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Energy Efficient Solutions for EAF

Ecoplants-Technologies by SMS Group

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Introduction

Introduction – Who we are

The familiy owned SMS group is internationally active in plant construction and mechanical engineering relating to the processing of steel and nonferrous metals.

SMS group

3,070 m Euro turnover ca. 13.500 employees (total)

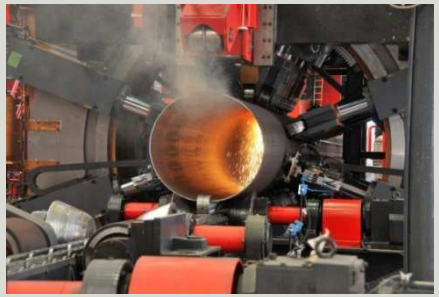
SMS SIEMAG SMS group

1,8 m Euro turnover
ca. 7,500 employees

Metallurgical plant | Continuous casting | Hot rolling mills | Cold rolling mills | Aluminum rolling mills | Strip processing lines/ Furnace technology | Electrics and Automation | Service | Energy & Environmental Technologies

SMS MEER SMS group

1,2 m Euro turnover
ca. 3,500 employees



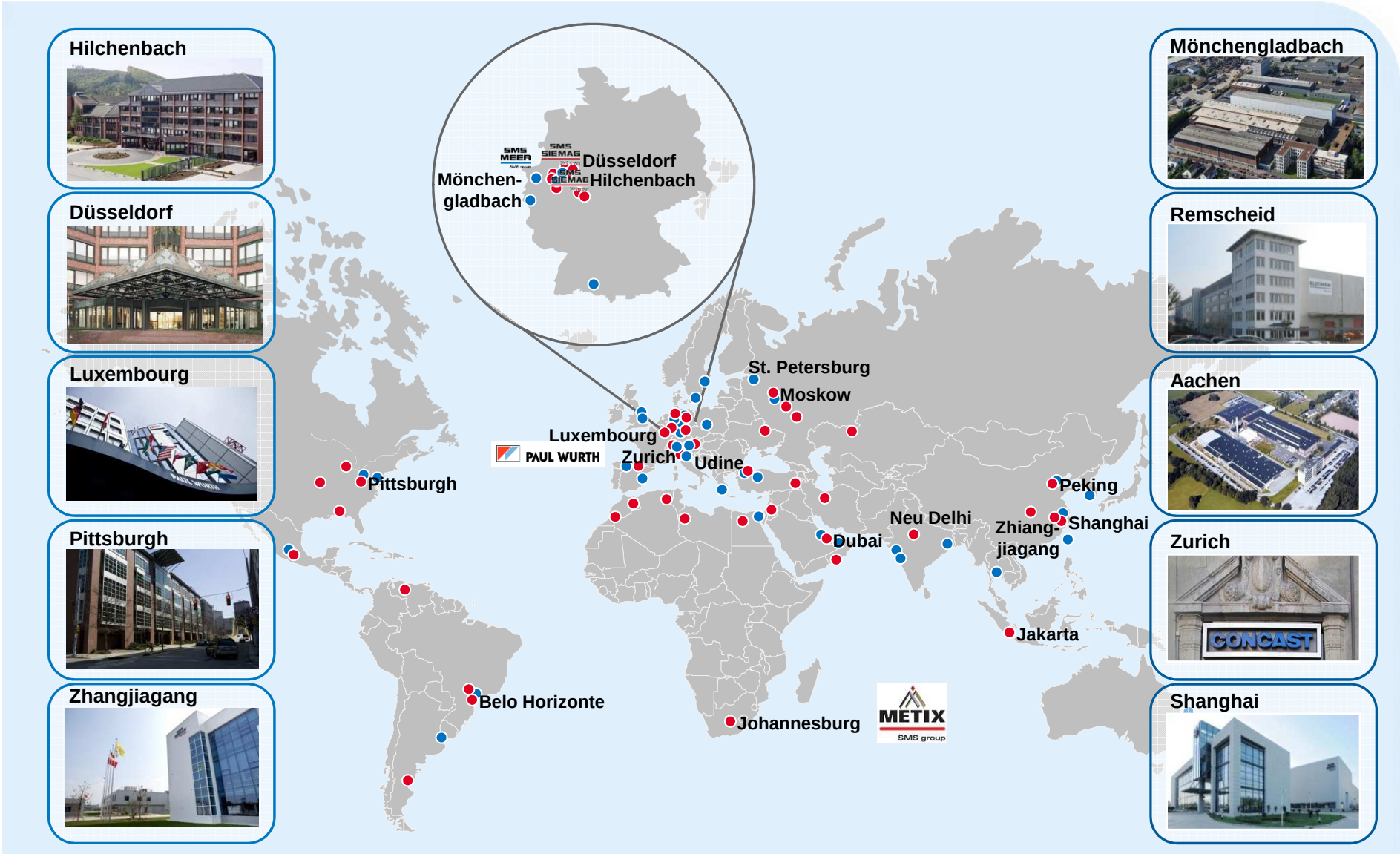
Steelmaking plants / Continuous casting | Tube plants | Long product rolling mills | Forging technology | Nonferrous metal plants | Induction technology | Electrics and Automation | Service

PAUL WURTH SMS group

ca. 1,500 employees

Ironmaking | Cokemaking | Steelmaking | Environmental solutions | Recycling technolgies | Non Ferrous | Civil & Environmental Engineering

International locations - SMS Group



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Environment protection and economical success – a conflict?

Green is the colour of nature…

…and the color of money!

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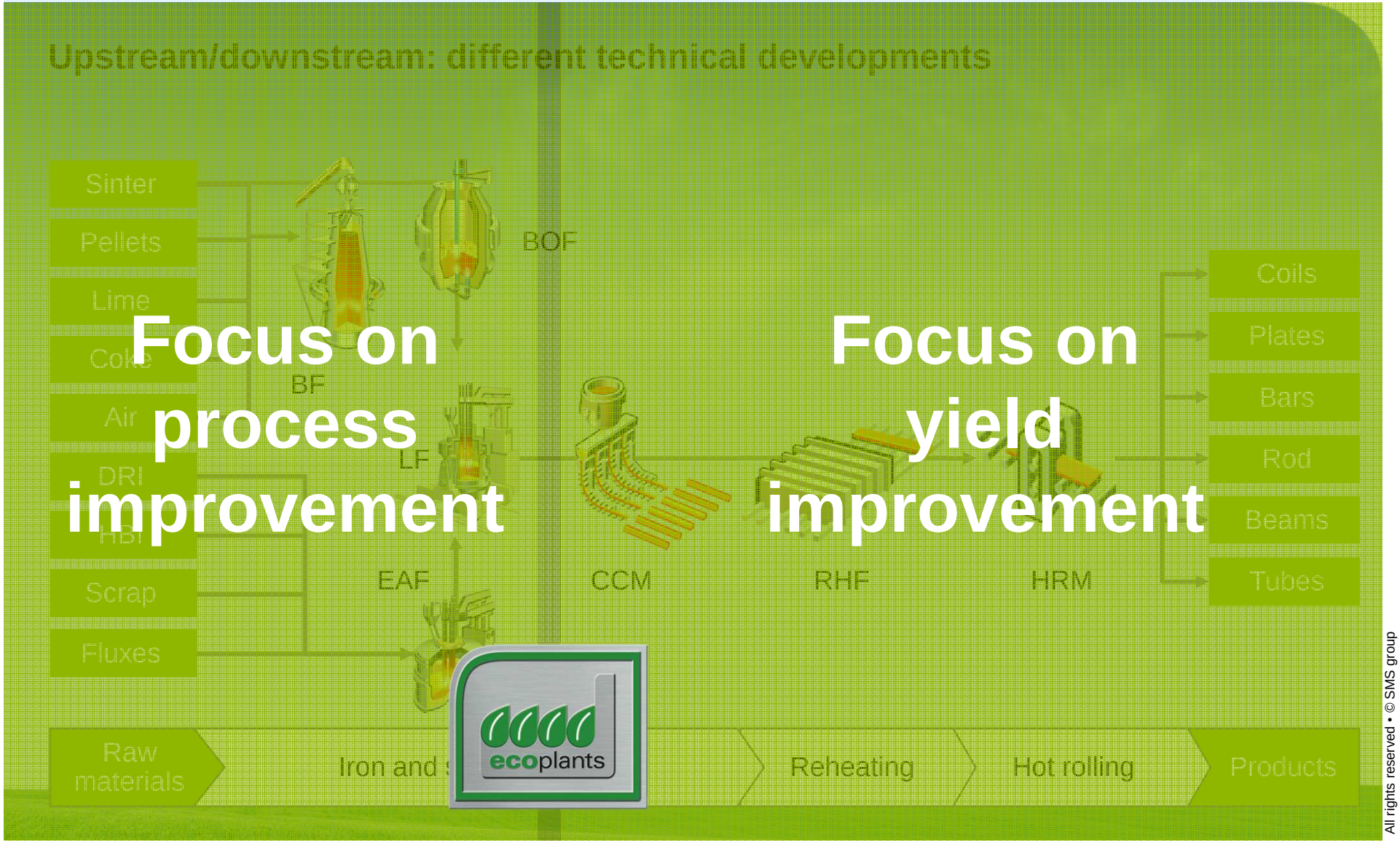
Ecoplants – resource-efficient technologies



Focus on process improvement

Focus on yield improvement

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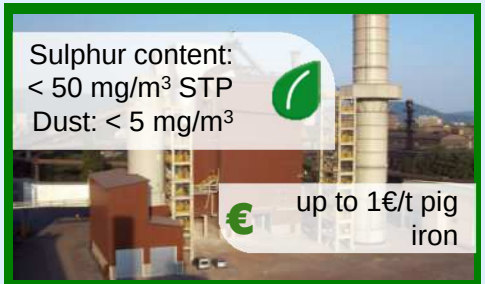
Selection of references

CMT™ Minimill

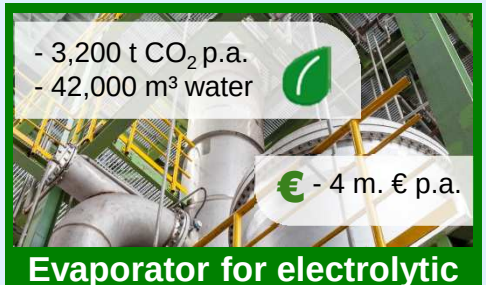
Laminar cooling system

ARCCESS® steady EAF



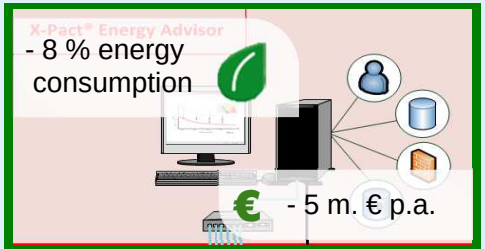
EFA™ – Process

ecoplants



Evaporator for electrolytic tinning lines

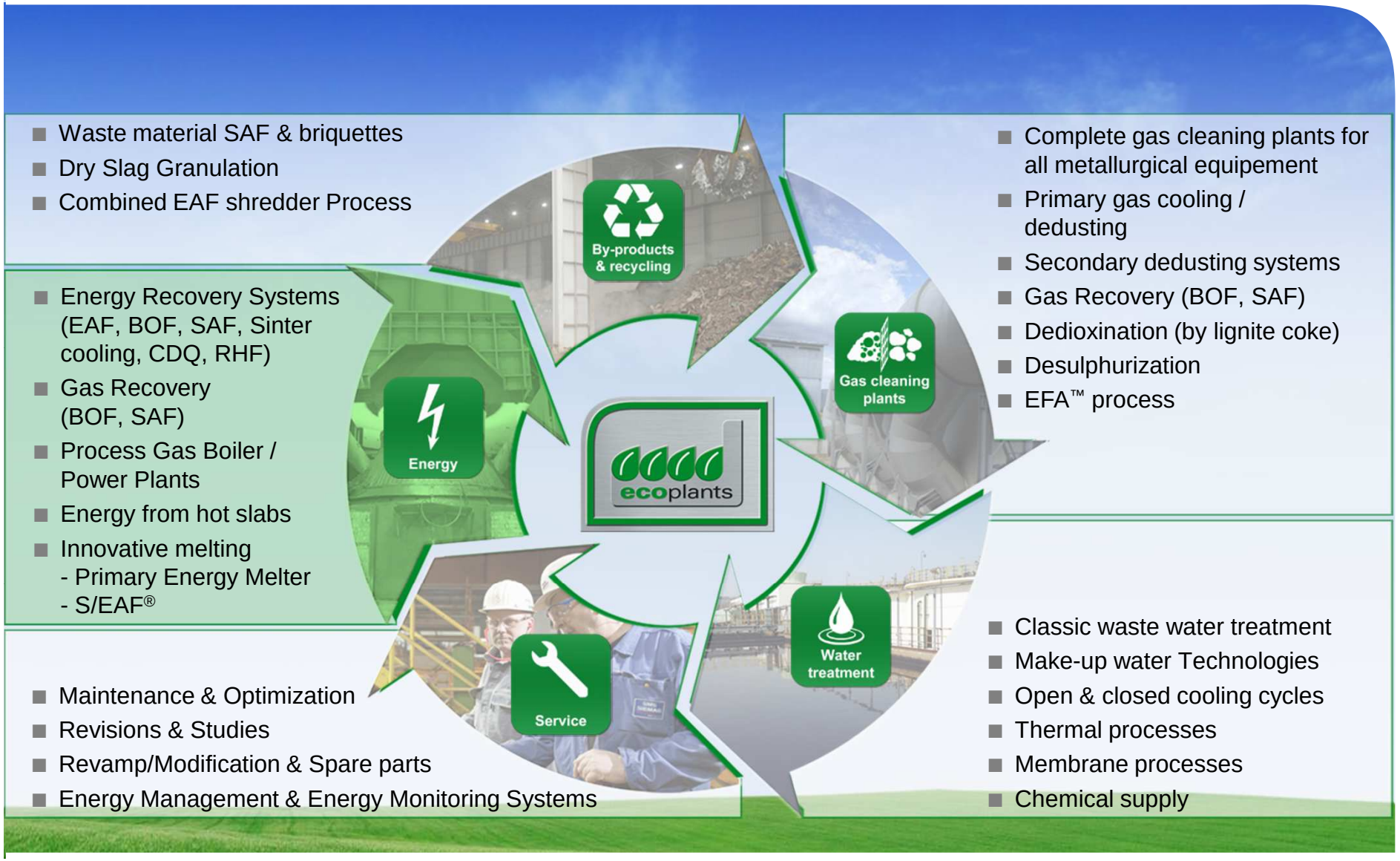
Energy Recovery at melting and casting



X-Pact® Energy Advisor

Gas Cleaning Assistant

Our product portfolio of environmental technologies



- Waste material SAF & briquettes
- Dry Slag Granulation
- Combined EAF shredder Process

- Complete gas cleaning plants for all metallurgical equipement
- Primary gas cooling / dedusting
- Secondary dedusting systems
- Gas Recovery (BOF, SAF)
- Dedioxination (by lignite coke)
- Desulphurization
- EFA™ process

- Energy Recovery Systems (EAF, BOF, SAF, Sinter cooling, CDQ, RHF)
- Gas Recovery (BOF, SAF)
- Process Gas Boiler / Power Plants
- Energy from hot slabs
- Innovative melting
  - Primary Energy Melter
  - S/EAF®

- Maintenance & Optimization
- Revisions & Studies
- Revamp/Modification & Spare parts
- Energy Management & Energy Monitoring Systems

