

China, Norway and Offshore Wind Development

A win-win wind relationship?

Rachel Enslow

Wind Consultant

Offshore Wind China 2010

Bergen, Norway, March 15, 2010



azure^{td}

international



- Established in Beijing, China in 2003
 - Sino-Foreign owned clean tech consulting firm
- Focused exclusively on the commercial expansion of sustainable energy technologies in China
- Energy strategy consulting, wind research, clean tech research, clean tech investment
- Specialized team in wind market analysis with quarterly tracker reports

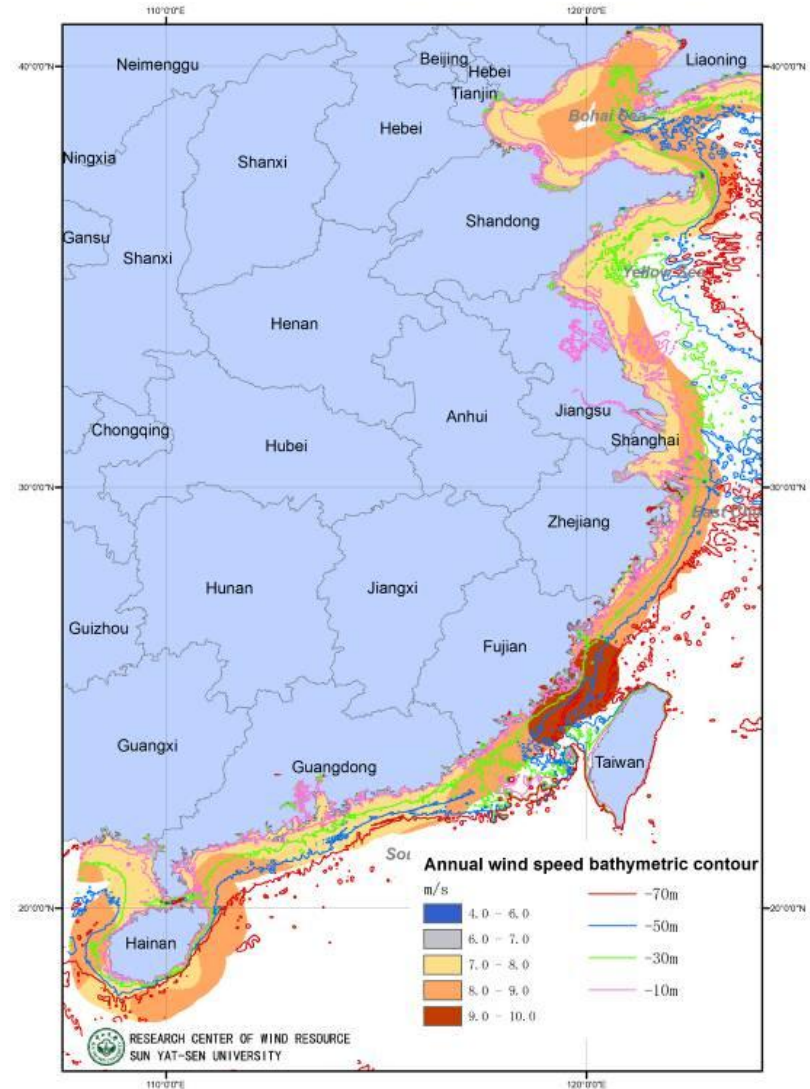
“Enable China’s Sustainable Energy Future”





China's offshore wind potential

- 11,000TWh in areas with wind speeds greater than 7m/s at 100m hub height
- Similar to the potential in the North Sea
- Wind potential distributed within 100km from shore*
 - 43% in less than 30m water depths
 - 34% in greater than 50m water depths

