



SIEMENS



Siemens Power Technologies International

Next Generation Integrated Resource Planning

Agenda

1. Who is Siemens PTI?
2. An overview of the Industry Challenges
3. Regulatory and Legislative Impacts
4. Integrated Resource Planning
5. Siemens PTI Experience

Who is Siemens PTI?

Overview

Power System Consulting ... full range of consulting competences

T&D System Planning
System Dynamics and Disturbance Analysis
Generator and Load Interconnections
Insulation Coordination and Transients

Energy Markets, Regulation, and Rate Impact
NERC Compliance
Market Analytics
Smart Grids and Reliability Evaluations

PACE Global... an Energy Management Consulting Firm

Energy Planning & Risk Management
Energy Market and Commercial Advisory
Energy Supply Management

Strategic Resource Planning
Market, Commercial, & Regulatory Advisory
Energy Procurement & Risk Management

Software Solutions ... complete power system analysis tools

PSS®E
PSS®SINCAL
PSS®ODMS
PSS®MUST
MOD®

Transmission system planning
Utility & industry system planning
Enterprise data integration and management
Power transfer capability analysis
Centralized planning projects coordination

Siemens Power Academy TD ... meeting your training needs

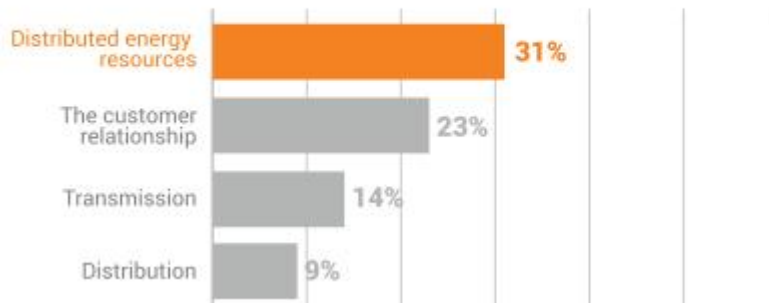
Standard training courses
Customized training courses

NERC and University Accreditation
Energy Professional programs

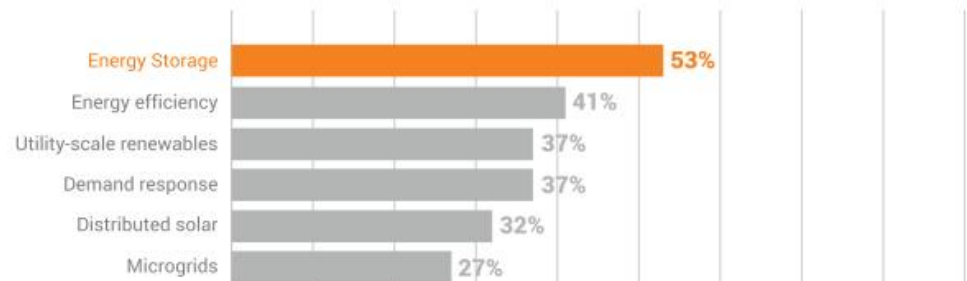
An Overview of Industry Challenges

2015 Industry Survey

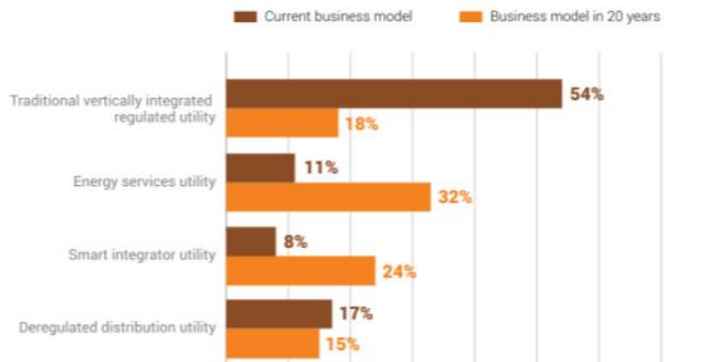
What does your utility see as its biggest growth opportunity over the next five years?



