



# NICKEL IN THE EUROPEAN UNION

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The Atomium was originally the Belgian pavilion at the World Exposition held in Brussels in 1958. Designed by engineer André Waterkeyn, the building represents a giant, walk-in representation of an iron atom – enlarged 165 billion times.

The Atomium was meant as a temporary construction but at the end of the exhibition, it was decided to keep the structure as a monument to the beauty of technology and the fascinating discoveries of science.

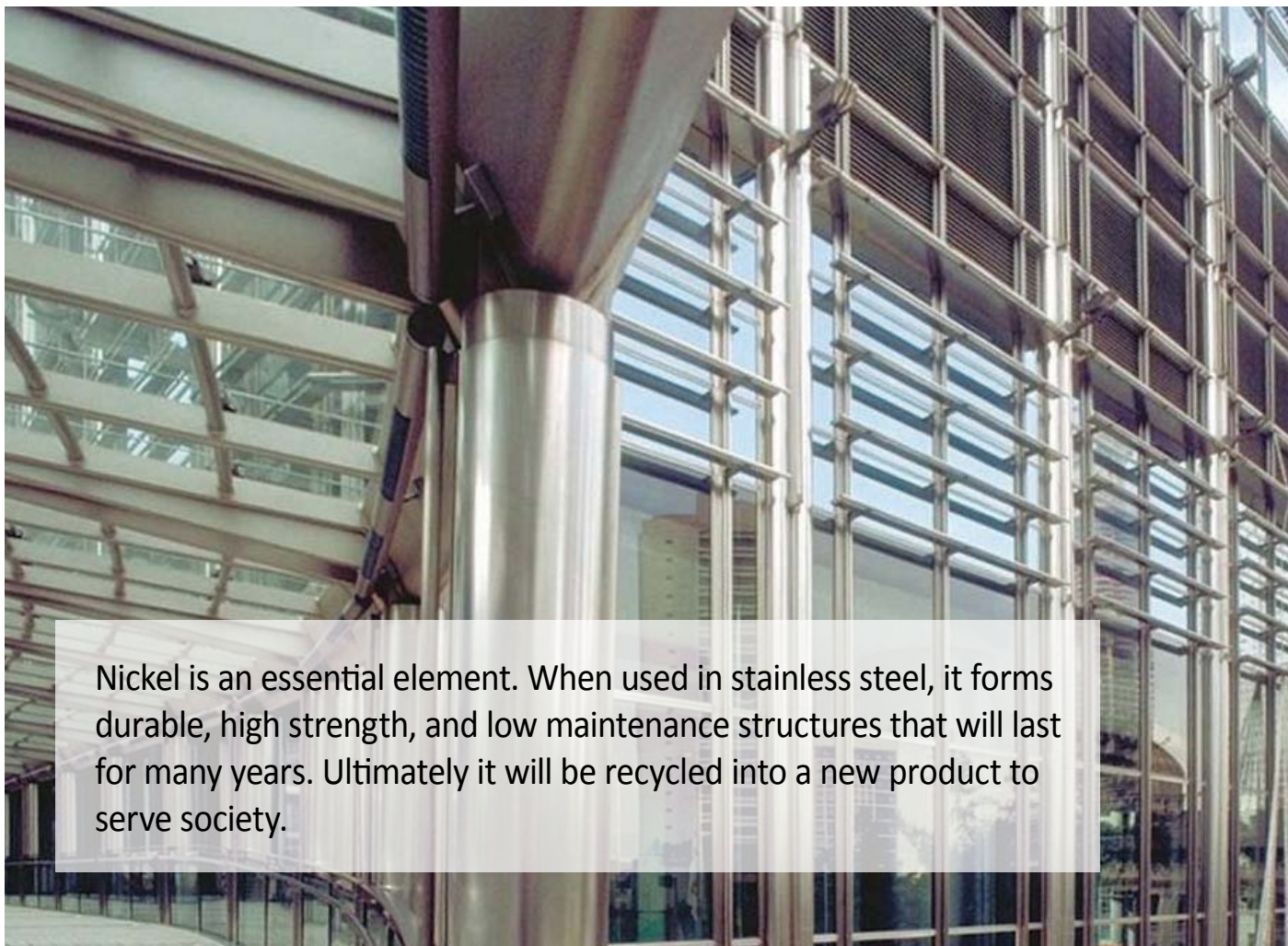
However, over time, the aluminium skin lost its sheen, steel components began to rust and joints leaked. The wrong cleaning materials, a lack of corrosion protection and damaging environmental influences such as air pollution, pigeon droppings and storms hastened its deterioration.

In 2001 a plan to refurbish the structure was launched and because of its excellent material properties, grade 1.4404 stainless steel was chosen for the new cladding material. This grade of chromium-nickel-molybdenum steel has high corrosion resistance and good formability. The 2B mill finish of the stainless steel was then electrolytically polished. As a result, the smooth, reflective surface attracts less dirt, and has self-cleaning properties when it rains. Today the Atomium remains a unique expression of the age in which it was created and an important landmark in the Brussels skyline.

Source : Euroinox







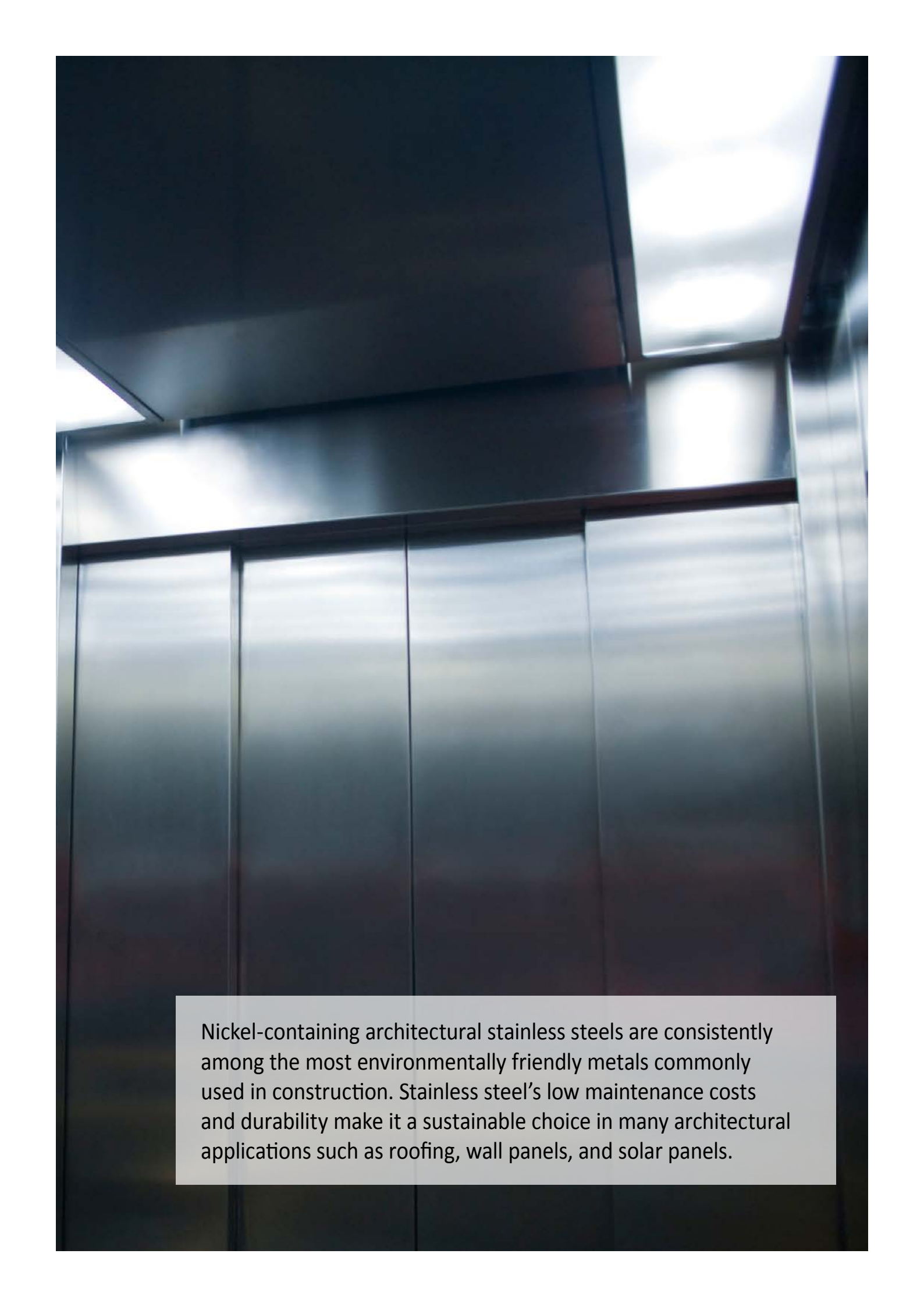
Nickel is an essential element. When used in stainless steel, it forms durable, high strength, and low maintenance structures that will last for many years. Ultimately it will be recycled into a new product to serve society.

