Exploring low-carbon opportunities for materials production in a beyond 2°C world

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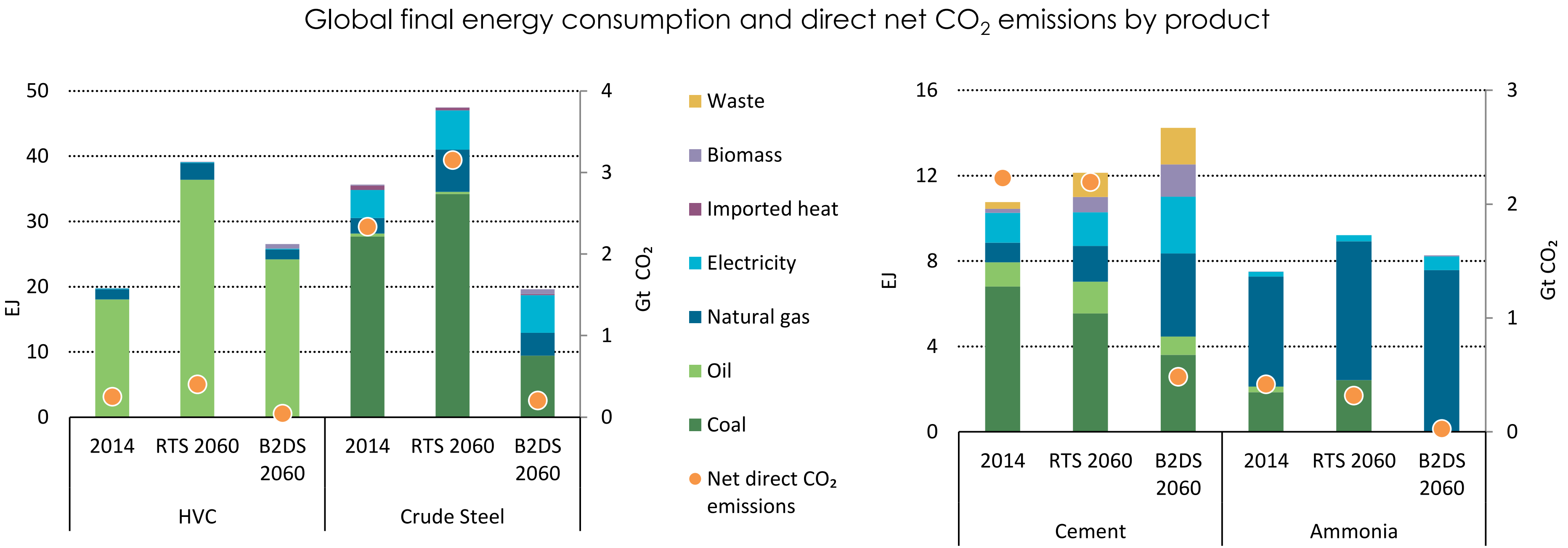
IEA

What are the specific challenges for key materials production?