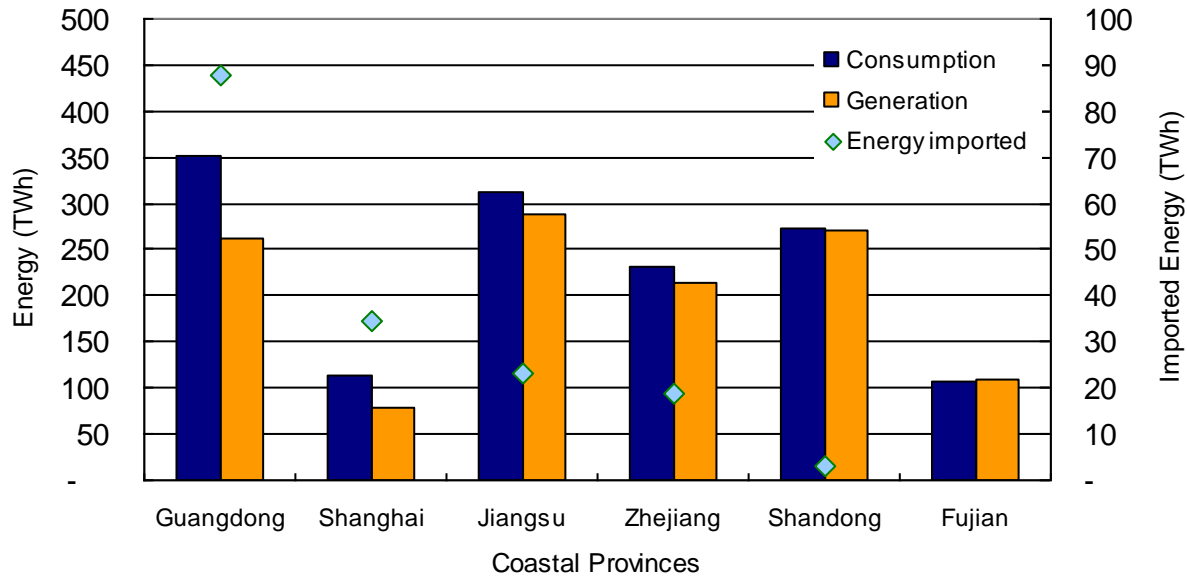


* Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan



Energy demand in coastal provinces

Energy Consumption and Generation in Coastal Provinces

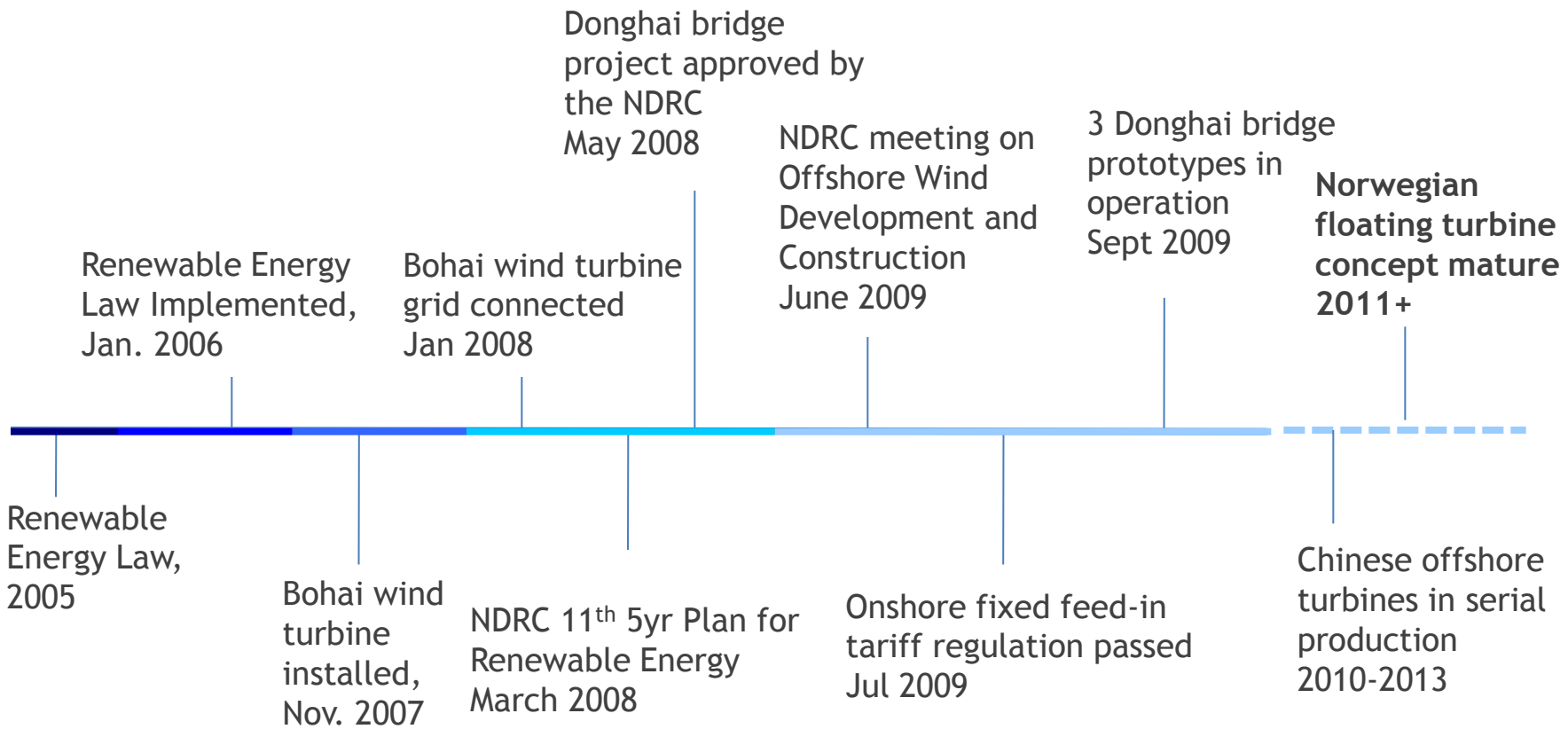


Source: China Energy Yearbook 2009

- Up to 25% of energy is imported in coastal provinces
- Jiangsu could offset 60% of its imported energy with its current offshore pipeline of 6.8GW



Major milestones for the development of the industry



Source: Azure International



China's Renewable Energy Goals

- Renewable energy goal: “Medium to Long Term Development Plan for Renewable Energy”
 - 10% by 2010
 - 15% by 2020

By 2020

- China's GDP is likely to double
- China will reach 1.3-1.4TW of installed energy capacity
 - Estimated 150GW of wind needed to meet RE goal
 - Estimated 30GW offshore wind market by 2020
 - 74 billion Euro industry

