NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Multi-timescale Integrated Dynamics and Scheduling for Solar (MIDAS-Solar)

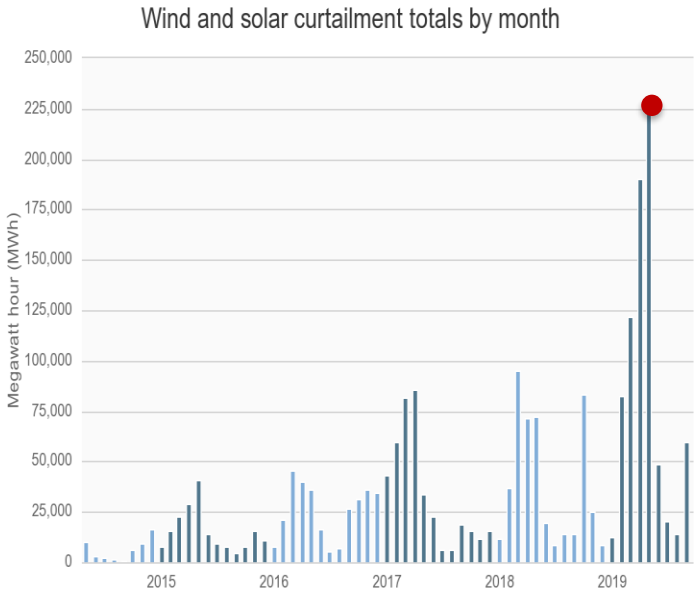
Jin Tan
National Renewable Energy Laboratory
10/29/2019

ESIG Fall technical workshop 2019

Contents

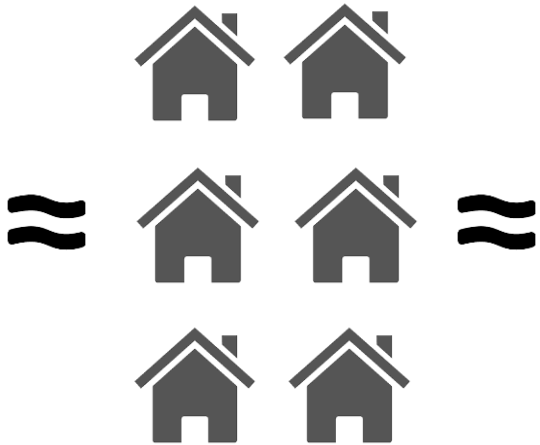
California curtailment hits a record high

223,195 MWh

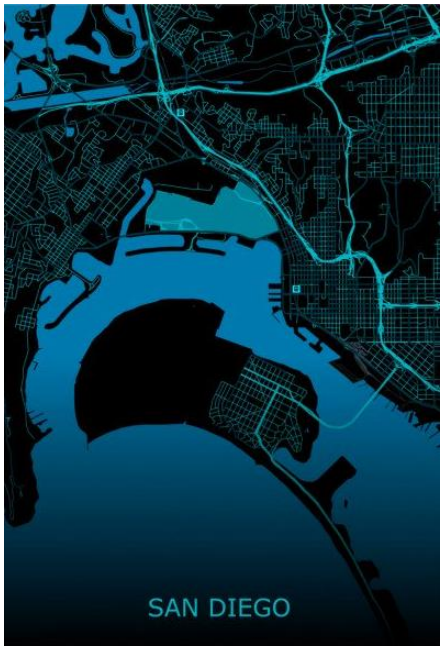


Source: CAISO

247,990 households



50%

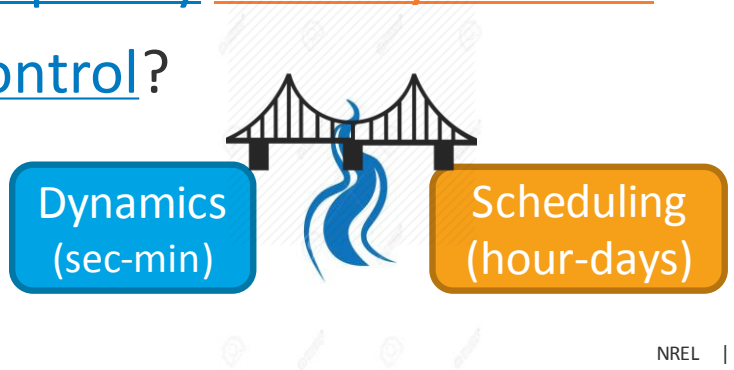


Source: google

Challenges

❑Frequency control and regulation

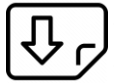
- How much reserve do we need for high PV penetration?
- Do we need PV to provide new grid service (fast frequency control services)?
- How to incentive PV to provide frequency ancillary services?
- A market for primary frequency control?
- Can PV provide reliable services?
- ……



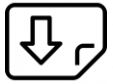
What is MIDAS solar?

