



Neometals

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Re: Inquiry into technological and service innovation in Western Australia

Thank you for the opportunity to comment on your inquiry into how technological and service innovation can be encouraged to expand and diversify the Western Australian economy.

In regards to your inquiry and in particular the mining, energy and advanced manufacturing sectors, I wish to frame my comments in terms of a rare opportunity encompassing these sectors and a few of the challenges involved in exploiting this opportunity.

The comments come on the back of personal direct involvement in a segment of the industry in question since 2009 and almost two decades watching with interest from the sidelines. In addition, I have over 25 years experience working in the mining and finance industries.

A growing strategic industry

The opportunity relates to batteries. Panasonic, who are currently the world's largest producer of lithium based electric vehicle batteries forecast in August 2015 that the lithium battery business would grow from approx. US\$8bn in 2014 to closer to US\$200bn by 2025.

(<http://benchmarkminerals.com/blog/chart-panasonic-predicts-lithium-ion-utility-storage-surge/>). Significantly for WA and Australia, this growth is forecast to be driven primarily by stationary energy applications for renewable and utility applications (US\$165bn in 2025) with electric vehicle applications making up the balance. This is in contrast to earlier forecasts where electric vehicles were expected to drive battery production and innovation and may be a result of the massive response to the release of the "Powerwall" and "Powerpack" products under the Tesla brand earlier in 2015 (entire production for 2016 was sold out in under a week after the initial announcement) in conjunction with rapidly declining solar pv costs and its subsequent adoption. I say this is significant because the conventional wisdom was that battery manufacturing took place near established automotive industries as they were seen as being the primary driver of battery demand and required customised battery designs. However, with stationary energy storage taking over the role as the main driver of battery demand, the requirement to have a local automotive industry is no longer relevant. (See attached note on comments from Kokam re Australia's market potential where "Kokam CEO C.Y. Chong told RenewEconomy that Australia – because of its huge geography and excellent renewable resources – was one of the most attractive markets in the world."

<http://reneweconomy.com.au/2015/battery-storage-barely-scratched-surface-of-possibilities-in-australia-43560>)



All the right elements

While there are a number of battery chemistries being touted as potential candidates for economical storage solutions, it is the lithium based chemistries that have the most investment and production capacity behind them and which are bringing the costs of batteries to the point where they are genuinely beginning to have an impact on energy markets and forecasts on the evolution of energy markets. Lithium has the advantage of being the third lightest element known to man - with only hydrogen and helium being lighter - and it is the lightest metal.

The battery value chain

Before getting to the crunch, let us first look at the traditional battery manufacturing value chain.

As it stands, the value chain can be broken down into 5 basic segments: raw materials, processed materials, electrode production, cell construction and final packaging. To date, this chain is spread over a number of countries with no country hosting the entire process. Until Tesla came along...

The world's newest, biggest and most advanced battery factory

The Tesla Gigafactory is a \$5bn lithium battery factory that, based on initial plans, will produce approximately the same amount of batteries in capacity terms as the rest of the world produced in 2013. The factory is expected to come on line in 2018 and be at full capacity by 2020. Already, there is talk that expansions are under way and that a second factory is under consideration. The Governor of Nevada believes that hosting the Gigafactory will bring about US\$100bn of economic benefit to the State over two decades.

The investment in the Gigafactory was made after Tesla identified the opportunity to hark back to the days of Henry Ford and create one big factory where raw material (including processed materials in this case) was sourced from as close to the factory as possible and then the rest of the process takes place under one roof with finished battery packs being produced at the end of the Tesla production process. By doing this "all under one roof", it is estimated that they can reduce production costs by approximately 30%.

In addition, Tesla places a heavy emphasis on automation and as a result, the company produces more cars per worker from their automotive operations than any other automotive manufacturer.

And the Gigafactory will be powered entirely by renewables.

As a result, Tesla have announced market prices for consumer and industrial stationary storage products in 2015 that were not expected to be achievable until well into the 2020's.

Therefore, Tesla have changed the game and the existing industry players will need to consider the "all under one roof" approach - or consolidation of supply chain as well as invest in highly automated processes in order to match the economics of the Tesla approach. Future production facility investment will need to take this approach into consideration.



A rare opportunity

And this is where the opportunity arises for WA...

In 2014, Western Australia was the single largest supplier of lithium to the world market. Production figures for 2014 were: WA 13,000t, Chile 12,900t, China 5,000t and then the rest. All WA production in 2014 came from the Greenbushes mine in the South West. The Mt Marion mine near Kalgoorlie is expected to commence production in 2016 at a rate of 5,500tpa. And Pilbara Minerals are saying they hope to bring their mine near Port Hedland into operation in 2017. So, clearly, WA is a leader in global lithium production. While there are much larger resources touted in the South American countries, it is WA that is actually delivering and the resource differential may simply be a result of the lower cost of resource estimation in brine versus the expense of exploration and drilling in hard rock scenarios – particularly when taking into account resources that may be under cover and the lack of motivation – to date – to pursue them.

So, effectively, when looking at the battery supply chain, it begins in WA. And, like many things, we mine the raw material, export it to a foreign country/ies where it is converted into a finished product and then we import the finished products.

Opportunity to innovate

Two factors arose that provided Neometals with the incentive to focus on innovation:

First, the most commonly used lithium compound used in the manufacture of lithium batteries has been lithium carbonate. This is primarily due to the fact that it is relatively easy and cheap to produce from brines. However, as scientist look to make better batteries they are looking to better compounds as raw materials – such as lithium hydroxide. However, producing lithium hydroxide from brines is a more complex and expensive process than producing lithium carbonate and as a result it commands a significant market premium (Li₂CO₃ approx US\$5000/t v LiOH US\$8000/t). Despite this, Tesla will be using lithium hydroxide as their primary lithium compound (remember, Tesla's Gigafactory 1 will produce more batteries than the entire world produced in 2013 - but they are also demanding that suppliers who hope to sign long term supply contracts with Tesla must do so at prices dramatically lower than the current market price. However, until they can find a supplier/s who is able to do that they are forced to deal at prices that one can only presume are close to the market price).

