ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Challenges & opportunities for the steel industry in moving towards green growth

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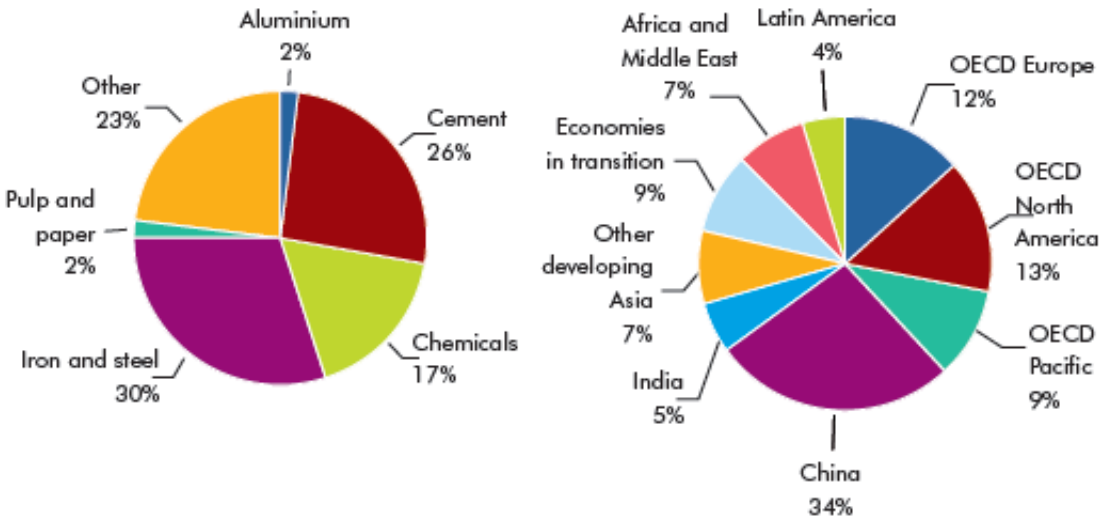
1. Current situation

Current status of steel industry

- The production of steel accounts for approximately 5% of total CO2 emissions.
- It is the largest industrial emitter and a prime focus for governments.

Direct CO2 emissions in industry by sector and by region, 2006



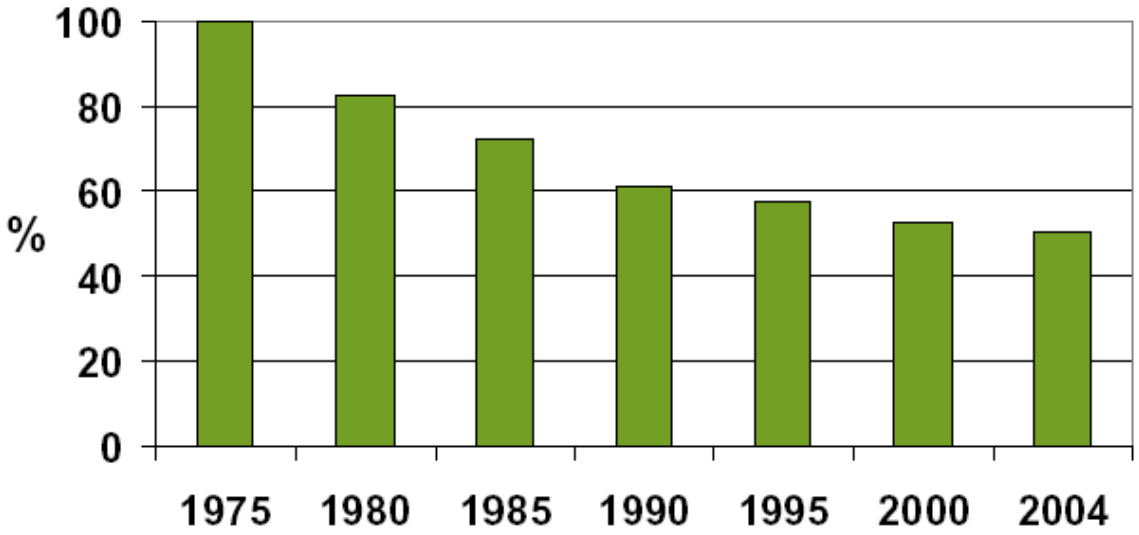
Source: IEA

Note: In 2006, direct industrial energy and process CO2 emissions amount to 7.2 Gt, about 25% of total worldwide emissions, of which 30% comes from the iron and steel industry. Indirect industrial emissions amount to 3.4 Gt.

