LifeSaver – Context sensitive monitoring of energy consumption to support energy savings and emissions trading in industry

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Novel concept of context sensitive energy and environmental management system for support sustainable development of industrial companies

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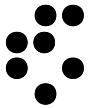

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Content

- Introduction
- Proposed Concept and Methodology
- Case Study: Energy Intensive Company from Slovenia
- Results and Discussion
- Conclusion and Future Challenges

Introduction

- Monitored energy consumption enriched with context from ambient intelligence data can be the basis for the identification of energy profiles as well as energy consumption and emissions patterns
- Analysis of user behaviour and environment
- Active human operator support
- Ambient Intelligence supported energy monitoring

Our Motivation

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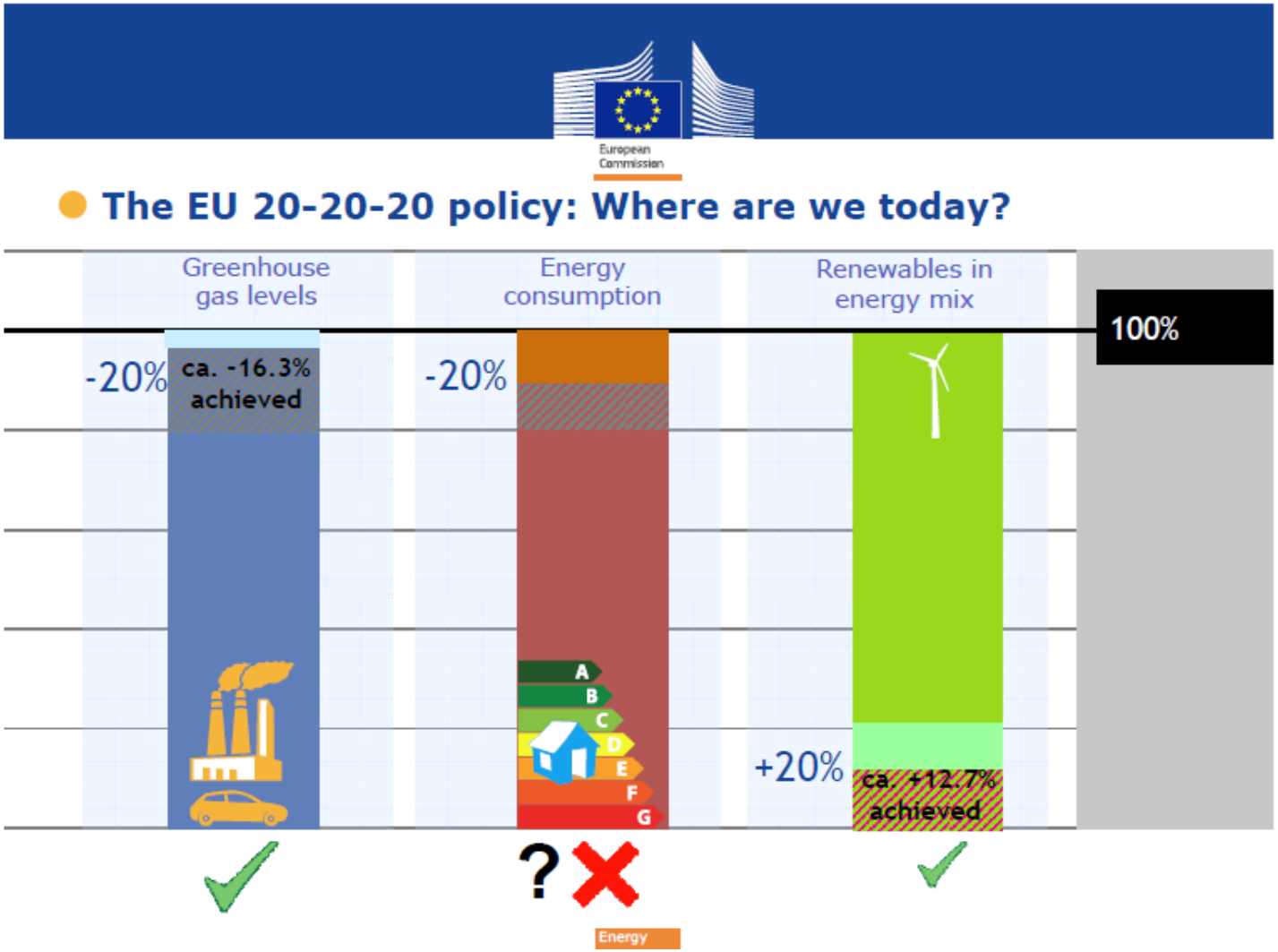

