iea wind

IEA Wind Task 41 Annual Progress Reports for IEA Wind TCP ExCo Meeting 89

Task 41: Enabling Wind to Contribute to a Distributed Energy Future

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1 Background and Goals

Task Description:

The purpose of IEA Wind TCP Task 41, "Enabling Wind to Contribute to a Distributed Energy Future," is to expand, coordinate, and facilitate international research on wind as a distributed energy resource to lower its costs and deployment barriers. While large-scale wind project costs have decreased over time, the distributed wind system costs have not seen this same decrease. Task 41 was initiated in January 2019 and will be completed in December 2022.

This task work plan is divided into five work packages (WPs) to advance wind technology as a cost-effective and reliable distributed energy resource:

1. **Standards**: Research to support future development of design and testing standards for small and mid-sized wind turbines
2. **Data Catalog**: Create an information sharing platform for distributed wind research and data
3. **Integration**: Enable efficient and reliable integration of wind technology into evolving electricity systems
4. **Outreach and Collaboration**: Facilitate and coordinate distributed wind research with other IEA tasks and international organizations
5. **Innovation and Downscaling of Large-Scale Wind Technology**: Apply advances of large-scale wind technology to smaller-scale wind technology

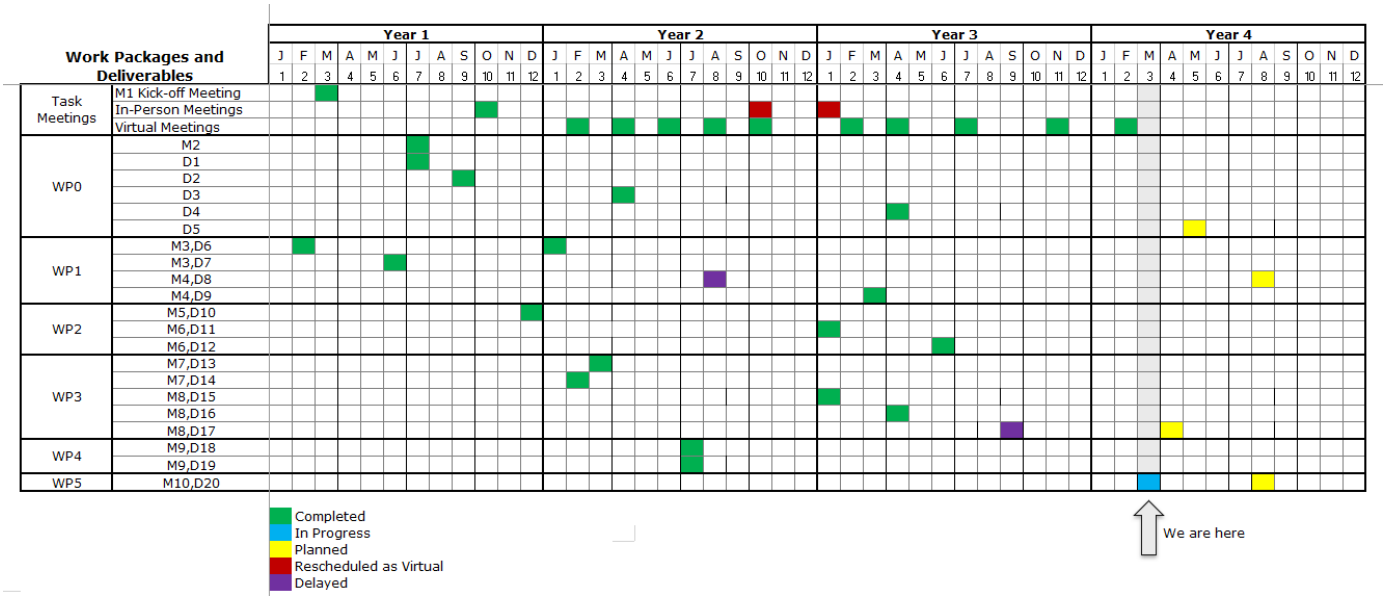
Task Time Plan and Milestones:

The milestones associated with the five work packages, as well as the lead organizers and contributors, are shown in Table 1. The task schedule for milestones and deliverables is shown in Figure 1. Because Task 41 was unable to hold a stakeholder forum to engage wind industry around the effectiveness or modifications of current standards for small and mid-sized turbines in Asia due to Covid-19 travel restrictions, this work is assumed to be completed with publication of Deliverable 9 in March 2021 documenting workshops completed in Europe and North America. Milestone 8 is delayed pending one final deliverable publication, but is expected to be completed in summer 2022. Milestone 10 has been drafted and used as part of the ongoing University Research Collaboration, but is expected to be completed in summer 2022.

