

Methodology & Data Sources

The following pages summarize the database's underlying methodology and data sources accessed during the preparation of this model and evaluation tool. The following aspects are covered:

- 1. Definitions of investigated parameters
- 2. Collection and calculation of "direct" information by main category
- 3. Estimation of "indirect" impacts on the economy by means of an input-output model
- 4. Data sources
- 5. Overview of key companies identified and active in nickel-relevant segments

1. Definitions of investigated parameters

The main parameters to be identified in this socio-economic analysis were:

- 1. Production Value
- 2. Value Added
- 3. Direct employment
- 4. Employment cost

On a Eurostat-level the following definitions apply:

- 1. *Production Value* V12120  
  
"production value is defined as turnover, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, minus the purchases of goods and services for resale, plus capitalised production, plus other operating income (excluding subsidies)."
- 2. *Value Added at Factor Cost* V12150  
"Value added at factor cost is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. [...] it can be calculated from the gross operating surplus by adding personnel costs."
- 3. *Number of Employees in Full Time Equivalent Units* V16140  
"Number of employees is defined as those persons who work for an employer and who have a contract of employment and receive compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind. A worker from an employment agency is considered to be an employee of that temporary employment agency and not of the unit (customer) in which they work."
- 4. *Personnel Cost* V13310  
"Personnel costs are defined as the total remuneration, in cash or in kind, payable by an employer to an employee (regular and temporary employees as well as home workers) in return for work done by the latter during the reference period. Personnel costs also include taxes and employees' social security contributions retained by the unit as well as the employer's compulsory and voluntary social contributions. Personnel costs are made up of wages and salaries and employers' social security costs."

In order to match above Eurostat aggregated "macro"-parameters with the "micro"-data collected by means of reviewing individual companies, the following calculations have been applied:

- 1. *(Ni-related) Turnover / Production Value*  
Ni-related respectively product related turnover; either as stated by the individual entity or estimated at market-related prices.
- 2. *Value Added*  
Value added on a company level has been calculated as (depending data availability):  
(a) EBITDA + Personnel Cost or  
(b) Turnover - Costs of Goods Sold + Personnel Cost
- 3. *Number of Employees (FTE)*  
The number of employees / direct employment considered is the sum of the number of employees reported and (an estimated) number of employees on-site from third party contractors.
- 4. *Total Direct Labour Cost*  
Total direct labour cost is the sum of reported/estimated labour cost incl. social security and escalated scala pro rata to match the number of total employees (as above).

Other parameters collected / evaluated (where available) - and that are self-explanatory - are:

- the number of enterprises (V11110\_na ) active in segment
- the number of enterprises employing more than 250 people (V11110\_sc )
- Research & development expenditure (database: rd\_e\_berdindr2 )
- Investment rate, i.e. investment/value added at factor cost (V94415 )
- Fixed assets (database: nama\_10\_nfa\_fl )

2. Collection and calculation of "direct" information by main category

Although the statistical data available from sources like Eurostat is vast, it is restricted by the level of detail. In case of the nickel industry this could be detrimental as certain economic activities may be included only as parts of a bigger activity: e.g. refined nickel production as part of NACE 2445 "other non-ferrous metal production", or crude stainless steel production as part of NACE 241 "manufacture of basic iron and steel and of other ferro-alloys".

Another potential source of information – industry associations – also proved not to be able to provide the amount of detail needed as in the case of those approached they also obtained their information from the same statistical database.

Thus in order to be able to *really* obtain nickel-relevant data, in particular in the mining, smelting, refining segment and in key first use segments, like stainless steel for instance, it was decided to work on the smallest entity level possible: the individual operation, i.e. nickel refinery, or stainless steel mill in a country. This required the collection, review and evaluation of corporate financials. Subsequently more than 60 such evaluations have been undertaken (see overview of key companies below) as part of this project.

It should be noted that some of these evaluations would not have been possible without the temporary access to a corporate financial database, the so-called Orbis database. Where used it is quoted as such. Other hurdles to overcome were for instance the accounting systems of multi-national operations: Vale Europe and Glencore Nikkelverk have been such examples. Technically speaking the companies are treated as "converters" neither accounting for revenues nor raw material costs of the refined nickel sold respectively the imported nickel matte it is converted from.

Working with both the Eurostat database and individual company reportings also revealed other short-comings of the more higher level database: depending on a company's allocated code – they may have several, a "primary" and "secondary" code if active in several areas. E.g. Belvedere Resources, a mining company based in Finland, operates under the primary code of NACE 2441 "precious metals production", and only lists "non-ferrous mining" NACE 0729 as its secondary code.

