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PERFECOAT/CHAMPION final stakeholder Event

Environmental and Social Sustainability Assessments

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under grant agreement No 887398. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio Based Industries Consortium.

Content

Environmental assessment

in the CHAMPION project

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Life Cycle Assessments,
Sustainability, Chemistry

Social Sustainability assessment

in the PERFECOAT project

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Innovation and sustainability transitions, social sustainability and impact assessments

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Circular High-performance Aza-Michael Polymers as Innovative materials Originating from Nature

CHAMPION circular bio-based polymers

Environmental Sustainability

Ángel Puente | angel.puente@nova-institut.de | 24.05.2024

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Bio-based Industries Consortium

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Environment

Economy

Society

Sustainability in CHAMPION

CHAMPION circular bio-based polymers

Objectives

- Increase **environmental** (health & safety) and **economic performance** of the targeted polymers by establishing an innovative, cost-effective testing strategy to rapidly evaluate toxicological safety issues of candidate monomers, and polymers
- Increase overall **resource efficiency** and reduce **greenhouse gas emissions** for the targeted applications by demonstrating sound End-of-Life options (biodegradation, anaerobic digestion and/or chemical recycling) for each lead candidate, fitting with the **Circular Economy**
- Evaluate in **environmental, social and economic** terms possible industrial-scale production processes of the most advanced bio-based polyester candidates, **benchmarked** against the conventional petrochemical material they will replace

Let's focus on environmental sustainability

How to measure Environmental Sustainability?

Multicriteria assessment

Different System Boundaries Perspectives

Different Methods (& KPIs) Available

Quantitative / Qualitative

Single indicator	Few indicators	Multicriteria

Accuracy →

Specificity →

Data requirements →

Complexity →

Green metrics

$$Atom\ economy = \frac{\Sigma\ molar\ mass\ products}{\Sigma\ molar\ mass\ reactants}$$

$$E - factor = \frac{\Sigma\ mass\ of\ waste}{\Sigma\ mass\ of\ products}$$

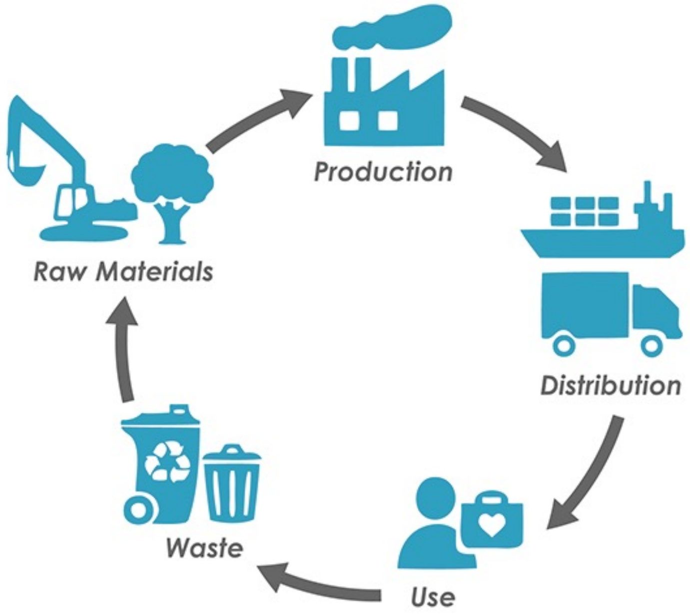
Life Cycle Assessment

- Method to assess the **potential environmental impacts** of a product or service throughout its entire (cradle-to-grave) or partial life cycle (e.g. cradle-to-gate)

- Internationally standardised method under **ISO 14040/44**

  (ISO 14067 for Carbon Footprint of a Product – CFP –)

- LCA assesses environmental impacts covering climate change, resource use and impacts on humans and ecosystems



