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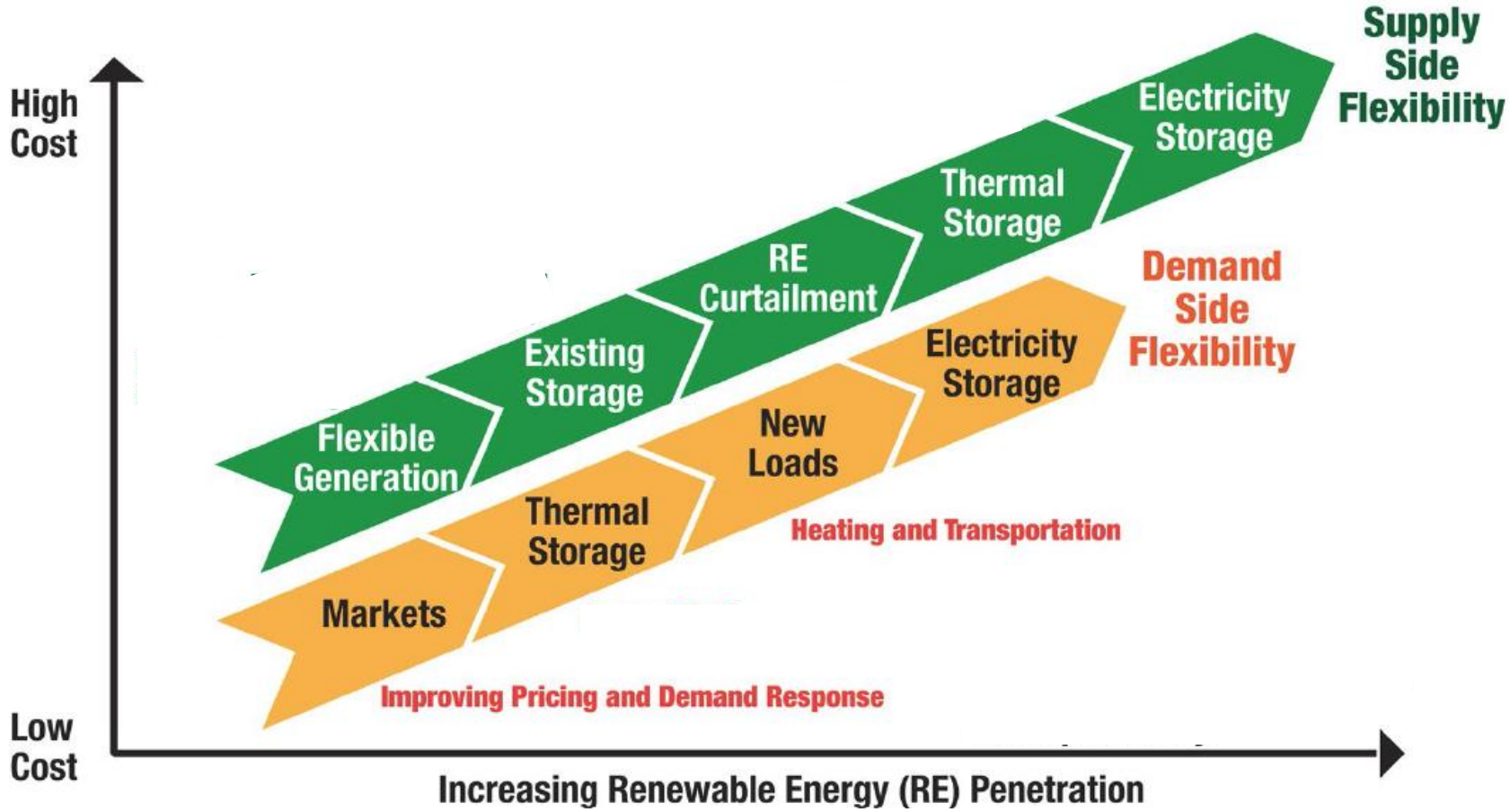
130th NARUC Annual Meeting and Education Conference

Breaking Out New Moves: How Resource Flexibility Benefits Utility Operations

Flexibility Supply Curve



Source: NREL, “The Role of Energy Storage with Renewable Electricity Generation”, Paul Denholm et al., January 2010

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Flexibility from Utility-Scale Resources

"Breaking Out the New Moves: How Resource Flexibility Benefits Utility Operations"

