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Identifying Suitable Indicators to Assess Supply Risks along the Supply Chain

74th Swiss LCA Discussion Forum: LCA in the NRP 73

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Outline

- Introduction
- Methods and Materials
- Results and Discussion
- Conclusion
- References

Introduction

Project Context

Open Assessment of Swiss Economy and Society (OASES)

Objective: Significant improvement of social, economic and environmental impact assessment of Swiss production and consumption



Final outcome: Complete sustainability assessment of Swiss production and consumption

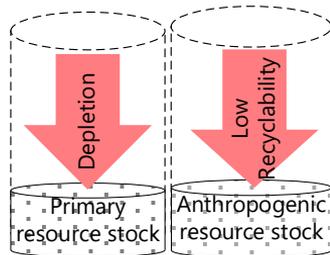
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Introduction

Reasons for supply risk

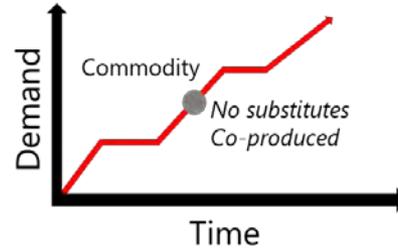
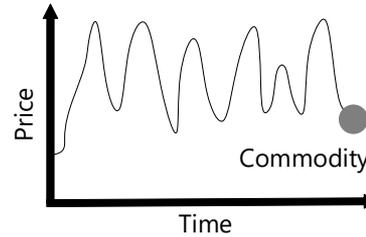
Technical



