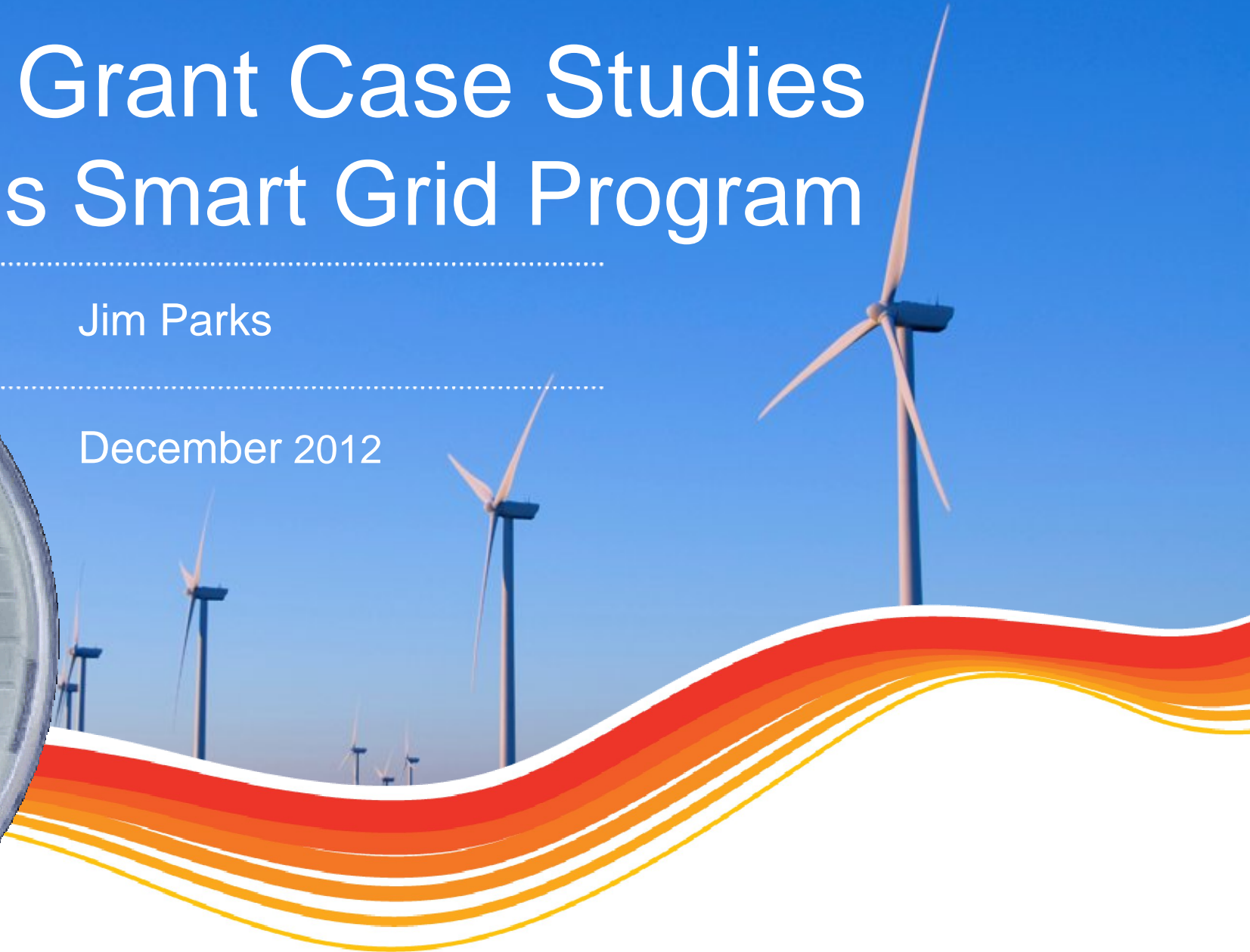
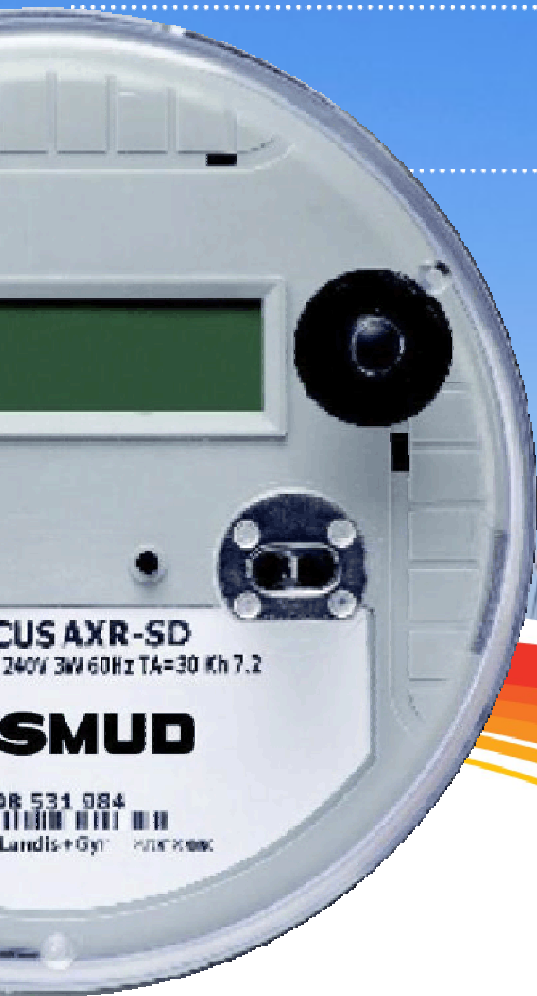


# ARRA Grant Case Studies SMUD's Smart Grid Program

Jim Parks

December 2012



Powering forward. Together.

