X Simexmin: Brazilian Symposium on Mineral Exploration

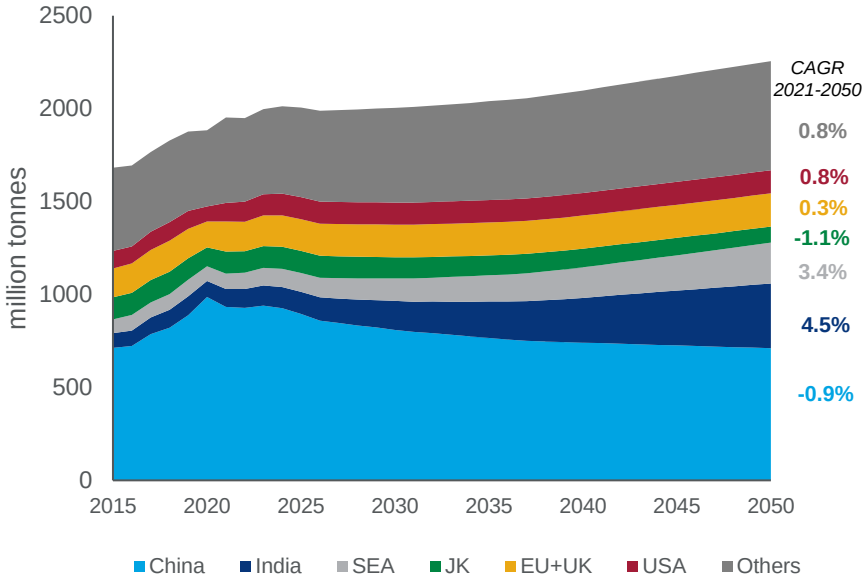
Steel decarbonisation and its effects over the new “two tier” iron ore chain

28 November 2022

Steel consumption to slow on inflation and the Russia-Ukraine conflict

India and Southeast Asia to be the key growth drivers and China the major deterrent

Global steel consumption outlook

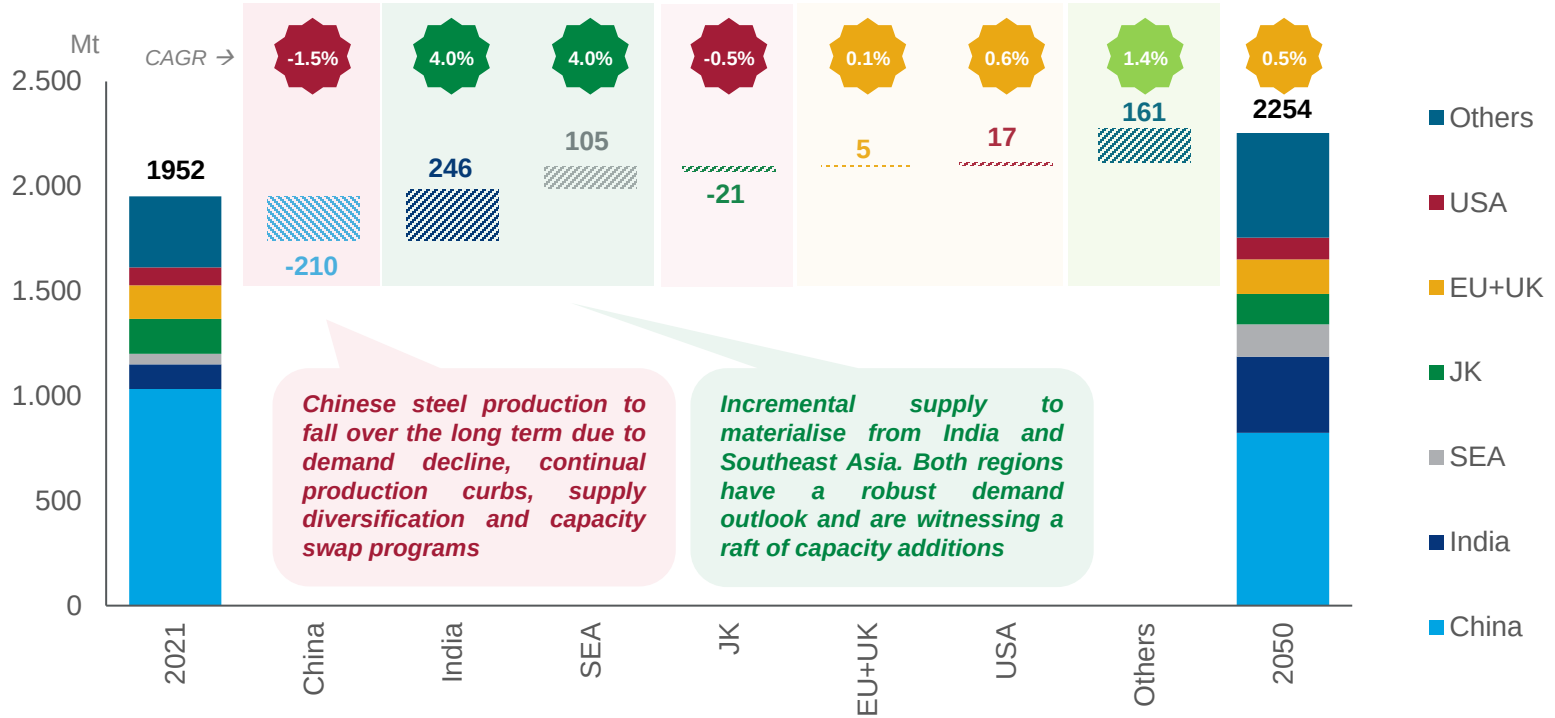


	Demand share (2021)	Country wise demand growth 2021	2022	2023-2050	Demand share (2050)
China	48%	-5%	-0.4%	-1%	32%
India	5%	12%	4.2%	4.4%	15%
SEA	4%	4%	7%	3.2%	10%
JK	6%	17%	-2.7%	-1.1%	4%
EU+UK	8%	16%	-2%	0.3%	8%
USA	5%	24%	7.9%	0.3%	6%