The following overview compares key individual commodity codes as taken from the German production statistics with corresponding 2/4 digit NACE codes.

Allocation of Nickel-Related activities to "Standardized" NACE codes

Category	Sub-Segment	Applicable 2/4 digit	
Mining, Smelting, Refining	Mining	7	07 29
	Smelting	24	24 10
	Refining	24	24 45
First Use	Adhesion (inc. rubber adhesion agent)	C20/C22	Combination
	Batteries	C27	C2720
	Bespoke/Niche Applications	Avg	Average of others used
	Biotech – animal feed and fertiliser	C10	C1091
	Biotech – biogas production	D35/D38	Combination
	Biotech - fermentation, biotech processes, health and medicine	C21	C2120
	Carbide Diamond Tools	C25	C2573
	Catalysts – used as catalyst precursor	C20	C2059
	Catalysts – used as oxidation catalyst/for PTA and IPA	C20	C2059
	Driers / paints	C20	C2030
	Electronics	C26	C2611
	Magnetic alloys	C25	C2599
	Metallurgical alloys	C24	C2445
	Pigments (inc. decolourising (glass))	C20	C2012
	Surface treatment	C25	C2561
	Other	Avg	Average of others used
	Portable electronics	C2640	C26
	Power and motive	C2790	C27
	Energy storage	C2712	C27
	Automotive	C2910	C29
	Other transport	C30	C30
	Mining and construction	Combination	B/F
	Agriculture	A	A
	Energy	Combination	B/C19
	Aerospace	C3030	C30
	Fabricated metal products	C25	C25
	Chemical	C20	C20
	Appliances	C2751	C27
	Engines and turbines except transport	C2711	C27
	Machinery and equipment	C28	C28
	Paints, inks and coatings	C2030	C20
	Plastics	C2016	C20
	Other	Average of othe	Avg
Recycling		E37-39	

While above comments largely relate to mining, smelting and refining and to some first use segments, using Eurostat data for the indentified nickel end use segments would lead to a huge exaggeration of nickel's relevance. This in turn required the introduction of a "nickel allocation factor".

This **nickel allocation factor** is calculated as follows:

Nickel Allocation Factor =

Nickel Value [in Mill €]  
Sectoral Value Added [in Mill €]

with

Nickel Value [in EUR] = sum of identified primary and secondary Nickel volume [t] \*  
Sectoral Value Added [in EUR] = value added at factor cost as reported by EUROSTAT

weighted average market price [in EUR per t]

The individual evaluations of the different categories, segments and subsegements thus applied one of the following main methodologies:

- 1. Evaluation on enterprise level
- 2. Application of a nickel allocation factor
- 3. Alternative factors:
  - a) volume / market share of the relevant product
  - b) relative share of the production value reported for German 9dgt code related to 4dgt NACE code level

How each category, segment and subsegment has been treated is illustrated in the following overview:

Category	Sub-Segment	Evaluation Method of SEA Parameters
Mining, Smelting, Refining	Mining	Enterprise level, evaluation of 11 independent entities
	Smelting	
	Refining	
First Use	Stainless Steel	Enterprise level, evaluation of 21 independent entities and estimation of specific averages
	Alloy Steel	Alternative estimate: applying (a) share of alloy steel to total crude production and (b) the percentage of nickel-containing alloy steels to the Eurostat total of NACE 24 10
	Ni-Base	Enterprise level, evaluation of 19 independent entities and estimation of specific averages
	Cu-Base	Applying nickel allocation factor to NACE 24 44
	Plating	Alternative estimate: applying the German percentage of GP 25 61 11 900 / NACE 25 61
	Foundry & Casting	Applying nickel allocation factor to NACE 24 51 52,54
	Powder Metallurgy	Alternative estimate: applying the German percentage of GP 25 50 20 800 / NACE 25 50
	Catalysts	Applying nickel allocation factor to NACE 20 59
	Battery	Enterprise level, evaluation of 6 independent entities
End / True Use	Transport	Application of nickel allocation factors to all relevant NACE 2dgt - 4dgt codes
	Electro & Electronic	
	Engineering	
	Building & Construction	
	Tubular Products	
	Metal Goods	
Recycling	Recycling of nickel	Estimation of key SEA parameters based on EEA availability of stainless steel scrap. This assumes that the total tonnage is
	containing materials	

3. Estimation of"indirect" impacts on the economy by means ofan input-output model

In order to investigate the nickel value chain’s total contribution to the European economy reviewing the industries’ active in and related to the nickel market does not suffice. Doing so would neglect the impact a local nickel mine, a nickel refinery, a stainless steel mill or a producer of nickel batteries does have on the local community - and thus: economy. These inter-correlations and linkages between different economic activities, from industrial to services, are generally viewed as a circular flow of income and expenditure between businesses and individuals.

