

MUCH ADO ABOUT RARE EARTH TAXES: WHAT YOU NEED TO KNOW ABOUT ONGOING CHANGES IN CHINA

Adamas Intelligence: Critical Metals and Minerals Research

Herein, we examine the cost structures of two rare earth element concentrate producers in China to gain an understanding of how resource taxes have historically impacted production costs and REO prices in the nation, and to examine how changes to China's rare earth resource tax regime will impact these cost structures, and ultimately REO prices going forward.

This briefing builds on research and analysis presented in a 573-page report published by Adamas Intelligence in October 2014, titled "Rare Earth Market Outlook: Supply, Demand, and Pricing from 2014 – 2020", and precludes our upcoming release of a 'Rare Earth Market Outlook Update' in June 2015.

Our upcoming 'Rare Earth Market Outlook Update' will expand further on the implications of rare earth resource tax reform currently underway in China, with specific coverage of other production regions not analyzed herein. The impending update will also provide updated forecasts of rare earth supply, demand, and pricing for the period spanning 2014 through 2020. You can find more information about the aforementioned report and upcoming 'Rare Earth Market Outlook Update' at the end of this briefing.

Essential reading for:

- Informed investors and financiers
- Technology, material, and chemical developers
- Exploration and mineral development companies
- Government agencies and advisory boards
- NGOs and global think-tanks
- Research organizations
- Advisory firms

Lead Analyst:

Ryan Castilloux
Founding Director / Industry Analyst

rcastilloux@adamasintel.com
+1 347-708-0054

www.adamasintel.com

Introduction:

This briefing builds on research and analysis contained in a major report published by Adamas Intelligence in October 2014, titled "[Rare Earth Market Outlook: Supply, Demand, and Pricing from 2014 – 2020](#)", and precludes our upcoming release of a 'Rare Earth Market Outlook *Update*' in June 2015.

The upcoming market outlook update will expand further on the implications of rare earth resource tax reform currently underway in China, and will detail updated forecasts of rare earth supply, demand, and pricing for the period spanning 2014 through 2020. You can find more information about the aforementioned report and our upcoming market outlook update at the end of this briefing.

Herein, we examine the cost structures of two REE concentrate producers that mine and process China's ion adsorption clay deposits to gain an understanding of how resource taxes have historically impacted production costs and REO prices in China, and to enable an understanding of how changes to China's tax regime will impact these cost structures, and ultimately impact REO prices.

This briefing is not an analysis of every material fact or variable affecting costs, pricing, taxes, or other aspects discussed herein, and is provided for informational purposes with no assurances regarding the accuracy, reliability, completeness, or currency of information contained. This briefing has been prepared in good faith on the basis of information available up to the date of publication. Readers are responsible for assessing the relevance and accuracy of the contents of this publication.

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Key Takeaways:

- Tax changes in China's south could lift prices of certain REEs by up to 20% to 30%.
- Dy, Tb, Nd, Pr, and Gd will absorb the lion's share of the gains; Ce, La, and Y prices likely to hold.
- The current cost to mine and produce an HREO concentrate (>90% TREO) in China is between \$16.00 and \$22.00/kg TREO, including a profit margin.
- The current cost to separate and refine REOs from an IAC-derived REE concentrate in China is between \$5.00 and \$6.00/kg TREO, including a profit margin.
- Most Chinese REE producers are marginally profitable at current prices, if at all, presenting an additional catalyst for higher prices going forward.

As anyone reading is almost certainly aware, China eliminated export tariffs on rare earth compounds, chemicals, oxides, metals, and other materials on May 1, 2015, in response to a WTO ruling against such measures in early 2014. As shown in Figure 1 below, the export tariffs applied prior to May 1, 2015 amounted to 15% to 25% of the domestic price of the material in China, and as such, the elimination of these tariffs has resulted in a 15% to 25% decrease in Chinese FOB prices of rare earths. Simply put, Chinese FOB REO prices have converged on Chinese domestic prices, or are converging on them presently.