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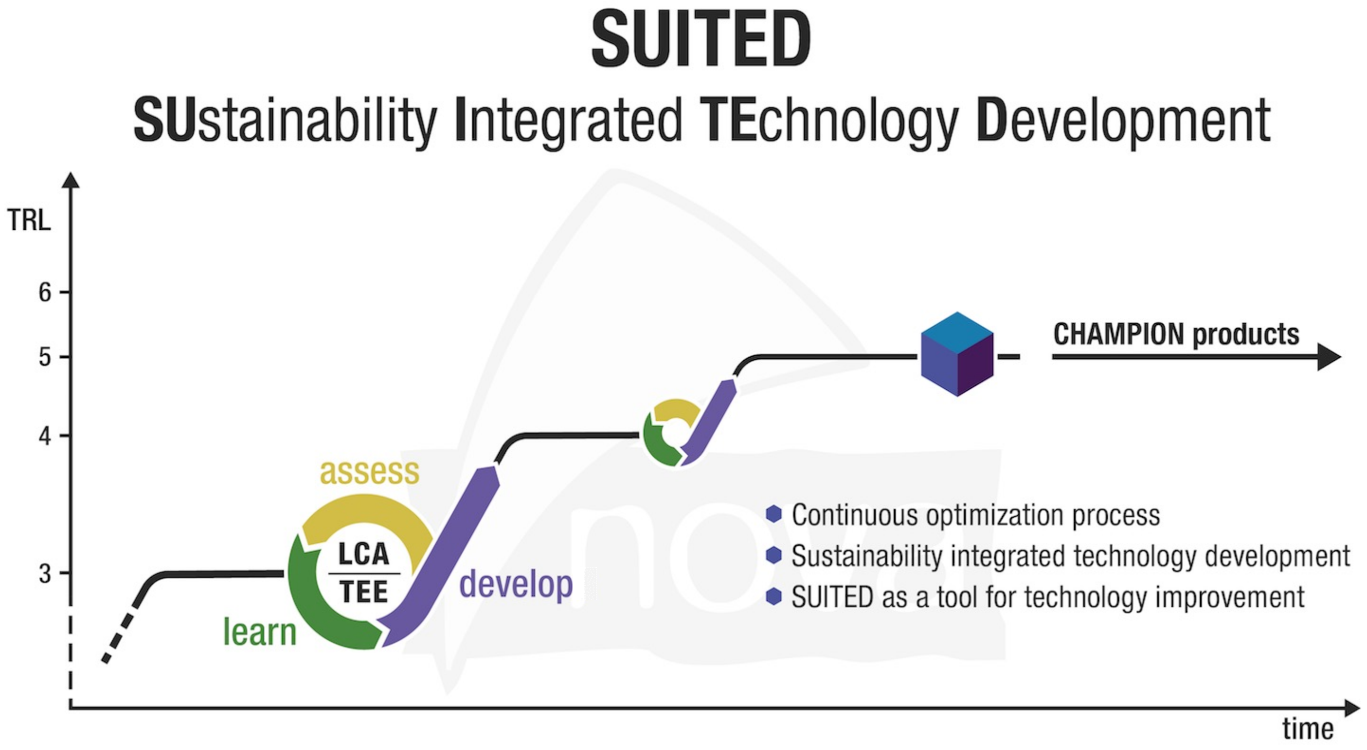
Role of LCA in CHAMPION



- Support selection of most promising candidates
- Guide process development – Identification of hotspots
- Reference point for benchmarking – fossil & bio-based counterparts

Life Cycle Assessment

Potential pitfalls of LCA

- **Wrong goal and scope** definition can lead to wrong messages
- Inventory is often limited by **lack of availability of data**
- **Different methodological choices**: cradle-to-gate/grave, allocation (interpretation necessary)
- **Disregard of actual application & performance** – misleading comparisons
- **Comparison** without typical efficiency improvements, integration
- Comparison of **new technologies vs. at scale**, mature incumbents
- LCA cannot answer all questions related to **sustainability**