- Classic waste water treatment
- Make-up water Technologies
- Open & closed cooling cycles
- Thermal processes
- Membrane processes
- Chemical supply

Recovery of energy from waste heat at EAF

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Recovery of energy from waste heat at melting units

- Hot off-gas (600 – 2,100 °C) has to be cooled down
- Use of chemical and sensible heat for steam generation
- Applications at:

EAF

BOF / AOD

CONARC

SAF

➡ Recovery of energy

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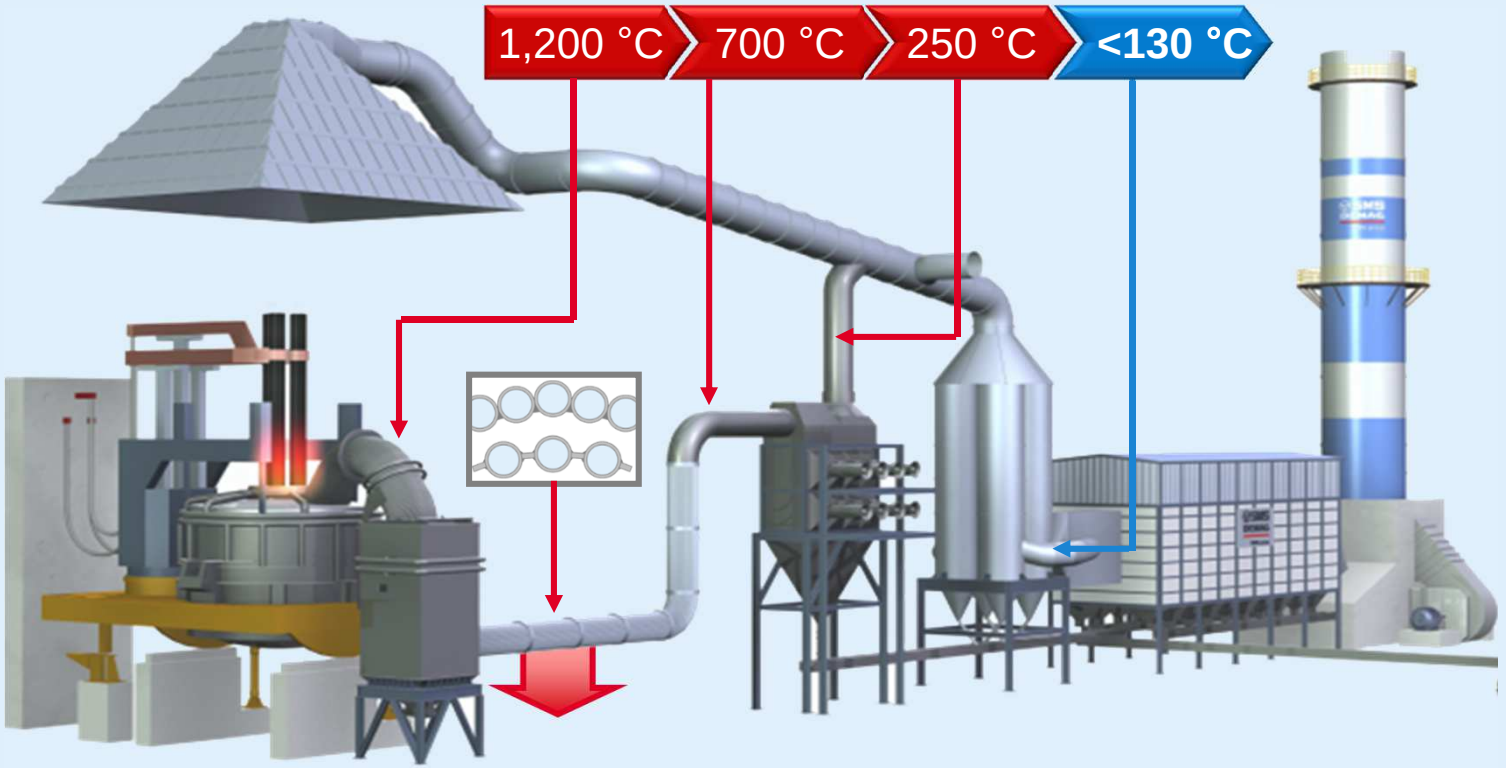
Recovery of energy from waste heat at melting units



Conventional
Water cooling

Innovative
Steam generation

Steam Utilization

Wasted energy

Energy recovery

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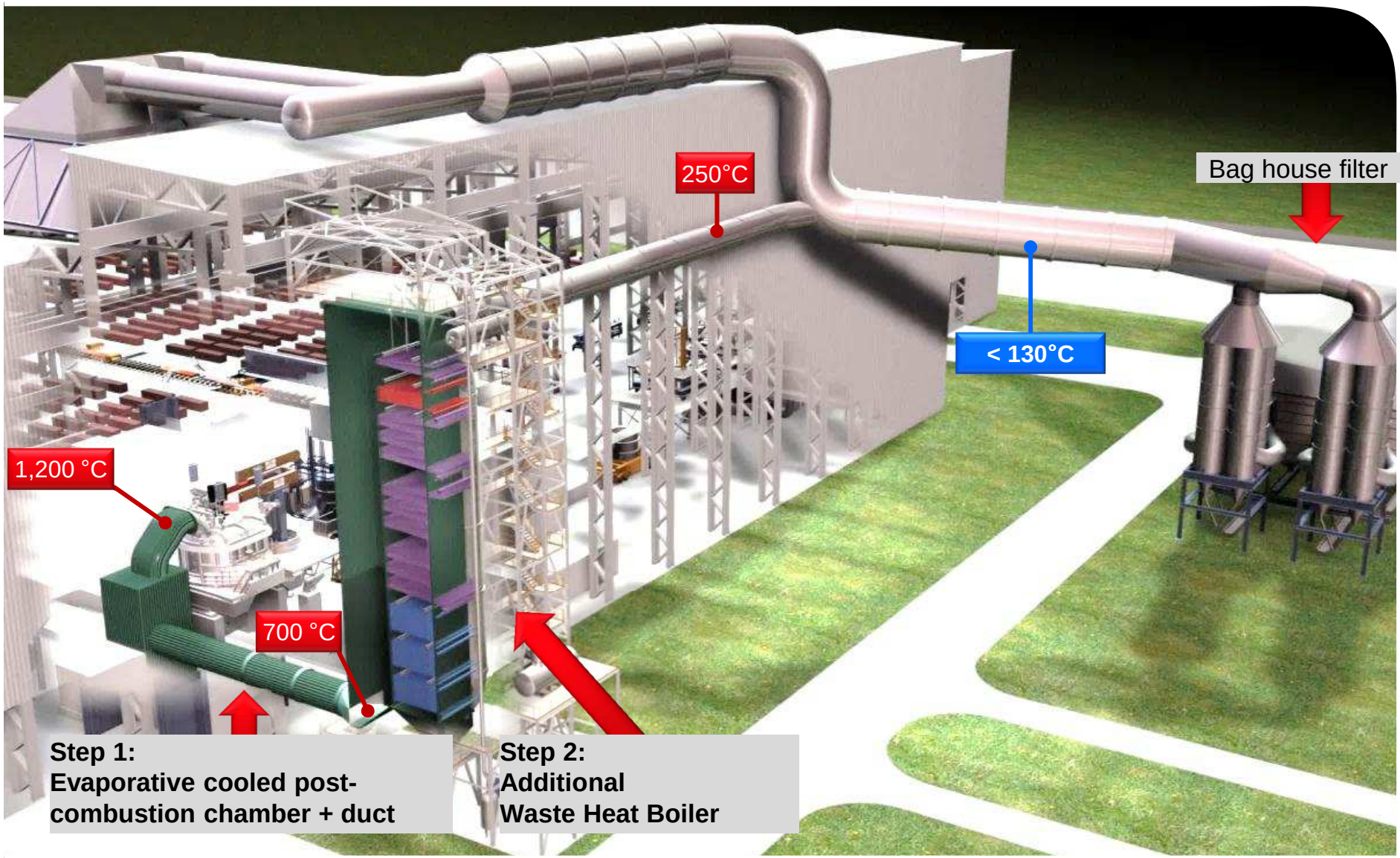
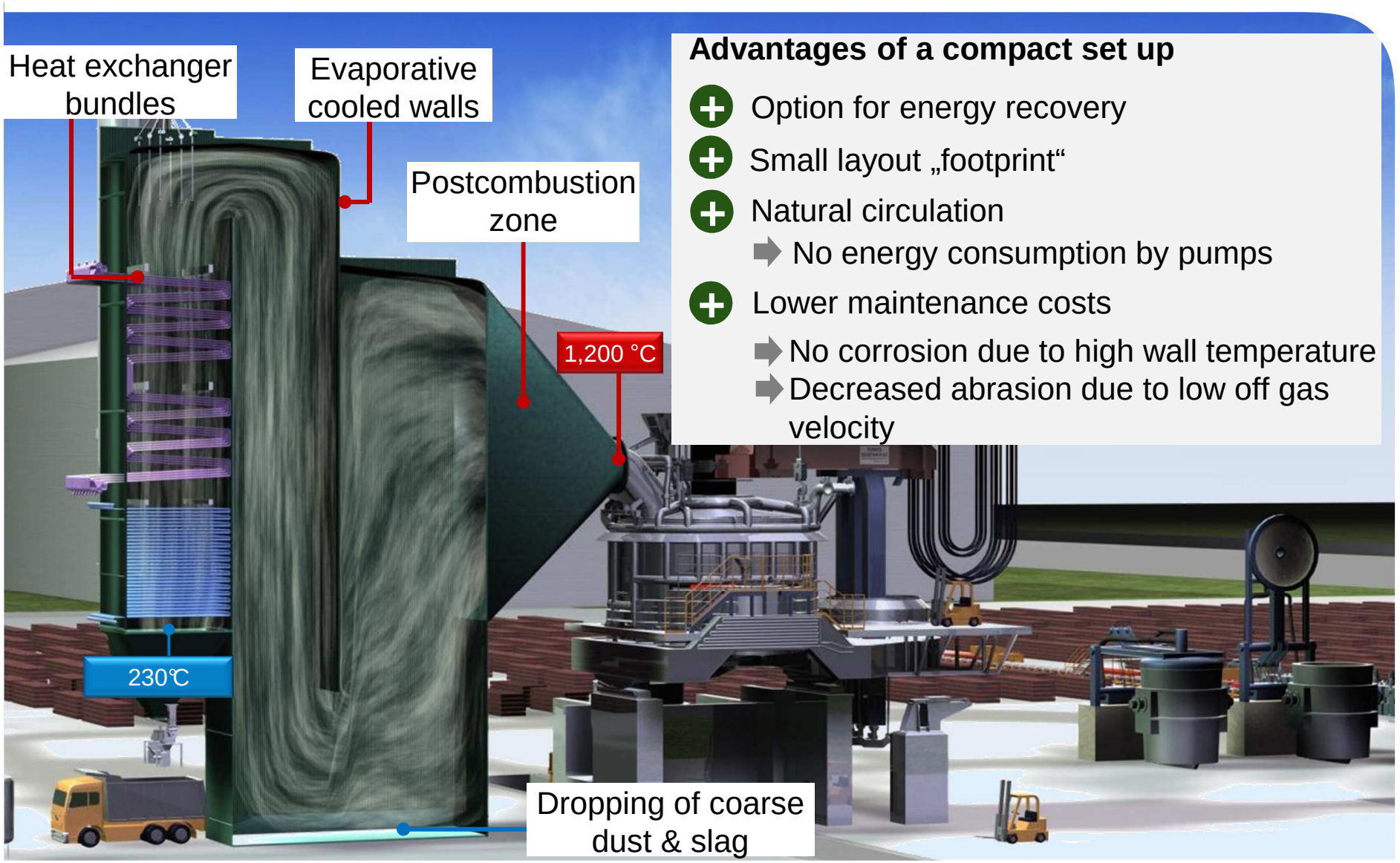
Typical set up of an EAF plant with a two step Energy Recovery System



Further development: Compact Boiler for EAF – future design



Advantages of a compact set up

- ⊕ Option for energy recovery
- ⊕ Small layout „footprint“
- ⊕ Natural circulation
  - ➡ No energy consumption by pumps
- ⊕ Lower maintenance costs
  - ➡ No corrosion due to high wall temperature
  - ➡ Decreased abrasion due to low off gas velocity

Four different cases for EAF

120 t EAF		190 t EAF	
100% Scrap	60% scrap, 40% hot metal	49% Scrap 51% $DRI_{hot40\%/cold60\%}$	90% HDRI, 10% CDRI

Offgas temp.	Energy recovery	Offgas temp.	Energy recovery	Offgas temp.	Energy recovery	Offgas temp.	Energy recovery
250°C	**30 t/h steam**	250°C	**45 t/h steam**	270°C	**91 t/h steam**	270°C	**118 t/h steam**

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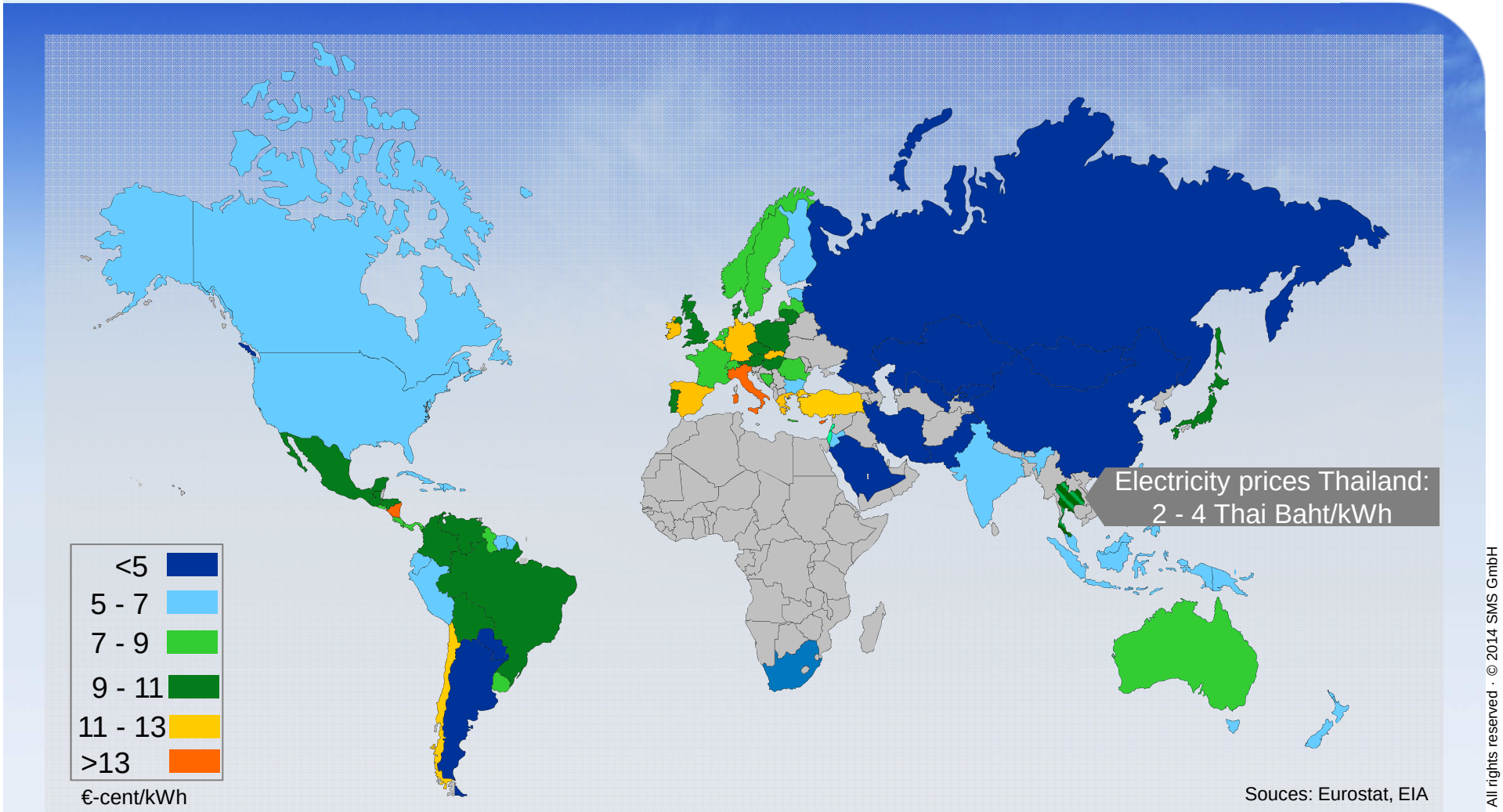
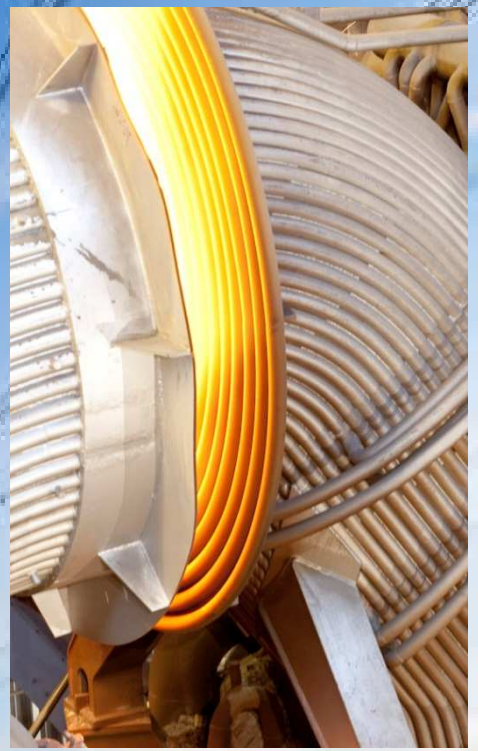
Electricity tariffs worldwide