Figure 1: Evolution of China’s export tariffs on various REE products from 2008 to 2015

Export Tariff	2008	Pre- May 1, 2015
15%	Neodymium metal, neodymium oxide, cerium oxide, cerium hydride, cerium carbonate, other cerium compounds, lanthanum oxide, other rare earth oxides, rare earth metal ore, mixed rare earth chloride, unmixed rare earth chloride, rare earth fluoride, lanthanum carbonate, mixed rare earth carbonate, unmixed rare earth carbonate.	Rare earths minerals, cerium oxide, cerium hydrate, cerium carbonate, other compounds of cerium, lanthanum oxide, neodymium oxide, other rare earths oxide, non-mixed rare neodymium fluoride, praseodymium fluoride, yttrium fluoride, other rare earths fluoride, lanthanum earths chloride, chloride of mixed rare earths, terbium fluoride, carbonate of mixed rare earths, carbonate of non-mixed rare earths, praseodymium chloride, yttrium chloride, neodymium carbonate, praseodymium carbonate, yttrium carbonate.
20%	Not applicable	NdFeB strip-casting permanent magnet flake, other NdFeB alloys, other ferro alloys.
25%	Dysprosium metal, terbium metal, other unmixed or fused rare earth metals, battery mixed or fused rare earth metal, mixed or fused rare earth metal, scandium metal, yttrium metal, yttrium oxide, europium oxide, dysprosium oxide, terbium oxide, terbium chloride, dysprosium chloride, terbium carbonate, dysprosium carbonate, rare earth metal, other yttrium and scandium compounds.	Neodymium metal, dysprosium metal, terbium metal, lanthanum metal, cerium metal, praseodymium metal, yttrium metal, non-mixed or non-fused rare earths metal, mixed or fused rare earth metals, other mixed or fused rare earths metals, yttrium oxide, europium oxide, dysprosium oxide, terbium oxide, praseodymium oxide, terbium chloride, dysprosium chloride, lanthanum chloride, neodymium chloride, terbium carbonate, dysprosium carbonate, other rare earths metals, other compounds of yttrium and scandium, other lanthanum compounds, other neodymium compounds, other terbium compounds, other dysprosium compounds, other praseodymium compounds, other yttrium compounds, ferro alloys containing more than 10 wt. % rare earths elements.

Source: Adamas Intelligence report, “Rare Earth Market Outlook (2014)”

Concurrent with the elimination of export tariffs, China also recently announced changes to the industry’s resource tax regime from a volume based tax to a value based tax.

Prior to May 1, 2015, miners in China paid a tax based on the amount of ore mined to produce a unit of saleable REE concentrate. Miners of ion-adsorption clays (IACs) and xenotime paid 30 RMB (\$4.80) per tonne of ore mined, and miners of bastnaesite and monazite paid 60 RMB (\$9.60) per tonne of ore mined (see Figure 2).

Figure 2: Resource tax applied to HREE concentrate produced in China prior to May 1, 2015

Typical Chinese IAC	Metric	
Mine Head Grade (wt. % TREO)	0.20%	
TREO Recovery	70.0%	
Tonnes of Run of Mill / Tonne TREO Produced	714	
Resource Tax / Tonne Run of Mill	¥ 30.00	\$ 4.80
Resource Tax / kg TREO Produced	¥ 21.43	\$ 3.43

Source: Adamas Intelligence

As such, the tax levied from each producer prior to May 1, 2015, was a function of each producer’s head grade (wt. % TREO) and TREO recovery rate through production to a saleable concentrate (see Figure 3). This method of taxation was effective in two ways. First, it forced miners to make efficient use of resources through recovery of as much REE as possible from every tonne of ROM leached. Second, it dissuaded miners from exploiting low grade resources, which inherently result in operations with significantly larger footprints, environmentally speaking.