NARUC Annual Meeting
November 14, 2018

Commissioner Liane Randolph

California Public Utilities Commission

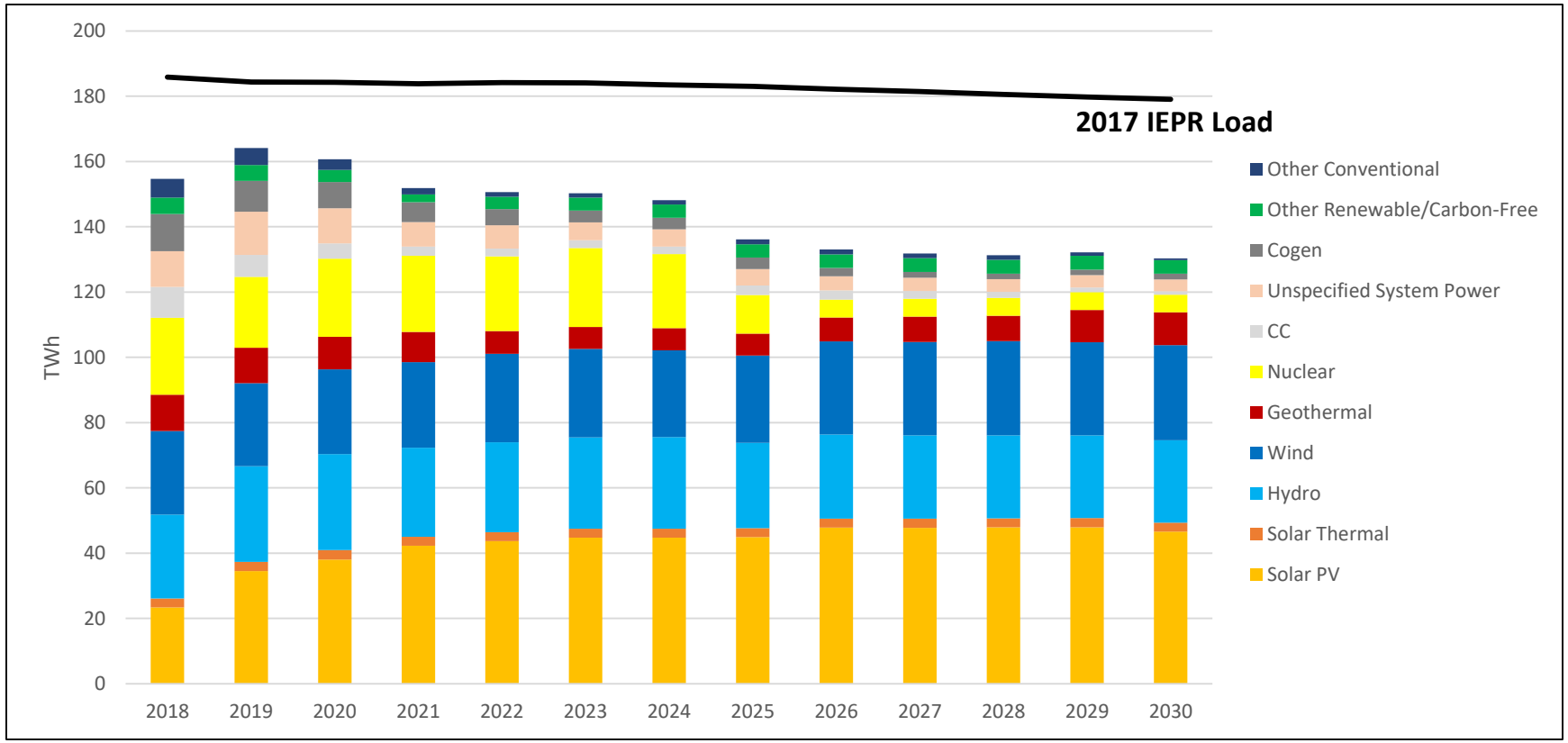
RESOURCE ADEQUACY

- Multi-Year requirements
- Single Buyer for local capacity

INTEGRATED RESOURCES PLANNING

- Planning towards decarbonization
- Meeting reliability with high penetration of renewables
- Considering not just GHG but air pollutants as well