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Our Added Value

- Directly connected to industrial needs
- From the industrial point of view, insufficient or inappropriate monitoring of energy consumption may lead companies in a wrong direction and not knowing what potential they have for profitable energy investments
- The complexity of the proposed concept arises from the need to tie together people, procedures and technologies in order to achieve consistent and lasting performance improvements

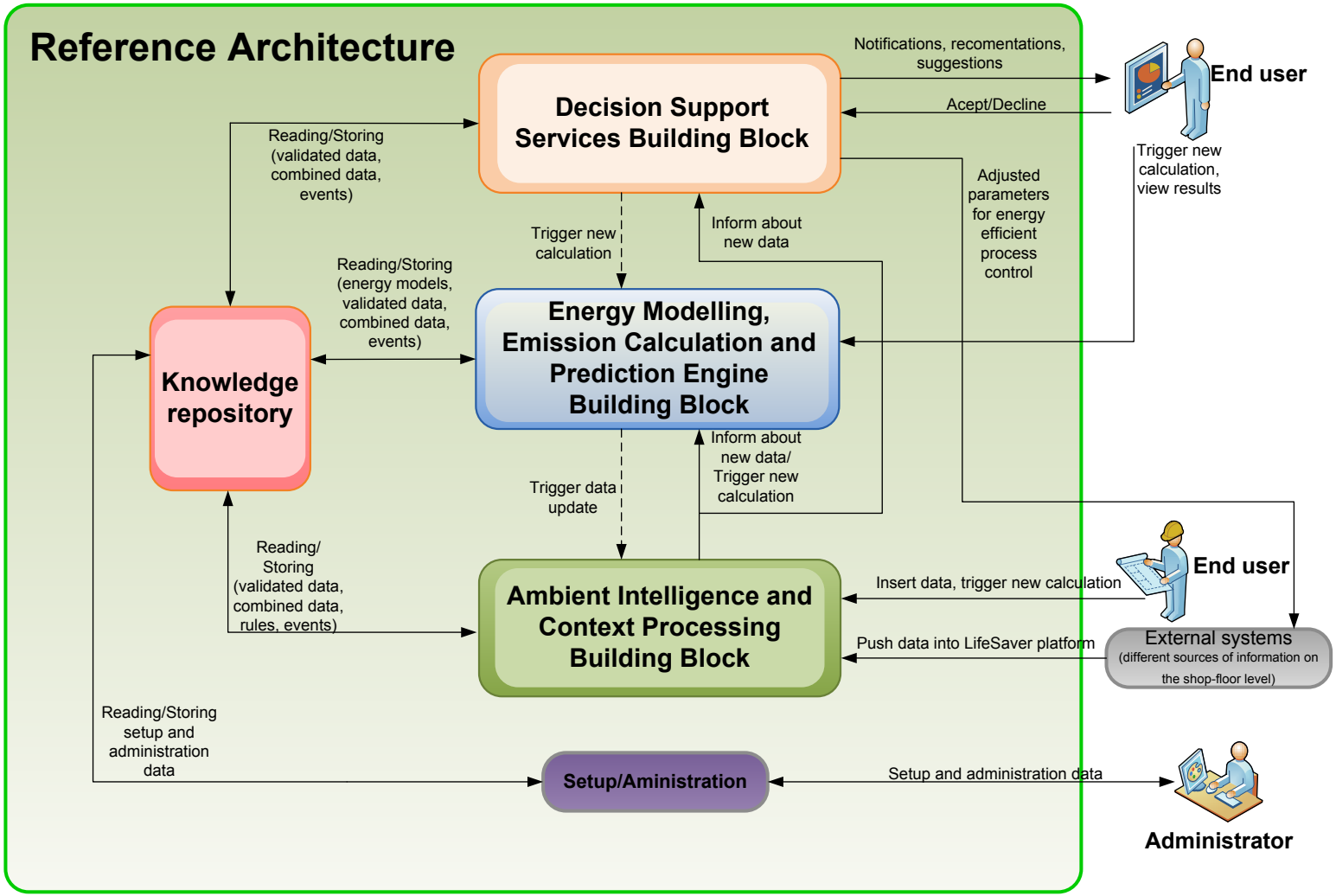
Energy models…

- Complexity of the problem:
  - Is it possible to describe it by a simple, time invariant, low-order relationship between the input and output variables?
  - Is it possible to identify all the relevant variables that affect energy consumption?
  - Is the problem well posed by nature and supporting some type of structuring?
  - Is the problem computationally solvable in real-time?

Modelling Approach

- In general our modelling approach is based on process integration which is a family of methodologies for combining several processes to reduce consumption of energy and raw materials
- Energy cost centre approach – introduced by Morvaj and Gvozdenac belongs to the process integration family (similarities to the Total Site Integration)

Reference Architecture



Business case - example

- Cement production is one of the most energy intensive processes in industry
- Global cement industry accounts for about 70 to 80% of the energy use in the non-metallic minerals sub-sector and accounts for almost one-quarter of total direct CO_2 emissions in industry

