

# Hybrid power plants – power system operation

IEA TCP WIND Task 25: Design and Operation of Energy Systems with Large Amounts of Variable Generation



Hannele Holttinen, Juha Kiviluoma,  
Operating Agent Task 25

IEA Wind TEM #101 Hybrids 24 August 2020

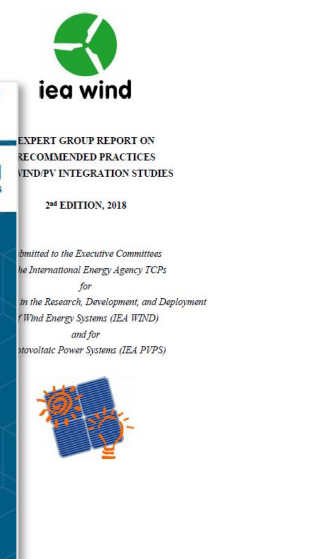
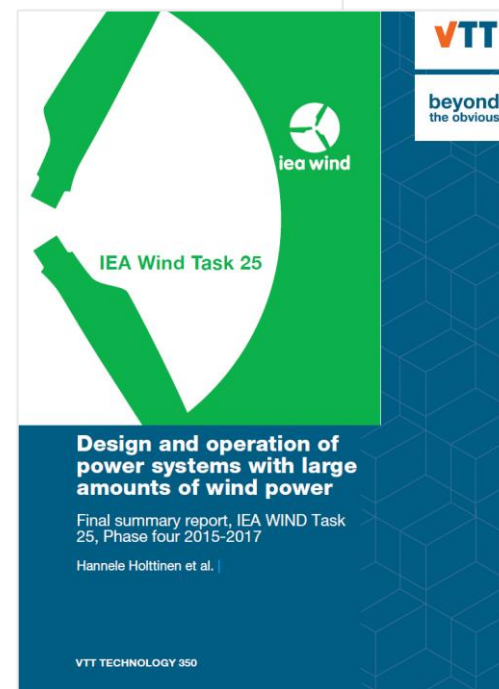


iea wind

# IEA Wind Task 25: Design and operation of energy systems with large amounts of variable generation



Country	Institution
Canada	Hydro Quebec (Alain Forcione, Nickie Menemenlis); NRCan (Thomas Levy)
China	SGERI (Wang Yaohua, Liu Jun)
Denmark	DTU (Nicolaos Cutululis); Energinet.dk (Antje Orths); Ea analyse (Peter Børre Eriksen)
Finland (OA)	VTT (Hannele Holttinen, Juha Kiviluoma)
France	EdF R&D (E. Neau); TSO RTE (J-Y Bourmaud); Mines (G. Kariniotakis)
Germany	Fraunhofer IEE (J. Dobschinski); FfE (S. von Roon); TSO Amprion (P. Tran)
Ireland	UCD (D. Flynn); SEAI (J. McCann); Energy Reform (J. Dillon);
Italy	TSO Terna Rete Italia (Enrico Maria Carlini)
Japan	Kyoto Uni (Y. Yasuda); CRIEPI (R. Tanabe)
Mexico	INEEL (Rafael Castellanos Bustamante, Miguel Ramirez Gonzalez)
Netherlands	TU Delft (Arjen van der Meer, Simon Watson)
Norway	NTNU (Magnus Korpås); SINTEF (John Olav Tande, Til Kristian Vrana)
Portugal	LNEG (Ana Estanquero); INESC-Porto (Ricardo Bessa)
Spain	University of Castilla La Mancha (Emilio Gomez Lazaro)
Sweden	KTH (Lennart Söder)
UK	Imperial College (Goran Strbac); Strathclyde Uni (Olimpo Anaya-Lara)
USA	NREL (Bri-Mathias Hodge); UVIG (J.C. Smith); DoE (Jian Fu)
Wind Europe	European Wind Energy Association (Vasiliki Klonari, Daniel Fraile)



