



# EESI HYDROPOWER BRIEFING MARINE ENERGY UPDATE *Technology Commercialization*

April 24, 2019



*Enabling the Blue Economy and Supporting Job Growth*

# MARINE ENERGY RESOURCES

*Vast Amounts of Untapped and Predictable Power*

**Wave Energy** is converted from offshore, near shore, and shore based locations. It is driven by wind blowing over water creating waves from which energy is captured.

**Tidal Energy** is converted from the ebb and flow of tides and is driven by the gravity of the moon and sun. Tidal energy can be predicted years in advance.

**Ocean/River Current Energy** converts the power from moving ocean or river currents.

Wave Energy



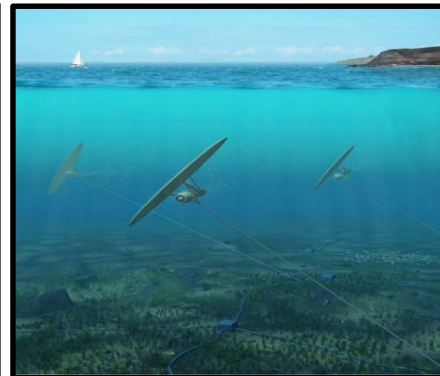
Columbia Power Technologies

Tidal Energy



Verdant Power  
Free Flow System Turbines

Ocean Current Energy



Minesto  
Turbine

In-Stream/River Current



Emrgy  
River Power Plant

# U.S. MARKET BACKGROUND AND FEDERAL SUPPORT



DOE estimates the technically extractable marine energy resource potential in the U.S. to be 1250 TWh/yr. Just 5% of the extractable resource could power 8 million (7%) U.S. homes. *A SIGNIFICANT MARKET OPPORTUNITY!*



EPACT 2005 officially recognized marine energy as a qualified renewable resource.



EISA 2007 authorized new DOE Water Power marine energy R&D activities. \$10 million appropriated in FY 2008 - \$70 million appropriated in FY 2019.



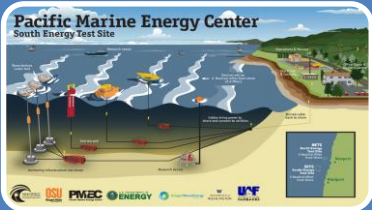
Increasing investments are critical to the emerging marine energy sector. Approximately \$600 million (\$540 million from DOE/DOD), cost-matched by the private sector, has funded 100+ R&D projects in the U.S since 2006.

# U.S. MARINE ENERGY R&D INVESTMENTS

## *Examples of Recent Progress*



The U.S. Navy Wave Energy Test Site - Full-scale devices deployed at Marine Corps Base Hawaii with testing and technical support from the Hawaii National Marine Renewable Energy Center.



The Pacific Marine Energy Center leads wave and tidal energy research. Oregon State University is constructing the grid connected PacWave offshore test facility near Newport, Oregon.

