

## Control of Complex Systems: An Integrated Perspective on Modern Power Grid Control

# Evaluation of Control Methods Through Large-scale Interconnected Energy System Simulations

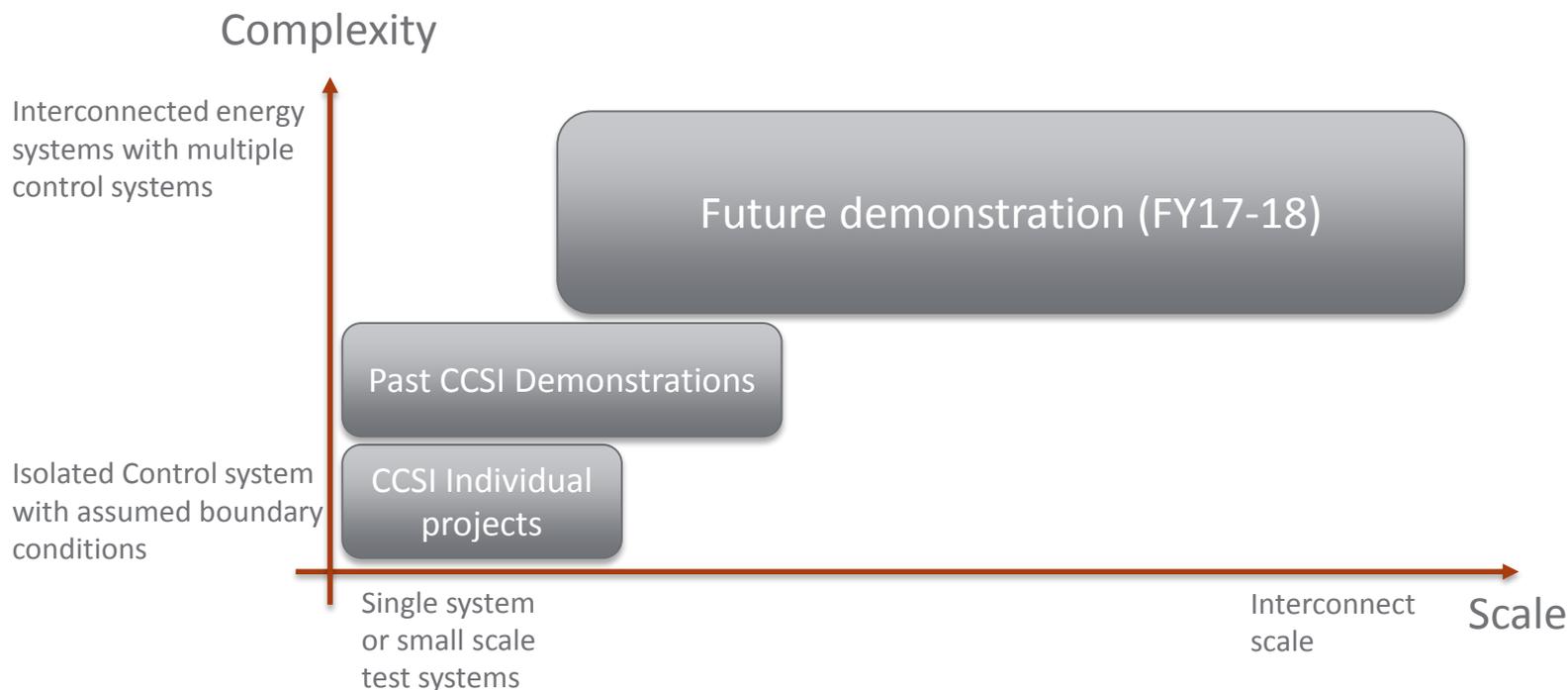
JACOB HANSEN, LAURENTIU MARINOVICI, PRIYA THEKKUMPARAMBATH MANA,  
JASON FULLER

Pacific Northwest National Laboratory

ACC – CCSI Workshop

# Objective

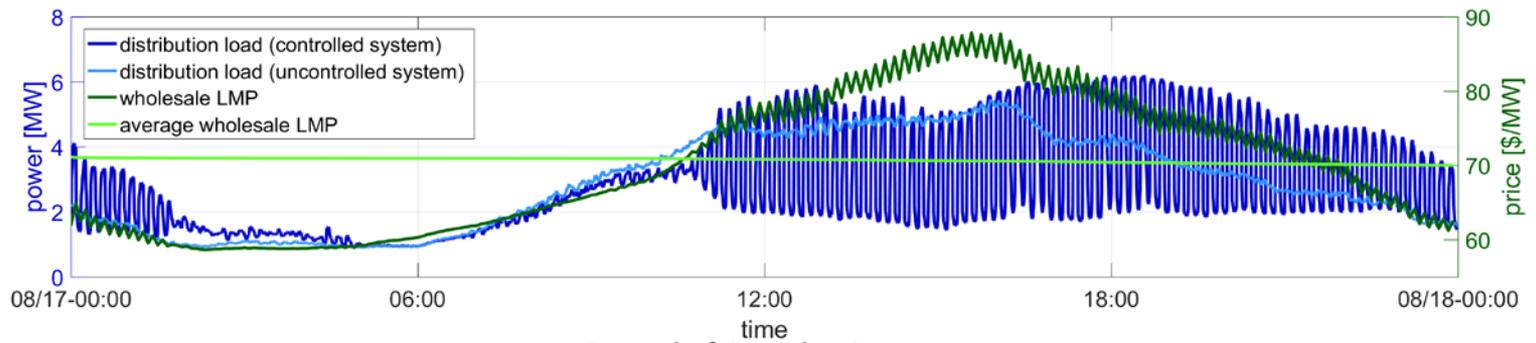
