



China wind market is booming:

----- Growth not only on-shore but off-shore

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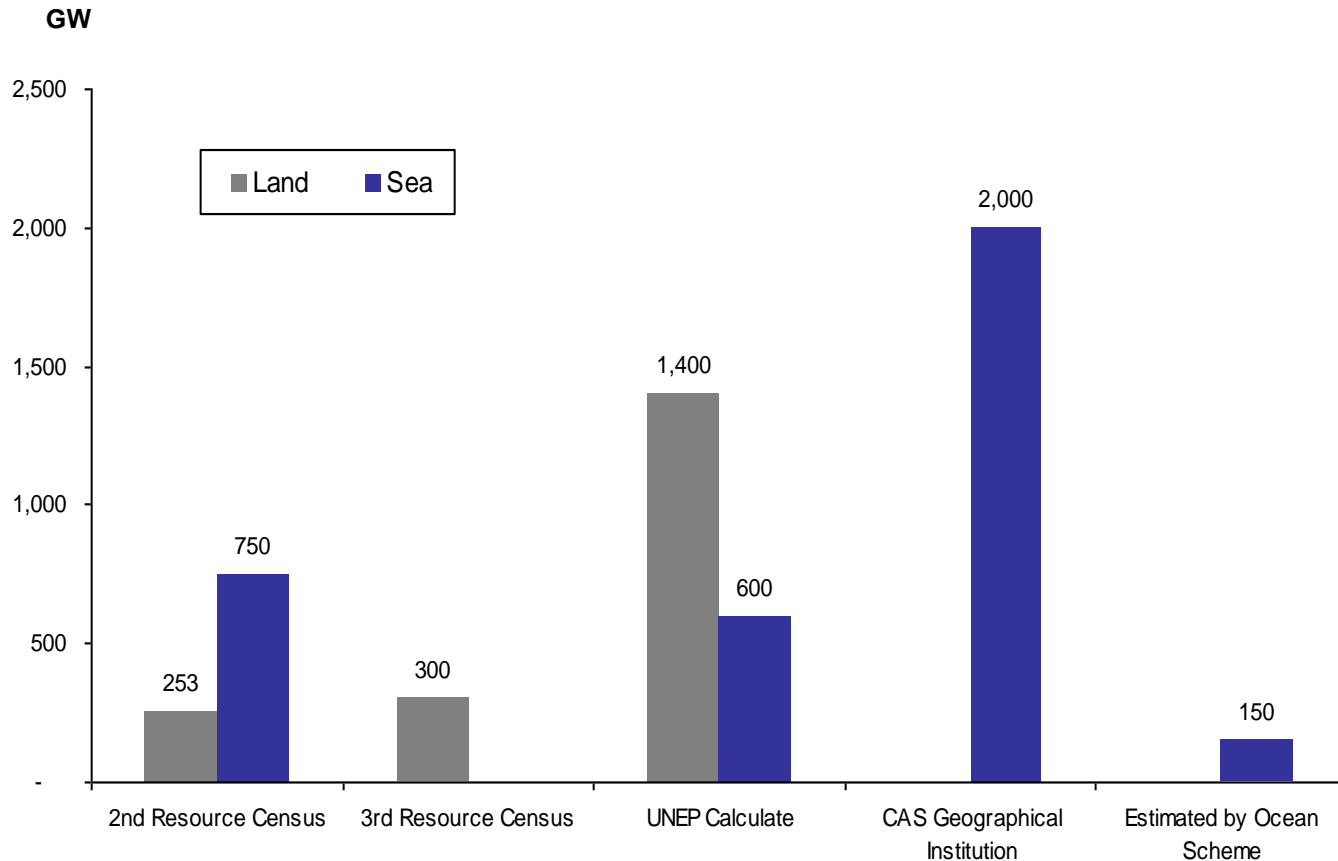
- Wind power resources allocation
- Development status
- Update recent years
- National policy
- Potential for more depends on
- Outlook supply vs. demand forecast

Why wind power in China



- Total energy demanded increased very fast
- Power installation reached about 850 GW in 2009, with about 80-100 GW newly added after 2006
- Chinese government made commitment for 15% of non-fossil fuel in total energy use by 2020
- Currently it was only 8.5%
- China is with a lot of wind, included in the off-shore area

National Wind Power Resource



- There are discrepancy between different institutions for evaluation of wind power resource in methodology and results.

- It still indicates that the wind resource in China is abundant.

National Wind Power Resource

Onshore Resource

- Theoretical reserves of more than 4,000GW above 10m height with technically exploitable reserve of 300GW. The practical development area is approximate 200,000 km²
- Based on current technology, over 50m level, it requires 3-5 MW wind turbine to cover 1km². With 200,000 km² development land area available in China, the total installed onshore wind capacity can probably reach 600~ 1,000GW.

Offshore Resource

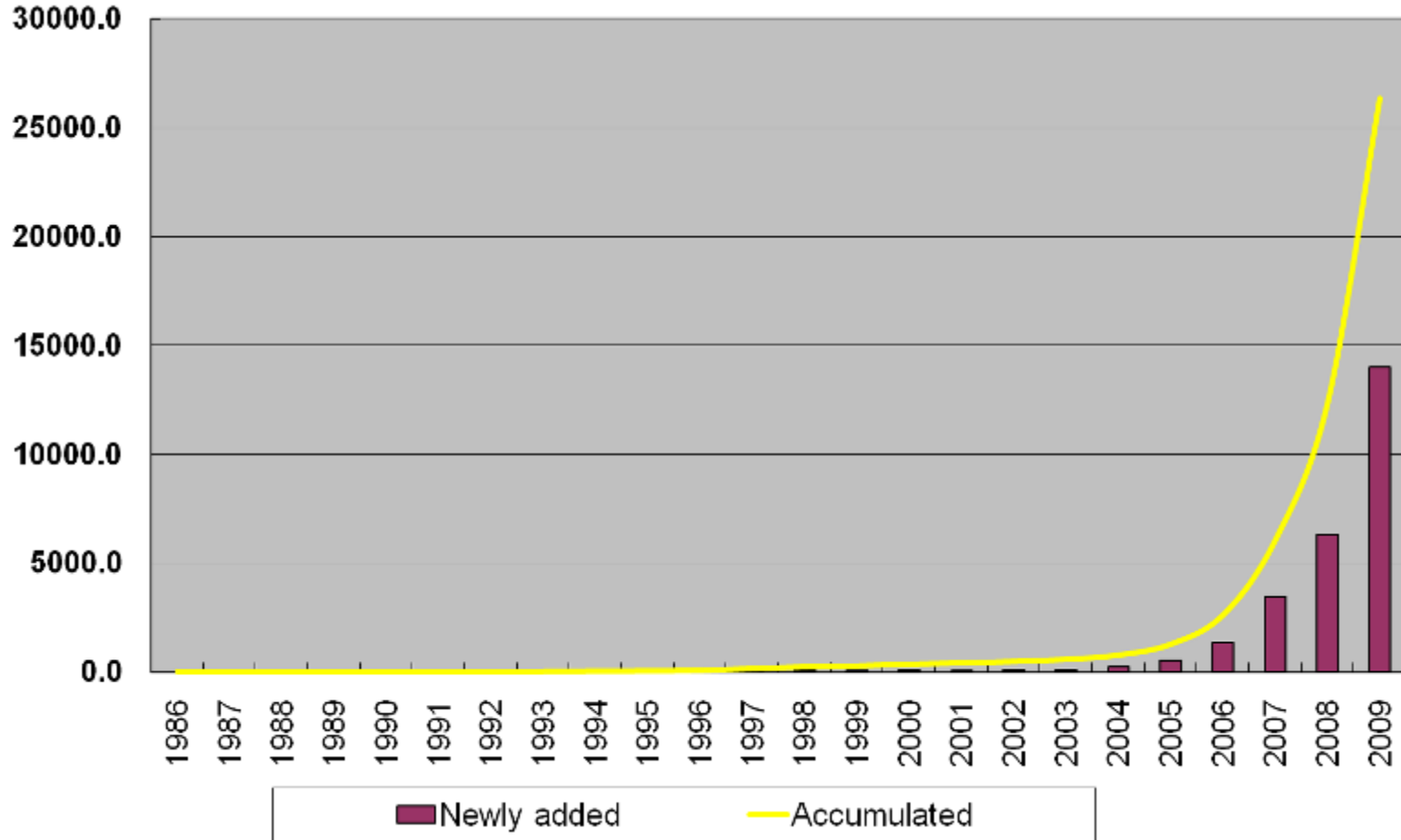
- According to the China Coastal Zone and Tideland Resource Investigation Report, the sea area of 0-20m off coastline is around 157,000 km²
- Assuming 10% to 20% of the total amount of sea surface used, the total offshore wind capacity can reach 100~200GW.

