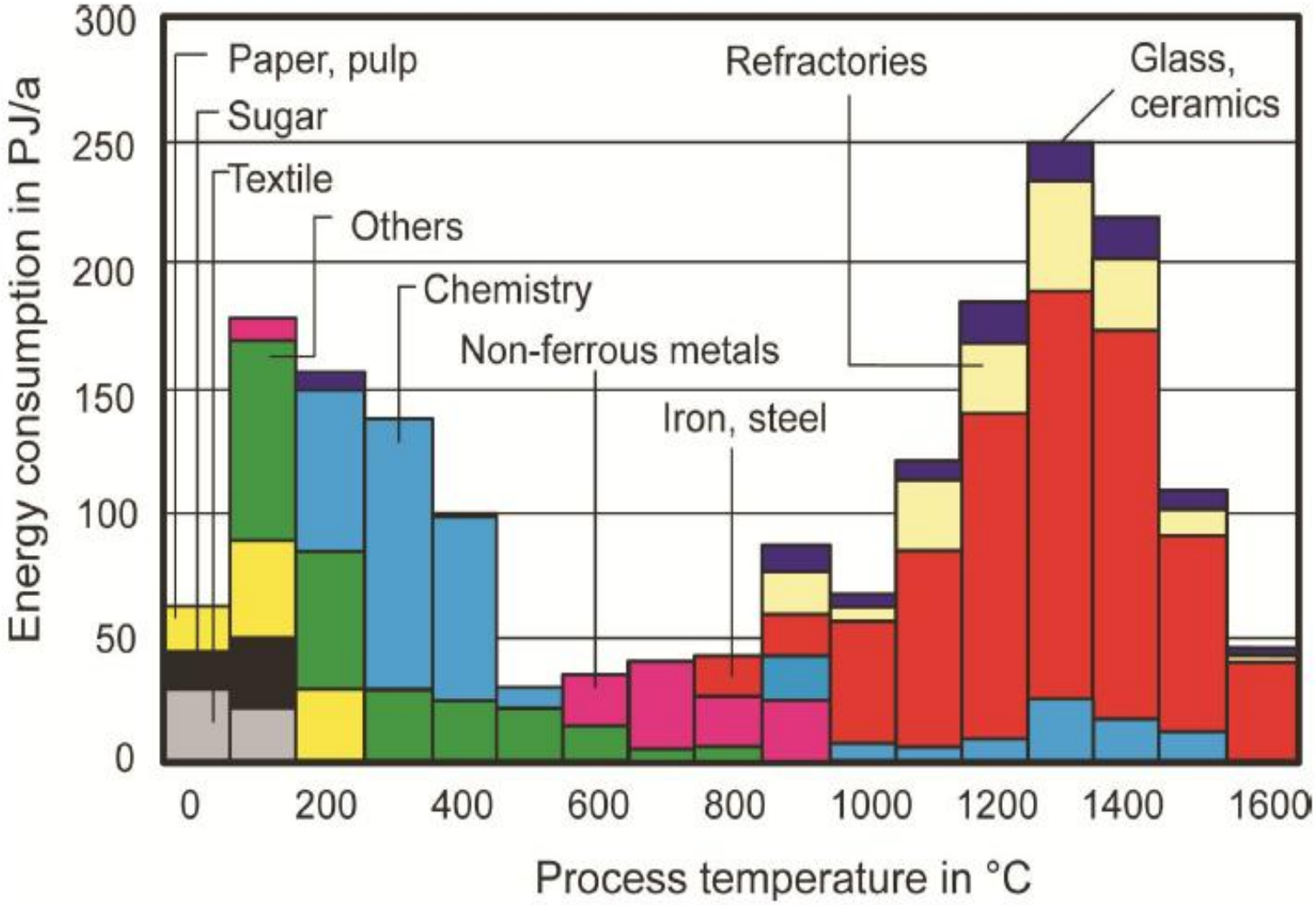
Energy Efficiency in Iron & Steel Industry in Germany 24th -29th , June, 2012

Steel Club Meeting
24th, July, 2012

Summary of Seminar & Visit to German Companies

- Lecture of Prof. Pfeifer , RWTH Aachen University
  - Principles of energy efficiency in RHF & EAF and new technology development
- Endress+ Hauser
  - Instruments Manufacture and energy efficiency services
- WS – Warmeprozesstechnik
  - Combustion and energy efficiency technology supplier
- Thyssen – Krupp
  - Energy efficiency management system
- Otto Junker
  - Induction and energy efficiency technology suppler
- SMS Siemag & Elotherm
  - Iron & Steel industry equipment and technology supplier
- ABP Induction
  - Induction furnace manufacturer
- Kuttner GmbH & Co
  - Energy efficiency technology, metallic waste recycling technology supplier
- LOI Italimpianti (TENOVA)
  - Industrial furnaces supplier