 **SMUD**<sup>TM</sup>  
Grid-Interop 2012


# About SMUD

- 600,000 customers
- 1.4 million population
- \$1.4 billion in revenues
- 900 mi<sup>2</sup>, 2331 km<sup>2</sup>
- Elected Board of Directors
- Not-for-Profit Utility
- 2<sup>nd</sup> largest muni in California, 6th largest in the US
- 3299 MW peak load
- 2034 employees



# Smart Grid Investment Grant (SGIG)

- October 2009 DOE Announcement
  - SGIG grants to 100 entities
  - \$203 million to California
  - \$127.5 award to SMUD for a \$308 million project
  - SMUD received 63% of the SGIG funds that went to California
- Additional grants from Smart Grid R&D FOA



**U.S. DEPARTMENT OF ENERGY**

**News Media Contact(s):**  
(202) 586-4940

**For Immediate Release**  
October 27, 2009

**President Obama Announces \$3.4 Billion Investment to Spur Transition to Smart Energy Grid**  
*Applicants say investments will create tens of thousands of jobs, save energy and empower consumers to cut their electric bills*

ARCADIA, FLORIDA – Speaking at Florida Power and Light's (FPL) DeSoto Next Generation Solar Energy Center, President Barack Obama today announced the largest single energy grid modernization investment in U.S. history, funding a broad range of technologies that will spur the nation's transition to a smarter, stronger, more efficient and reliable electric system. The end result will promote energy-saving choices for consumers, increase efficiency, and foster the growth of renewable energy sources like wind and solar.

The \$3.4 billion in grant awards are part of the American Reinvestment and Recovery Act, and will be matched by industry funding for a total public-private investment worth over \$8 billion. Applicants state that the projects will create tens of thousands of jobs, and consumers in 49 states will benefit from these investments in a stronger, more reliable grid. Full listings of the grant awards by category and state are available [HERE \(http://www.energy.gov/recovery/smartgrid\\_maps/SGIGSelections\\_Category.pdf\)](http://www.energy.gov/recovery/smartgrid_maps/SGIGSelections_Category.pdf) and [HERE \(http://www.energy.gov/recovery/smartgrid\\_maps/SGIGSelections\\_State.pdf\)](http://www.energy.gov/recovery/smartgrid_maps/SGIGSelections_State.pdf). A map of the awards is available [HERE \(http://www.energy.gov/recovery/smartgrid\\_maps/SmartGridGrantLocations.pdf\)](http://www.energy.gov/recovery/smartgrid_maps/SmartGridGrantLocations.pdf).

An analysis by the Electric Power Research Institute estimates that the implementation of smart grid technologies could reduce electricity use by more than 4 percent by 2030. That would mean a savings of \$20.4 billion for businesses and consumers around the country, and \$1.6 billion for Florida alone -- or \$56 in utility savings for every man, woman and child in Florida.

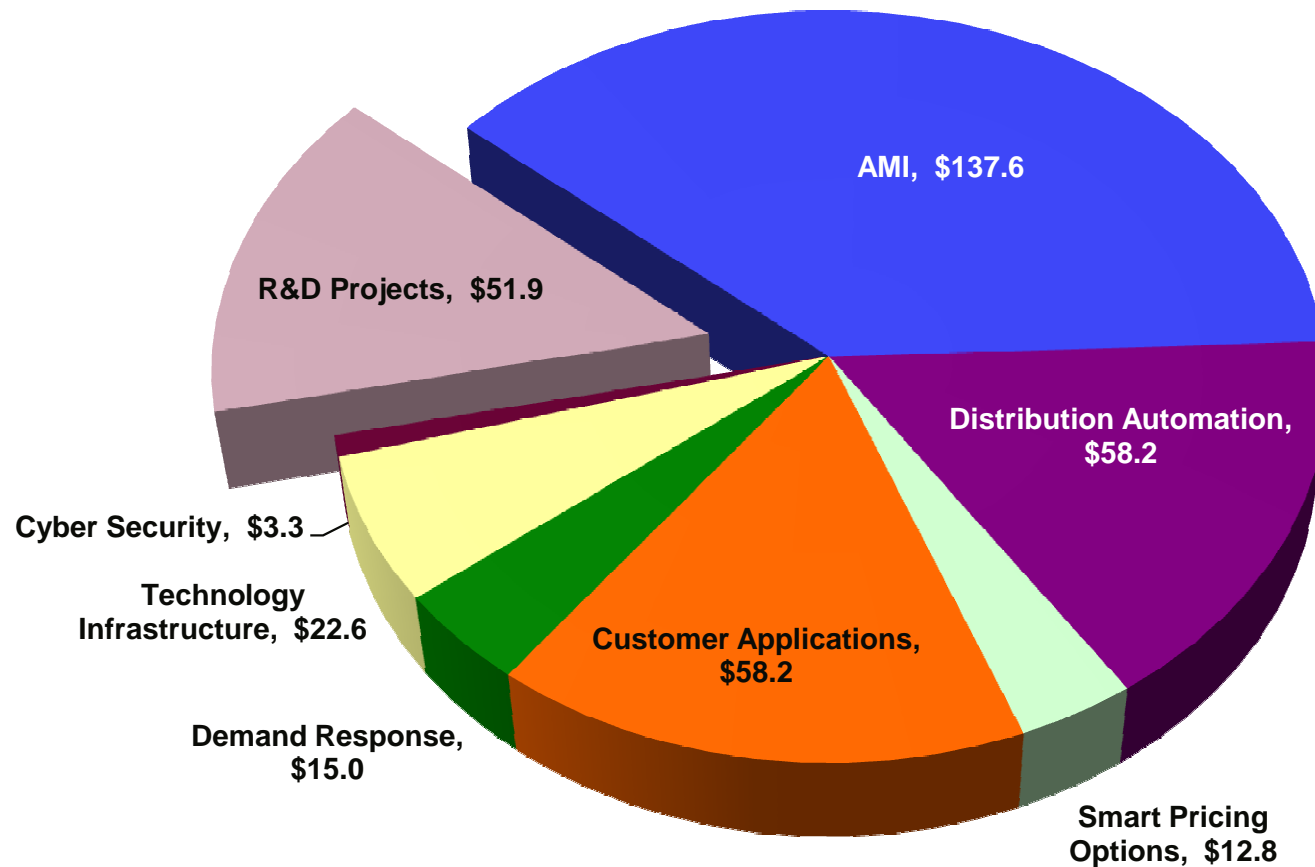
One-hundred private companies, utilities, manufacturers, cities and other partners received the Smart Grid Investment Grant awards today, including FPL, which will use its \$200 million in funding to install over 2.5 million smart meters and other technologies that will cut energy costs for its customers. In the coming days, Cabinet Members and Administration officials will fan out to awardee sites across the country to discuss how this investment will create jobs, improve the reliability and efficiency of the electrical grid, and help bring clean energy sources from high-production states to those with less renewable generating capacity. The awards announced today represent the largest group of Recovery Act awards ever made in a single day and the largest batch of Recovery Act clean energy grant awards to-date.

