Floating wind power for Taiwan

What we can learn from Dounreay Tri in Scotland

Strathy Point, Caithness north coast Scotland

HEXICON

WHAT IS FLOATING WIND POWER?

GVA 5000 for the Balmoral field (UK)

- Swedish design & engineering
- Draught: 22.5 m
- Water depth: 150 - 3000 m
- Built: 1986
- Still in operation

Source: GVAC.se

HEXICON for Dounreay Tri, Scotland

- Swedish design & engineering
- Draught: 12 m
- Water depth: 35 - 1000 m
- To be built: 2018
- Operative 20-25 years

Source: hexicon.se

WHY AND WHO WANTS IT?

A specific solution to specific problems

- Difficult soil conditions; standardization
- No expensive jack up vessels needed
- Bigger turbines, yet easy logistics
- Scalable, yet close to consumer centers

When applicable

- Saturation of onshore and shallow waters
- Good offshore domestic winds
- Need for renewable energy

RECHARGE

FID imminent on Hexicon floating wind pilot off Scotland

The company's multi-turbine platform concept is designed to align with wind direction Hexicon

By Darius Snieckus in London
Tuesday, February 02 2016
Updated: 41mins

Floating wind power pioneer Hexicon is targeting a final investment decision (FID) "in or before" April 2017 for its eye-catching two-turbine prototype, targeting installation in the deeps off northern Scotland.

THE INCENTIVE – ROC SCHEME

The Scottish Government introduced a temporary band for **demonstrating floating wind power** within the Renewables Obligation scheme

Renewable energy generators receives a fixed number of Renewable Obligation Certificates (ROCs) per MWh

- Floating wind is set at 3.5 ROCs per MWh
  (Fixed offshore wind 2 ROC, onshore wind 1 ROC)

Full scale floating demonstrators are eligible:
- 3.5 ROCs per MWh & Electricity sales
- = Roughly GBP 220 /MWh (€278 / MWh)

Model testing at Marin, The Netherlands, August 2015

The following prerequisites apply:

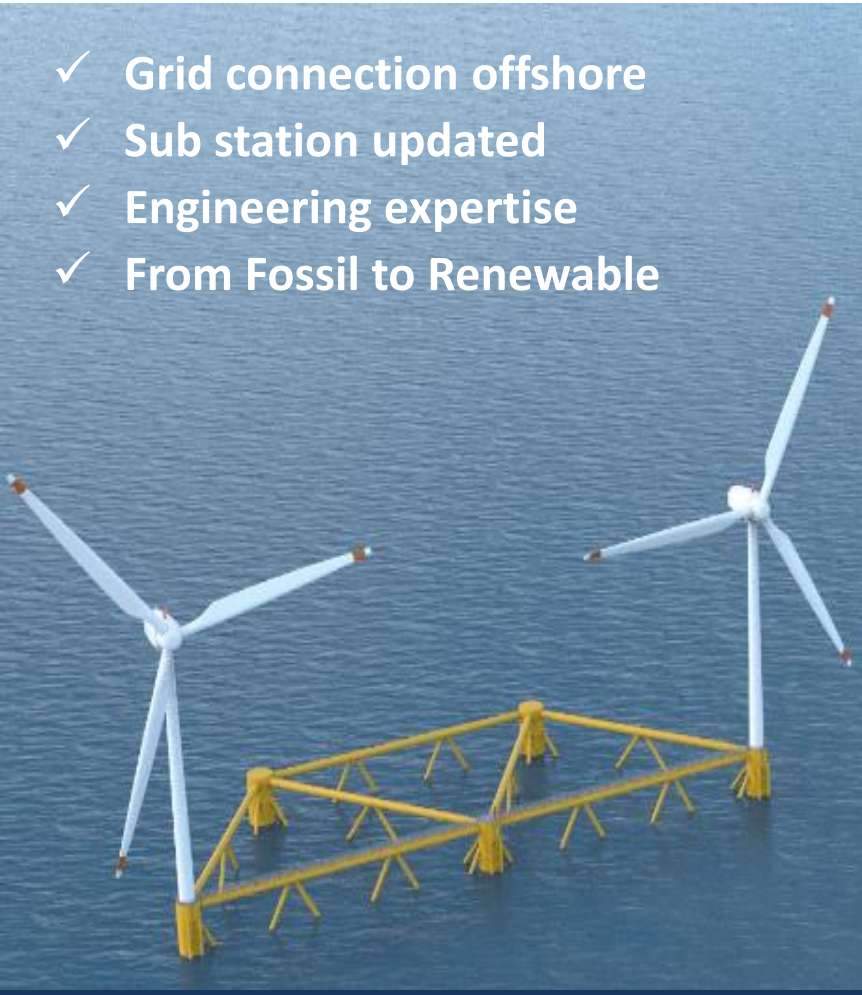
- Guaranteed under UK Government for 20 years
- All can apply; free market
- Preliminary accreditation by 31st March 2017, i.e. Marine License obtained and site consented.
- The floating unit to be commissioned and producing electricity by 1st October 2018.