Multi-timescale Integrated Dynamics and Scheduling

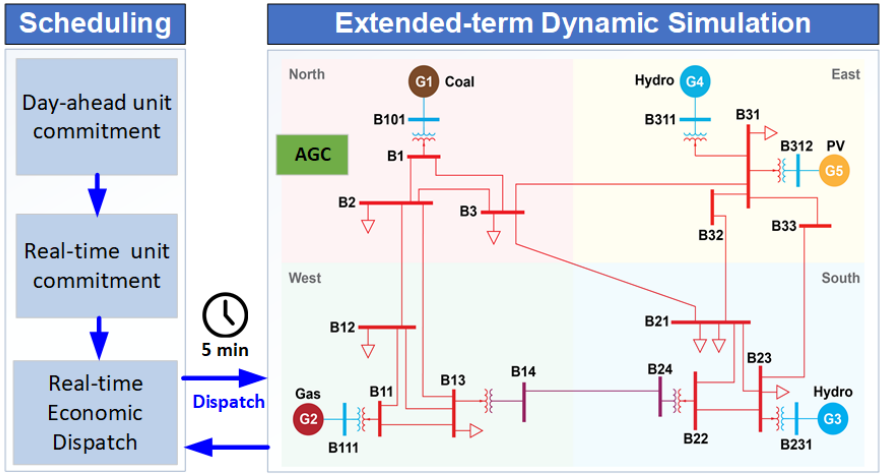
- **Economics, reliability and stability** of grid with **high PV penetration**

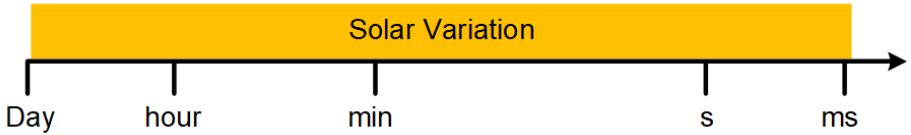


- Cost
- Forecasting
- Etc.

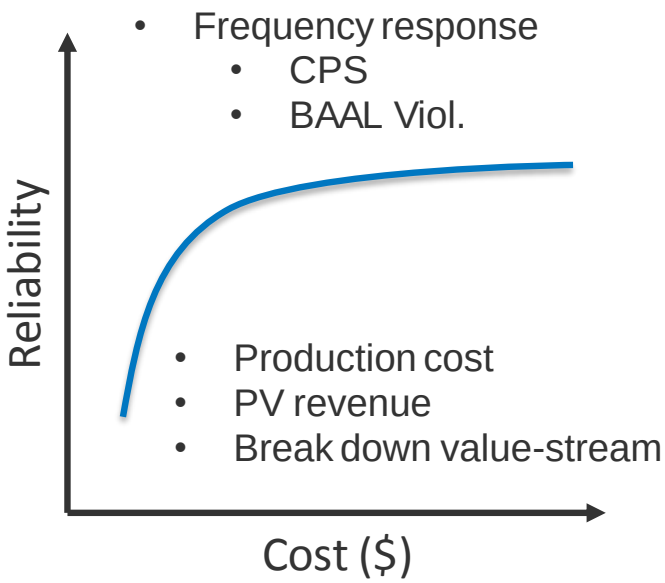


- PSS/E files
- Time-series solar and load data
- Etc.

