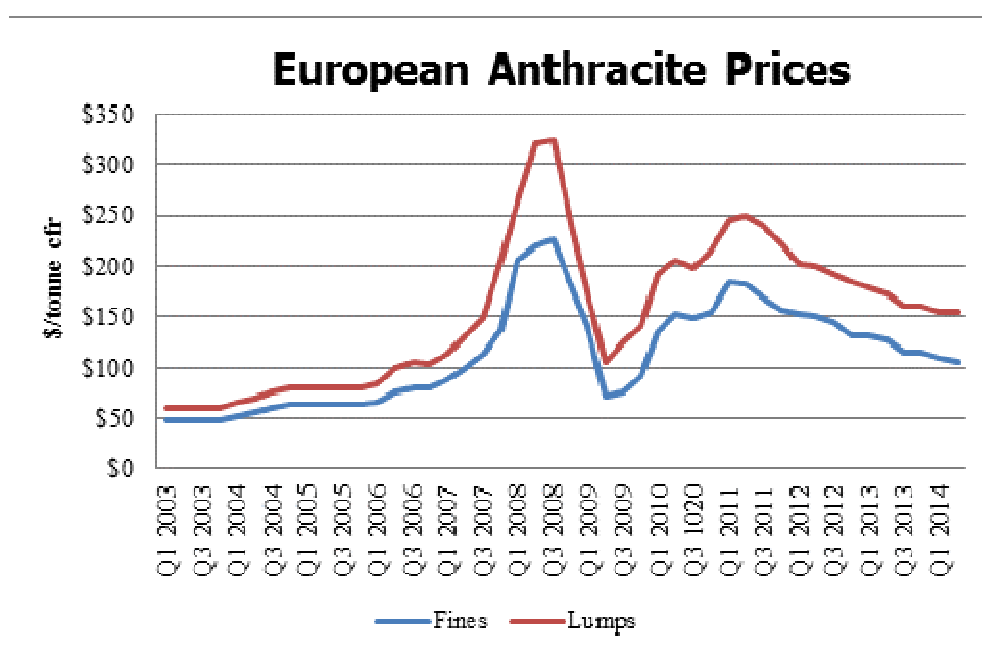


# Anthracite Market Survey

August 2014

## Key Points

- ✓ **Anthracite is low-volatile (<10%), high fixed-carbon (>80%) coal used in a number of industrial and other applications, as well as power generation in specially equipped plants.** The anthracite market divides primarily into applications needing sized lumps and those for fines (<10mm typically). Anthracite lumps are used as a metallurgical coke replacement in various industrial processes, as well as a household fuel. The main application for anthracite fines is as a fuel in ore sintering and pelletizing applications alongside other carbon materials including coke breeze. It is clear, therefore, the anthracite and coke markets are closely linked due to the nature of their applications. There are “niche” applications for anthracite requiring specific sizing and quality.
- ✓ Mining of high-quality anthracite occurs mainly in China, Russia, South Africa, Ukraine, the United States and Vietnam. There is sizeable production in some western European countries, but the quality is primarily suitable only for power generation. In terms of trade, Russia and Ukraine have become the dominant suppliers to world markets over the past five years or so due to their lower costs of production. In Asia, Russia is progressively replacing China and Vietnam in many markets. In the western hemisphere, Ukraine is becoming the main anthracite supplier.
- ✓ The high prices for coke for much of the 2000s decade led to significant substitution by anthracite as well as by other lower cost carbon materials. It is unclear how much replacement of coke is left for the future, given how low prices are currently. Reporting prices for anthracite is complicated by the range of grades available, but “Resource-Net” has successfully tracked the European market for high-quality lumps and fines for more than ten years, as shown below. There was a substantial run-up in prices in 2007-08 and again in 2011, followed by a gradual decline since then.



