towards a successful completion

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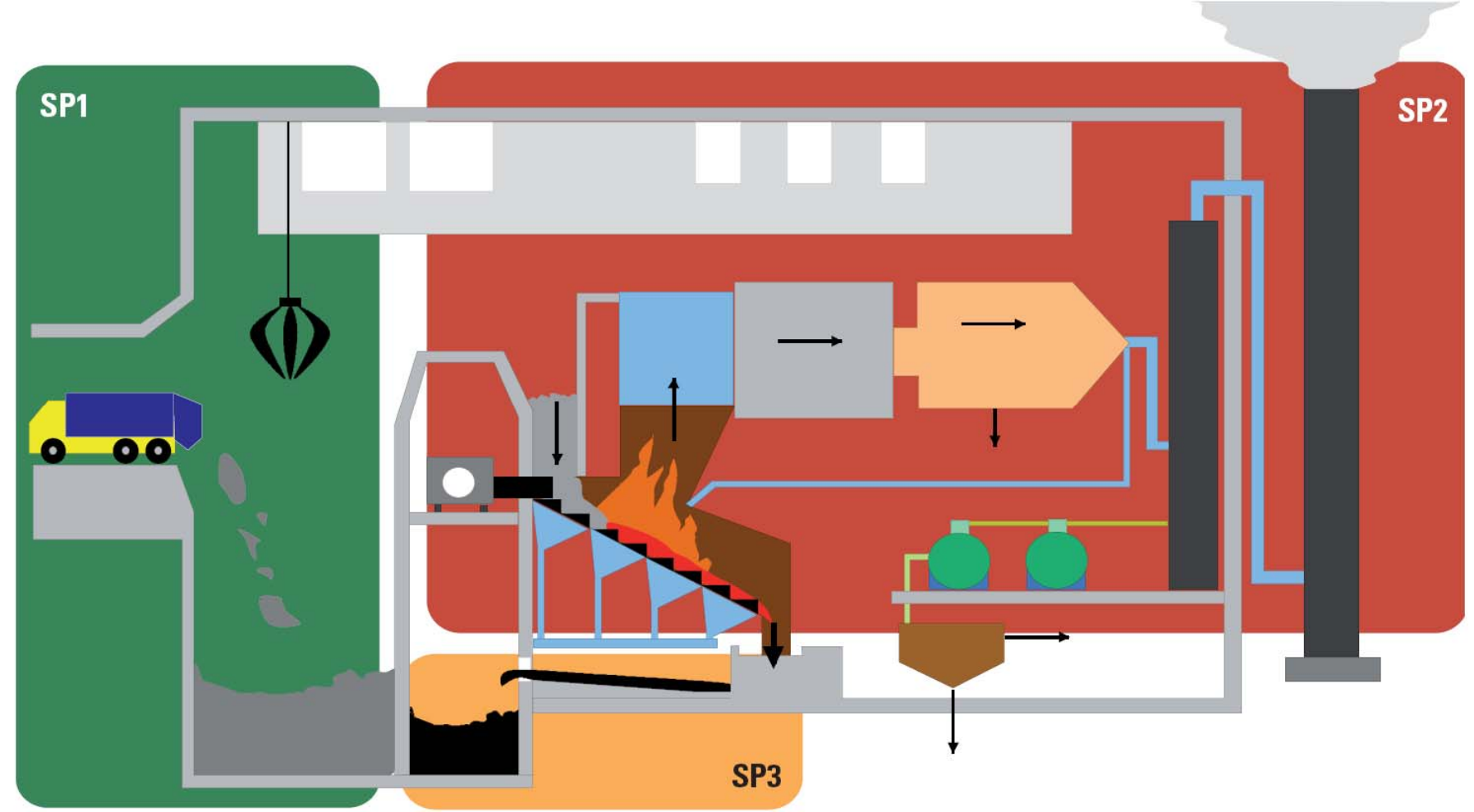
What is NextGenBioWaste really about?

- The process
  - Combustion
- Fuels
  - Municipal Solid Waste (MSW)
  - Biomass
- Type of plants
  - Grate furnaces (waste)
  - Fluidised bed furnaces (biomass and waste)
  - Pulverized fuels furnaces (biomass)
- Type of activities
  - Demonstration activities (80% of budget)
  - R&D (20 % of budget)

The scope of NextGenBioWaste



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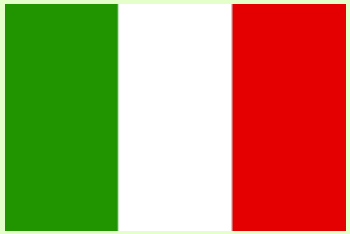
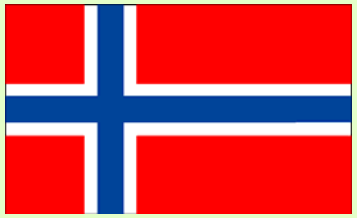
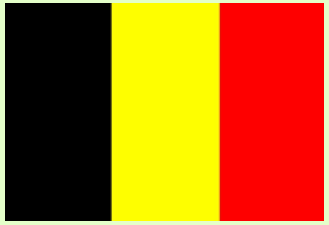
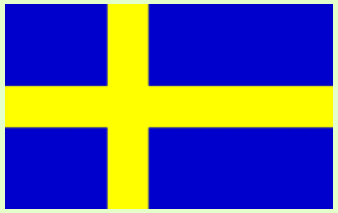
14 demonstration sites in 6 countries!

- **Italy**
  - A2A WtE plant, Brescia
- **Belgium**
  - ISVAG WtE plant, Antwerpen
- **Norway**
  - Marienborg bioenergy plant
  - Heimdal Varmesentral WtE plant
- **The Netherlands**
  - High efficiency waste fired power plant, Amsterdam
  - AVR WtE plant, Rozenburg
- **Germany**
  - Gemeinschaftskraftwerk Schweinfurth WtE plant
  - MVB Borsigstrasse WtE plant, Hamburg
  - MVR Rugenburger Damm WtE plant, Hamburg
  - WtE plant EVI, Emlichheim
- **Sweden**
  - Händelö CFB WtE plant
  - FB boiler Högdalen WtE plant
  - Nyköping BFB bioenergy plant
  - Uppsala pulverized fuel boiler