Source: Wood Mackenzie, WSA

Steel output to rebound in all major economies barring China

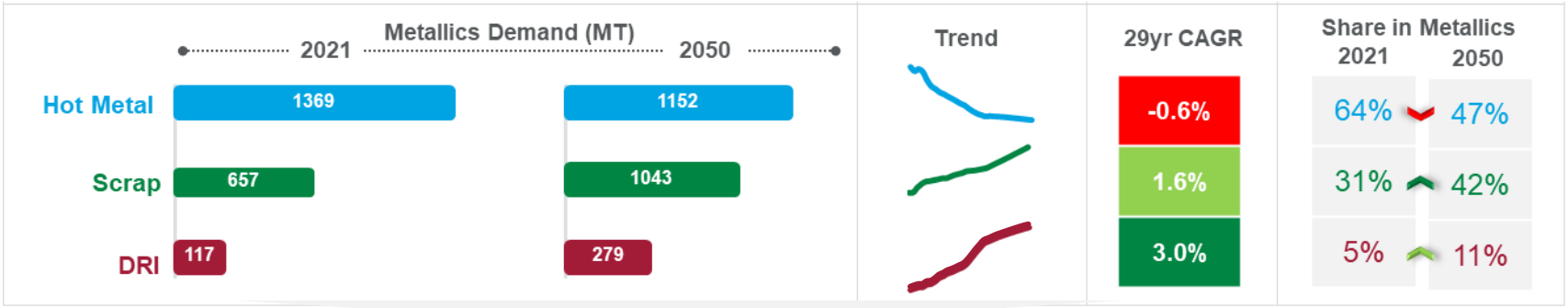
Fall in Chinese output will be compensated by India; global production to rise a meagre 0.5%



Source: Wood Mackenzie, WSA, NBS

Hot metal to be negatively impacted due to rising EAF preference

Scrap and DRI rapidly becoming the most sought after metallic due to its low carbon footprint



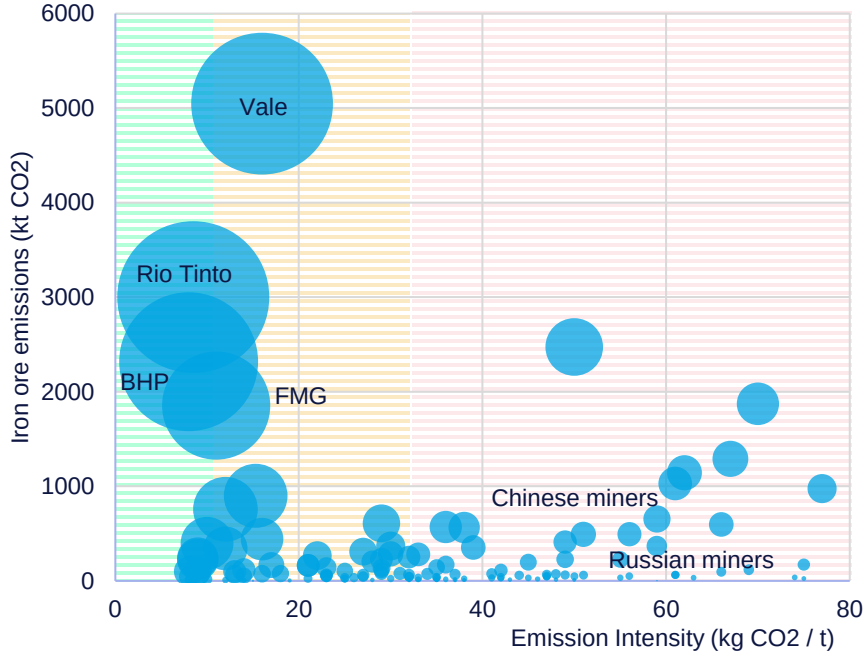
	Hot Metal (MT)			Scrap (MT)			DRI (MT)			EAF Share (%)		
	2021	2050	CAGR	2021	2050	CAGR	2021	2050	CAGR	2021	2050	VAR.
China	887	513	-2%	244	347	1.2%	1	41	14%	12%	35%	+23pp
India	78	270	4%	22	94	5.2%	39	45	0.5%	55%	35%	-20pp
SEA	23	86	5%	21	58	3.5%	1	11	8.8%	67%	56%	-11pp
JK	117	75	-1%	69	86	0.8%	-	10	10x	28%	47%	+19pp
EU+UK	85	33	-3%	100	133	1.0%	1	20	13%	60%	80%	+20pp
USA	23	20	-1%	74	88	0.6%	4	8	2.6%	70%	78%	+8pp

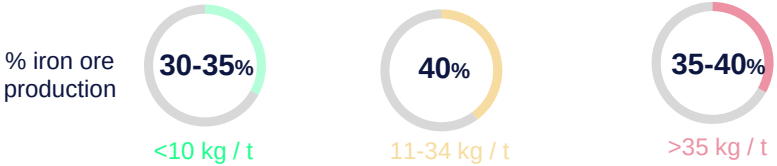
Source: Wood Mackenzie, WSA, NBS

Iron ore mining emits 70-75 Mt of operational emissions (28 kg CO2 / t)

