Demand-Side Management Strategies

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Trade Secret

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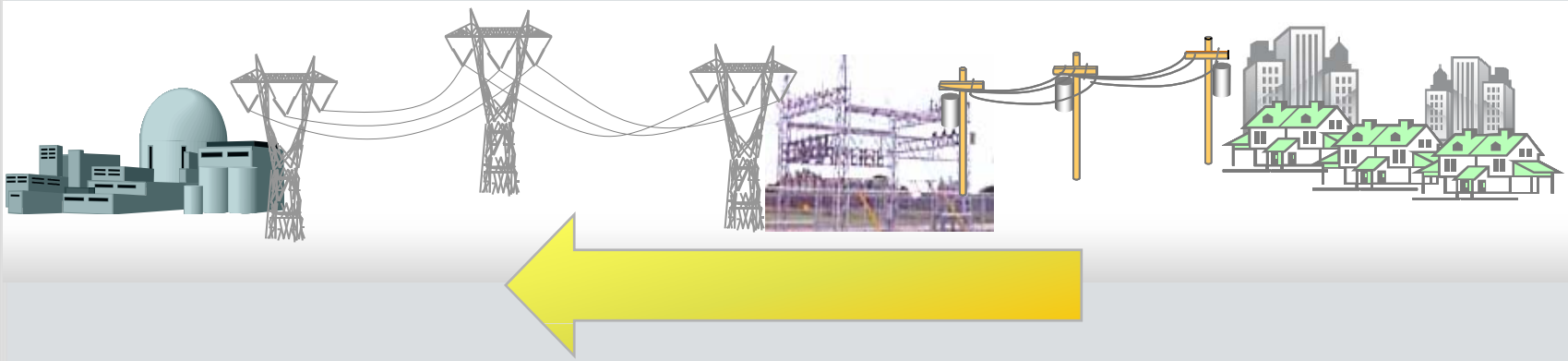
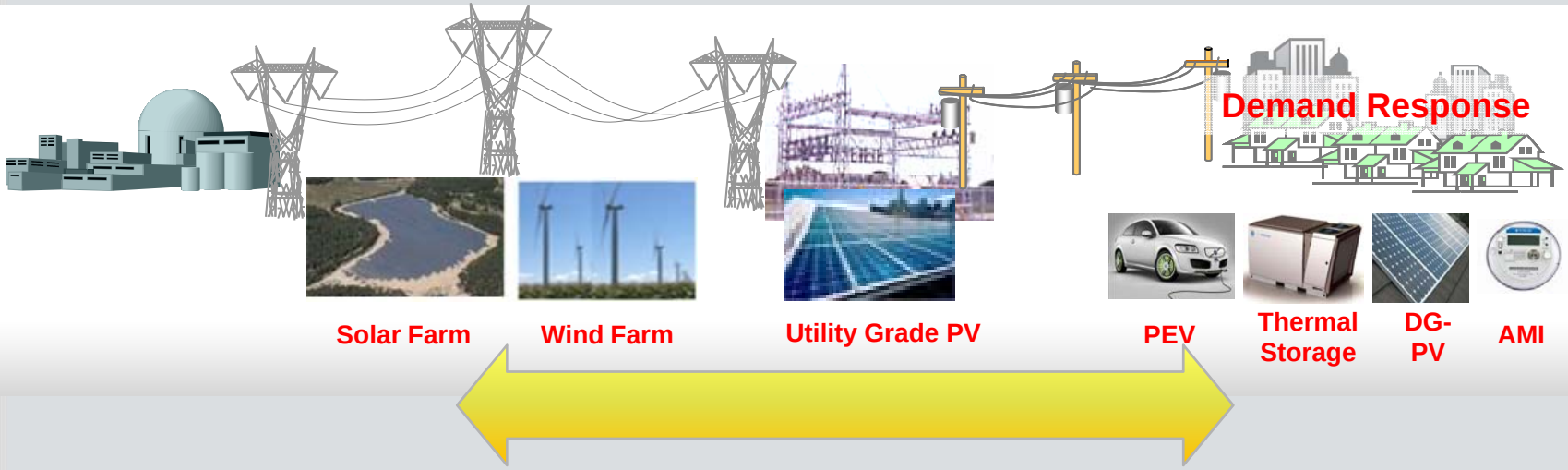
Conventional Operation



- Hourly Scheduling Practice
- Economic Dispatch to meet Forecasted Load
  - *Generation Set-points*
- Generation Control
- Balancing, Ramping and Regulating Capacity Planned for Contingency and Load Variations
- Given Load Forecast
  - *Limited Load Elasticity*
- Fixed Retail Tariff
- Limited Load Participation in Energy Markets
- Limited Data Communications