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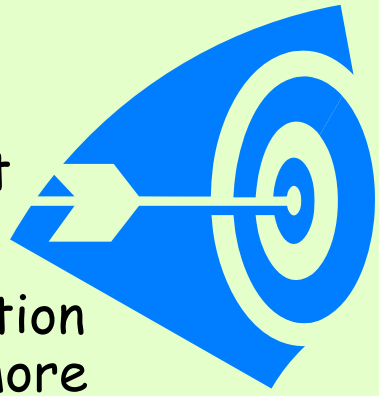
NextGenBioWaste's Targets

1. Increase the electric efficiency for waste to energy plants from 22% to 30% (gross generated)
2. Double the lifetime of heat exchanger components at existing steam temperatures
3. Increase the electric efficiency for biomass combustion plants from 33% to 35%, while making the systems more cost-effective by the use of more low-grade fuels
4. Lower the fuel cost at least 1 mill.€/year for a 100 MW_{th} biomass combustion plant
5. Enable technologies for upgrading of bottom ash, thus, enabling the utility companies to valorise from 70% of their bottom ashes for civil engineering purposes



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Target 1 – Increased electrical efficiency

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Key innovations

- Raising steam parameter to 440°C/130 bar
- Inconel cladding of superheaters
- Patented steam reheater, which reheates the steam between the high pressure and the low pressure turbine
- Boiler corrosion can be avoided by avoiding reheating in the boiler
- Extra economisers, optimization of energy consumption and yield of energy
- Bigger boiler than current standard in WtE: enables lower flue gas velocities and fouling of the boiler and superheater

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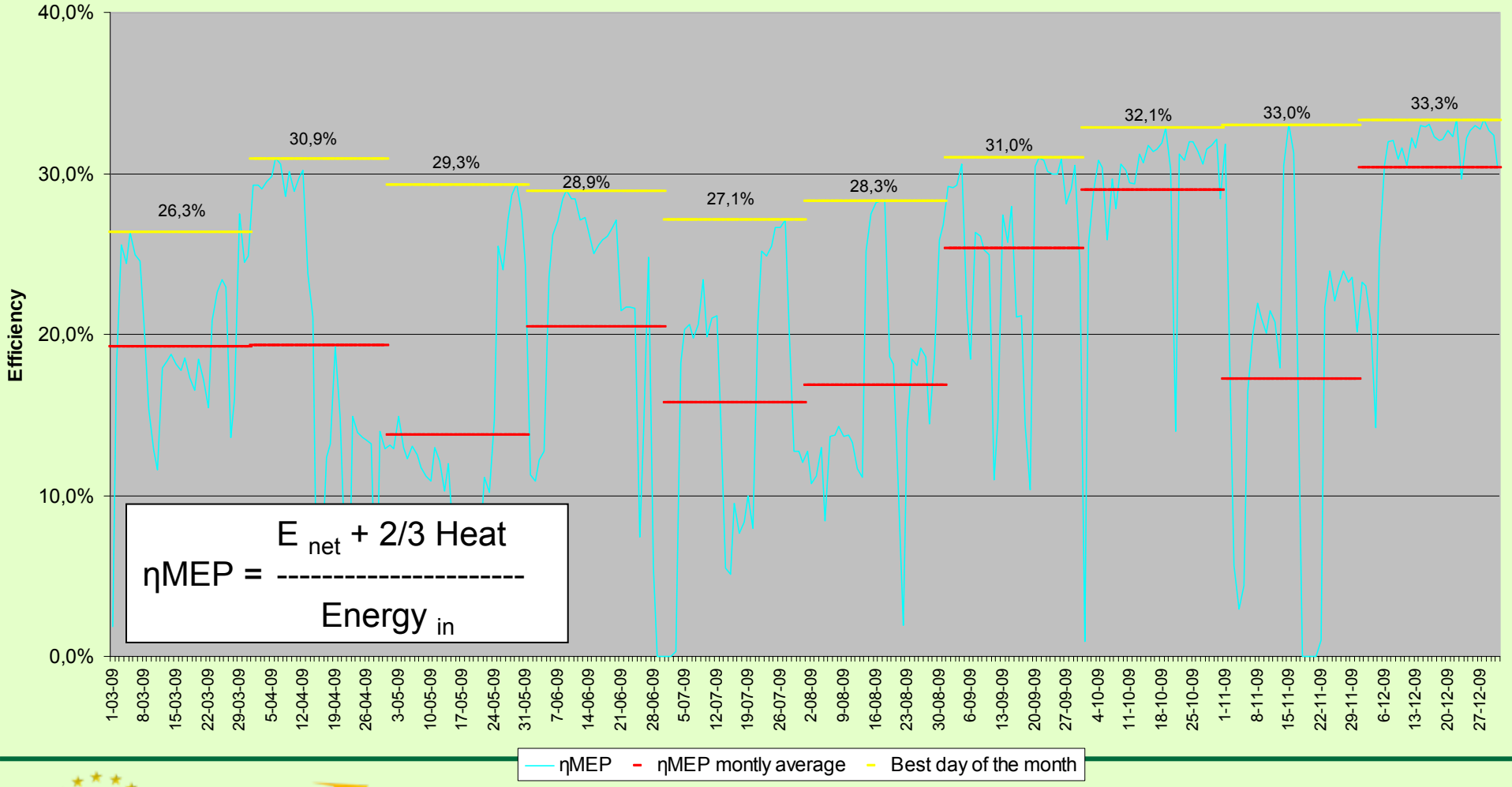
Efficiency Waste Fired Power Plant 2009

calculated according MEP (Dutch regulations for sustainable electricity production)