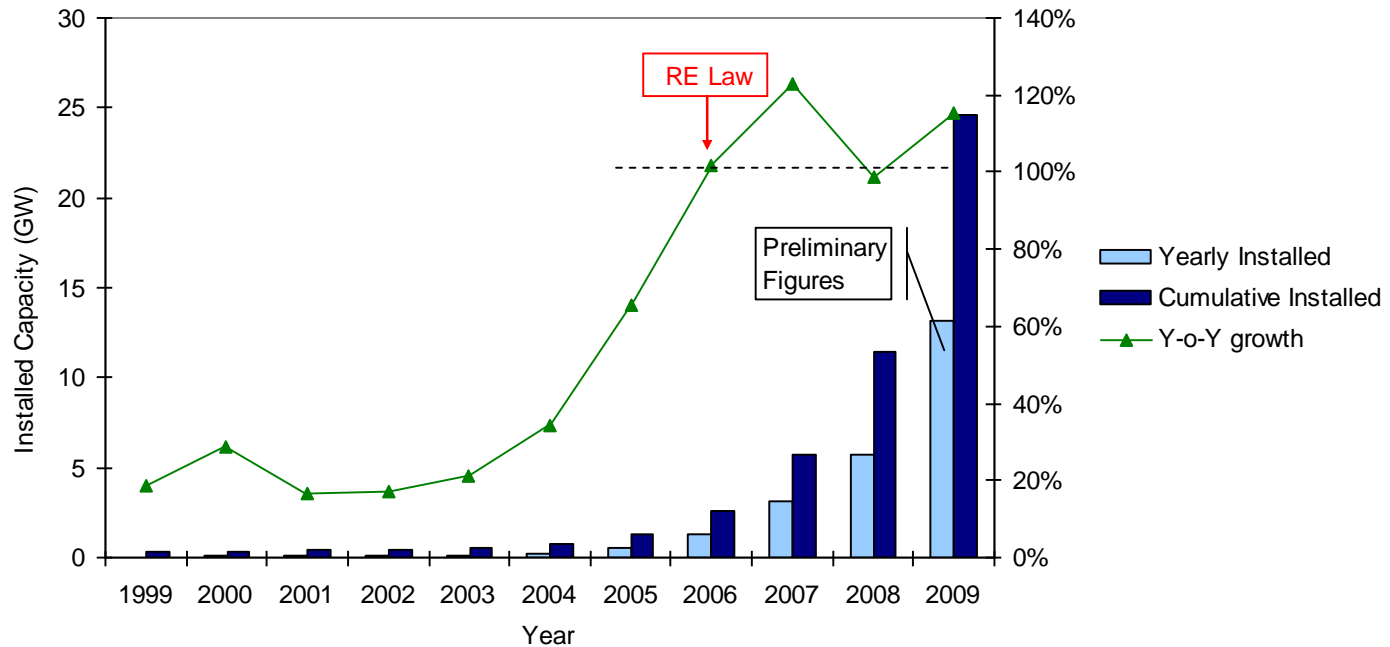
China's National Goals for Installed Wind Capacity					
Plan	Date	Year	Overall	Offshore	Note
NDRC: Medium-Long Term Development Plan for Renewable Energy	Sep-07	2010	5GW	1-2 100MW projects	
		2020	30GW	1 GW	
NDRC: The 11th Five-Year Plan for the Development of Renewable Energy	Mar-08	2010	10GW	1-2 100MW projects	Supersedes Medium-Long Plan

Source: China National Development and Reform Commission



Growth in China's wind industry

China's Onshore Wind Market Development



Source: Azure International

National wind energy goals:

- 2010: 10GW - **achieved in 2008**
- 2020: 30GW - **likely to be achieved in 2010**
- Establish 100MW demonstration project in Shanghai-Jiangsu area - **Donghai 102MW project**
- Develop a 3MW offshore wind turbine - **Sinovel**



- Offshore wind project development interim measure
 - Jan 22, 2010 National Energy Administration (NEA) (NEA[2010]29)
 - NEA is responsible
 - National level project planning in coordination with the State Oceanic Administration
 - Development approval
 - Project approval
 - Concession projects
 - State Oceanic Administration
 - Marine zoning specifications for offshore wind projects
- Developers participating in the offshore wind concession projects must be Chinese or be a joint venture with a Chinese majority share

