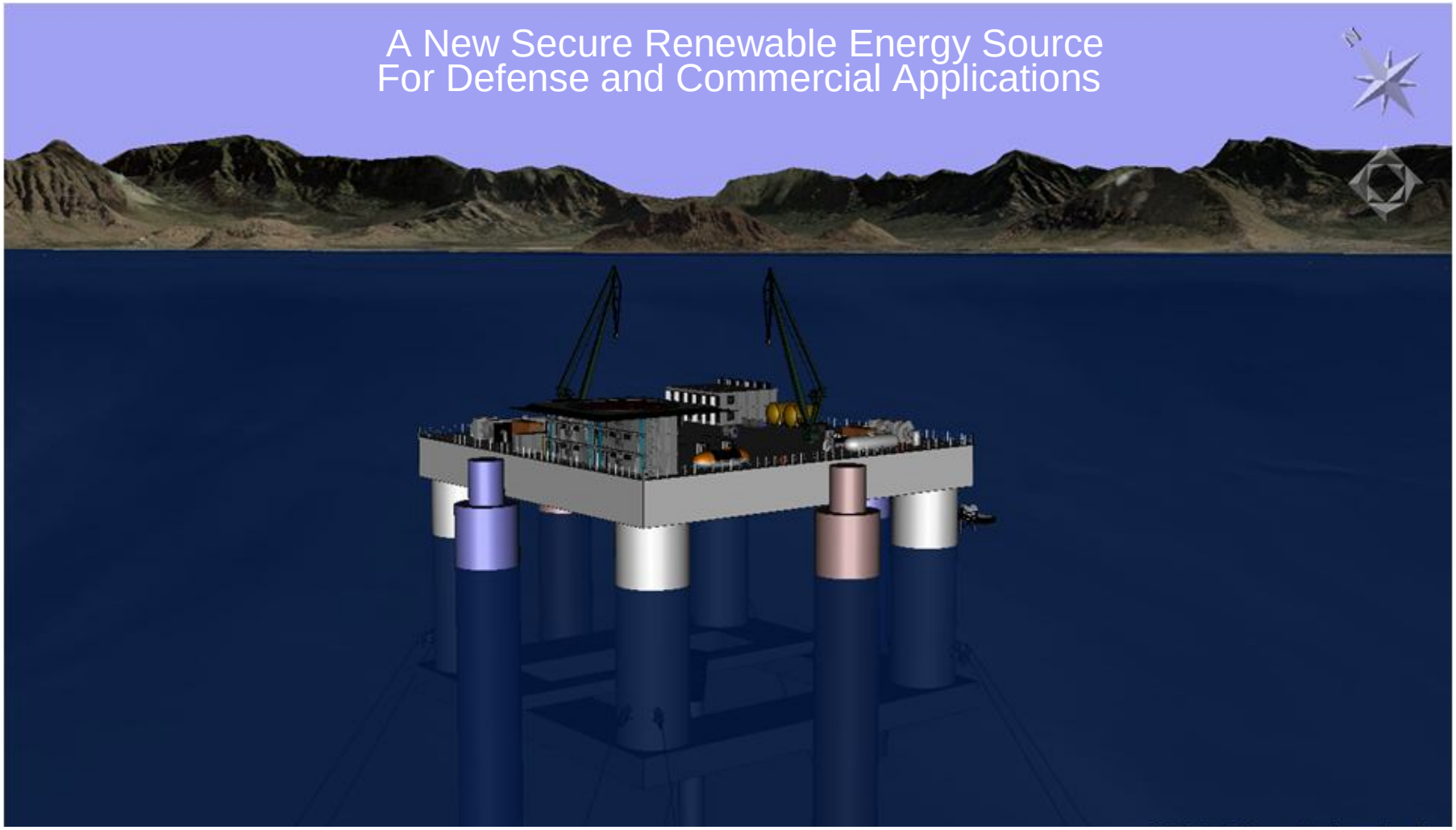
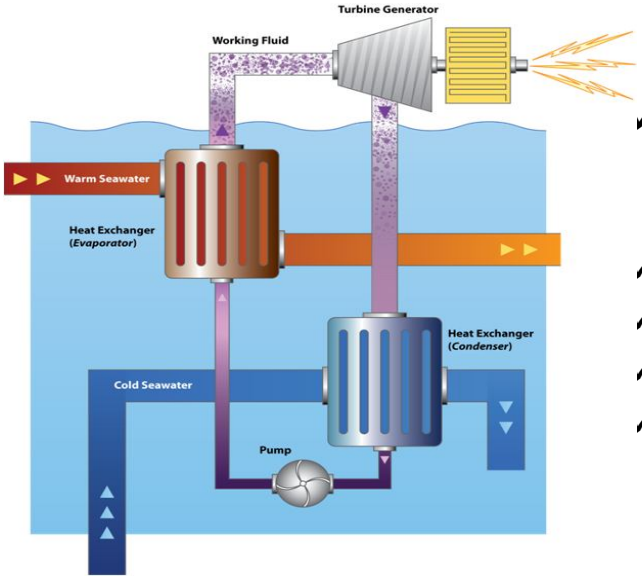
Ocean Thermal Energy Conversion (OTEC)



August 24, 2009

What is OTEC?

