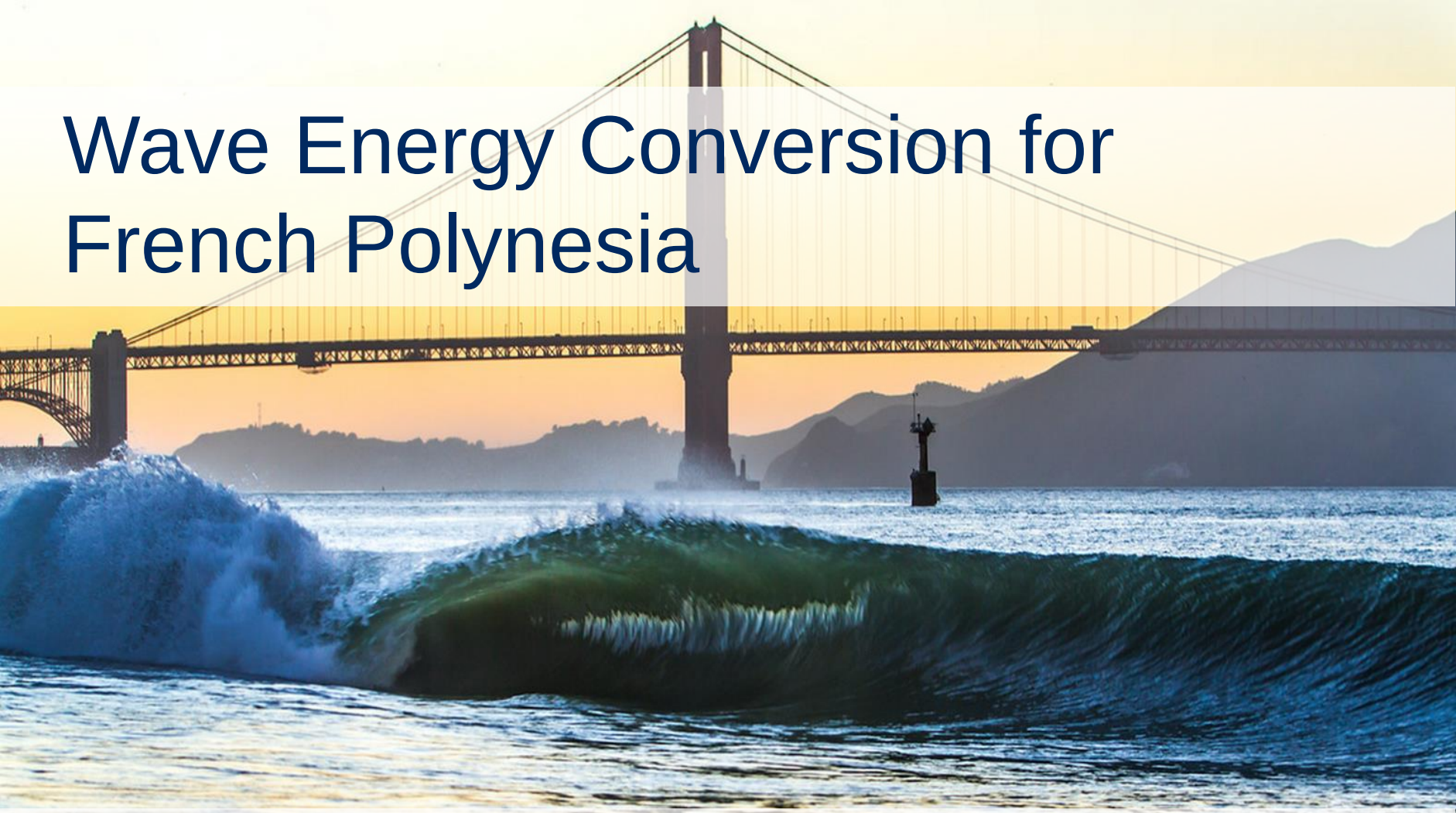
Wave Energy Conversion for French Polynesia



AGENDA

1) Introduction to Wave Energy
2) Wave Energy in French Polynesia
3) CalWave Potential

