



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

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**FASTMARKETS 7<sup>TH</sup> WORLD DRI & PELLETS CONFERENCE**

**DUBAI, JUNE 18<sup>TH</sup> 2019**

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## Presentation overview

- **DR grade pellet supply-side issues**
- **November 2018 analysis revisited**
- **Updated analysis**
- **Outlook for DR grade pellet supply**
- **Impact of lower grade DRI on EAF operation and costs**

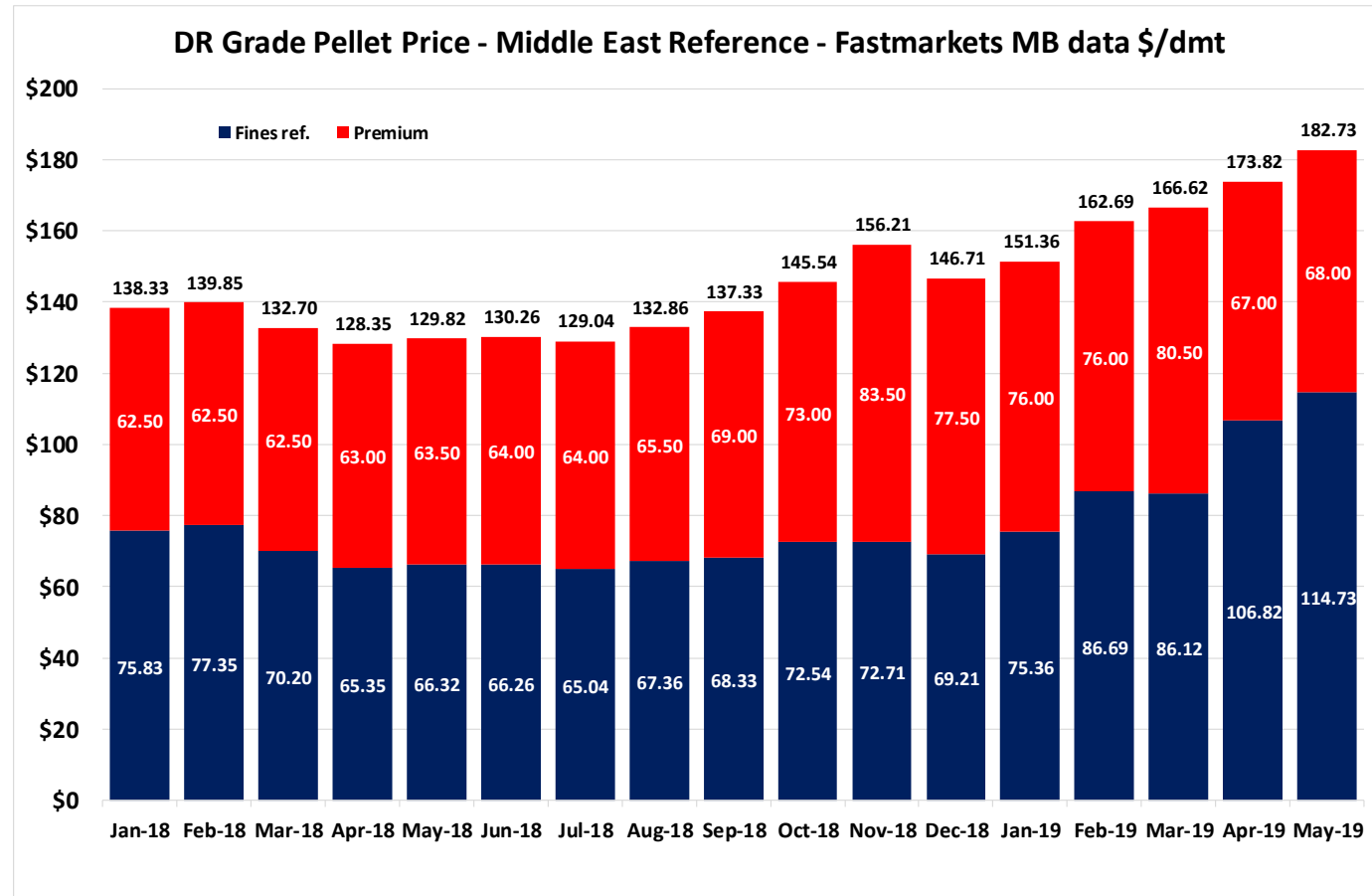
**Fastmarkets AMM DRI and mini-mills conference - November 2018**

[The Global HBI/DRI Market: outlook for DR Grade pellet supply](#)

# Setting the scene

**Lourenço Gonçalves, Chairman, President and CEO, Cleveland Cliffs during 2019 Q1 earnings call:**

**“.... the world is now entering in an extended period of time characterized by massive shortages of iron ore and pellets, affecting virtually all markets outside the United States. And there is no solution in sight to address this, at least for a few years. Going forward, that's the new normal. Welcome to the new normal.”**



## DR grade iron ore pellet supply issues

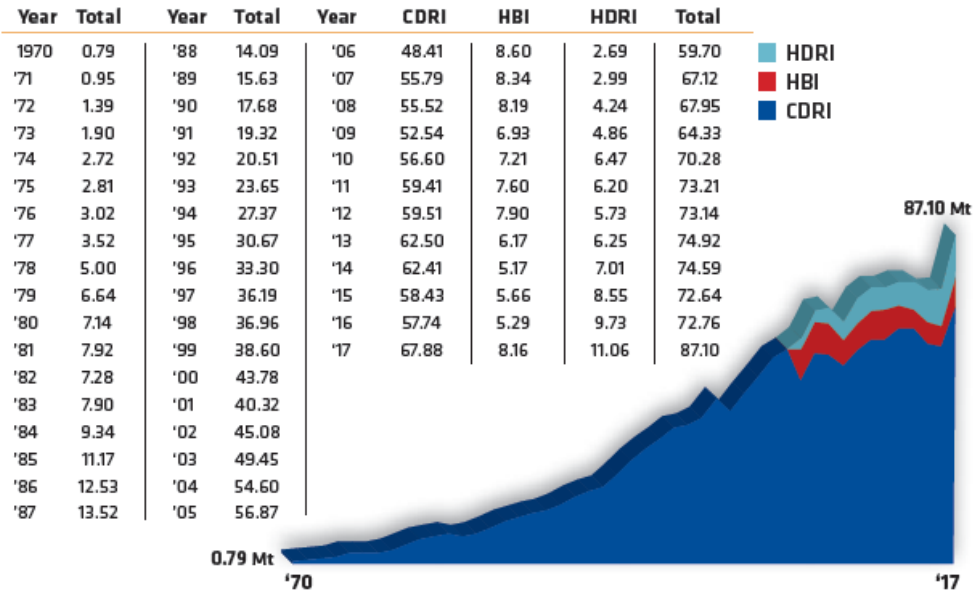
- **Samarco remains shut down (pellet capacity 30.5 mt)**
  - no definitive date for restart - H2 2020 at the earliest
- **IOC strike cost ±3 mt pellet production in 2018**
  - 2018 pellet production: 8.5 mt (capacity about 12.5 mt)
- **LKAB's Svappavaara plant was out of operation through February 2019 - 4 months lost production**
- **Anglo American's Minas Rio operation shut down in March 2018 for pipeline repairs, re-started Q4 2018**
- **Bahrain Steel 2018 production constrained by pellet feed supply**
- **January 2019: Vale's dam collapse at Córrego do Feijão Mine in Brumadinho (MG)**

