



FAU

SOUTHEAST NATIONAL MARINE
RENEWABLE ENERGY CENTER

SNMREC Overview

Florida Energy Systems Consortium Workshop

May 13, 2014

Gainesville, FL

Marine Renewables

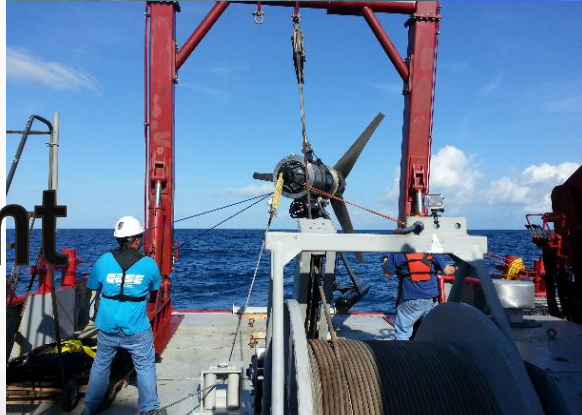
Tidal



Wave



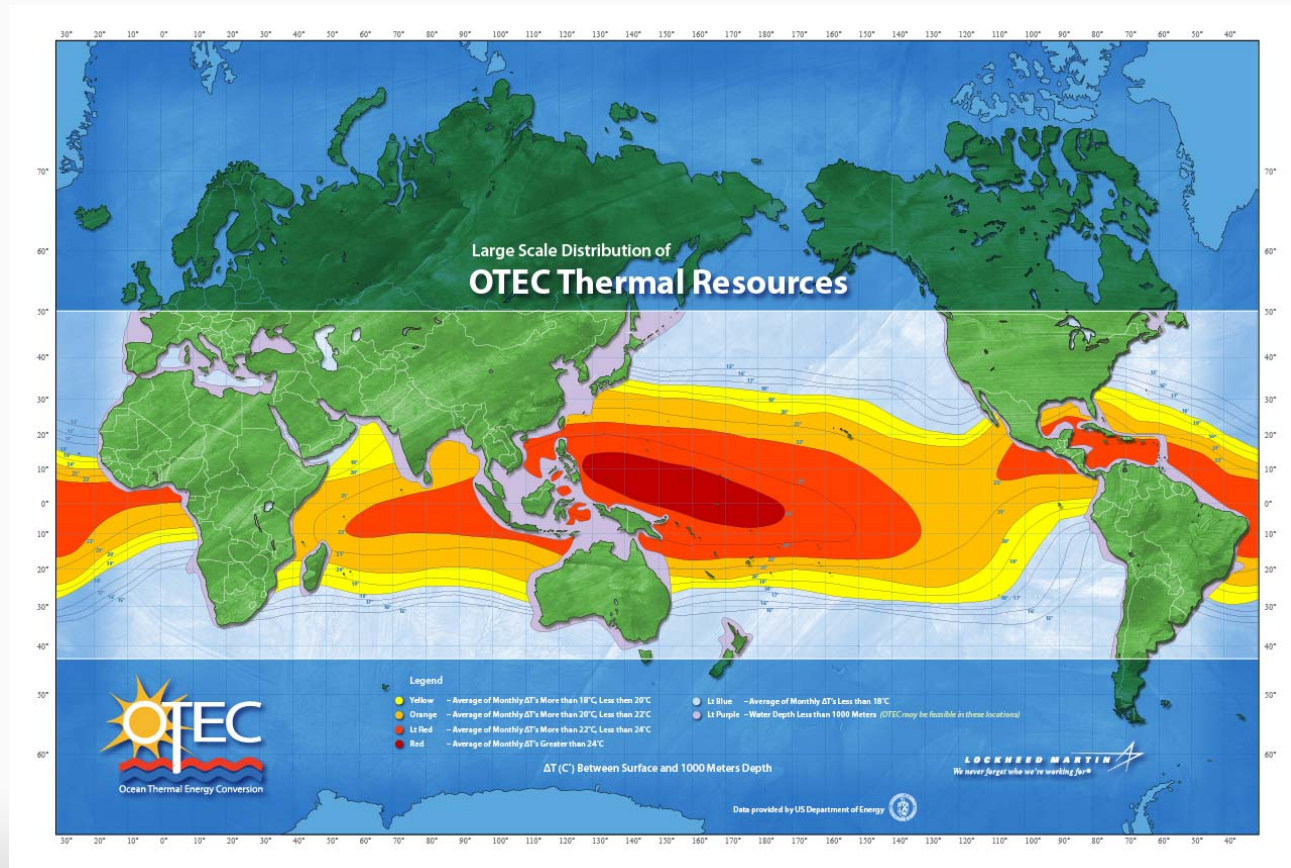
Current



OTEC



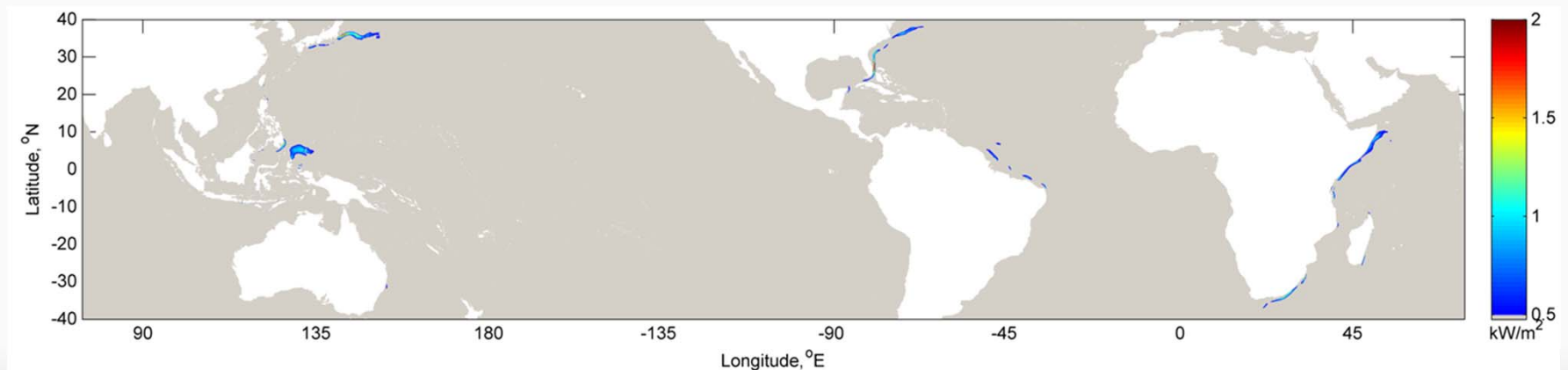
Ocean Thermal Energy Conversion



Ocean Current Energy Conversion

Ocean current installations differ from other in-stream projects:

- Energy-dense **flow located near the sea surface** (within upper 100 m)
- Flow located in total **water depths greater than 250 m** (99% found deeper)
- Current **reversals can occur** at many global sites
- Speeds can **temporarily decrease to near zero** at many sites

