THE EAST ASIAN SEAS CONGRESS 2015

Global Targets Local Benefits

Setting the Sustainable Development Agenda for the Seas of East Asia beyond 2015

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Outlook for Ocean Energy Development in Korea

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Ocean Energy Development in Korea

Sihwa Lake Tidal Power Plant

- Capacity of 254MW (25.4MW x 10)
- 8 Sluices
- Completed in 2011

Uldolmok Tidal Current Power Pilot Plant

- Capacity of 1,000kW (500kW x 2)
- Helical type Vertical Axis Turbine
- Completed in 2009

Jeju OWC Wave Power Pilot Plant

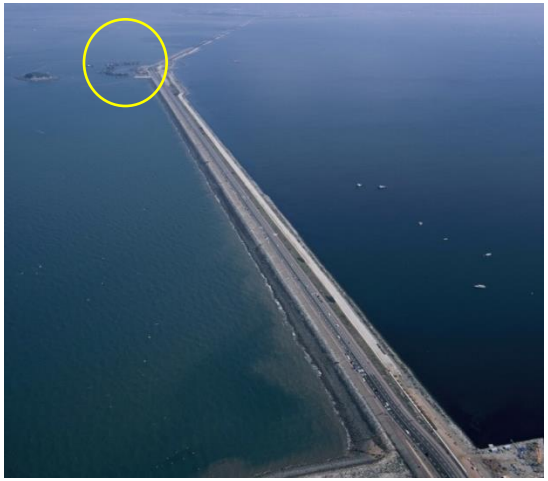
- Capacity of 500kW (250kW x 2)
- Impulse turbine of 1.8m(dia.), 26 blades
- 37.0m(L) x 31.2m(B) x 27.5m(H)
- To be completed in 2015

Goseong OTEC/SWAC Pilot Plant

60RT SWAC

20kW OTEC

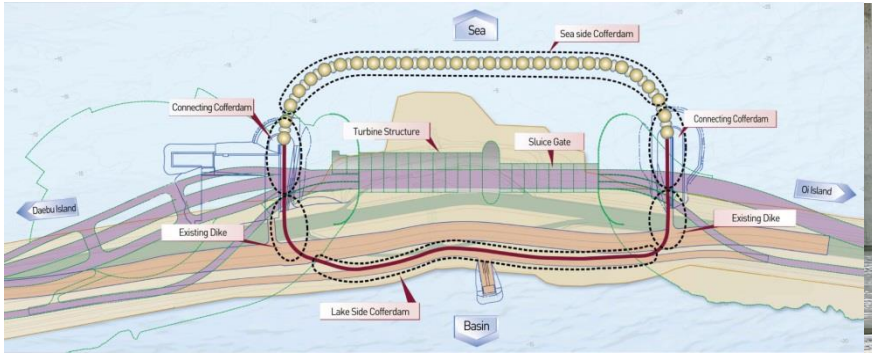
Sihwa Lake Tidal Power Plant



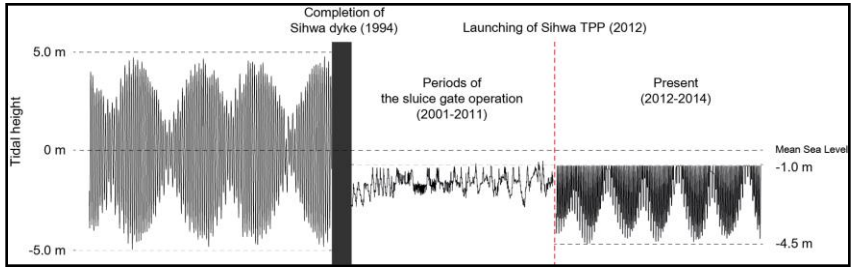
- **History**
  - ✓ Completion of Sea Dyke of 12.7km in 1994
  - ✓ Severe Lake water pollution
  - ✓ Tidal Power Plant was proposed as a counter measure, based on the findings from national R&D
  - ✓ Construction : 2004 ~ 2011
  - ✓ Total Project Cost : USD 355 million
- **Effects of Sihwa Tidal Power Plant**
  - ✓ Improve water quality in Sihwa Lake and environmental recovery
  - ✓ Generate renewable clean energy
  - ✓ Enhancement of regional economy by forming waterfront and tourist attraction
- **Power Output in 2011.8~2014.12**

