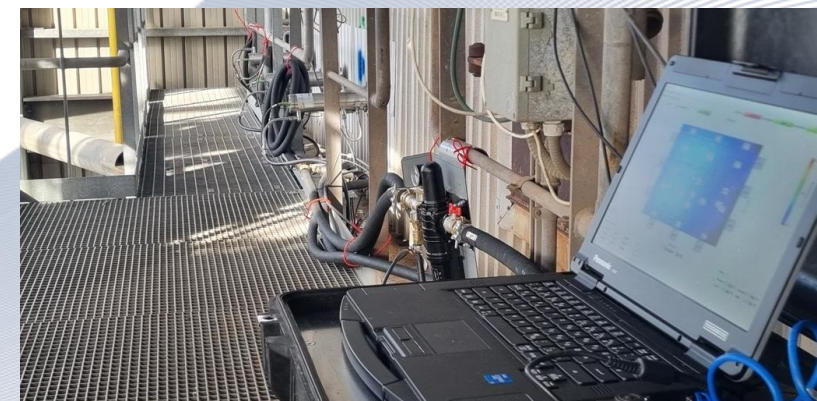


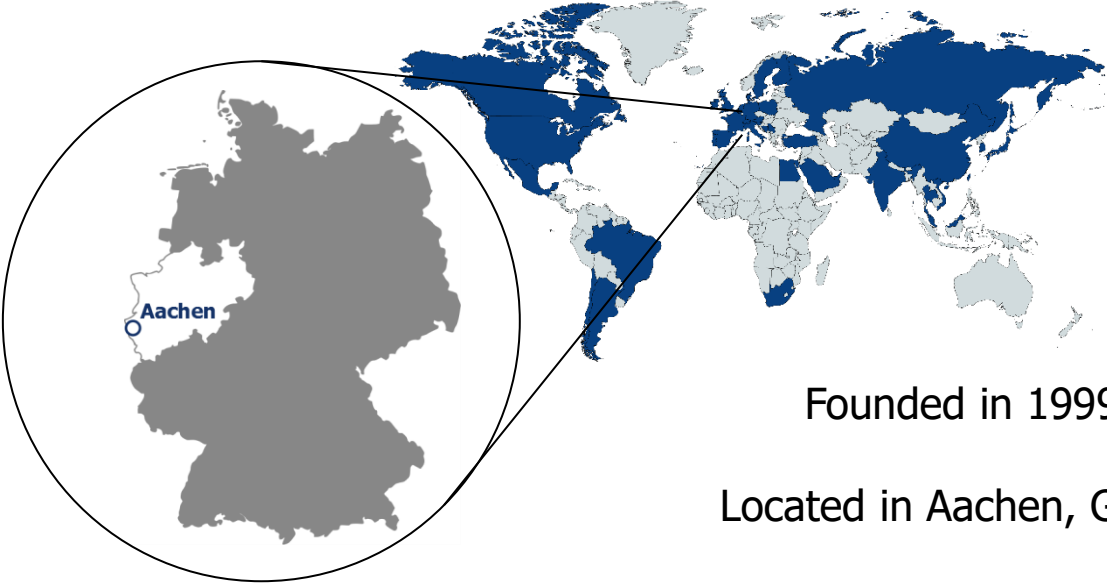
Smart online diagnostics, advanced data management & analytics to improve plant operation & combustion control

47th PREWIN Meeting, Dublin, Ireland

Francesco Turoni, Eutech Scientific Engineering GmbH, Germany



Company Profile



Founded in 1999 (1995)

Located in Aachen, Germany

1000+ executed engineering projects

International teams of highly qualified engineers

Global customer base from various industries

Regional engineering partners in Australia, USA, China, India, Vietnam, Taiwan, Europe, Brazil, Korea and Japan



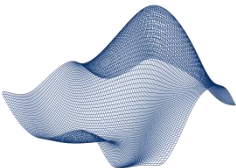
-  Digital Solutions
-  Energy Solutions
-  Testing Solutions



