



Using DR/DER for Balancing Variable Generation

Ali Ipakchi

Vice President, Smart Grid and Green Power

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Trade Secret

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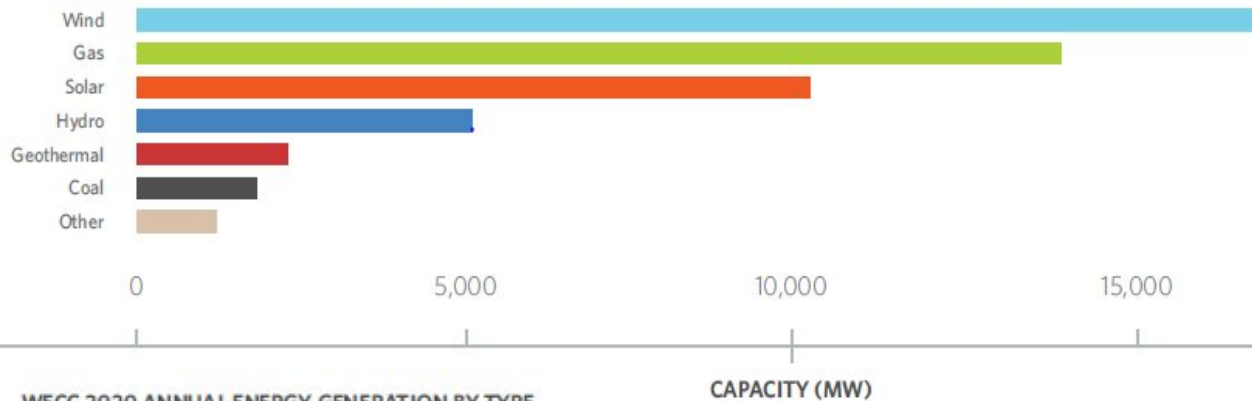
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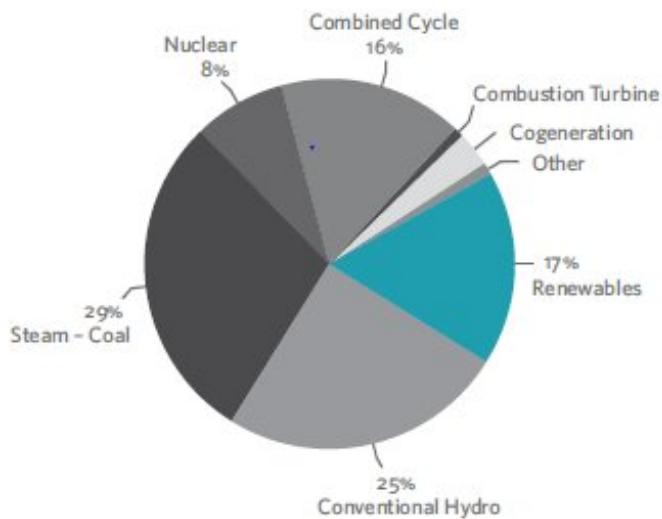


WECC Generation Additions and Retirements 2010-2020

WECC GENERATION CAPACITY ADDITIONS
BY RESOURCE TYPE 2010 - 2020



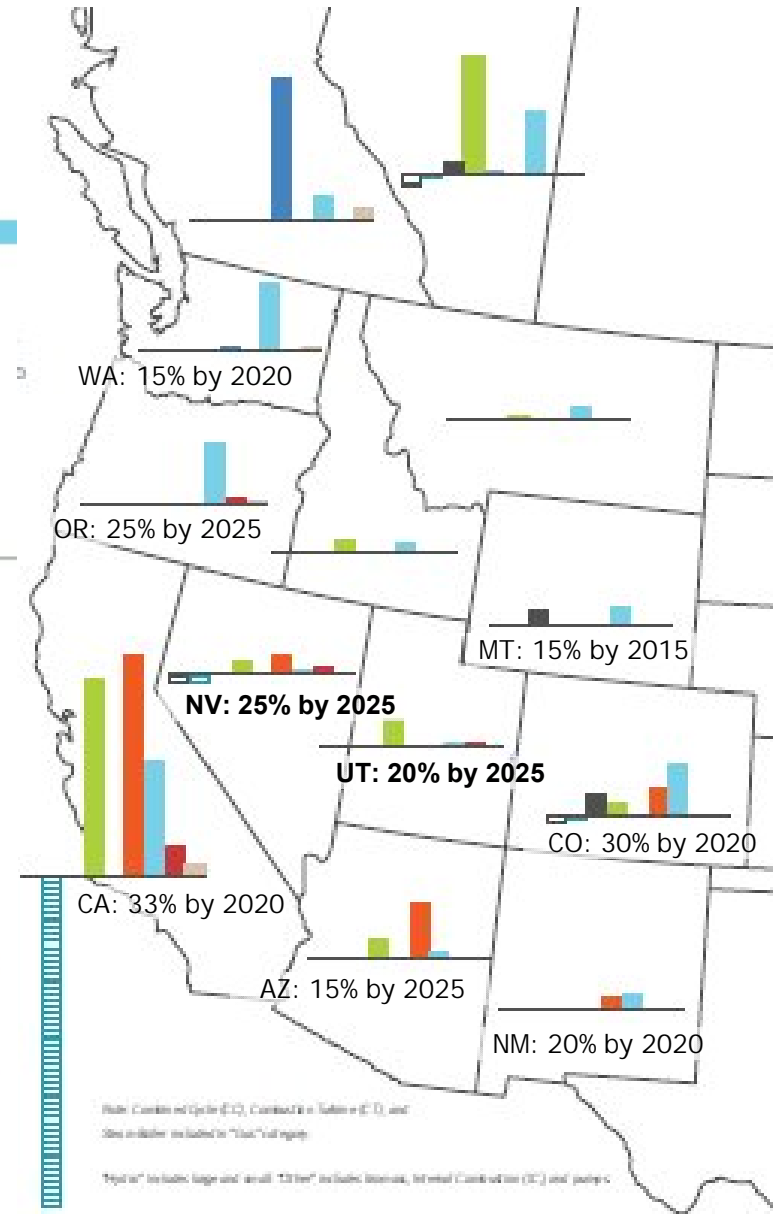
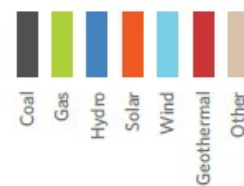
WECC 2020 ANNUAL ENERGY GENERATION BY TYPE



