

Electric Cars Are Revving up the Commodity Trade

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[Yesterday](#), we explained why lithium-ion batteries are fast becoming a really big deal – and it's all about electric vehicles (EVs). There are many ways of storing grid electricity – but for EVs, lithium-ion is really the only game in town. This means that the materials behind lithium-ion technology could be a key constraint. Today, we're going to be looking at the commodities story, behind this battery boom.

What are lithium-ion batteries made of?

A battery consists of a number of different components. Surprisingly, the lithium in lithium-ion batteries is only a small part. In fact, it's a tiny fraction of the whole weight of the battery. Also surprisingly, Tesla's giant car batteries use huge arrays of very small cells – similar to those found in laptops. Accordingly, much of the weight of these batteries is actually taken up by casing materials (typically aluminium). This means that there's a lot of dead weight. As a result there are investment opportunities in new caseless batteries.

If you'll allow me to digress from materials for a moment, you'll see what a big deal this could be...

Research published recently shows that radical redesign of battery form factors is possible. One possible approach is to create large, solid batteries. These are akin to telephone directories, in that they're based on a stack of very thin layers. These don't have small, individual cells, unlike with Tesla's design approach. Saving weight and space are therefore critical advantages, of such a shift. This could lead to range improvements of approximately 100% for EVs – as you can pack more battery in, because there's less case. That would be pretty revolutionary – and it would mean that an electric car has a higher range than a petrol car. Of course, that's not the whole story, and charging time will still impact on usability – as you can always pull into a gas station, to fill with petrol. Nevertheless, very few people need a car to do more than 500-600 miles in a day – which would be around the maximum achievable, using the new technology. The new, high-capacity batteries could mean that the main objection to electric vehicle uptake is pretty much overcome at a stroke. Now, where was I? Ah! Materials...

The case materials are weighty, but inexpensive. They're just standard aluminium or steel – bulk materials with plentiful supply. They make a big different to the cars – but car batteries will barely affect global demand. The actual battery chemistry is the tricky bit – and that's where the money goes. Here, a range of much less-common materials are used.

Let's look at each of the active materials, which make up lithium-ion batteries' core

Firstly, and most obviously, is lithium. Although lithium is a small proportion of the battery's mass (~3%), it's critical – as it's the charge carrier. However, not only is it a relatively small part of the battery, it's also not even the most expensive part. In fact, nickel and graphite are more costly, in the proportions they're used.

The most expensive part of a modern lithium-ion battery is actually the nickel. Now, nickel may not be cheap – but it's not really subject to medium-term supply constraints. Nickel is widely used as a part of steel manufacturing, and also ends up in other alloys. It contributes to everything from coins and pipes, to jet engines. This means that its supply chain is large, and it's well developed. The proportion of the world's nickel supplies used by lithium-ion batteries is quite small. Nevertheless, if we stick with lithium-ion while scaling global battery supply, it could have an impact on the nickel price in due course. But it isn't really the big commodities story, here.

Now, the graphite... Although it is quite a specific material, it's fundamentally just carbon. And while it's a particular *form* of carbon, we're currently not actually using the most optimal type. In fact, graphene-based nanomaterial batteries are looking very promising. For now, such futuristic technologies are limited to research applications – but they're a looming threat to any long-term graphite play you might be planning.

Presently, mined graphite is the preferred source for batteries. You can't use any old graphite – and the required flake graphite is fairly pricey. This material isn't actually subject to supply limitations – as it can be synthesised, if needed. However, this would likely result in severe price increases. Currently, synthetic graphite is around four times the price of the equivalent mined forms. However, if flake graphite gets “knocked out” by nanomaterials, then that's your flaked-graphite play dead. So don't bet the farm!

However, there's a problem – and it's cobalt

Cobalt is a tricky part of the story – and we'll get to that in a minute. But firstly: don't panic. There's at least a chance cobalt can be replaced, if developments to lithium batteries proceed apace.

Meanwhile, there are a few things you really need to know about cobalt. It's produced as a by-product of producing other metals – ie, nickel and copper. It's a fairly small proportion of those revenues – so scaling up to chase cobalt itself isn't really an option. Finally, most of the cobalt-rich ores comes from the hellhole that is the Democratic Republic of the Congo (think of the conditions in the movie *Blood Diamond*, and you get the general idea). Best not to think about that too hard, as you're feeling smug about your new "ethical" EV...

The problem with cobalt isn't that it's particularly rare, or even expensive. The issue is one of scaling. Unless we're going to bear the cost of mining cobalt directly, we'll have to work around the volume constraints from the existing supply chain. This makes it one of the few bits of Tesla's jigsaw that I've seen called into serious question. Consequently, it's a pretty promising commodity play.

So, that completes our whistle-stop tour of the materials behind the battery revolution. Hopefully, it's now apparent how important these commodities are, to the economics of EVs. What's more, the supply and costs issues probably don't lie where many people think they do.

Look beyond lithium: watch nickel, graphite and especially cobalt.

If you're interested in the commodities story behind the new energy revolution, [check out our "white diesel" presentation](#). It goes into far more detail, on how to trade this.

Feedback, as always, to: andrew@southbankresearch.com.

Best,

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