Including K-12 School Districts in the Clean Energy Equation

Better Buildings Summit 2015
Washington, DC
Friday, May 29, 2015
Agenda

- Introductions

- **Measuring Our Impact Project**  
  Anisa Baldwin Metzger, Assoc. AIA, LEED AP BD&C O&M  
  School District Sustainability  
  Center for Green Schools at the U.S. Green Building Council

- **Adding ESPCs to the Finance Mix**  
  Jeanna M. Paluzzi, Energy Performance Contracting Program Manager  
  Colorado Energy Office  
  Montezuma-Cortez School District, Trinidad School District

- **Is Capacity an Issue? Public Private Partnerships – Georgetown Energy Prize**  
  Malini Srivastava, Principal & Assistant Professor  
  Design and Energy Lab, North Dakota State University  
  Fargo School District

- **Prioritizing your Projects – Building Asset Score Tool**

- **Anatomy of an Implementation Model**

- **Knowledge Sharing: Barriers to EE & Solutions**

- **Take Aways & Next steps**
QUESTIONS

- who?
- what?
- when?
- how?
- where?
- why?
- discovering
- investigation
- clues
- asking questions
- challenge
- who?
Session Feedback Form

- Tell us what works and what doesn’t work
- Use notecards to submit unanswered and follow up questions.
Next Steps

- Develop more K-12 Showcase Projects and Implementation Models to add to the new Better Buildings Solution Center
- Develop a communications strategy for each partner
- Continue recruitment to achieve greater size and geographic diversity
- Continue to measure progress
Thank you!

- Encourage others to join the Better Buildings Challenge
- Keep us apprised of your needs and progress
- Thank you for participating in the Better Buildings Summit 2015
THE CENTER FOR GREEN SCHOOLS

Anisa Baldwin Metzger
Manager, School District Sustainability
Every child in a green school within this generation
Net impact
(waste, water, energy, CO₂)

Health & performance

Environmental literacy
T.C. Williams High School

Overview | LEED Dashboard | Collections (5) | Resources (3)

Gross Square Feet: 435,000
Space Type Use: University
Owner Sector: K-12 Education

LEED Credit Categories

- **Very Good**: 45/69 Possible Points
  - Top 3% of activities in VA
  - Top 9% of all LEED NC 2.1 activities in US

Benchmark

- Good
- Very Good
- Excellent
- Exceptional

This Project

United States

- Top 9% of all activities in US

Credit Achievement

- Energy and Atmosphere: 9/17
- Materials and Resources: 6/13
- Indoor Environmental Quality: 11/15
- Sustainable Sites: 9/14
The Indoor Investigation

Look around the inside of your school! Find the things below and tell us what you think about them by answering the following questions to the best of your ability.

Is there recycling at this school?
- Yes
- No
- I'm not sure

Is there composting at this school?
- Yes
- No
- I'm not sure

What do you think about the daylighting in this school's classrooms?
On a sunny day, a classroom that has good daylighting is bright even when the lights are off.
- Very Bad
- 1
- 2
- 3
- Very Good

What types of signs and posters can you find around this school? (check all that apply)
- Green instructions (like "How to Recycle")
- Green reminders (like "Don't forget to turn off the lights!")
- Information about green clubs/organizations
- Posters about nutrition or physical activity
- Environment-related signage (like posters about trees)
THE MEASURE OF A GREEN SCHOOL

Over the past four years, EDF Green Ribbon Schools Award has united the broad green schools movement with a universal set of criteria. These criteria have the potential to guide all schools toward sustainability, not just the very best of the best that have been seeking the award. We currently have a landmark opportunity as a community to define a clear and comprehensive set of measures that all schools can use to track their progress in harmony with the three pillars of EDF Green Ribbon Schools: minimized environmental impact, improved occupant health, and effective environmental and sustainability literacy for all graduates.

