UC San Diego

Smart Microgrid

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Manager,
Energy & Utilities

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Campus Quick Facts

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

As a research and medical institution, we have two times the energy density of commercial buildings

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

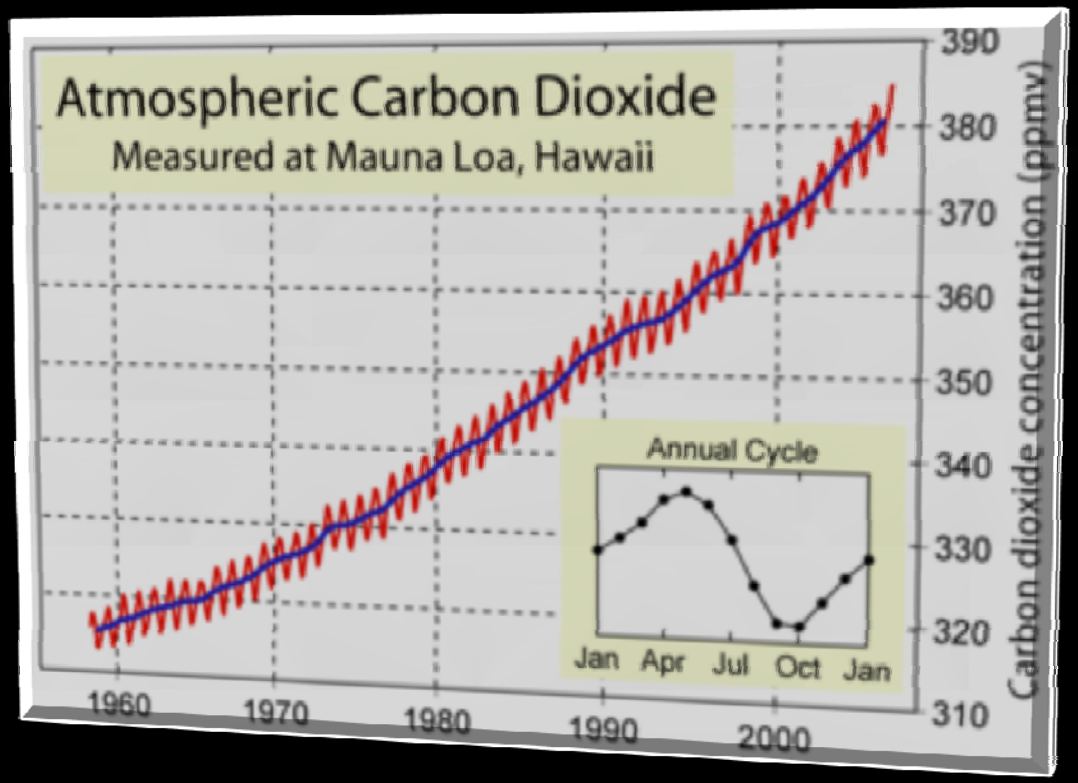
UC San Diego Operates a 42 MW_{peak} Microgrid

A History in Climate Research

UC San Diego and its Scripps Institution of Oceanography has long been internationally recognized for ***pioneering research*** in global climate change.

We feel it is imperative to have commensurate leadership in the sustainability of UC San Diego's ***operations***.

As a ***living laboratory*** for climate solutions, UC San Diego will be an early adopter for real-world tools and leading-edge technologies for California and global marketplace.



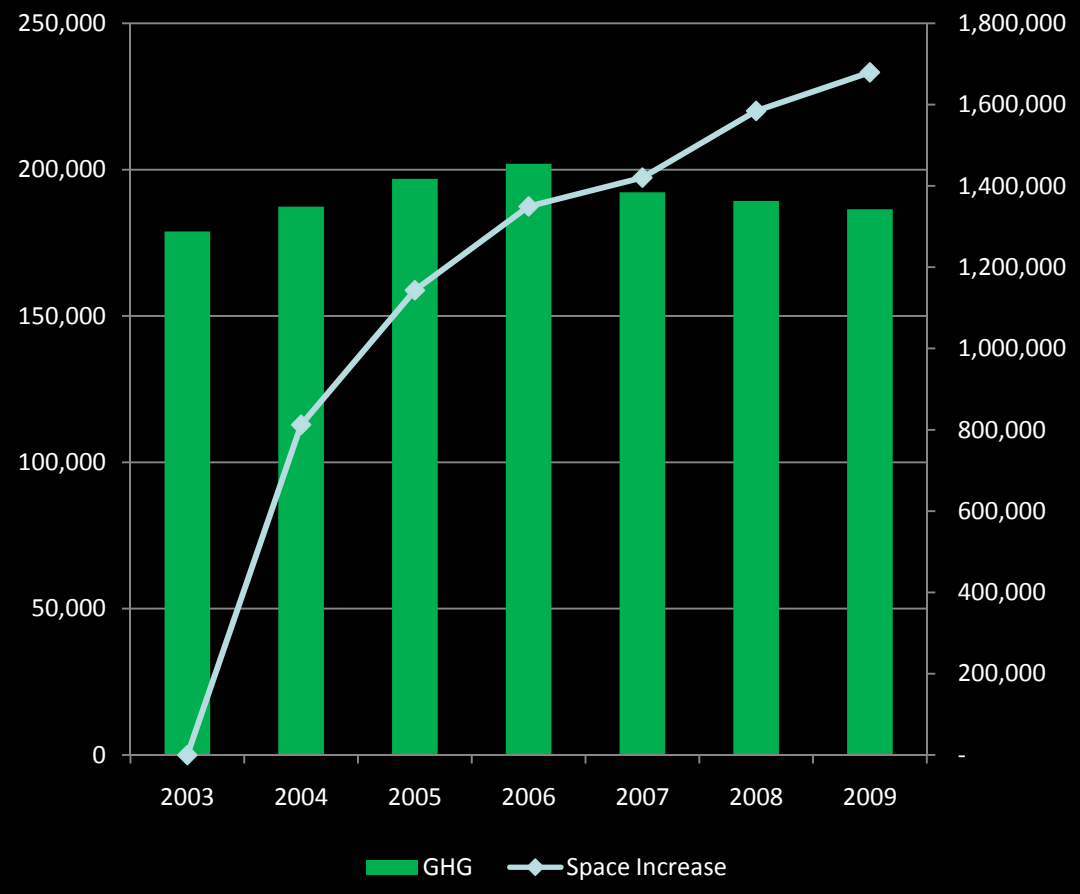
Growth Campus

Continue to be a Leader in Carbon Reduction and Energy Efficiency

Completed $60M in energy retrofits reducing energy use by 20% or 50M kWh/yr, saving UCSD $12M annually.

