The Permanent Magnet Market - 2015

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The Permanent Magnet Market Will Continue to Grow

- **After a potential 2013-2014 economic correction, PM demand will continue to increase**
- **Today's drivers will be tomorrow's drivers**
  - **Automotive (including electric and hybrid)**
  - **Consumer Electronics**
  - **Appliances & HVAC**
  - **Electric Bicycles**
  - **Wind Turbines (?)**

The *NdFeB* Permanent Magnet Market Will Continue to Grow

Metric Tons x 1,000

Production by Country/Region	2012	2015
China	**50**	65
Europe	1	1
Japan	10	8
USA	0	2
All Other	2	2
Total	**63**	**78**

Source: "Permanent Magnets 2010-2020"

Caution: Accurate Chinese NdFeB Production Statistics are Elusive!

- **Previous chart (2012) – 50,000 Tons**
- **A recent "company-by-company" build-up suggests the reality of current Chinese NdFeB production may be closer to *80,000* Tons**

China's RE Magnet Exports are Recovering From the 2009 "Hit"

- **RE magnet exports reportedly dropped to 9,400 tons in 2009**
- **RE PM exports rebounded to 16,400 tons in 2011 (2013 "official allocation": 15,500 tons)**
- **But: Record year was 2007 – 21,500 tons!**
  - **Source: The Chinese Society of Rare Earths**

Will New REO Supplies Meet 2015 Magnet Market Requirements?

- **DOE estimates 17,000 additional tons of Pr + Nd oxide by 2015** **("Critical Materials Strategy" Dec 2011)**
- **This would translate to approximately 28,000 Tons of NdFeB Magnets** **(Stan Trout, Molycorp – Dec 2012)**
- **28,000 Tons of NdFeB magnets would represent an increase of 30-40% of total 2012 estimated production** **(Equivalent to 10-12% increase/Yr.)**

No Major Shift in RE Prices is Expected

- **Increases in Western and Chinese REO production will represent a supply “relief valve”**
- **Much of the new (Western) REO production will end up in China and Japan**
  - **Neodymium price should be relatively stable**
  - **Dysprosium will continue to be “dear”**

Continued Dysprosium Shortages Will Impact Design Decisions

- **Some motors and systems will be designed for lower operating temperature**
- **Alternate materials (and system designs) will continue to be adopted**
- **Lower Dysprosium usage will be a necessity – there simply won't be enough.**
- ***Industry will design around this issue!***

We will not Have “The New Holy Grail” Permanent Magnet Material in 2015

- **Anisotropic Bonded NdFeB**
- **Sintered Sm-Fe-N**
- **Iron-Nitride PMs**
- **Modified Fe-Ni Alloys**
- **Nano-structured NdFeB**
- **High Temperature SmCo**
- **Correlated Magnetization of PMs**
- **Diffused Dy NdFeB PMs**

