

# **OTEC Strategy for Puerto Rico:**

## **Power and Economic Development**

Presentation to:

**Institute of Electrical Engineers**  
**College of Professional Engineers and Surveyors of Puerto Rico**

August 8, 2008

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*President*

**Offshore Infrastructure Associates, Inc.**

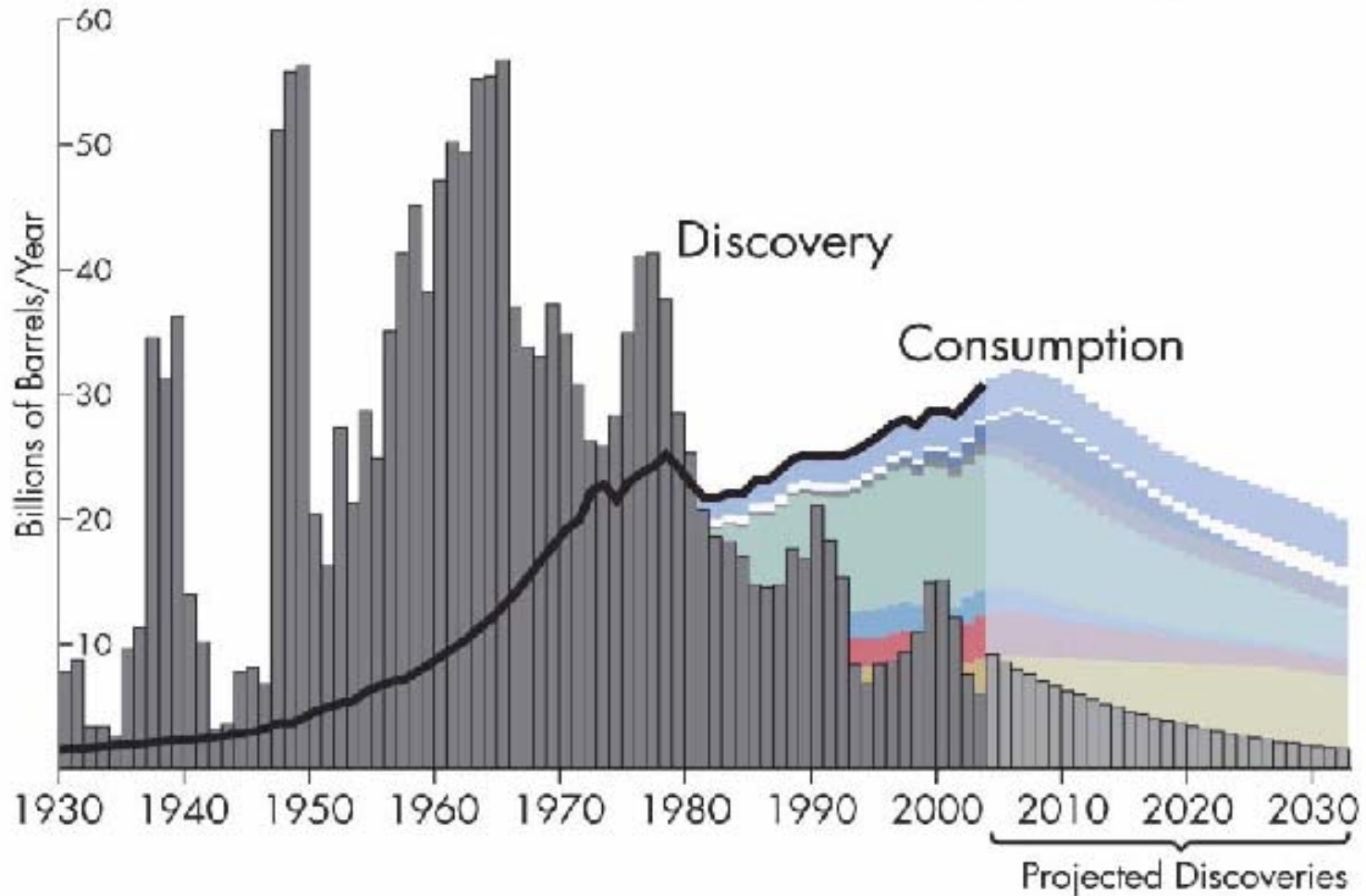


We are at a turning point in economic development throughout the world.