Process Temperature in Various Industries

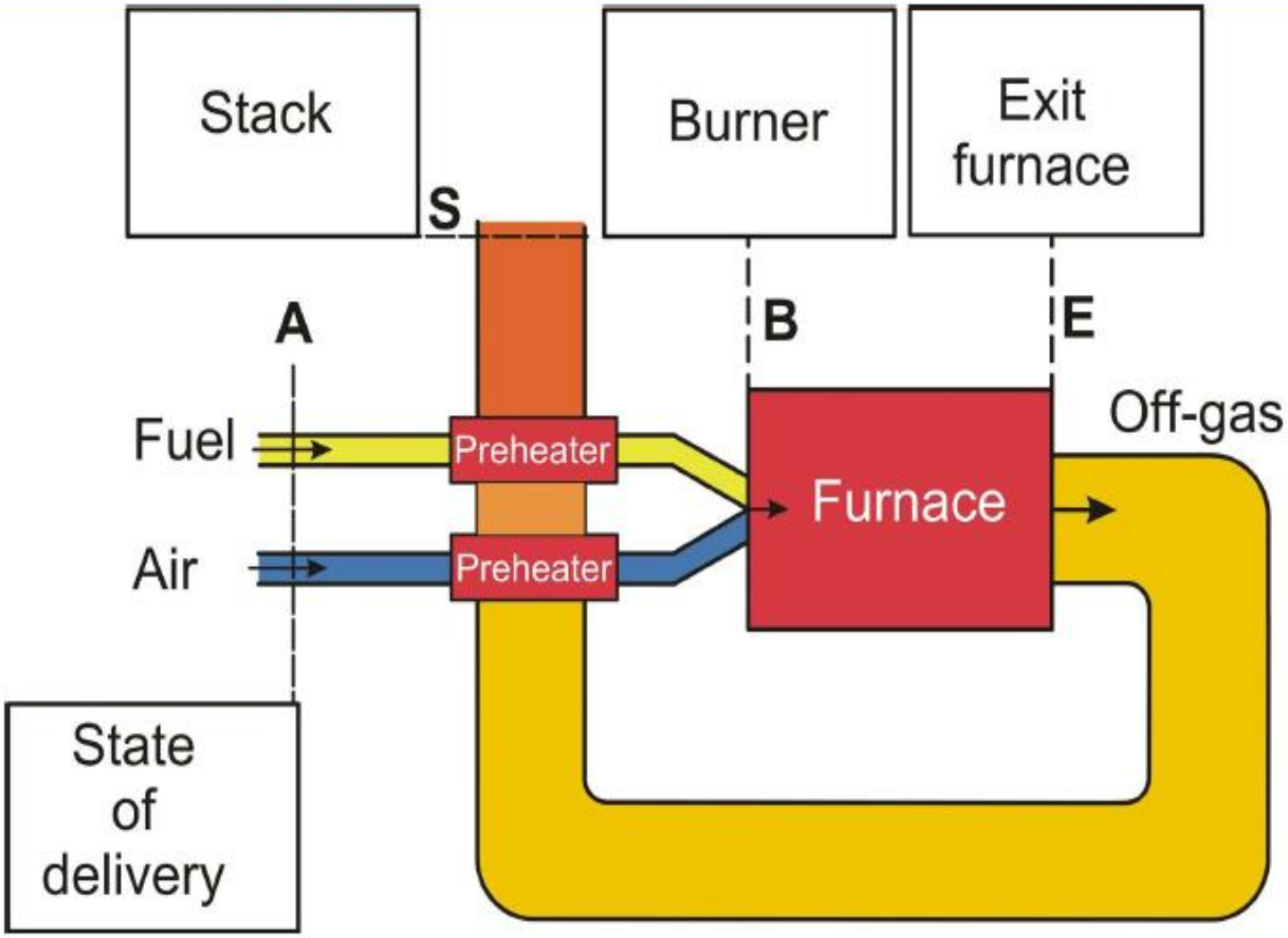


Energy consumption and process temperatures for industrial sectors in Germany

Relevant Matters to Thai Steel Industry

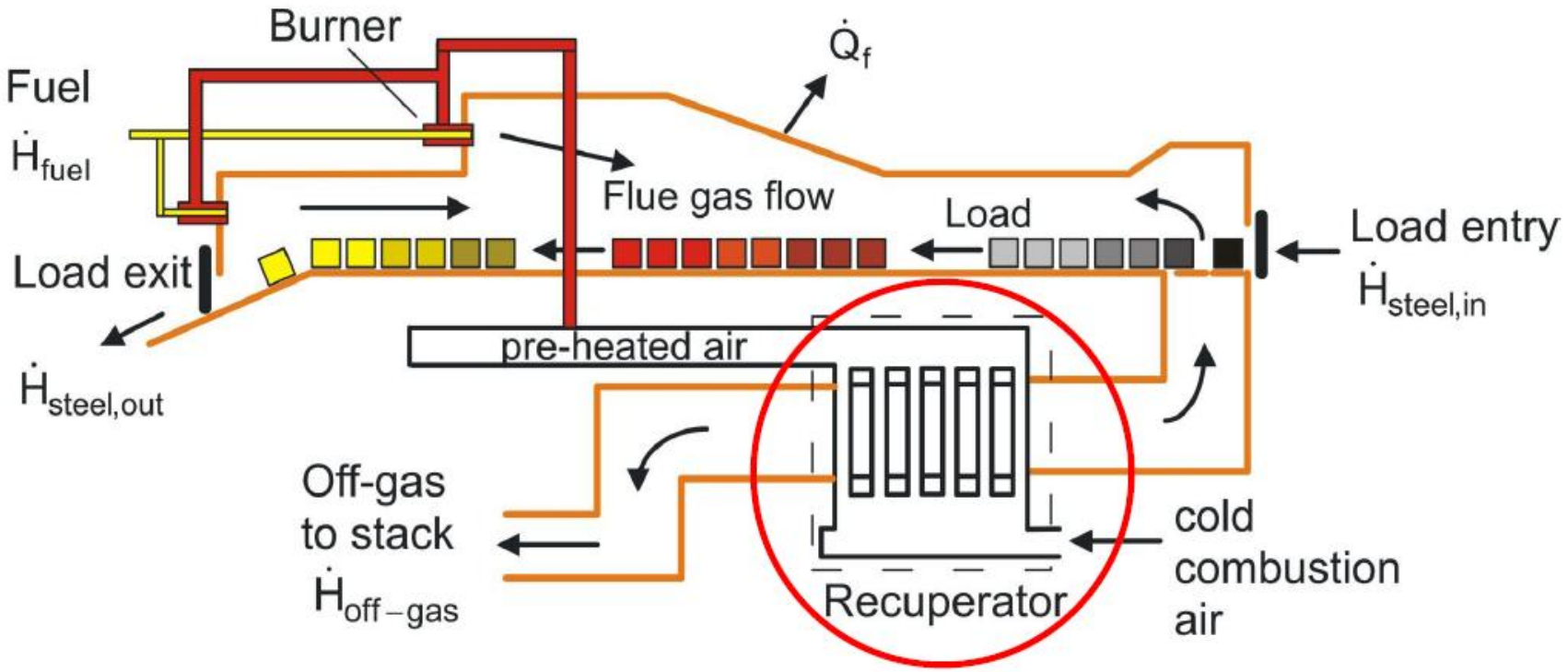
1. Reheating Furnace (Industrial Furnace)
2. Electric Arc Furnace

RHF Mass Flows of Combustion



Characteristic mass flows of combustion

Typical RHF heat recovery from off- gas



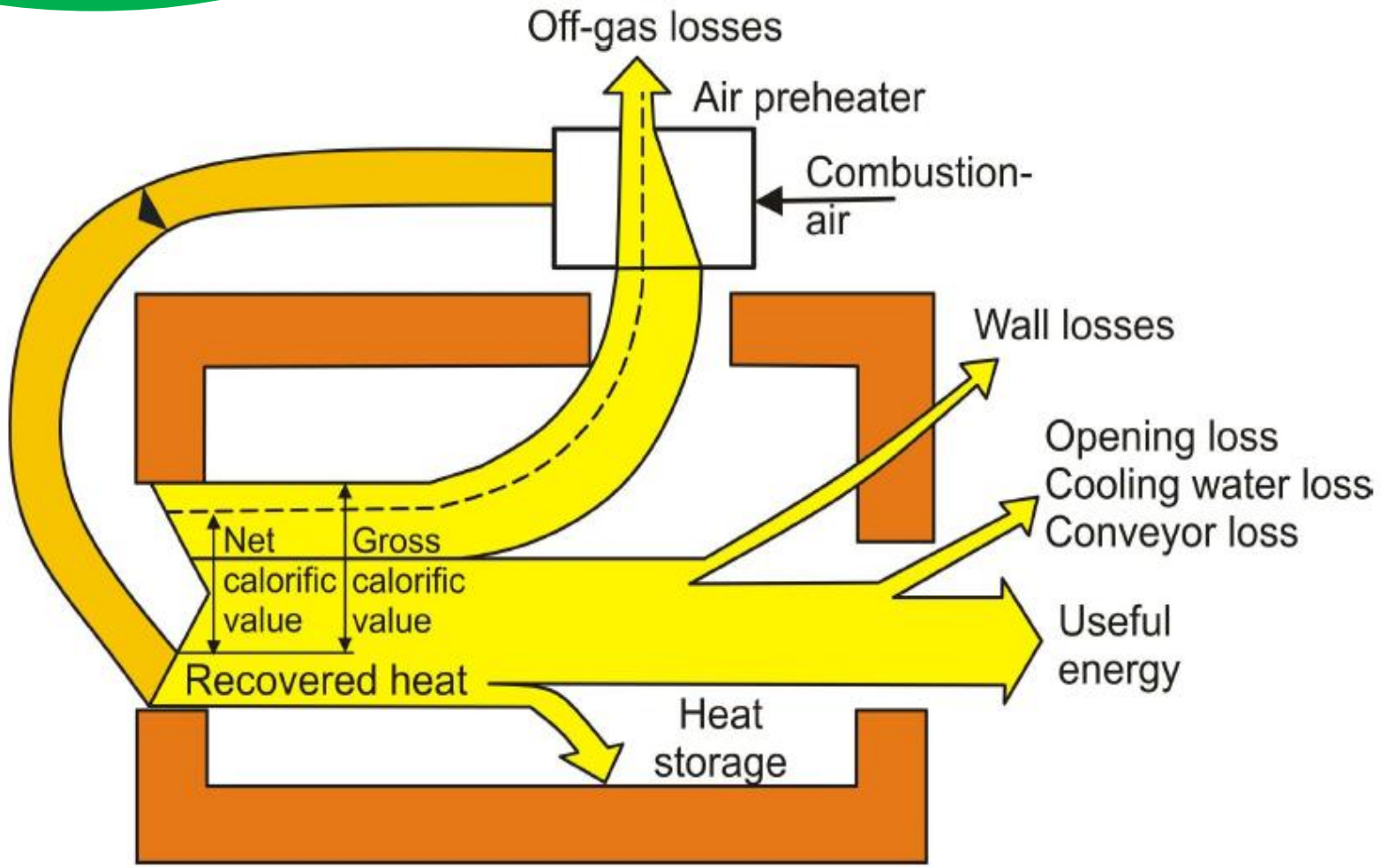
- Central recuperator
- Recuperative burners (decentral)
- Regenerative burners (decentral)

