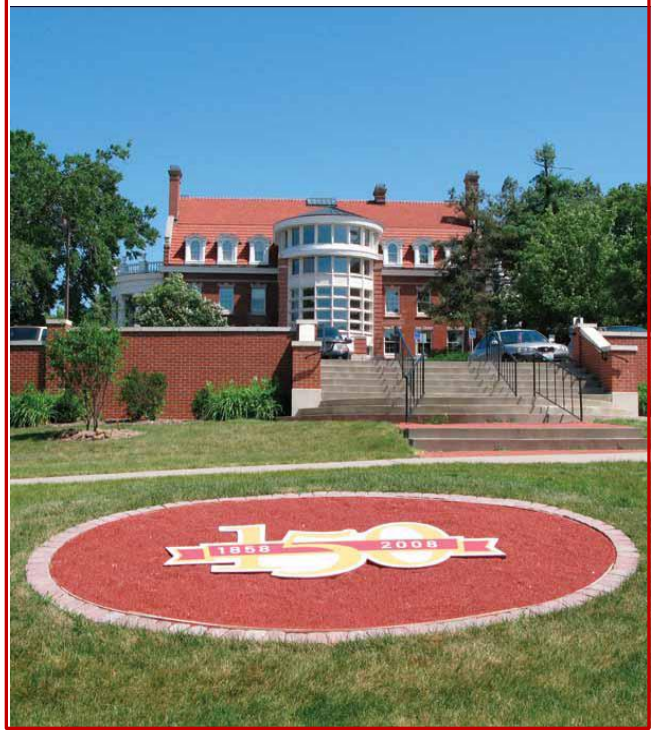
Our Campus


Minneapolis
Sioux Falls
Milwaukee
Chicago
AMES
Omaha
Quad Cities
Kansas City
St. Louis


150
150


Apply for Admission.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2008

Our College

- One of nation's top-ranked engineering colleges
- 2nd in the nation in R&D 100 awards
- 5th in the nation in patents (over 300)
- 12th in the nation in start-up companies launched from research

- Undergraduate Enrollment: 5000+
- Graduate Enrollment: 1012
- Degrees per year: 140 MS and 80 PhD
- Over 40,000 alums worldwide

- Fulltime faculty: 220+
- Research expenditure M$70+

Topics

- Wind Energy at ISU
- Research Laboratories and Facilities
- Educational Effort
- Wind Energy Institute
- Recent/Ongoing Research

Wind Energy Research and Education at ISU

- Activities have taken place for several years
- Interested/Participated ISU organizations include
  - COE – AE, ME, IMSE, ECpE, CCEE, Mat S, Atmos. Sciences
  - Ames Lab
  - Iowa Energy Center
  - Electric Power Research Center (EPRC)
  - Power Systems Engineering Research Center (PSERC)
  - Center for Nondestructive Evaluation (CNDE)
  - Institute for Transportation (InTrans)
  - Centers for Agricultural and Rural Development (CARD)
  - Agricultural Law and Taxation (CALT)
- Organized "Wind Energy Group" in 2008

Wind Energy Research at Iowa State University

Home
Research Projects
Research Capabilities
Research Centers and Labs
Undergraduate Research Experiences
Symposiums

News

January 14, 2009
Video: Highlights from First ISU Wind Energy Symposium

December 10, 2008
Iowa State drives green technologies with First ISU Wind Energy Symposium

Contact Information

Mike O'Donnell
Phone:
515 294-1588
E-mail:

2008 Wind Energy Symposium

On December 9, 2008, the College of Engineering hosted the **"1st ISU Wind Energy Symposium: Challenges and Opportunities"** in order to begin the work of drawing a road map that will better define Iowa State University's role in this rapidly evolving energy sector. In addition to representatives from the U.S. Department of Energy and the American Wind Energy Association, as well as industry leaders from John Deere, Siemens, Mid-American Energy, and Clipper Windpower, Iowa State research faculty led discussion panels on wind turbine systems, manufacturing and deployment, and infrastructure and delivery—all areas with developing or active research projects at Iowa State.

