

# Environmental Feasibility of an Ocean Thermal Energy Conversion (OTEC) Project in Hawaii

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## INTRODUCTION

Ocean thermal energy conversion (OTEC) is a renewable energy generation technology with the ability to provide baseload power in certain locations. However, there are potential challenges to its commercialization related to technological, financial, social, and environmental issues. Given the large volumes of seawater required to drive the electricity-producing cycle, there is potential to adversely impact marine resources in the source waterbody. This DOE-funded project is designed to: 1) evaluate the available warm water intake alternatives that would minimize potential impacts and 2) estimate the potential impacts of the warm water intake on the local marine organisms. A site-specific assessment of the intake technology alternatives is being conducted to develop a conceptual design for a warm water intake for a land-based OTEC facility in Hawaii. In addition, a field sampling program will be completed to generate empirical biological data on the potential efficacy of a selected warm water intake technology for protecting aquatic organisms from impingement and entrainment.

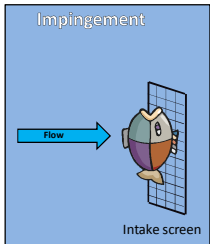


## OBJECTIVES

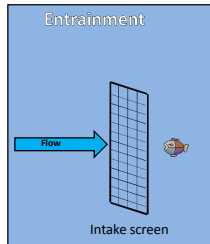
The overall goal of this project is to evaluate the potential impact of a potential OTEC facilities on aquatic organisms at a particular site. Meeting this goal will be accomplished through the completion of the following specific objectives:

1. Complete a site-specific engineering assessment of available and feasible warm water intake technologies to determine the best intake designs for minimizing impacts to aquatic organisms.
2. Complete a field sampling program at the Port Allen, Kauai OTEC site to collect biological data that will help determine the potential efficacy of a selected warm water intake technology in minimizing impacts to aquatic organisms.

## IMPINGEMENT AND ENTRAINMENT



Pinning of larger organisms on screen mesh



Passage of smaller organisms through screen mesh



## WARM WATER INTAKE EVALUATION

Warm water intake technologies that passed a preliminary evaluation step were subjected to a more detailed screening process to determine those that offer the greatest potential for practical application at the proposed Port Allen OTEC facility. A technology was considered to have potential for application at this site if:

- The technology has proven biological effectiveness.
- The technology is available and does not require extensive engineering development.
- The technology has engineering and/or biological advantages over the other technologies evaluated.

Table 1. Preliminary screening of warm water intake alternatives. Technologies selected for conceptual design and preliminary cost estimation appear in bold.

Intake Type	Biological Effectiveness Proven?	Engineering Alternative Available?	Advantages Over Other Concepts?	Potential for Application at the Proposed OTEC Facility?
<b>Behavioral Systems</b>				
Sound	Yes	Yes	No	No
Infrasound	No	Yes	Yes	No
Strobe Lights	Yes	Yes	No	No
Mercury Lights	No	Yes	Yes	No
Chemicals	No	No	No	No
Electric Screens	No	Yes	No	No
Air Bubble Curtain	Yes	Yes	No	No
Water Jet Curtain	No	Yes	No	No
Hanging Chains	No	Yes	No	No
Visual Keys	No	Yes	No	No
Hybrid Barriers (e.g., strobe light/air bubble curtain)	No	No	No	No
<b>Velocity Cap (in conjunction with modified traveling water screens)</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Exclusion Systems</b>				
Fixed-screens	Yes	Yes	No	No
Conventional Traveling Water Screens	Yes	Yes	No	No
Rotary Drum Screens	Yes	Yes	No	No
Barrier Net	Yes	Yes	Yes	No
Bar Rack Barrier	No	Yes	Yes	No
Infiltration Intakes	Yes	Yes	No	No
Porous Dike	Yes	Yes	No	No
Aquatic Filter Barrier	Yes	No	Yes	No
<b>Cylindrical Wedgewire Screen</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Collection Systems</b>				
<b>Modified Traveling Screens with Fish Protection</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
Fish Pumps	Yes	Yes	No	No
<b>Dispersion Systems</b>				
Louvers/Angled Bar Racks	Yes	Yes	No	No
Angled Screens (Fixed or Traveling)	Yes	Yes	No	No
Angled Rotary Drum Screens	Yes	Yes	No	No
Inclined Plane Screens	No	Yes	No	No
Eicher Screen	Yes	Yes	No	No
<b>Modular Inclined Screens</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
Submerged Traveling Water Screens	No	Yes	No	No
Modified Pump Operation	Yes	Yes	No	No

## CONCEPTUAL DESIGN AND PRELIMINARY COST

Conceptual designs are currently being prepared for each of the following feasible warm water intake alternatives:

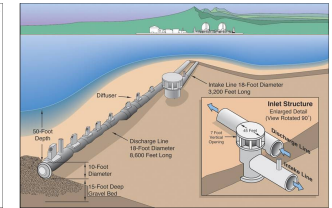
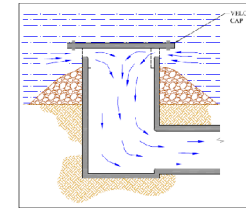
- Modified traveling water screens
- Offshore velocity-capped intake with onshore modified traveling water screens (with screen meshes of 0.5, 2.0, or 9.5 mm)
- Onshore modified traveling water screen intake (with screen meshes of 0.5, 2.0, or 9.5 mm)
- Offshore cylindrical wedgewire screens (with screen slot sizes of 0.5, 2.0, or 9.5 mm)
- Modular inclined screens (2.0 mm)

Preliminary cost estimates are being developed to estimate the costs for each warm water intake alternative.

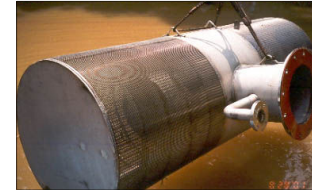
Funding provided by:



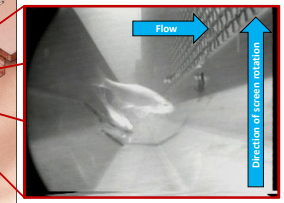
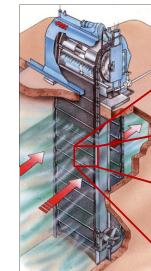
Velocity Cap



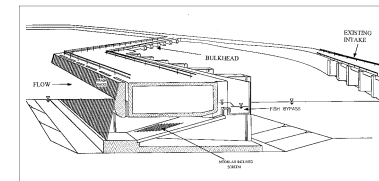
Cylindrical Wedgewire Screen



Modified Traveling Water Screen



Modular Inclined Screen



## FIELD SAMPLING PROGRAM

The biological field sampling program will be comprised of two parts:

1. **Preliminary baseline biological sampling**
  - to determine which species and life stages are present in the proposed intake locations
  - to determine vertical stratification and diel variations in densities
2. **Biological field sampling with a pilot-scale intake screen**
  - to determine the biological efficacy of a pilot-scale screen for minimizing entrainment of early life stages