During the next year, the Center for Green Schools will convene a conversation about how schools should be given credit for important work they have already done, as well as what existing and available data can inform the public about the state of schools in their area. When it comes to comprehensive sustainability, the next school leaders will need clearer ways to measure progress & central to our movement’s collective ability to track improvement, spur on innovation, and incubate change.
The 2014 Green Apple Day of Service brought together students, teachers, parents, community groups, companies and more to transform their schools and campuses into healthy, safe and efficient places to learn.

All kinds of projects took place for the third annual Day of Service, with at least 40% of volunteers spending the day outside! Check out some of the other kinds of projects at mygreenapple.org.

In 2014, 3,836 Green Apple Day of Service projects, events and commitments took place.

Events took place in 50 U.S. states and 43 countries.

All over the world, 306,000 volunteers gave their time.

Communities raised $4.7 million to support local efforts.

These events had an impact on the learning environments of 2.1 million students.
Anisa Baldwin Metzger
Manager, School District Sustainability
anisa@usgbc.org
Anisa Baldwin Metzger

- School District Sustainability Manager for the Center for Green Schools at the U.S. Green Building Council.

- In 2014, she was named one of the Most Powerful Women in Sustainability by Green Building and Design Magazine.

- With a background in architecture, she began her work with USGBC in New Orleans, hired to assist with rebuilding the schools after Hurricanes Katrina and Rita.

- After two years with the city’s Recovery School District, she moved to Washington, DC to begin the Green Schools Fellowship Program at the Center for Green Schools, a program that places and trains sustainability directors in school districts.
  - At the Center, Anisa leads the Fellowship program and provides sustainability resources, tools and research to a growing network of sustainability-focused staff at school districts across the country.

- She is a Little Rock native and holds a B.S. in Architecture from Washington University in St. Louis and an M.Arch. from the University of Washington in Seattle.
Energy Performance Contracting
Earning an A in public schools
The Colorado Energy Office

MISSION STATEMENT

The CEO’s mission is to improve the effective use of all of Colorado’s energy resources and the efficient consumption of energy in all economic sectors, through providing technical guidance, financial support, policy advocacy and public communications.

DEPARTMENT VISION

The CEO’s vision is to help Coloradans live more prosperous and healthy lives by promoting innovative energy production and efficient energy consumption practices that are beneficial to the economic and environmental health of the state.
Energy Performance Contracting basics

- CO legislation enables state and local gov’t participation
- Energy Service Company
- Investment grade audit and project proposal
- Energy and water savings guaranteed
- Robust private sector financier support
- Construction
- Measurement and verification
Colorado public sector EPC performance

- Available since the mid-1990s
- As of June 30, 2014
  - 142 public sector clients
  - 182 active & completed projects
  - $447.4 M total investments
  - #4 in the nation, per the Energy Services Coalition’s *Race to the Top*
  - Projects in communities across 75% Colorado counties
Public school districts is a key market

<table>
<thead>
<tr>
<th>Metric</th>
<th>Public Schools</th>
<th>Overall portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td># Clients</td>
<td>57</td>
<td>142</td>
</tr>
<tr>
<td># Projects</td>
<td>69</td>
<td>182</td>
</tr>
<tr>
<td># Buildings improved</td>
<td>602</td>
<td>2254</td>
</tr>
<tr>
<td>Total investments via EPC</td>
<td>$157,893,140</td>
<td>$447,377,551</td>
</tr>
<tr>
<td># Projects in construction</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Annual energy + water savings</td>
<td>$9,170,143</td>
<td>$28,822,008</td>
</tr>
<tr>
<td>Electricity savings ($)</td>
<td>$2,268,023</td>
<td>$5,384,716</td>
</tr>
<tr>
<td>Electricity savings (kWh)</td>
<td>49,352,112</td>
<td>141,779,619</td>
</tr>
<tr>
<td>Natural gas savings ($)</td>
<td>$1,679,412</td>
<td>$4,041,831</td>
</tr>
<tr>
<td>Natural gas savings (therms)</td>
<td>2,370,100</td>
<td>9,945,003</td>
</tr>
<tr>
<td>Water savings (kgal)</td>
<td>154,456</td>
<td>467,200</td>
</tr>
</tbody>
</table>