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# Anthracite Market Survey

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# Anthracite Market Survey

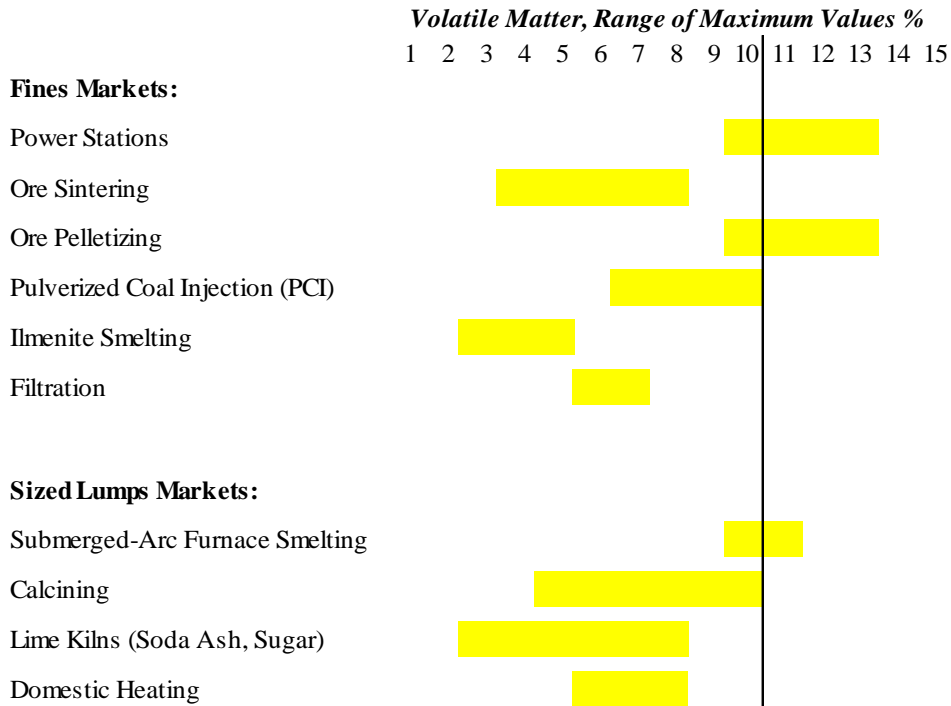
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# Anthracite Market Survey

## Anthracite Applications & Specifications (cont'd)

Note, the above show **the range of maximum values** that are specified for each application, not the range actually specified.



Absolute definition of anthracite = volatiles < 10%

So from the above it can be deduced that among the **fines** applications, ilmenite smelting and filtration require the highest qualities, regarding both volatiles and ash contents. Sintering of iron ore requires higher quality than pelletizing. Power stations tend to burn the lower qualities of anthracite.

For **lumps**, the volatile contents are similar for the main applications. Submerged-arc furnace smelting uses lower grades to lower the cost, this being possible as anthracite is in a blend with coke.

# Anthracite Market Survey

## Anthracite Applications & Specifications (cont'd)

### End-use Market / Typical Specification

#### *Fines Markets (cont'd):*

#### **Ilmenite Smelting:**

Sizing: 0/10mm

Ash Content: 4-8% max

Volatile Matter: 3-5% max

Fixed Carbon: 86-92% min

Sulphur: 1.0% max

Phosphorous: 0.02% max

### Market Characteristics

Ilmenite smelting in submerged-arc furnaces (either AC or DC) uses anthracite fines as reductant. There is no replacement for anthracite in this application.

There are a limited number of ilmenite smelters: three in South Africa, one in Canada plus one in Norway; the latter plant uses no anthracite as it has a different process to the other four. They produce enriched slag from which titanium oxide is extracted, plus high-purity pig iron.

**Rio Tinto** has had a longstanding dominant position in the ilmenite-smelting sector, via its ownership of **Fer et Titane** in Quebec, Canada and majority shareholding in **Richards Bay Minerals (RBM)**, South Africa. These two plants account for 2.4m tpy of the world total capacity of 3.0m tpy.

In South Africa, **Namakwa Sands** and **KZN Sands** were set up in 1994 and 2003 respectively. The chemicals group **Kronos** acquired the plants in 2011.

