Carbon Capture, Utilisation and Storage (CCUS) and Energy Intensive Industries (EIIs)

From Energy/Emission Intensive Industries to Net Zero Emission Industries

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Champaign, Illinois, USA
25 April, 2018

Outline of the presentation

- Content of the report.
- Main topics of the executive summary.
- Recommendations : views on the required commitment from various players in order to develop CCUS.
- Specific information on each sector.
- Interactions between EIIs.
- Next steps

Content of the report

- Energy Intensive Industries ~ Emission Intensive Industries

- Steel (2.3 $GtCO_2$/year)
- Cement (2.3 $GtCO_2$/year),
- Chemicals (1 $GtCO_2$/year),
- Refining (1 $GtCO_2$/year),
- Hydrogen (0.5 $GtCO_2$/year),
- Natural gas and
- Heavy oil production,
- Fertilizers (0.4 $GtCO_2$/year),
- Waste to Energy (0.2 $GtCO_2$/year)
- Other energy intensive industries have not been studied. For example, paper/pulp, aluminum.

- Note: Numbers for steel, cement and chemicals are for 2014 (IEA ETP 2017). Consistent numbers across all EIIs difficult to find

Executive Summary

- EIIs are key building blocks of all economies,
  - Ex : steel and cement to build cities in emerging countries
- They are needed for climate change mitigation and adaptation,
  - Ex : hydrogen for energy and industrial process
- Their cumulative share of CO_2 emissions is significant,
  - Their cumulated emissions are close to power generation emissions
- They are actively working on decreasing CO_2 emissions,
  - Energy efficiency, process improvements, new sources of energy…
- CCUS will play an essential role in decreasing CO_2 emissions,
  - CCUS will be needed to achieve net zero emissions
- CCUS : EIIs are pursuing efforts and facing challenges.
  - All sectors are active in CCUS at different stages.
  - Beyond technology, costs and competitiveness (carbon leakage) are major issues

The development of CCUS in EIIs will require commitment from various players.

- EIIs,
  - Developing cooperation between the different sectors (R&D, projects),
  - Developing hubs,
  - Coordinating with the oil and gas sector (transport, storage),
  - Development of CO_2 utilisation.
- Governments,
  - Providing predictability on CCUS support,
  - Encourage procurement of low-carbon products and development of infrastructure, avoid carbon leakage.
- The oil and gas sector,
  - Bringing its expertise in transport and storage
  - Potentially, an important facilitator of interactions between EIIs
- End use consumers,
  - Taking into account that the cost of CCUS can be relatively modest when compared with the total cost of the final product
- CCUS organizations.
  - Advocate the paramount importance of CCUS to meet the challenge of climate change mitigation

Specific information for each sector

- Each sector's contribution to today's economies and to their growth,
- A geographical analysis of its production,
- The trends in emissions,
- **The main CO_2 emission patterns for typical facilities of this sector,**
- Other ways than CCUS to decrease CO_2 emissions,
- How CCUS is needed to achieve net zero emissions,
- The development status of CCUS in this sector,
- The main challenges to CCUS development.

