Distributed PV and Service Transformation

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Agenda

- Service in Context: The Macro Drivers
- IT Systems: Foundation of Service
- Service Operations: Enabler for Transformation
- Transparency: The New Paradigm of Service

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Service Transformation in Context: The Macro Drivers of PV

- ***Financing and Modular Systems Capacity***
  - Lower financing thresholds for the street
  - Better portfolio risk management

- ***Climate Change***
  - Keeping the lights on while putting the fires out
  - Meeting regulatory obligations

- ***Constrainted Transmission Capacity, Distribution Challenges***
  - Fewer transmission options (BANANA and NOPE)
  - Major distribution investment requirements
  - Longer implementation timeframes

- ***Political dynamics***
  - New players in the space
  - Observed inefficiencies that are drawing new players

Bottom Line*: Many factors are forcing a move to PV solutions*
These are forcing changes in Service

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IT Systems: Foundation for Strong Service Offers

- Understanding Load at the Point of Load
  - SCADA Lite data acquisition *inside the building*
  - Near real time monitoring requirements (4 second end-to-end)
  - Aggregation of load data for gross impact across substations
- Understanding Generation at the Point of Load
  - SCADA Lite – at the inverter
  - Aggregation of generation data across substations and feeders
  - Near real time monitoring
- Forecasting Load net of Distributed Generation
  - Looking at the Grid as an Interactive 2-Way Network
  - 24 Hour Day-ahead Forecasts
  - 15 Minute and Hour-ahead Forecasts
- Scalable, Real-time, Networking Elements
  - Robust data networking infrastructure
  - Transitional storage for buffering

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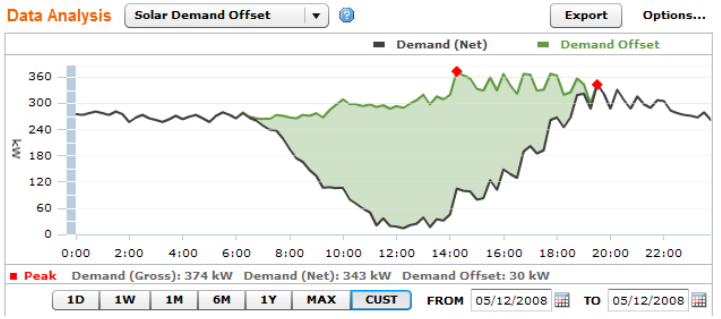
IT Systems: Smart Grid PV enabling accurate service tracking

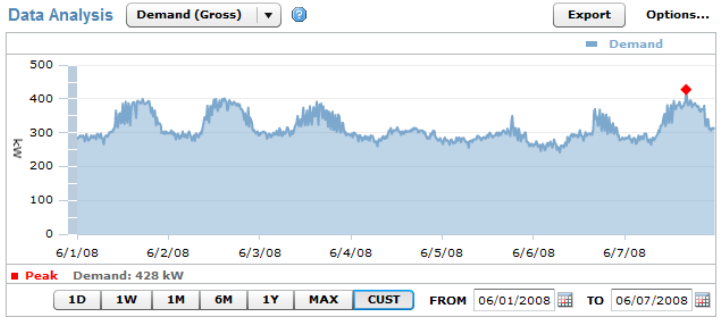
Solar Production Profiling

- Solar power production (kW)
- Solar energy offset (kWh)
- Solar demand offset (kW)



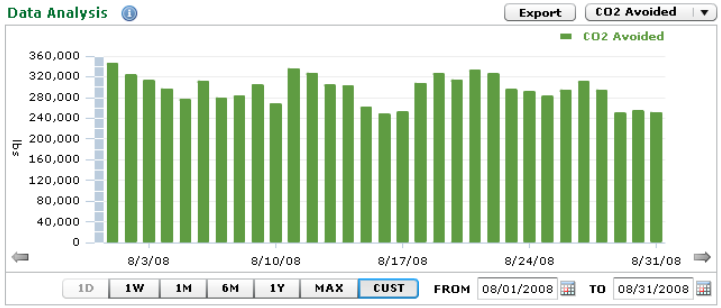
Solar Load Profiling

- Energy Usage (kWh) – gross and net
- Demand (kW) – gross and net



Environmental Offset Profiling

- Track Carbon emissions
- Export data from charts
- Adjusted time periods in charts