CalWave Power Technologies

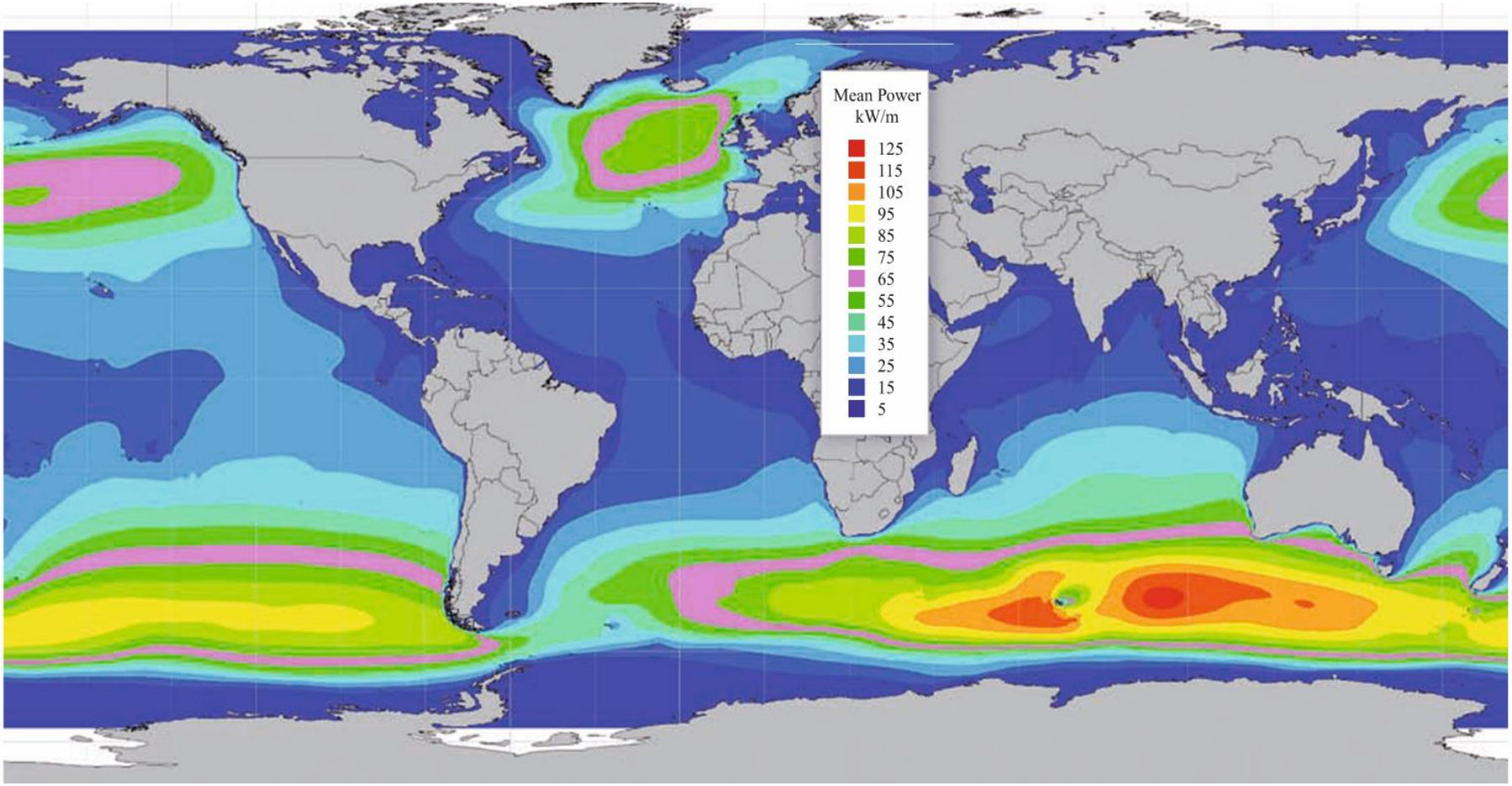
BERKELEY LAB
Lawrence Berkeley National Laboratory

Ocean Energy or Marine Hydrokinetics (MHK)

Ocean Energy Technology	Worldwide Theoretical Power Potential [TWh/year]
Thermal	44,000
Current	50,000
Tidal	1,200
Wave	29,500

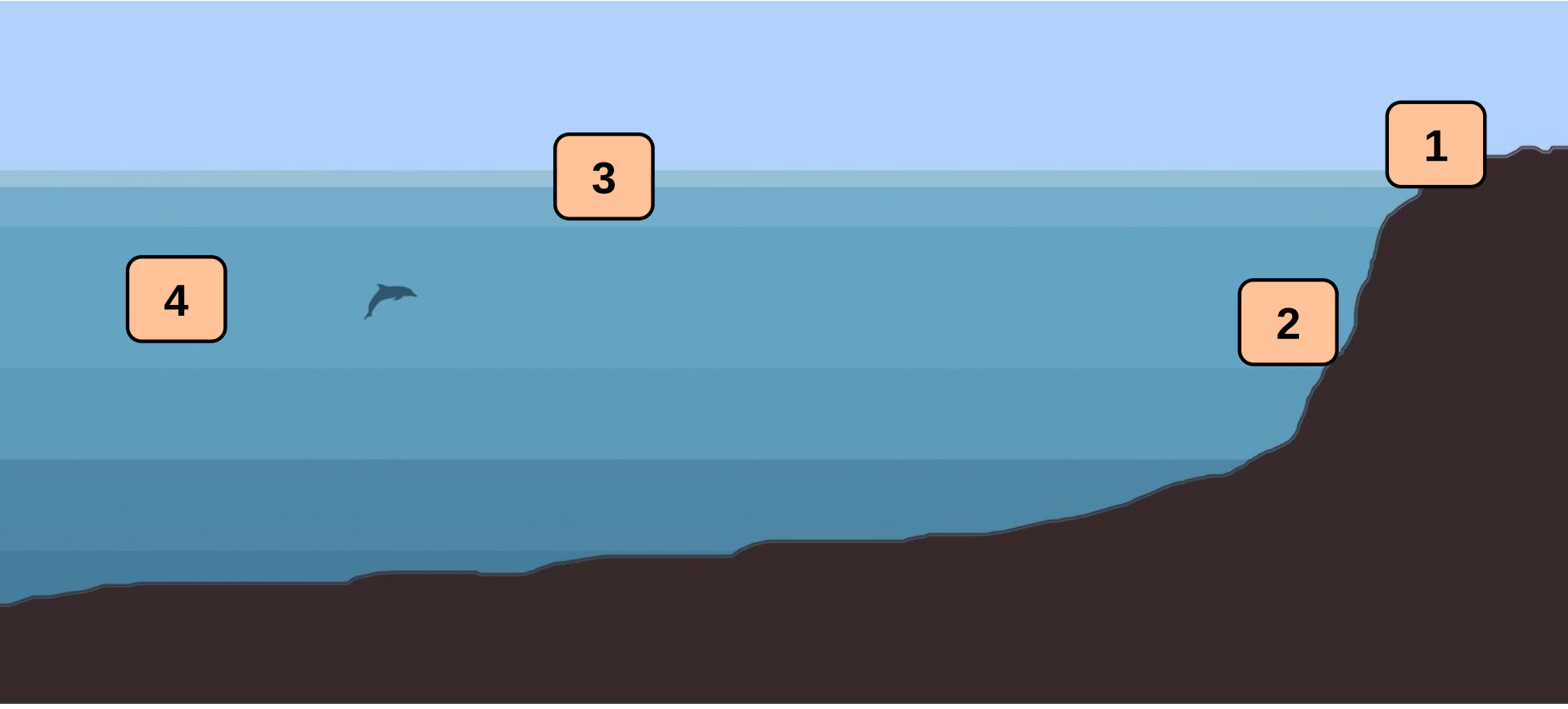
Source:
Renewable energy policy network for the 21st century: RENEWABLES 2012 GLOBAL STATUS REPORT, 2012.
Ocean Energy Systems: An International Vision for Ocean Energy, 2012.

