

March 2019

PDAC 2019: Toronto's Mineral Exploration and Mining Convention.

Increasing dissonance between future demand, future production, and capital allocations.

A year of transition?

Attendance was about the same at this year's convention as compared to last year— however access rules and pricing structures having changed (to mixed reviews: “business section” now opened to all; “investor section” now paying), and therefore it is difficult to make attendance comparisons. While some exhibitors (often in relation to mining equipment for existing operations) reported a fruitful convention, often exhibitors were not sure if attendance was better or not.

The overall mood was certainly more subdued than last year, not surprisingly given the decline in commodities prices since the middle of 2018 and the three main unresolved macroeconomic uncertainties that kept being mentioned in forecast presentations:

- How will the US induced trade actions play out (China now, potentially Europe later)? What will be their impact on the global economy and demand?
- Uncertainty about what else could come out of the US
- Concerns about weaker growth in Europe (Brexit, Euro) and China, especially given awareness that the US growth rate is bound to slow.

At the same time, the lack of discoveries and new projects in the face of increasing demand was repeatedly mentioned with concurrent warnings of future shortfalls.

But it was nevertheless acknowledged that the industry remains currently risk adverse given the beating it has received over the last decade. As a result, mining companies maintain a marked preference for consolidating their balance sheets, soothing investors (dividends) and limiting capital expenditures at or around existing operations. What is still missing is a stronger appetite for exploring and developing new resources.

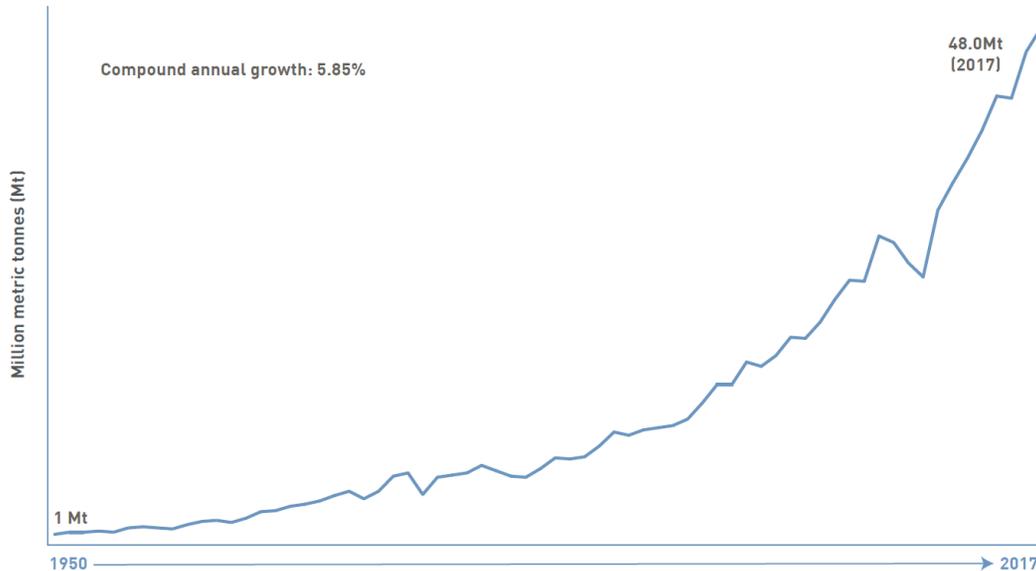
While the above is true for many metals from copper to cobalt (and even iron), the metals for which the situation could become the most challenging are nickel first, then copper then cobalt.

Looking at nickel, about 70% of the “new” nickel mined every year (“primary nickel”) is consumed by the stainless-steel industry, where nickel is necessary to bring ductility to the final product. This demand for nickel grows together with the demand for stainless steel, whose demand has been growing at an average rate 5.85% per annum since 1950 and at 5.4% over 2007-2017. While economic factors may affect year on year demand, the underlying growth trend remains powerful, driven by factors with considerable constancy: increasing world population, increasing urbanisation, and increasing standards of living (fig.1 next page).

The balance of nickel demand (other alloys 17%, plating 9%, electric batteries 4%) grows at a slower rate than for stainless steel (about 3 % per year). Overall, nickel demand has grown over the period 2007-2017 at “only” 5% per annum in average. And in 2018, despite all the uncertainties, nickel demand still grew by 4.9%.



Figure 1 Compound annual growth rate of world stainless melt shop production (slab/ingot equivalent)



It is worth noting that a growth rate of 5% per annum implies a doubling of demand every 14 years.

Furthermore, these historical growth rates do not account for the additional potential demand that will come from the electrification of transportation: electric vehicles demand batteries that require large amounts of nickel, cobalt, lithium, graphite, copper wires, tin for soldering etc.

While quantifying this additional demand remains speculative as products and infrastructure remain to be created, there was a consensus at PDAC from both conservative and optimistic forecasters that their previous forecasts had been too timid, the market developing faster than they had thought. The gap between the most optimistic and conservative forecasts remains wide by a factor of at least two, but the trend is definitively toward more bullish forecasts.

