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Title: Applying LCA in decision making- the need and the future perspective

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Short abstract (2500 characters)

There is nowadays a need of including sustainable considerations in the policy and decision making. Sound decision making requires evidence-based support, i.e. decision analysis to help decision makers in identifying the best alternative based on the associated impacts. Decision analysis includes four steps: 1) structure decision problem; 2) assess possible impacts associated with alternatives; 3) determine stakeholder preferences and 4) evaluate alternatives. Decision analysis can be performed applying different tools, such as cost-benefit analysis (CBA), risk assessment, and life cycle assessment (LCA).

LCA is a decision analysis tool that focuses on environmental impacts. One limit is that LCA is based on defined impact categories and therefore does not provide information for those impacts and consequences out of the LCA scope. However, the LCA framework closely follows the decision analysis scheme and has the potential to be integrated with other decision analysis tools to enhance their assessment of environmental impacts.

To understand why LCA is needed in the policy decision context, we looked into the decision support for policy in several disciplines. Taking sustainable transport policy as an example, the traditional decision analysis tool for choosing the best alternative is CBA. CBA mainly analyses socio-economic impacts, such as travel time savings and costs, while only some environmental impacts are considered; i.e. the damage costs of greenhouse gas emissions, particulate matters, SOx, NOx and noise. Therefore, current transport policy making rarely reflect a full environmental profile of the suggested alternatives. Making decisions based on incomplete information may lead to sub-optimal solutions, especially where the environment is a major concern. There is a growing attention of conducting LCA in transport. Some identified environmental hotspots, such as consumer and household behavior, which may be the focus for future policies. Others assess the environmental impacts associated with building infrastructures and vehicle use. These studies verify that LCA can successfully quantify the environmental profile of alternatives in transport policy, if the relevant physical changes, e.g. vehicle travel distance and new infrastructures, are well-defined. However, before integrating LCA with other decision analysis methods for decision support, the study system, objectives, scopes, evaluation metrics and uncertainty handling need to be aligned.

Title: Applying LCA in decision analysis- the need and the future perspective

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Introduction

Earth has limited resources and it cannot satisfy the needs of human-beings without limitation. Putting overloaded burdens on the environment has caused tremendous effects in the last decades, e.g. the London fog, acid rains, coral reef bleaching and climate change. Learning from those problems, the global community agrees that managing environmental problems after they appear may be ineffective and hazardous. Many problems can be minimized or even avoided with less effort, if environmental considerations are taken into account in decision making beforehand. This leads to an increasing need of including environmental aspects in the decisions making process, especially in sustainable policy making, where environmental impacts are of major concern.

Decision analysis and LCA

Policy and decision making requires evidence-based support. Since the mid-20th century, decision-analysis theory has been developed to fulfill the purpose. It provides a structured methodology to help the decision makers choosing the best alternative out of the available ones based on the associated impacts. The steps are shown in Figure 1. Decision analysis theory can be applied in different research fields with different consequence-analysis methods. Cost benefit analysis (CBA), multi criteria analysis (MCA) and risk analysis are few examples of decision-support tools.

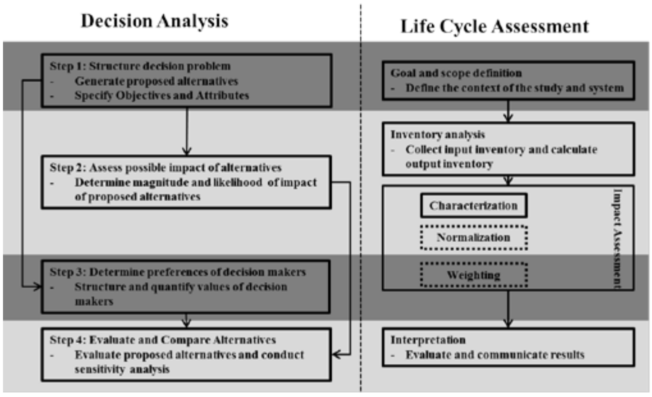

Figure 1. **Steps of decision analysis and LCA, adapted from Keeney (1982) and ISO 14040: 2006. Steps with dotted frame are optional.**

Life Cycle Assessment (LCA) is a mature methodology for assessing the environmental impacts associated with products and service. The steps of conducting an LCA study are shown in Figure 1 and, as can be seen, they closely follow the four steps of the decision-analysis approach. In LCA, the goal and scope definition aim to structure the decision problem, where objectives and alternatives are identified. The inventory analysis, characterization and normalization of impacts quantify the possible environmental impacts of the alternatives. The quantification of the stakeholders' preferences in decision analysis is represented in LCA by the weighting phase. The last step of evaluation and comparison is similar in LCA and decision analysis. This clearly shows that LCA is very well suited as a decision-support tool providing scientifically based answers to decision questions regarding environmental impacts. However, when facing policy decisions, additional impacts may be included, such as social and economic considerations. Here traditional LCA on its own is not a sufficient approach. Nevertheless, LCA has the potential to be integrated with other decision tools to serve such purposes. To understand the need of the integration and the advantages of doing so, we looked into three specific policy-decision contexts, namely transport projects, flood management and food production and consumption. In the following section we take sustainable transport as an example for illustration.

