Annual Report 2024

Task 53

Photo: *Dublin meeting (Photo credit: Hannele Holttinen) .*

Wind Energy Economics

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The work within Task 53 aims to inform the analysis, research, and regulatory communities of the current and future cost of wind energy for land-based and offshore wind technologies, and the technology's value proposition.

The Task is focused on new wind applications, insights on evolving economic metrics and procurement instruments, and analysis and outcomes that examine a future where wind energy is tailored towards a fundamentally different power system; specifically, one where wind is providing more than half of the total electricity supply in several markets globally. By providing high-quality data that supports analyses related to cost and value of wind energy, the Task enhances the broader energy community's efforts to plan for the future. The Task also develops novel methods that are often applied by key stakeholder groups and industry.

Organizations such as IEA and the International Renewable Energy Agency (IRENA) have used Task 53 wind project cost and performance statistics, and participants of the Task regularly use these data for internal and external purposes.

Introduction

In service of a better understanding of cost reduction opportunities and how society can maximize the value of wind energy, Task 53 was formed in 2022 to generate data and insights that inform the potential role of wind power in the future energy system. The Task is focused on new wind applications, insights on evolving economic metrics and procurement instruments, as well as analysis examining a future where wind energy is tailored towards a fundamentally different power system.

The Task has ten IEA Wind TCP Members, representing 18 distinct organizations with participation from 22 individuals (Table 1). In its work program, the Task considers the full array of land-based and offshore technologies but focuses primarily on utility-scale applications. The work scope extends through calendar year 2025.

In the end of January 2023, the first in-person meeting was hosted by TNO in Amsterdam, Netherlands, which was followed by in-person meetings in Kassel, Germany (November 2023); Dublin, Ireland (April 2024); Glasgow, Scotland (November 2024).

The in-person meeting in Dublin was held together with a joint Task meeting with IEA Wind Task 25 to explore common research interests and a Topical Expert Meeting (TEM) on "Net Zero Systems" (Figure 1). Industry stakeholders and external research entities regularly collaborate on work products and participate in the Task's in-person meetings.

COUNTRY/SPONSOR	INSTITUTIONS
Denmark	DTU Wind, EA Energy Analysis
European Commission	Joint Research Centre (JRC)
Germany	Deutsche WindGuard, Fraunhofer IEE, Fraunhofer ISI
Ireland	Sustainable Energy Authority of Ireland (SEAI), University College Cork
Japan	University of Tokyo, Osaka Sangyo University
Norway	Norwegian Water Resources and Energy Directorate (NVE)
Sweden	Swedish Energy Agency (SEA)
United Kingdom	Offshore Renewable Energy (ORE) Catapult, University of Sussex
United States	Lawrence Berkeley National Laboratory (LBNL), National Laboratory of the Rockies (NLR)
The Netherlands	Netherlands Organisation for Applied Scientific Research (TNO), Eneco

Table 1. *Countries Participating in Task 53*

Figure 1. *Experts participating in the Joint IEA Wind workshop between Task 53 and Task 25 (Photo Credit: Hannele Holttinen.)*

Progress and Achievements

Task 53 is now in its third and final year of this phase. A summary of the collaboration, dissemination, and publications accomplished in 2024 include:

- A draft manuscript to summarize the findings from a survey on wind energy experts' perspectives of how wind plant siting, layout, and operations might differ from today under a highly decarbonized energy future by 2040
- A draft report on the challenges and opportunities of mapping the global wind energy technology supply chain
- A draft report on cost and remuneration uncertainty in the offshore wind sector.

In addition to monthly web meetings, in-person Task meetings took place in Ireland and the United Kingdom. Collaborations from among the group have been robust and covered a variety of areas with a few highlights from select Work Packages (WPs):

WP 1: A core team led by NLR with support from LBNL distributed and analyzed a survey instrument to elicit perspectives on how wind plant siting, layout, and operations might be different in a highly decarbonized energy future by 2040. A draft manuscript was prepared by the project team for submission to a journal.

WP 2: Published an article in Applied Energy focused on the capital expenditures for fixed-bottom offshore wind farms through a probabilistic assessment [1]. The author team from the University of Tokyo have developed an offshore wind cost model for Japan and tested the impact of technology innovations on CapEx by comparing their extent to those reported by U.K. projects.

WP 3: Published a perspective article in Nature Energy on "The enduring role of contracts for difference in risk management and market creation for renewables" [2]. The author team challenges the notion of contracts-for-difference as subsidies and highlights the risk management qualities the contract vehicle provides to renewables and wind energy, specifically.

WP 4: Integrated the country-specific cost and performance data into a viewer in Tableau on the *IEA Wind TCP website*, allowing for an improved visual experience and export features for utilization of the data by global users.

WP 5: The project team from EA Energy Analyses calibrated the *Balmoral power sector model* to explore value implications and trade-offs of transmission and hydrogen options for offshore wind energy coupling.

WP 6: The European Commission Joint Research Centre completed a draft report on the opportunities and challenges of wind energy's global supply chain data based on a data collection of Tier 1 through Tier 5 wind energy turbine and component suppliers.

