The Iron Ore Market 2012

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INTRODUCTION

The iron ore market demand, driven by steel demand led by China, will exceed 2 billion tonnes per year by 2016. Australia and Brazil will remain the leading supply sources while projects are proceeding on a global basis. Iron ore prices will remain high as new project implementation is challenged by financial, infrastructure, manpower, environmental and technical issues. New projects require increased beneficiation; nevertheless lower grades are being produced with the proportion of pellet feed also increasing. New ironmaking technology will not impact significantly upon iron ore demand as such new ironmaking processes also require iron ore.
This paper will cover global iron ore supply/demand, China iron ore supply/demand, constraints (physical, financial, political, etc) on developing new projects, new capacity by region and type, impact of new capacity on pricing, new ironmaking technology: effect on iron ore demand and North American iron ore supply/demand

DISCUSSION

Global steel and iron ore supply/demand

Iron ore demand is driven by steel demand. The explosive growth in steel production in China in the past decade has driven a dramatic growth in iron ore demand as the Chinese steel production is by the traditional BF/BOF, given limited scrap availability in China. The past, present and predicted future growth in global steel production is shown in Figure 1 (1). Global steel production nearly doubled between 1998 and 2009, driven by China. The Chinese percentage of global steel production increased from 15 % to 46 % over this time frame. Projections by CRU are for global steel production to exceed 2 billion tons/year by 2021 with the Chinese percentage expected to drop back slightly to 43 % of global steel production as other developing regions (India, Brazil, and SE Asia) are expected to contribute to global growth. Regardless of the production route (DR or BF) it takes about 1.5 tons of iron ore to produce one ton of virgin iron units (hot metal or DRI).
Global iron ore consumption is shown in Figure 2 (2). As discussed above, consumption is led by China with developed Asia (Japan, Korea, Taiwan) playing the next leading role followed by Europe, the CIS and the Americas. The seaborne iron ore trade is quantified in Tables 1 and 2 (3). China is the leading importer but developed Asia and Europe still playing important roles. Exports are dominated by Australia and Brazil; Australia's proximity to China has led to it surpassing Brazil; both regions had been nearly equal until recent years. India's role in third place will diminish as India tries to save more iron ore to feed its own growing steel industry. South Africa, Canada and Sweden will continue to increase their export positions. However, China will need to maintain a certain level of equivalent 62 % Fe production to provide a global supply/demand balance.

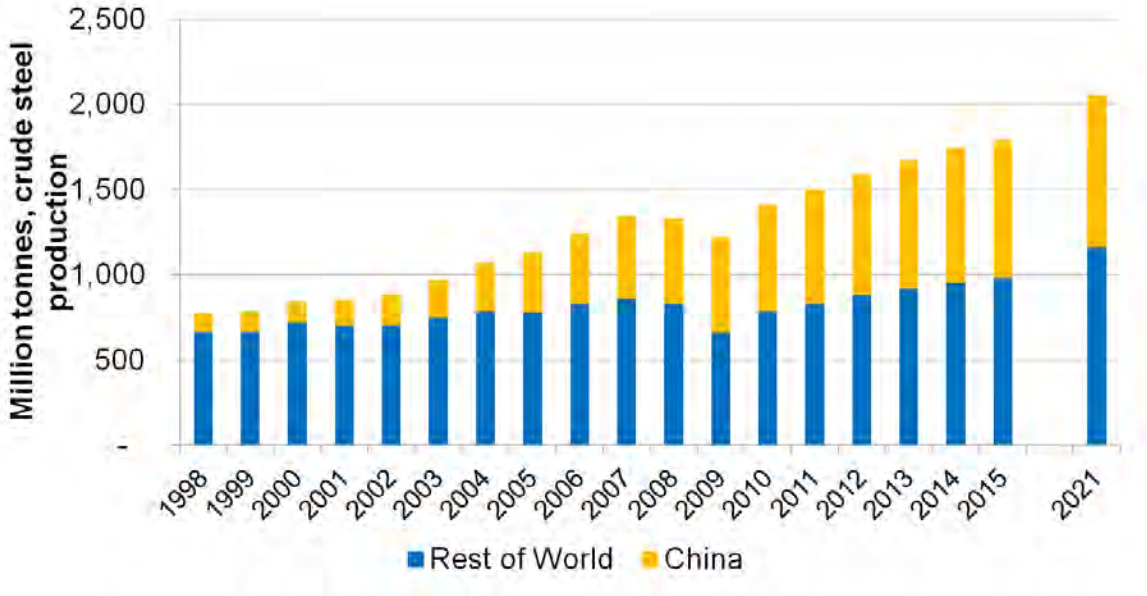

Figure 1. Global Steel Production Since 1998; Projections Through 2021 (1)

