

The Socio-Economic Impact of the Nickel Industry in the EU:

Germany Country Report

Prepared for

The Nickel Institute

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1. NICKEL – AN ENABLING TECHNOLOGY

Nickel, because of its wide-ranging properties and applications, is an ‘enabling technology’, not simply an industry processing primary materials. Most nickel is combined with other metals to form alloys with particular properties such as ductility, very high temperature strength and corrosion resistance, as well as magnetic attraction and controlled expansion.

As a result of these and other properties, nickel brings significant benefits to producers of finished products in a wide array of end-uses ranging from cars, aeroplanes, ships, power generation, process equipment, information technology, and buildings on the one hand, to consumer appliances, cutlery, coins, and medical appliances on the other.

In turn, this widespread use of nickel technology generates an extensive range of important socio-economic benefits for Germany and its citizens:

- **Jobs and wealth** are created and sustained through the operation of a complex ‘value chain’ whereby semi-processed nickel is progressively converted into more complex products and end uses;
- **Sectoral competitiveness** of important German-based industries is strengthened through the contribution that nickel-based technologies make to firm-level innovation and operating efficiency;
- **Economy-wide economic performance** is enhanced because nickel-based technologies help improve resource efficiency and, because of their role as platform technologies, they provide a basis, grounded in decades of know-how and experience, for both incremental and radical innovation;
- **Sustainable economic development** is supported because nickel-based platform technologies help deliver ‘real world’ solutions to environmental challenges, enabling citizens and businesses to respond to regulatory incentives, exploiting fuel sources more efficiently and with fewer emissions, and underpinning the progressive transition towards new sources of energy.

2. JOBS AND WEALTH – THE NICKEL VALUE CHAIN

2.1. The Nickel Value Chain

Nickel brings significant benefits to manufacturers of alloys and to producers of many finished products. Nickel therefore sustains a complex value-chain that creates and sustains jobs, whilst also creating output and wealth.

The value chain for nickel is complex. It involves three distinct tiers. These are the ‘Direct Nickel Industry’, ‘First Use Sectors’ and ‘End Use Applications’.

The ‘**direct nickel industry**’ comprises nickel mines, smelters and refineries. It also includes the transport and logistical activities associated with the movement of nickel within the EU and the activities associated with the importation of raw materials for



refining (ore concentrates, nickel matte and nickel oxides) and refined nickel. The direct nickel industry also includes all activities associated with the recycling of nickel-containing products.

However, only a small amount of nickel is used as a product in its own right. Most often, it is usually combined with other materials to produce nickel-containing alloys (such as stainless steel) with distinct performance characteristics. Nickel is also used as a plating material, and to produce special chemical products for batteries and catalysts. These are known as **'First Use'** applications.

The nickel-containing alloys produced during the 'First Use' stage are sold to product manufacturers both directly and indirectly. Those that are sold indirectly go via **'Intermediaries'**. These include distributors who serve smaller customers and fabricators, metal formers and surface engineering companies who undertake specialist services such as metal shaping, forming and sub-assembly.

Product manufacturers use the nickel-containing alloys as part of their manufacturing process. This group comprises a large number of manufacturers of components, sub-assemblies, and other products that are then used in the manufacture of further products. Collectively, they are known as **'End Use' applications'**.⁴ In many End Use applications, nickel plays a critical role in achieving functional or cost performance.

2.2. The Direct Industry in Germany

- Over the last 20 years, the market for nickel in Germany has expanded substantially as many new uses of nickel have been developed. Germany is the largest nickel user in Europe and the fourth largest user in the world (after China, the USA and Japan). Total German use of nickel reached around 150 kte in 2007, representing over 20% of total EU use.
- Demand is satisfied in Germany through a combination of imports of refined nickel and recycling of existing nickel.
- Primary nickel is not produced in Germany. Substantial quantities of refined nickel are imported into Germany (97kte), mainly from outside the EU.
- The remainder of German demand is satisfied through the recycling of scrap (particularly stainless steel scrap) to produce re-usable nickel. The majority of this recycled nickel is derived from scrap collected from within Germany. Over 50kte (Nickel Units) of recycled nickel was collected in Germany in 2007. Recycled nickel comes from the recycling of end of life products and through the re-use of waste produced during the First Use manufacturing and fabrication process.
- The nickel industry produces around Euro 1.5 billion in value-added in Germany, through recycling activities.
- Employment in nickel recycling activities in Germany was approximately 2,000 in 2007. This includes people employed directly in recycling activities and those employed in support activities such as importation and logistics.



