Carbon Dioxide Capture and Storage in the Iron and Steel Sector

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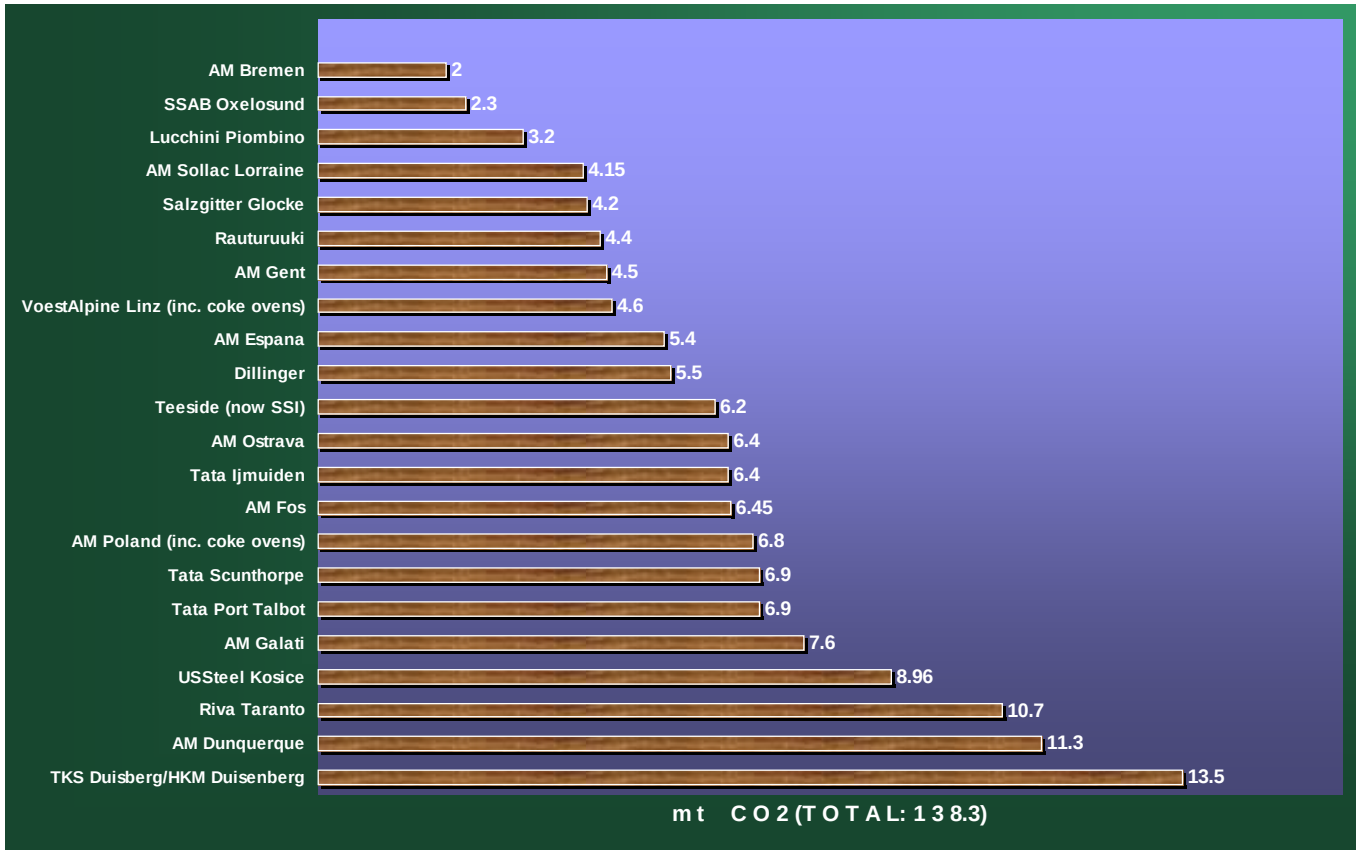
The Necessity of CCS: Looking Beyond Fossil Power

COP-18

Doha

3 December 2012

Iron and Steel in Europe – 22 Sites with > 2 Mt/y CO_2 Emissions (2008)



Data from C. Beauman – EBRD

Amount of CO_2 capture per site could be greater than what we get from coal fired power plant.