Wind turbine manufacturing facilities – in operation



 Operation

Wind turbine manufacturing facilities – under construction

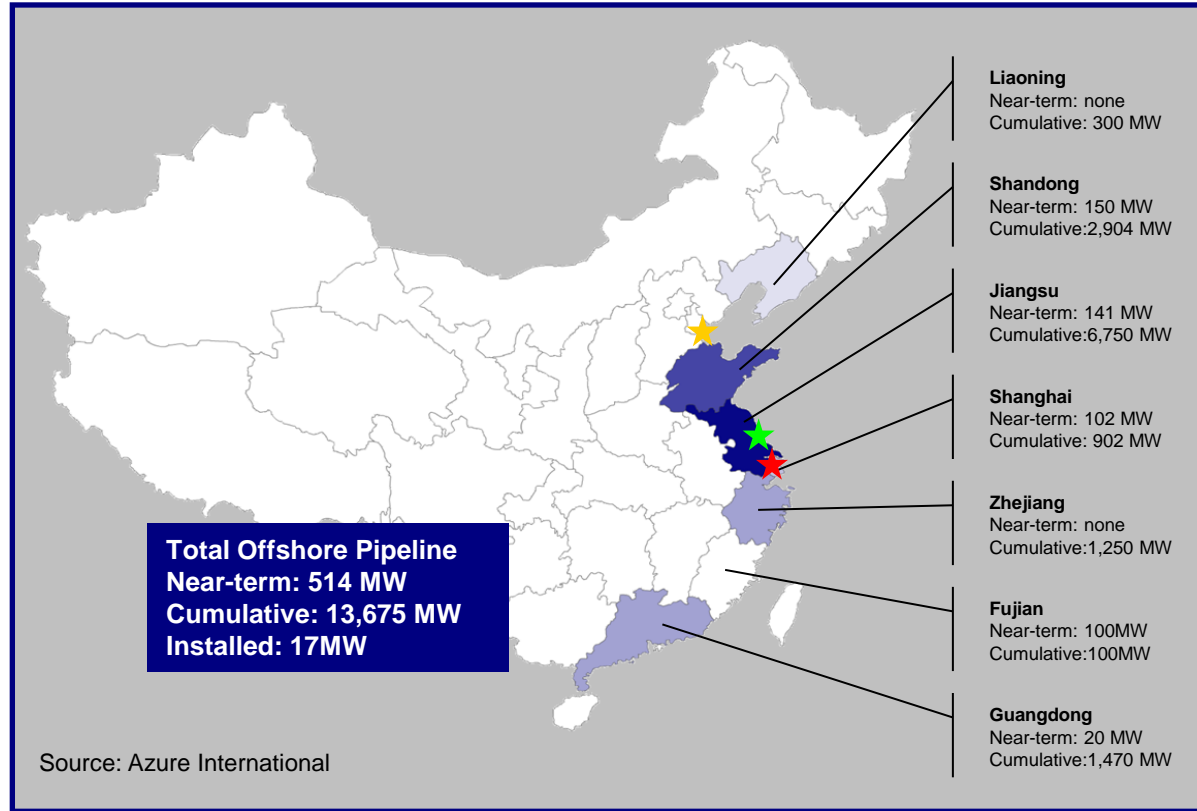


 Operation

 Construction

China's offshore wind industry unleashed

- New significant players to the offshore wind industry
- Call for tender of first round of 200-300MW concession projects within 50m water depths
- Projects considered more economical if exceed 1GW
- In April provinces are required to start offshore wind grid implementation plans



Top Offshore Wind Farm Developers	Pipeline (MW)
China National Offshore Oil Corp (CNOOC)	3,102
Longyan Power Group	2,465
China Three Gorges Project Corporation	2,010
Huaneng(China) Group (CHNG)	1,302
Guangdong Baolihua New Energy	1,250
Guodian Group	800
Shenhua Group Limited Liability Company	500
Datang Corporation	329
Changdao Wind Power Development Compa	300
Shandong Sanrong Group	300
Zhejiang Lvneng Co. Ltd.	196

Source: Azure International



Bohai-CNOOC 1.5MW



Donghai Demonstration-102MW

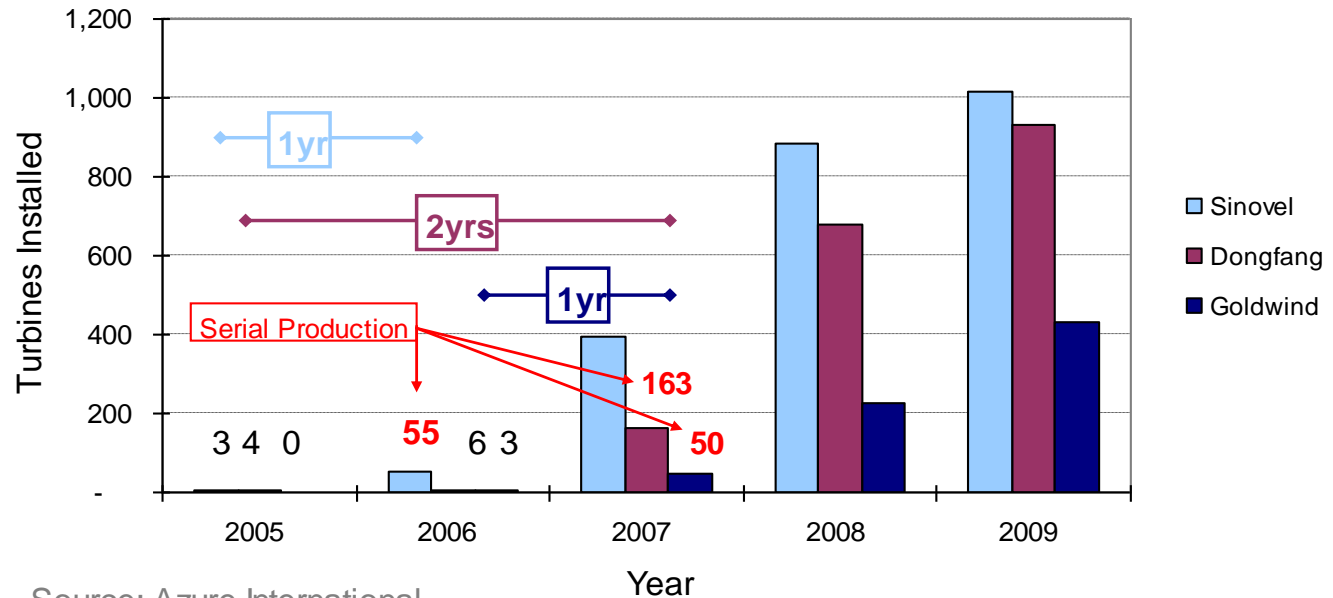


Rudong Intertidal- Longyuan 30MW

Offshore turbine development - Prototype to serial production

- 1-2yr prototype to serial transition
- Establishment of international R&D centers
- Development of offshore turbine prototypes
- Increasing focus on international certification such as DNV, GL, TUV

