

Status and Prospects of Taipower's Offshore Wind Power



Department of Renewable Energy
Taiwan power Company



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1. Taipower profile

- **Date of Establishment : May 1 ,1946**
- **Total Assets : NT\$ 1,935.5 billion**
- **Capital Stock : NT\$ 330 billion**
- **Stocks : Government 94% , Others 6%**
- **Number of Employees : 26,659**
- **Customers : 13.6 (million)**
- **Installed Capacity : 41.04GW**
- **Energy Sales : 205.6 TWh**

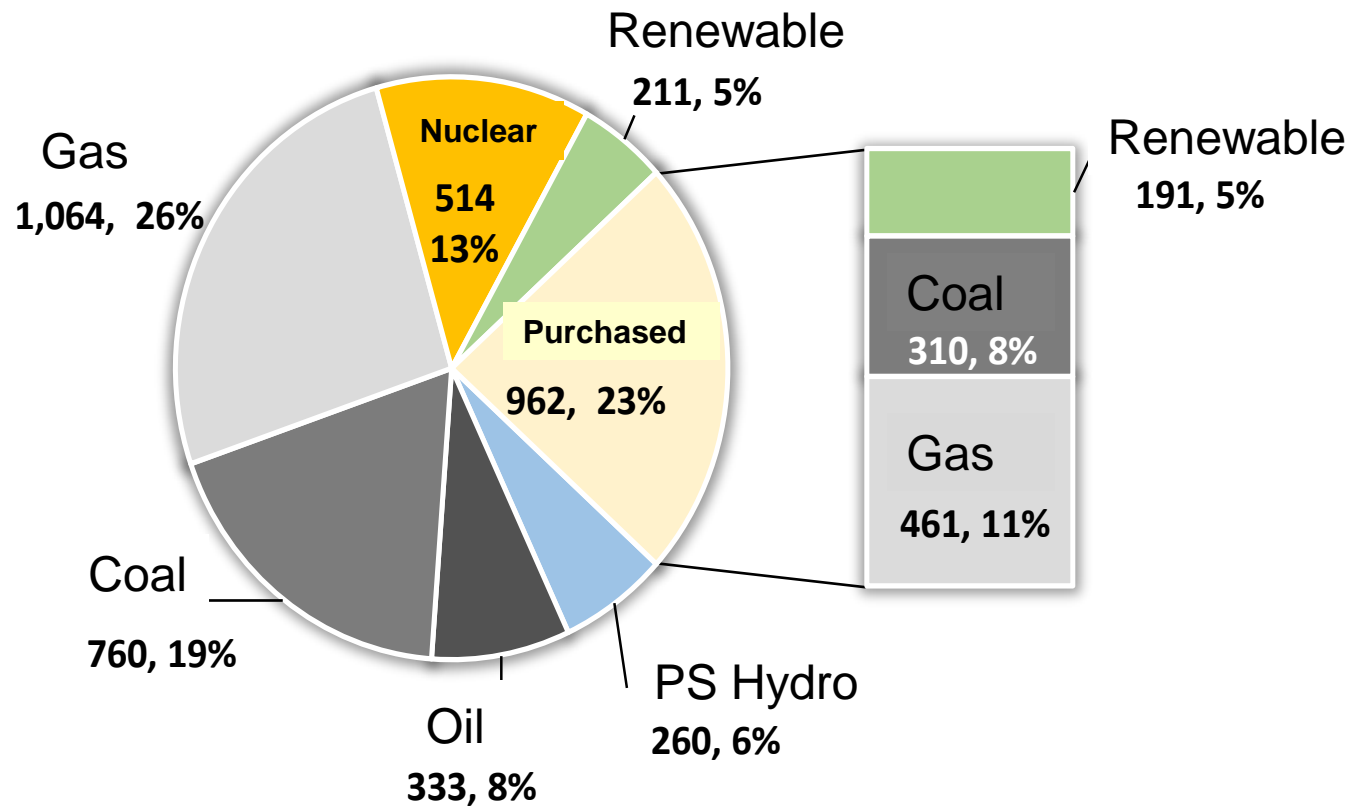
(Note : Figures calculated up to December 2015)



