IEA Wind Task 51 “Forecasting for the Weather Driven Energy System”

Wind & Solar Integration Workshop

Session 4D - IEA WIND AND PVPS TASK 51 AND 16

Helsinki, Finland – 8th October 2024 -

C. Möhrlen (WEPROG) and John Zack (MESO)

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Photography encouraged

Technology Collaboration Programme by iea

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International Energy Agency History

The IEA was founded in 1974 to help countries co-ordinate a collective response to major disruptions in the supply of oil.

Image source: dpa

Specific Technology Collaboration Programs (in renewable energy):

- Bioenergy TCP
- Concentrated Solar Power (SolarPACES TCP)
- Geothermal TCP
- Hydrogen TCP
- Hydropower TCP
- Ocean Energy Systems (OES TCP)
- Photovoltaic Power Systems (PVPS TCP)
- Solar Heating and Cooling (SHC TCP)
- **Wind Energy Systems (Wind TCP)**

iea Energy Technology Network

See iea.org!

IEA Wind TCP Research Tasks

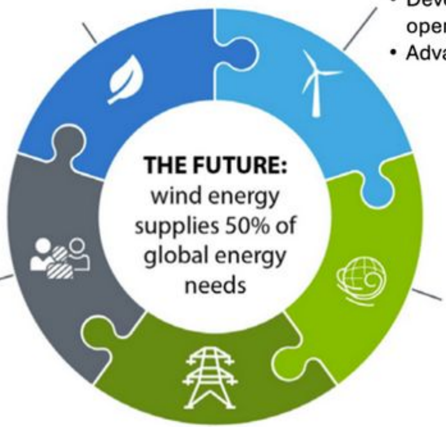
Technology Collaboration Programmes

Environmental Co-Design
- Avoiding, minimising, compensating for environmental impacts
- Incorporating environmental costs, benefits into decisions
- Addressing both immediate concerns, future impacts

Tasks 42, 45, 59 & 60

The Turbine
- Incorporating holistic design
- Developing intelligent controls, operation, maintenance
- Advancing industrialisation

Tasks 44, 49, 52, 54 & 57



Social Science
- Acknowledging the transformational nature of development
- Creating just processes
- Valuating benefits, effects, burdens

Tasks 39, 53 & 62

The Atmosphere
- Increasing atmospheric observations
- Expanding, validating universal predictive capability
- Integration, adopting improved models

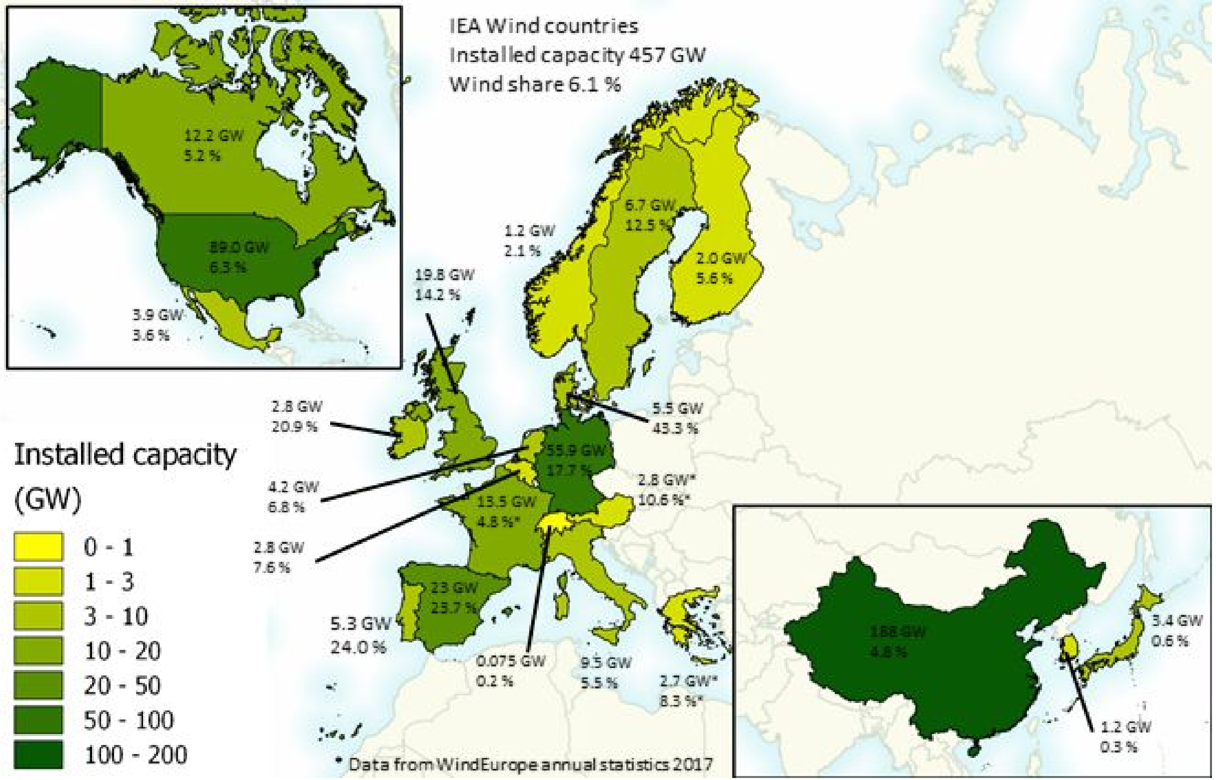
Tasks 43, 46, 47, 48, 49, 51, 56

The Plant and Grid
- Improving modelling
- Optimising plant design for multiple objectives
- Readying wind plants for grid support

Tasks 25, 41, 50, 55, 58 & 61

Capacity

As of 2020, about 85% of the world's wind generating capacity–and nearly all offshore capacity–resides within the participating countries. To learn more about the work of each participating member, please click on any of the countries or sponsors below.



