American Concrete Institute®
Advancing concrete knowledge

Emerging Technologies in the Concrete Industry

ACI Fall 2012 Convention
October 21 – 24, Toronto, ON

ACI
WEB SESSIONS

Dr. Markus Wernli is a senior project manager at BergerABAM. He received his Ph.D. from the University of California in San Diego on applications of advanced composite materials for construction. During his 18 years of experience in civil engineering he has been focusing on the development of new technologies for the construction industry. Dr. Wernli has been involved in the development of advanced composite material applications; large floating concrete structures for ship berthing, storage, renewable energy, and military facilities; large cryogenic storage tanks made of precast concrete; accelerated bridge construction technologies in seismic regions; and tall concrete wind turbine towers. Dr. Wernli is the champion for the Accelerated Technology Implementation team for concrete wind turbine towers of the Strategic Development Council of the ACI Foundation. He shares a Robert J. Lyman Award from PCI and an ACI Construction Practice Award for his efforts on advancing the concrete industry.

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WEB SESSIONS

Concrete Wind Turbine Towers Opportunities and Road Blocks

Markus Wernli, PhD, PE
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The Opportunity

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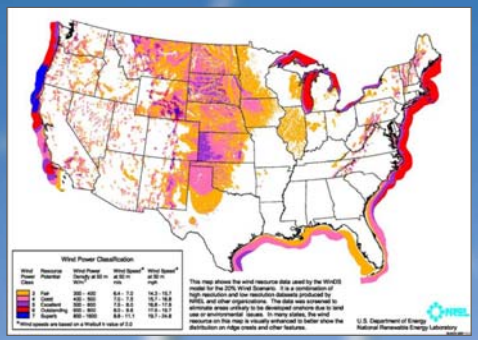
Where the Wind Blows



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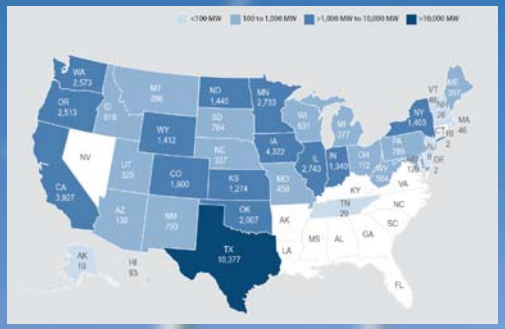
U.S. Wind Power Installations by State



AWEA Forth Quarter 2011 Market Report

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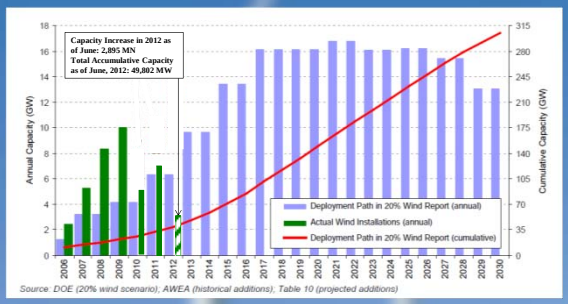
Potential Growth of Wind Industry



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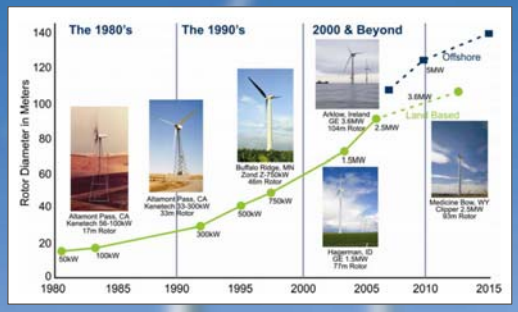
Development Path of Wind Turbines



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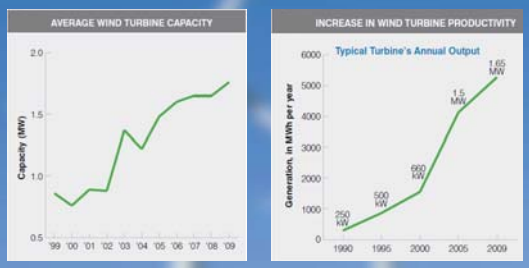
Performance Improvement of Wind Turbines



AWEA 2009 Annual Market Report

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Turning Point

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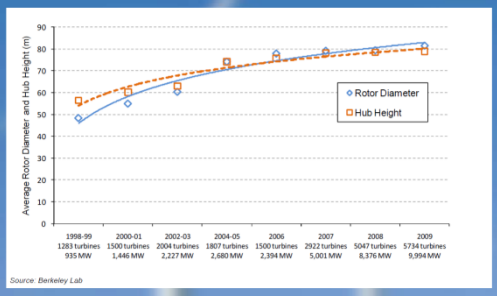
Development of Tower Height



