Nickel Industry

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Nickel is a non-ferrous metal mainly used for manufacturing non-corrosive materials such as stainless steel. It is a naturally occurring, lustrous, silvery-white metal and is the fifth most abundant element by weight that occurs extensively in the earth's crust. Nickel is mined and refined across 25 countries in the world, however, the top 5 countries account for more than 60% of the world's mine reserve as well as production.

The global mine production of Nickel is estimated to be 2.1 million tonnes in 2017. Global Nickel extraction has been 2.6% of the world nickel reserves on an average for the period 2006-17.

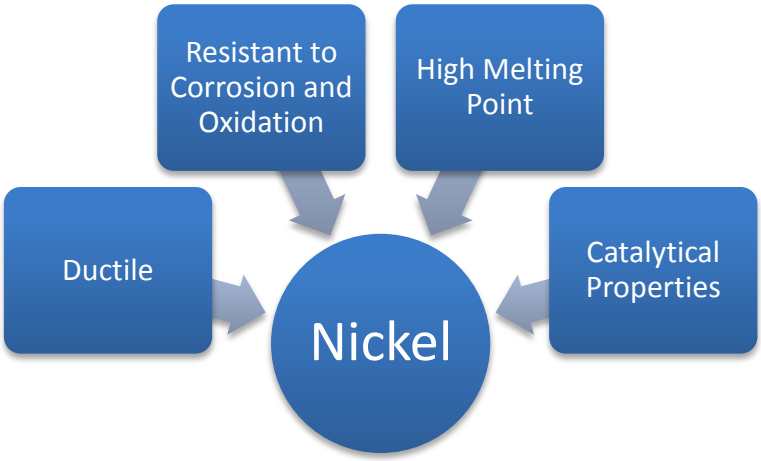
Nickel prices are highly volatile, given its limited sources of supply. As of Dec-18, LME Nickel was traded at US$ 10,835/tonne (monthly average), which is approximately (-) 6% lower than the price recorded in Dec-17. The metal is expected to average around US$ 11,000-13,000 per tonne for CY2019.

Nickel demand in India is around 45,000 tonnes and is met only through imports. Although a few states in India report nickel reserves, no effective nickel production has taken place since FY05.

Some of the key characteristics of nickel are its high melting point, resistance against corrosion & oxidation, ductility and catalytical properties. These properties of the metal make it suitable for electroplating and formation of alloys.

Manufacturing of stainless steel consumes almost 75-78% of nickel produced. Duplex and Austentic Stainless Steel have the highest nickel content. The stainless steel production in India is constrained by non-availability of nickel domestically and its highly volatile prices.

Chart 1: Characteristics of Nickel



Source: CARE Ratings

Production of Nickel

Nickel does not occur freely and is most commonly found in sulphidic or oxidic (laterite) form. The oxides or laterites of nickel are mainly found in the tropical regions with warm climate and abundant rainfall, like in Australia, New Caledonia, Brazil and Indonesia. The process of extracting nickel from oxides is simpler than that from sulphidic ores which have a large number of pollutants. However nickel extraction from oxides requires a huge amount of energy as it has high water content which is removed using a large rotary kiln surface. Sulphidic ores are often found along with copper-bearing ores.

Global Production

Mine production of nickel contracted in the period 2014-16. Nickel production from mines grew by 0.5% in CY2017 as compared with the decline of (-) 8.3% in CY2016. As of CY17, the production of nickel grew by 0.5%. Extensive nickel resources also are found in manganese crusts and nodules on the ocean floor. The decline in discovery of new sulfide deposits in traditional mining districts has led to exploration in more challenging locations such as east-central Africa and the subarctic.

