

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



Corinna Möhrlen

G. Giebel, H. Frank, C. Draxl, J. Zack, J. Browell, G. Kariniotakis, R. Bessa, J. Yan, D. Lenaghan





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)**

See [iea.org!](http://iea.org)



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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

Social Science

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

Tasks 39, 53 & 62



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

The Plant and Grid

- Improving modelling
- Optimising plant design for multiple objectives
- Readying wind plants for grid support

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

The Turbine

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

Tasks 44, 49, 52, 54 & 57

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.

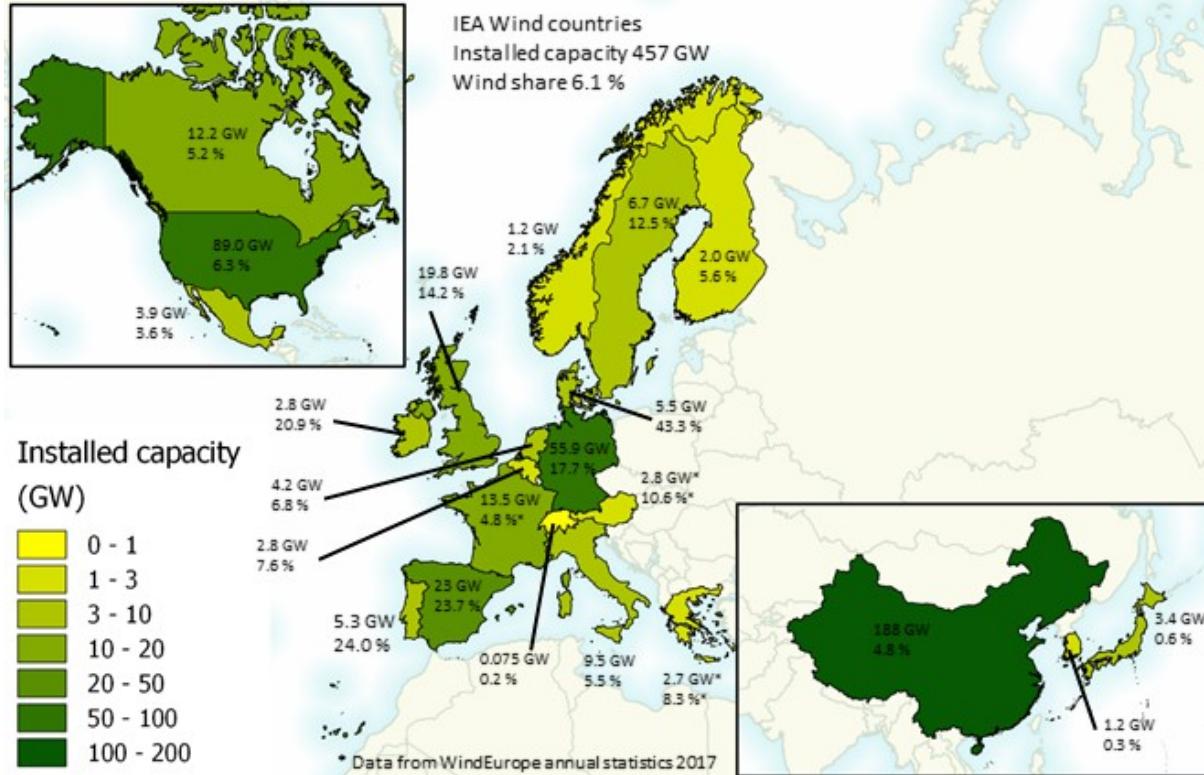
The Atmosphere

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



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task 51: forecasting for the weather-driven energy system



