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# 1 Developing Life Cycle Sustainability Assessment methodology by 2 applying values-based sustainability weighting - tested on biomass 3 based and fossil transportation fuels

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## 17 Abstract

18 The production and use of transportation fuels can lead to sustainability impacts. Assessing them  
19 simultaneously in a holistic way is a challenge. This paper examines methodology for assessing the  
20 sustainability performance of products in a more integrated way, including a broad range of social  
21 impacts. Life Cycle Sustainability Assessment (LCSA) methodology is applied for this assessment.  
22 LCSA often constitutes of the integration of results from social LCA (S-LCA), environmental life cycle  
23 assessment (E-LCA) and life cycle costing (LCC). In this study, an S-LCA from an earlier project is  
24 extended with a positive social aspect, as well as refined and detailed. E-LCA and LCC results are built  
25 from LCA database and literature. Multi Criteria Decision Analysis (MCDA) methodology is applied to  
26 integrate the results from the three different assessments into an LCSA. The weighting of key  
27 sustainability dimensions in the MCDA is performed in different ways, where the sustainability  
28 dimensions are prioritized differently priority based on the assumed values of different stakeholder  
29 profiles (Egalitarian, Hierarchist, and Individualist). The developed methodology is tested on selected  
30 biomass based and fossil transportation fuels - ethanol produced from Brazilian sugarcane and US  
31 corn/maize, and petrol produced from Russian and Nigerian crude oils, where it delineates  
32 differences in sustainability performance between products assessed. The outcome in terms of relative  
33 ranking of the transportation fuel chains based on sustainability performance differs when applying  
34 different decision-maker profiles. This result highlights and supports views that there is no one single  
35 answer regarding which of the alternatives that is most sustainable. Rather, it depends strongly upon  
36 the worldview and values held by the decision maker. A key conclusion is that sustainability  
37 assessments should pay more attention to potential differences in underlying values held by key  
38 stakeholders in relevant societal contexts. The LCSA methodology still faces challenges regarding  
39 results integration but MCDA in combination with stakeholder profiles appears to be a useful  
40 approach to build on further.

41 Keywords: LCSA, weighting, values, stakeholders, transport, biofuels

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