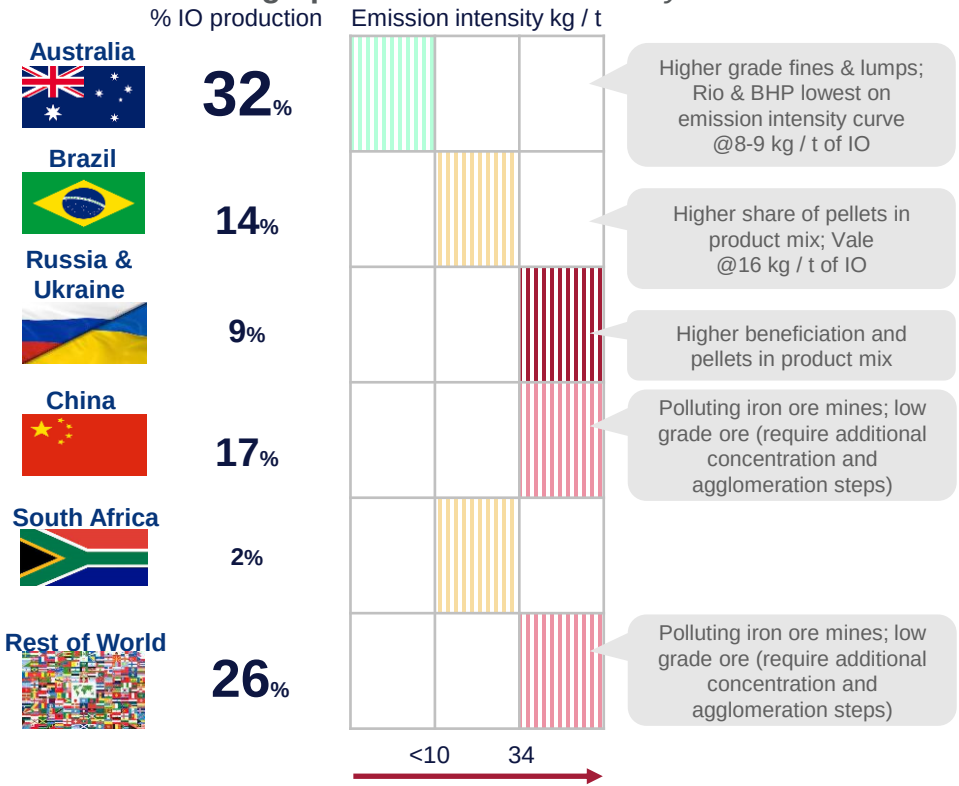
Australian miners emission intensity lowest; higher pellet share weighs on Brazil; polluting Chinese mines

Iron ore mining operational emissions: *by miners*





Iron ore mining operational emissions: *by countries*



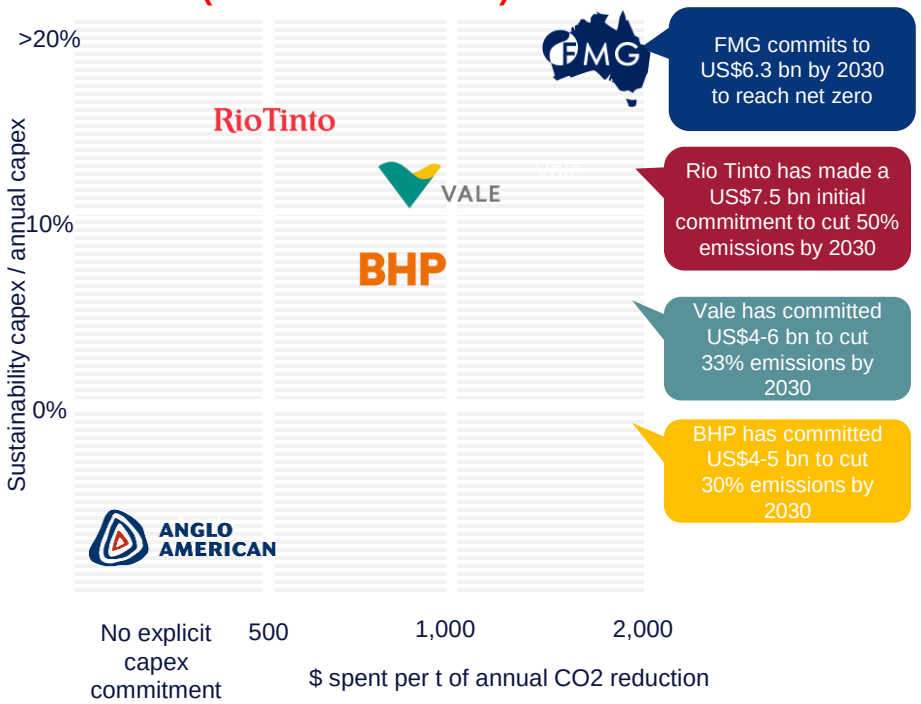
Source: Company Climate Change reports, Wood Mackenzie Emission Benchmarking Tool
Note: Analysis for scope 1 and 2 only. Analysis for iron ore (including pellets at mining site)

Iron ore majors set net zero targets, no noise by tier II and III players

Majors allocate around 10% of their annual capital budgets towards creating zero carbon mines

Top 5 miners set emission cut targets

Top four miners allocate US$23-24 bn for decarbonising their mines (across businesses)



