Report 2023

Task 51

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Forecasting for the Weather-Driven Energy System

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A decade ago, the idea of "wind integration" discussed how to integrate 10% or more of wind energy in an otherwise unchanged power system. A decade from now, wind and solar will be the backbone of the energy system, at least in some areas of the world at some times.

Task 51 reaches out to other Tasks and TCPs to discuss and improve forecasting for all aspects of the weather driven energy system. It aims to improve the forecast performance from minute-scale to seasonal scale, and increase the value obtained from the forecasts by improving their usage. The work is organised across three Work Packages (Atmospheric Physics, Conversion to User Variables, and End Use) and spans 13 work streams, e.g. minute-scale forecasting, seasonal forecasting, data sharing, the value of forecasting or extreme power system events.

In 2023, the main event was the public Workshop on Seasonal Forecasting in Reading, United Kingdom. See

the Highlight section for more details.

Industry collaborates as end users, e.g. those operating a renewable generation facility, trading the power or receiving it in a power system as Transmission System Operators. Industry also collaborates in the form of forecast providers, mostly using the results from weather predictions provided by national weather institutes, but sometimes also running their own weather models.

Introduction

Task 51 seeks to collaborate both within the IEA Wind TCP (i.e., Task 25 Large-Scale Integration, Task 44 Wind Farm Flow Control, Task 48 Airborne Wind Energy, Task 50 Hybrid Power Plants and Task 52 Large-Scale Deployment of Wind Lidar), and with the broader renewables sector. It has established a collaboration with IEA PVPS Task 16, Solar Resource for High Penetration and Large-Scale Applications, for its solar forecasts and organised a common workshop on minute-scale forecasting in 2024. Additionally, guests from the IEA Hydro Annex IX, Valuing Hydropower Services, have participated in some Task 51 meetings. Furthermore, Task 51 has established a collaboration with the WMO (World Meteorological Organisation) Study Group on Integrated Energy Services and the IEC (International Electrotechnical Commission) Sub-Committee 8A Working Group 2 on Forecasting Renewable Energy Power.

The work is structured in three work packages, partitioned according to stakeholders (meteorologists, forecast vendors and end users). Academics populate all three work packages. The participant list is around 350 people, which makes Task 51 the largest global discussion group on forecasting of renewables. The topical activities are designed across the work packages as work streams. The 13 work streams span meteorology, data, uncertainty, decision making, several specialised time horizons, and the value of forecasting.

Progress and Achievements

In 2023, the work of Task 51 focused on the dissemination of the many results from 2022 and connecting the parts on the forecast timescales.

Seasonal forecasting is filling the gap between short-/medium-range weather forecasting (0-10 days ahead) and climate change predictions (decadal time scales). A workshop on seasonal forecasting was organised in Reading, United Kingdom in May 2023 and showed there are services ready to be delivered to the energy industry. However, the industry lacks knowledge and use cases on how to employ and benefit from such forecasts. Today, seasonal forecasts are mostly used in the forward markets at power exchanges, but with limited success. Other applications are in system operations on adequacy and long-term reserves planning. It was found there are both services and applications, while education is needed for end-users for interpretation of seasonal forecasts, as well as guidelines for the various

