



# Low NO<sub>x</sub> BFB Combustion Technology

**STRABAG** Energy Technologies GmbH (SET)

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# Fluidized Bed Combustion

## Combustion technology for all kinds of fuels

### General advantages:

- Low content of burnable matters in ashes
- Excellent part load behaviour
- Technology related low emissions
- Highest availability and long overhaul periods
- Low maintenance costs

### Characteristics:

- Combustion under controlled temperature conditions
- Broad fuel range
- High fuel flexibility



# BUBBLING FLUIDIZED BED BOILER

## Design Features

**Fuel heat input :** up to 120 MW<sub>(th)</sub>

### Live-steam parameters:

- Pressure: up to 140 bar<sub>a</sub>
- Temperature: up to 540 °C

### Emissions\*

- CO: < 5 mg/Nm<sup>3</sup> / 3,5 mg/MJ
- NOx: with SNCR: < 60 mg/Nm<sup>3</sup> / 45 mg/MJ  
without SNCR: < 120 mg/Nm<sup>3</sup> / 90 mg/MJ
- TOC: < 1 mg/Nm<sup>3</sup>

\*(referred to 11% O<sub>2</sub>)

### Design

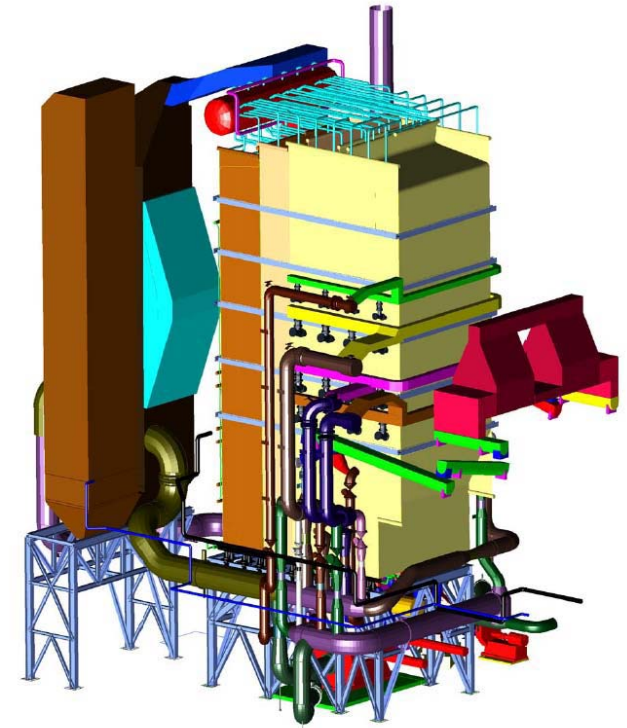
Bubbling Fluidized Bed (BFB) Boiler

### Fuels

Biomass, bark, sewage sludge, pulp and paper industry residues, agricultural waste, RDF, fossil fuels, waste wood