Secondly, all lithium exports from Western Australia are shipped overseas as a 6% concentrate (or lower). That means that 94%, or more, of every ship load of spodumene concentrate is actually waste material. Therefore the benefits of processing as close to the mine site are relatively obvious.

It was these factors that stimulated us to search for a way to produce lithium hydroxide from spodumene ore - ideally as close to the mine as possible if all other factors allowed us to. As a result we have been able to develop a patented process that will allow us to achieve this at a much lower cost than is currently possible from brines and at a cost that we expect to be lower than the current market price of lithium carbonate.



Initial research and testing was carried out at Murdoch University and follow up mini-pilot plant testwork was carried out in the USA due to availability and cost of relevant equipment and expertise.

We have also had contact with a number of State and Federal bodies and we expect that we will receive solid support for a pilot plant programme which will be based near the mine in Kalgoorlie.

So, with a bit of luck and some competitive assistance from relevant government bodies, Western Australia should be able to host at least the first two segments of the battery value chain.

But, why stop there? Why cant Western Australia develop a highly automated high-tech manufacturing industry using the position of dominance in raw materials (and hopefully processing) as a lever? We have the first part of the supply chain and we certainly have the brainpower to support an advanced manufacturing industry. What don't we have?

A key missing factor in WA/Australia

One of the most obvious things is a clear strategy from the government to develop this industry. There is not one major battery precinct in the world that has been established without very significant government assistance.

This is an extract on the topic from a US government sponsored research project looking at the issues involved in establishing a local battery industry:

(http://www.afdc.energy.gov/uploads/publication/lithium-ion_battery_supply.pdf)

“Japan’s LIB cluster grew from sustained investments in LIB technology by consumer electronics companies in the 1990s. The Japanese government bolstered private sector investments with R&D funding and low cost capital to establish manufacturing plants.

“Japan made these investments despite the long commercialization cycle of LIB technologies and the low returns on the LIB business because the technology enabled competitive advantages in portable consumer electronics end applications (Brodd 2012).

“Korea and China followed Japan’s lead in investing in LIB cell and pack production for consumer electronics.

“Korea’s LIB cluster is a result of government and industry efforts, started in the 2000s, to build up this portion of the supply chain within Korea (Pike 2011 and 2013). China, too, has fortified its LIB cluster development through various government R&D, tax, investment incentives (Patil 2008), domestic content requirements, and export restraints (Haley 2012, Stewart et al. 2012). While Korean and Chinese cell manufacturers initially relied heavily on Japanese suppliers, their national efforts to build LIB clusters have resulted in less dependence on Japanese suppliers, and may contribute to advantageous pricing on key materials for fully scaled, co-located Korean and Chinese cell producers (Pike 2011 and 2013).”



I can provide some specific examples:

- The Malaysian government has dangled the prospect of a 10 year tax holiday in front of Neometals to entice us to build our lithium hydroxide plant in Malaysia. Malaysia is trying to establish an advanced battery industry to attach to its indigenous car industry. They are yet to attract a similar business which indicates how difficult it is to attract a business such as Neometals lithium hydroxide operation and the opportunity to have one established in one's country should not be taken lightly.
- The State of Nevada granted Tesla around US\$1.5bn in tax incentives to establish the Gigafactory in Nevada in opposition to other States that were trying to entice the company to set up elsewhere. The Governor of Nevada believes that the Gigafactory will be worth US\$100bn to the State over its 20 year life.
- The US government provided US\$30m towards a small lithium hydroxide plant.
- The Canadian government contributed CAD\$13m towards a lithium hydroxide pilot plant.

So, it is a very competitive marketplace when it comes to the battery industry and many governments are playing hard ball in order to establish what is expected to be a major strategic industry moving forward.

The opportunities

Our leading position at the beginning of the battery supply chain provides us with many opportunities including:

Opportunity to leverage our leading position as a major miner and supplier of the key enabling raw materials in a growing globally strategic industry at what is arguably an embryonic stage.

Opportunity to provide focus to a range of related disciplines and establish a center of excellence focused on advanced battery manufacturing R&D and battery chemistry R&D.

Opportunity to take advantage of the dominant demand for stationary storage (versus automotive storage applications). Given our world leading position in roof top solar, Australia is seen to be a primary market for stationary storage in the near term.

Provides an opportunity to branch out from being a resource focused State and adding another string to our bow with advanced manufacturing which is not as reliant on cheap unskilled labour as other industries. This could then have implications for industries other than batteries.

Opportunity to enhance energy security.

Opportunity to establish a new export industry that will help offset imports of the same product.



To do list

We need to class the battery industry as a strategic industry and investigate the options that we have to make the State an attractive precinct for battery manufacturers - taking into account the competition from governments of other countries.

Then we need to identify prospective battery industry participants and sell them on the idea of investing in manufacturing operations in WA.

In addition, we should also do whatever we can to encourage local battery entrepreneurs to establish themselves here.

In tandem, we put in place a programme to create a center of excellence in all things related to batteries and their manufacture that encompasses a range of disciplines such as chemical engineering, automation, artificial intelligence, nanotechnology, materials science etc.

Please don't hesitate to contact me for further information or clarification on this issue.

Yours sincerely,

Simon Hicks
Stakeholder Relations
Neometals Ltd



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