Enhancement of energy efficiency

- Improvements in energy efficiency have led to reductions of about 50% in energy required to produce a tonne of crude steel since 1975 in most of the top steel producing countries.

Average energy consumption per tonne of crude steel produced for North America, EU 15 and Japan, 1975 to 2004 (1975= 100)

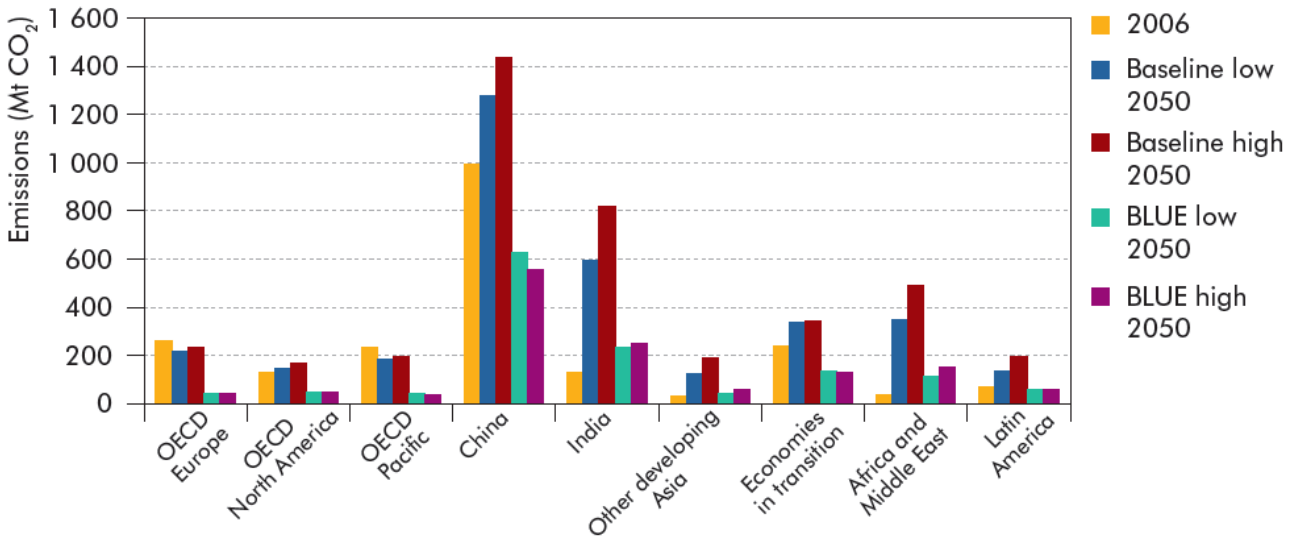


Source: worldsteel

Presence of developing economies

- China accounted for 34% of total steel production in 2006 and its emissions represented 47% of the total.
- China is, with India, the most CO2-intensive country in 2006, but it is also the largest contributor to reductions in direct emissions in the BLUE scenarios.

