# Renewables Integration

Bryan Hannegan, NREL

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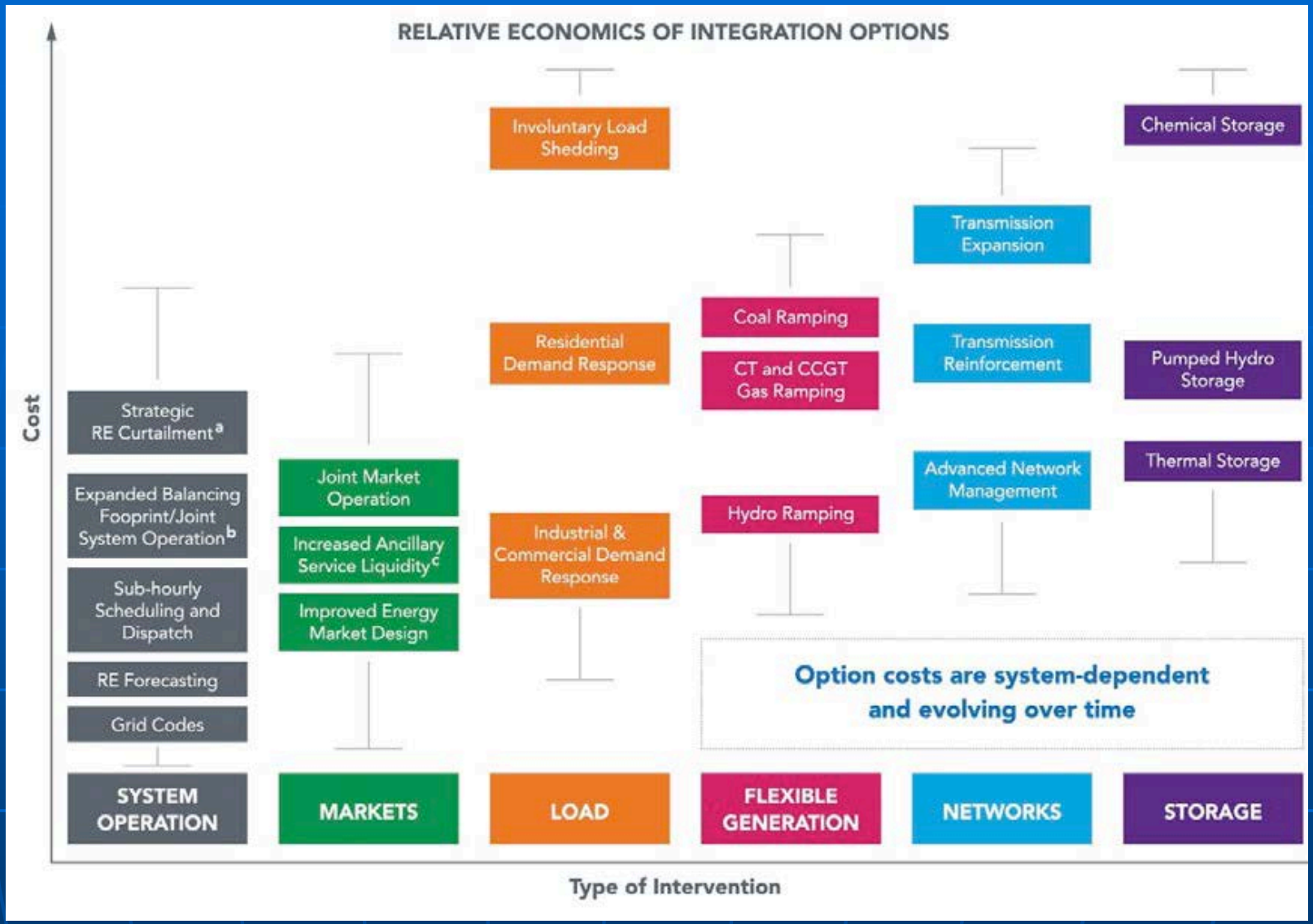