## 2018 analysis revisited: bridging the gap 2017-20

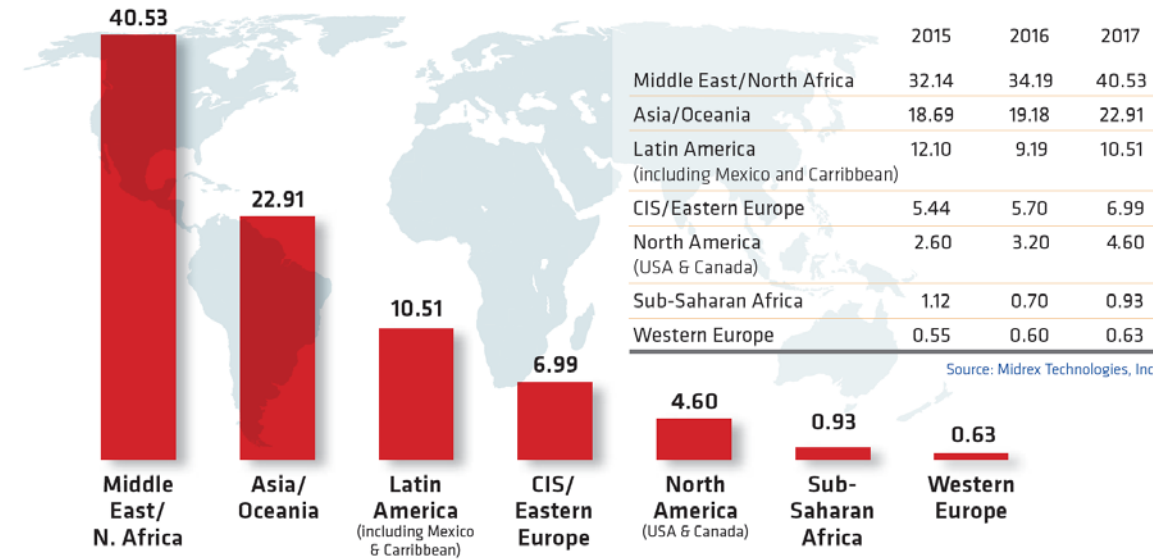
- **Incremental DR grade pellet demand is  $\pm 10$  mt which could be met from among:**
  - **Vale: estimated 5 mt increase in supply**
  - **IOC: between 0.2 and 1.2 mt increase in supply**
  - **Bahrain Steel: apparent latent capacity of 5.3 mt**
  - **Tosyali Algeria: ???**
  - **Samarco: ???**
- **Conclusion: market tightness can be expected to continue.**

## World DRI Production by Year (Mt)

Source: Midrex Technologies, Inc.



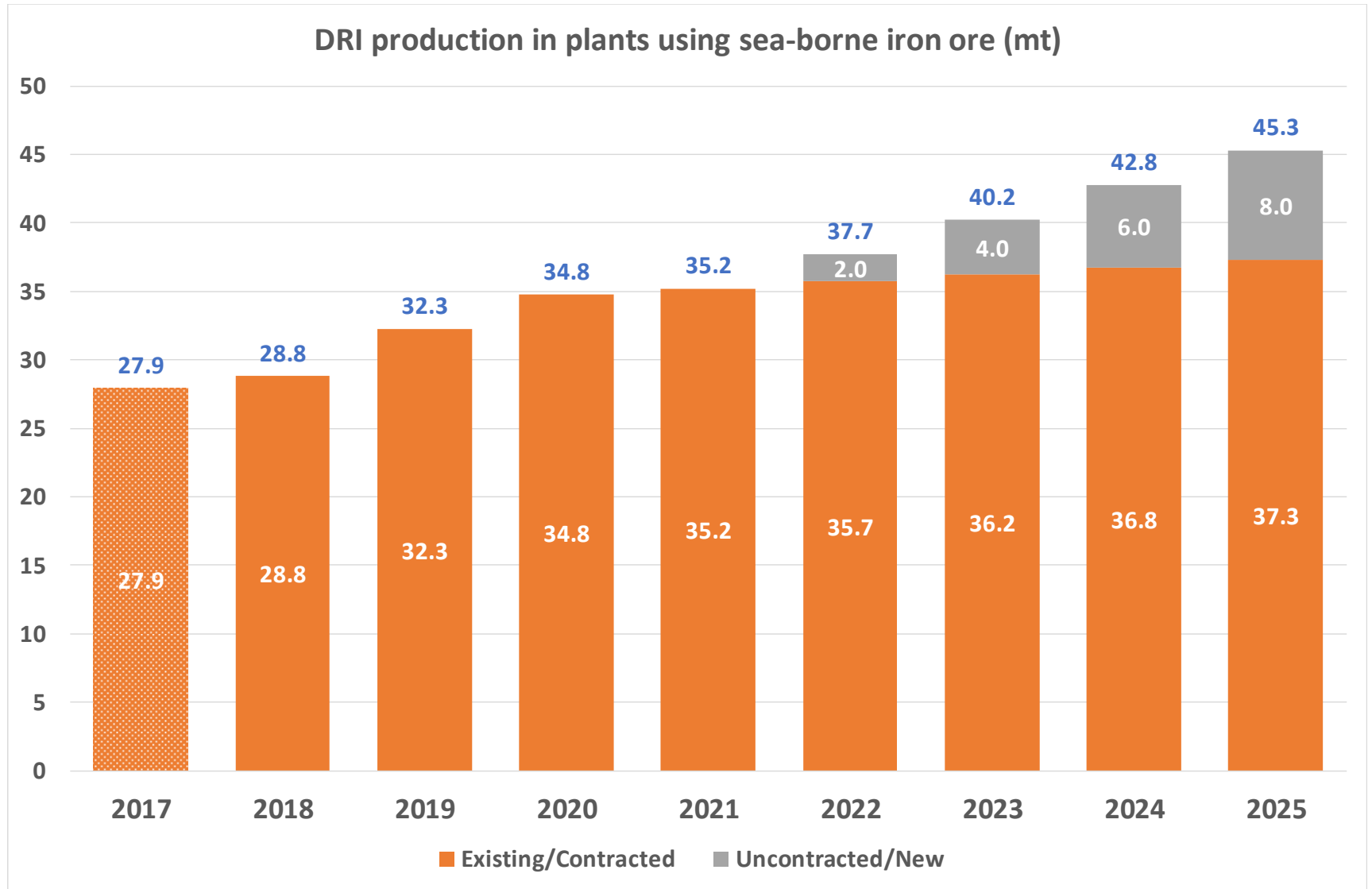
## 2017 World DRI Production by Region (Mt)



