



The Global HBI/DRI Market: outlook for seaborne DR Grade pellet supply

AIST DRITC

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Presentation overview

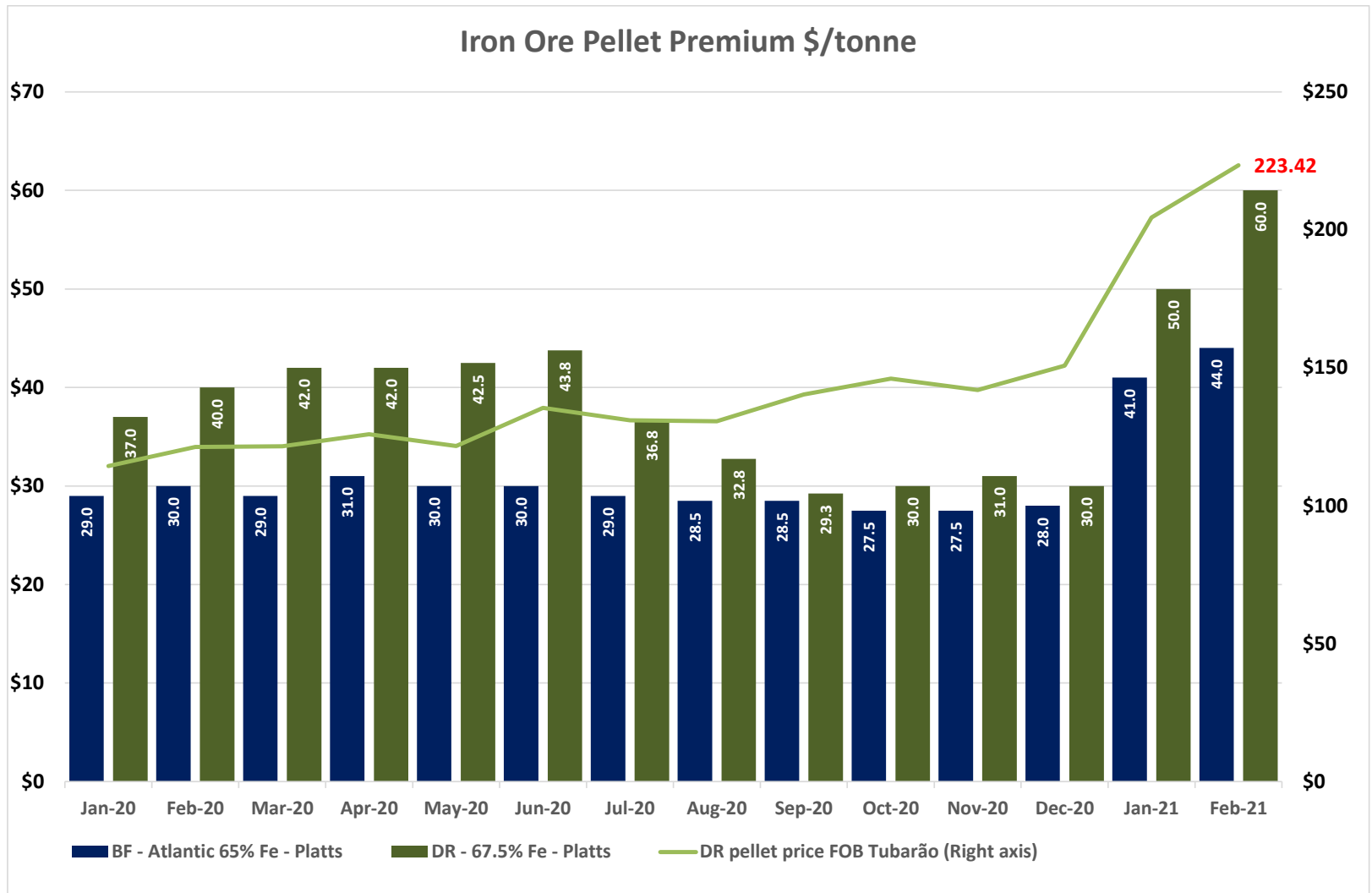
- **Setting the scene**
- **Outlook for DR grade pellet supply out to 2030**
- **DRI and the pathway to carbon-neutral steelmaking**

‘Green steel’: the race to clean up one of the world’s dirtiest industries

“From a cost perspective and an economic analysis, we just don’t see the right conditions yet to facilitate a wholesale shift across the industry,” says CRU’s Smith.

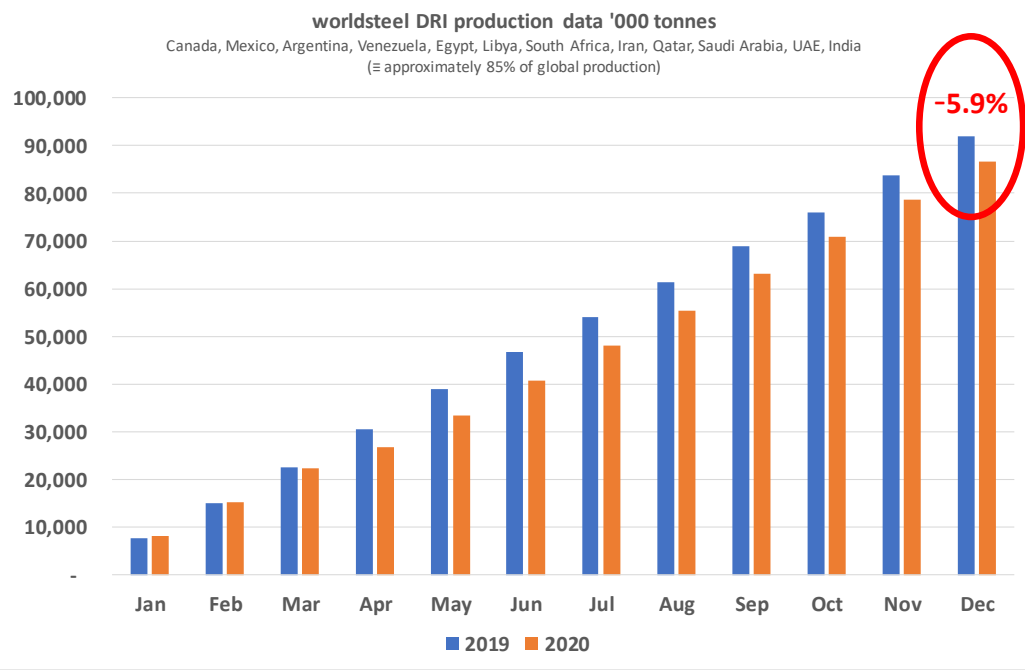
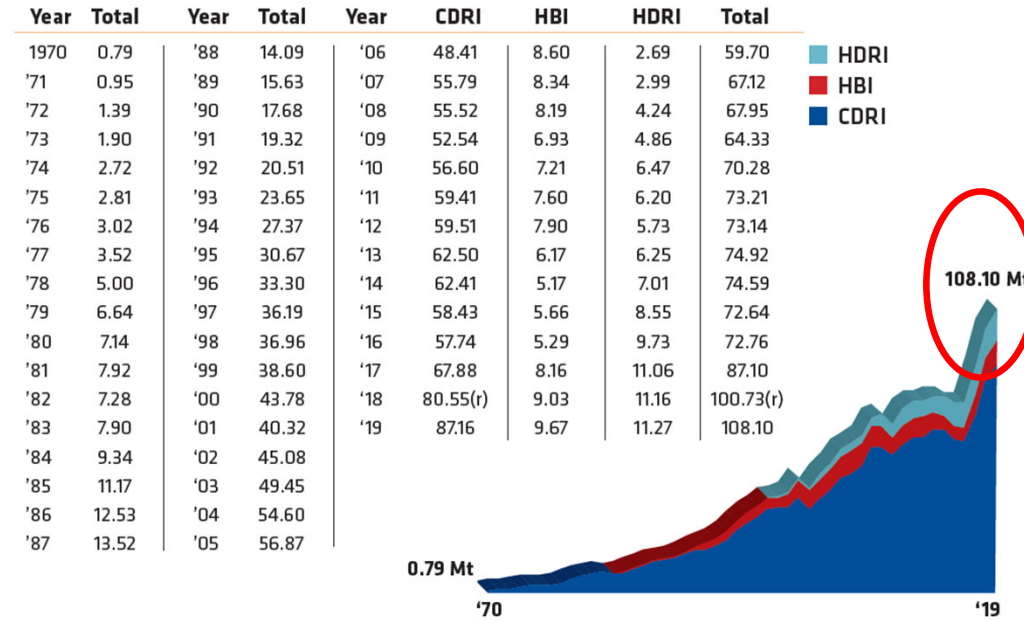
But Doug Parr, Greenpeace UK’s chief scientist, sees reason for optimism: “The momentum seems to be greater than in, say, the cement or chemicals industry. It could well be a test case of how an industry goes about it.” FT February 2021