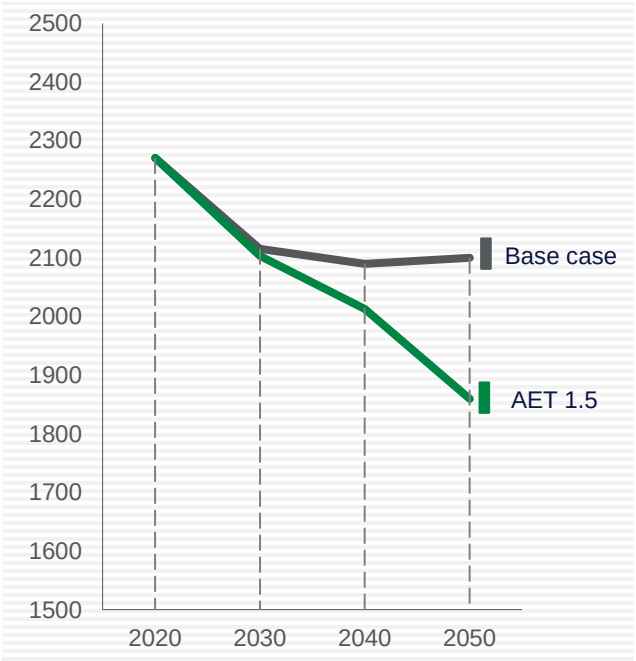
Source: Company Climate Change reports, Wood Mackenzie

Note: Analysis for scope 1 and 2 only; mining emissions include all business units (iron ore, coal, aluminium, etc.). FMG and Anglo have not explicitly announced any capex for the targets set by them in their climate change reports.

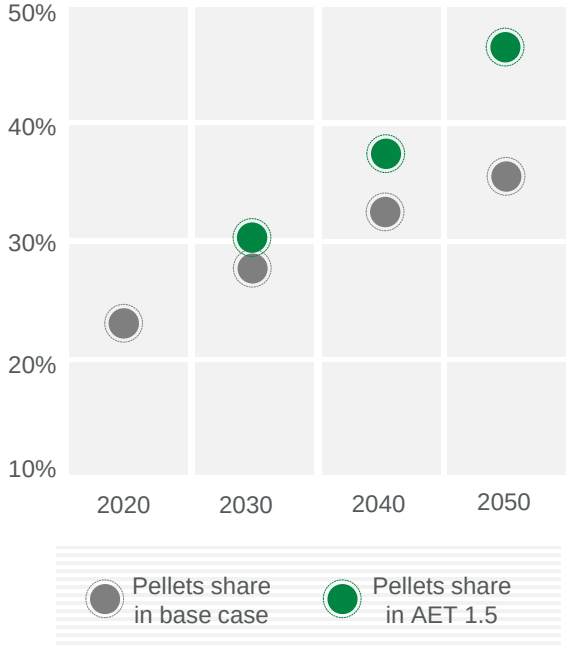
Iron ore demand to decline; pellet market to gain traction

Anorexic hot metal production and displacement by scrap to act as key deterrents under AET1.5

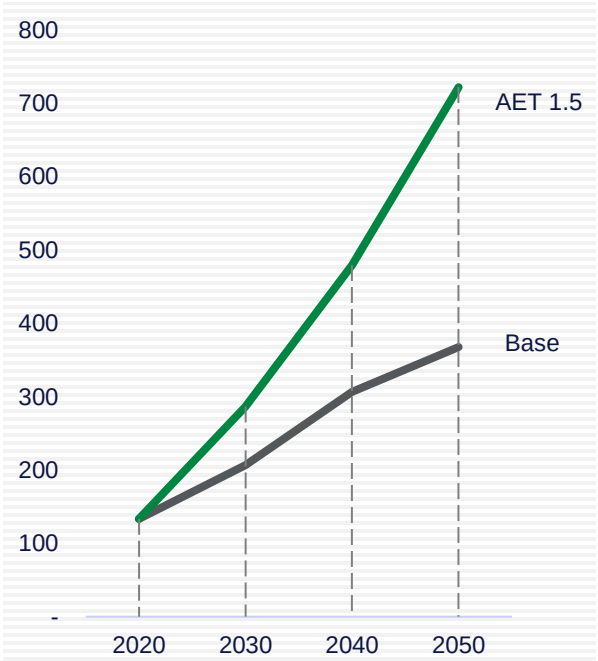
Iron ore demand (million tonnes)



Iron ore product mix



DR Pellet demand (million tonnes)



Global iron ore consumption is around 240 Mt lower than our base case forecast by 2050 led by scrap displacement which picks pace from mid 2030s.