**Estimated DRI production in 2018 ±100 mt**

# Updated analysis

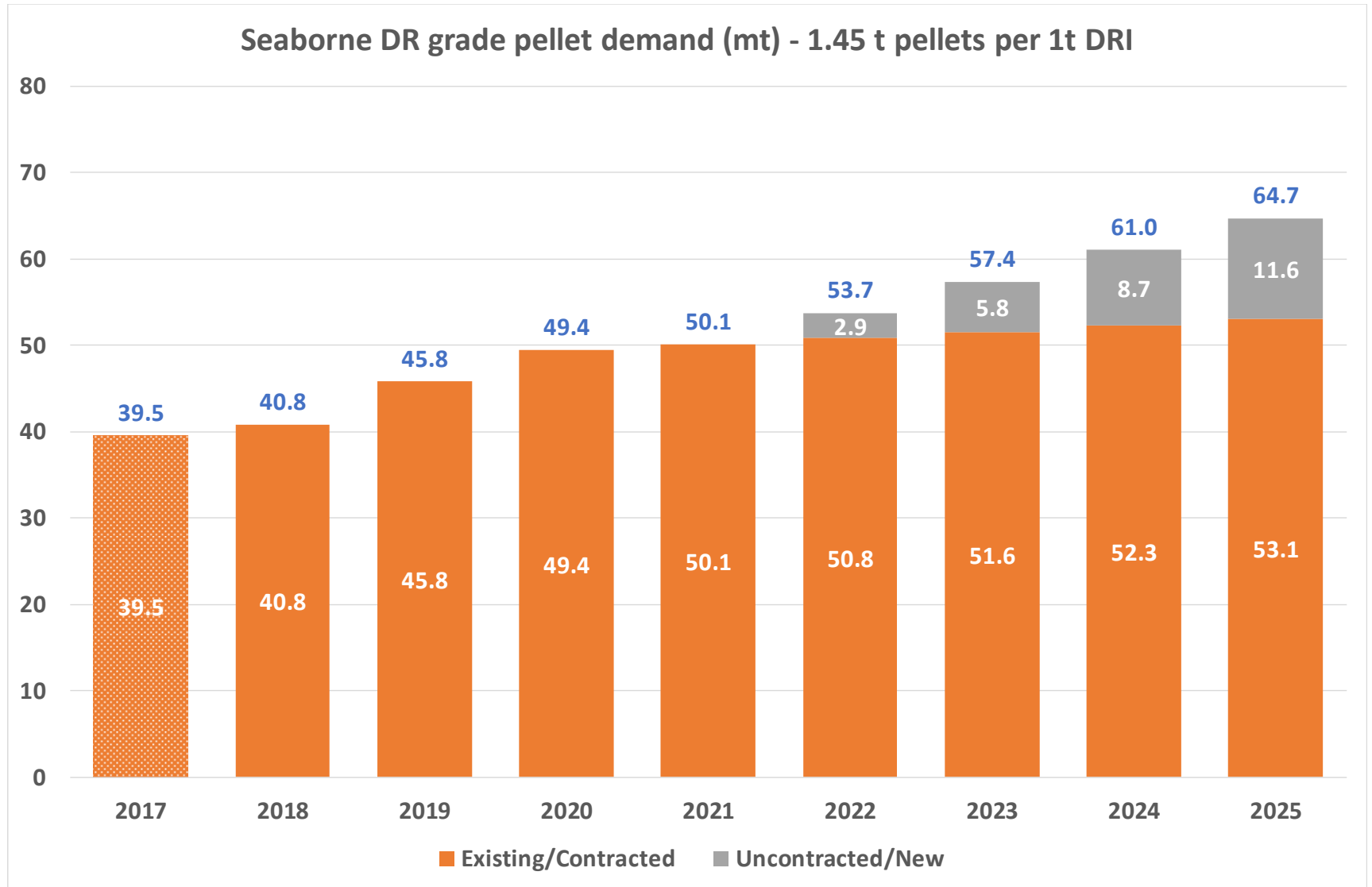
Argentina
Trinidad
USA
Germany
South Africa
Algeria
Libya
Egypt
Saudi Arabia
Qatar
Bahrain
UAE
Oman
Malaysia



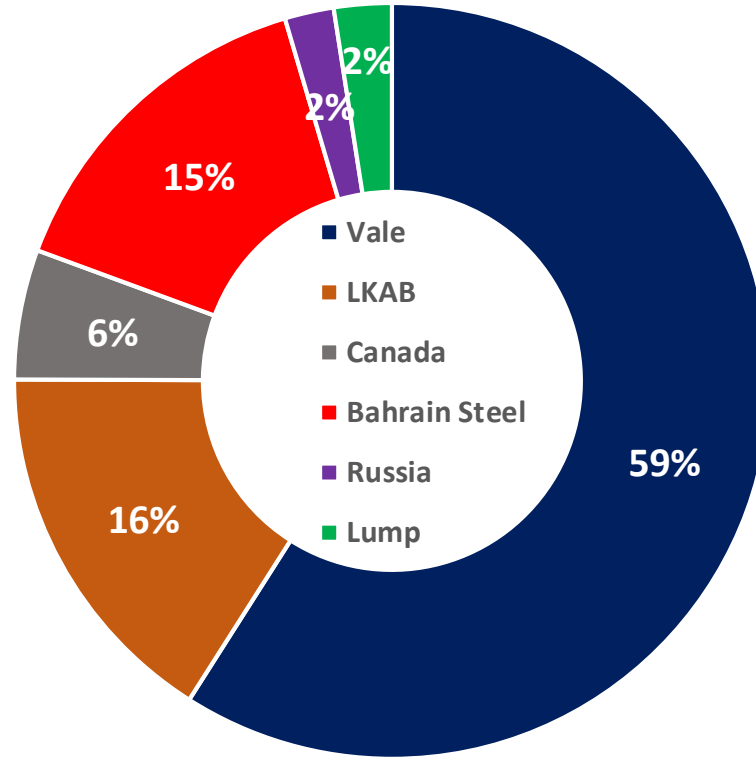
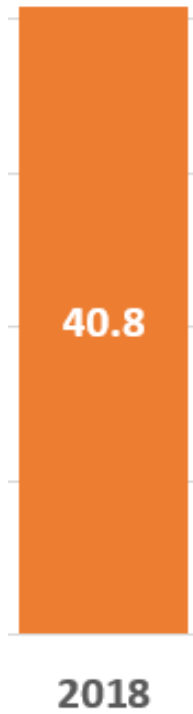