Scheme of a pusher-type furnace with air-preheating

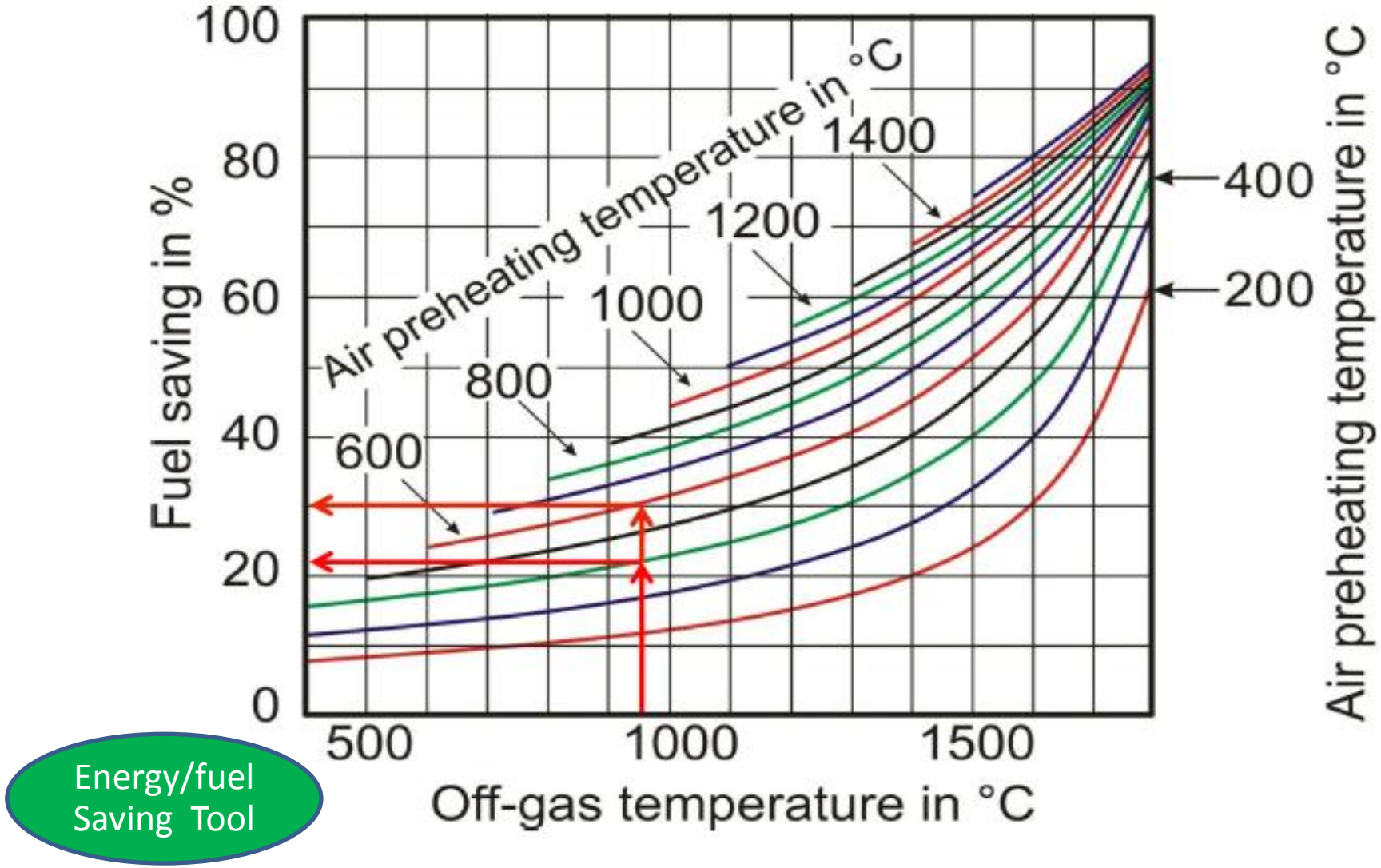
Energy Balance in RHF

Tool for

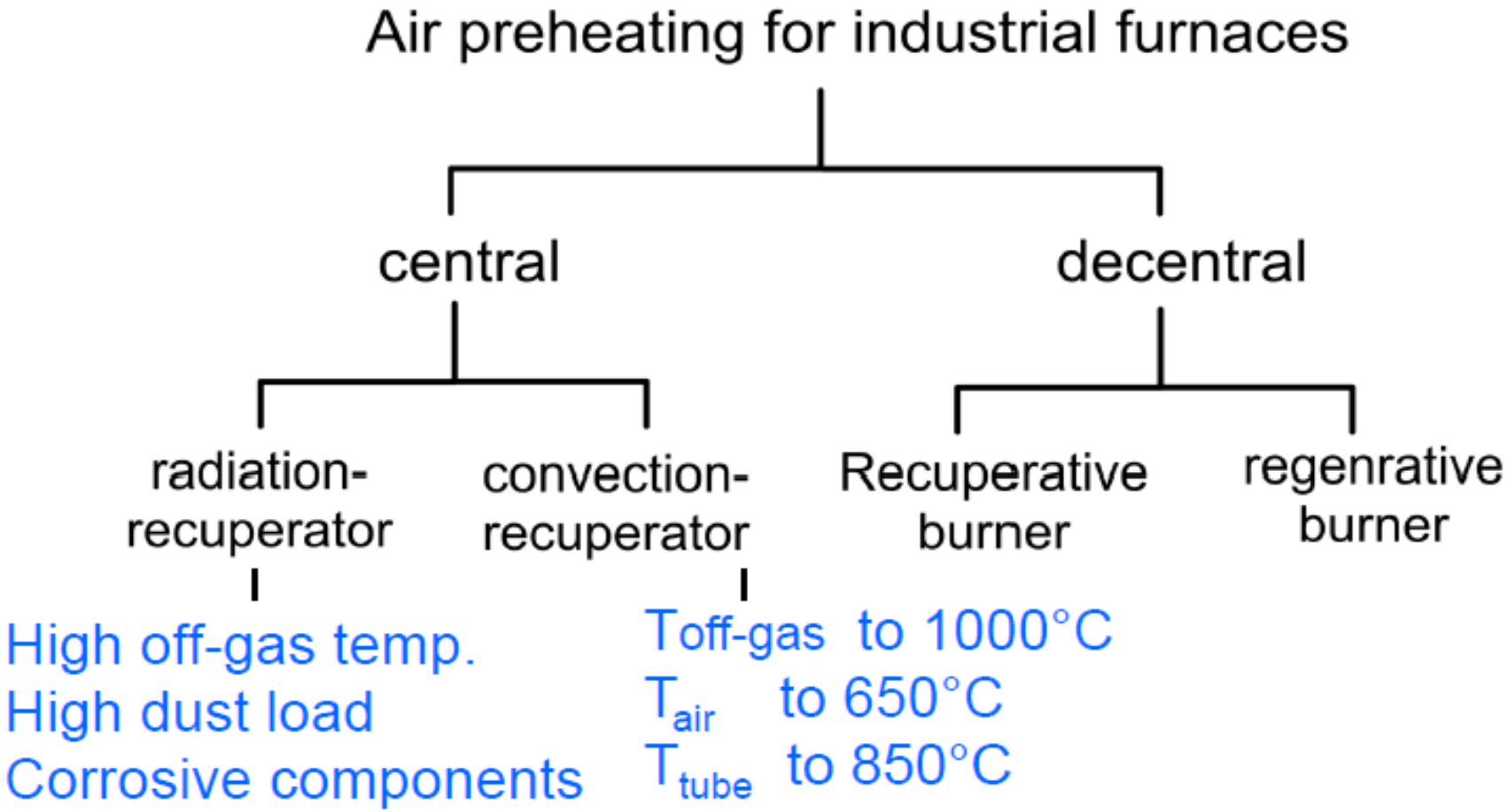
Energy Efficiency Improvement



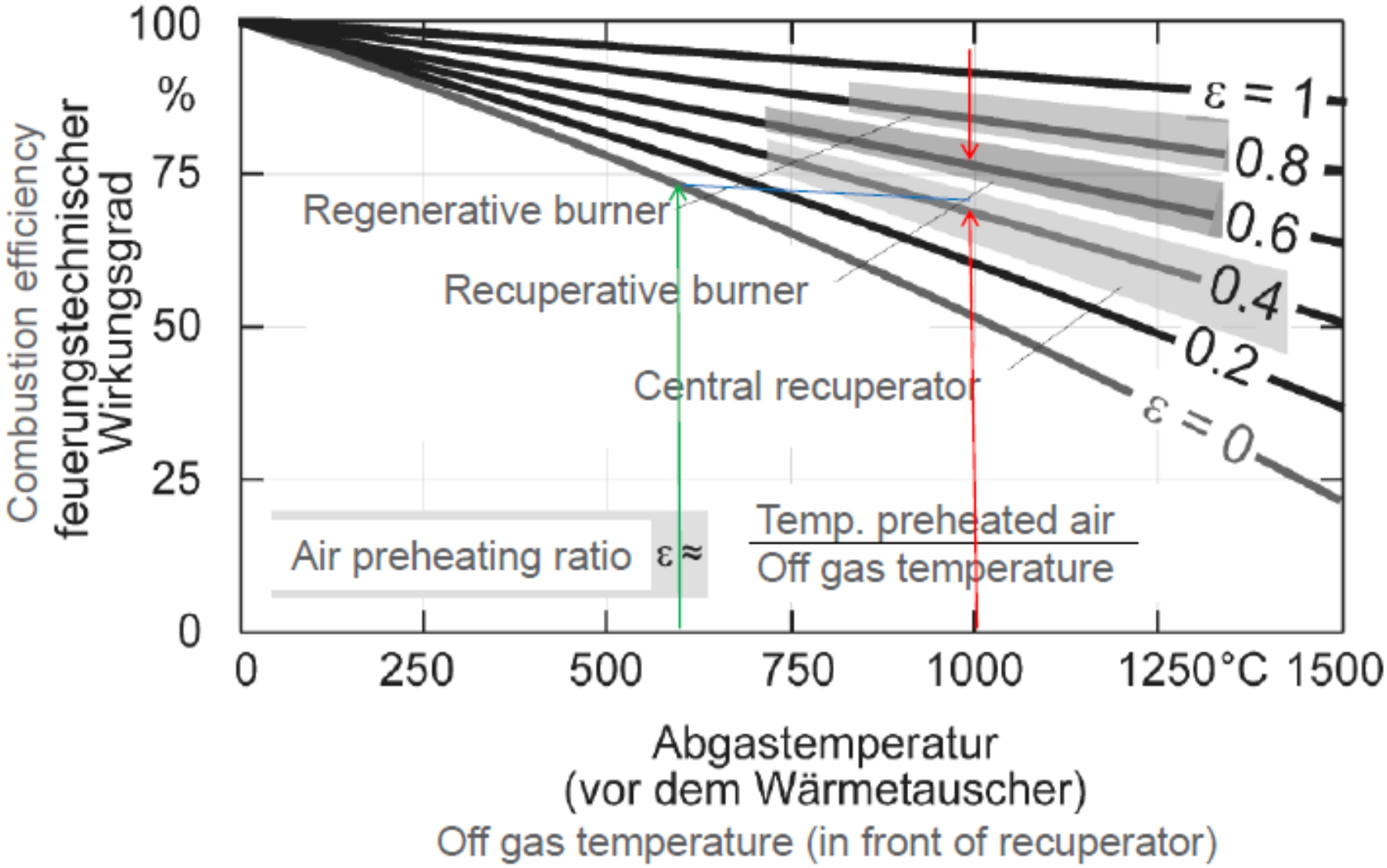
Sankey diagram (schematically) for the energy flow in an industrial furnace with recuperator



