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ClimaEast

Support to Climate Change Mitigation and Adaptation in Russia and ENP East countries

Cement industry – CO_2 abatement technologies

Andrzej Werkowski, Expert

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Cement production
CO_2 abatement technologies

- New technologies related to carbon emissions reduction from cement manufacturing cover the following areas:
  - Energy efficiency
  - Alternative fuel
  - Clinker substitution
  - Carbon capture and storage (CCS)
  - Innovative low-carbon cementitious materials as alternatives to the traditional Ordinary Portland Cement

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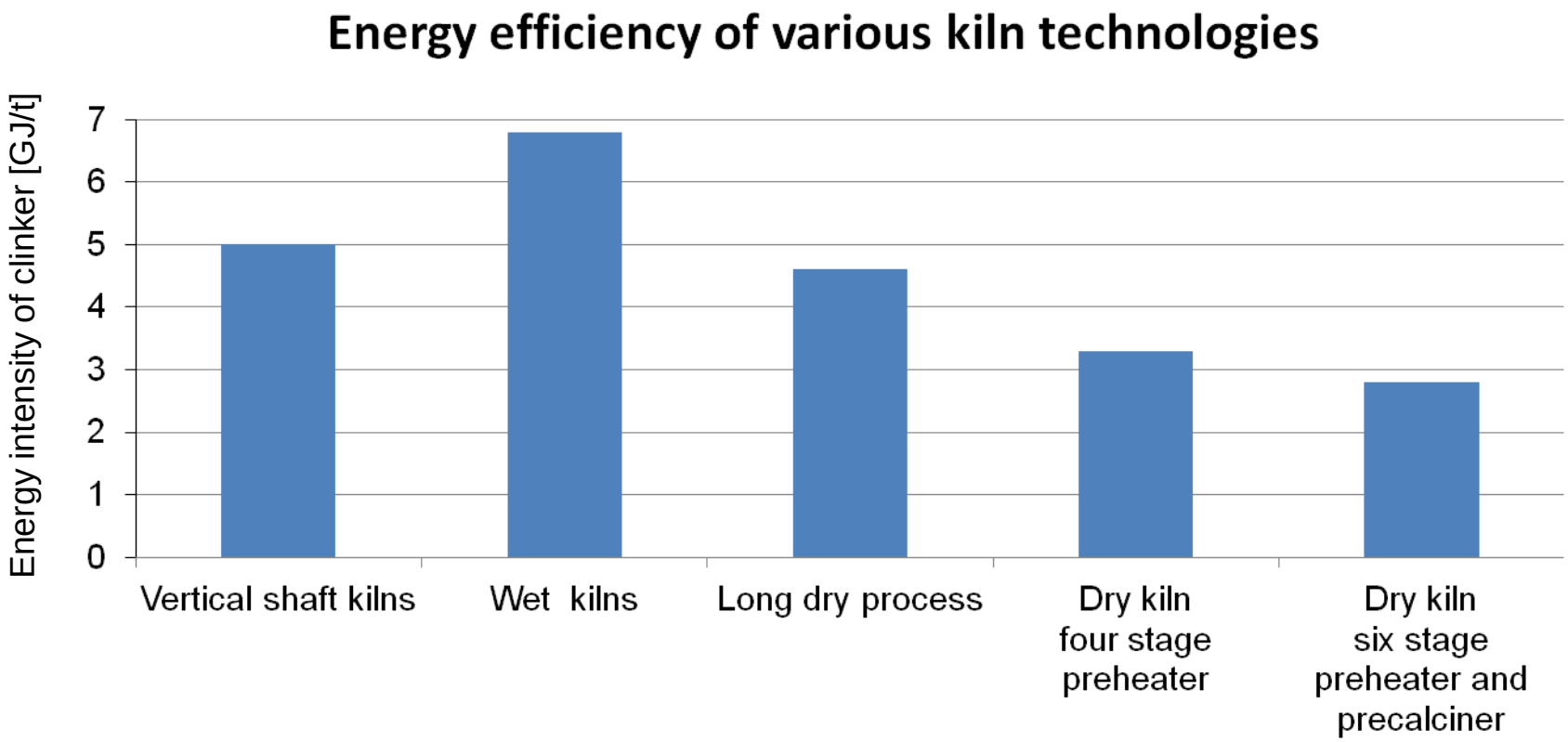
Cement production
CO_2 abatement technologies



