

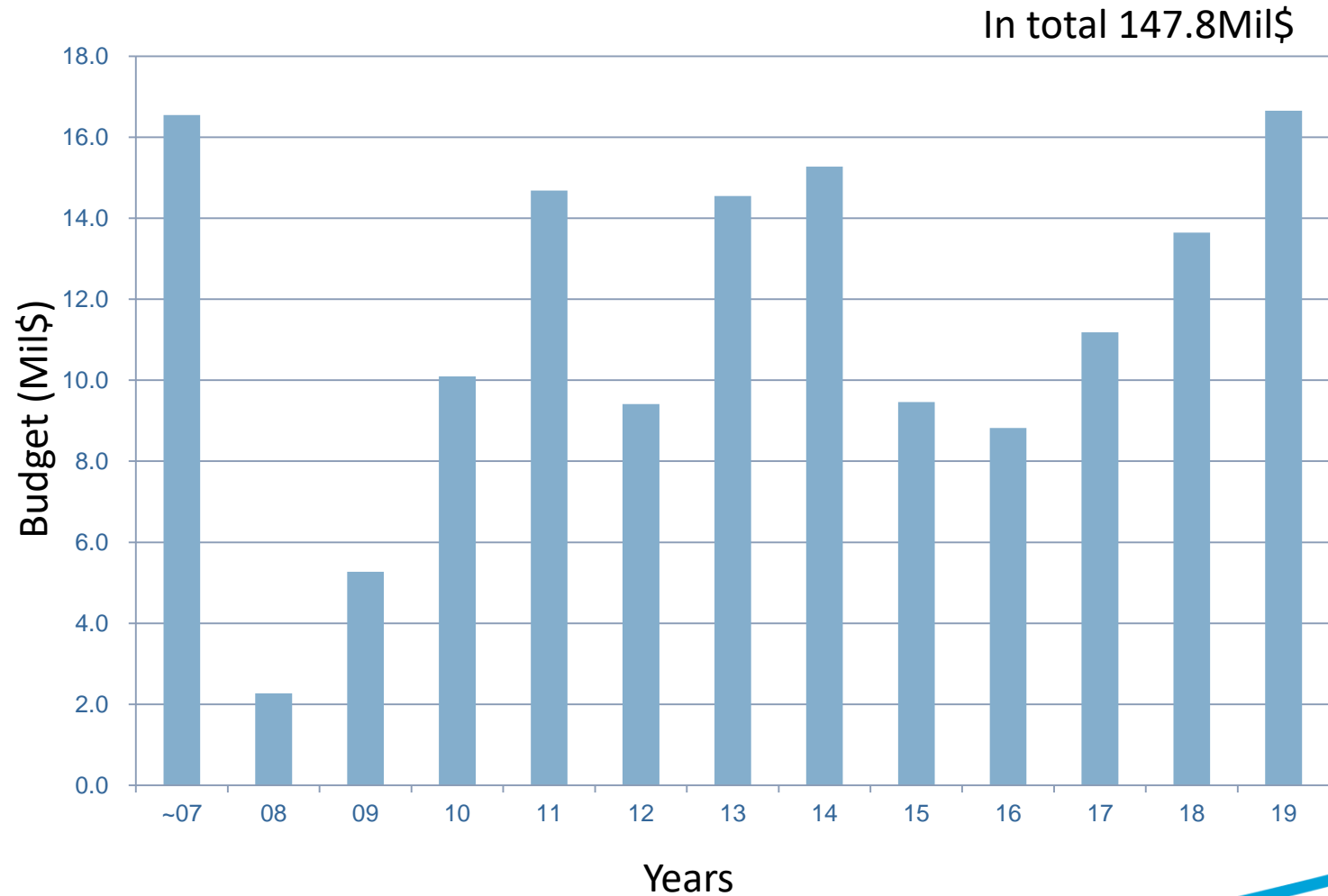
Development of Ocean Energy Systems for Remote Off-Grid Islands in Korea



KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

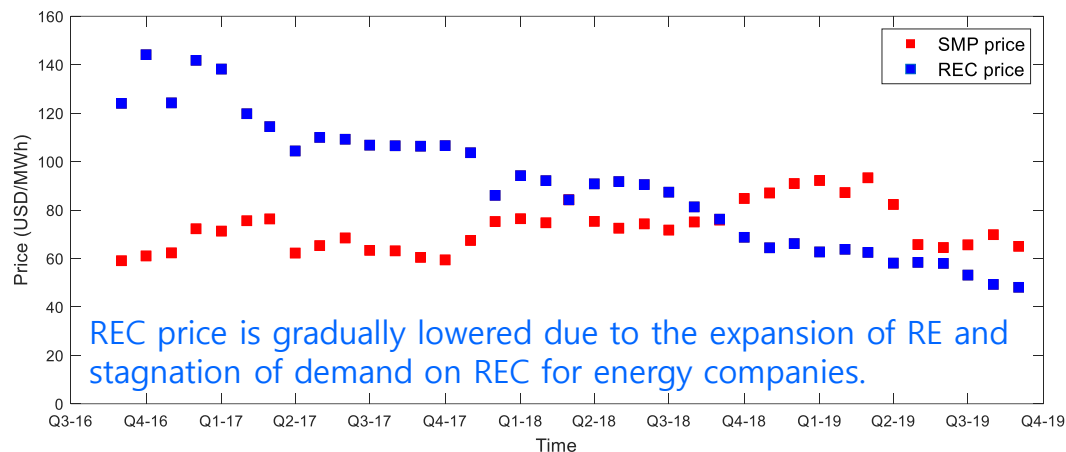
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Annual R&D Budget for OES in Korea



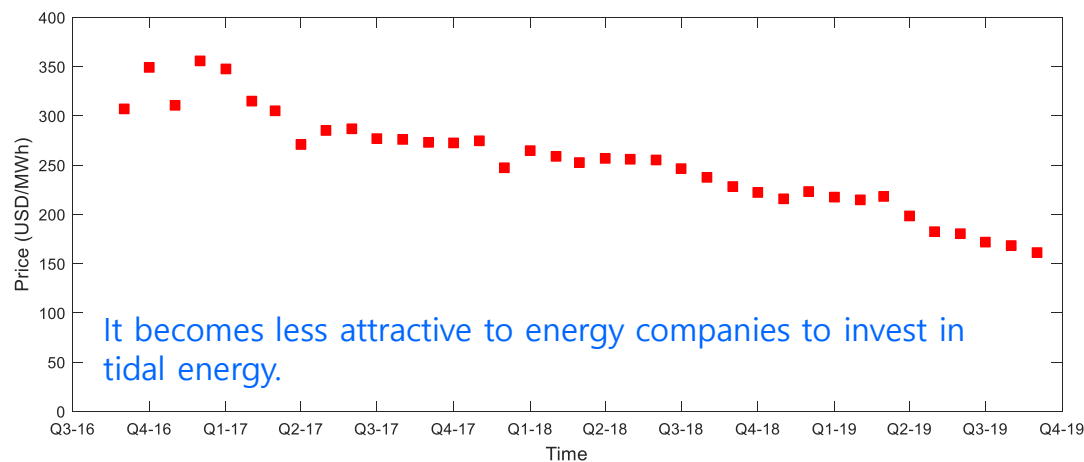
Renewable Energy Selling Price

Selling Price = SMP + W×REC



REC Weight	Resource	Notes
2.0	Tidal Range (w/o Barrage) Tidal Current	
2.0	Offshore Wind	~5km
2.5		5km~10km
3.0		10km~15km
3.5		15km~
4.5	ESS with Wind	'18, '19
4.0		'20

