energies

Editorial

Special Issue "Selected Papers from the 8th International OTEC Symposium"

Albert S. Kim

Civil and Environmental Engineering, The University of Hawai'i at Manoa, Honolulu, HI 96822, USA; albertsk@hawaii.edu

Ocean thermal energy conversion (OTEC) aims to use the temperature difference between surface and deep seawater to generate electricity and (possibly) freshwater. It is one promising source of renewable thermal energy, the vast amount of seawater on the earth. If we can convert ocean thermal energy into electric energy, this would significantly contribute to renewable energy production in the 21st century. However, there are several difficulties to overcome to make OTEC more available, such as (but not limited to) holistic integration with other renewable energy technologies [1]; preliminary data acquisition/analysis of sea surface temperature [2]; sensitive influence of ocean surface temperature on plant operation [3]; determination of plant-size for cost-effective production [4]; lack of standardization due to large plant size [5]; and transition from closed cycle to open cycle operations in the near future.

Although OTEC can produce net positive power generation, it has not been commercialized due to the significant initial investment required to build OTEC plants and the subsequent infrastructure for power generation, transmission, and storage. To improve OTEC availability and efficiency, a seamless link to other renewable energy technologies seems necessary, such as solar, wind, or other ocean energies. In our opinion, the application of holistic design concepts to regional testbeds can promote future technological advances.

Brecha et al. [1] discusses practical and flexible methods to integrate OTEC with pre-existing energy production methods by investigating OTEC feasibility for Caribbean island nations. They use a GIS mapping technique, calculate the technological and economic trade-offs for 100% renewable electricity systems, and show the possibility of (near-shore) open-cycle OTEC with accompanying seawater desalination facilities. Small-scale OTEC plants can be designed more cost-effectively by increasing connectivity to other renewable energy production technologies. Their case study and analysis for the Caribbean islands can, if successful, open a new direction to future OTEC improvements and practicality.

A critical factor in determining the future practicality of OTEC is to have a consistent temperature difference between the surface and deep seawater streams. Two core aspects of OTEC plants are location selection and the performance evaluation. An analysis of long-term data of sea surface temperature at a specific model location is of great importance, as investigated by Garduno-Ruiz et al. [2] for the Mexican Pacific and Caribbean Sea. In the same light, Huante et al. [3] emphasized the holistic use of available databases of sea surface temperature, i.e., the World Ocean Atlas (WOA), Satellite Oceanic Monitoring System (SATMO), and in situ sensor measurements. SATMO was regarded as superior to others for searching for suitable candidate locations with high temporal and spatial resolutions.

Once the prototype of a model plant is designed at a specific location, a sensitivity analysis at the actual plant level should follow. Using R-152a as an organic working fluid for the closed-cycle OTEC of the Rankin cycle, Tobal-Cupul et al. [4] developed an algorithm to obtain monthly averaged temperatures of the inlet and outlet streams of the heat exchangers. OTEC is a sensitive operation in regards to temperature difference, as well as subtle to various thermal conditions, such as the material properties of pipes and heat exchangers, and flow-controlled phase changes of the working fluid. Rankine, Kalina, and Uehara cycles are often incorporated into OTEC plant operation thermodynamic design, as discussed by Yasunaga et al. [5] for a closed-cycle OTEC.

check for updates

Citation: Kim, A.S. Special Issue "Selected Papers from the 8th International OTEC Symposium". *Energies* **2022**, *15*, 954. https://doi.org/10.3390/en15030954

Received: 21 December 2021
Accepted: 24 December 2021
Published: 28 January 2022

Three significant technical challenges for OTEC in the future consist of switching from closed cycle (using an organic working fluid) to open cycle (using seawater) operations for environmental sustainability, developing novel thermodynamic principles and operating schemes; and down-sizing integration with other renewable energy technologies.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Brecha, R.J.; Schoenenberger, K.; Ashtine, M.; Koon, R.K. Ocean Thermal Energy Conversion-Flexible Enabling Technology for Variable Renewable Energy Integration in the Caribbean. *Energies* **2021**, *14*, 2192. [CrossRef]
2. Garduno-Ruiz, E.P.; Silva, R.; Rodríguez-Cueto, Y.; García-Huante, A.; Olmedo-González, J.; Martínez, M.L.; Wojtarowski, A.; Martell-Dubois, R.; Cerdeira-Estrada, S. Criteria for Optimal Site Selection for Ocean Thermal Energy Conversion (OTEC) Plants in Mexico. *Energies* **2021**, *14*, 2121. [CrossRef]
3. García Huante, A.; Rodríguez Cueto, Y.; Hernández Contreras, R.E.; Garduño Ruíz, E.P.; Alatorre Mendieta, M.Á.; Silva, R. Validation of Sea-Surface Temperature Data for Potential OTEC Deployment in the Mexican Pacific. *Energies* **2021**, *14*, 1898. [CrossRef]
4. Tobal-Cupul, J.G.; Cerezo-Acevedo, E.; Arriola-Gil, Y.Y.; Gomez-Garcia, H.F.; Romero-Medina, V.M. Sensitivity Analysis of OTEC-CC-MX-1 kWe Plant Prototype. *Energies* **2021**, *14*, 2585. [CrossRef]
5. Yasunaga, T.; Fontaine, K.; Ikegami, Y. Performance Evaluation Concept for Ocean Thermal Energy Conversion toward Standardization and Intelligent Design. *Energies* **2021**, *14*, 2336. [CrossRef]