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Cement production
CO_2 abatement technologies

Energy efficiency improvement

- Today's state-of-the-art most energy efficient cement kiln process uses the dry kiln processes with multistage cyclone preheaters with an integral pre-calciner
- Other measures
  - Reducing the heat loss from the kiln system
  - Improving the kiln combustion system and optimising the kiln operation using process control and management system
  - Waste heat recovery for power generation

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Cement production
CO_2 abatement technologies

Energy efficiency improvement

- Significant reduction of electricity use and related indirect CO_2 emissions can be achieved through:
  - Modern grinding technologies reducing the electricity demand of the raw and finishing grinding operation as well as that of coal milling for fuel preparation
  - Using modern highly-efficient motors or improving the efficiency of the existing motor system
  - Improving raw material blending/homogenising, using high efficiency classifiers/separators, efficient transport systems and fans
  - Reducing pressure losses in cyclone preheaters

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Cement production CO_2 abatement technologies

Alternative fuels

- Coal is the most carbon-intensive fossil fuel and is the most widely-used fuel in the cement industry
- Replacing fossil fuel with biomass and/or waste derived fuels saves energy and natural resources, reduces CO_2 emissions, and gives number of potential benefits
  - Recovery of the energy content of waste
  - Conservation of non-renewable fossil fuels
  - Reduction of overall CO_2 emissions
  - Lowering cement production cost

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Cement production CO_2 abatement technologies

Clinker substitution

- Substitutes such as blast furnace slag, fly ash from coal combustion, and other natural and manufactured pozzolans
- The most cost-effective way to reduce CO_2 emissions from cement production with other environmental benefits
  - Thermal energy consumption of per unit cement produced decreases with the increased ratio of clinker substitutes in the blended cement
  - The reduced thermal energy requirements and lower power consumption result in decreases in both direct and indirect CO_2 emissions in cement production and in associated costs

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Cement production
CO_2 abatement technologies

Carbon capture

- Post-combustion capture
  - Chemical absorption process with carbonate looping using CaO as sorbent
  - Membrane and cryogenic separation processes (not yet commercially available)
- Oxyfuel combustion capture
  - Fuel is burned in pure O_2 instead of air – easy separation of CO_2 from flue gas but energy-intensive oxygen production

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Cement production
CO_2 abatement technologies

Low-carbon cement

- Replacing limestone with alternative calcium containing raw materials with less embodied CO_2
- Alternative raw materials: Cement kiln dust (CKD), steel slag, fly ash and other pozzolanic materials, and concrete wastes

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Cement production
Waste Heat Recovery

Waste Heat Recovery (WHR)

- Mature technology
- Broadly applied in the cement sector in China
- Small number of applications in the rest of the world-wide cement industry
- Range of comercially proven WHR power systems
  - Classic Rankine Cycle (steam-based)
  - Organic Rankine Cycle – ORC (organic liquids)
  - Kalina Cycle (ammonia-water solution)