Data Management and
Field Test Support



Diagnostics



Simulation & Control



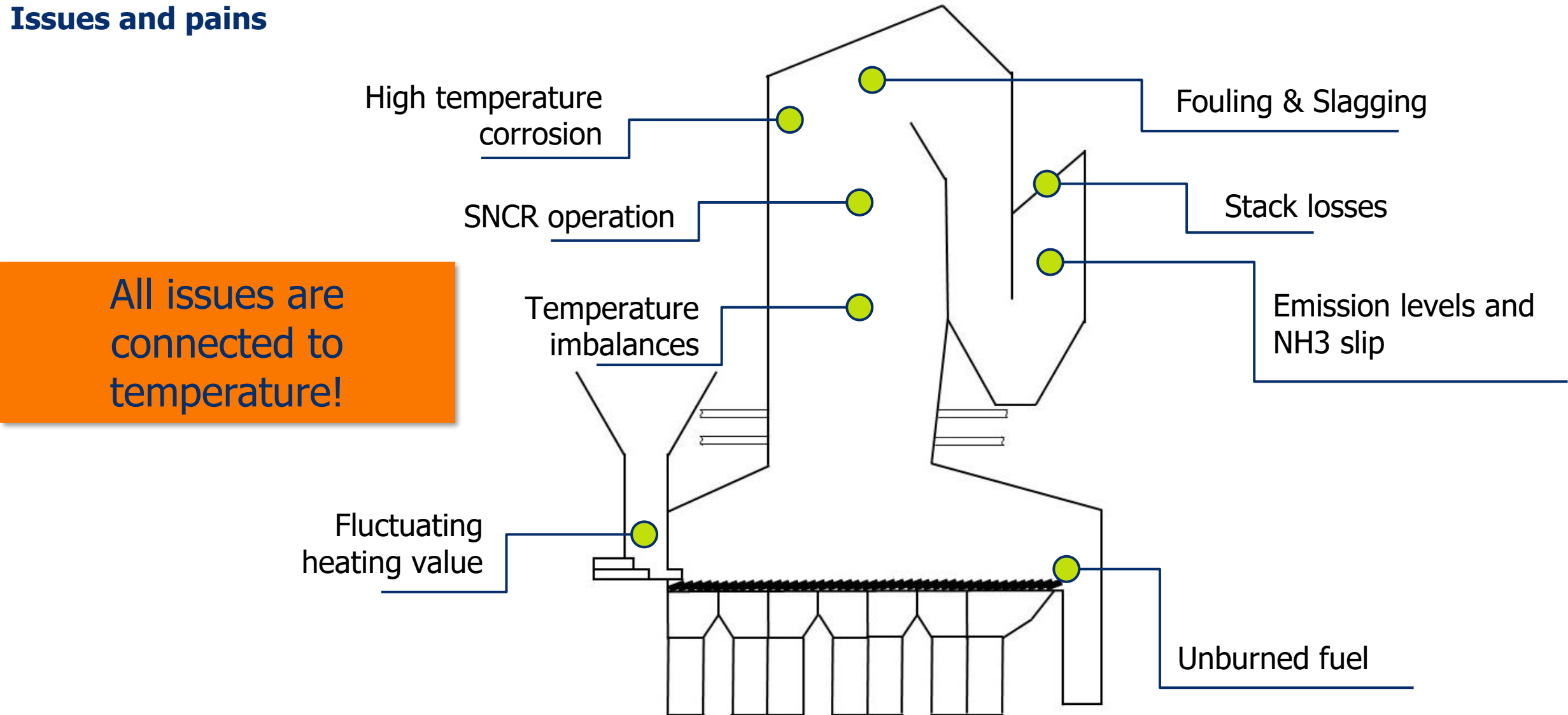
Services

Challenges in Waste-to-Energy (WtE) plants

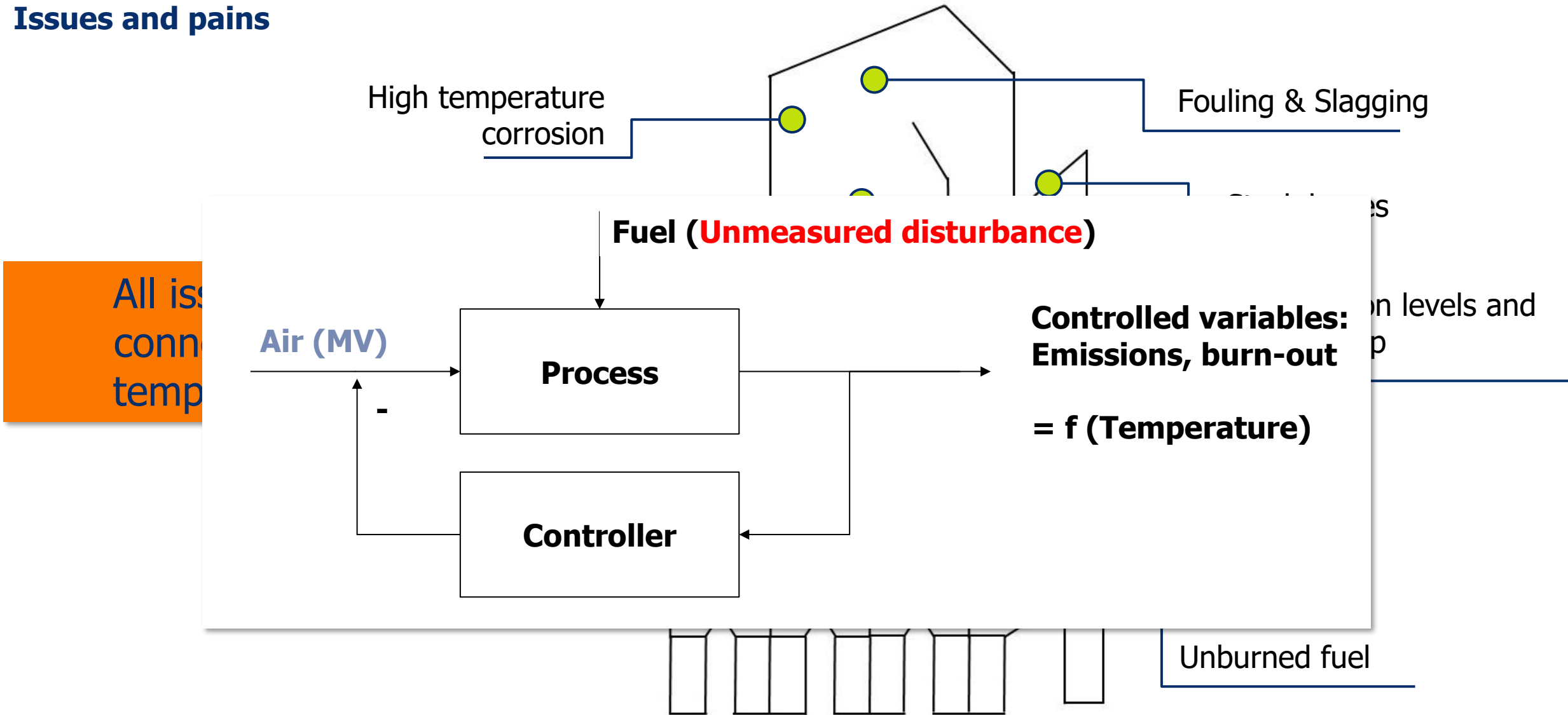


Combustion challenges & optimization potentials

Issues and pains



Issues and pains

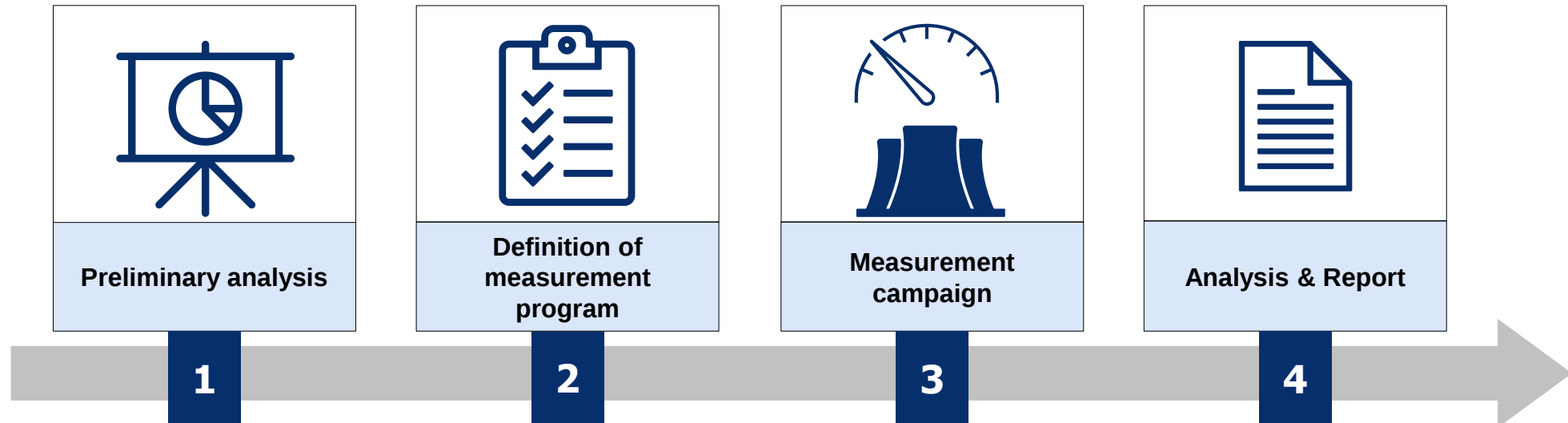


EUTech's Combustion Performance Assessment (CPA)



Intelligent determination of key process parameters in WtE

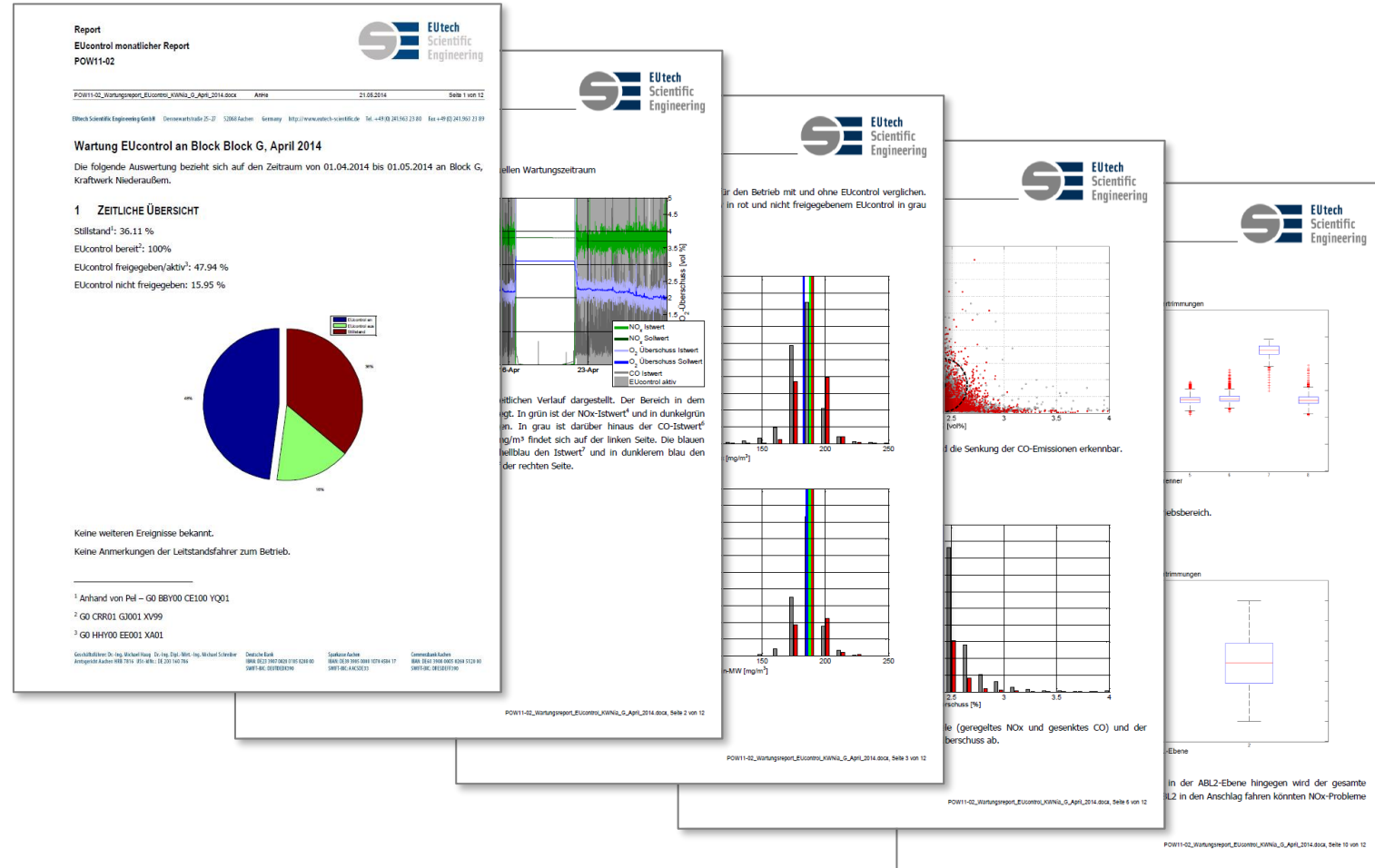
- Clarification of customer pains & objectives
- Analysis of combustion process using historical DCS data (Load, emissions, PA, SA, etc.)
- Generation of testable hypotheses
- Application of temporary online diagnostics
- Tests in close cooperation with plant personal
- Reporting with recommendations of actionable measures



