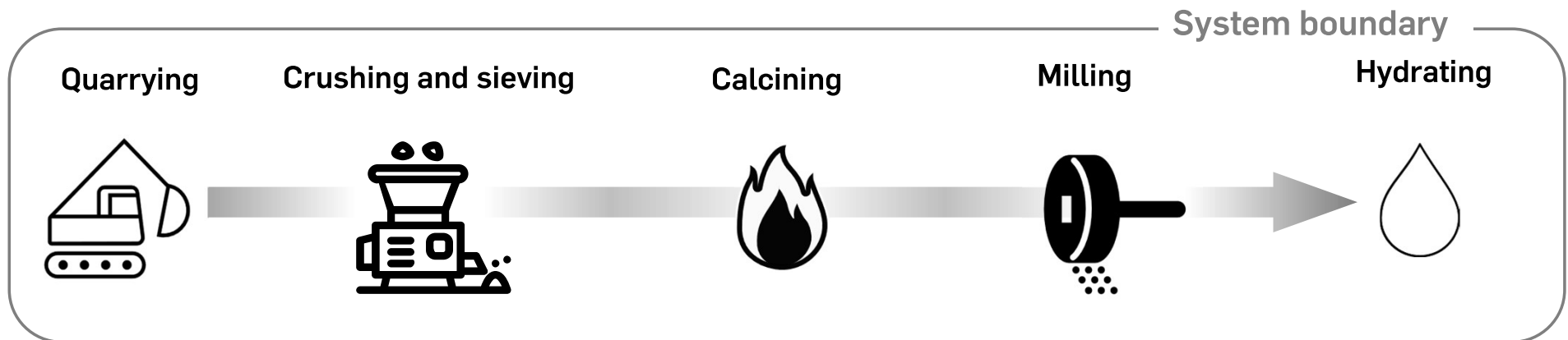


Evaluating the Environmental Impact of a reference lime production plant through Life Cycle Assessment, focussing on the effect of substituting fossil fuels with green hydrogen

