Energy Technology Perspectives 2015

ETP 2015: Iron & steel findings

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12 May 2015, OECD Steel Committee meeting

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Tracking Clean Energy Progress 2015 – trends in iron & steel

ETP 2015

- The iron and steel sector accounted for 22% of total industrial energy use and 31% of industrial direct CO2 emissions in 2012
- Energy use grew by 2.2% in 2012, while crude steel production rose by 1.4%
- The 2DS requires growth in energy use of no more than 1.1% a year on average to 2025, even though crude steel production is expected to grow by almost 2% per year
- Widespread application of BATs is needed to help overcome the ongoing challenges of fluctuation in raw material availability and quality, carbon leakage and industrial competitiveness
- Private and public collaboration is needed to mitigate the impact of slow capacity stock turnover and high carbon abatement costs

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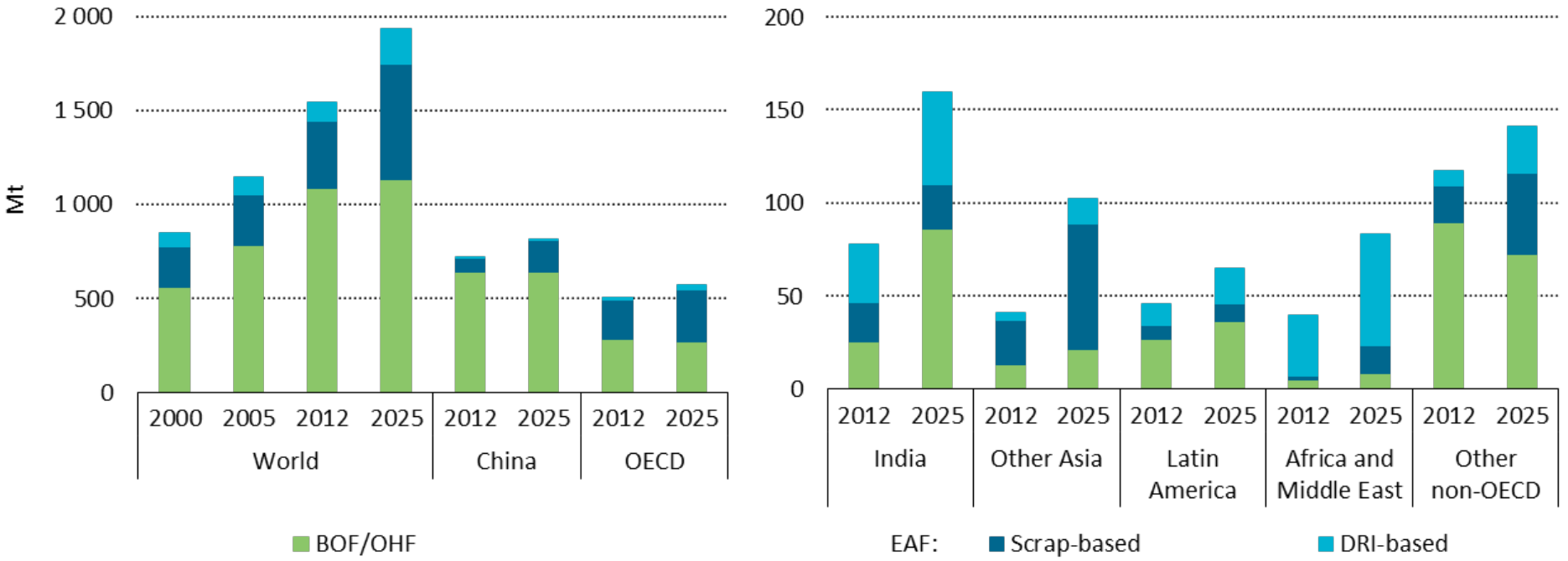
Crude steel process routes by region

ETP 2015



- Global production is expected to continue to grow steadily, so energy efficiency will need to be improved to meet the 2DS emissions target
- The EAF route represents 42% of crude steel production in 2025 in the 2DS, compared with 30% in 2012, though deployment is limited by scrap availability

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Energy intensity of crude steel production

