K1 MET

metallurgical competence center

Resource efficiency in the metallurgical competence center

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Stakeholder Dialog „kritische Rohstoffe“

2014-04-19 Linz

Financially supported by Research STATE UPPER AUSTRIA, Das Land Steiermark, SFG, tirol, bmvit, bmwfi, FFG, COMET

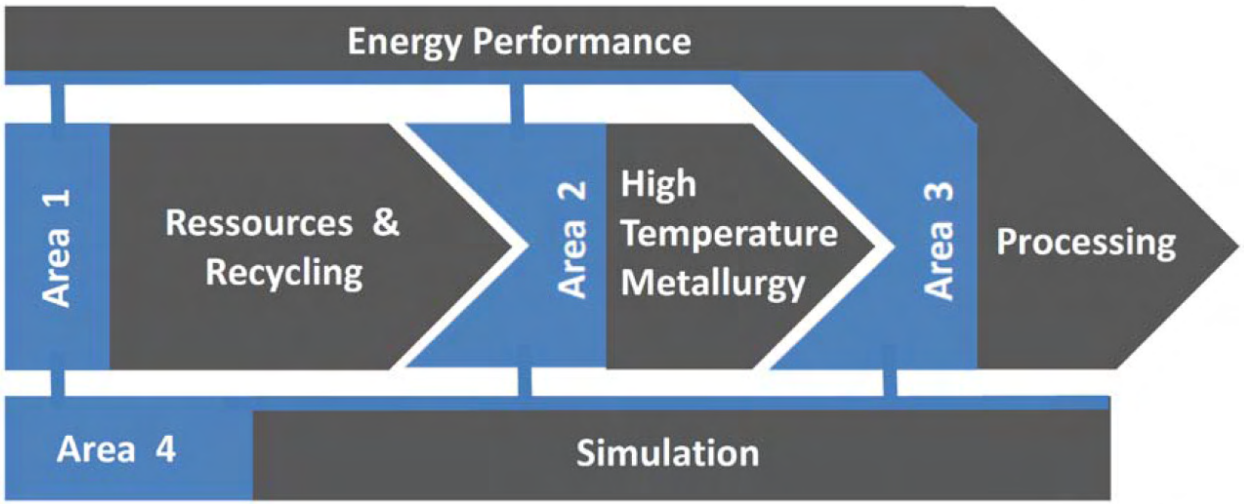
Vision for the next decade

CO_2 efficient production of metals and intermediate components

Cross sectorial approach to radically improved production processes

Leadership in solutions for more efficient processing and energy systems

by cooperate research of scientific and industrial organizations in four areas of a leading and internationally renowend metallurgical competence center



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Development of resource intensive processes



3rd COMET K1 call:

K1-MET Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development

Phase I 2015 – 2019
Phase II 2019 – 2023

Budget Phase I 22,7 M€

Financing:
30 % FFG
15 % Federal states
5 % University
50 % Industry

Locations:
Linz
Leoben

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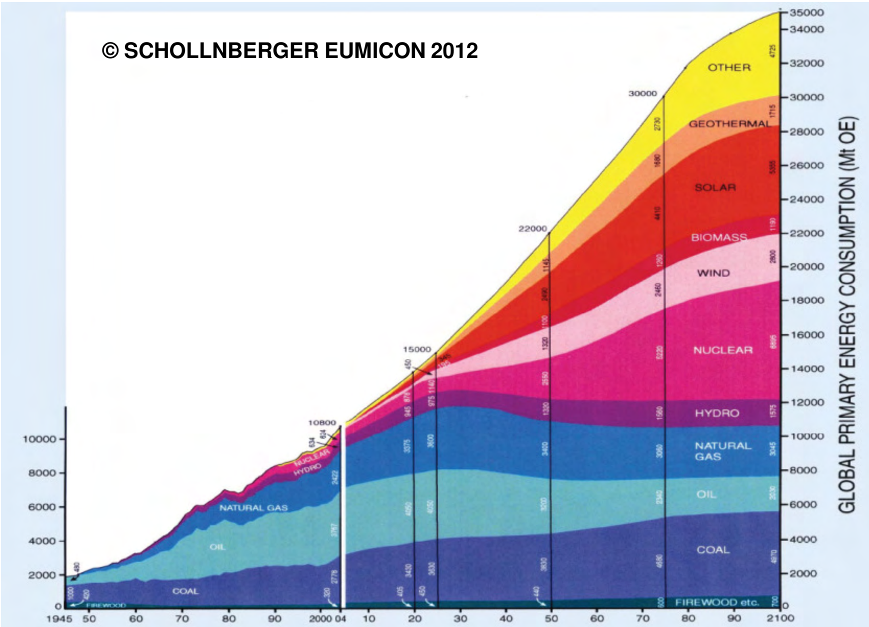
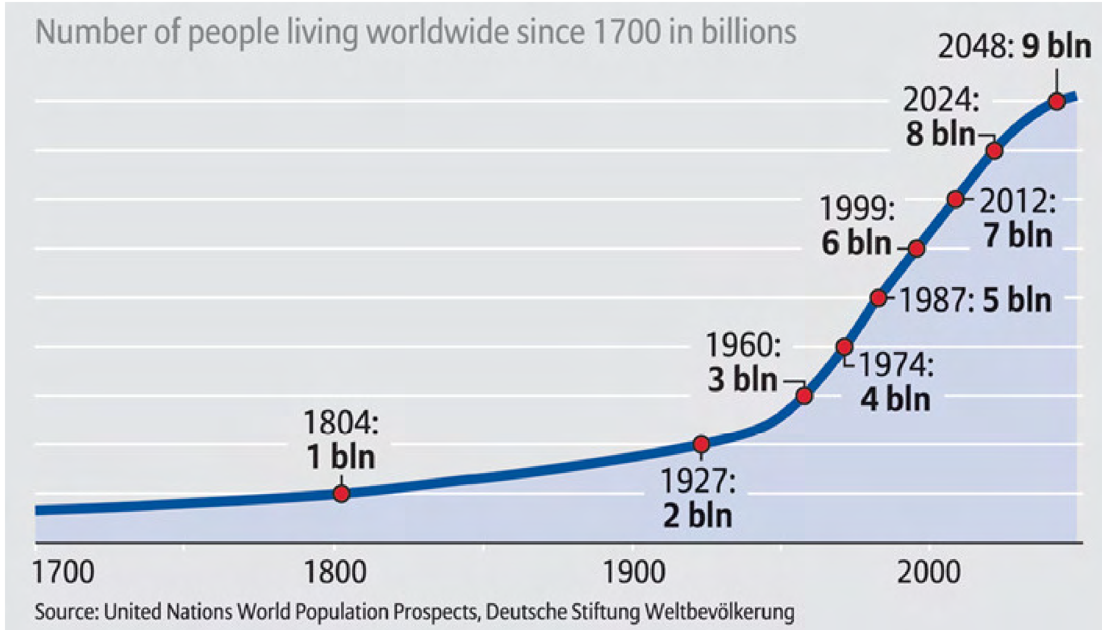
Global megatrends for energy and population





The growing rate of the global primary energy consumption is connected with the increasing population and the demand of the society for a social and technical development.

Fossil resources will play an important role in the future but the additional demand has to covered by forced use of renewable and carbon-free sources.

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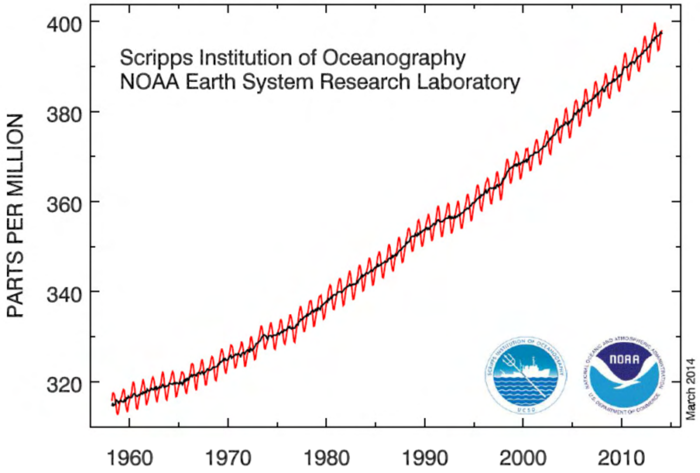
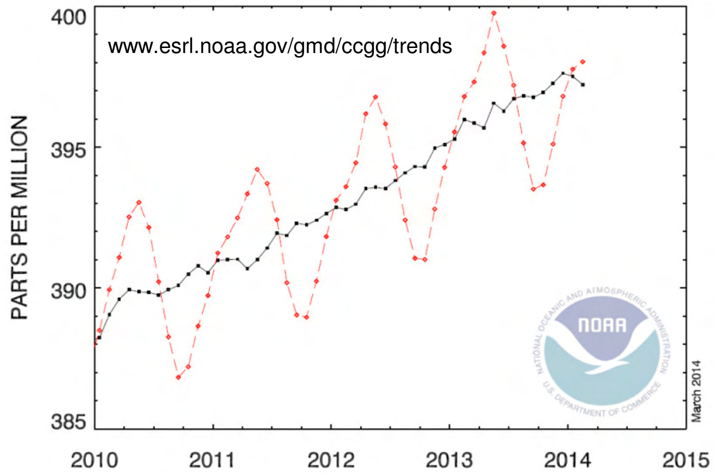
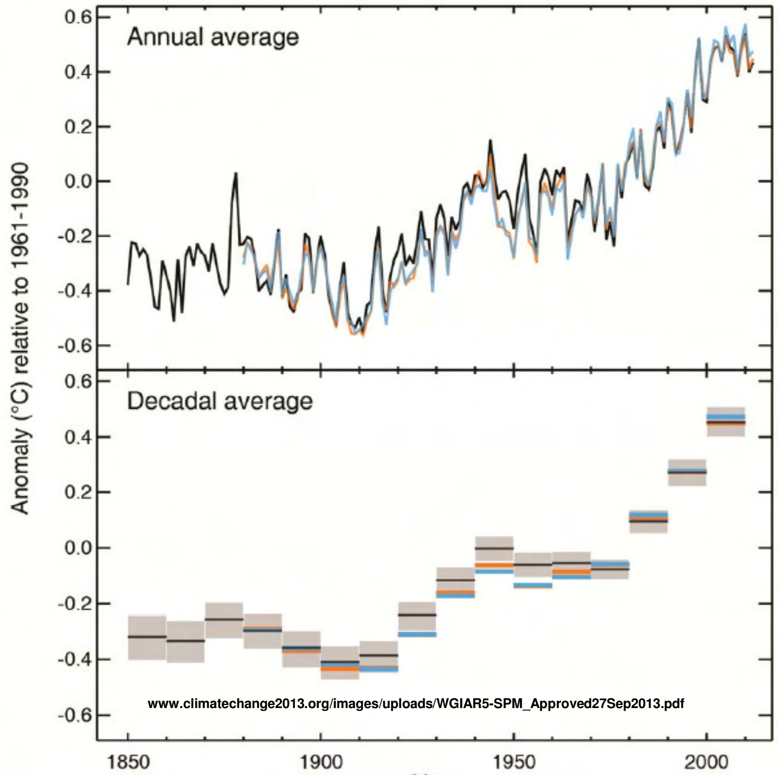
Trends of CO_2 and surface temperature



