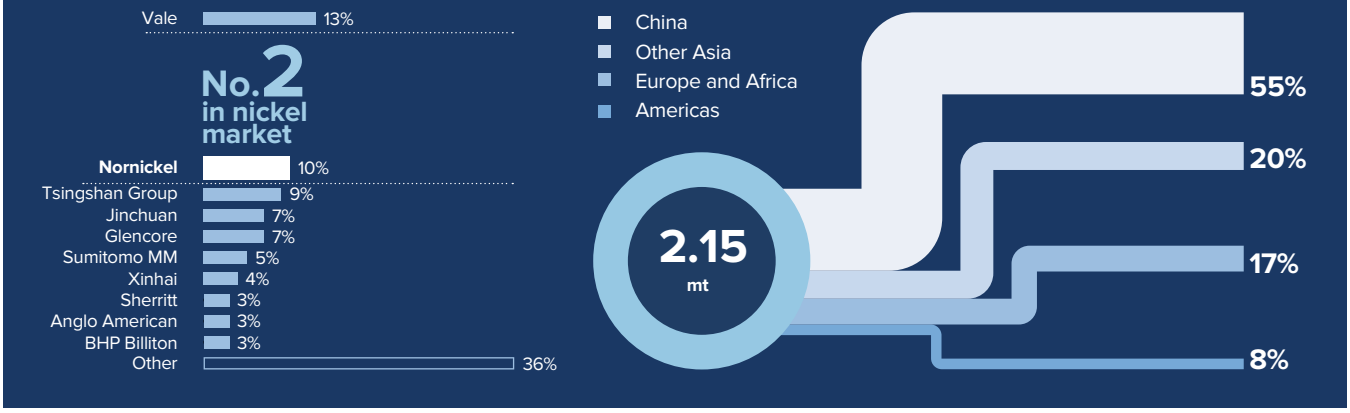
Nickel
Ni



Source: Company data

Key trends in the nickel market

In Q1 2017, the nickel price was highly volatile in the range of USD 9,380–11,045 per tonne reflecting a mixed news background from Indonesia and the Philippines. In early Q2 2017, it started to decline after the Indonesian government issued permits for the export of unprocessed nickel ore and Regina Lopez, Secretary of Environment and Natural Resources of the Philippines, was not re-appointed for a new term of office, which challenged the decisions made after the environmental audit of the country's mining industry. This trend was intensified by a reduction in stainless steel output in China. However, starting Q3 2017, prices began to recover backed by the news about the growth of stainless steel production in China and the launch of a large stainless steel plant in Indonesia. Early Q4 2017 saw a positive price performance amid considerable enthusiasm of the investment community about the potential increase in nickel consumption in electric cars, peaking at USD 12,830 per tonne – the highest level since June 2015. However, by the year-end 2017, there was a price correction to USD 12 thousand per tonne.

2017

Market deficit widened; demand increased in line with higher production of stainless steel in China and Indonesia and cathode materials for Li-ion batteries; production slightly went up driven by NPI output growth in Indonesia and China, which was almost entirely offset by declining production of high grade nickel.

Outlook: cautiously optimistic.