We have a choice:  
Keep oil producers rich  
or  
put Puerto Ricans to work to build  
energy independence and  
lower cost electricity

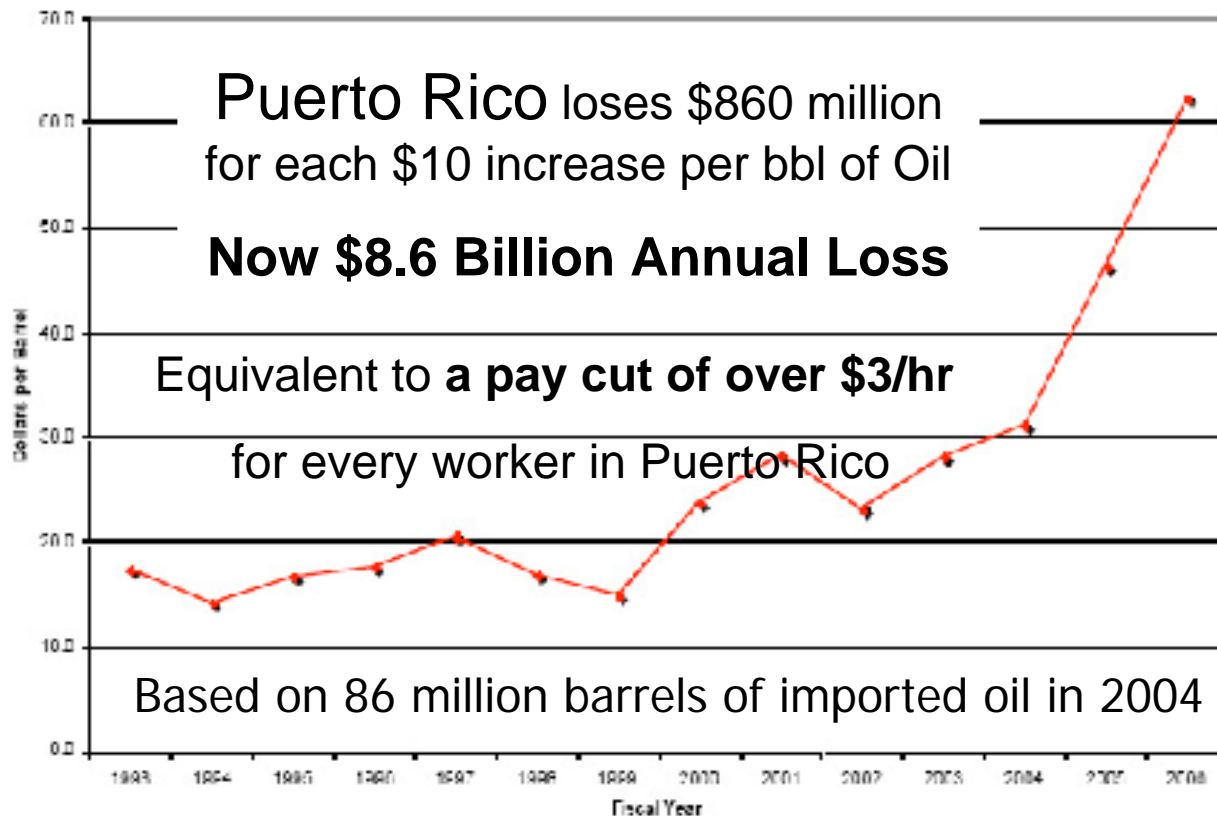


# Peak Oil - The Growing Gap



# Puerto Rico suffers