



Incentive-Compatible Solutions for Efficient Energy Consumption and Reliable Power System Operation

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Shifting Smart Grid Focus to Customer Driven Performance Outcomes

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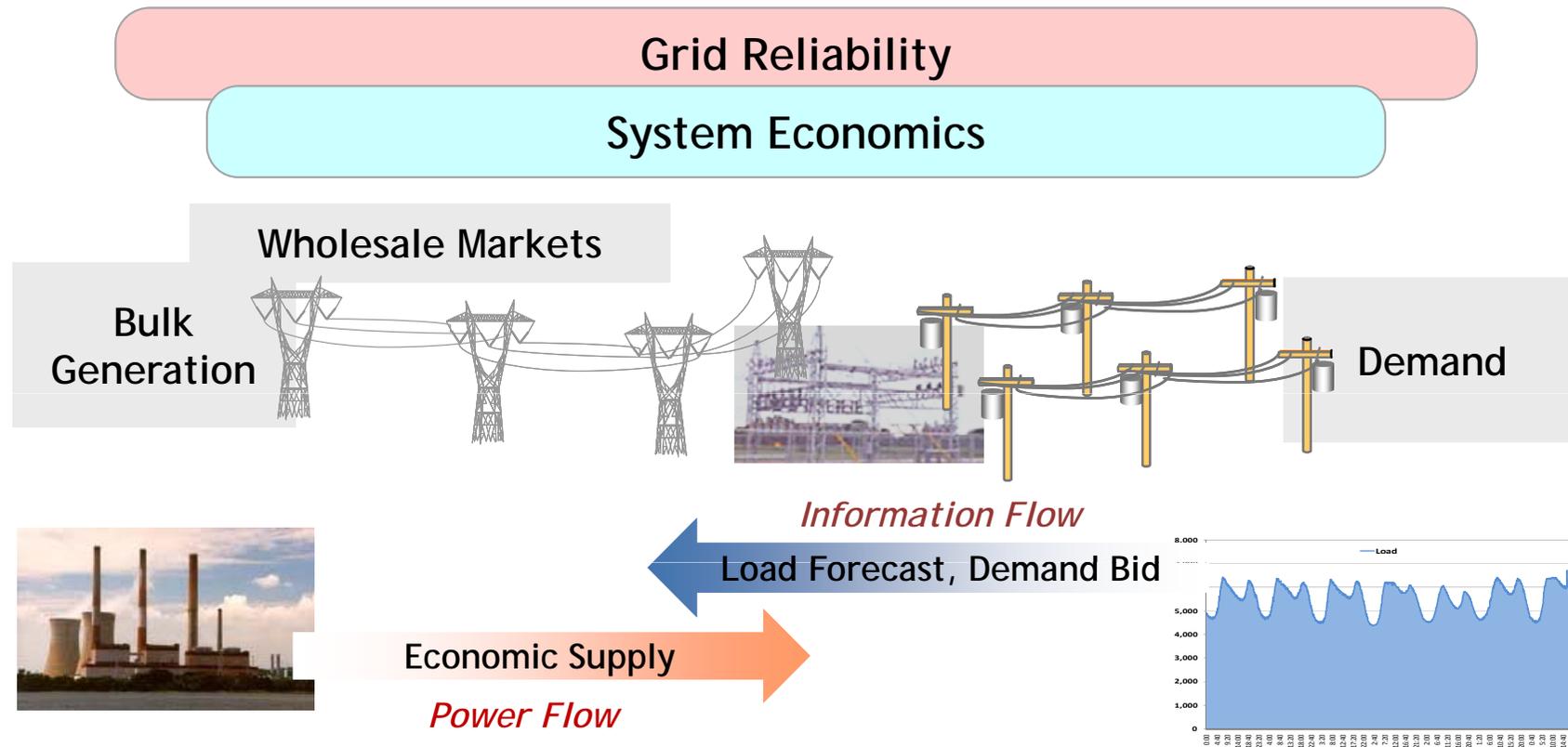


Topics

- New Electricity Supply-Demand Paradigm
- Regulatory Issues Related to Demand-Side Participation
- An End-to-End Solution Framework for Consumer Participation in Energy Markets with Beneficial Impact on Power System Operations