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



Forecasting for Wind Energy

2016-2018

2019-2021

T36 Phase 1

T36 Phase 2

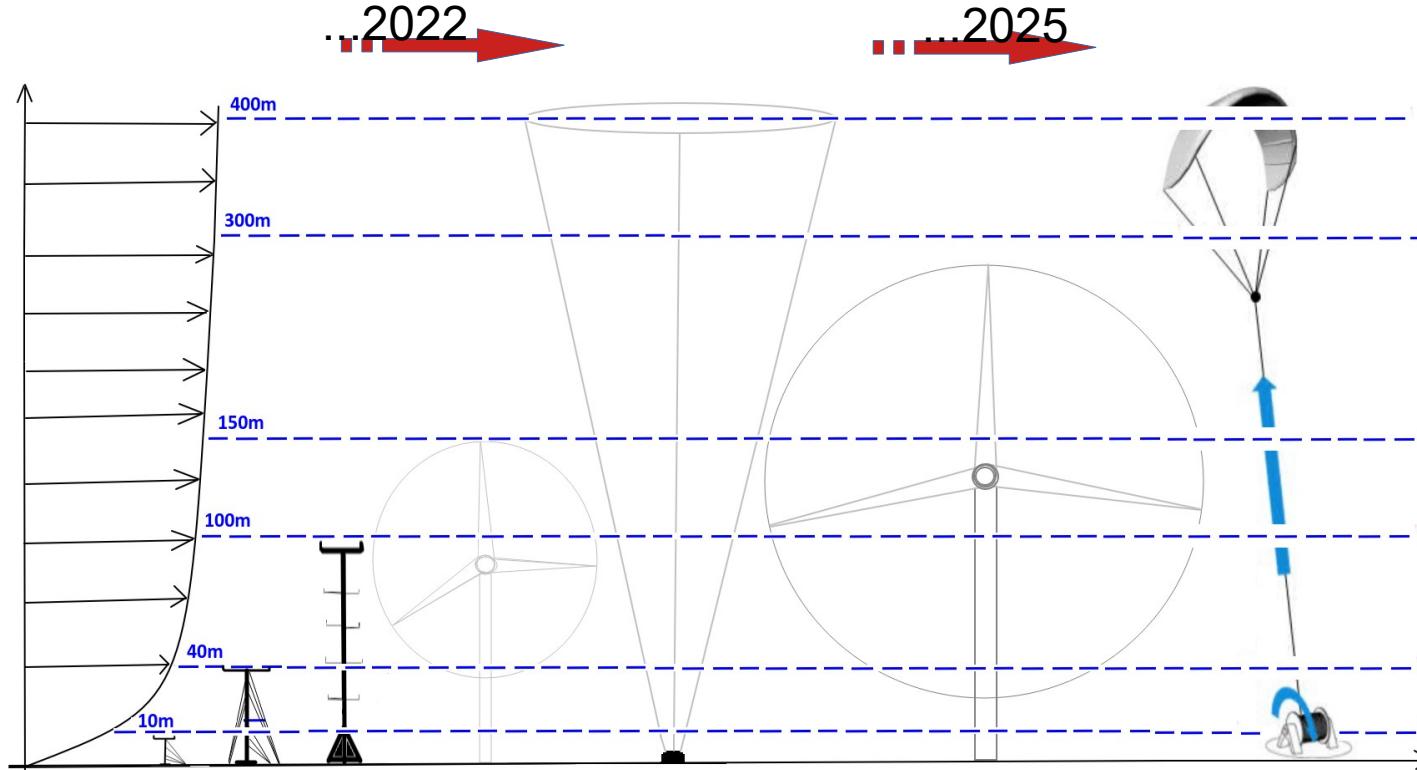
Redefinition

T51 Phase 1

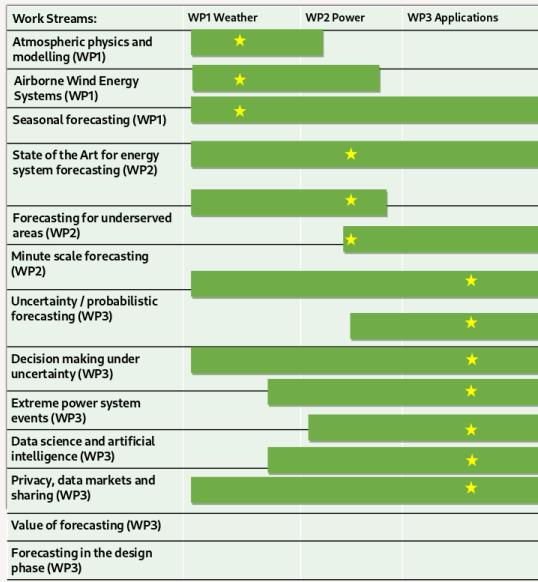
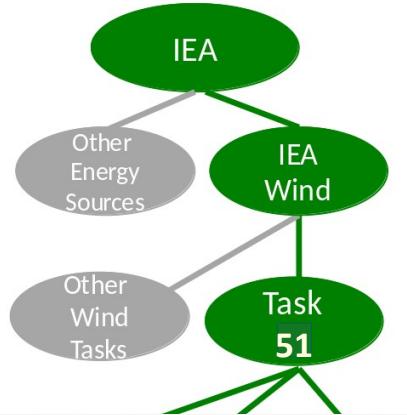
2022-2025