Bio-based as Renewable Carbon Source

CHAMPION circular bio-based polymers

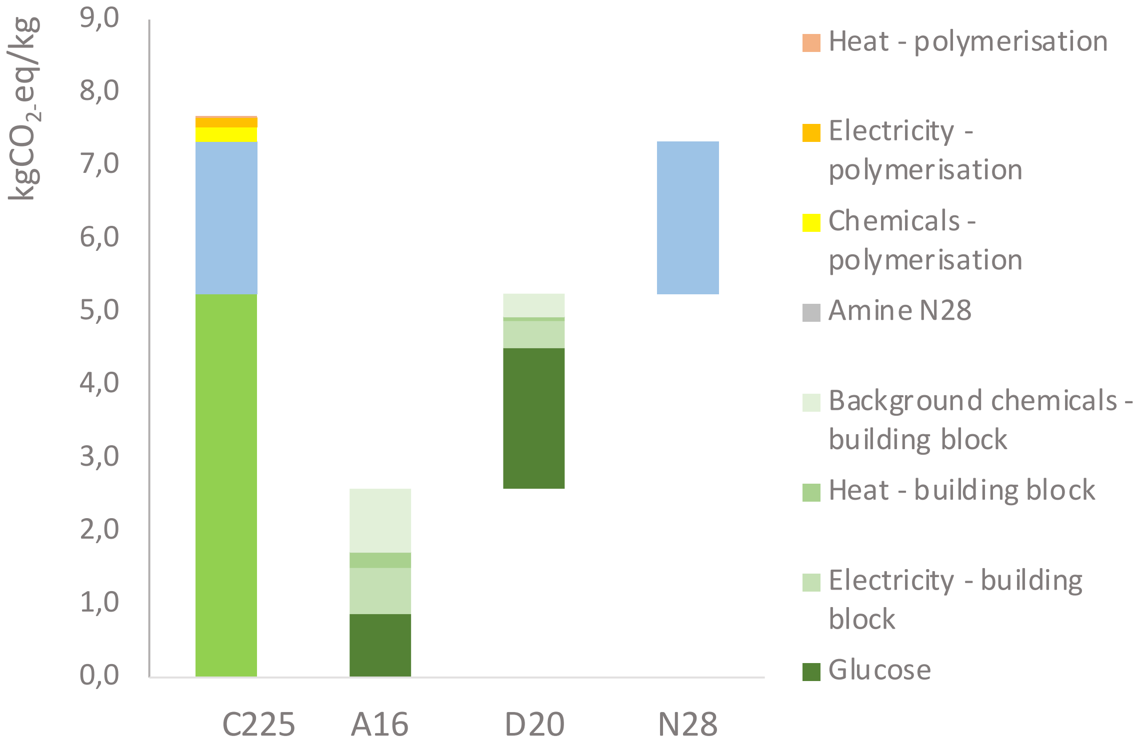
Representative CHAMPION novel candidates

Code	Bio-based platform	Feedstock	Bio-based content (%)
Diacid/Diesters			
A16a	Glucose	Maize	**79**
Diols			
D18a	Glucose	Maize	**100**
D20a	Glycerol	Rapeseeds	**100**
Amines			
N3a	Ethanol	Sugar beet	**72**
N6a	Furfural	Wood chips	**68**
N7a	Furfural	Wood chips	**69**
Prepolymers			
P46	Glucose, glycerol	Maize, rapeseeds	**72**
Polymers			
C364a	Glucose, glycerol, ethanol	Maize, rapeseeds, sugar beet	**72**
C225a	Glucose	Maize	**45**

- High bio-based content
- Available bio-based platforms and feedstocks

Environmental assessment

Contribution analysis of a representative CHAMPION new polymer



- **Bio-based feedstock** significant contribution to the impacts
- Carbon Footprints are reduced if temporary **biogenic carbon** storage is accounted
- Use of **chemicals & processing energy** are significant hotspots
- 5-10% reduction potential by switch to 2G feedstocks
- The use of Renewable Energy during manufacturing would be more relevant
- 30% GHG reduction potential if renewable electricity is used

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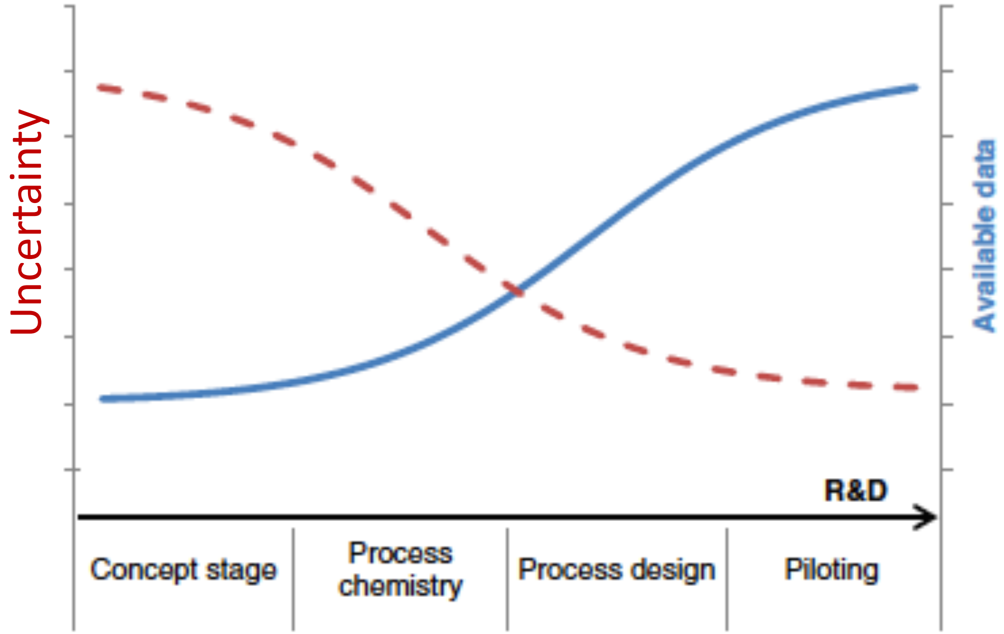
Limitations