Before the Industrial Revolution in the 19th century, global average CO_2 was about 280 ppm. During the last 800,000 years, CO_2 fluctuated between about 180 ppm during ice ages and 280 ppm during interglacial warm periods.



On May 9th, 2013, the daily mean concentration of CO_2 in the atmosphere surpassed 400 ppm for the first time since measurements began in 1958.



Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

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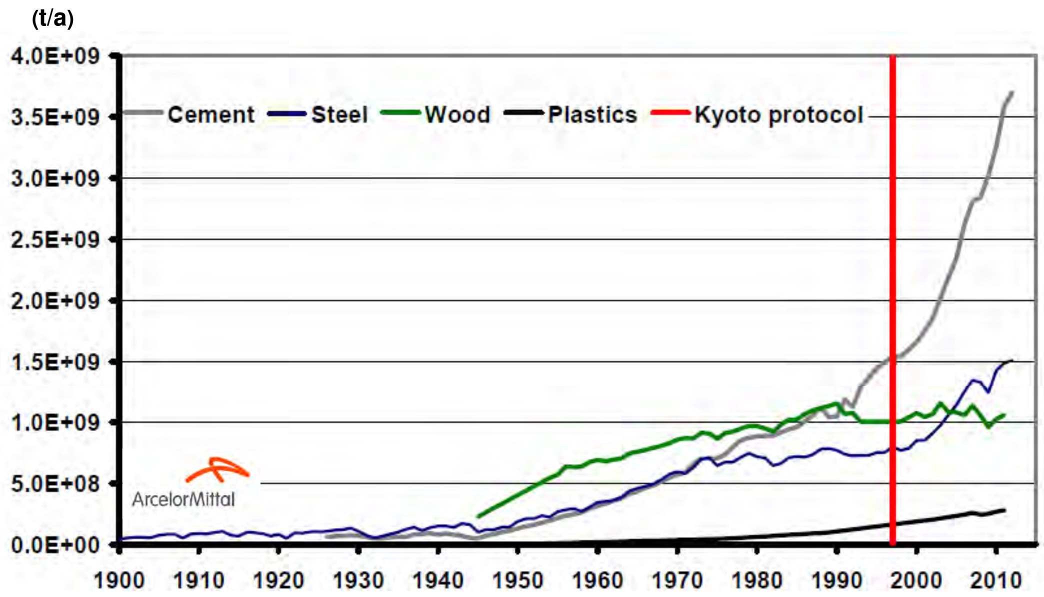
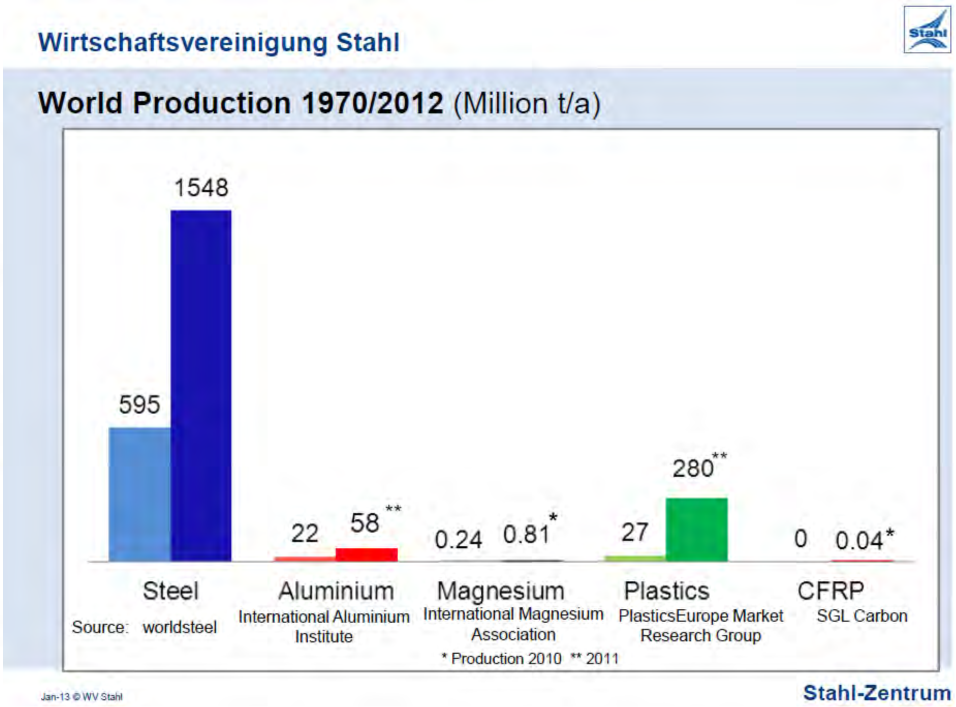
World production of materials





Steel is the most important metallic construction material and has a similar annual growing rate like cement since the year 2000. Cement (as concrete) is the world most used construction material.

The growing rate is linked with increasing population of the world and their demand for a development of the society, for which construction materials are the basis.

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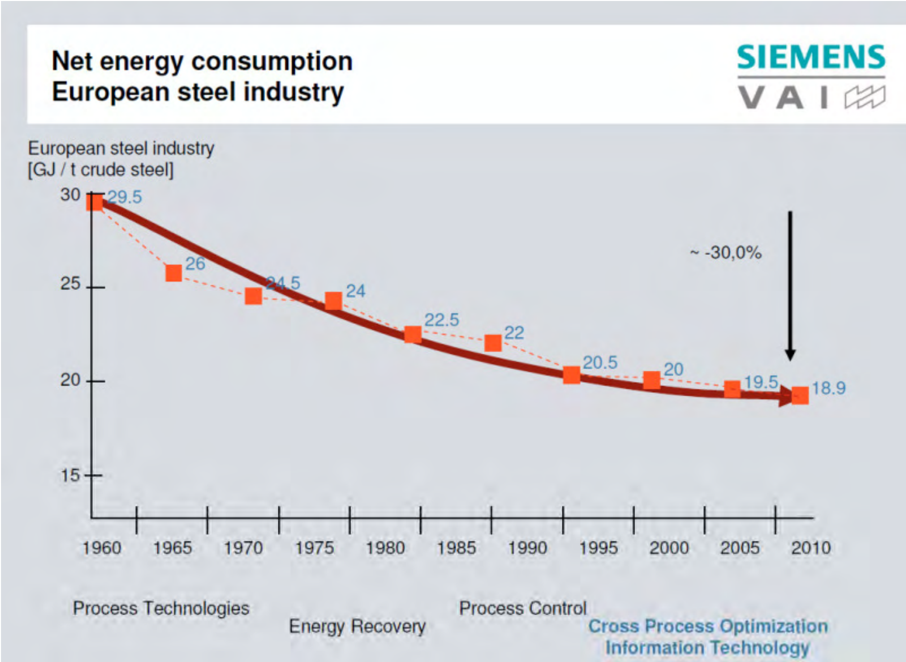
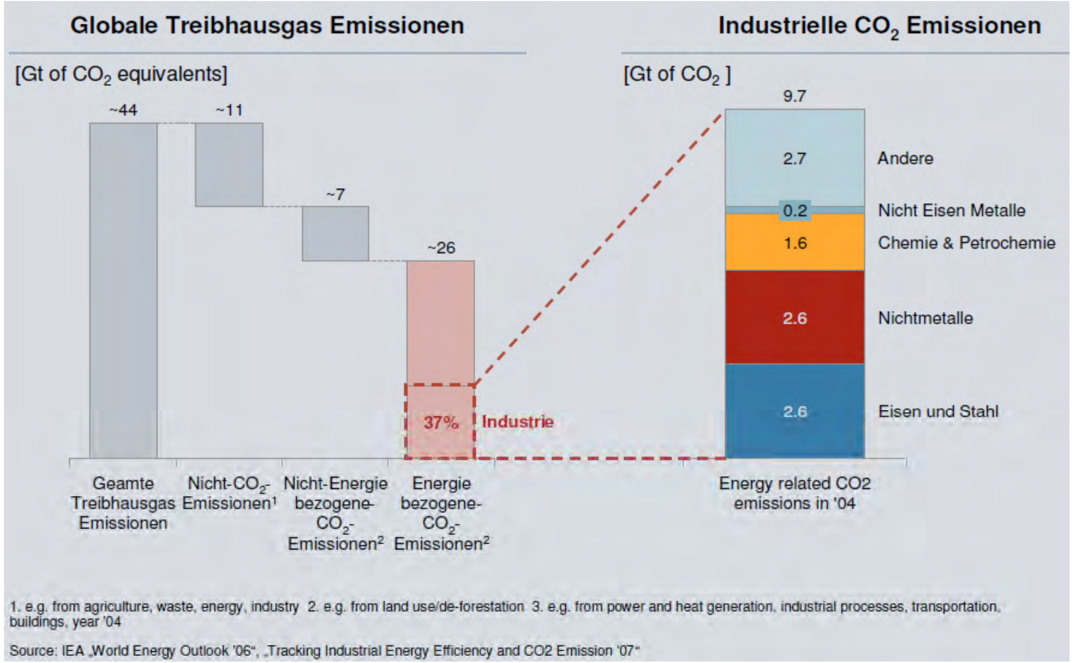
Primary energy consumption in steelmaking

