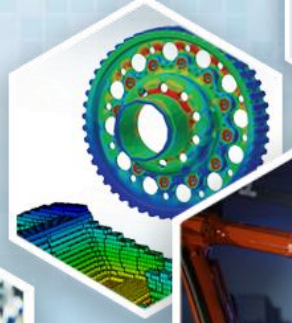
IACMI Fall 2021 Members Meeting
Wind Energy Working Group Report

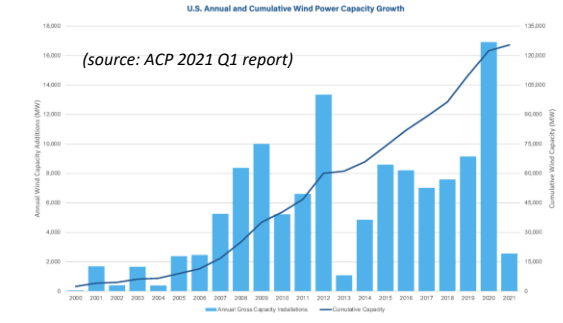
Steve Nolet, TPI Composites

October 06, 2021

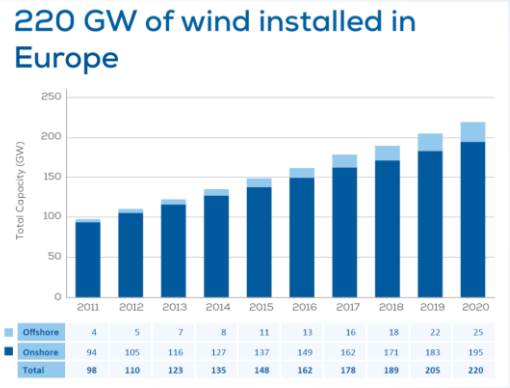


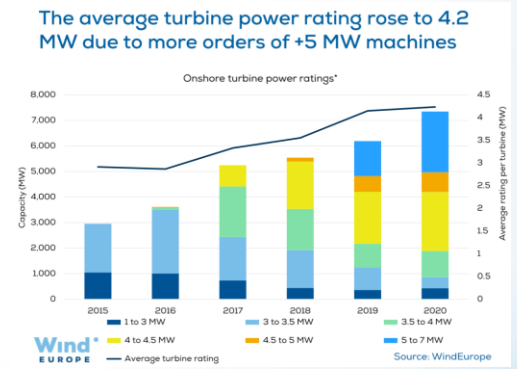
Industry Snapshot:
American Clean Power
US Wind Market Update

Wind Facts – 2020 was a Good Year Despite Pandemic Challenges



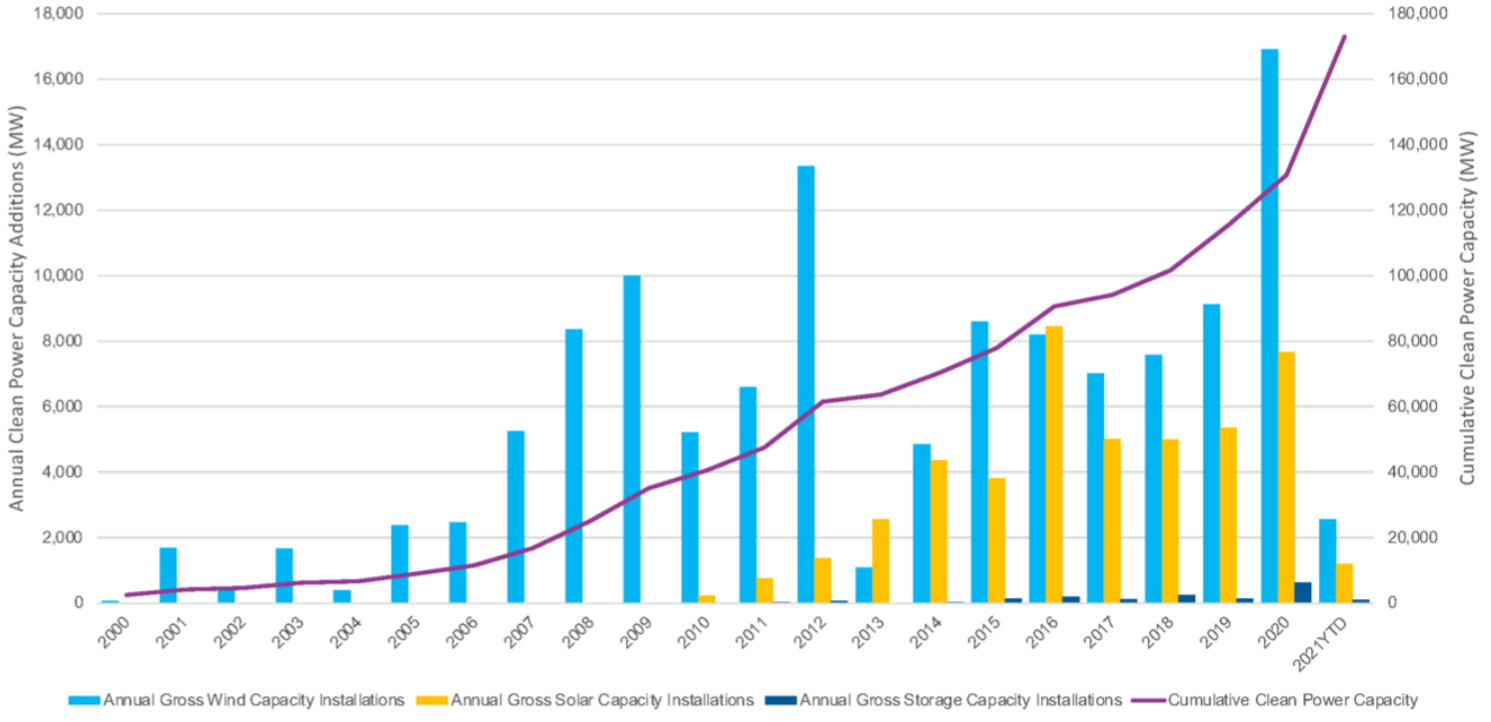
U.S. Installed Wind Capacity Grew by Total Electrical Generating Capacity to over 122 GW.