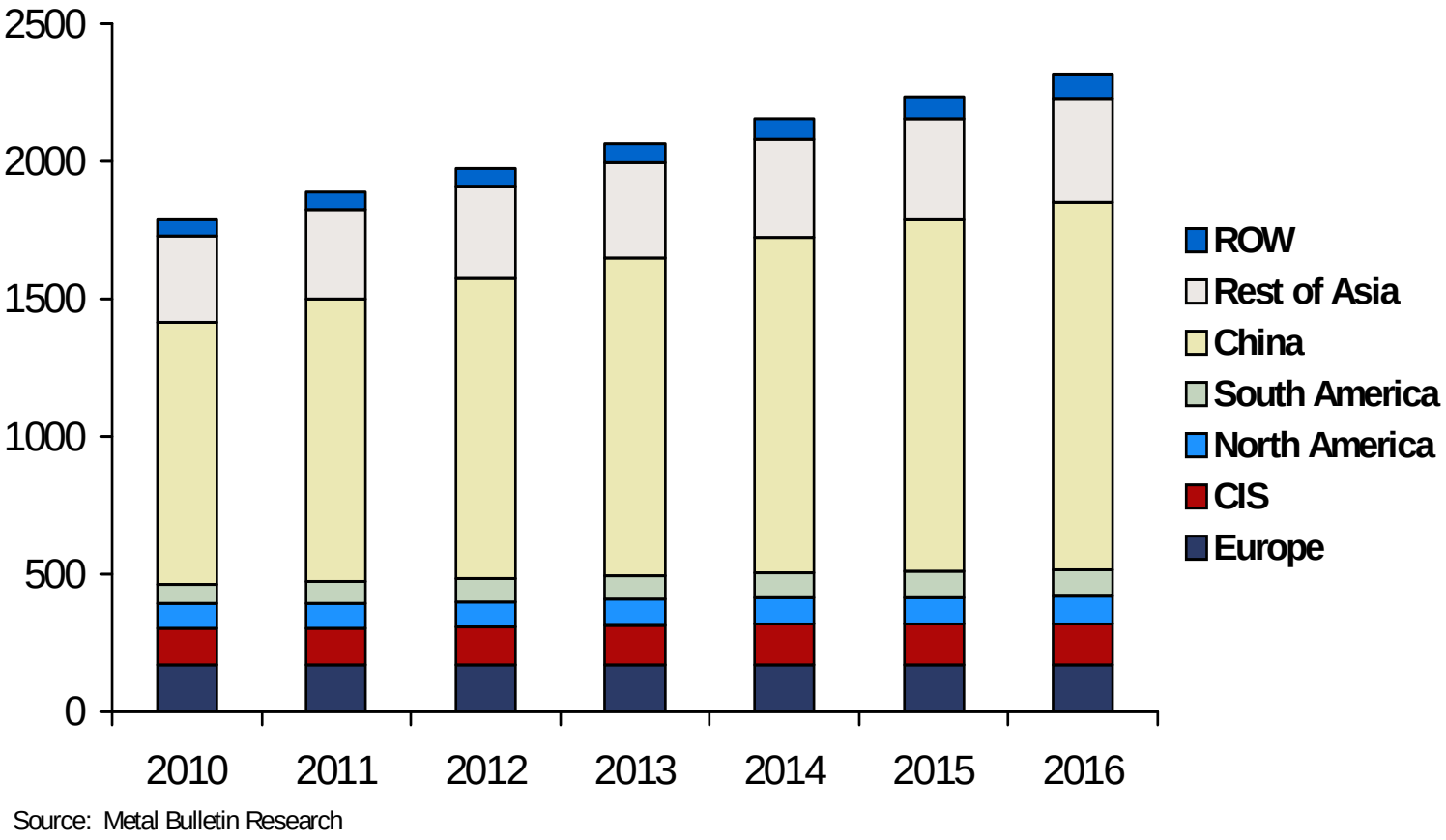

Figure 2. Iron Ore Consumption, 2010 projected through 2016 (2)

Table 1. Seaborne Iron Ore Demand, 2010 projected through 2016, MT (3)

Million tonnes	2010	2011	2012	2013	2014	2015	2016
Europe	128	136	138	138	138	138	139
Japan	134	131	132	132	132	132	134
Korea	56	73	76	78	79	80	82
Taiwan	19	19	19	20	21	21	21
Rest of world	39	36	38	41	44	46	47
Ex-China							
Total Seaborne demand	376	394	404	410	414	417	423
change year on year, MT	107	18	10	6	4	3	6
Total Chinese demand, 62 % basis	963	1028	1088	1131	1175	1217	1261
Total seaborne demand	1339	1422	1492	1541	1589	1634	1685

Table 2. Seaborne Iron Ore Supply, 2010 projected through 2016, MT (3)

Million tonnes	2010	2011	2012	2013	2014	2015	2016
Australia	128	136	138	138	138	138	139
Brazil	134	131	132	132	132	132	134
India	108	92	90	90	85	80	70
South Africa	48	48	56	59	62	63	65
Canada	28	33	35	40	46	49	49
Sweden	21	23	23	23	27	28	29
Others	106	115	92	96	104	78	89
Total seaborne supply	1042	1089	1157	1245	1334	1410	1483
% change year on year	11.0	4.6	6.3	7.6	7.1	5.7	5.2
Required Chinese domestic ore	298	333	335	296	255	224	202

China iron ore supply/demand

China is faced with an increasing need to import iron ore due to problems with Chinese domestic iron ore production. In Figure 3 the increase in Chinese iron ore production appears to be impressive on a total tonnage basis. However, as shown in Figure 4, the equivalent Fe basis of this production is actually declining over time. Accordingly, as shown in Figures 5 and 6, Chinese dependence upon iron ore imports has been continually increasing, hence the continued increase in iron ore prices.

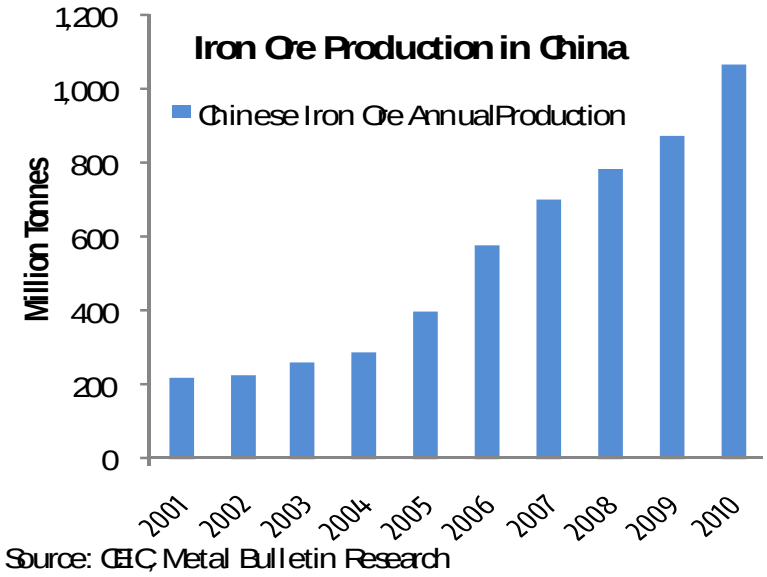

Figure 3. Chinese Iron Ore Production (2)