### References

Austria  
Bulgaria  
Germany  
Italy

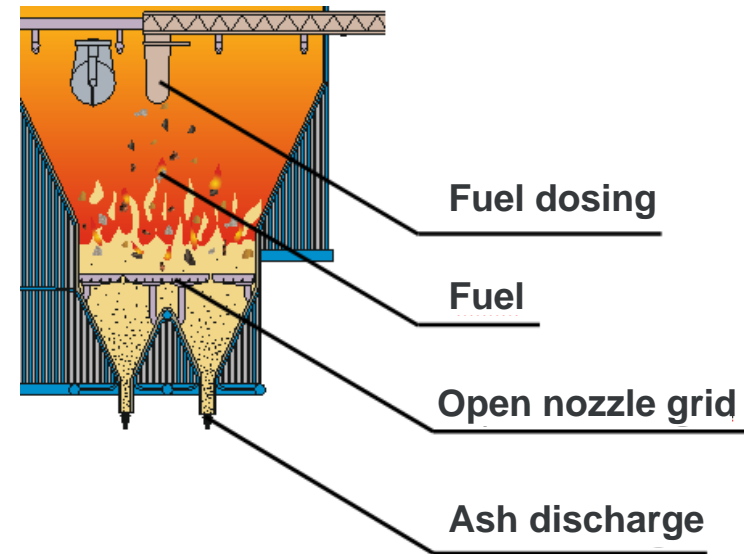


# Fluidized Bed Characteristics

## Design Features

## Steam Generator and Fluidizing Zone

- The Fluidized bed is integrated into the membrane walls of the steam generator.
- Boiler geometry and arrangement of the radiation and convection heating surfaces are adapted to the fuel characteristics.
- Fresh air and re-circulated flue gas in variable proportion - are injected through a gas distributor, which allows to extract inert coarse fractions from the fluidized bed combustion during plant operation.
- The fluidisation gas flow into the fluidized bed is constant and does not depend on the boiler load. This results in a constant pressure drop and uniform fluidization conditions.



# NOx Formation in the boiler

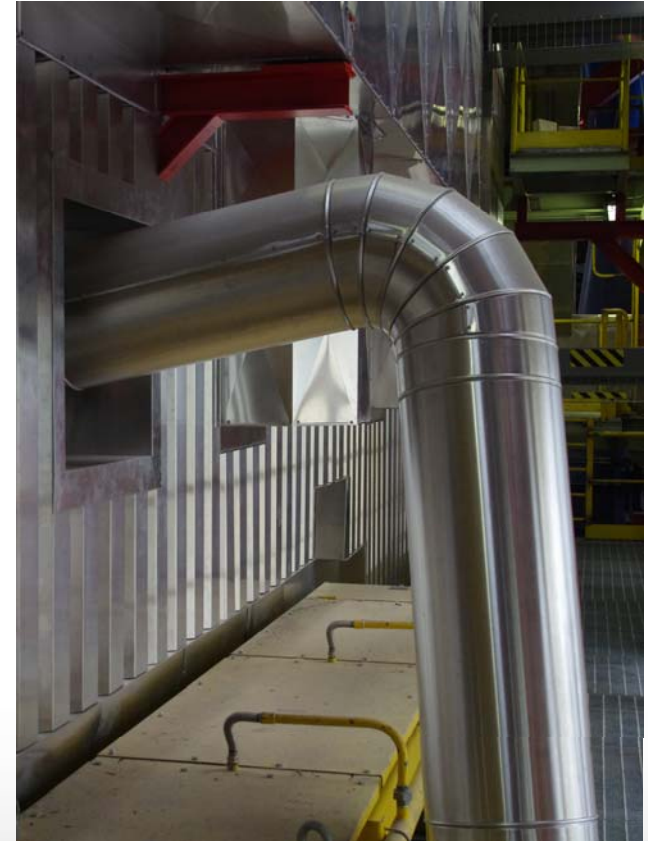
Two ways of NOx formation during combustion

