

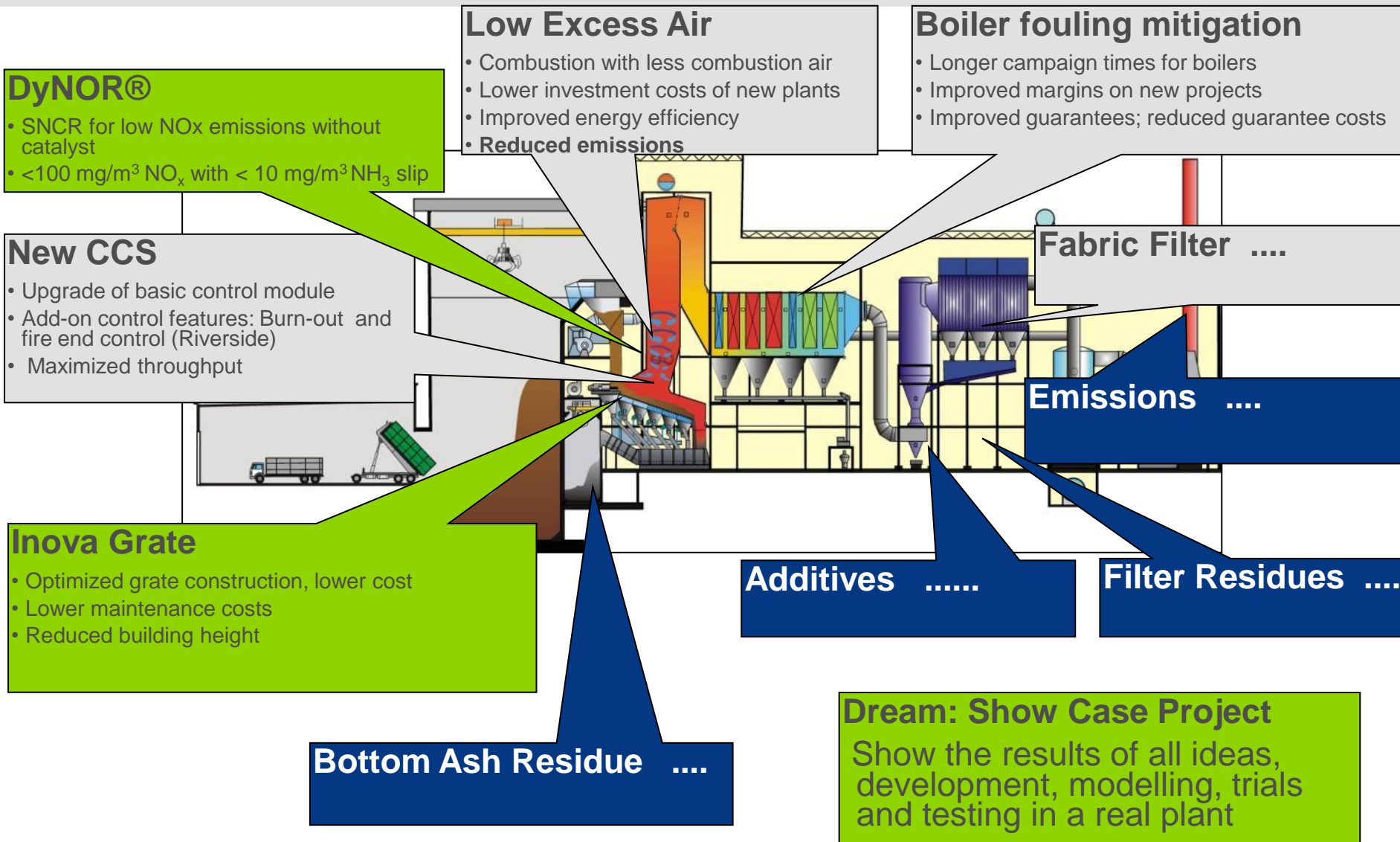


Hitachi Zosen
INOVA

Advances in Grate Combustion Technology

WTERT 2012 Conference, Columbia University, October 18

R&D Director's Dream



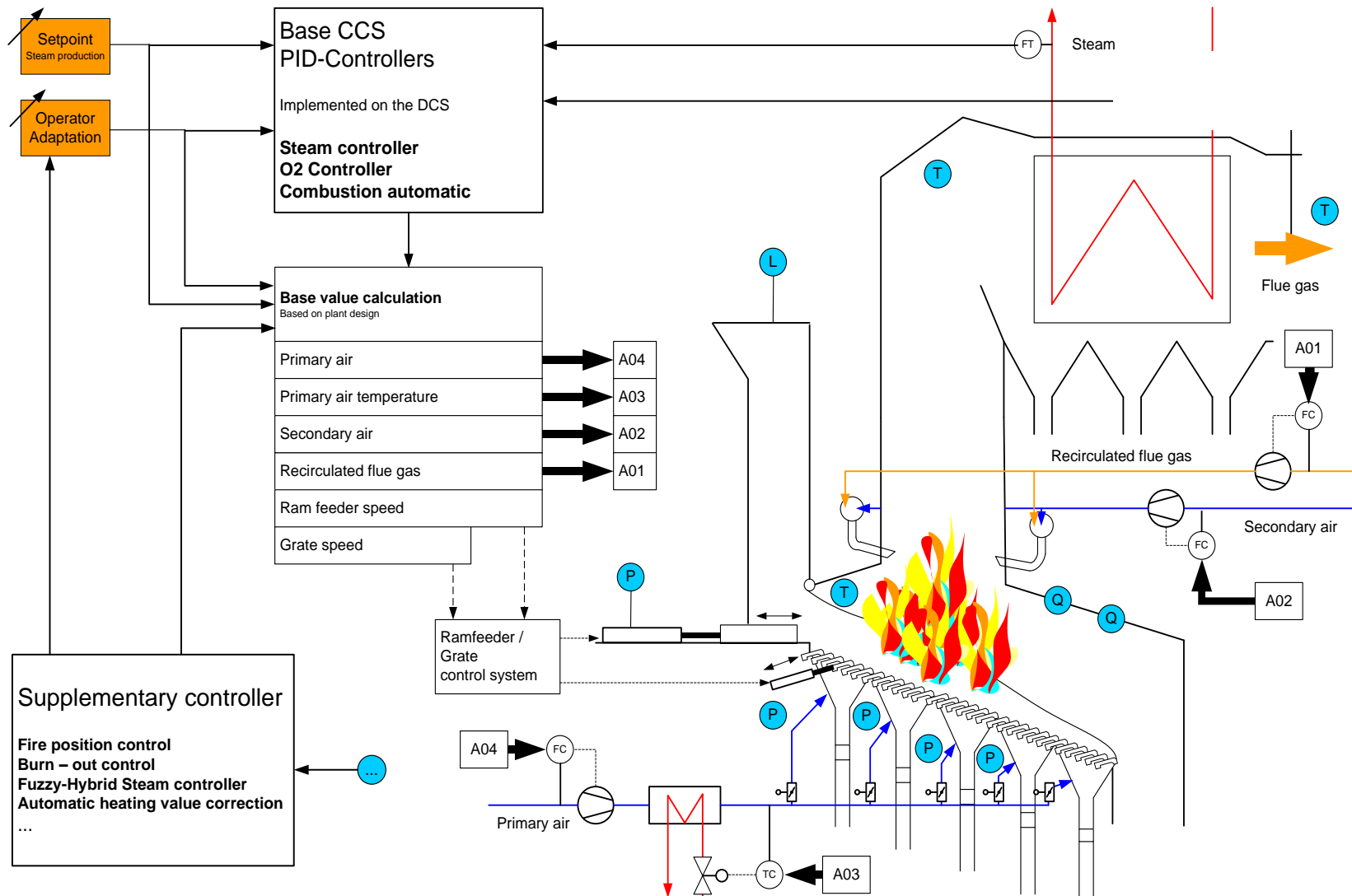
1) Inova Grate



Features of the Inova Grate

- Combines all positive aspects from cumulated years of experience
- In particular the Inova Grate is built to:
 - Accommodate a wide range of fuels
 - various configurations
 - air and water cooled
 - more grate movement controls
 - Further reduce burnout
 - Reduce plant building height (compared to Von Roll grate)