Today's announcement includes:

- **Empowering Consumers to Save Energy and Cut Utility Bills – \$1 billion.** These investments will create the infrastructure and expand access to smart meters and customer systems so that consumers will be able to access dynamic pricing information and have the ability to save money by programming smart appliances and equipment to run when rates are lowest. This will help reduce energy bills for everyone by helping drive down "peak demand" and limiting the need for "stand-by" power plants – the most expensive power generation there is.

# Smart Grid Projects & Budgets

Smart Grid Budget \$359.6M (\$307.7M SGIG + \$51.9M R&D)



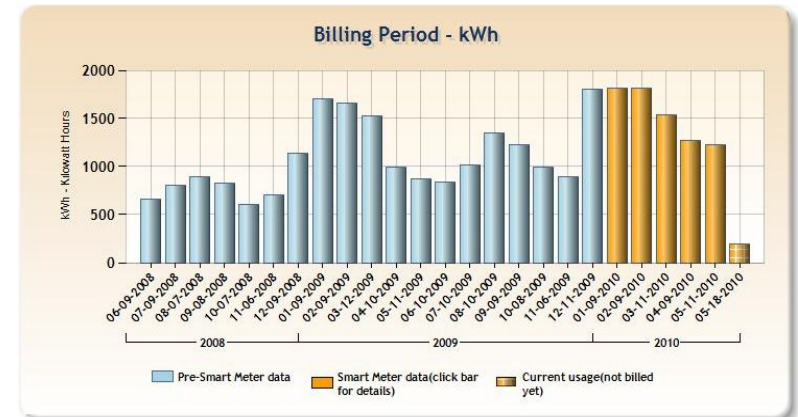


# Smart Meters



## Scope

- Install 614,000 meters and supporting communication network
  - TOU/CPP capable
  - Outage notification
  - Yesterday's data today
  - System voltage reads
  - Automatic connect/disconnect
  - Transformer loading characteristics



# Smart Pricing Options

## Scope

- Conduct a dynamic pricing pilot offering:
  - Opt-in
  - Opt-out
  - Time of Use (TOU)
  - Critical Peak Price (CPP)
  - Time of Use with a Critical Peak Price (TOU-CPP)

To residential customers to determine the impacts of various offers on peak load reduction & customer satisfaction

# Smart Pricing Options

## Accomplishments

- Recruitment
  - 3,000 customers on CPP or CPP/TOU rate
  - 5,100 customers on TOU rate
  - Pricing options will be tested through the summer of 2013 (two summer seasons)
  - CPP rate implemented up to 12 times/summer
  - Initiated CPP 9 events through 8/22/12
  - Less than 5% attrition—very low!
- In-Home Displays
  - In-Home displays (Energy Aware) provided to select customers
  - 4,000 IHDs delivered

# Demand Response

## Scope

- Procure and install a demand response management system (DRMS) software platform
- Demand Response Pilots for residential and small commercial customers-perform system integration and testing of 2,000 home area network (HAN) devices
- Develop and implement an Automated Demand Response (AutoDR) program for medium and large commercial customers



# Demand Response



## Accomplishments

- The Demand Response Management System (Lockheed Martin) installation nearing completion
- In-home display devices supporting the project are being tested by NTS labs to confirm functionality
- Pre-cooling demand response pilot (controllable thermostats) underway in 180 homes
- Commercial AutoDR test design complete—120 commercial buildings will prove Auto DR capability

# Distribution Automation



## Scope

### Line Automation

- Automate 109 distribution feeders

### Substation SCADA Retrofit

- Retrofit and automate 40 existing substation transformers with supervisory control and data acquisition (SCADA) system

