



"Ocean Renewables in the Asia Pacific region"

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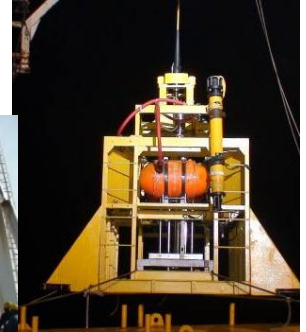
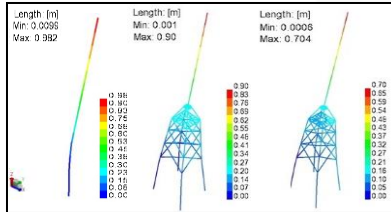
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NIOT Activities at a Glance

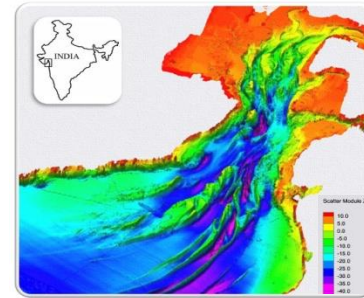


Energy and Freshwater



Deep Sea Technology

Offshore Structures



Ocean Observation System

Ocean Acoustics

Coastal & Environmental Engineering

Marine Sensor Systems



Marine Bio Technology

Ocean Electronics

Gas Hydrates

Vessel Management

Ocean Resources – Blue economy

Energy

- Wave
 - Tidal (range and stream), currents
 - Thermal Gradient
 - Salinity gradient
 - Biofuel
 - Offshore Wind
 - Floating solar PV
- } Motive force not sea water

Water – Desalination

Food – Sea cage culture

Minerals – Deep Sea Mining and associated deep water technologies

IEA Technology Collaboration Programme on Ocean Energy Systems

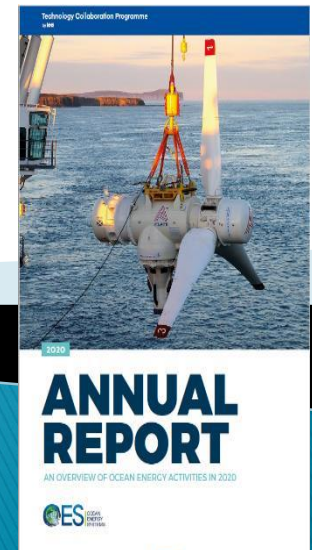
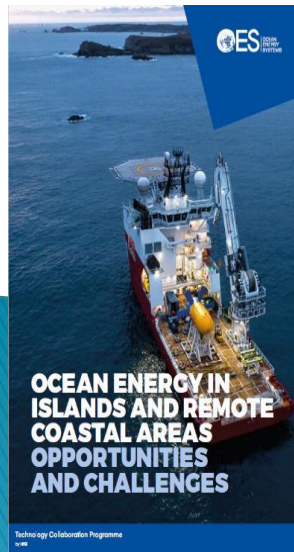
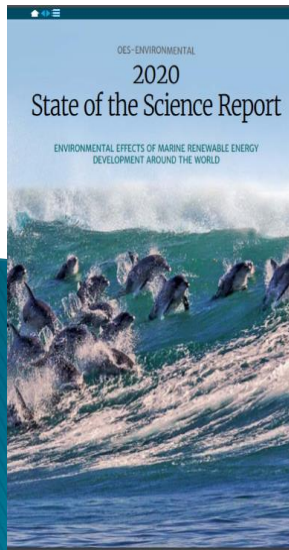


Participation in IEA-OES builds connections between national governments and industries, creates networks of experts and expands national research capacities