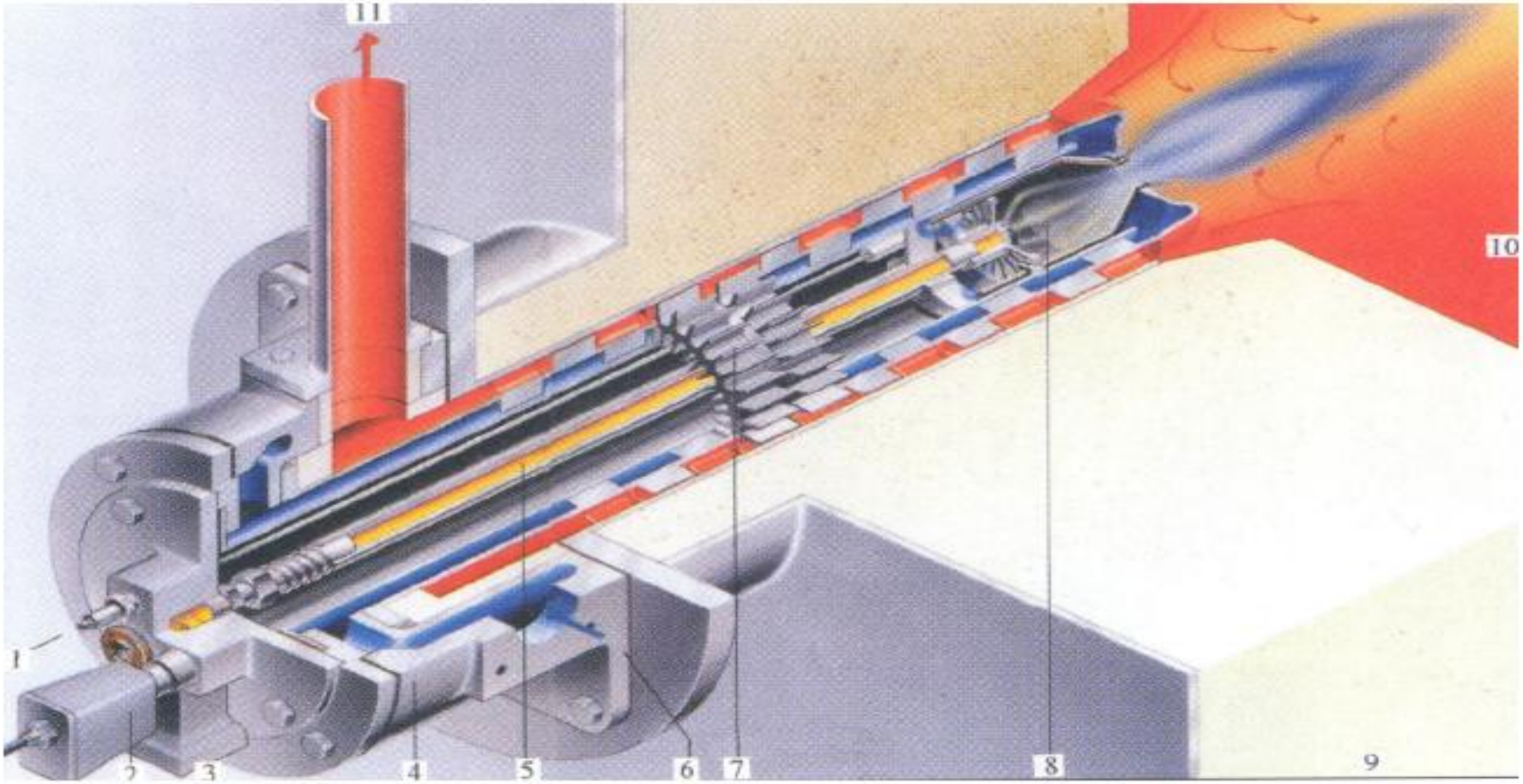
Fuel saving with air preheating for a natural gas
(Tfuel = 20 °C; λ = 1.1)



Systematic Air Preheating for Industrial Furnaces



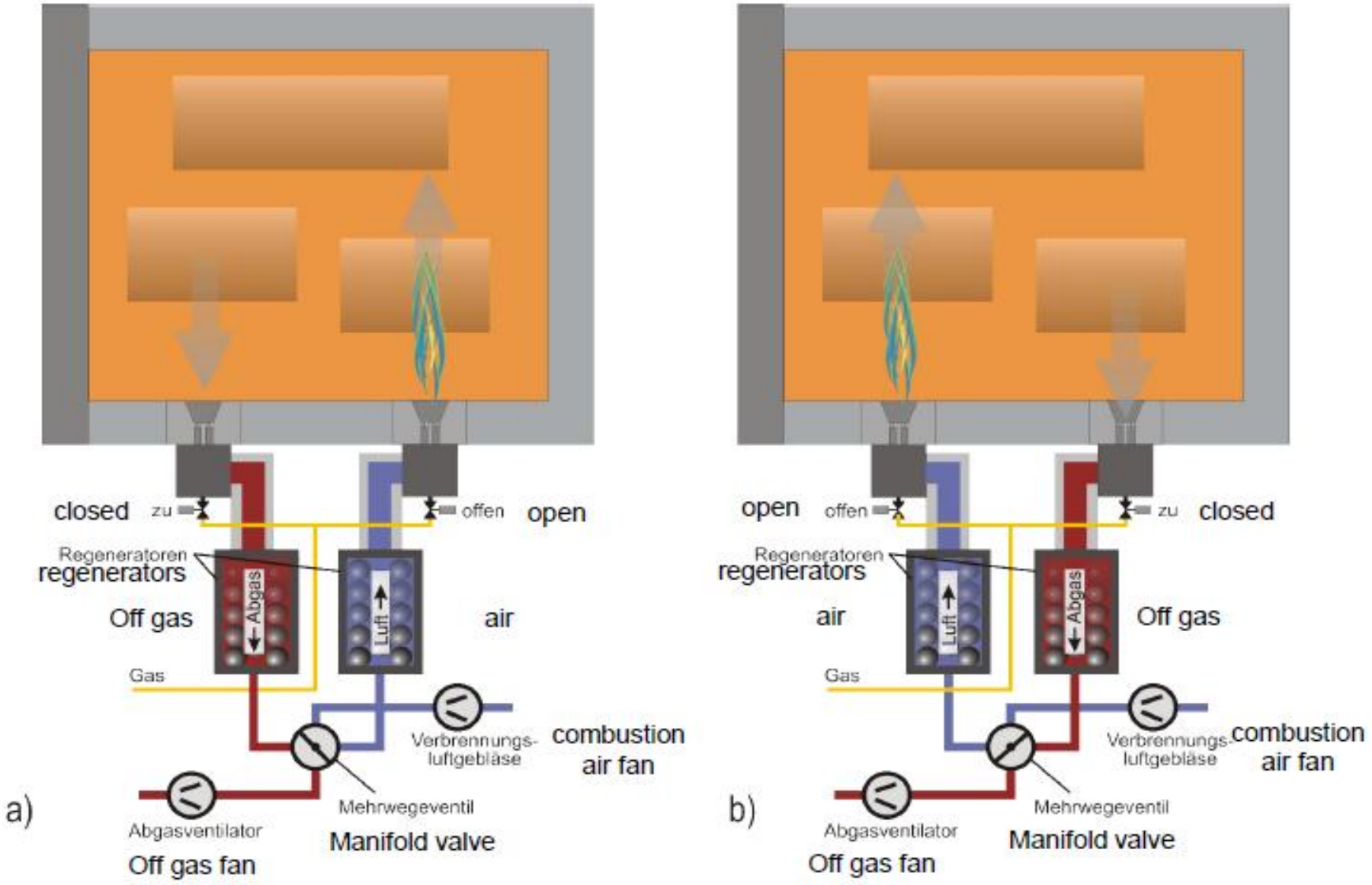
Combustion efficiencies of different burner concepts



