



Report 2021

# Task 43

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## Wind Energy Digitalization

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**While the wind industry has already made progress in digitizing specific segments of the wind plant life cycle, much remains to be done to increase digitalization momentum.**

This includes developing a holistic view and identifying wider opportunities to reduce lifecycle costs, expedite deployment, enhance the performance of assets, and integrate wind energy effectively into evolving energy grids and markets.

The scope of the Task includes digitalization topics across the following

dimensions:

- Lifecycle stages
- Value-chain components
- Interaction between and across the lifecycle and value-chain players

The purpose is to coordinate research and development activities, from data and analytics to connectivity across the global wind

**Table 1. Countries and actively participating institutions in Task 43**

	COUNTRY	ACTIVE INSTITUTION(S)
1	Canada	University Windsor
2	Denmark	DTU Copenhagen, Aalborg University
3	Germany	clockworkX, ForWind, Fraunhofer IEE, ZSW
4	Ireland	ServusNet Informatics, Brightwind, Bord na Mona
5	Norway	University Trondheim
6	Sweden	RISE Research Institutes of Sweden
7	United States	Brandville, DNV, EDF-RE, E.ON, Ensemble Energy Services, EPRI, Lloyd's Register, NREL, NRG Systems, ORNL, PNNL, Renewable Asset Partners, Scout Clean Energy, Sentient Science, SGRE, Stacker Group, TetraTech, Uptake Technologies, Sandia National Laboratories, Wisconsin Public Service Corporation, Texas A&M University

**Additionally, Task 43 closely collaborates with:**

Eastern Switzerland University of Applied Sciences, Rapperswil  
Ramboll UK Limited, London

**and has built strategic alliances with a variety of related groups, including:**

WindEurope  
American Clean Power Association  
ENTR Alliance  
IEC

industry, and to recommend best practices that maximise benefits from digitalization while minimising duplicate or inefficient effort. Task 43 will achieve those goals by convening an international expert body to:

- Define what is meant by wind energy digitalization
- Describe the current state of digitalization capability and practice within the wind energy sector
- Identify and prioritise value-add digitalization opportunities
- Develop recommended digitalization practices for the wind energy sector

Since the topic of digitalization is quite broad, the Task comprises several work packages. Now, the teams are working in parallel on both technical issues and cross-cutting topics. Additionally, based on the outcomes of a number of interviews

with external experts from research and industry and on the results of the technical discussions, Task 43 strives to develop a roadmap for digitalization in wind energy.

**Introduction**

The wind energy sector is data-intensive due to large commercial fleets of physically distributed turbines, dynamically changing ambient conditions, continuous interaction with the grid, and real-time processing of data from all systems. Stakeholders accumulate increasing volumes of diverse data for various purposes throughout turbine design and manufacture, development, construction, operation and maintenance, and decommissioning.

This evolving complexity demands highly scalable data infrastructure, efficient interoperability across sector participants, and innovative analytical methods to ensure continued competitiveness.

The key activities of IEA Wind Task 43 are:

**Work Package 1:** Wind Energy Digitalization Roadmap

**Technical Area 2:** Data Standards and Data Sharing

**Technical Area 3:** Data Science and Open Source

**Work Package 4:** Digital Resource Assessment

**Work Package 5:** Digital O&M

**Progress and Achievements**

**WP1, State of the art and roadmap**, continued its effort to publish expert insights about current challenges and promising opportunities in wind digitalization titled "Grand Challenges in Wind Digitalization," which is in the final stages of editing and publication. The team is now turning its attention to a roadmap document in response to those challenges. The roadmap covers two time horizons: 3-5 years (what we call the next state) and 5-10 years (The future state).

