The Link Between Land-based Reliability and Offshore Systems

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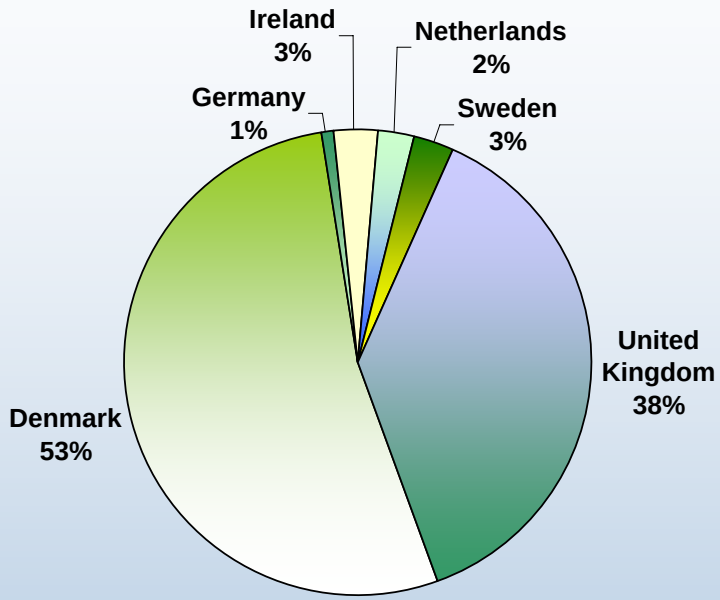
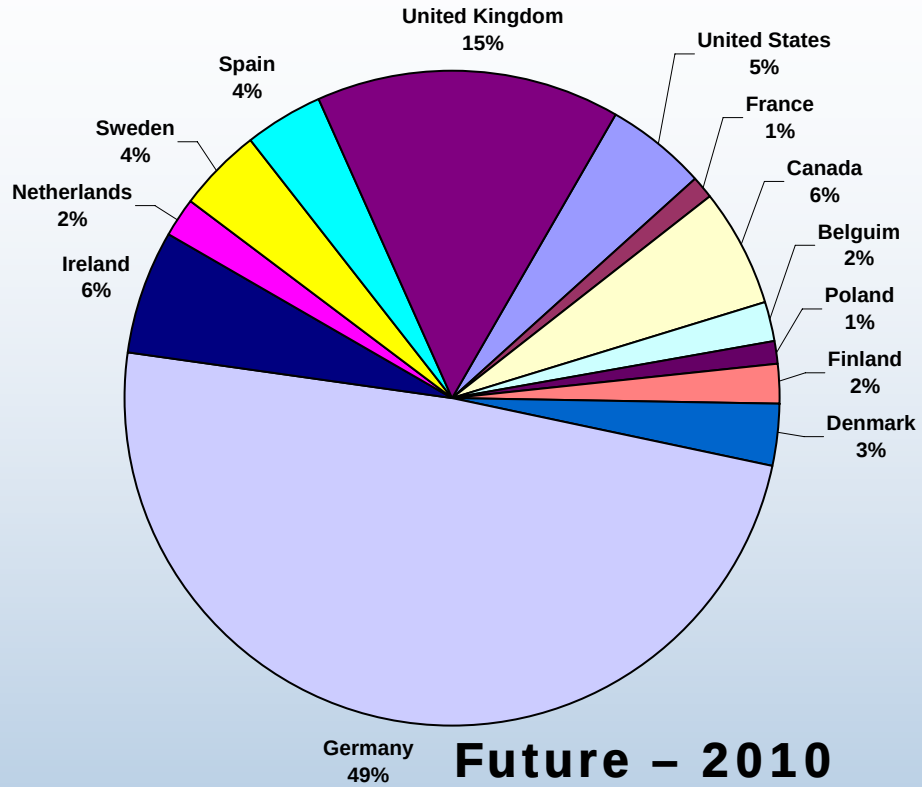
Status of Offshore Wind



Current -804-MW



Future – 2010

- Offshore 804-MW of 60,000 MW+ world-wide – less than 2%
- 11-GW+ offshore is projected for 2010
- Offshore has affected current land-based systems
- Offshore will continue to influence European markets.

