

HISARNA SMELTING REDUCTION A SOLUTION FOR SUSTAINABLE HOT METAL PRODUCTION

Jan van der Stel,

Koen Meijer, Christiaan Zeilstra, Johan van Boggelen,
Tim Peeters and Rod Dry (*)

Tata Steel Research & Development,
IJmuiden, The Netherlands

(*) RIO TINTO
Perth, Australia

Reducing the carbon footprint of the steel industry,

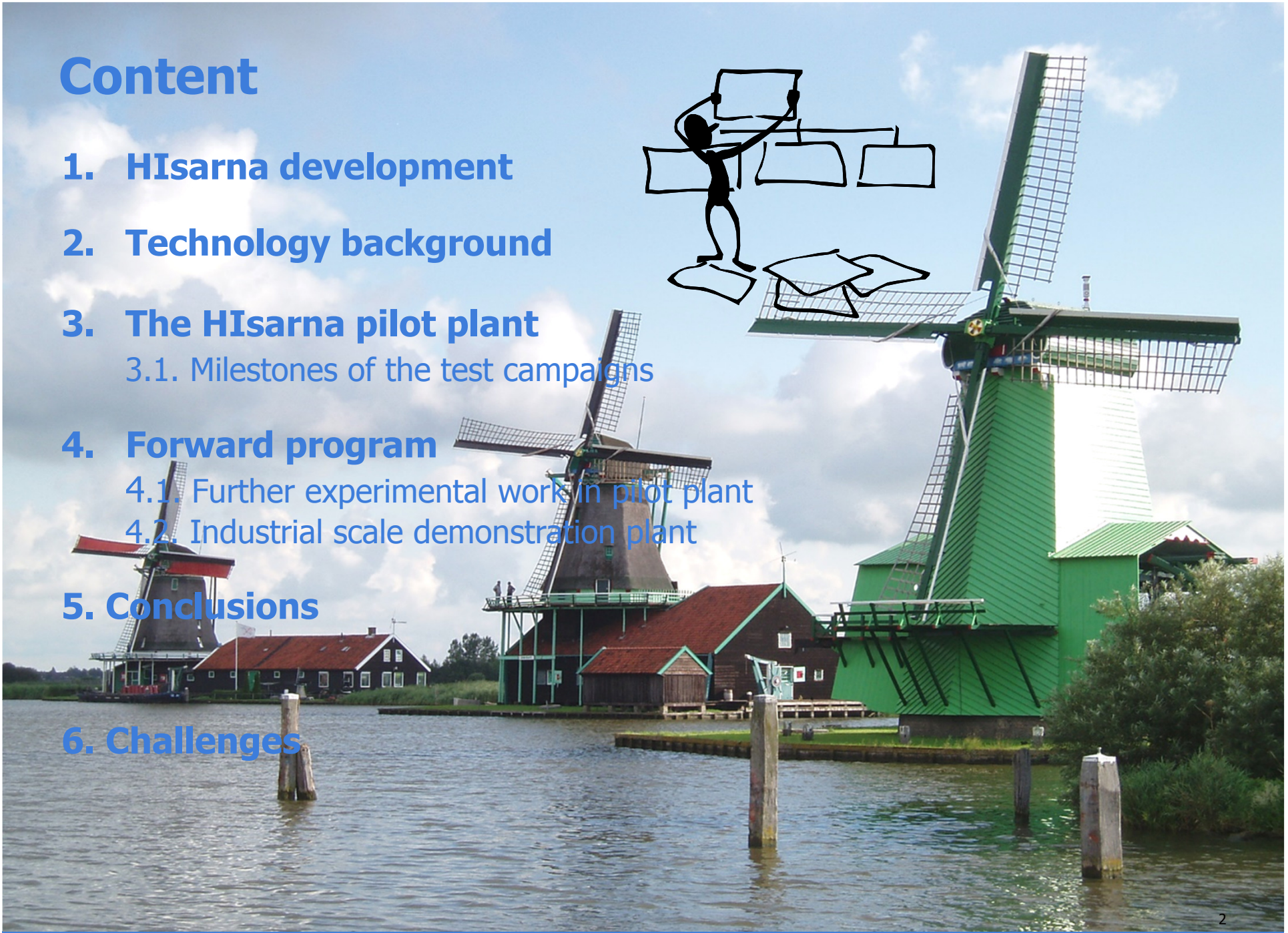
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Content

1. **HIsarna development**
2. **Technology background**
3. **The HIsarna pilot plant**
 - 3.1. Milestones of the test campaigns
4. **Forward program**
 - 4.1. Further experimental work in pilot plant
 - 4.2. Industrial scale demonstration plant
5. **Conclusions**
6. **Challenges**



