



Decarbonising steelmaking: technology options and regional pathways

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Climate change scenarios

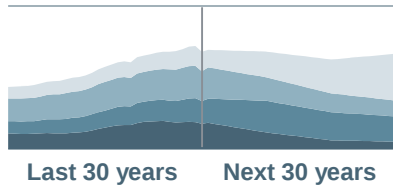
Our portfolio is tested across a range of futures



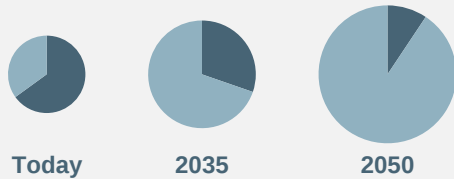
1.5 degrees

Paris Agreement goals met through unprecedented large-scale changes to the global energy system

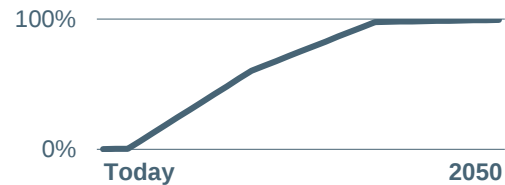
Total primary energy demand (Btoe)



Fossil fuel share of power generation



Electrified LDV fleet



CCUS

- 10,000 CCUS facilities installed
- 6 Bt of carbon captured by 2050

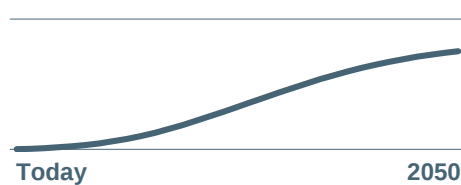
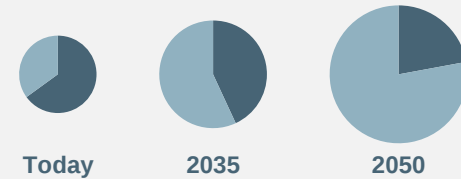
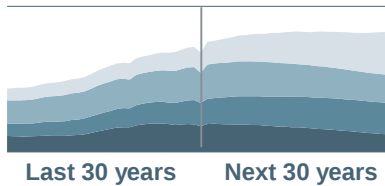
Carbon Price

Effective global carbon price of US\$160/t in 2030 and US\$280/t in 2050



Lower Carbon View

Faster and deeper decarbonisation trends and policies, particularly in the easier to abate sectors



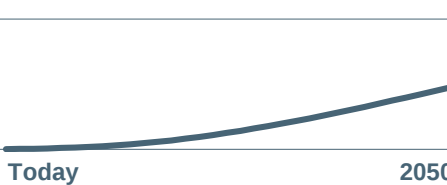
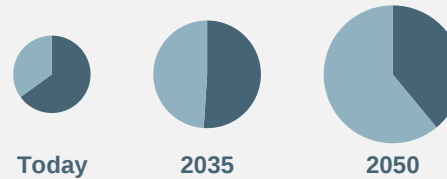
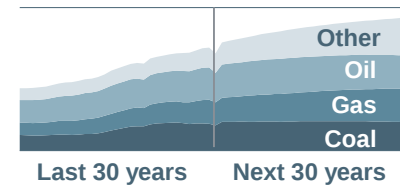
- CCUS is relegated to non-power "harder to abate" sectors
- Technology constrained by high upfront capital costs and lack of storage availability

Regional carbon prices ranging from US\$25-110 by 2030



Central Energy View

Reflects our view on the most likely pathway for policy, technology and consumer choice

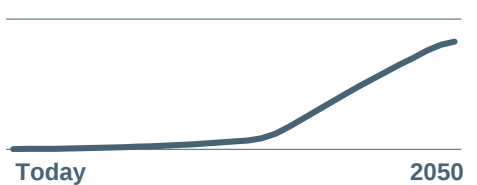
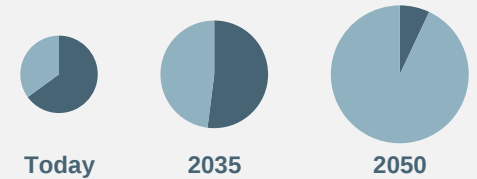
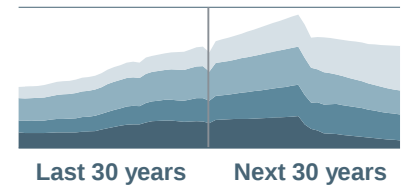


Regional carbon prices ranging from US\$10-40 by 2030



Climate Crisis

A climate shock leads to turmoil and massive economic contraction and hands a mandate to governments to coordinate and enact wide-sweeping climate policies

