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LCA of a new lead slag recycling technology

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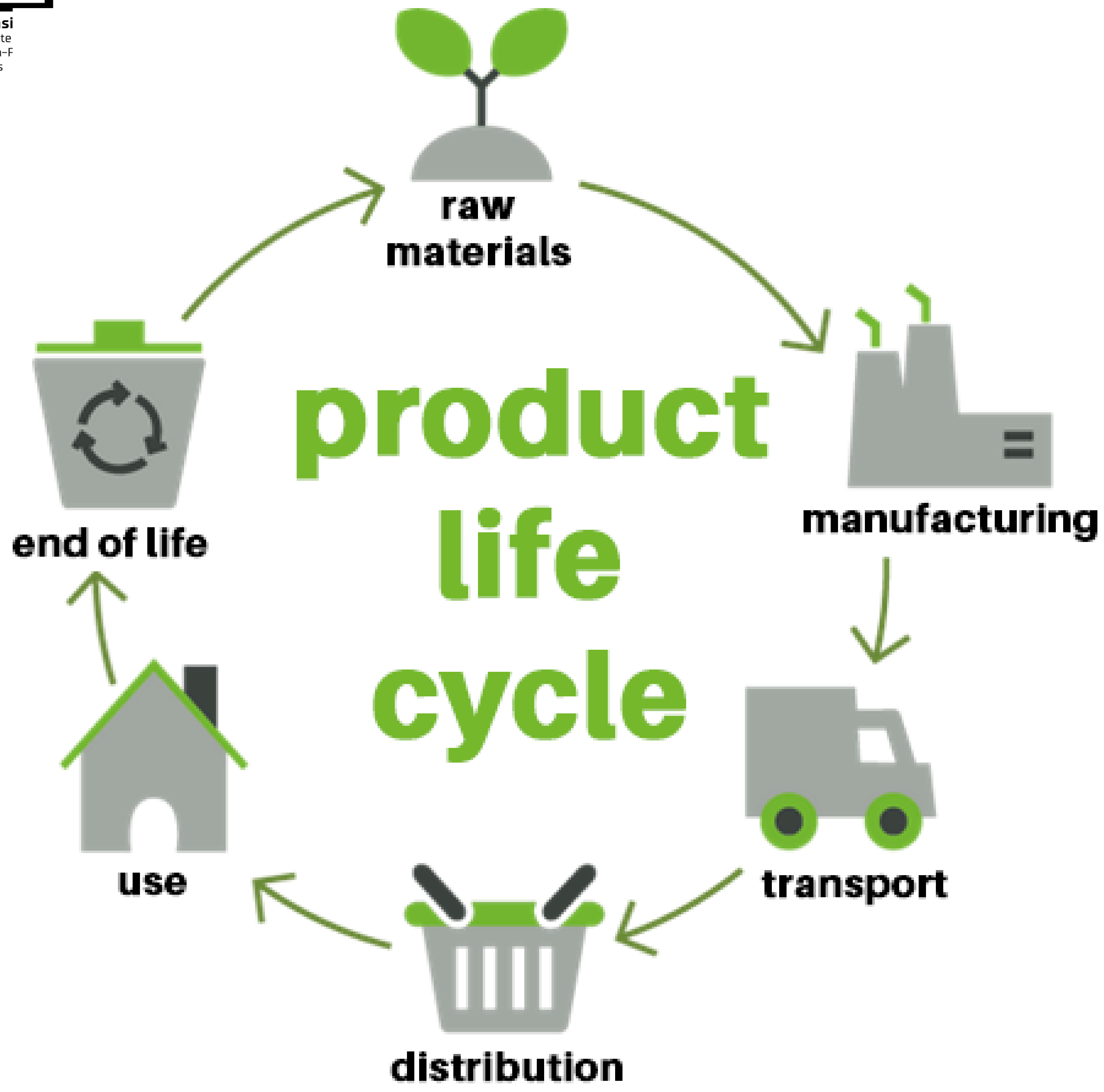
INTRODUCTION



LCA (Life cycle assessment) - the compilation and evaluation of the inputs and outputs of a product system and its potential environmental impacts over its full life cycle (according to EN ISO 14040).

