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Results 2 - MCDA
Assessment tools for sustainability monitoring of bioeconomy networks

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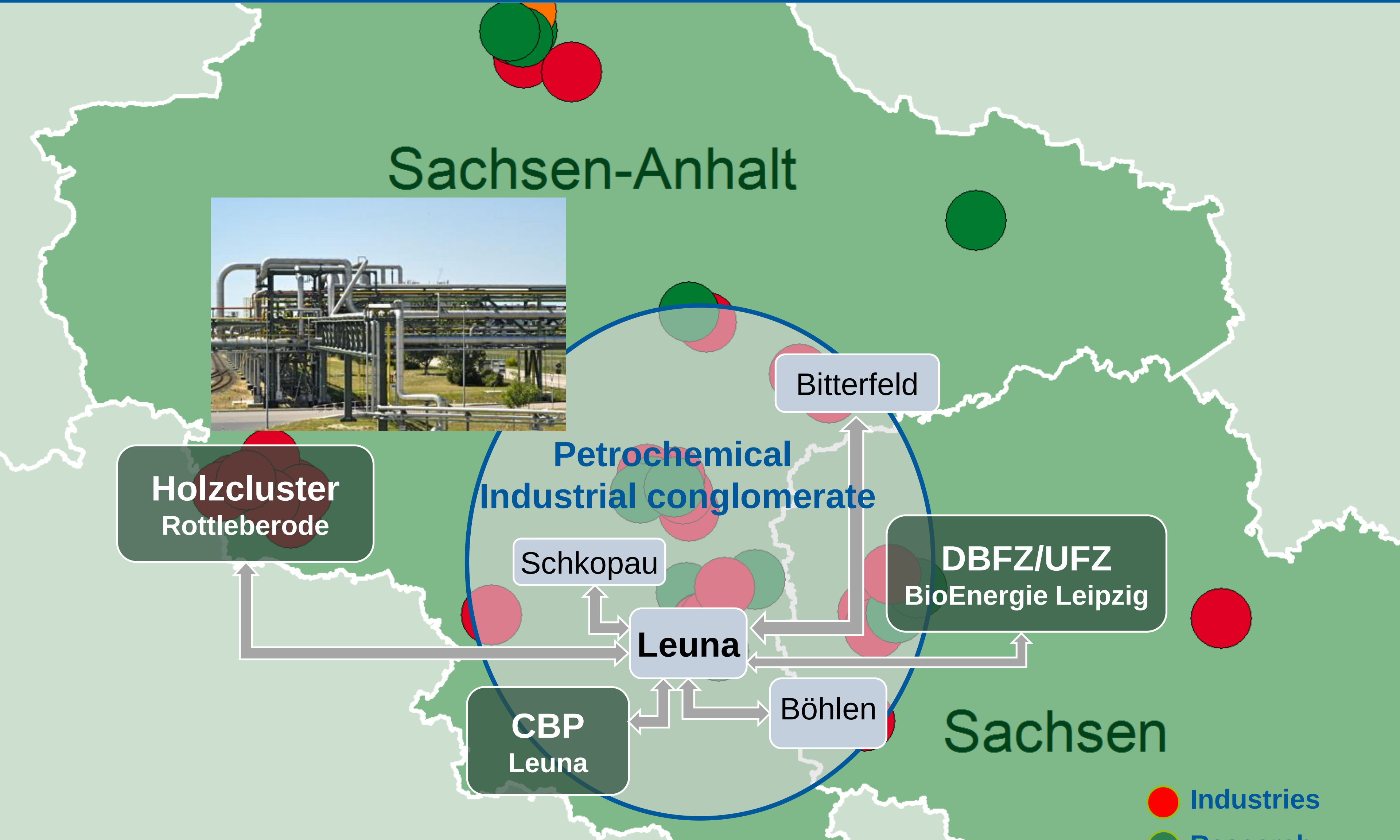
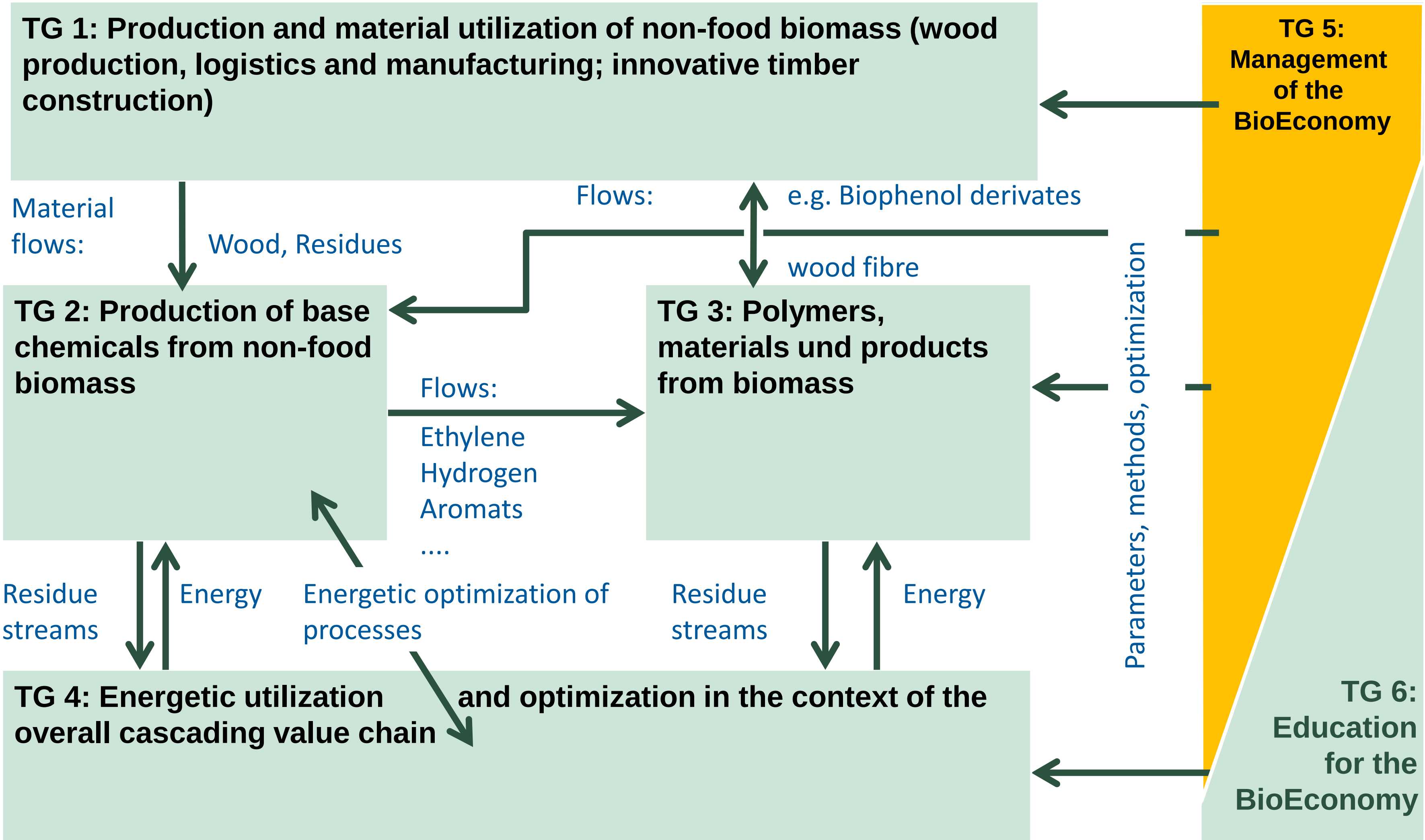
Contents