Q. What are the top three emerging technologies that you think your utility should invest more in?

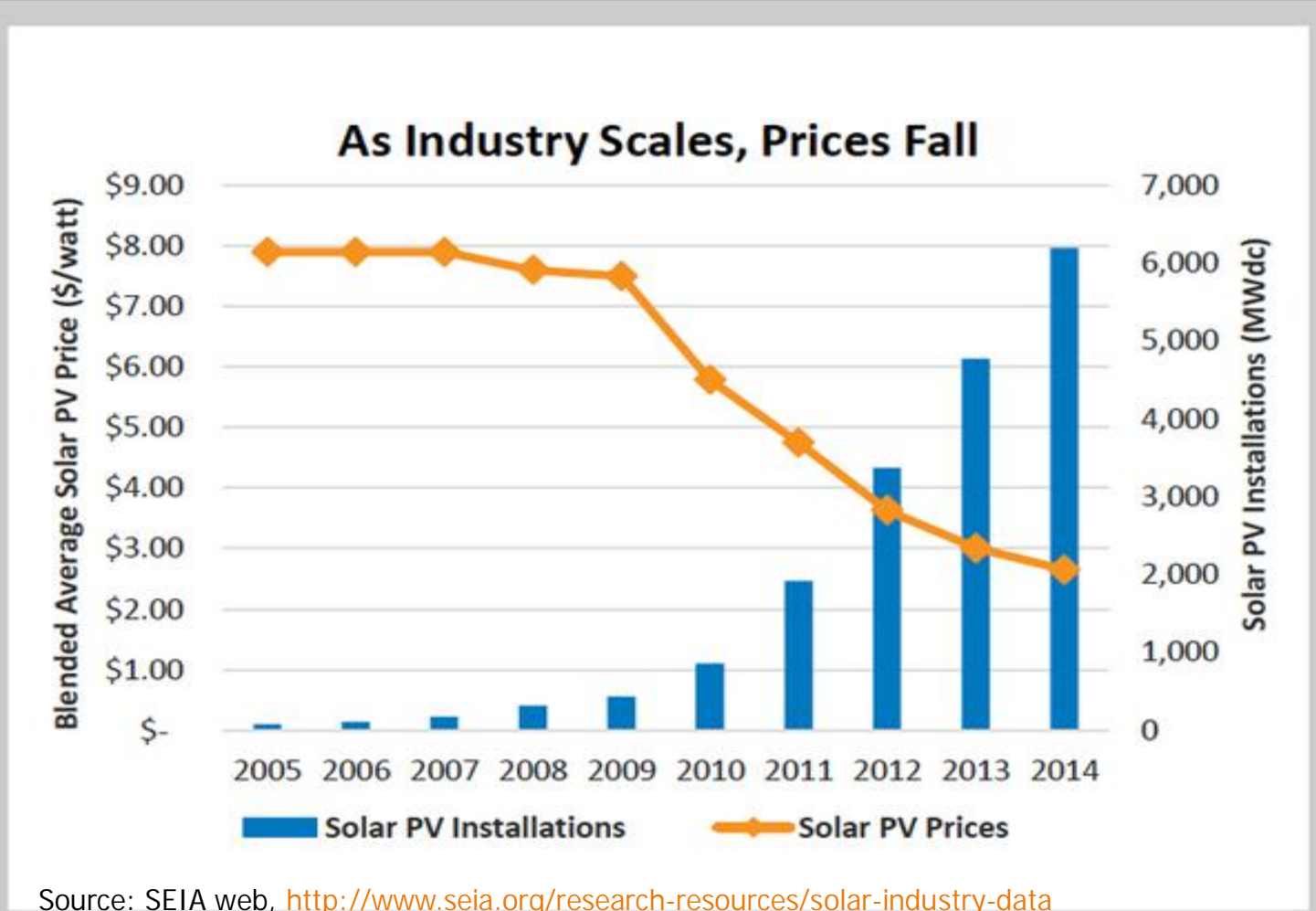


Q. What do you think your utility's business model will be in 20 years?



An Overview of Industry Challenges

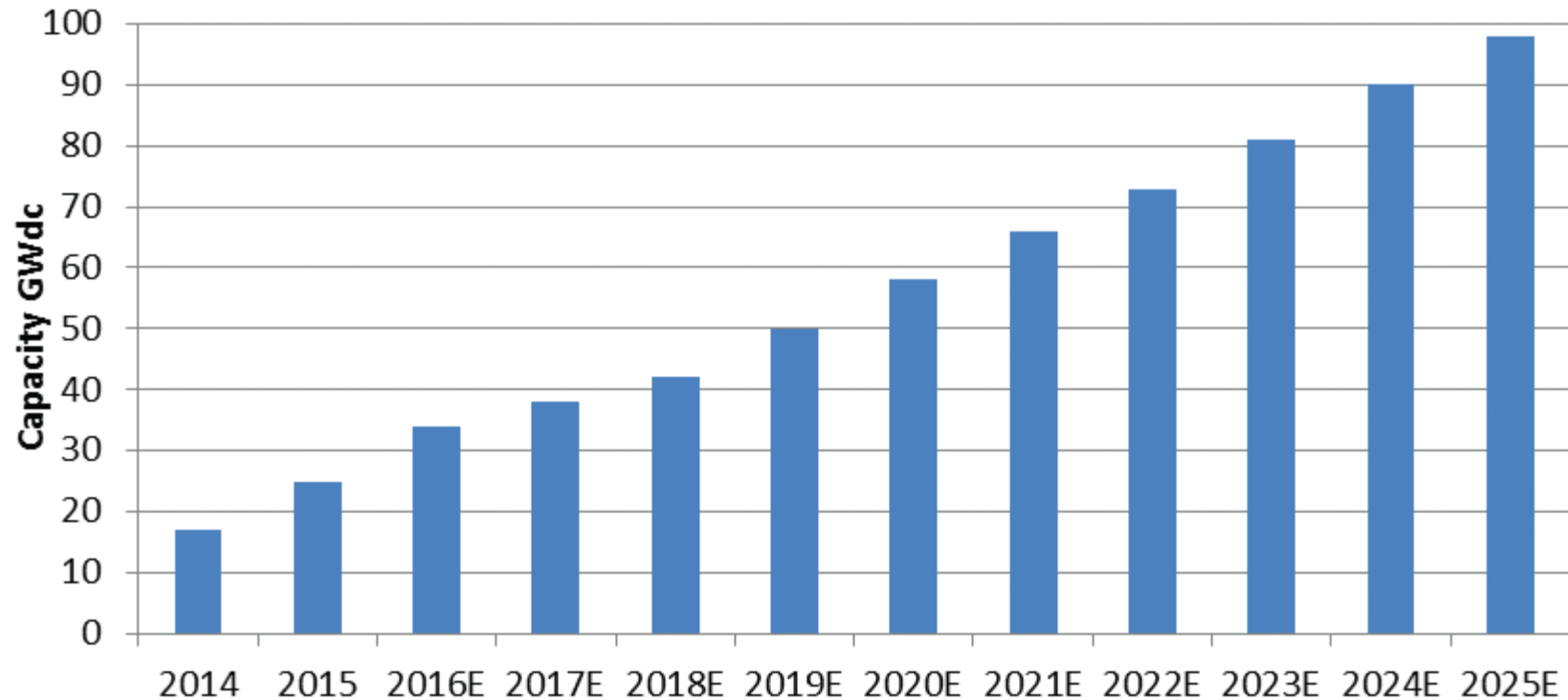
Solar Installation in MWdc – US Market



An Overview of Industry Challenges

Solar Projections– US Market

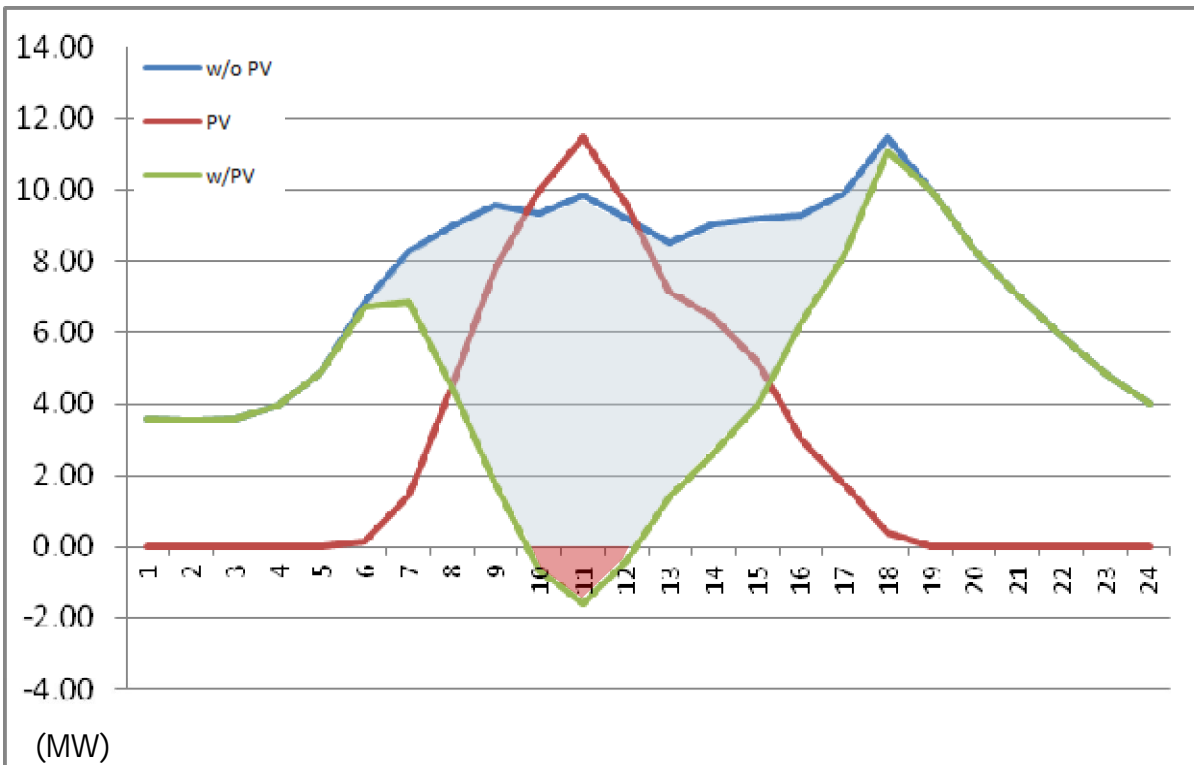
Cumulative US Solar Additions



Source: UBS Global Research: Solar Primer, The Burgeoning Opportunity, October 2015.

An Overview of Industry Challenges

Solar PV System Impacts



Distribution System Impacts:

- High voltages
- Voltage regulation
- Power quality
- Protection coordination
- Reverse power flow
- Safety concerns

Transmission System Impacts:

- System stability (50.2 Hz)
- Back feeding substation
- Ramp rates (duck curve)
- Frequency control

An Overview of Industry Challenges

Key Challenges

Cause	Effect