■ Conclusion:

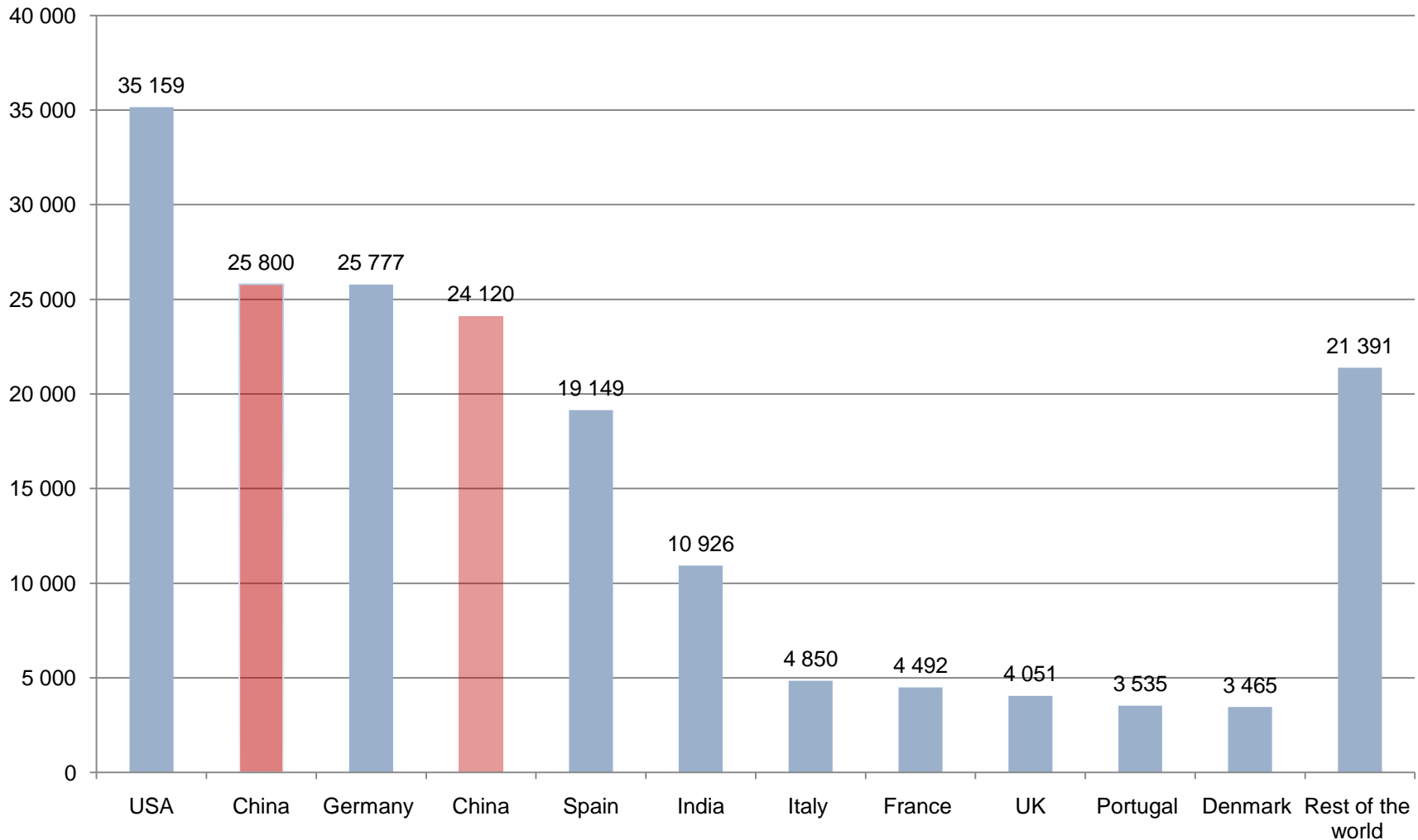
- Abundant wind power resource in China
- Great development potential
- A key constituent in future energy structure