Challenges to CCS deployment in the Iron and Steel sector

Synthesis Report:

Assessing the Potential of Implementing CO_2 Capture in an Integrated Steel Mill

Volume I: Estimating the Cost of Steel Production from an Integrated Steel Mill (Base Case)

Project Partners:

Swedish Energy Agency · swerea MEFOS · ieaghg · SSAB · LKAB

Project Management, Implementation and Delivery:

swerea MEFOS · TATA STEEL

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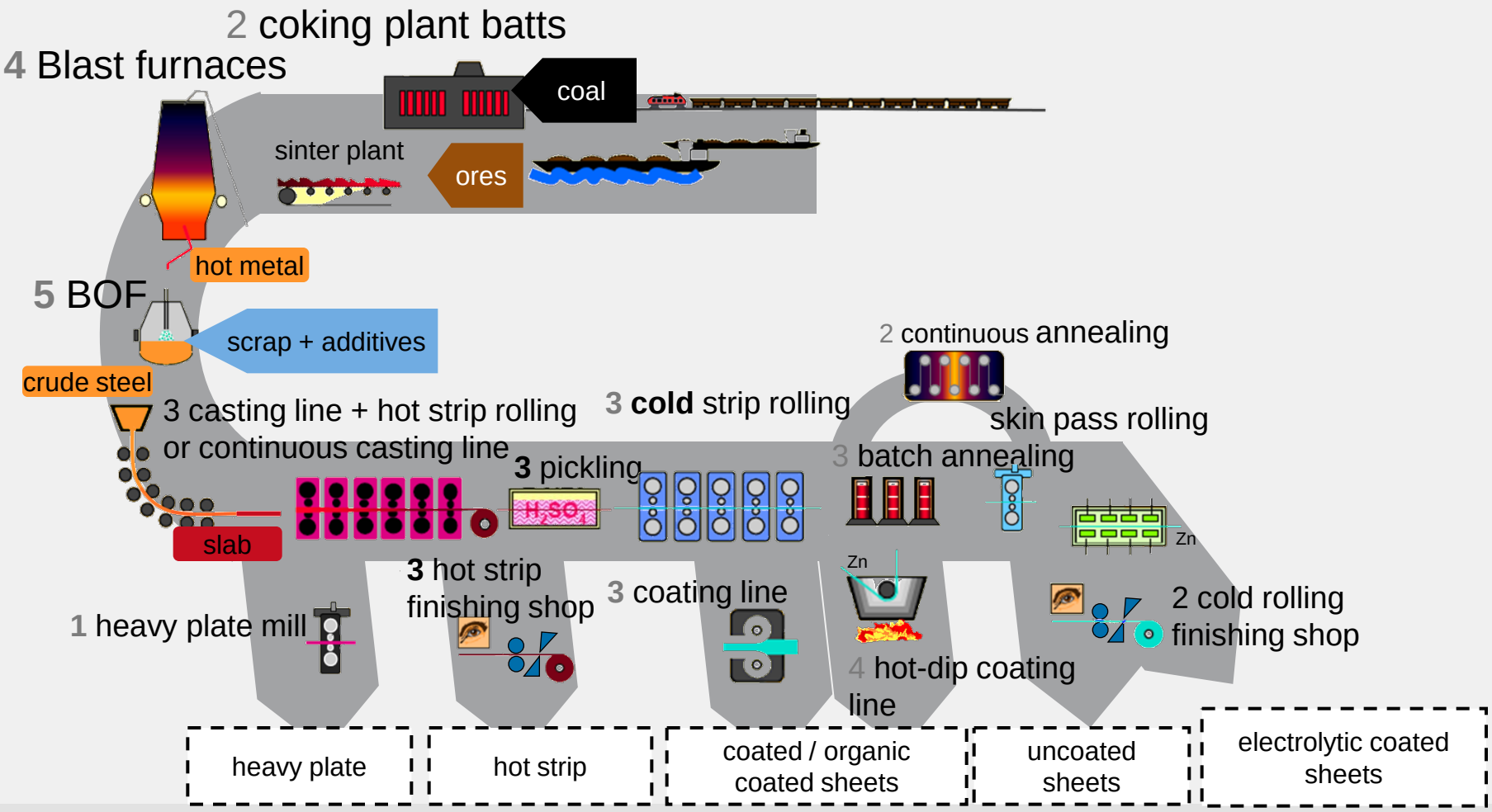
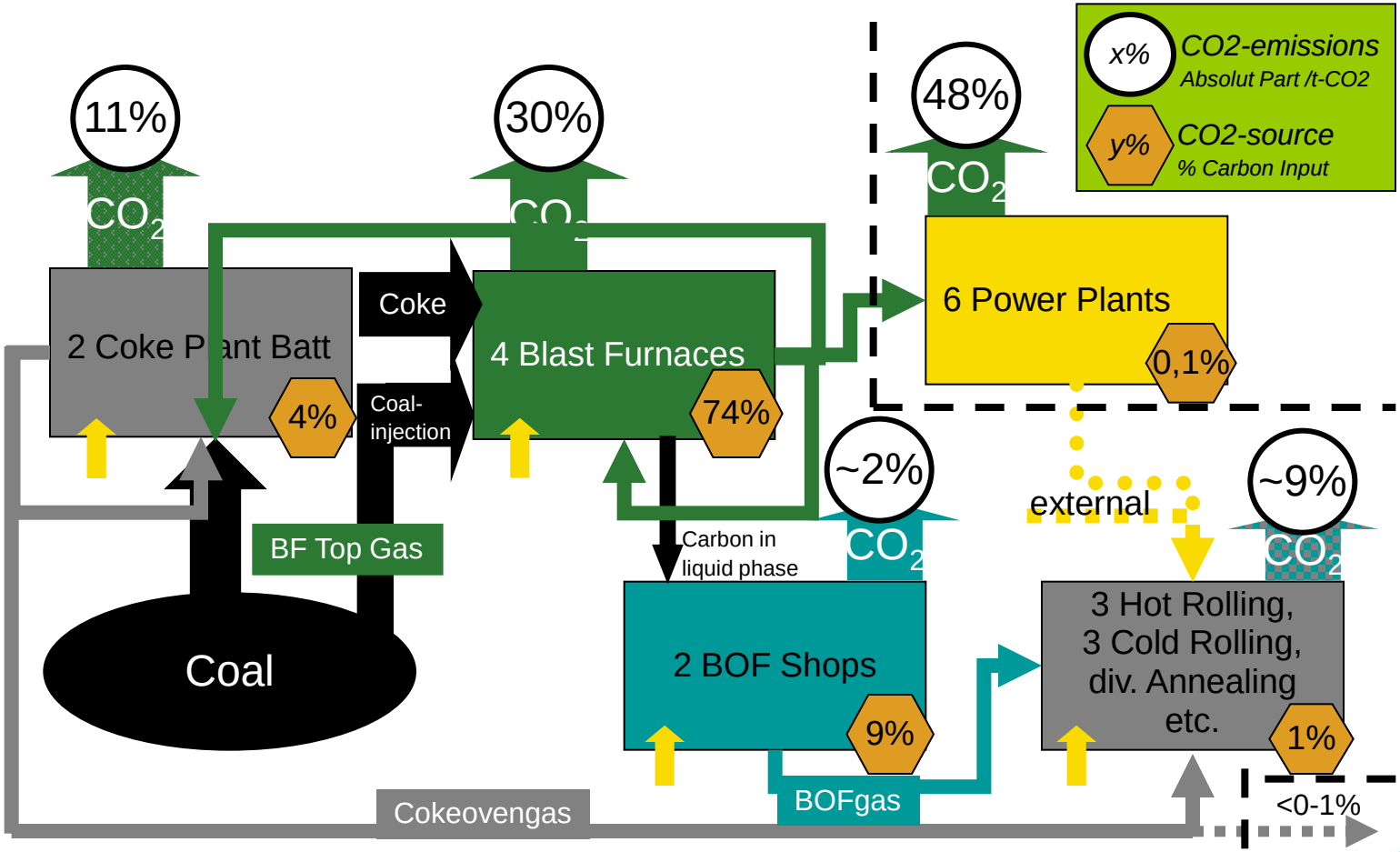
An integrated steel mill is composed by numerous facilities - from iron ore to steel products



First Challenge...

