



California Solar Initiative (CSI) Grant

Project Overview

Innovative Business Models,
Rates and Incentives

February 10, 2011

CSI Grant Overview



Working with the University of California San Diego (UCSD), the California Independent System Operator (CAISO), and San Diego Gas and Electric (SDG&E) with one of the most advanced microgrids in the state, Viridity and E3 have merged their respective expertise to:

- Test whether load can serve as a flexible resource to integrate high penetration solar
- Demonstrate that the barriers to deployment of solar resources can be overcome through providing appropriate incentives for real-time management and optimization of distributed energy resources.
- Provide economic, reliability and market price benefits to California ratepayers that accompany increased deployment of solar resources



Grant Funding



Co-sponsored through California Public Utility Commission (CPUC) grant funding from California Solar Initiative (CSI) Research, Development, Demonstration, and Deployment (RD&D) Program with Itron, Inc. as the program manager.



About Viridity Energy Inc



- Smart Grid demand management company
- Optimizes onsite energy systems and load control devices to reduce costs and take advantage of market opportunities
- Monitors and control resources based on real-time information and market signals
- Curtailment Services Provider that schedules demand side resources into the grid
- Aggregates customer profiles to provide benefits for supply and demand side economics
- Defines the carbon footprint for internal and external generation sources and dispatch accordingly

E3 works at the nexus of electricity sector planning, policy, and markets in California and beyond. A sample of our work/clients:

Regulatory/Policy

- q EPA/DOE National Action Plan for EE
- q EE avoided costs, MPR for CA utilities
- q CA 33% RPS and GHG analysis
- q CPUC long-term planning process
- q CA Solar Initiative cost-effectiveness
- q 2007 Idaho Energy Plan
- q China SERC GHG reduction analysis

Utility

- q Western Electric Industry Leaders Group RE-transmission study
- q PG&E, BPA, BC Hydro renewables procurement
- q PG&E Diablo Canyon relicense
- q Hawaii Electric Co. Feed-in Tariff
- q CAISO Sunrise line expert testimony
- q BC Hydro commercial tiered rates

IPPs/Technology Companies

- q Advising BrightSource, First Solar, Hydrogen Energy International, Calpine, Ice Energy
- q Analysis of energy storage markets for EPRI and VC clients
- q Represented Powerex and IPP/Marketers coalition in RTO West market design negotiations

UC San Diego Operates a 42 MW Microgrid

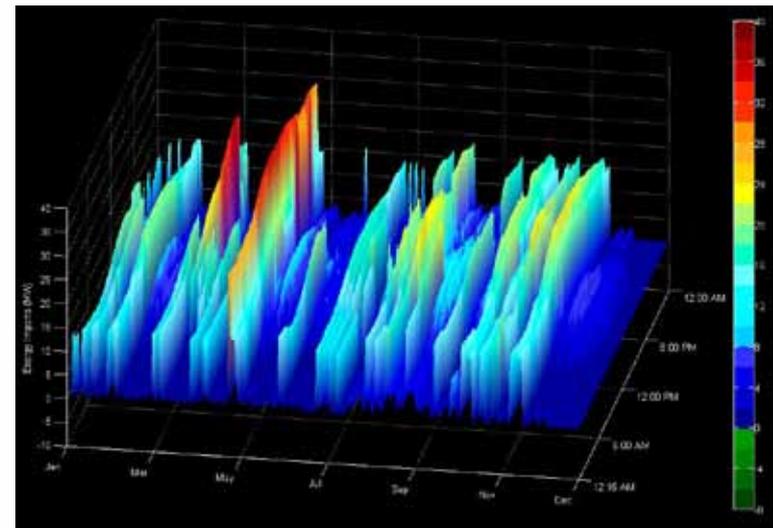
With a daily population of over 45,000, UC San Diego is the size and complexity of a small city.