Development status

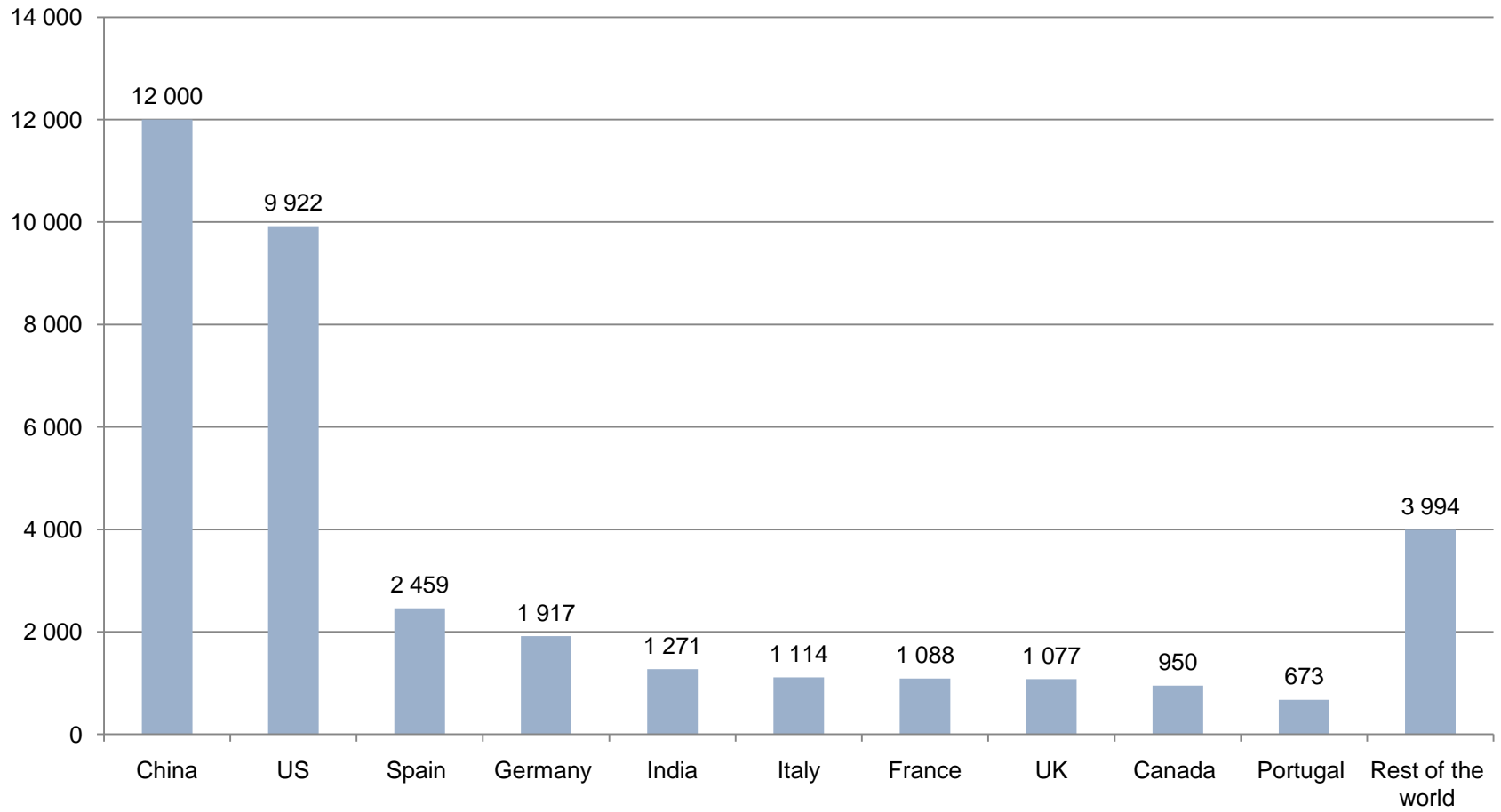
---totally about 24-26 GW



Ranked second in the world by the accumulated installation with about 24-26 GW



Ranked the first by newly added with 12-14 GW a year



Regional distribution of turbines installation

~ 15.5GW installed (at 2Q2009)

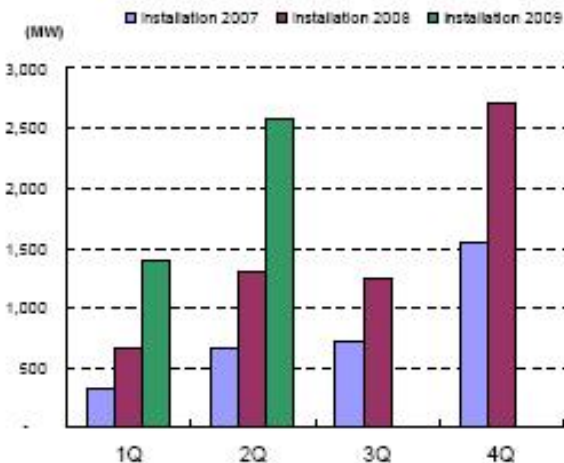
~ 350 "projects" operating

2008 Ins. 5.9GW vs. 2007 3.3GW
↑ 82%

100% CAGR '05-'08 means ave
WTG >1yr ops

100% y-o-y growth is ongoing...

Installation 2007-2009



Source: Azure International

Capacity installed



Source: Azure International, Google Earth

Development update - near-term activity

~ 650 sites represent ~45 GW of "imminent development"

...of which ~300 sites with 24 GW of orders outstanding

Installed & imminent development pipeline



Source: Azure International, Google Earth

Development update - including long-term pipeline

Future predicted by “long-term pipeline”

~ 1300 sites represent 210 GW of “Long-term cumulative Pipeline”

Long term cumulative pipeline



Source: Azure International, Google Earth

Development update - including long-term pipeline (6 wind bases)

Future may also be predicted by wind base planning

100GW achieved with no new “imminent development pipeline” as of today

6x10+ GW wind bases represent future pipeline

Jiuquan, Hami, IMAR E, IMAR W, Hebei N, Jiangsu

Coordinated grid development

Government selection of turbines/low price focus

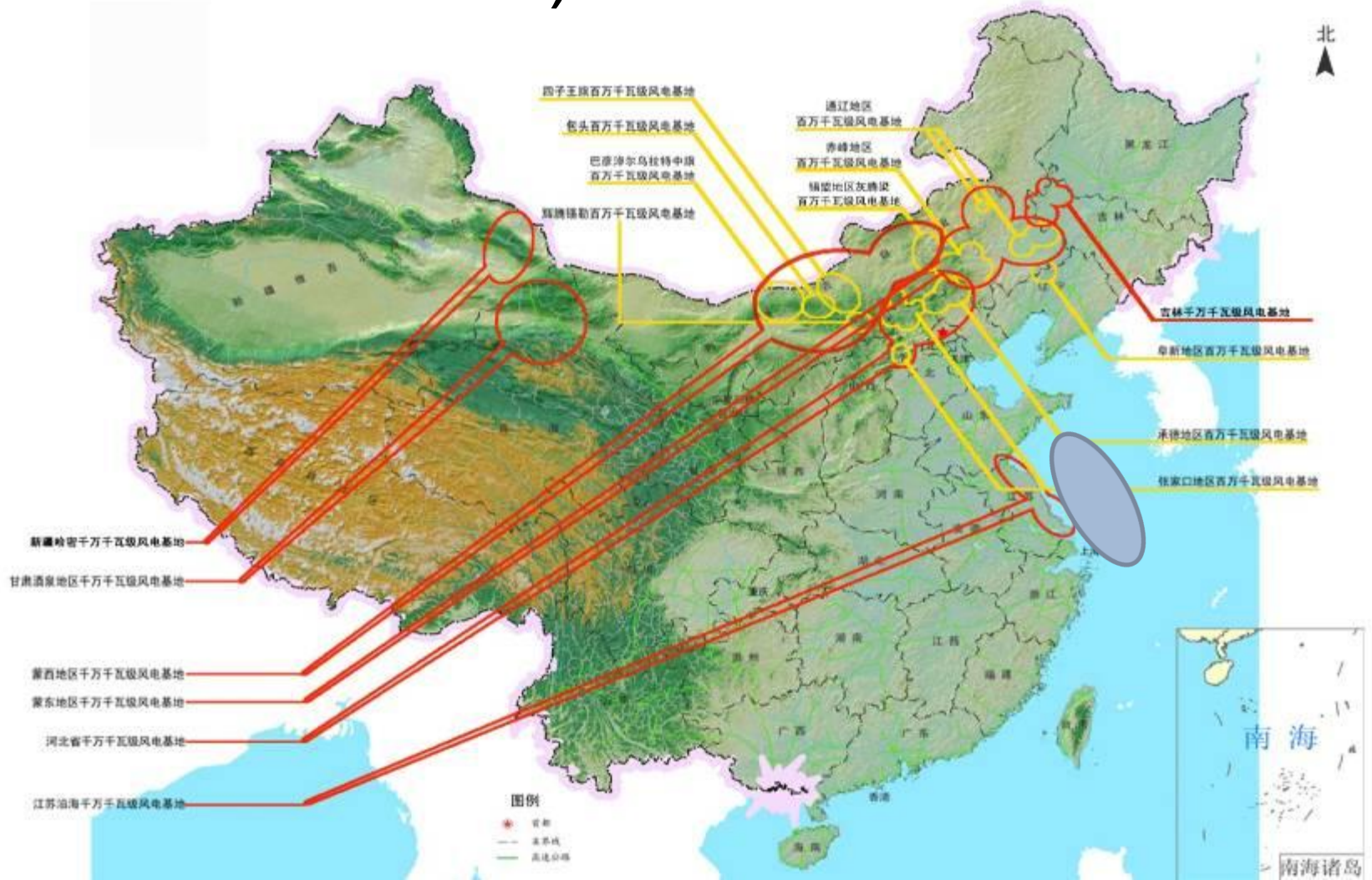
China non signatory of Gov't Procurement Agreement under WTO