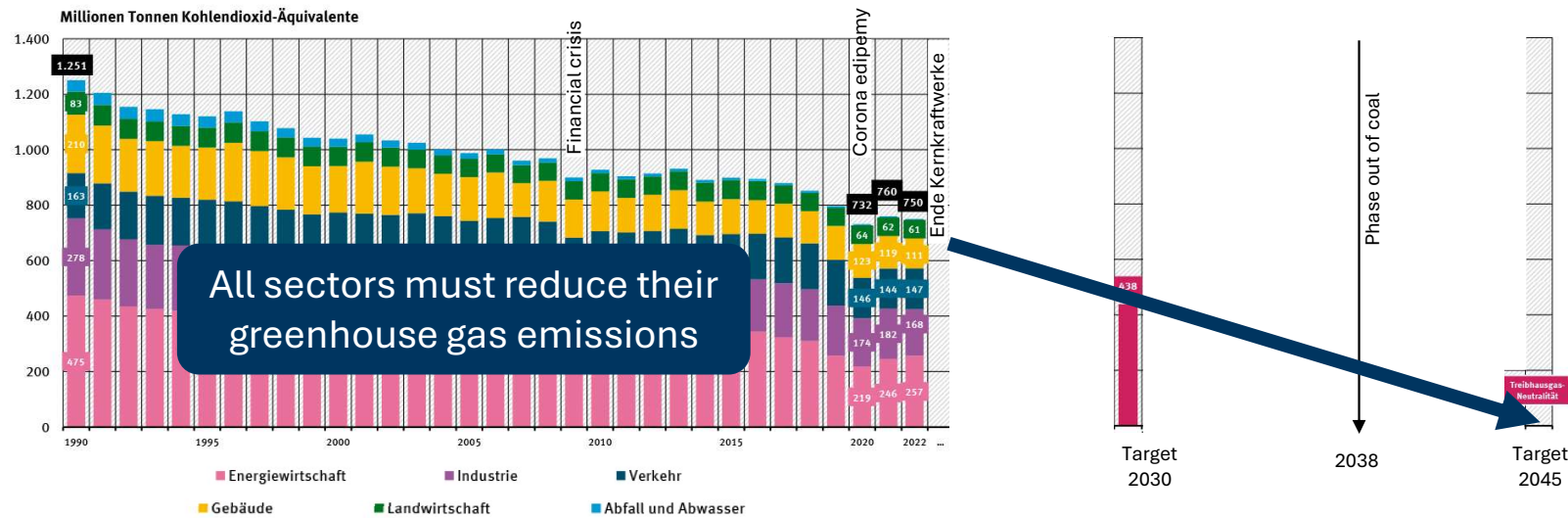
Viktor Schüßler

Chair of Energy Systems and Energy Economics

23. October 2024 | GOR Workshop "Umwelt und Energie" | FernUniversität Hagen

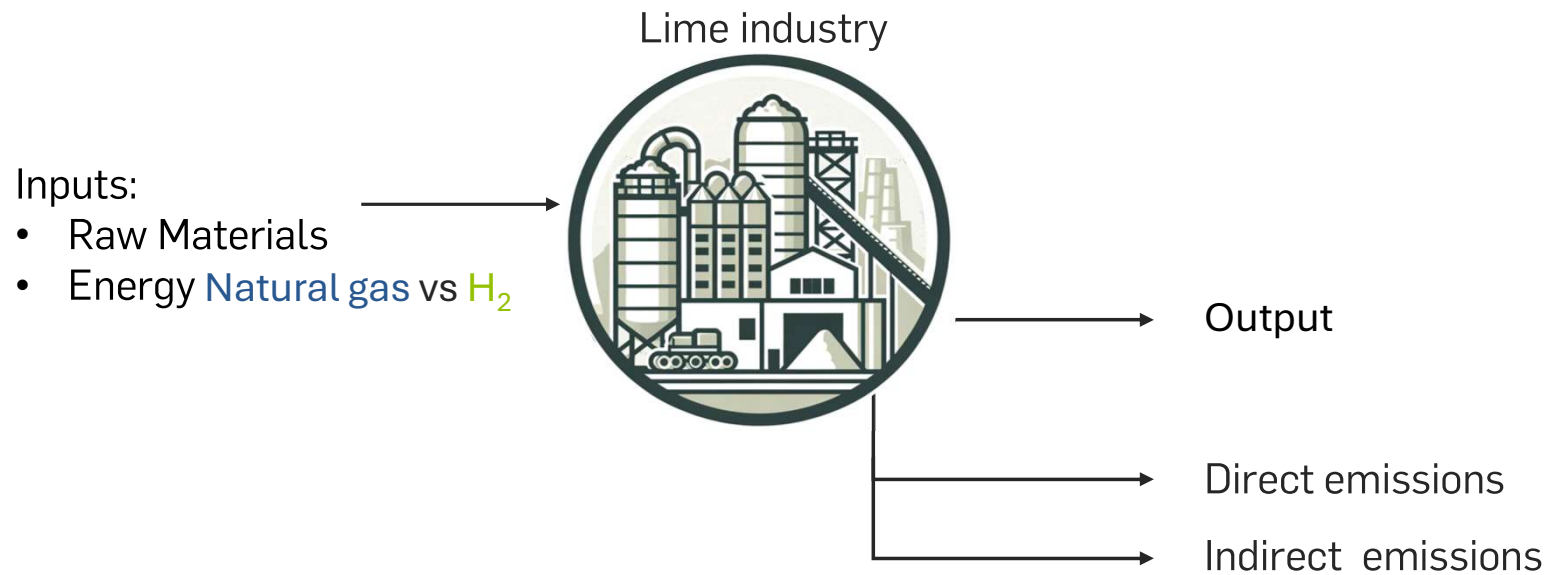


Reduction of greenhouse gases in all sectors

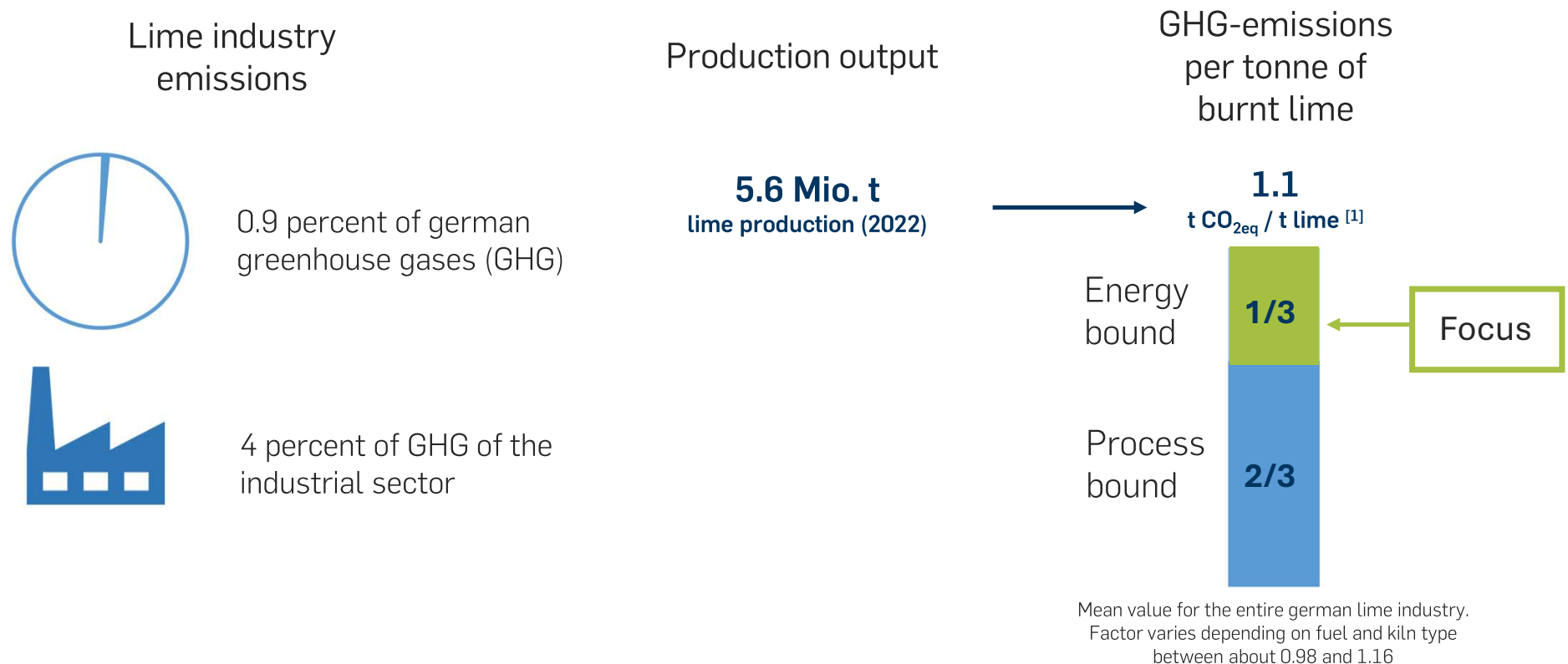