Source: https://altyor.com/wp-content/uploads/2021/03/cycle-de-vie-anglais.png

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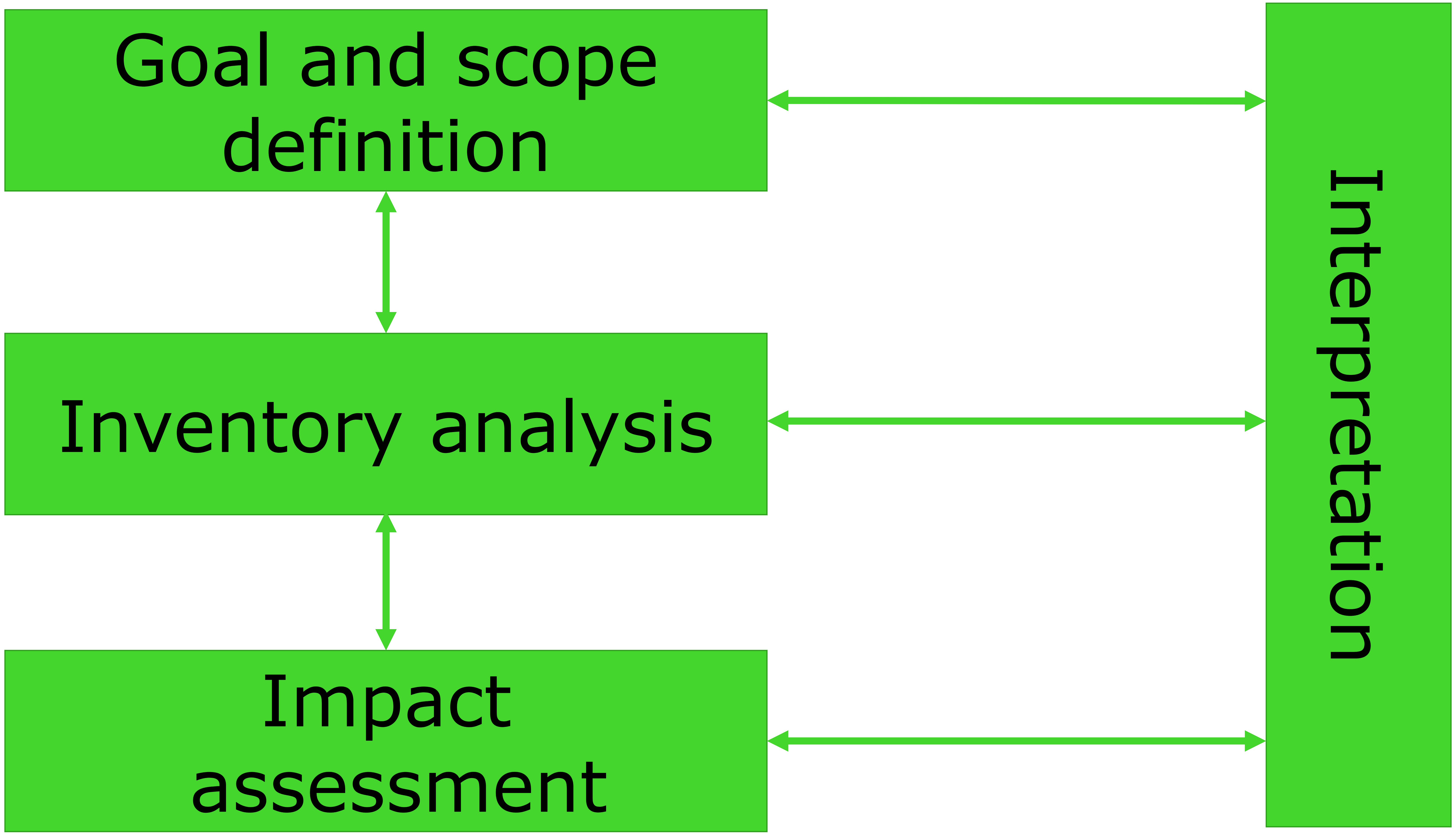
INTRODUCTION



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INTRODUCTION

The non-ferrous metal industry is responsible for generating many pollutants, including:

- Sulfur dioxide,
- Dusts,
- Metal compounds,
- Organic compounds,
- Water contaminated with metal compound,
- Furnace linings,
- Slugde,
- Filter dusts,
- Slag.

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ABOUT THE PROJECT

SlagVal project is a KIC added value activity (KAVA) funded by the European Institute of of Innovation and Technology (EIT) RawMaterials (project No. 17181). The EIT is a body of European Union and receives suport from the European Union’s Horizon 2020 Research and Innovtion Programme.

ABOUT THE PROJECT

The goal of the **SlagVal** project is to provide a ready for implementation solution for the growing challenge of waste management in the companies which produce white slag by complete transformation of its volume into construction material, thus eliminating the environmentally hazardous material, and at the same time providing additional profit to the companies thanks to the recovery of base (Zn, Pb, Cu) and by-product (Ag, Sb, Sn) metals which are contained therein.

