



Expert Seminar "Lime, cement, Ecology 2013"  
Bystřice Pernštejnem, CZ

ADVANCED SOLUTIONS FOR

GLASS MELTING – CONDITIONING – FORMING



## Successful Application of Model Base Predictive Control for Production and Thermal Efficiency Optimization of High Temperature Melters

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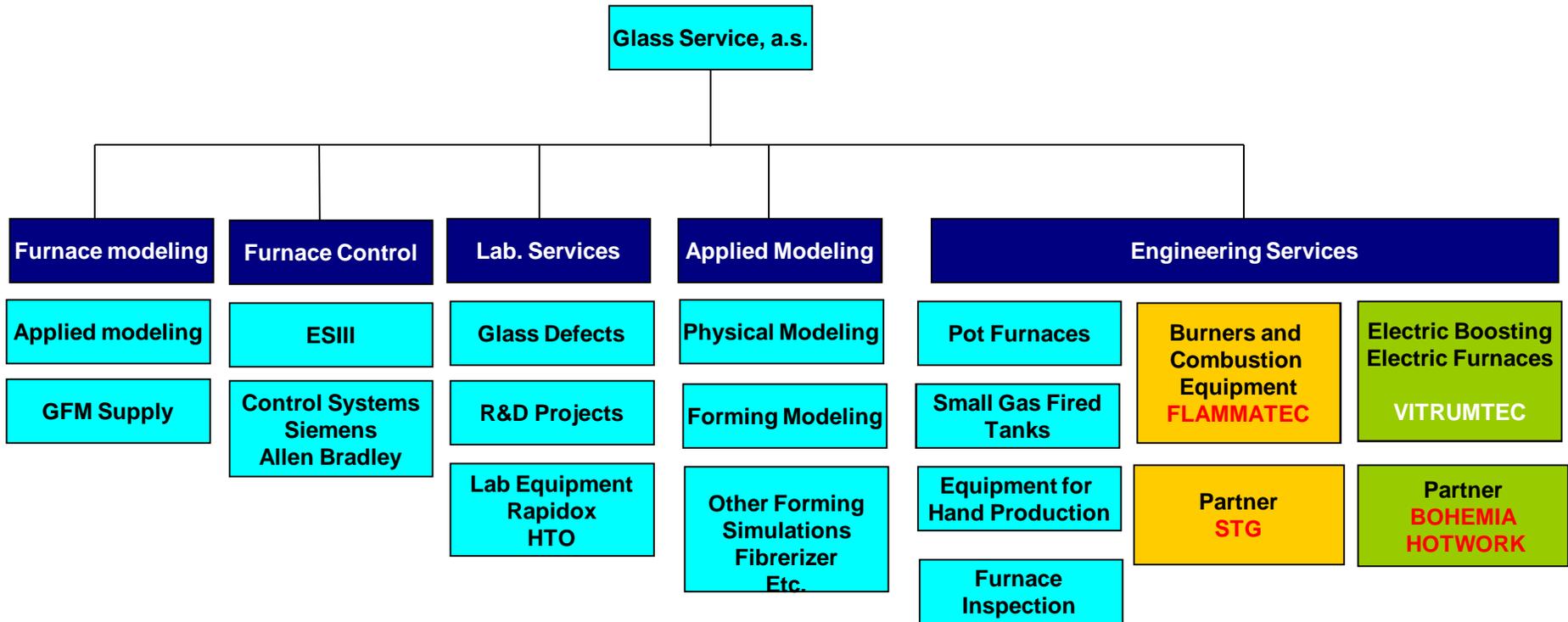
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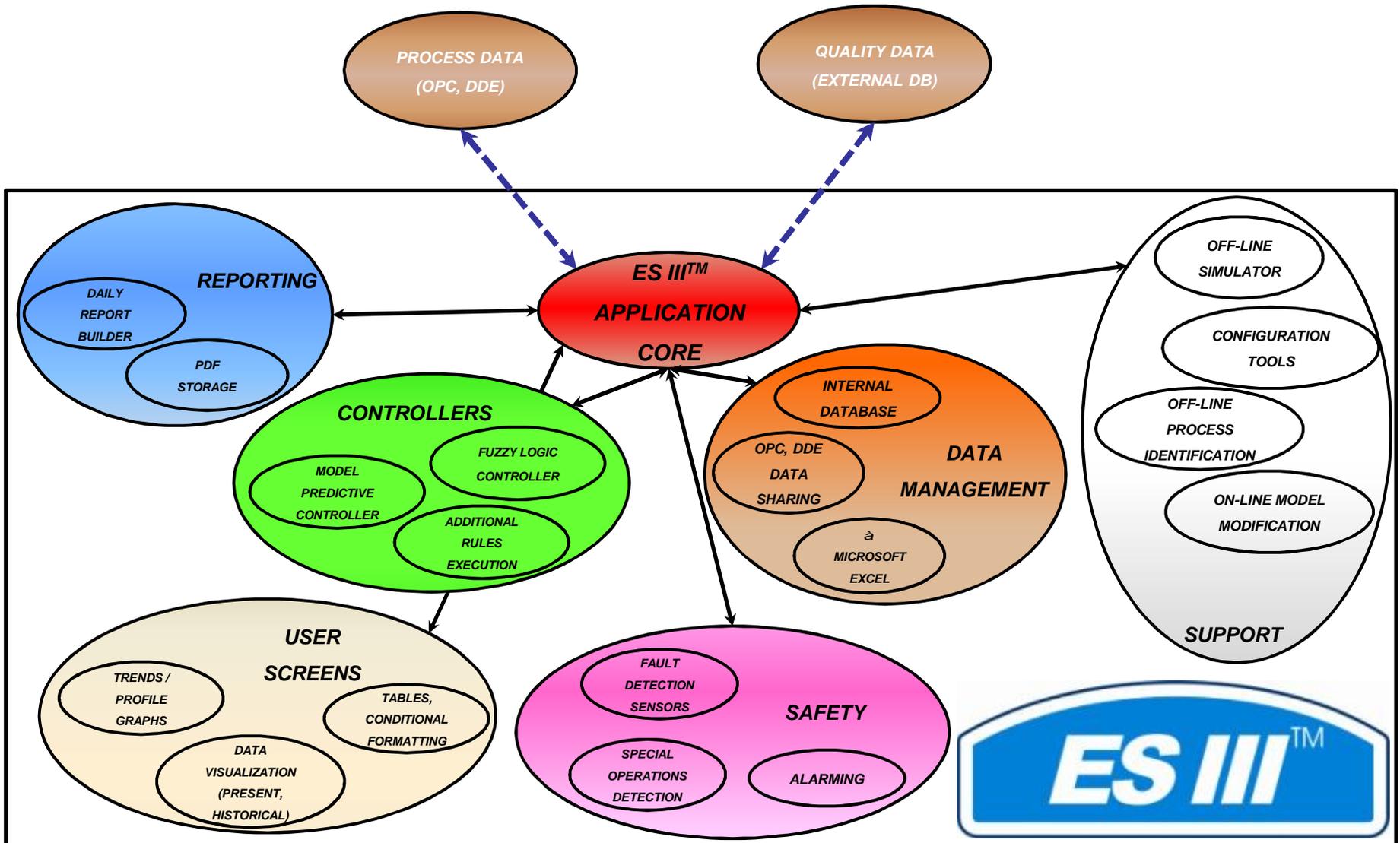
Cement Kiln #8 at ENCI plant  
Maastricht, NL

