Energy Transitions Commission

Supported by:

Breakthrough Energy

UNLOCKING THE FIRST WAVE OF BREAKTHROUGH STEEL INVESTMENTS

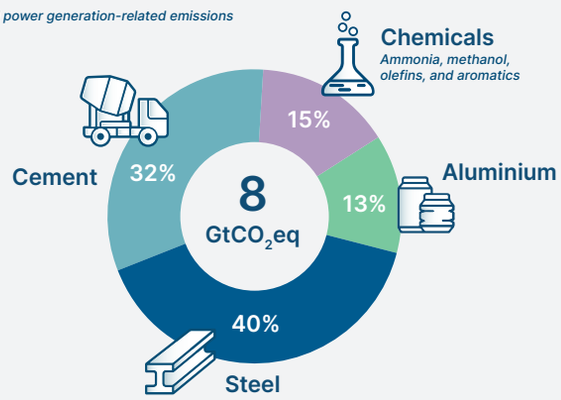
Steel is a fundamental material in the global economy

Iron and steel production accounts for more than a third of all CO_2 emissions within 'hard-to-abate' industries

HARD-TO-ABATE INDUSTRIES' EMISSIONS*

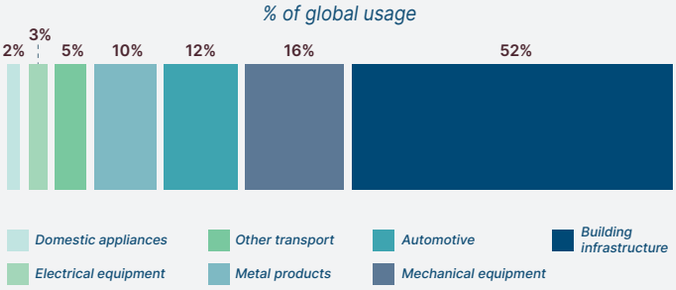
2020

**Direct and power generation-related emissions*



DOWNSTREAM CONSUMPTION OF STEEL BY SECTOR

% of global usage

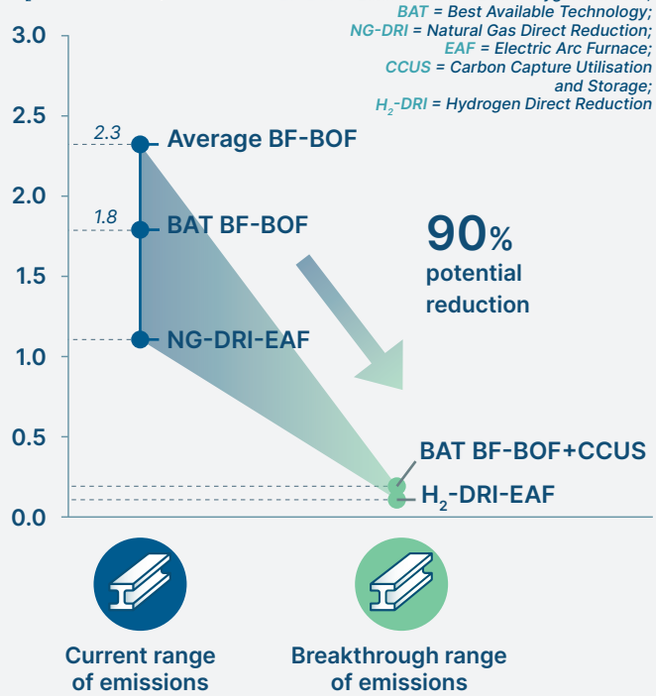


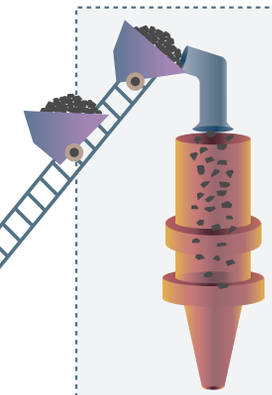
Breakthrough technologies could reduce iron and steel CO_2 emissions by ~90%

EMISSIONS BY TYPE OF INTEGRATED STEELMAKING TECHNOLOGY

tCO_2/t of steel (Scope 1 & 2)