RETIRED RESOURCES



INSTALLED RESOURCES

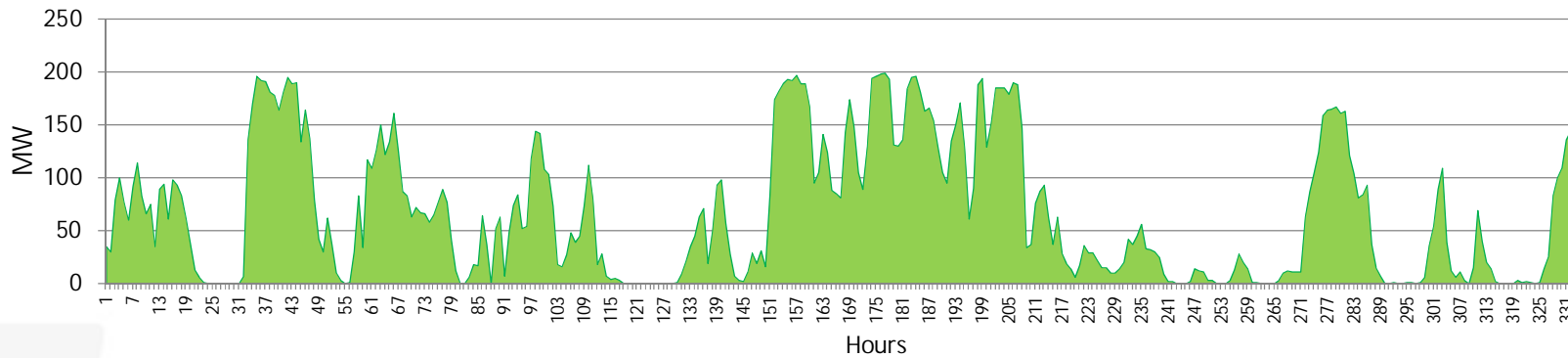
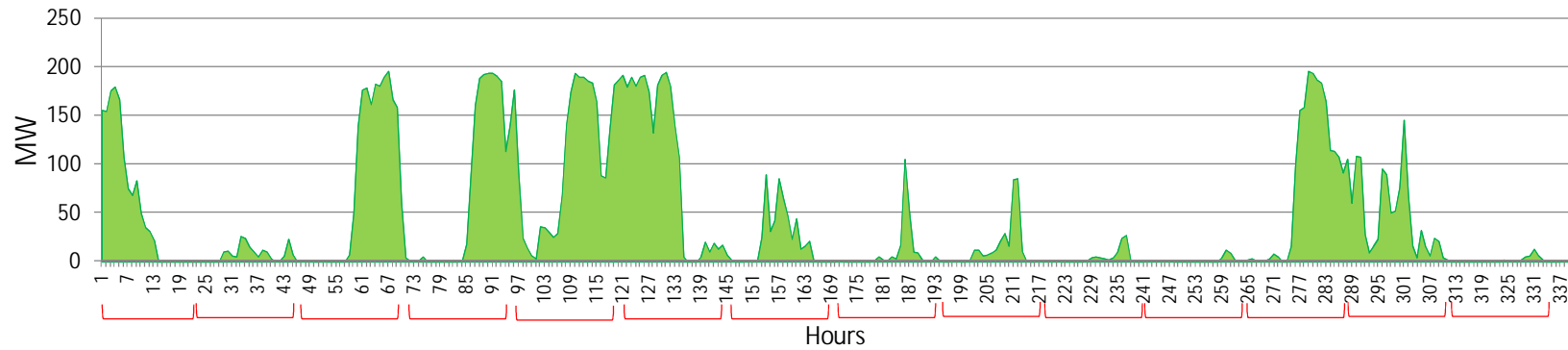


Source: 2011 WECC 10-Year Regional Transmission Plan - Executive Summary - Sept. 22, 2011

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Typical Variable Generation Data

