Classifying resource efficiency indicators based on LCA practices

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Introduction

Our whole society depends on the use of natural resources. But despite the fact that most natural resources are limited, they are not always used in a sustainable way. To monitor the transition towards a more resource efficient society, a wide variety of indicators has been developed over the years. However, these indicators are not univocally defined, generating confusion about the real meaning of resource efficiency. This paper tries to bring order into these different visions by proposing a systematized framework for resource efficiency indicators.

Defining the concepts

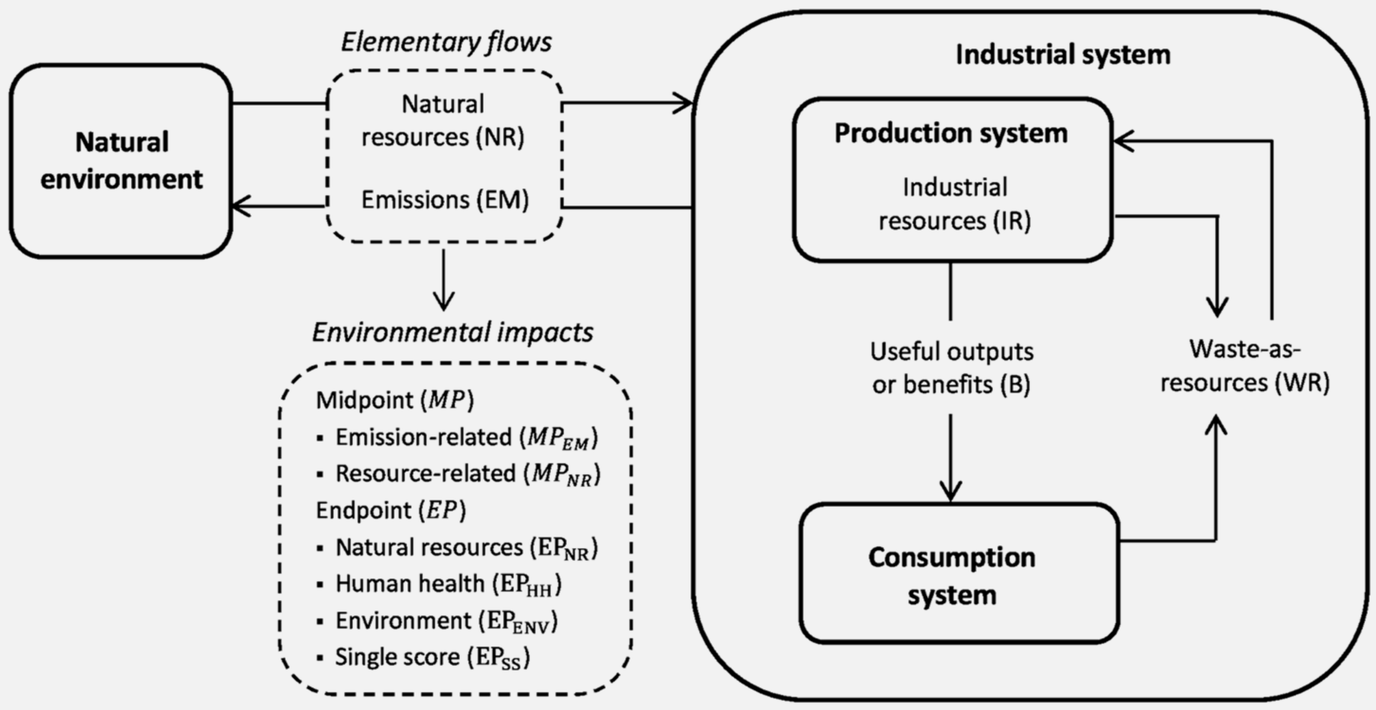
1) Defining efficiency:

Level 1 efficiency originates from process engineering = ratio of benefits over the inventoried flows.

Level 2 efficiency is based on the eco-efficiency concept = ratio of benefits over the environmental impacts.

2) Defining benefits, flows, impacts:

Flows = natural, industrial & waste resources, emissions
Benefits = the useful outputs, i.e. products and services
Impacts = based on natural resource or emission flows



Presenting the framework

- The framework provides insights in what exactly one likes to indicate: flows or environmental impacts, a domestic or global perspective, etc.
- The framework can be used to systematize and further develop existing indicators, or to theorize new indicators (e.g. for waste-as-resources).
- In the article, existing indicators were structured within the framework. One of the main observations was that policies may benefit from insights in the scientific community, e.g. a higher completeness at resource level and the use of other metrics than monetary values to evaluate outputs.

		Level 1		Level 2 (Eco-efficiency)		
Fields of study: environmental science and engineering versus environmental policy		**Resource efficiency at flow level** Benefits over resource flows (natural, waste or industrial)	**Emission efficiency at flow level** Benefits over emission flows (often the reciprocal is used)	**Resource efficiency at impact level** Benefits over impacts derived from the resource flows	**Emission efficiency at impact level** Benefits over impacts derived from the emission flows	**Overall efficiency at impact level** Benefits over impacts from both resource and emission flows
Micro scale ↓ **Macro scale**	**Gate-to-gate perspective**	*benefits over (kg) resources*	*benefits over (kg) emissions*	*benefits over (ADP) impact*	*benefits over (GWP) impact*	*benefits over single score impact*
	Life cycle Perspective	*benefits over (kg) resources in life cycle*	*benefits over (kg) emissions in life cycle*	*benefits over (ADP) impact in life cycle*	*benefits over (GWP) impact in life cycle*	*benefits over single score impact in life cycle*
	Domestic perspective	*GDP over (kg) domestic extracted resources*	*GDP over (kg) domestic emissions*	*GDP over domestic (ADP) impact*	*GDP over domestic (GWP) impact*	*GDP over domestic single score impact*
	Global Perspective	*GDP over (kg) global extracted resources*	*GDP over (kg) global emissions*	*GDP over domestic (ADP) impact*	*GDP over global (GWP) impact*	*GDP over global single score impact*

Framework with general examples

The white columns represent 'resource efficiency indicators in sensu stricto', the light grey columns represent 'resource efficiency indicators in sensu lato'. The dark grey columns are here not seen as resource efficiency indicators. They are also presented to clearly accentuate the difference with the other efficiencies

GDP= Gross Domestic Product
ADP= Abiotic Depletion Potential
GWP = Global Warming Potential

Reference: Huysman, S.; Sala, S.; Mancini, L.; Ardente, F.; Mathieux, F.; Alvarenga, R.A.F.; De Meester, S.; Dewulf, J. (2015) Toward a systematized framework for resource efficiency indicators. Resources, Conservation and Recycling, volume 95, pp. 68-76.

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