Setting the scene



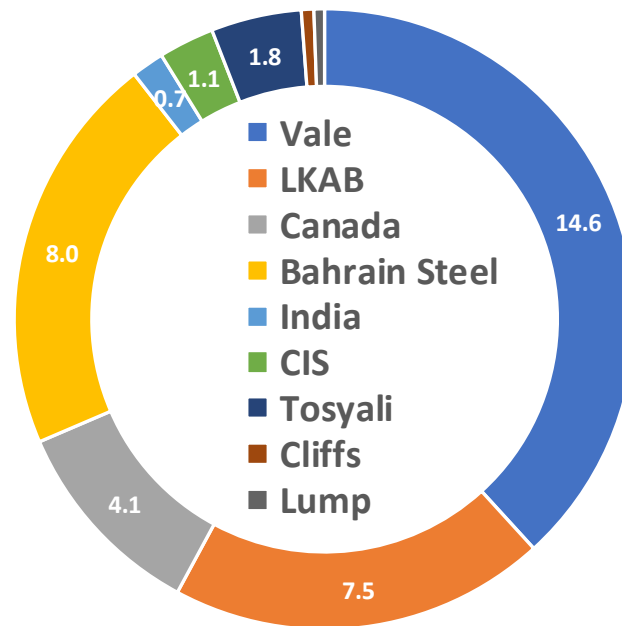
World DRI Production by Year (Mt)

Source: Midrex Technologies, Inc.

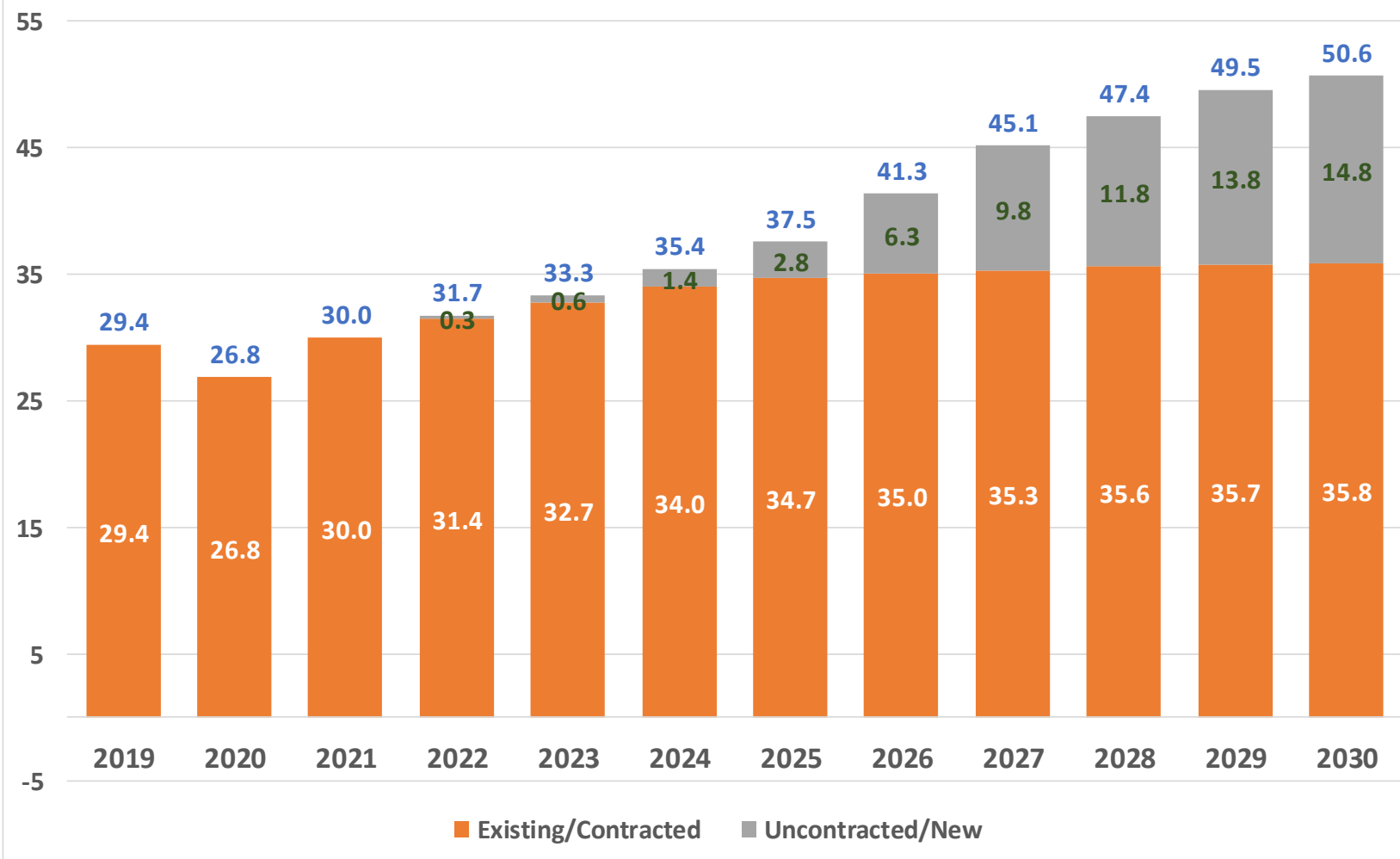


**Seaborne Ore Supply to DR plants 2020 (mt) - total 38.2 mt
(preliminary estimate)**

source: trade statistics and author's estimates
(compares with 38.9 mt derived from DRI production data)