1. Motivation (I): Cross-sectoral cooperation with in a bioeconomy region



Source. Bioeconomy e.V. bioeconomy.de

1. Motivation (II): Integration of energy and material flows along value chains



Source: Cluster BioEconomy

1. Motivation (III): Levering sustainability potentials of bio-based products before entering the market

Product group 1: Engineered wood products

Products:
Laminated veneer lumber
Glulam timber
Cross-laminated timber
Wood fibre boards

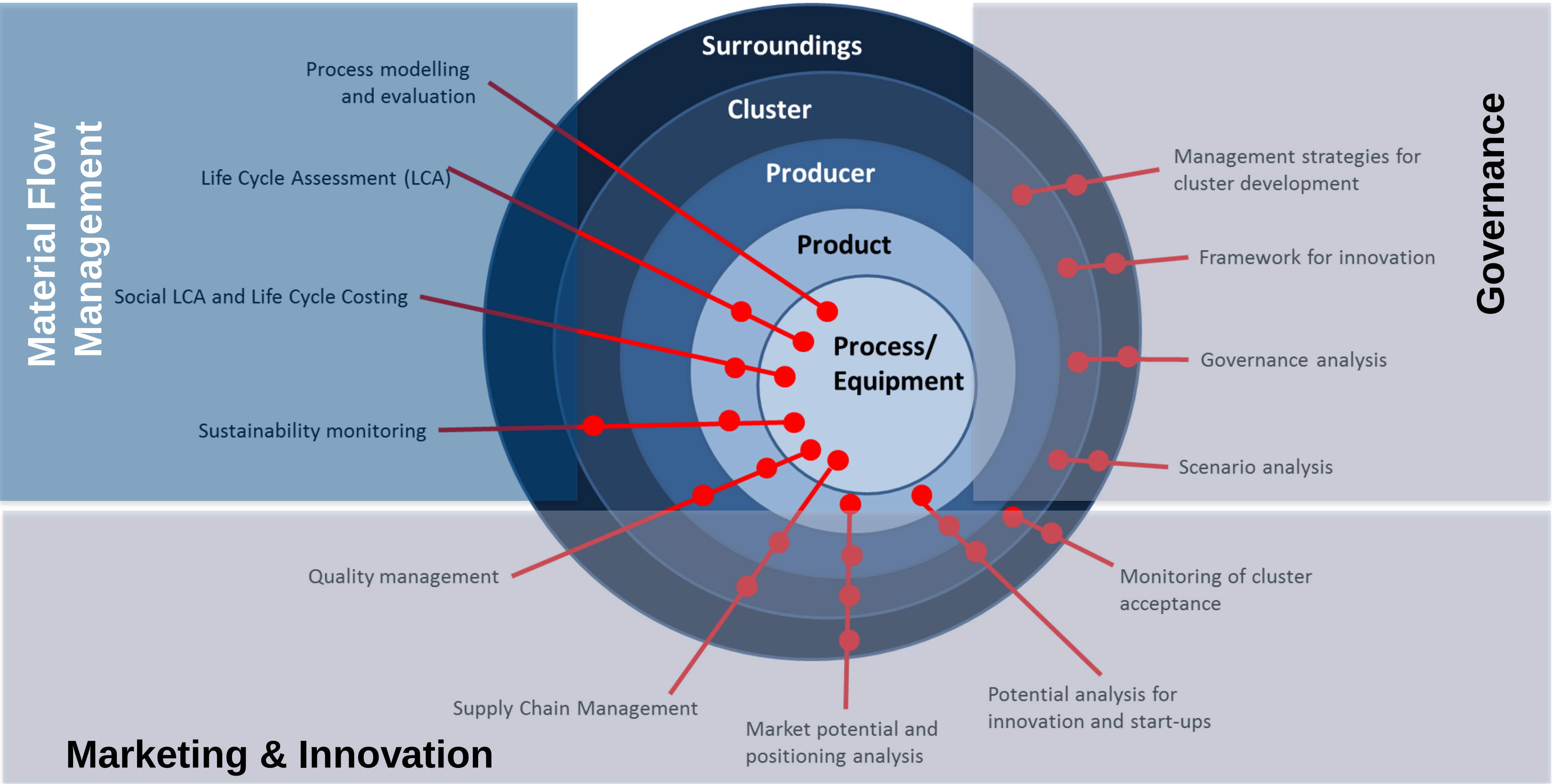
Product group 2 : Wood-based platform chemicals and polymers

Products:
Lignin-based Foams
Lignin-based Resins
Cellulose-based Olephines
Other bio-based polymers (e.g. PLA)

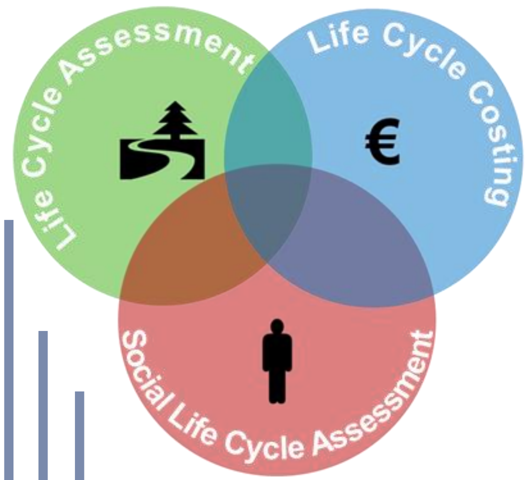
Product group 3 : Wood-based composites

Products:
Composite materials (structural elements)
Wood-Plastic-Composites (non-structural elements

Accompanying Research



2. Goal and Scope (I):



Sustainability monitoring

	a	b	c	Aggregation
Soziale Kennzahlen	8.5	4.5	5.5	∑
Ökologische Kennzahlen	7.5	3.5	4.5	∑
Ökonomische Kennzahlen	6.5	2.5	3.0	∑
Technische Kennzahlen	0.2	0.6	0.5	∑