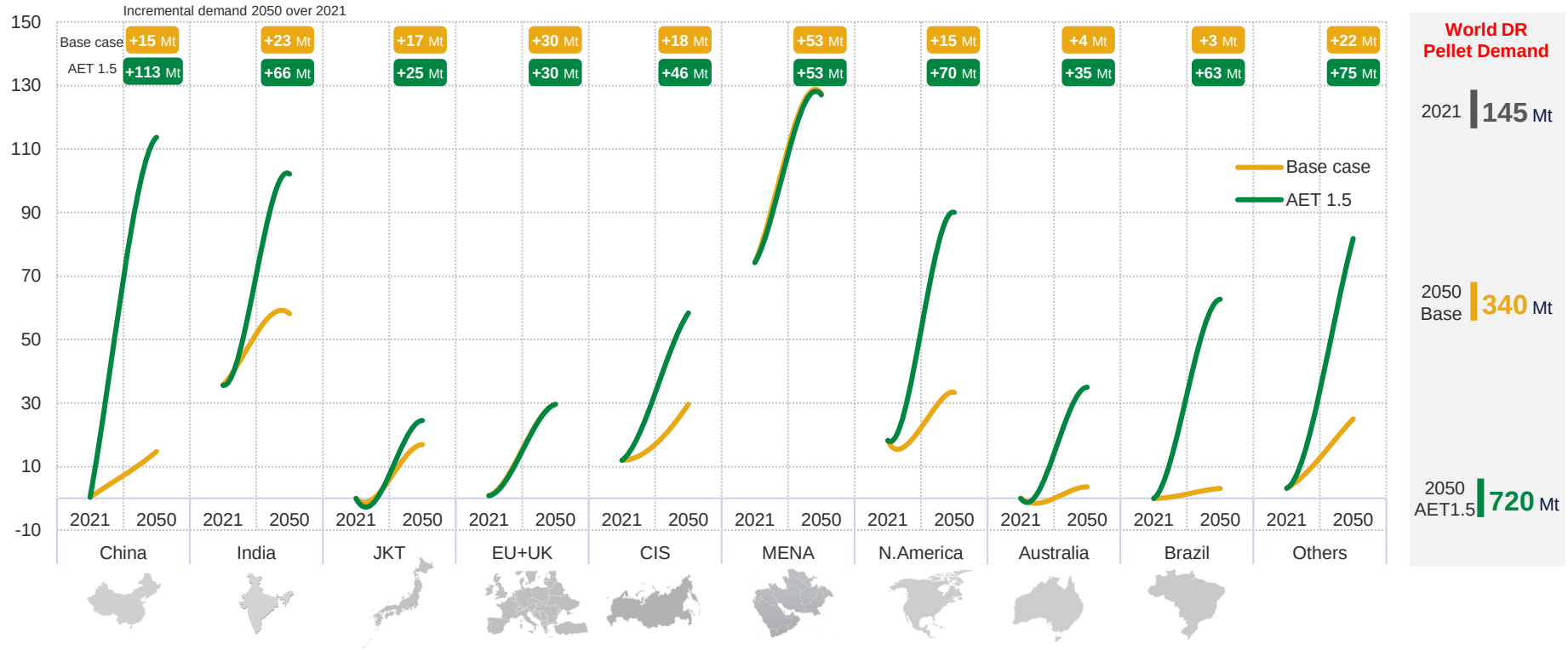
- DRI will benefit the most during steel’s decarbonisation pathway
- Commercial adoption of hydrogen based DRI route which will account for a third of total production by 2050
- This shall augur well for DR pellet and pellet feed market which will rise by 5.4-5.5x in AET 1.5 (over 2021)

Source: Wood Mackenzie

DR pellet demand to rise 2.4x by 2050 in base case and 5x under AET 1.5

China, North America, Brazil to be key epicenters of demand under AET 1.5

DR pellet demand across key regions (million tonnes)

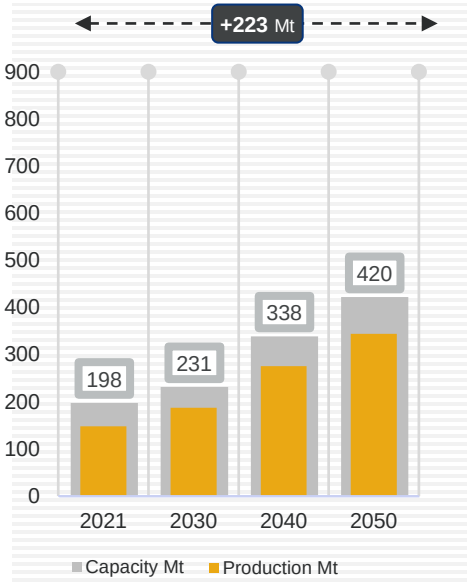


Source: Wood Mackenzie, GTT, Steel associations

4.2x of current DR pellet capacity needed to feed green steel under AET 1.5

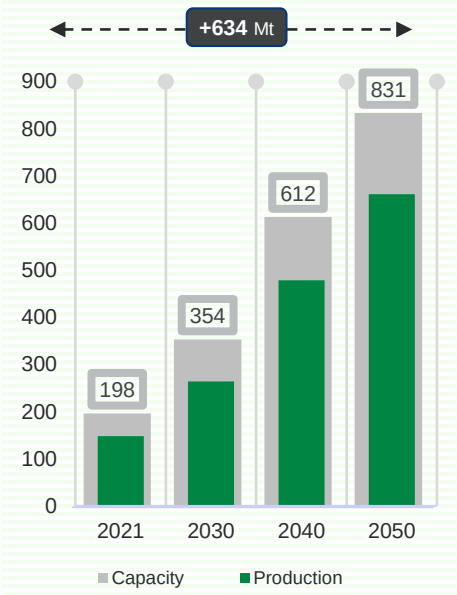
World will need 630 Mt of new DR pellet capacity under AET 1.5