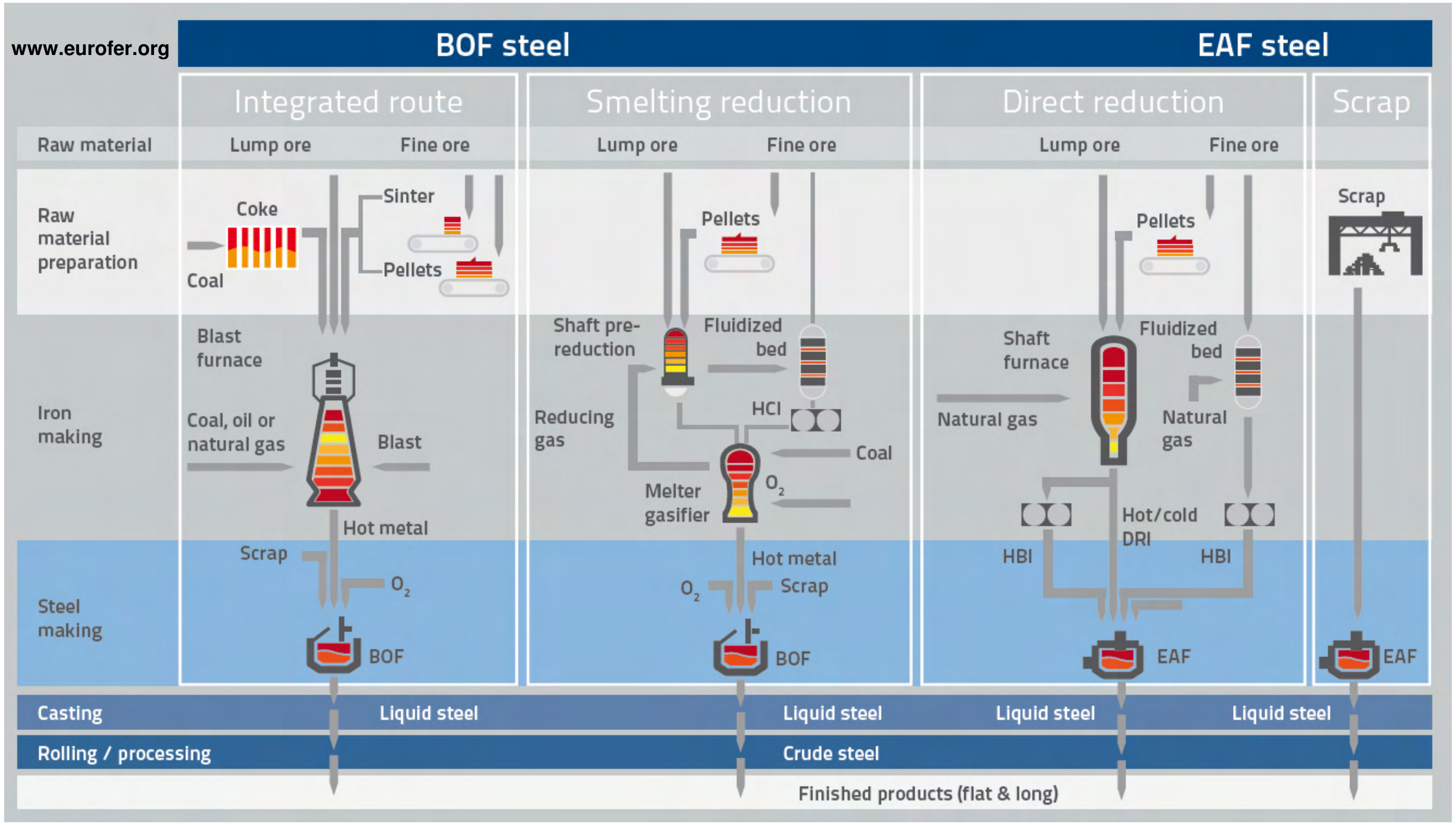




Industrial production is responsible for approx. 25 % of the CO_2 emissions world wide. 25 % of industrial CO_2 emissions are from the steel industry.

The technical development is demonstrated in the continouos decreasing energy consumption, but thermodynamic borders come closer.

Modern iron and steelmaking processes



The removal of oxygen from the iron oxide (= reduction process) in the different ironmaking units is the most energy intensive step in iron and steelmaking.

CO and H_2 are generated by gasification of coke, coal, NG and other solid, liquid and gaseous hydrocarbons like heavy oil, crude tar, waste oil, COG and plastics.

Ironmaking by indirect reduction: $Fe_2O_3 + 6CO(H_2) = 2Fe + 3CO_2(H_2O) + 3CO(H_2)$

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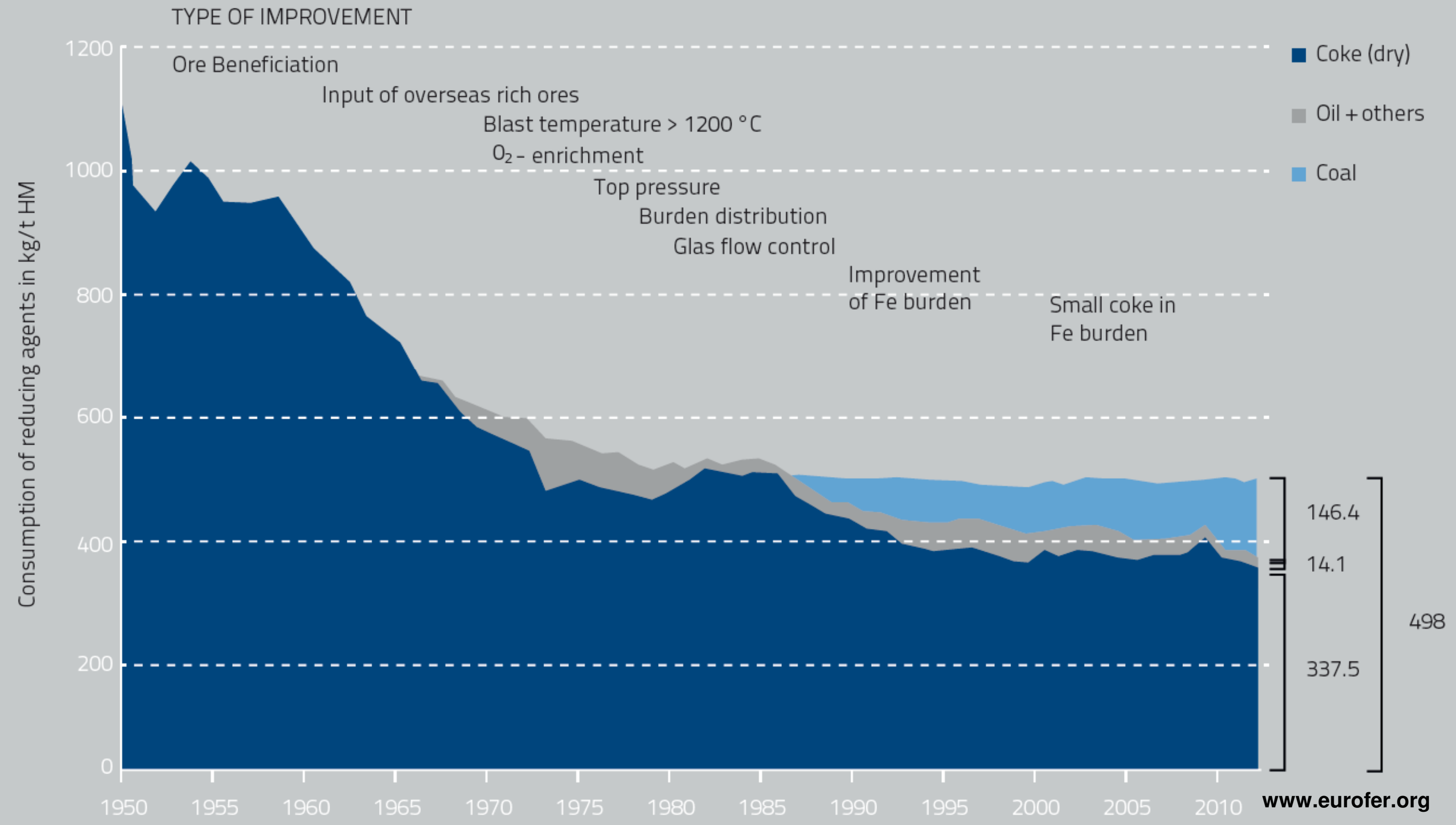
Development of BF process technology and reducing agents



The BF process is responsible for more than 90 % of the CO_2 emissions from the integrated BF/BOF steelmaking route.