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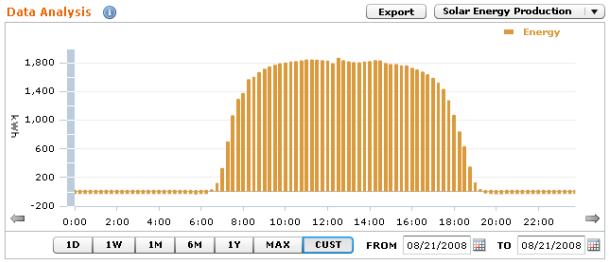
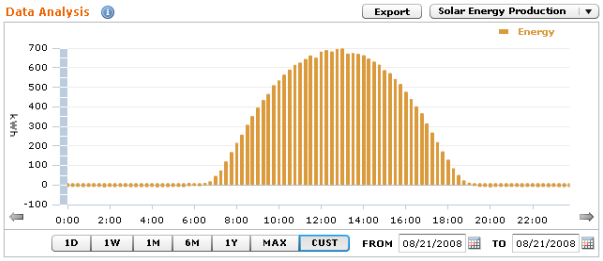
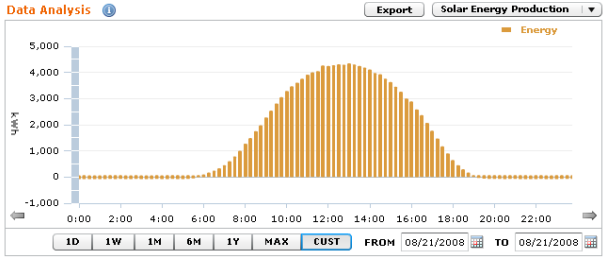
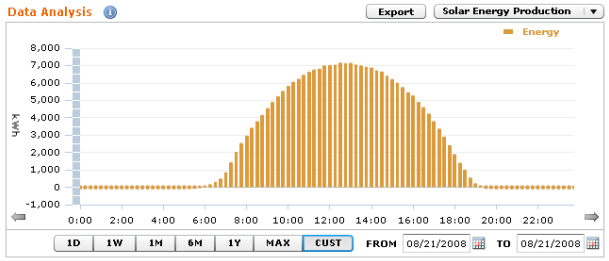
IT Systems: Smart Grid PV Aggregated Production Curves (1 Day)









CO - Colorado Energy Production Curve

- Large Ground Implementation
- Strong Shoulders (Tracker)

NJ – New Jersey Energy Production Curve

- More Variable Production
- Narrower Peak, Lower Shoulders (Irradiance)

CA – California Energy Production Curve

- Strong, Consistent Summer Production
- Broader Footprint (Irradiance)

USA – United States Energy Production Curve

- Strong, Consistent Summer Production
- Widest Footprint (Irradiance & Trackers)