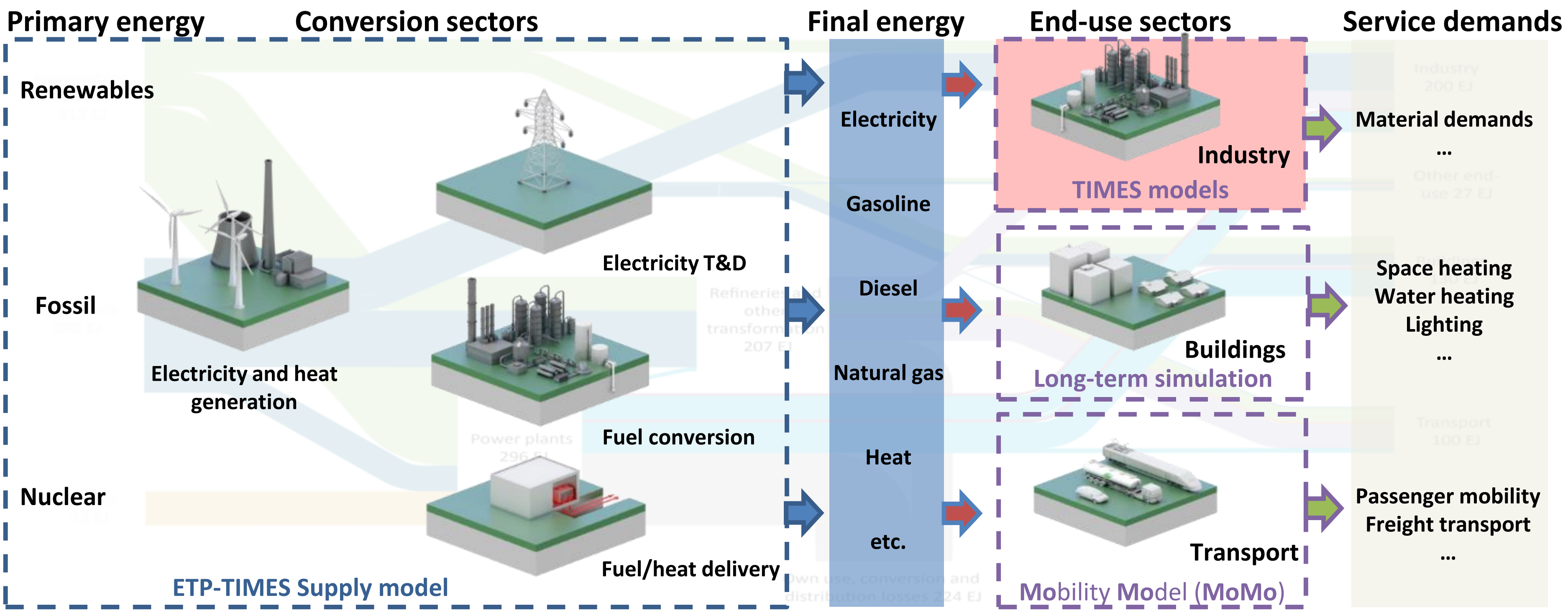


Note: energy use related to blast furnaces and coke ovens is include in crude steel final energy use. Petrochemicals feedstocks energy is included in HVC final energy use. Direct net CO_2 emissions include energy-related and process emissions.

Decoupling direct CO_2 emissions from production of key materials is needed in the B2DS

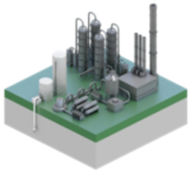
Source: IEA Energy Technology Perspectives, 2017