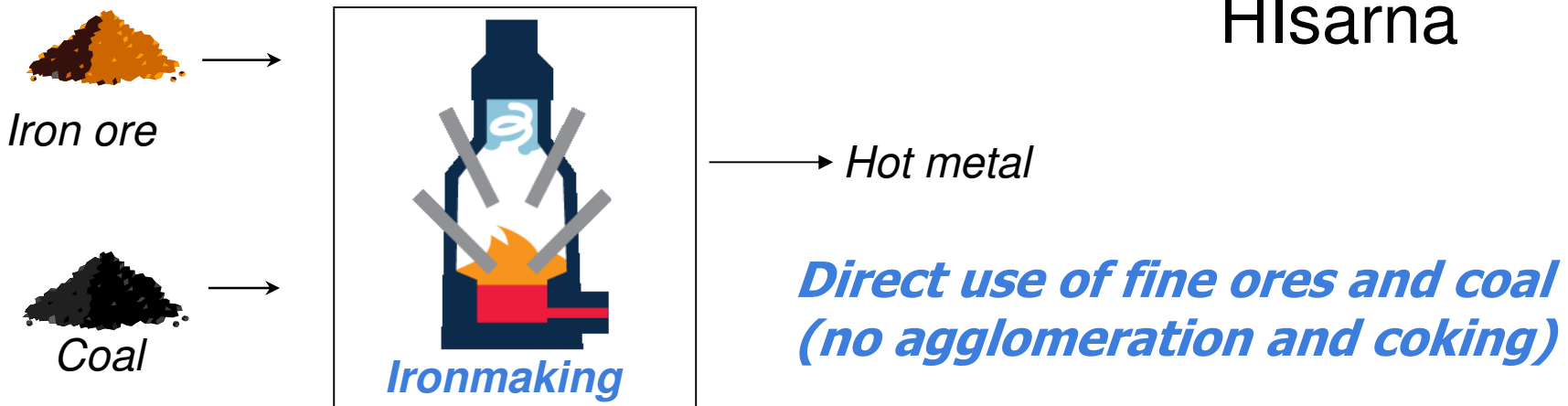
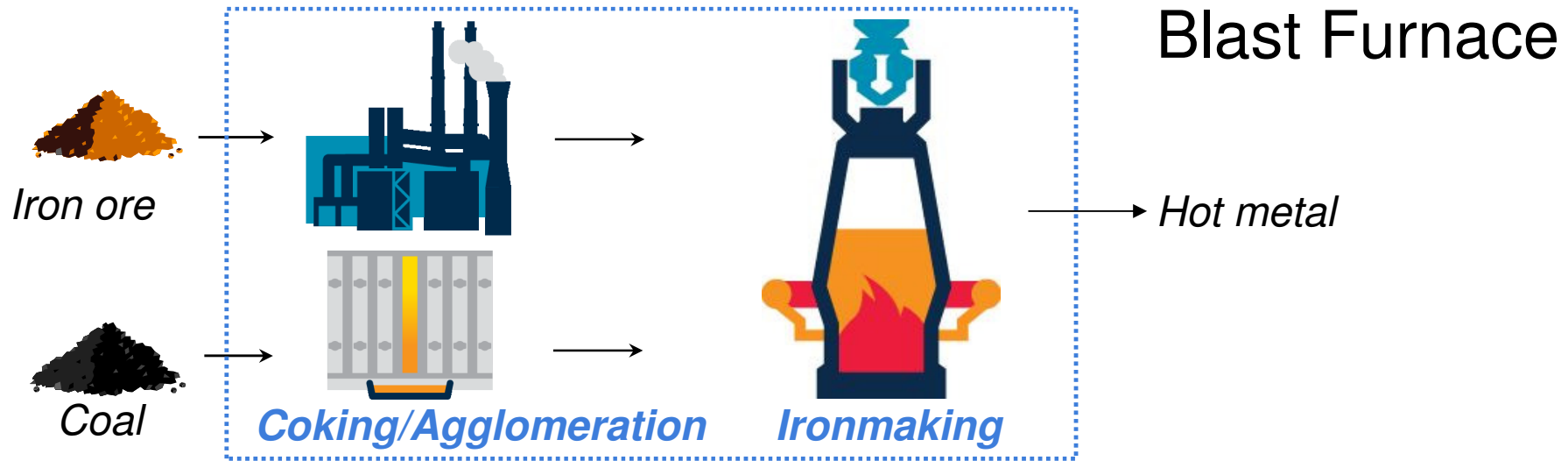
1. HIsarna development



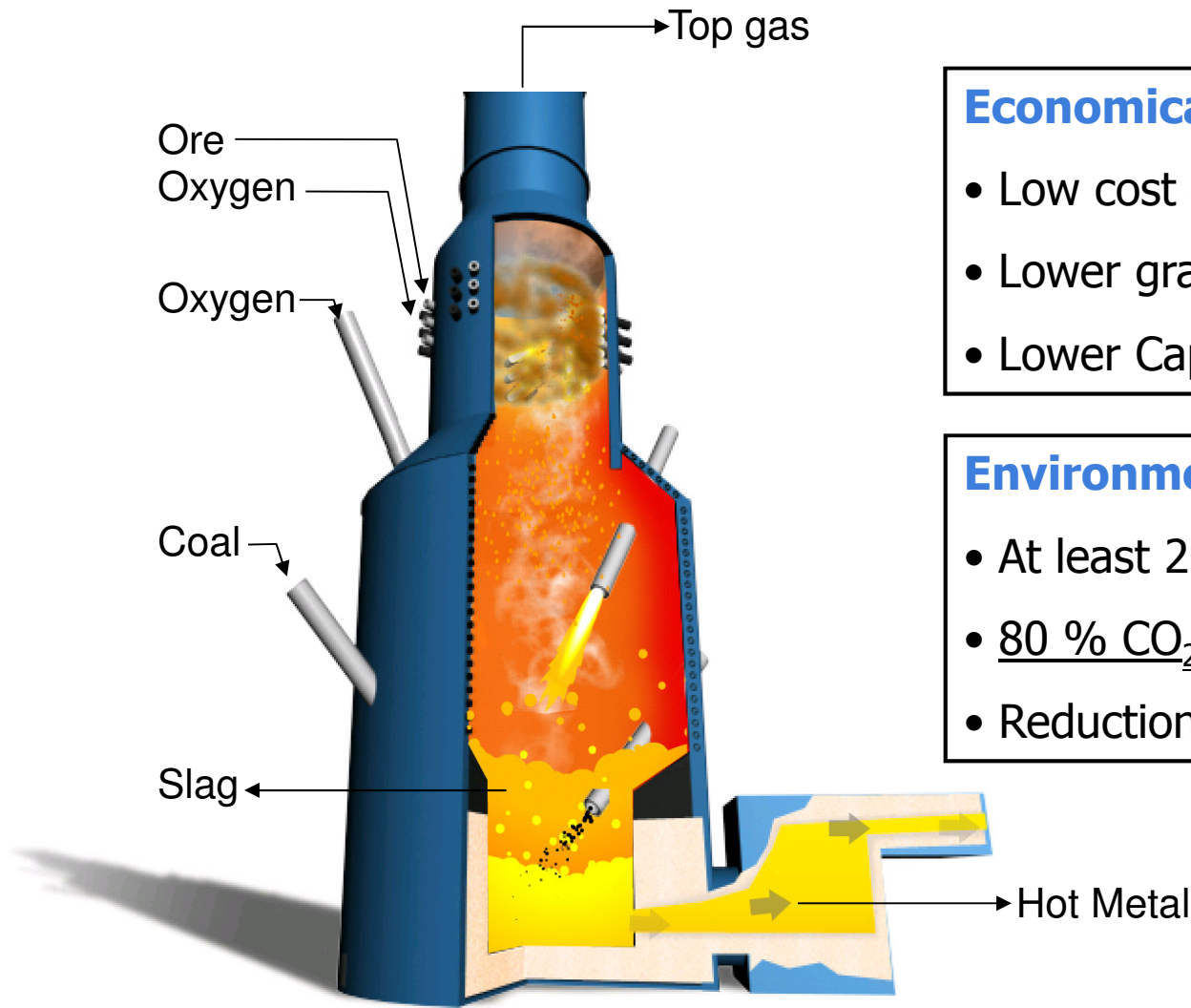
- In 2004 several European steelmakers proactively started the ULCOS project with the objective to achieve 50 % reduction of the CO₂ emissions of steelmaking
- HIsarna is one of the four process development that originate from the ULCOS project.
- Since 2007 Tata Steel, Rio Tinto and ULCOS have been active developing this coal-based smelting reduction process.
- To date over 80 mln Euro has been invested in this new technology.
- The HIsarna process offers a combination of **environmental** and **economical** benefits.



