

# TOWARDS ZERO-CARBON POWER MARKETS: WORKSHOP AGENDA AND LOGISTICS

## 16:00 Welcome

## 16:05 Current Power Market Operation Perspectives

Current developments in the Nordic power market

Bjørn Harald Bakken, Head of Section Reserves and Flexibility,  
Statnett SF (TSO in Norway) - 20min

Power producers' perspectives and experiences

Niklas Kalvø Tessem, Renewables Norway, Head of  
Brussels Office - 15 min

Design and operations of U.S. power markets: Status and outlook

Erik Ela, Technical Executive, EPRI - 20min

Regional power markets: Perspectives and experiences from the West

Vijay Satyal, Deputy Director of Regional Markets, WRA -15 min

Discussion – 20min

## 17:35 Coffee break

## 17:40 Research Findings: Electricity Market Design for a Zero-Carbon System – Experiences and Insights for Hydropower in the United States and Norway

Findings from: Fair and inclusive markets for Hydropower - HydroFai  
Viviane Aubin (NTNU), Michael Belsnes (SINTEF) – 20min

Findings from: Market design and operations in zero-carbon systems  
Mark Noll (ANL, Northwestern) - 20min

Konstantinos (Kostas) Oikonomou (PNNL) – 20min

Discussion – 15min

## 18:55 Closing remarks

### Meeting logistics:

- Teams chat is open for comments/suggestions/discussion
- Ask questions by raising your electronic hand or through the chat

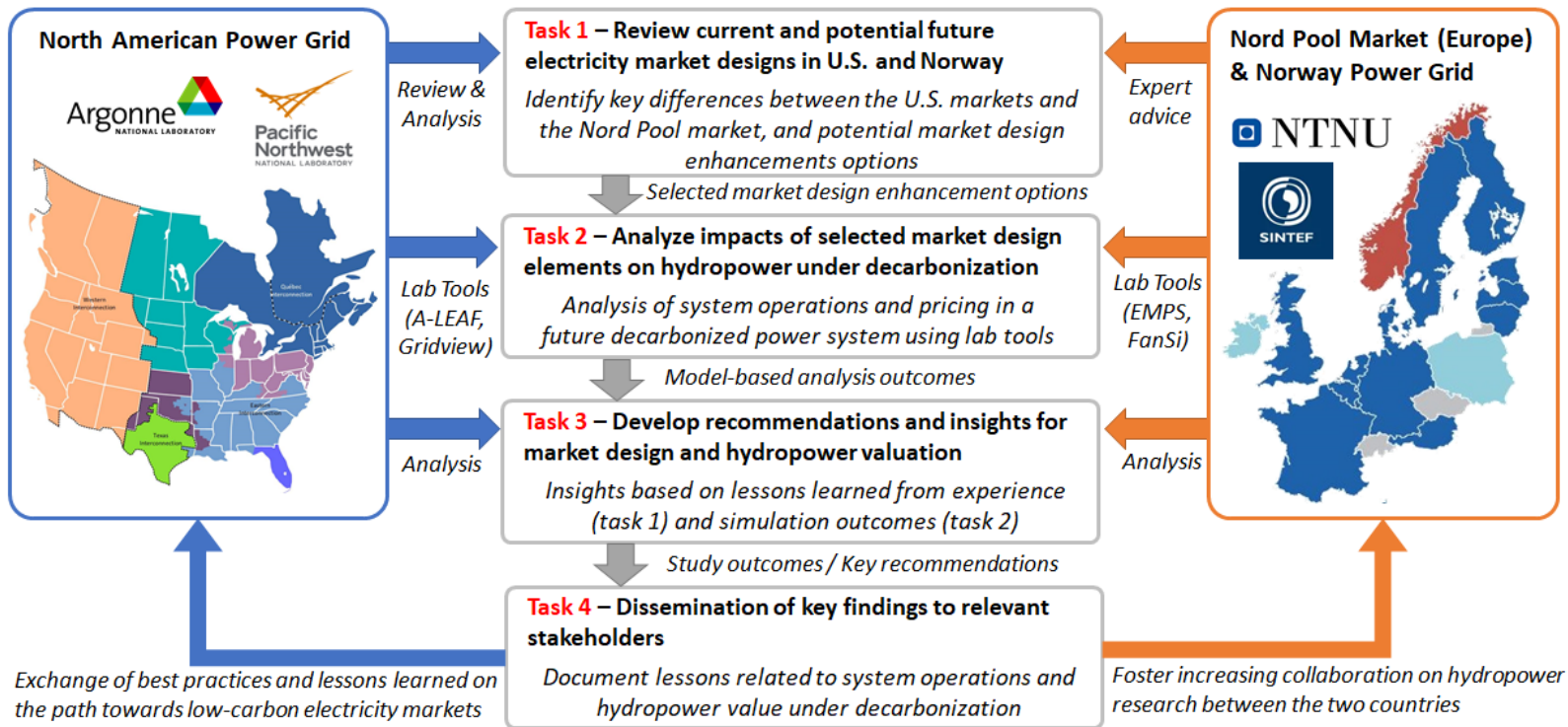
***ELECTRICITY MARKET DESIGN IN ZERO  
CARBON SYSTEMS – EXPERIENCES AND  
INSIGHTS FOR HYDROPOWER IN THE UNITED  
STATES AND NORWAY***

***INTRODUCTION***



Audun Botterud, Argonne National Laboratory

# PROJECT OVERVIEW



Sponsors: DOE WPTO (US)/ HydroCen (Norway)

# BUILDING ON EXISTING US-NORWAY COLLABORATION

## ■ New/upcoming papers (ANL, PNNL, SINTEF, NTNU)

- Mari Haugen, Paris L. Blaisdell-Pijuan, Audun Botterud, Todd Levin, Zhi Zhou, Michael Belsnes, Magnus Korpås, Abhishek Somani, "Power Market Models for the Clean Energy Transition: State of the Art and Future Research Needs," submitting to *Applied Energy*.
- Arild Helseth, Albert C. G. Melo, Quentin M. Ploussard, Birger Mo, Maria E. P. Maceira, Audun Botterud, Nathalie Voisin, "Hydropower Scheduling Toolchains – Comparing Experiences in Brazil, Norway and USA and Implications for Synergistic Research," *Journal of Water Resources Planning and Management*, Vol. 149, No. 7, 2023.

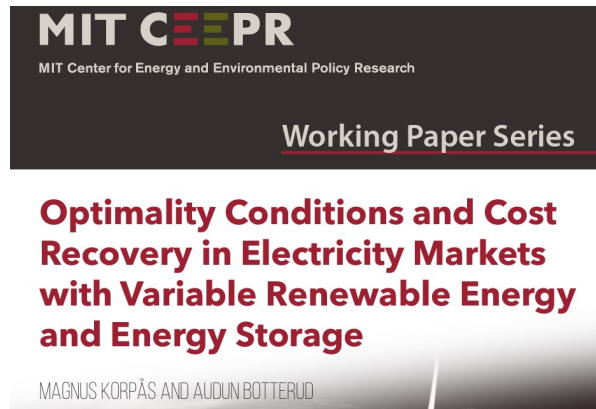
## ■ Other collaborations



Working Paper Series

**Long-term Equilibrium in Electricity Markets with Renewables and Energy Storage Only**

Guillaume Tarel, Magnus Korpås, and Audun Botterud



# THE ENERGY RESOURCE MIX WILL DRIVE PRICE FORMATION IN ZERO-CARBON MARKETS

	Zero Fuel Cost	Non-Zero Fuel Cost
Non-Zero Marginal Cost	<b>Opportunity Cost</b> Reservoir hydro Pumped storage hydro Batteries Other storage Demand response	<b>Variable Fuel Cost</b> Bioenergy Hydrogen gas with CCS <sup>a</sup> Coal with CCS
Zero Marginal Cost	<b>No Opportunity Cost</b> Wind Solar Run-of-river hydro Geothermal	<b>Fixed Fuel Cost</b> Nuclear

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