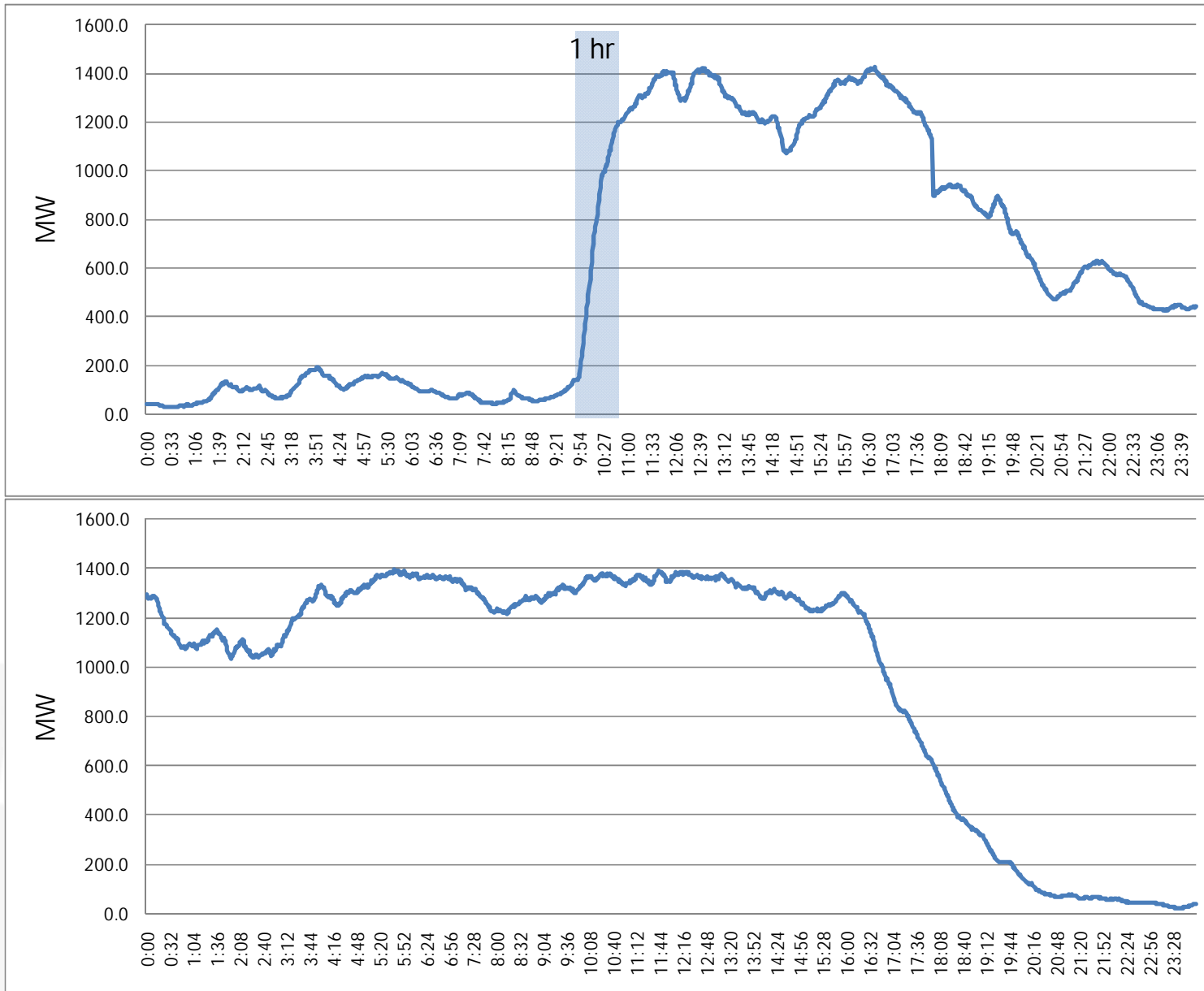


- A 200 MW wind farm in Utah
- Data from May 06 - June 10, 2010



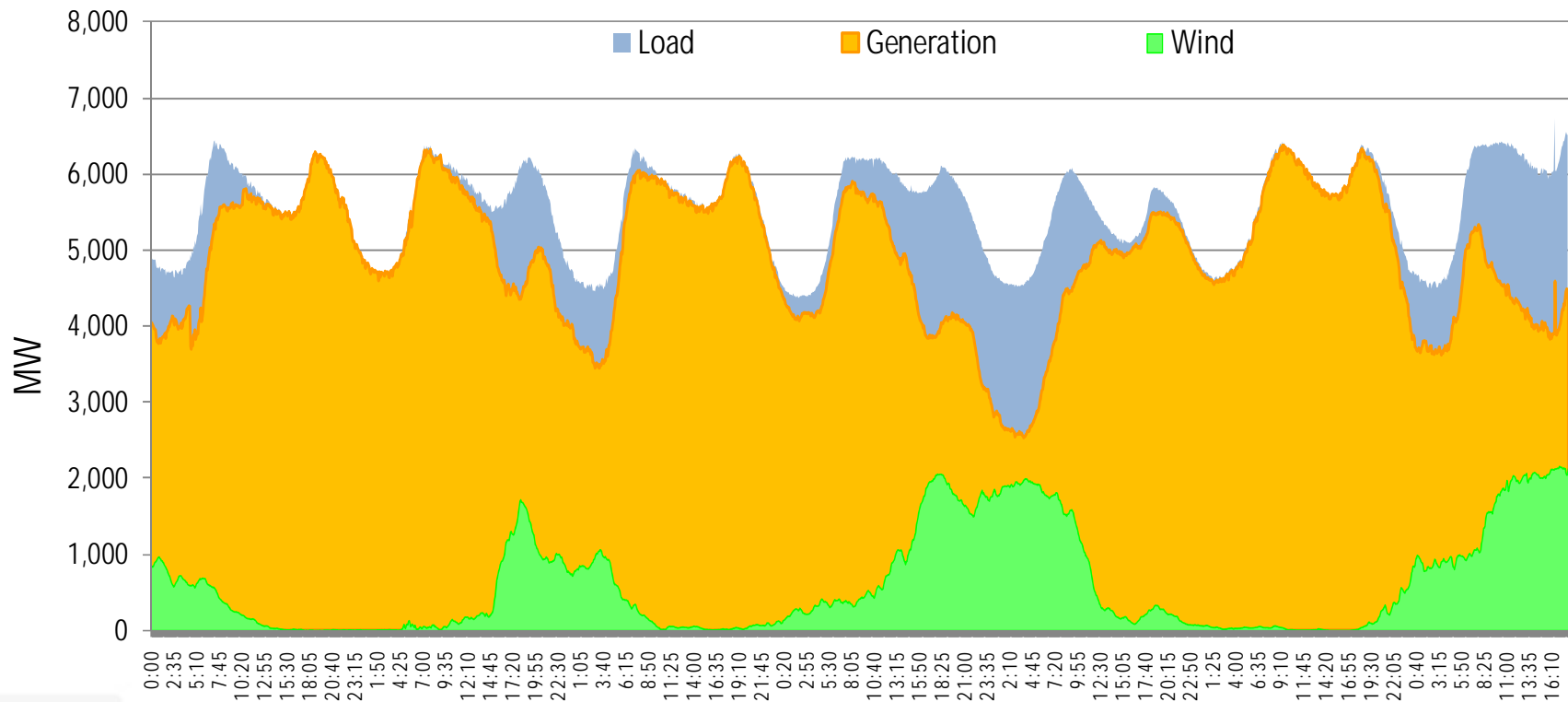


Wind Generation Data (BPA)





Variable Energy Resources (VER)



- Increased need for Ancillary and Energy Imbalance Services
- The additional Ancillary/Energy Imbalance Services are needed during all hours of the day
 - Ramping and “Slow Regulation” Services
- Conventional Generation Resources may not be adequate to meet the needs



CAISO: Expected Increase in Load Following Capacity, Regulation, Ramping Requirements at 33% RPS in 2020

Requirements

		2006	2012	2020
Load Following Capacity (MW)	Up	2,292	3,027	4,423
	Down	-2,246	-3,275	-5,283