**Many thanks to:**





- Glass Service has started in 1990 as a private company in Vsetín, Czech Republic
- Glass Service employs > 70 people, mainly ex-managers and engineers from glass industry
- Glass service is an engineering & consulting company that develops software tools and advanced equipment to support the glass industry in order to optimize the glass melting production process
- Glass Service conducts its own R&D and provides laboratory services for our customers
- Number of Glass Service customers is over 200 in more than 40 countries worldwide
- Company mission: increase quality and yield of our customer with reducing costs for melting and emissions



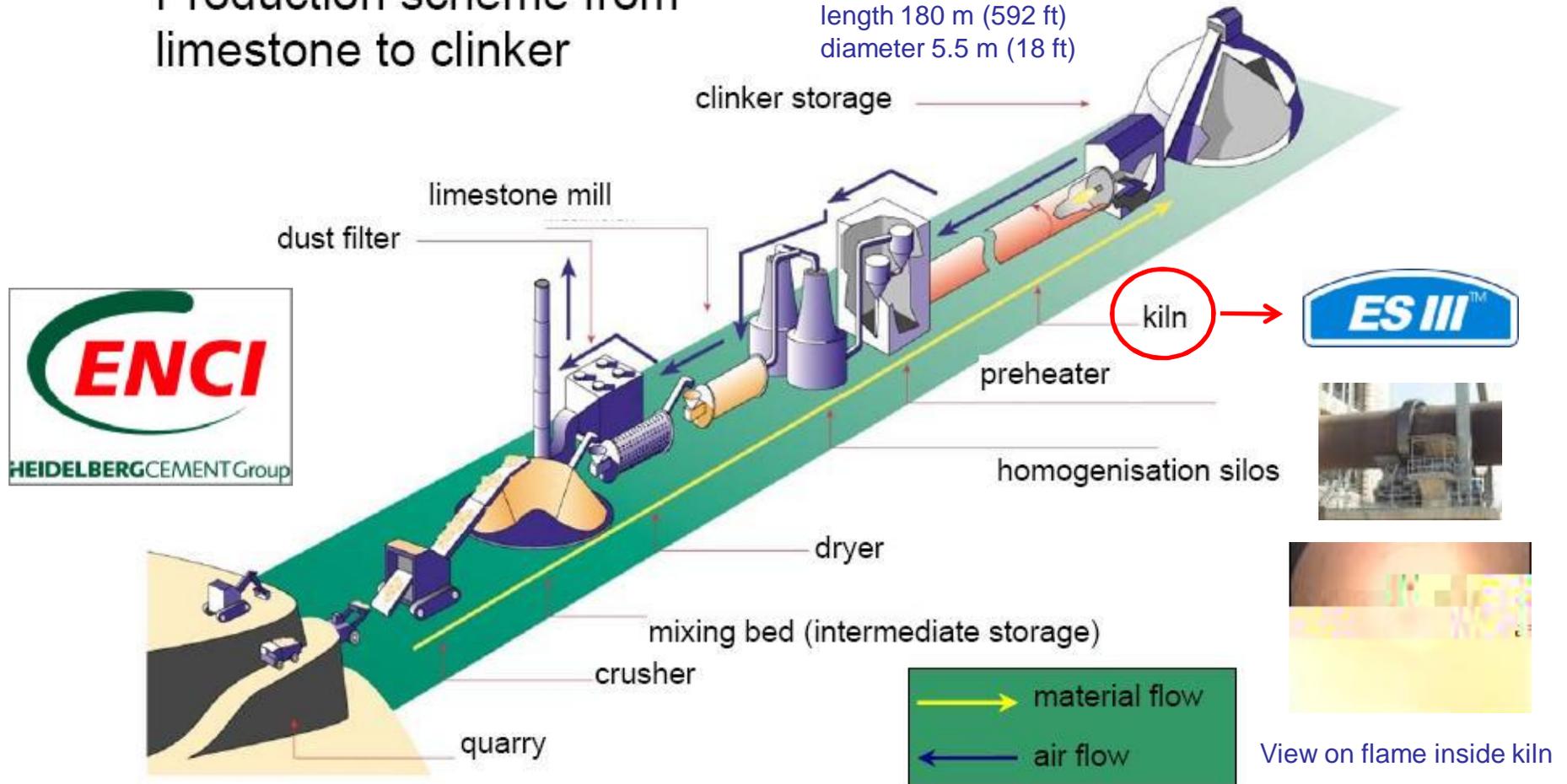
... PLANT INFORMATION SYSTEM FEATURES

## ***ESIII™* Advanced Control for High Temperature Melters**

1. ***ESIII™*** is a comprehensive supervisory advanced control tool
2. ***ESIII™*** is designed for high temperature melting and conditioning processes
3. ***ESIII™*** stabilizes long and short term processes
4. ***ESIII™*** provides full automatic control of melt production temperatures
5. ***ESIII™*** brings consistent operation to furnace: 24/7 without operator intervention
6. ***ESIII™*** uses energy sources efficient – saving energy and costs
7. ***ESIII™*** optimizes combustion – emission control
8. ***ESIII™*** stable furnace operation – impact on furnace lifetime

Production scheme from limestone to clinker

Rotating kiln dimensions:  
length 180 m (592 ft)  
diameter 5.5 m (18 ft)