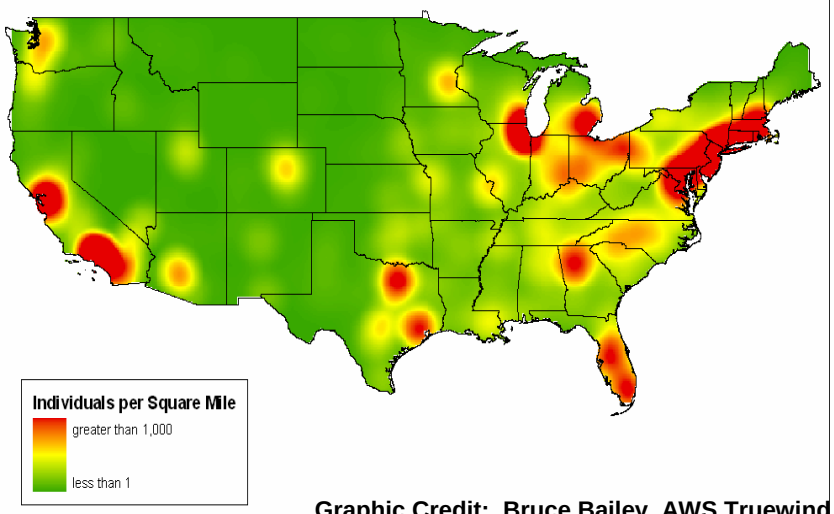
Why Offshore Wind ?

Land-based sites are not close to coastal load centers

Load centers are close to offshore wind sites

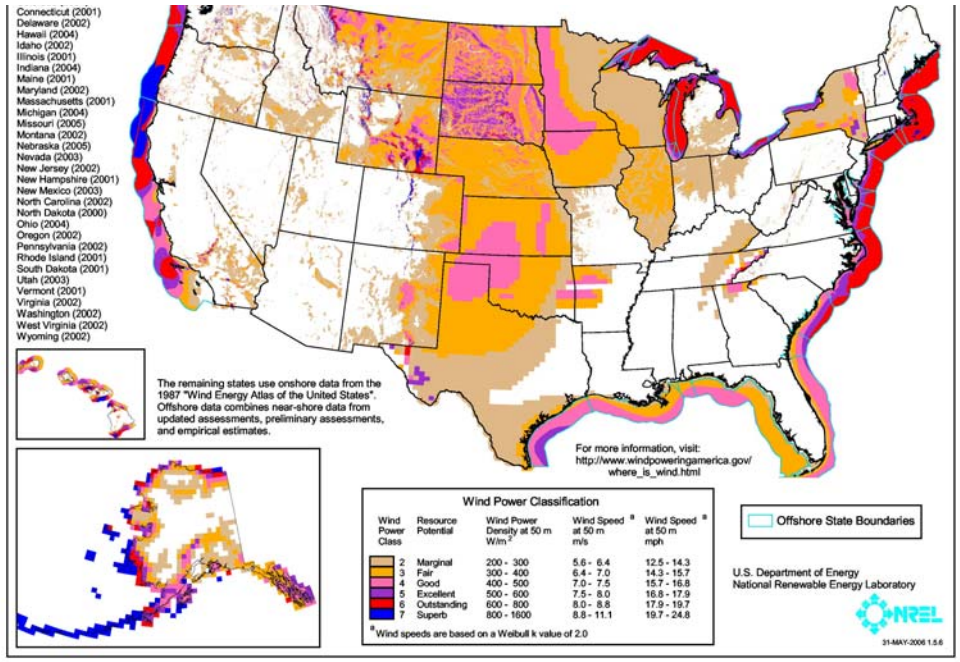
28 coastal states use 78% of the electricity in US