- Symposium Agenda
- Symposium Presentations
- Symposium Video

Research Competencies

AerE
ABE
CNDE
CCEE
CTRE
ECpE
IMSE
ME
MSE
CSI

Farm Site
Tower Design
Blade Design

Macro and Micro Siting
Generator & control design
System Integration
Vibration, Acoustics, Control, Design, Airflow, Efficiency

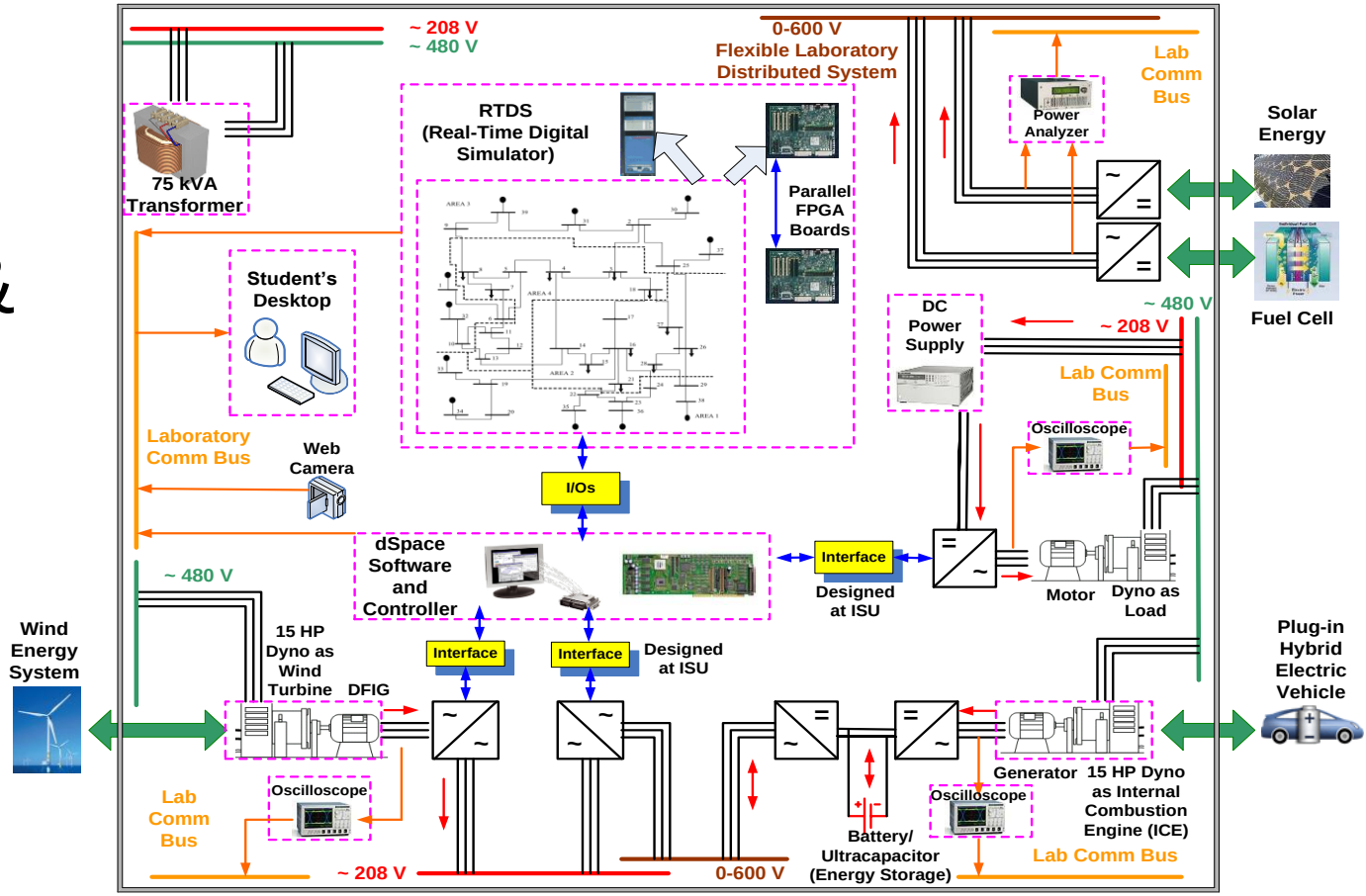
Grid Integration
Advanced Manufacturing
Seasonal Predictions