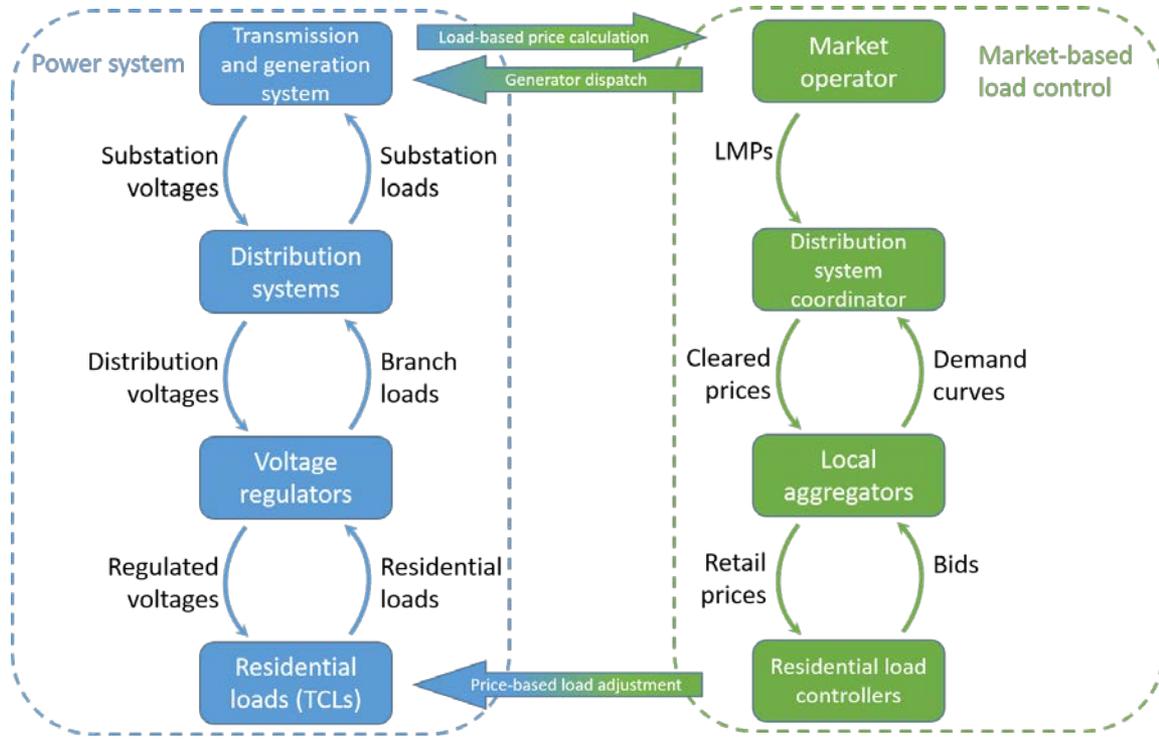
- Investigate and understand prototype-stage advanced control methods within large-scale complex interconnected energy systems





# Previous CCSI Efforts

- Power system model of integrated T&D
- Added Transactive Energy controllers for TCLs
- Added single period OPF calculation at the Wholesale Level
- Evaluation showed potential for instability due to lack of integration between Retail and Wholesale operations

