



Wind Energy – a real source?



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DNV South East Asia & Pacific

Presentation Outline

1 Is Wind Energy a real energy alternative?

2 Economics

3 Technology

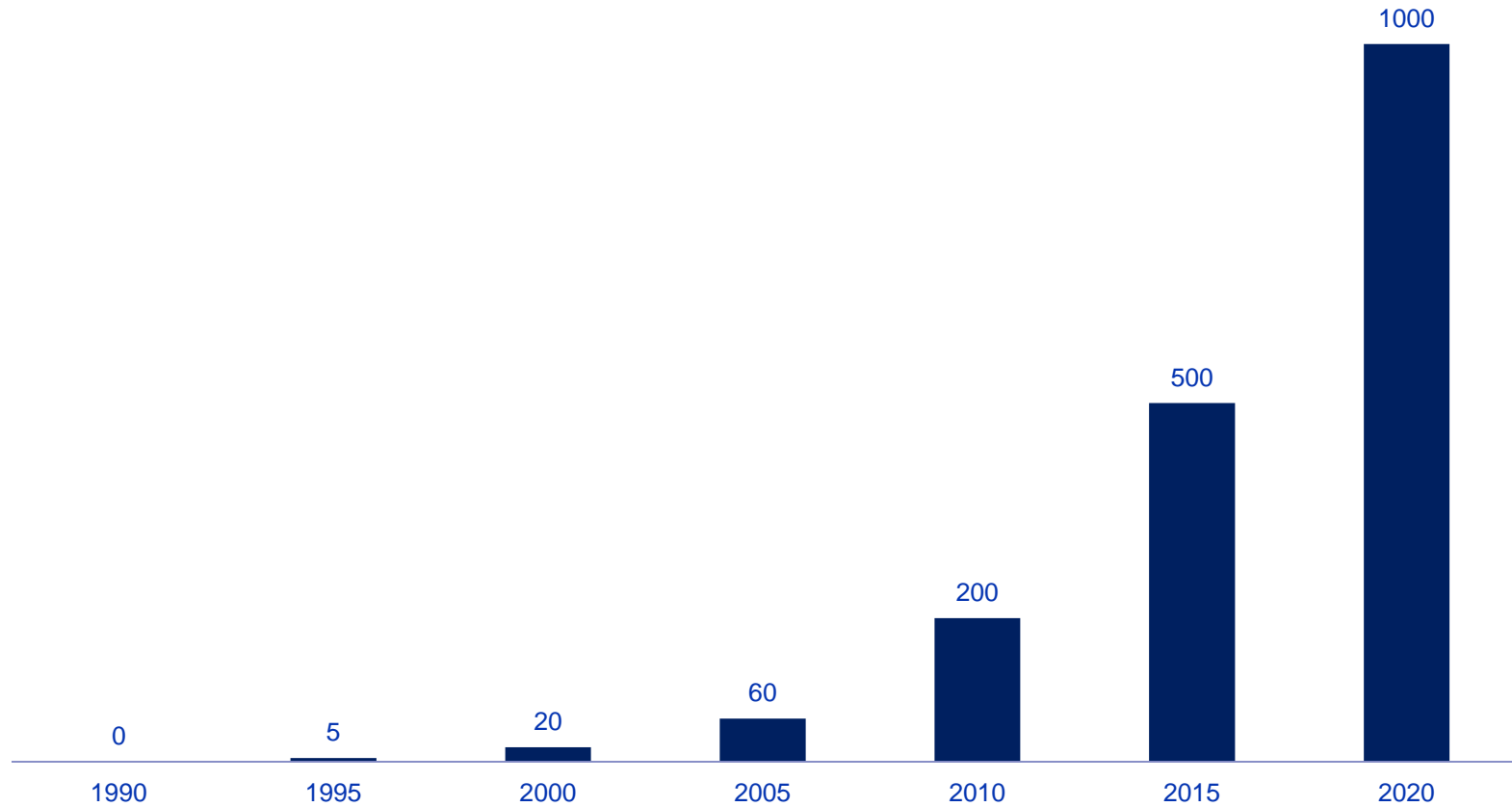
4 Risk

Presentation Outline

- 1 Is Wind Energy a real energy alternative?**
- 2 Economics
- 3 Technology
- 4 Risk



Installed Global Wind Capacity in GW



Why Wind Power?

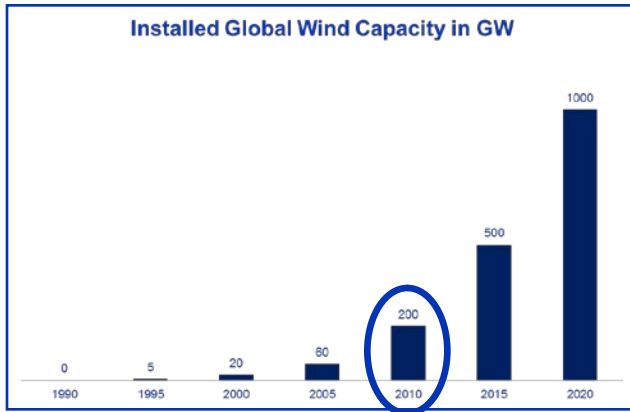
Climate Change Mitigation

Not enough Oil & Gas – Energy Security

Imminent pollution problems in China

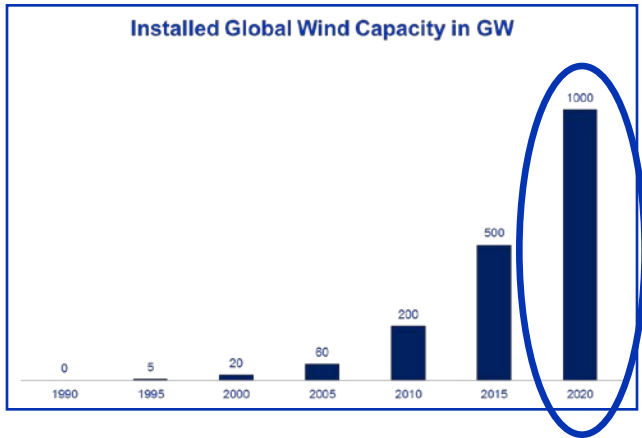
Fuel local economies.

