants with increased efficiency

Plant	Brescia # 1+2 (Italy)	Brescia # 3 (Italy)	Amsterdam # 5+6 (Netherlands)	Mainz (Germany)	Bilbao (Spain)
Start-up	1998	2004	2006	2003	2004
Combustion system	MARTIN reverse-acting grate	MARTIN reverse-acting grate	MARTIN horizontal grate	MARTIN reverse-acting grate	MARTIN reverse-acting grate
NOx reduction	SNCR	SNCR	SNCR	SNCR	SNCR
Special feature	Optimized for high efficiency	Optimized for high efficiency	Intermediate steam superheating and water condenser	Coupled with combined cycle process (natural gas turbine)	Integration with combined cycle process (natural gas turbine)
Fuel	MSW, sewage sludge, biomass	Biomass, sewage sludge	MSW	MSW, natural gas	MSW, natural gas
Steam pressure [bar]	61	73	130	40	100
Superheated steam temperature [°C]	450	480	440	400 / 555	540
Gas temperature at boiler outlet [°C]	135	135	180 (135 °C with additional heat recovery after ESP and fabric filter)	200	200
Electricity produced [%; gross]	27	28	> 30	> 40 (referred to total gross heat of waste + natural gas) 25,8 (referred to gross heat of waste)	46 (referred to total gross heat of waste + natural gas)
Electricity exported [%; net]	24	25	30	> 40 (referred to total gross heat of waste + natural gas) 23,3 (referred to gross heat of waste)	42 (referred to total gross heat of waste + natural gas)

