

HOW CAN INDUSTRY ADAPT OPERATIONS TO MEET CHANGING DEMAND FOR MINERALS DRIVEN BY THE UPTAKE OF LOW-EMISSION TECHNOLOGIES

Framework Step:

STEP 4. Support and contribute to innovation leading to new products and services

4. A What can host governments do?

- Identify changing trends in global consumption and production patterns (progressive ore grades decline and increasing labour, transport, energy, processing, capital/ equipment costs), changes to end uses for minerals (innovation in final products), and carbon emissions trading.

4. B What can extractives industries do?

- Leverage extractives sector operations to increase use of renewable energy, as appropriate. This could be done for example by either linking production to renewable energy (e.g. making use of solar and wind power to reduce the contribution of fossil fuels and greenhouse gases to mineral and oil & gas production, while reducing high electricity costs associated with the use of decentralised diesel generators) or by developing green supply chains (e.g. mining rare earths and supporting local manufacturing of magnets for wind turbines to provide clean energy or mining lithium to manufacture electric batteries for incorporation into green products).

4. C Host governments, extractives industries and civil society can work together to:

- Engage in co-operation based on project life cycle analysis, covering the entire value chain and offering the opportunity to build on best practices of several sectors.

Tags: *In addition to the Framework step(s) that they fall under, examples will also be tagged by crosscutting issues. Please select all applicable tags.*

- local employment
- local supplier participation and development, including SMEs
- marginalised groups (women, indigenous people)
- skills development and upgrading
- access to credit
- shared infrastructure (transport, water, power)
- technology transfer
- innovation
- economic diversification
- Other: Low Carbon Transition

Problem Statement:

Mining companies are projecting and adjusting operations for changing mineral demand, in particular, copper, nickel and cobalt due to the growing market for electric vehicles (EVs), which are driving increasing demand for lithium and rare earths not previously foreseen. As EVs become an increasingly important segment of the transportation market, the specific demands of electric engines, differing from traditional internal combustion engines, will need to be supported by robust supply chains. While electric vehicles currently make up a small percentage of the global transportation market – as of 2017, just 0.2% of the total number of passenger light-duty vehicles – this share is forecast to grow significantly over the coming decades (IEA, 2017).

An average pure battery-powered EV requires four times more copper than a conventional vehicle, approximately 80kg, amounting to approximately 8.5 million tonnes of genuine new demand, equivalent to more than a third of current total global copper demand. In addition to copper, the growing EV and battery market is also disrupting other mineral markets through increased demand including nickel and cobalt, and associated chemicals such as nickel and cobalt sulphate — key components in lithium-ion batteries that power EVs and other energy storage technologies.

Parties Involved:

- BHP Nickel West
- State Government of Western Australia
- South Metropolitan TAFE (Technical And Higher Education)
- Department of Industry, Innovation and Science, Commonwealth of Australia

Common Ground:

Significant growth of electric vehicles and energy storage systems is creating radical changes in the demand for minerals and metals, such as nickel, cobalt and copper, used in the batteries required to address these trends. This created an opportunity for BHP's Nickel West operations to reorient its business by exiting the stainless steel market, and dedicating itself to supplying the nascent battery market with nickel and other products required along the value chain.

Australia is the 5th largest nickel miner in the world, producing more than 200 000 tonnes each year. Globally, 68% of nickel is still used in stainless steel, with 3% used for batteries. Australia has the world's largest nickel reserves, an estimated 18.5 million tonnes, representing 24% of the world's total estimated nickel reserves. Western Australia is currently the sole producer of nickel in Australia, and nickel refineries are located in Queensland and Western Australia. State Governments are responsible for the majority of Australia's onshore minerals legislation and regulation, and receive royalties from resources extraction. State governments have started to take steps to facilitate industry's reorientation to support value chain development. State governments have contributed towards the establishment of new energy research centres and offered favourable leasing conditions to commodity producers moving downstream. In addition, they are playing an active role in strategic leadership for Australia's future battery industry through participation in, and contribution towards funding of, co-operative research centres and chambers of commerce and industry. The objectives of these groups include identifying and assessing government policy options that can be used to facilitate investment in downstream processing, with the goal of positioning Australia as a globally strategic supplier for the battery industry supply chain.

