Community Energy Systems and the Utility

CEC PAC TRP Workshop

October 25, 2010

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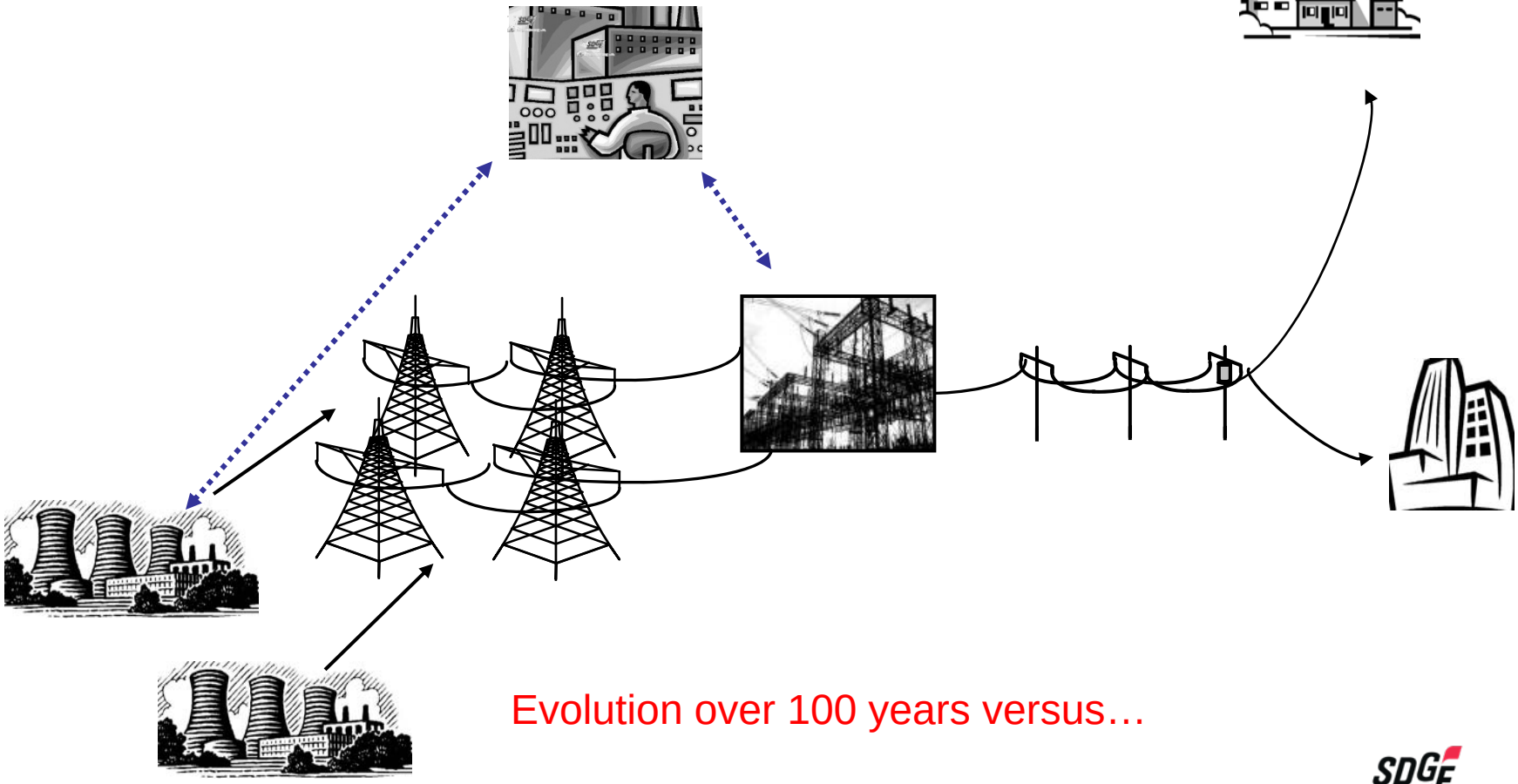
Today's Electric Utility

Limited 2-Way
Communication & Information

Energy Flow



Evolution over 100 years versus…

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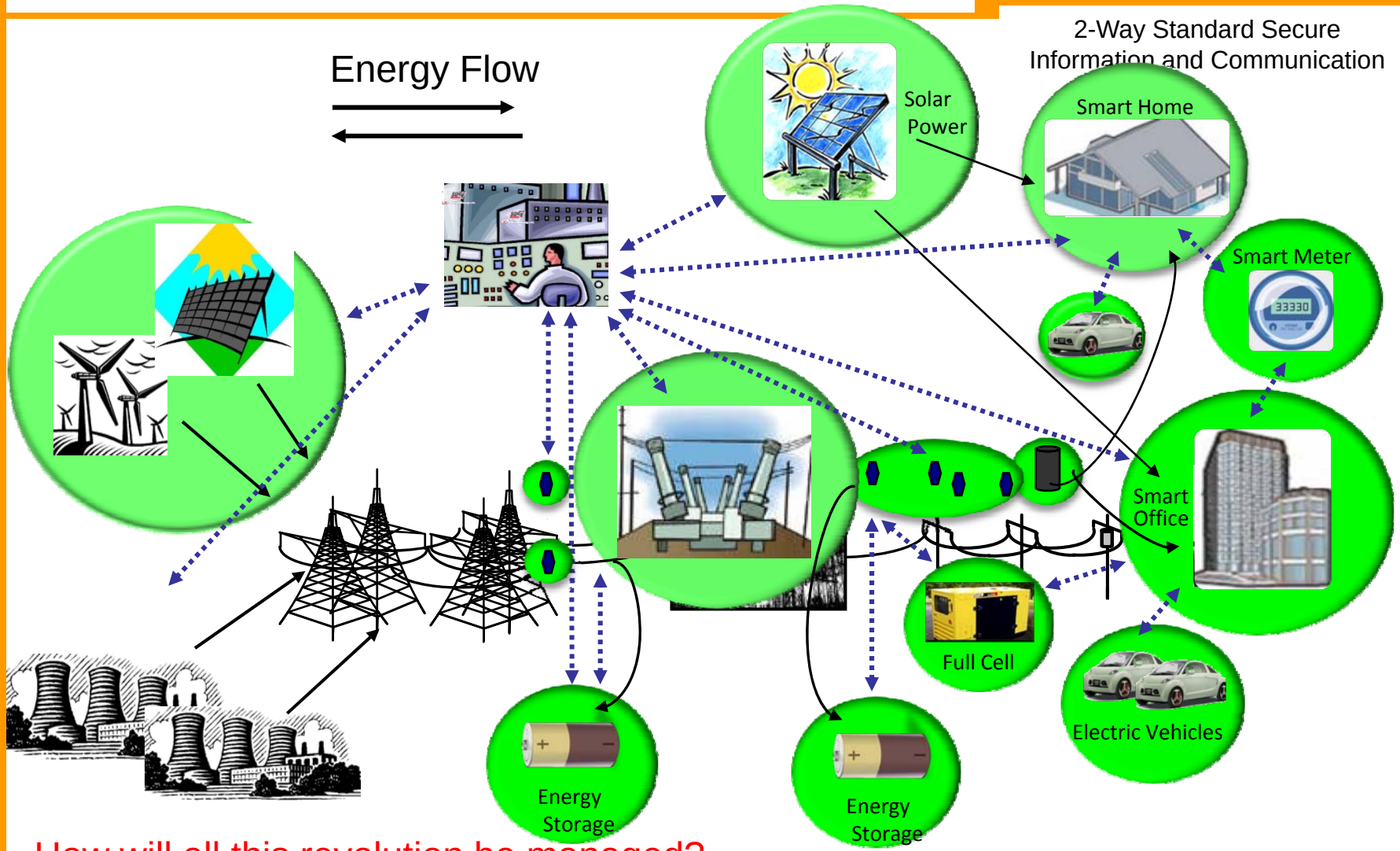
Tomorrow's Smart Grid