## Fuel bound NOx

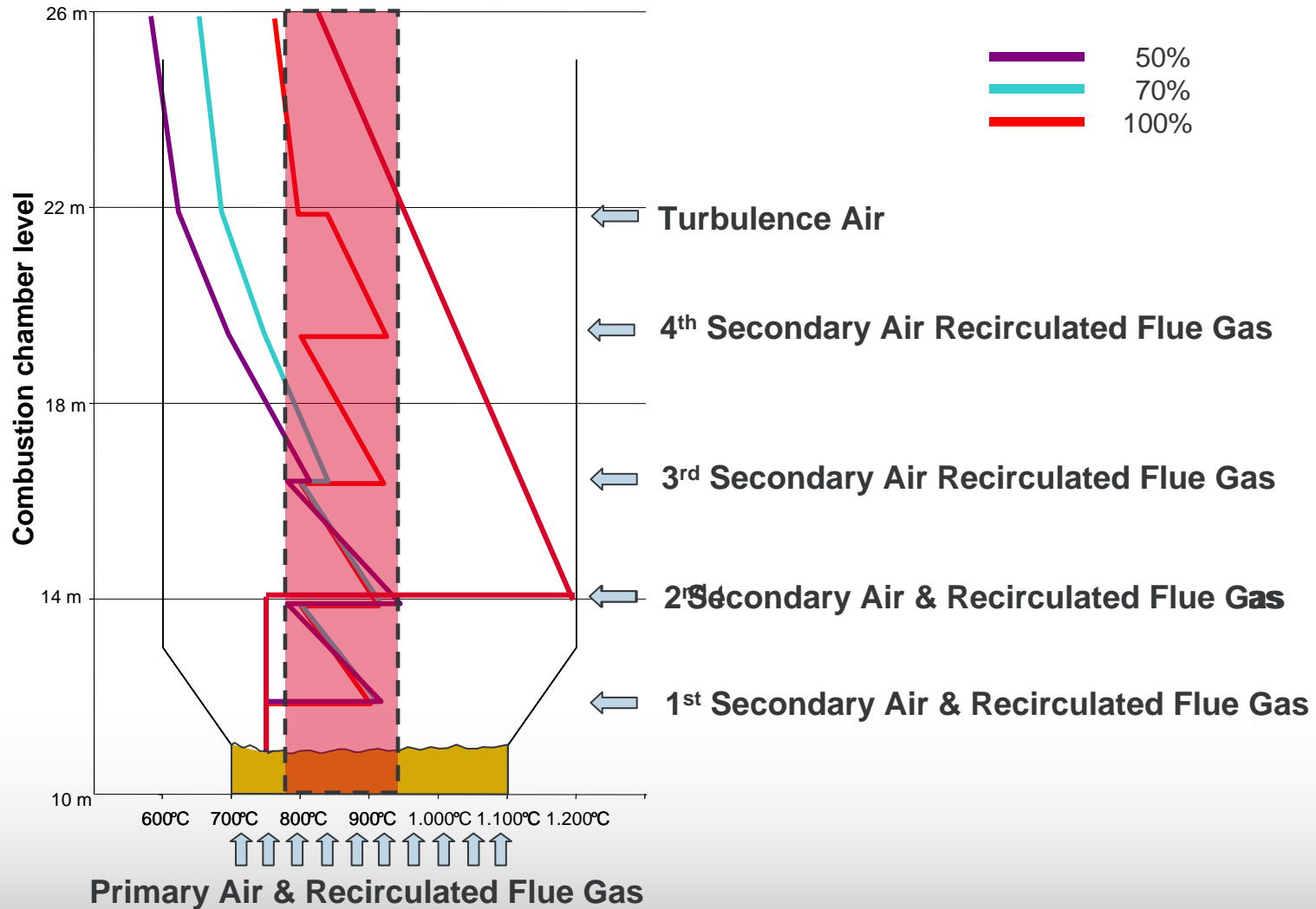
- ◆ Thermal NOx
- ◆ Prompt NOx

How can you influence NOx formation

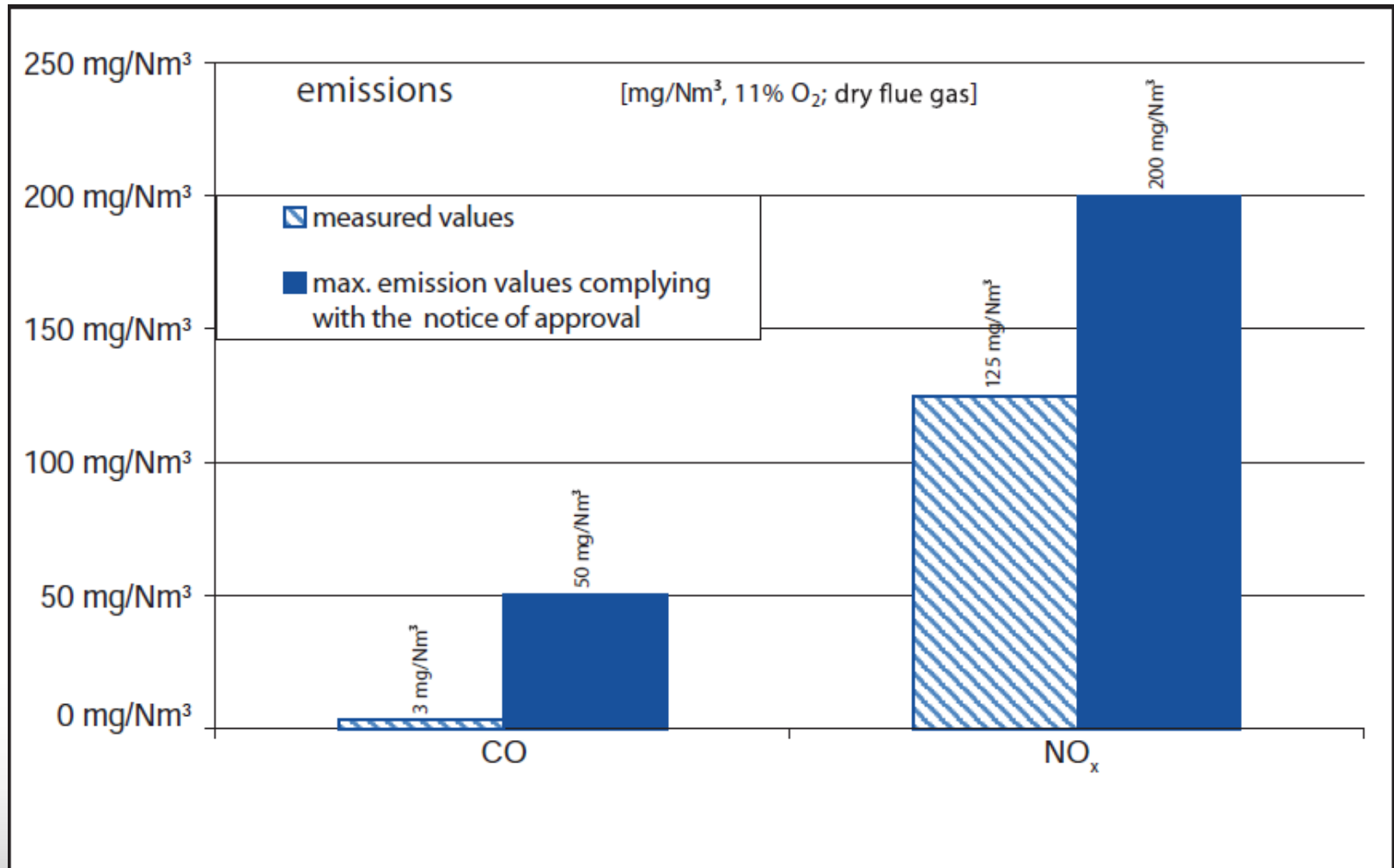
- ◆ ~~Fire low Nitrogen containing fuel~~
- ◆ Reduce the thermal NOx formation during combustion
- ◆ Establish a homogenous combustion