Political



Economic



Environmental & Social



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Resource stocks

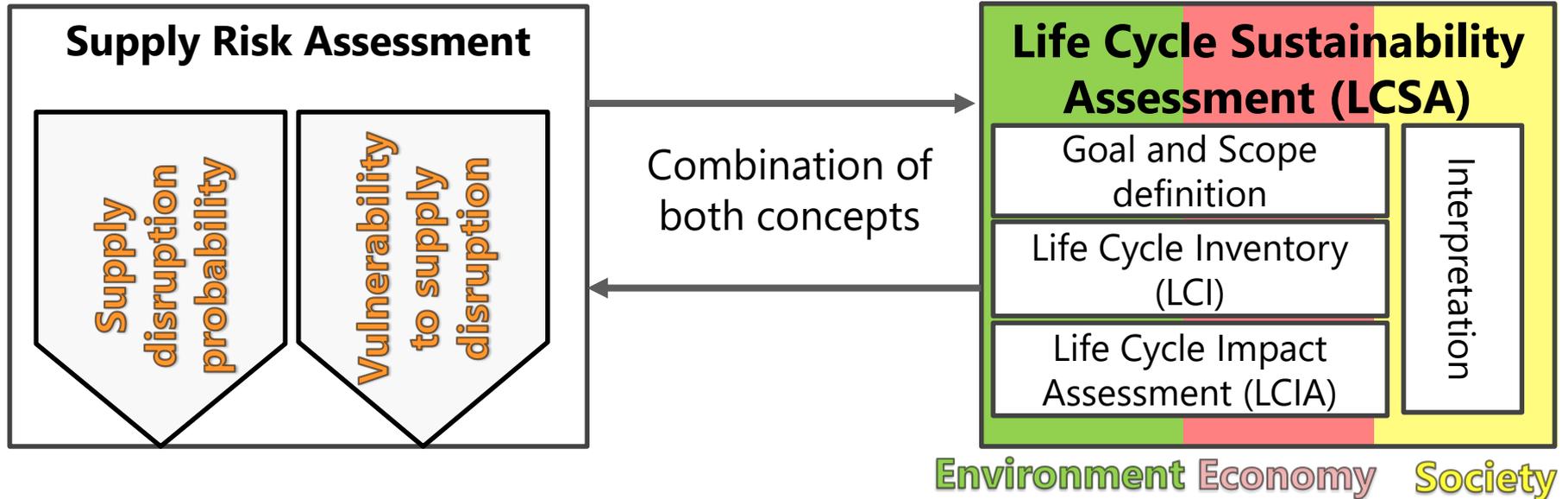
Supply chain

Use

Introduction

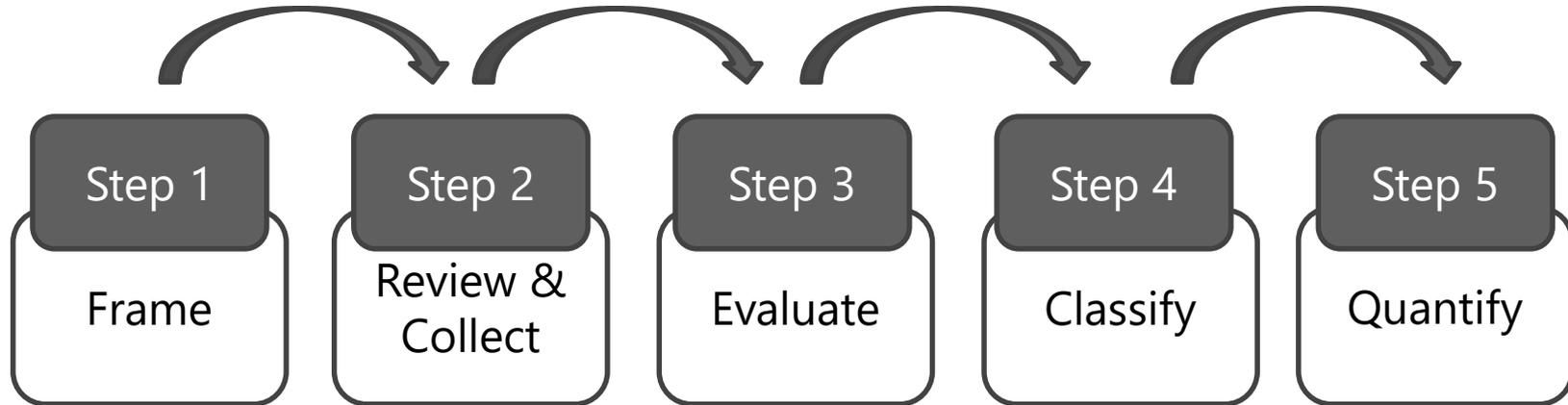
Objective

Identify suitable indicators to assess supply risks along the entire supply chain



Method and Materials

Five step approach



Results and Discussion

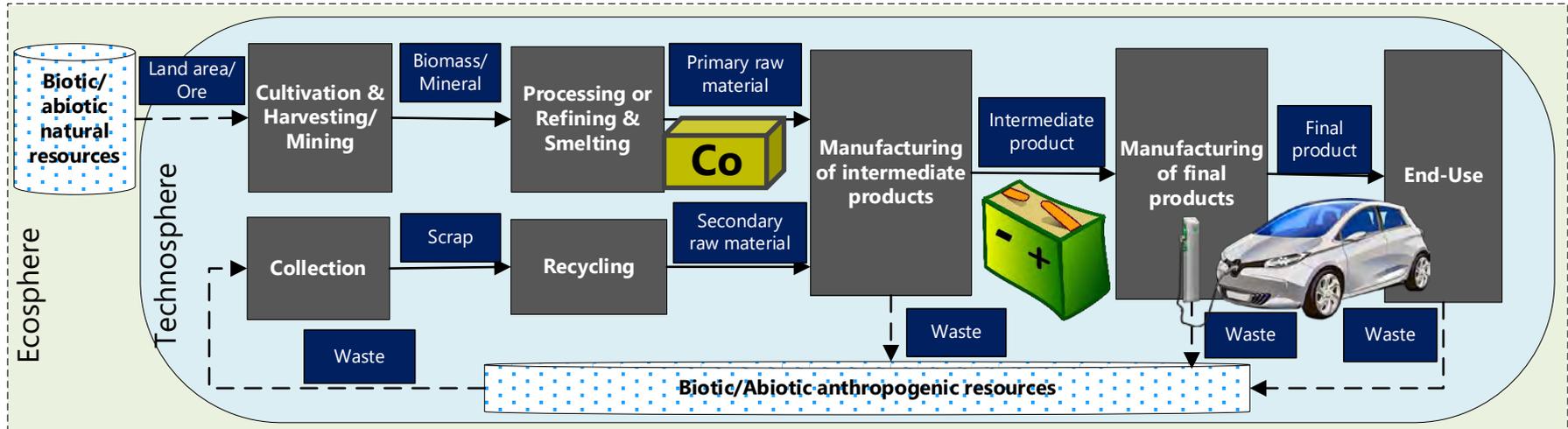
Frame (1)