How will all this revolution be managed?
How will we meet these challenges?

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Macro-Drivers of the Smart Grid

Strategic Components

- **Environment** – Incorporate and enable all generation and storage options to support customer choice, improve grid stability, improve power supply options, reduce GHG

Plug-In Electric Vehicle (PEV) Integration, Renewable Resource Integration

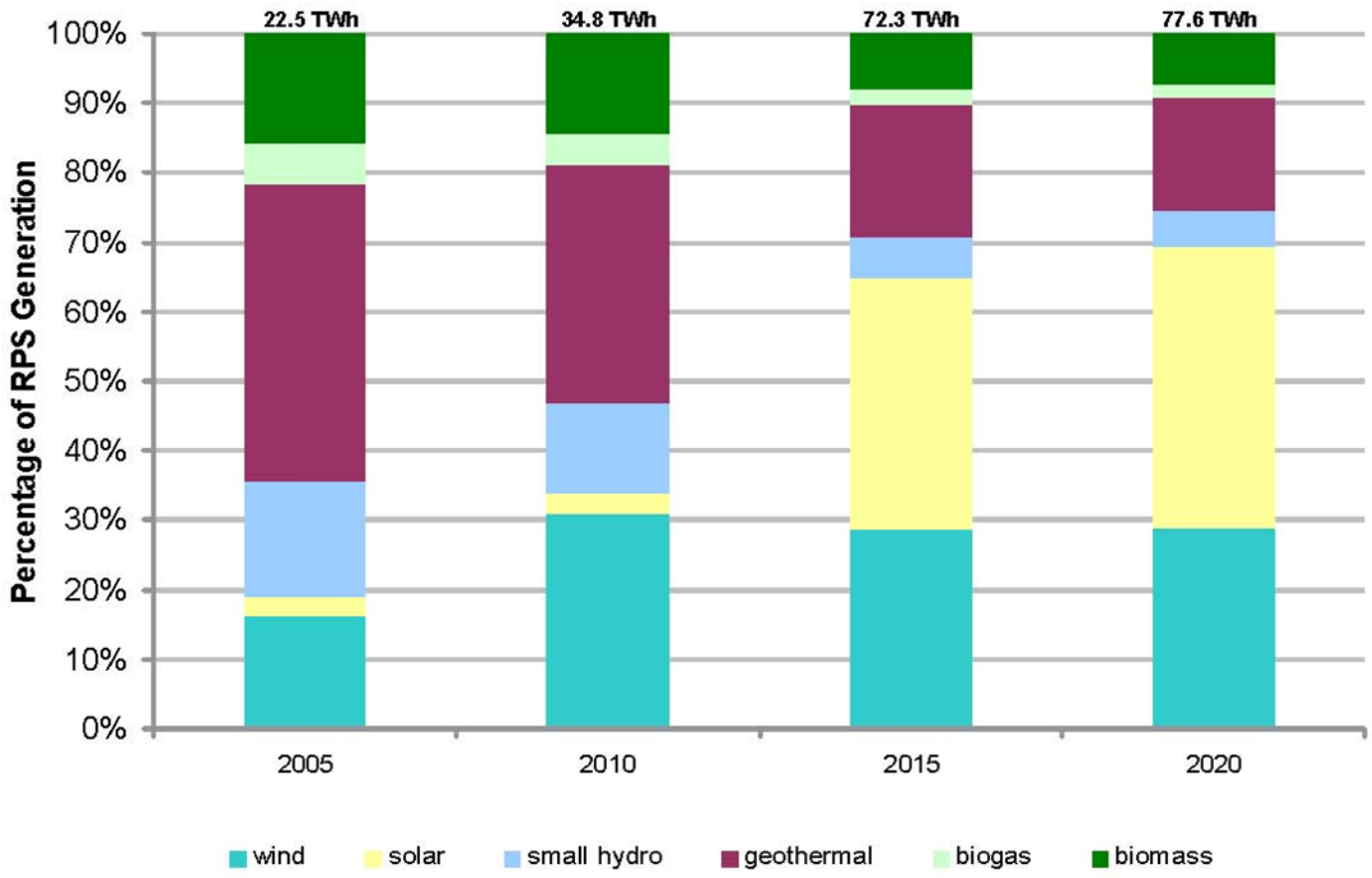
- **Customer** – Enable and motivate customer's energy management through smart energy devices, new products and services, increased Energy Efficiency (EE)/Demand Response (DR), adoption of PEVs and renewable resources

In-home/in-premise displays, control of individual appliances, Energy management systems/controllers

- **Grid** – Enhance the grid to reduce customer disruptions, resist attack, improve workforce and asset optimization

Large Scale Energy Storage, Phasor Measurement Units, Self Healing Grid, Network Communications

Large IOU Renewable Resource Mix Expected to Change Over Time



Source: California Public Utilities Commission, 3rd Quarter 2009

What impact will there be from this change in mix of resources?
How will we manage the intermittency associated with wind/solar?

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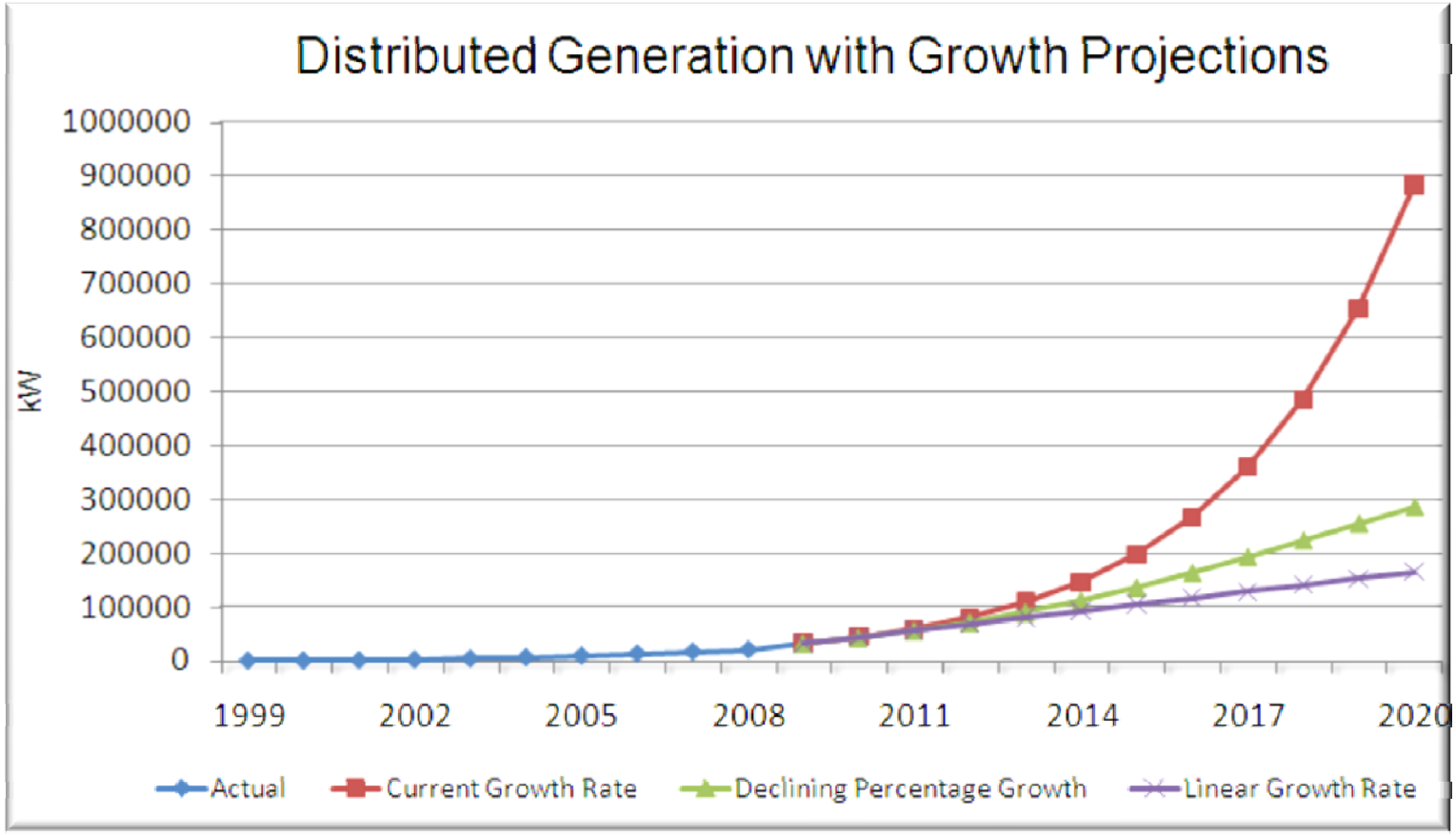
Residential Solar



Values are for illustration only and do not represent forecasts

- How will the uncertainty of growth be managed?
- How can this be included in resource planning?
- How will residential solar effect system reliability?

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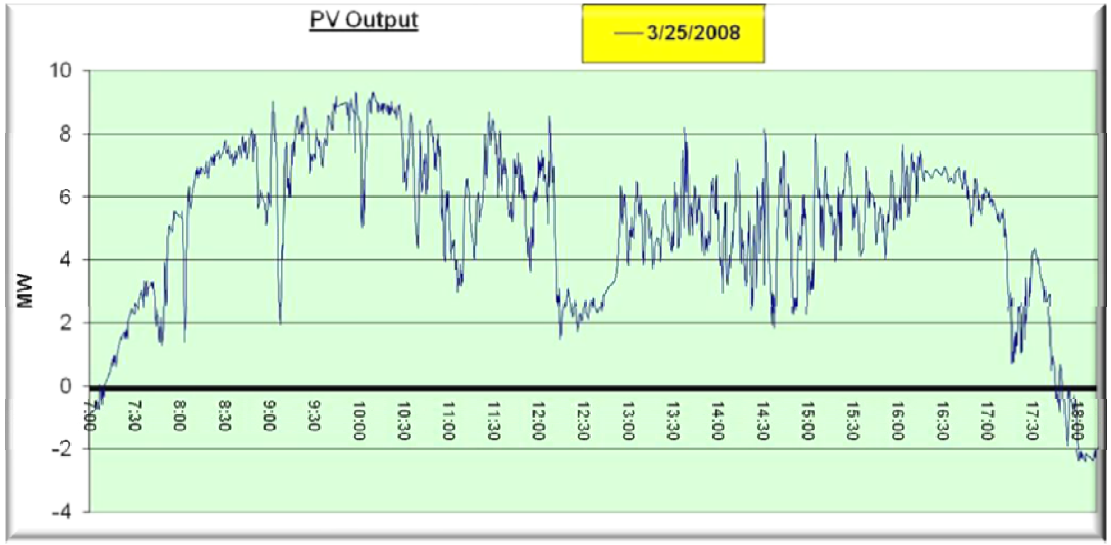
Photovoltaic Panel Output Variations

Images: US DOE

Image: sdge.com



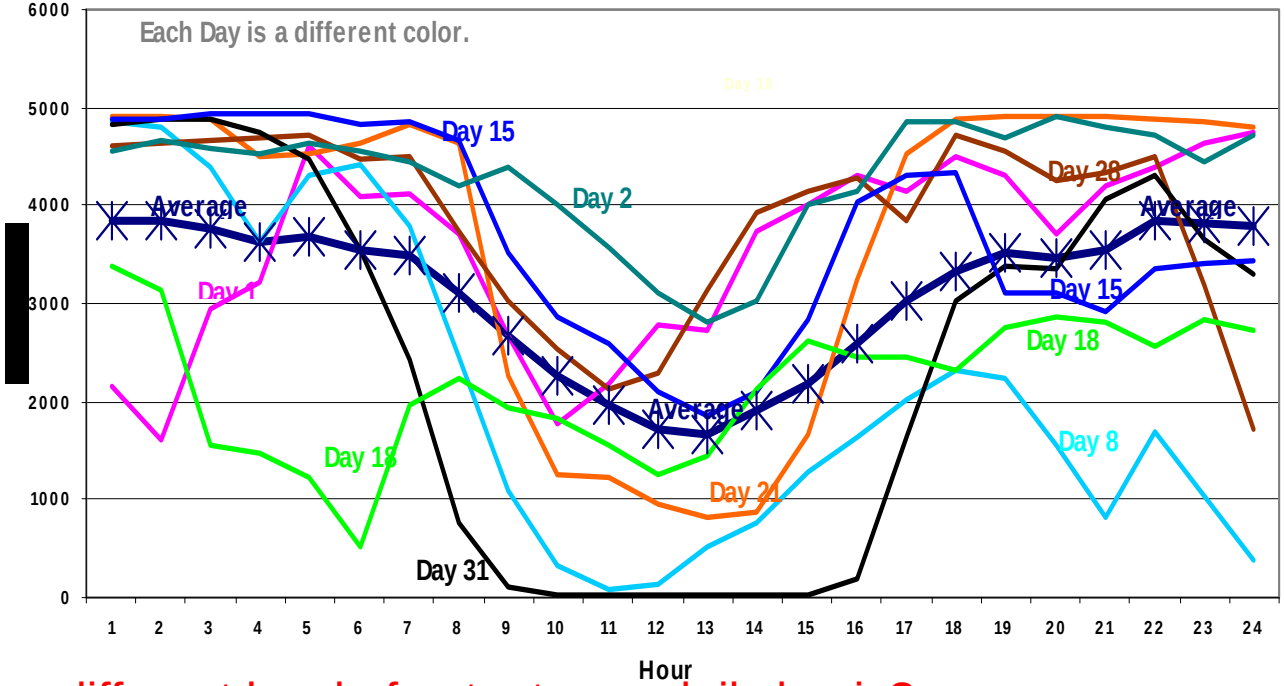
°How can the hourly variability be managed?

°How can this resource be optimized?

Graph: CAISO

Tehachapi in year 2010 with 5200 Megawatts of wind (projected)

Image: SCE



°How do you plan for a different level of output on a daily basis?

°Do you need '*firm*' resources to back-up intermittent resources?

Graph: CAISO

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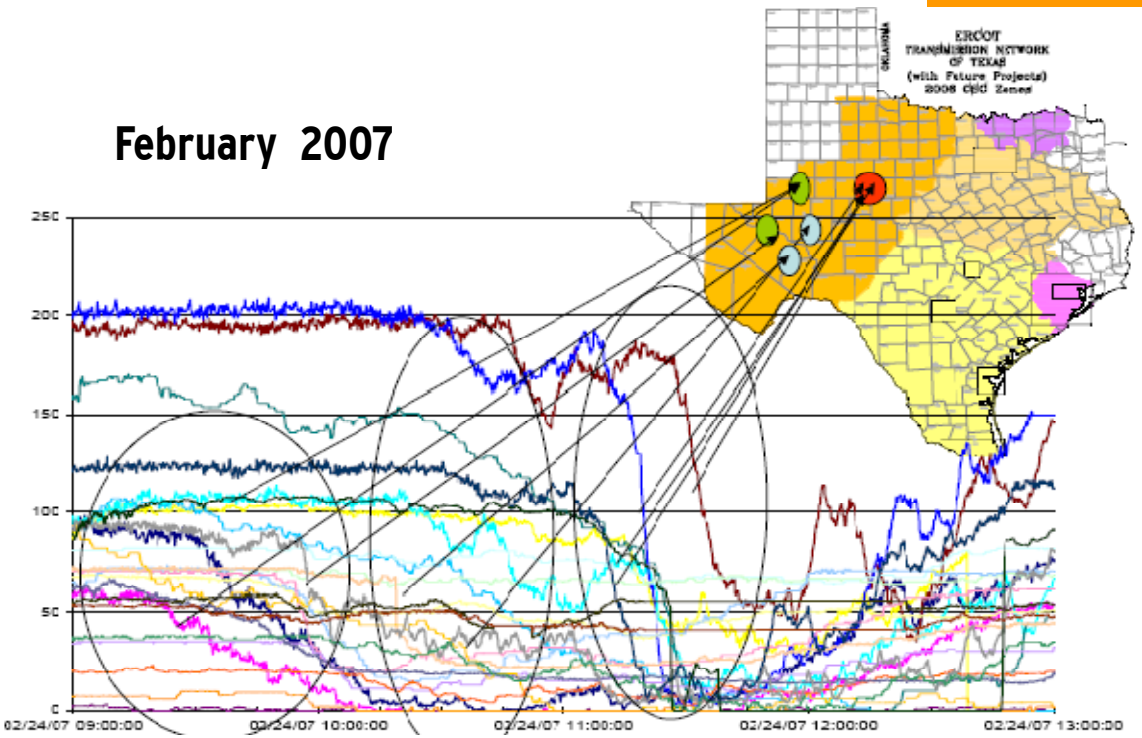
Texas Overspeed Event



Overspeed Wind Shutdown

"Wind Event on February 24, 2007", ERCOT presentation, C. Gonzalez-Perez

- What do you do if the wind stops blowing?
- What do you do if the wind blows to hard?

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Sodium Sulfur (NaS) Batteries

Images: NGK Insulators

Image: Electricity Storage Association

Normal operating temperatures of 575-650° F

- What size of storage is needed?
- What is the optimal location?
- Is the technology stable?
- How will the economics work?

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Roll-out Schedule for Plug-in Electric Vehicles

PHEV | BEV

2009

- BYD in Europe
- Fisker Karma
- Subaru Stella
- Chrysler
- Smart for Two
- ZENN City
- BYD EV in China
- Tesla Roadster

2010

- Saturn VUE
- Chevrolet Volt (5.3kW charge)
- Kia LPG/Electric
- EPRI, Eaton, Ford Trouble Truck
- Nissan LEAF
- BMW Mini E (7.7kW charge)
- Mitsubishi iMiEV
- Aptera

2010/2011

- Toyota Prius
- BYD F3DM

2012

- Ford Escape
- Hyundai

Tesla Roadster

53kWh, 17kW@240V, 70A
3.5 hr charge

Nissan Leaf

24kWh,3.3kW@240V,13A
8 hr charge

Prius PHEV Prototype

BYD F3DM

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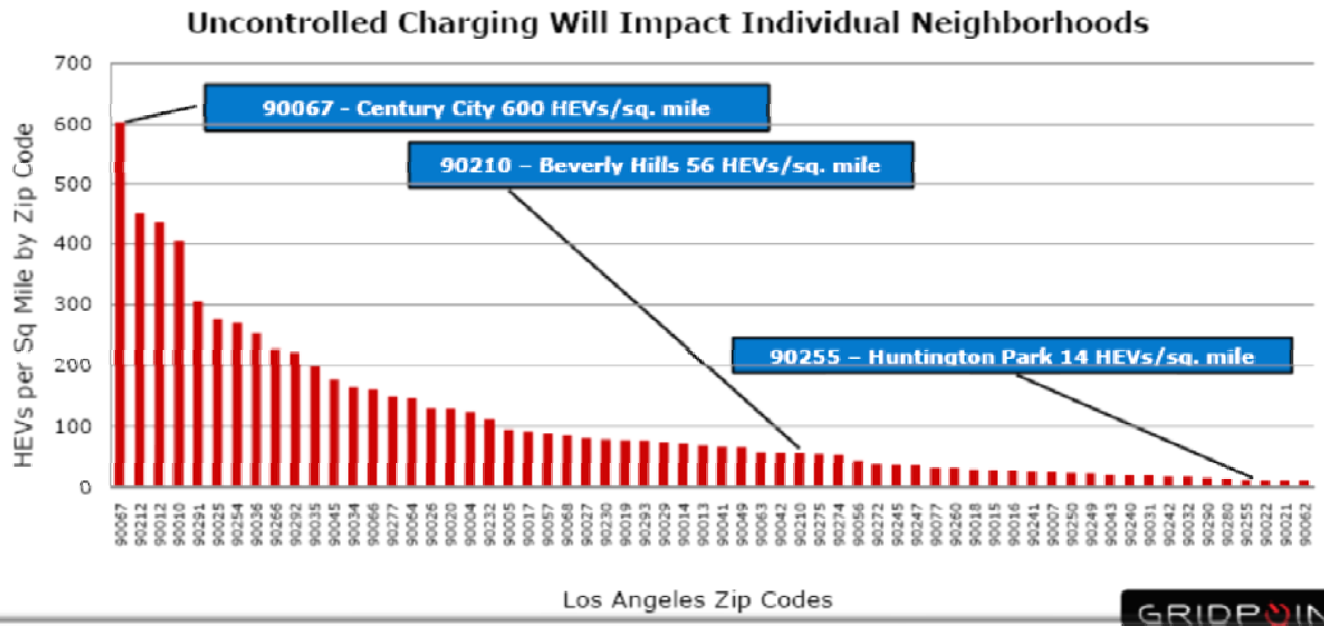
Distribution Impacts are Immediate Concern

In some areas charging management will be required almost immediately

- Density of plug-in adoption will vary significantly within a single utility grid
- This translates into a distribution level impact far before system level impact
- Clustered adoption requires location based charging management



°How do you plan your grid to meet uncertain demand?

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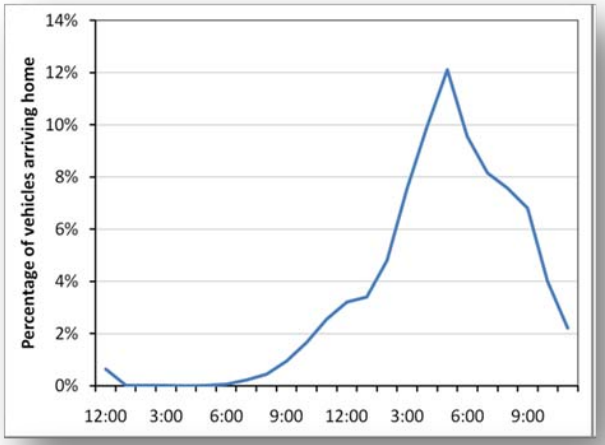
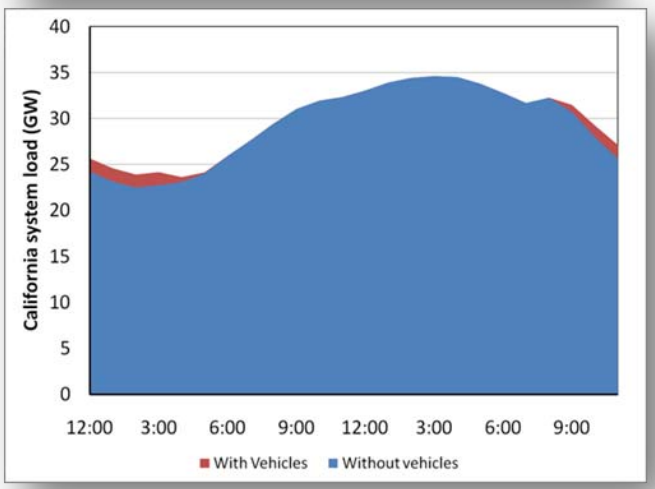
Electric Vehicle Charging

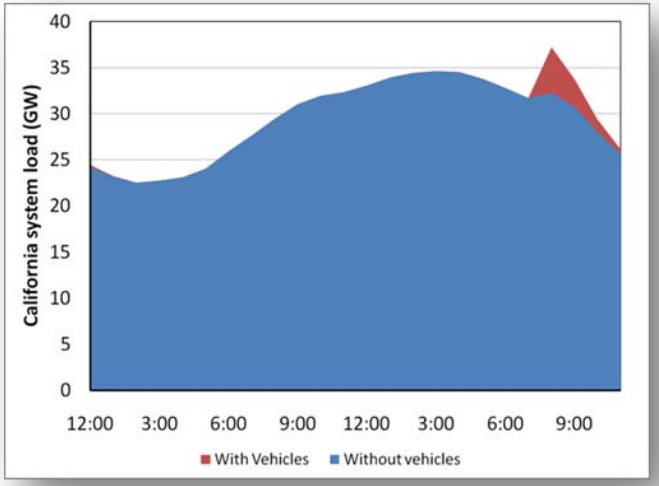
Many drivers share patterns and arrive home near the same time





A typical level 2 EV charge, 220V @ 30a could draw 6.6kW power

Power demand from "badly" controlled charging – a new, potentially disruptive peak



Controlled overnight charging could result in no increase in peak load

Source: EPRI

°How do you ensure charging at the '*right time*'?

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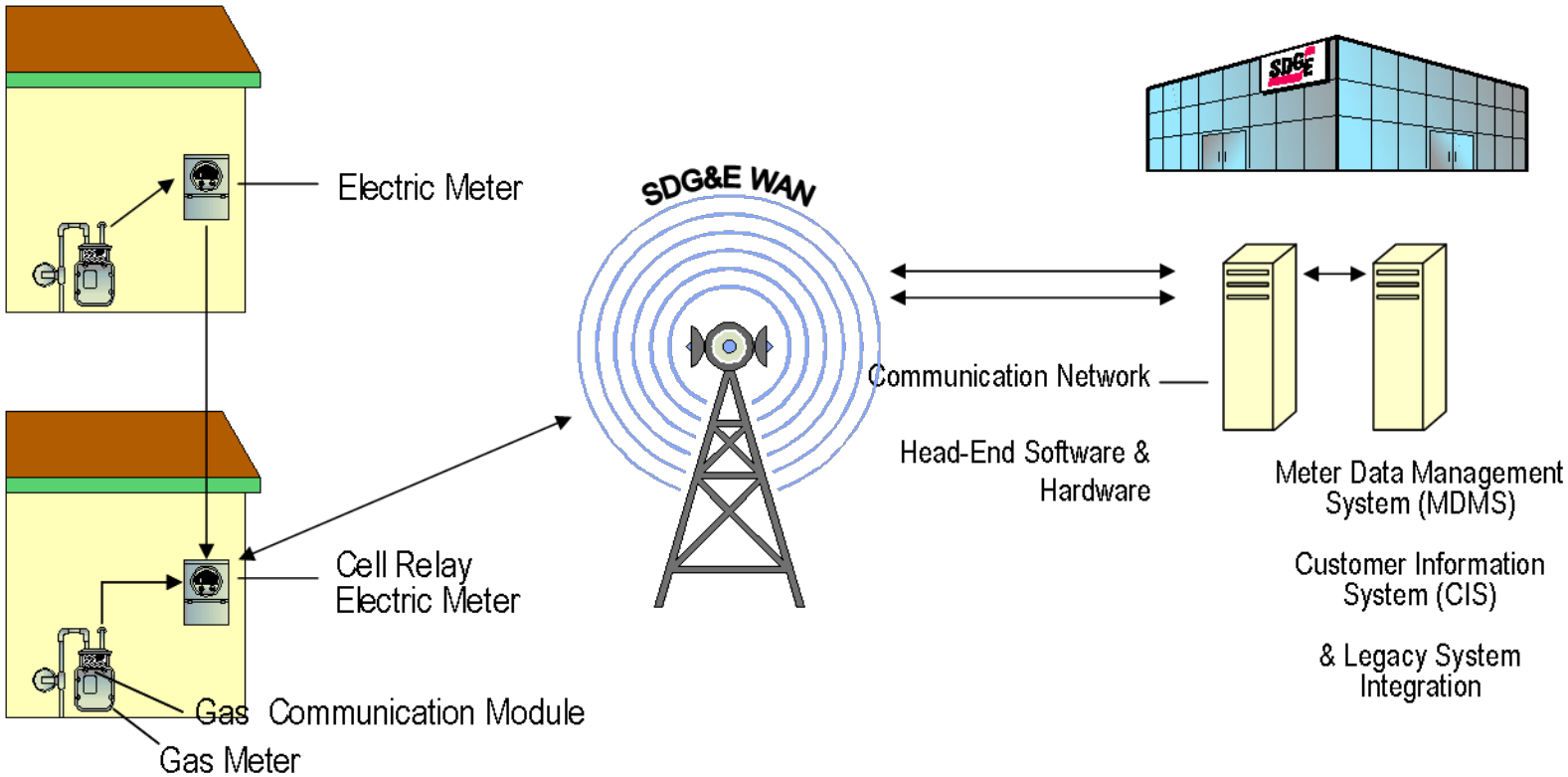
Smart Meter Program

- Will provide automated metering services to all SDG&E customers by 2011.
- Offers enhanced system and usage information and, eventually, automated in-home control of appliances, electronics & lighting.



°How do you maximize the benefits of smart meters?
°How do we get the appropriate rate structure?