Long term cumulative pipeline – wind bases only



Source: Azure International, Google Earth

Location of 6 wind power bases (over 10 GW of each)



Off-shore wind development status

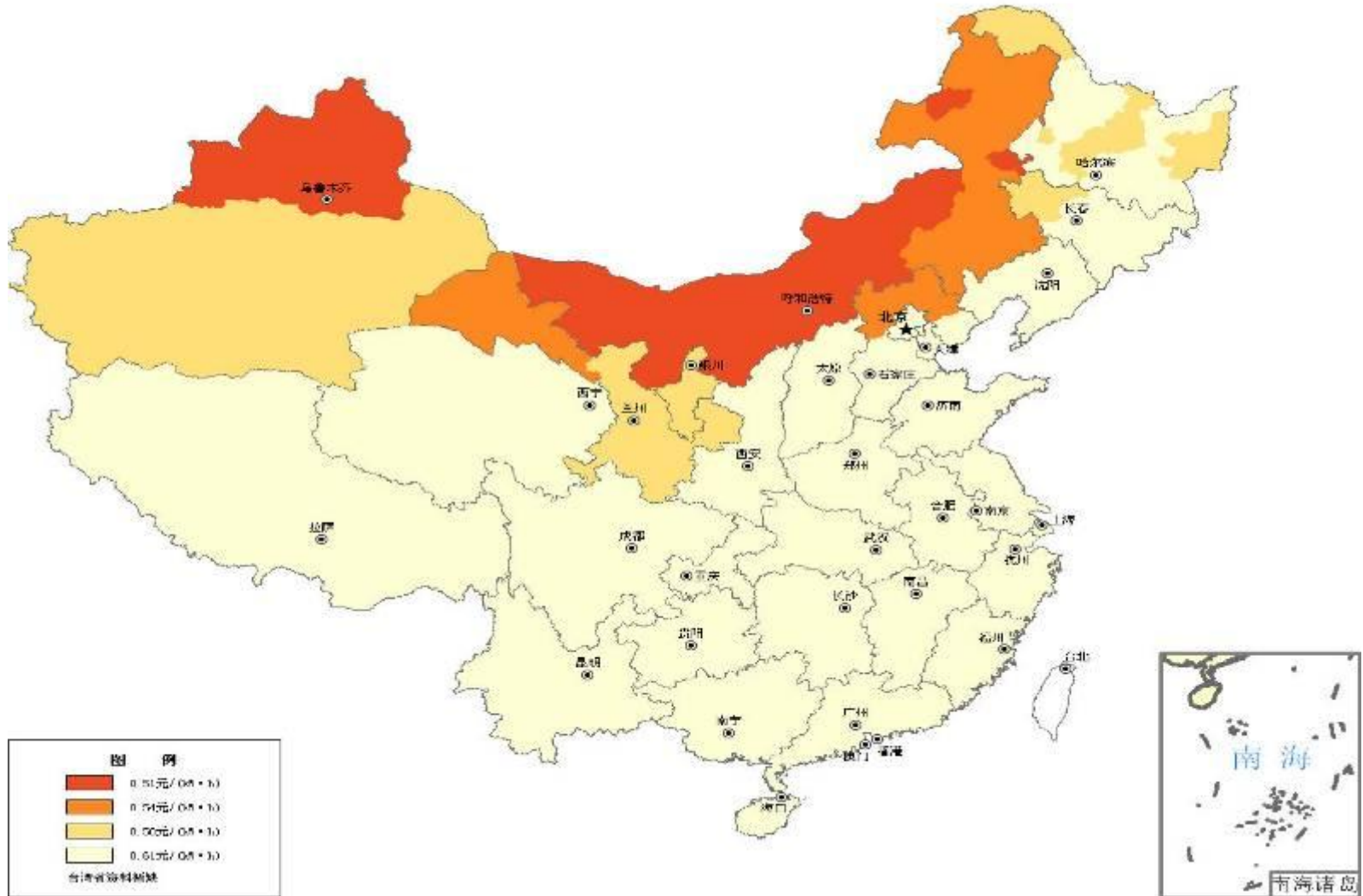
----34 3 MW turbine installed in Shanghai