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ABOUT THE PROJECT

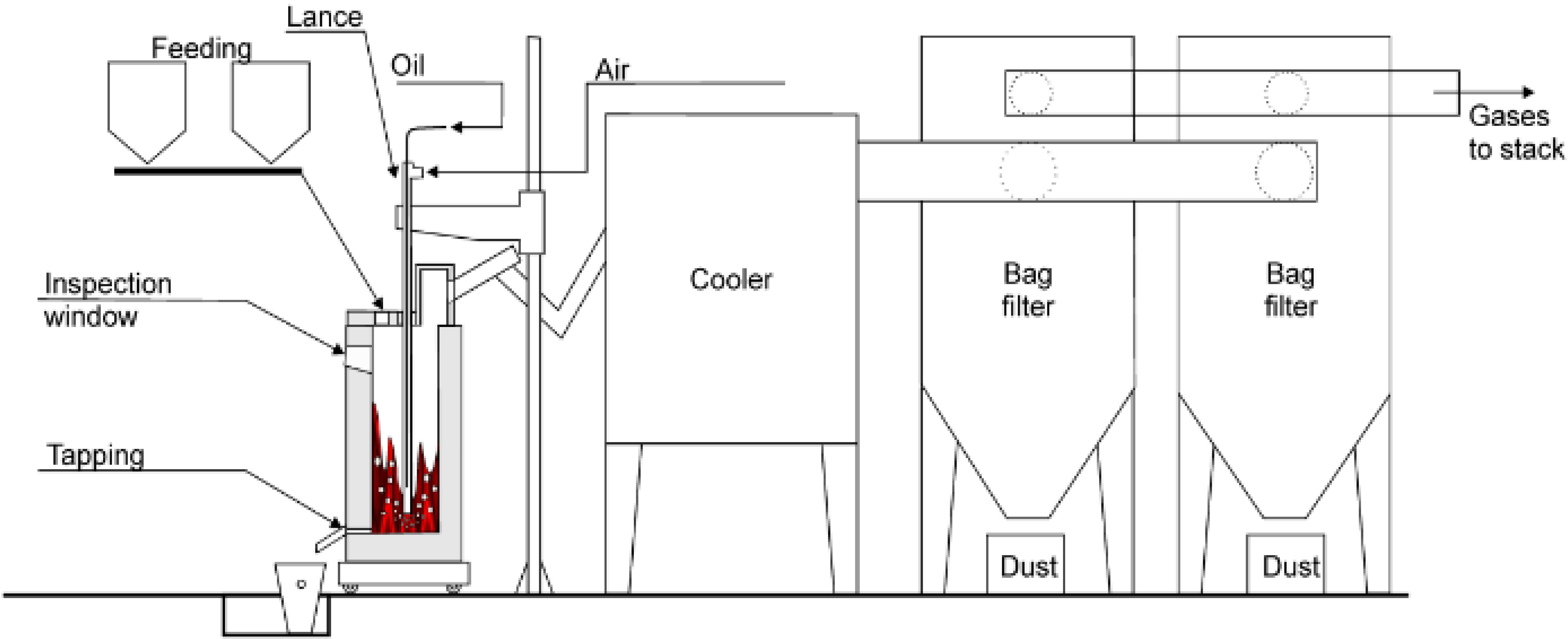
The primary objective of this project was to upscale a technology to recover metals from waste slags produced by lead/zinc and copper industry. These slags are a potential sources of valuable base metals, which can be recovered in the form of a marketable products. Additionally, after the process the slag can be transformed into a non-hazardous material which can be used in the building sector as aggregate, i.e. for road construction or other applications. The project results in a verified TRL8 process performed with application of the electric SAF furnace and the **TSL furnace**.

ABOUT THE PROJECT

Consortium:

- Łukasiewicz Research Network – Institute of Non-Ferrous Metals (project leader),
- Rheinisch-Westfaelische Technische Hochschule Aachen, RWTH Aachen,
- Vlaamse Instelling voor Technologisch Onderzoek NV (VITO),
- Baterpol S.A.,
- Küttner GmbH & Co. KG,
- BERZELIUS Stolberg GmbH.

TECHNOLOGY



Lance
Feeding
Oil
Air
Inspection window
Tapping
Cooler
Bag filter
Bag filter
Gases to stack
Dust
Dust

TECHNOLOGY

General slag smelting procedure assumed for trials in the pilot TSL furnace included the stages:

- Oxidative-reductive smelting slag at 1200°C for 3-4 hours (oxidation of MeS from matte and reduction of MeO from slag),
- Reduction and fuming of the slag at 1250-1300°C for 1.5-9 hours (extraction of copper into matte and fuming of Zn and Pb),
- Oxidation of gas (CO, H_2) and metal vapours,
- Gas cooling and dedusting,
- Metal, matte and slag tapping.

TECHNOLOGY

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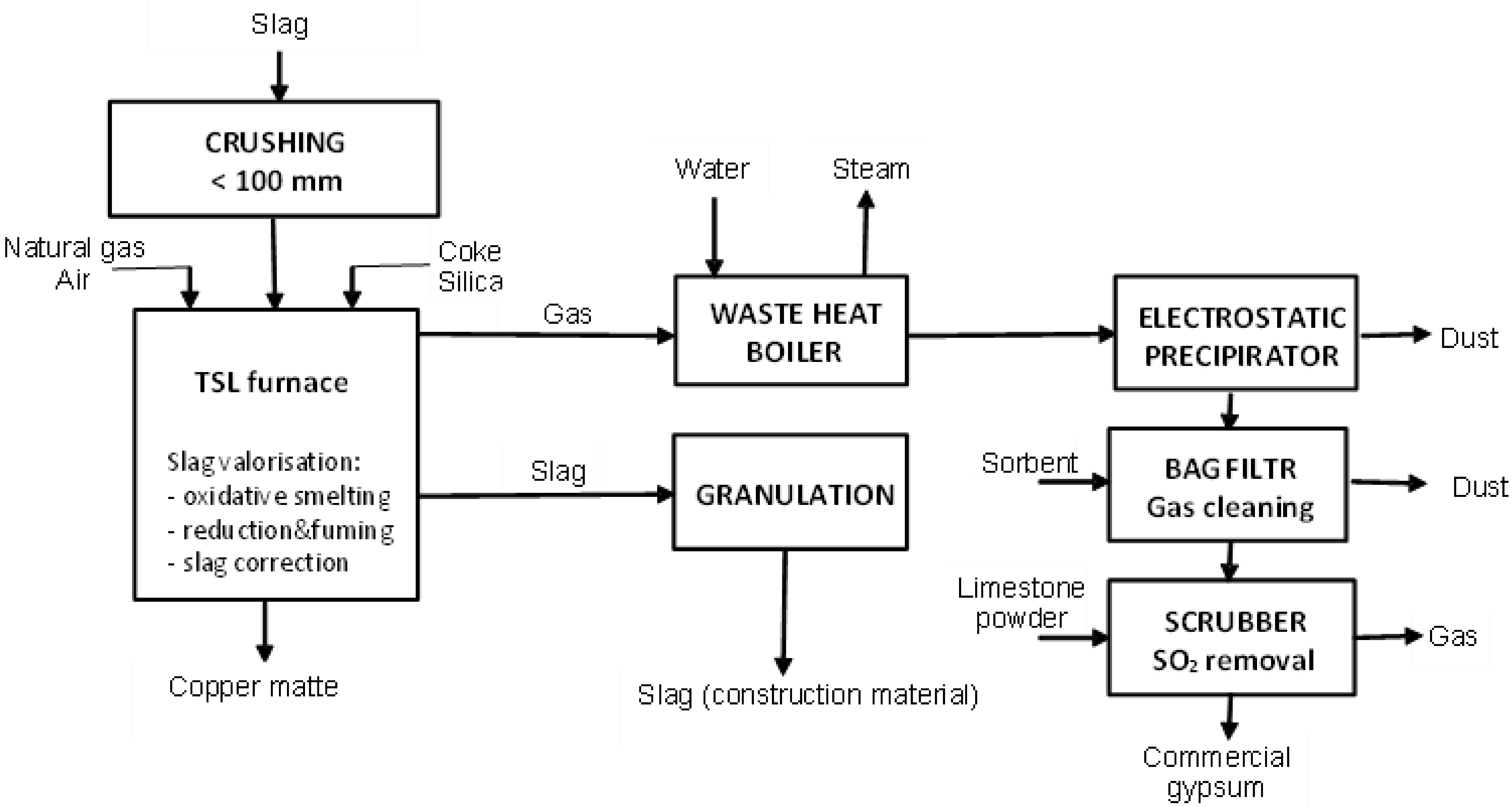

