Measuring industrial energy and GHG emissions – iron & steel and petrochemicals

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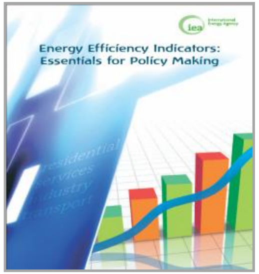
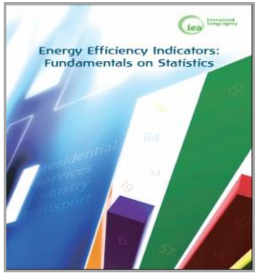
IEA's Industry Analysis

- **Energy Efficiency Indicators**
  - Trends in energy use and CO_2 emissions
  - Produce meaningful cross-country analysis to help identify EE opportunities and progress
  - Tracking Clean Energy Progress
- **Energy modelling and scenarios**
  - Role of future technologies and development of transition pathways
  - Modelling at sub-sector level with regional detail
  - Energy Technology Perspectives
- **Sector Roadmaps**
  - Working with industry to develop an implementable low carbon strategy for the sector

IEA Energy Efficiency Indicators

- **Manual provides an overview of existing IEA Indicators**
- **Ambition to develop meaningful indicators and cross-country comparisons**
- **Quantify energy efficiency**
  - Past trends according to existing IEA decomposition analysis
  - Future trends based on detailed end-use models





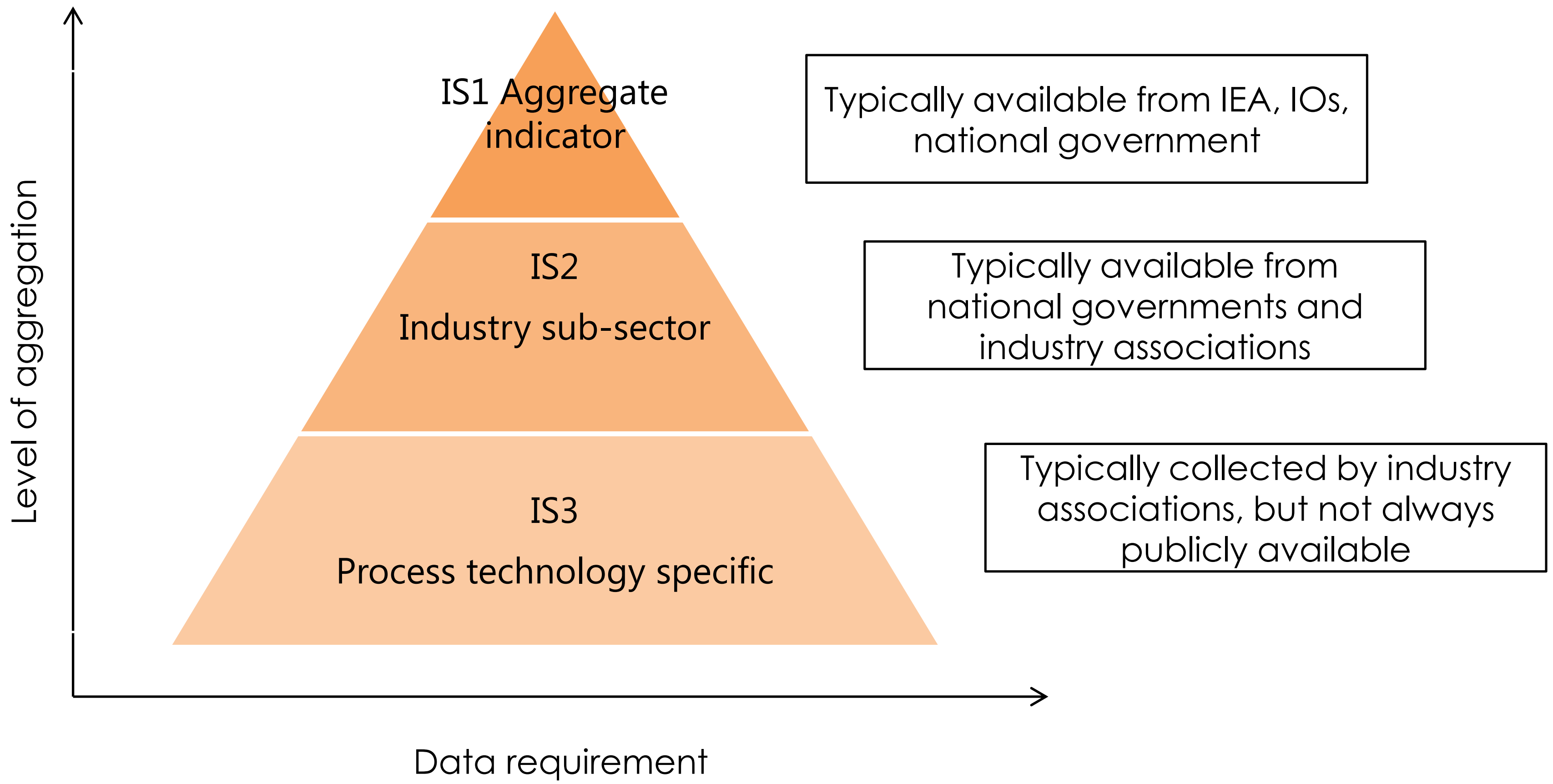
The right data for the adequate indicators

Indicator	Coverage	Energy data	Activity data	Limitations
Energy consumption per unit of physical output	Sub-sector	Total sub-sectoral energy consumption	Sub-sectoral physical output	• Not possible to compare across countries because of differences in industrial structures
	Process/ product type	Process/product type energy consumption	Process/product type output	• Can be influenced by operational factors in process technology
Energy consumption per unit of value added	Sub-sector	Total sub-sectoral energy consumption	Sub-sectoral value added	• Not possible to compare across countries because of differences in industrial structures • Value-added is influenced by a range of pricing effects unrelated to physical production or energy efficiency
	Process/product type	Process/product type energy consumption	Process/product type value added	• Can be influenced by operational factors in process technology • Value-added is influenced by a range of pricing effects unrelated to physical production or energy efficiency