11 million sq. ft. of buildings,
\$250M/yr of building growth

Self generate 80% of annual demand

- 30 MW natural gas Cogen plant
- 2.8 MW of Fuel Cells contracted
- 1.2 MW of Solar PV installed, additional 2 MW planned
- Twice the energy density of commercial buildings

UC San Diego grid imports 2007



- **Install and Integrate Viridity's VPower™ System**

Enables the ability to optimize the community's generation, energy storage, demand response and load resources and allows the analysis of the integration of PV for larger commercial and industrial entities with distributed energy resources on and off campus
- **Identify and specify strategies for integrating high penetration PV**

Develop specific strategies to integrate Distributed Energy Resources (DER) as they relate to high penetration PV solar systems being implemented at UCSD and within the surrounding community
- **Identify, develop tariffs and incentives to promote integration of DER**
 - Reducing demand and standby charges
 - Enabling critical peak pricing and peak time rebates
 - Taking advantage rate discounts
 - Establish subscription tariffs and two-part rates
- **Establish baseline performance**

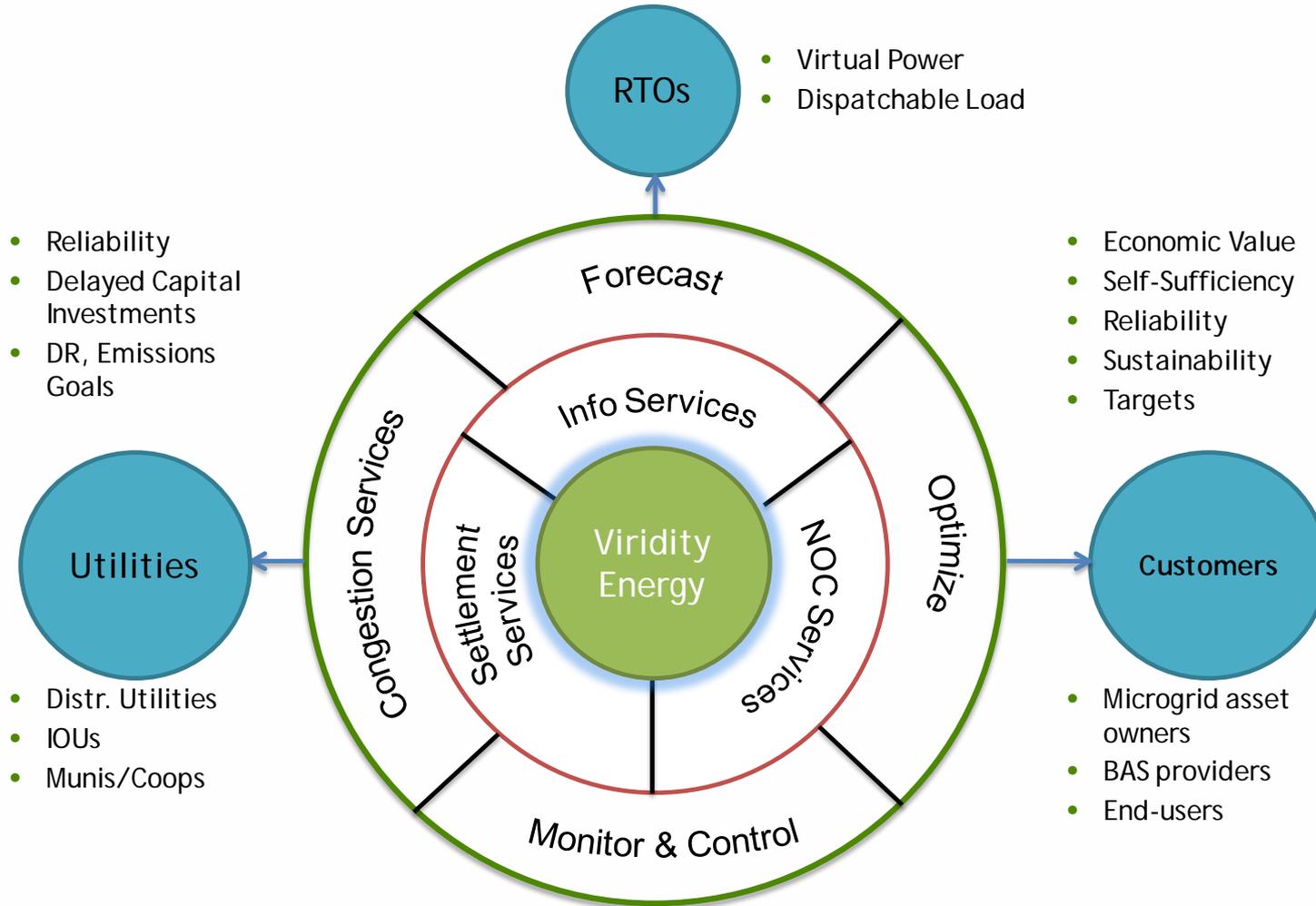
Provide a statistically robust analysis of baseline UCSD campus DER performance using the current rates and incentives prior to the optimized management that will be provided by VPower™
- **Refine business models, strategies, tariff and incentives**

