Tesla battery plant will need 6 new flake graphite mines

$5bn ‘gigafactory’ to spark EV uptake; battery graphite demand could double in 6 years with no growth elsewhere

US automotive giant, Tesla, has revealed plans to build a new $5bn lithium-ion battery (Li-ion battery) ‘gigafactory’ which could potentially increase natural graphite demand by up to 37% by 2020.

The factory, which is forecast to start production by 2017, is expecting to have an output of 35 gWh/year by as early as 2020, which would over double the size of the current market.

It’s important to stress that the plant is in the planning stage and capacities depend strongly on market demand, but Tesla believes it can be the market leader by producing low cost batteries in the USA.

In **IM Data**'s calculations, Tesla's plant - which is set to be based in the south-west USA - will consume at least 28,000 tonnes of spherical graphite every year if operating at capacity. This equates to 93,000 tonnes of flake graphite if produced to today's standards which sees raw material wastage of up to 70%.

If achieved, battery demand for natural graphite will increase 112% from today's levels of 83,000 tpa. This is assuming no other growth in regions such as Asia which is today's primary consuming region.

While R&D firms have been actively exploring non-graphitic carbon anode alternatives, the position of graphite anodes as the current material of choice for Li-ion battery producers means the graphite industry is likely to be the beneficiary of this growth.

Whether Tesla plans to utilise spherical graphite - made from large natural flake graphite – or synthetic materials remains unclear.

Nonetheless, expansion of the battery market for electric vehicles (EVs) on this scale presents a valuable opportunity to graphite suppliers.

Seizing an opportunity

In 2012, consumption from the battery sector constituted 8% of global natural graphite demand.

For the natural graphite market to supply the type of market growth Tesla are forecasting, large flake graphite output will need to increase significantly over the coming years.

IM Data estimates that large flake grades (+80 mesh and larger) only made up just over 20% of total flake graphite output of 375,000 tonnes in 2013, and with competition for these grades from other traditional markets (i.e. the refractories sector), new projects are likely to be required to meet the battery market demand.

A number of junior projects are aiming to reach production over the coming 2-3 years, many boasting large flake reserves capable of supplying new hi-tech markets.

With China's large flake reserves depleting, and the efficiency of the country's spherodization process under question, these projects have an opportunity to play a major role in supplying emerging markets.

Tesla's rapid EV expansion plans are, however, centered around lowering Li-ion battery costs by over 30% per kWh, which will allow the company to bring a more price competitive product to market.

Raw material costs are therefore likely to be under close scrutiny as the company gears up for production, meaning any potential graphite suppliers will have to be competitive not only with other producers but also alternative carbon anode companies.

The FOB price of Chinese uncoated spherical graphite, 99.95% C, 15 microns stands at $3,400/tonne today, while prices of coated spherical graphite – the final material used in battery anodes – is valued at around three times this level.

From Ford to Tesla?

In 1913, Henry Ford introduced the use of an assembly line in the production of the Ford Model T motor car, which revolutionised the automobile industry and brought an affordable product to market in the US.

Over a century on and Tesla's plans to internalise its Li-ion battery production could prove just as pivotal in the emergence of the EV market, unlocking a lucrative new layer of demand for natural graphite producers.

Although the use of graphite in Li-ion battery technologies is not a new concept, the quantities used in more developed portable device markets, such as phones or tablets, are not substantial enough to be a major source of demand for flake graphite.

As much as 56kg of graphite is, however, used per EV, making the market an exciting new prospect for the graphite community which has fueled a wave of interest in recent years.

While the market has failed to expand at the rate many had forecast –both the US and China have fallen short of government growth targets - EVs present the most feasible opportunity for graphite producers to diversify from traditional industrial markets.

If Tesla manages to meet its expansion plans over the coming six years, the company is likely to further the cause of not only the EV industry, but also the graphite market in its path.

How many graphite mines will Tesla need?

Should Tesla choose to use spherical graphite sourced from natural flake as its raw material of choice, at capacity the plant will need substantial volumes.