Forecasting for the
weather-driven
Energy System

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



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 Arbeitspakete

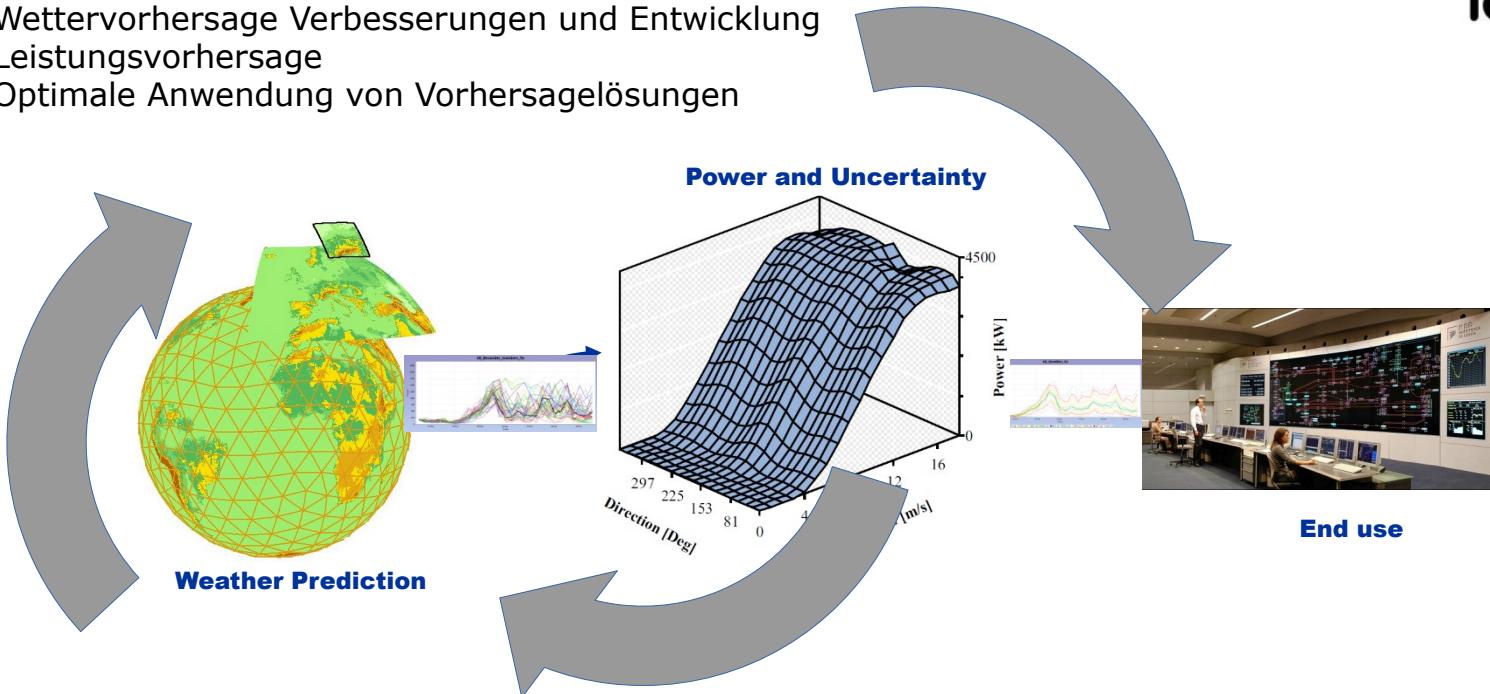


Task Arbeit ist in 3 Arbeitspakete aufgeteilt:

WP1: Wettervorhersage Verbesserungen und Entwicklung

WP2: Leistungsvorhersage

WP3: Optimale Anwendung von Vorhersagelösungen

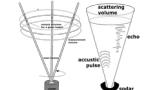


IEA Wind Task 51 Aufteilung in “Arbeitsflüsse”



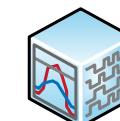
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Work Streams:	WP1 Weather	WP2 Power	WP3 Applications
Atmospheric physics and modelling (WP1)			
Airborne Wind Energy Systems (WP1)			
Seasonal forecasting (WP1)			
State of the Art for energy system forecasting (WP2)			
Minute scale forecasting (WP2)			
Data science and artificial intelligence (WP3)			
Extreme power system events (WP3)			
Uncertainty / probabilistic forecasting (WP3) & for underserved areas			
Decision making under uncertainty (WP3)			
Privacy, data markets and sharing (WP3)			
Value of forecasting (WP3)			



Modellierung & Datenassimilierung

Workshops



Verifikationsplattform

Publikationen



Das Task 51 Informationsportal ist für Interessengruppen im Bereich der Wetter- Wind und Solarprognose und beinhaltet insbesondere Links zu öffentlich verfügbaren Daten für die Modellentwicklung.

<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.

Research projects

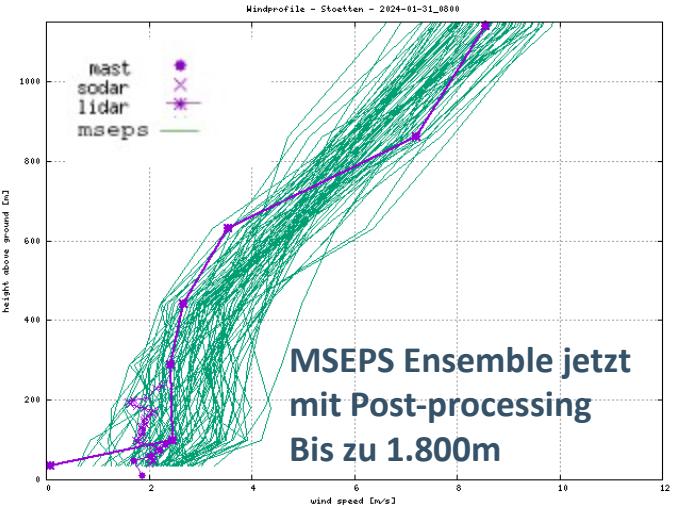
<https://iea-wind.org/task-51/project-list/>

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.

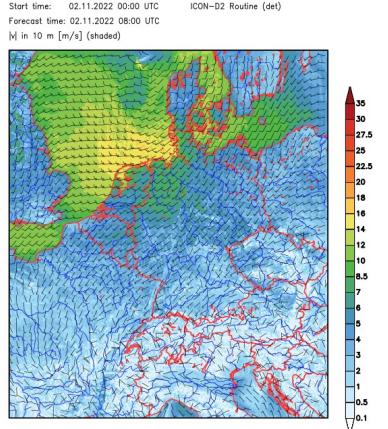
Country	Project acronym	Full title	Sponsor	Total / Funded budget	Start – end date	Participants incl. those from IEA Task 36/51
DE	WindStore	Optimized system integration of offshore wind energy through intelligent linking of various forecast concepts and forward-looking management of distributed cascade storage systems.	BMWK (German Federal Ministry 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



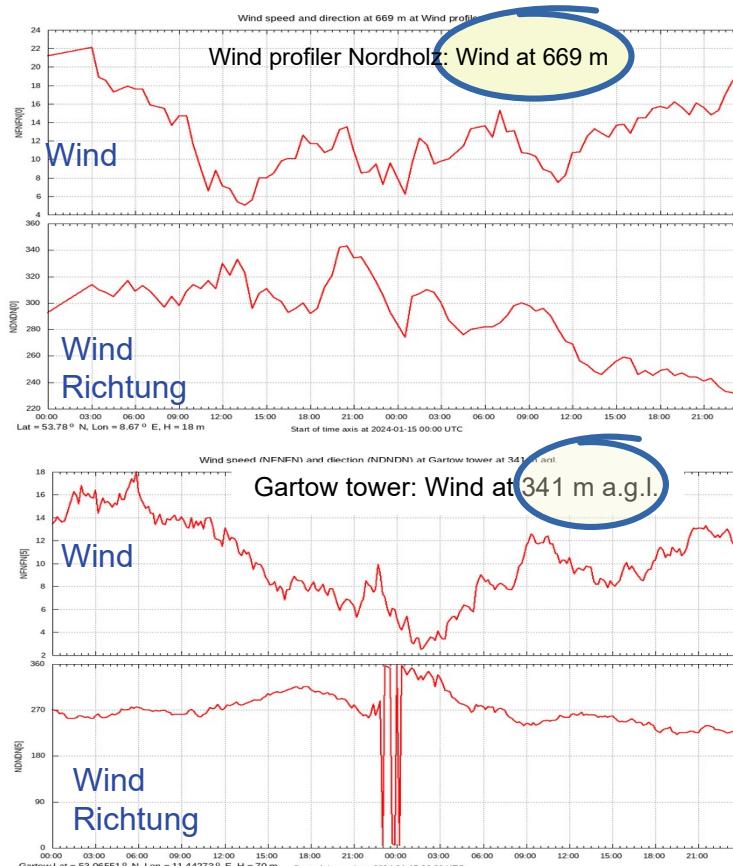
Workstream Atmosphärische Modellierung und Physik & erste Simulationen für “airborne” Windenergie