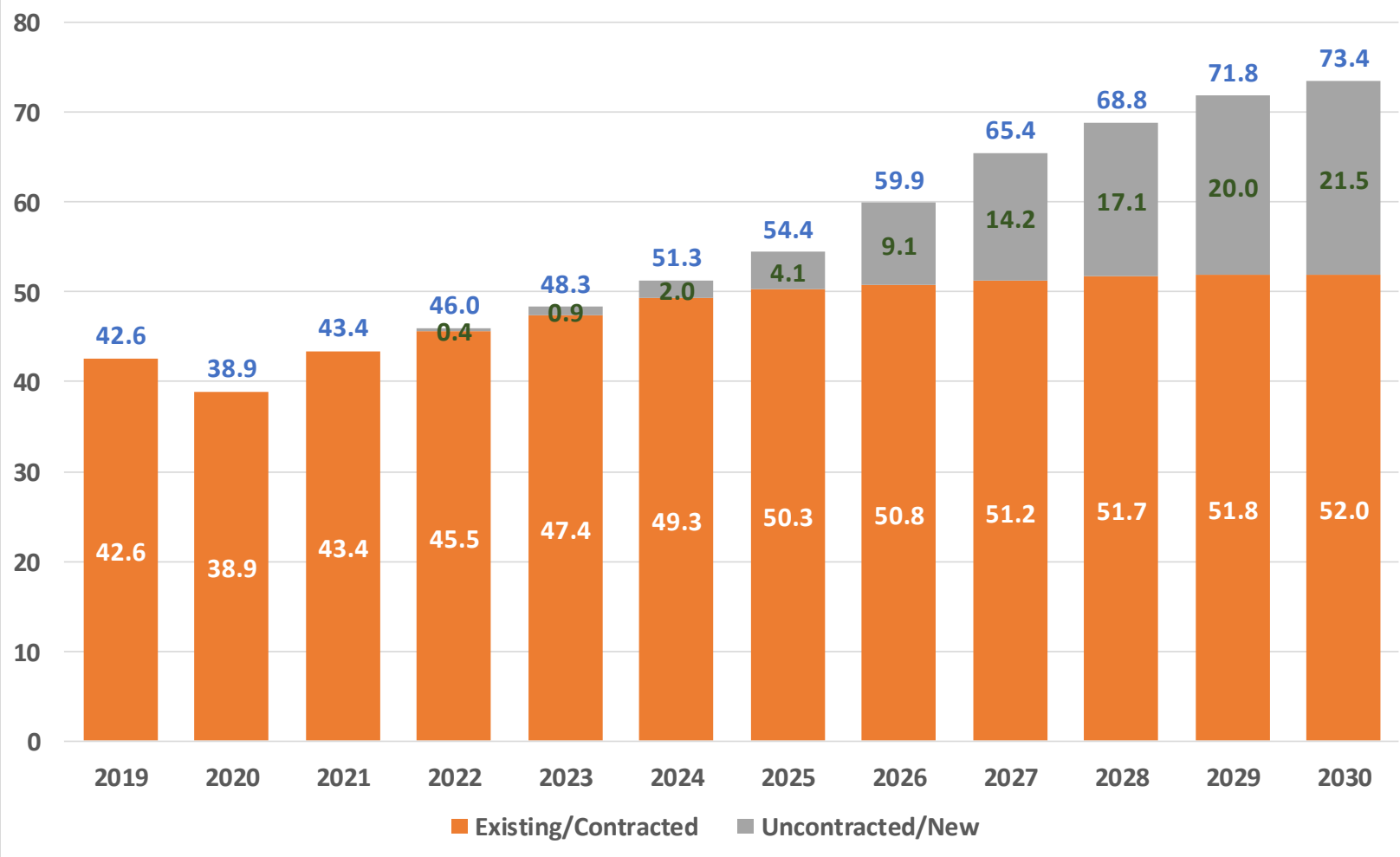


DRI production in plants using merchant iron ore (mt)



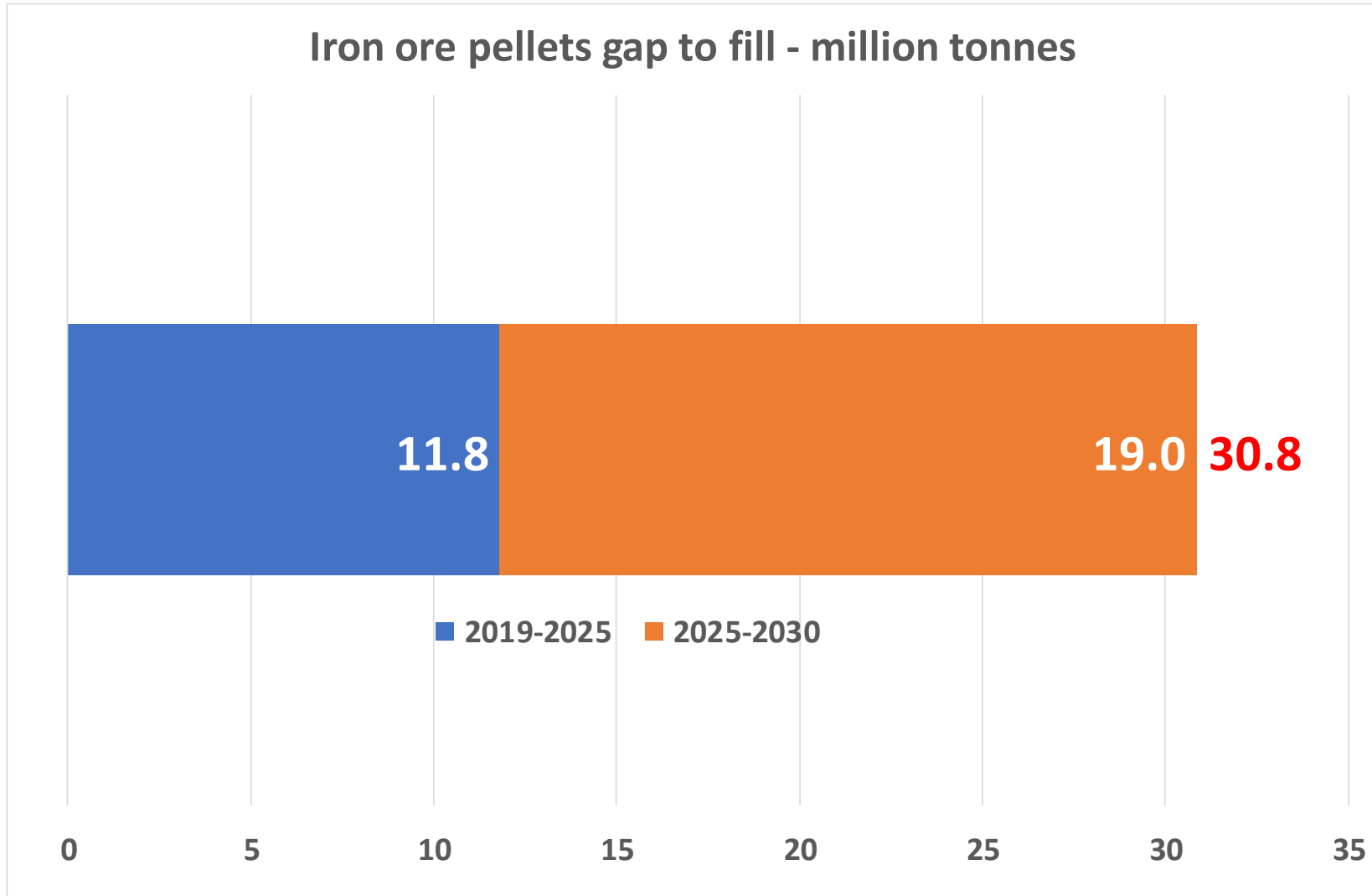
Argentina
Trinidad
USA
Germany
South Africa
Algeria
Libya
Egypt
Saudi Arabia
Qatar
Bahrain
UAE
Oman
Malaysia

