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Ore-Based Metallics: Overview

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- Ore-Based Metallics
- USA - Shale Gas Impact
- Summary

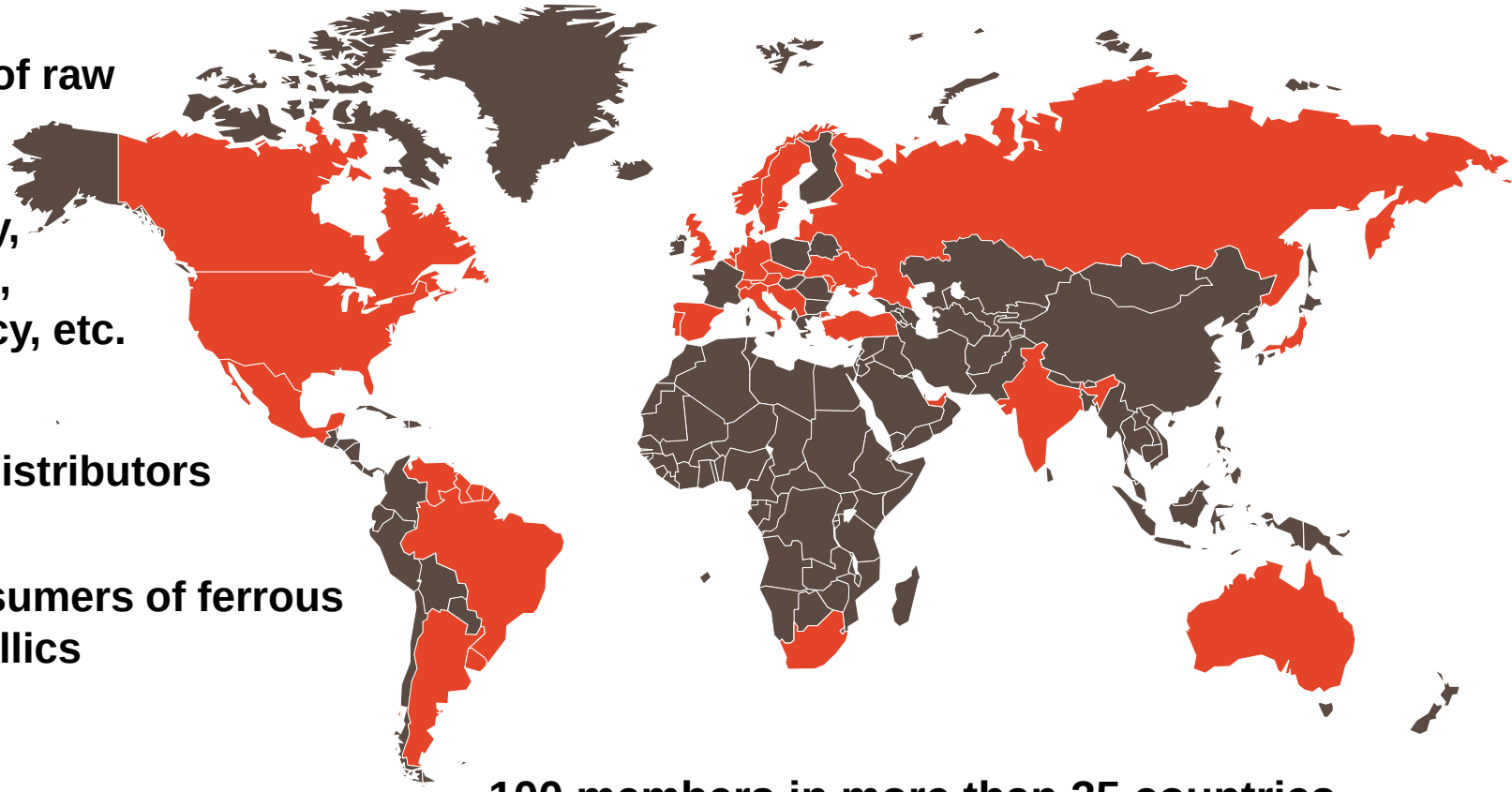
IIMA - Who We Are

Producers of Merchant Pig Iron (MPI), Hot Briquetted Iron (HBI), Direct Reduced Iron (DRI) and Iron Nuggets

Suppliers of raw materials, logistics, technology, equipment, consultancy, etc.

