Neometals offers five great opportunities for the price of one

One of the first rules of investing is don't put all your eggs in one basket. Diversification adds layers of protection and opens up new opportunities as you will read below.

Neometals Ltd. (ASX: NMT) is not just another lithium company as they also have nickel, titanium, vanadium and coming soon, processing and recycling. Neometals has two key divisions – a fully integrated lithium business and a titanium-vanadium development business. Both are supported by proprietary technologies that assist downstream integration through revenue enhancement and cost efficiencies.

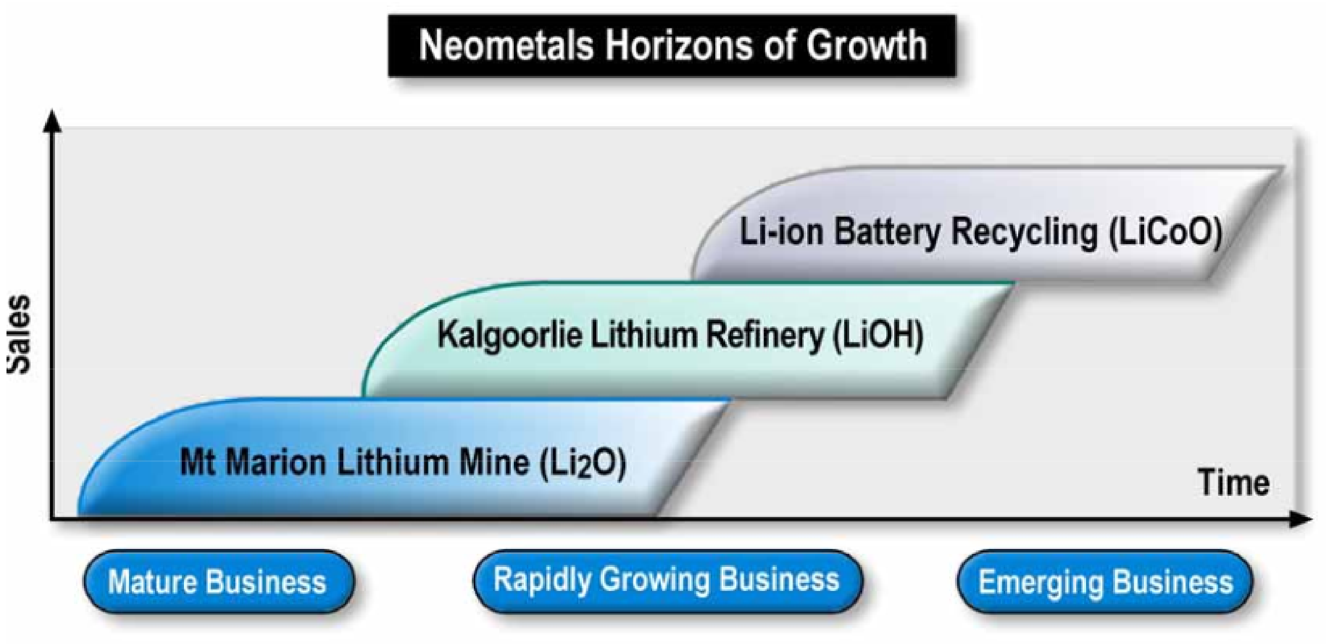
Neometals offers five great opportunities

1) Lithium mining. Neometal's owns a 13.8% stake in the Mt Marion lithium mine near Kalgoorlie, which is currently producing lithium spodumene. Neometals project loans are now all fully paid off and the project is profitable and cash flow positive.

Mt Marion location map

2) Lithium processing. Neometals is currently assessing the possibility for a 20,000 tpa lithium hydroxide plant near Kalgoorlie Western Australia. The plant will potentially be fed from Mt Marion, Mt Holland and Mt Edwards lithium spodumene projects, commencing processing in 2021 assuming it goes ahead. Neometals has also arranged a 2 year option to sublease a 40 hectare site near Kalgoorlie.

3) Lithium-ion battery recycling. Neometals have completed a scoping study showing they can recycle cobalt from lithium-ion batteries. The study showed cobalt could be recycled for as low as US$4.45/lb Co (US$10k/t). The company has a pilot plant in Montreal Canada. Neometals plan to bring in a partner and say that the project can be up and running after 3.5 years.



Neometals growth plans

4) Titanium and Vanadium. The 100%-owned Barrambie Titanium-Vanadium Project in Western Australia's mid-west is one of the world's highest grade hard-rock titanium-vanadium deposits. Titanium is a small market mostly involving super strong alloys. There is a possibility that titanium may be used in the future for lithium ion battery anodes, due to its extreme strength. Vanadium is mostly produced as a by-product from processing titanium iron ore. Vanadium is rapidly gaining popularity especially in China for energy storage in the form of Vanadium Redox Flow Batteries (VRFBs) and for the steel hardening industry as just 0.05% vanadium doubles the strength of steel. Also demand for vanadium in China has increased as new rebar laws are now forcing builders to increase the strength of the steel that is used. This has resulted in the vanadium price rising over 5 fold in the past year.