- ***There is no steel mill in this world which is alike...***
  - Steel is produced with different processes
  - Steel is produced with different types of finished or semi-finished products
  - Steel is produced with different grades

ThyssenKrupp Steel Europe – main CO_2 emitters (schematically) up to 20 Mt CO_2 p.a.

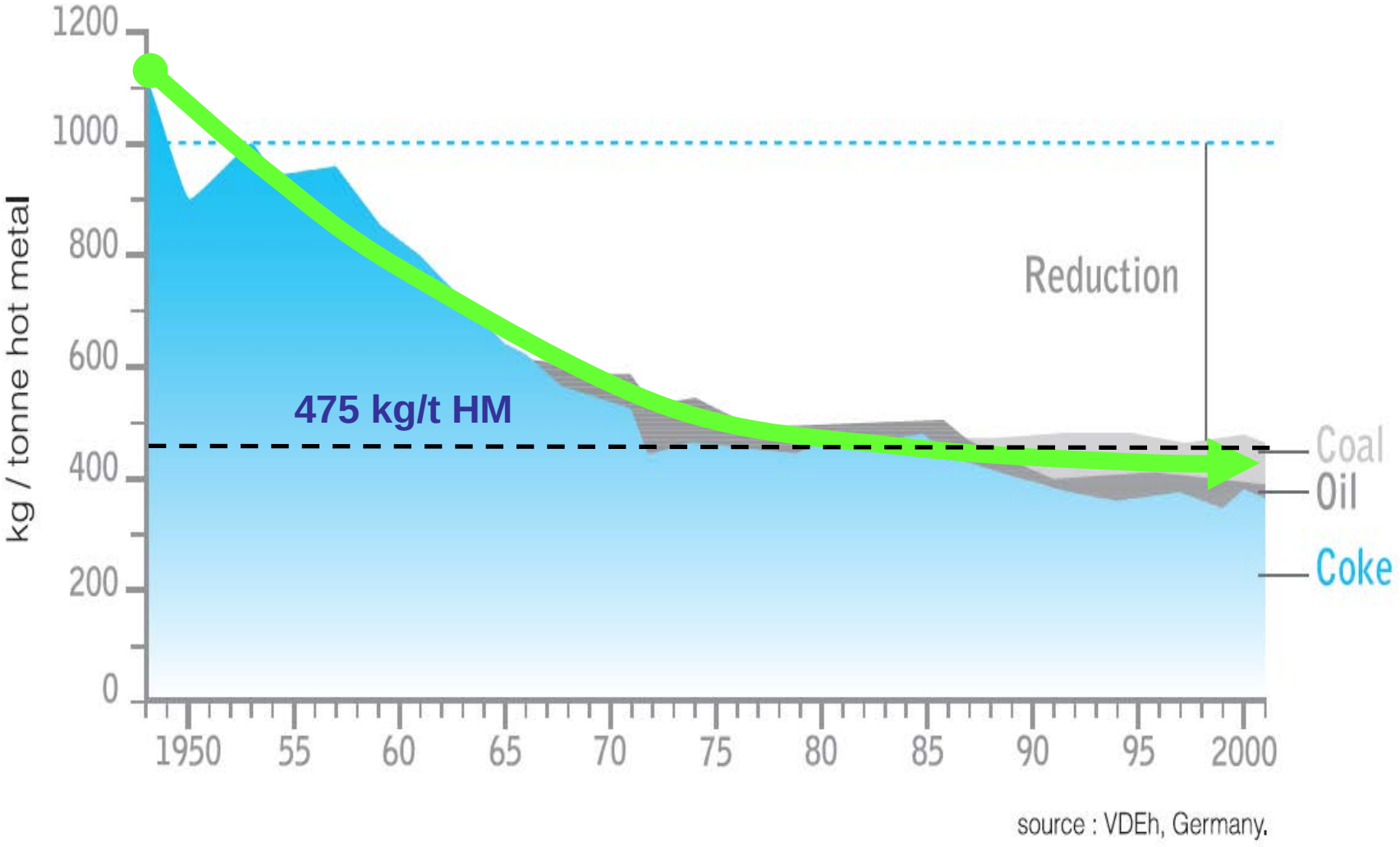


2nd and 3rd Challenges…

- ***Emissions from integrated steel mills come from multiple sources.***
- ***The source of CO_2 may not be the emitter of the CO_2.***
  - Strongly dependent on how you define *boundary limit*
  - In addition to the direct use of fossil fuels, the emissions is also strongly dependent on the use of by-product gases

4th Challenge...