Table 1: Work Plan Milestones, Contributors, and Due Dates

No.	Milestone	Milestone Description	Lead Organizations & Contributors	Milestone Due Date	Milestone Completion
WP0	M1	Project kick-off meeting.	Austria, China, Denmark, Ireland, Poland, South Korea, Spain, United States	Winter 2019	✓
	M2	Launch Task 41 web site	NREL, PNNL	Spring 2019 New web site: Winter 2021	✓
WP1	M3	Wind turbine standards report	NREL	Winter 2020	✓
	M4	Compendium of standards recommendations	DTU, NREL	Summer 2022	✓
WP2	M5	Specification of data sharing catalog	PNNL, DTU, All	December 2019	✓
	M6	Completion of initial implementation of DW data catalog	PNNL, DTU, All	December 2020	✓
WP3	M7	A review document of control and communication for advanced wind system integration	NREL	Summer 2020	✓
	M8	State of the industry report on isolated microgrid power systems	NREL	Fall 2021	Delayed
WP4	M9	Implementation of IEA Wind TCP task outreach and engagement plan	All	Fall 2019	✓
WP5	M10	Report on downscaling opportunities for mid and small-scale wind turbines	CIEMAT	Fall 2020	Delayed

Figure 1: Schedule for Work Packages with Deliverables and Dates



Milestones for past 6 months (October 2021 - March 2022):

Please see Section 2 below as only task meetings, no milestones, fell directly into this 6-month time period.

2 Progress Toward Goals

This section provides updates on the technical progress in relation to the Task objectives, milestones, and deliverables planned in the approved Task Proposal.

Progress in WP1

Task members from Canada, the United States, and Denmark have worked together to establish a clearer understanding of the simplified loads methodology (SLM) and aeroelastic modelling. Research is in progress to refine knowledge about both of these loads methodologies with a target of completion during the tenure of writing the fourth revision of IEC 61400-2.

Task 41 members implemented an international small wind turbine modelling forum held virtually on the 5th and 6th of October 2021 to build international consensus on needed improvements to aeroelastic modelling for the wide variety of distributed wind turbine configurations. The October workshop and associated modelling assessments will be published as part of an NREL technical report, *Aeroelastic Modelling of Distributed-Scale Wind Turbines* to be released in the spring of 2022.

As was originally envisioned at the start of this work package, a new MT2 is convening by holding their kick-off meeting by summer 2022. The goal of this cycle of IEC 61400-2 revisions is to incorporate the many improvements into a revised IEC 61400-2 standard.

Deliverable 9, "Recommendations on potential standards changes for distributed wind: driving research via IEA Task 41," was completed in March 2021 but was not captured in our previous progress report. Given the inability to engage effectively with Asian stakeholders due to Covid, the task plans to pass direct engagement to the formulation team for MT2, which will include direct participation from many IEA Task 41 members.

Progress in WP2

Deliverable 12, "Distributed Wind Data Catalog Development Guide and Instruction Manual," was completed in June 2021. The data provides instructions for the IEA Wind Task 41 distributed wind data catalog. While IEA Wind Task 41 created a minimal viable product for Work Package 2, the deliverable also describes additional features that could be added to the data catalog or included in the development of future data catalogs with supplemental funds.

Progress in WP3

Deliverable 15 was completed in January 2021, but not captured in our previous report, as part of the U.S. Department of Energy's Microgrids, Infrastructure Resilience, and Advanced Controls Launchpad (MIRACL) project with the "Distributed Wind Controls: A Research Roadmap for MIRACL" report. The report discusses for distributed wind advanced controls for grid support capabilities, control strategies, and how to to support and manage high contributions of wind in isolated grids.

Deliverable 16 was completed in April 2021 by Tom Cronin and Per Nørgård (DTU) with their report titled, "Design guide for high-renewable-contribution isolated power systems."