<https://community.ieawind.org/task25/>

# Contents

---



- Benefits / drivers for hybrids – power plant operator point of view
- Benefits and opportunities from hybrids for power system operation
- Electricity market incentives versus power system needs



# Power plant operator view



- Decrease imbalance costs (forecast errors) by aggregation benefits and storage
- Enable bidding system services
- Enable providing capacity and time shift generation to higher price hours
  - If larger storage
- Grid connection – savings by co-locating generation that not at full power simultaneously

TODAY

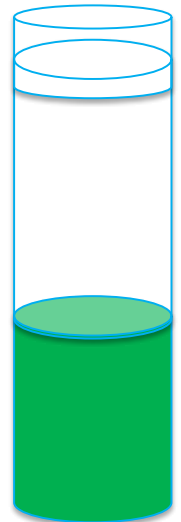


System services

Energy

Capacity

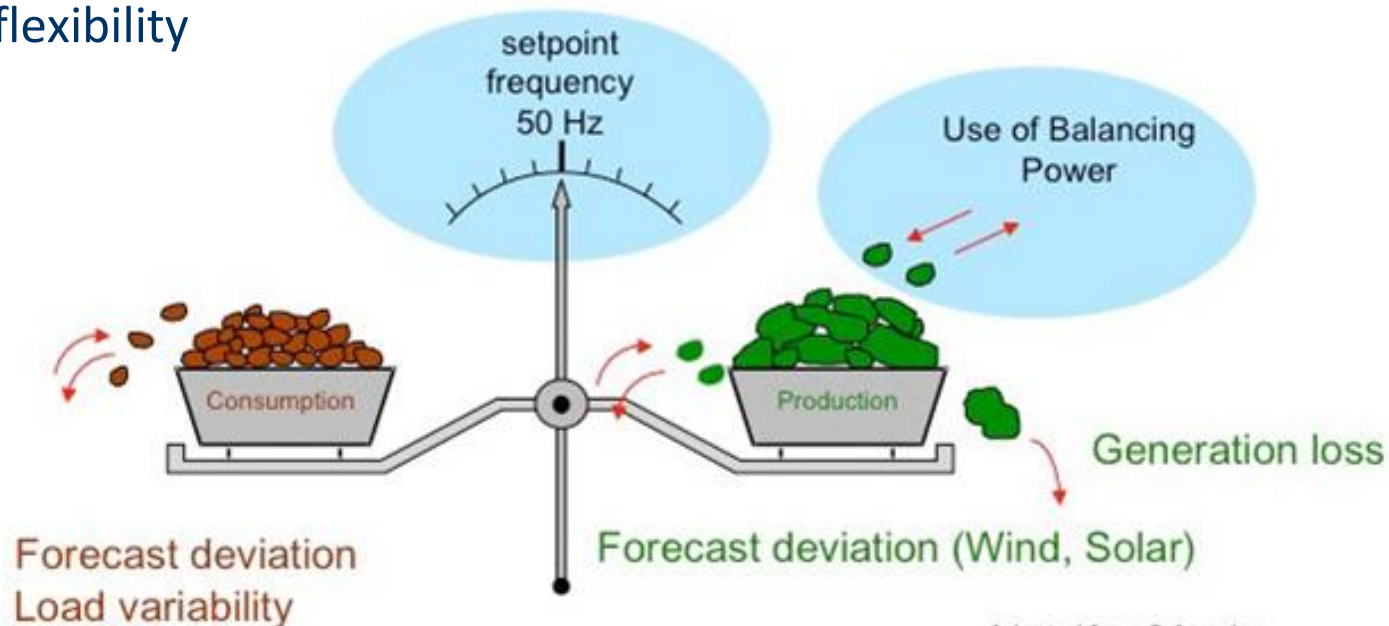
FUTURE?