∑ Sustainability-Index

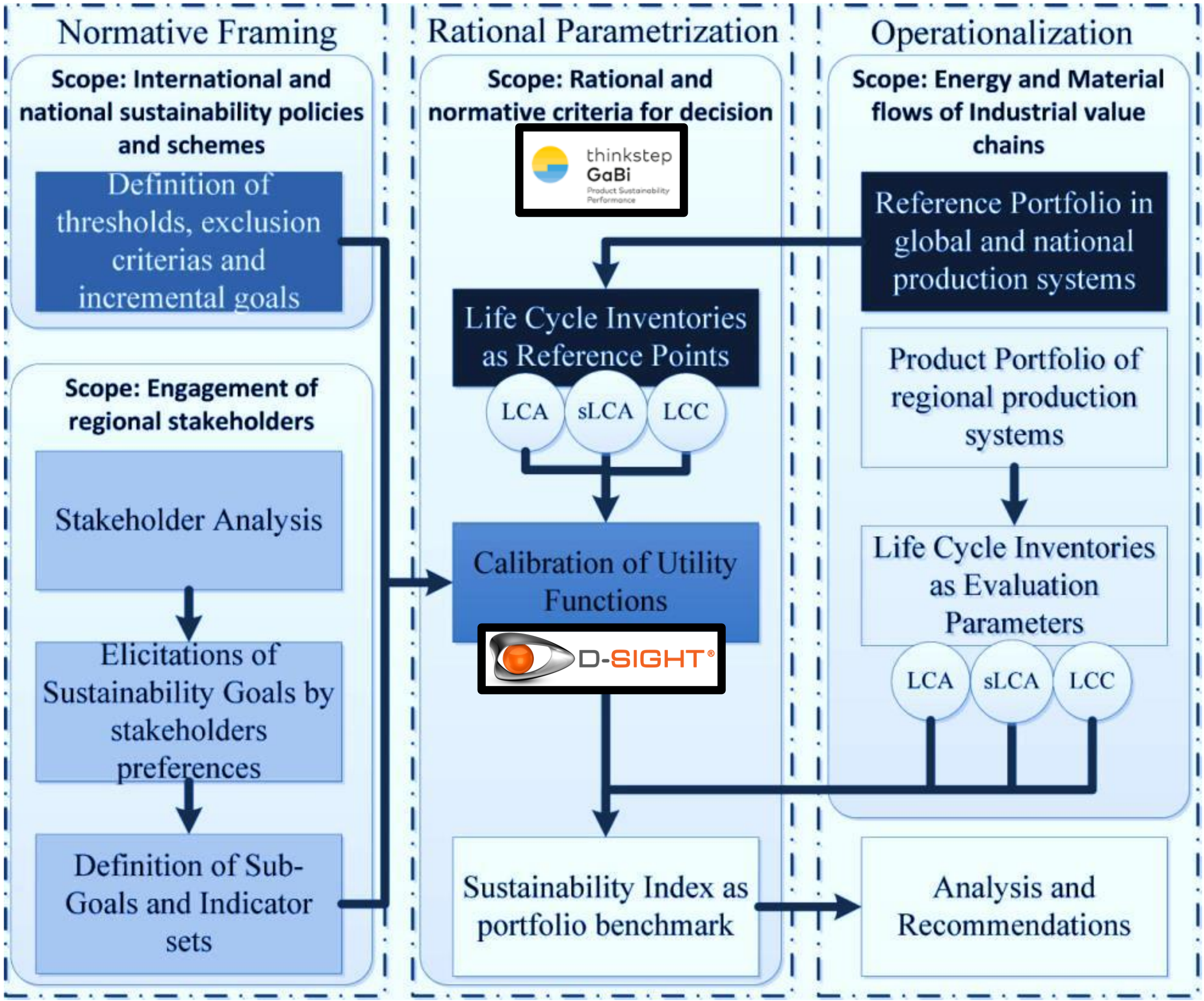
Goal:

- Development of a monitoring system for portfolio management with selected key performance indicators
- Establishment of a sustainability index for value-added networks within a bioeconomy region
- Identification of trade-offs between decision alternatives

Operationalization:

- Collecting Life Cycle inventory data for socio-economic and environmental assessment of selected production chains
- Early identification of chances & risks (Hotspots) for development towards sustainable production and consumption

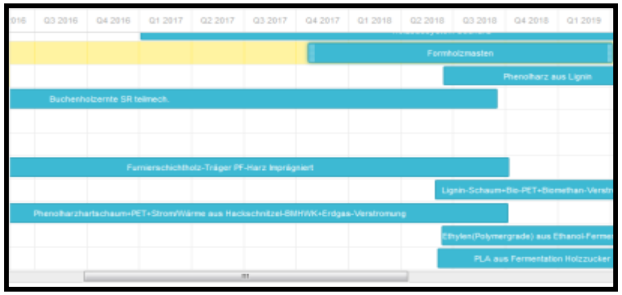
SUMINISTRO – Sustainability monitoring Index for assessing regional bio-based industry networks



Bezama, A.; Siebert, A.; Hildebrandt, J.; Thrän, D. (2016). Integration of LCA, LCC and social LCA for assessing a bioeconomy Region: In book: Life Cycle Approaches to Sustainable Regional Development, Chapter: 37, Publisher: Taylor & Francis Ltd, Editors: Stefania Massari, Guido Sonnemann, Fritz Balkau, pp.7 (258 -264)

Main features

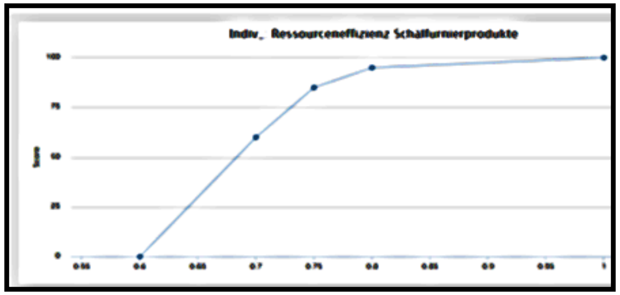
Implementation planning



Combined monitoring (Ex-Post) and ex-ante evaluation

Resource constraints can be monitored, considered and managed over time

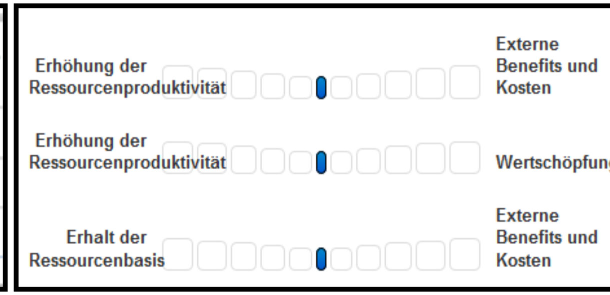
Utility Functions:



Combined indicator calibration through pair-wise comparisons or utility functions

Integration of benchmarks for Sustainability assessment

Weighting of Indicators



Participative goal definition and indicator weigthing

Constant adjustment and integration of newly cooperating or conflicting stakeholder groups possible