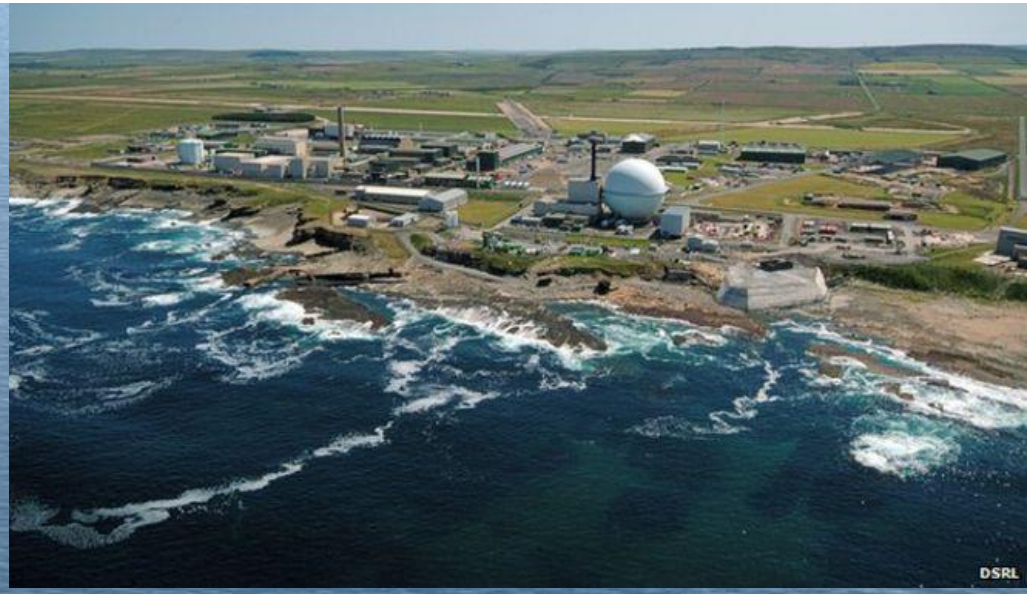
Current participants are: Hywind, Kinkardine and Dounreay Tri

THE SITE

The Dounreay Trì Project's site located at decommissioned nuclear power plant

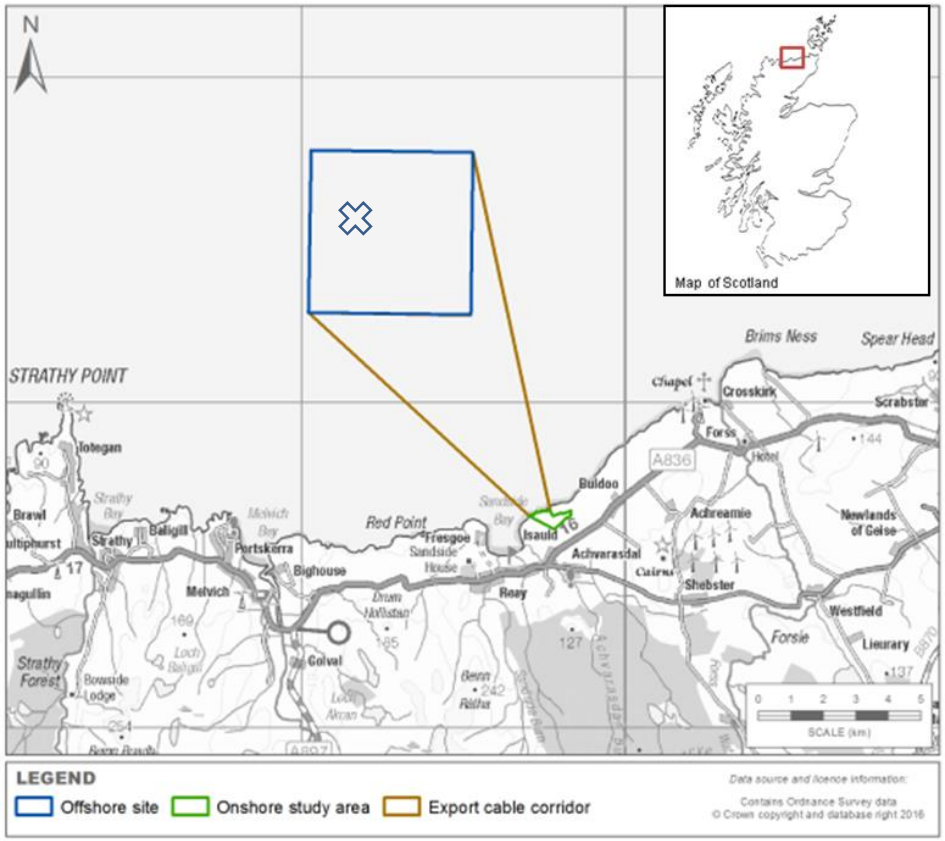
- ✓ Grid connection offshore
- ✓ Sub station updated
- ✓ Engineering expertise
- ✓ From Fossil to Renewable