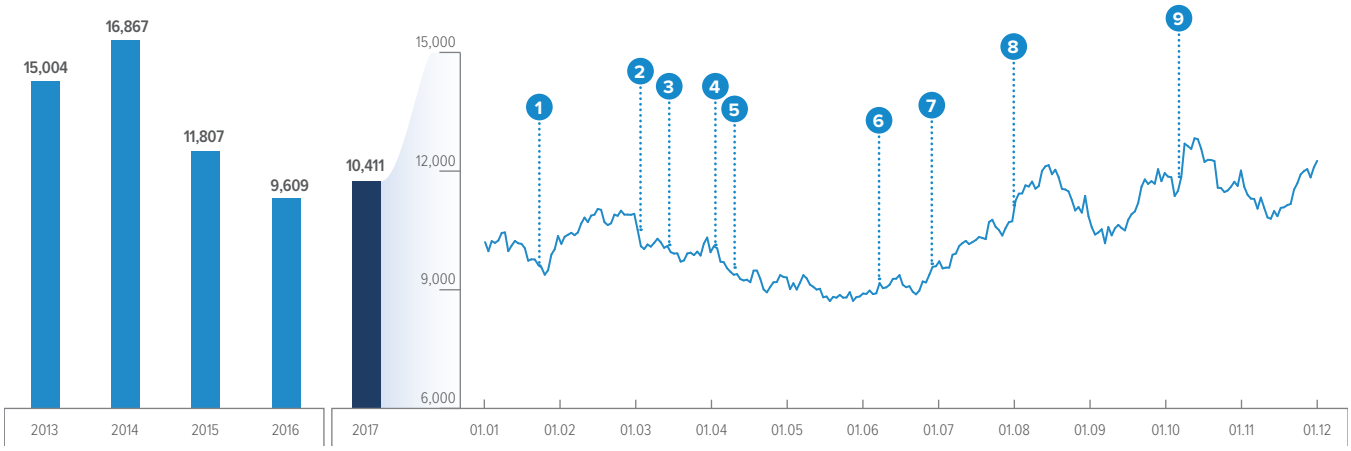
In 2018, the market deficit may go down a result of a much greater availability of high grade lateritic nickel ore.

Market balance

Following several years of surplus, the nickel market recovered the balance in 2016, with consumption outstripping production by 20 kt. In 2017, nickel shortage went up to 108 kt. The demand was mainly driven a 7% y-o-y increase in metal consumption primarily attributable to the Asian producers of stainless steel and batteries. In turn, primary nickel output gained as little as 2%. High grade nickel production declined by 6% (60 kt) largely triggered by the reconfiguration of the Company's production facilities, shutdown of sulphide ore mines in Canada, and the shortage of hydrometallurgy semi-products and sulphide concentrates on the market after the closure of loss-making mines in 2015–2017, with the Ravensthorpe shutdown coming as the last of those. Only nickel production from lateritic ore was on the rise. In 2017, low grade nickel production increased by 11%, or 100 kt y-o-y, mainly due to the Chinese and Indonesian NPI output growth.

During the year, total exchange warehouse stocks at the LME and the SHFE decreased by 55 kt to 411 kt, which is about 10 weeks of global consumption.

Key industry developments and nickel price // USD/t



Source: LME, Company data

1) Leaked data on possible easing of the ban to export ore from Indonesia and uncertainty in the Philippines after environmental audits of the mining industry;

2) Lower stainless steel output in China;

3) Permit issued by the Indonesian government to PT Antam to export up to 2.7 million wet tonnes of unprocessed nickel ore;

4) R. Lopez's failure to be re-appointed as Secretary of the Philippines' Department of Environment and Natural Resources;

5) Permits by the Indonesian government issued to Fajar Bhakti Lintas Nusantara to export up to 1.06 million wet tonnes of unprocessed nickel ore;

6) Relaunch of Delong's stainless steel plant (China);

7) Launch of a stainless steel production line at Tsingshan plant (Indonesia):

8) Recovery of stainless steel output in China;

9) LME Week that aroused investor interest in nickel on the back of the expected electric car market growth.

Surplus/deficit in the nickel market // kt

Source: Company data

+7%
growth of consumption of primary nickel

+2%
growth of primary nickel output in 2017

Consumption

Stainless steel comes to the market in various grades from all over the world, whereas its smelting structure ultimately determines the primary nickel consumption patterns.

Austenitic stainless steel comprising the 200 series and 300 series steel is the most widespread type of that product (over three quarters of the global production).