In addition nickel-related activities created a further 1,000 jobs in the economy through income and supplier ‘multiplier’ effects. (Each Euro of expenditure on goods and services by companies and employees in the nickel industry generates additional employment in other sectors, especially services).

2.3. First Use in Germany

- The primary uses of nickel are in the production of nickel containing alloys (stainless steel, alloy steels, non-ferrous alloys, and foundry products), nickel plating, and ‘other’ products such as nickel cadmium batteries, chemicals, and catalysts.
- Nearly 60% of all nickel sales are concentrated in one sector – stainless steel, where nickel is a critical ‘enabling technology’ that facilitates a number of important benefits for stainless steel producers. Among these are corrosion resistance, formability and ‘weldability’.
- Around 2 million tonnes of stainless steel and other alloys produced in Germany are *critically dependent on* nickel. These have a sales value in excess of Euro 6 billion.
- ThyssenKrupp Norita (TKN), one of the world’s leading producers of stainless steel, has its headquarters in Germany. The company has five production sites in Germany: stainless steel melting takes place in Bochum and Krefeld; slabs are processed at cold rolling mills in Dillenburg, Dusseldorf and Krefeld; and, specialist stainless steel precision strip is produced at Dahlerbruck.

Other important producers of stainless steel are BGH Edelstahl (at Neukieritzsch, Frietal, Lugar, and Siegen), Philip Boeker + Wender Stahl (Iserlohn), Schmiedewerke Groeditz (Groeditz), and Deutsche Edelstahlwerke, part of the Schmolz & Bickenbach group (at Witten, Krefeld, Siegen, and Hagen).

- Germany is Europe’s largest producer of nickel-containing specialist alloys, castings and components for demanding applications in the mechanical engineering, IT, automotive, aerospace, power generation, chemicals, oil refining, and pharmaceuticals industries. Overall Germany accounts for nearly half of total EU production. Important producers are Deutsche Nickel at Schwerte, Doncasters Superalloys at Bochum, KM Europa Metaal at Lindar, Thyssen Krupp VDM at Altena, Unna and Werdohl, Vacuumschmelze at Hanau, Saarstahl (Völklingen), Wieland-Werke at Vöhringen, Walzwerke Einsal (Nachrodt-Wiblingwerde), Buderus Edelstahl Schmeidetechnik (Wetzlar), Stappert Spezial Stahl (Dusseldorf), and Platesthal (Ludenscheid).
- There are around 550 companies involved in electroplating, most of whom offer a nickel plating service. Most of these companies are SMEs. In addition, more than 1,000 manufacturing companies have their own in-house plating plant, most of whom undertake nickel plating. They are located throughout Germany, but



with particular concentrations in the regions of North Rhine Westphalia and Bavaria.

- ‘First Use’ industries that are critically dependent on nickel produce around Euro 1.8 billion in value-added at this stage in the value chain. Half of this comes from stainless steel.
- In addition, Intermediaries (e.g. fabricators) produce an additional Euro 0.9 billion in value-added.
- Employment in ‘First Use’ industries and Intermediaries that are critically dependent on nickel is estimated at 28,000 people. This includes both the people employed directly by the ‘First Use’ industries and those employed indirectly in activities that have now been outsourced to third party suppliers.

In addition, ‘First Use’ industries created a further 11,000 jobs in the economy through income and supplier ‘multiplier’ effects, and capital expenditure effects.