Award winning program:

- **8 Best Practice Awards**
- **5 Excellence in Energy Efficiency Awards**
- **2 Energy Education & Leadership Awards**



New Technology in Old Buildings

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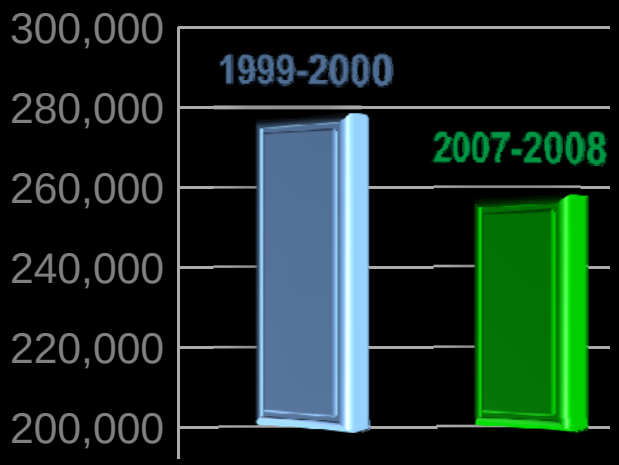

Centralized Systems

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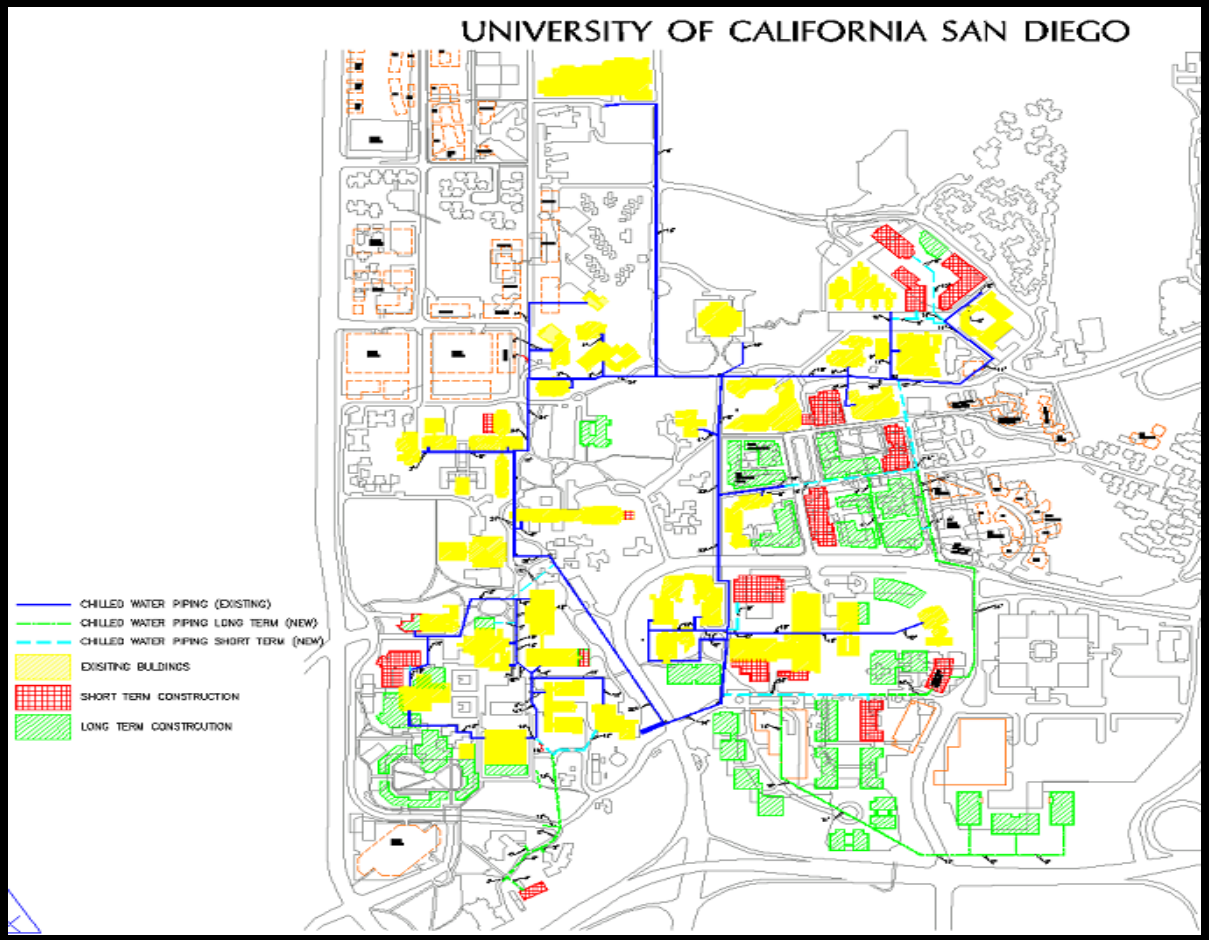

High Voltage Substation

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Digital Controls

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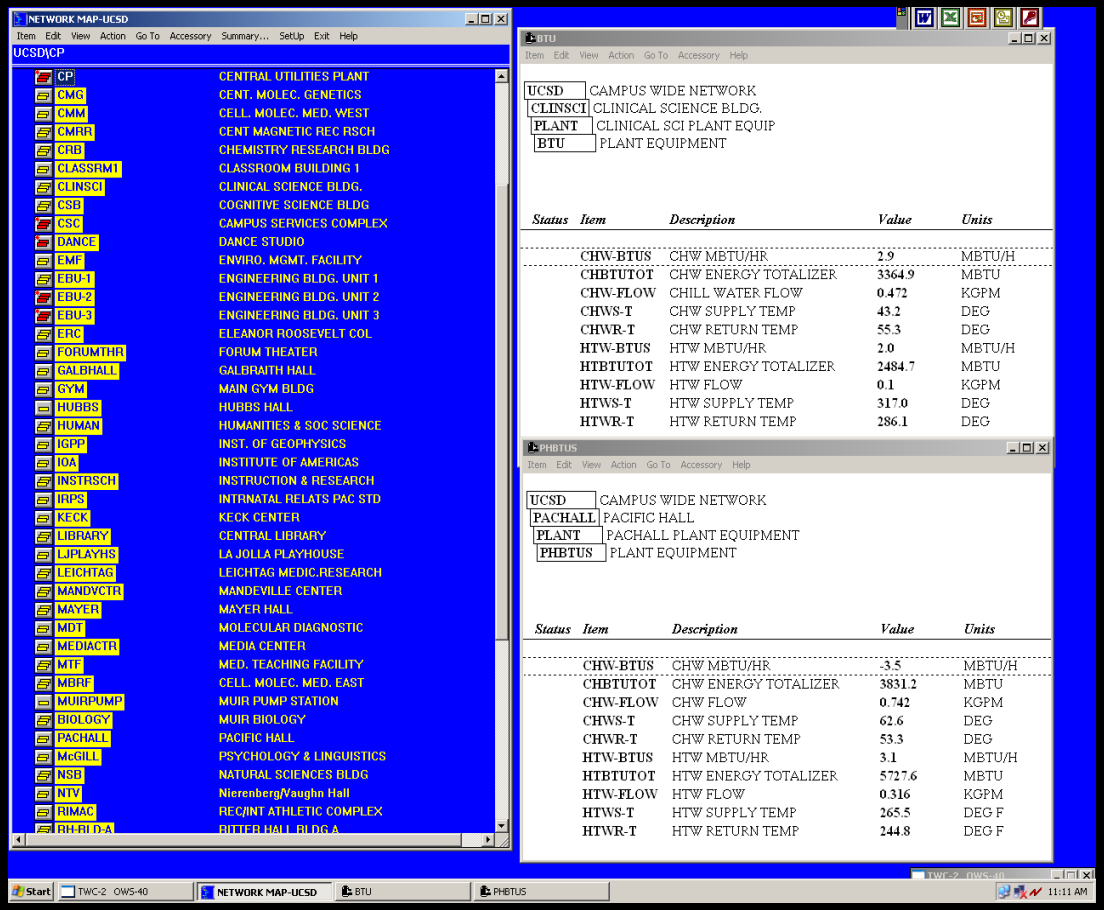