***Note:** Neometals plans to demerge Barrambie Titanium-Vanadium Project and associated non-lithium technology assets, subject to shareholder/regulatory approvals and third-party consents.*

5) Other

The ELi process, converts spodumene concentrate into a high purity lithium chloride solution, then uses "electrolysis" to produce high purity lithium hydroxide and lithium carbonate.

Lithium Titanate Anode production which shows the potential to replace graphite anodes.

The Alphamet – Neomet Process designed to effectively extract valuable metals for a wide spectrum of base, light and precious metal oxides and sulfides, intermediates and waste feeds.

Zeolite – Neometals are successfully turning engineered material out of spodumene leach residue into a product called Zeolite. Zeolites can be used to remove carbon dioxide (CO2) in air purification, moisture and hydrogen sulfide (H2S) from natural gas and in catalyst protection, among other things.

Neometal's Managing Director Chris Reed said: "External market studies show a large addressable market where we have what appears to be a clear competitive advantage associated with zero cost feed material. Conversion of spodumene leach residues into a sale-able zeolite co-product also creates an opportunity to significantly reduce lithium production costs".

With a market cap of AUD$138M Neometals Ltd. will continue to develop projects and bring in partners to reduce their upfront running costs. Neometals is debt free, cashed up, cash flow positive, and have already paid a dividend to shareholders. Additional revenue streams from licensing and third party royalties for some of their IP processes involving lithium extraction, processing, or recycling will also be welcoming.

Neometals certainly do have their fingers in many promising investments, and are not putting all their eggs in one basket. A great company making all the right moves.

The ‘Real’ Secret Sauce for Recycling Lithium Ion Batteries

Mankind has been recycling since the first metal object broke and couldn’t be put back together with glue made from mammoth bones. Pretty soon the metal sphere had morphed into alloys such as bronze and mankind was off to the races. Recycling bronze meant extracting two metals from the mix or at least resmelting the original object back into something from the same metal.

We have heard several times in recent the use of the term “unscrambling the egg” to refer to the process of recycling Lithium Ion batteries. This makes the process sound almost miraculous because as we all know you cannot unscramble an egg. Having been involved in the initial stages of a recycling set-up I know which technology I prefer to extract the metals and it was eerily simple. This makes us wonder at some of the more complex “patented” processes out there and wonder “why reinvent the wheel?’

Anyway, the promoters of recycling of Lithium Ion batteries are somewhat taking it for granted that there is a latent supplies of batteries to supply their plants. We would agree that there is such a supply but the issue that is not addressed is how that latent supply is mobilized and moved to the plant gate. Moreover while numbers fly about as to how much is gained in value of Lithium and Cobalt (and maybe other metals like Copper) from each battery and we are giving numbers on how much such metals might cost to extract, there is zero cost factored in (that we have seen) for how much the inputs cost.

Let’s couch this in mining terminology. It is like producing a PEA for a mining project and forgetting to add a mining cost. It’s sexy to recall recycling “urban mining” but does the actual mining (as distinct from the processing) come free. The batteries (even if free, and they won’t be) need transporting to the “mill”. Add to that the consideration that the most effective urban mining operation would rapidly “strip mine” the easily available battery stocks and after a certain point the “high-grading” of the Lithium Ion batteries, with a low “strip-ratio” would swiftly become a thing of the past. We all know that high-grading frequently comes back to bite one in the behind leaving the business model untenable in the long term.

Let’s look at some other considerations…

Solving Part of the Problem

There is an old expression about “taking care of the pennies and the pounds look after themselves”. To some extent this applies to the Lithium Ion battery space. Sure the big prize is the EV/HEV market but that is still off in the future. In the short term though (and recent past) the main game has been the battery market in portable devices.

One of my “party tricks” at metals conferences is to ask the audience to think how many redundant cellphones and laptops (and portable power packs) they have lying around in their house. Usually the answer is a multiple of two or three times the number of devices that they are actively using. This implies on a global scale that the “population” of Lithium Ion batteries in personal devices is enough to replace all the batteries in currently used devices when they “die”. This means in a perfect recycling world, zero new demand for Lithium and Cobalt for such devices, indeed there is sufficient metal in extant batteries to more than replace the demand for replacement cellphones/laptops. That leaves some spare for repurposing into other usages (e.g. EV/HEV batteries). Now the other usages are a quantum larger in their consumption of Lithium and Cobalt but frankly as far as the smaller applications are concerned, then recycling has potentially “got ya covered”.