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

ETP Industry model scope



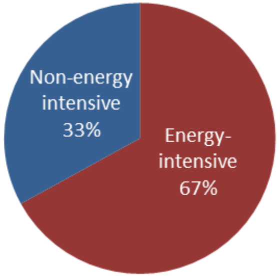
INDUSTRY model

Global coverage:
39 regions

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

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

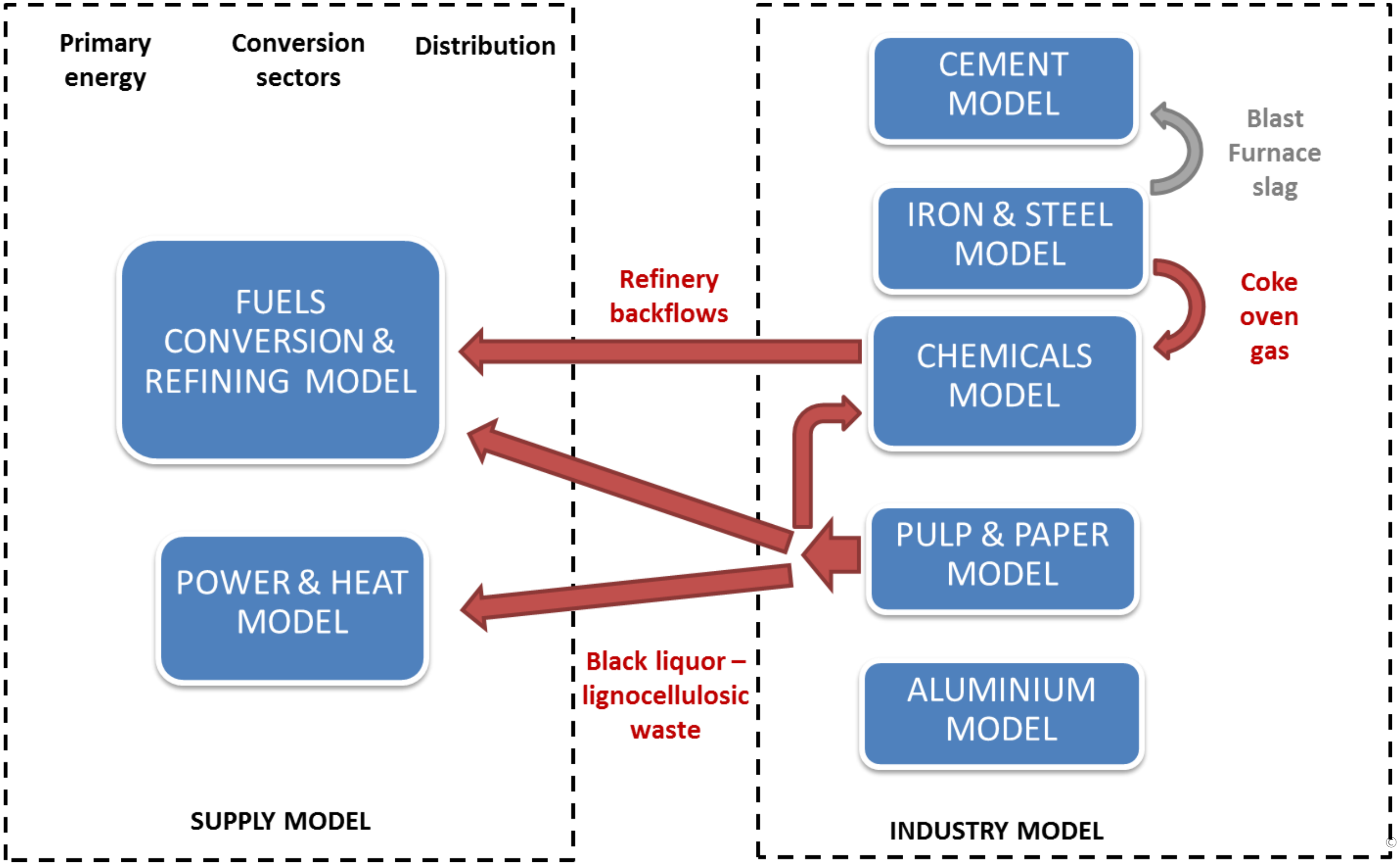
Global industrial energy demand



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

Reverse flows from ETP Industry model to Supply model



ETP materials demand projection methodology

MACRO ECONOMIC INPUTS
- GDP projection
- Population projection

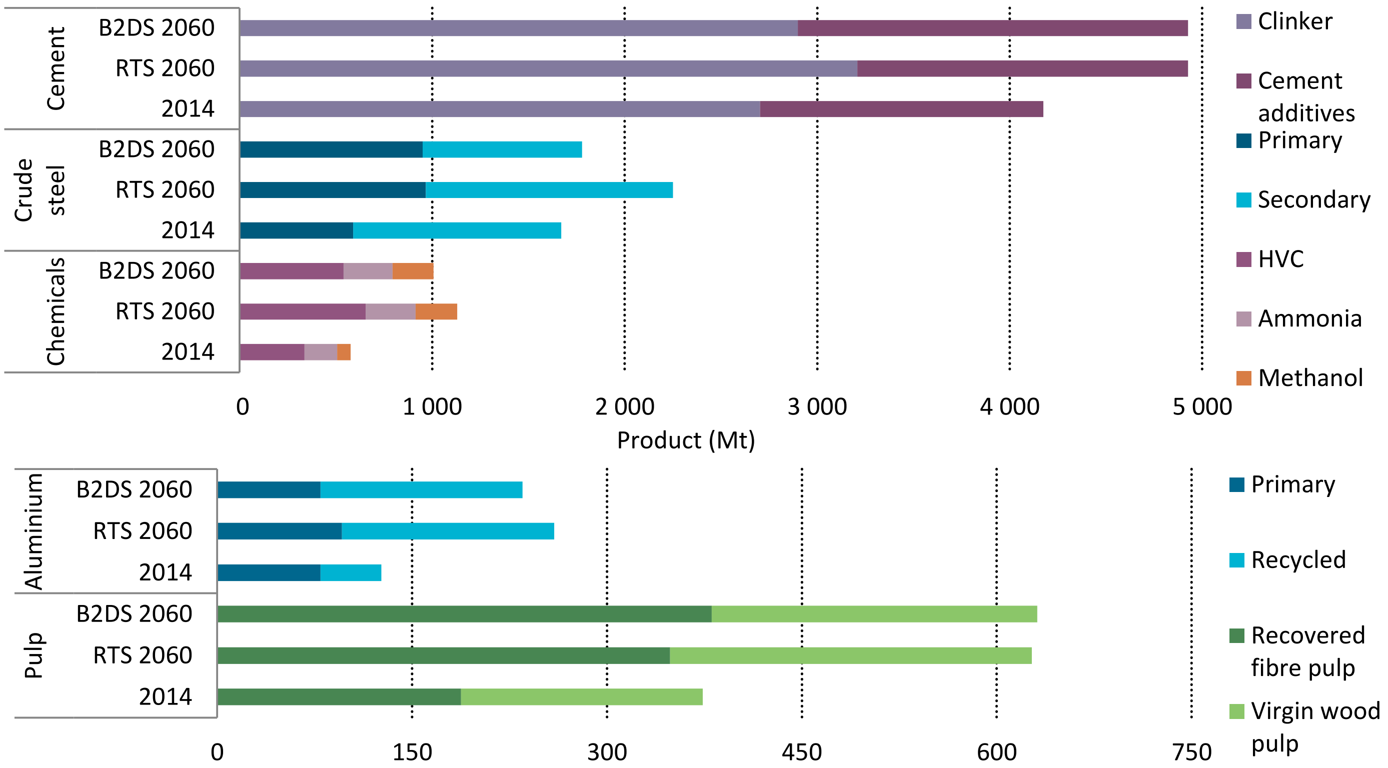
MARKET DYNAMICS
- Base material production
- Material demand historical dynamics