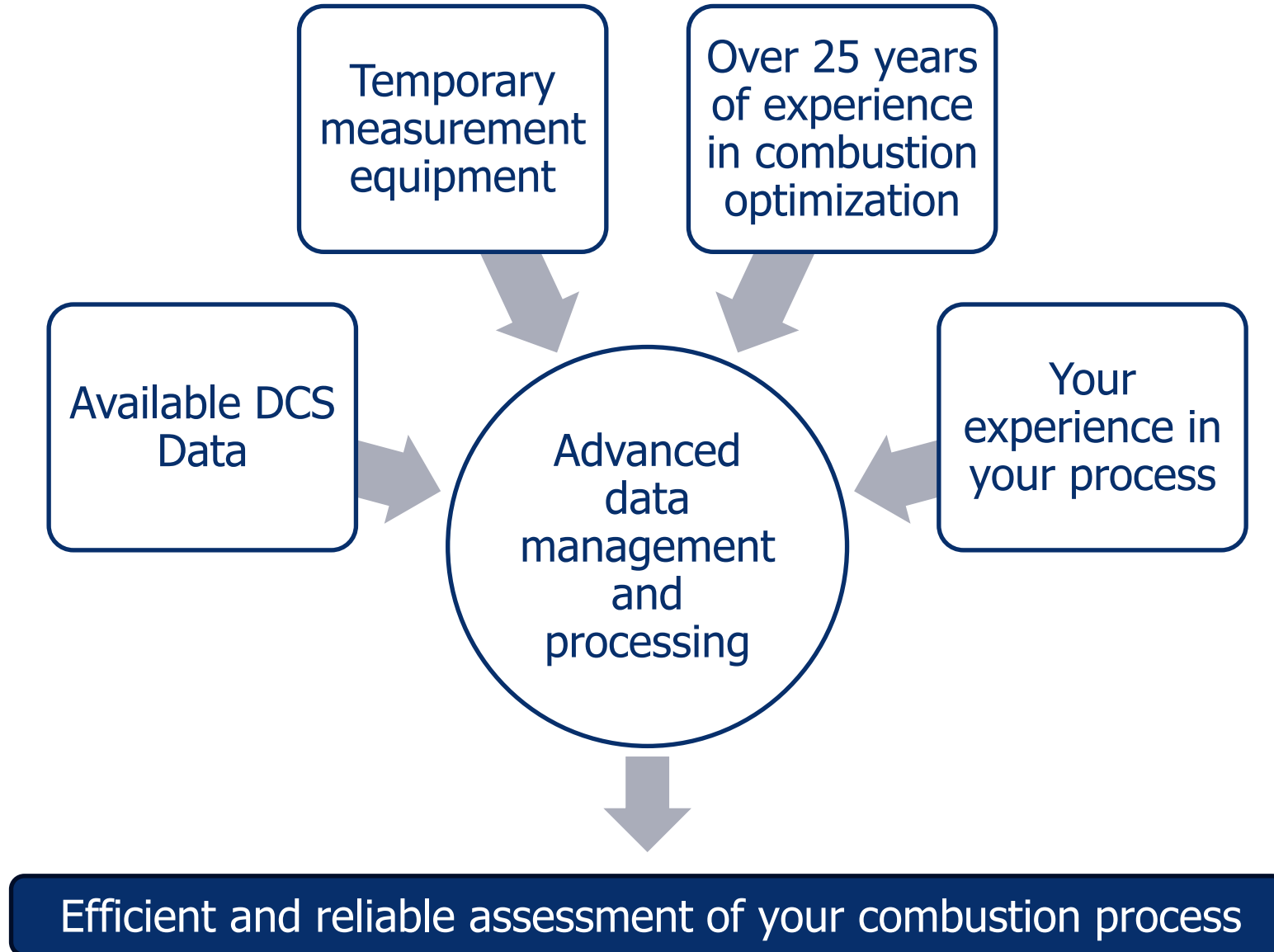
Data analysis - key to combustion improvement

Status quo

- Using existing historical data to obtain information about the relationship between the most important variables and objectives
- Standard reports
 - KPIs
 - Availability
 - Performance
- Specific analysis
 - Root-cause
 - Sensitivity analysis
- Customized report



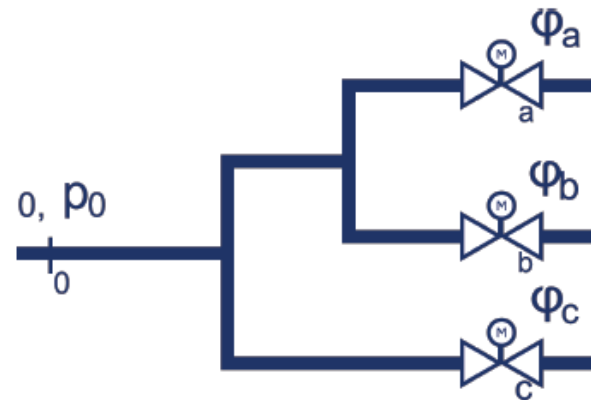
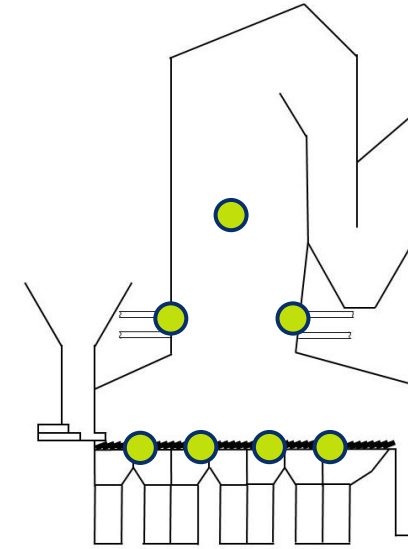
Benefits of Eutech's CPA



Combustion Performance Assessment

Intelligent determination of key process parameters in WtE

- Standardized procedure & turn-key service
- Adaptation to customer objectives
- Easy and quick application of online diagnostics (FEGT, airs, etc.)
- Efficient data analytics (benchmarking)
- Proof by real-time tuning/optimization



Combustion Performance Assessment **HERAmbiente - WtE Pozzilli (IS), Italy**



HERAmbiente - WtE Pozzilli (IS), Italy

- Plant Powered by Renewable Sources (RES power plant)
 - 1 x 50 MW_{th} unit, using waste derived fuel (WDF)
- Martin grate incinerator
 - 3 grates with 4 combustion zones each
- DeNO_x-System
 - SNCR system with 2 levels & 4 injectors per level
- Objectives
 - Potentials of SNCR system for meeting future NO_x targets
 - Enhancement of primary combustion process
- Why EUtech?
 - Online mobile diagnostics for air and temperature
 - Over 25 years of experience in combustion process applications
 - Cost-effective Combustion Performance Assessment service