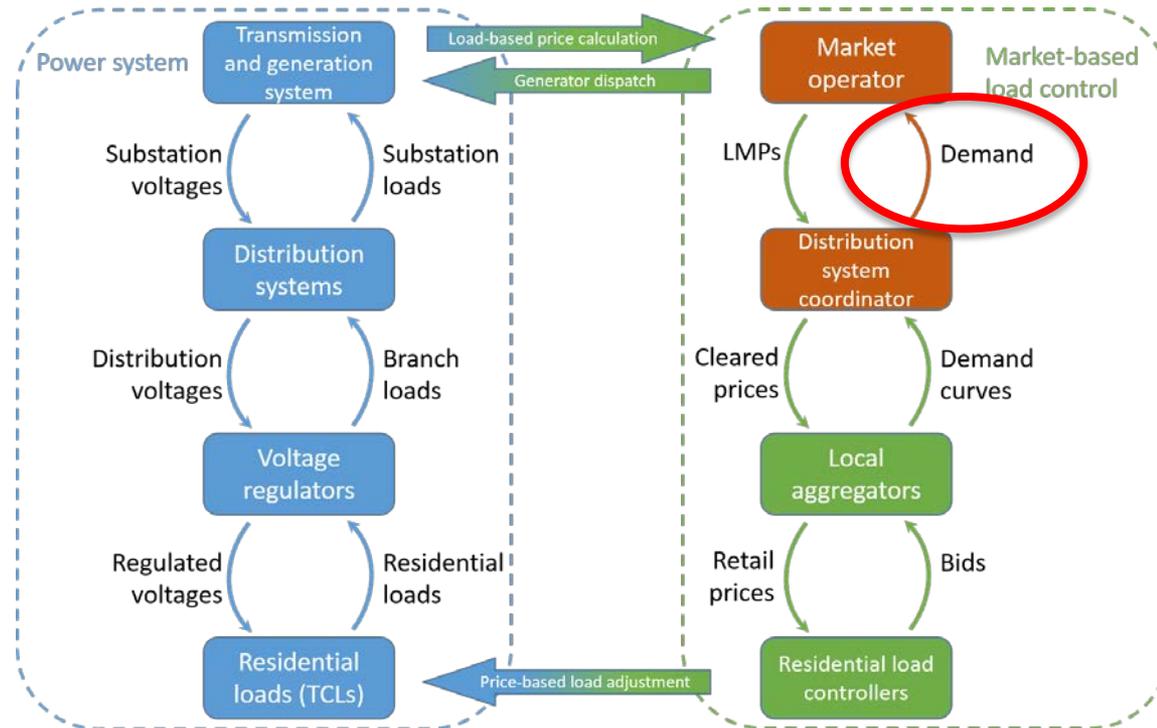


Control of Complex Systems:



# Full Retail–Wholesale Markets Integration

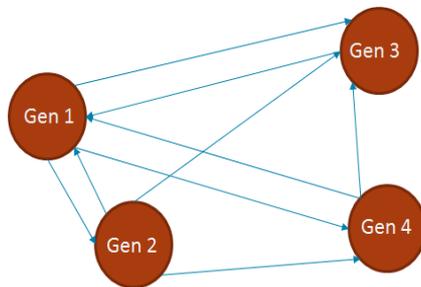
- Integration of the retail and wholesale markets where bidding curves from TCL coordination algorithm are submitted to the wholesale market
- Introducing uncertainty at the transmission and generation level due to contingencies and/or variations in load and renewable modelling
- Increasing scale by using larger transmission and distribution networks



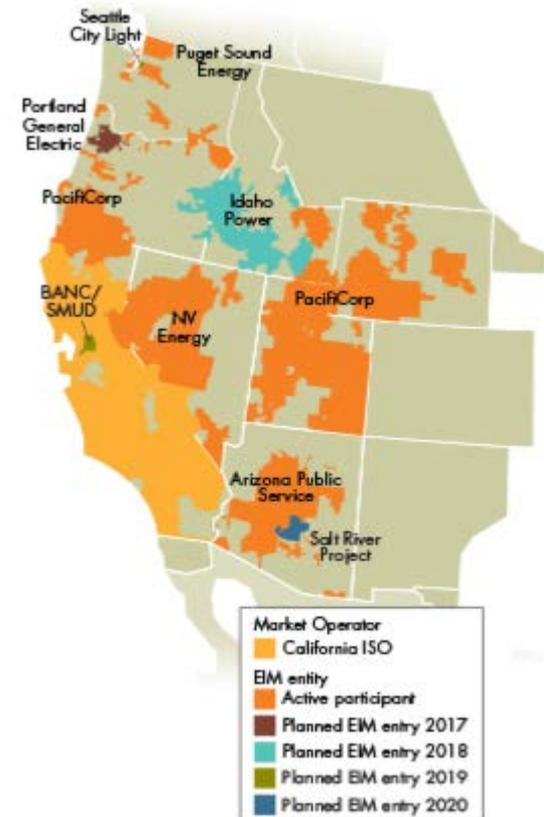


# Distributed Economic Dispatch (ED)

- Investigate a distributed ED algorithm on a large complex transmission and communication system model
- Distributed ED may help large-scale markets with lots of participants, as could potentially be seen in the western EIM
- Test the accuracy and performance of distributed ED in presence of communication delays and data loss



Communication between generators to solve distributed economic dispatch



The western Energy Imbalance Market (EIM)



**Pacific Northwest**  
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

# Thank you!

PNNL-SA-126292