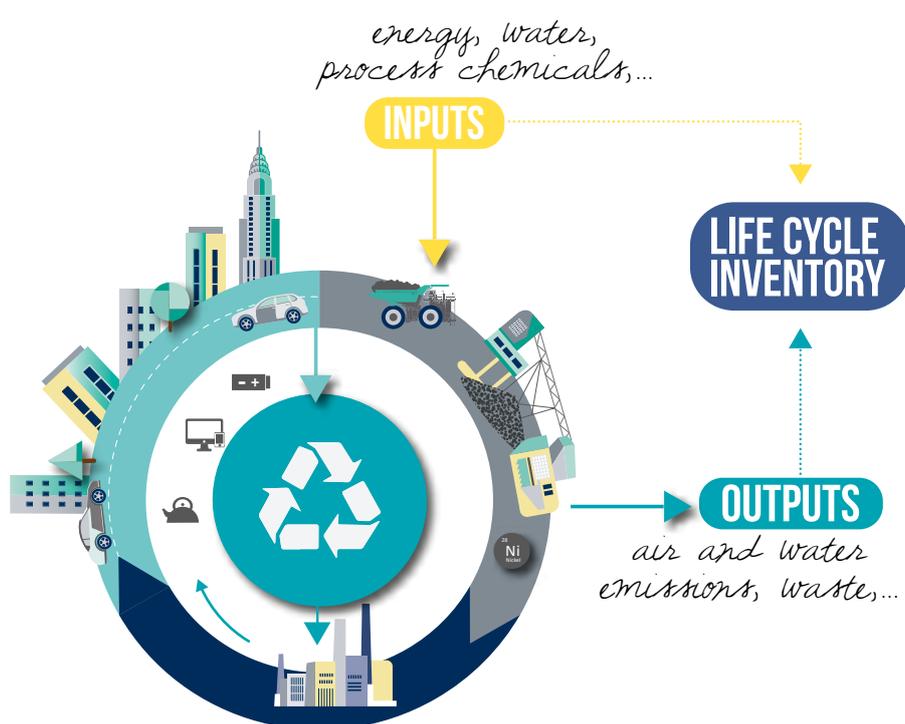


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Life cycle data

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1. What are life cycle data?

Life cycle data describe process in- and outputs. They are collected for each process step in the production of nickel products. Besides inputs such as energy, process chemicals or water, they also contain process outputs such as emissions to water, air or waste. Life cycle data build the basis for impact assessments (LCIA). In-and outputs are converted into environmental impacts, such as carbon and water footprint or the potential for acidification per kg of nickel product (e.g. Ni metal, ferronickel) produced.

2. What are life cycle data used for?

Life cycle data are used by e.g. end users to assess the environmental performance of a product. Existing tools are e.g. ISO standardized life cycle assessments. The in- and outputs of two products fulfilling the same function are compared. As an example, nickel-containing stainless steel rebar and carbon steel rebar can be compared along their entire life cycle. In the case of nickel sulphate, life cycle data are used to compare e.g. Nickel containing EV battery technologies with a classical combustion engine car.

3. What substances are covered in the update of the Nickel life cycle data report?

The new data set contains data for nickel metal, ferronickel and nickel sulphate from member companies of the Nickel Institute. The basis for the report is 2017 as reference year.

4. How is the data quality?

The report comprises data from 24 production sites from nine Nickel Institute member companies which belong to the major nickel producers globally. The data were collected in compliance with the protocol described in ISO 14040 standards and therefore fulfil the highest requirements. The report was moreover critically reviewed by an independent LCA expert.

5. Are the data representative?

All relevant production technologies are covered as well as different ore types and all major nickel producing regions (except China). The data provided for nickel metal and ferronickel cover more than 50% of the global production; for nickel sulphate the data collected cover 15% of the global nickel production. In summary, the data are considered as representative.

6. Nickel producers from which countries participated in the data gathering?

Data were provided from the production sites of nickel producers in the following countries (alphabetic order): Australia, Belgium, Brazil, Canada, Colombia, Cuba, Finland, France, Indonesia, Japan, New Caledonia, Norway, the Philippines, Russia, South Africa and the United Kingdom.

7. Why are Chinese nickel production data missing?

The data collection is work done by NI member companies. There are currently no Chinese nickel producers in the NI membership. Chinese nickel production is therefore not covered.