Total planned baseline and new energy purchases, TWh, by resource type



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Michael Goggin

www.gridstrategiesllc.com

Grid Strategies LLC

Renewables are now dispatchable

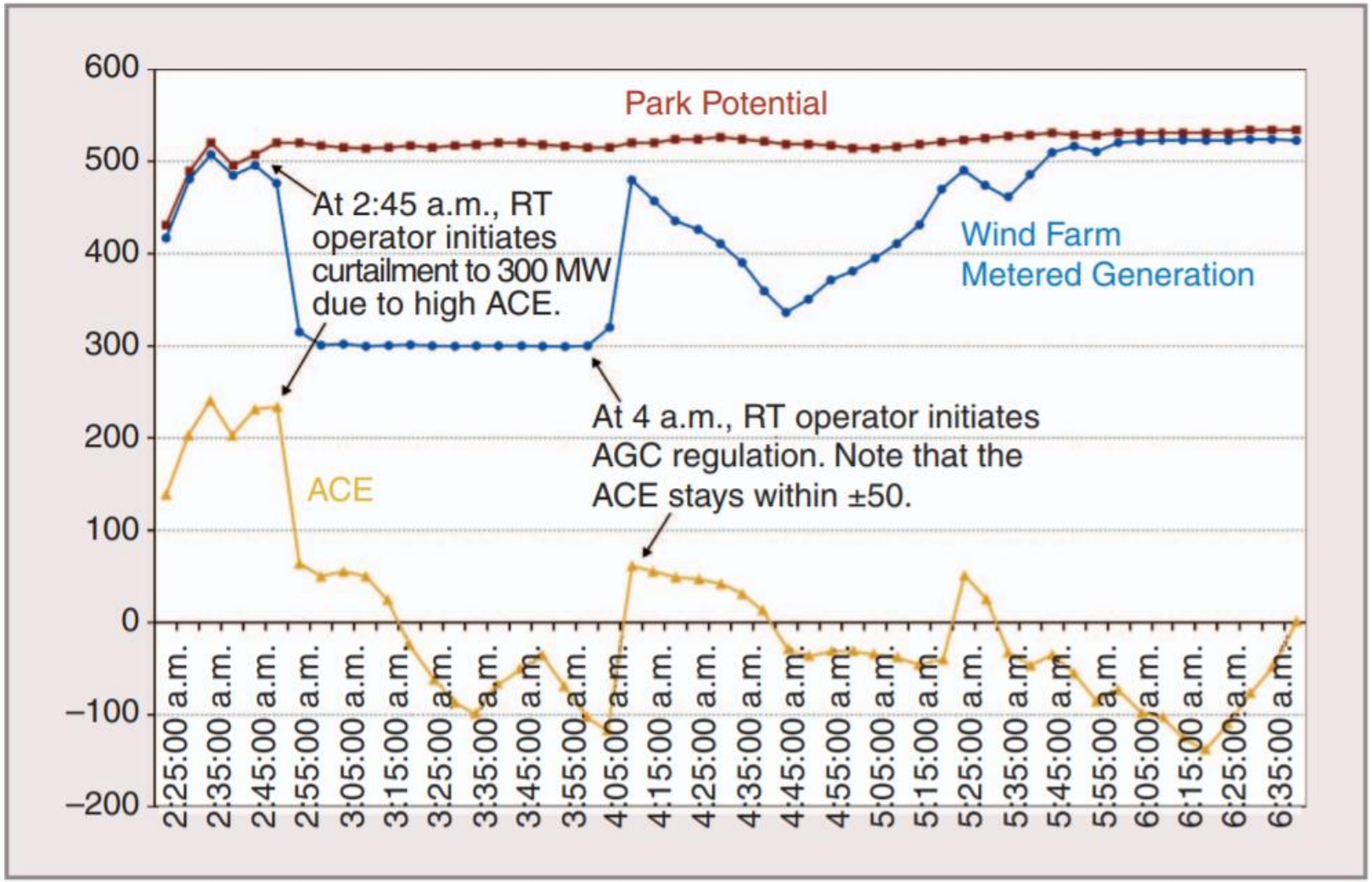
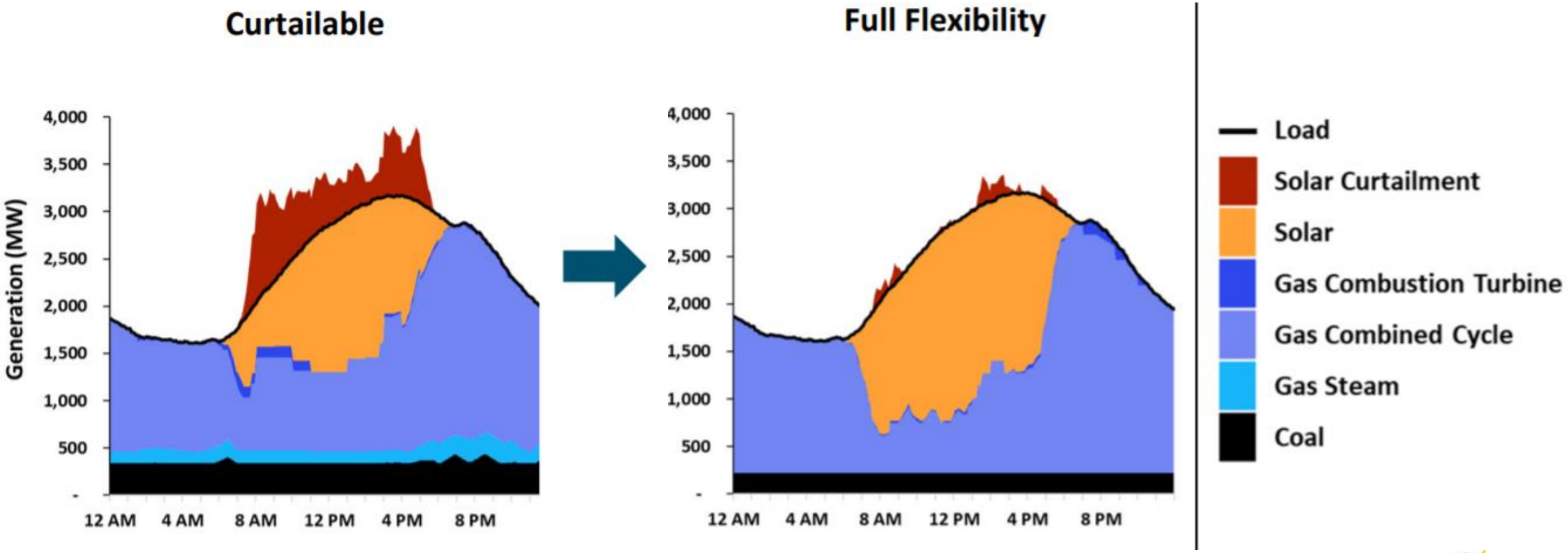


figure A wind power plant in the Xcel/PSCO area is the first to manually block curtailed wind and then put it on AGC regulation. The y axis is in megawatts. The resulting ACE is shown in yellow.

Source: IEEE magazine chart, data from Xcel Colorado power system
http://iiesi.org/assets/pdfs/ieee-power-energy-mag-2015.pdf

Renewables will increasingly provide flexibility



Source: E3 study of TECO system for First Solar
https://www.ethree.com/wp-content/uploads/2018/10/Investigating-the-Economic-Value-of-Flexible-Solar-Power-Plant-Operation.pdf

Market reforms for a more flexible, cleaner power system

ENERGY MARKET REFORMS

- Ensure energy market prices reflect the value of reliability.
- Bring self-scheduled resources into markets.
- Multi-Day Unit Forecasts
- Price the inflexibility costs of conventional generators.
- Ensure accurate, detailed generator bid parameters.
- Reduce operational over-commitment of conventional units.
- Create operating reserve zones.
- incent improvements in renewable energy forecasting
- Probabilistic Unit Commitment.
- Improve gas-electric coordination.
- Respect bilateral contracts.
- Allow flexible resources to bid flexibly without being inappropriately constrained by market power mitigation rules.
- Allow real-time prices and demand response aggregation for electricity customers and allow demand resources to set prices.
  - Streamline ISO seams.
  - Use advanced grid technologies and operating practices to improve utilization of existing transmission.

