Building Performance:

Three Areas You Can Manage to Control Costs
Three Areas You Can Manage to Control Costs

Agenda

- Beyond Sustainability
- Legislative Resolve and Mounting Expectations
- What and How Should We Measure
- Benchmarking and Baseline Variables
- Paths to Improvement: Examples
- Planning the Next Steps: 10 Year Facility Plan
Three Areas You Can Manage to Control Costs

Thinking Beyond Sustainability

- Occupant Comfort
- Operational Efficiency
- Energy Efficiency
Three Areas You Can Manage to Control Costs

Consider Occupant Comfort

- Thermal Comfort
- Acoustics
- Lighting
- Visual Distractions
- Views
New Pressures: Going Green

- Energy Reduction
- Waste Reduction
- Alternative Energy Sources
- Carbon Foot-Printing
- Water Resource Management

Three Areas You Can Manage to Control Costs
Governments and Green Initiatives

Executive Order 13693 Planning for Federal Sustainability and reduced greenhouse gas emissions in the next decade:

- Diverting 50% non-hazardous solid waste for recycling.
- Food recovery: estimated that 34 million tons (35% of the food supply) of food was thrown out. Food supply is considered the third largest source of methane gas.
Governments and Green Initiatives

Clean Energy Jobs and Power Act establishes broad expectations regarding a variety of environmental issues that are being defined by a variety of departments and agencies:

- Reduce carbon emissions by 20% by 2020 and 80% by 2050
- Invest in clean energy technologies
- Reduce global warming pollution: transportation and power plants
- Emphasis on alternative energy and water efficiency
Governments and Green Initiatives

GSA’s Leadership and Innovation Program encourages reductions in energy consumption without making infrastructure changes:

- Region 10’s Auburn facilities saved 8% in energy consumption
- In 2009, GSA reduced energy consumption by 14.29% over its 2003 baseline
Three Areas You Can Manage to Control Costs

What Others are Doing:  
**Private Corporations**

- **General Mills** cut carbon emissions by 28% in the next decade.

- **Walmart** saved over $150 million in 2013.

- **Ford Motor Company** has switched to sustainable

**Other companies supporting “Green Initiatives”**

- Bank of America, Ceres, General Electric, DuPont, Budweiser, Coca-Cola, Tesla, Brooks, SC Johnson, Continental, MGM Properties
Consensus:
Benchmarking is the First Step

- Studies using the EPA’s Portfolio Manager demonstrated that benchmarking alone can save 2.3% in energy costs a year.

- Analysis revealed the 51% of energy efficiency opportunities could be achieved through low and non-cost operational improvements.

- In 2013 the City of Minneapolis released a benchmarking report that demonstrated that a number of public school buildings were amongst the highest users of energy per square foot compared to other buildings in the city (public and private)
What does this mean?

B3 and B3

Benchmarking: The Power of Building Energy Data
Consumption, Costs, and Carbon Emissions
The Buildings, Benchmarking, and Beyond Program
Over a Decade of Expertise
The Weidt Group developed and evolves the B3 Benchmarking system. Buildings that are “current” in the system have identified potential energy savings of over $23 million.

Currently, the B3 Benchmarking program has reduced energy consumption by over 10% since 2009 for the Minnesota State College and University System (mandated by law to participate). They are half way to their goal of a 20% reduction in consumption.

LHB is one of two firms who are licensed to offer the program beyond its use for Minnesota Public Buildings.