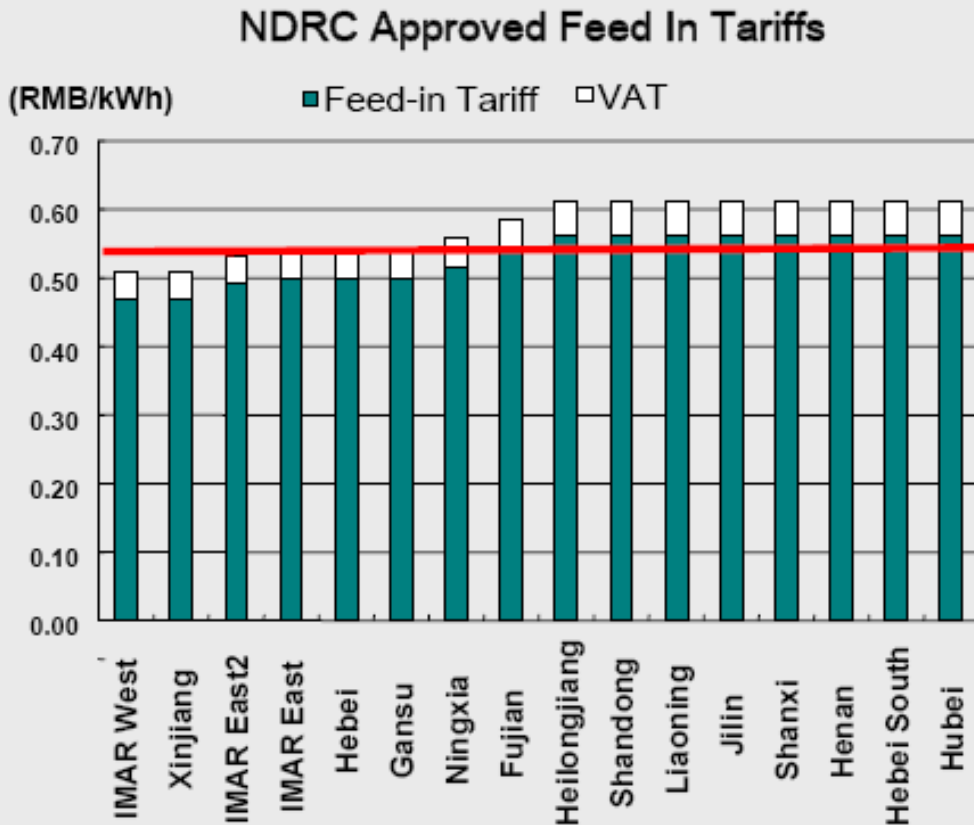
Current wind power policies

- Feed in tariff in 4 regions with each of them 0.51, 0.54, 0.58 and 0.61/kWh with a local special support
- VAT deduction of equipment cost (usually it is 17% of total investment)
- Income tax for 2 year free and 4 years half (normally it is 25% of net income)

Wind tariff in china



Wind tariff in china



Source: Azure International

Ave net feed in tariff = RMB 0.53/kWh for 30k hrs
 @ EUR 12/tce add RMB 0.10/kWh thru 2012

On 9 Jun 07, 23 projects approved in 4 provinces

On 3 Dec 07, 72 projects approved in 8 provinces

On 10 Jan 08, Guangdong approved the fixed tariffs

On 23 July 08, 48 projects approved in 10 provinces

143 projects in 14 provinces covered thus far represent over 85% of pipeline identified to date (100GW)

Cheaper manufacture in China

Established international and Established domestic companies each with potential for 2GW by the end of 2007

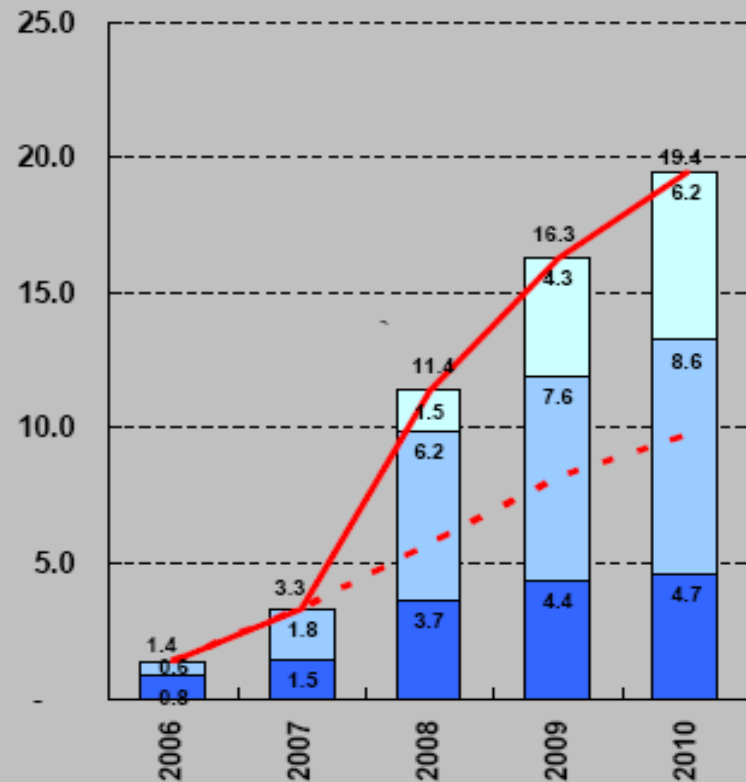
By 2009 each grouping could represent about 1/3 of the market, but “new entrants” will be challenged in acquiring market share

Expect consolidation within the next 3-years

WTG Manufacturer Company Groupings

- Established International
Gamesa, GE, NCWA, Nordex, Suzlon, Vestas
- Established Domestic
Sinovel, Dongfang, Goldwind, Windey, Changzhou, Huayi, Shanghai, Xiangdian
- New entrants
24+ companies with tech or license agreements and detailed business plans for WTG manufacturing
- Aggregate pdn plans - - - Tempered pdn

WTG Manufacturer Production Plans (GW)



Source: Azure International data

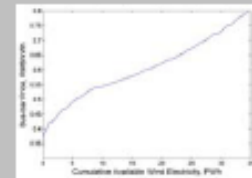
Future potential

All power needed by China to 2030 (7000TWh ~ 3000GW wind) could come from the wind resource based on reasonable geographical limitations and feed-in tariff of RMB 0.516/kW

Study by Michael B. McElroy (Harvard), Xi Lu, Chris P. Nielsen, Yuxuan Wang (Tsinghua)

Wind resource could provide 24,700 TWh of electricity annually, more than 7x current national consumption!

Doubling power use in China to 2020 (792GW) if all done with wind would require ~ 1680GW



Source: McElroy et al. "Potential for wind generated electricity in China," Applied Science and Department of Earth and Planetary Sciences, Harvard University, June 2009. Published in *Science*.

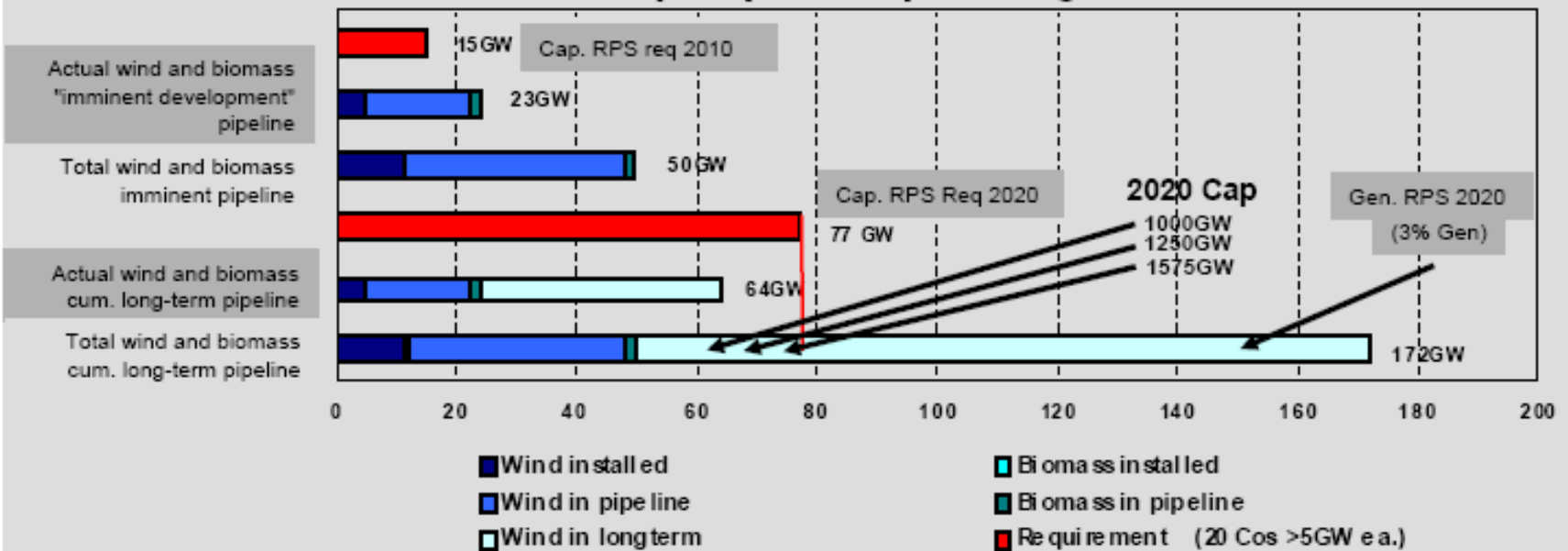
Floor in place - RPS - powerful driver of sector but other factors at work