- General objective: Identify need for mitigation of risks along the supply chain
- Specific objective: Assess supply risks in the supply chain of cobalt (Co) used in batteries of electric cars

- System scope: Electric car purchased in Switzerland
- Functional unit: One electric car
- System boundary: Supply chain of cobalt (Co) used in batteries of electric cars
- Impact category: Supply risk due to political instability
- Time horizon: 5 years



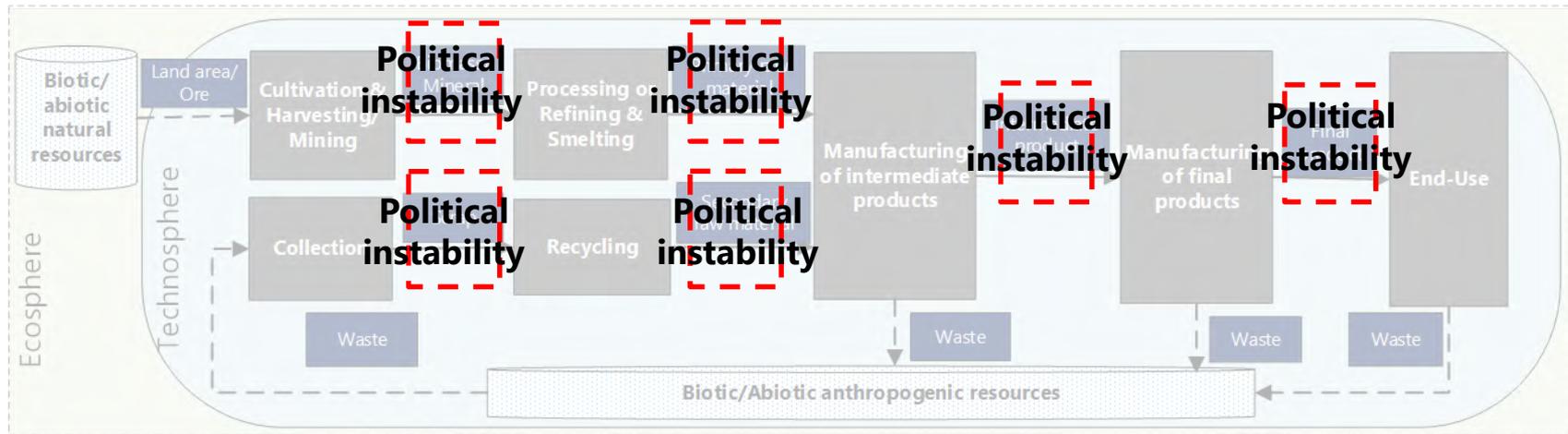
Results and Discussion Frame (2)



- Compile and quantify physical and economic inventory flows throughout the supply chain

Results and Discussion Frame (3)

