Integrated Combined Energy (ICE) Box

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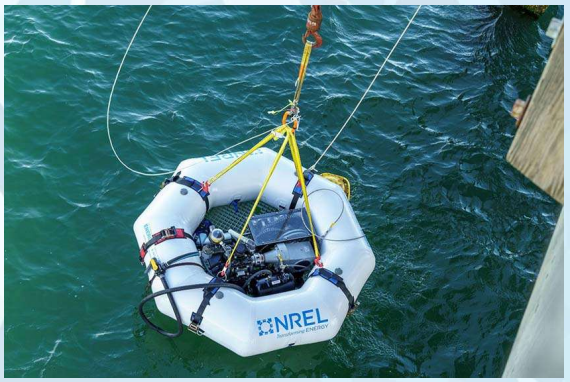
Challenges in Wave Energy

- Wave energy is inherently stochastic and highly variable (10:1 peak to average speeds in normal operation)
- This results in electrical energy that has high fluctuations in both voltage and current
- Most electrical applications require at least a semi constant voltage to operate (120V at 60 Hz, 208V, 220V, 480V…) making energy management essential
- Very limited commercial off-the-shelf solutions
- Additionally, the cyclical, bidirectional nature, coupled with the variance associated with all renewables, make some energy storage essential for continual power supply

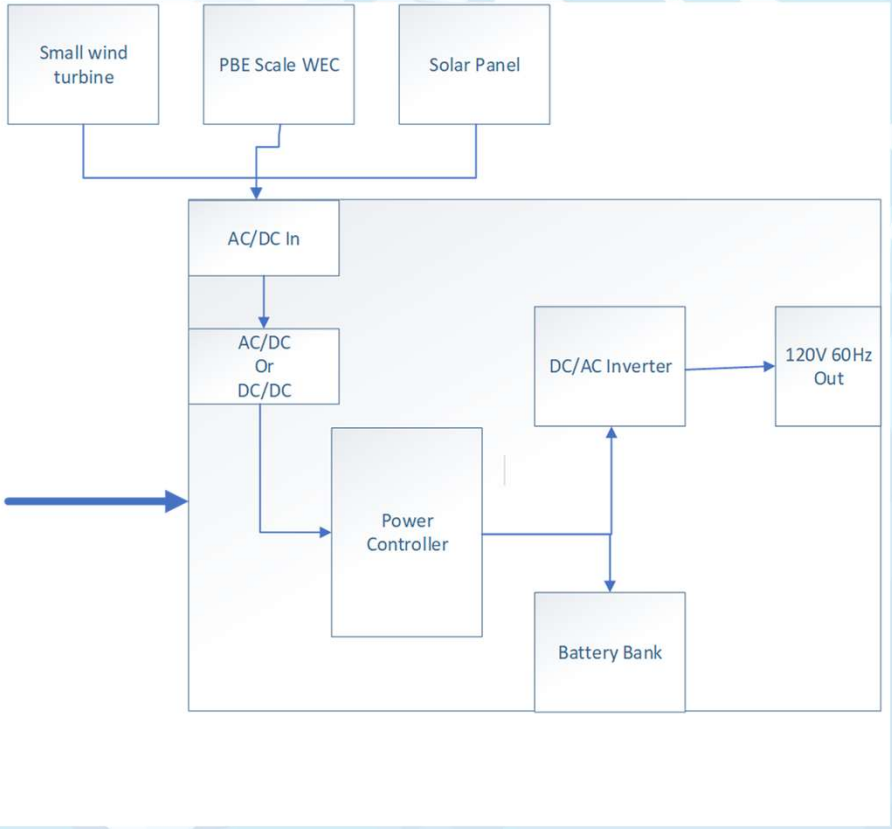
ICE Box Origins and HERO WEC

- Energy management system for a heave type WEC
- Current system developed as part of the Waves 2 Water - HERO WEC project.
- Used to turn “wild AC” into useable 120V 60Hz to power a desalination system
- Successfully completed extensive in-lab testing and field tested at Jennette’s Pier in NC



ICE Box Features

- Highly robust and durable
- Rapidly deployable and simple to operate
- Essentially turnkey (drop and go)
- 1.9 kW max rating
- 80 Ah energy storage
- 120V, 60 Hz AC power output
- Wave, tidal, river, wind, and solar energy compatible



Ongoing Work

- Increase rating (10 kW or higher)
- Increase energy storage capacity (5x or higher)
- Parallel power paths
  - 2 renewable inputs (reduce energy intermittency challenges)
  - 2+ power connection points for multiple applications
- Validate with river, wind, and solar inputs
  - Develop control strategies

Future Work: Emergency Response and the Blue Economy- Challenges and Opportunity

- Increased frequency of extreme climate emergencies
- Emergencies and disaster scenarios can last for days-weeks-months
- Urgent need for flexible, robust, and reliable energy solutions that are not reliant on fossil fuels
  - Sustainability
  - Availability
  - Cost
- The Blue Economy needs applications, use cases, end-users, and demonstrations, to become self sustaining

The need and opportunity is clear but the question remains:

How best to address the requirements of emergency response organizations while supporting the development of the blue economy and the advancement of MHK technologies?