What is 200 GW?

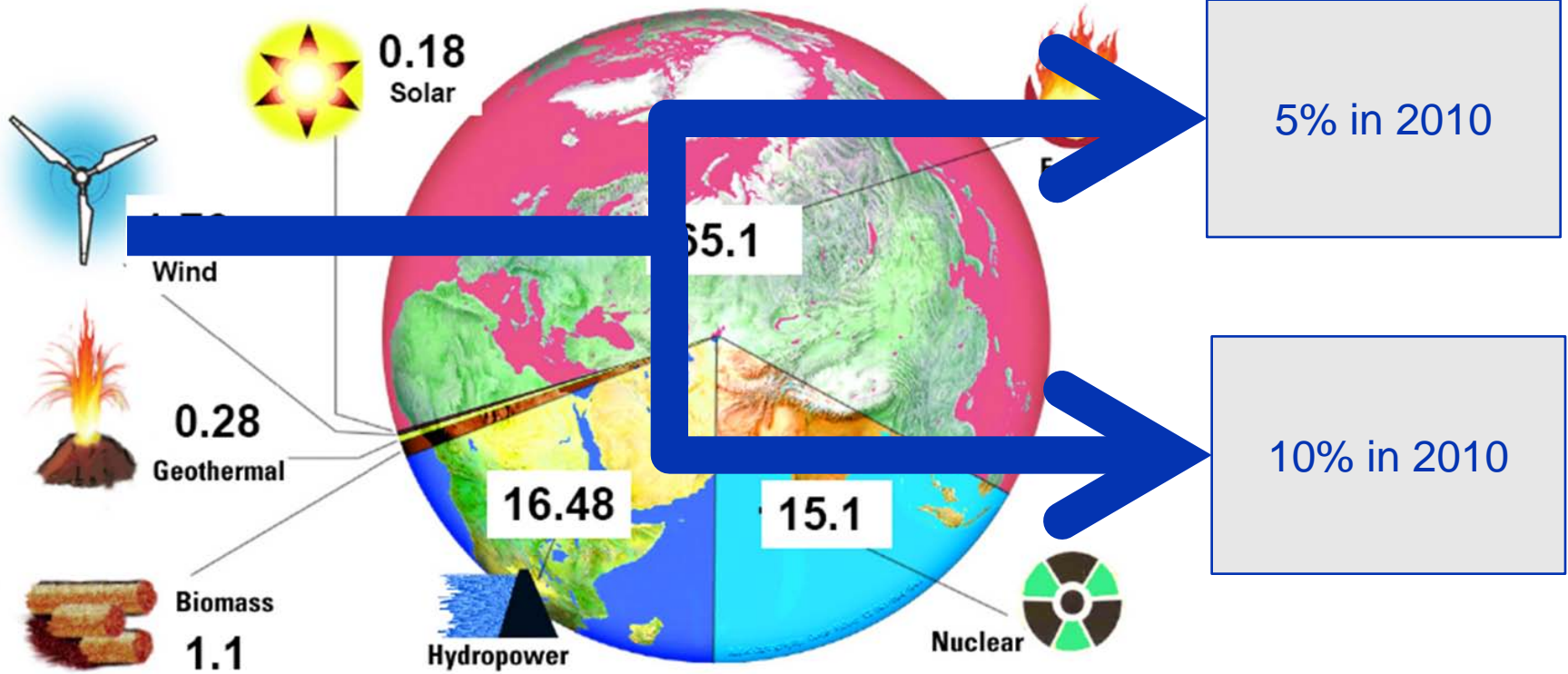


- 2% of worlds electricity demand
- 50% of Chinas Electricity Generation
- 70% of India's Electricity Generation
- 175,000 wind turbines

What is 1,000 GW?