Emerging "Smart Grid" Paradigm



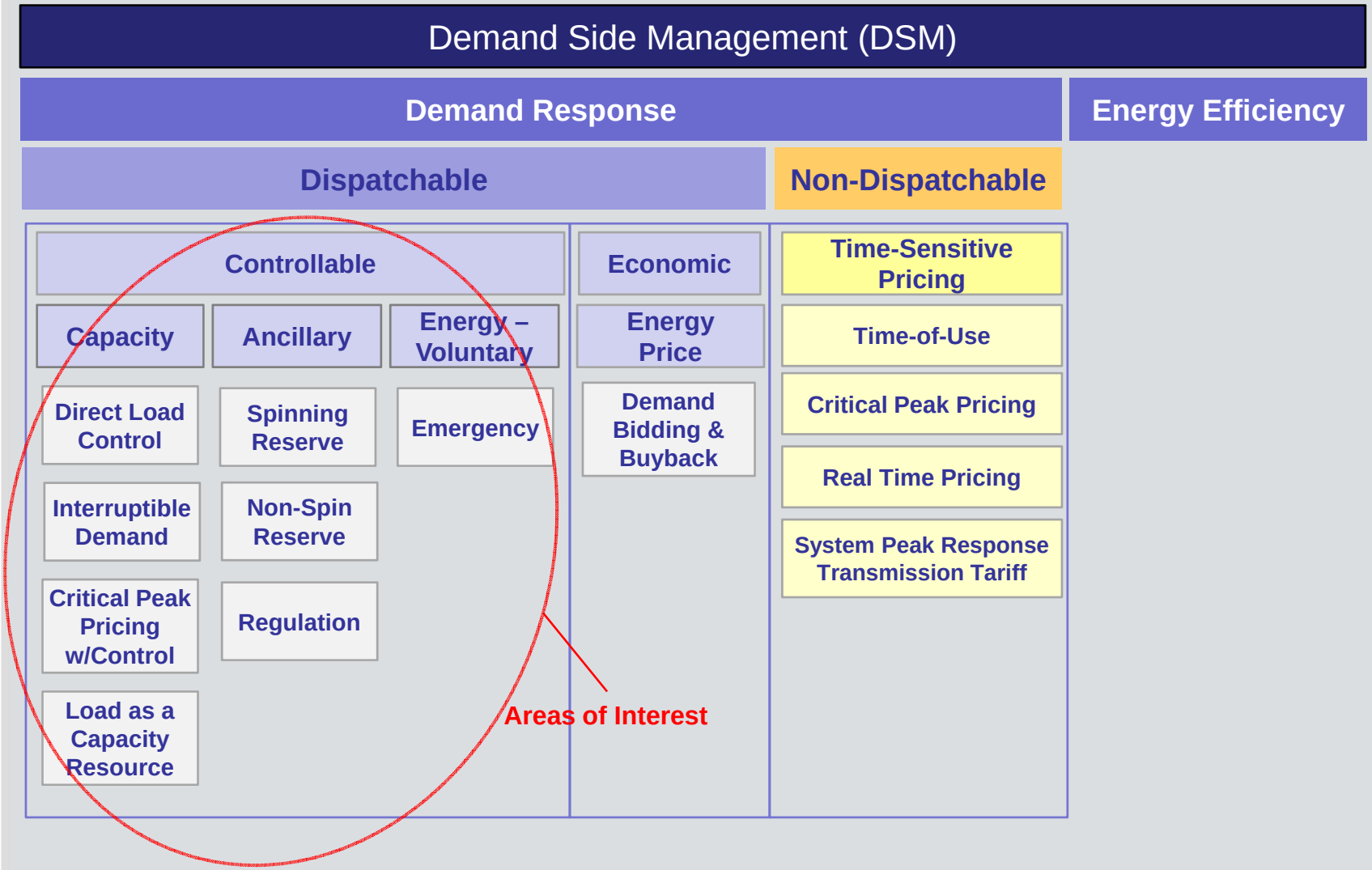
- RPS and GHG Targets
- Variable Resources
- Sub-hourly Scheduling
- New Dispatch Strategies
  - Demand-side Resources

- Demand-side Resources
- Controllable Demand
- Dynamic Tariff
- Communications Infrastructure

