ACEEE Market Transformation

Market Transformation Symposium – March 2016

Market Transformation and the Distribution System Grid

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Market Opportunities

Enabling and Supporting Prosumers

FERC Order 745 – Market Integrations Rules

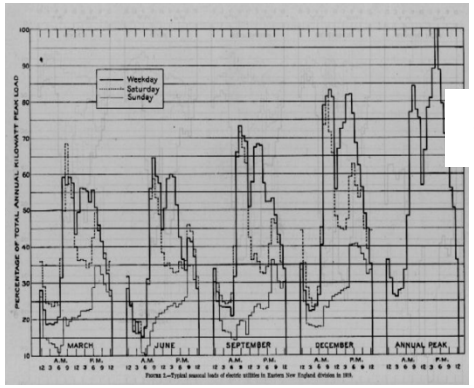
ISO/RTO Market Architectures evolving to comply with Order 745 – Regulatory Support
➔Reserves, load relieve, price response demand and settlement

Distribution System Management

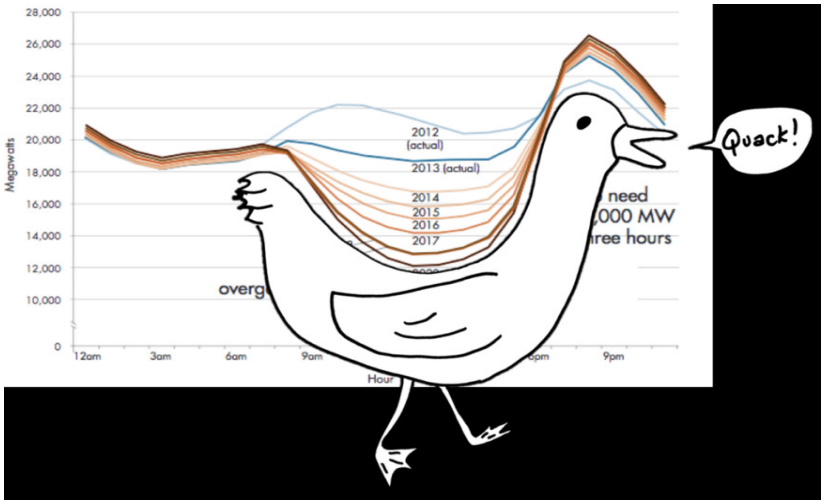
EVERSOURCE ENERGY

Voltage Control Please!

Give me vars!



Match my load!



Over supply mid-day

Steep ramp-up evening

Potential Pilot Objectives

Assess new demand response technologies and practices to better manage the distribution grid.

- Identify advanced new demand response technologies and practices including;
  - Connected equipment, energy management and analytic systems
  - Advanced thermostat controls for HVAC systems
  - Advanced/Smart energy management systems (Auto DR systems)
  - Sensing, feedback and use of algorithms
- Control a building's performance holistically for minimizing energy use and costs
- Determine what technologies are needed for Demand Response to successfully meet the new ISO-NE rules that were put in place to comply with FERC Order 745