Thermal Energy Storage

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Cogeneration

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Topping Steam Turbine

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Tracking Performance

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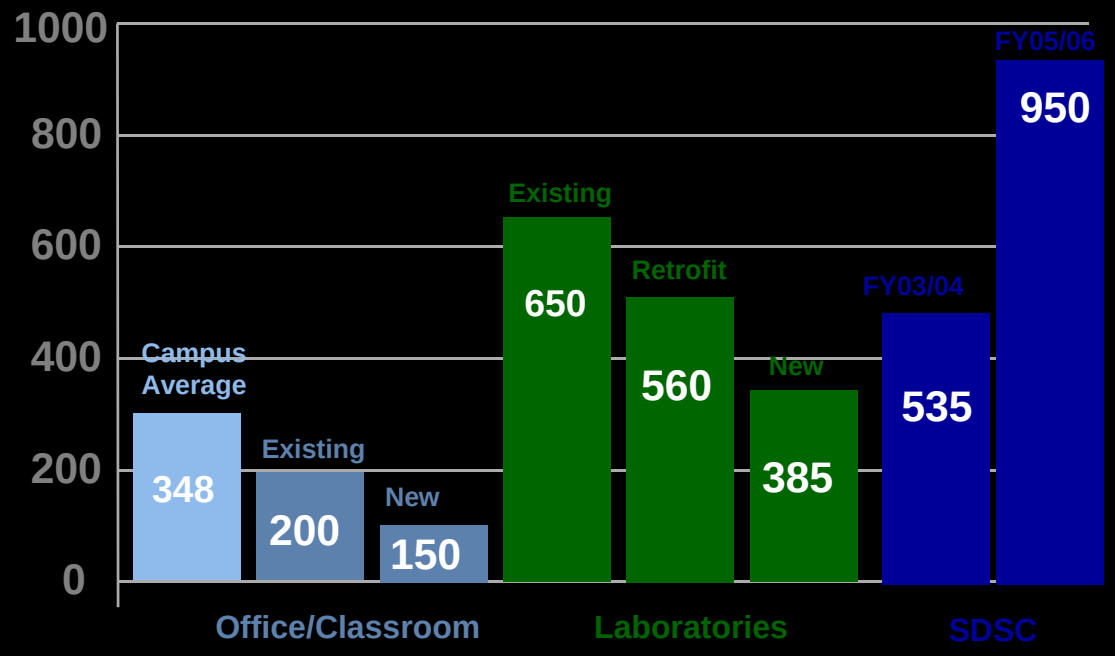
Comparative Energy Intensity (KBtu/sq-ft)