As outlined earlier, a conservative case will see the plant demanding 93,000 tonnes of flake graphite but in a bullish case this could rise as high as 140,000 tonnes. The challenge for the graphite industry will be not only the volumes but the sufficient quantity of medium and large flake graphite.

At present, medium flake (-100 mesh) graphite from China is used to produce spherical graphite which is then coated in Japan. Should the new, more economical processing techniques take off in the next two years as

expected, a large portion of this demand will be for large flake (+80 mesh) and spherical graphite production hubs will emerge in Europe and North America.

The flake footprint of each mine varies quite significantly, each with its own blend of large and medium flakes in addition to fines. Therefore a number of mines will need to be built to satisfy a Tesla plant running at full capacity.

Below, **IM Data** offers the following consumption scenarios for Tesla's battery plant by 2020:

Conservative case for Tesla plant running at capacity

Spherical graphite demand = 28,000 tpa
Flake graphite demand = 93,000 tpa
New graphite mines needed (equivalent) = 6

Bullish case for Tesla plant at running capacity

Spherical graphite demand = 42,000 tpa
Flake graphite demand = 140,000 tpa
New graphite mines needed (equivalent) = 9

Graphite takes off in 2014 as industry shapes for future

Asbury's expansion into Europe and Syrah's spherical graphite tests, adds to Tesla gigafactory plans and 2 significant off takes

After a quiet 2013, graphite has hit the headlines in a big way in the first three months of the year as the industry looks to reshape for the near term future.

With demand and prices still sluggish on the back of a torrid 18 months, supply developments have been coming thick and fast with major producers expanding in addition to significant developments in the exploration sector.

Asbury Carbons' decision to launch a new plant in the Netherlands marks a significant development which will see the US-based company look to take market share from other major traders in Europe.

The plant will be located in Maastricht which hosts one of many major ports in the Netherlands, and receives bulk shipments of graphite from the world's leading supplier, China.

Asbury sells a wide range of carbon products including amorphous, flake and vein graphite but has predominately focused on North America as its primary market with major players like Grafit Kropfmuhl (AMG Mining), Georg Luh and Technografit supplying European demand.

The bullish move by Asbury is a statement of intent to the industry and will ensure the company is well positioned for any potential demand increases from both industrial and new hi- tech markets.

Asbury also revealed it is ready to purchase outright, or take a controlling stake, in a new mine in 2014.

The company used to own mines in the 1980s but with China's emergence in the marketplace this became uneconomical. Global supply security issues and rising prices have allowed the company to revisit this strategy and an announcement is expected by Q3 2014.

Flake graphite developer, Syrah Resources, has made a second significant announcement in as many weeks and revealed the production of battery-grade spherical graphite from its Balama project in Mozambique.

Syrah used feedstock from the Sushi zone of the deposit, using a +100 mesh flake with an air powered jet mill. The company also revealed it has purchased a spherical graphite pilot plant for A$40,000.

Syrah is seeking to be the largest volume supplier of flake graphite in the world. Its plan to produce 200,000 tpa in Mozambique was met with surprise and scepticism in an industry which only produced around 400,000 tonnes of flake graphite in 2013.

Nevertheless, the company last week announced a Memorandum of Understanding with Chinese aluminium giant, Chinalco, for 80,000 tpa of this output, taking many in the industry by surprise.

The agreement is for the use of flake graphite in cathode and anode blocks used to produce aluminium - a potential new market for graphite in replacing the lower value carbon products such as petroleum coke and anthracite.

Syrah, however, are not the only graphite junior to reach an offtake agreement in the past few months. Focus Graphite's 40,000 tonne deal with another unnamed Chinese industrial conglomerate in December 2013, was an industry first and has seemingly set a trend.

Tesla offers long term optimism

While there have been a number of supply developments in recent months, news that Tesla Motors are planning to revolutionise the US electric vehicle industry by building the world's largest battery plant has also offered the long term boost many exploration projects needed.

Tesla's grand plans to build a $5bn lithium-ion battery plant in the US by 2017 could boost long term flake graphite demand in the battery sector by nearly 40%.