Composite Blade Design & Fabrication
Equipment Transport
Supply chain

Blade Ops/CFD
System Health Monitoring
Constr.
System Perform.
Repair
Maintenance

AEGIS Lab (Alternate Energy Grid Infrastructure & Systems (Aliprantis)

A multi-functional lab for research & education on "smart-grid" technologies



Wind Energy Manufacturing Laboratory

Mission: Advance the state of the art for producing wind turbine components Focus: Productivity, quality, cost, sustainability

Unique capabilities:

- Laser tracker for large scale metrology
- Laser scanner for measuring fabric placement
- Vistagy FiberSim software for composites mfg
- 2400 ft^2 facility

Current Research: Advanced Manufacturing Initiative

- Partnership with TPI Composites and Sandia Labs
- Manufacturing improvement of blade production
- Focus areas: fabric layup, finishing operations, NDE, automation solutions

tpi DELIVERING COMPOSITE SOLUTIONS

Sandia National Laboratories

Wind and Gust Tunnel

Micro Turbine Research

ISU Educational Activities

- REU on WESEP (Wind Energy, Science, Engineering & Policy)
- UG Wind Energy minor
- Wind energy-dedicated courses

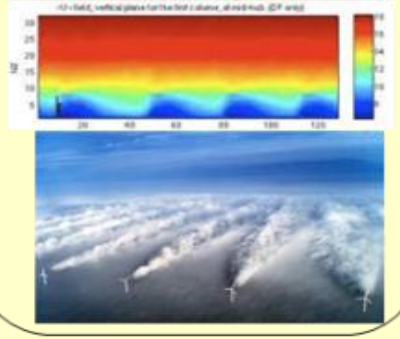
  Engr 340: Intro. to Wind Energy Science, Engr. and Policy
  EE 459/559: Electromechanical wind energy conversion and grid integration
  IE 443/543: Wind Energy Manufacturing
  AeroE 381: Introduction to Wind Energy
  AeroE 481: Advanced Wind Energy: Technology and Design
  MatSci 364: Materials for Wind Energy - Generation, Distribution, and Storage

- Annual 2-day short course on wind energy

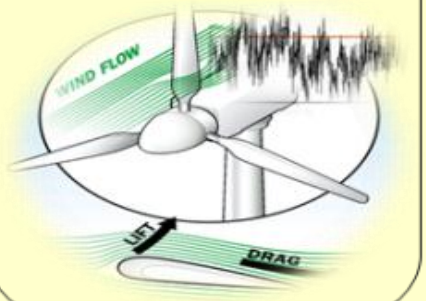
NSF IGERT Proposal

- Wind Energy Science, Engineering and Policy (WESEP)
- 20 faculty, 5 European institutions, 25 companies
- $3M
- 20 Domestic PhDs, 5 years
- 100 selected out of 412, and we were one.
- 20 to be selected out of 100, and we intend to be one ☺

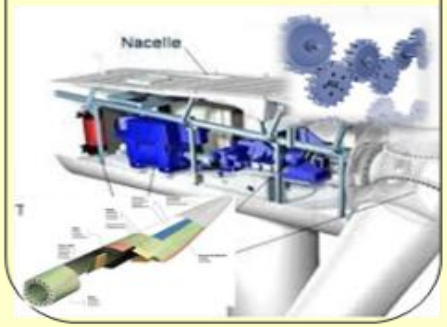
TA1: Meteorology, Siting, Characterization, Prediction



