



Annual Report 2024

Task 43

Photo: Some of the IEA Wind Task 43 participants at the Annual General Meeting 2024 in Rapperswil, Switzerland. (Photo credit: OST, Eastern Switzerland University of Applied Sciences).

Wind Energy Digitalization

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In 2024, further progress was made toward the mission of acting as a digital transformation catalyst to deliver insights, recommendations, standards, and tools in the areas of data, culture, and cooperation. One of the highlights was the Annual General Meeting, which took place in Rapperswil, Switzerland.

The four working groups, WG1 Data, WG2 Culture, WG3 Cooperation, and WG4 Use Cases, meet regularly online with invited inspiring speakers. Task 43 Wind Energy Digitalization totals 15 sub-working groups, which meet separately. There are nine participating countries, and 180 active members and observers from academia and industry in 30 different countries.

In the area of “data,” one of the key results was to release the TechnoPortal ontology publishing portal and to populate it with wind energy ontologies.

In the area of “culture,” a key result was to run the IEA Wind Task 43 Culture Questionnaire, which aims to further our understanding on how organizational culture can foster digitalization.

The results will be presented at the Wind Energy Science Conference in June 2025.

In the area of “cooperation,” a key result was the launch of the new WeDoWind ecosystem, a thriving community of people from the wind energy sector sharing data and knowledge and learning from each other openly. Several IEA Wind Task 43 groups are participating in this ecosystem, including the newly launched Data Users’ sub-working group, which aims to identify and address the key challenges that impede the effectiveness of SCADA-based data analytics in the wind industry.

Introduction

Digitalization is one of the key barriers to increasing the value of wind energy. A recent Task 43 publication [1] defined the “grand challenges” to digitalization in wind energy to be:

1. Data: creating FAIR (findable, accessible, interoperable, and reusable) data frameworks.
2. Culture: connecting people and data to foster innovation.
3. Cooperation: enabling collaboration and cooperation between organizations.

These grand challenges include a mix of technical, cultural, and business aspects that will need collaboration across industry, academia, and government to solve. This is the focus of the second phase of Task 43, which was approved in October 2023 following a task extension proposal. The main objectives of Task 43 in this second phase are:

- Learn about data, data services, knowledge graphs and knowledge engineering [3].
- Publish recommendations for

improving data sharing in the sector.

- Develop and publish existing and new ontologies collaboratively.
- Publish a data maturity roadmap to help the sector plan collaborative activities to increase data usage.
- Understand how organizational culture and competition between organizations can be improved in the sector to foster digitalization. Publish recommendations and success stories for doing so.
- Carry out “deep dive” use cases and develop guidelines or best practices for how priority use cases can be solved in practice.

The countries currently participating in Task 43 are listed in Table 1. Observing countries include Spain (Vortex, Creadis, EGP), France (Vaisala, France Energies Marines), and Norway (NTNU, University of Oslo, Microsoft, TGS).

COUNTRY/SPONSOR	INSTITUTIONS
Switzerland	Eastern Switzerland University of Applied Sciences, EPFL, Berner Fachhochschule, Akselos, Microsoft
USA	NREL, EPRI, Georgia Tech, Apex Clean Energy, Wood, DNV, UL, Shell, NIST, BSEE, University of Miami, Texas A&M University, ENTR Foundation, Ocergy, Nextera, BP, AWS, Ramboll
Ireland	ServusNet, Brightwind, University College Dublin, Atlantic Technological University Sligo, Microsoft
Sweden	RISE, Luleå University of Technology, SR Energy AB, Fortum
Canada	University of Windsor, UL Solutions, Southern Alberta Institute of Technology, University of Victoria, Agriculture and Agri-Food Canada (AAFC)
Denmark	DTU Wind, Aalborg University, SEWPG European Innovation Center ApS, Twind Solutions, R&D Test Systems
Netherlands	TU Delft, Twindo, Suzlon, Wageningen University, TouchWind b.v., Whiffle, Leiden University, Microsoft, Vattenfall
UK	Octue, Natural Power, Bitbloom, Carbon Trust, BayWa r.e., Ramboll, The Crown Estate, Oldbaum Services, University College London, SSE Renewables, RES, Durham University, UKRI, Vattenfall
Germany	Fraunhofer IWES, enviconnect, Ramboll, University Stuttgart, Turbit Systems, University of Oldenburg, Technical University Munich