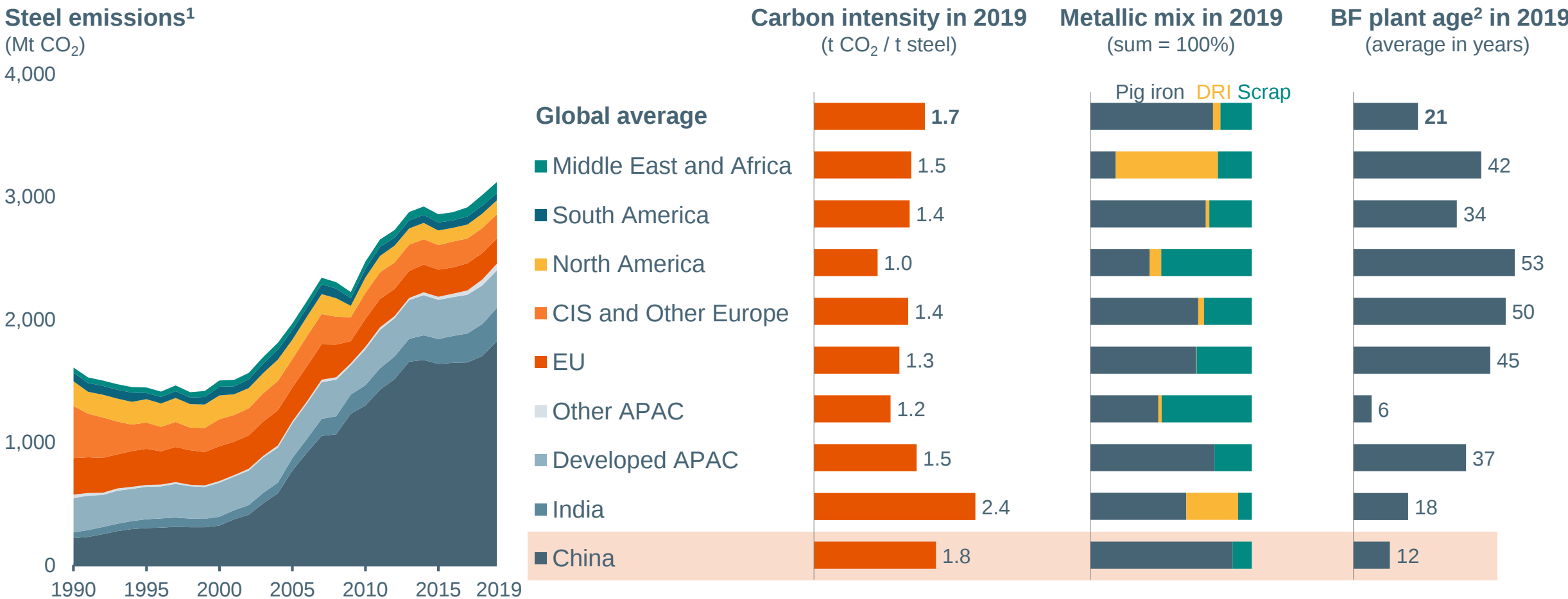


- ~1 Bt of CCUS captured by 2050
- Policy push enables CCUS in non-power sector post-crisis

Pre-crisis: Regional carbon prices average <\$10/t

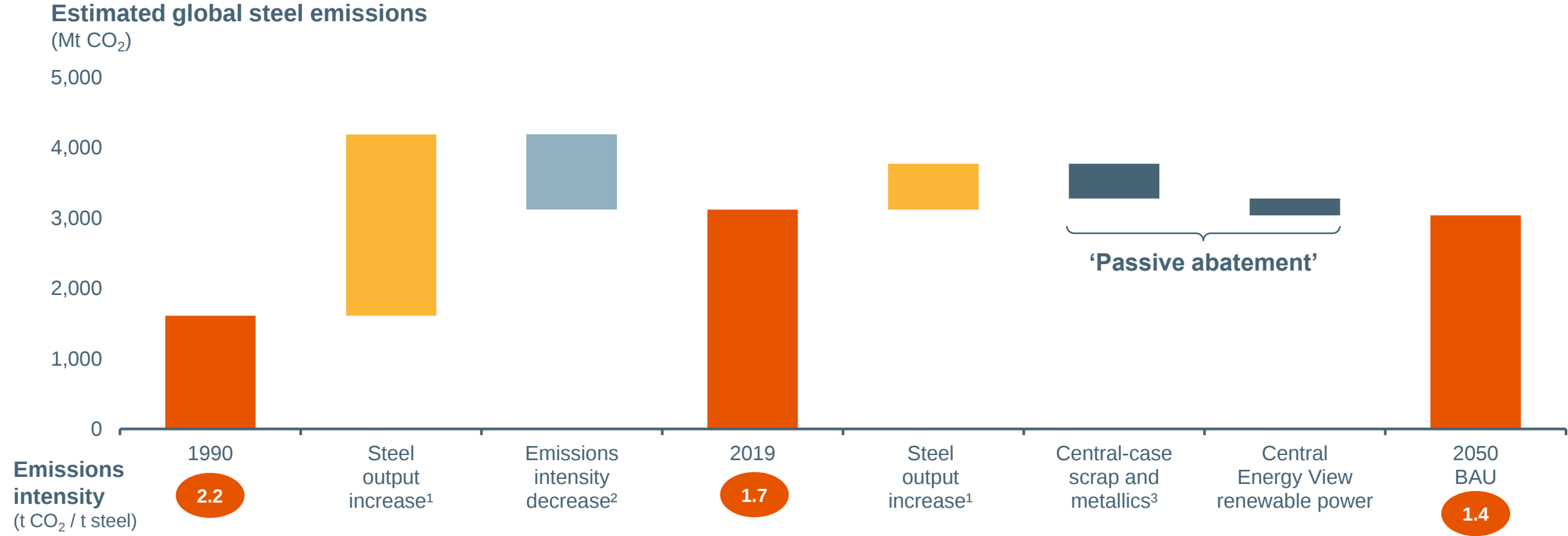
Post-crisis: Global carbon price increases to \$160/t