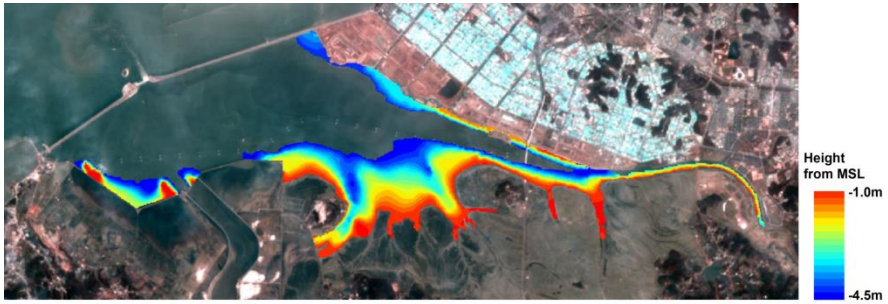
2011.08 ~ 2011.12	52,304 MWh
2012.01 ~ 2012.12	465,924 MWh
2013.01 ~ 2013.12	483,777 MWh
2014.01 ~ 2014.12	492,172 MWh

Sihwa Lake Tidal Power Plant

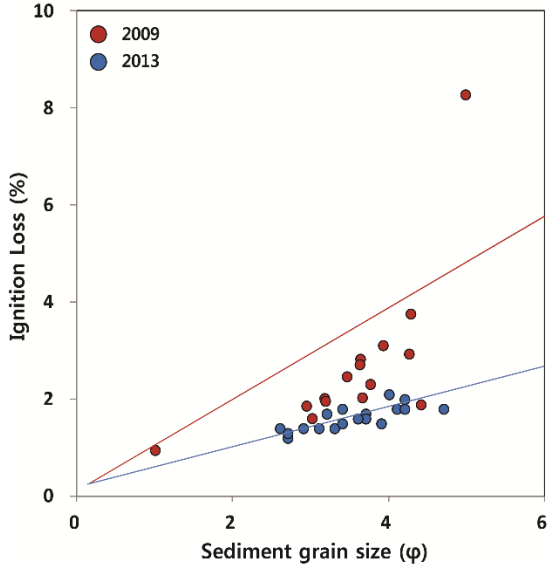


- **Water Level Variations & Restored Tidal Flat**





- **Variation of ignition Loss in tidal flat**



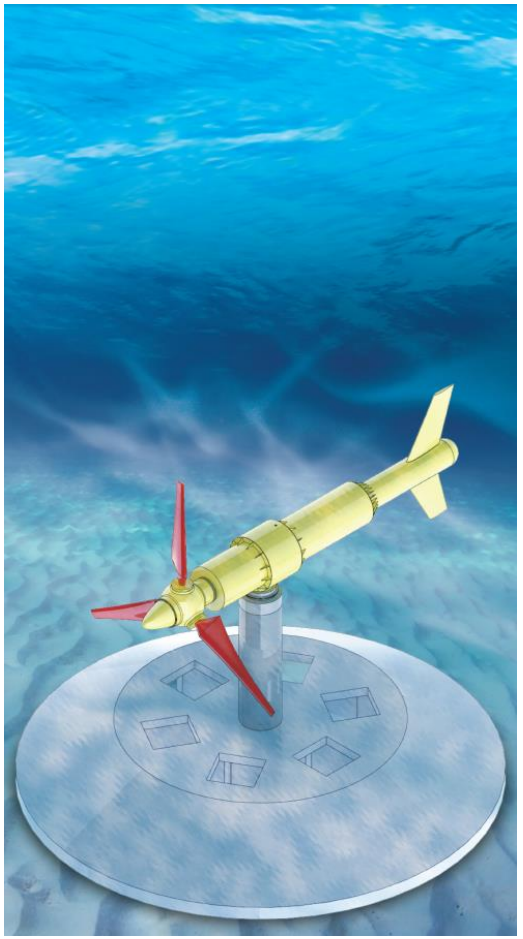
Tidal Current Power Generation System with active-control device

