SEVENTH FRAMEWORK PROGRAMME

THEME [ENERGY.2009.8.1.1 ENERGY]

[Energy efficiency in energy intensive industry]

EUROPEAN COMMISSION

National Technical University of Athens (NTUA), Greece

ENEXAL (2010-2014):

Novel technologies for enhanced ENergy and EXergy efficiencies in the primary ALuminium production industry

Dr Dimitrios I. Gerogiorgis

Postdoctoral Fellow, NTUA

Email: dgerogiorgis@metal.ntua.gr

Introduction to the ENEXAL project

Objective

Provide the primary aluminium production industry with 'green' innovative technological and economical solutions

- Improve the energy and exergy efficiency
- Reduce Greenhouse Gas Emissions
- Eliminate Solid Wastes

*Ensure Industrial **Sustainability** & **Competiveness***

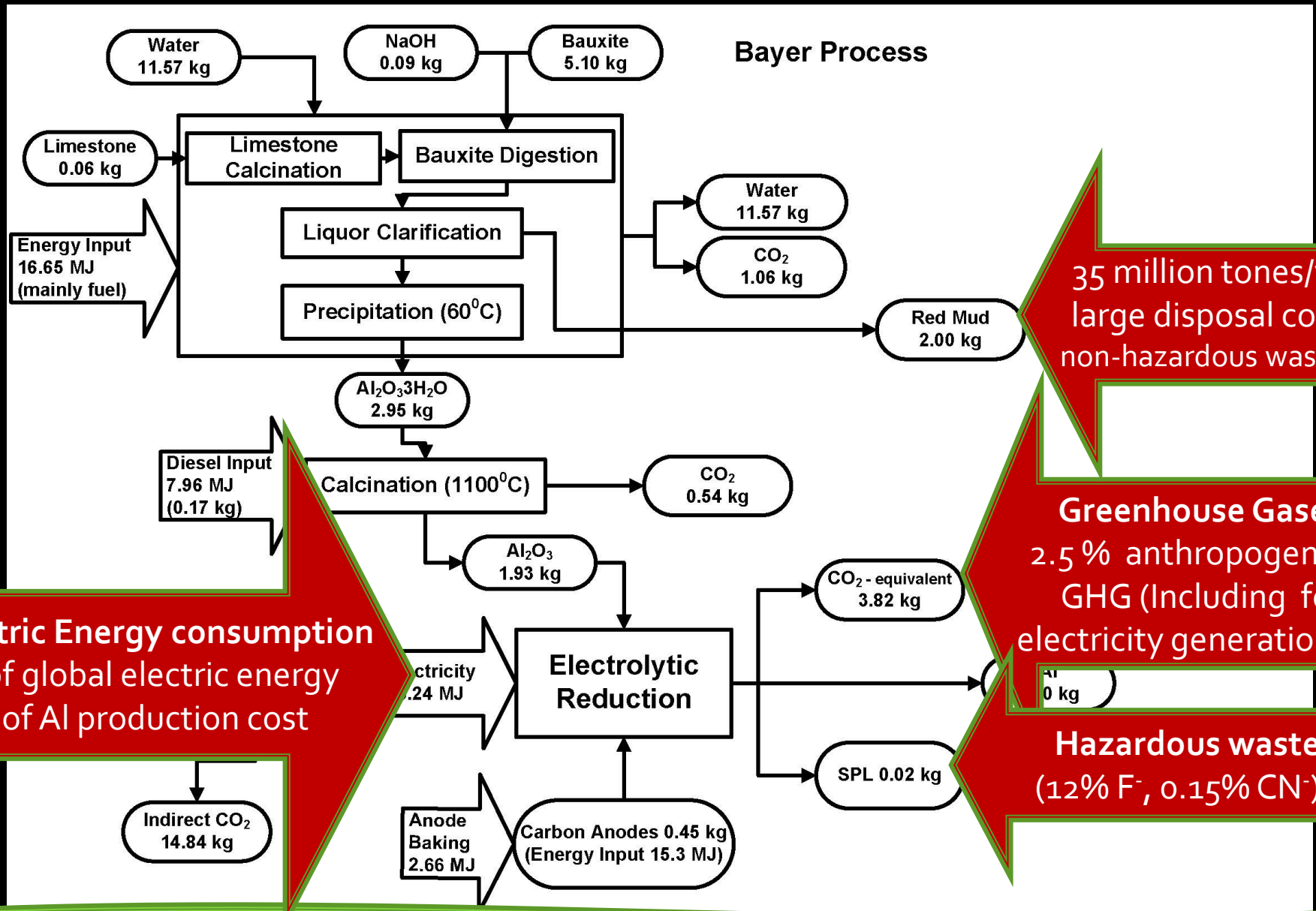
End result

Render the primary Aluminium industry a leader in energy efficient technologies

Partners of the ENEXAL project

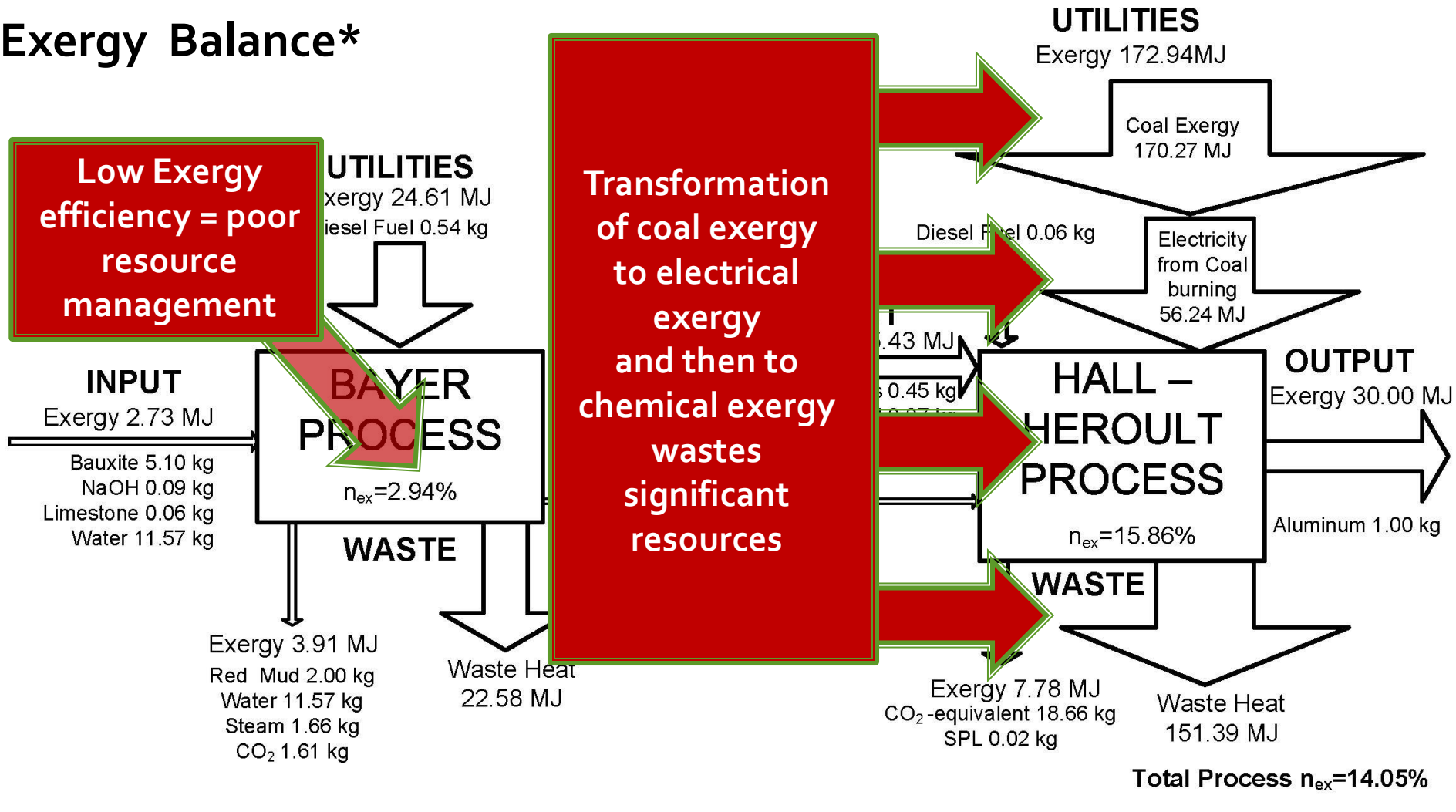
- Aluminium S.A. (GR)
- NTUA (GR)
- RWTH-Aachen (DE)
- ETH-Zurich (CH)
- Weizmann Institute (IL)
- TMF-Serbia (RS)
- Sirmium Steel (RS)
- D'Appolonia (IT)
- Pegaso Systems (IT)
- Lindbergh (ZAF)