Figure 3: Resource tax on HREE concentrates in China as a product of head grade and recovery rate

		Head Grade (wt. % TREO)					
		0.05%	0.10%	0.15%	0.20%	0.25%	0.30%
TREO Recovery	80%	\$ 12.00	\$ 6.00	\$ 4.00	\$ 3.00	\$ 2.40	\$ 2.00
	75%	\$ 12.80	\$ 6.40	\$ 4.27	\$ 3.20	\$ 2.56	\$ 2.13
	70%	\$ 13.71	\$ 6.86	\$ 4.57	\$ 3.43	\$ 2.74	\$ 2.29
	65%	\$ 14.77	\$ 7.38	\$ 4.92	\$ 3.69	\$ 2.95	\$ 2.46
	55%	\$ 17.45	\$ 8.73	\$ 5.82	\$ 4.36	\$ 3.49	\$ 2.91
	45%	\$ 21.33	\$ 10.67	\$ 7.11	\$ 5.33	\$ 4.27	\$ 3.56
Resource Tax (\$/kg TREO Produced)							

Source: Adamas Intelligence

Where the old resource tax failed, however, was its inability to recognize that not all REE concentrates produced from a specific type of host (i.e. ion-adsorption clay) bear the same relative distributions of REEs thus are intrinsically different in value. As a result, producers of concentrates that differed significantly in market value were bearing the same tax burden (see Figure 4), while others with nearly-identical concentrates were paying significantly different tax amounts, thus would seek to sell their respective concentrates at considerably different prices, fueling volatility in the market, and causing confusion among participants.

Figure 4: Resource tax paid by producers in Longnan and Xunwu versus respective concentrate prices

	Longnan High Y-Dy Concentrate (92 wt. % TREO)	Xunwu High La-Nd Concentrate (92 wt. % TREO)
Resource Tax	\$3.43/kg TREO	\$3.43/kg TREO
Concentrate Price (includes 17% VAT)	\$29.57/kg TREO	\$22.61/kg TREO