- **Task 51 members (12)**
- AT, CN, DE, DK, ES, FI, FR, IE, PT, SE, UK, US

Forecasting for Wind Energy

2016-2018

T36 Phase 1

2019-2021

T36 Phase 2

Redefinition

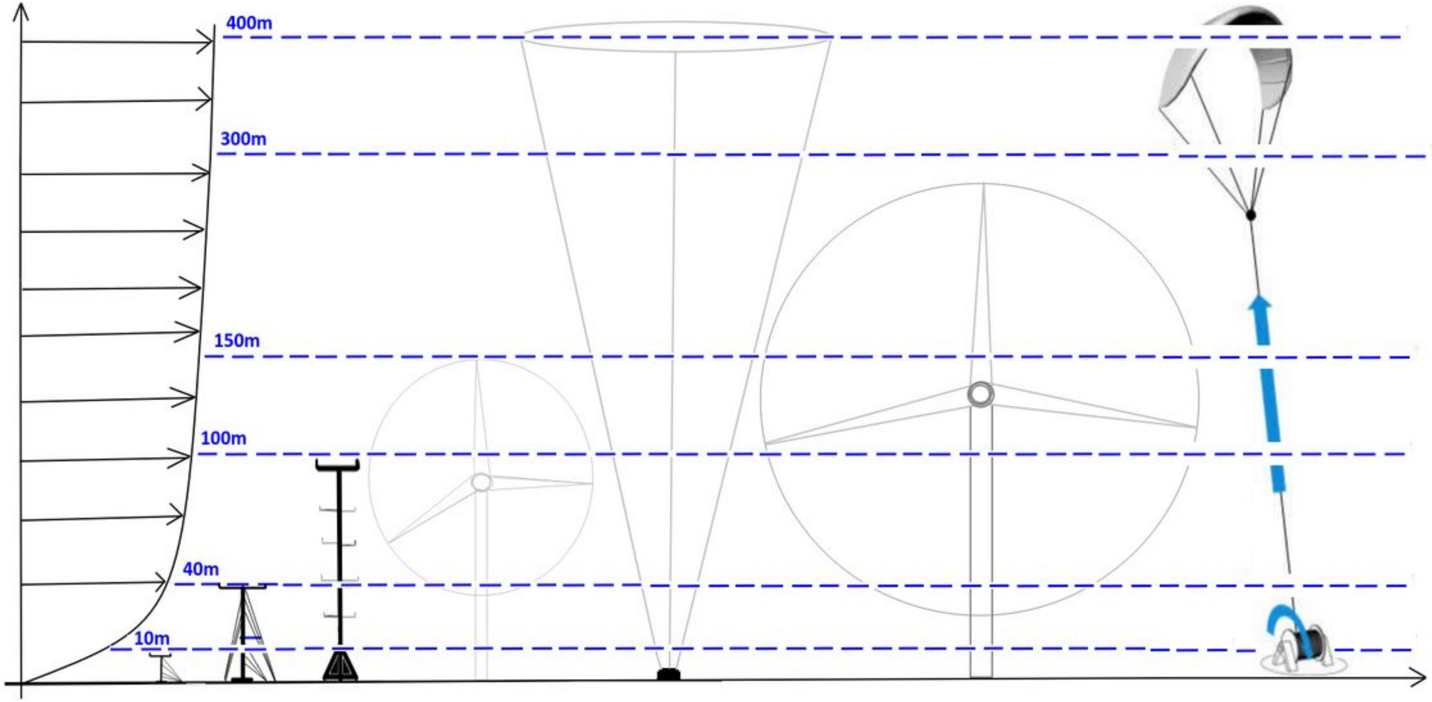
T51 Phase 1

2022-2025

Forecasting for the weather-driven Energy System

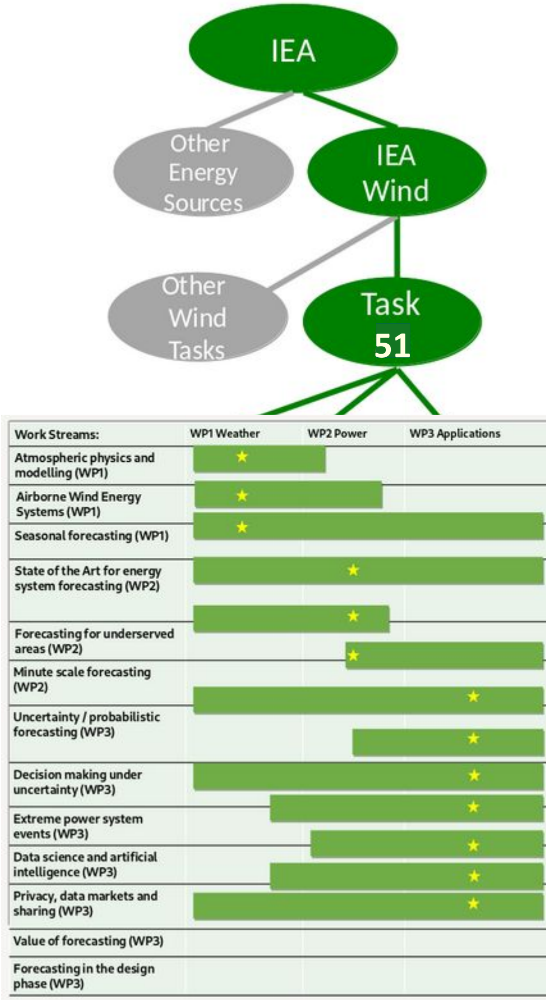
From groups of single wind turbines to large-scale Wind Energy Systems

...2022 ...2025



Slide design: Corinna Möhrlen

IEA Wind Task 51: Forecasting for the weather-driven Energy System



What is the IEA (International Energy Agency)? (www.iea.org)

- International organization within OECD with 30 members countries and 8 associates
- Promotes global dialogue on energy, providing authoritative analysis through a wide range of publications
- **One activity: convenes panels of experts to address specific topics**

Task 51: Forecasting for the weather-driven Energy System:

- One of 17 Tasks of IEA Wind: https://iea-wind.org/
- Task 36: Phase 1: 2016-2018; Phase 2: 2019-2021 **Task 51: Phase 3: 2022-2025**
- Operating Agent: Gregor Giebel of DTU Wind Energy
- Objective: facilitate int. collaboration to **improve wind energy forecasts**
- Participants: (1) research organization and projects, (2) forecast providers, (3) policy-makers and (4) end-users & stakeholders