2.4. End Use Applications in Germany

- Nickel-containing alloys are used in a very wide range of products, but there are a number of critical applications of nickel where nickel-containing alloys **significantly** transform either the production process or the end product being manufactured. Moreover, in a number of these applications, this transformation cannot be achieved in any other way, or only through a substantial reduction in the performance of the product or the production process. These products can be called ‘critically dependant’ on nickel. They include, for example:
 - **Turbochargers:** Nickel is used in the production of ‘ housings’ and turbine wheels in turbo-chargers (which boost performance, improve fuel consumption, and reduce pollutant emissions). Germany is one of Europe’s major producers of automotive turbochargers. BorgWarner TurboSystems of the USA, one of three leading companies in this sector has a plant at Kirchheimbolanden for manufacturing turbo-charger systems. It also houses the main R&D facility for the division.
 - **Jet engines.** All the parts of the engine that are exposed to extreme temperature conditions include nickel-containing superalloys. Additionally, many of the steels used in shafts, for example, incorporate nickel in order to cope with elevated temperatures and to minimise corrosion. Rolls Royce Deutschland has factories at Dahlewitz and Oberursel, whilst MTU Aeroengines, an independent German company and major strategic partner of a number of global jet engine producers, has manufacturing facilities at Munich and Erdig.
 - **Industrial and marine gas turbines:** Nickel-based super alloys are essential to the successful operation of the gas turbine. Germany the EU’s largest producer of modern, complex gas turbines for power generation, oil refining, petrochemicals, and production of oil and gas. The principal



German producers of stationary and marine gas turbines include Siemens (Erlangen, Berlin, and Mulheim), Alstom Power Systems (Mannheim), and MAN Turbo (Oberhausen and Berlin).

- **Process plant equipment** manufacturers (for industries such as food and drink processing, oil and gas production, petroleum refining, chemicals and pharmaceuticals) are critically dependent on nickel. Its major use is as an alloying element in stainless steel but, in special environments such as high temperature or corrosive environments, nickel alloys are applied instead of stainless steel. German companies are leading producers in this sector

Leading German suppliers of advanced tubes, pipes and complex metal components to the Oil and Gas, Chemical, and Pharmaceutical industries include H Butting (Kneesebeck), Eroform Edelstahl (Bochum), Stahlwerk Ergste Westig (Schweste, Unna), fischer Edelstahlrohre (Achern-Faitenbach), Mannesman DMV Stainless (Remscheid), Schmidt+Clemens (Lindlar), and TPS Technitube Rohrenwerke (Daun).

German-based producers of process plant for the food and drink industry include GEA group. Based in Bochum, GEA is one of the world's leading suppliers of process engineering and equipment for the food industry. Production locations in Germany include Mulheim, Ettlingen, Kitzingen, Buchen, Sanstedt, and Ahaus. Other producers include Krones, the world leader in beverage filling, with sites at Neutraubling, Nittenau, Rosenheim, Flensburg, and Freising, and Buehler with production at Bergneustadt.

- **Commercial catering equipment market:** The properties of stainless steel that are most valued by purchasers of commercial catering equipment include corrosion resistance, ease of fabrication, heat resistance and ease of cleaning. Germany is a leading producer of commercial catering equipment. Producers include Rieber (Reutlingen and Trebbin), Kuepperbusch (Gelsenkirchen), Hupfer Metallwerke (Coesfeld), Stahl Grosskuechen (Markt Einersheim), and Lohberger (Schalchen).
- **The CD/DVD pressing market:** Electroformed nickel is used in the production of 'stampers', which are used to manufacture CDs and DVDs. Plated nickel is also used in the final stages of preparing the 'glass master' from which the stampers are produced. Germany is one of the most important production centres for CDs and DVDs in the EU. Major manufacturing facilities in Germany Sonopress (Gutersloh), MPO (Cologne), ODS Optical Disc Services (Dassow), EDC (Langenhagen), and CDA Datentrager Albrechts (Albrechts).
- **Medical and dental instruments market:** German-based facilities also produce stainless steel products such as injection needles, pincers, drills and surgical instruments, and specialist hospital furniture. These end uses are critically dependent on nickel.



