Working Group Case Statement

Wind Energy Community Standards
Sarah Barber, Eastern Switzerland University of Applied Sciences (OST)
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1. **WG Charter**:

The goal of the WG is to reduce data management overhead within and between organisations working with wind energy. This will be done by firstly creating a recommendation "Guidelines for improving FAIR data maturity in wind energy in practice". This will then be used to create a wind energy FAIR Implementation Profile (FIP)[1], which is a methodology developed within the GO FAIR initiative. FIP will give the scientific and research communities the opportunity to express their choices of standards, technologies, tools and procedures by which they fulfil the FAIR principles.

We will achieve these goals by first reviewing and evaluating the current data sharing and publishing landscape in wind energy. This landscaping step will be based on a review paper we recently wrote about knowledge engineering in wind energy [1], but will extend the review of semantic artefacts to data sharing and publishing in general. For example, we will verify to which degree these artefacts can be described using the available controlled vocabularies. This includes, for example the WEAVE and NEAT controlled vocabularies, as well as the Task 43 WRA Data Model [1]. We will also will apply the "FAIR Data Maturity Model" [2] and the "Guidelines for publishing structured metadata on the Web" [3] to a choice of existing open data sets as well as data with access restrictions provided to WG members by commercial organisations such as wind farm owner/operators or service providers or governmental organisations (maintaining confidentiality). The choice of datasets will be made by taking a range of different data sets across the wind energy project lifecycle at different FAIRness levels based on the results of the above-mentioned review.

The results of the landscaping and review steps will then be used to identify high potential areas for improving FAIR data maturity in wind energy (i.e. areas for which a clear path to improvement can be seen and a large impact on the FAIRness is expected). We will utilise the knowledge of other RDA community members, e.g.
- FAIR Data Maturity Model WG,
- Harmonised terminologies and schemas for FAIR data in materials science and related domains WG,
- Metadata Standards Catalog WG,
- Data Versioning IG,
- Domain Repositories IG,
- Engaging Researchers with Data IG,
- Metadata IG,

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[1] https://www.go-fair.org/how-to-go-fair/fair-implementation-profile/

- Vocabulary Services IG,

together with inputs from IEA Wind Task 43 members to then develop guidelines for improving FAIR data maturity in practice for these high potential areas (i.e. which tools to use, how to use them, why to use them, definition of relevant use cases). Then, we will make concrete suggestions for improving or extending the "FAIR Data Maturity Model" and the "Guidelines for publishing structured metadata on the Web". Finally, we will use the results to create a wind energy FAIR Implementation Profile (FIP), with guidance from the WorldFAIR project[2].

2. **Value Proposition**:

The "Guidelines for improving FAIR data maturity in wind energy in practice" and the FIP will have the potential to help anyone working in the wind sector share data. It will also support less advanced communities to kick-start their activities. In the RDA context this domain is of particular interest as industry plays a more central role compared more academically-focused areas. Therefore, this WG can implicitly serve as a testbed for further industry involvement in FAIR data practices.

In wind energy, data sharing is a particular challenge for several reasons. Firstly, data is available at a very wide range of spatial and temporal resolutions, from mm-scale sound emission measurements of rotor blade trailing edge separation up to 100s of km-scale seasonal wind conditions [4]. Secondly, the data is very heterogenous, ranging from hand-made log-book notes from a technician, survey results from local communities afraid of wind turbine health effects, wind turbine component geometries, as well as wind, vibration and load measurements [5]. Thirdly, a multitude of stakeholders across the wind energy project lifecycle have different data sharing needs [5]. Finally, the sector is very siloed and resistant to open innovation or data sharing, due to fears regarding the loss of competitive advantage [6].

In this respect, FAIR data will not only improve innovation by enabling a more productive and fluid collaboration between diverse industry and academic partners, but it will also increase the efficiency of data sharing processes within the core business of commercial organisations. For example, the guidelines will provide researchers with concrete suggestions and tools for publishing research outputs and data sets in the most effective, easily reusable way. Such resources will help data scientists by providing them with better prepared and structured data for their models. The ecosystem resulting from our work will provide anyone from the wind energy industry or academia with tools and suggestions for preparing and structuring their data, helping them to share data with project partners in a more efficient way. It will allow researchers and data scientists to start building shared data repositories and knowledge graphs, which could be used as a basis for AI models in the future. It will provide a basis for developing community-agreed and harmonised vocabularies and ontologies.

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[2] https://worldfair-project.eu/

The need for improving FAIR data maturity in wind energy is strong. Digitalisation is one of the key drivers for reducing costs and risks over the whole wind energy project life cycle[3]. However, digitalisation in the absence of accompanying process, policy and standards developments will have only (very) limited benefit. A recent review paper "The Grand Challenges of Digitalisation in Wind energy[4]" defined the three main challenges of a successful digitalisation in wind energy as: (1) Creating FAIR data structures; (2) Connecting people and data to foster innovation; (3) enabling collaboration and competition between organisations. The results of the WG will act as an important basis for addressing the first challenge. It will also contribute to the second two challenges by bringing together a community of people to foster innovation and to enable collaboration and competition.