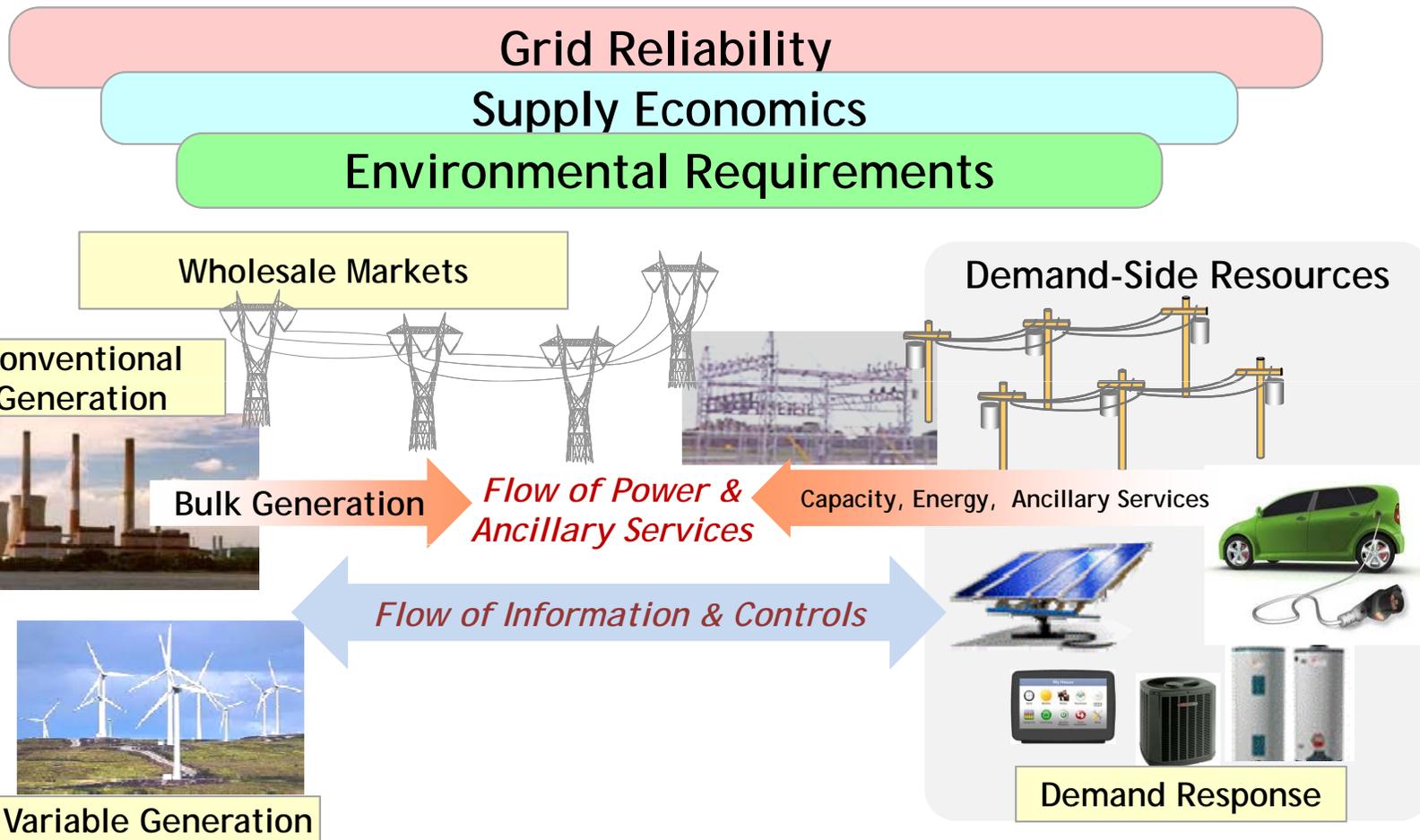


Traditional Flow of Information and Power



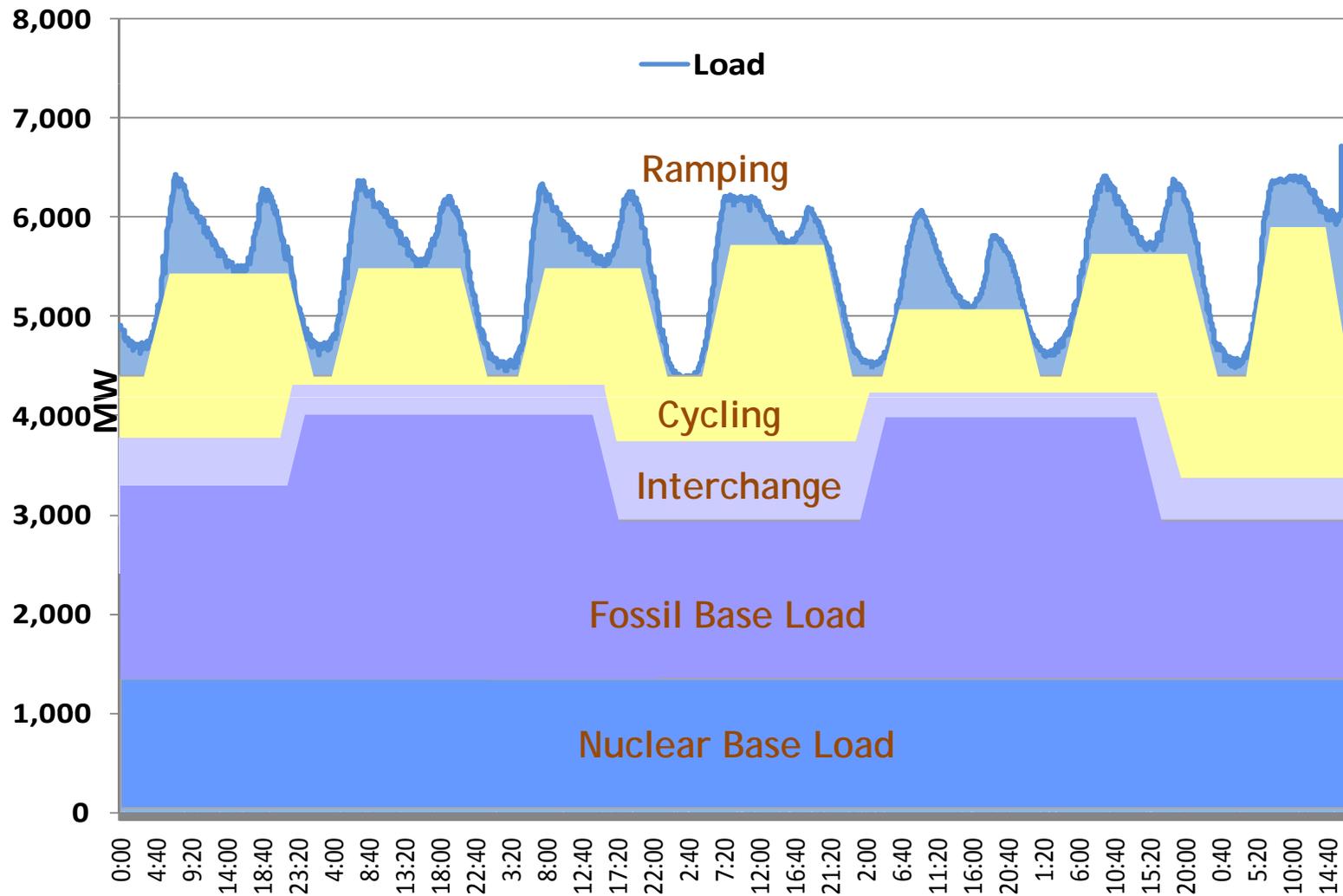


Emerging New Paradigm



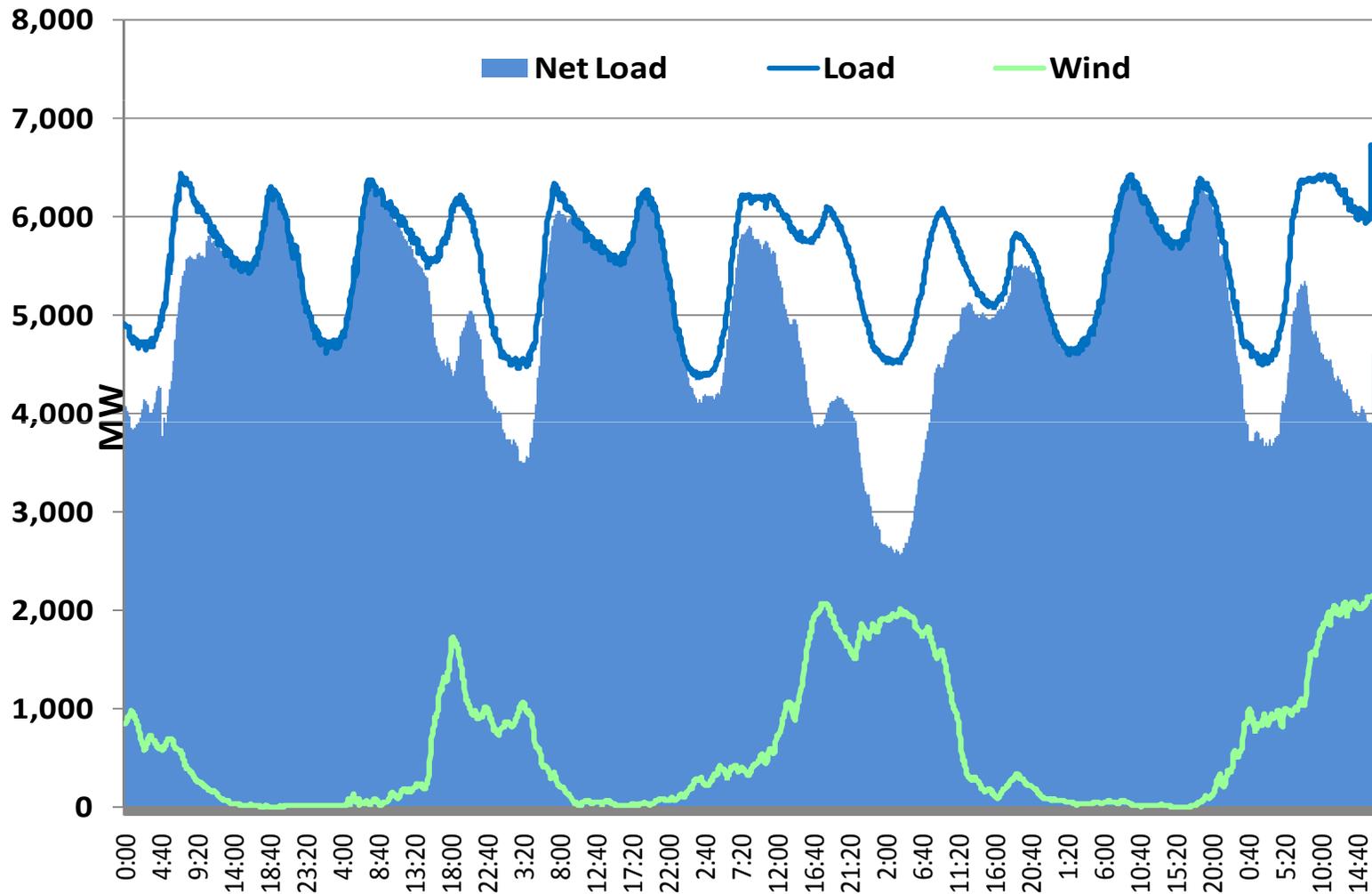


Conventional Generation Dispatch Scenario



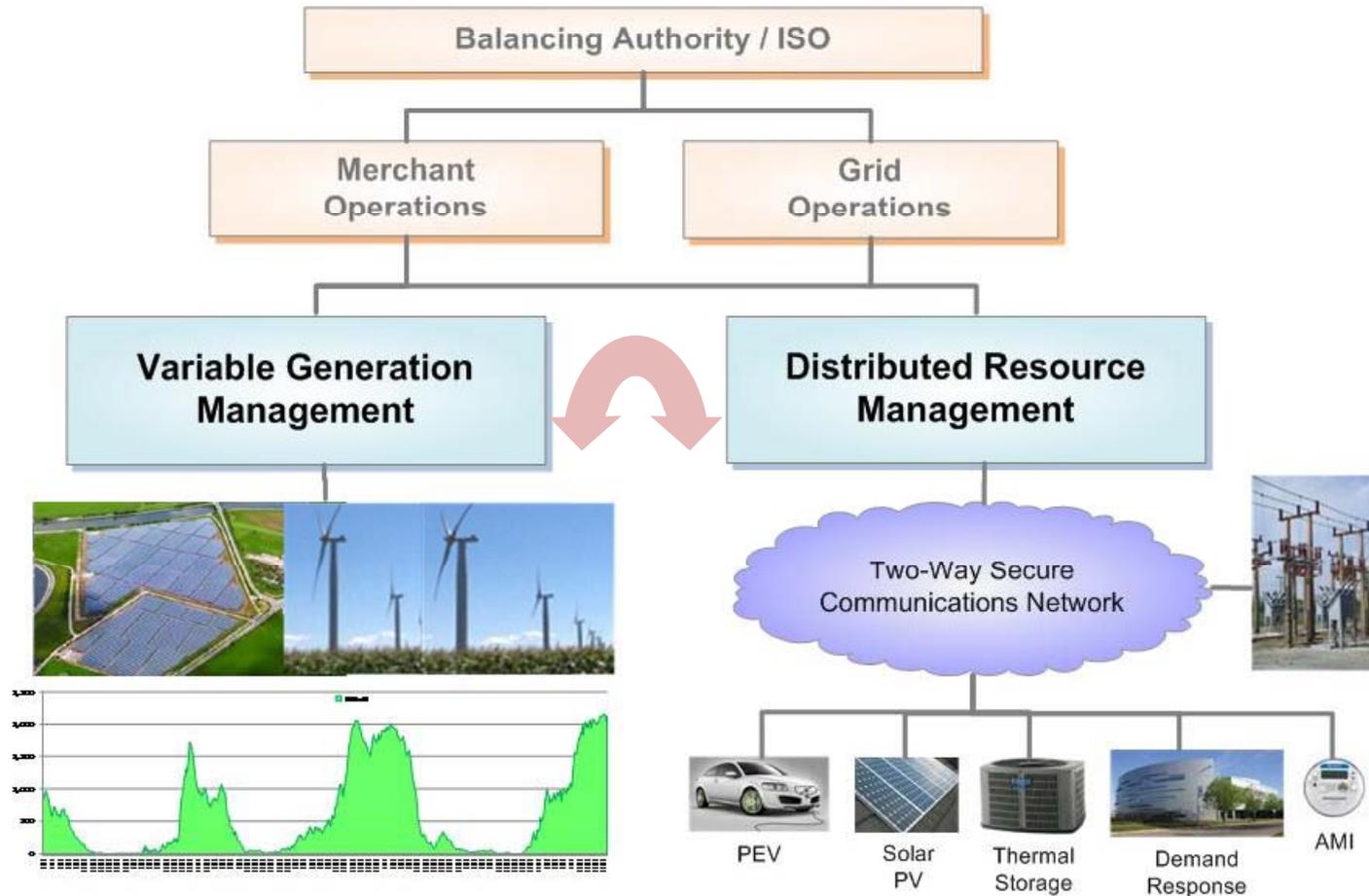


Impact of Variable Generation





Demand Response as a “Dancing Partner” of Variable Energy Resources





Regulatory Initiatives

- October 2008 • **FERC Order 719 - ISOs Treatment of Demand Response (DR):**
 - *Equal Treatment of Supply and Demand Side Resources*
 - *Curtailment Service Providers*