The two smelters located in KwaZulu Natal, **KZN Sands** and **RBM**, rely on locally produced anthracite. **Namakwa Sands** in the Western Cape imports from Vietnam.

The three South African smelters were largely set up to take advantage of exceptionally low power prices at the time. Since then, the escalation in costs will have reduced their long-term competitiveness.

There appears to have been some expansion to the Canadian smelter in the past few years.

Anthracite fines (0/10mm) with high fixed carbon are needed, i.e. more than 85-86%. Unlike in other processes, with ilmenite smelting it is the slag which is the most valuable portion of the production; so for this reason the anthracite's ash content has to be as low as possible, i.e. less than 8-9%. Volatile content is not critical as it is mostly driven off in the smelting process - though if it is too high, excessive gas evolution can cause slag foaming.

*(Cont'd)*

# Anthracite Market Survey

## Anthracite Applications & Specifications (cont'd)

### End-use Market / Typical Specification

### Market Characteristics

#### *Lumps Markets (cont'd):*

#### **Lime Kilns (cont'd):**

A list of producers in Europe and the Mediterranean region are listed on the next page. Of the 9.8m tpy, **Solvay** accounts for 5.4m tpy (or 55% of the total).

European producers are under heavy pressure from supply from **Eti Soda** of Turkey, which began producing natural soda ash (from trona) in 2009. Current capacity is 1.1m tpy, and it plans to add another 0.5m tpy in 2017. Due to its lower cost base, the Turkish supply is leading to closures of soda ash plants in Europe (although the carbon regime is another difficult issue for the soda ash industry).

Low-cost US trona producers based in Wyoming have also been a factor on the world market for some years.

Over the past five years, around 2.3m tpy of soda ash capacity has closed around the world, as detailed below:

Location	Company	Capacity, 000 tpy	Year
Australia	Penrice	375	2013
Austria	Solvay	160	2009
Japan	Central Glass	260	2014
Netherlands	Brunner Mond (now Tata Chemicals)	420	2009
Portugal	Solvay	230	2014
Romania	GHCL Upsom	310	2010
UK	Tata Chemicals	540	2014

(Not all of the above plants were using anthracite.)

Due to its high cost structure, Solvay's Italian plant is vulnerable to closure in the next few years.

*(Cont'd)*

# Anthracite Market Survey

## World Anthracite Production (cont'd)

CIS (cont'd)

Mine Capacity  
Million tonnes - a

Ukraine

**15.50** Production of anthracite is in the Donbass region of eastern Ukraine (Donetsk and Lugansk). In common with the rest of the coal industry, anthracite mines suffer from a historic lack of investment and low efficiency. Without subsidies from the Kiev government, a major part of Ukraine's coal production would be uneconomic.

In 2013, subsidies to Ukraine's coal mines totalled \$1.2bn. As production was 84m tonnes, the average subsidy per tonne was \$14/tonne. Around 80% of all coal mines (75% of total production) required subsidies to keep operating.

Under the trade agreement made with the EU, such subsidies will be eliminated; this will lead to the closure of many mines. Furthermore, since 2010 the government has been trying to put coal mines into the private sector; this drive will be accelerated by the IMF bail-out programme.

There are seven major anthracite mines, of which Rovenki and Sverdlov are by far the largest. Combined, they account for 70% of the total Ukraine's anthracite production. Rovenki and Sverdlov have shallower depths of mining (0.5-1 km) and lower sulphur than the other mines.

Since the start of 2012, these mines have been operated by private energy group DTEK under a concession agreement with the government. Previously, they were state owned and managed.

DTEK, owning several coal mines and one power plant in Ukraine, is part of System Capital Management (SCM), an investment group controlled by Rinat Akhmetov.