Merchant DR grade pellet demand (mt) - 1.45 t pellets per 1t DRI



Argentina
Trinidad
USA
Germany
South Africa
Algeria
Libya
Egypt
Saudi Arabia
Qatar
Bahrain
UAE
Oman
Malaysia

Iron ore pellets gap to fill - million tonnes



DRI production from new projects

(based on merchant iron ore)

Project	2022	2023	2024	2025	2026	2027	2028	2029	2030	Location
HBIS Group	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	China
Salzgitter			0.8	1.6	2	2.0	2.0	2.0	2.0	Germany
TKS				0.6	1.2	1.2	1.2	1.2	1.2	Germany
Liberty/PW/SHS					1.0	2.0	2.0	2.0	2.0	France
IOC/PW/SHS					0.5	1.0	1.0	1.0	1.0	Canada
MENA 1					1.0	2.0	2.0	2.0	2.0	North Africa
MENA 2						1.0	2.0	2.0	2.0	North Africa
EU							1.0	2.0	2.0	Austria, Italy, Romania....
Asia								1.0	2.0	ASEAN, China
Total	0.3	0.6	1.4	2.8	6.3	9.8	11.8	13.8	14.8	

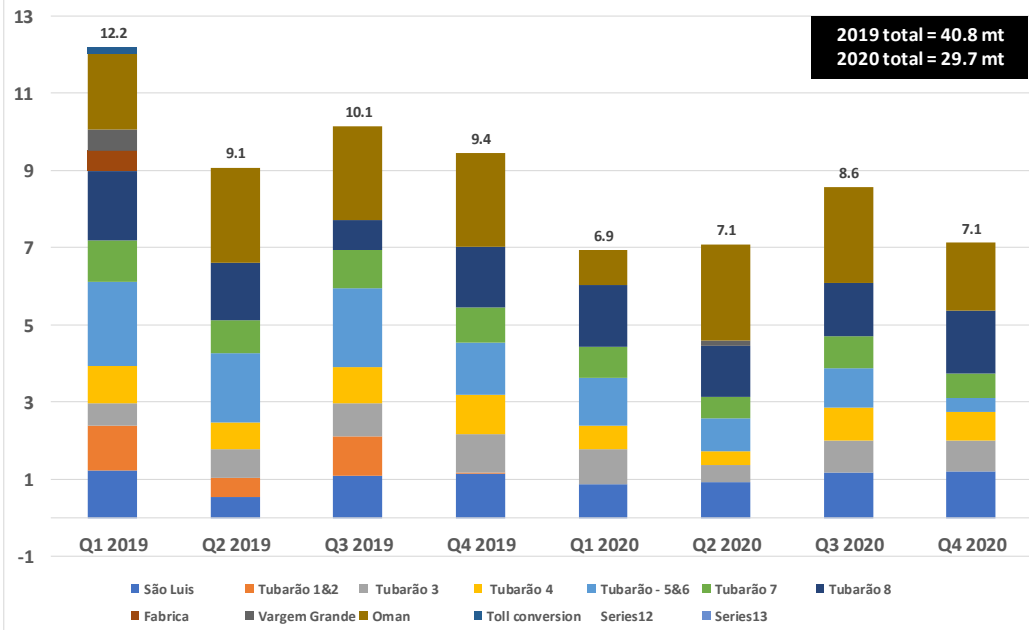
Author's assumptions

Vale in 2020

source: Q4 2020 production report

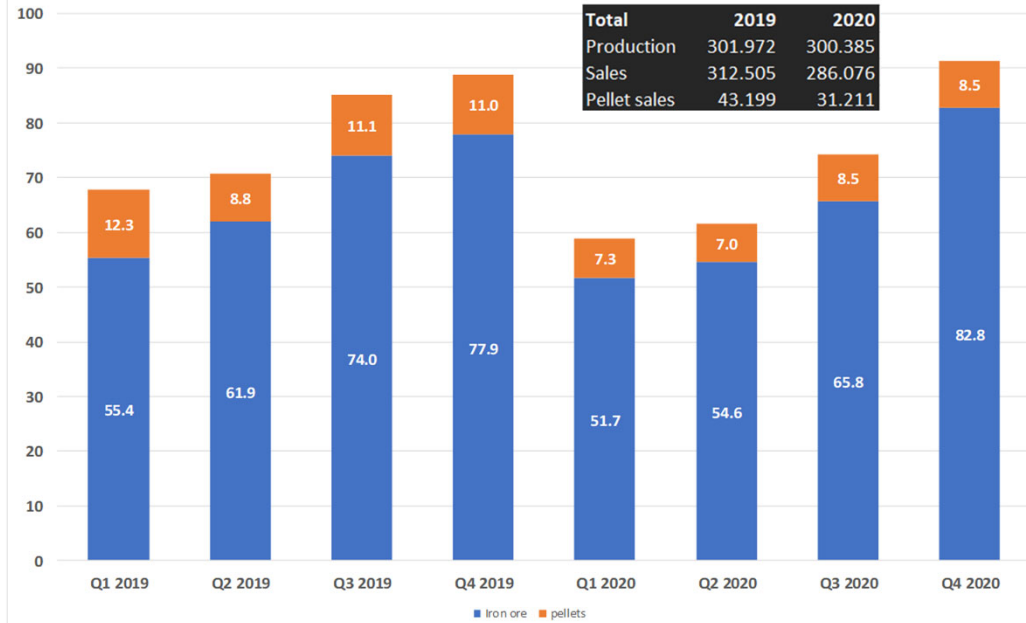
Vale's quarterly pellet production (mt)

2019 total = 40.8 mt
2020 total = 29.7 mt

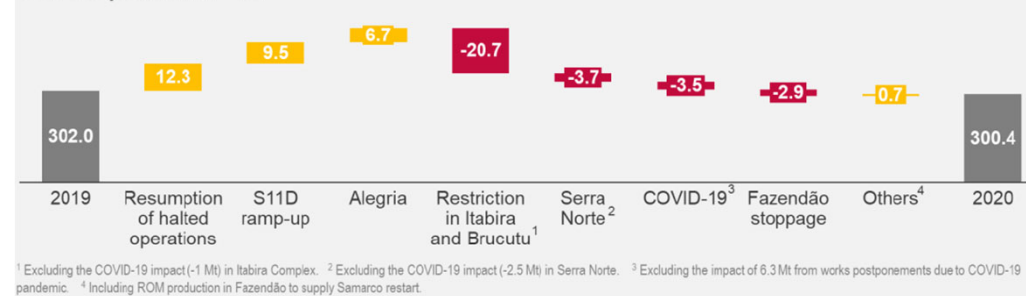


Vale's iron ore sales (mt)