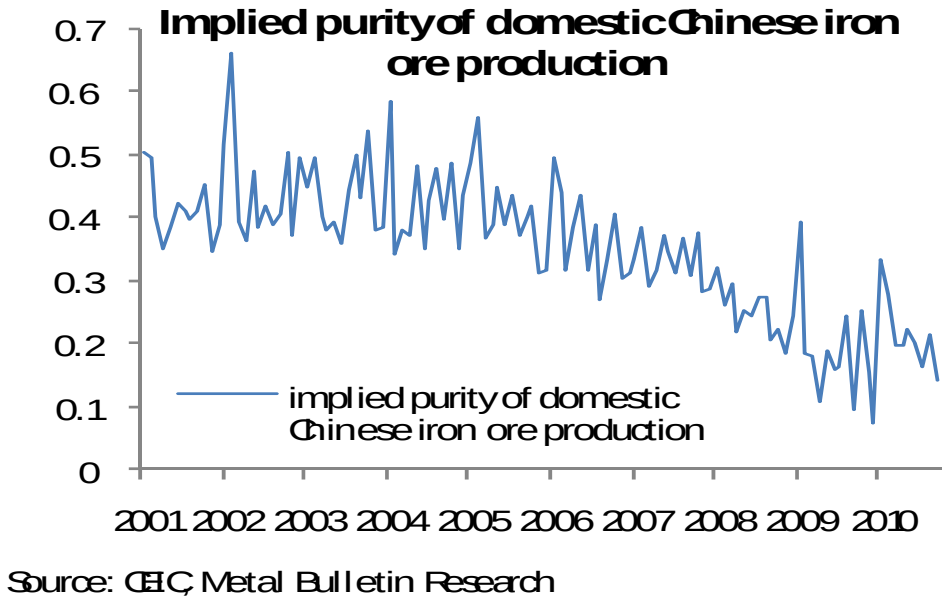

Figure 4. Implied Purity of Chinese domestic iron ore production (2)

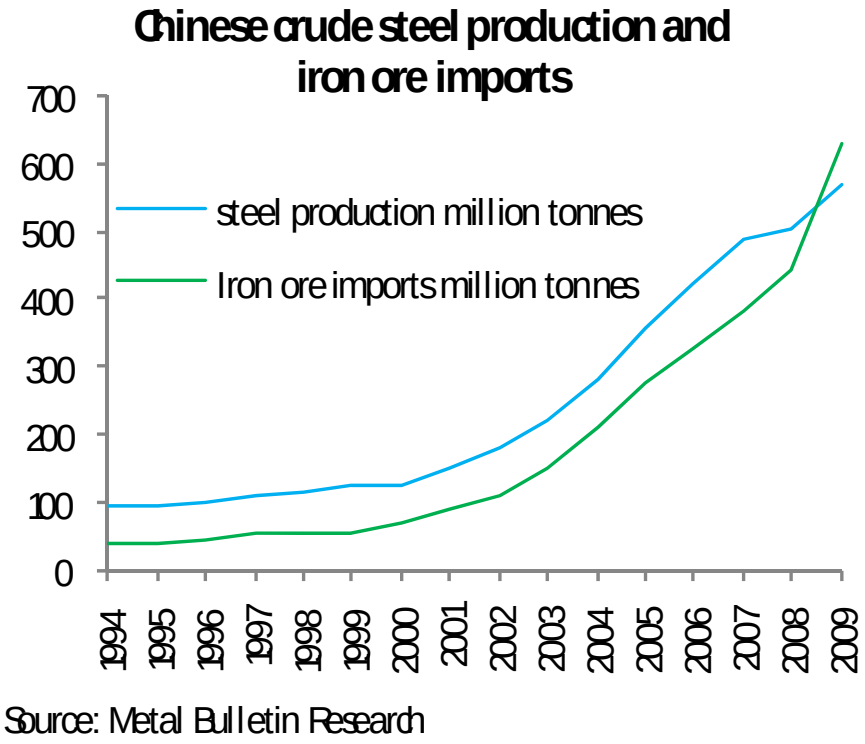

Figure 5. Chinese crude steel production and iron ore imports (2)

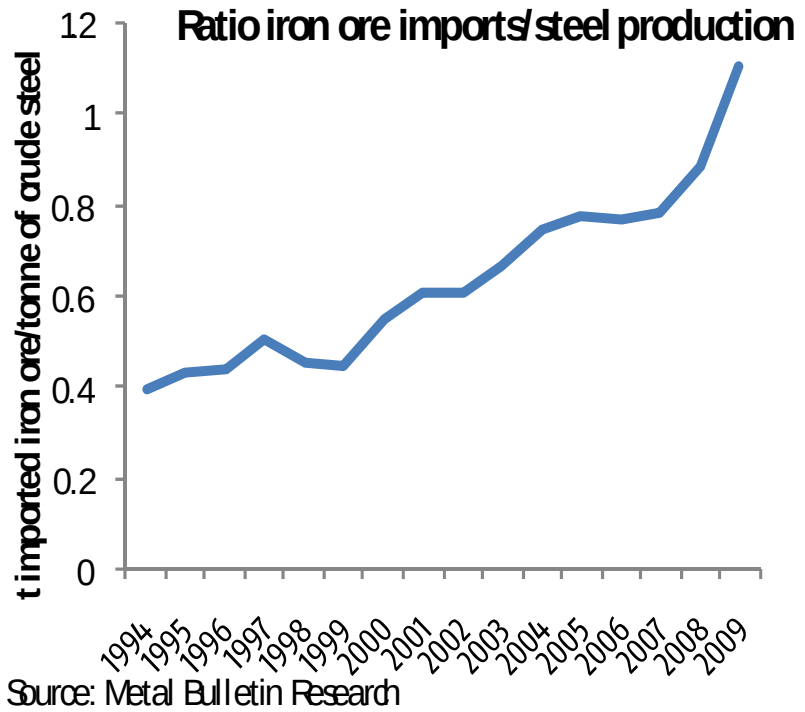

Figure 6. Ratio of Chinese iron ore imports to crude steel production (2)