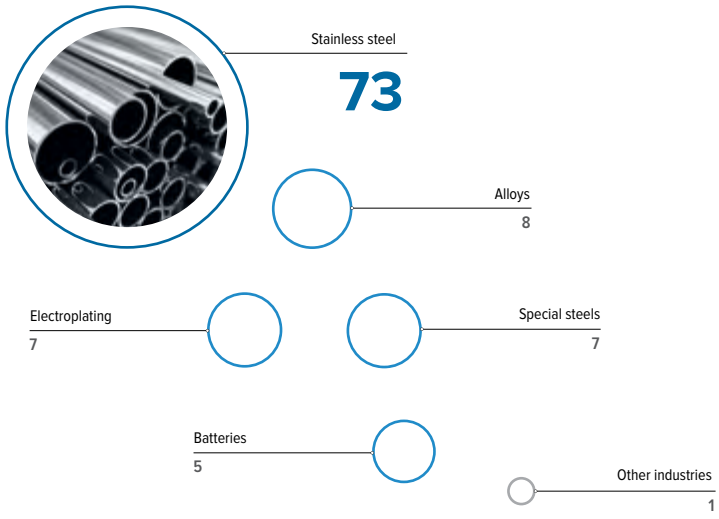
The 300 series steel has a higher nickel content (normally 8–12%, or up to 20% in a number of select grades). Nickel added in this proportion improves the steel's corrosion resistance and robustness in a wide range of temperature conditions, boosts its ductility and durability in aggressive environments, and enhances its non-magnetic properties. This series enjoys the highest demand, as it is applied in various industries, including construction, food and chemicals manufacturing, energy, transportation, etc.

The 200 series steel cannot serve as a full substitute for the high nickel content grades, as it has a lower nickel content due to the addition of manganese. The 200 series steels are susceptible to surface (pitting) corrosion and non-resistant to heat and aggressive environments. Due to the lower price, this steel grade is often used in the production of consumer goods, such as home appliances. China and India account for over 90% of the total 200 series steel output.

Austenitic-ferritic (duplex) stainless steels also use nickel and are characterised by a higher content of chromium (18–25%) and molybdenum (1–4%), but they account only for 1–2% of the global smelting output. For statistical purposes, these steels are usually grouped with the 300 series.

Ferritic and martensite stainless steels (400 series) usually do not contain nickel, while their properties are similar to those of low-carbon and highly corrosion-resistant steels. However, their mechanical properties are inferior to those of austenitic stainless steels. These steels are mainly used to manufacture automotive exhaust systems, cargo container frames, water heaters, washing machines, utensils and cutlery, kitchenware, home decor items and razor blades.

Primary nickel consumption in 2017 by industry // %



Source: Company data

Nickel consumption is predominantly driven by the stainless steel industry (over 70% in 2017).

In 2017, the total stainless steel output increased by 6% and hit a record high of 48 mt.

China (with a share of over 50% of the global output) and Indonesia accounted for the most part of production growth. Smelting output growth in China ensued from the re-launch of Delong's capacities (over 1.1 mtpa) previously suspended after more stringent environmental controls had been imposed. Indonesia is a new steel market player with a robust growth outlook, sufficient reserves of high grade lateritic ore, growing NPI capacities and, hence, low cash cost of austenitic stainless steel.

Except for Europe, where stainless steel smelting stayed flat, nickel consumption in stainless steel making was steadily growing in 2017 across all regions. The USA was leading the charge in this segment with an 8% rise, according to our estimates.

Consumption of primary nickel by the global stainless steel producers rose by 7% to 1.57 mt as a result of an increase in the 300 series and 200 series global output by 7% and 5%, respectively, and a flat share in the use of scrap y-o-y. However, the use of high grade nickel in stainless steel smelting has not changed vs 2016 mostly due to the growing availability of low-grade nickel.

Nearly all types of nickel feedstock are used in stainless steel production (except for a number of specific products, including nickel powder and compounds). Since the quality of nickel barely affects the quality of conventional stainless steel grades, the manufacturers opt for the cheapest nickel feedstock, turning to high grade nickel as their last resort. This is the reason why high grade nickel share has been declining in the structure of nickel units consumed in stainless steel production in recent years with higher volumes of NPI, ferronickel and metallised products with a lower nickel content.

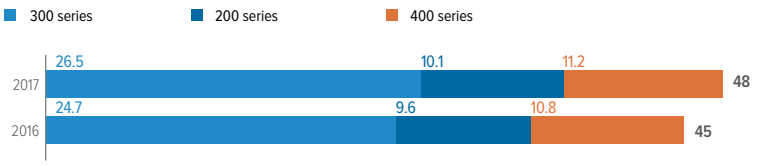
In 2017, primary nickel consumption in alloy production increased by 2%, which was mainly attributable to the recovery of demand from the oil and gas industry, and high demand from the aerospace industry.

Except for Europe nickel consumption in stainless steel making was steadily growing in 2017 across all regions.