The final deliverable of WP3 (Deliverable 17) is a state of the industry report for isolated microgrid power systems that will be drafted summer of 2022. It will build from the previous deliverables, and the NREL "Isolated Grids and Grid-Connected Turbine Reference Systems" report that will be published soon. Deliverable 17 will be completed primarily by Task 41 members from Denmark and the United States with support from Canada, Korea and China.

In addition to these deliverables, a virtual meeting was held on 23 November 2021 to discuss hybrid power plants and hybrid power systems. This meeting was led by Kaushik Das (DTU) and members of the University Research Collaborative (initiated under Work Package 5). Eight participants from Australia, Denmark, Spain and the United States shared their current and near-term research plans for hybrid power plants and systems, identified student PhD/MS research on this topic, and shared plans for future student symposiums. Task 41 members have also engaged with the new Task 50 (Hybrid Power Plants).

Progress in WP4

The Technical University of Denmark (DTU) added a subpage for its Danish EUDP-funded Task 41 project deliverables to the Task 41 website. This puts all of DTU's Task 41 deliverables in one place and with Task 41's other deliverables.

Virtual task meetings were held in April, July, and November of 2021 and February of 2022.

Progress in WP5

To support the successful completion of work within WP5, WP5 will continue in its modified format (i.e., supporting the University Research Collaborative) and is likely to do so through the rest of this phase of Task 41. Deliverable 10 / Milestone 20, the report on the potential opportunities for cost reductions in mid and small-scale wind technology based on current LCOE lowering technology innovations being applied to large and offshore turbine technologies, has been drafted but has been continuously revised through successive engagements with the wider distributed wind and academic community. It was determined that finalizing such a document was not a high priority as the topics continued to evolve. Task 41 members from Spain and the United States plan to complete the document the fall of 2022.

The University Research Collaborative, which was developed in an effort to coordinate academic research on key topics related to distributed wind, including the potential opportunities identified in this work package, consists of approximately 160 professors and students from around the world. Current work efforts focus on aeroelastic modeling and hybrid power plants and systems. The last topic is a natural overlap with Work Package 3. The project team is planning to host a student symposium for the University Research Collaborative as part of the planned joint task October 2022 meeting, allowing both virtual and in person attendance if possible.

Recent Results

Non-proprietary technical information and results are as described above in the progress for each work package.

3 List of Participants

Table 2 gives a list of Task 41 participants and their organizations over the past year from 11 member and 3 observer countries.

Table 2: Task 41 Participants

Country	Contacts	Organization
Austria	Mauro Peppoloni	University of Applied Sciences FM Technikum Wien
	Alexander Hirschl	University of Applied Sciences FM Technikum Wien
Belgium	Mark Runacres	Vrije Universiteit Brussel
Canada	Sergio Gualteros	Nergica
	Dominic Bolduc	Nergica
	Imen Romdhane	Nergica
	David Wood	University of Calgary
China	Charlie Dou	Chinese Wind Energy Association
	Chong Zuo	Inner Mongolia University of Technology
	Jia Yan	Inner Mongolia University of Technology
Denmark	Anca Hansen	Technical University of Denmark
	Anna Maria Sempreviva	Technical University of Denmark
	Kaushik Das	Technical University of Denmark
	Aeishwarya Umesh Baviskar	Technical University of Denmark

	Mark Kelly	Technical University of Denmark
	Niels Adema	Hanze University
	Gerard Schepers	Hanze University
	Tonny Brink	Nordic Folkecenter for Renewable Energy
Greece	Nikolaos Stefanatos	Center for Renewable Energy Sources and Saving
India*	Kannan Balaraman	National Institute of Wind Energy
Ireland	Raymond Byrne	Dundalk Institute of Technology
Italy	Francesco Castellani	University of Perugia
Poland*	Maciej Karczewski	Windtak
Singapore*	Narasimalu Srikanth	Energy Research Institute at Nanyang Technological University
South Korea	Seokwoo Kim	Korea Institute of Energy Research
Spain	Ignacio Cruz	CIEMAT
	Luis Cano	CIEMAT
	Beatriz Ramos	CIEMAT
United States	Alice Orrell	Pacific Northwest National Laboratory
	Bethel Tarekegne	Pacific Northwest National Laboratory
	Danielle Preziuso	Pacific Northwest National Laboratory
	Sarah Barrows	Pacific Northwest National Laboratory
	Ian Baring-Gould	National Renewable Energy Laboratory
	Brent Summerville	National Renewable Energy Laboratory
	Robert Preus	National Renewable Energy Laboratory
	Jeroen van Dam	National Renewable Energy Laboratory
	Jim Reilly	National Renewable Energy Laboratory
	Ben Anderson	National Renewable Energy Laboratory
	Desirae Majors	Penn State University
	Susan Stewart	Penn State University
	Trudy Forsyth	Wind Advisors Team

* Observer countries.