In addition to the rapid growth in Chinese iron ore exports, the range of countries exporting to China has increased over the past decade. In 2003 the import volume of about 200 MT was dominated (88%) by the major exporting countries: Australia, Brazil and India, while the mid sized exporters: South Africa, Russia, Kazakhstan and Canada, took nearly all of the remaining (11 %) while all others were only 1 % of the total. The rapid growth of imported iron ore to about 600 MT by 2010 was led by the major exporting countries on an absolute basis but their percentage share had dropped to 80 % while the mid size exporters remained at 11 % (but also with a large increase on an absolute basis). Another 8 % or nearly 50 MTPY came from emerging exporters: Ukraine, Iran, Venezuela, Mauritania, other Asia (Malaysia, Indonesia, Vietnam, Saudi Arabia, North Korea) and other Americas (Mexico, USA, Chile, Peru). China's investments in Africa will lead to larger role from this continent in the future.
While the preceding discussion focuses on iron ore imports, the role of domestic iron ore mining in China may surprise some observers in the next several years. Some data published in the TEX Report shown in Table 3 below indicates a rapid growth in 2011 in Chinese domestic iron ore production:

Table 3 Chinese Domestic Iron Ore Production, Imported Iron Ore, Pig Iron Production, MT, 2011

	Domestic Iron Ore	Imported Iron Ore	Pig Iron
Jan	74	69	49
Feb	72	49	50
Mar	94	59	55
April	98	53	55
May	102	53	55
June	124	51	55
July	117	55	55

Annualized rate: > 1.2 BT China Goal: 50 % domestic ore

Source: TEX Report 8/12/2011

Global iron ore supply and new projects
Three critical factors when planning iron ore projects in developing regions are
- Transportation
- Infrastructure
- Geopolitical risks

Transportation
An ocean port is required with at least Panamax or preferably Capesize vessel capacity. There is also a need to provide rail access to the ocean port in order to participate in seaborne market. Unlike many coal mining areas, it is not likely that rail lines already exist from mine site to port. The billion dollar cost of such infrastructure requires a scale of >10 MTPY of iron ore production.

Geopolitical risks
These refer to the following challenges:
- continuity of mining rights
- enforcement of contracts
- security of assets: mine, plant, rail and port
- safety of personnel, employee retention
- increased capital and operating costs due to above

A sad commentary on this is that project failure is one bullet away in politically unstable countries; i. e. agreements made with a current government leader can easily be negated by a sudden change in political leadership.

Infrastructure
Beyond the transportation requirements listed above, we frequently have to deal with remote locations. A remote location requires construction of town site and some supporting facilities even if a "fly in, fly out mode" is planned. Remote locations will increase manpower costs and restrict availability of both skilled workers and professional, technical personnel. In such areas upgrading a low grade ore with a sophisticated upgrading circuit might not be practical
The need for new iron ore projects is driven by three factors:
- demand growth from China, perhaps more than 50 % of the total,
- demand growth from other developing countries: India, Brazil, etc,
- grade reduction: the decrease in Fe content from existing and many new mine projects means that more iron ore has to be mined and processed to provide the equivalent Fe units.

While many new iron ore projects have been announced, many analysts prefer to classify these into three groups:

- **Certain to proceed** - these are mainly the expansion projects of the "Big Three" (VALE, BHPB and Rio Tinto) and other leading producers such as Anglo American (Kumba and Brazil) and selected other global projects backed and well financed by leading steel (ArcelorMittal, Tata, Essar, Severstal, Posco, China Inc, CSN, Usiminas) and resource players (MMDC, LKAB, Cliffs, Glencore, Xstrata, etc). The latter include some state owned companies.
- **Probable to proceed** – includes many of the same players from the above list and some prominent newer companies: FMG, MMX, Labrador Iron Mines and many direct shipping ore projects in Australia particularly those with Chinese equity interests,
- **Possible to proceed** – this would include many projects in Africa where infrastructure and sovereign risk issues are still paramount, early stage projects in Canada where total capital cost and distance from market are issues and many magnetite projects in Australia where the Chinese appetite for huge capital expenditures may be reduced by experiences with the first two projects.

As of mid 2011, there were about 1.5 million tons per year (planned productive capacity) of iron ore projects in various stages of study and development. However, as illustrated below in Figure 7, the actual project delivery falls far short in any given year.

Figure 7. Shortfall of Iron Ore Project Delivery (3)

The reasons for the gap between project planning and project delivery include the following:

- **Financing** - the capital costs of new projects has escalated sharply: over the 2006-2010 period the average capital intensity of iron ore projects has more than doubled, from 59 to 126 $/annual tonne of capacity.
- **Execution around infrastructure –** most new projects have substantial infrastructure needs: long rail road runs, need for new deepwater ports, needs for local town sites, utilities, etc; in many cases the infrastructure hurdles could not be overcome in former times and this was the key reason for not developing such projects in the past.
- **Environmental permitting –** these requirements are now globally more demanding and further add to the capital intensity and extended lead times.
- **Grade depletion –** much of the easily accessible rich natural ore deposits have already been developed so a good deal of new project activity is aimed at upgrading lower grade ores thus further adding to the capital intensity and extended time line of new projects.