Taiwan Power 2015 System - Installed Capacity

Data time : 12/31,2015

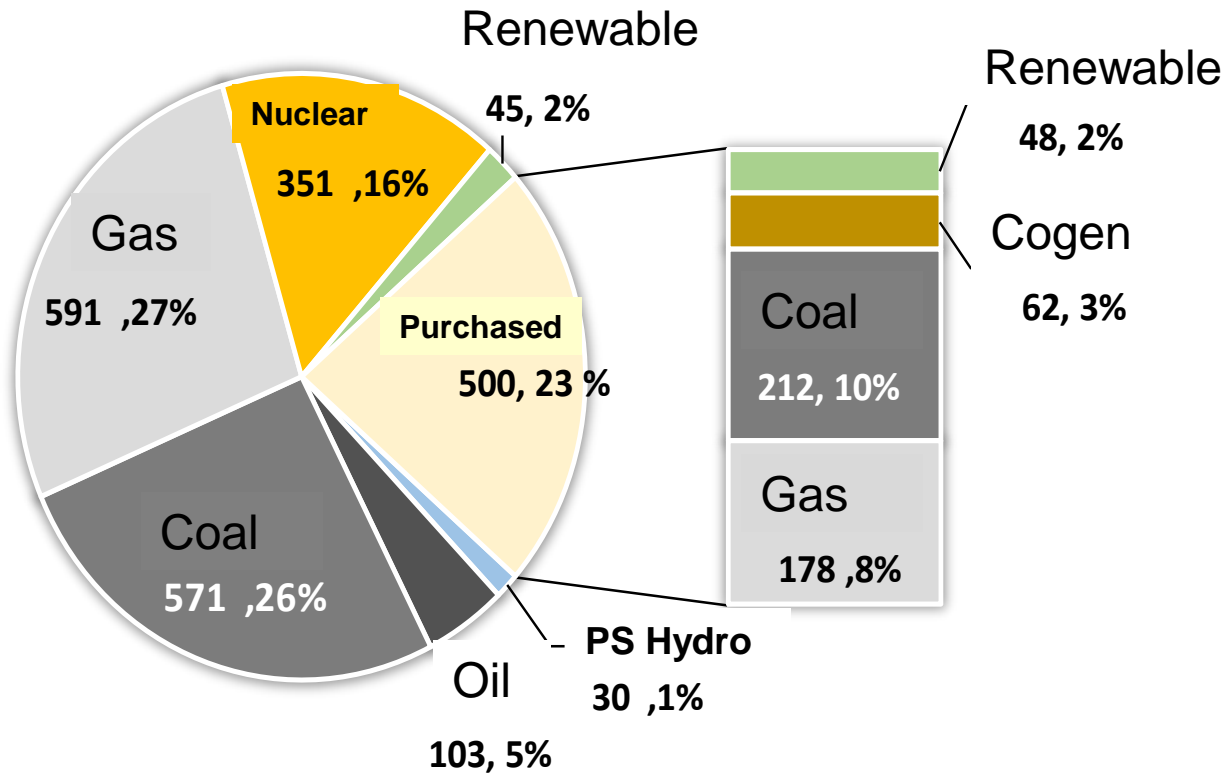
Total : **41.04 GW** (Including IPP, Excluding Cogen)



Taiwan Power 2015 System - Power Generation

Data time : 12/31,2015

Total : 21.91TWh (Including IPP, Excluding Cogen)



2. Offshore Wind Potential in Taiwan

■ Shallow Water (5-20 m)

- Area: 1,779.2 km²
- Potential: 9 GW
- Feasible: 1.2 GW

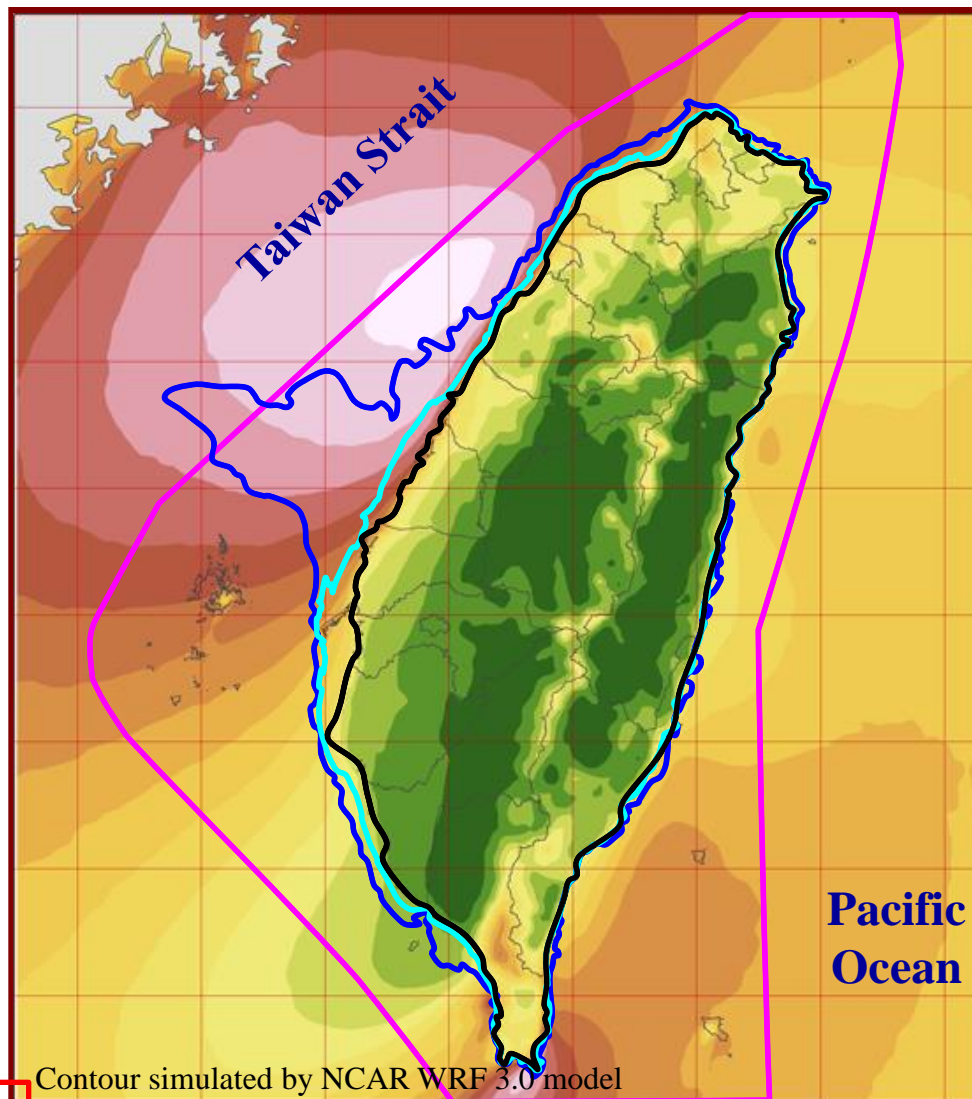
■ Deep Water (20-50 m)