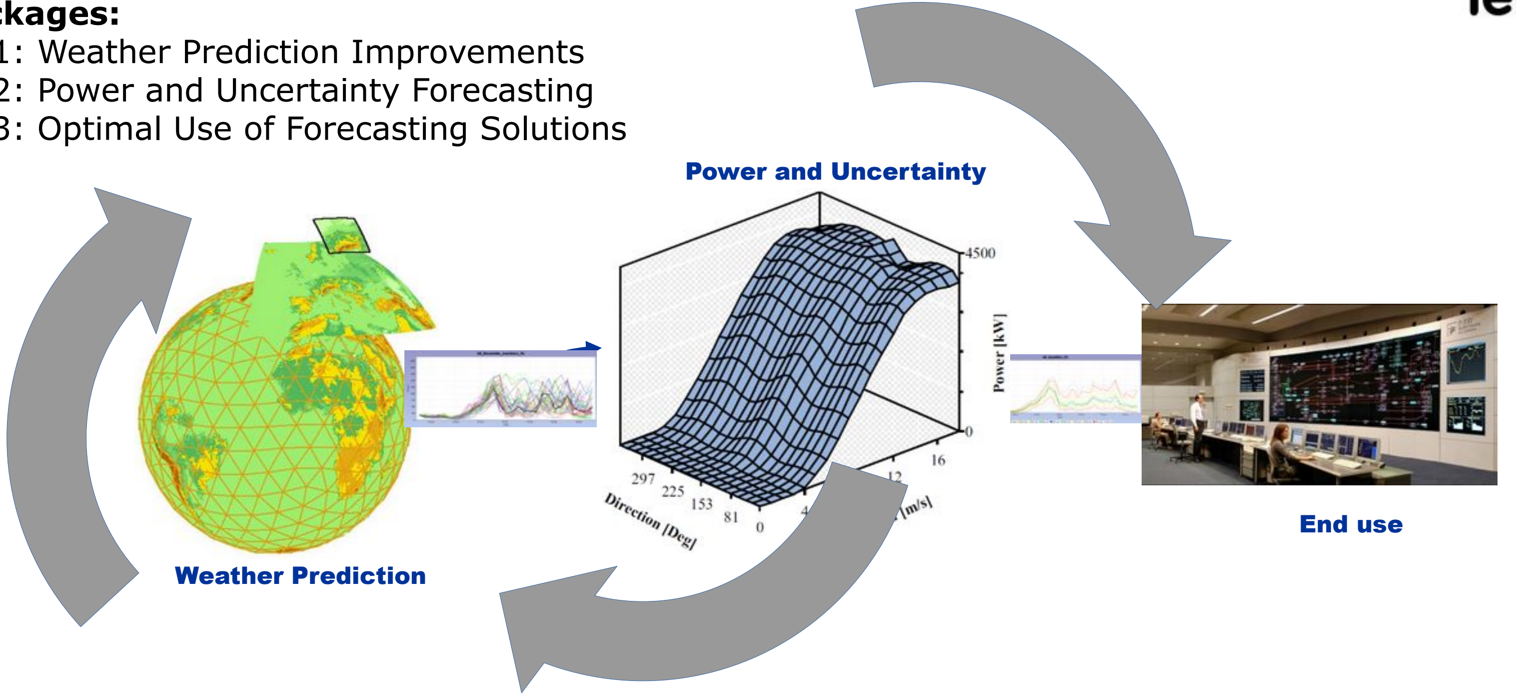
Task 51 Scope: 3 “Work Packages” distributed over 13 “Workstreams”

- WP1: Global Coordination in Forecast Model Improvement
- WP2: Benchmarking, Predictability and Model Uncertainty
- WP3: Optimal Use of Forecasting Solutions

Task homepage: https://iea-wind.org/task51

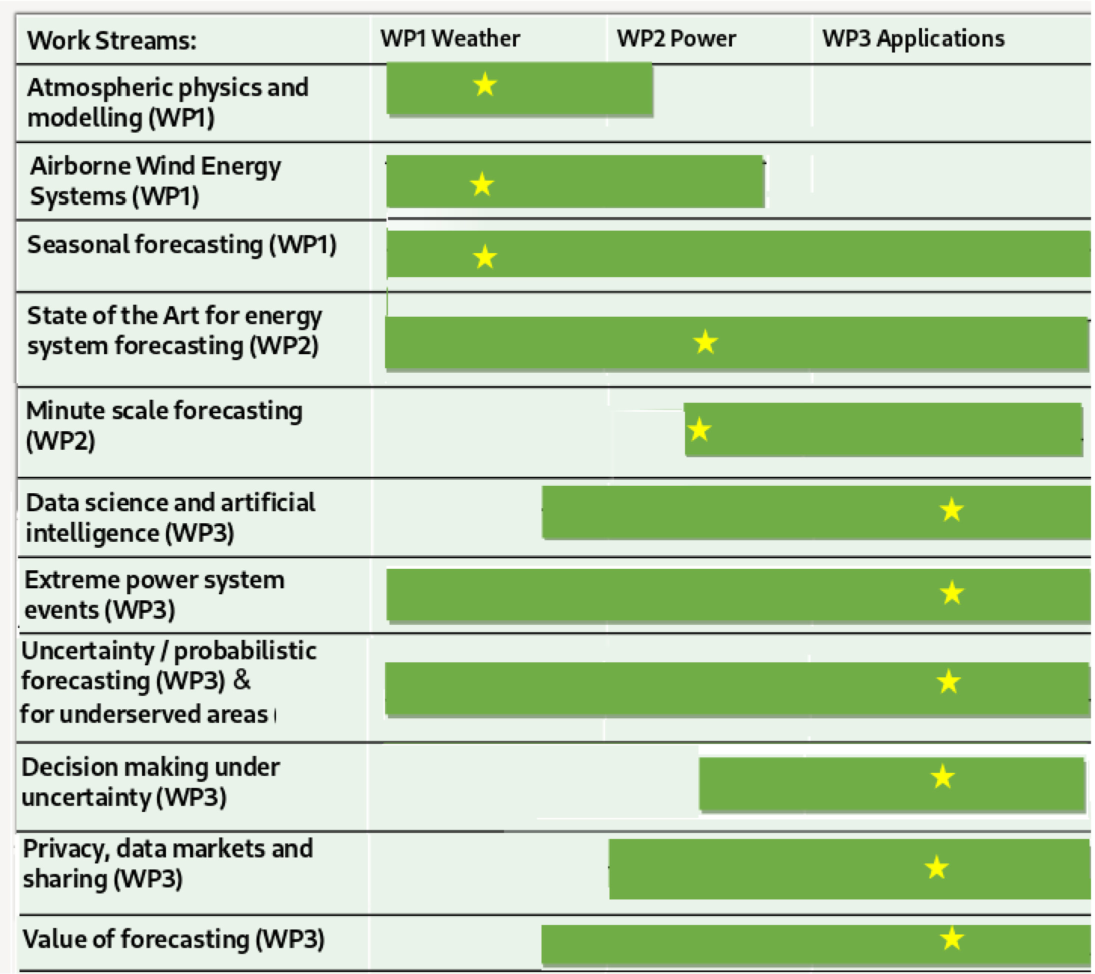
IEA Wind Task 51 Work distribution

Task Work is divided into 3 work packages:
WP1: Weather Prediction Improvements
WP2: Power and Uncertainty Forecasting
WP3: Optimal Use of Forecasting Solutions



Australian Government
Bureau of Meteorology

IEA Wind Task 51 Work distribution



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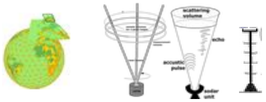

Modelling & data assimilation

Workshops

Verification Platform

Publications

Technology Collaboration Programme
by iea

IEA Wind TCP | Task 36 | Information Portal | Work Packages | Partners | Publications

The Task 51 Information Portal aims to be a useful resource for people in forecasting, especially providing links to publically available data for model development.

https://iea-wind.org/task-51/t51-information-portal/

Information Portal

The Task members identified several issues which might be useful in an information portal for wind power forecasting. Those are:

- A list of meteorology masts with online data over 100m height, useful for verification of wind speed predictions
- A list of meteorological experiments going on currently or recently, either to participate or to verify a flow model against
- A list of publicly available wind power forecasting benchmarks, to test your model against
- A list of current or finished research projects in the field of wind power forecasting
- A list of future research issues
- A list of open weather data

For all of those, we would be happy to accept input, so head over to the site and see where you can help, or what you can use!