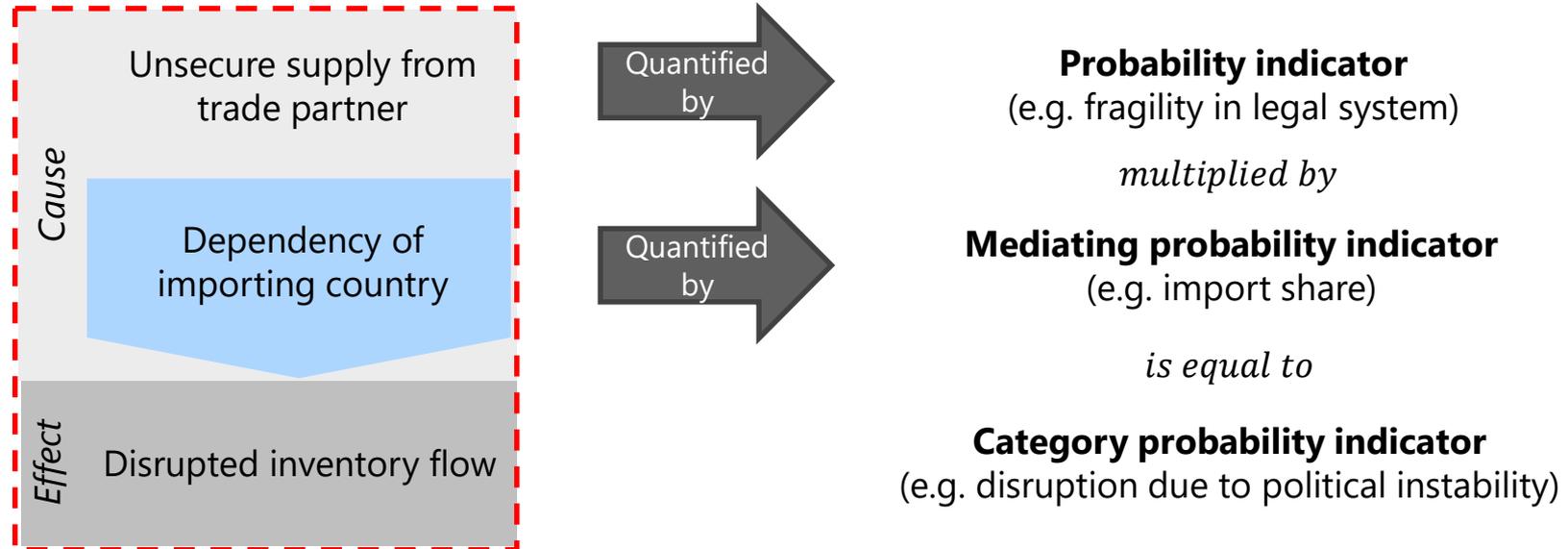
Impact category: Supply risk due to political instability



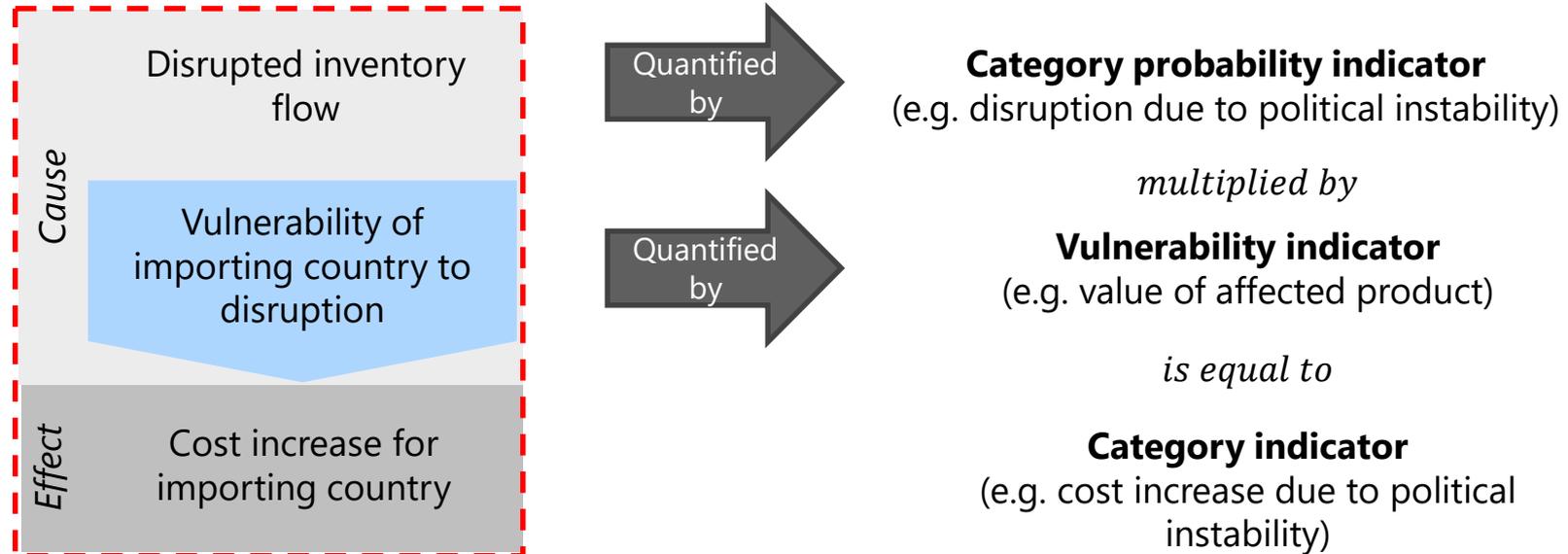
Results and Discussion

Frame (4)

