iea wind

INTRODUCTORY NOTE

IEA WIND TASK 11 TOPICAL EXPERT MEETING

ON

ARTIFICIAL INTELLIGENCE FOR WIND ENERGY

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A. VALUE FOR IEA WIND TCP

BACKGROUND

The past decade has seen a renaissance in artificial intelligence (AI) and machine learning (ML), fundamentally transforming science and society by reshaping how we use data and make decisions. In the wind energy (WE) sector, AI is being effectively applied in areas such as state estimation, reduced order modeling, surrogate modeling, uncertainty quantification, control and optimization.

MOTIVATION

There is an urgent need to tackle challenges in WE to support the ambitious carbon-free targets set by many countries. AI has already been shown to be useful for several applications, and there are still numerous untapped opportunities for AI to drive innovation in WE today. Furthermore, the AI field continues to rapidly advance, and problems that are out of reach for AI today may come within its scope in the coming years. AI's potential to address critical technical and operational challenges in the WE sector—such as optimizing energy capture, enhancing predictive maintenance, and improving grid integration—is immense. However, realizing this potential requires a collaborative approach that bridges diverse expertise in both AI and wind energy. As a first step in this direction, we propose to convene experts from around the world for a technical experts meeting (TEM) focused on the application of AI techniques in wind energy.

ADDED VALUE OF COLLABORATION

The TEM proposed herein is the first international meeting of experts to focus on AI for WE. As such, the meeting encompasses all the Grand Challenge areas, and requires representation across multiple disciplines, application spaces, and operational sectors. Without a diverse group of representatives, the discussion would be confined to niche areas, limiting the impact of the meeting to potentially siloed scientific advances rather than expanding and accelerating the use of AI for the benefit of the entire WE industry.
The TEM delegation will include representatives from academia, research laboratories and industry. Meeting participants from academia and laboratories will cover a wide

range of disciplines such as engineering, atmospheric science, data science, computational science, environmental science, and social science. Industry representation will include consulting companies, owners and operators of wind plants, and manufacturers of wind turbines.

Past collaborative efforts in AI for WE include the workshop held in Boulder, CO in June 2023. The TEM builds on this experience, deepening and broadening the discussion topics and taking them to an international scale. Looking forward, it is anticipated that the longevity of collaborative efforts established in the TEM will be achieved through existing IEA Wind tasks which are already working with or interested in AI. To ensure this, operating agents and key participants from the following IEA Wind tasks will be presenting on their challenges and vision at the intersection of AI and WE:

- IEA Wind Task 43 (Digitalization)
- IEA Wind Task 44 (Controls)
- IEA Wind Task 50 (Hybrids)
- IEA Wind Task 51 (Forecasting)
- IEA Wind Task 52 (Lidar)
- IEA Wind Task 57 (JAM)
- IEA Wind Task 62 (Social Sciences)

The AI TEM will be jointly hosted with Task 43 annual meeting. Due to the co-located nature of these two meetings, we strongly recommend the IEA Wind members to encourage participation from Task 43 members who are interested or engaged in AI.

ALIGNMENT WITH IEA WIND STRATEGY

AI for WE is a cross-cutting topic with the potential to touch on all Grand Challenge areas: Atmosphere, Turbine, Plant & Grid, Environmental Co-Design and Social Aspects of Wind. As such, it fits perfectly within the scope of IEA Wind. The coordination and collaboration initiatives stemming from this meeting are expected to advance all four strategic objectives of the IEA Wind TCP: maximizing the value of wind energy, reducing its costs, facilitating its deployment within a social and environmental context, and fostering collaborative research while exchanging best practices and data.

B. MEETING FORMAT AND GOALS

OBJECTIVES

The primary objective of this TEM is to expand and accelerate the effective and responsible use of skillful, robust, safe, reproducible, and trustworthy AI in wind energy. To achieve this objective, the meeting will serve as a platform to review the current state-of-the-art, existing data and practices, discuss common challenges and adoption barriers, reach consensus on best practices in areas where AI is already in use, and identify immediate opportunities for applying AI to collaboratively address pressing problems.

