European Union side events

Retrofeed
smart retrofitting in process industry

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Energy-intensive industries: Innovative technologies toward climate neutrality

RETROFEED, Angela Nunes, Secil

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ACT NOW

Decarbonisation of energy-intensive industries

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- **ENERGY-INTENSIVE INDUSTRIES ARE RESPONSIBLE FOR HIGH CO_2 EMISSIONS THAT CONTRIBUTE TO CLIMATE CHANGE**

- **IMPROVEMENTS IN ENERGY AND RESOURCE EFFICIENCY ARE KEY TO TRANSITION TO A CARBON-NEUTRAL INDUSTRY**

- **EXISTING INDUSTRIAL PLANTS NEED TO BE TRANSFORMED TO ADDRESS THE ENVIRONMENTAL CHALLENGES AND REMAIN COMPETITIVE**

  - Increasing the resource and energy efficiency
  - Decreasing GHG emissions
  - Decreasing the utilisation of fossil resources
  - Reducing operational costs and/or increasing productivity

  } of the industrial processes

Retrofeed (RETROfitting + FEEDstock)
smart retrofitting in process industry

«Implementation of a smart RETROfitting framework in the process industry towards its operation with variable, biobased and circular FEEDstock»

5 energy-intensive sectors

AGROCHEMICAL	ALUMINIUM	CEMENT	CERAMIC	STEEL

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TOTAL COST
15,468,861.25 €

EU FUNDING
9,912,915 €

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PROJECT MAIN GOALS FOR HARD-TO-ABATE INDUSTRIES

- Energy efficiency
- Circularity and use of Bio-based materials as alternative feedstock (as secondary raw materials or alternative fuels)
- CO_2 emissions reduction
- Process digitalization;
  - new monitoring infrastructures;
  - advanced modelling techniques;
  - smart control systems of retrofitted processes;
  - develop a process Decision Support System;
- Develop a retrofitting methodology for industry replication

New Flexible Burner To Increase Productivity And Reduce Electricity Consumption

CFD simulations of the melting furnace and development of a digital twin at ASAS

Design and drawings of the new burner head design

Main environmental and economic impacts on cement production

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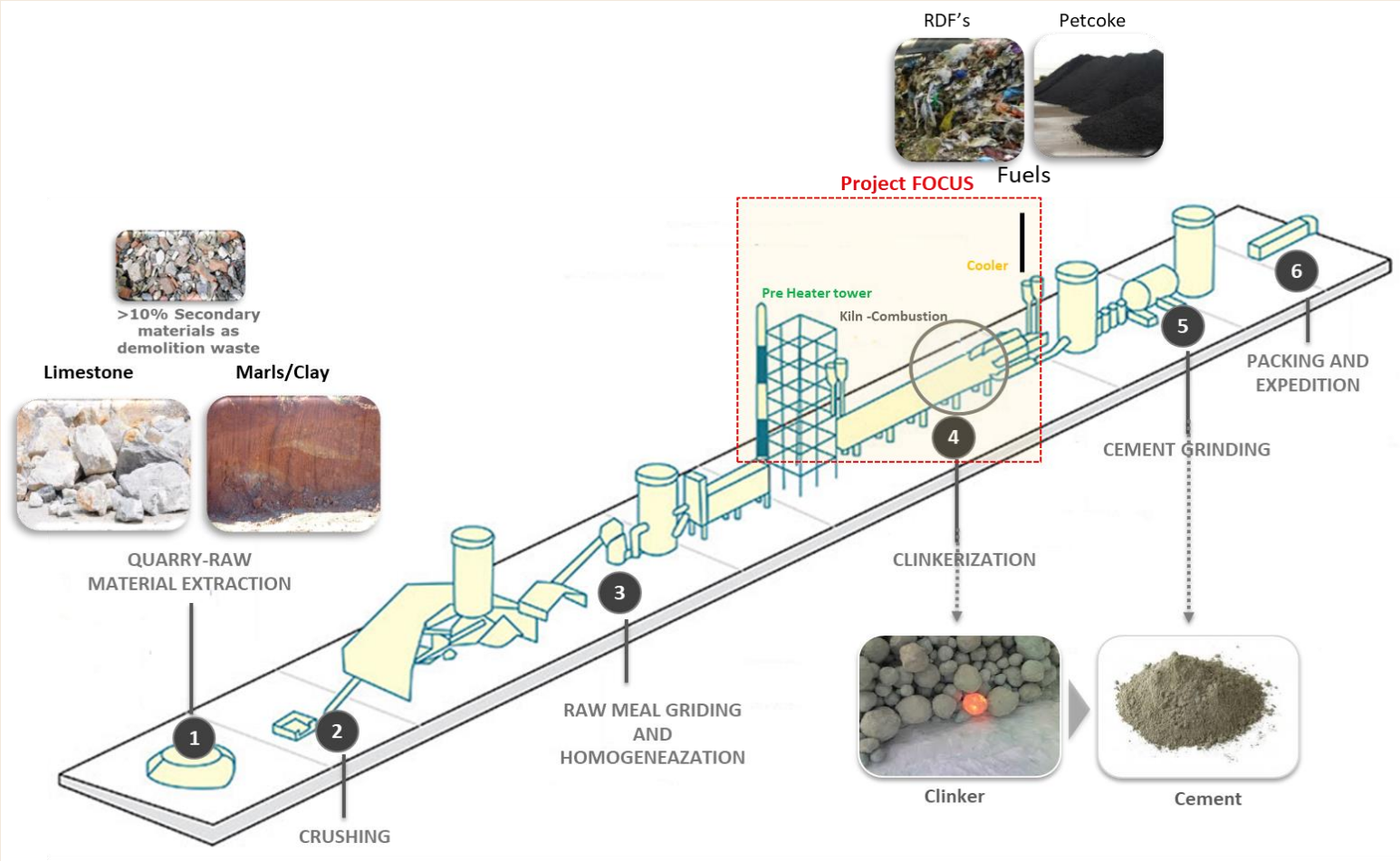
Energy intensive