BF technology is already near the theoretical limit of efficiency



Essentials for CCS deployment

- Accounting of CO_2 Emissions is an *essential activity* for Deployment of CO_2 Capture Technology in the Iron and Steel Sector.
- Accounting of CO_2 Emissions should be based on a globally consistent methodology that will allow production normalised CO_2 emission comparable between regions.
- These would result in better benchmarking – therefore providing a meaningful number for the CO_2 avoidance cost.

IEA Greenhouse Gas Study – Brief Overview and Key Results

UNDERSTANDING THE COST OF INCORPORATING CO_2 CAPTURE IN AN INTEGRATED STEEL MILL

Acknowledgement

- ***PROJECT PARTNERS***

Swedish Energy Agency

swerea | MEFOS

SSAB

LKAB

ieaghg

- ***PROJECT DELIVERY***

swerea | MEFOS

TATA STEEL

SINTEF

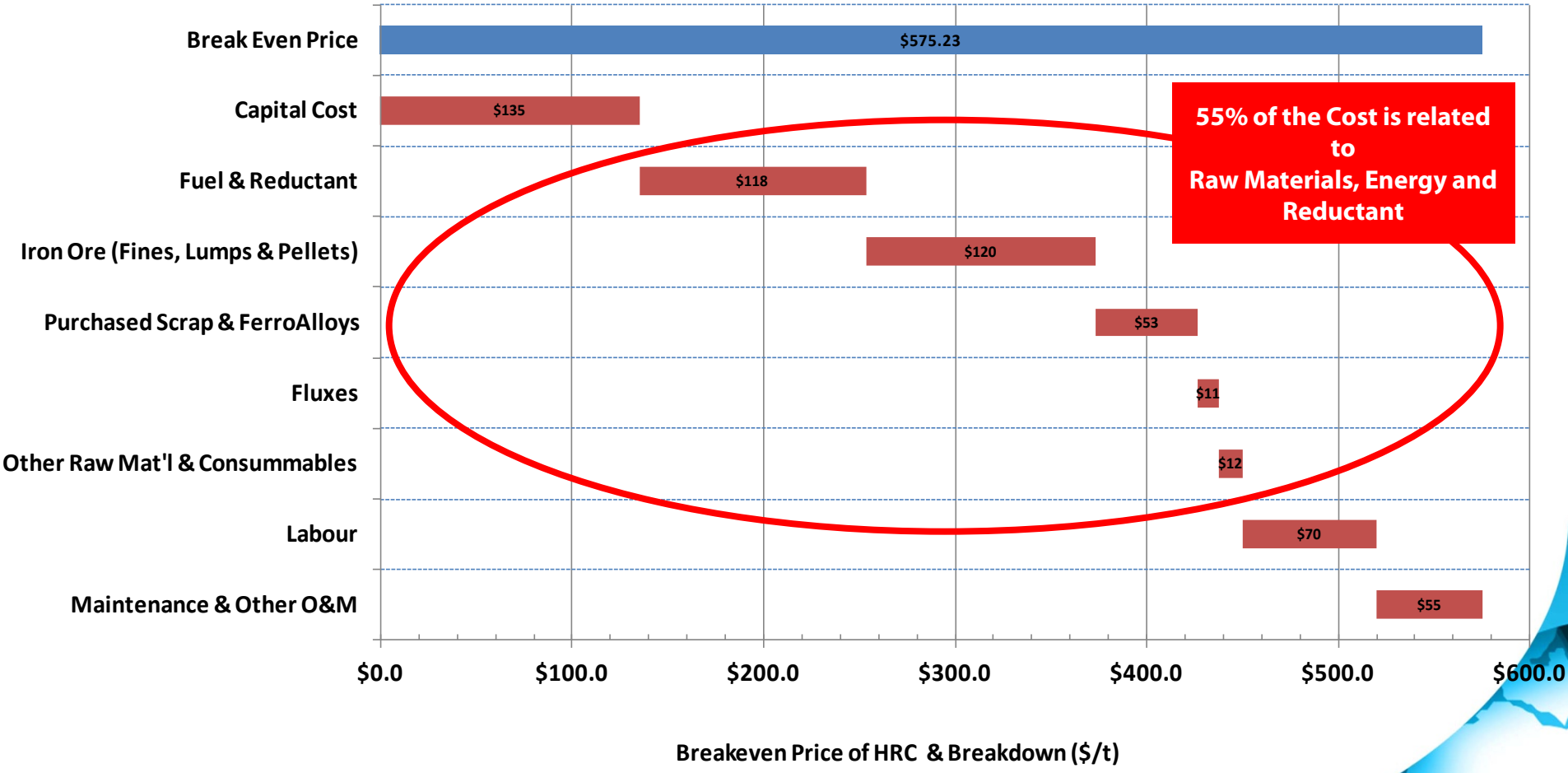
Total value of the Project: ~4.4 million SKr
IEA GHG Contribution: ~1.2 million SKr