Load Following Ramp Rate (MW/Min)	Up	150	168	325
	Down	-138	-162	-541

Regulation Capacity (MW)	Up	227	502	1,135
	Down	-382	-569	-1,097

Regulation Ramp Rate (MW/Min)	Up	67	122	447
	Down	-66	-90	-310

Increase Over 2006 Levels

		2012	2020
Load Following Capacity (MW)	Up	735	2,131
	Down	-1,029	-3,037

Load Following Ramp Rate (MW/Min)	Up	18	175
	Down	-24	-403

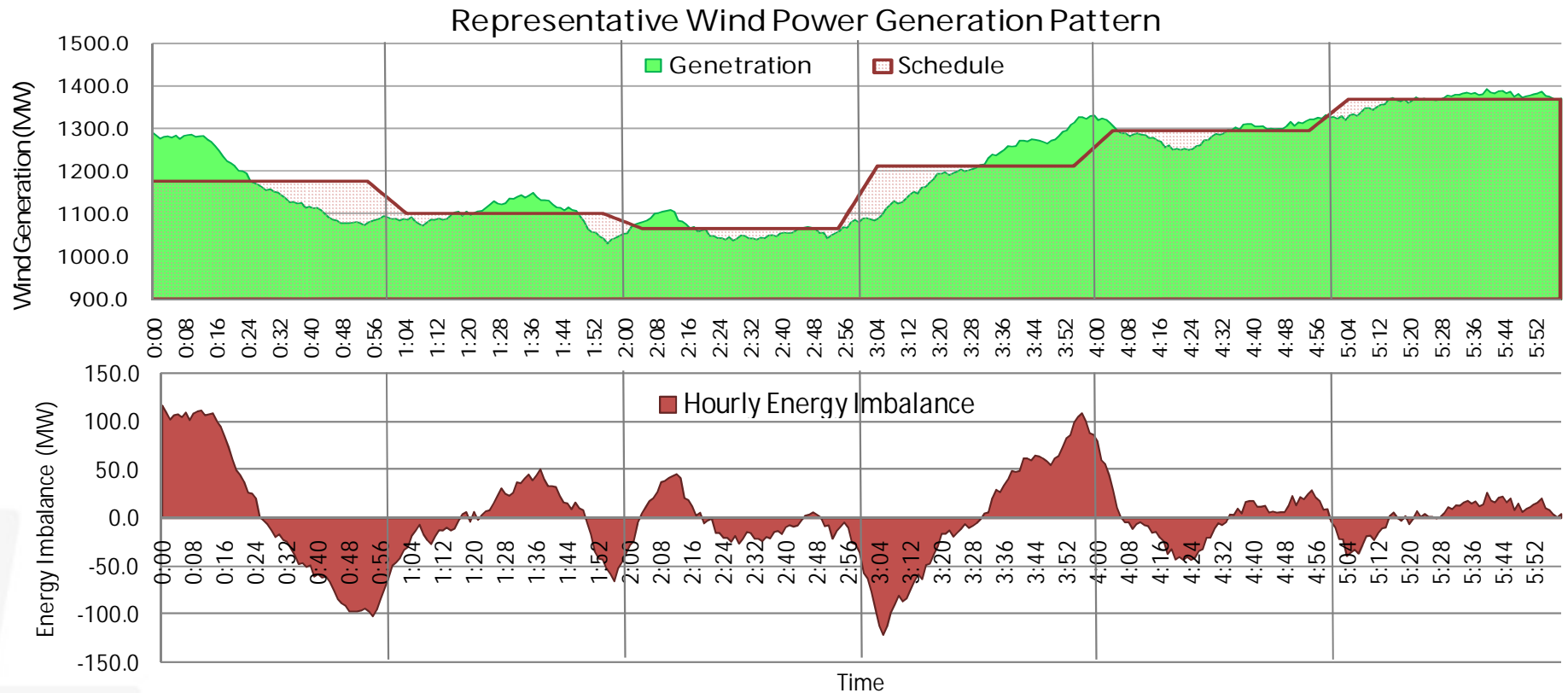
Regulation Capacity (MW)	Up	275	908
	Down	-187	-715

Regulation Ramp Rate (MW/Min)	Up	55	380
	Down	-24	-244

Source: CAISO Presentation at Renewable Integration and Product Review Forum: Folsom, CA, July 16, 2010



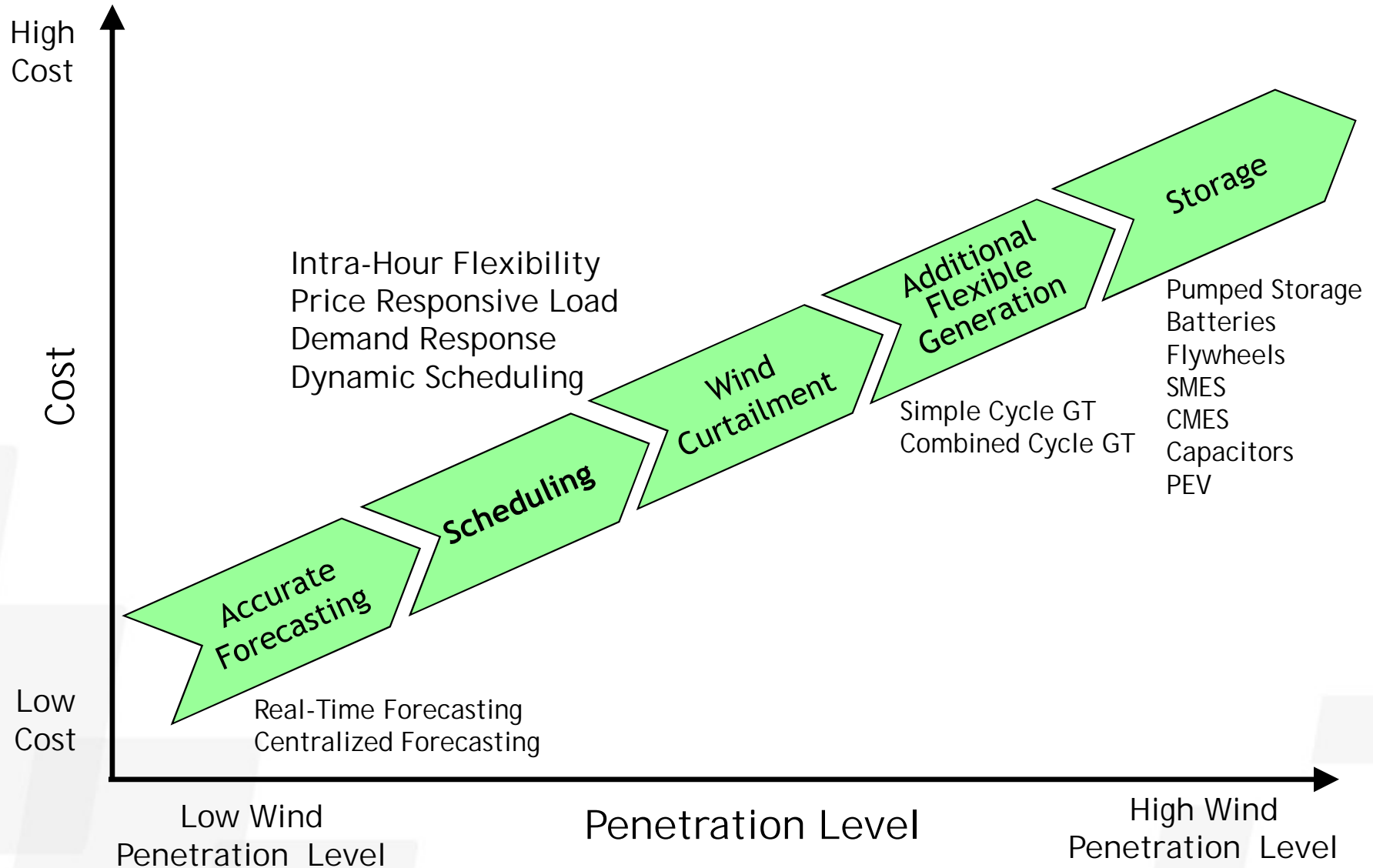
Hourly Scheduling Practice



- Balancing Area Operators Require New Capabilities
 - Intra-Hour Scheduling - 15-minute intervals
 - Accurate Short-Term Forecast of VER
 - "Slow Regulation" a.k.a. Energy Imbalance Service Product
 - 1-minute Regulation Service (Up and Down)