Increased efficiency - Development

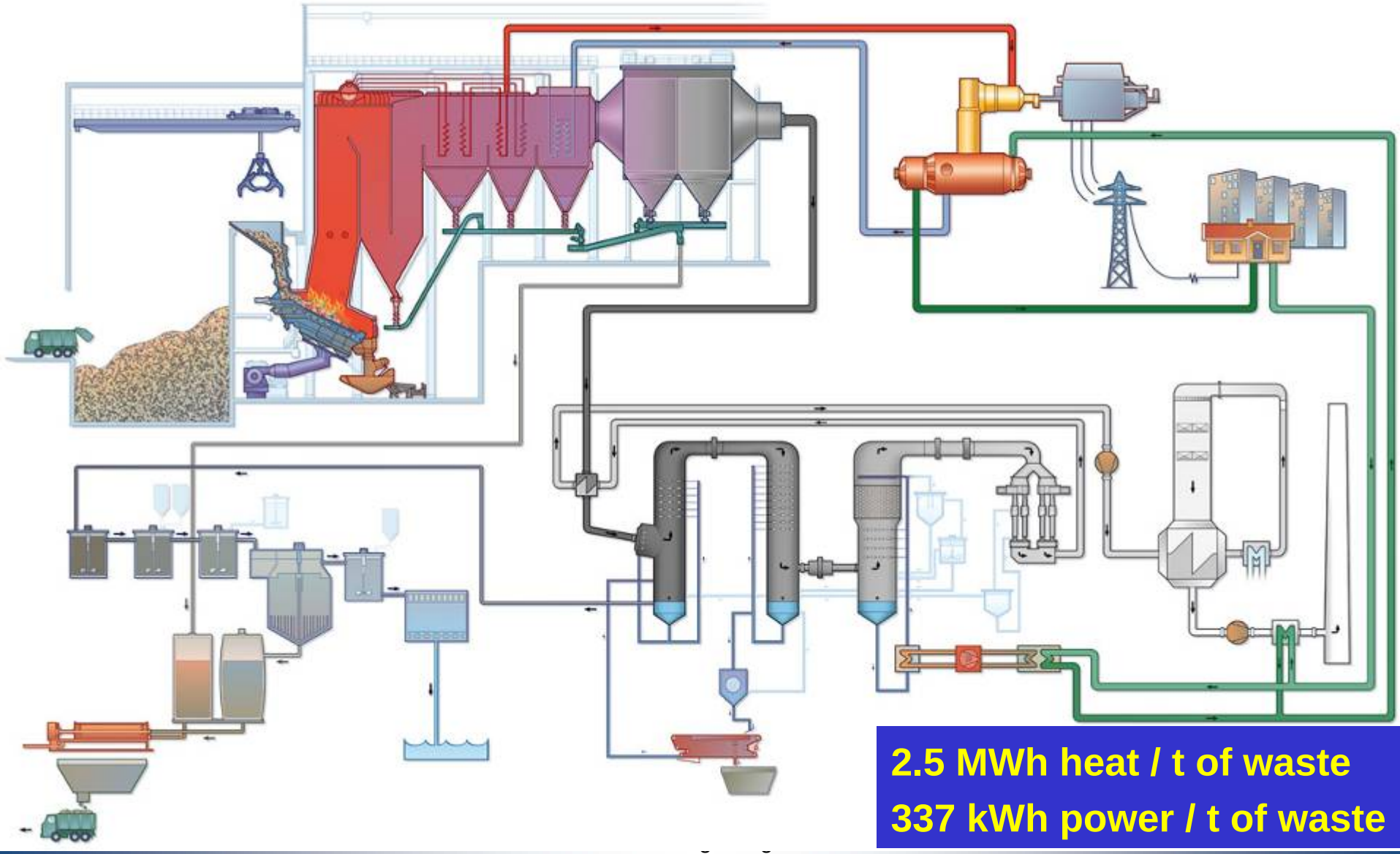
Wall Superheater



Combined Heat and Power

- **Very popular especially in northern Europe**
- **EfW plants often provide the base load - year round - for the district heating network**
- **Sale of heat greatly improves the financial situation of the plant**
- **Combination of heat / electricity production can vary in wide range**