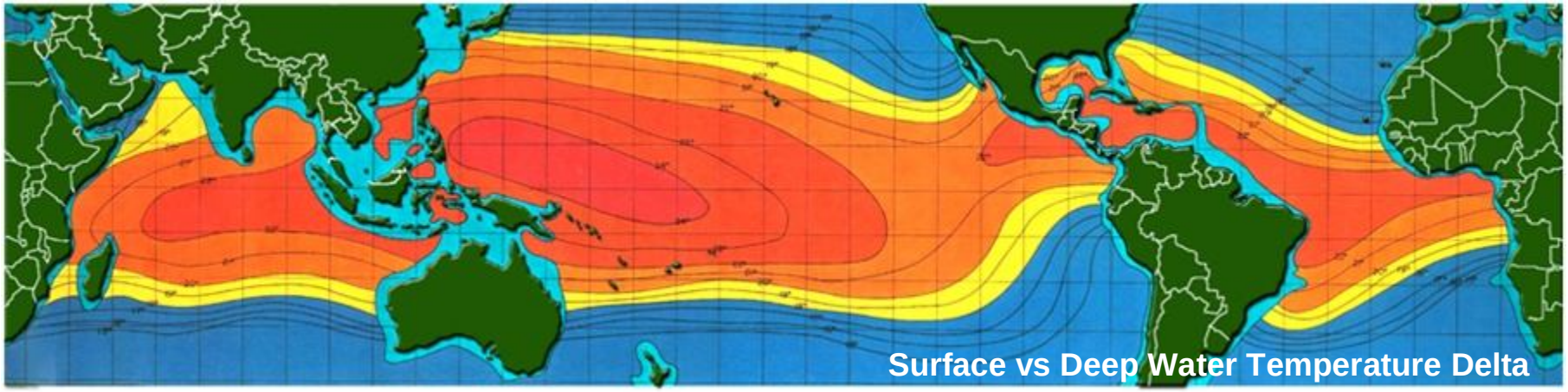
OTEC uses a ***well known*** process to exploit ocean Temperature gradients to drive a steam engine



OTEC Benefits:

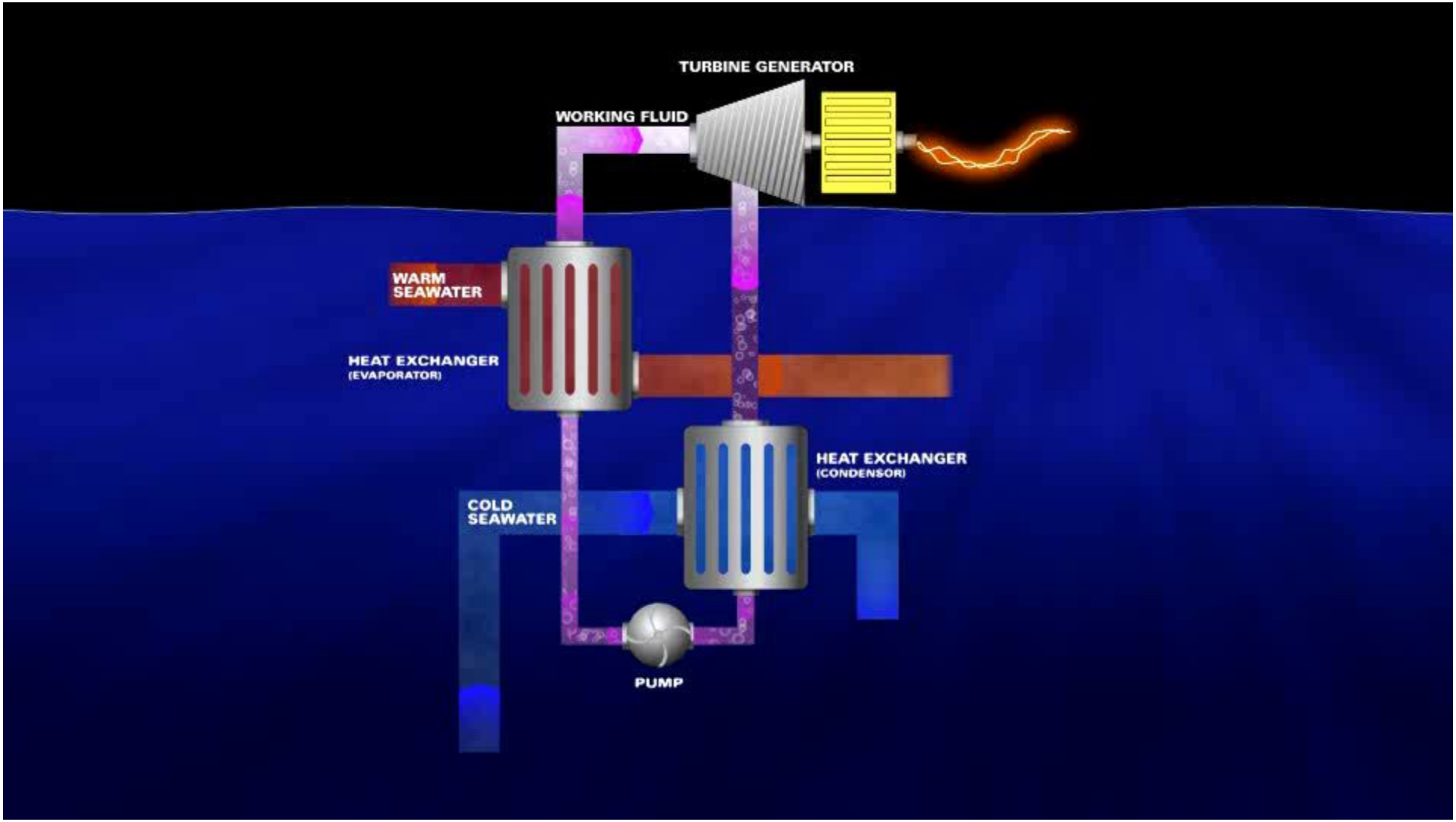
- ✓ **Large Renewable Energy Source**
  - ✓ **3-5 Terawatts available* (~ 30% Global Energy Consumption)**
- ✓ **Base Load Power (24/7)**
- ✓ **Independent of oil imports**
- ✓ **Near-carbon free**
- ✓ **Fresh Water Production**

*** A Preliminary Assessment of OTEC Resources ASME 3/2007**



A New Clean Renewable 24/7 Energy Source

OTEC Process



OTEC Is a New Solution for:

Electricity & Fresh Water for Remote Bases

- OTEC can generate clean secure electrical power plus potable water source for isolated DoD bases
  - Immediate Needs
    - Diego Garcia
    - DoD/Oahu
    - Kauai (PMRF)
  - 2011+
    - Guam
    - Kwajalein

Diego Garcia

Pacific Missile Range Facility (PMRF)

Electricity Generation for Commercial GRIDS

- OTEC can generate power reducing dependence on fossil fuels
  - Hawaii
  - Florida / Gulf States
  - Lower Southeast US
  - Guam
  - Puerto Rico

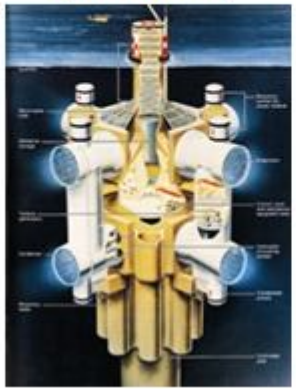
Expanded DoD Mission – Nation Building

- OTEC can generate power and water to assist developing economies

OTEC History

1974 - Hawaii established Natural Energy Laboratory (NELHA)

1975 - NSF OTEC Scientific Study (Lockheed)



1979 - 50 kW Mini-OTEC (Lockheed & Makai)

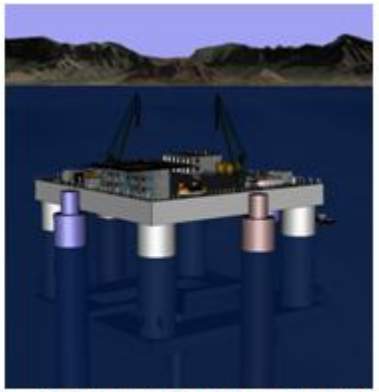
1983 – 8ft Pipe At Sea test (TRW for DOE)

1993 - 250kW Open Cycle (NELHA)

1996 – 2000 50KW Hx testing (NELHA)