## **Nickel, essential today, essential tomorrow**

It is hard to imagine a world without nickel. In use, nickel is of high value as it can be found in many critical applications that bring widespread benefits to society, including clean air, clean water, safe food preparation, and health care, as well as everyday items in the home as diverse as kitchenware and computers.

In industry, nickel catalysts and alloys are at the heart of an efficient and modern industry, including oil refining, allowing the production of low sulphur fuels. Nickel enables clean power generation, and is found in all renewable energy solutions.

It can be found in advanced, green technology that increases energy efficiency and reduces carbon emissions. In architecture, nickel alloys combine functionality and high recyclability with aesthetics.



Nickel-containing architectural stainless steels are consistently among the most environmentally friendly metals commonly used in construction. Stainless steel's low maintenance costs and durability make it a sustainable choice in many architectural applications such as roofing, wall panels, and solar panels.

Before nickel in any form is put to use, it first has to be explored, mined, refined, fabricated and integrated into products for domestic use and for export. While the general view may be that the “raw material” stage of the nickel value chain is something that happens outside the European Union the reality is that elements of every part of the value chain are found within the EU.

# PRODUCING NICKEL IN THE EU

## Major European Producers of Nickel

### EXPLORATION / MINING

Finland  
Greece  
France (New-Caledonia)  
Spain  
Sweden (exploration)

### SMELTING

France (New-Caledonia)  
Greece  
Austria  
Finland

### REFINING

Finland  
France  
Norway  
United Kingdom

### CHEMICALS

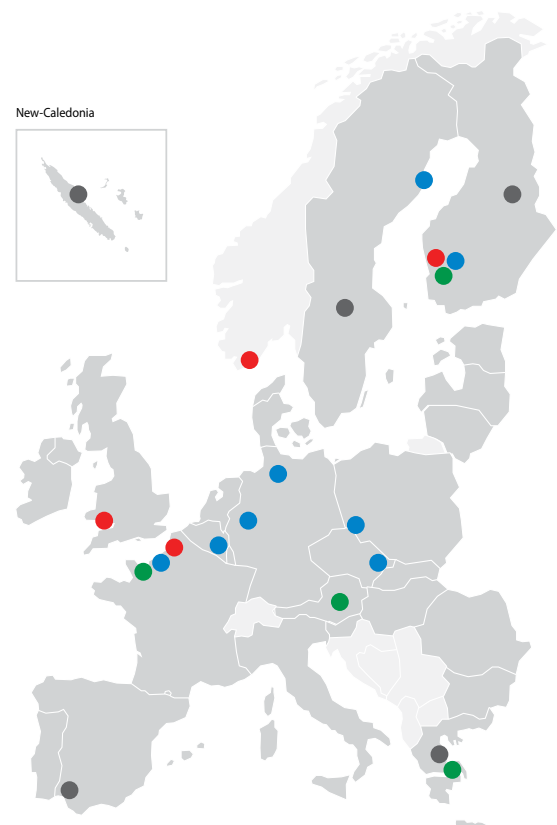
Finland  
France  
Belgium  
Germany  
Poland  
Sweden

## Nickel Mining, Smelting and Refining

Nickel ore is mined in Finland, Greece, France (New Caledonia) and, on a smaller scale, in Spain. Sweden (where the element “nickel” was first identified) has a history of mining nickel and is exploring growth in the sector.

Nickel-containing ore is usually smelted to produce a raw material for the steel industry (“ferronickel”) or for subsequent refining into nickel metal or nickel containing chemicals.

**Nickel is refined into high purity nickel, notably in Finland, France, Norway and the United Kingdom.**







Hybrid and electric vehicle technology has been greatly assisted and improved through the use of nickel metal hydride batteries. Indeed, thanks in part to nickel, hybrid cars produce 50% fewer harmful pollutants and greenhouse gases than comparable gasoline cars.

# USING NICKEL IN THE EUROPEAN UNION

## In industry

The EU uses approximately 700,000 tonnes of nickel per annum: 387,200 tonnes in 2008 from mines, the rest contained in recycled material, mainly stainless steel. Most of that goes into the production of over 8 million tonnes of stainless steel – about 35% of all the stainless steel produced in the world. Of that production, net exports are approximately 1.8 million tonnes. Besides China, the EU is the largest single producer and exporter of stainless steel.

Alloys similar to stainless steel but with higher nickel content are used in the chemical, petrochemical, energy and aerospace industries. Alloys of iron and nickel find many uses in electrical and electronics industries and other specialist engineering fields. Alloys of copper and nickel are used in coinage and marine engineering.

Nickel provides hard-wearing coatings for either decorative (“brushed nickel” and “chrome” finishes) or engineering purposes. Nickel is also essential to many battery chemistries from nickel metal hydride to innovative versions of lithium ion, nickel zinc and other chemistries. Nickel has strong catalytic properties that serve the chemical and petrochemical industries.