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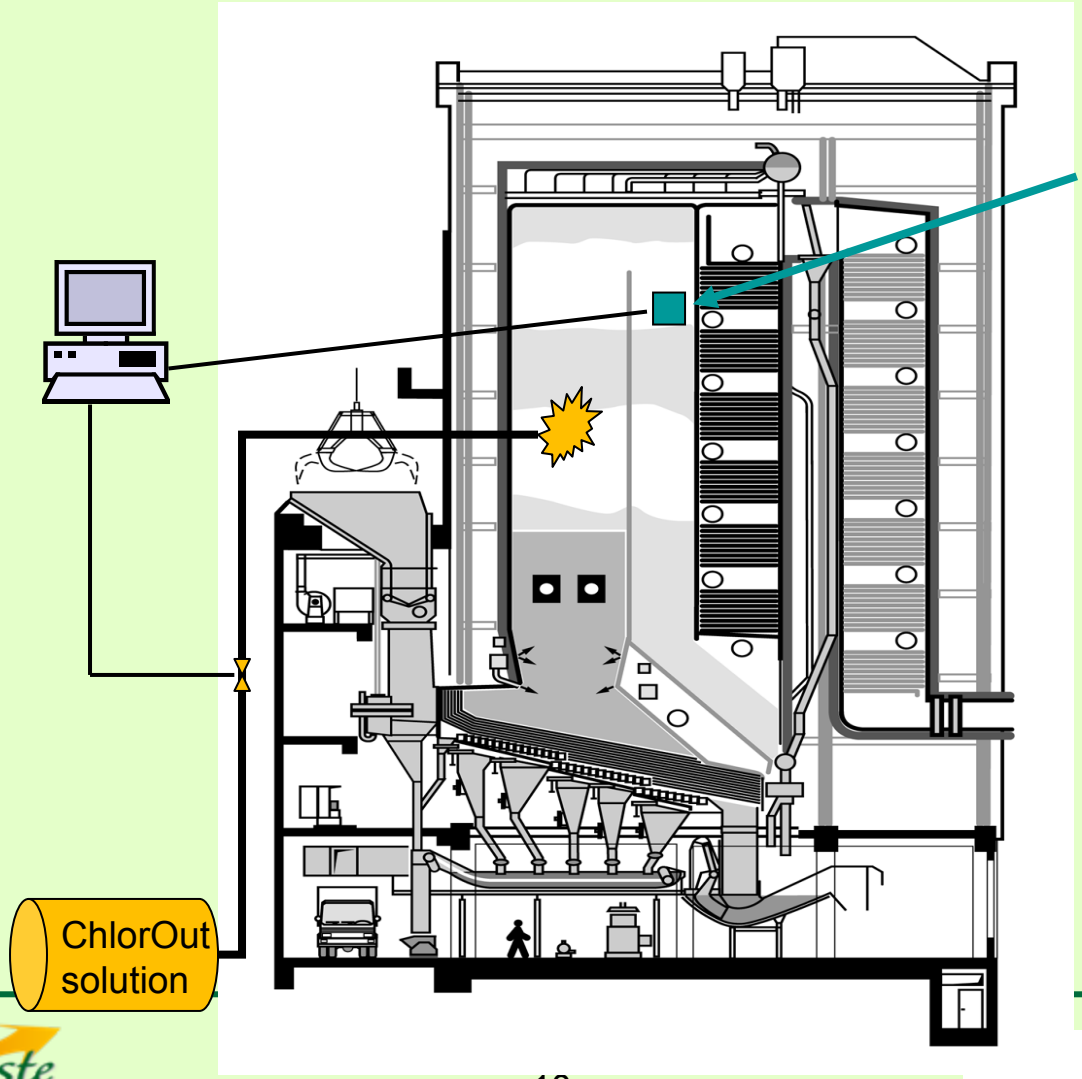
The use of the additive ChlorOut® to reduce corrosion, fouling and NOx emissions

Vattenfall Germany, Vattenfall Power Consultant and Vattenfall R&D

The ChlorOut additive system – known to work with virgin biomass, but not proven with household waste

1.
Sulphate additives are sprayed into the furnace and convert corrosive alkali chlorides into less corrosive alkali sulphates



2.
IACM (In situ Alkali Chloride Monitor) measures the amount of alkali chlorides left in the flue gas

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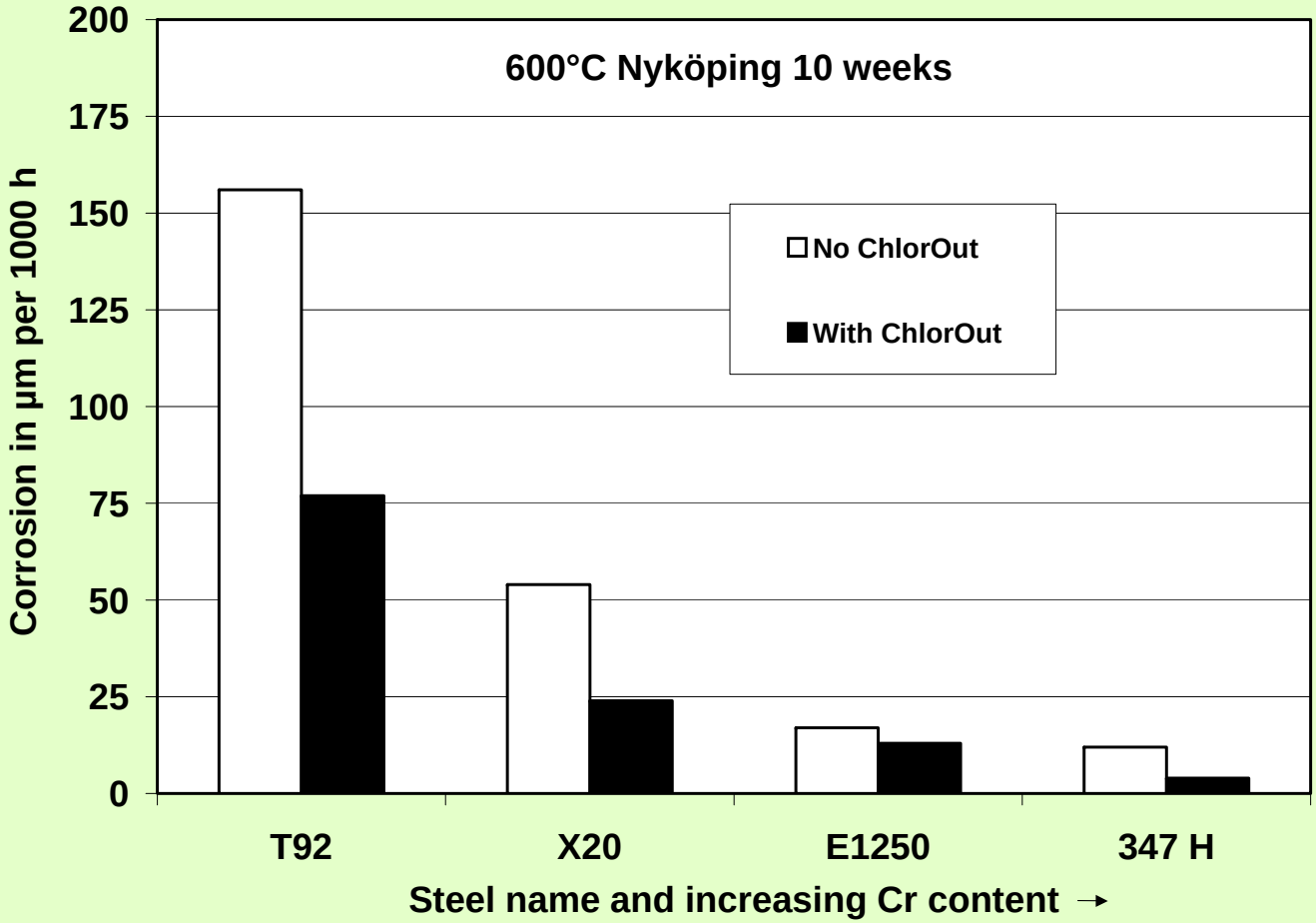
Results with ChlorOut ®