WAVE ENERGY – Global Resource



Wave Energy Converter (WEC) Classification – Location

Deep Water Submerged | **Deep Water Floating** | **Shallow Water Bottom Mounted** | **Shore Based**



Wave Energy Conversion for French Polynesia

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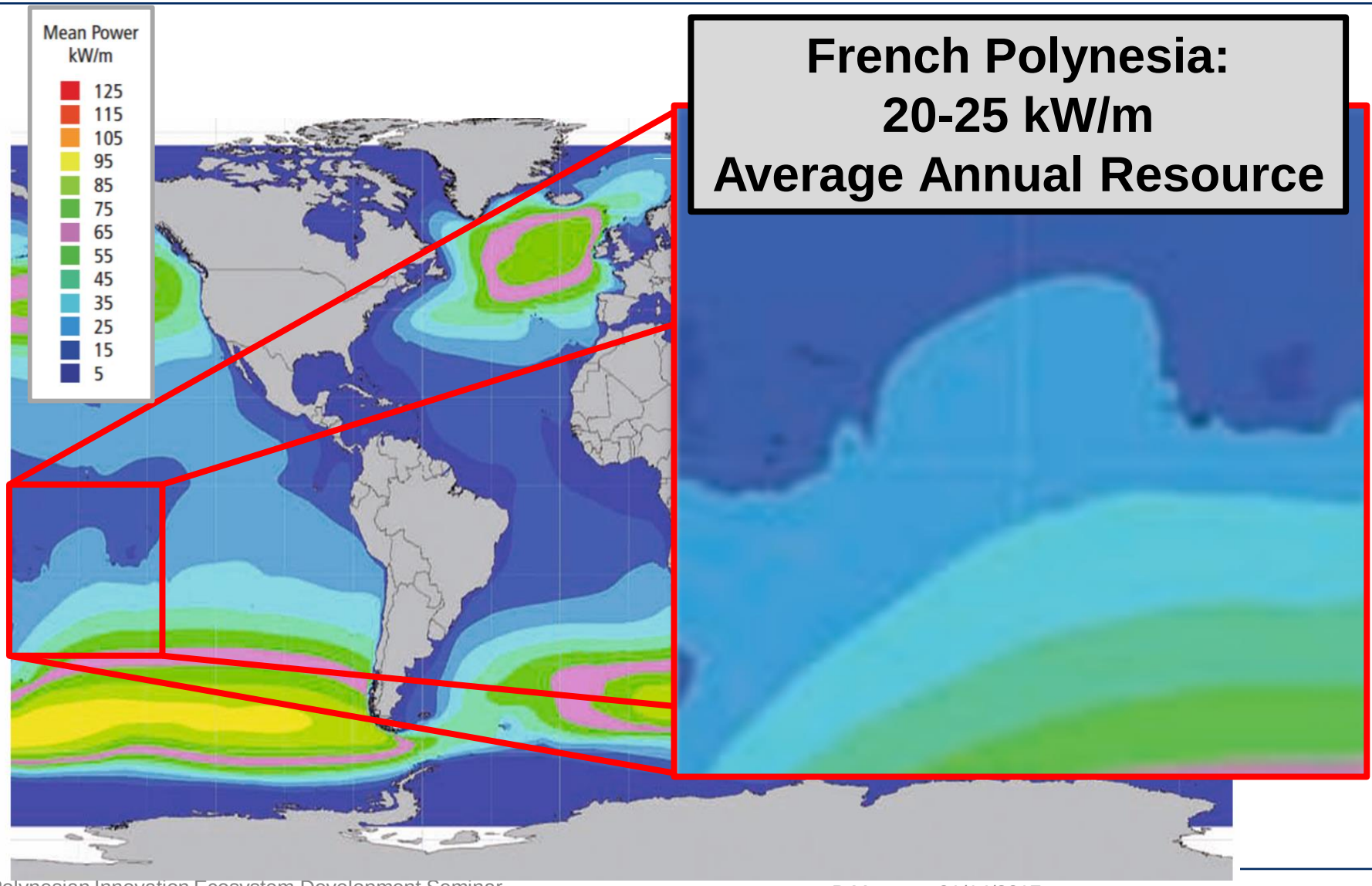
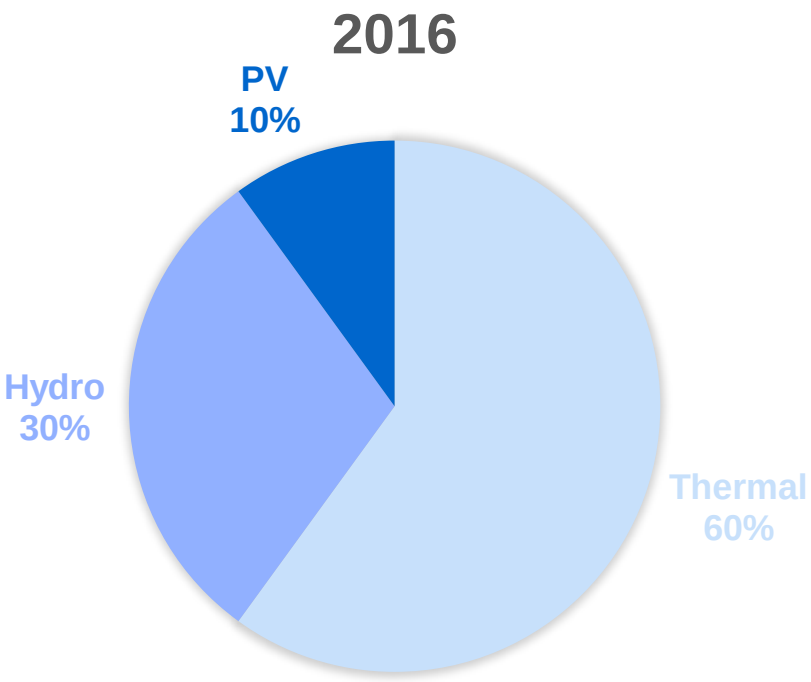
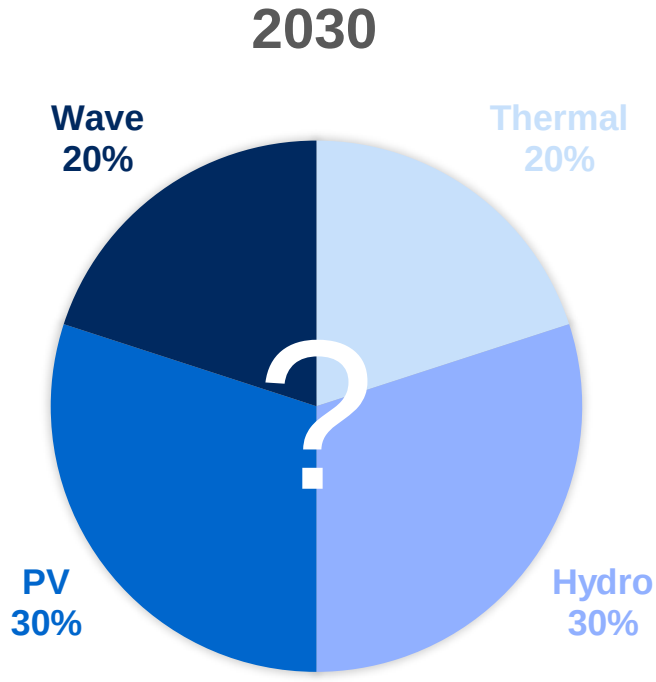
WAVE ENERGY – Maximum Practical Resource