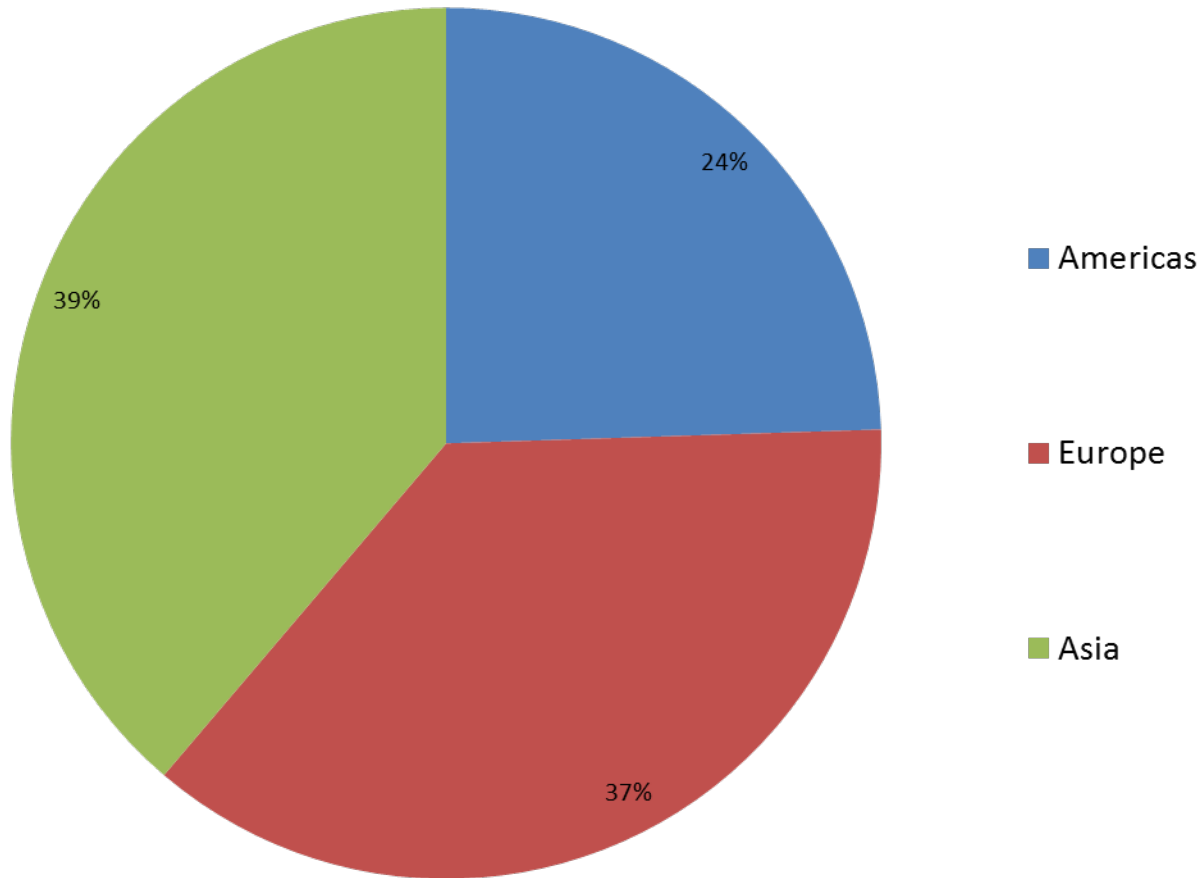
- 10% of worlds electricity demand
- 5% of worlds energy demand
 - 500,000 wind turbines