Objectives of the Study

- ***To specify a "REFERENCE" steel mill typical to Western European configuration and evaluate the techno-economic performance of the integrated steel mill with and without CO_2 capture.***

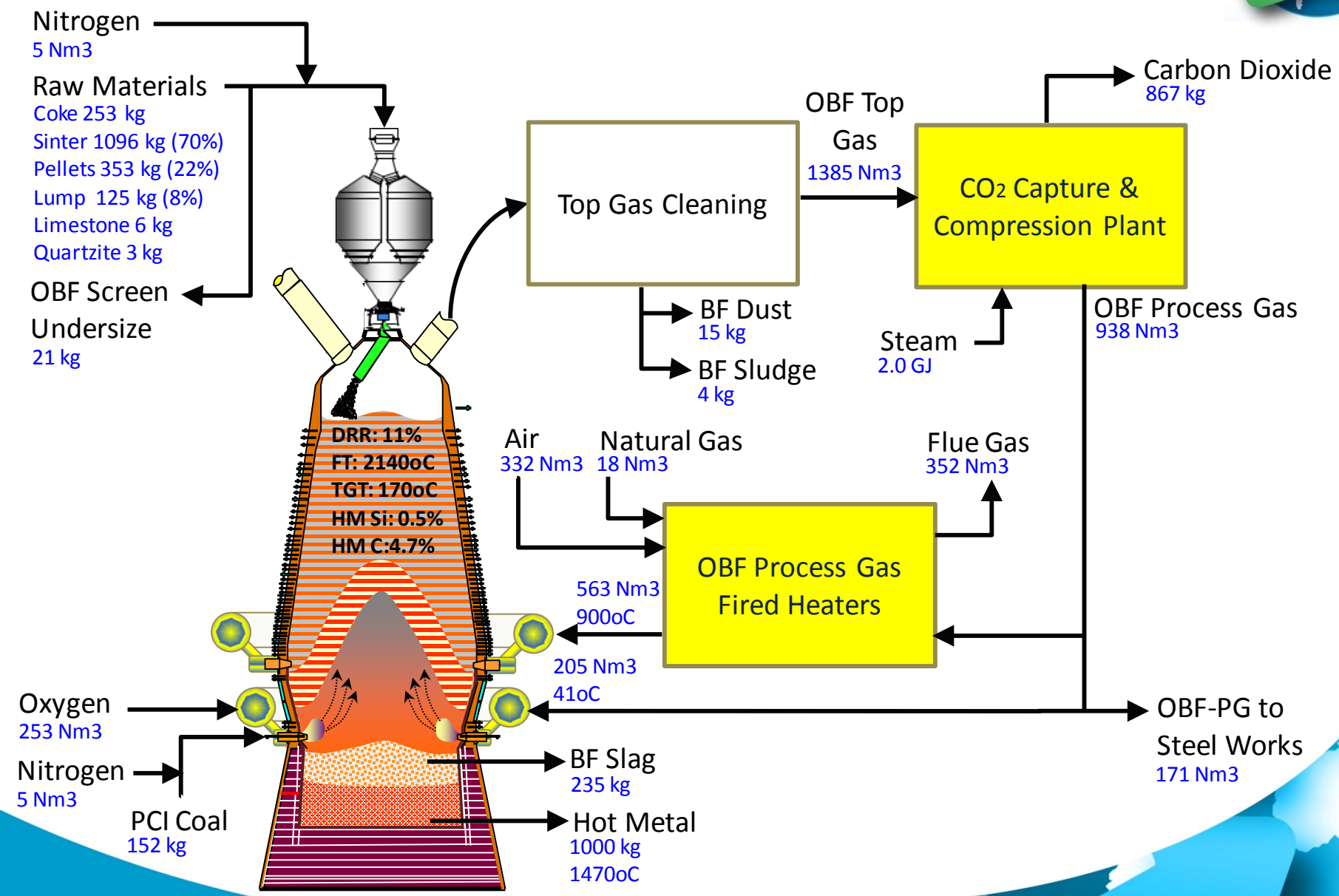
- ***To determine the techno-economic performance, CO_2 emissions and avoidance cost of the following cases:***
  - An integrated steel mill typical to Western Europe as the base case.
  - An end of pipe CO_2 capture using conventional MEA at two different levels of CO_2 capture rate
  - An Oxygen Blast Furnace (OBF) and using MDEA for CO_2 capture.