Steel emissions have roughly doubled in the last three decades, with rising demand dominating a major efficiency uplift



Source: Worldsteel; BHP analysis.
1. Estimated emissions from direct steelmaking process (captive sintering, pelletising, coking, ironmaking, steelmaking, casting and hot-rolling) and purchased power.
2. Regional capacity-weighted average age for the integrated steel plants. This is a sample estimate, not a census of all operations.

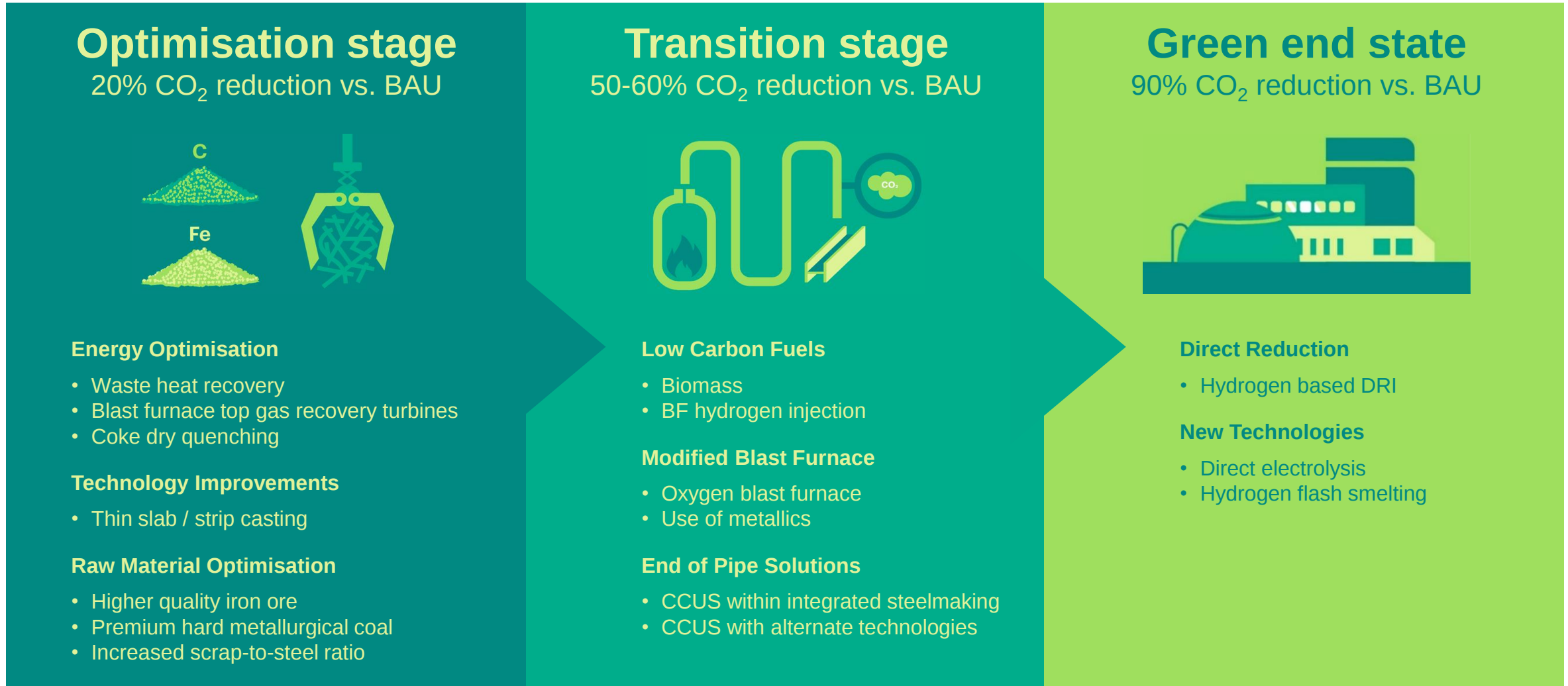
BAU passive abatement to barely offset demand growth to 2050