Malmo plant overview



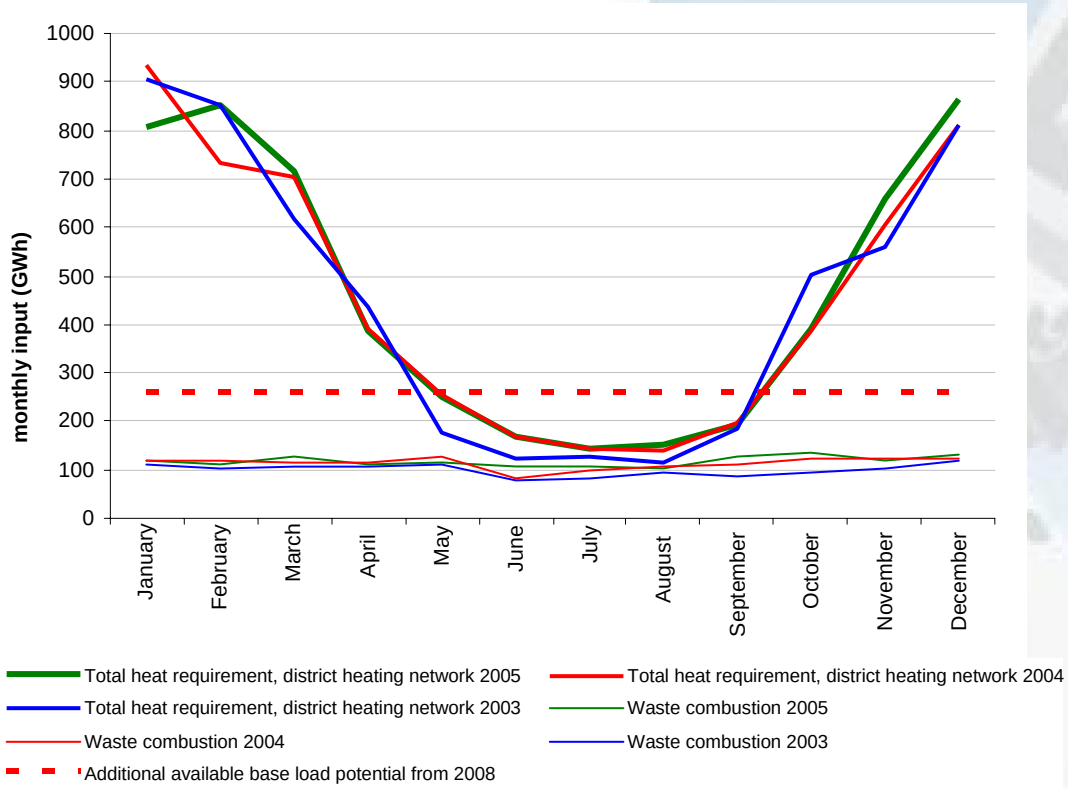
2.5 MWh heat / t of waste

337 kWh power / t of waste

District Cooling

- **System in planning by Fernwärme Wien**
- **They operate among others the Waste Incineration Plants in the City of Vienna, located in the middle of this city**
- **A substantial district heating network exists**
- **But there is also a growing demand for cooling capacity, especially for high rise buildings/complexes**

District Cooling
Fernwärme Wien



To date heat requirements have been met by waste combustion in summer

New waste heat in future:

- 3rd municipal waste recovery plant

- Biomass combined heat and power generation

- Geothermics

- Longer service life of CHP

District heat accumulators provide useful waste heat for producing cold energy with absorption

District Cooling
Fernwärme Wien

Factors contributing to competitiveness of district cooling:

- It is possible for existing plants to supply cold water at 4 °C (requires compression cooling machines in addition to absorption machines)
- Favorable re-cooling possibilities
- Resources for free-cooling
- Economical sources of energy (waste heat) for absorption machines
- District cooling becomes increasingly competitive as cold energy requirements and the number of full load hours increase

District Cooling
Fernwärme Wien

Cold energy centre directly in the waste combustion plant (Spittelau)

Approx. 50 MW are currently planned in the final construction

Cold water at 4 °C will be distributed via the district cooling network

Possible customers nearby: general hospital, Skyline office complex, University of Agricultural Science technology centre, …

5. Incineration of high-cal waste

- **Demand for incineration of high-cal waste has risen**
- **High-cal: 10 - 20 MJ/kg, with the design point often around 13 - 15 MJ/kg**
- **This high-cal waste can either be commercial type waste or be the product of a pretreatment operation**
- **Known under the names: RDF, CDR, EBS, SRF etc**
- **Tests with about 500 t have been carried out in a plant in Switzerland**
- **This material can be handled w/o problem on a grate**
- **The MARTIN reverse-acting grate does not even need water-cooling of grate bars**