Cost of Steel Production – Breakdown without CO2 capture



Oxy-Blast Furnace Operation

(Picture of OBF courtesy of Tata Steel)



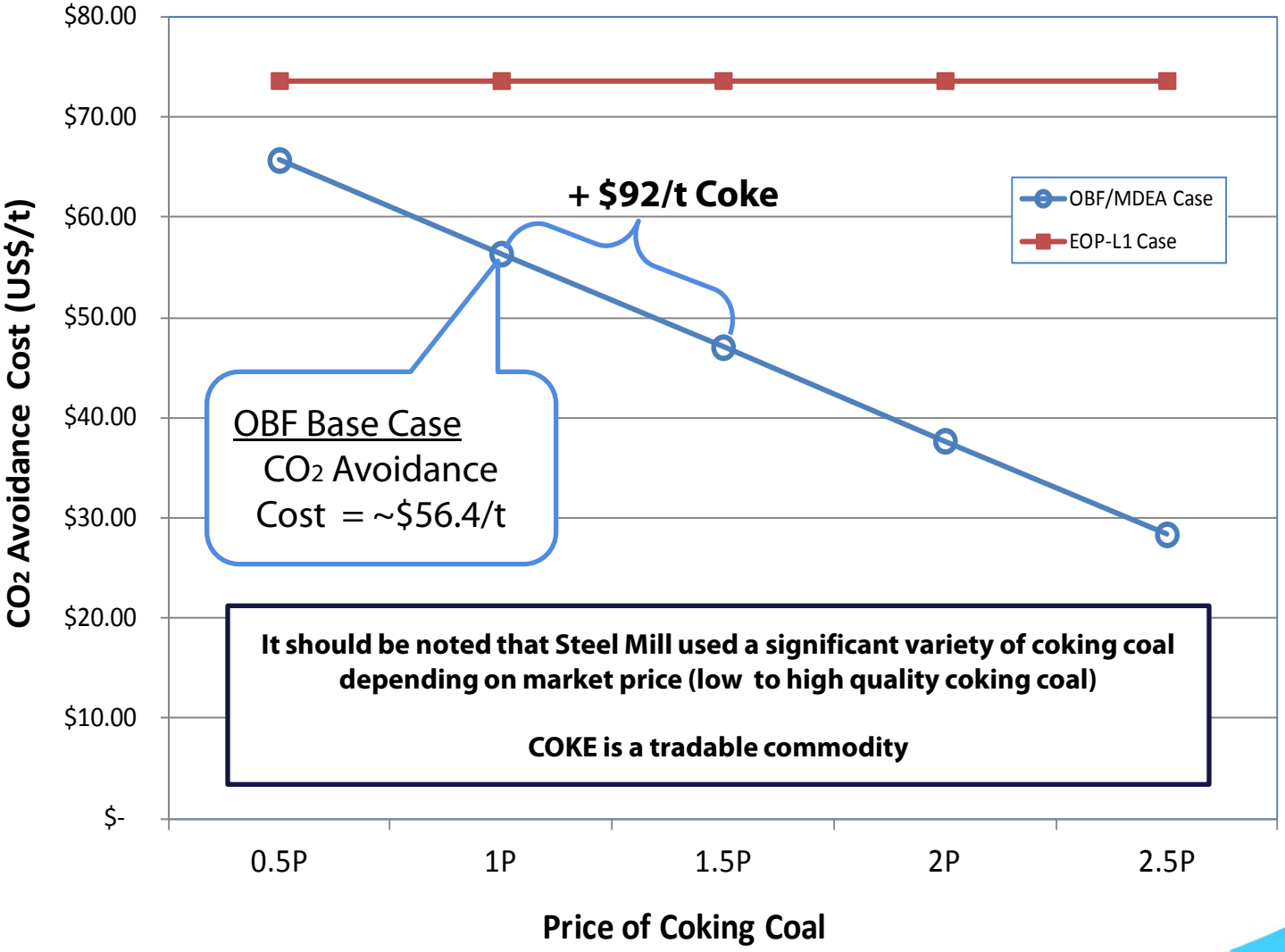
Impact of the OBF/MDEA CO2 Capture Plant to the Breakeven Cost of HRC Production