Ukraine's anthracite production was 15.5m tonnes, 5% up on the previous year. The volume has risen from a recent low of 10.5m tonnes in 2009.

a – Saleable product, end 2013

# Anthracite Market Survey

## World Anthracite Production (cont'd)

Capacity of mines at end of 2013 (cont'd):

		<b>M tpy</b>
<b><u>North America</u></b>		
<b>Mexico</b>		
Carbones DC, other	Sonora	0.07
<b>United States</b>		
Atlantic Coal	Stockton, PA	0.20
Blaschak Coal Corp	Mahanoy City, PA	0.40
Jeddo Coal Company	Hazleton, PA	0.30
Lehigh Anthracite	Tamaqua, PA	0.30
Reading Anthracite Company	Pottsville, PA	0.55
Other	Pennsylvania	0.75
<b><u>Latin America</u></b>		
<b>Peru</b>		
Black Hill Company	Chimu	0.10
Sudamericana de Carbon	Oyon	0.05
<b><u>Sub-Saharan Africa</u></b>		
<b>South Africa</b>		
Jindal Africa	Kiepersol, Mpumalanga	0.80
Leeuw Mining (Keaton Energy)	Vaalkrantz, KZN	0.35
Petra Mining (Petmin)	Somkhele, KZN	1.20
Sentula Mining	Nkomati, KZN	0.30
Shanduka Coal	Springlake, KZN	0.80
Slater Coal (Buffalo Coal)	Aviemore, KZN	0.30
Zululand Anthracite Colliery	Kwa-Sheleza / Deep E, KZN	0.80
<b>Swaziland</b>		
Maloma		0.20

*(Cont'd)*



# Anthracite Market Survey

## World Anthracite Trade (cont'd)

Exporter	Volume Exported - a, Million tonnes			Comments (main markets, end-use industries)
	2011	2012	2013	
Vietnam (Cont'd)	17.4	15.2	12.8	Likewise, exports to Europe have declined significantly over the past decade. In 2001, exports to Europe accounted for around one-third of the total. Since 2009, the volumes have been minimal.

It is the long stated aim of the government to reduce exports in order to preserve coal for the development of the domestic economy. In December 2006, an export tax of 10% was applied to anthracite. Despite pressure from Vinacomin, the government is unlikely to cancel it ever. Twice it has been raised to 20% - in 2008 and 2011 - then lowered again. Since January 2013, the tax has been 13%. *(See chart on next page.)*

For pricing, the Vietnamese suppliers follow closely the international indicators, especially for hard coking coal.

Lumps only account for 3-4% of exports, mainly to India and Japan. The remainder are fines: 6-7% high quality, 50-55% medium quality and the balance (35-40%) low quality.

Sea-borne trade is mostly via a dedicated terminal at Campha, under the control of Vinacomin since 1990. There are also exports from smaller ports in northern Vietnam.

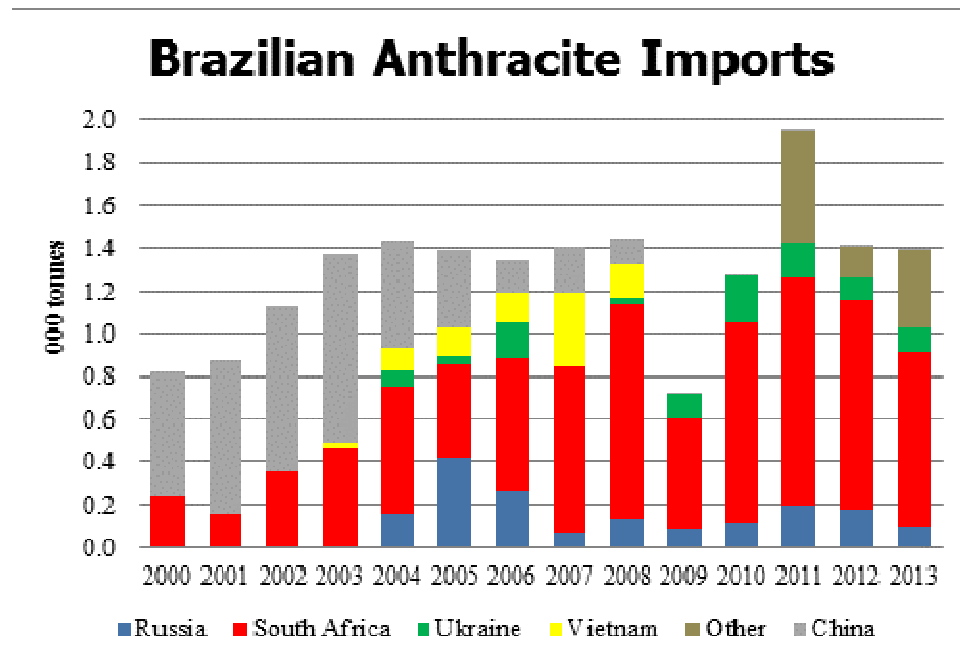
Vietmindo ships from Cai Lan and Hon Net ports.