The main CO2 emission patterns for typical facilities of the steel sector

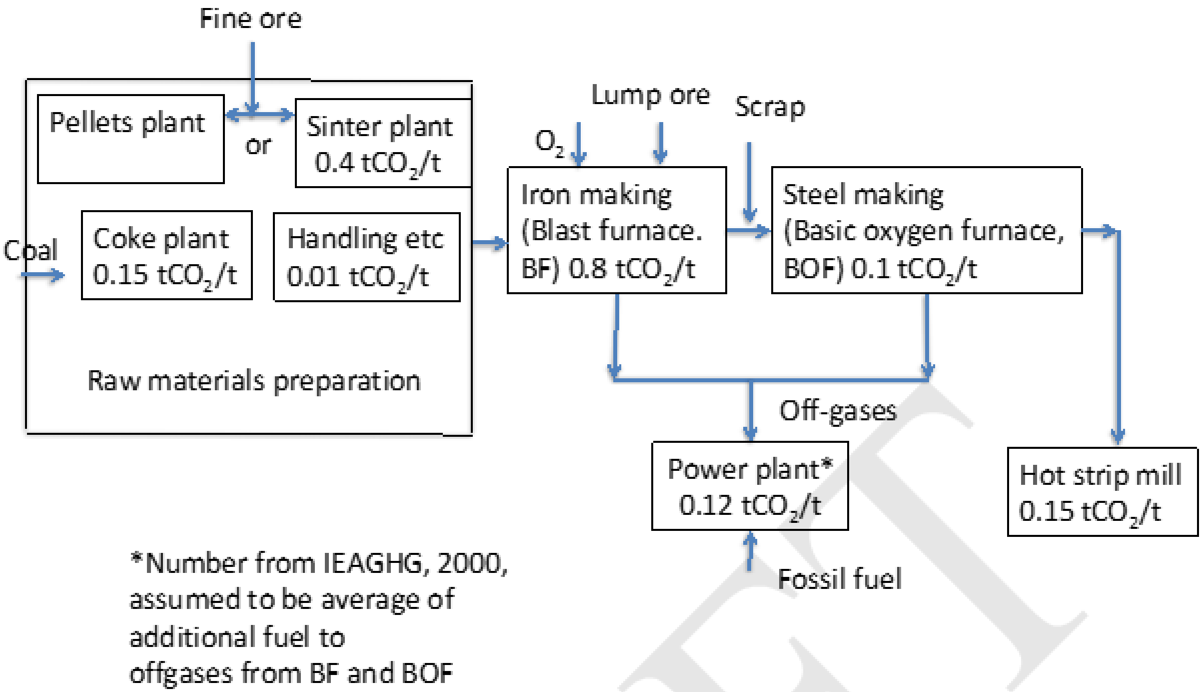

Figure A.1.1. The integrated steel mill/blast furnace route to steel production. (Based on Figure 2 in Birat and Maizières-lès-Metz,2010, and on IEAGHG, 2013).

Table A.1.1. Characteristics of exit gases from the different facilities in an integrated steel mill, with use of off-gases as fuel taken into consideration (ISO, 2016)

Facility	CO_2 emissions, tCO2/t rolled coil	CO_2 concentration, %	Pressure of gas stream, Mbar	Other parameters
Coke plant	0.15	2	30	N_2, CH_4, H_2,CO, , water, dust, tar, H_2S
Sinter plant	0.40	5		N_2, CO, O_2, NO_x, SO_x, water, dust, H_2S
Blast furnace	0.80	25	50	, H_2, CO, N_2, water dust, H_2S, NOx, SOx
Basic oxygen furnace	0.10	20	20	H_2, CO, N_2, water, dust, H_2S
Other	0,01			
Total crude steel	1.46			
Casting, rolling, finishing	0.15			
Total hot rolled coil	1.61			
Power station	0.1 – 0.15(?)	27		N_2, O2, NO, NO_2, SO_x, water, dust,

Interactions between EIIs

- Most capture technologies can be applied to several if not all the EIIs,
- All capture technologies are CAPEX and energy demanding: the latter opens the door to monetize waste heat for capture purpose,
- Some EIIs will play a significant role in decarbonising other industries
    - Hydrogen for steel industry,
    - Mineralisation (involving the cement industry) for CO_2 storage in all industries,
    - Chemical industries by providing chemical utilisation of CO_2,
    - Oil and Gas industries by providing transport and geological storage solutions.
- Examples of today's collaboration between industries are shown in the report.

- The report will be published by the next fall CSLF Technical Group Meeting.

- Thanks for your attention!

Back-up

Still to be improved/implemented

- Interactions between EIIs (we have been working for a relatively short time on this).
- English to be improved (we might drop reviewing the annex).
- Make sure that we took on board the last comments (we know there are a few comments which were not taken on board yet).
- There might be some room for new ideas too.

Main contributors to this report

- France
- Norway
- Canada
- Saudi Arabia
- IEAGHG
- Sectorial business organisation and companies covering the full perimeter.