- Area: 6,547 km²
- Potential: 48 GW
- Feasible: 5 GW

■ Deeper Water (> 50 m)

- Potential: 90 GW
- Feasible: 9 GW

Wind Power Density(W/m²)



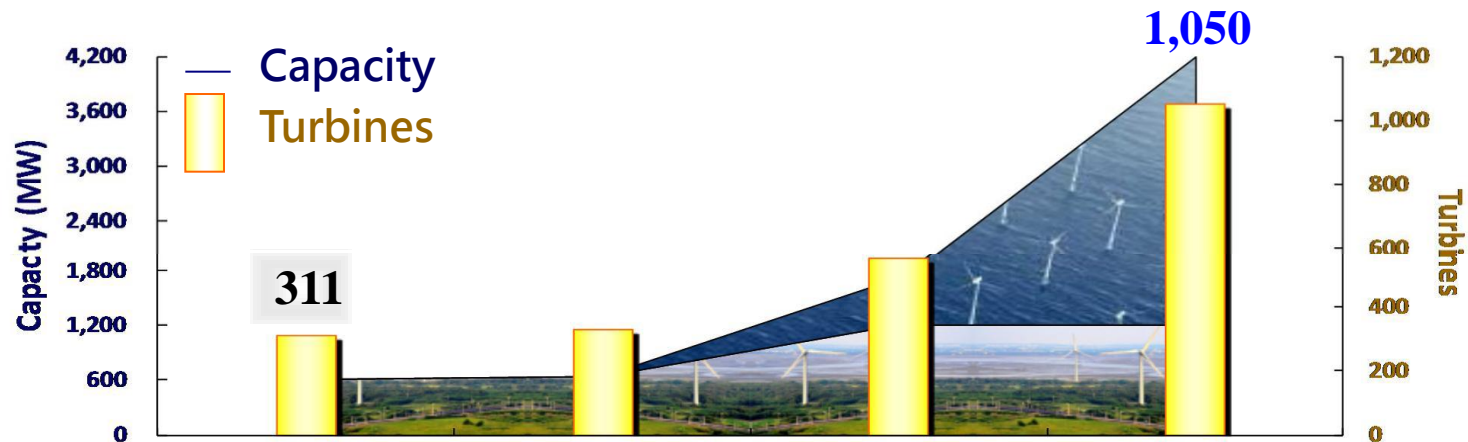
CF : 35 ~ 37% (3,240hrs)

Ref. "Wind Resource Assessment Handbook," ITRI, 2011

3. National Target for Wind Energy

■ Thousand Wind Turbines Project

- **Short-term** : 4 demonstration offshore wind turbines by 2016.
- **Mid-term** : onshore 1,200MW, offshore 520MW by 2020.
- **Long-term** : onshore 1,200MW, offshore 3,000MW by 2025.