Low-carbon fuels
 Electrification
 Carbon capture, utilization and storage

Motivation and Research Gap



Greenhouse gas emissions in the german lime industry



[1] DEHSt, „VET-Bericht-2022“, Berlin, 2023

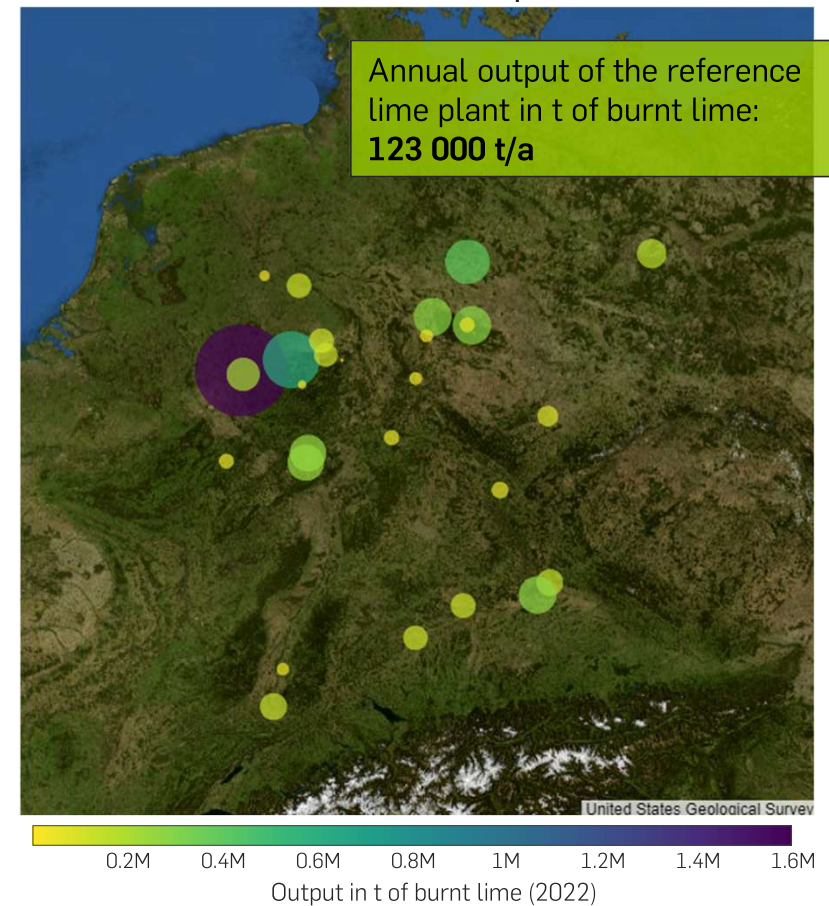
Defining a reference lime production plant

Method:

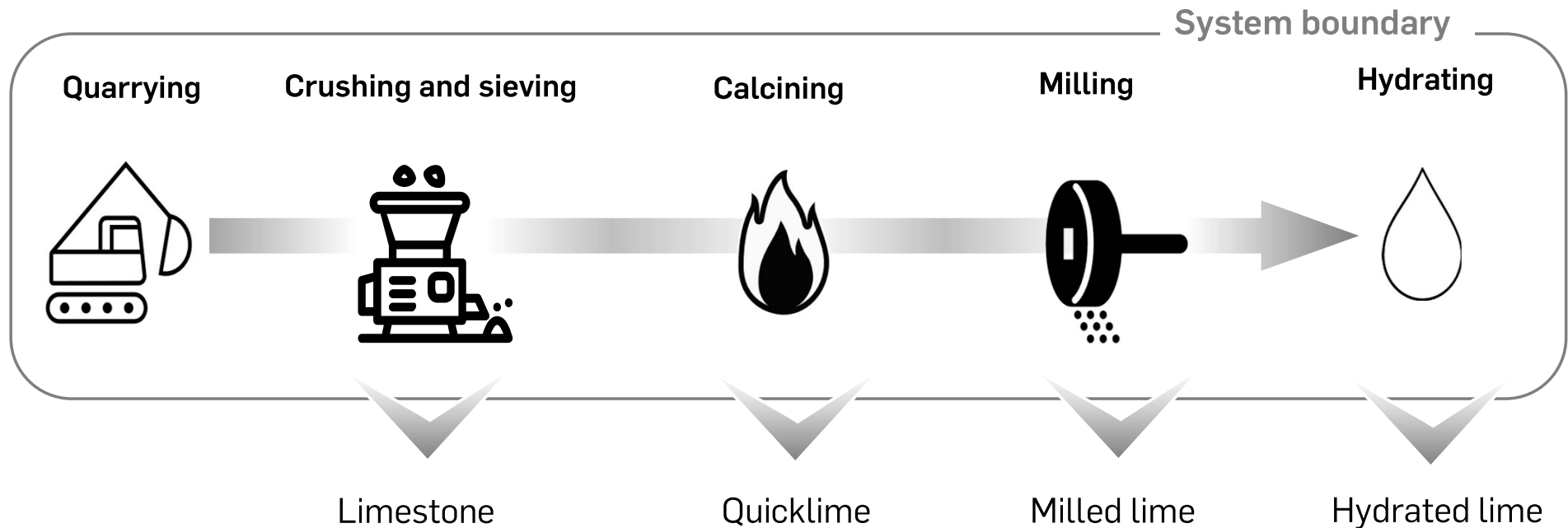
1. Analysis of emission and statistical data
2. Derivation of key production parameters
3. Production process definition through literature review and expert interviews
4. Validation of reference lime plant



