Pacific Gas & Electric
WaveConnect Projects

UC Davis Energy Week – Wind Energy Forum
April 5, 2011
Pacific Gas and Electric Company (PG&E)

Delivering gas and electricity to 15 million Californians

| Employees | 19,800 |
| Electric and gas distribution customers | 5.1 MM electric 4.2 MM gas |
| Electric transmission circuits | 18,610 miles |
| Gas transmission backbone | 6,136 miles |
| Owned Electric generation capacity | 6,000+ MW |
| Total Peak Demand | 20,000 MW |

PG&E serves 5% of the U.S. population but emits less than 1% of the total CO2 emitted by the utility sector.
The PG&E WaveConnect program is exploring the feasibility of using wave energy to provide renewable, carbon-free electricity in California to help meet renewable energy goals.

The proposed Humboldt WaveConnect pilot project near Eureka was suspended in Fall 2010. A FERC preliminary permit on state waters offshore of Vandenberg AFB in Santa Barbara is still active as the Central Coast WaveConnect project.
PG&E WaveConnect Overview

- **Objective to provide testing and demonstration platform WEC devices**
  - Aid incubation of this new technology
  - Lead to viable commercial, utility-scale projects for PG&E and other developers

- **Funding for Permitting Feasibility and Engineering only**
  - DOE grant (2008, $1.2 million) and
  - CA Public Utilities Commission authorization (2009, $4.8 million)

- **Funding for Construction Phase requires future application to CPUC**

- **Originally 2 locations identified - Humboldt and Mendocino**
  - Good wave resource and access to PG&E grid
  - Mendocino eliminated due to inadequate harbor characteristics
  - Central Coast site under investigation as potential second site

- **Humboldt - Lead Project Site**
  - Located 3 nm offshore of Eureka, California (Humboldt County)
  - 45 meters depth
  - FERC Draft Pilot License Application (DPLA) submitted March 2010
  - Final Pilot License Application (FPLA) anticipated in 2011
WaveConnect Project Description

- **Up to four arrays of WEC devices**

- **PG&E Assets**
  - Interconnection to PG&E Fairhaven substation (12kV)
  - Gen Tie Infrastructure
  - Power Conditioning Devices (depending in final agreement)
  - Subsea Transmission Cable
    - 5 cables, one for each array and one spare
    - 9 miles to site in application, approx 3 to 4 miles to new site

- **Wave Energy Conversion (WEC) Device Owners’ Assets**
  - WEC devices (max 30 devices in up to 4 separate arrays)
  - Mooring cables and anchors for devices
  - Power Conditioning Devices (depending in final agreement)

- **Environmental monitoring buoys**
  - Up to 6 environmental monitoring buoys
  - Up to 6 US Coast Guard approved markers as navigational aids
Wave energy conversion (WEC) devices capture the ocean’s energy. The energy is transmitted through an undersea cable to land, where the energy is conditioned and fed to the electric grid.
Original preliminary permit granted by FERC was for an area of 136 square miles.

Large area was initially requested for study to allow for anticipated environmental, economic, and technical constraints on an actual smaller site.
Humboldt WaveConnect Preliminary Permit Area and Site

This is a draft map of the proposed offshore site for the Humboldt WaveConnect Pilot Project as of April 29, 2019, based on consensus from the siting subcommittees. This site is pending final approval by MCE management.

LEGEND
- Farhaven Substation
- Freshwater Mill Substation
- Underwater Lanes
- 3 Nautical Mile
- Dredge Dumping Site
- WEC Deployment Area
- Preliminary Permit Area

ENERGY OCEAN PACIFIC
OregonWaveEnergy TRUST
Humboldt Cable Landing

- Fairhaven Substation
- Water Tank
- Overflow

Town of Samoa
Power Poles
Parking Lot
Humboldt Cable Landing

N
Humboldt WaveConnect™ Project Location
WaveConnect Location

- DPLA proposal is to locate approximately 2.5 to 3 nautical miles offshore Manila on the Samoa Peninsula of Humboldt Bay
- Surface and subsurface area approximately 1 sq nm
  - 2 nm north-south by 1/2 nm east-west
- Transmission interconnection at PG&E substation
- Location determined after extensive consultation with stakeholders
Humboldt Working Group Members

**Academic**
- Humboldt State University
- Ocean Science Applications
- SeaGrant California

**Commercial/ Recreational Fishing**
- Commercial crab and trawler fishermen
- Humboldt Area Saltwater Anglers
- Humboldt Fisherman’s Marketing Association
- Pacific Coast Federation of Fishermen’s Associations
- Trinidad Bay Fisherman’s Marketing Association

**Community / Public at Large**
- Arcata Planning Commission
- HSU Student

**Economic/ Business**
- Humboldt County Office of Economic Development
- Freshwater Tissue
- Humboldt Bay Harbor

**Energy**
- Redwood Coast Energy Authority
- Schatz Energy Research Center

**Environmental**
- ACA Open Coastal Kayak
- Humboldt Bay Stewards
- Humboldt BayKeeper
- Surfrider Foundation, Humboldt Chapter

**Federal and State Permitting Agencies cont.**
- National Marine Fisheries Service
- State Water Resources Control Board
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Fish & Wildlife Service

**Labor**
- Building and Construction Trades Council of Humboldt and Del Norte Counties
- International Brotherhood of Electrical Workers

**Public Officials**
- City of Arcata
- City of Eureka
- City of Trinidad
- Humboldt County

**Tribe**
- Resighini Rancheria
- Trinidad Rancheria
HWG Agency Participation

Permitting Agencies Participating in the HWG

California Coastal Commission
California Department of Fish & Game
California Office of Historic Preservation
California State Lands Commission
Federal Energy Regulatory Commission
National Marine Fisheries Service
California State Water Resources Control Board
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Fish & Wildlife Service
Permit Applications

• FERC Hydrokinetic Pilot Project License
• State Lands Commission Lease/CEQA Compliance
• Coastal Development Permits/CZMA – Coastal Commission
• Other Federal Authorizations
  – Endangered Species Act – USFWS and NMFS
  – Marine Mammals Act – NMFS
  – National Historic Preservation Act Section 106 - SHPO
  – Rivers and Harbors Act Section 10 - USACE
• Other State Authorizations
  – California Endangered Species Act - CDFG
  – Section 401 Water Quality Certification - SWRCB
  – 1603 Streambed Alteration Agreement - CDFG
WaveConnect WEC RFI Process and Results

• **Sent WEC RFI invitations to 53 manufacturers**
  - Designed to solicit technical, commercial and financial information

• **14 WEC manufacturers responded**
  - Detailed discussions with WECs providers
    - Financial and risk management capabilities
    - Partnership arrangements
    - RFP vs Bi-lateral negotiations
Overview of Technology Types

- Attenuator
- Point Absorber
- Oscillating Wave Surge Converter
- Oscillating Water Column
Challenges

• New technology

• Developing regulatory framework

• Uncertainty of environmental effects

• Conflict with existing uses

• High costs
Deepwater wind

- What PG&E is doing
- Tracking floating platform technology developments
- Monitoring offshore pilots and research (DeepCwind Consortium, NREL, DOE)

What others are doing
- Maine: RFP for 30 MW deepwater wind/tidal pilot projects
- Norway: Statoil installed 2.3 MW floating turbine in 2009 (“Hywind”)
- Portugal: EDP & Principle Power MOA to develop deepwater site
- Denmark: Floating power platform

- BOEMRE (federal) jurisdiction over 3 nm
- 7-10 years permitting
WaveConnect Information

www.pge.com/waveconnect/

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