 - less inclination
 - Minimize investment costs
 - lower weight, fewer parts
 - Reduce maintenance costs
 - easy access
 - Improve plant availability
 - less and shorter outages

2) New Generation Combustion Control System (CCS)



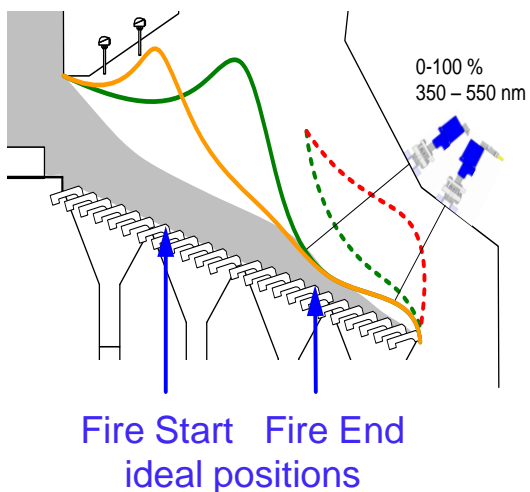
2) New Generation CCS Features

Fire Position Control Burnout Control

Ideal temperature
distribution on grate

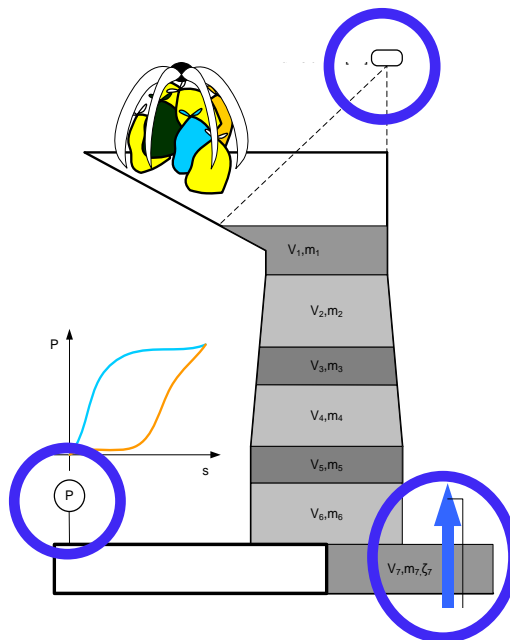
Early fire start

Late fire start



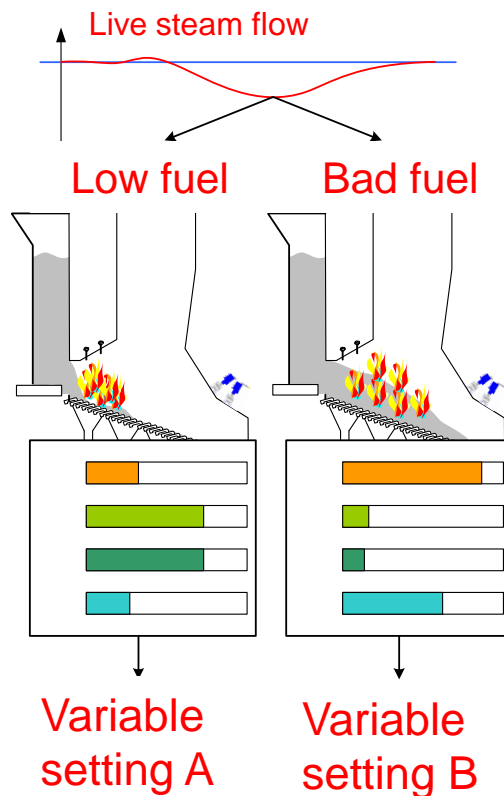
Early Detection of Fuel Property Changes