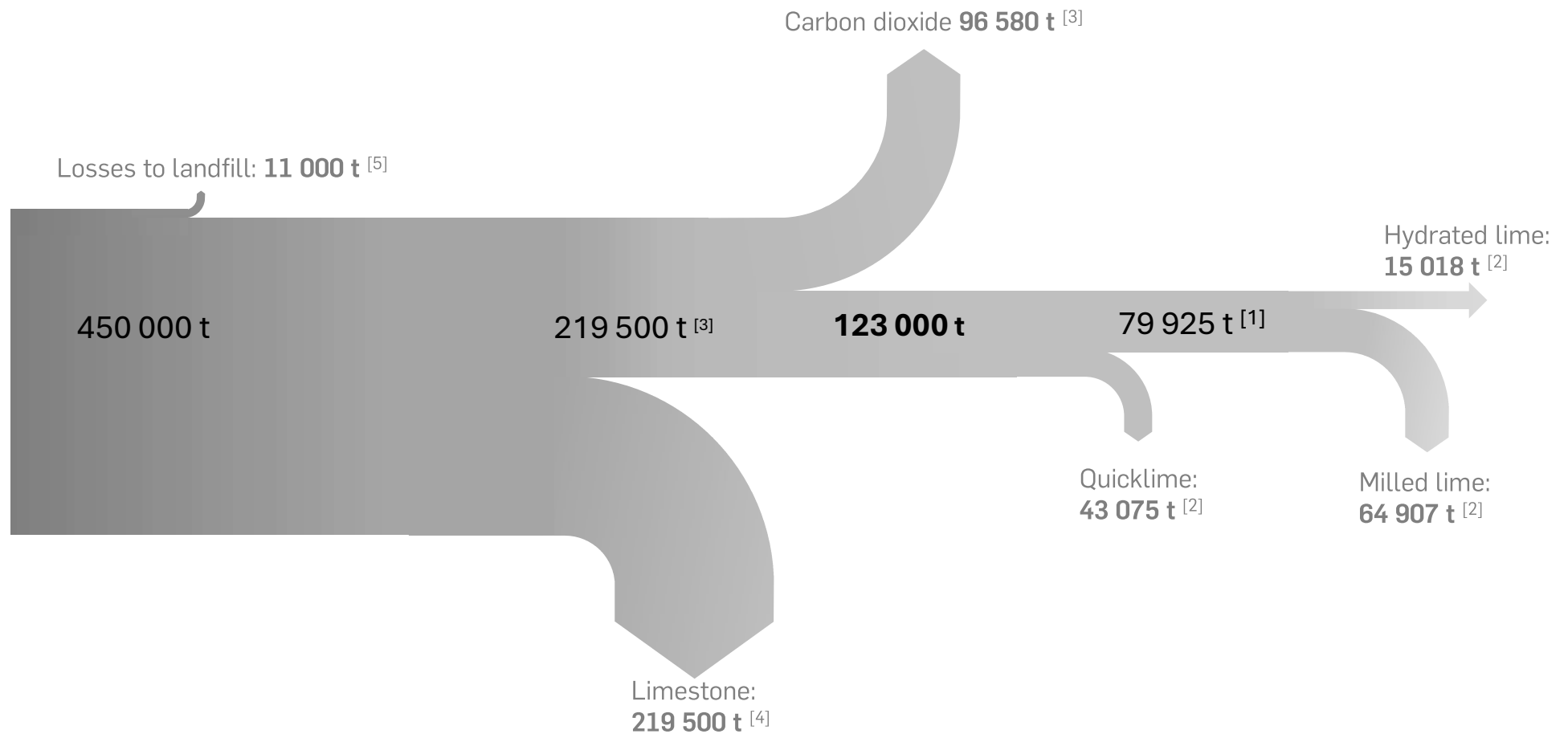
German lime plants



Main processes and products of a reference lime production plant



Product flow within a reference lime production plant



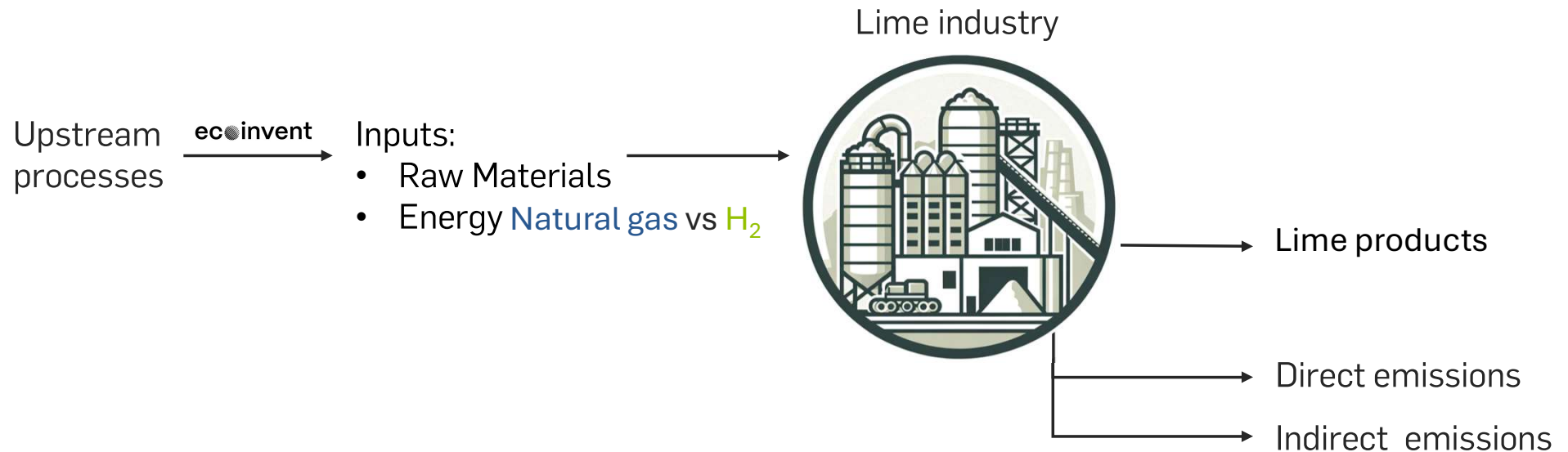
[2] Calculations based on BV Kalk, „Statistisches Jahreshft 2022“, Cologne