4 Statement of Accounts and Value of Contributions

Status of accounts:
Operating Agent costs for PNNL and NREL are paid by the U.S. Department of Energy, therefore there are no revenues and cost of participating to report. The U.S. DOE operates on a fiscal year cycle.

Table 3: Task 41 Expenses

Costs	Total Budget (2021)	PNNL Actual to Date (Apr 2021-Mar 2022)	NREL Actual to Date (Apr 2021-Mar 2022)
Operating Agent Labour	US $150,000	US $22,600	US $34,700
Task Labour		US $25,600	US $23,200

Travel	0	0	0
Other costs	0	0	0
TOTAL	US $150,000	US $48,200	US $57,900

Value of in-kind activities:

Table 4 presents the estimated national in-kind labour person months per country (observers are marked with an asterik). Individual labour hour estimates were provided by task participants. Assuming a labour hour value of US$200 per hour, 8 hours per day, 20 days per month, and a combined total of 12.51 person-months, the value of the in-kind labour is US$400,200 for April 2021 through March 2022.

Table 4: Estimated In-Kind Labour Person Months

Country	In-Kind Labour Person-Months
Austria	0.46
Belgium	0.04
Canada	1.38
China	0.07
Denmark	2.52
Greece	0.56
India*	0.03
Ireland	0.10
Italy	0.08
Poland*	0.03
Singapore*	0.10
South Korea	0.01
Spain	0.16
United States	6.98
Total	12.51

5 New Developments Since Last Report

India, represented by the National Institute of Wind Energy, joined Task 41 as an observer in July 2021 (after ExCo 87 when it joined the IEA Wind TCP) and has been invited to become a member of Task 41.

Otherwise, new developments since Task 41's last progress report presented at ExCo 87 in May 2021 are captured in Figure 1 and described in Section 2.

6 Future Milestones

Plans and Deliverables for the Coming Year

Table 5 lists all deliverables, showing their status and planned completion. This report represents Deliverable 5. Deliverable 8 is delayed because of Covid-19 travel restrictions and is not likely to be implemented by the end of Task 41's current work plan period of performance. Deliverable 17 and Deliverable 20 will be completed by the end of the work plan performance period.

Table 5: Work Plan Deliverables, Contributors, and Due Dates

No.	Deliverable	Deliverable Description	Lead Organizations & Contributors	Deliverable Due Date	Deliverable Completion
WP0	D1	Development of general IEA Task 41 and distributed wind PowerPoint presentation for use by members	NREL/PNNL	Spring 2019	✓
	D2	First annual progress report	NREL/PNNL	Fall 2019	✓
	D3	Second annual progress report	NREL/PNNL	Spring 2020	✓
	D4	Third annual progress report	NREL/PNNL	Spring 2021	✓
	D5	Final Report	NREL/PNNL	Spring 2022	✓
WP1	D6	Stakeholder forum to engage wind industry around the effectiveness or modifications of current standards for small and mid-sized turbines in the U.S.	NREL	Winter 2019	✓
	D7	Stakeholder forum to engage wind industry around the effectiveness or modifications of current standards for small and mid-sized turbines in the Europe	Austria, Denmark, Ireland, South Korea, Spain, Taiwan, United States, Germany	Summer 2019	✓
	D8	Stakeholder forum to engage wind industry around the effectiveness or modifications of current standards for small and mid-sized turbines in the Asia	NREL, China	Fall 2019	Delayed
	D9	Report on recommendations for potential standards changes that will be used to drive additional national and international research	NREL	Winter 2020	✓
WP2	D10	Specification of a data sharing catalog; including a review of needs, what meta data should be collected, and potential options for hosting the catalog	PNNL, DTU, All	Fall 2019	✓
	D11	Development of data sharing, storage and if needed security protocols for meta data to be stored on the platform. Specification of a potential data sharing portal that expands on the catalog	PNNL, DTU, All	Fall 2020	✓
	D12	Development of a data instruction guide for the DW data catalog	PNNL. DTU, All	Spring 2021	✓
WP3	D13	Summation of relevant international and defined national electrical standards, operational practices that would be	China, Denmark, Germany, Ireland,	Fall 2019	✓