## Task 43 Roadmap/Maturity Levels

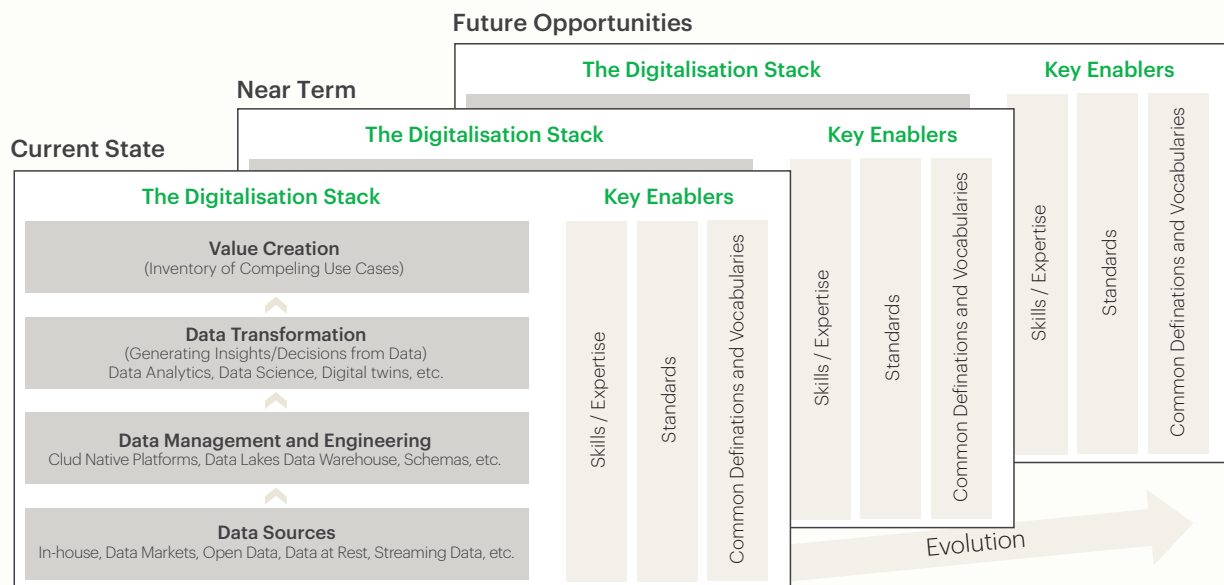


Figure 1. Concept for Wind Digitalization Roadmap and Maturity Levels

**TA2, Data standards and data sharing,** discuss possible solutions for enabling and encouraging stakeholders in the wind energy sector to benefit from data sharing. One current focus is on defining metadata schemas, which enable data owners to describe their datasets in a standardised way that allows third parties to find these datasets and recognise it as a suitable source supporting their task. Another focus is on a comprehensive list of publicly available data sources for applications in wind energy.

**TA3, Data science and open source,** is working on a Data Science Application Basics guidelines document. This document aims to bridge the gap between technical teams and decision-making teams by providing insights into how data science can be used to drive decisions and to understand key technical issues involved. The ethos of this work has been presented as a poster at the 2021 WindEurope Technology Workshop.

**WP 4, Digital Resource Assessment,** has developed and published a data model which structures wind re-

source measurement metadata, providing a foundational building block in the sharing, digitizing, and automation of the wind resource assessment process. It is fundamental to building automation tools as the data model is machine readable. This data model is implemented as a JSON schema with accompanying documentation and is available through the IEA Task 43 Github ([https://github.com/IEA-Task-43/digital\\_wra\\_data\\_standard](https://github.com/IEA-Task-43/digital_wra_data_standard)) under an open source, BSD 3-clause license.

**WP5, Digitalization of O&M,** continues to investigate representative use cases. The "Value of Data" team is working on a "cookbook" providing guidance on implementing a value-driven data strategy. The "Value of Data" Standards Gap Analysis effort collaborates with the TA2 team on a more comprehensive mapping. The "Risk-Based Maintenance" team is capturing its findings on cost-optimised inspection & repair in a technical paper on the model and data methodology, and an outlining the approach in an operational context. The "Digital Twins" use case is exploring the application of the technology as

an operations decision-support tool. Additionally, the "Digitalization Maturity Model" team collaborates with the WP1 Roadmap effort, while WP5 is working with TA2 on a structured inventory of digitalization use cases.

### Highlight

The data standards and data sharing work package (TA2) has provided a summary of publicly available data sources to the community. This summary is available via Task 43's website (<https://www.ieawindtask43.org/proceedings-work-products/open-data-resources>). The intention behind this summary is to provide an accessible resource to those who may visit Task 43's website. While we believe it is a comprehensive list, we recognise that it may not be exhaustive.