Cause-effect chain for supply disruption probability:



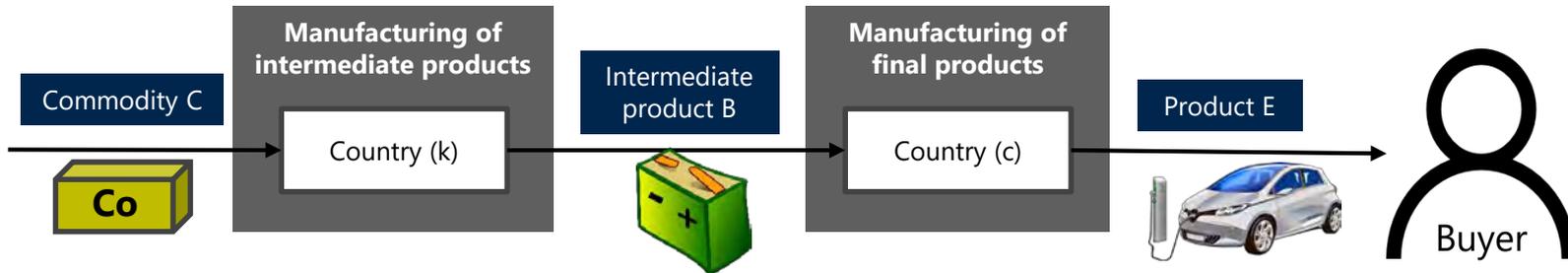
Cause-effect chain for vulnerability to supply disruption:



Results and Discussion

Frame (5)

Calculation of category indicator result for the example of political instability in the supply of Intermediate product B:

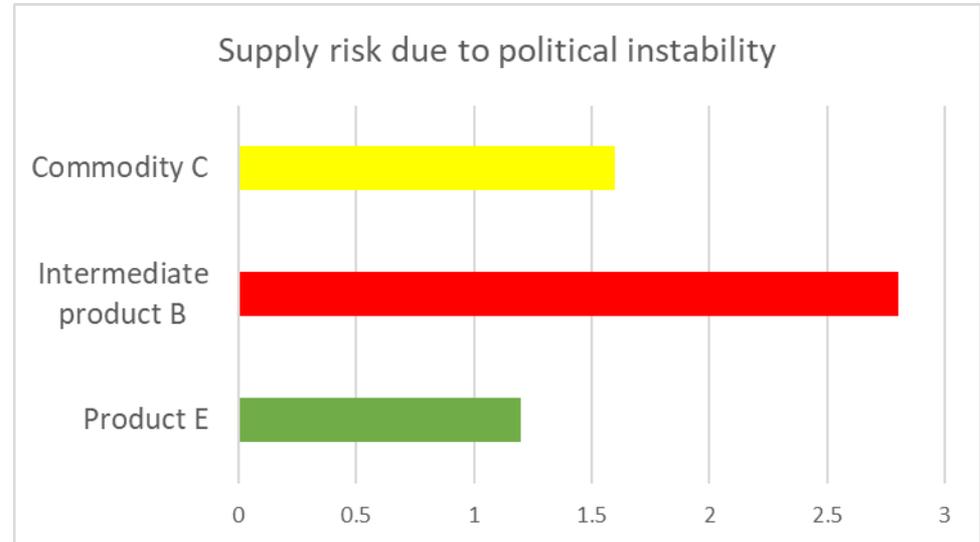


*Cost increase due to political instability $B,E,C =$
value added * fragility in legal system * import share * value of affected product*

Results and Discussion

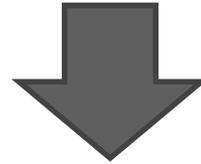
Frame (6)

- Identification of relative supply risk of commodities and (intermediate) products within the supply chain
- Identification of commodity or (intermediate) product flow with the highest need for risk mitigation



Review of:

- 53 individual supply risk methodologies
- additional (review) articles and reports



- Over 50 probability indicators
- Over 20 mediating probability indicators
 - Over 10 vulnerability indicators