Price **Availability** **National Discrepancies**

Options for steam utilisation

- Power generation
- Air separation
- Fan or pump drive turbine
- Steam injector pumps for VD / RH process
- Cooling by absorption chilling
- Steam accumulator vessels
- Steam net
- ORC process
- Water treatment (e.g. desalination)



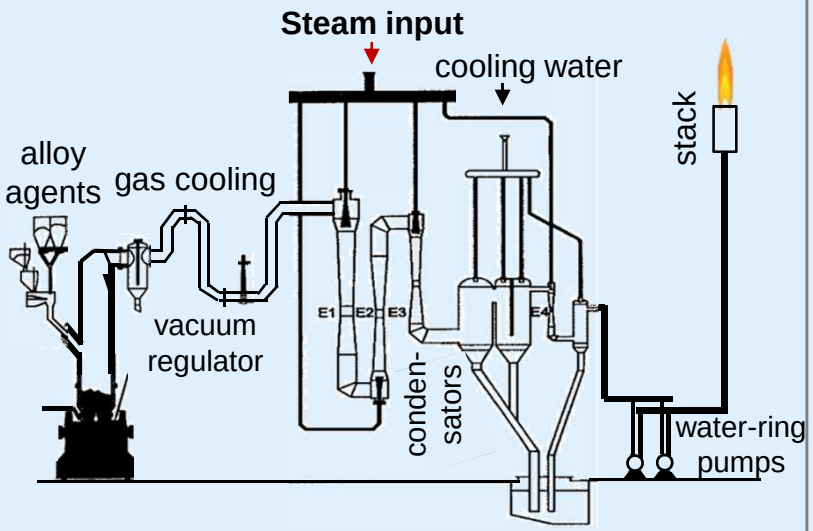
Wide influence on ROI!

Examples for steam utilisation

Drive vacuum pumps at VD/RH plant with steam

- Usage of steam to degas steel

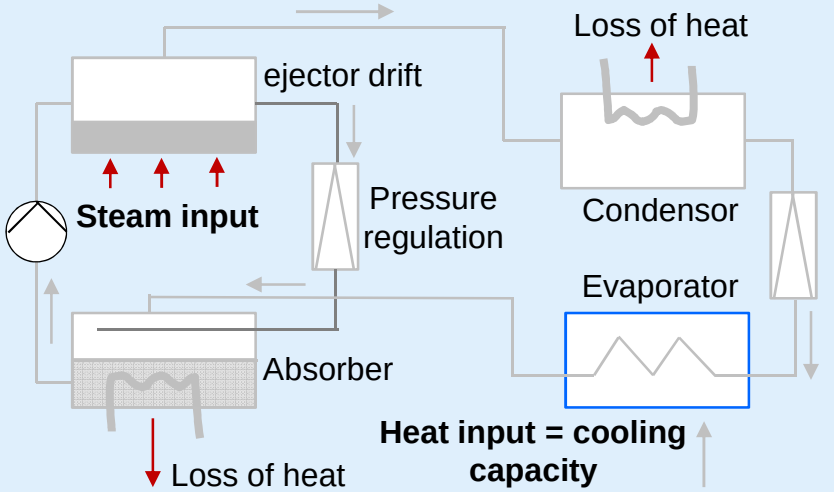
Steam need:	1 t steam / 10- 20t steel
Steam conditions:	10-15 bar / 185-208° C



Cooling by absorption chilling

- Delivery of steam to steam-fired absorption chillers
- Cold production for cooling control rooms