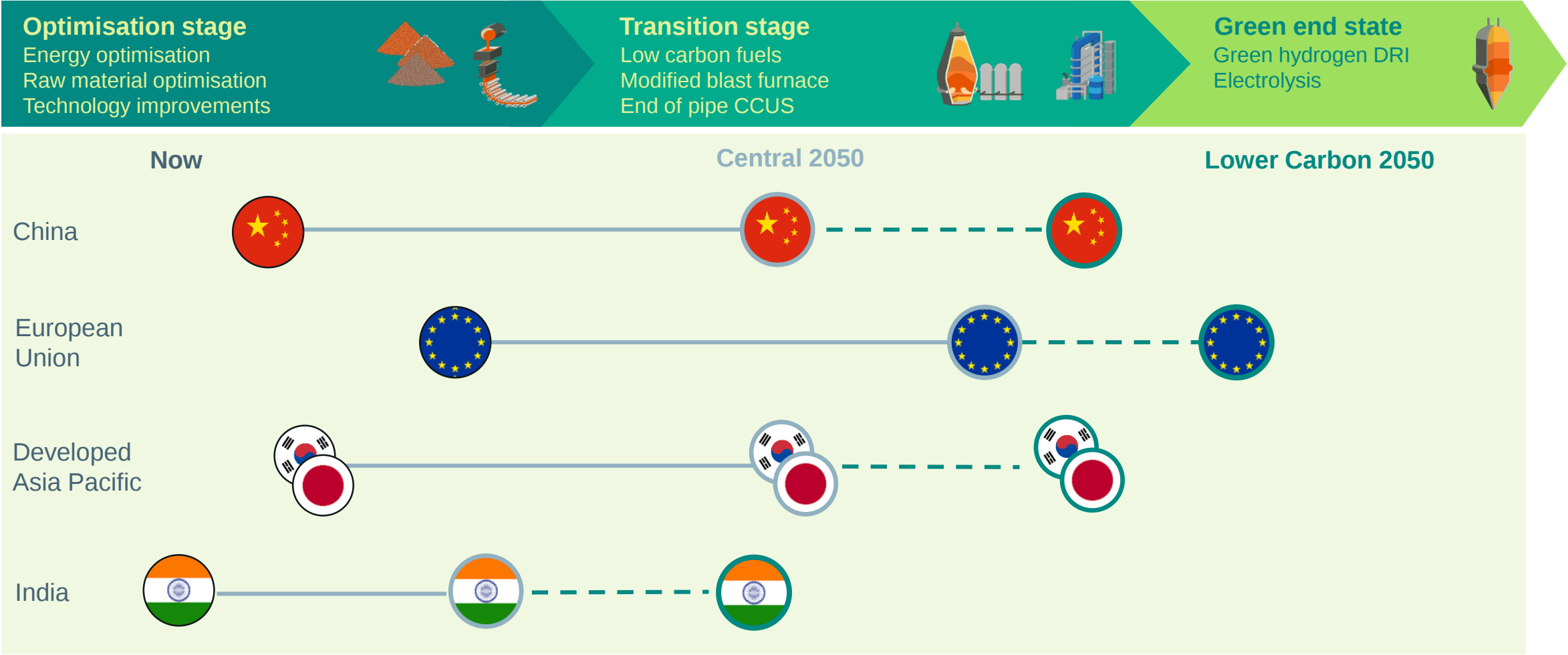
Source: BHP analysis; worldsteel.
1. Steel output increase multiplied with initial base year emissions intensity.
2. Includes technological shifts, efficiency gains and passive abatement levers such as steel metallic and power mix changes from 1990 to 2019.
3. Central-case scrap availability increase and business-as-usual natural-gas DRI development in gas-rich traditional markets.
Note: BAU means business-as-usual.