German companies lead the world in the production of surgical instruments. The most important centre of production is at Tuttlingen which is home to over 200 specialist instrument makers along with supporting metal producers (such as Bronner & Martin). Aesculap, the world's biggest producer of surgical instruments and a subsidiary of B Braun Melsungen, is based in Tuttlingen. Other German-based companies include Karl Storz (Tuttlingen), Fehling Instrumente (Berlin), Medicon Instrumente (Tuttlingen), Baeramed Instrumente (Schwenningen), and Gebruder Martin (Tuttlingen).

- These 'nickel dependent' End Use markets account for nearly Euro 7 billion in value-added in Germany.
- These industries employ nearly 90,000 people. Additionally, they create a further 35,000 jobs in the economy through income, supplier 'multiplier' and capital expenditure effects.

2.5. German Nickel Value Chain – Overall Jobs and Wealth

Whilst the German nickel industry itself is relatively small, it has a significant impact on the German economy through its value-chain. Through its critical use in nickel-containing alloys, it has a major impact on leading German industries such as stainless steel. In turn, the use of nickel-containing alloys in many important products manufactured in Germany means that the impact of nickel is substantial in many end-use markets.

As a consequence, the total value-added in Germany by nickel and its value-chain is estimated to be over Euro 11 billion.



Table 1: Value Chain Summary

| | Value-Added (Euro Million) | Total Employment | Examples |
|----------------------------------|---------------------------------------|-----------------------------|---|
| Direct nickel industry/recycling | 1,500 | 3,000 | |
| 'First Use' | 1,800 | 21,000 | <i>Stainless Steel:</i> ThyssenKrupp Norita (TKN), BGH Edelstahl, Philip Boeker + Wender Stahl, Schmiedewerke Groeditz, and Deutsche Edelstahlwerke <i>Nickel-containing specialist alloys:</i> Deutsche Nickel, Doncasters Superalloys, KM Europa Metaal, Thyssen Krupp VDM, Vacuumschmelze, Saarstahl, Wieland-Werke, Walzwerke Einsal, Buderus Edelstahl Schmeidetechnik, Stappert Spezial Stahl, Platesthal. |
| Intermediaries | 900 | 18,000 | Large number of distributors, fabricators, metal finishers |
| 'End Use' | 7,000 | 125,000 | <i>Turbochargers:</i> BorgWarner <i>Jet Engines:</i> MTU Aeroengines, Rolls Royce Deutschland <i>Gas Turbines:</i> Siemens, Alsom Power Systems, MAN Turbo <i>Process Plant Equipment:</i> H Butting, Eroform Edelstahl, Stahlwerk Ergste Westig, Fischer Edelstahlrohre, GEA Group, Krones, Buehler. <i>Commercial Catering:</i> Rieber, Kuepperbusch, Hupfer Metallwerke, Stahl Grosskuechen, Lohberger. <i>CD/DVDs:</i> Sonopress, MPO, ODS Optical Disc Services, EDC, CDA Datentrager Albrechts. <i>Medical Instruments:</i> Aesculp, Karl Storz, Fehling Instrumente, Medicon Instrumente, Baeramed Instrumente, Gebruder Martin. |
| Total | 11,200 | 167,000 | |



Moreover, the direct nickel industry and the industries in its value-chain that are critically dependent upon it, employ a substantial number of people. Total employment in Germany in the direct nickel industry, 'First Use' industries and Intermediaries, and product manufacturers that depend on nickel is around 120,000. A further 47,000 jobs have been created in the economy through income and supplier 'multiplier' effects, and capital expenditure effects. Hence around 167,000 jobs are 'critically dependent' on nickel in Germany.

3. OTHER SOCIO-ECONOMIC BENEFITS

Nickel and nickel-based platform technologies provide a range of additional socio-economic benefits to Germany and its citizens that are often not apparent to policy-makers and the general public. Important insights into the scale and nature of these additional benefits can be obtained through an examination of the role that nickel compounds (complex chemicals based on different forms of nickel) play in underpinning the competitiveness of major industrial and service sectors in Germany (such as aerospace, automotive, oil refining, and optical media), and in supporting economic efficiency and innovation across large parts of Germany's economy.