2005 - Diego Garcia Feasibility (OCEES SBIR)

2006 – OTEC Study (Makai SBIR)

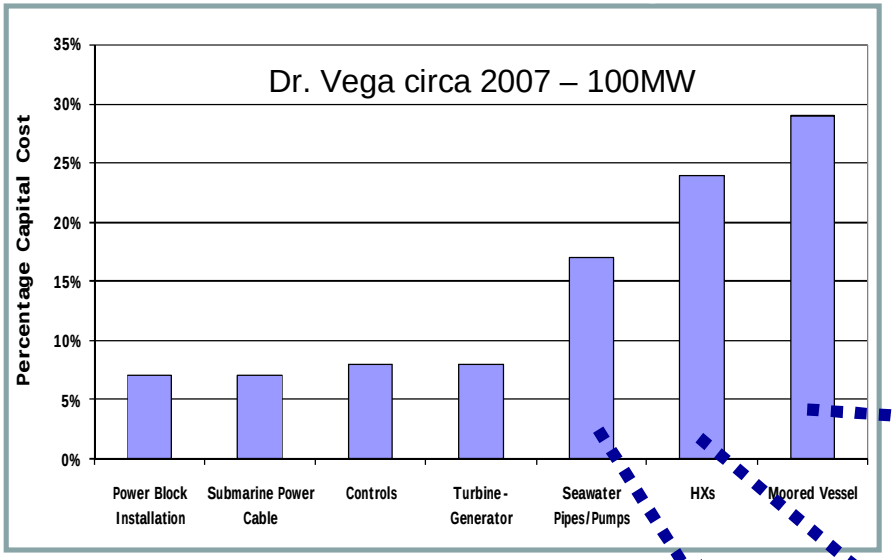


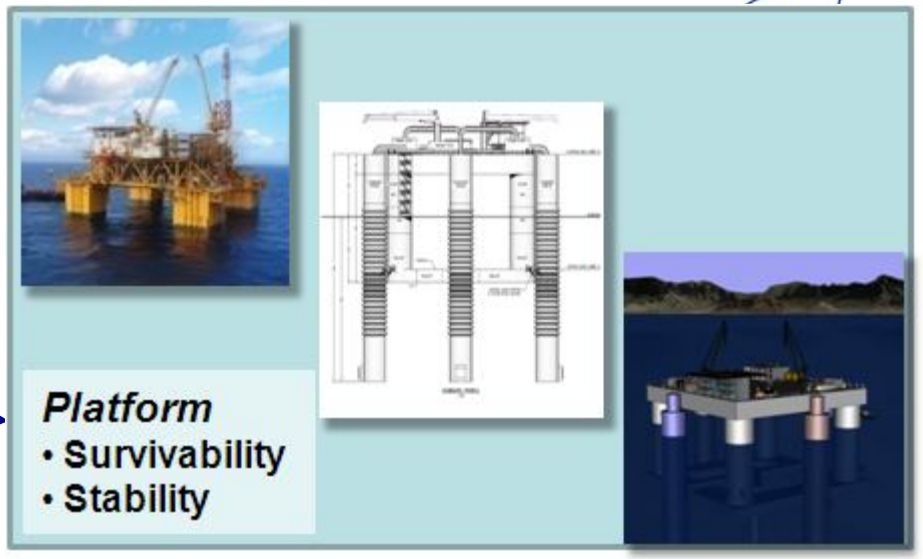
2007-2008 10MW Pilot Plant Design (Lockheed Martin Team)