1 ignition electrode 2 UV-flame monitor 3 gas 4 burner head 5 gas lance 6 air
7 recuperator 8 ceramic combustion chamber 9 furnace wall 10 process chamber
11 waste gas

Recuperative burner

Regenerative Burner



Relevant Matters to Thai Steel Industry

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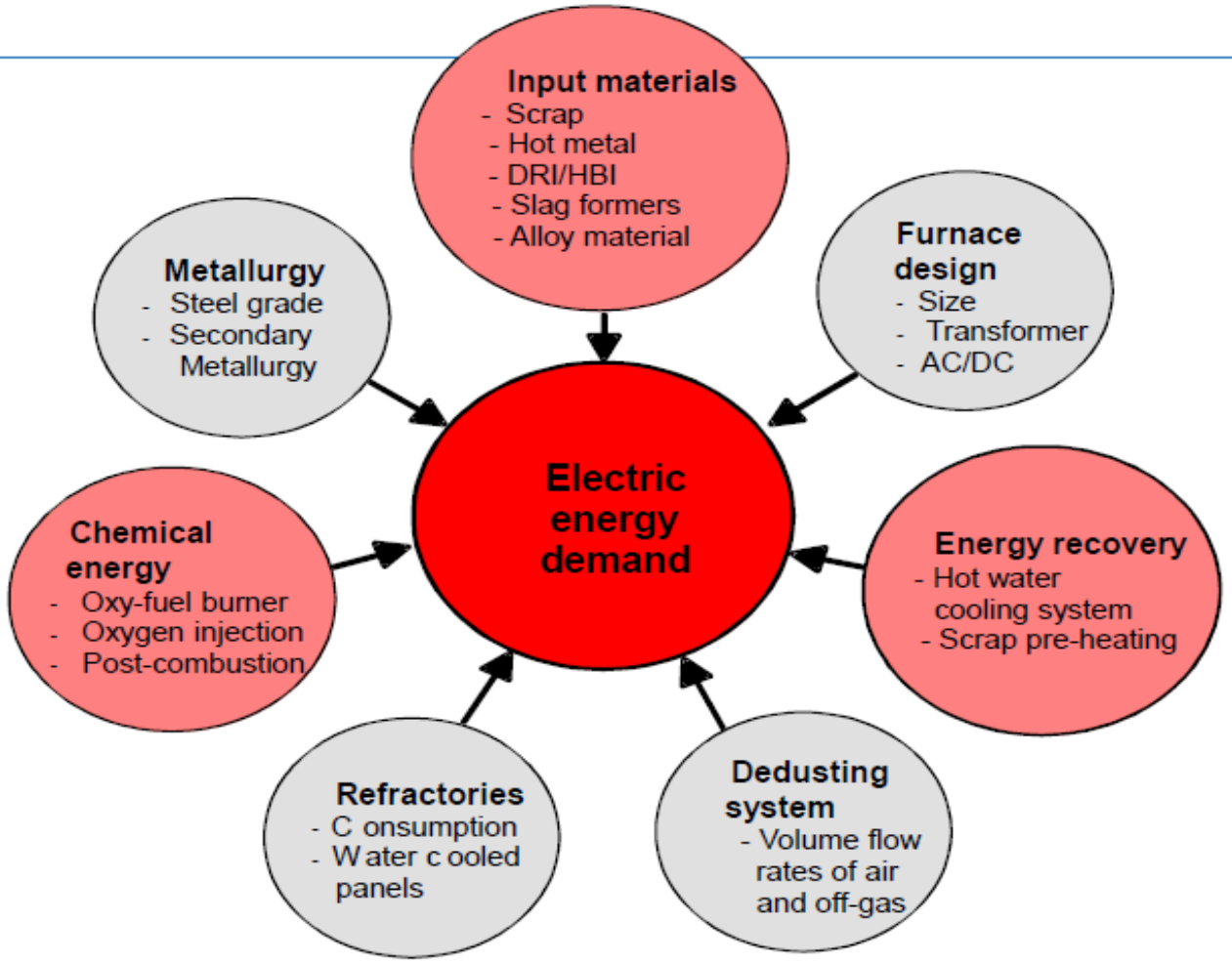
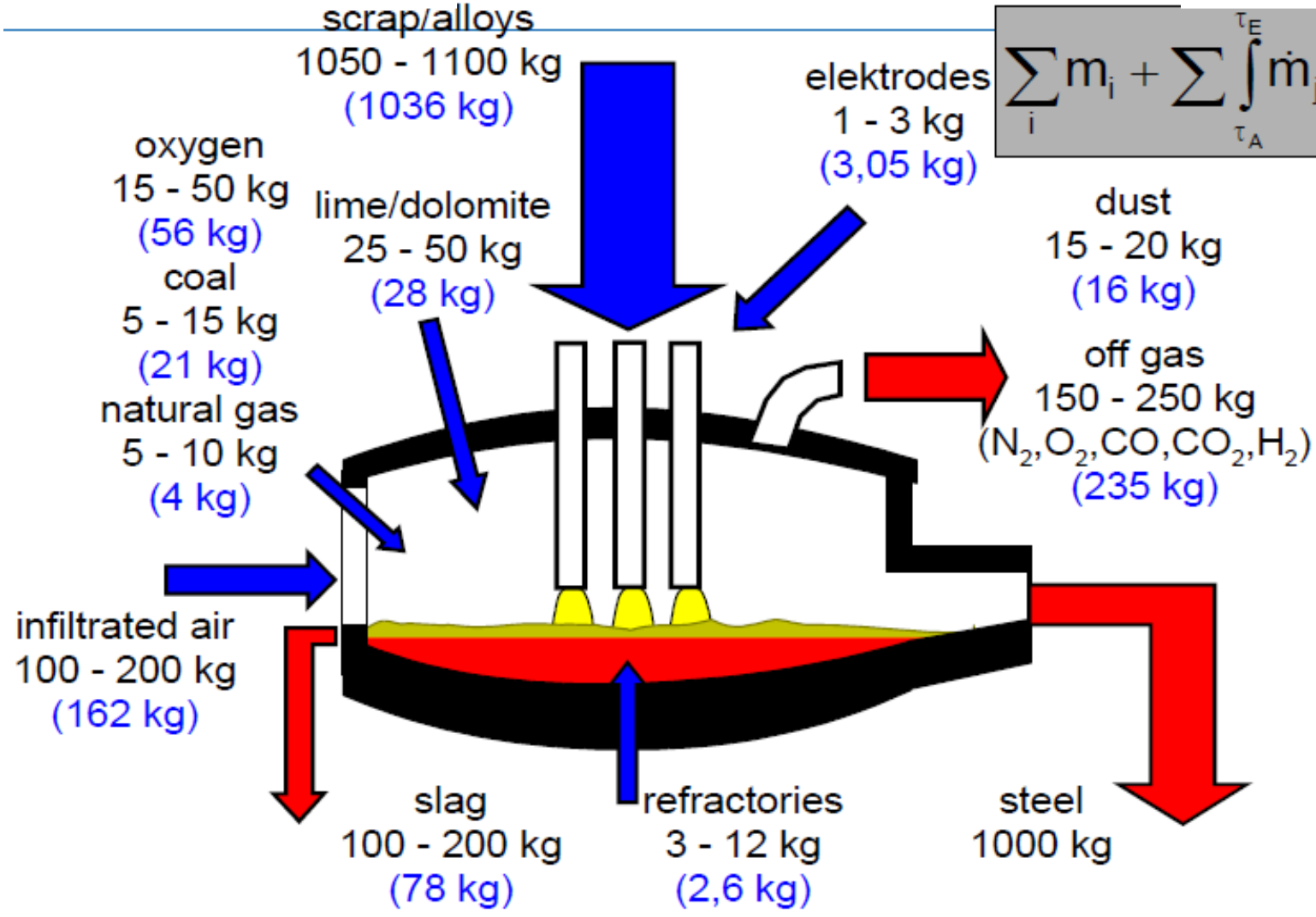
Influence Factors for EAF Energy Efficiency