3. **Engagement with existing work in the area**:

This WG intends to engage strongly with IEA Wind Task 43, which is co-lead by Sarah Barber, a suggested co-chair of this WG. The mission of IEA Wind Task 43 is to act as a digital transformation catalyst by driving open collaboration within and beyond the wind community to deliver insights, recommendations, standards and tools in the key areas of data, culture, and coopetition. Within Working Group 1, previous wind energy initiatives in the area of knowledge engineering have recently been reviewed[5], and work is now progressing on the community-lead development of new vocabularies and ontologies. This differs from the work within this RDA WG, which goes on to apply some of these tools to a range of datasets in order to develop the recommendation "Guidelines for improving FAIR data maturity in wind energy in practice". The participants of IEA Wind Task 43 will benefit immensely from the results of this RDA WG. Additionally, some topics may overlap, and we intend to use synergies to benefit both groups. In particular, we will focus on the international character of both the RDA and IEA Wind Task 43 communities.

Other groups with whom a collaboration may be of interest, besides other RDA groups mentioned in Section 1, include the ENTR Alliance[6], that develops open data standards for clean energy (with whom IEA Wind Task 43 already collaborates), the PPDM Association International Energy Data Standards group[7], who define and create standards to help oil and gas companies manage exploration and production data, the WindEurope Digitalisation Task Force, which includes the Wind Energy Data Standards group (which Sarah Barber is a part of), and TIM Wind[8] (with whom IEA Wind Task 43 already collaborates with), who concern themselves with Technical Information Management for the wind industry.

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[3] https://windeurope.org/intelligence-platform/product/wind-energy-digitalisation-towards-2030/
[4] https://wes.copernicus.org/articles/8/947/2023/wes-8-947-2023.html
[5] https://arxiv.org/abs/2310.00804
[6] https://www.entralliance.com/
[7] https://ppdm.org/ppdm/PPDM/IEDS/PPDM/IEDS.aspx
[8] https://apqp4wind.org/tim-wind

4. **UN Sustainable Development Goals (SDGs)**

This WG will mainly contribute to SDG 7 (affordable and clean energy) by improving data sharing in the wind energy sector. In particular, it will foster target 7a "By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology". It will enable the sector to become more innovative, inclusive and collaborative, thus reducing the costs and increasing the value of wind energy. This brings with it additional contributions to SDG 9 (industry, innovation and infrastructure), SDG 10 (reduced inequalities) and SDG 5 (gender equality).

5. **Work Plan**:

The WG will operate via monthly online meetings, in which first an overall structure of the final recommendation will be drafted and specific people assigned to specific sections. Additional working sessions will be organised at RDA Plenary events in order to encourage wider participation and to leverage the advantages of face-to-face meetings. The initial structure of the recommendation will be based on the following planned tasks:

- Review and evaluation of the current FAIR data landscape in wind energy.
- Application of the "FAIR Data Maturity Model" and the "Guidelines for publishing structured metadata on the Web" to a choice of existing open data sets as well as data provided to WG members by companies (maintaining confidentiality).
- Identification of high potential areas for improving FAIR data maturity in wind energy (i.e. areas for which a clear path to improvement can be defined and implemented; a large impact on the FAIRness is expected).
- Development of guidelines for how to improve the data FAIRness in practice for these high potential areas (i.e. which tools to use, how to use them, why to use them).
- Make concrete suggestions for improving or extending the "FAIR Data Maturity Model" and the "Guidelines for publishing structured metadata on the Web" (extending the work already carried out in Sarah Barber's previous RDA grant[9]).

An approximate time plan for these tasks (plus dissemination) is given in the timeline below. The group members will work on their assigned sections between the meetings, and progress will be discussed every month. Community consensus will be achieved through discussions, a public request-for-comments on intermediate results, and online voting. This may include attending meetings or collecting inputs from other people from the wind energy community, especially from IEA Wind Task 43, as well as from knowledge engineering and metadata experts from the RDA community. We expect to gain momentum as we go along. In particular, once we have carried out the first two activities, we will be able to approach specific experts from the RDA community who can help us. In order to increase participation and engage a wider community, public webinars will be organised at the start and after nine months into

the WG existence, in collaboration with IEA Wind Task 43. A webinar at the end aims to help adoption of the guidelines in the wind energy community. RDA TIGER support has been secured to support us in the initial start-up stage, in organising meetings, assigning/following-up on actions, and especially in communications and dissemination. We intend to launch the WG at the RDA P22 plenary in May 2024, if the session gets accepted.