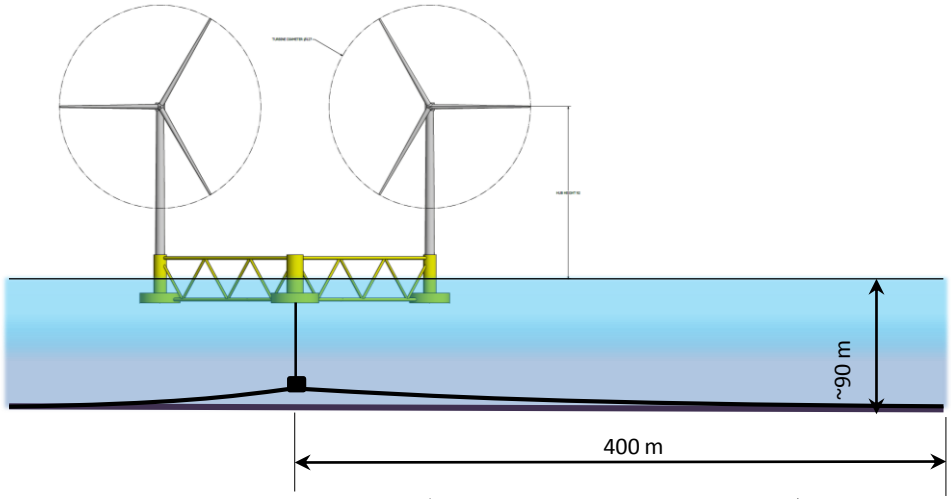


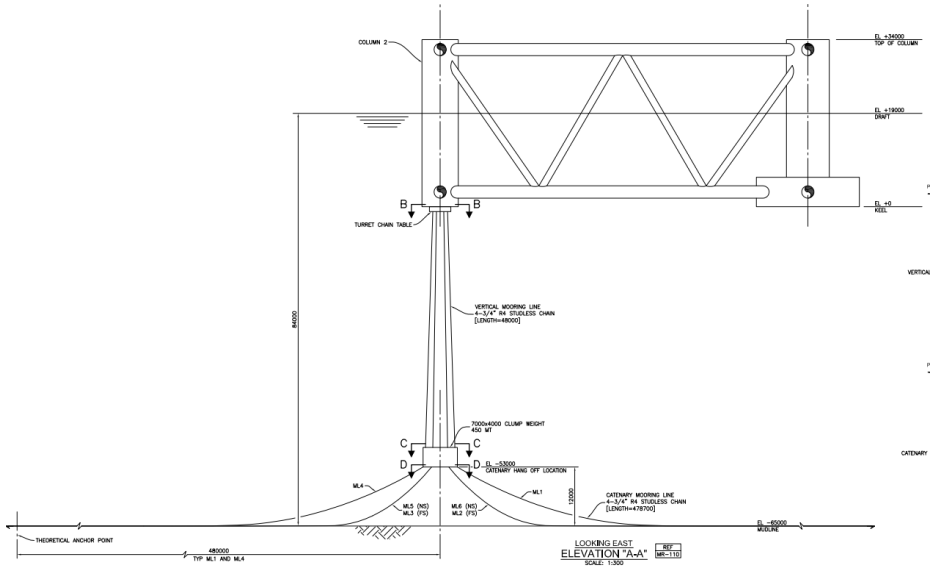
THE DOUNREAY TRÌ PROJECT

- The Dounreay Trì Project comprises the development, construction and operation of the Hexicon multi turbine floating offshore wind farm.
- The wind farm will be deployed in Scottish Territorial Waters in June 2018
- The Project consists of:
  - A two turbine offshore wind farm with an installed capacity of 10 MW, approximately 8 km off Dounreay, Caithness, Scotland;
  - A single export cable to bring the power to shore; and
  - The associated onshore electrical infrastructure.



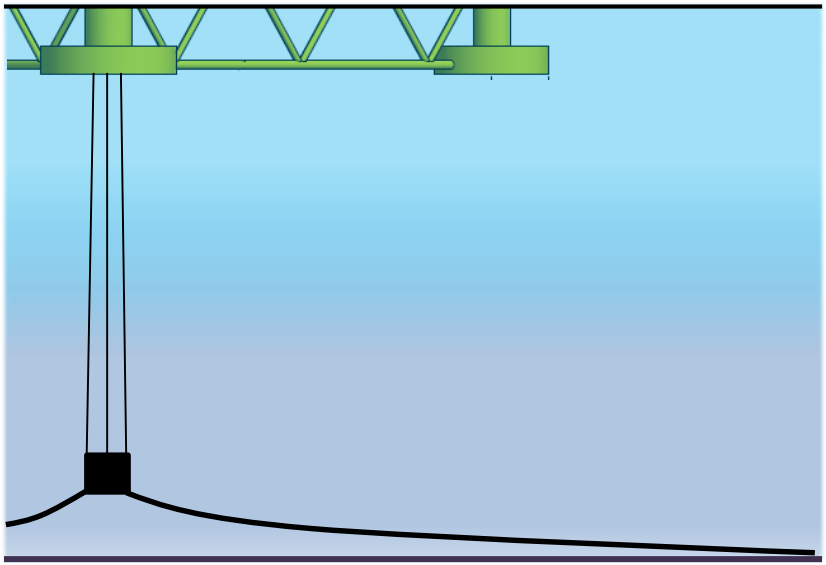
MOORING SYSTEM





- Single point mooring system, a pendulum configuration
- Clump weight near the seabed
- Vertical mooring lines connected to a turret
- Anchored to the seabed by a catenary mooring system
- Drag embedded anchors, configured for 95 m depth

Designed to suit the depth and local conditions at the site in question to minimizing risk and cost
Depth, bathymetry, geological setting and soil conditions all influence the optimal mooring configuration and anchor type to be used



PROJECT PARTIES

- Development and Consent Management
- Owner's Engineer and Principal Designer
- WTG Package Manager
- Cable Package Manager