Software: D-SIGHT®

3. Materials and Methods (II): Case study system of the Spitzencluster Region (TRL 3 – 9)

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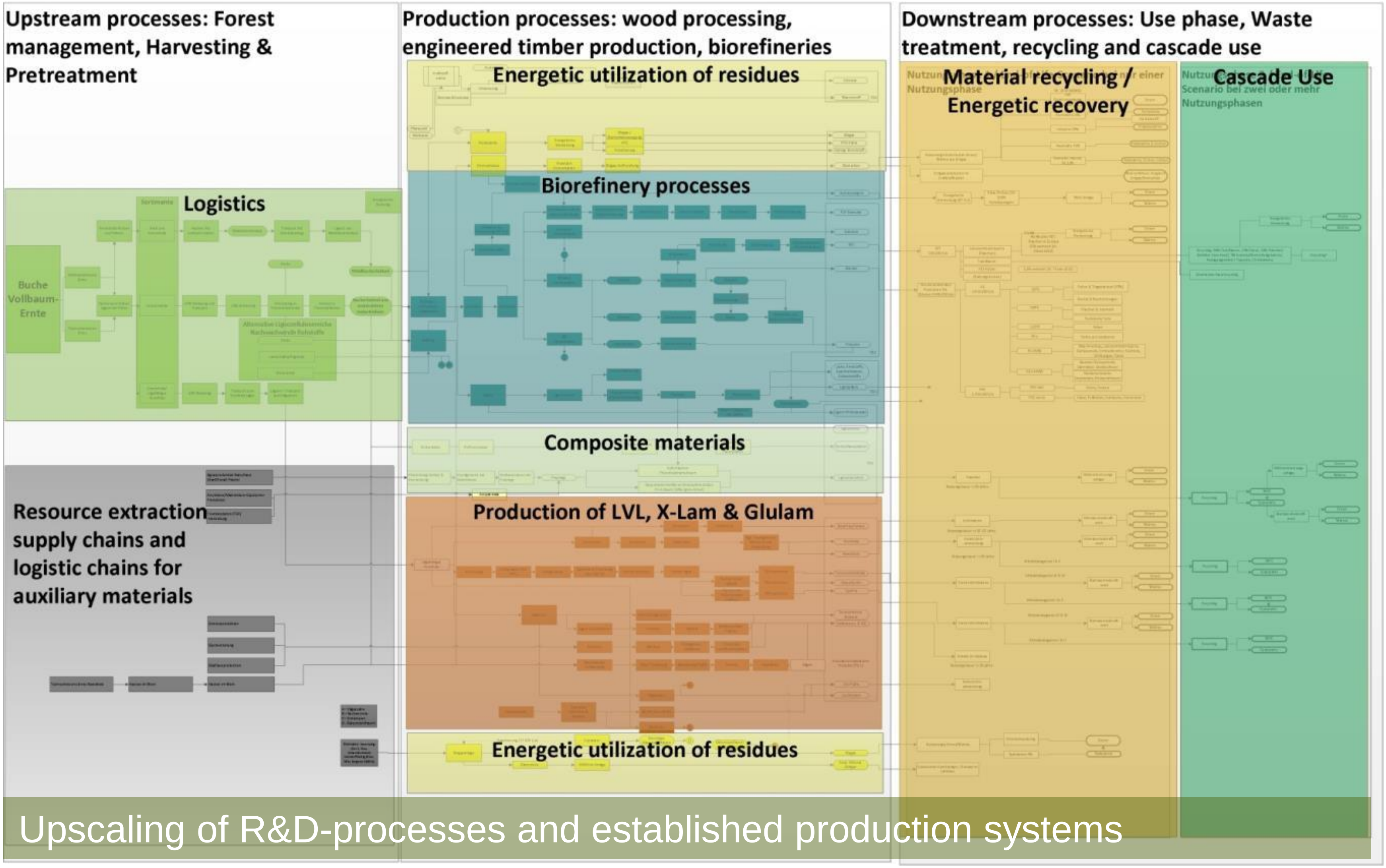
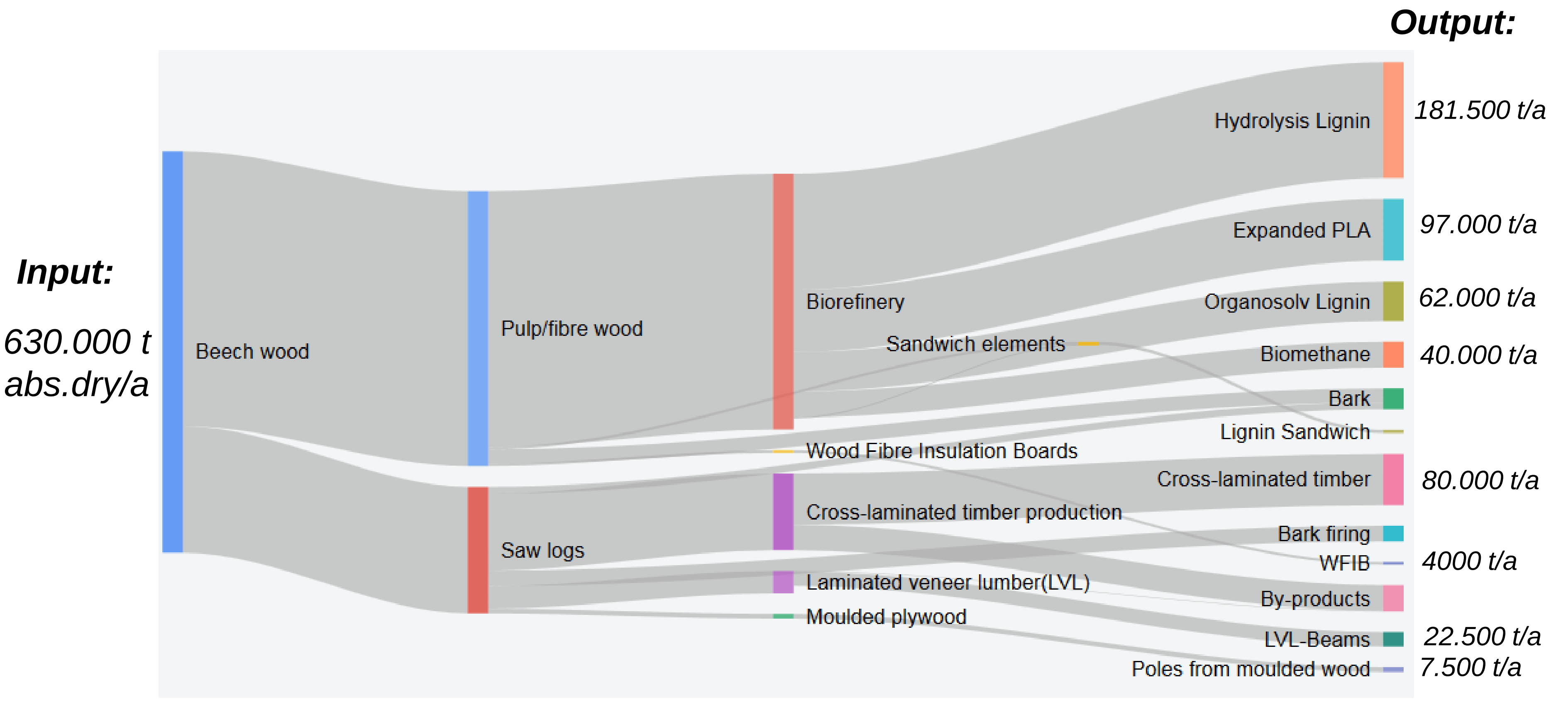


3. Materials and Methods (III): Representative product basket case (TRL 7 - 9)



3. Materials and Methods (IV): Data sources along value chains and aggregation levels

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Economic benchmarks

Europäische Kommission | eurostat

UNECE

FAOSTAT

DESTATIS Statistisches Bundesamt

Forestry potentials & sustainability

BUNDESWALDINVENTUR

Forest Europe growing life

BISE Biodiversity Information System for Europe

Techn.-econ. data

Kuratorium für Waldarbeit und Forsttechnik e.V.