RELIABILITY SERVICES REFORMS

- Reactive power compensation.
- Remove barriers to renewable energy providing operating reserves like frequency regulation.
- Primary frequency response markets.
- Allow renewables to provide and set price for all reliability services.
- Create additional flexibility products.
- Make contingency reserves available to accommodate abrupt drops in renewable output.

CAPACITY MARKET REFORMS

- Respect state resource choices.
- Allow MOPR to be avoided through bilateral contracts
- Ensure capacity markets reflect renewable resources' true capacity value.
- Relax the requirement for capacity to perform year-round, and create seasonal rather than annual capacity products.
- Allow storage participation in capacity markets.
- Ensure conventional generators are not awarded excess credit relative to renewable resources.
- Efforts to add a fuel security component to the capacity market should be abandoned unless demonstrated to improve reliability or efficiency.
- Reform the capacity performance penalty structure to be symmetric
- Allow generators to retain their Capacity Interconnection Rights (CIRs) if capacity values change.
- Allow hybrid projects for purposes of meeting market rules

Source: Grid Strategies paper for Wind Solar Alliance
Available at https://gridstrategiesllc.com/

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U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Breaking Out the New Moves: How Resource Flexibility Benefits Utility Operations Panel

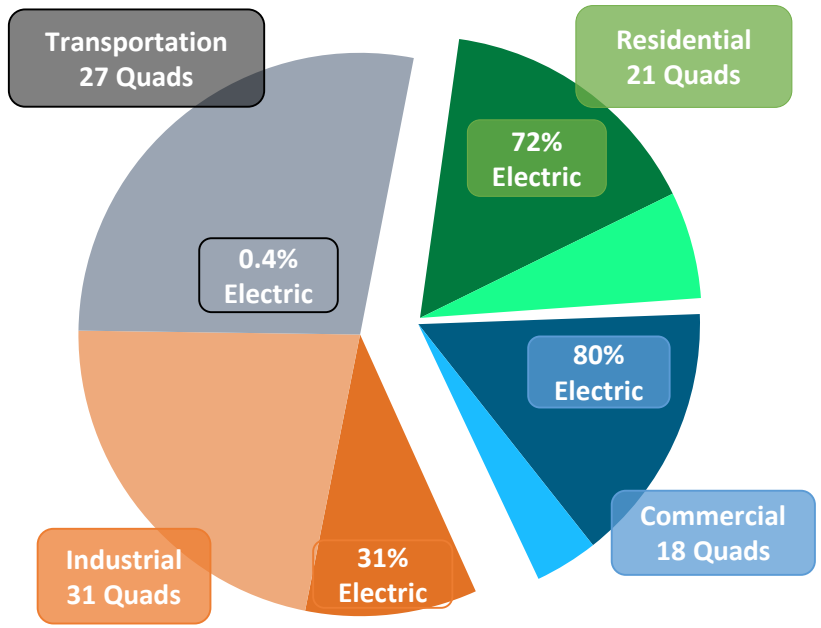
Grid Interactive Efficient Buildings

David Nemtzow
Director, Building Technologies Office
November 14, 2018

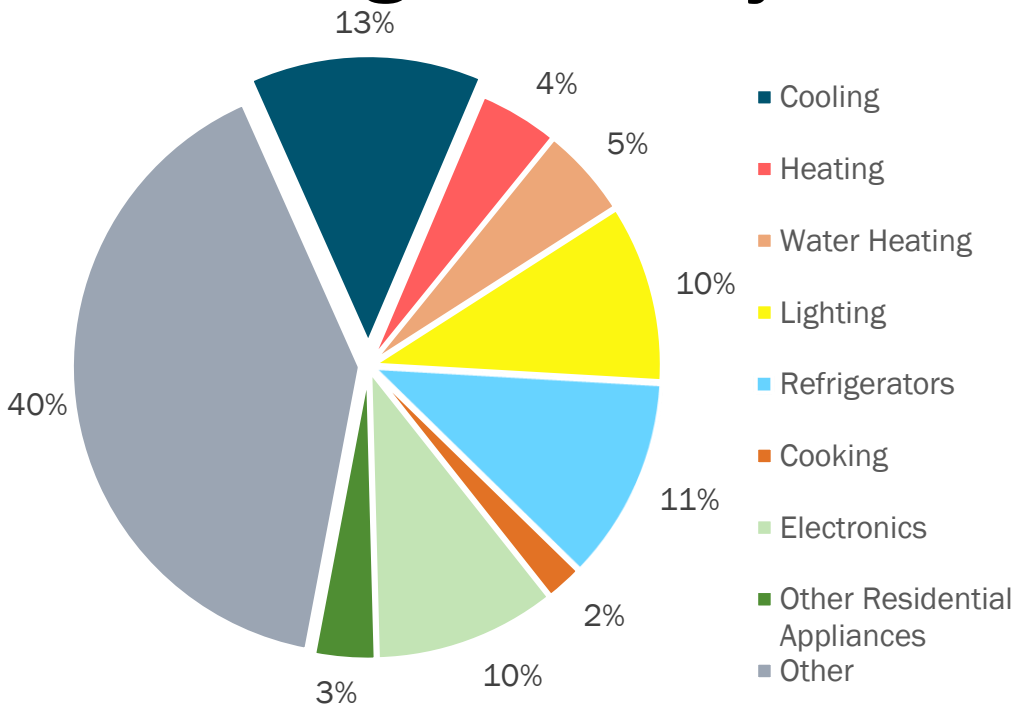
https://www.energy.gov/eere/buildings/geb