Break- even Cost of HRC Production for OBF @ $630/t increase of $55/t over reference plant without capture

- ***Capital Cost*** ***increased by 18.8%***
- ***Fuel and Reductant Cost*** ***increased by 17.3%***
  - Coking Coal Cost – decreased by ~24%
  - Natural Gas Cost – increased by ~495%
- ***Iron Burden Cost*** ***increased by 1.0%***
  - Iron Ore (Fines, Lumps and Pellets), Purchased Scrap & Ferroalloys
- ***Fluxes Cost*** ***decreased by 9.4%***
  - Significant reduction of limestone and quartzite consumption
- ***Other Consumable Cost*** ***increased by 15.7%***
  - Increased in cost of raw water consumption
  - Additional cost due to Chemicals & Consumables used by SGP.
  - Additional cost due to MDEA/Pz Solvent Make Up
- ***Labour Cost*** ***increased by 1.4%***
- ***Maintenance and Other OPEX*** ***increased by 10.4%***

Summary of Results

(Sensitivity to Coke Price)



What We Have Learned from this Study

- ***Recognising the different limitations for this study allows us to identify where the gaps in information are and what we need to evaluate in future studies.***

- ***What are these limitations…***
  - Availability of a reliable cost data
  - Limited budget for this study didn't allow us to optimise certain aspects of the different processes evaluated.

What We Have Learned from this Study…

- ***Technical Aspects…***
  - Helped us understand the dynamics of the integrated steel mill – especially interaction of various processes with respect to CO_2 emissions.
  - Identified the uncertainties with respect to the operation of the oxy-blast furnace.
    - Need to verify and validate coke reduction potential of the oxy-blast furnace.
    - This study presented a reduction of 24% of coke requirements for the Blast Furnace

What We Have Learned from this Study…

- ***Stakeholders discussion***
  - 1st Workshop – November 2011
  - Review Meeting – April 2012
  - Planned 2nd Workshop – April/May 2013

- ***ULCOS Data Comparison***

Conclusions

- ***CCS** has and **important** role to play **in emissions mitigation** in the 2°C policy scenario*
- ***Industrial sector** is expected to contribute **40% of the overall CCS emissions reduction by 2035**, with Iron and Steel having a big role to play in this sector*
- *The **strategy** for the Iron and Steel Sector has **to also look at efficiency improvements and fuel switching***
- ***Much needs to be done** in terms of **benchmarking emissions and costs**, identifying the **best options** and in **optimising** process **performance***
- ***Cost competiveness** is a **significant challenge** to the Iron and Steel industry*
- ***Demonstration of** integrated **CCS** with large scale storage **~10 Mt/y** would be **a key milestone***

Thank You

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