MEMBERSHIP



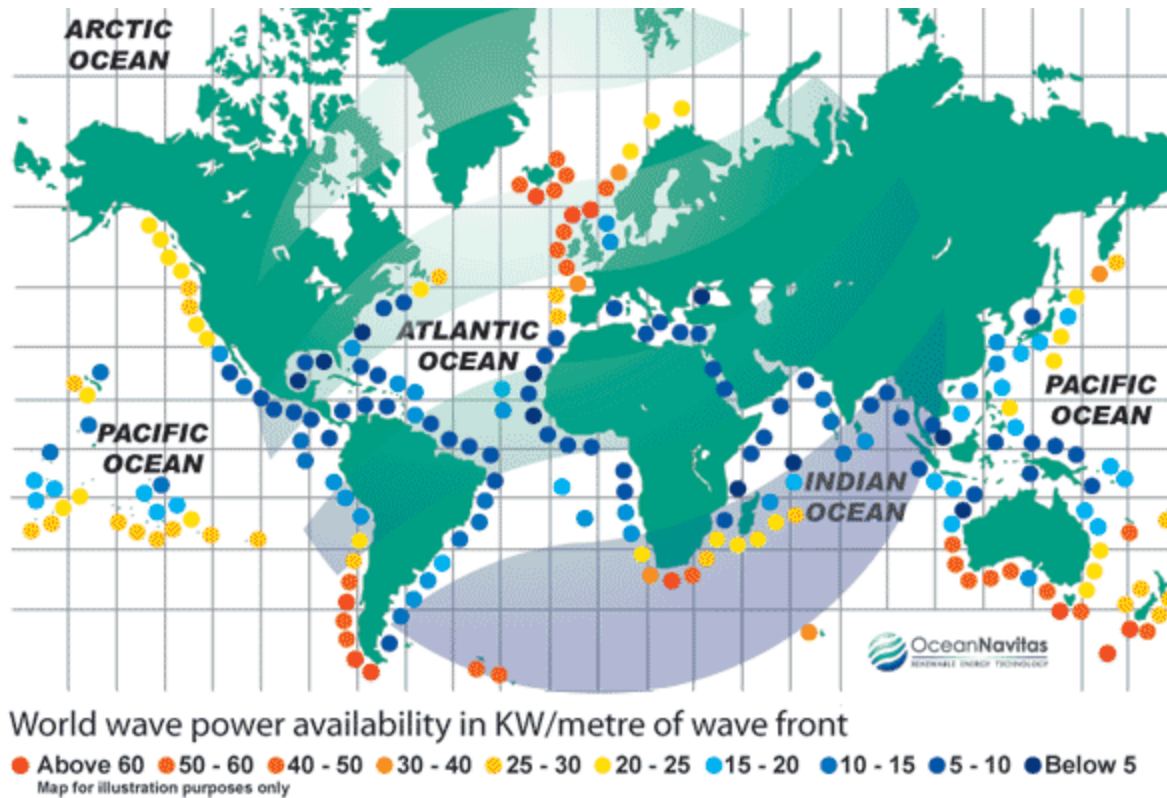
“As the authoritative international voice on ocean energy., we collaborate internationally to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner.”



Future Potential for Ocean Energy Utilization



Wave Energy Resource



Wave Energy Projects Around the World (courtesy OES TCP under IEA)

