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OFF-SHORE AND ON-SHORE MACROALGAE CULTIVATION AND WILD HARVESTING: AN LCA-BASED EVALUATION FROM BALTIC CASE STUDIES

Riccardo PAOLI^{1*}, Bjarni BJARNASON², Tanel ILMJÄRV³,
Francesco ROMAGNOLI⁴

^{1,4} Institute of Energy Systems and Environment, Riga Technical University, Āzenes iela 12/1, Riga, LV-1048, Latvia

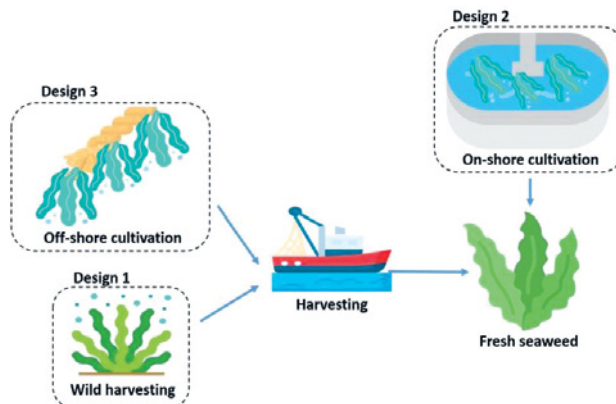
² Hyndla Ltd., Research & Development, Thingholtsstræti 30, 0101 Reykjavík, Iceland

³ Vetik OÜ, Lahe cottage, 93859 Muratsi village, Estonia

* **Corresponding author.** E-mail address: riccardo.paoli@rtu.lv

Abstract – Seaweeds are organisms with unique characteristics. They contain a broad spectrum of micro and macro elements (i.e., minerals, carbohydrates, proteins, lipids, pigments, and vitamins). Furthermore, they have a very high growth rate and are present in large quantities and species in nature. Therefore, they represent an ideal feedstock for a biorefinery concept. Historically, macroalgae used in biorefineries have been harvested directly from the sea or the shores (*off-shore* technique). However, recent studies are analysing the possibility of creating *on-shore* cultivation facilities. This research aims to perform a Life Cycle Assessment (LCA) study that analyses and compares the environmental impact of two seaweed cultivation and wild harvesting techniques in the Baltic conditions based on existing pre-commercial and commercial projects. Inventory data are collected directly from two macroalgae producers in the Baltic Sea region (one wild harvester and one *on-shore*), integrated with literature, and then normalized to the selected functional unit, i.e., 1 ton of harvested fresh macroalgae. The results, implemented with *SimaPro 9.4* software, determine which of the two techniques has the highest environmental impact and which are the most sensitive environmental indicators. Furthermore, the results underline the critical parameters for the two cultivations (i.e., fuel consumption and electricity), contributing to identifying environmental benchmarks for further optimization strategies. The alternative scenarios analysis included in the study aims to explore and highlight the effect of the variation of selected input parameters or assumptions to provide a consistent assessment of the uncertainty of the model outputs and the main findings in terms of environmental impacts.

Keywords – Baltic region; LCA; seaweed; sustainability



Different scenarios considered in the study.