Nickel compounds are used in a very wide range of applications in many different industries. In many cases, they act as ingredients or raw materials, delivering important product-specific benefits, such as cost or performance. In some cases, however, nickel compounds act as enabling technologies, supporting important industrial processes. These include: the use of electro-forming to produce specialist moulds, dies, and meshes; the production of complex, modern batteries, including fuel cells; and the production of advanced nickel-based catalysts.

In turn, these processes support the competitiveness of major industrial and service sectors in Germany; deliver jobs and wealth; trigger innovation; support economic efficiency; and help Germany achieve its environmental goals.

In Germany Oil Refining industry, for example, nickel-based catalysts, through their critical role in reforming, hydrocracking, and desulphurisation, enable oil refiners to meet the needs of customers and regulators for low sulphur transport and heating fuels, whilst, at the same time, helping to minimise raw material costs by facilitating greater use of lower cost crude oils and by enhancing energy efficiency. Nickel-based catalysts also facilitate improvements in yield, and hence product prices, by supporting advanced conversion and up-grading technologies used to maximise output of lighter transport fuels.

Over time, enhanced sectoral competitiveness helps to sustain employment. In Germany the Oil Refining sector supports nearly 25,000 jobs directly and indirectly and contributes over Euro 4.5 billion to German GDP. Major sites are located at Inglostadt, Gelsenkirchen, Wilhelmshaven, Rheinland, Hamburg, Karlsruhe, Schwedt, and Leuna. German-based companies, most notably BASF, Degussa, and Sud Chemie, are some of world's leading suppliers of nickel-based catalysts.



Moreover, platform technologies based on nickel and nickel compounds help deliver ‘real world’ solutions to environmental challenges. Today, the use of non-metallic materials in the aerospace and automotive industry, made possible by nickel electro-forming, reduce weight, increase fuel efficiency, and cut emissions, for instance.

In the near future, fuel cell technology, based on nickel and its use in batteries, provides power generation operators with a realistic and effective way of responding to regulatory incentives to reduce greenhouse gas emissions. Alongside this, Hybrid cars offer substantial environmental benefits: emissions of carbon dioxide and other pollutants are reduced; fuel consumption is cut; and noise levels are lower. They offer Europeans a practical technology pathway towards meeting environmental goals.

4. CONCLUSIONS

Nickel is an ‘enabling technology’, not simply an industry sector processing primary materials. Its particular properties, such as strength at high temperatures, corrosion resistance, and ductility, have helped German users create new products and industries, to develop new user benefits, and to deliver enhanced performance in a wide range of advanced manufacturing sectors.

Whilst the German direct nickel industry itself is relatively small, it has a significant impact on the German economy through its value chain.

Based on applications that are critically dependent on nickel, the total value-added by Germany nickel industry and its value chain is estimated to be over Euro 11 billion.

The nickel value chain also supports large numbers of jobs in Germany, estimated to be in the order of 168,000. Many of these jobs are well-paid and highly skilled, and are often in manufacturing industries that are globally competitive suppliers of capital goods.

Indeed, Germany is a global leader in the production of complex nickel-containing alloys, particularly for capital goods industries that are critically dependent upon nickel technology. Advanced ‘End Use’ manufacturing sectors in Germany that are critically dependent on nickel include the manufacture of jet engines and gas turbines, the production of process plant equipment used in important industries such as food and drink, oil, chemicals, and pharmaceutical production, medical equipment, and the pressing of CDs and DVDs.

However, the socio-economic contribution of nickel and nickel-based platform technologies to Germany and its citizens also includes additional benefits that are often not apparent to policy-makers and the general public.

Nickel compounds, for instance, play an important role in underpinning the competitiveness of major industrial and service sectors in Germany (such as aerospace, automotive parts, oil refining, and optical media), in supporting economic efficiency and innovation across large parts of Germany’s economy, and in helping Germany achieve its environmental goals.