Sources: IHA/IEA,2006/REN21,2006



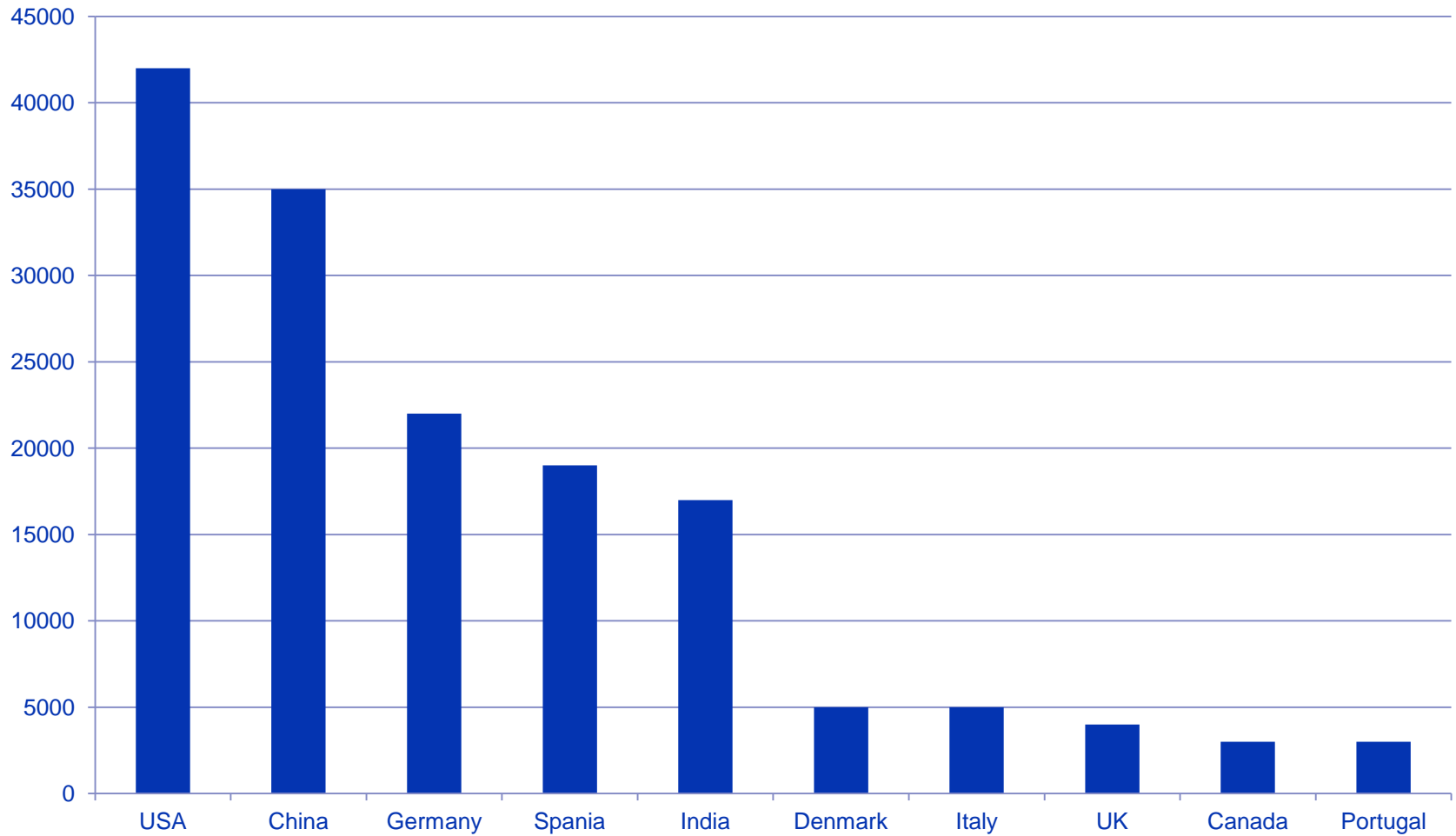
Installed Capacity per Market



Number of turbines



MANAGING RISK



Presentation Lay-Out

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Is Wind Energy a real energy alternative?

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Economics

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Risk

The economics of a 1.5 MW wind turbine

- Typical electricity market price: 0.2 USD per kWh
- 1.5 MW = 1500 kWh → 300 USD per hour

BUT

A wind turbine is running 20% average:

- 60 USD per hour/ 0.5 MUSD per year
- Cost is around 3.6 MUSD per MW
- Very low OPEX