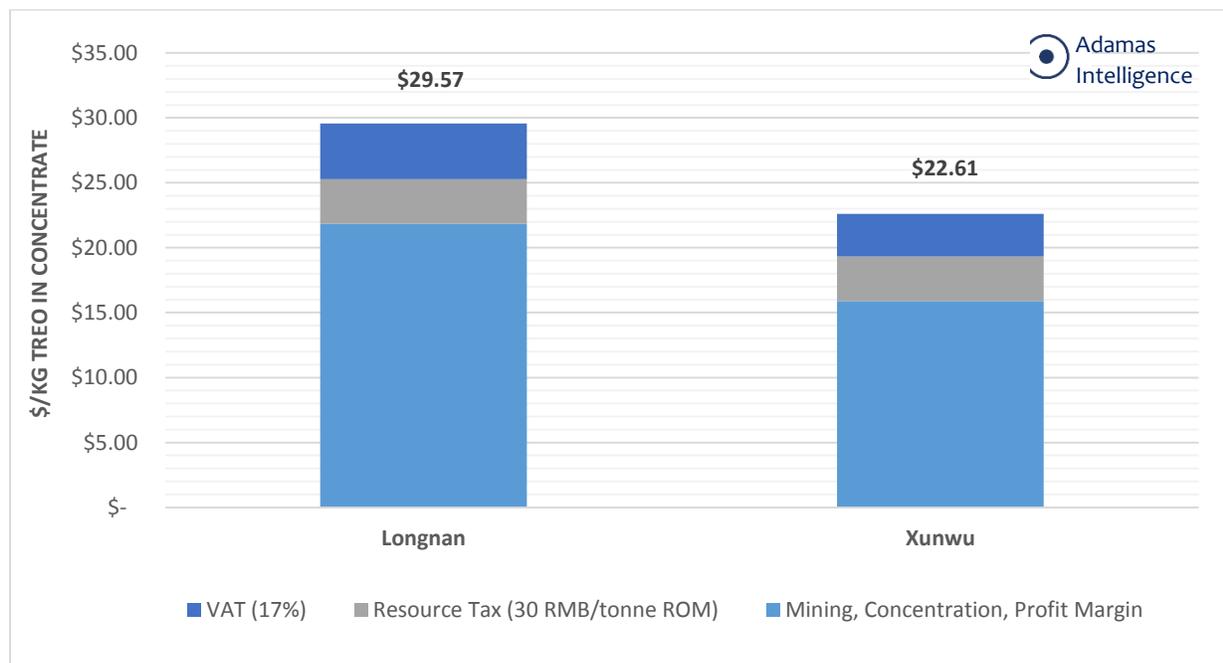
Source: Adamas Intelligence

In the two cases examined above, the \$3.43/kg TREO resource tax amounts to 12% - 15% of the market value of concentrate produced, which itself includes a 17% value added tax (VAT). Knowing this, we can estimate the cost to produce such a concentrate, including a profit margin, which is equal to the price of concentrate from each region less VAT and resource tax.

The current price of a Longnan Y-Dy rich concentrate (92 wt. % TREO) in China is \$27.20/kg concentrate (170 RMB), or \$29.60/kg TREO. The VAT included in this price (17%) amounts to \$3.95/kg concentrate. Assuming this concentrate was produced from a mine with a head grade of 0.2 wt. % TREO and a recovery rate of 70%, the resource tax amounts to \$3.16/kg concentrate, or \$3.43/kg TREO as shown above in the examples in Figure 4. Therefore, we estimate that the cost to produce a Longnan-style Y-Dy rich concentrate in China is approximately \$20.00/kg concentrate, or \$22.00/kg TREO, including a profit margin.

As a second example: the current price of a Xunwu-style La-Nd rich concentrate (92 wt. % TREO) in China is \$20.80/kg concentrate (130 RMB), or \$22.60/kg TREO. Again, there is a 17% VAT included in this price, as well as a \$3.16/kg concentrate resource tax, assuming a 0.2 wt. % TREO head grade and a 70% recovery rate. As such, we estimate that the cost to produce a Xunwu-style La-Nd rich concentrate in China is approximately \$14.50/kg concentrate, or \$16.00/kg TREO, including a profit margin.

Figure 5: Production costs, profit margin, and taxes that make up China’s concentrate prices



Source: Adamas Intelligence

By inferring from the relative distributions of REOs in these two varieties of concentrates (Longnan and Xunwu), we can further estimate the basket value (\$/kg TREO) that each concentrate will yield when separated and purified to market desired specifications. In Figure 6 below we provide estimates of the relative distributions of REOs in each of these concentrates and multiply them by the current Chinese domestic prices of each REO to approximate the basket value that each concentrate will yield.