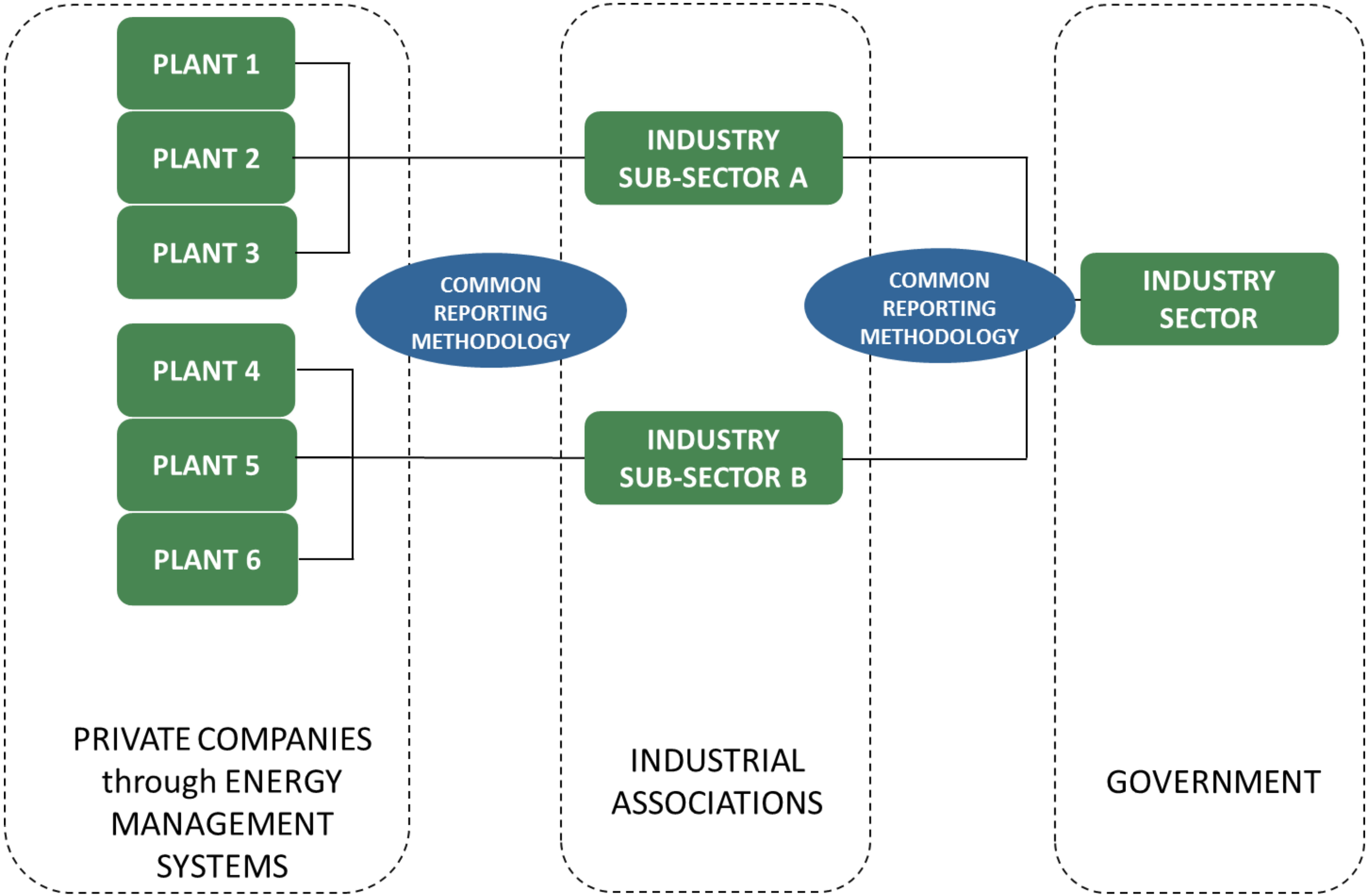
Data challenges

- **Boundary issues**
  - Definitions and boundaries of products, processes, and sectors should be defined clearly to allow for standardised data and easily comparable indicators
  - IEA approach based on UN Statistics' International Standard Industrial Classification (ISIC) definitions
- **Quality of input resources**
  - Some input materials, such as ores and alternative fuels, can vary significantly in terms of quality and energy content.
  - Ensure that factors used accurately reflect the local context, and that data is collected on a standardised basis.
- **Allocation of co-generation and on-site generation data**
  - These should be accounted for at the site level to ensure accurate accounting of energy efficiency and emissions. However, boundaries (particularly for surplus heat and electricity sold) should be clearly defined.

Where to get the data from?