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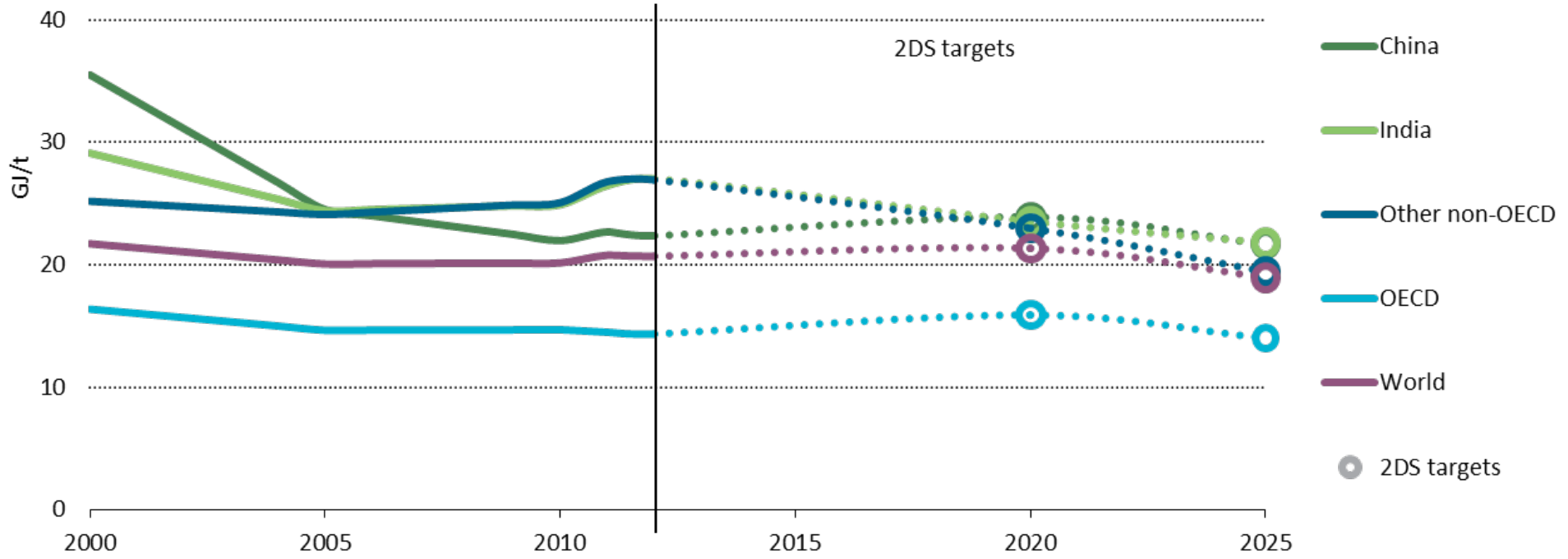

- Global aggregated energy intensity remained static at 20.7 GJ/t
- Energy intensity decreased by 1% to 14.3 GJ/t in OECD countries
- Improvement is needed to put the iron and steel industry on a trajectory to meet 2DS targets. Growth in energy demand must be limited to 28% below current trends, even though crude steel production is expected to grow by 25% from 2012 levels

Note: Aggregated energy intensity also includes fuel used in captive utilities which is related to thermal generation used onsite.