Steam need:	1 t steam / 0.45 MWh
Steam conditions:	1.1 bar / 125 ° C



Steam network

Delivery of steam to different producers

DRI-Plant

- 1 t Steam / 2 t DRI
- 145 – 190 °C / 3 – 15 bar

Heating Pickling Line

Heating of pickling fluid

- 1 t steam / 40-50 t sheets

Fan or pump drive turbine

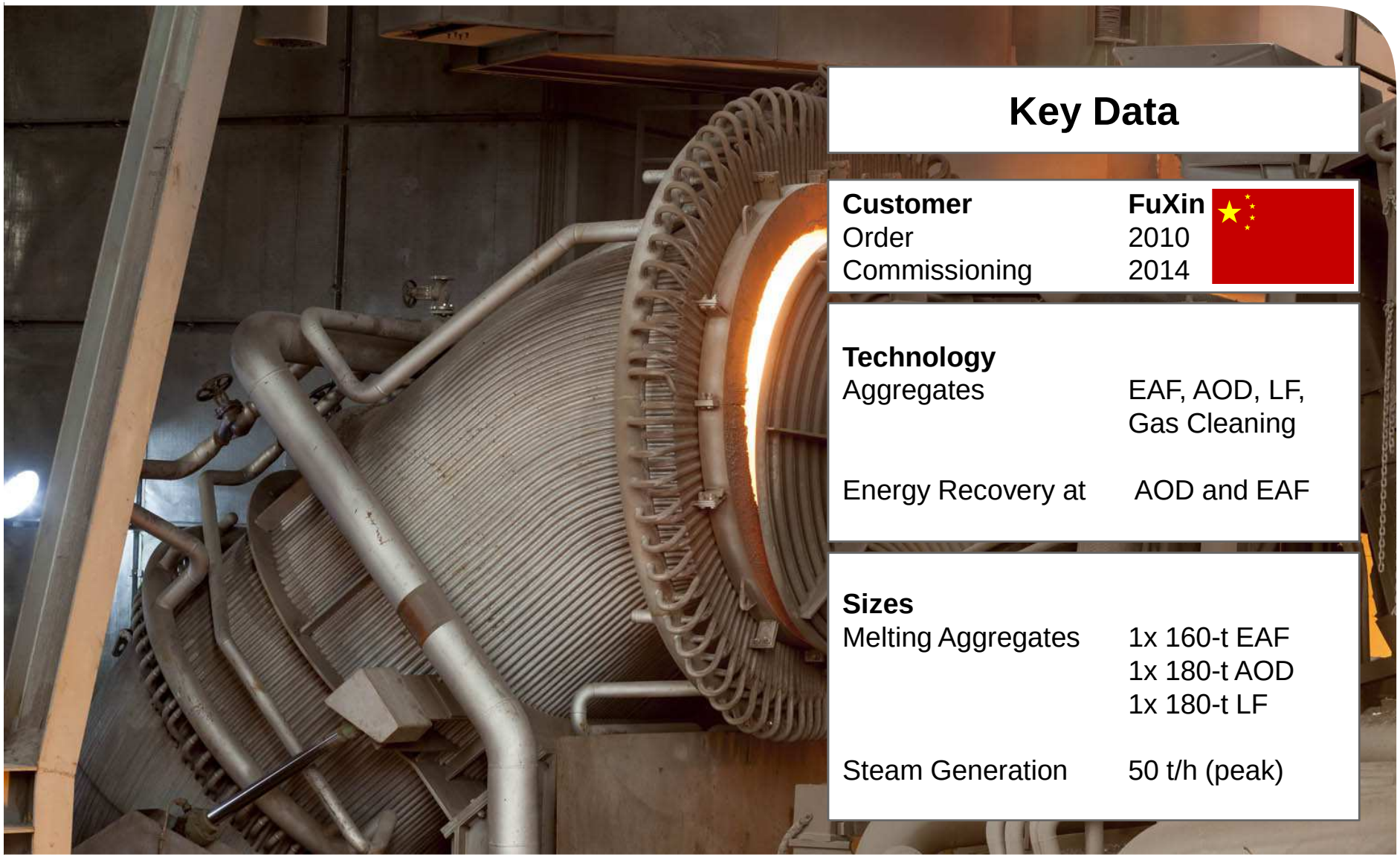
Delivery of steam to fan drive

- 1t steam / 90 - 170 KWh

Evaporation of liquid wastes

e.g. Preparation of oil-in-water emulsions by using steam

- 1 t steam / 6.5m³



Key Data

Customer	**FuXin**
Order	2010
Commissioning	2014

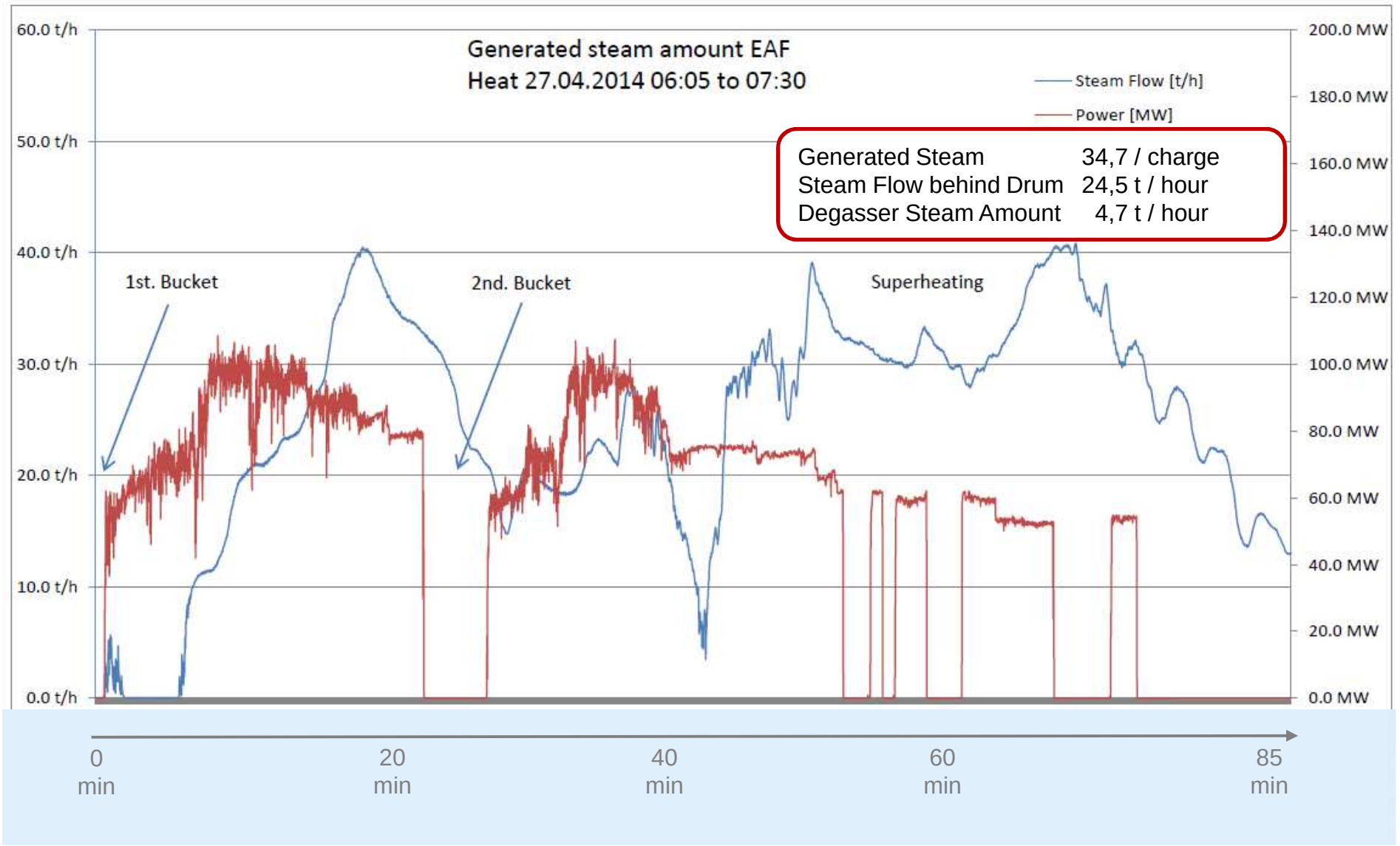
Technology

Aggregates	EAF, AOD, LF, Gas Cleaning
Energy Recovery at	AOD and EAF

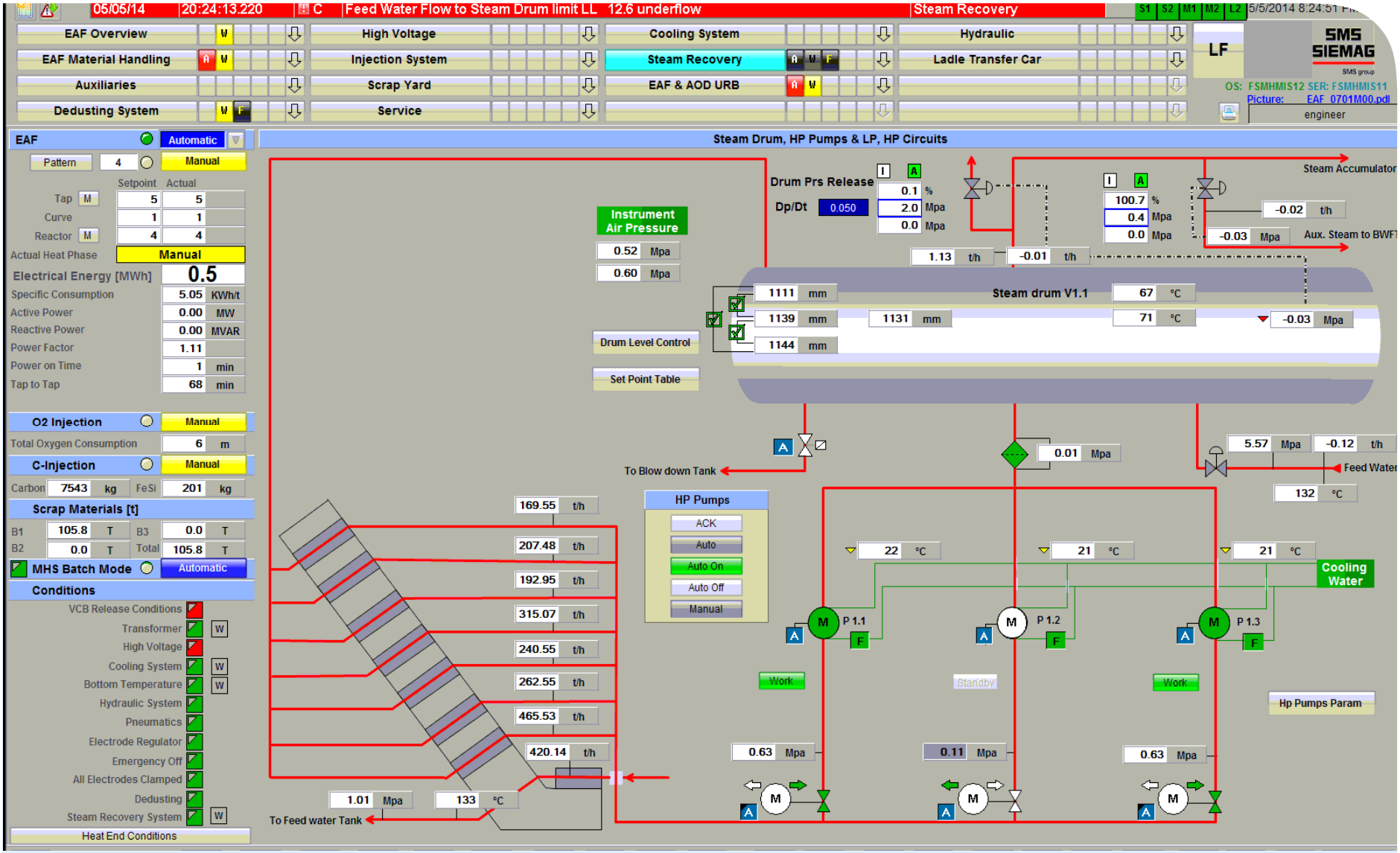
Sizes

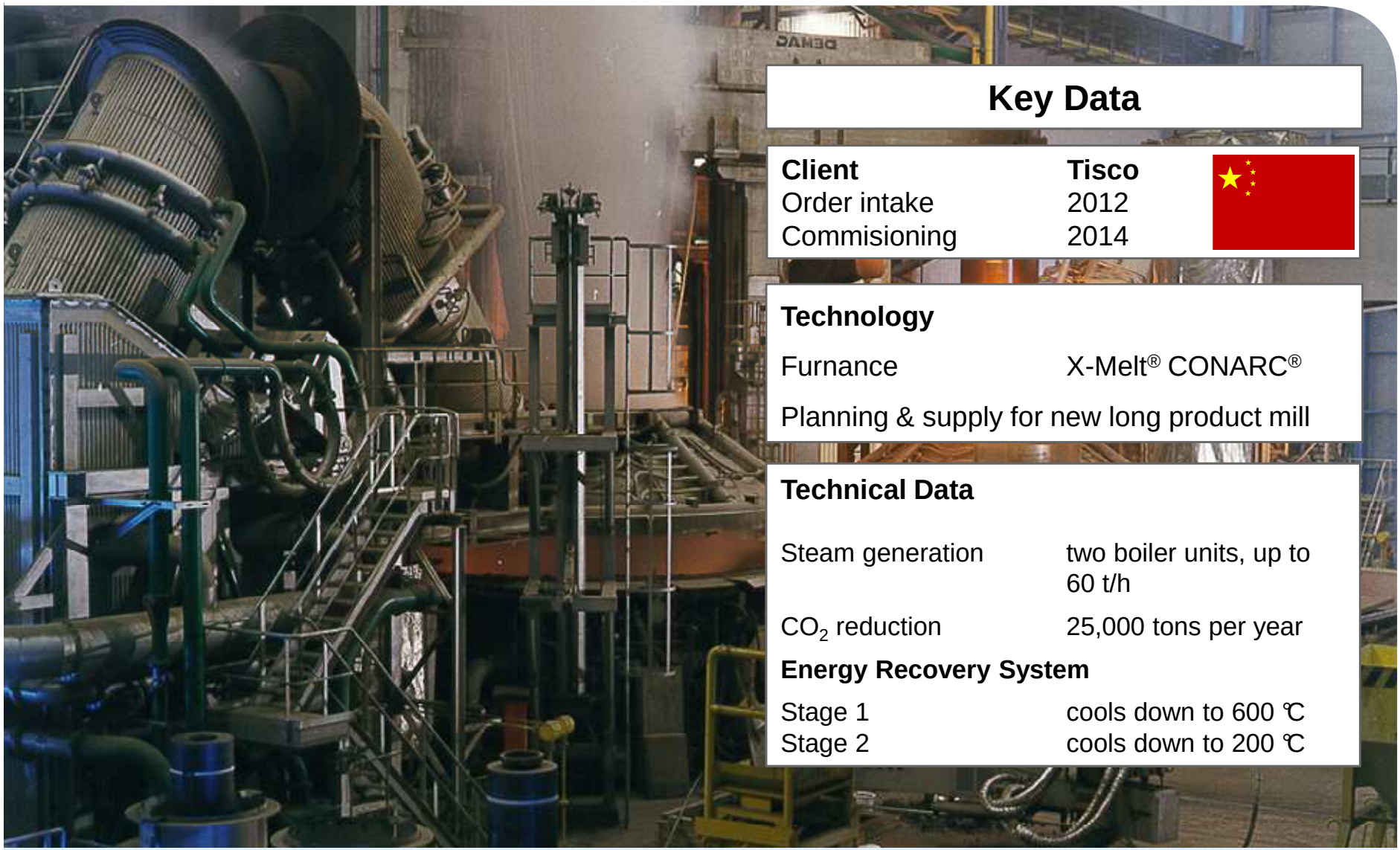
Melting Aggregates	1x 160-t EAF 1x 180-t AOD 1x 180-t LF
Steam Generation	50 t/h (peak)

Example EAF: steam generation at one charge (FuXin, China)



Example EAF: Human-Maschine-Interface (FuXin, China)





Key Data

Client	**Tisco**
Order intake	2012
Commisioning	2014

Technology

Furnance	X-Melt® CONARC®

Planning & supply for new long product mill

Technical Data

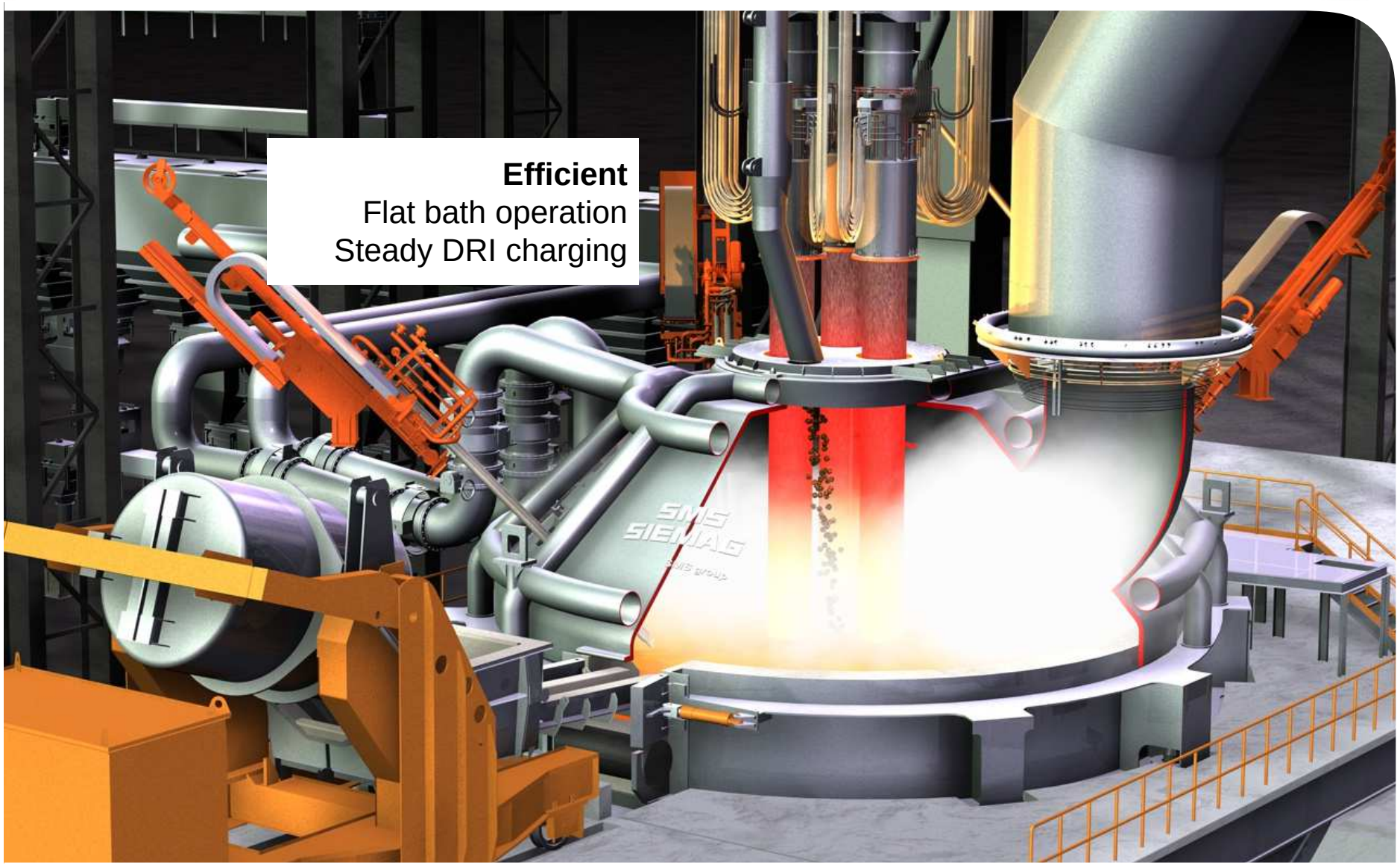
Steam generation	two boiler units, up to 60 t/h
CO_2 reduction	25,000 tons per year

Energy Recovery System

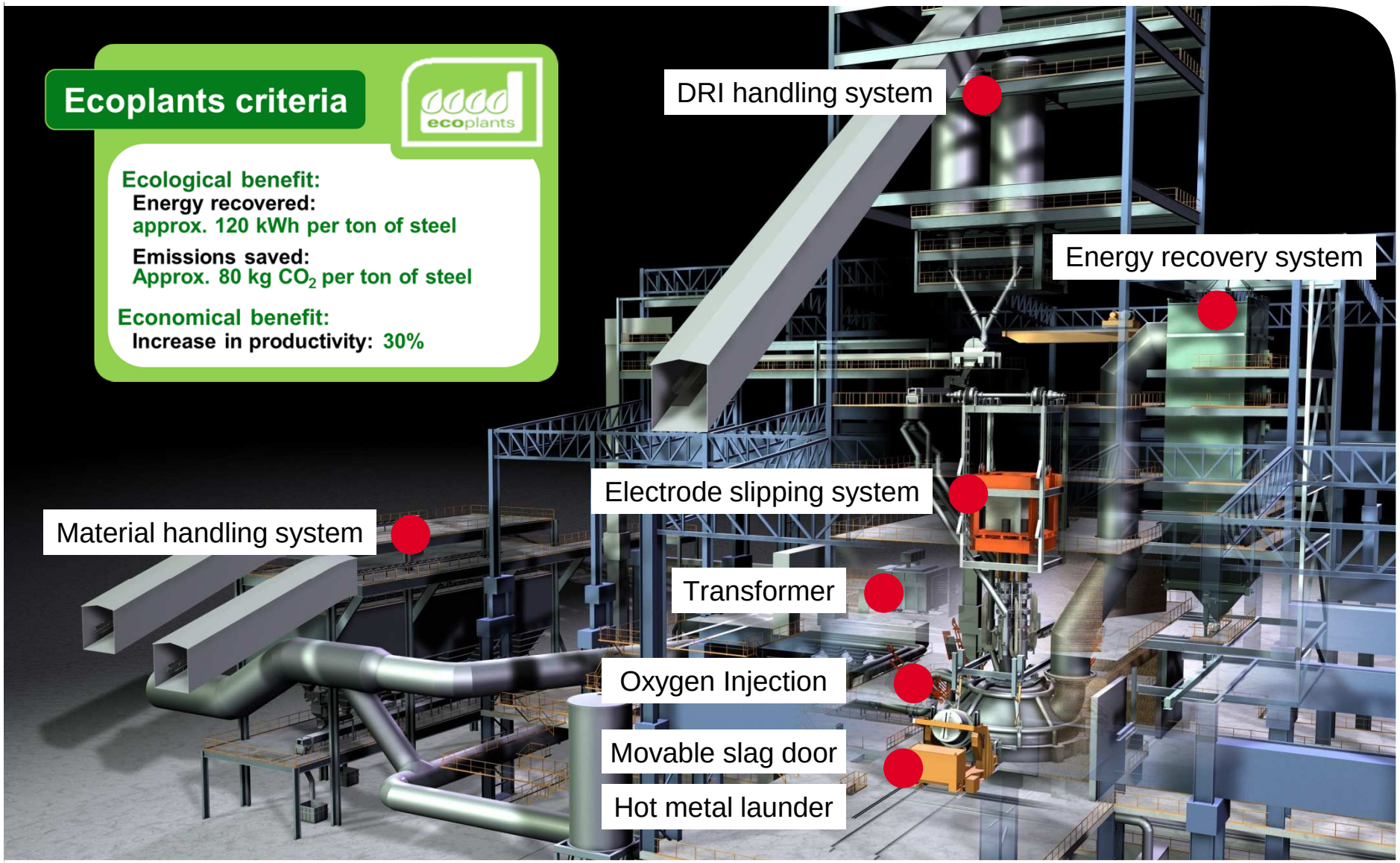
Stage 1	cools down to 600 °C
Stage 2	cools down to 200 °C

ARCCESS® steady EAF (S/EAF®)

ARCCESS® steady EAF (S/EAF®) – continuous steelmaking



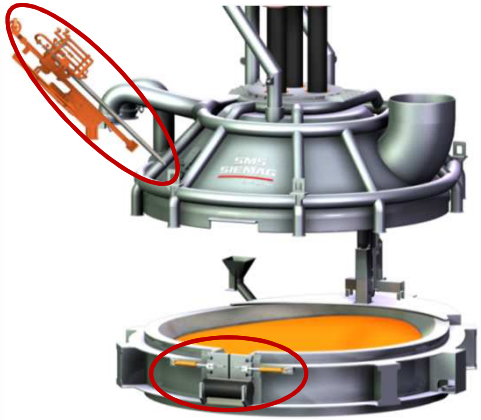
S/EAF® - core components



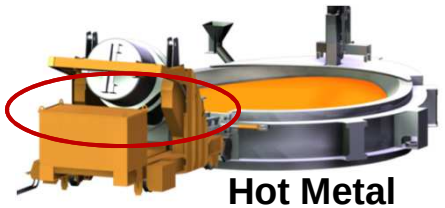
A new electric arc furnace S/EAF® for continuous operation