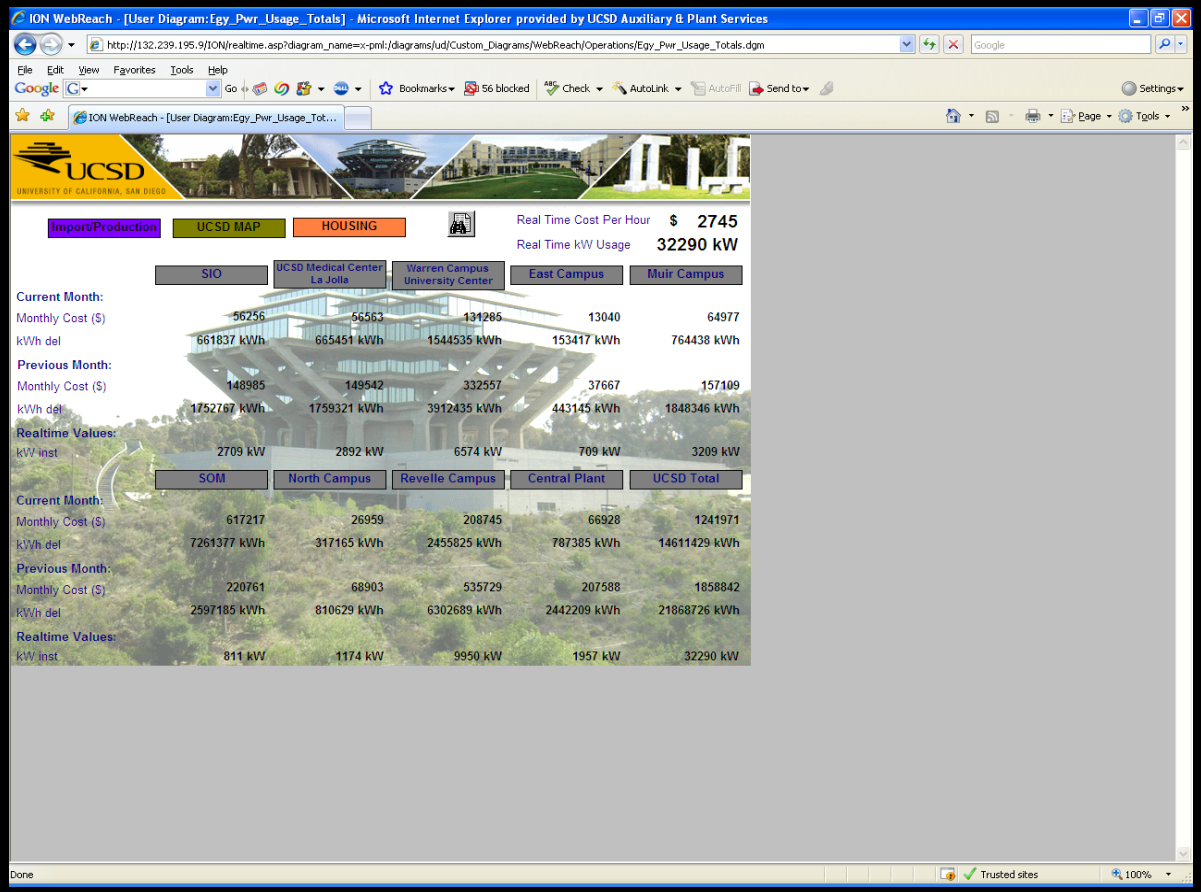


Creating a *Green* Smart Microgrid

Comprehensive Metering

Electric and Thermal Interval Meters reporting to Central Database

http://mscada01.ucsd.edu



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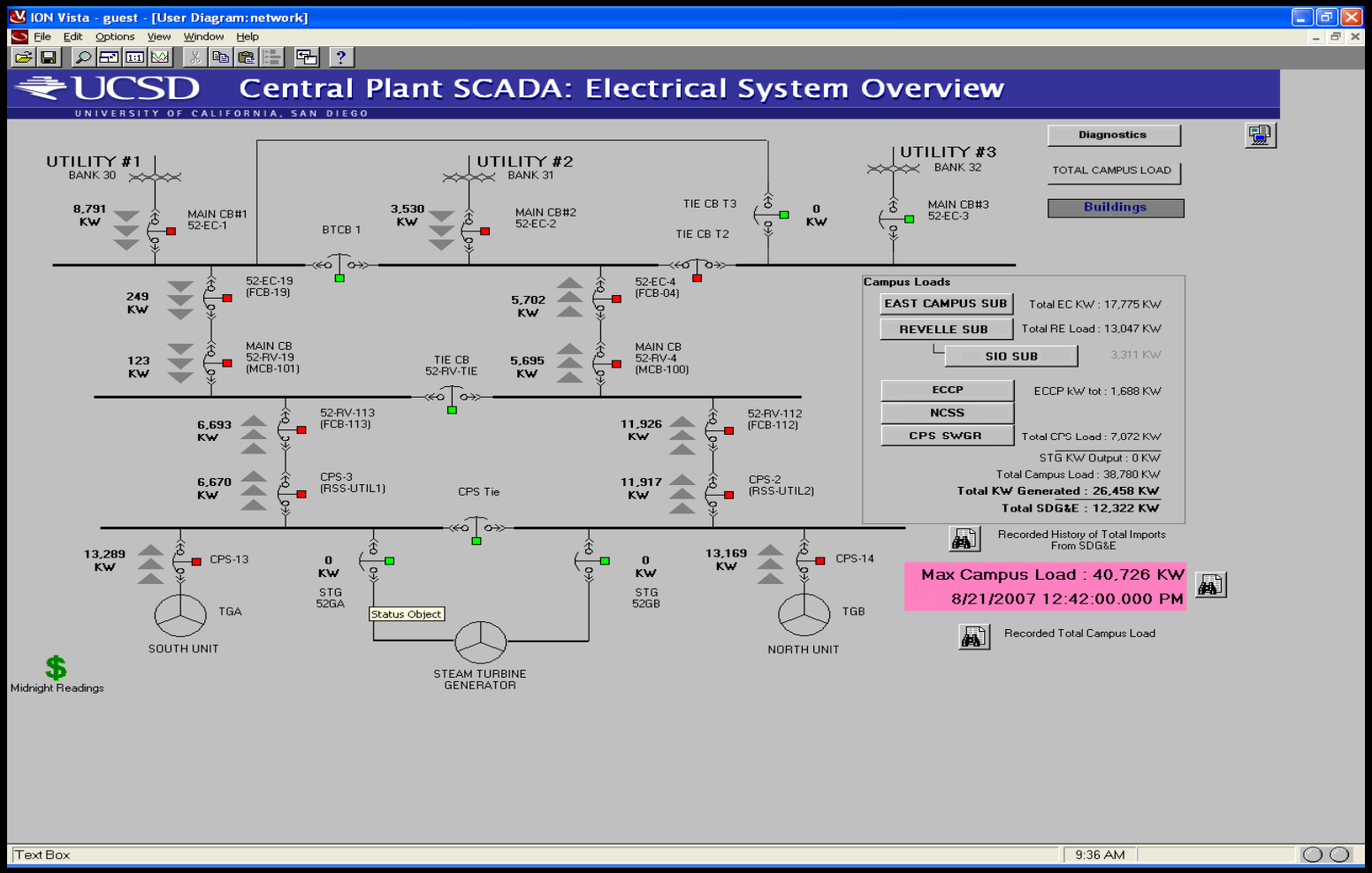
Leveraging an Existing System