US Population Concentration



Graphic Credit: Bruce Bailey AWS Truewind

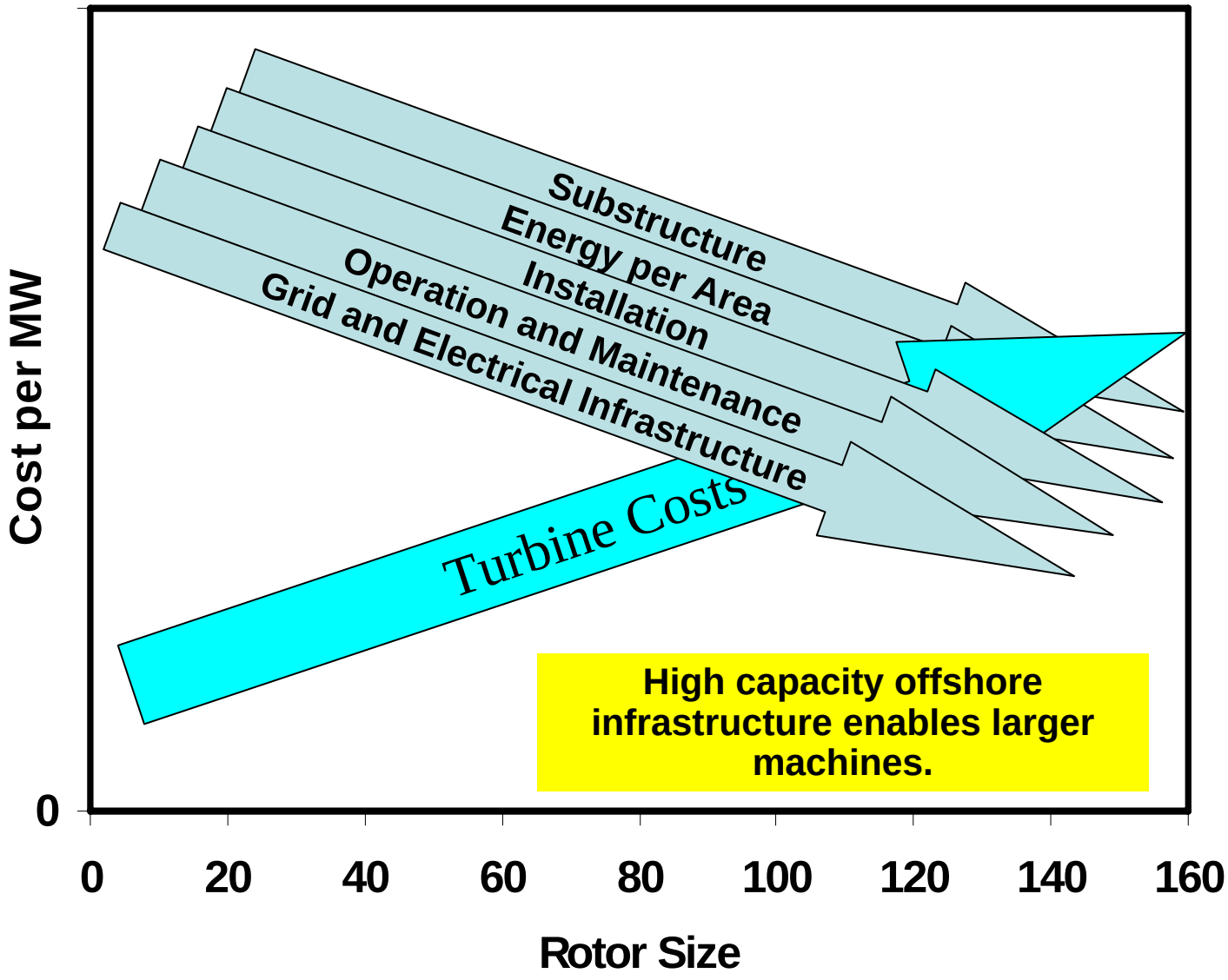
U.S. Wind Resource



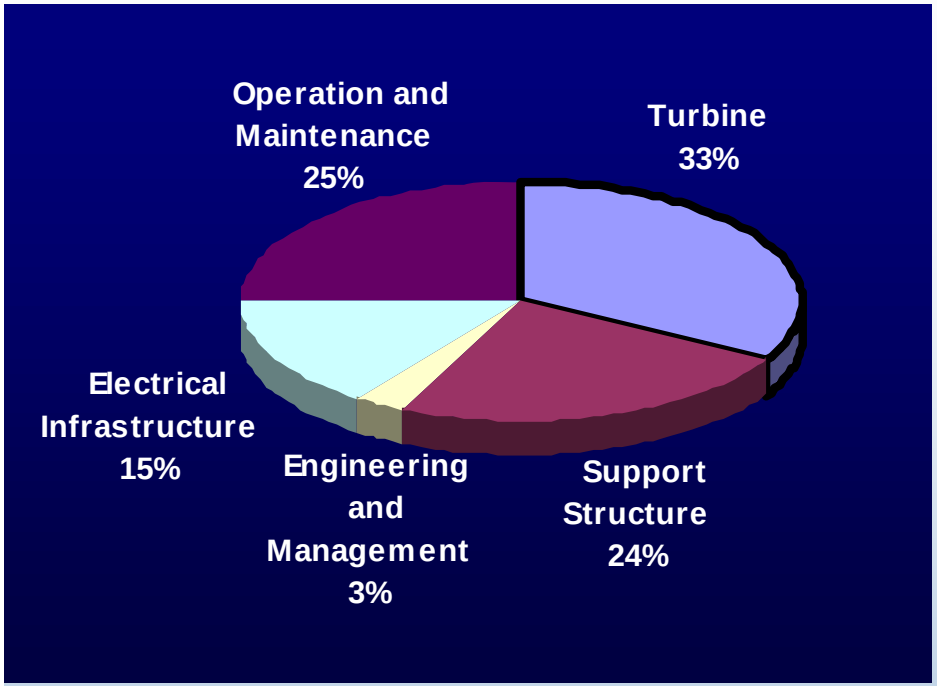
Offshore Maintenance Challenges