Revolutionary
Electrodes are clamped and slipped continuously

Oxygen injection

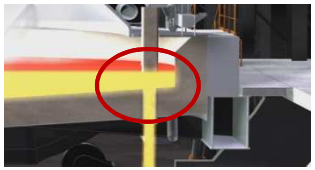


Patented moving slag door



Hot Metal Launder

Patented Tapping Device

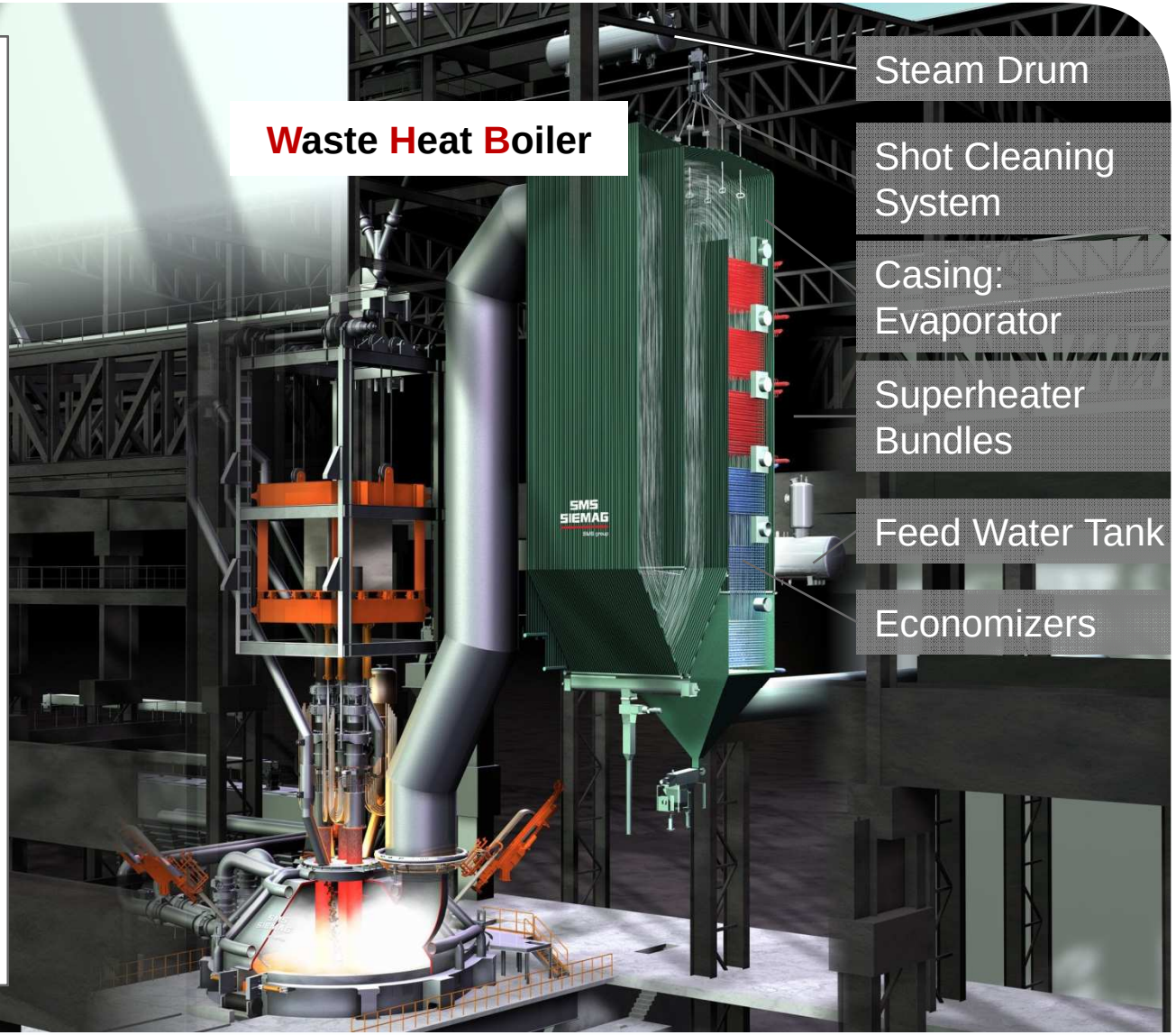


Energy Recovery at S/EAF®

Scenario

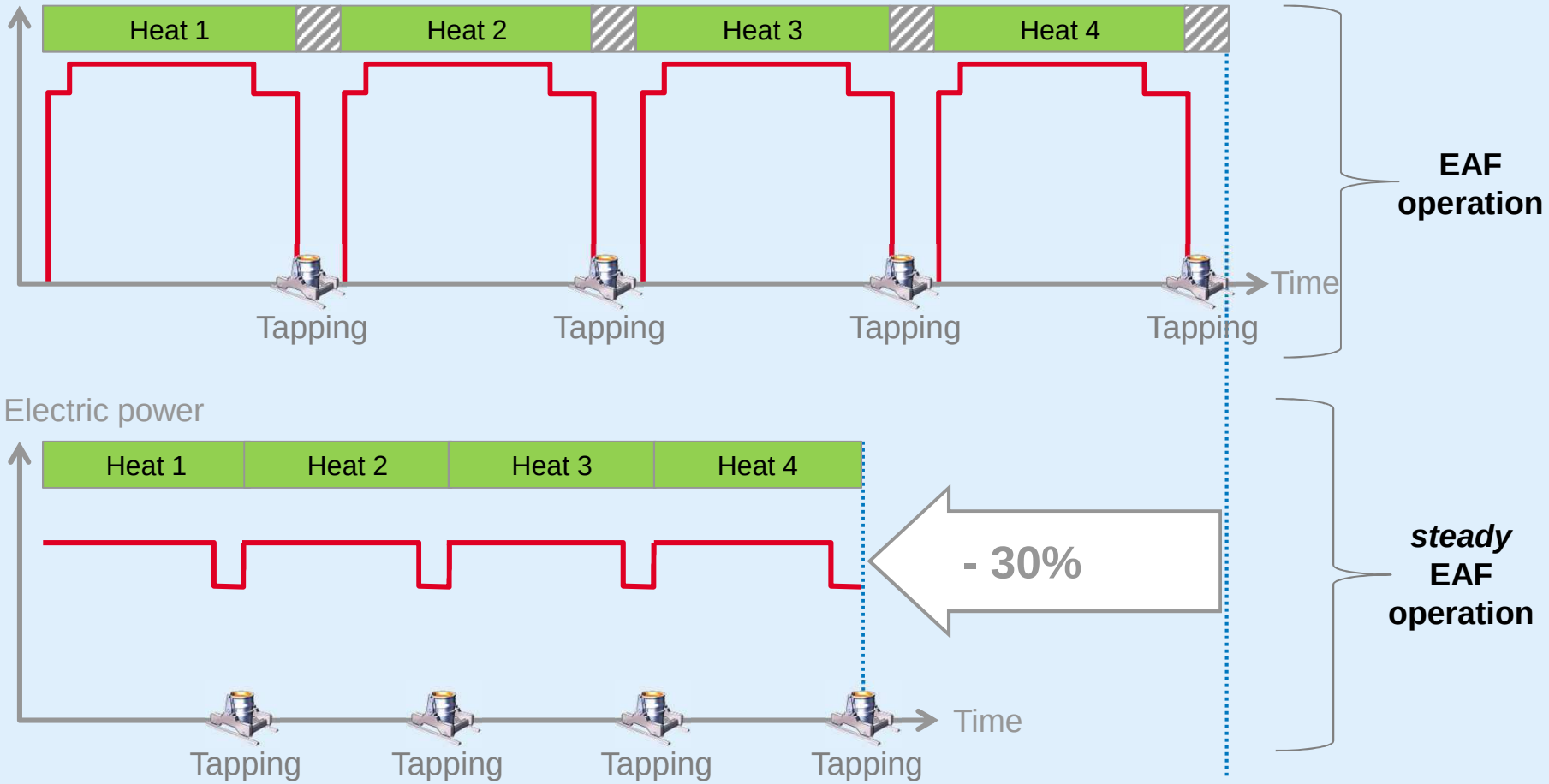
120 t S/EAF® with
85% HDRI + 15% CDRI

- Steam generation:
  88 t/h
  (398°C, 38 bar
  = superheated)
- 18 MW_{el}
- Steam production:
  747,000 t/a
- Electricity production
  157,700 MWh p.a.



Cost reduction

S/EAF®: Electric Arc Furnace without non-productive downtime



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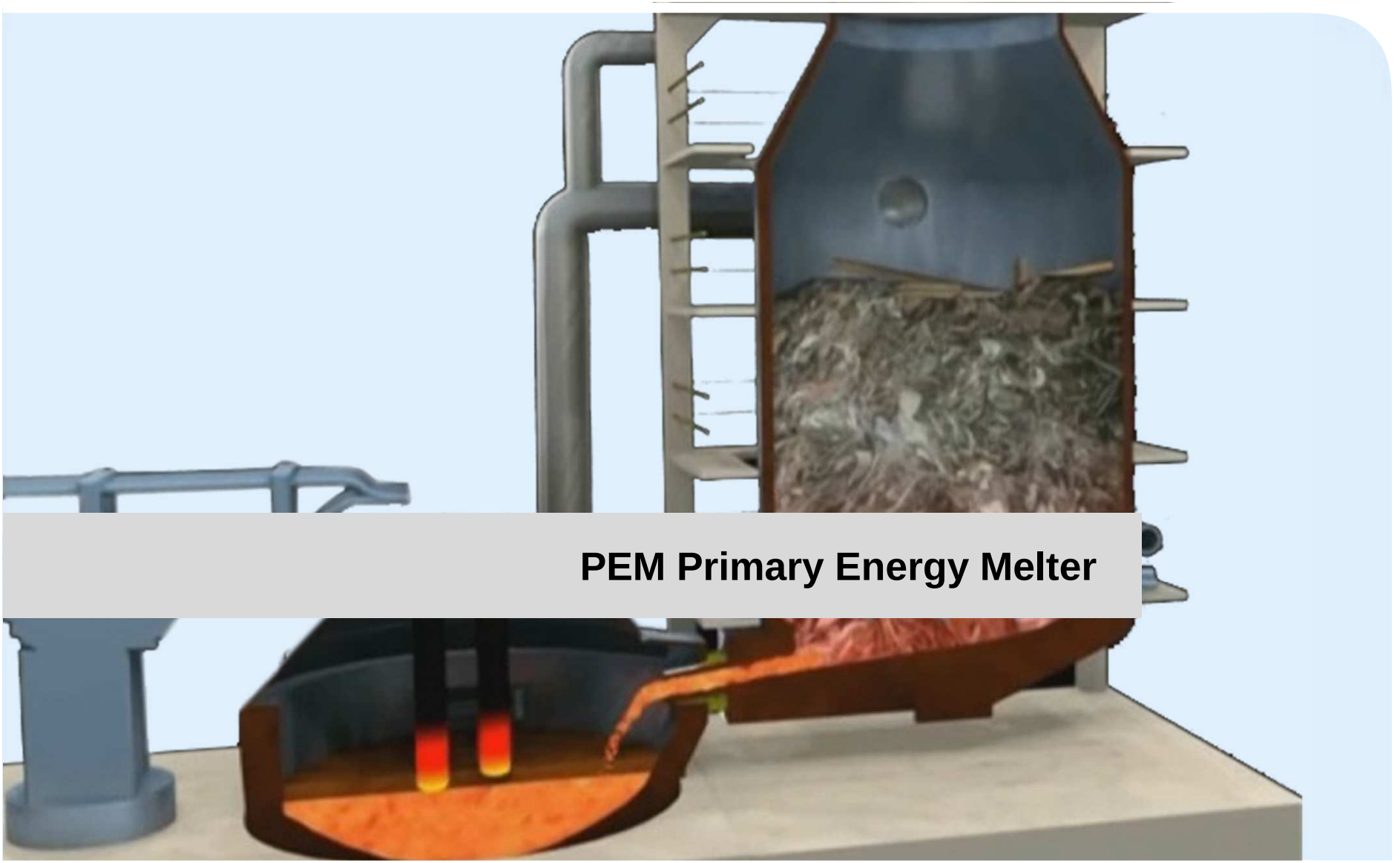
Comparison of S/EAF® and EAF Process – Scenario Calculation

Increased Productivity at same Heat Size or smaller Equipment for same annual Steel Production

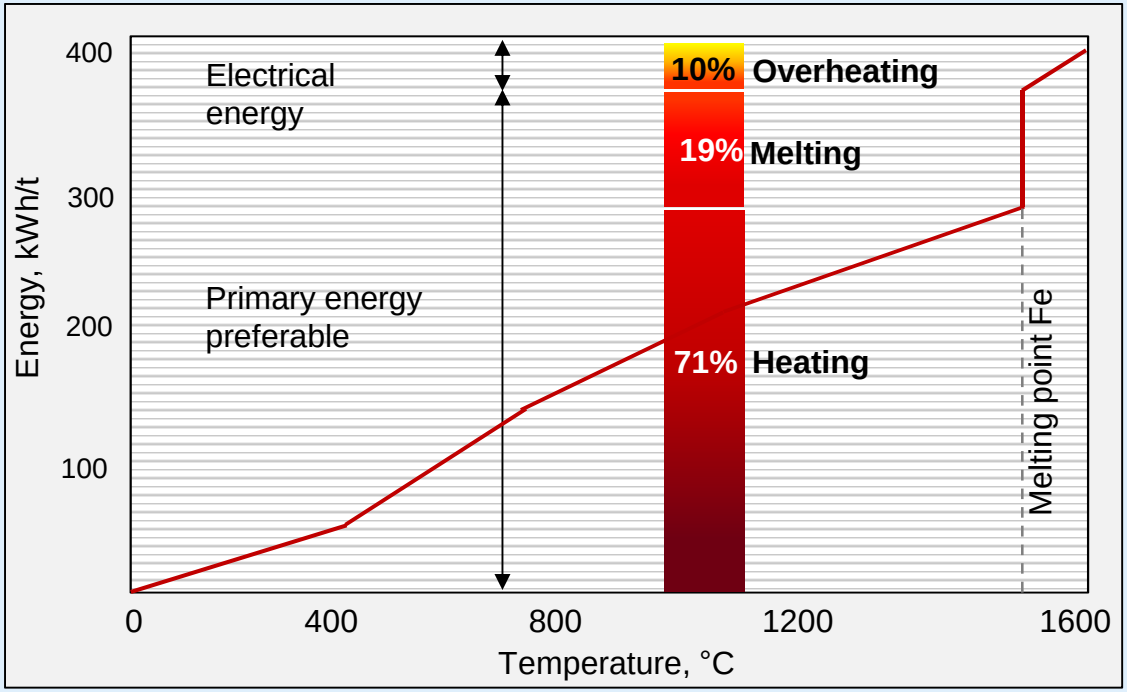
	EAF_{160}	$S/EAF^{®}_{160}$	$S/EAF^{®}_{120}$
Tapping weight	160 t	160 t	120 t
Production capacity	1.6 m. tpy	2.1 m. tpy	1.6 m. tpy
Productivity	210 t/h	280 t/h	210 t/h
Specific energy consumption → incl. Energy Recovery	420 kWh/t 375 kWh/t	400 kWh/t 310 kWh/t	390 kWh/t 305 kWh/t
Tap-to-tap time	46 min	34,5 min	34,5 min
Transformer capacity	160 MVA	160 MVA	130 MVA
Energy Recovery	9,5 MW_{el}	25 MW_{el}	18 MW_{el}