High ore prices will drive new project development including projects:

- in high risk areas
- requiring extensive upgrading (Australian magnetite, Brazil itabarites, Canadian taconites)
- producing pellet feed
- producing sintering ores of lesser quality

The high risk areas include many countries in West Africa where a number of new projects are being planned while several are already shipping including some in Liberia and Sierra Leone. Other projects in the Atlantic basin include many in Canada and some in Brazil that are aiming to produce concentrates and pellet feed. However, the main market for much of this new capacity is in the Pacific basin, mainly China, and furthermore, the main product desired are sintering ores. So a good portion of new project activity is in the wrong place and producing less desirable products.

The head grade of iron ore for new projects is shown in Figure 8 for projects in many parts of the world.

Generally speaking, we can make the following observations:

- Magnetite projects are generally capital intensive due to their scale and the necessity of upgrading: these include those in Australia (Ridley, Southdown, Gindalbie), Canada (Kemag, Baffinland), Mauritania and Sweden/Finland (Northland Resources).
- Hematite projects are capital intensive, both for upgrading but particularly for infrastructure needs (rail, port): these include those in Brazil (Minas Rio, Casa de Pedra, Usiminas), Australia (Roy Hill, others) and Africa (Mbalam, Tonkolili, others),
- Direct shipping ore (DSO) projects tend to be less costly due to limited upgrading requirements and access to existing infrastructure: these include those in the Minas Gerais region in Brazil and those near ports in the Pilbara and the Mid West region in Australia.

Impact of new projects on iron ore pricing

On an overall basis, it is clear that new projects will increase the long range base or "floor" price for iron ore due to the higher operating and capital costs of many new projects. Some estimates of the costs for 62 % Fe ore with consideration of CAPEX, OPEX, freight and Fe adjustment follow:

Table 4 Projected total (OPEX, CAPEX) costs (3)

	$/tonne
Australia	
BHPB expansion	71
Pilbara greenfield	93
Midwest greenfield	94
Brazil	
VALE Southern expansion	58
Others	75
West Africa	82

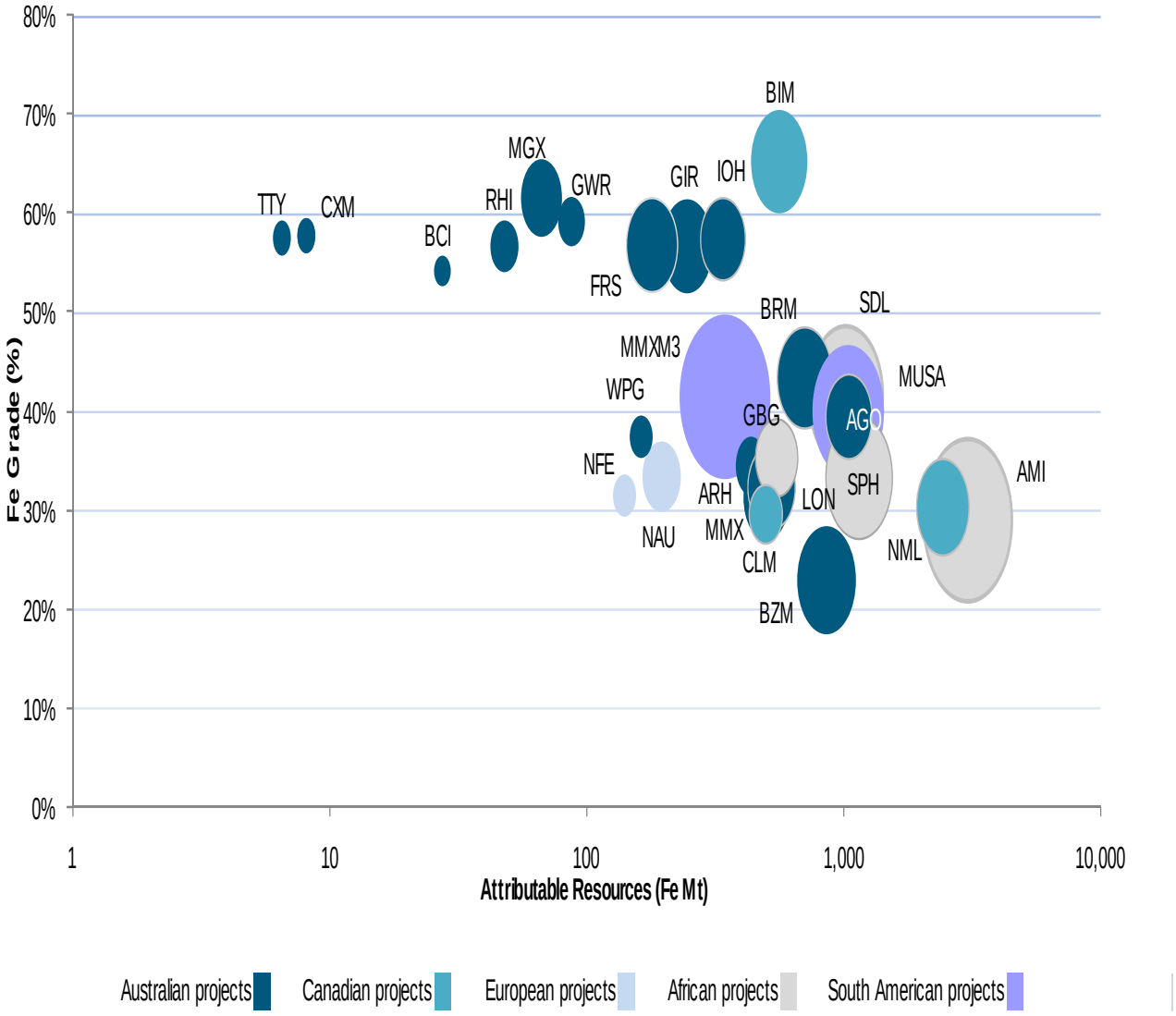

Figure 8. Head Grades of Iron Ore Projects on a Global Basis (3)

