

# Agreed Challenges and Opportunities



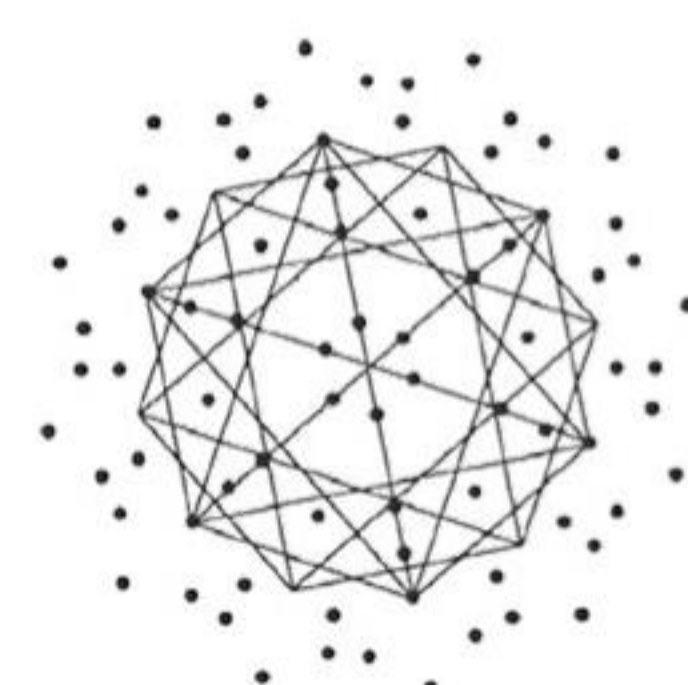
RESULTS FROM 30+ INTERVIEWS: MOST SEVERE CHALLENGES TO FOSTERING DIGITALIZATION IN WIND ENERGY

## TASK 43 REPORT 2020

### Digitalization of wind energy

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.

≡ JASON FIELDS, National Renewable Energy Laboratory  
BERTHOLD HAHN, Fraunhofer IEE



**WIND ENERGY  
DIGITALIZATION**  
IEA WIND TASK 43

Increasing volumes of diverse data are accumulated for a variety of 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

Following the task's proposal, six working groups formed, decided on aims and drafted work plans. However, the planned content for WP6 on digital life assessment did not attract enough participation and it also turned out that there would be some overlap with WP5. They were therefore combined and WP5 will address the topic of asset valuation throughout the lifetime of the plants.

**WP1 'State of the art and roadmap'** started with an outline of their planned state-of-the-art and roadmap report. This included developing taxonomies of digital technologies and the wind plant life cycle phases to which they can be applied. Through a series of expert interviews, the team gathers opinions and perspectives of experts about current challenges and promising opportunities in wind digitalization. These insights are being analyzed to create an initial release of findings titled "Grand Challenges in Wind Digitalization". To date, several research and industry partners have participated in the process, including 30 individuals and representatives from WindEurope.

**TA2 'Data standards and data sharing'** will develop recommendations for the wind industry on requirements for data standards and how to foster data sharing. Digitalization promises many opportunities regarding data generation, management and data driven analysis. However, realization depends much on data quality and data availability. The planned recommendations will address gaps in data standards and strive to describe mechanisms for data owners and potential data users to match requests and offers including concepts like data marketplaces, federated learning and the FAIR data principle.

**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. TA3 is also working towards organizing a hackathon in order to accelerate the developments in some key areas. Finally, TA3 is running a paper club, where participants introduce and discuss a scientific paper on topics related to data science within and outside the wind industry.

**WP 4 'Digital resource assessment'** intends to describe a complete WRA assessment data standard enabling standardized data sets as input for data science methods. This "universal data standard for wind resource assessment" data model was 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))