Oil Well
40,000 \$/hour

Wind turbine
100 \$/hour

Singapore Taxi
50 \$/hour

5 Common Support Models

Feed-InTariff

Price premium

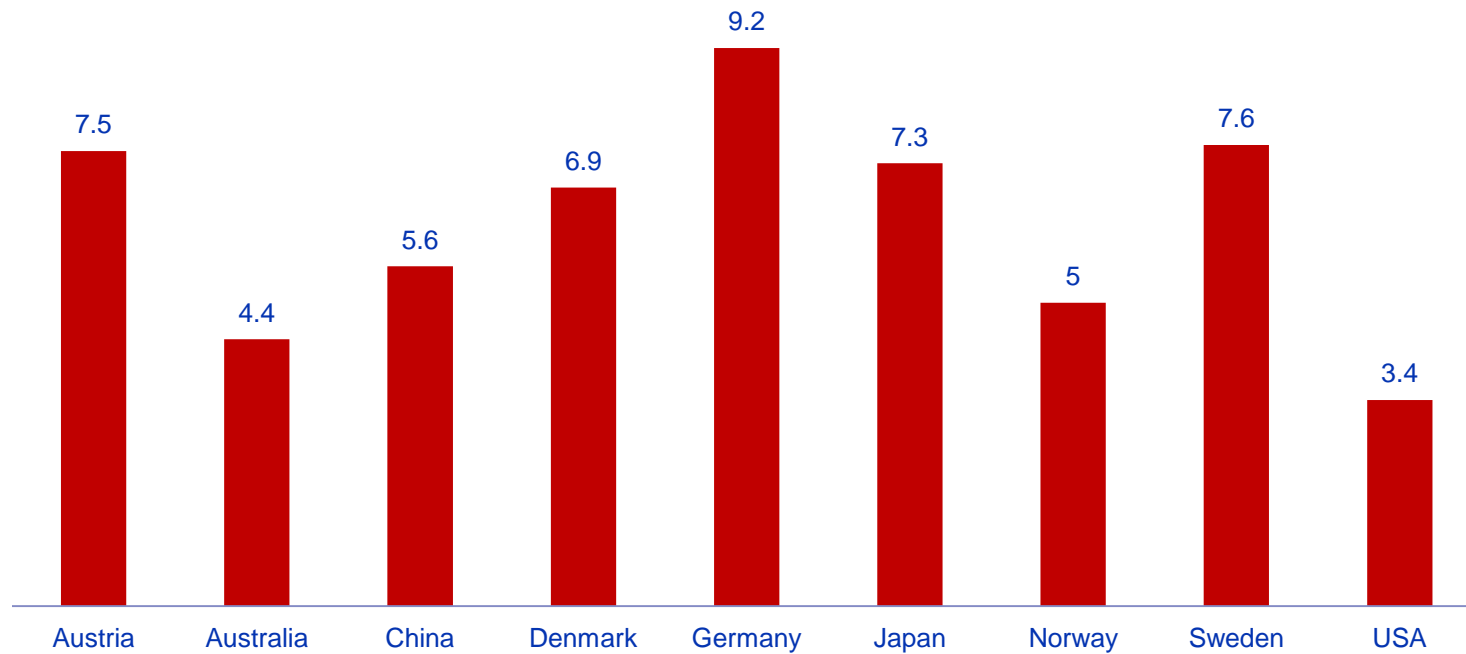
Energy Taxes

Investment Grants

Green Certificates

CDM

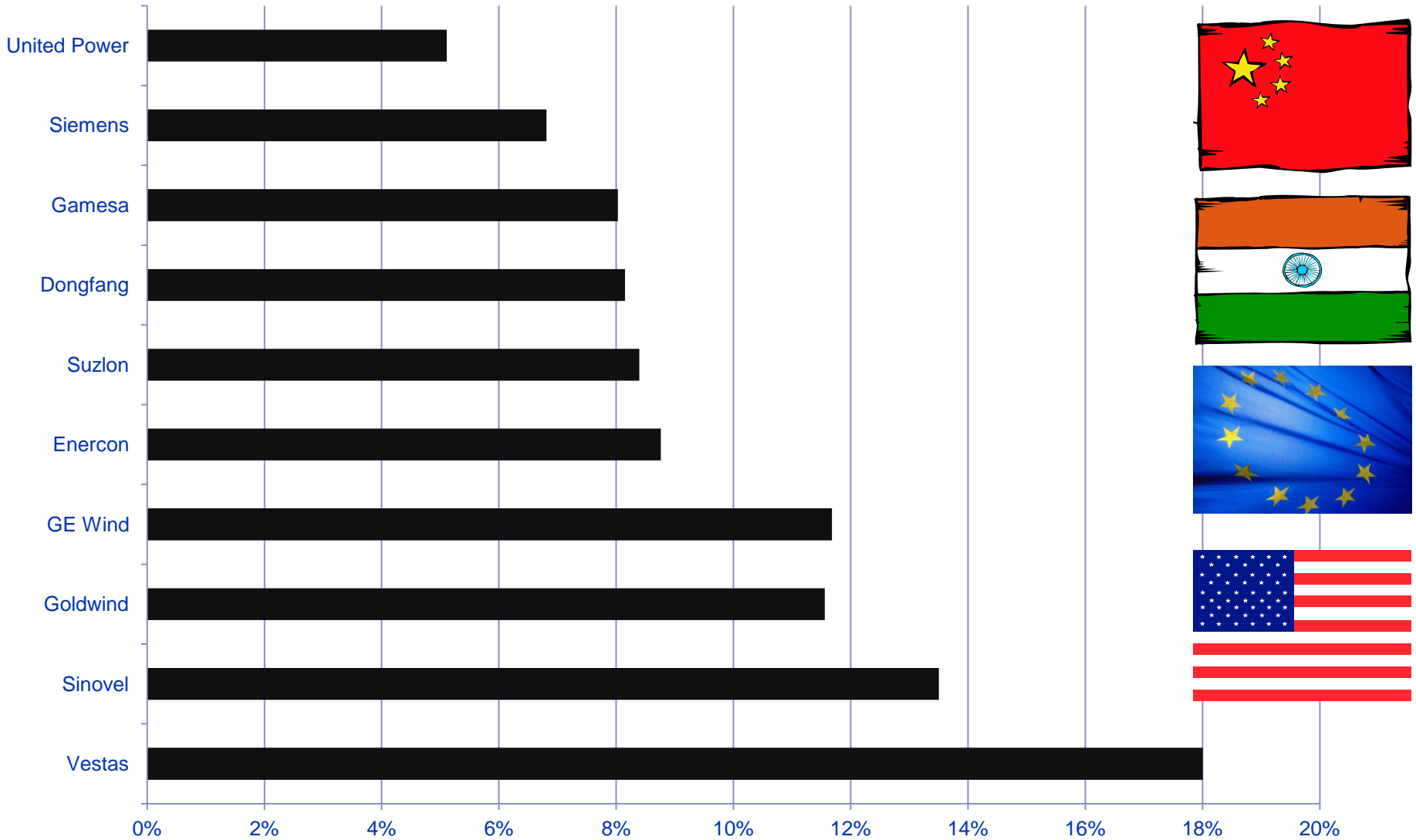
Feed In Tariffs in Selected Countries EuroCents per kWh