Results and Discussion

Evaluate (1)

- Evaluating the relevance of impact categories for a supply risk assessment
- Evaluating the application of impact categories along the supply chain

Impact category	Category relevance		Category application*							
	Based on frequency	Based on literature	L/O	Wa	B/M	Sc	PR	SR	IP	FP
Supply risk due to political instability	high	moderate	not applicable	not applicable	applicable	applicable	applicable	applicable	applicable	applicable

*Abbreviations of inventory flows along the supply chain: L/O: Land area/Ore, Wa: Waste, B/M: Biomass/ Mineral, Sc: Scrap, PR: Primary raw material, SR: Secondary raw material, IP: Intermediate product, FP: Final product

Category relevance:



high



moderate



low

Category application:



applicable



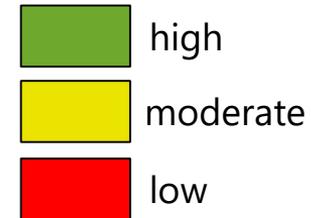
not applicable

Evaluate (2) – on-going work

- Evaluating the suitability of indicators in view of an integration in the established framework:

Indicator	Indicator suitability				
	Indicator adequacy	Time horizon*	Data utilization	Commodity scope	System scope**
Fragility in legal system	high	s	Quantitative data	Biotic and abiotic	
Import share	high	s			
Value of affected product	high	s/m			p, e, c

Indicator adequacy:
(the degree to which the indicator covers and contributes to the required topic)



*s: short-term, m: medium term, l: long-term; **p: product-level, e: economy-level, c: company-level

Classify – on-going work

Evaluation results reveal that...

- 8 probability indicators ('fragility in legal system', 'Trading across Borders Indicator', 'historical price volatility', 'recycling share', 'raw material/energy consumption', 'child labor, excessive overtime & high conflicts', 'annual loss through floods, tsunami, earthquake', 'CO2 growth rate, tree cover loss, terrestrial/marine protected areas')
- 3 mediating probability indicators ('Kwoka's Dominance Index', 'import share', 'domestic supply') and
- 3 vulnerability indicators ('value of affected product', 'demand to supply ratio', 'price sensitivity')

...are suitable for an integration in the established LCSA framework.

Results and Discussion

Quantify (1)

- Data coverage of the constitutive indicator(s) of each indicator by the LCA Databases, ecoinvent, EXIOBASE, Social Hotspot Database:

Evaluation scheme for information content of databases

Commodity/product-related information

precise
moderate
imprecise

Supply chain information

precise
moderate
imprecise

Geographical information

precise
moderate
imprecise

Actuality and quality of information

high
medium
low

Parameter uncertainty

available
not available

Indicator	Constitutive indicator	ecoinvent		EXIOBASE		Social Hotspot Database	
		AI	Co	AI	Co	AI	Co
Fragility in legal system	Political instability indicator	-	-	-	-	moderate	moderate
Import share	National import amount	precise	-	precise	imprecise	-	-
	Total import amount	precise	-	precise	imprecise	-	-
Value of affected product	National apparent consumption	-	-	precise	moderate	-	-
	National demand amount for specific commodity	-	-	imprecise	moderate	-	-
	National value added by specific commodity	-	-	-	-	-	-

Conclusion

Quantify (2)

■ How can missing data be acquired?

Indicator	Constitutive indicator	Additional potential data sources
Fragility in legal system	Political instability indicator	e.g. Worldwide Governance Indicators
Import share of trade partners	National primary commodity import amount	e.g. UN Comtrade, Material flow analysis studies, industry reports
	Total primary commodity import amount	
Value added of affected product	National apparent consumption	
	National demand amount for specific product	
	National value added by specific product	e.g. OECD database, market or industry reports

LCSA framework to assess supply risks

- Integration of supply risk indicators into a Life Cycle Sustainability Assessment framework facilitates assessing supply risks along an entire supply chain.
- Assessing supply risks along the entire supply chain is especially relevant for products with long supply chains (such as electric cars).
- There is a need for data acquisition in LCA databases to support the supply risk assessment along the entire supply chain.
- On-going work strives at identifying indicators that allow for assessing potential technical, political, economic, social and environmental supply risks within an LCSA framework.

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Questions?



Thank you for your attention!

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