Sustainable transport policies - the need and potential of applying LCA in policy decisions

To improve the mobility of people and goods, transport projects are continuously being implemented. Those projects often have local or regional scale of social and economic impacts, as well as environmental impacts. There is a strong interest of promoting sustainable transport. Several policy proposals may be available to serve such goals, for example, promoting public transport by reducing ticket price or building bus lanes, promoting electric cars by reducing tax, and limiting the use of private vehicles in cities by charging parking fees. Which alternative(s) should be implemented?

The traditional decision-analysis tool for answering such questions in the transport sector is CBA, based on a number of socio-economic performance measures, such as travel-time savings, operating cost and revenues. Only few environmental costs, namely air pollution and noise from vehicles operation, are normally included in CBA (European Commission 2014). In order to cover more evaluation criteria, transport CBAs are sometimes complemented by other evaluation methods. Examples are MCA and the assessment of the so-called wider economic impacts (e.g. agglomeration impacts and the effects on labor market). Nevertheless, the current practice in transport-project evaluation fails to incorporate the full set of environmental impacts. Making decision based on the incomplete information may lead to a sub-optimal solution, especially where environmental impacts are of essential considerations in sustainable transport policy decisions.

Lately more attention has been given to the possibility of including LCA in transport projects. Some of the available studies aim at identifying the missing environmental impacts in the current decision analysis (e.g. Chester and Horvath 2009) and identifying the hotspots where improvement can be made, e.g. passengers and household behavior (Kimball et al. 2013). Others look at the environmental profile of the infrastructures. These studies show that LCA can point out the potential areas for environmental improvements, which suggested policies may then focus on. In addition, LCA can provide the environmental impacts assessment of physical changes on the transport system, e.g. change of private vehicle travel distance, and details on the newly planned infrastructure. However, to integrate the LCA results with standard transport CBA, the monetarization of the impact scores may be necessary.

The future perspective

There are many foreseen challenges to integrate LCA with other decision-analysis tools. The consistency of temporal and spatial scope is a major challenge. While LCA gives results integrated over time and regardless of location, the other decision analysis tools often target specific time period and locations. An alignment is needed here. The unbalanced uncertainty assessment of the results is another issue. Uncertainty in transport projects has now been acknowledged for a long time and it is a common requirement that uncertainty is evaluated and communicated. On the other hand, uncertainty is addressed to a much less extent in LCA, despite that this does not mean that the LCA results are more reliable. This difference needs to be clearly communicated and managed. Moreover, the metrics used in the conventional decision-analysis tools are different from the ones applied in LCA. Some harmonization is therefore required to integrate the results from the different tools. Similar conclusions are drawn from other case studies. To overcome the above issues, a harmonized framework is desired in the near future, to facilitate bridging LCA with other decision analysis tools for policy support.

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Conference information

Conference: SETAC EU 27th annual meeting 2017, Brussels
Track: Life cycle assessment and environmental foot-printing
Session: LCA for supporting policy and decision making
Chairs: Serenella Sala, Marco Cinelli, Paolo Masoni

Sustainability is a multi-dimensional concept, which involves different areas (economic, environmental and social), normative positions, and empirical knowledge. Environmental, economic and social aspects of the society interact in a complex pattern. The cultural, social, political and regulatory contexts affect the assessment of these interactions. Life cycle thinking (LCT) and LCA have a high potential to be used more extensively in supporting policy making, from problem definition up to policy impact assessment and policy implementation. However, when the object of the assessment is moving from products and service to systems and macro-scale, several improvements are needed in order to benefit the most from the LCA application. This require to reflect upon current and future challenges for LCA within the policy domain.

The session on LCA and policy builds on this reasoning and aim at providing an overview of the current challenges for a wider adoption of Life Cycle Thinking and LCA in the policy context. Suitable frameworks, methods, and tools for system analysis are need to properly develop sustainable policies on, e.g., bioeconomy, circular economy and resource efficiency, sustainable production and consumption, ecoinnovation etc , policy makers require integrated assessments of current and potential future policies. This session aims at presenting and discussing the role of LCA, LCSA and other methodologies for support of policy development at different scale, from local to country and European level. Which developments are needed to address such complexities? Which indicators? Which targets should be considered? How can scenario modeling further structure the analysis? How results could be presented in order to be comprehensible?

We invite contributions that show how LCA could be used for policy support at different scales, what approaches are available for deepening of the analysis, what important aspects cannot be accounted for and, thus, what is needed to better address mechanisms in the analysis, especially in light of inclusion of economic and social aspects. Methodological developments and case studies related to sustainability assessment of policies and systems using life cycle approaches are the main focus. However, we also welcome comparative analyses on how different assessment tools may relate to each other and could be combined with LCA.

Sponsored by: Life-Cycle Assessment Advisory Group (Europe)
Preliminary session type: Platform and Poster

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