- **Medium Scale Model(1:5) Outdoor Experiment**
  - ✓ 2013~2014 / Uldolmok Test Site
  - ✓ Rotor Dia. : 2.4m
  - ✓ Blade Active Pitch Control
  - ✓ Passive/Active Yawing by Rudder
- **Design of KS200**
  - ✓ 2014~2015
  - ✓ Based on Experimental Results
- **Fabrication of KS200**
  - ✓ 2015~2016
- **Installation**
  - ✓ 2016. 9 ~ 10
  - ✓ Near Uldolmok Test Site
- **Verification Test**
  - ✓ 1st : 2016. 11 ~ 2017. 12.
  - ✓ 2nd : 2018 ~ 2020
  - ✓ Performance Assessment
  - ✓ Environmental Impact Monitoring

- **KS200 (Korean Shark 200)**

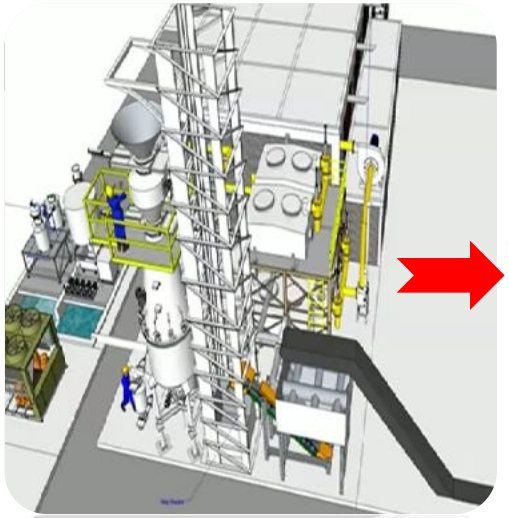
Specification

Rotor	
Diameter	12m
Swept Area	113m²
Rotor speed	16 rpm
Power regulation	Active blade pitch regulation
Yawing system	
Type	Rudder pitch control
Control type	Passive/Active
Transmission system	
Type	Direct drive
Mechanical brake	
Type	Hydraulically released
Generator	
Type	Permanent Magnet Synchronous Generator (PMSG)
Rated power	225kW
Voltage	3Φ 575 V_{LL}
Cooling system	Direct to passing sea water
Monitoring system	
SCADA system	Server-client
Remote control	Full turbine control
Tower & Substructure	
Type of tower	Cylindrical tubular steel
Type of substructure	Gravity type circular caisson
Hub height	11m from seabed
Operational data	
Cut-in current speed	1m/s
Rated current speed	2.3m/s
Weight	
Nacelle & Drive train	Less than 60 tons
Tower & Substructure	Less than 700 tons



Hybrid-OTEC Power Plant (200kW, 2014)

- Combined operation with wood chip gasification power plant
- Using multiple heat sources



500kW Wood Power Plant (MOTIE)

