CAPTION: THIS 850-KW VESTAS V52 IS ON THE CAMPUS OF THE DUNDALK INSTITUTE OF TECHNOLOGY. TASK 41 RESEARCHERS HAVE USED ITS OPERATIONAL DATA FOR COLLABORATIVE RESEARCH AND PUBLICATIONS. PHOTO CREDIT: RAYMOND BYRNE, DUNDALK INSTITUTE OF TECHNOLOGY

TASK 41 REPORT 2020

Enabling Wind Power to Contribute to a Distributed Energy Future

Task 41 was initiated in January 2019 to advance wind technology as a cost-effective and reliable distributed energy resource. While large-scale wind project costs have decreased over time, distributed wind costs have not. Furthermore, great potential exists, worldwide, for expanded distributed energy resource markets, particularly as grids evolve and the need for clean, low-cost energy increases.

ALICE ORRELL,
Pacific Northwest National Laboratory,
United States

To address these issues, the objectives of Task 41 are to coordinate international distributed wind energy research, facilitate collaboration on priority research topics, and increase the visibility of wind technology as a distributed energy resource.

Expected results include the following:

- research to support updates to design and testing standards for small and mid-sized wind turbines
- the creation of an information sharing platform for distributed wind research and data
- research to enable efficient and reliable integration of wind as a distributed energy resource into evolving distribution and microgrid electricity systems
- outreach and collaboration with other IEA tasks, international organizations, and universities
- research on applying advances of large-scale wind technology innovations to smaller-scale wind technology.

Progress and achievements

After an initial year of building the groundwork needed to complete the approved work plan, Task 41 participants collaborated on a number of topics in 2020. Some highlights include identifying research needs for international design and testing standards for small and mid-sized wind turbines and facilitating global collaboration opportunities.

Task 41 has hosted a series of International Standards Assessment Forums to identify the challenges and gaps in the existing International Electrotechnical Commission (IEC) 61400-2 small wind turbine standard, and other relevant standards. A North American forum was held virtually in August and September 2020 and an Asian forum is planned for the summer of 2022. Discussion topics at these forums include conformity assessment, power performance results, aeroelastic models, simplified loads models, and the new United States draft standard, ACP 101-1, with an emphasis on identifying research topics. Some of these research topics will be addressed through multi-year contributions and collaborations with Task 41 experts. It is planned that these results can be used for consideration by standards experts working on the fourth revision of IEC 61400-2.

To expand distributed wind research and engage with the next generation of distributed wind researchers, Task 41 initiated a University Research Collaboration pilot project in 2020. The research topics focus on identifying opportunities to both down-scale innovations from

TABLE 1. COUNTRIES PARTICIPATING IN TASK

Table 1. Task 41 Participants in 2020

	Country/Sponsor	Institution(s)
1	Austria	University of Applied Sciences Technikum Wien
2	Belgium	Vrije Universiteit Brussel
3	Canada	Nergica University of Calgary
4	China Wind Energy Association (CWEA)	CWEA China General Certification Center Goldwind China Inner Mongolia University of Technology Taiwan Institute of Economic Research Taiwan Small/Medium Wind Turbine Association
5	Denmark	Nordic Folkecenter for Renewable Energy Technical University of Denmark (DTU)
6	Greece	Center for Renewable Energy Sources and Saving
7	Ireland	Dundalk Institute of Technology
8	Italy	University of Perugia
9	Republic of Korea	Korea Institute of Energy Technology Evaluation and Planning
10	Spain	Centre for Energy, Environment and Technology
11	United States (Operating Agents)	National Renewable Energy Laboratory Pacific Northwest National Laboratory

IN ADDITION TO THE PARTICIPATING COUNTRIES THAT HAVE FORMALLY JOINED TASK 41, TASK 41 INCLUDES OBSERVERS FROM GERMANY, POLAND, AND SINGAPORE, AND UNIVERSITY RESEARCH COLLABORATION PARTICIPANTS FROM AUSTRALIA.

CAPTION: TASK 41 MEMBERS, ALONG WITH THE REST OF THE WORLD, HAVE LEARNED HOW TO TAKE GROUP PHOTOS OF ZOOM MEETINGS. PHOTO CREDIT: ALICE ORRELL, PACIFIC NORTHWEST NATIONAL LABORATORY

large wind turbine design and refine small wind turbine design, with a goal of reducing the levelized lifecycle cost of energy. Student researchers participating in the University Research Collaboration pilot project will share their results at a virtual July 2021 meeting.

Highlight

Task 41 facilitates international collaboration to lower the costs and deployment barriers for wind as a distributed energy resource. Understanding distributed wind turbine performance can inform re-powering options for older turbines. Task 41 members from the Dundalk Institute of Technology and the University of Perugia collaborated on research of wind turbine performance deterioration with age through operational data analysis of the 850-kW Vestas V52 wind turbine installed on the Dundalk Institute of Technology campus. This research was published in the open access journal Energies in April 2020 [1].

The wind turbine operated from October 2005 to October 2018 with its original gearbox; the gearbox was replaced in 2019. The research found that over a ten-year period, the performance of the wind turbine has declined on the order of 5%; the performance deterioration seems to be nonlinear as years pass by; after the gearbox replacement, a fraction of the performance deterioration has been recovered, but not all, because the rest of the turbine system has been operating for thirteen years from its original state. The Task 41 members at Dundalk Institute of Technology and the University of Perugia plan similar research collaboration for 2021.

Outcomes and significance

The desired outcome of Task 41 is to enable wind as a cost-effective and reliable distributed energy resource in a world increasingly reliant on distributed energy resource-generated electricity. While much research has already been conducted on solar photovoltaics and battery storage systems as distributed energy resources, wind offers additional, and to some extent, unrealized resource diversity, and resilience benefits to distribution systems, microgrids, and isolated grid systems.

Specific results to achieve this outcome include the following:

- Identifying challenges and gaps that need to be addressed to update international small and mid-size turbine standards
- a distributed wind research and data catalog
- a state-of-the-industry report on the integration of distributed wind systems

- identification of research on large wind turbine down-scaling for distributed wind and small wind turbine design refinements
- expanded engagement in the wider distributed energy research fields and deployment markets
- best practice guide for high-renewable-contribution isolated power systems
- collaboration across relevant IEA Technology Collaboration Programmes on wind deployment.

Next steps

Task 41 participants will continue to meet, both virtually and in person when allowed, and work to complete the approved work plan. As one of the focuses of Task 41 is to research how distributed wind can contribute to evolving electricity systems, this research may evolve as well. With interest in hybrid power plants and hybrid power systems growing, some of Task 41's next research steps may shift to distributed wind's role in hybrids.

References

[1] Byrne, R., Astolfi, D., Castellani, F., and Hewitt, N.J. (2020). A Study of Wind Turbine Performance Decline with Age through Operation Data Analysis. Download from https://www.mdpi.com/1996-1073/13/8/2086.

Task Contact

Alice Orrell, alice.orrell@pnnl.gov

Ian Baring-Gould, ian.baring-gould@nrel.gov

Webpage: https://iea-wind.org/task41/