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Target 2 – Doubled lifetime of heat exchangers

- Results:
  - Long-term tests in waste-wood boiler showed that using the ChlorOut additive halved the corrosion rates.
  - Short term test using ChlorOut on household waste combustion confirm a reduction rate of more than 50%
  - Supporting information
    - Studies of the initial corrosion rates on both ferritic and austenitic steels shows a reduction rate with about 60%
    - Reduction rate of more than 75% of the concentration of alkali chlorides in the flue gas
    - Chloride concentration in deposits reduced from ~8% to almost 0!

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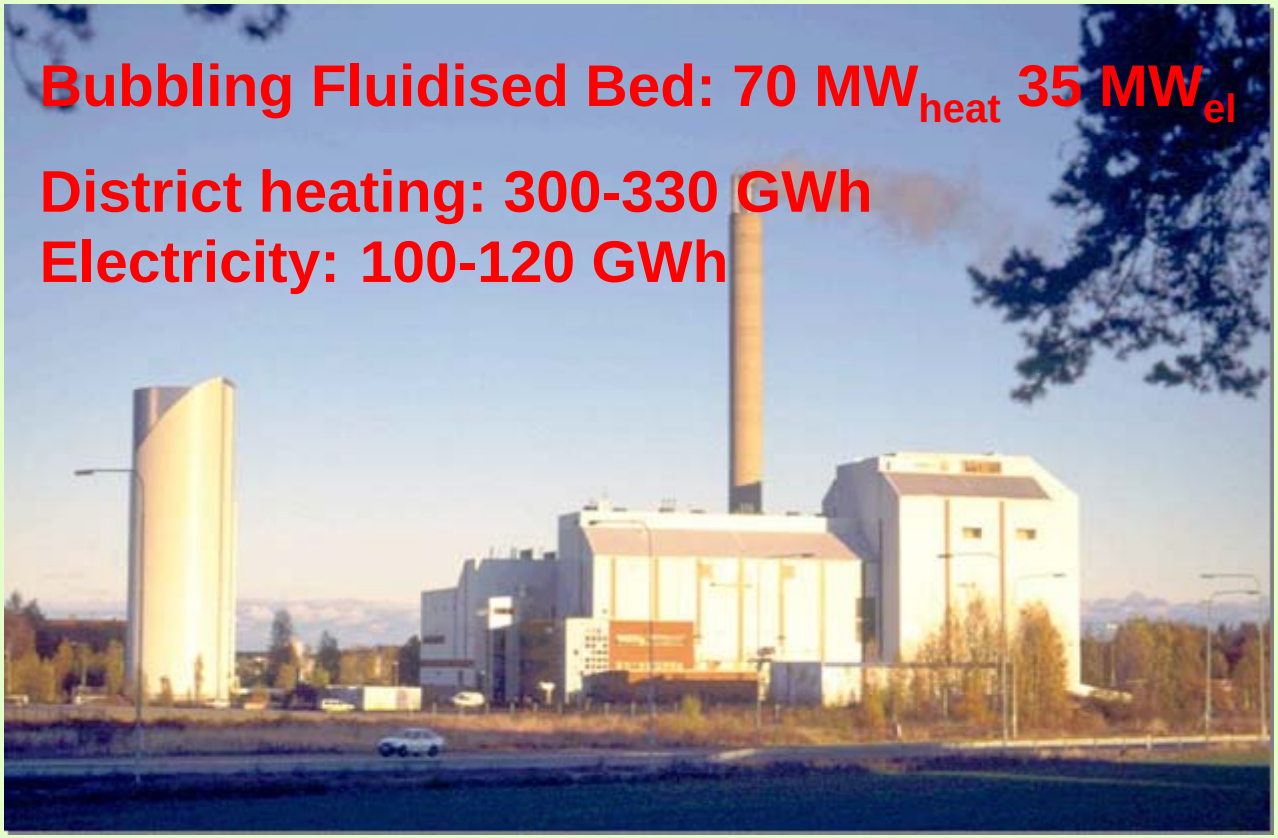
Demonstration of combustion of 100% waste wood in the Nyköping CHP plant



Vattenfall Nordic Heat

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Need for new bed bottom

- 50% waste wood => stop every month for bed cleaning
- Target: 100% waste wood!

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Work performed

- New bed bottom designed, tested and installed
- 40% less magnetic metals to boiler by improved separation

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Target 3 and 4 – Fuel cost savings and high electrical efficiency with low-grade biomass fuels

- **Results**
  - Share of waste increased from 50 to 100%
  - Availability maintained at same level
  - Fuel costs lowered by 5 €/MWth
  - Annual fuel consumption is 500 GWh
  - Total savings: 2,5 M€/year
  - Electrical efficiency is proven to be high and in the range of 35% depending on mode of operation

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Target 5 – Ash upgrading

- One major demonstration activity was originally planned
- Artificial aging of bottom ashes by the use of CO_2
- The planned demonstration facility was stopped due to less stringent requirements on ash quality for utilisation purposes