# Updated analysis

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



**Seaborne Ore Supply to DR plants 2018 (mt) - total 40.5 mt**  
source: trade statistics, private communications



## Updated analysis: the gap to bridge

- **Between 2018 and 2025, DRI production at plants using seaborne pellets increases by 16.5 mt, requiring an additional 23.9 mt iron ore, ideally DR grade pellets:**
  - **short/medium term (between 2018 and 2020): +6 mt DRI production, requiring +8.6 mt iron ore**
  - **longer term (between 2020 and 2025): +10.5 mt DRI production, requiring +15.3 mt iron ore**

## Short term outlook - **Vale**

- **Estimated pellet supply to the DR sector in 2018 = 23.9 mt,  $\pm 42\%$  of total 56.6 mt pellet deliveries (2017: 21.7 mt,  $\pm 43\%$ ).**
- **In 2018 Vale restarted idled pellet plants with aggregate capacity of 13 mt, adding  $\pm 5$  mt production in 2018, bringing total capacity in Brazil and Oman to  $\pm 60$  mt.**
- **Prior to the Brumadinho dam rupture, we estimated Vale's supply of DR grade pellets in 2019 and 2020 at  $\pm 27$  mt ( $\pm 45\%$  of pellet sales by volume).**

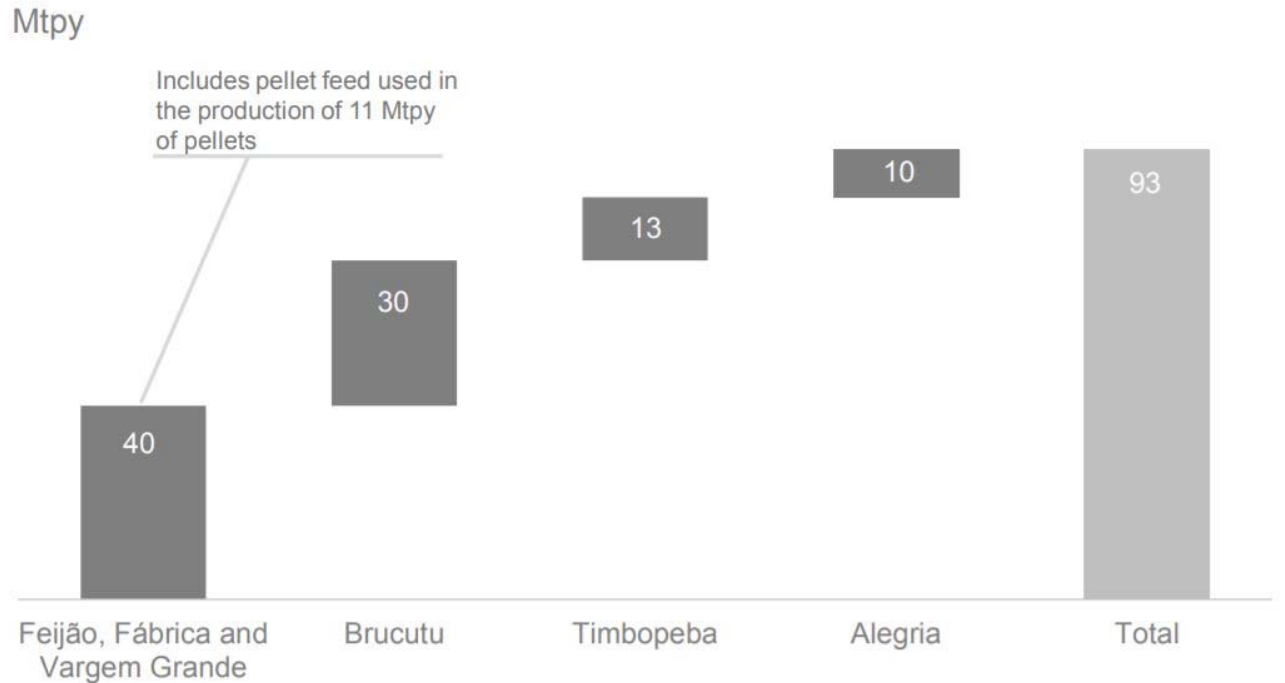
**Vale's estimate of 2019 iron ore + pellets production ranges between 307 and 322 mt (March 28<sup>th</sup> 2019).**

**Latest guidance: sales in bottom half of range - Q1 production 67.73 mt.**

**Original guidance was ±400 mt.**

**2018 production was 385 mt.**

## Annualized impacts in production



Sales higher than production in 2019 (consumption of inventories)

Source: Vale Webcast 4Q18

## Short term outlook - **Vale**

- **Vale's Vargem Grande and Fabrica pellet plants with aggregate capacity about 11 mt out of operation since 20/02/2019 - these plants were focused on the domestic market. 1-3 year horizon to deal with the various tailings dams. Vargem Grande plant may be restarted later in 2019 using alternative supply of pellet feed (NB acquisition of Ferrous Resources now approved).**
- **Vale can be expected to support the domestic market (12-14 mt?).**
- **Vale hopes to increase production at São Luis to 7 mt in 2019 (0.95 mt in 2018) - this will be challenging. Q1 2019 production 1.221 mt.**
- **DR grade pellet production at the Tubarão plants may be constrained by reduced supply of high grade pellet feed from the Brucutu and Timbopeba mines - perhaps 10% downside risk. Total production Q1 2019 7.76 mt (14.6% below Q4 2018)**
- **Oman will produce at full capacity  $\pm 9.5$  mt - will use some feed from Carajas, perhaps 25-30%. Q1 2019 production 1.97 mt (scheduled maintenance on both lines).**
- **DR pellet production in 2019 and 2020 currently expected to be  $\pm 2.2$  mt less than in 2018, but for 2020 this is more of a guesstimate given the many uncertainties.**

## Short/medium term 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 production / sales in 2018: 23.9 mt / 22.1 mt.**
- **Estimated 2018 DR grade pellet supply was 6.5 mt (36.4% of total exports by volume).**
- **Based on its contract portfolio, it seems that about 7 mtpy is a maximum level of DR grade pellet supply for the foreseeable future.**

## Short/medium term outlook - **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, with estimated shipments of 1.7 mt in 2018 (3.3 mt in 2017).**
- **IOC is expected to increase supply to the DR markets in 2019 to close to 4 Mt ( $\frac{1}{3}$  of estimated production of about 12 mt)**
- **As total pellet production keeps ramping up towards full capacity of 12.5 mt, the DR share in IOC's portfolio is expected to grow beyond the 4 Mt mark post 2019, perhaps to 4.5 mt**
- **AM is considered unlikely to supply DR grade pellets to external DRI producers.**