1.5MW Turbines - Prototype to Serial Production



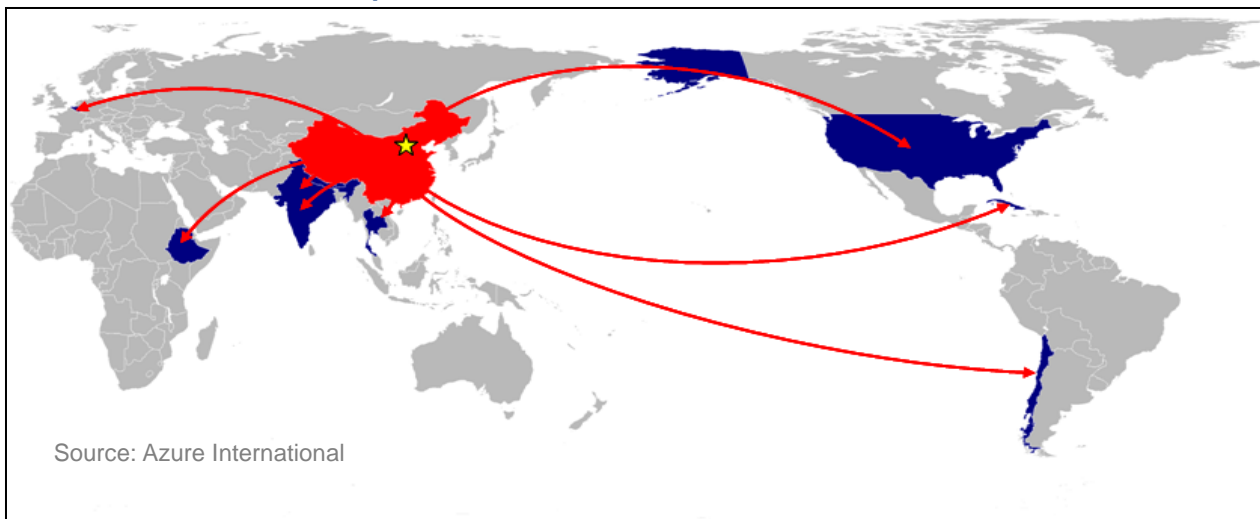
Source: Azure International

Offshore turbine development

- Turbine export

Chinese turbine exports: ordered and delivered

- Wind turbines already delivered to the USA, India, Thailand, Chile, and Cuba
- Top Chinese manufacturers already producing offshore turbines
- Offshore turbines likely ready for export in ~3-4yrs
- Already fabrication and export of offshore wind installation vessels and foundations



Source: Azure International

Offshore Turbine Design Development Pipeline				
Company	Turbine	Design company	Prototype	Serial
Sinovel	3MW	AMSC and Sinovel	5 erected, 3 operating	2010
Sinovel	5MW	AMSC and Sinovel	2010	na
Dongfang	2.5MW	AMSC	2010	2012
Dongfang	5MW	AMSC and Dongfang	2012	2013
Goldwind	2.5MW	Vensys and Goldwind	1 erected onshore	2010
Goldwind	3.0MW	Independent	1 erected onshore	2010
XEMC	5MW	XEMC Darwind B.V.	2H 2010	2011
Shanghai Electric	2MW	Aerodyn	1 erected offshore	na
Shanghai Electric	3.6MW	Independent	2010	na

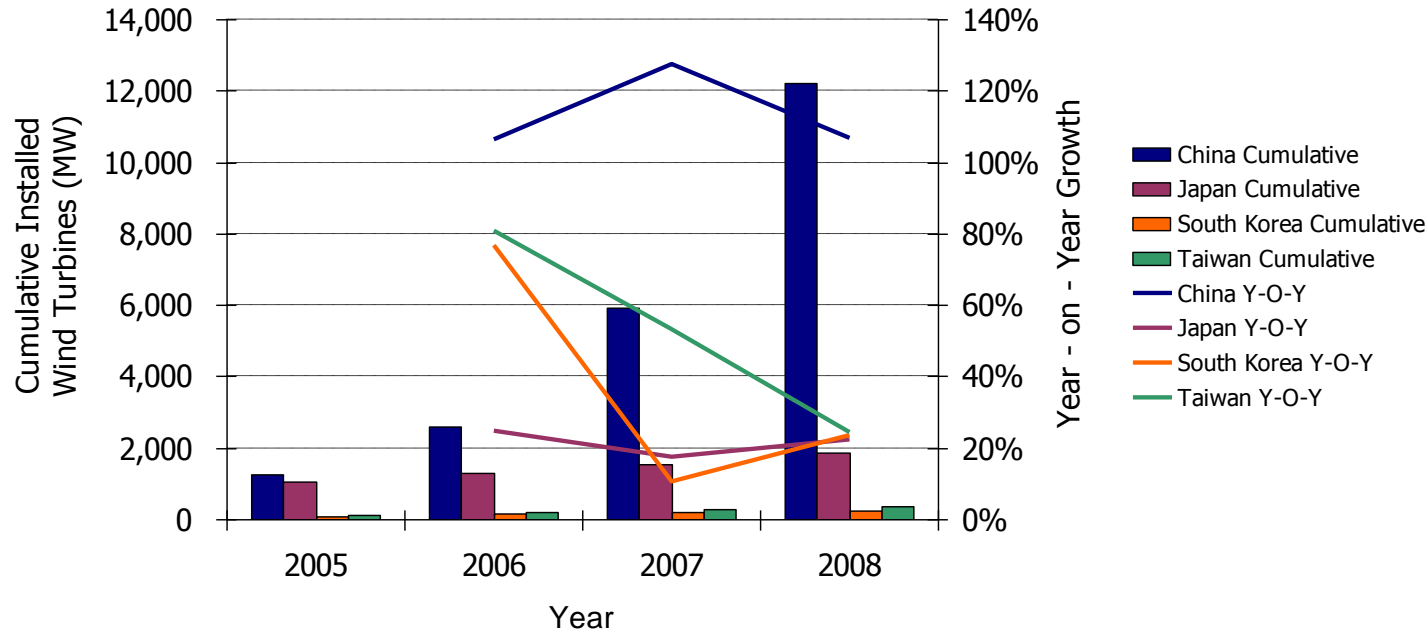
Source: Azure International



Broader Asia – Industry growth

- Slow wind industry growth outside of China
- Barriers for onshore wind
 - High population density
 - Mountainous regions
 - Infrastructure constraint
- Offshore wind - new opportunity
- New renewable energy policies implemented in 2008-2009