[3] Joint Research Center (2013), „BAT Reference Document“, Luxembourg

[4] Expert Interview (2024), F. Ohnemüller, BV Kalk

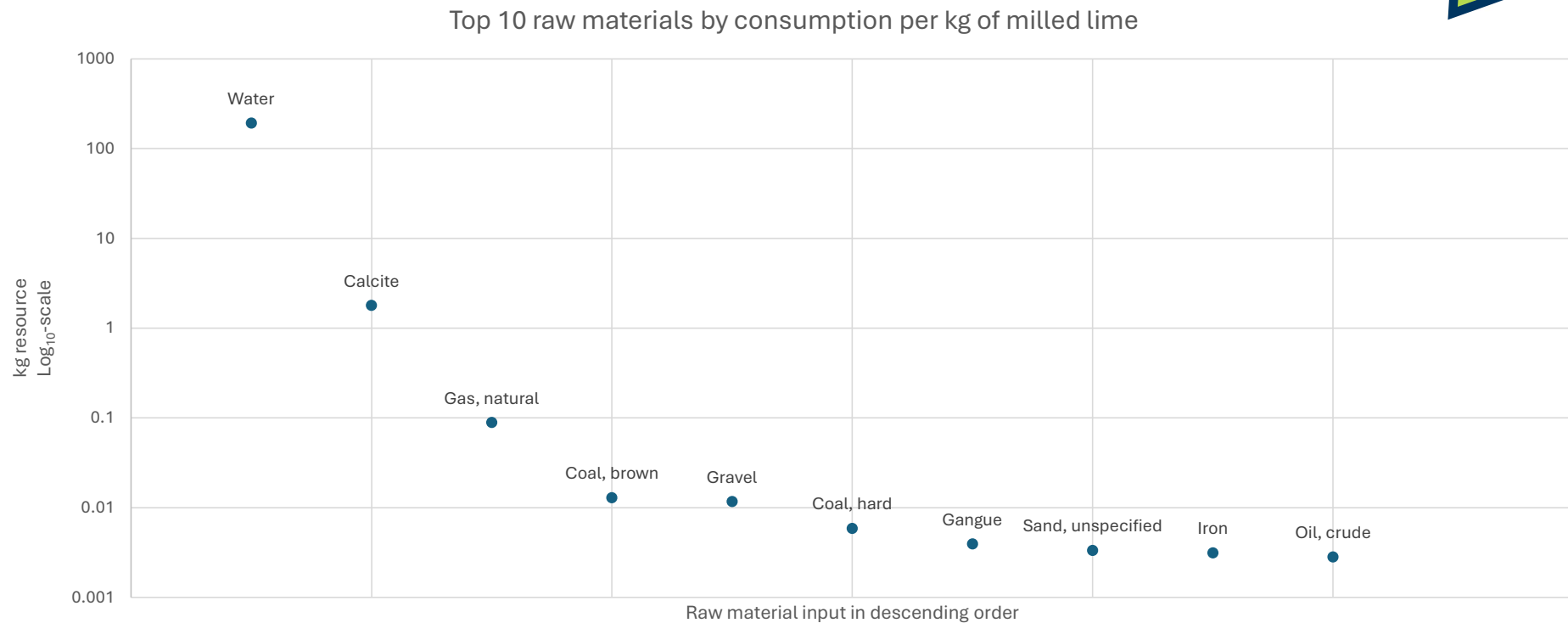
[5] Expert Interview (2024)

Application of Life Cycle Assessment



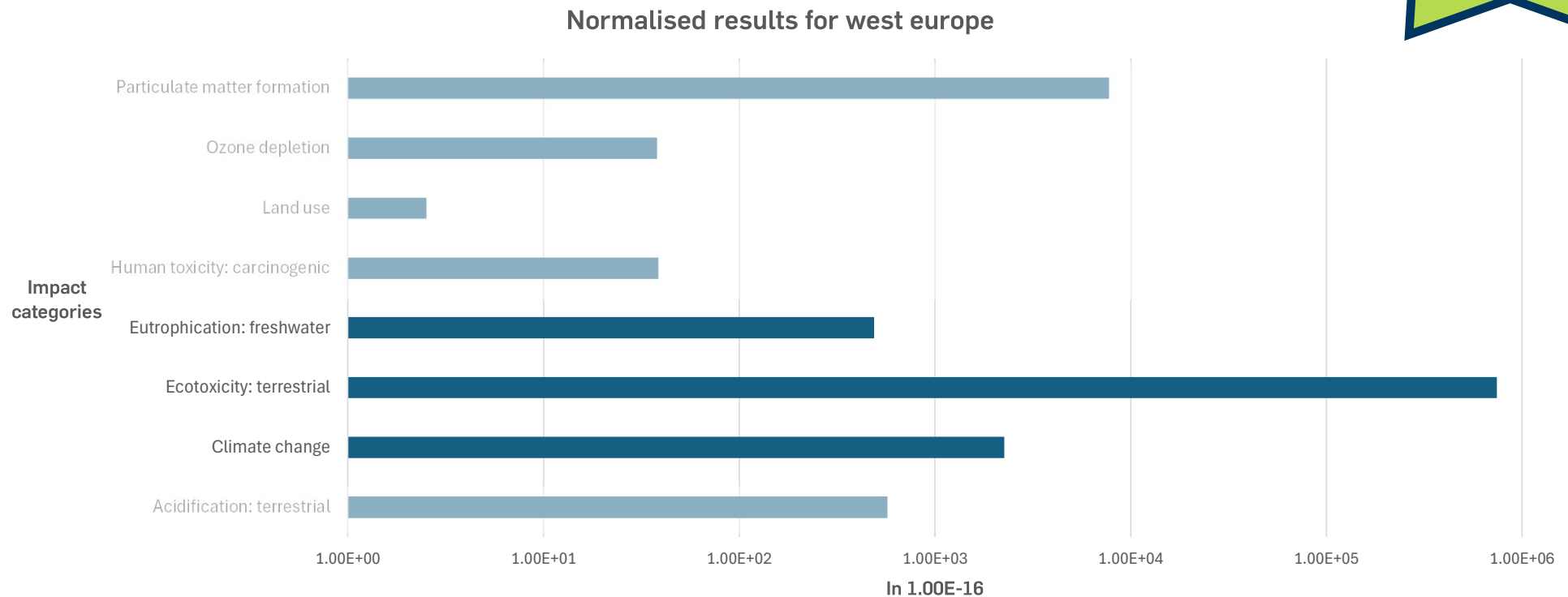
Life cycle inventory: Analysis of input materials