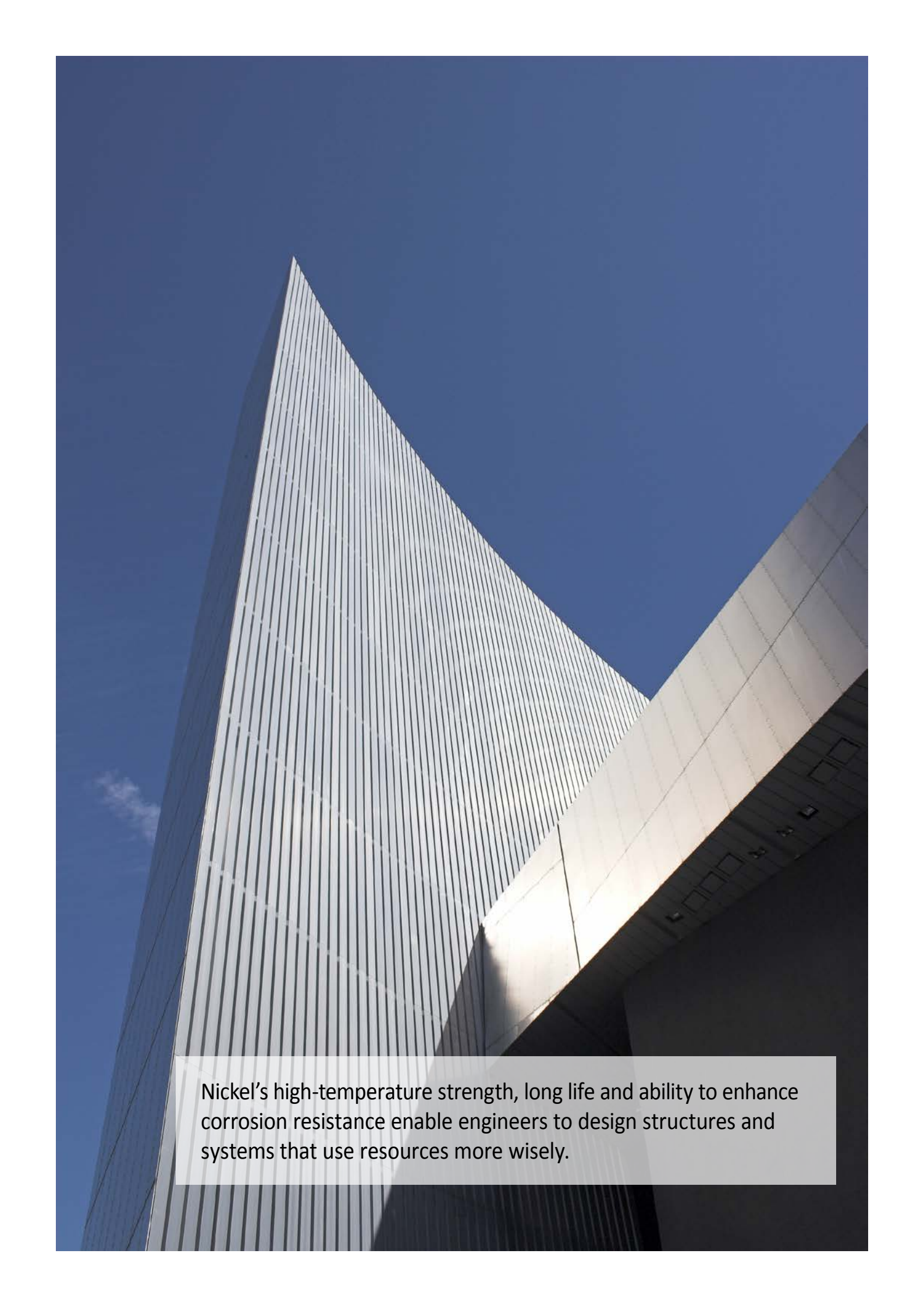
## In daily life

Nickel’s combination of properties makes it an essential part of the economic and social infrastructure, contributing to human shelter, transportation, energy production and transmission, and virtually to all manufacturing industries.

More often than not, food is either manufactured or cooked at home using nickel-containing stainless steel appliances, utensils... and eaten using stainless steel cutlery. While durability, toughness and aesthetics are appreciated qualities, the most important is the ability to withstand aggressive cleaning. Clean surfaces that do not support bacterial growth or compromise the quality or taste of food make nickel-containing stainless steels an essential part of any food safety regime.

## EU Nickel Value Chain

The greatest value is added in the end-use stage and it is there — the part of the value chain that is most prominent for the European Union — that there is value added in every part of the EU in the form of employment, taxes, investment and the utility of the end products themselves.



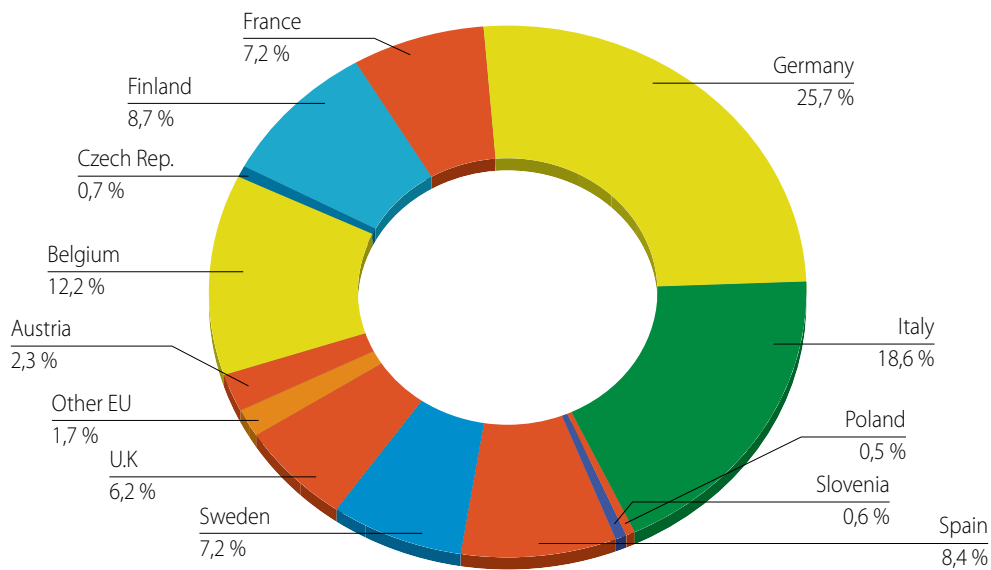
Nickel's high-temperature strength, long life and ability to enhance corrosion resistance enable engineers to design structures and systems that use resources more wisely.



