

Asia Pacific Clean Energy Summit

International OTEC Symposium

Developer's Perspective Round Table



Robert Varley

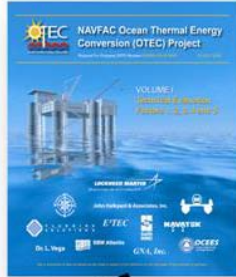
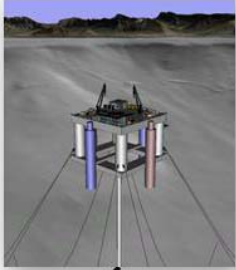
September 9, 2013

Lockheed Martin's OTEC Roadmap



Lockheed Martin
Investment

NAVFAC CRAD



DOE AWPP
CWP Grant



ONR HX Program



DOE OTEC Model
Basin Test

**10 MW
Pilot Plant**

1st 100 MW Plant



100 MW+ Plants



**Additional
10 MW Scale Plants**

**10 MW Pilot Plant Critical Step to Transition from
R&D to Opening of the OTEC Market**

Challenges



- **Transition from research / pre-commercial to commercial**
 - Significant capital costs associated with MW scale projects
 - “In the absence of operational records, however, financing for such plants remains a daunting challenge.” (Vega, 2010)
- **Environmental data collection**
 - Support for impact assessments
- **Government support of technology development and initial projects**
 - Long-term support for test beds that advance industry toward commercialization
 - Difficult budget climate

Status



- **10 MW Reignwood Group project**
 - Memorandum of Agreement signed; progressing toward project start in 2013

- **NELHA Ocean Energy Research Center**
 - Continued Heat Exchanger deployment & testing in relevant environment

- **Makai plume model**
 - Support environmental assessments

Lockheed Martin and Reignwood Group to Develop Ocean Thermal Energy Conversion Power Plant

- Reignwood Group is a multinational enterprise headquartered in Beijing, China
- Strives to set the benchmark for a higher quality of life
- Invests in green related industries, products and services
 - property, new energy, aviation, agriculture, luxury lifestyle, healthcare and sports and culture

*Lockheed Martin & Reignwood
OTEC Memorandum of Agreement
Signing ceremony, Beijing, China
April 2013*



Multi-product commercial plant



OTEC as an Industry



Core OTEC Plant

- Generates Electricity
- Initial Market – Cable to Shore & Grid
- Larger Market – Energy Carriers & H₂O



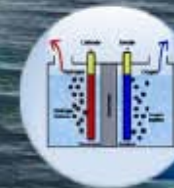
Water Desalination

- Est 278 Tonnes/MWh (RO) to 378 Tonnes/MWh (Open Cycle)
- (Theoretical max = 1,160 Tonnes/MWh)



Energy Intensive Industries

- Locate candidate industries on OTEC-powered "energy islands"



Hydrogen Production

- Est 0.02 Tonnes/MWh
- (1kg H₂ = 11.13 Normal m³)
- (<http://iplanetlight.blogspot.com/2011/02/free-energy-discovered-infinite-battery.html>)



Synthetic Fuels

- Est TBD Tonnes/MWh
- (Requires: development of marine algae feedstock & harvesting concept; Fischer-Tropsch process)



Ammonia Production

- Est 0.13 Tonnes/MWh
- (Assumes development of Solid State Ammonia Synthesis; electricity, H₂O & air)