Vom rapid-update bis Langzeitvorhersagen



ICON-DE Modell ist jetzt auch in 15min Auflösung einmal pro Stunde erhältlich



Elsevier OpenAccess Buch

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 Wind Recommended Practice for the Implementation of Renewable Energy Forecasting Solutions



Corinna Möhrlen
John W. Zack
Gregor Giebel

IEA Industrierichtline für die Implementierung von Vorhersagelösungen für Erneuerbare Energien: Set of 4 Documents



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



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



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



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>



Validierung & Verifikation Quellcode Beispiele



Frei zugängliche Beispiele aus Projekten des
IEA Wind Task 36 und Task 51:

WE-validate

Available on GitHub: <https://github.com/joejoeyjoseph/WE-Validate>

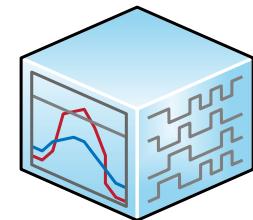
Publication: <https://www.sciencedirect.com/science/article/pii/S0960148122014707>

Use Case: Demo Jupyter Notebook (U.S. Mountain Wave case):

https://nbviewer.jupyter.org/github/joejoeyjoseph/i-validate/blob/main/notebooks/demo_notebook.ipynb

Verwendete Metriken: RMSE, cRMSE, mean bias, mean absolute error

Graphische Darstellung: time series, histogram, scatter plot



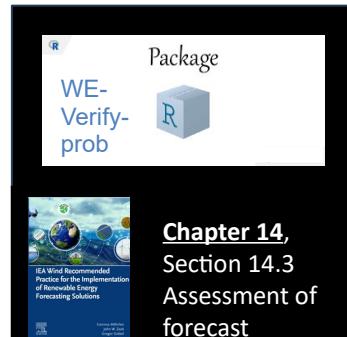
WE-verify-prob – R-package for probabilistic verification

Verwendete Metriken: CRPS, Brier Score, ROC curve, Histograms,
Reliability Diagram, Contingency table

Graphische Darstellung: time series, histograms, ROC curve, CRPS

See also our workshops & conference page:

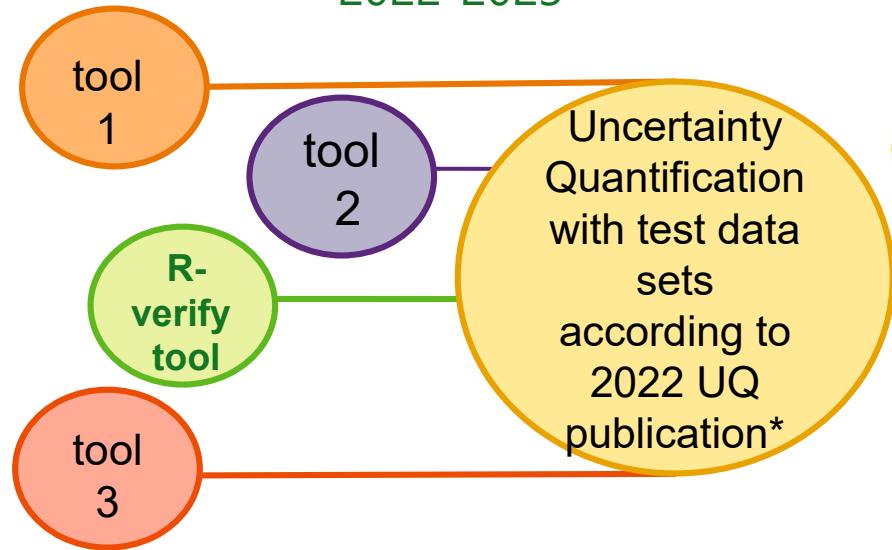
<https://iea-wind.org/task51/task51-publications/task51-workshops-and-special-sessions/>



Workstream Unsicherheit :

Unsicherheitsverteilung in der gesamten Modellkette mit realen Daten

PHASE I
2022-2023



PHASE II
2024



Diskussion & Test der Verificationsplatform

PHASE III
2025



Publication

Diskussion & Verfassen einer Publikation mit reellen Anwendungsbeispielen

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

Review der Verteilung von Unsicherheit

Arbeitsprogram Teil I

- Qualitative Beschreibung der Ursprung und Verteilung von Unsicherheit in der Prognoseprozesskette (D2.2)

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

Arbeitsprogram Teil II (2023-2025)

- Quantifikation des Ursprungs und der Verteilung von Unsicherheit in der Prognoseprozesskette

Uncovering wind power forecasting uncertainty origins and development through the whole modelling chain^{*,**}

