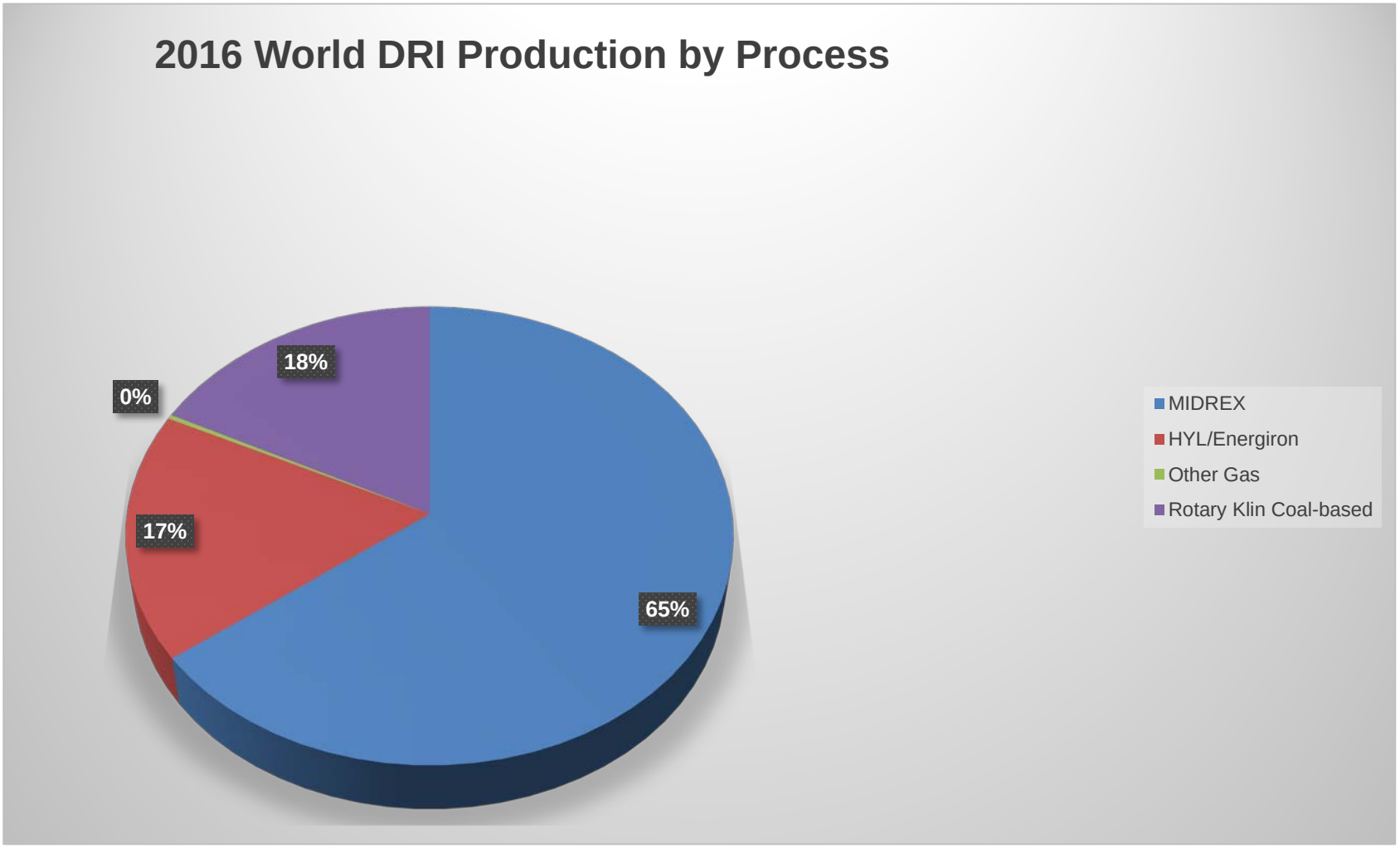
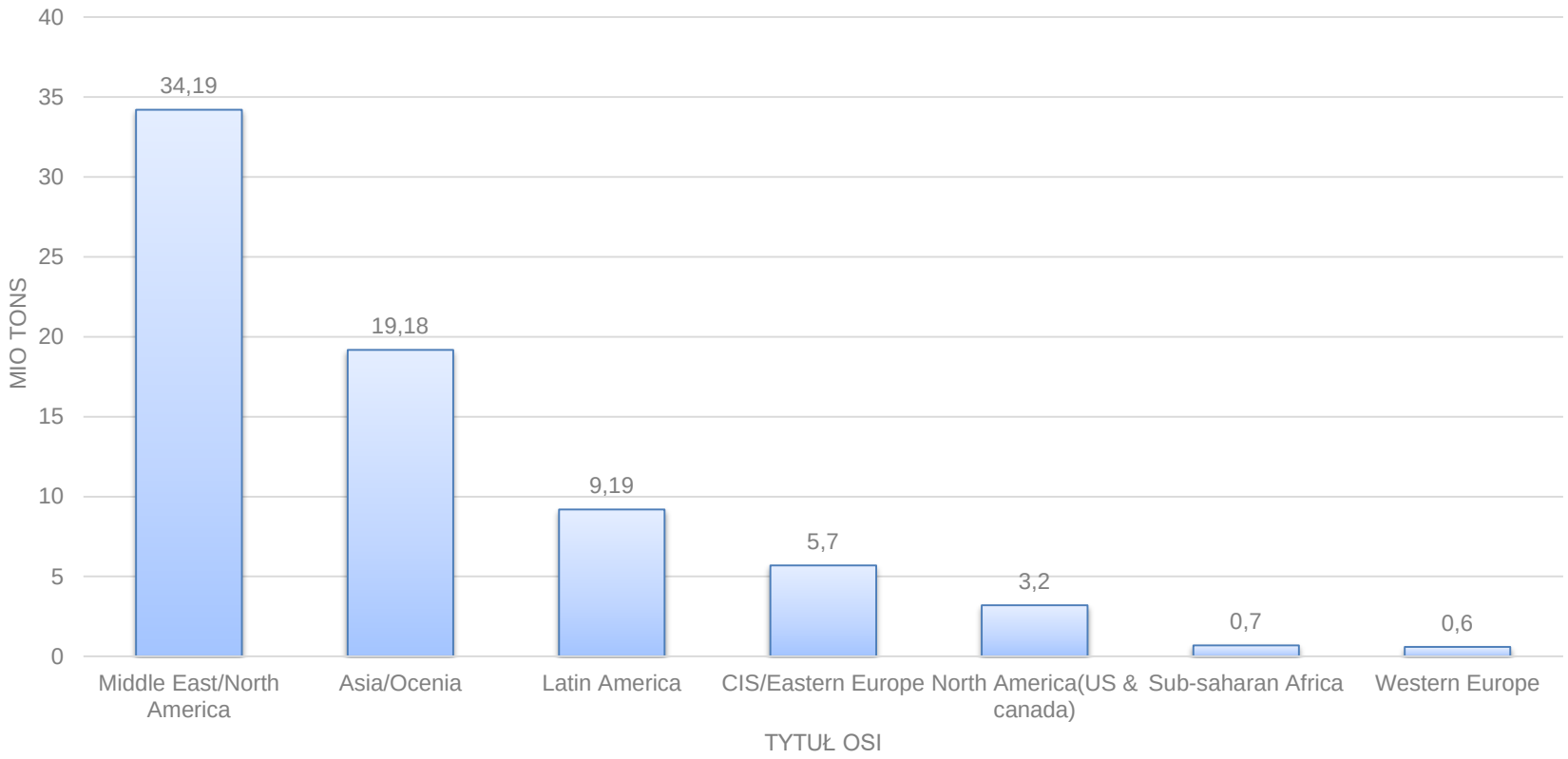
Coal to Steel
World DRI Indusrties & Steel Outlook