Combustion Performance Assessment

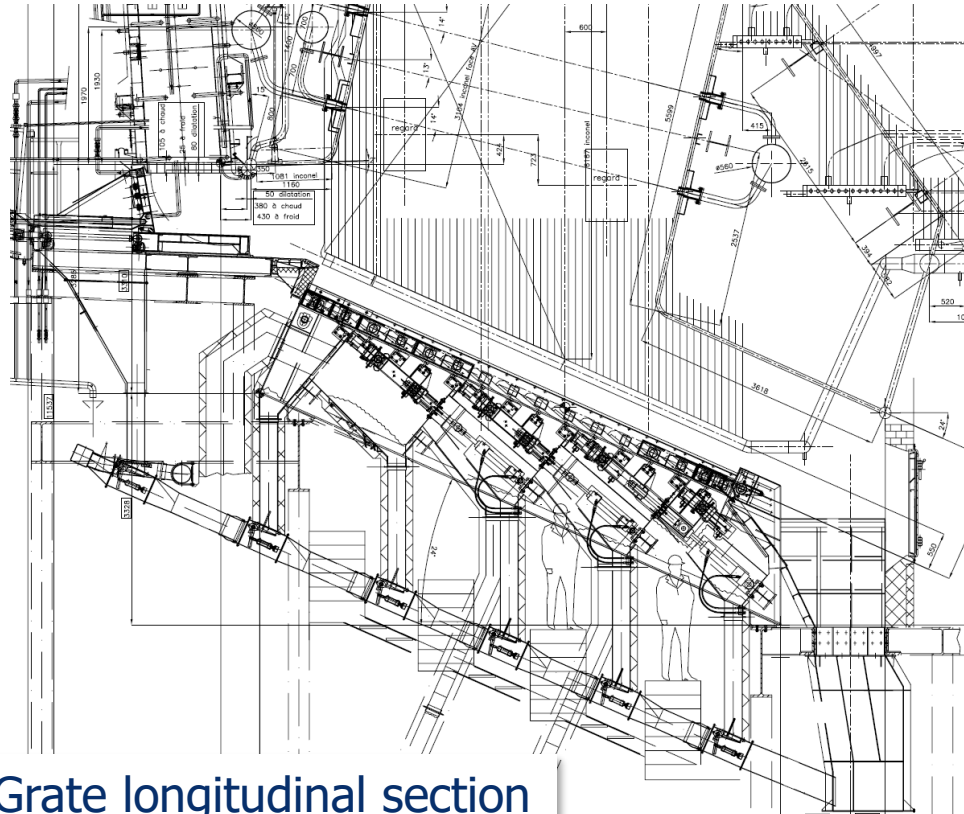
Preliminary analysis



Preliminary analysis

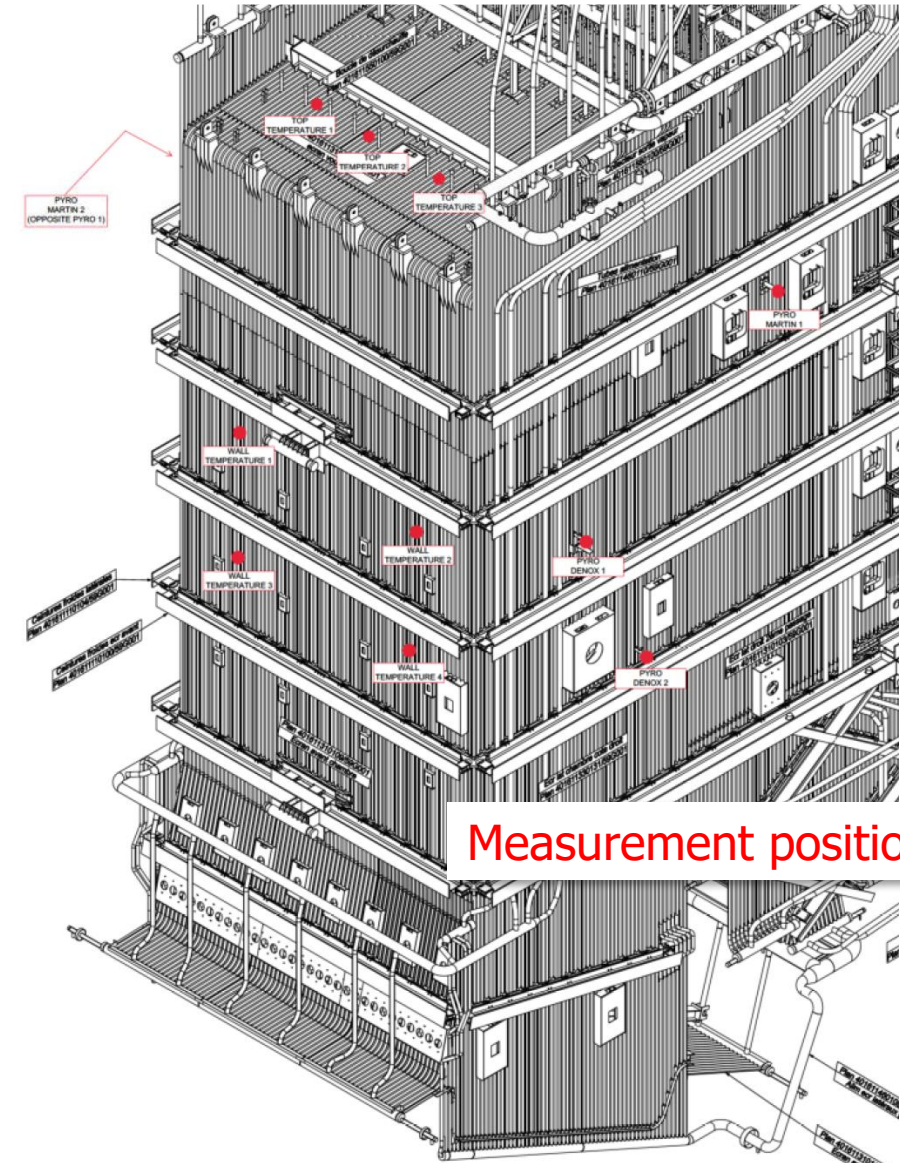
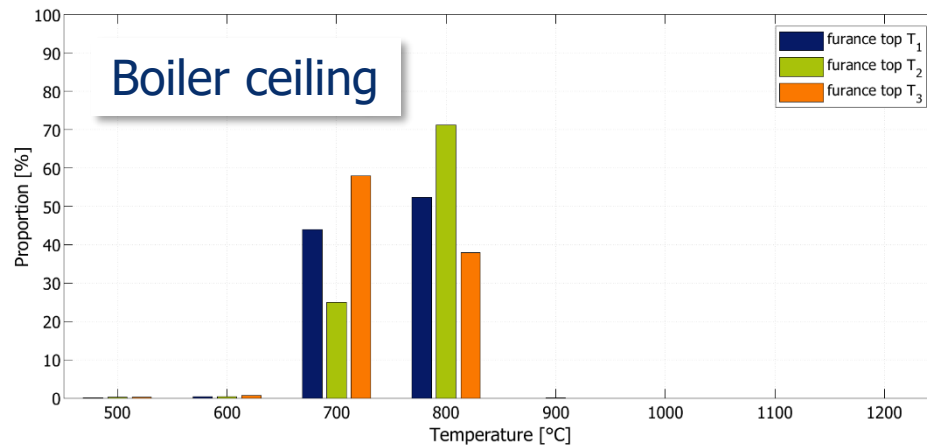
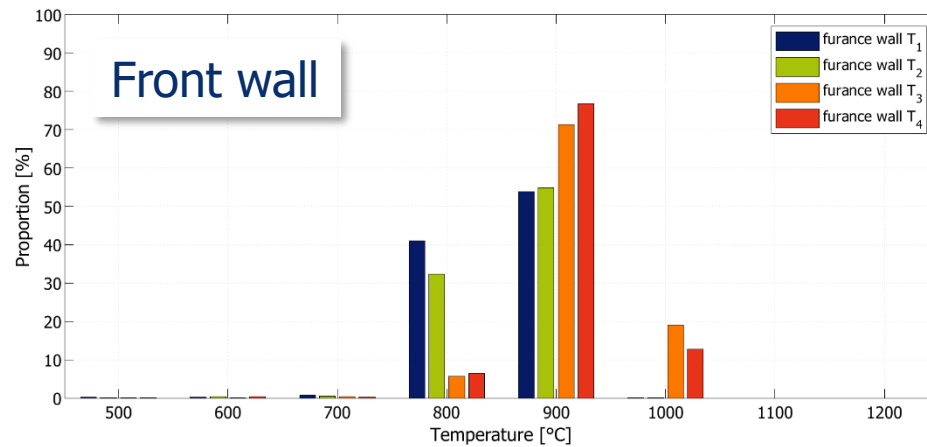
Air flow distribution on the grate

- Similar primary air flow distribution along the combustion zones between the grates



Temperatures

- Measurements at different locations and elevations
- Temperatures show sensible deviations and fluctuations



Hypotheses

- **Preliminary analysis**
 - Fluctuation of emission values at all operation loads
 - Similar air distribution (PA) along the combustion zones between the grates
 - Local temperature measurements show deviations and fluctuations

- **Hypothesis 1** The waste flow rates are most probably non-homogeneous on the three (3) grates

