

# Accelerating Prototype Development with Machine Learning

At Sandia National Laboratories, engineers have developed a framework for using machine learning (ML) to enhance the design and optimization of hybrid offshore co-generation systems and wave energy converters (WECs).

## Hybrid Offshore Co-Generation Systems

Sandia engineers are developing open-source software that combines scientific models and machine learning. By rewriting existing software to work with physics-informed machine learning (ML), they have laid the groundwork to use ML to maximize energy production and reliability in co-generation systems. This holistic approach allows for rapid prototype design and system optimization for metrics beyond the traditional levelized cost of energy. Sandia worked with the Navy's Carderock division to develop three case studies that address military needs, including co-generation for defense applications and power generation for arctic missions.

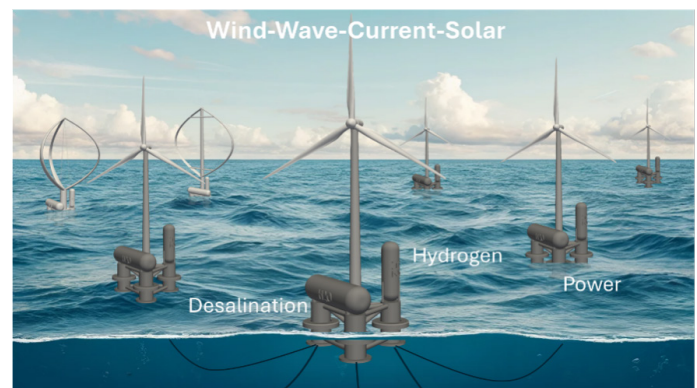
## Advancements in Wave Energy Converters

Traditional models that assume simple, straight-line relationships have not been effective in accurately predicting how wave energy converters (WECs) interact with water. To address this, Sandia's Hydrodynamic Energy Systems engineers are using ML to investigate more complex, non-linear models.

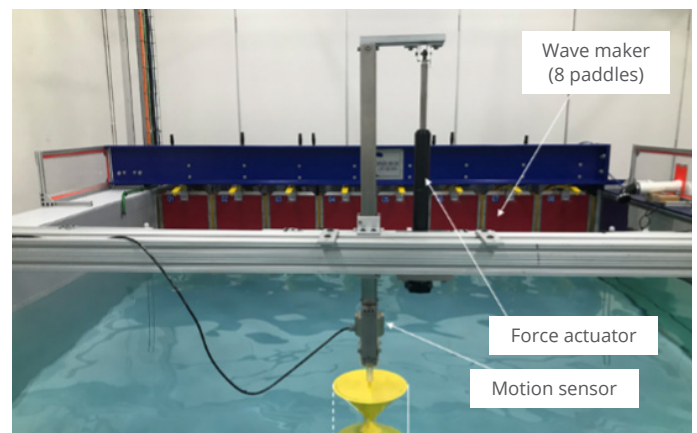
Leveraging ML, Sandia's engineers have developed a testing rig and methodology that can capture the intricate behaviors of WECs. Measuring these delicate dynamics without introducing spurious noise is tricky but critical. Along with 3D printing, engineers are able to leverage rapid prototyping and testing to obtain data for a range of geometries. The knowledge gained from these experiments helps create strong, data-driven models that can be used to improve the design and efficiency of WECs, making them more effective at harnessing energy from ocean waves.

## Future Directions

By harnessing ML, Sandia's engineers are accelerating prototype development and paving the way for more efficient energy systems that can meet the diverse needs of military and civilian applications. The integration of ML into the design and optimization processes represents a significant advancement in the field, positioning Sandia as a leader in the development of next-generation energy solutions.



Example of a hybrid offshore co-generation system where wind, wave, current, and solar energy production can be optimized by ML.



Wave tank used for testing of bi-directional dynamics of different geometries through rapid-prototyping.

## Contact Information:

**Peter Kobos**  
Program Manager  
phkobos@sandia.gov

**Carlos Michelen Strofer**  
Technical Contact  
cmichel@sandia.gov