Agenda

1. Pilot Overview
2. Research Objectives
3. Methods
4. Key Findings
5. Conclusions
Pilot Overview
CEI Overview

• Permanently integrate energy management into facility operations and management

• Focus Areas
  ✓ Capital Upgrades
  ✓ Process Improvements
  ✓ Predictive Maintenance
  ✓ Employee Engagement

➢ 8 organizations enrolled: 7 industrial, 1 healthcare
Pilot Design

Typical Participation Process

• Enroll with MOU
• Kick-Off Workshop
• Energy Assessment and Plan Development
• Energy Use Tracking Tool Workshop
• Monthly Energy Efficiency Progress Meetings
• Employee Engagement Workshop
• Employee Engagement Action Plan
• Goal Achievement Report Out
### Evaluated Facility Characteristics

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Industry/Commercial Building Segment</th>
<th>Fuels</th>
<th>Data Frequency</th>
<th>CEI Beginning Engagement Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Hospital/Medical Center</td>
<td>Electric</td>
<td>Daily</td>
<td>02/13/2014</td>
</tr>
<tr>
<td>F2</td>
<td>Manufacturing</td>
<td>Electric</td>
<td>Daily</td>
<td>02/13/2014</td>
</tr>
<tr>
<td>F3</td>
<td>Manufacturing</td>
<td>Electric</td>
<td>Weekly</td>
<td>02/13/2014</td>
</tr>
<tr>
<td>F4–E1</td>
<td>Resort: Hotel/Conference Center/Dining</td>
<td>Electric, Propane, Oil</td>
<td>Electric: Daily; Propane: Monthly; Oil: Monthly</td>
<td>02/13/2014</td>
</tr>
<tr>
<td>F4–E3</td>
<td>Resort: Fitness/Pool/Indoor Tennis</td>
<td>Electric, Propane</td>
<td>Electric: Daily; Propane: Monthly; Oil: Monthly</td>
<td>02/13/2014</td>
</tr>
<tr>
<td>F5</td>
<td>Manufacturing</td>
<td>Electric</td>
<td>Daily</td>
<td>02/13/2014</td>
</tr>
</tbody>
</table>
Research Objectives
Research Objectives

• Independently estimate the energy savings for each CEI participant, accounting for the impacts of any capital measures, in 2014 and 2015
• Verify EVT’s estimates of site-specific CEI, capital measure, and total Pilot savings.
• Develop recommendations for improving the Pilot data collection, measurement and verification (M&V), and impact evaluation approaches, specifically:
  – Facility data reporting and sub-metering
  – Establishing reliable M&V baseline models
  – Collecting program-related costs and conducting cost-effectiveness testing
  – Identifying potential OM&B savings for future program planning
• Assess program successes and challenges
Evaluation Activities

**Process Evaluation**
- In-depth staff interviews
- Pilot document review
- Participant interviews

**Impact Evaluation**
- Analysis of first-year pilot outcomes as reported in annual reports
- Collect facility-level energy use data
- Regression analysis of each site’s energy use and savings estimation
- Estimate pilot savings for 2014 and 2015
- Analyze pilot cost-effectiveness

**Synthesis**
- Provided technical expertise and consultation to produce findings that informed actionable recommendations for the CEI Pilot
- Entertained alternate scenarios for measure life
Methods
In-Depth Interviews

Objectives

- Pilot history
- Pilot objectives and goals
- Pilot design and implementation
- Pilot successes and challenge
- Readiness for Pilot expansion

Interviews

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Number of Interviews</th>
<th>Number of Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVT Pilot portfolio manager</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>EVT Account Managers</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>EVT Energy Consultants</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>
# Document Review

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 MT&amp;R (Monitoring, Targeting, and Reporting) reports</td>
<td>Report describing organization’s CEI implementation and data collection</td>
</tr>
<tr>
<td>CEI one-pager</td>
<td>Description of program for potential organizations</td>
</tr>
<tr>
<td>Statistical tools</td>
<td>Description of benefits of using statistical tools to track energy use</td>
</tr>
<tr>
<td>Memorandum of Understanding (MOU) template</td>
<td>Agreement organizations signed at the beginning of their engagement with the Pilot</td>
</tr>
<tr>
<td>CEI assessment tool</td>
<td>Tool outlining the program milestones and EVT’s scoring procedure</td>
</tr>
<tr>
<td>CEI overview PowerPoint presentation</td>
<td>Presentation created by EVT to introduce the program to potential Pilot participants</td>
</tr>
<tr>
<td>CEI white paper</td>
<td>Paper describing the benefits of CEI programs</td>
</tr>
<tr>
<td>Sample energy plan</td>
<td>Workbook for organizations to track energy reduction activities and ideas</td>
</tr>
</tbody>
</table>
Impact Method

• Review facility MT&R report
• Define the baseline and reporting periods
• Collect facility data on energy use and energy use drivers
  – Output
  – Occupancy
  – Weather
• Build the baseline regression model of energy use
• Estimate facility and CEI savings
  – Facility savings = Adjusted baseline energy – metered energy
  – CEI savings = Facility savings - capital project savings
Estimation of CEI Energy Savings