Jitendra Kumar Nanda
VP & Head Raw Materials
Essar Steel India Ltd

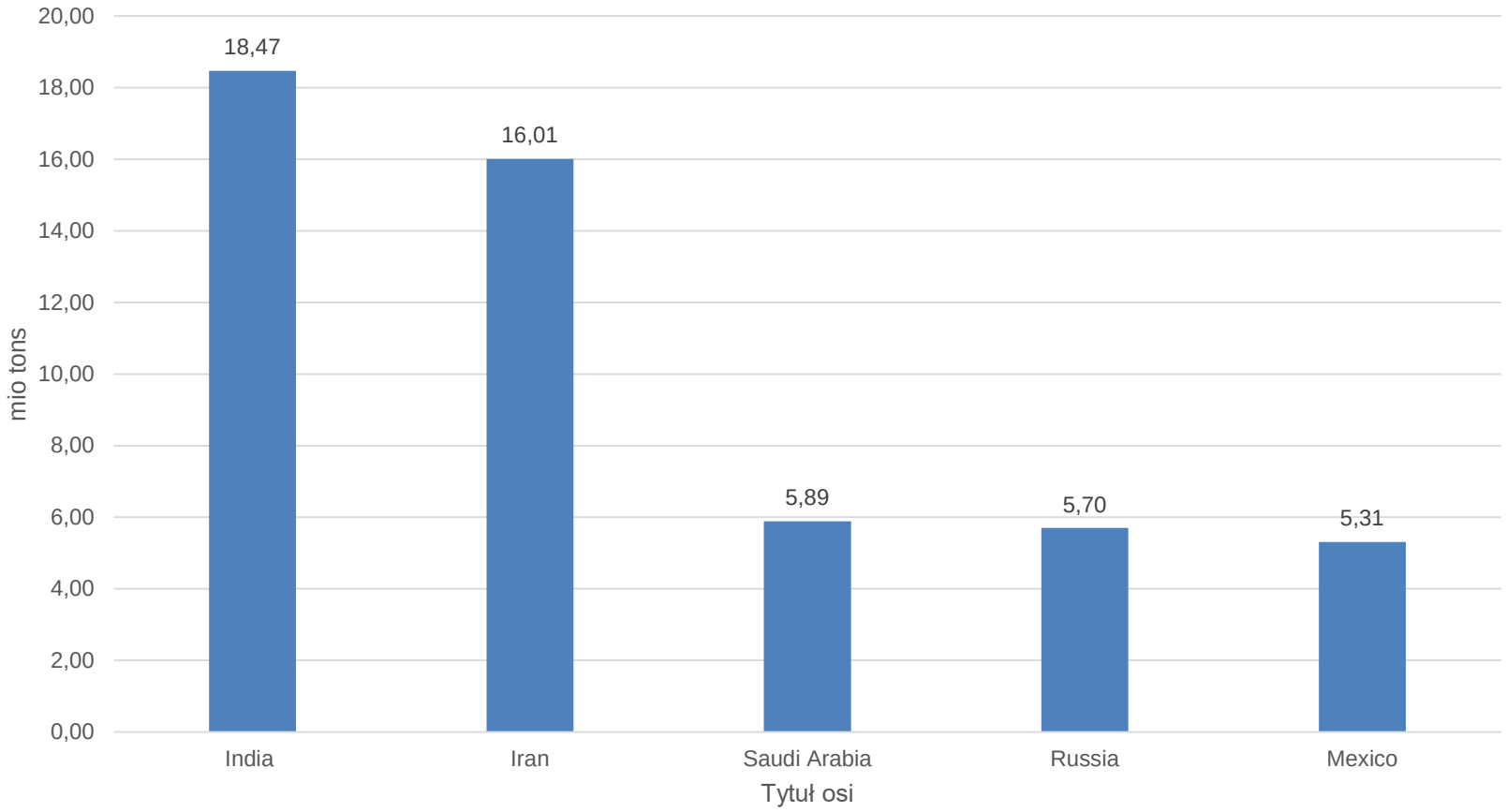
World DRI production by Process



2016 world DRI Production by Region(Mt)