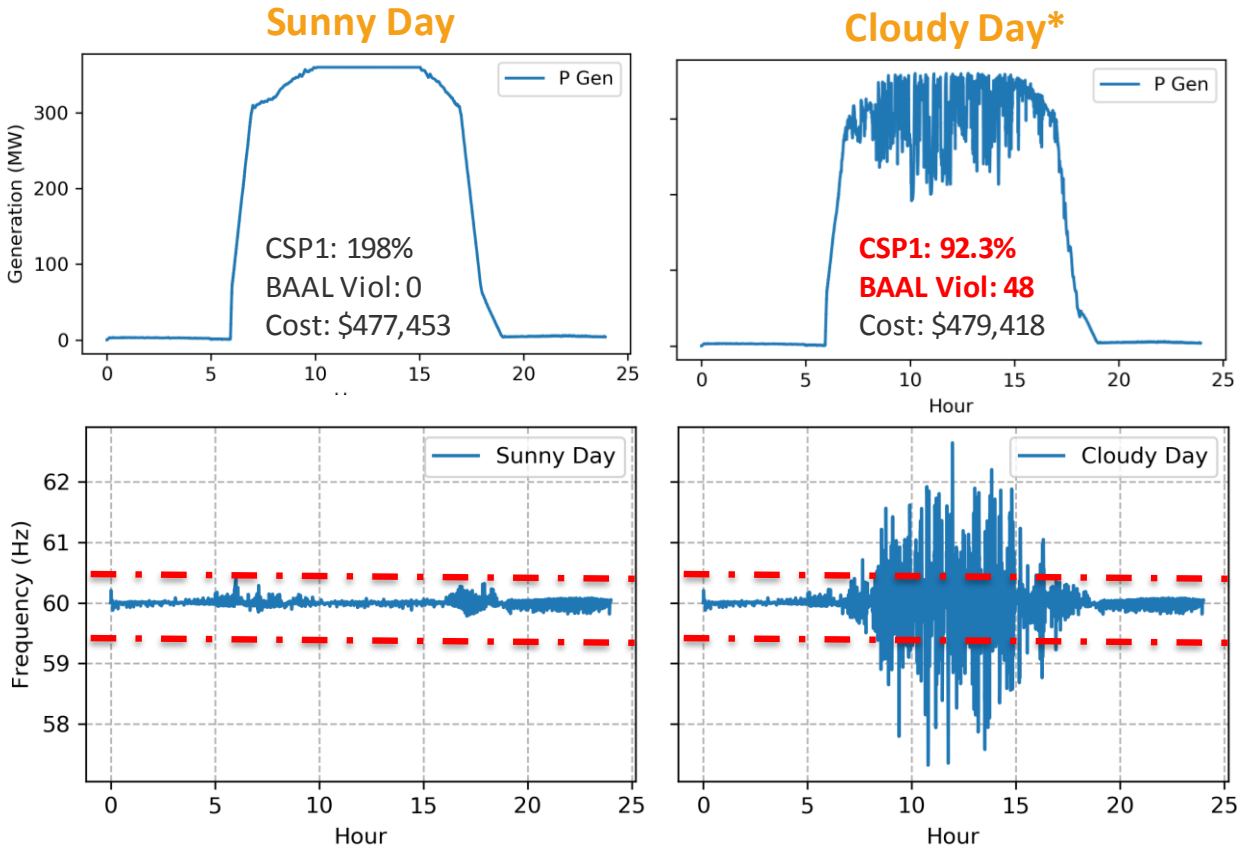




Output



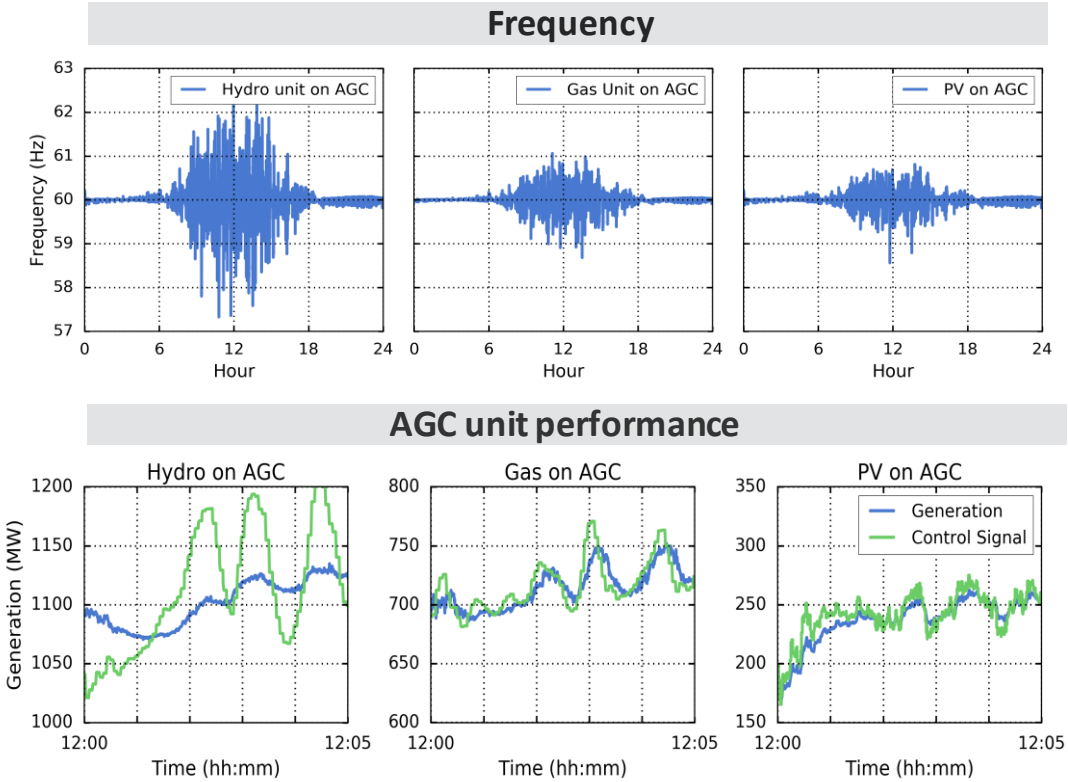
I. Impact of solar variation on system reliability metrics

