Lessons Learned:
How Utilities Leverage Data
An *Intelligent Utility* Reality Webcast

December 13, 2011
Lessons Learned: How Utilities Leverage Data

Alan Dulgeroff
Director - IT Enterprise & Corp Systems
Sempra Utilities

Paul Dick
Director, Enterprise Information Management
OGE Energy Corp

Martin Mysyk
Senior Enterprise Architect
TransAlta Corporation

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
The Best-Run Businesses Run SAP

Lance Charlish  
Senior Utilities Industry Principal  
SAP America, Inc.  
601 108th Avenue, N.E.  
19th Floor  
Bellevue, WA 98004  
T +1 (503) 423.7544  
E lance.charlish@sap.com
Lessons Learned: How Utilities Leverage Data

H. Christine Richards
Senior Analyst
Utility Analytics Institute
Agenda

Introduction
• Why is now the time for data and analytics?
• Utility analytics defined

The discussion
• Utility experiences with data analytics
• Q&A

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
Why is now the time for data and analytics?
*The smart grid path is leading us there*

**2000-2010**
- Concept
- Scoping
- Investment
- **DESIGN**

**2007-2012**
- Build out smart grid
- Install smart meters
- **TECHNOLOGY IMPLEMENTATION**

**2010-2020**
- Identifying ROI
- Renewables Integration
- EV growth
- Intell. asset mgmt.
- Grid optimization
- **Much/most of the value will be driven by ANALYTICS**

Technology aligns with business & regulatory requirements

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
Utility analytics defined

Collected data

<table>
<thead>
<tr>
<th>ANALYTICS</th>
<th>Grid analytics</th>
<th>Customer analytics</th>
<th>Other analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Actionable insights

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
Lessons Learned:
How Utilities Leverage Data

Alan Dulgeroff
Director - IT Enterprise & Corp Systems
Sempra Utilities

Join the conversation on Twitter using #IUWebcasts
and follow Intelligent Utility on Twitter @IntelUtil
Lessons Learned: How Utilities Leverage Data

Webcast – December 13, 2011
Data Diversity and Density
Example: SDG&E Weather Network

- 128 Weather Stations
- MesoNet --- A network of automated weather stations designed to observe weather in a localized region.
- 3rd largest MesoNet in the United States
- Densest MesoNet in the United States
- Information is made available to the NWS and the public
San Diego Gas & Electric

- Subsidiary of Sempra Energy
- Regulated public utility
- Provide safe and reliable energy service to 3.4 million consumers
  - 1.4 million electric meters
  - 800,000 natural gas meters
- 4,100 square mile service territory in San Diego and southern Orange Counties (25 cities)

- 1,800 miles of electric transmission lines and 21,600 miles of electric distribution lines
- Two compressor stations, 160 miles of natural gas transmission pipelines, 8,100 miles of distribution pipelines and 6,200 miles of service lines
- 4,500 employees

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved
Key Characteristics

- Layering on Solid Foundations
- Environment and policy
- Diverse and engaged community
- Collaboration with stakeholders
- Culture of leadership, innovation, progress
History of Data Growth at SDG&E - Examples

- Electric GIS, OMS ~ 20 years
- 70% SCADA Substations, 1300 Field Devices
- Engineering and Customer Data Warehouses
- Operational Data Store
- Mobile Data Terminals
- Smart Meters
- Operational Excellence
- Third largest privately owned Weather Network
- Smart Grid Deployment Plan…
SMART GRID DEPLOYMENT PLAN: VISION

- 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."

- Focuses on customers and stakeholders, and their adoption of renewables, PEVs, other technologies, and environmental policy
  - SDG&E cannot wait for others to move forward – our customers are already moving forward.

- Incorporates stakeholder ideas, recommendations and priorities

- SB 17 Alignment
  - Describes our vision of how the 11 SB17 smart grid goals will be realized by 2015/2020
Smart Grid Roadmap Programs

- Baseline includes projects put in service as of 12/31/2010
- SDG&E’s roadmap includes smart grid investments in 9 programs:
Customer Empowerment: Smart Meter

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 about 2.18 Million meters installed (>95%)!
Tools and Programs
- Google PowerMeter / SDG&E Online Tools
  - About 12,000 users
- Demand Response
- Dynamic Pricing – future offering
- Home Area Network Pilots

Awards and Recognitions
- SDG&E’s Smart Meter program was awarded “Best in Quality”, by Chartwell, Inc. for customer service
- Recognition of being a “gold standard” utility by CPUC Commissioner Ryan in 2010
- Second year in a row the honor of “Smartest Utility in the in Nation” by Intelligent Utility Magazine and IDC Energy Insights.
At the Sempra Energy utilities, an enterprise GIS will store data about gas and electric transmission, distribution, substation and telecommunication facilities, including new smart grid components like electric vehicles and solar panels. Details include location, connections to other facilities, make, model, and characteristics.
Operational Efficiency: Outage and Distribution Management