- Functional unit: 1kg of milled lime



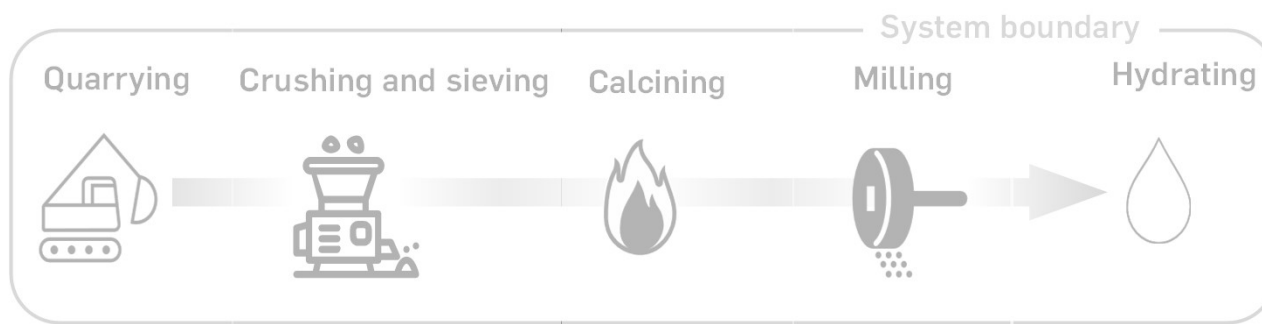
Results in multiple impact categories and their relative impact

- Functional unit: 1kg of milled lime



Impacts along the process chain

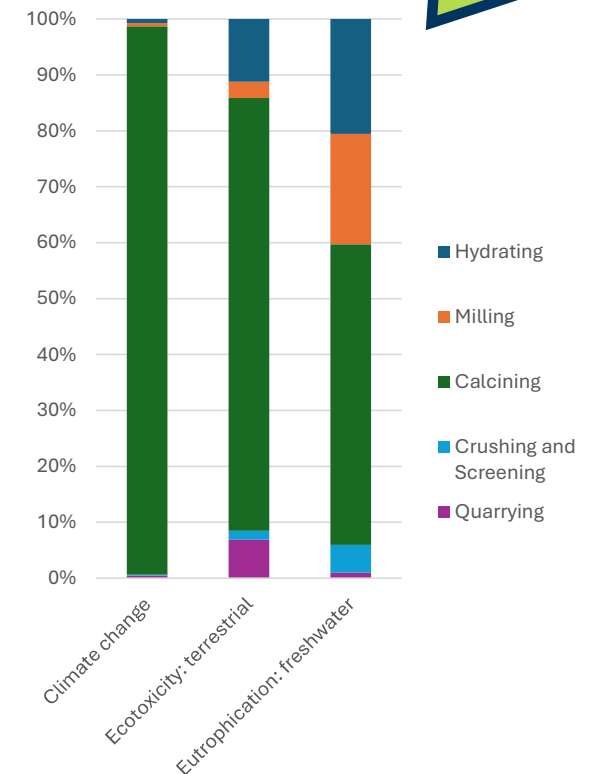
- Functional unit: 1kg of hydrated lime
- Impact Assessment Method: ReCiPE 2016 midpoint (H)
- Number of impact categories: 18



Average relative share of environmental impacts of the processes
(assuming homogenous weighting of impact categories)

Quarrying: 6.61%
 Crushing and sieving: 2.73%
 Calcining: 73.50%
 Milling: 7.25%
 Hydrating: 9.92%