## EUROPEAN UNION USE OF NICKEL

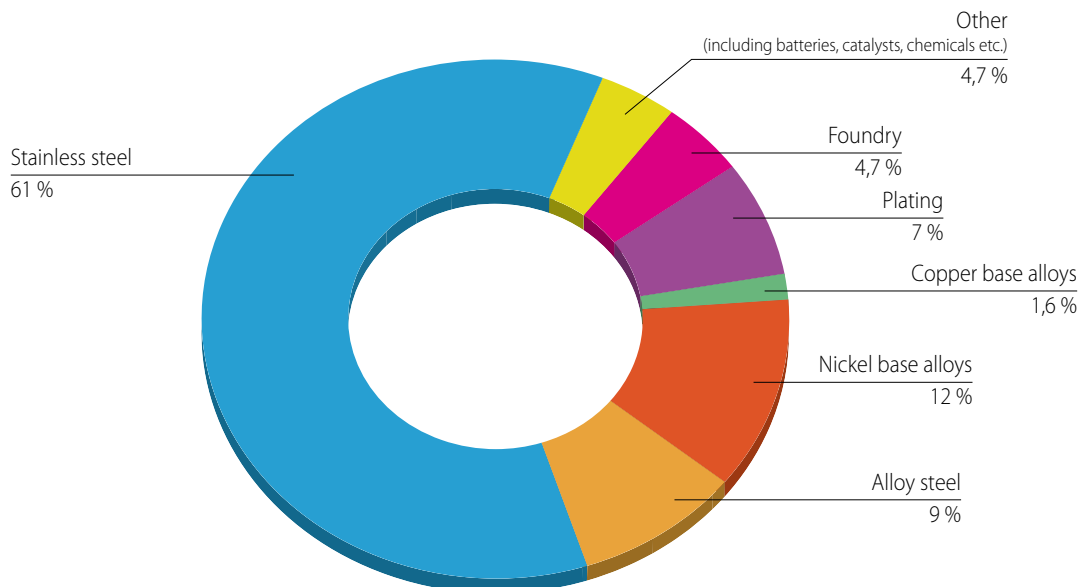
In many ways, nickel is a metal of advanced societies. Its major uses are for high-performance technological products which take advantage of its valuable characteristics such as high heat resistance, strength, and durability. Therefore the use of nickel is influenced by both a society's level of affluence and the nature of its manufacturing sector.

### EUROPEAN UNION USE OF NICKEL - GEOGRAPHICAL BREAKDOWN (2010, NOT INCLUDING RECYCLING)



Source : Heinz H Pariser Alloy Metals & Steel Market Research, 2011

### EUROPEAN UNION MAIN USES OF NICKEL (2010)



Source : Heinz H Pariser Alloy Metals & Steel Market Research, 2011



Virtually all manufactured metal surfaces require some form of finishing. Of all the metals used, nickel is the most versatile. Nickel coatings meet many needs, both functional and decorative.

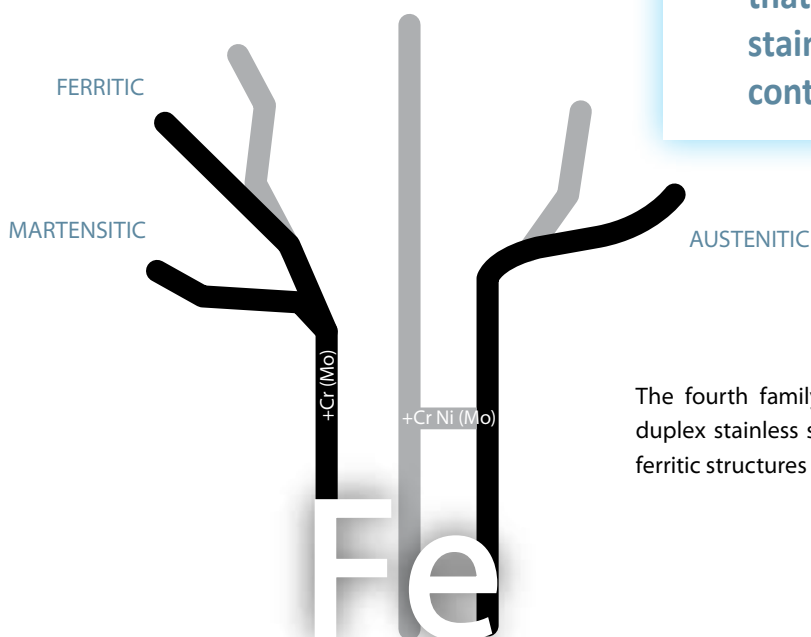
Over 85% of new nickel – that is, nickel coming from primary production – and most recycled nickel, goes into producing alloys of which there are approximately 3000 kinds.

Essential qualities of nickel-containing alloys:

- Ability to withstand extreme (>1000° C) heat...  
or near absolute zero cold
- Ability to resist strong acids
- Strongly magnetic...  
or completely non-magnetic
- Ability to have a thermal expansion of practically zero...  
or tailored to match the thermal expansion of other non-nickel-containing components
- Ability to have low electrical resistance...  
or the high resistance necessary for heating elements
- Ability to add strength and resilience to steel structures...  
or give “shape memory” to specialist applications from spectacle frames to stents

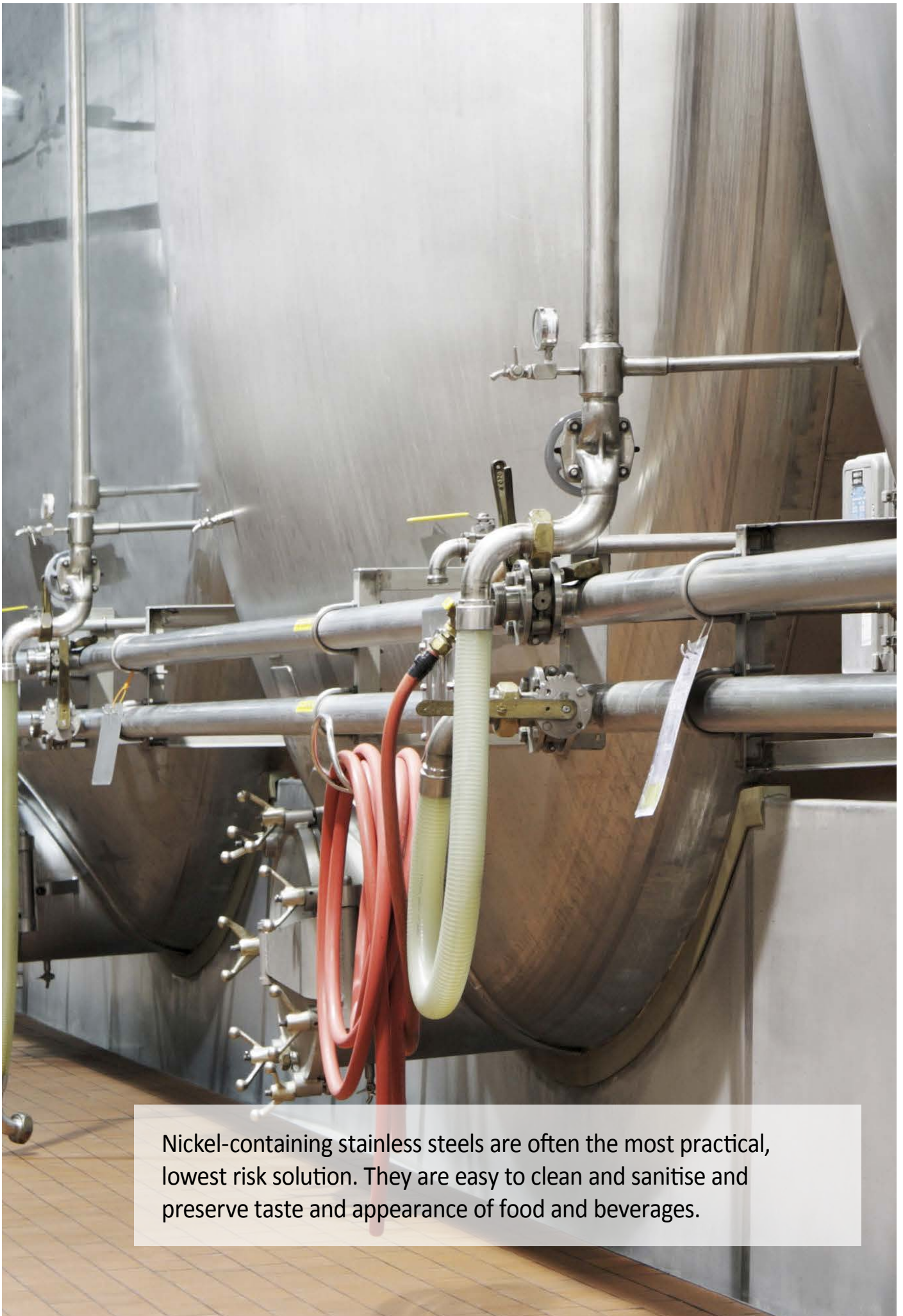
Of all the alloys, the family of stainless steels is the best known. The majority of those stainless steels contain nickel in the range of 8% to 12%, and two thirds of new nickel and almost all nickel-containing scrap goes into making stainless steels. Furthermore, in addition to the corrosion resistance of stainless steel, other properties such as strength and ductility make them the material of choice for many applications in the chemical and petrochemical industries, food processing and brewing, medical equipment and pharmaceuticals, all forms of transportation and energy production.