Nickel is widely used in decorative and protective platings with their thickness ranging from 1 to 100 microns. Nickel electroplating is highly corrosion-resistant, hard and pleasing aesthetically. It is used for corrosion protection, and as an alternative to chromium plating. In 2017, primary nickel consumption in the electroplating industry grew by 5% (4 kt), mainly due to demand in Asia. In recent years, China has been the leading manufacturer of nickel electroplating products. Since 2012, though, the electroplating industry has started to develop in other Asian countries, and the Chinese businesses are now transferring their production to achieve cost savings.

The battery industry uses nickel as a major component of the active material for battery cells. The extent of nickel utilisation depends on the battery type.

Stainless steel production by grade series // mt



Source: Company data

Primary nickel consumption in 2017 // mt

Source: Company data

+6%

48

mt

record stainless steel output in 2017

Battery

Nickel-cadmium

Ni-Cd

The first nickel-cadmium batteries were developed in 1899. Currently, their use is restricted, since cadmium is prohibited as a toxic substance under the EU ban.

Nickel-metal hydride

Ni-MH

Ni-MH batteries were developed in 1989 as a substitute for Ni-Cd batteries to avoid using cadmium. Producers use nickel to manufacture this type of batteries. Currently, though, the nickel-metal hydride battery market is growing at a slow pace (with hybrid vehicles being its only growth driver) and faces considerable competition from the lithium-ion batteries.

Lithium-ion

Li-Ion

Li-Ion batteries were first commercially released in 1991 and became fairly widespread due to their high energy capacity and reliability (capacity is retained after many recharge cycles).

The key driver behind Li-Ion battery growth is electric vehicles gaining ground. Since 2014, CAGR of electric cars (hybrid and battery electric cars) has been around 46%.

The key factors driving electrification of the transport system are:

- incentives offered by the state;
- transformation of the consumer mindset;
- improved technical specifications of batterie.

For instance, Norway (where electric cars account for 30% of all sales) grants tax exemptions (one-off registration tax and VAT) to buyers. Also, annual electric car tax is six times lower than that for a car powered by an internal combustion engine. Buyers of electric cars in a number of other European countries, including Belgium, Germany, the UK and France, enjoy considerable subsidies (ranging from EUR 4,000 to EUR 10,000) and fiscal incentives.

There are several types of lithium-ion batteries depending on the cathode materials: LCO, LFP, LMO, NCM, NCA.

LCO is largely used in portable devices. This type of the cathode material is not applied in electric cars as a result of high cobalt prices, limited capacity, and technical issues of making a high-capacity battery safe for operation. However, other types of Li-Ion batteries are widely applied in the industry. LFP and LMO tend to be replaced with other Li-Ion battery types containing nickel as a result of a higher gravimetric and volumetric capacity of NCM and NCA. It helps to increase mileage and shrink battery volume and weight. The share of nickel compounds in the total cathode material output used in Li-Ion batteries went up from 32% in 2012 to 51% in 2017.

Growing nickel consumption in Li-Ion batteries comes not only on the back of increasing share of NCM/NCA containing nickel, but also higher average nickel content in the cathode material triggered by the need to substitute expensive cobalt units. While in 2016 NCM 1:1:1 (with nickel mass fraction of 20%) accounted for the lion share of nickel-magnesium compounds of the cathode material, in 2017 Li-Ion batteries with NCM cathodes 6:2:2 (with nickel mass fraction of 36%) and NCM 5:3:2 (30%) took the lead. Going forward, batteries are expected to switch to NCM 8:1:1 (with the nickel mass fraction of 48%), and some producers announce plans to launch commercial production of LNO, a nickel-based cathode material.

Further development of the automotive industry, the growing popularity of electric and hybrid cars, along with the evolution of the cathode technology towards nickel-intensive NCM lay the groundwork for major expansion of primary nickel consumption in this industry in the long run.