1.1 Comparison BF route - Hisarna



1.2. HIsarna benefits



- ### Economical benefits
- Low cost coals
 - Lower grade iron ores
 - Lower Capex

- ### Environmental benefits
- At least 20 % CO₂ reduction
 - 80 % CO₂ reduction with CCS
 - Reduction of dust, NO_x , SO_x

2. Technology background



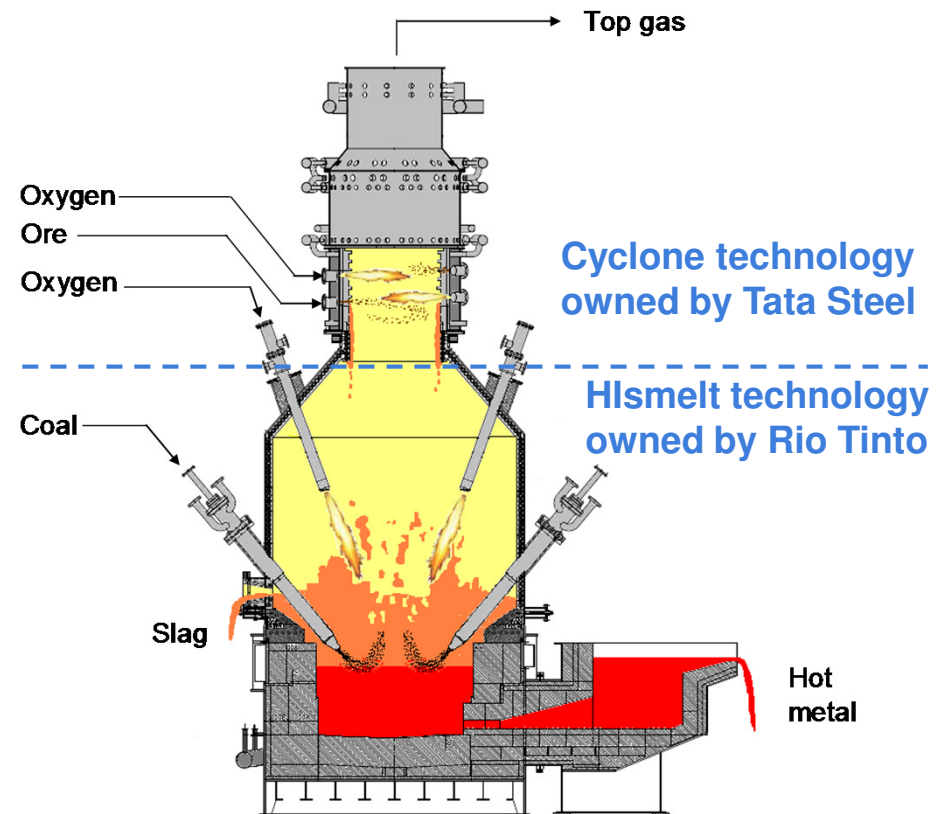
The HIsarna process produces liquid hot metal directly from fine ore and (non-metallurgical) coal

HIsarna consists of two process steps integrated in a single furnace

- Pre-reduction and smelting in a cyclone
- Final reduction and coal gasification in a Smelting Reduction Vessel (SRV)

The smelter technology is based on HIs melt.

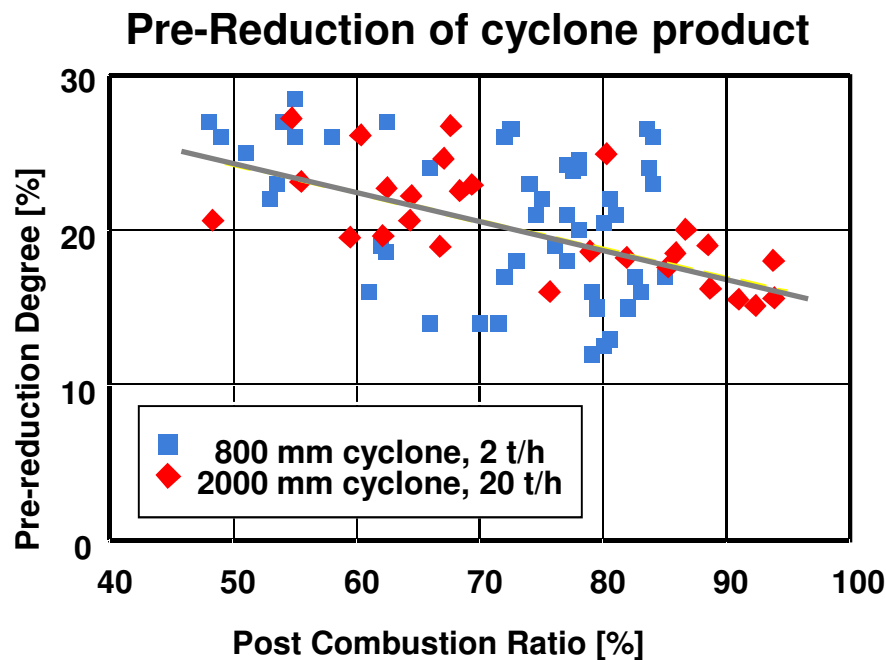
The cyclone technology was developed in IJmuiden in the 1990s.



History of smelt cyclone technology



The cyclone was developed in IJmuiden as part of the European “Coal-based Ironmaking” project. The project was technically successful but stopped in 1999 because there was no business case for proceeding to the Demo stage.