Increasing Renewable Penetration	<ul style="list-style-type: none"> • DER Integration issues • New T lines to import large gen • Variability of Renewable generation • Renewable peak to load peak not coincident • Potential impacts to system stability
Focus on Environment	<ul style="list-style-type: none"> • Retiring Coal Plants and effect on generation capacity
Customer Engagement	<ul style="list-style-type: none"> • DR & customer owned DER • Impact on revenue • New markets i.e. DSP/DSO
Aging Grid Assets	<ul style="list-style-type: none"> • Need investment • Need to consider NTA's



Integration and evaluation of new markets

New technologies i.e. energy storage

Improvements in system Operations

Integrated resource planning

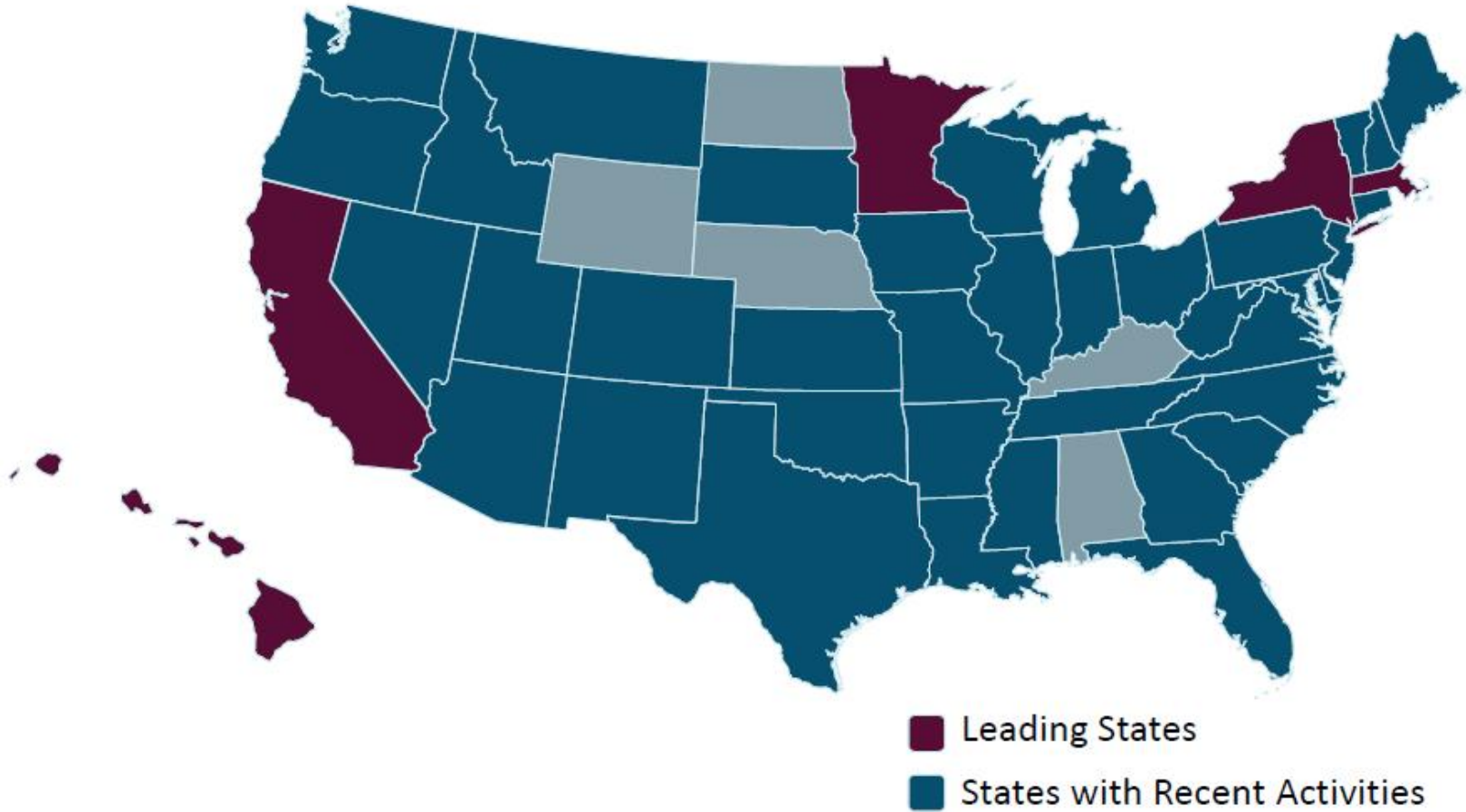
New business models

Regulatory and Legislative Impacts Overview

- Clean Power Plan
- FERC Order 745: Demand Response
- State RPS
- Net metering (California)
- NERC requirements
- **State level DER proceedings**