*(Cont'd)*

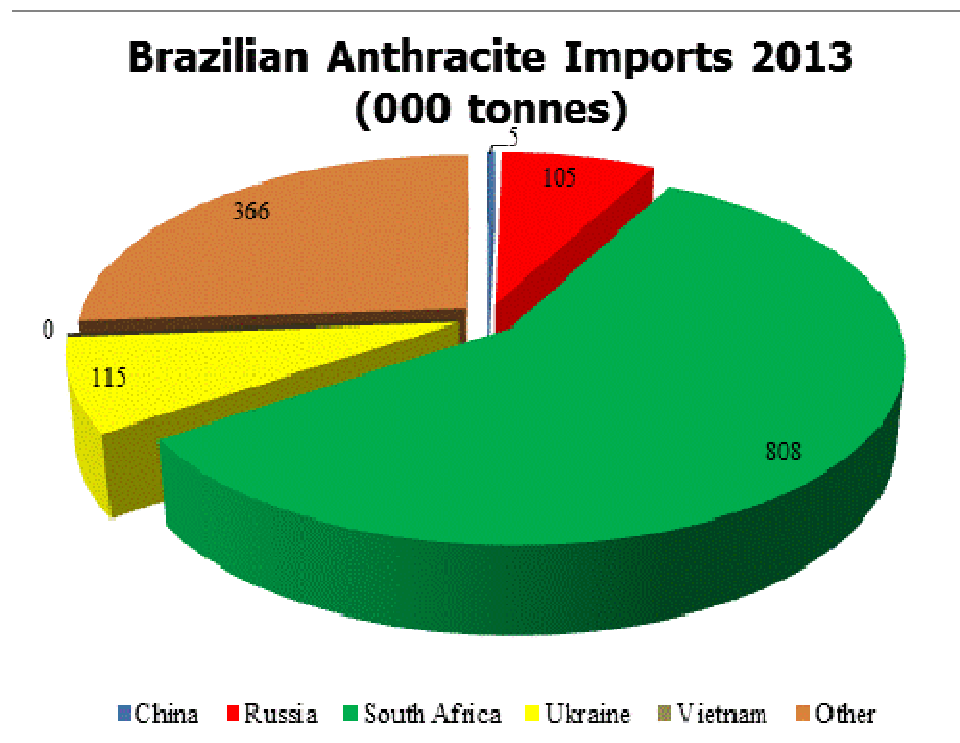
*a – Reported by customs data.*

# Anthracite Market Survey

## Anthracite Demand (cont'd)



*Imports of anthracite by Brazil have broadly stabilized at around 1.4m tpy since ten years ago. South Africa has emerged as the main supplier in long term, with Russia and Ukraine also active.*