- March 2009 • **FERC Smart Grid Policy Statement and Action Plan**
 - *Digital technology to enable real-time coordination of information from generation resources, demand resources, and distributed energy resources*

- July 2010 • **FERC National Action Plan - DR**
- March 2011 • **FERC Order 745 - Demand Response Compensation in Organized Wholesale Energy Market**
 - *DR is paid by Location Marginal Price (LMP)*

- July 2011 • **FERC Order 1000 - Regional Transmission Planning and Cost Allocation**
 - *must consider more efficient or cost-effective alternatives , e.g., DR and Energy Efficient (EE)*

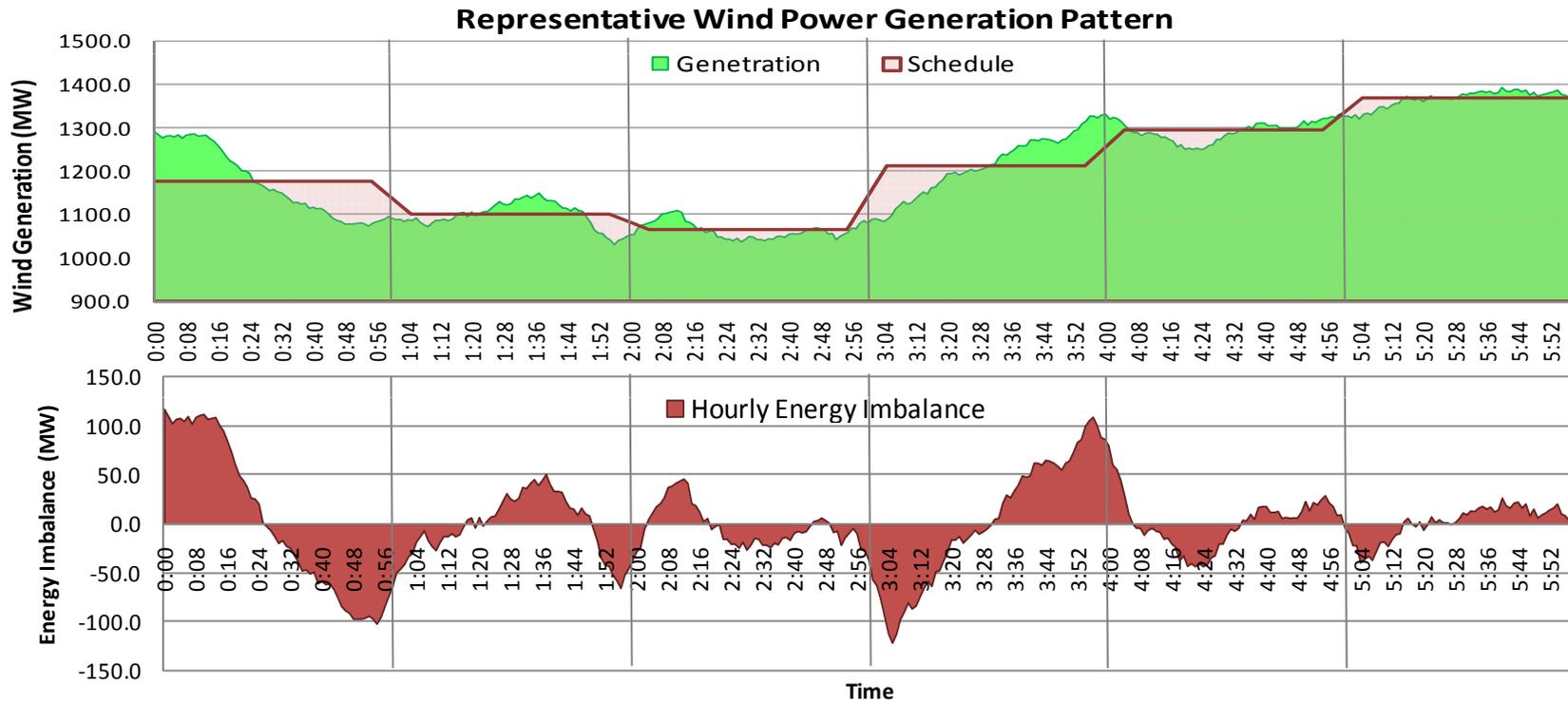
- April 2012 • **FERC NOPR on DR Measurements and Verification**
 - *NAESB Phase II M&V and Baseline definitions*

- June 2012 • **FERC Order 764 - Integration Of Variable Energy Resources**
 - *Intra-hourly scheduling - 15 minute*
 - *Forecast Data*

- **NARUC/FERC Smart Grid Collaborative**
 - *Bridge Federal and State Level Initiatives and Regulations*
 - *FERC Order*