LFP
Lithium Iron Phosphate
$LiFePO_4$

LMO
Lithium Manganese Oxide
$LiMn_2O_4$

LCO
Lithium Cobaltite
$LiCoO_2$

NCA
Nickel Cobalt Aluminium
$LiNi_xCo_yAl_nO_2$
(49–54% Ni)

NCM
Nickel Manganese Cobalt
$LiNi_xCo_yMn_nO_2$
(20–48% Ni)

Production

Primary nickel can be split into two major groups:

High grade nickel
(cathodes, briquettes, carbonyl nickel and compounds) is produced from both sulphide and lateritic nickel ore. In 2017, the major high grade nickel producers included Nornickel, Vale, Jinchuan, Glencore and Sumitomo Metal Mining.

Low grade nickel
(ferronickel, NPI and nickel oxide) is only produced from lateritic ore. In 2017, the major low grade nickel producers included Chinese and Indonesian NPI companies and also ferronickel producers: Eramet, Anglo American, South 32, Pamco and Posco (SNNC).

In 2017, primary nickel production grew by 2%, or 48 kt y-o-y, driven only by an increase in low grade nickel output, which more than offset the decline in high grade nickel production that continued into 2017.

In 2017, high grade nickel output dropped by 5%, with production cuts coming from the following producers:
- Vale's Canadian refining operations after the shutdown of its Birchtree (Thompson) and Stobie (Sudbury) mines;
- Nornickel due to ongoing capacity reconfiguration;
- Chinese refined nickel producers as a result of nickel feedstock shortage following the closure of loss-making mines in 2016–2017;
- Ambatovy (Madagascar).

Production of nickel forms for cathode use saw a substantial decline, which entailed their shortage in the market.

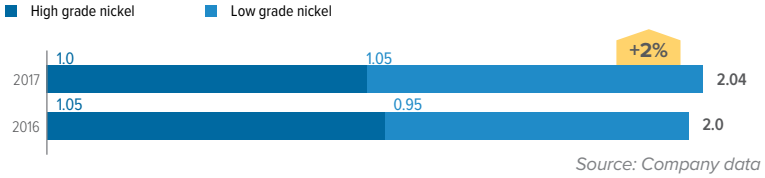
This was coupled with greater output of nickel sulphate that serves as a key feedstock for the precursors of the cathode material in Li-Ion batteries.

In 2017, low grade nickel production gained 10% globally. This was driven by NPI output increase in China and Indonesia, along with ferronickel in all major regions except Europe.

The key driver behind NPI production growth was the easing of the ban on exports of unprocessed nickel ore from Indonesia in March 2017 contributing to the availability of rich nickel ore.

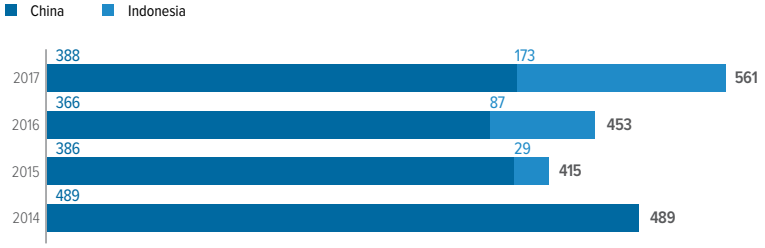
The total amount of Chinese ore imports reached the level of 2015 and exceeded 35 million wet tonnes, considering that the total nickel ore export quota issued by the Government of Indonesia exceeded 24 million wet tonnes by the end of 2017. In 2018, a major growth of NPI output is expected in China.

Primary nickel production // mt



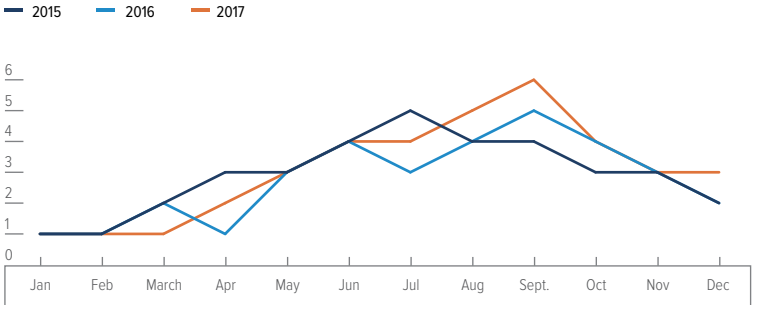
Source: Company data

NPI production // kt



Source: Company data

Nickel ore and concentrate imports to China // mt



Source: Company data