Fraunhofer IML

Socio-econ. data

BG RCI Berufsgenossenschaft Rohstoffe und chemische Industrie

UNTERNEHMENS-REGISTER

IAB

Spec. process inventories

Pollmeier

HOMATHERM

Fraunhofer CBP

Fraunhofer IWM

thinkstep GaBi Product Sustainability Performance

AkzoNobel

LOCTITE

BioEconomy Cluster

C3 House Technologies

DBFZ

ante

KNAUF Gips

Linde

Prefere Resins

Env. benchmarks of production sites

E-PRTR The European Pollutant Release and Transfer Register

Env. product benchmarks

AMERICAN WOOD COUNCIL

Institut Bauen und Umwelt eV

baubook ökologisch ausschreiben

Techn. process benchmarks

thinkstep GaBi Product Sustainability Performance

THÜNEN

Ecoinflow SawBenchmark

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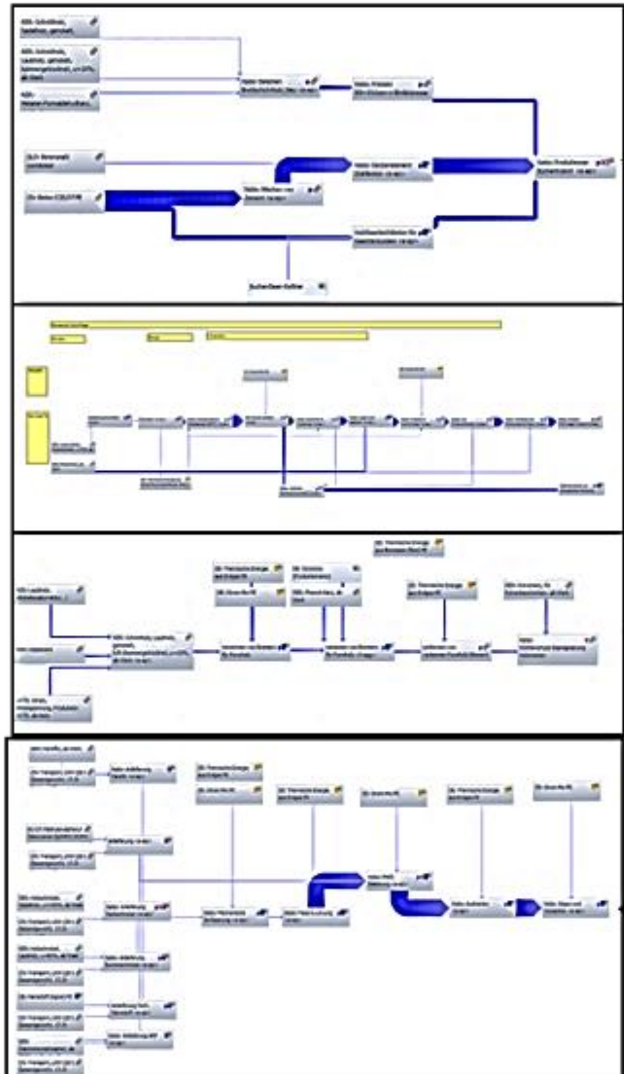
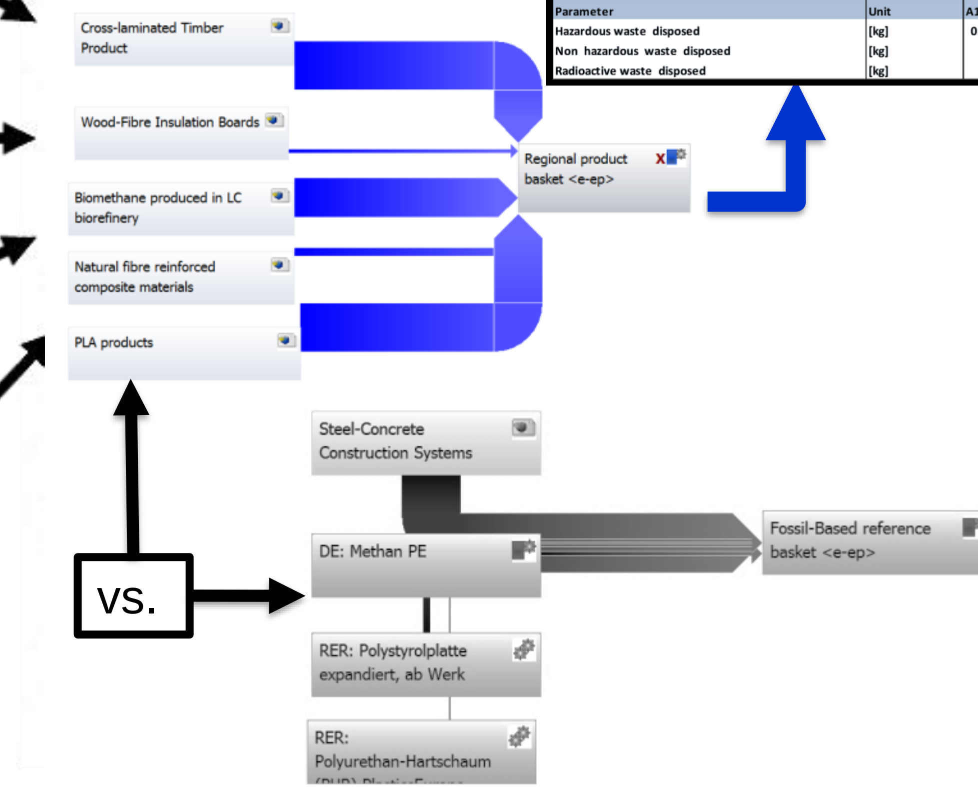
3. Materials and Methods (V): Extracting Life Cycle Impacts from a LCA-Modell of the product basket

