Smart GRID

SDGE connected

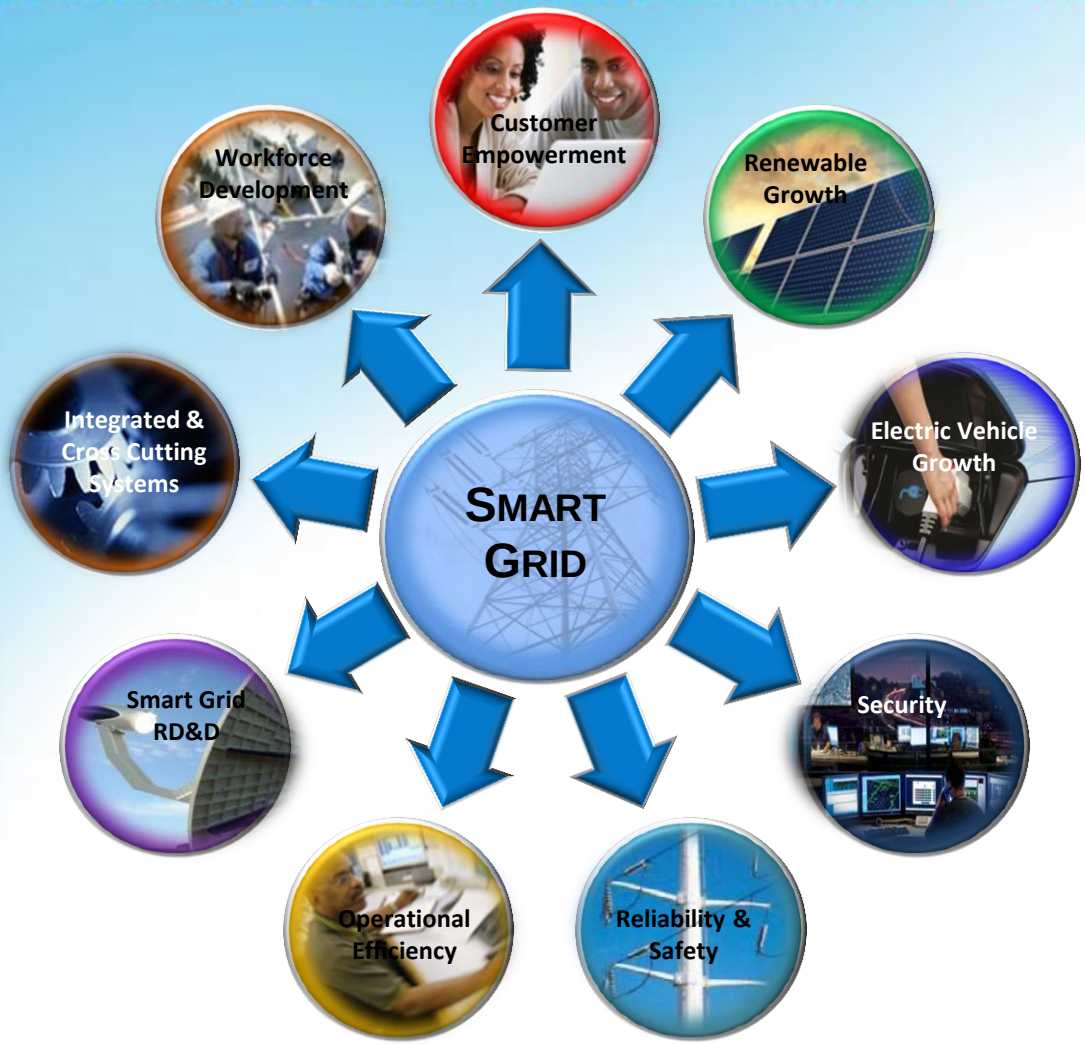
A Sempra Energy utility℠

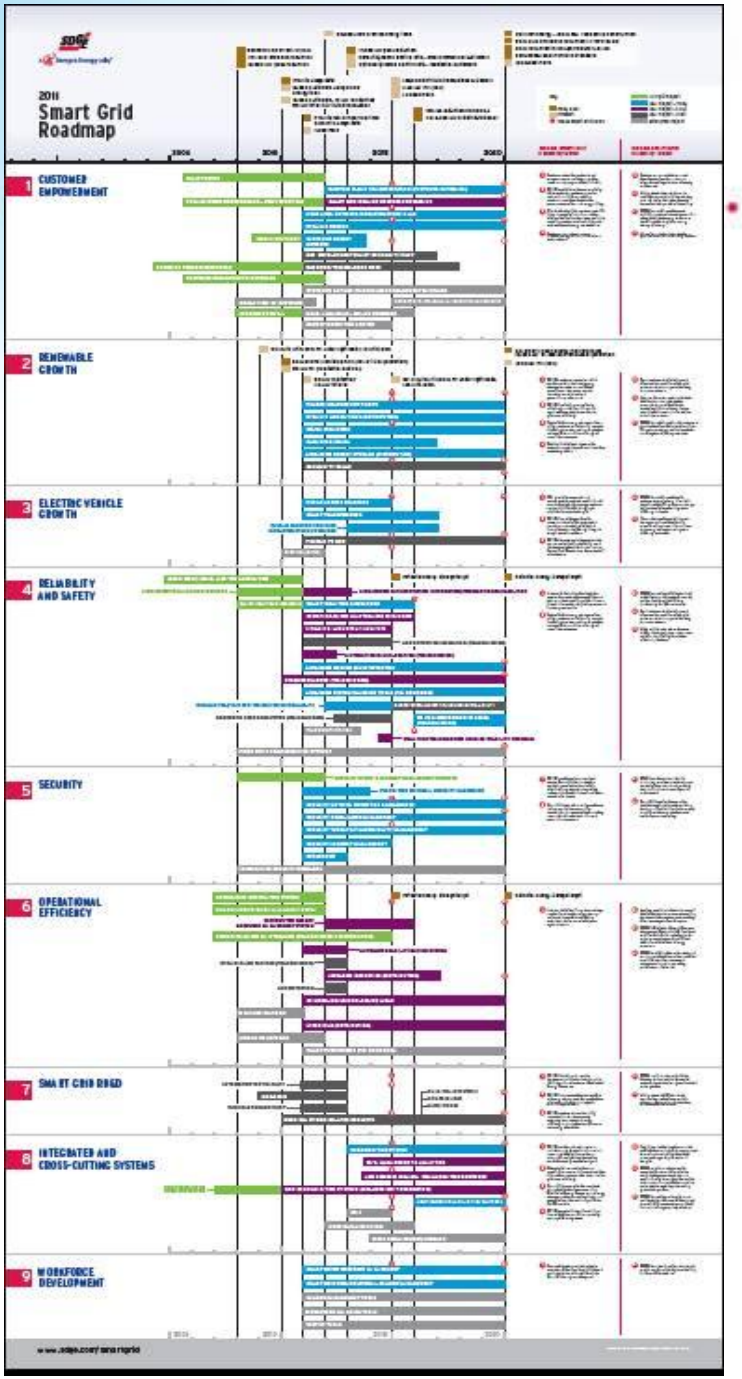
Thomas Bialek, PhD PE
Chief Engineer – Smart Grid

IEEE Switchgear Committee Meeting

October 2, 2012

Smart Grid Roadmap





[Deployment Roadmap | San Diego Gas & Electric]

Customer Empowerment

Smart Meter Installations and Benefits

- As of June 30th 2012 – Approximately 2,243,850
  - 1,377,091 electric meters
  - 864,488 gas modules
  - Residential 2,074,938
  - Commercial 168,912
- 30k Remaining – 28K electric / 2K gas)

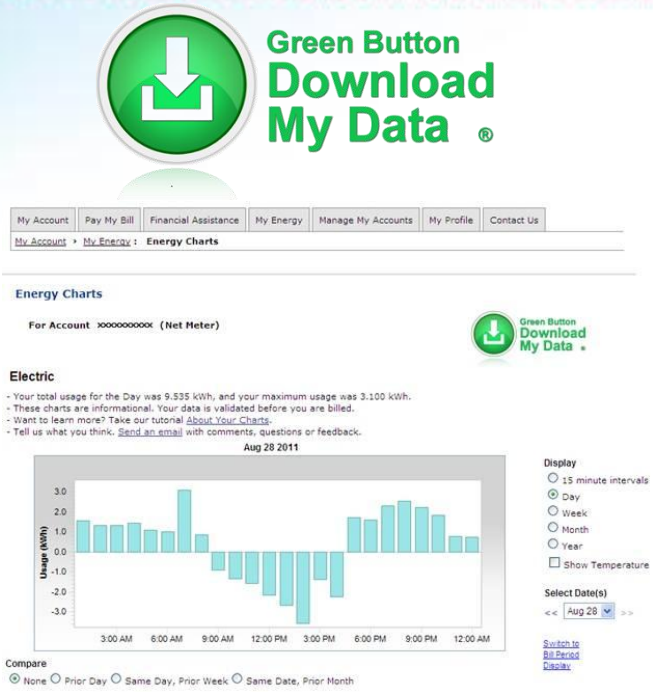
  Percent complete ~99%

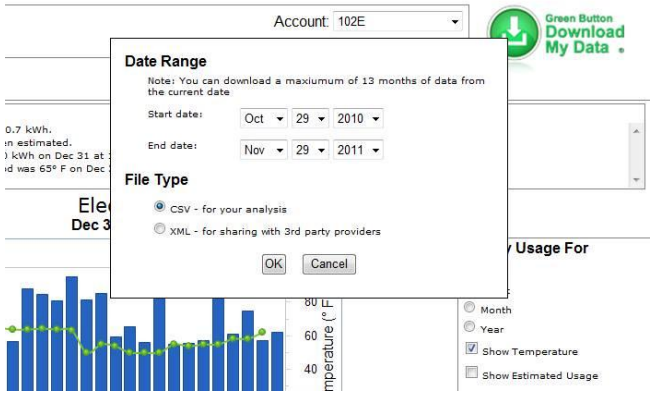
- More than 2.5 million miles NOT traveled by SDG&E trucks
- More than 220,000 gallons of gasoline SAVED
- 1,950 metric tons of CO2 equivalent NOT emitted (10% reduction in SDG&E fleet emissions)
- Providing customers the ability to better manage energy use through on-line tools such as EnergyCharts and Green Button

Disclaimer: These emissions reductions are estimates calculated based on standard assumptions and EPA emission factors.

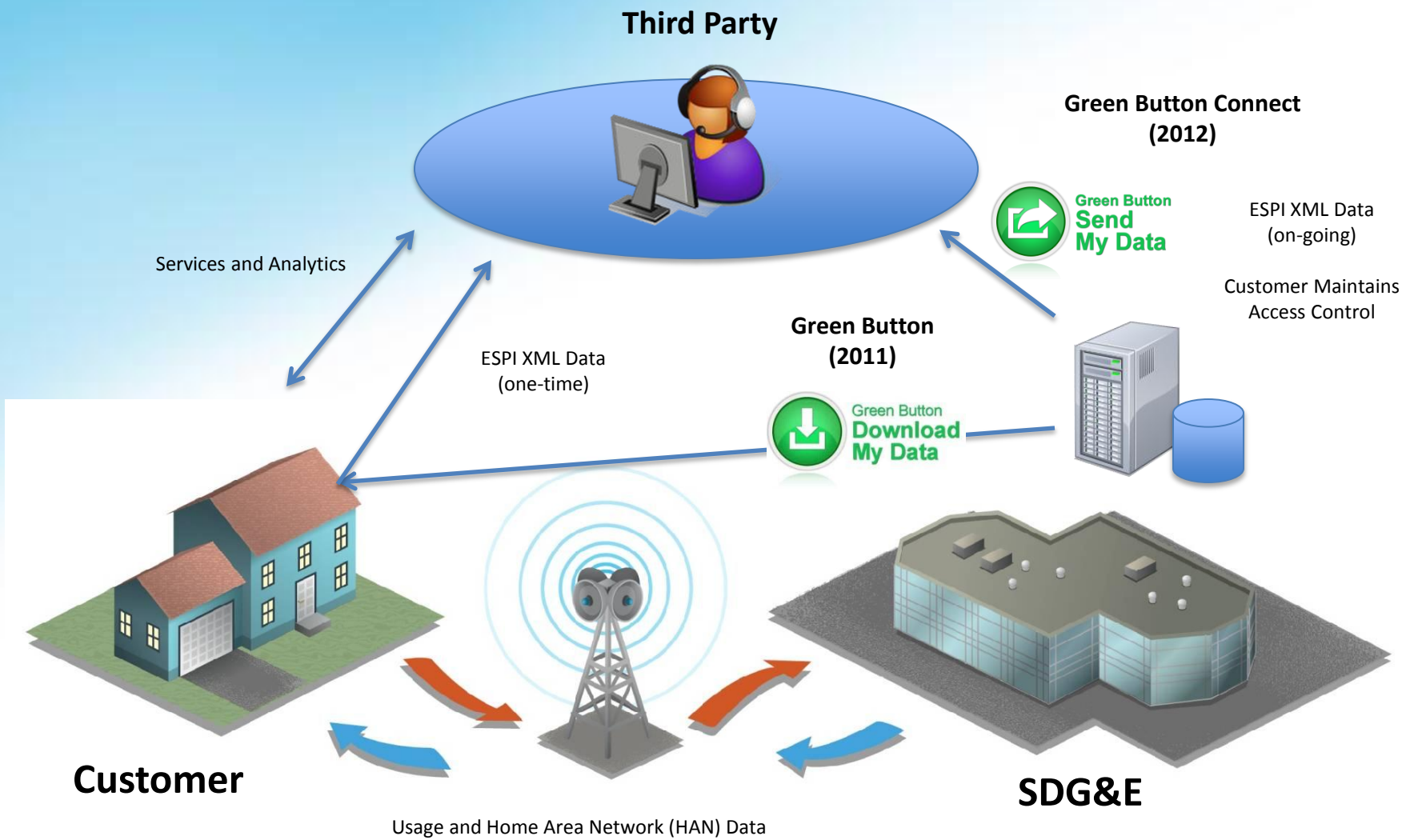
Green Button - Empowering Customers

- In September 2011, the White House challenged utilities throughout the United States to develop a tool to provide energy consumers timely access to their own energy data with the click of a single button online
- In December 2011, SDG&E launched the Green Button, a new tool that provides customers with easy access to their energy usage data in a simple, common format.
- SDG&E customers are now among the first in the nation to be able to download their energy usage data in a standard format and share it with third-parties for energy evaluation and analysis.
- Download up to 13 months of data!
- There are numerous Green Button apps to explore and share your energy use data! OpenEI
- Oct. 1, 2012 “Green Button Connect My Data” , Power Tools app demonstration in Washington, DC





Customer Data Access (ESPI) Options



Reduce Your Use

Save electricity between 11 a.m. and 6 p.m. on a Reduce Your Use day and earn rewards by using less power.

- 5 events were called as part of the 2011 pilot over the summer (including weekday and weekend events)
  - Email, text, and outbound dialer notifications were sent for each event day ahead
- 3,000 customers participated
  - Average load reduction for customers who reduced was 4.5 kWh per event (or 22.5 kWh over the 5 events).

- 2012 "Test event" held on July 20th to test systems and processes
- Four additional events: August 9, 10, 11 (Saturday) and 14 have been called – very preliminary results indicate an average of over 20MW reduction
- Customers who opted in to email or text alerts reduced on 10% on average – an order of magnitude more that those who did not

Biggest Energy Saver Customer Engagement

SDG&E piloted a Biggest Energy Saver contest that challenged residential electricity consumers to reduce their electric energy consumption and demonstrate the benefits of using smart meter energy consumption information.