Regulatory and Legislative Impacts

Key States Leading DER Policies

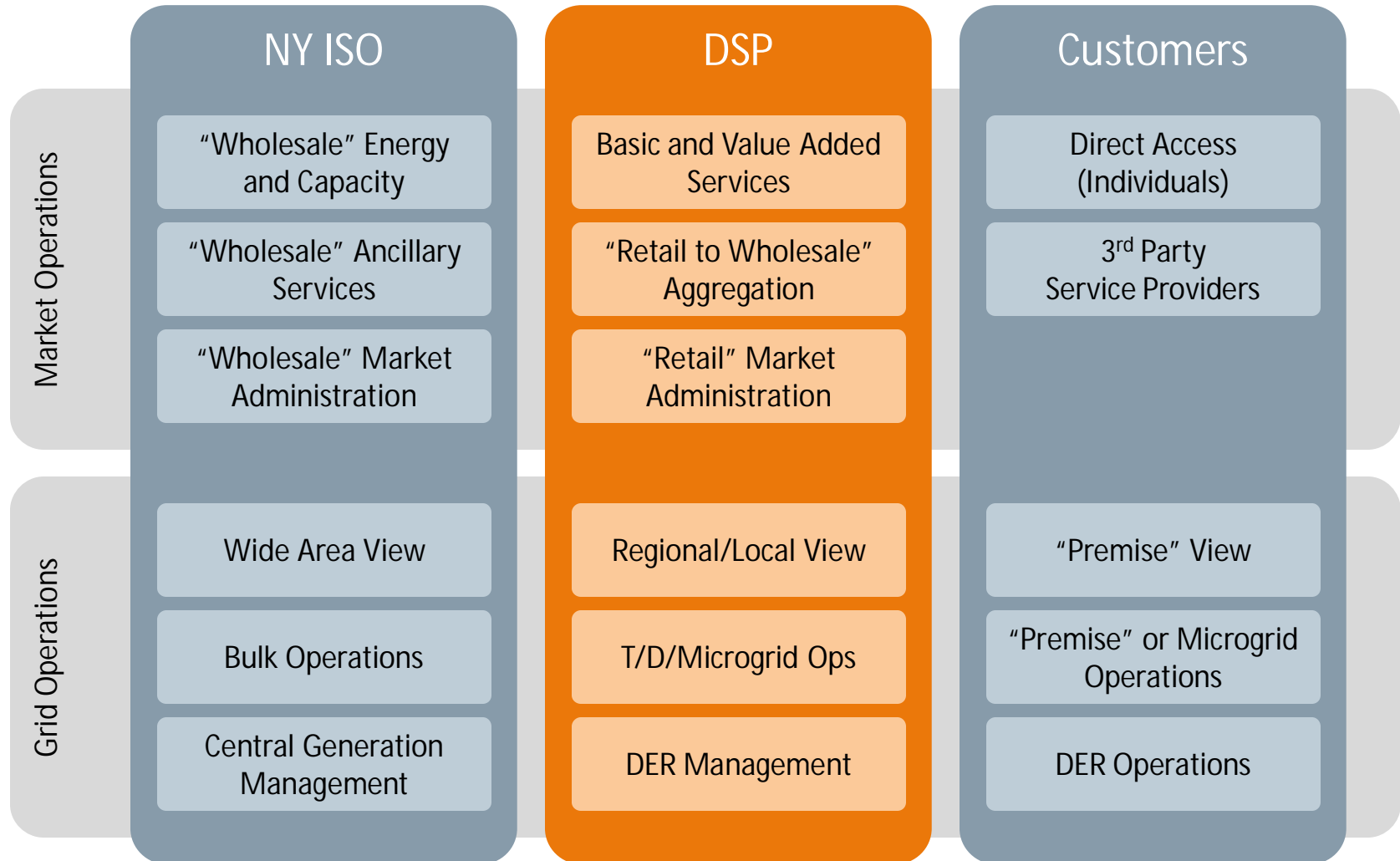


Regulatory and Legislative Impacts

Breakdown of Leading DER Policies

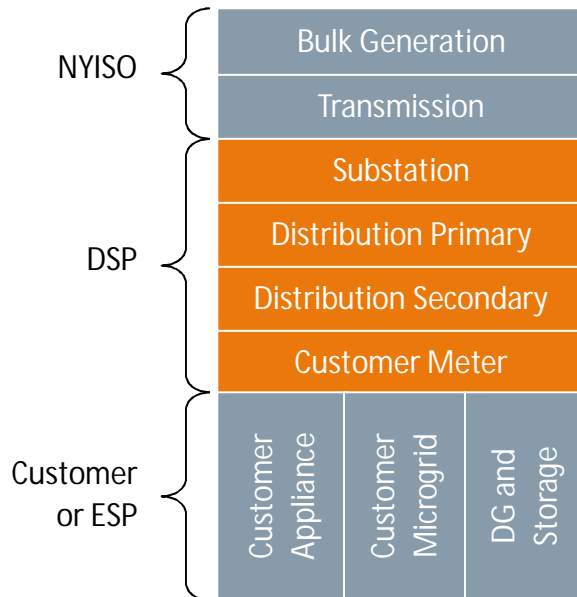
State / Program	Objectives
New York REV Program	<ul style="list-style-type: none"> • Transition to a DSP Service Model • Reliance on Cost-Benefit Streams, Transparency • System-wide Efficiency • System Reliability & Resiliency • Fuel and Resource Diversity
California Section 769 Distribution Resources Plan	<ul style="list-style-type: none"> • Integration of DER into DRP, Operations, Investments • Location Value Methodology • Tariff Structures to Reflect Location Value • Reliability & Safety Impacts, Challenges
Minnesota E21 (21 st Century Energy System) Initiative	<ul style="list-style-type: none"> • Consumer options and local source focus • Reliance on distributed, flexible, intelligent technologies • Diverse resources, supply reliability, resilience and security • Self-Regulating, Performance-based Rate Structures
Massachusetts DPU (12-76-A) Grid Modernization Program	<ul style="list-style-type: none"> • Utilities required to develop Grid Modernization Plans (GMP) plans under established cost-benefit guidelines, DPU approval standards