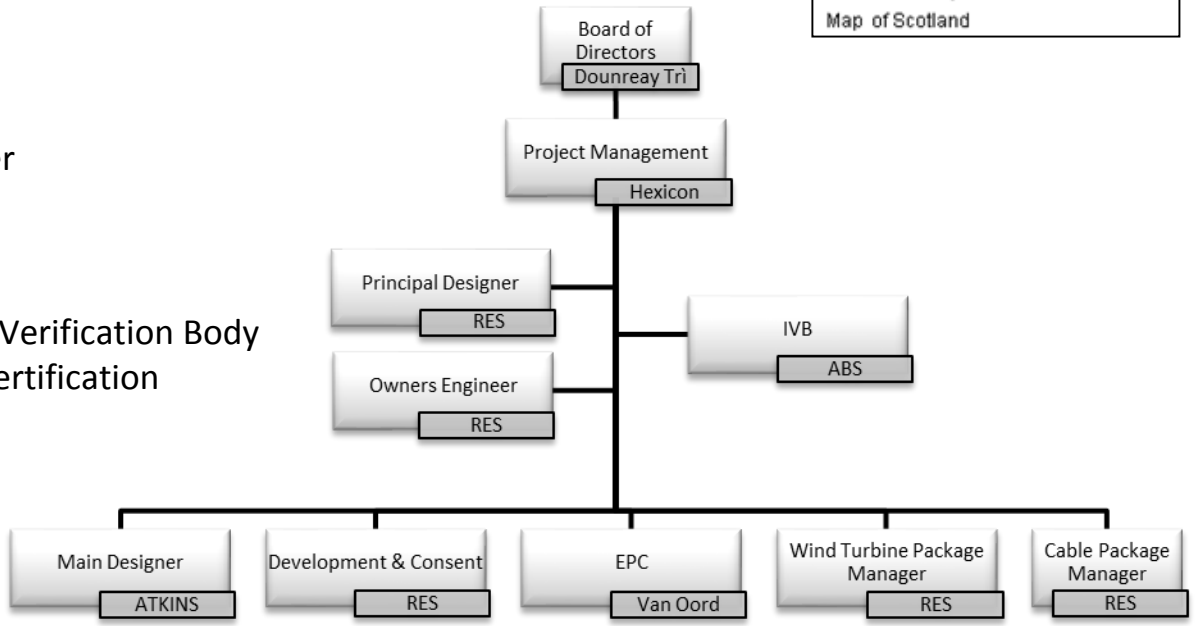
- EPC Contractor

- Main Designer

- Independent Verification Body
- Full Project Certification

WTG Supplier

- T.B.D.



ANCHOR SHAREHOLDERS

SEB Trygg Liv is one of the most successful pension funds in Sweden. SEB manages approx. EUR 20 billion and is the long term anchor investor in the project. SEB considers investments in the renewables sector to be a vital part of its portfolio in the coming years.

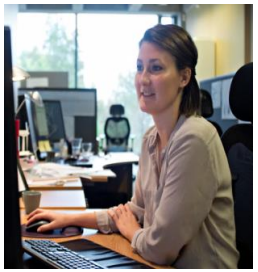
Doxa Holdings Ltd. (nominated by parent company N.S. Lemos & Co. Ltd) holds several Greek shipping companies managed from London with interests in offshore wind. N.S. Lemos holds board seats in both Hexicon and Dounreay Holding.

Dounreay Interests AB

Dounreay Interests AB is formed by a group of Hexicon shareholders as a vehicle to invest directly into the project.

HEXICON

- Hexicon started 2009