Total	2019	2020
Production	301.972	300.385
Sales	312.505	286.076
Pellet sales	43.199	31.211



Iron ore production - Mt



Estimated pellet supply to DR sector in 2020: 13.6 mt

¹ Excluding the COVID-19 impact (-1 Mt) in Itabira Complex. ² Excluding the COVID-19 impact (-2.5 Mt) in Serra Norte. ³ Excluding the impact of 6.3 Mt from works postponements due to COVID-19 pandemic. ⁴ Including ROM production in Fazendão to supply Samarco restart.

outlook Vale

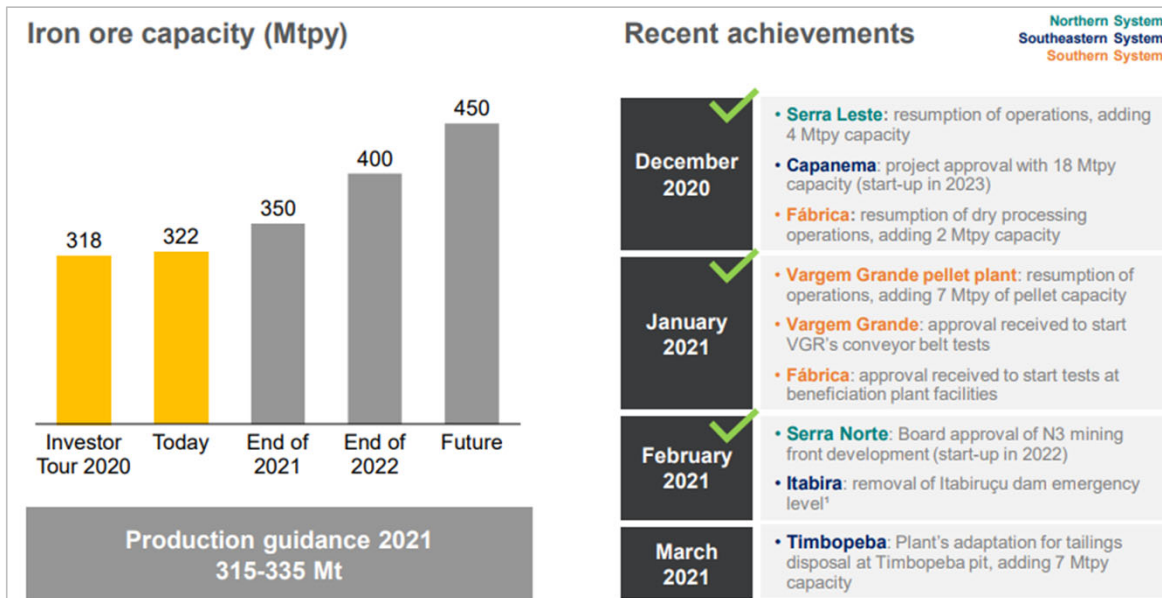


Chart source: Vale Q4 2020 earnings call 26/02/2021

- No formal guidance yet for 2021 pellet production – “slightly more than in 2020” per Vale Q4 earnings call on 26/02. guesstimate: 30-35 mt of which DR grade 14-17 mt**

 - Vargem Grande pellet plant restarted in January 2021 (7 mt capacity – domestic market focus)
 - Fabrica dry processing started 12/2020 with pellet plant restart scheduled in 2022
 - 2021 Tubarão pellet production will be driven market demand and in the case of DR grade pellets by high grade pellet feed availability
 - 2021 Oman pellet production will likely be 9-10 mt, all for DR sector
- Prior to the Brumadinho dam rupture, we estimated Vale’s pellet supply to DR sector in 2019 and 2020 at ~27 mt (total pellet capacity 60 mt).**

outlook - LKAB

- LKAB has 10 mt capacity at pellet plants with coating capacity (Kiruna KK3 and KK4)
 - KK3 produces only DR grade, KK4 can switch between BF and DR grades
- LKAB's pellet deliveries in 2020: 23.9 mt (20.7 mt in 2019)
- Estimated DR grade pellet supply (basis trade data):
 - 6.9 mt 2020 to November \equiv 7.5 mt on annualised basis (6.7 mt in 2019)
 - Kiruna still affected by earthquake in May 2020 (4.9 on Richter's scale) and has announced plans to mine 1 mt at mothballed Mertainen mine (near Svappavaara) to provide crude ore buffer for the Kiruna and Svappavaara pellet plants
- Based on its contract portfolio, it seems that about 7 mtpy is a maximum level of seaborne DR grade pellet supply for the foreseeable future
- From ~2025 HYBRIT project will utilise ~1.5 mt “fossil-free” pellets from Malmberget

WE TAKE A NEW POSITION ON THE MARKET

A successive change from supplier of iron ore pellets to supplier of sponge iron

THE PACE OF TRANSFORMATION



Source: LKAB presentation 23/11/2020

overview - **Canada**

- **Canada has two pellet producers, Iron Ore Company of Canada (IOC) and ArcelorMittal Canada (AM)**
 - **AM supplies DR grade pellets to captive DR plants in Canada and Germany**
 - **IOC supplies the wider DR market**
- **AM is considered unlikely to supply DR grade pellets to external DRI producers**

outlook: **Iron Ore Company of Canada (IOC)**

- **2020 pellet production was 9.6 mt (2019: 10.1 mt).**
- **2020 pellet sales were 10.2 mt of which 3.6 mt was to DR markets (2019: 9.6 mt of which 3.5 mt to DR markets).**
- **Expectation for DR pellet supply in 2021 is about ~4 mt and by the middle of the decade annual supply potential of ~5 mt DR grade pellets.**
- **Most recent news 16/02/2021: Rio Tinto, Paul Wurth and SHS-Stahl-Holding-Saar signed MoU to explore production of low-carbon steel feedstock:**
 - **transformation of iron ore pellets from IOC to low carbon HBI using green H₂ generated from hydro-electricity**
 - **project to be located in Eastern Canada - understood to be 1 mt HBI plant (≡ 1.45 mt pellets)**
 - **feasibility study scheduled for completion in late 2021, to be followed by investment decision – earliest start-up probably 2026**
 - **SHS-Stahl-Holding-Saar is majority shareholder of Dillinger Hüttenwerke (steel plant at Dillingen) and indirect owner of Saarlouis (steel plant at Völklingen) – the two companies each own 50% share of ROGESA Roheisengesellschaft Saar (two blast furnaces at Dillingen, 4.6 mt hot metal)**

outlook - **Bahrain Steel**

- Bahrain Steel is in effect partly captive to adjacent DR plant SULB which produced 1.5 mt DRI in 2019 (est. 2019 pellet offtake from BS ~2.2 mt).
- Nameplate capacity of the two pellet lines is 11 mt and production at the 12 mt level has been achieved on sustainable basis.
- Ore imports in 2020 are estimated per trade data at about 8 mt (mainly from Brazil, but also Canada and Sweden) with pellet production of about 8.3 mt
 - of which ~ 2 mt supplied to SULB (now exporting surplus DRI to North African markets) and
 - ~ 6 mt to export markets, mainly in MENA region, but also USA and Trinidad
- Production is now running at full capacity of about 12 mt
- 20 year contract ($\geq 67\%$ Fe / $\leq 2\%$ gangue) with Anglo American/Minas Rio (annual DR grade pellet feed capacity of which is ~8 mt).