Regulatory and Legislative Impacts NYREV DSP Functions

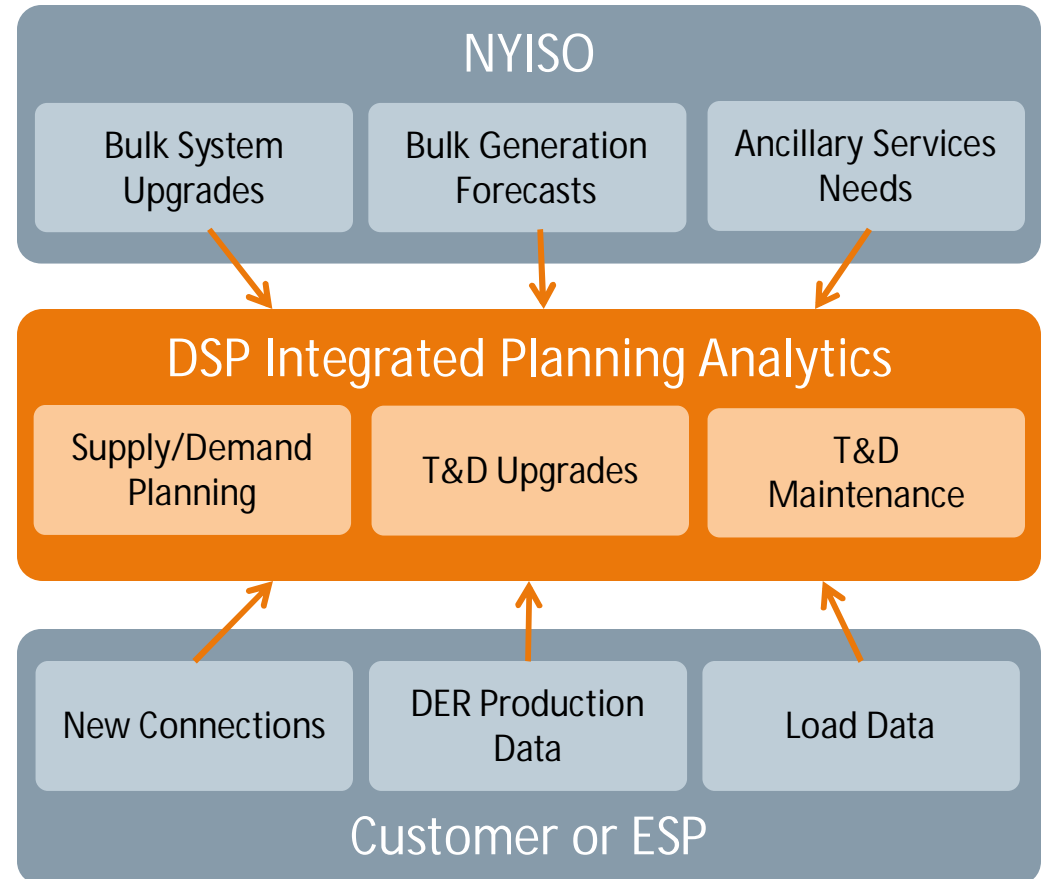


Regulatory and Legislative Impacts NYREV DSP Functions

Electric Network Levels



Integrated System Planning



Integrated Resource Planning Planning Evolution

Historical

- Safe, Reliable Power Delivery, subject to:
 - Least cost Planning
 - Generation & Transmission Constraints
 - Contractual constraints (e.g., must-takes)
 - Environmental constraints
- Additional considerations:
 - Assess tradeoffs of attributes and risks of options

Well-Established Tools

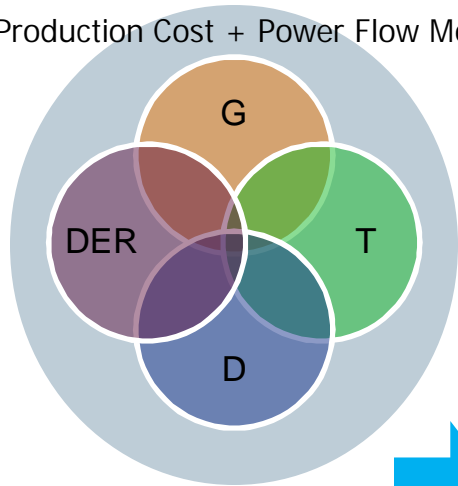
Emerging

- Evolve Utility Role and System to:
 - Greener and more distributed supply
 - Smarter more efficient energy use
 - Increased behind-the-meter generation
 - Distributed and grid-based storage
- Utility “System” viewed as a “platform” with to enable two-way flow of services across the meter (services from customers and to customers)
- Accommodate new vision in most cost-effective way