Individual product chains



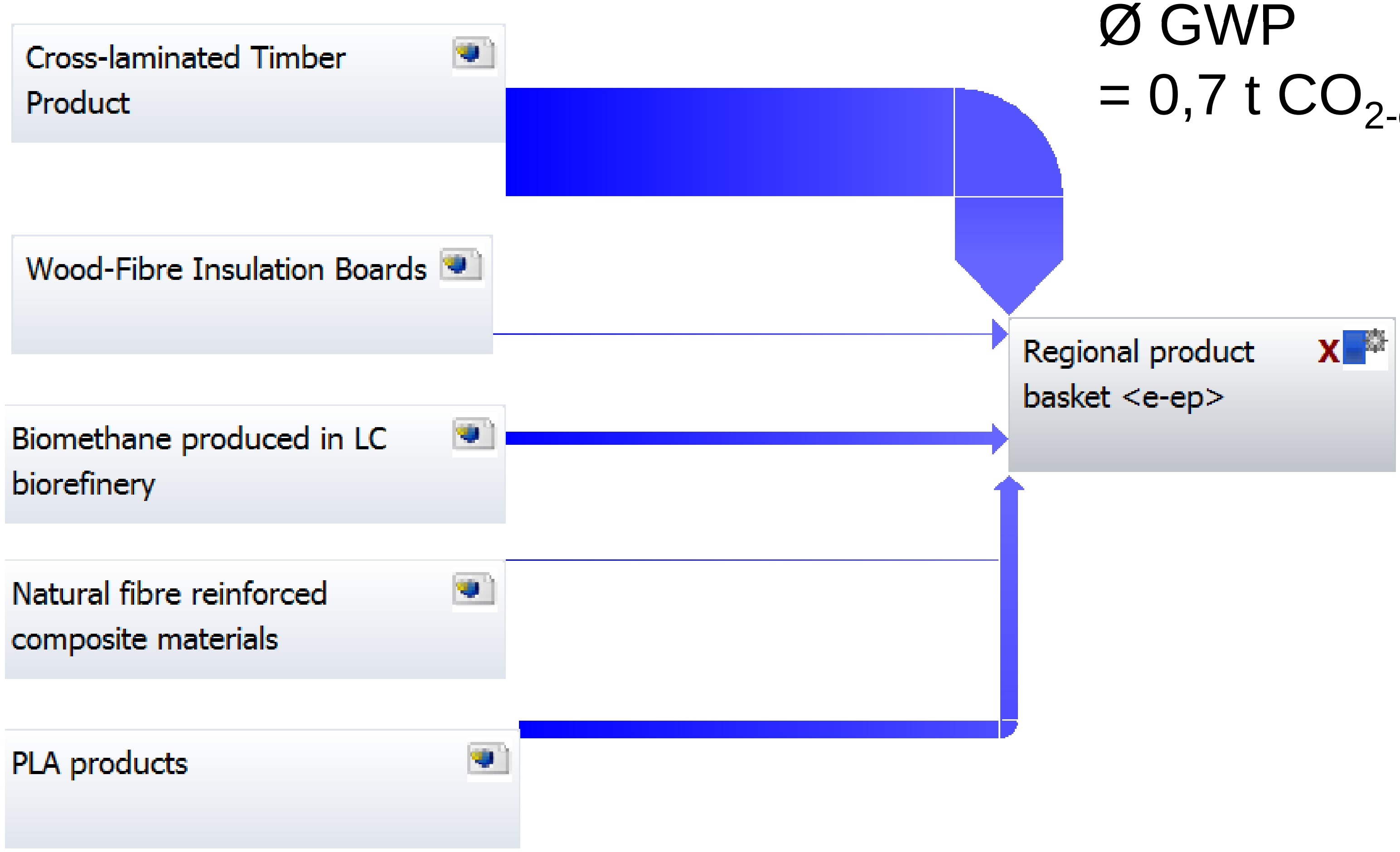
Product basket



Life Cycle Impacts

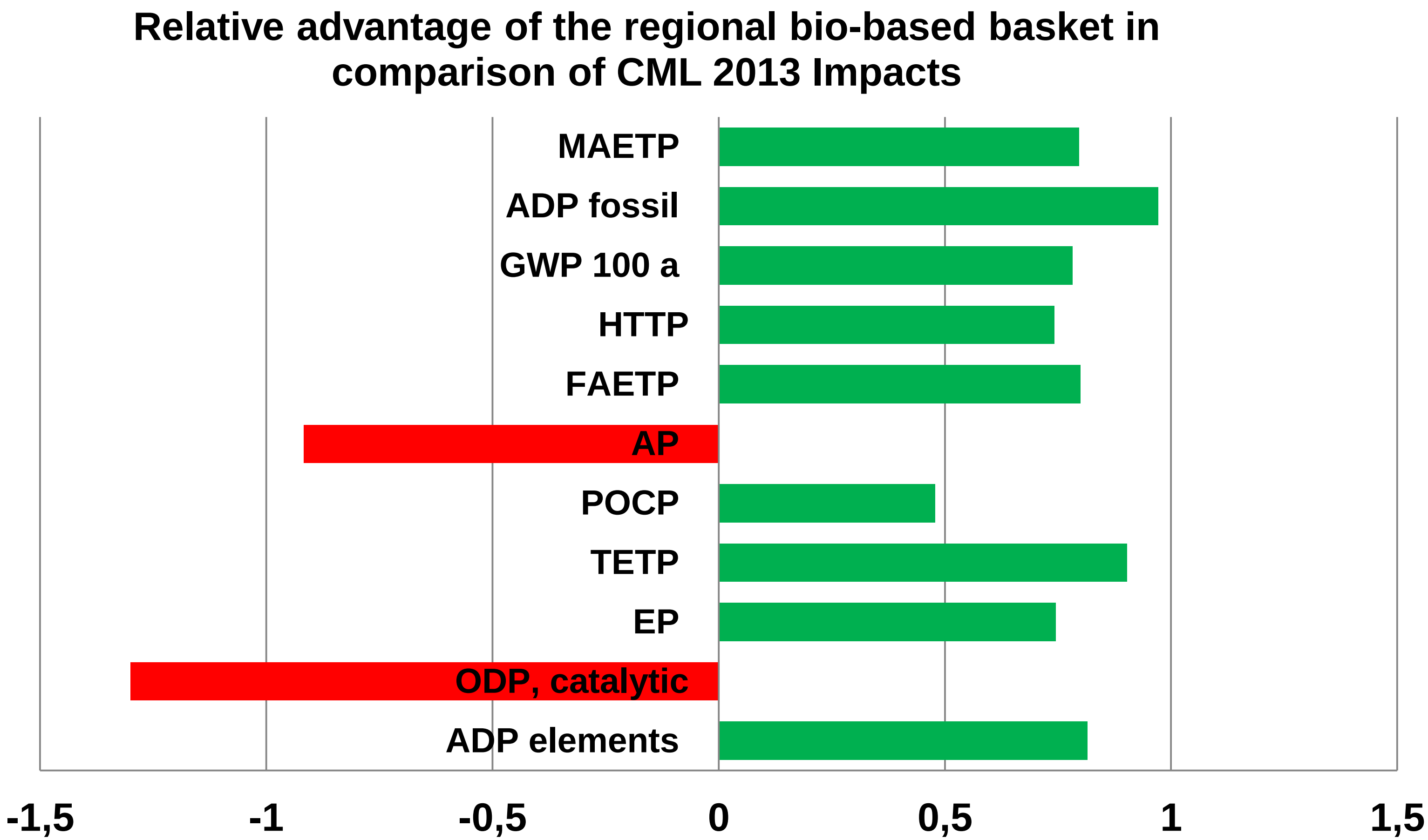
RESULTS OF THE LCA - ENVIRONMENTAL IMPACT:		
Parameter	Unit	A1-A3
Global warming potential	[kg CO2- Eq.]	0.634/2.27
Depletion potential of the stratospheric ozone layer	kg CFC11-Eq.]	5.14E-08
Acidification potential of land and water	[kg SO2-Eq.]	0.0104
Eutrophication potential	kg (PO4)3-- Eq.]	0.00594
Formation tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	-0.0004362
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.05E-06
Abiotic depletion potential for fossil resources	[MJ]	31.7
RESULTS OF THE LCA - RESOURCE USE:		
Parameter	Unit	A1-A3
Renewable primary energy as energy carrie r	[MJ]	18.1
Non renewable primary energy as energy carrier	[MJ]	37.6
Use of net fresh water	[m³]	1.66
RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES:		
Parameter	Unit	A1-A3
Hazardous waste disposed	[kg]	0.00000947
Non hazardous waste disposed	[kg]	3.730
Radioactive waste disposed	[kg]	0.0017

4. Results (I): Varying weighted average of aggregated life cycle impacts



Ø GWP
$= 0{,}7\ t\ CO_{2\text{-equiv.}}/t$

4. Results (II): Comparative LCA of the regional product basket



ADP elements: Abiotic depletion of elements [kg Sb-equiv.]
EP: Eutrophication potential [kg Phosphat-equiv.]
TETP: Terrestrial ecotoxicity potential [kg DCB-equiv.]
POCP: Photochemical ozone creation potential [kg Ethen-equiv.]
AP: Acidification potential [kg SO2-equiv.]