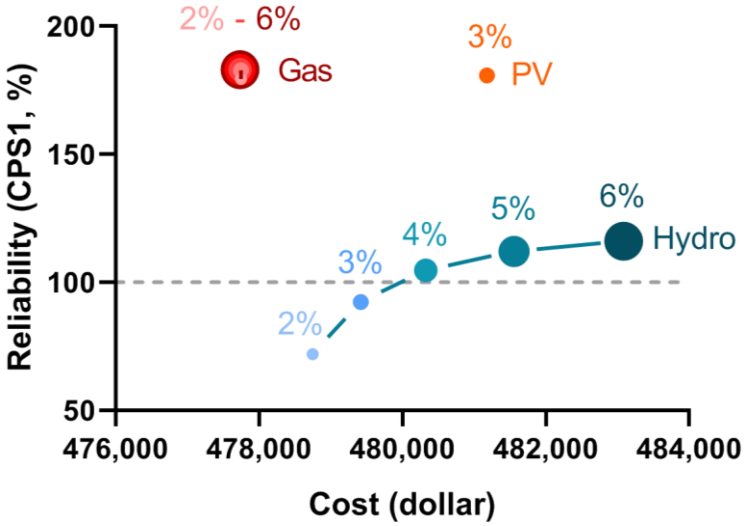


* 1-sec solar data from Oahu, Hawaii

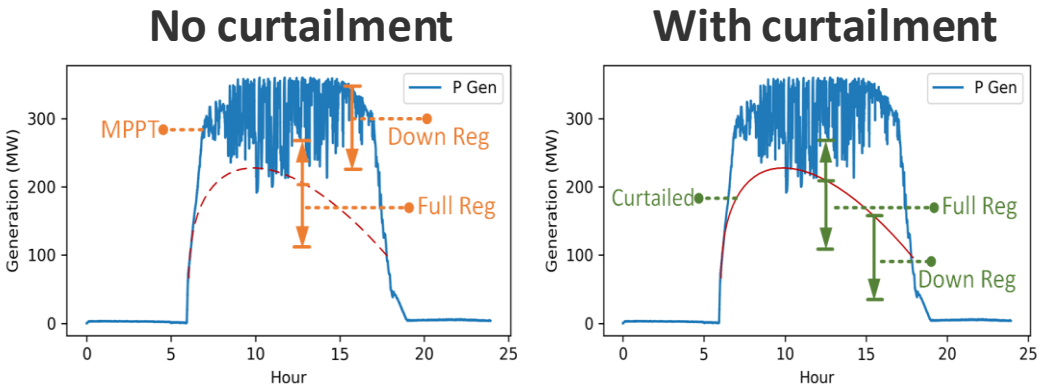
II. Fast vs slow response resources for regulation