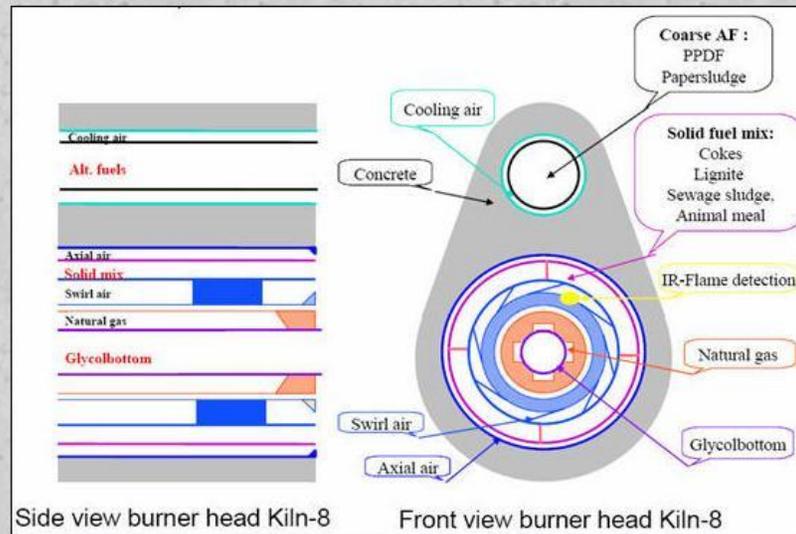
## **ESIII™ Kiln Control Objectives?**

- Stable and efficient production process
- Optimal energy usage, energy cost savings
- More stable free lime control
- Good quality product
- Reduce NOx production
- Through stable kiln operation longer kiln lifetime

## Special burner supplies up to 9 (alternative) fuels

The long dry kiln No 8 was installed in 1968 and measures 180m in length and 5.5m in diameter. The kiln line has a two-stage preheater with no precalciner. Heat consumption of the kiln is 3.6 GJ/t clinker and it is equipped with a planetary cooler. Kiln capacity is approximately 3000tpd.

An FLSmidth Swirlax burner has been adapted to burn alternative fuels via an extra burning tube mounted on top of the main burner.



FLS-Swirlax burner with ENCI-overfire lance

- Cokes
- Lignite
- Sewage sludge
- SBI/PPDF (plastics, carpet)
- Paper sludge
- Animal meal
- Glycol bottom
- Anode dust