In essence, the Tesla plant alone has created a new market for flake graphite, much in the same way the Syrah aluminium deal promises to do so.

This means future demand will not only be dependent on growth in existing markets but also new applications, which demonstrates the diversity of graphite's applications and bodes well for an industry geared for growth.

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China and the role of spherical graphite in EV batteries

Is Chinese graphite as green as Tesla would like? Natural and synthetic compete for lion's share of emerging electric vehicle battery market

Tesla motor's $5bn electric vehicle (EV) battery plant plans have once again got the world talking about the critical minerals and metals that supply the hi-tech products of today and tomorrow.

The pending battery economy is coming. There is little doubt about that considering how mobile the world has become in the last 5 years. This mobility has been made possible by the lithium-ion battery and the minerals that make it.

With Tesla planning to more than double the worlds lithium-ion battery capacity by 2020 and make them cheap enough to spark a mass uptake of EVs, the question is over the sourcing of minerals that will fuel this US manufacturing revolution.

Graphite, whether naturally mined or synthetically produced, is the largest input raw material into a battery. Even more so than lithium.

Tesla's plant alone could potentially require 140,000 tpa of natural graphite and 25,000 tpa of lithium compounds, growing each market by 37% and 20% respectively.

Battery grade graphite comes in two forms: spherical and finely ground, pure powder.

Spherical graphite is the sought after grade for today's battery makers as it offers improved conductivity and performance to the battery.

The present tug of war is over whether the battery industry will go with natural or synthetic spherical graphite. At the moment the decision, for an industry which we estimate to have an output of 50,000 tpa worldwide, is split 60:40 in favour of natural graphite.

Nearly all natural spherical graphite is produced in an uncoated form in China.

Battery customers, who are predominately located in Japan, are not yet satisfied with the consistency of what is a relatively new product from China. Cost is also an issue and is strongly tied to the price of flake graphite, which has seen all-time highs in recent years.

China's production problems

As a recent Bloomberg Businessweek article outlined, China has its fair share of problems surrounding the sustainability of its flake graphite production.

The article forced Tesla Motors' CEO, Elon Musk, to respond on twitter: "the amount of graphite in our cars comes from Japan and is mined in a very clean way."

While China has a handful of larger scale, modern professional graphite producers, it also has a number of small, inefficient operations. Tracking which mine the graphite comes from is very difficult.

The country's graphite industry is fragmented with a handful of small to medium sized mines contributing to the country's output - 250,000 tpa in 2013, 60% of global supply. Heilongjiang, Shandong and Inner Mongolia are leading production hubs in China.

Pingdu in Shandong, which can be seen as the graphite capital of the province, came under fire from local media in December over graphite dust issues from the abundance of processors near the city. This sparked the government to enforce a blanket shut down and inspection of the industry, taking 60,000 tpa of flake graphite off the market.

Graphite dust is one of the major problems with graphite manufacturing in China, the majority of which has undergone little modernisation since the 1980s.

Similar environmental problems have also been seen in Heilongjiang - the world’s premier graphite producing region. Graphite rain was reported to have fallen over local towns, while poor processing practices have also affected surrounding agriculture and businesses.

The second major issue is the acids used to purify the spherical graphite to the high carbon levels required for battery customers. These can be hazardous to the environment if not disposed of properly, which has drawn the attention of local media and residents.

It is important to note that China does have a handful of large, modern graphite companies which would act as consolidation vehicles should the government choose to act in this way.

Another point to make clear is that while graphite dust can cause disruption, the mineral itself is inert and safe.

Nevertheless, China's flake graphite industry is in need of modernisation. The government is not happy with any mining that is inefficient, wasteful and polluting. One can turn to rare earths and phosphate rock for recent examples of this.

Some small graphite mines in China should have been shut down years ago. They are low grade and extraction is now at depth, which is increasing costs. The country can still produce it at the lowest cost in the world, but it relies strongly on the cheap raw material from Heilongjiang in the north.

Should the government switch focus from Shandong to Heilongjiang, the industry and the world would be facing a significant supply problem and large scale battery operations, like Tesla is planning, will begin to feel the impact of rising prices.

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