Use existing or new
data to calculate feed
properties

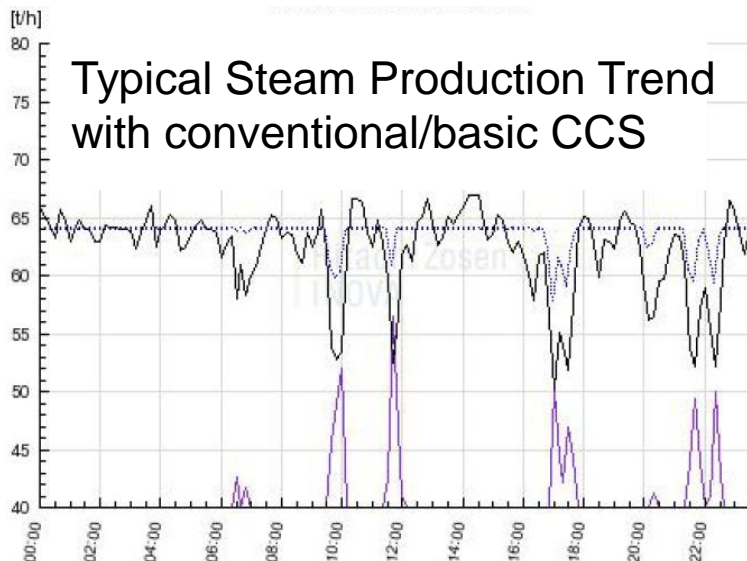


Reduce Load Drops

Determine reason for
Load Drop



2) New Generation CCS Benefits



Sample calculation 2 x 500 tpd - 19 days:

█ Steam production: 55'842 tons

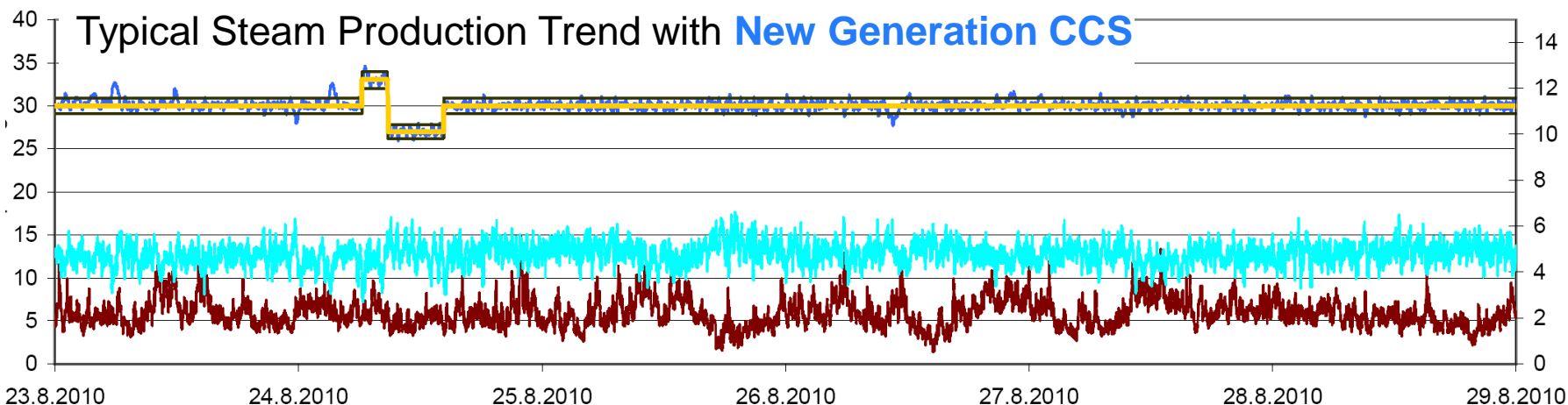
█ Lost steam production: 2526 tons

Extrapolated to whole year (330 days):