- **Thermal energy for clinker production** (high temperatures needed 1450ºC)
- **High electrical power consumption** (griding and transportation)

CO_2 emissions

- **Fossil fuels combustion** (petcoke)
- **Limestone Decarbonation** (530kg CO_2/t Clinker)

The cement production process



Replacement of fossil fuels

Petroleum coke

RDF (Refuse Derived Fuel)

+

H_2

Cement kiln

Retrofeed (RETROfitting + FEEDstock)
smart retrofitting in process industry

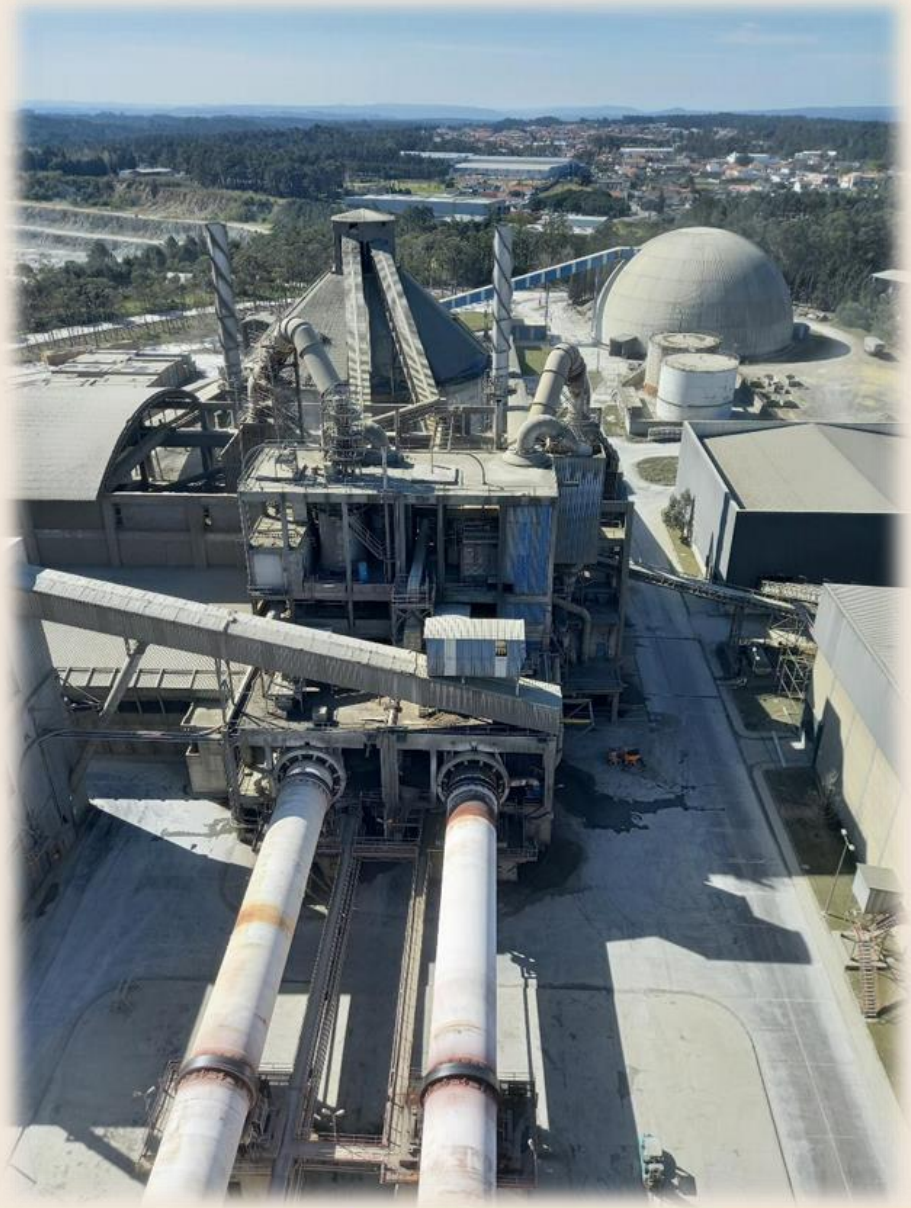
Cement Demo Site

SECIL

Our project goals/Why?

- ✓ Improve plant **environmental performance** by replacing fossil fuel for alternative fuels, **decreasing CO_2 emissions.**

- ✓ Increase **knowledge on operations** conditions and feedstock for improved monitoring **improved energy efficiency, reduced operational costs and improved process yield**.



Cement Demo Site

Why use of Alternative Fuels (AF)?

- ✓ **Fuel emissions** account for **35% to 40% of total CO_2 emissions** from cement manufacturing.