Table 1: Global reserves and production of Nickel (Quantity in million tonne[1])

Calendar Year	Reserves	Mine Production	Y-o-Y% Change in production
2011	72.8	1.8	
2012	68.3	2.0	14.4
2013	67.3	2.4	18.5
2014	73.7	2.2	-6.8
2015	71.9	2.1	-6.9
2016	71.0	1.90	-8.3
2017*	67.3	1.91	0.5

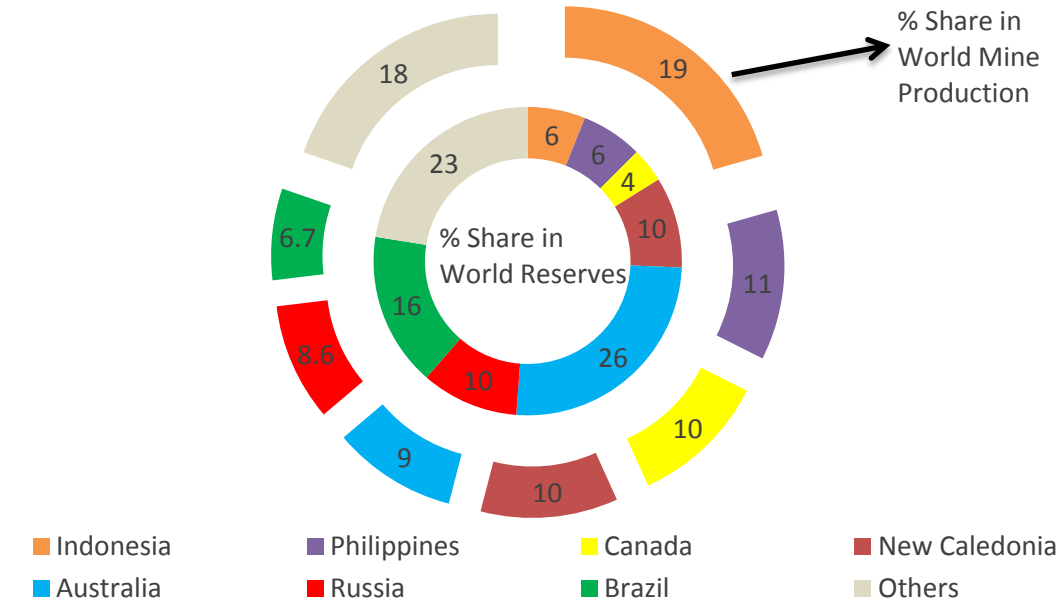
*estimated

Source: U.S. Geographical Survey

As of CY2017, Indonesia is the largest producer of nickel with 19% share in world nickel production, followed by Philippines (11%), Canada (10%) and New Caledonia (10%). New Caledonia is a special collectivity of France located on the Pacific Ocean. In CY2016, Philippines recorded the highest mine production of nickel 22% of world nickel production. Australia has the largest share of nickel reserves in the world (26%), as of CY2017. It is followed by Brazil with a 16% share. New Caledonia is famed for its huge nickel reserves. However a majority of the nickel deposits in the island nation remains unexplored and hence are not reported in the total nickel reserves of the country.

[1] Conversion unit : 1 US Short Ton (or metric ton) = 0.91 tonne

Chart 2: Country-wise Nickel Production and Reserves in CY2017



Source: US Geological Survey

Production in India

- In India, Nickel occurs as oxides, sulphides and silicates. It is found as oxide in Odisha which has 93% of the India's nickel resources. In Jharkhand, nickel is found along with copper and uranium deposits. However the exact extractable amount of nickel reserves is uncertain.

- Nickel is also produced as a by-product of copper mining, as in the Ghatsila area of Jharkhand where nickel occurs in small quantities in the copper sulphide ore. The Ghatasila copper smelter (a part of the Indian Copper Complex) of the Hindustan Copper Limited is the first and the only unit in India to produce nickel of LME grade. Companies engaged in nickel production in India include Sterlite Industries Ltd (Thotukodi), Nicomet Industries (Goa) and Jhagadia Copper Ltd.

- Hindustan Copper Ltd has entered into a joint venture agreement with Mishra Dhatu Nigam Limited (MIDHANI), a central public sector enterprise under the Ministry of Defence, for production of copper-nickel tubes. Copper-nickel tubes are currently imported and there is a huge demand for these in naval fighter ships, submarines, etc. The company looks forwards to scale up its nickel production through its new facility at Ghatasila in Chhattisgarh.

