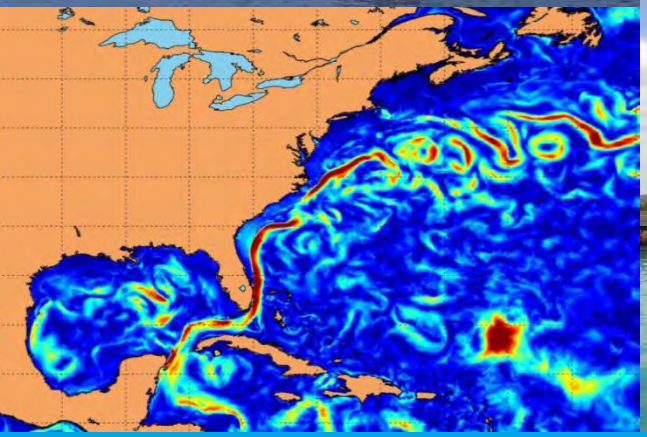
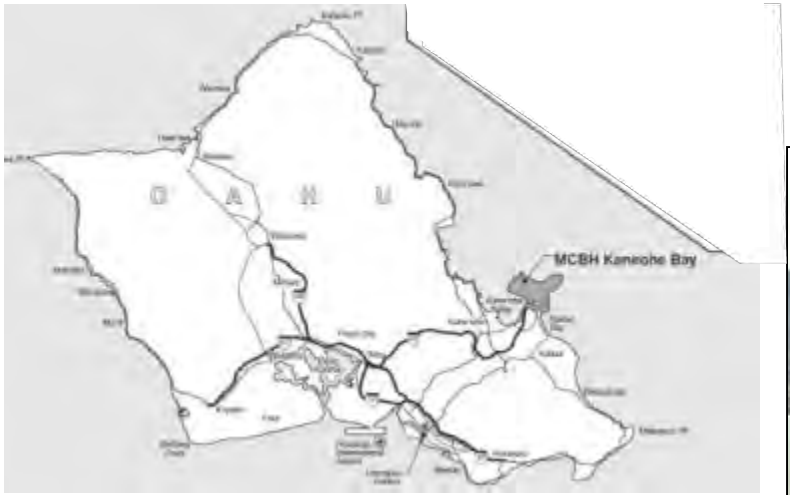
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



DOE Overview and the Global Update on Test Centers

Hoyt Battey
Program Manager for Market Acceleration and Deployment
Wind and Water Power Technologies Office
July 16, 2015

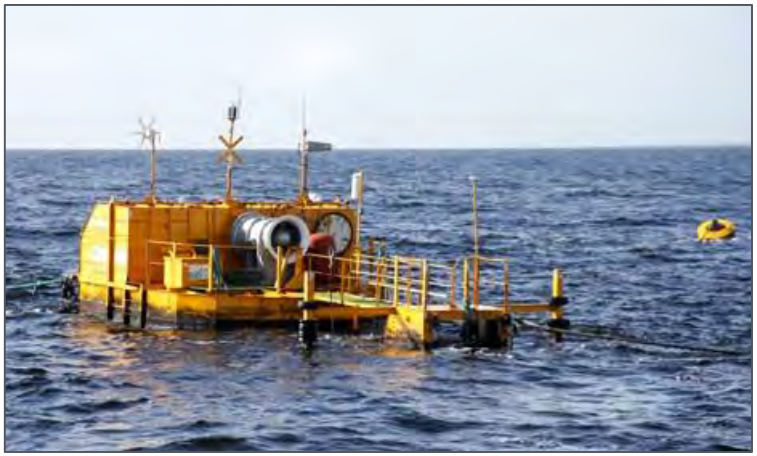
Hawaii Wave Energy Test Site



Navy Wave Energy Test Site
Marine Corps Base Hawaii

EXISTING 30M SITE

WETS (60/80 m) Deployment 2017/2018
Point Absorber & Oscillating Water Column



Energy Department Announces $10 Million for Full-Scale Wave Energy Device Testing - October 29, 2014

The Energy Department, in coordination with the Navy, is funding two companies that will continue to advance marine and hydrokinetic (MHK) technology as a viable source for America's clean energy future. Ocean Energy USA and Northwest Energy Innovations will test their innovative wave energy conversion (WEC) devices for one year in new deep water test berths at the Navy's Wave Energy Test Site …

http://energy.gov/eere/articles/energy-department-announces-10-million-full-scale-wave-energy-device-testing

http://oceanenergy.ie/gallery/

testzzzzOct

MHK Industry Feedback – Desired Attributes of a Grid-Connected, Fully-Energetic Wave Test Facility

- Fully-permitted
- Multi-unit, grid-connected berths; depth > 80m
- Fully energetic similar to commercial site
- Short to long-term deployments
- Baseline environmental characterization and environmental monitoring
- Characterized resource with wave monitoring
- Logistical support
- Power purchase agreements for revenue generation
- Environmental, social, and economic research
- Supportive community
- Ability to deploy/recover 12 months per year

testzzzzOct

DOE Wave Energy Testing Infrastructure Projects

(2 Projects – Oregon State Univ and Cal Poly Univ)

Objective:

- Develop a preliminary facility design
- Cost estimate and schedule
- Operations and maintenance cost

Site Location & Resource:

- Test berths subject to a full oceanic wave regimes
- Wave annual average power density ≥ 30 kW/m
- Testing berth water depths ≥50m

Site Capacity:

- 4 testing berths with supporting infrastructure
- Up to 1 MW per berth
- Grid interconnection

testzzzzOct

U.S. Test Sites

Test Site Name	Location	Promoter/ manager	Grid connection	Status
U.S. Navy Wave Energy Test Site	Kaneohe Bay Hawaii	U.S. Navy	Yes	Operational
Pacific Marine Energy Center – North Energy Test Site	Newport, Oregon	NNMREC	No	Operational
Pacific Marine Energy Center - Lake Washington	Seattle, Washington	University of Washington	No	Operational
Pacific Marine Energy Center Tanana River Hydrokinetic Test Site	Nenana, Alaska	University of Alaska Fairbanks AHERC	No	Operational
Pacific Marine Energy Center – South Energy Test Site	Newport, Oregon	NNMREC	Yes	Planned
California Wave Energy Test Center (CalWave)	Vandenburg Air Force Base, California	California Polytechnic State University	Yes	Planned
Southeast National Renewable Energy Center	Boca Raton, Florida	Florida Atlantic University	No	Planned
Center for Ocean Renewable Energy Atlantic Marine Aquaculture Wave Test Site	Iles of Shoals, New Hampshire	University of New Hampshire	No	Operational
Center for Ocean Renewable Energy General Sullivan Bridge Tidal Energy Test Site	Portsmouth	University of New Hampshire	No	Planned
Camp Rilea Test Site	Camp Rilea, Oregon	Oregon Military Department	No	Operational

testzzzzCut

U.S. MHK Testing Infrastructure Investment Strategy

TRL	Approx. Scale	Infrastructure Requirements	High Cap-Ex Gaps	Approximate Leveraged Cost to Fill Gap ($M)
1-4	$^1/_{50}$ -$^1/_{10}$	Small oscillating drivetrain simulator Wave basin/flume (1-5m deep, .1-1m Hs)	No gap	-
5/6	$^1/_5$ - 1	Med. oscillating drivetrain simulator (2 MNm) Wave basin/flume (5-10m deep, 1-2m Hs) Wave basin/flume (10-20+m deep, 1-2m Hs) Protected berths (10-50+m deep, 1-2m Hs)	1 "mid-size" No gap 1 "deep lab" 2 protected berths	1 – 3 - 8 – 23 1 – 3
7/8	½ - 1	Large oscillating drivetrain simulator (10 MNm) Open water berths with grid sim. / connection (20-100+m deep, 2-4+m Hs)	1 "large" 2 open water berths (critical)	5 - 15 8 - 23
9	Array	2 array strings, 3-5 berths each	2 array strings	15 - 45

Red: High priority investment Yellow: Medium priority investment Green: Low priority investment

Update on International Marine Energy Testing Activities

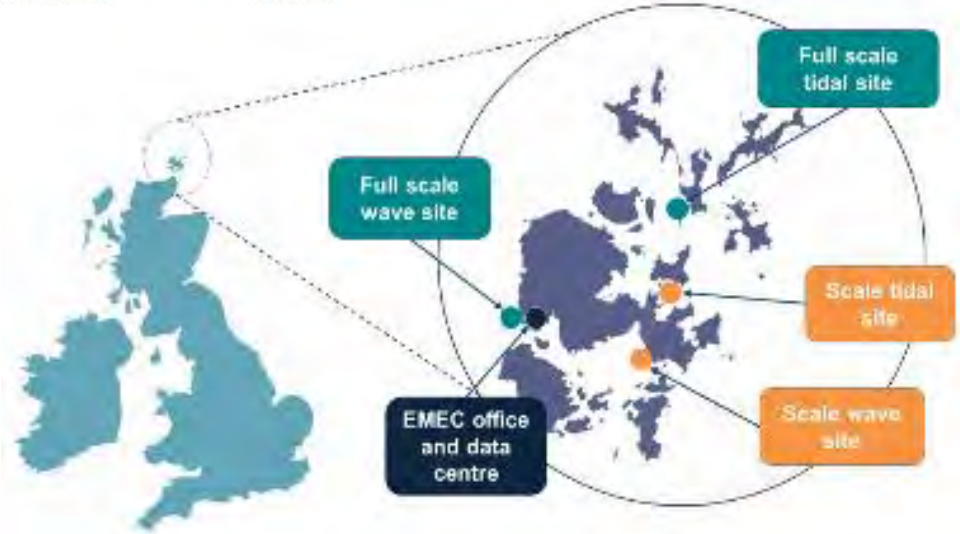
EMEC ORKNEY

THE EUROPEAN MARINE ENERGY CENTRE LTD

Wave Energy Clients

AQUAMARINE POWER

WELLO OY



Tidal Energy Clients

ALSTOM (FORMERLY TGL)