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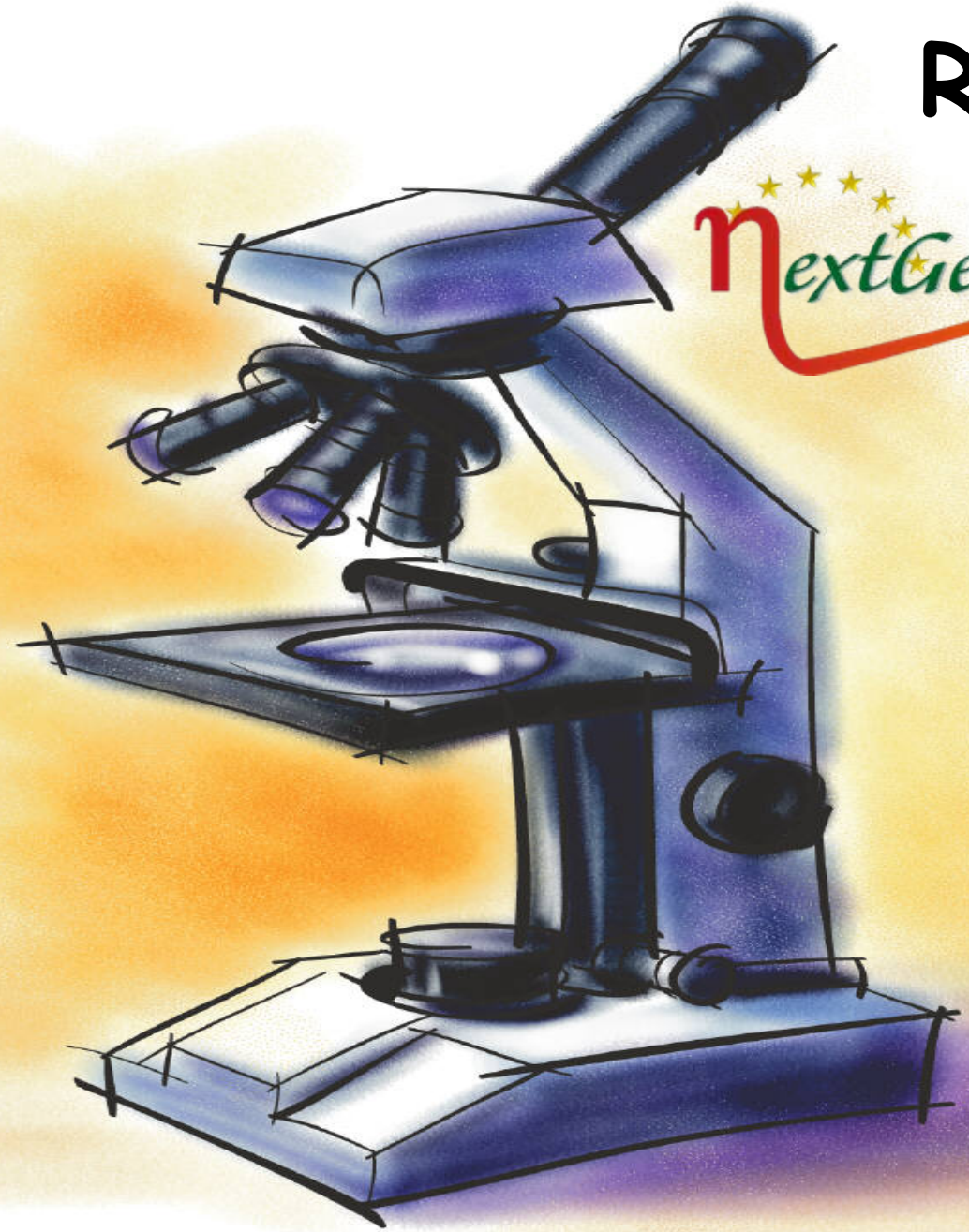
R&D in

NextGenBioWaste



Combustion Layer Sensor

Objectives:

- To measure directly on the grate the combustion conditions (temperature, gas composition $O_2/CO/CO_2$)
- To obtain data for combustion models

Main results:

- Measuring tool able to survive 3h at T>1000°C
- Data for operators (combustion conditions, residence time, etc.)
- Possibility to extend measuring capabilities

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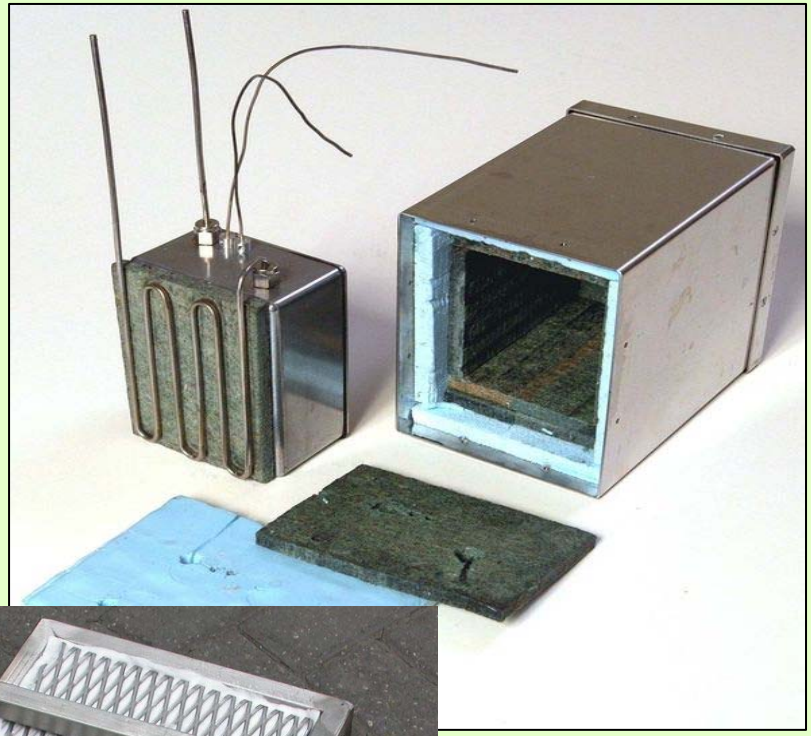
Tests made in 8 MSW combustion plants:

- Rozenburg (NL)/AVR
- Rotterdam (NL)/AVR
- Amsterdam (NL)/AEB
- Schweinfurt (D)/GKS
- Prague (CZ)/Municipality
- Brno (CZ)/Municipality
- Twence (NL)/Twence A&E BV
- Coevorden (NL)/EUROPARK