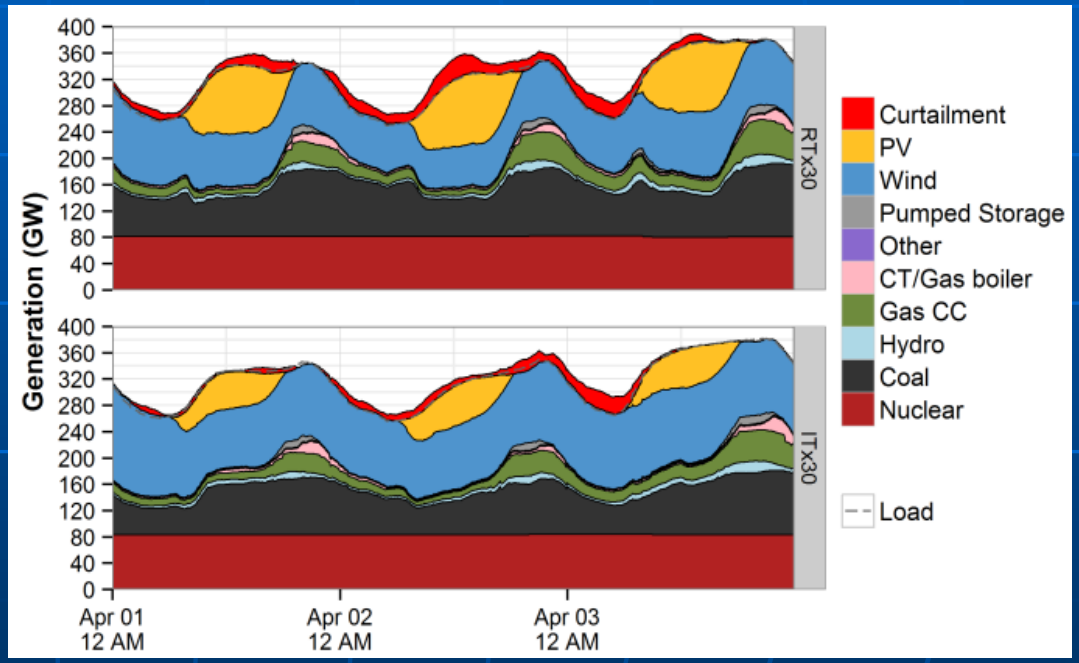

Cochran et al., NREL Pub 62607, 2015

# Grid Integration Studies

- Industry driven integration study of the Eastern Interconnection with over 300 GW of wind and solar capacity
- Advanced computing facilities used to enable unprecedented model fidelity.
- Wind and solar can be balanced with thermal and hydro at a 5-minute level
- Detailed regional and thermal fleet impact analysis
- 30+ member TRC with representation from utilities, RTOs, NERC, EPA, etc.

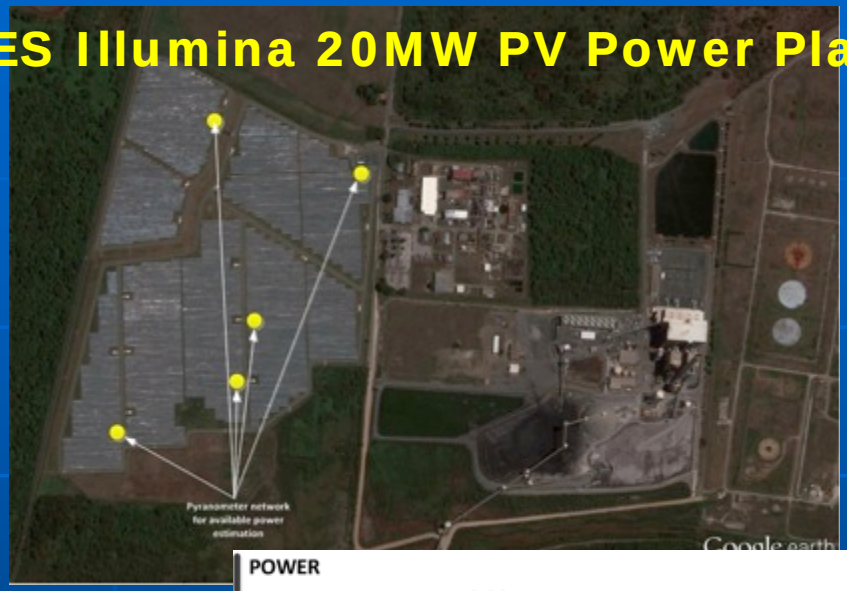
## Eastern Renewable Generation Interconnection Study