June 30, 2014
Standards for Success

- Enabling legislation
- Bipartisan support
- Standardized, state-approved contracts + protocols + guidance
- A pool of pre-qualified ESCOs, providing both depth + breadth
- CEO advice and technical support
- Private market-based financing
- Strong state chapter of the Energy Services Coalition
State and local synergies

- Colorado Department of Education’s Capital Construction Assistance Program (CCAP) priorities:
  - CCAP safety, security, and health
    - Roof, window, and door replacements
  - EPC energy and water efficiency
    - Mechanical, electrical, and plumbing upgrades

- Project examples
  - Trinidad School District 1
  - Montezuma-Cortez School District Re-1
Jeanna Paluzzi

- Energy performance contracting program manager at the Colorado Energy Office.

- Her first work in energy took place as an undergrad at Michigan State University when the nation was still feeling the economic impacts of the Middle East oil embargo.

- Jeanna volunteered as a residential energy efficiency counselor at a nonprofit off-campus and presented research into protecting passive solar access through local zoning and development standards.

- Most of her subsequent work in natural resources was devoted to river restoration and protection in the Great Lakes basin, until she moved west to the Rocky Mountains five years ago.

- She initially worked as a community energy coordinator in the San Luis Valley in Colorado, then moved to Denver to manage the state's energy contracting program manager.
“e” is for energy-efficient, enterprising Fargo!

5/5/5 by 2016

<table>
<thead>
<tr>
<th>P</th>
<th>PARTNERSHIP</th>
<th>NDSU</th>
<th>City of Fargo</th>
<th>Utilities</th>
<th>Plains Art Museum</th>
<th>K-12 School</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Expertise</td>
<td>Seed Funding</td>
<td>Data</td>
<td>Museum</td>
<td>School</td>
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<tr>
<td></td>
<td></td>
<td>Resources</td>
<td>Networking</td>
<td>Solar Parks</td>
<td>Bakken Boom</td>
<td>STEM</td>
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<tr>
<td></td>
<td></td>
<td>Time</td>
<td></td>
<td>Dashboard</td>
<td>Edu. Programs</td>
<td>STEM</td>
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</table>

<table>
<thead>
<tr>
<th>A</th>
<th>ACTION</th>
<th>Weekly Meetings</th>
<th>Online Meeting</th>
<th>Events</th>
<th>Presentations</th>
<th>Outreach</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Team &amp; Community</td>
<td>Website</td>
<td>Kick-off</td>
<td>NDARE</td>
<td>Partners</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Social Media</td>
<td>Alley Fair</td>
<td>City Comm.</td>
<td>Supporters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mapping</td>
<td>Hodo, etc.</td>
<td>CERTS, ect.</td>
<td>Volunteers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>COMPETITION</th>
<th>K-12 Challenge</th>
<th>Urban Game</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Provide a limited and intense activity period to meet the 5% goal.</td>
<td>Close the energy efficiency gap based on educational.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E</th>
<th>EDUCATION</th>
<th>Top Ten</th>
<th>Demo House</th>
<th>K-12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategies for various building typologies.</td>
<td>Create, expertise, demand and capacity.</td>
<td>Educate children so they can educate adults.</td>
<td></td>
</tr>
</tbody>
</table>
Fargo competes for a $5m Energy Prize!
## Aurora Elementary

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47800</td>
<td>56000</td>
<td>54400</td>
</tr>
<tr>
<td>2</td>
<td>64000</td>
<td>60800</td>
<td>56200</td>
</tr>
<tr>
<td>3</td>
<td>48000</td>
<td>49800</td>
<td>53200</td>
</tr>
<tr>
<td>4</td>
<td>69400</td>
<td>66400</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>51000</td>
<td>49400</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>33400</td>
<td>37600</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>36800</td>
<td>36600</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>37400</td>
<td>45800</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>56200</td>
<td>52200</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>50300</td>
<td>55600</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>52400</td>
<td>50800</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>53600</td>
<td>52400</td>
<td></td>
</tr>
</tbody>
</table>