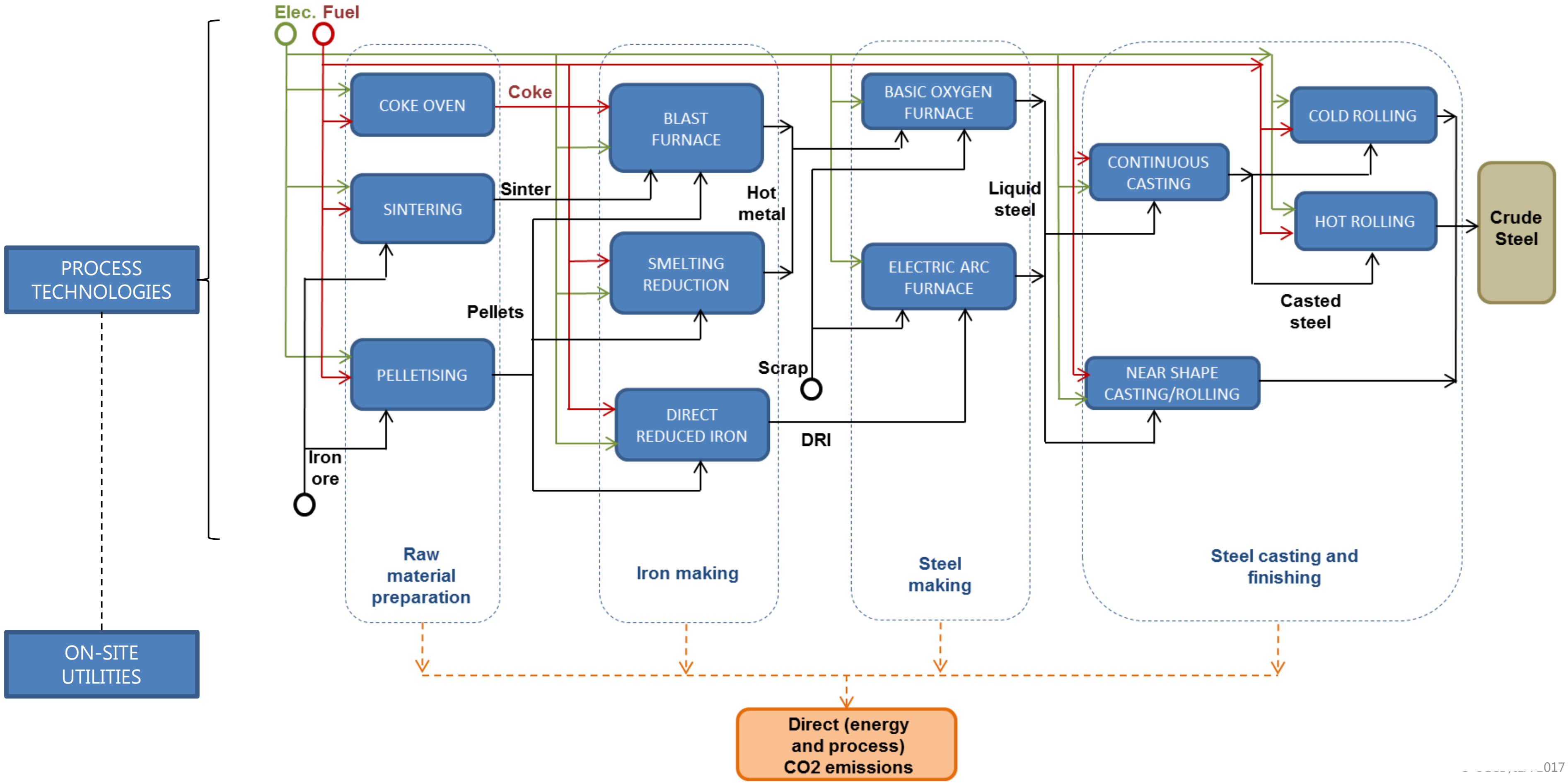
Bottom-up data collection process



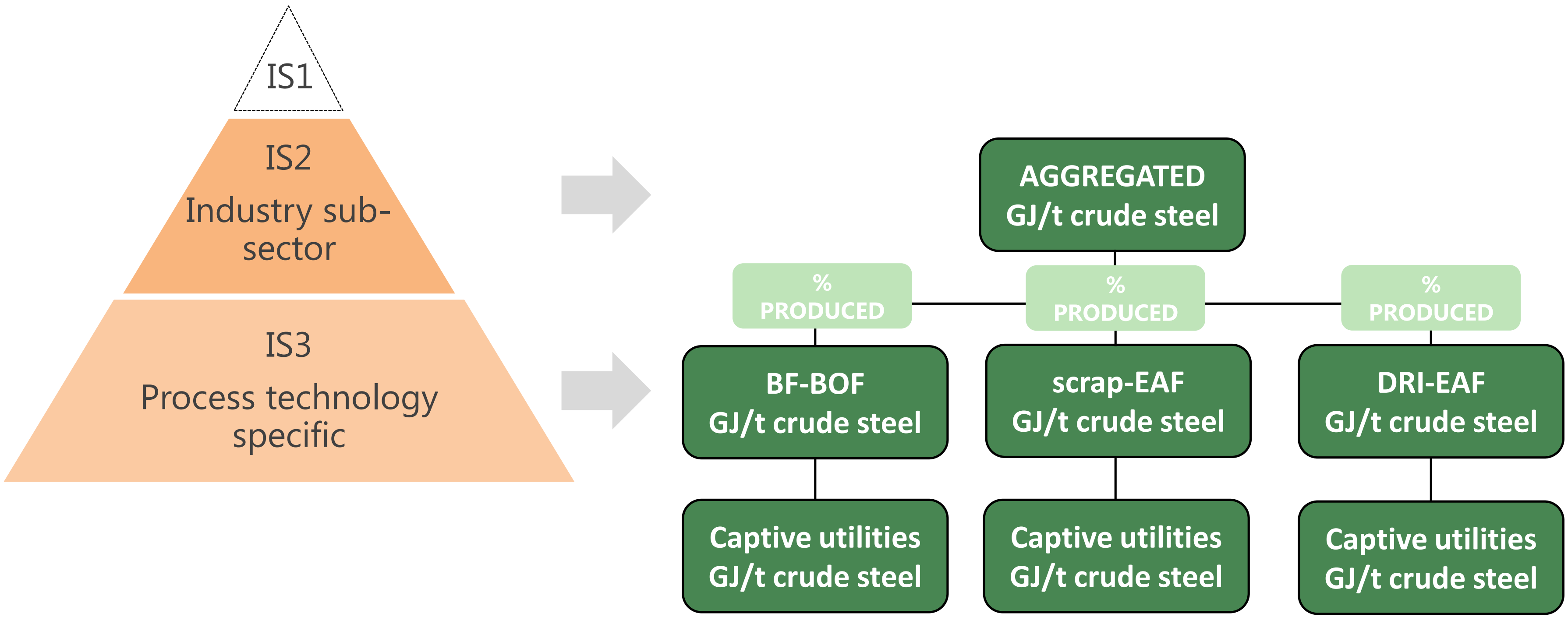
Industrial data collaboration initiatives – global level

- **World Steel energy and CO_2 performance database**
  - Voluntary reporting by members
  - Anonymous site- and process-level data available to World Steel members only for benchmarking purposes
- **Cement Sustainability Initiative (CSI) – Getting the Numbers Right (GNR) Database**
  - Voluntary reporting (21% of global cement production)
  - Publicly available country-level data and indicators for some countries, more detailed data available to members only
- **World Aluminium statistics**
  - Voluntary reporting by member and non-member companies
  - Publicly available data and indicators at regional level
  - Data also available from member associations