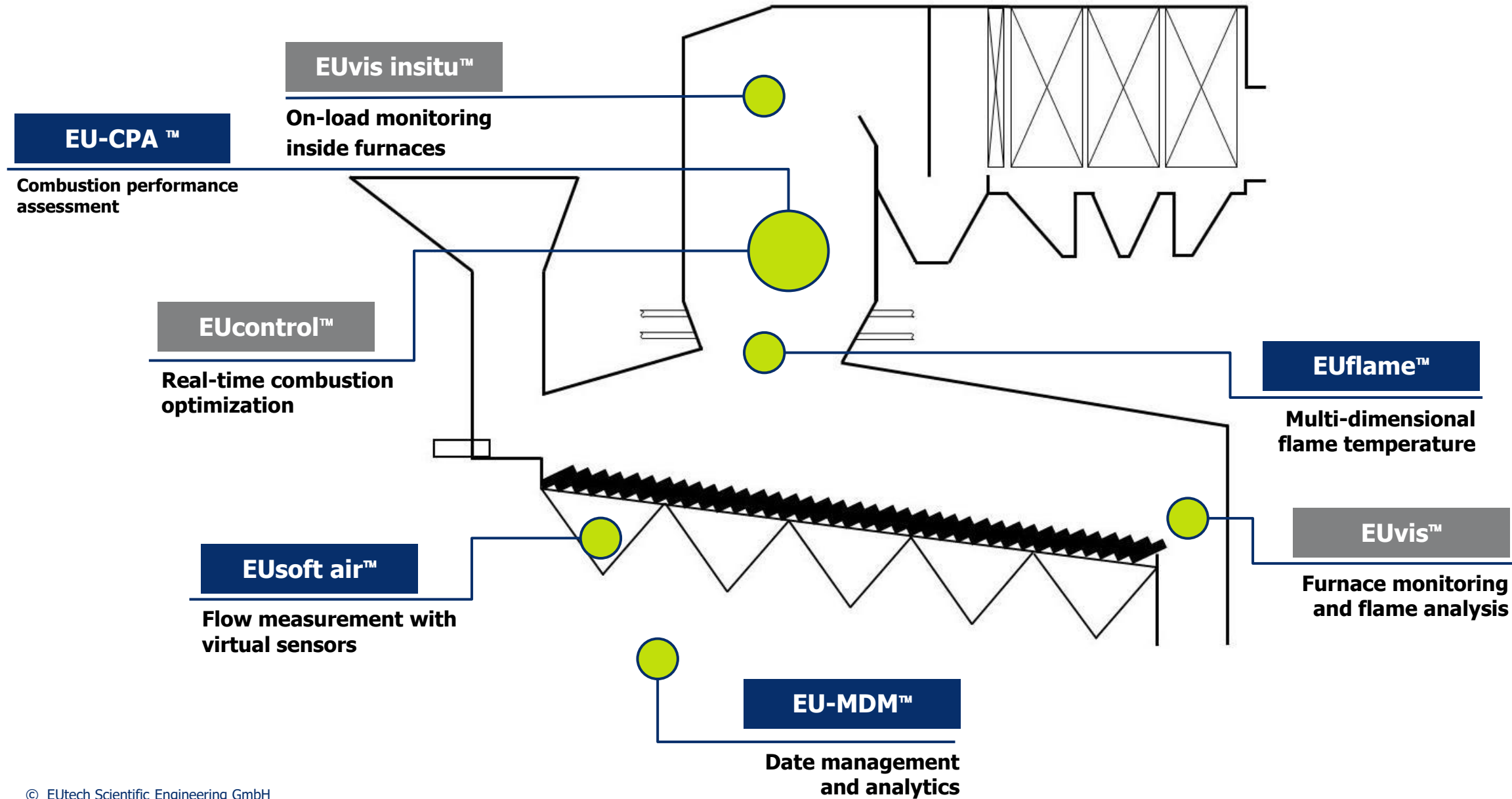
- **Hypothesis 2** The FEGT level and distribution over the boiler cross section are relatively dynamic

- **Hypothesis 3** DeNO_x operation is negatively affected by dynamic flue gas temperature fluctuations

- **Hypothesis 4** Uneven fuel leads to steam flow, O₂ & CO fluctuations without changing air flows

- **Hypothesis 5** With adjustments in the air path, the combustion and boiler operation can be improved and thus the emissions better controlled/reduced

Smart online diagnostics & advanced data management



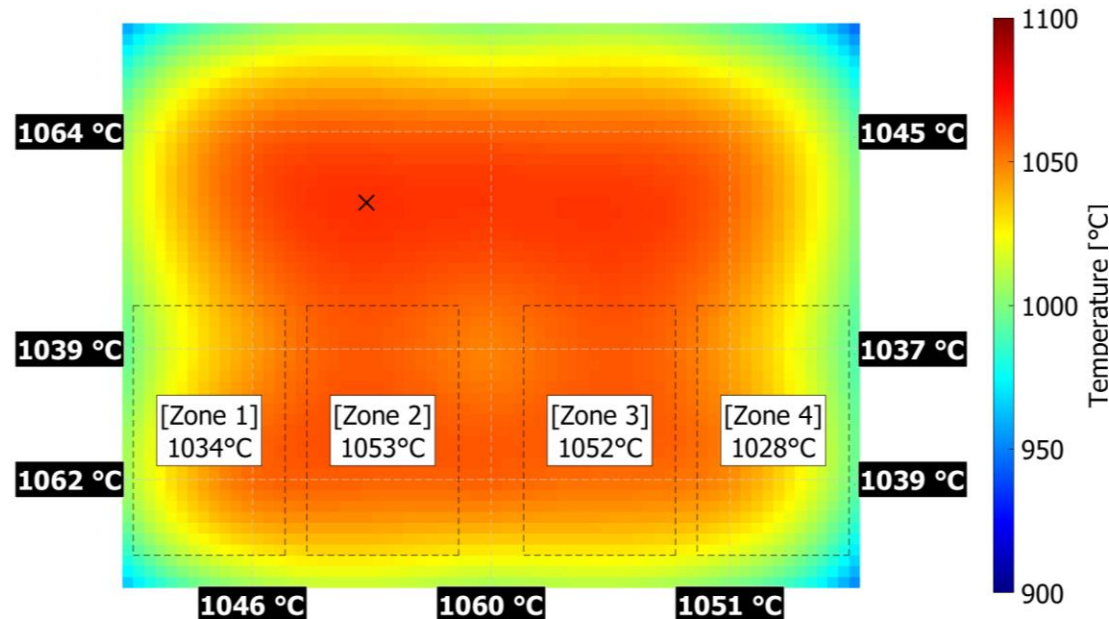
Results



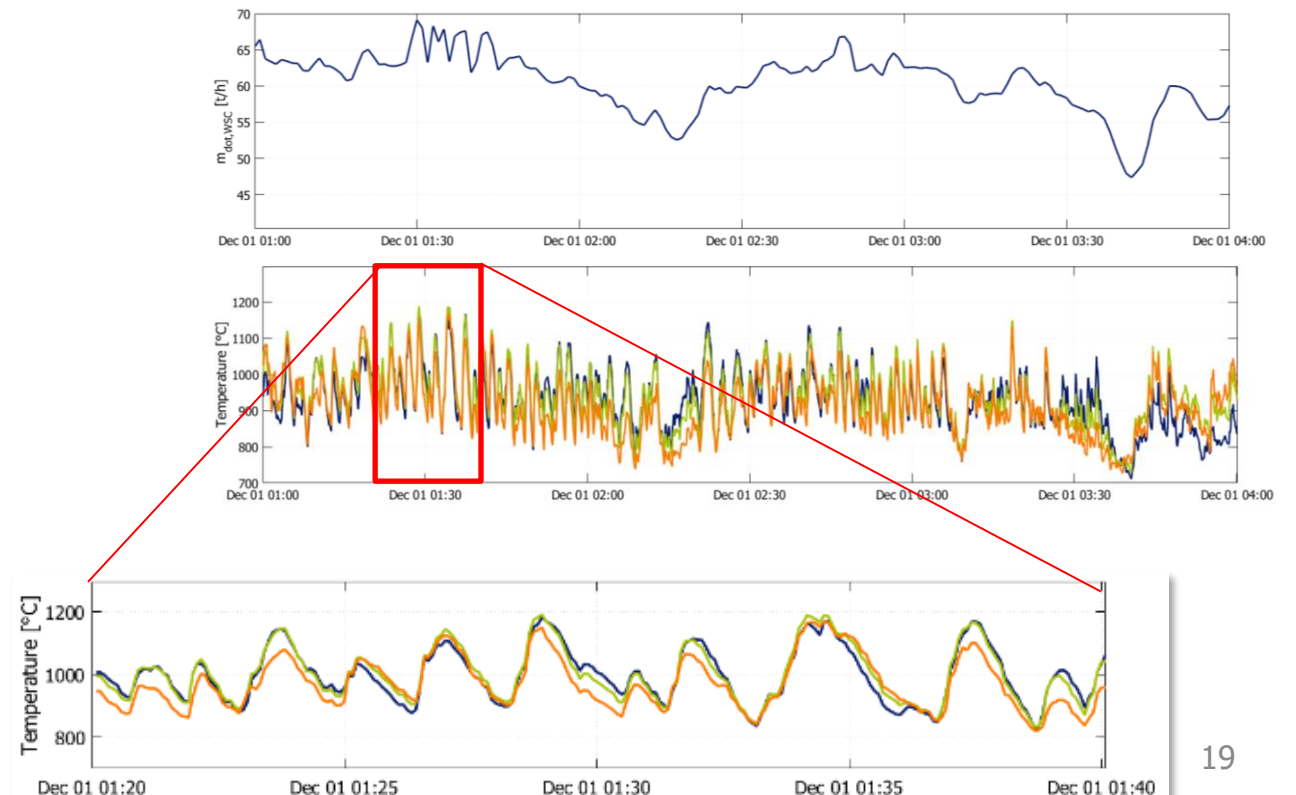
Hypothesis 2 (EUflame): FEGT distribution and dynamic fluctuations