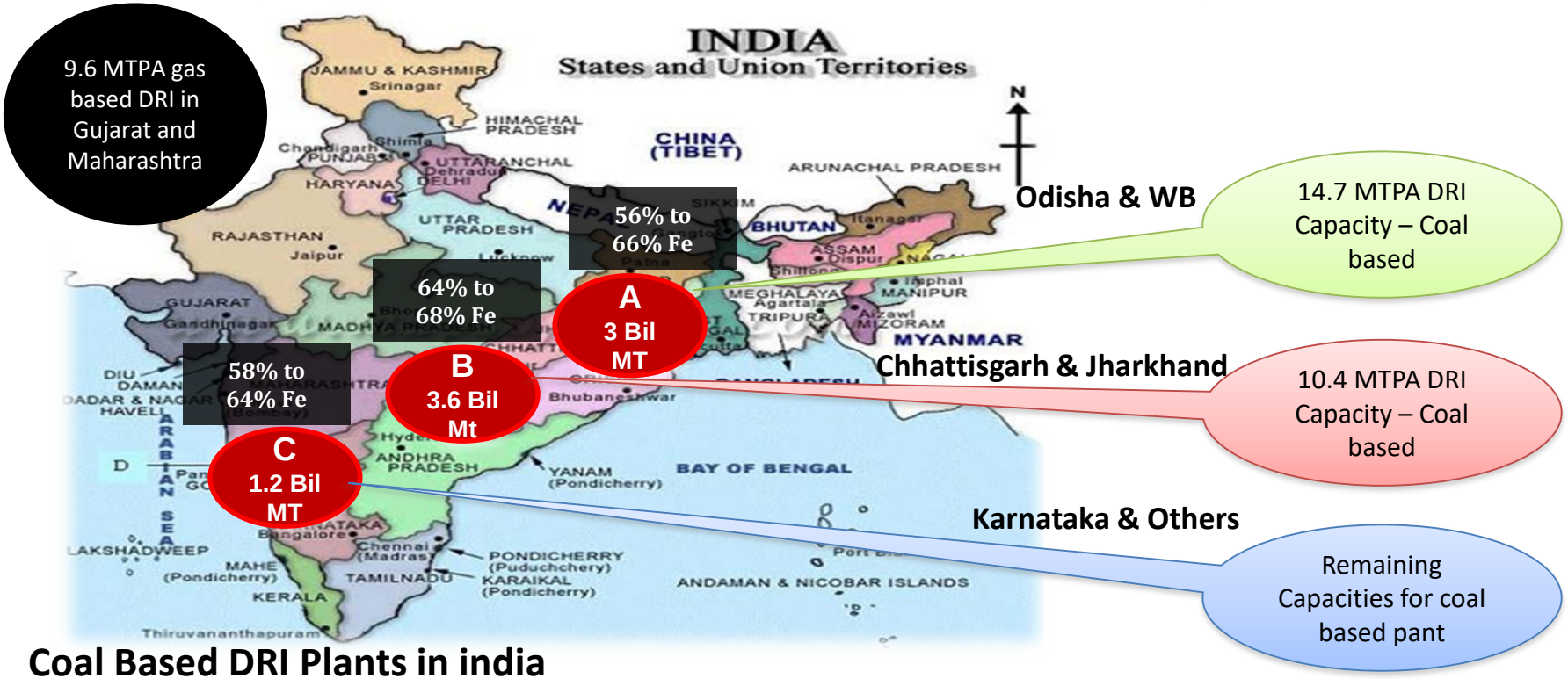


Top DRI Producing Nations



Indian DRI Industry – An Outlook

- India is world's highest DRI producing country.
- Indian DRI production in AY 2013 is at 18.10 MTPA, which is 26% of the world DRI production (69.6 MTPA).



Coal Based DRI Plants in india

States	Total installed capacities	Total No. Of plants installed	Major areas
Odisha	10.5 MTPA	108 No's	Rengali, Koramunda, Barbil est.
Chhattisgarh	8 MTPA	68 No's	Siltara, urla est
West Bengal	4.2 MTPA	57 No's	Durgapur, Raniganj, Barjora est.
Karnataka	1.8 MTPA	39 No's	Bellary, raichur, Mangalore est.
Jharkhand	2.4 MTPA	37 No's	Chandil
Other states	2.4 MTPA	21 Nos	Like Andhra Pradesh, Tamilnadu, Maharashtra est

Indian DRI Industry – Concerns

India's DRI Capacity Utilization

FY 12-13	Installed Capacity	Production	Capacity Utilization
Coal Based DRI	28.06 MTPA	15.5 MTPA	**55.24 %**
Gas Based DRI	9.6 MTPA	2.61 MTPA	**27.18 %**

***** Highest DRI production was 23.25 MTPA in 2010 which has now reported a drop by 22% where as the steel production have reported a steady growth of 15% (70.6 MTPA in 2010 to 81.5 MTPA in 2013)***

Concerns affecting growth of DRI

- Iron Ore Mining (218 MT in 2010 to 140 MT in 2013).
- Availability sized quality ore.
- Natural Gas Non Availability & unviable Pricing (Applicable for Gas based DRI).
- Coal availability and linkages in india. (Applicable for Coal based DRI).
- Higher scrap Utilization and cheaper hot metal scrap.
- Reduced Market margins and economic slowdown.

Quality of DRI/Pig Iron with Pellets

M/s Essar have Gas based DRI and Blast Furnace where its is using pellet as feed Material.

- Utilization % in Blast Furnace : 60 % with pellet feed

- Utilization % in DRI : 100 % with pellet feed

Input pellet quality	Kiln Feed	Pellet Feed/ MT DRI	Yield	Fe% (M)	Metallization
63.5 % Fe	100%	1.33	75 %	77 %	92 %
66 % Fe	100%	1.21	83%	82.3 %	93 %

Many Coal based DRI plants in Andhra Pradesh have also changed over to pellets especially in Hyderabad region where 100% Pellets are used as feed to the kiln.

The Typical Quality comparison with pellets & CLO in a 300 TPD DRI Kiln is as follows :

Input Burden quality	Kiln Feed	Pellet Feed/ MT DRI	Yield	Fe% (M)	Metallization
Pellet :63.5 % Fe	100%	1.47	67%	78 %	89%
CLO : 66 % Fe	100%	1.55	64 %	83%	88%

Can Iron ore producers achieve balance between Domestic consumption and International exports

Sponge Iron

000 Tonnes

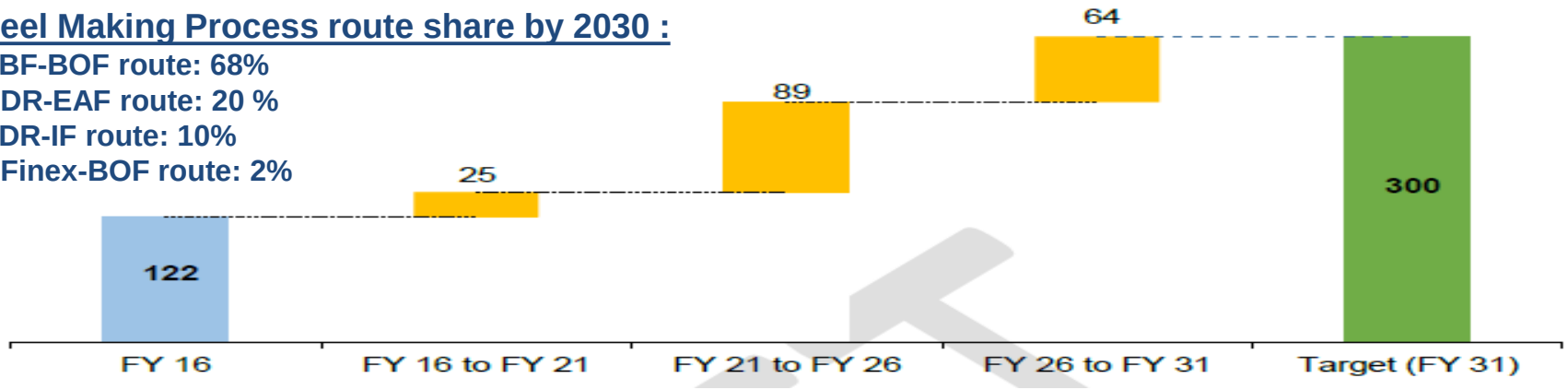
		2015 - 16	2016 - 17	2017 - 18 (Apr - Sep)
1	Coal Based	19,987	23,908	9,420
2	Gas Based	2,440	4,854	2,909
3	Total Production	22,427	28,762	12,329
1	IPT / Own Consumption	7,902	11,287	4,961
2	Production for Sale	14,525	17,475	7,368
	Total	22,427	28,762	12,329
1	Export	127	130	130
2	Import	0	1	47
	Net balancing of Import and Exports	127	129	83