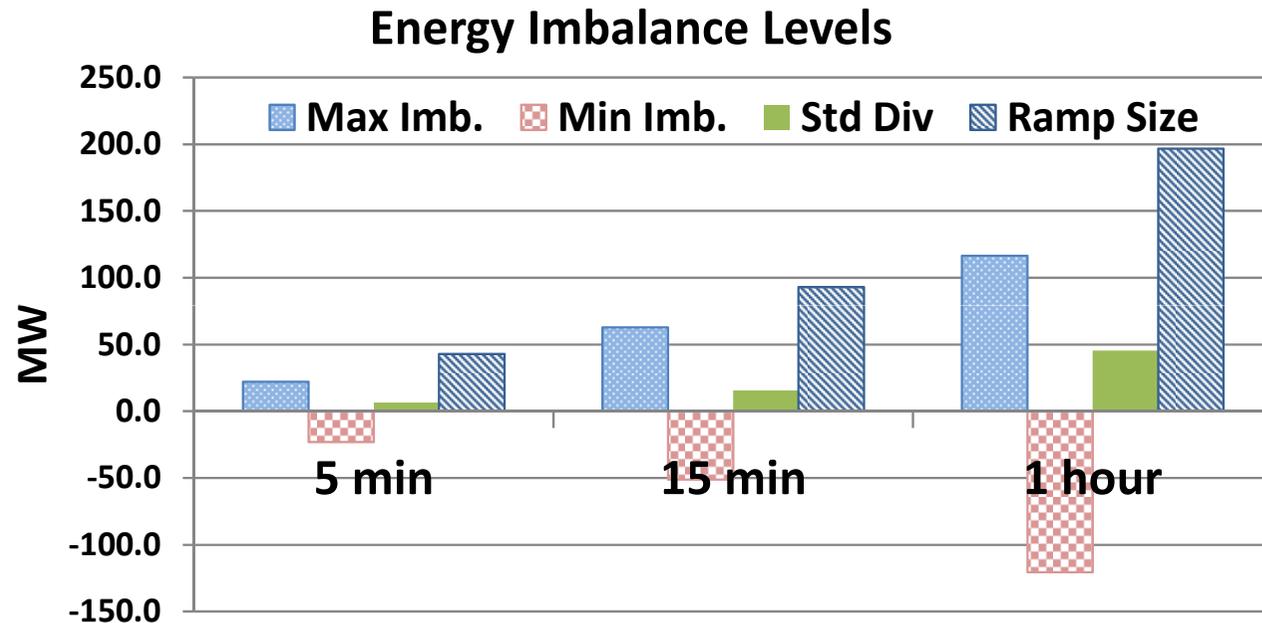


Balancing Energy Requirements with High Wind Power Generation under Hourly Scheduling Practices





Reduction of Balancing Energy Requirements under Sub-Hourly Scheduling





New Products and Practices

- Energy Imbalance (Energy Product)
 - *5-15 Minute Product*
 - *Similar to “Load Following” capability*
- CAISO Flexible Ramping Product Proposal
 - *A 5 minute Ramp Up, and Ramp Down products*
 - *Stakeholder process*
- WECC - Energy Imbalance Market Proposal
 - *Energy Imbalance Market (EIM)*
 - A reliability-constrained economic dispatch from voluntary offers of resource to deliver least-cost Imbalance Energy supply
 - *Enhanced Curtailment Calculator(ECC)*
 - A seams coordination tool, to manage reliability across the entire interconnection

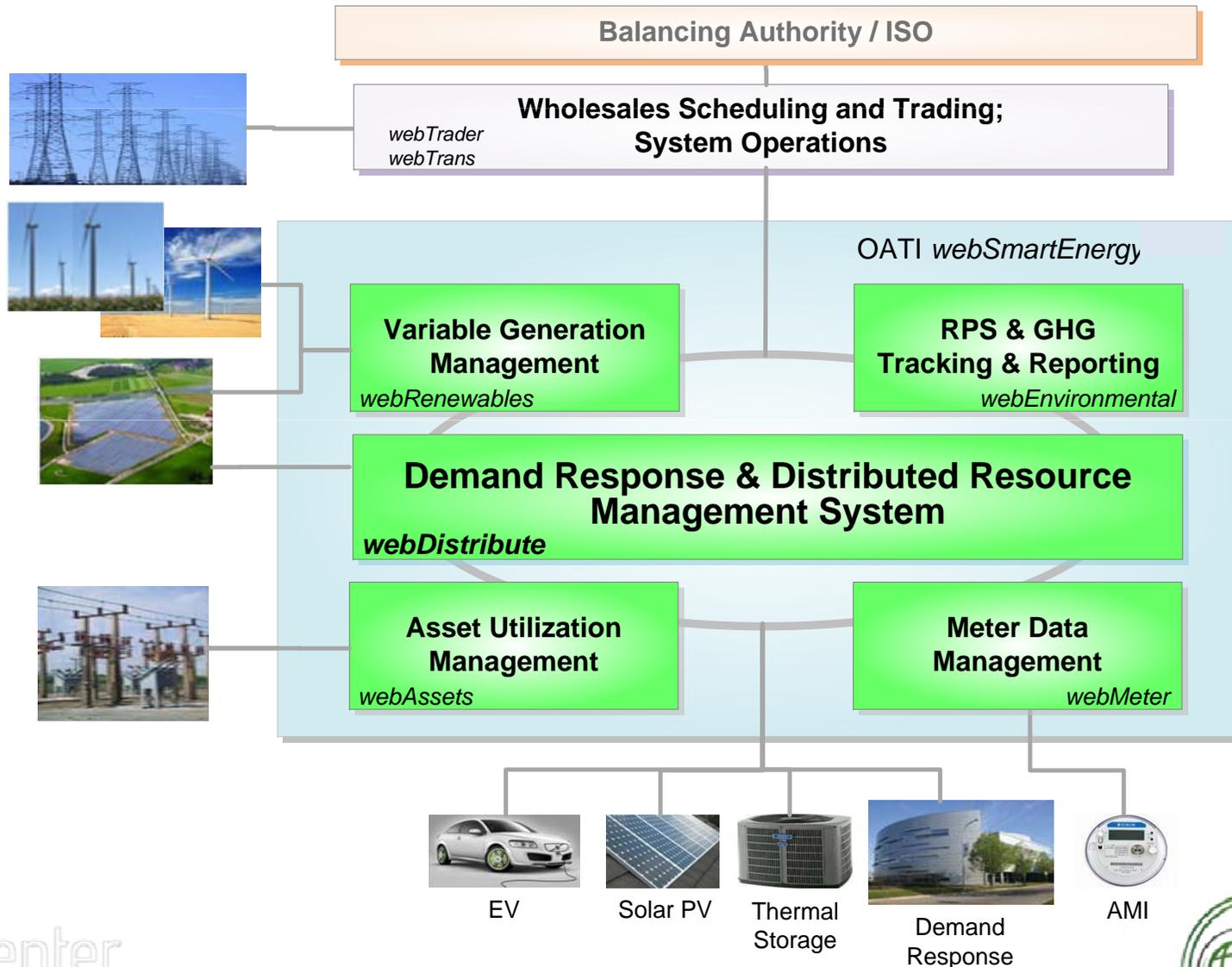


Current Challenges

- Seams between Wholesale and Retail Markets
 - *Operational*
 - Scheduling practices and protocols
 - Retail and Wholesale Coordination
 - *Pricing*
 - LMPs versus Retail Tariff
 - Distribution Charges
 - Distribution Congestion
 - Rate-Case and Rate-Setting Process
- Impact of Distribution Operation
 - *Impact of Voltage Levels on Load*
 - *Coordination of DR Operations and Distribution Automation*