Iron & Steel sector: setting the boundaries

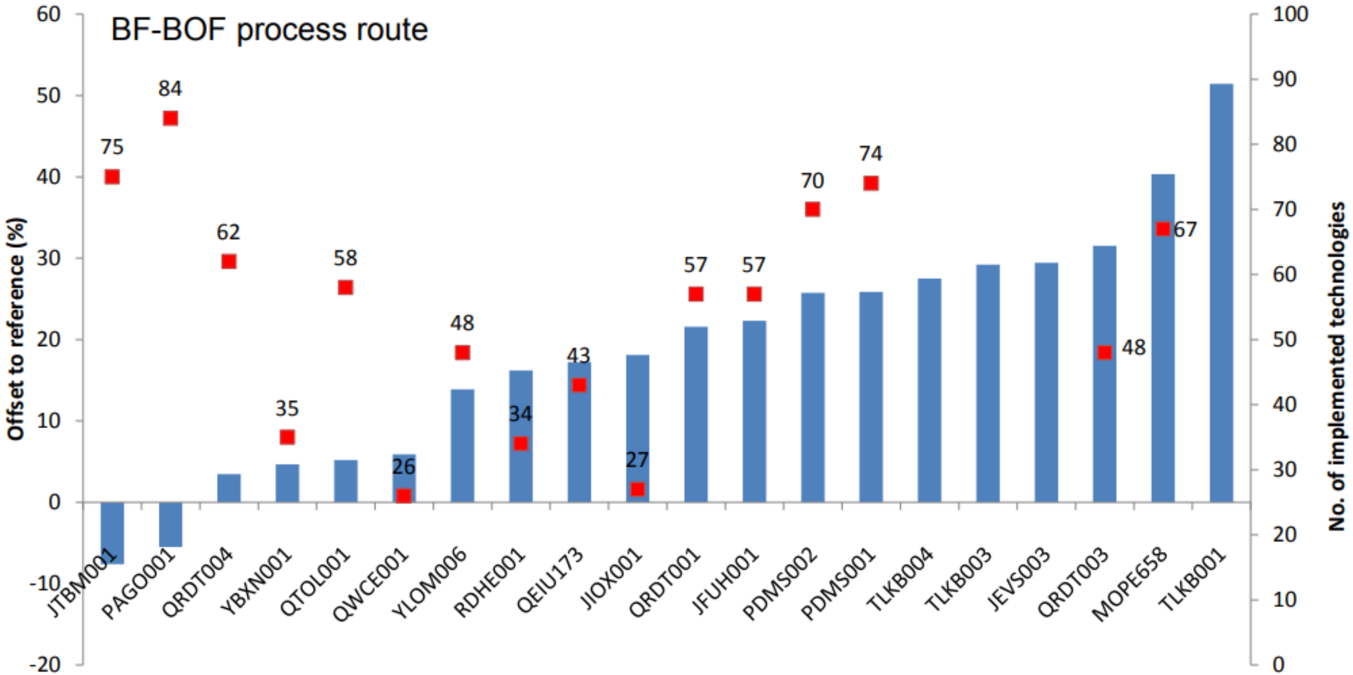


Example of country/regional iron and steel energy indicators



Sub-sector level energy performance indicators should be encompassed with process technology level indicators to account for structural differences

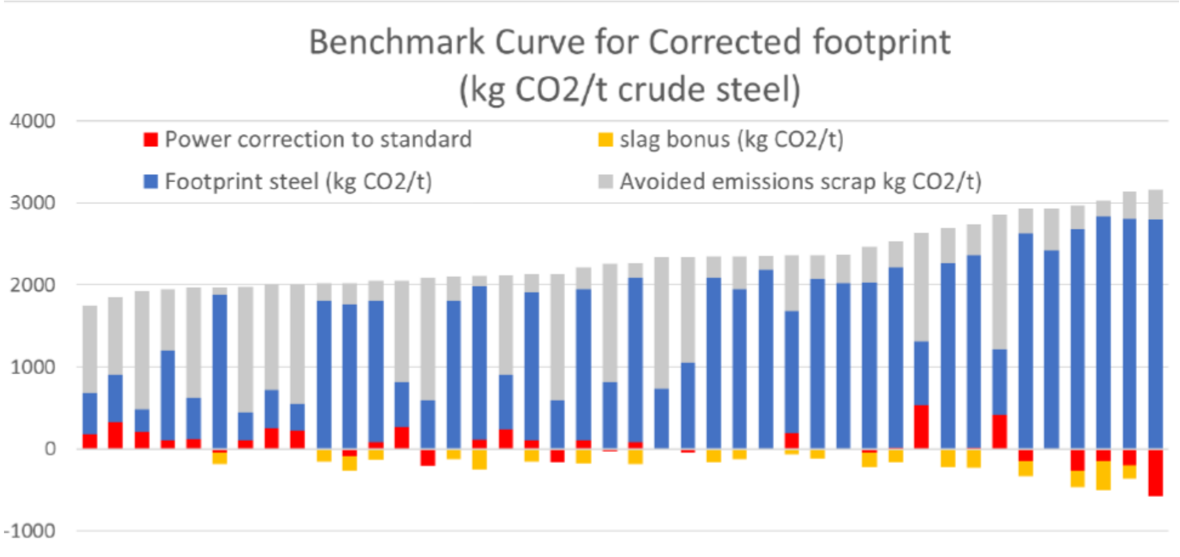
Reported site-level energy intensity and number of EE measures implemented



Source: Worldsteel 2014, presentation at IEA Global Industry Experts Dialogue Workshop, 2014.

Plant-specific integration level and operational characteristics shouldn’t be neglected when assessing energy performance