- 12 Employees, 5 consultants
- Privately held, raised 11 Million Euro risk capital
- Main owners;
  Swedish bank Pension fund SEB Trygg Liv, INDEX Equity, MGA Holding and London based Lemos NS
- Owns & licenses patents for multi wind turbine floating platforms
- Commercial Project: Dounreay Tri, UK/Scotland
- HQ Stockholm, Sweden



Hexicon Main Share Holders:

SEB

MGA Holding

INDEX Est.1998

N. S. LEMOS & COMPANY LIMITED

VICTORIA STEAMSHIP Co Ltd.

EXPERIENCED TEAM EARLY STAGE DEVELOPMENT

1. Project development

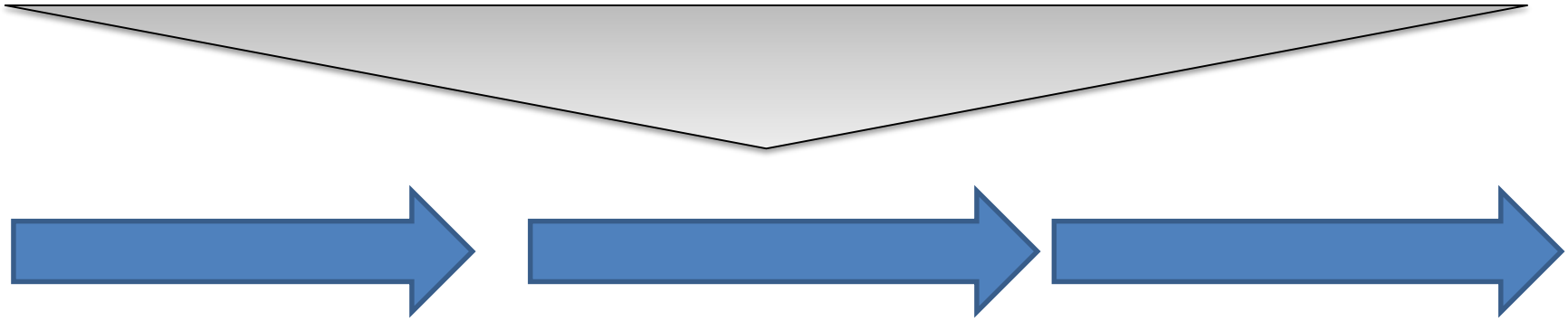
Feasability study
Design
Engineering
Project financing and modelling

2. Licensing

Licensing of existing and new IP
R&D

3. Equity investments

Project participation during development face and potentially until installation and/or long term



Consulting, project management, contracting of vendors and partners.