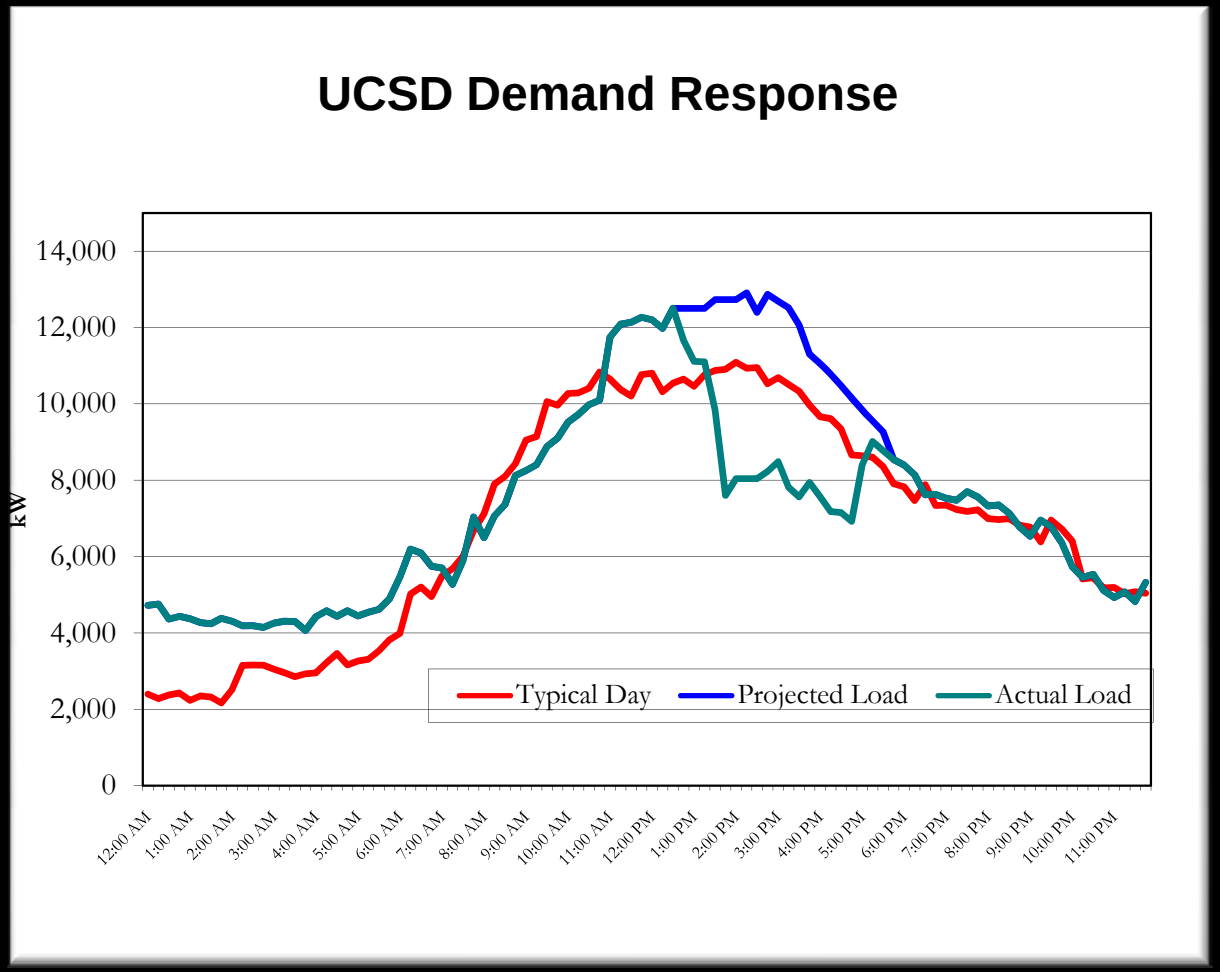
Demand Response in Action

110:53 am – SDG&E declares a Demand Response Event for today; Please review your energy reduction procedures and reduce your load during the hours noted below:

Event Start Time: 2:00 PM PDT

Event End Time: 5:00 PM PDT

Program Name: Capacity Bidding Program

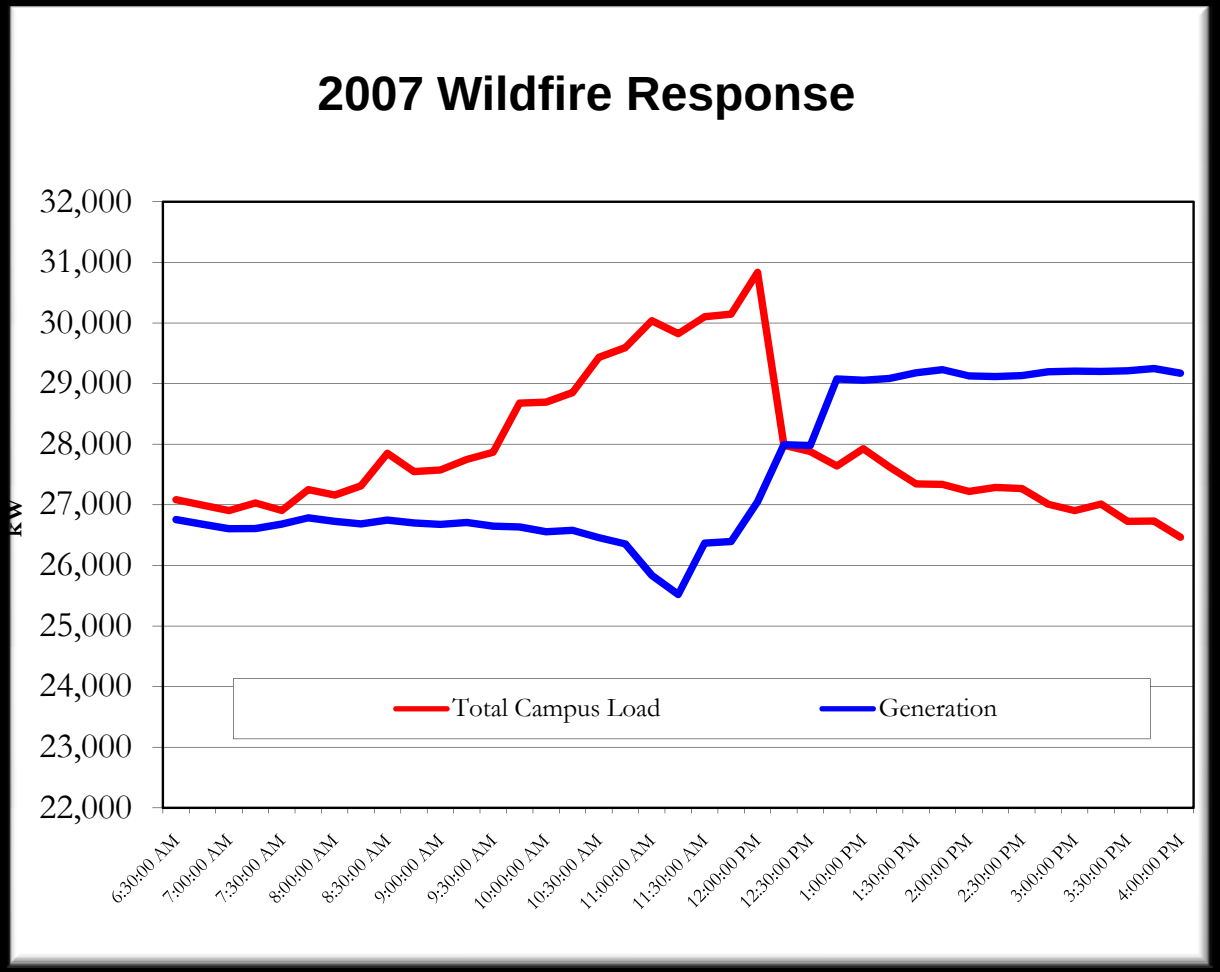


Grid Emergencies

12:00 pm – SDG&E call for assistance; UCSD initiates Demand Response

2:00 pm – SDG&E loses South Bay Unit 4, Peaker Plants not performing

2:30 pm – Loss of San Onofre link

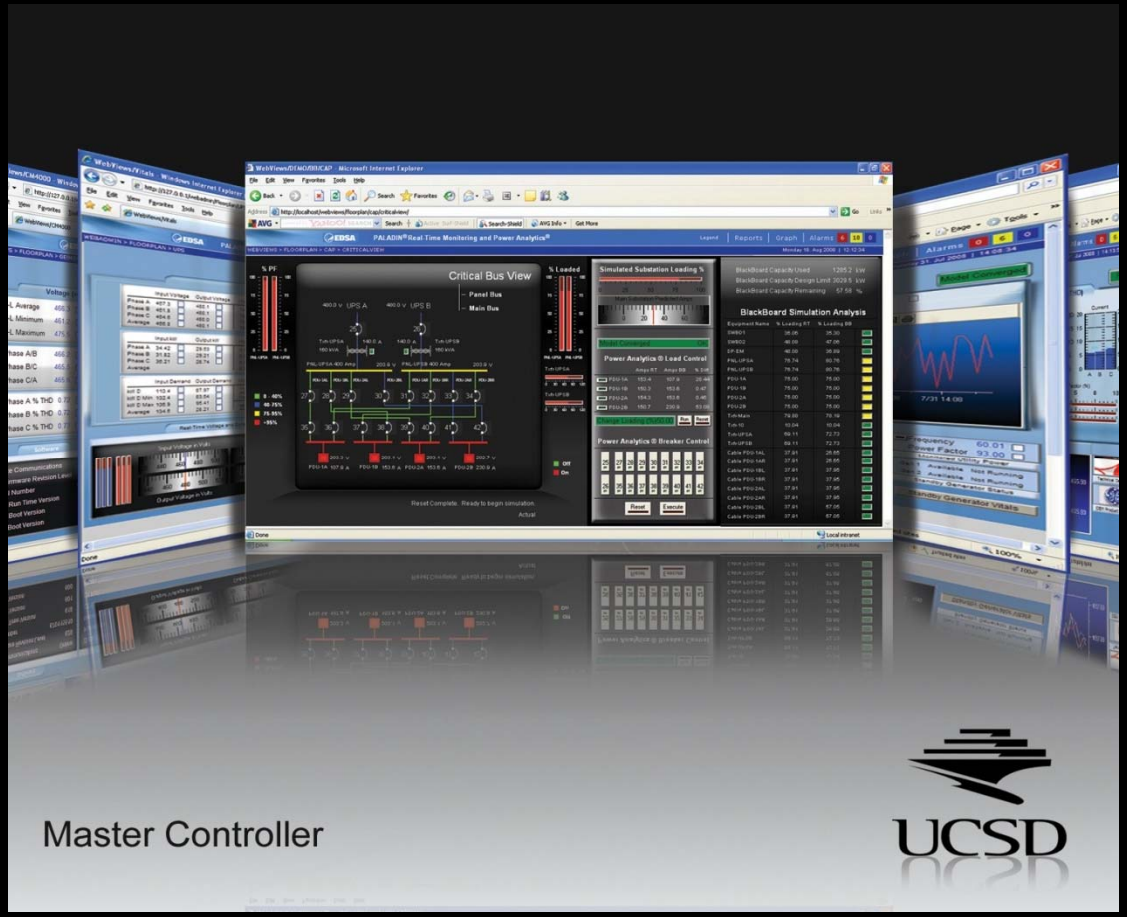


Creating a *Green* Smart Microgrid

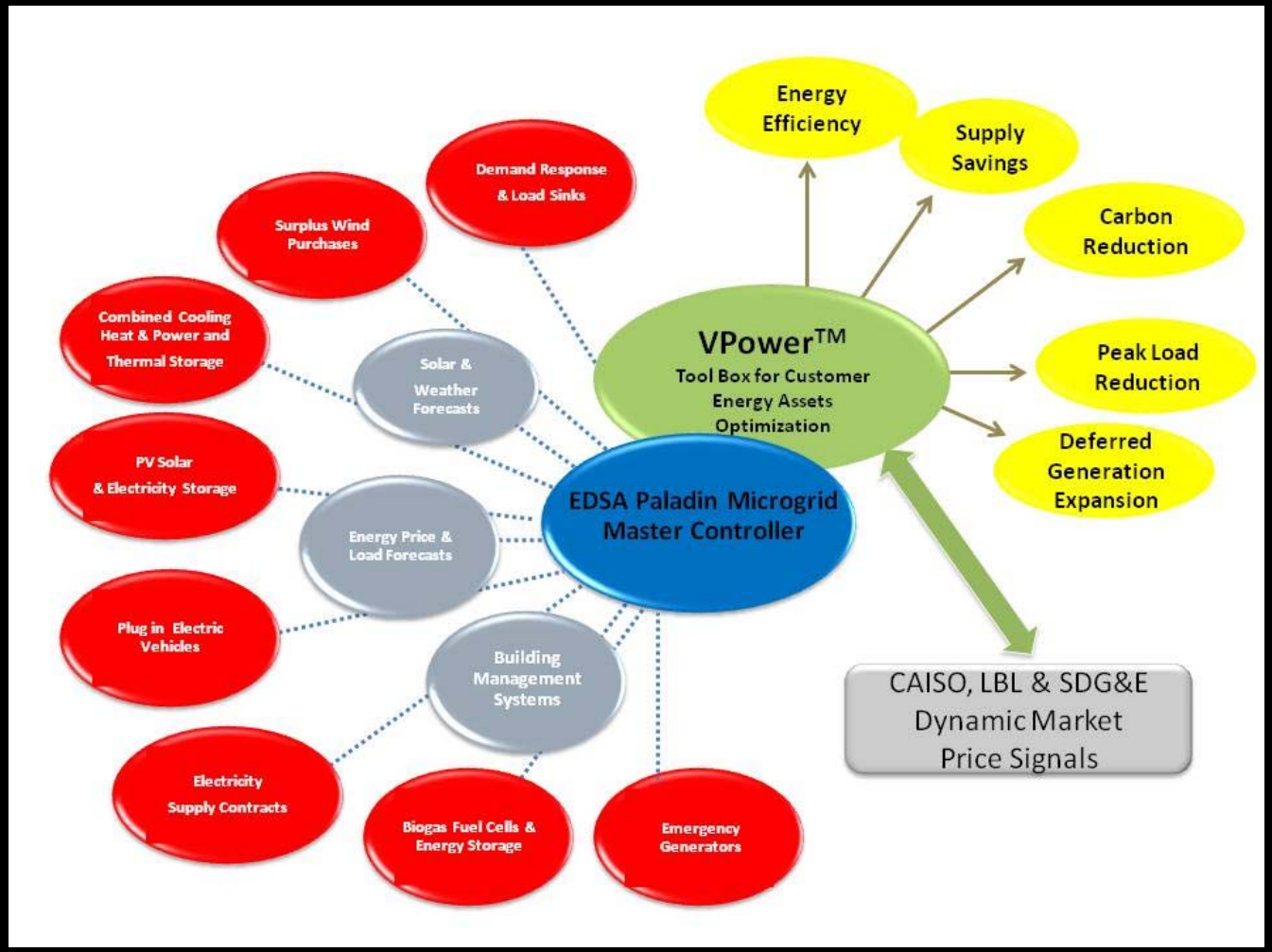
UCSD's Microgrid will embody all 7 Smart Grid Functions envisioned by the Energy Independence & Security Act, 2007

RESCO $2M program with CA Energy Commission will deploy:

- **Advanced master controller for microgrids**
- **Siemens scheduler platform for dynamic market signals allow optimization of storage and supply**
- **Real time data acquisition for analysis**