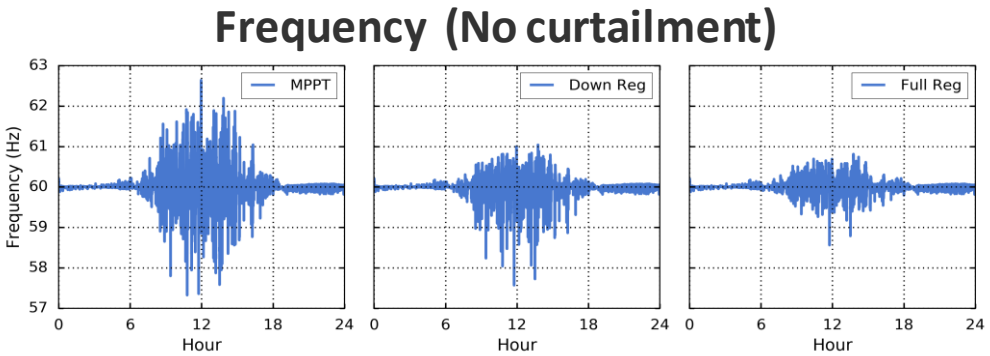
Hydro **Gas** **PV**

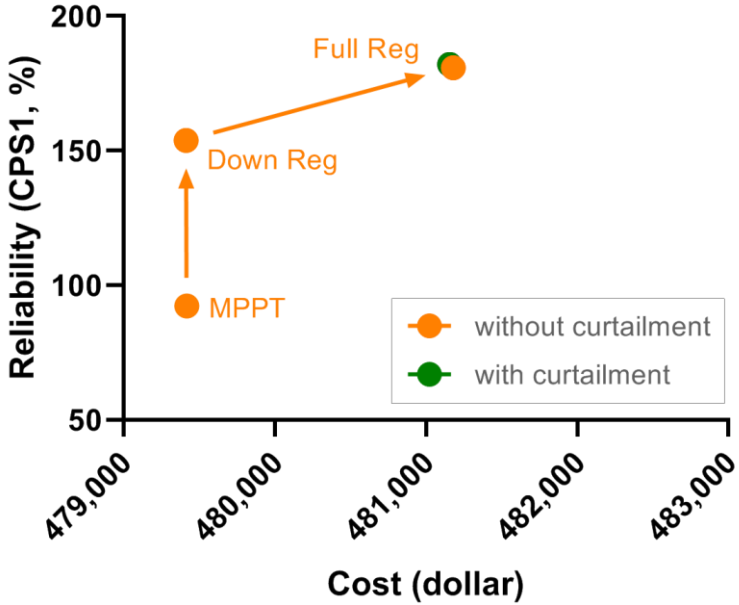




III. Impact of different PV control strategies

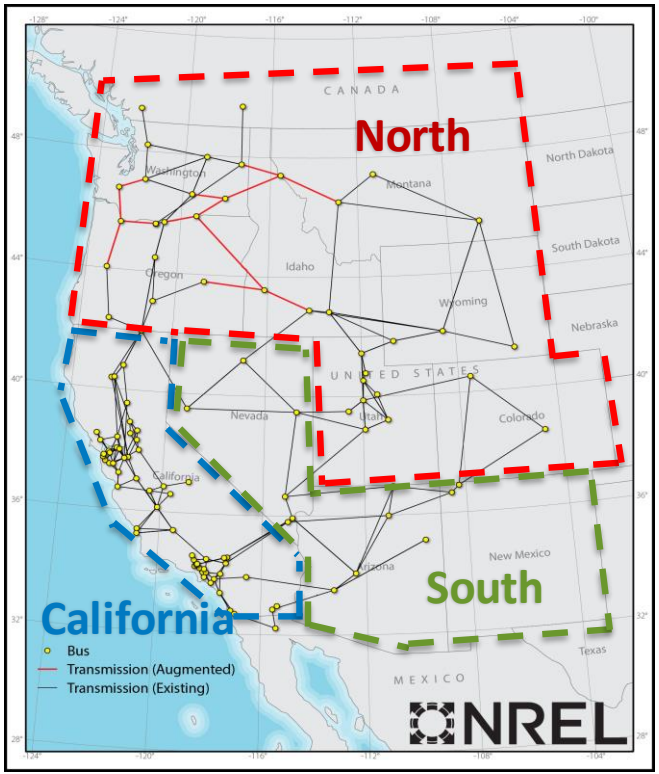




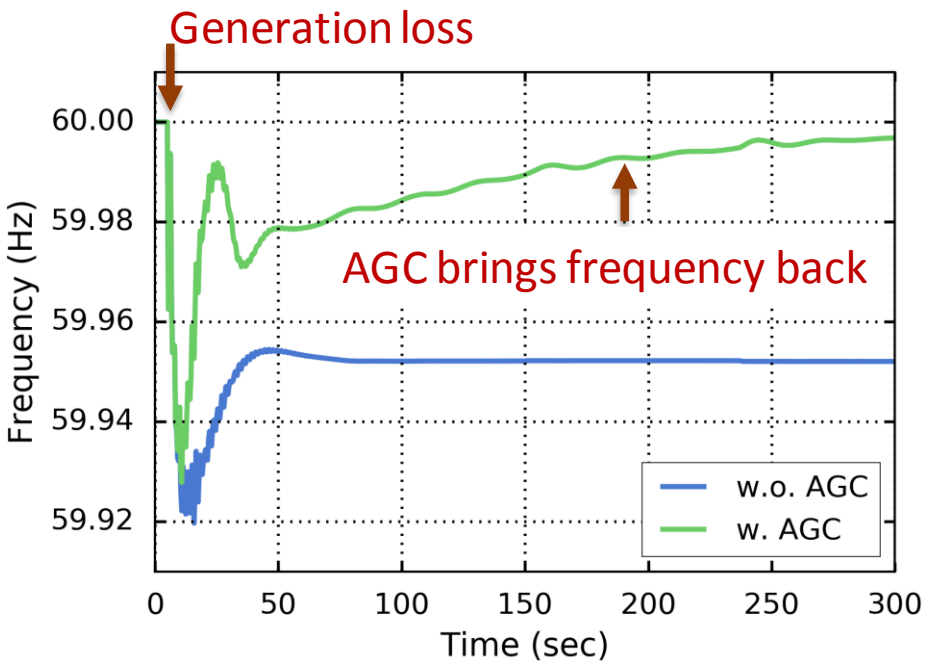


IV. Interaction between primary frequency control and regulation control