█ Lost steam production: 43'873 tons

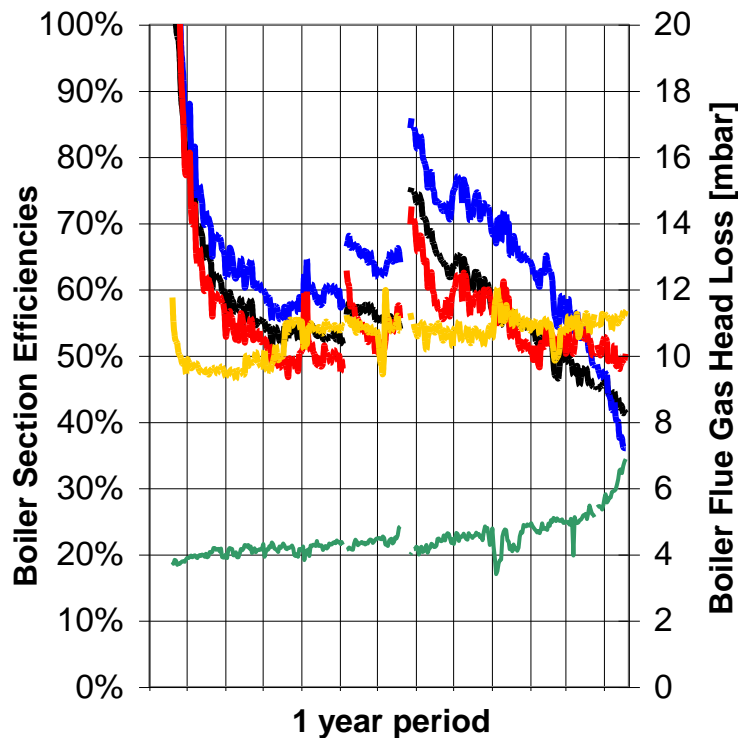
→ Lost electric production: 7239 MWh/y

→ Lost \$ (\$80/MWh): 579'119 \$/y

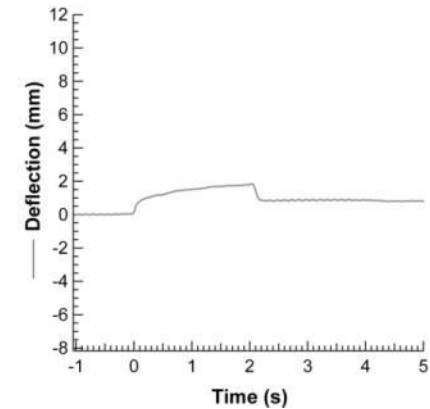
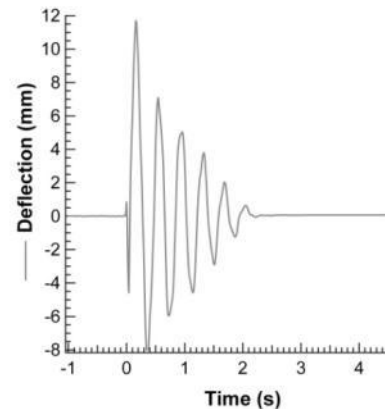


3) Boiler Efficiency Analysis and Intelligent Boiler Cleaning

- Scaling almost instantly reduces boiler efficiency
- Efficiencies are calculated for individual boiler sections
→ cleaning efforts are optimized

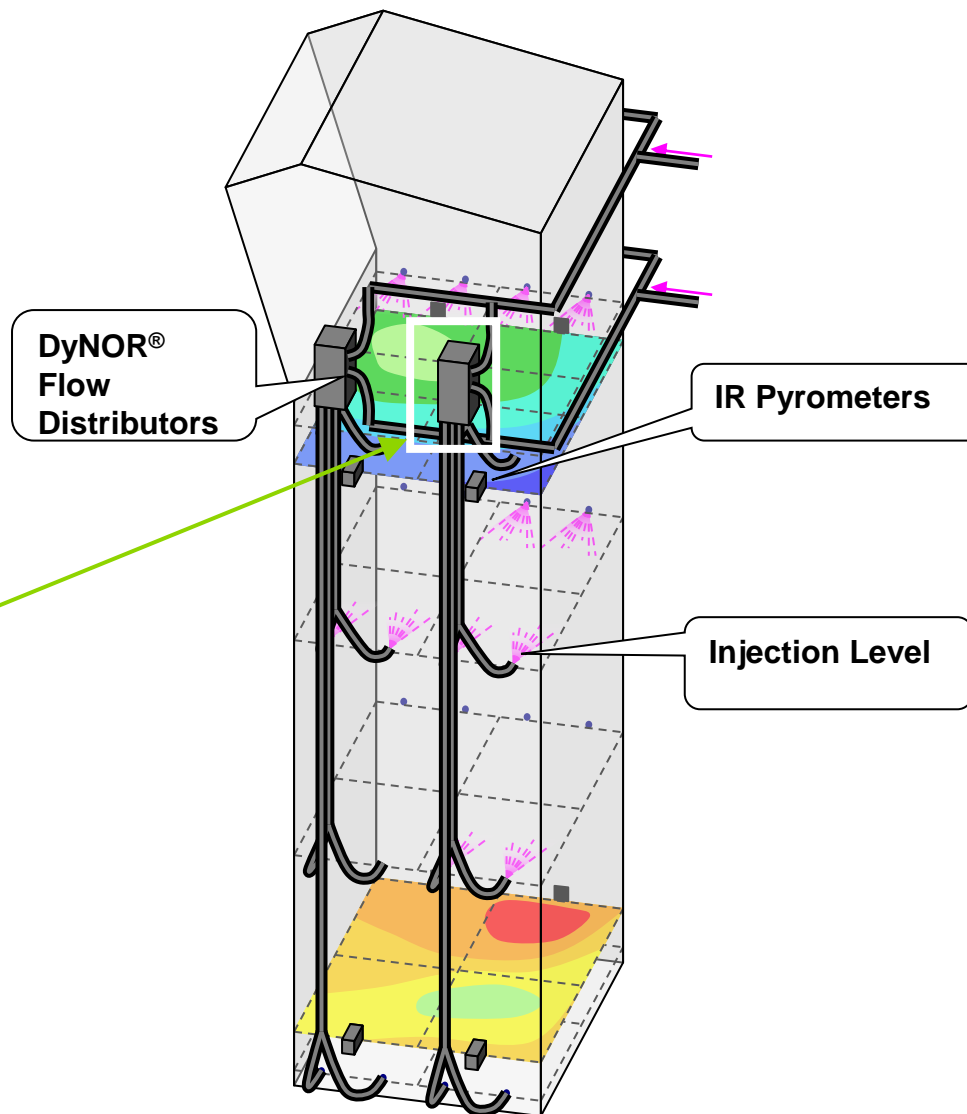


- Shower cleaning
- Explosion cleaning
- Automated and monitored pneumatic rappers:

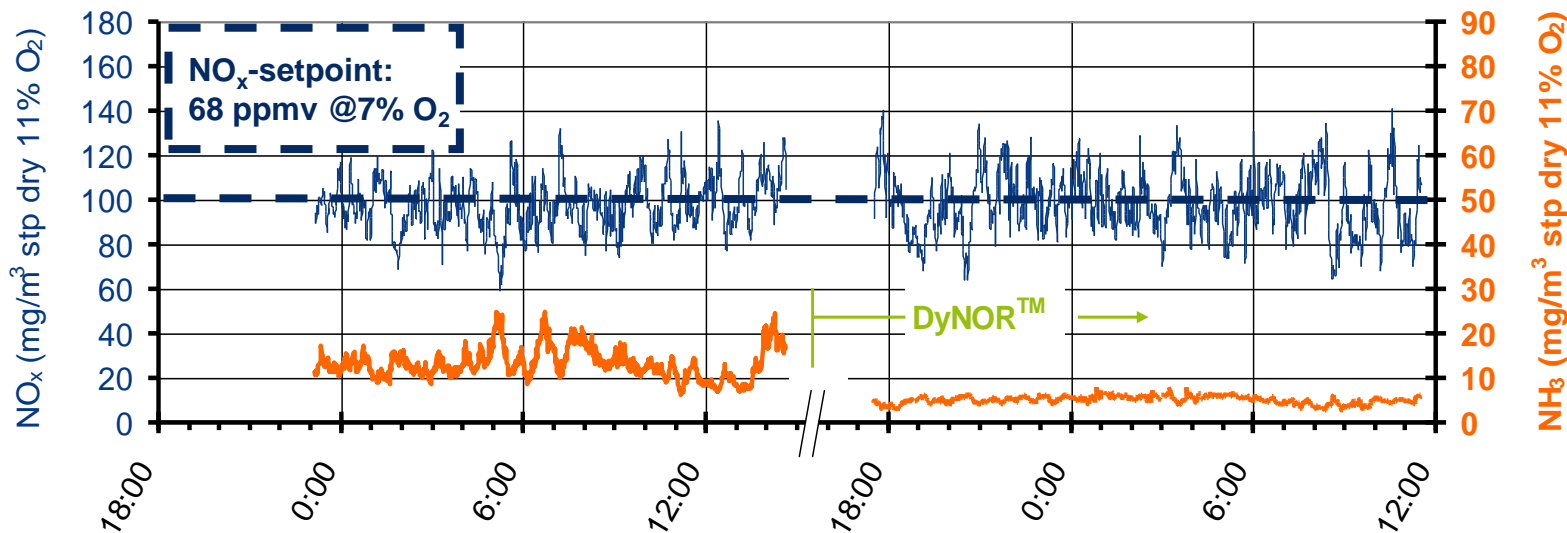


4) DyNOR[®] - Dynamic NOx Reduction

- Virtual segmentation of the boiler
- Quick temperature measurement
- Dynamic, precise and quick responding reagent injection



4) DyNOR[®] performance (before other measures)

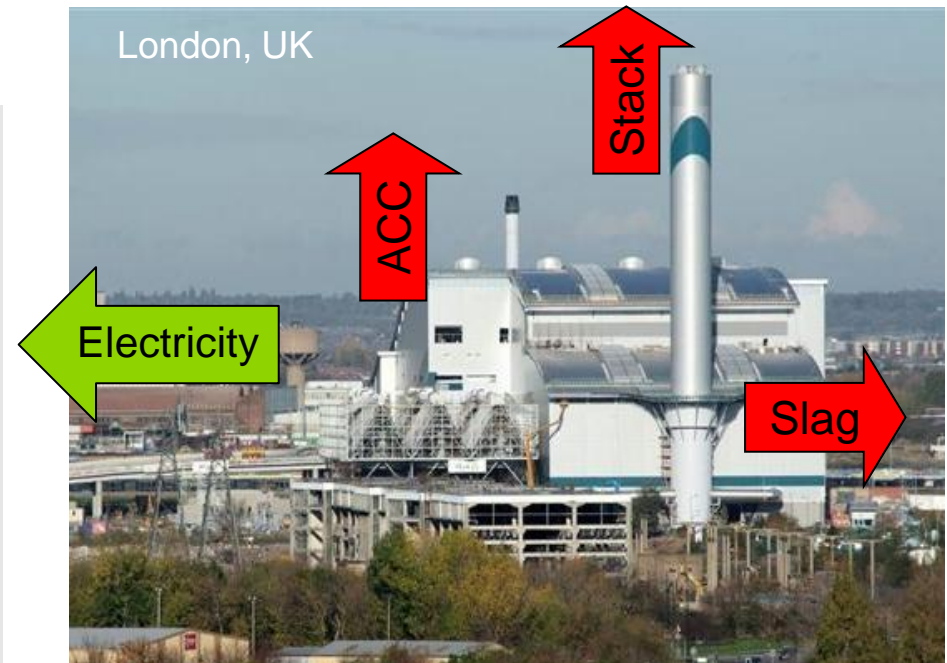
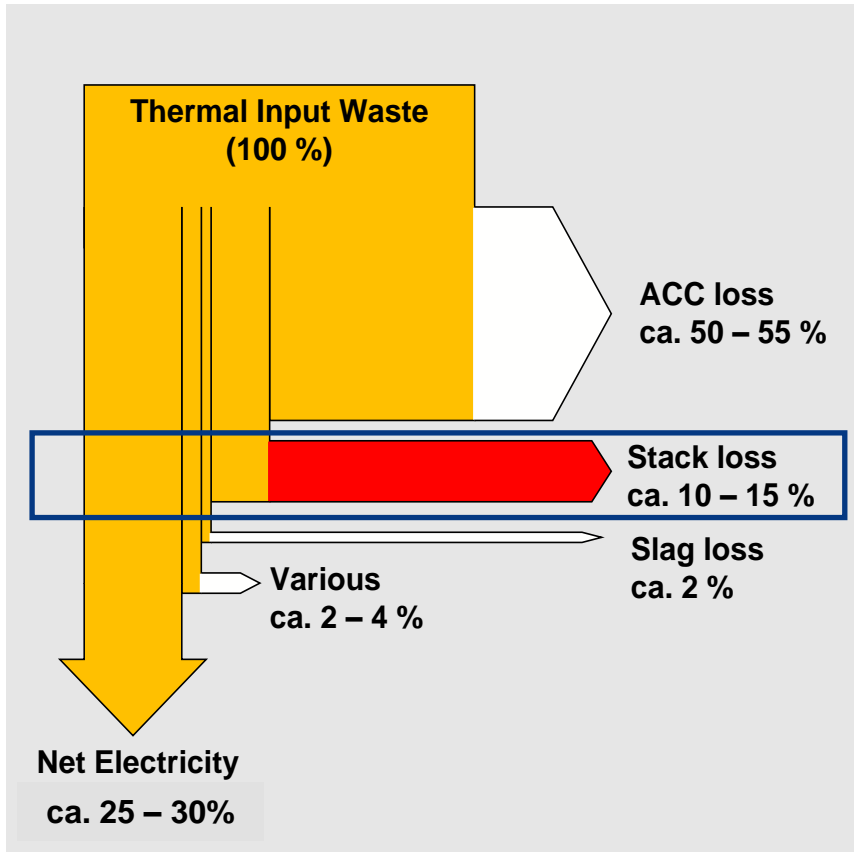