Perform DER simulations on prototypes and actual configurations, evaluating and verifying business models, management strategies
- **Cost Benefit Analysis of DER management strategies**

Quantify kW and kWh impact of the strategies with focus on System, PV integration, and Local Distribution benefits. Total Resource Cost (TRC), Participant Cost Test (PCT), Program Administrator Cost (PAC), and Ratepayer Impact Measure (RIM) tests will be performed for applied tariff and incentive options
- **Final Report and Analysis Tools**

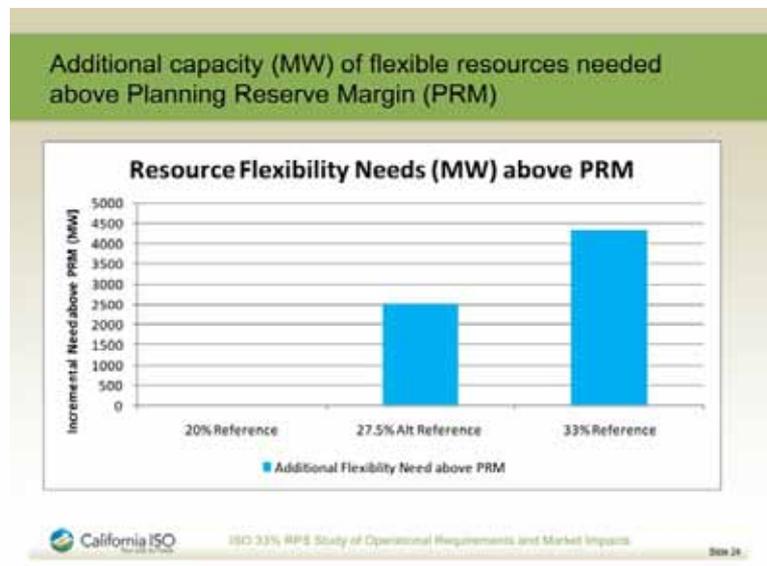
Provide the public with a transparent analysis tool to analyze proposed tariffs and resulting costs and benefits in the final report that will assist managers and operators in selecting and prioritizing DER and PV management and integration strategies.

Viridity's VPower™ , an Enhanced Optimization Solution coupled with a Network Operations Center

