A graphite pro reviews recent battery event and the conflict mineral challenge

The Battery Conference in Fort Lauderdale that I recently attended from March 20-23rd is an annual event where the top battery scientists, industry executives, forecasters and enthusiasts gather to hear about the latest developments and the current state of research. On my part, I care about:

- The worldwide state of lithium-ion market penetration and its forecasted growth;
- How many EVs were produced in the last year and the forecasted trends for next year and beyond;
- Getting a feel for the progress of lithium-ion in the field of ESS's connected to the grid;
- Looking for a battery breakthrough that has a chance of making it to production in the coming years;

There are dozens of presentations, several of which run concurrently. Anyone interested in an understanding of the current market penetration of lithium-ion needs to attend Avicenne Energy's presentation. Here are the main things to know:

- In 2016, the world's lithium-ion production capacity surpassed 78 gigawatt hours (GWh). The production capacity was only 2 GWh in 2000;
- By 2025, the world's lithium-ion production capacity is expected to grow to 210 GWh (at a CAGR of over 14%) under a conservative scenario;
- The average manufacturing cost of an 18650 cell reached $150/kilowatt hour (kWh) last year
- Of all lithium-ion chemistries, NMC/Graphite is forecasted to experience the most growth between 2015

and 2025 at a CAGR of over 15%;

- Micro-hybrid batteries (which are typically of the NMC/graphite variety) are expected to achieve a 50% market penetration by 2020-25. The potential of this market is huge as the number of internal combustion engine (ICE) cars sold on a yearly basis is about 90 million;
- The graphite anode material market had a volume of over 88,000 tonnes in 2016 and is forecasted to grow at a CAGR of 18% between 2015 and 2025;
- Avicenne Energy evaluated that 362,000 New Energy Vehicles (NEV) and Plug-in Hybrid Electric Vehicles (PHEV) were sold in China. However, another presenter, Pulead Technology Industry and China Industrial Association of Power Sources (CIAPS), evaluated that number to be around 500,000 units;
- For 2017 CIAPS and Cadenza Innovation both predict the number of NEVs to reach 800,000 units in 2017 in China alone;
- The number of E-buses sold in China in 2016 is very impressive. Avicenne evaluates this at 132,000 units. Each bus comes equipped with a battery size between 100 and 300 kWh;
- Avicenne also forecasts the ESS market to be a $10 billion market at the pack level within the next 5 years. If the lithium-ion manufacturing cost reaches $150/KWh at the pack level, they warn that the market could be much more important.

A plenary session that was very well attended was the one given by Kurt Kelty, Senior Director of Battery Technology at Tesla. A couple of things he said strongly resonated with me. First of all, he made it clear that Tesla wants an ethical supply chain. Thus, unethical mining of cobalt in the Democratic Republic of Congo (DRC) will not be tolerated. Secondly, he said that Tesla wants to do business with suppliers that adhere to the same principles as them, when it

comes to usage of fossil fuels. He clearly said to the hundreds of attendees that Tesla wants to do business with suppliers that make use of renewable energy. When asked by an attendee if Tesla values the sourcing of graphite from North America, he said that they will source graphite and other raw materials locally, assuming other factors are equivalent.

I did attend a number of research and development (R&D) sessions. From what I gathered, I conclude that there are no battery breakthroughs. Research on silicon anodes has been ongoing for more than a decade, and they still have a very short lifespan due to swelling and contracting issues. Cells with Lithium-Metal anodes and organic electrolytes are very dangerous and may never make it to production due to safety issues. Lithium-sulphur and lithium-air are still experimental at a lab scale and are a very long time away from production, if they ever make it.

It’s important to understand that lithium-ion was invented in the 70’s and later commercialized by Sony in 1991. Avicenne Energy says that past experience shows it takes 10 to 20 years to commercialize a new material in the battery industry. Tobias Glossman of Mercedes-Benz R&D of North America also confirmed the very long time leading to production. During his presentation on Advancing Battery Technology for Mercedes-Benz Applications, he warned that any new battery technology will take a minimum of 8-10 years before being introduced into cars.

Background Note: Given my background in IT, I have always been fond of technology. Therefore it was natural for me to educate myself on lithium-ion battery technology while taking a liking to making assumptions on how this technology could eventually impact society. Energy Storage Systems (ESS) for the grid as well as electric vehicles (EV) holds the potential to change the paradigm in how we produce and consume a large part of our energy.