NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Hybrid Power Plants Challenges and Opportunities

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Topical Expert Meeting # 101

Why Hybrid Power Plants

- Enhance flexibility of renewable generation
- Provide reliability for the grid of the future

Challenge: Highly complex systems that must be customized to a given application

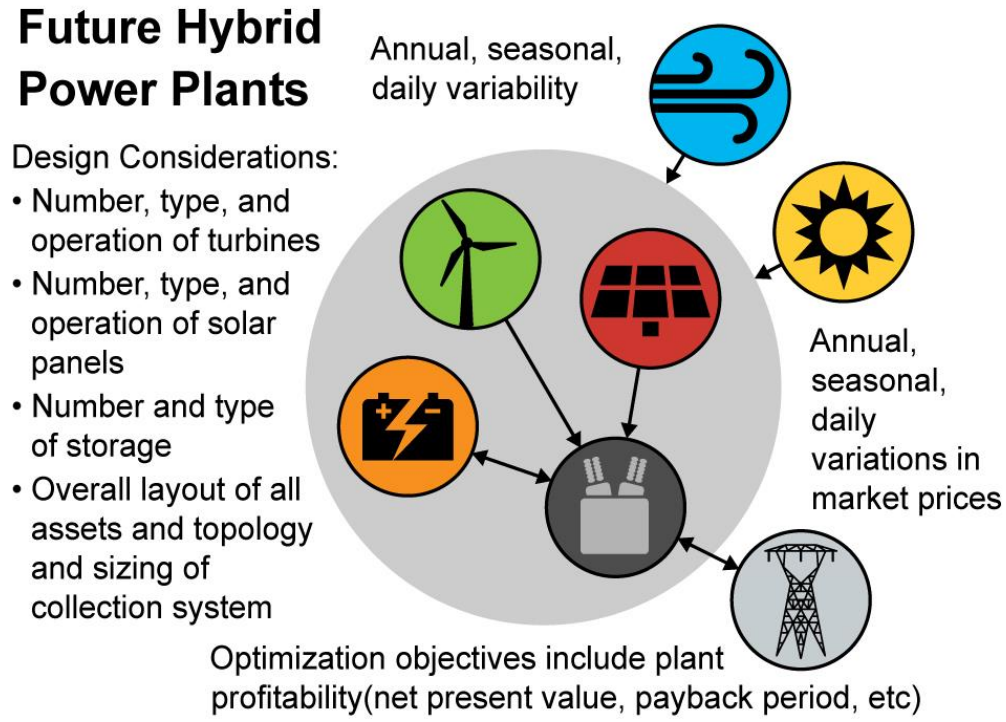
Goal of this Meeting

Overall: Accelerate the development and deployment of hybrid power plants

- What are our biggest roadblocks?

- **Topical Experts Meeting (TEM):** If this were to become an IEA Task
  - Determine areas of international collaboration
  - Determine the role of this task

- **Critical Areas:**
  - Benefits of hybrid power plants
  - Microgrids and control
  - Sizing/Optimization and Storage solutions