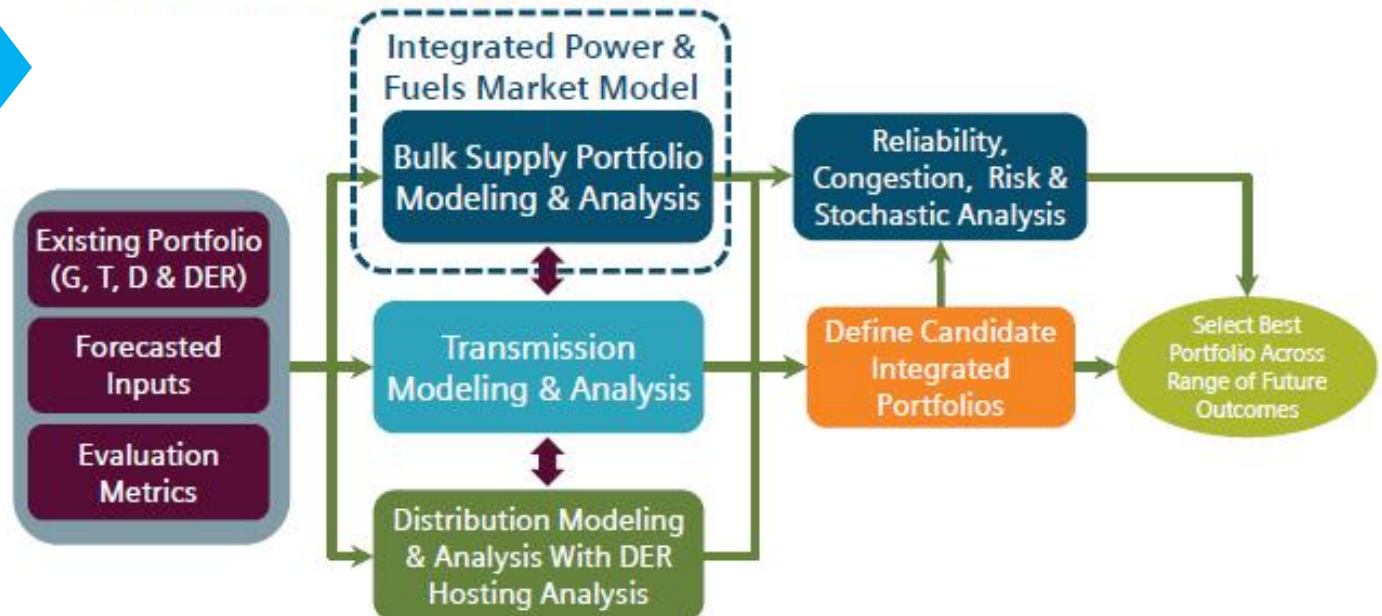
Emerging Framework and Tools

Integrated Resource Planning The Siemens PTI Approach

Production Cost + Power Flow Modeling



Integrated Generation, T&D Planning Process



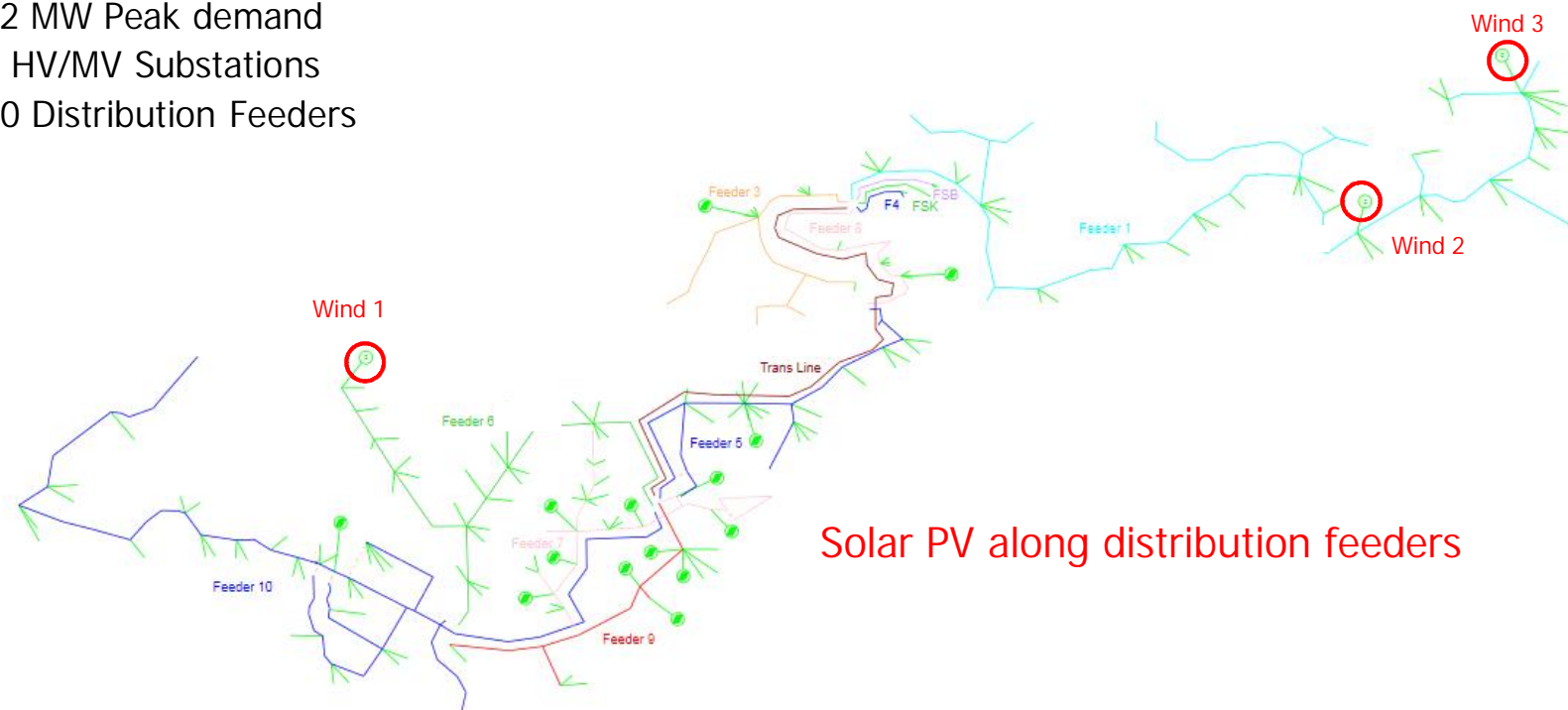
Integrated Resource Planning Modeling and Simulation Options

Modeling and Simulation Option	Description	Advantages	Disadvantages
Fully Integrated Large System Model (8760 hrs)	Fully integrated GTD&DER production cost modeling and power flow	<ul style="list-style-type: none"> • Accounts for system wide impacts and total system optimization 	<ul style="list-style-type: none"> • Only suitable for small systems • Simulation tools not capable yet
Fully Integrated Subsystem Model (8760 hrs)	Fully integrated and optimized GTD&DER at sub system, roll up sub systems to large simplified system for optimization fine tuning	<ul style="list-style-type: none"> • Accounts for DER – Bulk gen optimization • Accounts for DER impacts on distribution system 	<ul style="list-style-type: none"> • Does not account for DER optimization in subsystem interface flows • Requires modeling of all distribution feeders
Nodal Optimization and roll up to wider system (8760 hrs)	Optimized net load at each node and system wide bulk dispatch optimization to meet optimized net load	<ul style="list-style-type: none"> • Does not require modeling of distribution networks 	<ul style="list-style-type: none"> • Does not account for distribution system impacts • Does not account for DER-Bulk gen optimization

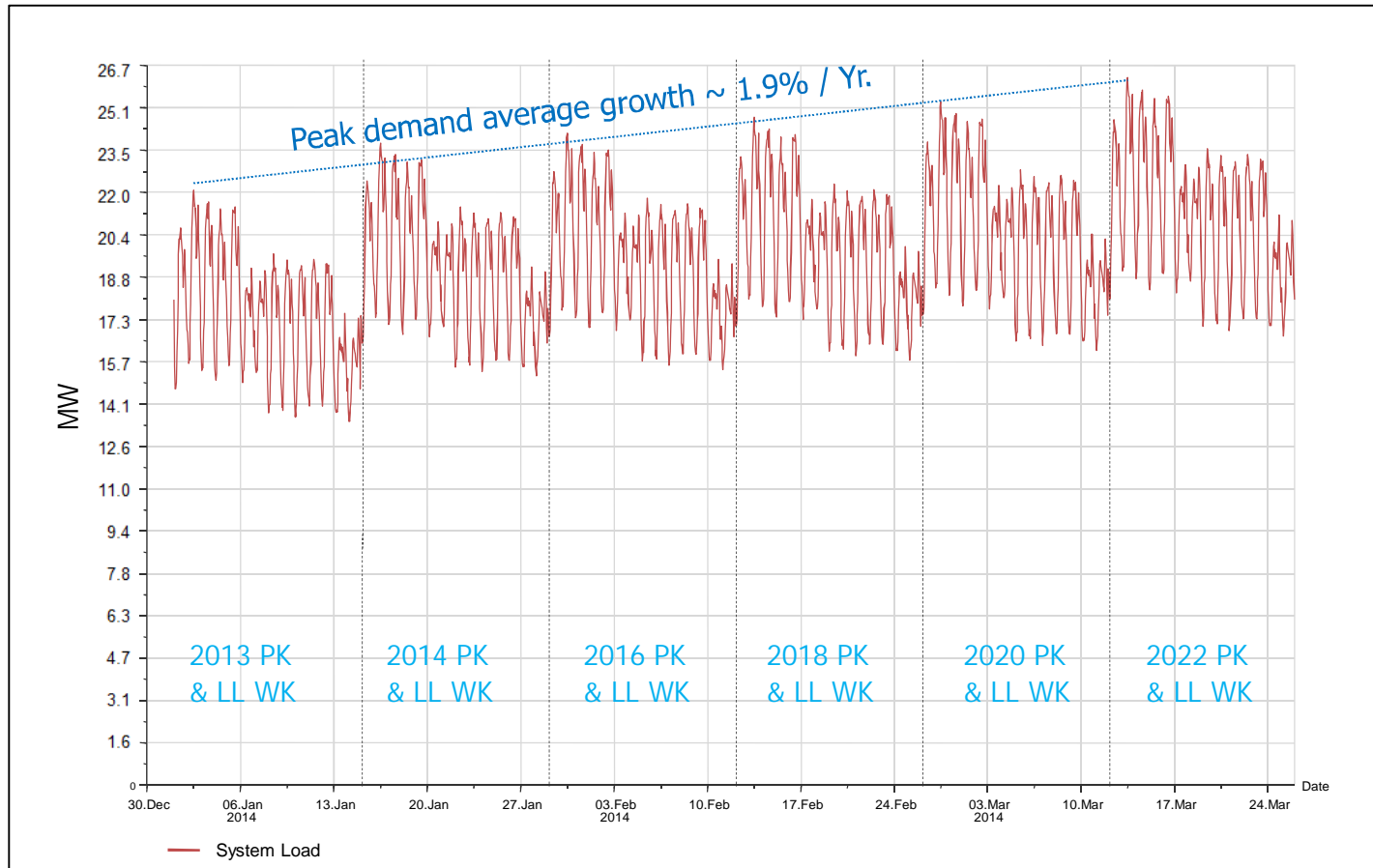
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Siemens PTI Experience Small T&D System Study