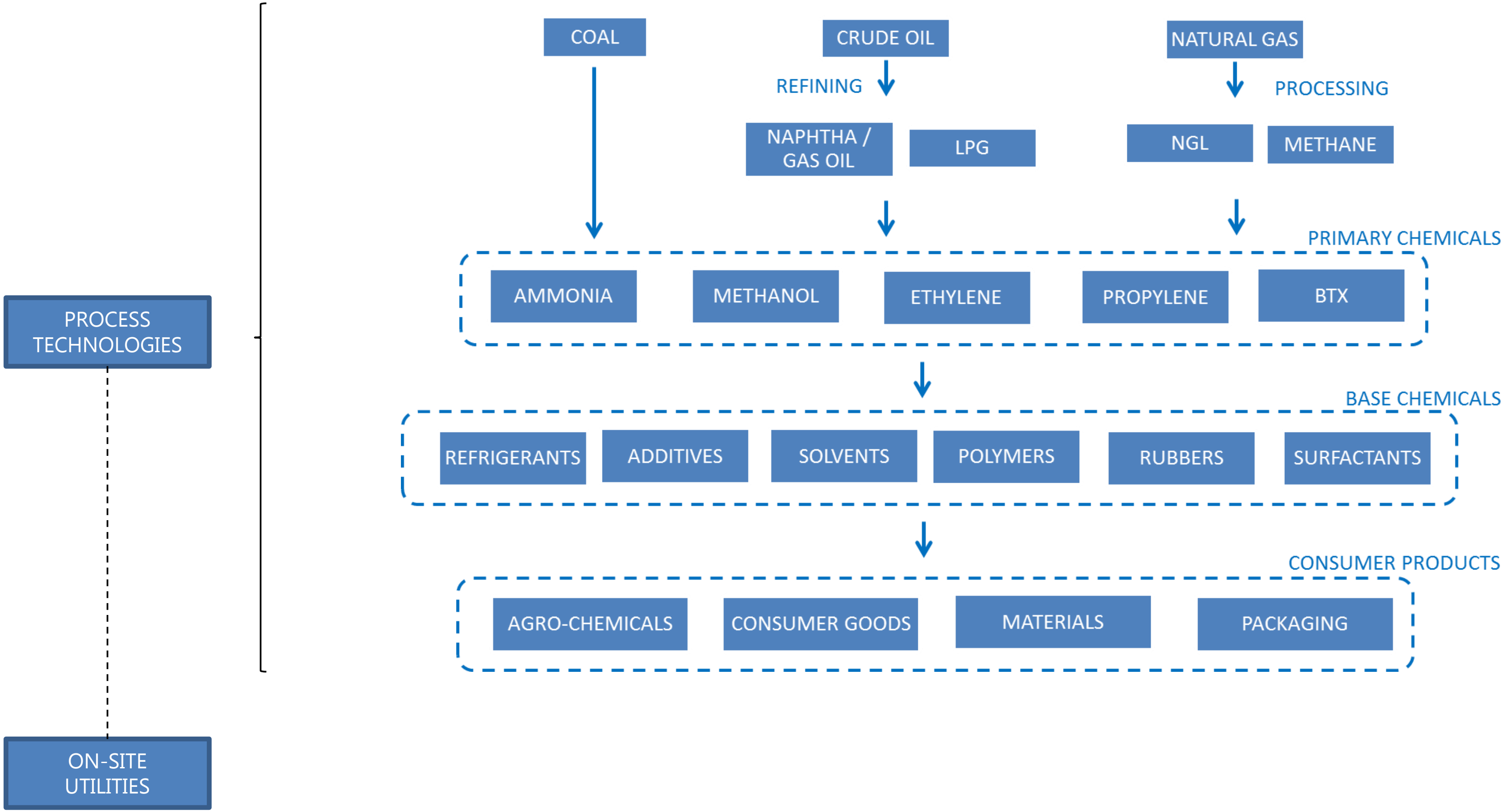
Operational/local differences impacting energy performance



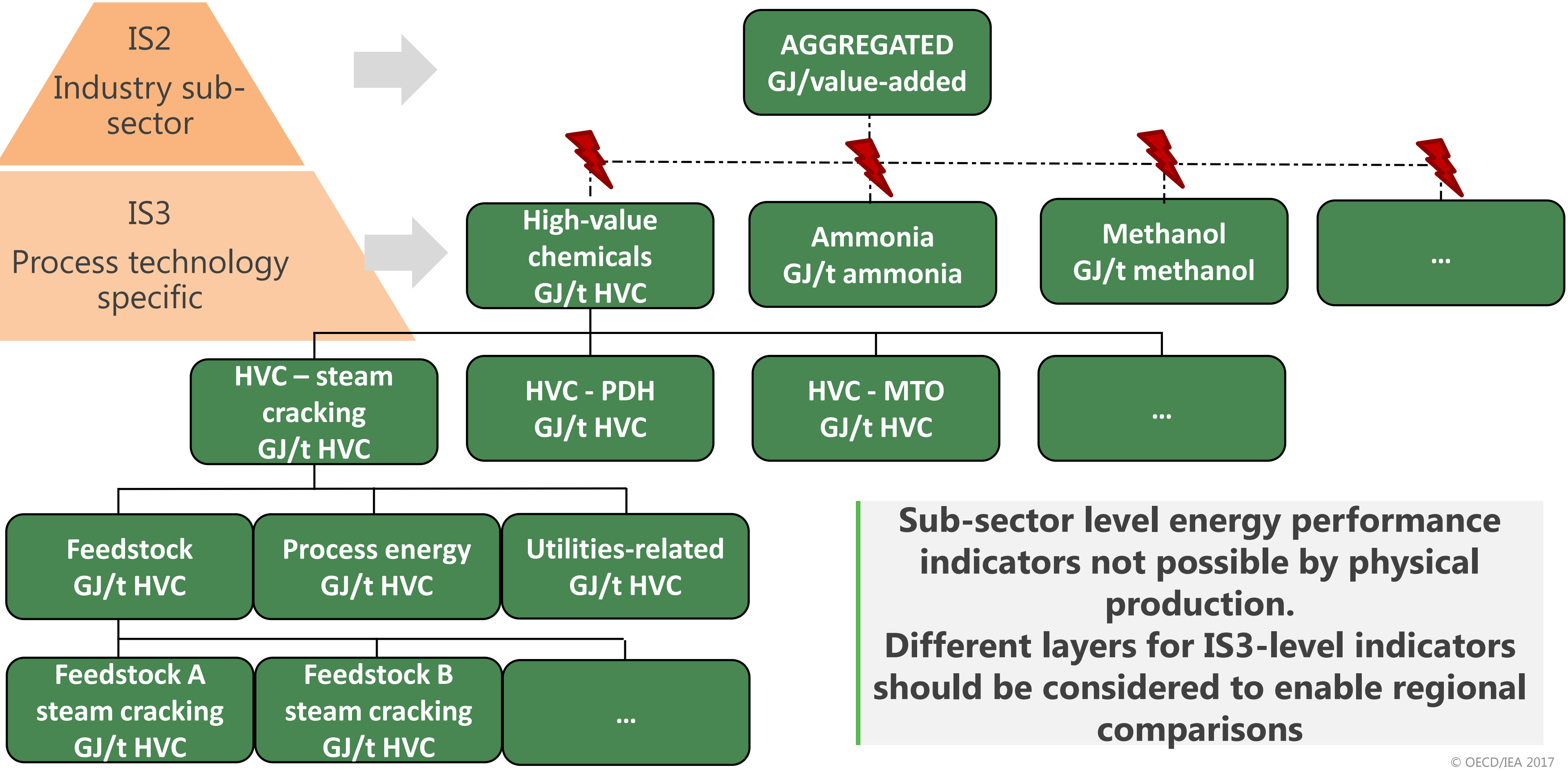
Source: ArcelorMittal 2017, presentation at IEA kick-off workshop Global Iron and Steel Technology Roadmap, 2017.