## Short/medium term outlook - **Bahrain Steel**

- **Bahrain Steel is in effect partly captive to adjacent DR plant SULB which produced 1.6 mt DRI in 2018 (est. 2018 pellet offtake from BS 2.2 mt).**
- **Production in 2018 was 8.2 mt and target for 2019 is 10 mt (per CEO's speech) - nameplate capacity of the two pellet lines is 11 mt, but plants are now thought to be operating at 1.1 tonnes per month, i.e. >12 mt annualised rate. There is therefore apparent latent capacity of  $\pm 4$  mt based on 2018 production.**
- **Ore imports in 2018 per trade data totalled about 9 mt (mainly Brazil, Chile and Canada). Pellet supply to external markets in 2018 was  $\pm 6$  mt (less than implied by reported trade data).**
- **New 20 year contract ( $\geq 67\%$  Fe /  $\leq 2\%$  gangue) signed with Anglo American (Minas Rio production guidance for 2019 is 18-20 mt [wet basis] - Q1 2019 production 4.9 mt).**

## Short term 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 was a major constraint due to lack of grinding capacity which is now being remedied - the grinding plant will be completed in late 2019/early 2020.**
- **Pellet production is understood to have been about 0.15 mt in 2018 and is expected to be about 2.5 mt in 2019, with full production in 2020.**
- **Currently pellet plant feedstock sources are understood to be Brazil, Turkey and Ukraine.**

## Short/medium term outlook - **Samarco**

- **Licensing process almost completed - completion expected by end July 2019. Filtration is the last step.**
- **Restart now planned for 2020 Q3/Q4.**
- **Ramp up will progressive - starting with one concentrator/pellet plant (8 mt pellets); the second (8 mt pellets) could be 1-2 years later; timing of the third (8 mt pellets) is unclear at this point.**
- **Best estimate today is that product split will be similar to the pre-dam collapse -  $\pm 50\%$  BF pellets,  $\pm 50\%$  DR pellets (about 4 mt DR grade pellets) in first phase.**

(author's estimates)

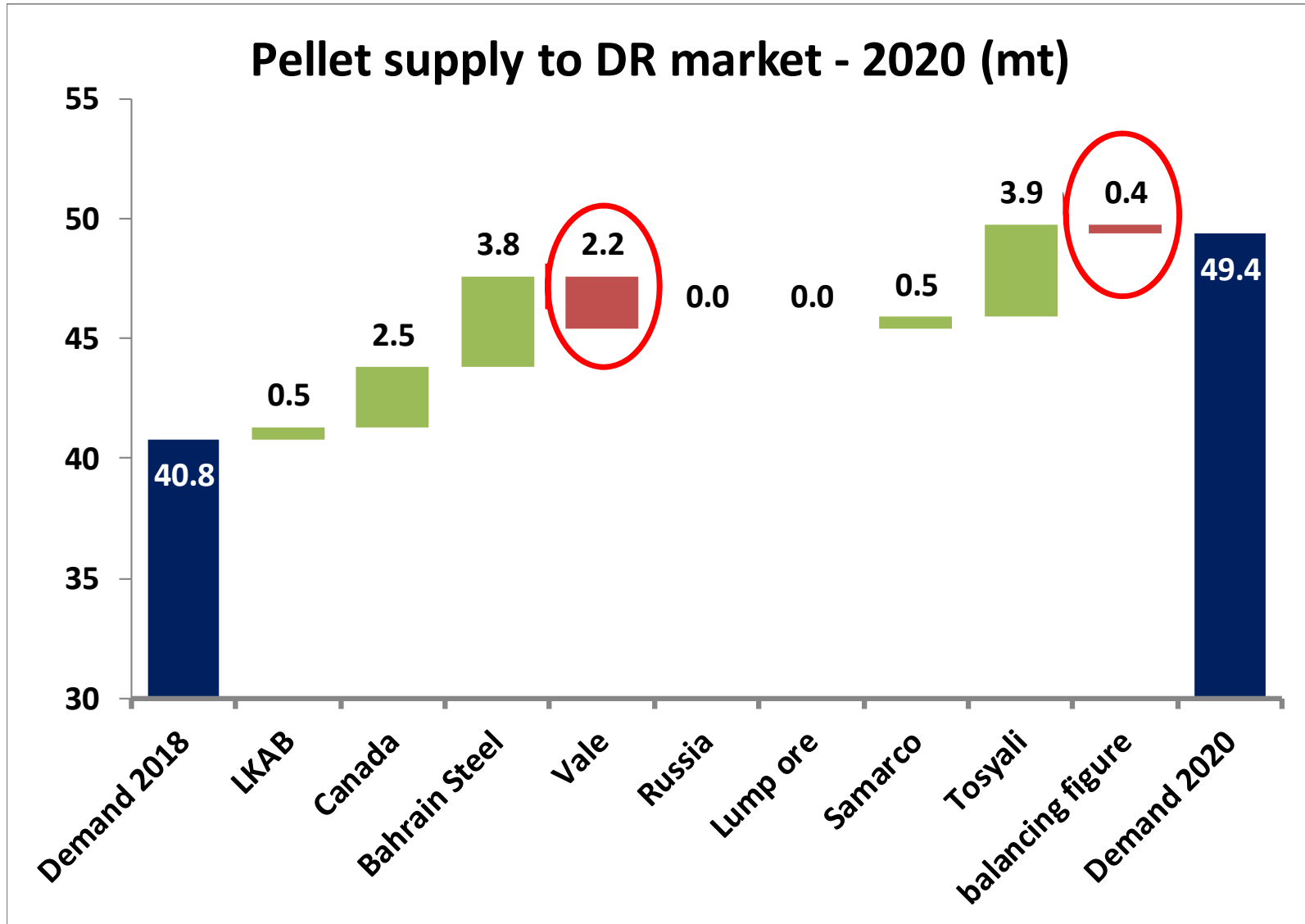
## Short term outlook - **Cleveland Cliffs**

- **Cleveland Cliffs is about to start production at its DR grade pellet facility at its Northshore operation - capacity 3.5 mt.**
- **Cliffs' Toledo HBI plant scheduled to start up in mid-2020 and consume 2.8 mt pellets.**
- **Thus, 0.7 mt DR grade pellets is potentially available for sale to third parties.**



