THE LOW CARBON FUTURE OF THE EUROPEAN STEEL SECTOR
OUTLINE

• The challenging future for the EU steel sector
• The role of EU steel in “greening” the EU economy
• Breakthrough technologies in steel production to reduce CO$_2$ emissions
• Policy recommendations
ECONOMIC EVOLUTION & STEEL USE

1: low level
2: Rapid growth
3: Levelling off
4: Decline
5: Stabilisation

Steel Intensity (SI) Curve

ASU = Apparent Steel Use

Source: DG Enterprise and Mr. Armand Sadler, Former Chief Economist of Arcelor
PRODUCING STEEL IN A MATURE MARKET

Total Profit = tonnes sold \times profit-margin per tonne

Company goal = increase shareholder value
shareholder value depends company assets incl. profits

no/little growth in EU

under pressure due to additional (energy, labour, carbon, ...) costs compared to other regions

Sector behaviour/positioning
• idle plants, restructure production across EU
• no new (big) investments (e.g. Blast Furnaces) & keep old ones operating as long as possible
• limited spending on R&D
• fight new energy/climate legislation (viscously)
How to keep a competitive profit-margin

**Increase Value Added**
- develop specialties
- for specific and new markets
- aka Innovation

**Decrease “relative” energy/carbon/... costs (over time)**
- Increase productivity (if possible)
- Further investments in energy-efficiency
- R,D&D of low carbon breakthrough technologies (create competitive advantage)
- If needed, market protection from non-EU markets without carbon price
Automotive and Construction have important demand for steel in Europe

- EU automotive in decline (structural over-capacity?)
- Fuel efficiency standards are opportunity for developing and selling new light-weight steel products (examples: US NanoSteel, GM ventures LLS investment and recent R&D by ArcelorMittal)
- EU construction boom (Spain, Greece, ...) over (structural?)
- Energy performance in buildings standards can lead to higher renovation rates (if applied to existing buildings)
What the Future could bring...

Renewables: wind, wave, sun will require a lot of steel ... if EU 2030 RES targets are ambitious enough (one 3MW turbine = +/- 500 cars)

Upgrading, linking and integration of EU power grid, including links with off-shore renewables. (cables, transformers and pylons = steel)

Hybrid and electric cars driven by EU CO2 efficiency in cars directive: batteries needed incl. steel encasing (product innovation opportunities)
Conclusion on future markets

Ambitious European renewables and energy-savings policies could drive future steel demand in Europe especially offering the opportunity for producing new (high value) added products.
(CURRENT) STEEL PRODUCTION IN EUROPE

Blast Furnace (Cokes) + Basic Oxygen Furnace

or

scrap + Electric Arc Furnace

Average (BF): 1.6 t CO2/t hot metal
ULCOS (ULTRA LOW CO2 STEEL MAKING)

- Origin 2004: consortium 48 companies, 15 Member States
- 75 million EUR (60% private/40% public a.o. FP6 and RFCS)
- Goal: find and develop breakthrough technologies for CO2 reduction in steel production of more than 50%
- ULCOS I: 2004-2010
- ULCOS II: Now. Move to pilot and demonstration stage
- a.o. support through NER300 (EU ETS) for CCS
- Market readiness of breakthroughs by 2020-2030 and EU wide deployment afterwards
• Re-use of waste gases (in existing Blast Furnaces)

• Direct reduction of iron ore by natural gas or (non coking) coal, avoiding the process of cokes production.