Amount of scrap use, quality of iron ore and CO_2 footprint on electricity used impact the aggregated CO_2 footprint of crude steel. Benchmarking needs to take these into account.

Chemicals and petrochemicals: setting the boundaries

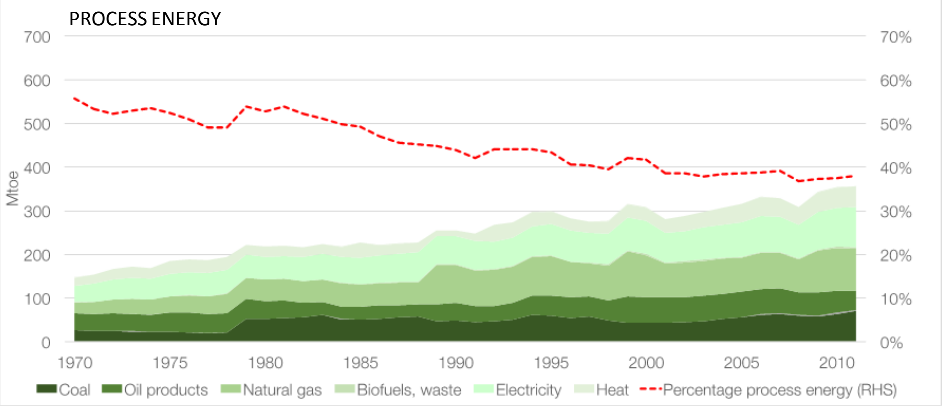


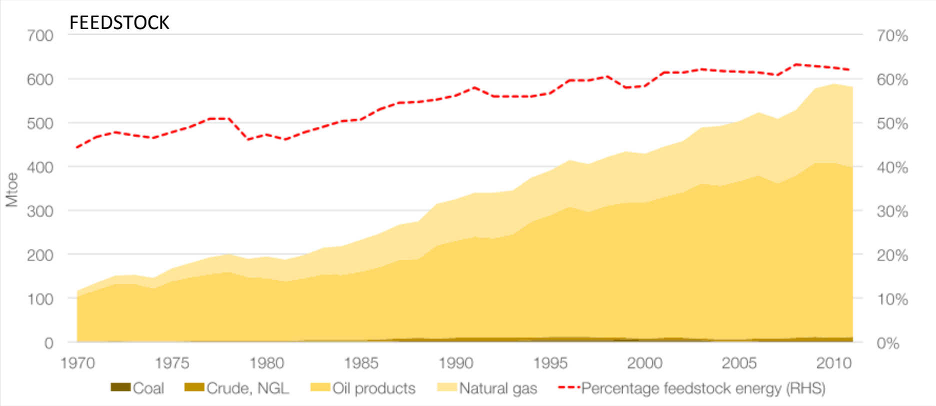
Example of country/regional chemicals energy indicators



Sub-sector level energy performance indicators not possible by physical production.
Different layers for IS3-level indicators should be considered to enable regional comparisons

Feedstocks evolution over total sub-sector energy use





Source: IEA (2016) *World Energy Balances.*

Feedstock accounts for an increasing share of the chemicals sub-sector's overall energy inputs as a result of process energy efficiency improvements and structural changes in chemicals production

Examples of literature on best available technologies

- Tracking Industrial Energy Efficiency and CO_2 emissions, IEA 2007.

  http://www.iea.org/publications/freepublications/publication/tracking_emissions.pdf

- World Best Practice Energy Intensity Values for Selected Industrial sectors, LBNL 2008.
- Available and emerging technologies for reducing GHG from the Iron&Steel industry, US EPA 2012.
- Steel's contribution to a low-carbon Europe 2050, BCG 2013.
- Energy and GHG Reductions in the Chemical Industry via Catalytic Processes, IEA, Dechema and ICCA, 2013.

  http://www.iea.org/publications/freepublications/publication/technology-roadmap-chemical-industry-via-catalytic-processes.html

Considering best available technology energy performance information can provide a benchmark context when regional benchmarking from actual performance is not possible