Process share in selected impact categories



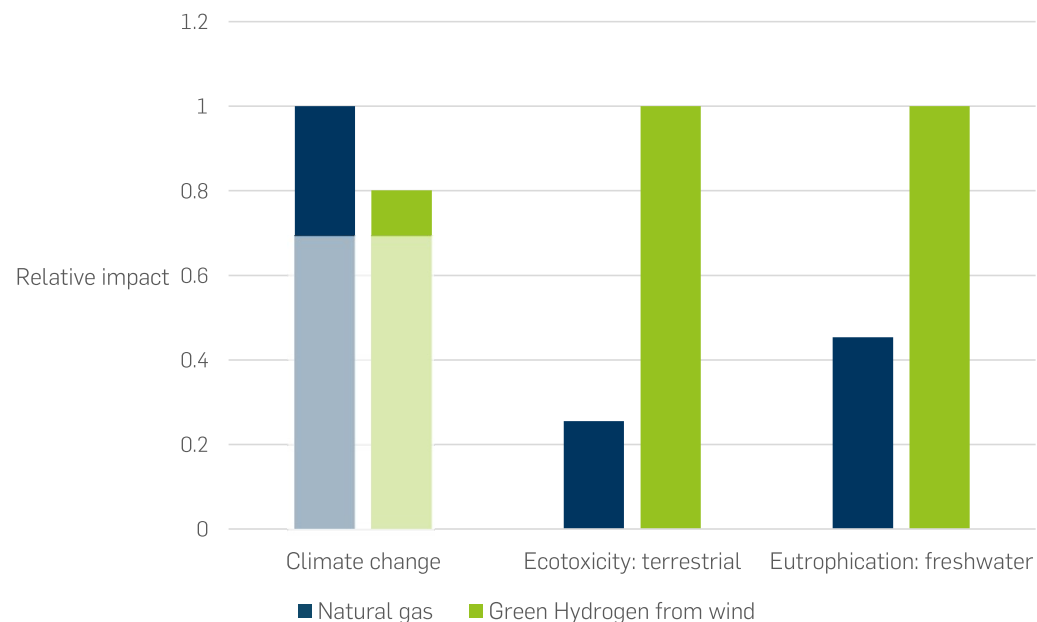
Preliminary results

Effects of substituting natural gas with green hydrogen from wind energy

- Functional unit: 1kg of milled lime
- In 14/18 impact categories H₂ is higher than natural gas

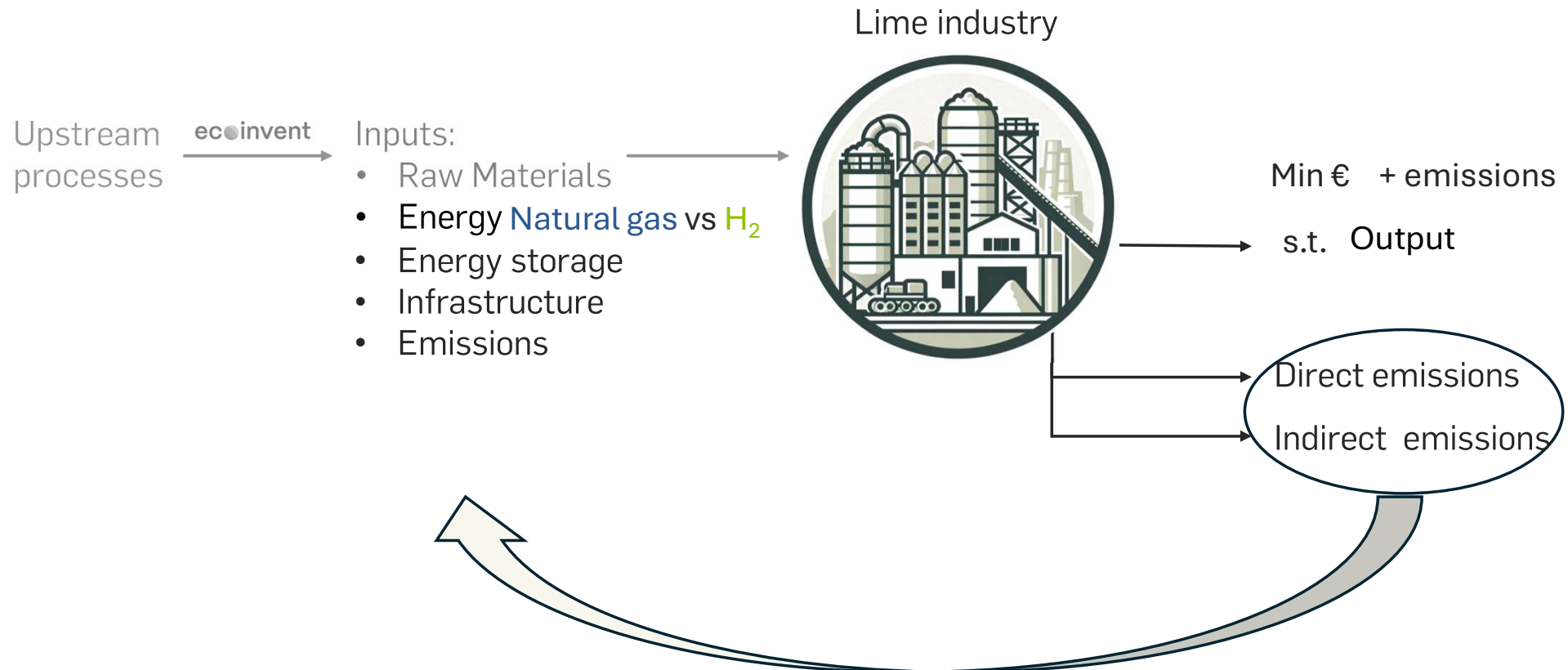


Effects of a fuel switch in selected impact categories



- Analyse different hydrogen technologies and pathways
- Look into upstream data (solar, wind, gas)
- Compare with other fossil fuels
- Use Weighting to assess importance of impact categories
- Think into the future
--> prospective LCA
- Calculate abatement costs

Research Outlook



Thank you for your attention!

 Lehrstuhl
Energiesysteme &
Energiewirtschaft

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Gefördert durch:



Bundesministerium
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