8. Why are sulfidic and lateritic nickel metal production data aggregated?

Production processes within the nickel industry differ significantly and are tailored to specific raw material inputs as well as other framework conditions. NI member companies therefore agreed on displaying one consistent data set for all nickel metal production processes which represents an industry average.

9. How much CO₂ is emitted when producing 1 kg nickel metal? Are these direct or indirect emissions (Scope 1-3 emissions)?

The production of 1kg of nickel metal is linked to 13kg CO₂ emissions. Roughly 60% of the CO₂ emissions are related to direct emissions onsite (scope 1 emissions); another 15% to indirect emissions related to the consumption of electricity (scope 2 emissions). Moreover,

there are 25% emissions which are related mainly to process chemicals used during the production process, such as e.g. sulfur (scope 3 emissions).

10. How do these figures compare to earlier data collections?

A series of data collections have been conducted by the Nickel Institute, covering the reference years 1999, 2007 and 2011. Given changes in the participating member companies and the heterogenous production processes of nickel production as well as some data inconsistencies spotted in an earlier data collection, a comparison would not be appropriate.

In order to allow a comparison, NI conducted a normalization study. Only data sets from companies participating in all data collections were considered. The study shows that since 2007, the CO₂ emissions reduced by 9%, and since 2011 by 4%, demonstrating the efforts of the nickel industry to contribute to the UN COP Paris Climate Change Agreement.

11. How much CO₂ is emitted when producing 1kg of ferronickel?

The production of ferronickel emits 45kg CO₂ per 1kg of nickel content. The primary extraction stage accounts for 87% of total CO₂ emissions related to ferronickel production. 72% of emissions relate to onsite fuel combustion and electricity generation (scope 1 emissions). Scope 2 emissions account for 17% and scope 3 emissions for the remaining 11% of the CO₂ emissions.

12. How much CO₂ is emitted when producing 1kg of nickel sulphate?

The production of 1kg of nickel sulphate emits 4kg CO₂. The principal stages of the life cycle where emissions occur during the production of nickel sulphate are primary extraction (57%) and refining (33%). In view of Scope 1-3 emissions, in total 62% of all CO₂ emissions relate to scope 1 emissions (i.e. onsite energy provision); scope 2 emissions account for another 10% (indirect emissions through electricity) and scope 3 emissions for 28% of CO₂ emissions in e.g. process chemicals such as sulfur.

13. How does nickel compare to other metals such as copper or aluminium?

Nickel is mainly used as an alloying element. Stainless steel accounts for 70% of current nickel use. Another 15% relate to nickel in e.g. nonferrous alloys and alloy steel. Nickel is therefore used in smaller concentrations than e.g. aluminium. A comparison is therefore not appropriate. The relevant ISO standards mention that comparisons should be done on a functional level, i.e. where products fulfilling the same function are compared.

14. Are company and site-specific data available?

As part of the life cycle data collection, the participating companies are provided with a company specific report. This report contains company and site-specific life cycle data for their specific nickel products.

A report with aggregated life cycle data from all participating companies is also made available. Only those aggregated life cycle data are then also entered into life cycle databases.

15. Which companies participated in the study?

In total nine companies participated in the study: Anglo American, Eramet, Glencore, Nornickel, Sherritt, South 32, Sumitomo, Umicore and Vale.

16. Why is Nickel Pig Iron (NPI) not covered in the study?

The study comprises life cycle data for the major nickel products of the Nickel Institute member companies. Nickel Pig Iron is not part of the NI member companies' product portfolio. Some data on energy and emission intensity of Nickel Pig iron can be found in literature (see link).

17. Are these data different from other datasets found in other sources?

There are various life cycle data sets available e.g. in publications of life cycle databases. We are currently

approaching the most relevant database providers to ensure that old and outdated nickel datasets are replaced by our life cycle data set.

18. How can I get access to the report?

Please send an email to communications@nickelinstitute.org. A copy of the report together with a statement of the critical reviewer will be then sent to you.

The Nickel Institute is the global association of leading primary nickel producers. Our mission is to promote and support the proper use of nickel in appropriate applications.

The NI grows and supports markets for new and existing nickel applications including stainless steel, and promotes sound science, risk management, and socio-economic benefit as the basis for public policy and regulation.

Through our science division NiPERA Inc., we also undertake leading-edge scientific research relevant to human health and the environment. The NI is the centre of excellence for information on nickel and nickel-containing materials and has offices in Asia, Europe and North America.