Outline

» Defining Operational Efficiency
  – Within the context of “behavioral” initiatives

» Survey of the OE Program Environment
  – Types and characteristics of OE programs
  – Trends and patterns, including the rise of data analytics
  – Measurement challenges

» Case Studies of OE Efforts
  – Small commercial buildings – Opower perspective
  – Large commercial buildings – FirstFuel perspective
  – Industrial process optimization – NYSERDA program example

» Gaps and Opportunities
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» **Gaps and Opportunities**
Operational efficiency (OE) is a system or building approach to energy savings, not necessarily at an individual measure level.

OE represents efforts to increase the efficiency of how a building utilizes its existing equipment and systems.

By providing opportunities to educate and inform energy managers about the energy usage in their facilities, operational changes lead to improvements and ultimate innovation.

OE is becoming more important as it potentially represents a large portion of savings in C&I facilities.
» Requires the two energy regulatory agencies (California Energy Commission and California Public Utilities Commission) to develop new rules for the measurement and reporting of EE savings in existing buildings

Includes:

- Allows EE programs to broaden the scope of energy savings, including to-code, operational efficiency and behavioral initiatives drawing on meter-based performance data to set goals and determine cost-effectiveness
- Provides for better access to energy usage and benchmark data for commercial and multi-family buildings
- Creates a benchmarking program that allows large building owners to compare their buildings' energy use to similar buildings
Defining OE - Comparing EE and OE Load Shape Impacts

» Characteristics of load shape change from EE efforts

- Reduce power required for each load cycle.

<table>
<thead>
<tr>
<th>Existing machine operating profile</th>
<th>Modified machine operating profile</th>
<th>Savings (Green shade)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="chart" alt="Time" /></td>
<td><img src="chart" alt="Time" /></td>
<td><img src="chart" alt="Savings" /></td>
</tr>
</tbody>
</table>

» Characteristics of load shape change from OE efforts

- Convert constant load to variable load.
- Reduce time duration of load cycle.
- Reduce total number of load cycles.
- Eliminate load or load cycle.

<table>
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<td><img src="chart" alt="Time" /></td>
<td><img src="chart" alt="Savings" /></td>
</tr>
</tbody>
</table>

# NAVIGANT ENERGY
### Comparative

<table>
<thead>
<tr>
<th>Relationship to Work</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing the same work for less energy</td>
<td>Doing less work</td>
<td>Doing less work</td>
</tr>
<tr>
<td>Definition</td>
<td>Associated with ‘efficiency’</td>
<td>Associated with ‘conservation’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel savings</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same operating duration at lower power</td>
<td>Different operating duration and / or variable power levels</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demand savings</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings a certain</td>
<td>Savings are uncertain</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load shape impacts</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps load shape, but shifts it ‘down’</td>
<td>Changes load shape</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organizational decisions</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing decisions</td>
<td>Operating decision</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code intent</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specify equipment efficiency</td>
<td>Specify equipment control or maintenance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forecasting EE potential</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential is estimated by modelling equipment stock turnover</td>
<td>Potential is calculated by estimating the average change in load profile for a subset of the equipment stock.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of measure costs</th>
<th>Equipment Selection</th>
<th>Equipment Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many projects require capital budgets</td>
<td>Most projects are expense</td>
<td></td>
</tr>
</tbody>
</table>
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» Gaps and Opportunities
Introducing the 5 Identified OE Program Types

1. **Efficient Design/Construction (EDC)**
   - New Building Commissioning
   - Efficient Design Assistance

2. **Operations and Maintenance Improvement (O&M)**
   - Retro-Commissioning
   - Monitoring-Based Commissioning

3. **Strategic Energy Management (SEM)**

4. **Education and Training (E&T)**

5. **C& I Energy Dashboards (EDash)**
OE Utility Program Examples

**Northwest:**
- Bonneville Power Administration (BPA)
- Energy Trust of Oregon (ETO)
- Northwest EE Alliance (NEEA)
- Snohomish PUD (SnoPUD)
- Puget Sound Energy (PSE)

**Midwest:**
- Wisconsin Focus on Energy
- Xcel Energy – Minnesota
- Consumers Energy
- DTE
- AEP – Ohio

**Northeast:**
- Efficiency Maine Trust
- Efficiency Vermont
- NYSERDA

**Southwest:**
- NV Energy
- Pacific Gas & Electric (PG&E)
- Rocky Mountain Power
- Southern California Edison (SCE)
- San Diego Gas & Electric (SDG&E)
- Southern California Gas (SCG)
- Xcel Energy – Colorado

**South:**
- Duke Energy
Sample OE Evaluation Approaches

➢ Results from OE Programs

1. **NYSERDA New Construction Program**
   - EDC
2. **Efficiency Maine Trust RCx**
   - RCx
3. **Energy Trust of Oregon Kaizen Blitz**
   - MBCx
4. **BPA High Performance Energy Management**
5. **NEEA Industrial Initiative**
6. **Xcel Colorado Process Efficiency**
7. **Focus on Energy E&T Initiative**
8. **SnoPUD Behavior-Based Energy Efficiency Pilot**