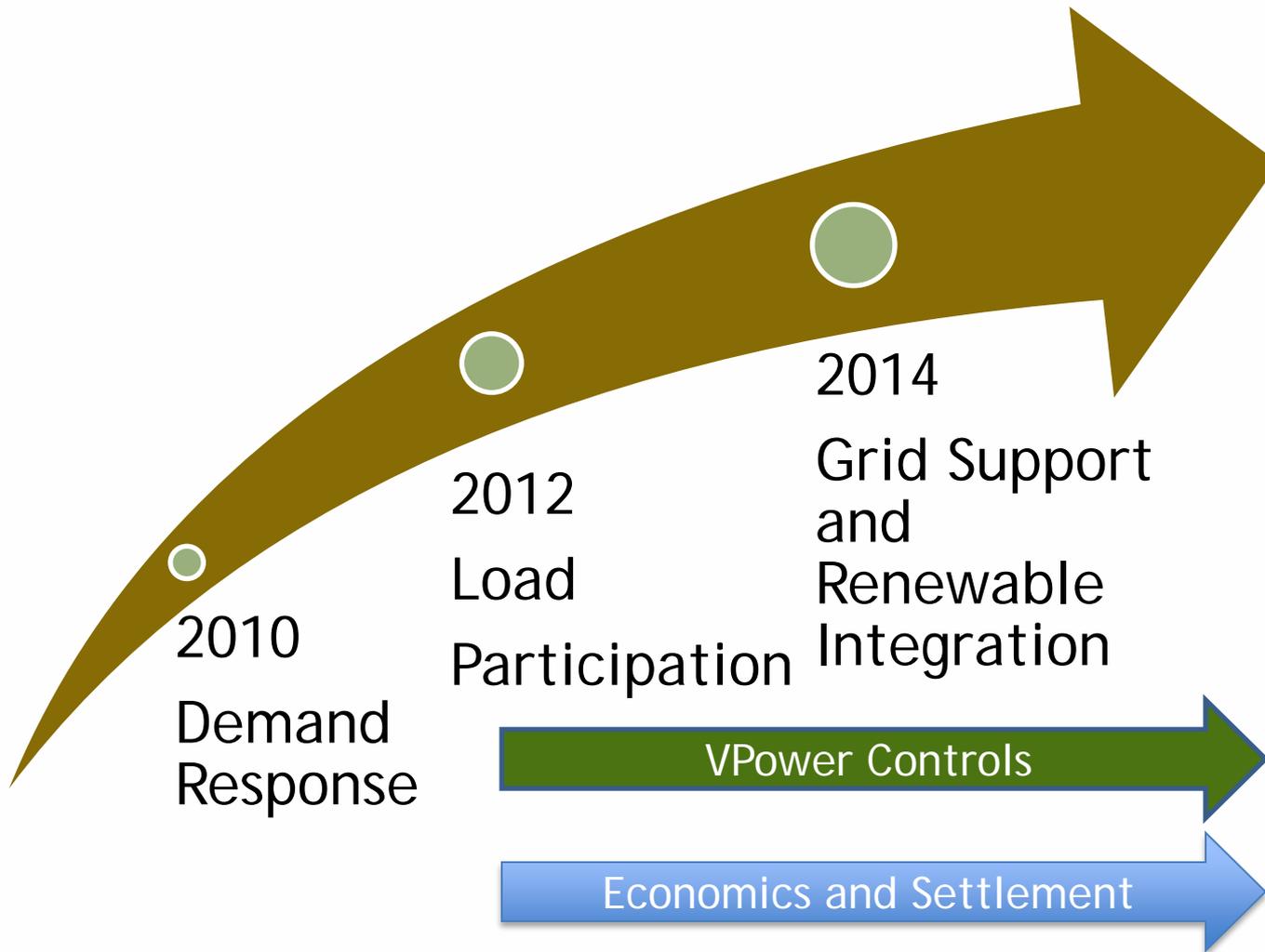


- Crux of the 33% RES integration problem is intra-hour load balancing
- Fundamental R&D question: Can load serve as a flexible resource?
- Dimensions of the analysis
 - Technical - can we coordinate and control loads 24X7 in short time-scale?
 - Economic - is it less expensive than a supply-side solution?
 - Business case - how can we pay loads appropriately and do settlement?

Initial CAISO results show a need of ~4,000MW of 'generic flexible capacity' in 2020 to support 33% RES standard