Highlight

In a draft manuscript [3], the Task 53 authors report on the findings of a global expert elicitation survey on future land-based wind energy siting and technology development under a scenario of extensive land-based wind energy deployment by 2050. In a 36-question survey, land-based wind energy experts from around the world were asked to anticipate key land use and siting conflicts as well as market and technology opportunities that may arise as wind energy density increases.

Respondents expect that eight of the ten potentially conflicting land uses are likely to become more restrictive to wind deployment by 2040 (Figure 2), with the most restrictive future conflicts involving perceived social or cultural incompatibility and wind plants' increasing proximity to humans and wildlife.

To increase energy generation and decrease impacts to surrounding communities, respondents recommended the use of fewer, larger turbines (5 MW) more frequently than smaller turbines (2.5 MW) in most terrain types, with a stronger preference for large turbines among European respondents.

While local approaches to reducing wind energy siting tensions were popular in all regions, elicitation results indicate a greater preference for policy interventions in Europe and technological interventions in North America.

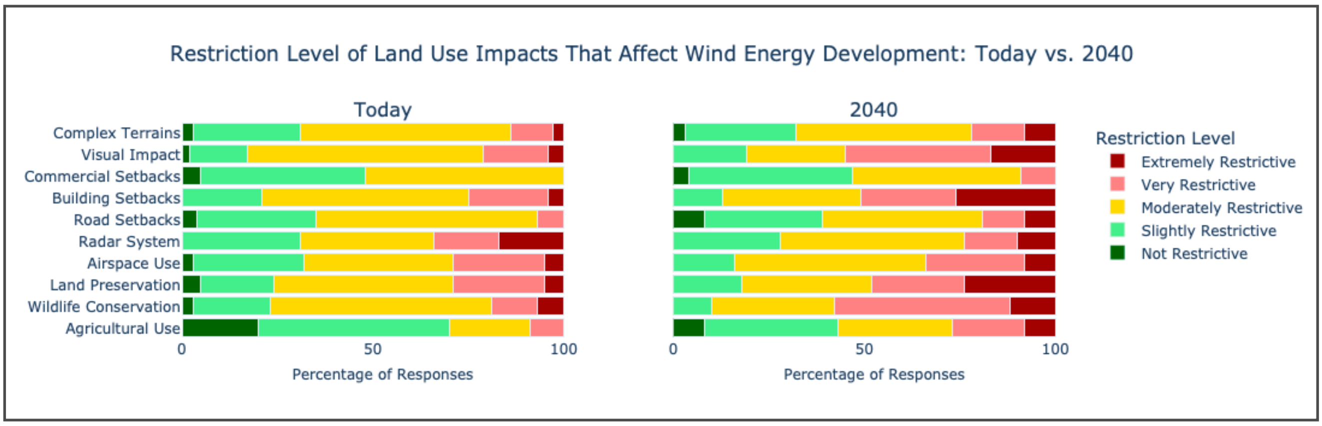

Figure 2. *Perceived and anticipated restrictiveness of land uses today versus in 2040 under a high wind and renewable energy deployment scenario. (Source: [3])*

Outcomes and Significance

Task 53's work aims to inform the analysis, policy, and regulatory communities of the current and future cost of wind energy for land-based and offshore wind technologies and the technology's value proposition within an evolving power system.

By providing high-quality data and published analyses that inform our understanding of the cost and value of wind energy, the Task enhances the broader energy community's efforts to plan for the future.

The Task also develops novel approaches and insights that can be applied by key stakeholder groups and industry.

Organizations such as IEA and IRENA have used Task 53 wind project cost and performance statistics, and Task participants regularly use these data for internal and external purposes. Task 53 members are frequent presenters at conferences and leading industry events around the world.

Next Steps

In 2025, the task is expected to continue constructive dialogues during the monthly web meetings and the upcoming in-person Task meetings in Tokyo, Japan (April 2025) and in Copenhagen, Denmark (fall 2025) hosted by the Technical University of Denmark (DTU). A Task Extension proposal is prepared for submission to the IEA Wind TCP Executive Committee by the Task participants. The latter joint meeting will serve the purpose of identifying joint research activities to pursue in the future.

Major upcoming deliverables include a journal article on the accounting of wind energy uncertainties and risks, dissemination activities for our planned expert survey, a technical report on cost and value considerations for offshore wind and hydrogen coupling, and a report on challenges and opportunities with global wind energy supply chain data.

References

[1] Kikuchi, Y., T. Ishihara (2023) "Assessment of capital expenditure for fixed-bottom offshore wind farms using probabilistic engineering cost model". The University of Tokyo, School of Engineering, Department of Civil Engineering, Japan.
[2] Beiter, Philipp, Jérôme Guillet, Malte Jansen, Elizabeth Wilson, and Lena Kitzing (2024) "The enduring role of contracts for difference in risk management and market creation for renewables." Nature Energy 9 (1): 20–26. *https://doi.org/10.1038/s41560-023-01401-w.*

[3] Houghteling, C., P. Beiter, C. Brush, A. Elkins, R. Wiser, J. Rand, J. Seel (Forthcoming) "How will the wind blow in 2050? A global expert elicitation survey on the future of land-based wind energy siting and technology development". Draft manuscript.

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