		applicable to DW looking from the grid or microgrid perspective with a specific consideration of turbine size and complexity	Spain, United States		
	D14	Based on initial work completed in the U.S., review how DW is modelled in distributed grid and microgrid systems, the availability of design tools and models and an assessment of the modeling methods used for wind energy	PNNL	Fall 2019	✓
	D15	Assessment of different levels of DW system control, including a classification for DW control strategies for high contribution distributed grids, including different capabilities of grid support and likely data needs for future wind systems	NREL	Summer 2020	✓
	D16	Design or best practice guide for the design of high renewable contribution isolated power systems	DTU	Fall 2020	✓
	D17	State of the industry report for isolated microgrid power systems	NREL	Fall 2021	In Progress
WP4	D18	Development of a specific IEA Wind TCP task engagement plan to be reviewed by Task. This will include DW focused research efforts that could be incorporated into future task proposals, allowing the specific consideration of DW topics within other IEA Wind TPC efforts	All	Fall 2019	✓
	D19	Identification of specific, high priority non-IEA Wind TCP stakeholders that could be a source for additional targeted engagement	All	Summer 2020	✓
WP5	D20	Report on the potential opportunities for cost reductions in mid and small scale wind technology based on current LCOE lowering technology innovations being applied to large and offshore turbine technologies	CIEMAT	Fall 2020	In Progress

7 Detailed work plan for coming year

Task 41 will develop a work plan extension proposal for another 4-year task period. This intention will be shared during the Task 41 progress report presentation at ExCo 89 and the formal proposal submission will be in conjunction with ExCo 90. In addition to follow-on research related to our current work plan, the new work plan will include research on the human dimensions of distributed wind and how the task can help facilitate responsible deployment of distributed wind in emerging market countries.

Task 41 (Distributed Wind), Task 52 (Large-Scale Deployment of Wind Lidar) and Task 54 (Cold Climate Wind Power) are planning co-located in-person meetings at the University of Applied Sciences FM Technikum Wien in Vienna, Austria in October 2022. There will be parallel meetings and collaborative meetings. The Austrian Wind Energy Association is also organizing a co-located industry event the day before the meetings start.

Additional virtual meetings will be scheduled for the remainder of the 2022 calendar year as needed.

8 Publications, presentations, dissemination

Publications, presentations, dissemination

Baviskar, Aeishwarya; Das, Kaushik; Hansen, Anca Daniela; Menegatos, Panos: Loss Minimization in Distribution Network using Wind Power Plant Reactive Power Support. TechRxiv. Preprint. https://doi.org/10.36227/techrxiv.14554845.v1. July 2021.

A. Baviskar, A. D. Hansen, K. Das and P. J. Douglass, "Open-Source Active Distribution Grid Model with a large share of RES- features, and studies," 2021 9th IEEE International Conference on Power Systems (ICPS), 2021, pp. 1-6, doi: 10.1109/ICPS52420.2021.9670223. December 2021.

A. U. Baviskar, K. Das, M. J. Koivisto and A. D. Hansen, "Multi-Voltage Level Active Distribution Network with Large Share of Weather-Dependent Generation," in IEEE Transactions on Power Systems, doi: 10.1109/TPWRS.2022.3154613. March 2022.

M. Kelly. “Towards updating the standards for small wind turbines, via IEA Wind Task 41.” A presentation at the 6th International Conference on Small & Medium Wind Energy. September 2021.

Participation in the Task meetings

For the February 2022 virtual meeting, nine participating task member countries presented country reports and all meeting attendees participated in discussing Task 41’s work plan extension proposal. In general, virtual meeting attendance and participation has been strong, with the exception of the Task 41 members in Asian time zones.

Industry participation

Task 41 did not have industry participation in task events this past year beyond the participation of our Poland industry observer, but there was industry participation in specific work package efforts, such as the aeroelastic modelling workshop.