outlook - **Tosyali Algeria**

- **Tosyali Algeria (2.5 mt DR plant) has adjacent 4 mt pellet plant, but no captive supply of pellet feed.**
- **Supply of suitable pellet feed has been a major constraint, initially due to lack of grinding capacity (now remedied), but also to difficulty in sourcing DR grade pellet feed and port constraints. Latest developments are port improvements and addition of a 4.5 mt ore beneficiation plant, due to commission in 2021.**
- **DRI production in 2020 was 2.23 mt, requiring ~3.2 mt pellets.**
- **Based on the previously estimated in-house pellet production of 1.8 mt in 2020, pellet imports would have been ~1.4 mt (trade data for 2020 are so far incomplete).**
- **Once the ore beneficiation plant is fully operational, dependence on imported pellets should be significantly reduced or eliminated by 2022.**
- **Tosyali Algeria Phase 4 project beginning 2021 is 4 mt integrated flat steel production facility**

outlook - **Samarco**

- **Licensing process is complete.**
- **Restarted pellet production in December 2020.**
- **Ramp up will be progressive in three “step-by-step” phases (nominal capacity 7-8 mt pellets each phase):**
 - **Phase 1: starting with concentrator #3/pellet plant #4 with ramp-up Q1 2021**
 - **Phase 2: “official” position is to restart concentrator #2/pellet plant #3 in 2026, but could be sooner, say in 2023 - timing will depend on Phase 1 performance, etc.**
 - **Phase 3: timing is unclear at this point as a tailing solution has still to be determined, but will hopefully be by 2030 - based on 2015 performance, total pellet production of ~28 mt could be achieved**
- **Initial ramp-up will be on BF pellets - best estimate today is that product split in 2021 will be 50-60% BF pellets, 40-50% DR pellets (3.0-3.75 mt DR grade pellets) - ultimately product split will be market driven (author’s estimates).**



“Samarco resumes its operation with a filtration technology whereby 80% of tailings (the coarsest sandy part) will be filtered and dry stacked. The finer slurry part, representing 20% of tailings, will be disposed of in the "Germano pit" (a totally confined environment).”



outlook - Cleveland Cliffs

- Cleveland Cliffs produces DR grade pellets (67.3% Fe, 2% SiO₂) at its Northshore operation - capacity ~3.0 mt.
- Cliffs' 1.9 mt Toledo HBI plant started up in late 2020 and will consume 2.7-2.8 mt pellets at full production.
- Thus, ~0.25 mt DR grade pellets is available for sale to third parties (understood to be contracted to Nucor).



Images from Cliffs website

CIS - Ukraine

Metinvest – Central GOK

- **Upgrading plan approved in 2018 and now completed:**
 - **beneficiation plant: concentrate quality upgraded to 70.5% Fe**
 - **pellet plant: addition of double deck screening, new mixer and pelletising disc**
 - **full scale operation from Q3/4 2020**
- **Nominal capacity is now 5.5 mt concentrate and 2.2 mt pellets (basis DR grade).**
- **Plan is to produce 2.0-2.2 mt DR grade pellets with target specification of min. 67.6% Fe and max. 2.6% SiO₂. DR plants In MENA region are the key target market.**
- **Production of pellets with Fe >67.5% in 2020 was 1.004 mt and deliveries to DR customers have started and are ongoing**

Ferrexpo

- **Ferrexpo produced 0.339 mt DR grade pellets (67% Fe) in 2020 and plans to increase production of DR grade pellets in the medium term.**

Russia - Metalloinvest

- Mikhailovsky started pilot scale shipments of DR grade pellets (~68% Fe, 1.4% SiO₂) made from Lebedinsky concentrate to OEMK and Lebedinsky in mid-2020. Ore beneficiation is being upgraded to enable production of 16.4 mt high grade concentrate from 2022, including 8.8 mt flotation concentrate grading 70% Fe.
- Metalloinvest plans to produce ~0.5 mt DR grade pellets (68% Fe) at Mikhailovsky for trial shipments to the market in 2021 and could supply ~2 mt to the market from 2022 - the decision to produce DR or BF pellets will be market-/margin-driven.
- Metalloinvest's 4th HBI plant (capacity 2.08 mt) to be built at Mikhailovsky – production expected to start in H1 2024. DR pellet production will be increased to supply this plant.
- *OMK is studying a project to build a 2.5 mt Energiron DR plant at Vyksa Metallurgical Plant (VMP), to be commissioned H2 2024. So far there is no final decision. Company has no iron ore assets.*

