

## 論文の内容の要旨

論文題目      An Optimal Design on Sustainable Hybrid Energy  
Systems by Multiobjective Functions for Shrimp Aquaculture Industry  
(エビ養殖業のための持続可能なハイブリッドエネルギー  
システムに関する多目的評価関数に基づく最適設計)

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The shrimp aquaculture industry has been rising significantly, not only around the world but also in Vietnam. The shrimp farming in the Mekong Delta, Vietnam, makes a substantial contribution to the national economy via exporting to foreign countries. However, the energy consumption for the shrimp farming industry has continued rising considerably in recent years due to the expansion of shrimp production to meet food demand. Most of the energy demand at shrimp farms is consumed by the aeration system, which utilizes electrical motors to drive aerators for maintaining suitable dissolved oxygen in ponds continuously for improving water quality and promoting shrimp growth. Moreover, the intensive energy consumption from electric motors for aeration and pumping systems leads to high operation costs and associated greenhouse gas emission from using conventional power resources. Although many improvements have been made for the design and operation of aerators and even renewable energy resources have been applied, the traditional aeration system inherently consumes high power with low oxygen transfer from the air. This dissertation, therefore, proposes an optimal design on a sustainable hybrid energy system by multiobjective functions for the shrimp aquaculture industry.

The proposed system harnesses renewable energy resources to power the electrolyzer to produce pure oxygen in situ for oxygenation according to the changes of species under culture. In addition, the by-product hydrogen from the electrolysis process could be used for either commercial purposes or backup

power. The mathematical models of the system were developed for simulation and optimization to assess the performance of the system regarding technical, economic, and environmental aspects as multiobjective functions in autonomous mode as well as on-grid mode. Besides, the optimal results and their sensitivity analysis showed that the sustainable hybrid energy system connecting to the national grid in which the by-product hydrogen is primarily either sold for commercial purposes or used for backup power could bring significant benefits for farmers thanks to a notable reduction in the annualized cost the system as well as CO<sub>2</sub> emission in comparison with the conventional system run by common paddlewheel aerators.