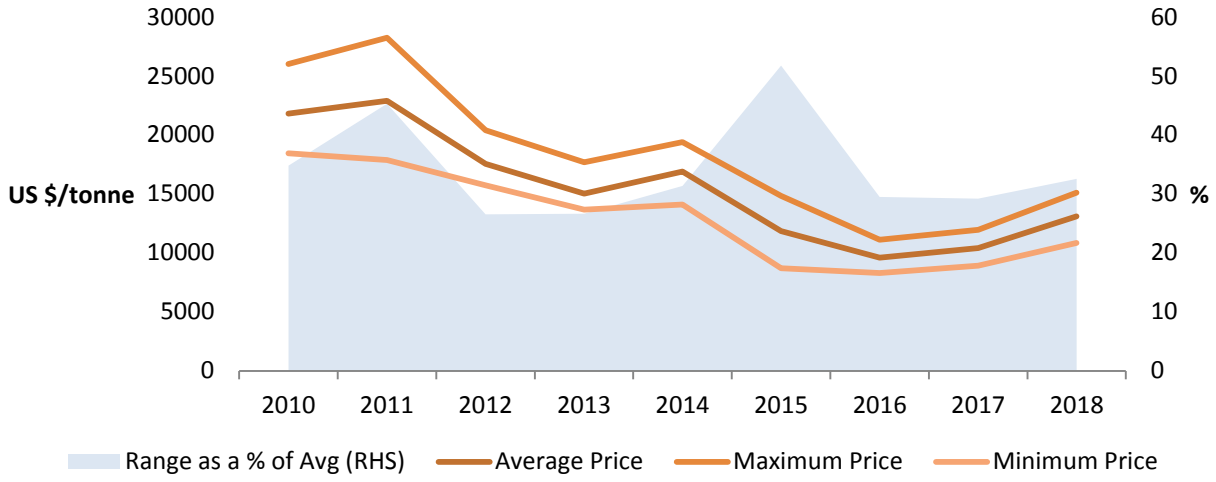
Price Trends

- Prices of Nickel are highly volatile. The highest price of nickel was recorded in the average volatility in prices has been around 30% since CY2012 onwards. The range (difference between minimum and maximum monthly values for a given year) as a percentage of annual average prices of LME Nickel is plotted in Chart 4. The price volatility around average price was the highest at around 50% in 2015.

- The Chart 5 shows the volatility range of the monthly average LME Nickel prices. The price volatility has been around 15% for the period from Sept-14 to Dec-18.

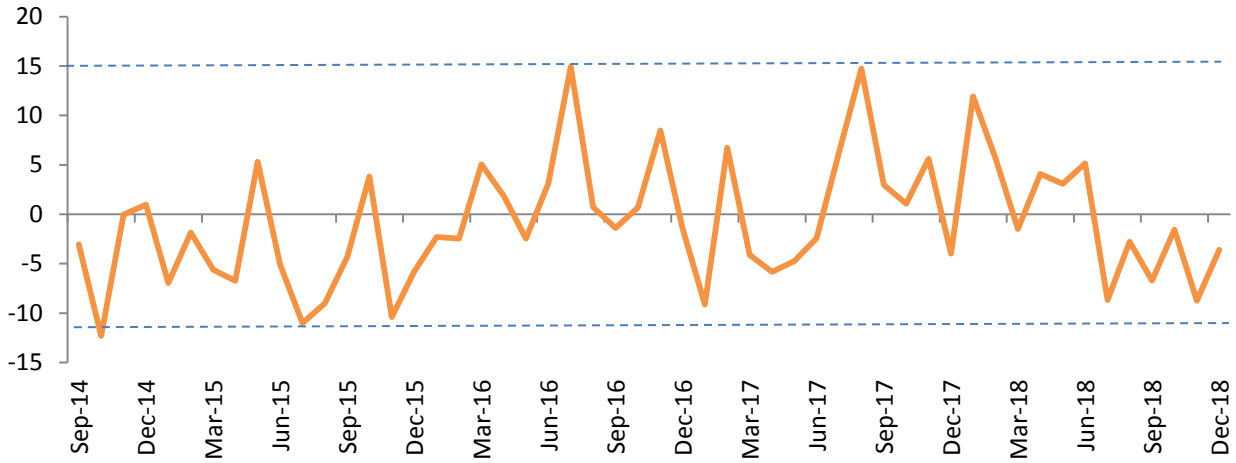
- The price of Nickel Futures on MCX India largely mimics the LME prices. This is shown in Chart 6. The closing price of Nickel futures as of Nov-18 is Rs 767.30 – which is a 5% growth over the price in the corresponding period last year. The closing price of the futures contract maturing I Apr-19 was Rs.810/kg.