Traders/Distributors

Consumers of ferrous metallics



100 members in more than 35 countries

Ore-Based Metallics

Steel Production
Metallics Sources

- Metallic Source
  - Scrap
    - New
      - Home
      - Prompt
    - Obsolete
  - Iron Ore
    - Reduction Proccess
    - BF / RH


DRI


HBI


Pig Iron


Iron nuggets

What Ore-Based Metallics Are Not

OBMs are <u>not</u>

SCRAP SUBSTITUTES

What Are Ore-Based Metallics?

- DRI, HBI, iron nuggets & pig iron are ore-based metallics (OBMs), which are manufactured from iron ore
- OBMs are best used as **SCRAP SUPPLEMENTS** to dilute impurities in ferrous scrap in EAF steelmaking
- OBMS are **PRODUCTIVITY ENHANCERS** in BF ironmaking and BOF steelmaking

DRI

HBI

Iron Nuggets

Pig Iron

Merchant HBI/DRI Sources

Russia	Capacity (HBI MMT)
Lebedinsky GOK	2.3

Libya	Capacity (MMT)
Lisco	0.65 (HBI)
	1.1 (DRI)
Total	1.75

India	Capacity (MMT)
Welspun Maxsteel	0.9 (HBI/DRI)

Venezuela	Capacity (HBI MMT)
Comsigua	1.3
Briqven(Matesi)	1.5
Venprecar	0.9
CVG FMO	1.0
Orinoco Iron	2.2
Total	6.9

Qatar	Capacity (MMT)
Qatar Steel	1.5 (HBI/DRI)

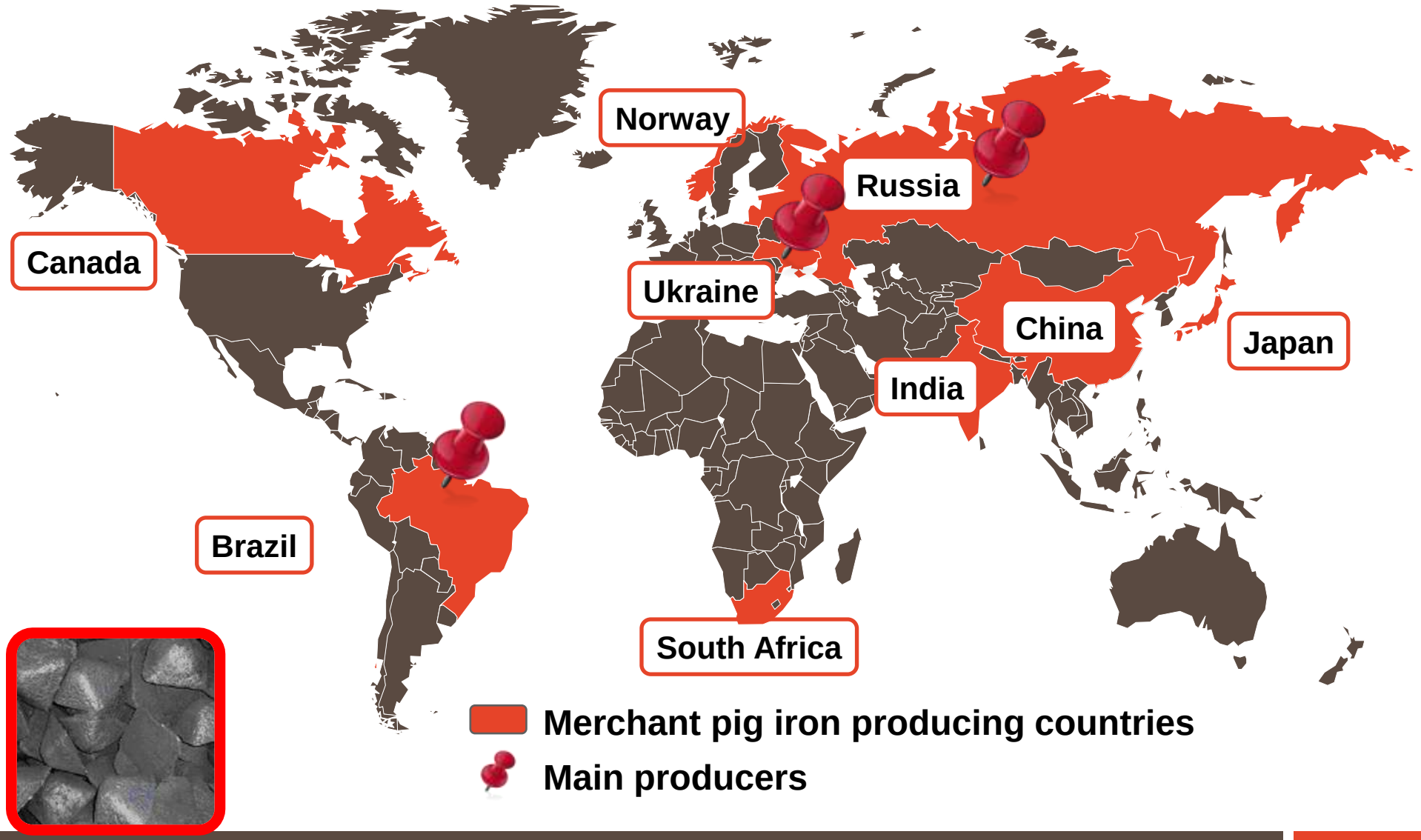
Malaysia	Capacity (MMT)
Antara Steel	0.9 (HBI)
Lion DRI	1.54 (HBI/DRI)
Total	2.44