Results have been confirmed in other plants:

- Client: Westenergy OY
- Location: Vaasa, Finland
- Capacity: 1 x 520 tpd
61 MW_{th}
- Start-up: 2012



5) Energy Efficiency Improvement: minimize losses



- | Stack losses are significant
- | Roughly 10 – 15% of energy (LHV basis)
- | Efficiency improvement by ...
 - | ...lowering exhaust gas **temperature**
 - | ...lowering exhaust gas **flow rate**

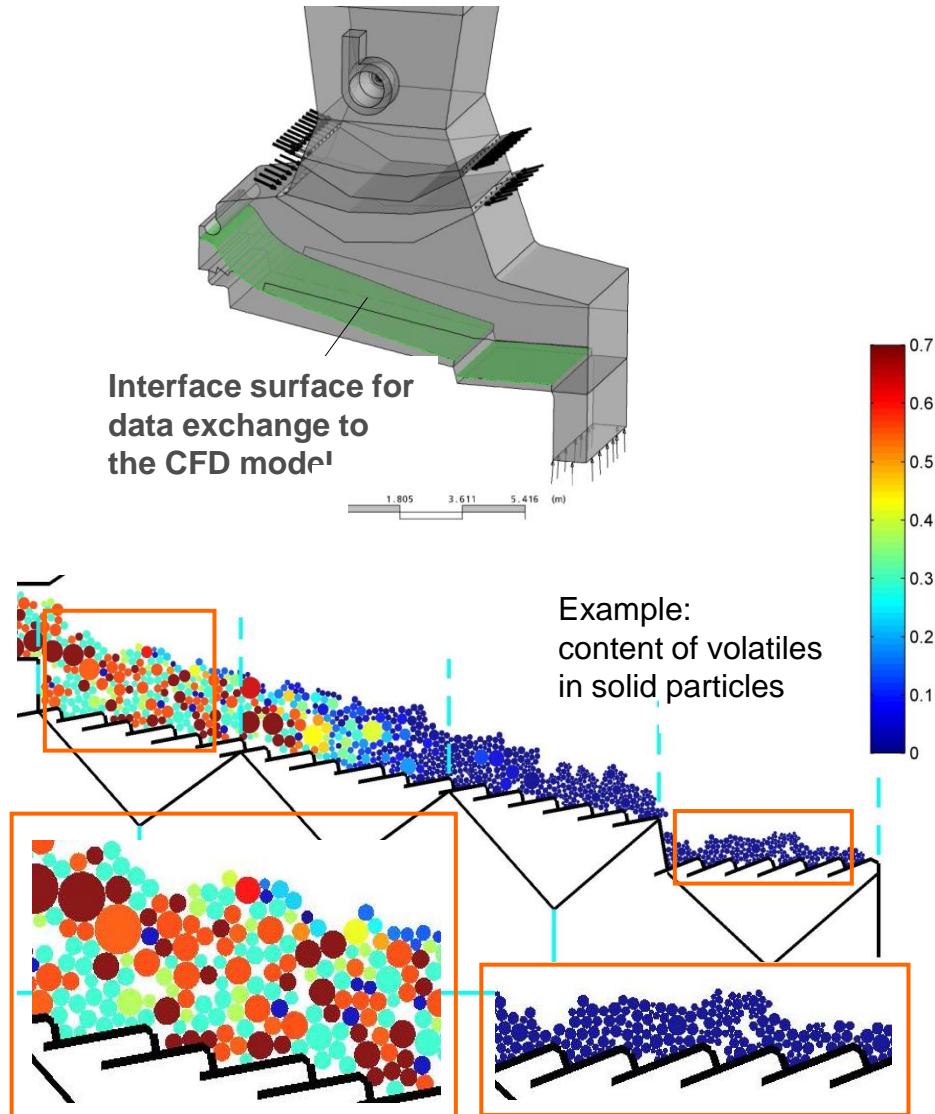
5) Energy Efficiency: after lot of modelling

DEM Model (Discrete Elements Method)

(in cooperation with LEAT / U of Bochum)

- Objective:
Numerical model of **movement** on grate and **thermochemical processes** within particles and gas phase