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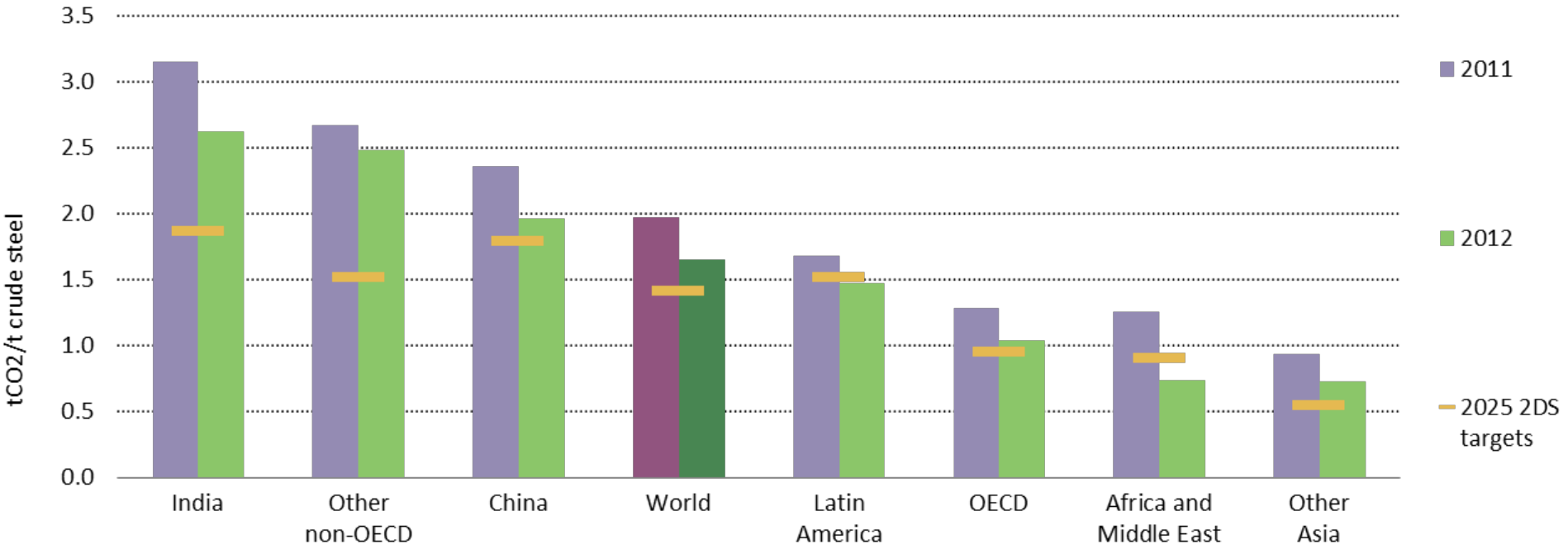
Direct CO_2 emissions intensity of crude steel production

ETP 2015



- Process routes shares (BOF vs EAF) is critical when assessing this indicator
- Direct CO_2 emissions intensity fell in all world regions from 2011 to 2012
- The world average decreased from 2.0 tCO_2/t crude steel to 1.7, while OECD countries improved from 1.3 tCO_2/t crude steel to 1.0
- Though progress has been made, development and deployment of innovative technologies to reduce CO_2 emissions from the iron and steel-making process is critical

Note: Aggregated CO_2 intensity also includes fuel used in captive utilities which is related to thermal generation used onsite.

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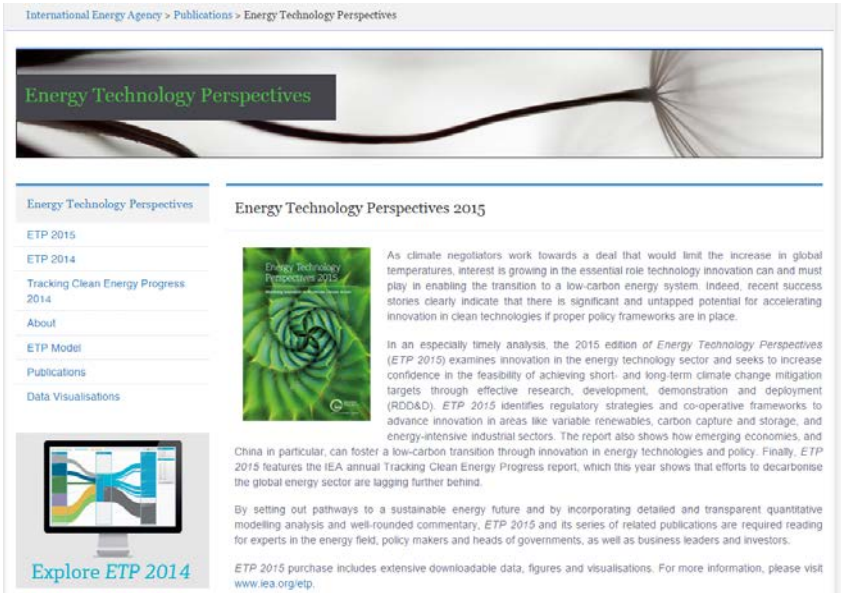
- ETP 2015: Mobilising Innovation to Accelerate Climate Action
- Available for purchase and in OECD iLibrary



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ETP 2015 – Key findings

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- Progress on low-carbon industrial innovation over the next decade is crucial to achieve the 2DS with non-OECD countries being pivotal.
- Integrating CCS, improving resource efficiency, reusing industrial wastes and diversifying product applications should be cross-sectoral industry goals.
- Economic and policy uncertainty, and the need to manage risk and maintain competitive advantage, create substantial challenges to innovation progress.
- Existing measurement methods are inadequate to assess low-carbon industrial innovation performance.