SPECIFIC OUTCOMES

At the end of the meeting, participants will have reviewed and discussed the state-of-the-art in AI for WE and agreed on actionable, collaborative solutions that can be realistically implemented within the funding constraints, cross-discipline dependencies, and logistical limitations. The state-of-the-art and recommended actions will be summarized in a memo that represents a diverse expert perspective on the topic and identifies fruitful areas for collaboration across existing IEA Wind Tasks and beyond the IEA Wind TCP.

INTENDED PARTICIPATION

Country	Institutions	Number of Experts
BE	WindEurope Vrije Universiteit Brussel von Karman Institute	4
CA	University of Windsor Veer Renewables	2
CH	OST BFH Microsoft RTDT Laboratories ETH Zurich	5
CN	Huazhong University of Science and Technology Electric Power Research Institute	2
DE	enviConnect RWE IWES Ramboll ECMWF TUM Ørsted	7
DK	DTU DNV DHI Ørsted	8
ES	EOLOS	1
FR	France Energies Marines	1
IE	Brightwind ServusNet Analytics Miscrosoft	3
KR	Korea Institute of Energy Research	1
NL	TU Delft Twindo Technologies	3
NO	Microsoft NTNU	2
PT	Vestas	1
SE	KTH	1
UK	Bitbloom EDF Nuveen Infrastructure University of Sheffield University of Edinburgh ECMWF	6
US	Amazon Web Services Argonne National Laboratory Department of Energy, Wind Energy Technologies Office General Electric Research Georgia Tech Jupiter Intelligence	46

	National Center for Atmospheric Research (NCAR) National Institute of Standards and Technology National Renewable Energy Laboratory Pacific Northwest National Laboratory Renewable Energy Systems Sandia National Laboratories Shell SparkCognition The College of New Jersey University of Arizona University of Colorado Boulder University of Maryland University of North Carolina at Charlotte University of Texas at Austin Oak Ridge National Laboratory	

TENTATIVE PROGRAM

This in-person meeting will take place over 1.5 days in June 2025. It will be co-located with the IEA Wind Task 43 annual in-person meeting taking place in Colorado, United States. The preliminary agenda is shown below.

Day	Duration	Topic
Day 1 Duration: 4 h Time: 13:00 to 17:00 local time	30 min	Welcome, Overview and Introductions
	30 min	Setting the Stage Past: Summary of 2023 Workshop Present: Workshop Format and Objectives Future: Vision
	1 h	AI for Wind Energy – Academic Perspective 4 x 10-minute Expert Presentations Facilitated Discussion
	15 min	Break
	1 h	AI for Wind Energy – Industry Perspective 4 x 10-minute Expert Presentations Facilitated Discussion
	45 min	AI for Wind Energy – IEA Wind Grand Challenges Instructions for Breakout Parallel Sessions Breakout Parallel Sessions #1: “AI and Grand Challenges”
Day 2 Duration: 8 h Time: 9:00 to 17:00 local time	45 min	Summary of Day 1 Presentations and Breakout #1 Reiteration and Revision of Workshop Objectives
	1 h	AI for Wind Energy – Data and Digitalization 4 x 10-minute Expert Presentations Facilitated Discussion
	1 h	AI for Wind Energy – Overlaps with Existing IEA Wind Tasks Short Presentations by Task Managers and Operating Agents Group Discussion
	1h	Networking Lunch, Group Photo
	1h	AI for Wind Energy – Best Practices across Applications Instructions for Breakout Parallel Sessions Breakout Parallel Sessions #2: “Best Practices”
	1h	Summary of Breakout #2 AI for Wind Energy – Urgent and Important Gaps across Applications Instructions for Breakout Parallel Sessions Breakout Parallel Sessions #3: “Gaps”
	15 min	Break
	1 h	Summary of Breakout #3 Facilitated Discussion on Pathways for Collaboration
	1 h	Wrap Up, Open Forum, Next Steps