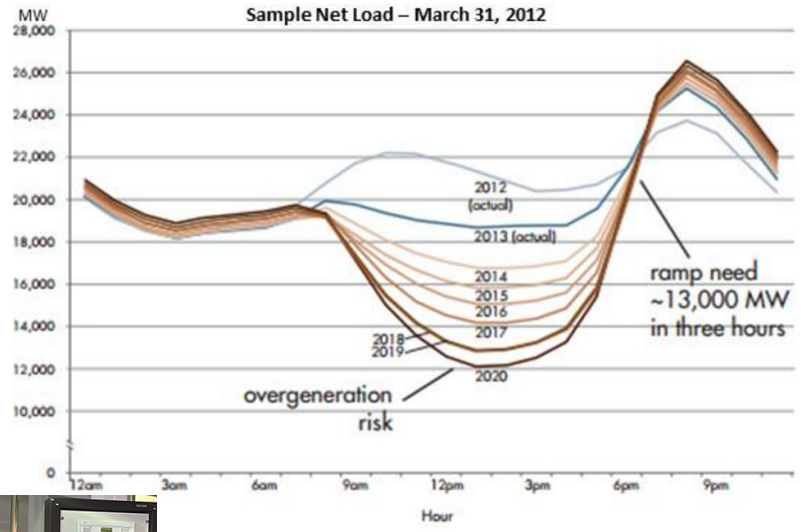
Potential Pilot Design

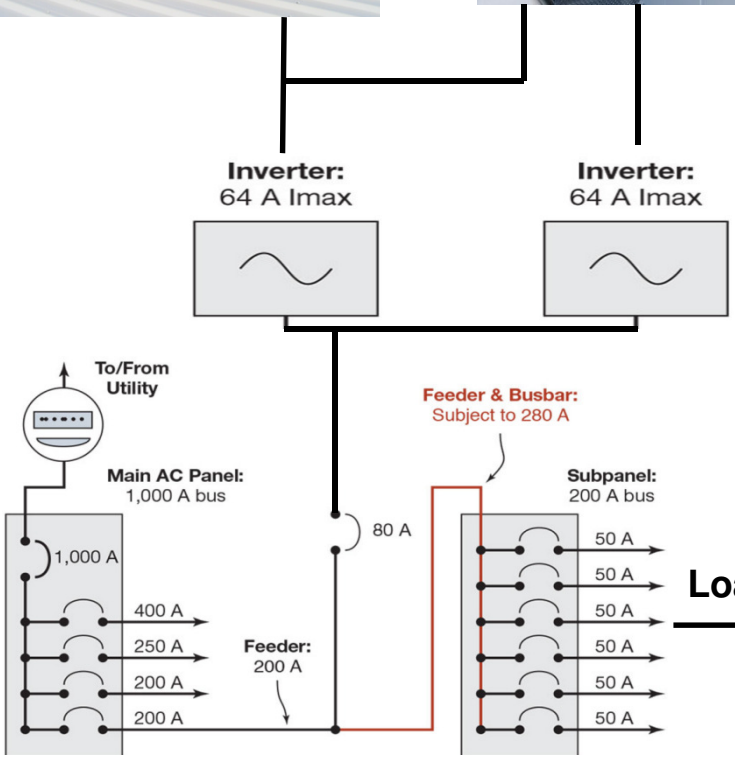
- **Three segment approaches:**
  - **Small Business:** Inexpensive computerized “thermostat” with smart phone app control
  - **Mid-Market:** Solar and storage combined with Demand Response to achieve peak load relief, voltage control, and power factor support as well as DER impact mitigation
  - **Large Facilities:** Engage customers by augmenting existing controls for load duration curve mitigation to reduce billed demand and leverage knowledge gained to implement behavior based load reductions strategies

Potential Pilot Hypotheses

- **Small Business**: By using advanced thermostat controls, in small-commercial buildings with multiple zones, summertime peak demand can be cost-effectively reduced 10-15% without impacting thermal comfort.
- **Mid-Market**:
  - Remote management of Advanced Function Inverters can improve voltage stability at on-site solar PV locations and mitigate the impact of solar PV output variability on distribution circuits.
  - Advanced Function Inverters coupled with on-site solar PV can improve voltage stability however, the addition of Energy Storage coupled with Advanced Functioning Inverters provide higher levels of voltage stability.
- **Large facilities**: Targeted controls can be used to modify load duration curve characteristics and reduce billed demand. End-user knowledge can be leverage to develop behavior-based load reduction strategies.

Demand Resources and DER Mitigation

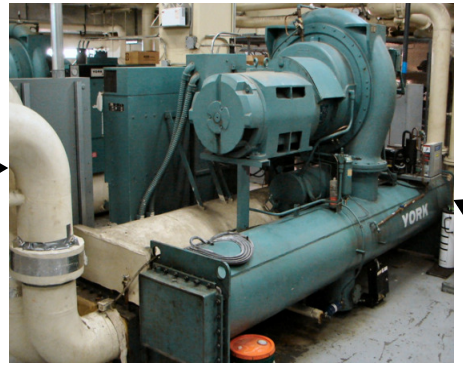




Load

Key Control Conditions:

- Local overvoltage
- Var support
- Mid-Day Duck Curve
- Evening Duck Curve



Demand Response Asset

Integration and Operational Controls

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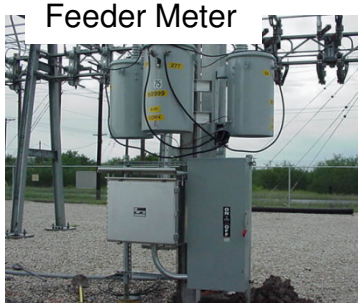
Inputs