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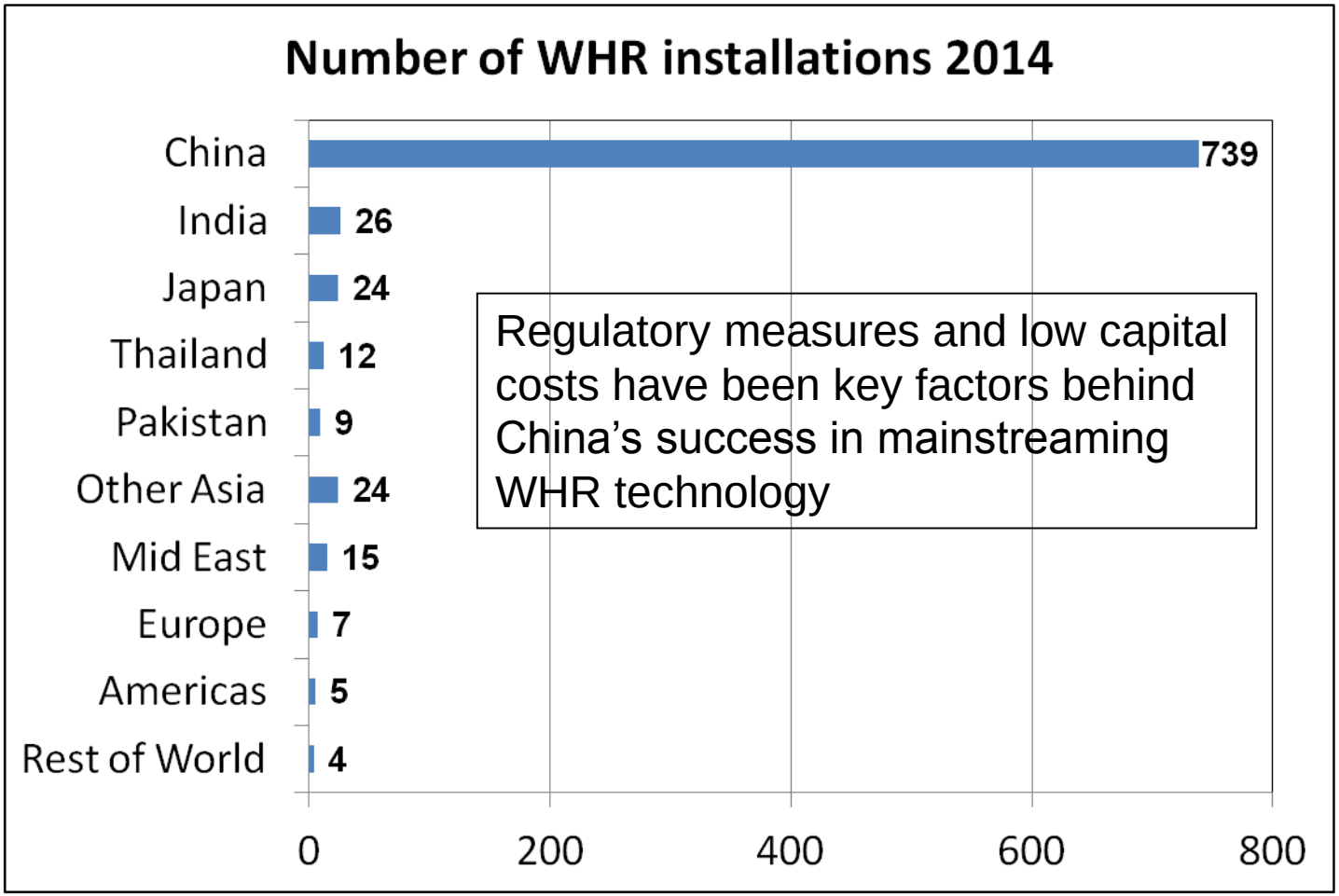
Cement production
Waste Heat Recovery



Cement production
Waste Heat Recovery

- Waste Heat Recovery (WHR) can reduce the operating costs and improve EBITDA margins of cement factories by about 10 to 15 percent
- WHR technology utilizes residual heat in the exhaust gases generated in the cement manufacturing process and can provide low-temperature heating or generate up to 30 percent of overall plant electricity needs
- Steam Rankine Cycle – temperature > 300°C
- ORC and Kalina Cycle – low-temperature heat > 100°C

Cement production
Waste Heat Recovery

- WHR-based electric power generation
  - Provides clean „zero-emission” electricity
  - Reduces purchased power consumption (or reduces reliance on fossil-fuel-based captive power plants)
  - Mitigates the impact of future electric price increases
  - Enhances plant power reliability
  - Improves plant competitive position in the market