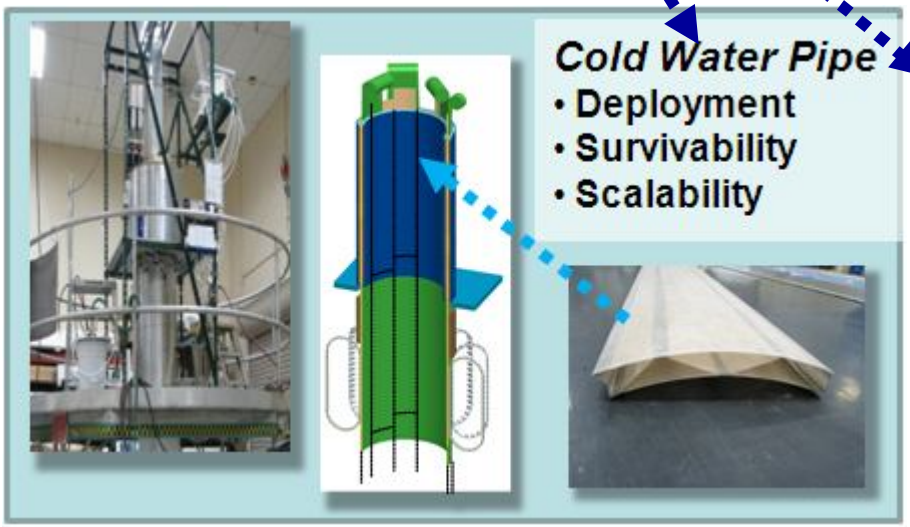
What has Changed

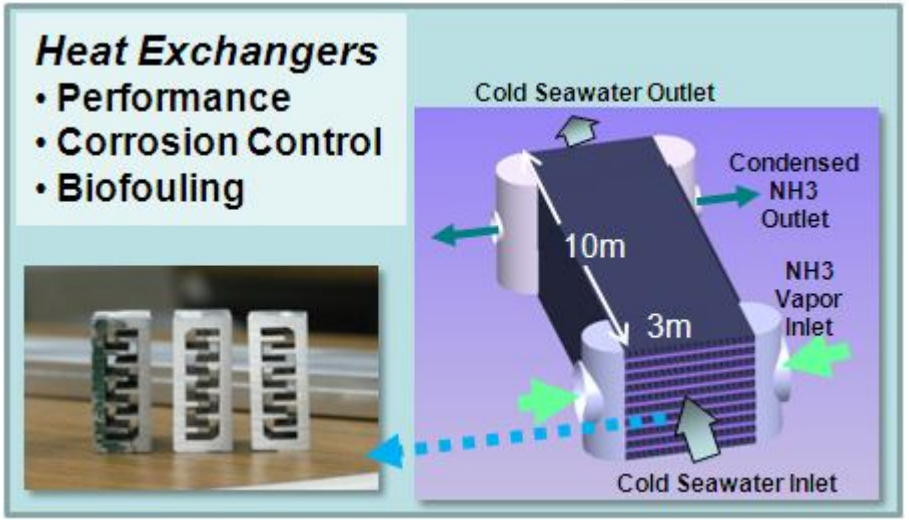
25 YEARS AGO	*TODAY*
➢ Large capital construction cost	➢ New composite materials and construction techniques address high-cost components (Cold water pipe and heat exchanger)
➢ Offshore technology not mature at requisite scale	➢ Mature offshore technology at requisite scales in deep water
➢ Different economic and political environment	➢ Current political focus on new jobs, energy, and environment
➢ Global warming, energy security not in public consciousness	➢ Widespread renewable mandates ➢ Growing concern for air pollution & global warming ➢ Energy security serious concern