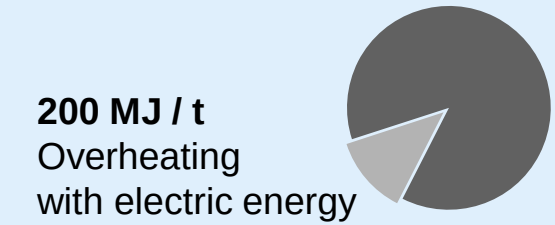


PEM Primary Energy Melter

PEM – Primary Energy Melting

Optimization of energy input for scrap-based steelmaking

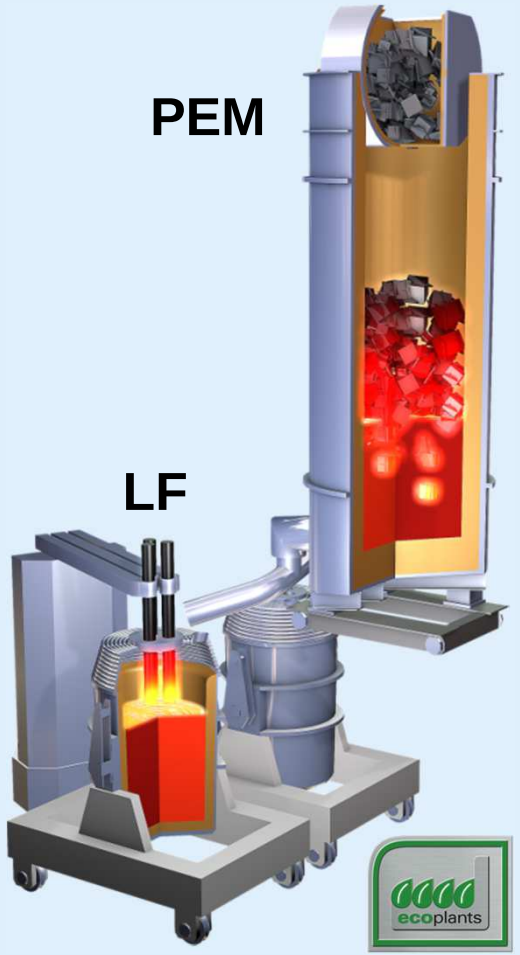




200 MJ / t
Overheating
with electric energy

Melting with gas
(instead of electric energy)

1,400 MJ / t

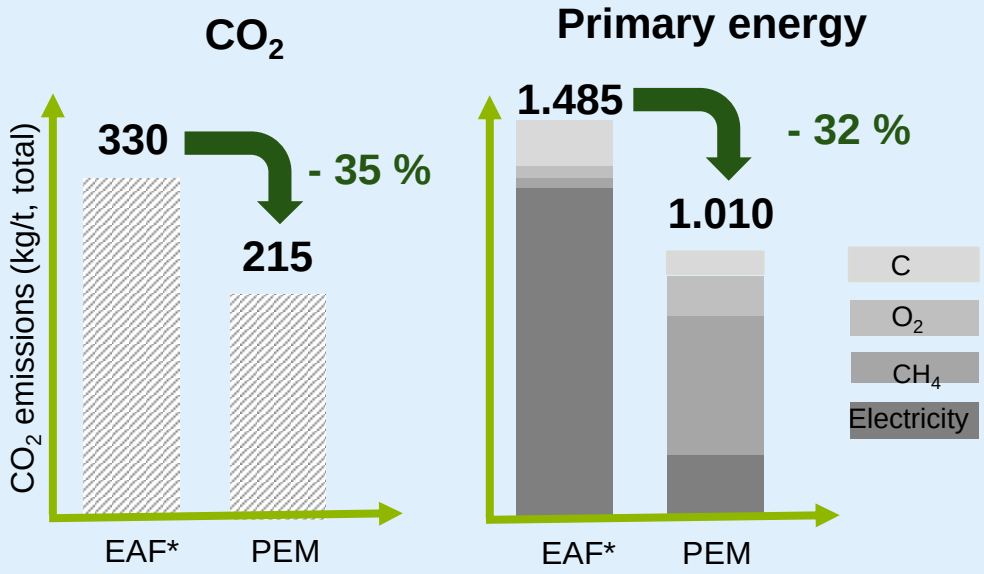


PEM – Primary Energy Melting

Primary Energy and CO_2 reductions using PEM technology

Concept

- Scrap melting with primary energy
- Direct conversion of primary energy into heat
- No energy losses through electric power generation and transmission



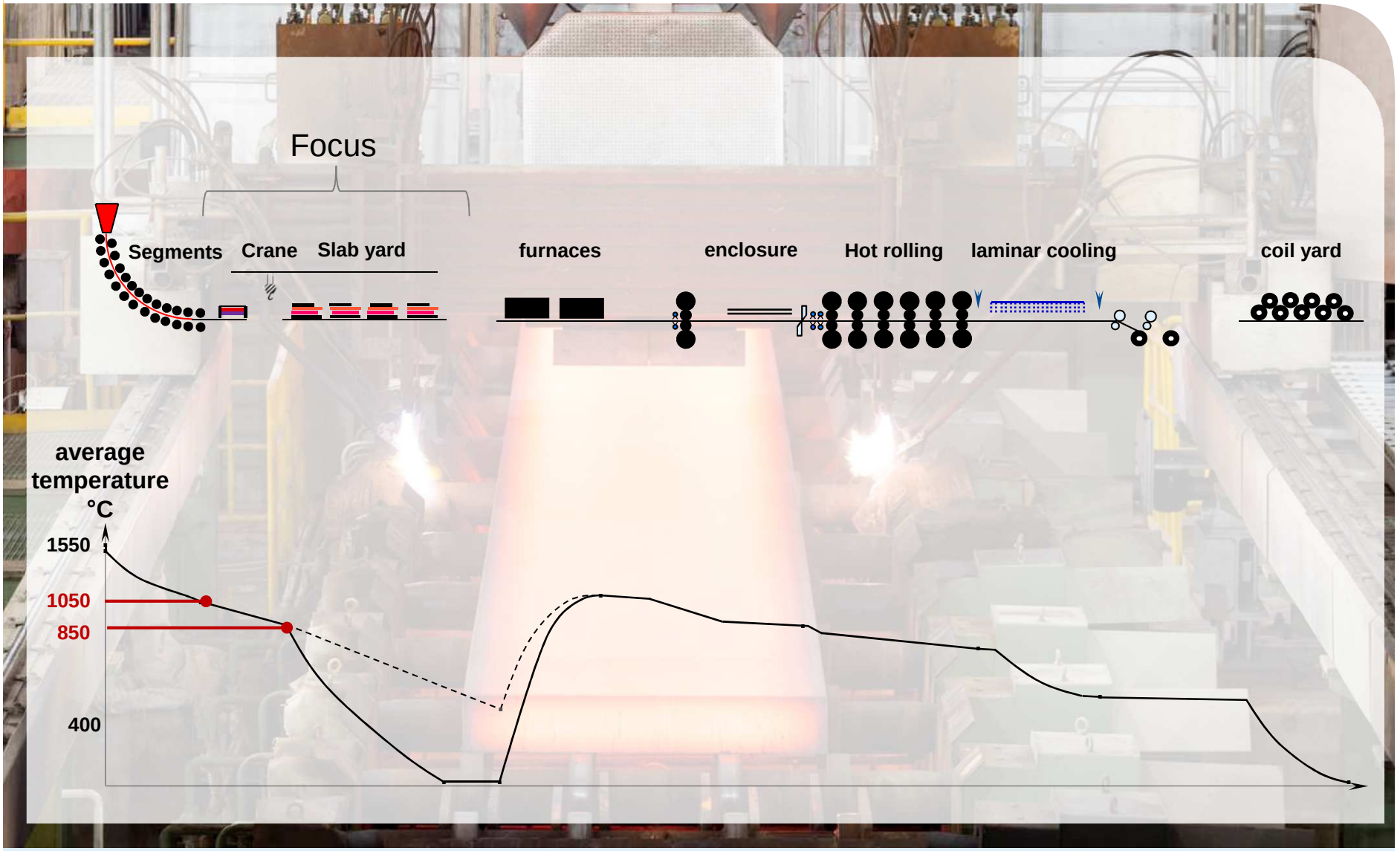
* Average according to a study by World Steel Association

Pilot plant facts

- Installation: in existing melt shop
- Target: increase hot metal offer for BOF
- PEM melting capacity: 30 t/h
- Shaft diameter: 2 m
- Start hot commissioning: 05/2014

Energy recovery from hot slabs

Energy recovery from hot slabs



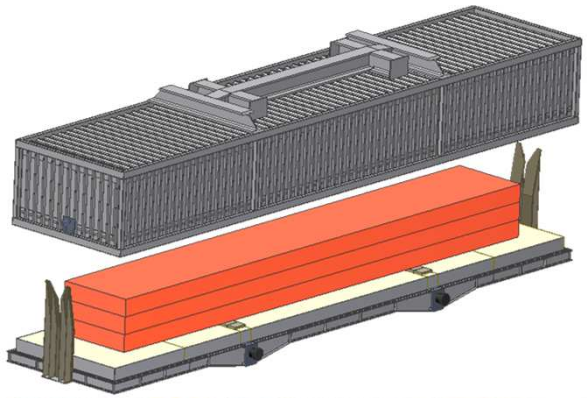
Rise of energy efficiency : Transportable isolation box

Transportbox for hot slabs

- Simple steel design with isolation, includes couple device for crane
- Multifunctional applicable

A: Slow cool down at crack vulnerable steel grades (high carbon contents)

B: Isolation = Low temperature losses → for hot charging



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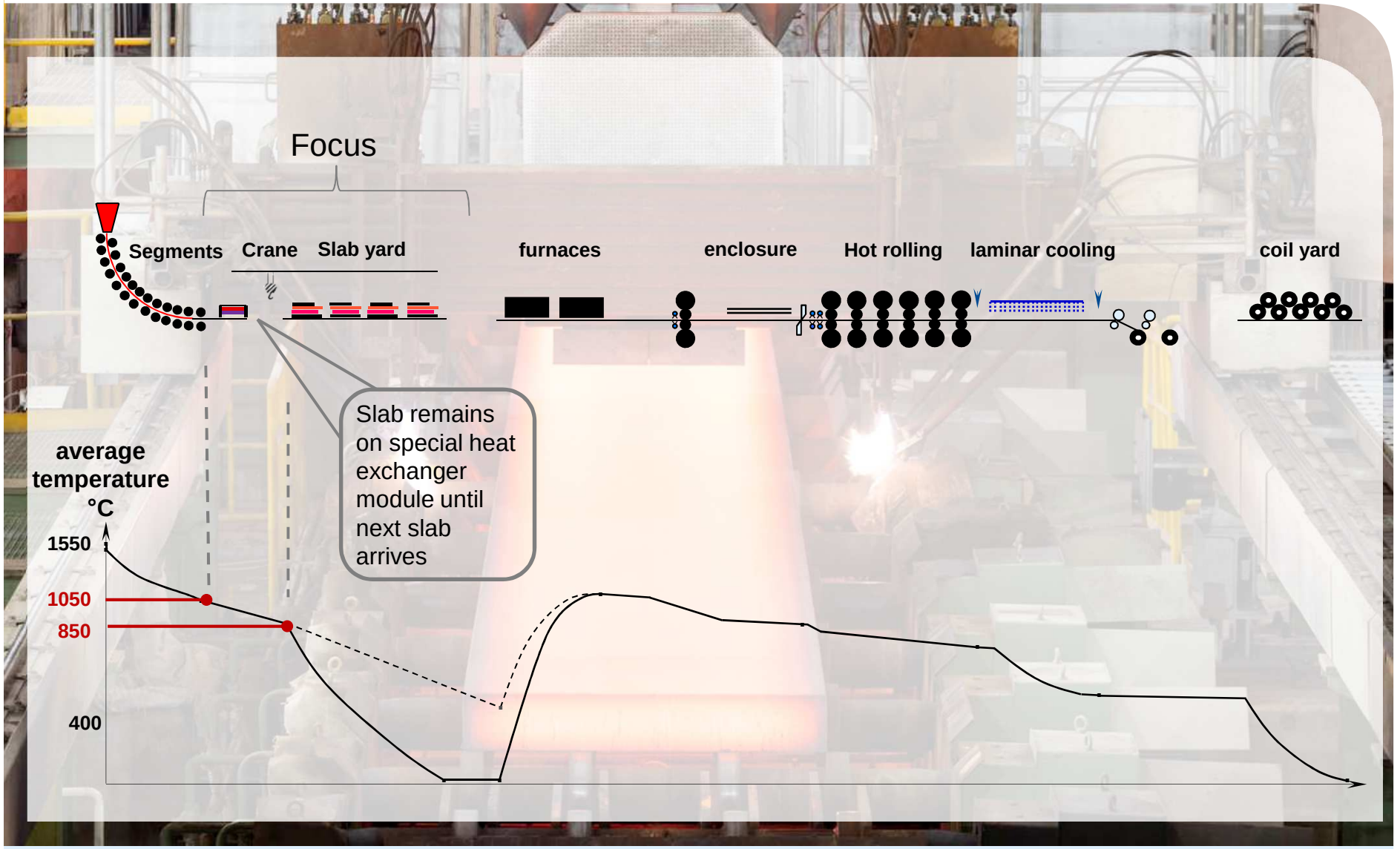
Energy recovery from hot slabs