Current State

- Paperwork
- Manual processes
- Labor intensive
- Software systems are not fully integrated
- Unplanned outages are reported by customers
- Limited ability for specialized reports

Future State

- Near real-time data and modeling
- Automated processes
- Integration with more systems
- Optimize asset utilization
- Faster outage restoration times
- Enhance customer experience
- System generated reports
- System generated switching plans
Operational Efficiency: Condition Based Maintenance

LTC energy is measured at the control cabinet on the other side of the bank.
Research, Development & Demonstration: Microgrid Project and Data on the Edge

<table>
<thead>
<tr>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>In cooperation with the US Department of Energy and the California Energy Commission, SDG&amp;E and 10 public and private sector partners will develop a &quot;microgrid&quot; project - a small version of its electric grid which takes advantage of local distributed energy resources and state-of-the-art controls to enhance grid operations - to achieve a &gt;15% reduction in feeder peak load and improve system reliability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Site Selection complete - Borrego Springs</td>
</tr>
<tr>
<td>• Finalizing system requirements and high level design</td>
</tr>
<tr>
<td>• Developing customer communication plan</td>
</tr>
<tr>
<td>• Collaborating with environmental agencies to satisfy permitting requirements</td>
</tr>
</tbody>
</table>

Conceptual illustration courtesy of National Energy Technology Laboratory

- **Distributed Energy Resources**
  - Utility-scale Energy Storage
  - Rooftop PV Solar
  - Micro-turbines
  - Building Energy Storage
  - Community Energy Storage
  - Distributed Generation
  - Home Energy System
  - PHEVs
  - Ground PV Solar Array

- **Information**
  - Electricity Pricing
  - DER status
  - Demand Response Programs
  - Network status
  - Community Objectives
  - Load and Resource Profiles

- **Grid Resources**
  - Capacitor Banks
  - Voltage Regulators
  - Automated Switches
  - Power Electronics
  - Communications

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved
Renewable Growth: Distributed

Residential Distributed Generation

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved
Renewable Growth: High PV Penetration

- **Operational Challenges (PV Power Variability)**
  - Monitoring and ensuring resource adequacy
  - Frequency regulation
  - Voltage regulation
  - Impact is highly location dependent (urban v.s. rural)
  - O&M impacts

- **Engineering / Planning**
  - Capacity planning (size, location, time, guaranteed production)
  - Volt/VAR planning
  - Conservation Voltage Reduction impacts
  - Electrical models
  - Transient analysis tools

- **Regulatory**
  - Rule 21
  - Rule 2
  - Cost causation
Renewable Growth: Circuits with Potential Issues

Values are for illustration only and do not represent forecasts.

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved.
Renewable Growth: PV Intermittency Example of Forecasting Challenges


Variability within a typical day (2/28/10)

Each data point recorded at 10 min intervals

12 hrs. daytime
Renewable Growth:
1MW PV for 10 Minutes on a Cloudy Day
Extreme voltage fluctuation results
Renewable Growth:
SDG&E Projects for Evaluating PV Impacts and Solutions

- Technical modeling and simulation studies – transient and dynamic for high penetration and inverter technologies
- SDG&E Borrego Springs Microgrid Project with load/DG balancing
- Power Quality Field Measurement and Analysis Project
- Dynamic voltage and VAR support project on distribution circuit with known voltage regulation issues due to high levels of PV
- Distributed Energy Storage
- Dynamic Line Ratings for distribution
- Synchrophasors for distribution
- Distributed Energy Resource Management System
Electric Vehicle Growth

SDG&E Electric Vehicle Owner’s Club
Electric Vehicle Growth: Charging

Many drivers share patterns and arrive home near the same time

A Level 2 EV charge, 220V @ 30 A can draw 6.6 kW

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

More coordinated charging could result in no increase in peak load

Source: EPRI
Reliability Challenges: Solar & Electric Vehicle Customers

PV and EV Customers
Photovoltaic and Electric Vehicle Customers as of April 5, 2011

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

San Clemente Oceanside Vista Carlsbad Encinitas Del Mar Poway San Diego El Cajon Coronado Imperial Beach Chula Vista

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved
Reliability Challenges:
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.
A Smart Grid model that demonstrates a vision for a future intelligent electric distribution system.