SDG&E's Biggest Energy Savers:

- **E.Faunce, Lakeside, CA - Savings 46.5% -1,356 kWh**

"I'll admit, we got *really* into the contest. All of the my friends knew about it and they wrote notes on my Facebook wall encouraging us to keep it up."

- **L. Hale - La Mesa, CA - Savings 42.8% -1,488 kWh**

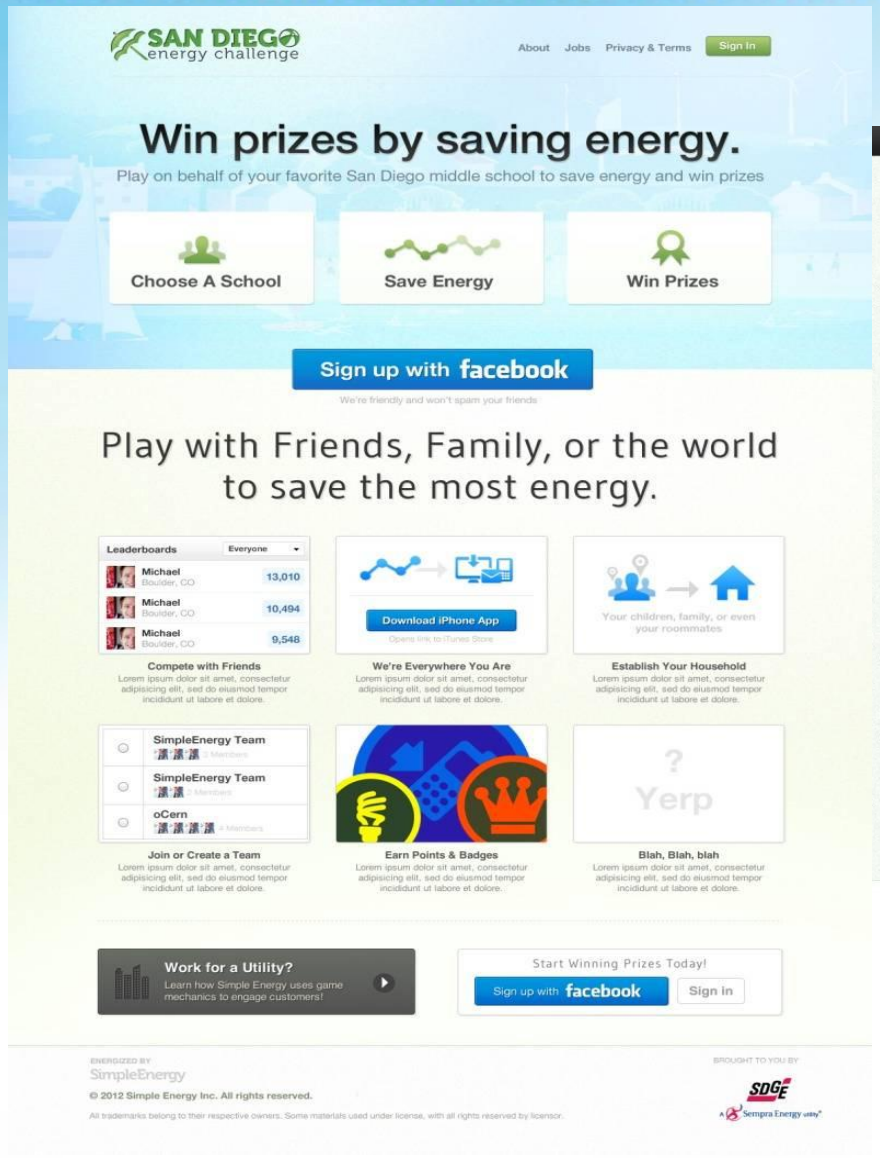
"I had no idea how much energy the 'can lights' in the kitchen used – and, I probably never would have thought to investigate that – but, the daily reminders motivated me to. Now, unless I need all of those lights, I use as few as possible."

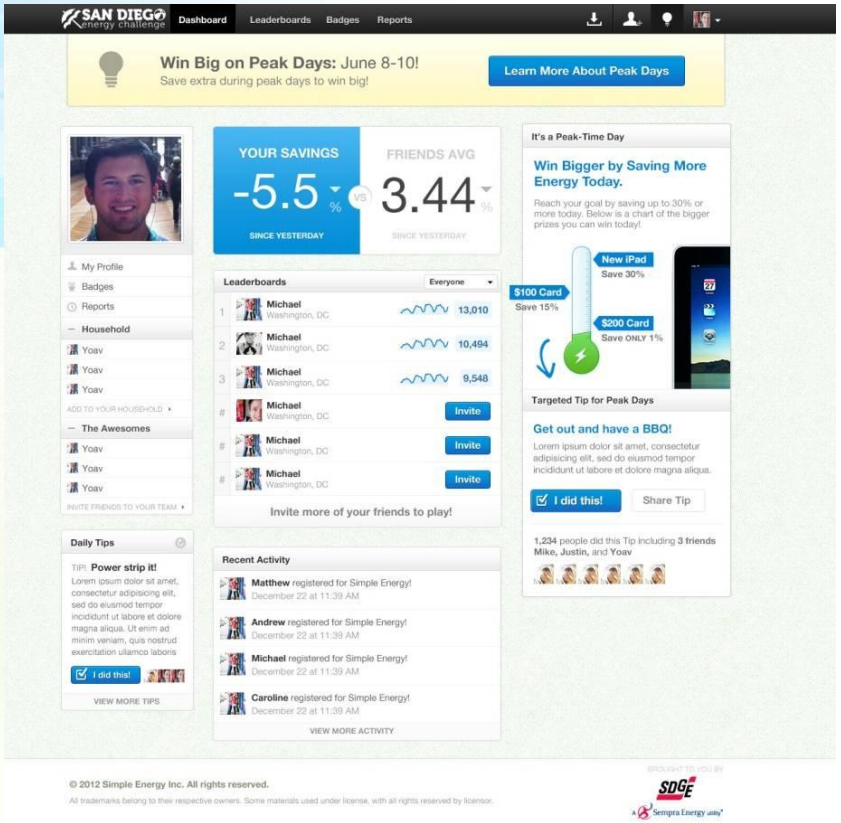
- **J. Gonzalez - Alpine, CA - Savings 34.2% - 1,506 kWh**

"Every time I can see that there are other people on the leaderboard saving more energy than I am, I'm motivated to save even more."

On average BES+HAN households saved 12% more energy than HAN-only households.

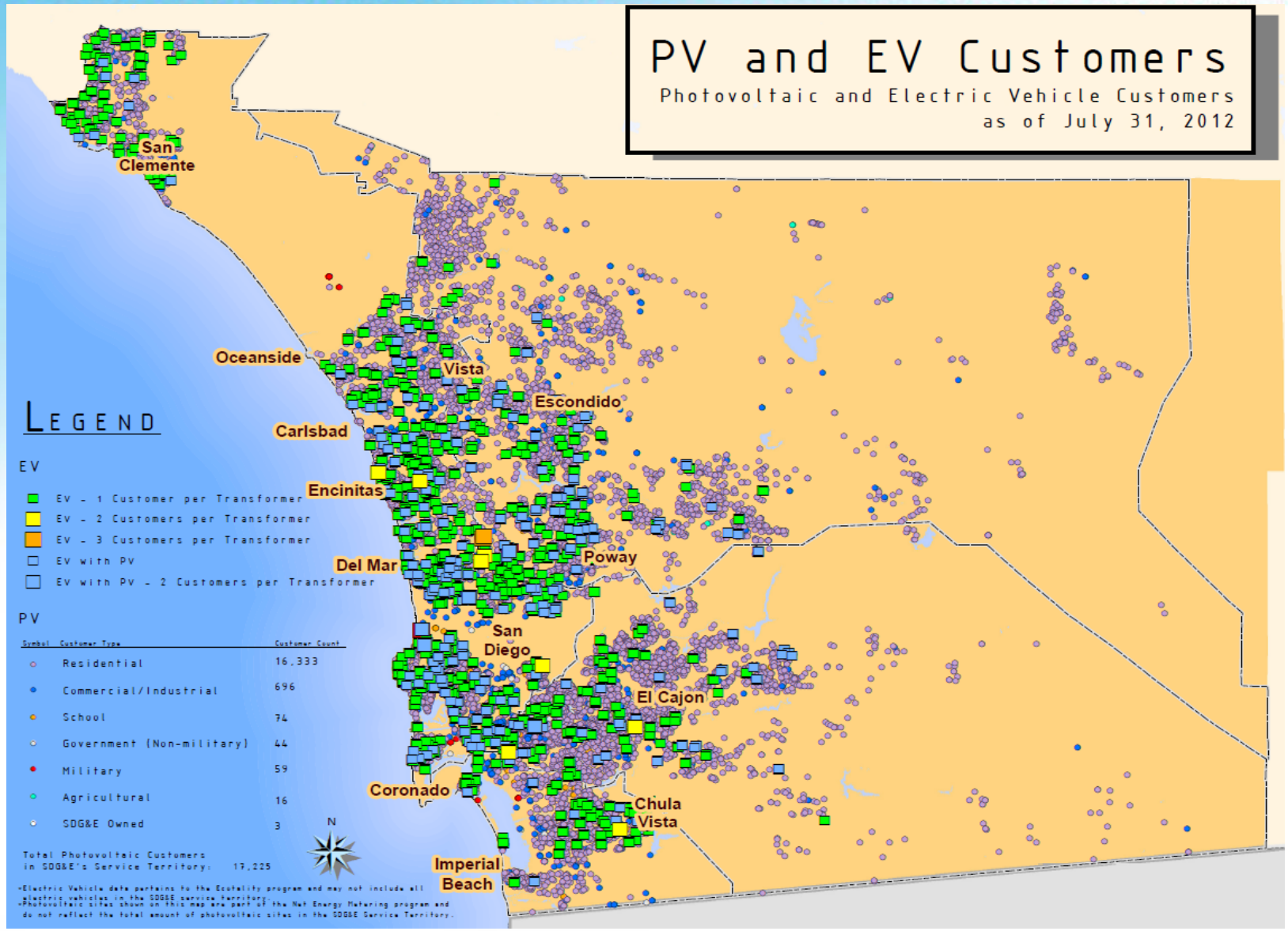
San Diego Energy Challenge





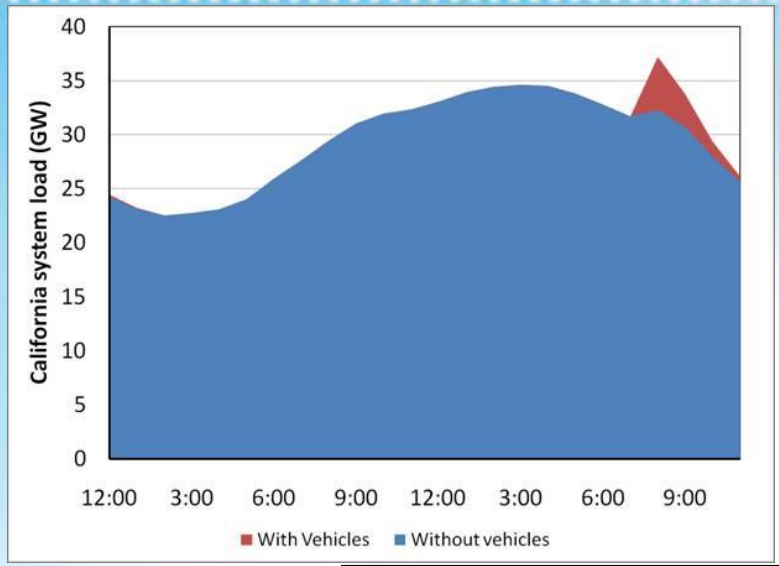
Electric Vehicle Growth

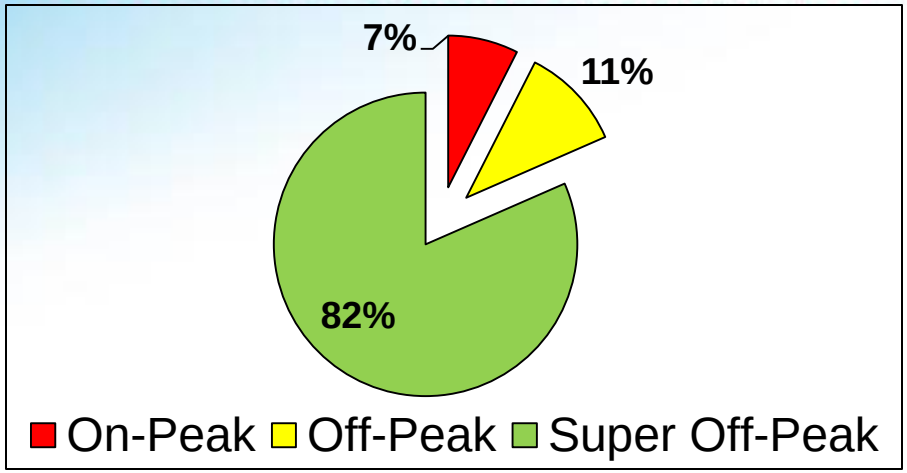
Integration of DER
Solar & Electric Vehicle Customers