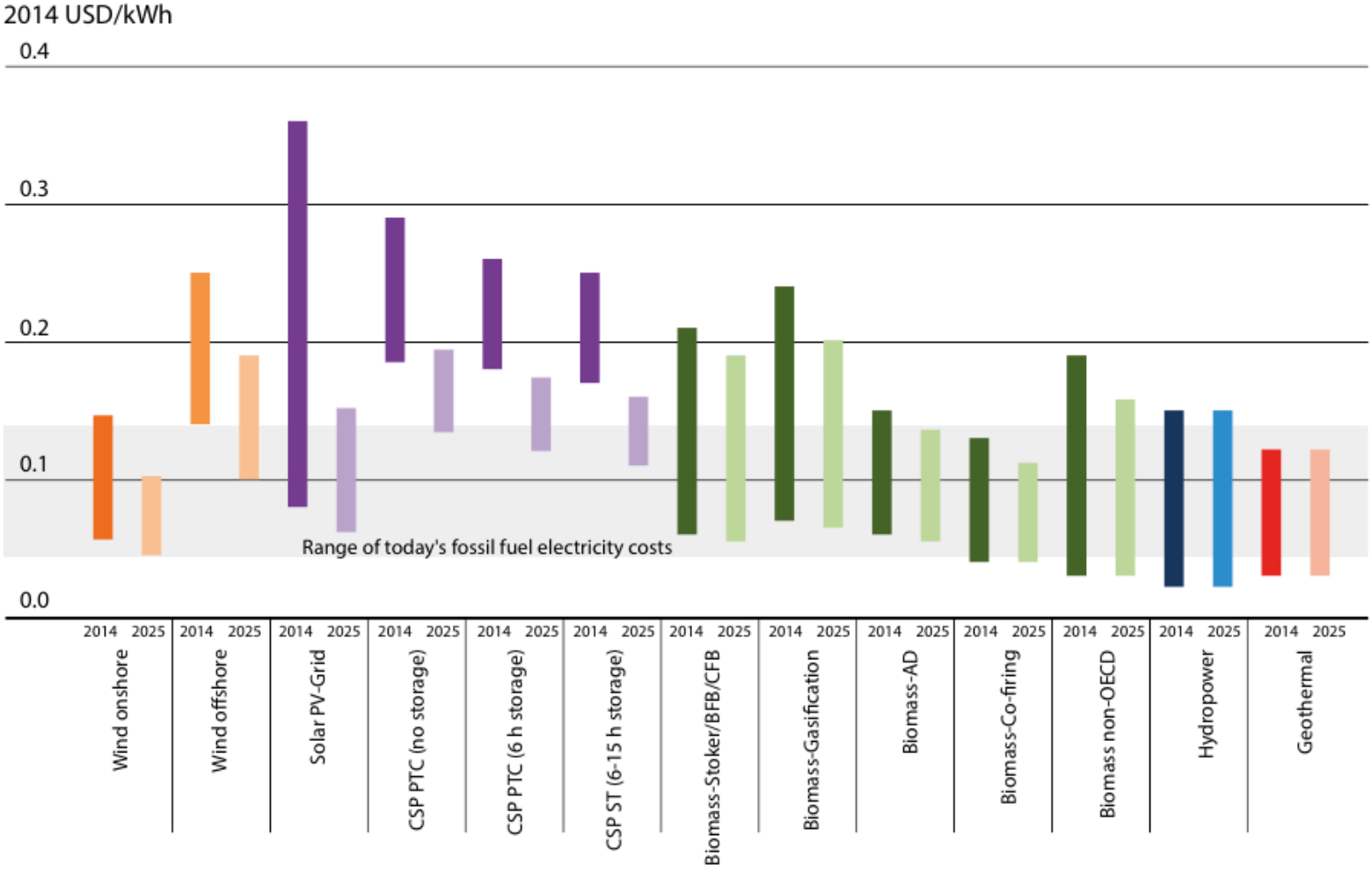
Current Energy Mix and Goal for 2030





What Options are available for French Polynesia?

