



Oryx Stainless research study stainless steel 2012:

Key raw materials nickel, chrome and iron: Limited availability despite sufficient geological reserves?

A study by Prof. Dr. Matthias Finkbeiner, Chair of Sustainable Engineering, Technische Universität Berlin
Commissioned by Oryx Stainless Group
Mulheim an der Ruhr/Dordrecht



2012

ORYX
STAINLESS

The partner of the stainless industry

Assignment



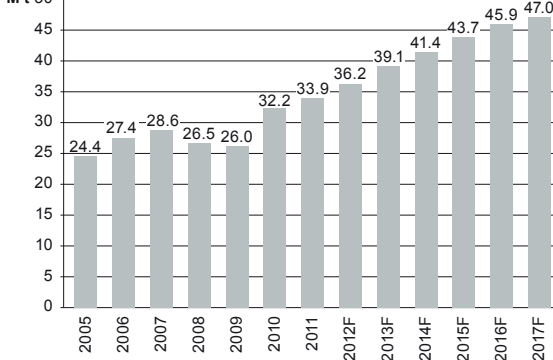
The stainless steel production has increased almost 70 percent within ten years and a further growth is expected. This also increases the demand for nickel, chrome and iron. What are significant effects for the industry? Will the raw materials be available in sufficient quantities at fair prices in the future? Beyond the geological availability, are there other criteria which are relevant for the determination of the criticality? Which role do they play?

Oryx Stainless commissioned Prof. Dr. Matthias Finkbeiner, Chair of Sustainable Engineering at the Technische Universität Berlin, to research these questions in the context of a scientific study.

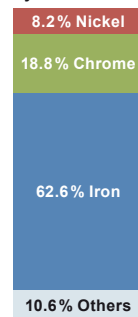
Other criteria beyond the geological reserves, which are affecting the availability of nickel, chrome and iron, have been analyzed in detail so far.

Stainless steel production continues growing – Main components nickel, chrome and iron

production in
M t 50



By volume/t



Research methodology



The Chair of Sustainable Engineering at the Technische Universität Berlin researched in a comprehensive study which factors beyond geological reserves are relevant to the availability of the primary raw materials nickel, chrome and iron. This has also been analyzed for the secondary raw material stainless steel scrap. The goal was to determine which primary and secondary raw materials exhibit a criticality in the production in that respect and which factors are primarily responsible for this.

More complex supply chains, globalized markets, trends to national protectionism make the assessment of raw material availability more and more difficult.

”Distance to target“-method for the evaluation of the criticality of the different indicators

$$\text{Indicator result} = \prod_i \left(\frac{\text{current value}_i}{\text{threshold}_i} \right)$$

Criticality indicators



The availability of raw materials at fair prices depends on a number of factors, beyond geological availability. Among others, relevant factors for the measurement of the criticality with regard to nickel, chrome and iron are the recycling rate, the reserve-to-production ratio, the geographic concentration of the reserves, the industry structure of the producing companies, the political stability in the relevant markets, the demand development and the extent of the limitations by trade restrictions.

Stainless steel scrap as a "resource" –
Ignored for the determination of criticality so far.

When do criteria have a critical effect on availability?

Indicators		Limit		
Herfindahl Index	If the value exceeds a certain threshold, sign for substantial market concentration	<	0.1	<
Worldwide Governance Indicators	Shows the quality of governance (e.g. value for Germany: 0.2)	<	0.33	<
Demand growth	Expected demand growth	<	0.01	<
Trade barriers	Percentage of the annual output affected by trade barriers	<	0.25	<
Percentage of primary material	Based on the objective with regard to recycling	<	0.25	<
Reserve-to-production ratio	Amount of reserves divided by amount used per year	<	40	<

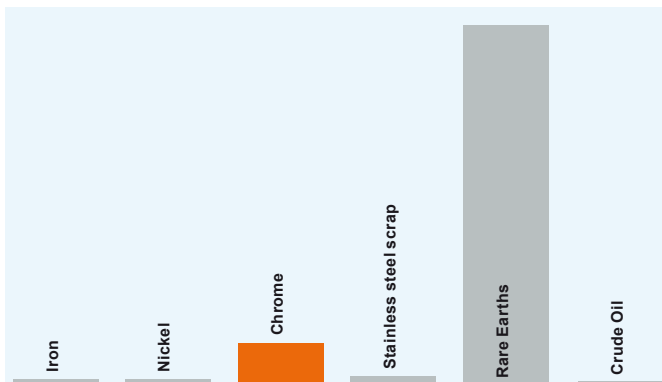
Availability



Chrome is the raw material which exhibits the highest criticality by far for the stainless steel production. With a percentage of almost 19 percent, chrome is among the most relevant alloying elements of stainless steel. In comparison, iron, the base of the stainless steel alloy, and nickel, price factor No. 1 for the production, are less critical. A slightly higher, but overall also rather uncritical value was determined for stainless steel scrap. Scrap is the main raw material source for the stainless steel production. It supplies more than 50 percent of the nickel, chrome and iron required for the production.