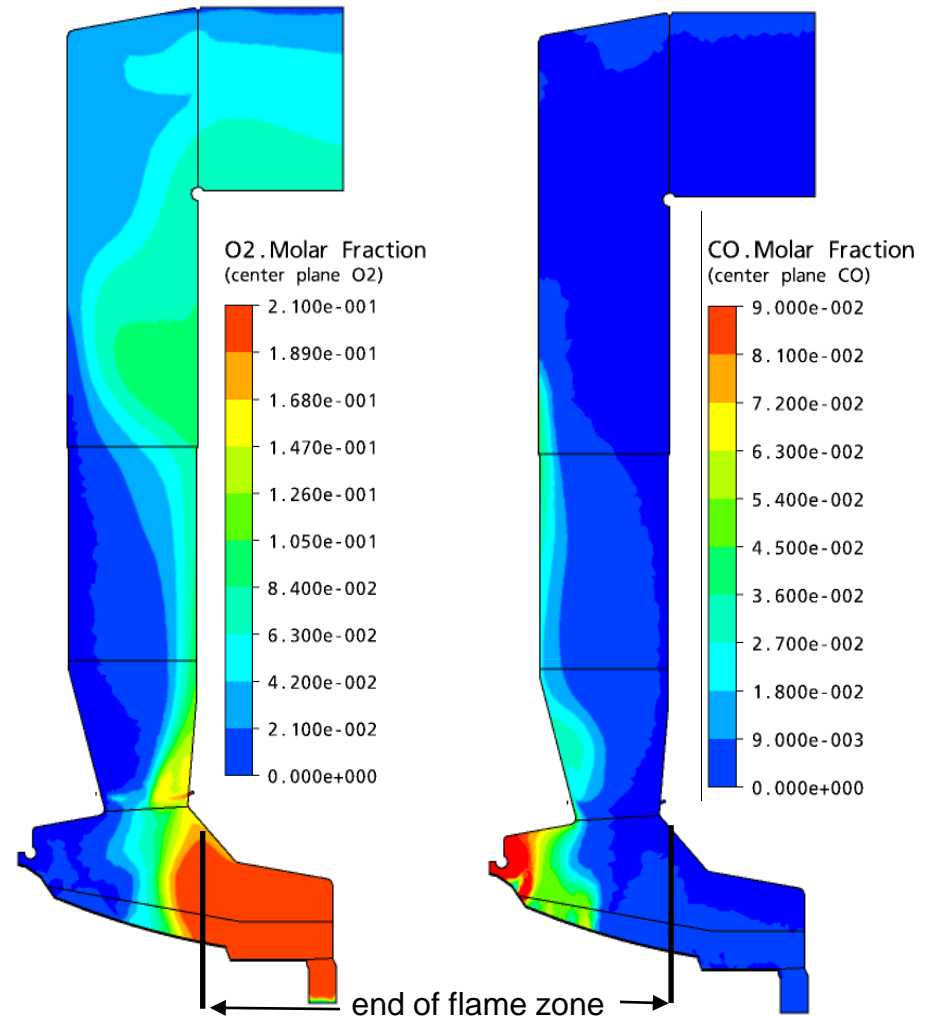
- Method:
coupling of various modelling modules to account for:
solid mechanics/ **particle movement**
drying/gasification/pyrolysis of particles
heat transfer to/within particles
gas flow pattern and **burn-out** of gases
radiant heat transfer



5) Energy Efficiency: ..and even more modelling

Results:

- | Good agreement of modelled and measured temperature and oxygen profiles
- | Identification of two extreme gas conditions:
 - | **Feed end**
 - | oxygen: 0 – 10 %
 - | CO: 5 – 20 %
(varies greatly in time)
 - | hydrogen: 2 – 5 %
 - | **Discharge end**
 - | oxygen: 20 %



5) Energy Efficiency: the Solution

New Patented Premixing Solution

With premixing on...

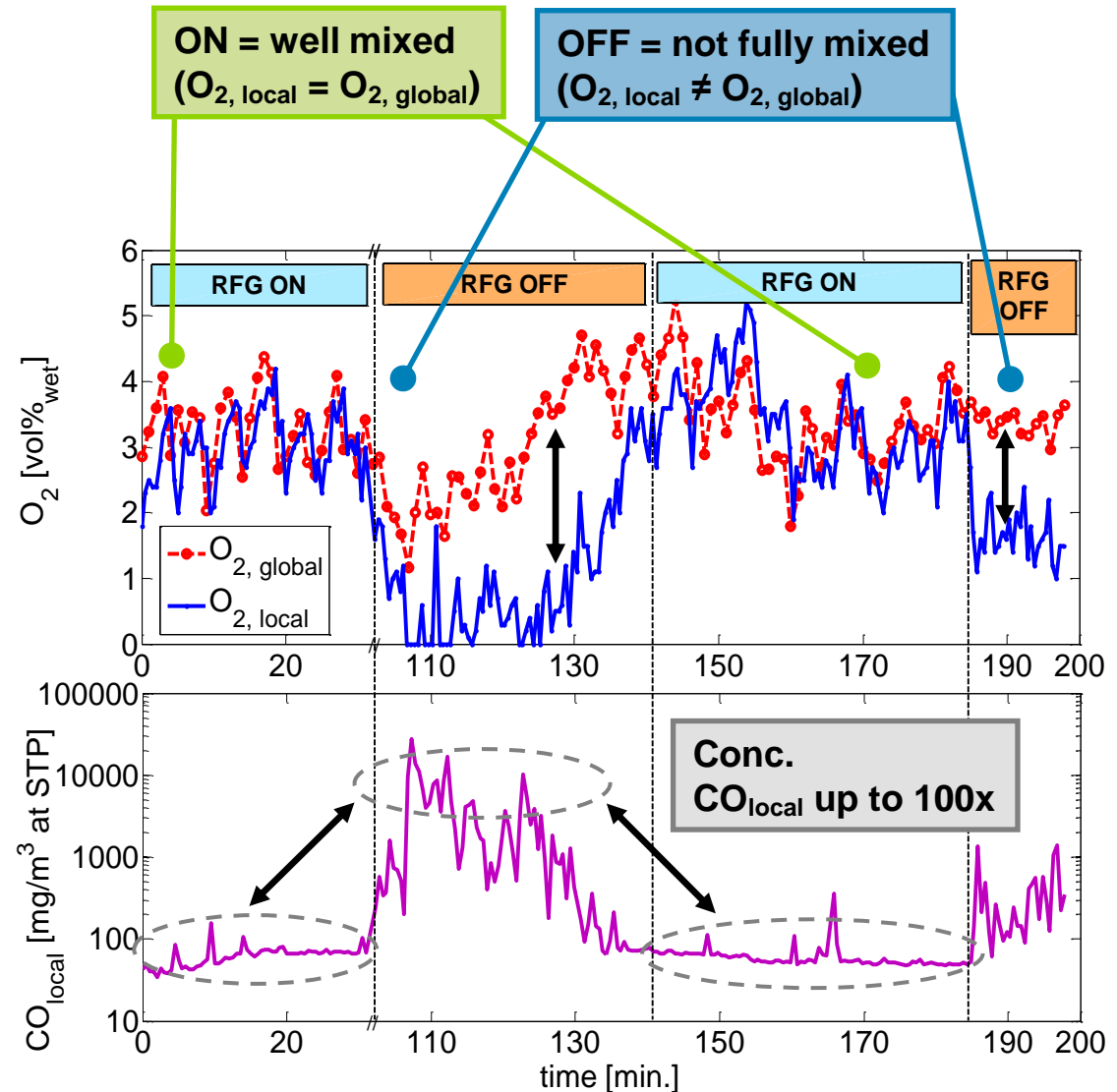
- local $O_2 = O_2$ at stack
- local CO homogeneous and low