Facility energy consumption

Metered energy use

CEI engagement begins

Baseline period

Adjusted baseline (estimated)

CEI savings

Reporting period
Cost-Effectiveness Analysis

• Evaluated pilot cost-effectiveness using the Societal Cost Test (SCT)
  – Electricity benefits (energy and capacity)
  – Program administration costs
  – DRIPE
  – Electric externalities (emissions reductions of GHGs, \( \text{SO}_2, \text{NO}_2 \))
  – Non-energy benefits (10% adder)

• Employed Vermont Statewide Cost-effectiveness Screening Tool to perform the analysis
Pilot Successes

• Peer-to-Peer Interaction most valued program element
• Success with implementing CEE minimum elements
  ✓ Customer commitment
  ✓ Planning and implementation
  ✓ Systems for measuring and reporting
• Communication and partnership with EVT
Satisfaction with EVT

Accuracy of information provided to you throughout the program by Efficiency Vermont: 5 Very satisfied, 1 Somewhat satisfied

Efficiency Vermont’s ability to answer all your questions: 4 Very satisfied, 1 Somewhat satisfied

Timeliness of Efficiency Vermont’s response to you: 4 Very satisfied, 1 Somewhat satisfied

Ability of Efficiency Vermont to resolve problems: 3 Very satisfied, 2 Somewhat satisfied

Number of Participants: n=5
Workshop Satisfaction

- **Location of workshops**: 2 very satisfied, 3 somewhat satisfied, 3 don't know.
- **Length of workshops**: 2 very satisfied, 3 somewhat satisfied.
- **Number of workshops**: 2 very satisfied, 2 somewhat satisfied, 1 don't know.
- **Topics of workshops**: 1 very satisfied, 4 somewhat satisfied.

Number of participants: 5
<table>
<thead>
<tr>
<th>Component</th>
<th>Implementing in 2016 (n=5)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy team</td>
<td>5</td>
<td>2 meet bimonthly with energy team</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 meet monthly with energy team</td>
</tr>
<tr>
<td>Employee engagement activities</td>
<td>4</td>
<td>1 does not planning any as they have no more low- or no-cost activities to implement</td>
</tr>
<tr>
<td>Energy action plan</td>
<td>5</td>
<td>2 review biweekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 review quarterly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 reviews semiannually</td>
</tr>
<tr>
<td>Energy Management System (EMS)</td>
<td>5</td>
<td>4 use SENSEI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 uses SkySpark</td>
</tr>
<tr>
<td>Energy tracking</td>
<td>5</td>
<td>4 review weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 reviews monthly</td>
</tr>
</tbody>
</table>
Challenges (from participants)

• Finding time—both as energy champion and in engaging employees
• Creating and maintaining cross-functional team; agreeing on priorities across departments
• Gaining corporate level commitment
• Time and distance required for workshop attendance
• Making business case for sub-metering, competing priorities, identifying appropriate variables, accurately quantifying savings
Impact Evaluation Findings
# Evaluated CEI Electricity Savings 2015

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Evaluated Facility Savings</th>
<th>Lower Bound 90% Confidence Interval</th>
<th>Upper Bound 90% Confidence Interval</th>
<th>Evaluated Capital Project Savings</th>
<th>Evaluated CEI Savings</th>
<th>Reported CEI Savings</th>
<th>Realization Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (MWh/year)</td>
<td>1,877.8</td>
<td>1,718.1</td>
<td>2,037.5</td>
<td>868.6</td>
<td>1,009.2</td>
<td>1,109.7</td>
<td>91%</td>
</tr>
</tbody>
</table>

Notes: Evaluated facility savings equaled Cadmus’ point estimate of facility savings based on regression analysis. Evaluated capital project savings were savings for capital projects receiving incentives from other EVT programs and were obtained from EVT’s database. Evaluated CEI savings equaled the difference between the evaluated facility savings and the evaluated capital project savings. Reported CEI savings were CEI savings reported by EVT. The realization rate was the ratio of the evaluated CEI savings to the reported CEI savings.
2015 CEI Electricity Percent Savings

- Evaluated Facility Savings: 5.4%
- Evaluated CEI Savings: 2.9%
- Evaluated Capital Project Savings: 2.5%
Evaluated CEI Electricity Savings by Facility

Note: Savings estimated as a percent of facility electricity consumption.
Evaluated Facility, Capital Project, and CEI Electricity Savings

- Evaluated Facility Savings
- Evaluated CEI Savings
- Evaluated Capital Project Savings
Comparison of Evaluated and Reported CEI Savings by Facility

Notes: Data labels are evaluated MWh savings.
Cost Effectiveness

<table>
<thead>
<tr>
<th>Parameter</th>
<th>One Year Measure Life</th>
<th>Two Years Measure Life</th>
<th>Three Years Measure Life</th>
<th>Five Years Measure Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>$158,223</td>
<td>$306,255</td>
<td>$449,194</td>
<td>$698,866</td>
</tr>
<tr>
<td>Costs</td>
<td>$350,042</td>
<td>$350,042</td>
<td>$350,042</td>
<td>$350,042</td>
</tr>
<tr>
<td>Net Benefits</td>
<td>($191,819)</td>
<td>($43,787)</td>
<td>$99,151</td>
<td>$348,824</td>
</tr>
<tr>
<td>Benefit / Cost Ratio</td>
<td>0.45</td>
<td>0.87</td>
<td><strong>1.28</strong></td>
<td>2.00</td>
</tr>
<tr>
<td>Levelized $/kWh</td>
<td>$0.347</td>
<td>$0.196</td>
<td>$0.133</td>
<td>$0.082</td>
</tr>
</tbody>
</table>

Notes: 2015 pilot cost-effectiveness estimates based on societal cost test.