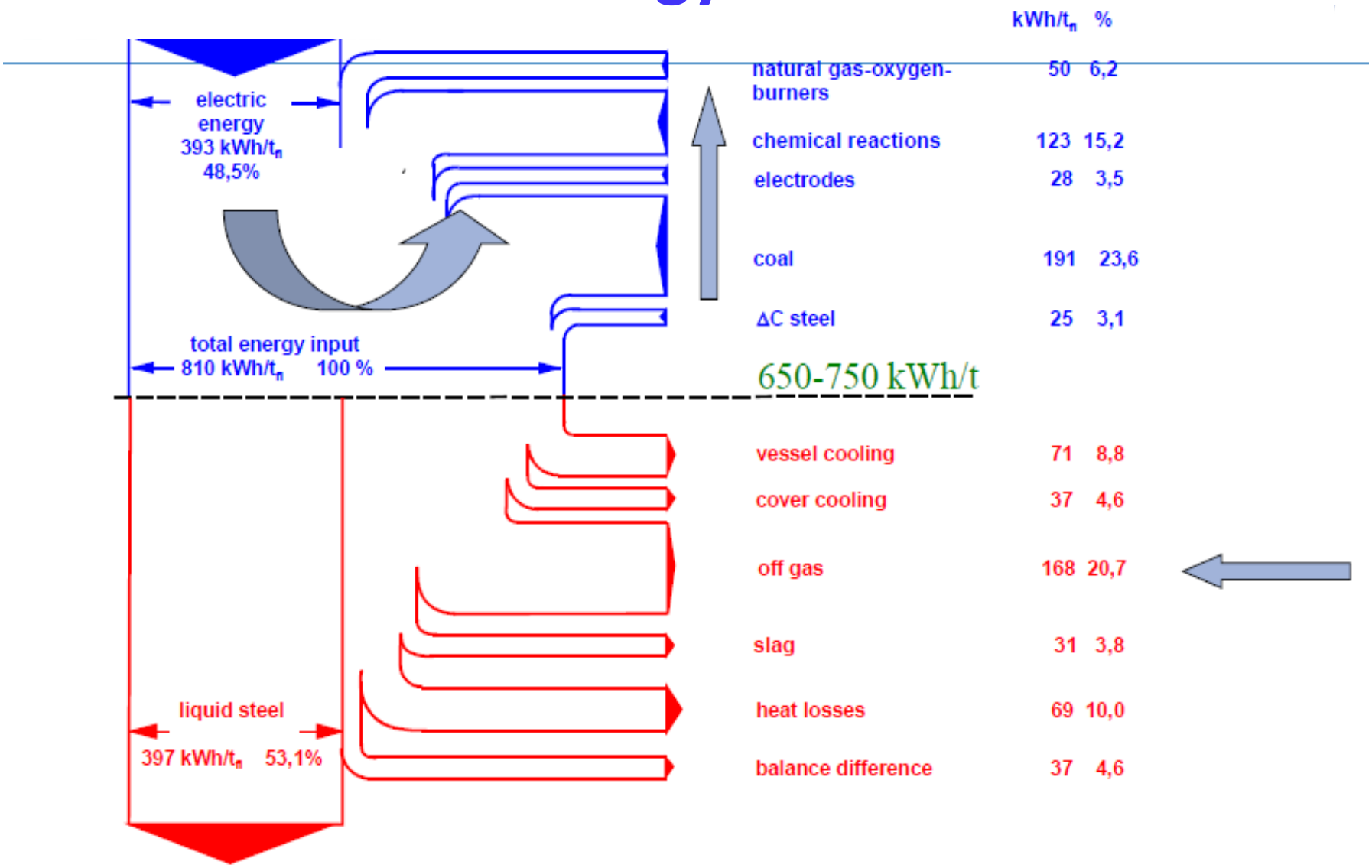
Influence of EAF process parameters to electric energy demand

EAF Mass Balance

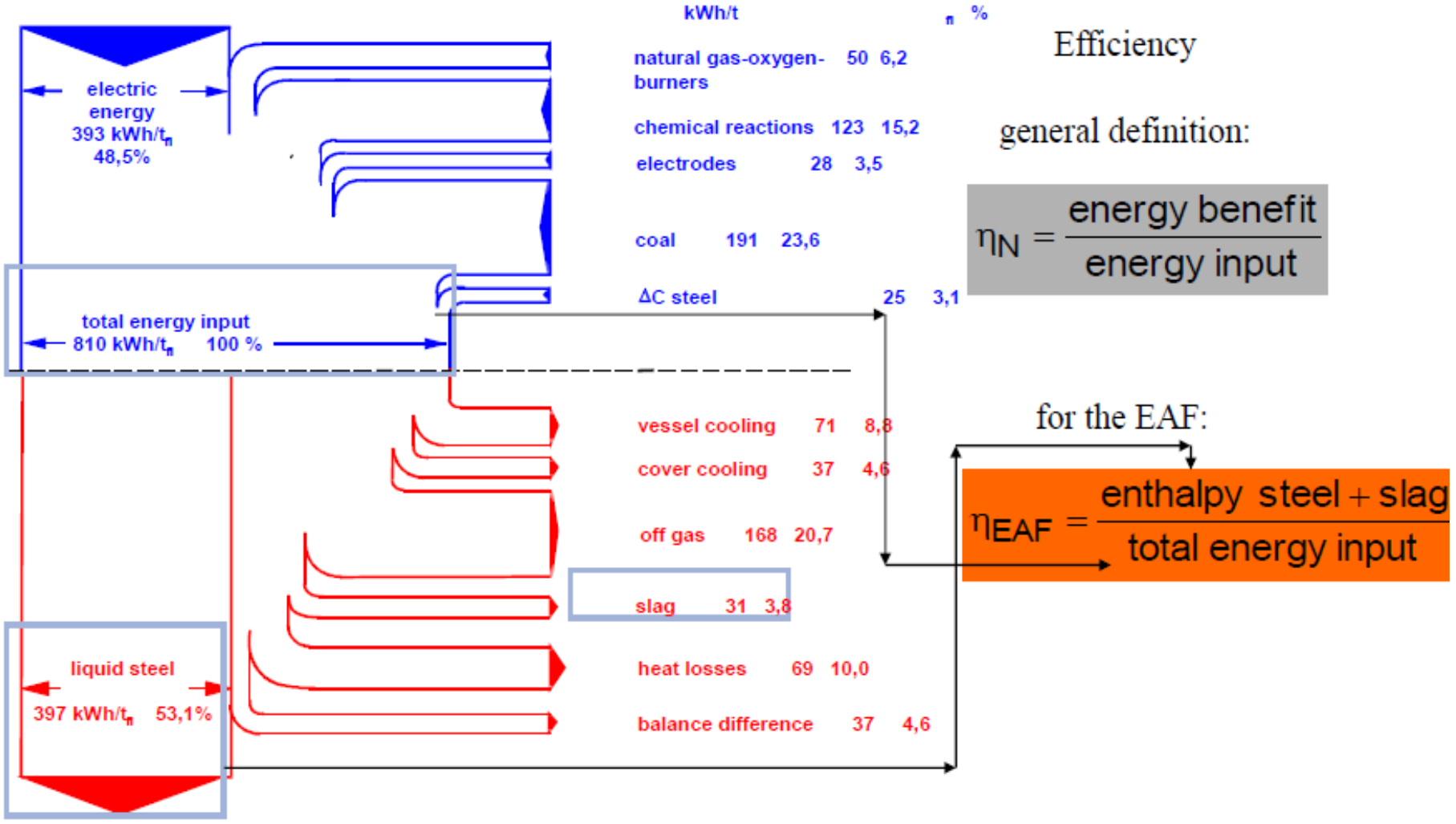
$$\sum_i m_i + \sum \int_{\tau_A}^{\tau_E} \dot{m}_j(\tau)d\tau = 0,$$