Future Prospects – National Steel Policy 2017

- Crude steel capacity of 300 Mil MT & Production of 255 Mil MT
- Finished steel per capita consumption of 158 Kgs
- Domestically meeting 100% demand of high grade automotive steel, electrical steel, special steels and alloys for strategic applications.
- Thrust on Pellet industry as it helps in mineral conservation by acting as direct feedstock in Blast Furnace in place of high grade iron ore.
- Utilization of low grade fines lying at mine sites of captive iron ore miners..
- Strengthening of Beneficiation and agglomeration industries through suitable support.

Steel Making Process route share by 2030 :

a. BF-BOF route: 68%
b. DR-EAF route: 20 %
c. DR-IF route: 10%
d. Finex-BOF route: 2%



****Steel Capacity in Mil MT**

Sector Wise Steel consumption in India as projected in NSP (MT)

Sr.No	Item	Current demand in (2015-16)	Projected demand in (2030-31)
1	Construction and infrustructure	50.5	138
2	Engineering and Fabrication	18	50
3	Automotive	8.2	28
4	Other Transport	2.4	8
5	Packaging & others	2.4	6
	Total finished Steel Consumption in MT	81.5	230
	Per Capita Finished Steel consumption in Kgs	61	158

Supply – Demand Gap analysis as per NSP-2017

Iron making routes & preferred feed stocks :

		Type of Feed stock		
	% share in steel route	Sinter	Pellet	Lump
DR	32.00%	0.0%	70.0%	30.0%
BF	68.00%	60.0%	25.0%	15.0%
Cumulative	100.00%	40.8%	39.4%	19.8%

Mining Requirement:

Total Feed stock required :	Qty in Mil MT	Lump: fines ratio
Total Fines required :	396	82
Total Lumps required :	89	18
Total Mining requirement :	485	

Supply – Demand Gap analysis

All Figs in Mil MT

	FY'17	FY'30	Gap/Potential for growth
Iron ore mining	190 Mil MT	471 Mil MT	***281 Mil MT***
Sinter	50 Mil MT (Assumed)	182 Mil MT	***132 Mil MT***
Pellets	60 Mil MT (Assumed)	176 Mil MT * **DR:BF = 57:43**	***116 Mil MT***
Lumps	74 Mil MT (Assumed)	89 Mil MT	***15 Mil Mt***

**Considered FY'17 production figures assuming no exports/imports done

- ***Lumps requirement is going to come down in future and Pellet usage is going up.***
- ***With more of the low grade ore reserves, Iron ore beneficiation and Pelletization are going to be highly prominent in future.***

To what Extent National policy will Impact MENA

with Increase demand and per capita consumption, preference to domestic producers as stated in National Steel policy 2017,MENA organisation will have the following advantages.

✓Demand for Raw material for producing the Finished steel in India.

✓Cheap Logistic cost.

✓ Lesser Voyage timing.

✓Capitalization of large iron ore resources.

✓Extra ordinary natural gas reserves.

✓Recent capacity expansions and plant under constructions.

Gas based DRI to use Coal gas, Corex gas to replace natural gas will these impact quality and quantity

Currently in view of increase in natural Gas prices and re-use of captively produced coal gas and Corex most of the Steel Making industry replace natural gas with Coal and Corex gas the impact of it given below:

✓Cost of production reduces.

✓Sulphur Content in Corex gas reduces the life of refectory.

✓Due to lesser CV productivity is lesser as compare to natural Gas.

✓Coal and Corex gas creates more greenhouse gas emissions as compare to Natural gas .

✓Sometime Non availability of Natural gas leads to usuance of Corex and coal gas.

28 billion tonne
Hematite-17.88 Bil.MT

Proposed Production
2020 = 400 Mil MT

Exploitation of High grade ore and increasing un-utilization of low grade ores.

Will last for next 40-50 years ?

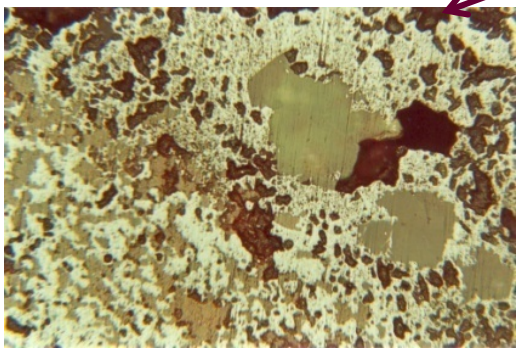
Usage of Low grade ores and iron ore fines utilization in iron and steel making

- High Alumina
- Intricate nature
- Poor liberation

- Adoption of Beneficiation & Agglomeration.

Indian Iron Ore

Availability
Consumption
Concern
Initiative
Issues
Options
Problems
Challenges
Solutions



Complex association of Hematite (white) with Goethite (dull grey), Quartz (gray) and Clay (brown)