Variable Generation Remedies



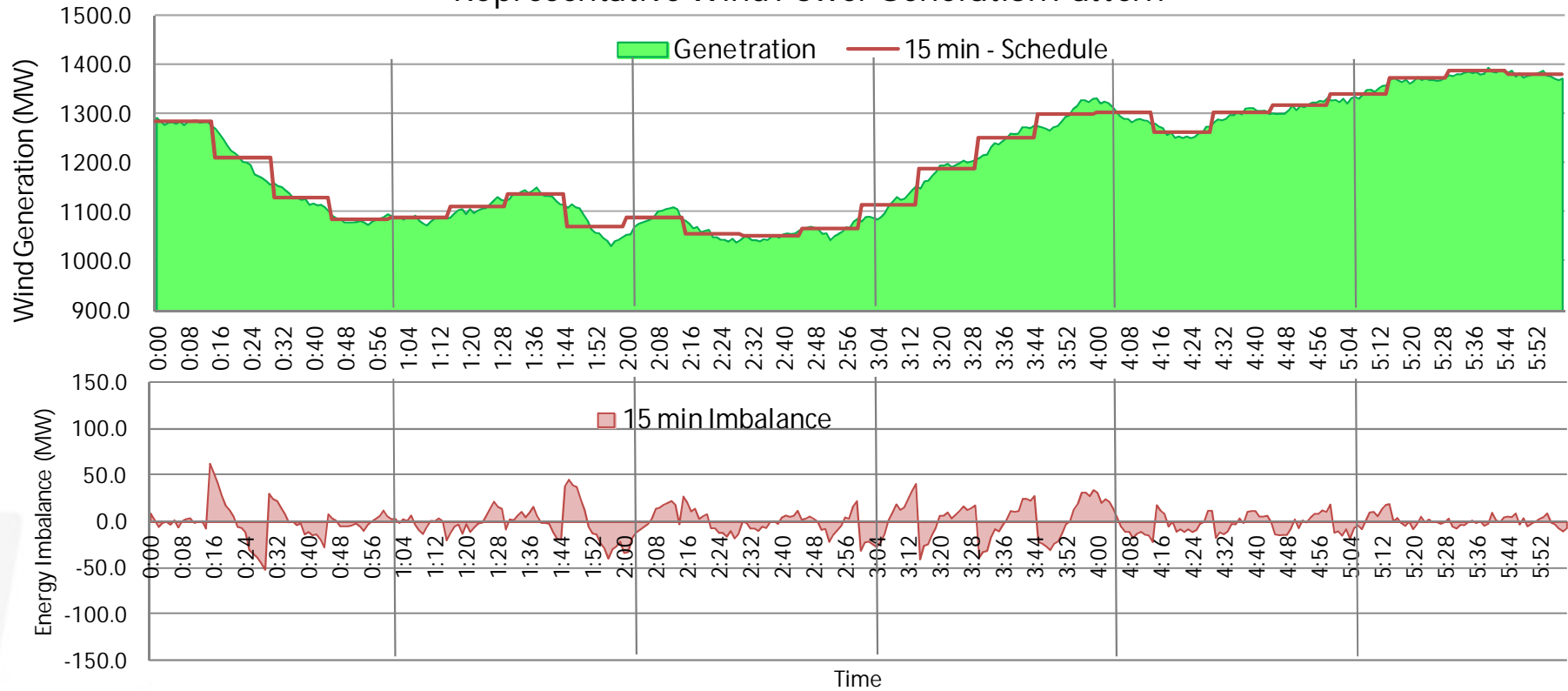
Source UWIG / NREL - IBR

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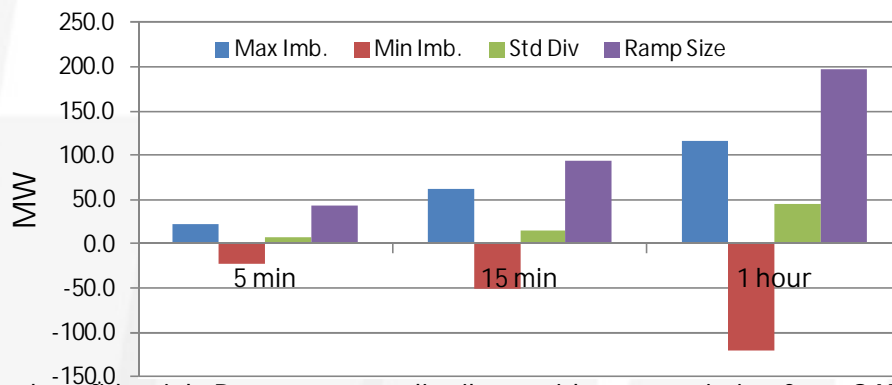