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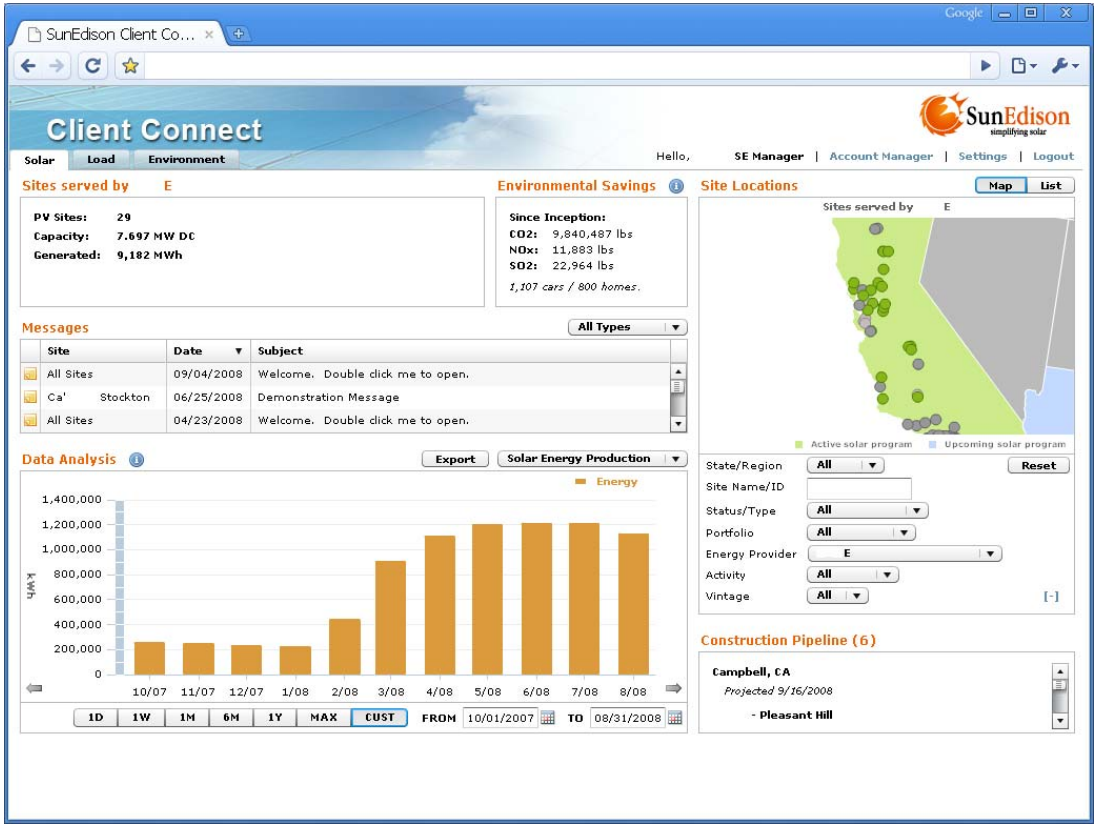
Bringing it Together: Operator Wide Production & Integration



10 Month Energy Production

- 9.1GWH Delivered
- 23 Systems & ~8MW
- 6 New Forecast (<45 Days)
- Variable Peak – May/June/July
- Rapid Modular Growth

Message Management

- System Events
- Turn-up Notifications
- Outage Response

Environmental Attributes

- 9.8M lbs of C02 Offset
- 11K lbs of NOx Offset
- 22.9K lbs of SO2 Offset

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Service Operations: The Enabler for Smart Grid Transformation

- ***The uptime game***
  - "Four 9's" – no longer sufficient in a DG PV world
  - Smart Grid PV – amplifying uptime events
  - Uptime dynamics – driven by financing requirements

- ***Service operations: impacts on energy delivery***
  - Not a "zero maintenance" proposition
  - The #1 factor influencing Smart Grid PV energy delivery
  - Finance structures driving the dynamics of Smart Grid PV

- ***Reporting – redefining traditional measurements***
  - From SAIDI, SAIFI, and CAIDI to…
  - OPR, IPR and CPR