Simplified 240-bus WECC system



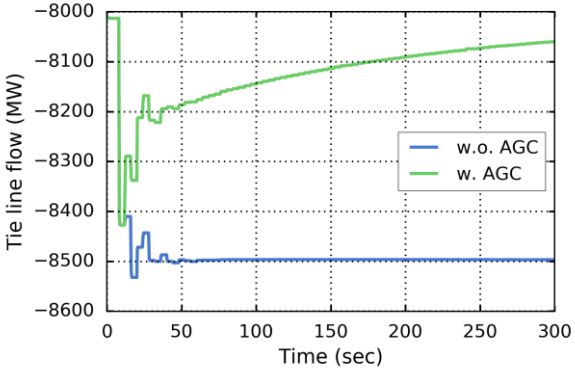
Frequency response

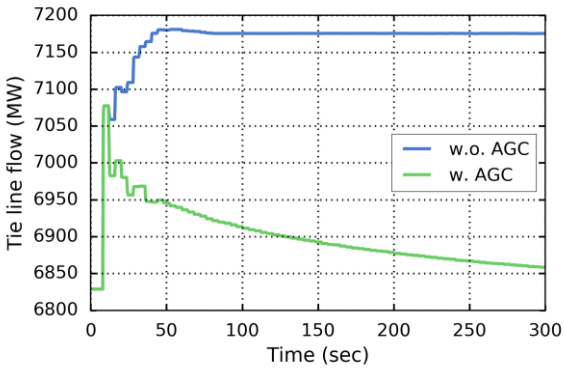


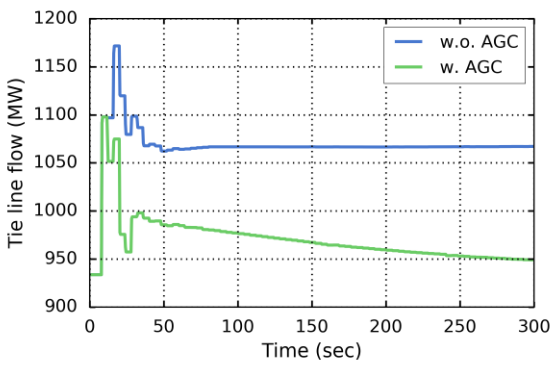
IV. Interaction between primary frequency control and regulation control