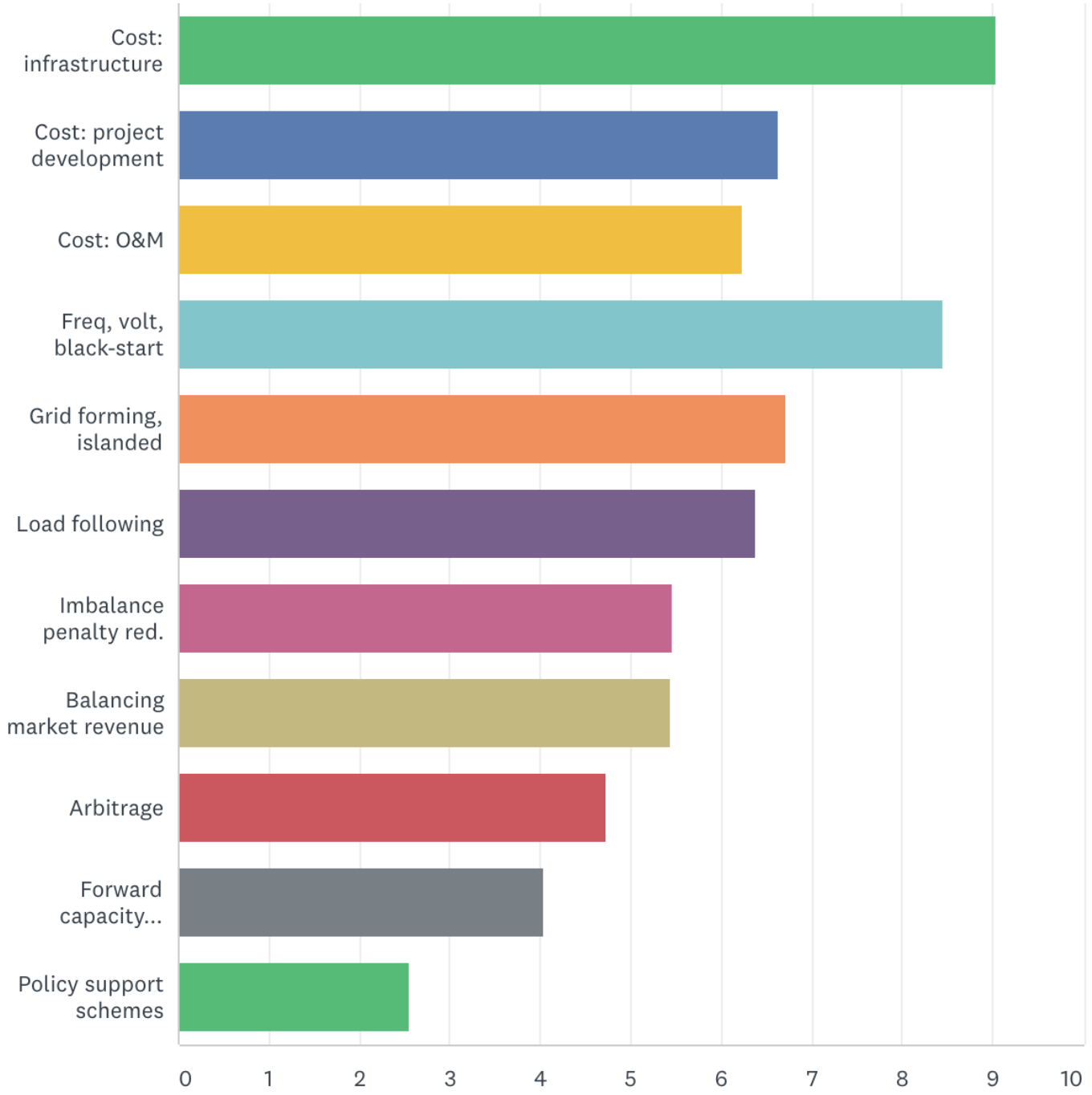


Survey Results

Objectives of HPP

- Rank based on importance of HPP being able to achieve the following