Experimental results CCF trials 1994 – 1999

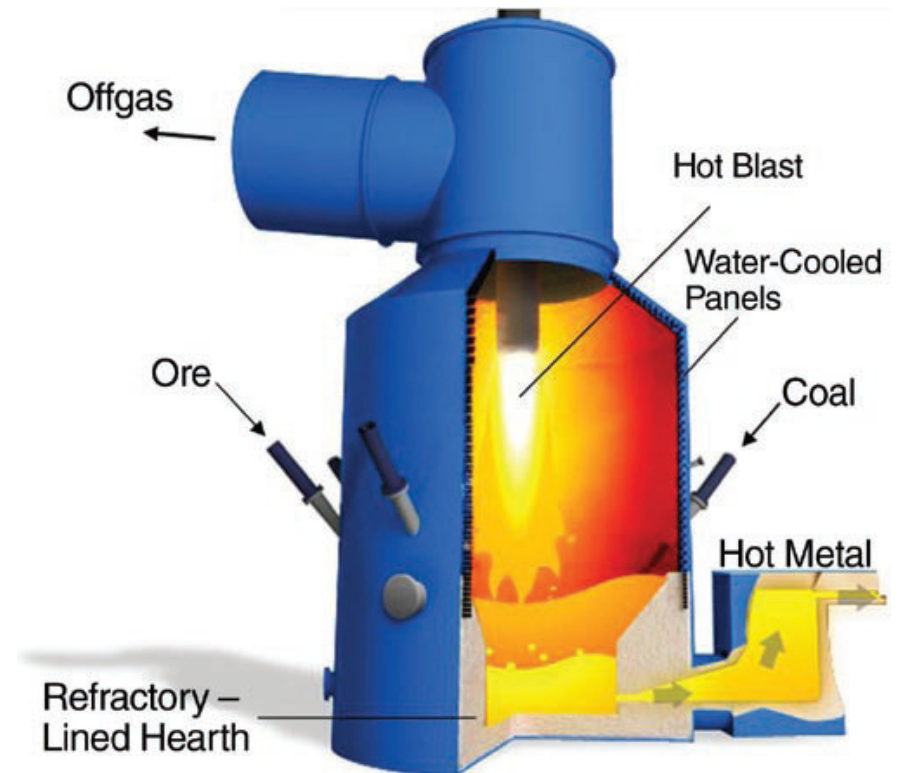


Experimental cyclone plant in IJmuiden

Hismelt technology



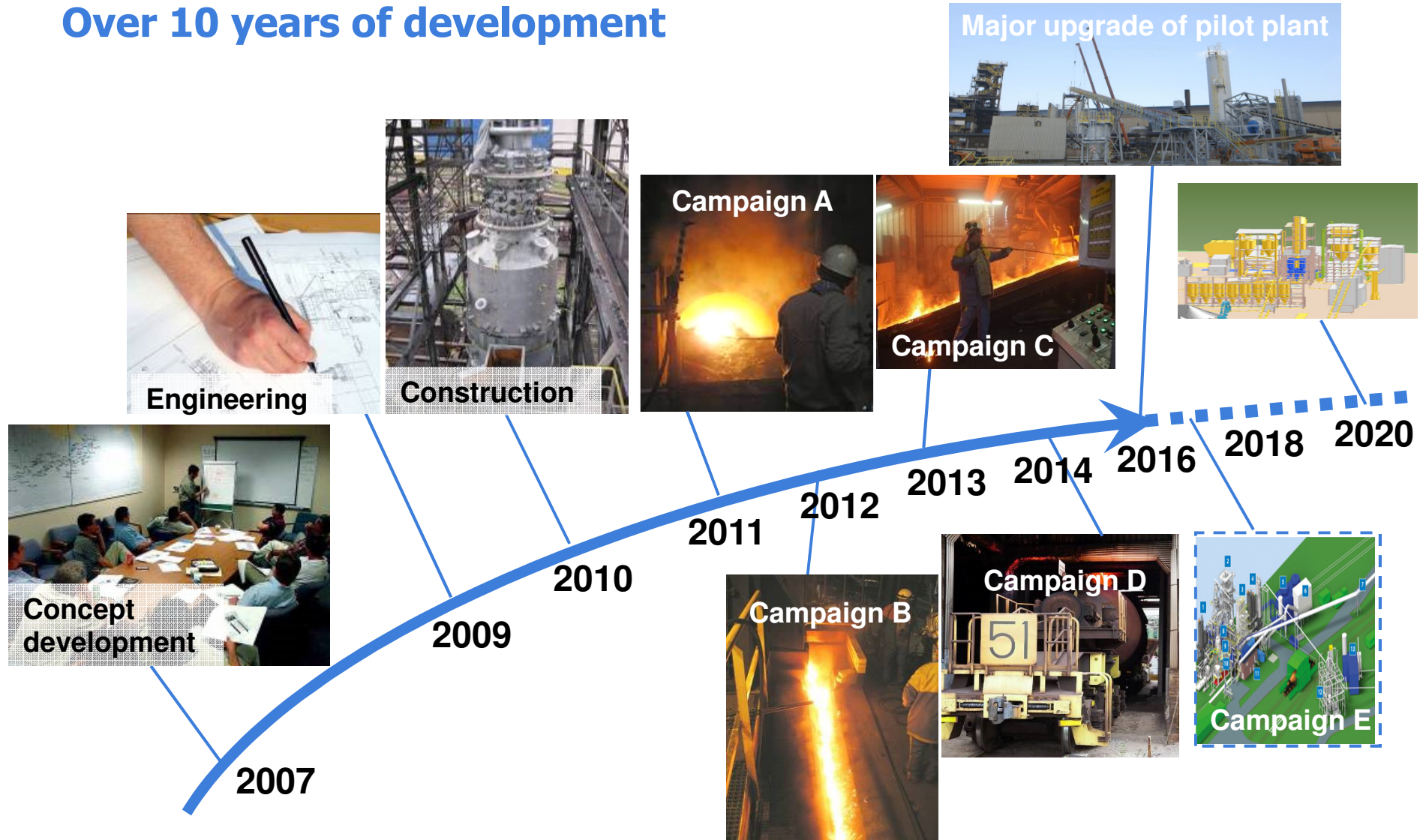
- Hismelt is owned by Rio Tinto
- Large scale demonstration plant was constructed and operated in Kwinana, Australia
- Smelter technology is combined with ore pre-reduction in a fluidized bed
- Smelter operates with hot blast (enriched with oxygen)



