econsense

Forum for Sustainable Development of German Business

Technische Universität Berlin

A comprehensive approach to model abiotic resource provision capability in the context of sustainable development

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AGENDA

- INTRODUCTION
- FRAMEWORK AND METHODOLOGY
- RESULTS
- CONCLUSIONS AND OUTLOOK

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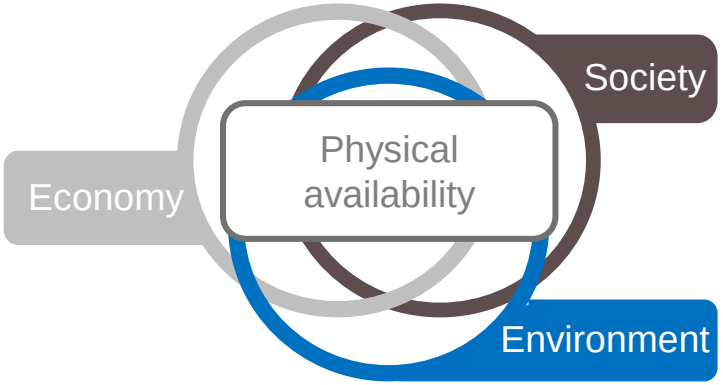
What needs to be secured?

- Functionality of materials → availability at a certain point in time (now or in the future)
  - need to sustain availability for future generations
  - need to sustain access to resources for current generations
- Resource provision capability rather than availability in nature → all dimensions need to be considered



→ From a one-dimensional approach to a multi-dimensional approach

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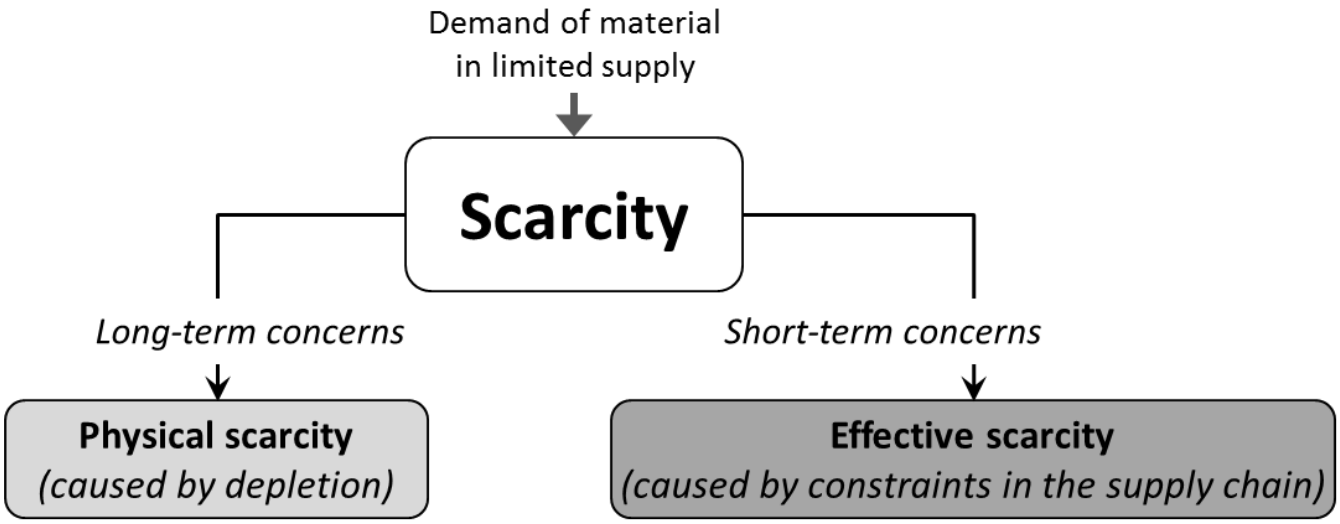
Framework: Forms of scarcity