Licensing revenue

Part ownership that could give a high rate of return over project life time. In Dounreay a projected NPV of over XX MEUR

HEXICONS ADVANTAGES SHARING TURBINES

Business case advantages

- Integrated Technology & project development & financing

Environmental advantages

- Less anchoring and cabling, easier permits

Construction advantages

- Less installation costs and time
- Sub station integration

Economic advantages

- Standardization
- Foundation the same through out a wind farm
- Cost of specialised vessels reduced
- Electrical infrastructure cost wind farm reduced

Operations & Maintenance

- Easy access and on-board facilities reduces OPEX

WHY NOT?

ARE THERE ANY REASONS FOR TAIWAN *NOT* TO UTILIZE FLOATING WP?

TYPHOONS/HURRICANES	*….as in Scotland & Japan*
STRONG CURRENTS	*….as in Scotland & Japan*
EARTH QUAKES	*….as in Scotland & Japan*
FINANCIAL AND PROJECT CHALLENGES	*….as in Scotland & Japan*

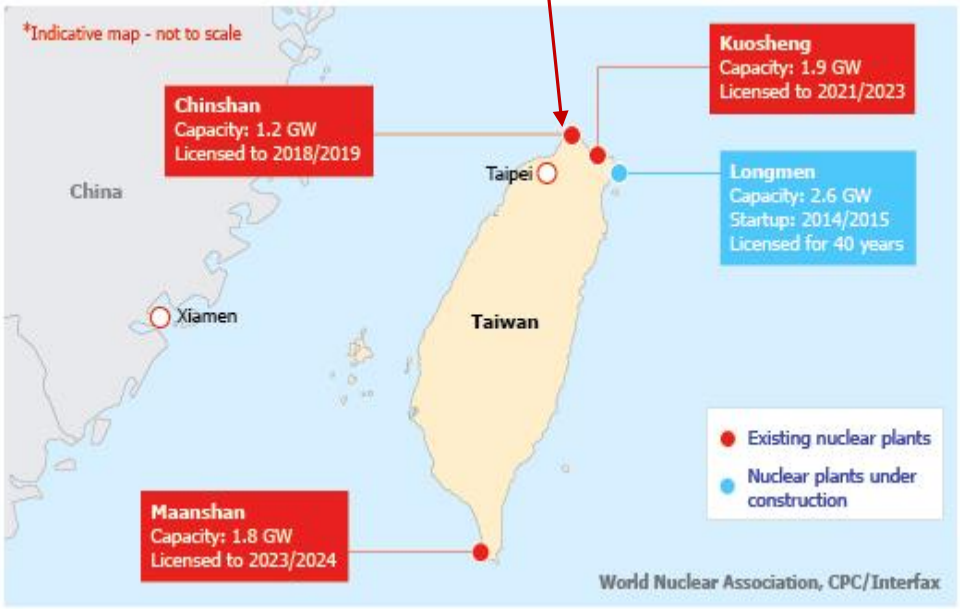
REASONS *FOR* HEXICON IN TAIWAN

2018/2019

HEXICON™

Energy & security
- Increased domestic energy security
- Clean & renewable energy