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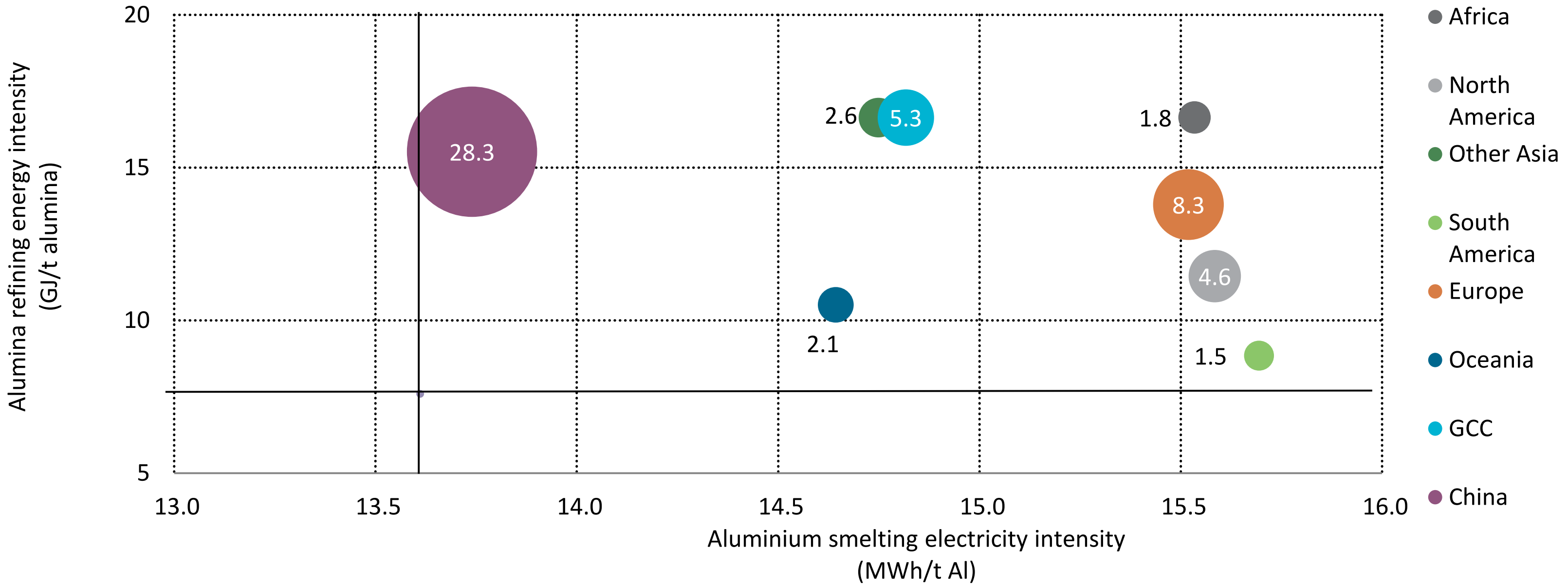
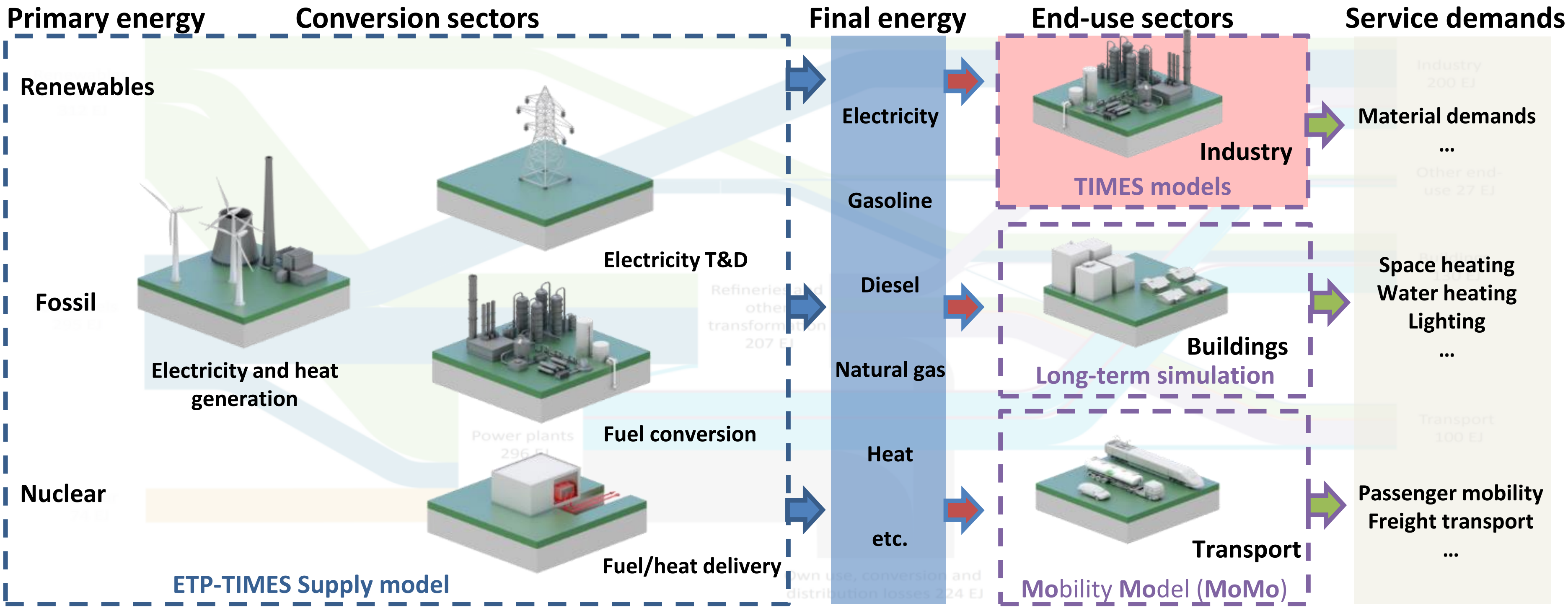
Energy efficiency opportunities in Aluminum sector

Alumina refining and aluminum melting energy intensity, 2014



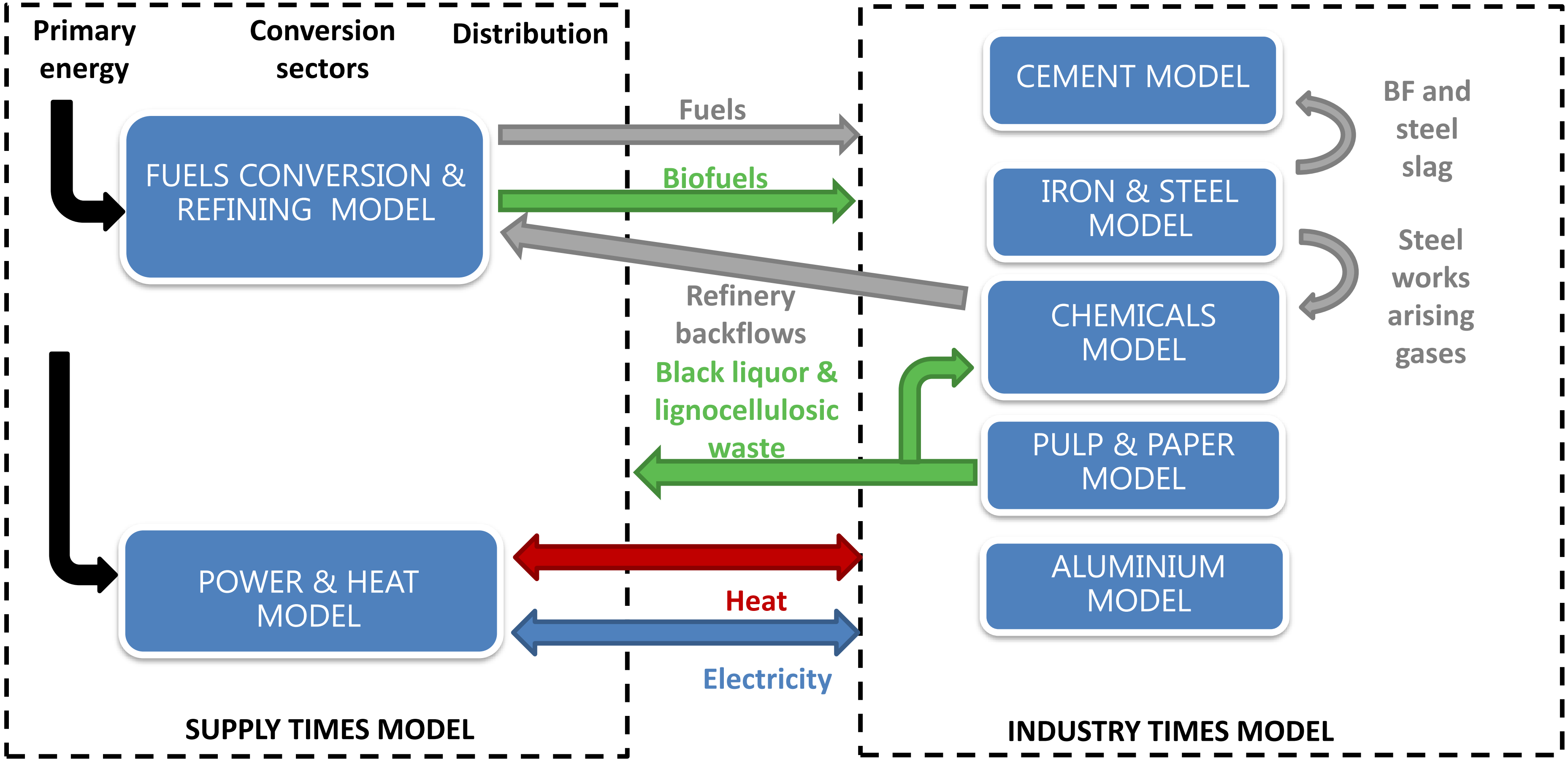
North America shows one of the largest potential for improvements compared to BAT