With Australia's position as a major producer of nickel, the Australian Federal Government maintains an interest in its global financial, economic and political shifts. The Federal Government funds the Co-operative Research Centre program, which has a number of resources related initiatives, and the Industry Growth Centres, National Energy Resources Australia (NERA) and METS Ignited. Other Federal Government initiatives include the Clean Energy Finance Corporation (CEFC), which was established to help mobilise investment in renewable energy, low emissions and energy efficiency projects in Australia, and the Australian Renewable Energy Agency (ARENA) with funding focused on finding and demonstrating first-of-a-kind renewable energy solutions. Both the CEFC and ARENA have supported mining companies supplying the renewable energy market.

Actions Taken:

BHP conducts short and mid-term forecasting on different trends that may impact their business. The company projected that two related megatrends, electrification of transport and decarbonisation of the power sector, would have a strong positive uplift to nickel and cobalt demand through the use of nickel-rich lithium-ion batteries. In order to meet projected increased demand, BHP planned to expand its production of nickel and cobalt and produce downstream products for the battery supply chain, while also keeping copper as a focus of the company's portfolio.

Lithium-ion batteries – in which nickel can be a core component – are a dominant EV battery technology, and are expected to remain so for the foreseeable future. Lithium-ion battery demand for EVs is expected to grow from 21GWh in 2016 to 1300GWh and by 2030, and the market to supply nickel for EVs may be worth approximately USD 4 billion. BHP noted that the nickel-rich chemistries in particular used in these battery technologies are popular due to higher energy density, lower costs and increased vehicle range. Tesla for instance uses Nickel-Cobalt-Aluminium (NCA) for the Lithium-ion batteries in its EVs. A higher cobalt price was also expected to incentivise rapid adoption of more nickel-heavy technologies.

Nickel West Nickel Sulphate Project at Kwinana Refinery

Despite a decision to sell Nickel West in 2014, including mines and concentrators at Mt Keith, Cliffs and Leinster, the Kalgoorlie smelter, Kambalda concentrator and the Kwinana refinery, BHP altered its strategy and began work to build a nickel sulphate plant at the site in early 2018, and is considering further expansions to make it the largest source of nickel sulphate worldwide, as well as a hub for other battery ingredients.

Through Nickel West, BHP is now aiming to sell more than 90% of its outputs into the global battery supply chain by 2020. Further expansions are being considered to increase outputs and to add cobalt sulphate to the production mix, as well as significantly extending the projected life-span of the operations.

Obstacles:

- New deposits of base metals tend to be found either in lower concentrations or deeper underground than previous finds. This may add to the technical complexity and cost of development. As such, Nickel West are innovating their vertically integrated value chain to maximise recoveries, process recycle streams and residue streams, and add infrastructure to treat existing but unutilised equity resources.
- The same green trends that are driving the growth in EVs, such as pressure to reduce greenhouse gas emissions, are also driving strong environmental regulations around energy efficiency, local pollution and site rehabilitation. This is likely to impact the cost of new projects. Relatedly, there are potential obstacles to the use of EVs, such as availability of charging stations, which tend to be heavily dependent on the policy and regulatory

environment. Government policies may impact the projected pace and scale of the deployment of EVs.

- Alignment with, and where necessary adaptation of applicable standards for sustainable sourcing practices is recommended, to reduce risk for firms entering new markets or regions.
- Water scarcity, and competing demands for limited water supplies is also an ongoing issue, particularly in environments where water management and supply is already a concern such as in Western Australia.