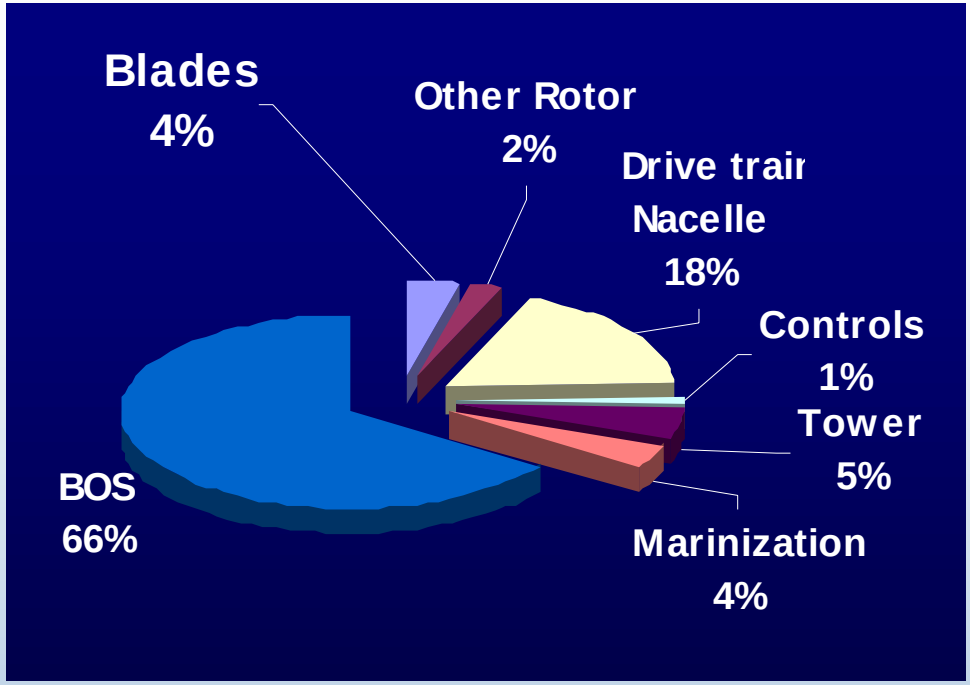
- Turbine size
- System Reliability – Minimize work at Sea
- Accessibility and Availability
- Weather windows - forecasting
- Testing and Validation

Why Are Offshore Turbines Getting Bigger?