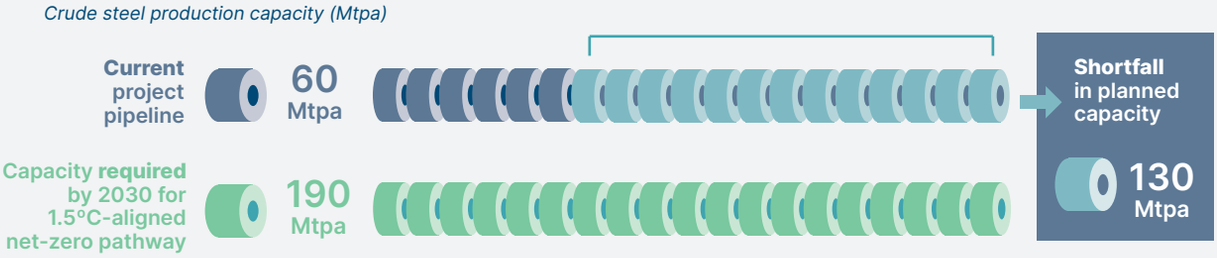
BF-BOF = Blast Furnace - Basic Oxygen Furnace;
BAT = Best Available Technology;
NG-DRI = Natural Gas Direct Reduction;
EAF = Electric Arc Furnace;
CCUS = Carbon Capture Utilisation and Storage;
H_2-DRI = Hydrogen Direct Reduction





The current pipeline of breakthrough steel projects must more than triple before 2030 to keep the steel sector with a 1.5°C-aligned carbon budget...

Crude steel production capacity (Mtpa)



...and project lead times mean decisions in the next three years are critical

TIMELINE FOR COMMERCIAL-SCALE BREAKTHROUGH STEEL INVESTMENTS

Energy Transitions Commission

Supported by:

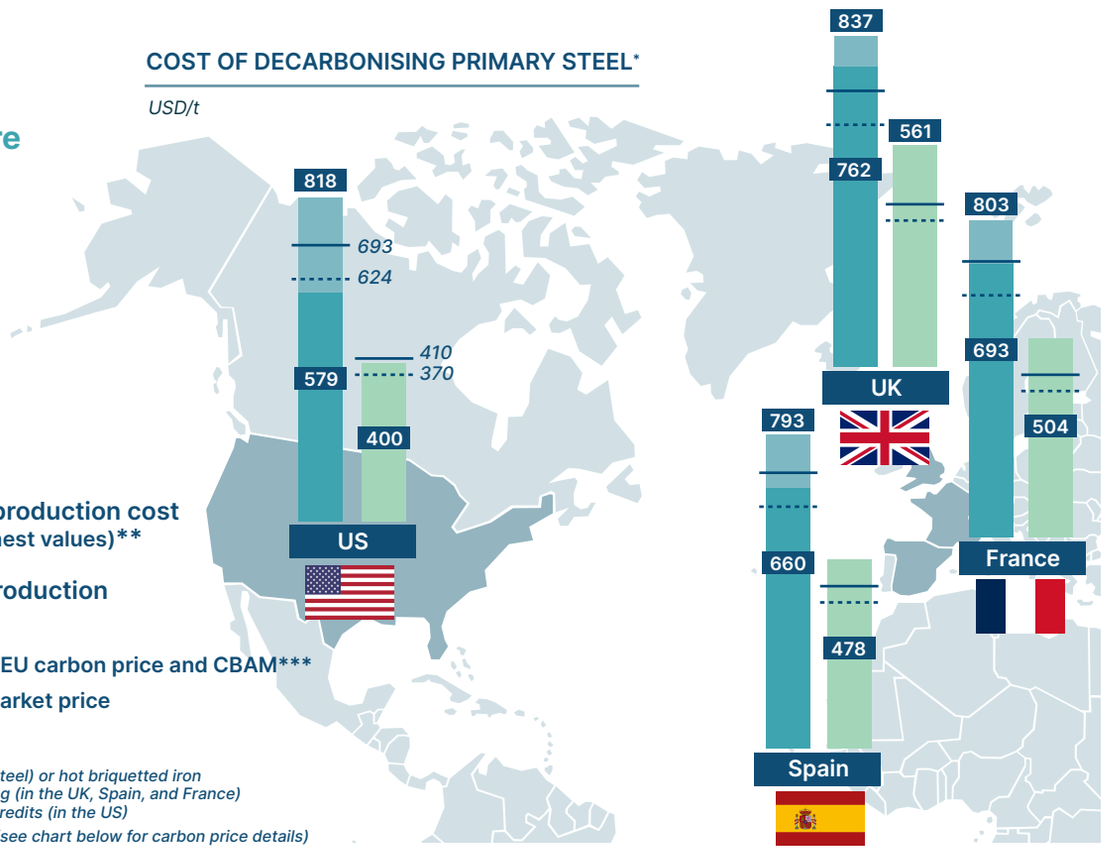
Breakthrough Energy

UNLOCKING THE FIRST WAVE OF BREAKTHROUGH STEEL INVESTMENTS

Breakthrough, low-emissions steel will be - initially - more costly, but with large variation across the regions, drawing attention to issues of international competitiveness

COST OF DECARBONISING PRIMARY STEEL*

USD/t



Breakthrough steel production cost range (lowest and highest values)**

Breakthrough iron production cost**

International average + EU carbon price and CBAM***

International average market price

*on a levelised cost basis

**for a 2 Mtpa plant of hot-rolled coil (for steel) or hot briquetted iron (for iron), taking into account carbon pricing (in the UK, Spain, and France) and low-carbon hydrogen production tax credits (in the US)

***carbon border adjustment mechanism (see chart below for carbon price details)

NET PRESENT VALUE OF A GREENFIELD H2-DRI-EAF INVESTMENT**

Net present value impact of levers (USD millions)

Baseline net present value (NPV)

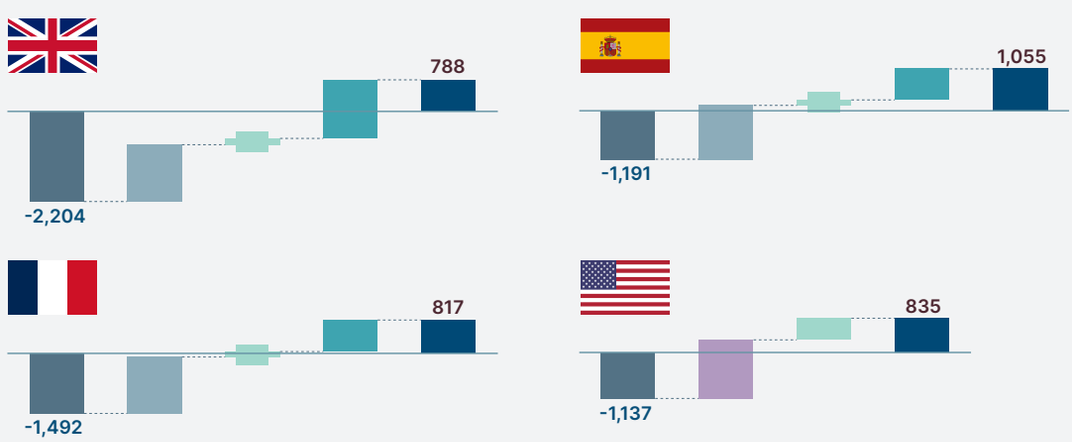
Carbon pricing with CBAM and carbon allowance price rising to $100/tCO$_2$ by 2030 and $122/tCO$_2$ by 2050

30% DRI capital expenditure subsidy

Forward purchase agreements for offtake at a premium

PTC for hydrogen of $ 3/kg for 10 years

NPV with levers



Breakthrough steel is within reach in all 4 studied regions, but policy and market action will be needed to close the financial gap to get first projects off the ground

Companies and governments should collaborate internationally in three areas to create enabling conditions for investment in the first wave of breakthrough steel investments:

Aggregate and direct private demand

Harmonise standards, definitions, and certification schemes

Coordinate separation of iron and steelmaking