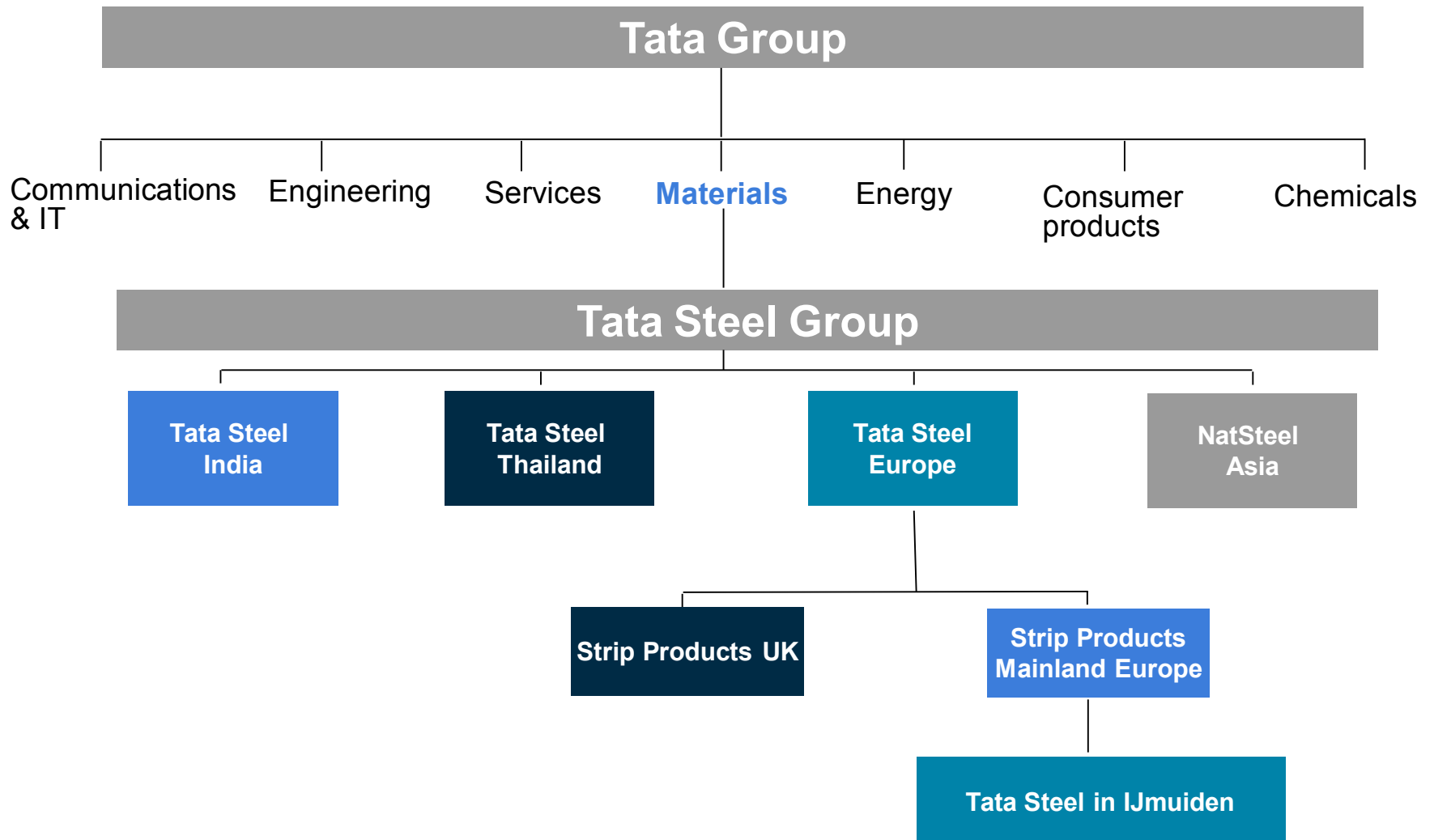


Sustainable development in Steel Industry

Gerard Jägers,
Programme Manager Energy Efficiency,

Hans Kiesewetter
Group Environment

From Tata Group to Tata Steel in IJmuiden



The values of the Tata Group

- **Integrity**
 - Fair, honest and transparent
- **Responsibility**
 - Personal leadership in health- and safety
 - Devotion and ownership
- **Understanding**
 - Care, respect and sincerely concern
- **Excellence**
 - Highest norms, first time right
 - Share, learn and improve continuously
- **Unity**
 - Cooperation in the interest of the customer



“, the community is not just another stakeholder in business but is in fact the very purpose of its existence”

“ Improve the quality of life of the communities we serve through leadership in sectors of national economic significance”