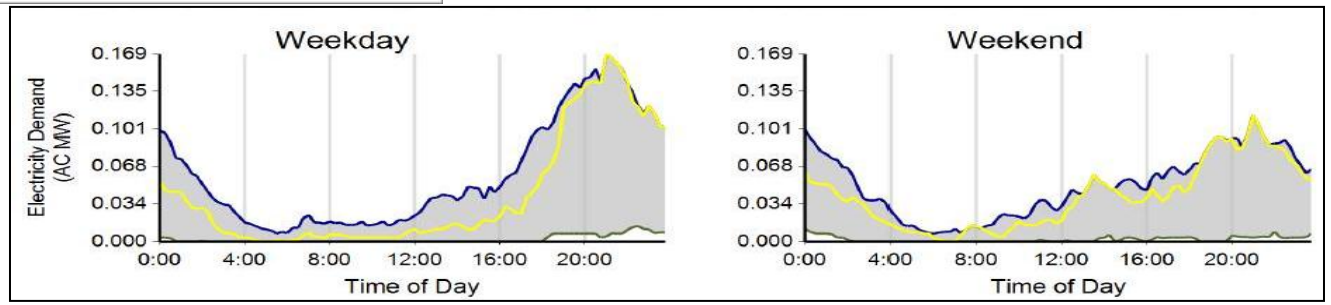
PEV Charging

Plug In Electric Vehicle (PEV) Impact

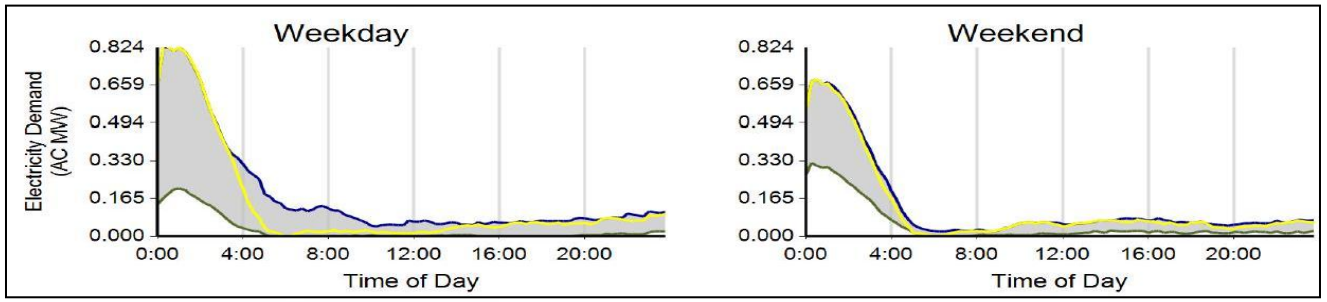




Nashville Electric Service, TN

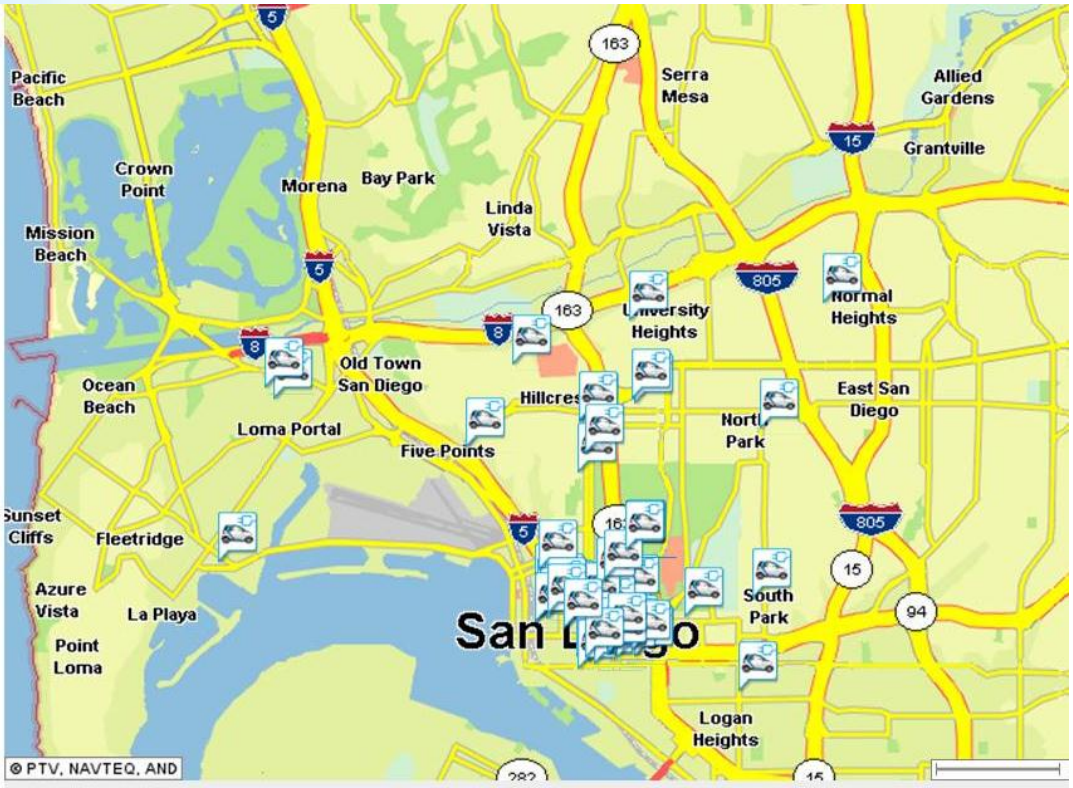


SDG&E, CA



Smart City San Diego: Car2Go

San Diego is the first city to have an all electric-drive large scale carshare fleet in North America. There are currently 100+ Smart Fortwo Electric-Drive vehicles in the San Diego Car2Go network.



Smart Transformers

Purpose

- Install sensors on distribution transformers to monitor and report load to reduce transformer replacements while preventing overloads from PEVs and heat storms

Scope

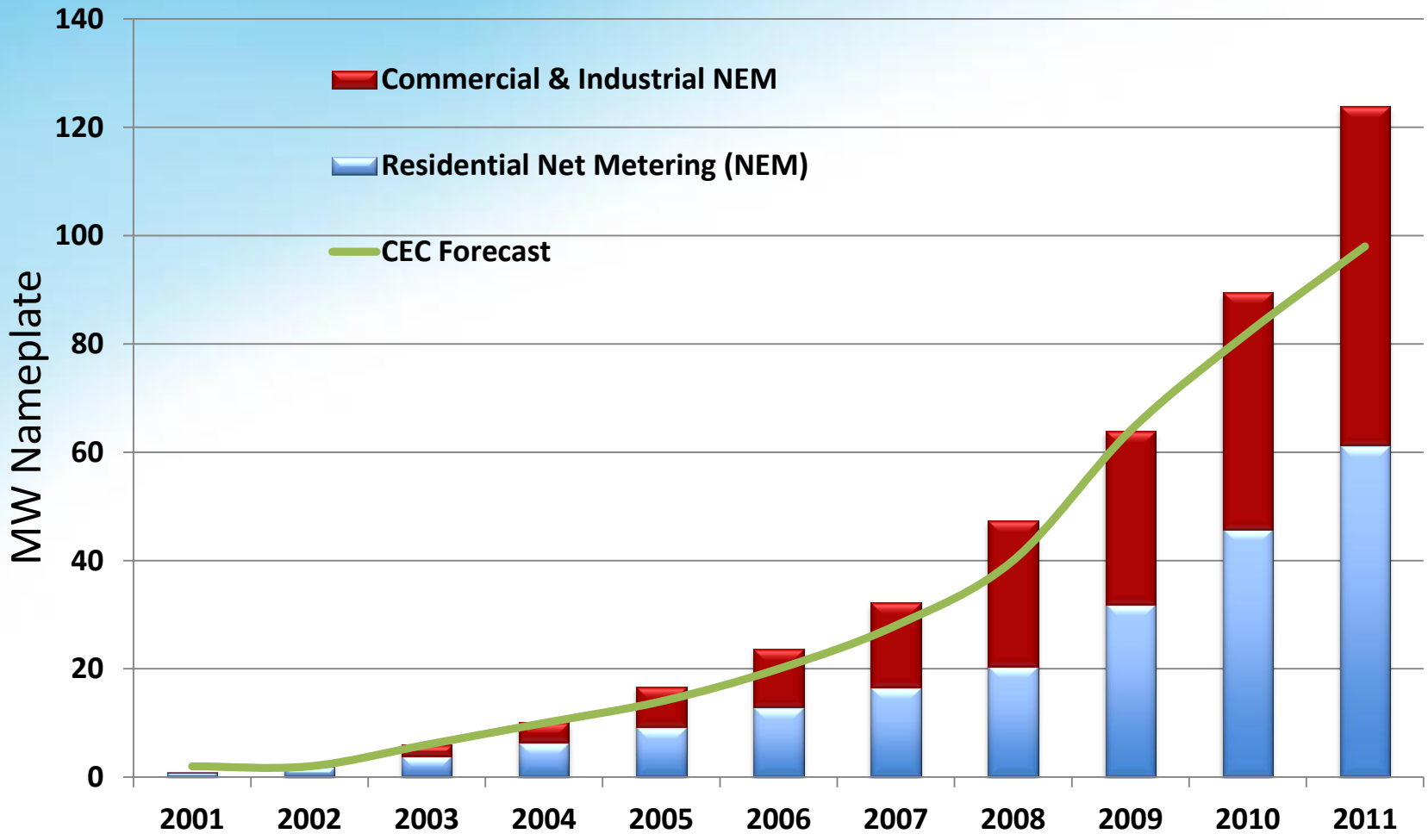
- In 2012 install 500 sensors integrated with low power communication equipment on transformers with PEVs

Status

- 10 sensors have been installed and are being monitored
- Remaining sensors to be installed in 2012