GOAL AND SCOPE DEFINITION

- Goal: Determination of the environmental impact of the TSL process developed as a part of SlagVal project
- Reason: identification of potential areas that require improvement for process optimization; comparison LCAs are planned as the following steps
- Functional unit: 1Mg of the processed lead-bearing slag
- Software: SimaPro version 9.2.0.2
- Database: Ecoinvent 3.6
- Method: ReCiPe 2016 Midpoint (H)

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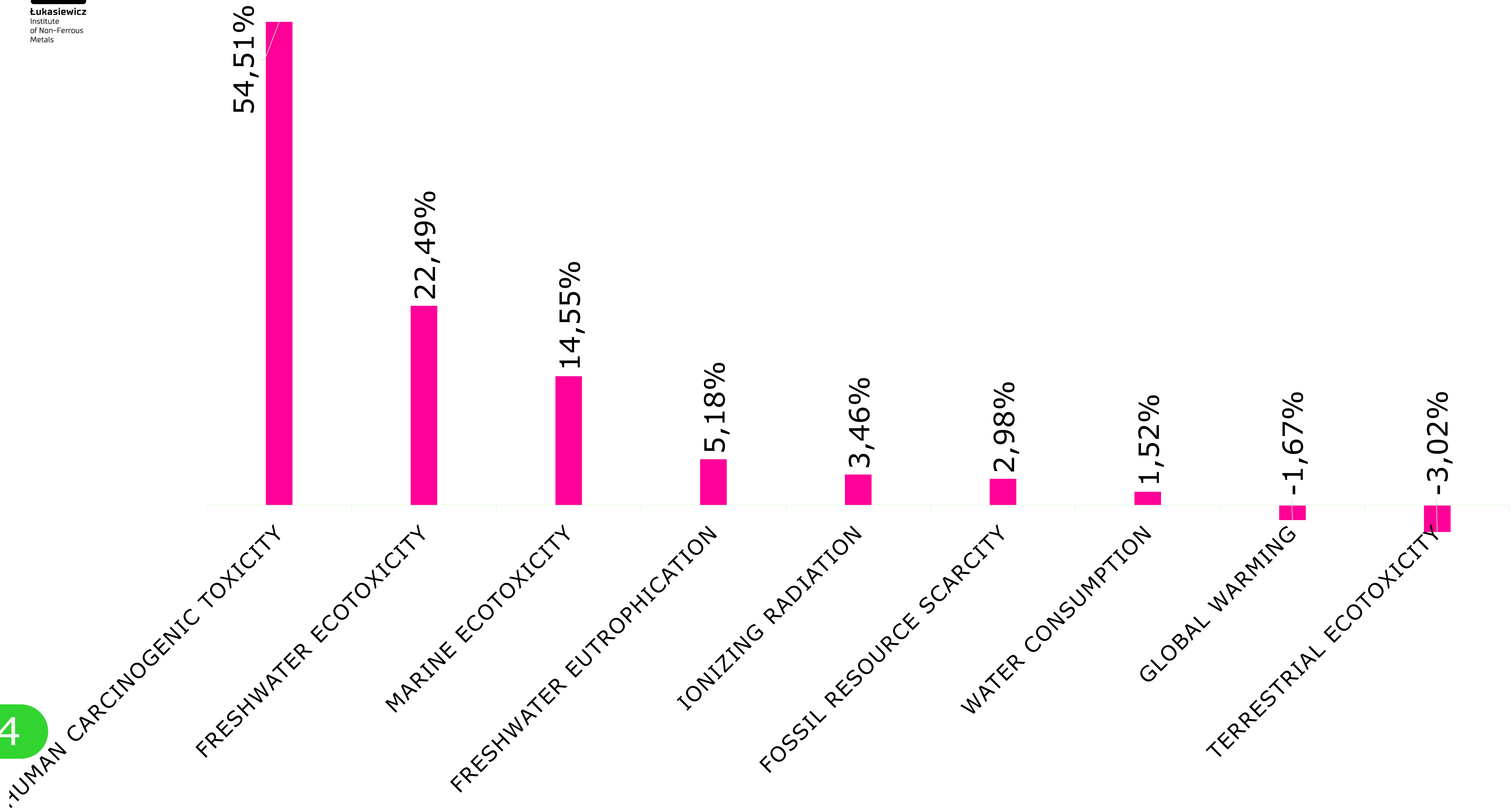
RESULTS - CHARACTERIZATION