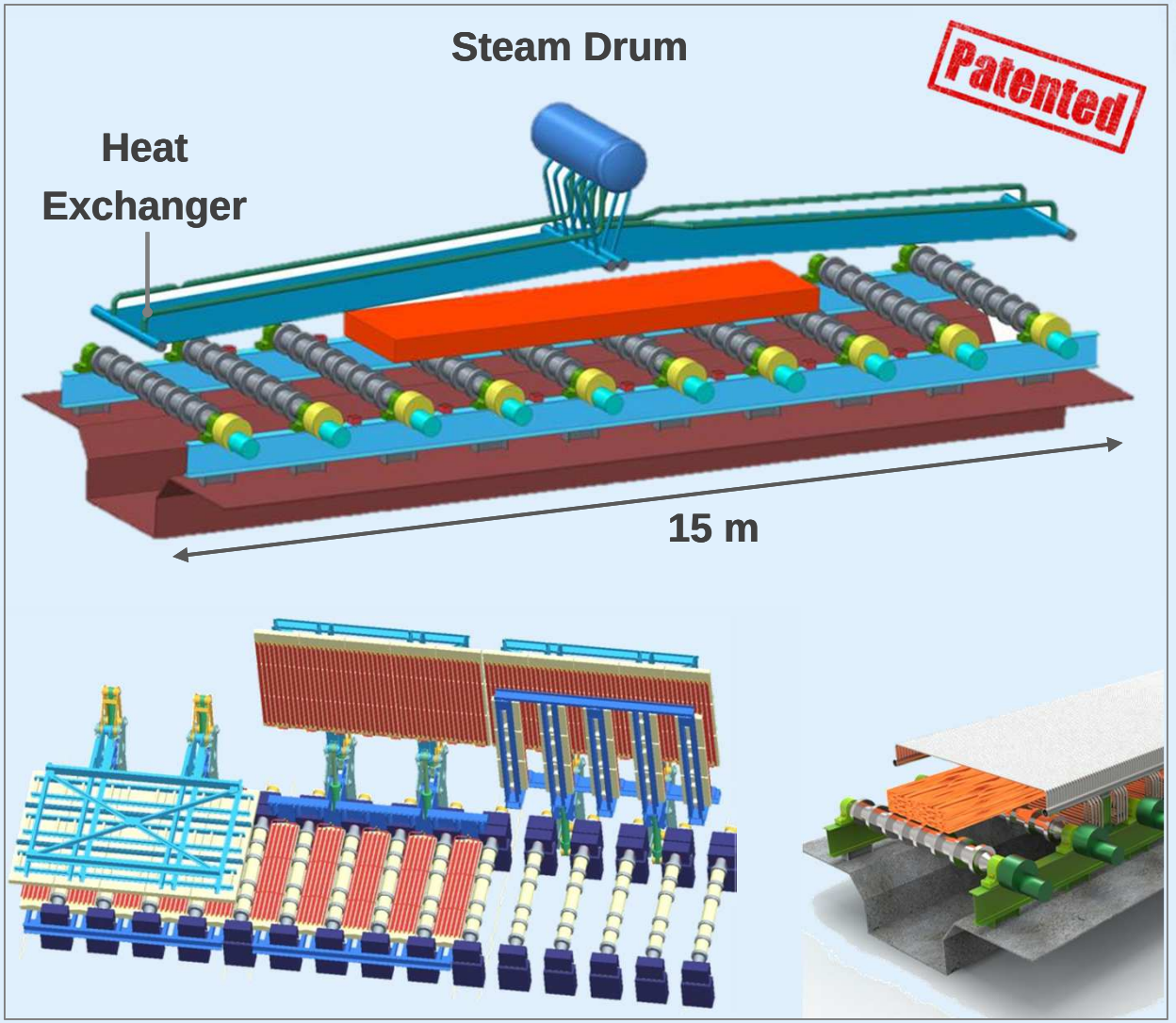


Design of heat exchanger module

Energy recovery

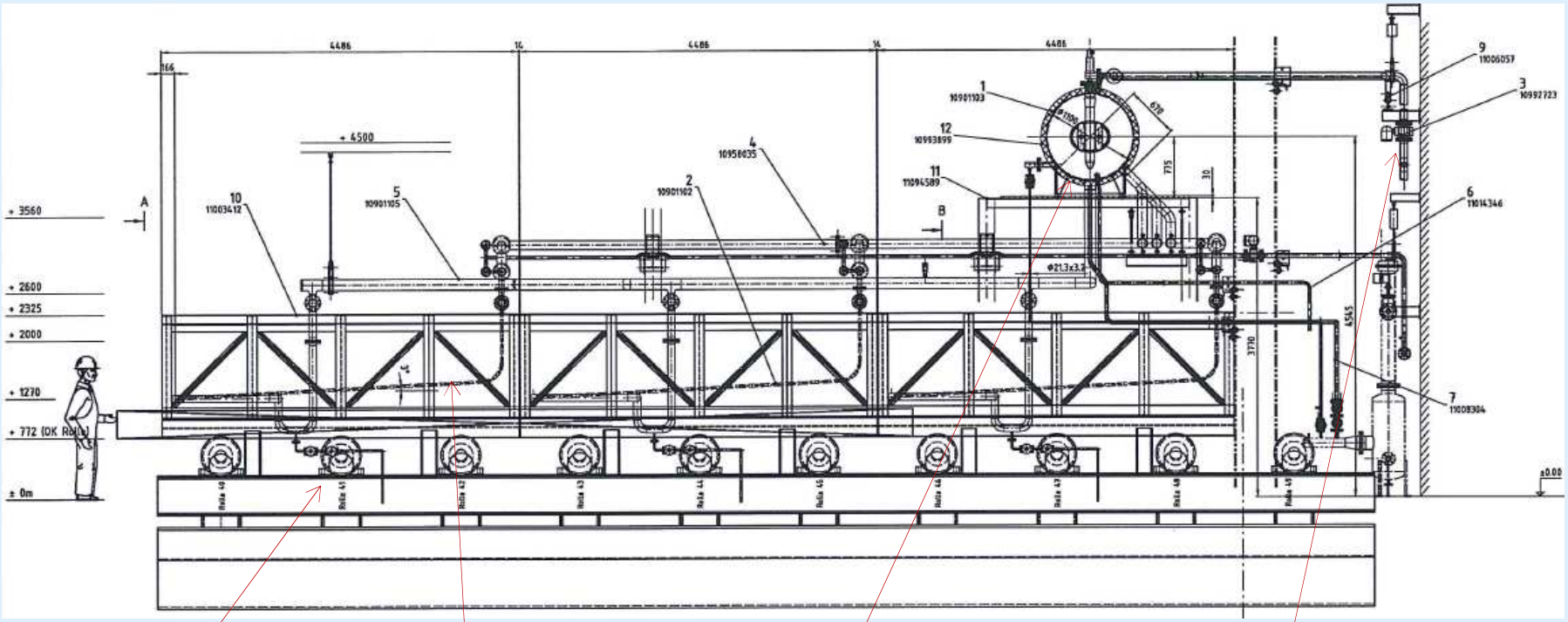
- 50 - 70 kW_{therm} / m^2 at casting outlet
- 15 m roller table (1,500 mm wide slabs) enables the generation of about 7,000 to 10,000 tons of steam p.a.

- No influence on production process!
- Simple and maintenance free design
- Modular and easy expandable
- Qualified for hot charging



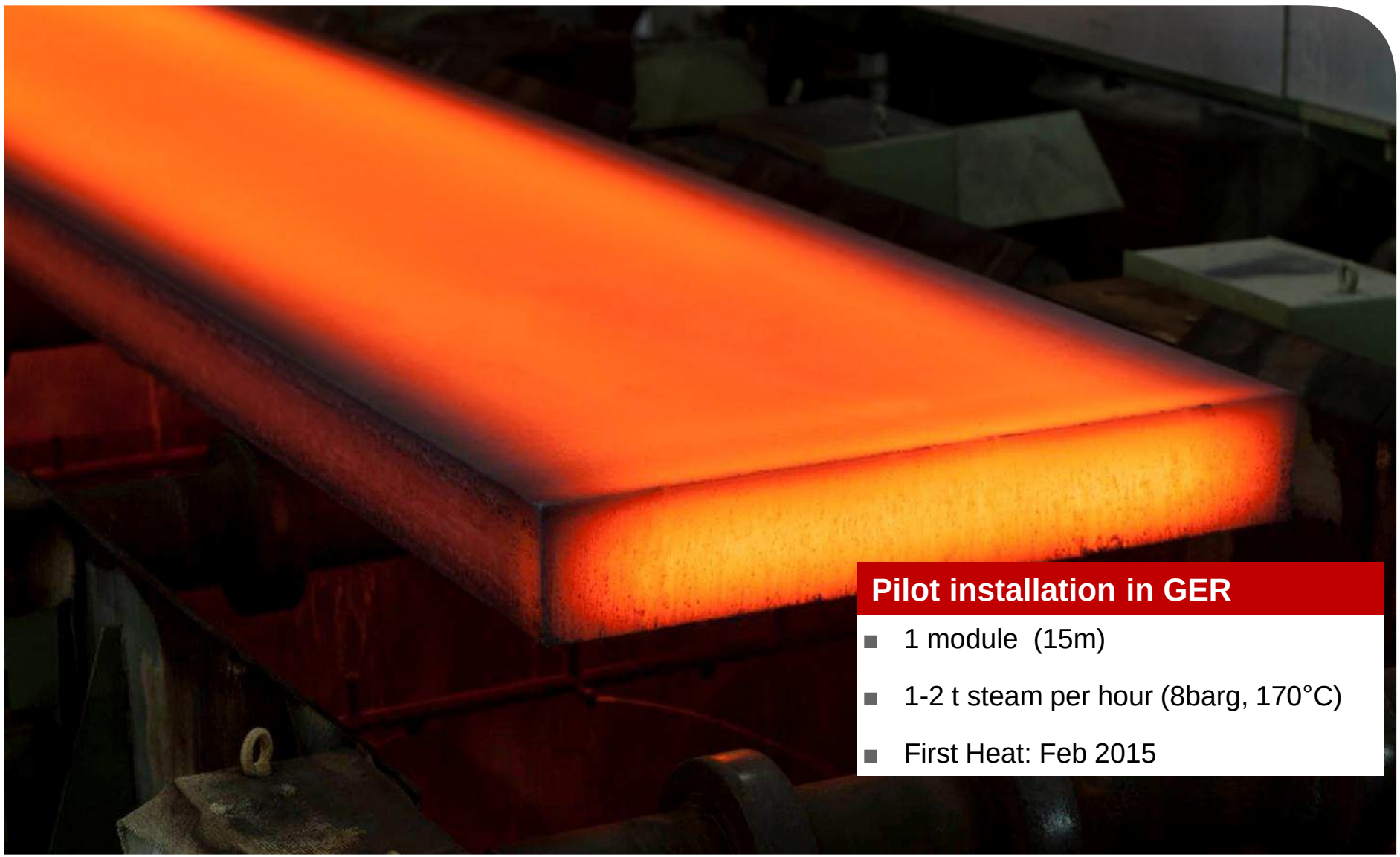
Design of heat exchanger module

Cross section drawing of the heat recovery system



Roller Table Heat Exchanger Steam Drum Connection to steam grid

Reference: Salzgitter Flachstahl, Germany



Pilot installation in GER

- 1 module (15m)
- 1-2 t steam per hour (8barg, 170°C)
- First Heat: Feb 2015

Environmental Services

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Environmental Services

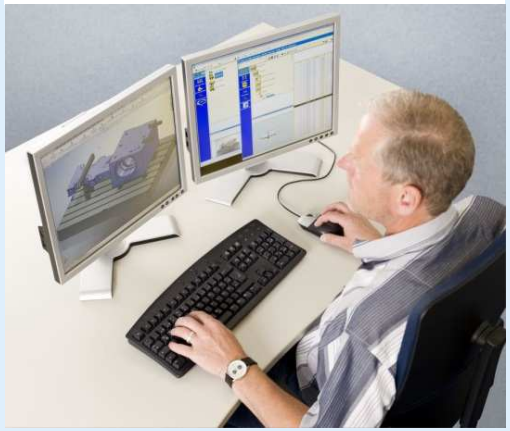
Overview

Maintenance

- Maintenance
- Inspection
- Repair work
- Revisions
- Service-contracts
- Replacement 1:1
- Spare parts

Modification

- Plant upgrades/ Retrofit
- Performance improvement
- Emission reduction
- Efficiency improvement
- Firing system upgrades
- Life time calculation
- Plant behavior



Engineering

- Engineering
  (case studies, feasibilities)
- Supervision
- Commissioning
- State Examinations
- Measurement + Analysis
- X-pact Energy Advisor
  (Monitoring-System)

Concept of Energy Optimization Studies

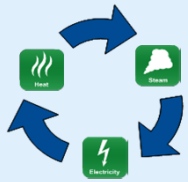
- One-week on site analysis for the detection of optimization potential
- Priorisation of the potentials with customer
- Development of specific energy efficiency measures

Low to no investment	Modernizations	Plant revamp and extension
Consumption forecast / individual procurement	Replace inefficient consumers	Waste heat recovery at EAF/BOF
Peak load shedding	Use more efficient media	Process gas utilisation at BOF
Optimise production plan from an energetic point of view	Adapt temperature levels	Heat recovery from hot slabs
	Start-stop mechanisms	

Saving energy

Reducing energy costs

Recovering energy



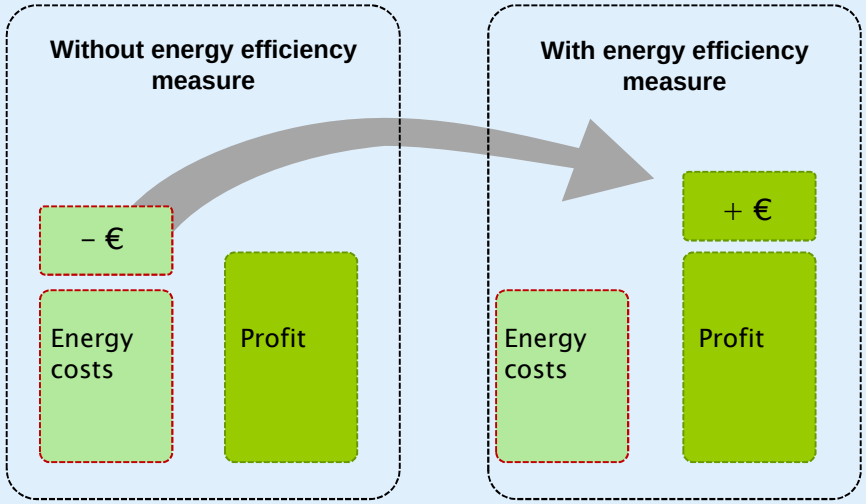
Energy efficiency measures and energy costs

Example for saving potential

Excerpt from the *Stahl und Eisen* journal 2009

"If an Energy Monitoring Information System has been installed correctly and the respectively appropriate measures have been taken, savings of between 5% and 20% are typical, with 8% being a realistic value. The amortisation period of these systems typically amounts to between one and two years."

J.Hundrieser / O.Seifert, *Stahl und Eisen* 129 (2009) No. 7

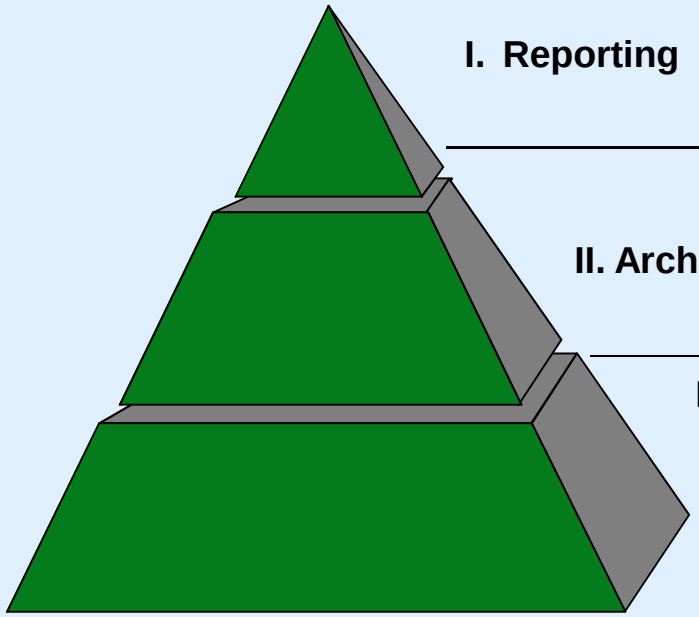


- 31 m. €/year — Generating electricity from blast furnace gas (2 blast furnaces, 250.000 m^3/h gas)
- 5 m. €/year — Electric energy efficiency measures (Savings of 5% by a consumption of 2 TWh electrical energy)
- 2 m. €/year — Usage of converter offgas (3 converters, 1.3 m t liquid steel)