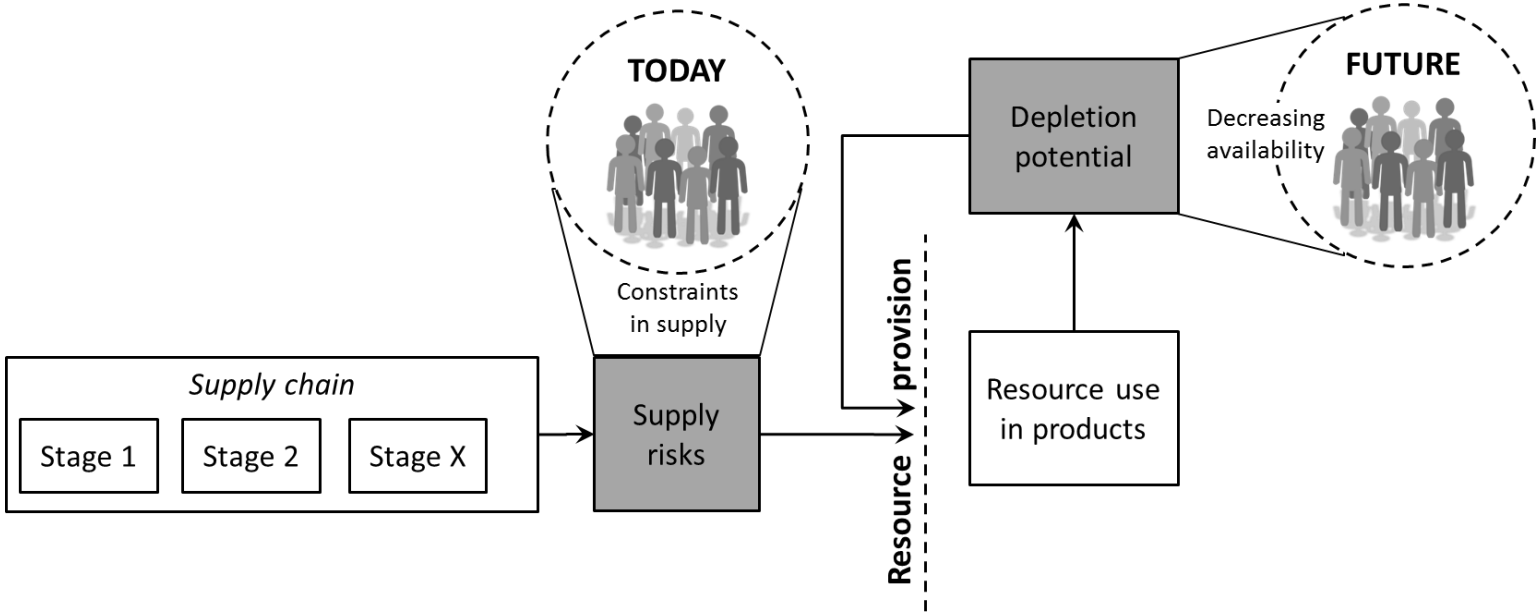


Physical and effective scarcity I

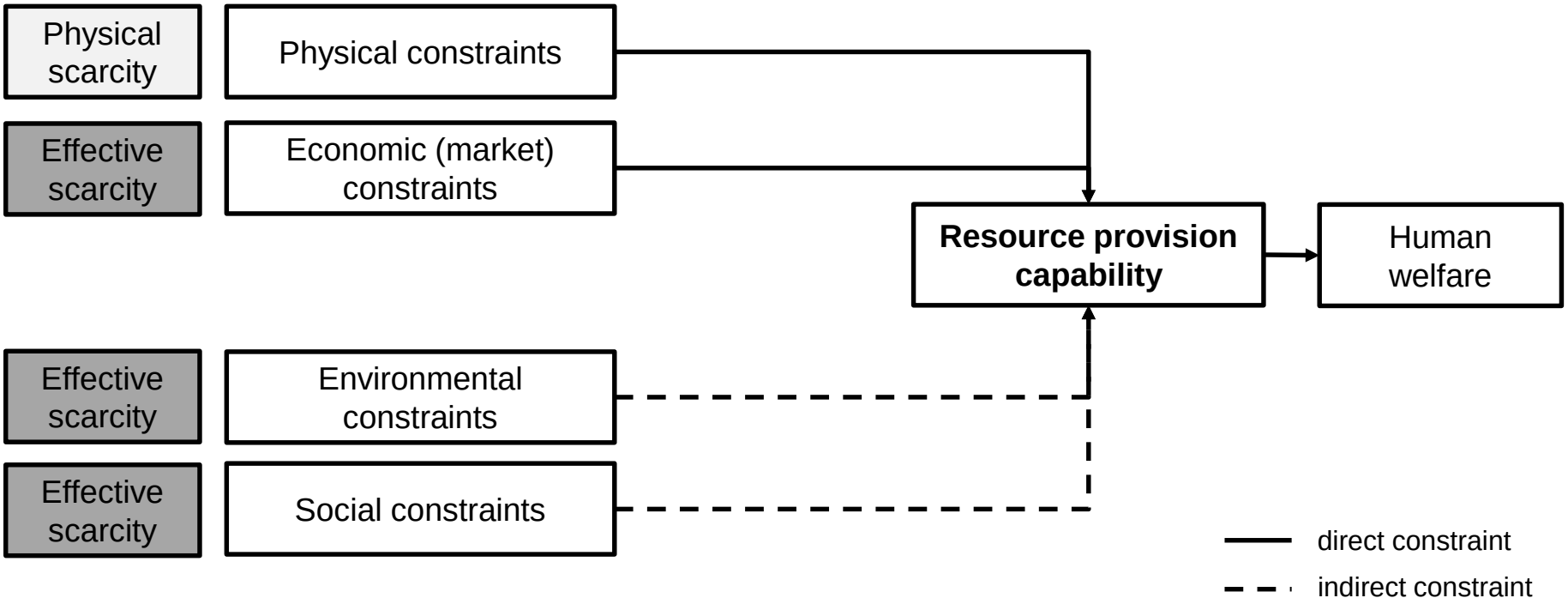
Physical scarcity		Effective scarcity
Problem: Depletion	⟷	Problem: Supply risk
Focus: Future generations	⟷	Focus: Current generations
Consequence of resource use today	⟷	**Effect on** resource availability today
Scope: resource stock	⟷	Scope: resource flows

Physical and effective scarcity II

- Depletion: consequences of resource use today
- Supply risks: effects of constraints in the supply chain on resource supply