Asian Wind Market Development

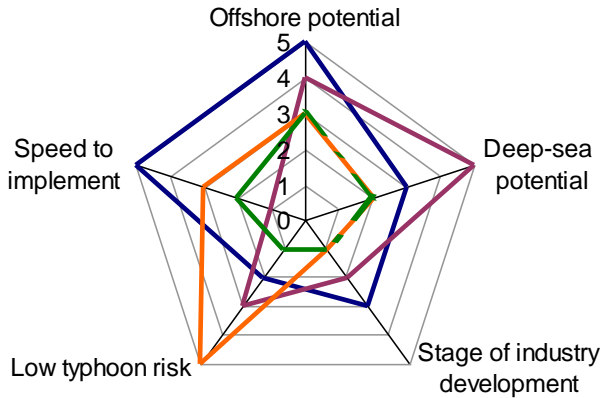


Source: GWEC - Global Wind Report



Broader Asia - Market comparison

Project Development



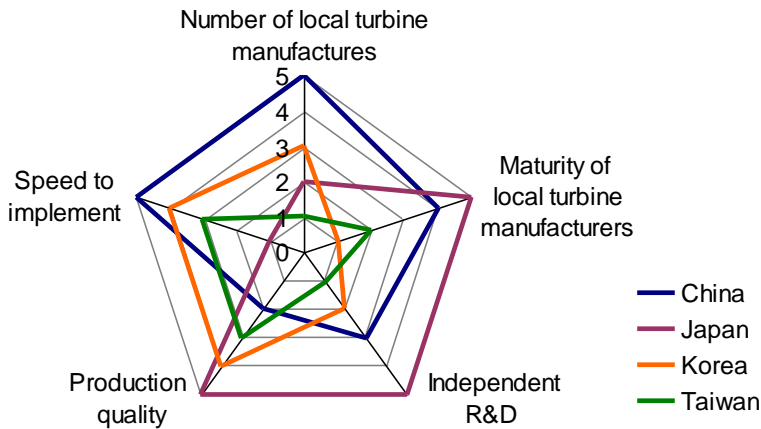
Japan

- 3% RE by 2020 - 2.1% from wind 3000MW
- Long term experience in wind industry
- Mature domestic turbine manufacturers
- Already engaged in offshore wind deep sea research
- **Slow wind industry growth**

Korea

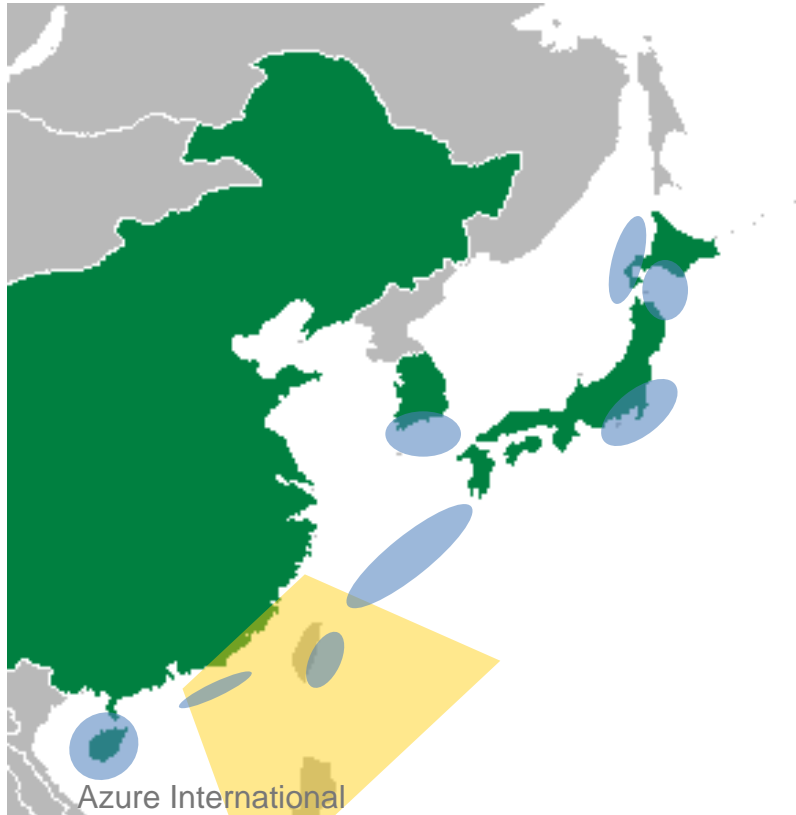
- Implemented RE law in 2008-6.1%RE by 2020, RPS by 2012
- Will invest 61.5billion Euros in RE
- Limited experience in wind industry
- Quickly emerging domestic turbine manufacturers
- **Limited wind industry experience**

Manufacturing



Taiwan

- RE law published in June 2009
- Will invest 650million Euros in RE
- Offshore fixed feed in tariff set: eqv. 0.09Euros/kWh
- **Limited wind industry experience, high typhoon risk**