TA2: Aerodynamics, loads, Control and Design, Noise



TA3:Blade, Gearbox, Drivetrain



TA4:Tower, Foundation & Construction

Wind Energy Institute

MTS

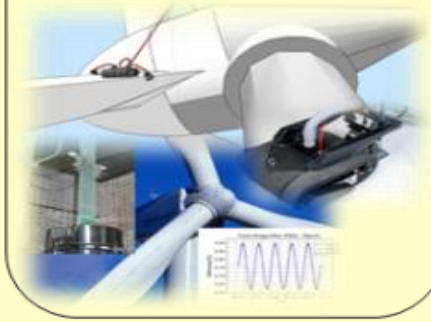
UST

OST

TA5: Materials, Manufacturing, Supply Chain, Transportation

TA6: Transmission, Storage, Integration, Electrical Systems

TA7: Reliability, NDE



TA8: Social Acceptance, Policy, Legal, Avian

IOWA STATE UNIVERSITY

Name, Affiliation & Title	Major Role including leads for Thrust Areas (TA)
ISU Core Members	
Sri Sritharan, **CCEE** Wilson Engineering Professor	**TA4**: **Tower and foundation design, and construction**; Team Lead for WEI
Eugene Takle*, **GE-AT, AGRON** Professor & Director of **CSP**	**TA1: Meteorology, siting, resource characterization, & prediction;** Program coordinator for off-shore turbines
Ganesh Rajagopalan, **AeroE** Professor	**TA2: Aerodynamics, structural loads, control, and noise**; Program lead for midsize standalone turbine systems
Frank Peters, **IMSE** Associate Professor	**TA5: Materials, manufacturing, supply chain and transportation**; Program lead for utility-scale turbines;
James McCalley, **ECpE** Harpole Professor	**TA6: Transmission, storage, grid integration, day-ahead and real-time electricity markets, generators and converters**
Lisa Brasche*, **CNDE** Associate Director	**TA7: Reliability and nondestructive evaluation**; Coordinate interactions with partners and funding agencies
Raj Aggarwal, **ECpE** Adjunct Professor	Business development: identify major opportunities, contribute to proposal formulation, and provide systems design expertise
Core Members from Partnering Institutions	
Robert Lindyberg; **University of Maine;** Asst. Director	Program lead for off-shore turbines; collaborator representing DeepCwind (http://www.deepcwind.org/)
Daniel Laird, **Sandia National Lab**; Manager	**TA3: Blade, gearbox, and drivetrain;** collaborator representing Sandia's wind power technologies (http://windpower.sandia.gov/index.htm)
Soji Adelaja, **Michigan State University (MSU)**; Dist. Professor	**TA8: Social Acceptance, policy, legal, and ecology;** represents Renewable Energy Policy Program (http://www.landpolicy.msu.edu/)

Associate WEI Members

- **Ames Lab**: Alex King, Director (5); Iver Anderson, Sr. Metallurgist (5); **AeroE: Vinay** Dayal, Assoc. Prof. (3,5,7); Par**tha Sarkar, Prof. (3); Peter Sherman, Assoc. Prof. (2); Ames Lab**: Alex King, Director (5); Iver Anderson, Sr. Metallurgist (5); **AeroE: Vinay** Dayal, Assoc. Prof. (3,5,7); Par**tha Sarkar, Prof. (3); Peter Sherman, Assoc. Prof. (2); CCEE**: Jeramy Ashlock, Asst. Prof. (4); Jennifer Shane, Asst. Prof. (4); Konstantina Gkritza, Asst. Prof. (5); **ECpE**: Dionysios Aliprantis, Asst. Prof. (3,6); Venkataramana Ajjarapu, Nicholas Prof. (6); Nicola Elia, Assoc. Prof. (6); **IMSE**: John Jackman, Assoc. Prof. (5); Matthew Frank, Assoc. Prof. (4,5) Lizhi Wang, Asst. Prof. (6); **MSE**: Scott Chumbley, Prof. (4,5,7); Michael Kessler, Assoc. Prof. (5); Alan Russell, Prof.(5); **ME**: Erin MacDonald, Asst. Prof. (8); Sriram Sundararajan, Assoc. Prof. (2,5); **Animal Sciences**: Mark Honeyman, Prof. (1); **Supply Chain Management**: Michael Crum, DeVries Endowed Chair (5); Jennifer Blackhurst, Assoc. Prof (5); **Economics**: James Bushnell, Assoc. Prof. & Cargill Chair (8); Chad Hart, Asst. Prof. (8) Leigh Tesfatsion, Prof. (6); **Atm.Sci: William Gallus*, Prof. (1); Statistics**: William Meeker, Dist. Prof. (7); **U of Colorado & NREL**: **Julie** Lundquist, Asst. Prof. (1); **U of Iowa**: Kyung Choi, Prof. (2); **U of Northern Iowa**: Reg Pecan, Prof. (2); **U of Wyoming**: Jay Sitaraman, Asst. Prof. (2); **Denmark Technical University (DTU)**: Henrik Madsen, Prof. (1)); **University College Dublin**: Mark O'Malley, Prof. (6).

