Battery 101: Why Lithium?

I don't understand what's happening in the lithium industry.

For another article involving a lithium company (Nemaska Lithium), I did a fair bit of research into the lithium mining industry. How is a lithium deposit found? How is lithium processed and separated from the host ore? What makes a deposit economic? Global reserves? Uses? Total annual consumption? Energy efficiencies? How much lithium goes into the rechargeable battery on my Ryobi nailgun?

The answers make me wonder why the battery industry is supporting lithium and graphite technologies at all.

Unlike graphite, lithium is an element on the periodic table, checking in at atomic number 3 between helium and beryllium. Like graphite, lithium has been pursued as a key component in batteries, with the electric vehicle industry as the main target market.

Let's start with Battery101. A battery is hardware that stores electrical energy in chemical form. A battery can hold one or more cells, with the cell being the actual working chemical unit inside the battery. A functional cell requires only four parts: a positive electrode, a negative electrode, some chemical to keep them separate (the electrolyte), and something to house it all in. Connecting a battery to a circuit causes a chemical reaction in the electrolyte, flowing

ions through it one way and electrons around the outer circuit.

This flow is what makes “electrical current” in the cell.

There are two kinds of batteries, namely, disposable and re-chargeable. When you charge your smartphone on its rechargeable battery, you’re reversing the current and bringing an electrical charge into the battery. Disposable batteries can’t do this.

Batteries are made from a variety of metals and electrolytes. There are alkaline batteries (containing manganese dioxide and zinc), button cells for hearing aids and watches (zinc, mercury oxide and graphite), nickel cadmium rechargeable batteries, and of course lithium ion batteries. None of these is environmentally friendly.

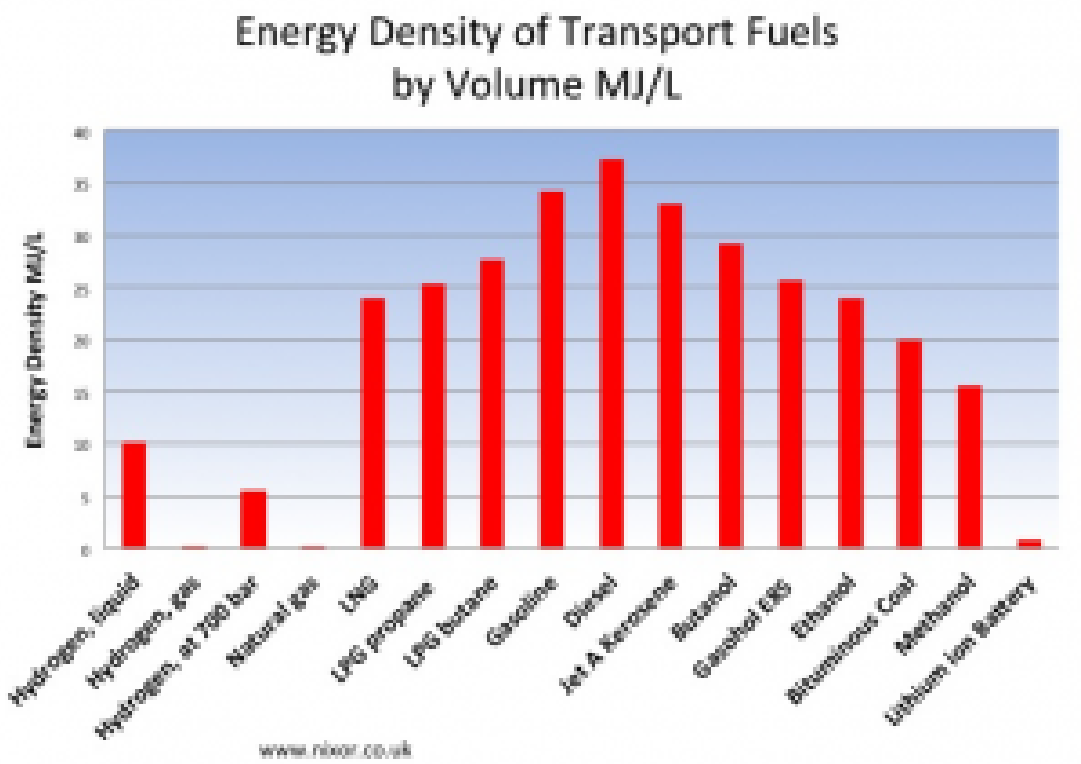
In lithium ion batteries, the positive electrode is lithium and the negative one is graphite. When the lithium is ionized, the electrical current is created.

There’s a great article here that explains in simple science how a lithium ion battery charges, discharges and re-charges.

For the rest of this article assume we’re talking about batteries for the electric vehicle market.

Since you have to take your fuel with you (fill up your car with gasoline, or recharge the battery, or in the days of steam trains load the coal bin), what you want is a process / technology that delivers more chemical energy with less mass. Gasoline and diesel are still the highest density deliverers of energy when compared to their mass.

My concern about lithium begins with this chart from Adrian Nixon:



See gasoline and diesel as still being the two most energy dense fuels. Then look to the far right end of the chart. Lithium and graphite have an extremely low energy density, which means you have to carry a lot of them to create the electrical flow required to power the vehicle. That means more batteries to add to the overall mass of the vehicle and require more power to carry the batteries to hold the lithium and graphite, which adds to the need for more batteries on the vehicle, which adds to the mass, and so it goes. It isn't a "green" solution to keep adding more batteries to yield the same power as could be had from a smaller mass of gasoline.

Mr. Nixon's book "Diesal?" can be bought through Amazon and he's available at his website.

If lithium is this inefficient, why is it being pursued as "the answer"? Tesla Motors seems to believe in lithium, but it's hard to take Tesla's business judgment seriously when it has no plan to address its staggering wall of debt coming due in the next few years. Tesla wants you to think it's Apple but it's looking more like this generation's Nortel.

I was a guest at the Ring of Fire golf tournament this past weekend (thank you, GTA Resources, Ken Adderson and Howard House). Because of a rain delay there was ample opportunity to speak with representatives of companies active in and around the Ring. I asked some of them about this graphite / lithium energy imbalance. No one there was surprised by this, and in fact everyone seemed to know about it, even the reps of the graphite companies.

So, if lithium and graphite fare so poorly in the energy density to mass game, why are they the apparent front runners in the electric vehicle market?

The answers I've received range from "I don't know", "it's the best of what's out there", and "lithium is the greenest of the choices in front of us". That last explanation is a lot like being the best hockey player in Ecuador.

This issue bothers me. If lithium is the clear winner, there should be clear metrics why it's a better positive electrode than any other metal. So it must be easier to find as a resource? Well, no, it's not. Is it easier to extract once found? No. Easier to process? No. Abundant? No. Short supply response? No.

So why lithium?

I don't have an answer to this yet but I do plan on attending the Technology Metals Conference in Toronto on October 14th towards gaining more insight.