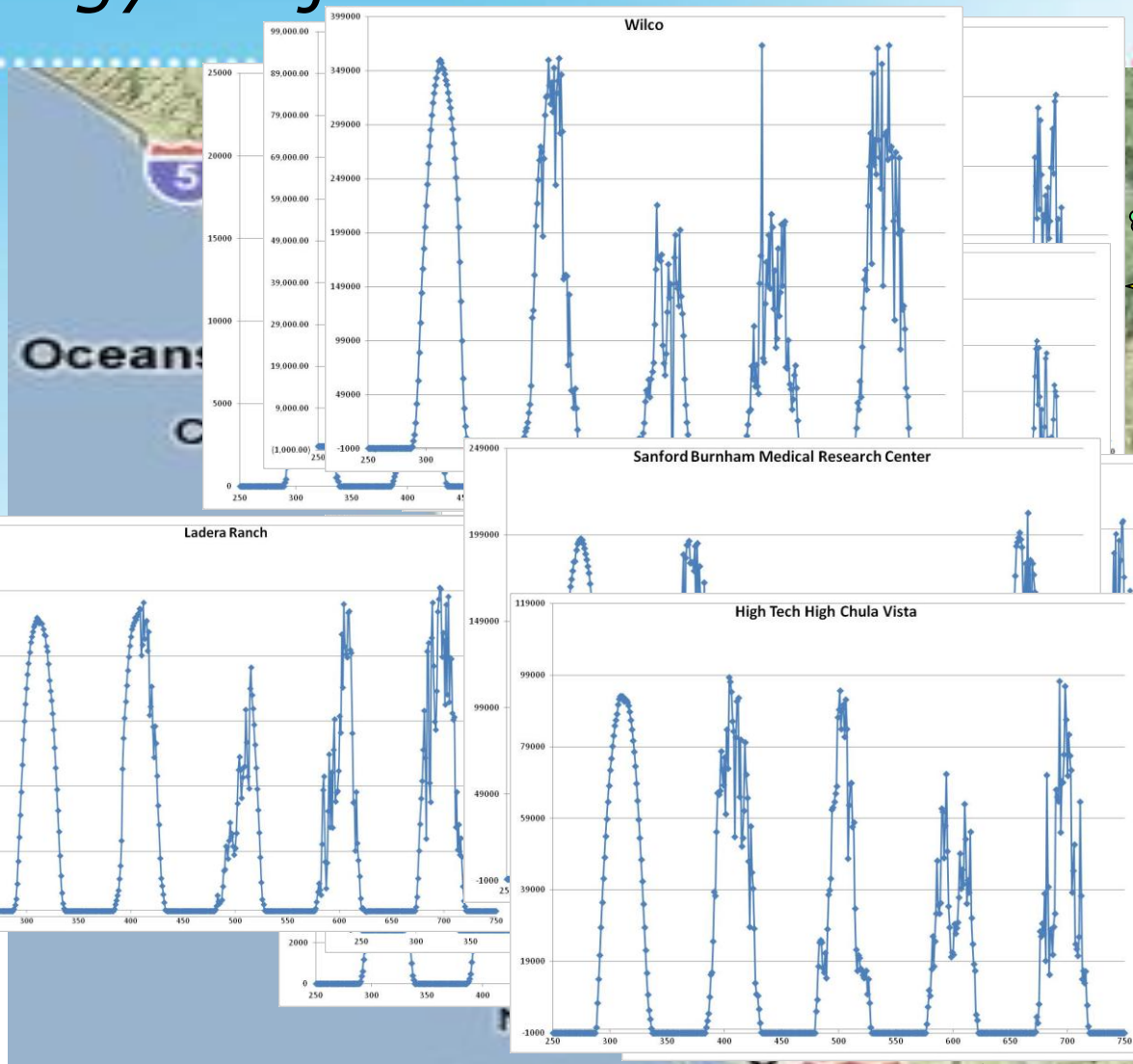
Renewable Growth

Commercial & Residential Generation



Sustainable Communities Clean Energy Projects

SDGE connected
A Sempra Energy utility℠



Installed Fuel Cell – 400 kW

Installed Solar – 3588 kW

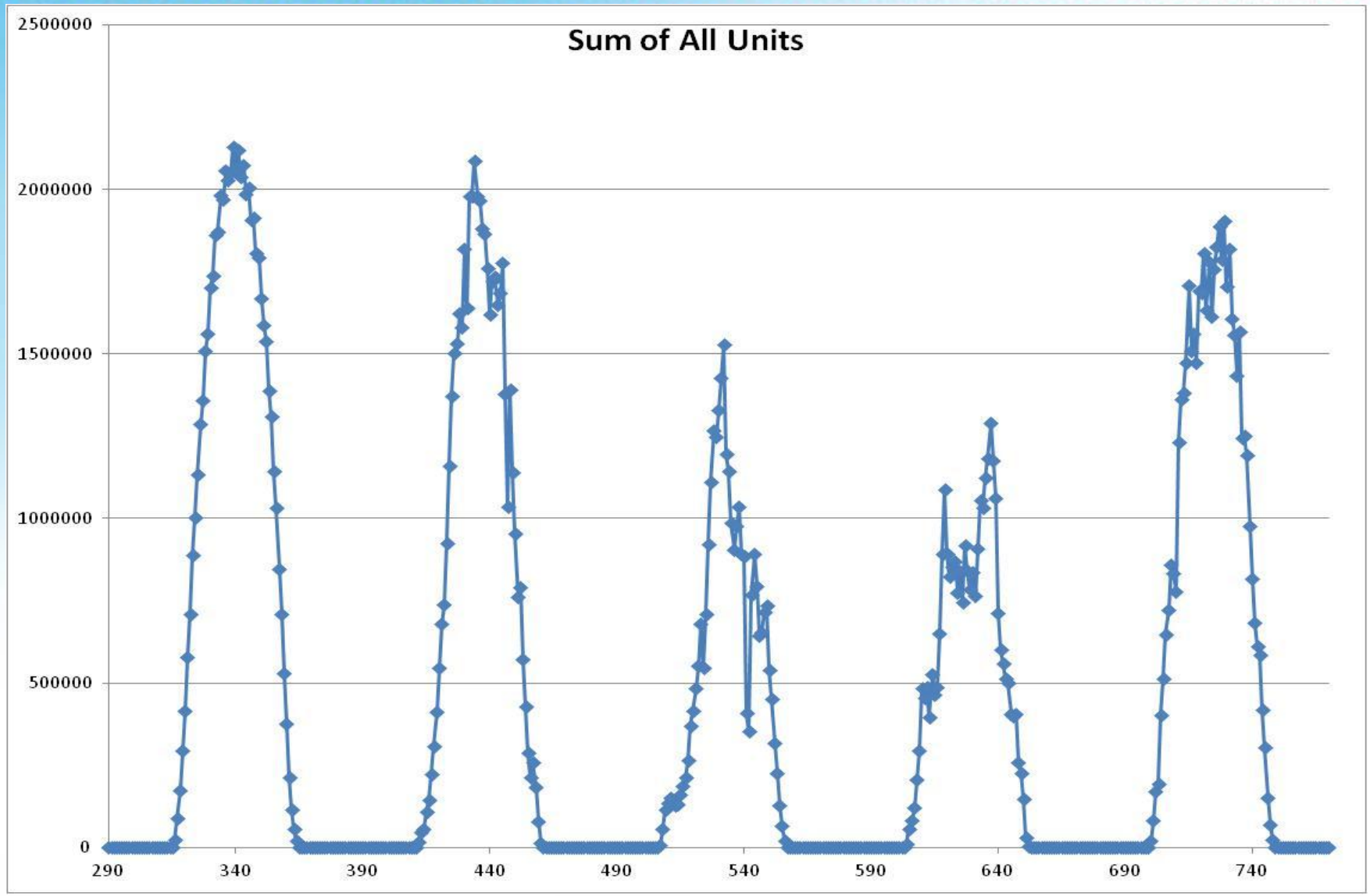
TOTAL – 3988 kW

Installed Projects as of 5/15/12

SDG&E's Sustainable Community Projects

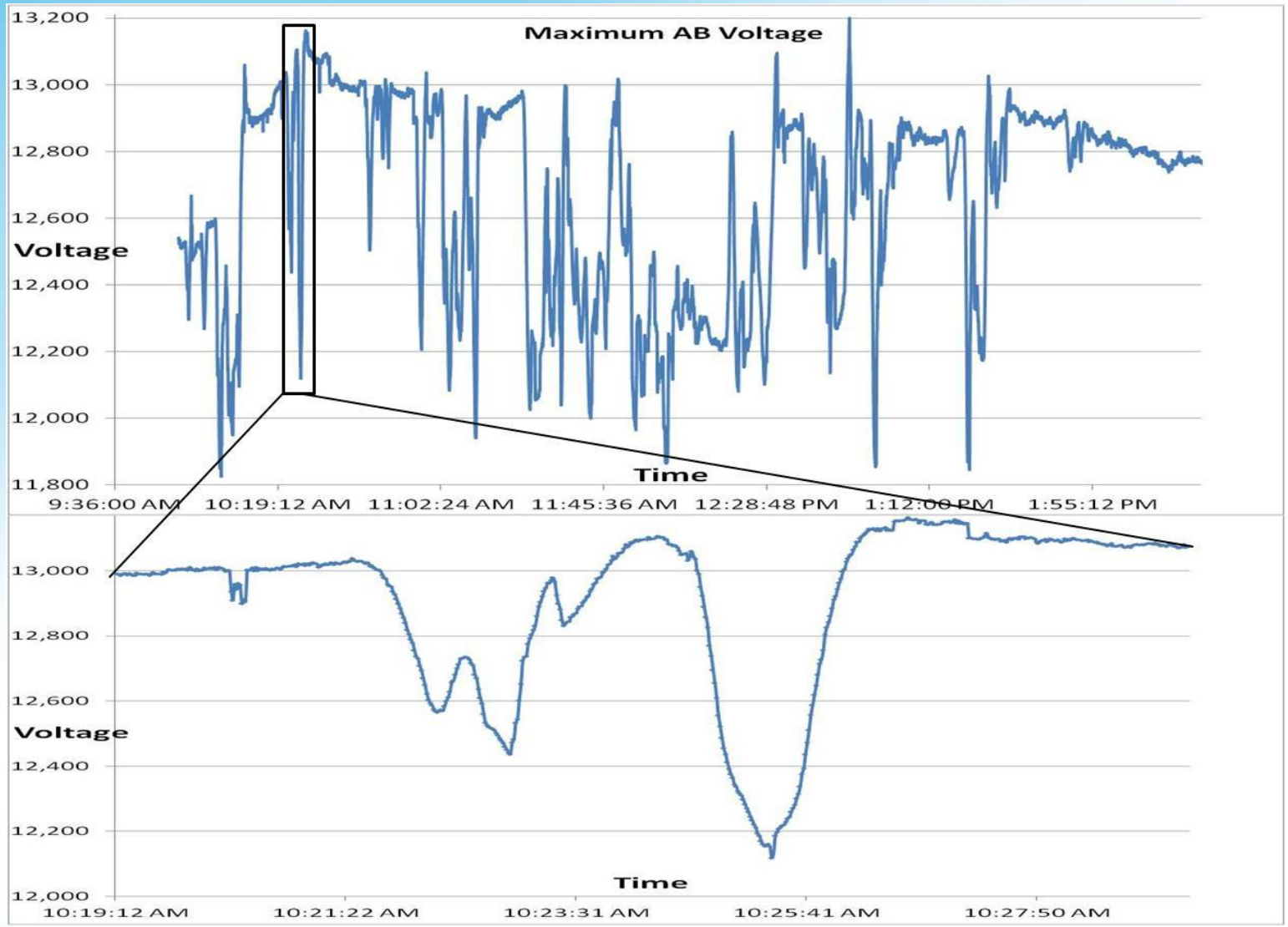
- Dates shown April 4, 2011 to April 8, 2011
- Fat Spaniel data repository
- 15 minute data
- Consistency across SD County
  - April 4th nice smooth power production
  - April 5 to 8 all show intermittency issues
- Minimal diversity with 15 minute data

Sum of All Units



INTEGRATION OF DER

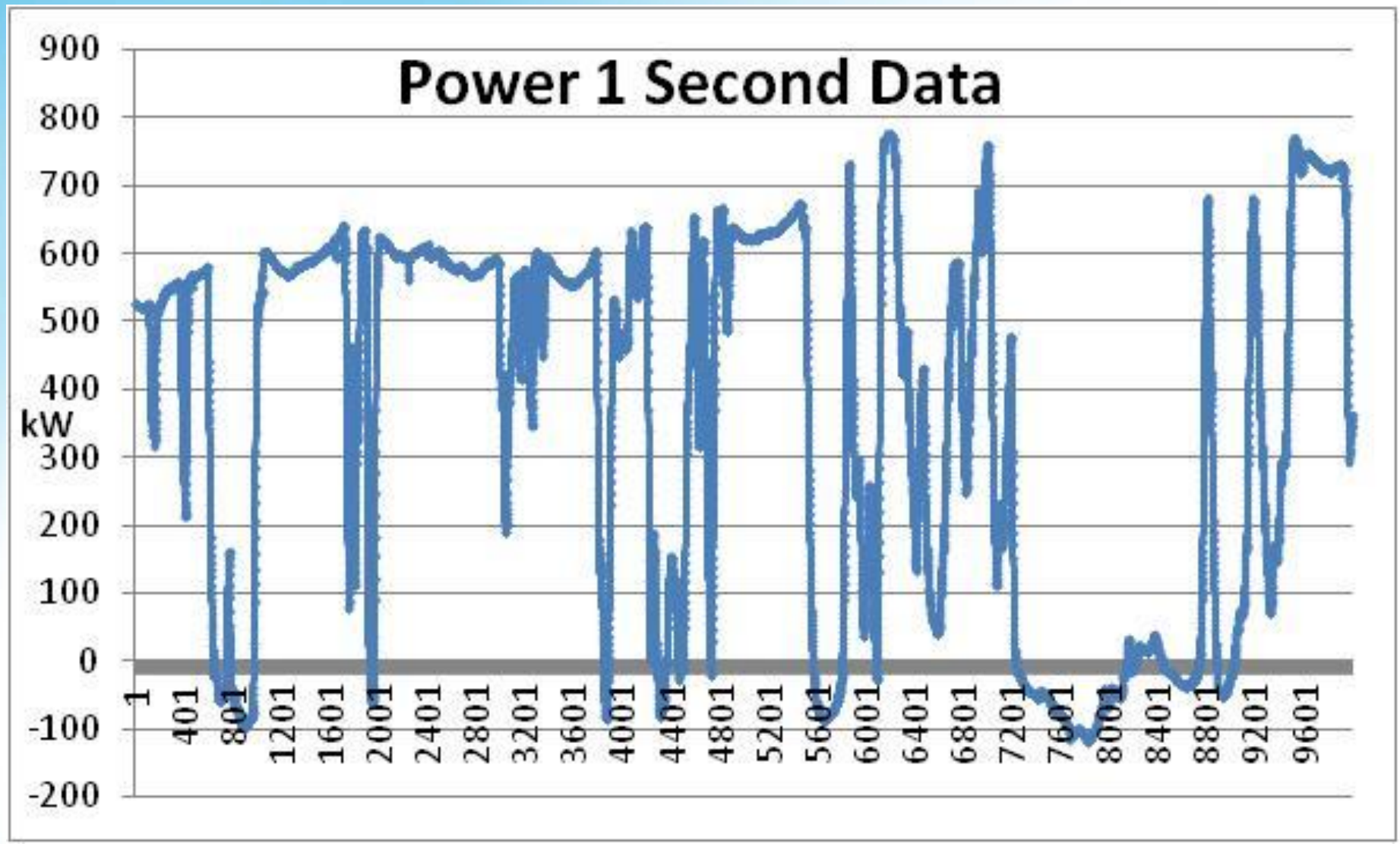
PV Intermittency



- Outside ANSI ranges
- Not CVR Compliance
- CBEMA Violations
- O&M Issues

INTEGRATION OF DER

PV Intermittency



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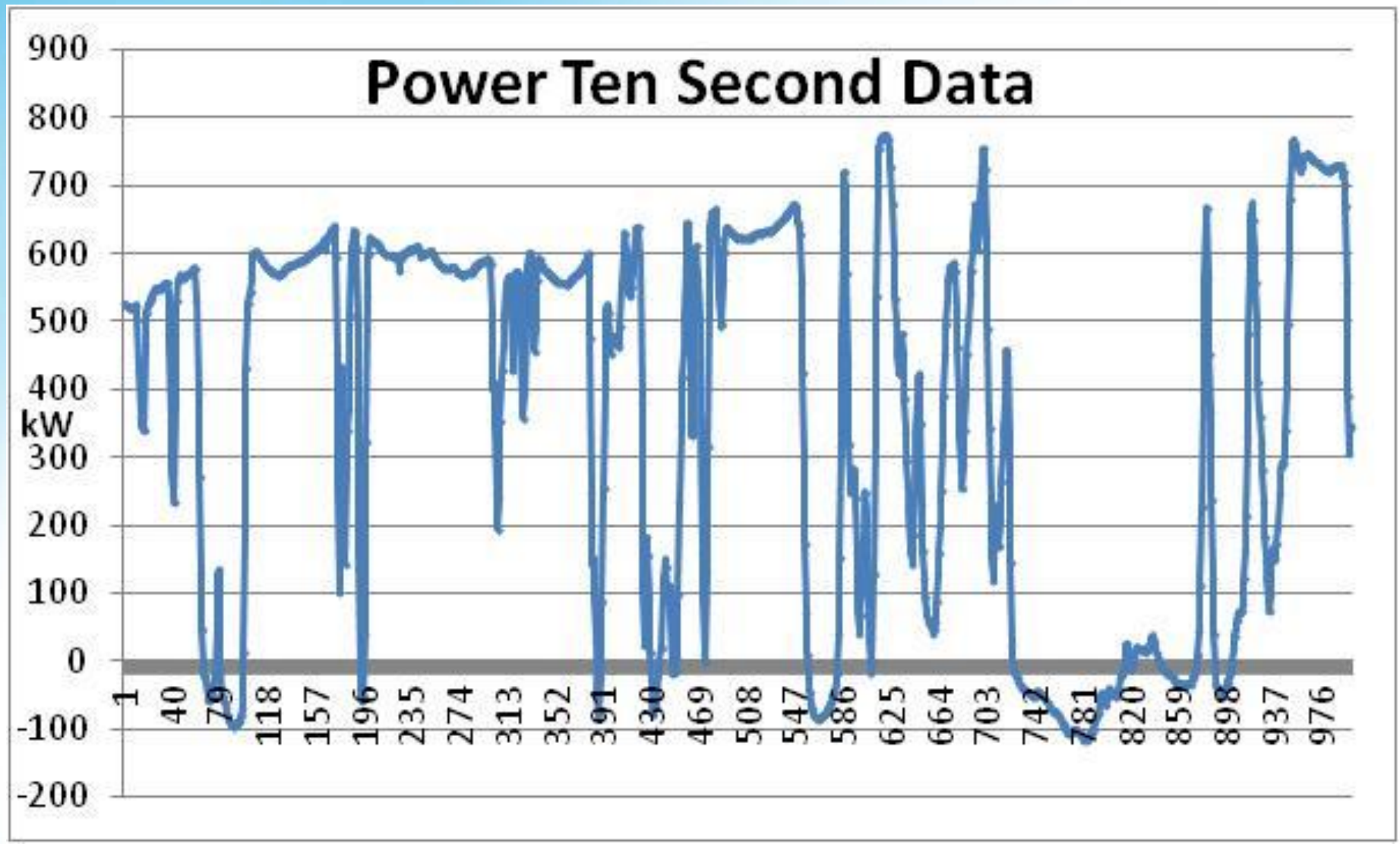
PV Intermittency



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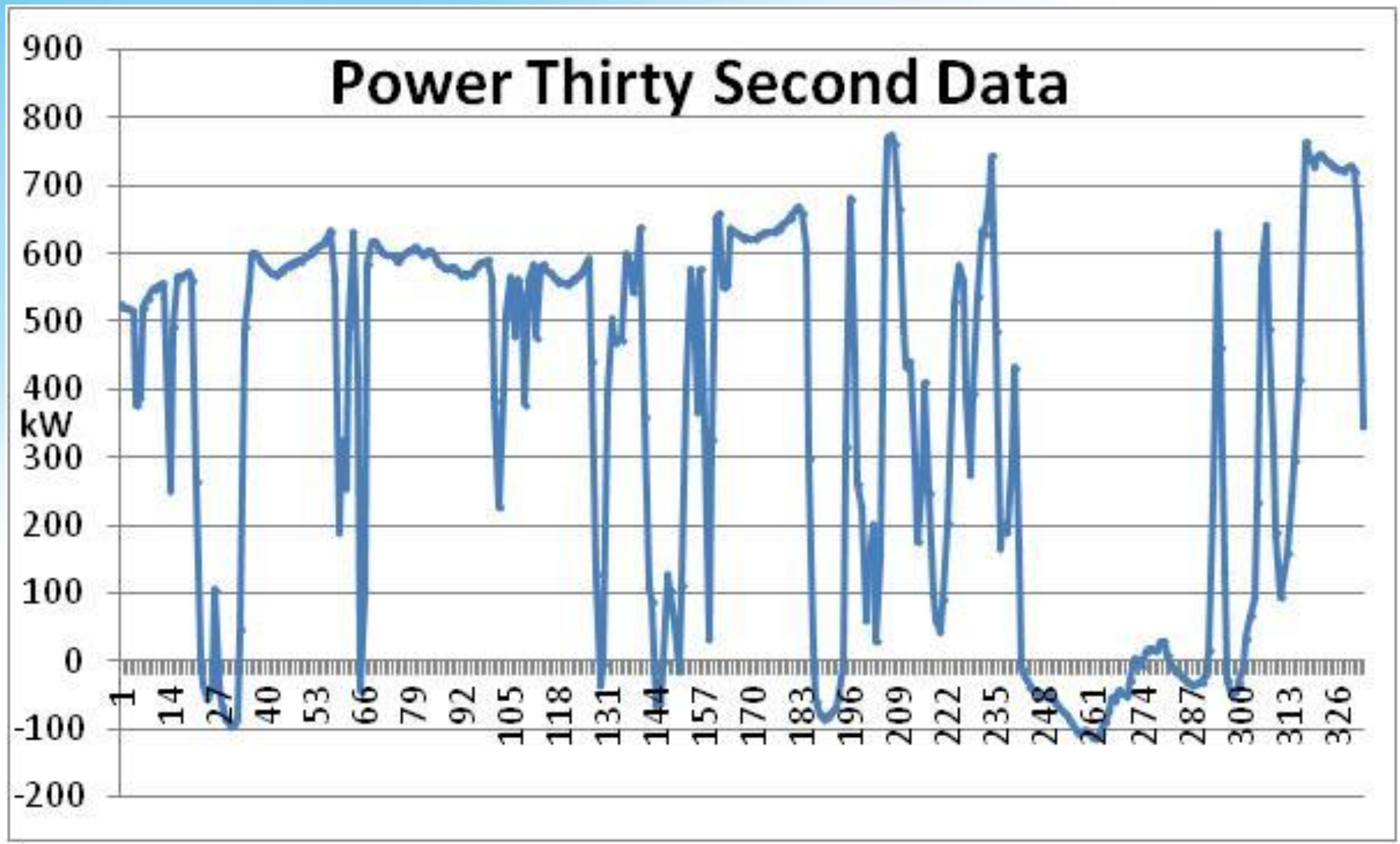