Ames Laboratory Wind Program

K.M. Bryden, Program Manager (kmbryden@ameslab.gov)
E.S. Takle (gstakle@iastate.edu)
W.A. Gallus (wgallus@iastate.edu)

Objectives:

Improve wind forecasts and understand turbine-crop interactions under multiple land use in the Central US

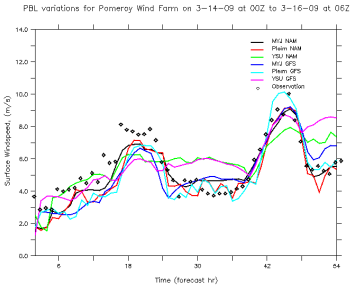
Approach:

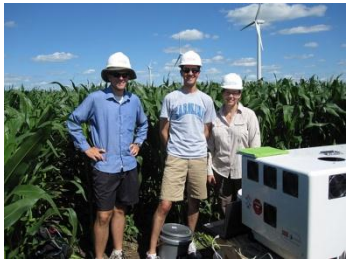
Measure surface fluxes of heat, momentum, moisture, CO2 over crops; measure surface-layer stability and low-level jet characteristics

Major Accomplishments:

Creation of ensemble forecasts

Successful flux and wind profile field campaign with CU/NREL (J Lundquist) team July 2010





Funding Sources:

DOE Wind and Hydropower Technologies Program

National Science Foundation

MidAmerican Energy Company

Center for Global and Regional Environmental Research (U Iowa)

Ames Lab Royalty Funding

Top and bottom photos: Lundquist group, Dept. of Atmospheric and Oceanic Sciences, University of Colorado

IOWA STATE UNIVERSITY

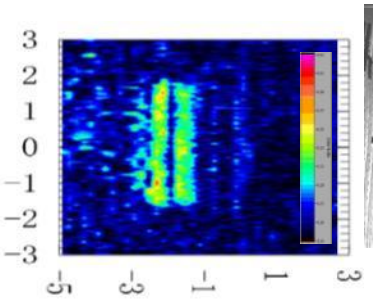
Advanced Manufacturing Innovation Initiative (AMII)

Matt Frank, Frank Peters, Vinay Dayal, John Jackman

mfrank@iastate.edu , fpeters@iastate.edu, vdayal@iastate.edu, jkj@iastate.edu

Objectives:

- Increase throughput for blade manufacturing by 35%
- Improve reliability through process control and NDE



- Test mold to study fabric placement
- Induced waves through multiple fabric layers
- Measurement method for analyzing individual tows

Approach:

- Analyze current wind blade manufacturing methods
- Develop process control and automaton technologies for:
  - Fabric placement
  - Blade assembly
  - NDE

Major Accomplishments:

- Measurement and control of dry fabric placement
- Process control of wind blade assembly
- Non contact UT solutions

Funding source: Iowa Power Fund; TPI Composites; DOE

Period of performance: 7/2009-5/2012

Low-Frequency Transmission for Wind Farm Power

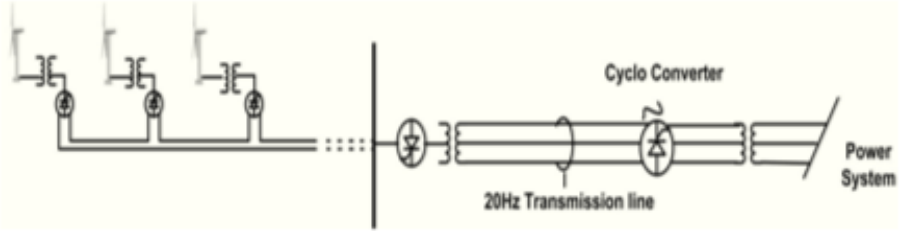
PI(s): Dionysios Aliprantis, dali@iastate.edu, (Iowa State)
Sakis Meliopoulos, a.meliopoulos@ece.gatech.edu (Georgia Tech)