EAF Energy Balance



EAF Energy Balance & Efficiency Evaluation



Efficiency

general definition:

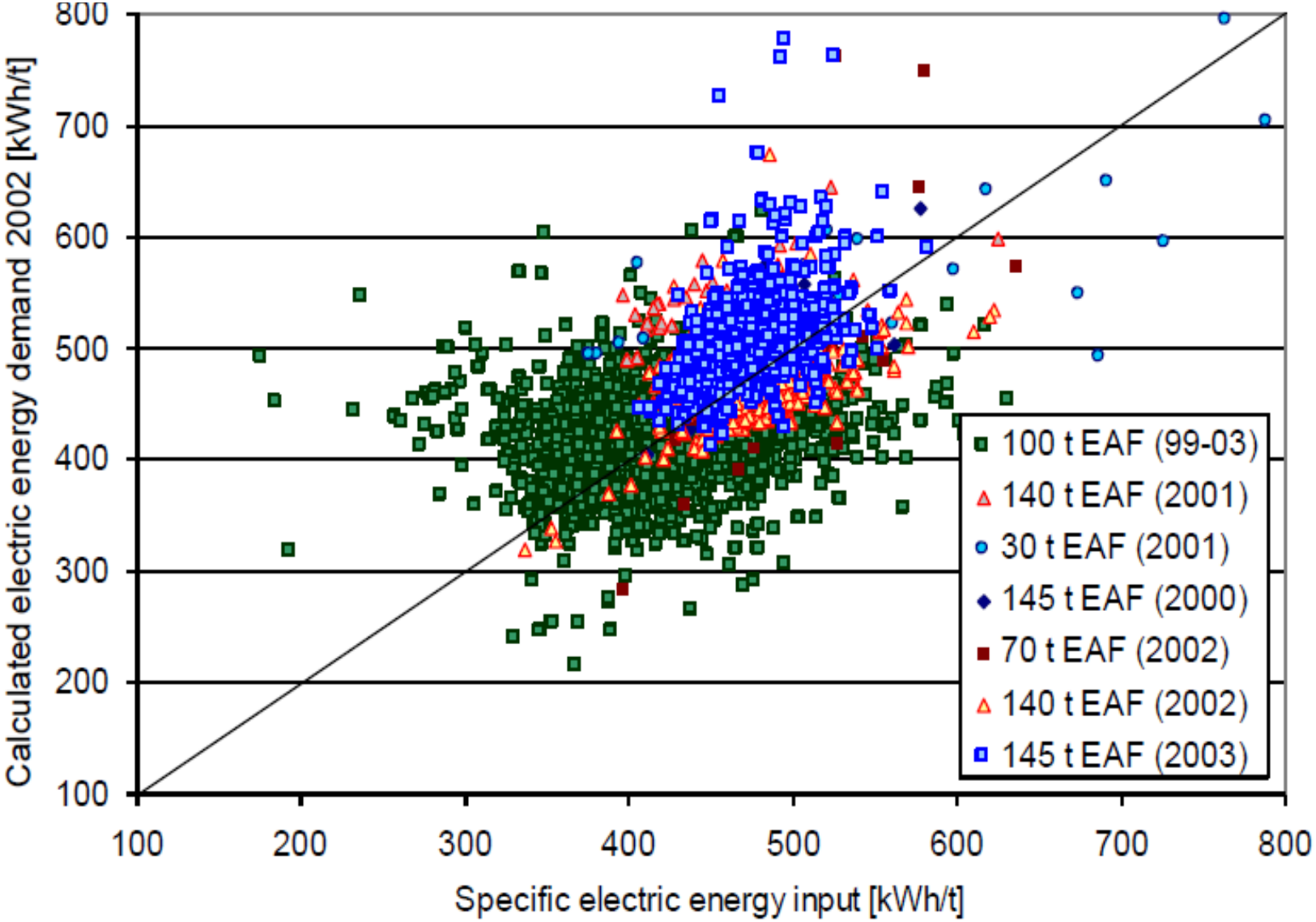
$$\eta_N = \frac{\text{energy benefit}}{\text{energy input}}$$

for the EAF:

$$\eta_{EAF} = \frac{\text{enthalpy steel} + \text{slag}}{\text{total energy input}}$$