Impact category	Unit	SlagVal TSL process
Human non-carcinogenic toxicity	kg 1,4-DCB	92,58
Fossil resource scarcity	kg oil eq	40,82
Ionizing radiation	kBq Co-60 eq	23,23
Marine ecotoxicity	kg 1,4-DCB	8,83
Freshwater ecotoxicity	kg 1,4-DCB	7,91
Human carcinogenic toxicity	kg 1,4-DCB	7,84
Water consumption	m3	5,65
Land use	m2a crop eq	5,15
Terrestrial acidification	kg SO2 eq	0,09
Freshwater eutrophication	kg P eq	0,05
Marine eutrophication	kg N eq	0,00
Stratospheric ozone depletion	kg CFC11 eq	0,00
Fine particulate matter formation	kg PM2.5 eq	-0,02
Ozone formation, Terrestrial ecosystems	kg NOx eq	-0,04
Ozone formation, Human health	kg NOx eq	-0,08
Mineral resource scarcity	kg Cu eq	-61,68
Global warming	kg CO2 eq	-186,47
Terrestrial ecotoxicity	kg 1,4-DCB	-641,74

RESULTS - NORMALIZATION



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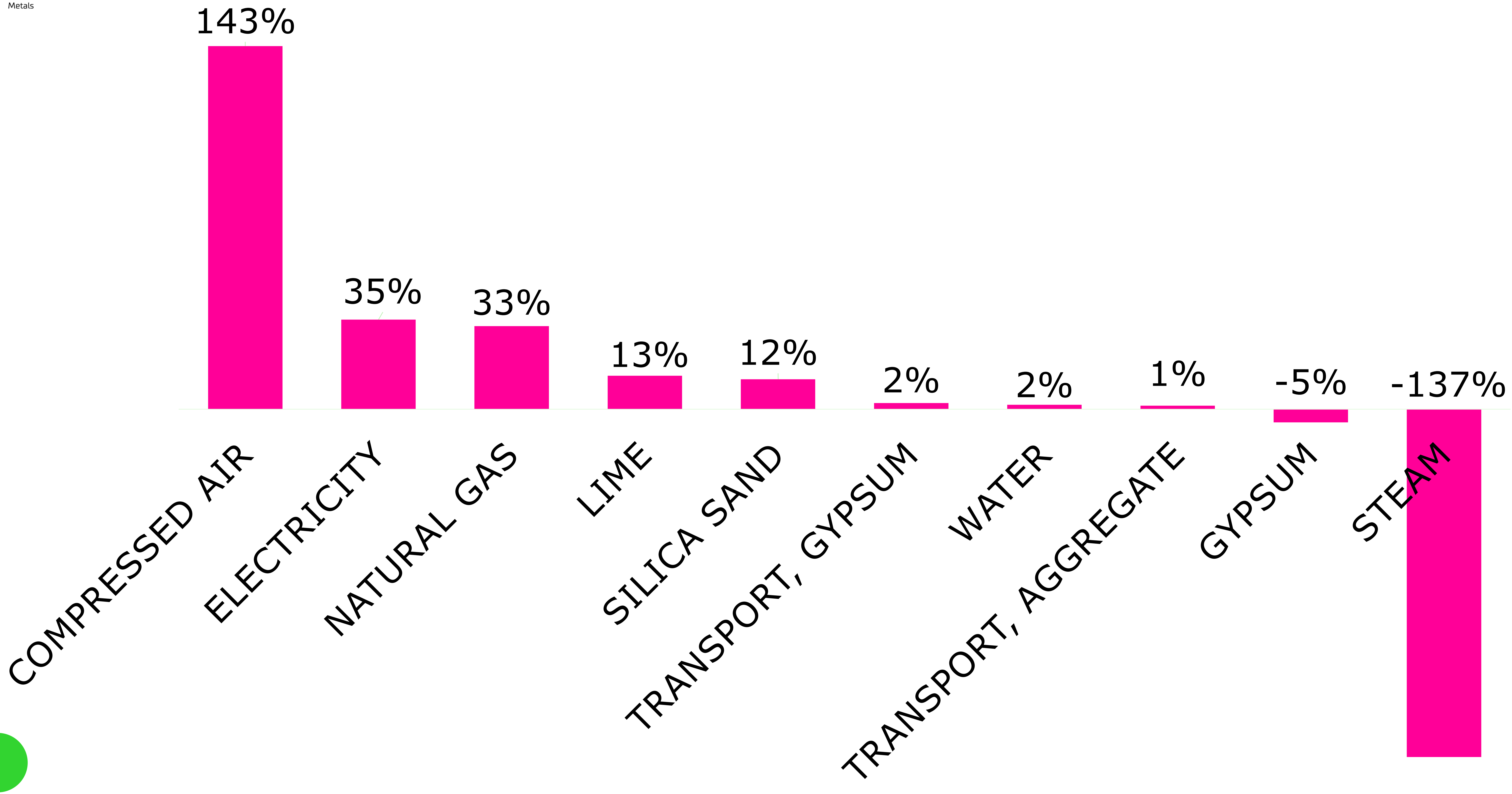
RESULTS–HUMAN CARCINOGENIC TOXICITY (TSL PROESS ONLY)



