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# **The Exploration and Utilization of Ocean Energy in China**

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- April 1st, 2010, “PRC Renewable Energy Law” enacted,  
marking a new historical period in the exploration and utilization of the renewable energy in China.
- ocean energy
  - an important part of renewable energy,
  - a focus of China’s renewable energy development.

I. The exploitation of the ocean energy is of strategic significance

# Ocean Energy

- The ocean energy: all forms of natural energy sources embedded in the sea or derived from the sea.
- Renewable ocean energy: tidal energy, wave energy, current energy, thermal gradient energy, salinity gradient energy, sea biomass energy, and offshore wind energy.
- A massive source of clean and renewable energy, ocean energy drew extensive attention from the coastal countries in 1970s.

# Why ocean energy for the world

- In new century, depleting fossil nergy ,tremendous pressure of global climate change,necessity of energy conservation and emission reduction
- international consensus: only with the clean energy technology can a country lead the global economy of the 21st century.
- ocean energy: strategic importance in the future energy development.

# China's emission reduction goal

Backdrop: UN Climate Change Framework Convention, World Climate Change Conference in Copenhagen

Chinese government goal: GHG emission control on Nov. 25th, 2009

- cutting CO<sub>2</sub> emission by 40% to 50% per unit of GDP against the 2005 level
- incorporating this as a binding indicator in the medium to long term national economic and social development plans.

# Why Ocean Energy ?

The ocean energy :a major part in efforts to realize this action plan

China's theoretical installed capacity of offshore ocean energy : > 2750 Gigawatt, three times the total installed capacity of electricity in 2009.

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## Strategic importance

- optimizing energy structure
- developing clean energy
- dealing with climate change
- promoting low carbon economy



## II. China has great potential to tap in ocean energy

China: a big ocean country with

- a coastline of 18000 kilometers
- over 6900 islands bigger than 500 squaremeters in area,
- rich in ocean energy reserves

# Tidal energy

The total capacity developable  $\approx$  22 gigawatt  
mainly found in the coastal areas

- -Qiantangjiang River Estuary,Zhejiang Province
- - Leqing Bay,Zhejiang Province
- -Sandu Bay, Fujian Province
- -Luyuan Bay,Fujian Province

An average tidal range of four to five meters  
maximum tidal range being 7 to 8.5 meters.

# Current energy

- The developable capacity  $\approx 14$  gigawatt.
- Zhejiang Province  $>50\%$  with 37 waterways in its coastal area.
- Fujian + Liaoning Provinces  $\approx 42\%$

# Wave energy

Total developable capacity  $\approx$  13 gigawatt  
offshore winds relatively weak

- China's power density is low with an average capacity = 2-7 kilowatt /meter
- given the vast waters, many regions are developable
- Zhejiang+ Fujian + Guangdong provinces > 40% ,Shandong > 10%.

# Thermal gradient energy

- Thermal gradient energy reserves: the biggest in all types of ocean energy
- developable capacity= 1300 gigawatts
- richest reserves in the South China Sea waters
- -highest power density
- - temperature difference between the surface water and deep water = 20 to 24 degrees Celsius.

# Wind energy and biomass energy

- Rich offshore wind energy and biomass energy.
- developable offshore wind energy = 450 gigawatts, three times the land wind energy
- Fujian, Jiangsu and Shandong rank top 3
- A large number of oil-rich algae species suitable for development and utilization for biomass energy.

# China's endowment of ocean energy

- Rich current and thermal gradient energy leading the world in power density
- Medium level in tidal energy
- The offshore wind energy and marine biomass energy present great potential for development.

### III. Where we are in technology for the exploration and utilization of ocean energy



# What we have done

- Starting from 1960s,
  - conducted an extensive survey of ocean energy sources
  - started to build tidal power stations
  - developed the technologies of wave energy, tidal energy, thermal gradient energy, and salinity gradient energy.

# Status quo of energy development techs

- Relatively mature technologies of tidal power generation
- -Jiangxia Experimental Power Station in commercial operation, ranking No. 3 in the world in terms of installed capacity
- technologies for wave and current power generation are still at the stage of experiment and demonstration.

# Status quo of energy development techs (continued)

A series of invention patents and scientific and technological achievements claimed in wave power generation e.x.

- - 40-watt buoy wave power generation device
- - 10-watt wave power generation device for navigation flights
- - 100 kilowatt oscillating water column wave power plant in Shanwei, Guangdong Province
- - a 30-kilowatt oscillating wave power station in Daguan Dao, Shandong
- Substantial progress has been made in current energy and thermal gradient energy.

# Measures taken to Promote Ocean Energy

Support E&U in research, application, and management. R&D and demonstration of major ocean energy technologies listed as the key items in Scientific and Technological Support Plan of the 11th Five Year Plan.e.x.

- - the 100 kilowatt buoy wave power plant
- - the 100 kilowatt oscillating wave power plant.

# Special Programs

- --Survey and evaluate through general site prospecting and assessment the ocean energy reserves and developable capacity
- -- Build independent power plants on nearshore islands as a demo by making comprehensive use of wave energy, solar energy and island wind energy.

# National 863 Plan

- Several projects set to support the basic studies of ocean energy and the development of key technologies for the power generation facilities.
- These projects helped to substantially enhance China's capacity for independent innovation and provide a solid base for the industrialization of ocean power generation.

## IV. Outlook for China's future development of ocean energy

# Strategy

- In line with national strategy of the development of sustainable energy, energy conservation and emission reduction, China is drafting “Special Plan for the Development of Renewable Ocean Energy”
- Given technological gap in the development of ocean energy, China will accelerate international cooperation and domestic innovation in exploration and utilization of ocean energy
- Surmount the bottlenecks for the use of ocean energy through experimental and demonstrative projects.



# Policy

- Initiate and improve relevant policies and public utility system
- Facilitate general public's access to power on the remote islands in process of enforcement of “Law on Island Protection”
- Promote the development of the technologies and the industry of sustainable ocean energy
- Improve the R&D capacity and the level of industrialization,
- Enhance the ability to develop and use ocean energy on a large scale.

# Technological forecast 2015

- by 2015, China will catch up the level of the advanced countries at the turn of this century in terms of general capacity of ocean energy development and utilization.
- - acquire a substantial capacity of demonstrating and applying the ocean power generation system
- - reach level of practical application for ocean energy development technology
- - extend technologies for large scale tidal energy internationally

# Technological forecast 2015 (continued)

- -grasp and localize core technologies of offshore wind power generation for scale production
- -overcome key technological barriers for current power generation
- -develop wave energy technologies suitable for China's marine features
- -make greater efforts to study comprehensive use of thermal gradient energy.
- -beef up studies on ocean biomass energy with applicable prospects.

# A Structured Ocean Energy Industry

- Establish the supporting service system
- Set up comprehensive test centers
- Step up process of industrialization of ocean energy in a substantial way.
- Help to form an industrial chain of R&D, equipment manufacturing, project engineering, and operation and management .
- Develop a compatible soft environment with a standard system, regulations and mechanisms on the management of ocean energy.

Thank you !