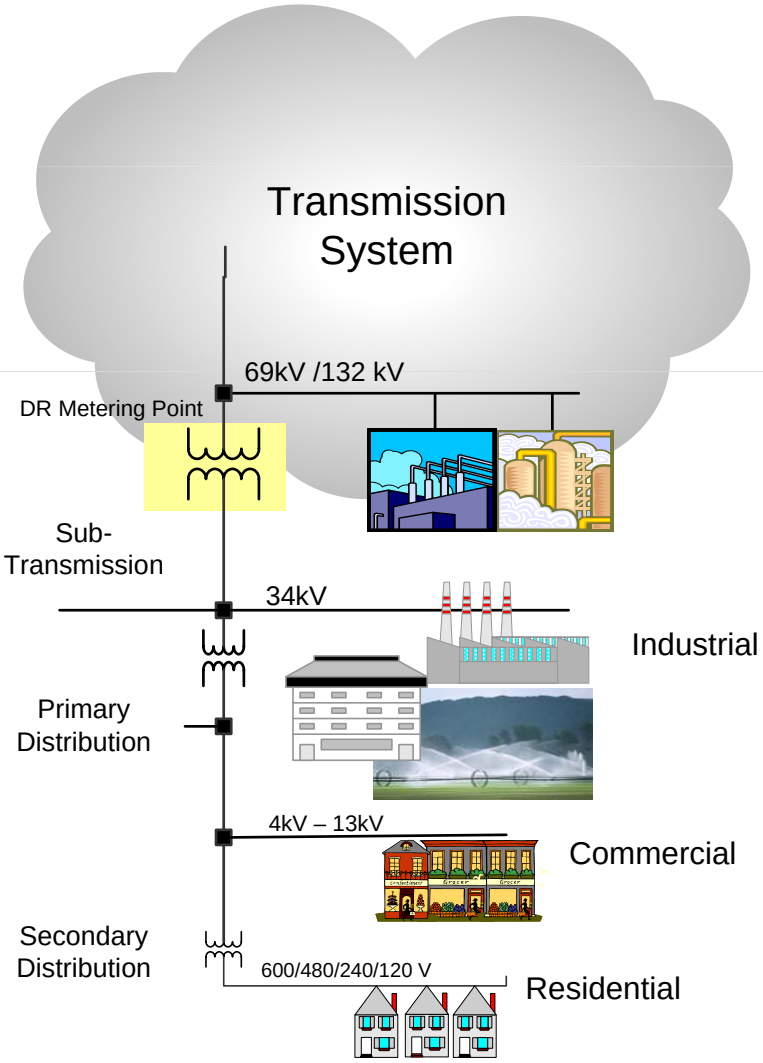
Industry Development

- FERC Order 719 – ISOs treatment of demand response
  - *Equal Treatment of Supply and Demand Side Resources*
  - *Curtailment Service Providers*
- NIST Standards - $10 Million of the Stimulus Funding
  - *H2G, B2G, I2G, V2G &T&D Standards*
- $4.5 Billion Stimulus Funds for Smart Grid Demonstrations
  - *Smart Grid Task Force Recommendations*
  - *DOE Gridwise and other industry initiatives*
- NERC DR Initiatives
  - *NERC IVGTF: Demand Response as one of the mechanisms to address issues associated with variable generation*
  - *NERC DR Data Collection Task Force*
- NAESB DR Measurement and Verification Standards
- Various Smart Grid working groups and standards initiatives
  - *Demand Response (DR) and Distributed Energy Resources (DER)*
  - *NARUC/FERC Smart Grid Collaborative*
  - *ISO Smart Grid initiatives*