California **North** **South**

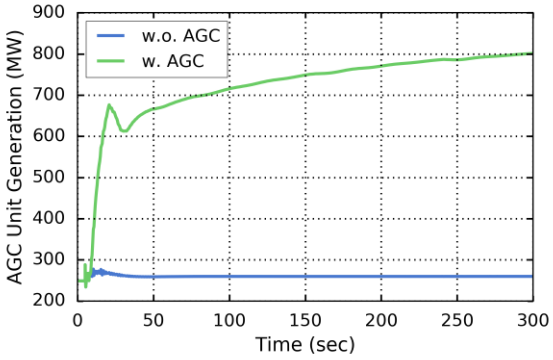
Tie line flow

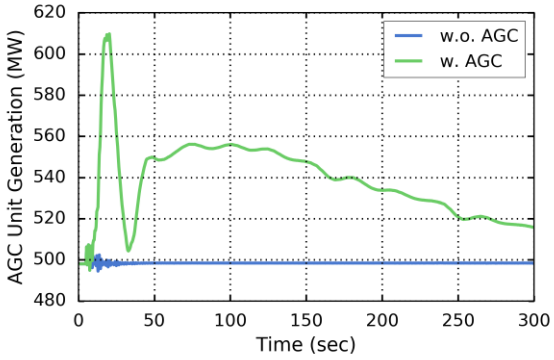


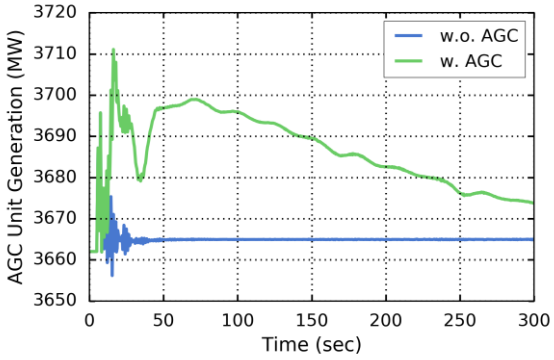




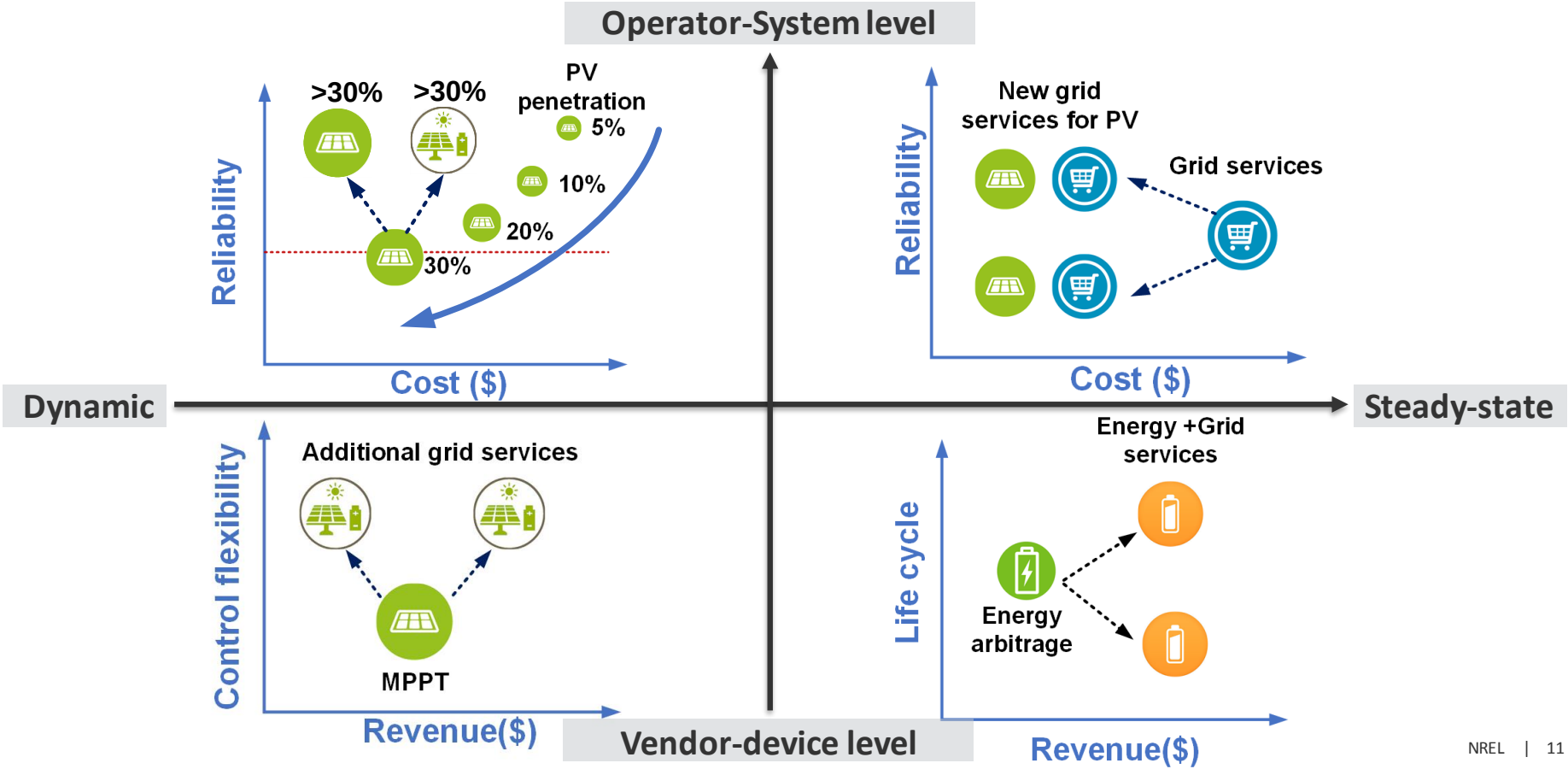
AGC unit







Future applications for MIDAS Solar



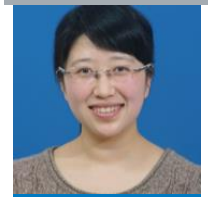
Conclusion

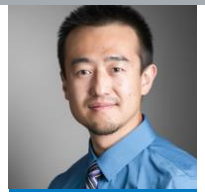
MIDAS bridges the power system dynamics and scheduling across different time-scales.

- Evaluate the impact of multi-timescale variability of REs on system reliability and economics simultaneously.
- Assess the regulation reserve/ PFR reserve requirement under different renewable variations and penetration levels.
- Understand the overall performance of regulation fleets. (Fast resources vs slow resources)
- Evaluate different PV control strategies for providing grid services.
- A better understanding of the interactions of PFC , SFC and their reserves.