PRODUCTION MODULE

MATERIAL EFFICIENCY STRATEGIES
- Post-consumer scrap recycling and reuse
- Manufacturing yields improvement
- Clinker substitution

MATERIAL PRODUCTION PROJECTIONS
HIGH and LOW demand variants by SCENARIO
- Crude steel
- Cement
- Aluminium
- Ethylene, Propylene, Benzene, Toluene, Xylene, Ammonia and Methanol
- Different types of pulp and paper

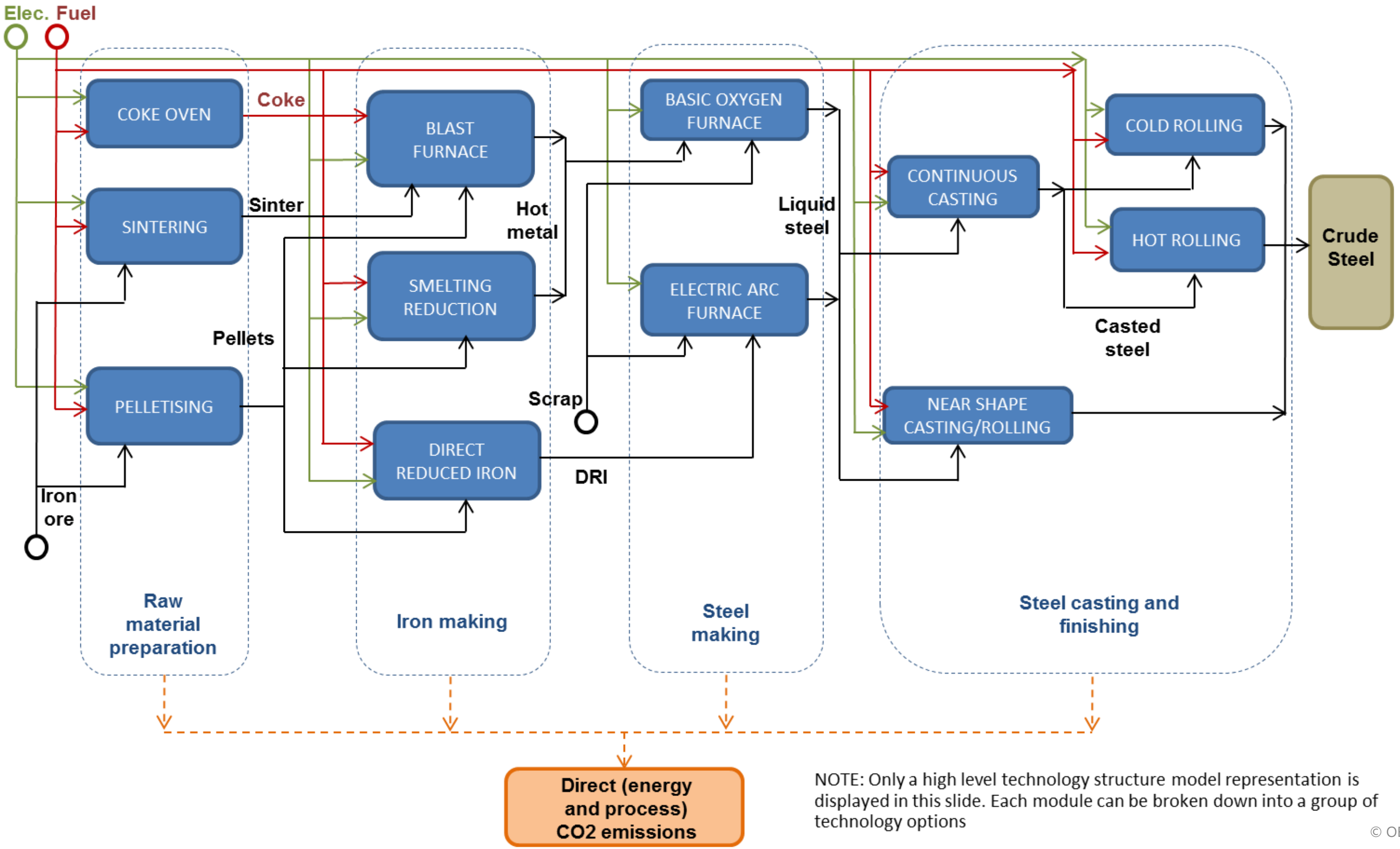
Global material production projections under different contexts