FIGURE 10.1: LCOE RANGES BY RENEWABLE POWER GENERATION TECHNOLOGY, 2014 AND 2025



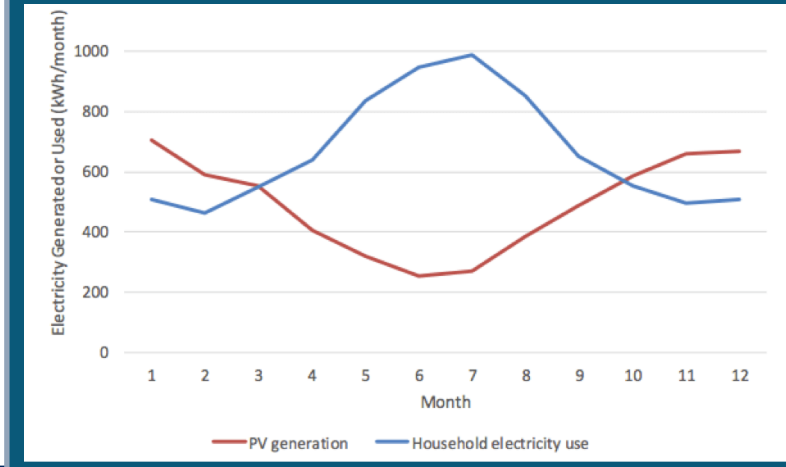
Important Issues of Wind and Solar Energy

Ugly

Vast amount of land required

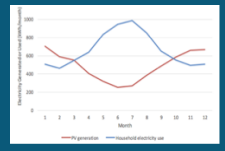
Polluting (rare-earth metals, cadmium)

Mismatch between output and demand



Wave Energy Solves the Issues of Wind and Solar Energy

Issues of Wind and Solar

1. Ugly 
2. Land required 
3. Demand mismatch 

Wave Energy instead is…

- Invisible 
- Concentrated 10X
- Consistent & predictable 

Rendering of Deployed Device

Wave Energy Conversion for French Polynesia

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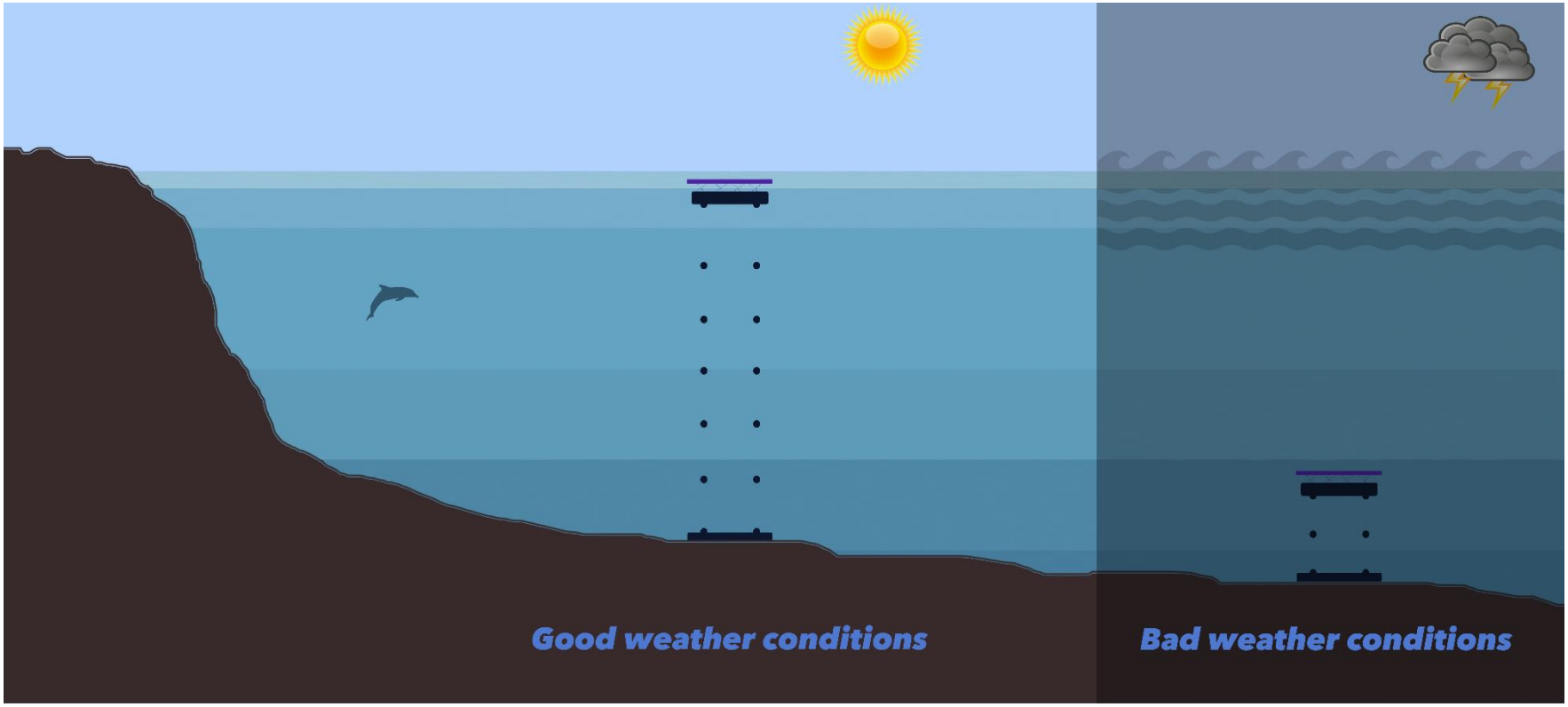
CalWave Power Technologies

BERKELEY LAB
Lawrence Berkeley National Laboratory

Innovative Wave Power Absorption: Inspired by Nature

Optimized Shallow Water Prototype reached over 60% Efficiency

Adaptation to “Deep” Water



CalWave has 3 Unique Features

Energy absorption in 3 directions:

- Very high efficiency

On board storage:

- Power output smoothening

Vertical movement along the water column:

- Optimal operational conditions
- Switch-off capability

CalWave has 3 Distinct Products:

CalWave Power Technologies

BERKELEY LAB

A Dampen Waves	B Produce Electricity	C Pressurize Water
▪ Manage Structural Load ▪ Protect Coral Reefs	**On-shore:** ▪ Baseload Power ▪ Energy Storage **Off-shore:** ▪ Research Stations ▪ Autonomous Vehicle Docking	**Salt Water:** ▪ Circulation for Aquaculture ▪ Pressurized Water for Cleaning **Desalinated Water:** ▪ Secure Drinking Water ▪ Irrigation for Gardening

Introducing CalWave Power Technologies

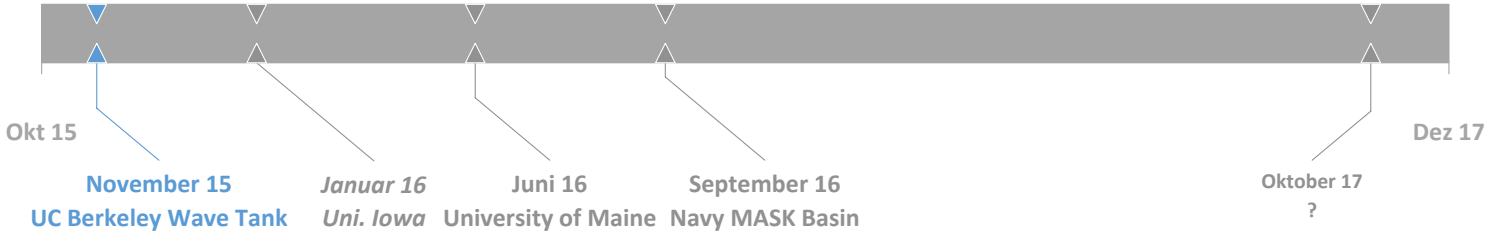
Marcus Lehmann, MS
Project Lead, Cyclotron Road

Nigel Kojimoto, MS
Lead of Mechanical System Design

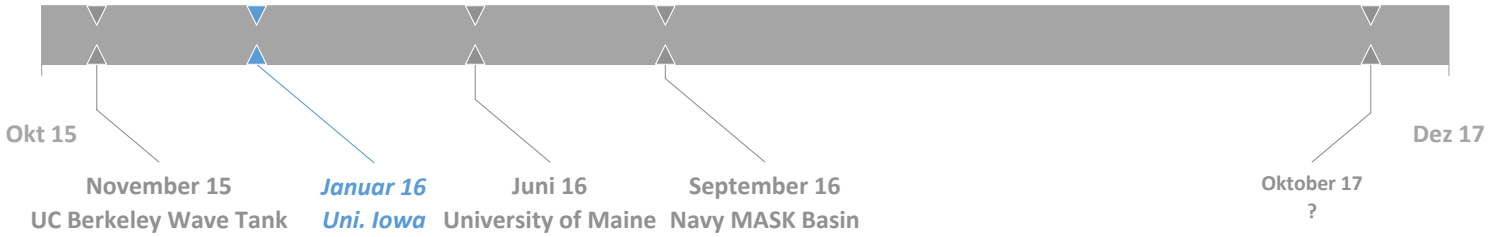
Thomas Boerner, MS, MS
Lead of Hydrodynamic Simulations

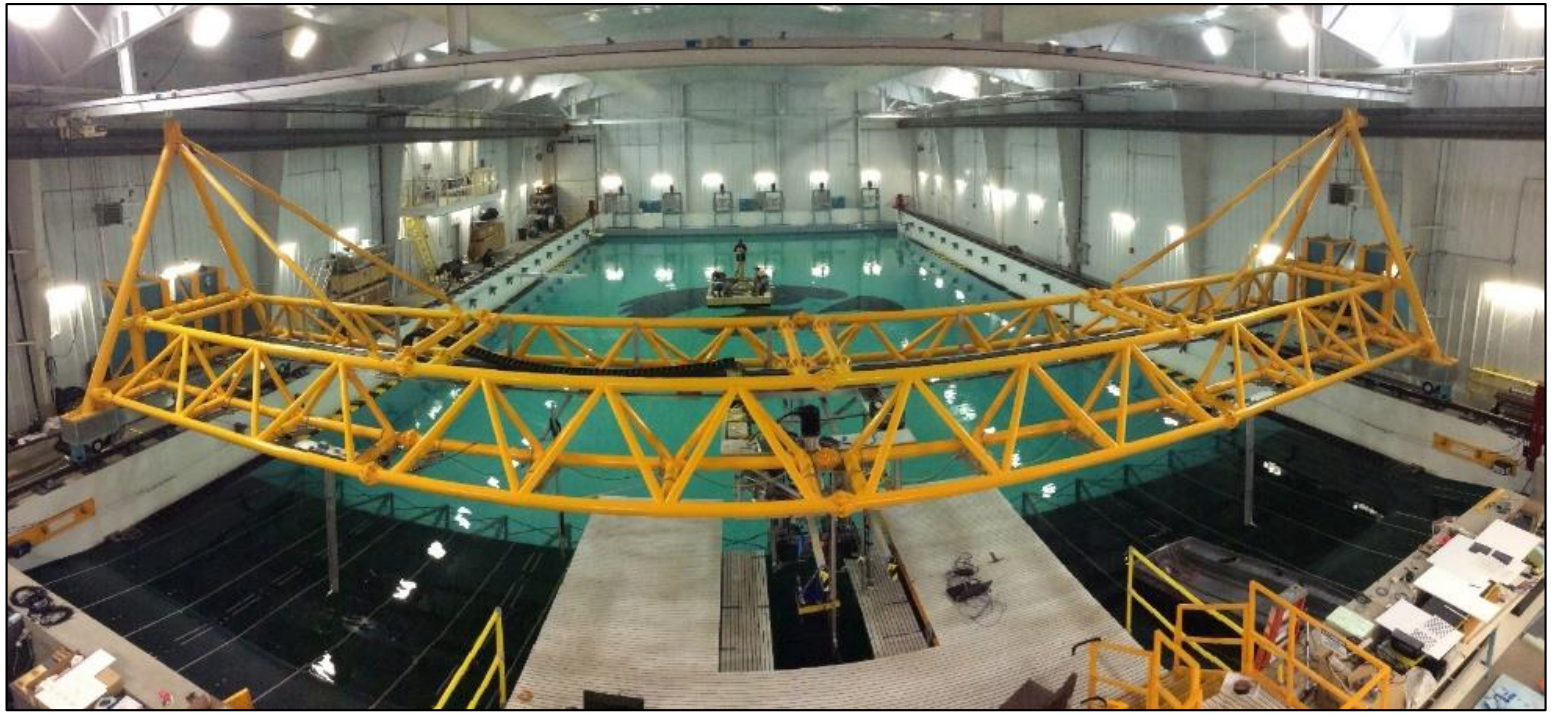
Bryan Murray, BS
Lead of Power Electronics