Table 1. Countries Participating in Task 43

Progress and Achievements

Task 43 has undertaken a wide array of research and communication activities aimed at advancing digitalization in the wind energy sector. The Task has facilitated knowledge exchange through invited speakers from both industry and academia on topics such as knowledge engineering and digital twin architecture.

Significant research initiatives include the development of a recommended practice for ontology creation, publication, and maintenance targeted at wind energy domain experts, alongside the formation of a dedicated ontology sub-working group.

In partnership with the European Academy of Wind Energy, the group is co-developing a Joint Recommended Practice focused on classifying and valuing digital twins in wind energy.

Complementary efforts involve the implementation and preliminary analysis of the IEA Wind Task 43 Culture Question-

naire, and the launch of a skills mapping activity aimed at identifying both current and future digital competencies needed in the sector.

Key technical progress includes launching the redesigned WeDoWind ecosystem (see “Highlights” below) and establishing the new IEA Wind Task 43 Data Users’ Group [2] to tackle SCADA-based analytics challenges. The WRA Data Model has been extended to incorporate floating lidar measurements [8].

Additional technical work has focused on validating risk-based maintenance modeling for blade leading-edge erosion and assessing extreme weather impacts on gearbox reliability using Cooke’s method based on expert elicitations. Decision support tools for financial planning and major O&M decisions are also under development.

Publications and deliverables feature the journal article “Knowledge Engineering for Wind Energy” [3], the TechnoPortal ontology publishing platform [4], and the IEA Wind technical report “Evolving the

Wind Energy Sector Towards Frictionless and Sustainable Data Usage” (in review).

Presentations were delivered at major events, including NREL’s Drivetrain Reliability Workshop 2024 [5], the TORQUE Conference 2024 [6], and the WindEurope Annual Event 2024 [7]. Case studies on structural health monitoring [6] and power curve benchmarking [7] were highlighted in these forums, along with the new release of the WRA Data Model [8] and a publication examining standards in the wind energy sector [9].

Communication efforts include the Annual General Meeting held June 17–19, 2024, in Rapperswil, Switzerland [10], regular meetings with the Industry Advisory Board, and public engagements through four webinars under the IEA Wind Task 43 Webinar Series [11].

Participation in key industry conferences and forums further supported the dissemination of insights and collaboration opportunities across the wind energy community.