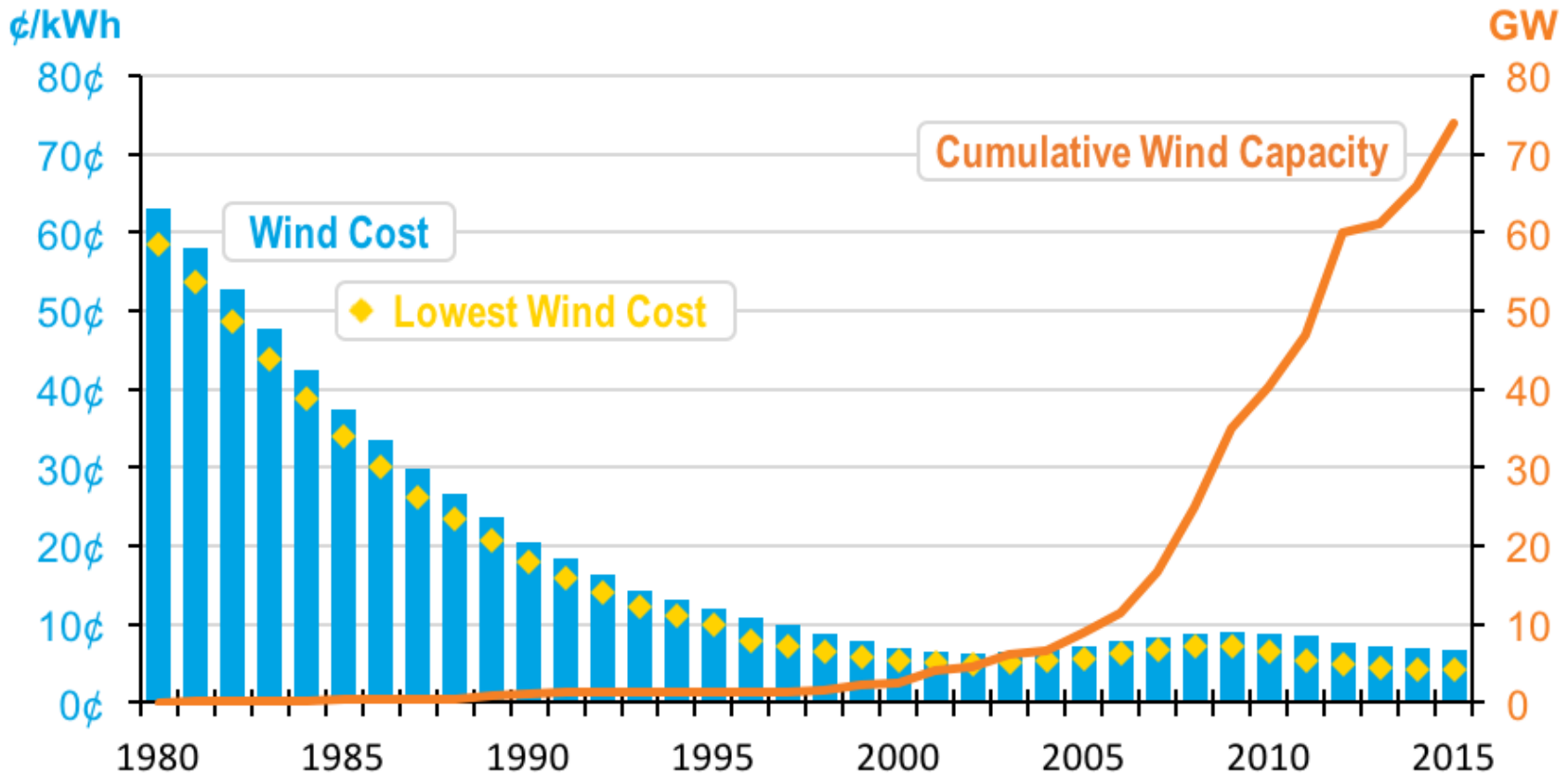


National Labs (NREL, SNL, PNNL, ORNL) supporting component testing and modeling of various generators and blades.



ORPC deploying a modified tidal energy device in an Alaska river and powering a tribal community.

# EXPERIENCE FROM OTHER DOE R&D INVESTMENTS



In the U.S., the first larger-scale wind farms were installed roughly **35 years ago**, though national wind power deployment did not begin to surge for another 15-20 years, when wind costs dipped into the cost-competitive range of 5 to 10 cents per kilowatt hour (¢/kWh).

Through DOE support of advanced technology R&D activities to reduce deployment barriers, the pace of marine energy technology commercialization can be accelerated.



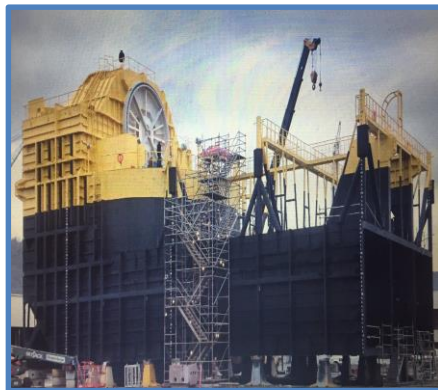
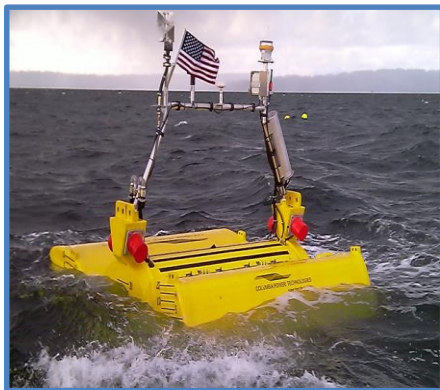
# DOD MARINE ENERGY ACTIVITIES

Congress provided \$120+ million over past decade for U.S. Navy marine energy R&D.