Wider implementation of material efficiency strategies leads to reduced demand for materials, as well as to increased shares of secondary routes of production in the B2DS

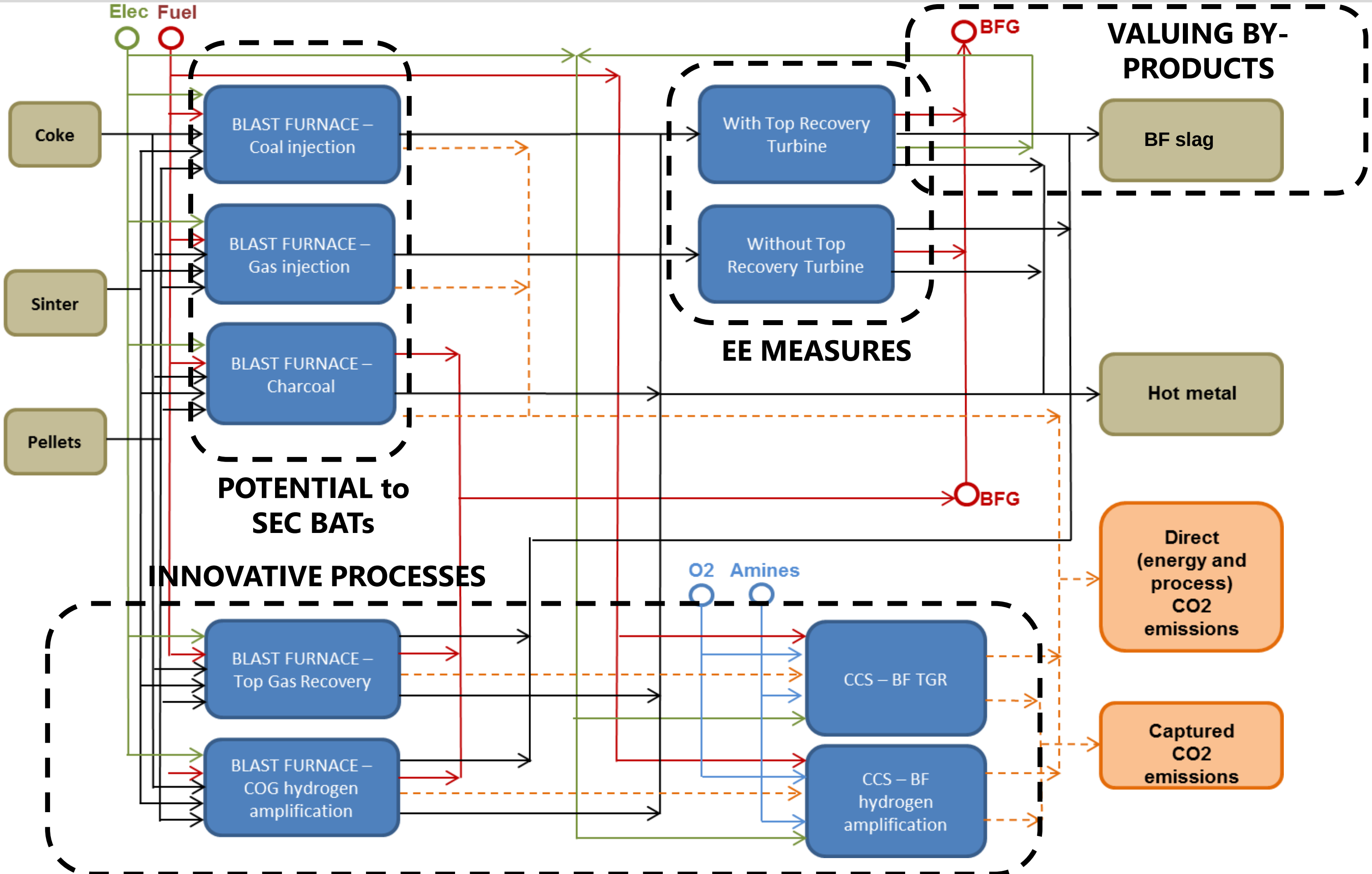
Source: IEA Energy Technology Perspectives, 2017