## Davis High School

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>423000</td>
<td>453000</td>
<td>442500</td>
</tr>
<tr>
<td>2</td>
<td>486750</td>
<td>537000</td>
<td>459000</td>
</tr>
<tr>
<td>3</td>
<td>403500</td>
<td>479250</td>
<td>450000</td>
</tr>
<tr>
<td>4</td>
<td>390000</td>
<td>399750</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>283500</td>
<td>354000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>235500</td>
<td>234000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>219750</td>
<td>235500</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>225000</td>
<td>259600</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>274500</td>
<td>300000</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>303750</td>
<td>351000</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>376500</td>
<td>416250</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>494250</td>
<td>454500</td>
<td></td>
</tr>
</tbody>
</table>
K-12 SCHOOLS

Efficiency through facilities improvements
10 year maintenance assessment overview

No long term master plan for district maintenance and replacements had been established.

Cost about $10,000 for all Fargo district buildings to be assessed for a 10 year prediction period starting in 2014.

Every building in the Fargo Schools district was assessed individually for maintenance and replacement requirements.

Based on each building a maintenance and replacement schedule was developed with cost estimates.

Major issues to be addressed during first few years include: roofs, parking, pools, air conditioning and heat pumps.

Outcome of about $4 - $5 million a year needed in maintenance and replacements.

Fargo School District currently has about $2.8 million allotted each year.
## K-12 SCHOOLS

### Energy efficiency efforts

<table>
<thead>
<tr>
<th>What</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat Pumps</strong></td>
<td>Heat pumps in many of the new schools are over 20 years old.</td>
</tr>
<tr>
<td><strong>Air Conditioning</strong></td>
<td>Older schools had ineffective systems resulting in poor air quality in classrooms.</td>
</tr>
<tr>
<td><strong>Building Automation</strong></td>
<td>Old pneumatic or electronic controls ineffective at achieving optimal performance.</td>
</tr>
<tr>
<td><strong>LED lighting</strong></td>
<td>Lighting demands are approximately 50% of electricity use in district facilities each year.</td>
</tr>
<tr>
<td><strong>Roofing Upgrades</strong></td>
<td>Roofing replacements identified as immediate concerns during the start of the next 10 years.</td>
</tr>
<tr>
<td><strong>Pool System Upgrades</strong></td>
<td>Ventilation in pool systems identified as being ineffective at handling pool demands.</td>
</tr>
<tr>
<td><strong>Experimental Classroom</strong></td>
<td>Classroom features like lighting are tested in a single room before wider application.</td>
</tr>
</tbody>
</table>
K-12 CHALLENGE Energy efficiency through education
<table>
<thead>
<tr>
<th>What</th>
<th>How</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campus Conservation Nationals</strong></td>
<td>The world's largest electricity and water reduction competition for universities and colleges.</td>
<td>Competition for 3 weeks measured again baseline readings. Between Buildings or other schools.</td>
</tr>
<tr>
<td><strong>San Diego School Energy Conservation Competition</strong></td>
<td>Energy conservation competition to save money and reduce impact on the environment.</td>
<td>Schools compete with each other for 3 weeks to see who can save the most energy.</td>
</tr>
<tr>
<td><strong>Igniting Creative Energy Challenge</strong></td>
<td>Contest for students to share their ideas about energy and the environment.</td>
<td>Students share their ideas about how to help conserve energy and promote stewardship.</td>
</tr>
<tr>
<td><strong>Battle of the buildings 2014</strong></td>
<td>Annual competition related to buildings and their impact on the environment.</td>
<td>Minnesota schools challenged to reduce energy use by the greatest percentage.</td>
</tr>
<tr>
<td><strong>The Spirit to Saving</strong></td>
<td>Energy conservation competition to catalyze savings and provide experiences for students.</td>
<td>Schools create “Green Teams” and “Energy Monsters” to help understand energy issues.</td>
</tr>
<tr>
<td><strong>Global Green Cup Energy Challenge</strong></td>
<td>Challenge to raise awareness about climate change and resource conservation.</td>
<td>Schools are invited to join the challenge to save energy and bring positive change.</td>
</tr>
</tbody>
</table>