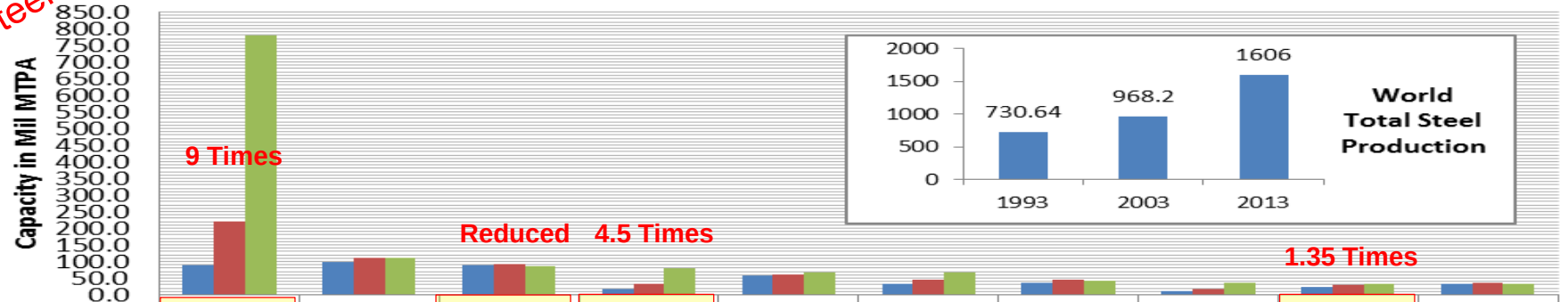
- Total beneficiation
- Optimize lumps to pellet
- Higher proportion of blue dust in sinter
- Low grade fines for DR processes
- Exploitation of low grade ores >45% Fe
- Utilization of residual slimes/ tailings
- Cost Economics

- Development of efficient Centrifugal separators, Flotation, Magnetic Separation, gravity separators, Solid–liquid separation.
- Improved sintering technology
- Pelletization with improved properties

INDIA-Iron Ore & Steel : Now & Then

Steel Stats

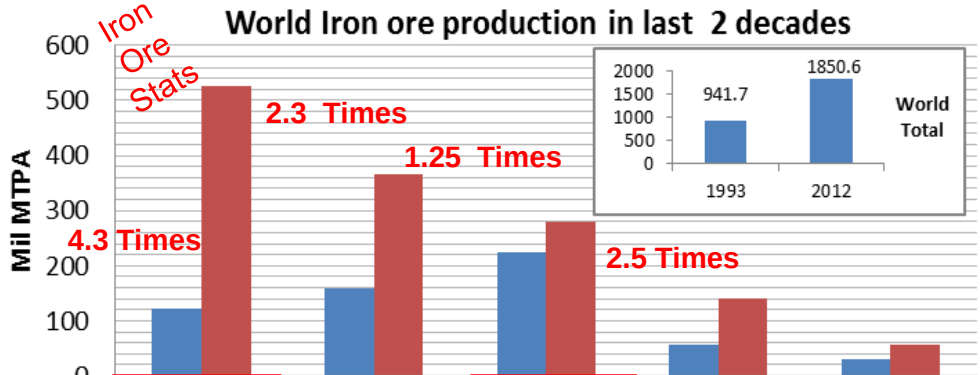
FY 13-14 Top 10 steel producing countries 2 decade statistics



	China	Japan	United States	India	Russia	South Korea	Germany	Turkey	Brazil	Ukraine
1993	89.5	99.6	88.7	18.2	58.3	33.0	37.6	11.4	25.2	32.4
2003	220.1	110.5	93.7	31.8	62.7	46.3	44.8	18.3	31.1	36.9
2013	779.0	110.6	86.9	81.2	68.7	66.1	42.6	34.7	34.2	32.8

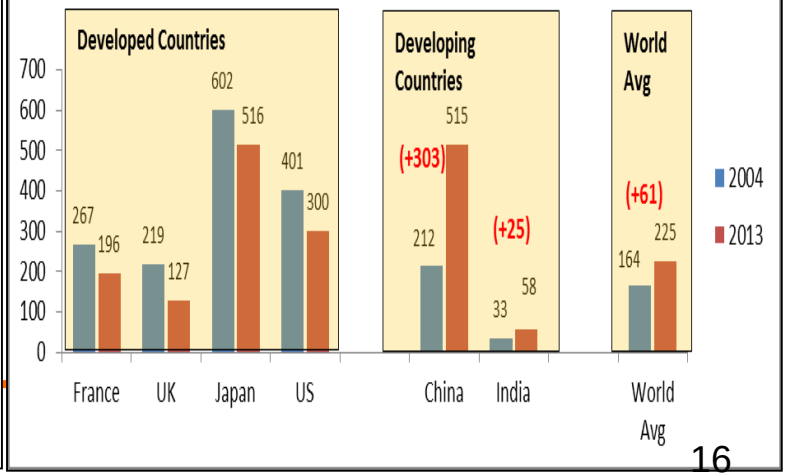
Iron Ore Stats

World Iron ore production in last 2 decades

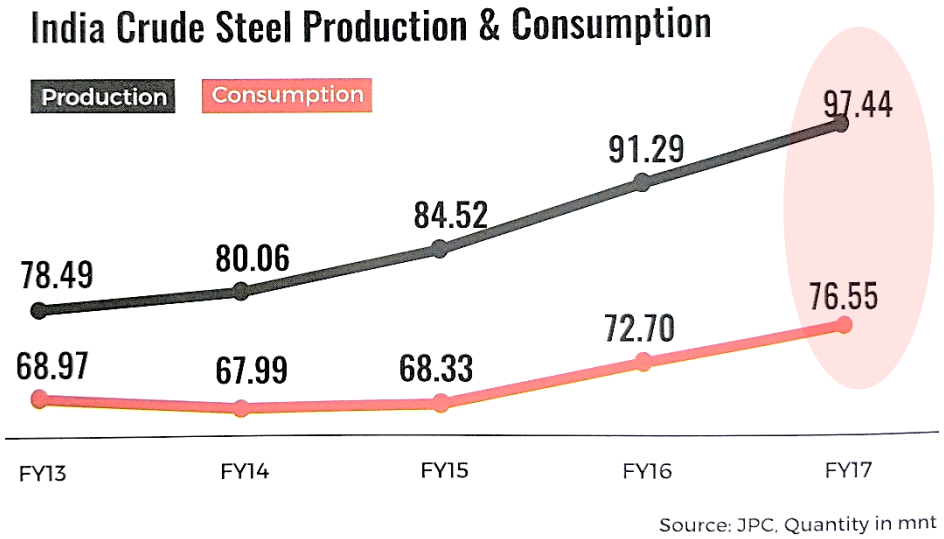


	Australia	Brazil	China	India	S. Africa
1993	121.4	159.4	224.7	56	29.4
2012	525	367	280.8	140	56.8

World Per capita steel Consumption in KG for last decade



India Steel Sector - FY'16-17 Performance



Steel Imports

FY 15-16	FY 16-17
8.72 Mil MT	5.37 Mil MT

Steel Exports

FY 15-16	FY 16-17
3.48 Mil MT	7.59 Mil MT

Highlights :