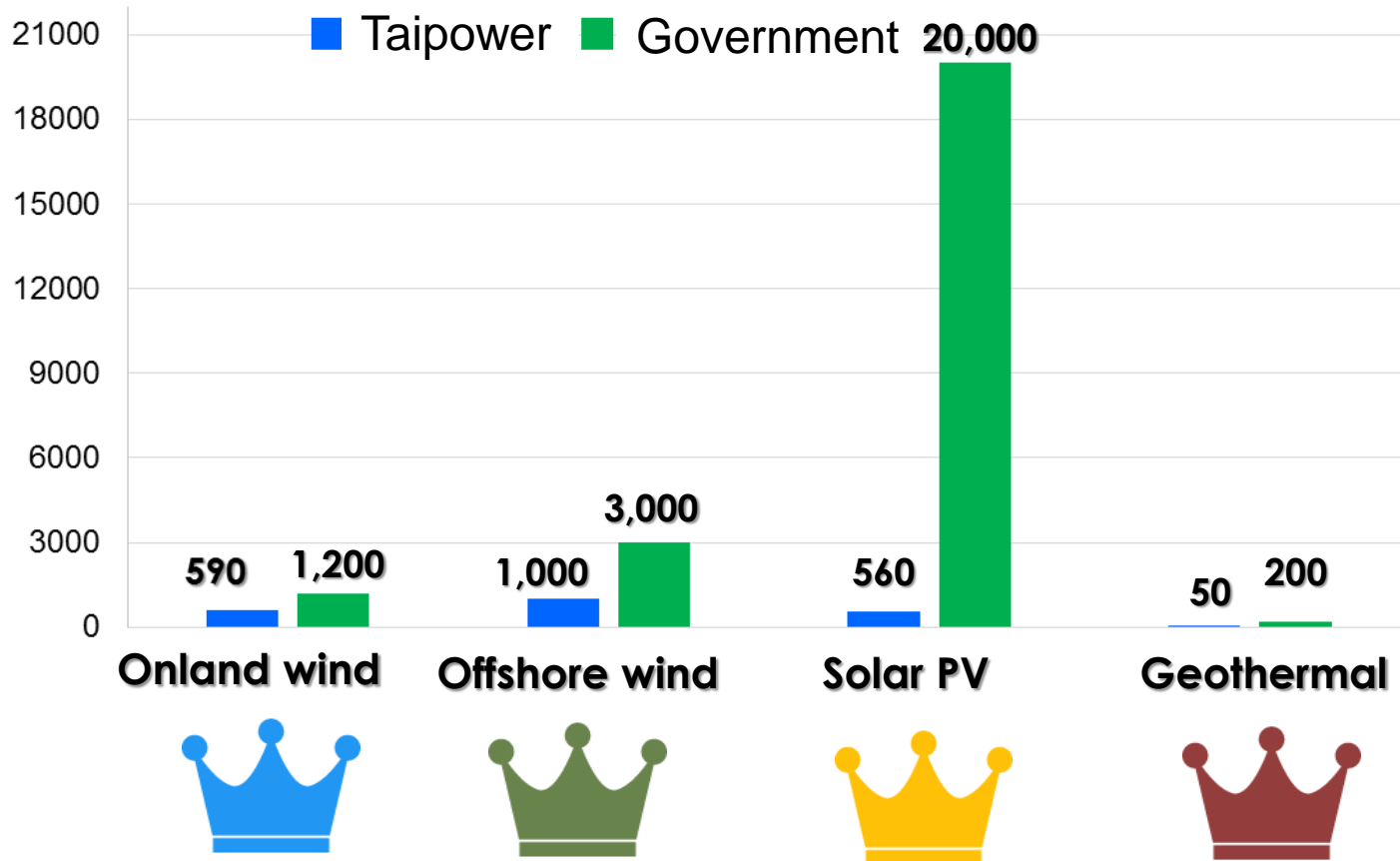


Year	2013		2015	2020	2025	
	MW	Turbines	MW	MW	MW	Turbines
Onshore	614	311	647	1,200	1,200	450
Offshore	0	0	0	520	3,000	600
Total	614	311	647	1,720	4,200	1,050



Target of Renewable Energy by 2025

Unit : MW



Our vision : Champion of all enterprises producing green energy in Taiwan

Task Allocation for Offshore Wind Power

- **Strategy Planning, Feasibility Study & Acquiring Permit : Department of Renewable Energy**
- **EIA : Department of Environmental Protection**
- **Grid Connection : Department of System Planning**
- **Tender and Project Management : Department of Construction**
- **Construction Supervision : Marine Wind Power Construction Office**
- **Operation & Maintenance : Offshore Wind Power Station**
- **R & D : Taiwan Power Research Institute**



Potential Sites of Offshore Wind Power

Short-term Plan (By 2020)

Phase I Changhua (110MW)

Mid-term Plan (2020~2025)

Phase II --- Changhua No.26 Lot (812MW)

