TASK 25 WIND INTEGRATION FACT SHEETS UPDATED IN 2020, ALSO IN JAPANESE

TASK 25 REPORT 2020

Design and operation of energy systems with large amounts of variable generation

System impact studies are important for defining targets for wind and other variable renewable energy, and also for defining future decarbonizing pathways. Task 25 is working towards commonly accepted standard methodologies to be applied in system impact studies for wind and solar dominated power and energy systems. International collaboration remains key to learn from both experience and studies in different countries, in the evolving power and energy systems of the future.

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In 2020, Task 25 published updated fact sheets for integration issues—also in Japanese. Hourly timeseries of measured data was gathered from the participating countries, to publish as profiles of large-scale wind power production—correcting for curtailments, if necessary. A summary report for all results in national case studies was compiled, to be published in 2021. Two collaborative journal articles 'Addressing Technical Challenges in 100% Variable Inverter-Based Renewable Energy Power Systems' and 'System impact studies for near 100% renewable energy systems dominated by inverter based variable generation' were published in Wiley's WIREs and IEEE TPWRS (open access).

Task 25 brings best practice wind integration experience, study methods, and results to member countries and a wider audience through IEA, IRENA, ESIG, IEEE, and various Task publications. The main industry stakeholders are the system operators, that also follow Task 25 work directly (from Denmark, France, and Italy). The collaboration with IEA PVPS Task 14 resulted in a Recommended Practices report including solar integration issues in 2018, and is planned to continue in the update process starting in 2021.

Introduction

Task 25 work started in 2006 to tackle differences seen in results for wind integration studies and cost of integration. By analysing the multitude of studies investigating the power system impacts of wind power, most differences were explained and best practices for system studies drawn. Since then, a convincing amount of experience from wind integration has emerged as well as targets for wind and solar reaching higher and higher shares of demand. The concerns regarding variable generation are shifting from costs of integration to costs of inflexibility. Assessing the impacts in practice means comparing costs and reliability of alternative power and energy systems.

International collaboration remains key to learn from both experience and studies in different countries, in the evolving power and energy systems of the future. Task 25 is now starting its sixth term (2021-24). The main stakeholders are the system operators, some of them joining Task 25 directly (Denmark, France, Italy) and as observers (Ireland, Romania, Spain). IEA and IRENA are frequent observers to Task 25 meetings, as well as new countries aiming to join, most recently India and Romania.

Progress and achievements

Task 25 has established an international forum for member countries, including their Transmission System Operators (TSOs), to exchange knowledge of and experiences with electricity system operations with large amounts of wind and solar energy. This work was rewarded an ESIG excellence award in March 2021.

The spring and fall meetings in 2020 were held online. This enabled more participation from the member countries, almost 60 persons logged in for at least one of the three meeting days, and also reaching out to more stakeholders (TSOs from Denmark, France, Ireland, Italy, and industry observer Ampacimon).

In 2020, Task 25 published two collaborative journal articles 'Addressing Technical Challenges in 100% Variable Inverter-Based Renewable Energy Power Systems' [1] and 'System impact studies for near 100% renewable energy systems dominated by inverter based variable generation' (open access IEEE TPWRS Special Collection) [2]. Task 25 work is highlighting the evolving best practice on system impact studies for the feasibility of wind and solar-dominated power systems. The main challenges for high share wind and solar systems are stability due to the inverter based, non-synchronous grid interface, and balancing due to the varying resource. For both challenges there are already mitigation options, however, research, and demonstration will be needed to determine how wind and solar power plants including grid forming capabilities can become the backbone of future power systems. For the flexibility needs of 100% renewables systems, storage and flexible demand may provide two cost efficient pathways in future. This will depend on how far cost reductions of storage technologies will go, and how much new electrification loads can help, for both short-term balancing and for seasonal mismatch of future demand and generation.

A blog at ESIG was published to discuss Task 25 experience on 'Sharing of Lessons Learned Among System Operators: Is It Working?'
https://www.esig.energy/category/blog/ (Holttinen, H.)

Presentations disseminating the work of Task 25 included:

- ESIG Down Under Sep 2020 'The evolving Transmission-Distribution Interface - local flexibility markets' (H.Holttinen)
- Sweden Wind power in focus -conference keynote 'Towards 100% renewables—can wind and solar be the backbone or power systems' 13 Oct 2020 (H.Holttinen)
- Workshop on Estimating the system value of VRE using reference systems 9 Nov 2020, co-organised by Tasks 25/26/37
- Wind Integration Workshop WIW20 12 Nov 2020: A session disseminating Grand Challenges Grid and Towards 100% renewables work (K.Dykes, O. Carlson, M.O'Malley, J.C. Smith, H.Holttinen).