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Before

During

After

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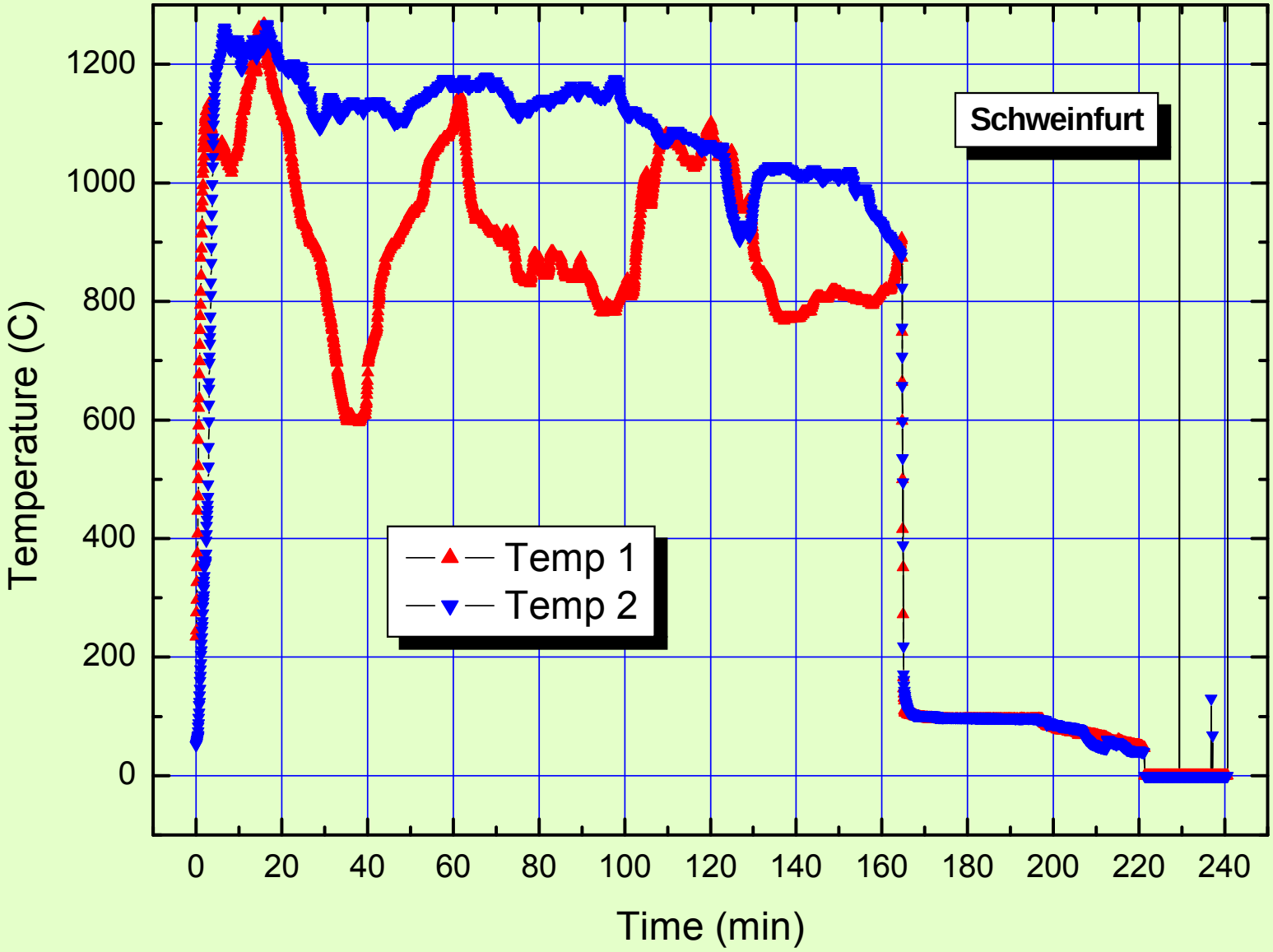