Impact of 15-Minute Scheduling

Representative Wind Power Generation Pattern

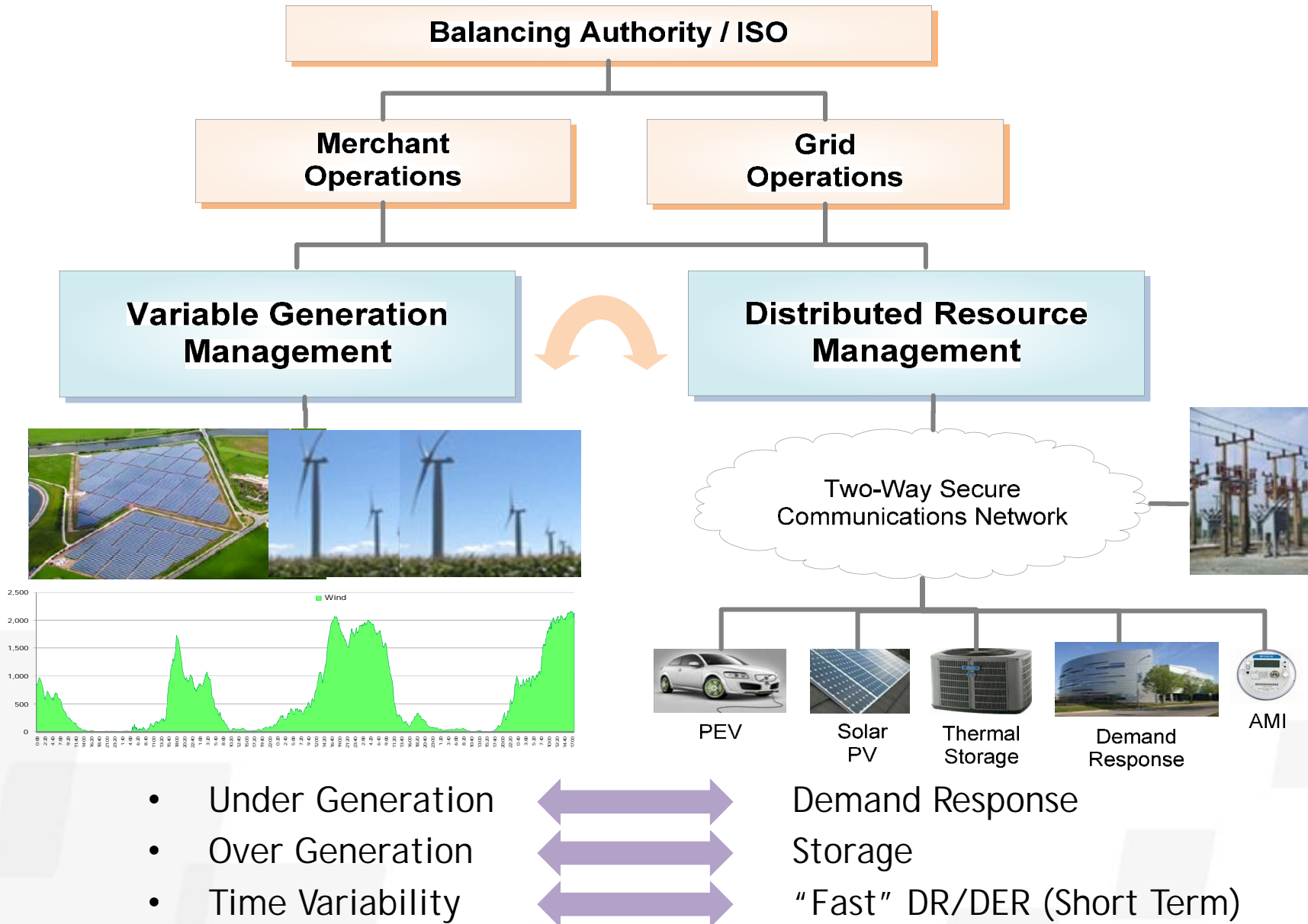


Energy Imbalance Levels



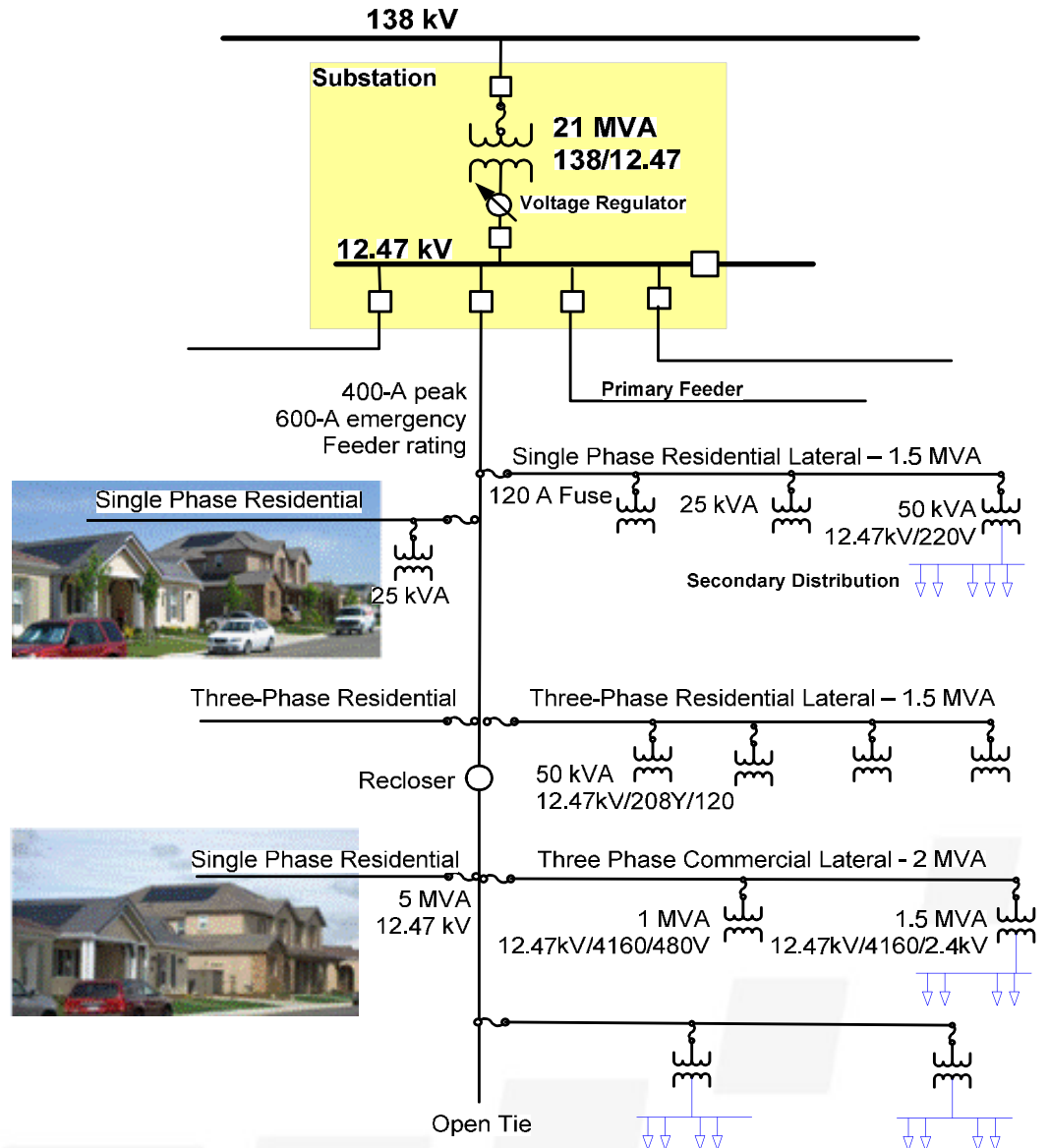


DR/DER the "Dancing Partner" of VER





Variable and Distributed Generation - Impacts on Distribution Operation





Value of Demand Response

DR Benefits Overview

Economic

- Energy
 - Load Shifting
 - Peak Shaving
 - Load Reduction
- Deferred Generation Investment
- Deferred T&D Investment
- Reduced O&M Costs

Reliability

- Distribution Reliability
 - Lower CAIDI
- Power Quality
- System Reliability
 - Capacity
 - Ancillary Services
 - Load Following
 - Balancing Energy