Highlight: Cross-cutting activities

Task 25 has aimed to form links between other networks from the start: TSO forums like ENTSO-E and ESIG have seen presentations from the main results in the first phases of Task 25. The newly formed Global Power System Transformation Consortium G-PST is an important collaboration forum for Task 25 in the current phase.

IEA collaboration has also been very relevant from the start, and links with IRENA were formed in the second phase of Task 25. IEA and IRENA are joining Task 25 meetings with presentations of ongoing work, Task 25 makes reviews of their publications, and joint sessions during the yearly wind and solar integration workshops (WIW and SIW) have been set up.

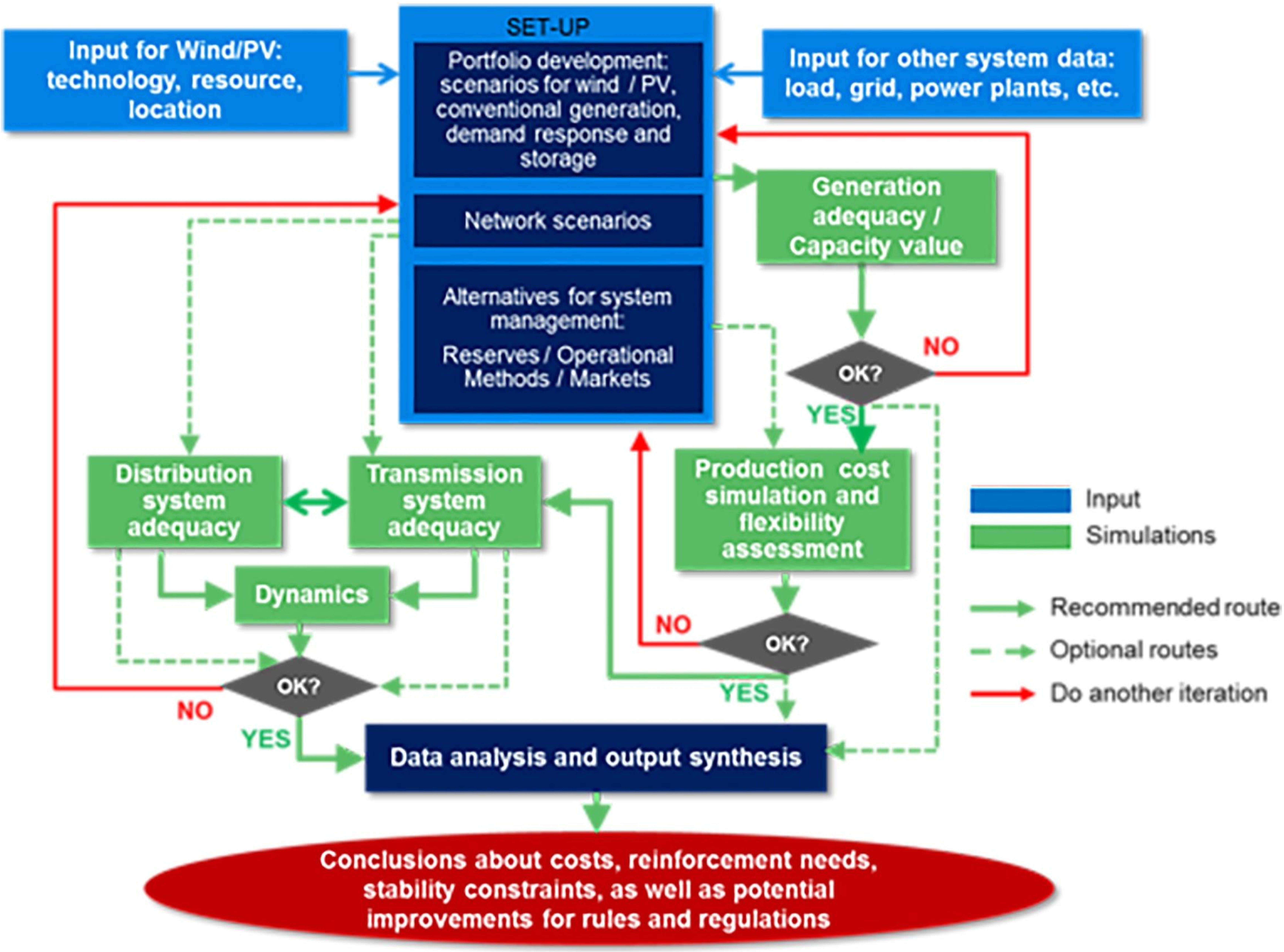

FIGURE 1. RECOMMENDED PRACTICES FOR WIND AND SOLAR INTEGRATION STUDIES FOLLOW A FLOW CHART, INCLUDING ALL POSSIBLE PARTS OF AN INTEGRATION STUDY [3].

