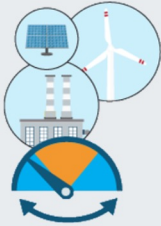




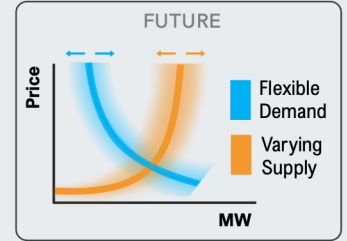
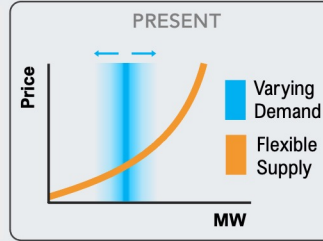
Stochastic Market Auction Redesigned Trading System

PROBLEMS

Unpredictable, intermittent and correlated energy supply sources make the market more difficult to balance and the grid less reliable.

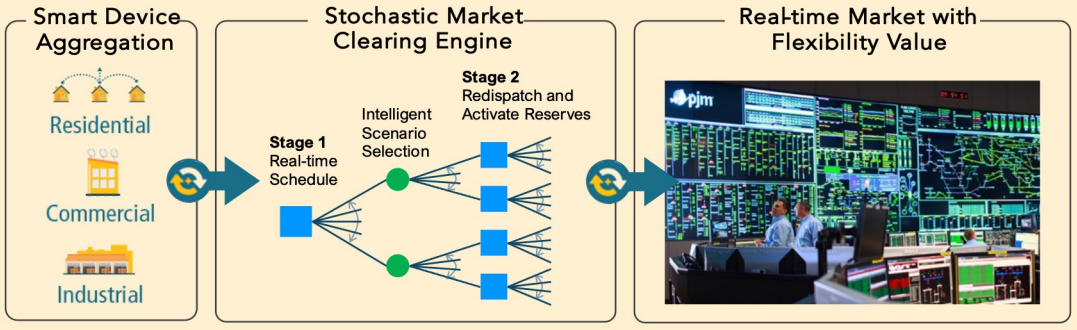


As the power system becomes more difficult to operate, market prices will need to reflect the value of flexibility in order to meet future grid reliability needs.



SOLUTION

SMARTS provides a flexible trading platform that manages load and generation uncertainties and leverages new technologies fostering competition of smart devices and distributed energy resources in shaping the future grid.



VPPs from Many Aggregated Small Controlled Devices (IoT smart devices)

ZOME models the uncertain energy yield of curtailable devices through:

- Conditional probability density distribution function
- Estimated with offline sampling techniques
- Large database linking energy uses with device type, nameplate capacity, location, time of day and temperature, etc.
- Collect and organize one-minute energy consumption data
- Estimate hourly energy yield curves using of 2-phase adaptive K-Means and hierarchical clustering algorithms.

Managing Uncertainty in the Real-Time Market

Market platform:

- Customizable
- Enables Virtual Power Plants (VPPs) harnessing flexibility of demand resources
- Resource variability addressed with stochastic control techniques

Engine:

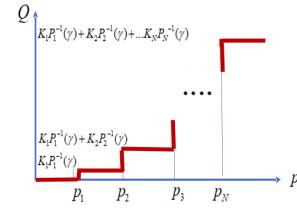
- Intelligent scenario selection
- Look-ahead capability
- Multi-period pricing

Machine:

- Stochastic auction algorithms
- Learning capability for solution selection

Supply Function

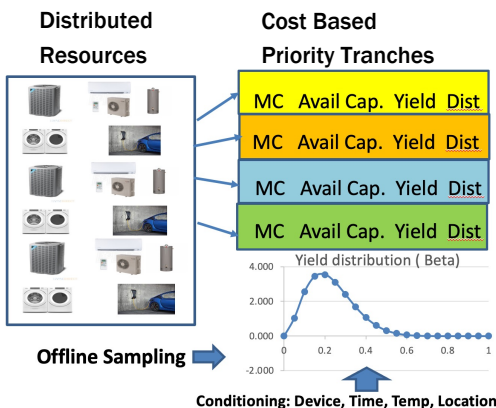
(Offered Energy/Clearing Price)



Shortfall Probability

Risk-Controlled VPP Supply Function

- Aggregates large number of small devices through the ZOMECloud
- Calculates MWh available from MW interruptions using Revenue Management techniques
- Energy yield estimation with selectable confidence interval



Leveraging Grid-Responsive Buildings & VPPs

Creation of VPP "Kits" for Residential Buildings for Market Participation



Bidding energy curtailment into ISO market energy programs



Creation of closed meshed networks for VPPs based on aggregation of IoT devices in residential buildings for market participation via energy yield modeling and supply function determination