The Use of Microalgae for Wastewater Purification in Canada

Executive summary

Having access to clean water is a basic necessity. While traditional water treatment systems offer a procedural, time-tested solution for municipalities, there is room for innovation. For example, there are considerable energy costs, as well as various pollutants especially found in industrial effluent. As the Engineering General of Canada, we are tasked with examining microalgae as an innovation to traditional water treatment methods. Microalgae has unique wastewater treatment properties, such as being able to absorb harmful dyes and become benign, compared to sludge formation in traditional treatment methods. Moreover, using microalgae presents financial incentives, due to its low-cost accessibility and ability to generate “value-added” byproducts such as biodiesel.

There have been numerous research studies conducted, both nationally and internationally. Most papers highlight the theoretical benefit of algae. This presented a problem of which papers to analyze, and so we devised a research-selection methodology. Firstly, we identified active researchers who were interested in microalgae in the context of water treatment (noting that microalgae has applications beyond water treatment). We further narrowed down studies by picking Canadian researchers, due to climate similarities. While after narrowing down the list we found relevant studies, ultimately we decided to include international studies to diversify our understanding of the theory.

Findings were complex. As the human population grows, not only the amount of wastewater is increasing, but also diversity in harmful substances. Yet, the treatment processes are largely remaining the same. This presents an opportunity to implement microalgae technology. For instance, if appropriately selected, microalgae can absorb harmful pharmaceutical compounds that would otherwise be “generally” treated in traditional methods that produce unwanted sludge. Overall, findings show that microalgae as treatment technology presents many desirable benefits, such as reducing energy costs, circumvents sludge production, and produces financially viable products such as biodiesel and bioplastics. Moreover, there is an ecological benefit that cultivating microalgae itself helps absorb CO_2 from the atmosphere (being 400 times more efficient than plants). Despite promising benefits, we noted potential constraints, such as net profitability, and physical limitations (spatial).

Potential stakeholders were identified as impact investors, who have a collaborative benefit of their socio-geographical understanding, as well as private companies who may find profitability in microalgae technology.

Moving forward from the findings, we as Engineer Generals recommend a collaborative, agile approach that focuses heavily on rapid prototyping. Rapid prototyping, rather than implementing right away, ensures practical value later on. We recommend bringing stakeholders on at different stages, rather than everyone at once. We take on a holistic analysis of the situation, noting the promising benefits of microalgae technology, but also noting its constraints. Overall, we recommend rapidly producing prototypes that pique the interest of stakeholders, rather than outright policy implementation of this innovative technology.