Blog

Metals for the global energy transition

Opportunities and salutary lessons

by Alan R. Roe

In a series of high-level UN Roundtables (https://www.wider.unu.edu/news/unu-wider-experts-key-role-global-roundtable-process-extractives) , in which I participated in 2021, experts and stakeholders explored the risks and opportunities presented by the global clean energy transition. Discussions included the prospects for lower-income countries arising from the electric vehicle (EV) revolution in the global automotive market.

In addition to the benefits for reducing climate risks that such a change portends, several lower-income countries are richly endowed with the metal and mineral inputs which are essential to that transition. An assumption often heard during the Roundtables was that the existence of these endowments of itself provides a strong case for investments in a domestic processing industry: surely a route to increased local value-added and enhanced national development!

This familiar assumption holds particular force in countries such as Bolivia, whose President spoke at the 2021 Latin America Roundtable (https://www.wider.unu.edu/event/tony-addison-and-alan-roe-2nd-un-roundtable-extractives) on his country's ability to achieve significant value addition on the back of its huge lithium resources, and Zambia, with similar hopes for its copper reserves.

But is the domestic processing of critical metals required for EVs really an opportunity for such countries?

History offers several counter examples which show how large investments in downstream processing can even be value-reducing given the various policy incentives that such investments normally require. Documented examples include efforts, such as India's, from 2011 onwards, to encourage iron-ore processing and a domestic steel industry, and Indonesia's, from 2014 onwards, to encourage local bauxite processing.

These and other examples are discussed in a UNU-WIDER research paper (https://www.wider.unu.edu/node/237313) by Östensson and Löf (2017). The authors argue that without economies of scale, or when alternative processing capacities are

readily accessible, domestically processed metal can be less competitive on world markets, more expensive than the alternative imports, and so unattractive commercially for domestic manufacturers. Common factors which also constrain successful downstream processing include the unreliability or cost of crucial inputs, especially electricity.

To offset such problems, governments may need to resort to high tariffs and import quotas to force domestic manufacturers to buy the more expensive domestic product. This in turn raises prices and harms domestic manufacturing. The alternative of subsidizing processing is also undesirable because those subsidies might be better spent on infrastructure, education, and health, all potentially of greater value.

In the context of the EV discussion these general problems are compounded further by the reality that the critical metals required, such as lithium and cobalt, also require highly specialized technological capacity to process. That capacity is globally scarce and presently much of it is concentrated in a few companies and geographically in Asia, especially China. It is not at all easy to develop locally.

In summary, any lower-income but resource-rich economy needs to overcome several daunting challenges if it is to successfully convert its specialised mineral wealth into the batteries and other industrial products needed by EVs. These include:

- the need to achieve reasonable economies of scale to avoid the need for large subsidies
- having access to critical inputs notably electricity at competitive prices
- having the ability to access the relevant but highly specialised technical capacity to process the raw metals, and so derivatively from the points above
- having reasonable prospects of being able to compete with existing and accessible processing industries elsewhere in the world.

Bolivia, a cautionary tale

Bolivia under Evo Morales (President from 2006 to 2019) set out ambitious development aspirations designed to exploit its huge lithium resources as a key part of its strategy to remedy the country's chronic poverty: Bolivia is Latin America's poorest economy. Efforts by Bolivia's neighbours have similarly tried to build development on the basis of their own large natural resource endowments.

Venezuela's questionable use of its oil reserves comes to mind, and Chilean copper (at certain points in its history) provides a significantly more successful example.

Chile has the world's largest reserves of copper. Bolivia has the world's largest potential reserves of lithium — it has been labelled the Saudi Arabia of lithium — the most critical metal in the production of the batteries used to power EVs. So could Bolivia's lithium reserves deliver the same developmental gains seen from Chilean copper?

There are four main stages in the production of EV batteries from lithium. After raw material production (extraction from brine), there is purification/refinement, processing, the manufacture of battery cells, and finally the assembly of cells into a battery pack. Bolivia has tried and so far, failed to overcome the technical complexities involved.

These technical problems stem in part from the extraordinarily high ratio of brine to usable lithium carbonate in raw material production — up to 150kg of brine is needed to produce 1kg. Furthermore, an incredible level of purity is required for battery cathode materials.[1]

As Bolivia has painfully discovered, a number of institutional realities compound these technical difficulties. The country's President from 2006 to 2019, Evo Morales — deeply suspicious of Western capitalism — committed to using the country's lithium to produce battery grade chemicals, to establish local battery manufacturing capacity, and even to produce Bolivian-made electric vehicles. Given the absence of the necessary Bolivian technical skills, Morales was aware of the need to partner with appropriately skilled foreign companies. But he also insisted on the Bolivian state retaining at least a 51% control of any such partnership. The search for this technically competent, but politically compliant, foreign partner has so far led Bolivia down several blind alleys: documented in detail by Lukasz Bednarkski (2021 (https://www.hurstpublishers.com/book/lithium/)). These include:

- Failed negotiations starting in 2009 with French President Sarkozy, the French companies Total and Eramet, and the international logistic group Bolloré — all abandoned in frustration in 2010 (Bednarski 2021 (https://www.hurstpublishers.com/book/lithium/) : 134).
- Failed discussions with the Japanese company Sumitomo — already heavily invested in other mining in Bolivia — over its interest in developing the lithium-rich Uyuni salt flats. This was abandoned by Sumitomo because of the

impenetrable red tape, trade-union objections, and the potential threat of full nationalization (Bednarski 2021 (https://www.hurstpublishers.com/book/lithium/) : 135).

- Plans promoted by the German government that led eventually to a $1.3 billion investment commitment by the German industrial equipment company ACI Systems — aborted suddenly in November 2019 when Morales, responding to local protests, unilaterally repealed the Decree establishing the joint venture (Bednarski 2021 (https://www.hurstpublishers.com/book/lithium/) : 141).

The upshot is that the Bolivian state — the would-be 'Saudi Arabia of lithium' — today has only a tiny production of lithium battery chemicals (mainly from pilot projects) and is upstaged by some Latin neighbours. It has failed to partner with any of the world's most technologically advanced battery companies — especially the Chinese — to deliver a potential lithium boost to Bolivian development.

Southern neighbours Chile and Argentina, and Mexico, have been more astute in this regard. Chile, for example, orchestrated a $4 billion deal between the large Chinese company Tianqi Lithium and its own Sociedad Química y Minera de Chile (SQM) (Bednarski 2021 (https://www.hurstpublishers.com/book/lithium/) : 63). Mexico similarly achieved a large investment by China's Ganfeng Lithium (https://lithiumcongress.com/ganfeng-lithium-wagers-28m-on-sonora-lithium-deposits-in-mexico/) — a top global producer of battery metals — into its own Bacanora Lithium. So, world leading technology is now married in both countries to their large reserves of lithium.

What Bolivia's experience to date illustrates so well is that a large natural resource endowment is only potentially valuable to a country's development trajectory. To leverage the endowment, even when global demand is high, is no simple task.

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Endnotes

[1] A much more detailed explanation of these points can be found in Bednarkski, pages 52,104, and 131.

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