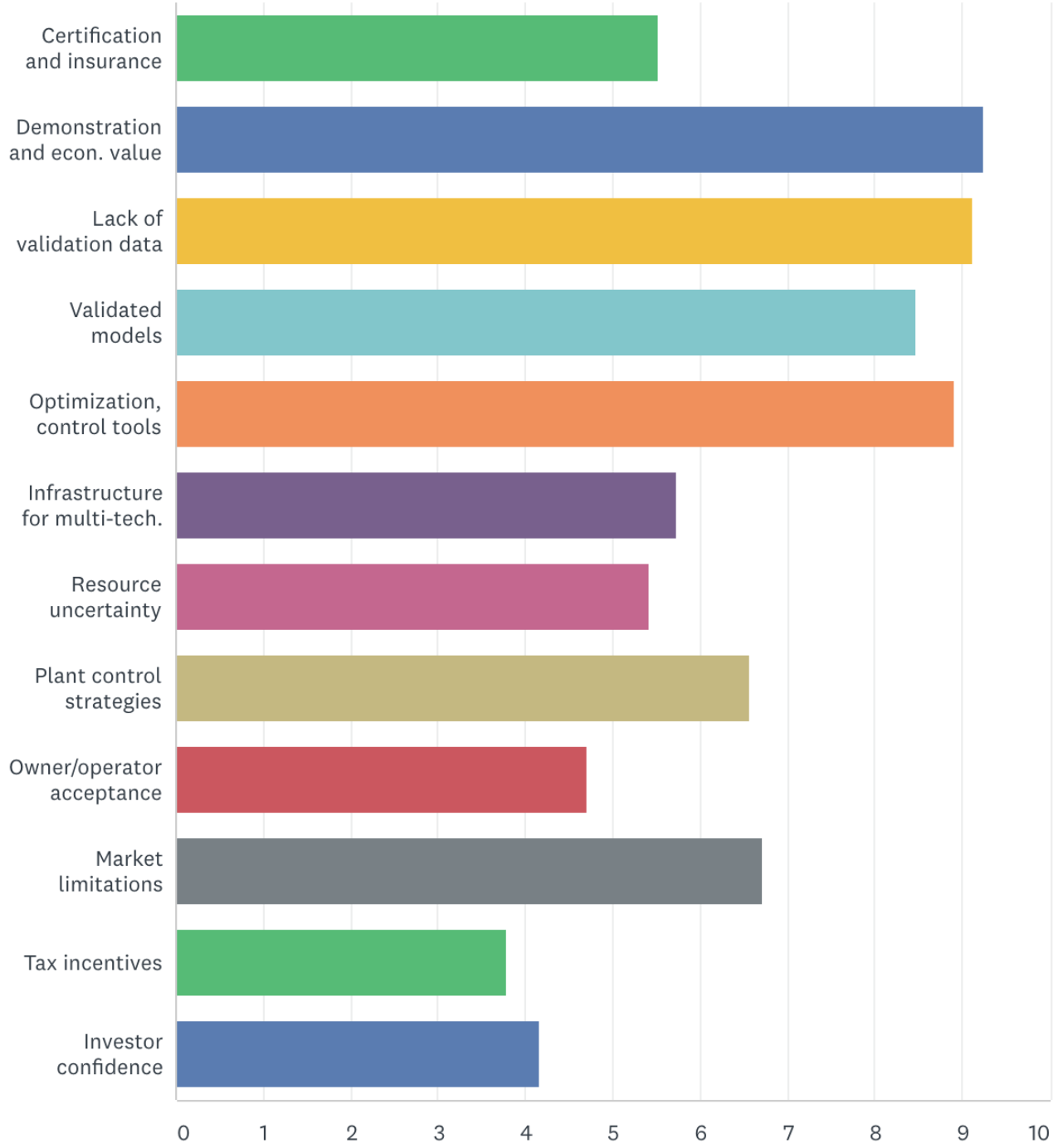
- Top responses:
  - Cost reduction: infrastructure
  - Grid services (freq support)