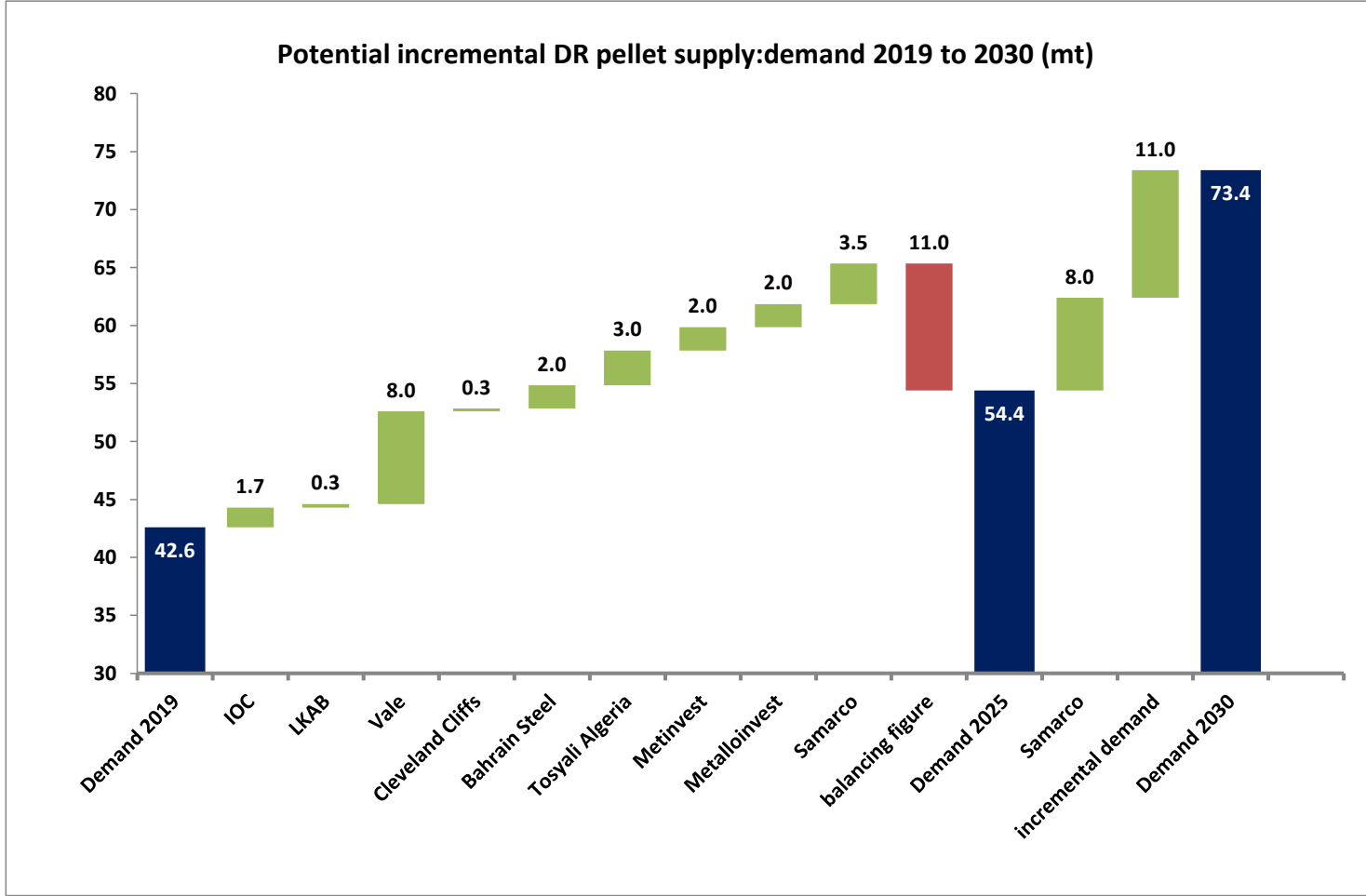


Image from Metalloinvest website

Lump ore

- **Main current supplier is Kumba (Anglo American) from Sishen mine:**
 - Only 0.21 mt DR grade was exported in 2020 (to Egypt).
 - Premium grade lump ore (typically 65.2% Fe) is understood to involve selective mining and as the pit gets deeper, scope for increased production is limited.
- **Potential new supplier is Baffinland Iron Mines' Mary River mine (jointly owned by ArcelorMittal and Nunavut Iron Ore):**
 - current production 6 mt of which 70% lump with >67% Fe, 1.6% SiO₂, 0.9% Al₂O₃ - could be enriched by selective mining
 - proposed Phase 2 Expansion Project would involve constructing a railway from the Mary River Mine Site to the Port Site, adding a second ore dock at the Port and increasing production to 12 Mt per year

- Assumes Vale reaches 60 mt pellet production of which 45% is DR grade
- Assumes 12 mt from Bahrain Steel
- Assumes Tosyali Algeria is self-sufficient in pellets by 2025
- Assumes start date for Samarco Phases 2 & 3 during second half decade
- According to [this scenario](#), potential 2025 DR pellet supply exceeds demand by 20%
- To meet the 2030 level of demand, Samarco Phases 2 and 3 and much more will be needed....