unprecedented thermal/hydro cap. Expansion (+100GW in 2007 alone / cum cap forecast at 1,575 GW by 2020*)

2010F overall power gen capacity 840GW at 3% implies 25GW of non-hydro renewables; with 60% cap from companies >5GW = 15GW mandated by 2010

2020F overall power gen capacity 1575GW at 8% implies 126GW of non-hydro renewables; with 60% cap from companies >5GW = 77GW mandated by 2020

Capacity RPS Implied Target



Source: Azure International

Major suppliers in China

Domestic Investment

- **Gold Wind**
(Xin Jiang Urumchi)
- **Sinovel Wind**
(Liao Ning Da Lian)
- **Dong Fang Electric**
(Si Chuan Mian Zhu)
- **United Power**
(Guodian and others)
- **Ming Yang Electric**
(Guang Dong Zhong Shan)
- **Hara XEMC Wind Power**
(Hu Nan Xiang Tan)

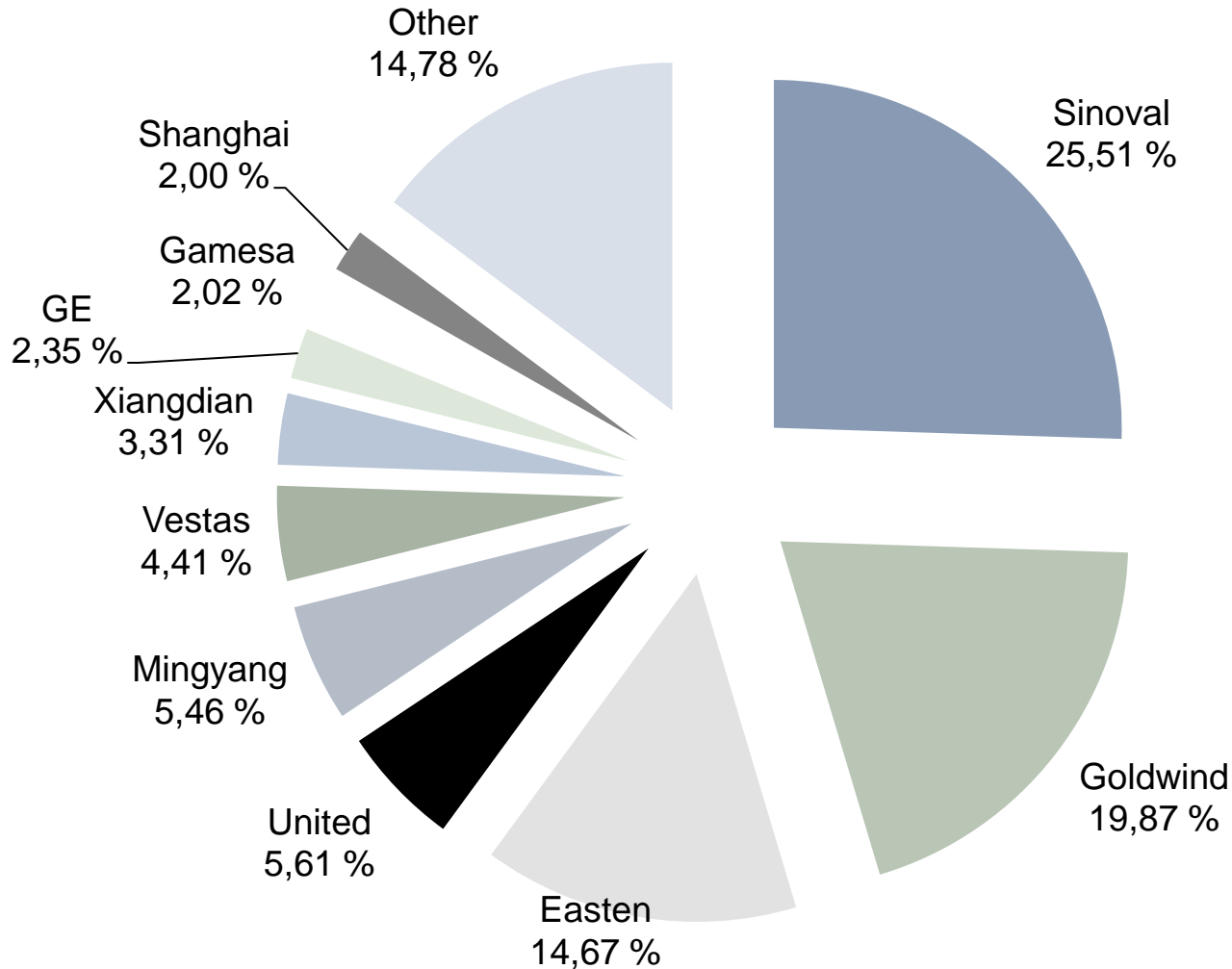
- **Chong Qing Wind Power Equipment**
(Chong Qing)
- **Shanghai Electric**
(Shanghai)
- **Zhejiang Windey Wind Generating Engineering**
(Zhe Jiang Hang Zhou)
- **CRE Wind**
(Liao Ning Sheng Yang)
- **Harbin Power**
(He Long Jiang Harbin)
-

Foreign Investment

Gamesa、 Vestas、 GE、 Suzlon、 RE Power、 Acciona、 Nordex
SKF、 FAG、 LM、 XREB

There are currently more than 40 wind turbine generator manufacturers in China, including 4 foreign-invested enterprises , 7 joint-venture companies and over 20 domestic manufacturers.

Top 10 of the manufactures



Off-shore wind development potential in China.....