### Advanced Operating System

- Develop and implement control strategies that achieve volt/var optimization, conservation voltage reduction, and automatic sectionalizing and restoration on upgraded circuits

### Upgrade Outage Management System

- Upgrade to Integraph's OMS 8.2 and Mobile Thin Client

### Situational Awareness and Visualization Intelligence -- Distribution Dashboard

- Implementing a dashboard for system operators

### Outage Communication

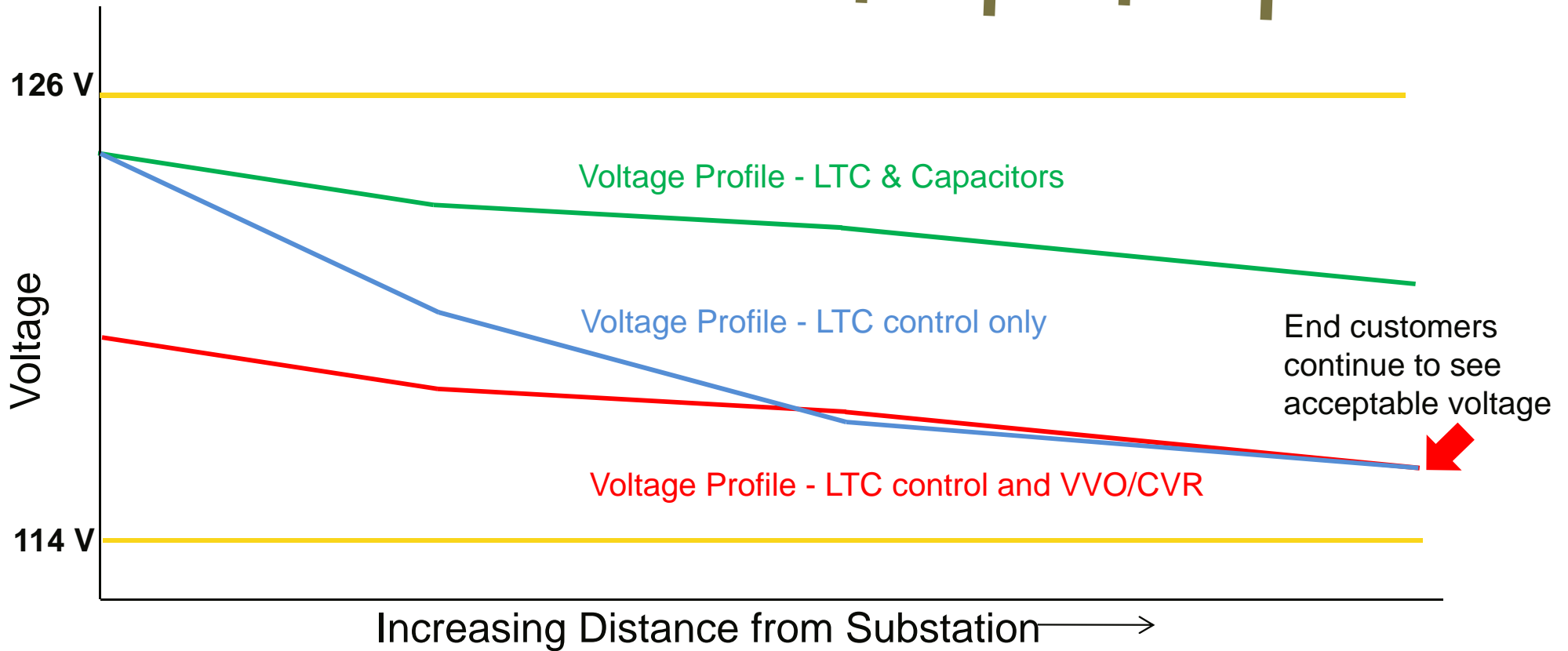
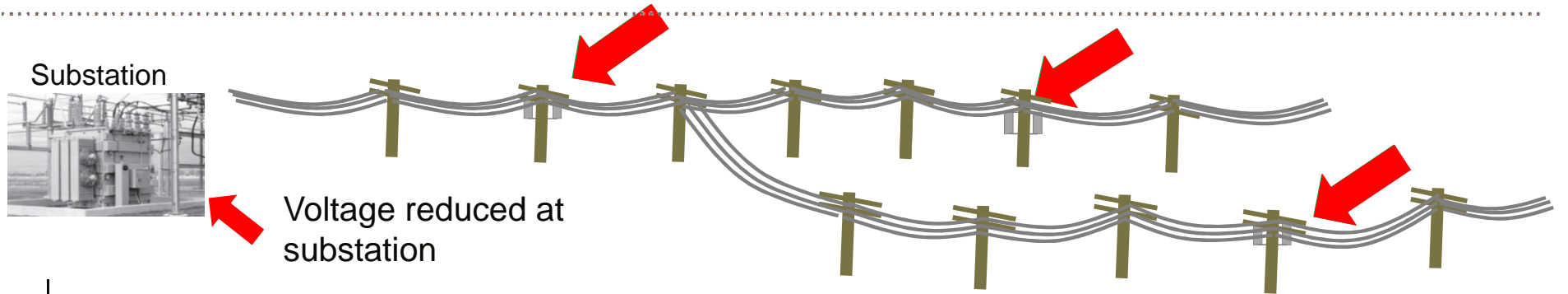
- Design and develop automated process for customer notification of outages