Creating a *Green* Smart Microgrid



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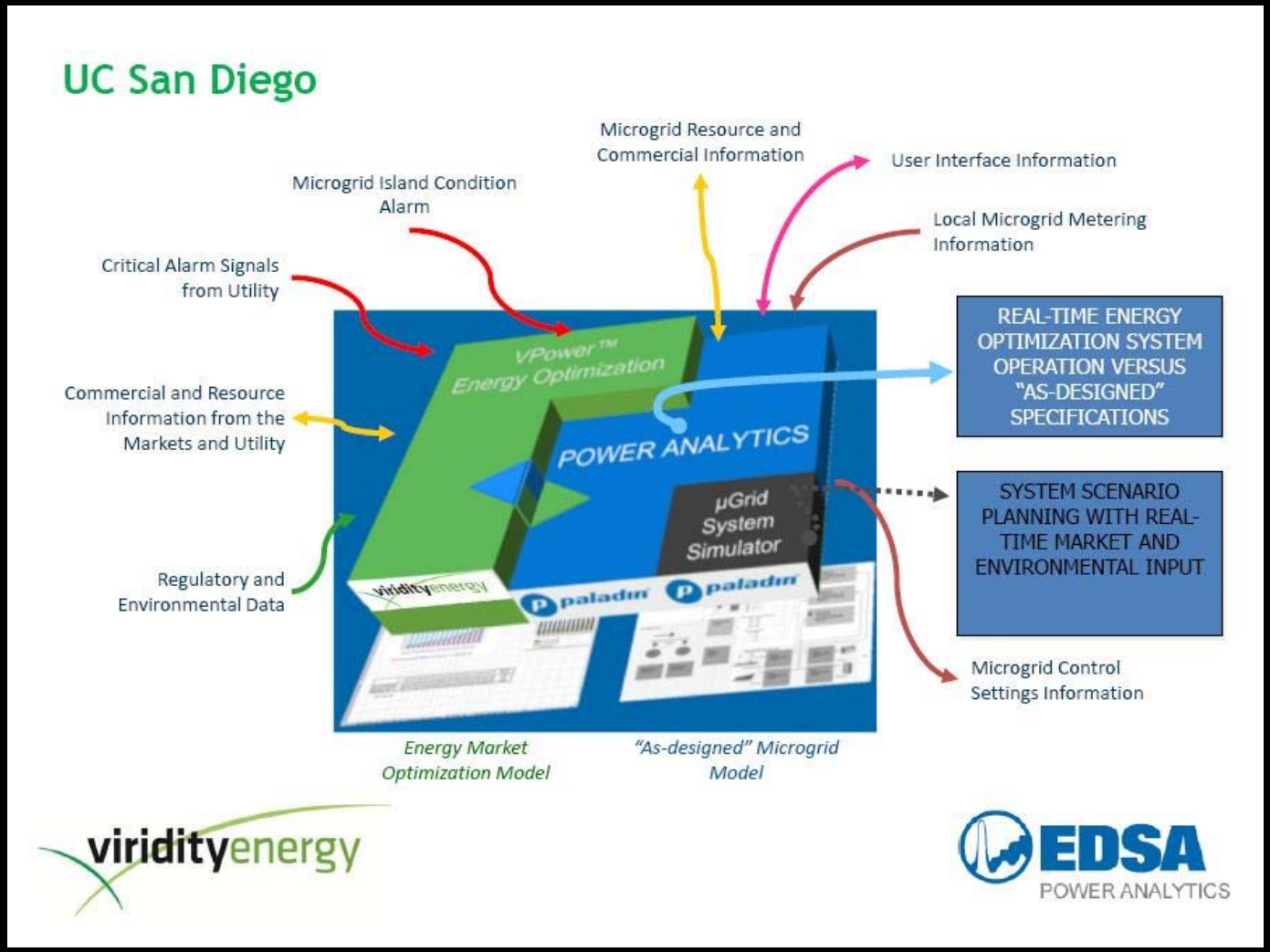
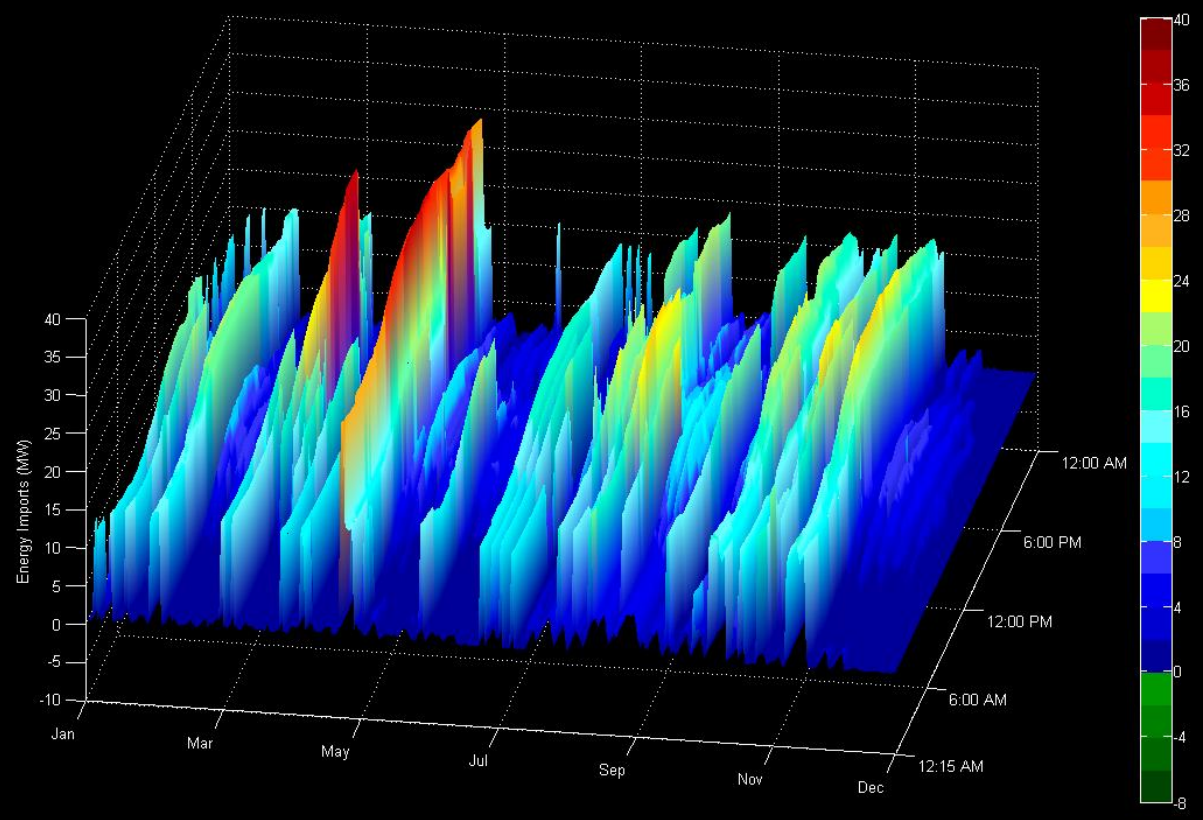


Creating a *Green* Smart Microgrid

Goal is to create an Unparalleled Granularity of Knowledge for dynamic and efficient operations

The use of San Diego Super Computer will provide an unprecedented real time data computing, analysis, and visualization.

UC San Diego grid imports, 2007



Deploying Solar Power

Become one of the Leading University Sites in the World for Photovoltaic Energy (PV)

We have used CSI incentives to develop 1MW of PV energy

Deploying Fuel Cells

Become Leading University Site in the World for *Ultra Clean* Fuel Cells

Campus plans to install 2.8 megawatt methane powered Fuel Cell.