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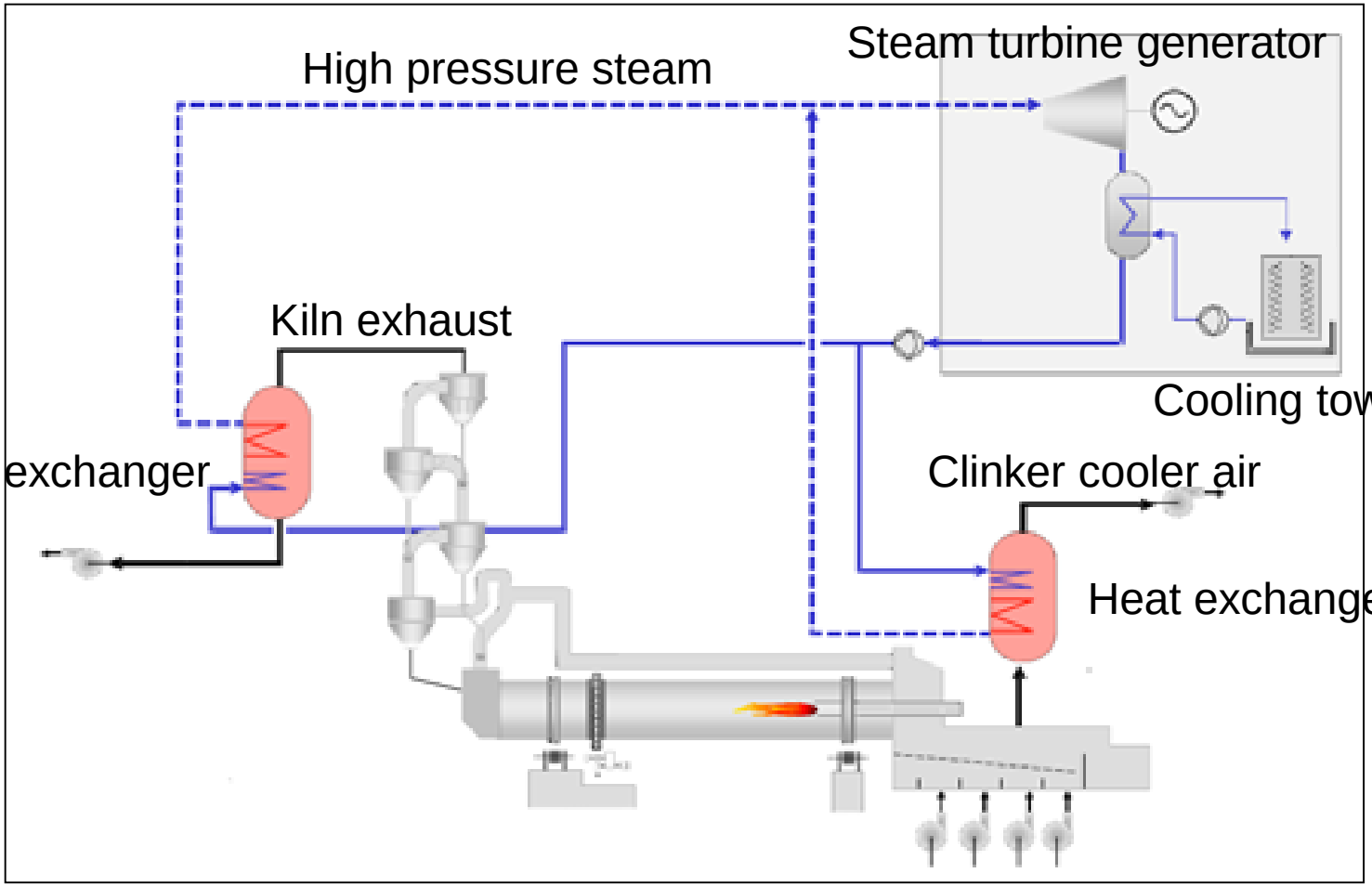
Cement production
Waste Heat Recovery



Cement production
CO_2 abatement technologies

CO_2 reduction

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Less energy consumed

↓

Decreased cost of cement production

↓

Competitive advantage

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How to contact ClimaEast

The project team can be contacted at personal e-mail addresses a.werkowski@hotmail.com and:

info@climaeast.eu

Clima East Office, c/o Milieu Ltd

Chaussée de Charleroi No. 112

1060 Brussels (Belgium)

Tel: +32 2506 1000

Website:

English: www.climaeast.eu - Russian: http://russian.climaeast.eu/

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