Direct CO2 emissions by region and by scenario, 2006 and 2050



Source: IEA

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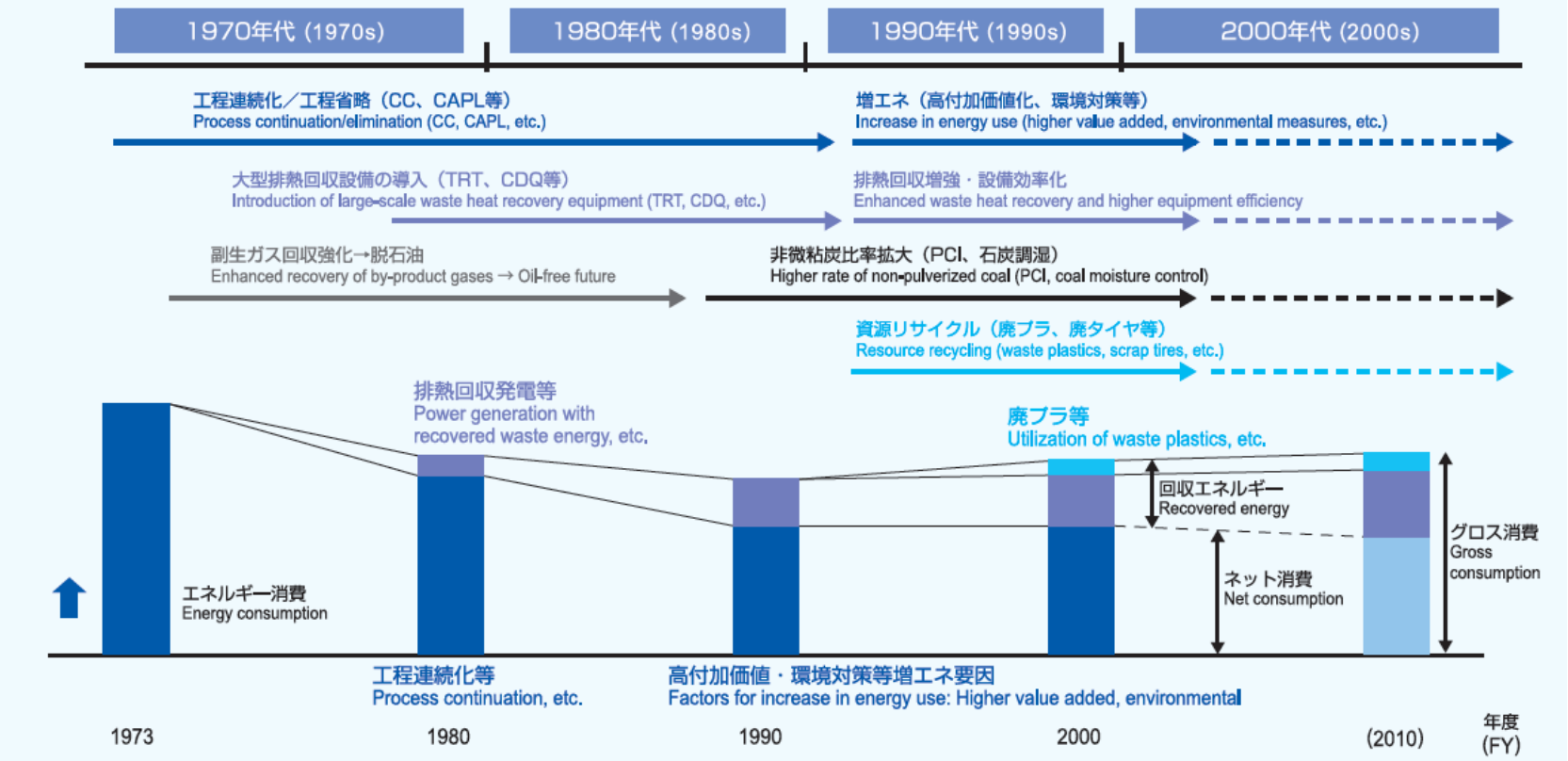
2. Present and medium-term approach

Further enhancement of energy efficiency

- Further improvements in energy efficiency, by making the greatest possible use of state-of-the-art technologies