severely for its Oil Dependency

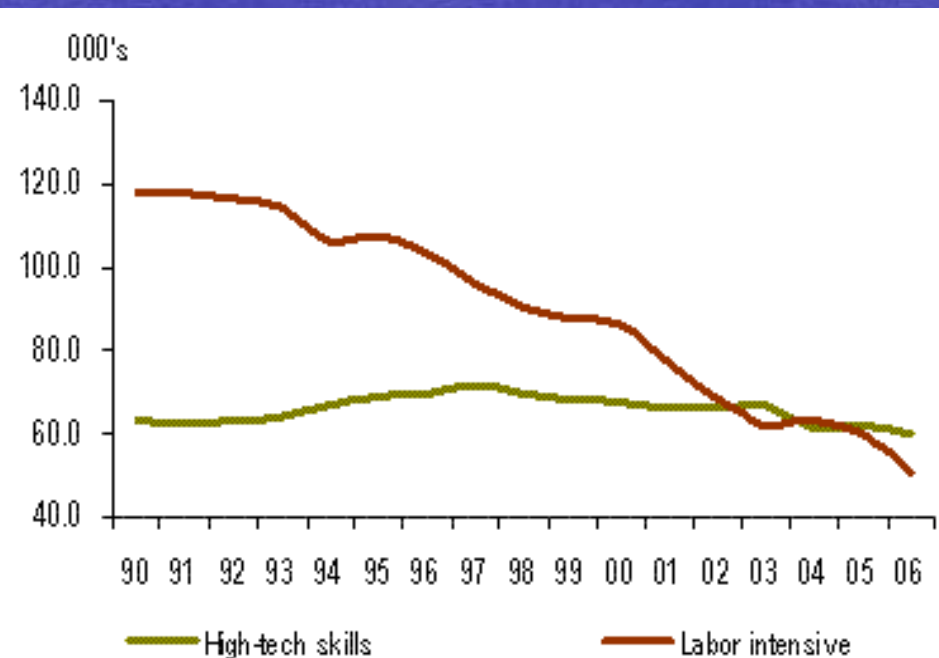
## Average Price of Imported Crude Oil (dollars/barrel)



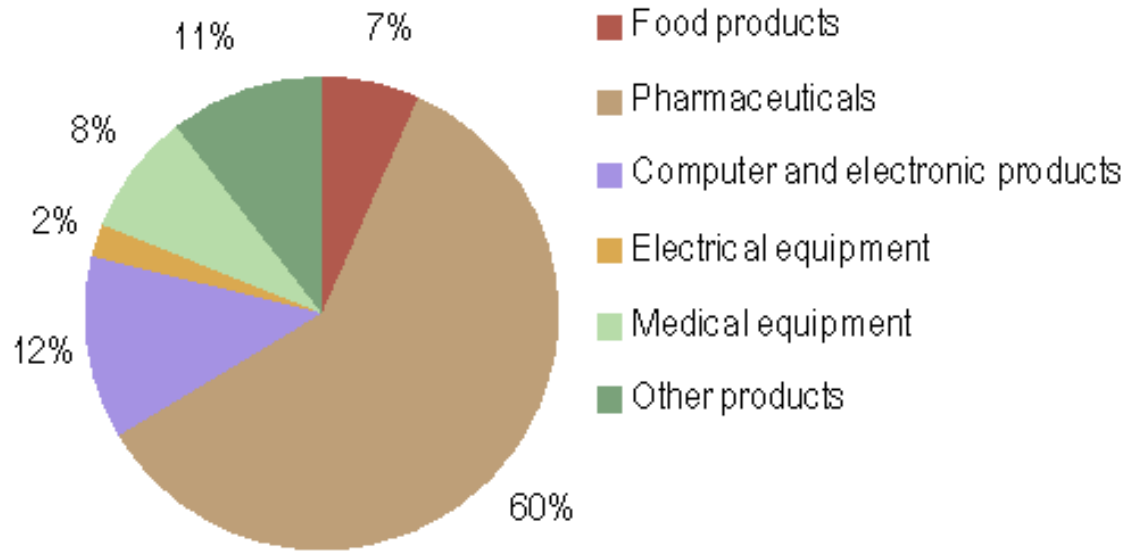
# Puerto Rico has lost 35% of its manufacturing jobs since 1995



