

# The Global Life Cycle of Stainless Steels

Minimising mining (primary production) and maximising recycling (secondary production) are core principles of sustainable resource management. Consequently, there is an increasing interest in quantifying the material life cycle of stainless steels and their efficiencies from production, to fabrication, manufacturing, use, recycling and, in some cases, disposal.

In 2006, Team Stainless and Yale University started the first project to quantify stainless steel stocks and flows cycles in 2000 and 2005. This fact sheet provides highlights from the latest study 'Comprehensive Multilevel Cycle of Stainless Steel in 2015' by B.K. Reck, covering 50 countries, territories and country groups.



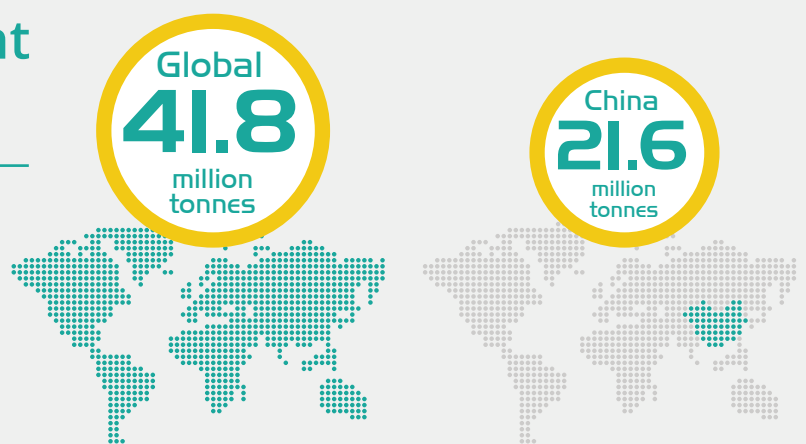
## Stainless steels: a sustainable solution for more than a century

Stainless steels are produced in various grades and support many essential applications in our modern world from transportation, buildings, bridges, water pipes and industrial processes to medical uses, food processing and preparation. They are often selected as the sustainable material of choice for a myriad of domestic and industrial applications because of their recyclability, strength, toughness, durability, hygienic properties, and resistance to corrosion, heat, cold and blasts.

## 2015 global production & apparent consumption

In 2015, global stainless steel meltshop production was **41.8 million tonnes**, with more than half being produced in China (21.6 million tonnes).

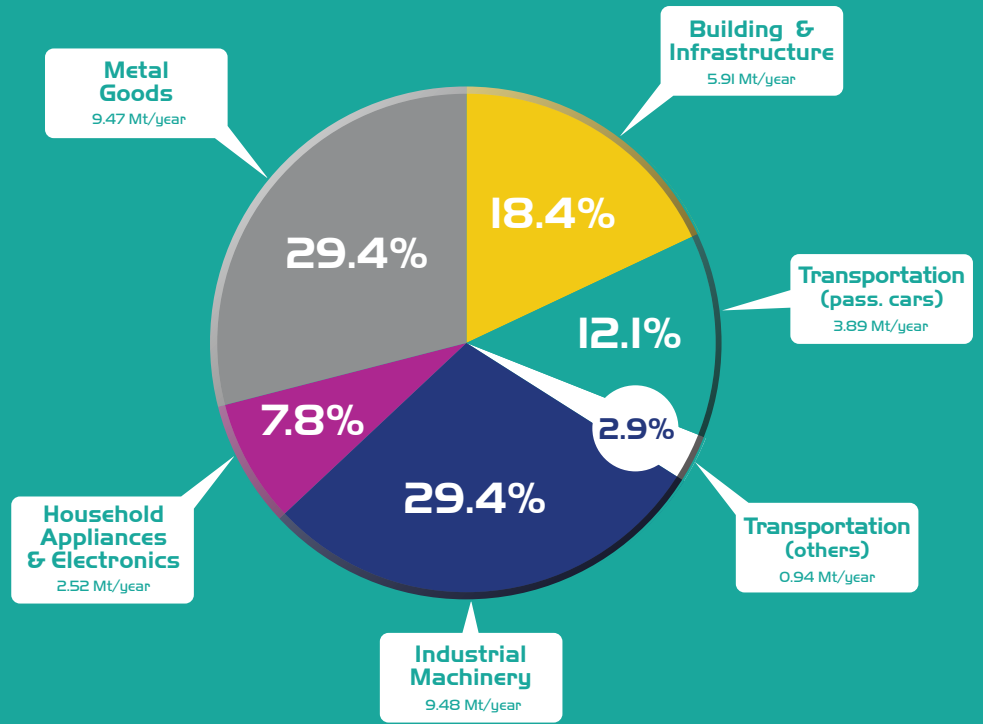
Use in manufacturing was estimated to be **35 million tonnes**, **46% of which was in China**.