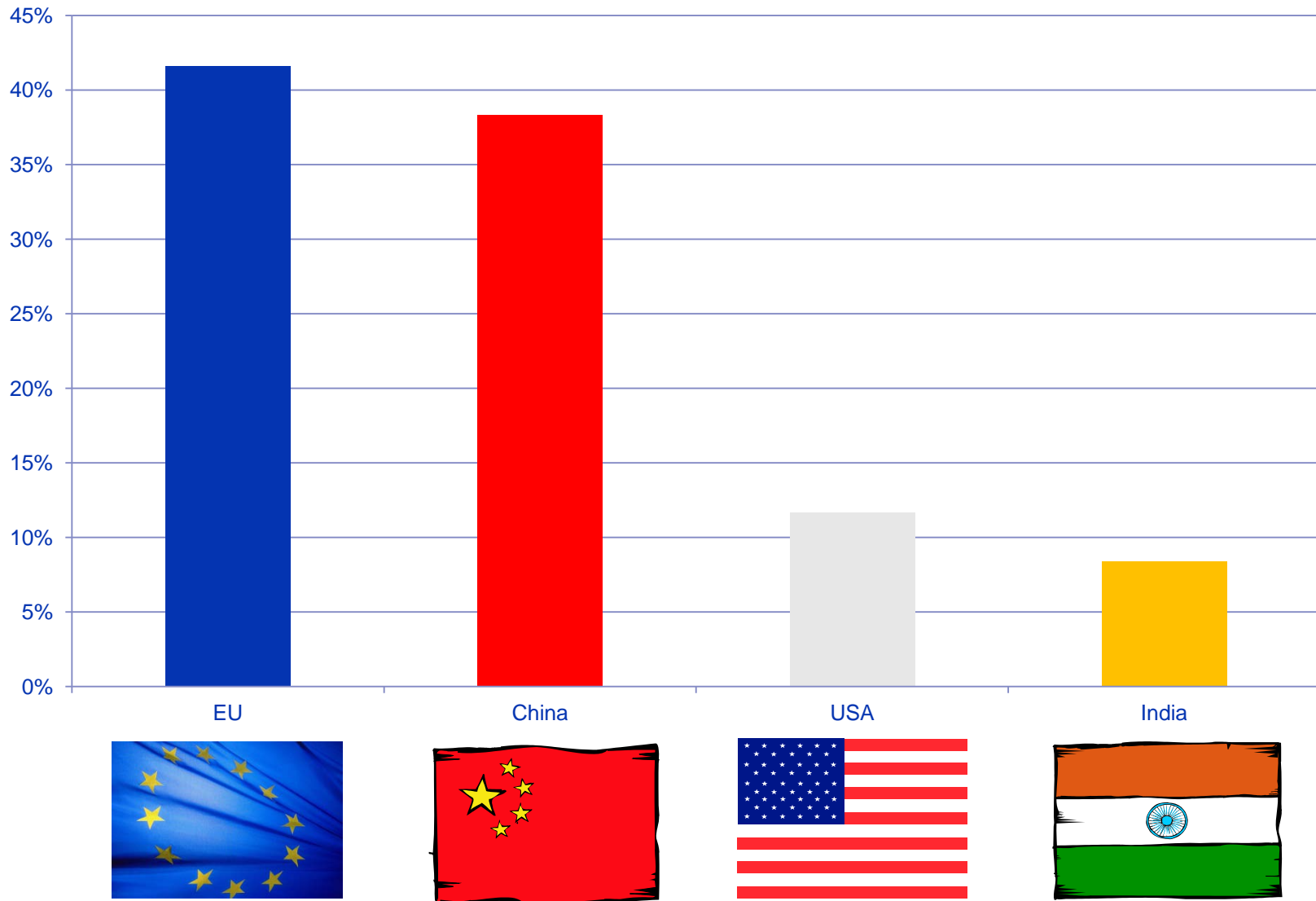
Manufacturing moving east



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Manufacturing



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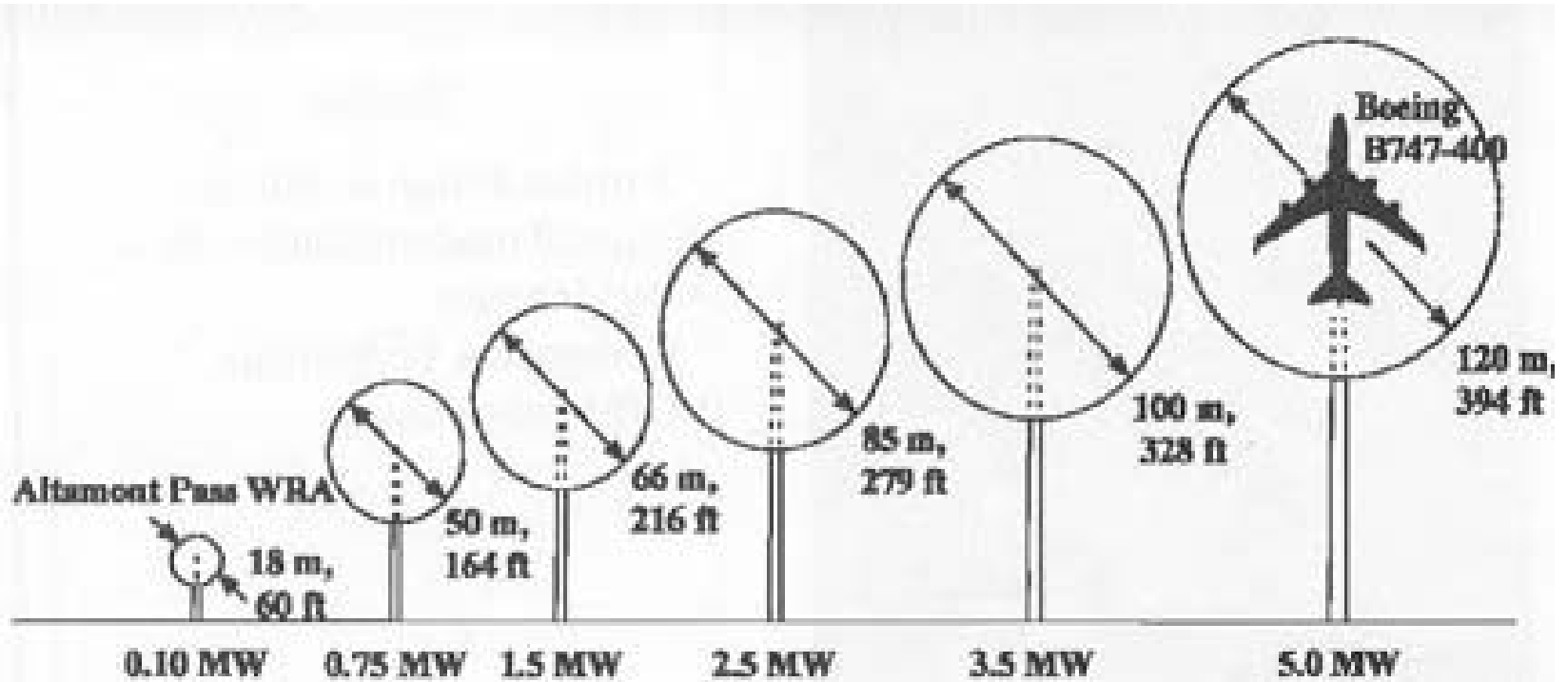
3