# System operator view



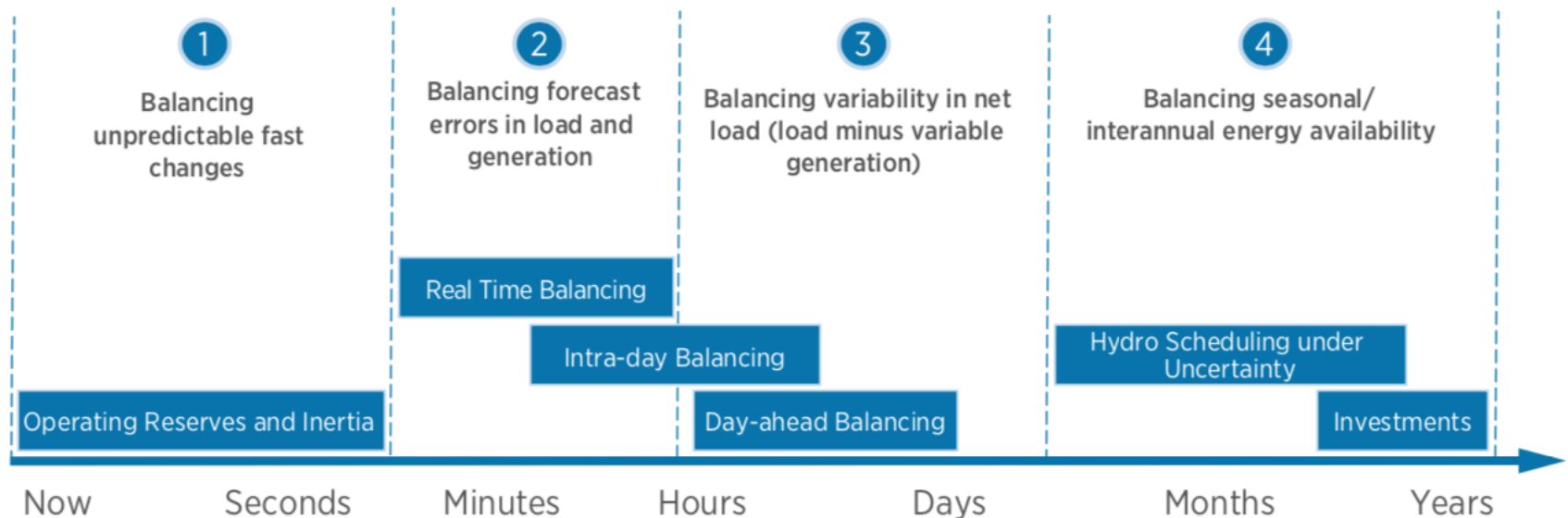
- All actors are aggregated for system operation
  - Aggregation benefits of hybrids not seen at system level, but some benefit of less imbalances to manage real-time due to using storage
- Benefits from hybrids:
  - More system services offered NOTE: usually VRE offers used when surplus of energy, and enough that ~20% of VRE offer services
  - Potentially also less grid reinforcement needs and more time-shifting flexibility



# Systems value flexibility



- Short term: increasing AS payments: for frequency control, but also new services like inertia and black start
- Medium term: paid through ability to pick the highest priced energy-only-market hours: future markets see higher (scarcity) prices more hours of the year
- Long term: capacity payments (and scarcity pricing)