Acknowledgments

Dynamic Modeling Team


Jin Tan
PI


Yingchen (YC)
Co-PI


Vahan


Harry


Vikas

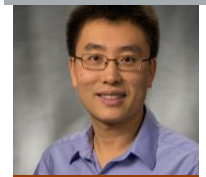

Parag


Himanshu

Project Management

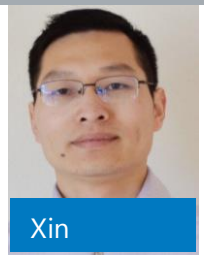

David
Project Manager

Scheduling Modeling Team

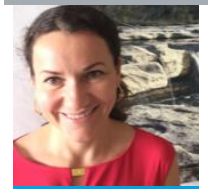

Jianhui
Technical Lead


Shengfei


Erik
Technical Lead


Xin

Technical Advisor

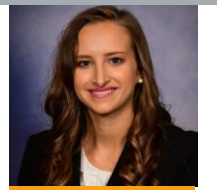

Julia


Clyde

Data-driven Security Assessment


Yilu
Technical Lead


Steve


Summer

EPRI UTK ERCOT
NREL SMU CAISO

Question?

www.nrel.gov

This work was authored in part by Alliance for Sustainable Energy, LLC, the manager and operator of the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Jin Tan
Senior Engineer
Power System Engineering Center
National Renewable Energy Laboratory
jin.tan@nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY