Smart Grid: How Smart is it?
Smart Grid and it’s Environmental Impact

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San Diego Gas & Electric
Definition of Smart Grid

• Wikipedia
  • A smart grid delivers electricity from suppliers to consumers using digital technology to:
    • Save energy, reduce cost and increase reliability and transparency

• SDG&E focus
  • A smart grid delivers electricity from generation to consumers using digital technology and communications to:
    • Ensure workforce and public safety
    • Empower consumers and open energy markets
    • Improve grid reliability, resiliency, security and efficiency in the face of increased complexity
Drivers of the Smart Grid

**Customer** – Enable energy markets and encourage customer’s participation in energy management through smart energy devices, new products and services, increased Energy Efficiency (EE)/Demand Response (DR), adoption of PEVs and renewable resources.

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

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

- In-home/in-premise displays, control of individual appliances, Energy management systems/controllers
- Plug-In Electric Vehicle (PEV) Integration, Renewable Resource Integration
- Large Scale Energy Storage, Phasor Measurement Units, Self- Healing Grid, Network Communications
Factors Driving Urgent Need for Energy System Changes

- **Customer Empowerment**
  - Choice, Control, Convenience
  - Smart Appliances, Smart Charging, Smart Rates

- **Centralized renewables**
  - Intermittent availability issues
  - Increased volume threatens grid stability

- **Distributed renewables (rooftop solar)**
  - No control, can’t see it, no communication
  - Power quality issues will increase

- **Electric vehicles**
  - Current electric grid cannot manage potential volume
  - Overall consumption may rise significantly

Job of managing grid getting more complex; need to leverage technology
Background

• Installing 1.4 million smart electric meters and adding module to existing 850,000 gas meters for all customers by December 2011

• Install 1.4 million smart electric meters for all customers
  • Solid-state electric meter technology with ZigBee Chip
  • Electric interval data reads:
    • Residential: hourly, Commercial/Industrial: 15-minutes

Customer Benefits

• Enhances reliability and outage detection, and speeds restoration

• Gives customers more control over their everyday energy usage, opportunity for lower bills

• Reduced need to access property, more privacy

Currently over 2.2 Million meters installed (over 95%)!
Distributed Renewable Growth

Residential Distributed Generation

Total number of MW at year end

- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010

Total number of MW at year end
Reliability Issues Changing San Diego Energy Mix

Energy mix for 2015 and 2020 are subject to substantial uncertainty. Values are for illustration purposes and do not represent forecasts.
1MW PV: 10 Minutes on a Cloudy Day

Maximum AB Voltage

- Primary Voltage
Reliability Issues
Solar & Electric Vehicle Customers

PV and EV Customers
Photovoltaic and Electric Vehicle Customers as of June 30, 2011

Legend
- EV - 1 Customer per Transformer
- EV - 2 Customers per Transformer
- EV with PV

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number</th>
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<tbody>
<tr>
<td>Residential</td>
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<tr>
<td>Commercial/Industrial</td>
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<td>27</td>
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<td>13</td>
</tr>
<tr>
<td>SDG&amp;E Owned</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Photovoltaic Customers in SDG&E’s Service Territory: 13,938

*Electric vehicle data pertains to the Edison program and may not include all electric vehicles in the SDG&E service territory.

Photovoltaic data shown on this map are part of the Net Energy Metering program and do not reflect the solar generation data in the SDG&E service territory.
Electric Vehicle Charging – charging at peak versus charging off-peak

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
Smart Grid Deployment Plan (SDGP)

SB 17 requires a “Smart Grid Deployment Plan” to be filed by July 1st

**Vision**
- Smart Market, Customer & Utility. Meet environmental policies.

**Baseline**
- Inventory of SG investments and assessment of privacy & security.

**Strategy**
- Provide benefits to consumers and compliance with SB17.

**Security**
- Describe Grid and Cyber Security strategy.

**Roadmap**
- Timing of deployment of SG technologies.

**Cost**
- Cost estimates for SG investments for next 5 years.

**Benefits**
- Analysis: policy driven, environmental goals, economic, etc.

**Metrics**
- Measure performance.

Source: CPUC
Smart Grid Deployment Plan Overview

➢ The Smart Grid Deployment Plan is the same as the SDG&E Vision

“SDG&E, in collaboration with key stakeholders, will create the foundation for an innovative, connected and sustainable energy future in the San Diego region.”