Jamsetji Tata, founder Tata Group

The worldwide businesses of Tata Steel make the effect of our operations substantial



We're serving the most demanding markets worldwide in the most sustainable way

Consumer products



Automotive



Construction



Lifting & excavating



Energy & Power



Packaging

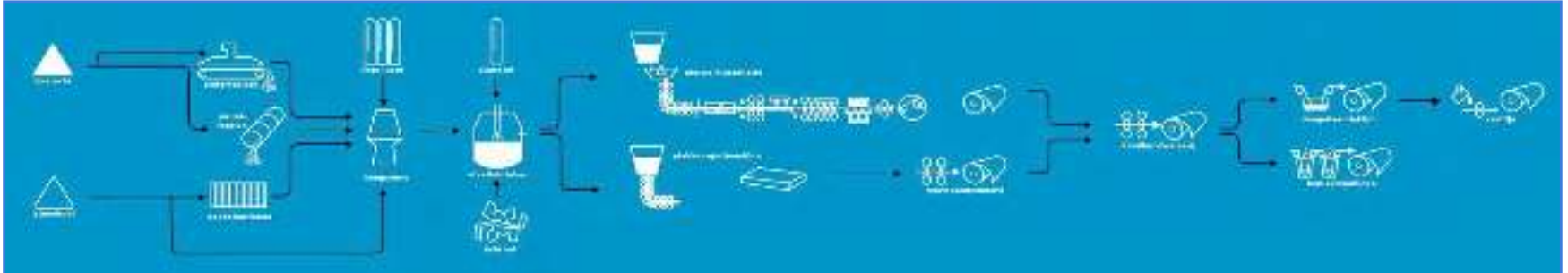


... the heart in IJmuiden ... part of the high tech manufacturing industry...

- High tech integrated steel company
 - 9.000 fte's, incl. 350 researchers (total R&D TSE 600 fte),
 - 7,2 million ton steel in 2014 and ambition for 8 million ton steel
 - Excellent geographic position
 - Long history of industrial symbiosis
(blast furnace slag, blast furnace gas delivery)
- Much attention for the environment
 - From 2004 to 2012 € 800 million invested.
 - Next 5 years € 1 billion.



High quality and high energy intensive processes give opportunities to reduce the overall energy consumption