Such effects can be calculated by the input-output model build by ReachLaw and incorporated here to estimate “indirect” effects of nickel-related activities on:

- a) jobs generated (direct + indirect)
- b) output generated (direct + indirect)
- c) value added (direct + indirect)

The input-output model incorporated here uses Eurostat's so-called input-output-multipliers <sup>2)</sup> for Europe on a 2-digit NACE code level (NB that individual economy's input-output tables are not included in this model. In other words: the indirect contribution for individual economies is calculated by means of average European multipliers ). The model can be used and adjusted to calculate impacts of different non-use scenarios, as required by the Nickel Institute.

<sup>2)</sup> <https://goo.gl/6HpKfz>

4. Data sources

The following sources have been accessed and used in the preparation of this database and evaluation tool:

Financial Data and Socio-Economic Parameters

- 1) Individual company filings at local company registries, see:
- 2) Orbis company database (with temporary access), see:
- 3) Eurostat databases:
  - sbs\_na\_ind\_r2
  - sbs\_sc\_ind\_r2
  - sbs\_na\_dt\_r2
  - rd\_e\_berdindr2
  - nama\_10\_nfa\_fl

<https://goo.gl/4stbZ7>  
<https://goo.gl/6fVvef>  
<https://goo.gl/aS2luA>  
Annual detailed enterprise statistics - industry and construction  
SMEs - annual enterprise statistics by size class  
Annual detailed enterprise statistics - trade  
Business enterprise R&D expenditure by economic activity  
Cross-classification of gross fixed capital formation by industry and by asset

Market and Volume Information

- 4) International Nickel Study Group (INSG)
- 5) Pariser: "End-Use of Nickel 2006-2015", Xanten, September 2016
- 6) Pariser: Heinz H. Pariser in-house database
- 7) worldsteel association
- 8) Eurofer
- 9) Reck, B.; et al.: Antropogenic Nickel Cycle: Insights into Use, Trade and Recycling, Environ Sci. Technol. 2008, 42, pp 3394-3400
- 10) Prins, Lok.: Production and Application of Nickel Catalysts in Europe and the World, 2012
- 11) ANSES: Analysis of the Most Appropriate Risk Management Option for Nickel Oxide, 2014
- 12) ARCADIS Belgium: Data collection on Ni Dihydroxide and Nitrate in Batteries, 2014
- 13) ANSES: Analysis of the Most Appropriate Risk Management Option for Nickel Sulphate, 2014
- 14) Pariser: Nickel in Chemicals, A Market Survey, 2012
- 15) Pariser: Nickel Salts & Powder for Selected Applications in the EU, 2011
- 16) Eurostat comext international trade data
- 17) UN Comtrade Database

-for selected data on primary nickel  
  
-for Ni first and end use  
-for crude stainless production data  
-for stainless scrap ratios and scrap availability  
-for estimates on alloy steel production  
-for nickel-based alloy supply data  
-for background info on Ni powders  
-for crude steel production data  
-for EU total alloy steel production  
  
-for non-stainless recycling ratios  
  
-for information on Ni in catalysts  
  
-for information on Ni in batteries  
  
-for information on Ni in batteries  
  
-for information on Ni in catalysts  
-for information on Ni in batteries  
  
-for information on Ni in catalysts  
-for information on Ni in batteries  
-for information on Ni powder manufacture  
<https://goo.gl/Y4DPw6>  
<https://goo.gl/GhuVbR>  
  
-for supporting trade information

Interviews / Discussions with Selected Associations / Market Participants

- 18) Gesamtverband der dt. Bundmetallindustrie (GdB)
- 19) Bundesvereinigung Deutscher Stahlrecycling- und Entsorgungsunternehmen e.V.
- 20) Verband Deutscher Metallhändler e.V.
- 21) Individual discussions held with Cronimet Holding, ELG Haniel and Oryx Stainless

-on availability of segmental SE data  
  
-on stainless scrap markets and SE data

5. Overview of key companies identified and active in nickel-relevant segments

(Focus on M-S-R, First Use and Recycling)