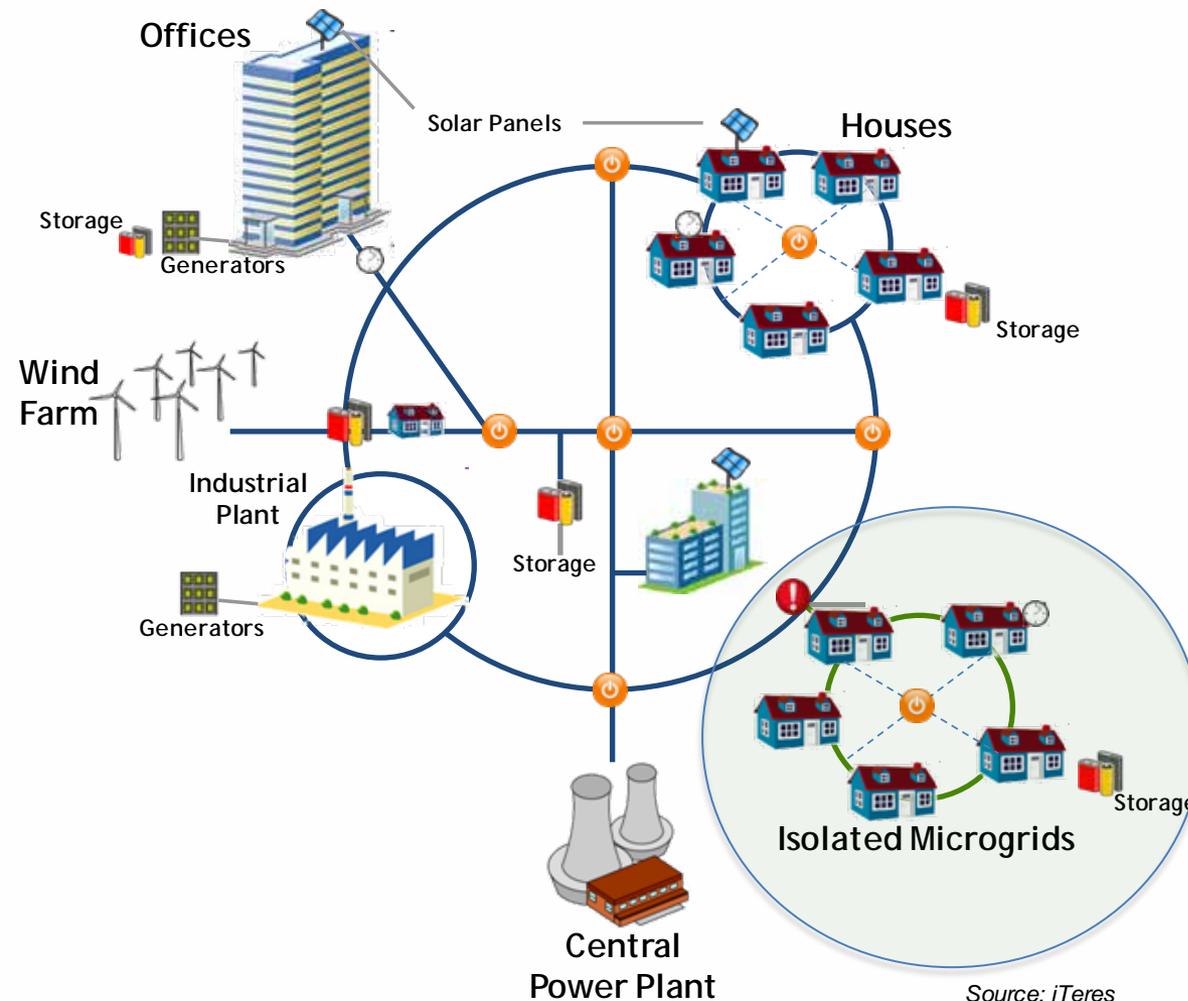


'Smart Customer' Vision



Microgrids transform power distribution, unleashing new levels of reliability and efficiency

Focus on: Microgrid Intelligence



Source: iTeres

Self-healing

- Responds to system disturbances automatically
- Capable of operating as an “island” off of the regional grid

Self-coordination

- Coordinates real-time demands of energy users, distributed resources, microgrid operations and distribution system integrity

Self-scheduling

- Schedules dispatch of distributed energy resources using decisioning tools to optimize overall grid operational performance

- Use standard cost tests to compare DER economics to other solutions
- Supply-side solutions
 - Combustion turbine
- Demand-side solutions
 - battery and thermal storage
- Looking for win-win-win
 - Customer
 - Utility / CAISO
 - Society