RESULTS – FRESHWATER ECOTOXICITY (TSL PROESS ONLY)

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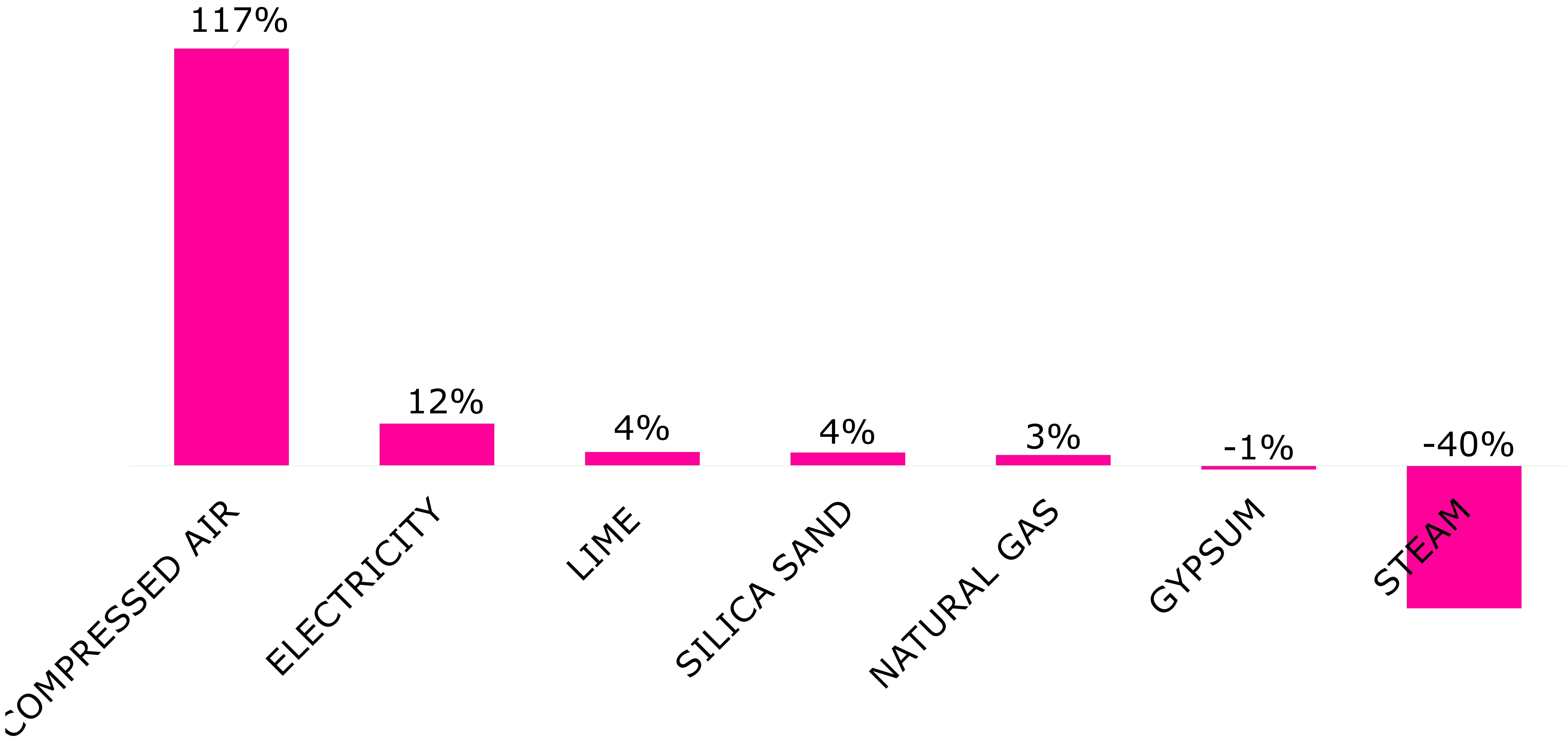
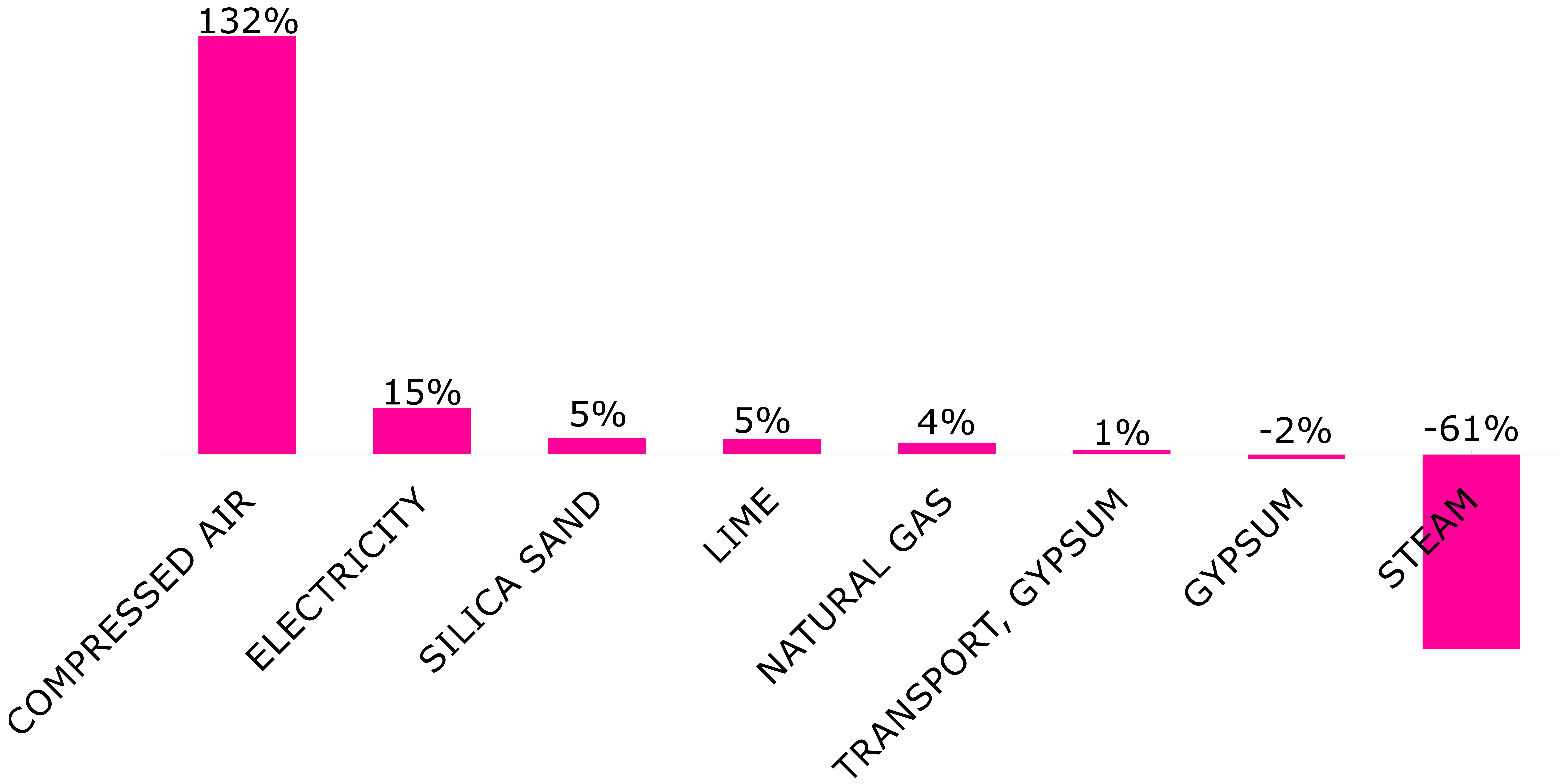
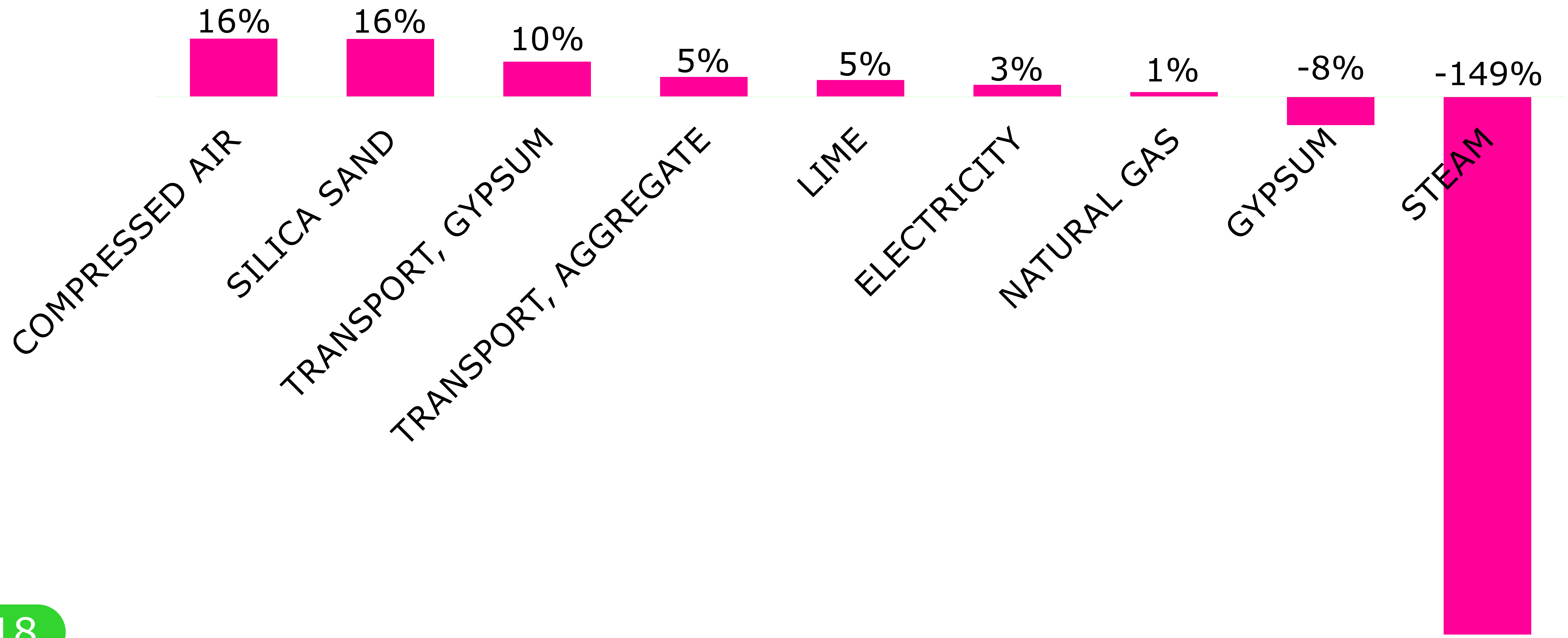


