CEPS – Benchmarking Insights from Steel – Benchmarks and the Environment

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Benchmarks cannot be seen in isolation but are embedded in systems

Benchmarking and Time
• Are Benchmarks eternally fixed?
• How do Benchmarks evolve?
• How does time affect applicability?

Benchmarking and Competition
• What are Benchmarks worth?
• How do Benchmarks impact competition?
General Elements of a benchmark approach - schematic

Starting point: e.g. average
2008-2012

Distribution of individual installations
Mean transition path

Technological Benchmark

Fundamental benchmark based on technological-scientific aspects

Fundamental Benchmark
New production paradigm
In distant future

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Transition phase
Benchmark phase
Past achievements in Europe Steel Industry (EU15) are already considerable – very early action!

$CO_2$ emission per ton of finished product
Index 100 for 1975

Source: Eurostat/Eurofer
The Blast Furnace is main CO₂ emitter in steel production
Direct and related emissions account for well over 90%.

Total CO₂/t hot metal: >1516 kg
average 2000 - 2006

Indirect CO₂ emissions caused by use of blast furnace route

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Reduction Agents’ Consumptions already reduced to minimum – no way to go further on this route to reduce CO₂

Consumption of reduction agents near the theoretical minimum of 414 kg C/t\textsubscript{hot metal}*

=> Hot Metal around 1.5 t\textsubscript{CO₂}/t
Finished Steel around 2 t\textsubscript{CO₂}/t

coal

482 kg reduction agents/t\textsubscript{hot metal}

coke (dry)

oil

Source: VDEh, Blast Furnace Committee

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*414 kg C/t\textsubscript{hot metal} according to 465 kg coke/t\textsubscript{hot metal}
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Breakthrough Research for Production Paradigm Shift

*414 kg C/t$_{\text{hot metal}}$ according to 465 kg coke/t$_{\text{hot metal}}$

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Fundamentals of CO2 Emissions
Scientific fundamentals limit possible actions.

\[ \text{Fe}_2\text{O}_3 \, \text{& C} \quad \Rightarrow \quad \text{Fe} \, \text{& CO}_2 \]
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\[ \text{Fe}_2\text{O}_3 \text{ & } \text{C} [\text{H, e}^-] \Rightarrow \text{Fe} \text{ & } [\text{CO}_2] \]

a) replace C by H (hydrogen reduction)
b) replace C by e$^-$ (electrolysis)

availability, direct use (natural gas, electricity)
industrially viable process still far away (2050?)
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a) Use Scrap instead of Iron Ore

Limited scrap supply (already \~100\% used)
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- \( \text{Fe}_2\text{O}_3 \text{ & C} \Rightarrow \text{Fe} \text{ & } [\text{CO}_2] \)
  a) Use CCS

Technology does not yet exist, requires energy

\[ \begin{align*}
\text{CO}_2/\text{t} &\quad \text{Energy/t} \\
\text{Reduction of C-based energy} &\quad \text{e.g. coke rates} \\
\text{Additional energy for} &\quad \text{etc.}
\end{align*} \]

Requires non-coal based energy carriers,
But: China, India, USA?
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\[
\begin{align*}
\text{Fe}_2\text{O}_3 \text{ & C} & \rightarrow \text{Fe & CO}_2 \\
a) & \text{ accept necessary CO2 in steelmaking as investment in CO2 saving products downstream}
\end{align*}
\]
ULCOS – Ultra Low CO2 Steelmaking

Breakthrough Technologies for the next generations of steel making processes

Top-gas Recycling Blast Furnace from 2025?

Hlsarna from 2030?

Direct Reduction (ULCORED) from 2035?

Electrolytic Steelmaking (ULCOLYSIS, ULCOWIN) 2050?

However, all solutions rely on commonly availability CCS and CO2-free electricity

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Upscaling of Blast Furnace Concepts takes very long time
ULCOS developments not expected to be applicable immediately…
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Timeframe of Operations much longer than ETS phases

### Cokeplants
- Hamborn: 1964 - 2004
- Schwelgern: 2003 - ???

### Sinterplants
- Schwelgern 2: 1964 - ???
- Schwelgern 3: 1970 - ???
- Schwelgern 4: 1979 - ???

### Blast Furnaces
- HO 4: 1964 - 2008
- HO 8: 2007 - ???
- Schwelgern I: 1973 - 1996
- Schwelgern II: 1993 - ???

### Steelplant
- Beeckerwerth: 1962 - ???
- CC1: 74-85, 85-98, 1998 - ???
- CC2: 80-90, 90-01, 2001 - ???
- Bruckhausen: 1969 - ???
- CC1: 79-96, 1996 - ???
- GWA: 1999 - ???

### Hot Rolling
- WBW 1: 1964 - ???
- WBW 2: 1966 - ???
- WBW 3 (Bo): 1976 - ???


ETS 3: Availability of ULCOS

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Steel Production and Environmental and Climate Issues

After decades of optimisation very complex process.

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Intelligent Steel Uses taps into huge saving potentials
Examples – Heavy Plate, Hot Rolled, Electrical Steels, Tin Plate

Heat-treated heavy plate for high performance applications

HR with thicker diameters in sour gas qualities

Mobile Cranes: Relation Lifting Capacity to Weight in use raised to 8:1

Supports economic access to oil and gas fields under increasingly difficult conditions

Grain-orientated Electrical Steel for effective energy generation

Tin Plate offers innovation potential for packaging applications

Efficiency up to 99%

Thicknesses of 0.07mm results in extreme demands on deep-drawing capability

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Carbon Leakage must be avoided – free allocation one way

But how comparable are benchmarks?

Preferred Solution:
- Benchmark-based free allocation

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Benchmarks:
- 10% best?
- Average performer?
- Political number?
- Allocation process …

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Benchmarks, Cap and Carbon Leakage

Benchmarks are important, but only part of the story…

Climate Issues

• Cap setting
  • Benchmarks to identify the „doable“ (Bottom-up approach)

• Sharing the burden: Sectoral crediting, CDM, etc.
  • Benchmark to identify the reference
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Competition Issues
- Benchmark-based Allocation
  - Global comparability and competitive level-playing field requires
    - Same benchmarks (but regional particularities?)
    - Same allocation rules (costs and amounts)
- Benchmark-based Border Adjustment Measures
  - Company, Country or Global?
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Technology Issues
- Benchmark CO2 emissions of technologies ($x \frac{t_{CO2}}{t_{product}}$); or
- Benchmark existence of technology ($x$ out of $y$ technologies from list)
Wherever the future leads us,
Steel will bridge the challenges!

Many thanks for your kind attention!

Viaduc de Millau

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