BHP's three stage steel decarbonisation framework

Each region will transit through these stages at its own pace, based on unique local conditions faced by steelmakers

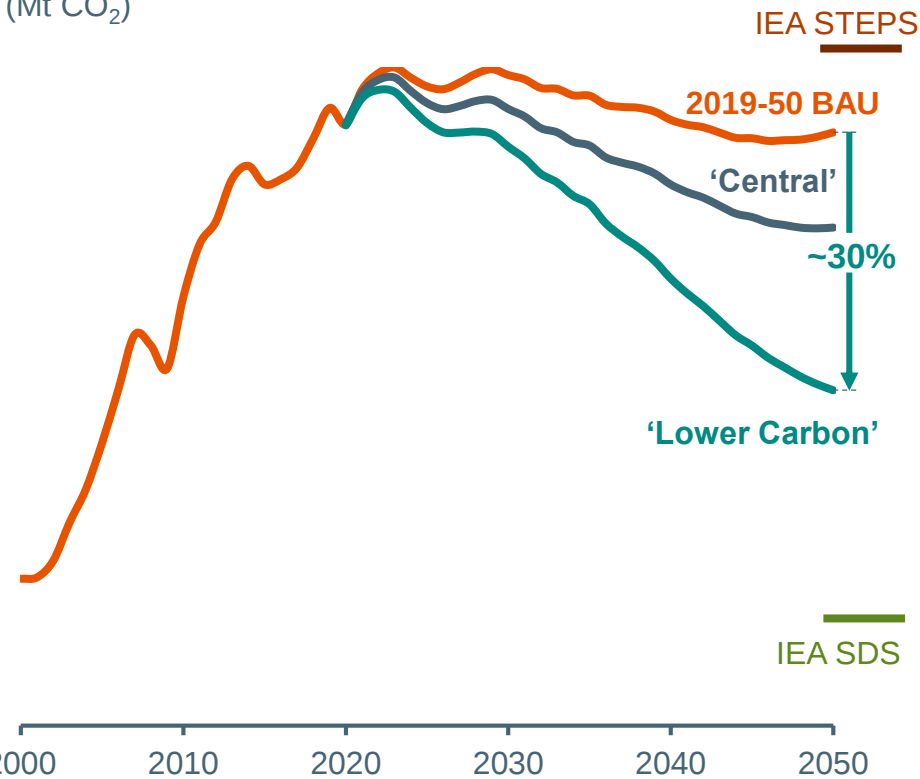


Key regions in 2050 under Central and Lower Carbon cases



Global scenarios and a bottom-up view of regional pathways

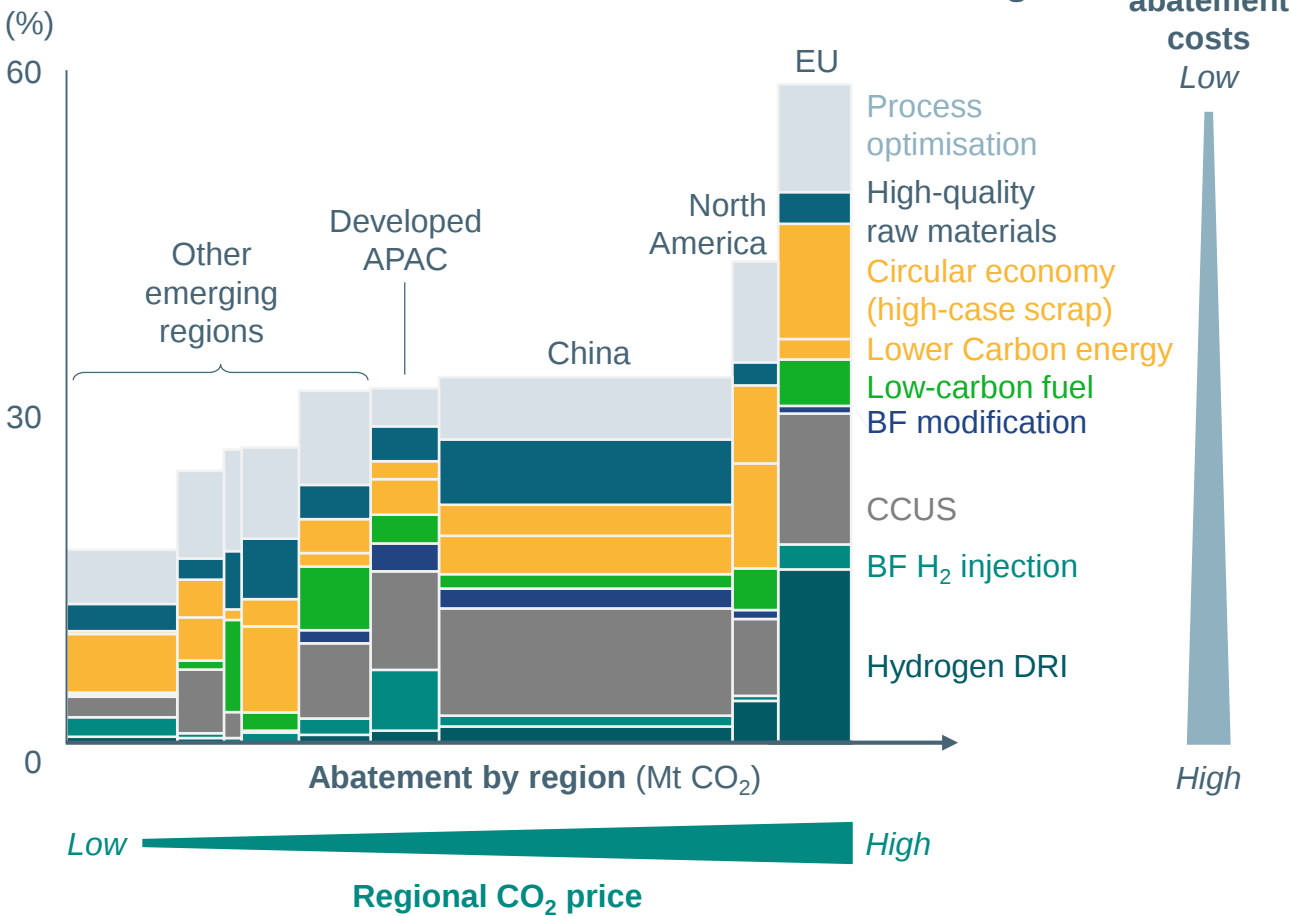
Global steel emissions
(Mt CO₂)