We might quote one of the best-organized recycling chains, which is that of the aluminium drink can. The Aluminium Association states that 67% of the material in the drink cans is recycled. In cellphone batteries we do not see why something like 95% or more should not be recycled. As we have noted many people can’t bring themselves to toss old cellphones. I personally have my doubts about the breezy statement that “they go to the landfill”. My own enquiries would indicate that many people have a growing pile of quasi-redundant electronics with Lithium Ion batteries that they cannot bear to throw away. And neither should they… There’s “gold in them thar hills” but is it gold for the hoarders of moribund cellphones in their bottom drawer? Recyclers imagine they will be given these cellphones and laptops (or at least the batteries) but if word gets around that the cobalt is 20% of a battery and its worth USD56,000 per tonne then the beady eyes of the consumers will open wide and they will imagine that some of that pile of loot should come their way. Payback time! Or is it?

Storage

There is a non-apocryphal tale about a certain US recycler that set up a plant in British Colombia. One day the plant went up in a fireball. Insurance company paid, company did not do that again. Scuttlebutt would say that they were relatively new to the Lithium Ion battery business and in typical “junkyard” practice made a big pile of received material and much to their surprise something went wrong.

The issue of combustibility of Lithium Ion batteries is a real one and immensely pertinent for the Lithium Ion battery collection chain. Too many Li batteries in a collection bin in a supermarket and, oops, supermarket goes up in flames in middle of the night. Who would have thought it?

We don’t need to go back too far to the disappearance of the Malaysian Airlines flight over the Indian Ocean. After hijacking was first discounted, the story circulated that there was a pallet of Lithium Ion batteries on board. That idea in turn was discounted but the mere fact that it was mentioned shows that there is an undercurrent of knowledge on the subject of the spontaneous combustion of these items that is not mentioned publicly to “not scare the horses”. However, it is well known now that United Airlines will not take Lithium Ion batteries as freight and the travails of Samsung’s tablets have put them on the “no fly” list.

One thing of course is to manage the “pile” lithium ion batteries in a junkyard (and that doesn’t seem to be entirely under control) and it’s another to have a myriad of lesser collection points springing up around the world with the keepers of these piles unaware of the risks they face or engender.

Conclusion

Unlike my usual conclusions in which I sum up “how to do it” in this case frankly I have my own ideas and I am not going to tell you. Knowledge is power. In the case of battery recycling the ‘secret sauce’ is not how you unscramble the egg of a Lithium Ion battery it’s how you get your hands on sufficient batteries to make your plant viable. If you build it and they (the batteries) do not come then the promoter will end up with serious egg on face.

I have seen a number of battery recycling plans in recent months and frankly none of them have as good a concept of how they will collect sufficient feedstock as my own conception of how it should be done. This is not rocket science and frankly those that are lacking on this front are not failing because its overly complicated instead they are failing because they have put almost zero thought into how they get the batteries in the front door of the plant. We have often lashed Tesla for relying on the power of prayer to ensure it has ensure battery materials, well might we also critique the putative battery recyclers for the same failing.

InvestorIntel's 6th Annual Cleantech & Technology Metals Summit – The Next BIG Thing.

Cobalt, Lithium, Graphite, Uranium, Niobium, Vanadium, Scandium, Manganese, Hafnium or the next great Magnet Material – perhaps, a Rare Earth star (again)? What is "**the next BIG thing**", "**what is real**", and "**what is fake news**" in the cleantech and technology metals market are center stage on InvestorIntel.com.

With Trump in power, the focus on the global electric vehicle market has presently taken a backseat to geopolitical drivers. Where will countries secure their dysprosium or graphene for fighter jets or the cobalt needed in our smartphones if the Chinese lock the door? This is today's top issue for the industry and investors alike.

The industry and frontline investors are center stage at the #1 international conference for debate and dialogue on these relevant challenges on Monday and Tuesday, May 15-16th in Toronto, Canada – the **InvestorIntel 6th Annual Cleantech & Technology Metals Summit** or as we like to call it – CTMS2017.

So, what should you expect at **CTMS2017**?