Chart 4: Annual Monthly Average Nickel Prices on LME (US $/ tonne)



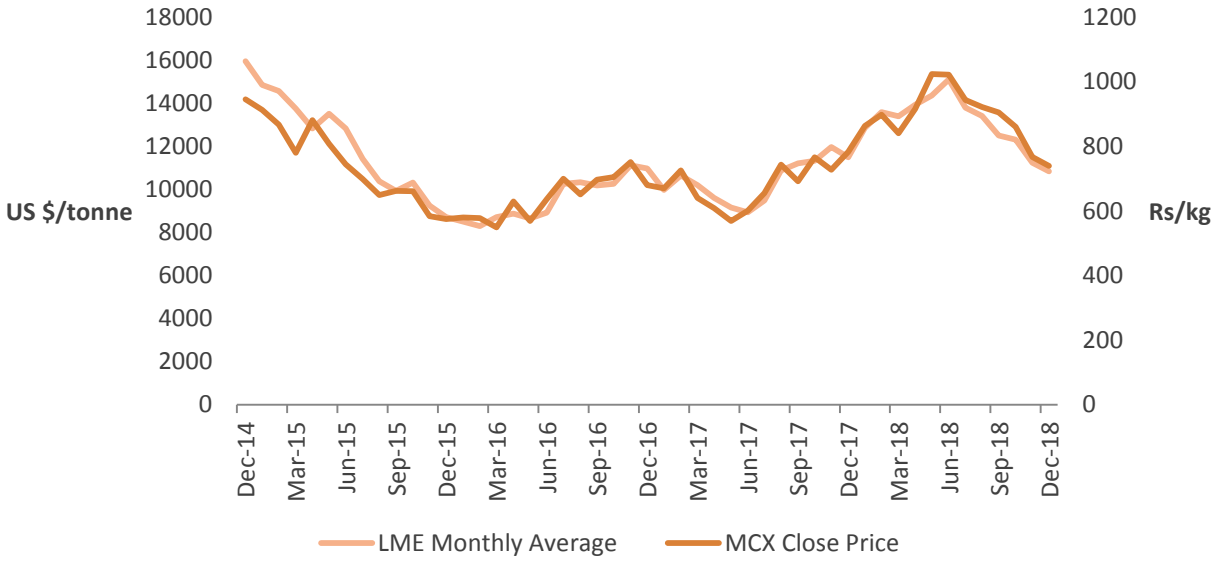
Source: World Bank

Chart 5: Price Volatility in Monthly Average LME Nickel Prices



Source: World Bank

Chart 6: LME Nickel Monthly Average (US $/ tonne) and MCX Nickel Futures Closing Price (Rs/kg)



Source: MCX, World Bank

Usage of Nickel

Nickel has a domain derived demand. The metal is mostly used in combination with other metals in a wide range of electrical and engineering appliances.

Primary Use of Nickel

Alloying

Nickel is called a ferro-magnet and is most prominently used in alloying. About 75-80% of new nickel goes into alloying. There are about 3000 nickel-containing alloys in everyday use. Nickel-base alloys are excellent in corrosion resistance and hence, are used in many applications where they are subjected to harsh environments at high temperatures. Nickel alloys are often divided into categories depending on the primary metal with which they are alloyed and their nickel content.