- The results show a quite even distribution of exhaust gas temperatures (FEGT) with a mean deviation of about 50 K
- Nevertheless, exhaust gas temperatures fluctuate dynamically with an amplitude up to 300 K and a relatively constant period of about 3 minutes

2D-FEGT distribution at 22-meter level

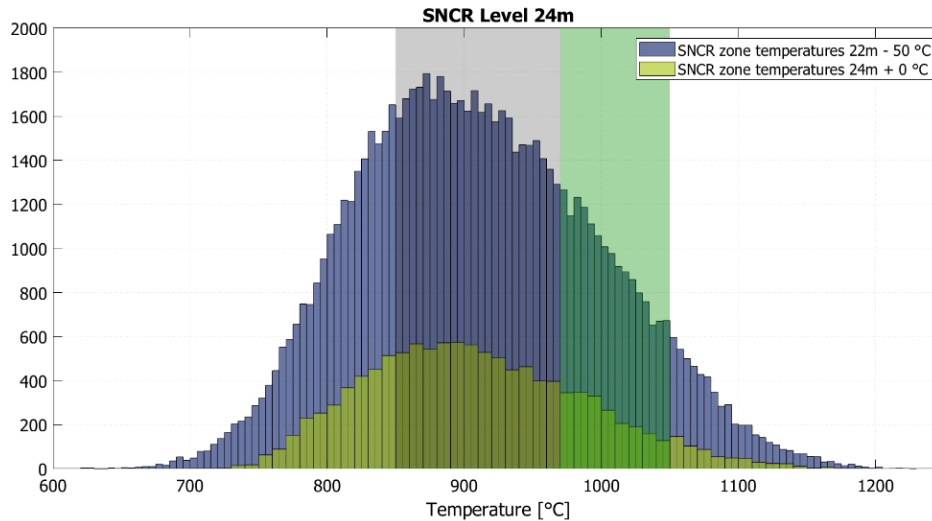


Steam flow & FEGT zones at 22-meter level

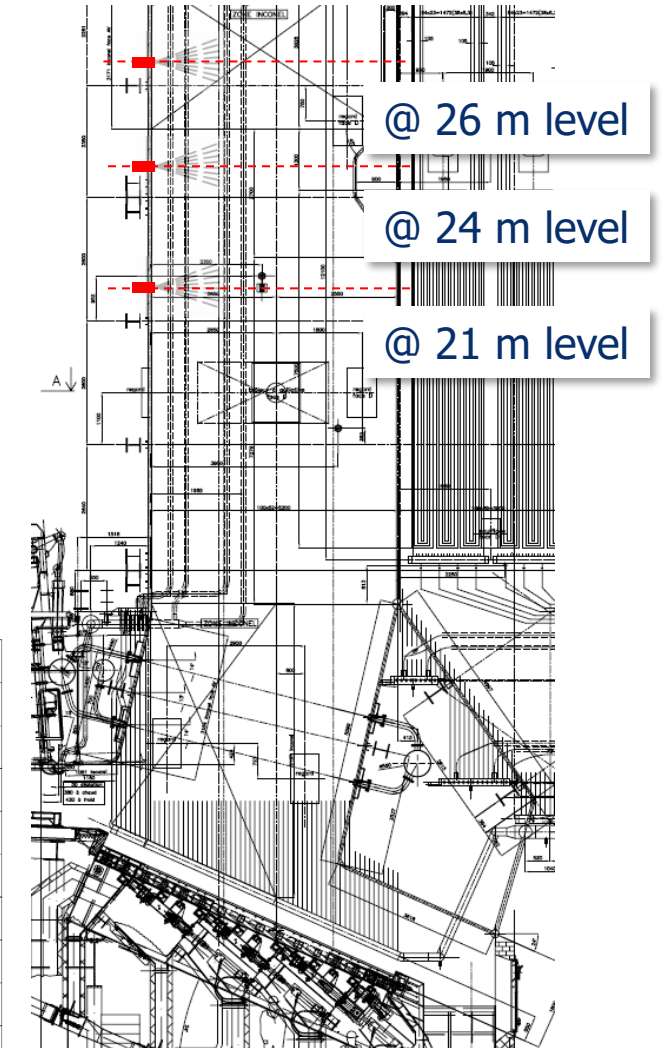
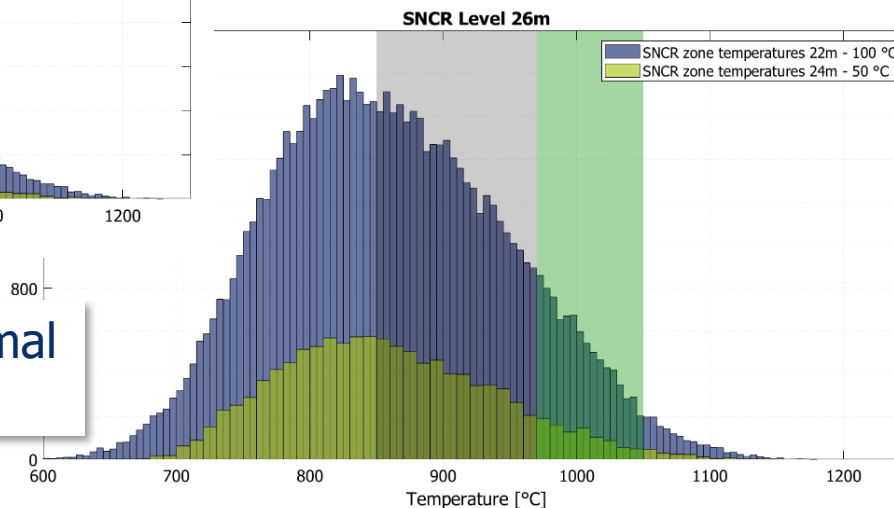