Oman	Capacity (MMT)
Shadeed	1.5 (HBI/DRI)

Total: 17.29 MMT

Merchant HBI/DRI Sources

Merchant Pig Iron Sources



Merchant Pig Iron Sources

State	Furnaces (N°)	Capacity (MMT)
Maranhão	22	2.7
Pará	21	2.8
North System	43	5.5
Minas Gerais	106	8.5
Espirito Santo	8	0.8
Mato Grosso S.	6	0.8
South System	120	10.1
Total	163	15.6

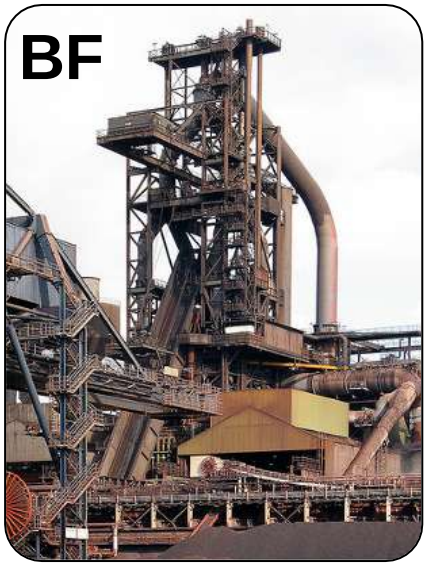
Main producers

Merchant Pig Iron Sources

Place	Capacity/ Shipments (MMT)
Tulachermet	3.0
Kosaya Gora	0.7
Chusovskoy	0.6
Ural Steel	0.5
NMLK Lipetsk	0.5
Svobodny Sokol	0.8
Russia	6.1
Donetsksteel	0.6
Ukraine	0.6