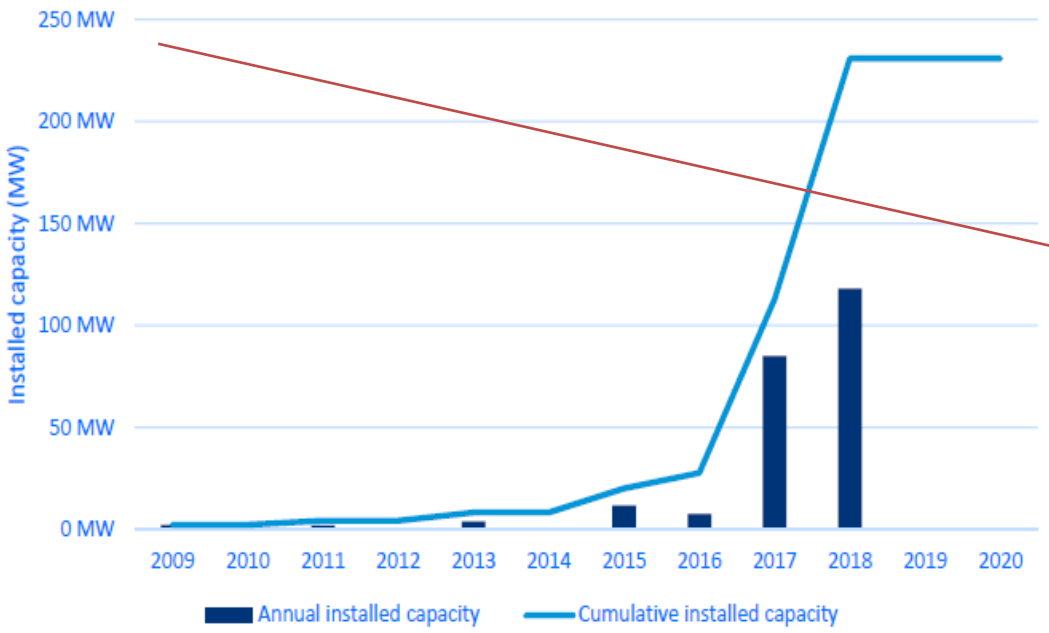
Technical
- Solution to challenging soil conditions
- No need for jack up vessels
- Best wind resources at deep sea



Commercial
- Enhancing local job creation
- Export possibilities from Taiwan for Taiwanese companies
- IP license sharing benefitting Taiwanese long term industrial interests

BIG POTENTIAL – DECREASING LCOE

Country/Region	Share of offshore wind resource in deep water locations (>60m depth)	Potential floating wind capacity
Europe	80%	4,000 GW
USA	60%	2,450 GW
Japan	80%	500 GW



LCOE towards 2018/2030

…with (CAPEX) reaching £2.7m/MW, ….deliver a levelised cost of energy (LCOE) below £100/MWh
= €129/MWh

Leading concepts are estimating even lower costs of £85-95/MWh (£2.4m/MW CAPEX)
= €110-122/MWh

Potentially 100€/MWh, 2030 (UK/ETI)

SOURCE: Carbon Trust, Floating Offshore Wind: Market & Technology Review, June 2015

OFFSHORE POTENTIAL – ITRI 2014

Best Winds untapped
10 km offshore
>50 m depth

Shallow Water (5-20 m)