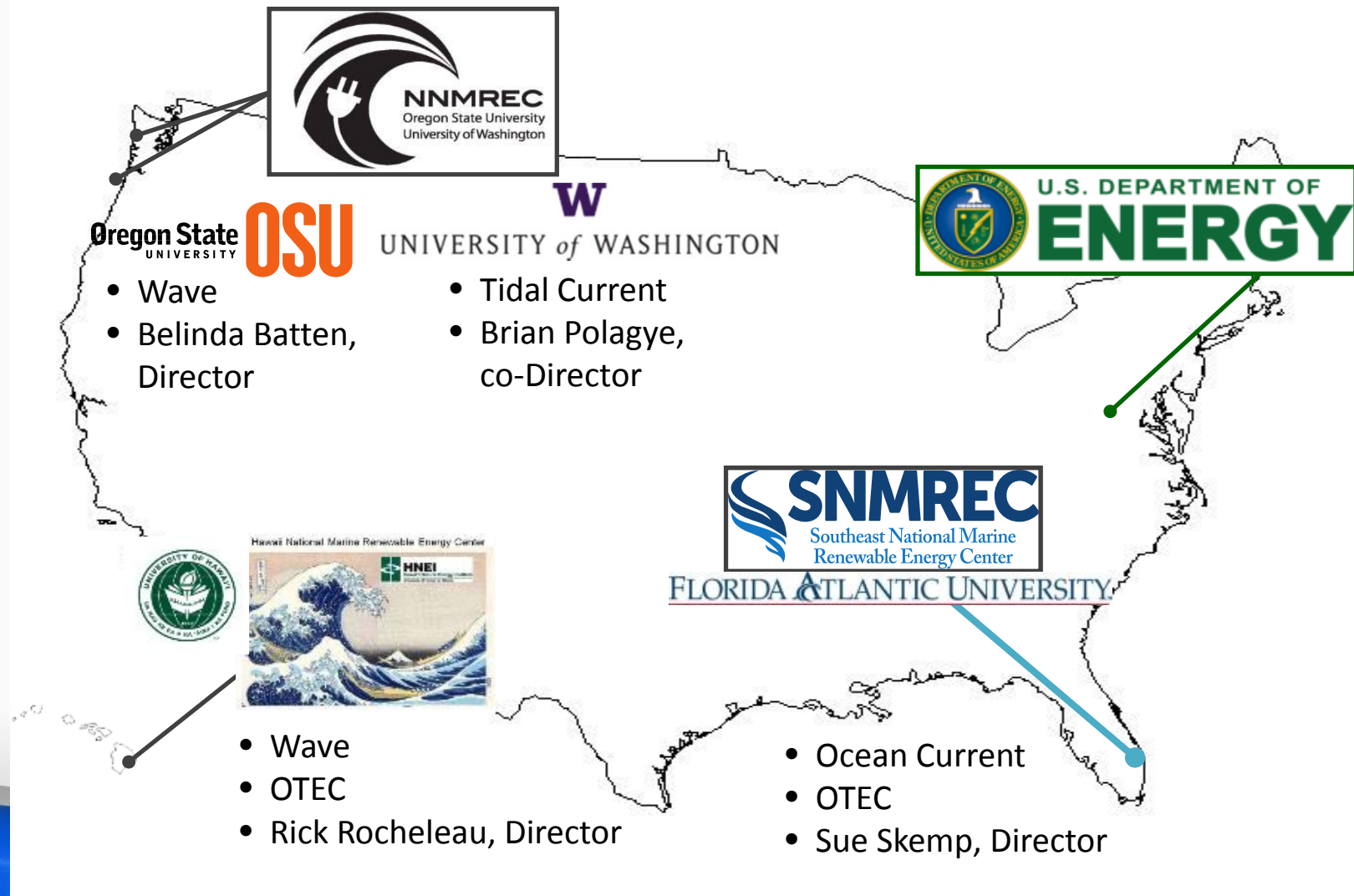


3 year averaged kinetic energy density $> 0.5 \text{ kW/m}^2$ at a depth of 50 m

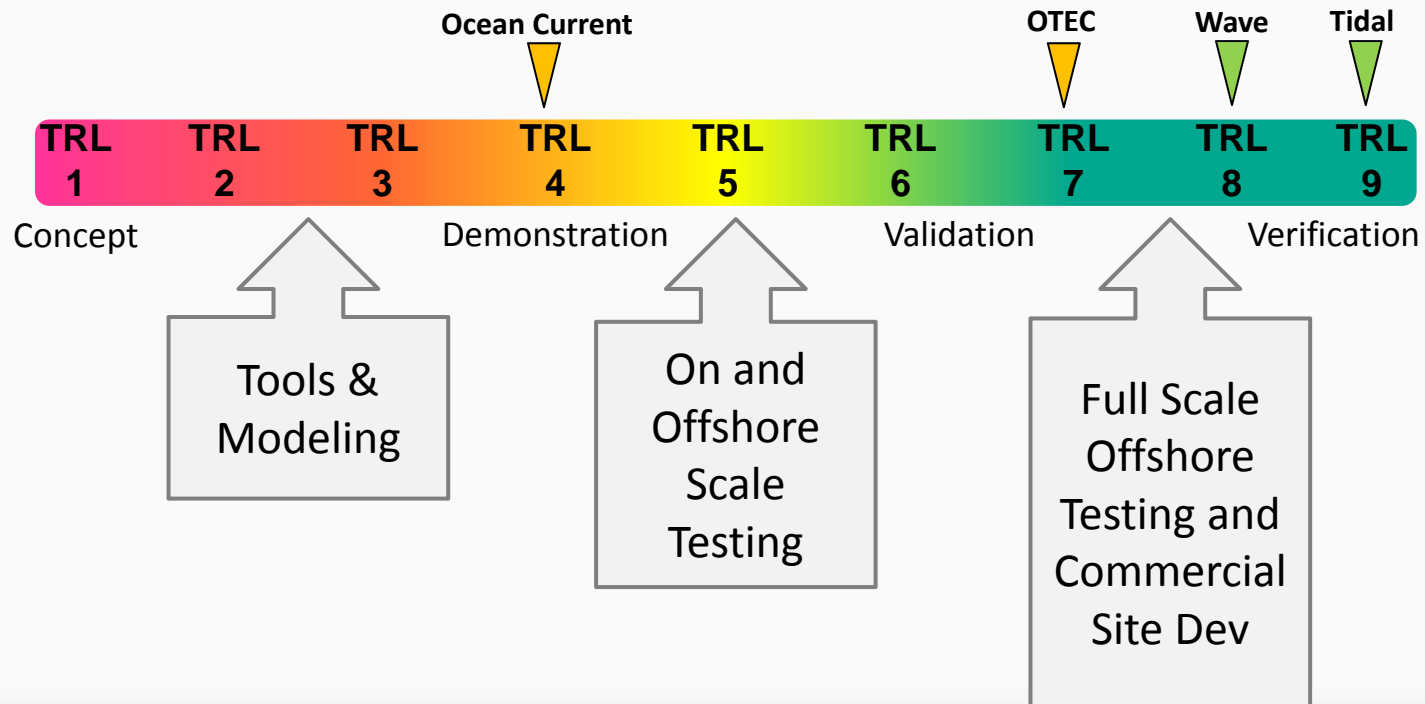