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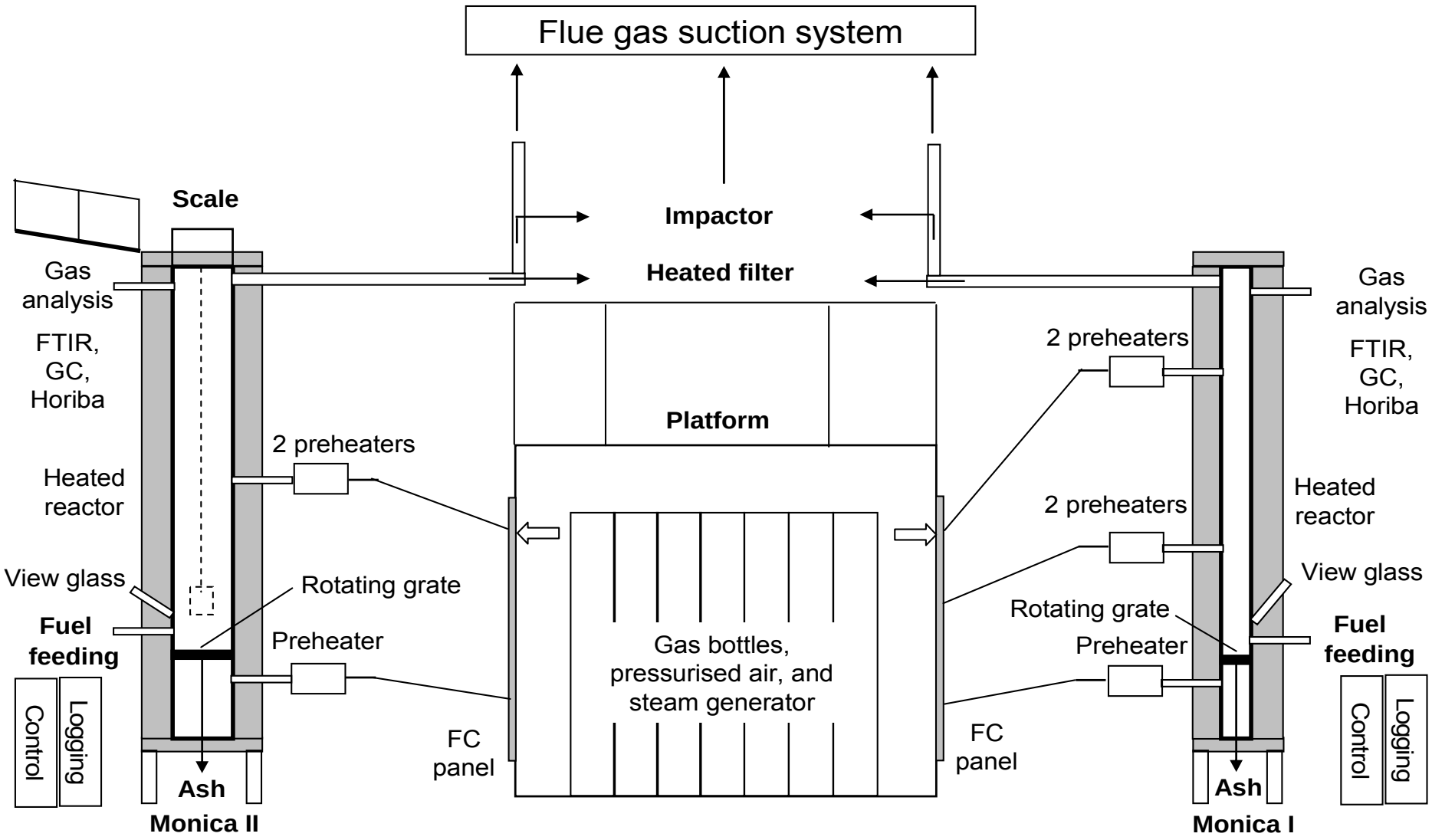
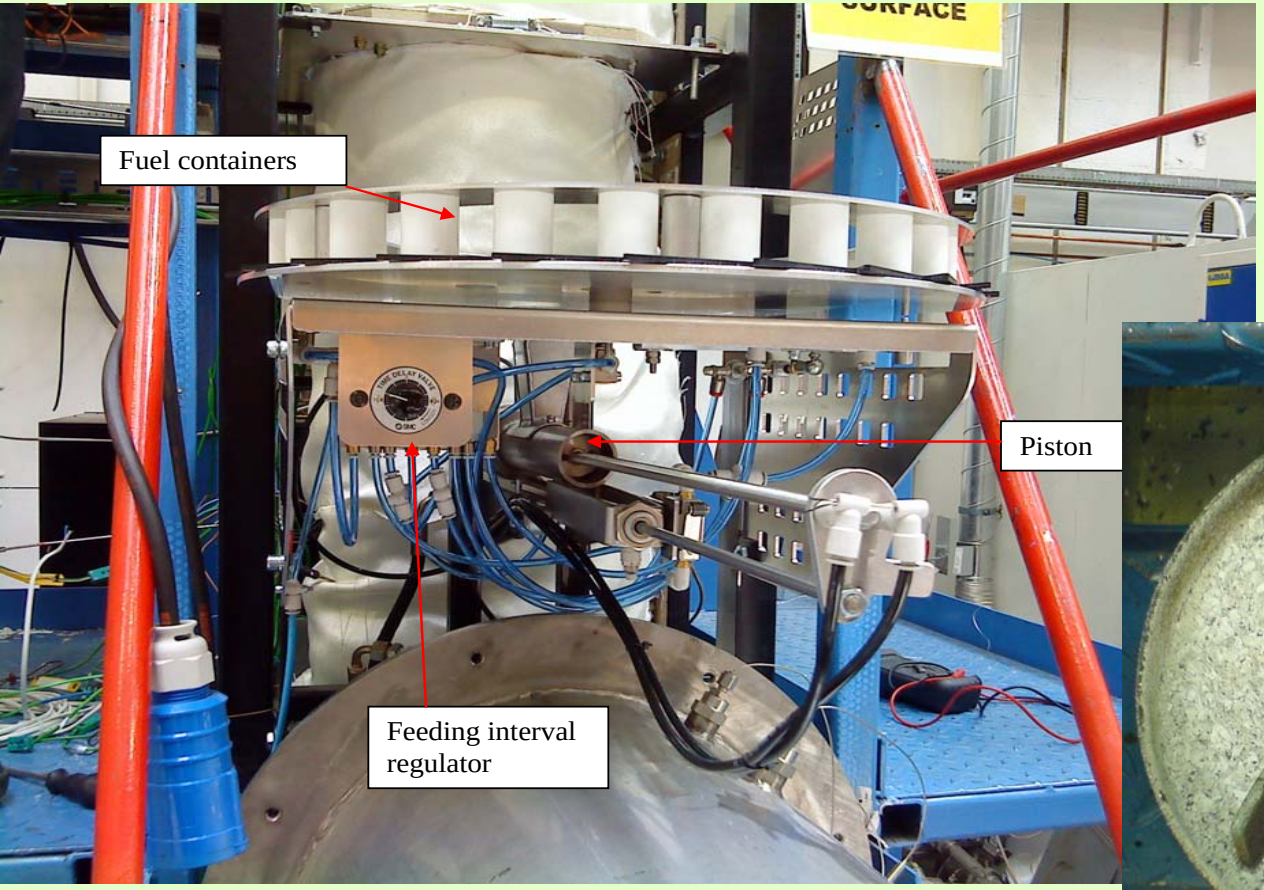
The multi-fuel reactor system

System overview



Fuel feeding and grate



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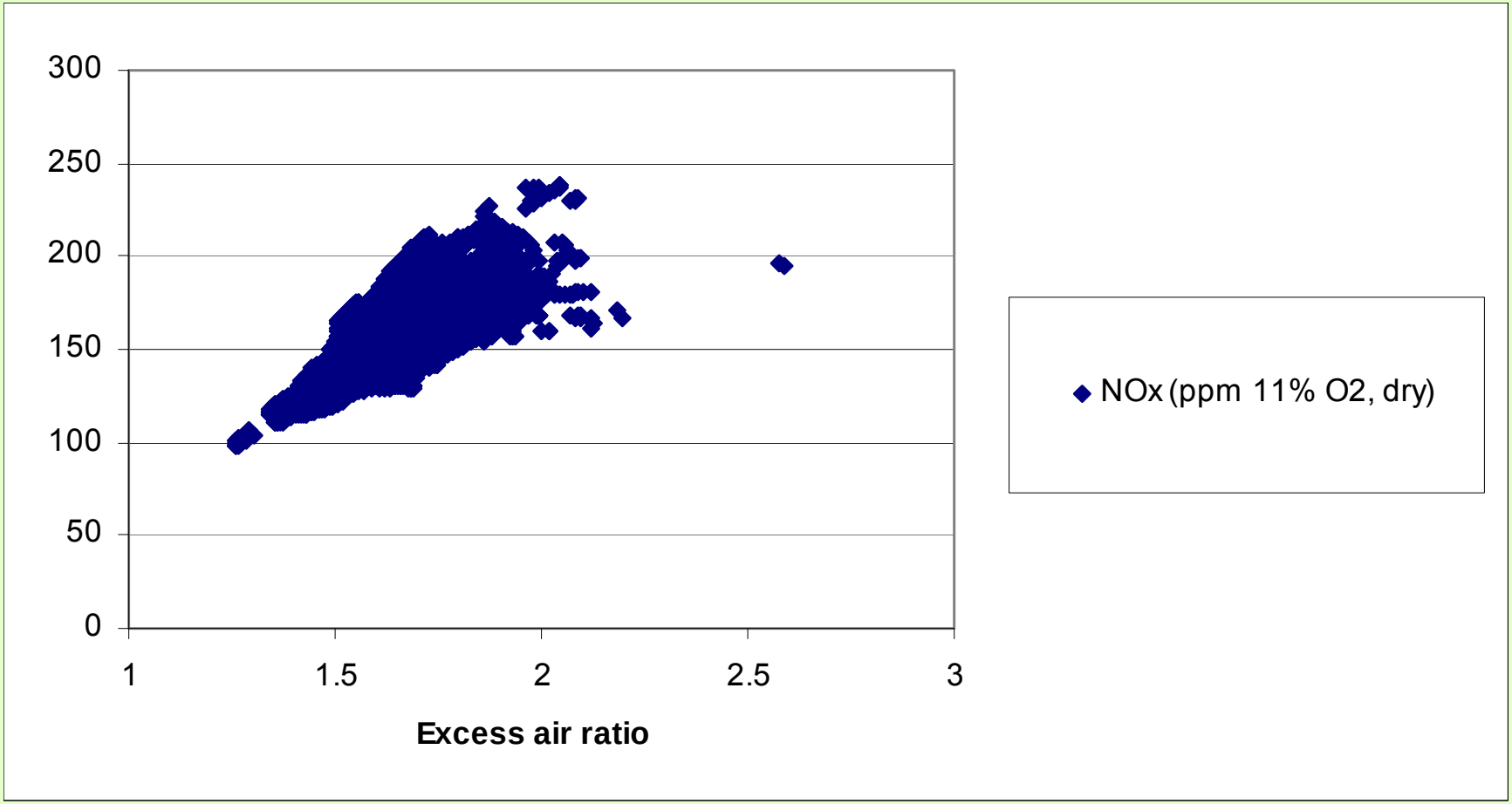
Results