Continous improvement of the BF process in the second half of the last century has reduced the consumption of reducing agents to a thermodynamic minimum level.

Further improvements are not possible without changes in the fundamental process design.

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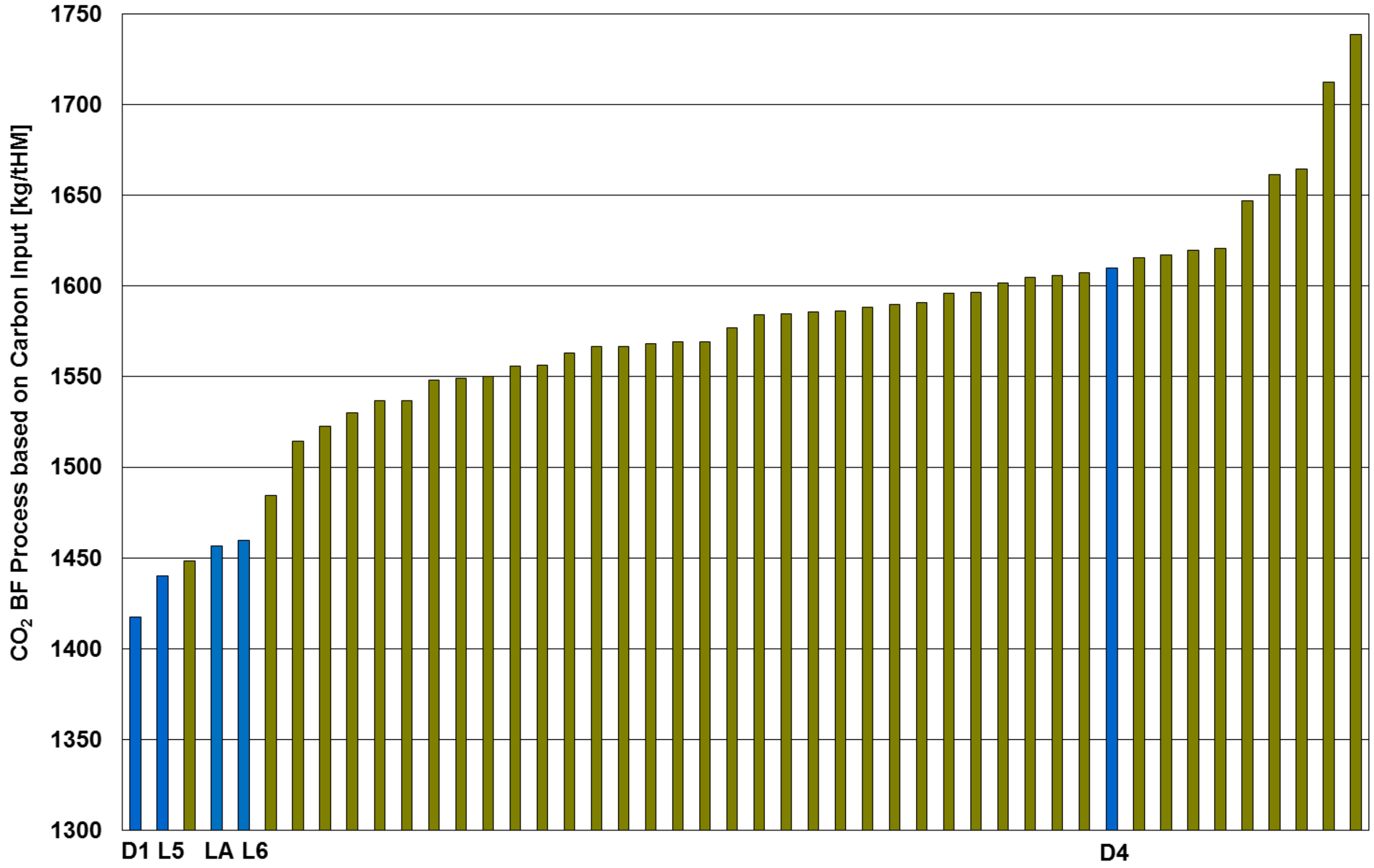
European comparison of CO_2 generation BF process (EBFC 2012)

The continuous improvement of the BF process with low-grade raw materials philosophy, closed-loop expert systems, alternative reducing agents and new charging technology shows the leading position of Austria in BF technology.

The further decrease of reducing agents consumption for BF D1 and BF L5 is the result of trials with HBI (no continuous operation over the year). BF D4 was out of operation over 3 months for relining and modernization.



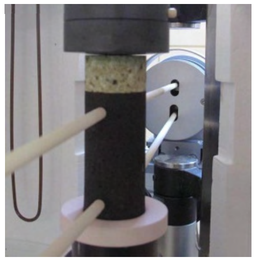
Analysis of Refractory Wear

Chemical & mechanical durability

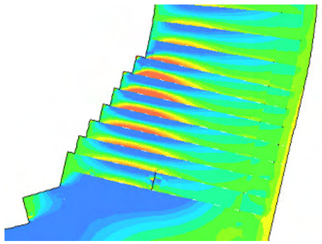
Mechanical performance

Erosion & corrosion resistance

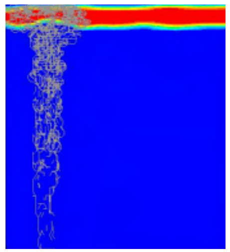
Experience:	Testing	FE-Simulation	CFD - Simulation	Thermochemical Simulation



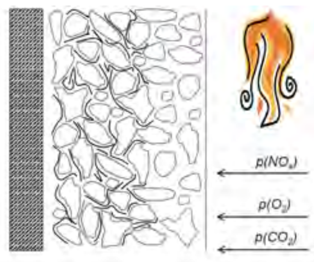
Compressive creep testing



Bottom/wall transition area in a BOF converter



Gas purged steel ladle



Carbon burnout in MgO-C refractories

Connection to AREA 4
Development of CFD-models

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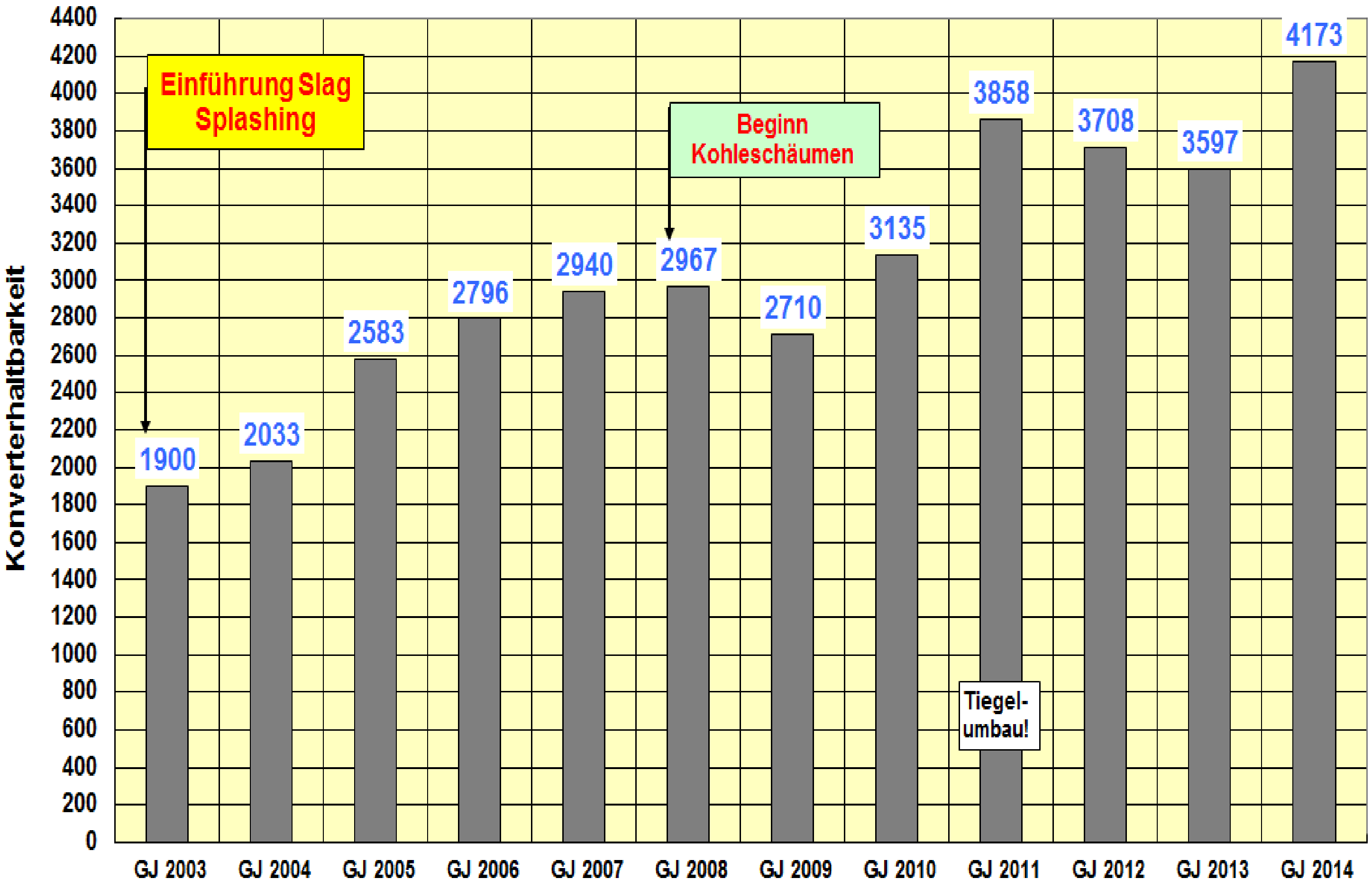
Development of refractory lifetime BOF process