Offshore Components Cost





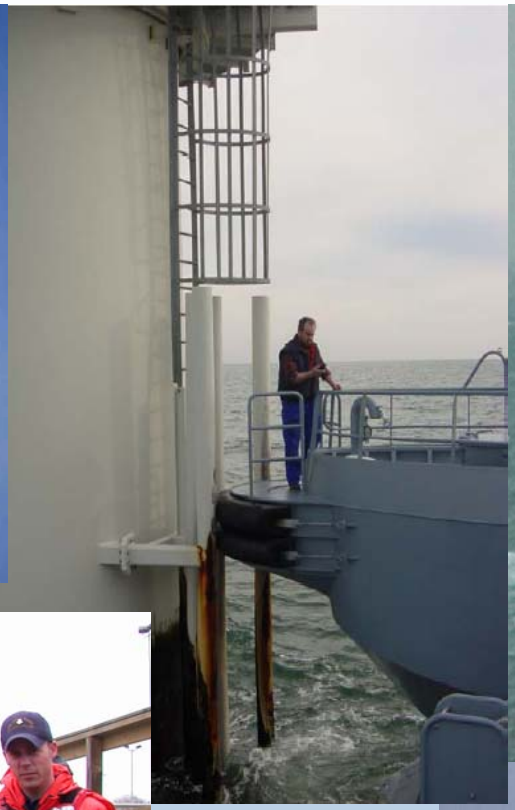
Cost of Energy

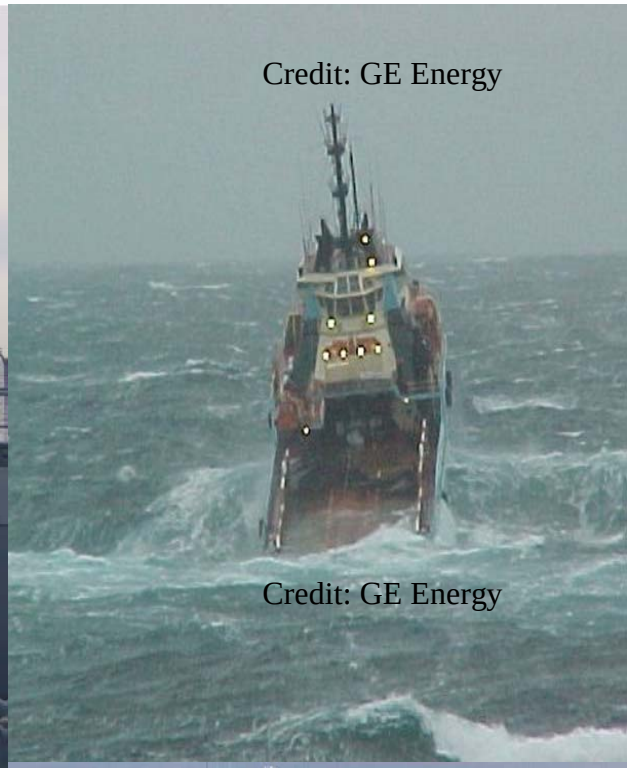
Can we afford to spend more on Turbine Systems such and condition monitoring, rotors, controls, etc?

Offshore Turbine Reliability

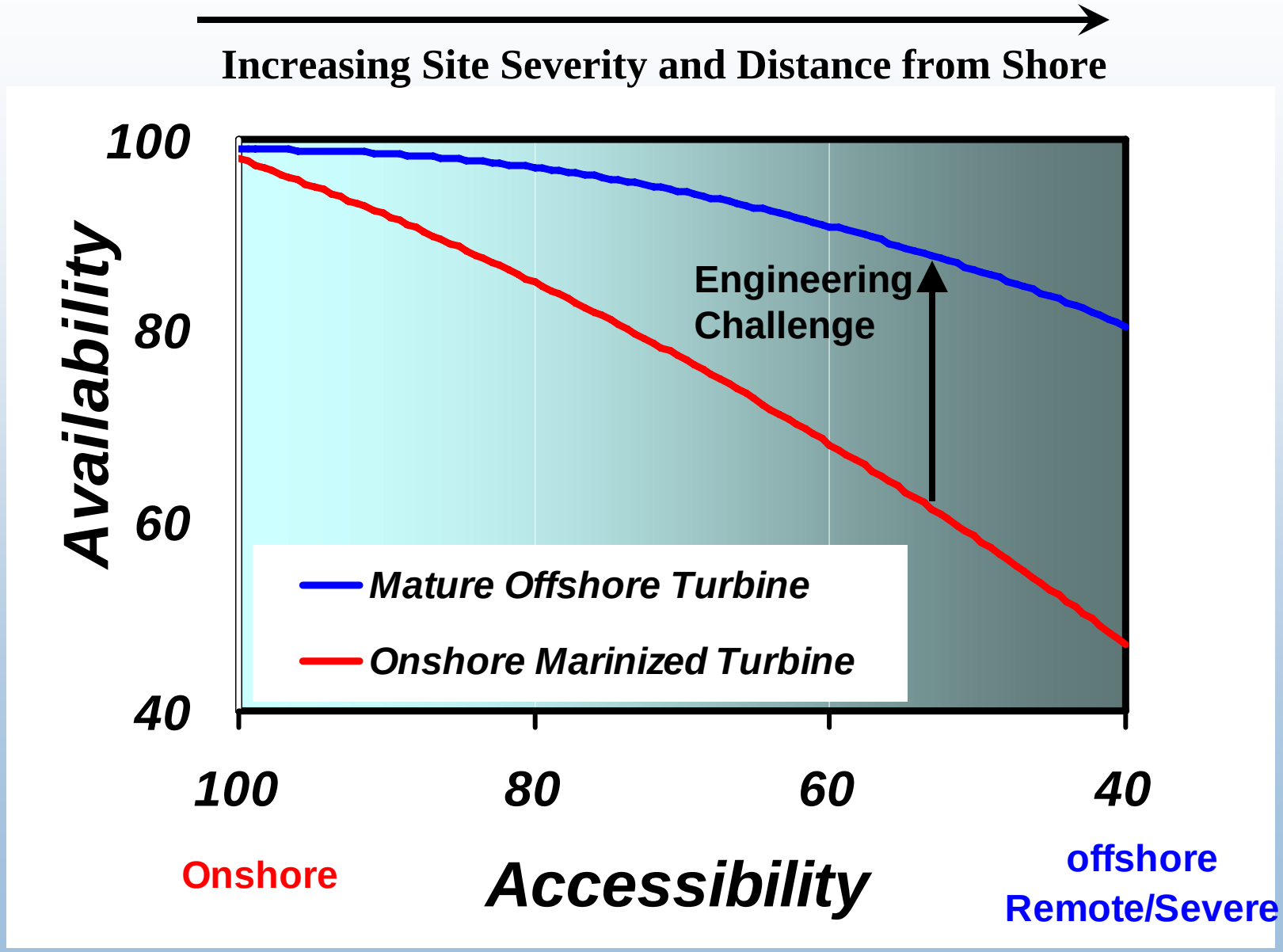
- Design turbines that need less maintenance.
- Design for in-situ repair –avoid the crane!
- Develop condition monitoring and advanced self-diagnostic systems to minimize collateral damage and down-time.