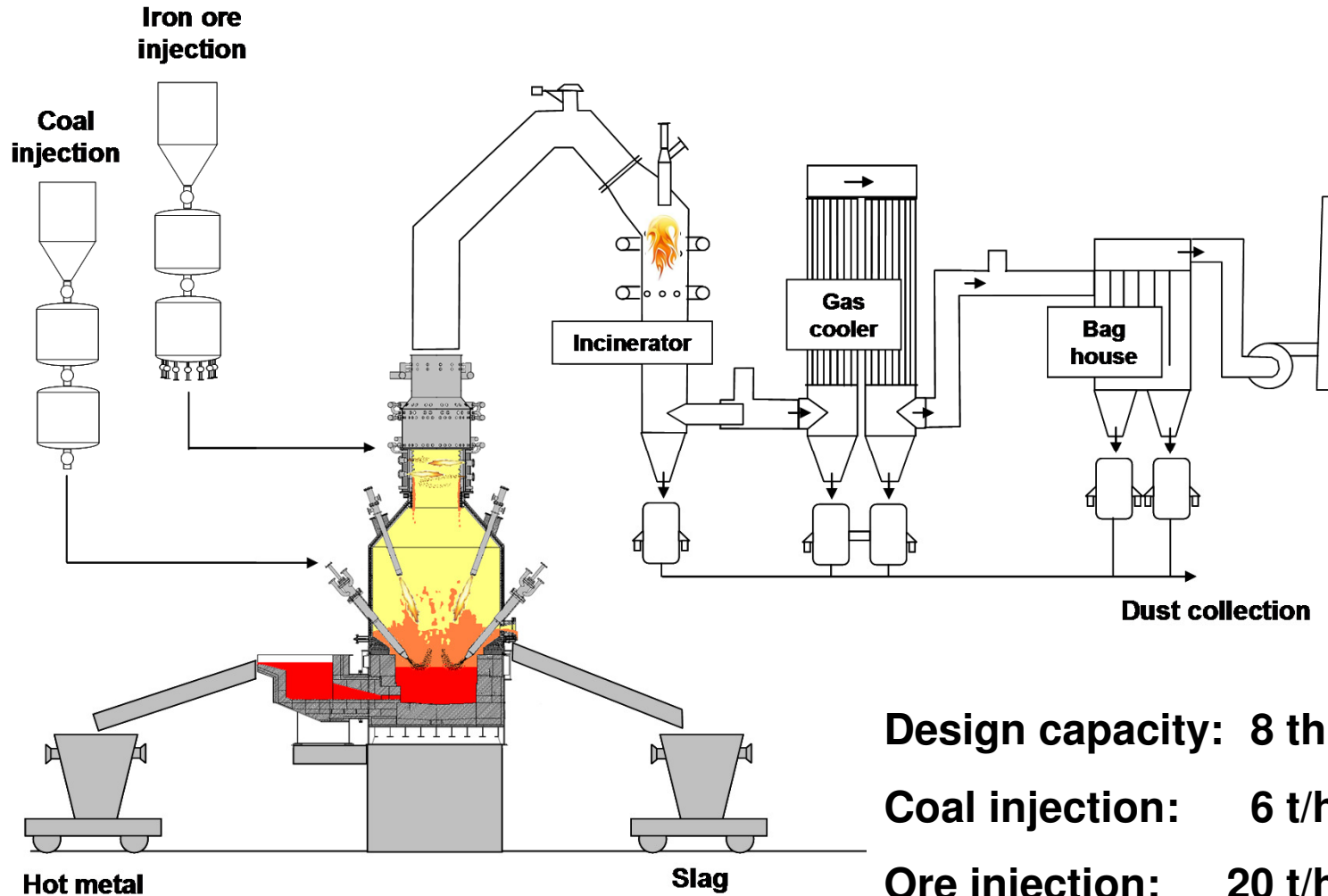
3. Pilot plant development



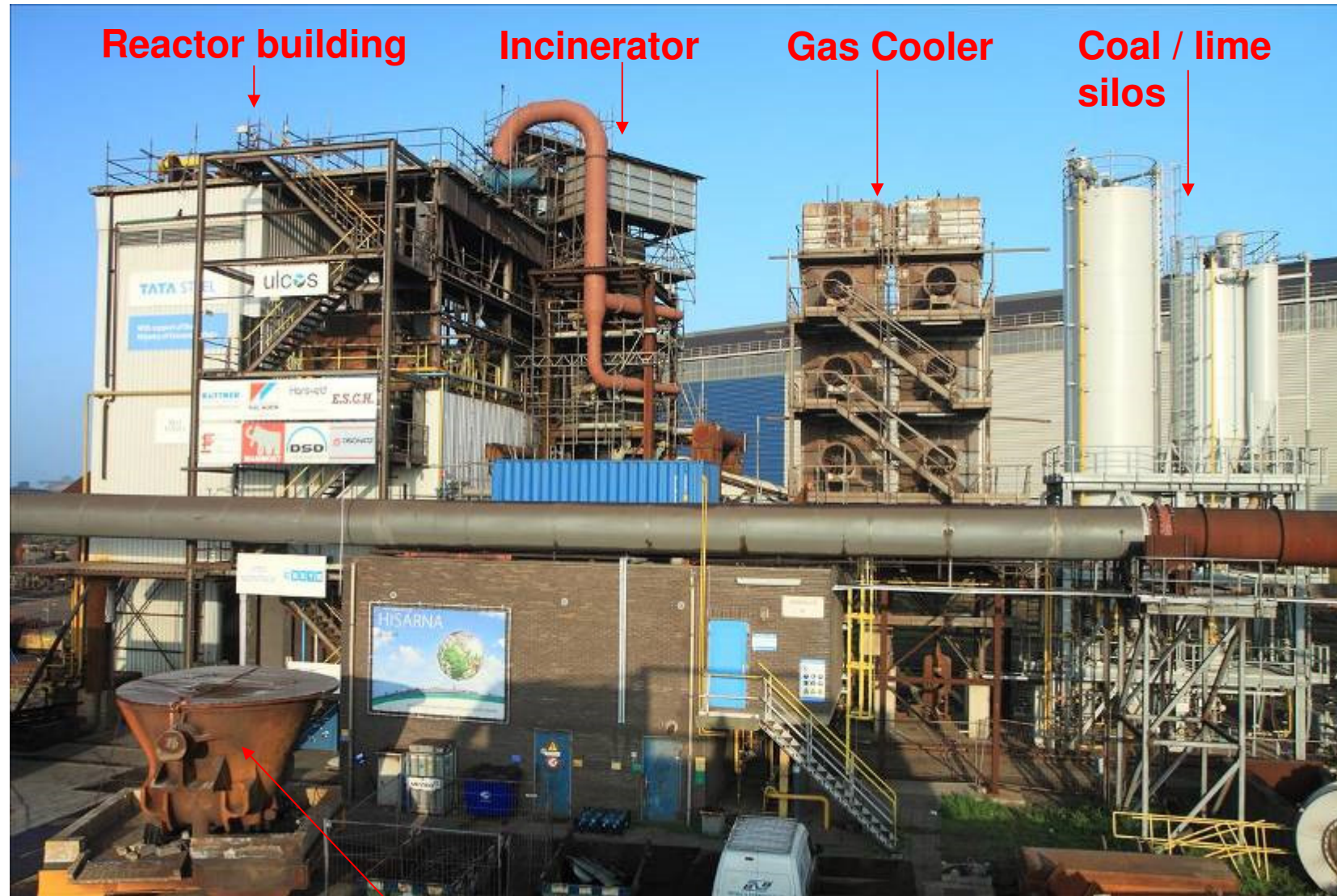
Over 10 years of development



3.1 The HIsarna pilot plant

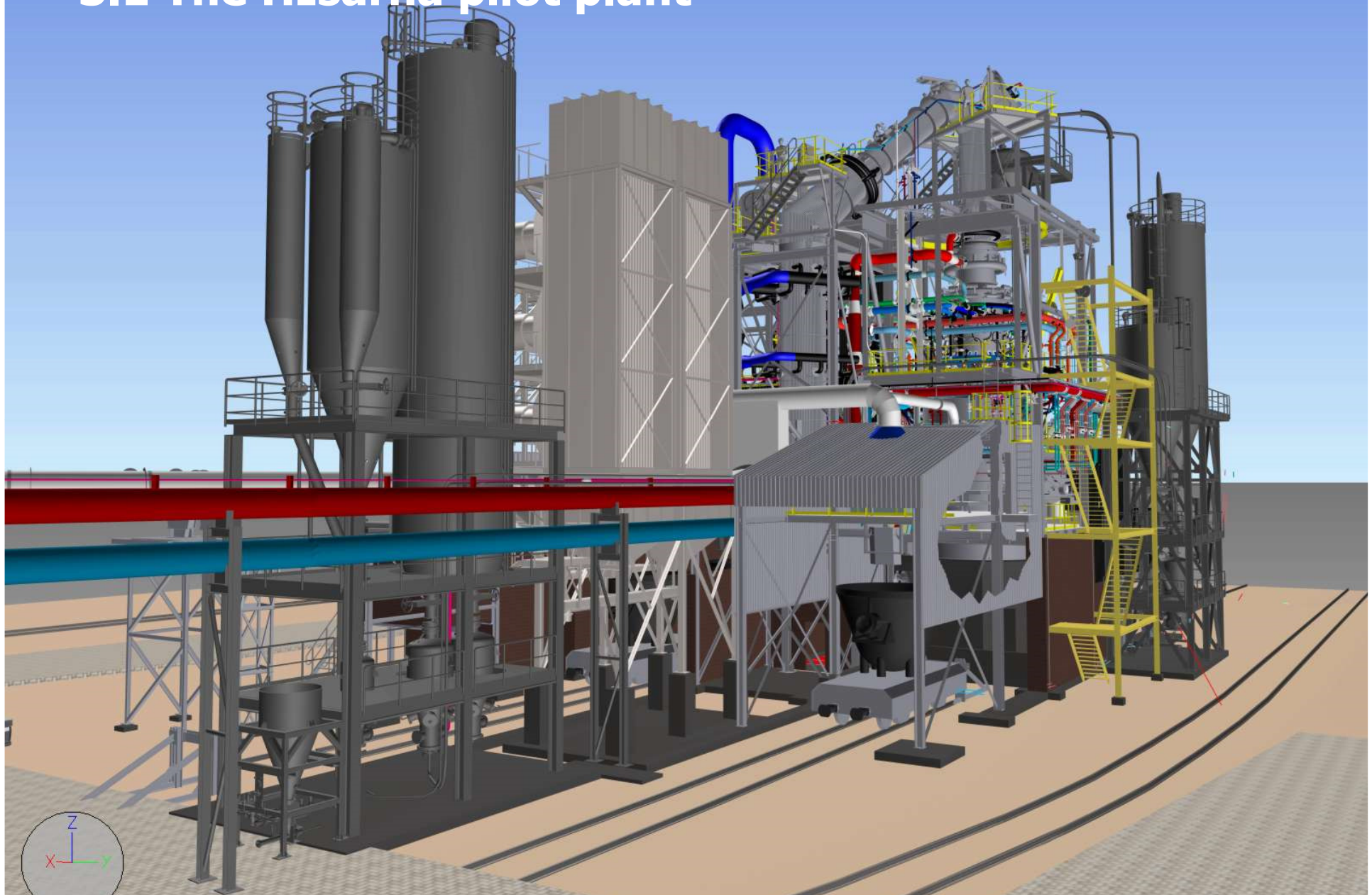


3.1 The Hisarna pilot plant

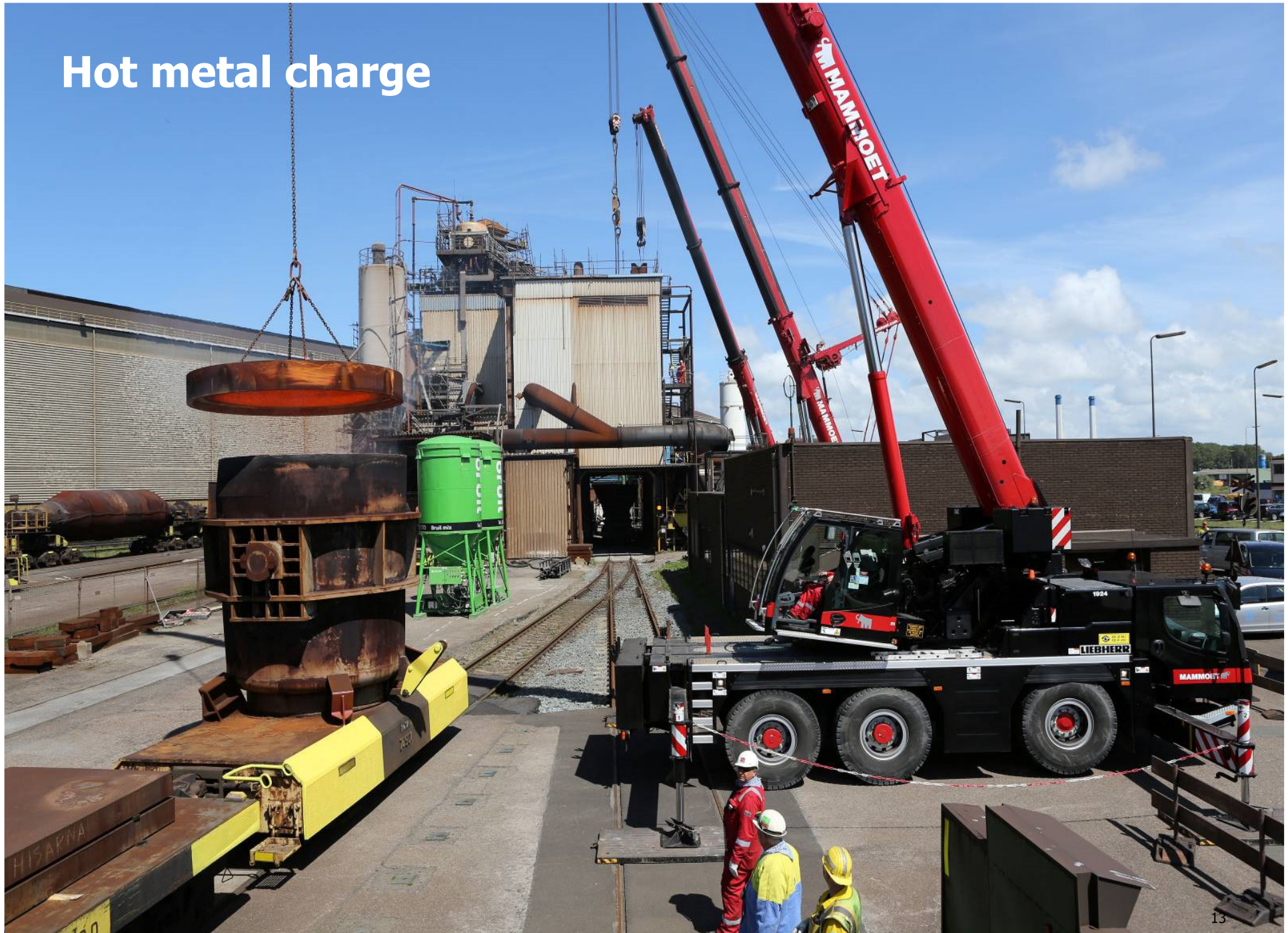


TATA STEEL Hot Metal / Slag pot

3.1 The HIsarna pilot plant



Hot metal charge



Hot metal tapping



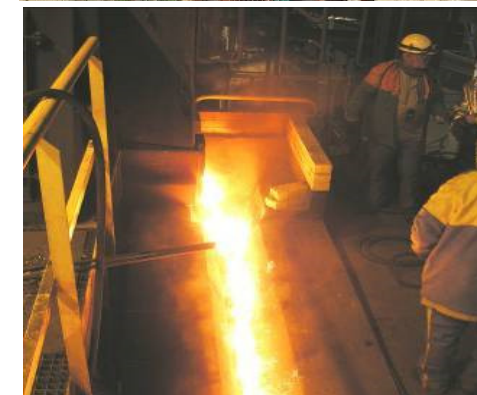
Slag tapping



3.2. Milestones of the test campaigns



2011	Campaign A	Feasibility of new process First tap May 2011
2012	Campaign B	First long operating period Standard raw materials 80 % of productivity target reached