CHINA
Sharp Eagle



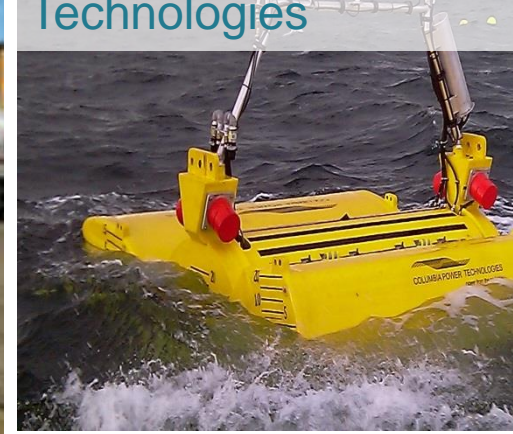
DENMARK
Weptos



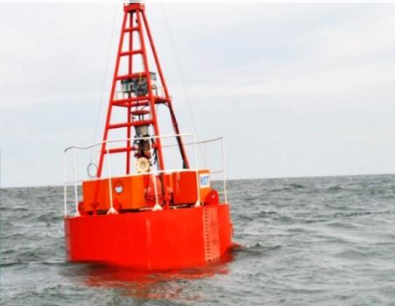
BELGIUM
Laminaria



USA
Columbia Power
Technologies



INDIA
Wave Powered
Navigational
buoy



IRELAND
SeaPower
Platform



SPAIN
MARMOK-A-5



SWEDEN
Corpower



Asia Pacific Efforts – China, Wave Energy

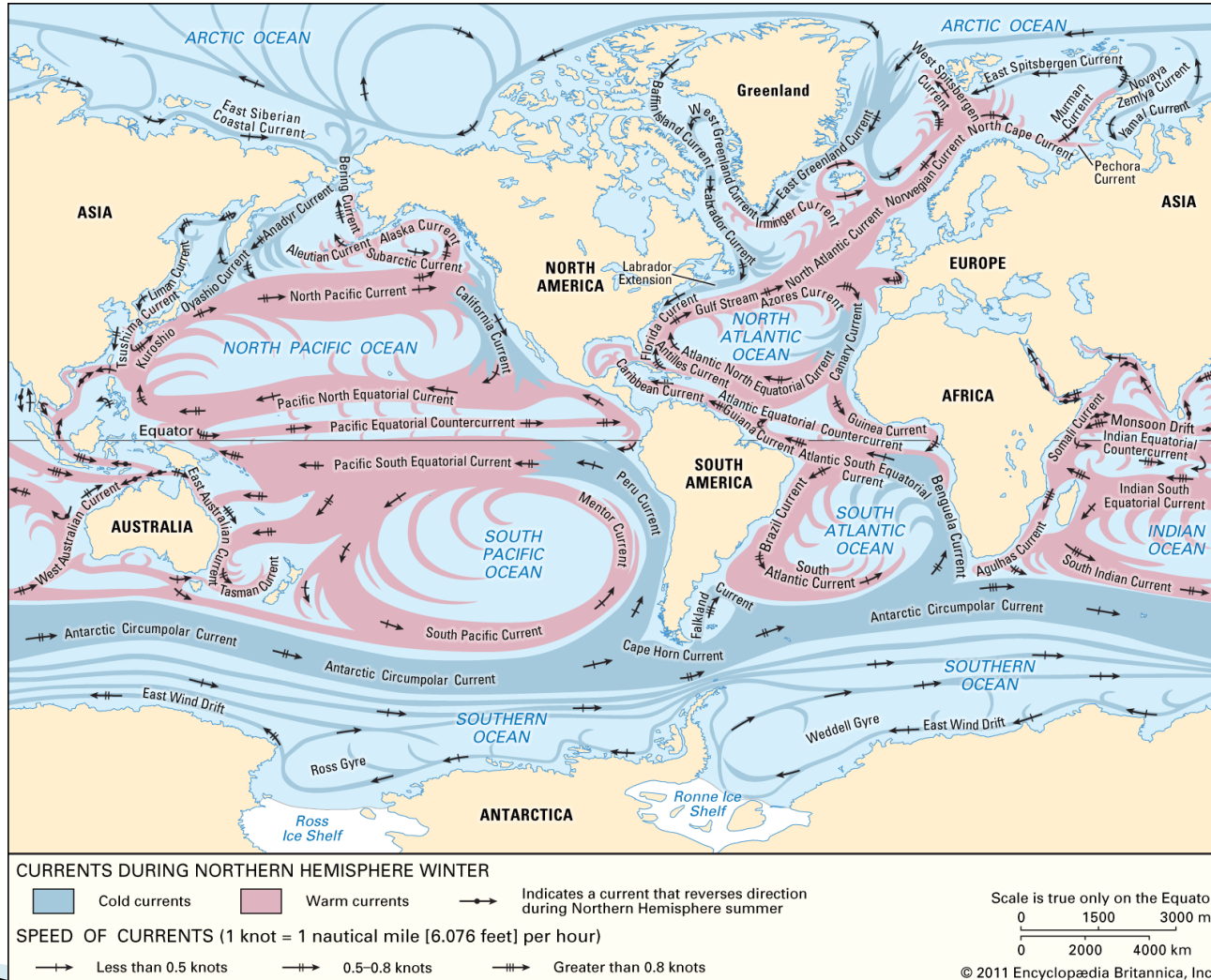


GIEC floating energy platform in open sea test (Wave energy, solar and desalination)

Wave energy aquaculture cage “Penghu” in sea test, 120kW WE and 10000 cu m aquaculture space



World Ocean Currents



Tidal Current Projects – (courtesy OES TCP under IEA)