Key in the development of the Electric Vehicle (EV) market is when it will become cheaper to own an electric vehicle rather than a gas engine one. This is the point at which we should see a marked acceleration of demand. Studies a year ago were pointing to 2025. Now 2023-2024 is seen as possible, accelerating the future demand for the required materials.

Batteries in general (consumer electronics, vehicles, storage, etc.) currently account for only about 4% of nickel primary demand – but this will change. In 2018, sales of EVs increased by 65% over 2017, albeit from a low base and with a heavy concentration in China. For the period 2018 - 2025 estimated EV sales are expected to grow at a rate of 20-25% to 35-40% **per year**. Calculating the amounts of metal required to satisfy such growth depend on many assumptions around the chemistry and size (increased power, range) of the batteries that will be used. Nickel will also be required to build the infrastructure around these vehicles: electricity production, transmission, storage, charging. And more batteries will also be needed for other means of transportation (buses, trucks...) and electronic devices. It is therefore conceivably conservative to apply the low end of the above growth rate (let's say 22.5%) to the current nickel demand for batteries to get a sense of future demand.

The following table shows the impact of expected future demand for all nickel usages:



Nickel demand forecast				Increase in demand over 2018 :	As percentage of primary demand	
('000s metric tonnes)	Growth Rate*	2018	2025		2018	2025
Primary** for stainless steel	5.0%	1,550	2,181	631	70%	66%
Scrap for stainless steel	5.0%	1,050	1,477	-		
Electric batteries	22.5%	100	414	314	4%	13%
Other uses***	3.0%	580	713	133	26%	22%
Total demand		<u>3,280</u>	<u>4,786</u>	<u>1,078</u>		
Less scrap		- 1,050	- 1,477	-		
Total primary** demand		<u>2,230</u>	<u>3,308</u>	<u>1,078</u>	100%	100%

*Annual growth rate, compounded

**Primary: new nickel from mining

***Other uses: other alloys, plating

The above calculation shows that:

- Between now and 2025 annual demand from primary sources (mines) will increase by 1.1 million tonnes, or 48%. Asking an extractive industry to grow by close to 50% within 6 years is a tall challenge indeed.
- Stainless steel demand will remain the main consumer of nickel by far. It is not before the 2040-2050s (depending on assumptions) that batteries will demand as much nickel as stainless steel – and by then there may be other energy sources available.
- The additional 630,000 tonnes required for stainless steel manufacturing could be satisfied by new NPI production in Indonesia and China. As a rough estimation, NPI plants cost about US\$15,000-20,000 per tonne of capacity (NPI plants have comparatively low construction costs but high operating costs). The required investment would therefore be in the order of US\$ 10-13 billions¹.
While NPI production is growing fast in Indonesia, total NPI production from China and Indonesia amounted to 580,000 tonnes in 2018 – we therefore need more than a doubling of production over the next 6 years.
- The remaining increase in demand of about 450,000 tonnes requires better nickel purification than what NPI plants can provide. Given currently available sources of ore most of it will come from laterite mines through the HPAL process pioneered by Sherritt. Here costs vary depending on the process route but a rough estimation (just to produce concentrates out of the ore - excluding final processing into pure metal or chemical) is about US\$ 50,000-55,000 per tonne of capacity for a required total investment of US\$ 23-25 bn¹. That is assuming all goes well, as HPAL plants are complex and finicky, have a history of cost and construction time over-runs, and take time to ramp-up.
In term of capacity, this increased demand would require the equivalent of 8 Ambatovy (mine and plant – assuming annual capacity of 60,000 tonnes running at 90%). Any such plant takes 4 to 5 years to build and 4 to 6 years to ramp-up.

Even though the market is already in deficit, the economic uncertainties mentioned above have helped depress commodity prices to levels that are just too low to attract the necessary capital to undertake such new developments.

¹ Numbers to be understood as orders of magnitude.



Some are occurring, especially on the NPI side from Chinese firms in Indonesia and for final chemical transformation/refining capacity being built in China (especially for what batteries require), but far from enough to satisfy the foreseen demand.

Not only does this bring forward the time at which a lack of metal availability will start pushing prices upward, but it also risks a “building bottleneck” (engineering, equipment, personnel shortages) if too many mines and processing plants are suddenly being built at the same time (there are similar potential issues for copper and other metals). What is rather strange is that while massive amounts of capital (north of US \$150 bn as per some tallies) have been committed by the auto and battery manufacturing industries toward this new field of electric mobility, no commensurate investments are being made into building the capacity to supply the metals required.

The dilemma is of course that if the raw materials are not there the batteries cannot be manufactured and the development of the EV market will be affected.



Source: Vale

The only solution to this dilemma is higher metal prices. As the market’s awareness of coming potential shortages increases, prices will move up to balance expectations of supply and demand. But this is not enough: prices will have to become reliably high enough for capital to find financing mine developments acceptably risky.

For miners and current investors, it cannot come too soon.

As always, please call if you have any questions.

J.-Dominique Sellier

March 31, 2019

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