Jie Yan^a, Corinna Möhrlen^b, Tuhfe Göçmen^c, Mark Kelly^c, Arne Wessel^d and Gregor Giebel^{e,*}

^aNorth China Electric Power University, State Key Lab of Alternate Electrical Power System with Renewable Energy Sources, Beijing, P.R. China

^bWEPROG, Dreijerengaet 8, 5610 Assens, Denmark

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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, endogenous 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 Möhrlen, 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*

Entscheidungs-Findung unter der Prämisse von Unsicherheit



Decision making under uncertainty

Forecasting Games		
Forecast Game	Short Description	Link
IEA Wind Task 36/51 and MPI for Human Development have released a forecast game at the European Meteorological Society Annual Conference 2021.	In the game the player is managing a water supply reservoir!	Forecast Game (choose "Play the Game" at top menu)
Wind Power Trading decisions for a Wind Park in complex Terrain	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.	Forecast Game Results Links to additional material: WfW2022 Key Note Presentation EMS 2022 Presentation AMS 2022 Presentation Electric-City 2021: Page & award winning Poster EMS 2021 Presentation IEA Task 36 Webinar YouTube & Presentation
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.	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 (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 IafPhys_Conf Series 2021
Wind Power Trading decisions for an Offshore Wind Park	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 Purpose of the Game is to train with forecast information and improve decision-making. Call for Water Game 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.
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.	Forecast Game License conditions Creative Commons CC-BY-NC-ND 4.0 Call for Water Game 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.
HEPEX Forecast Game "Pathogen" running a flood forecasting centre: an adventure game	The game is played in two rounds of 5 years each. The game simulates the responsibilities of a water management centre in charge of protecting a city against floods.	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		
Water Management Game	The game experiment focuses on risk-based decision-making in water management using probabilistic forecasts of inflows to a reservoir	HEPEX Forecast Games Download: English (online 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 discussion of the use of ensemble predictions in operational hydrology.	Download: Peak Box Game Reference: Zappa et al., 2013 HEPEX blog post

Tabelle mit Vorhersagespielen und Experimenten:
iea-wind.org/taks 51
→ Workstreams → Decision Making under Uncertainty

<https://iea-wind.org/task51/tas51-work-streams/ws-decision-making-under-uncertainty/>

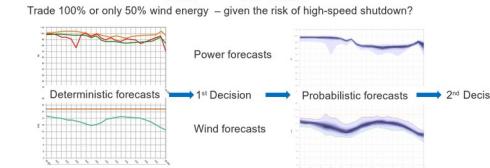
Initiative “probabilistische Vorhersagespiele & Experimente”

1. Experiment (2020)

Spiel: 12 Fälle

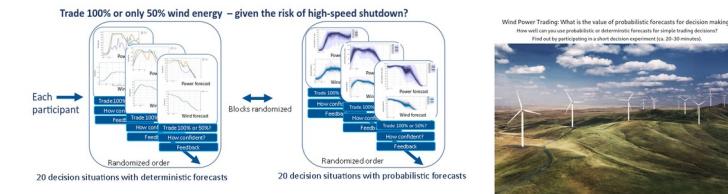
Entscheidungsstruktur: 12 deterministische Vorhersagen gefolgt von probabilistischen Vorhersagen

Nach jeder Entscheidung, konnte die Entscheidung geändert werden aufgrund der zusätzlichen Information



2. Experiment (2021-2024*)

Game: 40 cases



Entscheidungsstruktur: jeweils 20 deterministische Fälle + Entscheidungskonfidenzabfrage und 20 probabilistische Fälle + Entscheidungskonfidenzabfrage

* immer noch offen...: <https://meteorology.mpib.dev/wind-power-decisions/about.html>

Workstream Data Science and AI – *EDV und KI*



Webinar now available in our YouTube channel

IEAWindForecasting

<https://youtu.be/t6H7diavQdg>

Künstliche Intelligenz (KI) ist die am schnellsten wachsende Technologie der Welt und prägt Branchen wie Energie und Meteorologie rasant.

Die Auswirkungen der zunehmenden Einbeziehung von KI und maschinellem Lernen in Wetter- und Stromvorhersagemodelle schürt viele Sichehstsbedenken in der Branche.

Um diese zu diskutieren und Experten, die neuesten Fortschritte im Bereich ML/DL für die Wettervorhersage erklären zu lassen, organisierten wir im Januar 2024 ein Webinar zum Thema „Deep Learning für Wetter – und wetterbasierte Leistungsvorhersage“.

Wichtige Erkenntnisse aus dem Webinar:

- + Positive Entwicklungen:
- + Die Modelle zeigen erste Ergebnisse
- + Die Modelle legen einen neuen Ansatz für meteorologische Fragen nahe
- + Schnelle Hypothesentests und Einschränkung des Umfangs für Simulationen mit Physikmodellen
- + Die Modelle entwickeln sich schnell, da große Ressourcen in neue Funktionen investiert werden
- + Riesige Ensembles (>1000 Mitglieder) sind in Sicht
- + Es wird daran gearbeitet, die KI-Modelle allein auf Basis von Messungen zu starten

Zu lösende Herausforderungen:

- Qualitätskontrolle der Eingabedaten ist unzureichend – Ausreißer, fehlende oder korrupte Daten
- Hohe Komplexität und Vielfalt der Daten zum Trainieren der Modelle ist eine Herausforderung
- Feature-Entwicklung erfordert Funktionen – ohne Physik wird dies schwierig
- Datengesteuerte Modelle erfordern einen neuen Blick auf die Datenfreigabe, was bisher eine Herausforderung war

Workstream Data Sharing - Datenaustausch

Workplan

Ein kürzlich für die Europäische Kommission erstelltes **Strategiepapier zur Transformation des Energiesystems**, das Digitalisierung und Datenaustausch umfasst, bezog sich im Allgemeinen auf den Energiesektor – **erneuerbare Energien wurden nur oberflächlich behandelt.**

Status: Entwicklung eines Positionspapiers zum Datenaustausch für den Sektor der erneuerbaren Energien wurde begonnen

Eine Gruppe von Mitwirkenden behandelt verschiedene Aspekte erneuerbarer Energien: Ressourcenbewertung/Standortbestimmung, Prognosen, Handel, Betrieb und Wartung usw.