- 22 MW Peak demand
- 2 HV/MV Substations
- 10 Distribution Feeders



Siemens PTI Experience Load Forecast Studied

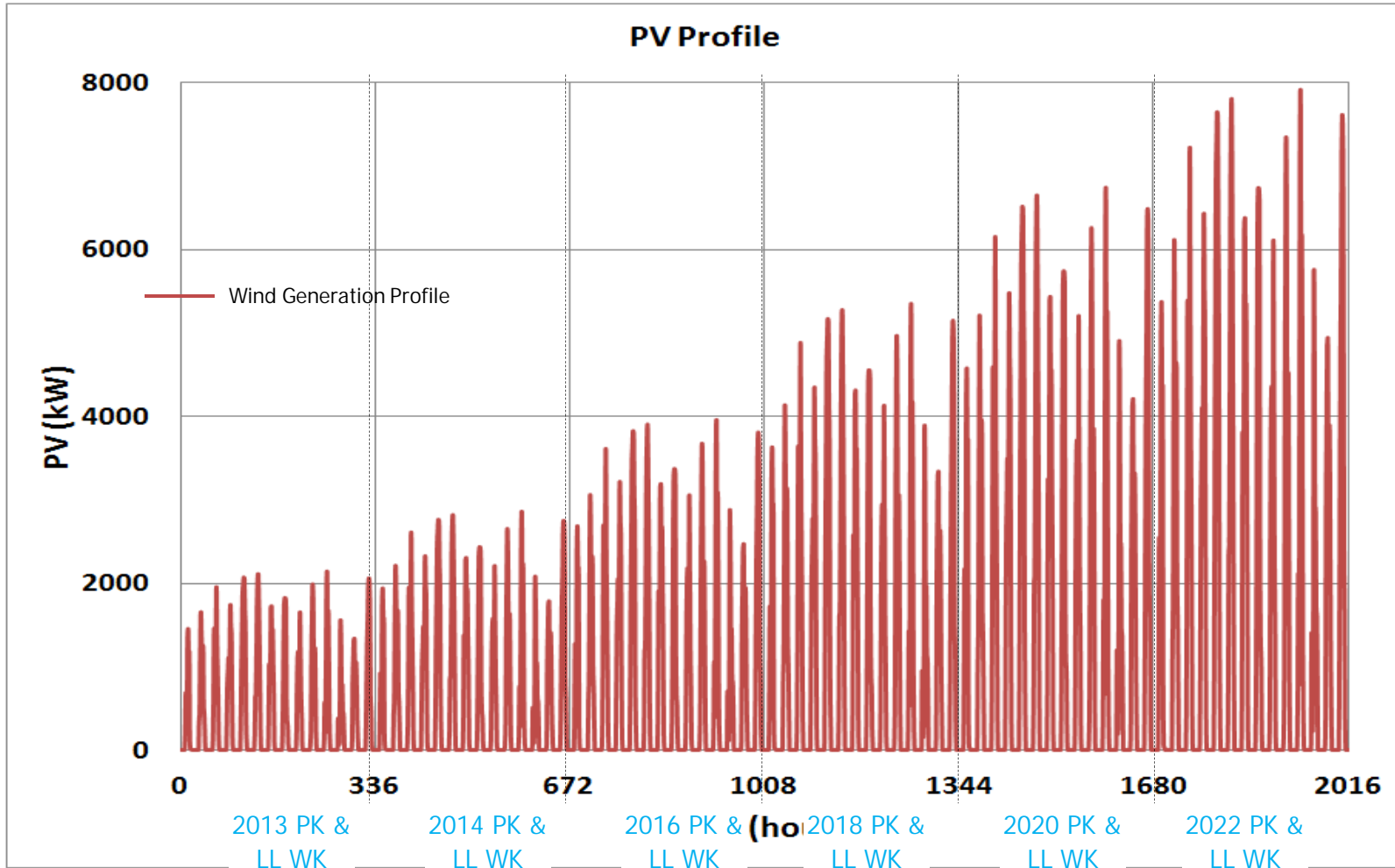


Identifying The Limits To Solar PV and Wind Integration Provided The Primary Input For Scenarios