Aluminium production today



Aluminium production today

Exergy Balance*



*Exergy quantifies the maximum work obtainable from any natural resource, as this resource comes into thermodynamic equilibrium with our environment

Enexal activities

goals

- Reduce Energy Consumption
- Reduce Greenhouse Gas Emissions
- Improve Resource Management
- Eliminate Solid Wastes

RTD & demonstration activities

1. High temperature carbothermic reduction of alumina
2. Moderate temperature carbothermic reduction of alumina
3. Red mud treatment
4. Site optimization

1 High temperature carbothermic reduction

idea

Utilize the coal used to produce electricity for the Hall-Heroult process in a direct carbothermic reduction of alumina

process

High temperature (2100 °C) reduction of alumina in an Electic Arc Furnace (EAF)

expected results

16% reduction in energy consumption

35% reduction in GHG emissions

Elimination of SPL wastes

3 percentile point increase of exergy efficiency

Increase of industry's profit margin

RTD PERFOMERS & DEMONSTRATORS

TECHNOLOGY EVALUATION

2 Moderate temperature carbothermic reduction

idea

Utilize concentrated **solar radiation** to provide the process heat necessary for the carbothermic reduction of alumina

process

Carbothermic reduction of alumina in solar furnace, under vacuum in order to reduce the operational temperature (<1600 °C)

expected results

68% reduction in electric power consumption

65% reduction in GHG emissions

Elimination of SPL wastes

82 percentile point increase of exergy efficiency

Increase of industry's profit margin

RTD PERFOMERS & DEMONSTRATORS

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zürich

TECHNOLOGY EVALUATION

AVL

D'APPOLONIA

3 Red mud treatment

idea Complete transformation of the **red mud waste** into valuable products

process Reductive smelting of alumina in the AMRT-EAF towards producing pig-iron and viscous slag for mineral wool production

expected results

- Complete elimination of all Bayer solid wastes
- 6% increase of exergy efficiency
- Economic expansion in new markets

RTD PERFOMERS & DEMONSTRATORS

TECHNOLOGY EVALUATION

D'APPOLONIA

4 Site optimization

idea Integrate the novel technologies in the primary aluminium industry

process Reduce overall energy consumption through site optimization (off-gasses utilization, heat exchange, …)

expected results

Create a new production schema for a sustainable primary aluminium industry

Formulate a technology implementation and exploitation plan

RTD PERFOMERS

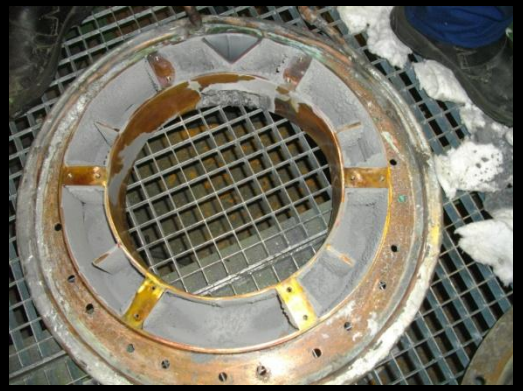
ENEXAL Mid-Term Results

1 High temperature carbothermic reduction of alumina

Two different technologies are under study in lab scale (RWTH/NTUA)