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

WS Extreme Power System Events – Workshops



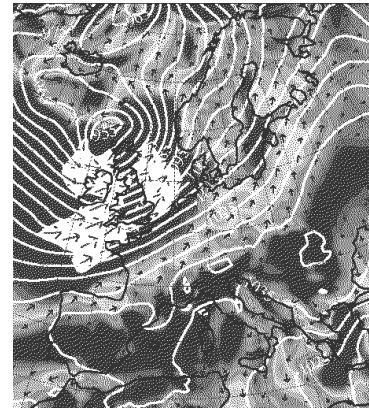
Join us at the Wind & Solar Integration Workshop Session 4D and 8D on 8.-9. October 2024



Join us at the North American Wind Energy Association's Annual Conference on October 29, 2024, 1-5pm



IEA Wind Task 51 Austria Workshop at the NH Danube City Hotel in Vienna on November 6, 2024



IEA Wind TCPTask 51
"Forecasting for the weather driven energy system"

Collaboration

DestinE Digital Twins



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

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

**Workshop on
Extreme Power System Events
Boulder, April 2025**

WS Value of Forecasting – Wertschöpfung durch Vorhersagen

Quantifizierung des Werts probabilistischer Prognosen für die Betriebsplanung von Stromnetzen

Die Highlights des OPTSUN-Projekts:

- Entwicklung verbesserter probabilistischer Leistungsprognosen im Versorgungsmaßstab und hinter dem Zähler (BTM)
- Identifizierung fortschrittlicher Methoden zur Verwaltung von Unsicherheiten im Versorgungsbetrieb
- Validierung von Methoden durch detaillierte Simulation des Stromnetzbetriebs
- Demonstration einer Planungsmanagementplattform zur Integration probabilistischer Prognosen und Planungsentscheidungen mit als OpenSource Quellcode



Schlussbericht:

<https://www.epri.com/research/products/000000003002025442>

Projekt-Home[page]: <https://www.epri.com/optsun>

Veröffentlichung:

“Quantifying the value of probabilistic forecasting for power system operation planning”:

<https://doi.org/10.1016/j.apenergy.2023.121254>

Mehr Info: iea-wind.org/task51 → Workstreams → Value of Forecasting

Direkt: iea-wind.org/task51/task51-work-streams/ws-value-of-forecasting/

WS Value of Forecasting – Wertschöpfung durch Vorhersagen

Der Status wird durch Betrachtung und Diskussion der Nutzung von Windkraftprognosen überwacht

+++ in Zusammenarbeit mit Task 50 Hybrid Power Plants +++

Kleine Auswahl an vorgestellten Anwendungsfälle + Berichte

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](#)

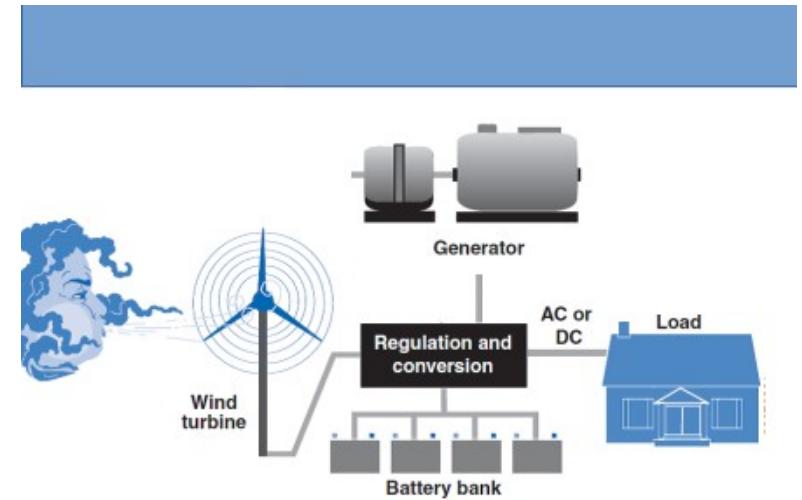
Antonio Couto, LNEG, Portugal: [Addressing the challenges of wind power plants hybridised with solar power: A generation forecast perspective. \(see also publication\)](#)

Ruijie Zhu, Technical University of Denmark: [Value of forecasting for hybrid Energy Management](#)

See iea-wind.org/task51

→ [Publications](#)

→ [Workshops & Special Sessions](#)



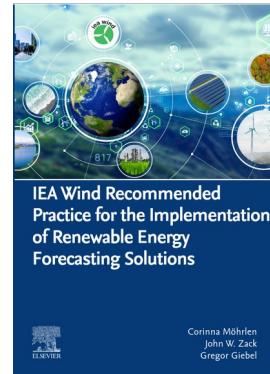
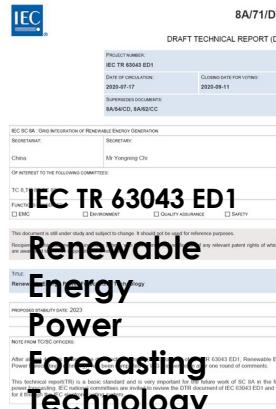
Zusammenarbeit und Liaison mit dem IEC Wissenschaftlichen Kommitte 8A für Netzintegration Erneuerbarer Energien