# Distribution Automation

## Accomplishments

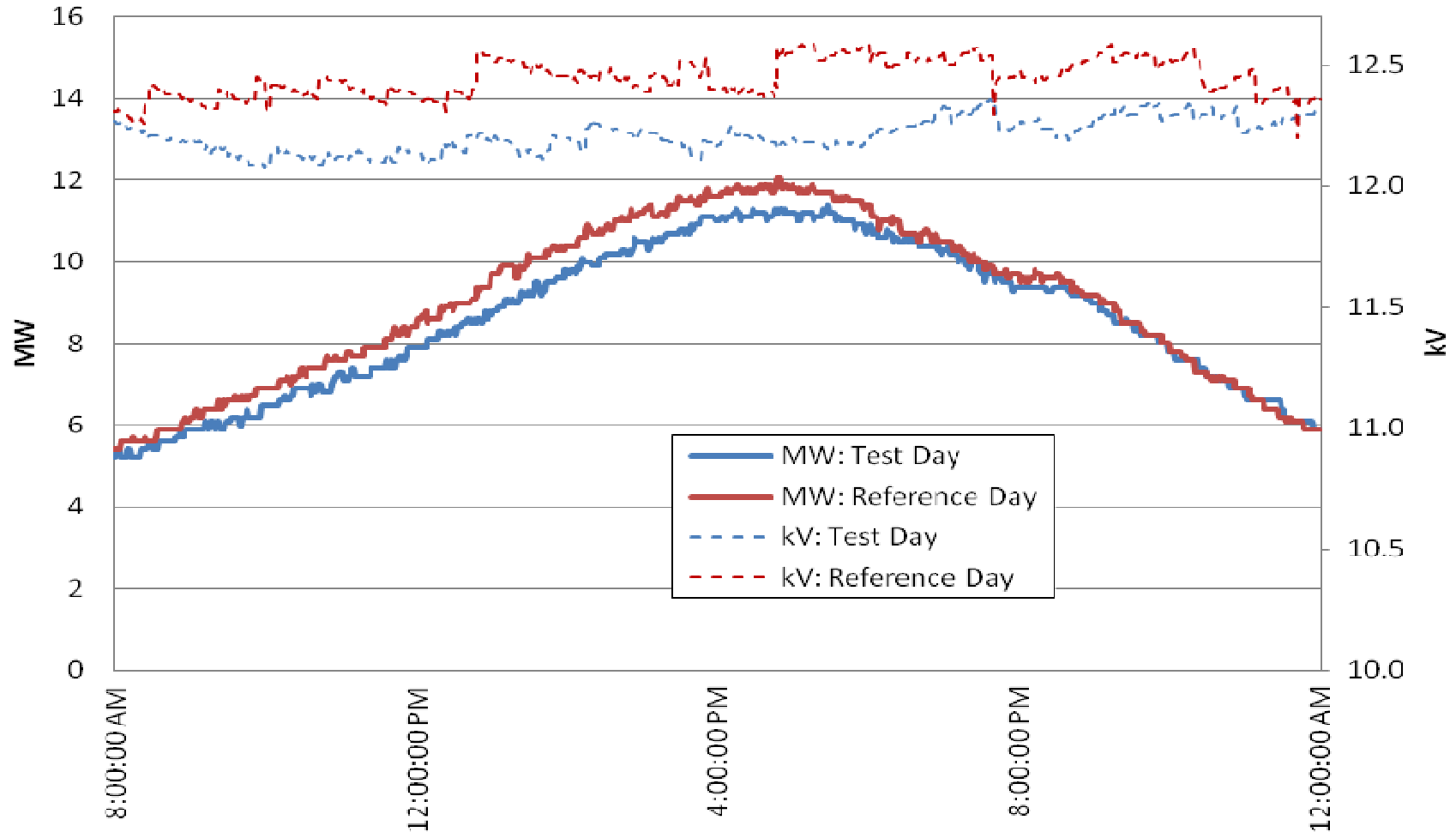
- 36 of 40 substation SCADA upgrades completed and energized
- Design of all circuit automation complete
- Line Construction 60% complete
- Measurement/Testing of CVR/VVO in Pilot areas has been completed, additional testing planned
- Lab testing of Automatic Sectionalizing & Restoration control logic complete
- Outage Management System upgraded

# VVO / CVR – Voltage Drop



# 2011 Pilot Deployment - CVR Results

## Myrtle-Date 2% CVR Analysis



# Pilot Test Findings

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- Pilot test results illustrated a range of potential impacts depending on individual feeder load response to a voltage reduction.

## Pilot Test Results for 2% Voltage Reduction

	Madison-Kenneth	Myrtle-Date
Ave Peak Demand	15.0 MW	12.4 MW
Avg Peak Demand Reduction	150 kW (~1%)	310 kW (~2.5%)
Avg Energy Impact*	0.5 MWh	4 MWh

\* Over 16 hour period



# Customer Services & Solutions

## Scope

- Develop expanded energy information and education toolset to help customers manage their energy use
- Provide technology solutions allowing customers to control and automate their electric use
- Deploy six residential and small commercial pilots to assess effectiveness of various levels of technology, automation, control and education enabled by the smart grid in comparison to more traditional methods

# Customer Services & Solutions

## Accomplishments

- Procured Residential Energy Information & Tools (REIT) web portal (Aclara) for residential and small C/I customers to help them manage their energy usage (bill alerts, energy efficiency comparisons)
- Projects underway for residential and small commercial pilots: Smart Thermostats, Energy Management Systems, Low Income Energy Management and IHD Check-Out Pilot
- Vendor selected for med-large C/I Energy Information & Tools (EPO), working on real-time pilot
- Rebate programs developed for C/I EMS and Advanced Lighting