NERC Demand Response Callasification



Demand Side Management - Demand Response



ISO Energy Market

- Day-Ahead
- Real-Time
- Energy
- Ancillary Services
- Capacity

Prices

Constraints

Transmission System

Supply

Demand

Distribution System

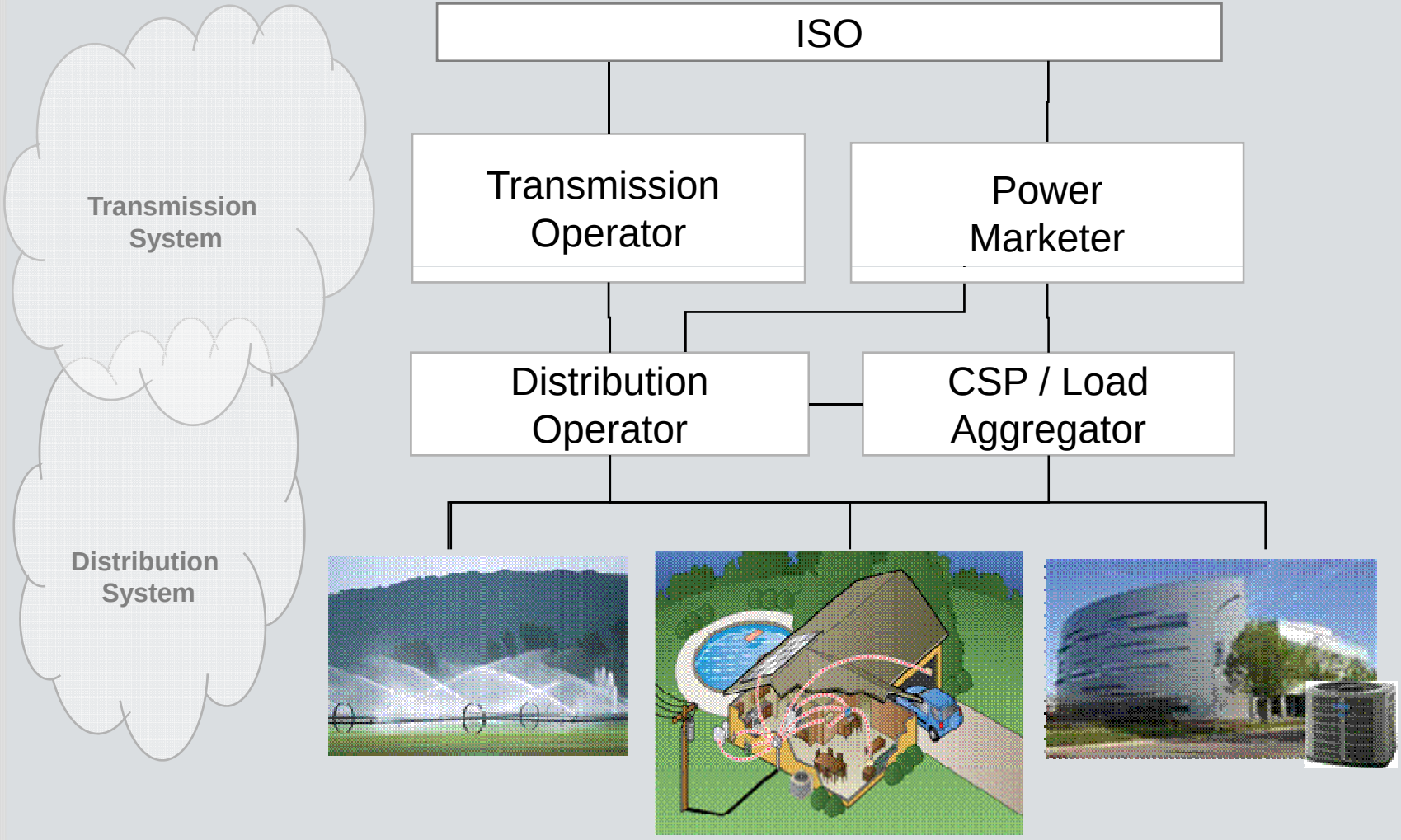
Supply, Quality, Reliability

Prices

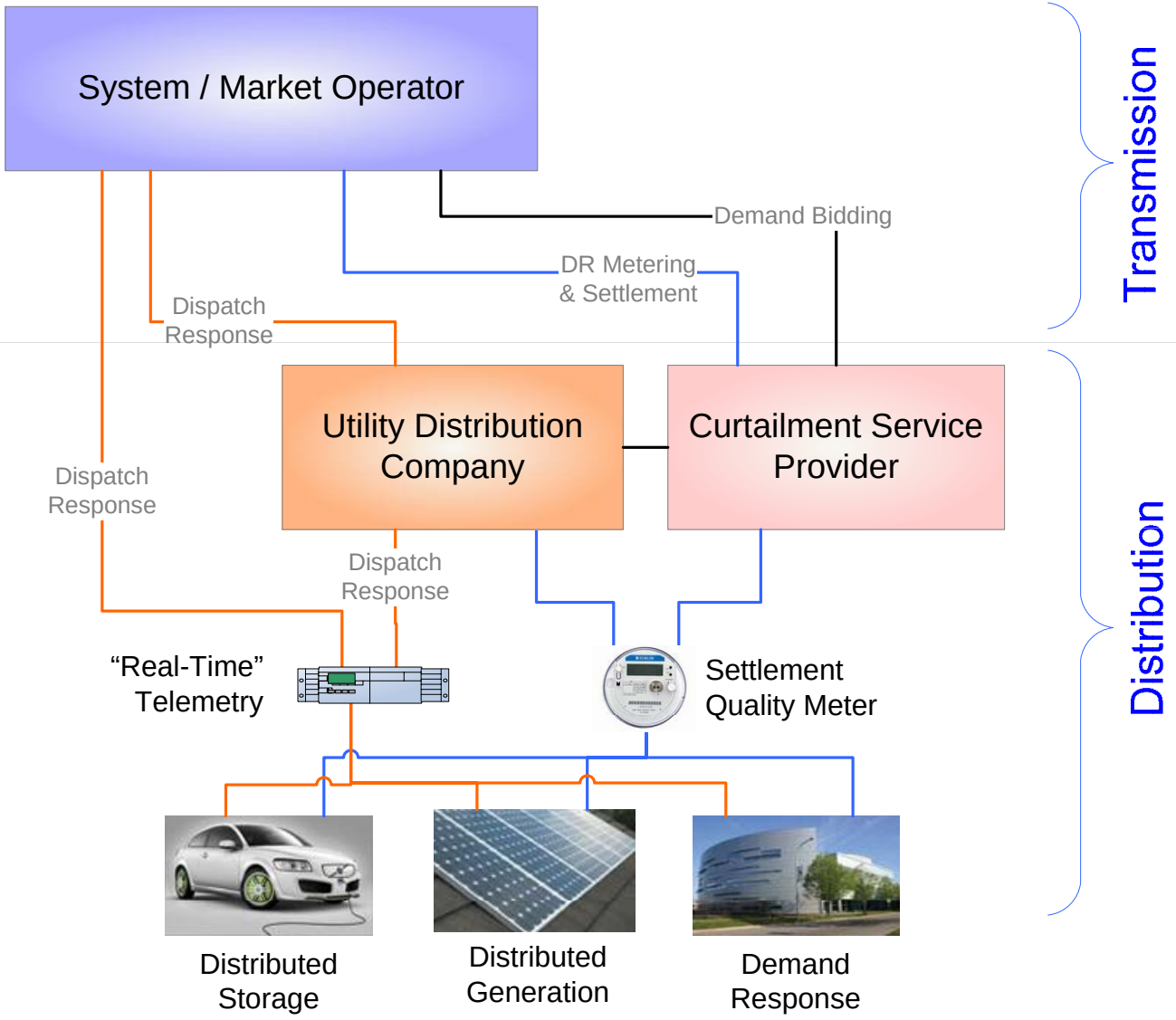
Demand & Supply

Customers

Logical Connectivity

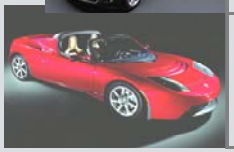


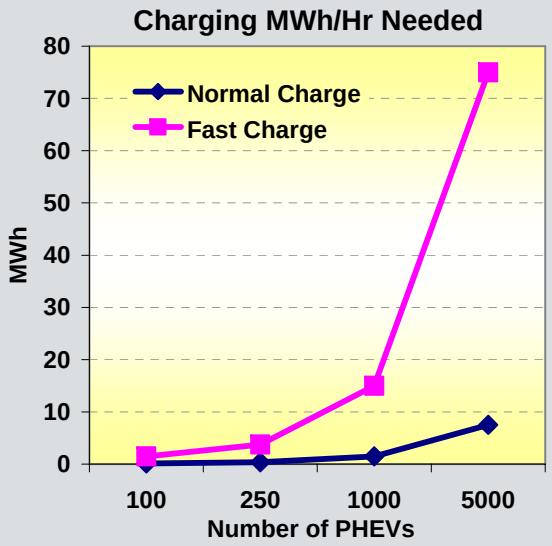
Metering & Telemetry Requirements