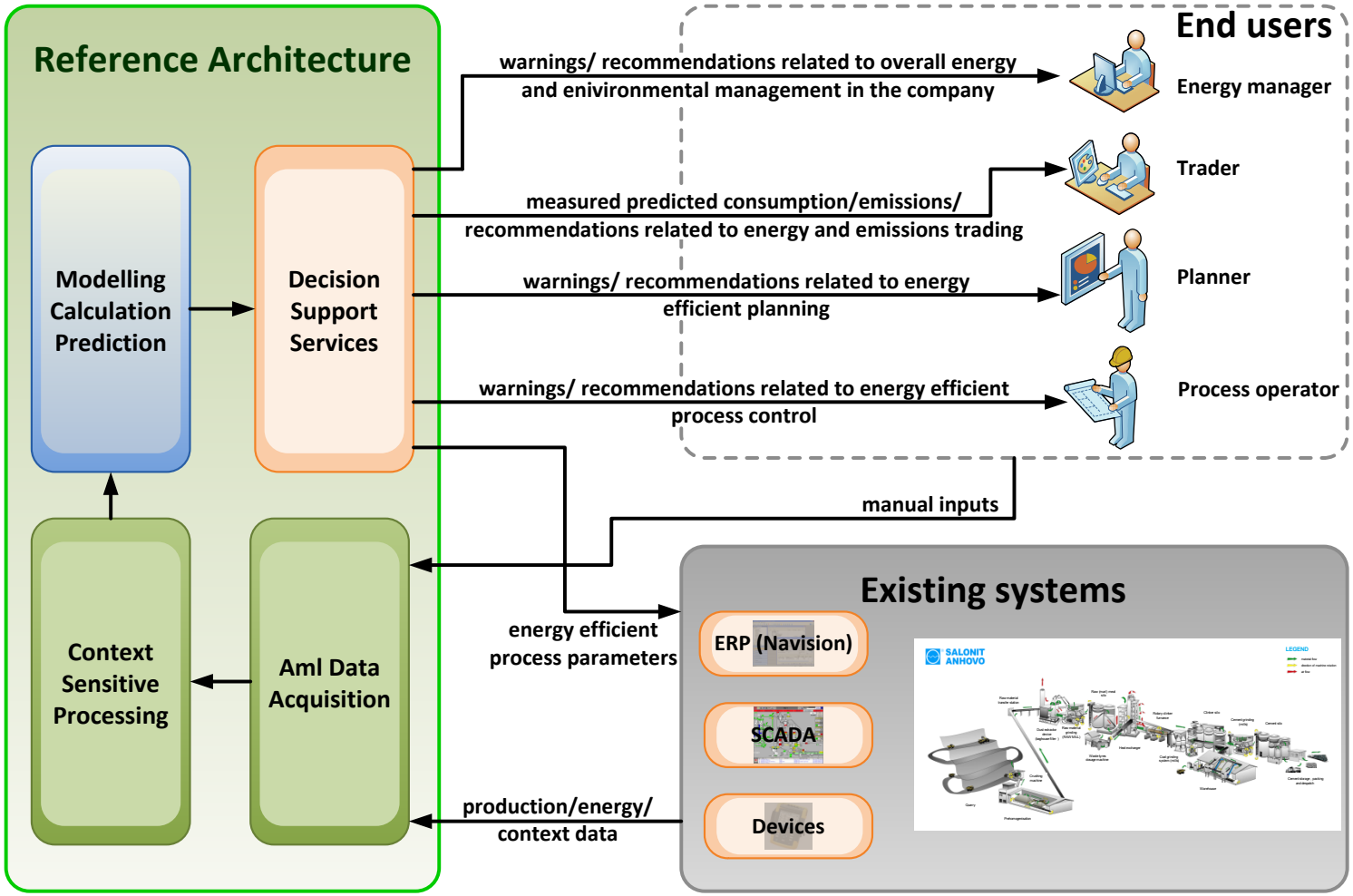
Business case – main challenges

- How to remain the leading cement producer and how to further strengthen its leading position on the local and neighbouring markets?
- How to achieve a leading position in production and marketing of lime?
- How to sustainably increase production capacity?
- How to continuously enhance environmental, energy and economic efficiency - reduce the use of non-renewable energy sources in all parts of the production process?

Business case – outputs

- On-line calculation of specific energy consumption for process control, planning and comparison,
- Complex evaluation of process parameters influence on energy consumption, CO_2 emissions and costs,
- Complex evaluation of the energy and environmental performance in the factory, based on actual energy consumption, production data and related environmental issues,
- Simulations of hypothetical future situations for decision making (production planning, energy consumption prediction and emissions trading, etc.) and past decisions results tracking,
- Separate treatment of 8 different cements in two mills including the comparison of the specific consumption on a short and long term basis for more precise equipment adjustment.