# Temperature Profile at different Boiler Loads



# NOx-Emissions compared to guarantee values

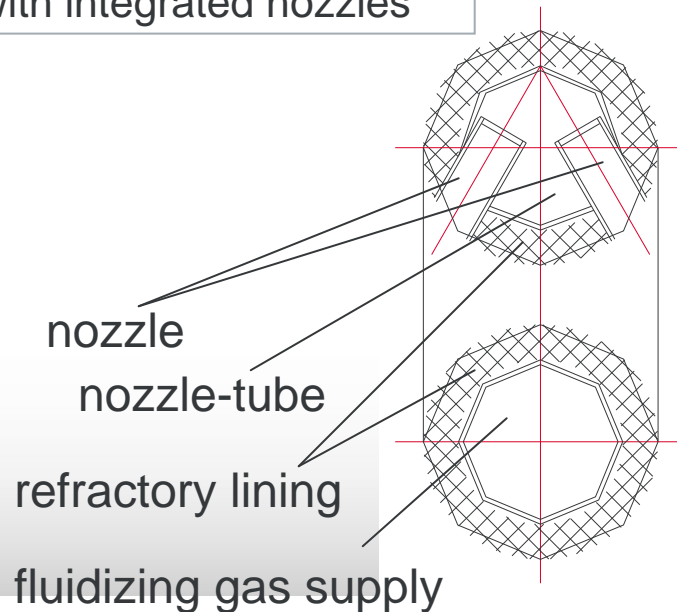




# Establish a homogenous Combustion

## Open Nozzle Grid

- **Refractory lined**
- No salient parts
- No jamming by wires or accumulation of coarse material in the vicinity of the nozzle heads
- Fluidizing gas supply by means of tubes with integrated nozzles