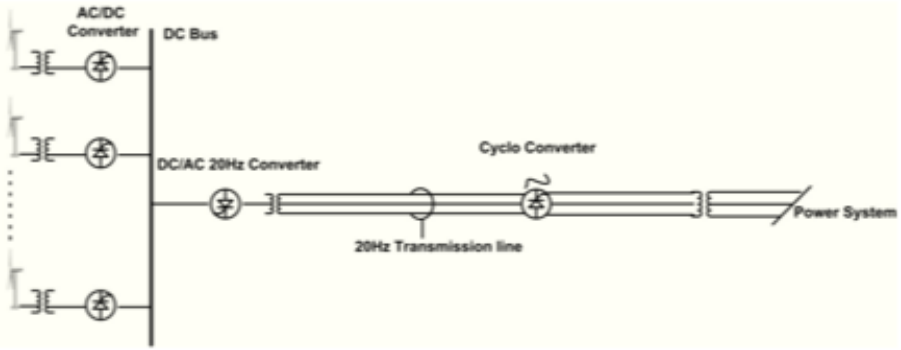
Objectives:

- Evaluate alternative transmission systems from remote wind farms to the main grid using low-frequency AC technology (20 Hz)

Approach:

- Compare technical and economic performance of low-frequency AC transmission technology to HVDC transmission (including HVDC Light) and conventional AC transmission



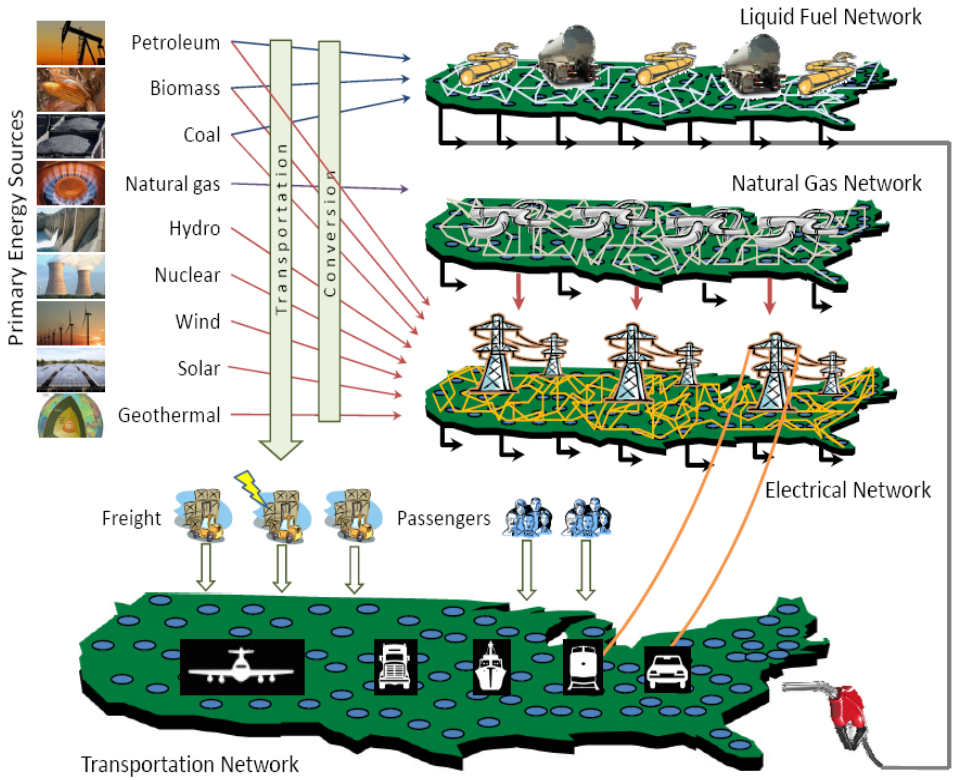


Funding source: PSERC
Period of performance: 2010–2012

NETSCORE21: 21st Century National Energy and Transportation Infrastructures: Balancing Sustainability, Costs, & Resiliency

PI: J. McCalley, jdm@iastate.edu, Funded by NSF, $2M, '08-'12

OBJECTIVE: Develop computational process and related software system to identify 40-year national investment plans for energy and transportation infrastructures to optimize cost, sustainability and resiliency.