Concept Applied in Cement Factory



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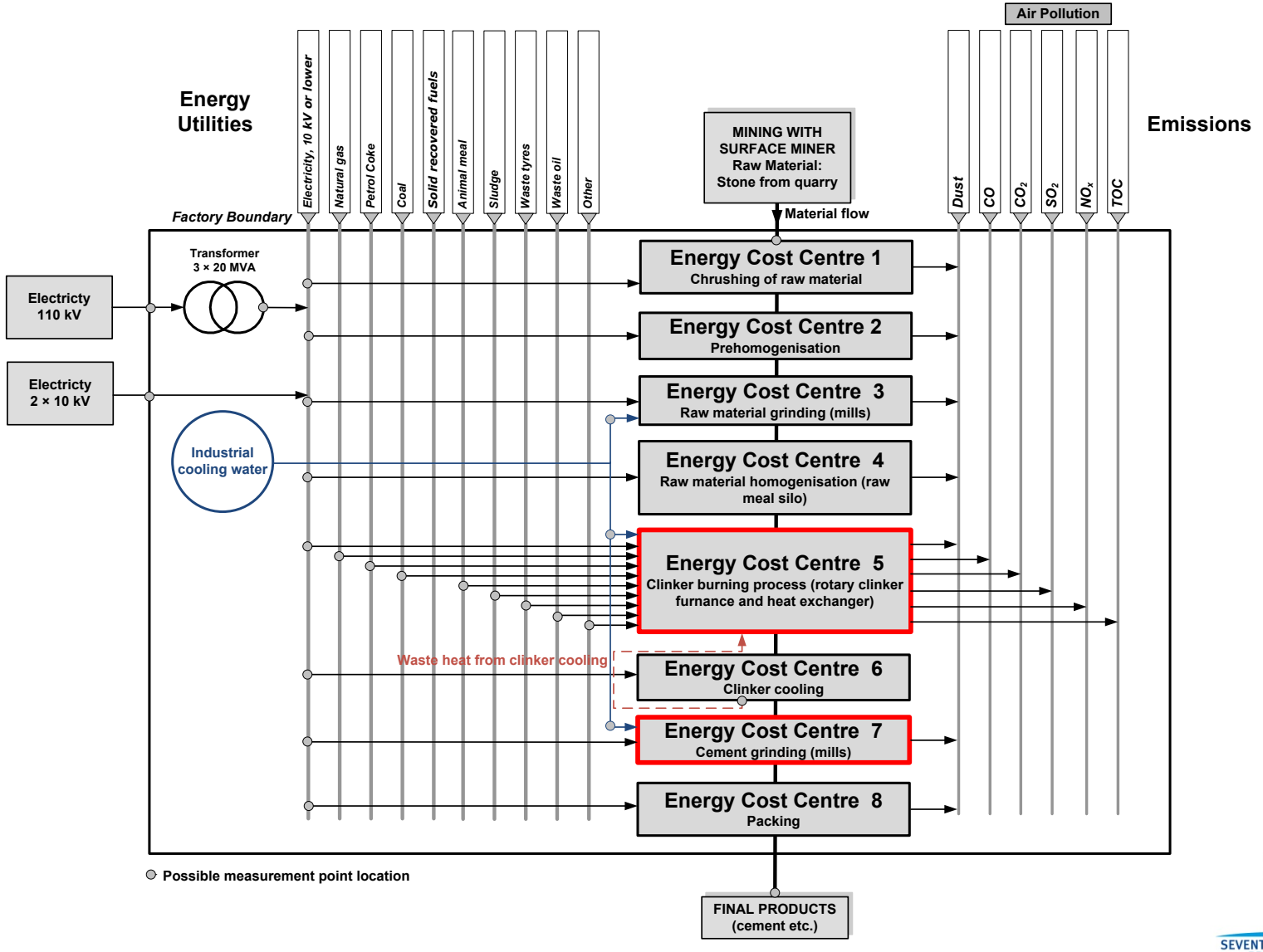
Process and Energy Flow Chart