# 2015 end use

End use refers to the final products where stainless steels are used.

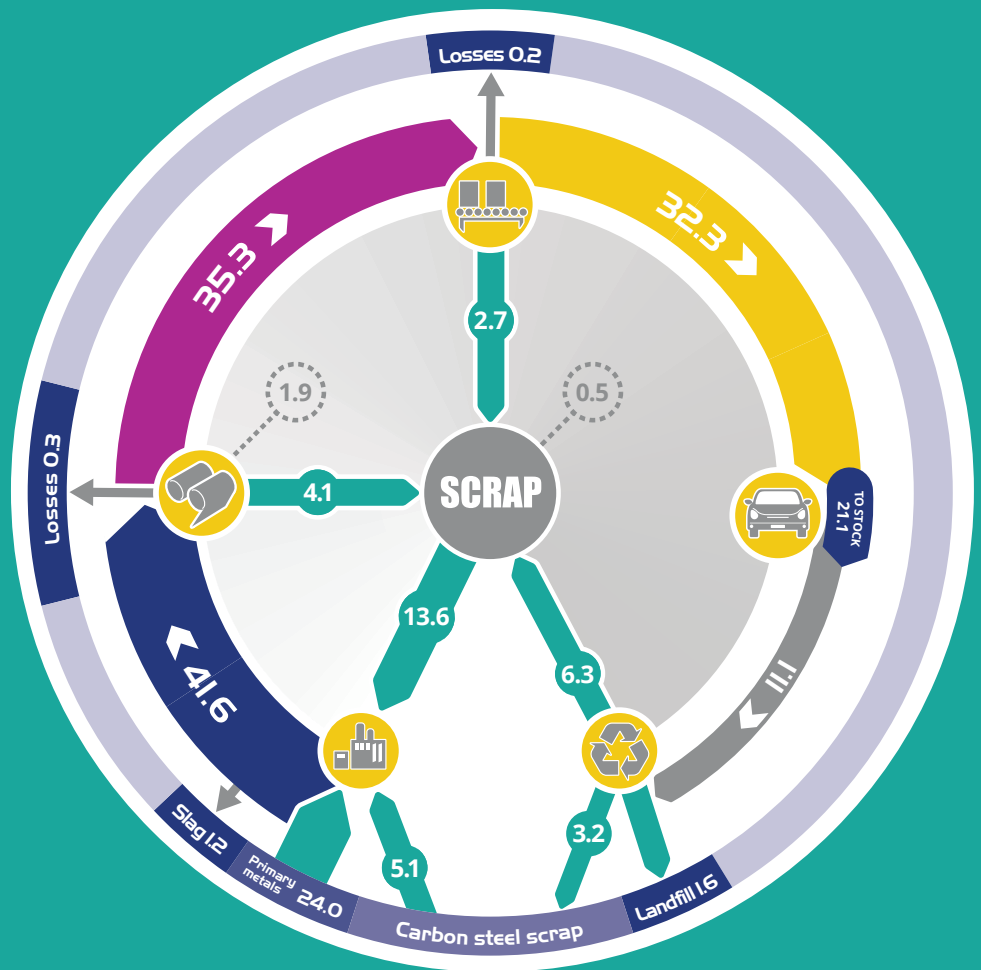
Stainless steels are used by many sectors, in many countries and in a multitude of end use products, remaining in use for a few years to many decades.