Enabling Factors:

- Low technical risk and existing installed infrastructure in the Nickel West system will assist in reducing the overall capital cost of installation for Nickel West and BHP in this particular initiative. The Pilbara, in Western Australia has a long history of mining, and BHP's presence in the region is also well-established. Historically, Western Australia's nickel industry has also been unique in that producers were often dependant on the operations of competitors. For example, Independence Group, Mincor and Panoramic sold ore to Nickel West for processing and in turn, Nickel West relied on such companies to ensure a consistent supply of ore to maintain operations (Government of Western Australia, 2017).
- The association between nickel production and the manufacturing of green technologies such as EVs may help to provide some degree of social licence for new projects, particularly in countries where air pollution is a critical challenge. In addition to the use in EVs, lithium-ion batteries are being increasingly used to provide grid stability, which will become increasingly relevant in a carbon neutral world.
- While the global supply of nickel is substantial at ~2Mtpa, this supply is highly fragmented, serving large pools of various end uses. Almost half of global nickel supply is met by low grade Class 2 nickel producers (Nickel Pig Iron and Ferronickel) and covers the needs of the stainless steel sector (~70% of primary nickel demand). The remainder is met by higher quality Class 1 nickel producers, which address the demand in alloys, specialty steels, plating and the battery sector. Currently, Class 2 nickel production is growing and displacing Class 1 from stainless steel, which has kept the nickel price depressed in recent years. However, battery producers require a higher purity supply of nickel in the form of nickel sulphate, which currently can be derived only from a small segment of Class 1 production in a cost-effective manner. While this represented an opportunity for BHP, as a Class 1 producer, it may present an obstacle to entry to others.
- On the other hand, nickel prices rose from approximately USD 13 000 a tonne in April 2018 to over USD 15 540 a tonne in early June 2018. Prices are expected to hold onto much of their recent gains over the remainder of 2018, easing off only slightly towards the end of the year as growth in the production of stainless steel slows marginally, and the supply of pig-iron nickel picks up. Prices are expected to continue easing marginally out to 2020, as new supplies of pig iron continue to enter the market. Longer-term demand for new battery and medical technology (nickel is the biggest component of most medical implants) is expected to start adding more significant price pressures in the refined nickel market towards the end of the outlook period.
- Nickel West's operations are located close to both the raw materials and the Asian battery market, where demand is likely to grow significantly particularly given the potential co-benefits between air pollution and low-carbon future.
- The Paris Declaration on Electro-Mobility and Climate Change and Call to Action, announced at COP21 in 2015, expressed the ambition to exceed globally the threshold of

100 million electric cars and 400 million electric two-wheelers by 2030 (UNFCCC, 2015). This has also been reflected in national policy frameworks and in recent years, a number of governments have also set national EV deployment targets as part of their clean energy goals. EVs are expected to become price competitive from 2025, with falling battery prices likely to play an important role in the increased adoption of EVs and the pace at which vehicle manufacturers are committing to EV and hybrid technology is accelerating. In 2017, Volvo committed to 100% electric or hybrid models from 2019, and Mercedes brought forward the launch of 10 new EV models by three years to 2022 (Guardian, 2017).

Lessons Learned:

- Economic and supply chain changes and deployment of new technologies often involves shifts in demand for minerals and metals. In this case, the shift towards EVs created new demand for metals, including lithium, nickel, manganese and cobalt. Policy changes that encourage the more rapid deployment of EV technology could further increase demand – as will the deployment of more renewable energy.
- Climate-friendly technologies typically require more metals than alternative higher carbon technologies (World Bank, 2017), and the demand for critical metals is not only a matter of how aggressively the technologies are deployed globally, but also on which technologies, including which battery technologies, will win out in the market place.
- Increased mineral extraction in any form requires more effective implementation of sustainable practices in the mining sector to ensure the social, environmental and carbon footprint of extraction and processing, including of minerals and metals that are extracted to contribute to a low-carbon future, is sustainably managed.

Selected References:

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