Flue gas flow

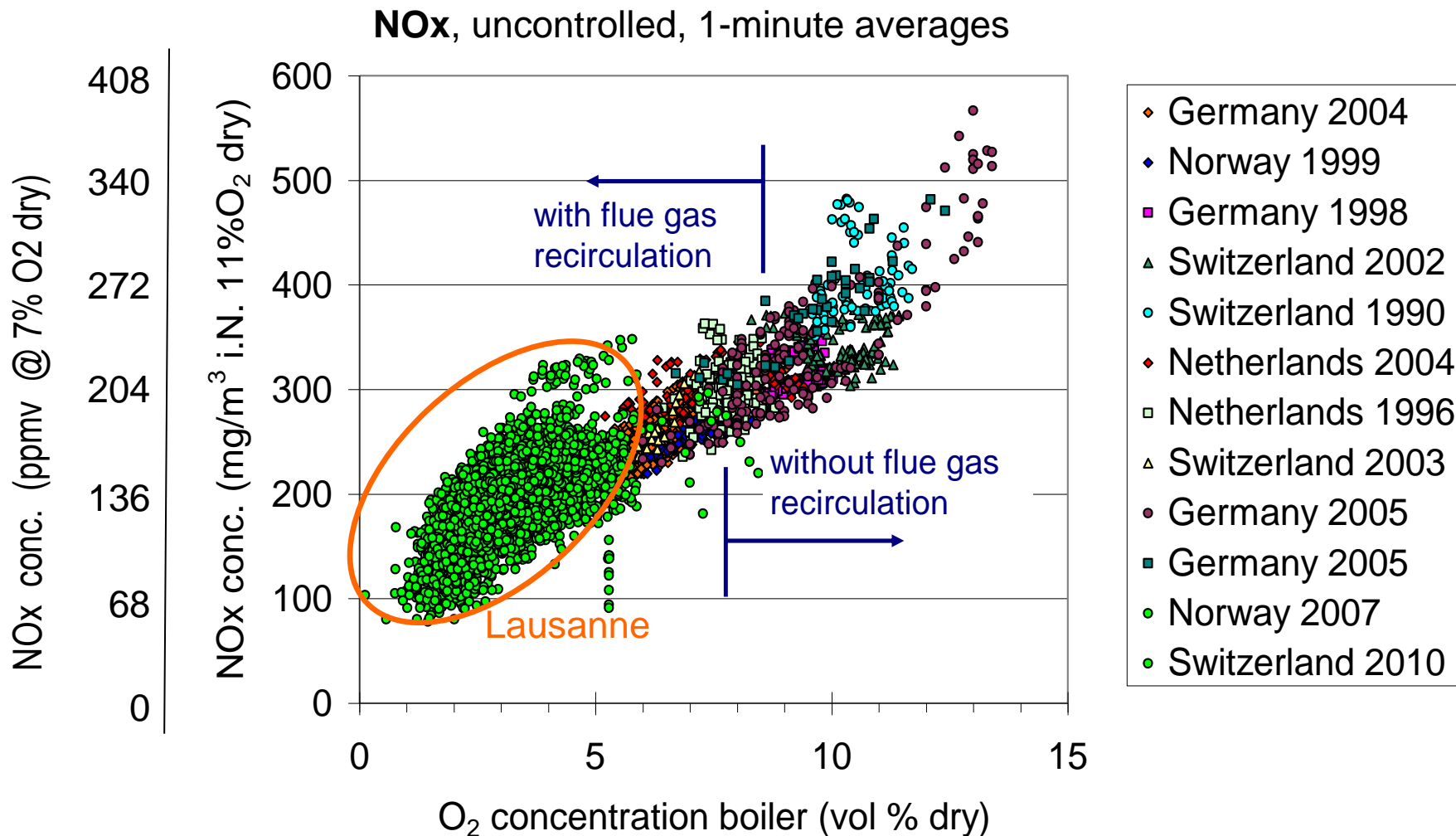
20% lower ($\lambda < 1.20$)

Expected electricity prod.

4% higher



5) NOx generation



And R&D Director's Dream Came True: RENERGIA

- | Location: Perlen, near Lucerne, Switzerland
- | Capacity: 2 x 410 tpd
2 x 47 MW_{th}
- | Contract: 04/2012
- | Start-up: 01/2015
- | Many of the above described new developments will be included in this plant



Thank you for your attention

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