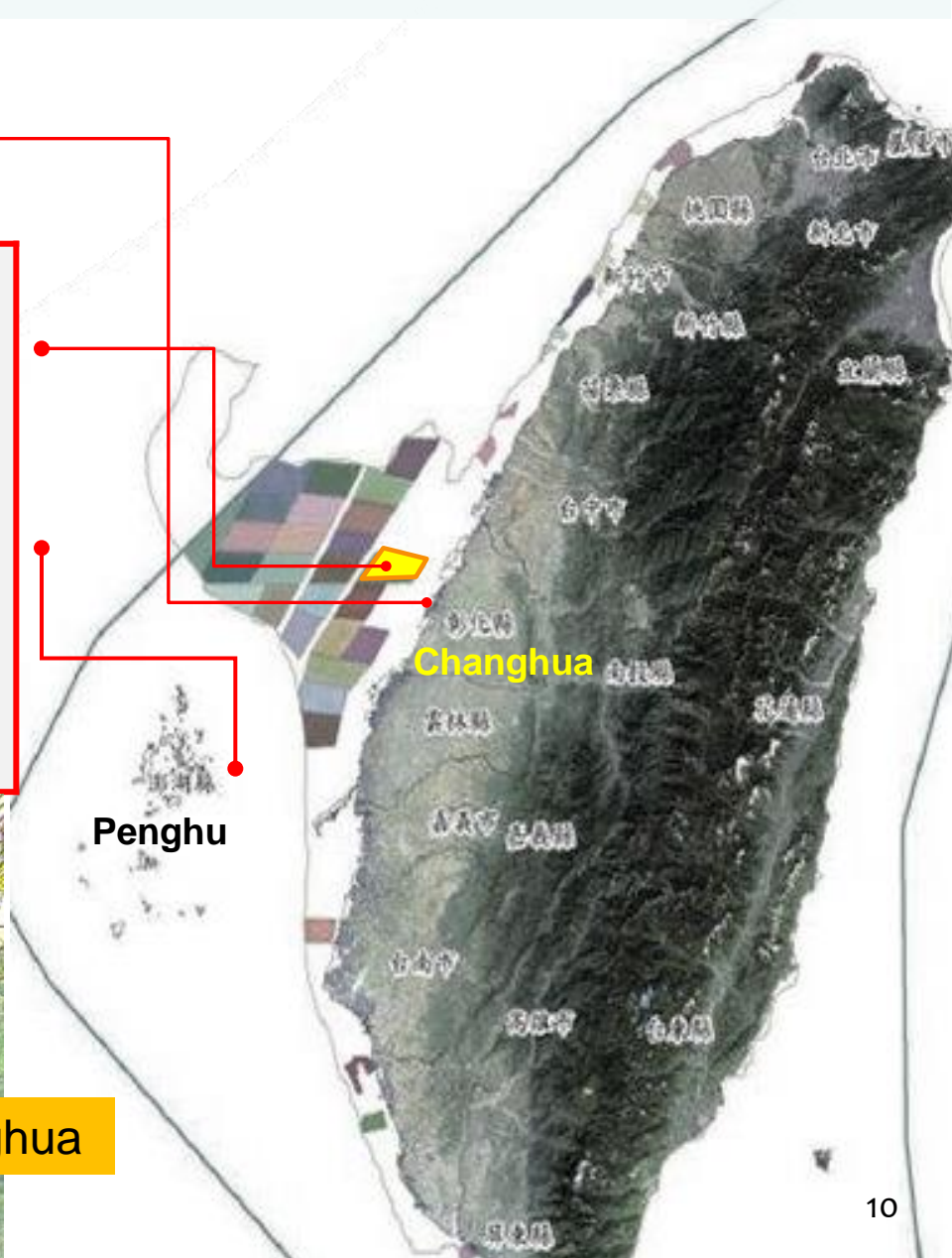
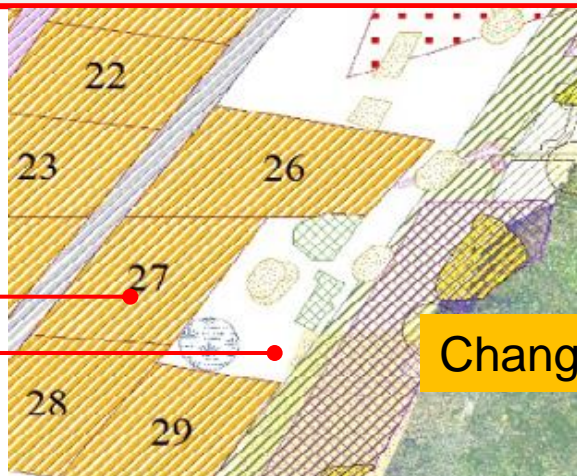
Long-term Plan (2026~2030)

Penghu (150MW)

Phase III ---

--- Changhua No.27 Lot (588MW)

--- Changhua Extended Lot (154MW)



Changhua

4. Current Taipower's Offshore Wind Power Development

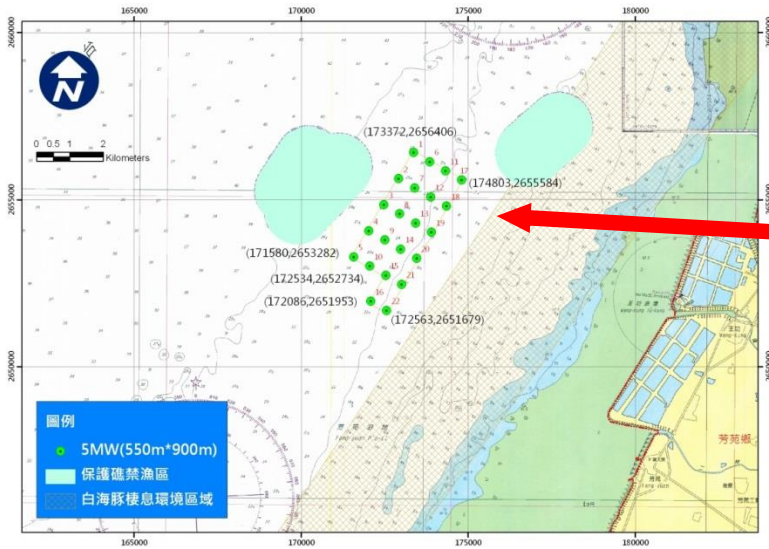
■ Offshore Wind Farm Phase 1 Project

- Awarded the Offshore Demonstration Incentive Program in Jan. 2013.
- Met mast constructed in Dec. 2015.
 - Water depth : 15m
 - Height : 97m
- Two demonstration turbines built by 2020.
 - Capacity : at least 5MW each
- Demonstration wind farm commissioned by 2020.



Offshore Wind Farm Phase 1 Project

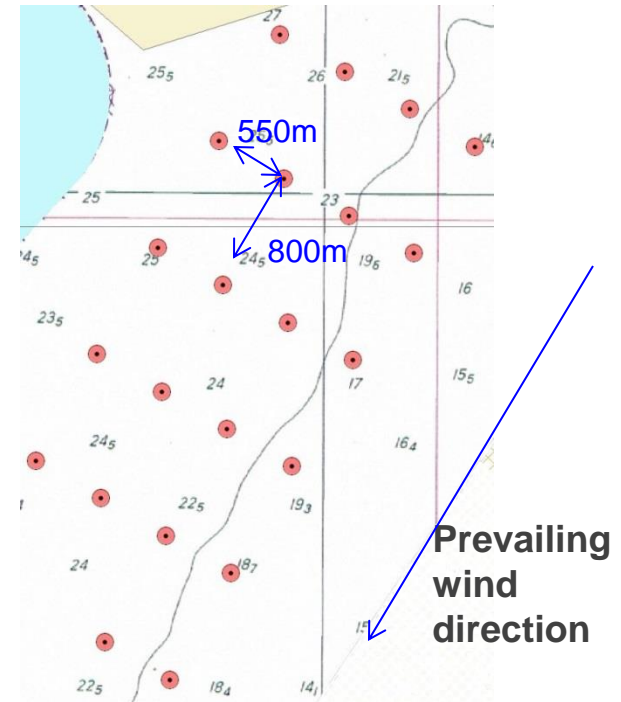
- Capacity: 108MW~110 MW (22-30 turbines)
- Unit Capacity: 3.6MW~6.0MW
- Water Depth: 15-26 m
- Yield Per Year : 340GWh
- Investment : NT\$19.5 billion (US\$650 million)
- Completion : June 2020