- International Analyst and European **InvestorIntel** Editor Christopher Ecclestone will not only address the global supply and 'real' demand for technology metals – he will reveal "the next big thing"…
- Internationally known expert and creator of the term "technology metals", Jack Lifton Sr. Editor of **InvestorIntel** will moderate a panel on the most competitive extraction and separation technologies in the world and will address the 'real' future backup source for these technology metals – the recycling market.
- Chris Reed of Neometals Ltd. who just shipped their 1st supply of lithium to Chinese industry giant Ganfeng, will talk 'real Lithium' – from demand to pricing to what we should expect from the global electric vehicle market…
- Ian Chalmers of Alkane Resources Ltd., an ASX and OTCQX listed multi-commodity mining and exploration company with a focus on gold, copper, zirconium, niobium and rare earths (neodymium, praseodymium), will pull an ace out of his pocket in the cleantech industry and identify what may just be – the next 'magic metal' for the industry: hafnium…
- Bernard Tourillon of HPQ Silicon Resources Inc., with a North American silicon advantage for both supply and technology, will address not only how the solar industry is evolving but how their technology will revolutionize the market!
- Frédéric Dugré of H20 Innovation Inc. will start by explaining why their technology beat out every other major world player to be awarded the #1 water technology of the year in the world (2016) and how clean drinking water may just be your best hedge for your investment portfolio.
- Paul Farquharson of eCobalt Solutions Inc., who

represents the only near term, cobalt deposit in North America, will discuss conflict minerals and what Tesla and the electric vehicle industry face moving forward that may stall the vision unless these issues are addressed….

- Nathan Hansen, CEO of Robix Environmental Technologies Ltd., which just secured a $50 MM expandable contract with PEMEX, will talk about how governments and industry are working together to minimize and mitigate the damages of oils spills.

And we have so much more lined up with a kick off speech from Mark Smith of both NioCorp Developments Ltd. and Largo Resources Corp. on the overall sustainability challenges facing the market, using examples of niobium, scandium and vanadium – the CTMS2017 agenda promises to be our most exciting yet!

Other speakers that have just confirmed include but are not limited to: Alix Resources Corp., Argentina Lithium & Energy Corp., Avalon Advanced Materials Inc., Lithium Australia NL, Search Minerals Inc., Talga Resources Ltd., Wealth Minerals Ltd., Scandium International Mining Corp., Lithium X Energy Corp., Energizer Resources Inc. and Nemaska Lithium Inc.

About #CTMS2017: From electric vehicles to technologies that are changing the world, #CTMS2017 promises to provide the #1 source for debate and dialogue for industry and investors alike looking for the next big thing. Cobalt, Lithium, Graphite, Niobium, Vanadium, Scandium, Manganese or the next Super Metal – #CTMS2017 has 2 dozen presenters and 10 panels filled with international experts over a 2-day intense summit that will leave you with the most exciting review of global equities focused on strategic materials, critical metals and the associated technologies that impact the world.

Engage in the off-the grid, on-the-grid debate; lithium vs graphite demand in the battery battle war; or what about conflict minerals, and is cobalt the real deal – engage with the best and attend **InvestorIntel's 6th Annual Cleantech & Technology Metals Summit** being held on Monday, May 15th and Tuesday, May 16th from 8AM – 6PM at the Omni King Edward Hotel on 37 King St. East in Toronto, Canada (CTMS2017.com).

#CTMS2017 Delegate Passes: To secure a 2-day **InvestorIntel's 6th Annual Cleantech & Technology Metals Summit** delegates pass (includes lunches/reception) for Monday, May 15th and Tuesday, May 16th from 8AM – 6PM, click on the following link: http://bit.ly/2p2lC3k

#CTMS2017 Contact Information: For more information on **InvestorIntel's 6th Annual Cleantech & Technology Metals**, please contact Neil Lock, *Summit Director* at +1 647 345 5486 or 604 380 4888 Neil@InvestorIntel.com. For regular updates on the **Cleantech & Technology Metals Summit**, please go to CTMS2017.com or follow us on twitter @CTMS2017.

Lifton on the global race for lithium ion battery materials

What are the ***fundamental*** business ***type start-ups*** the creation of which point to a permanent increase in demand for a natural resource? For technology metals the business type that small investors must pay attention to is "**recycling**". In particular the investor must note the time between an increased demand for a natural material and the creation of or increased commercial recycling of the end use products containing that material in order to recover the material for re-use. Lithium today is already widely recycled from electric vehicle, computer, and small consumer product batteries in China. This fact has been overlooked by non-Chinese "lithium" entrepreneurs.

It took the Chinese battery industry, the world's largest, very little time to institute recycling once it was clear that lithium ion battery production was a stable and growing business. China has large domestic hard rock and clay lithium resources and these today produce about 25% of the world's total. Lately China has purchased control of or outright ownership of enough overseas' lithium production resources, so that Chinese companies (ie, China) control(s) more than half of the world's productive lithium capacity. Even so lithium ion battery recycling continues to expand within China. I met in China two weeks ago with BRT New Materials in Shenzhen. BRT today produces all of the fine (finished) chemicals that go into making lithium ion battery cells. It buys newly produced raw material precursors and it also recovers such materials from recycling for re-refining and finishing. BRT supplies both Panasonic and Samsung, for example, with 1000 tons a month of engineered graphite for lithium ion battery anodes. What does that indicate?