UC Berkeley – Proof of Concept

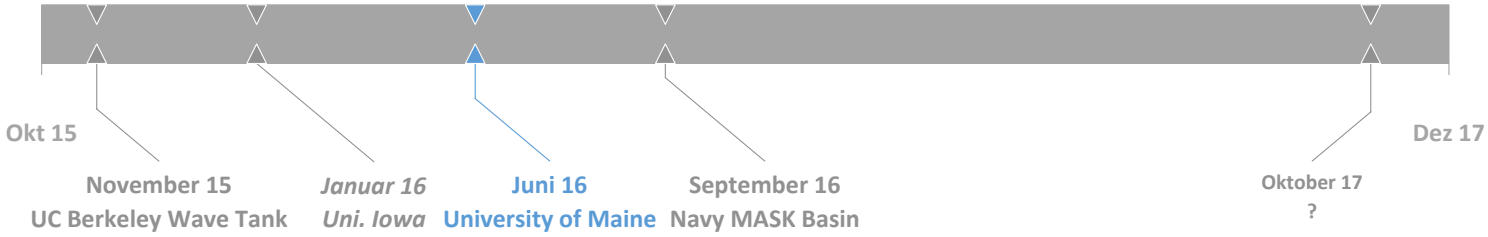


University of Iowa – Full System Assembly

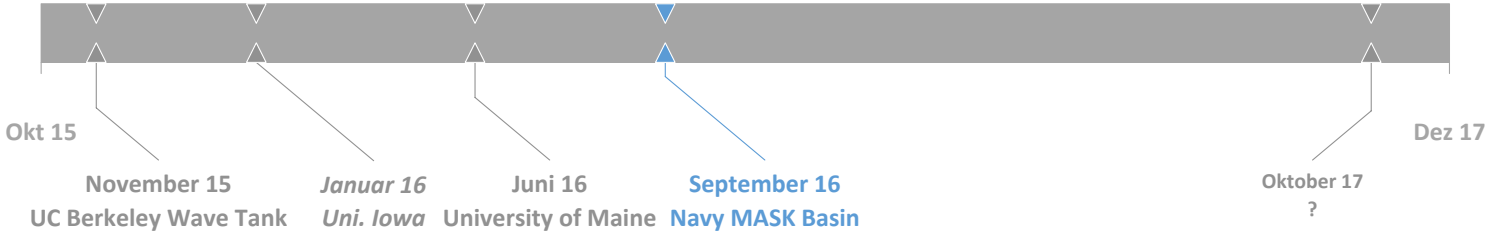




University of Maine – Controls Testing and Extreme Events



U.S. Navy's "Indoor Ocean" – Realistic and Extreme Seas Power Calculation

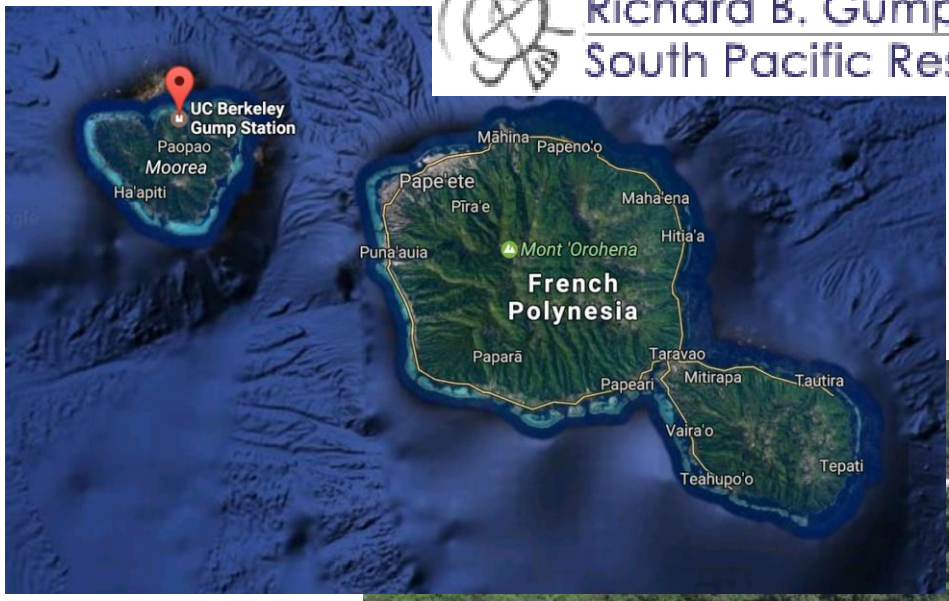


Scaled Testing in U.S. Wave Energy Prize

Testing on Moorea?