The Steel Industry's Commitment to Energy Savings in Japan

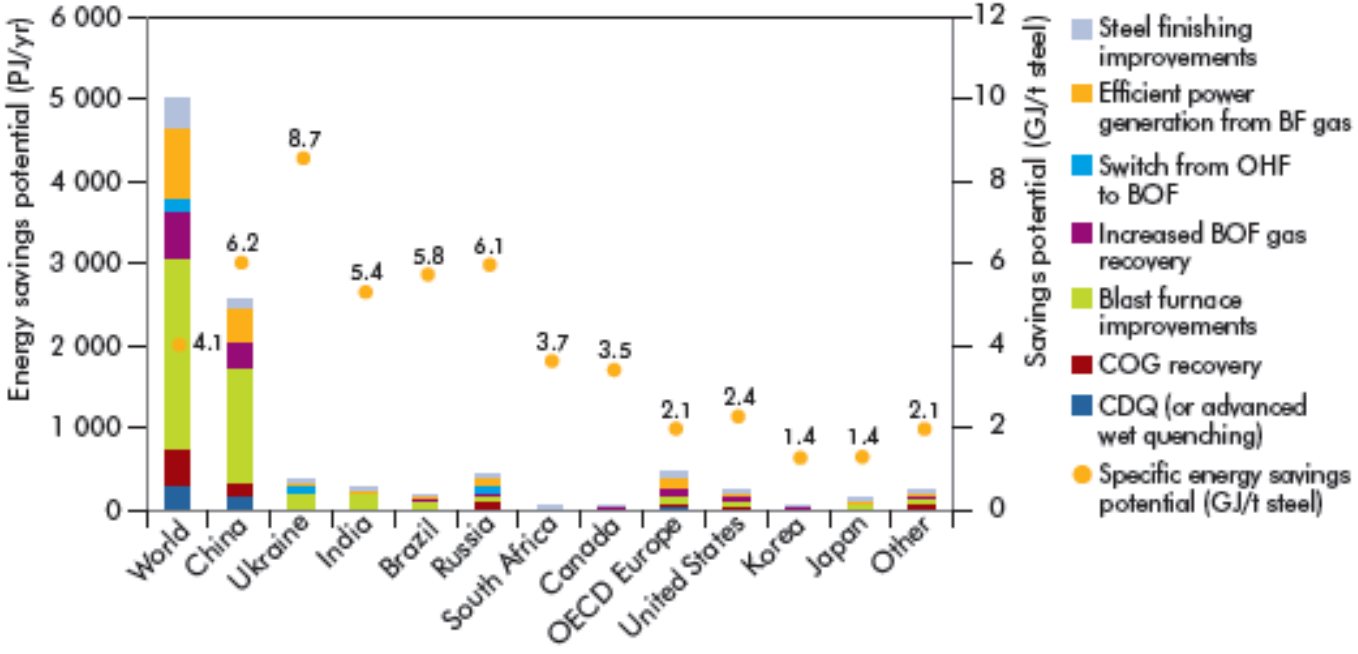


Source: JISF

Best available technology and technical savings potential

- Medium-term energy efficiency improvements are expected through technology transfer, or applying best-available technology to out-dated steel plants worldwide.

Energy savings potential in 2006, based on best available technology

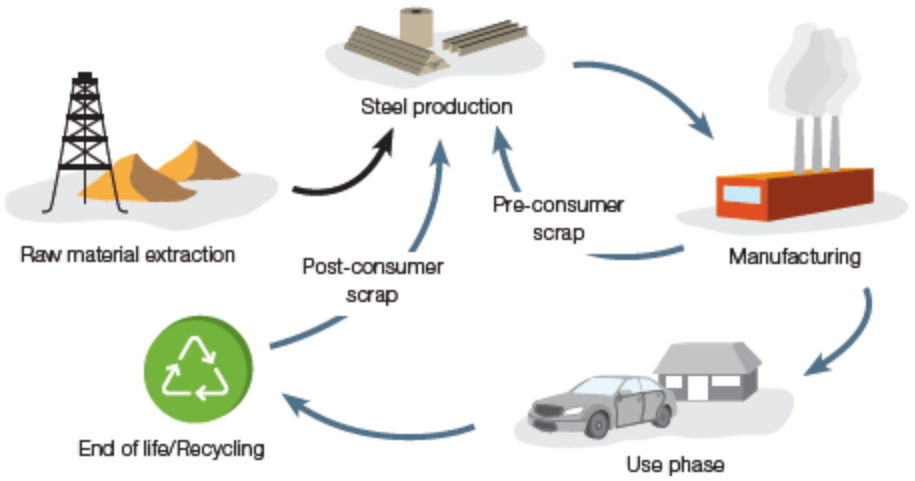


Source: IEA

Use of steel to create a greener low-carbon world

- Across a broad range of industries and applications, the development and use of high-performance steels help to reduce greenhouse gas emissions.
- Steel plays an important role in renewable energy technologies (e.g. wind and solar energy).
- Steel industry has been reducing the need for raw materials and encouraging reuse of existing products. Steel is the world's most recycled material.