➢ Engage customers and other stakeholders to create a Smart Grid Deployment Plan that reflects the region’s priorities and values – not just those of the utility.

➢ Align the organization so that it can continue the cultural change necessary to create the Utility of the Future.

➢ Analyze a wide range of potential projects oriented toward “smart” technologies and services – prioritizing cost vs. benefits, both financial and societal.
SDG&E’s roadmap includes smart grid investments in 9 programs:

- Customer Empowerment
- Renewable Growth
- Electric Vehicle Growth
- Security
- Reliability & Safety
- Operational Efficiency
- SG RD&D
- Integrated & Cross-cutting Systems
- Workforce Development

SMART GRID
2011 Smart Grid Roadmap

RENEWABLE GROWTH

50,000 users of online energy tools

17,000 MW peak reduction
- Default dynamic electric rate – small commercial customers
- Optional dynamic electric rate – residential customers

8 circuits with >30% PV under light loads, 10 with >20%

Economic DR at 5% of peak
11% GHG emission reduction
12,000 MW peak reduction

20% of RPS from bio power
(4% of total generation)

Provide usage data
10,000 customers using online energy tools
90 MW PV (residential and C&I)

10% EE reduction from 2006
CSt: 3,000 MW of distributed solar

53 circuits with >30% PV under light loads, 130 with >20%

>168 MW PV (CEC)
>25,000 distributed renewables customers
>60,000 PEVs

Zero net energy – 100% new residential construction
30% GHG emissions reduction to 1990 levels
20% reduction in non-petroleum fuel use
33% Renewable Portfolio Standard
Governor’s Clean Energy Plan proposes
12,000 MW of localized renewable generation
>200 MW PV (CEC)
>260,000 PEVs

SDG&E Smart Grid Vision: by 2015
1. SDG&E, customers and other third parties continue to install energy storage to enable more efficient use of renewable resources and to reduce overall base load generation requirements
2. SDG&E is relieving congestion by utilizing dynamic line ratings and synchrophasor data to operate the grid more efficiently
3. Cost-effective energy storage – either utility, customer, or third party owned – is helping to resolve voltage regulation, voltage flicker, and intermittency of renewable resources
4. Residential distributed generation output has metering and control options enabled by HANs

SDG&E Smart Grid Vision: by 2020
1. Synchrophasor data is being used to assess the condition of the grid and respond to changes before they become problems
2. Advanced inverter controls (for both distributed and central station renewables) are utilized for the smoothing of intermittency issues associated with solar photovoltaics and wind resources
3. SDG&E is providing options for customers to sell output from their electric vehicle, PV system or storage device to optimize overall system efficiency and costs

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2011 Smart Grid Roadmap

ELECTRIC VEHICLE GROWTH

Key
- Policy Goal
- Forecast
- SDG&E Smart Grid Vision
- In Flight Project
- New Project - Policy
- New Project - Value
- New Project - Pilot
- Enterprise Project

Figure 6-6

- 50,000 users of online energy tools
- 17,000 MW peak reduction
- Default dynamic electric rate - small commercial customers
- Optional dynamic electric rate - residential customers
- Zero net energy - 100% new residential construction
- 30% GHG emissions reduction to 1990 levels
- 20% reduction in non-petroleum fuel use
- 33% Renewable Portfolio Standard
- >260,000 PEVs

SDG&E Smart Grid Vision: by 2015
1. PEV growth is supported and encouraged through the application of new technologies to manage customer load and facilitate EV charging to minimize impacts to the grid
2. SDG&E is providing options for customers to prioritize and control load to accommodate distributed intermittents and efficiently integrate plug-in electric vehicles
3. SDG&E, through metering and related measures, is tracking electricity used for transportation in order to earn Low Carbon Fuel Standard credits on behalf of customers

SDG&E Smart Grid Vision: by 2020
4. SDG&E is providing options for customers to sell energy from their electric vehicle, PV system, or storage device to optimize overall system efficiency and costs
5. The market continues to integrate the aggregation of distributed resources, plug-in electric vehicles, and energy storage

06-2011 SDG&E Smart Grid Vision - by 2020
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Questions?

Thank You

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