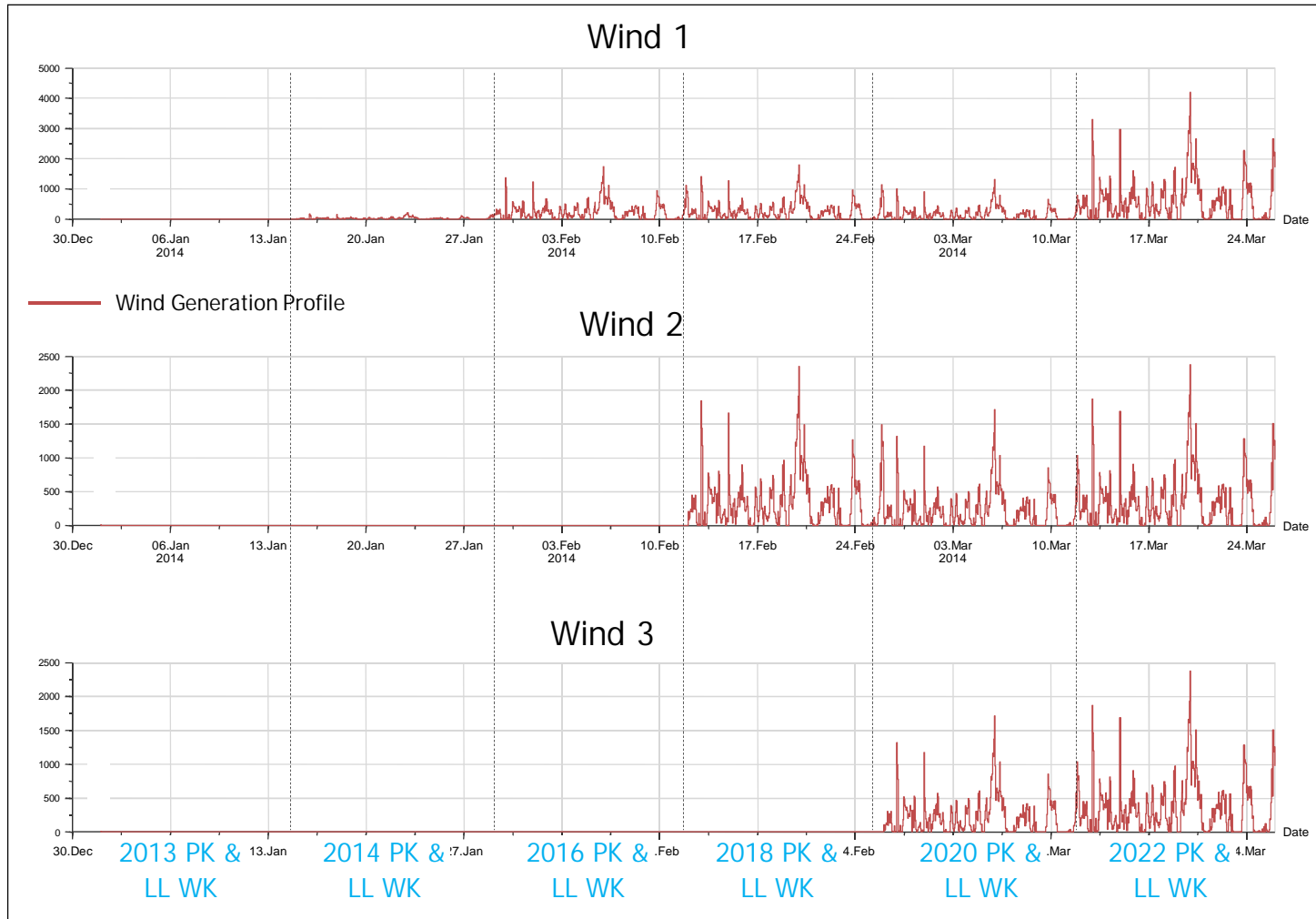
Aggressive scenarios

Scenario	Wind (%)	Solar PV (%)	Total Penetration (% of peak load)
Baseline	0%	10%	10%
Scenario 1	1%	16%	17%
Scenario 2	9%	22%	31%
Scenario 3	21%	28%	49%
Scenario 4	31%	35%	66%
Scenario 5	41%	39%	80%

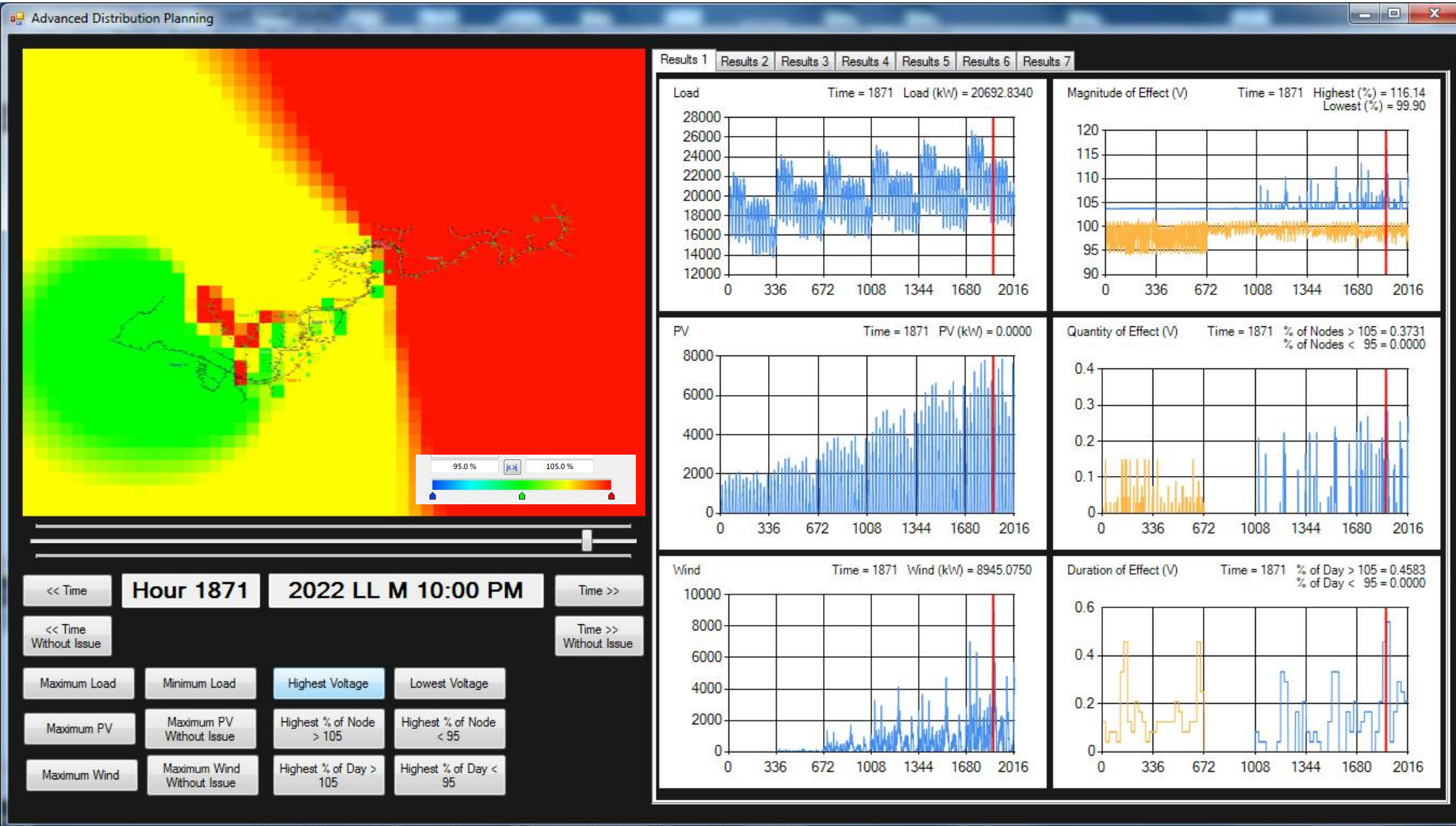
Solar PV Generation Forecast



Wind Generation Forecast



Advanced Planning Analysis



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Thank you for your attention!



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