ETP TIMES Iron & Steel model: High level structure



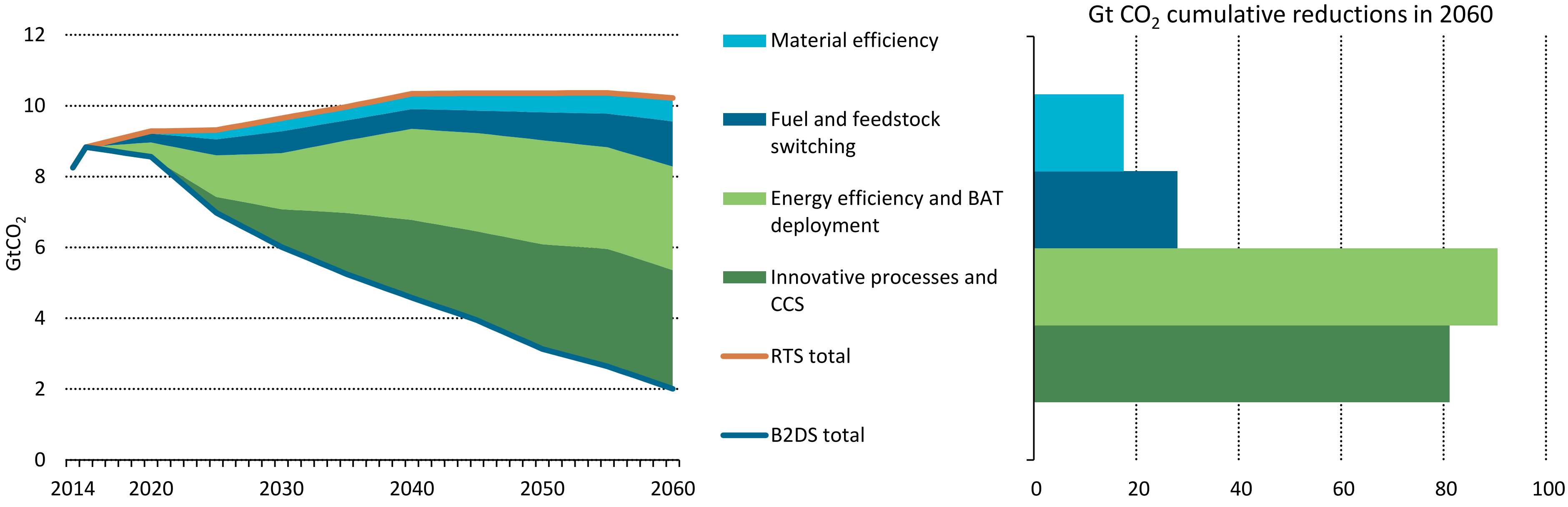
NOTE: Only a high level technology structure model representation is displayed in this slide. Each module can be broken down into a group of technology options

Strategies to improve the sustainability of industrial activities



How can the industrial low-carbon transition be realised?

Global direct industrial CO_2 emissions



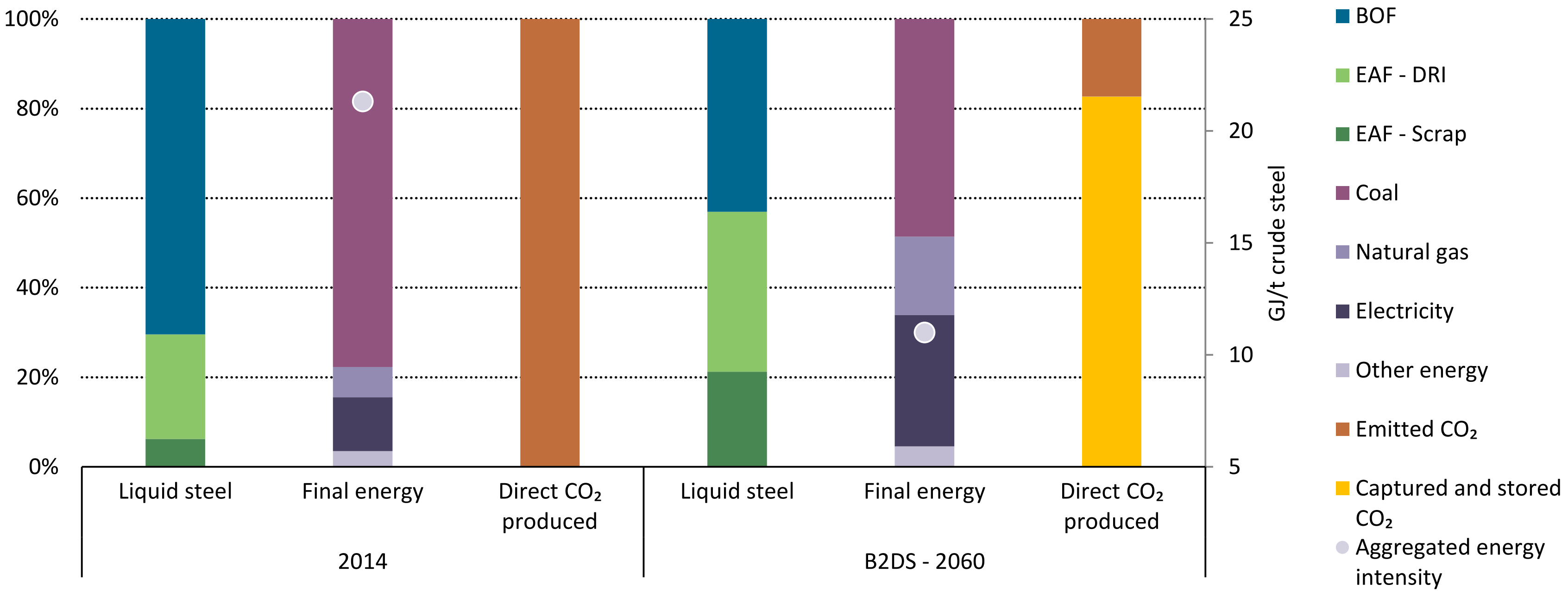
A number of strategies contribute to industrial emissions reductions – there is no silver bullet