## Bridging the gap to 2020 - **summary**

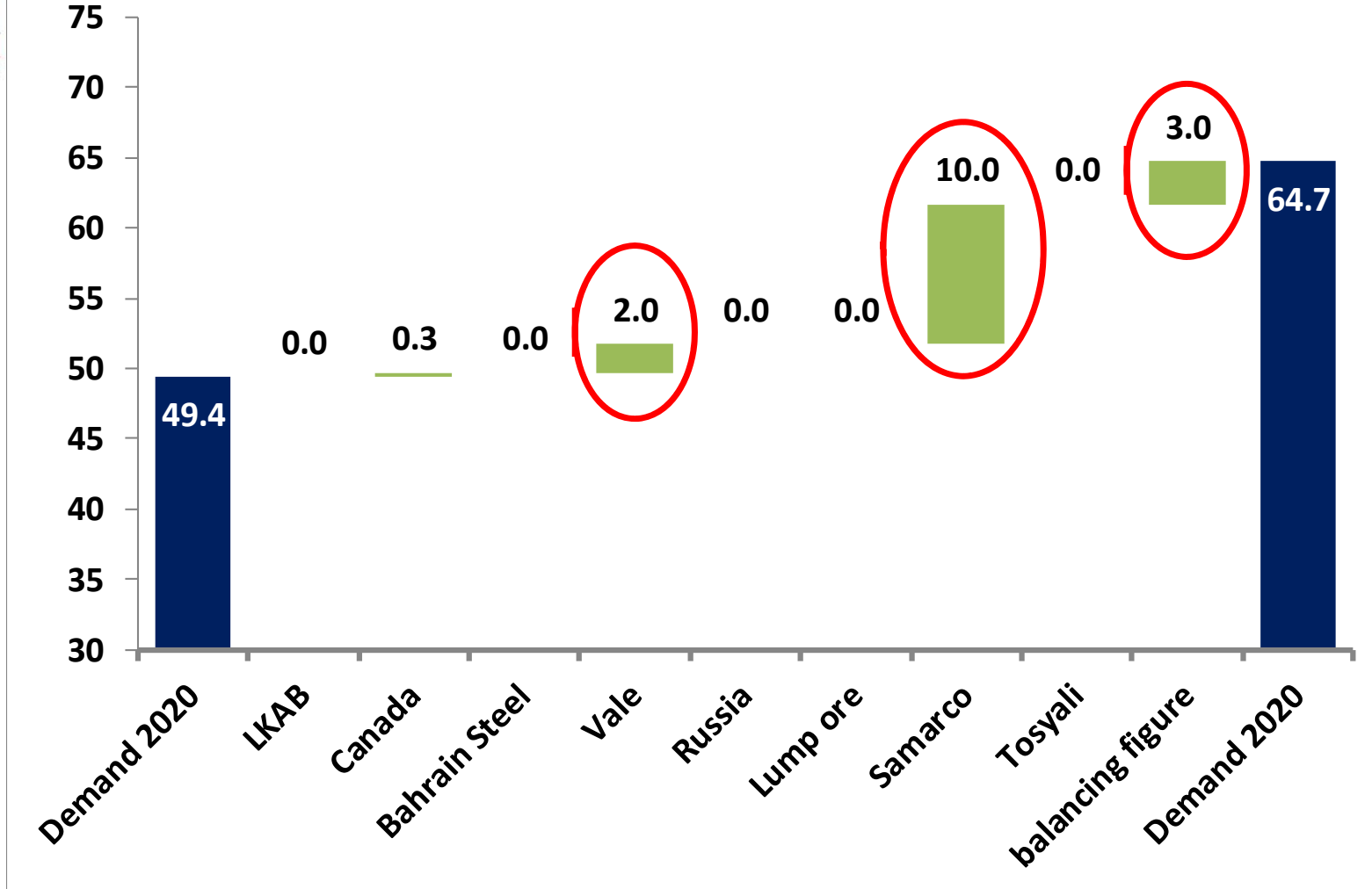
- **Incremental DR grade pellet demand 2018-2020 is  $\pm 8.6$  mt which could be met from among:**
  - **LKAB: perhaps +0.5 mt**
  - **IOC: perhaps +2.5 mt**
  - **Bahrain Steel: apparent latent capacity of  $\pm 4$  mt relative to 2018**
  - **Tosyali Algeria: assumption is +3.85 mt**
  - **Samarco: perhaps +0.5 mt**
  - **Vale: very complex situation, difficult to predict - estimate -2.2 mt**
  - **Cleveland Cliffs: +0.7 mt**



## Bridging the gap to 2025

- **To support increased DRI capacity an injection of “new” DR grade pellet supply is needed, either a substantial return to the market by Samarco, or new pellet plants, or both.**
- **Vale plans to increase capacity by 2 mt in Oman - capex ±\$30 million, start-up H2 2020**
- **In the meantime, who would be brave enough to build a new merchant pellet plant so long as Samarco’s 30.5 mt idle capacity is out there?**
- **Is there anyone else anyway, apart from existing players?**
- **Should new DR plants install captive pellet capacity?**

## Pellet supply to DR market - 2025 (mt)





## DR v BF grade pellets: value-in-use

- **BF pellets have lower total Fe content**
- **BF pellets have higher acid gangue content**
- **Main impact of this is lower yield and thus productivity in the EAF**
- **We have attempted to quantify the impact on DRI value-in-use with our VIU model**



Image source: Primetals Technologies / [primetals.com](http://primetals.com)

## Model assumptions

- **DRI produced from DR pellets has 94 % metallization**
- **DRI produced from BF pellets has 92 % metallization**
- **Carbon content = 1.5 % for all DRI products**
- **Moisture content and fines generation are assumed to be the same for DRI produced from DR and BF pellets**
- **Copper content is assumed to be the same for all pellets**
- **Ran VIU model with same DRI price/value for all cases**
- **Base case DRI is made using Vale Tubarão DR grade pellets**

# Pellet & corresponding DRI composition

Pellet chemistry %	Base case	A	B	D	E	F	G
Fe	67.75	65.70	66.60	66.72	65.34	66.62	65.89
SiO <sub>2</sub>	1.25	2.55	2.20	2.00	1.80	2.95	4.50
Al <sub>2</sub> O <sub>3</sub>	0.55	0.60	0.27	0.50	1.40	0.25	0.20
CaO	0.75	2.55	0.46	1.64	1.80	1.08	0.68
MgO	0.10	0.05	1.40	0.15	0.05	0.17	0.20
B4 basicity	0.47	0.83	0.75	0.72	0.58	0.39	0.19
DRI chemistry %	Base case	A	B	D	E	F	G
Fe <sub>total</sub>	92.54	88.26	89.91	90.14	87.60	89.95	88.61
Fe <sub>metallic</sub>	86.99	81.20	82.72	82.93	80.59	82.75	81.52
Fe oxide	7.12	9.05	9.22	9.24	8.98	9.23	9.09
C	1.50	1.50	1.50	1.50	1.50	1.50	1.50
SiO <sub>2</sub>	1.78	3.43	2.97	2.70	2.41	3.98	6.05
Al <sub>2</sub> O <sub>3</sub>	0.75	0.81	0.36	0.68	1.88	0.34	0.27
CaO	1.02	3.43	0.62	2.22	2.41	1.46	0.91
MgO	0.14	0.07	1.89	0.20	0.07	0.23	0.27