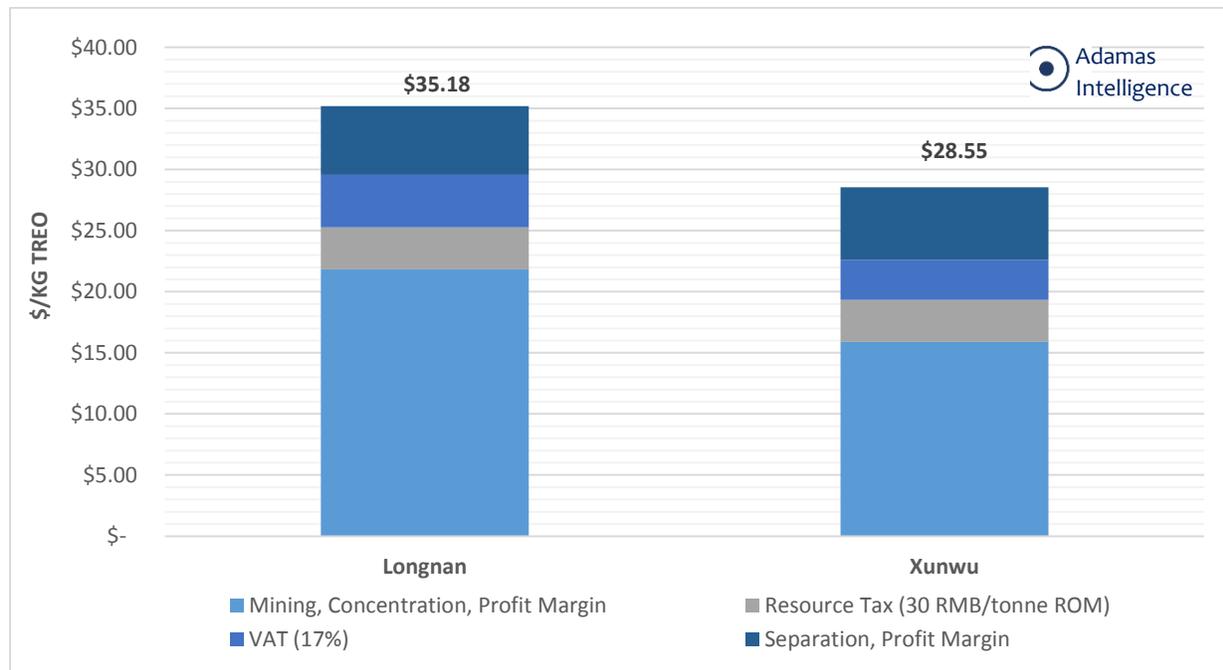
Figure 6: Current REO basket values of Longnan and Xunwu concentrates in China

REO	REO Price (RMB)	REO Price (USD)	Longnan Distribution	Xunwu Distribution
La2O3	¥12.50	\$ 2.00	2%	37%
CeO2	¥11.50	\$ 1.84	0%	3%
Pr6O11	¥387.50	\$ 62.00	1%	7%
Nd2O3	¥292.50	\$ 46.80	3%	29%
Sm2O3	¥16.50	\$ 2.64	3%	5%
Eu2O3	¥1,550.00	\$ 248.00	0%	0%
Gd2O3	¥79.00	\$ 12.64	8%	4%
Tb4O7	¥3,550.00	\$ 568.00	1%	0%
Dy2O3	¥1,615.00	\$ 258.40	8%	2%
Ho2O3	¥-	\$ -	0%	0%
Er2O3	¥242.50	\$ 38.80	0%	1%
Tm2O3	¥-	\$ -	0%	0%
Yb2O3	¥-	\$ -	0%	1%
Lu2O3	¥-	\$ -	0%	0%
Y2O3	¥33.00	\$ 5.28	73%	10%
Basket Price (\$/kg TREO)			\$ 35.18	\$ 28.55

Source: Adamas Intelligence; REO prices quoted May 20, 2015; 1 RMB = US\$0.16

From the above basket value approximations we can subtract the current market price of the respective REE concentrates from which they are produced to estimate the current cost of REO separation and refinement in China, including a profit margin, from IAC-derived concentrates. In doing so, we estimate that the current cost to separate and refine REOs from IACs in China, with a profit margin, is between \$5.00 and \$6.00/kg TREO. Figure 7 below combines the estimated costs, profit margins and taxes discussed herein for an overall breakdown of how REE product prices are fostered in China.

Figure 7: Costs, margins, and taxes involved in producing REOs from China’s IACs (pre- May 1, 2015)



Source: Adamas Intelligence

With this understanding of China’s historic (pre May 1, 2015) cost structure in hand, we can begin to assess how the elimination of the ‘old’ resource tax and subsequent replacement by the ‘new’ value-based tax will impact the cost structure, and ultimately REO prices, going forward.

It should be noted at this point that we have a high level of confidence in the figures, estimates, and analysis presented herein thus far, however, in looking forward at the impact of ongoing tax reform certain details remain unclear. However, having digested the Chinese Ministry of Finance and State Administration’s tax reform implementation announcement issued on April 30, 2015 and spoken with a number of market participants in- and outside of China in recent weeks, the broad strokes of the new tax regime are visible and we can begin to make sense of their implications.