The advanced continuous improvement of the BOF process with new refractory grades, optimized process technology, advanced process models, basic knowledge of metal/slag reactions and flow simulation shows the leading position of voestalpine in BOF technology.

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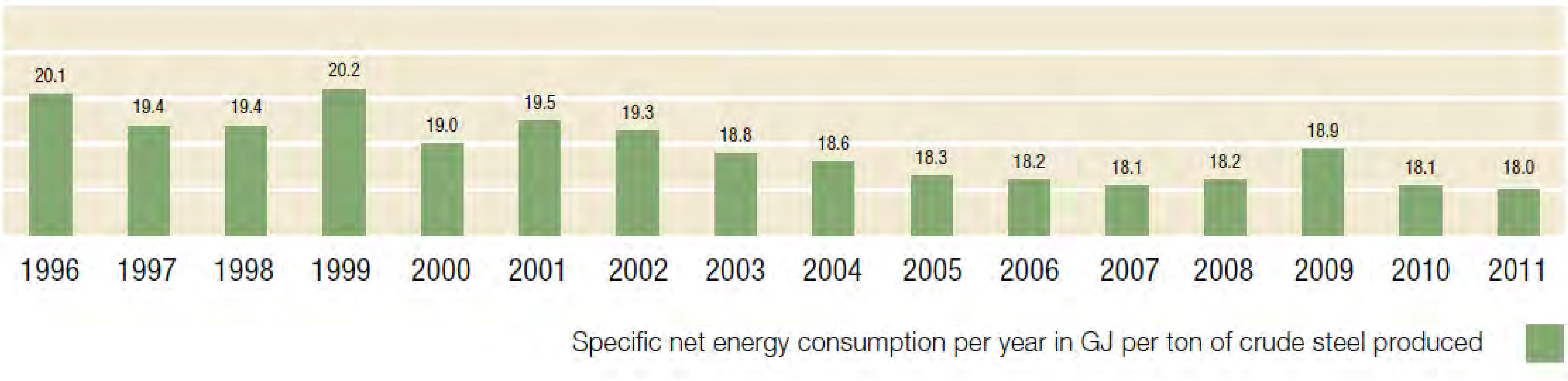
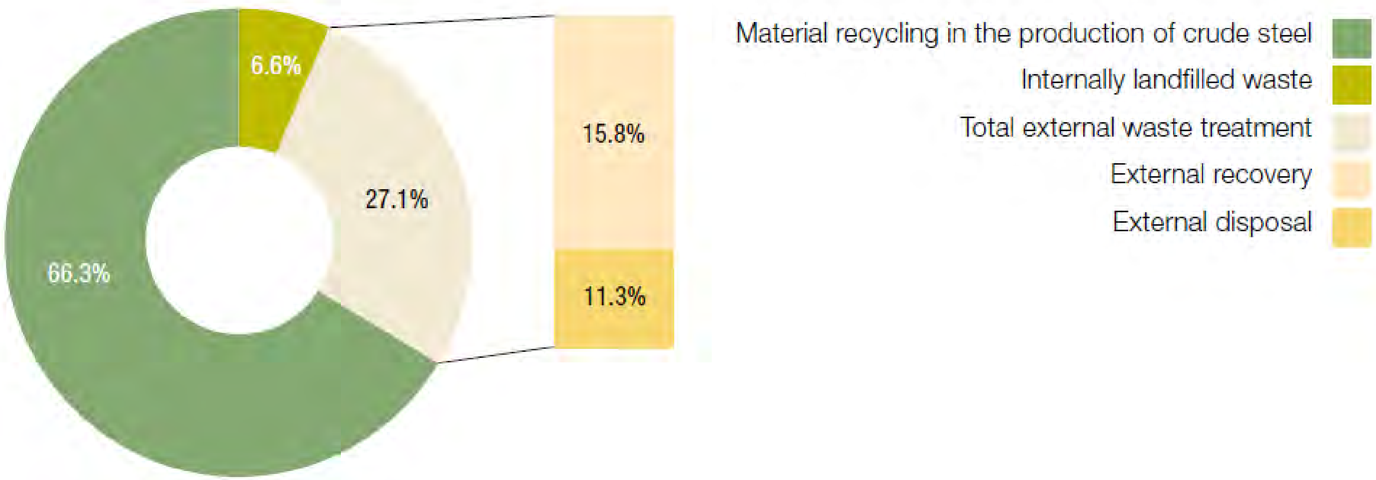
Centre specific target values for energy consumption and recycling

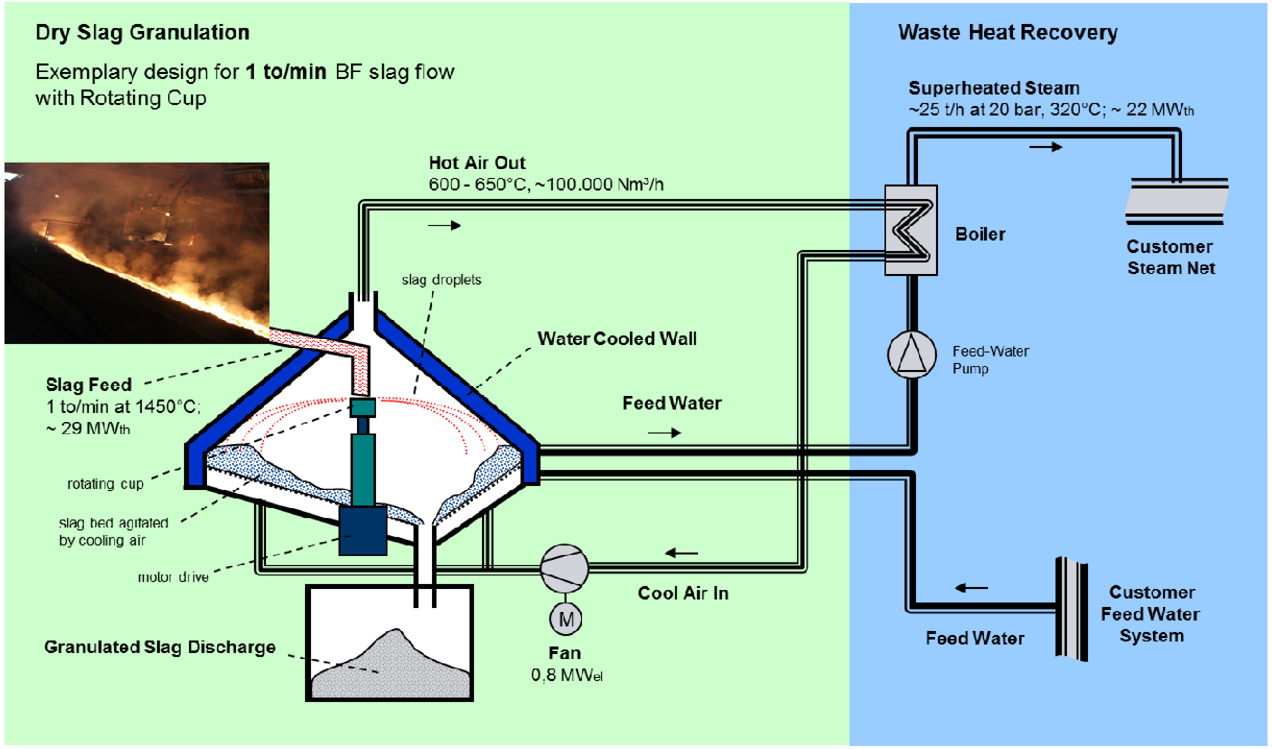




Energy recovery from dry slag granulation


Research plant SVAI/MUL-TPT


Granulation of BF slag



Glass content > 95 % comparable with wet granulated BF slag

EU Directive: yearly increase of energy efficiency by 1,5 % (0,37 % for ETS sector) from 2014 – 2020