- ✓ Alternative fuels are derived from **non-primary materials** (waste or by-products) and can be biomass, fossil or mixed alternative fuels. SECIL uses RDF (Refuse Derived Fuel) **avoiding landfilling disposal or incineration.**
- ✓ The extremely high temperatures and residence times of a cement kiln ensure these are managed in a **safe and environmentally sound way**.
- ✓ **CO_2 is saved** by replacing fossil fuels with the alternative waste streams, avoiding those emissions of being released by incineration or landfilling.

Petroleum coke

RDF (Refuse Derived Fuel)

Cement kiln

RDF Characteristics

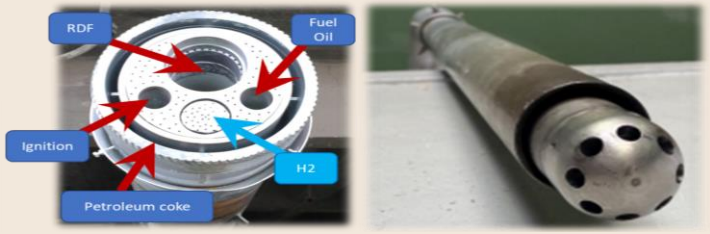
- ✓ **High heterogeneity material (size, composition),**
- ✓ **High variation of calorific value,**
- ✓ **High variation of moisture content,**
- ✓ **High feedstock variability**
- ✓ **High Chlorine content.**

RDF Challenges

- ✓ **Flame control, blockages and process instability,**
- ✓ **Product quality maybe affected**
- ✓ **Overall lost of energy efficiency and productivity (>15%)**

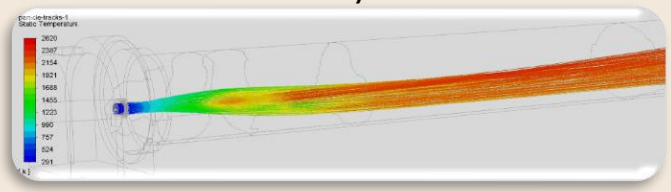
Cement Demo Site

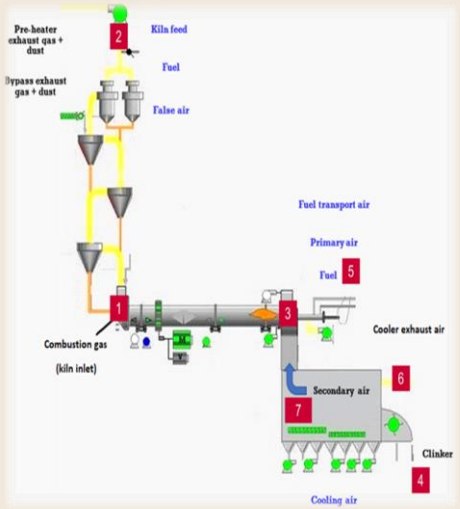
How?