INTEGRATION OF DER

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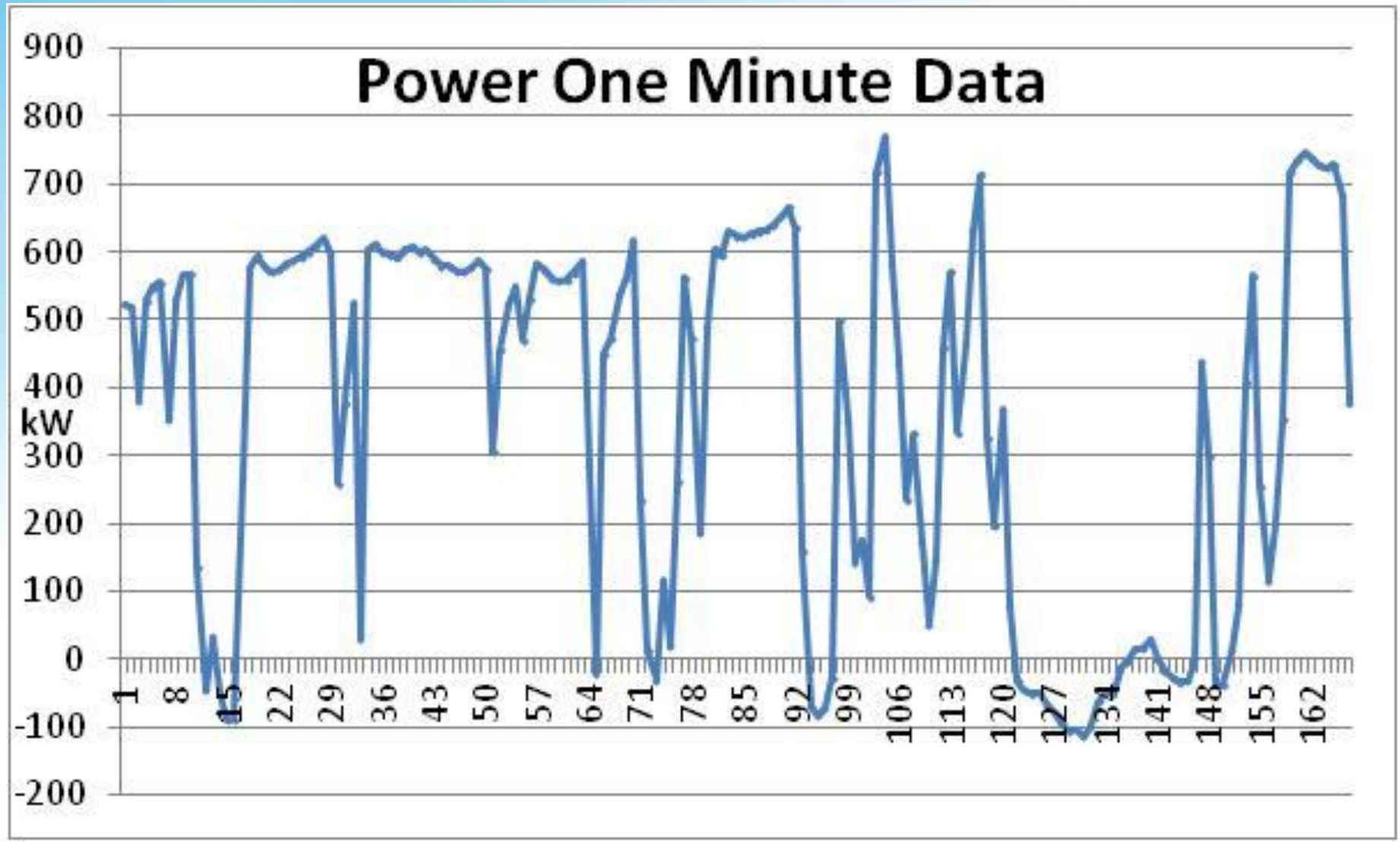
PV Intermittency



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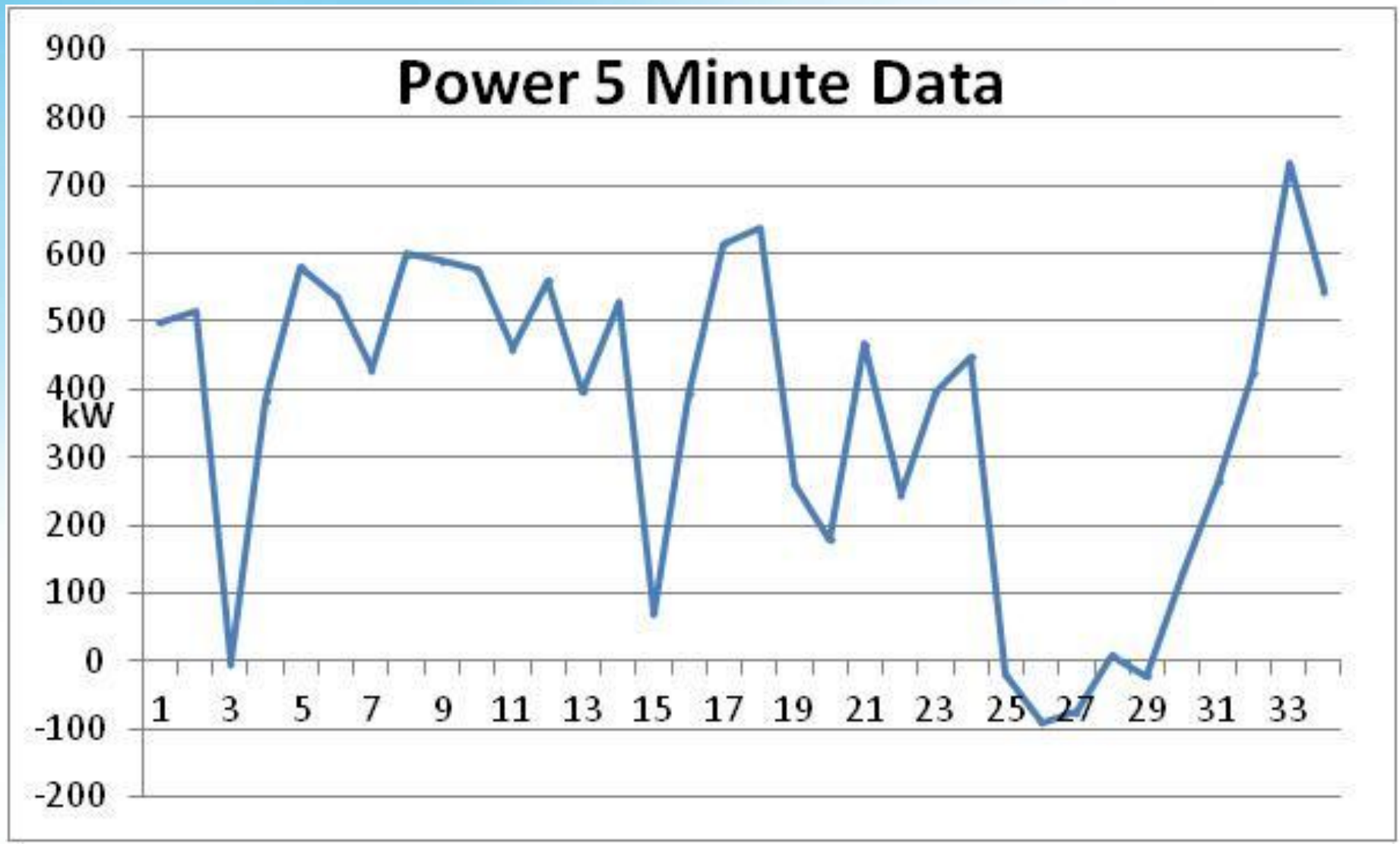

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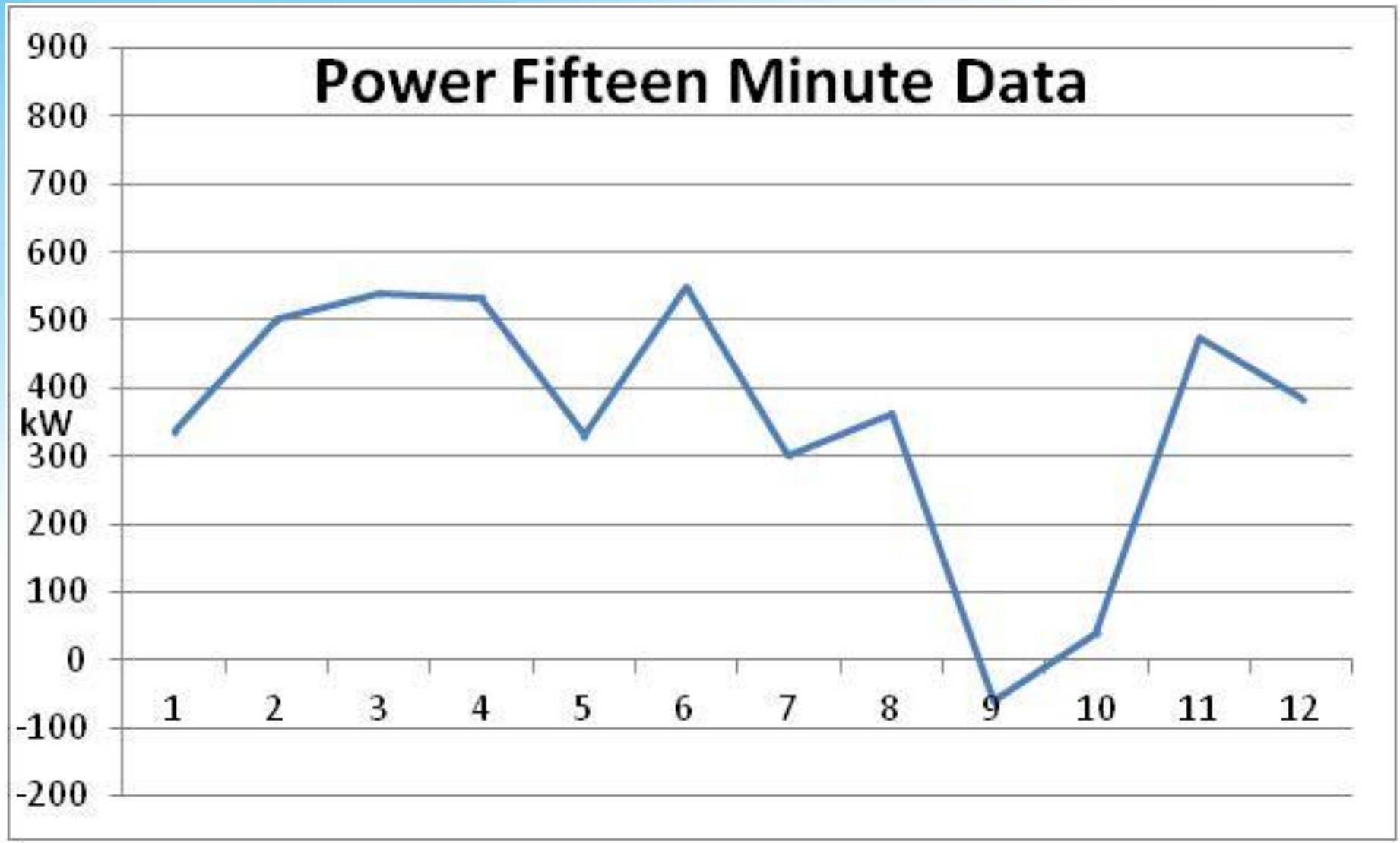

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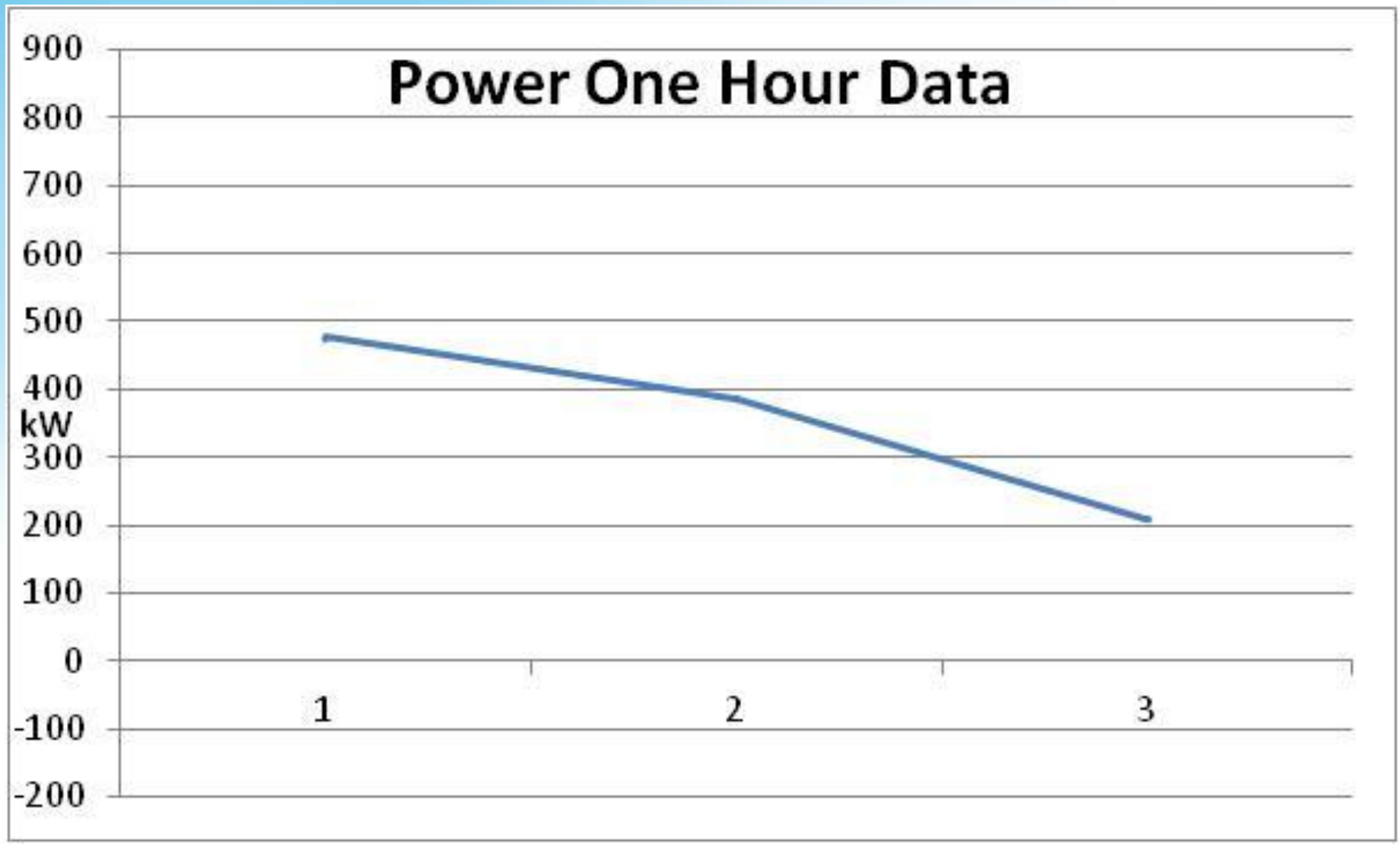
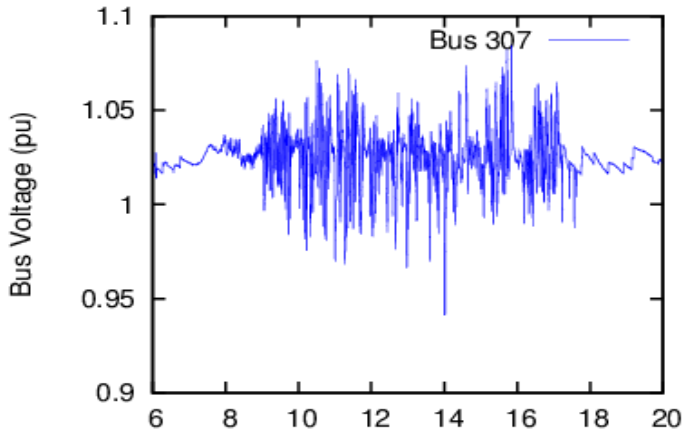
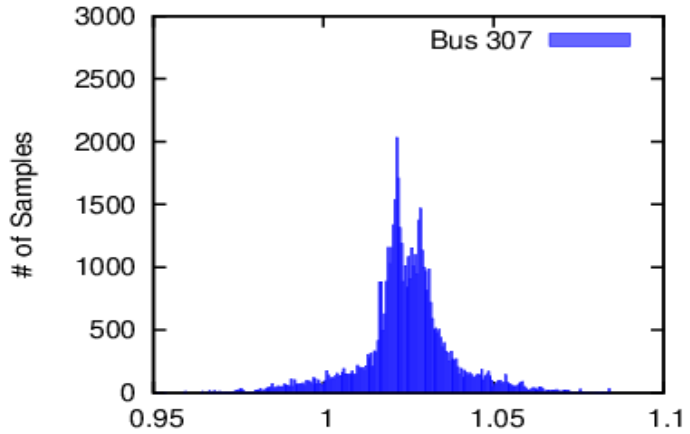
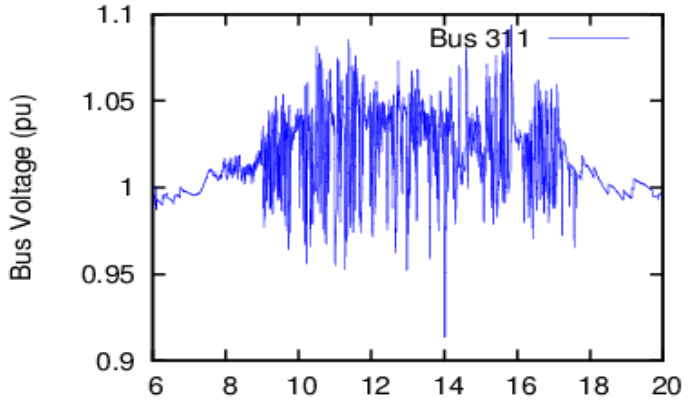
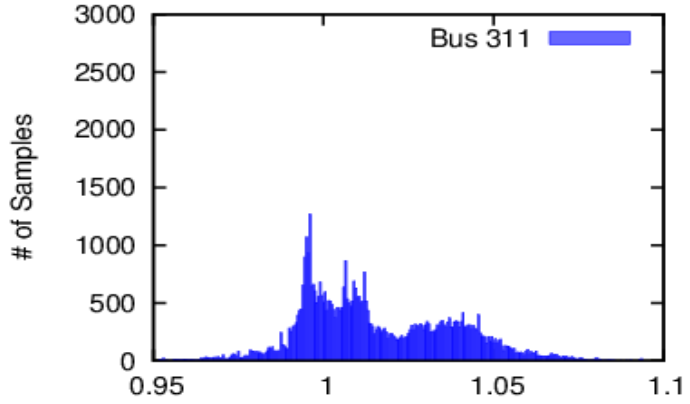