Current Statistics
State of Minnesota Statistics

- Number of Organizations .... 1,370
- Number of Sites ............... 5,738
- Number of Buildings .......... 7,822
- Number of Meters ............. 11,965
- Total Square Feet ............. 311,628,545

Over a Decade of Expertise
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Three Areas You Can Manage to Control Costs

Benchmarking and Baseline Variables

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<td>Peer comparison</td>
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<tr>
<td>Analysis of over 60 space usage types</td>
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<tr>
<td>Baseline tracking over time</td>
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<td>✓</td>
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<tr>
<td>Building versions (building additions, remodels, etc.) monitoring</td>
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<tr>
<td>Weather normalization</td>
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<tr>
<td>Sub-meters tracking</td>
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<td>Energy fuel source analysis</td>
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<tr>
<td>Dynamic reporting</td>
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<tr>
<td>Project verification</td>
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<td>✗</td>
</tr>
<tr>
<td>Target tracking</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>

**Benchmark**

An engineering modeling comparison using DOE-2 simulations and B3 energy standards predicts expected energy use.

**Peer Comparison**

An evaluation of a building to others with similar space usage, geographic location, and energy code provides true peer comparison.

**ENERGY STAR®**

A simple 0-100 score produced by ENERGY STAR® Portfolio Manager analyzes a building against similar buildings across the US.

**Baseline**

A weather-normalized comparison of a building to itself over time provides monthly and annual analysis.
Three Areas You Can Manage to Control Costs

B3 Benchmarking Contents

1. Basic Navigation

2. Energy Mode Overview
   - Summary Tab
   - Benchmarking Tab
   - Peer Comparison Tab
   - ENERGY STAR Tab
   - Baseline Tab
   - Improvement Tab
   - Reports Tab

3. Water Mode Overview
   - Summary Tab
   - Baseline Tab
   - Reports Tab

4. Entering Buildings

5. Entering Meters
Glossary of Terms

- **Benchmark**

  The Benchmark is a prediction of the Site’s consumption based on an engineering model of the Buildings, constructed as if each Building were built to the current energy code. Actual consumption of the Site will vary from the Benchmark.
Glossary of Terms

- **Benchmark**
  The Benchmark is a prediction of the Site’s consumption based on an engineering model of the Buildings, constructed as if each Building were built to the current energy code. Actual consumption of the Site will vary from the Benchmark.

- **Baseline**
  The Baseline is used to compare an Organization or Site’s current consumption to a Baseline Year. The B3 Reporting section displays the current consumption compared to the weather-normalized Baseline Year. A reduction in consumption is due to operation or changes in the building systems, not the weather.
Glossary of Terms

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- **Utility Costs**
  B3 Benchmarking allows the user to see consumption in three different currencies:
  - Energy: EUI – kBTU/SF/yr
  - Dollars: Energy $/SF - $/SF/yr
  - Carbon Emissions: CO2/yr
Three Areas You Can Manage to Control Costs

Glossary of Terms

- **Benchmark**
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- **Potential Savings**
  Potential Savings are rough estimates meant to provide a sense of the magnitude of savings possible for buildings. Because a significant number of buildings are able to reduce consumption below 85% of the expected Benchmark modeled annual consumption. The cost factor is calculated by looking at the weighted average energy cost by energy type per MMBTU for the entire portfolio of buildings in B3.
Three Areas You Can Manage to Control Costs

Building Benchmarking

- Input the Data
- **Benchmark** (to code) vs **Baseline** (the building)
- Peer Comparison
- Understand the Variables
# The Buildings, Benchmarking, and Beyond Program

## Counties - Ranked by Benchmark, Current within 90 days

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<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Benchmark</th>
<th>Actual (kBTU/SF/yr)</th>
<th>Benchmark (kBTU/SF/yr)</th>
<th>Index Ratio</th>
<th>Benchmark Complete Sq Ft</th>
<th>Total Sq Ft</th>
<th>Benchmark Complete Site</th>
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<td>29,043</td>
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14 counties listed

- Green: > 4.0 stars
- Orange: 3.0-4.0 stars
- Yellow: 2.0-3.0 stars
- Red: 1.5-2.0 stars
- Grey: < 1.5 stars
- Grey: Data Not Available
# The Buildings, Benchmarking, and Beyond Program