**There is no industrial sector  
that does not use nickel-containing  
stainless steels or other nickel-  
containing alloys.**



The fourth family of stainless steels is that of duplex stainless steel, combining austenitic and ferritic structures in one alloy.





Nickel-containing stainless steels are often the most practical, lowest risk solution. They are easy to clean and sanitise and preserve taste and appearance of food and beverages.

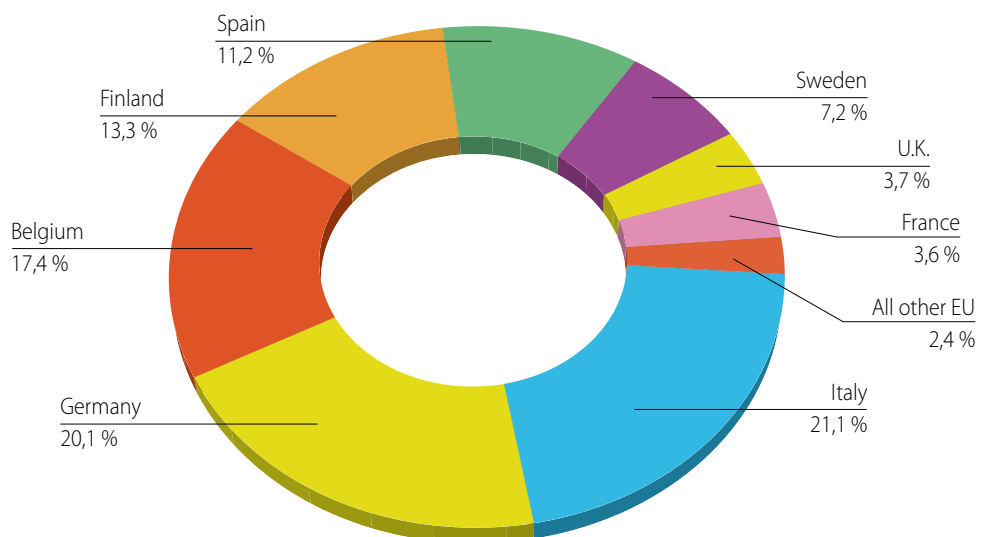
## Nickel-based Alloy Production

- In 2008, 98,000 tonnes of nickel-based alloys and castings were produced in the EU. While some was exported, most was used to make components of jet engines, turbines, process plant equipment and electronics that depend on the performance attributes brought to the alloys by the presence of nickel.
- Several large companies specialise in nickel-based alloy production and their operations are concentrated in France, Germany, Italy, Sweden and the United Kingdom... but many smaller companies throughout the EU also produce such alloys.

## Other Alloy Production

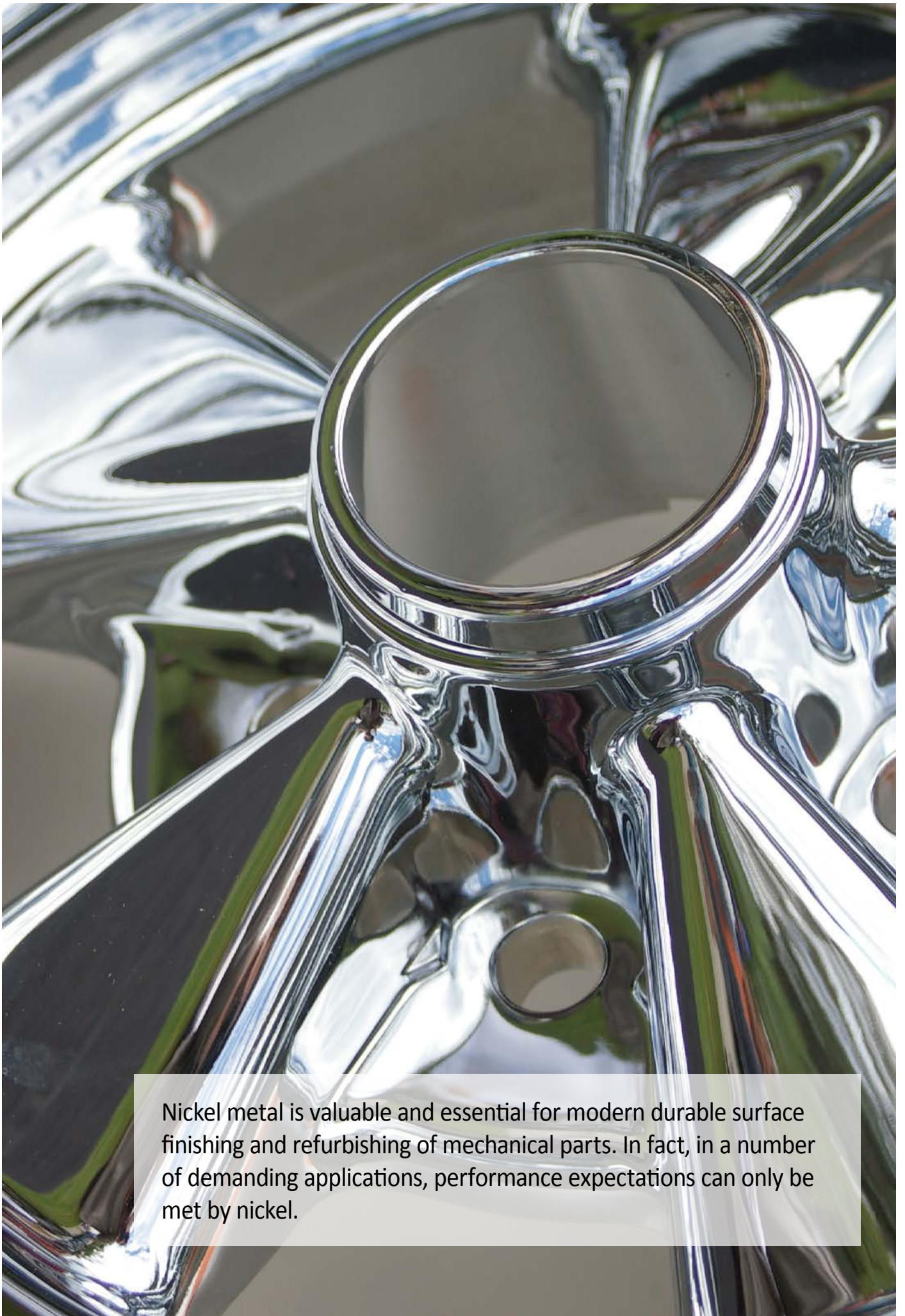
- Nickel-containing copper alloys are produced in several EU countries by copper and brass mills. The alloys are used in coinage and specialist corrosion resistant products for maritime use.
- Nickel is essential to a number of specialist cast alloys produced by the iron and steel foundries existing in nearly every European country, many of which are small or medium-sized enterprises. Castings containing nickel are especially important to the foundries in France, Germany, Italy and the United Kingdom.