Energy Technology Perspectives (ETP) modelling framework

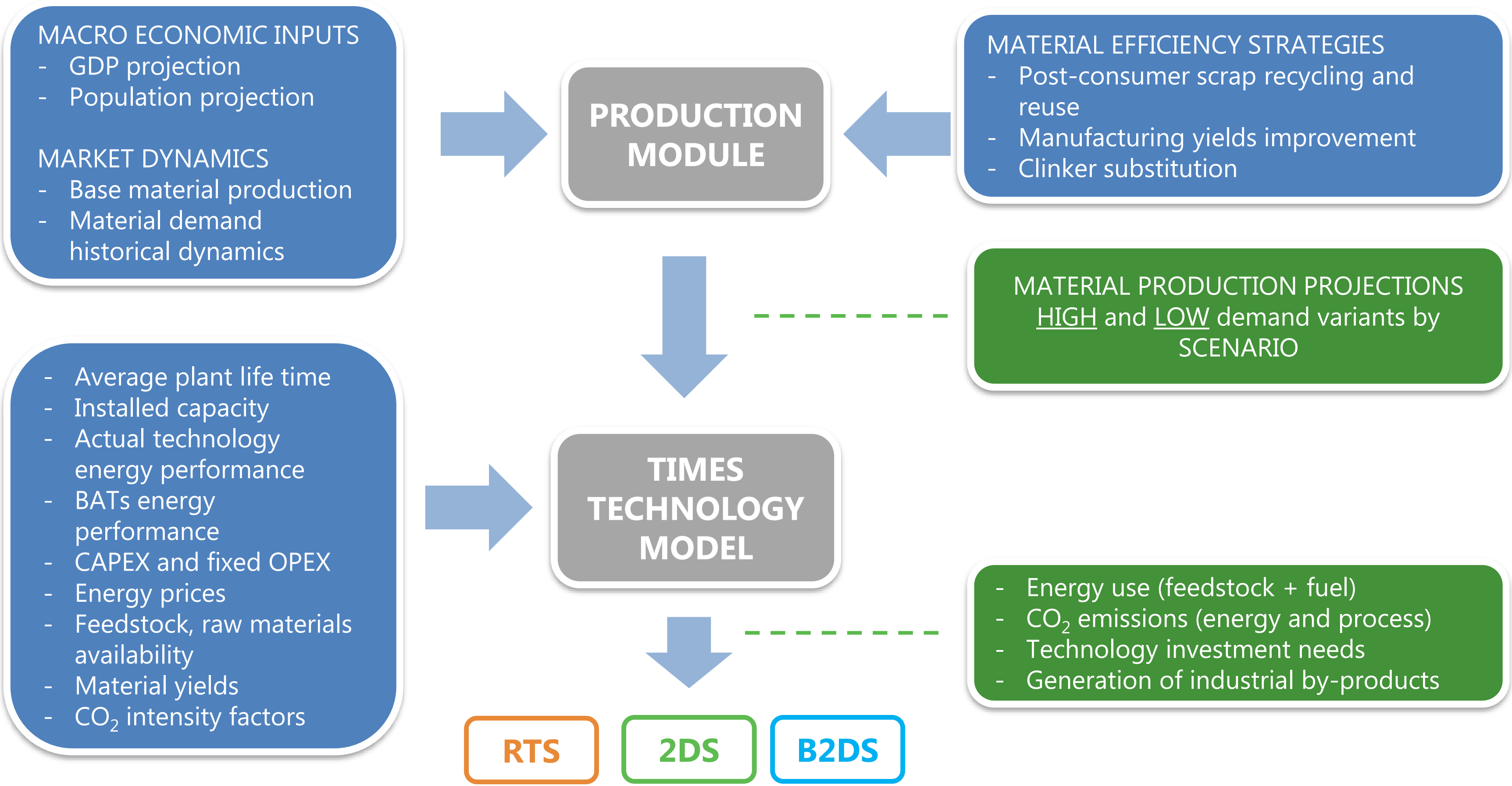


- Four soft-linked models based on simulation and optimisation modelling methodologies
- Model horizon: 2014-2060 in 5 year periods
- World divided in 28-42 model regions/countries depending on sector
- For power sector linkage with dispatch model for selected regions to analyse electricity system flexibility

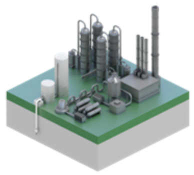
Interactions between ETP Industry and Supply models



ETP industry sub-sector models structure



ETP Industry model scope



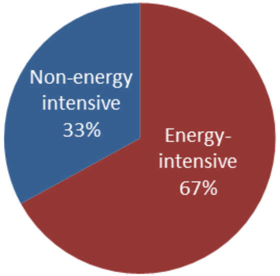
INDUSTRY model

Global coverage:
39 regions

Energy-intensive industrial sub-sectors:
technology-rich models

- Cement
- Iron & Steel + BF & CO
- Chemicals & Petrochemicals
- Aluminium
- Pulp & Paper

Global industrial energy demand



Less energy-intensive industrial sub-sectors:
activity-based model

OTHER INDUSTRIES
- Transport equipment
- Machinery
- Mining & quarrying
- Food & tobacco
- Textile & leather
- Wood & wood products
- Construction
- Non-specified industry