Three things: First of all that it is the considered opinion of those companies in the world's largest national lithium market that the demand for lithium will grow steadily and will soon outpace the supply;

Second, that the concomitant demand for battery grade cobalt and engineered graphite will also grow and, in fact, has probably already outpaced the supply of cobalt.

Third, and perhaps most important of all, the demand for technology metals and materials for lithium ion battery production is limited as much, if not more, by the existing capacity to produce downstream fine and engineered chemicals and materials than it is by lack of natural resources of these metals and materials.

So, investors should be least interested in junior ventures that are designed only to produce mineral concentrates

More interesting are those ventures that intend to produce and refine the metals and materials downstream to end user ready products from which to manufacture components (cells) of Li ion battery cells.

Most interesting are those projects that are designed to produce finished battery components such as anodes or cathodes.

The more integrated a battery materials producer is the more likely it will be successful.

Globalization will not collapse with a bang, it will recede slowly as the world's national "great powers" decline, recover, or emerge, and, in all cases, re-align. China is forging ahead to cement itself as the regional power in Southeast Asia, currently, collectively, the site of more than half of global GDP. The USA, still the world's greatest military and economic power will now retreat but still leads a North American regional hegemony. Europe is at a turning point; it could fracture into its historical mix or re-align as two military Great Britain and France, and three economic powers with the addition of Germany.

The EU and Great Britain are already pursuing natural resource and energy self-sufficiency and the EU has identified multiple domestic (continental European) sources of lithium, the rare earths, and graphite, which were ignored until this year, for immediate developmental focus so that the EU can convert to vehicle electrification and stationary storage as rapidly as possible. Recycling projects for lithium, cobalt, the rare earths, and graphite are already in operation and many more are in process.

North America has no lack of energy storage materials as natural resources; it has up until now lacked the will to capitalize both security of supply and green production systems. This is changing rapidly.

"Global" competition for natural resources for energy storage is well underway, and China is far ahead of all of the competitors. Recycling won't achieve domestic self-sufficiency anywhere but without it there can never be either security of supply or national self-sufficiency anywhere. The battle is joined.

Upcycling: The influence of de-globalization on the supply of technology metals and materials

The principal driver for change that I see in the overall supply picture for technology metals and materials as a result of the end of, and the slow reversal of, globalization is the realization by intelligent people of the need for capitalization of the security of their supply by individual nations. This I believe will re-start many projects that were deemed uneconomical without the added value of security of supply, **and it will make the conservation by recycling of critical materials not only nice but necessary**. The capital may well come from subsidies, both governmental and through apparent “premium” pricing used to enforce industrial policies such as already is in operation in China, Japan, and Korea; and even in the USA as governmental grants officially said to support **innovation** or the **environment**, since direct subsidies for critical materials would go against Washington’s neoliberal narrative (also in its death throes along with globalization-its baby). You can chose your own prime mover for this: It can be the political need to create domestic manufacturing jobs or the geo-political need for resource security either to insure those jobs or to become independent of the influence of other nations on your own nation’s economy and military preparedness.

The bitter competition among Asia’s largest economies, which collectively are nearly twice as large as that of the USA, for natural resources is now the principal driver of demand for all natural resources.

As for the infrastructure metals, so aptly named by my colleague, Christopher Ecclestone, the USA and Canada are uniquely insulated from global iron, aluminum, copper, zinc, and lead prices, to name the most useful, by not only the domestic presence of existing producing mines, reserve formerly producing mines, currently on care and maintenance, and known mineable deposits, but also by the world's most well developed recycling industry. Europe has far less domestic "mining" resources of these types (Thus the creation of the mercantile empires of the just now historical past), but it, Europe, has a large and well developed recycling industry across not just infrastructure metals but also technology metals and materials. Asia's main industrialized nations until this century were on the periphery of the continent and poorly endowed with natural resources, so they (Japan and Korea) became not only importers but from the very beginning recyclers of all metals, infrastructure and technology. One of the "causes" of Japan's expansion of its Asian war of conquest to include American colonies in World War II, celebrated by economic historians, was certainly the decision by President Roosevelt in 1940 to cut off Japan from exports of American iron, steel, coal, and oil leaving Japan's Imperial Navy with just a six-month supply of fuel, for example.

The advent of the Chinese raw material eating economy of the early 21st century was sudden and dramatic as well as immense. Just as with the American Revolution the world (of resource supply and demand) was literally turned upside down in just a few years. Financial engineers with no regard for future planning or long term outlook wasted enormous amounts of capital "looking for resources" from small investors to milk for "junior mining" schemes while real producing global miners and refiners foolishly overspent their unexpected gifts of capital on the supply of infrastructure metals while allowing scarce technology metals and materials supply as well as demand to move out of their control. The big three of Asian economies, now China as well as Japan and Korea, immediately added recycling to purchasing and domestic mining (China) of technology metals and materials. This was and is intended for security of supply. All of these nations have explicit or implicit industrial policies of conserving and recycling scarce natural resources necessary to maintain technological parity with each other.