# Partner Projects



## Scope

- Partner with six local government agencies to install and implement building energy management systems with automated demand response capability (120+ buildings)
- Install 25+ smart charging stations for plug-in hybrid and electric vehicles at CSUS and LRRCD
- Installation of AMI meter network and a grid improvement project at CSUS

# Technology Infrastructure



## Scope

### Enterprise Service Bus

- Install Enterprise Service Bus software platform to simplify integration of new smart grid systems and legacy systems
- Reduce the number, size, and complexity of integration interfaces between systems in order to reduce cost and improve speed of service to the customer

### Customer Relationship Management (CRM)

- Install Customer Relationship Management System software that integrates customer service call center with back office billing system

# Cyber Security



## Scope

- Procure and install cyber security hardware and software to prevent attack, monitor attempted attacks, and continuously check for vulnerabilities
- Incorporate cyber security at all levels of upgraded/new systems

## SMUD Smart Grid Projects

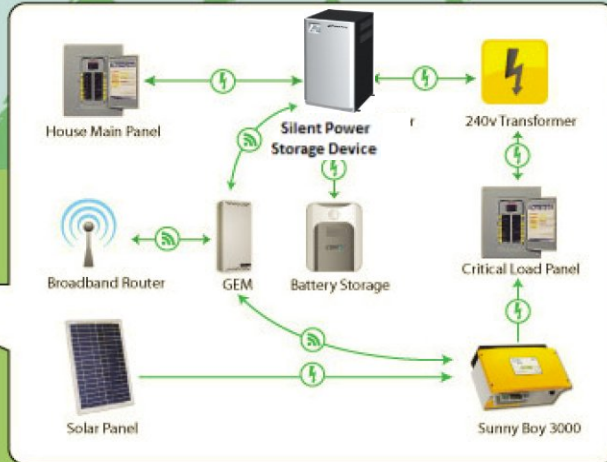
#	Project Name	Budget	DOE	CEC	3rd Party	SMUD \$
1	AMI	\$ 137.6				\$ 81.2
2	DA	\$ 58.2				\$ 34.3
3	Smart Pricing Options	\$ 12.8				\$ 7.6
4	Customer Applications	\$ 58.2			\$ 18.3	\$ 12.7
5	Demand Response	\$ 15.0				\$ 8.9
6	Technology Infrastructure	\$ 22.6				\$ 13.3
7	Cyber Security	\$ 3.3				\$ 1.9
<b>Total SGIG Projects</b>		<b>\$ 307.7</b>	<b>\$ 127.5</b>	<b>\$ 1.0</b>	<b>\$ 18.3</b>	<b>\$ 159.9</b>
R&D Projects						
#	Project Name	Budget	DOE	CEC	3rd Party	SMUD \$
8	Anatolia PV & Energy Storage Integration	\$ 6.0	\$ 4.3	\$ 0.5		\$ 1.0
9	Flow Batteries Distributed Storage	\$ 12.5	\$ 6.1	\$ 0.2	\$ 4.8	\$ 1.4
10	Microgrid Field Demonstration	\$ 3.0		\$ 1.6		\$ 1.4
11	Electric Transportation Infrastructure GM	\$ 4.0	\$ 2.0	\$ 0.6	\$ 0.2	\$ 1.2
12	Electric Transportation Infrastructure Chrysler	\$ 0.4	\$ 0.2	\$ 0.1		\$ 0.1
13	EV Impact Study	\$ 0.5			\$ 0.1	\$ 0.4
14	Residential Information and Controls Pilot	\$ 0.9			\$ 0.4	\$ 0.5
15	Smart Controls in Multifamily	\$ 0.5		\$ 0.3		\$ 0.2
16	PV System Advanced Inverter & Storage	\$ 3.3		\$ 2.0	\$ 0.2	\$ 1.1
17	Simply Solar	\$ 9.0	\$ 1.5	\$ 0.1	\$ 6.6	\$ 0.8
18	High Penetration PV (CPUC)	\$ 3.7			\$ 2.1	\$ 1.6
19	New Hope Dairy Digester	\$ 3.1	\$ 0.5	\$ 0.1	\$ 2.6	
20	Warmerdam Dairy Digester	\$ 5.0	\$ 0.7	\$ 0.1	\$ 4.2	
<b>Total R&amp;D Projects</b>		<b>\$ 51.9</b>	<b>\$ 15.3</b>	<b>\$ 5.5</b>	<b>\$ 21.2</b>	<b>\$ 9.8</b>
<b>Grand Total</b>		<b>\$ 359.6</b>	<b>\$ 142.8</b>	<b>\$ 6.5</b>	<b>\$ 39.5</b>	<b>\$ 169.8</b>



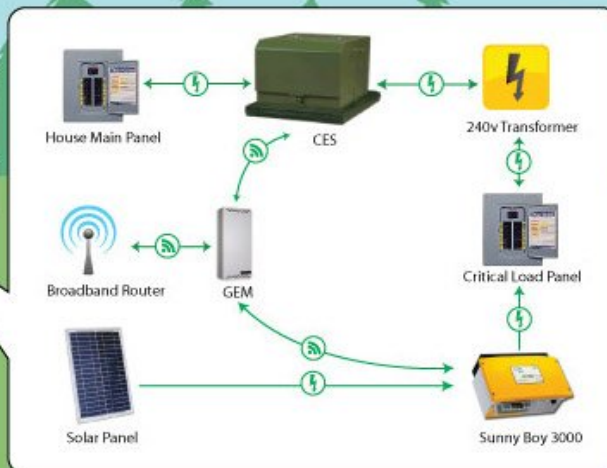
# SMUD PV & Smart Grid Pilot at Anatolia