RESULTS – MARINE ECOTOXICITY (TSL PROESS ONLY)

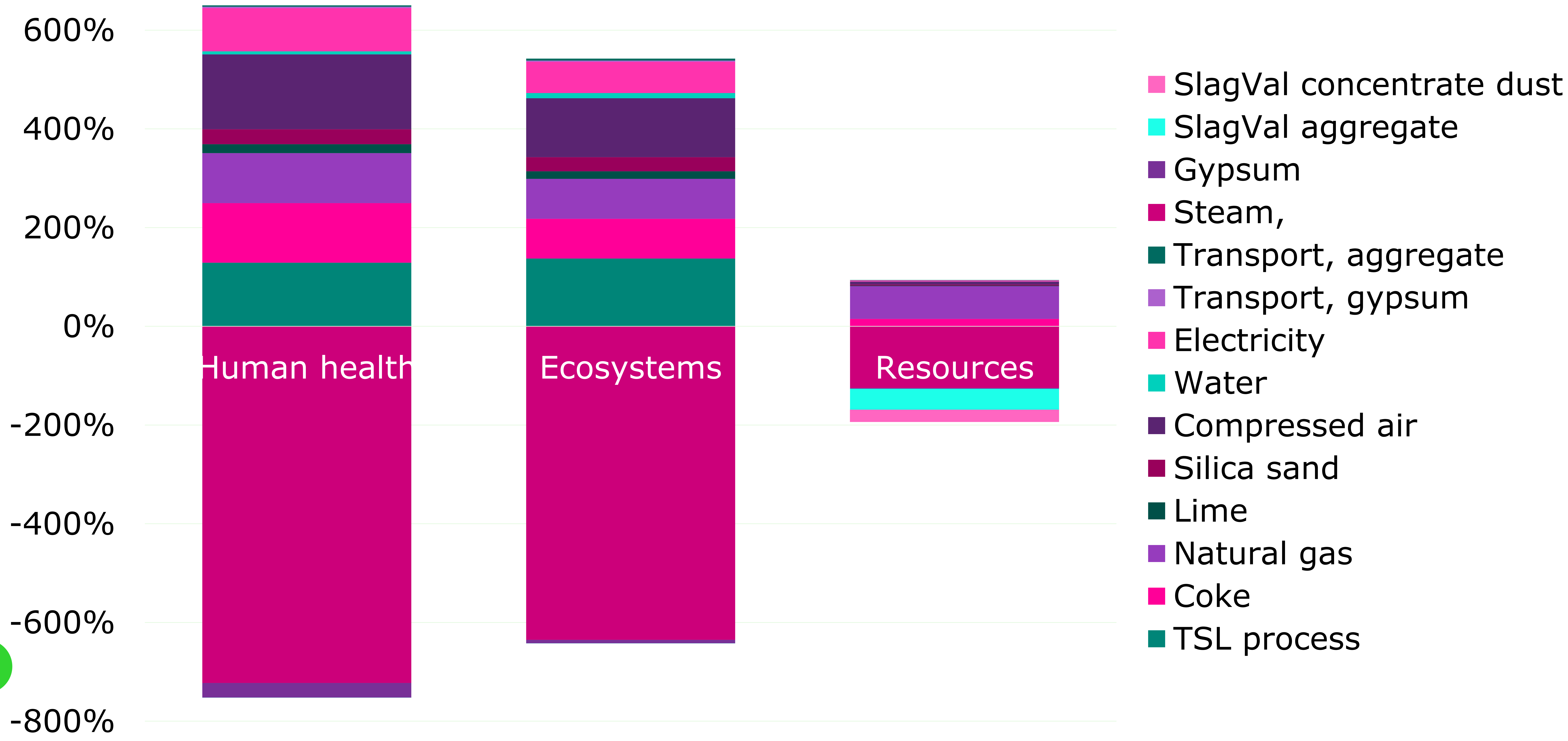


RESULTS – TERRESTRIAL ECOTOXICITY (TSL PROESS ONLY)



RESULTS – CARBON FOOTPRINT (TSL PROCESS ONLY)

RESULTS – ENDPOINT, DAMAGE ASSESSMENT (TSL PROCESS ONLY)



Summary

- LCA is a method that estimates the environmental effects associated with the entire life cycle of a product or process. The method covers an extremely broad range of process data from raw material extraction, through processing, production, distribution, use, collection, storage, and reuse.
- Because performing an LCA analysis is a modeling process, the results are subject to some error due to the need to make certain system boundaries and assumptions.
- The presented study is based on the results obtained as a part of SlagVal project funded by EIT RawMaterials.
- To goal of the project was to upscale a technology to process lead-bearing slags in order to recover valuable metals and produce an environmentally friendly construction aggregate.
- The study was focused on the results obtained for a TSL furnace and the batch-leaching tests of the final slag performed by VITO.

Summary

- The analysis was performed with SimaPro software and Ecoinvent 3.6 database.
- The tesults show that there is a huge negative impact associated with the fact, that the proces includes waste heat recovery to produce steam. This means, that some impact caused by the production of steam can be avoided.
- The highest impacts were observed for three categories: human carcinogenic toxicity, freshwater ecotoxicity and marine ecotoxicity.
- High impact of compressed air for most categories results from the electricity consumption.
- The lowest (negative) impact was observed for terrestrial ecotoxicity. This is due to the fact, that the technology allows to process waste (slag), which would be otherwise stored on landfill, so a huge portion of hazadrous metal compounds is not transferred into the soil.

Thank you!

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