Non-staged combustion of coffee waste (3% N in fuel)



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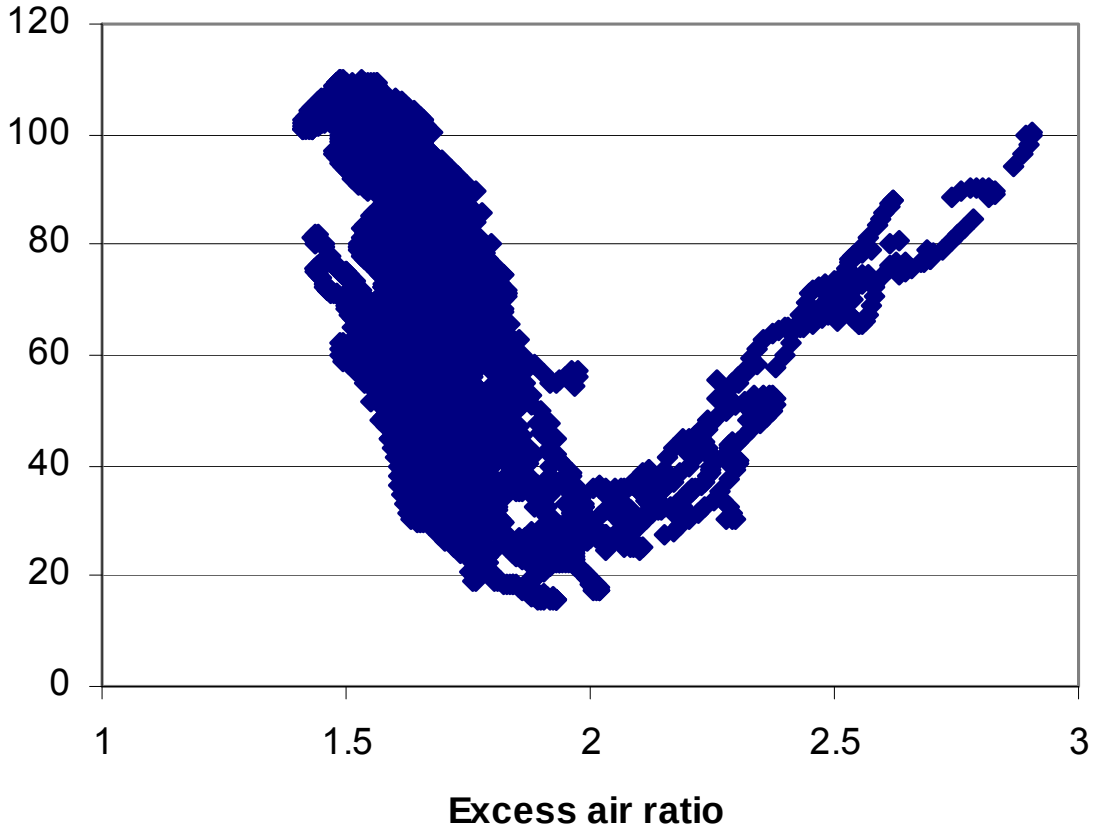
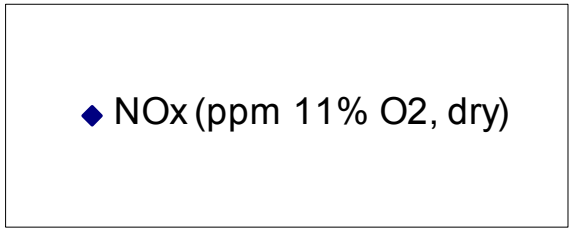
Results

Staged combustion of coffee waste (3% N in fuel)





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New technology and systematic slowness

- Climate researchers: ***We must!***
- Technologist: ***We can!***
- Politicians: ***We shall!***

- So why is renewable energy not being implemented to a greater extent?

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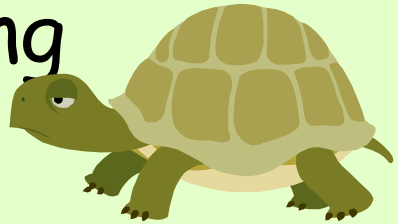
New technology and systematic slowness

- New technology and innovations must to a certain extent match existing systems and future plans



- Assumes knowledge and technology at different places in the value chain
- The challenge is not only to develop new technology, but also to develop the society in a direction of demaning it

Incentives for renewable energy production in Norway and Germany

Incentives for renewable electricity production in Norway and Germany
(numbers in €¢/kWh)

	Norway[1]	Germany[2]
• Hydropower	0,5	5-10
• Windpower (onshore)	1,0	5-9
• Immature technologies and electricity from biomass	1,3	9-56

References
1 St.meld. nr 29 (1998-1999)
2 Mindestvergütungssätze nach dem neuen Erneuerbare-Energien-Gesetz (EEG) vom 21. Juli 2004

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Non-technical barriers

- Statement from the NextGenBioWaste project

"The technology demonstrated is ripe for evolution of the legislation and framework"

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What's next?

Raising the electrical efficiency even further

- Trough advanced combustion
- -Through gasification systems

Reduced CO_2 emissions

- Combined biopower/CHP and CCS
- The only possibility for negative CO_2 emissions!