U.S. Annual and Cumulative Renewable Power Capacity Growth

Source: Clean Power Quarterly 2021 Q1, American Clean Power

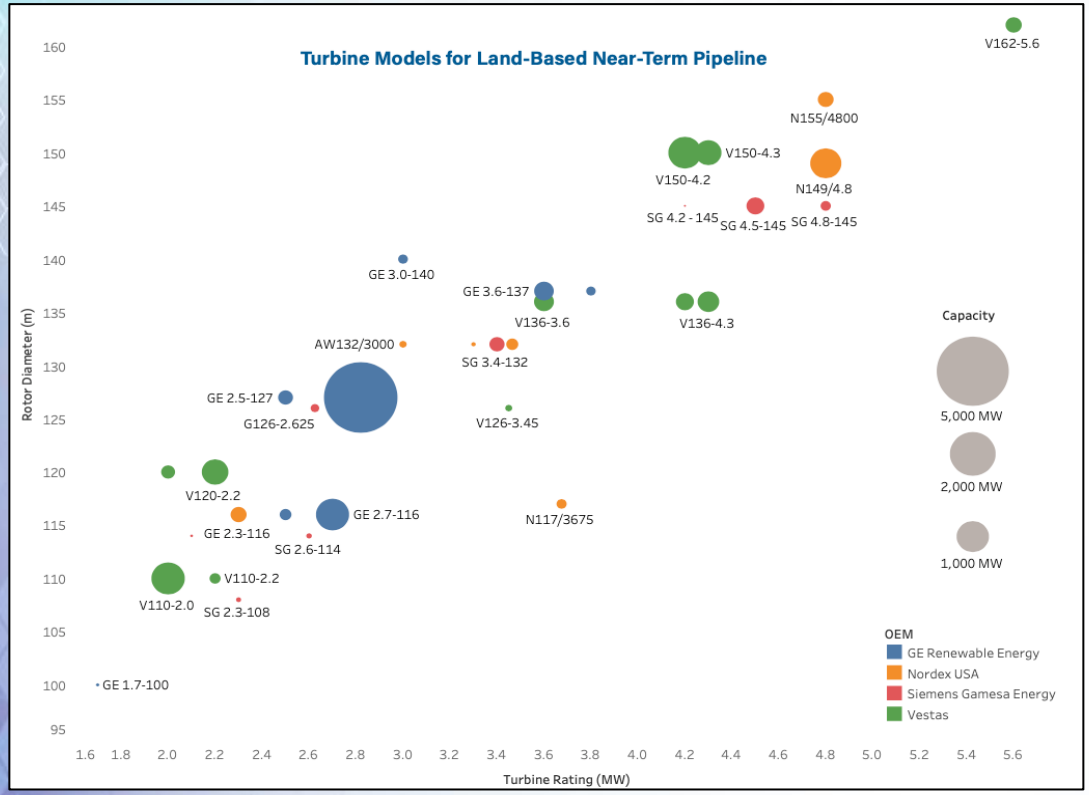


Wind Turbine Technology Trends

- Wind turbine technology continues to evolve as manufacturers introduce new models to reduce wind's levelized cost of energy and enhance performance.
- Wind turbine capacity sizes continue to increase with turbines in the advanced pipeline ranging from 1.7 MW to 5.6 MW in the pipeline.
- The capacity weighted average of all turbines in the pipeline is 3.23 MW.
  - Wind turbines rated between 2.5-2.0 MW remain the most popular for projects in the pipeline, representing just over 7,000 GW of capacity (46%).
  - Notably, the categories above and below that class are now even with the 2.0-2.4 MW and 4.0-4.4 MW classes each representing 16% shares, or around 2,400 MW each.
- The 4.5+ class now has over 1,800 MW of capacity (12%) in the pipeline

Source: Clean Power Quarterly 2021 Q1, American Clean Power

NEWSFLASH: Turbine Size/Rotor Diameter is GROWING



Source: Clean Power Quarterly 2021 Q1, American Clean Power

Accelerating the need for advanced technology!

- carbon spars (LCCF)
- manufacturing technologies
- faster/better NDT
- lifetime extension/reduced O&M
- logistics
- plant design
- so much more…

Offshore Wind Updates

- The Biden Administration announced an ambitious but achievable goal of 30 GW of offshore wind by 2030.
- Dominion Energy's 12 MW Coastal Virginia Offshore Wind project was officially commissioned. This project is expected to be a steppingstone for Dominion's larger 2.6 GW multi-phase project.
- The New York State Energy Research and Development Authority (NYSERDA) selected the partnership of Equinor and BP as the winner of the state's second offshore wind solicitation.
  - Under the award, Equinor and incoming strategic partner BP will provide generation capacity of 1,260 MW from Empire Wind 2 and another 1,230 MW of power from Beacon Wind 1.
  - The execution of the award is subject to the successful negotiation of a purchase and sale agreement.

Offshore Wind Updates (continued)