Energy Cost Centre Modelling

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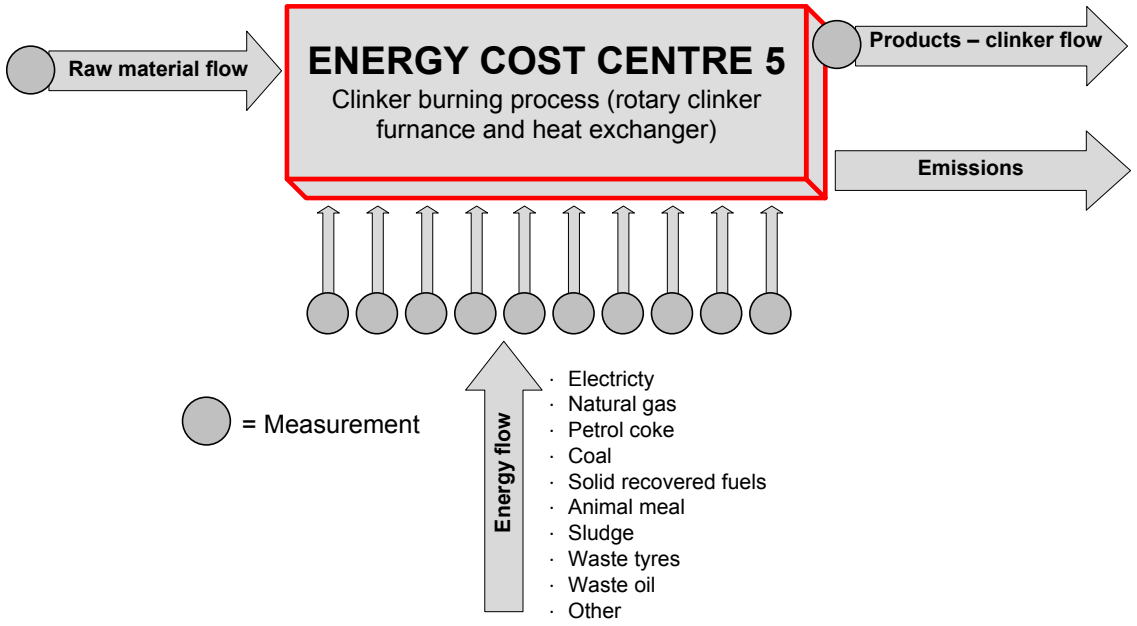
