In Love with Seaweed? The Argument for Kelp Farming Investment in Aid of Canada's 2050 Net-Zero Emissions Economy

Redevelop Challenge 2022 – CCUS Team

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SUMMARY

Issue

Global CO_2 emissions need to be targeted with carbon capture utilization and storage (CCUS) technologies to achieve emissions reduction targets, in service of preventing more than a 1.5 ^{o}C average temperature increase by 2030 (Zhongming et al., 2020). In order to achieve this goal, alongside Canada's international commitment to a net-zero emissions economy by 2050, it is in Canada's best interest to utilize CCUS technology. The key policy imperative is for Canada to work to remove as much CO_2 possible from the atmosphere with the technology available, at the lowest economically attainable cost, in the shortest time frame. This urgency arises from the fact that Canada is one of only two G7 countries that has raised its emissions since the Paris Accord of 2015 (Canadian Centre for Policy Alternatives, 2021).

CCUS technology refers broadly to a suite of technologies available to various stakeholders in the pursuit of removing carbon from the atmosphere. Extensive implementation of CCUS technology across Canadian economic sectors presents a two-fold opportunity for Canada, in regards to both combatting climate change as well as potential new economic opportunities, including the sale of sequestered carbon in domestic and international markets. Despite the potential of CCUS, various technological implementation has faced opposition due to a number of factors including prohibitive cost, the potential environmental costs of sequestering carbon in the land, and public concern over CCUS technology being a tool of "green-washing" to sustain large-scale emitting industries like oil and gas.

In an effort to address these concerns of CCUS technology implementation, and to provide an example of innovative CCUS implementation, our research team proposes broad investment and policy support in the implementation of short-term, smaller-scale CCUS technology through the creation and sustainment of kelp farms. Kelp farms provide not only an opportunity to capture CO_2 but also to create added economic value through by-product creation, as well as to engage coastal Indigenous communities in science and business partnership

Method

In regards to the potential of this investment, our research team worked to undertake a cost/benefit analysis of offsetting CO_2 through investing in and expanding kelp farms along the coast of Vancouver Island. Sequestration is not the focus of this proposal, but rather the focal point is on an example of a biological technology that not only has the potential to capture and provide temporary storage of CO_2 but also creates economic profit through the production of kelp based by-products. Kelp by-products can aid in the reduction of GHG emissions in other sectors, such as transport, in which kelp can be utilized to process biofuel (Alvarado-Morales, 2013), as well as a local nutrient source for the maintenance of a resilient Canadian food economy, and finally as an addition to livestock feed to reduce livestock methane releases. In the determination of the political and economic feasibility, as well as the impact of a project of this nature, our research team worked to research and establish an hypothetical pilot project of kelp farming. Our project provides an overview of a kelp based circular bioeconomy constructed on four main pillars as presented in Figure 1. Stakeholders, including Indigenous communities already participating in kelp related projects, were contacted, and long-term impacts of this project evaluated. The Indigenous communities on Vancouver Island include Huu-ay-aht First Nations and the Uchucklesaht Tribe (Bremner-Mitchell, 2022).

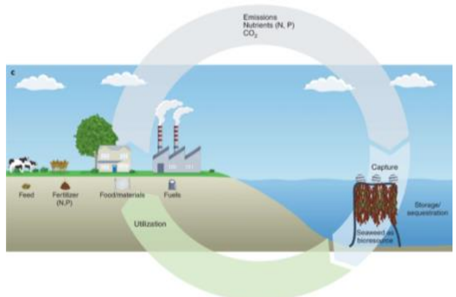

Figure 1. The seaweed based circular bioeconomy. The four pillars of this bioeconomy are Emissions, Capture, Storage, and Utilization of the emissions.[1]

The feasibility and barriers to these projects involve complex legal systems and regulations, which are addressed in a review of existing policy and feedback from subject matter experts. The project will also provide an analysis of this information and attempt to provide alternatives and recommendations in regards to reforms of the legal and regulatory arena, as well as proposals for a broader framework for the implementation of analogous small-scale CCUS projects. The lifecycle of the proposed project was evaluated over the course of seven-generations. This includes anticipated social, economic, and environmental benefits and consequences.

Results/Observations

Approximately 17 km^2 of seeded brown algae in the kelp genus *Laminaria* growing over the course of one year would be sufficient to offset the CO_2 emissions from a proposed solid waste plant located on Vancouver Island (Chung et al., 2010). Based on data gathered from a similarly sized solid waste plant located in Metro-Vancouver, the emissions of such a facility are approximately 300,000 tonnes of CO_2/year (Metro-Vancouver, 2021). This is a small fraction of the potential coastline suitable for kelp farming, and helps to demonstrate the potential positive impact of the expansion of kelp farming in Canada. Factors affecting feasibility include initial and long-term investment for the cost of supplies, limited seed supply for kelp farming, concern regarding the environmental impact of mariculture, and lack of regulations for biomass monitoring of the kelp detritus, which is naturally sequestered during the lifespan of the kelp. A life cycle analysis of a potential pilot project kelp farm was conducted, and the forecasted market value of the products was evaluated in context of a small kelp farm. To address the social concerns regarding the installation of a kelp farm, major stakeholders, such as local Indigenous communities, were consulted in conjunction with literature review and data collection.

Novel Information

Currently, CCUS projects tend to require more capital investment than they are able to return, thus contributing to the delay in the uptake of CCUS technologies. Our group presents a case study of a project that has the potential to not only offset CO_2 emissions, but also to produce materials that are in economic demand, presenting an opportunity for a return on investment, as well as further avenues for products to aid in GHG reduction in other sectors. The project was constructed with a multi-disciplinary view, intersecting policy, scientific technology, and Indigenous knowledge.

[1] Image modified from: Duarte et al., 2021.

Acknowledgements

Authors are scholarship recipients of CREATE REDEVELOP Grant #386133824, a collaborative research and training experience in responsible energy development funded by the National Sciences and Engineering Research Council of Canada [NSERC].

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