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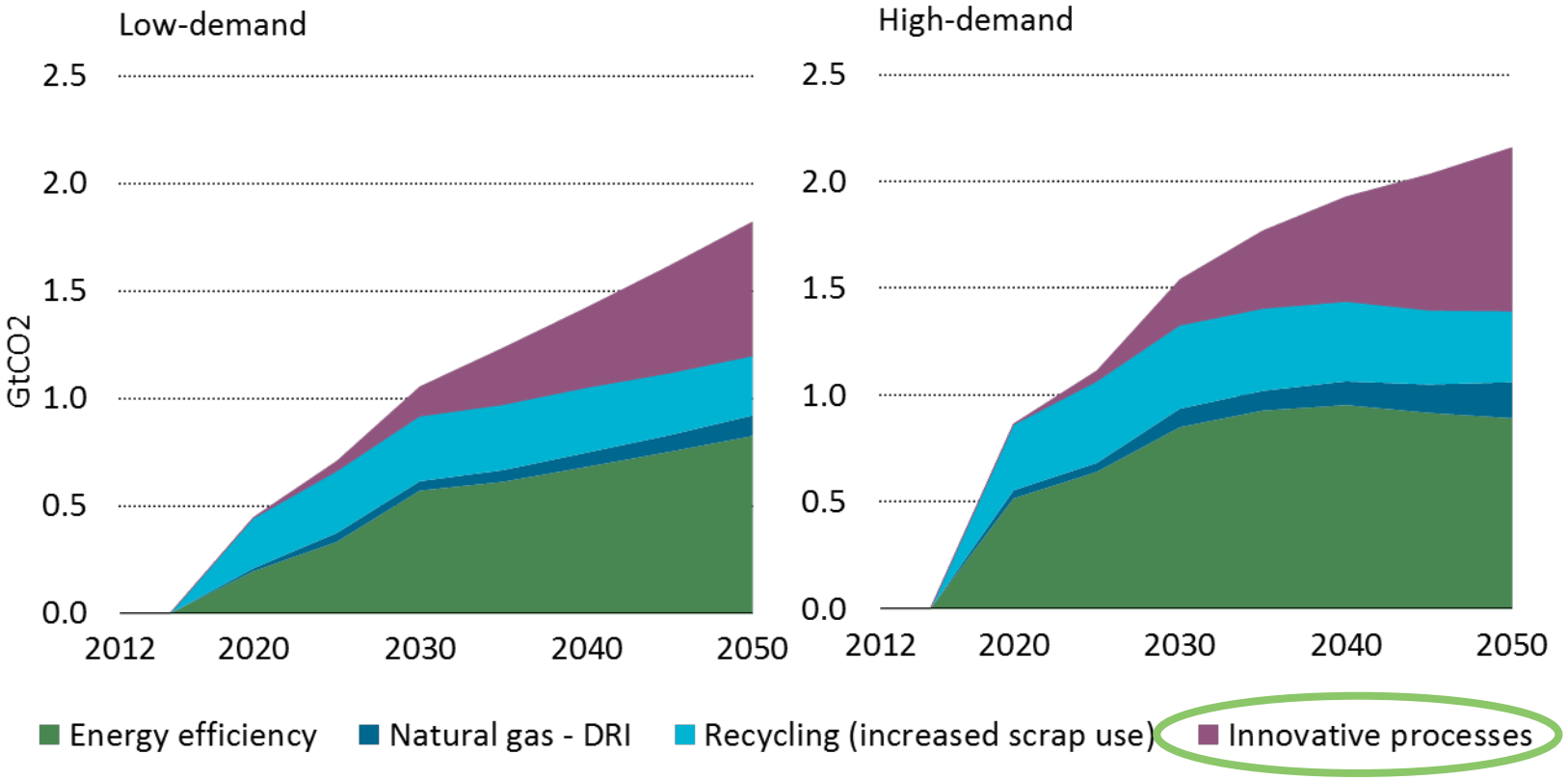
Iron & Steel direct CO2 emissions reductions 6DS vs 2DS by technology

ETP 2015



- Around 35% of required CO_2 emissions reductions in the iron and steel sector in 2DS in 2050 hinges on deployment of innovative processes