DR pellet supply – *Base case*



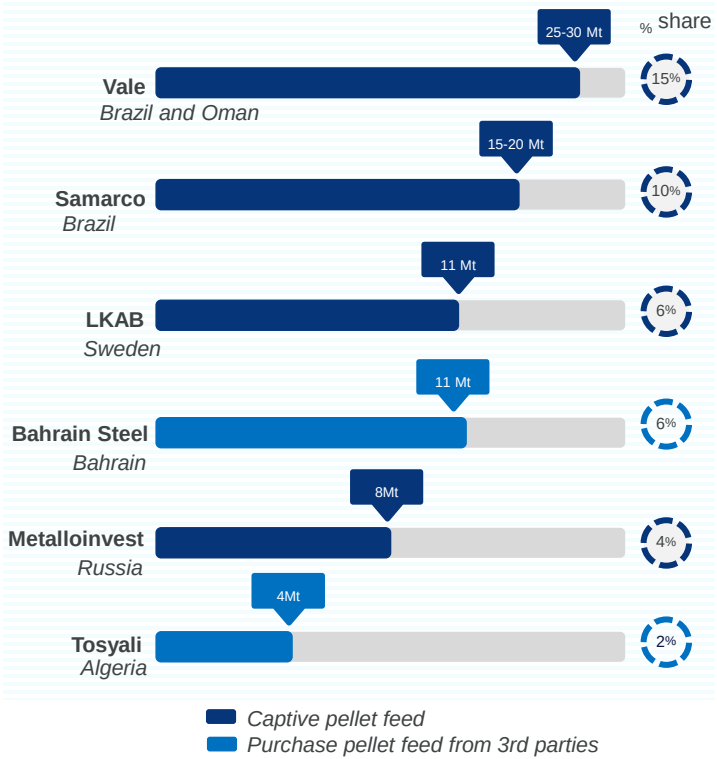
223 Mt of incremental DR pellet capacities will be added in our base case scenario

DR pellet supply – *AET 1.5*



AET 1.5 will warrant nearly 634 Mt of new capacity additions over the next three decades (i.e 4.2x of current capacity base)

DR pellet current supply landscape – *key players*

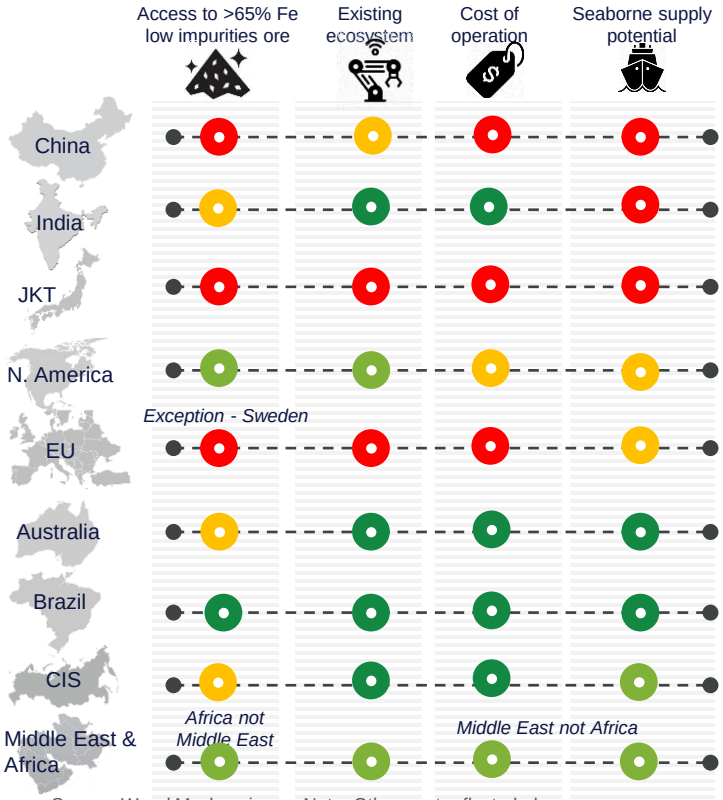


Source: Wood Mackenzie, Company reports

Brazil, Middle East and Africa will invest more in DR pellets under AET1.5

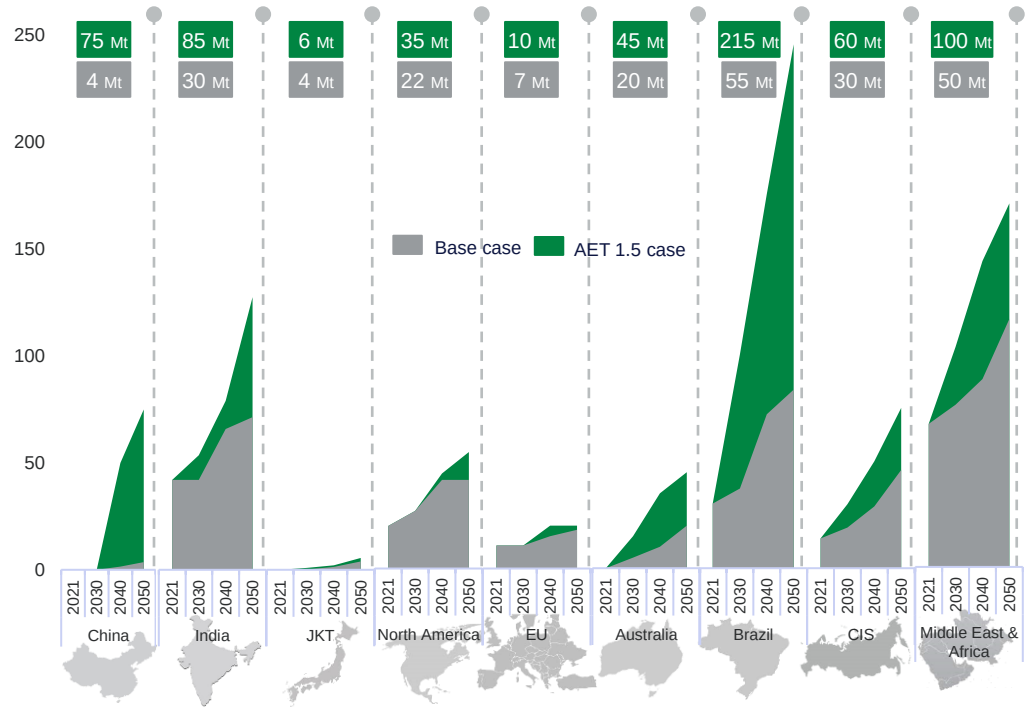
Proximity and access to high grade ore and associated ecosystem to be key determinants