**Fall 2010**
- Self healing circuit automation
- Renewable energy integration
- Advanced Energy Storage implementation

**Spring 2011**
- Smarter applications for dispatching resources
  - Decrease customer impacts during outages
  - Fill renewable intermittence gaps
  - Optimize system utilization
- Intuitive user interface
- Active customer participation

Students from both Computer and Electrical Engineering teaming to make the Smart Grid demonstration a success.
Educational Partnerships: Collaboration and Diverse Skills

Software Team responsible for:
- Developing the software for the user interface
- Creating algorithms for the Smart Grid functionality and data analysis
- Developing the Network protocol for interfacing electronics with software

Hardware Team responsible for:
- Design and construction of electronic circuitry
- Programming algorithms to monitor and control the devices and provide real-time values to the Smart Grid software
- Physical model layout

© 2010 San Diego Gas & Electric Company. All copyright and trademark rights reserved
Innovation does not wait...

EV Analytics
Questions?

Thank You

Alan Dulgeroff
Director, Sempra Energy
Acknowledgements

Acknowledgement: “This material is based upon work supported by the Department of Energy [National Nuclear Security Administration] under Award DE-FC26-08NT02870 “

Disclaimer: “This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed, or represents commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do no necessarily state or reflect those of the United States government or any agency thereof.”

LEGAL NOTICE

This report was prepared as a result of work sponsored by the California Energy Commission (Energy Commission). It does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors, and subcontractors make no warranty, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the use of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the Energy Commission nor has the Energy Commission passed upon the accuracy or adequacy of the information in this report.

COPYRIGHT NOTICE

© 2010

San Diego Gas & Electric Company. All copyright and trademark rights reserved.
Lessons Learned: How Utilities Leverage Data

Paul Dick
Director, Enterprise Information Management
OGE Energy Corp

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
OGE Energy Corp

Paul Dick
Director, Enterprise Information Management
dickph@oge.com
OGE Energy Corp.

Oklahoma Gas & Electric

• 109 Year Old Operating Utility
  • Serving Oklahoma & Arkansas
  • ~800,000 Customers

• Regulated Service Oklahoma & Western Arkansas

• Generation
  • 6600MW of Fossil Fuel
  • 720MW of Wind (EY 2012)

• Transmission & Distribution
  • Southwest Power Pool Member
  • 30,000 Square Miles of Territory
  • Large Investments in Transmission

Enogex

• Natural Gas Mid-Stream Pipeline
  • Gathering, Processing, Transportation and Storage capabilities

• Serving Oklahoma, Texas, Wyoming, Arkansas, and others

• ArcLight Co-Investment in to Enogex
  • 10% up to 50%
  • Grown Earnings while Maintaining Stability

• Gathering, Processing & Storage Assets
  • 8000 Miles of Pipeline
  • 9 Processing Facilities
  • 24BCF of Storage Capacity
OGE Energy’s 2020 Plan

• To **not** build a new fossil fuel generation facility until the year 2020*

• Supplement the need for new generation with:
  
  – Residential and Commercial Demand Response
  – Investments in Renewable Technology
    • Distributed Generation
    • PHEV’s
    • Geo Sources

• Looking to reduce peak load by 500MW
  – 70MW Targeted in 2012

*Does not account for retired assets
OG&E Smart Grid Program Highlights
POSITIVE ENERGY TOGETHER®

• Began installation of smart technology in February 2010

• Recipient of DOE & PUC funding

• Projects:
  – Integrated Distribution Management System
  – Installation of new Meter Data Management System
  – Automated Remote Connect / Disconnect Processes
  – Energy Information Website (EIW)
    • 15 Minute Interval Data Available to Customers in 1 Hour Increments
  – Residential and Commercial Demand Response Program
    • 30,000-50,000 Participants Goal for 2012
    • 5 Minute Interval Data Available to Customer in 15 Minutes Intervals
    • Programmable Communicating Thermostat Options

• People and Process
  – Integrated Operating Center
  – Energy Operations
OGE’s Big Data

• **Meter Interval Data**
  – Approximately 48 million reads / Day now
  – End State = 60M standard / reads Day and 77M DR reads / Day = 50B rows annually

• **Integrated Operating Center**
  – Expecting up to 2 million event messages a day from the grid intelligence systems (WAN, AMI, MTR Alarms, OMS)

• **Distribution Management Systems**
  – Large, wide DMS messages from the grid
  – Providing OMS the intelligence of DMS
  – IVVC
OGE Information Factory

• Three Tier Architecture
  – Performance Based Data Warehouse Capability
    • Sized to Grow to 100’s of TB’s by 2014
  – Expanded Data Integration
    • Including real-time messaging (ESB)
    • Master Data Information Web Services
  – New Presentation Capabilities
    • Geospatial Enabled Presentation
    • New Statistical Modeling Capabilities
    • Collaboration of Analytical Findings
OG&E Analytics (In Progress)

