HOW ARE CODES DRIVING ENERGY CHANGES?  COMMERCIAL ENERGY MODELING

SIPA
TUES APRIL 29, 4 - 5 PM
IS THIS REALLY IMPORTANT?

http://buildingsdatabook.eren.doe.gov/
COMMERCIAL SPACES

- **Largest floorspace**
  - Office
  - Retail
  - Warehouse & storage

- **Largest EUI (energy/sqft)**
  - Food service
  - Food sales
  - Health care

http://buildingsdatabook.eren.doe.gov/
## ENVELOPE ENERGY CODE

<table>
<thead>
<tr>
<th></th>
<th>ASHRAE 90.1 2007 Nonresidential—CZ 2</th>
<th>ASHRAE 90.1 2010 Nonresidential—CZ 2</th>
<th>IGCC ASHRAE 189 2011 Nonresidential—CZ 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque Elements</td>
<td>Assembly Max</td>
<td>Min R-Value</td>
<td>Assembly Max</td>
</tr>
<tr>
<td>Walls, Above-Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.151</td>
<td>R-5.7 ci</td>
<td>U-0.151</td>
</tr>
<tr>
<td>Metal Building</td>
<td>U-0.113</td>
<td>R-13</td>
<td>U-0.093</td>
</tr>
<tr>
<td>Steel-Framed</td>
<td>U-0.124</td>
<td>R-13</td>
<td>U-0.124</td>
</tr>
<tr>
<td>Wood-Framed &amp; Other</td>
<td>U-0.089</td>
<td>R-13</td>
<td>U-0.089</td>
</tr>
</tbody>
</table>
BUILDING ENERGY EFFICIENCY

- The earlier you start in energy efficiency the more impact & savings

- Envelope
- HVAC
- Appliances
- Renewables
- Hot Water
- Lighting
- Controls
Performance
• Accounts for building system interaction
• Design flexibility
• Hire another consultant
• Can take advantage of code & above code programs

Prescriptive
• Small buildings (>20,000 sqft)
• Can limit technologies
• Additional requirements
BUILDING MODELING

- Purpose of Modeling
  - Informing Design
  - Code Compliance
  - Utility Incentives
  - Green Certification

- Modeling Software
  - DOE2
  - EnergyPlus
  - COMcheck
  - ... And many others
INFORMING DESIGN

- DOE’s Commercial Reference Buildings
- ENERGY STAR Portfolio Manager
  - Target Finder
  - EUI Goals
- Goal: Inform Design
- Geometry: Similar size
- Building Systems: Preliminary
- Building Use: General use
- Model: Shows savings magnitudes
INFORMING DESIGN

- ASHRAE Advanced Energy Design Guides
- Architecture 2030 Challenge
### Target Finder

You can use this tool to set energy targets and possibly receive an ENERGY STAR score for design projects. To get started, tell us more about your property, including information about how it will be used once it's constructed, and optionally the estimated annual energy use.

#### About Your Design Project

- **Name:** Space Office Example
- **Country:** United States
- **Street Address:** 7th Avenue
- **City/Municipality:** Bozeman
- **State/Province:** Montana
- **Postal Code:** 79116
- **Year Planned for Construction Completion:**
- **Primary Function for your Design Project:** Office

#### Energy Use Intensity (EUI)

![Graph showing Energy Use Intensity (EUI)]

- **Site EUI (kBtu/SqFt):** Not Available
- **Source EUI (kBtu/SqFt):** Not Available

### Metric

<table>
<thead>
<tr>
<th>Metric</th>
<th>Property Estimate at Design</th>
<th>Design Target*</th>
<th>Median Property*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR score (1-100)</td>
<td>Not Available</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Source EUI (kBtu/ft²)</td>
<td>Not Available</td>
<td>132.9</td>
<td>148.5</td>
</tr>
<tr>
<td>Site EUI (kBtu/ft²)</td>
<td>Not Available</td>
<td>52.8</td>
<td>59.0</td>
</tr>
<tr>
<td>Source Energy Use (kBtu)</td>
<td>Not Available</td>
<td>757,591.9</td>
<td>846,450.0</td>
</tr>
<tr>
<td>Site Energy Use (kBtu)</td>
<td>Not Available</td>
<td>300,994.2</td>
<td>336,300.0</td>
</tr>
<tr>
<td>Energy Cost ($)</td>
<td>Not Available</td>
<td>6,369.16</td>
<td>7,116.24</td>
</tr>
<tr>
<td>Total GHG Emissions (Metric Tons CO2e)</td>
<td>0.0</td>
<td>39.1</td>
<td>43.7</td>
</tr>
</tbody>
</table>
CODE COMPLIANCE

- IECC/ASHRAE 90.1
  - COMcheck
  - Whole Building Energy Model

- Considerations
  - Cost

- Goal: Meet Code
- Geometry: As-Designed
- Building Systems: As-Designed
- Building Use: General use
- Model: Demonstrates compliance
ASHRAE 90.1-2010