WTE plant St. Gallen

Start up: 1988

Number of lines: 2

Waste throughput:
5.2 t/h - 9’600kJ/kg

Design heating value:
5’200 kJ/kg - 14’650 kJ/kg

Gross heat release: 50.24 GJ/h

Grate run width: 2’250 mm

Grate steps: 13

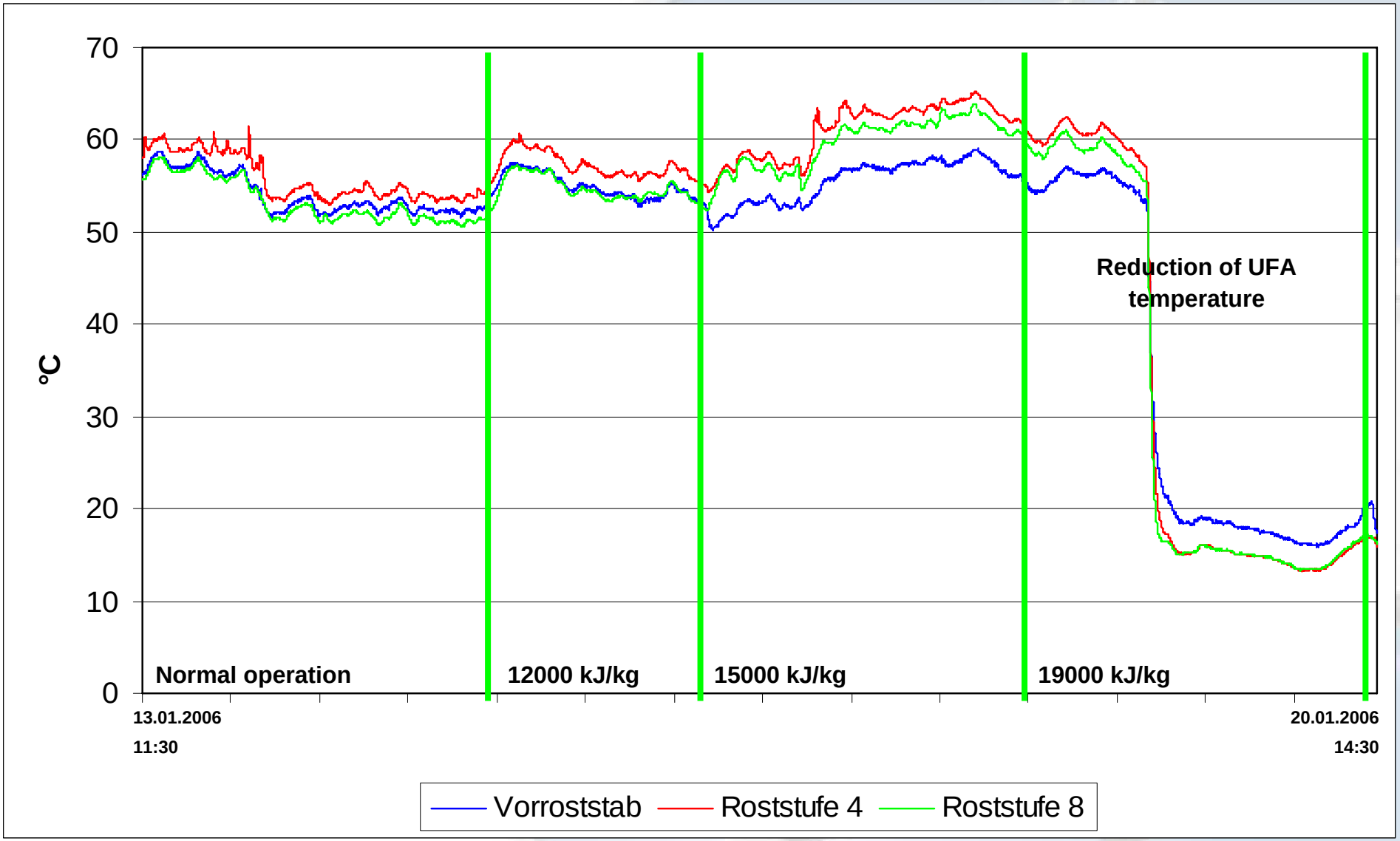
Grate area: 18.1 m2

Steam parameters: 40 bar / 400°C

Steam production: 15.1 t/h

Fuel properties

Test results (grate bar temperature)



6. Max line size

- **Lately, several projects for ‘large’ line sizes (> 80 MW, th; > 500 t/d)**
- **Motivation was mainly reduction of cost (less units)**
- **But also because acceptance / permitting etc encounters the same problems as for small unit**
- **Large units tend to be ‘behave’ better in operation**
- **But there are certain physical constraints in the max line size, based on our experience; these are summarised in the following**
- **In essence, this limits the max thermal input to one line to about 110 - 120 MW**

6. Max line size

Summary of restrictions

- **Grab volume: 8 - 10 m3**
- **Width of feed chute: 13 - 15 m**
- **Width of grate: approx 13 m**
- **Width of combustion chamber: 4.5 - 5.5 m**
- **Width of convective part of boiler: approx 10 m**

7. Summary / Conclusions

- **Technology for EfW plants in Europe is grate based**
- **Grate technology is well proven, but undergoes further improvement / adaptation to new needs**
- **Steady number of projects**
- **Energy efficiency is the main topic; more focus should be put on usage of recovered energy as steam or heat**
- **Many EfW plants with higher energy efficiency are in operation**
- **Incineration of high-cal waste poses no technical problem**
- **Discussion ongoing on usage of residues (bottom ash, fly ash)**
- **EfW is an indispensable part of a sustainable waste management scheme**

Thank you very much for your kind attention !