CANADA
Cape Sharp Tidal;
FORCE



ITALY
GEM device, the Ocean's
Kite



FRANCE
Sabella, Ushant



NETHERLANDS
Tocado



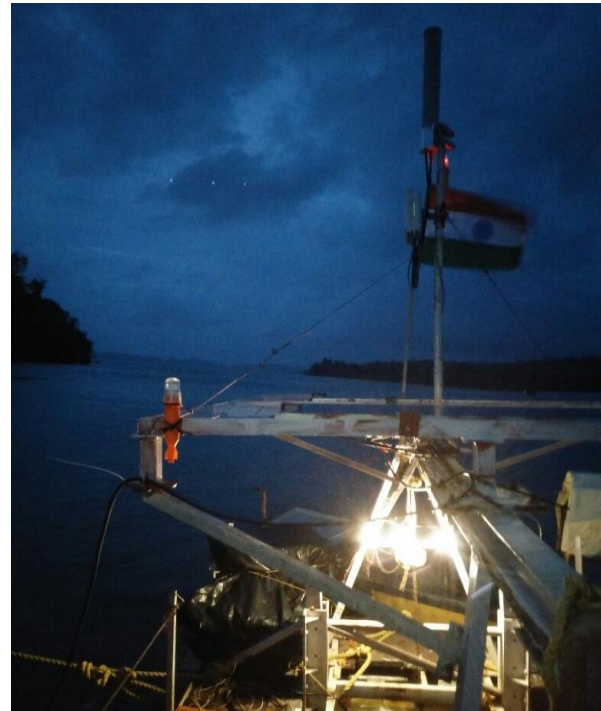
UK
Scotrenewables Tidal Power
SR2000



CHINA
LHD,
Xiushan

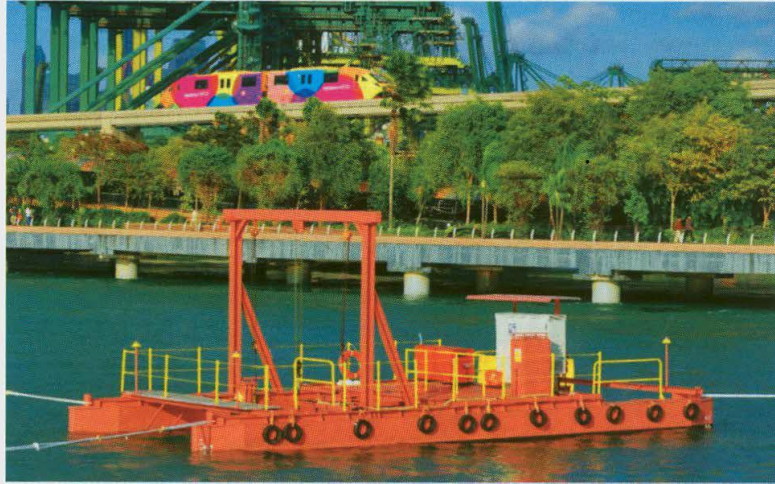


Indian Efforts – Hydrokinetic turbine



Open sea trial off Andaman Island

Asia Pacific Efforts – Tidal

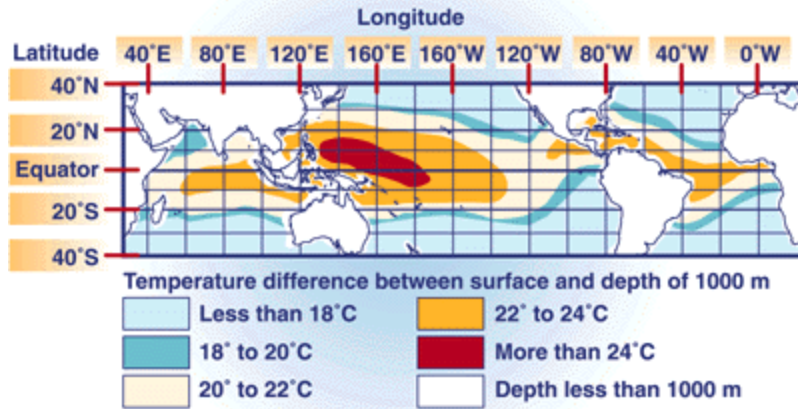


Sentosa Tidal test Site – Singapore

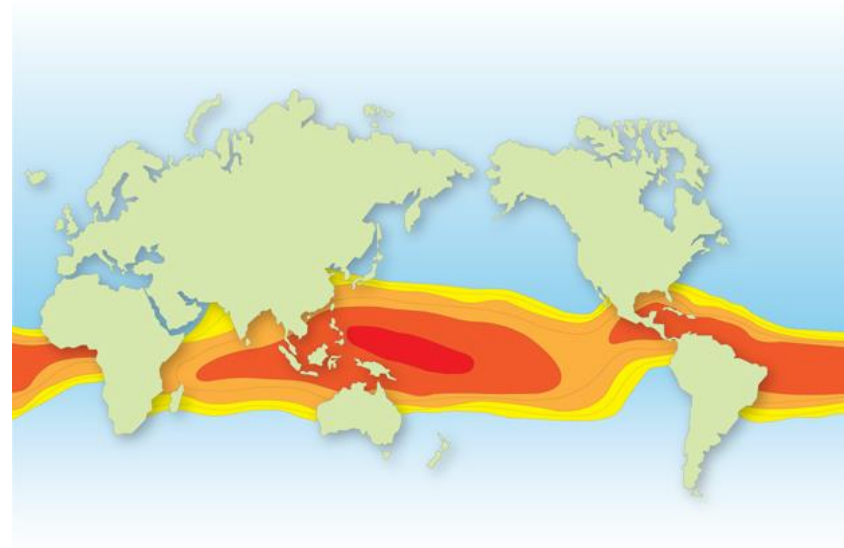
LHD Tidal Current Energy Demonstration
#1 Platform – China



Temperature difference around the world for OTEC



Asia Pacific countries well suited
For OTEC



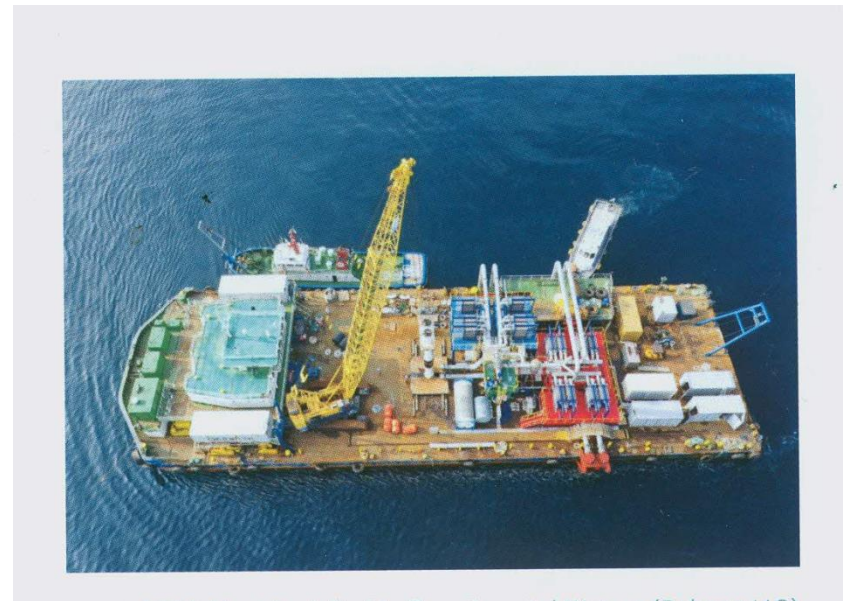
Asia Pacific Efforts – OTEC



Kumejima OTEC plant, Japan

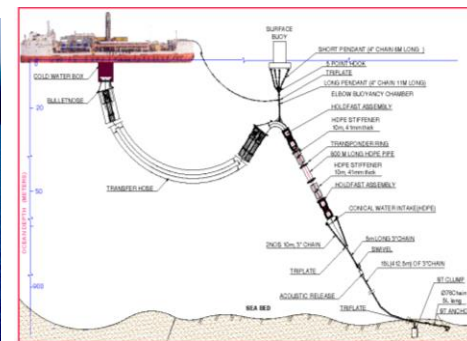
Other Interested countries
Malaysia
Indonesia

1 MW OTEC plant installed in Experimental waters
Pohang, South Korea



Indian Efforts on OTEC

- 1MW OTEC plant mounted on a barge to be moored in deep waters was attempted in 2000
- A non-self-propelled barge was designed and built in Goa.
- Sub systems trials were successfully completed.
- The 1000 m long pipe of 1 m diameter was towed 40 km to the desired site.
- Due to lack of Offshore handling facilities in India the deployment had to be carried out with serious limitations. Project could not be completed.
- Led to *desalination*.....



