SCORE LCA

STUDY N° 2012-02

RESOURCE DEPLETION INDICATORS IN LIFE CYCLE ASSESSMENT

SYNTHESIS

September 2013

Scientific Investigator – BIO Intelligence Service

bio Intelligence Service

Project information

REPORT NAME	Synthesis
PROJECT'S TITLE	Resource depletion indicators in Life Cycle Assessment
DATE	September 2013
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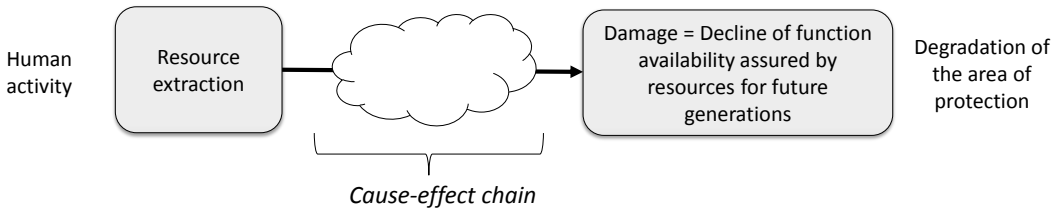
Synthesis

Primarily, this study allowed to clearly define concepts related to resources, and in particular concepts of resources and reserves. Moreover, the damage caused to resources usually considered in LCA has been presented: it consists in the decreasing availability of functions assured by resources for future generations. The relative cause-effect chain is schematised in the following figure:

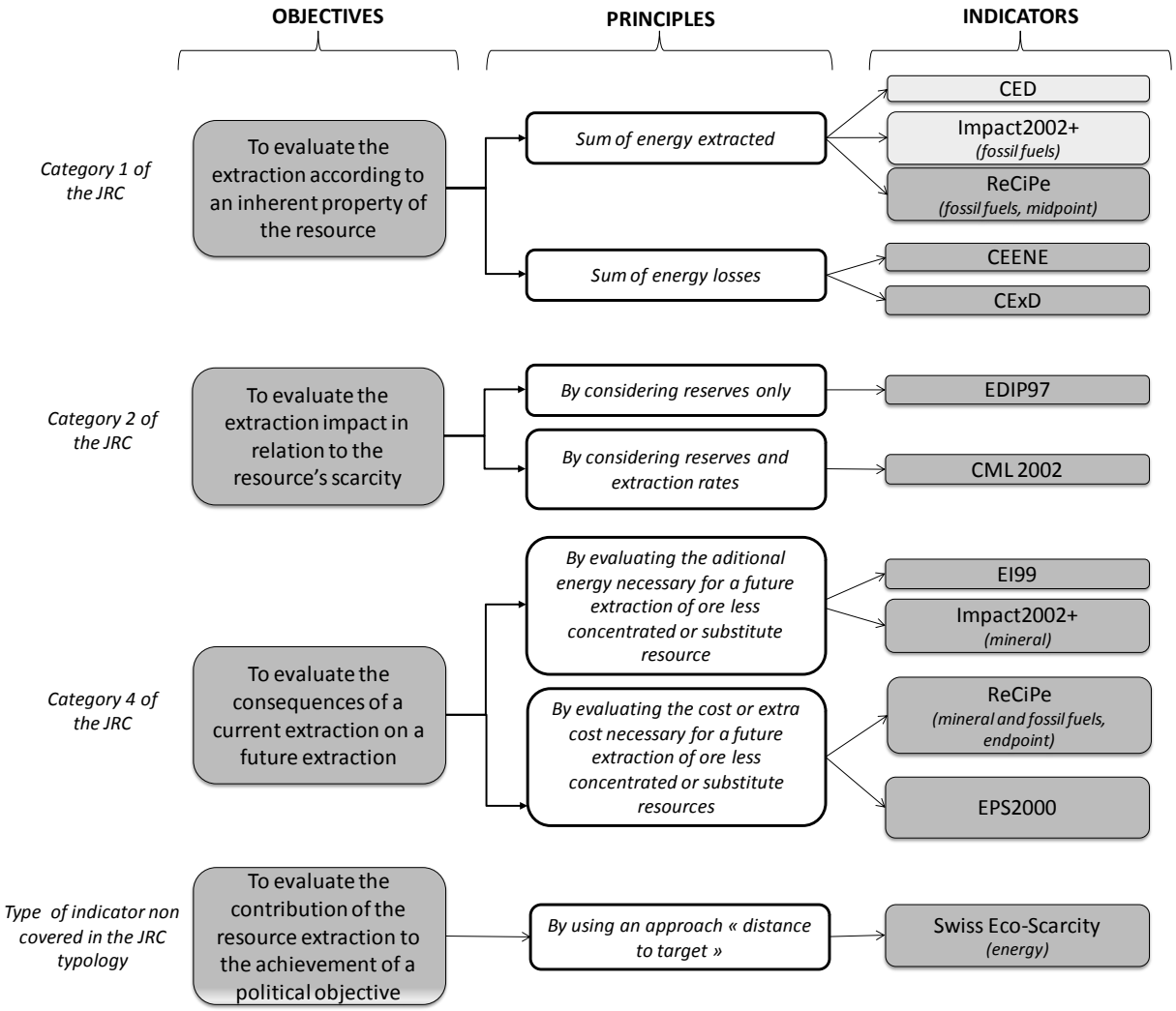


Cause & effect chain relative to resources in the case of a "functional value" perspective for resources