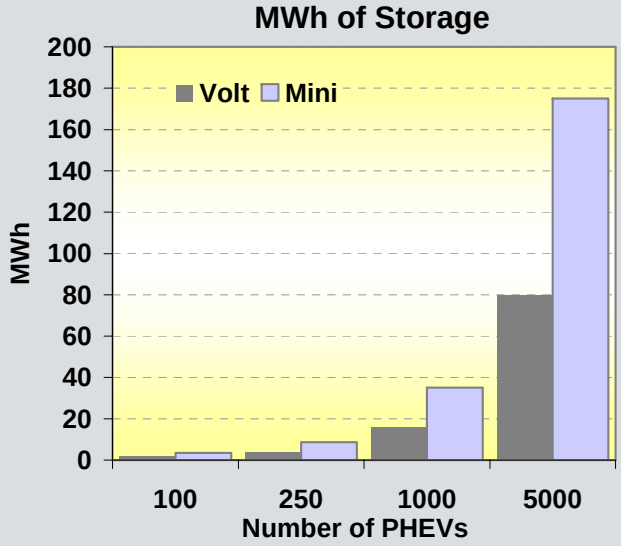


Impact of Plug-in Hybrid Vehicles (PHEVs)

Shifting Revenues From Oil Companies to Utility Companies

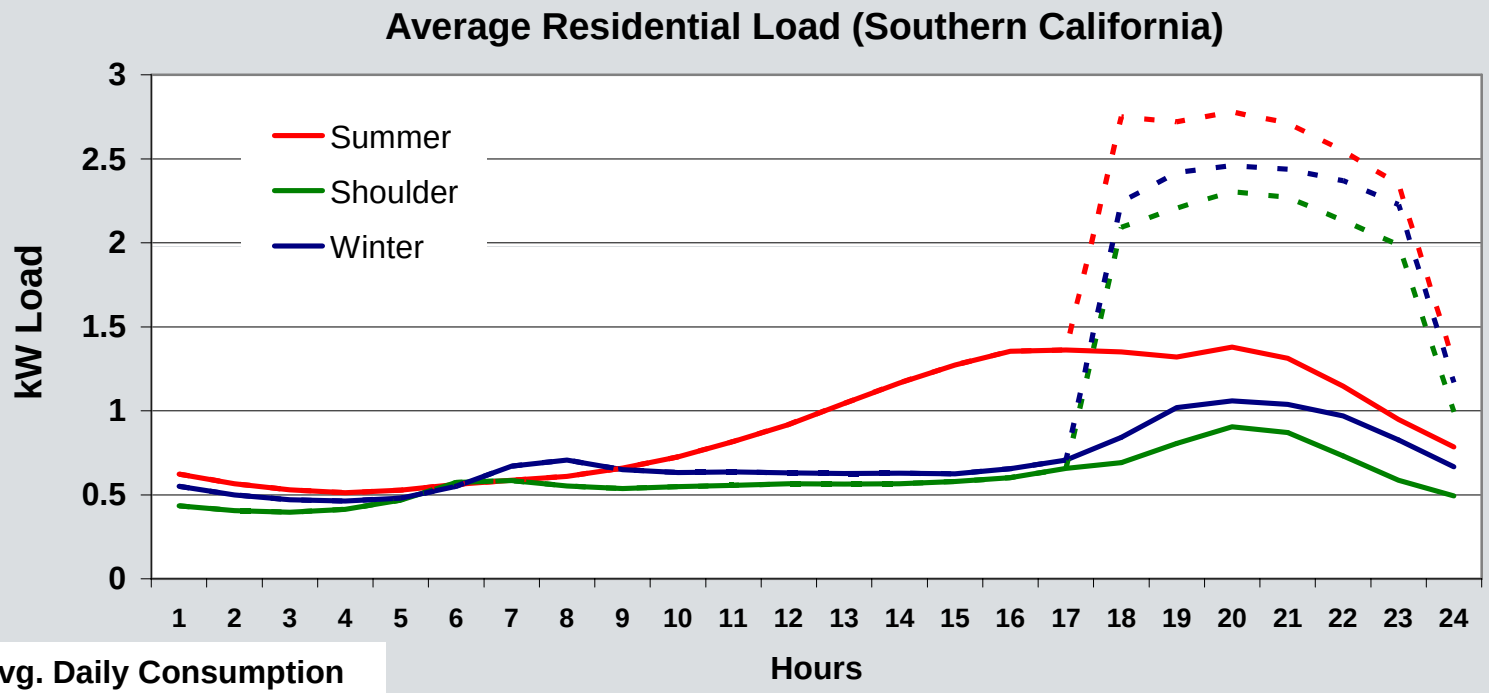
	Type	Driving Range on Batteries (Miles)	Battery Energy kWh	Mile per kWh	Full Charging Time (hrs)			
					House Outlet 110V /15 A 1.2kW	Upgraded Outlet 240V / 15 A 3.3 kW	Commercial Charger 220V / 30 A 6.6 kW	Fast Charge 220V / 80 A 15 kW
	**Sedan**	40	**16**	5	**8**	**3**		
	**Compact**	150	**35**	4-5	**22**	**8**	**4**	
	**Roadster**	220	**53**	5-7	**33**	**12**	**6**	**3**