Richard B. Gump South Pacific Research Station

university of california, berkeley
moorea, french polynesia



Partners


Berkeley
UNIVERSITY OF CALIFORNIA


DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA


NSF


BARDEX
CORPORATION


ANSYS


jki


BMT Designers & Planners
"Where will our knowledge take you?"


cruz atcheson
CONSULTING ENGINEERS


DNV·GL


Rexroth
Bosch Group


revision
Enabling Marine Renewables

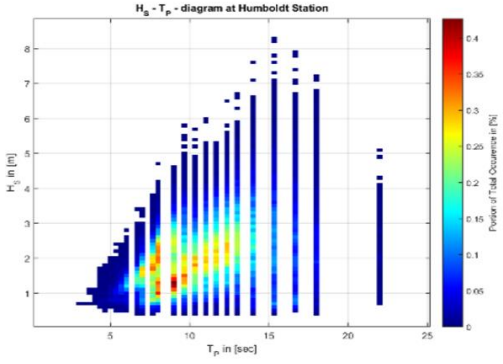
Capabilities & Services

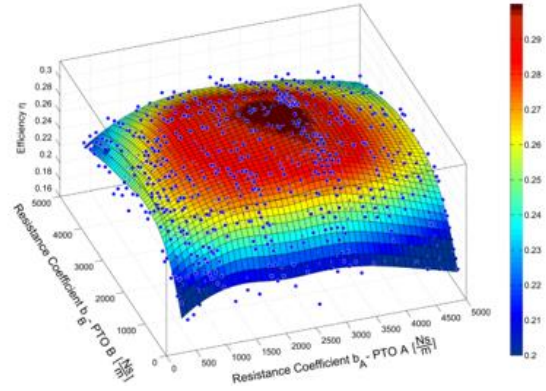
Concepts Offshore Design & Hydrodynamic Analysis

Project Management for Offshore Projects (e.g. Deployment)

Model Scale Experimental Concept Testing (Early stage iterations important)

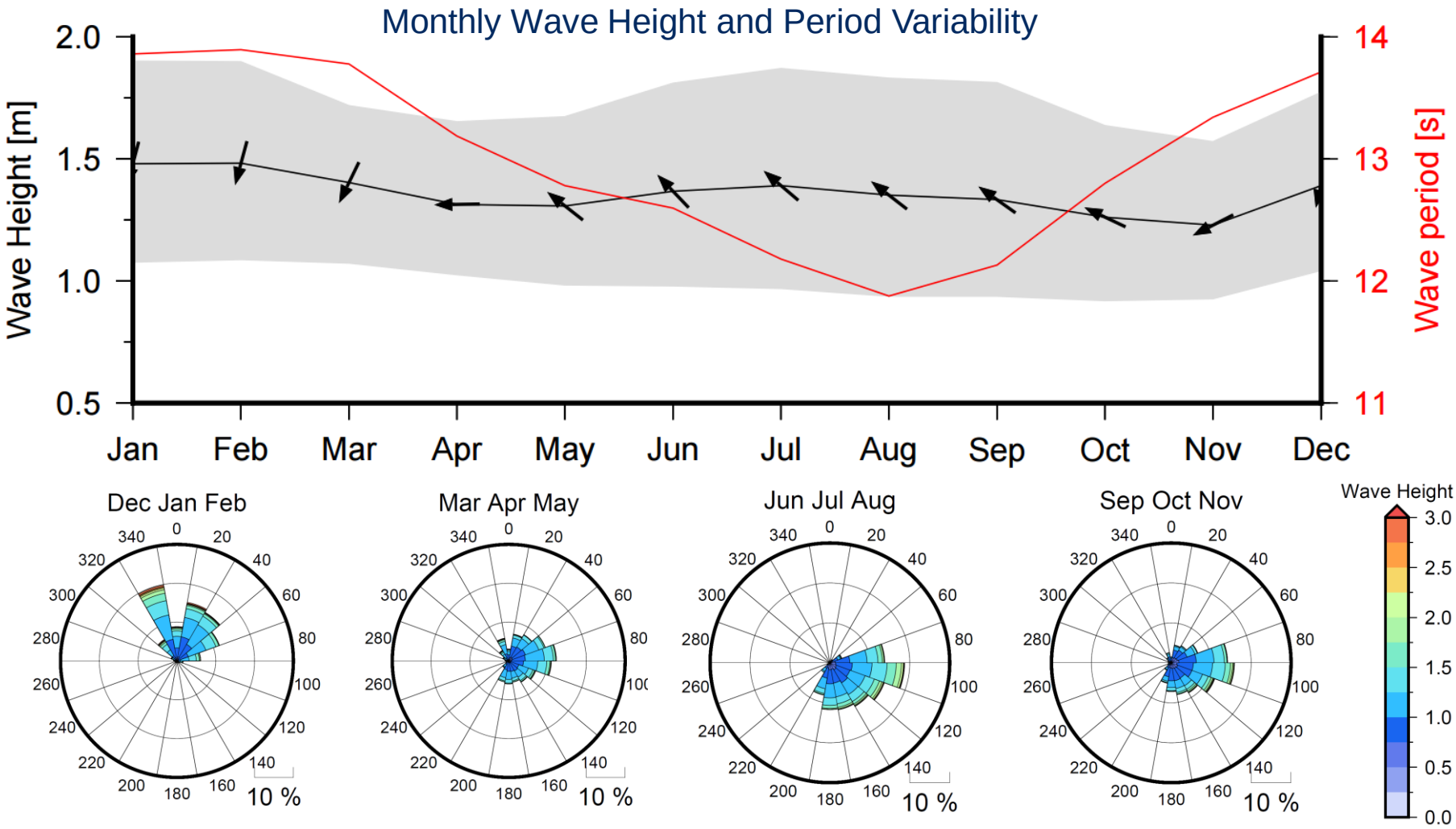
Access to Wave Tank, Computational Tools, ….





Bonus Slides

Closer Look: Bora Bora



(Bosserelle C., Reddy S., Lal D., (2015) WACOP wave climate reports. French Polynesia, Bora Bora. Secretariat of the Pacific Community.)

CalWave Energy Production

@25 kW/m:

Assuming 10m wide device:

10*25 = 250 kW resource potential

Assuming 50% Capture Ratio:

0.5*250 = 125kW average power

For 8,760 hours/year:

8760*125 = 1,095 MWh/year

What are the power requirements in French Polynesia?