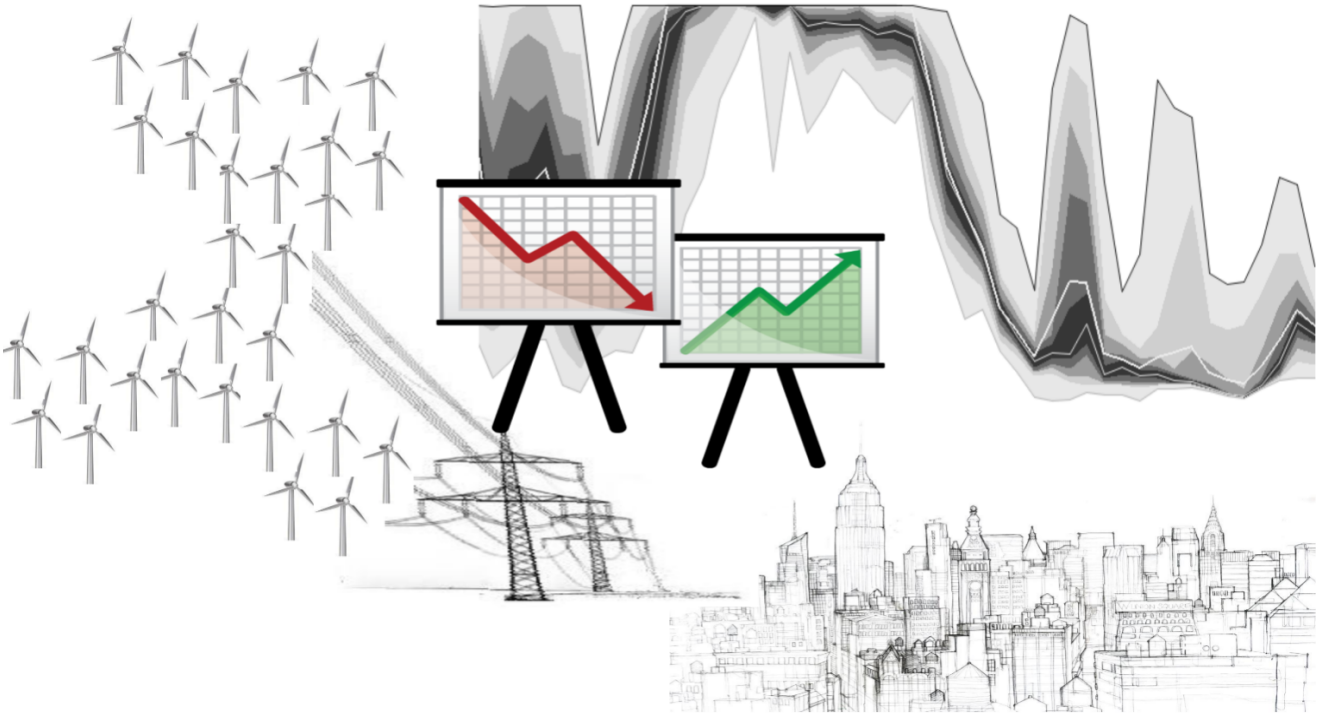

Figure 1: Wind Power Forecasting for Grid Integration. *Source: Corinna Möhrlen, WEPROG.*

Table 1. Countries Participating in Task 51.

COUNTRY/SPONSOR	INSTITUTION(S)
Austria	Geosphere Austria; Austrocontrol Digital Services
CWEA	China Electric Power Research Institute; China Meteorological Administration; Envision; North China Electric Power University; Xinjiang Goldwind; Zhejiang Windey
Denmark	Technical University of Denmark (DTU); Denmarks Meteorological Institute; DNV; ENFOR; WEPROG; ConWX; Ea Energianalyse
Germany	Deutscher Wetterdienst; Fraunhofer Institute for Energy Economics and Energy System Technology; Enercon; ForWind; Zentrum für Sonnenenergie und Wasserstoff-Forschung; WindForS; EWC; 4cast; Stuttgart University; DLR Vernetzte Energiesysteme; MPI Bildungsforschung; enercast, Overspeed; Uni. Tübingen
France	MINES ParisTech; MeteoSwift; MetEolien; Electricité de France; Compagnie Nationale du Rhône; Engie Green; Réseau de transport d'électricité
Finland	VTT Technical Research Centre of Finland; FMI
Ireland	Technological University of Dublin; University College Dublin
The Netherlands	Windpoint; TU Delft; Whiffle; KNMI
Portugal	INESC TEC; Laboratorio Nacional de Energia e Geologia
Spain	Iberdrola Renovables; Electricidade do Portugal Renovaveis; Red Electrica de España; Scirocco; Vortex FDC
Sweden	Uppsala University; Uni Halmstad; SVK
United Kingdom	UK National Grid ESO; Glasgow University; Reading University; Strathclyde University
United States	Pacific Northwest National Laboratory; National Renewable Energy Laboratory; National Oceanic and Atmospheric Administration; National Centre for Atmospheric Research; Electric Power Research Institute; ERCOT; SUNY Albany; MESO, Inc

services available.

This finding is in line with the use and application of probabilistic and ensemble forecasts for uncertainty quantification across all time scales in the energy industry, which is partly a result of the probabilistic forecasting games and experiments.