Energy use in the U.S. building sector

Energy Use



Building Electricity Use



Buildings Energy Use: 40% of U.S. total

Buildings Electricity Consumption: 75% of U.S. total

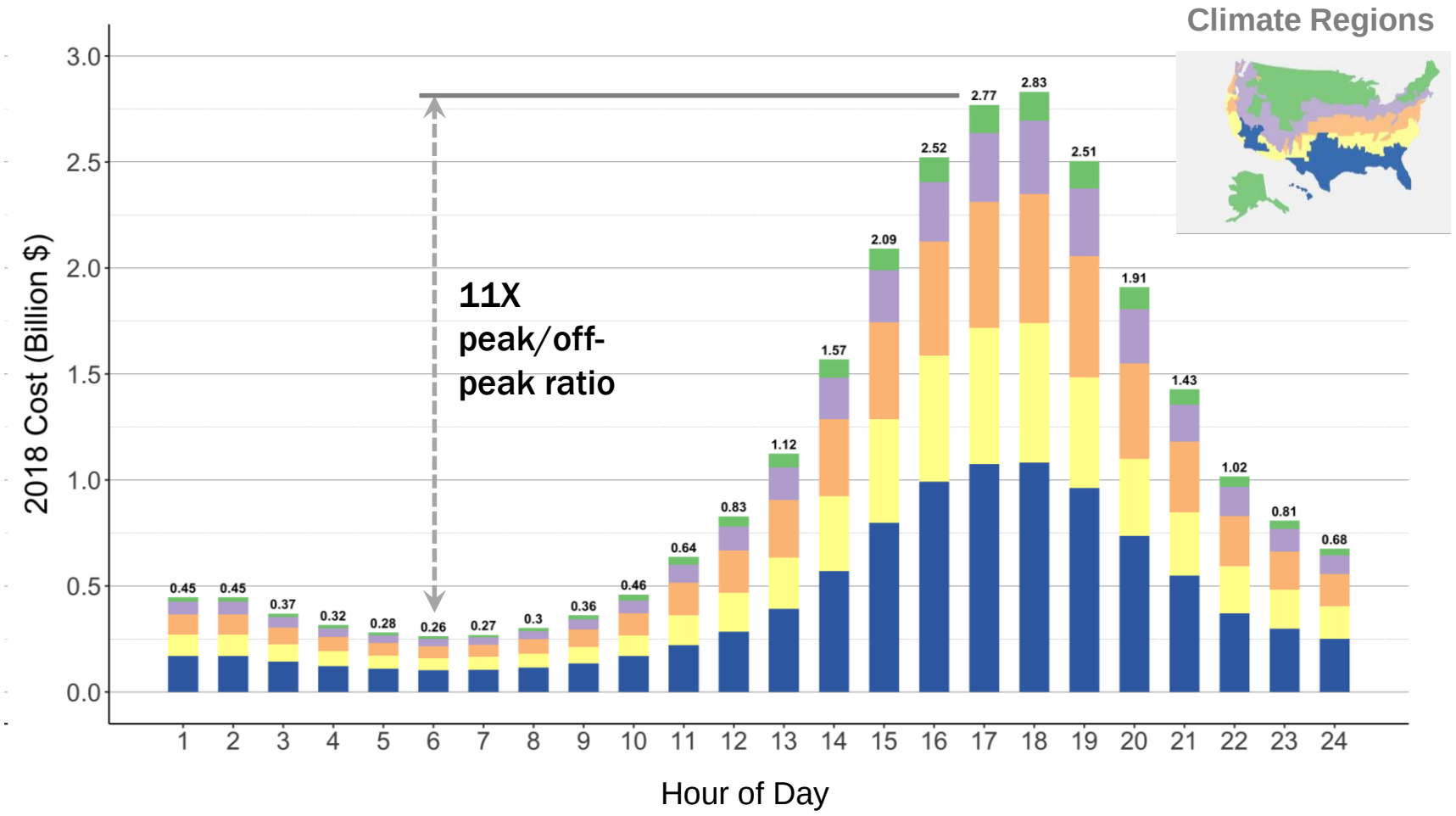
Buildings Peak Electricity Demand: ~80% of regional total