Develop Cost-effectiveness Tool

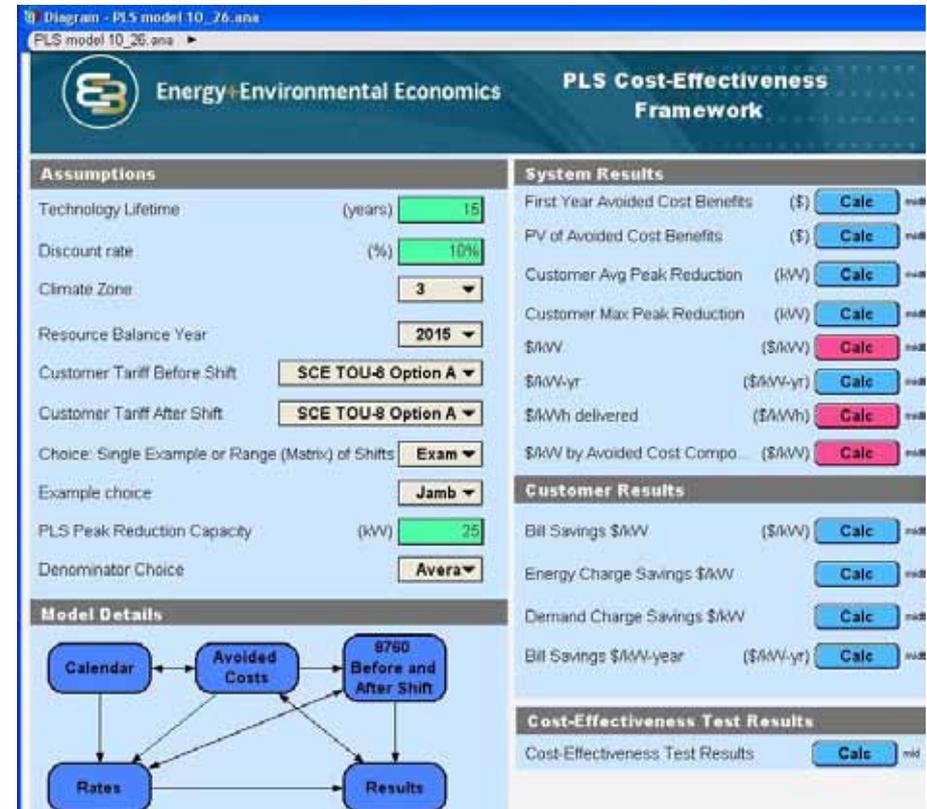


Diagram - PLS model 10_26.ana
PLS model 10_26.ana

Energy+Environmental Economics PLS Cost-Effectiveness Framework

Assumptions

Technology Lifetime	(years)	15
Discount rate	(%)	10%
Climate Zone		3
Resource Balance Year		2015
Customer Tariff Before Shift		SCE TOU-8 Option A
Customer Tariff After Shift		SCE TOU-8 Option A
Choice: Single Example or Range (Matrix) of Shifts		Exam
Example choice		Jamb
PLS Peak Reduction Capacity	(kW)	25
Denominator Choice		Avera

System Results

First Year Avoided Cost Benefits	(\$)	Calc
PV of Avoided Cost Benefits	(\$)	Calc
Customer Avg Peak Reduction	(kW)	Calc
Customer Max Peak Reduction	(kW)	Calc
\$/kW	(\$/kW)	Calc
\$/kW-yr	(\$/kW-yr)	Calc
\$/MWh delivered	(\$/MWh)	Calc
\$/kW by Avoided Cost Compo	(\$/kW)	Calc

Customer Results

Bill Savings \$/kW	(\$/kW)	Calc
Energy Charge Savings \$/kW		Calc
Demand Charge Savings \$/kW		Calc
Bill Savings \$/kW-year	(\$/kW-yr)	Calc