### EUROPEAN STAINLESS STEEL PRODUCTION (2010)



Source : Eurofer





Nickel metal is valuable and essential for modern durable surface finishing and refurbishing of mechanical parts. In fact, in a number of demanding applications, performance expectations can only be met by nickel.



## Nickel Surface Technology and Electroforming Operations

- Most surface technology is used on components or customised shapes, which means that it most often takes place near where the customers are. Thus there are few large stand alone surface technology operations. Overwhelmingly this industry consists of thousands of small or medium-sized firms or specialist units attached to larger companies that need such supplies.
- Surface technology operations are found in every significant manufacturing centre of the EU.

## Nickel Powders, Salts and Chemicals

- These specialist products are essential inputs for the powder metallurgy industry and for the production of nickel-containing catalysts, batteries, pigments and specialist paints for electromagnetic protection. Much of the innovation associated with the use of nickel is based on these products.
- The EU exports a considerable amount of these specialist products, especially to Japan for use in current and evolving battery technologies.
- Small powder and chemical production facilities are found in most EU countries but the large-scale production is in Denmark, Finland, France, The Netherlands, and Sweden.

## Manufacturing Industry Use of Nickel-containing Materials

- Specialist stainless steel wholesalers and manufacturers are found in every EU country. They vary enormously in size and include many small enterprises. Many have contractual or corporate connections with the large steel producing companies.
- Many different industries of every size produce and assemble components made from nickel and especially nickel-containing alloys. Nickel in some form is essential for components of jet engines and gas turbines for power generation, oil and gas production, and equipment for every area of industrial production from telecommunications to medicine, from transportation to food handling.
- Nickel-containing products of many types go into EU-manufactured automobiles and electronics.
- EU-manufactured products containing nickel are exported throughout the world. Typical products are components and equipment for turbines of all types, oil and gas production, chemical production, and defence equipment.
- For many of these products the use of nickel is critical to their performance: they depend on nickel for safe, reliable, efficient operation. For a variety of metallurgical, mechanical or economic reasons it is not possible to substitute another material for the nickel.



Using nickel for its high stiffness, and under the right conditions, high strength, researchers at HRL Labs have created 'micro-lattice', the world's lightest solid material. Thanks to its exceptional ability to absorb energy, nickel microlattice is expected to benefit various industrial sector such as vehicles, aircraft and batteries.

# NICKEL: CREATING VALUE

Nickel and its chemicals – whether in something as obvious as austenitic stainless steel or hidden in battery chemistries, catalysts or electro-magnetic shielding – enable a modern efficient economy and are used in thousands of applications.

**The properties of nickel enable technical innovation, making a clear contribution to EUROPE 2020.**

Jobs are created and sustained, and wealth is generated, as a complex value-chain of operations takes basic forms of nickel and progressively transforms them into ever more complex materials and products. Because nickel is valuable and does not degrade, it is recoverable at high rates from end-of-life products, generating more employment.


## NICKEL-DEPENDENT EMPLOYMENT IN THE EUROPEAN UNION (2004)

Value-chain Component	Direct Employment (where nickel is produced or converted into value-added products)	Multiplier effect employment (support industries from legal to trucking to advertising)	Total Employment
Production and recycling of nickel: mining, refining, scrap collection and preparation	16,000	7,000	23,000
"First use" of nickel: production of alloys and chemicals	75,000	60,000	185,000
Intermediate products and services: fabricators, surface finishers, stockists	50,000		
"End-use": nickel and nickel alloys in heavy engineering, chemical works, consumer goods	330,000	150,000	480,000
<b>Total</b>			<b>688,000<sup>1</sup></b>

Nickel contributes to European competitiveness and sustainability, and increases quality of life through its continued innovative use in materials that support resource efficiency.

In its different applications, nickel makes infrastructure last longer, perform more efficiently and will, at end-of-life, have a positive economic value because of the presence of recoverable and recyclable nickel.



A photograph showing the silhouettes of several wind turbines against a vibrant sunset sky. The sky transitions from a deep blue at the top to a bright orange and red near the horizon. The turbines are arranged in a line, receding into the distance. The foreground shows a dark, silhouetted landscape, possibly a field or forest.

Europe needs raw materials like nickel to produce resource and energy efficient technologies, electronics, consumer products and important infrastructure. Nickel-containing materials are important in construction, food production, power generation and medical equipment.

# CONTRIBUTION TO SUSTAINABILITY

## Nickel and Recycling

**Nickel is one of the most recycled materials.**

In the European Union, close to 100% of process scrap (from manufacturing processes) and about 80% of end-of-life nickel-containing products are collected and recycled, mostly into alloys. About half the nickel content of a stainless steel cooking pan purchased today will have come from recycled raw materials – and the majority of that will be from recycled end-of-life products.

These percentages would be higher except for two main reasons. Nickel-containing products have long lives and do not become available for recycling sometimes for decades. At the same time, the production of nickel-containing materials is increasing strongly around the world. As a result there is not enough end-of-life material (“scrap”) to satisfy demand.

The business of recycling nickel-containing materials is a large and profitable industry in the European Union. The high demand for nickel means that nickel-containing scrap commands a relatively high price in different market conditions, traditionally about two to three times the price of scrap aluminium and ten times the price of scrap steel.