Main producers

Where OBMs Are Used



Cupola Furnace

Ladle Metallurgy

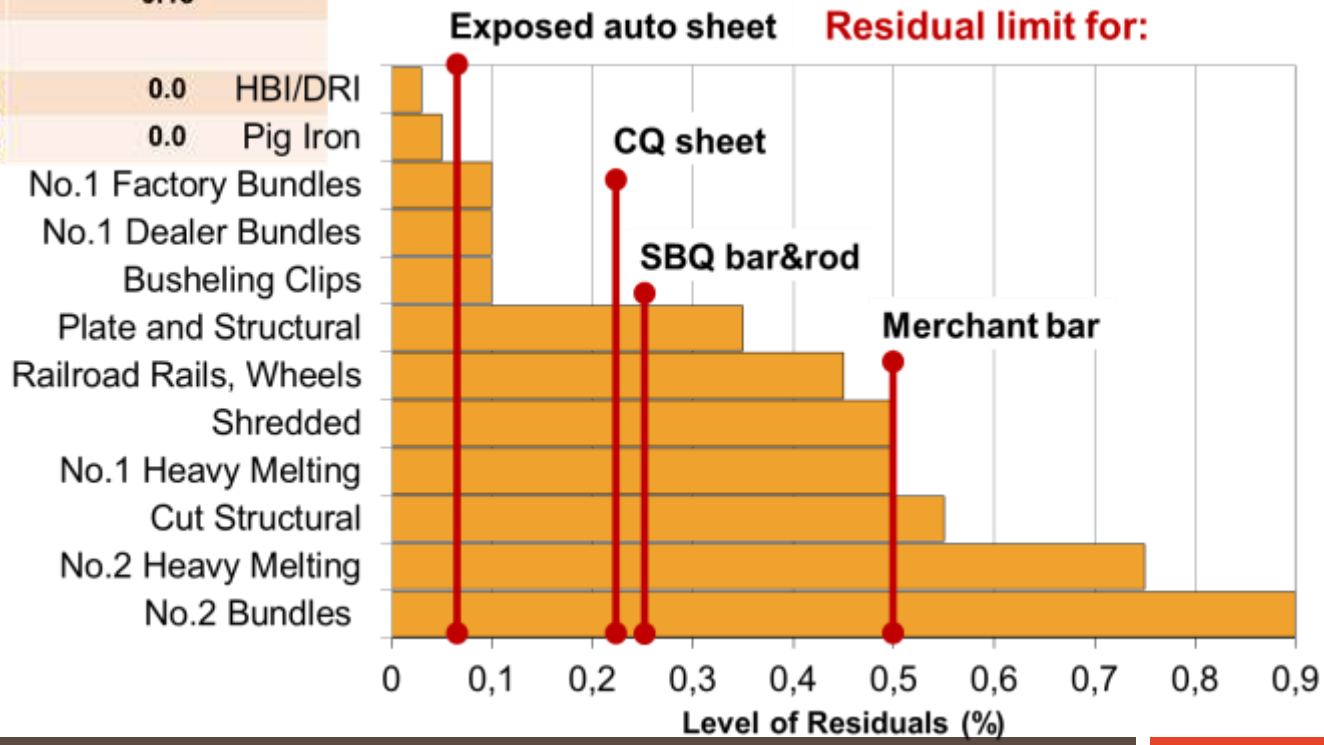
Benefits of OBMs

- **Consistent quality and low residual content**
- **Controlled C content, consistent C recovery**
- **Predictable mass and heat balances**
- **Continuous feeding and high density feedstock**
- **Application flexibility** ***(Reduces coke rate, Metallic yield similar to hot metal)***
- **Dilutes impurities in scrap**
- **Better slag foaming**
- **Easier on hearth refractory & electrodes**
- **Year-round production**
- **Attractive cost structure**
- **Lower copper content** ***(next slide)***

Steel Grade Specifications & Metallic Feed Quality

Metallics Type	Cu Content	Value Used
#1 Dealer Bundles	0.1	0.1
Bushelling	0.08 - 0.1	0.8
#1 HMS	0.25 - 0.35	0.3
#2 HMS	0.4 - 0.6	0.5
#1 Shredded	0.15 - 0.2	0.17
#2 Shredded	0.25	0.25
P&S	0.12 - 0.2	0.15
OBM Types		
HBI/DRI	0.002 (depends on ore)	0.0
Pig Iron	0.002 (depends on ore)	0.0

The inherent cost of a point (0.01 weight %) of copper in the scrap has been determined to be approx.$2.00



Charging Mix is Determined by Product Quality Requirements

USA – Shale Gas Impact

Shale Gas Will Fuel a U.S. Manufacturing Boom

Chemical producers abandoned the U.S. in droves. Cheap natural gas is luring them back. **MIT Technology Review, January 9th 2013**