Alloy steels contain alloying elements (e.g. manganese, silicon, nickel, titanium, copper, chromium and aluminum) in varying proportions. The most common type of alloy steel is stainless steel.

Stainless Steel

About 75% of new nickel goes into alloying and two-thirds of it goes into stainless steel. Recycled nickel from nickel scrap, forms a small part of the nickel used for alloying. India is the second largest producer of stainless steel in the world. Stainless steels can be of different types depending on their crystalline structure. The main alloying elements in stainless steel are chromium and nickel. Austenitic stainless steels contain at least 6 percent nickel and have good corrosion resistance and high ductility. The austenitic steels form the largest portion of the global stainless steel market. Type 304 is the most common grade of austenitic stainless steel, which contains up to 8% of nickel. Ferritic stainless steel is another type of steel in which nickel is sometimes added. Martensitic steels contain less than 0.4% nickel.Duplex stainless steels generally contain equal amounts of ferrite and austenite and have 1.35 to 8% nickel.

Table 2: Types of Stainless Steel and their Nickel Content

Stainless Steel Type	Nickel Content	Use of Steel
Austenitic	6-8%	Aircraft, piping, dairy and food-processing industries
Duplex	1.35-8%	Chemical Processing and containers for transporting chemicals
Ferritic	Mostly Nickel-free	Architectural and auto trim
Martensitic	Less than 0.4%	Cutlery, surgical instruments, wrenches, and turbines

Source: CARE Ratings Research

Chemicals and Catalysts

Nickel is also used in making of chemical compounds that are used as catalysts in the field of biochemistry and chemical research. It is also used as a catalyst (Nickel sulphide) in the petrochemical industry or as an intermediate in the metallurgical industry. A major concern is that half of global nickel production is not suitable for producing the nickel-sulfate needed for EV batteries. China has been investing smelting plants in Indonesia, which is the world's largest producer of nickel, to manufacture nickel-sulfate.

End Use of Nickel

Engineering: Nickel is used as cathodes in batteries. Nickel Cadium Batteries are used in in Oil and Gas exploration, power generation, railways and aviation. Further the metal is also used in manufacturing food processing equipment, marine and offshore engineering.

Tubular: There is a huge demand for copper-nickel tubes used in naval fighter ships, submarines, etc.