It is time for North America to play catch up on technology metals and materials conservation and recycling. North America has the most diverse supply of natural resources of any continent except Africa. North America also recycles a higher percentage of its infrastructure, transportation, and household “white” metal scrap than any other region on the planet. But as to technology metals and materials North American conservation and recycling has been woefully deficient in recycling even though the region long ago gave up the primary production (often as companion metals) of technology metals and materials. The short sighted financial engineers and politicians of North America have turned a blind eye towards the necessity of self-sufficiency in technology metals and materials.

The recent attempt, so-called, to “revive” rare earth mining in North America was a great success for financial promoters but achieved not one dollar of growth of North American wealth but rather a redistribution of existing assets to promoter fat cats. It is not at all surprising therefore that there also was no downstream supply chain development in the rare earth space in North America during the rare earth “boom.” Why develop processing assets if there is nothing to process and no reason to do so anyway.

But now as globalization reverts (or perhaps “re-sets”) once again (the third time in 125 years) to its primary driver, economic national self-sufficiency, it is time to take a fresh look at the North American technology metals and materials spaces. This time though we needn’t just pretend as the promoters desire us to that exploration has any more than nominal value. The key metrics now have to do with downstream supply chain development. And this will be measured by the costs and efficiencies of demonstration plants not drill holes, metallurgies, and laboratory results.

First let's look at the (technology metal) alloying elements used to make modern lightweight corrosion resistant steels: There are plenty of known but mostly undeveloped chromium resources in North America in Quebec and in California/Oregon; there are producing mines for niobium in Quebec today and at least three new ones in development, two in Canada and one in the USA; vanadium is produced as a byproduct of uranium both in the USA and Canada; one of the world's best developed nickel resources is in Sudbury, Ontario and geographically nearby is North America's newest nickel mine in Michigan's Upper Peninsula. Cobalt is produced as a companion metal at the Sudbury nickel complex, and there are primary cobalt deposits both in the USA and Canada. Molybdenum is mined in the USA both as a primary and as a companion (to copper) metal in such volumes that the USA is a net exporter of Molybdenum. Finally tungsten is present in known large deposits in North America and is currently mined in Canada in significant volume. All of these alloying elements are recycled today in the USA for re-use in making new steel alloys.

I am not going to discuss the platinum group metals, since I think they are already in sufficient supply, maintained by a very effective recycling industry in the USA and Europe, so that there will be no platinum group metals shortage so long as the electrification of vehicles by storage battery continues to grow apace. The most well organized scrap industries in the world are the West's iron and steel, aluminum, copper, lead , nickel, zinc and platinum group metals ones. Just to give an example of efficiency: Lead recycling in the USA accounts for 85% of annual demand for lead; somewhat less of the steel demand is met by recycling, and even the least demand replacement, that for the platinum group metals is already nearly 40% from recycling!

Where the North American manufacturing industry has not done the conservation and recycling job is with technology metals for electronics. This has been principally due to outsourcing and dissemination. Out of sight, out of mind is a good analysis of why seemingly intelligent American sourcing managers have ignored recycling. As recently as last year I was told of a meeting of a rare-earth junior with the PhD (physics) sourcing director of a California electric vehicle manufacturer who confidently told the visitor that his company did not use or buy rare earths. This person was apparently unaware of the rare earth enabled motors, generators, and sensors used in every motor vehicle no matter what the fuel for the power train might be. Yet someone at the same company directs the end of life and scrap lithium ion battery packs from that company's vehicles to a contracted disassembler and the separated cathodes (lithium and cobalt) and anodes (graphite and copper) thus produced to overseas reclaiming operations where the technology metals and materials are extracted, re-purified, and reformed into raw materials for new battery cell manufacturing. One of, if not, the world's largest vehicle manufacturers uses the same disassembler to not only recover the valuable critical technology metals from its lithium ion battery scrap but also from its nickel metal (rare earth) hydride battery scrap. All such prepared scrap is sent either to Japan or Vietnam for "recycling." Waste not want not, seems to be the Asian mantra.