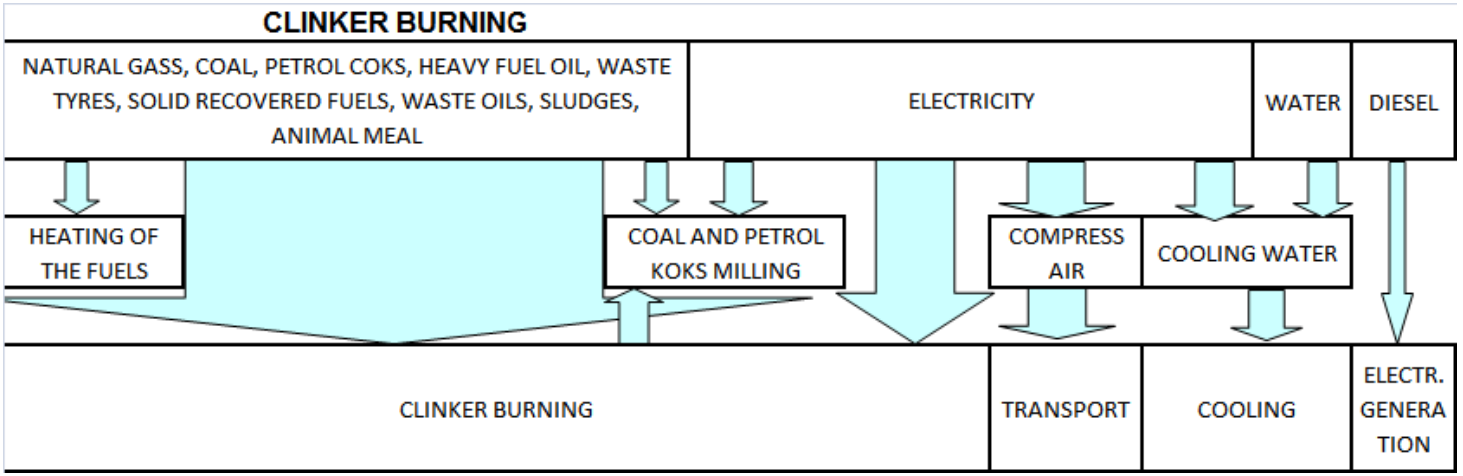
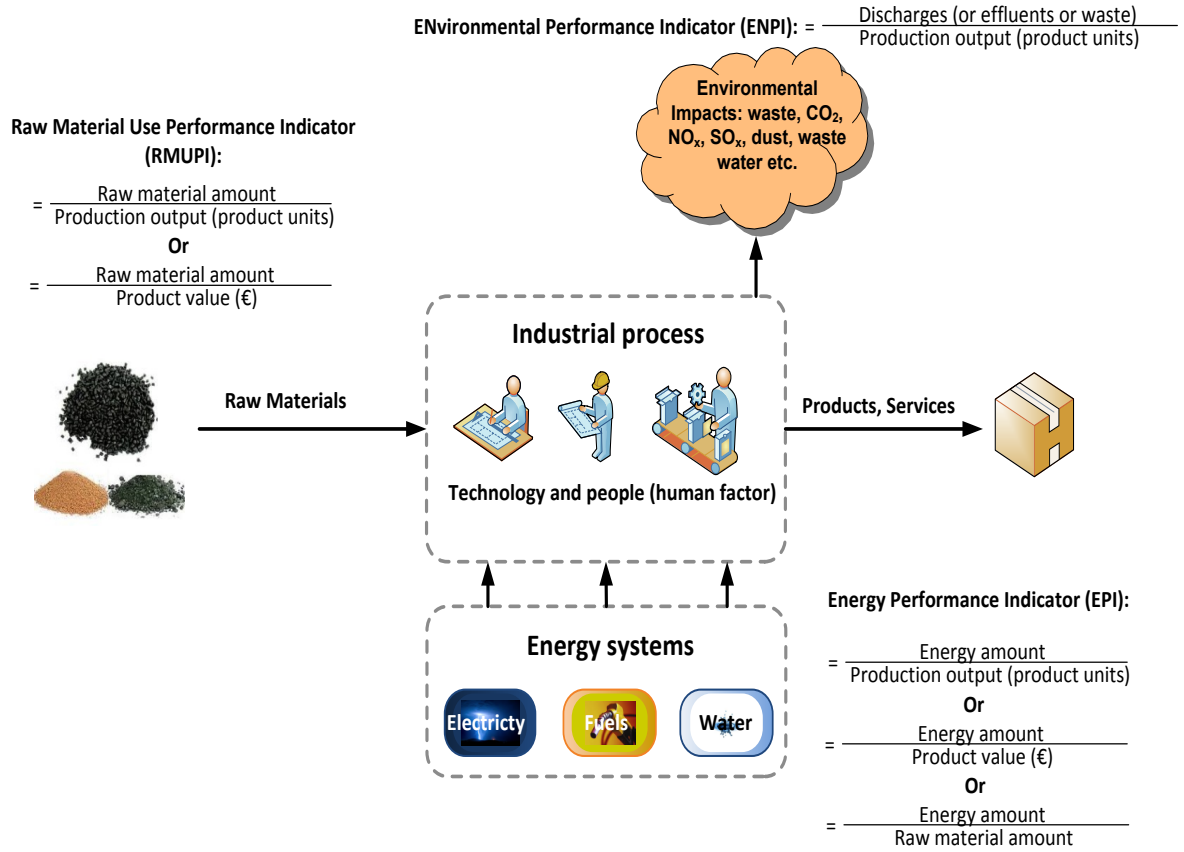