Layout of the offshore wind-farm

- **Optimal spacing of wind turbines**

Considering the trade-off between the cost of foundations, submarine cables, fishery compensation and the benefit of power generation, figure shown for 5MW case.



Unit capacity	No. of units	Transverse spacing(m)	Longitudinal spacing(m)
3.6 MW	30	500	800
5 MW	22	550	900
6 MW	18	500	1,100



Schedule of Offshore Wind Power Phase 1 Project

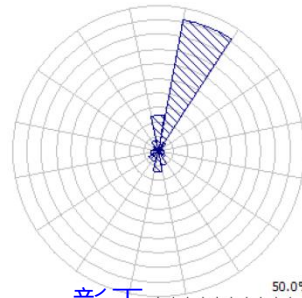
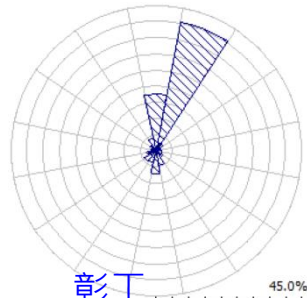
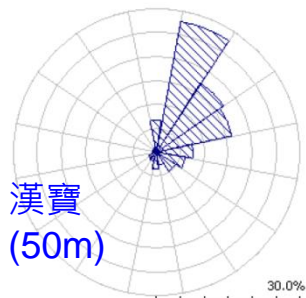
Milestone	Month/year
Project approval	Mar./ 2015
EIA approval	Jun./ 2015
General consultant tender award	Jan./ 2016
Construction tender award	Jun./ 2017
Completion	Jun./ 2020



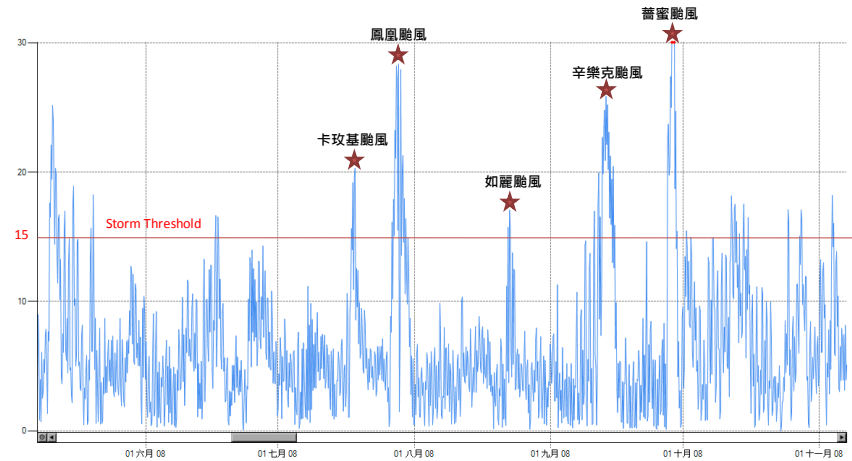
Wind data statistics of planning site

- Statistics of wind data

Station	Average speed (m/s)	Main wind direction	Max. speed (m/s)
漢寶 (50m)	7.44	NNE	39.7
彰工 EAST	8.28	NNE	39.3
彰工 WEST	8.44	NNE	39.6



- Extreme wind speed
50-year-return period at 90m high



Speed type (m/s)	彰工station	Proposed site
3 sec.	64.5	72.8
10 min. average	53.9	60.9

Consideration of offshore wind turbine

- Unit capacity : 3.6MW ~ 6MW.
- Considering the severe environment with typhoons and earthquakes in Taiwan strait, design level compliance with IEC Class I .

● Wind turbines Recommended:

- ✓ Siemens SWT-4.0-120 (4.0 MW)
- ✓ Areva M5000-135 (5.0 MW)
- ✓ REpower 6M+ (6.1 MW)
- ✓ General Electric G128-5.0 (4.1 MW)
- ✓ Gamesa G128-5.0 (5.0 MW)
- ✓ Alstom Haliade (6.0 MW)
- ✓ Siemens SWT-6.0-154 (6.0 MW)



Siemens SWT-3.6-120



Areva M5000-135



REpower 6M



Consideration of foundation

Three kinds of foundation include tripod, group-piles and jacket foundation are chosen. The final type will be decided by the general consultant.