- **Meter Interval Data**
  - Dynamic Segmentation
    - New segmentation beyond traditional PRIZM methodologies
  - New Load Curve Analysis Capabilities for All Segments
    - New Rate Making Capabilities
    - Beyond the load research meters to using all interval data

- **Integrated Operating Center / Manager of Manager**
  - Millions of message
    - Giving insights in to past performance and future predictive indications

- **Commercial Operations**
  - Predict Customer Billing and Financial Events Before They Happen

- **Distribution Management**
  - Grid Optimization

- **Future?**
Thank You

Paul Dick
Director, Enterprise Information Management
dickph@oge.com
Lessons Learned: How Utilities Leverage Data

Martin Mysyk
Senior Enterprise Architect
TransAlta Corporation

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil
Common challenges in the utility industry:

- Aging workforce
- Silos of data in applications
- Increasing demand for reporting and analytics
- Diverse analytic tool set
- Need for Self-Service capabilities to the Business
Key points:
• Geographically diverse data sources
• Variety of generation types
• Need to be agile for growth and acquisitions in business
• SCADA and Meter data continues to grow at an increasing rate
Leveraging Data From Plant Floor to Decision Maker – Value Scenarios

**Actionable information**
- KPI's and Dashboards
- Fleet Optimization
- Business Intelligence
- Reliability / Performance Data
- Predictive Monitoring
- Optimization of Assets
- Plant Level Operations Dashboards
- Plant Alarms
- DCS Real-time Access to Information
- Engineering Applications
- Exception Monitoring – Smart Signal
- Distributed Control Systems (DCS)
- Historians

**Enterprise value**

**Discrete data**
- Limited value
Data to Information - From Source to Delivery

Data Sources
- Operations Systems
  - Structured / Un-structured
- Production Systems
  - Structured / Un-structured
- Corporate Systems
  - Structured / Un-structured
- Planning Systems
  - Structured / Un-structured
- Other Systems
  - Structured / Un-structured

Data Supply
- Single Source
  - Metadata
- Master Data

Information Delivery
- Finance Cube
  - Dimension
  - Dimension
  - Dimension
- Purchasing Cube
  - Dimension
  - Dimension
  - Dimension
- Production Cube
  - Dimension
  - Dimension
  - Dimension
- HR Cube
  - Dimension
  - Dimension
  - Dimension
- Marketing Cube
  - Dimension
  - Dimension
  - Dimension
- Trading Cube
  - Dimension
  - Dimension
  - Dimension

Data Movement
- Business Rules

Transformation
- Analytics
- Integrated
- Reports

Delivery Channels
- Self-service
- Dashboard
- Search

Data Supply
- Single Source
  - Metadata
- Master Data
Fundamentals to Leveraging Data

- Data Quality is fundamental to reporting
  - Data Governance leads to trusted data
  - Only touch data once
  - Provide proof for data integrity to promote trust

- New technologies to enable business
  - In Memory - High Speed Analytic Appliance (SAP HANA)
  - Mobile Business Intelligence / Dashboards
  - Tools to drive end user enablement – ‘Self Service’
Lessons Learned – So Far

- Data Governance is hard work and takes time
- No shortage of analytic tools
  – Build decision tree on what tools to use when
  – Know differences and strengths of tools
- Make it easy for business users to find information so they can take action on it
- Industry is changing, new tools and technology give you agility for new business and data models
To submit a question . . .
Use the interface question box
to the right of your screen.

Visit us online at: www.intelligentutility.com

The magazine for building a smart grid and delivering information-enabled energy. FREE subscriptions available at www.intelligentutility.com/SUBSCRIBE
The first-ever event dedicated to analytics issues and practitioners.

February 15-16th
Orlando, FL

Register within 2 business days, by Thursday, December 15th at 5:00 pm EST and receive an additional $200 off the registration fee. Call Brittany Cameron at 303-228-4764 for details or register online with this discount code: IUWC11.

http://uaisummit.com

Visit us online at: www.intelligentutility.com
Utility Analytics Institute Annual Market Outlook & Forecast Report
Identify opportunities for product innovation, business development, and the deployment of analytics solutions.

For more information and to preview the Sample Report, visit:
http://www.energycentral.com/UAIreport
Save 15%! Call Eric Today! 303-228-4780

Visit us online at: www.intelligentutility.com
Thank You to our Sponsor
Upcoming Webcasts

• January 5 – Deep Data
• February 2 – Consumer Best Practices
• March 8 – Meter Data Management Best Practices

www.energycentral.com/events/audio

Join the conversation on Twitter using #IUWebcasts and follow Intelligent Utility on Twitter @IntelUtil