By Kevin Bullis on January 9, 2013

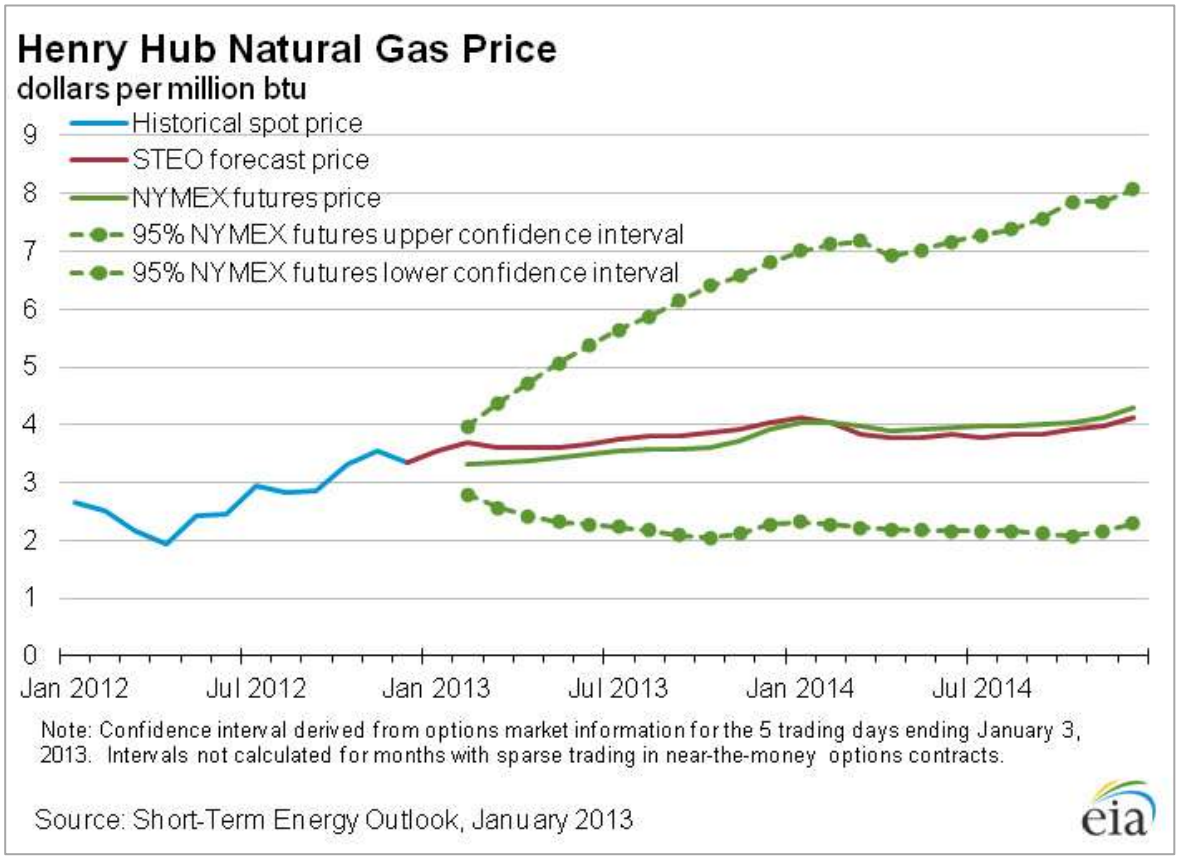
People predicting a manufacturing renaissance in the United States usually imagine whirring robots or advanced factories turning out wind turbines and solar panels. The real American edge might be in something entirely more mundane: cheap starting materials for plastic bottles and plastic bags.

The plummeting price of natural gas, which can be used to make a vast number of products, including tires, carpet, antifreeze, lubricants, cloth, and many types of plastic, is luring key industries to the United States. Just five years ago, natural gas prices were so high that some chemicals manufacturers were shutting down operations here. Now the ability to access natural gas trapped in shale rock formations, using technologies such as hydraulic fracturing and horizontal drilling, has led to a surge in natural gas supplies that have lowered American gas prices to a fraction of prices in other countries (see "King Natural Gas").