# Continuous Extraction of Coarse Particles is necessary!

## Example Funder Plant

### Coarse Particles in the Fuel

approx. 500 kg/h

approx. 12 t/d

approx. 85 t/week

equals approx. 40 m<sup>3</sup>

bed area 30 m<sup>2</sup>

Bed volume 22 m<sup>3</sup>

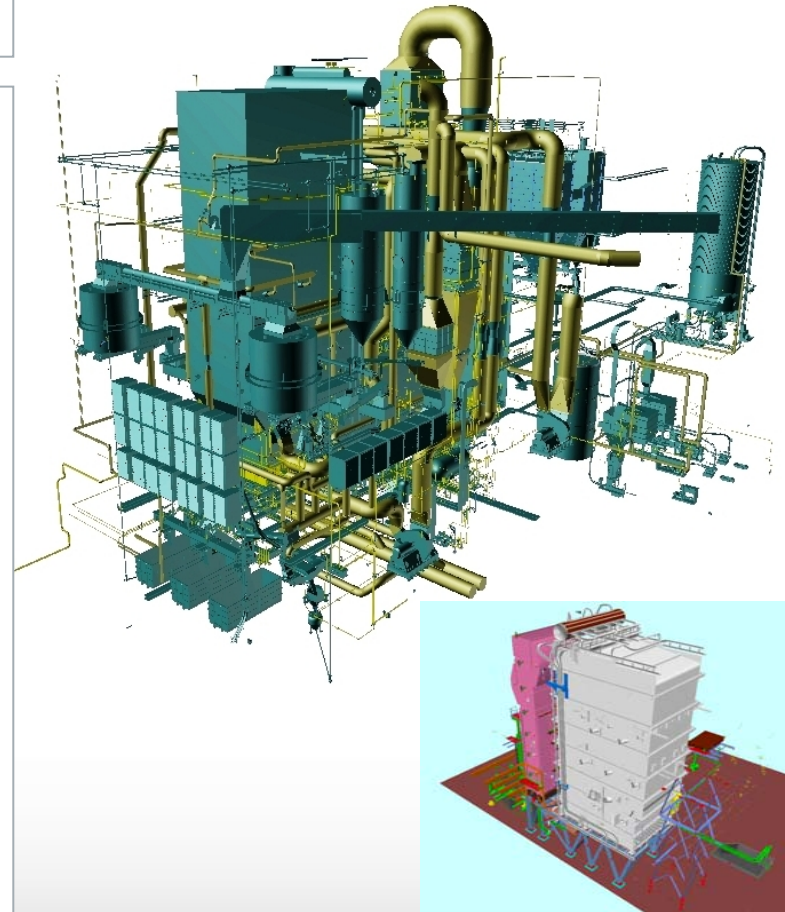
without coarse particle  
extraction the plant would  
have to be stopped every  
week!