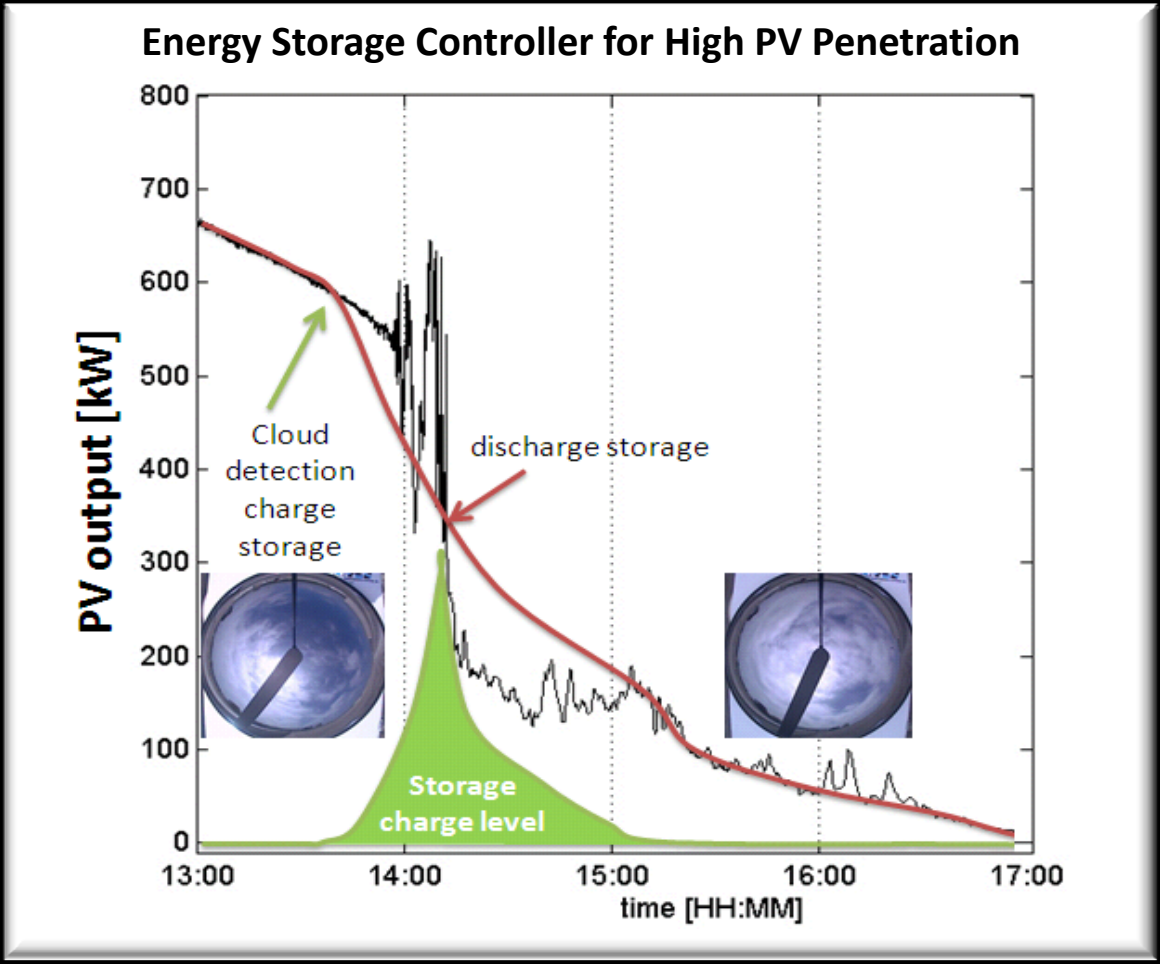
Methane transported to campus provides an economic, renewable energy resource with a net CO2 reduction.

Collaboration with Faculty Innovators

16 advanced weather stations across campus provide dense network of microclimate data

Automated Cloud Detection Alert has the potential to Manage Energy Storage in Real Time

- Automated cloud detection and alert
- Energy storage control based on PV output drop
- Decrease PV ramp rates from 50 kW/sec to 1 kW/sec
- Avoid voltage flicker and power outages



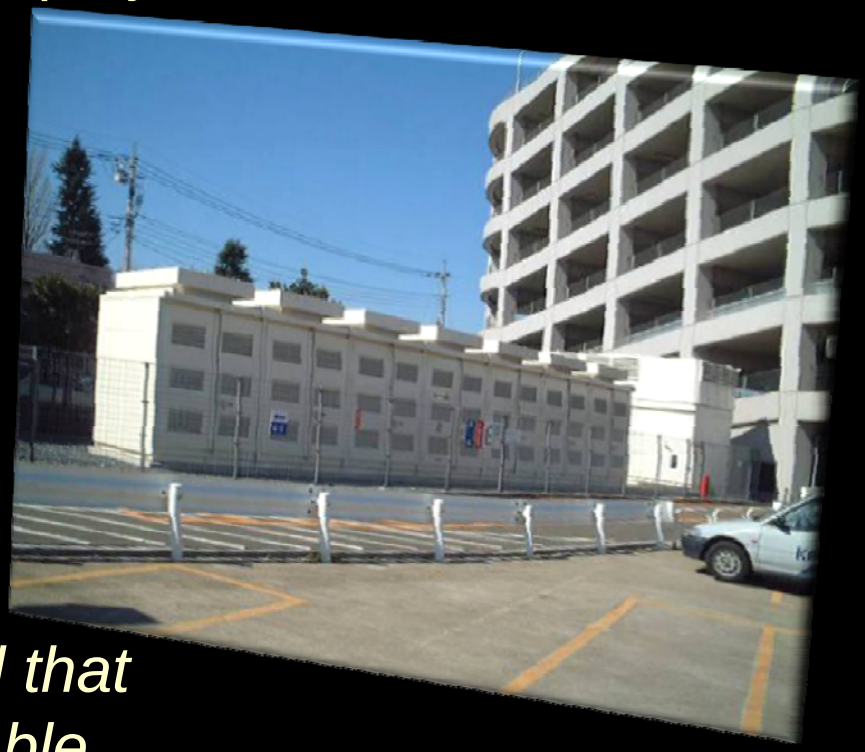
UCSD's Perspective on Energy Storage

Energy storage is the missing link and enabler technology

UCSD is pursuing 4 energy storage projects

- Distributed Energy Storage
- Frequency Regulation
- Optimized Thermal Energy Storage
- Grid to Vehicle Integration

UCSD has issued a $3.4M RFP for 2 MW / 10 MWH of Advanced Energy Storage, and bids are due December 15, 2009



The result will be a smart microgrid that is nationally replicable and scalable

Thank You

UC San Diego is a global leader in research and proto-typing solutions to climate change, renewable energy, and sustainable systems