***Bottom Line**: Smart Grid PV represents opportunities for service organizations*

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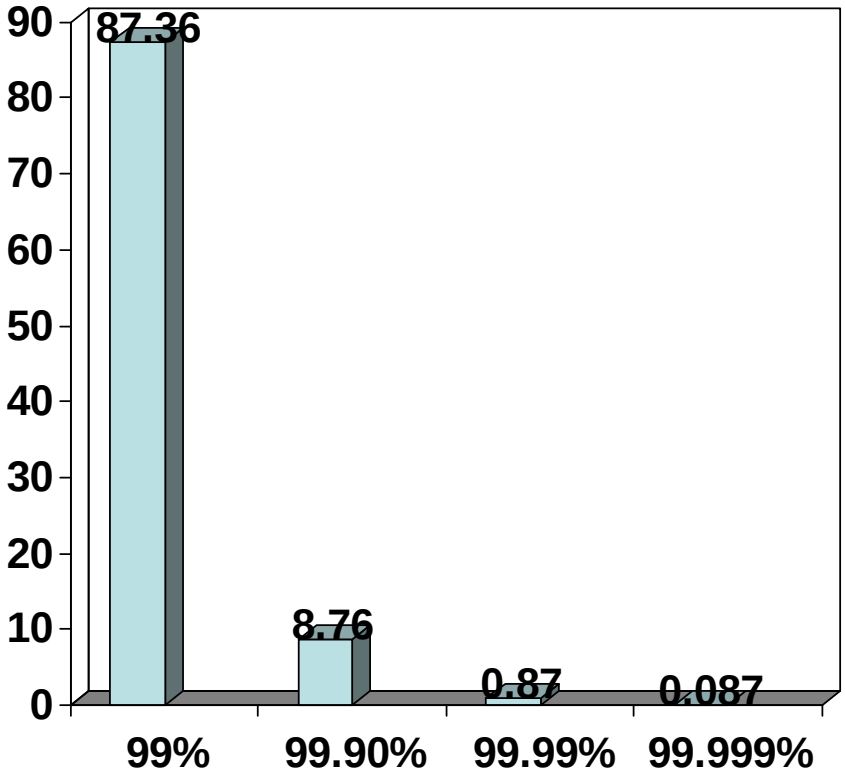
Service Operations: Measuring Uptime – Utility Service Territories

Hours of Downtime by Uptime Rate



- ***Utilities - Nationally***
  - Just over four 9's of uptime
  - ~ 45 Minutes annually
  - Measures entire service area
  - Key Metrics: SAIDI/SAIFI/CAIDI
  - Effective OPR* is .99994
- ***Smart Grid PV***
  - "Uptime" is "Sunlight hours"
  - Not measured system wide
  - Measured per instance
  - OPR* = a function of Grid + Site

* OPR = Operational Performance Ratio

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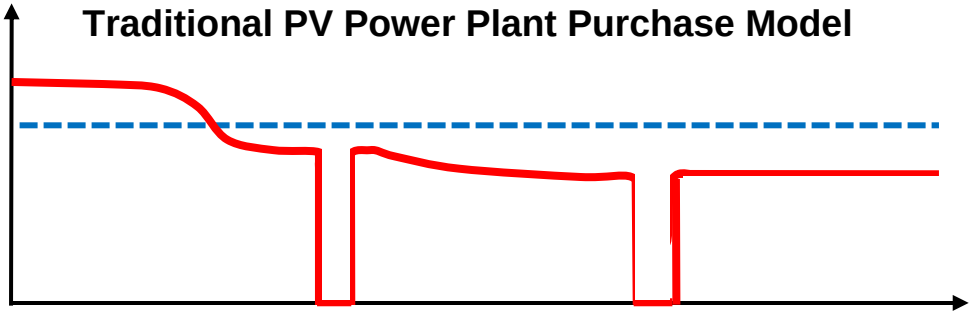
Service Operations: Lessons Delivering Smart Grid PV Energy

PR*

Traditional PV Power Plant Purchase Model



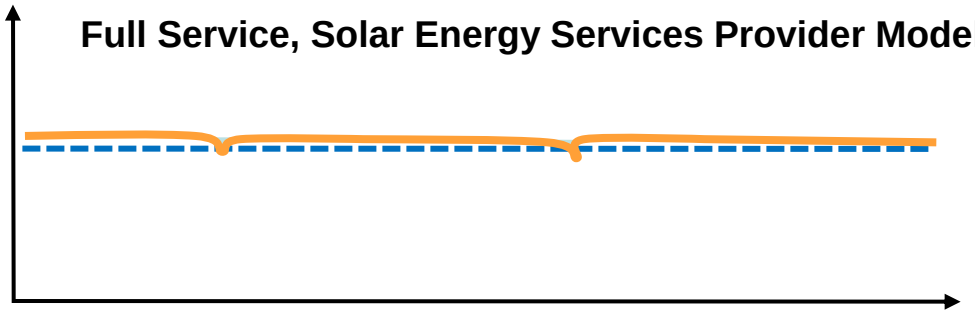
time

Independent Owner Analysis**

- OPR Range:	53% - 90%
- OR Range (EST):	8% - 17%
- Payback Impact:	(1.5x) to (3x)