Hypothesis 3 (EUflame): DeNO_x operation is affected by FEGT fluctuations

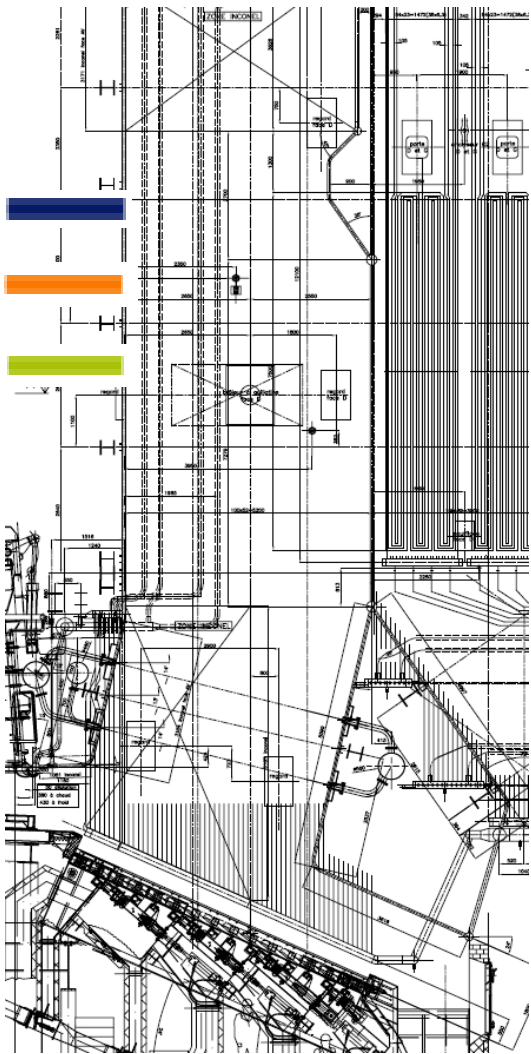
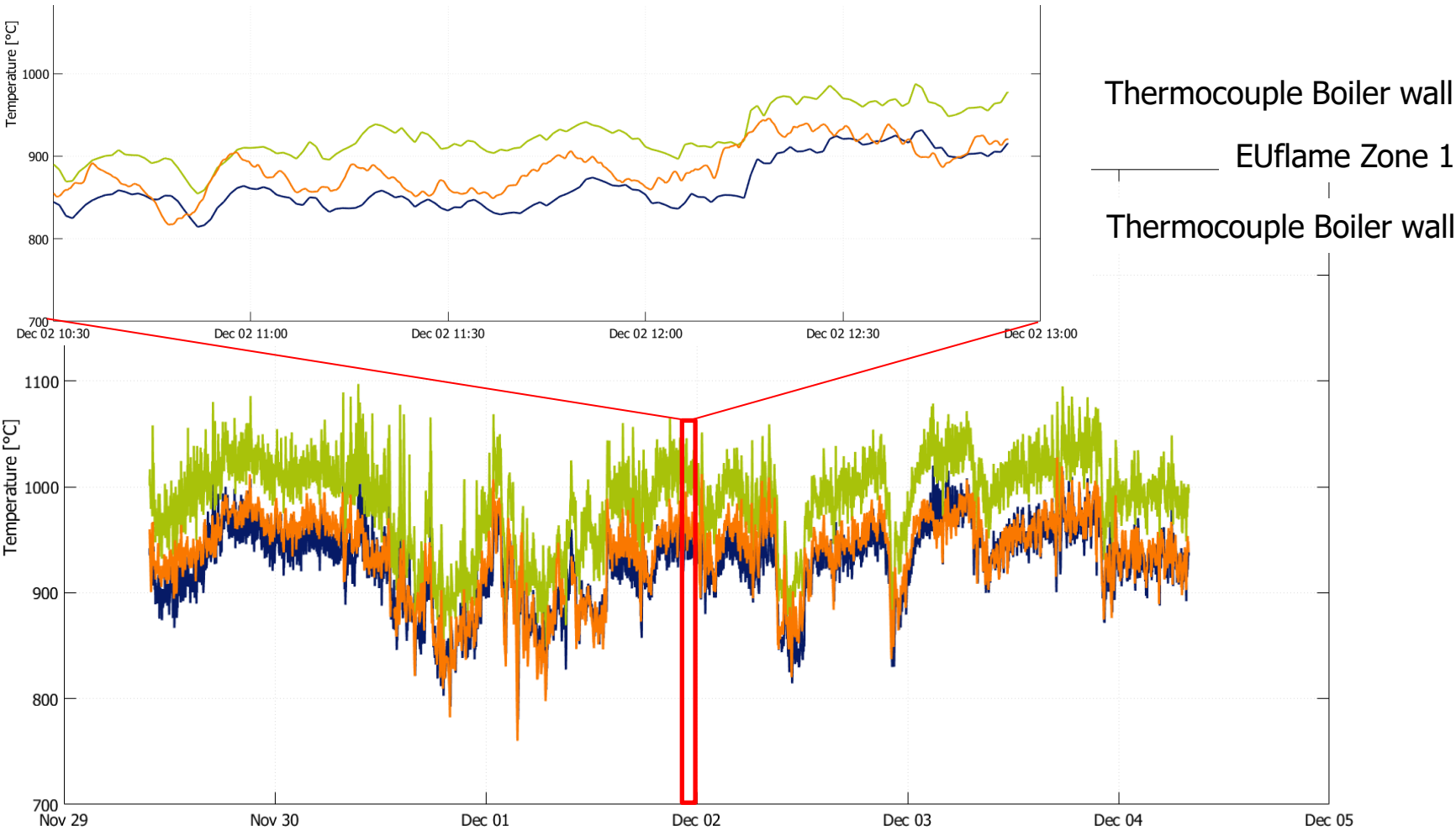
- The wide temperature range results in a significant portion of operating conditions outside the optimal window for NO_x reduction
- The temperature distribution at the middle level (24 m) is in better agreement with the assumed optimal temperature window



SNCR zones temperatures vs. optimal reaction temperature window

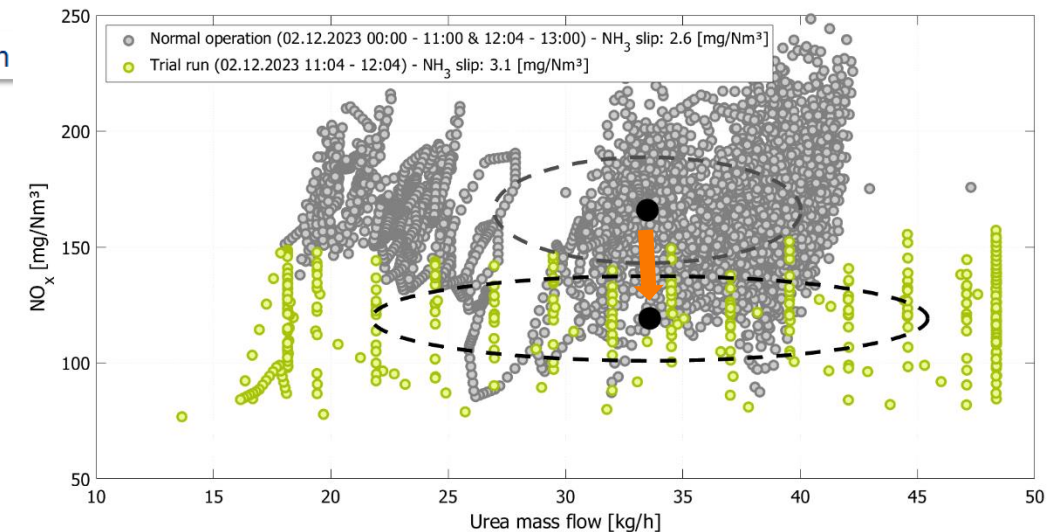
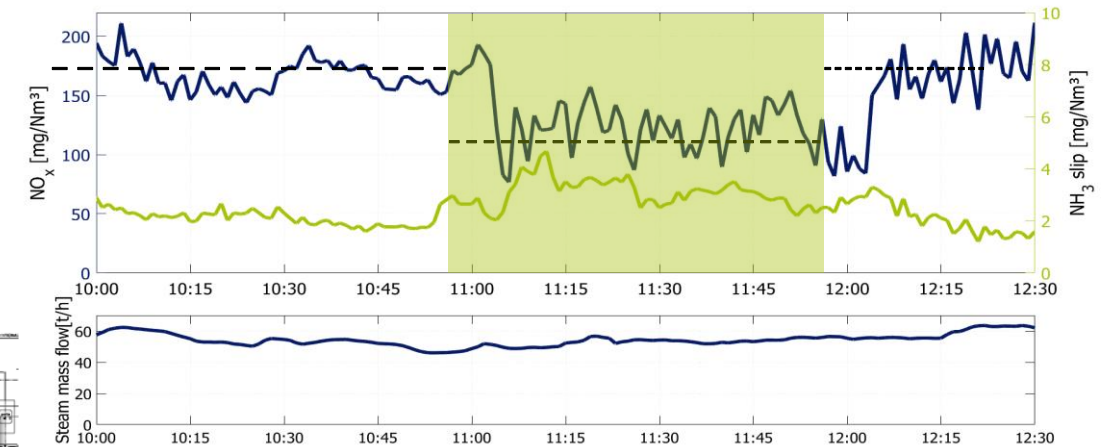
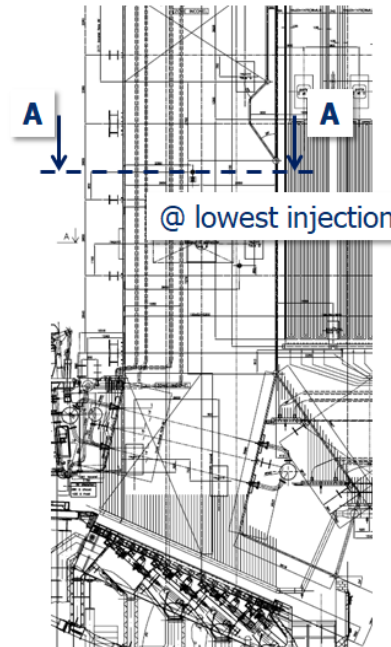
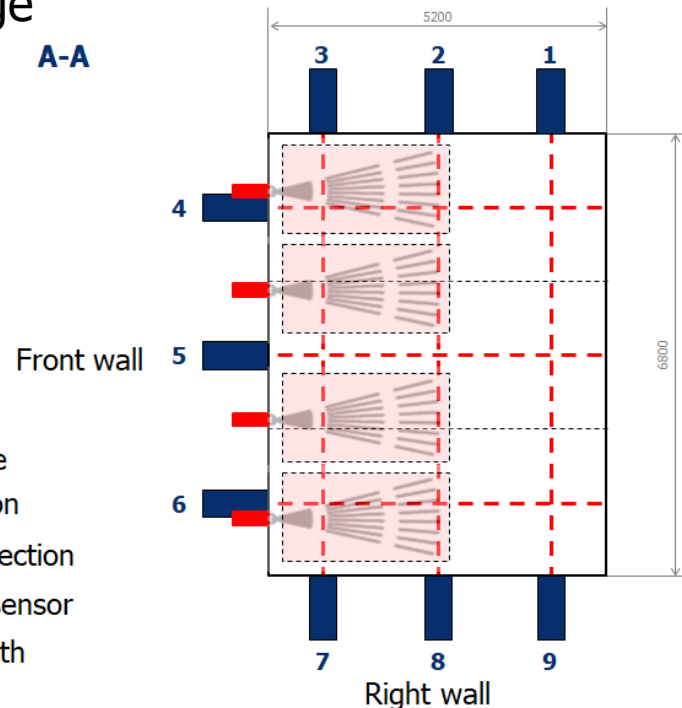