Raw materials - Pig iron - Steelmaking - Casting - Rolling - Coating



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Energy use



Global GHG emissions

WORLD GHG EMISSIONS FLOW CHART
2010

Total emissions worldwide (2010)
48 629
MtCO₂ EQ



Sector

Industry 29%

Non-metallic minerals 6.0%

Iron and steel 4.8%

Chemical and petrochemical 4.3%

Non-ferrous metals 1.4%

Food and tobacco 1.1%

Paper, pulp and printing 1.0%

Other industries 10.5%

Source*

Coal
25%

Natural Gas
19%

Oil
21%

Waste
0.4%

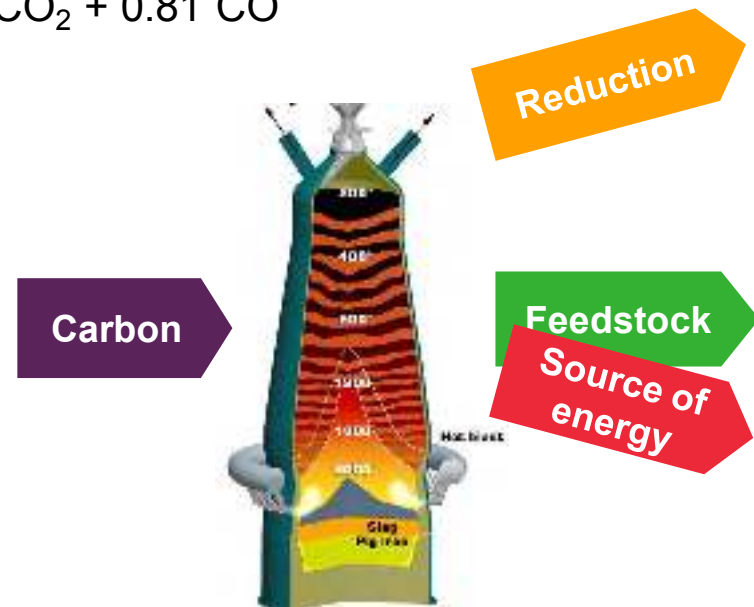
Direct
emissions
34.6%

Source: worldwaste (2010)
48 629
MtCO₂ eq

Greenhouse gas

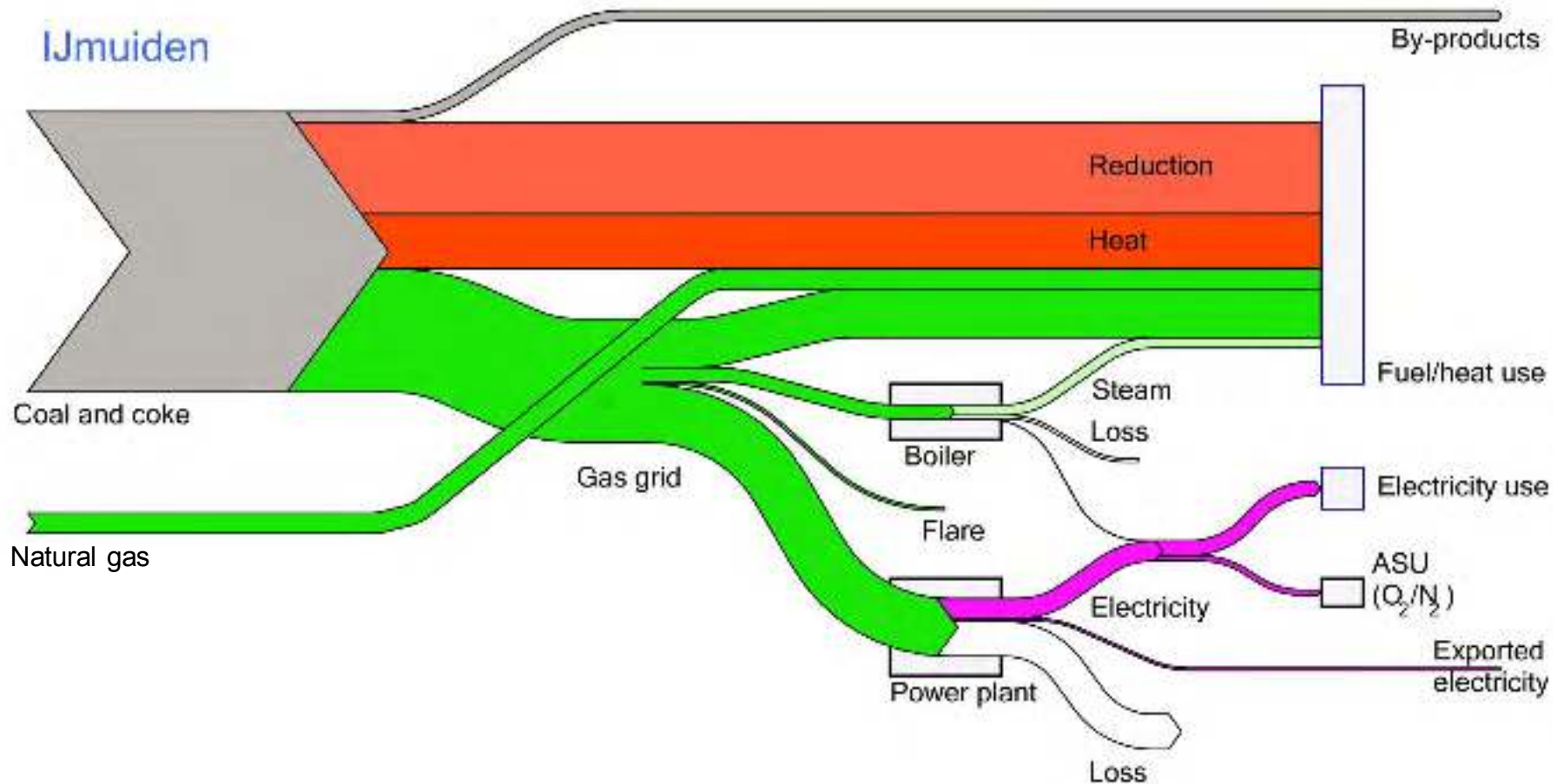
Carbon is used both for reduction of iron ore and for the required energy

- “Ideal” reaction:
 - $2 \text{Fe}_2\text{O}_3 + 3\text{C} + \text{energy} \Rightarrow 4\text{Fe} + 3\text{CO}_2$
- Blast furnace process:
 - $0.50 \text{Fe}_2\text{O}_3 + 1.63 \text{C} + 0.47 \text{O}_2 \Rightarrow 1 \text{Fe} + 0.81 \text{CO}_2 + 0.81 \text{CO}$
- Process quality largely determines CO_2 emission
- CO_2 as a result of the reduction cannot be limited



IJmuiden spends around 135 PJ on energy and produces nearly 12 million tons of CO₂

Consumption of reduction agent plus energy in IJmuiden represents approximately 4 % of Dutch consumption



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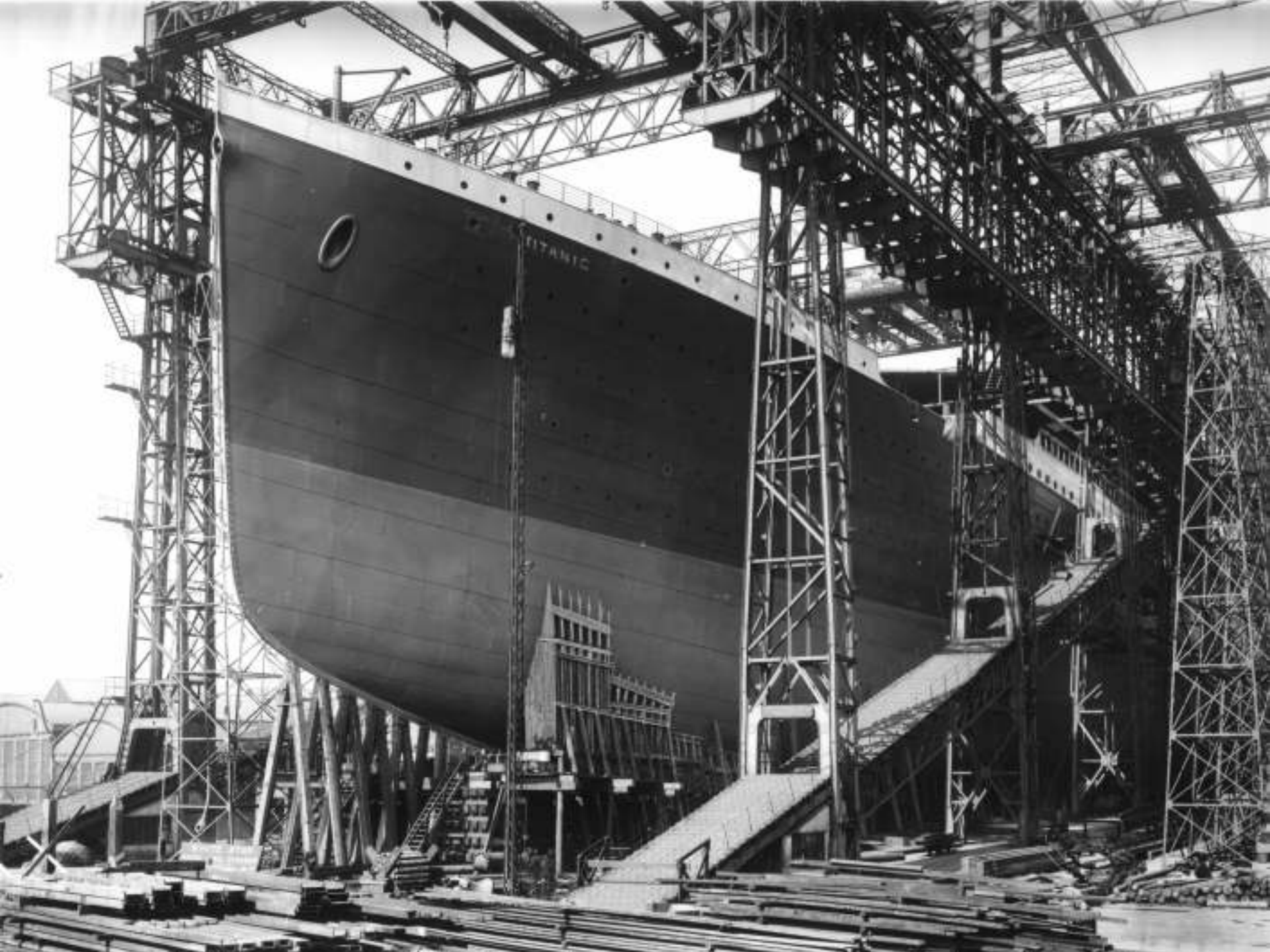


Material efficiency

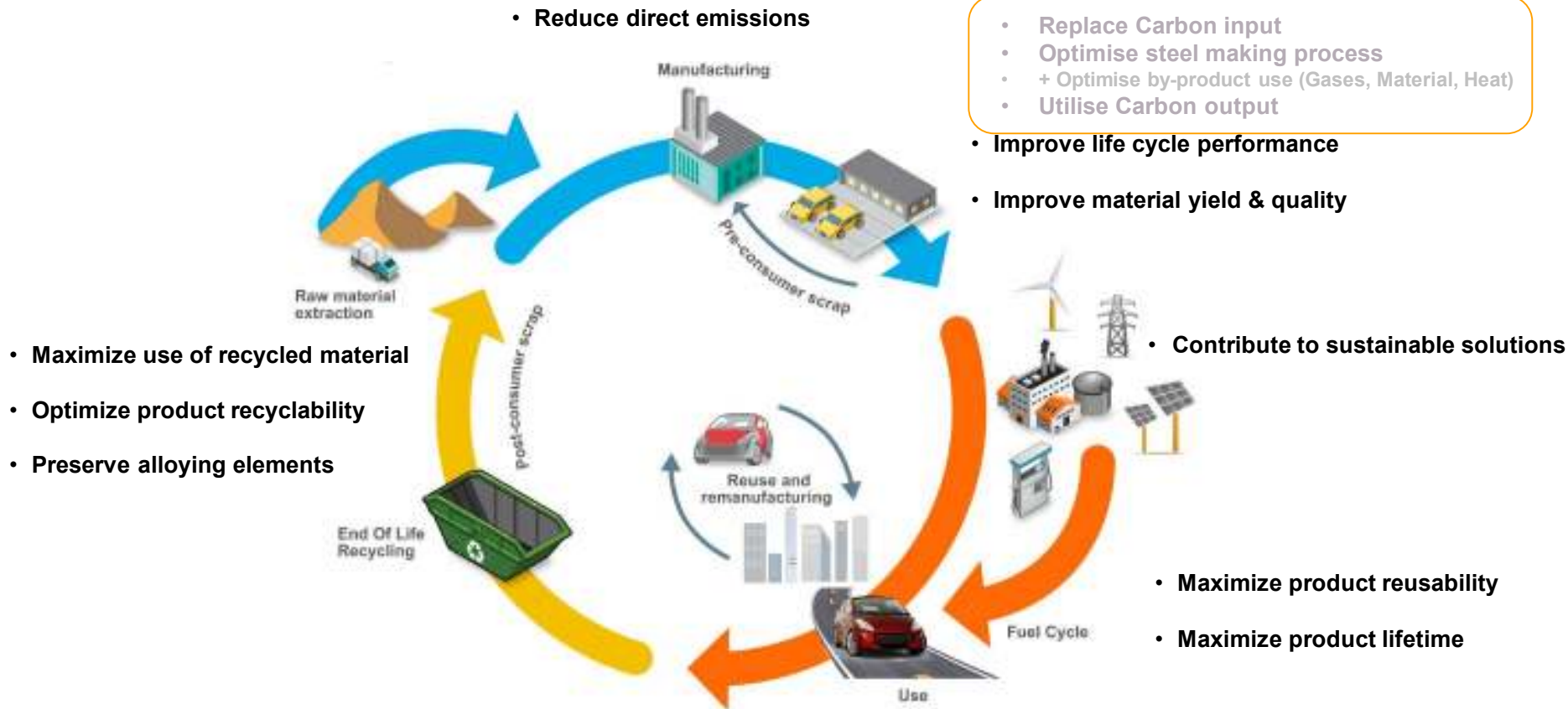








So how does the steel industry contribute to beat climate change?



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Future



ULCOS as solution?

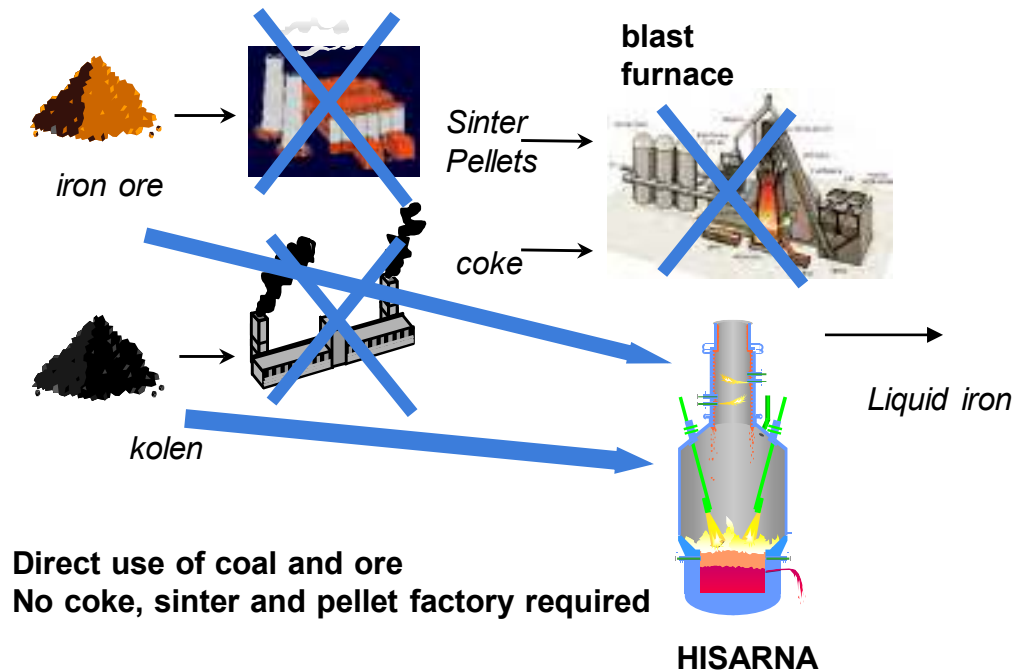


- For the European steel industry: ULCOS is the answer to climate change
- For the year 2050:
 - Steel production will be double
 - But emissions (per tonne) will be reduced by 50%



ULCOS in IJmuiden: HISARNA – Process innovation

- A **new process** that allows the direct use of **powdered raw material**. No more coke oven or ore processing required
- **Iron ore** is melted in the cyclone reactor
- **Fine coal** is injected directly into the smelter
- By using pure oxygen, we get gases **without nitrogen**
- This makes the combination with **CO₂ recovery & storage (CCS)** easier to realise



HISARNA technology will produce 20% less CO₂ emission in the future, with CCS 80%

Energy Efficiency Project



The Trias Energetica shows the way towards energy efficiency improvement in the steel industry



1

Reduce unnecessary energy consumption, by good heat insulation, innovative design, hot connect, start-stop management;



2

For the remaining energy requirement use sustainable energy, such as wind, solar, biomass or geothermal energy;

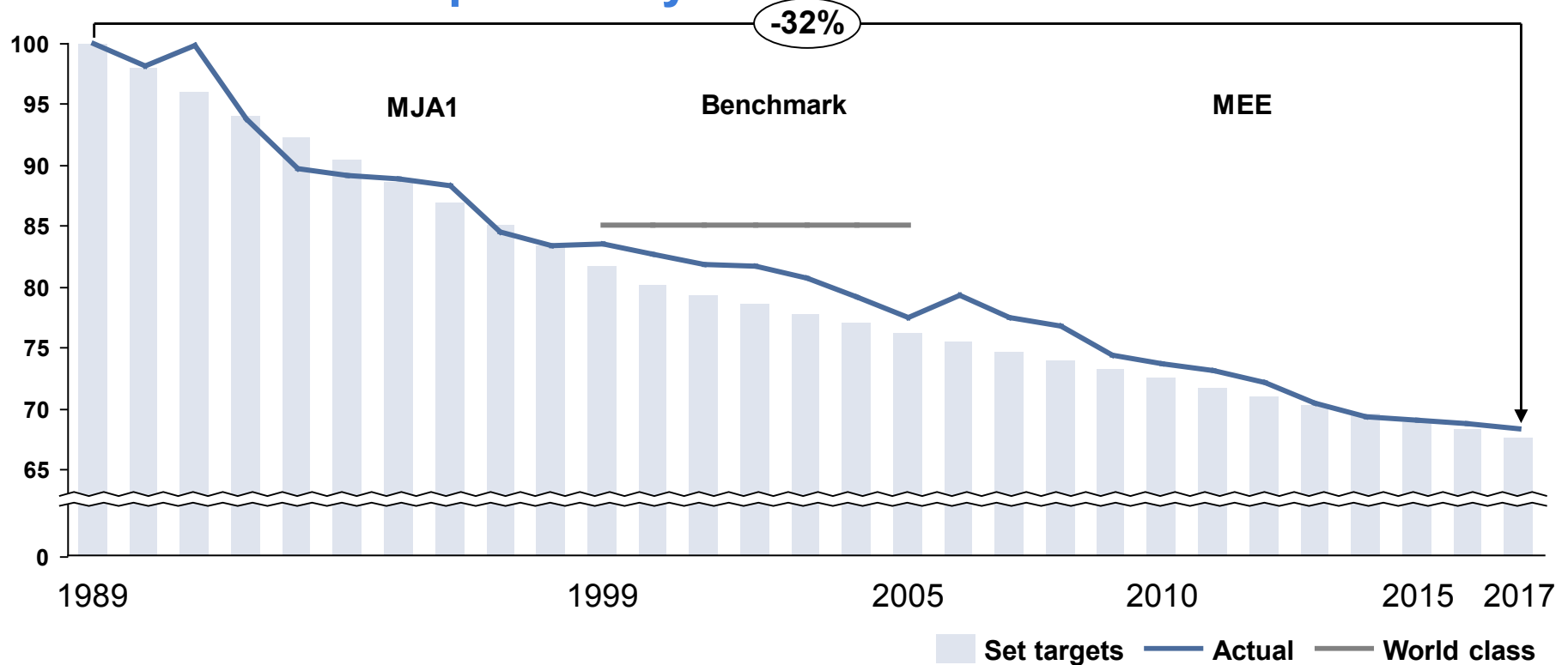


3

When renewable energy is not sufficient, make use of efficient fossil sources, for example, low-CO₂ power of an incinerator.



Over the last 28 years the energy efficiency at Tata Steel in IJmuiden has improved by 32%



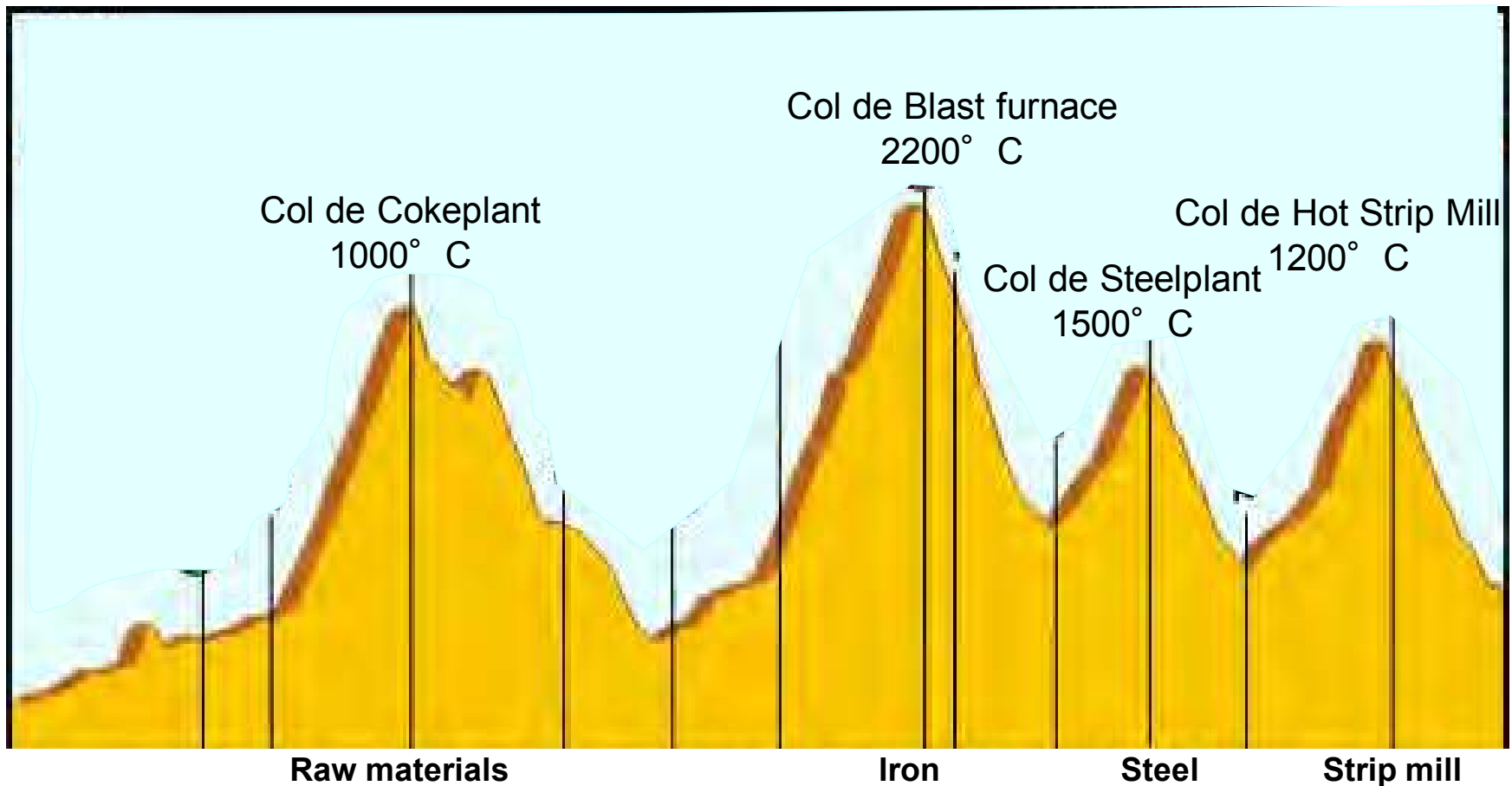
- In 2017 an energy reduction of 0.4 % has been achieved, equal to 2016.
- Incremental energy efficiency savings become increasingly difficult, step changes are needed for substantial energy efficiency improvements.

Internship or thesis priorities

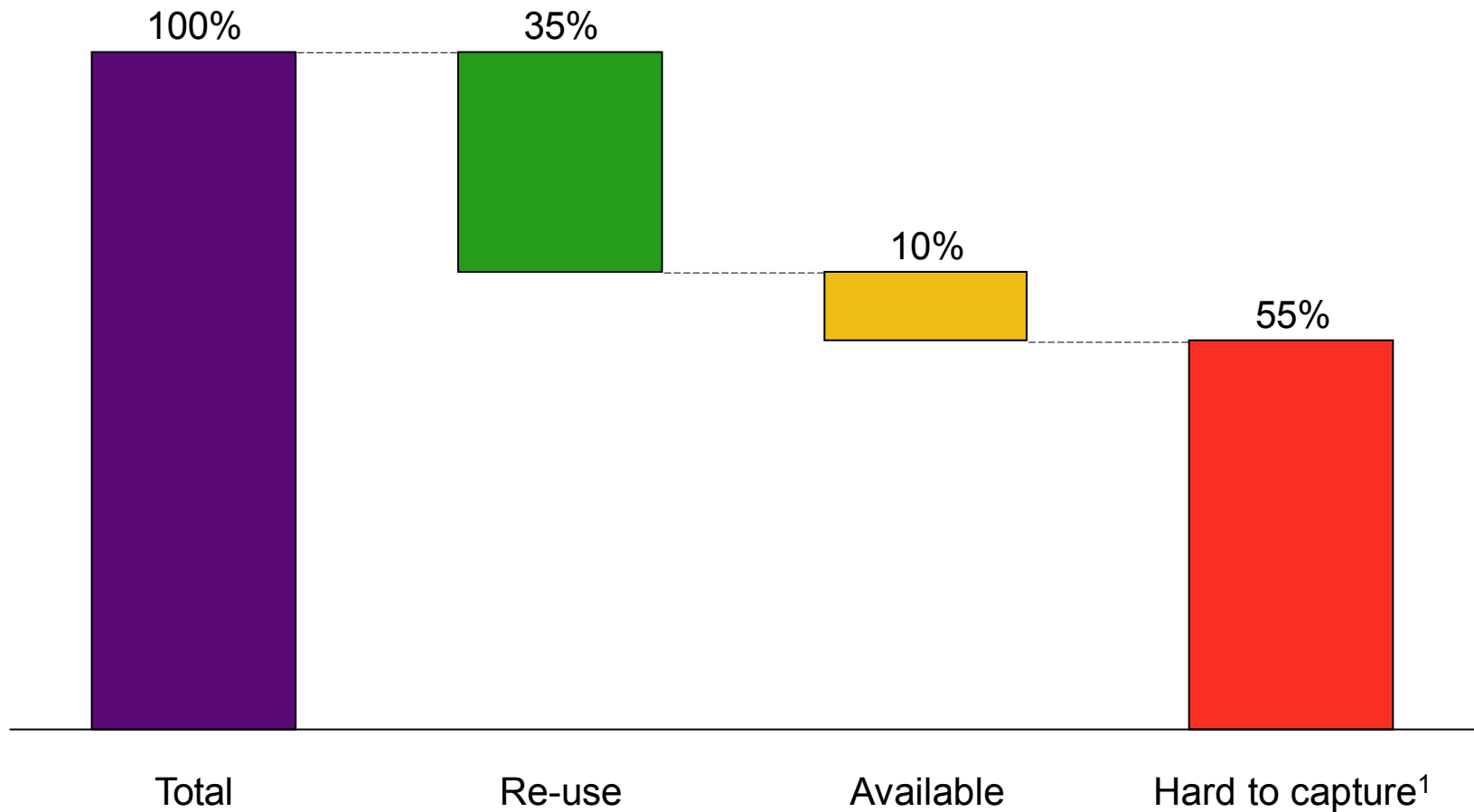
- DoH 1 projecten
- Smart metering, how to make use for the energy benefit
- CCU (ammonia, formic acid, kerosene, ...)
- Advanced analytics on energy subjects
- DC to succeed AC
- Electrification
- Flexibility in electricity supply and demand. Demand forecast and energy performance analysis- real time including process data
- Identify opportunities for sensor implementation
- Industrial internet of things – automated start-stop management
- Smart grids
- Cracking? of natural gas by means of high temperature waste heat from slag
- How to use waste heat for MEA recirculation
- How to supply heat to the CCU plant
- How will the legislation about heat develop?
- Start-stop CPR
- Develop a system to produce electricity from COG by means of SOFC (Solid Oxide Fuel Cells)

... Residual heat ...

The heatloop of steel is comparable with a heavy stage in the Tour de France with peaks and valleys



One third of the available residual heat is used for own purpose, which leads to mayor CO₂-reduction



Source: Residual heat projects CORUS (Kiesewetter & Hoebe)

¹ With current means of technology and sufficient economic value

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Together we make the difference