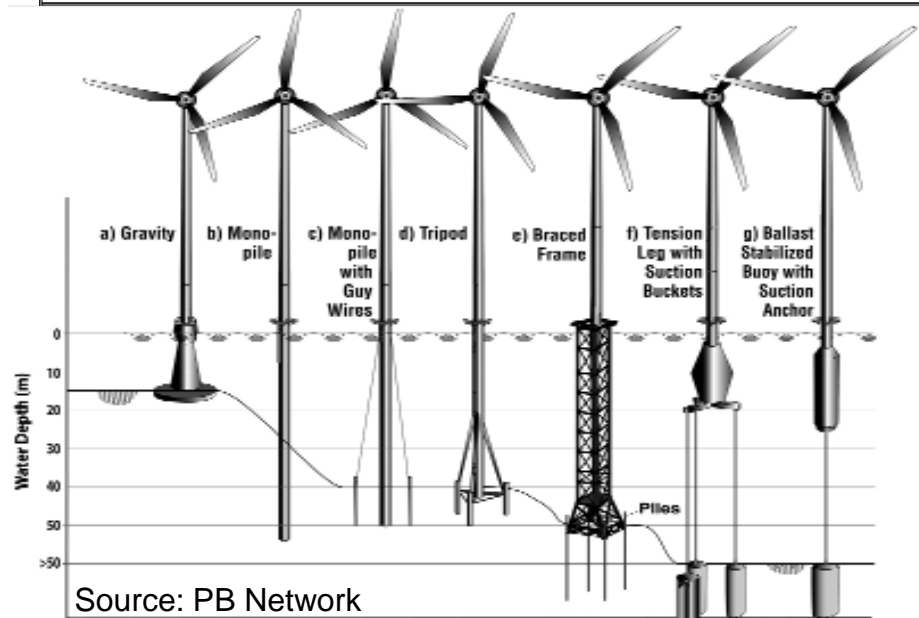


■ Deep Sea Offshore
■ Typhoon Prone

Deep Sea Potential - Floating Turbine		
Country	Potential (GW)	Foundation Type
China*	40	TLP
Japan	265	Spar and TLP
Korea	25	Spar and TLP
Norway	125	Spar and TLP

Foundation Type Classification	
Classic offshore	0-50m
Tensionless Leg Platform (TLP)	50-300m
Spar (Floating foundation)	150-500m

*Rough deep sea estimate
 Source: Garrad Hassan 2009

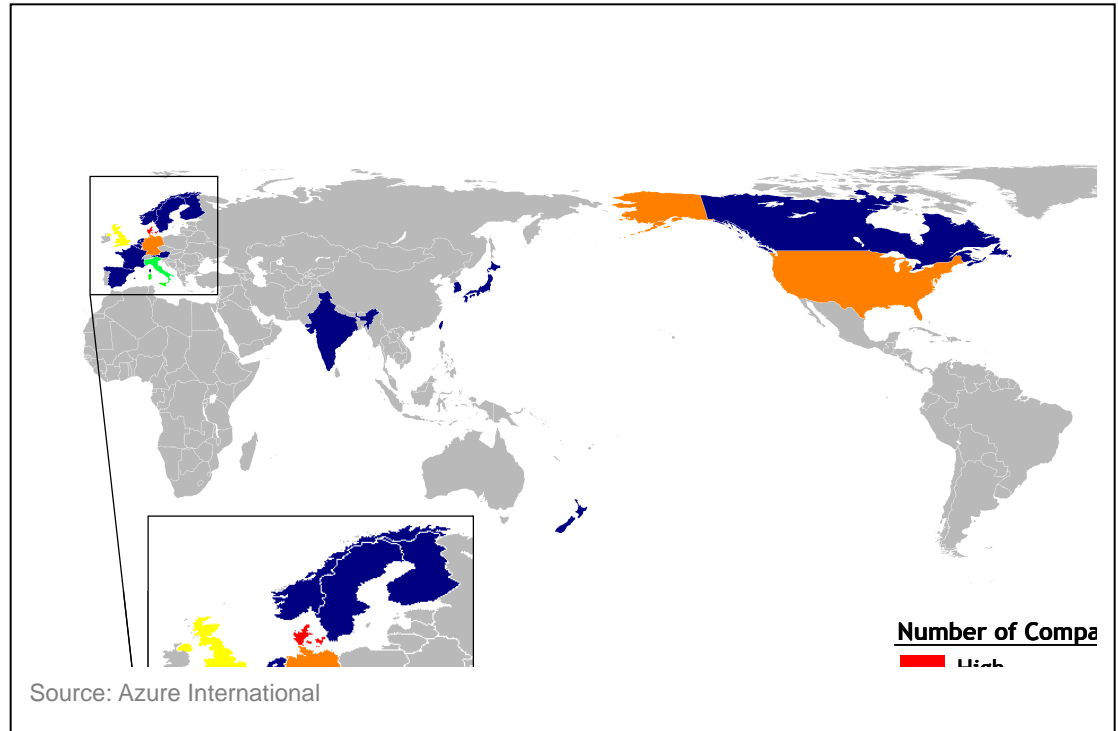


Source: PB Network

Competing cluster's in China's offshore wind market

- Clear cluster presence at key conferences
- Involvement in onshore wind in China
- Involvement in offshore industry in Europe
 - Denmark
 - *Danish-Chinese Wind Energy Development Programme (2006-2009)*
 - *Sino-Danish Renewable Energy Development Programme (2009-2013)*
 - Germany
 - *Wind Power Research Training Center (2005-2010)*
 - UK
 - Scotland

International companies engaged in China's wind market



Norway – Emerging offshore wind cluster

- Strengths
 - High wind resource potential - 14,000TWh (within 300m depths)
 - Potential to transition from being an oil and gas exporter to renewable energy exporter - Hydro balanced with wind
 - Highly innovative
- Barriers
 - Policy support needed
 - Limited domestic installed wind capacity
 - Lacks a domestic turbine manufacturer
 - Shortage of engineers

“Offshore wind energy may become the next adventure for the Norwegian industry and energy sector.”