Energy potential BF slag = min. 1% primary energy consumption steel

Zn recovery from iron- and steelmaking by-products

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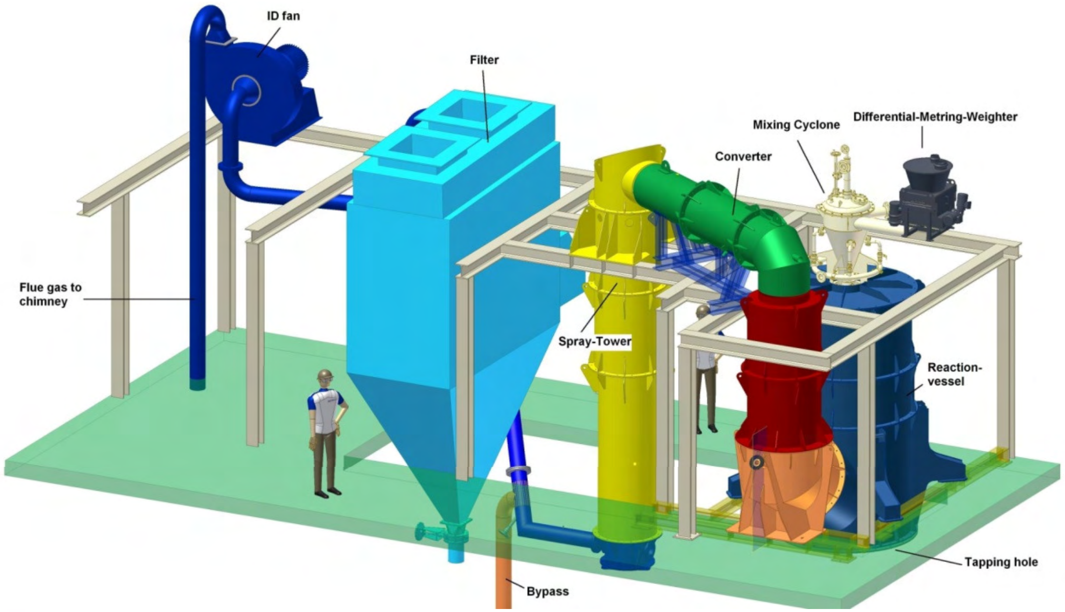
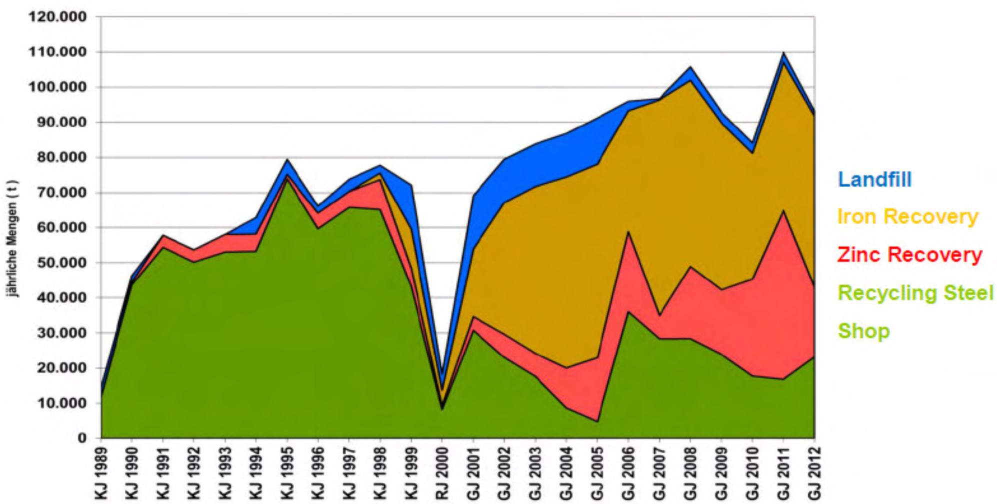
The Flash reactor pilot plant at Leoben university allows the treatment of Zn and Fe containing dusts and sludges in a reducing atmosphere up to 300 kg/h. The products are a ZnO concentrate for the Zn industry and a Fe rich slag for the ironmaking process.



Different dust grades BOF process (Linz):

- Secondary dusts, 7.000 t/a, 0,5 – 20 % Zn
- Coarse dust, 35.000 t/a, 5 % Zn
- Fine dust, 65.000 t/a, 13 % Zn



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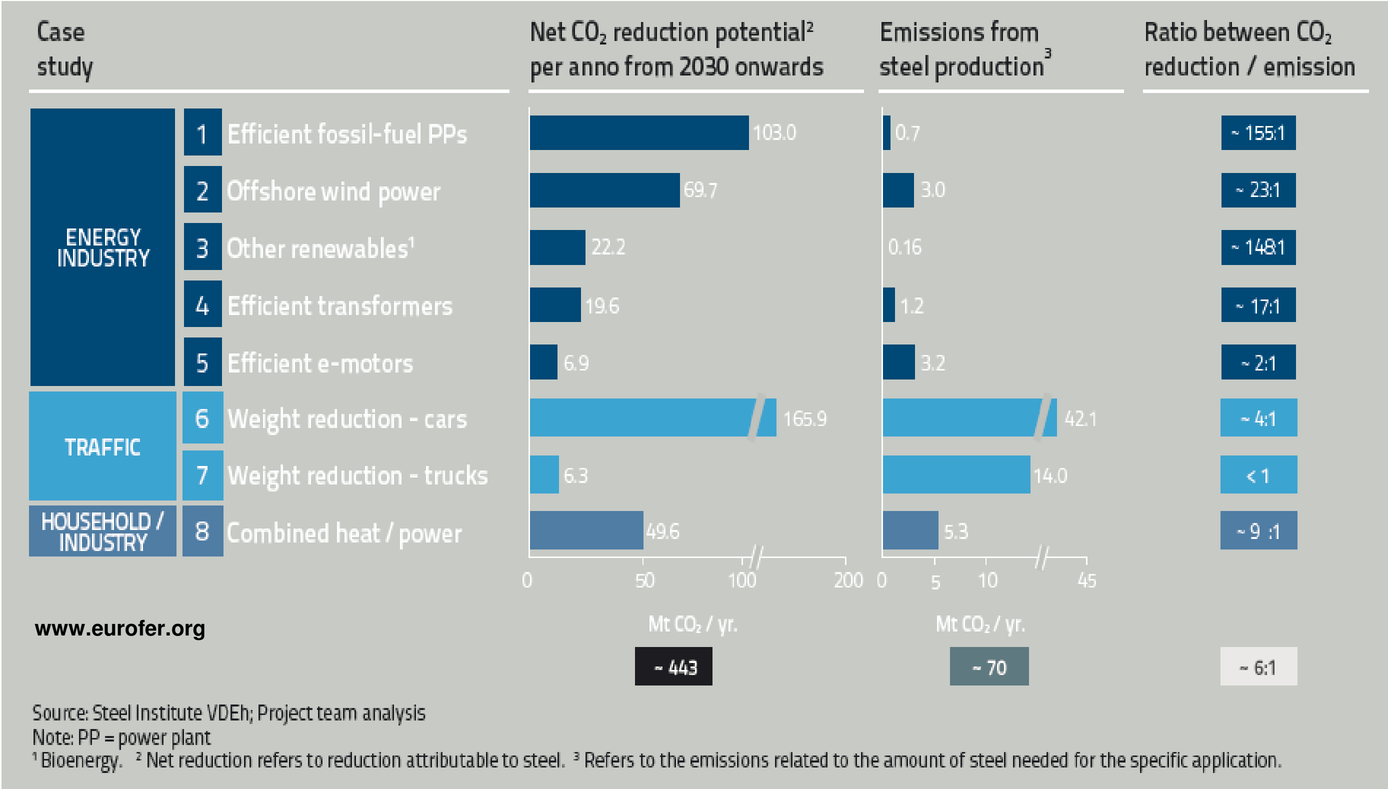
Effect of high tech steel grades on resources



Power plants with higher efficiency or cars with lower weight are the results of better material performance of steel.

Application oriented research and development is the key for the permanent improvement of our products.

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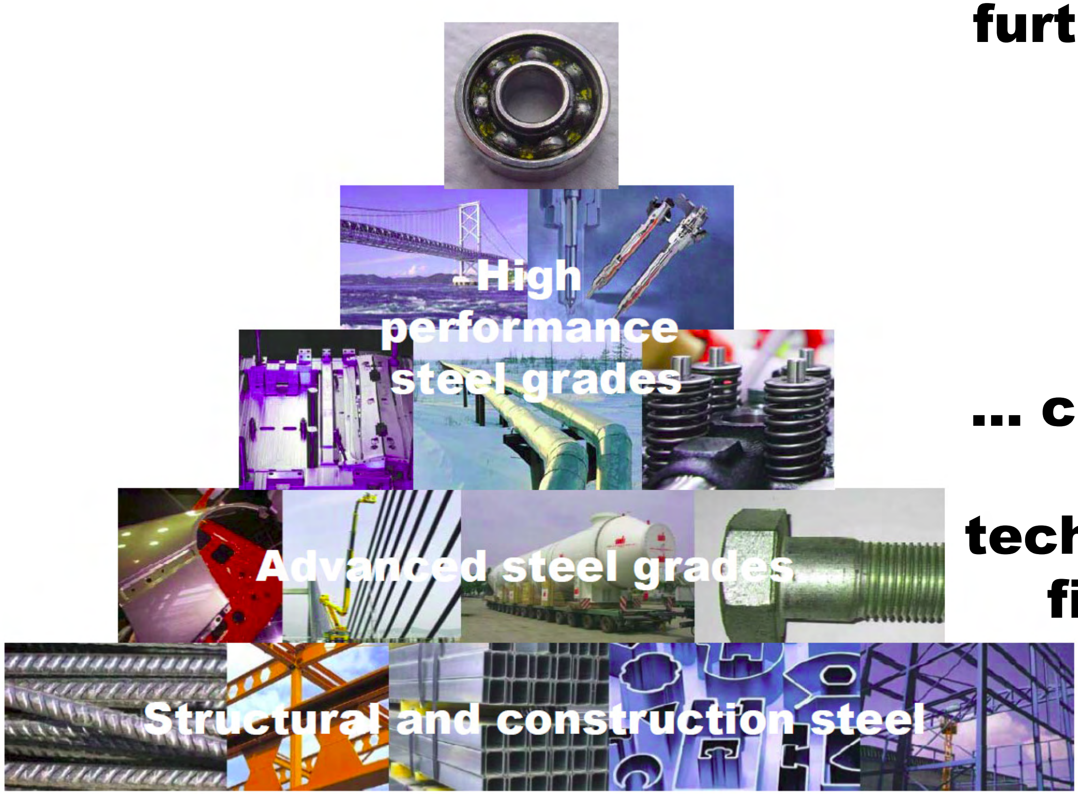
Quality pyramid: Increasing quality demands for high-performance steel grades



... claims the contribution to the further development of processes for the production of high-performance steel grades.