EUflame vs. thermocouples



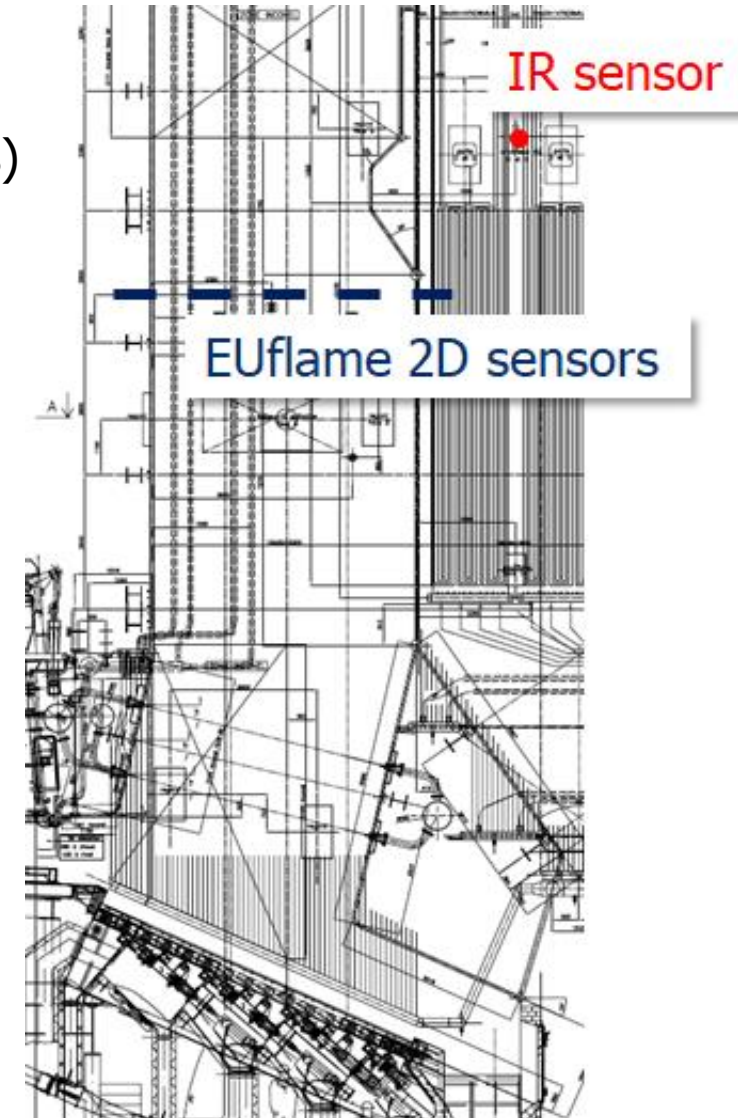
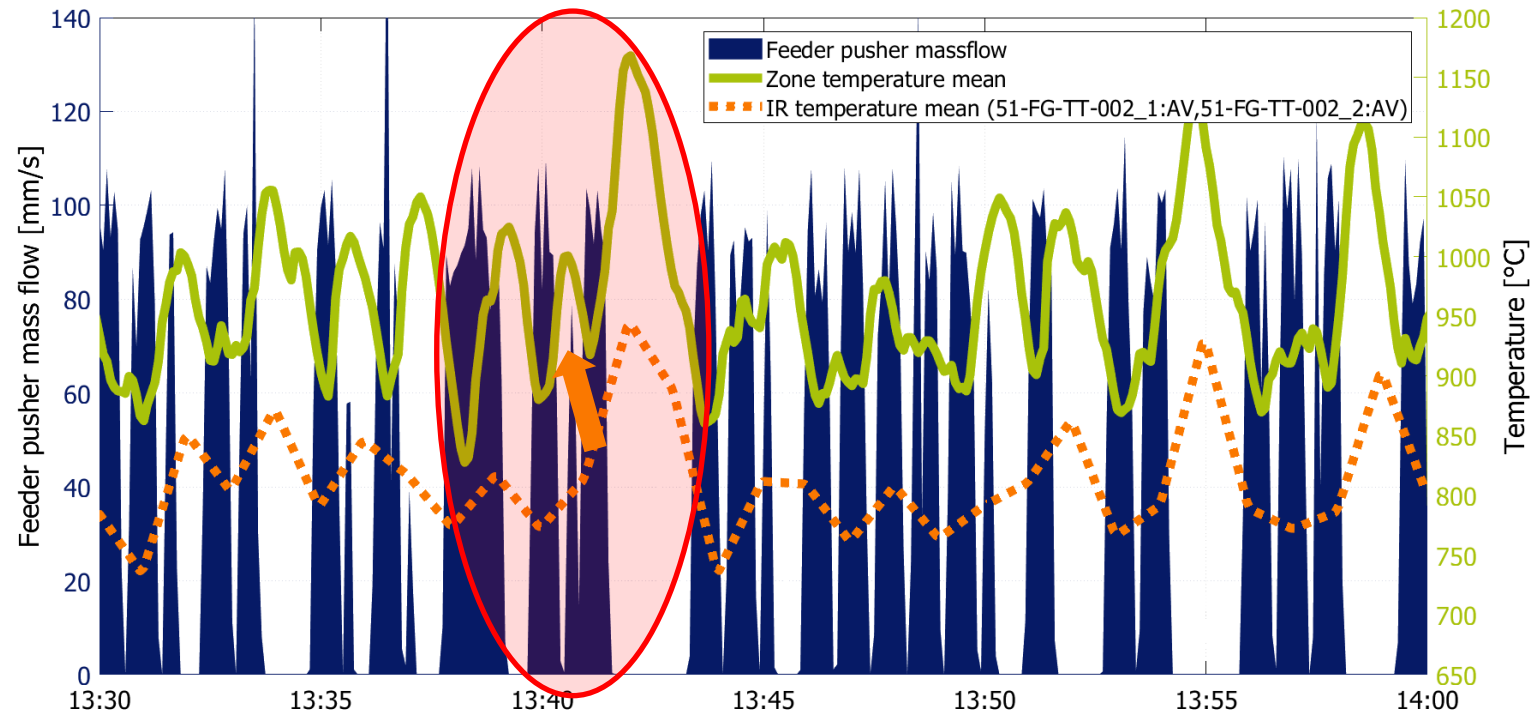
Hypothesis 2 & 3: Optimized SNCR-operation leads to NO_x emission reduction

- Significant improvement without changes of hardware
- Identification of temperature zones for SNCR injection
- Smart injector control and dosing
- NO_x reduction >35% without increasing mean. urea dosage



Hypothesis 5: Combustion optimization using advance diagnostics

- The average FEGT measured by the EUflame 2D system provides more comprehensive & dynamic information than the temperature measurement(s)
- EUflame 2D system identifies fuel supply over the grate and thus helps to improve the temperature distribution in the boiler
- Significant potential for improvement in the control of steam parameters



Summary



Combustion performance assessment

Summary

- Combustion process assessed in full operation
 - Waste and air flow distribution
 - O_2 , NO_x and CO levels
 - Furnace exit gas temperature FEGT
 - De NO_x system - SNCR operation
- Achieved results
 - Converting data into actionable information
 - Obtaining maximum information with smart online diagnostics
 - Temperature is the key to understanding combustion
 - Significant improvement potential tested



Outlook

HERAmbiente, WtE Pozzilli (IS)...

- ... installed EUflame 2D stationary system for online determination of 2D-FEGT in the first boiler pass
- ... is exploring the potential of using this information to improve primary & secondary combustion measures

Combustion performance assessment

De-Risking strategy - Low invest with high return

- **Analysis** of the combustion process and quality
 - Use of existing DCS data and
 - Application of innovative online diagnostics

- **Detection and Identification** of
 - imbalances, hot-spots, inhomogeneous and delayed combustion, faulty settings
 - root-cause and sensitivities of set-points

- **Combustion tuning and Optimization**
 - Direct adjustments and
 - Exploration of the optimization potential

Thank you!
www.eutech-scientific.de