APPROACH: We employ

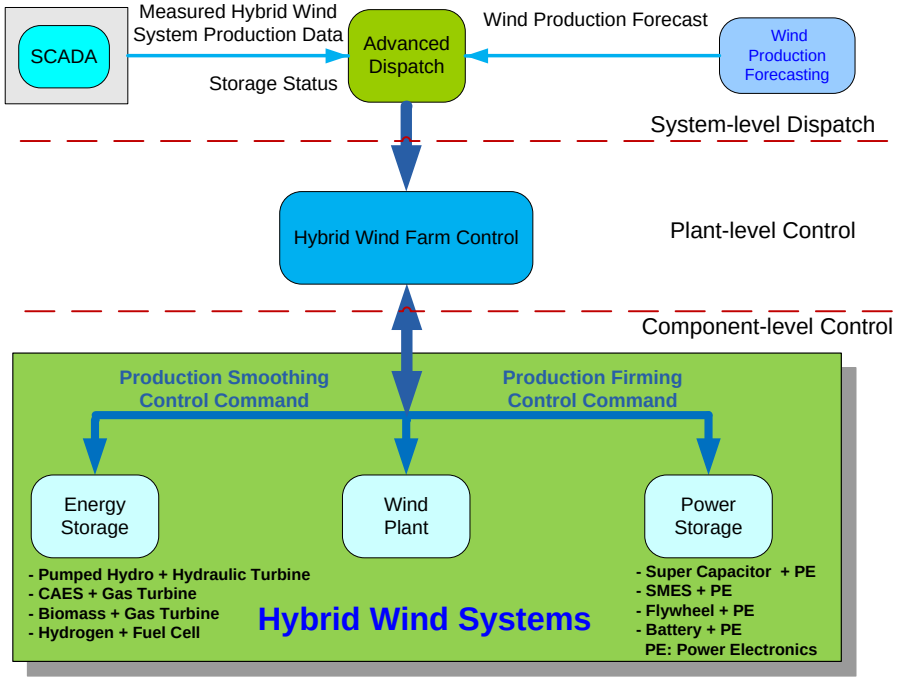
- Multi-objective optimization with a cost-minimization network-flow LP fitness function.
- Decomposition w/ parallel programming on high-performance computers; modeling of electric, fuel, & transportation technologies.

MAJOR ACCOMPLISHMENTS: Our version 1.0 software has been run on a large scale US model. Initial results indicate "greening" the electric infrastructure while electrifying the transportation infrastructure is a very attractive solution where *wind energy plays a very prominent role*.

Hybrid Wind Systems: Design, Operation and Control

PIs: J. McCalley, Ajjarapu, Aliprantis Funded by DOE, $80k, ’09-’10

OBJECTIVE: Develop an approach for designing and coordinating hybrid wind systems and evaluate the relative merits of different configurations, including configuring wind with compressed air energy storage (CAES), pumped hydro, lead-acid batteries, Li-ion batteries, Ni-Cd batteries, and NaS batteries.



APPROACH: We designed a multilevel control system which operates to perform coordinated system-level dispatch, farm-level inter-device control, and turbine-level local control, with advanced control features (curtailment control, ramp rate control and governing control) to reduce wind power fluctuation under designs with lower (and thus less costly) storage capacity.

MAJOR ACCOMPLISHMENTS: A hybrid system comprised of a wind plant with CAES and NaS battery storage is most effective in satisfying requirements on capacity, response time, cost, energy storage density, life cycle, and ability to compensate wind power fluctuation. We illustrate by designing a hybrid wind system comprised of a 140MW, 28000 MWh CAES, a 2MW, 50 MWh NaS battery, and a 545 MW wind farm.