U.S. Building Energy Bill: $380 billion per year

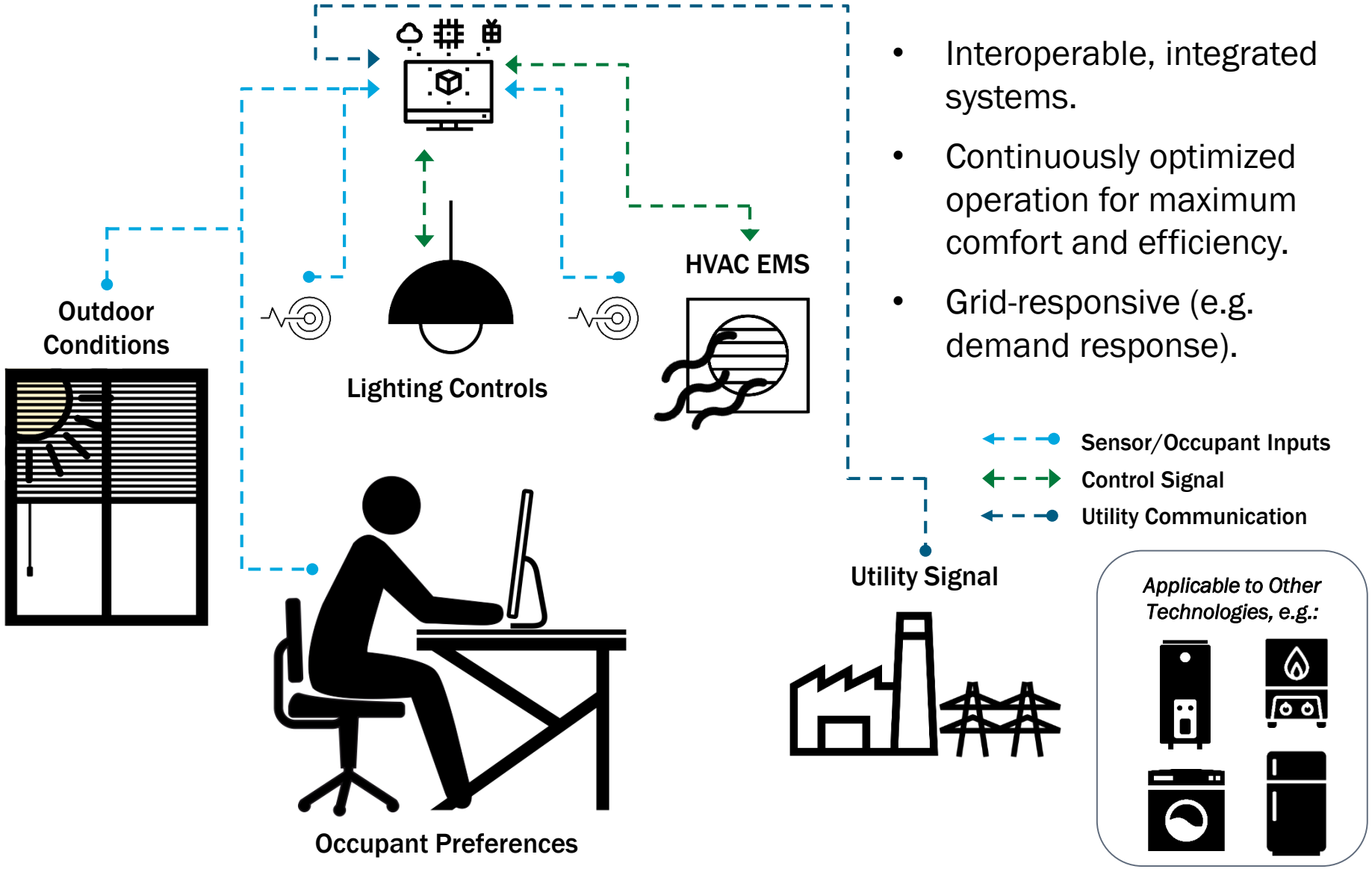
Source: EIA 2017 Annual Energy Outlook

“When” matters for some regions/loads more than others

Hourly Residential Cooling Cost Totals by Climate Zone in 2018 (May-Sep)



Interactions with Building Occupants

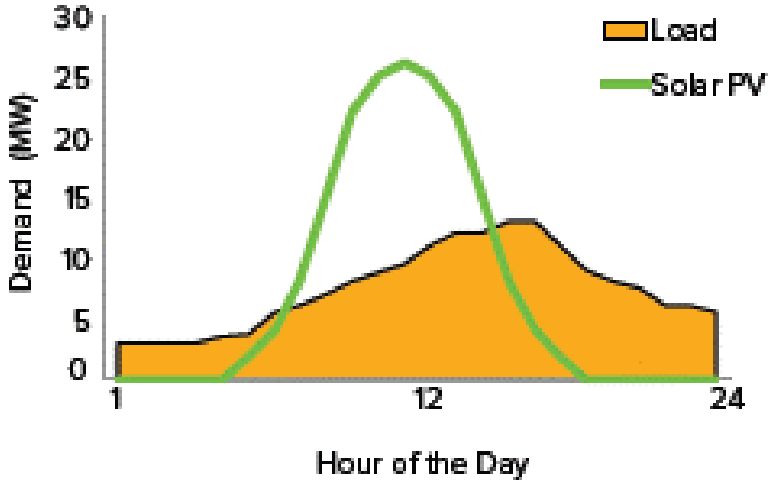


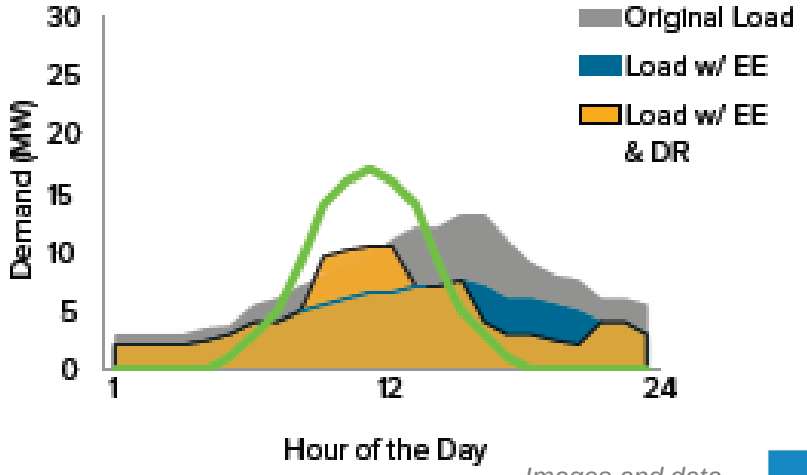
- Interoperable, integrated systems.
- Continuously optimized operation for maximum comfort and efficiency.
- Grid-responsive (e.g. demand response).