Feeder Meter



- Volts
- PF
- kW Static
- kW Change Rate

Facility Meter

- Volts
- PF
- kW

PV and Storage Metering

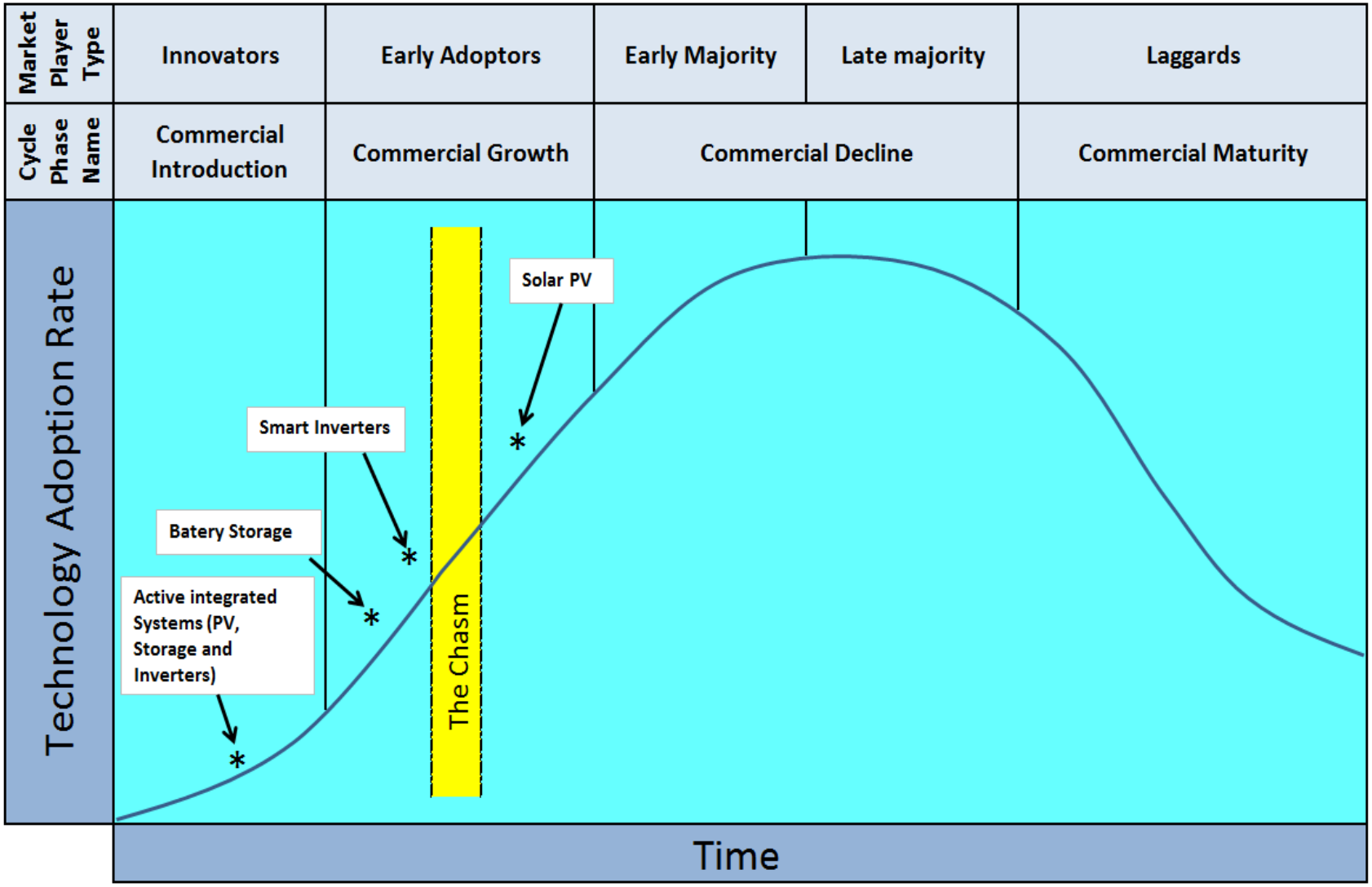
PV output - kW
Storage output – kW
Storage charge - kWh

Automation Controls

Outputs

- PV energy to load or storage?
- Discharge Storage?
- Inverter Operations:
  - Voltage output
  - VAR output
- Dispatch Demand Response assets?

Market Transformation Dynamics



Market Transformation Dynamics

Barrier and Opportunities

Technology	Phase	Barriers	Opportunity
Solar PV	Commercial Growth (past chasm)	Negative impact on grid conditions (overvoltage and duck curve issues)	Zero emission supply, volume continues to reduce cost
Smart Inverters	Commercial Growth (before chasm)	Cost, feedback controls add complexity	Conditioning of PV and storage power
Battery Storage	Commercial Growth (before chasm)	COST and controls add complexity	Ability to mitigate oversupply and steep evening ramp associated with PV
Integrated Systems (PV, Inverters and Storage)	Commercial Introduction	Complexity of grid integration, lack of architecture rules from FERC	Increases effectiveness of storage and PV running independently

Questions