Main Barriers for HPP

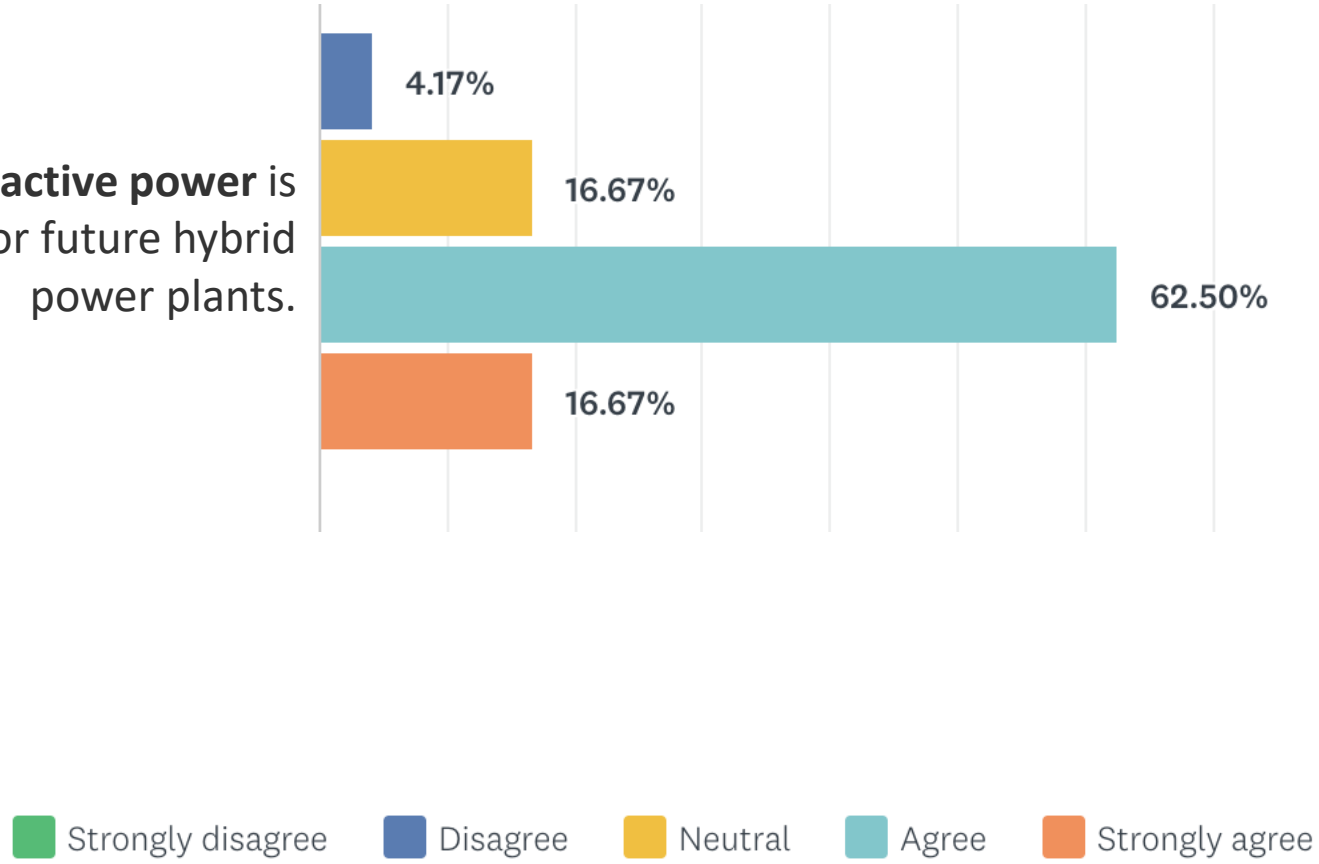
- Rank 1 through 10
- Weighted average

- Top responses:
  - Demonstration of economic value
  - Lack of validation/verification data
  - Optimization and control tools



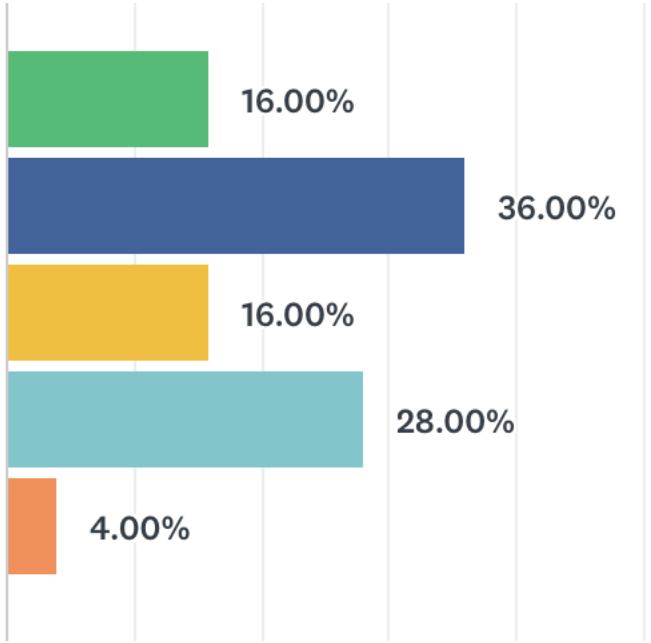
Reactive Power

Providing **reactive power** is essential for future hybrid power plants.



Hybrid versus Single Technology Plants

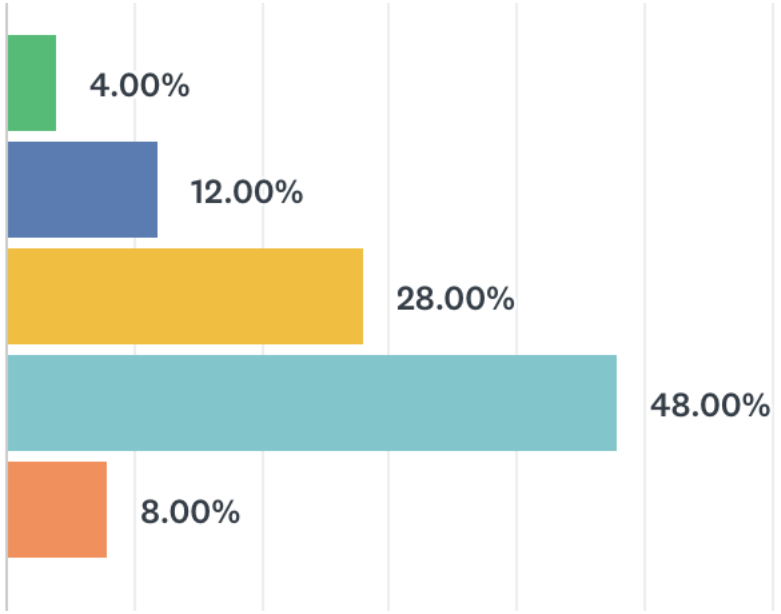
Only hybrid power plants should be developed in the future.



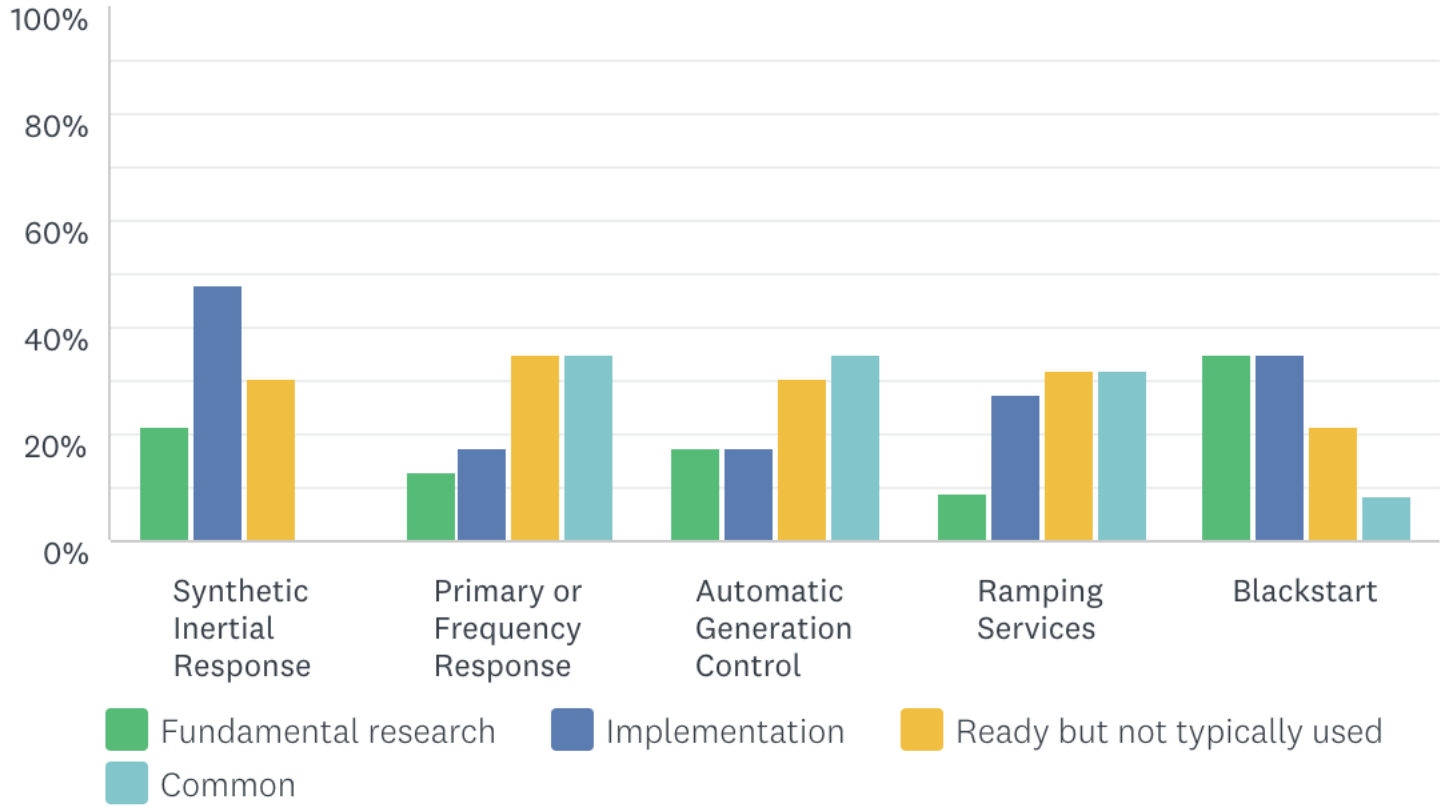
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Ancillary Services

Hybrid power plants are **primarily** good for grid services.