ANDRITZ HYDRO HAMMERFEST

ATLANTIS RESOURCES CORPORATION

BLUEWATER ENERGY SERVICES

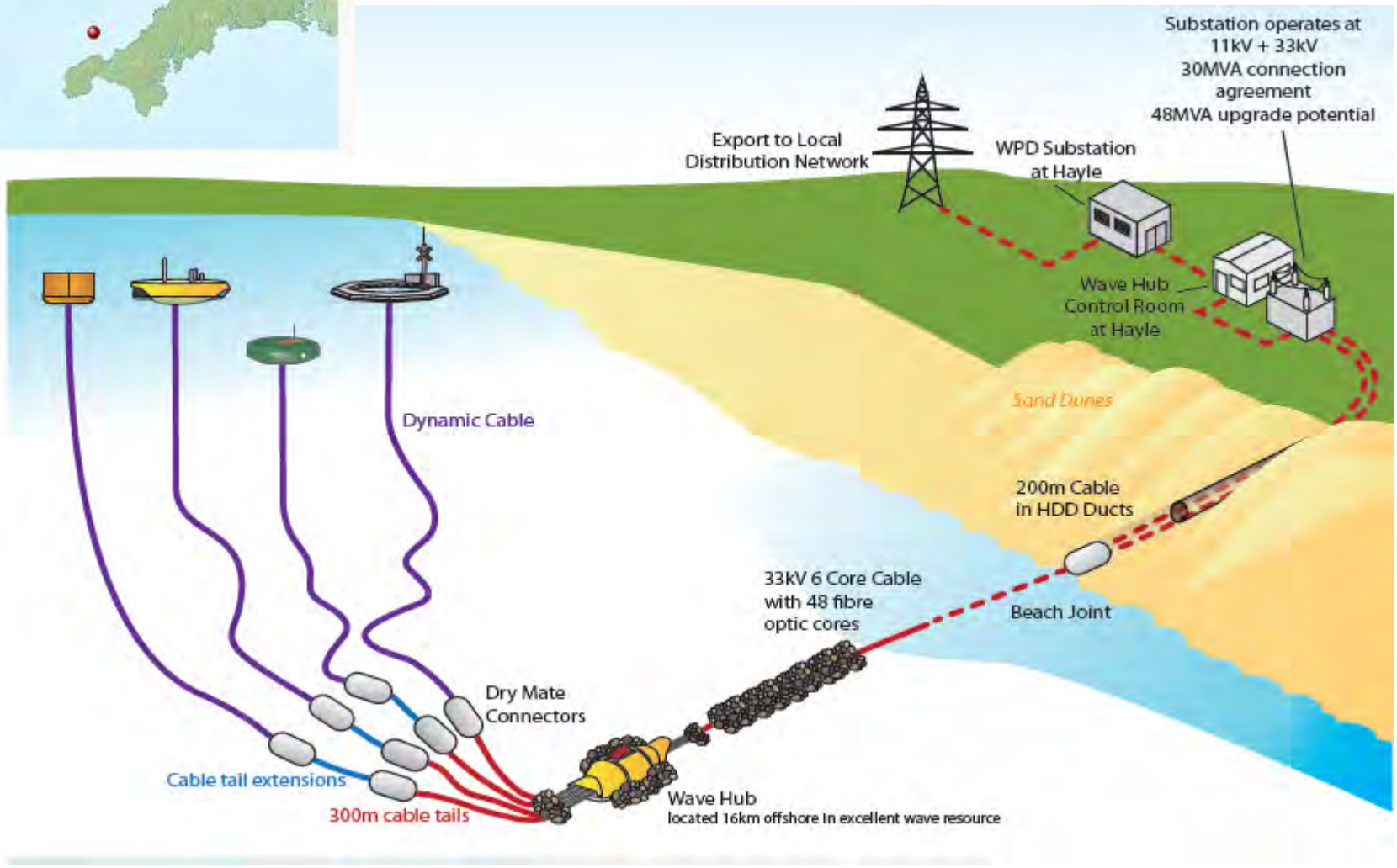
NAUTRICITY

OPEN HYDRO

SCOTRENEWABLES

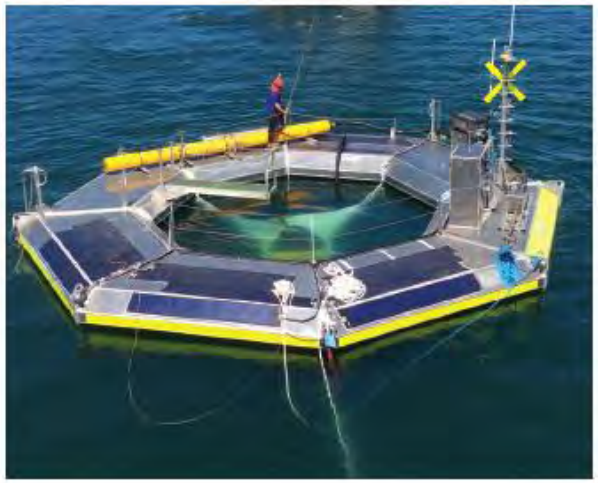
SUSTAINABLE MARINE ENERGY

Wave Hub


Substation operates at
11kV + 33kV
30MVA connection
agreement
48MVA upgrade potential
Export to Local
Distribution Network
WPD Substation
at Hayle
Wave Hub
Control Room
at Hayle
Sand Dunes
Dynamic Cable
200m Cable
in HDD Ducts
33kV 6 Core Cable
with 48 fibre
optic cores
Beach Joint
Dry Mate
Connectors
Cable tail extensions
300m cable tails
Wave Hub
located 16km offshore in excellent wave resource

Wave Hub

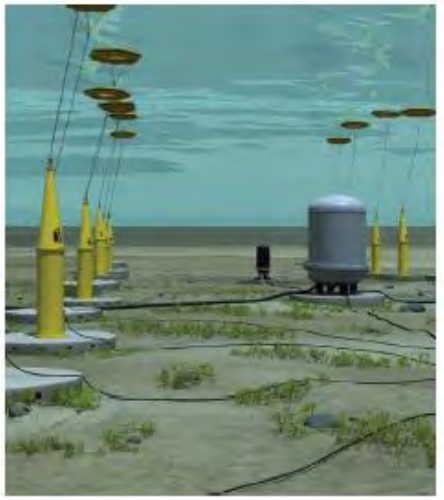
Seatricity



Fortum

Carnegie Wave Energy Ltd

Simply Blue Energy



Galway Bay Wave Energy Test Site: Ireland

FORCE

fundyforce.ca

Fundy Ocean Research Center for Energy

Canada's leading test center for in-stream tidal energy

Assets:

- 10km transmission line, substation + equipment
- Visitor/Observation facility
- EA approval for 4 berth sites, 5 MW
- 4 x 34.5kV subsea power cables; 64 MW capacity to be installed
- Comprehensive site and current data

Activities & upcoming events:

- Development of platform for high flow sensors (FAST)
- Ongoing environmental monitoring & research
- Oct: cable lay rehearsals; Power cables 2014
- Nov: 4th berth RFP closes; FIT to be set fall 2013
- Next turbine 2015