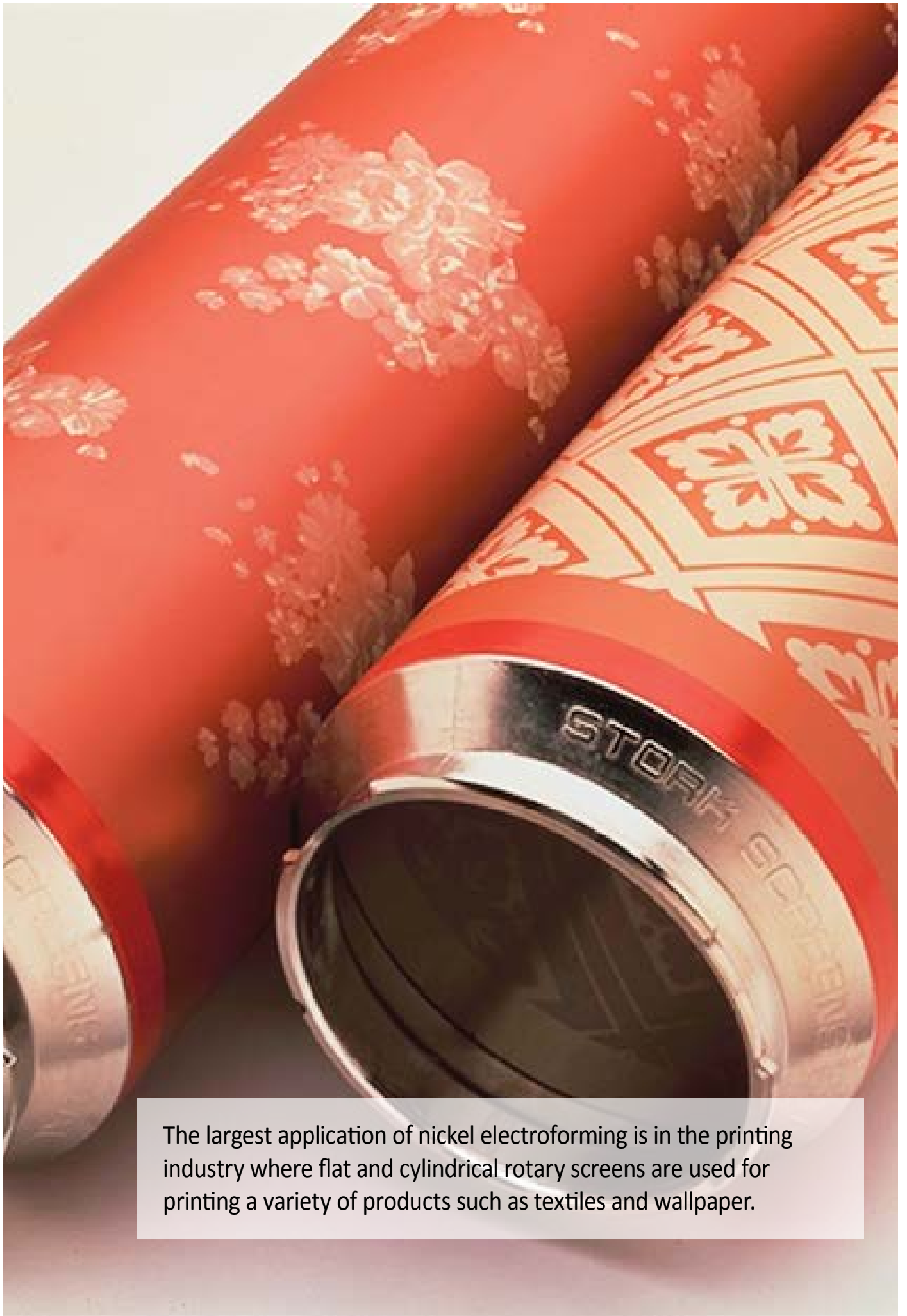
- The collection, sorting and recycling of nickel-containing product is a complex business with many different intermediate products flowing between specialist firms in order to maximise recoveries. This is an activity that is found throughout the EU.
- In 2008 an estimated 300,000 tonnes of nickel contained in scrap was processed. Approximately 200,000 of those tonnes originated as process scrap.
- With a nickel content of about 10%, the EU scrap industry annually handles about 3 million tonnes of nickel-containing scrap.
- Nickel-containing scrap is both imported into the European Union and exported, mainly to Asia. This traffic reflects differences in the suitability of certain materials and the tendency of scrap to flow to where the price is highest.

## Nickel and Sustainable Development

Most nickel-containing products have long useful lives. The average life of nickel-containing products is in the range of 25-35 years and for some applications such as roofs and cladding this can go up to 100 years. Nickel-containing materials and products are necessary for sustainability:

- Because of their durability, materials and products last longer without maintenance or replacement.
- Because of their strength, less material is needed in structural elements.
- Because of their recyclability combined with high economic value, end-of-life scrap comes back to be renewed through recycling, preserving the resource for future generations even as it lessens the need to replace material through mining.
- Because the recycling of nickel-containing material requires less energy than the production of nickel from mines, smelters and refineries, there are a whole range of reduced energy use and emissions to the environment.

The nickel in use in the EU and the additional nickel that is entering use constitute a stock of nickel that can be used and reused for generations to come.



The largest application of nickel electroforming is in the printing industry where flat and cylindrical rotary screens are used for printing a variety of products such as textiles and wallpaper.



## NICKEL STOCKS AND FLOWS IN EUROPE

The graphical representation below shows the nickel cycle in Europe, namely the stocks of nickel that are used by manufacturers to make products, and the flows of nickel that is mined and recovered as scrap.

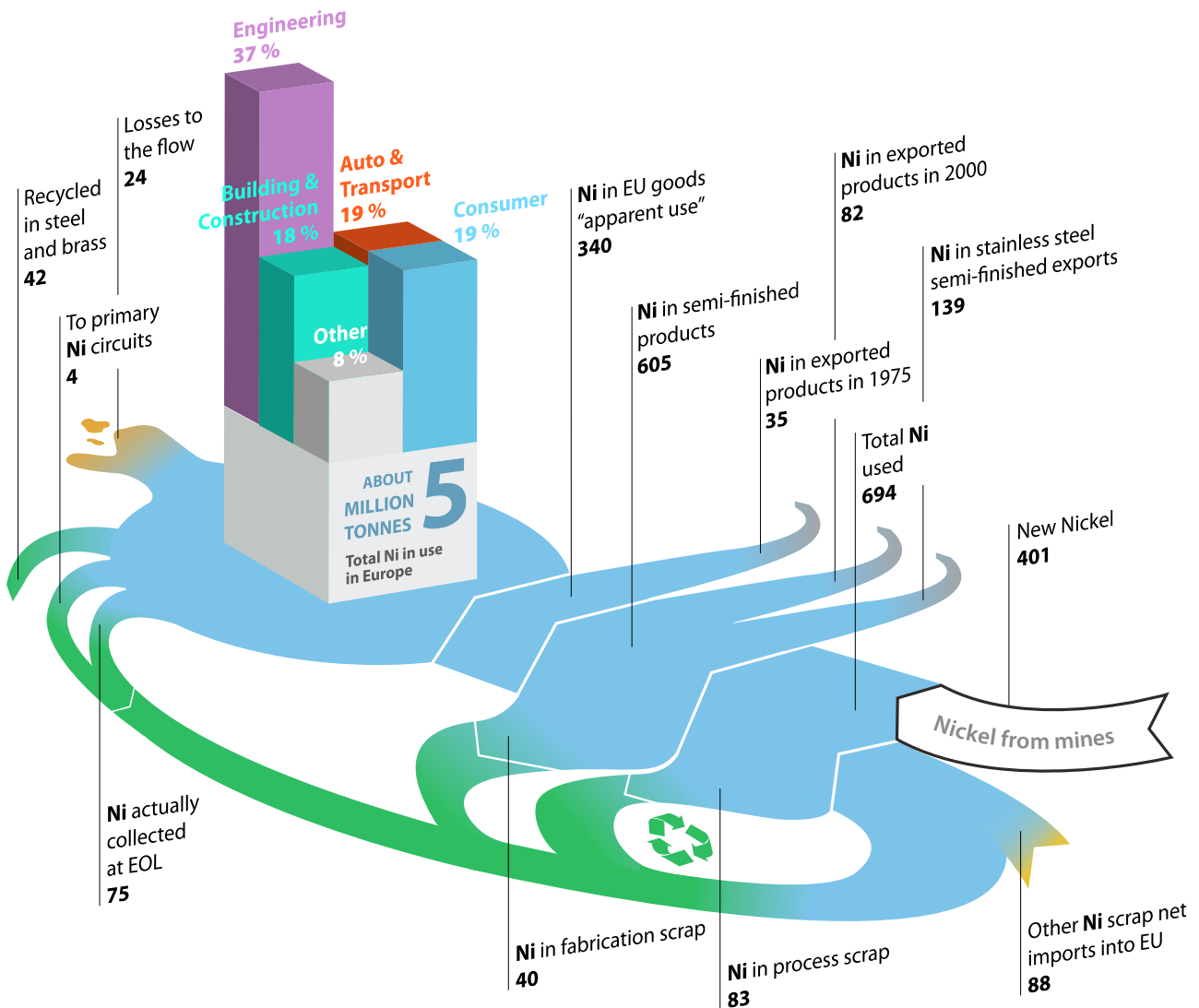
Figures in thousands of tonnes per year.