National Marine Renewable Energy Centers

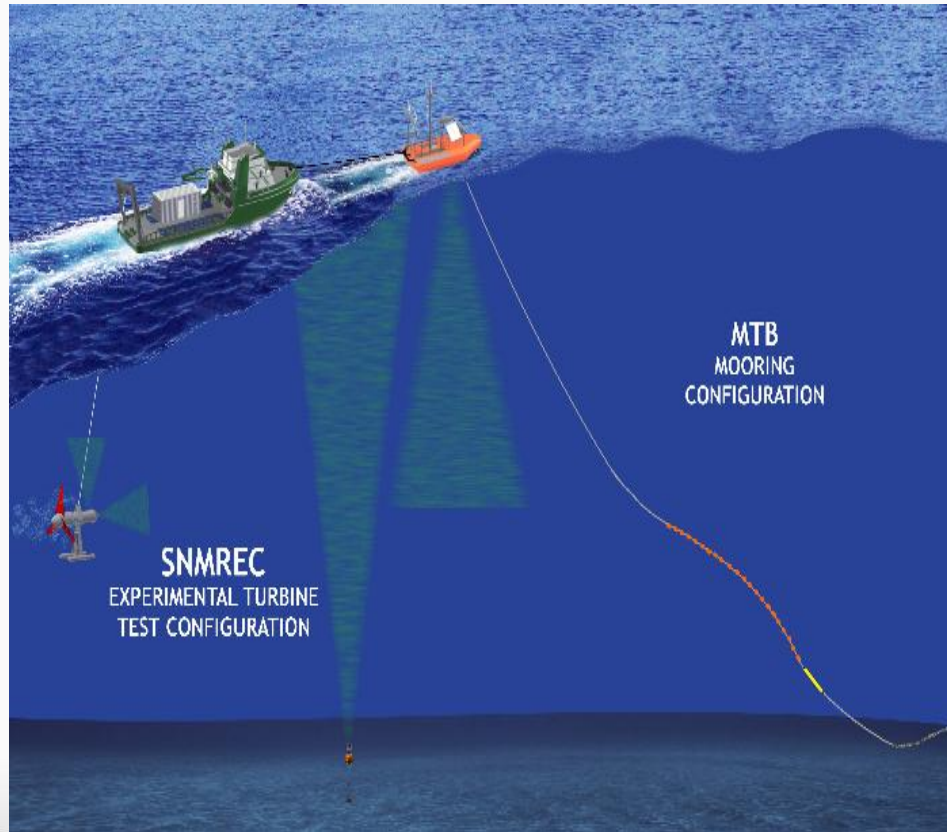
Working together to enable the MHK industry