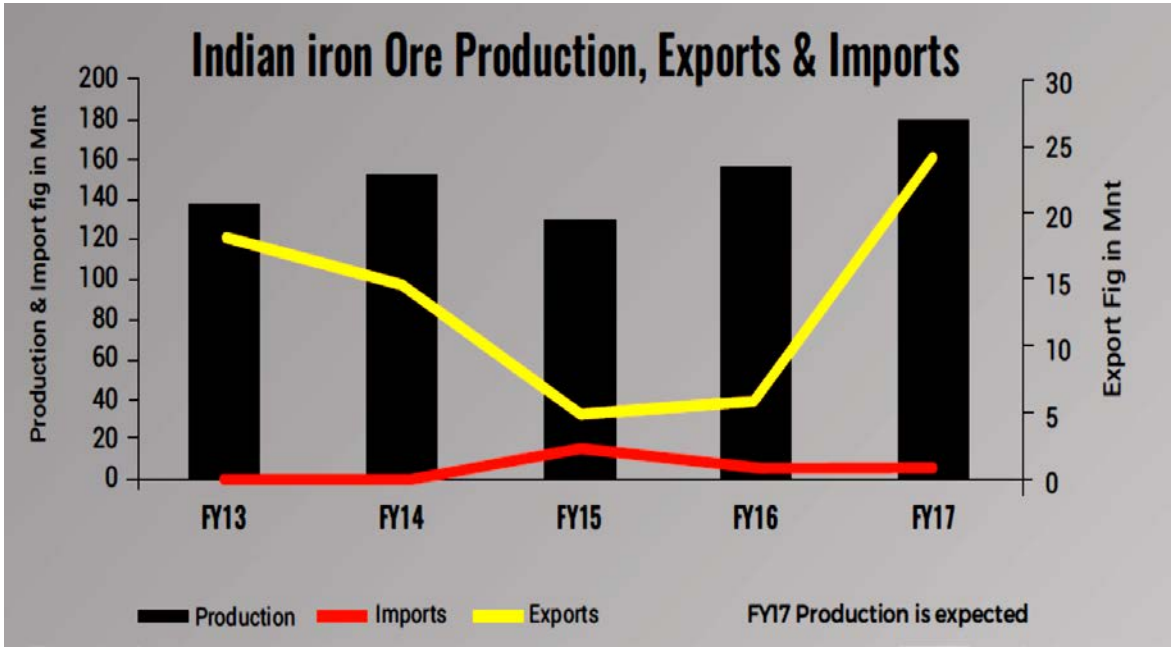
a.6.7% growth in production in FY'17, highest production increase % Y-O-Y in the world. (World average is 0.8% & China average is 1.2%)

b.Implementation of MIP, secured Indian domestic market growth.

c.Made in India initiative - thrust by Govt to use "Swadeshi steel" for PSU's & projects under government improved domestic market.

d.Reduction in imports by 38% and increase in exports by 118%. Net exporter of steel in FY'17.

Indian Iron ore & Pellets – FY'16-17 performance



Iron ore Pellets :

•Pellet production as per 12 Known pellet producers is seen increased by 27% Y-O-Y with capacity utilization going up to 76% in FY'17 than 60% in FY'16.

•Pellet exports recorded at 8.26 MnT in FY'17 against 0.8 MnT in FY16 over increased demand from China.

•Pellet imports stood at 0.34 in FY'17 against 0.16 in FY'16.

Iron Ore :

•190 Mil MT production, 20% increase Y-O-Y. Odisha & Goa states major contributors on account of high exports.

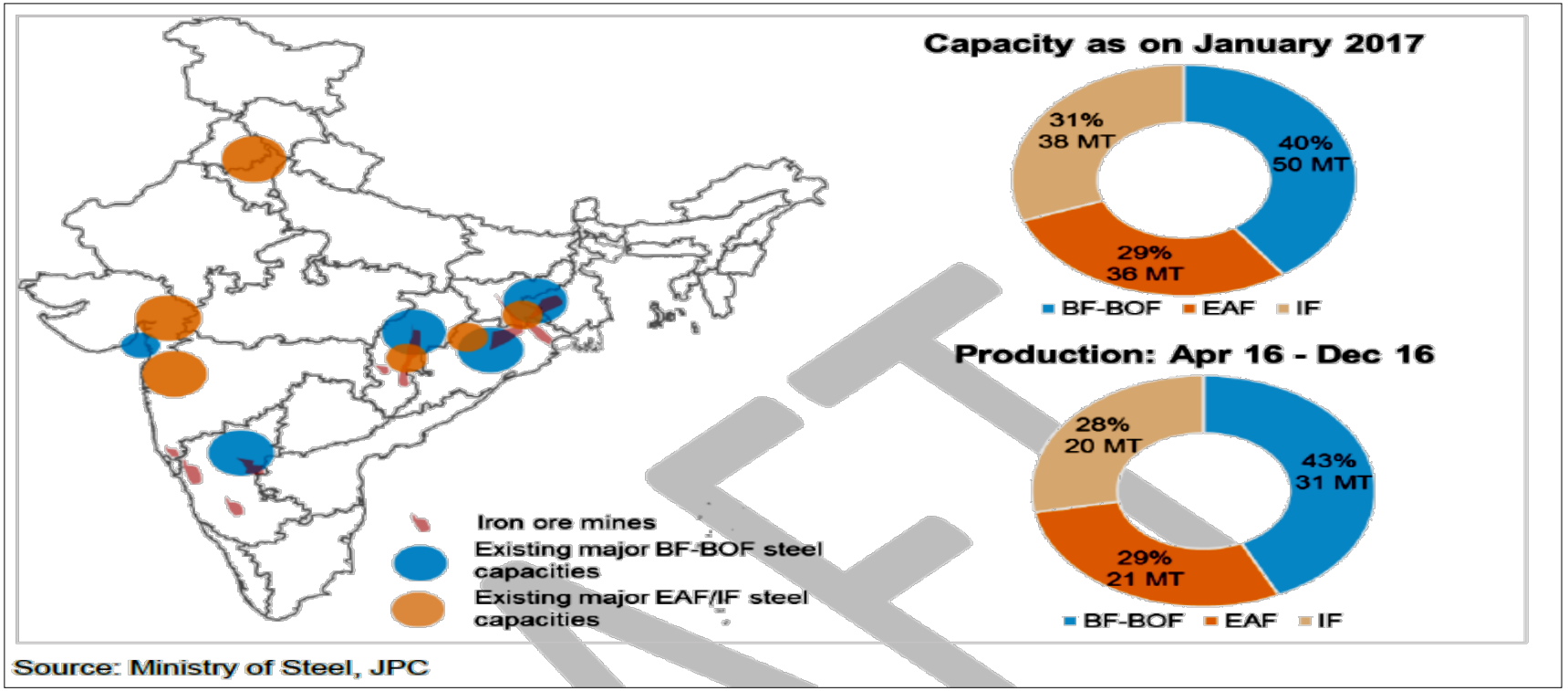
•NMDC- India Largest Iron ore miners increased output by 19% Y-O-Y, at 34.03 Mil MT.