Please find the full text of the task description here.

The task is led by Gregor Giebel from DTU Wind Energy.

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Research projects

https://iea-wind.org/task-51/project-list/

Here are some ongoing and finished projects towards short-term prediction of wind power throughout the last two decades. In total, the public (and partly private) spending on this list exceeds 150 million euro.

Country	Project acronym	Full title	Sponsor	Total / Funded budget	Start – end date	Participants incl. those from IEA Task 36/51
DE	WindStore	Optimized system integration of offshore wind energy through intelligent linking of various forecast concepts and forward-looking management of distributed cascade storage systems.	BMWK (German Federal Ministery for Economics and Climate Protection)	1.76 M€ / 1.47 M€	Jan 2024 – Dec 2026	Fraunhofer IEE, DLR, 4Cast, SETrade, WEPROG, EnBW, Stadtwerke Hassfurt und Wunsiedel
BE	BeFORECAST	Wake-effect included offshore wind power forecasting for smooth operation of the Belgian electricity grid based on advanced data handling and sensor technology, including airborne systems.	Energy Transition Funds of the Federal Public Service Economy of the Belgian Federal Government	3.25 M€ / 2.74 M€	Nov 23 – Oct 25	von Karman Institute for Fluid Dynamics, Vrije Universiteit Brussel, KU Leuven, 3E, SABCA, Royal Meteorological Institute of Belgium
UK		Multi-variate forecasting for wind power integration in electricity markets	Shell/ETP Scotland	90k€/120k€	Oct 22 – Mar26	University of Glasgow, Jethro Browell

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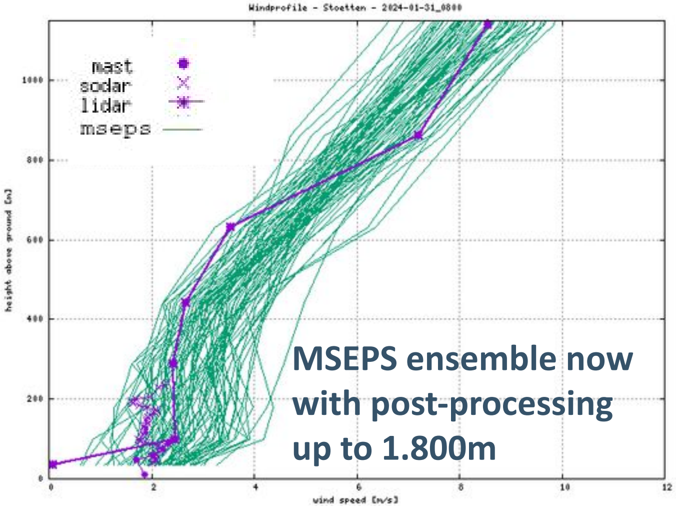
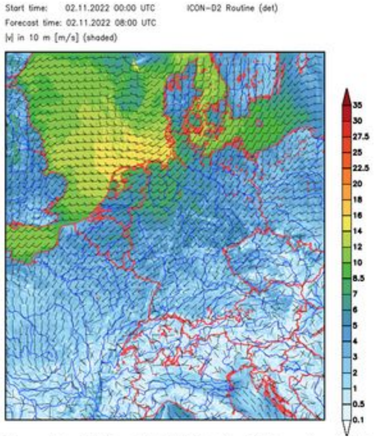
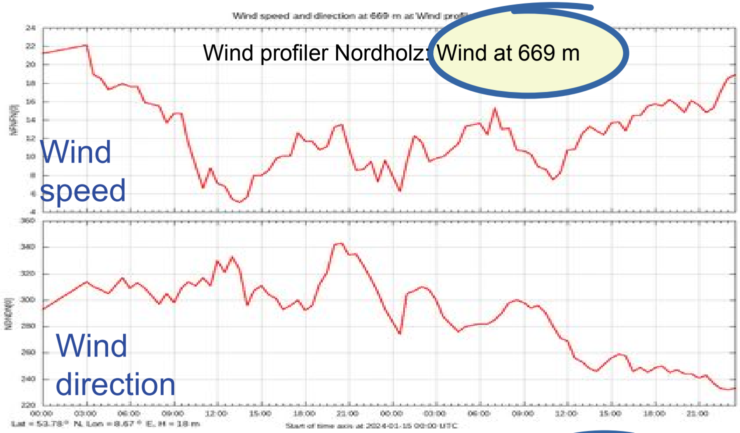
Workstream Atmospheric Modelling and Physics & first simulations for airborne wind