Desalination projects

Island Desalination

- First ever plant in the world was installed at Kavaratti from concept to commissioning using naturally occurring temperature difference in 2005
- Subsequent plants at Minicoy and Agatti in 2011



Low temperature thermal desalination technology at North Chennai Thermal Power Station using condenser reject waste heat

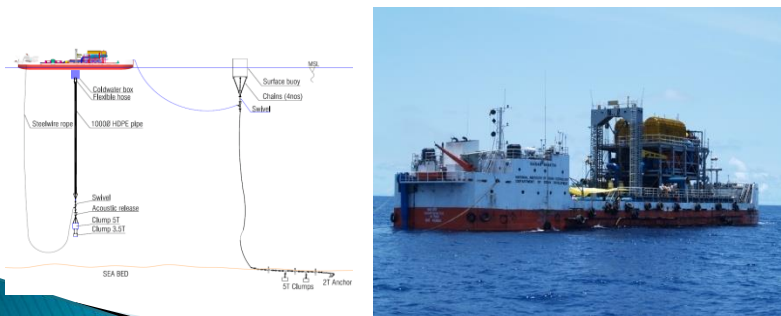
- The desalination plant setup in 2008 is being continuously operated and fresh water is being generated

The plant is able to generate fresh water of 2ppm quality



1MLD Barge Mounted LTTD Plant

- 1 MLD plant on barge Sagar Shakthi, single point moored in deep waters was successfully demonstrated and good quality water was produced

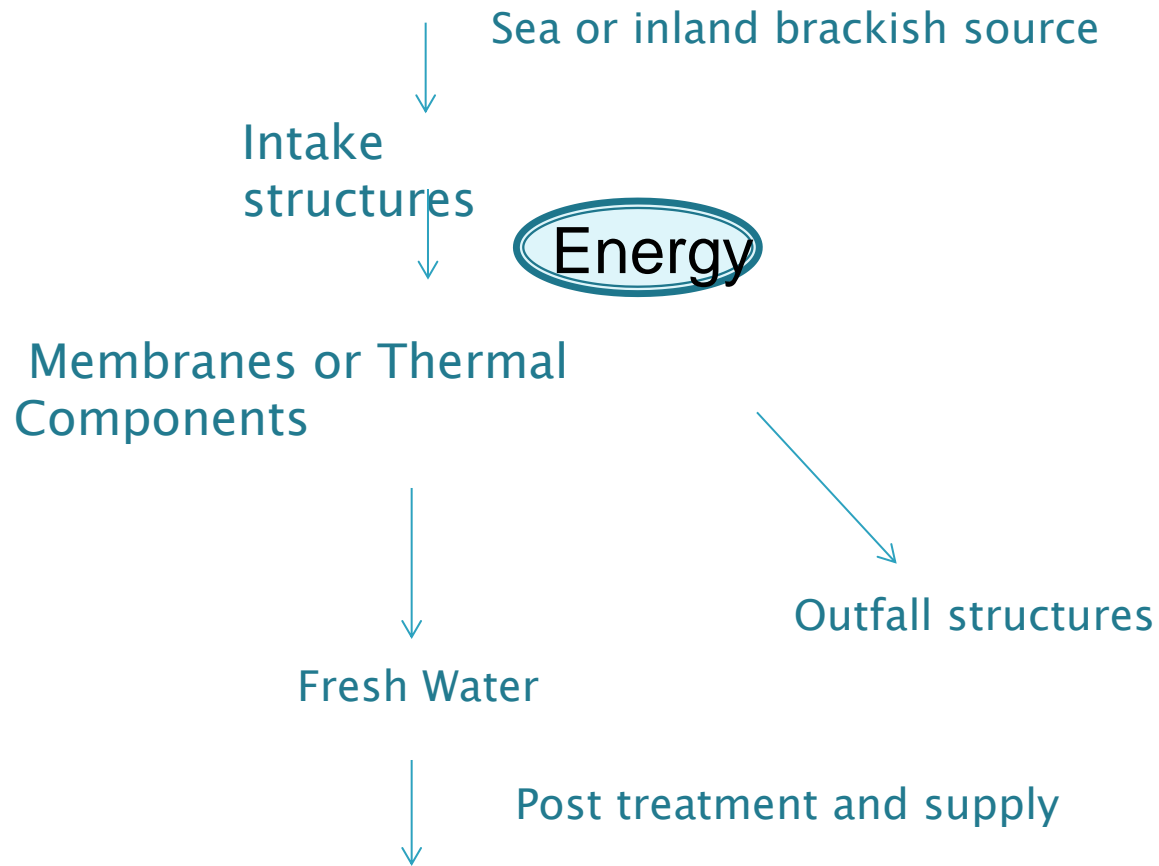


Design, Fabrication, Testing and Installation of Solar Multi-Effect Distillation System for providing potable water in arid rural areas