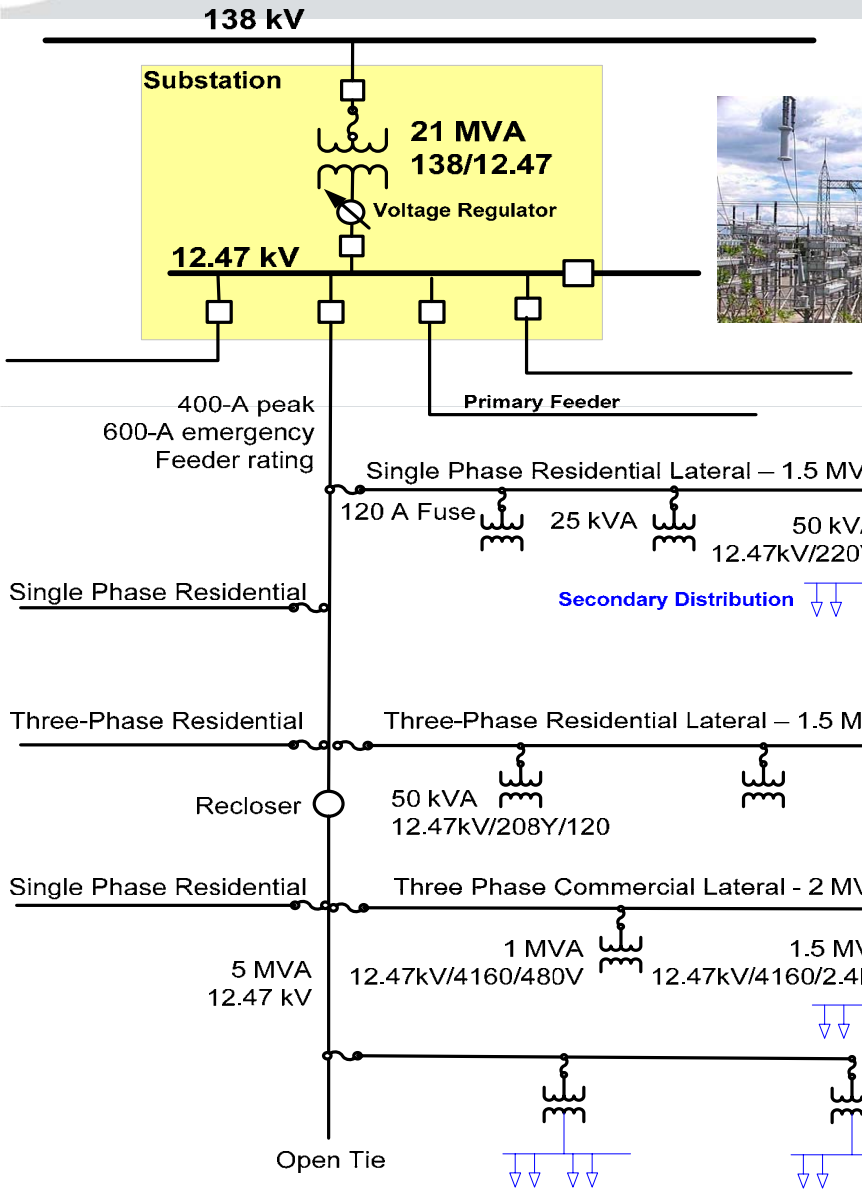
Impact of PHEV's

- Considering 1.4 kW loading – evening charging



Avg. Daily Consumption	
Summer	22.1 kWh
Shoulder	14.1 kWh
Winter	16.6 kWh
PHEV Load	8.9 kWh
Max Charge	16.0 kWh