## High Penetration Solar Development

Residential Energy Storage (RES) Group: Grid Tied with Battery Storage



Community Energy Storage (CES) Group: Grid Tied with Battery Storage

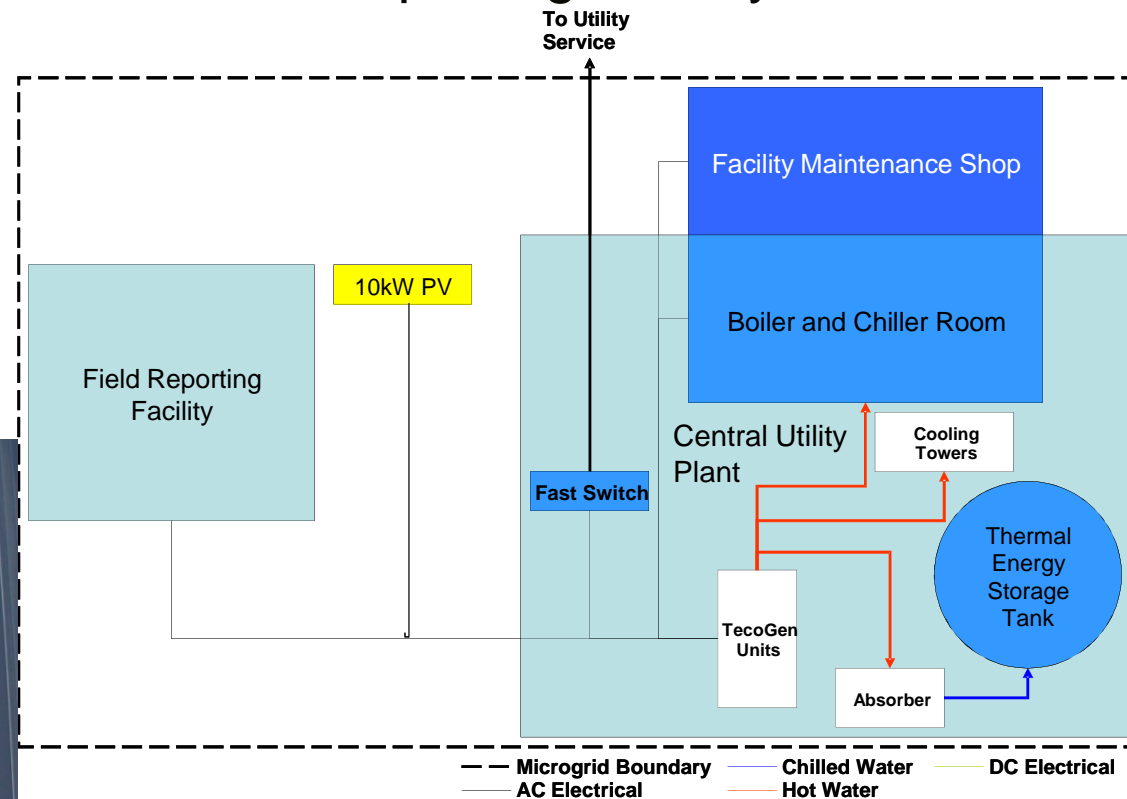


- Anatolia SolarSmart<sup>SM</sup> Homes Community (280 homes)
  - High building efficiency measures
  - 2kW PV systems
- Installing 15 RES (10kW/8.8kWh) and 3 CES (30kW/30kWh) units
- Will firm renewables, reduce peak load and improve reliability
- Installing utility and customer portals to monitor PV, storage, customer load
- Sending price signals to affect changes in customer usage
- Quantifying costs and benefits of this storage deployment to gain insights to broader application for SMUD

# SMUD Microgrid Project Overview

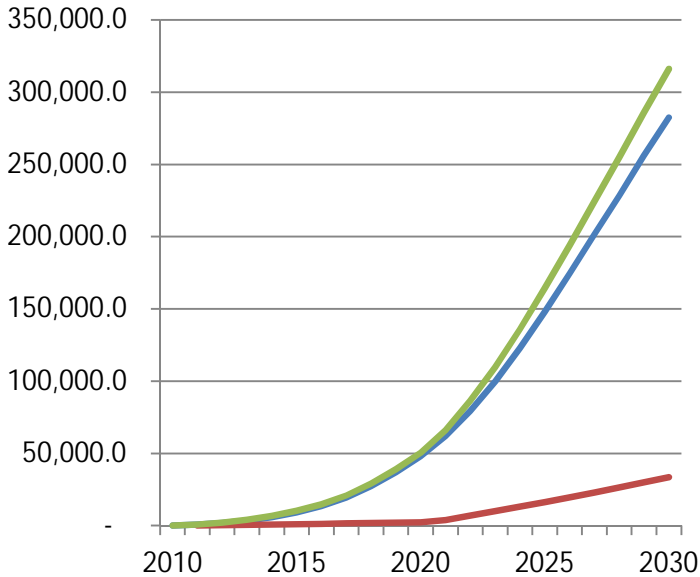
310kW demo of Microgrid concept  
for our central utility plant and Field Reporting Facility

- 3-100kW natural gas engines
- 10kW PV
- 500kW zinc-bromine flow battery
- Seamless separation and isolation from utility grid and resynchronization