# Stainless steels stocks & flows

Because of their durability and longevity, stainless steels are typically **in use** for many years before they become available for recycling. The average lifespan is estimated to be around 20 years, but there are examples of stainless steels in use for a century and beyond. All stainless steels still in use represent a valuable source of potentially recyclable raw material.

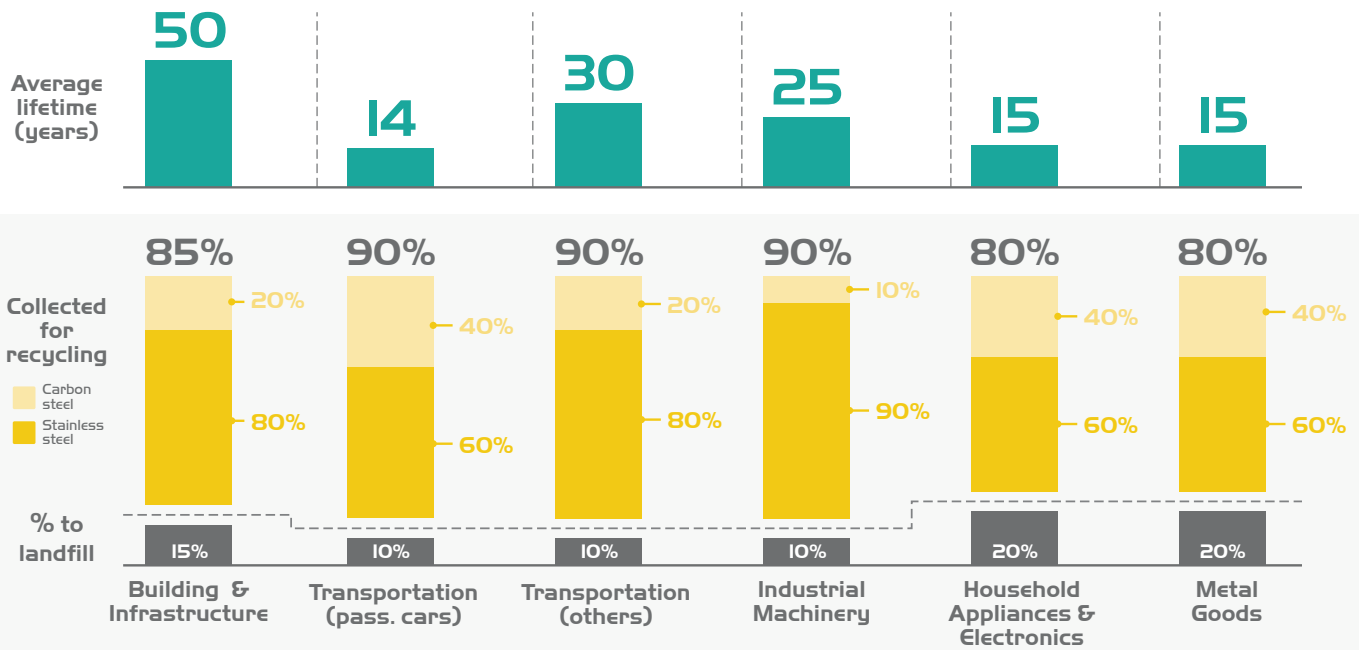
- PRODUCTION OF STAINLESS STEEL**
- HOT & COLD ROLLING**
- MANUFACTURING OF END PRODUCTS**
- USE/STOCK**
- RECYCLING & WASTE MANAGEMENT**



The outer ring establishes the boundary of the system within which stainless steels are transformed into products (such as cars, domestic goods, industrial machinery etc.), used and recycled. There is always movement. Arrows show stainless steels entering and leaving the system.