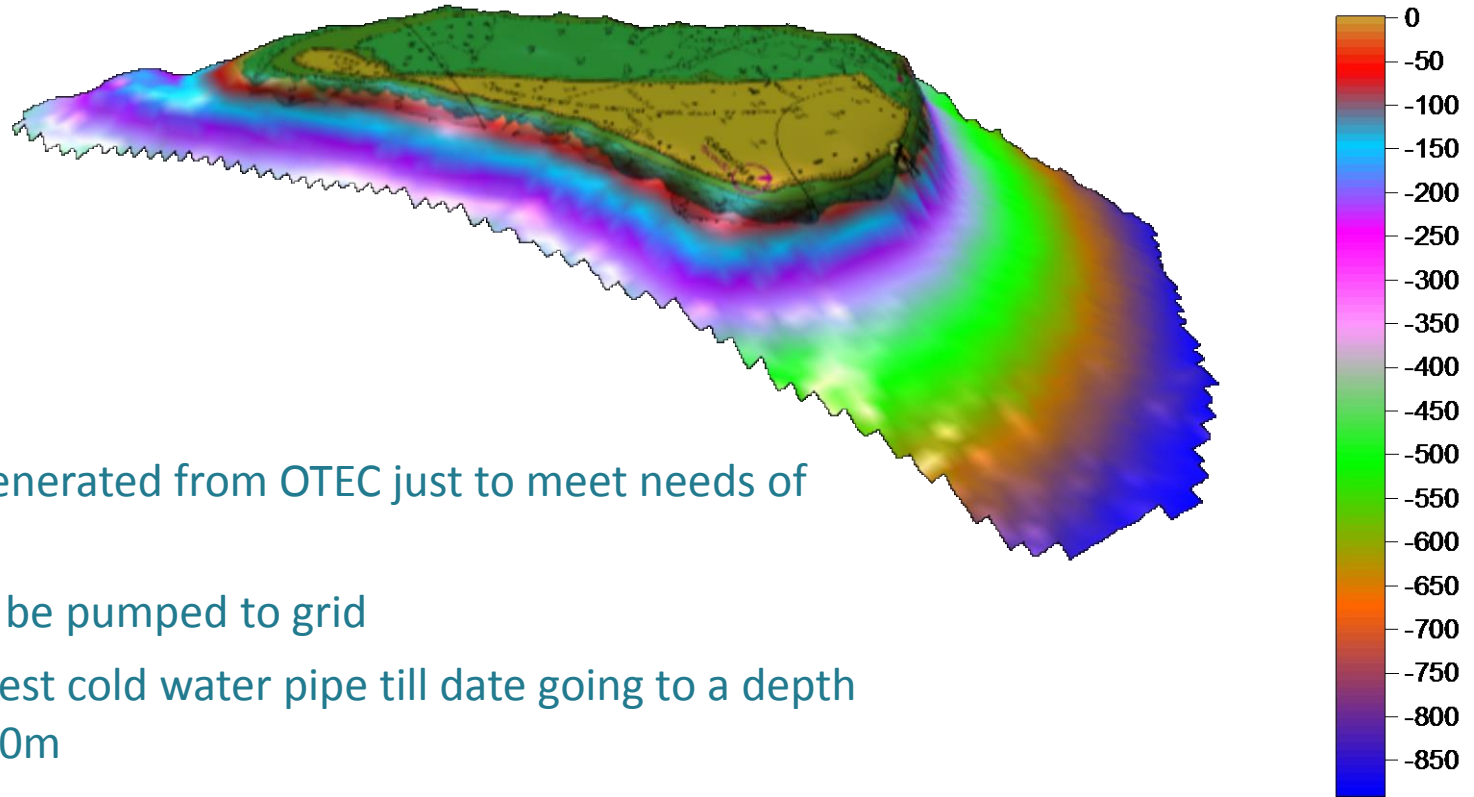
- A 6 m³/hr Solar/Biomass based MED Desalination System was developed with technical support from NIOT, at Narippaiyur, Ramanathapuram



Components of Desalination



New Challenge – OTEC Powered Desalination Plant for Kavaratti



- Total power generated from OTEC just to meet needs of desalination.
- No power will be pumped to grid
- Will have longest cold water pipe till date going to a depth of around 1000m
- First ever indigenously designed and fabricated OTEC turbine

Wave Energy Plant at Vizhinjam, Kerala



- ▶ An Oscillating Water Column Structure made of concrete caisson.
- ▶ Location: 45m from Vizhinjam Fisheries Breakwater, near Trivandrum, in 10m water depth
- ▶ Annual Average potential at the site: 15kW/m
- ▶ Four configurations of turbine-generator systems were studied.