Collaboration with IEA PVPS Task 14 has resulted in a thorough update of the Recommended Practices for Wind/PV Integration Studies (RP 16 Ed 2), with a Second Edition in August 2018 [3], that was also published as an IEA TCP PVPS report in 2019. Task 25 has also had presentations in IEA TCP ISGAN workshops.

In 2019-20, Task 25 had several other IEA TCP contacts regarding the value of flexibility of the different technologies (Hydro, Biomass, Storage), and modelling challenge (ETSAP). Task 25 was initiating an inter-TCP meeting with IEA on flexibility topic in 2020, and presenting in the workshop organized by a newly formed IESCG (Integrated Energy Systems Coordination Group) of the working party End Use (EUWP) in March 2021.

More recent Tasks of other TCPs can benefit from the knowledge Task 25 has accumulated, and there is more and more benefit of collaboration between Tasks and TCPs as we go forward and tackle the wider challenge of variable generation in future decarbonized energy systems. Pursuing these challenges together, potentially with a joint Task of several TCPs could be one way forward.

Outcomes and significance

System impact studies are important for defining targets for wind and other variable renewable energy, and also for defining future decarbonizing pathways. Task 25 is working towards commonly accepted standard methodologies to be applied in system impact studies for wind and solar-dominated power and energy systems.

An example is the Recommended Practices for Wind and Solar Integration Studies, Edition 2 updated though collaboration with IEA PVPS Task 14 including solar integration issues (Figure 1).

Task 25 brings best practice wind integration experience, study methods, and results to member countries. A wider audience is reached through IEA, IRENA, G-PST, ESIG, IEEE, and various Task publications.

It is technically possible to integrate very large amounts of wind and solar capacity in power systems, especially when new electrification loads are integrated in a flexible way and the capabilities of wind and solar power plants are fully exploited.

Next steps

Year 2021 will see the publication of the summary report—giving examples of study results and experience from 2018-20 phase, but also keeping the report on a more general level highlighting the main issues and state-of-the-art of knowledge. The new phase (2021-24) is starting, with the aim to update the Recommended Practices [3].

The spring meeting for 2021 is planned to be on-line, but for fall meeting, a new attempt to meet face to face at TU Delft, NL will be made.

References

[1] B.-M. Hodge et al. (2020) Addressing Technical Challenges in 100% Variable Inverter-Based Renewable Energy Power Systems. Wiley Interdisciplinary Reviews: Energy and Environment. DOI: 10.1002/wene.376

[2] H.Holttinen et al., Nov 2020, doi: 10.1109/TPWRS.2020.3034924 open access https://ieeexplore.ieee.org/document/9246271

[3] H. Holttinen et al. (2018) Recommendations for Wind and Solar Integration Studies. RP16 Edition 2. Available at iea-wind.org/publications

Task contact

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TABLE 1. COUNTRIES PARTICIPATING IN TASK

Table 1. Task 25 Participants in 2020		
	Country/Sponsor	**Institution(s)**
1	Canada	NRCan (Thomas Levy); Hydro Quebec IREQ (N. Menemenlis, A. Forcione)
2	China	SGERI (Wang Yaohua, Liu Jun)
3	Denmark	DTU Wind (Nicolaos Cutululis); TSO Energinet.dk (Antje Orths)
4	Finland, OA	VTT Technical Research Centre of Finland (H.Holttinen, J.Kiviluoma)
5	France	EdF R&D (E.Neau); TSO RTE (J-Y.Bourmaud); MinesTech (G.Kariniotakis)
6	Germany	Fraunhofer IEE (J.Dobschinski); FfE (S.vanRoon); TSO Amprion (P. Tran)
7	Ireland	UCD (D.Flynn); SEAI (J. McCann)
8	Italy	TSO Terna (Enrico Maria Carlini)
9	Japan	Kyoto University (Y. Yasuda), CRIEPI (R. Tanabe)
10	Mexico	INEEL (Rafael Bustamante)
11	Norway	NTNU (Magnus Korpås); SINTEF (John Olav Tande, Til Kristian Vrana)
12	The Netherlands	TUDelft (Arjen van der Meer, Simon Watson)
13	Portugal	LNEG (Ana Estanquiero), INESC-TEC (Bernardo Silva)
14	Spain	University of Castilla La Mancha (Emilio Gomez)
15	Sweden	KTH (Lennart Söder)
16	UK	Imperial College (G. Strbac), Strathclyde University (O. Anaya-Lara)
17	USA	NREL (Bethany Frew, Bri-Mathias Hodge)
18	WindEurope	European Wind Energy Association (Vasiliki Klonari, Daniel Fraile)