And more than half its labor intensive jobs

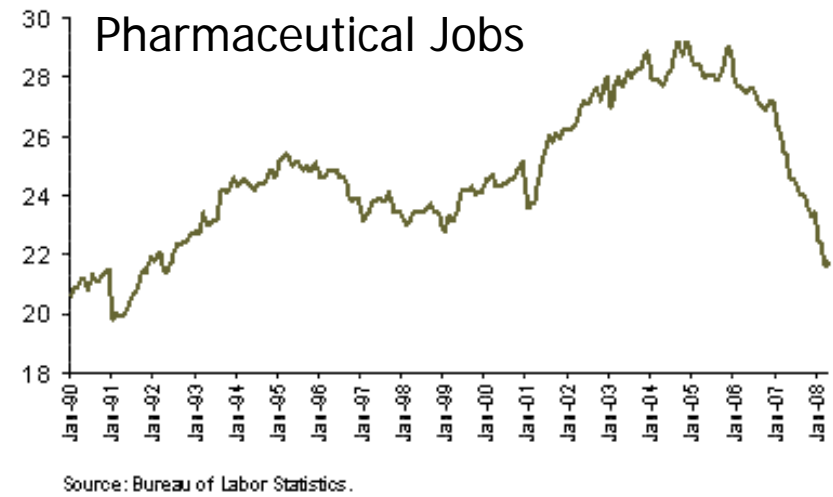
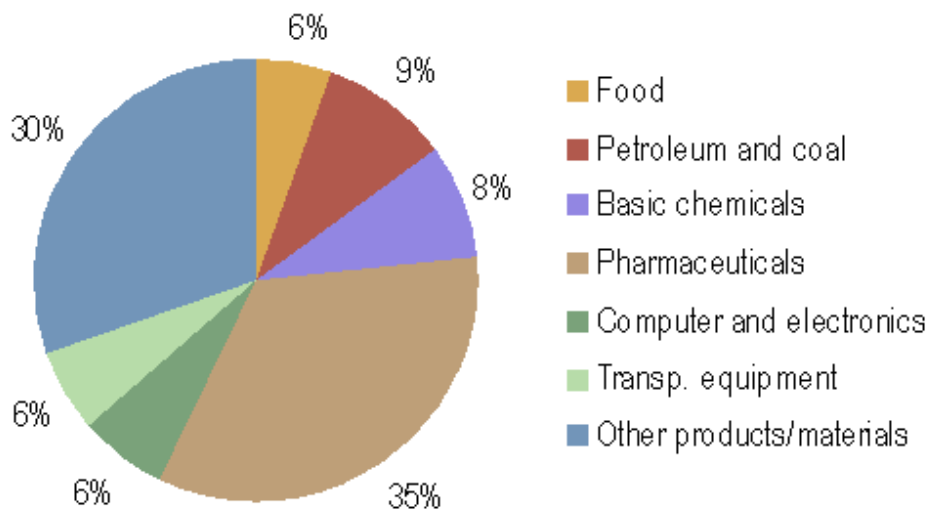