Advanced Carbon Fibers from Lignin for Wind Turbine Applications

PI: Michael Kessler (MSE), Co-PI: David Grewell (ABE)

Funded by IAWIND ($100K) and Siemens Energy ($50K), '10-'12

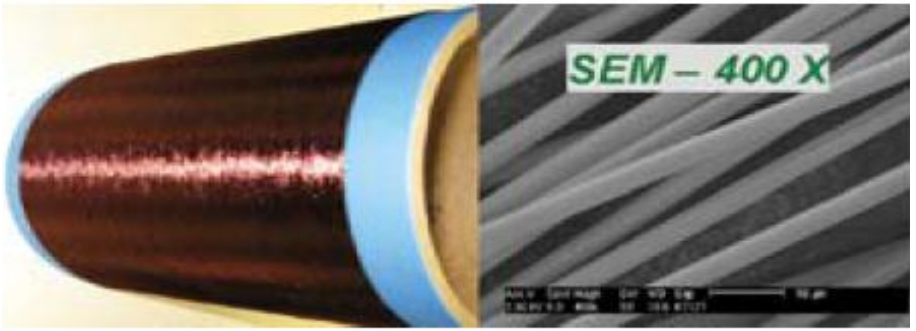
BACKGROUND: Key to enhancing wind energy production is the development of lightweight and low cost turbine blades. Carbon fiber composites are the best choice from a performance perspective, but high fiber costs limit their use.

New fiber spinning system

OBJECTIVE: Develop a robust process for manufacturing low cost carbon fibers from lignin/co-polymer blends for wind turbine applications

APPROACH:

- Evaluate and pretreat high purity grade lignin
- Spin fibers from lignin-copolymer blends
- Convert to carbon fibers and characterize



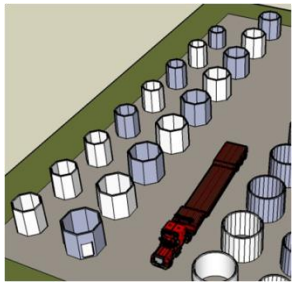
Warren C.D. et.al. SAMPE Journal 2009 45, 24-36

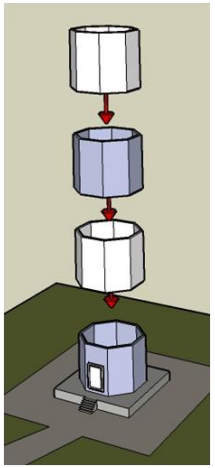
Investigation of Design Alternatives for 328-ft (100-m) Tall Wind Turbine Towers

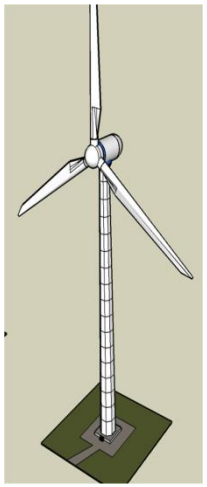
PI(s): Sri Sritharan, sri@iastate.edu
Tom Lewin, tlewin@iastate.edu

Objectives:

- Address options for reducing the tower costs through modularized construction
- Develop suitable options into useable, economic designs
- Contribute to the creation of an American standard for the design of wind turbine towers to improve design efficiencies and cost-effectiveness of future towers that will exceed a hub height of 328 ft (100 m)
- Reduce costs by designing towers to last for multiple turbines







Approach:

- Taller towers through modular construction
- Reduced on-site construction time and cost
- Improved sustainability through high strength materials
- Decreased material quantities with high strength concrete
- Taller Towers: 328-394 ft (100-120 m)

Major Accomplishments:

ISU 328-ft (100-m) Steel Design:

- Base diameter: 18 ft (5.5 m)
- Fatigue driven design limits the life of the towers to 20 years

ISU 328-ft (100-m) Concrete Design:

- Base diameter: 30 ft (9.1 m)
- Fatigue life increased far beyond 20 years

Higher Strength Concretes:

- Further reduction of materials, closer to steel in required volume
- Further reduction to transportation, on-site construction and maintenance costs

Tall Modular Wind Turbine Tower