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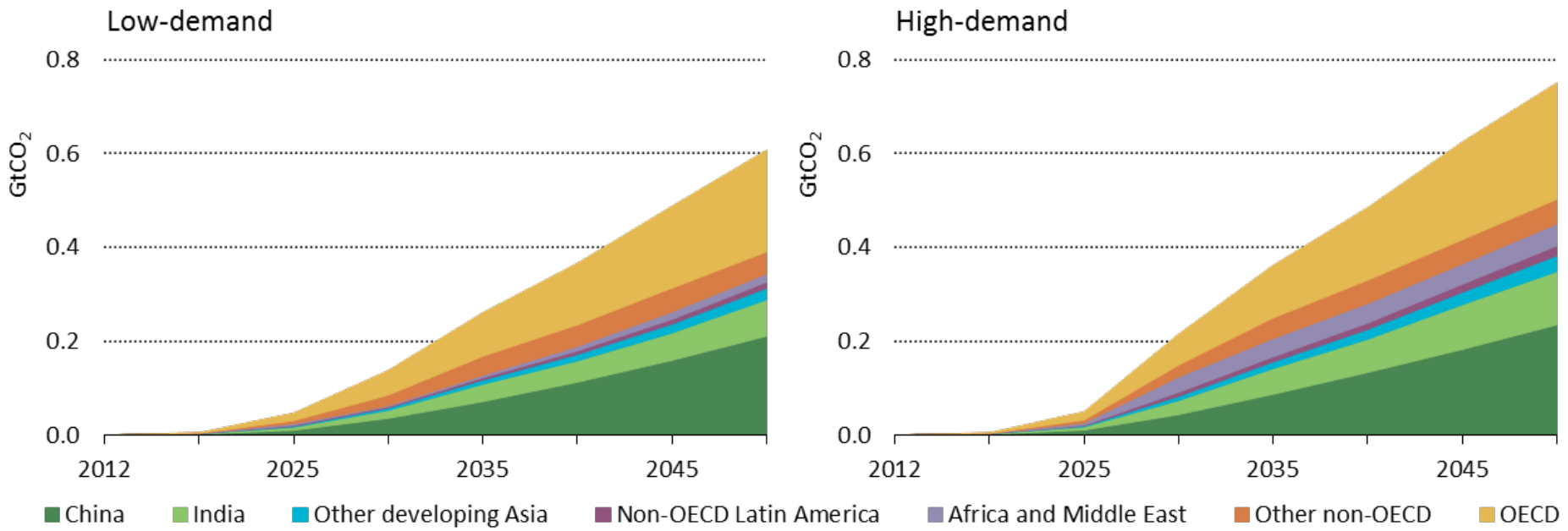
Iron & Steel direct CO_2 emissions reductions from innovative processes 6DS vs 2DS by region

ETP 2015



- About 36% of direct CO2 emissions reductions from innovative processes come from China in 2050, and 35% from the OECD in the 2DS vs the 6DS

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Iron & steel main innovative low-carbon options

ETP 2015

LOW-CARBON PROCESS INNOVATION

2015 2030 2050

INTEGRATING CCS

- BLAST FURNACE – TOP GAS RECOVERY
- ULCORED
- HISARNA
- COKE OVEN GAS REFORMING

PILOT PHASE

LABORATORY

- ULCOLYSIS - ULCOWIN

LOW-CARBON PRODUCT INNOVATION

- HIGH PERFORMANCE STEEL

Note: This slide is not intended to provide an exhaustive list. Sketch is not at scale and time milestones are just illustrative.

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ETP Industry model conversion

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MODEL CONVERSION

PRODUCTION PROJECTIONS

ENERGY PRICES
TECHNOLOGY INVESTMENTS
CO2 MAXIMUM EMISSIONS
FEEDSTOCK AVAILABILITY

ETP INDUSTRY MODEL:
- ENERGY TECHNOLOGY PORTFOLIO
- CAPACITY STOCK TURN-OVER
- FUEL MIX USE PROJECTION
- CO2 EMISSION CALCULATION

6DS
4DS
2DS

- Enables meeting a demanded production through the least-cost technology pathway for a given set of constraints.
- Structural improvements:
  - More detailed representation of innovative processes
  - Better integration with ETP TIMES Supply model
  - Enhanced economic assessments
  - Improved assessment of local contexts impact

