Fulltime team since 2014

Marcus Lehmann, MBA
CEO, 2014

Dan Petcovic, MS, P.E.
COO, joined 2018

Thomas Boerner, PhDc
Technical Lead, 2014

Nigel Kojimoto, MS
Lead Mechanical Design, 2014

Bryan Murray, BS
Lead Power Electronics, 2014

Josiah Clark, BS
Mechanical Design, 2019
CalWave’s Timeline

2015
Design

2016
Prototype

2017-2018
Design

2019-2021
Construction & Deployment

Open Ocean Pilot

2021+
Commercialization

PHASE

POWER RATING
1:50 scale
1:20 scale; US patent

COMPANY HIGHLIGHTS

cyclotronroad

U.S. DEPARTMENT OF ENERGY
Breakout Labs

Utility scale architecture
100% renewables requires diversification

1. Solar
2. Wind
AND ...
3. WAVE POWER

- Approximately 50x denser
- Consistent
- Predictable
Ocean based solution to tackle climate change:

- **International Shipping**: 0.75–1.5 GtCO₂e
- **Domestic Shipping**: 0.15–0.3 GtCO₂e
- **Aquaculture**: 0.02–0.04 GtCO₂e
- **Seaweed Farming**: 0.05–0.29 GtCO₂e
- **Ocean Energy**: 0.11–1.90 GtCO₂e
- **Wild Capture Fisheries**: 0.08–0.14 GtCO₂e
- **Offshore Wind**: 0.65–3.50 GtCO₂e
- **Mangroves**: 0.18–0.29 GtCO₂e
- **Dietary Shifts**: 0.3–1.06 GtCO₂e
- **Salt Marshes**: 0.05–0.10 GtCO₂e
- **Seagrasses**: 0.22–0.70 GtCO₂e
- **Seabed Storage of Carbon**: 0.5–2.0 GtCO₂e
### Motivation & Opportunity

Emissions of selected electricity supply technologies in gCo2eq/kWh.
Source: [IPPC](https://www.ipcc.ch), 2018.

<table>
<thead>
<tr>
<th>Options</th>
<th>Direct emissions</th>
<th>Infrastructure &amp; supply chain emissions</th>
<th>Lifecycle emissions (incl. albedo effect)</th>
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<tbody>
<tr>
<td></td>
<td>Min/Median/Max</td>
<td>Min/Median/Max</td>
<td>Min/Median/Max</td>
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<td>Currently Commercially Available</td>
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<td>Technologies</td>
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<td>3.7/12/110</td>
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<td>29</td>
<td>8.8/27/63</td>
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<td>Solar PV—rooftop</td>
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<td>42</td>
<td>26/41/60</td>
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<tr>
<td>Solar PV—utility</td>
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<td>66</td>
<td>18/48/180</td>
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<tr>
<td>Wind onshore</td>
<td>0</td>
<td>15</td>
<td>7.0/11/56</td>
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<tr>
<td>Wind offshore</td>
<td>0</td>
<td>17</td>
<td>8.0/12/35</td>
</tr>
<tr>
<td>Pre-commercial Technologies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCS—Coal—Oxyfuel</td>
<td>14/76/110</td>
<td>17</td>
<td>100/160/200</td>
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<tr>
<td>CCS—Coal—PC</td>
<td>95/120/140</td>
<td>28</td>
<td>190/220/250</td>
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<tr>
<td>CCS—Coal—IGCC</td>
<td>100/120/150</td>
<td>9.9</td>
<td>170/200/230</td>
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<tr>
<td>CCS—Gas—Combined Cycle</td>
<td>30/57/98</td>
<td>8.9</td>
<td>94/170/340</td>
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<tr>
<td>Ocean</td>
<td>0</td>
<td>17</td>
<td>5.6/17/28</td>
</tr>
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</table>
Wave energy potential in the US

Technical Power Potential of U.S. Marine Energy Resources (in TWh/year)

- West Coast: 250 TWh/year
- East Coast: 460 TWh/year
- Gulf Coast: 84 TWh/year
- Hawaii: 390 TWh/year
- All 50 U.S. States: 2,300 TWh/year
- Contiguous United States: 830 TWh/year
- Alaska: 1,100 TWh/year
- Samoa: 1,300 TWh/year
- Micronesia: 1,100 TWh/year
- Marshall Islands: 380 TWh/year
- Palau: 260 TWh/year
- Jarvis Island: 210 TWh/year
- Midway Island: 140 TWh/year
- Wake Island: 95 TWh/year
- Johnston Atoll: 84 TWh/year
Wave power is stable and abundant

Wind and solar are volatile.

Daily variability of renewables

- Wave
- Wind
- Solar

Annually, wave never drops as low
Beginning of Wind Power
Main functions of a wind turbine

Main function 1:
High Annual Energy Production

Main function 2:
Device Load Management/Shut down
Main functions of a WEC

Main function 1:
High Annual Energy Production

Example Humboldt Bay Resource

Main function 2:
Device Load Management/Shut down

$H_s$

survival
mode

operational
mode

?
Secondary functions of a marine energy system

Evaluation Areas - The key areas in which to measure the success of technology, in order to demonstrate progress and achieved performance.
TRL Status of ocean energy – 2015 (outdated)
Tidal energy hits 60 GWh power production milestone.

Global total:
- TIDAL STREAM
  - 2020 Installations: 865 kW
  - Cumulative Installations: 36.3 MW
- WAVE ENERGY
  - 2020 Installations: 700 kW
  - Cumulative Installations: 23.3 MW
Tidal Energy – Commercial projects

Bottom Piled Atlantis
17.5 GWh
2020 Japan 500kW

Floating Orbital Marine Power
3 GWh in 2016
R&D 2 MW since 2018
Construction in 2020

2020 NY
2020 Canada
2020 AK
(WEC) Classification – Orientation

(a) Point Absorber

(b) Attenuator

(c) Terminator
Active demonstrations
In 2015, DOE announces their search for the next generation.

92 Teams entered the competition.
US Wave Energy Prize – 92 teams
Calwave awarded
out of 92 teams!
Scripps Ocean Pilot Q2/2021

Anchor installed Sep 20

Project partners:
CalWave lined up for PacWave – 20MW test site

Location: Oregon
Depth: 60-80 m
Capacity: 20 utility-scale WECs

http://pacwaveenergy.org/
Exploring Coastal and Offshore Markets (Different Sets of Partners)
Total Cost – Turbine Cost = large of project development costs are mutual

Ideal layout of combined offshore wind and wave farm – wave shelters wind and reduces total CAPEX and OPEX for both!
Wave converter similar components

→ Comparable manufacturing requirements —
A tower manufacture can produce a wave converter hull

Source:
Lifecycle of an Offshore Wind Floating

Wave farm similar CAPEX

Wave farm similar OPEX

Figure 2. Wind system cost breakdown structure: CapEx levels 1 to 3

Figure 3. Wind system cost breakdown structure: OpEx levels 1 to 3

Source: NREL
Offshore hydrogen
Join us on our mission!

Please subscribe for ESG Report:

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