Offshore Turbine Access

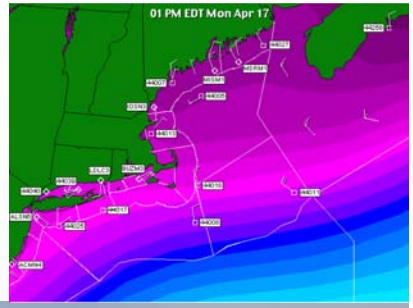




Offshore Turbine Availability



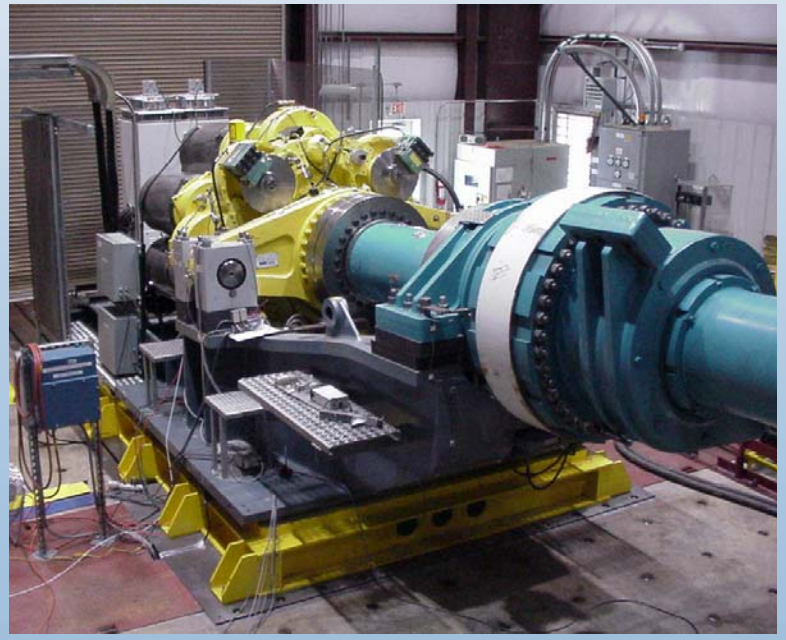
Weather Windows



- **Installation costs up to 20% of total project – Garrad-Hassan**
- **Large vessels cost $$$$**
- **Wider windows needed**
- **Reduced large vessel dependency**
- **Improve forecasting methods**

Reliability and Testing

- Full-scale Component Testing
  - Field deployment foolish without component verification – coupon to full-scale
  - Increased reliability requires more extensive testing
- Field testing – System verification land and sea
  - Baseline measurements for condition monitoring
  - Failure rates – parameter tuning



Summary

- European offshore turbine needs have contributed to new reliability push.

- Offshore requirements are bonuses for land-based turbines.
  - High Reliability Machines
  - In-situ repairs and service
  - Condition Monitoring
  - Wakes and arrays
  - Offshore wind resource assessment
  - Forecasting
  - Testing