- EXCEL BASED
- BOTTOM-UP TECHNOLOGY RICH
- SIMULATION MODEL

- TIMES BASED
- BOTTOM-UP TECHNOLOGY RICH
- OPTIMISATION MODEL

- IRON & STEEL
- CEMENT

2014

- CHEMICALS & PETROCHEMICALS
- ALUMINIUM

2015

- PULP & PAPER

2016

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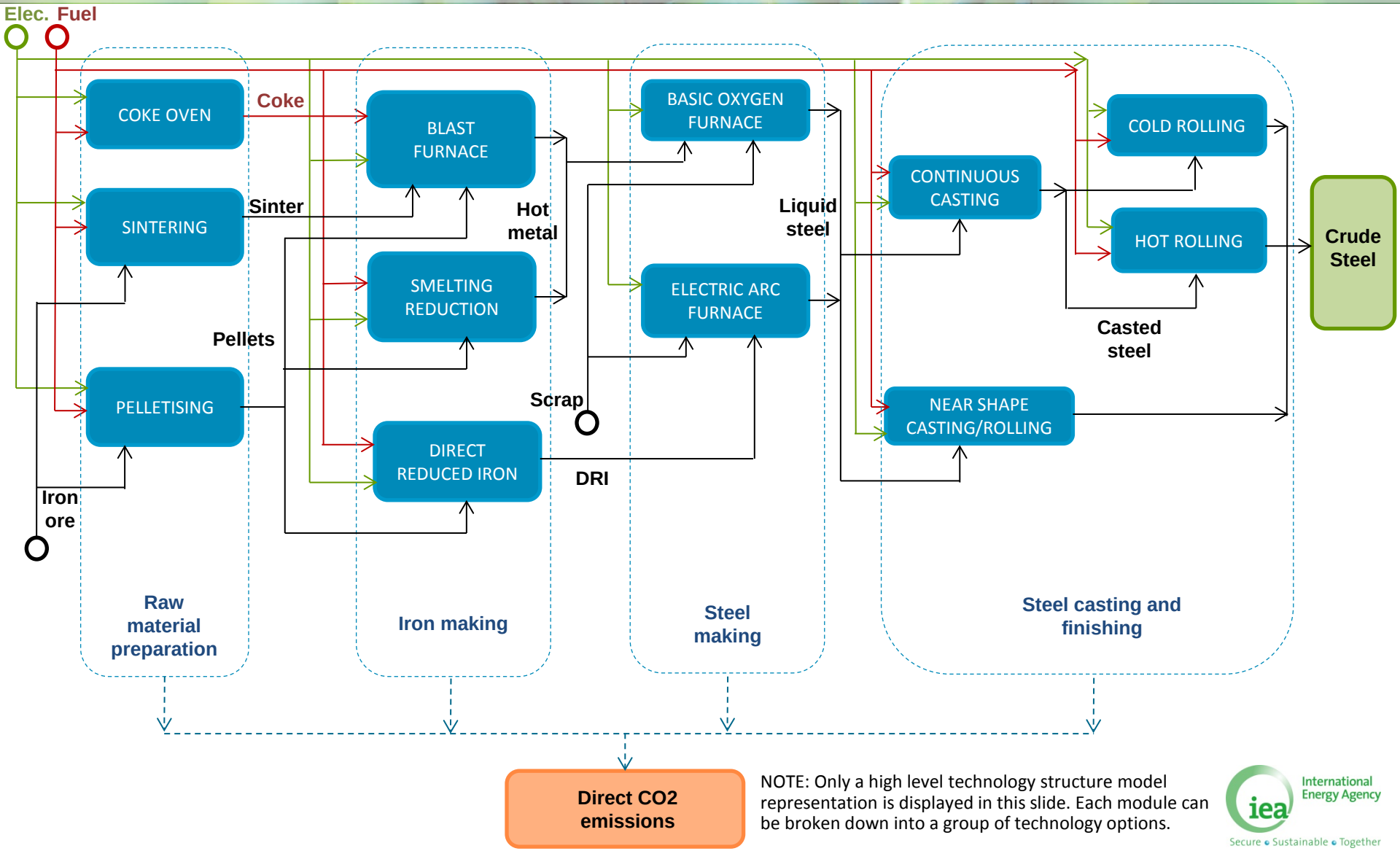
ETP TIMES Iron & Steel model scope

ETP 2015



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.

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