**Results**
- Behavioral change solutions.
- Turn everything off on weekends. Thermostats to 78 degrees, blackouts.
- Any means; artwork, science projects, essays, music, websites.
- Winning school reduced 29.1% over 6 week through simple means.
- Awareness, understanding, accountability.
- In 2013 300 schools saved over 1.5 gigawatt in 4 weeks.
Overview

6-week energy conservation challenge

**Challenge**
Promote energy efficiency and provide opportunities for the sustainability leaders of tomorrow.

**Help Defeat Dr. Waste-a-Watt**
Reduce the amount of wasted energy in your school alongside your very own Energy Conservation Superhero.

**Goals**
1. Educate K-12 students about the science of energy production, transmission and consumption.
2. Empower K-12 students to create change in their own environments through every day energy use practices.
3. Reduce the impact that our schools have on the environment by reducing energy use in school buildings by a minimum of 5%.
4. Help Fargo become a more energy efficient community.

**Recognition**
1. Certificate to each school will show the amount of energy they saved over the competition period.
2. (Potentially) Special recognition for teacher/staff/student from each school showing exemplary leadership.

How it Works

- Make a commitment
- Prepare and learn
- Set goals
- Design a Superhero
- Create an energy savings plan
- Promote your events
- Implement your energy savings plan
- Recognize your achievements
- Continue energy conservation
## Schedule

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall 2015</strong></td>
<td>Preparation, Orientation, Presentations, Workshops, Q&amp;A</td>
</tr>
<tr>
<td><strong>March 1st-4th 2016</strong></td>
<td>Challenge Kick-off Week, Super Hero Debut, Pledge, Create a plan, Film Festival</td>
</tr>
<tr>
<td><strong>March 7th - April 15th 2016</strong></td>
<td>Challenge Competition Period, Host events and activities, Super Hero Designs, Post pictures and storied, energy usage collected</td>
</tr>
<tr>
<td><strong>April 22 Earth Day 2016</strong></td>
<td>Challenge Celebrations, Each schools can host their own, All schools will be recognized nominations for outstanding efforts</td>
</tr>
</tbody>
</table>
Dr. Waste-a-Watt is a greedy, evil scientist who gains his evil powers from wasted energy. The more energy wasted throughout the city, the stronger he becomes. His goal is to gain enough power to take over the entire city. As a result, Fargo is becoming less green and is left to pay the price for his greedy appetite. Luckily, we have the ability to stop him!

As a community, we can come together to conserve energy and stop Dr. Waste-a-Watt before he conquers the city of Fargo. He may be powerful, but we are even more powerful when we work together! All we need to do is make sure that we’re not wasting energy. It’s as simple as turning the lights off when leaving a room or unplugging unused electronics.

efargo is inviting all schools to help defend the city of Fargo and defeat the evil Dr. Waste-a-Watt. Join forces with your school’s very own Energy Conservation Superhero to save energy in your school and prevent Dr. Waste-a-Watt from taking over our city! We have the power to make a change.
Malini Srivastava

- Malini Srivastava is a Certified Passive House Consultant and registered architect. In her roles as a 2014 Archibald Bush Fellow, Assistant Professor at NDSU, doctoral student at Carnegie Mellon University and co-Principal of Design and Energy Laboratory, she creates design-based solutions for energy issues in the built environment.

- Projects that Malini has worked on have been recognized with international, national and regional publications and awards for design, preservation and efficiency, including a COTE Top Ten award.

- Malini has served as a founding Board Member for the ND Chapter of the US Green Building Council and was awarded the AIA MN Young Architect Award in 2012.