Guidelines for implementation of new resource tax:

- All rare earth concentrates produced after May 1, 2015 are to be taxed according to the market value of the concentrate (less VAT) rather than the amount of ore mined to produce it.
- The tax rate applied varies by region; 7.5% for production from Shandong, 9.5% from Sichuan, 11.5% from Inner Mongolia, and 27% on production from IAC’s, and presumably xenotime.
- For sales of bulk ores which are yet to be physically upgraded and concentrated, a conversion ratio is applied to the tax rate to adjust it according to the lower value added via mining and beneficiation.
- Producers yielding REEs as by-products of other production streams on which separate resource taxes apply may be eligible for deductions.
- Vertically integrated producers that consume or utilize their own concentrates to produce value-added products will be taxed according to the market value of concentrate consumed.
- All inventories of ores, concentrates, compounds, REOs, REEs, etc. produced prior to May 1, 2015 are immune to the new tax rate since the historically-incurred cost to produce these inventories was inclusive of the old resource tax – it’s already baked in.
- As noted at the end of this briefing, the existing inventories of certain REOs in China are vast suggesting that the impact of the new tax regime on such oxides may not be realized for months, or even years in some cases.

Figure 8: Tax before and after May 1, 2015 for producers of China’s ion adsorption clays

	Before May 1, 2015	After May 1, 2015
REO Ores	\$4.80 - \$9.60/tonne ore	27% x Market Value x Ratio
REO Concentrates	\$3.16/kg concentrate	27% x Market Value

Source: Adamas Intelligence; China’s Ministry of Finance and State Administration

Inferring from the cost structures portrayed in Figure 7, we estimate that upon the removal of the old resource tax, the price of Longnan concentrate, excluding VAT, will decrease from \$23.25/kg to \$19.82/kg, which is equal to the cost to produce the concentrate plus a profit margin. With the new 27% resource tax applied, the concentrate price increases to \$25.17/kg, and with the additional 17% VAT applied, the price of concentrate will increase to \$29.45/kg, marking an 8% increase over the concentrate price with the historic tax rate applied. With the increased cost passed down the value chain, the basket value of separated REOs derived from such a Longnan concentrate will mirror the boost in concentrate price.

Similarly, we estimate that upon removal of the old resource tax the price of Xunwu concentrate, excluding VAT, will decrease from \$17.78/kg to \$14.35/kg, which is equal to the cost to produce the concentrate, plus a profit margin. With the new 27% resource tax applied, the concentrate price increases to \$18.22/kg, and with the additional 17% VAT applied, increases to \$21.32/kg, marking a 3% increase over the concentrate price with the old resource tax applied. Again, with the increased cost passed down the value chain, the basket value increase of separated REOs produced from such a Xunwu basket will mirror the increase in concentrate price upstream.

Superficially, a 3% to 8% increase in concentrate price, and ultimately REO prices, is seemingly insignificant in light of the sharp REO price decreases witnessed in early May 2015 following the elimination of Chinese export tariffs. However, the potential of this tax-driven price increase is rather significant when examining the distribution of REOs contained in each concentrate, and considering which REOs are able to absorb a price increase given the context of each REO's current supply-demand balance.

For example, REOs such as lanthanum oxide, cerium oxide, and yttrium oxide are currently in significant over-supply in China thus are unlikely to absorb and sustain any major price increases in the near-term due to an overabundance of competition. On the contrary, oxides of dysprosium, terbium, neodymium, praseodymium, and gadolinium are fundamentally poised to support a major rise in prices given their relative under-abundance and strong demand levels.