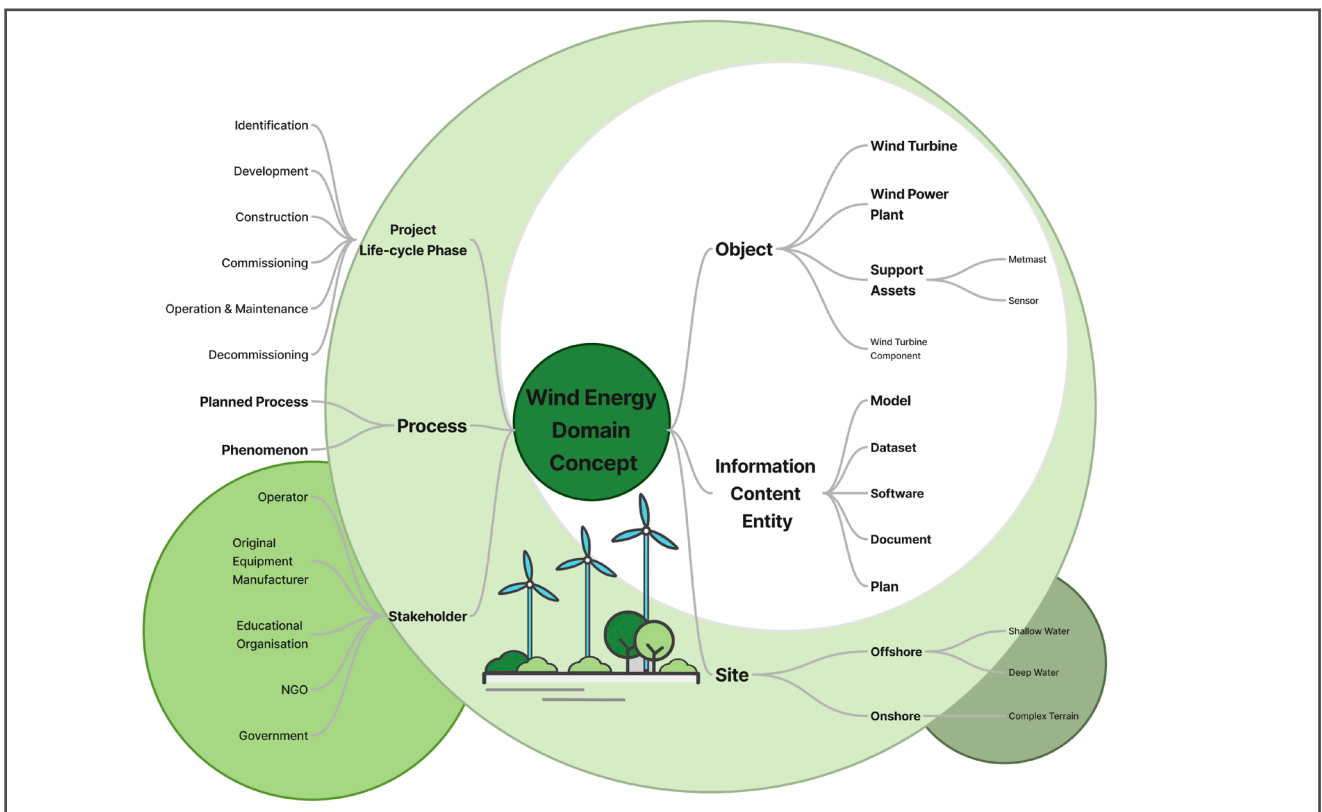


Figure 1. Concept of the new wind energy domain ontology. (Source: Yuriy Marykovskiy, OST, Switzerland.)

Highlights

Publication snapshot

The Task recently investigated [6] how the FAIR Data Maturity Model could be applied to improve data sharing in the wind energy sector via a structural health monitoring case study (FAIR = findable, accessible, interoperable, reusable).

The FAIRness of the provided data was limited due to the lack of community standards. The FAIR Data Maturity Model was then successfully applied to improve the FAIRness of the datasets.

Success story

One of the conclusions of last year’s publication “Knowledge Engineering in Wind Energy” [3] was that there should be a public portal for publishing ontologies in wind energy. Since then, the TechnoPortal ontology repository was published.

Members of IEA Wind Task 43 then published existing ontologies, which were previously not available in machine-readable format, on TechnoPortal (Figure 1). This serves as an essential basis for structuring data in the knowledge graph format required for generative AI in wind energy.

Cross-cutting activities

WeDoWind was expanded to a thriving community from the wind energy sector sharing data and knowledge, connecting users with open data, code, lecture material, information models, best practices, and guidelines for using and publishing code and data (Figure 2). Some IEA Wind Task 43 activities were integrated into WeDoWind, including the IEA Wind Task 43 Vocabulary and Ontology Development Group, the IEA Wind Task 43 WRA Data Model Group, the IEA Wind Task 43 Open-Source Community, and the IEA Wind Task 43 Data Users’ Group. This has the potential to be expanded to other IEA Wind TCP Tasks.