- She is completing her doctoral work at Carnegie Mellon University in pervasive, purposeful play as a design solution for large-scale energy conservation and serves as the Project Leader for efargo, City of Fargo's participation in the Georgetown University Energy Prize Competition.
Building Energy Asset Score
Including K-12 School Districts in the Clean Energy Equation
8:30–10:00, May 29, 2015

2015 Better Building Summit

Nora Wang, Ph.D.
Pacific Northwest National Laboratory
What is …?

- ENERGY STAR Portfolio Manager
- COMCheck
- BuildingSync
- Standard Energy Efficiency Data Platform
- ASHRAE Energy Audit
- Building Performance Database
- Building Energy Data Exchange Specification
- LEED
- AIA 2030
- EnergyPlus
- OpenStudio
- Many Other Tools…
- Energy Asset Score
- AIA 2030
We are all trying to show you the paths to energy efficiency.
What is …?

ENERGY STAR Portfolio Manager
COMCheck
BuildingSync
Standard Energy Data Platform
ASHRAE Energy

The More I Think
The More Confused I Get
Ideally...

- Architects
- Consultants
- Policy Makers
- Owners/Operators
- Auditors
- Utilities
- Tenants
- Brokers

Seamless Data Exchange Mechanism

- Design
  - Energy Model (As-Design)
  - Construction Documents & Specification

- Construction
  - Energy Model (As-Built)
  - Utility Bills

- Operation
  - Building Performance Database
  - Benchmarking: Portfolio Manager
  - Code Compliance (e.g., COMCheck)
  - Energy Audit
  - AIA 2030

- Retrofit
  - Retrofit Measures
  - Green Building Certificate (e.g., LEED)

- Sale
  - Energy Asset Score
  - Tool X
  - Tool Y
  - Tool Z

June 10, 2015
How Does the Eco-System Work?

**Performance-based Code Compliance (As-Design Energy Model)**

**Green Building Certificate (As-Design Energy Model)**

**AIA 2030 (As-Design Building Characteristics)**

**Asset Score (As-Built Energy Model)**

**ASHRAE Energy Audit (As-Built Building Characteristics)**

**Building Sync XML**

**Standard Energy Efficiency Data Platform**

**EnergyPlus OpenStudio**

**Portfolio Manager (Utility Bills)**

**Building Energy Data Exchange Specification**

**Building Performance Database (Anonymous Building Data)**

**Design Audit/Retrofit**

**Benchmarking**
Screening and Reporting

Initial Screening

- Benchmark Portfolio / Disclose Energy Use
  - Collect Consumption Data and Operation Parameters
  - Portfolio Manager / Tracking Tools
  - ENERGY STAR Scores / Portfolio Benchmarking Reports

Light Audit

- Select Buildings for Light Audit
  - Collect Asset Property Data from Site Walkthrough
  - Asset Scoring Tool
  - Asset Scores / Upgrade Opportunities

- Energy Model (for EnergyPlus/OpenStudio)

Full Audit

- Select Buildings for Detailed Audit
  - Conduct Detailed Data Collection by Professionals
  - Modeling Tools
  - Detailed Audit Reports

June 10, 2015
ENERGY STAR benchmarks the overall building performance against peers.

Asset Score evaluates the as-built physical characteristics (envelope, HVAC, lighting, service hot water) of a building and its overall energy efficiency, independent of occupancy and operational choices.