Source: IEA Energy Technology Perspectives, 2017

The case of crude steel in the B2DS...

.....combining energy and material efficiency

Global shares of liquid steel by route, final energy and direct CO2 emissions in crude steel making

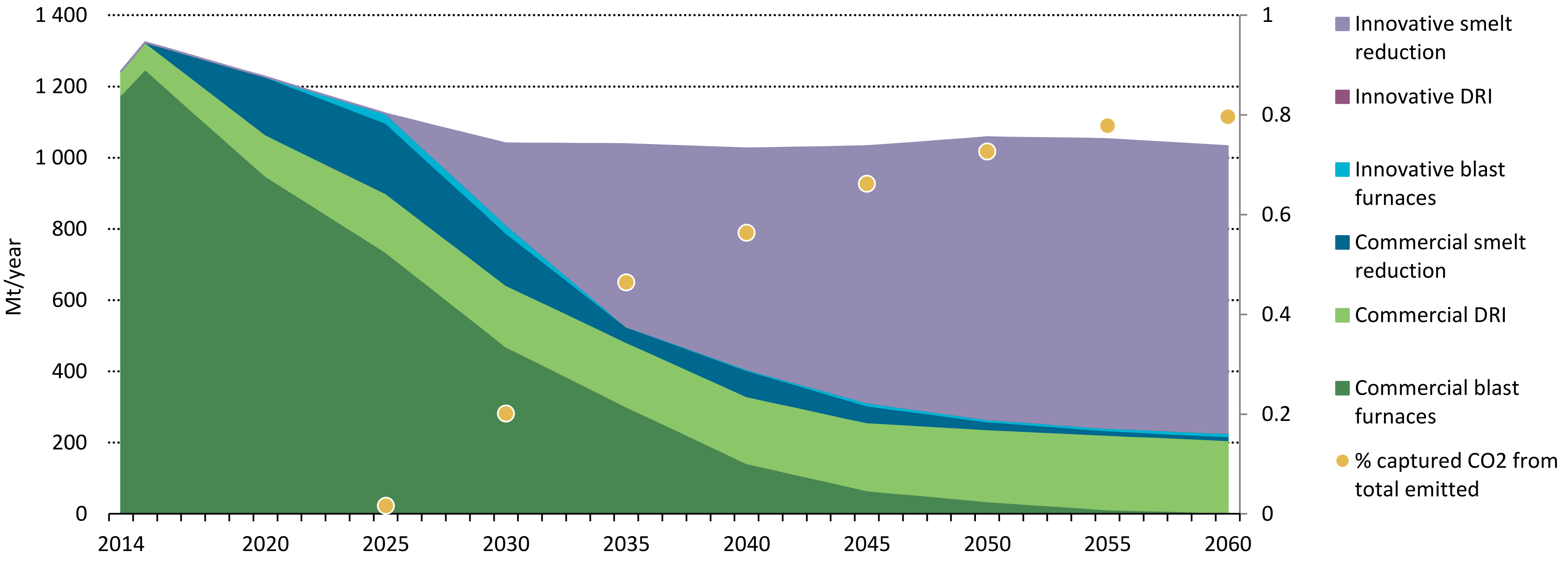


BAT deployment and energy efficiency combined with process route shifts enabled by material efficiency halve the aggregated energy intensity of crude steel in the B2DS by 2060