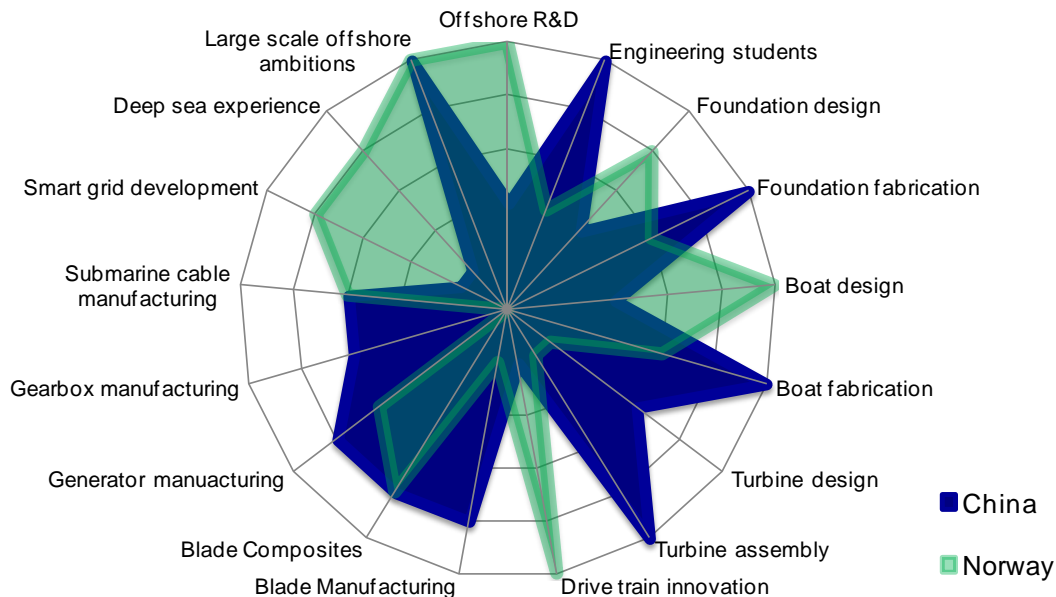
~ Norwegian Minister of Petroleum and Energy, Mr. Terje Riis-Johansen



Norway-China: Mutual Industry Engagement

- Points of Collaboration
 - Platform for deep sea offshore in Asia
 - Large scale ambitions
 - 9GW Dogger Bank project
 - 1GW scale projects
 - Collaboration on
 - Boat and foundation design and development
 - Working with Chinese turbine manufactures as they penetrate the global market

Offshore Wind Industry Comparison



Source: Azure International

Estimated Norwegian Economic Potential in China's Offshore Wind Market 2010-2020		Market potential (Euros)
Foreign market		22 billion
10% of Foreign market		2 billion
Norwegian potential based on industry strengths		930 million
Foundations		580 million
Electrical infrastructure		130 million
Electrical installation		220 million

Source: Azure International



Building on resources already established in China



- Strong long-term presence in offshore oil and marine industries
- Companies involved in the wind industry and in China
 - DNV
 - Statoil
 - Jotun
 - Greig Group
- Educational and research exchange
 - DNV and Shanghai Maritime University
 - Statoil and Tsinghua
 - ‘China Meeting Place’
 - Norcowe and Nowitech
- Nordic Industrial Park
 - Norwegian owned industrial park
 - Full package business support solution
 - Brought 45 countries to China

Norwegian Companies in China Suitable for Wind Industry Development	No.
CDM	1
Development zone	1
Finance	5
Law	1
Marine and Shipping	>32
Offshore	>3
Wind industry	4
Total	47

Data Source: Norwegian Business Forum Beijing



Bilateral cooperation

- Example provincial-country: Shandong - Norway
- Example company-company: CNOOC - Statoil
- Example cluster partnering: Scotland - Norway cluster



- Position Norway as an offshore cluster with
 - Experience in large scale offshore wind development
 - Innovative designs for industry development
 - Opportunities for Chinese manufacturers to establish and engage in the broader European market
- Establish a presence in China to engage in the larger deep sea market in Asia
- Increase collaborative R&D and educational exchange
- Investigate the potential for strategic bilateral relationships

Rachel Enslow

Wind Consultant

rachel.enslow@azure-international.com

Tel: +86 10 8447 7053

Fax: +86 10 8447 7058

Oriental Kenzo

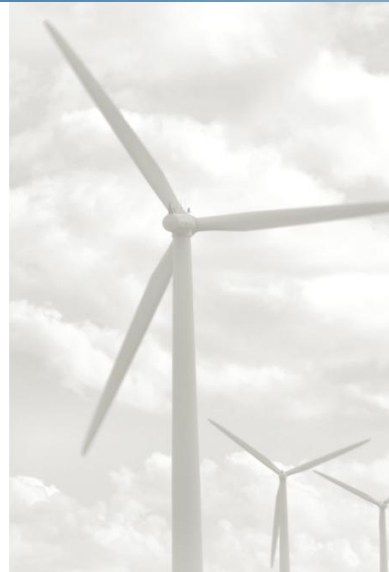
Suite H, Office Tower, 6th Floor

48, Dongzhimen Wai Street

100027 Dong Cheng District, Beijing

PR China

www.azure-international.com



azure^{td}
international