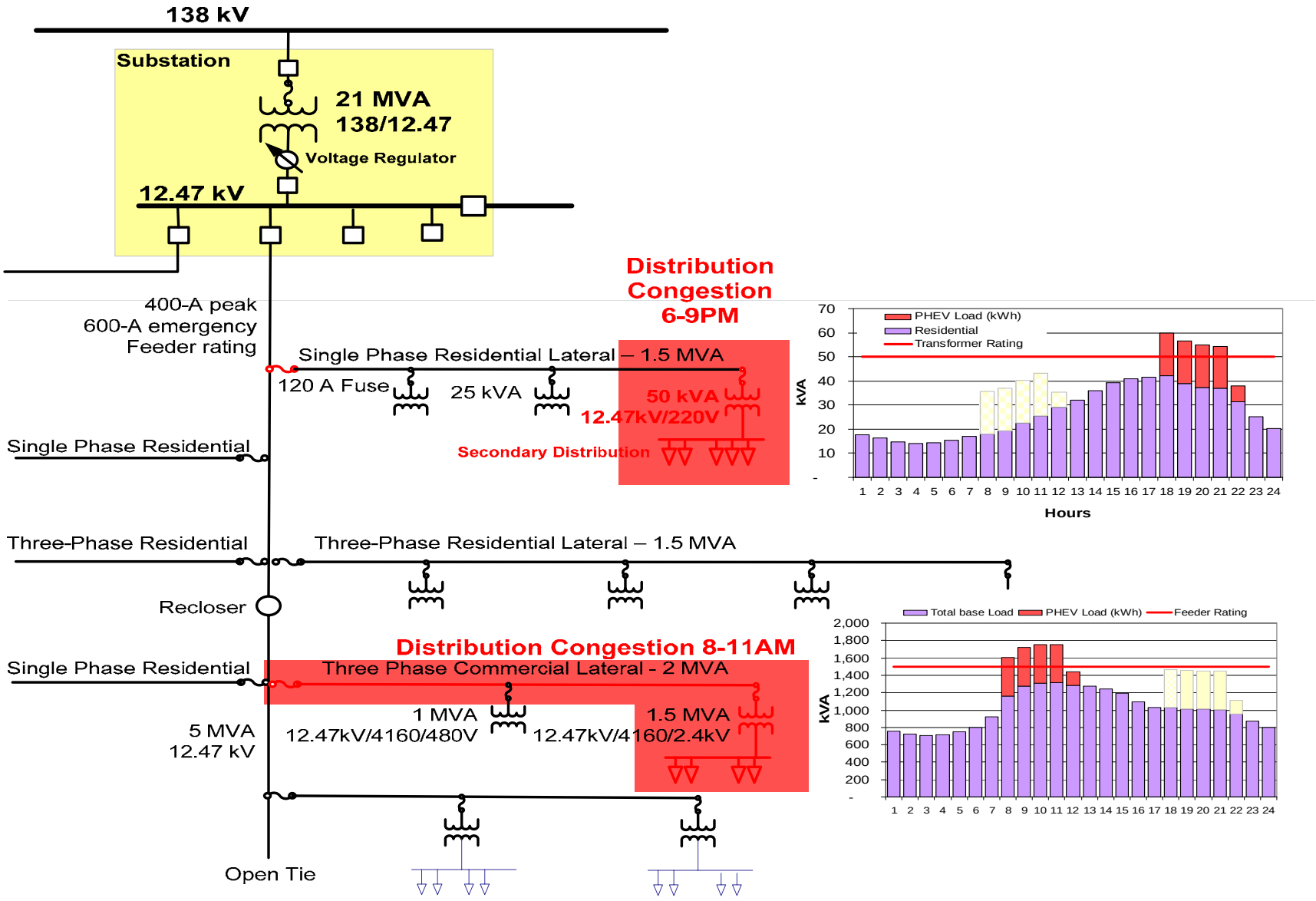
Impact on a Typical Distribution Feeder



Residential Circuit – Secondary Voltage

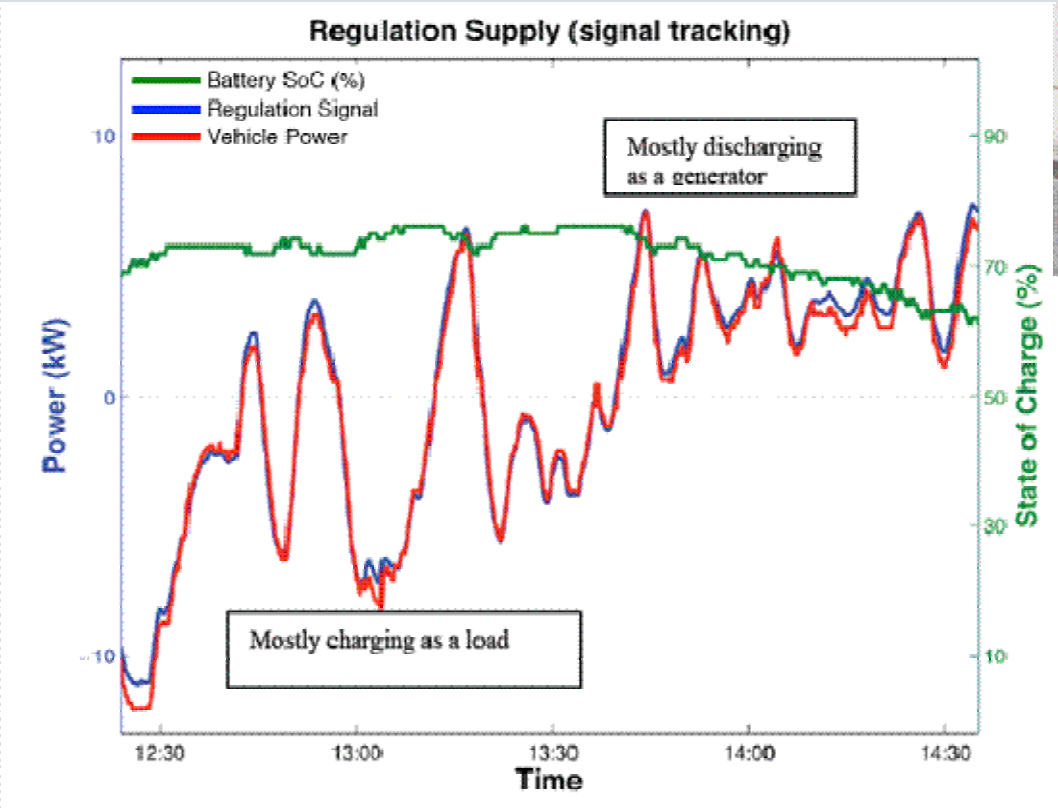
Commercial Customer - Primary Feeder Voltage