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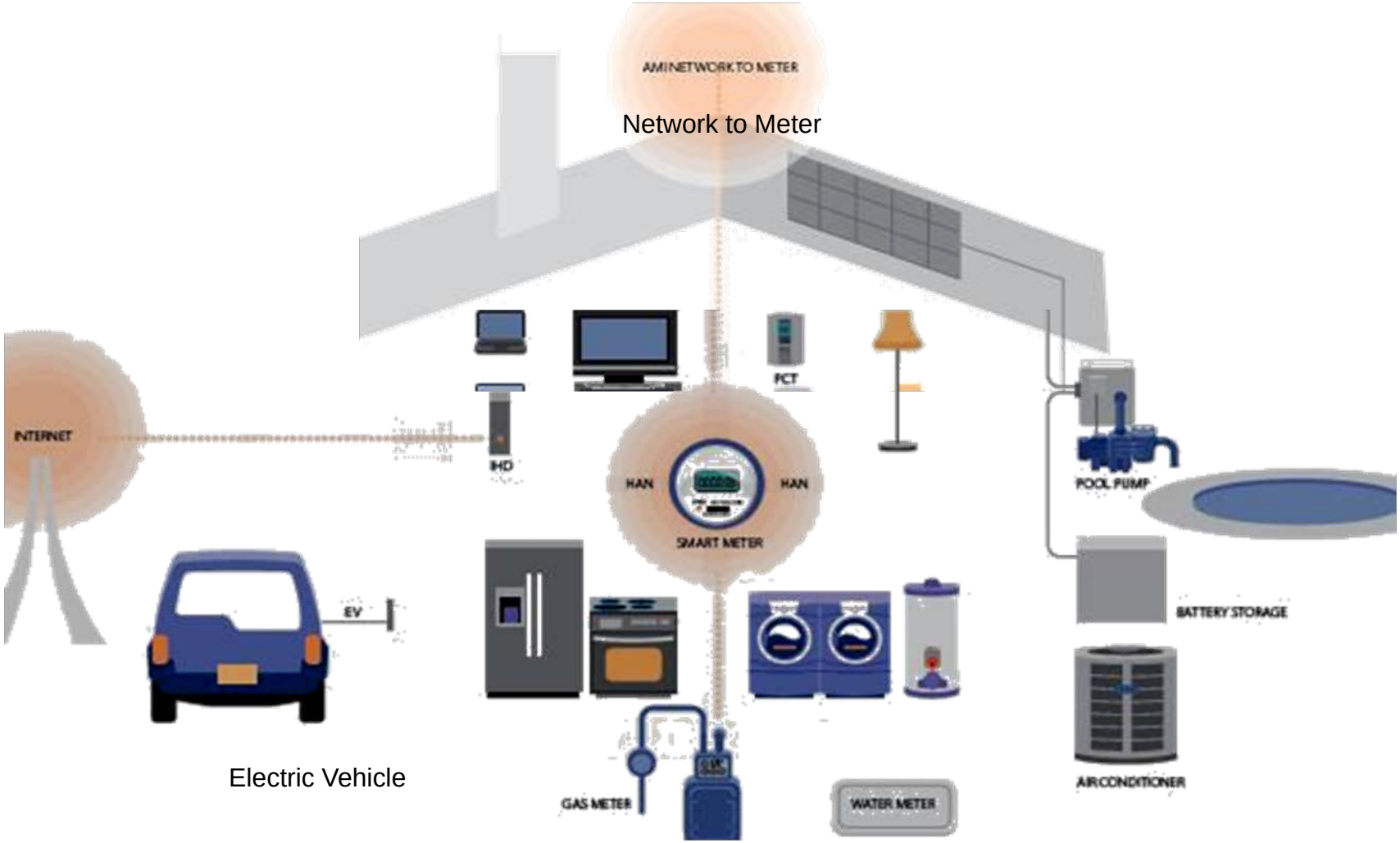
Smart Meter and Home Area Network



- What will the customers' response be to the "*Smart Home*"?
- What impact will the "*Smart Home*" have on the grid?

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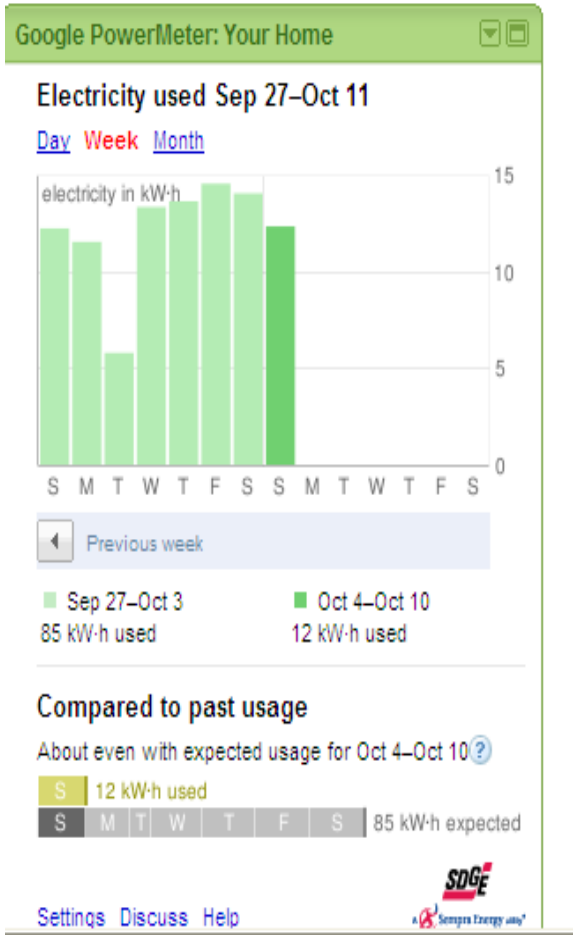
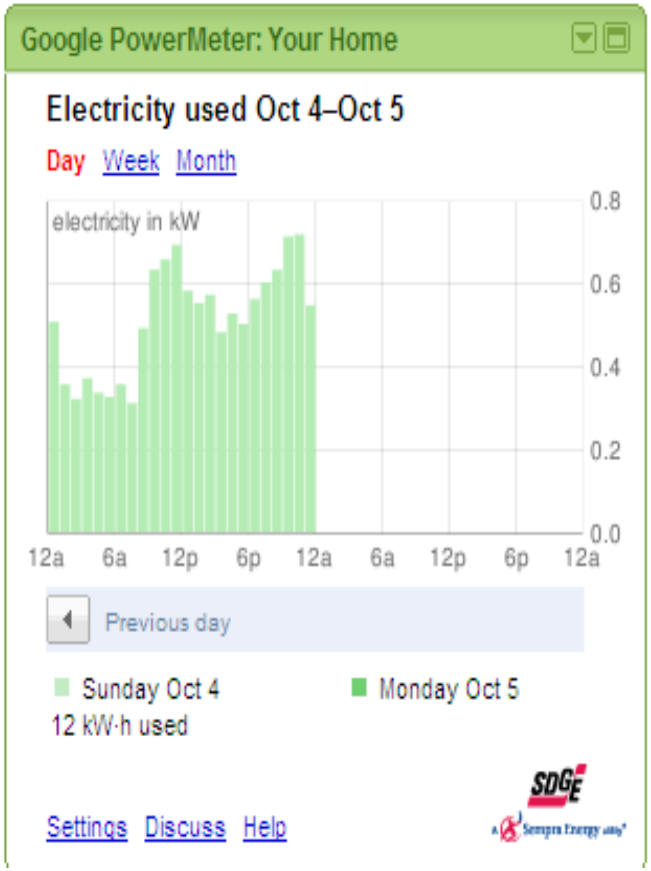
SDG&E Partnership with Google: iGoogle Home Page





- What is the best presentation of data to the customer?
- Will the data be adequate for the customers?