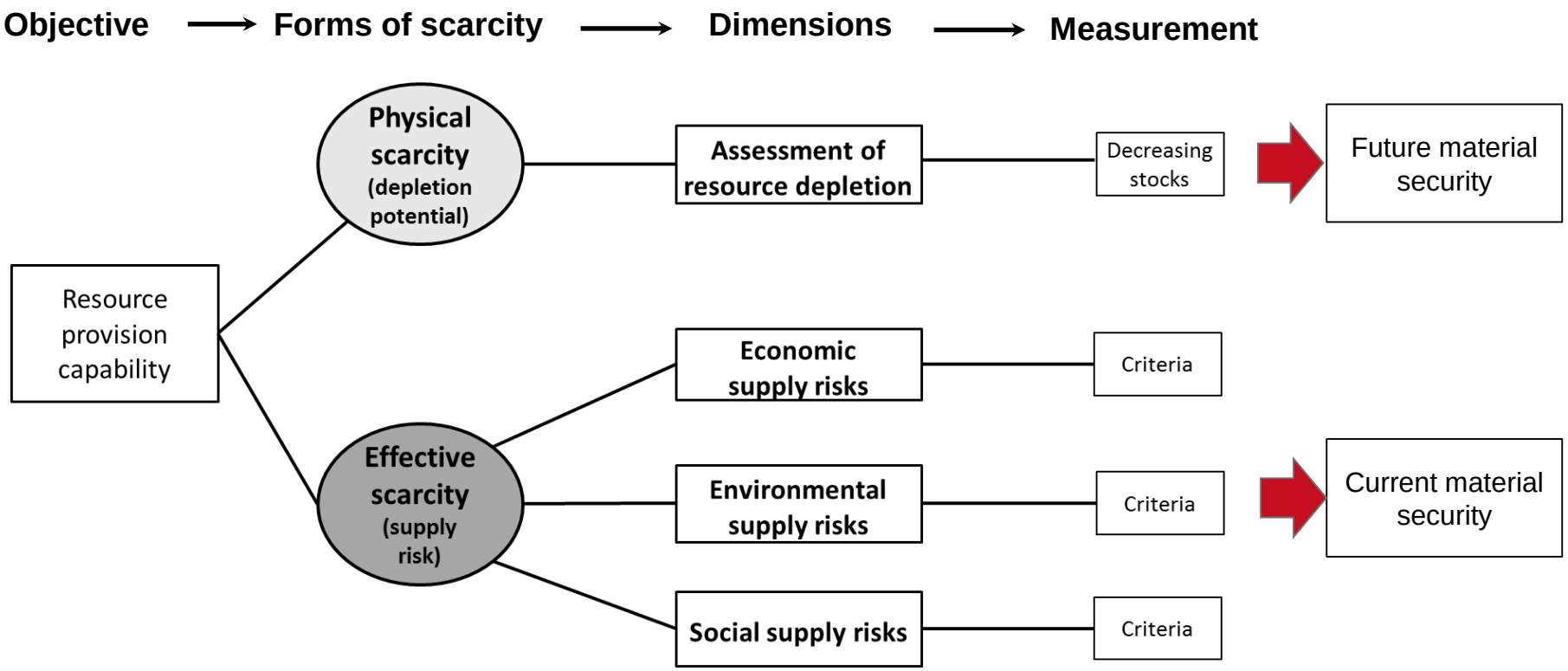


Framework: Dimensions of scarcity



Comprehensive analysis: methodological approach

- Physical **AND** effective scarcity need to be considered from a sustainability perspective



The assessment of resource depletion

- **Physical scarcity** of resources
  - decrease of resource stocks
  - considerations of depletion important for future material availability

- **Abiotic depletion potential** (ADP) - model is a good basis
  - but consideration of functional value rather than environmental availability
  - inclusion of all available stocks, including anthropogenic stocks

The assessment of supply risks

- **Supply risk** is a relative rather than absolute concept
  - determination from when certain situation becomes risk
  - inclusion of risk threshold

$$I_{i,j} = \left(\frac{\text{actual value}_{i,j}}{\text{threshold}_{i,j}} \right)^2$$

I = impact factor
i = resource
j = constraint

(Source: Müller-Wenk 1978; Frischknecht et al 2009)

- **Distance-to-target method**
  - application to the assessment of supply risk
  - exceedance of thresholds denotes risk to resource supply

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The economic resource scarcity potential (ESP) I

- Evaluation on a product level
  - identify hotspots
  - avoid risks, e.g. consideration of economic constraints in the design-phase
- Link to existing LCI data

Economic supply risks

- Market induced constraints due to geopolitical, political, technical and regulatory circumstances
- **Direct** effects on resource supply

→ Disruptions in the supply chain

Economic criteria

- Availability of reserves
- Concentration of production
- Concentration of reserves
- Company concentration
- Companion metals
- Use of recycled material
- Socio-economic stability
- Governance stability
- Demand growth
- Trade barriers

The economic resource scarcity potential (ESP) II

Application of the distance-to-target method to the different dimensions of supply risk

$$I_{ESPi,j} = Max\left\{\left(\frac{\text{indicator value}_{i,j}}{\text{threshold}_{i,j}}\right)^2;1\right\}$$

I = impact factor; i = material;
j = impact category

EXAMPLE:
Country concentration for material i

Indicator = Herfindahl index (HHI)

$$\text{Country concentration}_i = Max\left\{\left(\frac{HHI_i}{0.15}\right)^2;1\right\}$$

Economic resource scarcity potential (ESP)