Scale-up Onshore Wind Bases

- Northeast and Northwest (Gansu, Xinjiang, Inner Mongolia)
- Wind speed >8.0 m/s

Pilot Intertidal Offshore

- Equivalent to “Tantu” wind speeds – perhaps 6.0-7.0 m/s
- Mostly Jiangsu, Shanghai and Shandong coast

Initiate Medium-Deep Water Offshore

- Higher wind speeds than inter-tidal area – but very limited measurements
- Fujian, Zhejiang, Guangdong, Shandong, Jiangsu and Shanghai



Distinguishing the three main resource types is important

Onshore Wind

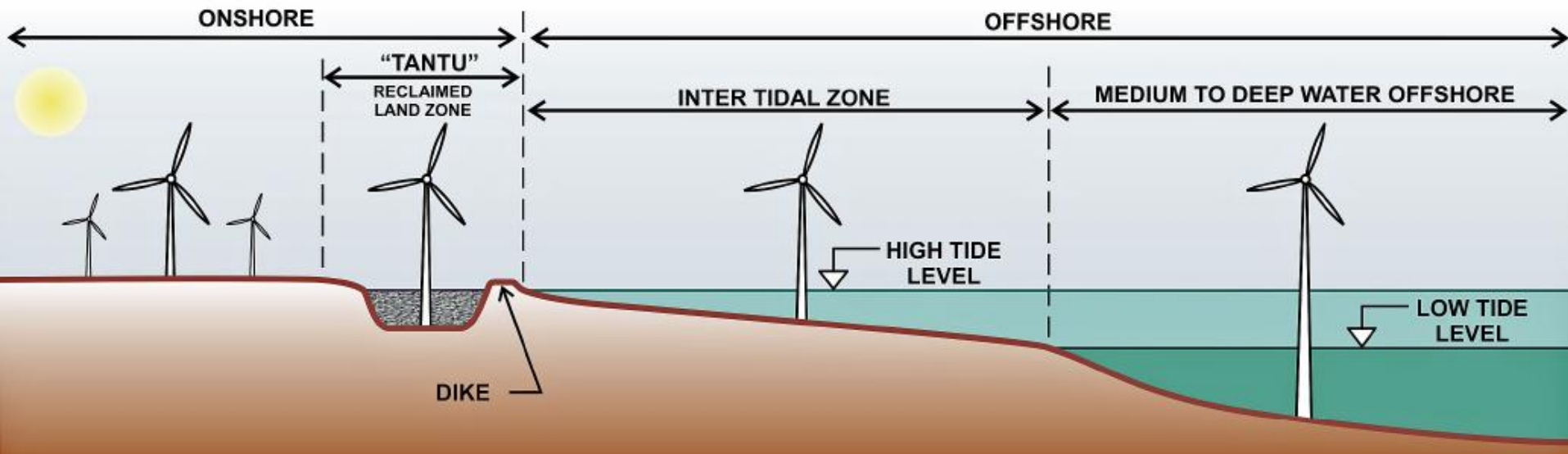
- Highest wind speeds
- Lowest cost
- Extensive local experience
- High potential in China
- Measures to improve capacity factor are key to cost efficiency.
- No global experience on planned 4-10 GW-scale wind bases
- Serious wake issue with large scale installations
- Grid planning and micro-siting of turbines key to success.

Offshore – Intertidal

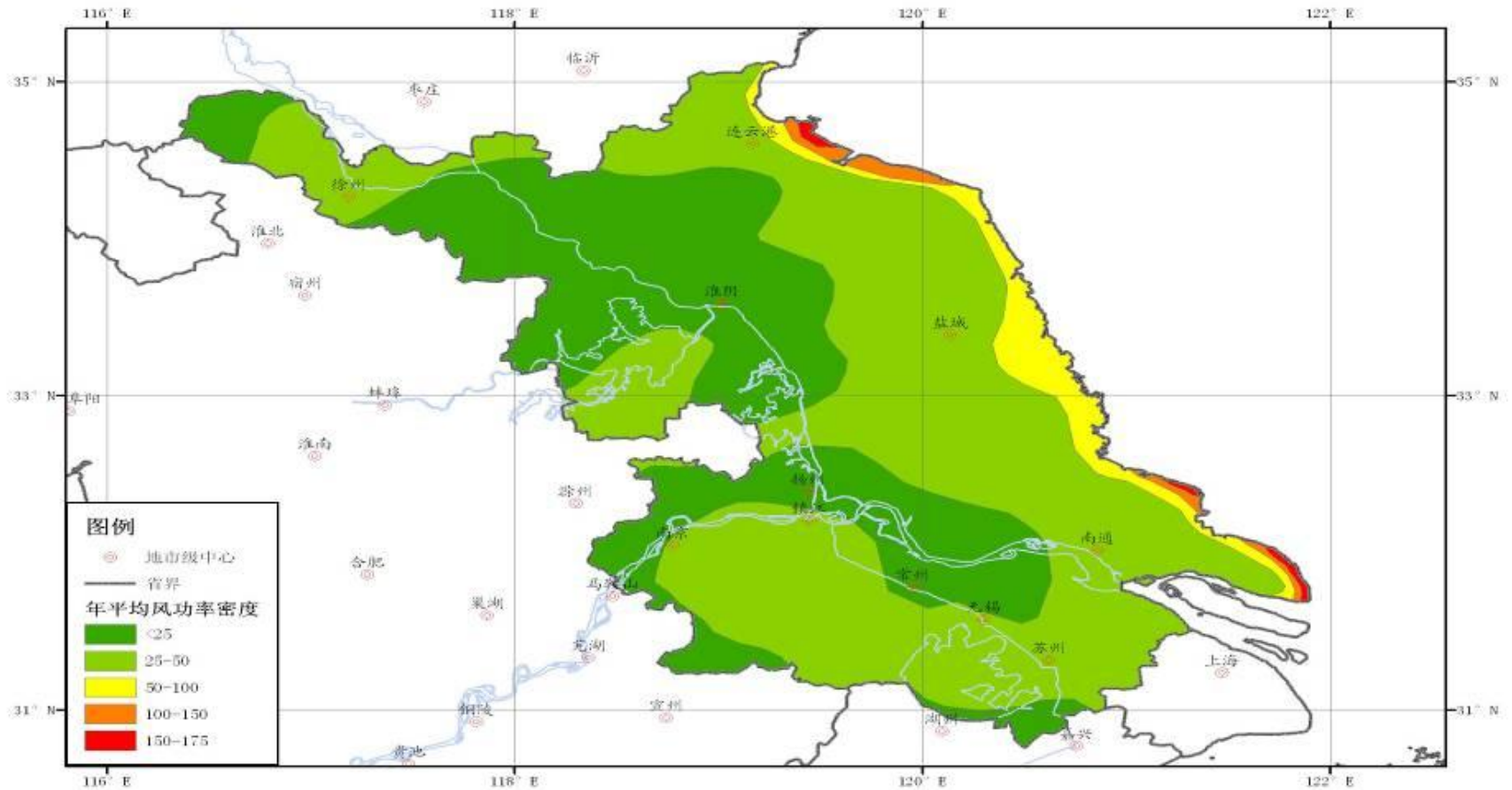
- Muddy tidal flat area
- Potential attractive from a cost perspective
- Virtually no international experience in constructing wind-farms on tidal flats.
- Potentially quite attractive given proximity to load centers – reducing transmission costs
- Foundation construction and turbine erection methods have to be developed to minimize costs.