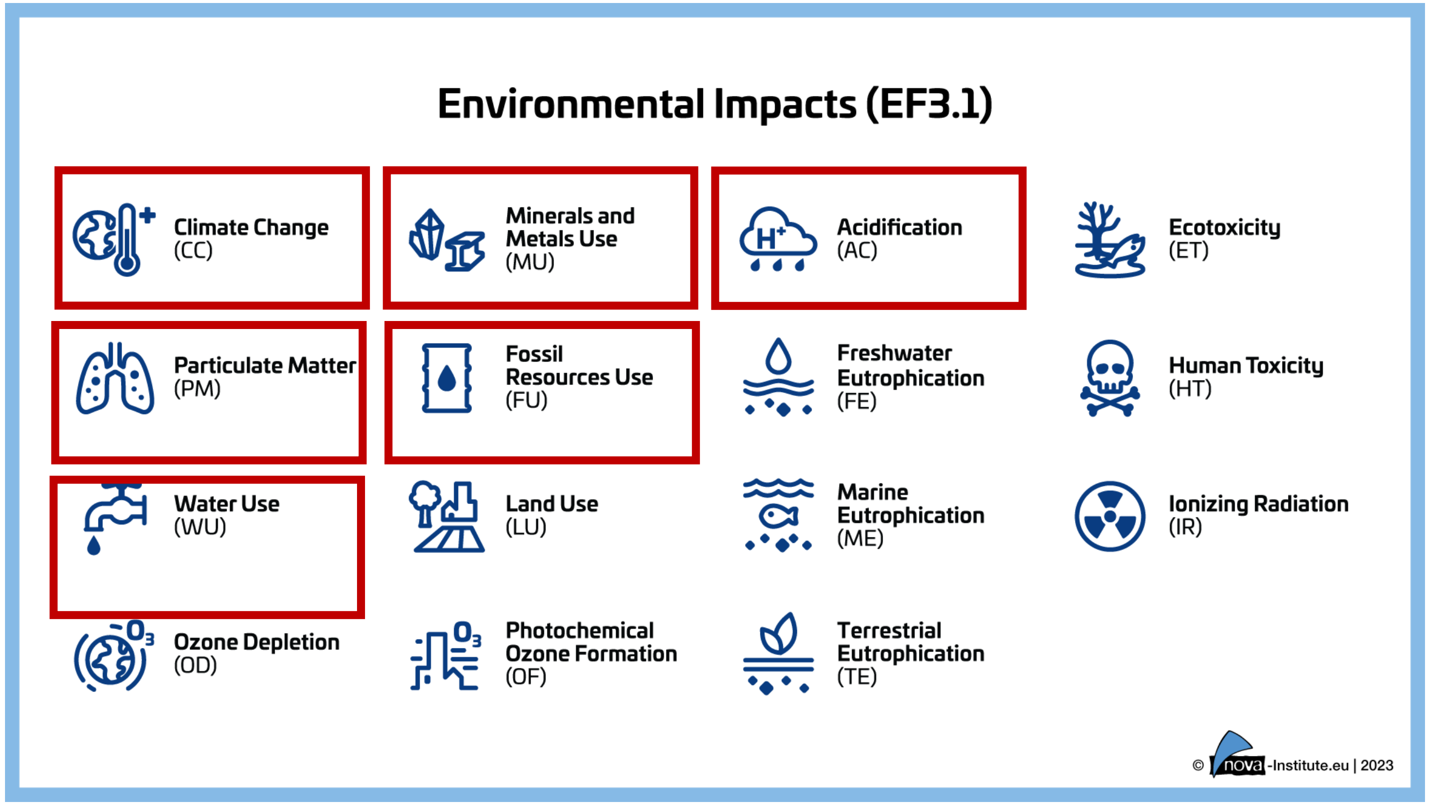
Challenge:

Early Stage development



- High uncertainty associated to low TRL projects
- Absolute figures have little informative value
- Comparisons and benchmarking are only illustrative
- EoL options to target circularity (uncertainty)

Environmental assessment



Identification of most relevant impact categories

- Based on EF 3.1 normalisation & weighting factors
- > 5% threshold

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Benchmarking

- A fair comparison need a correct definition of the **functional unit** in which the **performance** is taken into account
- In general, **bio-based diacids and diol**s have a lower potential carbon footprint and demand of fossil resources than fossil-based counterparts
- Bio-based diacids and diols generally perform worse than petrochemical counterparts when in **ecotoxicity, acidification and particulate matter impacts.** This is mainly due to the emissions associated to agricultural activities
- **Bio-based amine** with complex multi-step synthesis, including the use of several conventional chemicals have in general significantly **higher environmental profiles** in comparison to the petrochemical.

Take-aways

- Sustainability assessments are **multi-criteria analysis**
- We need to **considerer Sustainability during development** → It'll be otherwise too late!
- High uncertainty is present in early stage assessment → focus on hotspots and scenario analysis rather than on absolute figures or comparison
- Sustainability will highly **depend on establishing appropriate supply chains** for new materials (feedstock type and supply, waste management...)

High Performance Bio-based Functional Coatings for Wood and Decorative Applications

Social sustainability of biobased solutions in Perfecoat:

Social acceptance and social impacts study

24.04.2024, Brussels, Assiya Kenzhegaliyeva

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Objectives

Identify and assess the potential social impacts of the new solutions, with a special focus on social acceptance and perceived transition potential.

Nordic Ecolabelling

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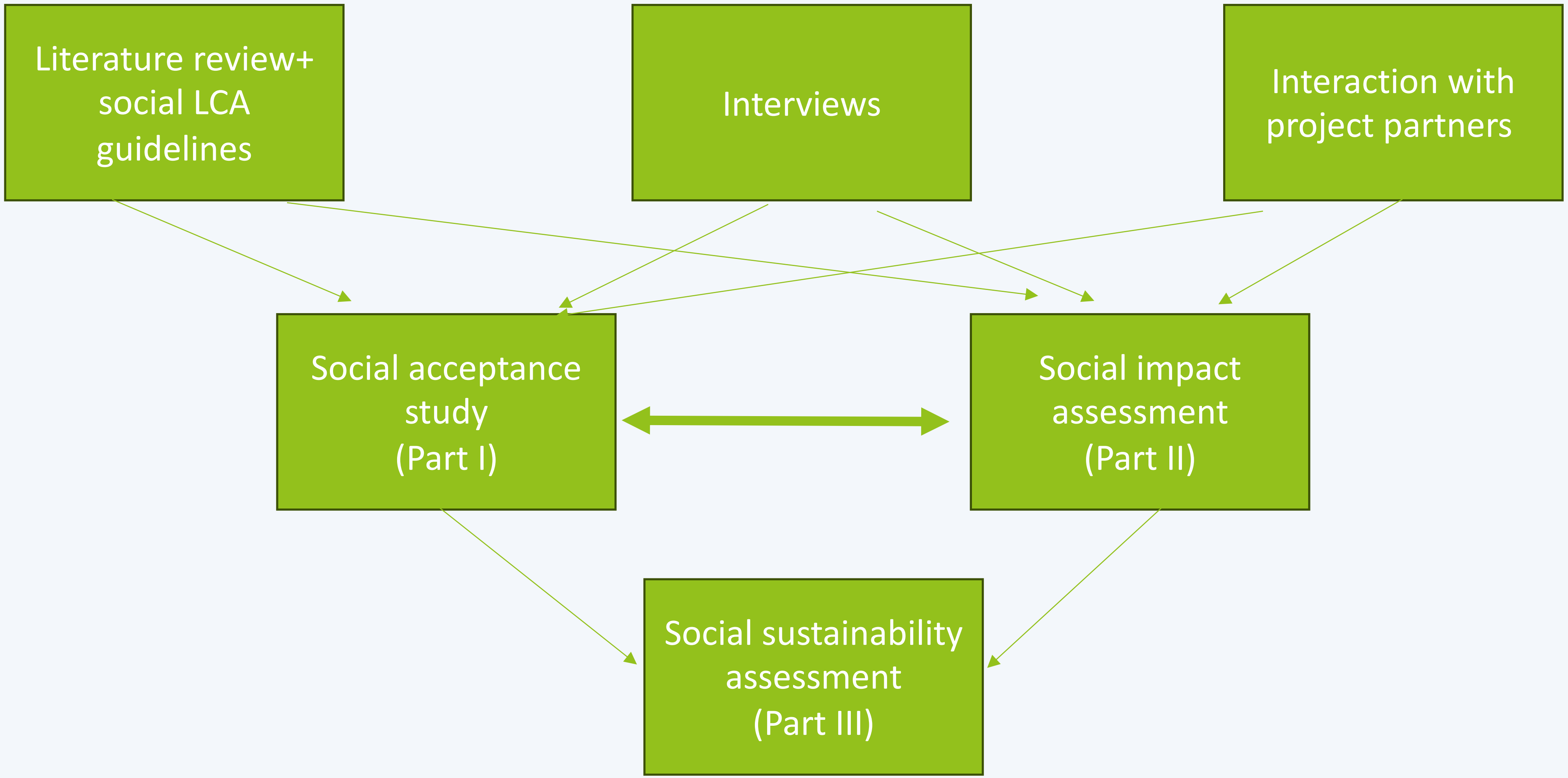
Social sustainability: methodology