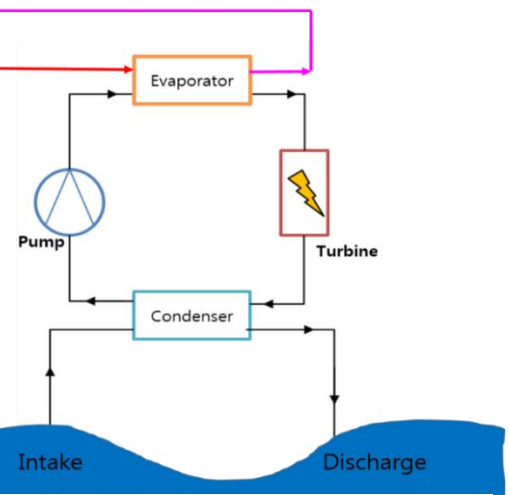
[Solar Energy]

[Wind energy]

[Incineration heat energy]

[Heat storage tank]

200kW H-OTEC Plant (MOF)



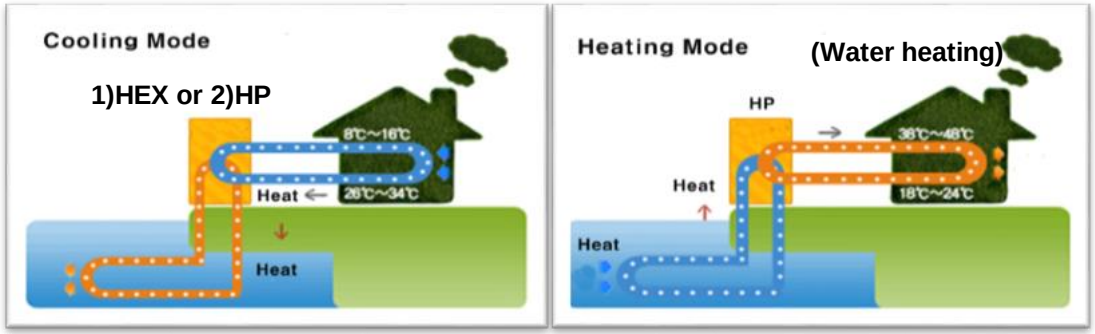
substituted by Geothermal or Solar heat sources for SIDS

SWAC plant to reduce energy demand

- **Cooling source can be acquired from**

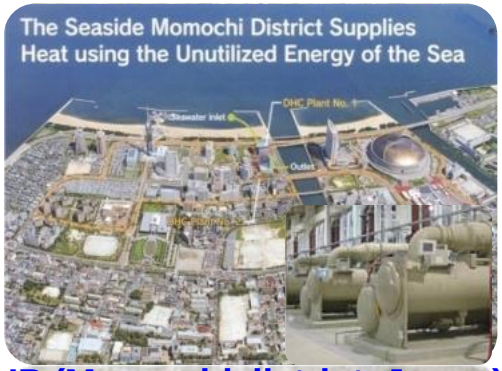
1) **direct heat exchanger by cold deep ocean water**
2) **cold heat of evaporator of heat pump by use of seawater as a condensing heat source**

- **Test bed (100RT & 500RT) were established in 2014 and 2015**



HEX & HP (KRISO, KIOST)

HEX (Resort, Bora Bora)



HP (Momochi district, Japan)

Technology Development

Technology Readiness Levels

Energy Resources	Europe	Korea
Tidal Barrage	TRL 9	TRL 9
Tidal Current	TRL 8	TRL 6-7
Wave	TRL 8-9	TRL 5-6
OTEC/SWAC	TRL 8-9	TRL 5-6