Frühere gemeinsame Arbeit: IEC Technischer Bericht TR63043 – Leistungsvorhersage-Technologien Erneuerbarer Energien

- Technischer Bericht TR63043 wurde in 2020 publiziert vom 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 für die Entwicklung eines IEC Standard in Oct. 2023 akzeptiert mit 100% der P-Member

See Presentations
from WIW2024
session 9D*

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



Corinna Möhrle
John W. Zack
Gregor Giebel

Task 51 Web Presence

Website

<https://iea-wind.org/task51>

The screenshot shows the homepage of the IEA Wind TCP Task 51 website. At the top, there's a navigation bar with links to 'IEA Wind Home', 'Task 51' (which is highlighted in green), 'Informational Portal', 'Work Streams', 'Partners', 'Published Reports', and 'Task 51 Members Site'. Below the navigation is a large banner featuring the text 'IEA Wind TCP Task 51' and 'Forecasting for the weather-driven Energy System'. To the left of the banner is a sidebar titled 'Work Streams' containing a list of topics such as Atmospheric Physics and Modeling, Airborne Wind Energy Systems, Seasonal Forecasting, State of the Art and Research Gaps, Forecasting for Underserved Areas, Minute-Scale Forecasting, Uncertainty / Probabilistic Forecasting, Decision-Making under Uncertainty, Extreme Power System Events, Data Science and Artificial Intelligence, Privacy, Data Markets and Sharing, Value of Forecasting, and Forecasting in the Design Phase. On the right side of the banner is a sidebar with links to 'Publications', 'Task 51', 'Articles & Reports', 'Posters & Handouts', 'Recommended Practices', 'Webinars', and 'Workshops & Special Sessions'. The main content area below the banner contains a brief description of the task's purpose: 'Forecasting for the Weather Driven Energy System – Improving the value of renewable energy forecasts to the wind industry'.

About Task 51

The Task 51, under the *IEA Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems* (IEA Wind) focuses on improving the value of renewable energy forecasts.

There are three distinct areas of challenge in forecasting wind power. The first area is in the continuing effort to improve the representation of physical processes in weather forecast models through both new high performance initializations and tailored parameterizations. The second area is the heterogeneity of the forecasters and end users, the full understanding of the uncertainties throughout the modelling chain and the incorporation of novel data into power forecasting algorithms. A third area is representation, communication, and use of these uncertainties to industry in forms that readily support decision-making in plant operations and electricity markets.

This Task will focus on facilitating communication and collaborations among international research groups engaged in the improvement of the accuracy and utility of forecast models and their utility for the stakeholders in the wind industry, in the power sector and in the energy system.

This Task has the following specific objectives:

- To establish an active, open forum for sharing knowledge among the participants, related IEA Wind Tasks and other related TCPs through workshops, dissemination and communication measures
- To establish and communicate standards and frameworks for the operation and evaluation of forecast model performance
- To identify paths to increased application and utility of forecast information to the task stakeholders
- To advance the knowledge in the underlying atmospheric physics, in the mathematical models converting the transforming atmospheric quantities to energy system application variables, in the modelling of the uncertainty and in the applications and decision-making
- To identify most promising areas for new research to improve the quality and utility of forecasts
- To provide guidelines for the implementation of optimal forecasting solutions



Channel

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

The screenshot shows the YouTube channel page for 'IEA Wind Forecasting'. At the top, there's a large thumbnail image showing a control room with multiple computer monitors displaying various data and maps related to wind energy forecasting. Below the thumbnail is the channel's profile picture, which is an orange circle with a white letter 'I'. The channel name is 'IEA Wind Forecasting' and it has 67 subscribers. There's a red button labeled 'ABONNIEREN' (Subscribe). Below the channel info is a section titled 'ÜBERSICHT' (Overview) with a link 'ALLE WIEDERGEHEN' (View all). Underneath are four video thumbnails with their titles and view counts:

- 'IEAWindTask36 Webinar4 2018' with 75 Aufrufe (views) and 11 Monaten (published)
- 'Probabilistic Forecasting in Practice' with 229 Aufrufe and 11 Monaten
- 'Webinar on Wind Power Forecast Solution Selection' with 139 Aufrufe and 11 Monaten
- 'IEA Wind Task 36 Forecasting - The Overview' with 313 Aufrufe and 11 Monaten

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/>

**IEA Wind Task 36
Forecasting for Wind Power**

FORECASTING FOR YOU

Impact
The Task sends out news a few times a year, is present on conferences and meetings, and has its own YouTube channel. There, alongside video transmissions of the presentations of the Task, we have webinars, short video talks plus audience questions on the major results of phase I. The fourth one was an additional one on forecast uncertainty.

The Task members also try to get a enhance collaboration between weather predictors and users. One activity for the current phase of the Task (2019-2021) is a look into standardization of the data to make data exchange easier across the industry and thus enable it to estimate the value of better forecasting.

A major part of the work of the Task is to disseminate the scientific basis for the wind predictions themselves. This includes the development of guidelines, which are also widely distributed information accessible datasets and training materials to support user and issues affecting the forecasters. Finally, the Task will be engaging and users aiming at dissemination of the best practices and results of the Task.

The Task is currently in its second phase, 2019-2021.

Results of phase I (2016-2018)
We developed an information portal, with links to data, projects and knowledge useful for wind power forecasting. The portal contains a large number of papers on validation of MWp models, a list of Field campaigns with open data for model verification, or a selection of benchmarks and a list of publications and existing reference frameworks.

