INDUSTRIAL ENERGY USE AND CO_2 EMISSIONS IN IEA MODELLING

KEY CHALLENGES AND TOOLS FOR MODELLING PROCESS INTEGRATION

Kira West, IEA
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This presentation will give an overview of current and future IEA work related to industrial energy consumption and CO_2 emissions; key ETP 2017 results; an introduction to modelling methodology; and a discussion of the challenges and gaps in this methodology with respect to representing process integration.

The International Energy Agency (IEA) has several modelling tools for estimating industrial energy consumption and CO_2 emissions. These modelling tools are used to develop long-term scenarios for the energy system, feeding into reports such as *Energy Technology Perspectives*, *Tracking Clean Energy Progress*, the *World Energy Outlook*, and the *Technology Roadmaps* series. These tools cover the whole energy system (see Figure 1). For the industrial sector, they focus on five energy-intensive sectors in technology detail, for 39 world regions, and estimate the total industrial sector energy use and CO_2 emissions (see Figure 2). Process integration (PI), a key lever for reducing industrial energy consumption and emissions, is challenging to include in these tools, but there are opportunities to improve the representation of benefits of PI within these frameworks.

The ETP industry model focuses on four key levers for CO_2 emissions reductions: energy efficiency and best available technology (BAT) deployment, fuel and feedstock switching, innovative processes including carbon capture and storage (CCS), and material efficiency. Because the model focuses on national and regional averages, and does not go into plant- or site-level detail, process integration as a specific lever is difficult to measure. However, certain elements of process integration are included, such as utilisation of industrial excess heat for electricity generation, integration of pulp and paper mills, recovery and utilisation of blast furnace and coke oven gases, and synergies for CO_2 capture among dilute and concentrated flue gas streams. See Figures 3 and 4 for an example of analysis of technical potential for recovery of excess thermal energy in the cement and iron & steel sectors.

Energy Technology Perspectives 2017 (ETP 2017), forthcoming in June 2017, will provide insights into how CO_2 emissions reductions can be achieved in the 2 Degrees Scenario (2DS) compared to the Reference Technology Scenario (RTS) through 2060 throughout the energy system. In the industrial sector, improved energy efficiency and BAT deployment plays a major role in the achieving the necessary cumulative emissions reductions, in part through process integration techniques in the energy intensive sectors that allow further energy efficiency opportunities to be tapped and synergies across sectors to be exploited. The publication also includes a more aggressive low-carbon scenario, called Beyond 2 Degrees Scenario (B2DS), to show the scale of the challenge of international CO_2 emissions mitigation ambitions, which illustrates the dramatic shifts necessary to further reduce CO_2 emissions beyond the 2DS levels.

The limitations of publicly available data are among the main challenges of improving modelling of process integration. Limited information is available on geospatial information, temperature level differentiation, and site-specific characteristics, all of which play important roles in determining the potential for process integration in industrial sectors. Filling these data gaps by improving public information would improve capabilities for modelling process integration in the IEA as well as other organisations.

The IEA plans to continue improving its modelling capacity and tools in this area, with input and dialogue with external experts, including IETS and its members. The presentation will give an

overview of upcoming work streams, annual schedule and opportunities for interaction with external experts. A particularly relevant initiative, an upcoming publication on *Digitalisation and Energy*, will be discussed in light of its synergies with process integration work, as well as the proposed IETS Annex on digitalisation in the industrial sector.

Key questions:

- Which industrial sectors have the most potential for energy benefits from implementing process integration techniques? How can these be quantified?
- What are the major barriers to further implementation of process integration techniques in industry?
- Which policy options are available to capture the full potential of process integration in industry?
- How could publicly available data be improved and techno-economic studies be carried out for better public understanding of the applications and potentials of process integration in industry?
- How can plant configurations be categorised to provide sufficient detail for improvement potential factors in modelling process integration?
- What roles do digitalisation and digital technology play in process integration? How can digital technology be harnessed to provide process integration and energy benefits in the industrial sector? What are the major synergies with process integration in the area of digitalisation?