## Counties - Ranked by Baseline, Current within 90 days

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<th>2014</th>
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<td>Houston</td>
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<td>↓ -50.5%</td>
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<tr>
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<td>25,270</td>
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<td>↓ -14.3%</td>
<td>↓ -29.0%</td>
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<td>↓ -33.1%</td>
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<tr>
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<td>Jackson</td>
<td>370,482</td>
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<td>0%</td>
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<td>N/A</td>
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- Blue Earth: N/A
- Dakota: N/A
- Grant: N/A
- St Louis: N/A

14 counties listed
## Counties - Ranked by EUI, Current within 90 days

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<th>Name</th>
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<th>Completed Sites</th>
<th>Total Sites</th>
<th>Completed Meters</th>
<th>Total Meters</th>
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<td>1</td>
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<td>32.30</td>
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<td>753,997</td>
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<tr>
<td>12</td>
<td>Hubbard</td>
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<td>1</td>
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</table>

14 counties listed

- **< 100 kBTU/SF/yr**
- **100-130**
- **130-140**
- **140-150**
- **> 150 kBTU/SF/yr**
- **Data Not Available**
## Counties - Ranked by Dollars, Current within 90 days

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<th>Name</th>
<th>Dollars ($/SF/yr)</th>
<th>Completed Sq Ft</th>
<th>Total Sq Ft</th>
<th>Completed Sites</th>
<th>Total Sites</th>
<th>Completed Meters</th>
<th>Total Meters</th>
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</thead>
<tbody>
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<td>1</td>
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<td>Anoka</td>
<td>$1.02</td>
<td>1,474,420</td>
<td>1,760,732</td>
<td>12</td>
<td>25</td>
<td>26</td>
<td>28</td>
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<tr>
<td>4</td>
<td>Dakota</td>
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<tr>
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<td>48,537</td>
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<tr>
<td>9</td>
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<td>$1.35</td>
<td>305,225</td>
<td>305,225</td>
<td>4</td>
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<td>8</td>
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<td>29,043</td>
<td>29,043</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Hubbard</td>
<td>$1.49</td>
<td>152,915</td>
<td>152,915</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
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<td>$1.74</td>
<td>93,539</td>
<td>93,539</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>Olmsted</td>
<td>$1.97</td>
<td>753,997</td>
<td>1,086,692</td>
<td>16</td>
<td>21</td>
<td>41</td>
<td>41</td>
</tr>
</tbody>
</table>

- Jackson

14 counties listed

[Legend: < $1.00/SF/Year; $1.00-$1.75; $1.75-$2.00; $2.00-$2.25; > $2.25/SF/Year; Data Not Available]
## Counties - Ranked by Potential Savings, Current within 90 days

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Pot. Savings (MMBTU/yr)</th>
<th>Pot. Savings ($/yr)</th>
<th>Benchmark Complete Sq Ft</th>
<th>Total Sq Ft</th>
<th>Benchmark Complete Sites</th>
<th>Total Sites</th>
<th>Benchmark Complete Metric</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Big Stone</td>
<td>0</td>
<td>$0</td>
<td>2,750</td>
<td>36,155</td>
<td>1</td>
<td>4</td>
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<tr>
<td>2</td>
<td>Kanabec</td>
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<td>$0</td>
<td>25,270</td>
<td>112,196</td>
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<td>4</td>
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<tr>
<td>3</td>
<td>Grant</td>
<td>88</td>
<td>$1,000</td>
<td>48,537</td>
<td>48,537</td>
<td>15</td>
<td>18</td>
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<tr>
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<td>$1,000</td>
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<td>490,482</td>
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<td>4</td>
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<td>76,489</td>
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<td>1</td>
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<td>$63,000</td>
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<td>151,982</td>
<td>12</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hubbard</td>
<td>3,951</td>
<td>$74,000</td>
<td>152,915</td>
<td>152,915</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hubbard</td>
<td>1,699</td>
<td>$22,000</td>
<td>29,043</td>
<td>29,043</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>St Louis</td>
<td>5,151</td>
<td>$56,000</td>
<td>93,539</td>
<td>93,539</td>
<td>1</td>
<td>1</td>
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<tr>
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<td>Dakota</td>
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<td>1,471,109</td>
<td>30</td>
<td>30</td>
<td></td>
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<tr>
<td>12</td>
<td>Blue Earth</td>
<td>11,877</td>
<td>$153,000</td>
<td>305,225</td>
<td>305,225</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Olmsted</td>
<td>25,815</td>
<td>$537,000</td>
<td>753,997</td>
<td>1,086,692</td>
<td>16</td>
<td>21</td>
<td></td>
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<tr>
<td>14</td>
<td>Anoka</td>
<td>39,587</td>
<td>$494,000</td>
<td>1,474,420</td>
<td>1,760,732</td>
<td>11</td>
<td>25</td>
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</tr>
</tbody>
</table>