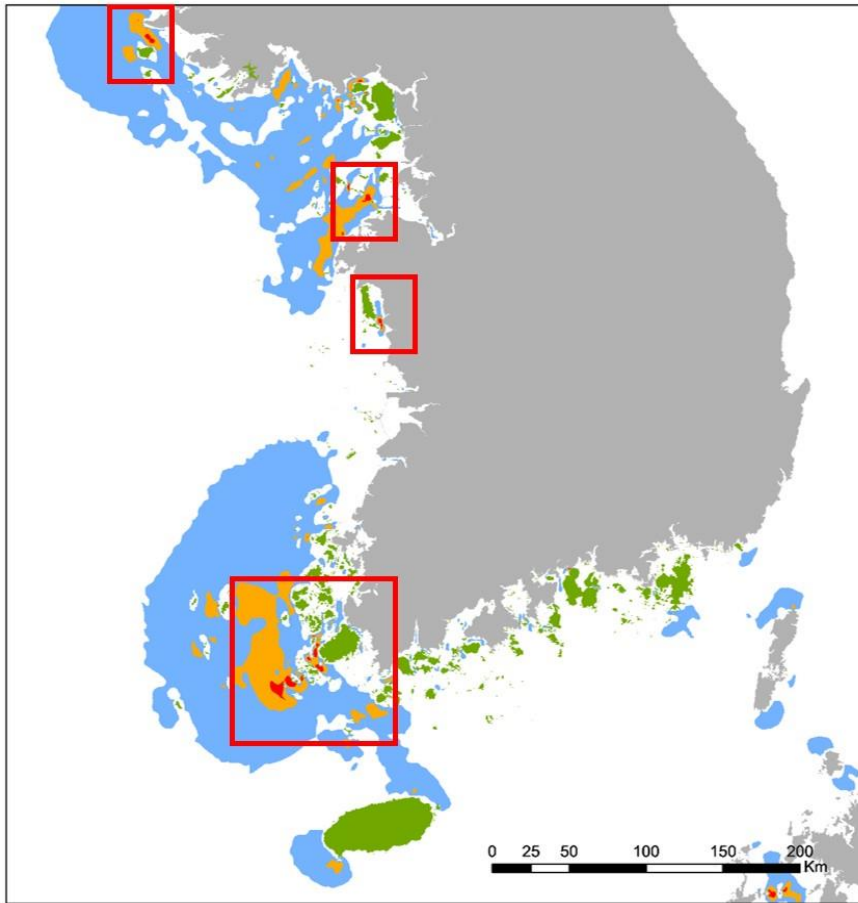
Selling Price for Tidal Energy (REC Weight for TE = 2.0)



Notes:
 SMP = System Marginal Price
 REC = Renewable Energy Certification
 W = Weight for REC
 ESS = Energy Storage System



Tidal Energy Resources in Korea

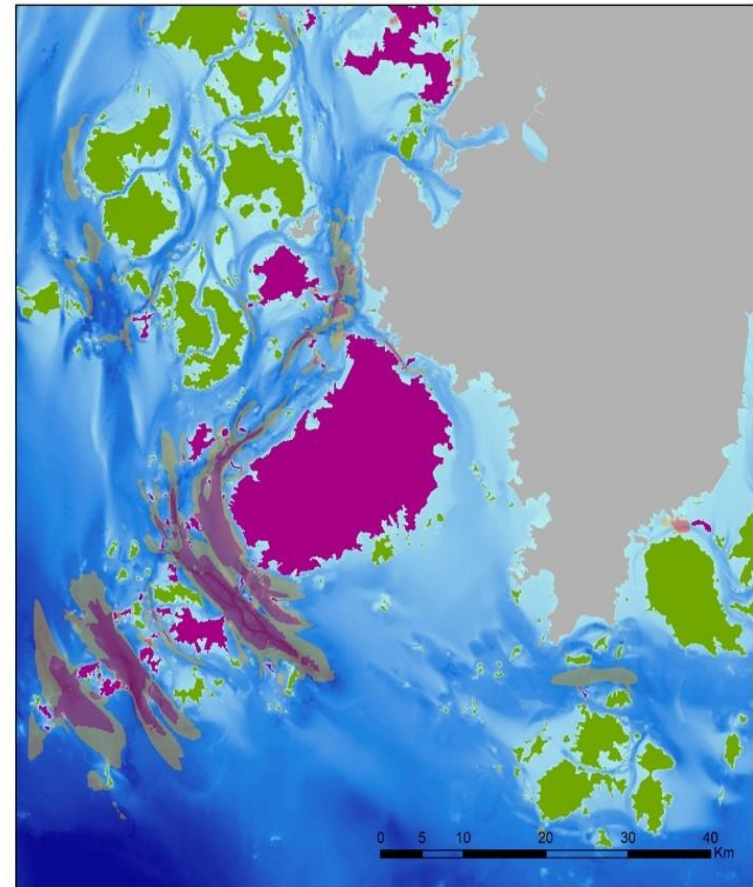


Legend

- Inland
- Inhabited Islands

Max Flow Speed(m/s)(1.8km res.)