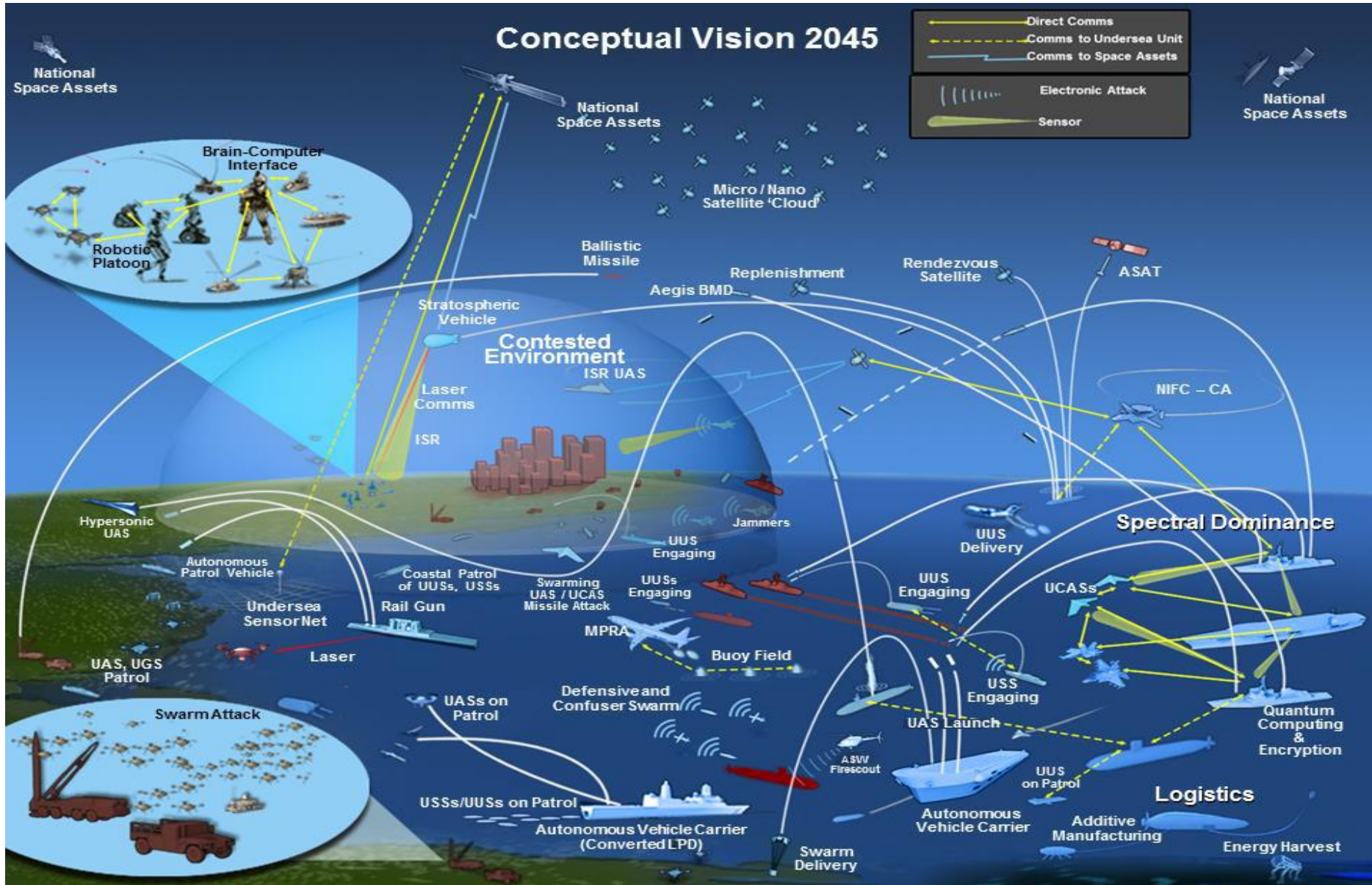
The U.S. Navy Wave Energy Test Site - Full-scale and scale devices are being deployed at Marine Corps Base Hawaii. WETS expansion to 3 berths completed in 2015.

Funded tidal energy R&D activities in Puget Sound (University of Washington).

Supported study of global Navy facilities with wave/tidal energy potential.