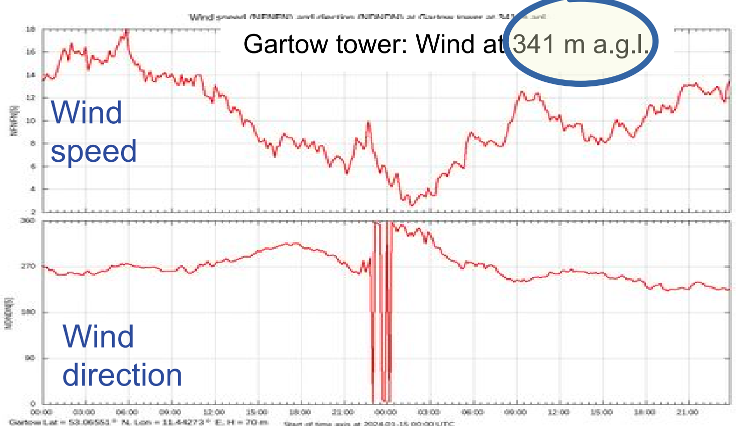


MSEPS ensemble now with post-processing up to 1.800m



ICON-DE model now in 15min resolution every hour





Elsevier OpenAccess Book

ORDER or **DOWNLOAD for free NOW!**

ISBN: 978-0-443-18681-3

PUB DATE: November 2022

DISCOUNT: Non-serials

FORMAT: Paperback

Editors: Corinna Möhrlen, John W. Zack, and Gregor Giebel

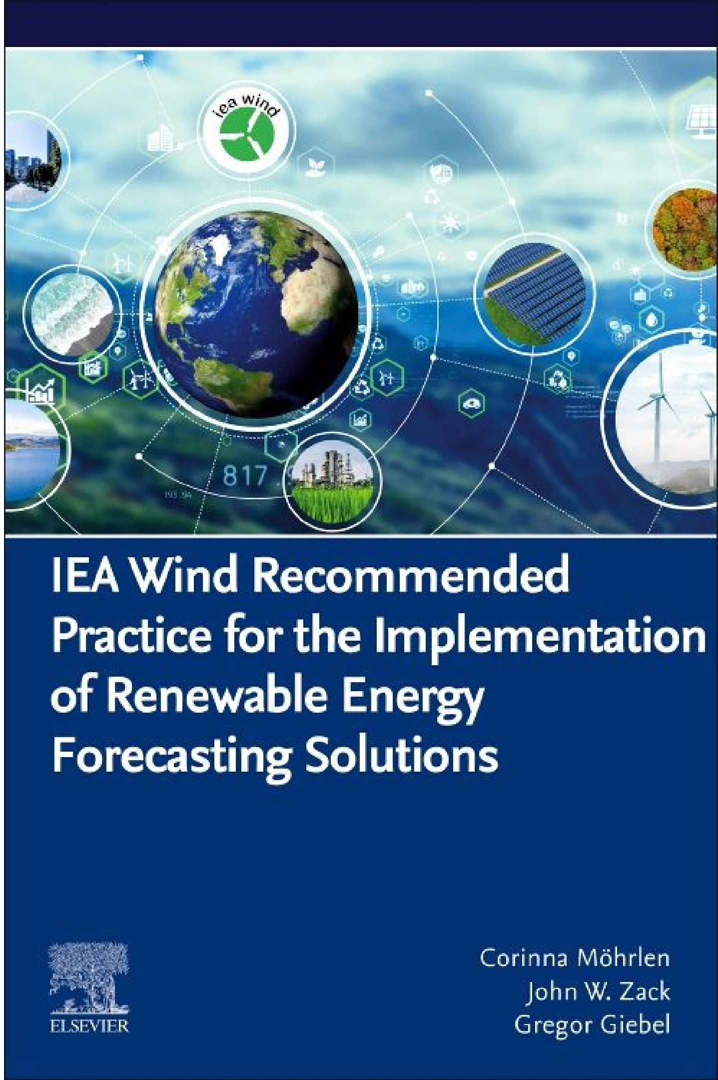
https://www.elsevier.com/books/iea-wind-recommended-practice-for-the-implementation-of-renewable-energy-forecasting-solutions/mohrlen/978-0-443-18681-3

Online OpenAccess:

https://www.sciencedirect.com/book/9780443186813/iea-wind-recommended-practice-for-the-implementation-of-renewable-energy-forecasting-solutions

IEA Wind Task 51 Information

iea-wind.org → Task 51 → Publications → Recommended Practice



IEA Best Practice Recommendations for the Selection of a Wind Forecasting Solution v2: Set of 4 Documents

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RECOMMENDED PRACTICE FOR THE IMPLEMENTATION OF RENEWABLE ENERGY FORECASTING SOLUTIONS

- Part 1: FORECAST SOLUTION SELECTION PROCESS -

2. EDITION

Draft for Review by the Executive Committee of the International Energy Agency Implementing Agreement

Prepared by IEA Wind Task 36

Part 1: Selection of an Optimal Forecast Solution

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RECOMMENDED PRACTICE FOR THE IMPLEMENTATION OF RENEWABLE ENERGY FORECASTING SOLUTIONS

- Part 2: DESIGNING AND EXECUTING FORECASTING BENCHMARKS AND TRIALS -

2. EDITION

Draft for Review by the Executive Committee of the International Energy Agency Implementing Agreement

Prepared by IEA Wind Task 36

Part 2: Design and Execution of Benchmarks and Trials

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RECOMMENDED PRACTICE FOR THE IMPLEMENTATION OF RENEWABLE ENERGY FORECASTING SOLUTIONS

- Part 3: Forecast Solution Evaluation -

2. EDITION

Draft for Review by Executive Committee of the International Energy Agency Implementing Agreement

Prepared by IEA Wind Task 36

Part 3: Evaluation of Forecasts and Forecast Solutions

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RECOMMENDED PRACTICE FOR THE IMPLEMENTATION OF RENEWABLE ENERGY FORECASTING SOLUTIONS

- Part 4: Meteorological and Power Data Requirements for real-time forecasting Applications-

1. EDITION

Draft for Review by the Executive Committee of the International Energy Agency Implementing Agreement

Prepared by IEA Wind Task 36

Part 4: Data Requirements for Real-time Applications

Now as OpenAccess book!

Introduction: https://www.youtube.com/watch?v=XVO37hLE03M

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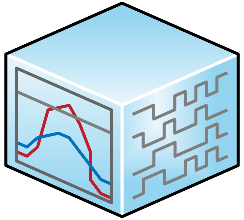
Validation & Verification code examples

Examples developed within the IEA Wind Task 36 and Task 51:

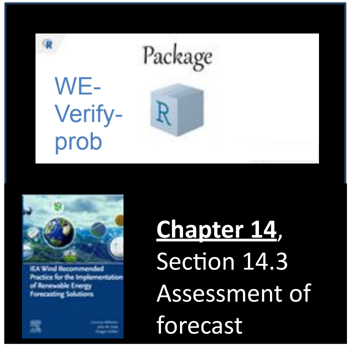
WE-validate
Available on GitHub: https://github.com/joejoeyjoseph/WE-Validate
Publication: https://www.sciencedirect.com/science/article/pii/S0960148122014707

Use Case: Demo Jupyter Notebook (U.S. Mountain Wave case):
https://nbviewer.jupyter.org/github/joejoeyjoseph/i-validate/blob/main/notebooks/demo_notebook.ipynb



Existing metrics: RMSE, cRMSE, mean bias, mean absolute error
Existing plots: time series, histogram, scatter plot

WE-verify-prob – R-package for probabilistic verification
Existing metrics: CRPS, Brier Score, ROC curve, Histograms, Reliability Diagram, Contingency table
Existing plots: time series, histograms, ROC curve, CRPS



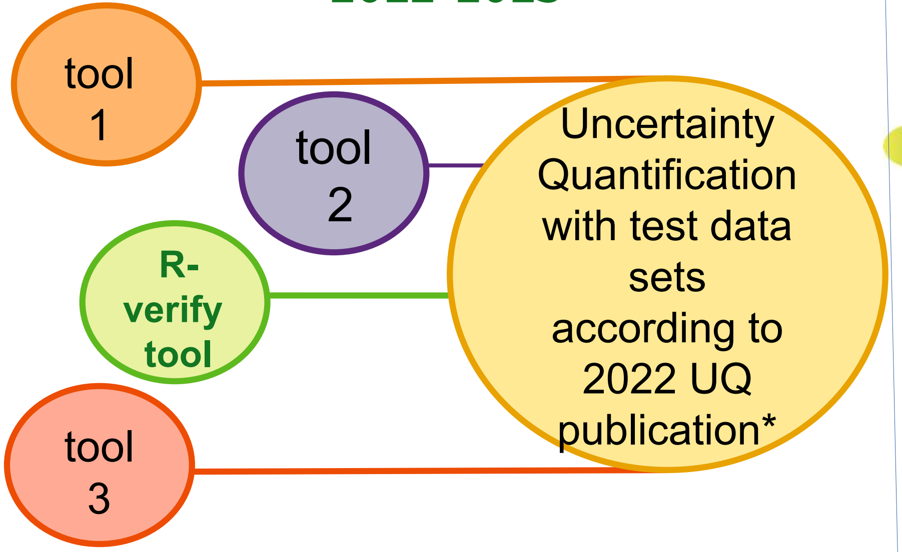
See also our workshops & conference page:
https://iea-wind.org/task51/task51-publications/task51-workshops-and-special-sessions/

Workstream Uncertainty :

Uncertainty Propagation throughout the model chain with real data

PHASE I

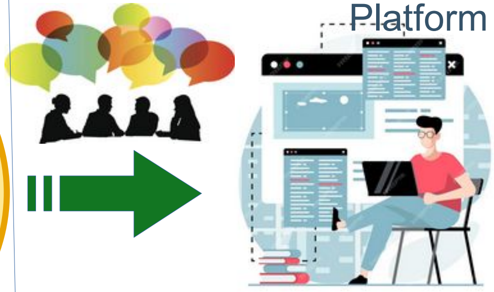
2022-2023



PHASE II

2024

Online Verification Platform

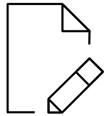


Discussion & testing of verification platform

PHASE III

2025

Publication



Discussion & writing of publication with most suitable test cases

* Uncovering wind power forecasting uncertainty sources and their propagation through the whole modelling chain
https://www.sciencedirect.com/science/article/pii/S1364032122004221

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Review of uncertainty propagation

Work program Part I

- **Qualitative description** of the origins and propagation of uncertainty through the forecasting chain (D2.2)

→ Published in *Renewable and Sustainable Energy Reviews* in 2022

Work program Part II (2023-2025)

- **Quantification** of the origins and propagation of uncertainty through the forecasting chain

Uncovering wind power forecasting uncertainty origins and development through the whole modelling chain⋆,⋆⋆

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[b]WEPROG, Dreijervaenget 8, 5610 Assens, Denmark
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[d]Fraunhofer Institute for Energy Economics and Energy System Technology IEE, Kassel, Germany

ARTICLE INFO

Keywords:
wind power
forecast uncertainty
modelling chain

ABSTRACT

Wind power forecasting has been supporting operational decision-making for power system and electricity markets since 30 years. Efforts of improving the accuracy and/or certainty of wind power forecasts, either deterministic or probabilistic, are continuously exerted by academics and industries. Forecast errors and associated uncertainties, which propagate through the whole forecasting chain, from weather provider to the end user, cannot be eliminated completely due to many reasons; for instance, endogenetic randomness of weather systems and varying wind turbine performance. Therefore, understanding the sources of uncertainty and how these uncertainties propagate throughout the modelling chain is significant to implement more rational and targeted uncertainty mitigation strategies and standardise the uncertainty validation. This paper presents a thorough review of the uncertainty propagation through the modelling chain, from the planning phase of the wind farm and the forecasting system through the operational phase and market phase. Moreover, the definition of the uncertainty sources throughout these phases build the guiding line of uncertainty mitigation throughout this review. In the end, a discussion on uncertainty validation is provided along with some examples. Highlights of this paper include: 1) forecasting uncertainty exists and propagates everywhere throughout the entire modelling chain and from planning phase to market phase; 2) the mitigation efforts should be exerted in every modelling step; 3) standardised uncertainty validation practice and global data samples are required for forecasters to improve model performance and for forecast users to select and evaluate the model's output.

1. Introduction

High penetration of wind power has been recognised globally as one of the most important features of current and future sustainable power systems. The natural randomness and variability of the wind itself can aggravate negative impacts of wind power on power system operation and market trading, which strengthens the significance of forecasting technology. Wind power forecasting (WPF) started more than three decades ago [16], with the first operational forecasting tools arriving at system operation level some 10 years later at the Danish transmission system operator ELSAM [10]. Since then, researchers have been making continuous efforts to improve the forecasting accuracy and reliability.

It is impossible to achieve perfect predictions of wind power at any given time or location, due to chaotic atmospheric motions having temporal and spatial scales that typically span more than six orders of magnitude [17, 18, 19]. Along with the complex wind field, wind turbine performance creates nonlinear and time-varying uncertainties in wind power forecasting. To improve the value of forecasts and their usage, we practically consider three questions: why, when and to what extent the forecasting uncertainty will happen [20]. Accordingly, this further guides the mitigation of forecasting uncertainty. There is plenty of literature in this area, and can be clarified into following three categories.

* This paper was coordinated under the auspices of IEA Wind Task 36 'Forecasting for Wind Energy'. Corinna Mörlen, Tuhfe Göçmen, Mark Kelly and Gregor Giebel were funded by the Danish EUDP project "IEA Wind Task 36 Phase II Danish Consortium", Grant Number 64018-0515.
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Workstream *Decision-making under Uncertainty*

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Decision making under uncertainty

Forecasting Games

Forecast Game	Short Description	Link
Wind Power Trading decisions for a Wind Park in complex Terrain	IEA Wind Task 36/51 and MPI for Human Development have released a forecast game at the European Meteorological Society Annual Conference 2021. The game investigates how ensemble forecasts showing forecast uncertainty can improve our ability to make informed decisions, also when the weather conditions are complex or extreme. In the experimental game, the player is asked to make trading decisions for a wind farm in complex terrain in a number of situations based on deterministic and probabilistic power and wind forecasts.	Forecast Game (choose "Play the Game" at top menu) Forecast Game Results Links to additional material: WIW2022: Key Note Presentation EMS 2022: Presentation AMS 2022: Presentation Electric-City 2021: Paper & award winning Poster EMS 2021: Presentation IEA Task 36 Webinar Youtube & Presentation
Wind Power Trading decisions for an Offshore Wind Park	IEA Wind Task 36 and MPI for Human Development have released a forecast game at the IEA Wind Task 36 Glasgow workshop in Jan 2020. The game investigates how useful different forecasts are for wind power trading decisions in a simplified way. In the game, the player is asked to make trading decisions for an offshore wind farm in the Northsea in a number of situations based on deterministic and probabilistic power and wind forecasts.	Forecast Game (offline version to come soon) Forecast Game Results Forecast game introduction presentation: IEA Wind Task 36 YouTube channel at time 3:03:00 Presentation Download Publications: MetApplications 2022 J of Phys. Conf Series 2021
Call for Water Game	In the game the player is managing a water supply reservoir! Purpose of the Game is to train with forecast information and improve decision-making. The player is newly appointed water manager for a	Forecast Game License conditions Creative Commons CC

Call for Water Game	In the game the player is managing a water supply reservoir! Purpose of the Game is to train with forecast information and improve decision-making. The player is newly appointed water manager for a reservoir that serves water uses for a town and is responsible to secure sufficient water for the town at a specific time. The game is played in two rounds of 5 years each.	Forecast Game License conditions Creative Commons CC BY-NC-ND 4.0
HEPEX Forecast Game "Pathways to running a flood forecasting centre: an adventure game"	The game simulates the responsibilities of a water management centre in charge of protecting a city against floods. The game is investigting what kind of information is needed and how many days in advance the forecast information is good enough to make a decision that could save lives and money.	Forecast Game A blog post on the game was published in the Imprex project website Reference: Arnal et al. (EGU 2017 abstract)
Feuerwache (only available in German)	The game's aim is to well users understand and are able to make use of the uncertainty of weather forecasts. The task of the game is to decide on 16 days, whether or not to request more firefighters for the next 21 hours to handle additional missions in predicted storm events.	Forecast Game

Offline Games

HEPEX Forecast Games		
Water Management Game	The game experiment focuses on risk-based decision-making in water management using probabilistic forecasts of inflows to a reservoir	Download: English (original version), German Reference: Crochemore et al. 2015 HEPEX blog post
Peak Box Game	The "Peak Box" game supports interpretation and verification of operational ensemble peak-flow forecasts, proposed by Zappa and colleagues, and encourages discussions of the use of ensemble predictions in operational hydrology. The Peak-Box defines the "best estimate" of a flood event's timing and magnitude by framing the discharge peaks of all members of an ensemble forecast and taking their median in timing and magnitude.	Download: Peak Box Game Reference: Zappa et al., 2013 HEPEX blog post

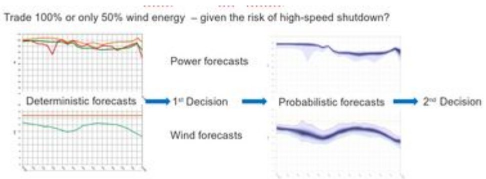
Table and collection of forecasting Games:

iea-wind.org/taks 51

→ Workstreams → Decision Making under Uncertainty

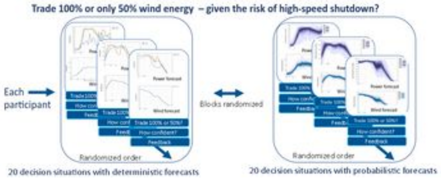
https://iea-wind.org/task51/task51-work-streams/ws-decision-making-under-uncertainty/

"Probabilistic Forecasting Games & Experiments" initiative



1. Experiment (2020)

Game: 12 cases
Decision structure: 12 deterministic Forecasts followed by a probabilistic forecast
After each decision, possible change of decision based on new information



2. Experiment (2021-2024*)

Game: 40 cases

Decision structure: 20 deterministic cases + decision confidence request
20 probabilistic cases + decision confidence request

* still open...: https://meteorology.mpib.dev/wind-power-decisions/about.html

Workstream Data Science and AI

Webinar now available in our YouTube channel IEAWindForecasting
https://youtu.be/t6H7diavQdg

As the world's fastest-growing technology, **Artificial Intelligence** (AI) is rapidly shaping industries such as Energy and Meteorology.

To help address stakeholders' concerns about the impacts of increasingly incorporating AI and Machine Learning into weather and power prediction models, a webinar in Deep Learning for Weather-Based Power Prediction was held in January 2024

In this Webinar we brought to-gether the **Energy Meteorology and Machine Learning/ Deep Learning (ML/DL) communities** to showcase the latest advancements in ML/DL for weather prediction.

Some Lessons Learned from the webinar:

Positive developments:

⇧ The models start to show skill
⇧ The models suggest a new approach to meteorological questions
⇧ Fast hypothesis testing and scope narrowing forsimulations with physics models
⇧ The models develop fast due to large resources put into new features
⇧ Huge ensembles (>1000 members) are on the horizon
⇧ There is work underway to start the AI models from measurements alone

Challenges to be solved:

⇩ Quality control of input data is not yet handled - outliers, missing or corrupt data
⇩ High complexity and variety of data to train models is a challenge
⇩ Feature engineering needs features – without physics this will be difficult
⇩ Data-driven models require new look upon data sharing which has been a challenge until now

Workstream Data Sharing

Workplan

A recently policy paper for the European Commission about the transformation of the energy system covering digitilisation and data sharing was generally for the energy sector – covering RES only on the surface.

Status: Development of a position paper about data sharing for the renewable energy sector has been started

A group of contributors are covering different aspects of RES: resource assessment/site location, forecasting, trading, O&M, etc.

* https://op.europa.eu/en/publication-detail/-/publication/21b0260e-a2d5-11ee-b164-01aa75ed71a1/language-en/format-PDF/source-300344208

WS Extreme Power System Events

IEA Wind TCPTask 51
“Forecasting for the weather-driven energy system”

Workshop on
Extreme Power System Events
Boulder, April 2025

https://iea-wind.org/2024/07/31/iea-wind-task-51-austria-workshop-in-vienna-on-6th-nov-2024/

Collaboration

Collaboration with Subtask: *On-demand digital twin extremes forecasting system for renewables - The Destination Earth Extremes digital twin*

https://destine.ecmwf.int/news/meteo-france-led-international-partnership-wins-bid-to-develop-destination-earths-on-demand-extremes-digital-twin/

WS Extreme Power System Events

THE IRISH TIMES

Storm Isha Live

Storm Isha: Second storm, Jocelyn, to hit on Tuesday as thousands remain without power and water

Some 93,000 properties still without electricity as Met Éireann issues further Orange warnings for Donegal, Mayo and Galway

Ireland

Storm Isha: Thousands without power and ov wind causes damage across Ireland

Flights cancelled and diverted in Dublin Airport due to 'severe and des reporting fallen trees

Expand

Waves crash over the pier at Fenit, Co Kerry on Sunday as Storm Isha lashes the southwest. Photograph: Domnick Walsh/Eye Focus

What is an extreme event ?

Ireland and UK experienced two storms in a row:

Isha on Jan, 21st 2024 and

Jocelyn on Jan, 22nd 2024

THE IRISH TIMES

14:31

Main points:

- **Follow live coverage of the** clean-up after Storm Isha in Monday with our live coverage.
- Over 170,000 homes and businesses are without power on Sunday evening
- A status red weather warning for wind is in effect in Co Donegal
- An orange weather warning is in effect for all of Ireland
- Earlier red wind warnings issued for counties Mayo and Galway have since expired
- Dublin Airport says Storm Isha is having an impact on flights
- Local authorities and fire and rescue services across the country are responding to reports of fallen trees

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WS Value of Forecasting

Status is monitored by looking and discussing the use of wind power forecasts

+++ now in collaboration with Task 50 Hybrid Power Plants +++

User Cases presented at Meetings + Reports

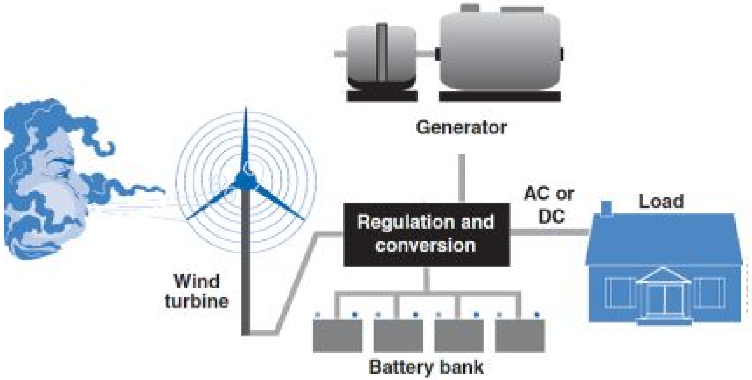
See iea-wind.org/task51 → Publications
→ Workshops & Special Sessions

Dimitrios Eleftheriou, Ea Energianalyse: *use of wind power forecasts in scheduling a hybrid energy asset consisting of wind turbines, electrolyser and hydrogen storage*

Honglin Wen, Shanghai Jiao Tong University: *Value-oriented Renewable Energy Forecasting for Coordinated Energy Dispatch Problems at Two Stages*

Antonio Couto, LNEG, Portugal: *Addressing the challenges of wind power plants hybridised with solar power: A generation forecast perspective. (see also publication)*

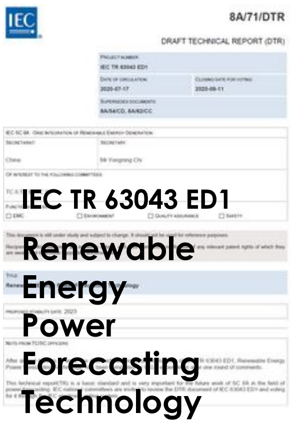
Rujie Zhu, Technical University of Denmark: *Value of forecasting for hybrid Energy Management*



Collaboration and Liaison with IEC Scientific Committee 8A on *Grid Integration of Renewable Energy Generation*

Common work: IEC Technical Report TR63043 - Renewable Energy Power Forecasting Technology

- Technical Report was released in 2020 by Sub-Committee 8A Grid Integration of Renewable Energy Generation, Working Group 2 Renewable energy power prediction
  https://webstore.iec.ch/publication/26529 - Link to IEC SC8A WG2



- New Work Item for the development of a IEC Standard in Oct. 2023

See Presentations from WIW2024 session 9D*

*https://iea-wind.org/task51/task51-publications/task51-workshops-and-special-sessions/

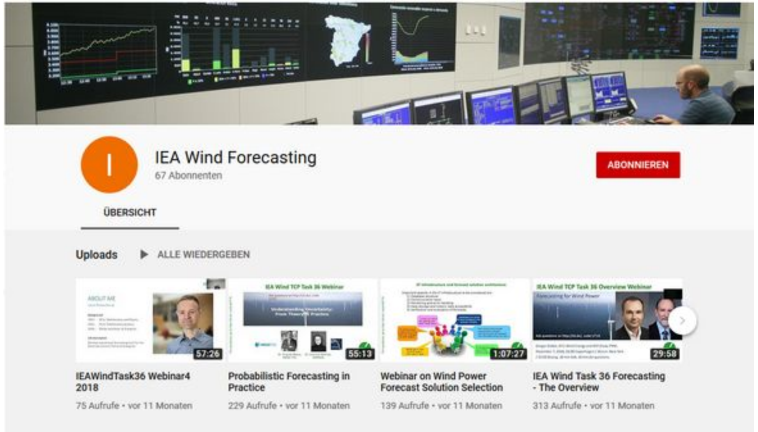
Task 51 Web Presence

Website

https://iea-wind.org/task51

YouTube Channel

https://www.youtube.com/c/IEAWindForecasting

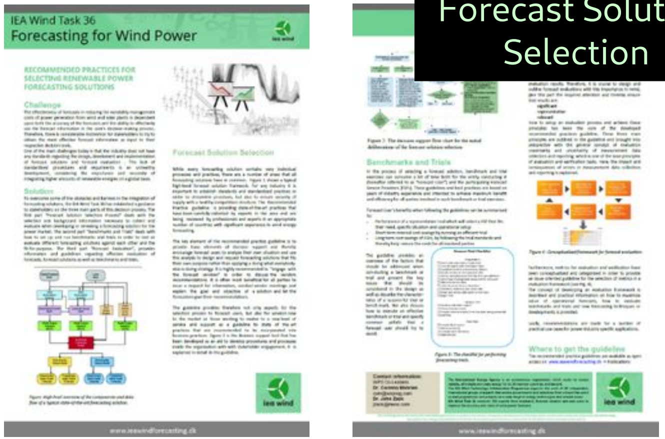


Handouts

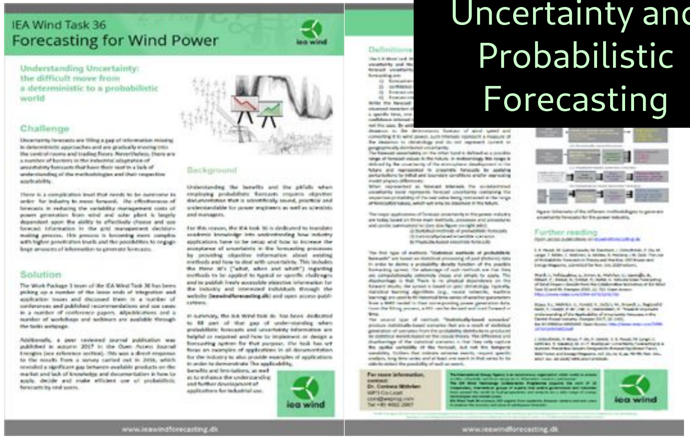
- 2-page handouts: quick overview of major results
- 3 currently available; can be obtained from:

  https://iea-wind.org/task51/task51-publications/task51-posters-and-handouts/

Task Overview



Forecast Solution Selection



Uncertainty and Probabilistic Forecasting

Summary

- Framework conditions changed since first phase of Task 36: **RES is no longer addition to system, but IS the system**; sector coupling to transport, heat, X…
- Has new challenges for **new forecast horizons** (seasonal forecasting…)
- Needs strong **collaboration with related TCPs** (**solar**, hydro, hydrogen, …) and related Tasks (Integration, Lidar, Farm Flow Control, Hybrids, Airborne Wind …), standardisation (IEC), data markets, data control & quality assessment (WMO)
- **Uncertainty**, probabilistic Forecasting & data-driven **AI** modelling is in focus
- **Workshops&Webinars**: State of the art Workshop (2022), Seasonal Forecasting (2023), Minute Scale Forecasting (2024), NAWEA Side-event IEA Wind Task51 (2024), IEA Wind Task 51 Austria Workshop (2024), Extreme Power System Events (2025) Webinar on AI in meteorology & energy

Task 51 – *"Forecasting for the weather-driven Energy System"*

iea-wind.org/task51

Get in touch with us…

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