• Carbon Capture and Storage (in combination with the above): first of all ensure pure CO$_2$ at end of pipe

• Electrolysis: room temperature or Molten Oxide Electrolysis
ULCOS Blast Furnace

**Status**
- Demonstration project in Florange (Fr) as part of EU ETS (NER 300)
- First full scale (industrial) CCS project
- Operational in 2014-2015
- Test phase of +/- 10 years
- Industrial implementation after 2020

Top Gas Recycling (CO)
Capture, Transport and Storage of CO₂
Existing, refurbished Blast Furnace

Reduction potential: up to 50-60% (incl. CCS) compared to average EU BF

Source: ULCOS
Hlsarna

Cyclone technology

smelting

Flexible process: can use coal, methane or hydrogen
Economically interesting CAPEX
Reduction potential: up to -80% (incl. CCS) compared to average EU BF

Status

• Demonstration project built in Ijmuiden (Tata Steel) 2011 without CCS
• Piloting to continue this year
• Industrial scale demonstration (2014-2018)
• Industrial implementation (2020 and beyond)
ULCORED/Midrex

Status
- Direct reduction with natural gas happens on commercial scale (US, Mexico) mainly through Midrex technologies (+/- 1 tonne CO2/tonne HM)
- ULCORED still needs to move to pilot phase (2013?)

ULCORED (DRI)
- Natural gas
- Natural gas reformed to reducing gas (direct reduction of Iron Ore)
- Pure CO2 for storage
- Reduction potential: up to 70% (incl. CCS) compared to average EU BF

! Shale-gas boom in the United States !
- Cheap natural gas replacing coal power
- New (big) investments in chemical sector (Ethylene)
- Huge opportunity for new steel plants (Midrex type) using (cheap) natural gas
- Potential competition w. (more expensive)EU steel production
ULCOwin and ULCOlysis

Status

• Laboratory phase but proof of concept is there
• views diverge on when market-ready post 2030 (EU) or post 2050 (US)
• MOE is becoming a “hot” field in metallurgic research esp. as potential (cheap) storage technology for intermittent renewable energy (MIT)

• Room temperature electrolysis (ULCOwin)
• Molten Oxide Electrolysis (ULCOlysis)
• CO₂ “free” if produced with renewable electricity

Source: Prof. Sadoway, MIT
Overview

Year the mentioned technologies likely become operational on commercial scale

- Reference level (average EU blast furnace)
- New blast furnace
- Fastmelt
- Fastmelt with CCS
- Top gas recycling with CCS
- HIsarna with CCS
- Electrolysis (using renewable electricity)

Source: CE Delft, CAN-Europe
Conclusions on breakthrough technologies

ULCOS:
• seems to bet on technology that can be applied to existing blast furnaces (BF gets refurbished once/15y) not new ones
• sees coal as the main fuel (for EU steel) for at least the next 40 years
• sees CCS not as a bridging technology (here to stay for 50-100y)

Recommendations/issues:
• ULCOlysis (Molten Oxide Electrolysis) might be interesting long-term bet. EC 2050 energy roadmap shows decreasing power prices after 2030 (i.e. opportunity for electricity based iron). Divergence of view between US (AISI, M.I.T., NASA, ...) and ULCOS
• Policy priority for industrial CCS v.s. power sector CCS
• Significant practical+economical issues related to CCS (Florange good location compared to other sites, companies can do capture but infrastructure for transport and storage requires public/tax-payer investments)
Recommendeds for policy makers

General

• Re-establish EU industrial policy (sector specific vision, goals, strategies, instruments, support, …)

• Increase RD&D budget at EU and national levels

• Focus R&D spending on space where private sector fails to engage (enough)

• Link R&D, innovation plans with major and long term challenges for EU (low carbon 2050, energy security, …)

Specific

• Horizon 2020 should more clearly link with sector specific industrial innovation leading to pilot and demo programs such as supporting ULCOS II and establish the appropriate instruments and facilities
...and recommendations for the EU ETS

- Smart EU ETS reform needed. Current carbon price will not drive (long term) emission reductions towards -80% by 2050
- Use EU ETS auctioning revenue recycling to drive innovation

CCAP-EU proposal

- (asap) set-aside EU ETS allowances intended for auctioning
- Change EU ETS directive by March 2014 to:
  - adjust linear reduction factor (1.74% to 2.5%)
  - recycle part of set-aside to EU industrial innovation (product and process innovation) funding
- this should give (at 20 EUR/t): 20 Bn EUR (between 2015 and 2024) for industrial product and process innovation.
Thank you

for more information or feedback please contact me

(twyns@ccap.org)