# Fluidized Bed Characteristics

## Characteristics

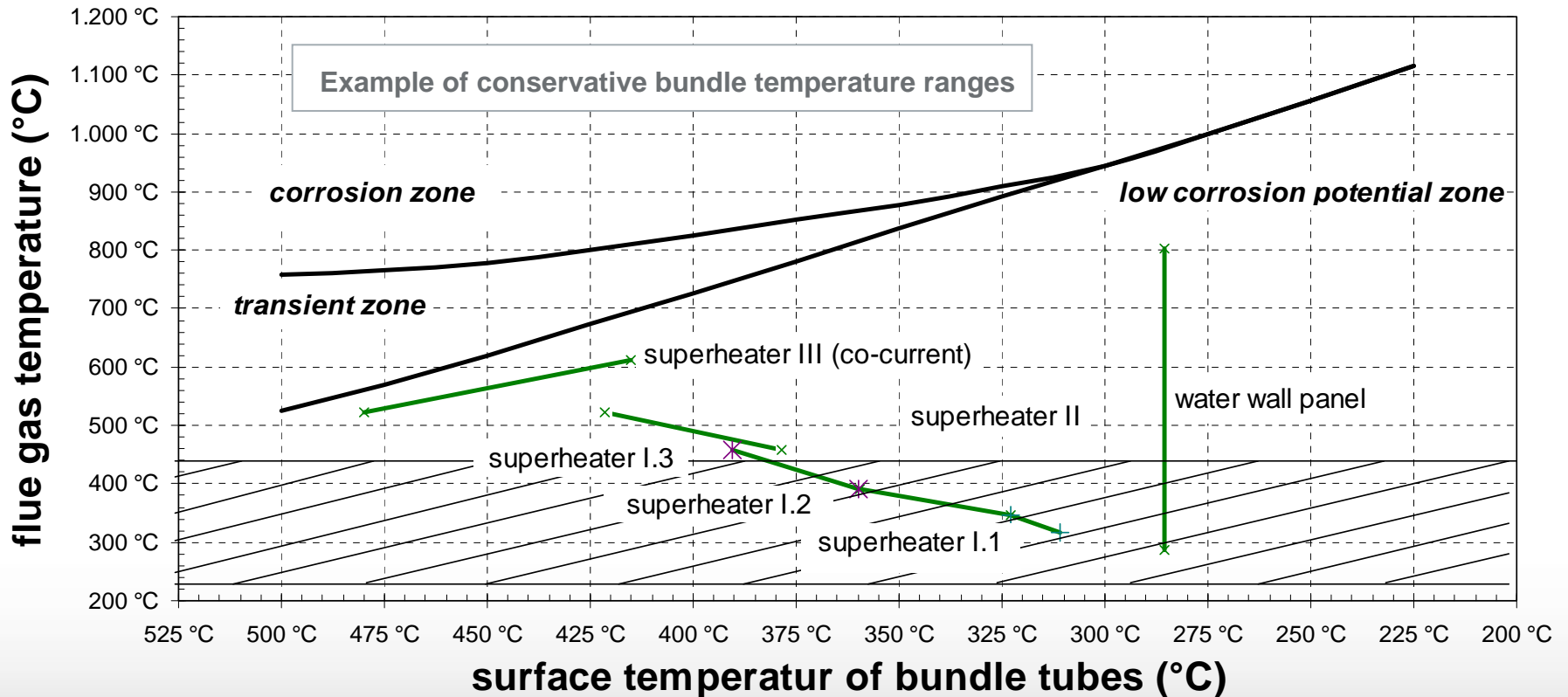
- Uniform combustion conditions across the cross sectional area of the combustion chamber
- Flexible combustion control, which provides an exactly defined temperature profile in the combustion chamber within the load range of the plant
- Compact plant design
- Highest availability
- Maximum flexibility referring to fuel qualities
- High efficiency due to low excess air
- Easy thermal treatment of exhaust vapours
- High operation stability under variable conditions
- Ash & coarse particle extraction during all operation conditions (open nozzle grid)