... contributes to the development of new manufactoring technologies to further extend the fields of application for high-performance steel grades.

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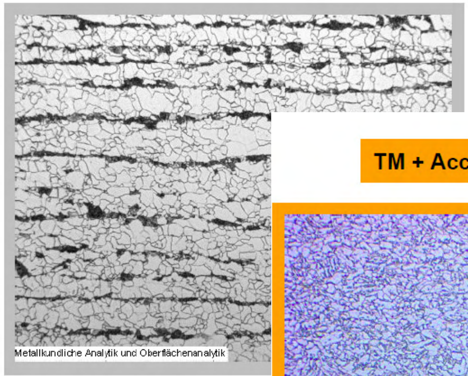
Quality demands on steel: Example Linepipe steels

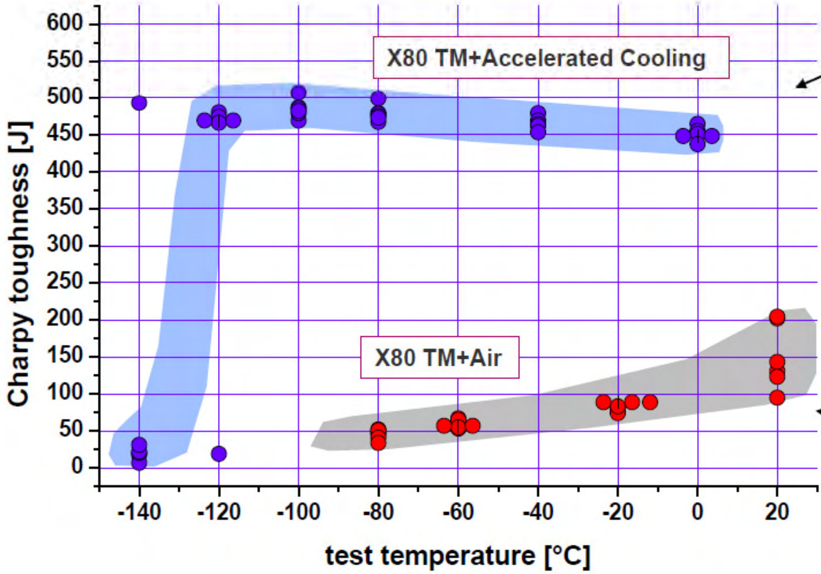
	Selected quality attributes							
	Steel cleanness			Internal soundness			Surface quality	
	Macro-inclusions	Micro-inclusions	Surface oxides	Macro-segregation	Meso-segregation	Homogeneity of micro-structure	Surface defects	Scale, Decarburizing
Quality demands								
High-performance steel grades	▲▲▲	▲▲	▲▲▲	▲▲▲	▲▲(▲)	▲▲▲	▲▲	▲▲▲

TM + Air Cooling

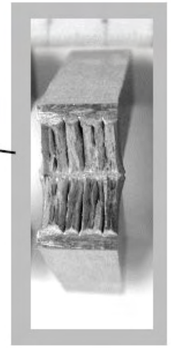


TM + Accelerated Cooling

Le Pera$_3$-etchant



X80, full size specimens, transverse (in accordance with ASTM)



Grill, R.: Modern Linepipe Steels for Future Demands, InnoTech Partner-Event

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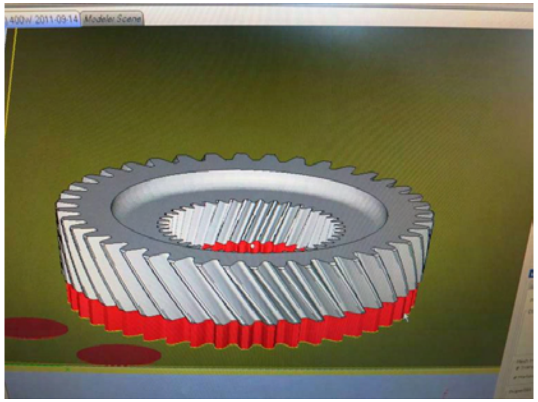
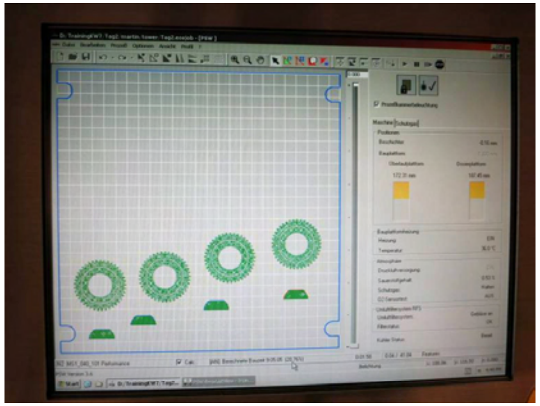
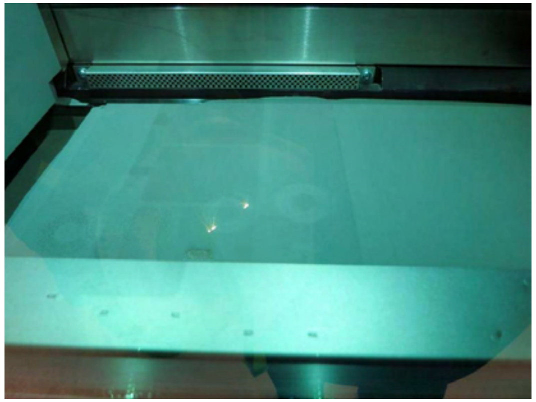
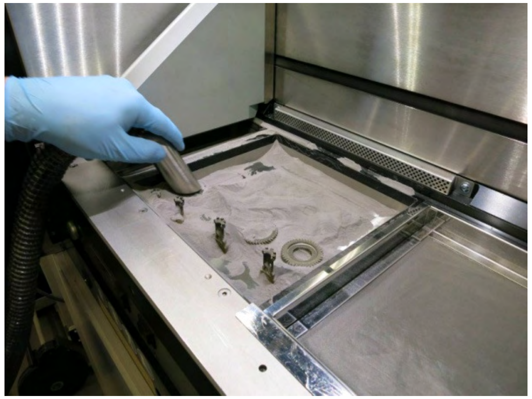
SLS/SLM for tool manufacturing and new metallurgical solutions

Selective Laser Sintering (SLS) und Selective Laser Melting (SLM)









Halterung Airbus 380 (Quelle: EOS/EADS)
Ausscheidungsgeh. rostfreier Stahl 17-4PH