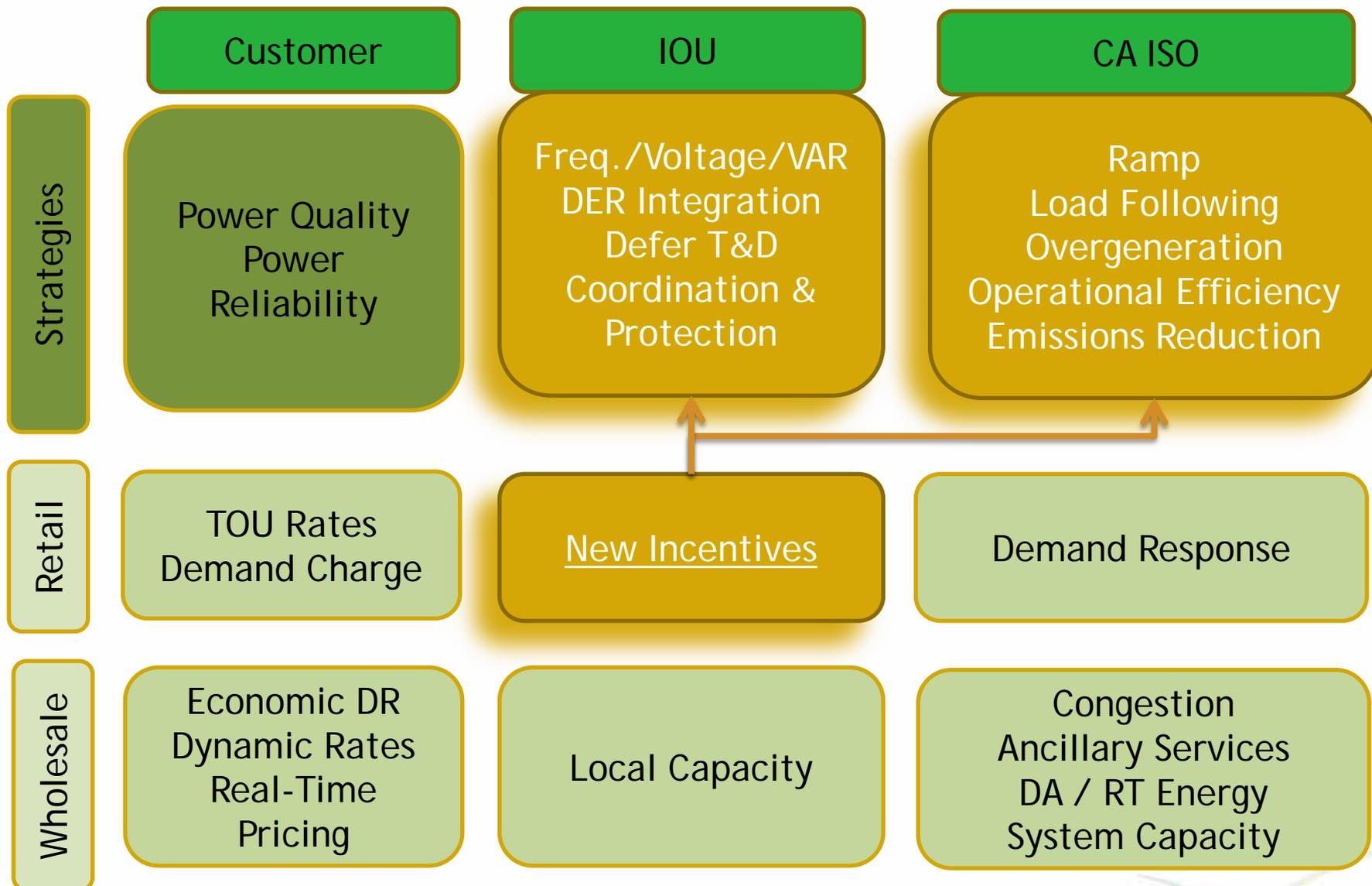
Model Details

Calendar → Avoided Costs → 8760 Before and After Shift → Results

Rates → Calendar → Avoided Costs → Results

PLS Tool Released 12/1/2010

Develop Incentives to Motivate Grid Support with Distributed Energy Resources



Questions?