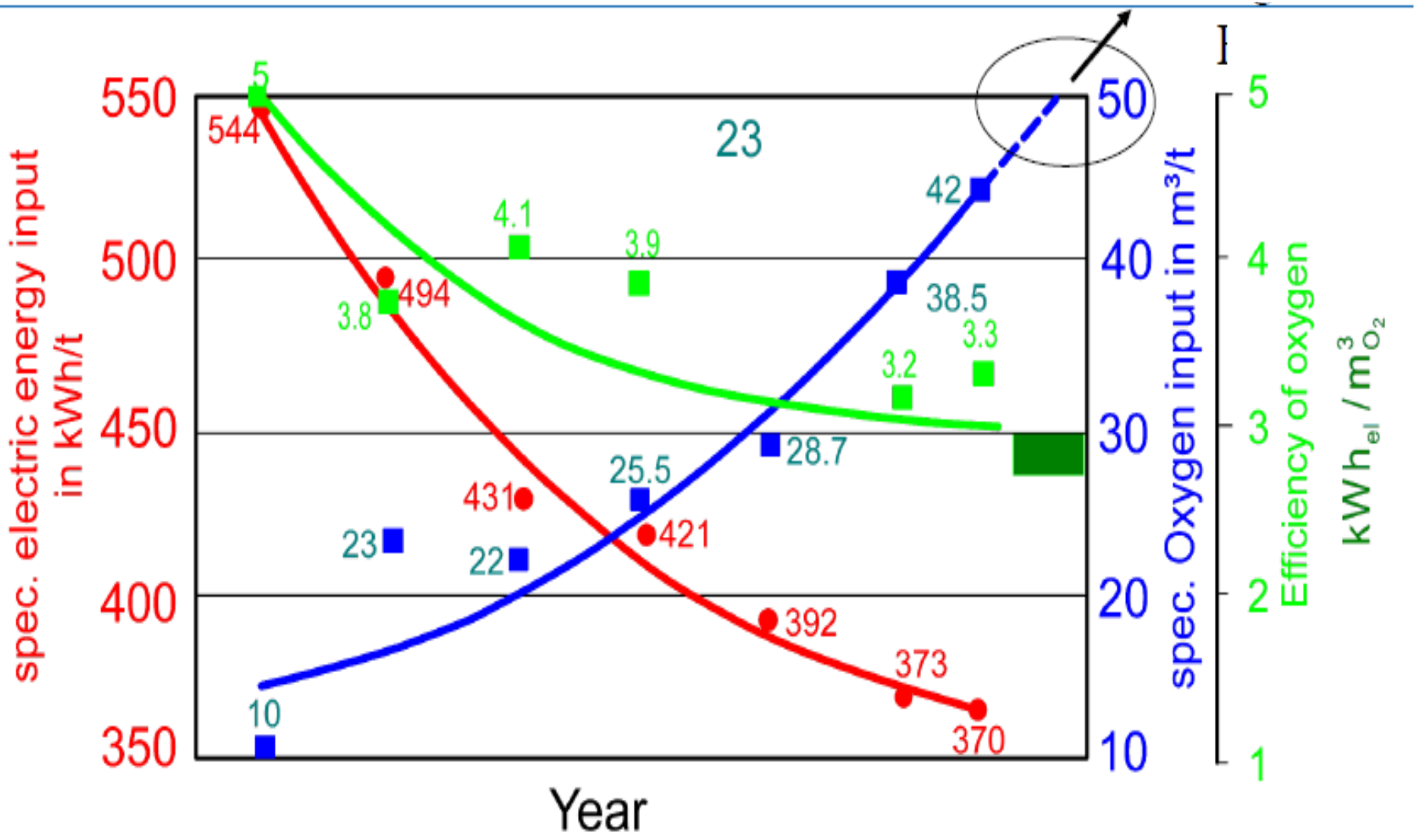
EAF Energy Balance and Efficiency

EAF Energy Model Prediction vs Actual Consumption

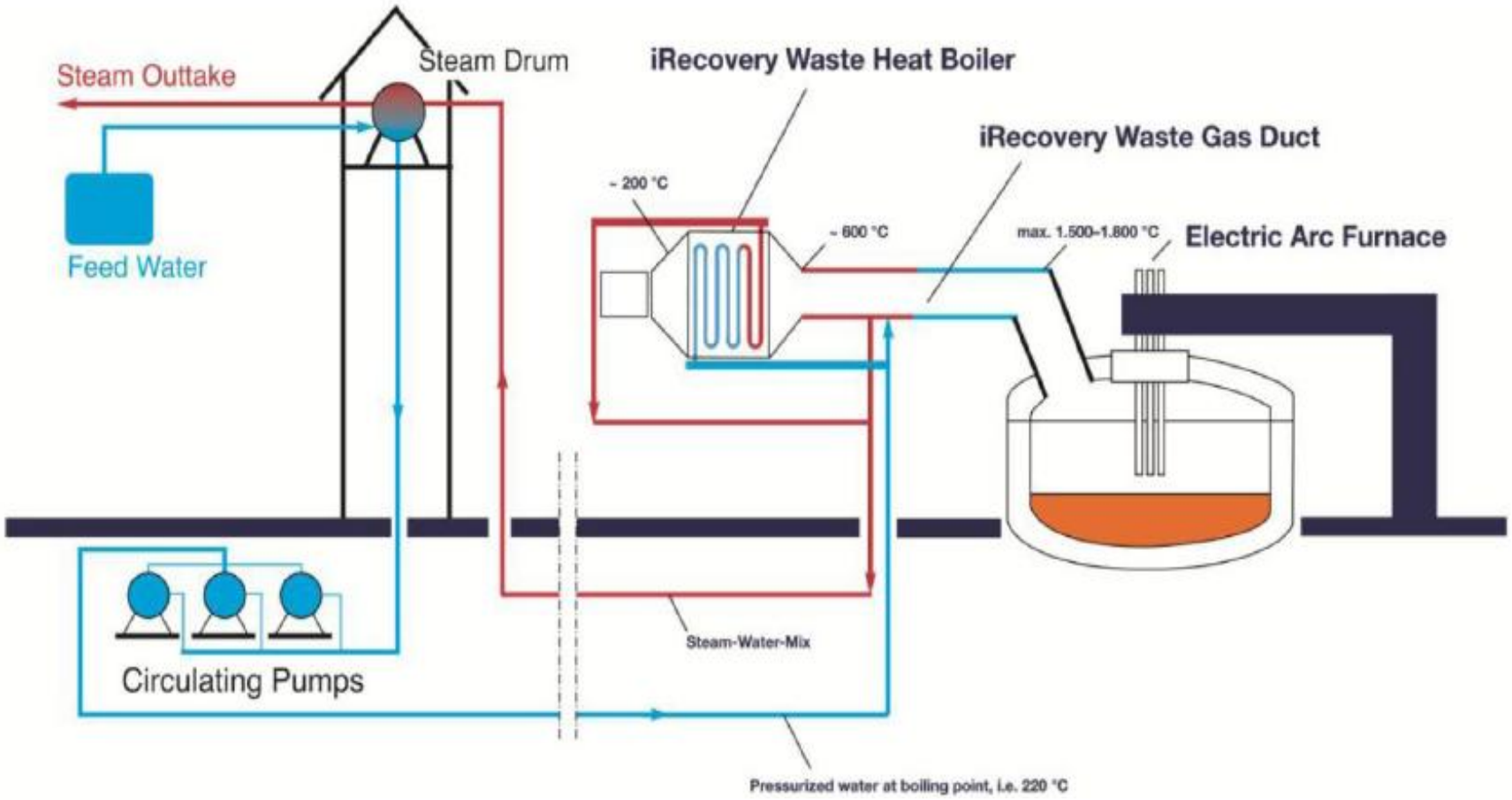


Model predictions and real electric energy demand

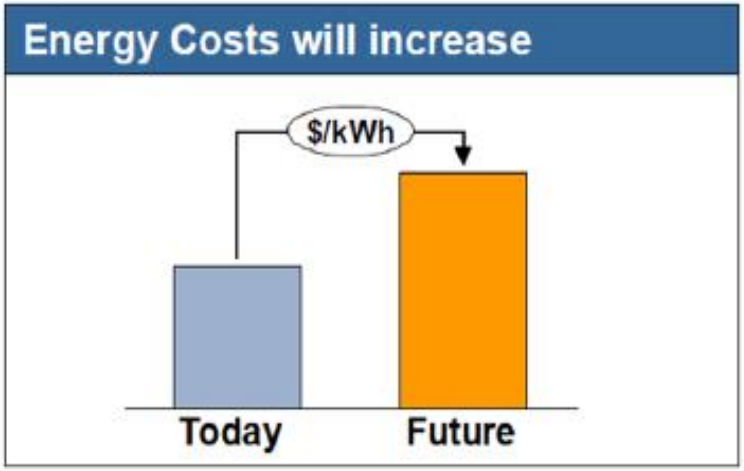
EAF Energy Consumption Improvement Trend

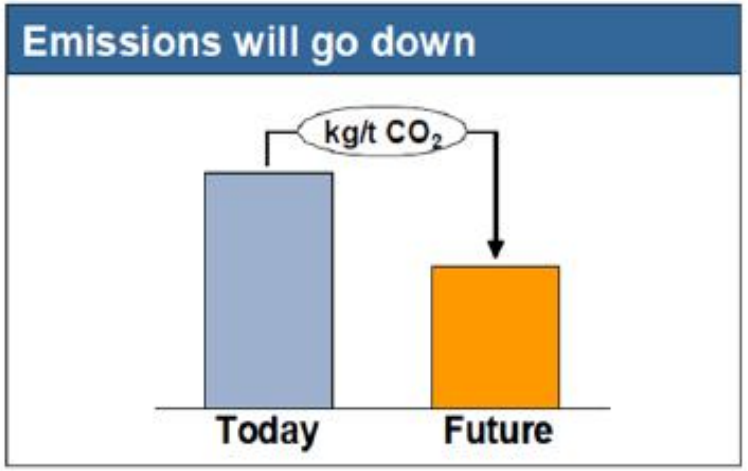


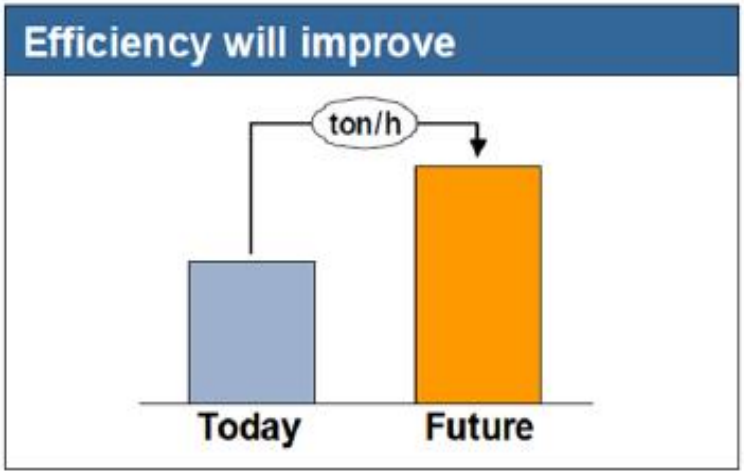
Waste Heat Recovery from EAF Off-Gas : Waste Heat Boiler

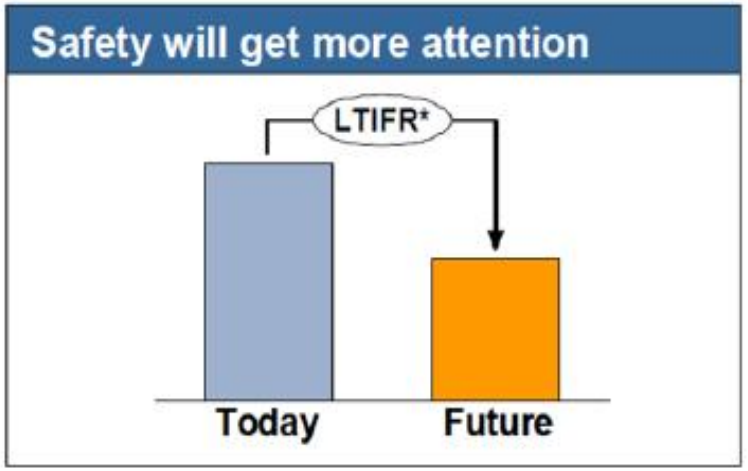


Trends of Energy, work safety & Environment Matters









* Lost Time Injury Frequency Rate

Future Challenges for Steelmakers

Thank you
for
your kind attention