# Fluidized Bed Characteristics

## Design Features

Accurate Design lowers Corrosion and Erosion Risk



# Boiler Types

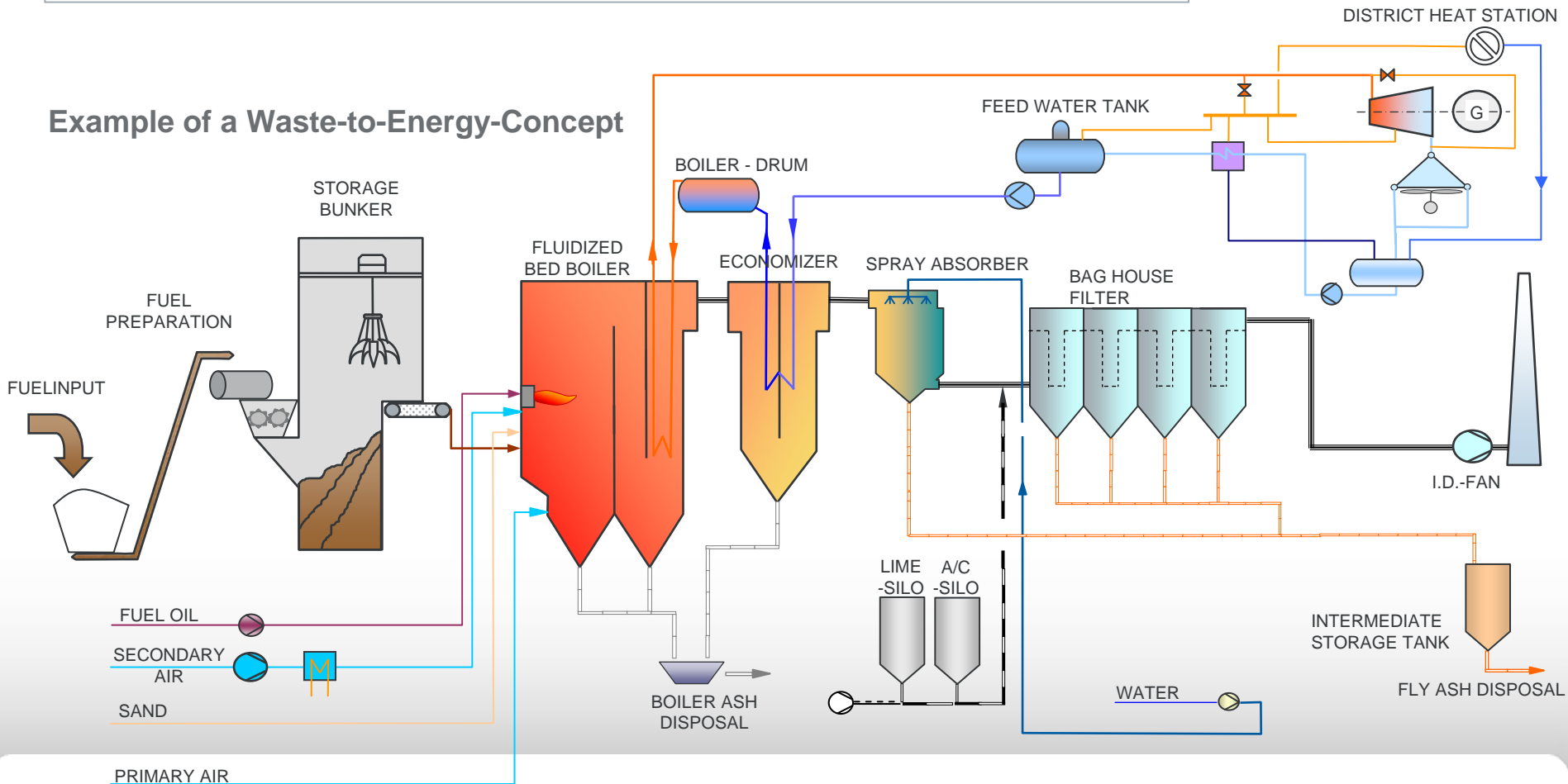
|        | Type - bio             | Type - multi                           | Type - residue       |
|--------|------------------------|--|----------------------|
| Design |                        |  |                      |
| Fuel   | wood chips, bark, peat | waste wood, sludge, agricultural waste | RDF, rejects, sludge |

# Power Plant Competence

## Solutions for Complete Packaging for Heat and Power Generation

Taylor-made Engineering leads to Your Success

### Example of a Waste-to-Energy-Concept



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Content

Fluidized bed  
combustion

Fluidized Bed  
Characteristics

Power Plant  
Competence

Open Nozzle Grid

References

# Biomass Power Plant SICET

63 MW<sub>th</sub> fluidized bed boiler

## Project Data

- Replacement of the boiler within an existing boiler house
- Increase of live steam parameters
- Fluidized bed boiler – biomass – compact design
- Modular construction and erection concept