## MAIN EXPORT PRODUCTS, 2006



Most major patented pharmaceuticals come off patent by 2012

## MAIN IMPORTS PRODUCTS, 2006

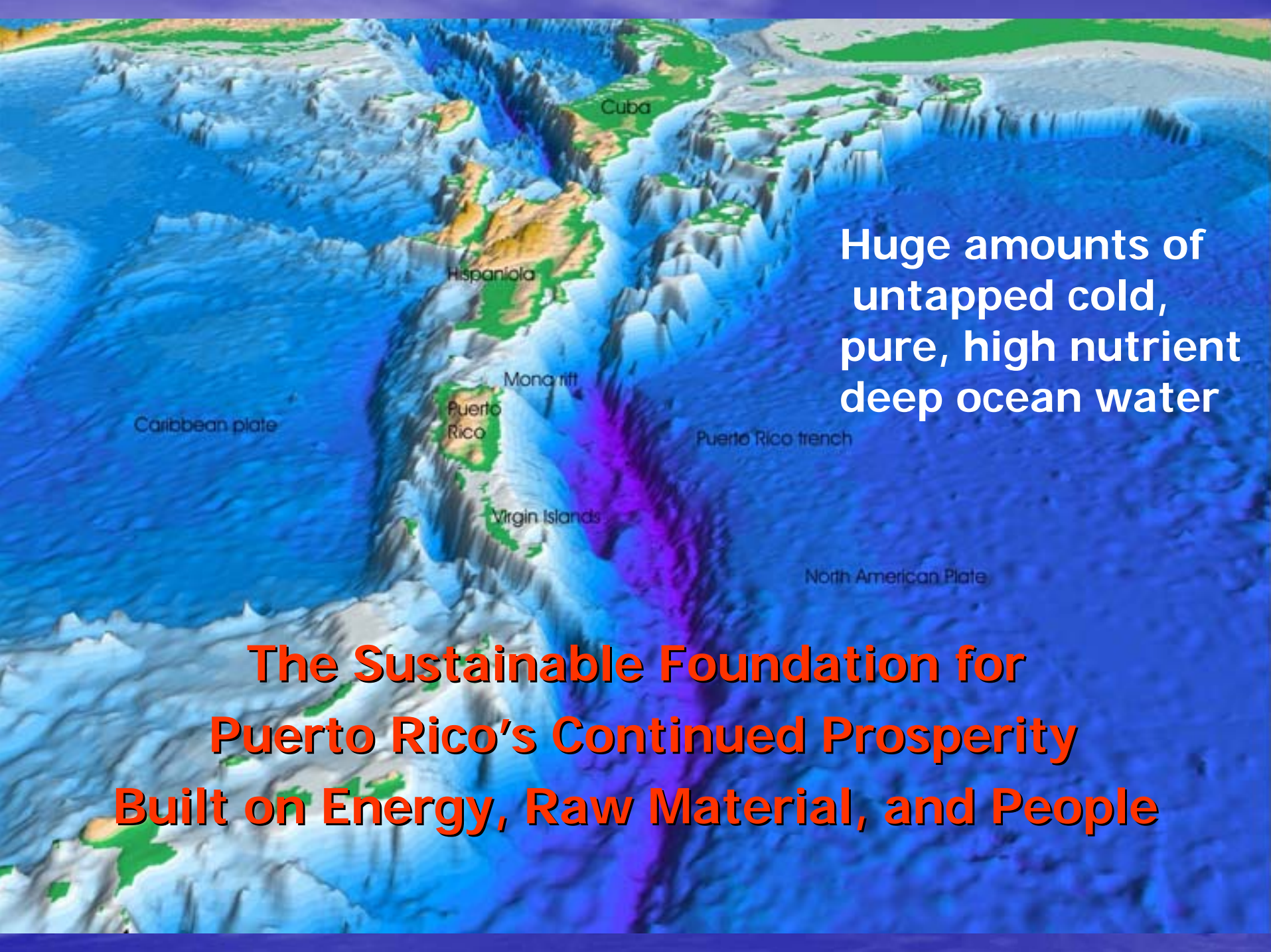


But Puerto Rico has  
A Huge Deep Ocean Natural  
Resource suitable for OTEC

*Plus*

The Intellectual Resources  
to develop OTEC related  
technologies *and* to manufacture  
and finance them





Huge amounts of  
untapped cold,  
pure, high nutrient  
deep ocean water

**The Sustainable Foundation for  
Puerto Rico's Continued Prosperity  
Built on Energy, Raw Material, and People**

This combination exists nowhere else  
in the World!

