Analysis of Renewable Ammonia Production and Transmission across the Atlantic Ocean

For: MSc Students; 12 months

Program supported: Oceans Program

Academic Collaborator	NRC Principal Investigator	Associated NRC Research Centre
University of Waterloo	Farid Bensebaa (Researchgate)	Ocean, Coastal and River Engineering Research Centre

Project Description:

We will explore a low-carbon hydrogen pathway, i.e., renewable power-to-ammonia (P2A) production and distribution to connect the hydrogen economy between Canada and Germany. Ammonia is a commodity for fertilizer with mature production and distribution infrastructure. However, careful analyses are required to evaluate its potential as a hydrogen carrier.

A combined techno-economic assessment (TEA) and life-cycle analysis (LCA) will be conducted to evaluate the levelized cost of ammonia and its associated life-cycle greenhouse gas (GHG) emission. Various renewable ammonia production, storage, transmission and distribution technologies will be compared using a performance matrix. The results of the project will facilitate the decision-making process for different stakeholders in a hydrogen economy.

The host (Prof. XiaoYu Wu) at the University of Waterloo will lead the collaboration and supervise the TEA study, while the NRC supervisor (Dr. Farid Bensebaa) will provide guidance on the LCA to fit into the existing NRC TEA-LCA framework. Through this internship, the student will have the opportunity to conduct research related with hydrogen economy under the supervisions of experts on TEA and LCA. As many countries including Canada and Germany have released their hydrogen strategies, students with this research experience will be of high demand in both industry and academia.

Decarbonization is the ultimate global shipping goal. While marine transport only contributes to 3% of transportation related GHG emissions, the movement of people and goods by sea also contributes to invasive species, water contamination, and noise pollution for marine life. After fishing, ships and ship building is one of Canada's largest blue economy industries and 98% of goods travel into Canada by ship. The purpose of the Intelligent Marine Assets technology theme is to reduce the environmental impact by optimizing maritime operations. This project complements by adding a commodity and potential fuel to NRC's current work with respect to ships and shipping.

This project will inform the potential of Canada to use transport hydrogen in the form of ammonia by ship. If feasible and can be operationalized, commercializing this technology could drastically reduce GHG emissions from land-based industrial operations and marine transportation. Ammonia as a feedstock would become a growth market and Canada/Germany can pave the way to more hydrogen fuel infrastructure. Ocean health. Ocean wealth.

Student Profile:

We are looking for a student with the following skills/background:

- Ability to work in a team and fluent in English
- Undergraduate studies in Mechanical or Chemical Engineering, or a closely related field
- Knowledge in programming in Excel and Python
- Enthusiasm in renewable energy and sustainability

Experience with process modelling (required), TEA or LCA (optional)