14 counties listed

- Limited potential savings
- < 500 MMBTU
- 500-1000
- 1000-1500
- > 1500 MMBTU
- Data Not Available
Case Study: Albert Lea Public Schools

Data is critical. I don’t know how anyone can know where they are going when they don’t know where they have been.

Steve Lund
Energy Manager for Albert Lea Public Schools
Three Areas You Can Manage to Control Costs

Case Study: Albert Lea Public Schools

District has saved $3 MILLION over 10 years

➢ Reduction in Electricity Use 33%
➢ Reduction in Natural Gas Use 31%
➢ Reduction in Water Use 11.5%

➢ Examples of Operational Saving Items
  o Remove extra appliances
  o When its not needed, “shut it down”
  o Staff training and understanding schedules
  o Envelope first
Three Areas You Can Manage to Control Costs
Three Areas You Can Manage to Control Costs

Annual Water Use Intensity for Complete & Accurate Campuses

Dormitory Project
Fountains
Lawns
Three Areas You Can Manage to Control Costs

- Identified energy inefficiency using B3 Benchmarking data comparison & hired McKinstry, Inc. to assess system
- Replacement of failing equipment and basic maintenance – fix broken dampers, inefficient motors, add VFDs on equipment
- Replace & upgrade Energy Management controls and VAV’s – started with least efficient buildings on campus
- Central Cooling system upgrades (similar to heating)
- Upgrades to mechanical system, controls & valves allowed for more sophisticated control – instead of bringing chillers online to balance heat during winter, prevent overheat in the first place by bringing up heat more slowly & use fresh outside air to fine-tune
- Occupancy sensors in all offices – shut off lights and ventilation when unoccupied
- Replacement of inefficient lighting – reduction of lights in “over-lit” areas, LED’s in elevators, Great Hall lighting upgrades that reduce heat gain from lighting
- Communicated to campus the goals & asked everyone to “cut the cord” on portable heaters & fans, and trust building services to troubleshoot problem areas
- New buildings on St. Paul campus designed to higher energy efficiency standards
The Buildings, Benchmarking, and Beyond Program

Commissioning and Re-Commissioning
- Establishes your current operational norm: above or below code
- Becomes another piece of data to guide decision making
- Can indicate a “building’s health contributor”

**School District of Somerset**  Somerset, Wisconsin

Data from 2012 through 2015

**Benchmark**
- Does not understand the code under-which your building operates
- Benchmark is the lowest efficiency building allowed by code
- This is different than a baseline which compares a building to its self

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**Three Areas You Can Manage to Control Costs**

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**School District of Somerset**

Data from 2012 through 2015

**Benchmark**
- Does not understand the code under-which your building operates
- Benchmark is the lowest efficiency building allowed by code
- This is different than a baseline which compares a building to its self
Three Areas You Can Manage to Control Costs

Peer Comparison
Weather Normalized across the nation
Is a comparison of similar building types, uses, and defined area
50 is the median of buildings contained in the data base