# EAF configuration

## Base Productivity Conditions

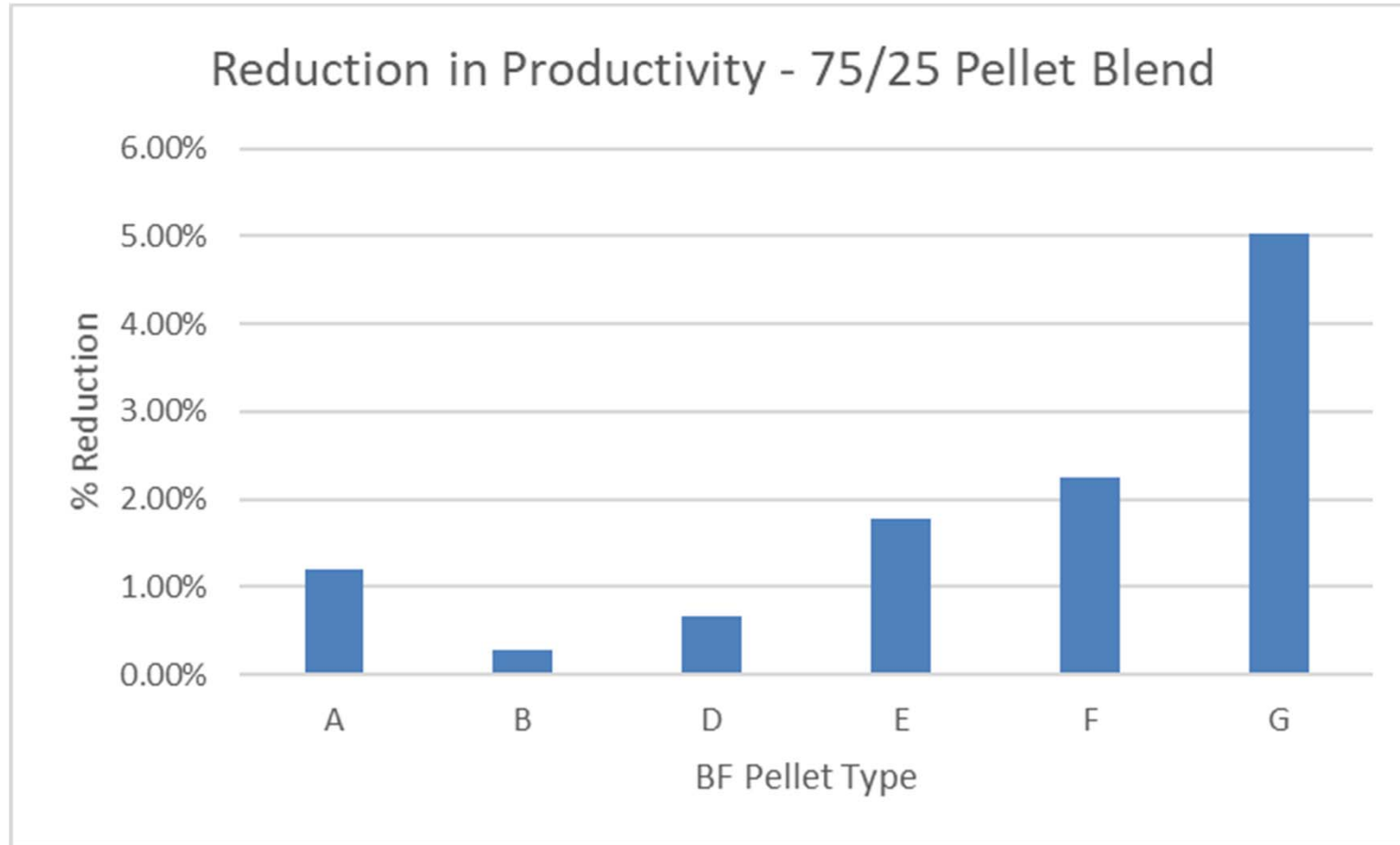
P-On time	<b>34</b>	minutes
Power	<b>360</b>	KwH/tonne
Slag FeO	<b>28.0%</b>	
Slag CaO	<b>34.0%</b>	
MgO Target	<b>9.0%</b>	
Productivity cost	<b>2.00</b>	\$/%
% of OBM in Charge	<b>100.0%</b>	