Financial engineers still try to trick us and to squeeze money out of politicians through the fantasy of "urban mining." This is my personal favorite con game. On a regular basis some new venture will announce that it has a "technology" allowing it to recover critical (technology) metals from undifferentiated consumer electronics. Overlooked purposely by promoters of this type of "venture" is the fact that the bulk of these materials are submerged in undifferentiated household garbage intended for landfill. Also overlooked is that the overwhelming revenue from giant garbage (waste) collectors is in “tipping fees.” The money that they are paid to pick up and take the garbage to “landfills” formerly known as city-dumps. A client of mine recently found out just how basic such collection is when they asked the largest American garbage collector for a price per kilogram of prepared (separated) rare earth permanent magnet scrap. They got the number $35/kg, which wasn’t unreasonable considering the dissemination of such material in household scrap. I had explained to them repeatedly how to get such prepared scrap much much cheaper from within the automotive and white metal scrap supply chains but they wanted to “outsource” the supply rather than develop it. When I go into the market to source such scrap I, of course, find that my competitors are Chinese or Japanese.

The technology metals and materials that could be collected and economically concentrated in the USA from our industrial and consumer scrap are:

- Rare earth battery and magnet component metals,
- Lithium,
- Cobalt, and
- Engineered (anode) graphite

A nascent industry for all of the above already exists in the USA-I am not aware of any domestically owned Canadian ventures at this time.

As the attraction of potential holes-in-the-ground to be filled with money (junior mining projects) subsides we may see “recycling projects” born to fill actual needs and on-shoring of manufacturing picks up again. Be very careful of “urban mining” and “disruptive technologies” put forward as differentiators of projects. Existing technologies are to be replaced **only** when it makes economic sense. The issue in recycling is the difference between the **total** costs and the **total** value of all of the components and materials that make up the devices or components to be recycled. Recycling projects are most often rejected by financiers because the selling price of one of the recovered metals is less than the cost of it when obtained as the only product from the recycling project. This is an incorrect analysis.

Here’s a new word for small investors and even institutional investors to add to their vocabulary:

Upcycling, also known as creative reuse, is the process of transforming by-products, waste materials, useless, or unwanted products into new materials or products of better quality or for better environmental value. **Upcycling** is the opposite of downcycling, which is the other half of the recycling process.

Lithium, Graphite, Cobalt, Neodymium, Praseodymium, Terbium, and Dysprosium poised to Skyrocket

Junior mining stories are invariably predicated upon peak supply stories. Either current supply is insufficient or future supply will be insufficient to match the market's demand. In either case therefore demand can only outstrip supply and prices therefore must go up.

But now we have a new metric to consider when looking at junior mining ventures, peak **demand**.

OPEC picked today to announce that its members, who collectively produce 1/3 of the world's petroleum, predict that demand for oil will peak in 2029 at 100 million barrels per day and decline after that.

It is the reasons why OPEC has forecast the end of its growth that should get our attention. First and foremost is the agreed and legislated reduction of fossil fuel burning to create electricity mandated by the just ratified (though not by the USA) Paris Accord on Climate Change, most importantly though for small investors is the reduction in the use of petroleum for making fuel for internal combustion engines.

I just returned from China where I heard a speaker from BYD forecast that China will produce 40 million cars and trucks per year by 2025 and that by 2030 30% of annual production of motor vehicles in China will be EVs. Thus China alone in 2030 would produce 25 times as many EVs each year as the entire world does now.

Assuming that the above forecasts, peak oil demand and EV vehicles as a percentage of all vehicle production are true globally then demand for: Lithium, Battery grade Graphite, Cobalt, Neodymium, Praseodymium, Terbium, and Dysprosium will skyrocket in the next 14 years, while demand for: Platinum, Palladium, and Rhodium should level off, **peak**, and decline in the next 14 years.

I note that the **recycling** of the metals and minerals (graphite) that I am saying will skyrocket is well underway in China, and hardly or not at all in the rest of the world. China’s practicality and focus could not be made more manifest.

Battery materials’ recycling **must now** become integrated into the supply chains for batteries, electric motors, and electric generators in those nations where the primary supplies are scarce or non-existent (such as the USA!!!).

For the platinum group metals **as demand peaks and then decreases recycling**, which is already 30-40% of the supply, will only increase until new mining is only marginally necessary if at all.

New technologies for recycling are nice but not necessary unless they show a clear reduction in cost and environmental impact!

When you are looking at the bottom line always capitalize environmental impact (or lack thereof) and then if you see profit and a return on your capital, invest.

Junior processing technology companies can only be successful when their process technologies decrease costs and improve the environmental impact of an industry. This is most likely to happen when new and newly applied processing technologies are used to address recycling. Mature industries that are profitable will not take on debt to replace technogies that work well enough. It is for junior technology metals and materials ventures, not the least of which are for recycling, that new and newly applied technologies show the most promise for a path to profitability.

As a recent Nobel Prize winner famously sang, “The times they are a-changin.”