OTEC Technology Challenges



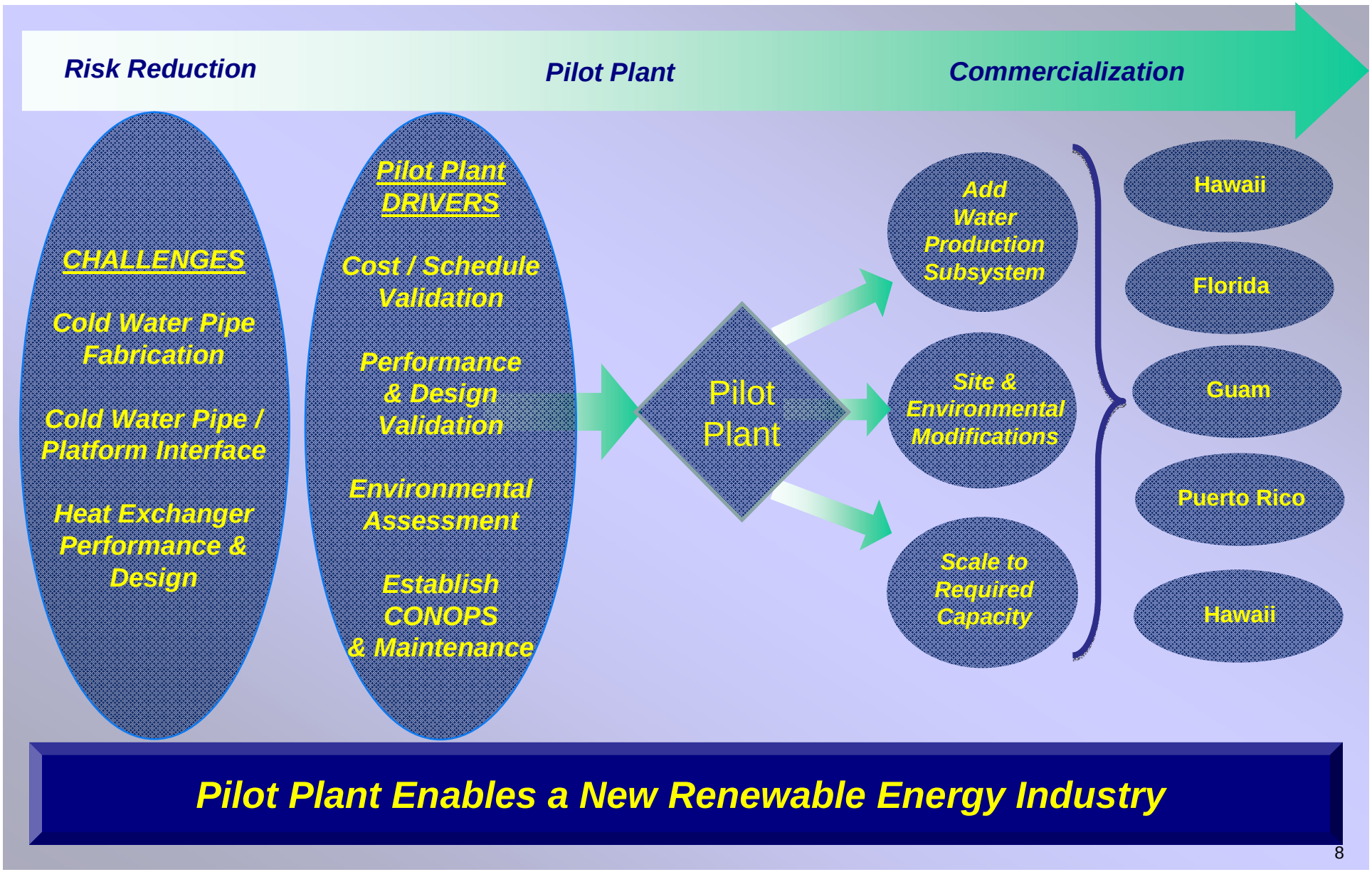




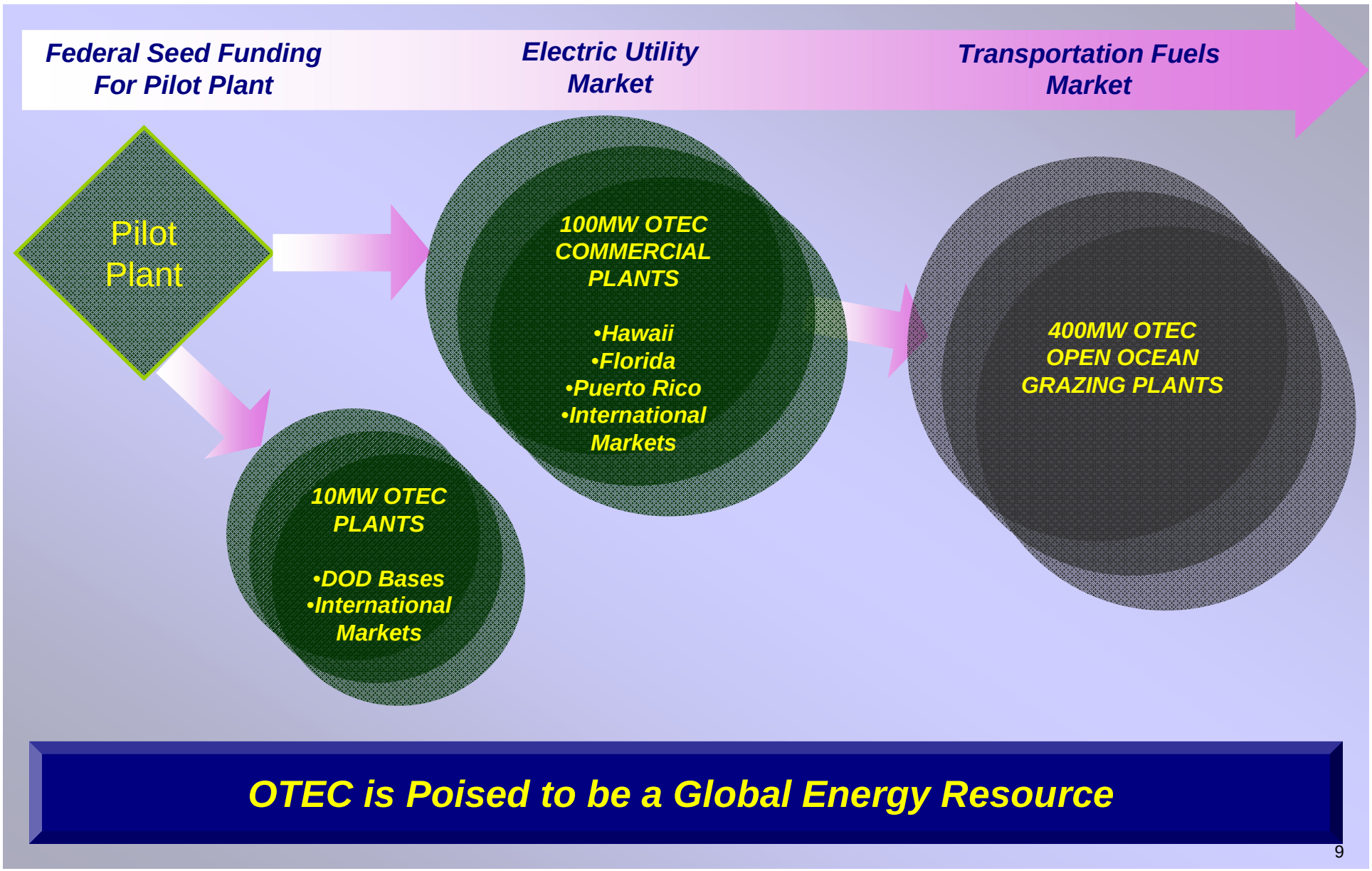


Focused on Addressing costs and Technical Challenges

OTEC Roadmap

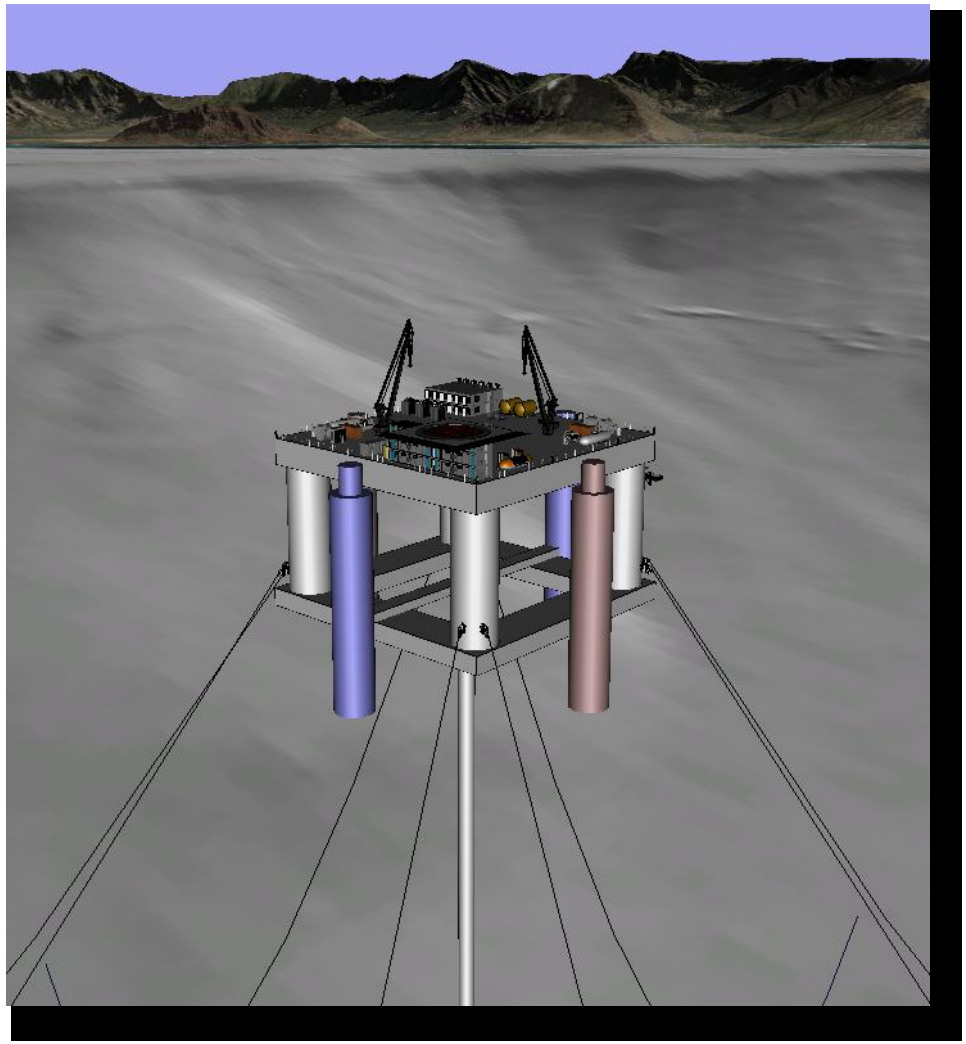


OTEC Vision



OTEC is Poised to be a Global Energy Resource

OTEC Pilot Plant



- **Must understand risks and costs associated with building and operating large OTEC plants**
  - **Capital Construction Risk**
    - **To date OTEC has been only demonstrated on a KW scale**
  - **Operation and Maintenance (O&M) Risk**