Energy Star score cards
50 is the median of nation wide building performance
75 or higher is a top performer and eligible for certification
Scores do not explain variations due to system types and ages
Three Areas You Can Manage to Control Costs

Consumption, Dollars, and Carbon
- Are dashboard indicators that must be read together
- When studied building by building, there may be a different story
- The carbon meter is related to your utility information

Remember the Variables
- Building schedules and uses from year to year
- Improvements to the systems and/or additions/renovations
- However, WEATHER is NOT a variable
Three Areas You Can Manage to Control Costs

Reporting Energy Consumption KBTU
Three Areas You Can Manage to Control Costs

Reporting Dollars Spent
Comparative Example:
Westonka Public Schools
A simple look at the 20 districts of similar size, we found the following:

The average annual operating costs per square foot for Westonka: $1.15
*Note: costs for the last 12 month period.*

The average annual operating costs per square foot for 20 districts: $0.94
*Note: There were 17 districts operating below Westonka and 3 above.*
*Note: There are districts with Auditoriums and a pool and 2 sheets of ice included in the “below” numbers.*

The average annual EUI per square foot for Westonka: 80.39
*Note: costs for the last 12 month period.*

The average annual EUI per square foot for 20 districts: 72.53

The difference between the operational average and Westonka is: $0.21

There are 461,534 square feet in the district so the potential operational savings to “average”:

\[0.21 \times 461,534 \text{ sf} = 96,922 \text{ dollars annually}\]

Some of the best performers include:
Albert Lea ($0.67), Sartell ($0.78), Columbia Heights ($0.75),
Austin ($0.77), Foley ($0.87), Buffalo ($0.90)

*Note: Building age has very little to do with the potential performance.*

Data From 04/26/16
Comparative Example: North St Paul Maplewood Oakdale

A simple look at the 15 districts of similar size, we found the following:

The average annual operating costs per square foot for NSP-M-O: $1.08
*Note: costs for the last 12 month period.*

The average annual operating costs per square foot for 15 districts: $0.96

The average annual EUI per square foot for NSP-M-O: 68.96
*Note: costs for the last 12 month period.*

The average annual EUI per square foot for 15 districts: 68.41

The difference between the operational average and ISD NSP-M-O: $0.12

There are 1,743,485 square feet in the district so the potential operational savings to “average”:

$0.12 x 1,743,485 sf = $209,218 dollars annually.

Some of the best performers include:

Albert Lea ($0.67), Duluth ($0.75), Burnsville ($0.79), Bloomington ($0.84), Eden Prairie ($0.82), Minnetonka ($0.87)

*Note: Building age has very little to do with the potential performance.*

*Data From 04/26/16*
Three Areas You Can Manage to Control Costs

B3 Benchmarking RADS – Public Schools
Ranked by EUI (kBTU/SF/YR)