- BOEM released the Vineyard Wind Final Environmental Impact Statement (FEIS). This is a key step towards final project approval, which is expected later this year (VW1 800 MW).
- The 132 MW South Fork offshore wind farm took another significant step forward with the approval by New York regulators of its 7.6-mile power export transmission cable.
- “Ocean Wind”, a joint venture between Ørsted and PSEG, and steel monopile foundation manufacturer EEW was formed.
  - The JV announced the groundbreaking of a $250 million EEW monopile manufacturing facility at the Port of Paulsboro Marine Terminal in Gloucester County, NJ.
  - The facility will manufacture monopiles to supply the 1,100 MW Ocean Wind farm off the coast of southern New Jersey, and other Northeast projects.

IACMI Wind Working Group: August 2021 Meeting

Wind Energy Areas of Research / Prioritization

Research Categories

- Manufacturing Optimization
- Automation
- Sustainability / Circular Economy
  - End-of-Life
  - Extension, reuse, recycling, etc.
- Advanced Materials
- Inspection
- Validation
- Others?

Research Priorities

- Wind turbine blade EOL: recyclability, reuse, etc.
- Innovative composite materials: in-situ thermoplastics, reversable thermosets, basalt, TCF
- Targeted automation in blade manufacturing
- NDE/NDI: in manufacturing and in field
- Maintenance, inspection and repair of composite blades
- Development of standards
- Technology demonstration at scale
- Blade manufacturing optimization / techno-economic model
- Additive manufacturing for tooling and/or blade composite structures
- On-site manufacturing / Factory in a box
- Large onshore blade design and manufacturing
  - Segmented / modular blade technology
  - Transportation challenges
- Offshore wind technology challenges
- Testing and validation (e.g., subcomponents)

Funding Critical Wind Research

Source: NREL

Funding Opportunity Announcements (FOAs)

- IACMI support for companies seeking funding under FOA process
- Funded projects enabled by IACMI created assets and capabilities

IACMI Consortium enabled funding

- Consortium resource pool derived from member fees
- Working to establish state matching funds for private funded work (single/multiple entity) at core partners