a) Carbothermic Al-Si Alloy production

b) Gaseous Al production

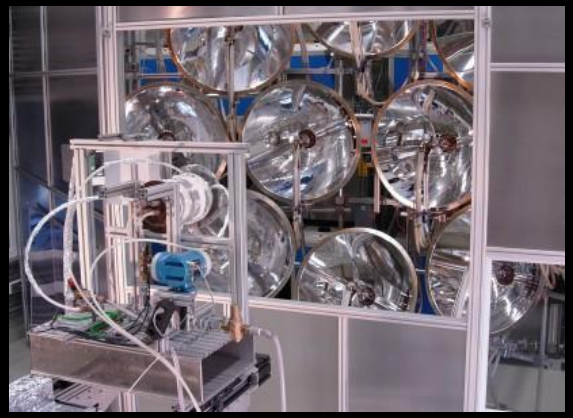


Pilot plant Demonstrations in ALSA scheduled in fall 2013

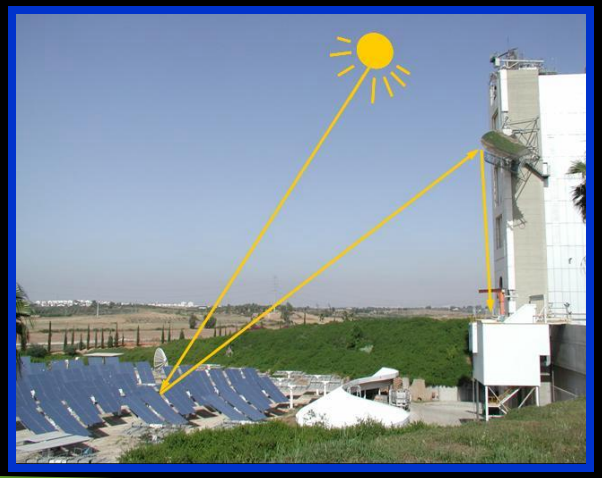
ENEXAL Mid-Term Results

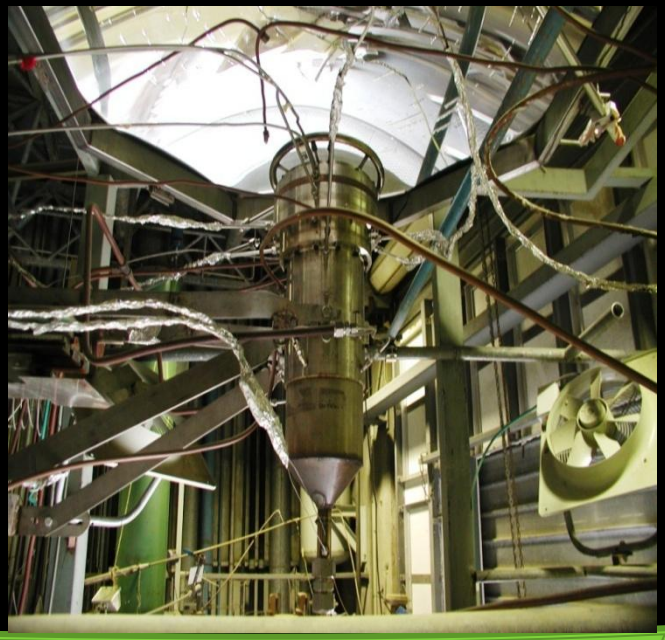
2 Moderate temperature carbothermic reduction of alumina

Process proven in lab scale (solar simulator in ETHZ)



Solar furnace in WIS in final stages of assembly – Demonstration to begin in March 2013





ENEXAL Mid-Term Results

3 Red mud Treatment

Process proven and optimized in lab scale

Pig Iron product suitable for secondary steel industry

Fiber production for mineral wool products

Pilot plant demonstrations in ALSA began in September 2012

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Thank you for your attention!

www.labmet.ntua.gr/ENEXAL
Dr Dimitrios I. Gerogiorgis
Postdoctoral Fellow, NTUA
Email: dgerogiorgis@metal.ntua.gr