**Customer:** Sicet S.r.l., Italy

**Technology:** Bubbling fluidized bed

**Live-steam flow:** 80 t/h

**Live-steam pressure:** 79 bar<sub>a</sub>

**Live-steam temperature:** 525 °C

**Electrical power:** 20.5 MW<sub>el</sub>

**Commissioning:** 2011

**Fuel:** wood chips

**Net calorific value:** 7.5 – 12 MJ/kg



Power plant SICET, Ospitale di Catoro

| <b>Emissions:</b>                        | <b>guarantee</b>           | <b>operation</b>                  |
|--|----------------------------|-----------------------------------|
| CO [mg/Nm <sup>3</sup> ]:                | < 50                       | < 20                              |
| NOx <sup>1)</sup> [mg/Nm <sup>3</sup> ]: | < 200                      | < 120                             |
|  | <sup>1)</sup> without SNCR | (referred to 11% O <sub>2</sub> ) |

# Biomass Power Plant SANKT VEIT a.d. GLAN

45 MW<sub>th</sub> Fluidized Bed Boiler

## Project Data

- Supply, erection and commissioning of a fluidized bed boiler for the combustion of residues and sewage sludge
- Modular construction and erection concept

**Customer:** Fa. FunderMAX, Austria

**Technology:** Bubbling fluidized bed

**Live-steam output :** 56 t/h  
**Live-steam pressure :** 65 bar<sub>a</sub>  
**Live-steam temperature:** 455 °C

**Commissioning:** 2007

**Fuel:** waste wood, waste of production, sludge, packaging, material, wood-dust

**Net calorific value:** 10 – 18 MJ/kg



Power plant FunderMAX, St. Veit

| <b>Emissions:</b>                        | <b>guarantee</b> |
|--|------------------|
| CO [mg/Nm <sup>3</sup> ]:                | < 50             |
| NOx <sup>1)</sup> [mg/Nm <sup>3</sup> ]: | < 150            |
| TOC [%]:                                 | < 2              |

<sup>1)</sup> without SNCR

(referred to 11% O<sub>2</sub>)

Type-residue  
Linz

Type-bio  
SICET

Type-multi  
Stambolijski

Type-multi  
FunderMAX

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# Biomass Power Plant STAMBOLIJSKI

35 MW<sub>th</sub> Fluidized Bed Boiler

## Project Data

- Supply, erection and commissioning of a fluidized bed boiler for the combustion of residues of a paper mill
- Modular construction and erection concept

**Customer:** Mondi Packaging EAD, Bulgaria

**Technology:** Bubbling fluidized bed

**Live-steam output:** 40 t/h  
**Live-steam pressure:** 85 bar<sub>a</sub>  
**Live-steam temperature:** 450 °C

**Commissioning:** 2010

**Fuel:** bark

**Heating value:** 5 – 9.2 MJ/kg



Lift of 2nd pass, Stambolijski

**Emissions:** **guarantee**

CO [mg/Nm<sup>3</sup>]: < 250

NOx<sup>1)</sup> [mg/Nm<sup>3</sup>]: < 300

<sup>1)</sup> without SNCR

(referred to 6% O<sub>2</sub>)

# Residue Derived Fuel Power Plant LINZ

72 MW<sub>th</sub> Fluidized Bed Boiler

## Project Data

- Supply, erection and commissioning of a fluidized bed boiler for the combustion of RDF & sewage sludge
- Designed for up to 31% of sewage sludge in the fuel
- Modular construction and erection concept

**Customer:** Linz AG, Austria

**Technology:** Bubbling fluidized bed

**Live-steam flow:** 90 t/h  
**Live-steam pressure:** 42 bar<sub>a</sub>  
**Live-steam temperature:** 420 °C

**Commissioning:** 2011

**Fuel:** treated municipal and industrial waste, sewage sludge, waste water screenings

**Net calorific value:** 6 – 13 MJ/kg



Power plant construction, Industrial area, Linz

**Emissions:** guarantee

CO [mg/Nm<sup>3</sup>]: < 45

TOC: < 30 g/kg

(referred to 11% O<sub>2</sub>)



**Contact me for further discussion about your project!**

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