- Bozeman, MT
- Office/Retail
- 8,700 sqft

8 ¼” EPS SIP
- R-29
- 9% envelope savings

8 ¼” PIR SIP
- R-42
- 12% envelope savings
BEYOND CODE

- Green Certification
  - LEED
  - National Green Building Certification

- Utility Incentives
  - Xcel Energy EDA (CO)
  - CPACE (CT)
  - NYSERDA (NY)

- Goal: Beyond Code
- Geometry: As-Designed
- Building Systems: As-Designed
- Building Use: Detailed Use
- Model: Demonstrates Energy Compliance

Welcome to:
- eQUEST
  Quick Energy Simulation Tool
- OpenStudio
<table>
<thead>
<tr>
<th></th>
<th>Small Office Reference</th>
<th>8.5” PUR SIPS</th>
<th>Savings</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GJ</td>
<td>GJ</td>
<td>GJ</td>
<td>%</td>
</tr>
<tr>
<td>Heating</td>
<td>72.16</td>
<td>56.09</td>
<td>16.07</td>
<td>22.0%</td>
</tr>
<tr>
<td>Cooling</td>
<td>8.31</td>
<td>8.01</td>
<td>0.3</td>
<td>3.6%</td>
</tr>
<tr>
<td>Interior Lighting</td>
<td>56.69</td>
<td>56.69</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exterior Lighting</td>
<td>36.15</td>
<td>36.15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interior Equipment</td>
<td>87.73</td>
<td>87.73</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fans</td>
<td>35.72</td>
<td>33.44</td>
<td>2.28</td>
<td>6.4%</td>
</tr>
<tr>
<td>Water Systems</td>
<td>11.81</td>
<td>11.81</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total End Uses</td>
<td>308.56</td>
<td>289.91</td>
<td>18.65</td>
<td>6.0%</td>
</tr>
</tbody>
</table>
OPTIMIZING BUILDING ENVELOPE

- Building loads
  - Reduced building loads
  - Lower energy use
  - Lower infiltration

- HVAC
  - Potentially downsizes HVAC
  - Intentional ventilation
BEYOND MODELING

- Streamlining Design
- Material Selection
  - First Cost
  - Installation
  - Durability
  - Repeatability
- Increasing Codes
  - Change technologies
  - Installation details
THOUGHTS FROM A MODELER ON SELLING SIPS

- **What sells?**
  - COMFORT
  - Value

- **Why?**
  - Selling is emotional

- **Potential issue**
  - Envelope & HVAC must both be installed correctly

- **Recommendation**
  - Require HVAC commissioning

http://www.sips.org/gallery/commercial-photos
<table>
<thead>
<tr>
<th>Wall Thickness</th>
<th>Fiberglass</th>
<th>Cellulose</th>
<th>EPS SIP</th>
<th>XPS SIP</th>
<th>NEO SIP</th>
<th>PIR SIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5&quot;Whole Wall</td>
<td>R-10</td>
<td>R-11</td>
<td>R-15</td>
<td>R-18</td>
<td>R-17</td>
<td>R-21</td>
</tr>
<tr>
<td></td>
<td>Center of Cavity</td>
<td>R-14</td>
<td>R-16</td>
<td>R-16</td>
<td>R-20</td>
<td>R-18</td>
</tr>
<tr>
<td>6.5&quot;Whole Wall</td>
<td>R-14</td>
<td>R-16</td>
<td>R-22</td>
<td>R-28</td>
<td>R-25</td>
<td>R-32</td>
</tr>
<tr>
<td></td>
<td>Center of Cavity</td>
<td>R-20</td>
<td>R-24</td>
<td>R-23</td>
<td>R-30</td>
<td>R-26</td>
</tr>
<tr>
<td>8.25&quot;Whole Wall</td>
<td>R-18</td>
<td>R-20</td>
<td>R-29</td>
<td>R-36</td>
<td>R-33</td>
<td>R-42</td>
</tr>
<tr>
<td></td>
<td>Center of Cavity</td>
<td>R-25</td>
<td>R-30</td>
<td>R-30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.25&quot;Whole Wall</td>
<td>R-23</td>
<td>R-26</td>
<td>R-35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Center of Cavity</td>
<td>R-31</td>
<td>R-38</td>
<td>R-38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SELLING? YES!

http://www.sips.org/gallery/commercial-photos
HOW ARE CODES DRIVING ENERGY CHANGES?

Average Commercial Building EUI

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Use Intensity (kBtu/sf/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003 BEDB</td>
<td>91.0</td>
</tr>
<tr>
<td>2006 IECC</td>
<td>73.3</td>
</tr>
<tr>
<td>2009 IECC</td>
<td>69.7</td>
</tr>
<tr>
<td>2012 IECC</td>
<td>62.1</td>
</tr>
</tbody>
</table>