FAU's Role



Small-scale Offshore Testing



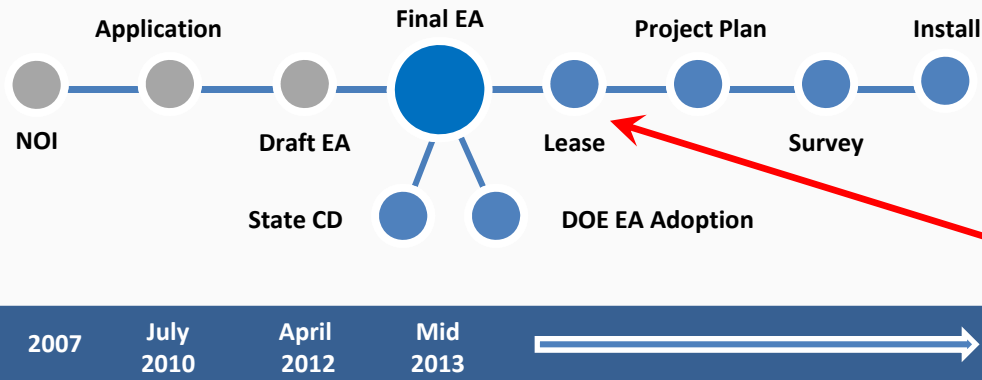
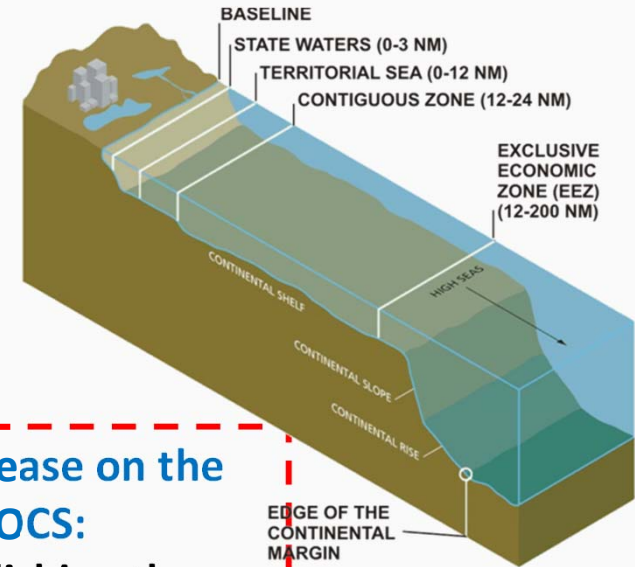
Surface-deployed
without power
transmission to shore

Capable of testing
1/10 – 1/4 scale systems
up to
100kW or **7m** diameter
demonstration turbines



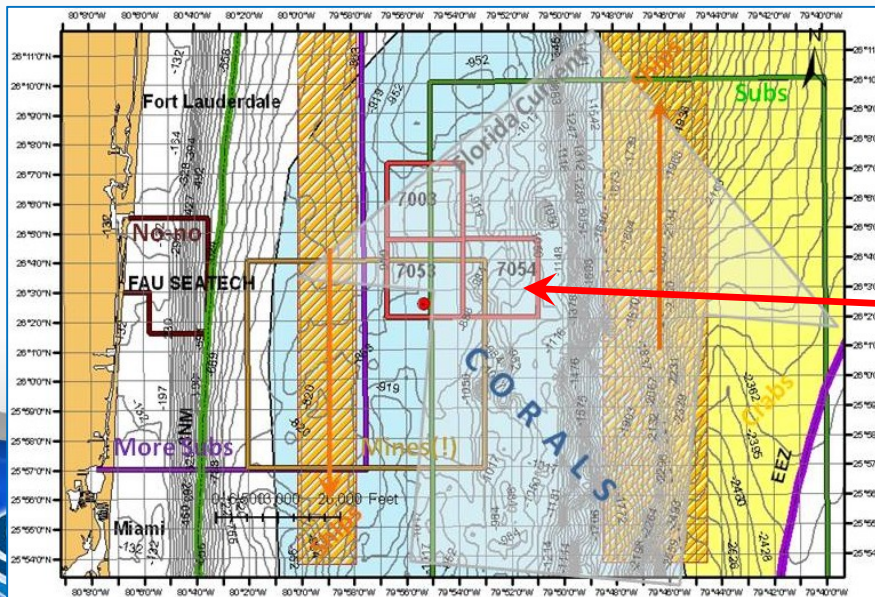
Regulatory Framework

BOEM Lease



FIRST Lease on the OCS:

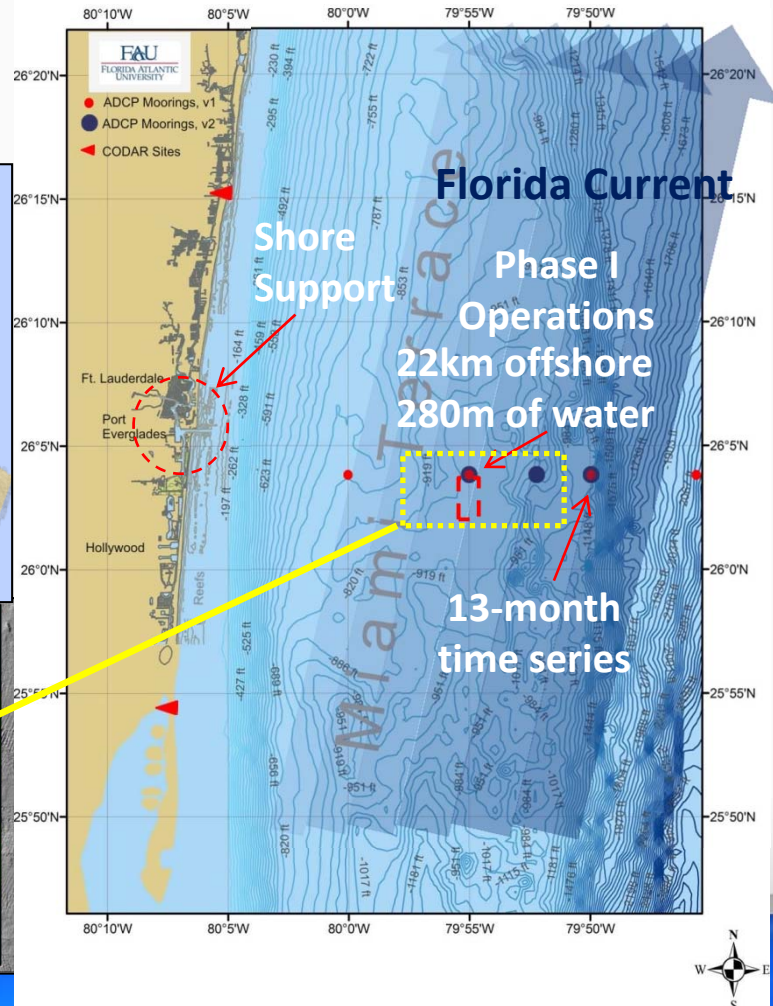
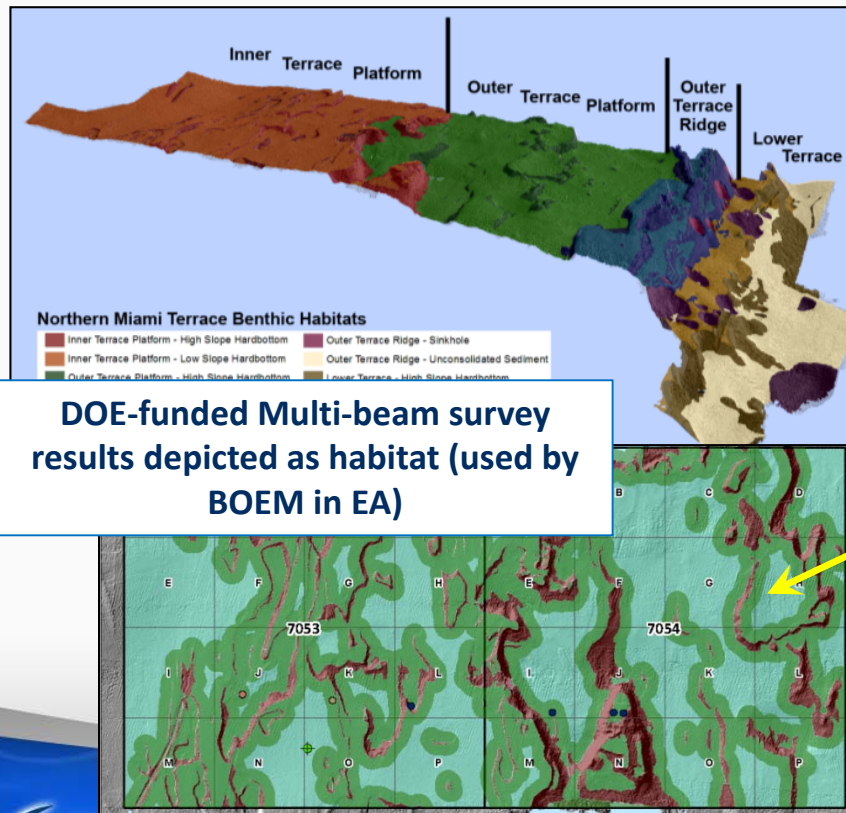
Establishing the framework for future applicants



SNMREC Lease Blocks:

Small-scale Offshore Test Berth

Location



Technical Approach

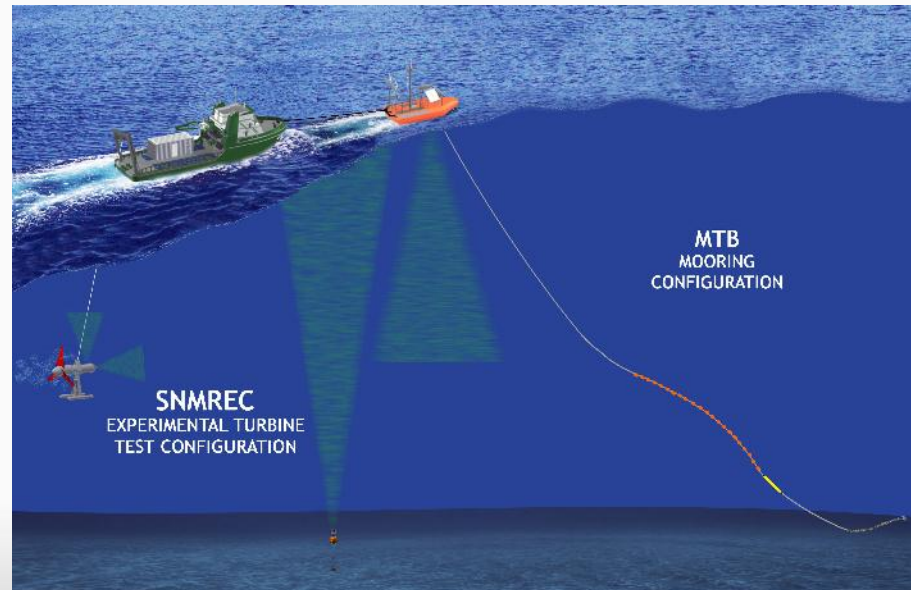
TRL 5/6 Demonstration-scale Turbine Test Berth

Technical Approach: Install mooring buoy for barge or vessel to deploy turbines (up to 100 kW or 7 meter rotor diameter) for surface-tethered validation tests.

Key Issues Addressed: Opportunity for industry to validate/explore energy conversion concepts and system dynamics prior to scale-up.

Unique Aspects:

- Relevant environment
- Fully characterized inflow
- Pre-permitted
- Standards-compliant measurements
- Simple management of generated power
- Vetted protocols and support infrastructure



Technical Approach

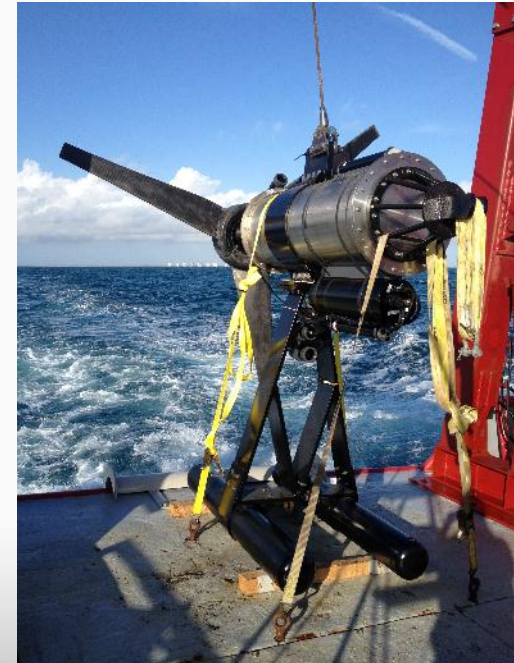
20 kW 3-meter Rotor Research Turbine

Technical Approach: Build small-scale research turbine with features representative of industry concepts.

Key Issues Addressed: Validate numerical tools, evaluate commercial component performance, develop and test prognostics systems, research rotor design and performance, and document environmental interaction.

Unique Aspects:

- Open-source and public design
- Many off-the-shelf reconfigurable components
- Standard tools used for design (NREL CAE Tools)
- Negative, positive, or neutral buoyancy configuration
- Comprehensively measured powertrain health, inflow, and turbine motion



Technical Approach

Ocean Current Resource Characterization

Technical Approach: Install moored ADCPs to collect long term large-scale ocean current measurements and perform monthly turbulence characterization measurements for one year as a baseline data set.

Key Issues Addressed: Offshore test berth condition pre-characterization, ocean current numerical tool validation/verification, commercial site evaluation measurement techniques, and collection of design input data for turbines.