Iron ore pricing for many years was determined by the annual benchmark system whereby a major ore supplier would negotiate a benchmark price for sintering ore fines with a major steel producer either in the European or the Asian (initially only Japan, later including China) market. All other iron ore producers and steel companies would follow, with adjustments for freight, quality, etc. The pellet price would be subsequently negotiated usually in the Atlantic basin. Some discounting would informally occur but broadly within the framework of the benchmark pricing. When China began to be a major imported ore consumer in the 1990's they began insisting upon discounts from the benchmark price being paid by the Japanese steel mills (JSM). In spite of resentment by JSM this continued until the China iron ore boom staring in 2003. The Chinese iron ore demand began to grow so rapidly that China needed to secure additional iron ore beyond the benchmark contract volumes. This was supplied mainly by India selling at spot prices much higher than the benchmark prices. The major iron ore suppliers were very unhappy about not realizing the high spot prices enjoyed by the spot suppliers mainly from India. Several of the major ore suppliers, notably BHPB, began advocating a departure from annual benchmark in pricing towards market driven spot pricing. When the financial crisis hit in 2008-2009 the major iron ore producers became enraged when the Chinese steel producers refused to honor the benchmark prices that remained higher than the spot prices that had collapsed in the fiscal crisis downturn. This was the end of the benchmark pricing as all major iron ore producers now insisted on a switch to a spot pricing mechanism. All of this is shown in Figure 9 below.

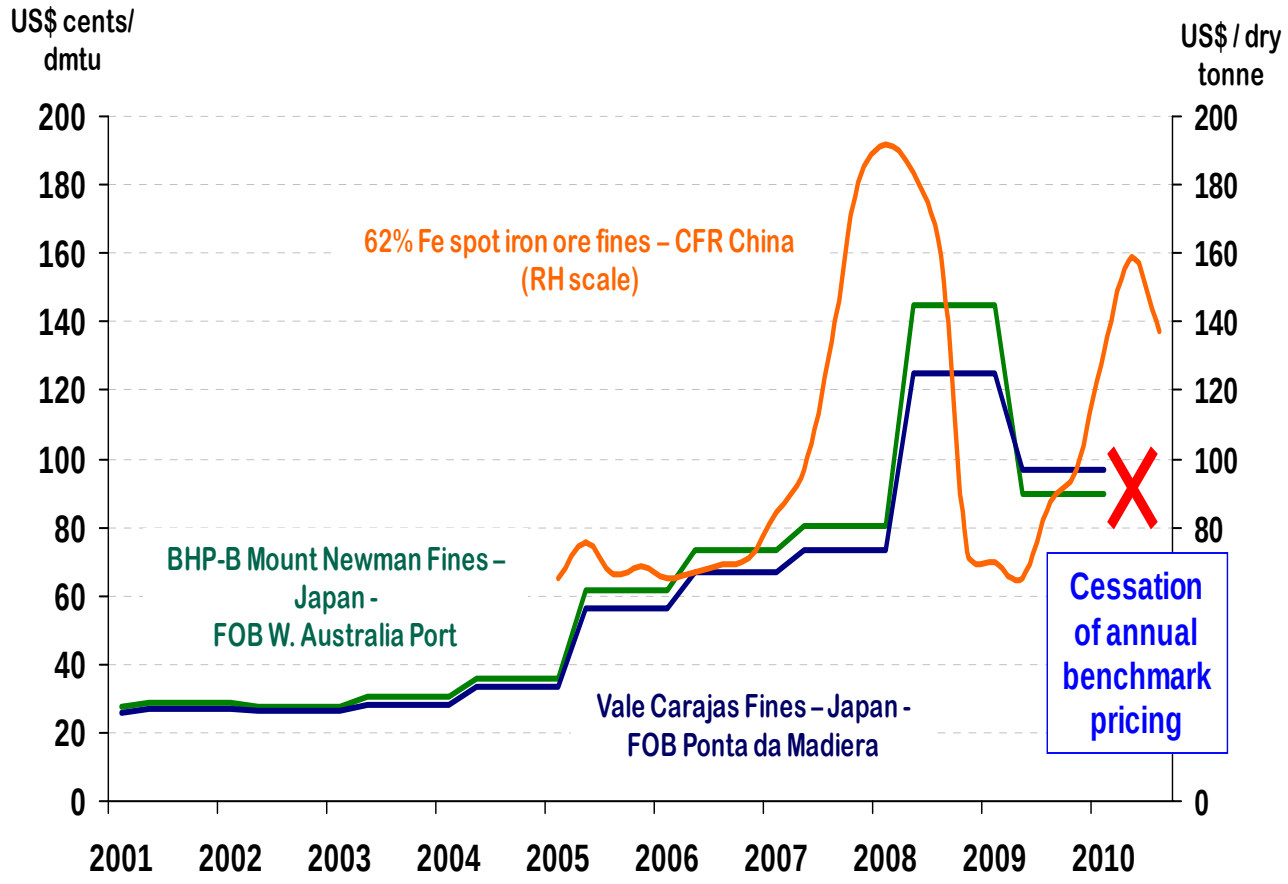

Figure 9. Iron Ore Fines Prices - Benchmark and Spot Prices 2001 – 2010 (4)

The evolution to spot pricing initially began with quarterly pricing (based on the average spot price CFR China for fines @ 62 % Fe for the prior quarter). This has now evolved mainly into monthly pricing, as illustrated in Figure 10. The solid horizontal lines represent the monthly price, taken from the average spot price of the prior month: the jagged line in Figure 10.