BÖHLER EDELSTAHL

voestalpine STAHL GMBH

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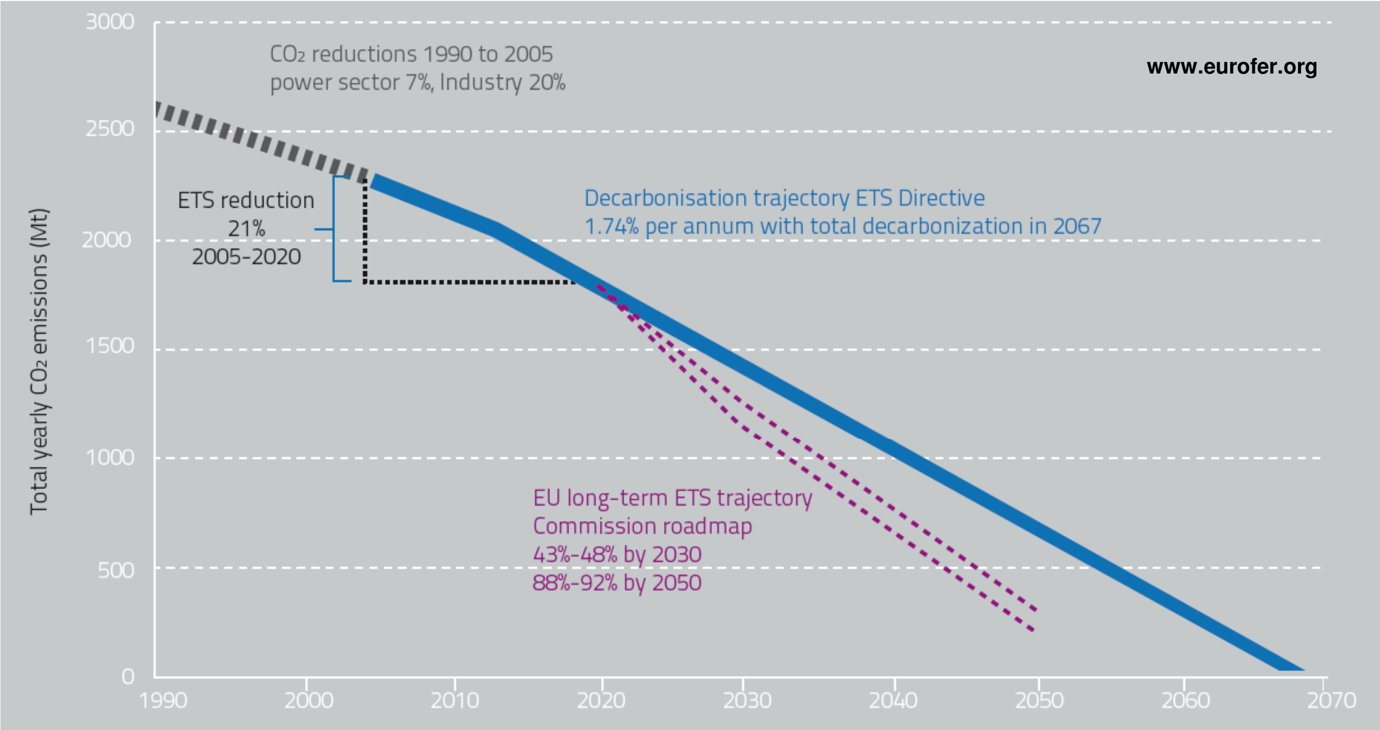
EU Rodmap for a low carbon economy

metallurgical competence center



In 2008 the EU revised its ETS Directive and adopted a mandatory linear CO2 mitigation pathway of 1.74% emission reduction per annum, resulting in a 21% reduction by 2020 compared to 2005 levels.

In 2011 the Commission published its 2050 Low Carbon Roadmap and suggested a further reduction of emissions under the EU ETS: 43-48% by 2030 and 88-92% by 2050 compared to 2005 levels.

The transition towards a competitive low carbon Europe requires the spread of the transfer of the energy system, new technologies and large investments in new infrastructure. Because of steel's contribution both to carbon-lean energy solutions and to the EU's economic wealth, a competitive low carbon Europe relies heavily on an economically healthy, modern, innovative and globally competitive European steel industry

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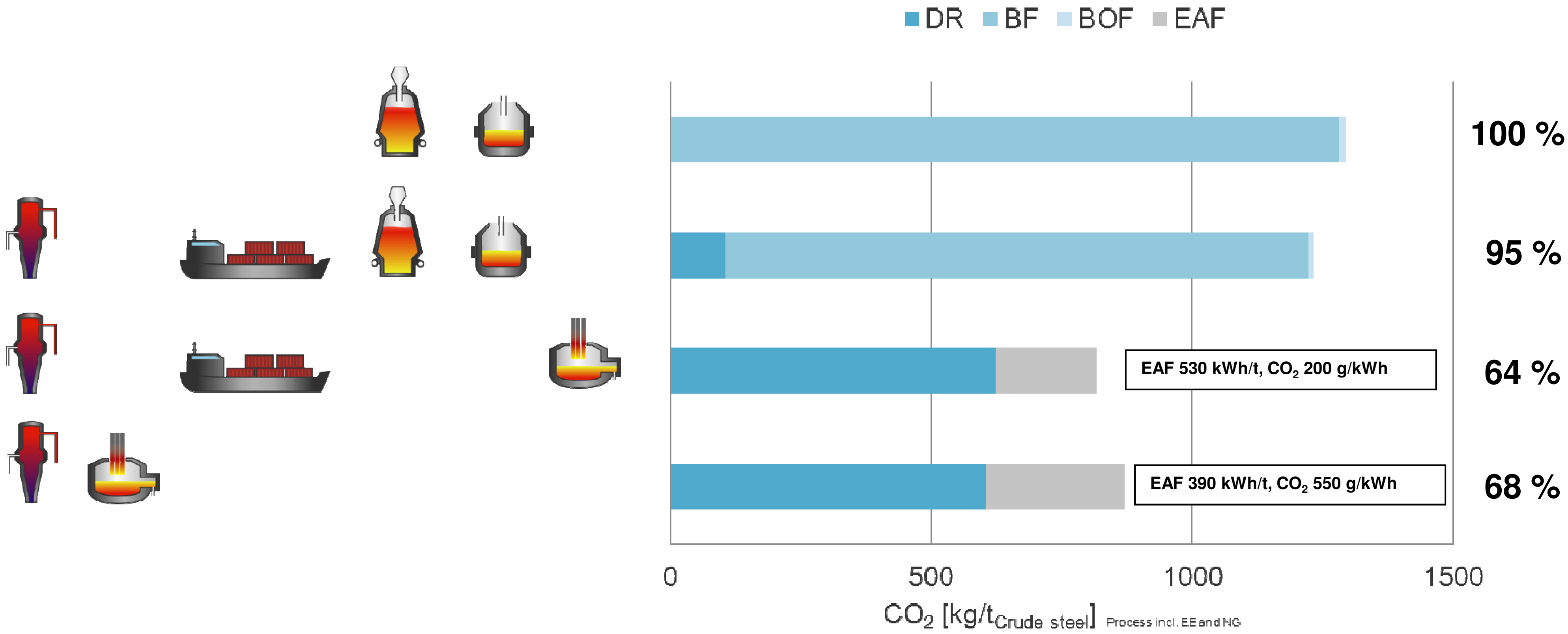
CO_2 emissions of different technology routes for iron and steelmaking



The generation of electric energy has the main influence on the CO_2 generation beside the basic differences of the two steelmaking technology routes.

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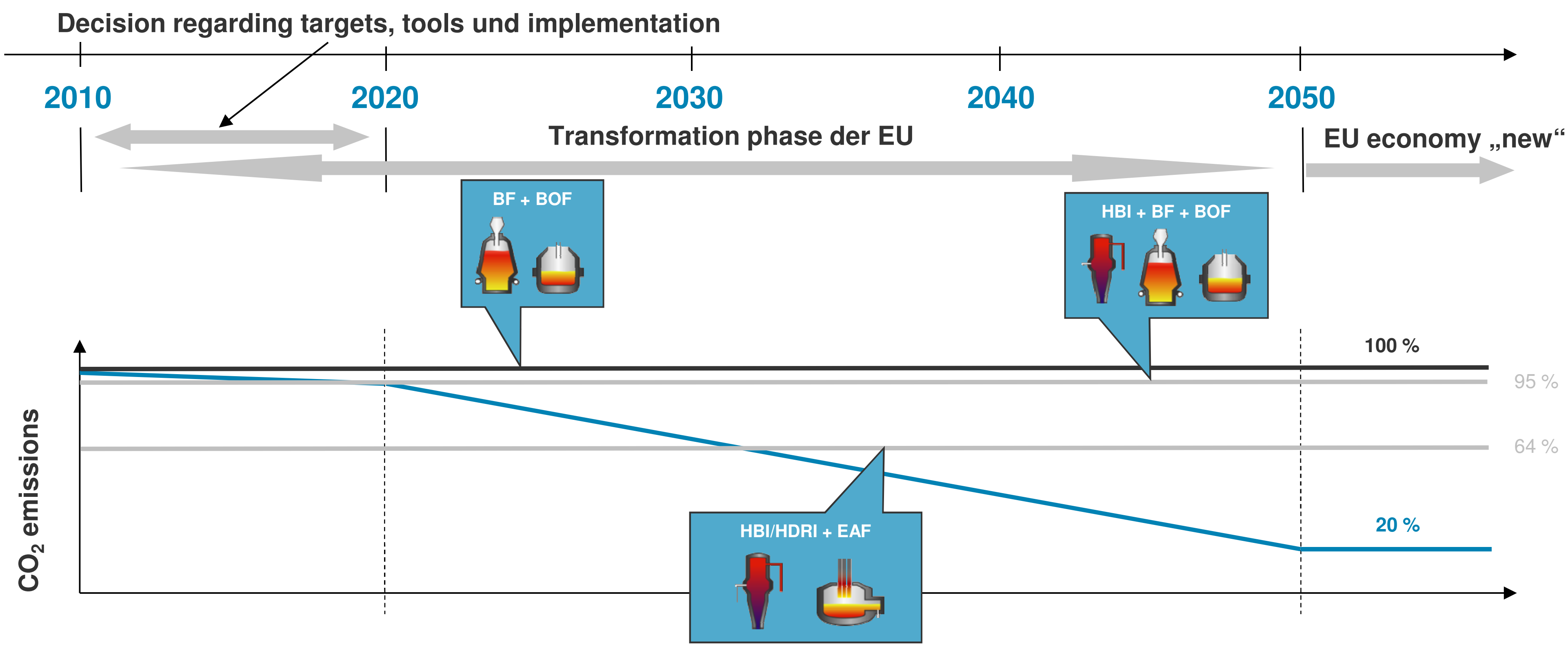
Technology routes in the EU roadmap for a low carbon economy

metallurgical competence center



The 2050 goal cannot reached without a transfer from a carbon based energy production to a renewables based energy production.

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