

# Multi-objective optimization of renewable urban energy system planning combined with waste to energy technologies for off-grid island

Jian Lin<sup>1</sup>, Yuan Huang<sup>1</sup>, Xuetao Bai<sup>1</sup>, Li Li<sup>1</sup>, Nianyuan Wu<sup>1</sup>, Meina Xie<sup>1</sup>, Jingzhi Huang<sup>1</sup>, Shan Xie<sup>1</sup>, Chao Meng<sup>1</sup>, Yingru Zhao<sup>1\*</sup>

<sup>1</sup> College of energy, Xiamen University, Xiamen, China

## ABSTRACT

For off-grid islands or archipelago, especially island towns far from the mainland, it usually has disadvantages in terms of the stability and economy of traditional fuel supply chains, and waste disposal is also an important issue facing the sustainable development of islands and marine ecosystems. In addition, due to the uncertainty of the ocean climate. Isolated island energy systems often face the dilemma of redundancy or shortage of renewable power at different periods. To meet the above challenges simultaneously, a multi time scale hierarchical optimization method is introduced for the investment and operation planning of the island sustainable energy system that combines renewable energy, seasonal energy storage and waste to energy technologies. Alternative technologies includes the photovoltaic, wind turbine, seawater source heat pump, as well as boiler and gas engine that utilize the synthesis gas and biogas produced from island waste and marine biomass, thereby simultaneously satisfies the cooling, heating and power demand of the off-grid island. Multi-objective optimization and decision-making are conducted with indicators of system economy and renewable energy consumption in normal conditions and indicator of energy security under extreme climatic conditions. Meanwhile, the environmental benefits of the integrated system under different scenarios are also compared. Case studies show that the introduction of distributed waste to energy and seasonal energy storage solutions improves the flexibility of the isolated grid system, thereby increasing the penetration and consumption of renewable energy, and further reducing the need of standby fossil fuels. The proposed integrated system has multiple benefits in energy, economic, environmental and social aspects, which is an effective means for the sustainable development of smart islands.

**Keywords:** off-grid energy system, energy system planning, renewable energy, waste to energy, seasonal energy storage, multi-objective optimization

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