Figure 1: IEA/ETP model structure

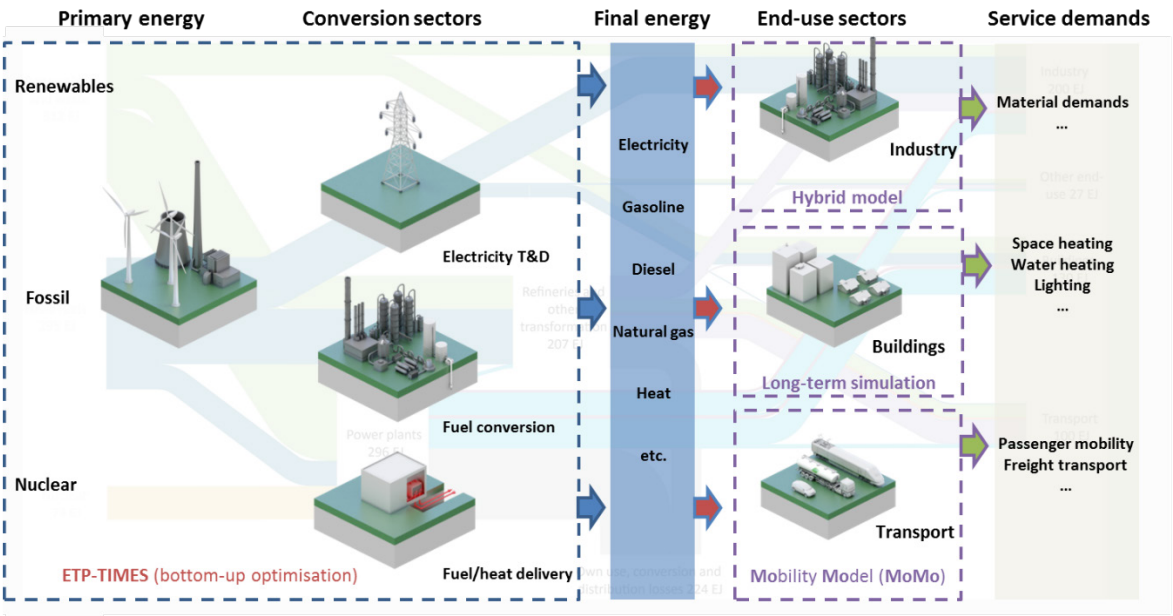


Figure 2: IEA/ETP Industry model structure

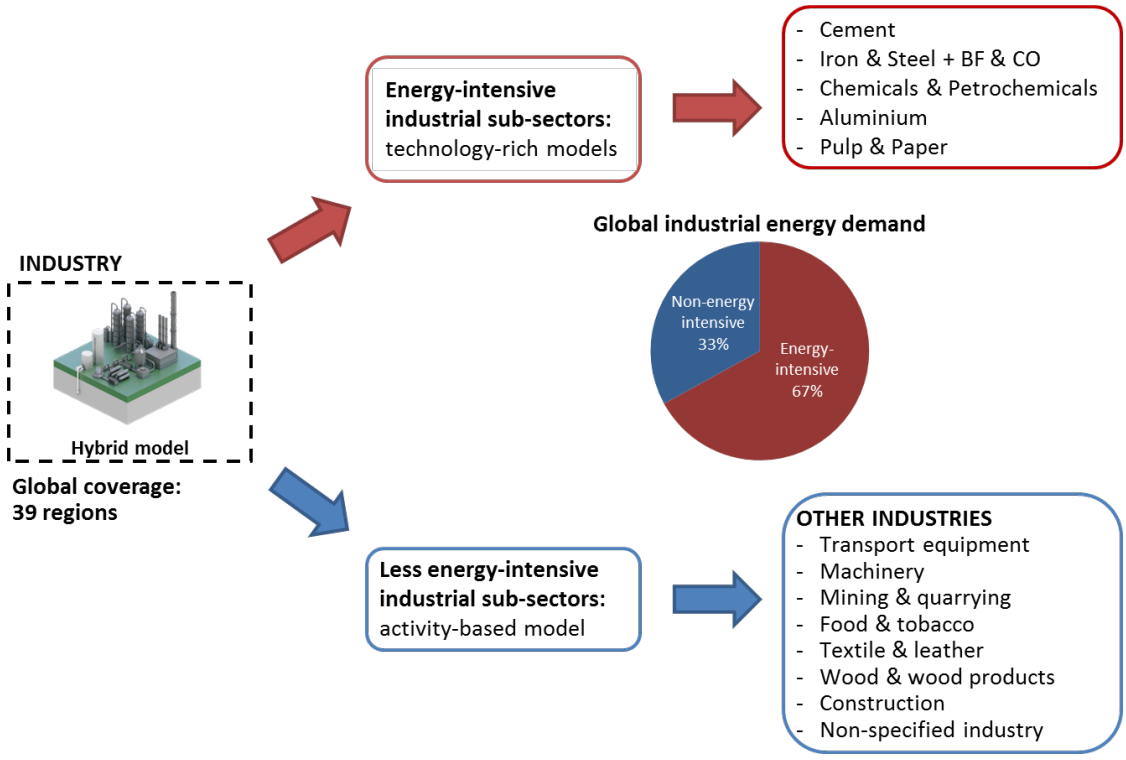
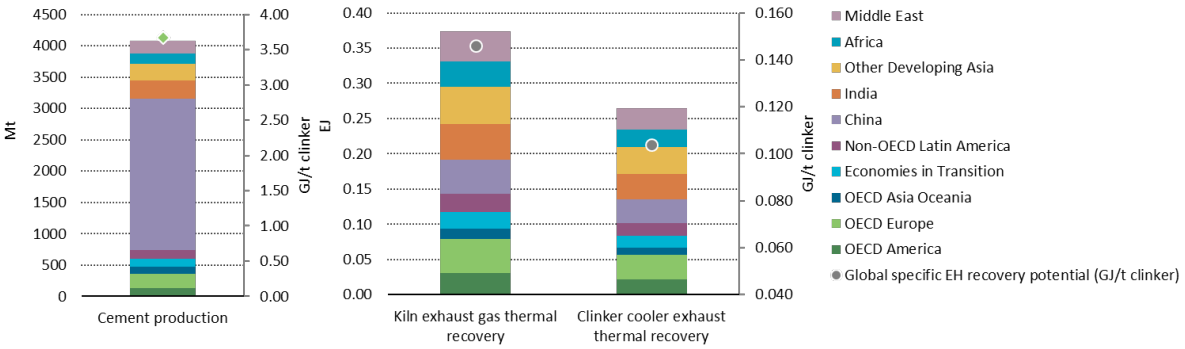
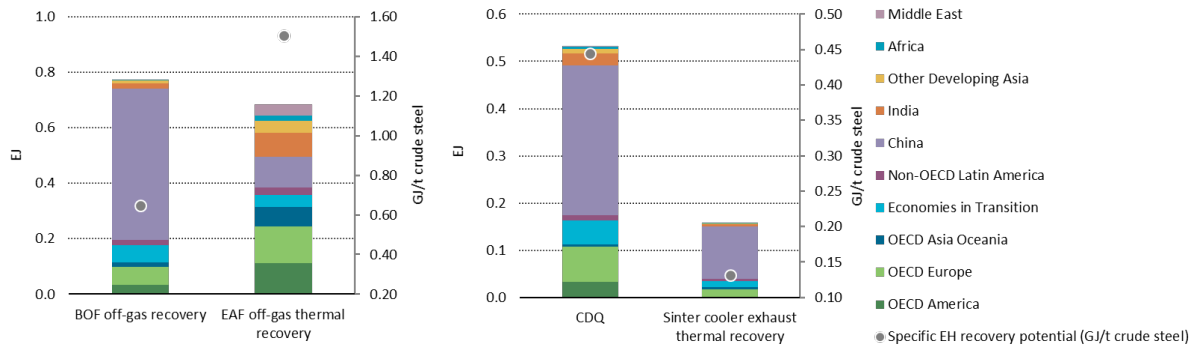


Figure 3: Technical thermal recovery potential from selected applications in the cement sector



Source: IEA (2016), *Energy Technology Perspectives 2016*, OECD/IEA, Paris.

Figure 4: Technical thermal recovery potential from selected applications in the iron & steel sector



Source: IEA (2016), *Energy Technology Perspectives 2016*, OECD/IEA, Paris.

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