USA – Shale Gas Impact

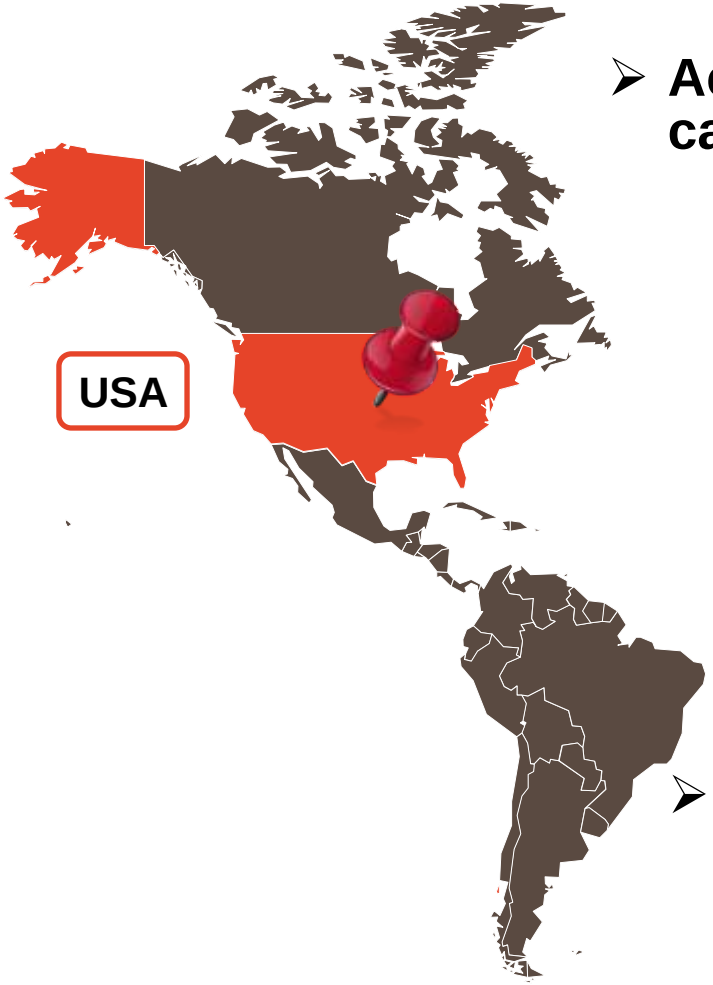
Opportunities for steelmaking:

- For EAF steelmakers, higher share of electricity from natural gas
- Scope for shift in auxiliary BF fuel [typically 150-200 kg/tonne hot metal] towards natural gas
- Indirect use of natural gas in the BF through use of DRI/HBI as charge material to boost productivity



- Futures contracts enable lock-in of forward gas prices - underpins viability of investment in DR capacity

USA – DRI/HBI Plants



- **Actual: Nucor Louisiana plant - 2.5 mtpy capacity, due to start up in mid-2013**
- **Projects: potential second and third modules at Nucor's Louisiana plant**
- **Projects: 6-10 companies are actively considering DR plants in North America, some very seriously, with a couple of contracts possible in 6-12 months**
- **US Steel, Severstal, Northstar BlueScope and ESSAR North America have received press mention**
- **VoestAlpine Stahl has announced the decision to build an HBI plant in the USA**

Problem or Opportunity For Merchant Scrap Supplements?

- **Increased production of DRI in the USA can have a significant impact on the metallics supply chain, but is this a problem or an opportunity for merchant suppliers?**
  - **Some offshore HBI and pig iron supply to the US market may well have to seek alternative markets for displaced US imports**
  - **But there is scope for increased demand for scrap supplements from steel mills without captive supply and from increased steel production resulting from the development of shale gas**
- **In any case, offshore suppliers of pig iron offer the US steel and metal casting industries a useful hedge against higher gas prices.**

Summary

- **OBM Capacity**
  - **Significant excess Pig Iron capacity in Brazil**
  - **Ample latent HBI capacity in Venezuela**
  - **Russia adding 1.8 MMTY of HBI capacity**
- **Perception of HBI value in use**
- **Offshore HBI and Pig Iron Producers will remain as a supply source for the US, European Market & Asian markets**
- **Lack of residual copper in OBM feed stocks for the EAF does demonstrate an intrinsic value**
- **Steelmakers should look for opportunities to blend lower grade scrap with OBM to achieve the lowest cost/MT of liquid steel.**
- **Shale gas and low gas prices should boost US manufacturing and increase steel demand.**

Cont..