Pilot proved cost-effective for measure life equal to or greater than three years.
Conclusions
Energy Savings

Conclusion

CEI pilot achieved 3% electricity savings in 2015

Pilot facilities achieved a range of savings from -1% to 14%

Recommendation

- Continue to evaluate this cohort to track savings persistence
- Future evaluations should attempt to understand causes of differences between facilities
MT&R Savings Estimates

Conclusion

Evaluation verified reported CEI savings. Savings realization rate = 91%

Recommendation

• EVT should continue to follow existing savings estimation approach
• Evaluation has few suggestions for improvements

• EVT should report negative savings estimates → yields more accurate estimate of pilot savings

Difference between reported and evaluated savings was due to different reporting conventions for “negative savings”
CEI Cost Effectiveness

Conclusion

Pilot proved cost-effective for measure life $\geq 3$ years

Recommendation

- Reassess pilot cost-effectiveness for 2016 to determine if cost-effectiveness has improved
- Conduct additional research to determine appropriate cost-effectiveness assumptions for Vermont CEI
Implementing CEI Elements

Conclusion

Participants engaged with implementing minimum CEI elements, resulting in greater EE awareness within organizations.

Some participants found too much time was required for implementation and attending workshops.

Recommendation

- Continue tracking implementation of CEE/CEI minimum elements at each facility.
- Consider reducing number of on-site workshops and consider alternate modes or formats for delivering content.
Organizational Culture Change

Conclusion

- High satisfaction with peer-to-peer interaction, EVT support
- Employee engagement challenging to maintain on an ongoing basis
- Participants are already invested in corporate sustainability efforts

Recommendation

- Consider developing more materials designed to increase employee engagement
- Checklist for common energy saving activities
- Share workshop topics and tips through newsletters
- Look for synergies with carbon disclosure or Global Reporting Initiative to dovetail energy savings with other sustainability reporting requirements
EVT account management software presented challenges for tracking CEI program tasks and costs.

The pilot is high-touch (by design), requiring significant staff time.

**Conclusion**

**Recommendation**

- Enhance training to make querying CEI tasks and recording staff time easier.
- EVT could consider study to streamline program to focus on steps and touchpoints most critical to success.
QUESTIONS/DISCUSSION
## Evaluated Electric Energy Savings

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Evaluated Facility Savings (MWh)</th>
<th>Lower Bound 90% Confidence Interval</th>
<th>Upper Bound 90% Confidence Interval</th>
<th>Evaluated Capital Project Savings (MWh)</th>
<th>Evaluated CEI Savings (MWh)</th>
<th>Reported CEI Savings (MWh)</th>
<th>Realization Rate</th>
<th>CEI Percent Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>512.1</td>
<td>475.4</td>
<td>548.9</td>
<td>309.5</td>
<td>202.6</td>
<td>197.0</td>
<td>103%</td>
<td>3%</td>
</tr>
<tr>
<td>F2</td>
<td>430.3</td>
<td>366.2</td>
<td>494.5</td>
<td>557.5</td>
<td>-127.2</td>
<td>0.0</td>
<td>N/A</td>
<td>-1%</td>
</tr>
<tr>
<td>F3</td>
<td>426.5</td>
<td>325.8</td>
<td>527.1</td>
<td>0.0</td>
<td>426.5</td>
<td>436.0</td>
<td>98%</td>
<td>11%</td>
</tr>
<tr>
<td>F4¹</td>
<td>100.7</td>
<td>86.6</td>
<td>114.9</td>
<td>0.0</td>
<td>100.7</td>
<td>78.7</td>
<td>128%</td>
<td>13%</td>
</tr>
<tr>
<td>F4 - E1</td>
<td>101.1</td>
<td>89.0</td>
<td>113.1</td>
<td>0.0</td>
<td>101.1</td>
<td>72.4</td>
<td>140%</td>
<td>14%</td>
</tr>
<tr>
<td>F4 - E2²</td>
<td>Not Evalable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4 - E3</td>
<td>-0.4</td>
<td>-7.8</td>
<td>7.1</td>
<td>0.0</td>
<td>-0.4</td>
<td>6.3</td>
<td>-6%</td>
<td>0%</td>
</tr>
<tr>
<td>F5</td>
<td>408.2</td>
<td>309.7</td>
<td>506.7</td>
<td>1.6</td>
<td>406.6</td>
<td>398.0</td>
<td>102%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,877.8</strong></td>
<td><strong>1,718.1</strong></td>
<td><strong>2,037.5</strong></td>
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