We note, however, that not all the datasets are open or described with standardised metadata. TA2 evaluated all data sources with respect to content, public availability, available publication, stakeholders, and similar criteria. We attempted to design the summary so that it guides the reader to help them find data that will suit their need. Our vision: an Open Data

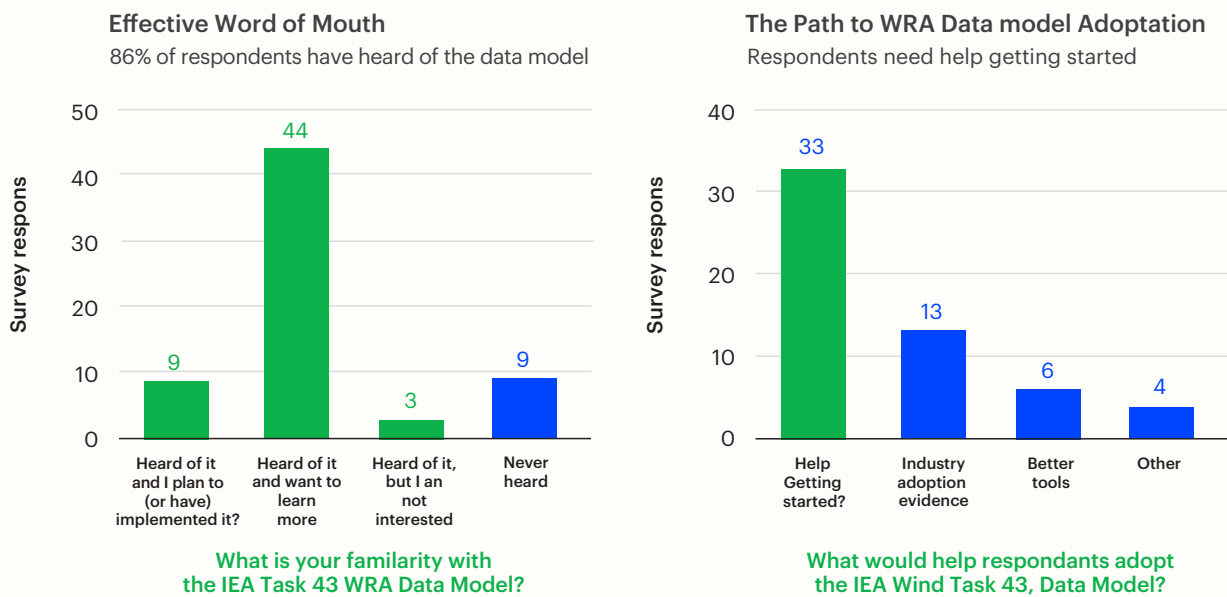


Figure 2. WRA Data Model Adoption

Sources Catalogue that eases the burden on researchers, educators, practitioners, and policymakers to find and access existing open data sources.

Meanwhile, WP4 developed a comprehensive data model for wind resource assessment within a relatively short period of time and released it on GitHub. First published a year ago, WP4 continues to iterate on the data model. The main highlight is the rising level of interest and committed support by commercial organisations and software developers in the wind sector. This was made visible and underscored by the greater-than-expected attendance at a recent WRA Data Model User Workshop (and the fact that there is now an established user base for the data model).

### Outcomes and Significance

Digitalization is an ongoing process in all life cycle phases of a wind farm and in all value chains. In this context, Task 43 intends to provide an overall picture of digitalization opportunities as well as barriers and possibilities to overcome.

Technical barriers include data completeness, quality, format, etc. Additionally, the volume or quality of data

available to a single owner, or user, is frequently not sufficient to yield valuable data-driven conclusions. Here, data sharing amongst several owners could be a solution, but due to technical and commercial barriers, data sharing is not yet common practice.

Obviously, there is one more barrier, which concerns the culture within organisations and companies. Data owners will be reluctant to share data to apply good data quality standards as long as the value of doing so is unclear. Currently, there is no forum for data owners to present their data, nor is there a common framework for describing any datasets being offered for sharing.

The international collaboration in Task 43 can provide clear recommendations and help stimulate a change in attitudes towards the value of data and digitalization opportunities.

### Next Steps

Apparently, Task 43 will not be able to achieve all initially planned goals. However, the plan for 2022 is to achieve important deliverables, which should be

- Publication of the paper “Grand Challenges in The Digitalization of Wind Energy”

- Presentations at WindEurope Annual Event in Bilbao, April 2022
- General Task 43 meeting in Brussels combined with the opportunity of attending the WindEurope Technology workshop in June 2022
- Draft of a “Data Maturity Roadmap” paper converging outcomes of the work packages and work package cross-cutting collaborative actions
- Extension proposal to continue the work in Task 43 and to finalize ongoing work

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