While chrome appears uncritical during the common geological evaluation, the economic scarcity is high – quite contrary to nickel.

Real criticality is not reflected in the public discussion – when it comes to economic aspects, chrome is far more critical than crude oil



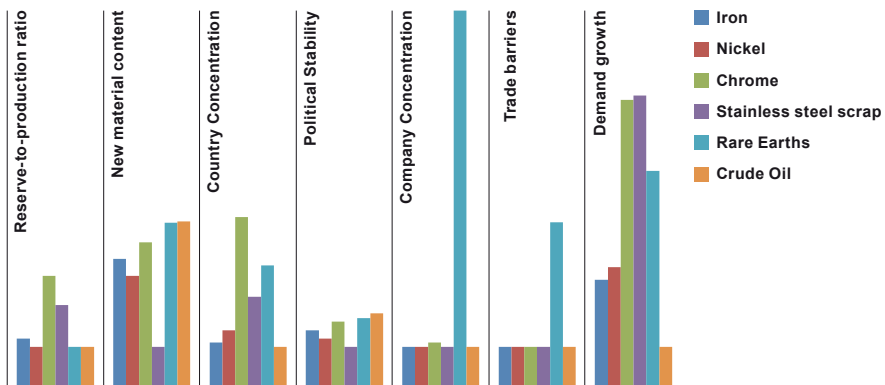
Influencing factors



The main driver of the high criticality for chrome is the anticipation of an increasing demand for the raw material. In addition, the availability is limited by the geographic concentration of the reserves, the supply from recycling, and the theoretical range of the reserves. The increasing demand is also limiting factor No. 1 by far for the raw material scrap, followed by the indicators geographic concentration of the reserves and theoretical range of the reserves. Criticality of iron occurs at later stages of the value chain.

In comparison, based on the thresholds defined here, trade restrictions, political stability, or market concentration are rather of secondary significance.

Increasing demand and access to material for recycling: Important factors for the stainless steel industry



Conclusion

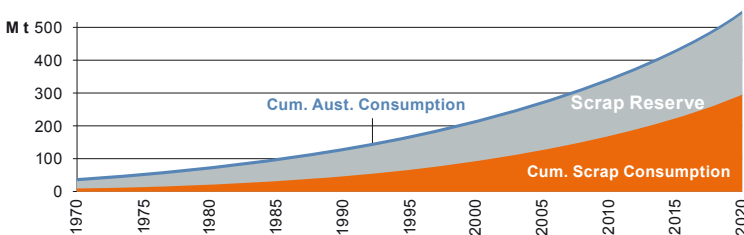


It is not enough to just pay attention to geological reserves. The actual availability of raw materials depends on a whole set of criteria. When it comes to professional risk management, the entire supply chain including all links must be considered and evaluated. An important factor for the stainless steel industry is stainless steel scrap. In addition to the increasing demand, scrap availability is critical for the stainless steel production. The recycling rates must be maintained at high levels and the global markets must be developed for an ideal utilization in this context. On principle, the results also underline the significance of the supply reliability which must be ensured via appropriate methods.

The economic availability of nickel, chrome and iron is critical, despite sufficient natural reserves.

Keeping an eye on stainless steel scrap

in M t	1980	2000	2009	2010	2020
Cumulated austenitic consumption	66.1	207.6	320.7	335.5	543.1
Cumulated scrap consumption	20.2	91.4	157.4	167.2	296.9
Scrap reserve	45.9	116.3	163.3	168.3	246.2



Source: Heinz H. Pariser

Profile



Oryx Stainless Group Founded in 1990, Oryx Stainless is as partner of the stainless steel industry one of the world's leading trading companies for raw materials used in the production of high-quality stainless steel products. The business focus of the company with locations in Mulheim an der Ruhr in Germany and Dordrecht in the Netherlands is on the handling and processing of stainless steel scrap.

Research team Prof. Dr. rer. nat. Matthias Finkbeiner, head of the Chair of Sustainable Engineering, has been teaching at the Technische Universität Berlin since 2007. Since 2010 he has also been Advisory Professor at the Aalto University in Lahti, Finland. In addition, Prof. Finkbeiner is involved as Leader of the Carbon Footprint Project of the UNEP/SETAC Life Cycle Initiative, to name but an example. Prof. Finkbeiner was supported by the scientific assistants Laura Schneider and Markus Berger.

Oryx Stainless research stainless steel

2010: CO₂ reduction via intelligent recycling of stainless steel scrap. A study by the Fraunhofer Institute UMSICHT

2011: Nickel market – playing field of speculators or driven by fundamentals? A study by JProf. Dr. Peter N. Posch, Ulm University/Center of Commodities

Oryx Stainless Commodity News – Oryx Stainless comments on relevant developments and trends on a monthly basis



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