HTTP: Human toxicity potential [kg DCB-equiv.]
GWP 100 a: Global warming potential [kg CO2-equiv.]
ADP fossil: Abiotic depletion of fossils [MJ]
MAETP: Marine aquatic ecotoxicity [kg DCB-equiv.]
FAETP: Freshwater aquatic ecotoxicity potential [kg DCB-equiv.]

4.Results (III): Comparing cumulated resource use over time, decoupling and limits to growth

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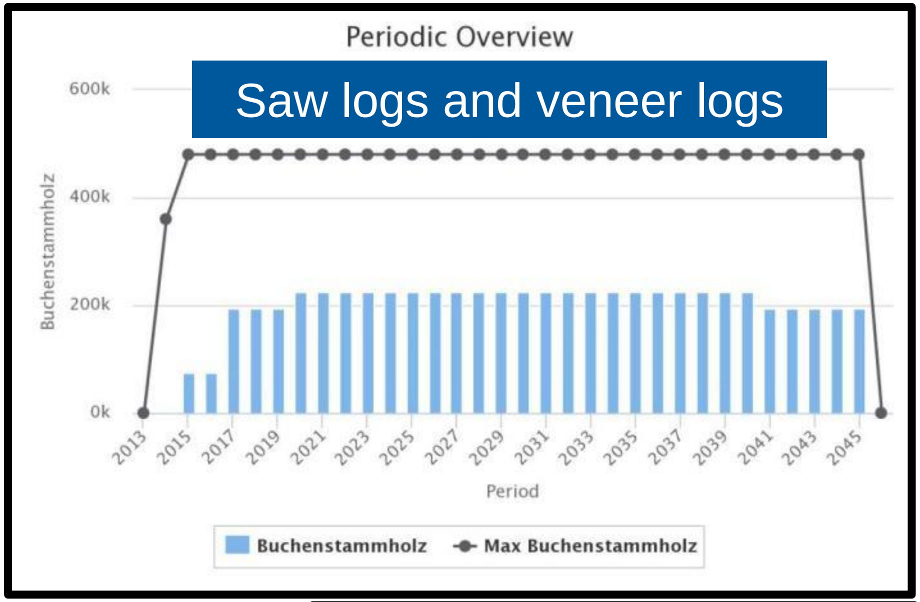
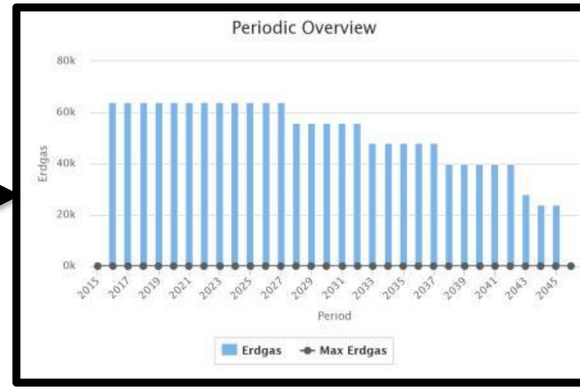
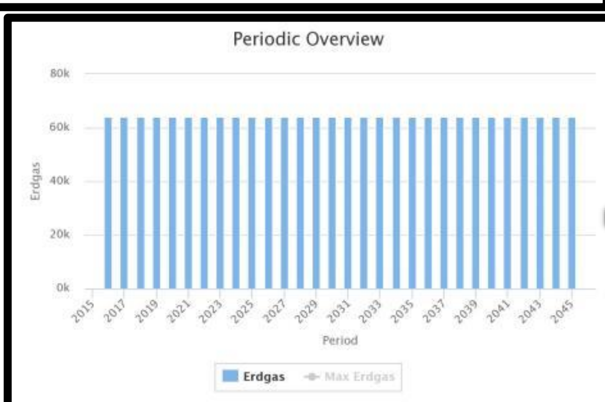
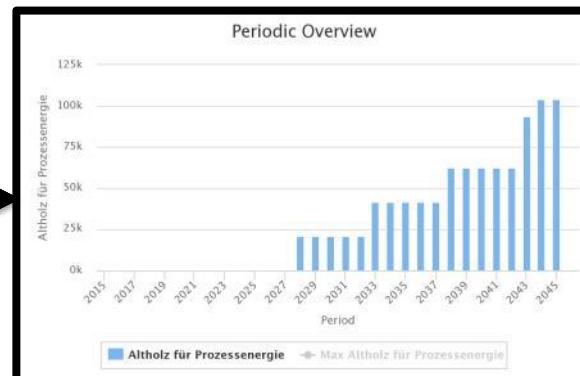


Saw logs and veneer logs

Substituting Natural Gas with biogenic heat





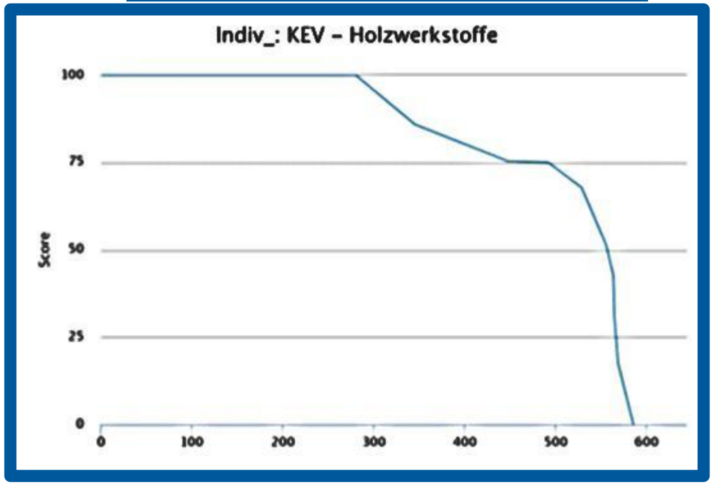


Use of Natural Gas

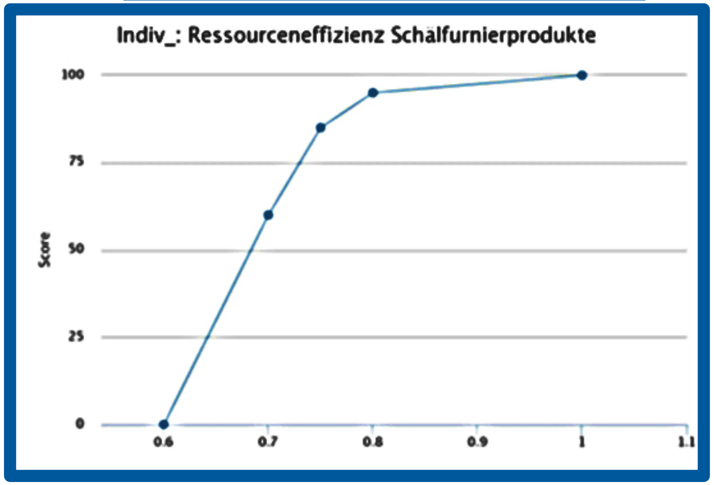
4. Results (IV): Benchmarking and definition of utility functions