Environmental Services - X-Pact® Energy Advisor

Target			
Energy Consumption	Monitoring	Controlling	Decreasing & Optimization

The X-Pact® Energy Advisor is assembled in three levels

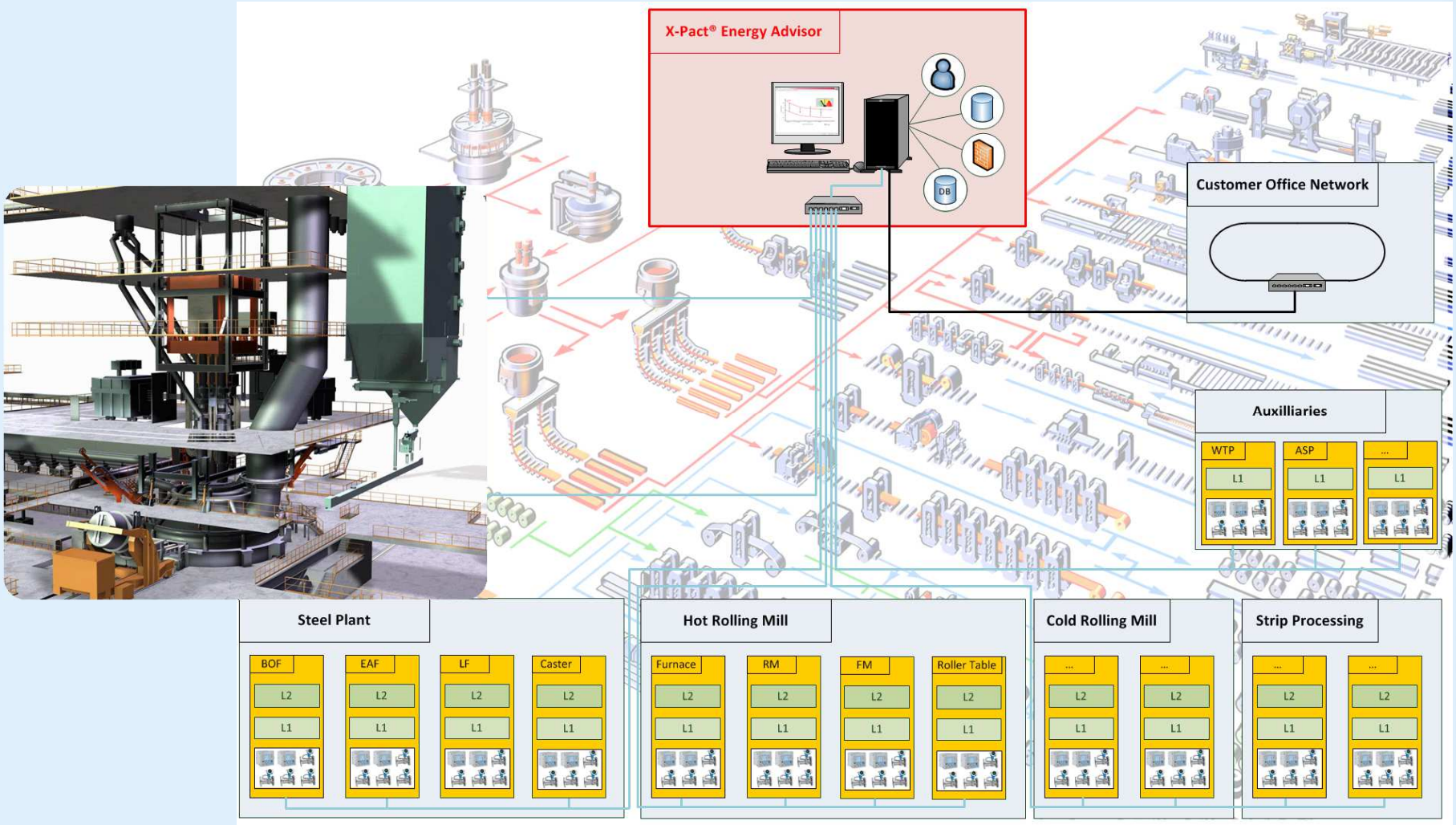


I. Reporting
- Management ratios
- Reports
- Visualization

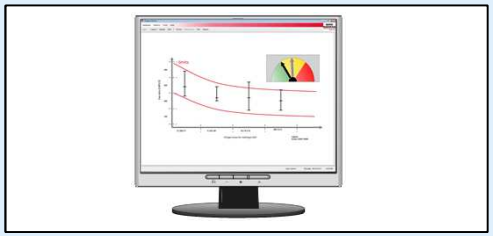
II. Architecture
- Bus-Systems
- Server
- Databank

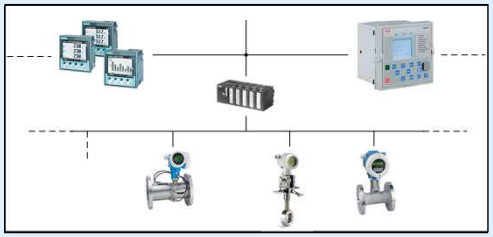
III. Performance Measure Concept
- Dispositive Media
- Interval measurements
- Measurement engineering

X-Pact® Energy Advisor collects energy data from all plant units



Specific Aspects of our X-Pact® Energy Advisor





Monitoring

Reporting-System

Alarm

via E-Mail or SMS

Description

Analysis

Evaluation

Supervise limiting values

Aggregate data

Record data

Archive data

Electrical energy

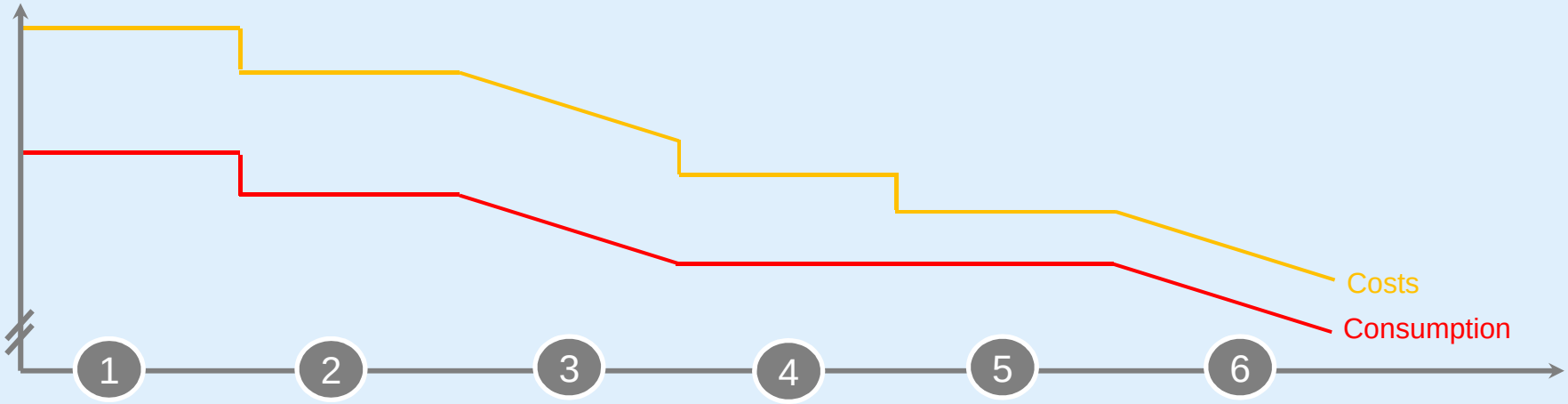
Media
e.g. Gas, fuels, O_2, Water, etc.

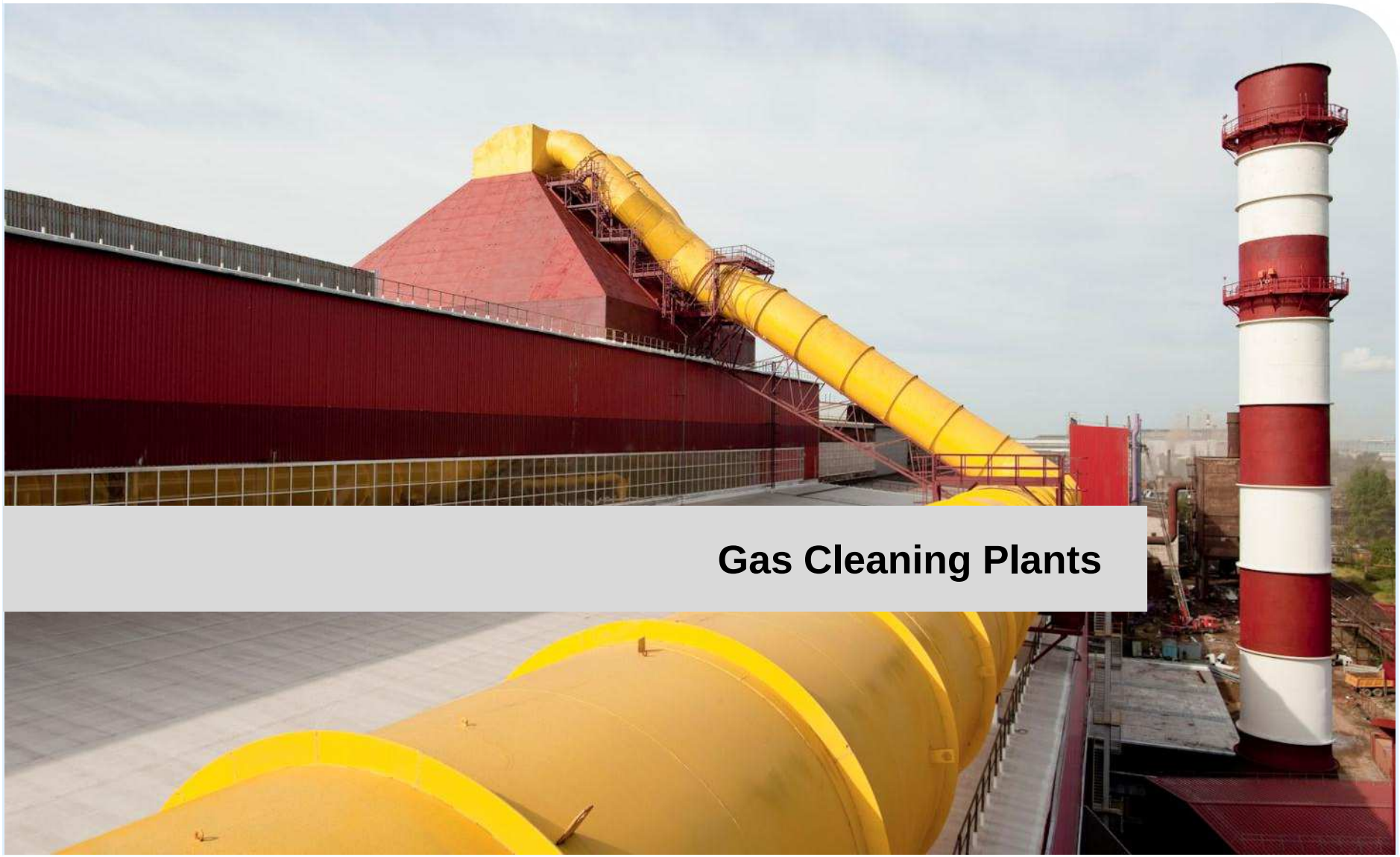
Process data

Summary Services

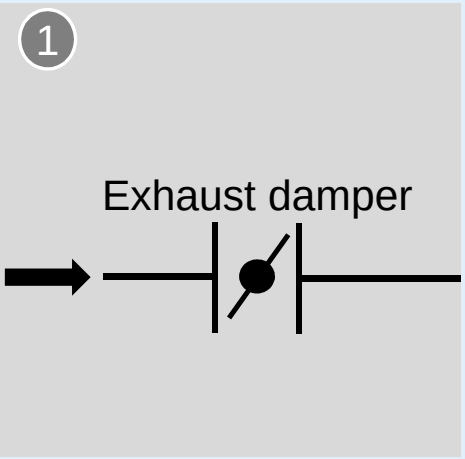
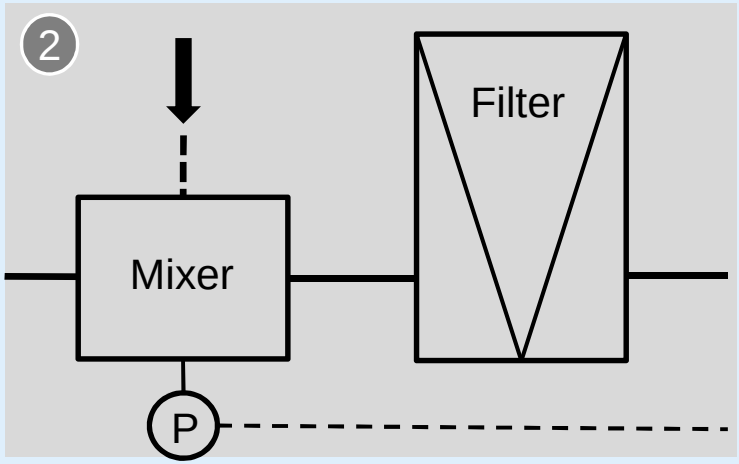
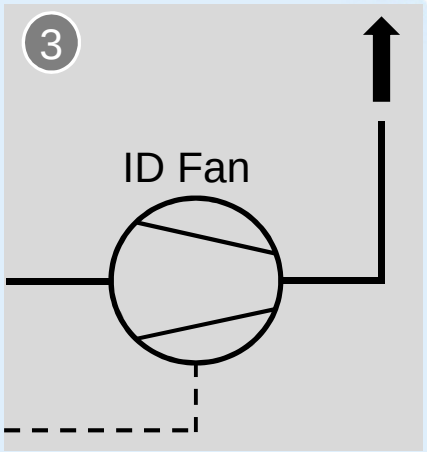
Benefits of Studies and X-Pact® Energy Advisor by SMS Siemag AG

		Low Invest	
1	Effective measurement concept		
2	Detect energy saving potential	Costs	Consumption
3	Increase efficiency continuously	Costs	Consumption
4	Optimize energy procurement	Costs	
5	Support energy controlling	Costs	
6	Profit from Certification ISO 50001	Costs	Consumption





Gas Cleaning Plants

	1	2	3
Gas cleaning process			
Conventional	**Indication of damper position** − Manual setting	**Constant pressure in main pipe** − No network analysis	**Controlling of ID Fan speed** − High under-pressure in every process step
GasCleaning Assistent	**Mathematical model - immediate calculation** + Optimal damper positions	**Consideration of network resistances** + High accuracy	**Variable underpressure** + Excellent energy efficiency

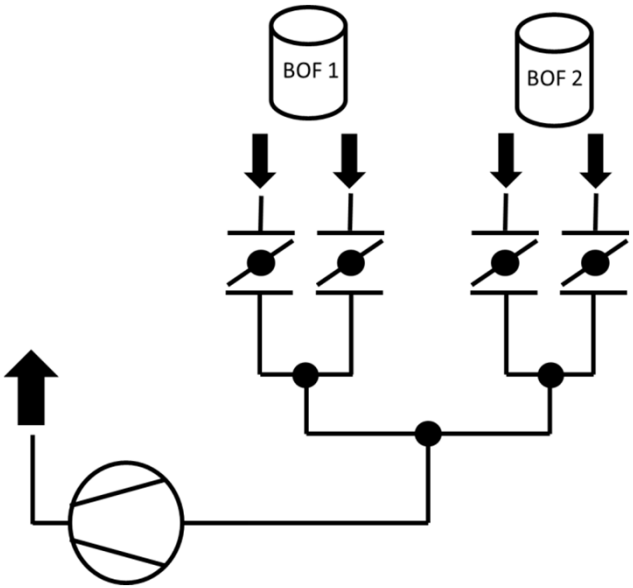
Reference: Kademir, Turkey

Plant Description

Reference KADEMIR

Characteristics

Annual output: 1.3 m. tons of steel
Converters: 2
Heats per year: 14,000 pieces
Energy price: 0.06 € / kWh



Comparison

Conventional

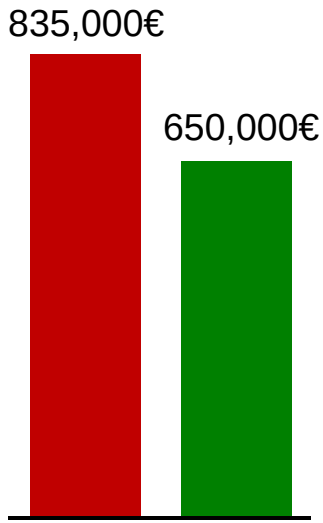
Energy input avg. = 1,600 MWh

Costs = 835,000 € / year

GasCleaningAssistant

Energy input avg. = 1,200 MWh

Costs = 650,000 € / year



Savings approximately 185,000 € p.a.
▶21%

Conclusion