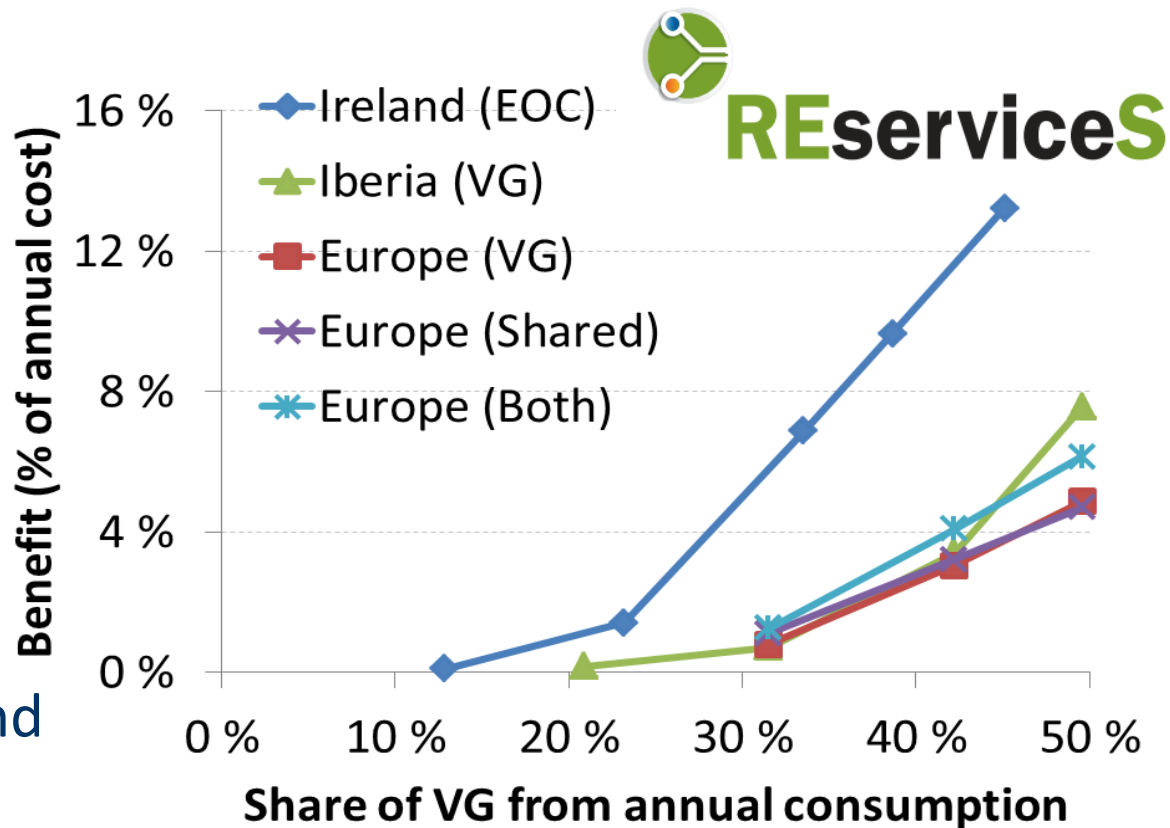




# AS from wind start to bring system value >20% share of VRE



- In many cases the services offered are used rarely, other options available
- 20% of WPPs offering the service will allow more conventional generation off-line at high share situation and all wind reduce curtailments



System benefits (decrease of annual operating costs) when introducing wind power and PV in frequency reserves will increase at higher shares of variable renewables

# Hybrids or separate assets?



- What is the difference of having (aggregated) hybrids or having same assets separately in the system?
  - Value for combining small assets to larger ones, transaction value
  - Would cost reflective and transparent electricity markets, with bidding rules enabling wind and PV to bid, provide same benefit for the assets separately than in hybrids?





# Grid support services from wind, solar, batteries and hybrids



- Requiring capabilities in grid codes, and paying for system support when needed/called for. Good experience:
  - Fast response is valuable for the system and helps reduce the overall need for automatically activated frequency support services
  - Balancing/real time markets already has individual plants bidding especially for down-regulation (up-regulation when curtailed)
- Aggregating will enable more bids than operating wind, solar, storages as separate assets
  - Especially if market rules require longer times btw bids and delivery, or there are congestions in the grid
  - More possibilities for upregulation
  - Future power systems with new capabilities and services like grid forming

# Thank You!!



Hannele Holttinen

[Hannele.Holttinen@recognis.fi](mailto:Hannele.Holttinen@recognis.fi)

+66 61 473 5255

+358 40 5187055



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.