Individual chains

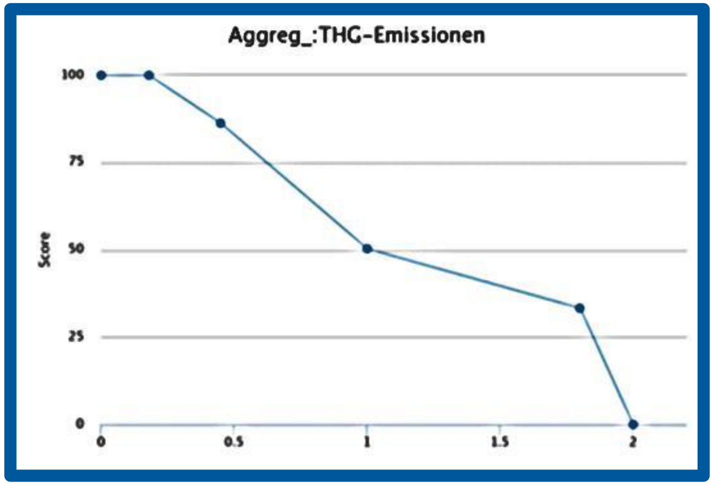
Min.

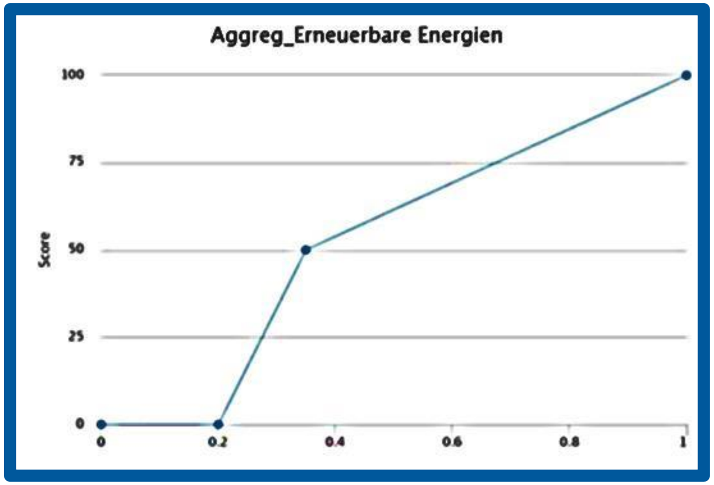


Max.

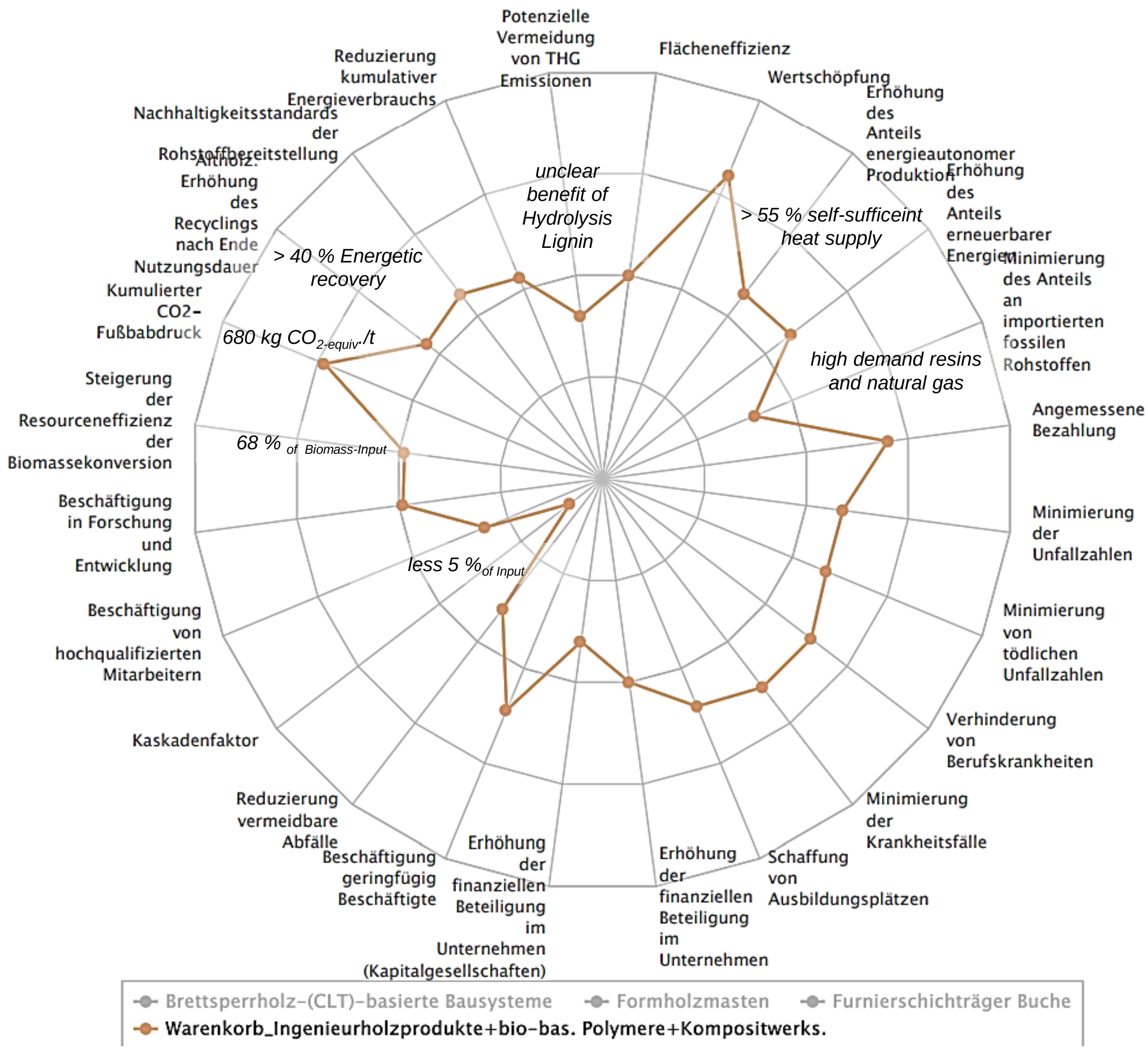


Aggregated networks





4. Results (V): Keeping indicators and product baskets on track of the radar



5. Conclusions (I): Capabilities of the monitoring tool

Single production systems can be evaluated as well as aggregated multi-product systems.

Resource flows can be traced and allocated to projects over time.

Specifying an "ideal " path towards more sustainable regional resource conversion and tracking progress in achieving it.

Aggregation of sustainability metrics for biorefinery concepts and sLCA was realized and embedded into assessment scenarios.

5. Conclusions (II): Areas of applications and potential users of the tool

R&D pipeline mgmt. → Time and resource constraints can be set and performance indicators be adjusted

Benchmarking → Comparing products from partners vs. global competitors as well optimized scenarios for cooperation

Reporting → Communicating progress in sustainable use and conversion of regional biomass resources

Regional councils → Exposing options for sustainable growth and cooperation within bioeconomy regions

Network managers → Bringing the success stories of innovation and cooperation onto a single dashboard

Plant managers → Coordinating efforts for horizontal and vertical integrations of their supply chains with other plant managers

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