Offshore – Medium to Deep Water

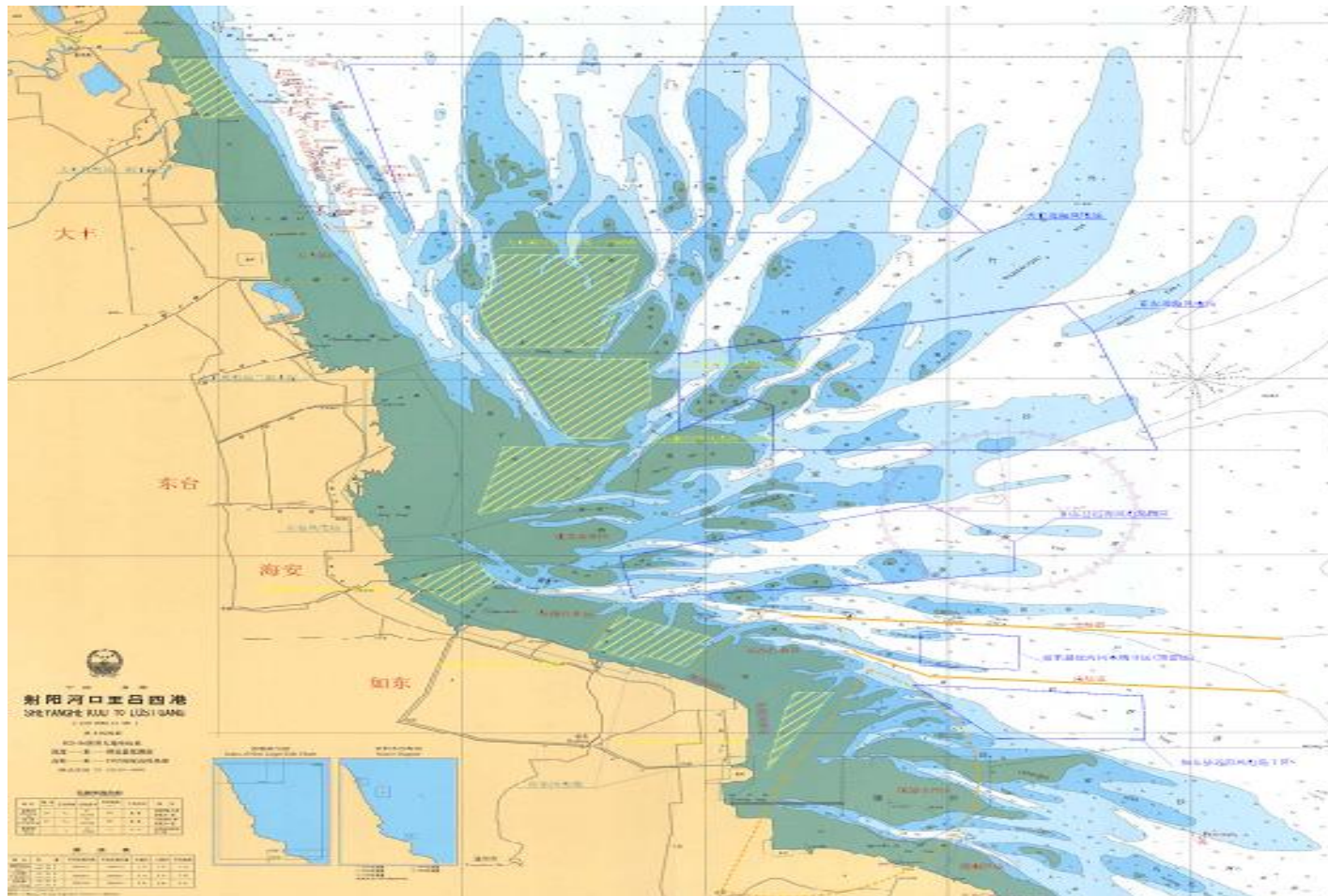
- Likely to be most expensive (at least twice the price of on-shore)
- Significant international experience to develop upon.
- High costs of construction and maintenance – large capacity wind turbine (> 3 MW) will reduce costs.
- Uncertainties/risks of foundation construction
- Typhoon risk may be high in south China



Special case in Jiangsu



Special case in Jiangsu



Future projection



- About 3 to 4 projects to be announced for bidding with 200-300 MW of total installation about 500 to 1000 MW
- Mainly in the inter-tidal area, such as Jiangsu, which with about 8 to 10 GW of inter-tidal wind power potential
- Followed by Zhejiang, Shanghai, Shandong, Fujian and Guangdong area, with total of installation by 2020 will be about 10 GW or more

Current policy and other support measures

- Planning made by National Energy Administration (NEA) for off-shore wind power development, which started in 2008 and it will be finished in middle of this year
- A regulation of off-shore wind power development management has been issued by NEA and the National Ocean Administration (NOA)
- Off-shore wind turbine developed supported by Ministry of Science and Technology (MoST) and National Development and Reform Commission (NDRC)
- A bidding price will be applied for the demonstration projects and fixed price will come later

The purpose of the regulation



- Enforcing the management of offshore wind farm development
- The developers should be a majority of Chinese companies, which followed all the harbor project development regulations
- The major reason for Chinese company to be the majority is the national security issues
- It will not be a big problem for international investors

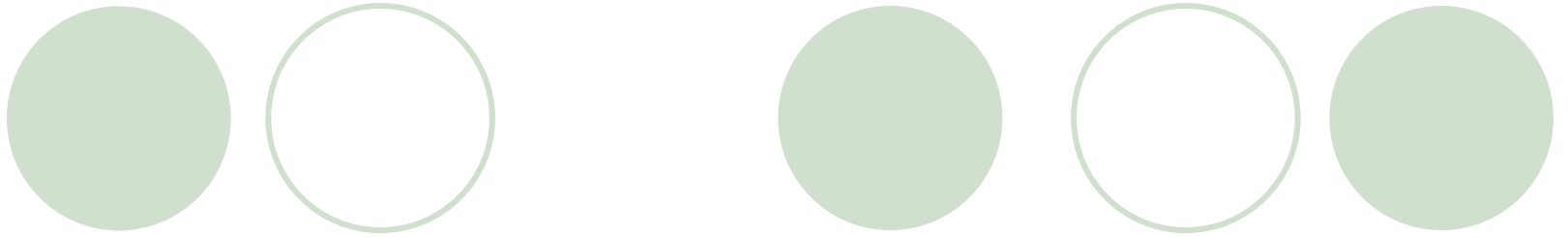
Details of the regulation

- 10 chapters with 38 Items
- Main contents
 - Planning requirement: NEA should make a national offshore wind development planning and the provincial government should make the local one
 - Permission of ocean use should be obtained from NOA
 - Chinese should be the Majority, above 50%
 - Bidding procedures for project developer selection will be promoted

International cooperation



- Learn from Norway and EU countries
 - Planning of grid connection
 - Installation of off-shore wind farms
- Develop new technologies for
 - Turbines and installation systems
 - Maintenance system
 - Grid connection & power distribution issues
- Policy dialogue
 - Climate change & renewable energy
 - R & D for better future



Thank You!

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