The second focus area was the dissemination of the IEA Wind Recommended Practice [1]. The collection of use cases and data is in progress to be used for online verification tools to quantify uncertainty according to the publication from 2022 [2] as well as Part 3 and 4 of the Recommended Practice tool, WE-verify [1, 3]. In addition, the use of Recommended Practice guidelines for evaluation of probabilistic forecasts and measurement data quality assessment was demonstrated at three workshops [4, 5, 6].

The third highlight of 2023 was the start of a collaborative effort to develop an international standard for renewable energy forecasting and evaluation with the IEC SC8A Workgroup 2 [7]. A workshop was held in June 2023 in Copenhagen, Denmark and led to the official submission of an IEC New Work Item for standard development. An official liaison with IEA Wind is underway in order to provide voting rights to engaged Task members.

In summary, 2023 showed that the use of forecasting methods on all time scales in the energy industry requires continuous education and dissemination efforts in the form of guidelines, recommendations and standards in order to serve this transforming industry. It also showed

that the work on thorough testing recommendations provided in the IEA Wind Recommended Practice [1] with real-data and use cases is a necessary step for the industry to be able to progress and adopt these recommendations.

Highlight(s)

In May 2023, a workshop on Sub-Seasonal to Seasonal Forecasting (S2S) was held at the University of Reading, United Kingdom. This event brought together around 50 participants, both in-person and online. The workshop highlighted the current capabilities and challenges of S2S forecasts, which cover a period between three weeks and nine months ahead. David Brayshaw, a professor at the University of Reading, delivered a keynote on the history and application of these forecasts.

S2S forecasts have been adept at predicting large-scale weather patterns and in estimating the reliability of specific forecasts. These predictions provide valuable insights for energy industries, particularly for planning and operational decisions involving wind, solar, hydro, and even demand forecasting. However, there are still challenges in communicating the probabilistic nature of these forecasts to end users.

The workshop underlined the need for improved user education and clearer guidelines to maximize the benefits of S2S forecasts. It also highlighted the potential for S2S forecasts to enhance operational efficiency across various sectors, which will lead to more reliable and sustainable energy systems.

Outcomes and Significance

Task 51 is the largest global forum for discussing renewable power forecasting issues and challenges. The Task has prepared a Recommended Practice on forecast choice and evaluation, which will be continually updated. Moreover, the Task has begun to create open software libraries for data exchange and forecast evaluation. Some of these error evaluation guidelines are now being incorporated into IEC standards.

Task 51 also undertook extensive dissemination efforts, including one public workshop per year, posters, talks, and special sessions at several conferences such as WindEurope's Annual Event, EGU, ICEM, WESC, the Wind & Solar Integration Workshop, the Hybrid Power System Workshop, among others.

Next Steps

Task 51 organised an open workshop on Minute-Scale Forecasting for the Weather Driven Energy System in cooperation with IEA PVPS Task 16 and IEA Wind Task 52 in Risø, Denmark in April 2024. Part of the workshop is available on the Task's YouTube channel [8], while the results of the workshop will be published and disseminated at various workshops throughout the year. Additionally, a webinar on Artificial Intelligence Weather Prediction was organised in January 2024, which can also be found on YouTube [8].

The Task's Information Portal on the website is kept up to date, and the work streams are discussing their

Figure 2: The participants of the Seasonal Forecasting Workshop in Reading, United Kingdom in May 2023.

respective deliverables, working to update the Recommended Practices and providing inputs to the IEC SC8A WG2 new standard development. An extension for the next four years will be discussed and prepared in the second and third quarters of 2024.

References

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[3] Mathias Blicher Bjerregaard, Corinna Möhrlen, John Zack, Jethro Browell, WE-verify-prob: R-package with example code base to verify probabilistic wind and solar energy forecasts. The tool WE-verify-prob is a project initiated within the IEA Wind Task 51, 2023.

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[6] Corinna Möhrlen, John Zack, Gregor Giebel, IEA Wind Recommended Practice for the Implementation of Renewable Forecasting Solutions: hands-on examples for the use of the guideline, Proc. 22nd Wind & Solar Integration Workshop,Kng. Lyngby, Denmark, 26. – 28. September 2023.

[7] IEC Technical Program Subcommittee 8A "Grid Integration of Renewable Energy Generation"'s Workgroup 2 "Renewable energy power prediction" https://shorturl.at/talhi

[8] https://www.youtube.com/c/IEAWindForecasting

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