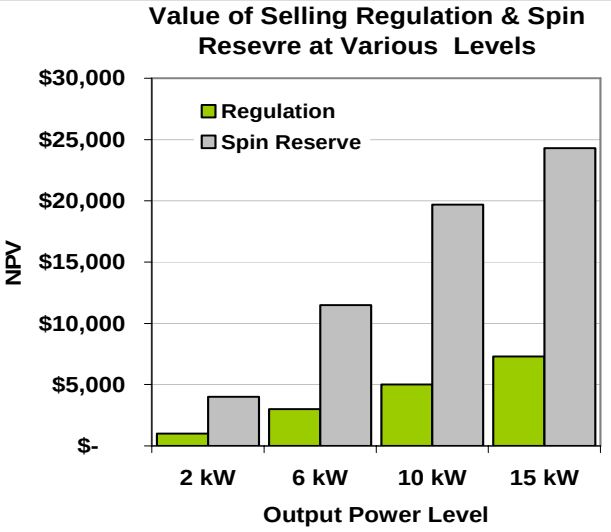
Potential for Distribution Congestion



V2G – Storage & Regulation Capability

- V2G Study Performed by Univ. of Delaware, PHI, PJM and Green Mountain Collage, Published Aug. 2008
- Connecting a PHEV to PJM Regulation Control Signal



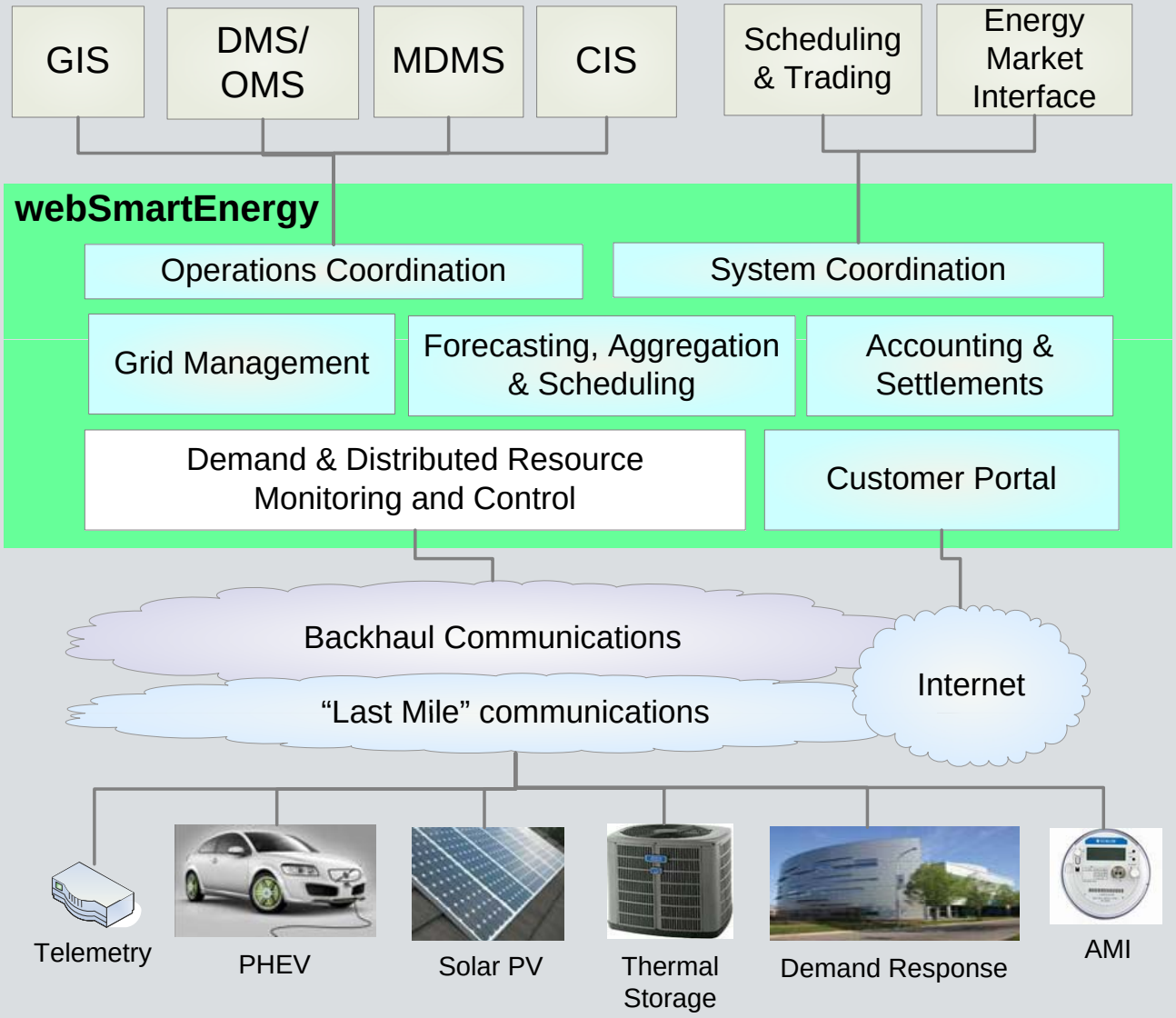


Source: W. Kempton, Victor Udo, Ken Huber, Kevin Komara, Steve Letendre, Scott Baker, Doug Brunner & Nat Pearre – A Test of V2G for energy storage & Frequency Regulation in the PJM System - August 2008

Demand-Side Management: Key Requirements

- Handle Various Demand-side Resources
  - *Load, Generation, Storage*
- Handle Various DR Programs
  - *Dispatchable and non-Dispatchable*
- Handle Various Market Products
  - *Energy, Ancillary Services, Regulation, Capacity*
  - *Aggregation and System Operations Interfaces*
- Handle Distribution Grid
  - *Voltage and VAr Management – 3 Phase Balancing*
  - *Losses*
  - *Operating Constraints*
- Customer and Other External Interfaces
  - *Customer Portal*
  - *Integration and Interoperability*

webSmartEnergy Demand Module



THANK YOU

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