Impact on a Building's Energy Use

Solar PV

Energy Efficiency, Demand Response, then Solar PV





Images and data courtesy of PG&E

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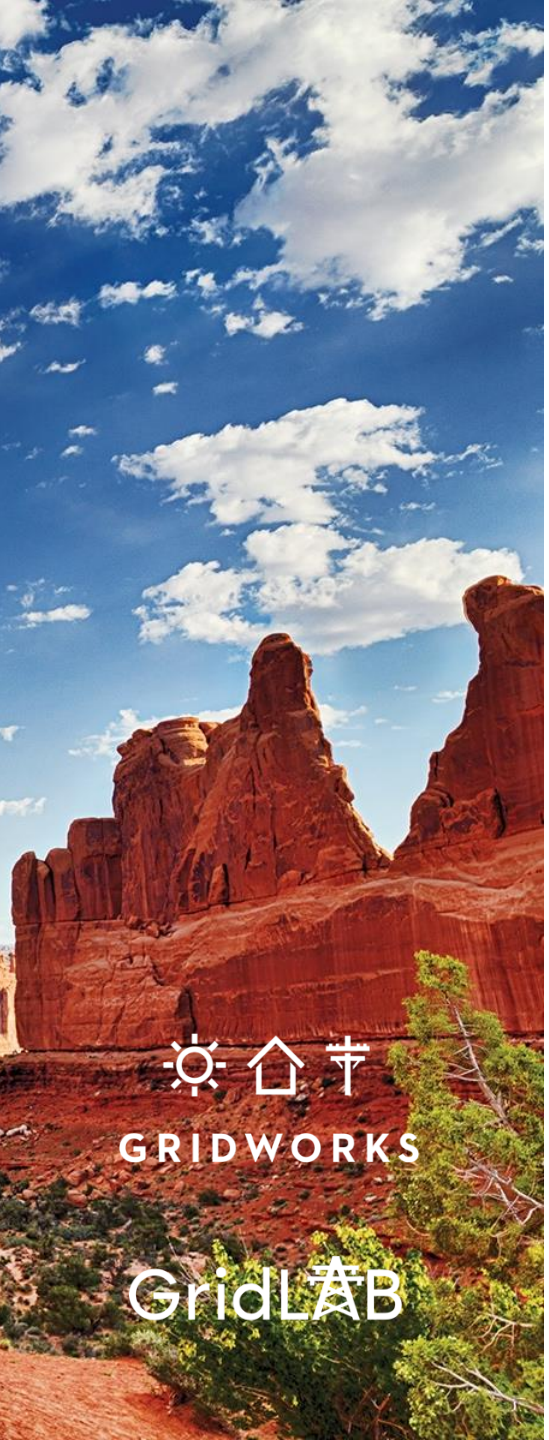
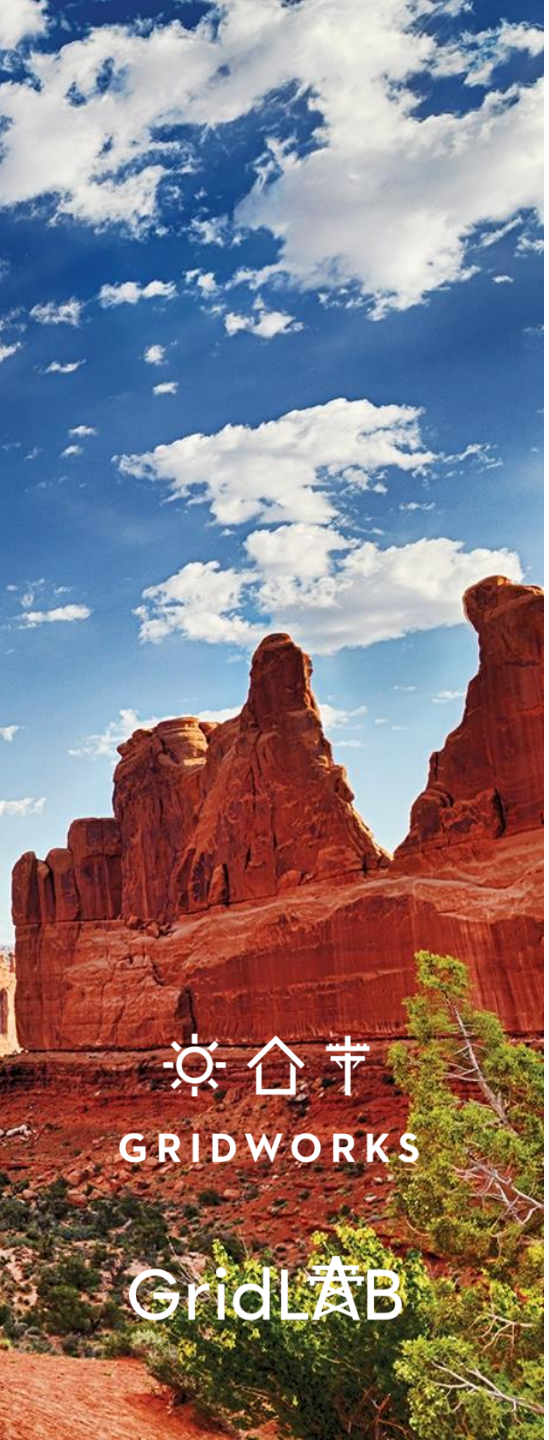