All values are in million metric tonnes (Mt) stainless steel per year (the sum of values may not add up due to rounding)

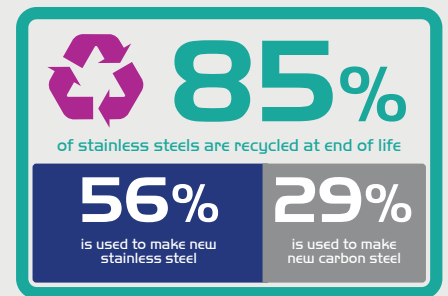
## End use sector specific end-of-life flows



## 2015 stainless steels end-of-life recycling rate

Recycling is highly beneficial, economically and environmentally. The high value of stainless steel scrap makes it worth collecting and sorting, and is the reason why it is recycled at such a high rate. Reusing its valuable alloying elements reduces cost, resource depletion, environmental impacts and energy use. The high end-of-life recycling rate indicates how efficiently stainless steel is recycled from end-of-life products.

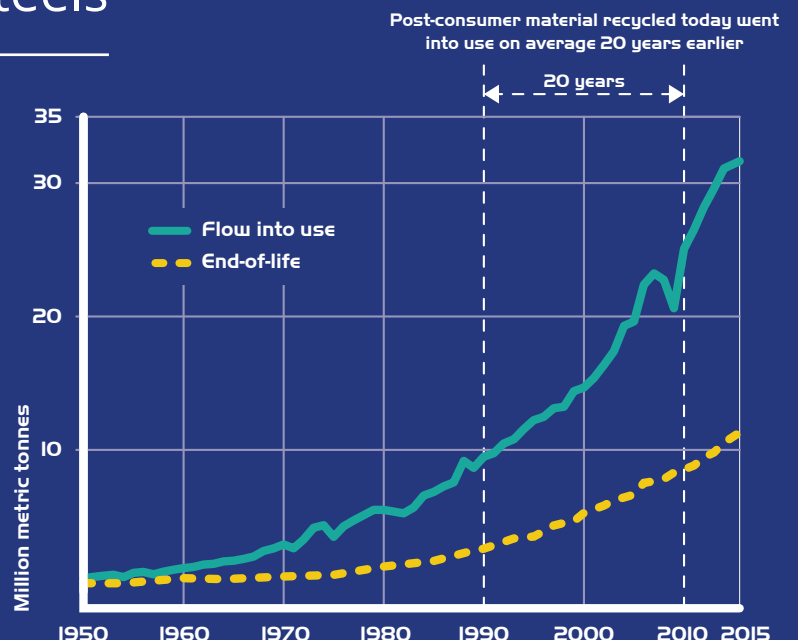
In principle, and as long as product design and recycling technologies allow, stainless steels can be recycled infinitely. Scrap is a secondary raw material arising from the product manufacturing processes as well as from finished products at the end of their life.



## Recycling of stainless steels

The production of stainless steels has grown at a rate of about 6% per annum, influenced particularly by the increase in Chinese production in the last 20 years. In 2015, China produced more than half of the world's stainless steels (53%). Its economy used 39%, up from 10% in 2000.

On average, post-consumer material becoming available for recycling now went into use some 20 years ago, demonstrating its long life. The graph shows how the theoretical maximum recycled content is limited by the availability of end-of-life recycled stainless steel which itself depends on past production, growth rates and lifespans of end products.



# 2015 recycled content of stainless steels

**The recycled content of stainless steels is the amount of scrap used in the production of new stainless steels.**

In many world regions, recycled content in new stainless steels was much higher than the 44% global average scrap ratio suggests. The world average is strongly impacted by the dominance of China's production with low recycled content (23%).

The availability of scrap is so low in China because most stainless steels currently in use were produced after 2005 and have not yet reached their end of life. In-use stainless steels in China will start to become available for reuse in the next five years, representing a large opportunity for recycling.

In the absence of sufficient domestic scrap availability they have developed another solution, i.e. NPI as a source of low cost nickel.



Global average recycled content of stainless steels



Comparative recycled content of stainless steels by region

\*Others includes Russia, Ukraine, South Africa & Brazil

## About Team Stainless

**Team Stainless is an informal alliance** of Eurofer, the International Chromium Development Association, the International Molybdenum Association, the International Nickel Study Group, the International Stainless Steel Forum, and the Nickel Institute. Its primary function is to support the stainless steels industry by providing accurate and industry-leading information about the properties and sustainable benefits of stainless steels.