Not Singapore

Not Ireland

Not anywhere else

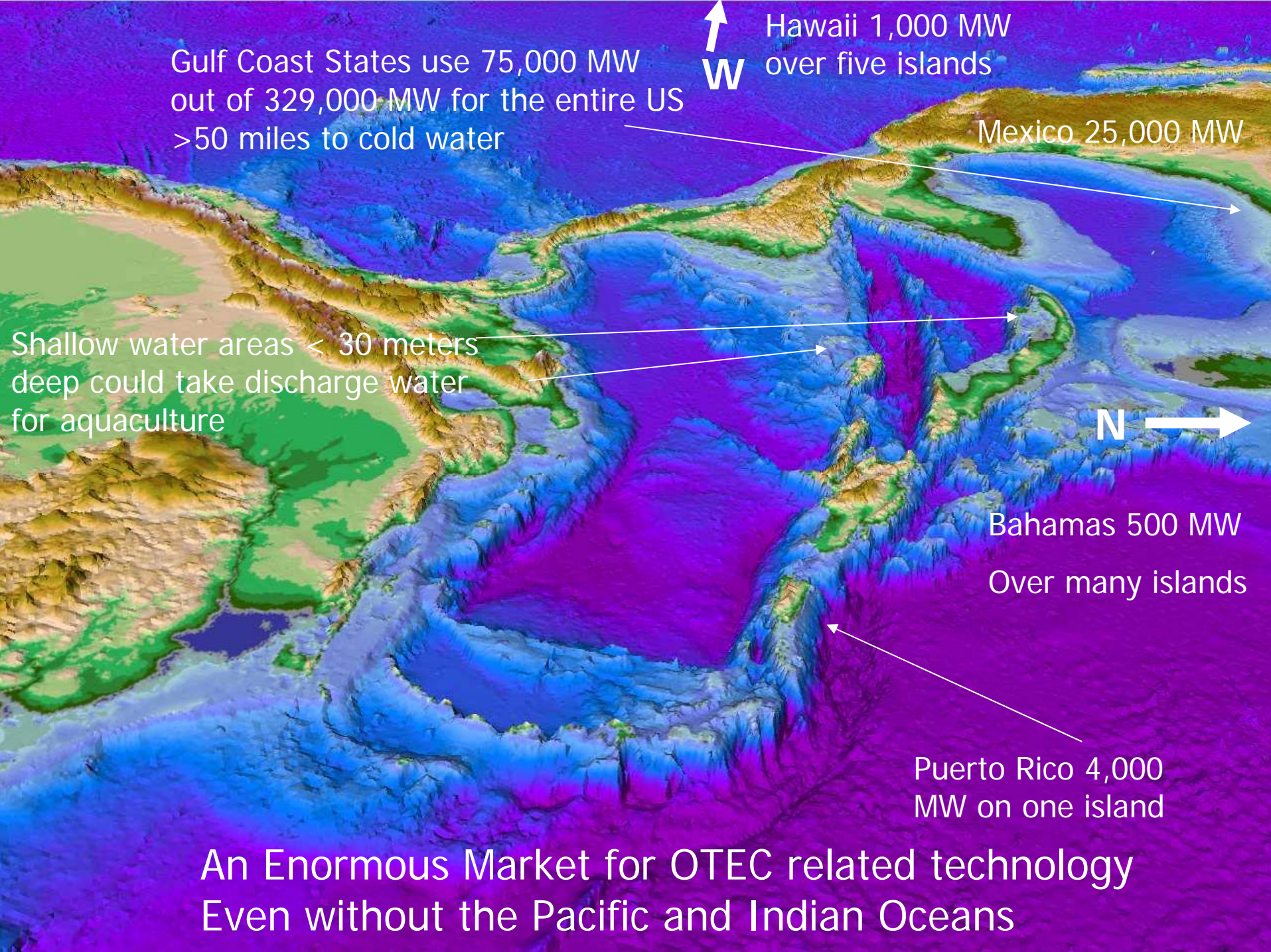
Puerto Rico and the Universities of Puerto  
Rico are ideally suited to become the  
World's Leader in OTEC  
& OTEC Related Deep Ocean Technology



# Puerto Rico's Unique Assets

- The deep ocean resource close to land
- Large electrical demand on one island
- A highly educated and capable workforce of more than 1.4 million
- Facilities able to build the OTEC units
- A strong and stable financial, political and economic infrastructure with excellent tax incentives
- A Biotechnology capability that can revolutionize microalgae & ocean based products





Gulf Coast States use 75,000 MW  
out of 329,000 MW for the entire US  
>50 miles to cold water

↑  
W  
Hawaii 1,000 MW  
over five islands

Mexico 25,000 MW

Shallow water areas < 30 meters  
deep could take discharge water  
for aquaculture

N →

Bahamas 500 MW  
Over many islands

Puerto Rico 4,000  
MW on one island

An Enormous Market for OTEC related technology  
Even without the Pacific and Indian Oceans

# Many Critical OTEC Elements can be Manufactured and Assembled in Puerto Rico

- Power System - commercially available
  - Turbines
  - Heat Exchangers
  - Pumps
- Platform – commercial design & construction
- CW Pipes – commercially proven to 2 M dia. Larger field tested but not in full size
- Moorings – same as for deepwater oil platforms



San Juan

UPR Humacao

Roosevelt Roads 10 miles to Deep Water



Abandoned Sugar Cane Fields

Port Yabucoa 3.5 miles to Deep Water

Playita

Yabucoa

El Negro

Maunabo

Emajagua



Faro de Punta Tuna 1.5 miles to Deep Water

# Resources that could employ large numbers of people in OTEC Related Activities

Image © 2007 DigitalGlobe  
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Image NASA

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My original plant started 1968 stopped in 2003

# An Ideal OTEC Assembly Location



Dry-dock at  
Roosevelt Roads  
1000 ft by 150 ft  
Unused

© 2007 Europa Technologies

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Ideal close support location