- > 2
- 1.5 - 2
- 1 - 1.5



Legend

- Inland
- Inhabited Islands
- Potential Islands
- Max Flow Speed(m/s)
- Water Depth (DL-m)

- > 2
- 1.5 - 2

High : 79.6524
Low : -7.97838



Statistics of Off-Grid Islands

Statistics of Off-grid Islands in Korea (Nov. 2017, MOTIE)

Island	System Operators			Total
	Local Resident	Local Government	KEPCO	
Number of Islands	39	23	65	127
Population	425	2,430	40,984	43,839
Households	200	1,146	31,248	32,594
Installed Capacity (kW)	1,674	7,316	95,715	104,705
Number of Generators	56	59	220	335

Energy Cost at Off-grid Islands

Island	Generator	Installed Capacity	Annual Generation	Energy Cost* (USD/kWh)
Maenggol-do	Diesel	240kW	360MWh	2.08
West Geocha-do	Diesel	450kW	1,200MWh	1.42

*Energy cost depends on several parameters, but usually it costs about 0.2~0.3USD/kWh in ordinary households in Korea.

OES for remote off-grid islands can be one way for early commercialization by supplying more economic and reliable energy by combining ESS and/or hydro pump system.



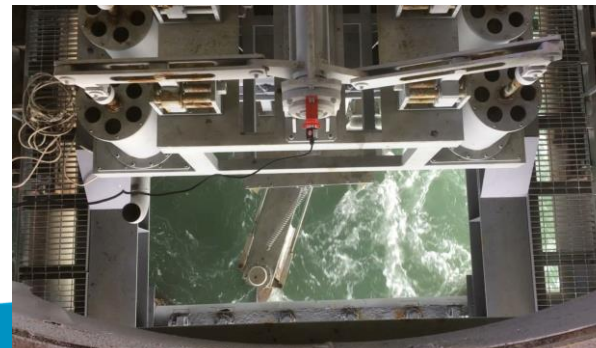
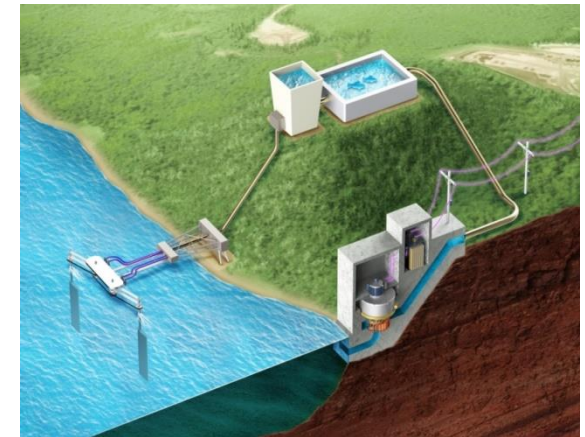
R&D Projects (1): TEC-Hydro Pump System

TEC & pumped Hydro-power Combined System

- Organization: Pields Eng., KIOST, Wonbang Forcetech
- Objective: To develop tidal current and pumped combined power generation system consisting of dual flapping type system and pumped storage tank

Research Contents

- System Configuration
 - Flap-type TEC for Pumping, Pumped Storage, Sluice
- Low-Head Hydro-Power System
- TEC for Pumping
- Low-Head Hydro-Power for Supplying Electricity
- Storage Tank for Aquaculture
- Main contents
 - Design technology for the tidal current and pumped storage hybrid power generation system
 - Pilot test for the tidal current and pumped Hydro-power combined generation system.