- 2 centrifugal chillers (600 ton and 200 ton)
- 2 boilers
- 15,000 ton-hour chilled water energy storage (760,000 gallons)

# Electric Vehicle Potential Load Impacts



- Load becomes significant around 2025
- Local distribution impacts will be felt sooner
  - Will need to manage load

PHEV Average Projection  
 - Adjusted EPRI Model  
 - CARB Model (Oct. 2009)  
 - Charles River Associates

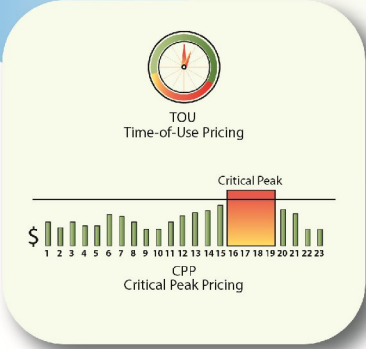
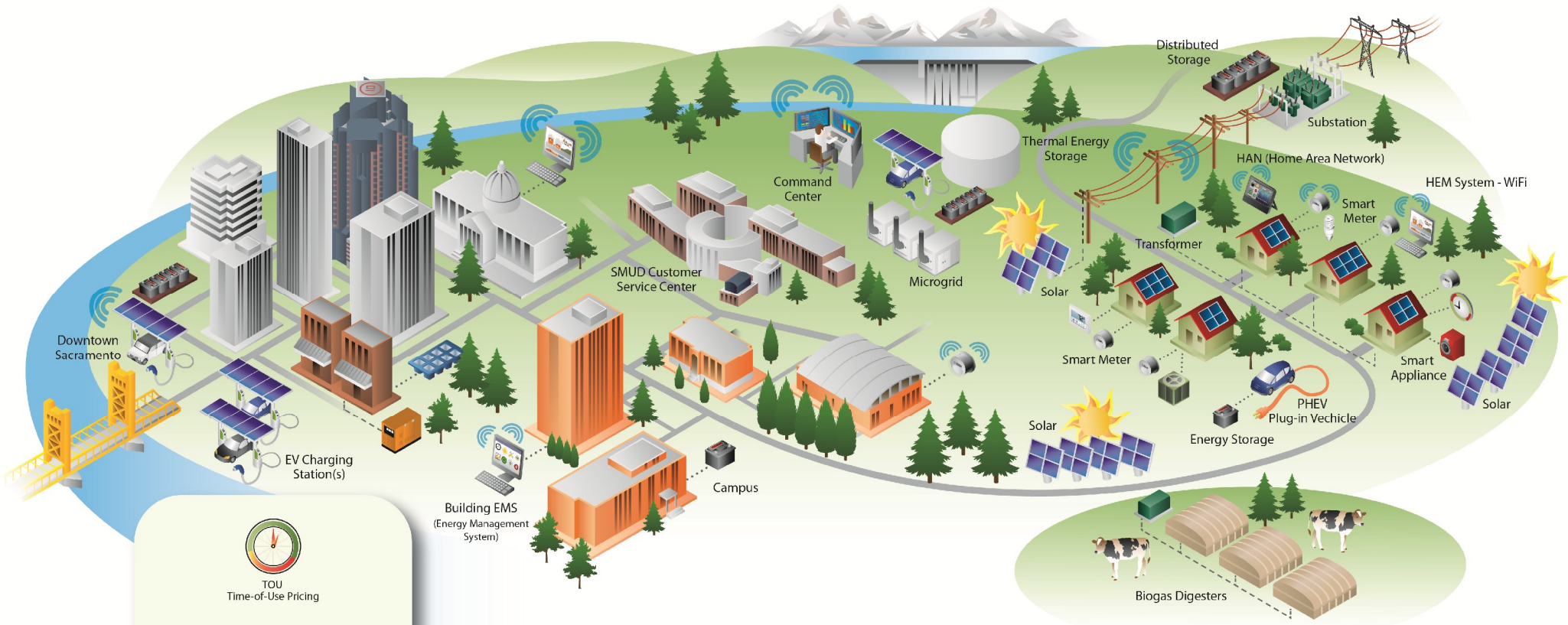
Load Calculation Assume  
 50% of PHEV's at 1.5 kW charge level  
 25% of PHEV's at 3.3 kW charge level  
 25% of PHEV's at 6.6 kW charge level  
 100% of BEV's at 6.6 kW charge level

Energy Calculation Assume  
 365 days a year of charging (worst case)  
 PHEV require 7.5 kWh of charging/day  
 BEV's require 15 kWh of charging/day

Year	PHEV	BEV	% Sac	Load	Energy
2015	9,225	1,045	0.3	35MW	53 GWh
2020	47,940	2,357	1.4	164MW	144 GWh
2025	148,108	16,322	12.2	566MW	495 GWh
2030	282,524	33,481	30.3	<b>1,097MW</b>	956 GWh



# Smart Grid Vision



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# The Possibilities

- Real-time bi-directional communication
- Accelerated fault detection and crew deployment
- Voltage monitoring to enhance CVR
- Distributed energy resources automated and integrated into the grid
  - EVs, PV, Wind, Storage, Demand response
- Full-scale automation/minimal human intervention

# Next Steps

- Finish implementing projects (major construction complete by 4/2013)
- Evaluate projects
- Evaluate interactive effects where applicable
- Develop implementation plan to guide future smart grid deployments
  - Identify projects for broad-scale deployment/expanded deployment
  - Identify budgets and staffing levels