Technology

4

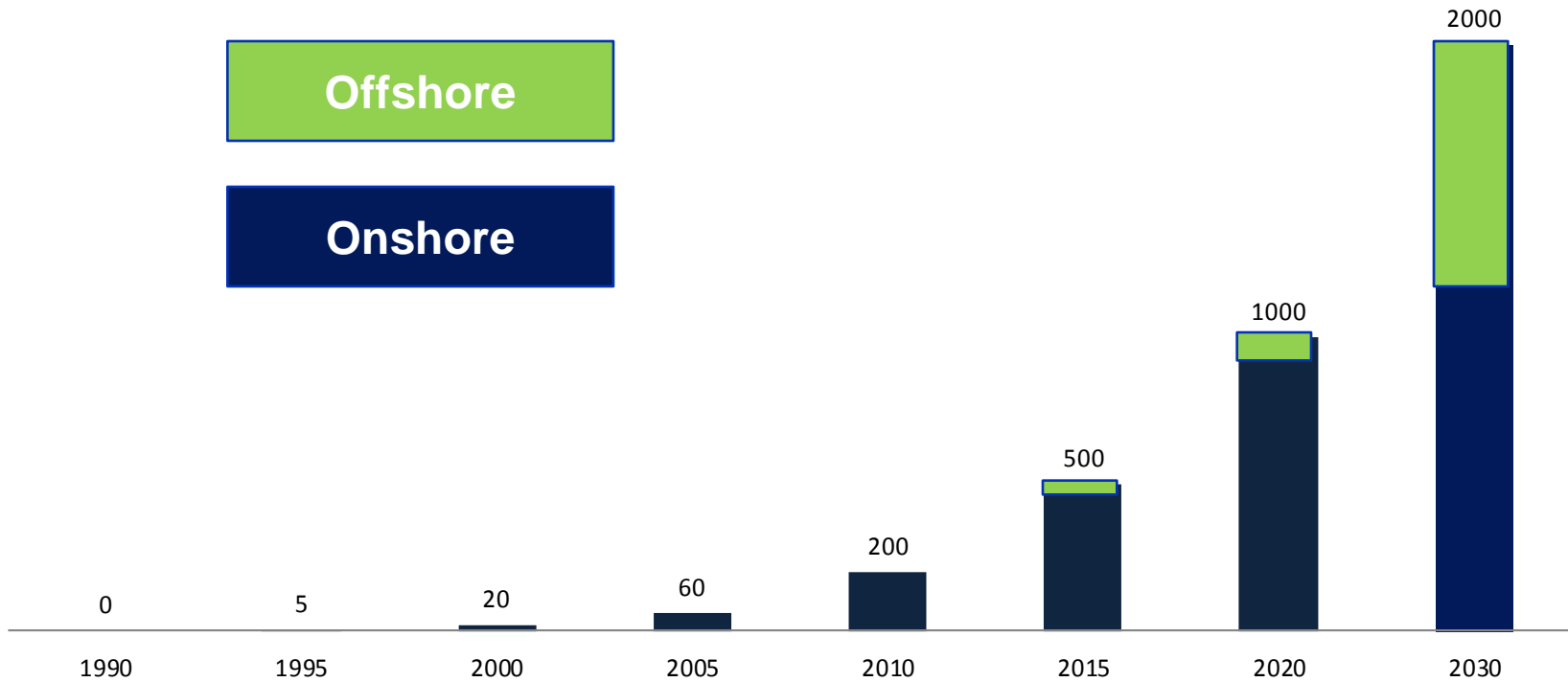
Risk

The turbines get bigger



□

Installed Global Wind Capacity in GW Moving Offshore



and they move offshore



Offshore wind – What is it?