Source: BHP analysis; IEA.
Note: BHP Central Energy View (Central-case) tracks 3°C temperature increase above pre-industrial level. BHP Lower Carbon View tracks approximately 2.5°C increase. IEA State Policies Scenario (STEPS) is the baseline scenario in its Iron and Steel Technology Roadmap 2020. The IEA Sustainable Development Scenario (SDS) tracks 1.5–1.65°C temperature rise.

Decarbonising steelmaking roundtable
11 November 2020

2050 'Lower Carbon' case vs. BAU steel emissions saving



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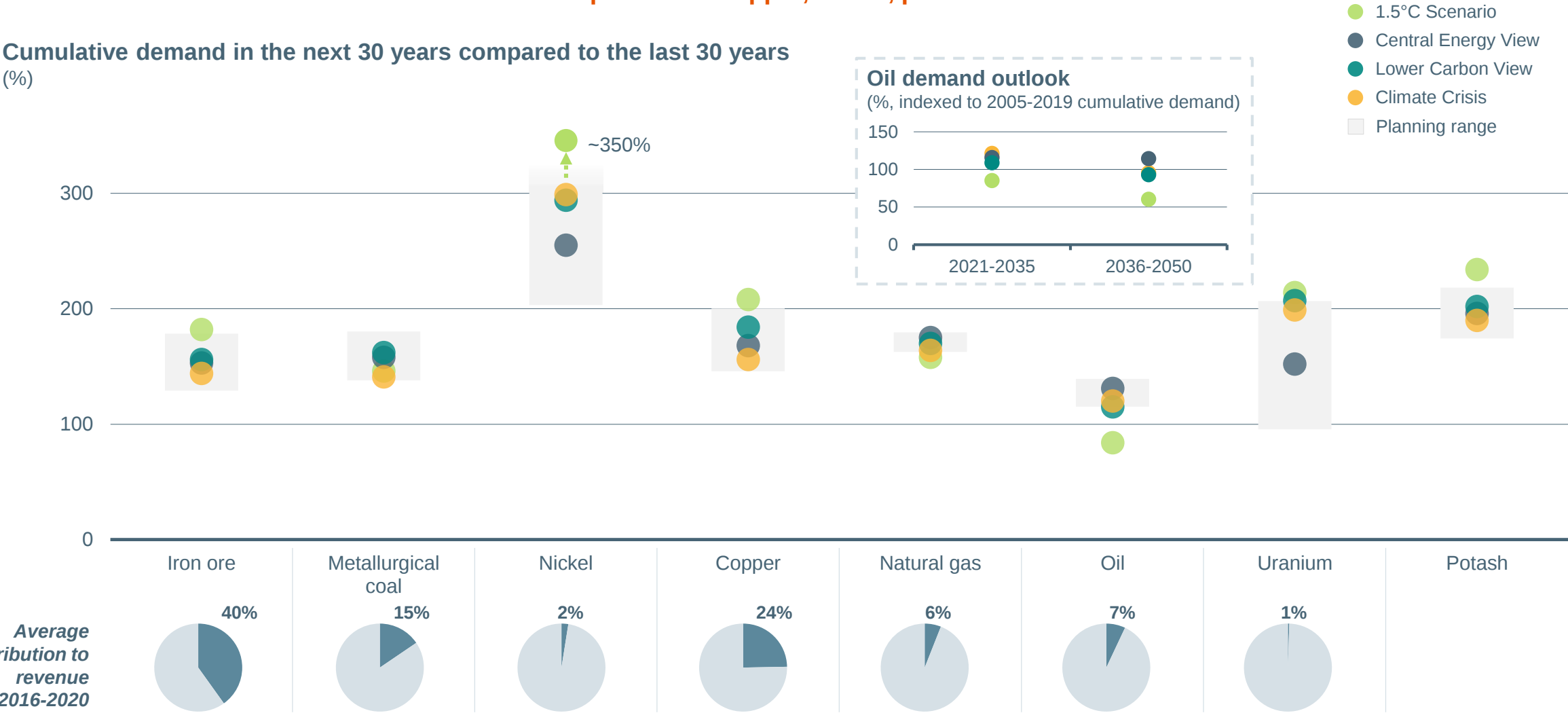
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Appendix