# NAVY 30 YEAR R&D PLAN





# MARINE ENERGY IMPACTS ON NATIONAL SECURITY

U.S. Navy interest in power for remote systems and tactical/base shore power.

China deployed a wave energy device to power remote island radar and communications.

China spending \$750M USD on marine energy R&D per 2016 5-year plan. \$90 billion for Hydro.



China's "Sharp Eagle" 200KW – Deployed in 2016 – Wanshan Island, South China Sea



# U.S./INTERNATIONAL COMPETITION

## U.S. Government Support



- DOE FY19 - \$70M for R&D
- One 3 berth, grid-connected, scale wave energy test site, 5 devices tested and 2 awaiting testing
- National fully energetic wave energy test center established, not yet built. None for offshore current or tidal
- Ad-hoc permitting regime/onerous environmental studies
- Tax credits lack parity with other renewables

Other countries investing in projects include Israel, Indonesia, Korea, Chile, Japan and Canada

## E.U. Government Support



- €3 billion for R&D announced since 2008
- Streamlined regulatory & licensing framework
- Renewable Energy Feed-In Tariffs
- Six+ functioning test centers with annual device deployments

## China Government Support



- **\$90+ billion** (5 yr. plan) for hydro/marine announced in 2016
- Almost no regulatory or licensing requirements – central planning via two ministries
- Several wave and tidal energy test sites operational

## Total Investments (to-date)

### Total European Investment:



**Total: \$3.9 billion\***

\*approximate total over 10 years in USD

### Total China Investment:



**Total: \$334 million\***

\*approximate total over 10 years

### Total U.S. Investment:



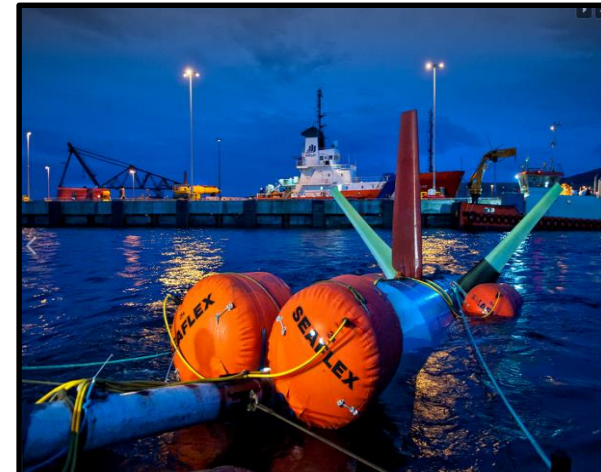
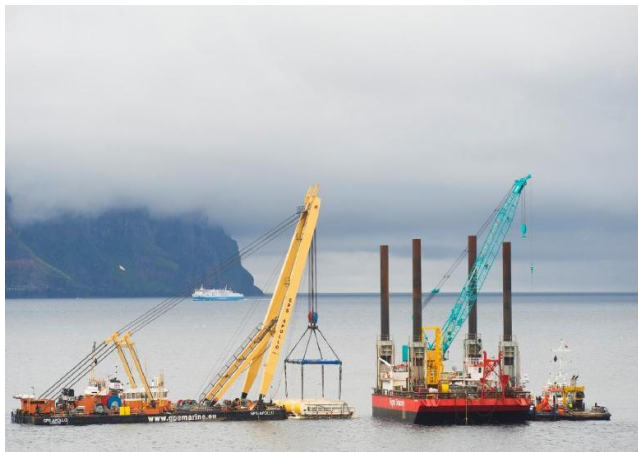
DOE \$420 M

DOD/Navy \$120M

**Total: \$540 million\***

\*approximate total over 10 years

# EUROPEAN MARINE ENERGY CENTER (EMEC) ORKNEY, SCOTLAND (\$16M/yr to local economy)



# U.S. FEDERAL PRIORITIES AND NEEDS

Funding to support technology advancement, verification that leads to private sector acceptance and utility adoption.

Clear, timely, predictable regulatory framework for siting and permitting of early stage and pilot demonstration marine renewable projects.

Continued funding for university-based basic and applied technology research, development and testing centers, which support private sector/utility efforts.

Implementation of a fair incentive regime structure that facilitates rapid, market proven advancement of technology deployment.

Federal agency coordination and stakeholder education on lessons learned from here and abroad on technology development, including standards and certifications, that will provide confidence to customers and financial markets.



Questions?

Thank You!!!

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