Unique Aspects:

- Builds on past legacy and data sets
- Adaptive approach (subsequent deployments re-configurable)
- Comprehensive: large and small scales measured
- Repeatable methods
- Consistent with oceanographic best-practice
- Most cost-effective approach
- Turbulence approach consistent with and in cooperation with NREL/NNMREC



Accomplishments and Progress

Major Tech Accomplishments FY12-13:

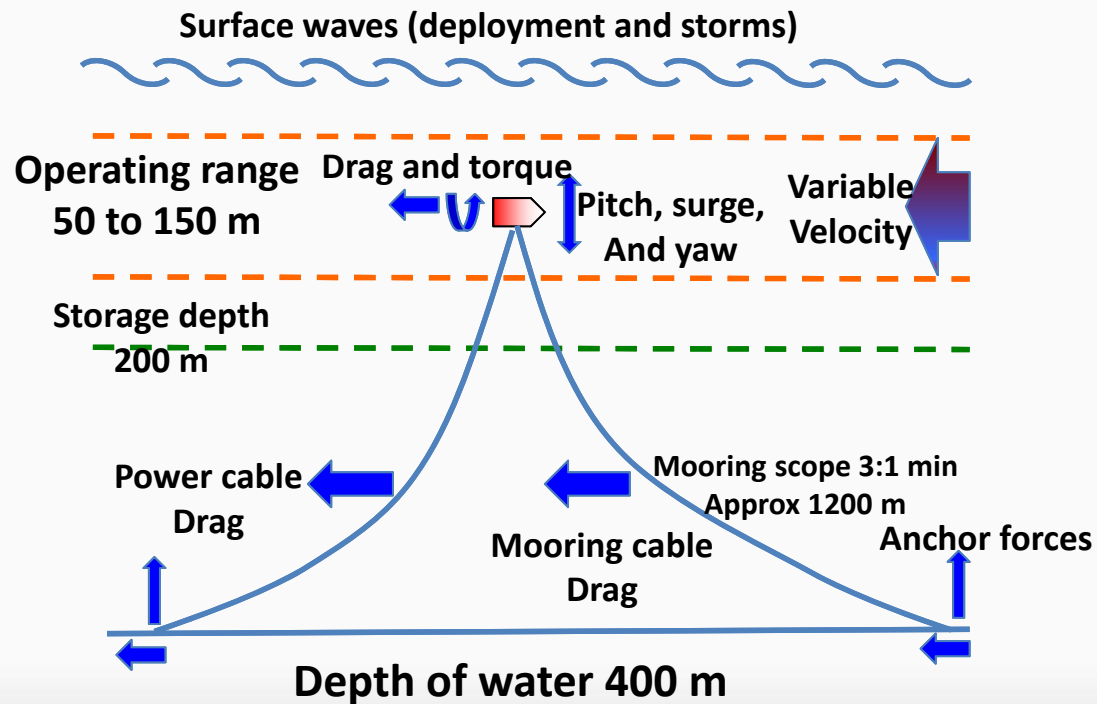
- First MHK Environmental Assessment and FONSI on OCS in U.S. (Q4 FY2013, originally expected Q2 FY12)
- Turbine rotor designed and non-instrumented blades delivered
- Turbine assembled and components tested
- PHM system concept completed and vibration analysis software beta tested
- Turbulence instrumentation lab tested/benchmarked (DE-EE0000319)
- Four years of moored ADCP data collected (DE-EE0000319)

Major Tech Accomplishments FY14:

- MTB sea trials complete and design verified
- Preliminary turbine tow tests complete (without generator, with rotor)
- BOEM Lease Offer to FAU – Due to finalize May 2nd

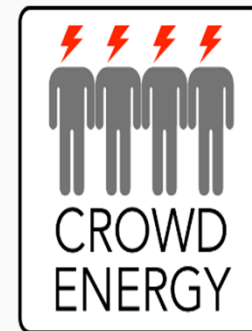


Full-scale Offshore Testing



Ocean Current MHK Industry 2014

SAFREMAENERGY LLC



Ocean
Current

OTEC

Wave
and
Tidal



Next Steps and Future Research

FY14/Current research plan:

Begin tasks previously under NEPA hold. Final installation of MTB dependent on BOEM lease process (possible barrier and/or delay), but majority of uncoupled tasks to finish by Q1 FY15:

- Turbine electrical and mechanical systems integrated Q4 FY14
- PHM research (preliminary designs, software, and data collection, and integration) to conclude Q3 FY14
- Instrumented rotor blades to be delivered Q3 FY14
- Moored ADCPs to be deployed Q2 FY14-Q1 FY15
- Turbulence measurements (1 year) completed Q2 FY15

Proposed future research:

- Deploy integrated research turbine for performance data measurement and tool validation
- As demand evolves, install additional test berths
- Customize and test PHM systems with commercial systems
- Continue resource characterization and evolve into now/fore-casting tools
- Leverage offshore testing and infrastructure for environmental interaction studies and further baseline population characterizations
- Mature modeling and analysis tools with commercial product evolution
- Begin grid-connected full scale test berth design/planning and leasing



THANK YOU!

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-See more at: <http://snmrec.fau.edu/>