<Movement of hydrofoil at 2.4 m/s>



R&D Projects (2): Islands WEC-ESS System

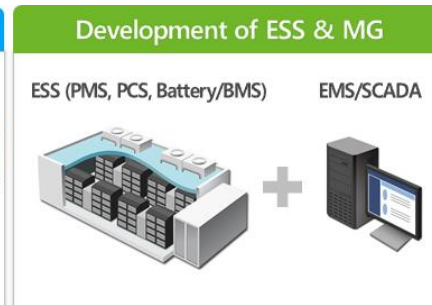
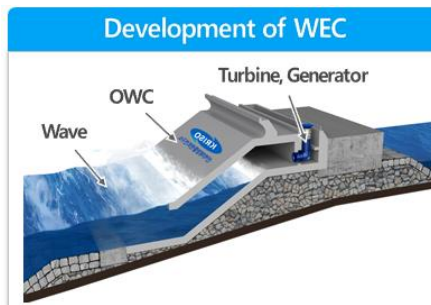
Island WEC with ESS

Project Summary

- Period: May 2016 ~ Dec 2020
- Budget: 1.2mil. USD
- Funded by MOF and Charged by KRISO

Features

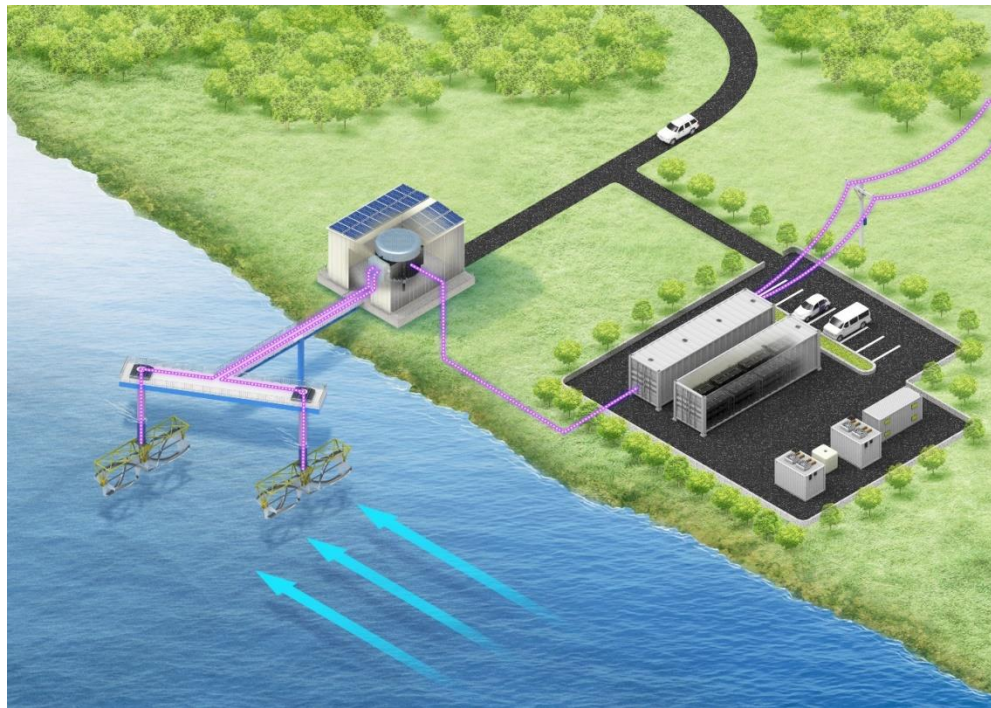
- Application for remote islands
- Small OWC WECs utilizing breakwater
- Combined with ESS and connected to micro-grid
- Deployment plan by MOF after RD&D



R&D Projects (3): TEC-ESS Hybrid System

Development of tidal current power generation-ESS hybrid system for the off-grid islands

- Period: May 2019 – Dec 2021
- Budget: 4,930K\$
- Funded by MOF and Charged by KIOST



Concluding Remarks

- **R&D projects on development of OES are facing to the challenges for commercialization in Korea**
 - However, investment from private sectors is not fully developed.
 - Currently governmental investment is only one funding source.
 - For commercialization, participation from private sectors is mandatory such as energy companies and heavy industries.
- **Renewable energy incentives become less attractive for operators**
 - REC price is continuously decreased due to the expansion of PV and wind and the private investors are suffering from low profit from renewable energies.
 - It becomes also less attractive to energy companies to invest in renewable energy sectors including tidal energy.
 - More strong incentive policy needs to be developed in Korea.
- **OES for remote off-grid islands can be one way to break through these difficulties**
 - By supplying more economic and reliable energy by combining ESS and/or hydro pump system.



Thanks for your kind attention!