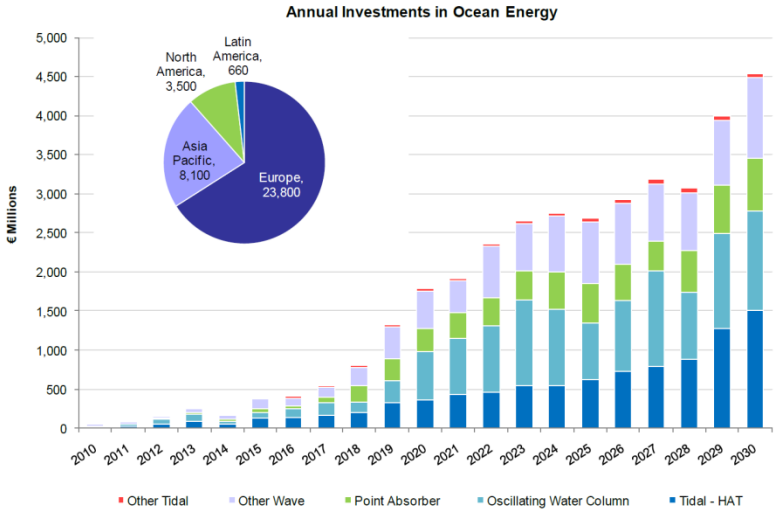
Technology Topics

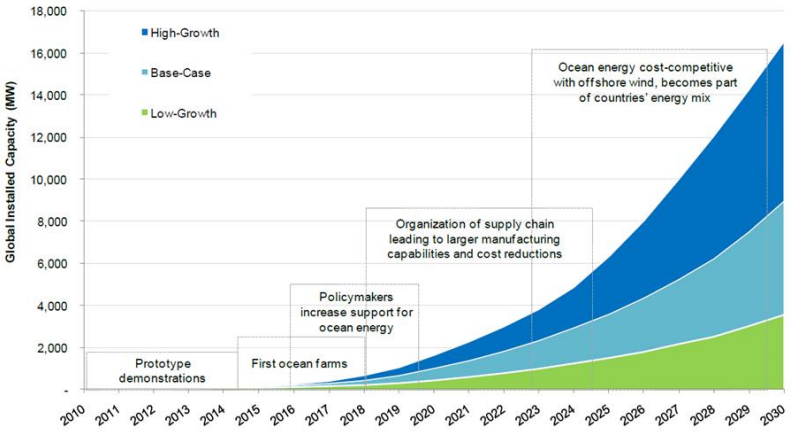
1. Proving reliable operation
2. Device design : cost reduction and development of promising technologies
3. Enabling technologies (cabling and electrical connection)
4. Innovation : novel technologies, new components and subcomponents
5. Knowledge sharing

❖ Wave and Tidal Energy Strategic Technology Agenda. SI Ocean (2014)

Prospectives

- **Wave and Tidal Energy in Europe**
  - ✓ 100GW of installed capacity by 2050
  - ✓ Up to 260TWh Generation
  - ✓ Power 66 million European homes
  - ❖ Ocean Energy Europe (2014)
- **Wave and Tidal Energy Worldwide**
  - ✓ Up to 337GW of installed capacity including Asia
  - ✓ Good opportunity to industry
  - ❖ Ocean Energy Systems : Annual Report 2013
- **Meygen Project in UK**
  - ✓ 398MW of installed capacity (269 turbines)
  - ✓ Power supply for 175,000 Scottish households
  - ✓ Commissioning of the 3 of 1.5MW Unit is scheduled for the end of 2016
  - ✓ ANDRITZ HYDRO Hammerfest
- **Tidal Current Energy in Korea**
  - ✓ The first pilot array of 10MW will be installed in 2020~2024





Global ocean energy markets and strategies: 2010-2030, IHS Report (2010)

Summary and Discussions

- Technology for ocean energy development have been improved rapidly, and several machines for wave and tidal energy is at the pre-commercial stage.
- By 2050, up to 337GW of wave and tidal energy could be installed around the world, which give an enormous opportunity to ocean energy industry in domestic waters and export markets.
- From 2000, MOF of Korea has supported the long-term RDI&D program for the development of ocean energy technology, and has a plan to build the field test centers for wave and tidal current energy from 2017 and the first pilot array of tidal current energy by 2024, which could be the good opportunity to industry and forming supply chain.
- For the successful industrialization, several barriers should be overcome, such as financial risks, technological reliability, environmental problems and grid-connection.