Key determinants of upcoming DR Pellet supply



Source: Wood Mackenzie Note: Others not reflected above

DR pellet capacity split – *Regional split (million tonnes)*

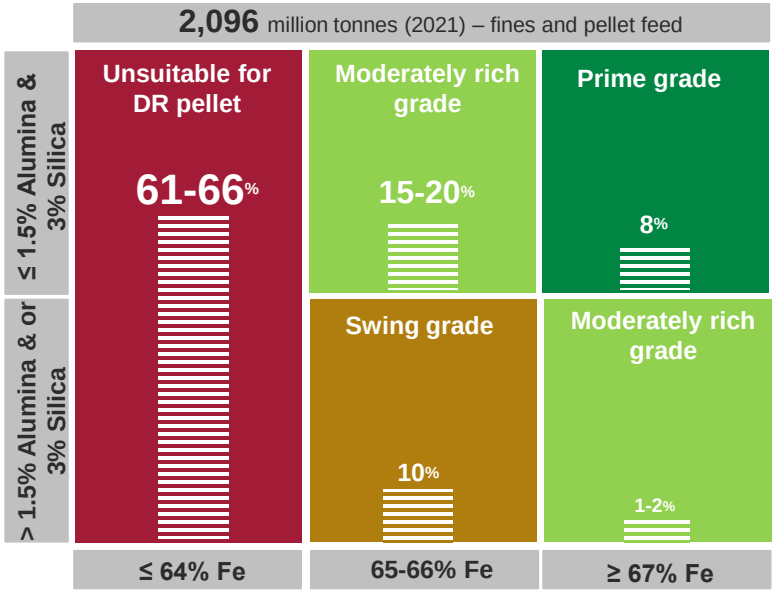


Under AET 1.5, China will need to add 75 Mt of DR pellet capacities despite weak supply side parameters. DR pellet feed demand for these projects will potentially originate from Simandou and other rich mines. Despite this, China would still import nearly half of its DR pellet demand.

Just 8% of current production is prime grade for green steel

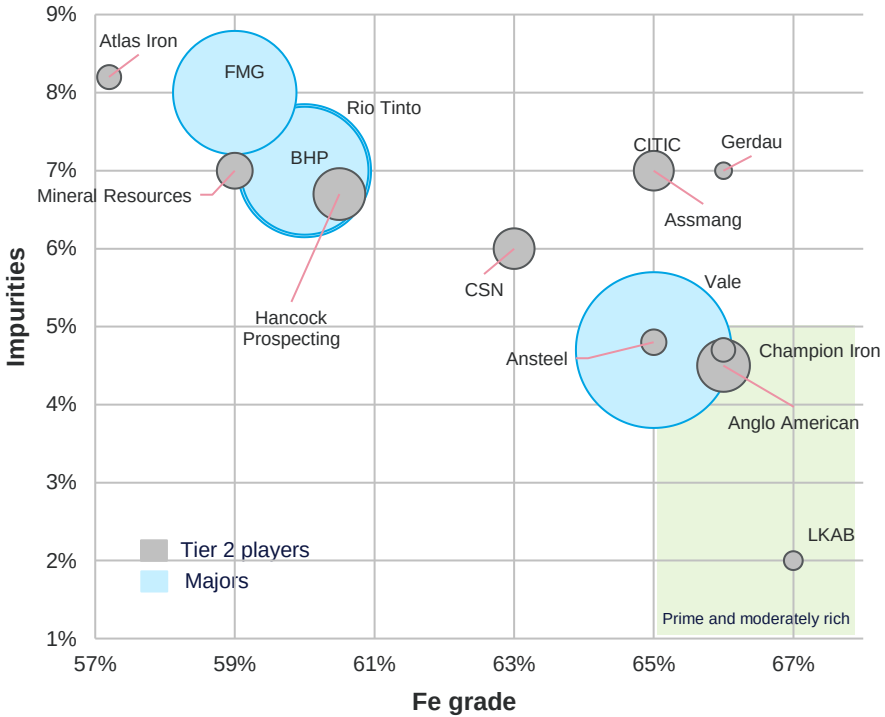
Another 15-20% can be beneficiated or processed to become prime grade

Market analysis by Fe grade and impurities



- Only 8% of current production is ideal DR grade, while 15-20% will need minimal beneficiation or processing.
- **Swing supply**: Another 10% will need high investments in beneficiation, processing, grinding and can swing on either side depending on ore’s mineralogy.

Analysis for key miners (2021)