Baseline Voltage Performance



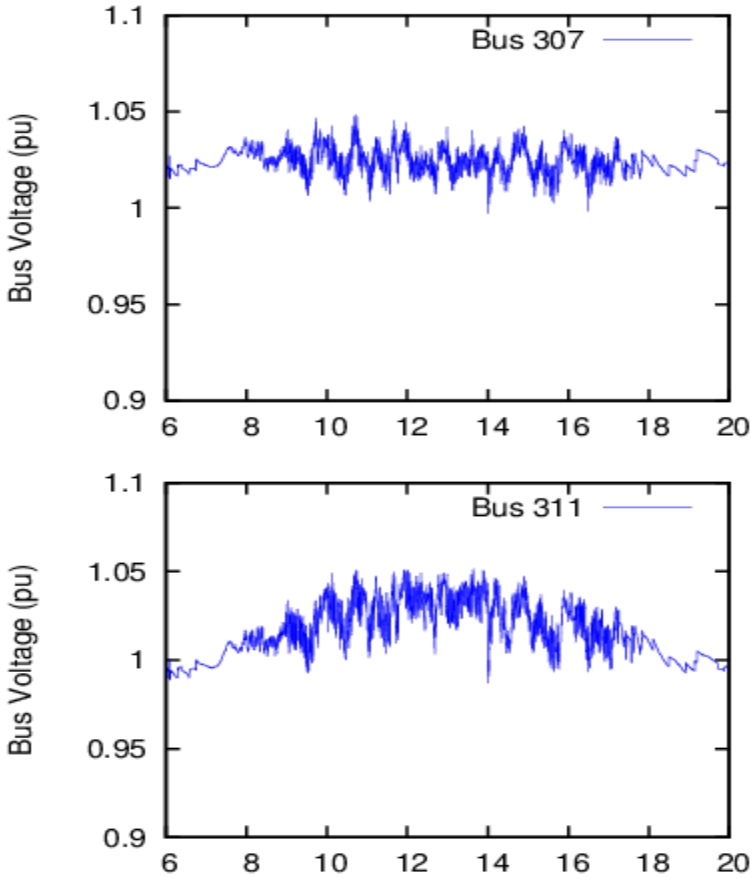


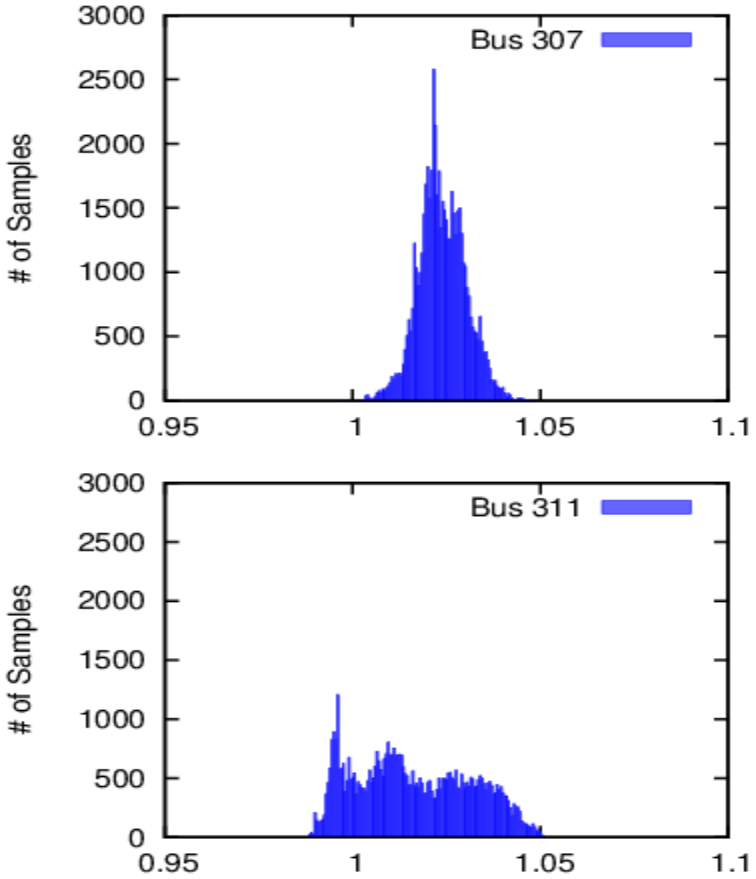




	VR 1020G	VR 1024G	VR 838G
Tap Changes	125	85	31

Modeling of Dynamic Voltage Control





	VR 1020G	VR 1024G	VR 838G
Tap Changes	45	77	121

Dynamic Voltage Control

Purpose

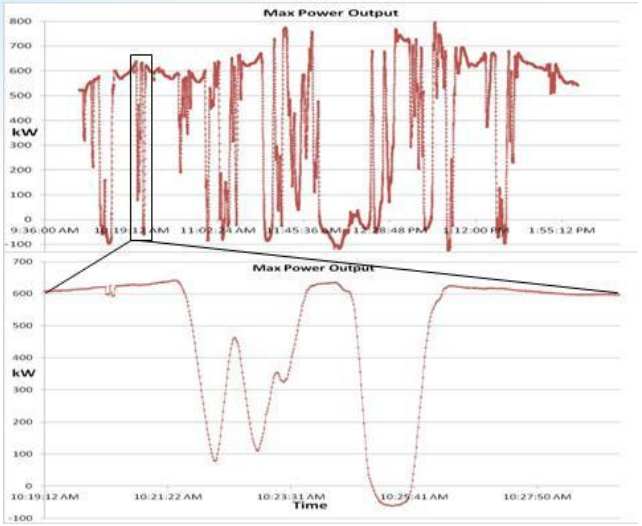
- Develop and install tools to maintain proper voltage due to intermittency of renewable energy sources.

Scope

- Two manufacturers' solid state inverters being installed to automatically adjust reactive power support to maintain voltage and reduce voltage swings due to solar intermittency.

Status

- In 2012 two solutions being implemented



Advanced Energy Storage

Purpose

- Deploy various types of storage to help integrate renewables and improve distribution system reliability

Scope

- Install 500 kW 1500 kWh Substation AES at two substations in 2012
- Install 25 kW 50 kWh Community AES at various locations in 2012

Status

- One Substation AES installed and under testing in Borrego Springs
- Community AES to be installed in 2012

Capacitor SCADA

Purpose

- Install SCADA control on all distribution line capacitors to allow greater grid visibility and improved volt/var management

Scope

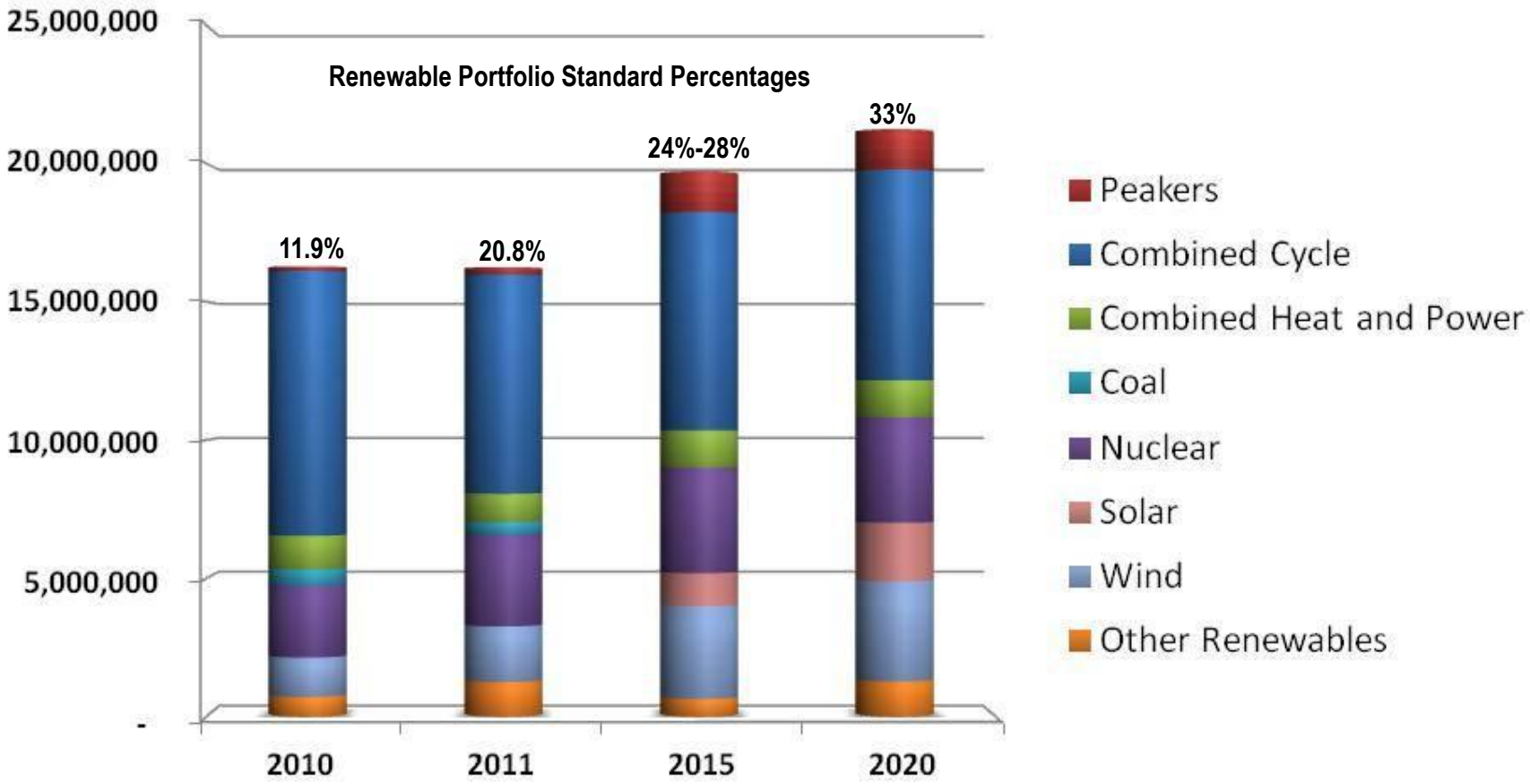
- In 2012 install SCADA control on 200 line capacitors