TABLE 1. COUNTRIES PARTICIPATING IN TASK

Table 1. Task 43 Participants in 2020		
	Country/Sponsor	Institution(s)
1	Canada	University Windsor
2	Denmark*	DTU (Copenhagen)
3	France	Meteolien
4	Germany*	clockworkX, ForWind, Fraunhofer IEE, ZSW
5	Ireland*	ServusNet Informatics, Brightwind, Bord na mona
6	Norway*	University Trondheim
7	Spain	Tecnalia, University Zaragoza
8	Switzerland	University Rapperswil, University Zürich
9	United Kingdom	EDF Energy, Ithaka Clean Energy, Red Rock Power, RES Group, University Southampton
10	United States*	Brandville, DNV, EDF-RE, E.ON, Ensemble Energy Services, EPRI, Lloyd's Register, MXV Ventures, NREL, NRG Systems, ORNL, PNNL, Renewable Asset Partners, Scout Clean Energy, Sentient Science, SGRE, Stacker Group, TetraTech, Uptake Technologies

FURTHER IEA WIND TASK 43 HAS WORKED TO BUILD STRATEGIC ALLIANCES WITH A VARIETY OF RELATED GROUPS INCLUDING WINDEUROPE, AWEA, ENTR ALLIANCE, AND IEC.



## What are your biggest challenges in digitalization?



IEA WIND TASK 43 MEETING SURVEY OF CRITICAL CHALLENGES IN WIND ENERGY DIGITALIZATION

under an open source BSD 3-clause license. Extensive discussion and effort went into understanding the value proposition, open source contribution rights and functional requirements for a data standard.

**WP5 'Digitalization of O&M'** decided to select and explore representative use cases as a way of identifying opportunities and challenges and, from this, formulate a set of best practices and recommendations. Use case one, 'Value of Data', focusses on the impact that the availability of historical data and comprehensive operational records can have on the assessment of asset value. Use case two, 'Risk-Based Maintenance', concentrates on combining cost, damage, and risk-based decision models to optimize scheduling of inspection and repair processes. The third use case revolves around the implementation of digital twins and how they can facilitate performance and maintenance actions. A fourth activity stream draws on each use case, and from other industry sectors, to build

an O&M Digitalization Maturity Model to help map capability levels and transitions.

### Highlight

Within a relatively short period, WP4 have developed a comprehensive data model for wind resource assessment and released it on GitHub. This data model will facilitate greater efficiency within and between companies utilizing pre-construction measurement data in the development process. It will also form the foundation for scalable data analytics and next generation machine learning workflows in wind resource assessment. It is publicly available as an open-source model and readily deployable due to a structure built for easy database implementation. It has been disseminated through a wide range of venues including AWEA, WRAG.io, ASME and WindEurope.

Currently the working group is working with equipment manufacturers and calibration centers to implement



instrument specific considerations as well as a digital calibration certificate scheme. WP1 is also working on some example applications that can be built on top of the data model. It is hoped that use will grow organically through continued dissemination and that the International Electro-technical Committee (IEC) may become a logical place for long-term adoption.

### 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 organizations 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

The participants of Task 43 come together twice a year for general meetings. The next “digital week” will take

place from 18-20 May with three sessions per day. First session on all three days will be keynote speeches or panel discussions with external experts from the Amazon, Linux Foundation Energy, Icebreaker One, Siemens-Gamesa Renewable Energy, Ithaca Clean Energy, Irish Health services, and more.

WP1 will publish a ‘Grand Challenges in Wind Digitalization’ report on the initial findings from the State of the Art and Roadmap interviews.

Several abstracts for the upcoming WindEurope Technology Workshop in September have been accepted as oral presentations. WindEurope has also reserved a dedicated Task43 session in the September technology conference, the contents for which are now being planned.

### References

M Jason Fields, Berthold Hahn, Des Farren, & John McCann. (2020, May 2). Proceedings of the IEA Wind Topical Expert Meeting #92 on Wind Energy and Digitalization. Zenodo. <http://doi.org/10.5281/zenodo.3782884>

### Task Contact

Operating Agent:

Jason Fields, [Michael.Fields@nrel.gov](mailto:Michael.Fields@nrel.gov)

2nd operating agent:

Berthold Hahn, [berthold.hahn@iee.fraunhofer.de](mailto:berthold.hahn@iee.fraunhofer.de)

### Authors

Jason Fields, National Renewable Energy Laboratory  
15013 Denver West Parkway  
Golden , CO 80401, USA

Berthold Hahn, Fraunhofer IEE  
Koenigstor 59  
34119 Kassel, Germany 🌐