Onshore Wind

+



Offshore oil & gas

=



Offshore wind

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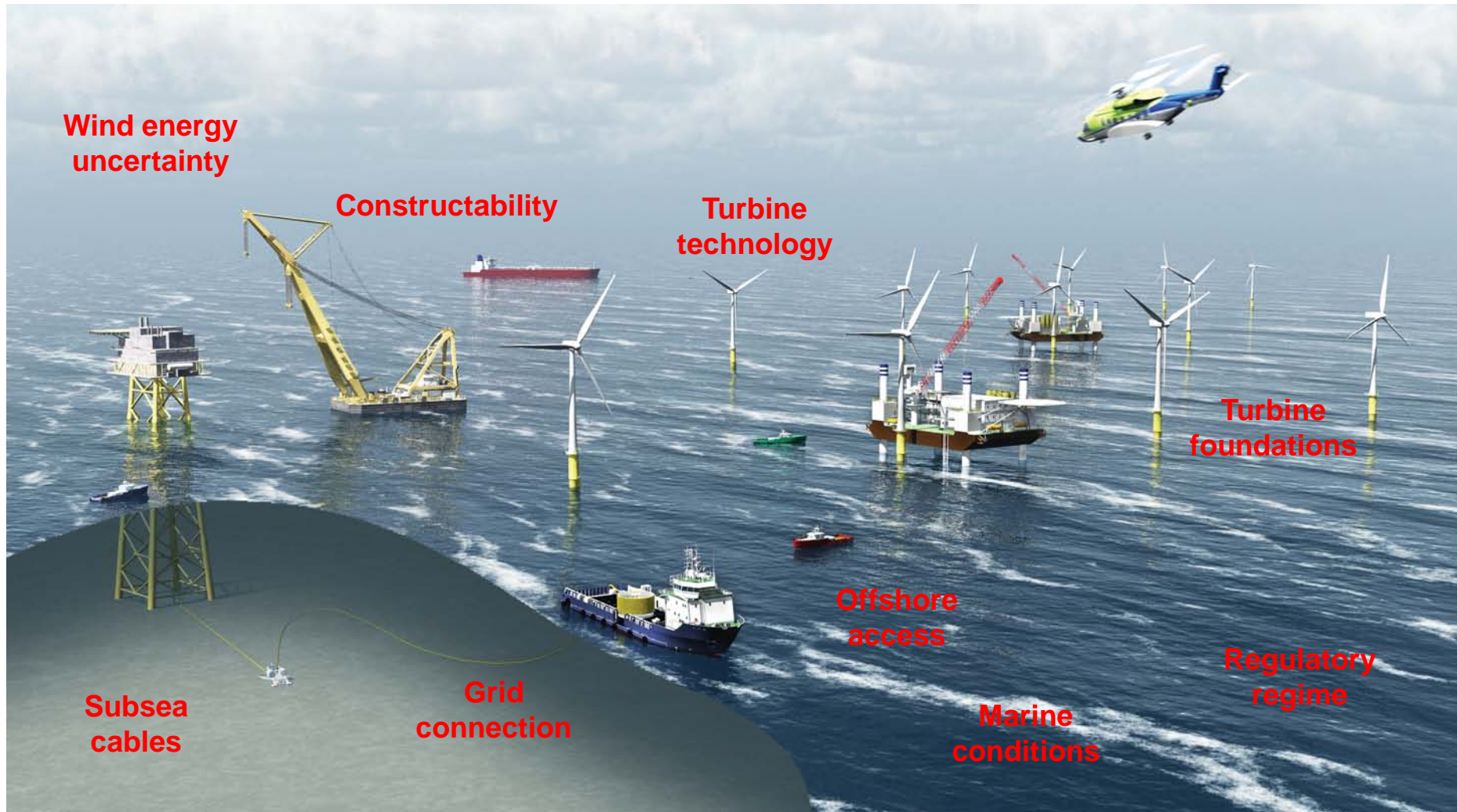
Typical Wind Project Risks

- Serial Failure
- Energy Production
- Site Conditions
- Permitting
- Schedule
- Quality
- Transmission/Interconnection



Major Risks in Offshore Wind Farms

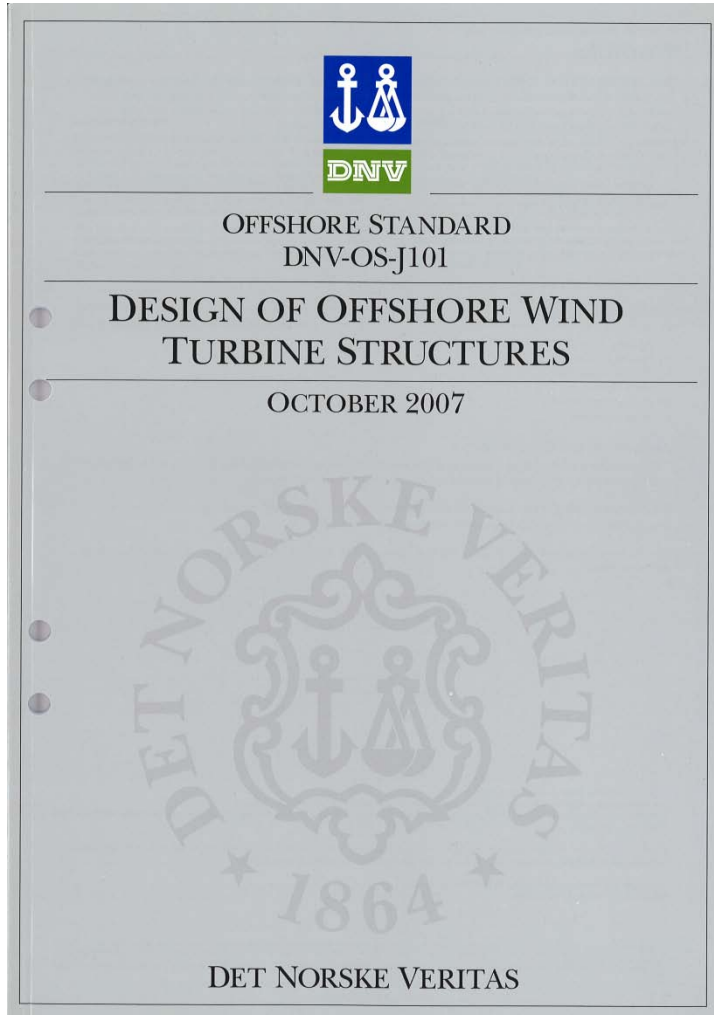
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Floating wind

- Japan
- Norway
- Deep water





Technical Risk Mitigation

- Turbine Certification
- Project Certification
- Wind Resource Assessment
- Grid Compatibility Assessment
- Due Diligence

5 Conclusions

- **10% of global electricity generation from wind by 2020**
 - **Dependent on financial support systems**
- **Turbines getting bigger and lighter to drive down unit cost per kWh**
 - **EU and China moving forward – USA sideways**
 - **Manufacturing moving to Asia**



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