Status

- SCADA control provided on 14 line capacitors thru June 2012

Reliability and Safety

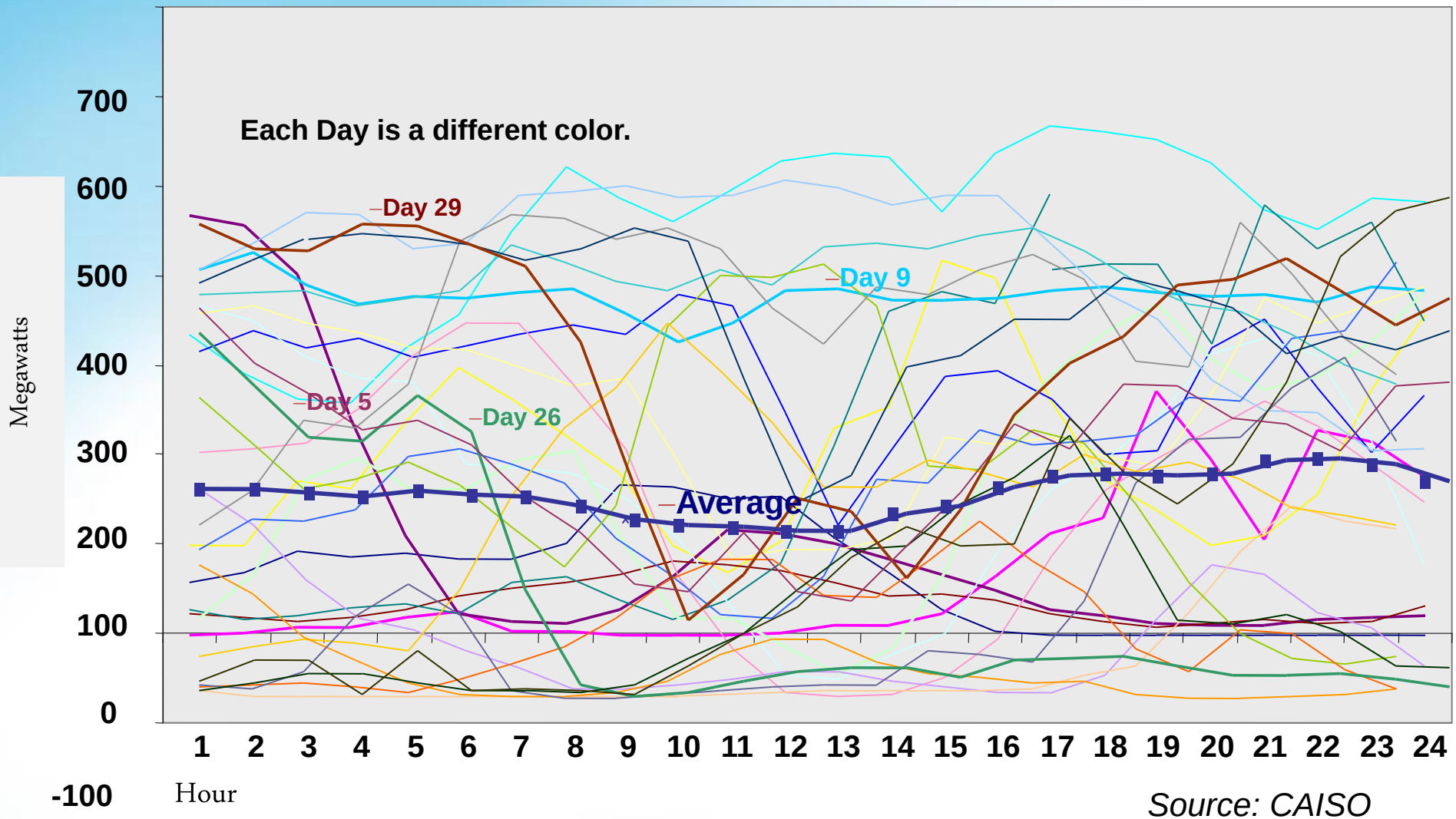
Changing San Diego Energy Mix



Energy mix for 2015 and 2020 are subject to substantial uncertainty
Values are for illustration purposes and do not represent forecasts

Tehachapi Wind Generation in: April – 2005

Could you predict the energy production for this wind park either day-ahead or 5 hours in advance?



Source: CAISO

Renewable Ramping

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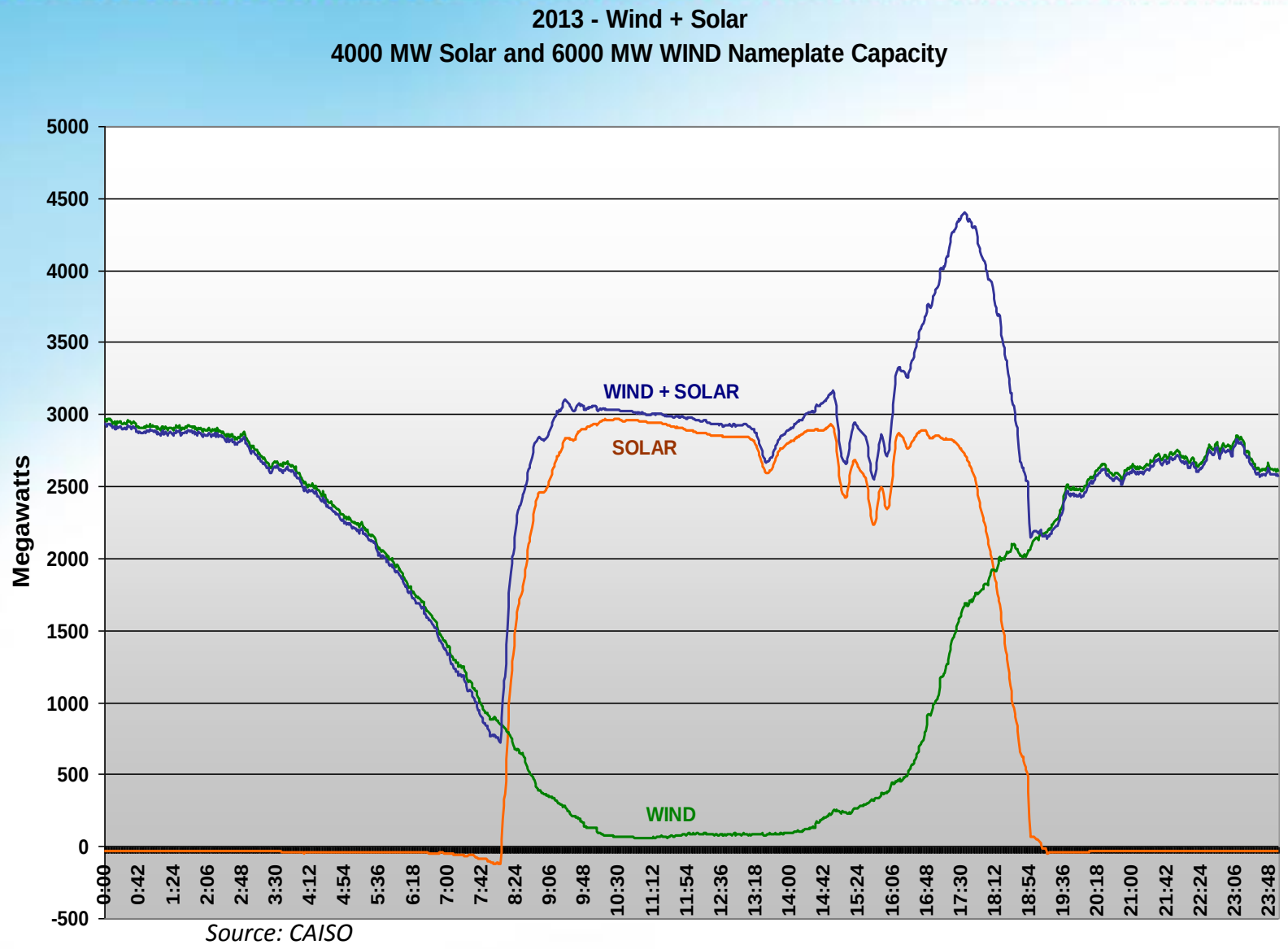

Source: CAISO

SDG&E Weather Network (135 Stations)

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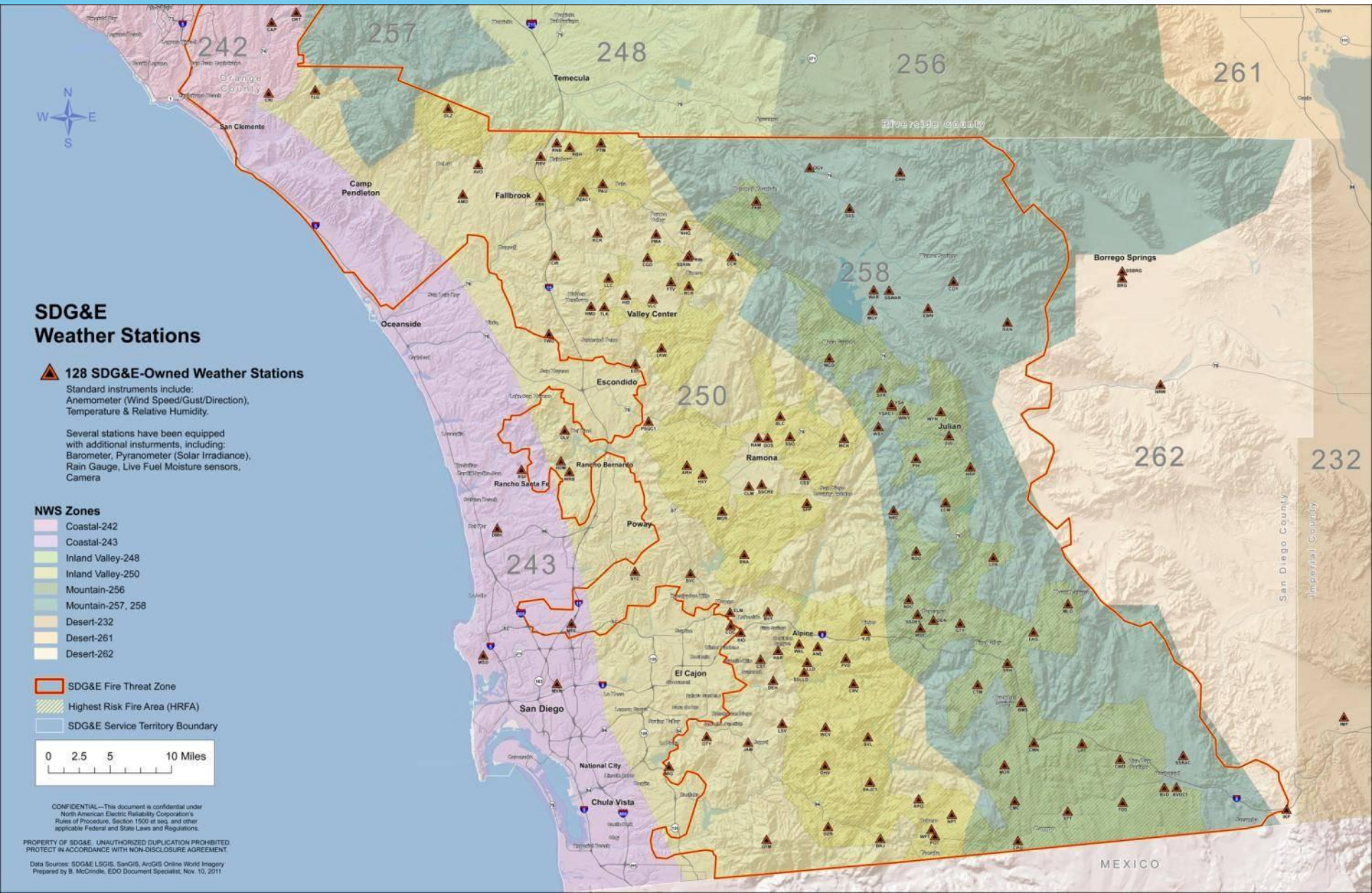


Fire Preparation and Safety Monitoring Santa Ana's

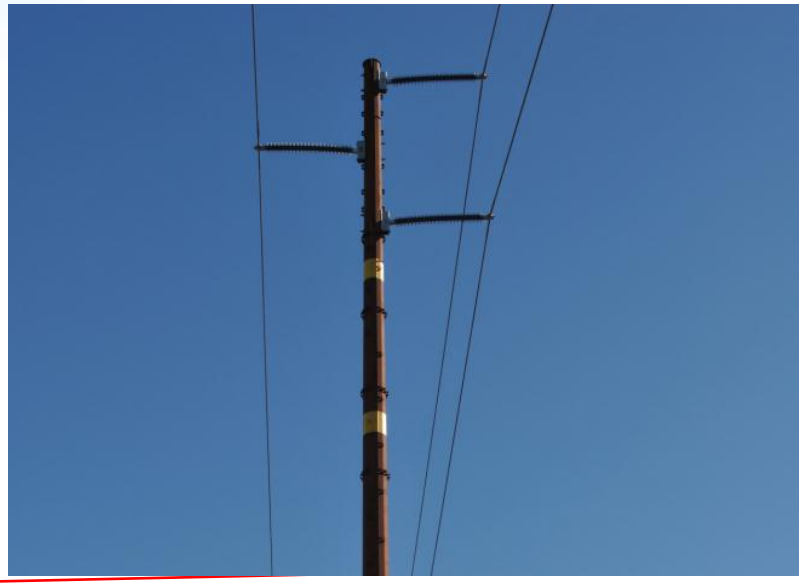
6 Cameras

Borrego Springs, Creelman, Loveland, Rincon, Rough-Acres, Warner Springs

Monitor the weather

Impacts (vegetation, structures)

Flying Debris



Wireless Faulted Circuit Indicators

Purpose

- Installation of wireless fault indicators (WFIs) to expedite location of distribution faults, using On-Ramp Wireless communication network.

Scope

- In 2012 Install about 3600 WFIs at 1200 locations
- Integrate with new OMS/DMS

Status

- Over 800 WFIs installed thru June

Smart Isolation and Reclosing

Purpose

- Application of pulse closing technology when reclosing onto faulted circuits to limit the energy into the fault, improving public safety

Scope

- Install 18 intellirupters in 2012

Status

- 2009-2011 installations = 157
- 2012 installations completed to date = 2
- 2012 installations under construction = 6

Operational Efficiency

Outage Management System (OMS)
Distribution Management System (DMS)

Purpose

- Replace existing OMS and install new DMS system to improve outage restoration response, predict potential distribution grid issues, and manage customer impact and increase process efficiencies

Scope

- Phase 1- Integrate SCADA and AMI for outage management
- Phase 1- Integration MDTs for Troubleshooters and Crews
- Phase 1- Storm Management features for improved restoration process
- Phase 1- Feeder Load Management provides information to Distribution System Operators
- Phase 2- Fault Location Analysis (FLA) and Fault Location Isolation Service Restoration (FLISR) for faster restoration of service
- Phase 2- Volt/Var Optimization

Status

- Phase 1 Live September 2012
- Phase 2 4th Quarter 2012

Operational Efficiency: Condition Based Maintenance

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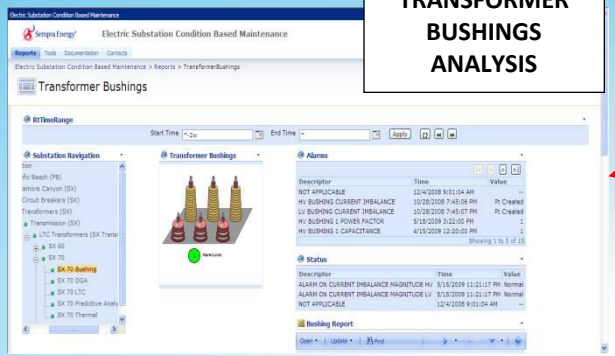
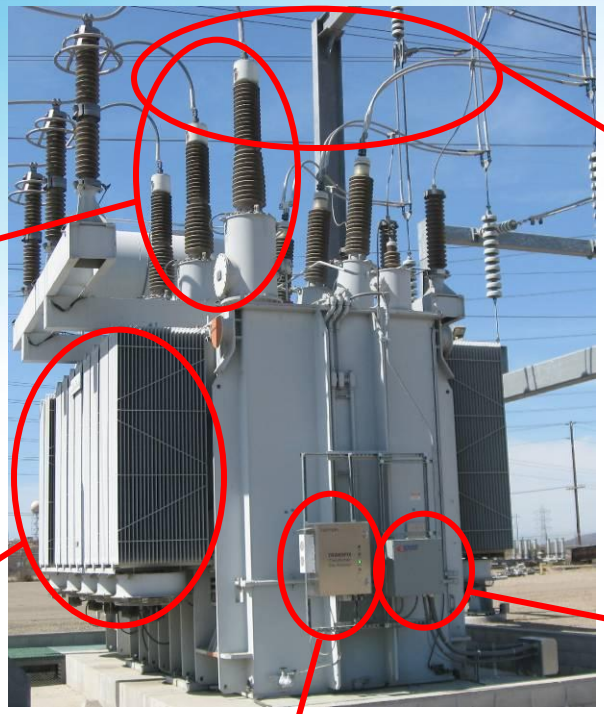
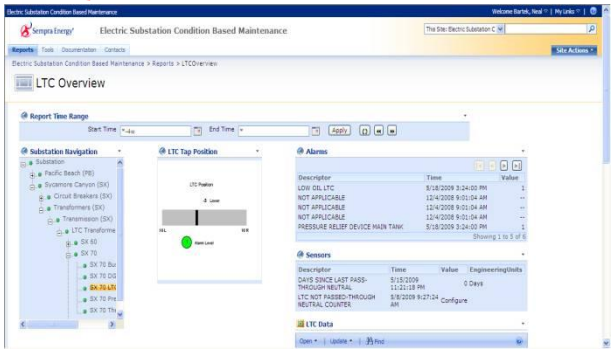
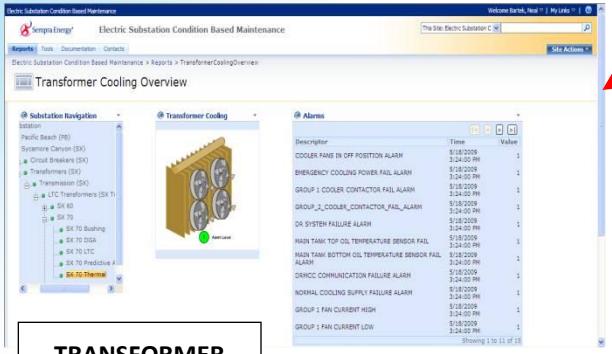
TRANSFORMER BUSHINGS ANALYSIS