PR*

Full Service, Solar Energy Services Provider Model



time

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- 2007 Portfolio:	OPR of 102%
- 2007 Portfolio:	OR of <2%
- 2008 (YTD):	OPR of 107%
- 2008 (YTD):	OR of 1.6%

The Bottom Line: ***The #1 Factor Impacting Energy Delivery is Smart Grid Service Operations***

* OPR = Operating Performance Ratio = actual production / expected

** Results based on >27 inspections of sites In NJ and CA

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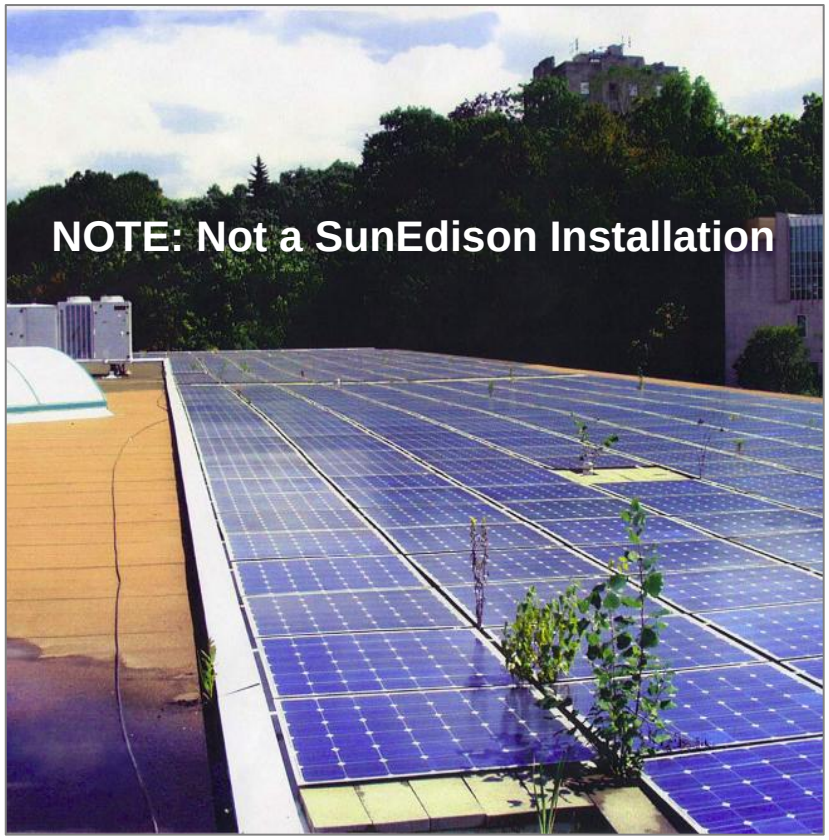
Service Operations: Lessons Learned Delivering Smart Grid PV

PV Systems = Low Maintenance…
NOT No Maintenance

- ***Factors impacting energy production***
  - *Active* Monitoring & Response
  - Preventative maintenance cycle
  - Inverter performance

- ***Implications of poor maintenance***
  - Mechanical integrity failure
  - Roof deterioration
  - Voiding of roof warranties
  - Safety risk



The Bottom Line: *All systems require maintenance in order to meet investor performance targets*

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Transparency: The new frontier for the Smart Grid PV services

- The human face of solar energy services
- Leveraging IT systems
- Ease of access: Internet portal availability
- Bringing the customer home

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Transparency: Simplifying the service process

Client Connect (2.0)
- Production
- Load
- Environment
- Service messaging

Simplify
- Service
- Performance
- Availability
- Visibility

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Summary: Transformation and the Greening of the Grid

- ***Smart Grid PV – a reasoned response to macro forces***
  - Climate change realities
  - T&D constraints
  - Financing and declining prices for PV systems
  - Political pressures

- ***The Requirement of Investment in IT systems***
  - A mandatory component for this change
  - Both challenges and great opportunities

- ***Service operations***
  - The key enabler for delivered energy
  - A complement to existing utility structures

- ***Service transparency***
  - A mandatory component for successful change
  - A great vehicle to strengthen customer relationships

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Thank You

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