24x7 x 365

Environmental

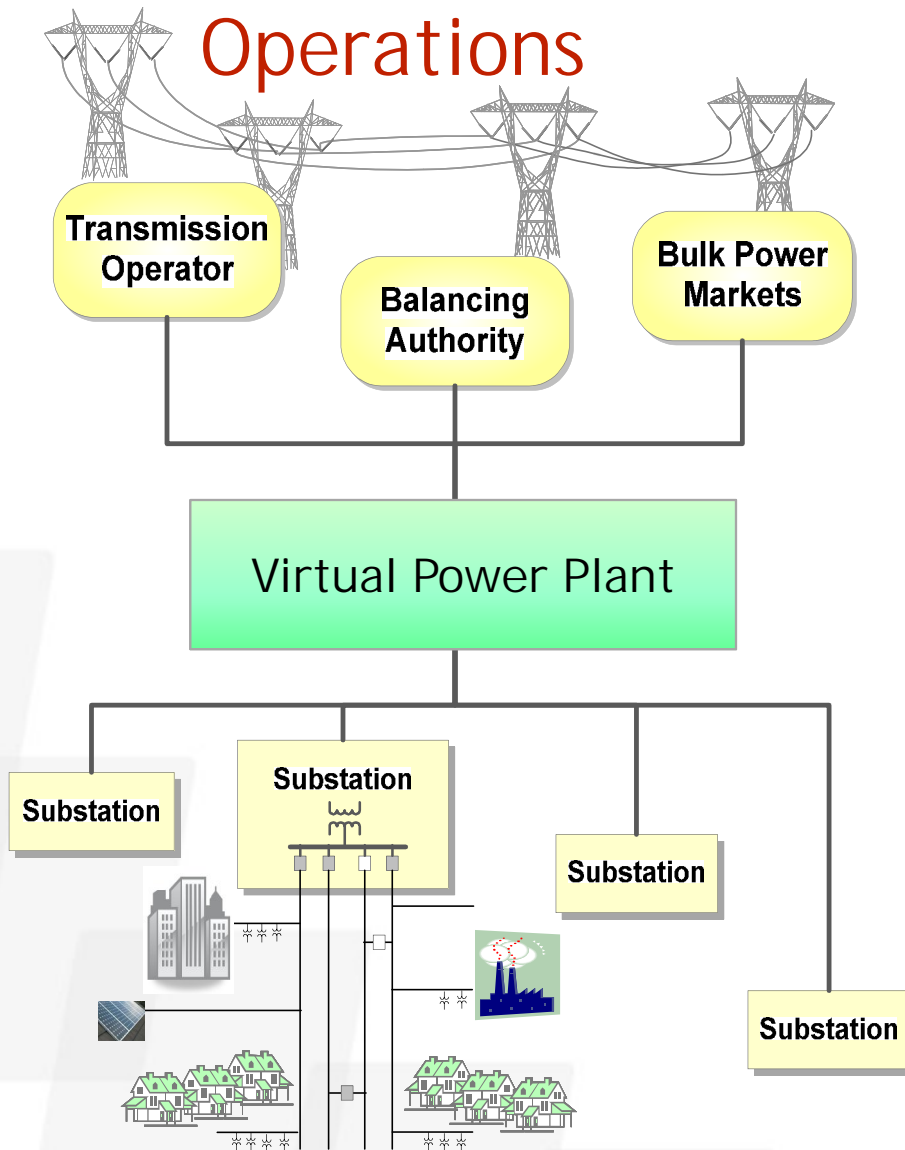
- Improved Green House Gas Reduction
- Higher Renewable Portfolio Standard Compliance
- Renewable Energy Credits

Social

- Enhanced Energy Independence
- Enhanced Economic Development
- Improved Customer Satisfaction
- Improved Customer Choice



Virtual Power Plant: Linking Demand-Side Capabilities to Wholesale Operations



- Bulk Power Products
- Hour-Ahead Firm
 - Non Spin
 - Spinning Reserves
 - Ramping/Balancing Energy

- Virtual Power Plant
- Grid Location
 - P_{MAX} , P_{MIN} , Ramp Rate
 - Min/Max up and Down Time
 - Incremental Cost Curve

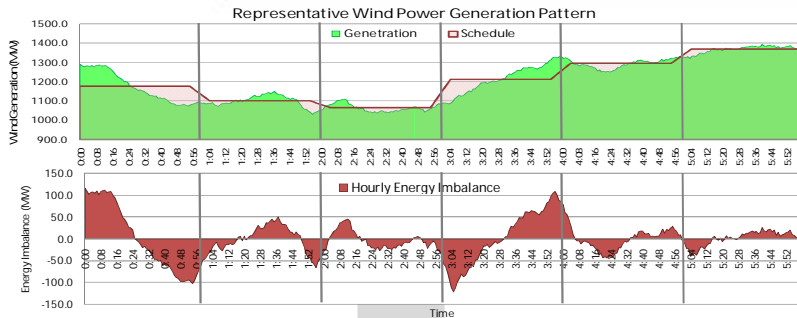


Retail Tariff

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



Sample Scenario



+/- 10 MW 15-Min Balancing Energy

Qualify, Enroll
Aggregate,
Forecast,
Schedule and Optimize,
Dispatch

7,000 A/C and 10,000 EWH

Asset	Capacity (kW)	Diversity (%)	Effective (kW)	# of Units 1 MW
Air Conditioner	4	25%	1	1,000
Water Heater	3.3	10%	0.33	3,030

