Big Data, Cloud Computing, and Real-Time Control

Emerging Technologies Showcase
February 18, 2016

Chris Burmester
Energy Solutions
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NOTE: Today’s presentation is being recorded and will be available at http://e3tnw.org/Webinars
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Energy Solutions
About Energy Solutions

**Our Mission:** Create *large-scale energy and environmental benefits* by implementing *market-based solutions* and developing policies that contribute to these goals.

- Founded in 1995
- 90 employees
- Employee-owned
- IDSM program implementation
- Offices in California, Oregon, and New York

*LED Streetlight Demonstration, San Francisco, CA*
Some Sample Programs

Upstream and Midstream Efficiency Programs
• HVAC, motors, lighting, water heating, food service since 1998
• 3 national awards since 2010

LED Accelerator Commercialization Program
• ACEEE Market Transformation Award in 2012

TV Market Transformation Initiative
• Program Design & Implementation
• EnergyStar specification

Automated Demand Response Program
• Integrates Energy Efficiency and Demand Response
Topics for Today

1. Definitions – what are we talking about?

2. Why now – what forces lead to this trend?

3. Challenges and opportunities – for DSM programs.
1. Big data, clouds, control—what are we talking about?
Buzz Words Defined: Big Data

Technology and new analytical techniques. Real-time processing of large sets of data to extract information.
Buzz Words Defined: Cloud Computing

Computational power as a low-cost, commodity service. You don’t need to own your own computer. You buy as much as you need and access it over the network.
Inexpensive and ubiquitous sensors and controls.

They can be in everything.
New Type of Energy Savings Device

- “Automated Conservation” via *reduced operation*
- Savings potential depend on usage patterns
- Devices not “intrinsically” more efficient
- Match *operation* to *demand for service*
- Savings *calculated* in *real-time* from device-level data
Huge Technical Potential

Total Building Savings % (actual results)

Operational Savings ≈ 50%

NA EE C&I Program Budgets

Operational Budgets < 5%

FirstFuel Database Sample, 60M square feet

% of total savings potential from retrofit opportunities

% of total savings potential from operational opportunities

E3T Energy Efficiency Emerging Technologies
Recipe for Intelligent Devices

- **Sensors**
  - Measure factors which affect demand for service

- **Software intelligence**
  - Determines level of service required

- **Control strategy**
  - Directs level of service

= **Intelligent Devices**
Some Example Offerings

- Smart Thermostats
- Package HVAC Optimization
- Lighting Systems
- Central Plant HVAC Optimization
- Process Optimization
- Plug-load Control
Common Characteristics

Specific customer segment
- Commercial, industrial process, residential, data center, etc.

Specific energy end use
- HVAC, lighting, motors, etc.

Specific control strategy
- Fan motor, compressor motor, lighting level, pump speed, etc.

Interactive customer interface
- Web and mobile control interfaces
Common Characteristics Continued

- Uses existing telemetry infrastructure
  - Wireless network
  - Advanced metering infrastructure

- Internal sensor / external data sources
  - Indoor temperature, occupancy, lumens, speed
  - Outdoor temperature, wind speed, rate plan

- Learning algorithms
  - Preference based learning
  - Per-facility response model
Yet More Common Characteristics

**Data-derived service/comfort model**
- Acceptable temperature ranges, light levels, etc.
- Notice when customer overrides
- Test assumptions periodically

**Ability to test baselines**
- Shut off control strategies
- Measure consumption without intervention

**10 to 25% end-use efficiency vendor claims**
- As high as 50% savings
- Similar claims across all vendors
- Formal evaluation studies in 1-40% range
2. Why now?
Low-cost Data Storage

Low-cost Microprocessors

Percent of American Adults who use the Internet 1995-2014

Increasing Investments in Clean Technology

Source: Walter Frick, BostInno, 2012

Energy Efficiency Investments

Smart Grid Investments
Increasing Investments in Smart Buildings

Smart Building Managed Services Spending, World Markets: 2012-2020

Source: Groom Energy, 2013
The Internet of Things

How are Utilities Responding?

Sampling of Utility Pilots Nationwide
3. What are the implications for IDSM programs?
New Value Streams

- Energy Markets
- Demand Response
- Flexible Capacity
- Customer Engagement
- Energy Efficiency
- Customer Comfort
- Operations & Maint.
- Air Quality
## Multiple Sectors and End Uses

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- **Residential Smart Thermostat**
- **Commercial/Industrial HVAC Controls**
- **Grid Balancing**

- **Commercial/Industrial Advanced Lighting**

![Logos of various companies](image-url)
Customer Engagement

- Leverage network connectivity as an engagement channel
- Analyze data to better understand customer behaviors
- Co-brand customer interfaces
- Behavioral initiatives and education
Pay-for-Performance Programs

• Real-time measurement of performance
• Pay on kW, kWh, and/or therms delivered
• Allow market actors to leverage across many utilities
• Spread risk across program stakeholders:
  – Vendors
  – Implementers
  – Customers
Evaluation, Measurement, and Verification

- **Calculate** impacts from real-time facility data
- **Trust** vendor data in evaluation framework
- **Monitor** customer experience and satisfaction
- **Verify** with independent data sources
- **Include** integrated costs and benefits

*TRUST BUT VERIFY*
Program Design Principles

- Align program design with market forces
- Integrate multiple value streams
- 100% vendor neutral
- Transparent and clear program requirements
- Customer engagement and analysis
- Data-driven, real-time M&V approach
- Ensure persistent and reliable impacts through telemetry
Energy Efficiency Procurement

- Define new “class” of energy efficiency resource
- Market pricing through bidding or market clearing
- Time and location of specific impacts
- Real-time telemetry of grid impacts
- Pay-for-performance
- Real-time M&V
Thank you!

Questions?

Chris Burmester
Energy Solutions
510-482-4420
cburmester@energy-solution.com
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