## Cost Data

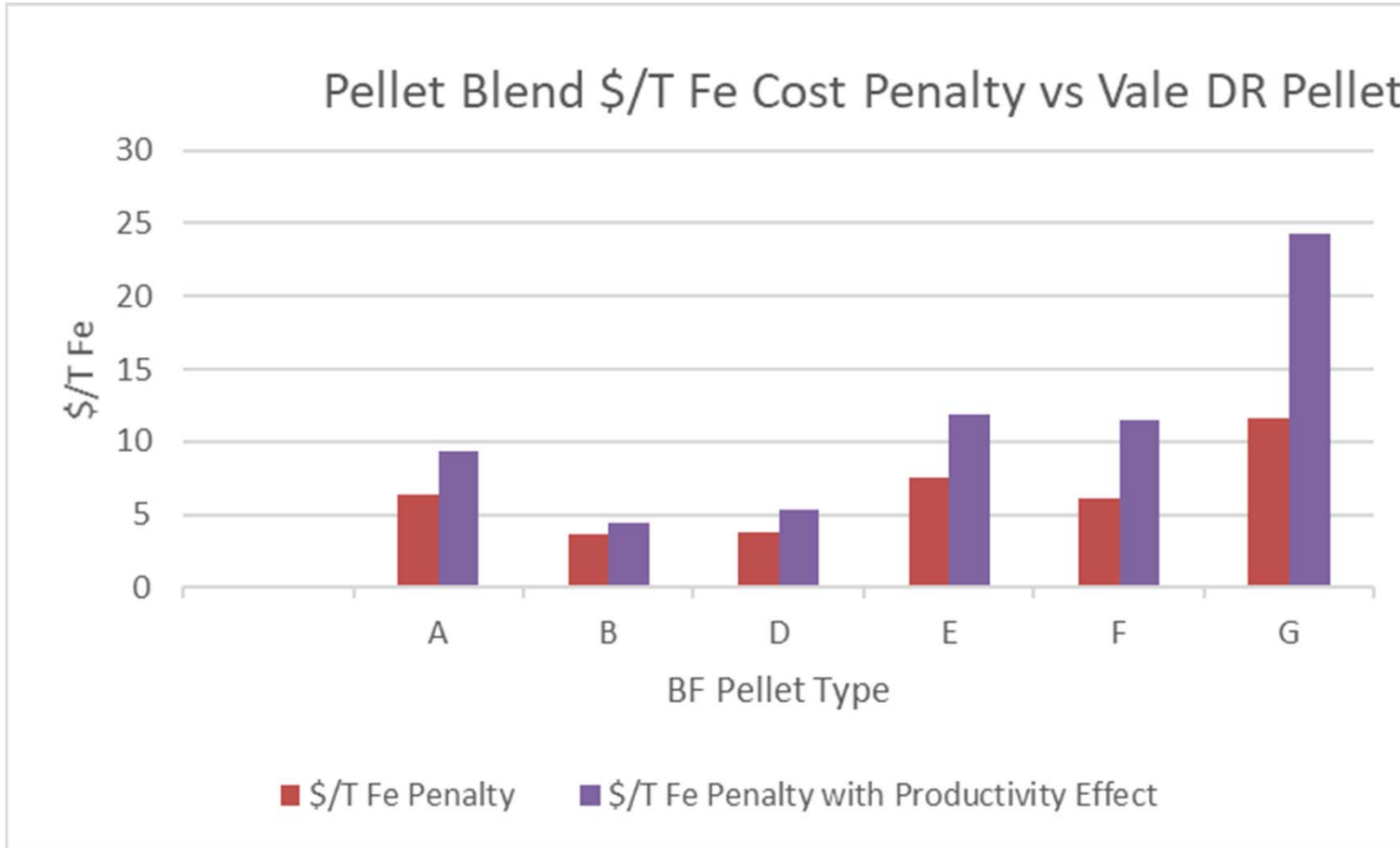
\$/unit

Cu cost	<b>\$ 1.75</b> per pt.
Lime	<b>\$ 110.00</b> tonne
Dolo-lime	<b>\$ 110.00</b> tonne
Carbon	<b>\$ 255.00</b> tonne
Power	<b>\$ 0.05</b> kWh
T-T-T	min

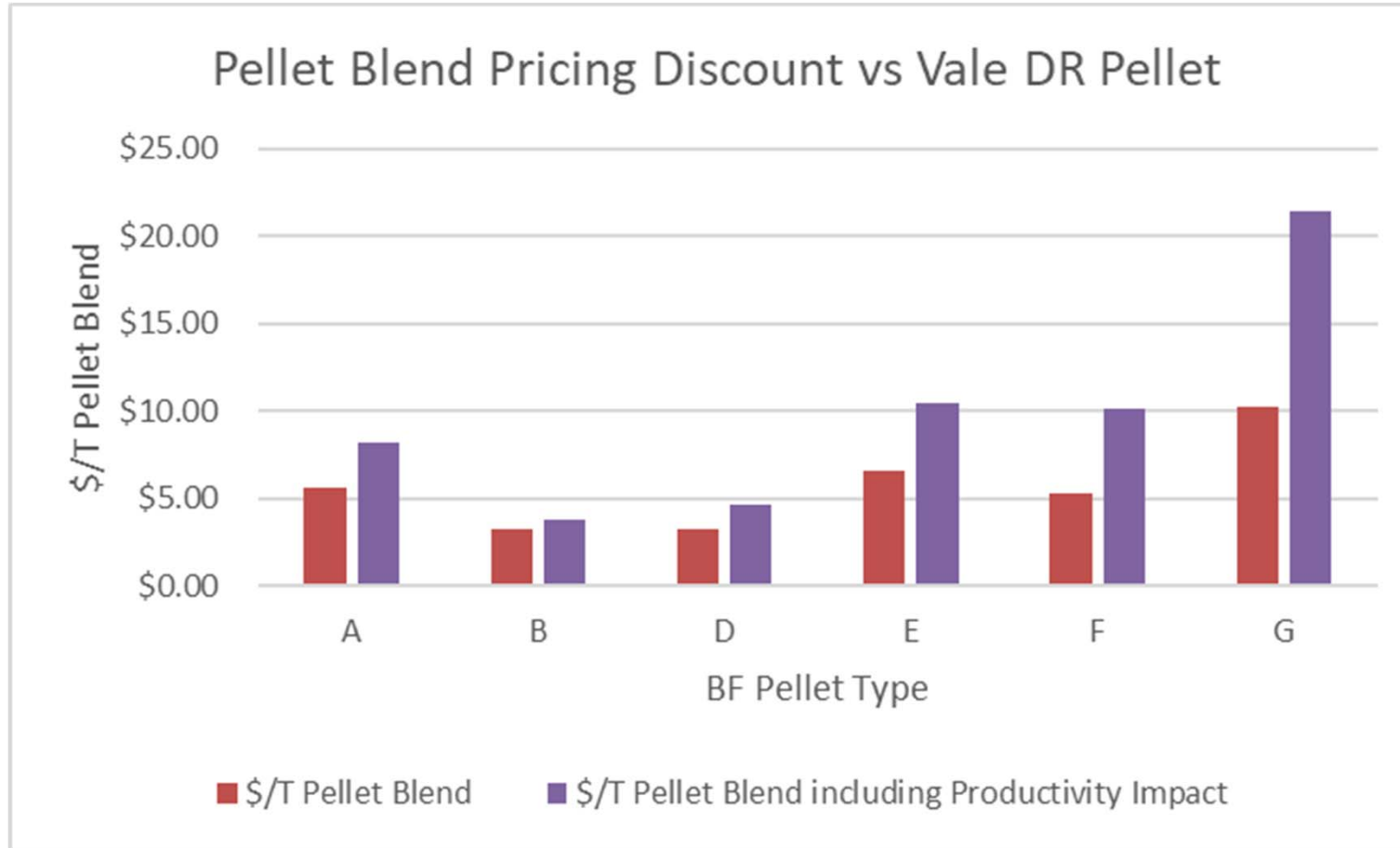
# Model results with blend of 75% Vale DR pellets and 25% BF pellets



# Head to head comparison: Vale DR pellet v blend 75% Vale DR pellet/25% BF pellet



# Head to head comparison: Vale DR pellet v blend 75% Vale DR pellet/25% BF pellet



## Head to head comparison: Vale DR pellet v blend 75% Vale DR pellet/25% BF pellet

**Pellets B and D have a minimal impact on productivity in the EAF (less than 1 %).**

**Pellets B and D have the smallest impact on \$/T Fe but still incur a cost penalty of \$3.65 and \$3.72 respectively – at 20 % DRI utilization this equates to \$0.73 - \$0.75 per tonne of steel**

**With productivity impact included, Pellets B and D incur a cost penalty of \$4.40/T Fe and \$5.33/T Fe respectively - at 20 % DRI utilization this equates to \$0.88 - \$1.07 per tonne of steel**

**Lower quality BF pellets incur a cost penalty as high as \$11.61/T Fe and \$24.34/T Fe with productivity impact considered**



## Key messages

- **To the pellet buyer:** the market remains tight, but perhaps not as tight as it appeared a year ago. In 2020, according to this analysis, supply and demand appear to be finely balanced.
- **To the pellet seller:** when setting your pricing strategy, keep in mind that DRI and HBI need to be competitive with scrap (on a value-in-use basis).
- **To the iron ore industry in general and pellet producers in particular:** post 2020 the market needs more DR grade pellets.
- **To those considering building new DR plants:** make sure that you have a sustainable supply of pellets. If you build a captive pellet plant, make sure that you have a sustainable supply of pellet feed and the right kit to process it to pellet plant requirements.
- **To those using BF grade pellets:** take into consideration VIU of the DRI.



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