NEXUS: A Simulation and Optimization Tool for Productive Use of Renewable Energy and Water Access Planning in Island Communities

Michael CASTRO[1*], and Wilbert James FUTALAN[1]

[1] Laboratory of Electrochemical Engineering, University of the Philippines, Diliman, Quezon City 1101, Philippines
* Corresponding author

Submission Category:
(A) Technical research proposal to solve concrete problems

SDGs Targets/Indicators:
This proposal focuses on SDG 6, 7, and 8 by creating a simulation tool that models the water-energy nexus in an island while considering the productive use of these resources. The tool can be used by investors and policy makers to implement sustainable energy and water on off-grid communities.

SDG 6: Clean water and sanitation
SDG 7: Affordable and clean energy
SDG 8: Decent work and economic growth

Abstract:
Island communities have energy and water demands that are difficult to supply due to remoteness and high logistics cost. The limited energy supply causes frequent power interruptions which impede the quality of life and economic development. Although research efforts are aimed towards the implementation of energy systems in these islands, there is less interest in considering the cogeneration of water. Desalination is a proposed method for freshwater generation due to the technical infeasibility of groundwater extraction. Island residents can then engage in the productive use of renewable energy (RE) to offset energy and water costs. The water-energy nexus must be considered when studying these islands. In this work, an optimization tool for the water-energy nexus of the island will be developed, while considering the productive use of RE. Solar photovoltaic (PV), wind, microhydro, and biomass were considered as renewable energy sources, while Li-ion battery systems and pumped hydro were used as energy storage technologies. Meanwhile, freshwater will be generated by via reverse osmosis (RO) of seawater. Productive use of energy will be reflected in the livelihood of inhabitants such as irrigation of agricultural area and fishing activities. Preliminary studies using deterministic mathematical models have shown that RO with PV and diesel minimized

the net present value of the system. Implementation of RO increases the levelized cost of electricity (LCOE) by only 0.87%. However, the complex interaction between water, energy, and productive use is not captured by deterministic mathematical optimization. Agent-based modelling (ABM) is therefore the appropriate technique for modelling the water-energy nexus with productive use. ABM introduces model variations and interactions between components. Future studies will focus on the implantation of ABM and demand side modelling. It is envisioned that this tool will aid investors and policy makers in the implementation of sustainable energy and water technologies in off-grid areas.