Summary

- **Lower gas prices offer the US steel industry, both the BF/BOF and EAF sectors, the opportunity to reduce costs and increase competitiveness**
- **There seems to be every prospect that the third wave of direct reduction plants in North America is upon us - the big differentiator from the past being the ability to lock in long term gas prices**
- **There seems to be significant scope for rationalization of the various projects to ensure maximum efficiency and cost effectiveness across the industry**
- **OBMs are Not Scrap Substitutes**

Thank you for your attention

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Attachments

Direct Reduced Iron (DRI)

DRI

HBI

Iron Nuggets

Pig Iron

Chemical Characteristics (ranges % by wt.) Based on 65.5-68% Fe iron ore	
Metallization	94.0%
Fe (Total)	86.1-93.5%
Fe (Metallic)	81.0-87.9%
C	1.0-4.0%
S	0.001-0.03%
P_2O_5	0.005-0.09%
Gangue*	3.9-8.4%
Mn, Cu, Ni, Cr, Mo, Sn, Pb, Zn	Traces
Size	4.0-20.0 mm
Apparent Density	3.4 – 3.6 t/m^3
Bulk Density	1.6 – 1.9 t/m^3

**minus S, P_2O_5 & trace elements*

Hot Briquetted Iron (HBI)

DRI

HBI

Iron Nuggets

Pig Iron

Chemical Characteristics (ranges % by wt.) Based on 65.5-68% Fe iron ore	
Metallization	94.0%
Fe (Total)	88.3-94.0%
Fe (Metallic)	83.0-88.4%
C	0.5-1.6%
S	0.001-0.03%
P_2O_5	0.005-0.09%
Gangue*	3.9-8.6%
Mn, Cu, Ni, Cr, Mo, Sn, Pb, Zn	Traces
Size	30 x 50 x 110 mm
Apparent Density	5.0 – 5.5 t/m^3
Bulk Density	2.5 – 3.3 t/m^3

**minus S, P_2O_5 & trace elements*

Iron Nuggets

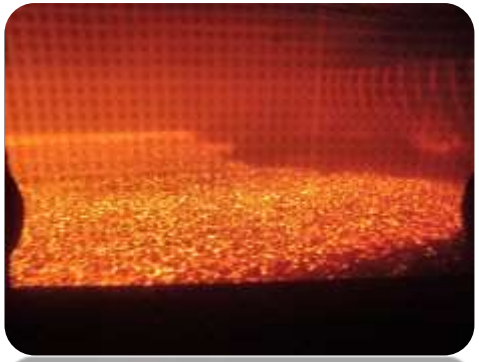
DRI

HBI

Iron Nuggets

Pig Iron

Chemical Characteristics (ranges % by wt.)	
Metallic iron	97.0 %
Carbon	2.5 - 3.0%
S	< 0.1%
Si, Mn, O	Depends on Ore
Size	80% 6 - 16 mm



SDI Steel Dynamics, Inc.