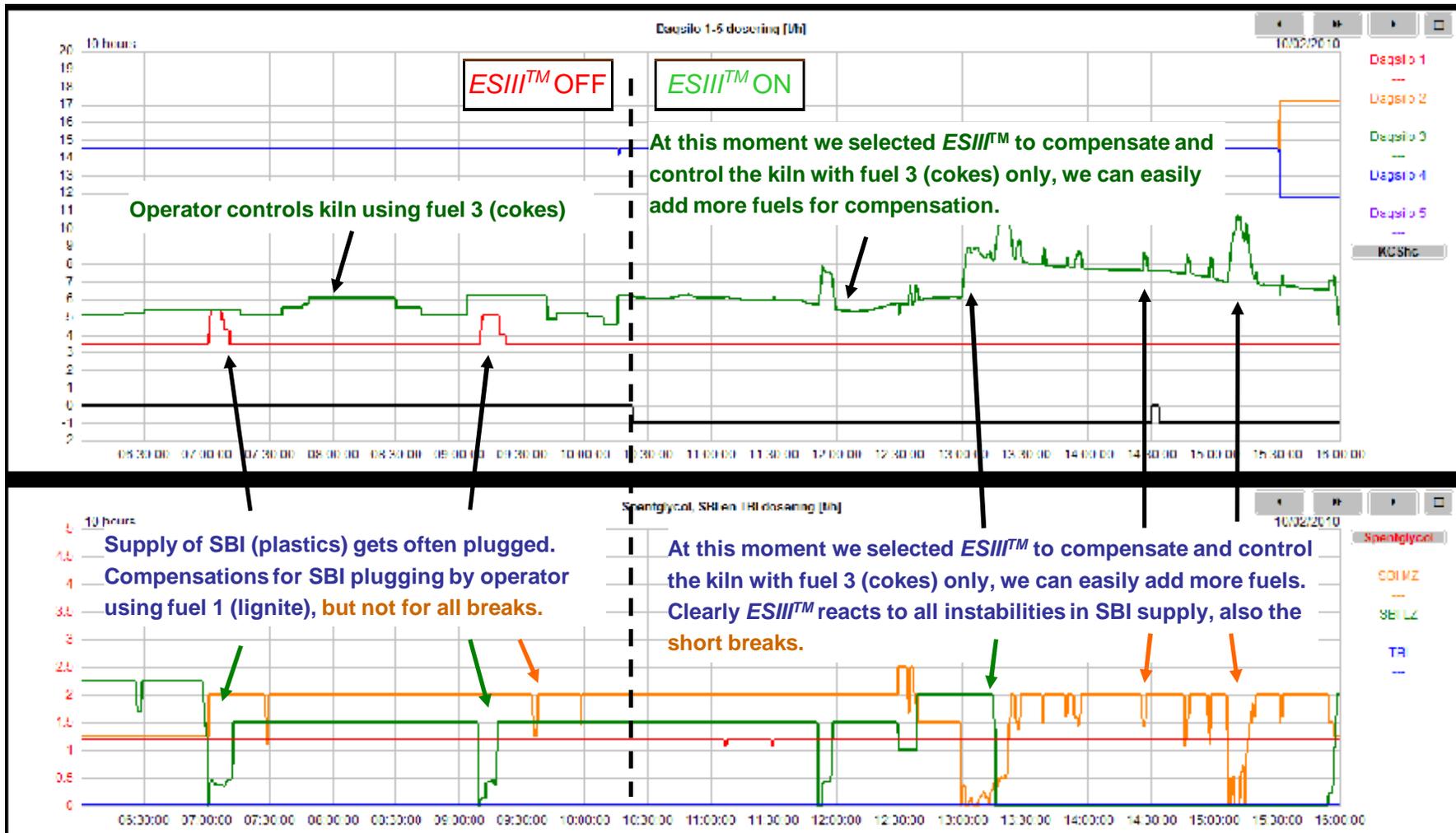
**Each fuel has own heat value and price**

The alternative fuel substitution rate at the plant is even higher than at CBR's Lixhe facility. Maastricht's 90% substitution rate of traditional fuels has been achieved by processing fuels like sewage, paper sludge, plastic, animal meal, glycolbottom, finecokes and anode dust. HeidelbergCement has a strategic plan for the use of alternative fuels and reached a substitution rate of 33% in 2006 that will rise to 40.2% in 2007. By 2011 around 55% of the ENCI's fuels should come from alternative fuel products. ENCI's impressive 90% substitution rate already exceeds the HeidelbergCement group's long-term substitution rate targets.

A recent investment at the plant in this respect is the SBI installation. SBI refers to a secondary fuel installation that is aimed at reducing fuel costs, it handles coarse fuels such as paper sludge, paper and plastic derived fuels and, in the past, shredded iron-free tyres. Material is unloaded and stored in a separate building on site and is handled by an automated grab system. Two dedicated bunkers and two feeders transport the material to rotating valves from where the material is pneumatically transported to the kiln's coarse waste fuel burner. Limitations of the SBI include truck unloading capacity, crane capacity, burnout of the coarser fuels as opposed to the fine fuels burnout, equipment availability and chlorine build-up in the kiln.

Early in 2007 the plant added an additional simple feeder unit for the feeding of extra low calorific coarse fuels.

**ESIII™ finds optimal mixture of 9 fuels with required total heat value at minimal costs**  
**ESIII™ compensates instantaneously in case supply of one of the fuels is plugged**



## **ESIII™ Actions and Targets**

### Actions:

- Total heat input
- Rotation rate of combustion air fan
- Kiln feed of raw materials
- Kiln rotation rate

### Targets:

- Kiln rotation power (torque, indirect melt temperature indicator)
- Level of free lime – quality of the product
- O<sub>2</sub>
- CO<sub>2</sub>
- NO<sub>x</sub>
- Flue gas temperatures in cyclones