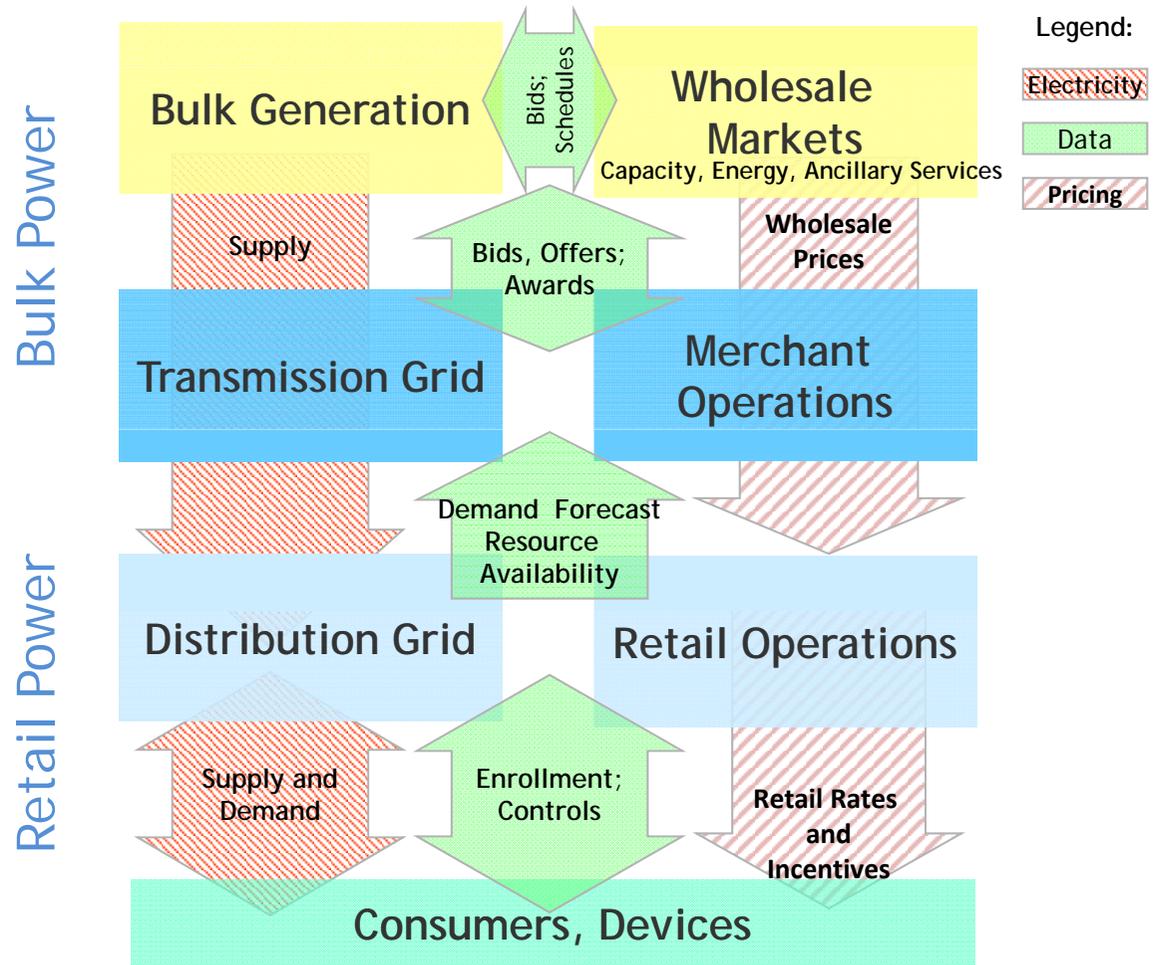
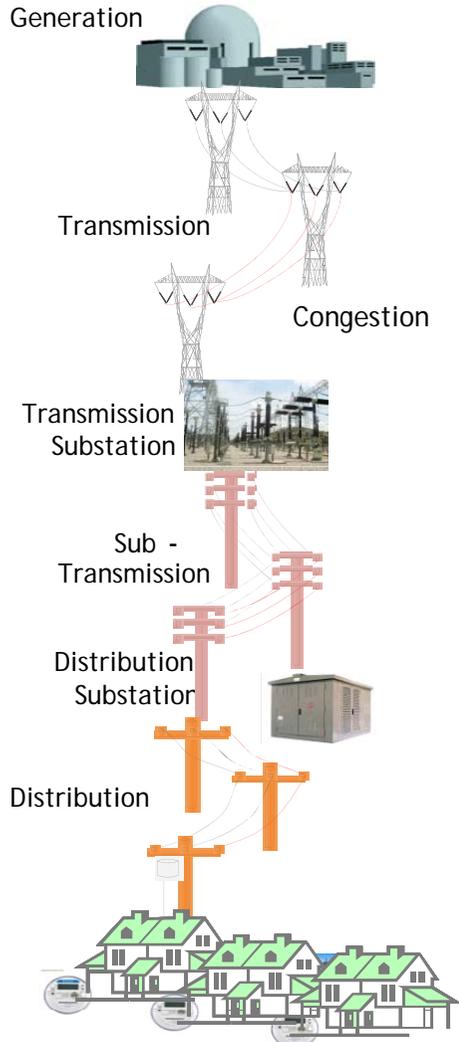