Mesabi Nugget

0.5 MMT plant started up in 2010; nuggets used in SDI melt shops

Hoyt Lakes, Minnesota

Pig Iron

DRI

HBI

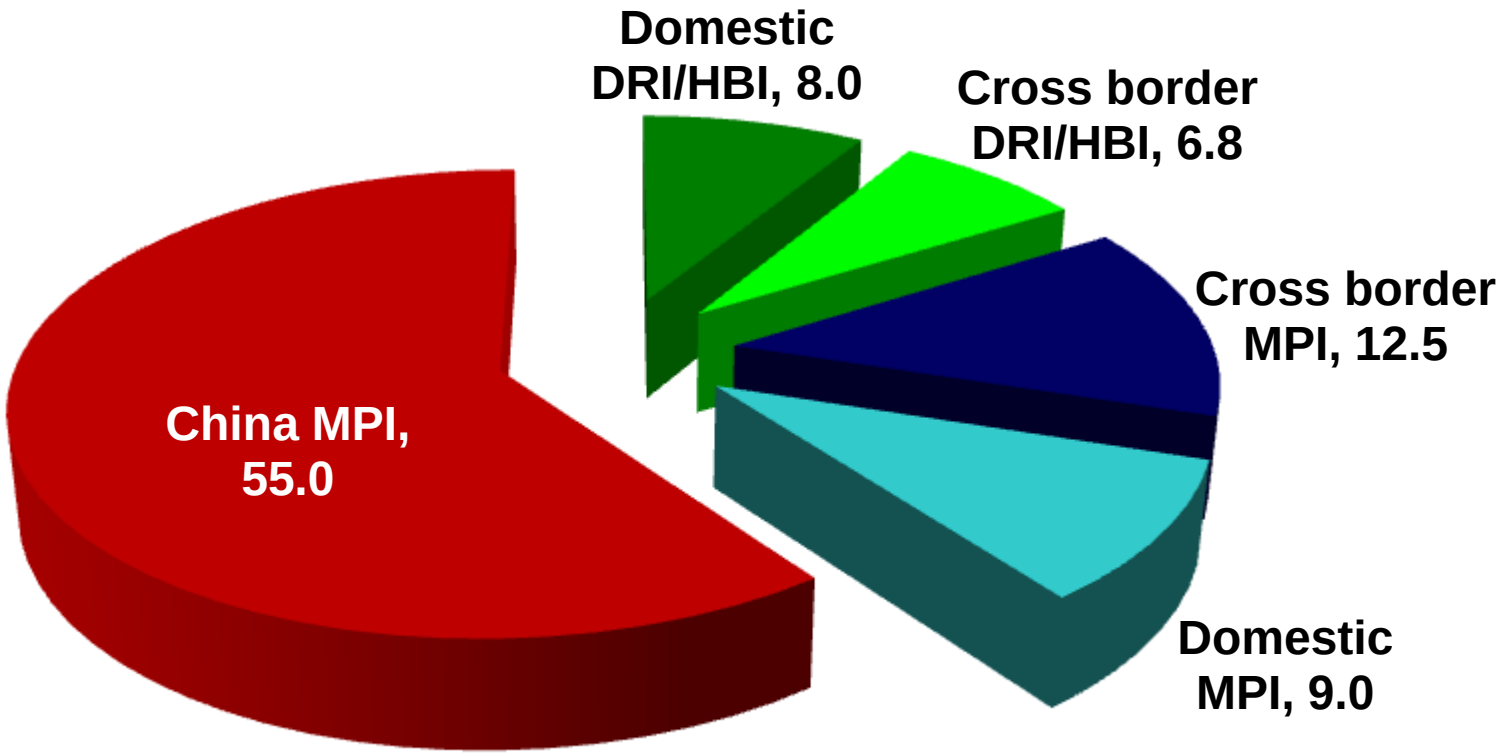
Iron Nuggets

Pig Iron

Chemical Characteristics (ranges % by wt.)			
	Basic	**Foundry**	**Nodular**
Fe	94.0 - 95.0%	94.0 - 95.0%	94.0 - 95.0%
C	3.5 - 4.5 %	3.5 - 4.5 %	3.5 - 4.5 %
Si	< 1.5 %	1.5 - 3.5 %	0.05 - 2.0 %
Mn	0.5 - 1.0 %	0.5 - 1.0 %	< 0.05 %
S	< 0.05 %	< 0.05 %	0.01 %
P	< 0.12 %	< 0.12 %	< 0.02 %
Ingot Weight	3.5 - 45.0 kg	3.5 - 45.0 kg	3.5 - 45.0 kg
Bulk Density	3.7 t/m^3	3.7 t/m^3	3.7 t/m^3

Real: Metallics Trade 2011

Units: MMT



Estimates for cross border trade 2012:
Pig iron - 12 mt
DRI/HBI - 8.6 mt

Source: IIMA