The dramatic changes in iron ore pricing over a two period 2009 to 2011 could be summarized as follows: In 2009, 80 – 85 % of the seaborne iron ore trade was based on annual benchmark pricing with the balance being spot transactions. In 2011 70 – 80 % of this seaborne trade volume is now based on short term indices developed from quarterly or monthly spot prices CFR China. About 15-20 % is still based on true spot pricing while a smaller fraction, 10 -15 % is based on bilateral annual contracts. These include the pellet sales of LKAB and perhaps some other Atlantic basin suppliers.

While iron ore prices over the past year have been at historically high levels, most industry observers expect that supply will eventually catch up to demand. Earlier we noted that high ore prices are driving new project development including projects in high risk areas, projects requiring extensive upgrading, projects mainly producing pellet feed and other projects producing sintering ores of lesser quality. High ore prices are also motivating steel producers to reverse an earlier trend by investing in ore properties; thus decreasing their reliance on the "Big Three": VALE, Rio Tinto, BHPB. High ore prices are also encouraging increased development of new steel plants in regions rich in iron ore such as Brazil and India. The implications of the preceding could be a "perfect storm" of:

- many new merchant projects
- much steel company equity iron ore investment
- new steel plants in iron ore rich areas
- leveling off of global steel demand

All of the above could lead to a global iron ore surplus and sharply declining ore prices. The potential impact of a global iron ore surplus and sharply declining ore prices might be projected as follows:

- the "Big Three" (VALE, BHPB and Rio Tinto,) with low costs and better quality, can afford to sharply drop prices and still survive
- some 2nd tier and many 3rd tier ore producers including new projects (with higher costs) will struggle

- steel companies (after investing in lesser quality, higher cost projects) will again wonder why they returned to the iron ore business

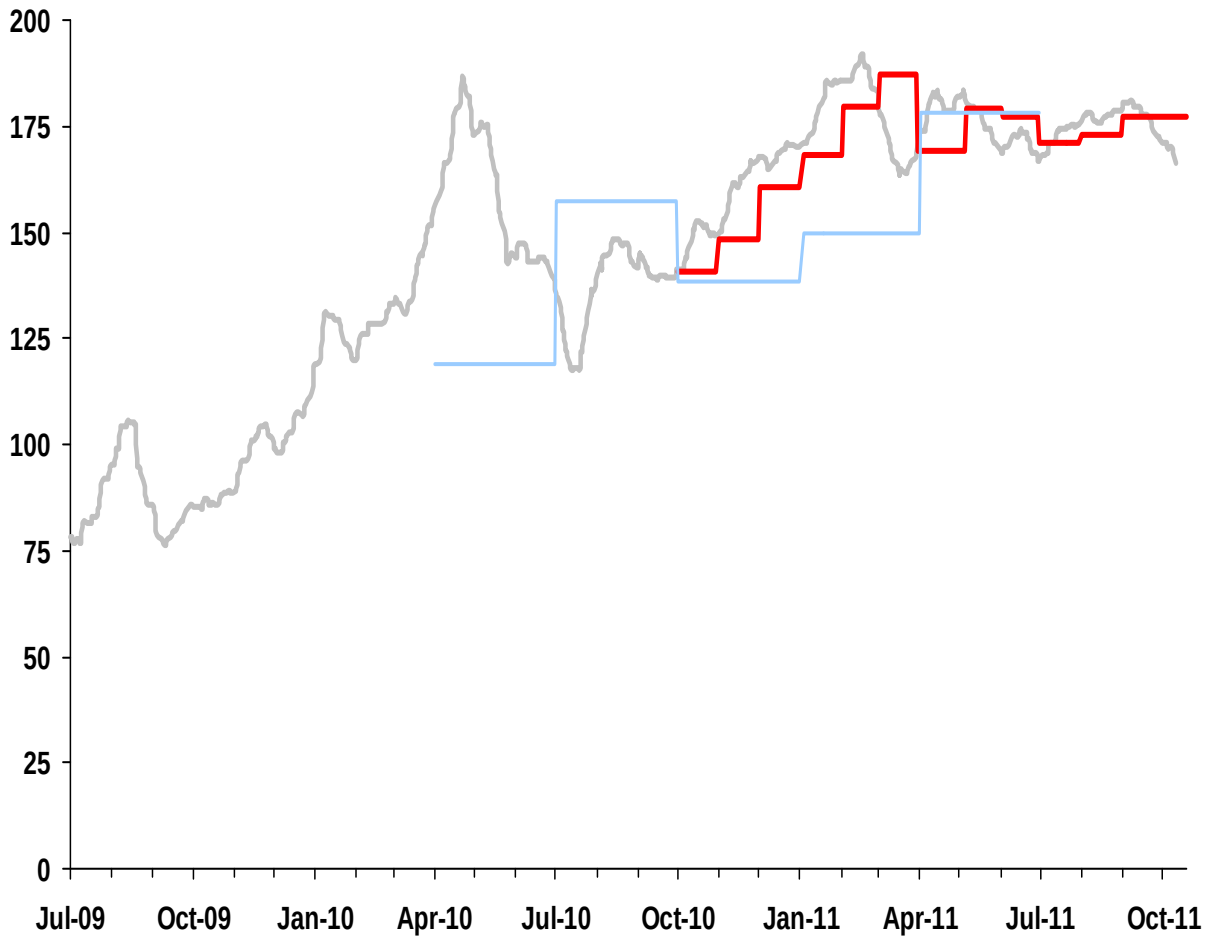

Figure 10. Index-linked Pricing: Monthly example, TSI 62% Fe Fines Reference Price - CFR China Port, 2009-11 (4)

The predictions of a future "long range average price" refers to when extensive new capacity finally comes on stream and when China iron ore demand "levels off". At that time (2015?) iron ore prices will rapidly decrease, but eventually an "equilibrium or floor price" will be reached that represents the costs of some higher cost producers. A compilation of predictions by an assortment of financial players, iron ore producers and consultancies is given below. The range of prices goes from 60 to 95 $/tonne, a wide range, but well below the current prices in the 130 – 140 $/tonne range.