- **EDC**: Bottom-up engineering analysis and calibrated simulation
- **RCx**: Bottom-up engineering analysis
- **MBCx**: Facility-Wide Regression Model
- **SEM**: MT&R Facility-Wide Regression Model (engineering analysis on capital measures)
- **E&T**: Bottom-up engineering analysis & Top-down statistical analysis
- **EDash**: Surveys/Interviews
- **EDash**: Surveys/Interviews
- **EDash**: Quasi-experimental panel regression analysis
OE Program Best Practices

- Prioritize savings opportunities
- Commit to improvement
- Enable information flow
- Educate & engage personnel
- Establish tracking & feedback mechanism
- Provide long-term technical support
- Follow up & reward persistence
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» Gaps and Opportunities
SMB Reports: Driving savings through engagement

Proactive reporting
Tailored insights & tips by business type

Data acquisition & validation
Get personal to grab attention

Efficiency Collateral
Enlist employees and customers

Web & Email
Encourage deeper engagement

Intro communications
Reach the person responsible for energy use
Third of customers report being motivated to action

Did the Business Energy Report motivate you to reduce your business’ energy usage?
1,083 interviews with recalling SMB report recipients
Average across 3 deployments

Motivated to reduce usage

38%

Not motivated

62%

What have you done? (Open Ended)
Multiple codings allowed

- Lighting upgrades & reduction: 42%
- Thermostat adjustment (ac/heat): 21%
- Raised general awareness: 19%
- Shared with stakeholders: 6%
- General reduction in usage: 6%
- Reduce usage of appliances: 4%
- General business upgrades: 4%
- Audit: 4%
- Reached out to Xcel: 3%
- Sealed or weatherstripped: 2%
- Large appliance upgrades: 2%
- Nothing: 12%
GSA has been very impressed by the energy usage information that FirstFuel provides for us. FirstFuel assists the GSA in meeting our energy efficiency and savings goals in our buildings."

Dorothy Robyn
Former Commissioner Public Buildings Service (former)

GSA won the 2014 Federal Energy & Water Management for this initiative

Meet congressional mandate EISA 432
100% compliant energy audits

Support 3% annual energy reduction goal
170GWh of identified energy savings opportunity

Gain building operator buy-in & commitment
All operators utilizing FirstFuel platform

Extract more value from smart meter investments
$10M+ in total monitored energy savings
# KEY DEPLOYMENT STATS

EE Roadmap Spans GSA’s Entire Covered Services Portfolio

<table>
<thead>
<tr>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 Bdgs</td>
<td>90 Bdgs</td>
<td>178 Bdgs</td>
</tr>
<tr>
<td>13M Sq.ft.</td>
<td>47M Sq.ft.</td>
<td>89M Sq.ft.</td>
</tr>
<tr>
<td>$6.5M ID Savings</td>
<td>$14M ID Savings</td>
<td>$21M ID Savings</td>
</tr>
<tr>
<td>85% cheaper</td>
<td>85% cheaper</td>
<td>85% cheaper</td>
</tr>
<tr>
<td>6 weeks vs. 6-8 months</td>
<td>12 weeks vs. 18-24 months</td>
<td>24 weeks vs. 3 years</td>
</tr>
<tr>
<td>50% operational savings</td>
<td>60% operational savings</td>
<td>55% operational savings</td>
</tr>
</tbody>
</table>
NYSERDA's Industrial and Process Efficiency program focus is on projects that improve manufacturing process productivity.

Incentives support projects that increase productivity including:
- Throughput increases.
- Scrap reduction.
- Quality improvements.
- Focus on reduced energy use per unit of production.

Integrates lean manufacturing principles into energy-saving approach by using advanced production management techniques.
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» Gaps and Opportunities
OE Challenges and Opportunities

1. *Data on observed savings are incomplete and limited*
   Small sample sizes led to large uncertainties in estimated savings
   Baseline energy use is difficult to measure

2. *Terminology is not consistent for reported savings across data sets*
   Presented vs. Implemented Savings
   Estimated vs. Actual Saving

3. *There are no standard naming conventions for OE-based measures*
   It would be beneficial to develop a TRM for OE-based measures

4. *A rigorous M&V process is lacking for OE measures*
   Regulators need to have confidence that savings are real and sustainable
OE Challenges and Opportunities (continued)

5. **What is the relationship of OE programs to improved economic output?**
   The NYSERDA Industrial & Process Efficiency Program provides incentives for improvements such as capacity additions that improve the energy use per unit processed, quality improvement, scrap reduction, or increased throughput. Other jurisdictions do not consider productivity metrics, such as increased throughput, in defining benefits.

6. **Methodologies for estimating economic useful life are not developed**
   Persistence of behavior is uncertain. E.g. impact of turnover of staff or residents.

7. **Advancement in data access will allow for disaggregation of impacts and improved persistence.**
   Smart thermostats collect data, wireless sensor are dropping in price.

8. **Methodologies for estimating OE potential are not refined**
   For EE, stock turnover models are studied, developed, and refined. For OE, methods to disaggregate populations of users and define the impacted end uses are only now nascent.
Thank You!

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