Shown in Figure 9 below, as shown previously in Figure 6, are the estimated relative distributions of REOs in Longnan and Xunwu IAC-derived concentrates. In a Longnan concentrate, we estimate that yttrium oxide comprises 72% of the total REO content and lanthanum oxide makes up an additional 2%. Because these oxides, which collectively comprise around 75% of all TREOs in a Longnan concentrate, are currently in oversupply we believe they will be unable to absorb and sustain a price increase if concentrate prices rise, thus the 8% tax-driven increase will have to be carried by the remaining 25% of REOs in the basket – namely oxides of Dy, Gd, Nd, Pr, and Tb. Given that these five REOs only comprise around 25% of all TREOs in the basket, their prices will need to increase by more than 30% to fully absorb the 8% tax-driven cost increase upstream.

Similarly, in a Xunwu concentrate, we estimate that lanthanum oxide, cerium oxide, yttrium oxide, and samarium oxide comprise over 50% of the material's total REO content and these oxides, owing to their over-abundance, will be unable to absorb and sustain a major rise in prices in the near term. Therefore, as the price of Xunwu concentrate rises, the remaining REOs in the mix will need to carry the burden of the 3% cost increase experienced upstream. Given the abundance of high-demand neodymium, praseodymium, gadolinium, and dysprosium in the remaining 50% of TREO basket, we estimate that prices of these oxides will be boosted to absorb the increased costs of concentrate.

Figure 9: Relative distributions of REOs in Longnan and Xunwu concentrates and their perceived abilities to absorb and sustain REO price increases resulting from resource tax changes

REO	Able to Absorb Near-Term Price Increase	Longnan Distribution	Xunwu Distribution
La2O3	No	2%	37%
CeO2	No	0%	3%
Pr6O11	Yes	1%	7%
Nd2O3	Yes	3%	29%
Sm2O3	No	3%	5%
Eu2O3	No	0%	0%
Gd2O3	Yes	8%	4%
Tb4O7	Yes	1%	0%
Dy2O3	Yes	8%	2%
Ho2O3	n/a	0%	0%
Er2O3	n/a	0%	1%
Tm2O3	n/a	0%	0%
Yb2O3	n/a	0%	1%
Lu2O3	n/a	0%	0%
Y2O3	No	73%	10%

Source: Adamas Intelligence

When will the full extent of the new REE resource tax be felt?

With regards to the most abundantly produced REOs globally, there will be a significant lag time, from months to a year or more in some cases depending on the level of historic production currently sitting in inventories.

In a major market research report we published in October 2014, titled “[Rare Earth Market Outlook: Supply, Demand, and Pricing from 2014 – 2020](#)”, we estimate that the world, and in particular China, has dramatically over-produced certain rare earth elements (Ce, La, Sm) over the last decade as a consequence of trying to keep up with growing demand for other rare earth elements (Nd, Pr, Dy, Tb) that are geologically co-hosted with the former. In the aforementioned report we quantified the amount of over/under production annually for each REO from 2008 through 2013 and forecasted the amount of future over/under production from 2014 through 2020.