Performance Indicators



Raw material
Total raw materials use (tonne/tonne clinker)
Recycled materials use (tonne/tonne clinker)
Energy
Total energy consumption (MJ/tonne clinker)
Total electricity consumption (MJ/tonne clinker)
Total fossil fuels consumption (MJ/tonne clinker)
Total alternative fuels consumption (MJ/tonne clinker)
Fossil fuel 1 consumption (MJ/tonne clinker)
Fossil fuel 2 consumption (MJ/tonne clinker)
Fossil fuel n consumption (MJ/tonne clinker)
Alternative fuel 1 consumption (MJ/tonne clinker)
Alternative fuel 2 consumption (MJ/tonne clinker)
Alternative fuel n consumption (MJ/ton clinker)
Environment
Total waste generation (tonne/tonne clinker)
Total non-product outputs (tonne/tonne clinker)
Total solid particulates emissions (kg/tonne clinker)
Total dust emissions (kg/tonne clinker)
Total SO_2 emissions (kg/ tonne clinker)
Total NO_x emissions (kg/ tonne clinker)
Total CO emissions (kg/ tonne clinker)
Total CO_2 emissions (kg/ tonne clinker)
Air use for combustion (kg/tonne clinker)
Costs
Total energy costs (EUR/tonne clinker)
Total CO_2 emissions costs (EUR/ tonne clinker)
Total electricity consumption (EUR/tonne clinker)
Total fossil fuels consumption (EUR/tonne clinker)
Total alternative fuels consumption (EUR/tonne clinker)
Fossil fuel 1 consumption (EUR/tonne clinker)
Fossil fuel 2 consumption (EUR/tonne clinker)
Fossil fuel n consumption (EUR/tonne clinker)
Alternative fuel 1 consumption (EUR/tonne clinker)
Alternative fuel 2 consumption (EUR/tonne clinker)
Alternative fuel n consumption (EUR/tonne clinker)