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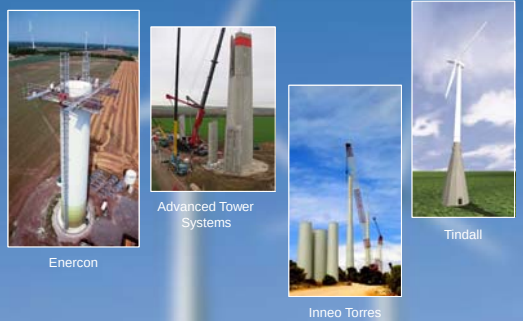
Current Proprietary Tower Systems on the Market



Enercon

Advanced Tower Systems

Inneo Torres

Tindall

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The Strategic Goal

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How to Build a New Industry

On April 25, 2012, the Strategic Development Council of the ACI Foundation identified Concrete for Wind Turbine Towers as an Industry Critical Technology

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Strategic Goal for the SDC

1. Concrete shall be a widespread used material for the construction of towers for wind turbines.
   - Competitive concrete tower component market
   - Market for technology providers selling/licensing proprietary tower system
2. The market condition shall foster innovation, fair competition, and an environment that leads to safe and reliable concrete towers.
   - Protection of public domain knowledge
   - Protection of proprietary systems
   - Providing a procedure for fast technology deployment
   - Certification of concrete contractors and precasters

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Benefits to the Concrete and Construction Industry

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Benefits to Other Stakeholders

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The Road Blocks

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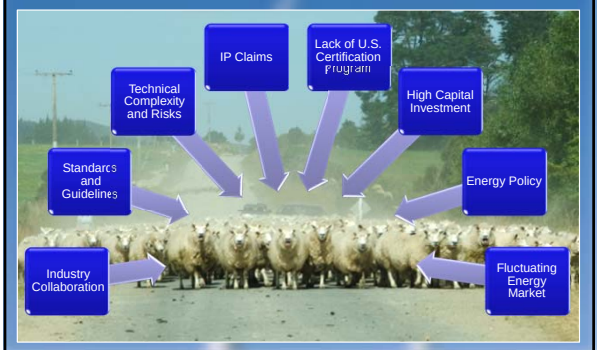
The Road Blocks



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The Deployment Plan

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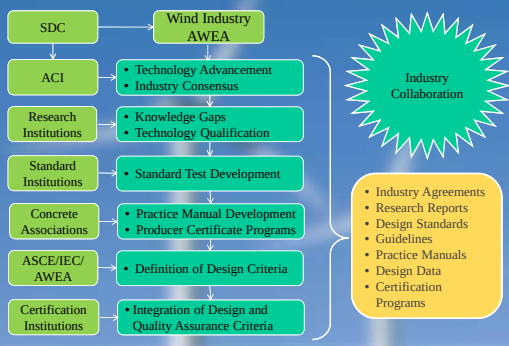
Potential Deployment Plan



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Initial Output

- State-of-the-Art and Risk Analysis Report for Turbine Towers Made of Concrete (FIB-TG 6.14)
- Definition of Concrete Tower Supply Chain (ACI/AWEA)
- Business Case for Turbine Towers Made of Concrete (ACI/PCI, NREL)
- Joint Industry Agreements on Intellectual Property (SDC/AWEA)

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Guidelines and Standards

- Guideline to the Design of Concrete and Concrete/Steel Hybrid Wind Turbine Towers with Sample Details and Design Examples (ACI)
- Several ASTM standards to address the heightened requirements on fatigue performance of construction materials (ASTM)
- Design Criteria and Load Assumptions for Wind Turbine Towers (ASCE/ICE/AWEA)
- Guideline to the Qualification of Concrete Components for Wind Turbine Towers (NIST, ICC-ES)
- Guideline to the Dynamic Characterization of Concrete Towers for Wind Turbines (NIST)

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Practice Manuals

- Manual of Practice for Standard Detailing for Wind Turbine Towers Made with Precast Concrete Elements (PCI)
- Manual of Practice for the Erection of Wind Turbine Towers Made with Precast Concrete Elements (PCI)
- Manual of Practice for the Construction of Cast-in-Place Concrete Towers for Wind Turbines (NRMCA)
- Quality Control Manual for the Construction of Concrete Towers for Wind Turbines (ACI)
- Quality Control Manual for the Fabrication and Erection of Wind Turbine Towers Made with Precast Concrete Elements (PCI)

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Industry Certification Programs

- Certification program for tower component precast plants (PCI)
- Certification program for tower concrete contractors (NRMCA)
- Certification program for concrete tower component erectors (PCI)
- Certification programs for proprietary components and details (ICC-ES)

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Conclusions

There are currently about 3000 turbines erected on steel towers annually, a $750 million industry for tower manufacturing alone

The concrete industry has to take a joint initiative if it wants to become a bigger contributor to the wind turbine tower market

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