Table 5. Long Term (> 2015) Iron Ore Fines Price Projections

	$/tonne	c/mtu
UBS	75	1.21
Dundee Capital Markets	90	1.45
Fortescue Metals Group	90	1.45
JP Morgan Chase	60	0.97
Rio Tinto	60	0.97
KPMG	70	1.13

Raw Materials Group	95	1.53
Average	77.1	1.24

New ironmaking technology: effect on iron ore dDemand

The quick answer is that we expect new ironmaking technology to have a limited impact on iron ore demand. The blast furnace/BOF route will remain the dominant production mode especially in high growth regions: China, India, Brazil, etc. The leading alternate ironmaking processes (Corex, Finex, Nuggets) will have a limited impact but these still require iron ore. In the area of blast furnace feed we expect that pelletizing will grow but sintering will remain very important. The continued growth of the EAF sector producing flat rolled, high end long products in North America and selectively elsewhere will require increased amounts of ore based metallics: pig iron and DRI/HBI. Ultimately, 1.5 tons of iron ore are needed to produce one ton of hot metal or DRI/HBI

North American iron ore supply/demand

Unlike the rest of the world, the North American iron ore scene is dominated by pellets so our discussion here is focused on North American mines and pellet producers. These producers enjoy the advantage of: producing high quality pellets and supplying a captive Great Lakes market where the use of pellets in the USA and Canada is > 90 % of the BF burden. Currently they can also exploit profitable export markets while these producers are also protected somewhat by the high barriers to entry facing potential competitors: high capital costs, environmental constraints, logistics, etc.

On the other hand, these pellet producers face some risks: potential overcapacity, the collapse of seaborne prices and logistic constraints for export sales. Overcapacity could come about in multiple directions: closures of North American blast furnace operations, new North American pellet capacity and penetration from imports (aside from internal NAFTA such as Canada) but also from Brazil. As noted in Table 6 below, North American blast furnace pellet supply/demand were in balance in 2011, aided by some exports

Table 6. North America Blast Furnace Pellet Supply/Demand Balance, Estimated for 2011 (5)

MTPY Supply and Demand in Balance = 68.9 MT

Steel Company	Demand	Equity Supply	Cliffs	IOC	AMMC	Sinter
AHMSA	6.7	5.1	0.5	0	0	1.0
AK Steel	5.2	0	1.4	2.4	1.4	0
Essar Algoma	4.1	0	4.1	0	0	0
ArcelorMittal	22.8	11.3	8.7	0	(3.0)[1]	2.8
SeverstalNA	2.8	0	2.8	0	0	0
RG Steel	4.0	0	1.6	1.4	0	1.0
USSteel	23.3	20.8	0.6	0	0	1.9
Available for export		1.3[1]	1.4	8.7	5.1	-

1 included in ArcelorMittal equity supply

Looking forward at changes in pellet supply/demand we can foresee the following pellet supply increases (MTPY):

- Essar Minnesota: 4.1 to 7.0
- USSteel KeeTac Expansion: 3.0
- ArcelorMittal Mines Canada: 9.0
- Magnetation/AK Steel: 3.0

The Essar Minnesota and Magnetation/AK Steel projects are certain to go forward while the USSteel Keetac expansion is likely; the AMMC expansion is uncertain, at present.

The potential for pellet demand increases (MTPY) could be listed as follows:

- Nucor Louisiana DRI plant: 3.7
- Other DRI plants (Severstal, USSteel) ?

The implication of the above is a blast furnace oversupply in Great Lakes that could only be balanced by multiple DRI projects and exports of pellets (either BF or DR grade) as well as pushing Canadian supply (IOC, AMMC) into the seaborne market. Fortunately, all of the new pellet capacity (except for Magnetation/AK Steel) will have the capability to produce DR grade pellets.

CONCLUSIONS

The continued growth in global steel production, led by the BRIC countries, particularly China, will provide continued growth in iron ore demand. New ironmaking and steelmaking technology will only marginally affect iron ore demand, as blast furnace based steel production will dominate growth but even the alternative ironmaking technologies have the same specific iron ore consumption. Seaborne iron ore supply will continue to be dominated by Australia and Brazil with South Africa, India, Canada, Sweden and eventually West Africa playing roles. Local and regional supply will be led by China, Russia and the Ukraine. Many new iron ore projects are in various stages of development globally but the schedules keep slipping due to financial, infrastructure, environmental and technical challenges. Furthermore, much of the new capacity is in the Atlantic basin, far from China, and the need to upgrade low grade ores produces too much pellet feed whereas sinter feed is the preferred feed material. The attributes of good iron ore projects that investors, project developers and steel companies should focus on are:

- ample, good quality reserves,
- reasonable infrastructure requirements
- moderate geopolitical risk
- locations close to growing markets
- competitive capex and opex projections
- ability to produce iron ore products with high value-in-use

The annual iron ore benchmark pricing system has been replaced with an index mechanism based on spot prices. When iron ore supply eventually catches up to demand, long term equilibrium prices will fall to much lower levels than currently observed, likely well below $ 100/tonne, CFR China @ 62 % Fe.
The North American iron ore market is dominated by blast furnace pellets. A potential BF pellet oversupply can be alleviated by production and shipment of DR grade pellets, hopefully to new DRI projects.

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