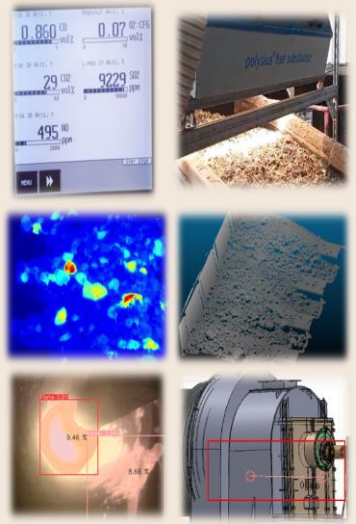


Hydrogen injector for the main burner

New secondary burner







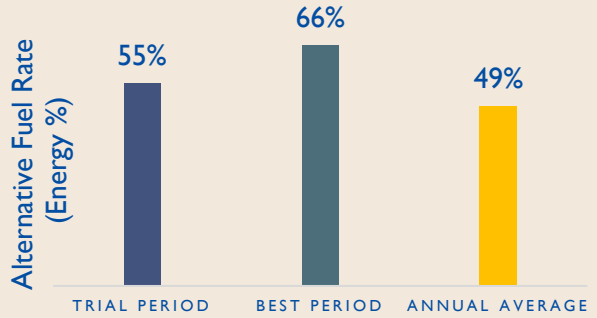
Retrofitting actions

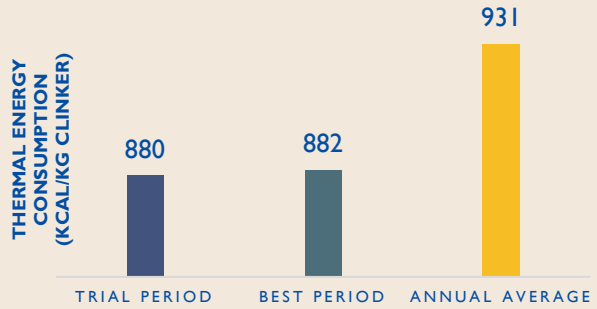
- ✓ **Kiln digital model (digital twin)**
- ✓ **Multi-fuel burner design** (allowing H_2 as main fuel)
- ✓ **New sensors and control system:**
  - Image based combustion diagnosis tool
  - Alternative fuels properties determination
  - Real time clinker optical characterization
- ✓ **DSS implementation**

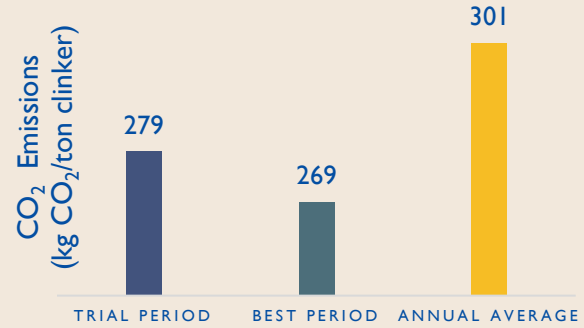
Cement Demo Site

RESULTS

- ✓ **Alternative fuels rate increases by :** **+13% to +34%**
- ✓ **Thermal energy consumption decreases by:** **-5%**
- ✓ **CO_2 emissions reduction of:** **-7% to -11%**







Other atmospheric emissions continuously monitored during the trials (dust, NO_X, SO_2, CO, NH_3, HCl, HF, TOC) comply with emission limit values.

Clinker quality: not affected by the retrofitting changes during tests. Expected improvement as well an increase in productivity due to a better burnability and combustion control system.

Cement Demo Site

IMPACT

- **Optimization**:
  - **Clinker carbon footprint reduction (CO_2 emissions reduction by 7 to 11%)**
  - **Energy consumption reduction (by 5%)**
  - **Productivity improvement (less 15% blockages stops)**
  - **Product Quality Improvement (standard deviation reduction)**
  - **Adaptation to a future hydrogen combustion use at industrial scale.**
- **Advanced control and monitoring systems.**

Circular economy

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