Port Yabucoa

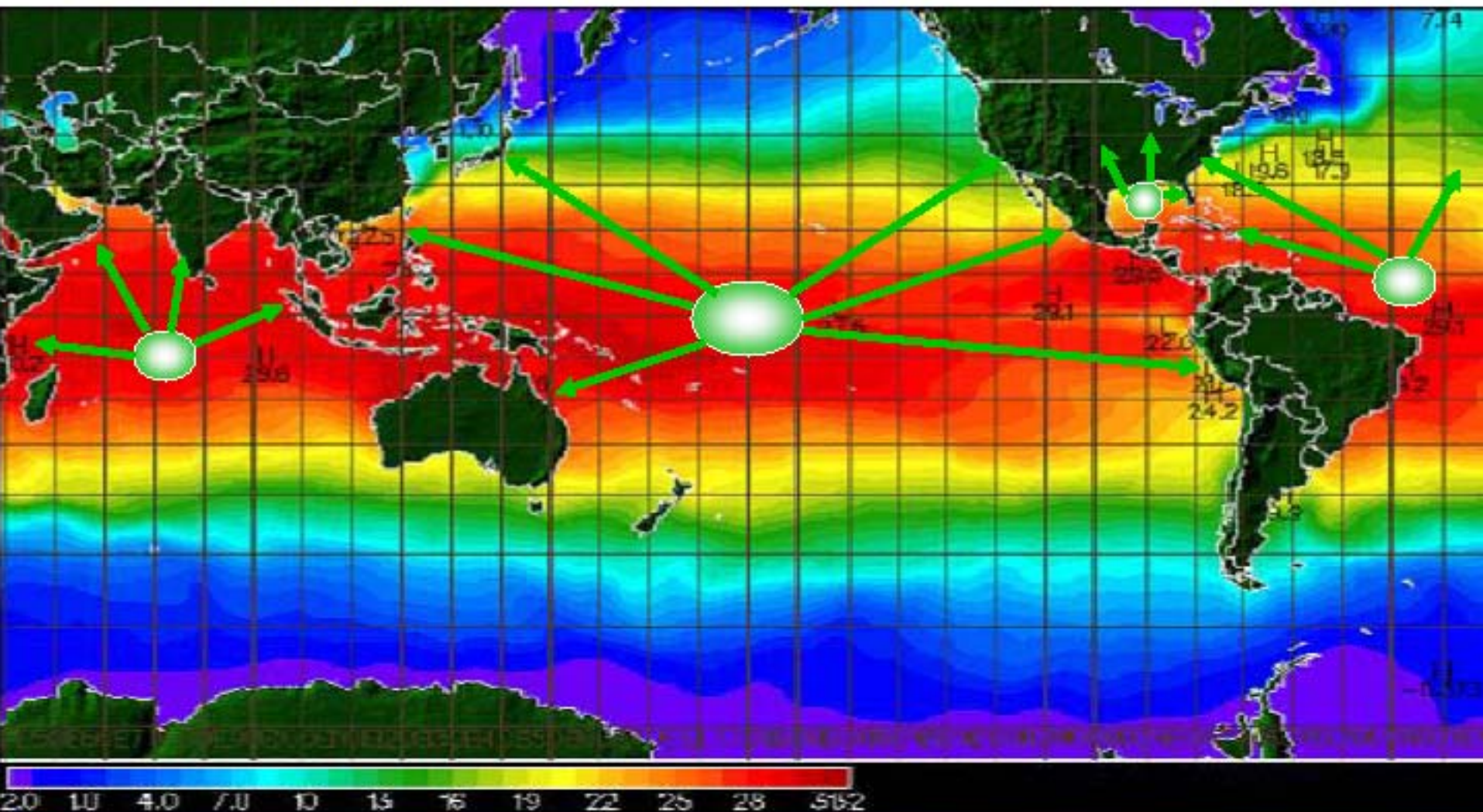
Vacant Building and unused dock

© 2007 Europa Technologies

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# Ocean Thermal Plantships

## Global Impact of Ocean Thermal Plantships – Four Strategic Regions



# OTEC

## Base Load Electrical Power

- No Land Use
- No Fuel Use
- No Environmental Impact
  - Little or No visibility
- Co-Production of Fresh Water
- Adaptable to Assembly Line Production