Operational Assessment evaluates the effectiveness of building operation and maintenance.
How It Works

Asset Score creates simplified energy models and runs centralized energy simulation using EnergyPlus

- The simulation normalizes for building operations, occupancy and tenant behavior
- Users (owner, operator, service, provider, etc.) enter building information through an web interface

- **General information:** # of floors, footprint dimension, orientation, use type
- **Envelope components:** Roof, exterior wall, floor types, insulation levels
- **Fenestration:** Skylights, windows, shading
- **Lighting:** Fixture types, # of fixtures or % of served floor area, lighting controls
- **Mechanical components:** Cooling/heating types, controls, equipment efficiency
- **Service water heating:** Fuel type, distribution type, equipment efficiency
1. Create a new building and enter basic building information

2. Identify building use type(s) and create an inventory of your building features

3. Create 3-D block(s) of your building and apply use type(s) and features to your building block(s)

4. Score your building and receive your Asset Score Report
Types of Buildings

- Multifamily
- Office
- Retail
- Assisted living
- City hall
- Community center
- Courthouse
- Educational (including K-12 schools)
- House of Worship
- Library
- Lodging
- Medical office
- Parking garage
- Police station
- Post office
- Senior center
- Warehouse (unrefrigerated)
- Mixed-Use (of the above types)
The Asset Score generates a report with the following information:

- 10-point score based on the energy efficiency of the building envelope and the mechanical, electrical, and service hot water systems
- EE assessment of the building’s individual systems
- Total estimated building energy usage and energy use by end use under standard operating conditions
- Opportunities to upgrade building efficiency, and a “potential” energy efficiency score based on identified upgrades
Asset Score Report

10-point scale based on predicted EUI

- “10” represents lowest expected energy usage using current energy efficiency technologies
- Climate normalized
- Scale moves in half-point increments
- Transitioning from 100-point scale
ABOUT THE BUILDING SYSTEMS

<table>
<thead>
<tr>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Lighting</td>
</tr>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Cooling</td>
</tr>
<tr>
<td>Overall HVAC Systems</td>
</tr>
<tr>
<td>Hot Water</td>
</tr>
</tbody>
</table>

ABOUT THE BUILDING ENVELOPE

<table>
<thead>
<tr>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof U-Value, Non-Attic (Btu/ft² h °F)</td>
</tr>
<tr>
<td>Floor U-Value, Mass (Btu/ft² h °F)</td>
</tr>
<tr>
<td>Walls U-Value, Framed (Btu/ft² h °F)</td>
</tr>
<tr>
<td>Windows U-Value (Btu/ft² h °F)</td>
</tr>
<tr>
<td>Walls + Windows U-Value (Btu/ft² h °F)</td>
</tr>
<tr>
<td>Window Solar Heat Gain Coefficient</td>
</tr>
</tbody>
</table>

ENERGY USE INTENSITY BY END USE

- **Interior Lighting**
- **Heating**
- **Cooling**
- **Hot Water**

- **Current Building**
- **With Upgrades**
- **Site Energy Use Intensity**
<table>
<thead>
<tr>
<th>COST EFFECTIVE UPGRADE OPPORTUNITIES</th>
<th>Energy Savings</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Envelope</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Add roof insulation in Office</td>
<td>Medium</td>
<td>$$</td>
</tr>
<tr>
<td>• Upgrade windows in Office with high performance double pane windows</td>
<td>Medium</td>
<td>$$</td>
</tr>
<tr>
<td><strong>Interior Lighting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Upgrade Fluorescent T8 lighting system in Office to compact fluorescent lighting system</td>
<td>High</td>
<td>$</td>
</tr>
<tr>
<td><strong>HVAC Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Upgrade cooling system in Office with high efficiency electric DX cooling system</td>
<td>High</td>
<td>$$ $$</td>
</tr>
<tr>
<td>• Add supply air temperature reset to HVAC system in Office</td>
<td>Low</td>
<td>$</td>
</tr>
<tr>
<td><strong>Hot Water Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Upgrade service hot water system in Office with electric heat pump water heater</td>
<td>Medium</td>
<td>$$</td>
</tr>
</tbody>
</table>
Pilot Buildings (As of August 2014)

- On average, lower scoring buildings have greatest potential for improving scores
- However, even those scoring in top third of scale can jump almost 10 points on average