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Social acceptance (Part I): preliminary results

- For the **socio-political acceptance**:
  - Existence of drivers at an overarching policy level (e.g., EU Green Deal, bioeconomy strategy and circular economy action plan of the EU, etc.)
  - Lack of direct incentives, sustainable innovations is up to the industry actors.
  - Eco-labels can influence the acceptance among end-users, however, customers tend to lack knowledge about the meaning of those (462 different labels in the market!) – Need of harmonized reporting requirements.

Social acceptance (Part I): preliminary results

- As to **market acceptance**:
  - Increased importance to document sustainability
  - Lack of explicit and specific sustainability targets, to guide suppliers. The exception is IKEA (aim to achieve 50% of bio-based components by 2030) → firm requirements on suppliers.
  - High costs and prices constitute a major barrier. Increased willingness to pay, if the products can be branded as 'luxury products’.
  - Users still need to be convinced on several coating functionalities. Smell, colour fading, indoor air quality and associated risks are also barriers.
  - For the value chain actors, the acceptability of new, bio-based solutions depends on their compatibility with the existing plant and production processes → radical process changes, costly and time-consuming.

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Social acceptance (Part I): preliminary results

- As to **Community acceptance**:
  - Land use and the risk of indirect land use change is a major topic.
  - Reliable supply of sustainably produced biomass is necessary, and some sources of biomass that compete with food production and/or threaten biodiversity (for example, palm oil).
  - Wish to localize supply chains and have more transparency regarding raw material origin but challenges due to global production networks.
  - When it comes to human rights and labour rights, few of the respondents had concerns as they operate in Europe. Perception that these issues are addressed adequately through compliance with existing rules and regulations.
  - Some key actors, such as IKEA, pose specific requirements regarding human rights and ethical production, while others have less focus.

Social impact assessment (Part II): categories emphasized by partners

Value chain segment	Stakeholder category	Impact category	Impact subcategory
Biomass production and collection	Local community	Contribution to local economy	contribution to economic development
			contribution to employment
	General society	Food security	food security
Biomass processing	Local community	Contribution to local economy	contribution to economic development
			contribution to employment
Final coating manufacturing	Workers	Health and safety	health and safety of workers
	Local community	Contribution to local economy	contribution to employment
Use	Consumers	Health and safety	health and safety of end-users
		Social acceptance	feedback mechanisms
			transparency
End-of-life	Local community	Health and safety	health and safety of local community

Further steps

- Finalize the social acceptance study
- Complete data collection for the social impact assessment
- Analyse and interpret the results using reference scale (from -2 to +2)
- Validate the results with project partners and other stakeholders
- Incorporate the validated results into the integrated sustainability assessment of the final formulation

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Final reflections

- Few studies on social sustainability of the biobased coatings
- Challenging data access
- Complex value chains
- Early stage development
- Increasing focus on social sustainability and sustainability in general

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Thank you for your attention !

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CHAMPION circular bio-based polymers

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