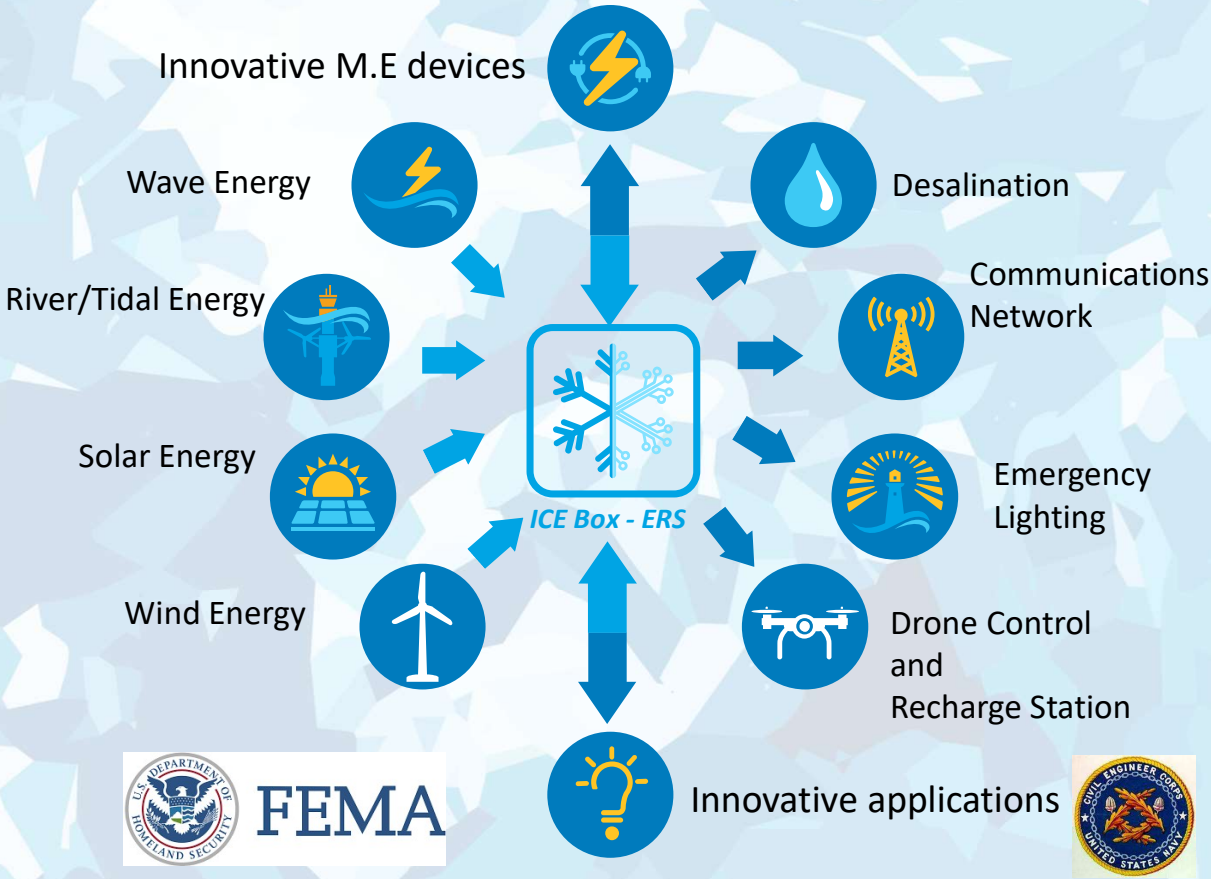
ICE Box - ERS

Future Work: ICE Box 2.0 – Emergency Response System (ERS)

ICE Box – ERS is a robust, rapidly deployable, and adaptable energy management system that is compatible with a variety of renewable energies and specifically designed to service the energy requirements in emergency and disaster response scenarios.

Work with emergency response stakeholders to identify the needs and requirements and then address through either:

1. Direct application/solution development
2. Co-design/co-develop with end application and/or marine energy device developers.
3. Facilitating partnerships and collaborations between end application and/or marine energy device developers.



FEMA

Next Steps

- Marine-energy and water-power developers
- Application developers
- Emergency response and disaster relief agencies

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