BSAP Fund

Combining Green Hydrogen Production and Deep Injection of Pure Oxygen Gas to Recover the Baltic Sea

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Executive summary of the project

Internal phosphorus loading in the Baltic Sea Proper and Gulf of Finland is caused by strong anoxia below the halocline. The importance of suppressing the internal nutrient loading has emerged with the success of the decrease of external nutrient loading.

Deep oxygen injection (DOI) below the halocline is proven technology to eliminate anoxia and suppress internal phosphorus loading that could be used in speeding up the Baltic Sea recovery. We propose tying this initiative of the Baltic Sea remediation to the emerging green hydrogen economy by using oxygen surplus from green hydrogen fuel production using water hydrolysis, which may be the key for the financial feasibility of the initiative.

Demonstration of the technology at pilot scale in coastal waters of the Baltic Sea would be the required next step prior to conceptualisation at large scale. After a successful demonstration project in a selected and representative coastal area, the DOI treatment could be replicated in other similar oxygen deficit areas. After several successful implementation cases in gradually larger deep areas, the technology could be scaled up to the largest and deepest oxygen deficit areas near Gotland and Bornholm.

The specific objectives of this project have been to:

- investigate the feasibility and risks of the concept in high level
- investigate potentially suitable coastal areas to pilot test direct oxygen injection at the Baltic Sea
- investigate potential financing of the demonstration project
- suggest next steps/preliminary road map with ultimate goal of speeding up the Baltic Sea restoration.

In October 2021, HELCOM promulgated Guidelines for Sea-Based Measures to Manage Internal Nutrient Reserves in the Baltic Sea Region. The guidelines "… provide decision support for relevant authorities when administering consultations and environmental permitting related to sea-based measures" (HELCOM 2021) Sea-based measures include, but are not limited to, chemical measures, physical measures, biological measures, or a combination of these measures. DOI is seen as a viable sea-based measure within the guidelines.

Lännerstasundet in Sweden was found to be an ideal piloting site.

Based on preliminary calculations, the demonstration project could cost 5-10 million euros (M€) if using liquid oxygen (LOX) for the demonstration project and 25-30 M€ if paired with green hydrogen production piloting.

The pilot project is likely to be 6 years in duration, whereas in subsequent full-scale Baltic Sea oxygenation there would be a 10- to 20-year timeline from start to finish based on professional judgement.

Successful remediation of the Baltic Sea would have major positive environmental and socio-economic impacts. Risks can be minimised with careful design and close collaboration with different stakeholders. Yet the economic feasibility of the concept remains to be proven.

In the next stage, to move the concept forward, we propose a complementary study with focus on the super-green hydrogen economy, pilot preparation, funding models and further engagement of stakeholders to acquire financing and political, and social approvals for the project. Concrete next steps could be to engage with the Swedish

Environmental Protection Agency and local governments and other stakeholders to map out development a pilot project in Lännerstasundet and to continue efforts on potential financing of the demonstration project