Lifton on the recycling of lithium ion batteries

I spoke at the Mines and Money, Toronto, Conference last Monday in the Battery Materials Section, and I was struck by the fact that battery materials’ recycling has a fluid definition, so I’d like to give you my answer to the question. What exactly do I mean by the “recycling of lithium ion batteries?” I mean the profitable recovery and reprocessing for re-use of the functional materials and their precursors necessary to construct the operational parts (the cathode, electrolyte, and anode) of a new lithium ion battery for the same purpose as the one that was” processed” to recover the raw materials used in its construction. So now what does all of that mean?

A lithium ion battery is a fabricated (man-made) device for the efficient economical storage of electricity and for its controlled release upon demand.

Such devices (the batteries) are manufactured with the lowest cost of construction, operation, and efficiency that is practical. They are not today designed for ease of recycling. So in order to recover the maximum value from a damaged or end-of-useful-life battery (i.e., a scrap battery) one has to devise a general purpose way of disassembling them mechanically; extracting the desired raw materials; and separating and refining them back into materials ready-for-use by manufacturers of battery cells, those modules from which the battery is itself constructed. It goes without saying that one also needs to sell the ready for use raw materials and components to a cell manufacturer who in turn can qualify his product with his end use battery manufacturer customer with your raw materials being used. To do this you need to be aware of your customer’s (the cell manufacturer’s) specifications before you start!

Not all of the desirable materials in the scrap are chemicals. There are the materials of construction of the case, the cathodes, the anodes, and the internal structure. There is also the internal copper or aluminum “wiring” in the battery; and there are the electronic control “chips,” the fluid control valves, and the sensors used in battery internal management.

The most efficient recycling will always be done if the feed stream is uniform. But in the real world this is unlikely to be economically feasible.

The stream of scrap batteries to be first disassembled to marshal the above desired raw materials, structures, and components will be mixed, so that although a general disassembly protocol can be developed it will be and must be designed to be flexible.

Liquid electrolytes can be simply drained but mixing the ones from different battery types destroys their recyclability. It is the same with electrolyte membranes.

It is unlikely that the profitability of lithium ion battery recycling will be dependent on the recovery for re-use of electrolyte liquids or membranes. But even if not a cost will be incurred for their safe and legal disposal.

Assuming that has been done the next step involves mechanically separating the components of the cathodes and anodes.

In modern large scale lithium ion batteries the cathode is an aluminum foil “coated” with a chemical or chemicals (such as lithium cobalt oxide-a cathode material formed by the cell maker which may contain, for example, nickel, manganese, and related metals). The anode will be a copper foil coated with a mechanically formed type of spherical graphite. The electrolyte liquid or membrane will be a mix of organic and inorganic chemicals and materials.

Probably the best way to recover the cathodes and anodes is by hand separation. It is best to separate the electrode coatings mechanically or even by freezing (as one recycler does) so as to break the bond between the coating and the support.

The metal foils upon which the coatings are put are if recovered intact and cleaned suitable for re-use perhaps not in a new battery but certainly in a refurbished one. At the very least they are pure metals, aluminum and copper, and have value in the scrap market.

The cathode coatings contain lithium and in the USA will probably contain cobalt and may contain nickel and manganese also.

These coatings can easily be put into solution in acid or base and the individual metals separated and purified by ordinary chemical processes or by newer processes that are more economical such as Molecular Recognition Technology the selectivity of which allows the desired metals to be recovered individually from mixtures without the need for elaborate traditional precipitation, filtering, and associated steps. Once the individual metals are in solution they can be easily transformed into the salts specified by the customer at the degree of purity required. In all cases the newly reformulated “salts’ must be battery grade. This means, for example, for cobalt that the cobalt salt must be iron free. Today both the extraction of the lithium and of the cobalt from the mixed solutions and the purification of the cobalt to be iron free could be done in a few steps by existing Molecular Recognition Technology developed by IBCAT of Utah.

The anode presents a different problem. The graphite coating must be “cleaned,” of residual metal ions and this is usually done as in the initial preparation of the graphite by an acid wash or by pyrolysis. It is the form of the graphite as well as its purity that must be maintained. Electrodes must have the greatest possible surface area so that the graphite has been “spheronized” and often coated so that the anode will be millions of graphite spheres giving orders of magnitude more surface area than a strip or chemically or physically deposited layer of pure graphite.

Clearly the total recycling for re-use of the recoverable materials in a scrap lithium ion battery is today feasible. Many companies already disassemble such scrap and sell it or send it to various other entities in the battery materials supply chain.

Now it is time to assess the total economics of recycling the recoverable raw materials in such batteries and refining them back to customer specifications for re-use by cell and new battery manufacturers. This involves collecting the scrap preparing it, extracting the desired metal and component values, remanufacturing the chemical values to customer specifications, and marketing the products.

All of the above steps are being done individually and in some combinations.

It’s time for vertical integration.