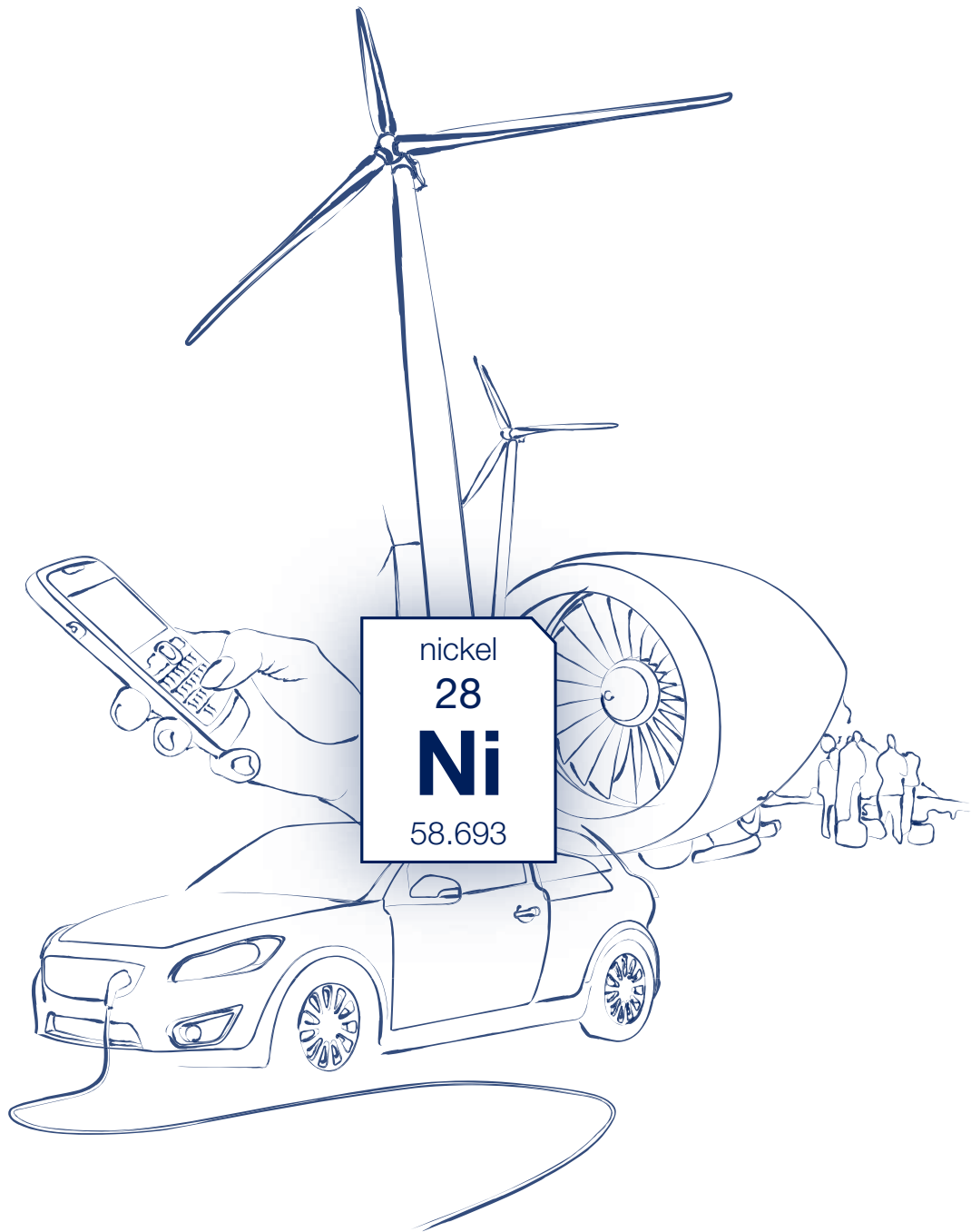
(representative of annual flows in the period 2005-2010, based on an assumed average 25 year life cycle).

Figures are rounded and some are based on estimates.

### NICKEL FLOWS IN EUROPE

The total of 5 million tonnes of nickel in use is explained by the versatile use of nickel, nickel alloys, and nickel technology, as well as the long life time of many nickel-containing end products.





nickel

28

**Ni**

58.693

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# ABOUT THE NICKEL INSTITUTE

The Nickel Institute is a nonprofit organisation that currently represents the interests of 24 companies, which together produce more than 75% of the world's annual nickel output.

## What the Institute does

We promote on behalf of our members the production, use and re-use (through recycling) of nickel in a socially and environmentally responsible manner.

This is achieved through:

- Promoting sustainable production and usage
- Advocating and developing sound science
- Developing partnerships through the value chain
- Proactively engaging with stakeholders
- Maintaining transparency and integrity in all our business relationships
- Working to earn the trust of our stakeholders

We provide a common, responsible voice for the global industry and we work with other international metals associations and stainless steel development associations to develop and promote the safe use of nickel around the world.

## Member Companies

Anglo American Brasil Ltda  
Anglo American Platinum Ltd.  
Aurubis AG  
BHP Billiton  
Bochemie s.r.o.  
Dynatec Madagascar S.A.  
Eramet S.A.  
ENK PLC  
Glencore International A.G.  
JFE Mineral Company, Ltd.  
Niref B.V.  
OJSC MMC Norilsk Nickel

Pacific Metals Co., Ltd.  
PT Vale Indonesia Tbk.  
Rio Tinto plc  
Sherritt International Corporation  
Sinosteel Corporation Limited  
Sumitomo Metal Mining Co. Ltd.  
Talvivaara Mining Company plc  
Umicore  
Vale Canada Limited  
Vale Inco Japan Limited  
Western Areas NL  
Xstrata Nickel

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