- Reverse osmosis plant of 10000 litres/day was installed in 2003.
- Plant was run using the power generated from wave energy plant.
- The plant drew both its water input and its energy from the sea. First of its kind!
- After successful demonstration, the wave energy plant was decommissioned.

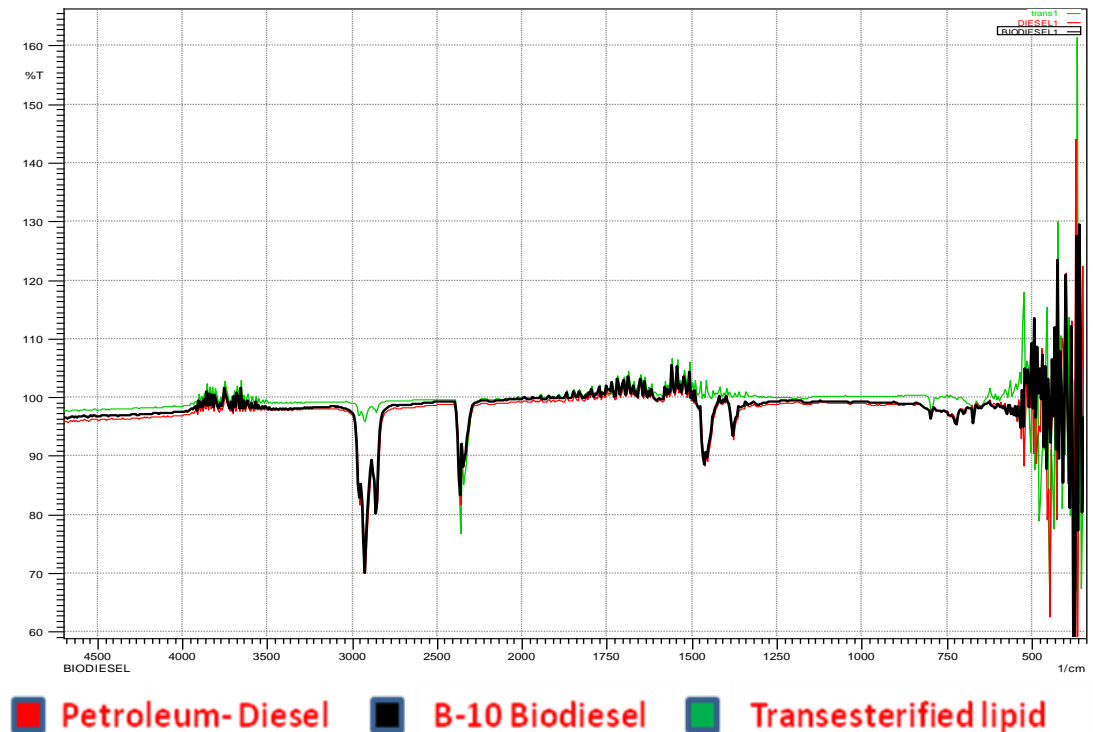
Energy from Algae



Mass Culture Of Micro Algae In Raceway Operate In Solar Powered Paddle Wheel

Preparation And Characterization Of B-10 Biodiesel

B-10 biodiesel prepared from the lipid extracted *Chlorella vulgaris* (NIOT 74/POSA)



FTIR spectra of B-10 blended biodiesel, and the trans esterified micro algal lipid were similar to those of the petroleum based diesel

Other energy forms

Offshore Wind

High capital due to offshore installations (Europe has many today)

Floating solar PV

Popular for rivers or inland water bodies. Challenging to design for open ocean

Barriers for Ocean Energy

Many Asia – Pacific countries have low marine infrastructure

Demonstration projects not high enough in scale

Perceived Risks

Techno commercial viability difficult to assess on small devices, however funding difficult for large ones –

Circular problem...

Way Forward

Resource assessment – take up energy forms suitable for the region
- Needs modelling capability and buoy data for validation

Small rating off grid devices (low capital and proof of concept)

Purchase of available devices around the globe and use as a study device

Federal investment for big prototypes to assess performance in field

Training programs and capacity building (multi country approach)

Thank you