<table>
<thead>
<tr>
<th>Building Rank by Score</th>
<th>Average Score</th>
<th>Average Potential</th>
<th>Average Change in Score</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Score (bottom 1/3)</td>
<td>31.7</td>
<td>60.5</td>
<td>28.8</td>
<td>91%</td>
</tr>
<tr>
<td>Average Score (mid 1/3)</td>
<td>56.2</td>
<td>75.5</td>
<td>19.2</td>
<td>34%</td>
</tr>
<tr>
<td>High Score (top 1/3)</td>
<td>79.1</td>
<td>88.0</td>
<td>8.9</td>
<td>11%</td>
</tr>
</tbody>
</table>

- 191 buildings
- 24 million square feet of commercial floor area
- 278 billion Btu site energy savings
- 838 billion Btu source energy savings
- 8.4 million dollar cost savings*
- $0.41/sq.ft. cost savings*

*assuming $0.01/kBtu source energy
**Thank you!**

nora.wang@pnnl.gov

<table>
<thead>
<tr>
<th><strong>Building owners:</strong></th>
<th><strong>Real estate managers:</strong></th>
<th><strong>Architects</strong></th>
<th><strong>Utilities and utility program administrators:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicate the underlying energy efficiency of your buildings to tenants and investors</td>
<td>Strengthen your sustainability service offerings for building ownership clients</td>
<td>Guide energy-efficient design considerations with a no-cost, standardized tool</td>
<td>Quickly and cost-effectively identify new customers for rebate and incentive programs</td>
</tr>
<tr>
<td>Demonstrate national sustainability leadership and corporate social responsibility</td>
<td>Provide added value to clients by understanding their asset portfolios and opportunities for energy efficiency improvement</td>
<td>Strengthen your sustainability-related platform for clients</td>
<td>Enhance customer service by providing Asset Score evaluations for customers</td>
</tr>
<tr>
<td>Ensure the market recognizes your energy efficiency investments</td>
<td>Support building owners in communicating their sustainability leadership to the marketplace</td>
<td>Demonstrate national sustainability leadership and corporate social responsibility</td>
<td>Demonstrate commitment to clean energy and corporate social responsibility</td>
</tr>
<tr>
<td>Guide energy-related investments and reduce operating expenses in a building or across a building portfolio</td>
<td>Demonstrate national sustainability leadership and corporate social responsibility</td>
<td>Collect energy-related metrics across projects and report metrics to national programs</td>
<td>Quantify energy efficiency results to regulators and other parties</td>
</tr>
</tbody>
</table>

Energy services companies, engineers and consultants:
- Strengthen your energy/sustainability service offerings for clients
- Enhance business development activities and create opportunities
- Help building owners communicate their sustainability leadership to the marketplace
- Integrate your data seamlessly with the Asset Score through our API

State and local governments:
- Strengthen government transparency by reporting building energy information to citizens
- Collect building energy-related metrics that inform the creation of local energy goals and milestones
- Demonstrate local clean energy and sustainability leadership and communicate progress
- Guide energy-related investments and reduce operating expenses across your building portfolio

Utilities and utility program administrators:
- Quickly and cost-effectively identify new customers for rebate and incentive programs
- Enhance customer service by providing Asset Score evaluations for customers
- Demonstrate commitment to clean energy and corporate social responsibility
- Quantify energy efficiency results to regulators and other parties
Dr. Wang specializes in building energy efficiency, sustainability, daylighting, and human behavior.

She has over ten years of research experience in building energy efficiency and sustainability. She received her doctorate degree in architecture from the University of Illinois at Urbana-Champaign.

Since joining PNNL in 2010, Dr. Wang has led a variety of building research projects, such as building energy asset rating, Buildings of the Future vision development, energy data analysis for benchmarking and disclosure, building performance evaluation, and daylighting design.

Beginning her career in architecture, Dr. Wang participated in a dozen large-scale international projects and won several design competitions.

Dr. Wang was the chief architect and lead of the Illinois team for the 2007 Solar Decathlon competition. She was a Building Energy Analyst at the Illinois Smart Energy Design Assistance, and also a visiting lecturer, teaching design studio in the School of Architecture, at the University of Illinois at Urbana-Champaign.