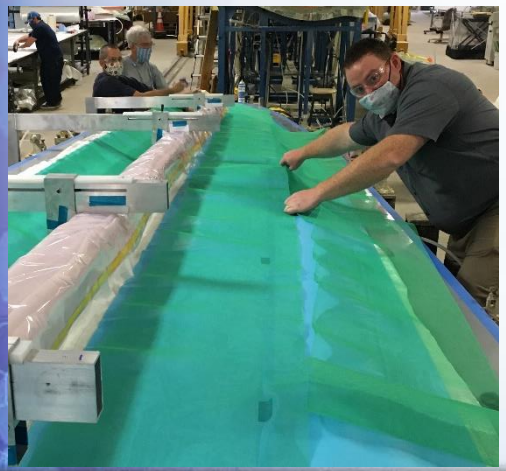
Private and co-funded projects

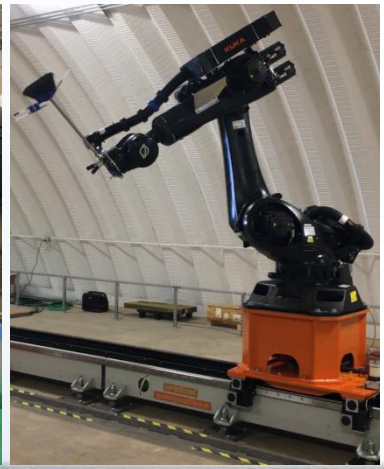
- IACMI supported private project contracting and administration
- Cooperative Research and Development Agreement (CRADA)

Core project funding

- Positioning IACMI for possible re-funding for FY22 onward

Developing Partnerships for Research



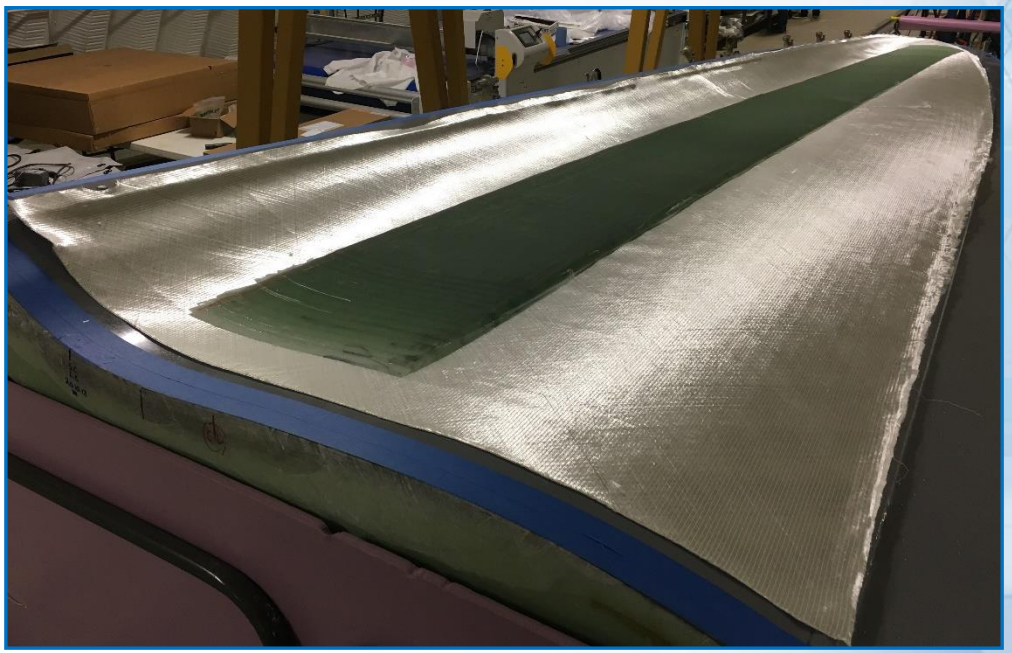


- Connect through IACMI Wind Working Group
- Reach out to IACMI for help with targeted partnerships
- Network at IACMI member meetings
- Engage existing IACMI research capabilities
  - Core partners
  - University research laboratories
  - National Labs
- Connect with industry partners

Source: NREL

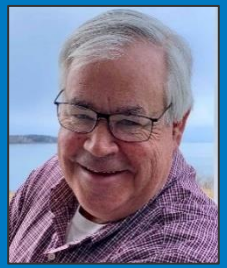
Structure and Operation of Wind Working Group

- Structure Wind WG to best achieve research priorities
- Consider the potential role of an advisory board / steering committee
- Subcommittees and smaller focused groups to effectively advance research
- Achieve the goal for the Wind WG: to advance critical research for the wind industry - and to maximize the benefit to member organizations



Source: NREL

Tomorrow's Joint Meeting:
CE and Wind Working Groups
October 7th, 2021 – 12:30 to 3:00 PM



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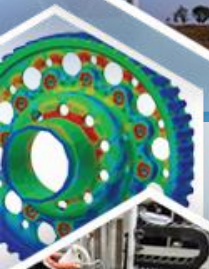

Thank you

IACMI Wind Energy Working Group

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