The life cycle of a steel item in a multi-material product



Source: worldsteel

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3. Breakthrough technologies

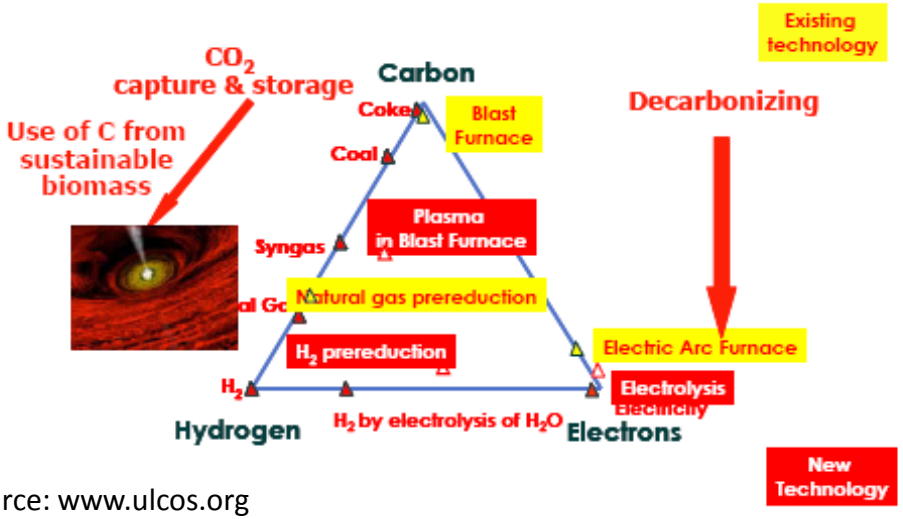
The CO2 Breakthrough Programme

- In 2003, the World Steel Association (worldsteel) launched the 'CO2 Breakthrough Programme', an initiative to exchange information on regional activities all over the world.
- Research is taking place in:
  - the EU (ultra-low CO2 steelmaking, or ULCOS)
  - the US (the American Iron and Steel Institute)
  - Canada (the Canadian Steel Producers Association)
  - South America (ArcelorMittal Brazil)
  - Japan (COURSE50)
  - Korea (POSCO)
  - China (Baosteel) and Taipei (China Steel) and
  - Australia (Bluescope/One Steel and HIsmelt).

Five key directions

- Coal
- Hydrogen
- Electrons
- Biomass
- Carbon capture and storage (CCS)

Pathways to breakthrough technologies for cutting CO2 emissions from the ore-based steel production routes



Source: www.ulcos.org

ULCOS (EU)

- Involving:
  - All major EU steel companies, energy & engineering partners, research institutes & universities. Also supported by the European Commission
- The four breakthrough technologies identified are:
  1) Top Gas Recycling Blast Furnace with CO2 Capture and Storage (CCS)
  2) HIsarna with CCS – smelting reduction
  3) ULCORED with CCS – new DR concept
  4) Electrolysis
- ULCOS is also working on…
  - Biomass and steelmaking
  - Hydrogen based steelmaking

AISI (US)

- Involving:
  - Public private partnership between AISI and the US Department of Energy's (Doe), Office of Industrial Technology
- Two projects represent significant steps:
  1) Suspension Hydrogen Reduction of Iron Oxide Concentrate
  2) Molten Oxide Electrolysis (MOE)
- In the nearer term, AISI members are also developing...
  - the Paired Straight Hearth Furnace, a coal based DRI and molten metal process for long range replacement of blast furnaces and coke ovens

POSCO (Korea)

- Involving:
  - POSCO, RIST, POSLAB, POSTECH
- Three promising routes of CO2 breakthrough solutions have been identified.

1) Carbon-lean Steelmaking
   - Carbon-lean FINEX process
   - Pre-reduction & heat recovery of hot sinter
2) Carbon Capture & Storage of Steelmaking
   - CO2 absorption using ammonia solution
   - CO2 sequestration in ocean gas field
3) Hydrogen Steelmaking
   - Iron ore reduction of FINEX using hydrogen-enriched syngas
   - Hydrogen Enriched Blast Furnace Process

COURSE50 (Japan)

- Involving:
  - 6 steel and engineering companies, the Japan Iron & Steel Federation, and New Energy and Industrial Technology Development Organization
- Research & development goals:

1) Reduction of CO2 emissions from Blast Furnaces
   - Iron ore reduction with other agents (hydrogen)
   - Reforming coke oven gas aiming at amplifying H2 content by utilizing waste heat
   - High-strength and high reactivity coke for reduction with H2

2) Capture of CO2 from Blast Furnace gas
   - Chemical and physical absorption to capture, separate and recover CO2
   - Reduction of energy requirement for capture, separation and recovery using waste heat from steel plants