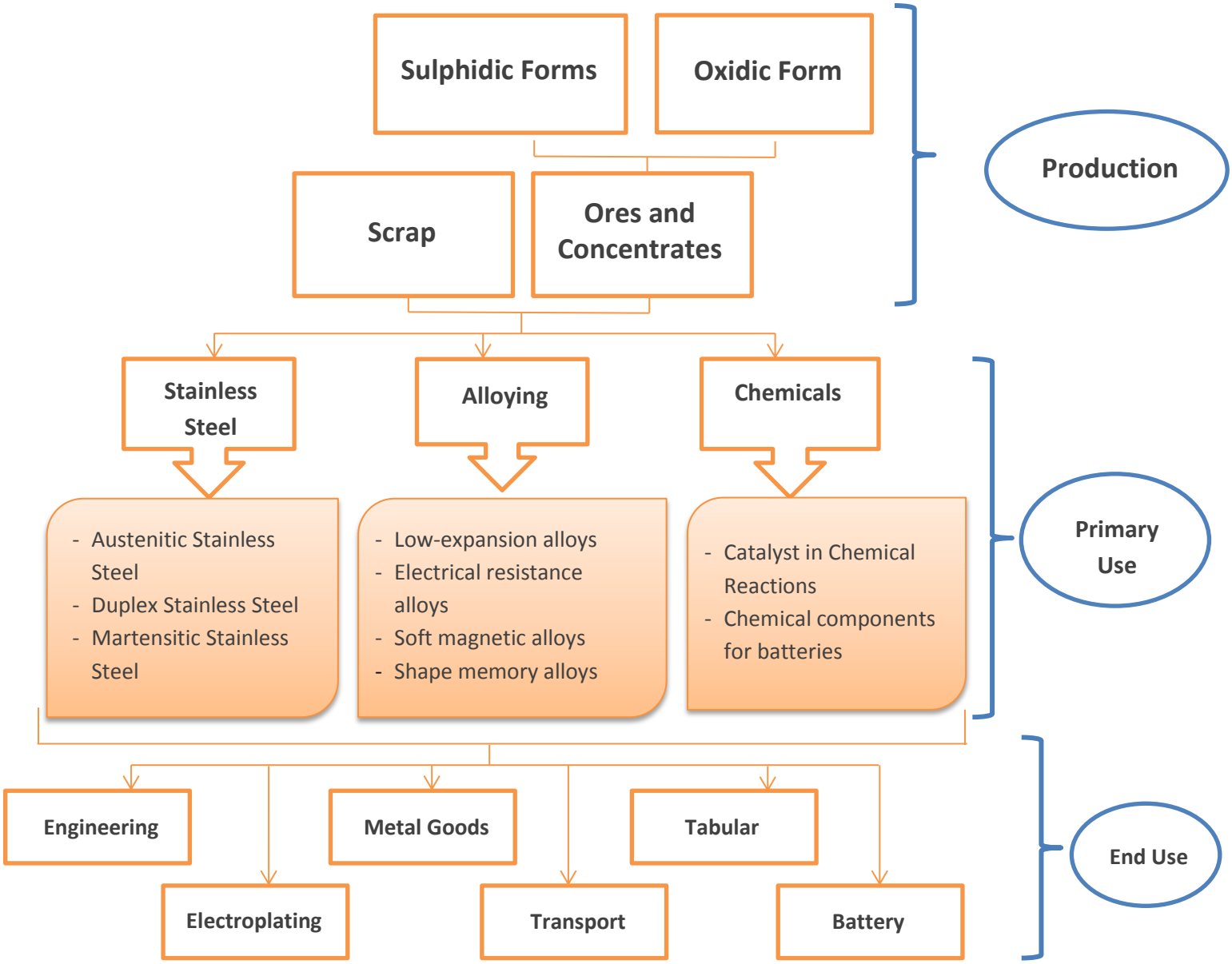
Transportation: Nickel alloys are used in jet engine turbines, while nickel-containing stainless steel is found in passenger trains and subways.

Electroplating: In electroplating, a thin layer of nickel is coated onto a metal object as a decorative feature or to provide resistance to both corrosion and wear. The process involves use of nickel salts.

Metal Goods: Nickel–copper alloys are used for coinage. It is also used in manufacturing specialty ceramics. Nickel is used in manufacture and handling of sodium hydroxide reactors.

Battery: Nickel–cadmium, Nickel–hydrogen, Nickel–iron, Nickel–lithium, Nickel–metal hydride and Nickel–zinc are some of the nickel based batteries. Each has applications in different sectors. There is a considerable growth anticipated in use of nickel-cadmium batteries for electric vehicles (EV).

Chart 7: Production, First Use and End Use of Nickel



Source: CARE Ratings Research

Trade

(Global trade in Nickel is looked at in value terms so as to enable comparison across different HS Categories of Nickel)

Ferro-nickel

Ferro-nickel is the major alloy used in the manufacturing of stainless steel. China is the largest consumer of ferronickel as the country is the largest producer of stainless steel in the world. The value of global imports of ferro-nickel stood at $3,289 million in CY2017. China's import of ferro-nickel was worth US$ 2,651 million (~1.6 million tonnes of ferro-nickel) and accounted of 55% of the total ferro-nickel imports in value terms for CY2017. India was the second largest importer of ferro-nickel at $355 million (~0.13 million tonnes of ferro-nickel), in the same period.

Nickel Articles

The nickel articles category contains nickel imported as rods, bars and alloys. In CY2017, global imports of nickel articles and scrap were worth US $22,128 million, which was a 5.8% growth over the $20,898 million of imports in CY2016. The largest importers of nickel articles was China (21% share in Total Nickel Imports), USA (11%) and Japan (9%), in value terms. India's import of Nickel Articles stood at $ 552 million in CY2017, which is around 2.5% of world nickel articles import. The imports to India were majorly sourced from Australia in CY2017 and Russia in CY2016. Canada was the largest exporter of nickel articles and was followed by Russia and USA, in CY2017. The total exports of Nickel Articles were valued at $18,212 million in CY2017. Trade in Nickel Articles category is the highest amongst all other nickel-related HS categories.

