Sustainability assessment of CO_2 valorisation routes for Latvia: LCA, S-LCA and LCCA

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Abstract. To initiate and maintain the European Green Deal transformative policies, an evident-based multi-sectoral forecasting model needs to be timely and effectively deployed. The overall decarbonisation solutions proposed in this research can be defined as regional CO_2 "value spots"– areas in regions where CO_2 can be directly (CO_2-based new products) or virtually (change in planning and implementation) utilised for the development of high-added value products, ensuring decarbonisation of rural areas, as well as promoting economic growth of the regions.

Within the framework of this work, three scenarios for using carbon dioxide are analysed – its use in methanol production, cement production and open-air algae ponds. The analysis aims to assess the potential environmental impacts of CO_2 utilisation and consider the impact on the environment, human health, labour rights, working conditions, social equity, and other social factors, as well as costs and economic sustainability.

LCA provides a decision-making platform to understand the mid-term and long-term environmental effects of CO_2 valorisation scenarios according to the ISO Standard 14044 standard requirements. Sensitivity analysis is performed to exclude high input data uncertainties (if any) and identify model behaviour factors. Effects of CO_2 valorisation scenarios on social endpoints (well-being of stakeholders) are identified via S-LCA based on multi-regional input/output methods of qualitative and quantitative generic data. The S-LCA include health and safety, cultural heritage, and governance impact categories covering the interests of such stakeholder groups as workers, the local community, society, and consumers.

Cost-effectiveness of CO_2 valorisation scenarios is performed. Regional valorisation scenarios are assessed and benchmarked via regional development sustainability indicators. A comparative assessment of core indicators is performed.

Keywords: CCU, decarbonisation, methanol production, cement production, open-air algae ponds, full sustainability assessment.

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