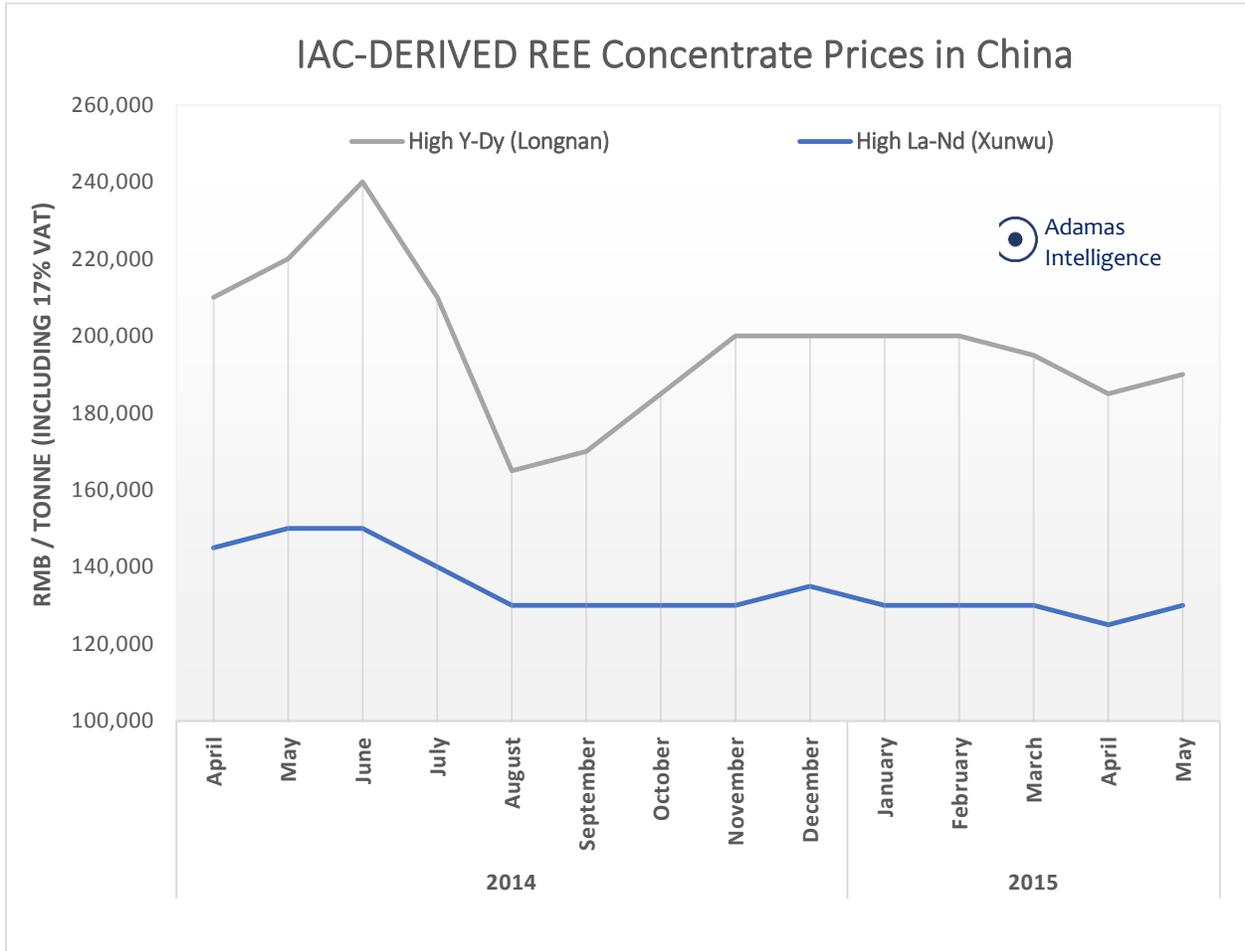
This analysis, along with the wealth of additional information contained in the report, offers extremely valuable insight into the amount of historically-produced REOs amassed in inventories globally, primarily in China. Understanding the scale and scope of these inventories and the rate at which they’re being drawn down or accumulated is key to understanding when China’s ongoing tax reforms will take hold, and to what extent they will impact future prices of REOs.

If you haven’t already purchased a copy of this report, don’t miss your opportunity. Adamas Intelligence will be issuing a complimentary market outlook update in June 2015 to clients with the report which will contain updated supply, demand, and pricing forecasts for the period from 2014 through 2020. This update will also expand further on the ongoing tax changes in China with a look at how tax reform will impact producers and prices of concentrates in other regions in China not discussed herein.

You can find more information about Adamas Intelligence and the aforementioned report on our website (www.adamasintel.com), or please contact us by email at info@adamasintel.com

Supporting Information:

Figure 11: Average monthly prices of two IAC-derived REE concentrates in China from April 2014 to present



Source: Adamas Intelligence; prices from Ganzhou Rare Earth Association