Most of our commodities benefit in a decarbonising world

As decarbonisation accelerates the world will require more copper, nickel, potash and steel

Cumulative demand in the next 30 years compared to the last 30 years (%)



Source: BHP; Vivid Economics.

Snapshot of global steelmaking as of 2019

Country / Region	Crude steel (Mt)	Global share (%)	BOF / OHF share (%)	EAF / IF share (%)	DRI in EAF (%) ²	BF plant age ³ (years)
China	996	53	90	10	1	12
India	111	6	44	56	57	18
Developed APAC	199	11	71	29	1	37
Other APAC	48 ¹	3	31	69	5	6
European Union	159	8	59	41	6	45
CIS and Other Europe	140	7	61	39	9	50
North America	120	6	32	68	14	53
South America	41	2	67	33	7	34
Middle East and Africa	61	3	10	90	87	42
Global	1,875	100	72	28	21	21

Sources: worldsteel; BHP estimates.

BOF – basic oxygen furnace; OHF – open hearth furnace; EAF – electric arc furnace; IF – induction furnace.

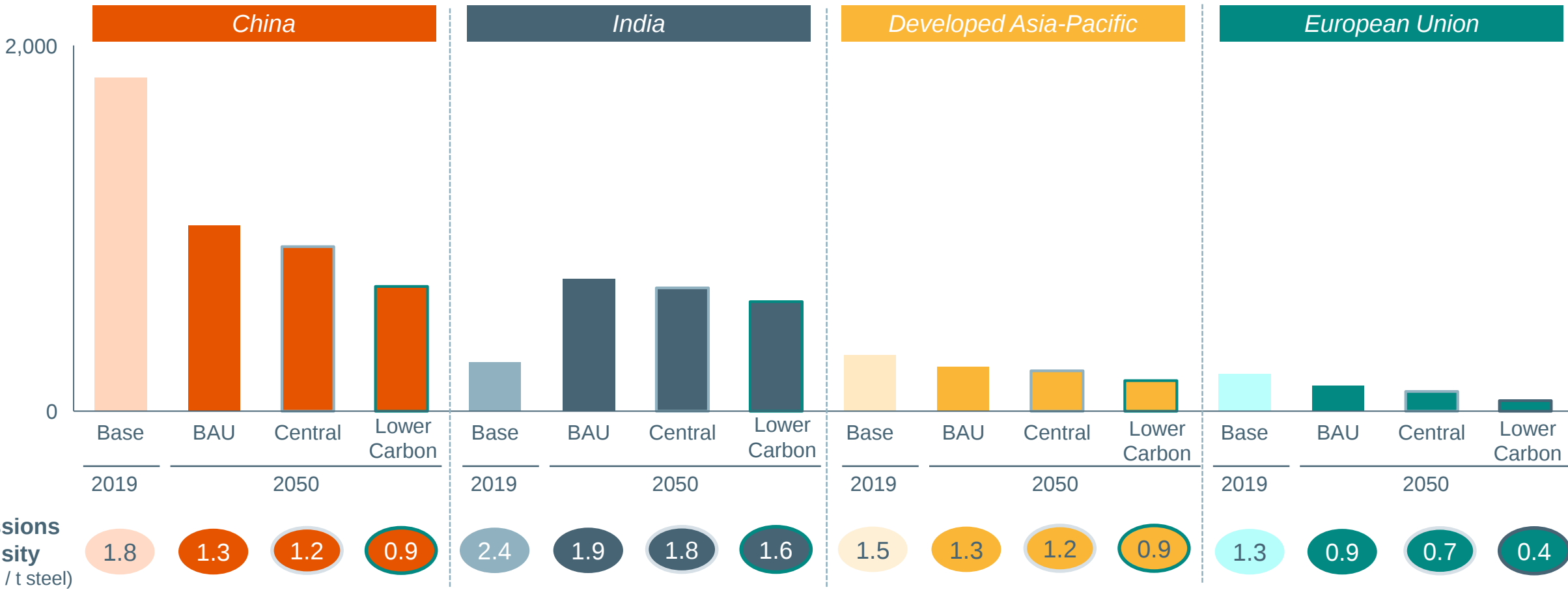
1. With some adjustment with possible hidden induction furnace production in Other Asia to balance global steel production and demand.