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>EUI (kBTU/SF/Yr)</th>
<th>Completed Sq Ft</th>
<th>Total Sq Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>136</td>
<td>Mankato</td>
<td>76.63</td>
<td>1,538,416</td>
<td>1,538,416</td>
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<tr>
<td>86</td>
<td>Wayzata Public Schools</td>
<td>63.80</td>
<td>992,240</td>
<td>1,613,919</td>
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<tr>
<td>-</td>
<td>Hopkins</td>
<td>0.00</td>
<td>81,526</td>
<td>81,526</td>
</tr>
<tr>
<td>132</td>
<td>Edina Public Schools</td>
<td>75.97</td>
<td>1,666,994</td>
<td>1,666,994</td>
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<tr>
<td>129</td>
<td>Minnetonka</td>
<td>75.26</td>
<td>1,689,112</td>
<td>1,689,112</td>
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<tr>
<td>107</td>
<td>North St. Paul, Maplewood, Oakdale</td>
<td>68.96</td>
<td>1,743,485</td>
<td>1,743,485</td>
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<tr>
<td>87</td>
<td>White Bear Lake</td>
<td>63.84</td>
<td>1,775,767</td>
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<tr>
<td>189</td>
<td>Mounds View</td>
<td>135.72</td>
<td>1,833,999</td>
<td>1,833,999</td>
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<td>68</td>
<td>Eden Prairie</td>
<td>60.53</td>
<td>1,883,279</td>
<td>1,883,279</td>
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<tr>
<td>75</td>
<td>Burnsville-Eagan-Savage</td>
<td>61.84</td>
<td>1,900,504</td>
<td>1,900,504</td>
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<tr>
<td>109</td>
<td>Eastern Carver County Schools</td>
<td>69.69</td>
<td>1,912,060</td>
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<tr>
<td>77</td>
<td>Lakeville</td>
<td>62.23</td>
<td>1,918,474</td>
<td>1,918,474</td>
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<tr>
<td>122</td>
<td>St. Cloud</td>
<td>74.35</td>
<td>1,947,142</td>
<td>1,947,142</td>
</tr>
</tbody>
</table>

Ranking Among Districts of similar size (1.5 – 1.9 million sf)
1. Eden Prairie – 60.53 (68 /197)
2. Burnsville-Eagan-Savage – 61.84 (75/197)
3. Lakeville – 62.23 (77/197)
4. Wayzata Public Schools – 63.80 (86/197)
5. White Bear Lake – 63.84 (87 /197)
7. Easter Carver County Schools – 69.69 (109 /197)
8. St. Cloud – 74.33 (122 /197)
9. Minnetonka – 75.26 (130 /197)
10. Edina Public Schools – 75.97 (132 /197)
11. Mankato – 76.63 (174 /197)
12. Mounds View – 135.72 (189/197)
Target: 62.25
Data From 04/26/16

Target: $0.78
Data From 04/26/16
Three Areas You Can Manage to Control Costs

Three Areas of Management: B3 is a Tool

1. Beyond the Meter: Understand the Rate Structure
   Savings Potential: 1% to 3%

2. Operational Assessments and Modifications
   Savings Potential: 7% to 17%

3. Building and Systems Management/Improvements
   Savings Potential: 5% to 20%

Notes: savings will vary based on building uses and system ages/types, and etc. estimates from client analysis and collaborative research with: TWG, Seventhwave, Center for Energy and Environment
Areas of Management: Beyond the Meter

1. Beyond the Meter

Meet with Your Utilities

- Each Utility is Different
- Rate Structures and Variables
- Understand the Performance Service Opportunities
- Review Available Rebates and The Processes to Obtain

Three Areas You Can Manage to Control Costs
Three Areas You Can Manage to Control Costs

Areas of Management: Operational Assessments

2. Operational Assessments

- Overlay the Use Patterns and Operations with Rate Structure
- Building Engineer/Staff Understanding and Training
- Occupant Comfort and Behavior Techniques
3. Building and Systems

Understand the Building System and Program Relationships

- Understand the Relationship of All Systems and Materials
- Envelope 1st – Electrical Systems 2nd – Mechanical Systems 3rd

The Mechanical System Strategies

- Commissioning and Determining System Potential
- Rebates Make It Difficult to not Focus on Mechanical Systems
- Performance Contracting
Three Areas You Can Manage to Control Costs

Building Schedules versus Energy Costs

Building Performance:
- Metering Strategies
- Zone Analysis
- Warm-Up Schedule
- Building Uses
- Types of Activities
- Technology Solutions
Three Areas You Can Manage to Control Costs

Window Approaches

Glass and Glazing Systems have changed over the last 15 years. Impacts to building occupants, systems sizes and operations can be dramatic.

- Blinds, Shades and Louvers
- Window Films for Existing Windows
- Glass and Glazing Management Systems
- Operations and Maintenance

Note: ETGs are becoming very impactful for both occupant comfort and operational costs