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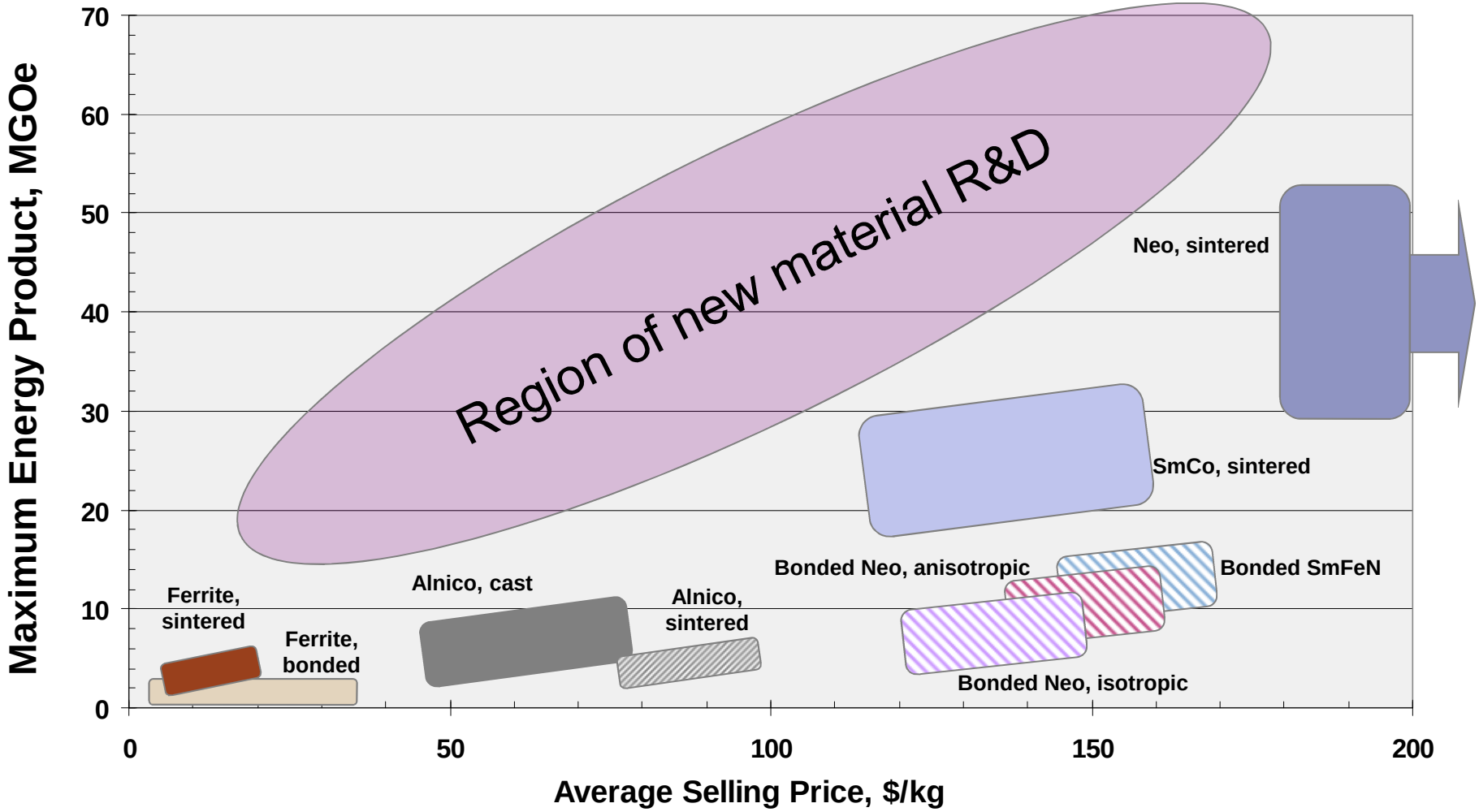
Magnet Price versus Energy Product



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Recycling Permanent Magnets Will Not be “The Answer”

- **Individual magnet producers will continue to implement “selective” in-house recycling**
- **Generic magnet (REO)recovery from motors and electronic devices will be limited by economic feasibility**

China Will Continue to be "The Big Dog"

- **Chinese NdFeB magnet production capacity will continue to increase**
- **At least 80% of global NdFeB magnet production will be in China in 2015**
- ***China will continue to be the low cost producer***

The Outcome of Hitachi's Current Initiative to Manage "Licensed Production" is Yet to be Determined

- **We're approaching the 30th year anniversary of the invention of NdFeB**
- **Hitachi's 2012 ITC appeal may not be resolved for some time**
- **Certain Hitachi patents may be challenged**
- **Landscape of "Hitachi Licensees" may change**
- ***Benecki guess: "50-50" chance of definitive resolution by 2015***

Summary

- **2015 is likely to be a year of attractive growth for the magnet industry**
- **Two new NdFeB production facilities outside China**
  - **(Hitachi Metals – US)**
  - **Molycorp/Mitsubishi/Daido JV – Japan)**
- **2015 REO supplies should meet overall magnet industry demand**
- **Magnet users will “design around” the Dysprosium issue:**
- ***Bottom line: Dramatic change in the RE magnet supply chain is unlikely***

Thank You!