Nickel Ores and Concentrates

The nickel Ores and Concentrates are mainly imported by countries that manufacture nickel articles and stainless steel. The imports of Nickel ores and concentrates grew by 13% from $ 2,612 million in CY2016 to $ 2,967 million in CY2017. The largest importers of nickel ores in CY2017 were China and Canada, while the largest exporter was Philippines.

Batteries

This category of items includes – nickel-cadmium, nickel-iron and nickel-metal hydride accumulators (batteries). Major importers are USA, Hong Kong and Germany, who are also major auto- manufacturers of the world. The total imports of batteries were valued at $2,245 million in CY2017. The penetration of EVs in the US markets makes it the largest consumer of nickel related batteries. The major exporters of nickel batteries were Japan, China and Germany.

Trade across all items was subdued in CY2016 due to a contraction of (-) 8.3% in the global mine production of nickel.

Table 3: Global Trade in Nickel (US $ million)

Year	Nickel Articles		Nickel Ores and Concentrates		Batteries		Ferro Nickel	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
CY2014	31,723	29,753	6,019	4,028	2,527	2,853	4,787	4,164
CY2015	26,638	24,890	3,997	2,847	2,305	2,625	3,866	3,271
CY2016	20,898	17,877	2,612	1,761	2,269	2,646	3,460	2,300
CY2017	22,128	18,212	2,967	1,691	2,245	2,635	4,761	3,289
CY2018*	11,264	14,863	597	1,010	1,376	1,392	1,756	426

*Upto October 2018

Source: UN Comtrade

Table 3(a): Global Trade in Nickel (Value Terms)

CY2017	% Share in Total Nickel Trade in Value terms	
Particulars	**Importers**	**Exporters**
Ferro Nickel	China (55%), India (7.5%), USA (5.5%), Italy (5.1%)	Indonesia (40.5%), Brazil (16.5%), Columbia (11%)
Nickel Articles	China (21%), USA (11%), Japan (9%), India (2.5%)	Canada (15%), Russia (11%), USA (11%)
Nickel Ores and Concentrates	China (70%), Canada (7%), Korea (7%), India (0.1%)	Philippines (41%), USA (14%), Australia (12.5%)
Batteries	USA (18%), Hong Kong (10%), Germany (9%), India (0.3%)	Japan (29%), China (21%), Germany (8.4%)

Source: UN Comtrade

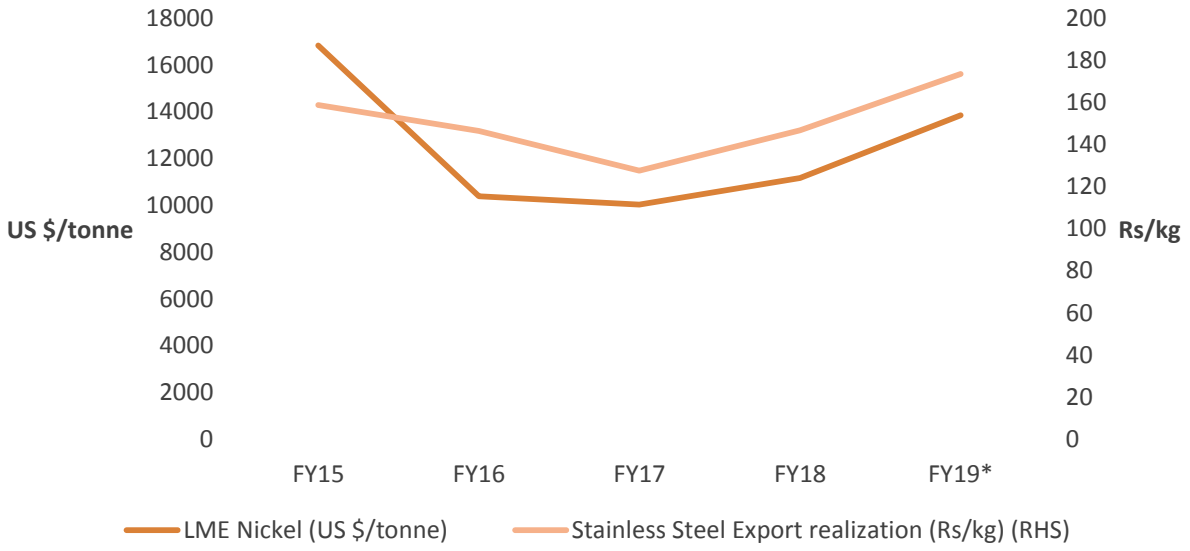
Nickel Consumption for Manufacturing Stainless Steel in India