2. Estimated direct reduced iron (DRI) consumption = (production + net import) / EAF production.

3. Regional capacity-weighted average age for the integrated steel plants. This is a sample estimate, not a census of all operations.

Steel emissions by 2050 for key regions

Regional steel emissions 2019 – 2050
(Mt CO₂)



Source: BHP analysis.

Partnering with China Baowu to address Scope 3 emissions

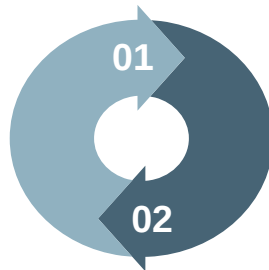
Supporting industry decarbonisation in line with our Scope 3 goals through partnership with one of the world's largest steel makers

Steel sector decarbonisation

- First major project under BHP's Climate Investment Program
- 5 year partnership with China Baowu focussing on:
 - ✓ Capturing emissions across the integrated steelmaking process; CCUS pilot at one of China Baowu's blast furnace facilities
 - ✓ R&D in hydrogen and oxygen enrichment in blast furnaces
 - ✓ Low carbon technologies with potential to reduce carbon emission intensity by up to 60%
 - ✓ Establishing a knowledge centre for industry stakeholders

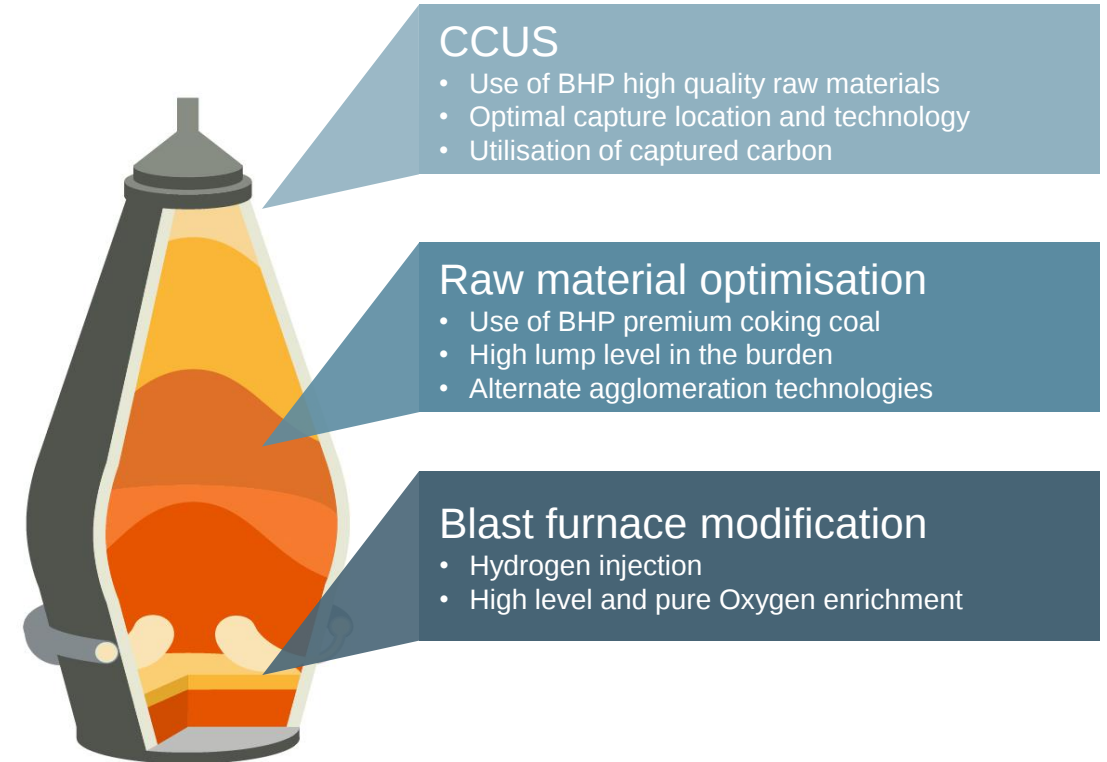
01 Reduce

Reduce emission intensity at their source through process improvement and raw material optimisation



02 Capture

Capture emissions across the steel making process through application of CCUS technology



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