OATI webSmartEnergy Suite of Applications

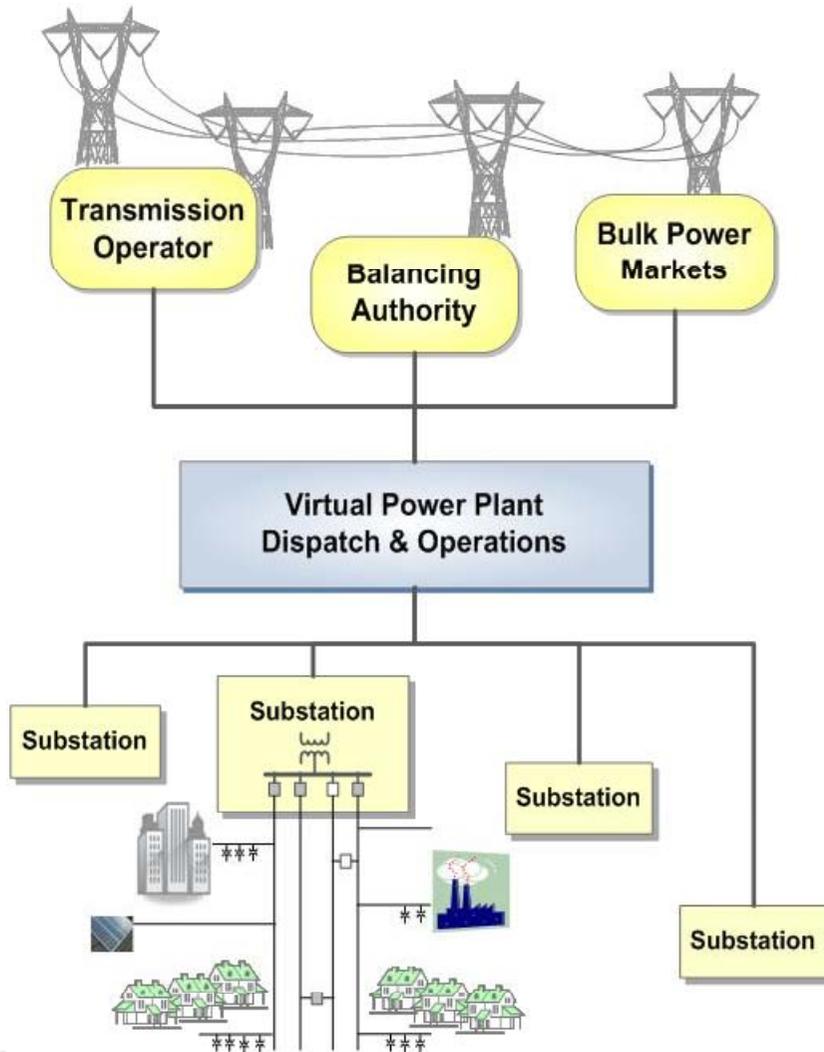




End-to-End Transactions of Information, Prices, and Power



OATI Virtual Power Plants - closing the gap between Retail and Wholesale Operations



Bulk Power Products

- Day-Ahead Energy
- Real-Time Energy
- Balancing Energy
- Non Spin
- Spinning Reserves
- Regulation

Virtual Power Plant

- Grid Location
- Pmax , Pmin
- Ramp Rate
- Min/Max Up & Down Time
- Incremental Cost Curve

Capability Data
Telemetry

Dispatch
Instructions

Retail Tariff

- Direct Load Control
- Time of Use
- Critical Peak Price
- Dynamic Pricing
- Commercial and Industrial Curtailment Contracts
- Etc



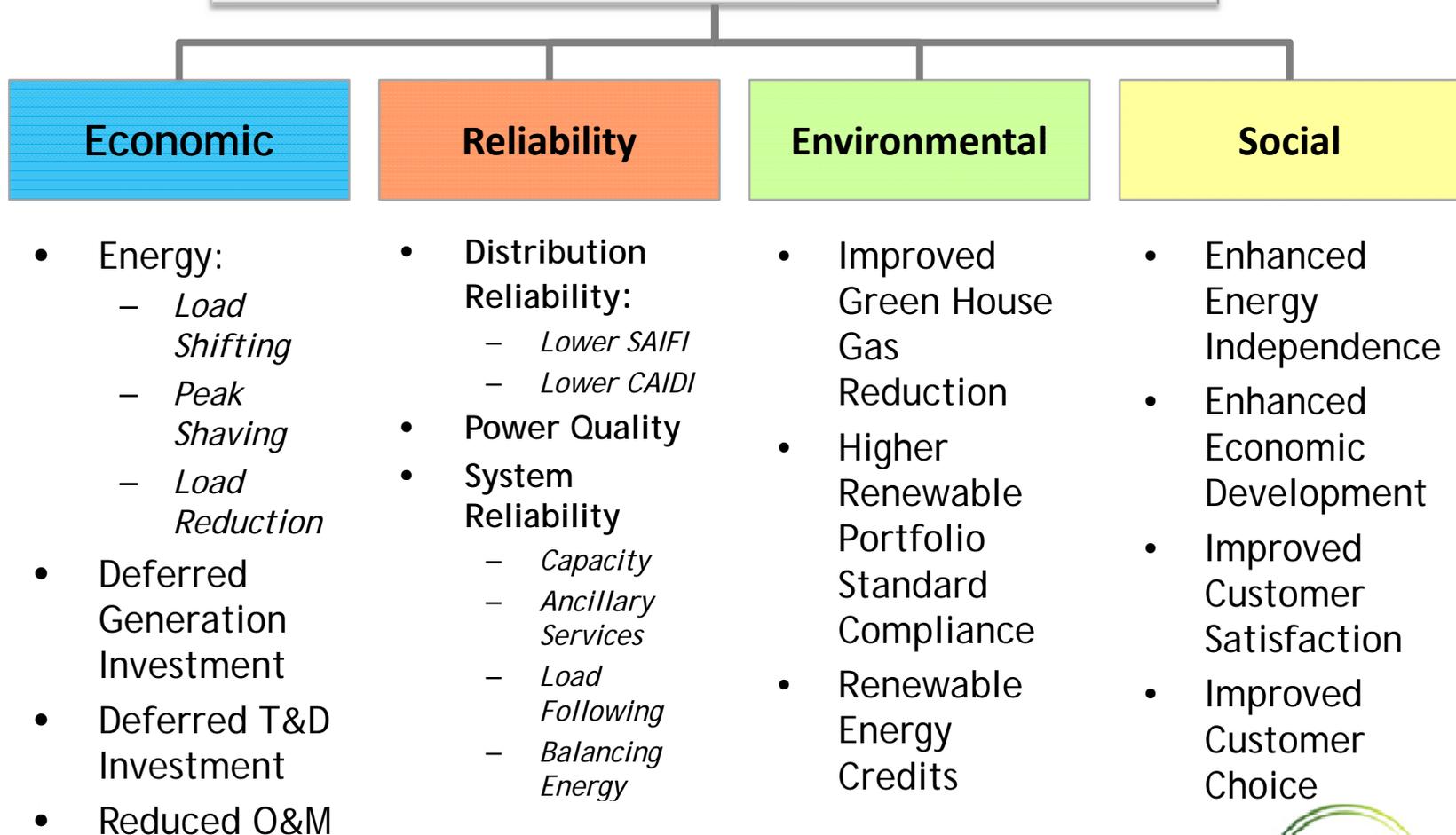
DR/DER Applications - Objectives (System Operation)

Economical Objectives	Reliability Objectives	Environmental Objectives	Enhance Customer Choice
Peak Load Reduction - Defer Capital Expansion	Reduce Facility Loading	Improved RPS Compliance	Meeting Customer Need
Shift Load to Lower Cost Period	Provide Ramping and Balancing Energy	Reduce GHG Emissions	Enhance Service Innovation
Trade and Market Opportunities	Provide Ancillary Services and Regulation		
Serve Isolated Remote Load	Improve Power Quality		
	Provide for Micro-Grid Operation		