Activity	Month																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Review and evaluation of the current FAIR data landscape in wind energy	█	█	█															
Application of the FAIR Data Maturity Model to a choice of existing open data sets				█	█	█												
Identification of high potential areas for improving FAIR data maturity in wind energy							█	█										
Development of guidelines for how to improve FAIR data maturity in practice									█	█	█	█	█	█	█	█	█	█
Creation of TIP														█	█	█	█	█
Make concrete suggestions for improving or extending the "FAIR Data Maturity Model" and the "Guidelines for publishing structured metadata on the Web".																	█	█
Dissemination																█	█	█
Public webinars	█								█									█

6. **Adoption Plan**:

The recommendation will be adopted by combining it with WeDoWind challenges, which are continuously running as part of another effort by OST to improve data sharing in wind energy. WeDoWind is a framework for bringing asset owners together with researchers and model developers in a "win-win" situation, whereby asset owners get easy access to state-of-the-art data analytics and model developers get access to relevant asset data to train and validate their models[10]. We intend to apply the recommendations to the datasets shared within WeDoWind challenges, and then to assess their impact and acceptance via participant surveys or workshops, similarly to previous projects[11]. Further via the participating DLR members, we envision to test and possibly apply the developed techniques using the DLR WiValdi wind energy research farm[12], its digital twin[13], and their associated data portal.

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[10] https://www.wedowind.ch/
[11] https://iopscience.iop.org/article/10.1088/1742-6596/2507/1/012003.
https://www.wedowind.ch/blog/interim-report-rtdt-space-aug2023
[12] https://windenergy-researchfarm.com/
[13] https://www.dlr.de/as/en/desktopdefault.aspx/tabid-19148/30640_read-83889/

7. **Initial Membership**:

Initial members are expected to include:

Name	Organisation	Country	Member type
Sarah Barber	OST	CH	Co-chair
Shawn Sheng	NREL	USA	Co-chair
Yuriy Marykovskiy	OST	CH	Member
Maarten Trekels	Plantentuin Meise	BE	Member
Marta Dembska	DLR	DE	Member
Sirko Schindler	DLR	DE	Member
Eugenio Arellanoruiz	DLR	DE	Member
Marek Cebecauer	JH Institute	CZ	Member
Anna Maria Sempreviva	DTU Wind	DK	Member
Julian Quick	DTU Wind	DK	Member
Marwan Abolmagd	Twindo Technologies	NL	Member
Paula Doubrawa	NREL	USA	Member
Jeffrey Clerc	NREL	USA	Member
Elizabeth Traiger	GNV GL	USA	Member
Guy Yakir	First Airborne	Israel	Member
Stuart Chalk	University of North Florida	USA	Member
Lewis Armistead	Apex Clean Energy / ENTR Alliance	USA	Member
Charles Henderson	ENTR Alliance	USA	Member

8. **References:**

[1] Marykovskiy, Y., Clark, T., Day, J., Wiens, M., Henderson, C., Quick, J., Abdallah, I., Sempreviva, A. M., Calbimonte, J.-P., Chatzi, E., and Barber, S.: Knowledge Engineering for Wind Energy, Wind Energ. Sci. Discuss. [preprint], https://doi.org/10.5194/wes-2023-173, in review, 2024.

[2] FAIR Data Maturity Model Working Group. (2020). FAIR Data Maturity Model. Specification and Guidelines (1.0). Zenodo. https://doi.org/10.15497/rda00050.

[3] Wu, M., Juty, N., RDA Research Metadata Schemas WG, Collins, J., Duerr, R., Ridsdale, C., Shepherd, A., Verhey, C., & Castro, L. J. (2021). Guidelines for publishing structured metadata on the web (3.1). Zenodo. https://doi.org/10.15497/RDA00066.

[4] Paul Veers et al., Grand challenges in the science of wind energy. Science 366, eaau2027 (2019). DOI:10.1126/science.aau2027.

[5] Clifton, A., Barber, S., Bray, A., Enevoldsen, P., Fields, J., Sempreviva, A. M., Williams, L., Quick, J., Purdue, M., Totaro, P., and Ding, Y.: Grand challenges in the digitalisation of wind energy, Wind Energ. Sci., 8, 947–974, https://doi.org/10.5194/wes-8-947-2023, 2023.

[6] Barber S, Lima LAM, Sakagami Y, Quick J, Latiffianti E, Liu Y, Ferrari R, Letzgus S, Zhang X, Hammer F. Enabling Co-Innovation for a Successful Digital Transformation in Wind Energy Using a New Digital Ecosystem and a Fault Detection Case Study. Energies. 2022; 15(15):5638. https://doi.org/10.3390/en15155638.