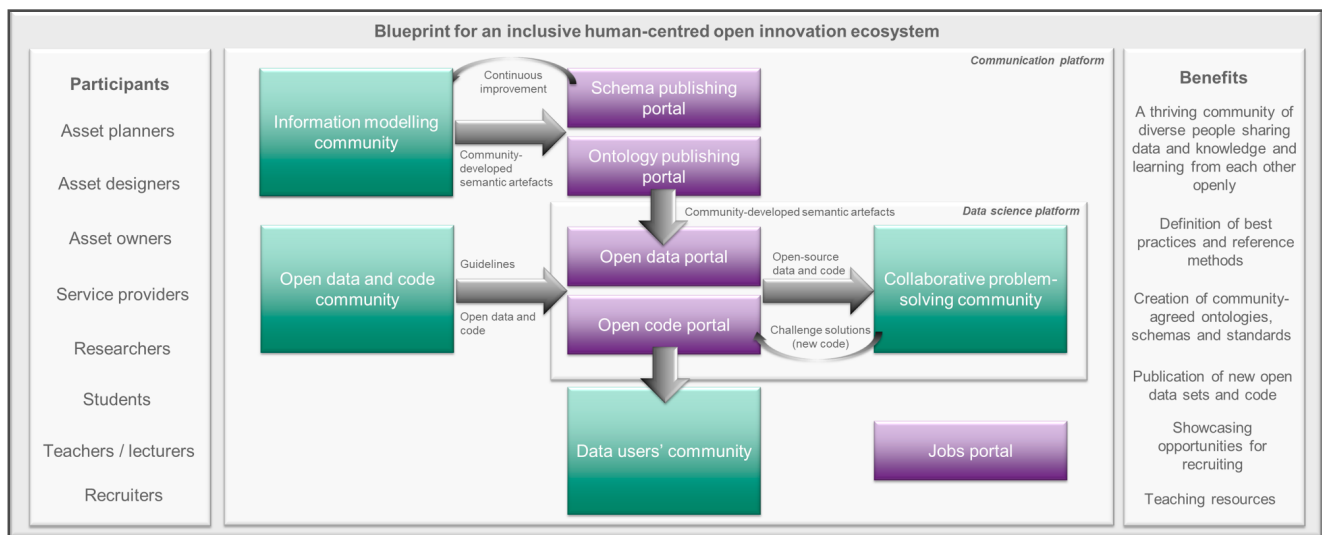


Figure 2. Overview of the WeDoWind ecosystem. (Source: Sarah Barber, OST, Switzerland)

Outcomes and Significance

The results are beneficial to the participants in several ways:

Learning effects: By attending invited talks, and working together on publications, guidelines and frameworks, the participants learn from each other and build up their own understanding of specific topics, which can then be transferred to their colleagues outside of the Task.

Network effects: By interacting with people from different areas of the sector from both academia and industry, the participants get to know each other and develop ideas together.

Early adoption: Through internal dissemination activities (website, Slack channel, webinars, yearly meetings), the participants are well-connected to all the activities within the Task and can test and adopt the results more quickly and effectively than non-participants.

Digitalization is a broad topic, but because the whole life cycle is addressed, the results are beneficial to the entire industry. The Task’s various published guidelines, papers, tools, code, and models are available publicly. The webinar series helps people connect and understand what the Task does. Furthermore, the results are applicable to society.

The Task’s work provides inspiration for international and open collaboration and innovation, especially since the introduction of the new WeDoWind ecosystem.

Next Steps

Task 43 Wind Energy Digitalization aims to publish the technical report “Evolving the Wind Energy Sector Towards Frictionless and Sustainable Data Usage”, finalize Recommended Practices on ontology management and digital twin valuation with the European Academy of Wind Energy, and release results from its skills mapping, use case studies, and culture questionnaire.

A draft wind energy domain ontology will also be published. Additionally, a task extension plan will be submitted to support continued progress in these areas.

References

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- [10] Report of the IEA Wind Task 43 AGM 2024; iea-wind.org/2024/07/08/task43-agm2024-report/
- [11] Webinar recordings available here; iea-wind.org/task43/task-43-events/

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