2013	Campaign C	Use of steam coal (23 %VM) Use of low grade ore (< 30 % Fe) First metal delivered to steel plant Good plant availability Productivity target reached
2014	Campaign D	30% of iron produced made into steel Use of high volatile coal (39 %VM) Use of high Zn waste oxides Use of scrap and ore concurrently Target coal consumption reached



4. Forward program



4.1. Further experimental work in pilot plant

Endurance campaign in pilot plant (Campaign E):

- Testing equipment endurance and long term process stability
- More focus on operational aspects and equipment aspects
- 6 months, starting early 2017
- Costs: 25 mln Euro
- Funding: project partners and EU
 - 7.4 mln Euro EU subsidy secured
 - Horizon 2020, SILC-II programme
 - 1.5 mln Euro funding from Dutch government
 - Demonstratie Energie Innovatie (DEI)

4.1 Plant modifications

Hisarna Pilotplant

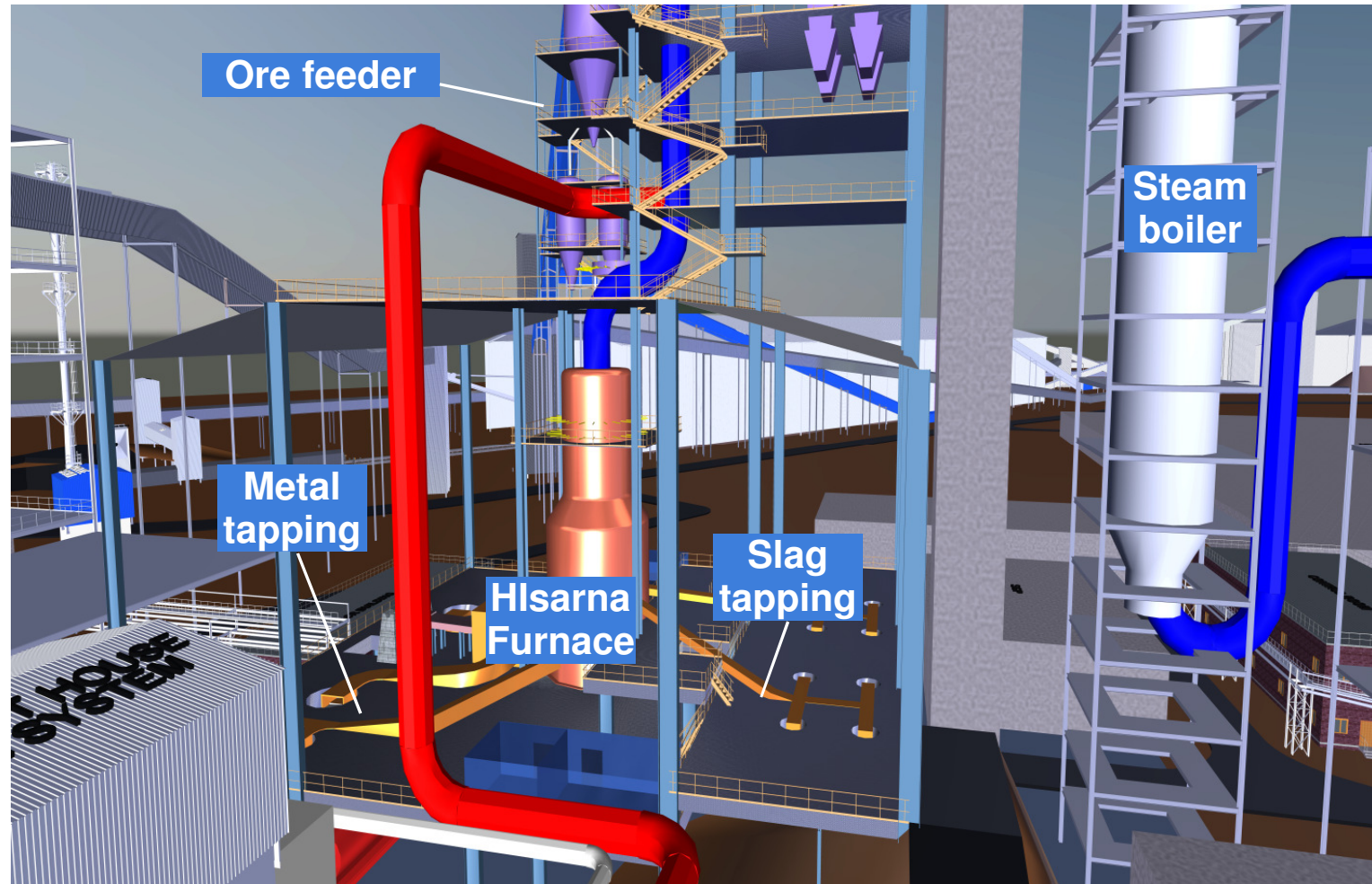
- 1 Alternative raw materials storage silos
- 2 Off-gas duct
- 3 Gas cooler
- 4 Coal and lime storage silos
- 5 Cooling towers
- 6 Bag filter
- 7 Secondary dedusting
- 8 Smelting cyclone
- 9 Smelting reduction vessel
- 10 Fore hearth
- 11 Control room
- 12 Coal grinding, drying and screening
- 13 Ore drying and screening
- 14 Raw materials storage
- 15 Offices
- 16 Workshop