Value of DR

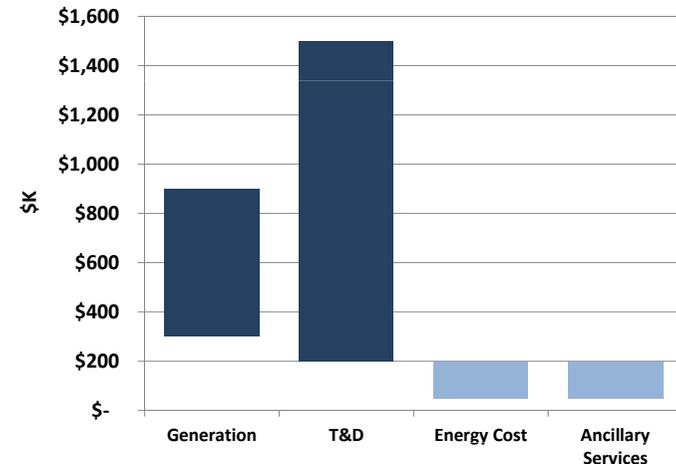
DR Benefits Overview





Overall Benefit Ranges per MW of DR

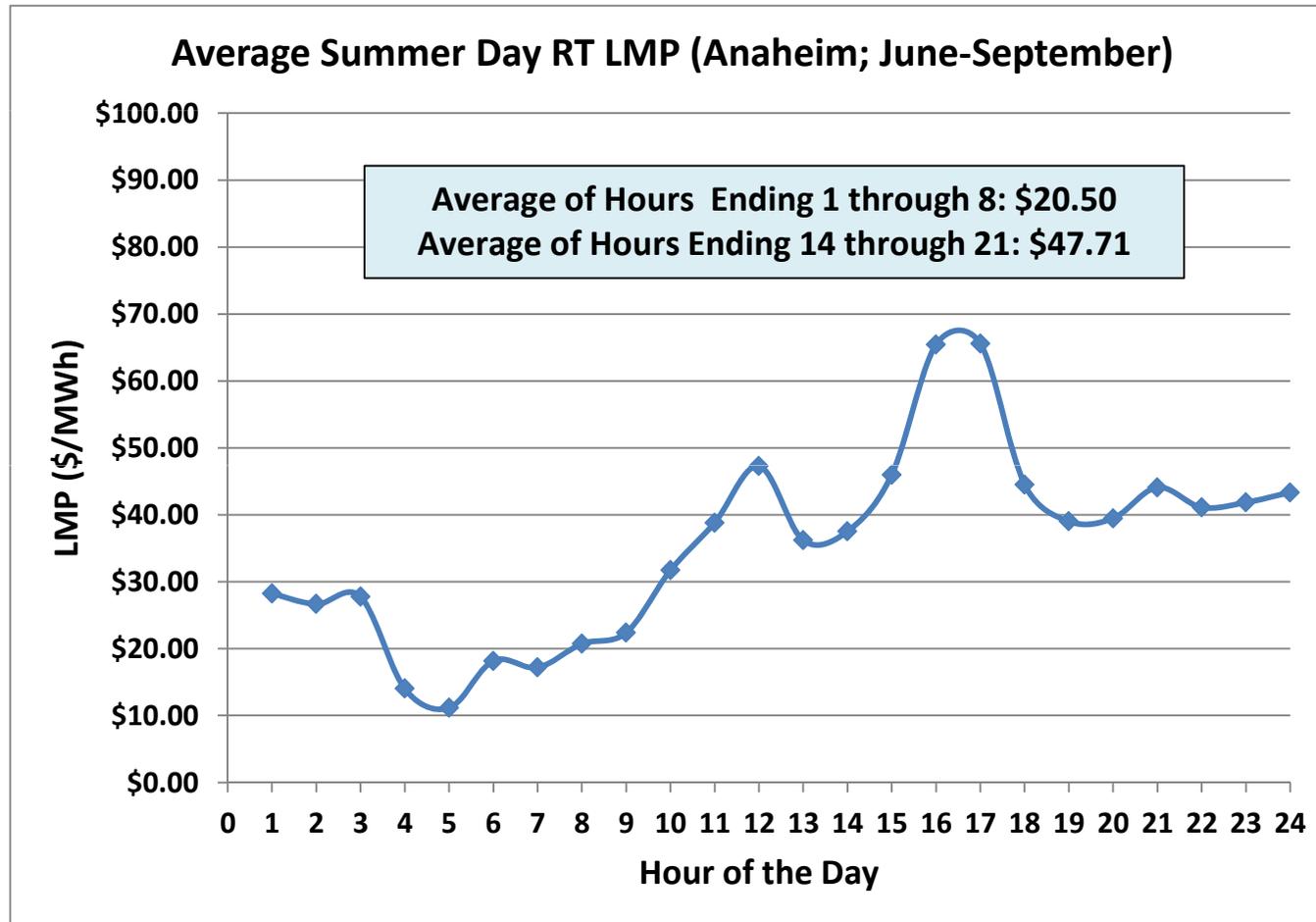
- Generation Capacity Cost Savings
 - Annual Savings per MW of DR: \$40K - \$120K
 - NPV: \$300K - \$900K per MW of DRNote: NPV Cost of a CT ~ \$600K per MW
- T&D Cost Savings
 - Widely different among Regions
 - Sample quoted number
 - High Annual Savings NPV: \$1.5M per MW of DR
 - Low Annual Savings NPV: \$200K per MW of DR
- Energy Cost Savings
 - A few thousand dollars per MW of DR per year
 - NPV Range: \$50K - \$200K per MW of DR
- Savings/Revenues from Ancillary Services
 - A few thousand dollars per MW of DR per year
 - NPV Range: \$50K - \$200K per MW of DR
- Total Cost Savings per MW of DR
 - NPV: \$600K - \$2.8M per MW of DR





Load Shifting Benefit Example

(Based on CAISO RT Market LMPs July 01, 2009 to June 30, 2010)



Potential Impact of Load Shifting for the Months of Summer:

- Fixed Load Shift Schedule: \$26,000/MW DR
- Optimal Load Shift Schedule (webDistribute): \$49,500/MW DR



Closing Remarks

- New electricity supply-demand paradigm
 - *Increased use of renewable resources*
 - *Increased demand-side participation*
- Paradigm shift is in power system and energy market operations
 - *Variability and unpredictability of Variable Energy Resources (VER)*
 - *Need for new products (ramping, load following, etc.)*
- Possibility of end-to-end solutions
 - *Smart Grid technologies are available for extensive consumer participation*
 - *End-to-end incentive-compatible solutions are available (e.g., OATI webDistribute platform)*
- Regulatory issues
 - *FERC Orders (719, 745, 1000, 764, etc.) facilitating participation of DR in wholesale markets and scheduling of VER*
 - *Main issue: Local regulatory barriers*



Questions?

Thank You

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