•Iron ore exports jumped 4 folds amid higher global prices recorded at 24.35 Mil MT in FY'17.

•Iron ore imports remained stable at 5.79 MnT in Fy'17 (5.62 MnT in FY16).

•Major imports include fines/concentrate from brazil at 56%, followed by south Africa lumps at 40%.

Steel Hub in the country

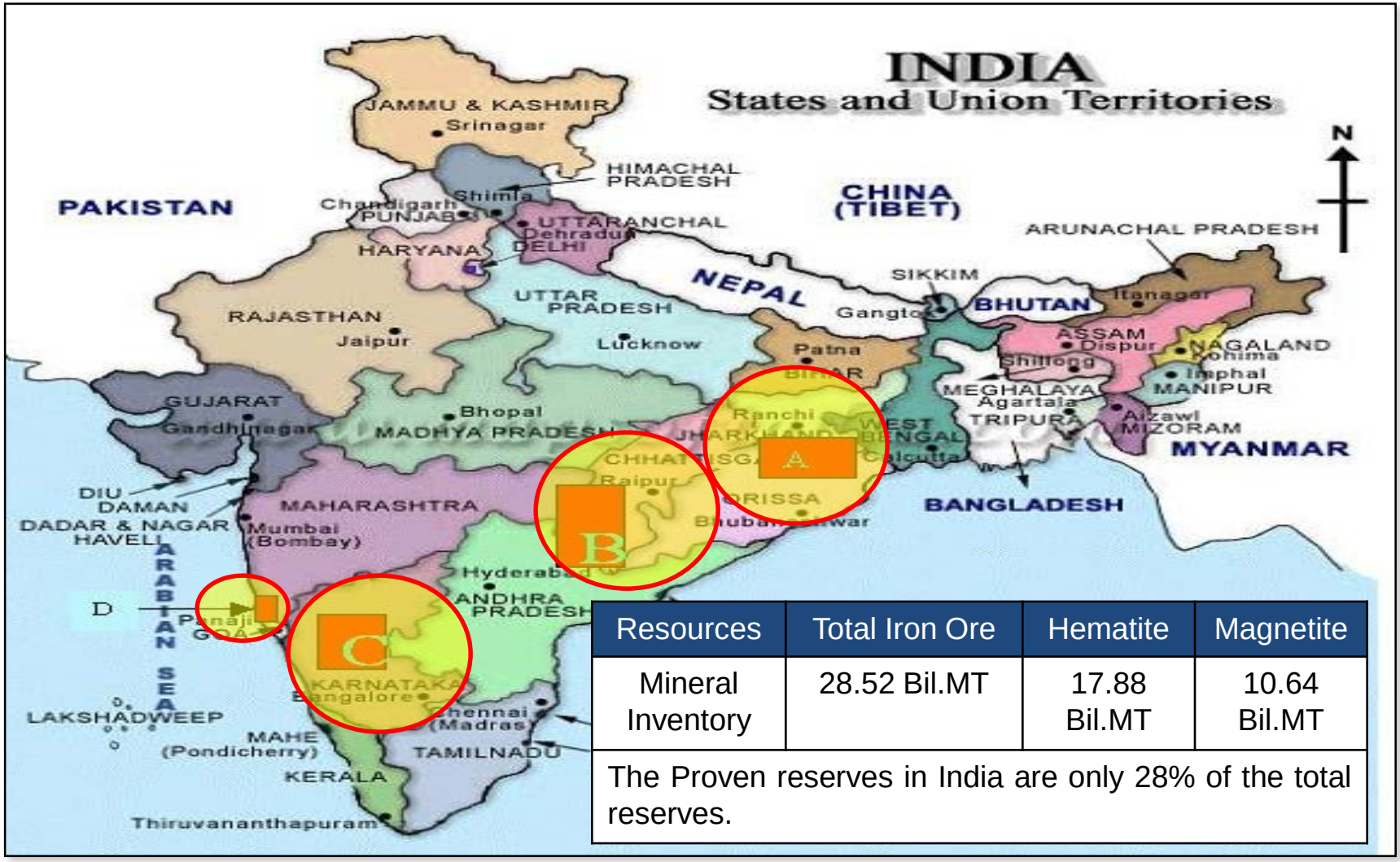


- Steel Capacity is at 122 MTPA with production output at 97.44 MTPA.
- BF capacity is at 50 MTPA ; Coal based DRI is at 29.3 MTPA & Gas based DRI is at 9.6 MTPA.

** Preferred feed stock for the two iron making routes are :

a. BF : Sinter, Pellets & Lumps
b. DRI : Lumps or pellets

India Iron Ore Mining Hubs & Reserves



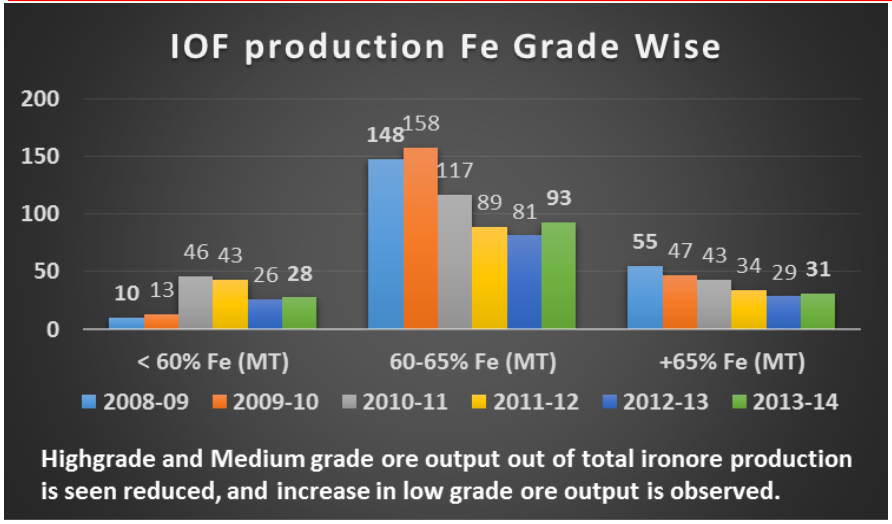
Resources	Total Iron Ore	Hematite	Magnetite
Mineral Inventory	28.52 Bil.MT	17.88 Bil.MT	10.64 Bil.MT

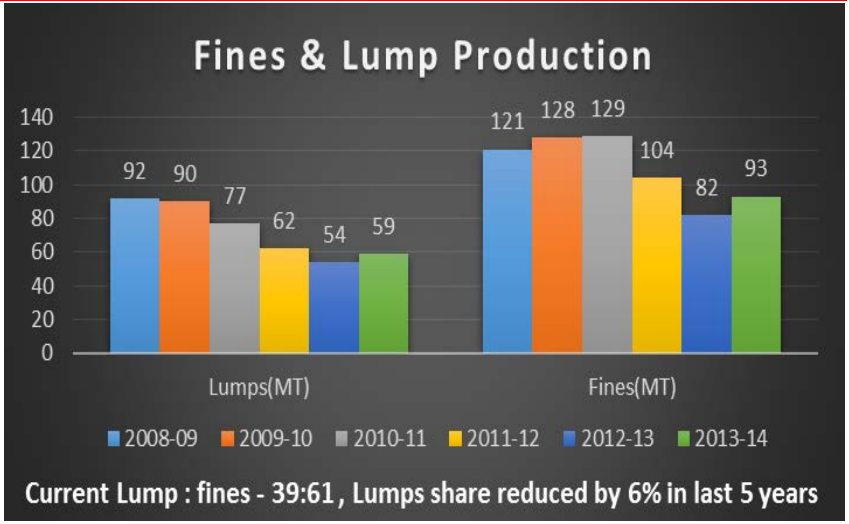
The Proven reserves in India are only 28% of the total reserves.

Ore characterization

Region	Ore Characterization	Focus
A Odisha & Jharkhand	- Hematite is the major mineral with limonite & Goethite. - Lateritic ore with limonites, goethite and ocherous material.	- DR & BF Pellets - Sinter Feed
B Chhattisgarh & MP	- Massive ore of high grade Hematite (64-68%) - Minor amounts of limonite and goethite. - Ore is associated with gangues like quartz, clay etc.	- DR & BF Pellets - Sinter Feed
C Bellary- Hospet in Karnataka	- Hematite is the major minerals - Minor amounts of magnetite, martite, specularite and goethite contents. - Quartz and clay are main impurity.	- BF pellets - Sinter Feed
D Goa & West Maharashtra	- Predominantly blue dust and fines with little lumps. - Goethite/Limonite and clay/Gibbsite occurs with banded ferruginous quartize and ferruginous phyllite.	- Sinter Feed.

IOF Scenario – Statistics





(Source : IBM Mineral Year Books)

- Out of total mineral resource of 28.5 Bil MT, only 12% is high grade iron ore.
- Preferred usage of Higher and medium grade ore will result in only low grade ore for future.
- Depletion in Lumps: fines ratio - **Lumps % decreasing and fines % increasing**.
- On an average 2.5 tonnes of run of mines (ROM) is required to get one tonne of CLO.
- *75% of total country's iron ore prod is fines. (During mining, handling and sizing).*

- ***Iron ore beneficiation and Pelletization are the key to the future of steel industry.***
- ***The same is envisaged in the recently released National Steel Policy -2017 by Govt. Of India***

Global Steel Developments

- Global Steel is witnessing broad based recovery with strengthening of growth momentum, the Chinese economy is expected to moderate in 2018, while the growth in India, ASEAN and developing economies remains on a solid footing buoyed by the structural reforms.

- The World Steel Association Short Range Outlook (SRO) released its April 2018 Short Range Outlook (SRO), which forecasts global steel demand will reach 1,616 million tons in 2018, an increase of 1.8% over 2017. In 2019, it is forecast that global steel demand will grow by 0.7% to reach 1,626.7 million tons.

- The OECD Steel Committee, a global forum of major steel producing nations, whose objective is to support the viability of the steel industry, through various policies, has identified excess capacity as being one of the main challenges facing the global steel sector today.

Global Steel Developments

- China has shuttered most of the Induction Furnaces and eliminated more than 50 million tons of steel capacity in 2017. The steel demand supply matrix is expected to be favourable going forward.

- The global steel industry is besieged with several recent trade remedial protectionist measures initiated across the globe. US has imposed tariffs under Section 232 against steel imports. EU and Turkey have initiated safeguard investigations concerning imports of major steel products.

India – On the Cusp of Strong Growth Momentum

- India remains one of the fastest growing major economies in the world, with sustained reforms and focus on infrastructure, driving positive growth outlook

- As per WSA, steel demand in India is expected to grow at 5.5% and 6% per annum in 2018 and 2019, respectively. The Indian economy is stabilizing from the impact of currency reform and GST implementation and steel demand is expected to accelerate gradually, mainly driven by public investment. Stronger growth is held back by still weak private investment.

- Trade remedial measures initiated by the GoI have curtailed the surge of imports, provided downside price cushions, improvement in demand, leading to better capacity utilization rates, higher realizations and better margins.

- National Steel Policy 2017

  - ✓ To Increase per capita steel consumption to 160 kgs and a crude steel capacity of 300 million tons by 2030-31.

  - ✓ Preference for domestically manufactured iron and steel products in government procurement

India – On the Cusp of Strong Growth Momentum

Parameters	2013-14	2014-15	2015-16	2016-17	2017-18
Crude Steel Production (MT)	81.69	88.98	89.77	97.94	102.33
Crude Steel Capacity (MTPA)	102.26	110.00	116.74	126.00	130.00
Capacity Utilization (%)	80%	81%	77%	78%	79%
	Total Finished Steel				
Production for Sale (MT)	87.67	92.16	90.39	101.80	104.97
Real Consumption (MT)	74.09	76.99	80.45	84.04	90.68
Import (MT)	5.45	9.32	11.71	7.22	7.48
Export (MT)	5.98	5.59	4.07	8.24	9.62

Source : Ministry of Steel-Annual Report , JPC

NATIONAL STEEL POLICY 2017

VISION TO TRIPLE STEEL CAPACITY TO 300 MILLION TONS BY 2030

- Questions to the Industries –

- Can we stay away with making steel
- What can be the alternate to Steel
- What can be the alternate to Coal
- Can this be usages of Different Iron Making Route
- How feasible and cost economic and can this be in large scale

- Answers :
- We can not do away with Steel
- No alternate to steel, but can be in small percentage while current steel demand is 1650 Mio tons world wide
- Yes , DRI / Scrap Route (Gas based DRI/ Scrap Route) – but this also can not be in large scale
- Cost economics for alternate route are higher as this is again linked to crude prices.
- So lastly we need to Have Coal to Steel.

ESSAR

Every achievement is not an end,
but the beginning of a new journey.

let's begin

Thank You