U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Powering the Blue Economy: R&D for Wave Energy Powered Microgrids

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"The ocean will become an economic force this century"
The Economist Intelligence Unit (2015)

Steve DeWitt: U.S. DOE Water Power Technologies Office
Andrea Copping: Pacific Northwest National Laboratory
Mark Hemer: Australian Blue Economy Cooperative Research Centre
Levi Kilcher: National Renewable Energy Laboratory
Bryson Robertson: Oregon State University
Giorgio Bacelli: Sandia National Laboratory
James Donegan: ORPC Ireland

Agenda

1. Workshop overview: 10 min (Steve DeWitt)
2. U.S. 'Powering the Blue Economy' Initiative: 10 min (Andrea Copping)
3. Australian Blue Economy Project: 10 min (Mark Hemer)
4. Energy Storage and Wave Energy Microgrids: 10 min (Levi Kilcher)
5. Case study: Microgrid in Remote Canadian Communities: 10 min (Bryson Robertson)
6. Power Smoothing Requirements based on Wave Characteristics: 10 min (Giorgio Bacelli)
7. MHK Microgrid Inverters: 10 min (James Donegan)
8. Ideas from audience re future wave energy microgrid R&D topics: 10 min

Background

Remote communities that are reliant on diesel fuel for electric power are one the best early market opportunities for wave energy.

Unique remote communities considerations not included in this panel:

1. Limited infrastructure available within communities
2. Community considerations, e.g. visibility of devices, availability of resources
3. Material shipping constraints to remote areas
4. Land use concerns in remote communities
5. Environmental concerns in remote communities re diesel fuel spills
6. Training of local population for operations and maintenance

Power Smoothing and Energy Storage

1. Power smoothing is required to compensate for large peak to average (P2A) power ratios
2. Voltage & frequency regulation are particularly challenging in microgrids
3. Power smoothing can be accomplished through multiple means:
   a) Combining WECs with other generation types, e.g. wind, solar, low head hydro
   b) Utilizing geographic separation of large number of smaller WECs
   c) Energy storage (ES) on WECs and at the point of grid interconnection
   d) Load shedding via WEC control systems
   e) Energy exchange between WECs
   f) ES options: battery, supercapacitors, flywheels, compressed air energy storage, etc
   g) Power smoothing and ES integration drives need for system level design

Potential R&D Projects

1. Hybrid ES integration for optimal power smoothing at different time scales at lowest costs
2. WEC positioning within an array and structural integration for optimal power smoothing
3. Microgrid controllers & inverters to optimize WEC integration with diesel generators
4. Integration of WEC arrays with other renewable energy resources

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THANK YOU!

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