TWO MOST SIGNIFICANT TRENDS IN US ENERGY MARKETS

1. Adoption of large, central renewable generation by utilities and policy-makers
2. Adoption of distributed energy resources by customers

QUESTION | *Do these trends complement or frustrate one another?*

CONCLUSION | *Distributed Resources increasingly seen as a complement to large, scale renewables, because they deliver unique benefits to customers AND* ***flexibility*** *to the grid.*



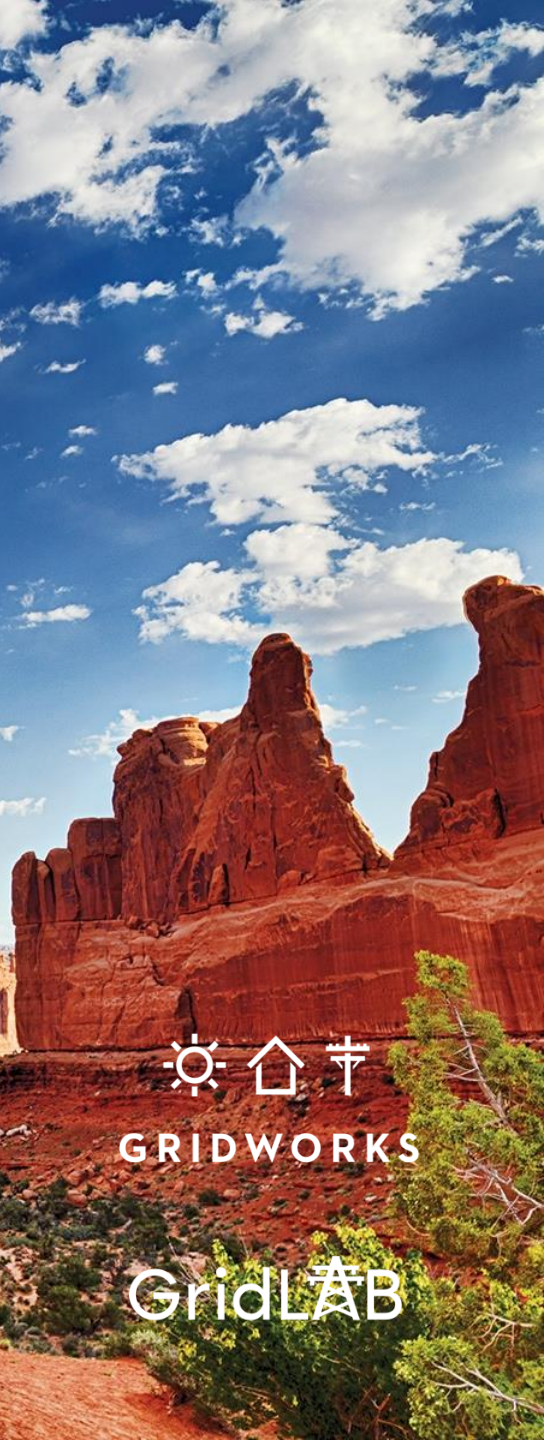
”NOT YOUR GRANDMA’S DER”

- Leveraging new technologies and low cost communications, DER can now provide **flexibility**
- Solar PV with Smart Inverters
- Storage
- Demand Response
- Electric Vehicles

WHAT IS FLEXIBILITY?

The flexibility the grid requires can be described as:

- **Ramp -** the ability to respond rapidly and over sustained periods to changes in load or generation.
- **Overgeneration -** the grid needs to be able to absorb or shift excess generation.
- **Frequency -** the grid needs to keep generation and load in balance at all times.
- **Voltage -** maintain voltage within acceptable limits. While the other flexibility needs are required at a larger system level, voltage is a local requirement and must be managed at a circuit level.



DER FLEXIBILITY

- New market products for DER
  - CAISO DERP
  - FERC NOPR
- Aggregation allows for participation models
- Modeling shows DER flexibility as key to unlocking higher RE penetrations (MN)

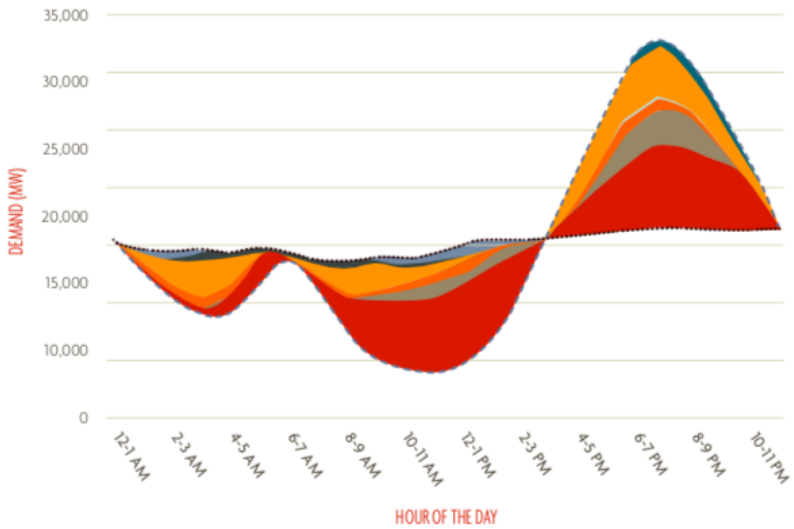


FIGURE 3. FLEXIBLE RESOURCES CAN BE USED TO REDUCE SYSTEM PEAKS AND FLATTEN N

Image courtesy of RMI

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Session C3

Look under the "polls" button