Markets and BAs

Scheduling and Trading



DR/DER Management System



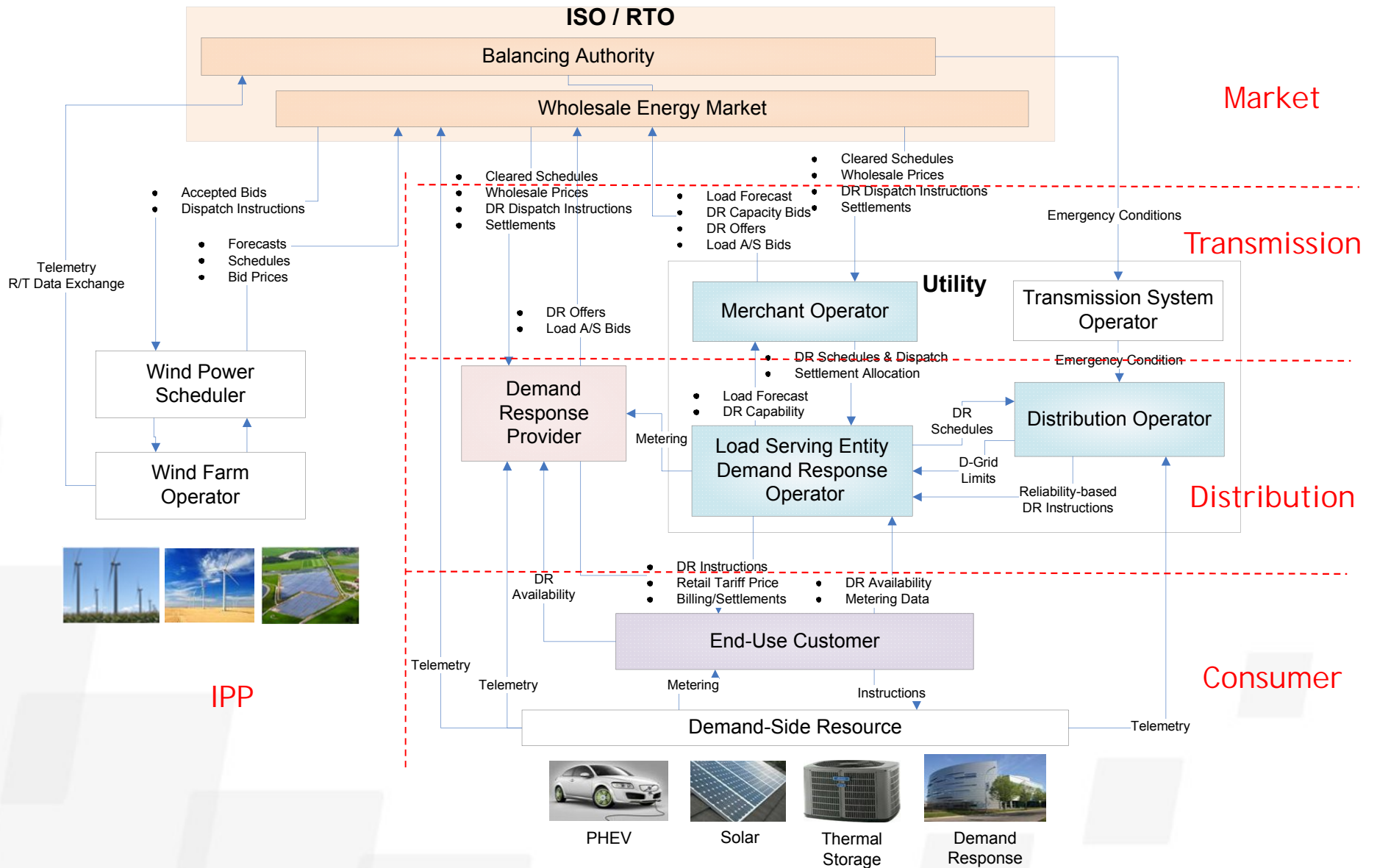
Data Communications

Distributed Controls



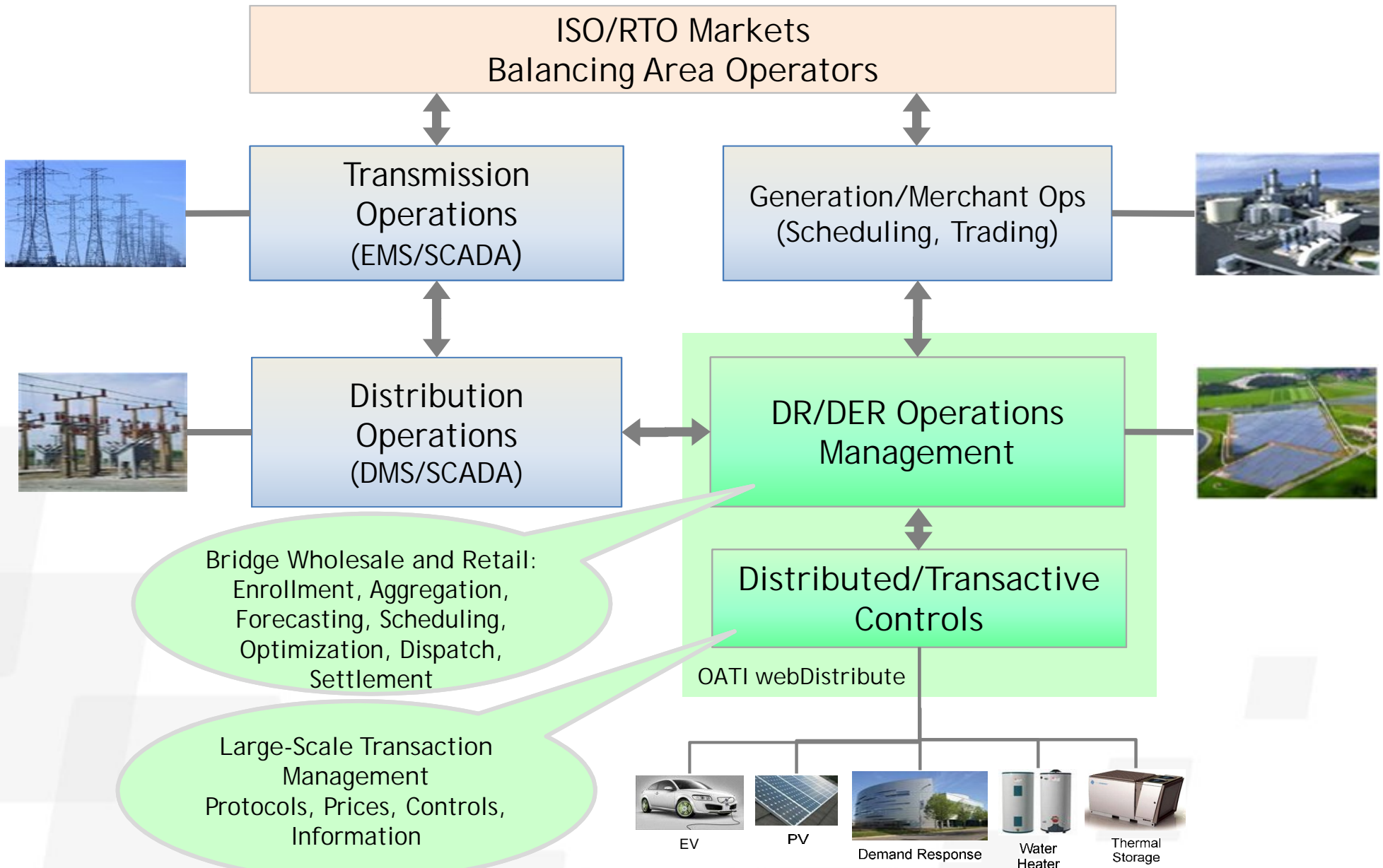


Intra and Inter Domain Transactions





Way Forward





Concluding Remarks: Data Related Issues

- Information Privacy Protection
 - Data Access Rights - Authorization Management
 - Identification Neutralization
 - Data Archival Policies
- Cyber Security
 - For the Different Levels of the Solution Hierarchy
 - At the Seams between Systems and Solution Layers
 - Internal and external to applications
- Aggregation, Mapping and Disaggregation
 - Aggregation Based on Functional Requirements & System Hierarchy
 - Disaggregation on the Way Back
- Solution Architecture
 - Recognition of system "seams" - Key Functional Layers
 - Integration and Inter-operability
- Data Models
 - Standardization of Data Models
 - Incremental Complexity per Intended Applications



Thank You

Ali Ipakchi
sales@oati.net
763-201-2000