**5-minute dispatch for three days with high VG and very low load**



# Utility PV Integration

**AES Illumina 20MW PV Power Plant**




## CHALLENGE ADDRESSED

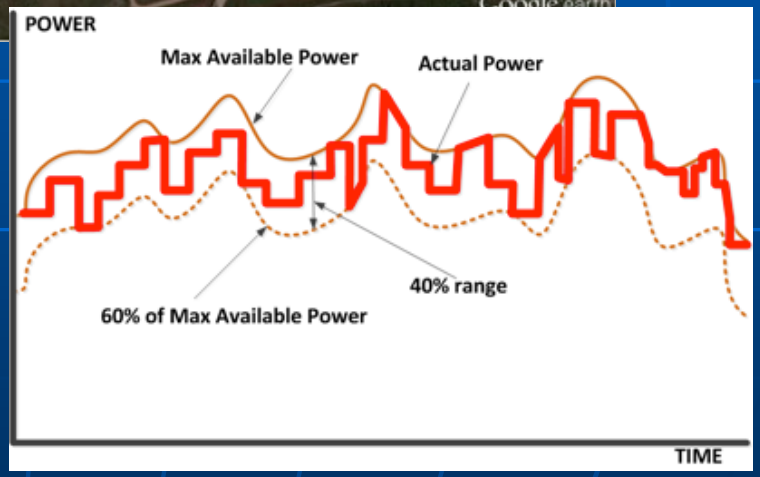
Demonstrate utility-scale PV can provide necessary ancillary services for island grid

## R&D STRATEGY

Develop, install and validate new controls allowing AGC, up- and down-regulation within 500ms

## IMPACT

Successful first of a kind real-world experiment using PV systems to maintain large-scale grid stability



# Customer PV Integration

## CHALLENGE ADDRESSED

Interconnection issues when connecting distributed PV at high penetration such as in Hawaii.

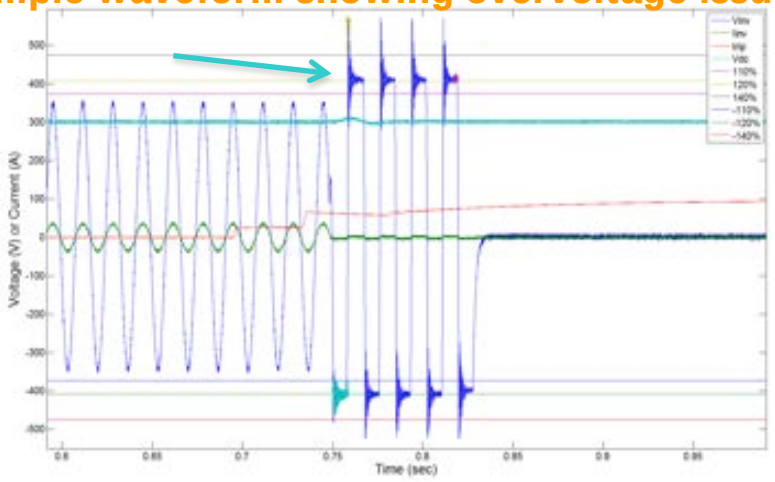
## R&D STRATEGY

Test solar inverters for their ability to mitigate transient overvoltage impacts

## IMPACT

HECO filed with the PUC to allow siting of PV systems with advanced inverters on neighborhood distribution circuits up to 250% of minimum daytime load (MDL).

**Sample waveform showing overvoltage issue**



# Future Work

## DEVICES AND INTEGRATED SYSTEMS

- Develop new grid interface devices to increase ability to provide grid services and utilization
- Coordinate and support the development of interconnection and interoperability test procedures for provision of grid services
- Common approach across labs and industry test-beds for effective validation of emerging technologies