4.2. Demo plant study



- Study carried out by Tata Consulting Engineers
- A location on the IJmuiden site has been selected

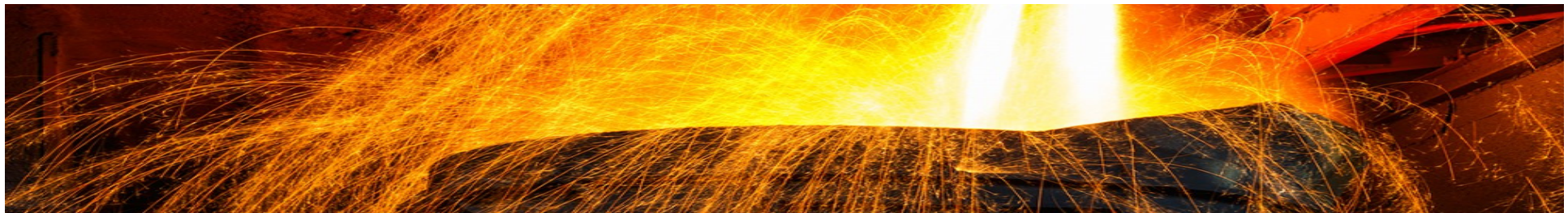


TATA STEEL

5. Conclusions



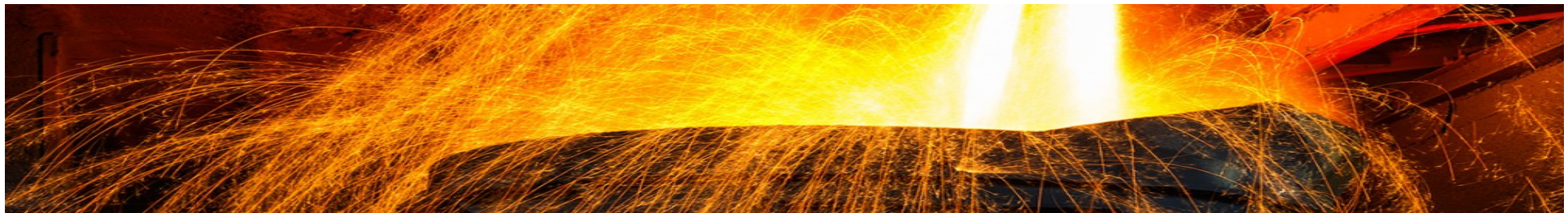
- HIsarna is a new coal-based ironmaking process offering both economical and environmental benefits
 - Reduced OPEX and CAPEX (30%) compared to Greenfield blast furnace route
 - Use of plant waste oxides (contaminated with Zn such as BOF or BF dust) or mining reverts
 - 20% lower primary energy consumption and 20 % lower CO₂ emissions per ton (48% with scrap usage)
 - Favourable combination with CO₂ capture because of N₂ free topgas. 80% lower CO₂ emission per ton of steel when CO₂ storage is applied
 - Reduction of other emissions associated with agglomeration and cokemaking, NO_x, SO_x, dust and CO



5. Conclusions



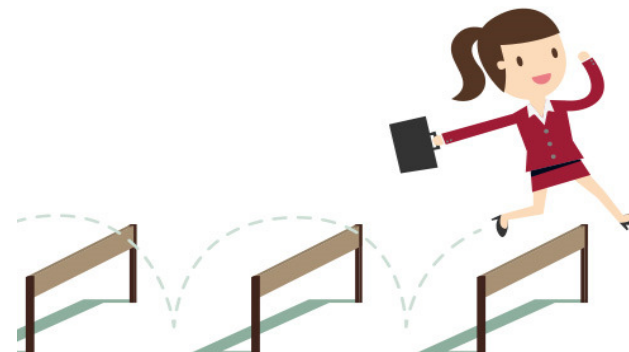
- HIsarna is a new coal-based ironmaking process offering both economical and environmental benefits
- Experimental results of the plant in IJmuiden have confirmed the:
 - High energy efficiency, the raw material flexibility and good start/stop abilities of the process
- The next pilot plant campaign is planned for 2017
- Conceptual engineering for the first industrial scale plant, 0.5 to 1.0 M t/y, has started



6. Challenges



- Support from EU needed to create level playing field for European steel industry. Specific challenges:
 - Stringent environmental legislation
 - High energy costs
 - High labour costs
- Substantial investments required to develop HIsarna into game changer technology to reduce CO₂ emissions
- Better EU funding mechanisms to better support large, demonstration breakthrough developments



Acknowledgement



The HIsarna project is made possibly with the support of:

- Ulcos partners:
 - ArcelorMittal, Tata Steel, ThyssenKrupp, Ilva, voestalpine, Dillingen/Saarstahl, SSAB
 - LKAB
 - Paul Wurth
- Rio Tinto/HIsmelt
- EU FP6
- RFCS
- Dutch Ministry of Economic Affairs



HIsarna plant

Thank you For your Attention

Any Questions?