A major part was the publication of Recommended Practice (RP) on Forecast Solution Selection, detailing out the necessary steps to get the best adapted forecasts for the individual needs of users. It is a step-by-step guide through deliberations which might or might not end up with the decision to do a forecast trial. The second document showed how to evaluate the forecast trial, including acceptable and unusable results for both the end user and the forecaster. The third document helped to evaluate the trial to get the optimum 21 recommendations and 31 reliable results.

For publication purposes, we published two papers with an overview (for a broader readership) and one with a long list of specific use cases (more technically oriented). We also developed a glossary of terms and tried to establish a common vocabulary. We also mapped the current use of probabilistic forecasts through a questionnaire.

www.ieawindforecasting.dk

Task Overview

IEA Wind Task 36 Forecasting for Wind Power

Understanding Uncertainty: the difficult move from a deterministic to a probabilistic world

Challenge: Uncertainties forecasts are still a part of industrial meeting, but there is a growing interest on probabilistic forecasts for the controls and trading floors. Nevertheless, there are a lot of misconceptions about what probabilistic forecasts are, what they mean, and how to use them. There is a lack of understanding of what probabilistic forecasts are, what they mean, and how to use them.

Background: Uncertainties forecasts are still a part of industrial meeting, but there is a growing interest on probabilistic forecasts for the controls and trading floors. Nevertheless, there are a lot of misconceptions about what probabilistic forecasts are, what they mean, and how to use them. There is a lack of understanding of what probabilistic forecasts are, what they mean, and how to use them.

Further reading: www.ieawindforecasting.dk

**IEA Wind Task 36
Forecasting for Wind Power**

RECOMMENDED PRACTICES FOR SELECTING RENEWABLE POWER FORECASTING SOLUTIONS

Challenges
The most important challenge in selecting appropriate management of power generation from wind and solar plants is to determine the best solution for each plant. This is because the forecast information in the work decision making process must be used to make the best possible decisions. Therefore, the right forecast solution may not be the best choice if it does not provide enough information or is not able to support the decision-making process. In addition, any decision regarding the design, development and implementation of wind energy systems should be based on a clear understanding of the requirements and constraints of the system.

Solution
To overcome some of the obstacles and barriers in the selection of forecasting solutions, the Task developed a set of guidelines for the users of wind energy systems. The first one was an additional one on forecast uncertainty. The second document showed how to evaluate the forecast trial, including acceptable and unusable results for both the end user and the forecaster. The third document helped to evaluate the trial to get the optimum 21 recommendations and 31 reliable results.

Forecast Solution Selection
While many forecasting tools are available, one needs to determine the best solution for each plant. For any industry, the right forecast solution is not always the most advanced or the highest forecast solution. For any industry, the right forecast solution is not always the most advanced or the highest forecast solution. For any industry, the right forecast solution is not always the most advanced or the highest forecast solution.

Benchmarks and Trials
In the process of selecting a forecast solution, benchmark and trials are used to evaluate the performance of different solutions. These benchmarks and trials help to identify the best solution for the specific needs of the user. The user can then make an informed decision based on the results of the benchmarks and trials. The user can then make an informed decision based on the results of the benchmarks and trials.

Forecast Trial Selection
The user can then make an informed decision based on the results of the benchmarks and trials. The user can then make an informed decision based on the results of the benchmarks and trials.

Figure 1: The guidelines support flow chart for the selection of forecasting solutions.

Figure 2: A conceptual framework for forecast selection

Where to get the guidelines
www.ieawindforecasting.dk

Forecast Solution Selection

IEA Wind Task 36 Forecasting for Wind Power

Definitions
The IEA Wind Task 36 Forecasting for Wind Power is a collaborative effort of the international wind energy industry to improve the quality of wind power forecasting. The task is divided into three phases: Phase I (2016-2018), Phase II (2019-2021), and Phase III (2022-2024).

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IEA Wind Task 36 Forecasting for Wind Power

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Further reading: www.ieawindforecasting.dk

Uncertainty and Probabilistic Forecasting

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Further reading: www.ieawindforecasting.dk

Zusammenfassung

Rahmenbedingungen haben sich seit der ersten Phase von Task 36 geändert:

Erneuerbare sind nicht länger eine Ergänzung zum System, sondern SIND das System

Sektorkopplung an Verkehr, Wärme, Power2X...

- Neue Herausforderungen durch Anwendungen in verschiedenen Prognosehorizonten (ultra-kurz zu saisonal)
- Extreme und Auswirkung wettergesteuerter Energie benötigen Unsicherheit, probabilistische Prognosen und datengesteuerte KI-Modellierung & stehen im Fokus unserer Arbeit
- Workshops & Webinare helfen uns zu vernetzen, Informationen und Erfahrung zu teilen und objektiv und transparent in die Industrie zu kommunizieren

Heutige Herausforderungen benötigen starke int. Zusammenarbeit mit

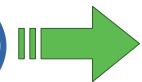
- verwandten TCPs (Solar, Wasser, Wasserstoff, ...)
- verwandten Tasks (Integration, Lidar, Farm Flow Control, Hybride, Wind aus der Luft ...)
- Standardisierung (IEC), Datenmärkte, Datenkontrolle und -qualitätsbewertung (WMO)



iea wind

Task 51 – “Forecasting for the weather-driven Energy System”

Fragen ?
Neugierig geworden ?



iea-wind.org/task51

- Mitmachen ist erwünscht!!!
- Unser Task Newsletter orientiert und verbindet...
→ einfach eine Email an **Gregor Giebel** schicken mit “Newsletter Anmeldung” im Betreff...

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Dr. Corinna Möhrlen

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The IEA Wind TCP agreement, also known as the Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems, functions within a framework created by the International Energy Agency (IEA). Views, findings, and publications of IEA Wind do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.