Source: IEA Energy Technology Perspectives, 2017

Finding alternative sustainable production routes also for primary production

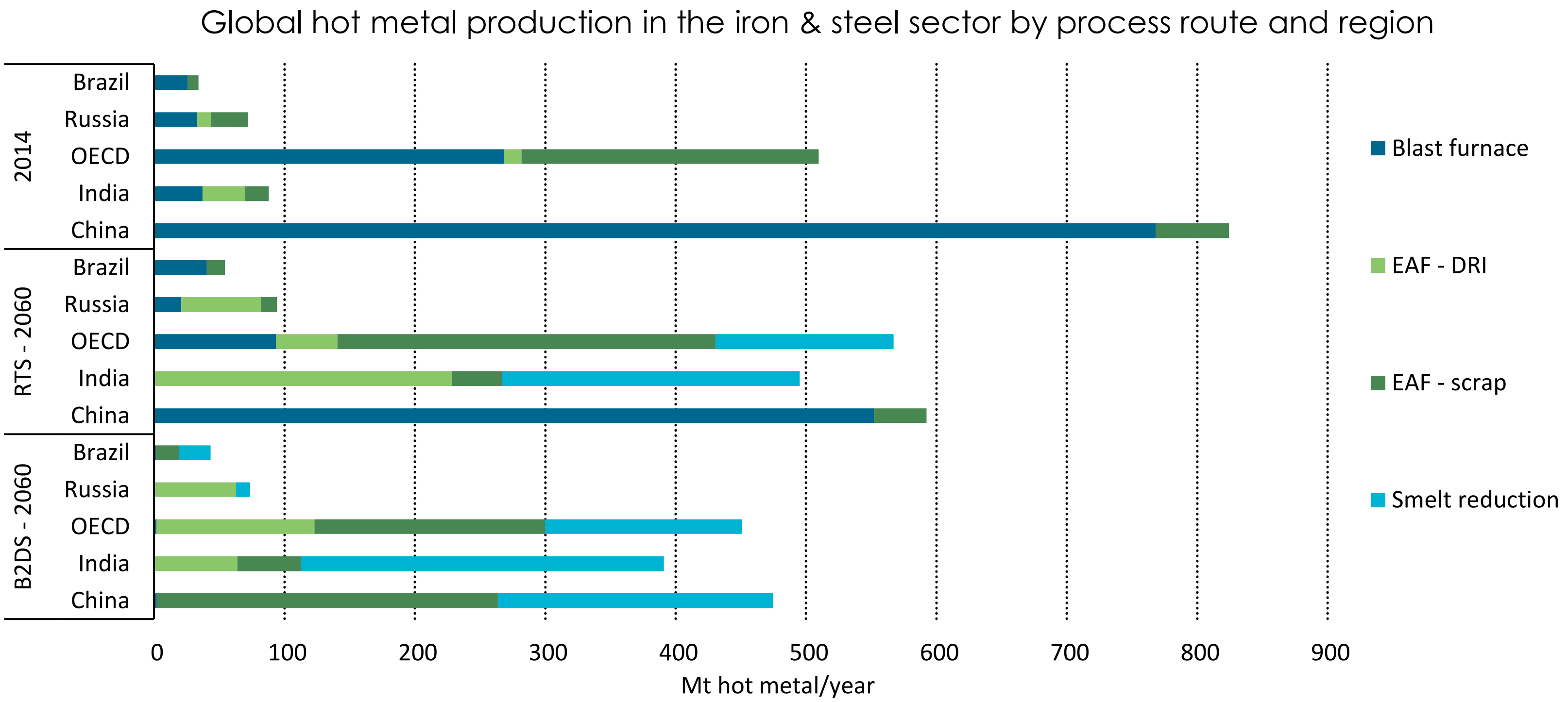
Global hot metal production in the iron & steel sector by process technology in the B2DS



Crude steel production shifts significantly away from blast furnaces in the long-term in the B2DS, opening opportunities for less carbon-intensive innovative processes

Source: IEA Energy Technology Perspectives, 2017

Regional differences matter



The deployment of different process routes is dependent on regionally specific factors, such as availability of raw materials, existing capacity, domestic product demand, energy costs and policy contexts

Where could we do better?

- Direct integration of end-use and supply models
- Materials demand projections methodology complemented with bottom-up end-use material intensity driven approaches
- Direct least-cost competition of material efficiency measures
- Expand techno-economic industrial scope to include less energy-intensive sub-sectors
- Better capture geospatial dependent integration potentials (e.g. industrial clusters process integration)
- How to capture learning rates for emerged and at demonstration-phase industrial technologies?

Closer collaboration with regional/national modelling groups can help this endeavor

Explore the data behind *ETP*

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