Nickel is an important metal that goes into the manufacturing of stainless steel. India is the second largest producer of stainless steel in the world. Stainless steel exports prices have been moving in tandem with the international nickel prices.

The price of nickel on LME as well as the per unit export realisation of stainless steel, declined in FY16. In CY2016 the global mined production of nickel contracted by (-) 8.3%. From FY17 onwards both the nickel prices and stainless steel export prices have been rising.

Chart 9 shows the production trend of alloy steel and stainless steel. Though the production of alloy steel has picked up in the last couple of years, stainless steel production has remained in the range of 2.9 to 3.6 million tonnes. Between FY14-18, stainless steel production accounts for around ~35% of the alloy steel production in the country. The consumption of stainless steel has also followed the same trend. Nickel accounts for ~5% of stainless steel production. Consumption demand of nickel in India is at ~0.18 million tonne and is largely driven by the demand from the stainless steel industry.

Chart 8: Price Trends of LME Nickel and Indian Stainless Steel Export Realization



*Upto October '18
Source: World Bank, CMIE

Chart 9: Stainless Steel and Alloy Steel in India (million tonnes)

Source: Joint Plant Committee, CMIE

Outlook

- Owing to the huge demand of nickel from the stainless steel industry, the ISSDA (Indian Stainless Steel Developers Authority) has asked for a removal of import duty on Ferro-nickel and steel scrap – which would further help bring down the input cost of stainless steel. Presently, the import duty on ferro nickel is 2.5%. The government had removed the customs duty on pure nickel (HS Code 75: Nickel and Articles thereof) in the FY18 budget.

- With the increase in penetration of EVs, the battery demand for nickel is expected to increase significantly in the next few years. However, the major concern is that a major part of the globally mined nickel is not suitable for producing the nickel-sulfate needed for EV batteries. New investments will have to be made in nickel capacity suitable for battery use.

- Although consumption of Alloy steel in Indian market has witnessed a significant growth, stainless steel (which is one of the major alloy steel) has witnessed a rather moderated growth. During the last five years (FY13-18) alloy steel consumption has grown at a CAGR of around 11% however, during the last 3 years (FY15-18), there has been a contraction in demand (FY15 consumption of alloy steel 11.20 millon tonnes as compared to 11.02 million tonnes recorded in FY18). On the other hand, demand for stainless steel has outperformed the demand for other alloy steel products.

- Going ahead CARE expects demand for alloy steel products is likely to increase at a CAGR of around 5-6% during the next 2-3 years, largely driven by the increase in demand for stainless steel products. The demand for nickel is largely dependent on the demand for stainless steel production. CARE expects that the domain demand for nickel is likely to follow the production path of stainless steel.

- Nickel production in India may gather pace once a commercial scale technology is established to recover nickel from the overburden of chromite ore in Odisha. Until such a capacity is developed, India will have to depend on nickel imports. Nickel production has huge potential given the increasing demand from the stainless steel industry in India.

- Nickel reserves in many parts of the world remain unexplored, as in the case of New Caledonia. In many geographies nickel is present along with copper and cobalt deposits. However, very few countries are capacitated with technology to separate theses minerals. Thus an innovation in mineral extraction technology may prove to be a turnaround for the nickel mining industry.