# Each 100 MW OTEC Plant

Provides Base Load Electricity for over 100,000 people

- Produces 800 Million kWh of electricity per year
- Saves 1.3 million barrels of oil each year
- Avoids the generation of up to 700 thousand tons of CO<sub>2</sub>
- Can be designed to co-produce 200 million liters of fresh water per day (50 million gallons per day)



# Overall benefits to Puerto Rico

## Renewable Energy Forever

Cost reductions from \$80 to \$40 a barrel oil


## Good Paying Skilled Jobs Forever

## Excellent Financial Returns Forever

To Puerto Rico and to Investors

Savings to Puerto Rico of over \$130 million per 100 MW Unit  
With oil at \$100 a barrel





Discharge Ocean Water from  
OTEC Plants can provide the  
foundation for an  
**Algae & Aquaculture Industry**


- \* Bio Fuels
- \* Pharmaceuticals
- \* Specialty Chemicals
- \* Food  
and

**Ocean Metals & Minerals**

Open Pond Production System

There are estimated to be between 1 million and 10 million undiscovered algae in the oceans. few have been characterized.

Use of local indigenous species can eliminate environmental risks – oils can be extracted with the remainder used for feed



**NEWS RELEASE**

▶ **EMBARGOED UNTIL: 09:00 GMT TUESDAY 11 DECEMBER 2007  
10:00 CET, 01:00 PST, 03:00 CST, 04:00 EST (23:00 TO DEC HAWAII)**

**SHELL AND HR BIOPETROLEUM BUILD FACILITY TO GROW ALGAE FOR BIOFUEL**


Royal Dutch Shell plc and HR Biopetroleum today announced the construction of a pilot facility in Hawaii to grow marine algae and produce vegetable oil for conversion into biofuel.

The announcement is a further step in Shell's ongoing effort to develop a new generation of biofuels using sustainable, non-food crop materials. Algae hold great promise because they grow very rapidly, are rich in vegetable oil and can be cultivated in ponds of seawater, maintaining the use of fertile land and fresh water.

**DOW**  
Deep Ocean Water  
as Our Next  
Natural Resource

MONITORING THE OCEAN

Presented by  
DR. JONATHAN J. COPELAND



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August 2006

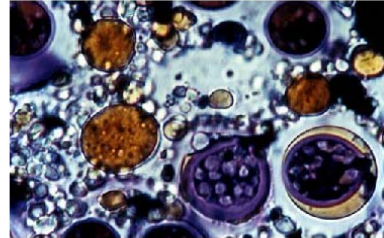
**Production of Micro algae-based Products**

A map of available production methods for micro algae and market opportunities for algae-based products as a basis for establishing commercial operations.



Author: Jan Berg-Nielsen

A Look Back at the U.S. Department of Energy's Aquatic Species Program:



**Biodiesel from Algae**

Part I:  
Program Summary

Algae can produce up to 20 times the oil that can be obtained from the highest yielding land plants and does not require fertile land.

Puerto Rico has  
The Five Conditions for Success

The OTEC resource  
The need for electricity

And most important,  
people with  
Competence  
Pride and Passion

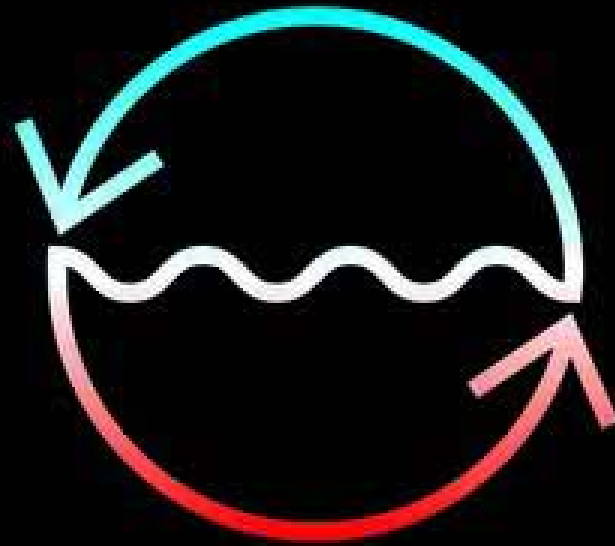


Spanish



An  
Energy  
Solution

English



An  
Energy  
Solution

# Thank You