## ESIII™ Model base Predictive Control (MPC)

TARGETS

ACTIONS

DISTURBANCES

Fuel heat

Fan

Kiln feed

Fuel heat value correction

Klinker outflow

O<sub>2</sub>

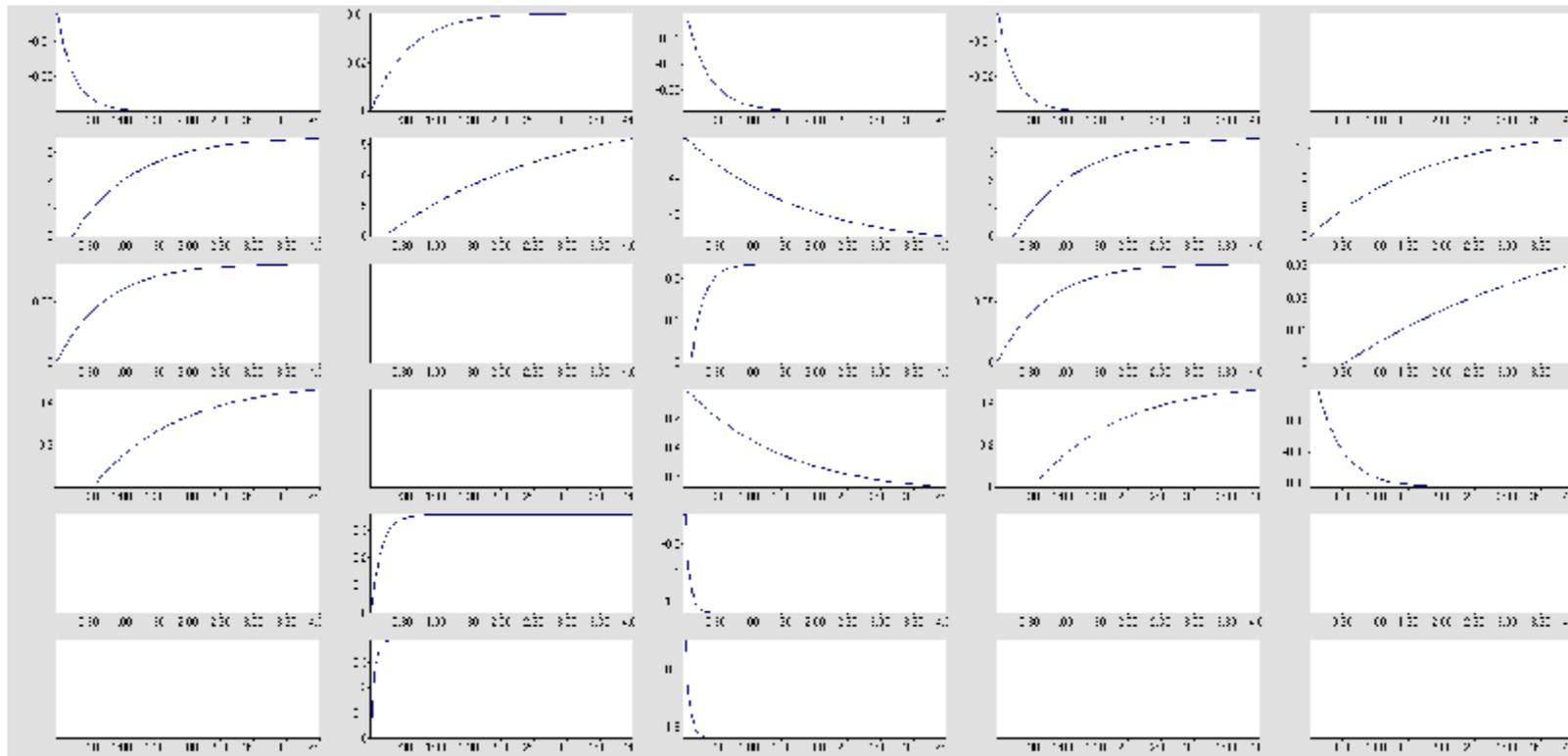
NO<sub>x</sub>

CO<sub>2</sub>

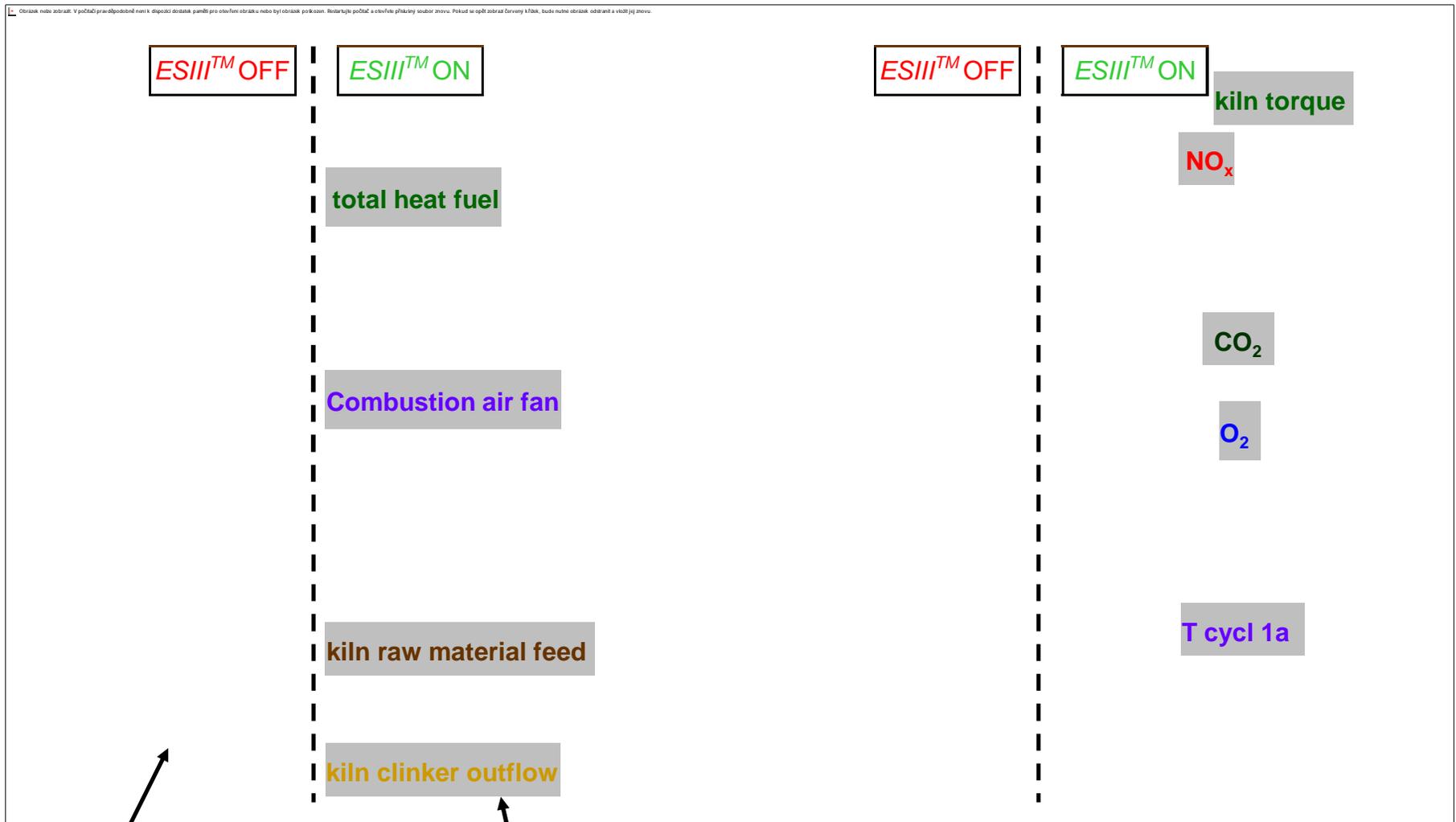
Torque

Flue T1

Flue T2



## ESIII™ gets kiln out of instable 'cycling' mode, stabilizes process and product quality



Kiln in 'cycling' mode    Kiln out of 'cycling' mode after ESIII™ start

## **ESIII™ Kiln Control Benefits**

- Stable operation of kiln according to prescribed setpoints.
- Control of level of free lime in clinker – product quality control.
- Set up of optimal 9 fuel package with required heat value and minimum costs.
- Fast compensation for fuel plugging – less chance for ‘cycling mode’, maintaining total heat input.
- Stabilizing the process: get kiln out of ‘cycling’.
- Full automatic kiln control without operator intervention.



## Thank you for your attention

We welcome CZ/SK partners to cooperate with us on further implementation of *ESIII*<sup>TM</sup> to the cement industry



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