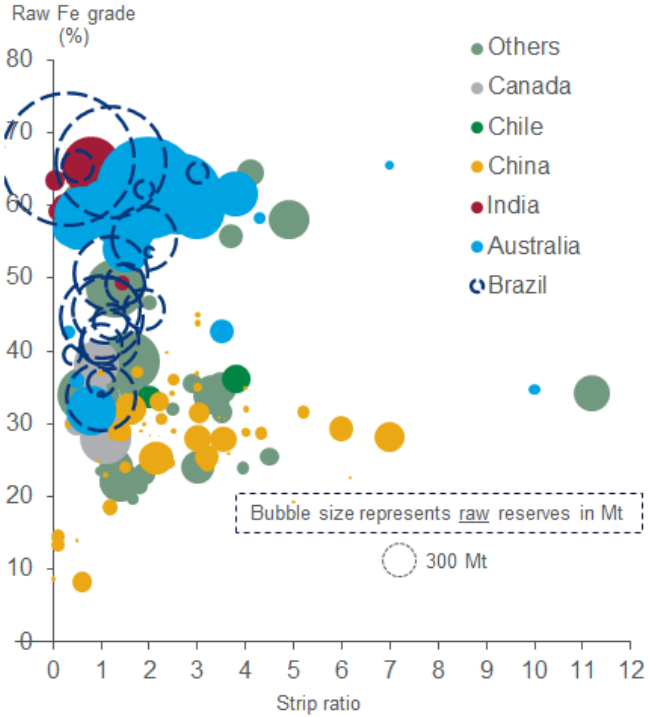
Note: The aforementioned chart is volume weighted average for fines and pellet feed

Source: Wood Mackenzie

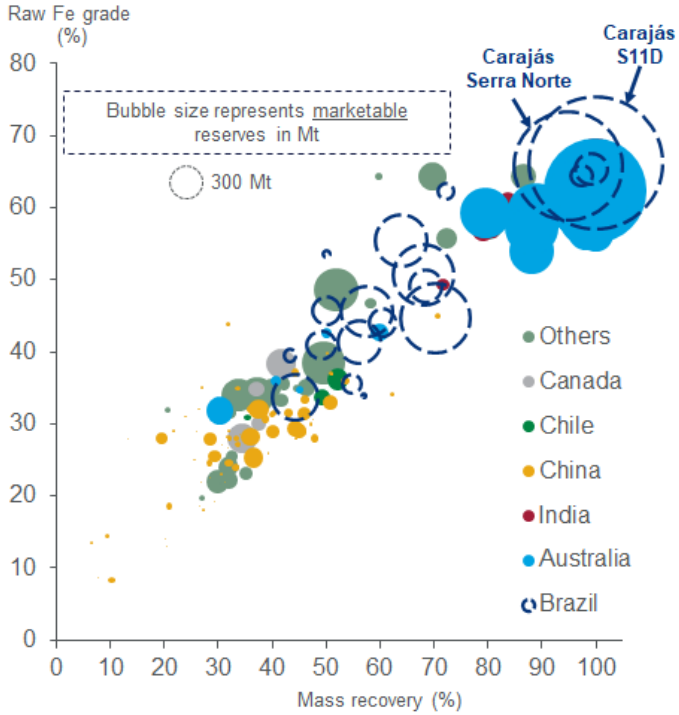
Brazil holds a vast low-strip ratio reserve base

Most of Brazil’s high-grade reserves are concentrated at Carajás

Overall, Brazil and Australia’s reported raw reserves are comparable in size and quality...



…but, if it wasn’t for Carajás, Brazil’s reserves would be far inferior to Australia’s

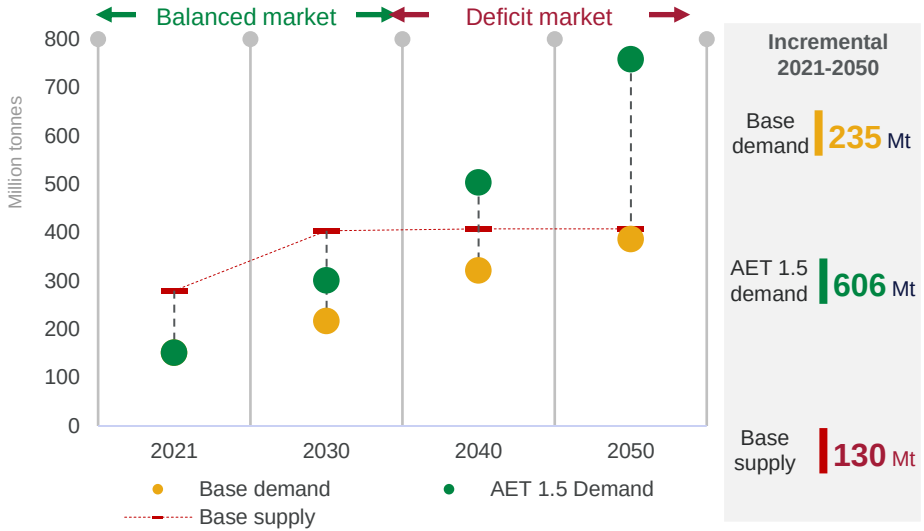


Source: Wood Mackenzie

DR pellet feed market to face deficit of 350 Mt by 2050 under AET 1.5

Miners would need to invest in high grade ore new mines

DR pellet feed demand supply gap analysis



DR pellet feed supply build-up under base and AET 1.5

The world will potentially face DR pellet feed deficit post 2030 in an AET 1.5 case (with current planned supply). Activation of new high grade ore projects in Brazil, Africa, and Australia will become pivotal to feed green steel.

Expansion by operating mines and upcoming high probability mines will add 120-130 Mt of pellet feed supply. Beyond that the world will need an additional 350 Mt to feed green steel under AET 1.5.

Source: Wood Mackenzie

Note: Pellet feed supply includes prime and moderately rich pellet feed only

Key Takeaways

- Green steel transition is a reality
- Capacity switch from BOF to EAF to gradually materialise
- Carbon emissions reduction increasingly committed by the mining companies
- Demand for direct high-grade feedstock like DRI/HBI, briquettes and pellets to spike
- Brazil is one of the main beneficiaries of those trends mainly as a high-quality iron ore base
- Lower to mid-grade producers, like India and Australia, to face more challenges to supply their products without investing in new/undeveloped technologies

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