Asia Pacific Clean Energy Summit

International OTEC Symposium

Developer's Perspective Round Table

LOCKHEED MARTIN

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Lockheed Martin's OTEC Roadmap

10 MW Pilot Plant

Additional 10 MW Scale Plants

1st 100 MW Plant

100 MW+ Plants

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

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**

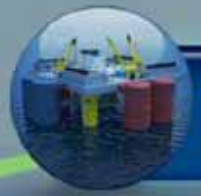
Lockheed Martin & Reignwood OTEC Memorandum of Agreement Signing ceremony, Beijing, China April 2013

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


OTEC
Multi-product commercial plant
SAMUEL A
Ocean Thermal Energy Conversion

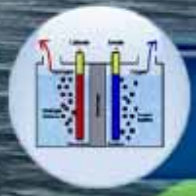
OTEC as an Industry



Core OTEC Plant
- Generates Electricity
- Initial Market – Cable to Shore & Grid
- Larger Market – Energy Carriers & H_2O

Water Desalination
- Est 278Tonne/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 Tonne/MWh
(1kg H2 = 11.13 Normal m3)
(http://planetlight.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)

Ocean Thermal Energy Conversion