*In 2013, South Africa accounted for more than half of Brazilian imports.*

# Anthracite Market Survey

## Anthracite Demand (cont'd)

Asia (cont'd)	Anthracite Demand, Million tonnes			Comments
	2011	2012	2013	
India	1.23	0.81	0.94	<p>Indian demand has risen from minimal quantities before 2004 to peak at 1.2m tonnes in 2011. It has since been lower. Russia, Ukraine plus South Africa have emerged as main suppliers (see chart on next page). Supply from China and Vietnam has declined. There remain good prospects for anthracite as a coke replacement in India as it is a “coke short” country, importing &gt;2m tpy.</p> <p>Iron-ore pelletizing capacity in India has grown from 13m tpy in 2009 to 52m tpy by the end of this year. There have been expansions by:</p> <ul style="list-style-type: none"> <li>Ø Bhushan Power &amp; Steel - 3.9m tpy from 2014;</li> <li>Ø Brahmani River Pellets (Stemcor) – 4.0m tpy from 2010;</li> <li>Ø Essar Steel – 6.0m tpy from 2012;</li> <li>Ø Jindal Steel &amp; Power – 9.0m tpy from 2011-14;</li> <li>Ø JSW Steel – 9.0m tpy;</li> <li>Ø Tata Steel – 6.0m tpy from 2012.</li> </ul> <p>All bar JSW Steel and Tata Steel are in Odisha state. They are using coke breeze with some imported anthracite. They primarily produced pellets for self-consumption.</p> <p>A 5% export tax was applied to iron-ore pellets in February 2014, however, affecting production and hence demand for anthracite. An iron-mining ban in some states in India has also reduced pellet production.</p> <p>Most imports appear to be fines, but there have been some imports of lump from South Africa in the past few years. Main users are in the ferroalloys and calcium carbide industries.</p> <p>Indian soda ash plants are a potential market for anthracite; but most of the capacity is in Gujarat, also the location of the largest merchant coke plants, so there is little incentive to shift to anthracite.</p> <p>Electrode paste and electrode plants in India prefer petroleum coke for reasons of greater availability. They can import calcined anthracite from China.</p>

*Demand estimates are compiled on “apparent basis” i.e. production + imports – exports.*

# Anthracite Market Survey

## Anthracite Demand (cont'd)

Demand by each region from 2004 to 2013 is summarized:

<b>World Anthracite Demand</b>											
<b>Million tonnes</b>											
	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<i>% Avge Ann Ch</i>
Europe	19.67	19.46	19.07	22.29	22.22	18.87	19.36	17.79	16.32	13.00	-3.2%
CIS	17.28	18.95	19.49	15.90	13.82	13.50	9.50	12.51	14.95	15.48	-3.9%
North America	2.18	1.85	1.69	1.88	1.86	1.91	1.81	2.43	2.49	1.94	1.8%
Latin America	1.65	1.62	1.53	1.53	1.58	0.83	1.39	2.06	1.51	1.50	-0.3%
Sub-Saharan Africa	0.85	1.08	1.37	1.46	1.48	1.42	1.33	1.59	1.87	2.10	7.3%
Maghreb & Middle East	0.42	0.46	0.64	0.68	0.92	0.51	1.16	1.19	1.22	0.96	10.4%
Asia	79.45	87.84	98.90	109.95	109.72	126.12	130.66	154.59	158.71	162.60	8.0%
Australia	0.09	0.17	0.11	0.11	0.12	0.07	0.08	0.15	0.04	0.04	-7.7%
<b>Total</b>	<b>121.57</b>	<b>131.42</b>	<b>142.80</b>	<b>153.81</b>	<b>151.71</b>	<b>163.22</b>	<b>165.30</b>	<b>192.31</b>	<b>197.11</b>	<b>197.63</b>	<b>5.4%</b>

The above data have been deduced for each major economy on “apparent basis” i.e production + imports – exports (see next pages).

The average annual growth rate in world anthracite demand over the ten years to 2013 was 5.4% per year.

Asia now accounts for more than 80% of world total compared to 65% ten years ago. Growth in Asian demand was +8.0% per year.

There has also been high growth in anthracite demand in Maghreb & Middle East (+10.4%) and Sub-Saharan Africa (+7.3% per year), both from a low base.

Europe and the CIS saw a negative trend in demand, -3.2% and -3.9% per year respectively, mostly due to lower demand for power generation. In Europe, the decline in demand has accelerated since 2010.