Next, a mapping of a selection of LCA indicators regarding resources has been made. A transversal analysis allowed selected indicators to be compared, notably in terms of objectives and resources covered. Afterwards, a detailed analysis presented the principles and foundations of the indicators, the calculation methods of characterisation factors, and inherent limits to each indicator.

The figure below shows the different indicators studied according to a typology that indicates the objectives and basic principles for each. The indicator category (according to the JRC definition) is also mentioned.

After this analysis of indicators, two case studies were carried out. The first one consisted of illustrating the indicators' variability of resource coverage and characterization factors. The second one consisted of illustrating the variability of results obtained during the comparison of several inventories using different indicators. The case studies revealed that depending on the resource indicator used, conclusions from a comparison of systems can be contrary.



Classification of the indicators according to objectives types and assessment principles

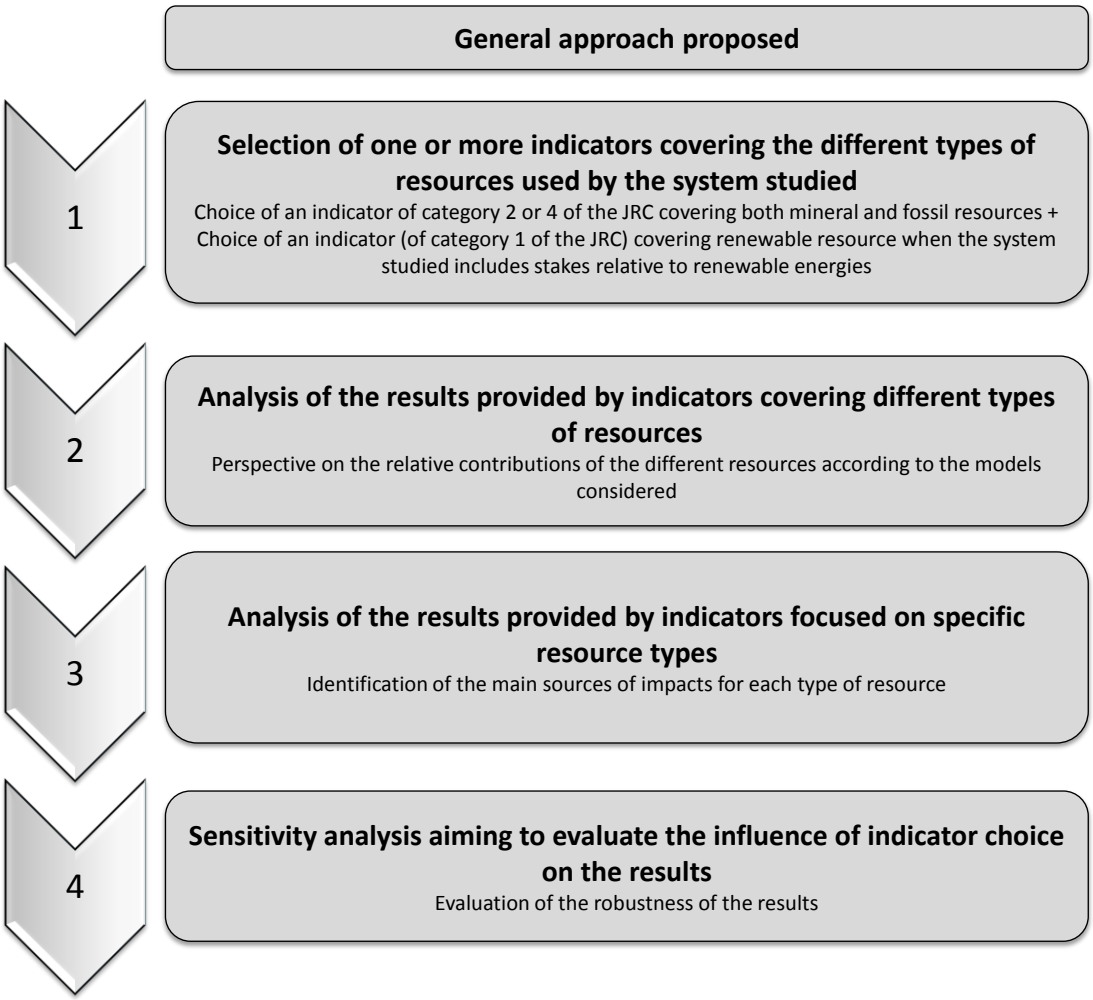
Recommendations and good practices regarding the use of resource indicators in LCA have been elaborated based on the analysis of indicators and the outcomes of the case studies. The main recommendations are presented below:

- Resource coverage is very important to take into account when choosing which indicators to use and during analysis and interpretation.
- Indicators covering different kinds of resources and indicators focused on specific type of resource present advantages as well as inconveniences. Therefore it is useful to combine both in order to get the most out of each analytical tool.
- It should be noted that no indicator that reflects the actual damage to resources (categories 2 and 4 of the JRC) takes into account renewable resources. This can be limiting when studying products using biomass or other renewable resources. However, in these cases, it may be worth using indicators of category 1 of the JRC such as CED, CExD or CEENE. Indeed, these indicators based on the intrinsic properties of resources are the only ones that take into account both non

renewable and renewable resources. And, even if these indicators do not actually assess the real damage to resources, they still offer insight into the different types of resources used by the system.

- No matter what the objective is of the study (aiming to analyse the main sources of impact or comparing products in order to identify the product with the least impact) it is always important to perform a sensitivity analysis in order to evaluate the influence of choice in resource depletion indicator on the results.
- It is possible to use normalisation methods to evaluate the magnitude of the environmental impact associated with fossil and mineral resources used by any given system. However, regarding renewable resources, it is recommended to use a qualitative approach based on the analysis of input flows if the studied product presents a specific stake with respect to these resources.
- Certain methods propose several cultural perspectives or can be calculated for different level of reserves reflecting different time perspective. The advantage of these methods is that they can be adapted to the type of stakeholder (sponsor, audience…).
- When communicating LCA results, the indicators where the objective is evaluating the extraction impact based on the scarcity of the resource can be used in priority. According to the JRC, acceptance and comprehension of these indicators are the most important. It is advised to use the indicator CML-ADP, which is recommended by the JRC. Nevertheless, a flow indicator, such as CED (which presents results by type of resource), can also be helpful in communication as it is simple and robust.
- It is essential to cover the entire life cycle of a product in order to integrate recycling loops and to perform sensitivity analyses on different methodologies for taking into account recycling.

These various recommendations and good practices have helped to construct the general methodology for treating the problem of resource depletion in LCA.



Proposed approach for the assessment of resource depletion in LCA

Next, the limitations in resource depletion indicators used in LCA were presented, as well as the ongoing developments that could help reduce them. The main limitations are the following:

- The existing LCA indicators mostly focus on non renewable resources (mineral and fossil), while only the indicators of category 1 of JRC, such as CED, CExD or CEENE, allow coverage of renewable resources. However, it turns out that category 1 indicators only evaluate the intrinsic value of resources and not the current amount of resource available nor the consequences of using it. In this case, they do not reflect the actual damage caused by using these resources.
- The functional value of resources is not properly taken into account by indicators of the LCA, which tend to aggregate the impacts associated with different resource functions. The future method Impact World+ aims to resolve this problem partially by considering substitutions of resources based on their actual usages.

- LCA indicators do not distinguish the competitive use of resources and their actual depletion. Hence, in practice, LCA indicators evaluate potential depletion and consider resource extraction the same as actual depletion. Again, the Impact World+ method aims to overcome this limitation by evaluating the potential restricted access for others to resource functions, rather than actual depletion.
- LCA indicators currently available only consider environmental reserves but not technosphere reserves. The on-going works of Laura Schneider aim to include these anthropogenic reserves, in order to find a way to assess more accurately the accessibility of resources for future generations.
- The geographic variability of resource availability is not integrated in LCA indicators. Generally, the location of the extraction site is not considered part of the impact on resources. However, the Impact World+ method aims to propose regionalised characterisation factors for resources shared at a continental scale.
- LCA indicators are, in principle, essentially focused on the environmental dimension, as they consider above all the physical (geological) availability of resource. However, they do not take into account other geopolitical or economic aspects (protectionism, monopolies, conflict areas…) which should be considered in order to assess resource availability and their short and mid-term access. LCA indicators thus present some limits and are not fit to fulfil various needs in terms of resource related assessments. To overcome this limit, it is possible to use criticality indicators as a complement to LCA indicators. These indicators take into account the supply risk and the economic importance of resources according to a specific system (continent, economic sector, company). Moreover, works are in progress to integrate the notion of criticality in the methodological framework of LCA, thus permitting the inclusion of these aspects in a product-based approach.

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