Category	Sub-Segment	Company	Country	Financials Evaluated
Mining, Smelting, Refining				
	Mining	Boliden Oy	Finland	yes
		Belvedere Resources	Finland	yes
		Terrafame Oy	Finland	yes
		Titania AS	Norway	yes
		Rio Narcea Recursos SA (Lundin)	Spain	yes
		LARCO GMMSA	Greece	yes
	Smelting	Boliden Harjavalta Oy	Finland	yes
		Refining	LARCO GMMSA	Greece
	Vale Europe Ltd		United Kingdom	yes
	Glencore Nikkelverk AS		Norway	yes
	Norilsk Nickel Harjavalta Oy		Finland	yes
	Eramet Nickel	France	yes	
First Use				
	Stainless	Boehler Edelstahl	Austria	-
		Breitenfeld Edelstahl AG	Austria	-
		Aperam Stainless Belgium	Belgium	yes
		ArcelorMittal INDUSTRIEL	Belgium	yes
		Trinecke Zelezarny	Czech Republic	yes
		Outokumpu Stainless Oy	Finland	yes
		Ugitech SA	France	yes
		ArcelorMittal INDUSTRIEL	France	yes
		Outokumpu Nirosta	Germany	yes
		Deutsche Edelstahlwerke	Germany	yes
		Acciai Speciali Terni	Italy	yes
		Acciaierie Valbruna	Italy	yes
		Cogne Acciai Speciali	Italy	yes
		Acroni (SIJ)	Slovenia	yes
		Metal Ravne (SIJ)	Slovenia	yes
		Acerinox Europe	Spain	yes
		Aceros Inoxidables Olarra	Spain	yes
		Aceria de Alava	Spain	yes
		Outokumpu Stainless AB	Sweden	yes
		Sandvik Materials Technology	Sweden	yes
		Outokumpu Stainless UK	United Kingdom	yes
	Ni-Based Alloys	Gebauer & Grillier	Austria	yes
		Boehler Edelstahl	Austria	yes
		Aperam Alloys Imphy	France	yes
		Aperam Alloys Rescal	France	yes
		Aubert & Duval	France	yes
		Industeel France	France	yes
		VDM Metals	Germany	yes
		Deutsche Nickel GmbH	Germany	yes
		Saarschmiede GmbH	Germany	yes
		BGH Edelstahlwerke GmbH	Germany	yes
		Fondinox S.P.A.	Italy	yes
		Foroni S.P.A.	Italy	yes
		Sandvik Materials Technology	Sweden	yes
		Special Metals Wiggins	United Kingdom	yes
		Sheffield Forgemasters	United Kingdom	yes
		Firth Rixson Metals (Alcoa)	United Kingdom	yes
		Howmet (Alcoa)	United Kingdom	yes
		Ross & Catherall (Doncasters)	United Kingdom	yes
		Doncaster Aerospace	United Kingdom	yes
	Battery Manu-facturers	SAFT Ferak	Czech Republic	yes
		SAFT (French Operations)	France	yes
		Hoppecke Batterie Systeme	Germany	yes
		GAZ - Geräte- und Akkumulatorenwerke Zwickau	Germany	yes
		Varta Microbattery	Germany	yes
		SAFT AB	Sweden	yes
		Chevron Phillips Chemicals International	Belgium	-
	Catalyst Manu-facturers	Euro Support Manufacturing Czechia	Czech Republic	-
		Haldor Topsoe A/S	Denmark	-
		Axens	France	-
		BASF	Germany	-
		CRI Catalyst Leuna GmbH	Germany	-
		Evonik Industries AG	Germany	-
		Süd-Chemie (Clariant)	Germany	-
		Catalyst Recovery Europe S.A.	Luxembourg	-
		Albemarle Catalyst Company BV	Netherlands	-
		Johnson Matthey	United Kingdom	-
	Ni-Powder Manu-facturers	Höganäs Group	Belgium	-
		Norilsk Nickel Harjavalta	Finland	-
		Höganäs Group	Sweden	-
		Vale Europe Ltd	United Kingdom	-
		Sandvik Osprey	United Kingdom	-
Recycling				
	Stainless Scrap	Cronimet Holding	International	yes
		Cronimet Belgium BV	Belgium	yes
		ELG Haniel	International	yes
		Jewometaal Stainless Processing	Netherlands	yes
		Oryx Stainless BV	International	yes
	Stainless Filter Dust Recycling	Paul Jost GmbH	Germany	yes
		BEFESA Valera	France	-
		Recyco	France	-
		HARSCO Plasminox	Italy	-
		BEFESA ScanDust AB	Sweden	-
	Chemicals, Catalyst, Battery	Treibacher	Austria	-
		UMICORE	Belgium	-
		Nickelhütte Aue	Germany	-
		Aura Technologie GmbH	Germany	-
		Königswarter & Ebell (TIB Chemicals)	Germany	-
		Moxba-Metrex	Netherlands	-
Number of identified companies:		90		
of which with financial data:		62	(69%)	