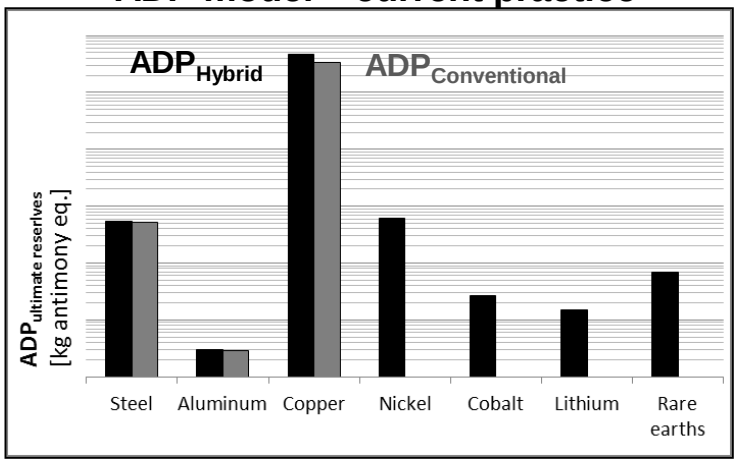
$$ESP_i = \prod_j \left(I_{ESPi,j}\right)$$

Testing the developed approach

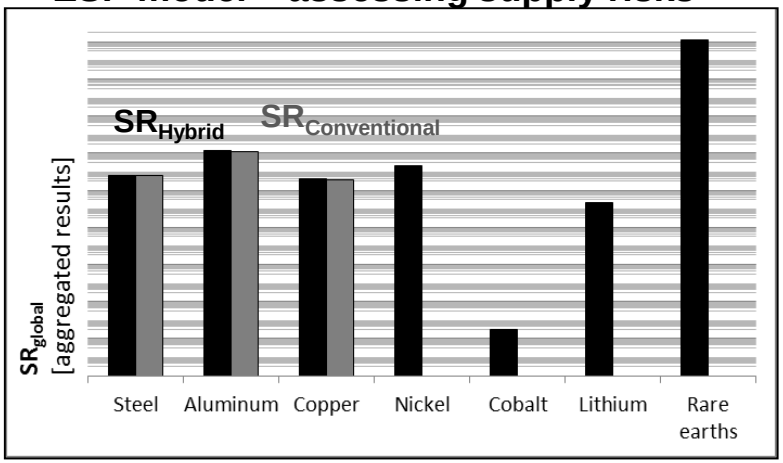
	Mercedes S400 Hybrid (kg)	Mercedes S350 (kg)
Steel	1035	1006
Aluminum	282	260
Copper	34,4	24,2
Nickel	0,95	0
Cobalt	0,17	0
Lithium	0,13	0
Rare earths	0,221	0

(Source: Daimler 2011; Schneider et al. 2011)

ADP model – current practice



ESP model – assessing supply risks



Hybrid car Conventional car

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Conclusions

- Comprehensive assessment of resource provision capability → complement and enhance current practice
- Inclusion of all relevant dimensions of resource provision capability
  - identify hotspots
  - avoid supply risks and negative impacts

→ **New model considers potential physical, economic, environmental, and social scarcity**

Improved assessment of resource availability towards life cycle sustainability assessment

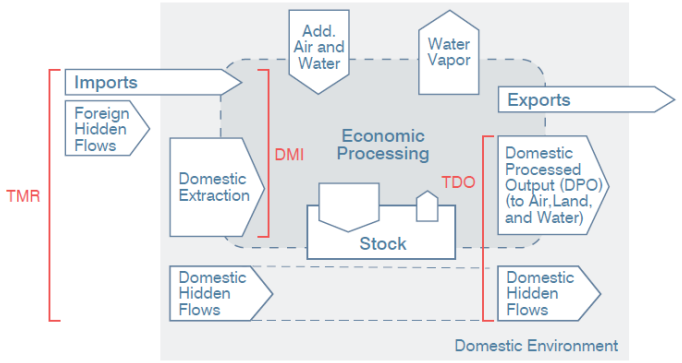
Resource efficiency assessment

- Resource efficiency is defined as

$$\mathrm{RE} = \frac{added\ value}{resource\ input}$$

  - On EU level:

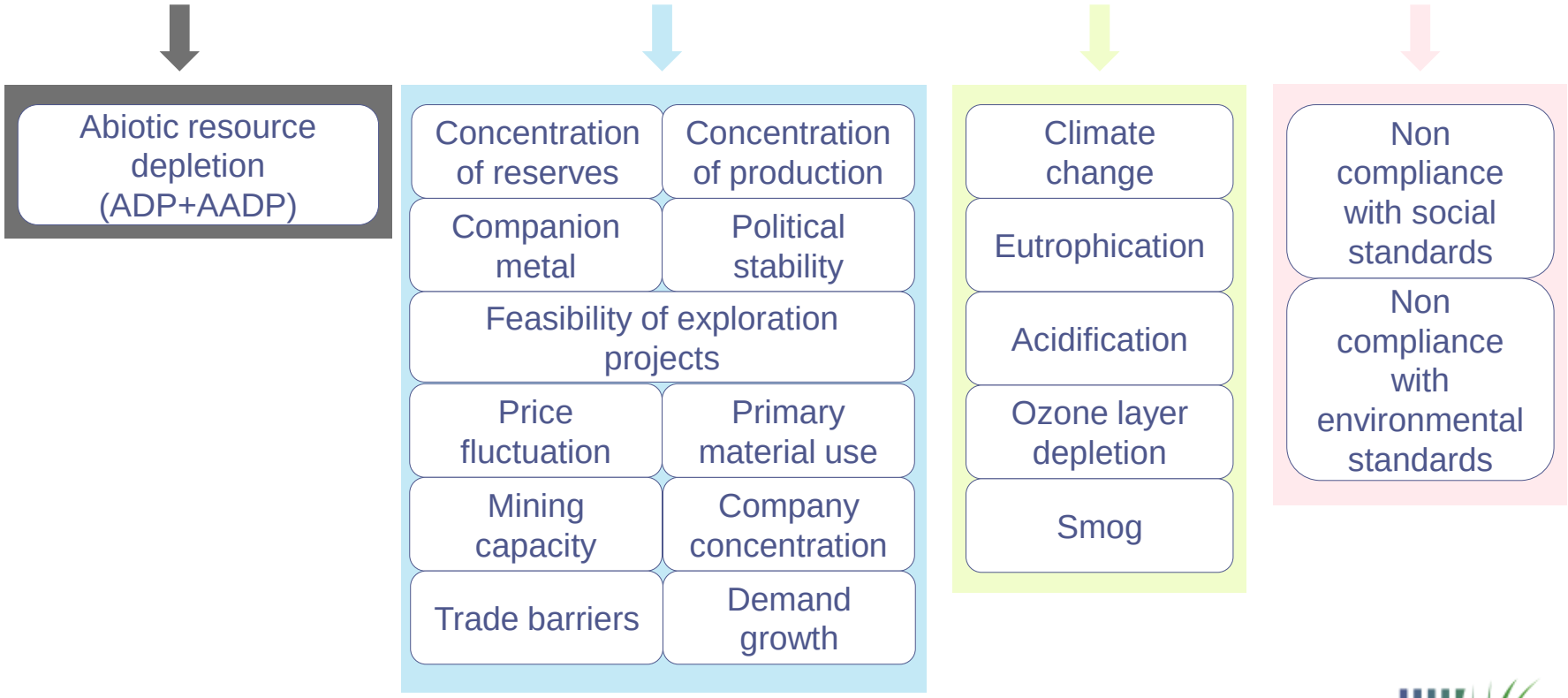
$$\mathrm{RE} = \frac{GDP}{DMC}$$



  - On product level: mass based indicators, e.g. MIPS

ESSENZ-Method

$$RE = \frac{\text{performance of product system}}{\text{Physical availability} + \text{socio}-\text{economic availability} + \text{envrionmental impacts} + \text{societal aspects}}$$



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Thank you very much!

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