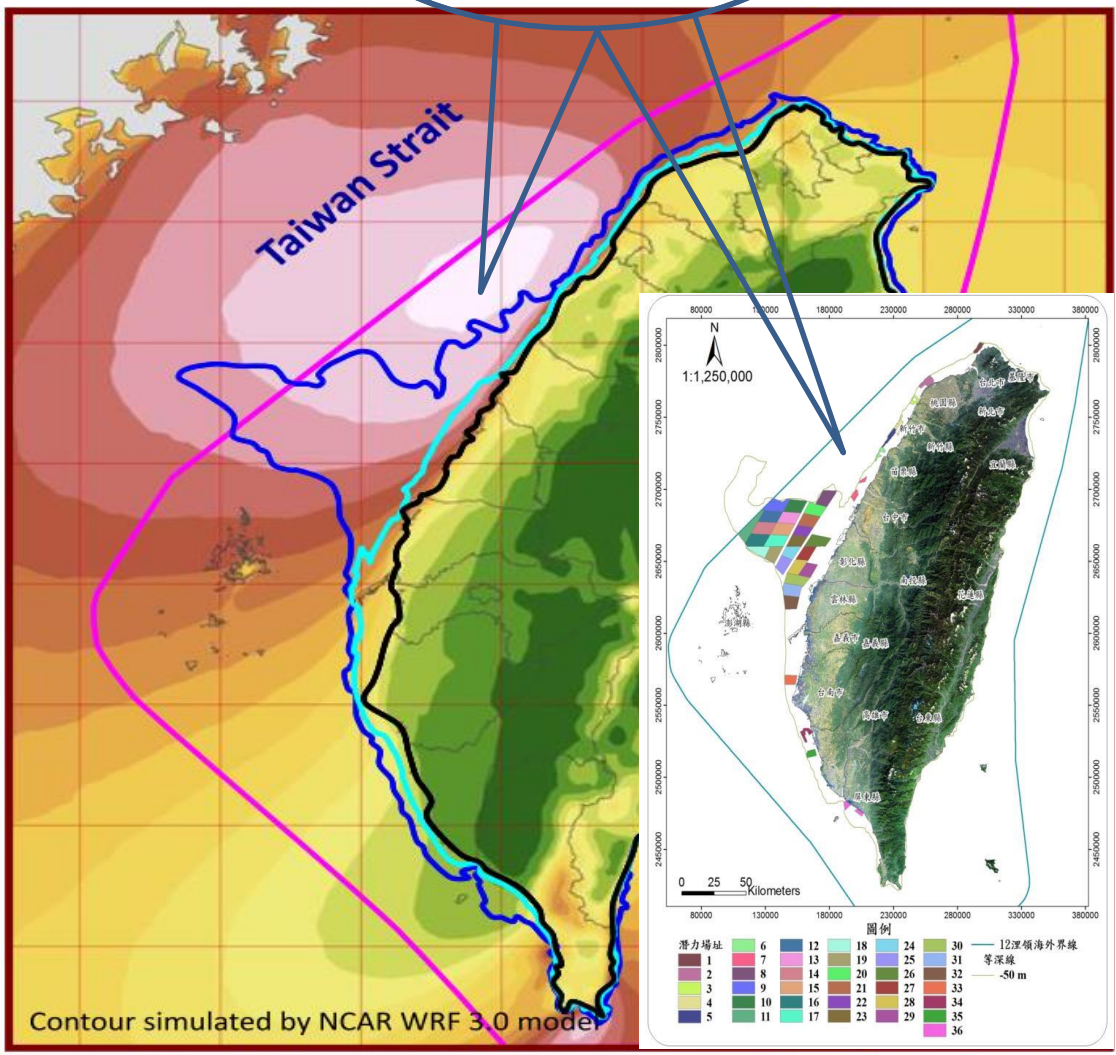
- **Area:** 1,779.2 km²
- **Potential:** 9 GW
- **Feasible:** 1.2 GW

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)

< 100	400 - 500	800 - 900	1,200 - 1,300
100 - 200	500 - 600	900 - 1,000	1,300 - 1,400
200 - 300	600 - 700	1,000 - 1,100	1,400 - 1,500
300 - 400	700 - 800	1,100 - 1,200	> 1,500

LESSONS LEARNED

(1) Governmental Incentives are crucial

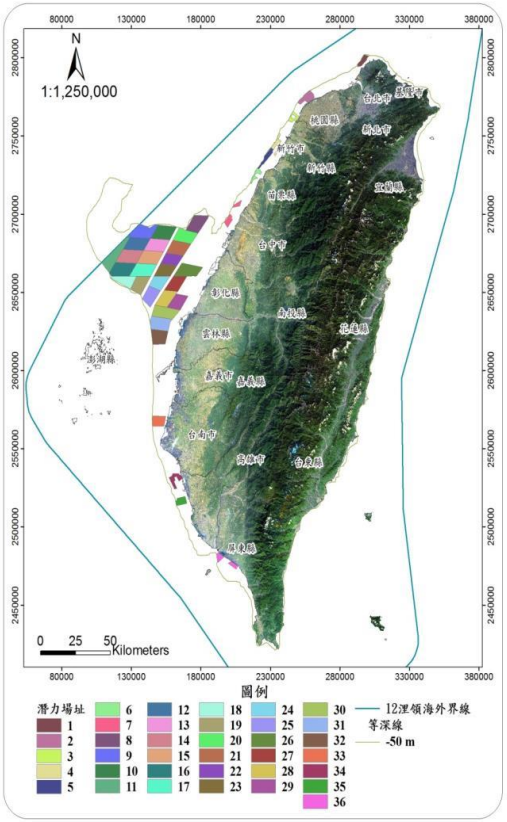
- DIP (Demonstration Incentive Program)
- FIT (Feed in Tariff), soft loans and others

(2) Integrated business case approach including

- Early stage project development
- Early stage project financing
- Site Specific Engineering Study, SSES

(3) Experienced International Investors & Developers

- As a team with Hexicon
- On the look out for new similar projects



THANK YOU

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