    - **No O&M and Life Cycle costs available**
- **Gov't / Industry need to understand OTEC economics**
  - **Important to Long Term Fixed Price Power Purchase Agreements**
- **Pilot Plant Validates:**
  - **Cost / Schedule**
  - **Design / Performance**
  - **Environmental Assessment**
  - **Operations and Maintenance**

Pilot Plant – Necessary First Step

OTEC Benefits

ENERGY

- Baseload power source
  Continuous power (24/7)
- No storage/backup generation
  Fewer grid integration issues
- Unexploited resource

NATIONAL SECURITY

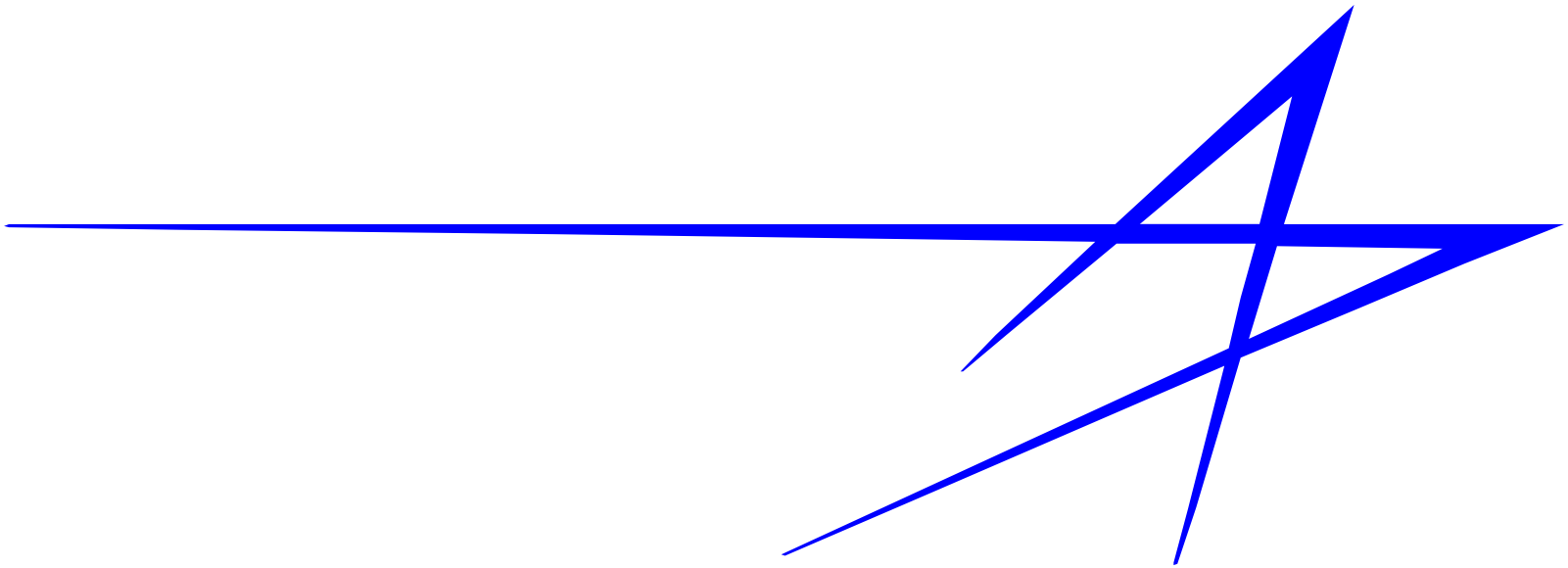
- Reduce dependence on unstable sources of oil
- Provides military bases with secure electricity and fresh water
- Power/water to developing nations

ENVIRONMENTAL

- Minimal CO_2 emissions
- Sea-based plant reduces land needs
- Designed to minimize impact on ocean environment
- Fresh water production

ECONOMIC

- Commercial products (fresh water, air conditioning, fuels)
- Leveraging and advancing existing technology
- Create new industry; green jobs
- Significant export opportunity



Getting a Feel for an OTEC Plant