jacket



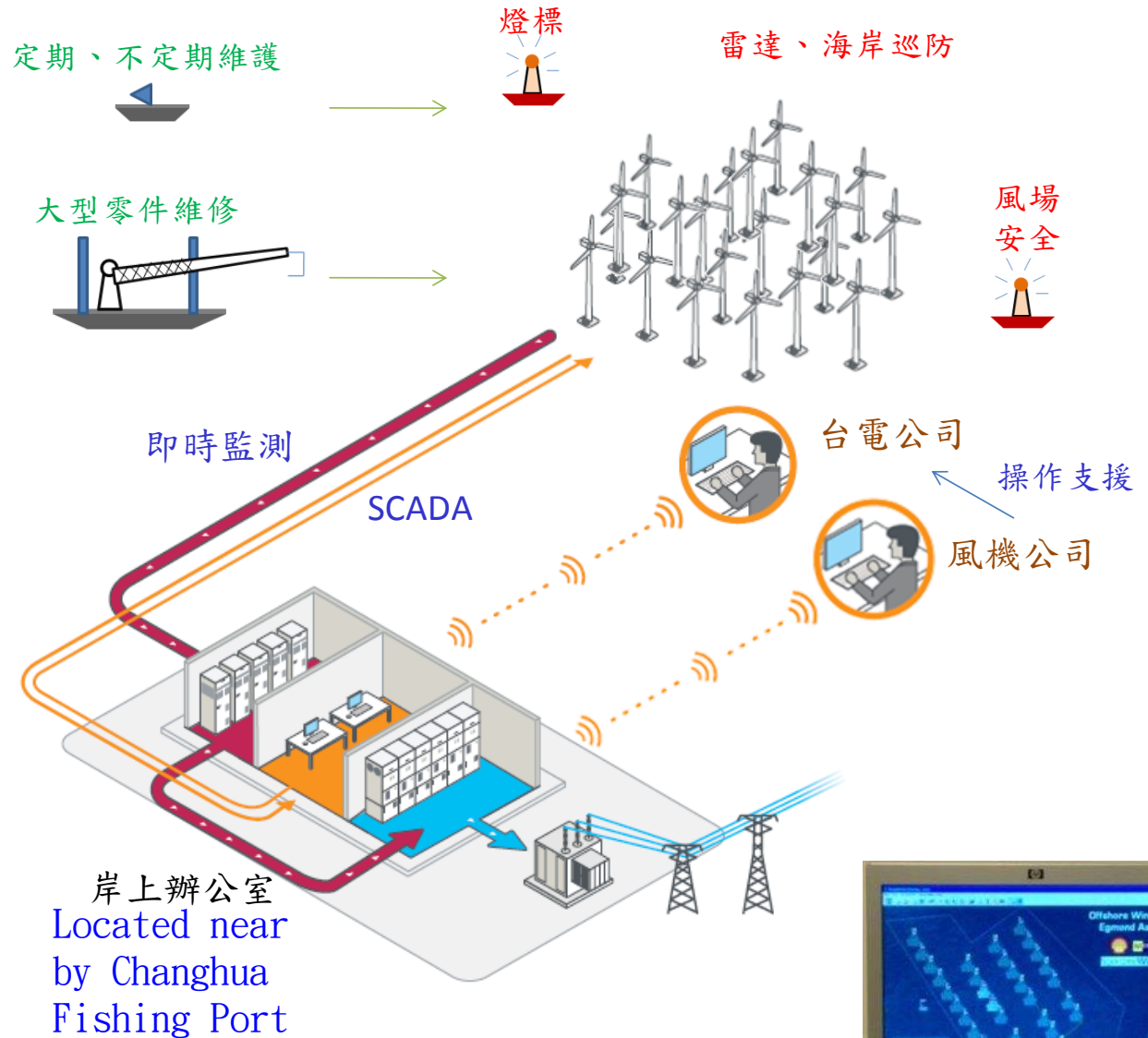
tripod



group-piles



Operation and Maintenance



5. Future Planning

Phase 2 Project



Penghu Project



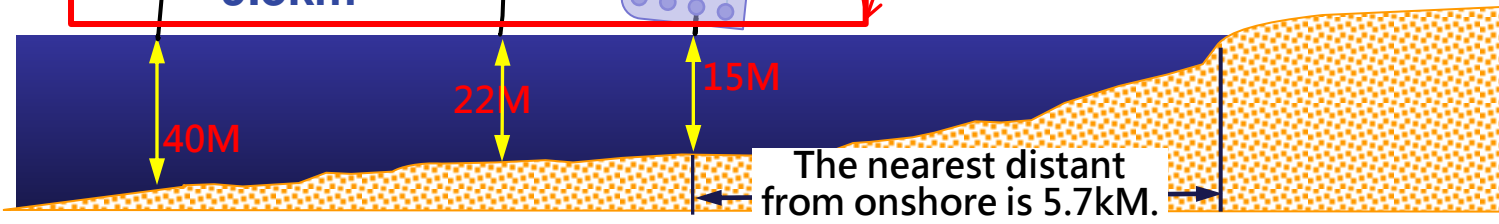
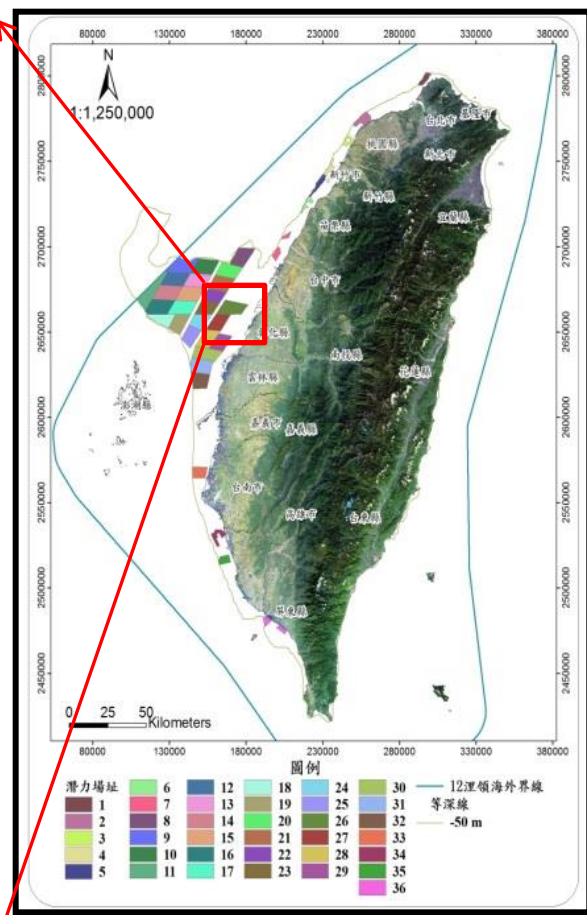
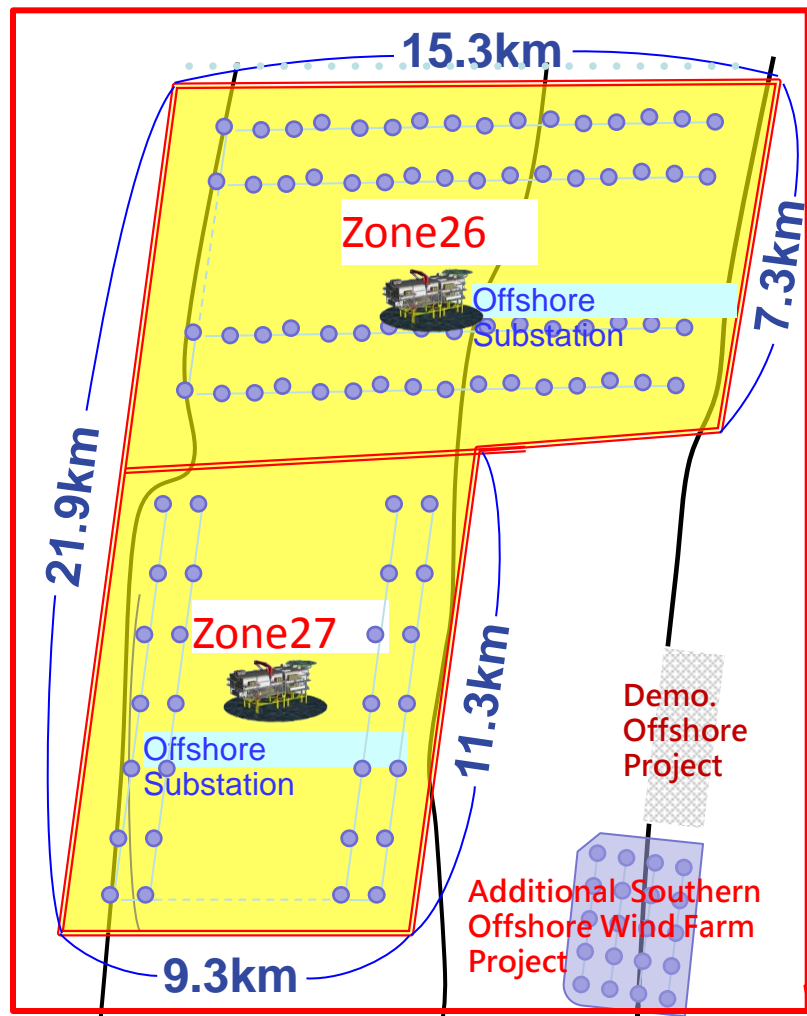
Phase 3 Project



	Location	Capacity	Area	Budget (billion)
Phase 2 Project	Zone 26	812MW	119km ²	NT\$150.3 (US\$4.7)
Penghu Project	Penghu Offshore	140MW	30km ²	NT\$23.7 (US\$0.7)
Phase 3 Project	Zone 27	588MW	93km ²	NT\$144.8 (US\$4.5)
	Additional Southern	154MW	30km ²	
Total		1694MW	272km²	NT\$318.5 (US\$9.9)



Penghu Offshore Wind Farm Project



6. Challenges

- **Local installation vessels are lack.**
- **Local supply chain capability isn't enough.**
- **There is no certificated port or wharf for offshore wind farm construction.**
- **Local marine technicians are lack.**
- **The negotiation between developer and fishermen group is not proceeding smoothly.**



7. Summary

- Taiwan strait has the best offshore wind resources in the world ($CF \approx 37\%$), and the most hard environment together.
- Taipower plans to install 1.8GW of offshore wind power capacity and invest around NT\$330 billion (US\$ 10 billion) in offshore wind projects by 2030.
- Though there are lots of challenges ahead, Taipower is confident to cope with the technical difficulties of OWP, while the government should help solving the non- technical ones, i.e. the social and environmental problems.



**Thank You
for Your Attention**