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MicroGrid Project Site: Borrego Springs

- Existing substation, plenty of land
- Remote location, no residences nearby
- Many existing solar customers
- Potential for major reliability improvements
- Possibility of being able to "island" whole community, peak load = 10MW
- Opportunity to extend what's learned to rest of service territory

°How fast will microgrids develop?
°How do we maximize the value of microgrids?

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MicroGrid Project Overview: Goals & Scope

SDG&E's Microgrid project integrates a DOE component, focused on feeder applications and a CEC component, focused on customer-side applications

MicroGrid Project

DOE Portion

- **$7.2M in DOE funds contribution towards $12M total project cost over 3 years**
- **Goal to achieve >15% reduction in feeder peak load and improve system reliability**
- **Perform cost/benefit analysis for full scale deployment**
- **Involves Integration of 5 technologies:**

1. ***Distrib. Energy Res. (DER) and VAr***
2. ***Feeder Automation System Technologies (FAST)***
3. ***Advanced energy storage (AES)***
4. ***OMS/DMS system***
5. ***Price-driven load mgmt (PDLM)***

CEC Portion

- Entirely CEC Funded ($2.8M)
- Sustainable Communities MicroGrid focused on interoperability, AMI and customer DER
- Schedule to mesh with larger DOE project
- Involves Integration of customer-based technologies:

1. *Remote-controlled demand response devices (e.g. thermostats)*
2. *Solar panels*
3. *Battery storage*
4. *Plug-in hybrid electric vehicles (PHEV's)*
5. *Grid-friendly appliances*

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Challenges & Benefits of Smart Grid Development

- **System reliability:**

Challenges

- Intermittency of renewable resources
- Increasing level of consumer-owned distributed generation (mostly PV)
- Need to manage power flow across multiple jurisdictions
- Slow development of technology
- Need for open architecture and standards

Benefits

- Predictive maintenance – resolving issues before outages
- Quicker identification, response and restoration of outages
- "Energy Bank" = utility of the future"

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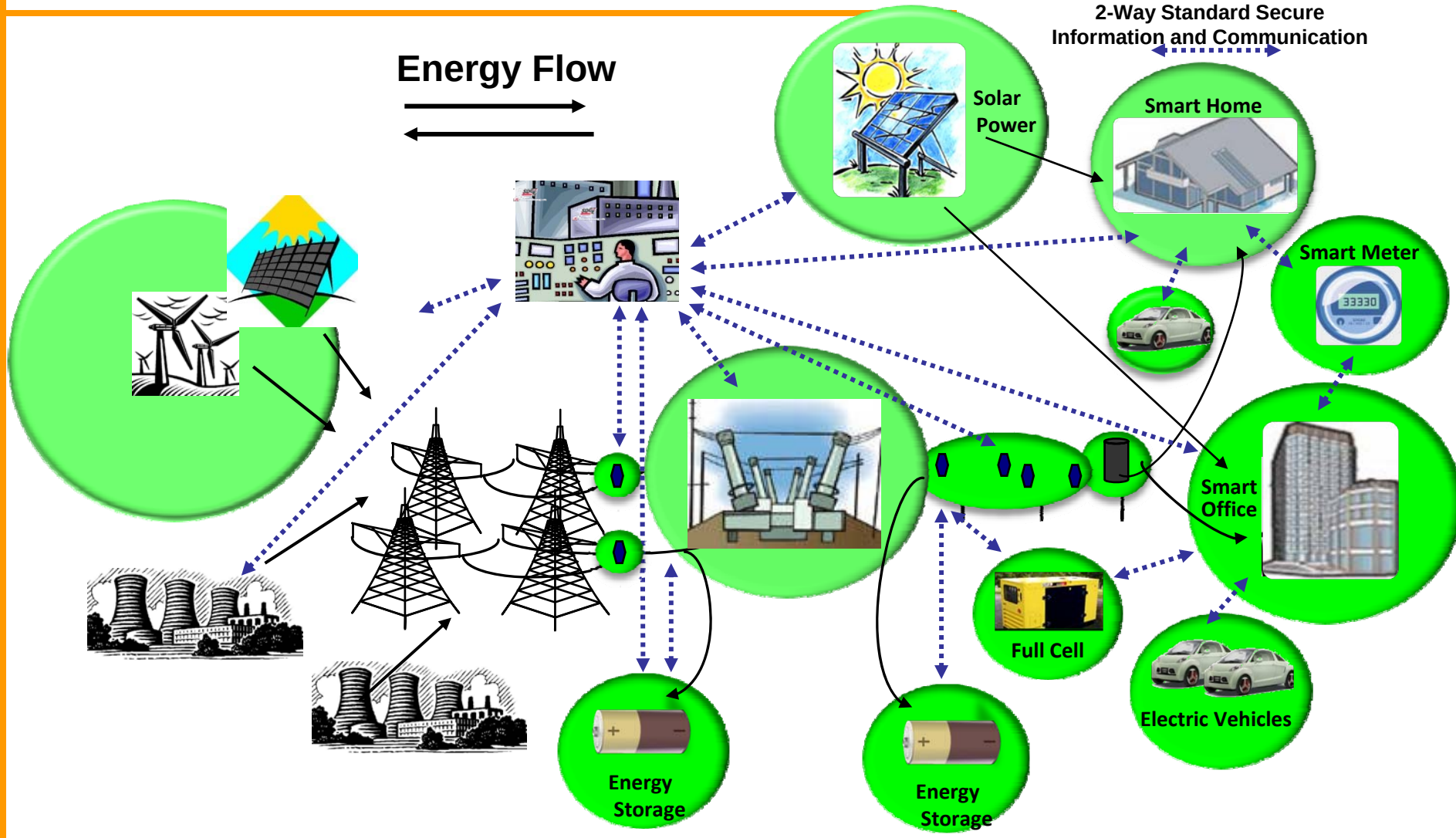
"Tomorrow's Smart Grid"…
THE FUTURE IS NOW!



°Are we ready for the Smart Grid? **We need to be – change is here!**

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