Simulations of hypothetical future situations for decision making

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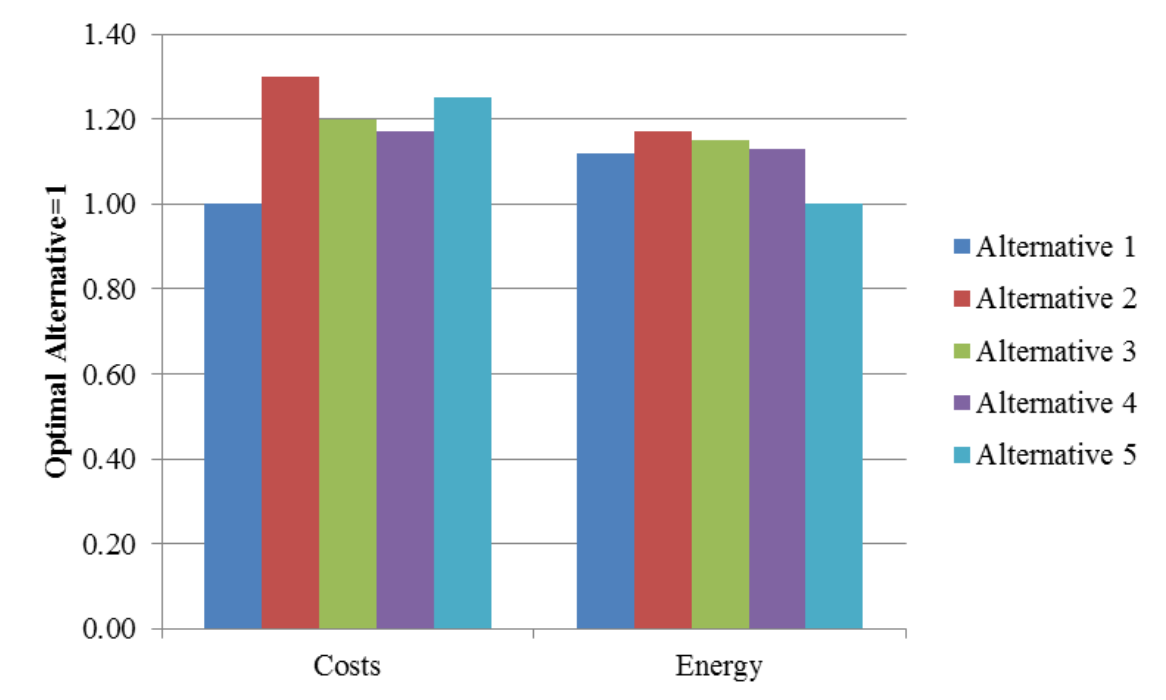
Fuels	Scenario Alternative				
	1	2	3	4	5
Petrol Coke	1	1	1	1	1
Coal	0	1	0	0	1
Waste oil	0	1	0	0	0
Waste tires	1	1	1	1	1
Solid recovered fuels	1	1	1	1	1
Animal meal	1	0	1	0	0
Sludge	1	1	0	1	0



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Conclusion and Future Challenges

- The proposed concept enables the simulations of hypothetical future situations and provides the required support in the decision making process (production planning, energy consumption prediction, emissions trading, etc.)
- Fast and accurate models for simulations and long term predictions of energy consumption and related costs
- Active human operator support for systematic reduction of the energy consumption - the first step in the transition to sustainable fuel switch

Thank you for your attention

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