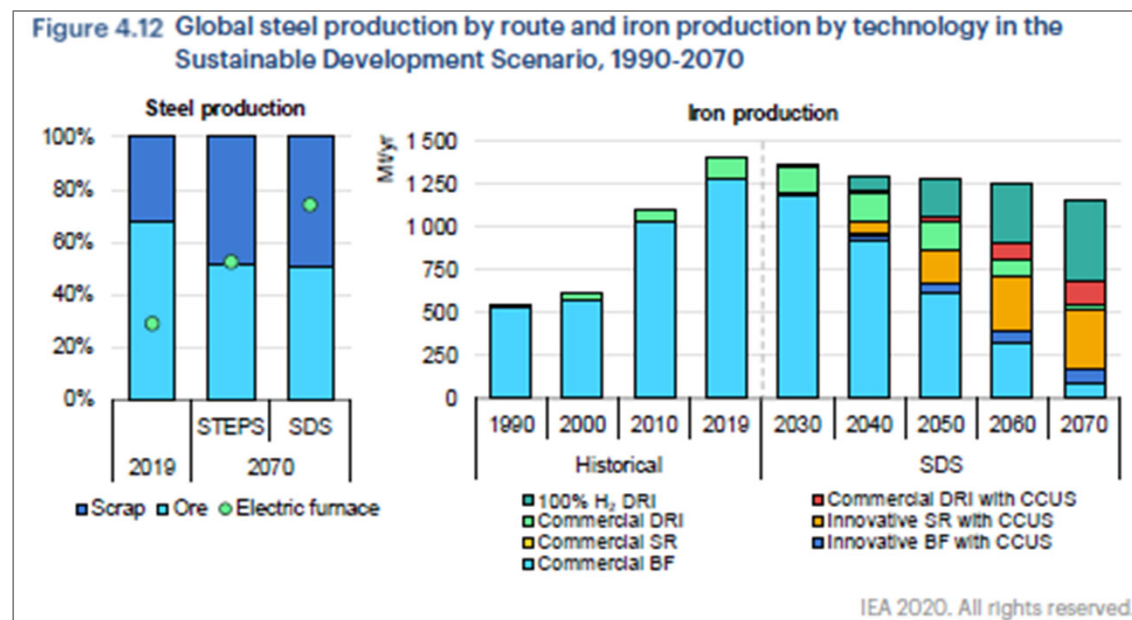


← +30.8 mt →

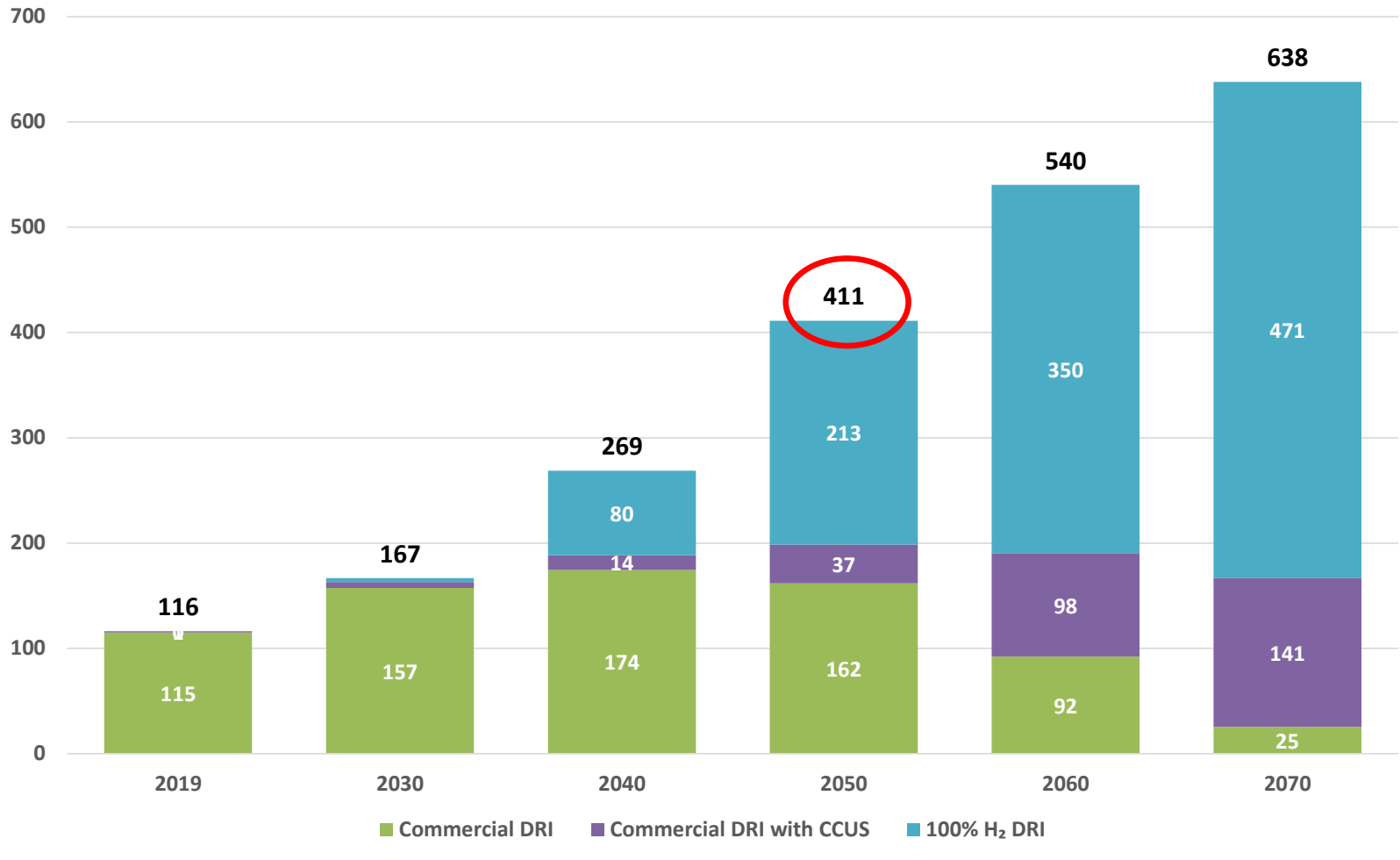
International Energy Agency’s “Energy Technology Perspectives 2020” and “Iron & Steel Technology Roadmap”

The IEA considers two scenarios:

- The **Stated Policies Scenario (STEPS)** takes into account countries’ energy- and climate-related policy commitments, including nationally determined contributions under the Paris Agreement, to provide a baseline against which to assess the additional policy actions and measures needed to achieve the Sustainable Development Scenario.
- The **Sustainable Development Scenario (SDS)** sets out the major changes that would be required to reach the main energy-related goals of the United Nations Sustainable Development Agenda, including an early peak and subsequent rapid reduction in emissions, in line with the Paris Agreement, universal access to modern energy by 2030 and a dramatic reduction in energy-related air pollution. The trajectory for emissions in the Sustainable Development Scenario is consistent with reaching global “net-zero” CO₂ emissions for the energy system as a whole by around 2070.



DRI production according to IEA's sustainable development scenario - mt

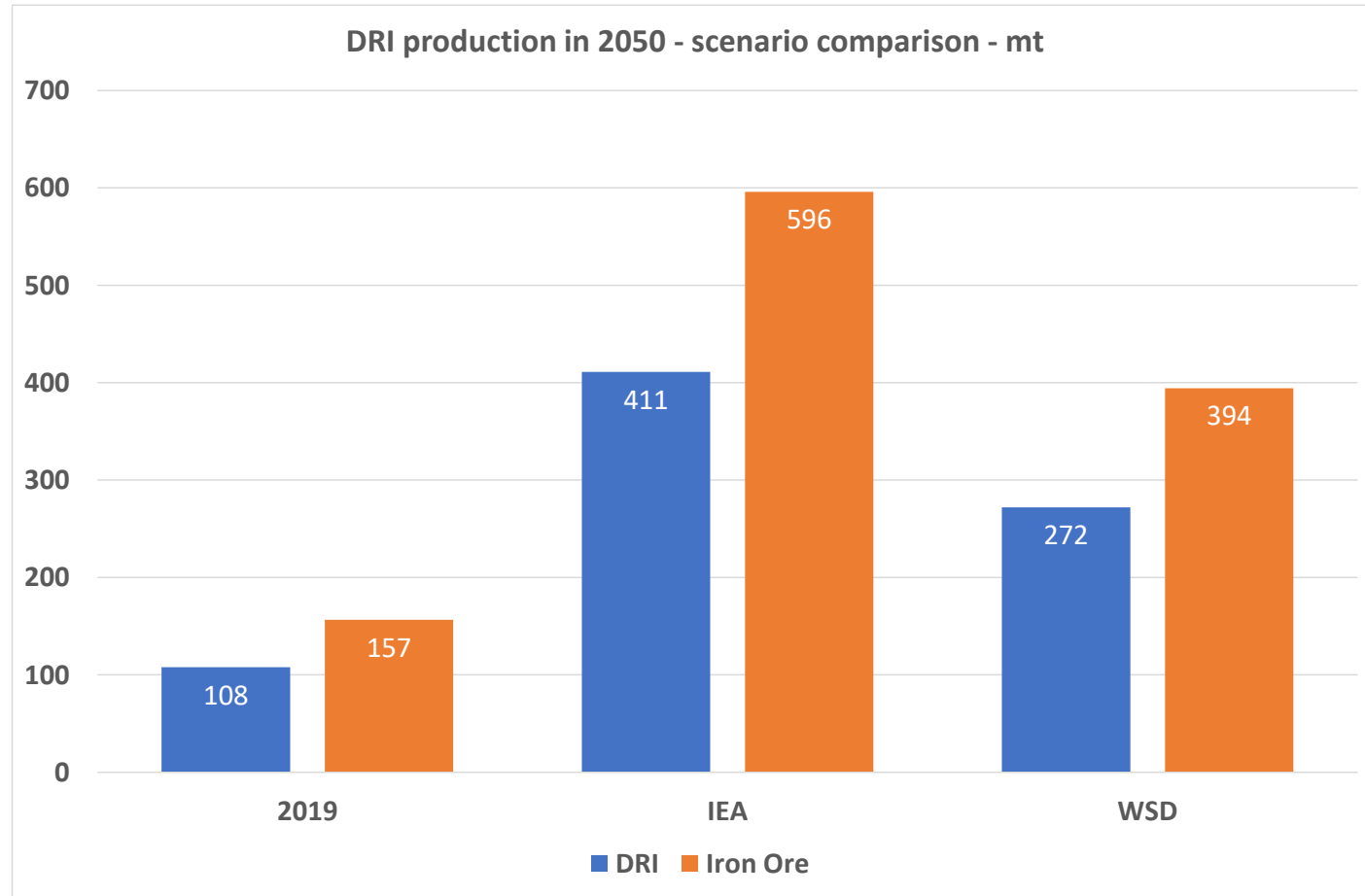


A head scratcher to conclude....

IIMA is preparing a White Paper on the role of and opportunities for ore-based metallics in the world of carbon neutral steelmaking - will be ready in 2021.

Thought starters:

- Iron ore quality in general is not improving – more beneficiation will be needed
- Should future DR plants be somehow integrated with iron ore mines and/or pellet plants?
- Is there scope for fines-based DR processes?



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Health warning: a forecast (or even a scenario) is not a prophecy!