Grid Services



Recap – Day 1

Day 1: Benefits of HPP

Technology talks from experts on the benefits of hybrid power plants

- Mark Ahlstrom (ESIG and NextEra Energy Resources)
  - Role of hybrid resources to act as conventional generator at the point of connection
- Hannele Holtinnen (IEA Wind Task 25 and Recognis)
  - Value of hybrids for power system in terms of flexibility and ancillary service provision
- Kaushik Das (DTU Wind Energy)
  - Value of hybrids as compared to individual technology projects in terms increased revenue and profit
- Thomas Ebel (South Denmark University)
  - Supercapacitors as a choice for storage for hybrid power plants
- Daniel Dixon/Ellen Phelan (EirGrid)
  - Action plan by EirGrid to integrate large volume of hybrids in Ireland

Recap – Day 1

Day 1: Benefits of HPP

Technology talks from experts on the benefits of hybrid power plants

- Aaron Barker (National Renewable Energy Laboratory)
  - Hybrid design and cost tools developed at NREL allowing to assses the value of hybrids in US
- Mohammad Amin (NTNU)
  - Microgrid control allowing for smooth and efficient transition between grid connected and island operation
- Andrew Mills (Lawrence Berkeley National Laboratory)
  - Motivation of large scale deployement of hybrids in US bulk power systems

Recap – Day 1

Day 1: Breakout sessions

- There is a value for task on HPP more focusing on utility scale hybrids collaborating with other IEA Wind tasks and other IEA technologies.
- Topics of field demonstration & validation of hybrid plants as well as modeling needs appear to be the most important for international collaboration, followed closely by market & policy changes.
- Discussions gave a good basis for collaboration across the participants at the TEM
  - Debate about whether LCOE is a useful metric for analyzing hybrid power plants
  - What is the baseline for comparison of hybrids? How do we come up with a reference hybrid power plant? how do we get data on hybrids? how can regulators make decisions based on this data and their current models?
  - This TEM could be an opportunity to share data or more likely at least results from HPP and different configurations under different market rules.
  - All the markets should be considered in tandem to find out which market is most relevant for HPP.

Research Priorities – Drive Breakout Session

Day 2: Microgrids and Control

- Grid services to consider by HPP
- Hybrids as a price maker
- Forecasting
- Dispatchability of HPP
- Grid reliability/stability
- Control needs (e.g. timescales, coordinated control across technologies)

Agenda

Day 2: Microgrids (Katherine Dykes, Technical University of Denmark and Vahan Gevorgian, NREL)

Recap

5:00 – 5:10am – *Recap* from Day 1 and relevant survey results (Kaushik Das, Technical University of Denmark)

Technology Snapshots

5:10 – 6:20am – *Technology talks* from experts on lessons learned from microgrids (10 min each)

- Antoine Amosse – Nergica
- Peter Lillenthal – HOMER Energy
- Ian Baring-Gould – IEA Wind Task 41, National Renewable Energy Laboratory
- Reo Kontani – Hitachi Power Solutions
- Philippe Pognant-Gros – IFPEN

6:20 – 7:00 am – Break

7:00 – 8:00 am – *Technology talks* from experts on control of hybrid power plants (10 min each)

- Arvind Tiwari – GE Research
- Vahan Gevorgian – National Renewable Energy Laboratory
- Parangat Bhaskar – National Renewable Energy Laboratory
- Andreas Rettenmeier – ZSW
- Jesper Thiesen – CONWX

Breakout

8:00 – 9:00 am – *Breakout* and reported results (Breakout chairs and notetakers)

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TEM#101
Hybrid Power Plants

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Ingénieurs conseils en énergies et environnement

I am representing the IEA Wind Task 11 and coordinating this TEM with the organising committee. My background is in mechanical engineering with a focus on isolated renewable energy systems, especially wind.

My task within IEA Wind is to foster information exchange by holding 4 TEMs per year, gathering experts on a given topic to initiate worldwide collaboration. Check out my presentation, which will be uploaded on the community page, if you'd like to find out more about our activities.

I am a project manager in renewable energies at Planair SA, Switzerland, and also a member of the secretariat of the Swiss Wind Energy Association.

Nicolas El Hayek
Planair SA – Switzerland
Task 11 Operating Agent

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