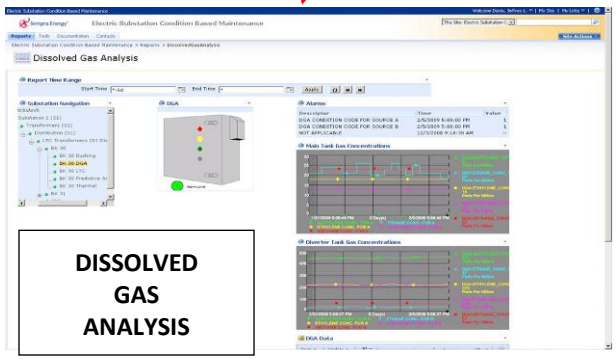


LTC energy is measured at the control cabinet on the other side of the bank

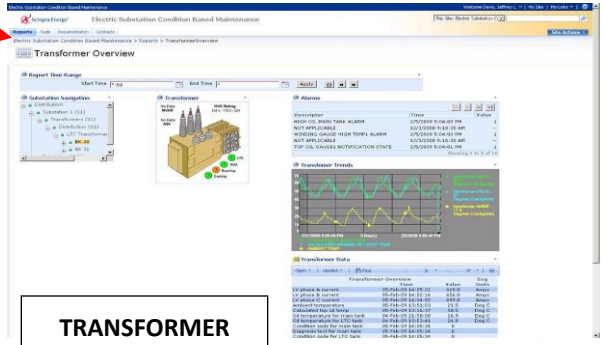




TRANSFORMER COOLING ANALYSIS



DISSOLVED GAS ANALYSIS

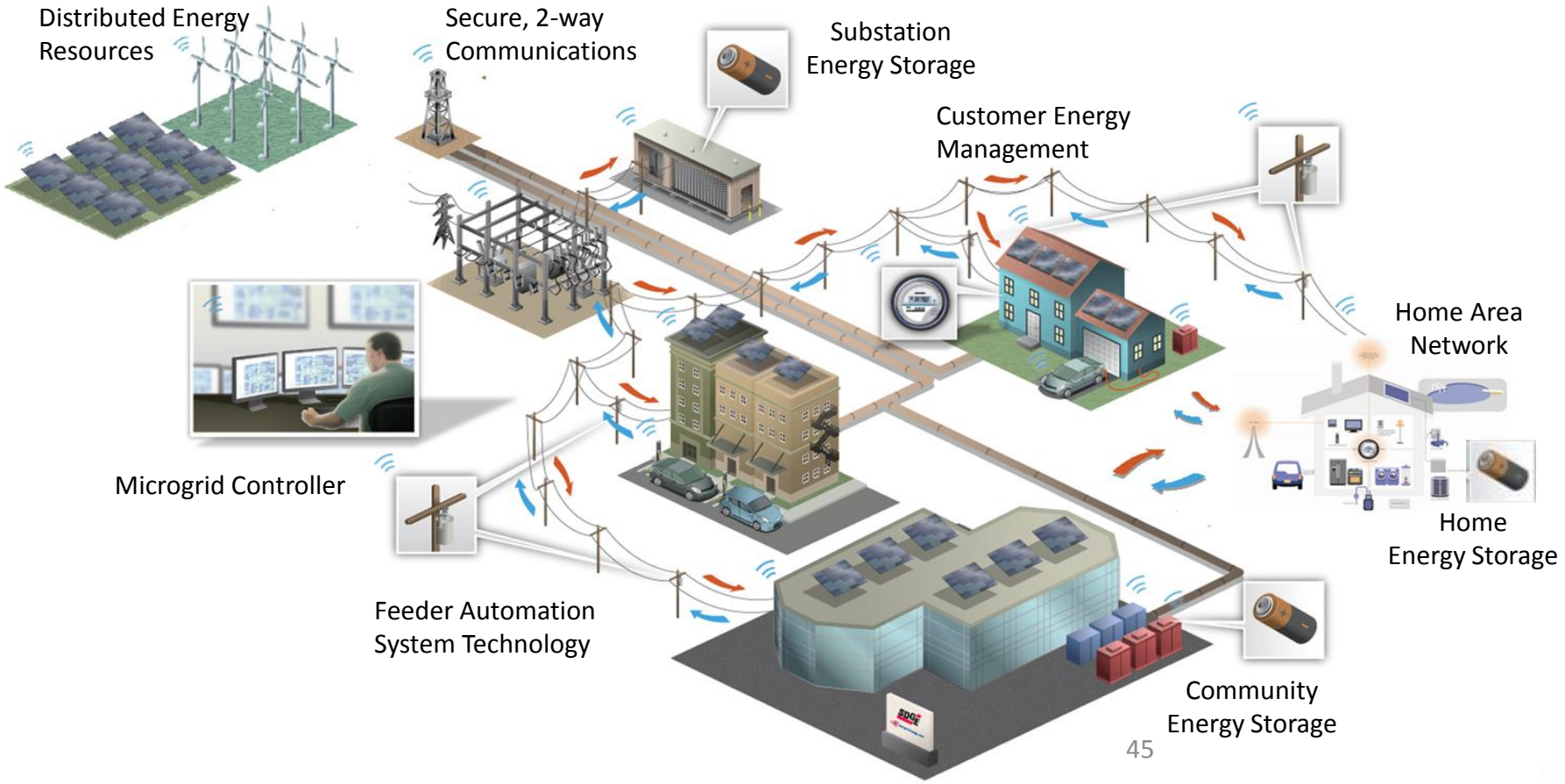


TRANSFORMER ANALYSIS

Research, Development, and Demonstration

Research, Development & Demonstration: SDG&E Borrego Springs Microgrid Project

Description	In cooperation with the US Department of Energy and the California Energy Commission, SDG&E along with public and private sector partners are developing a "microgrid" project – a small version of its smart electric grid.
Benefits:	• Integrate and leverage various generation and storage configurations and other smart grid technologies • Reduce the peak load of feeders and enhance system reliability • Enable customers to become more active participants in managing their energy use



Integrated and Cross-Cutting Systems

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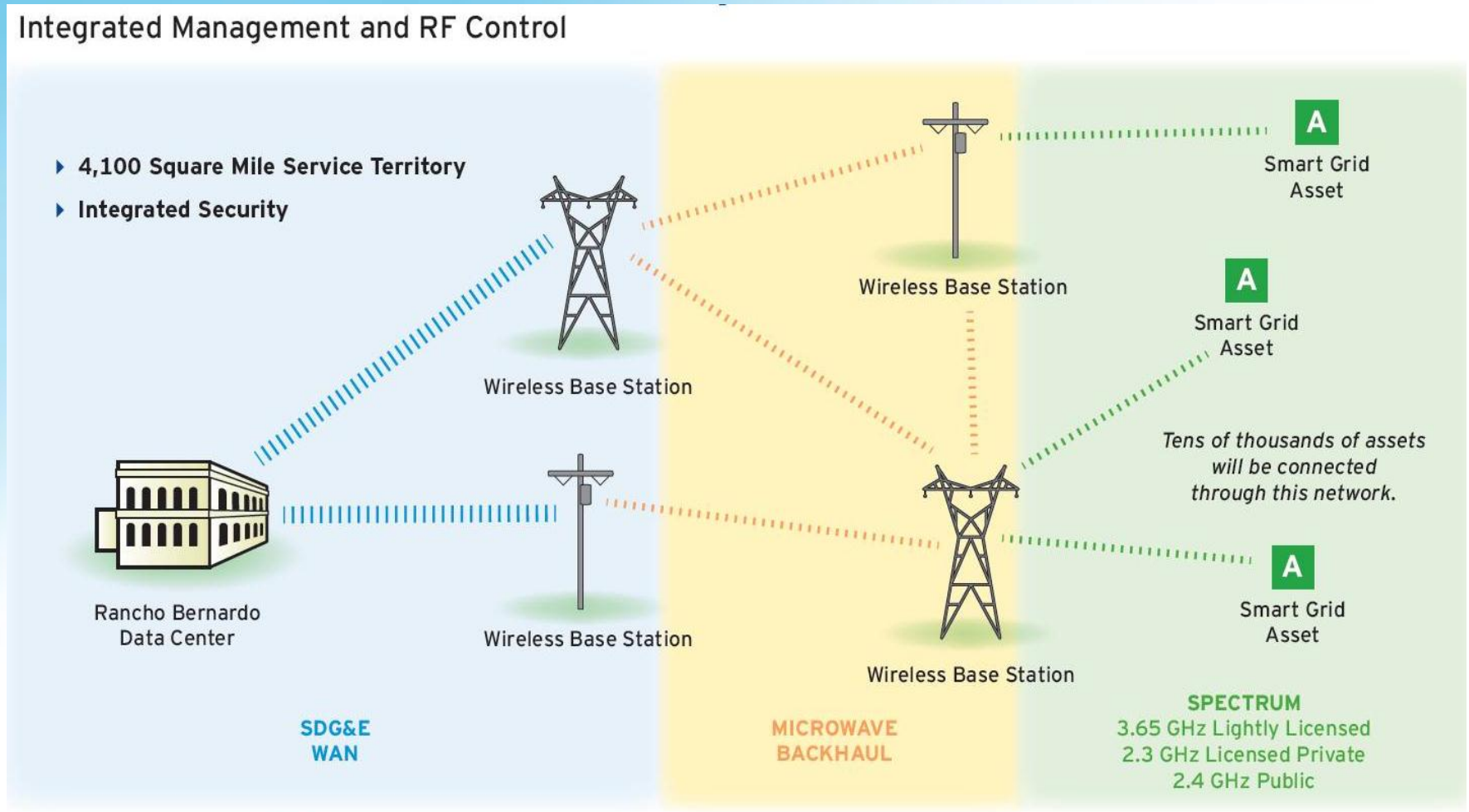
SGG&E Grid Communication System



A **Smart Grid Asset Examples >>** Reclosers | Switches | Fault Indicators | Transformers | Phasor Management Units

Low Power Communications Network (aka On-Ramp Wireless)

Purpose

- Deploy low speed wireless communication network and backhaul connectivity to enable electric T&D smart grid projects such as wireless fault indicators and smart transformers

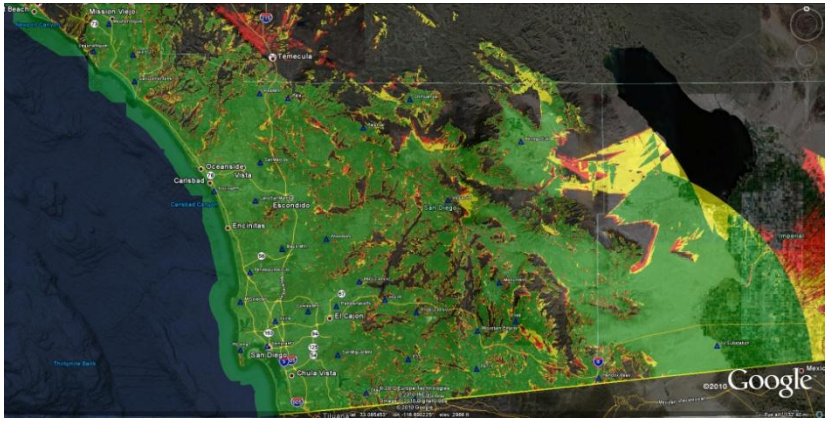
Scope

- Phase 1 – Install 35 access points for wide area coverage for overhead system
- Phase 2 – Install additional access points for improved coverage to enable installations on underground system

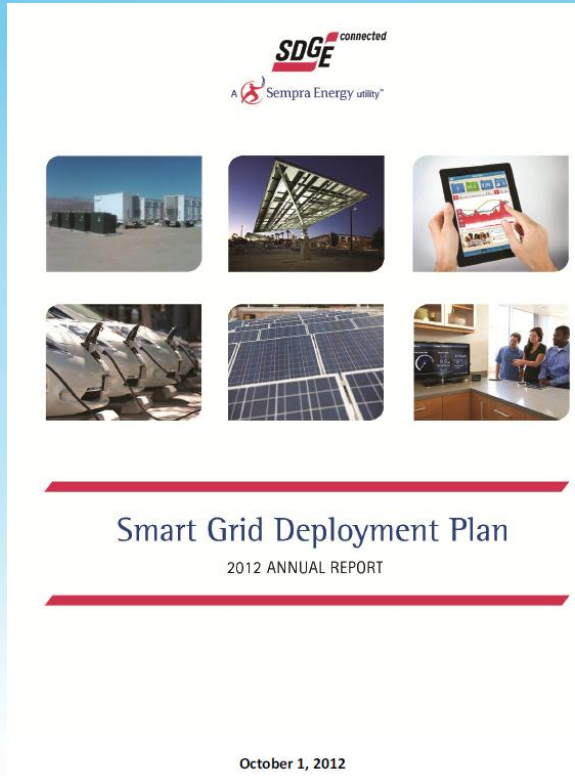
Status

- Phase 1- 30 of 35 access points installed
- Phase 2- Installations to begin 4th quarter

- **Green:** >95% probability of coverage
- **Yellow:** >75% probability of coverage
- **Red:** > 50% probability of coverage
- **No Color:** < 50% probability of coverage



SGDP Annual Report
Period Ending June 30, 2012



Estimated Spend During the Reporting Period Amounts in Thousands of USD	Reporting Period Value
Customer Empowerment/Engagement	$ 71,756
Distribution Automation/Reliability	$ 10,283
Transmission Automation/Reliability	$ 2,684
Asset Management, Safety & Operational Efficiency	$ 46,475
Security	$ 12,727
Integrated & Cross-Cutting Systems	$ 12,263
Total Estimated Costs	**$ 156,188**

Estimated Benefits During the Reporting Period Amounts in Thousands of USD	Reporting Period Value
Economic Benefits	$ 29,935
Reliability Benefits	$ 8,572
Environmental Benefits	$ 736
Societal Benefits	$ 627
Total Estimated Benefits	**$ 39,870**

- Overall Smart Grid investments of ~$156 million and ~$40 million in benefits during the Reporting Period
- 63 Smart Grid and related enterprise[3] projects underway or in the planning process

Questions?

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Thank You

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www.sdge.com/smartgrid/