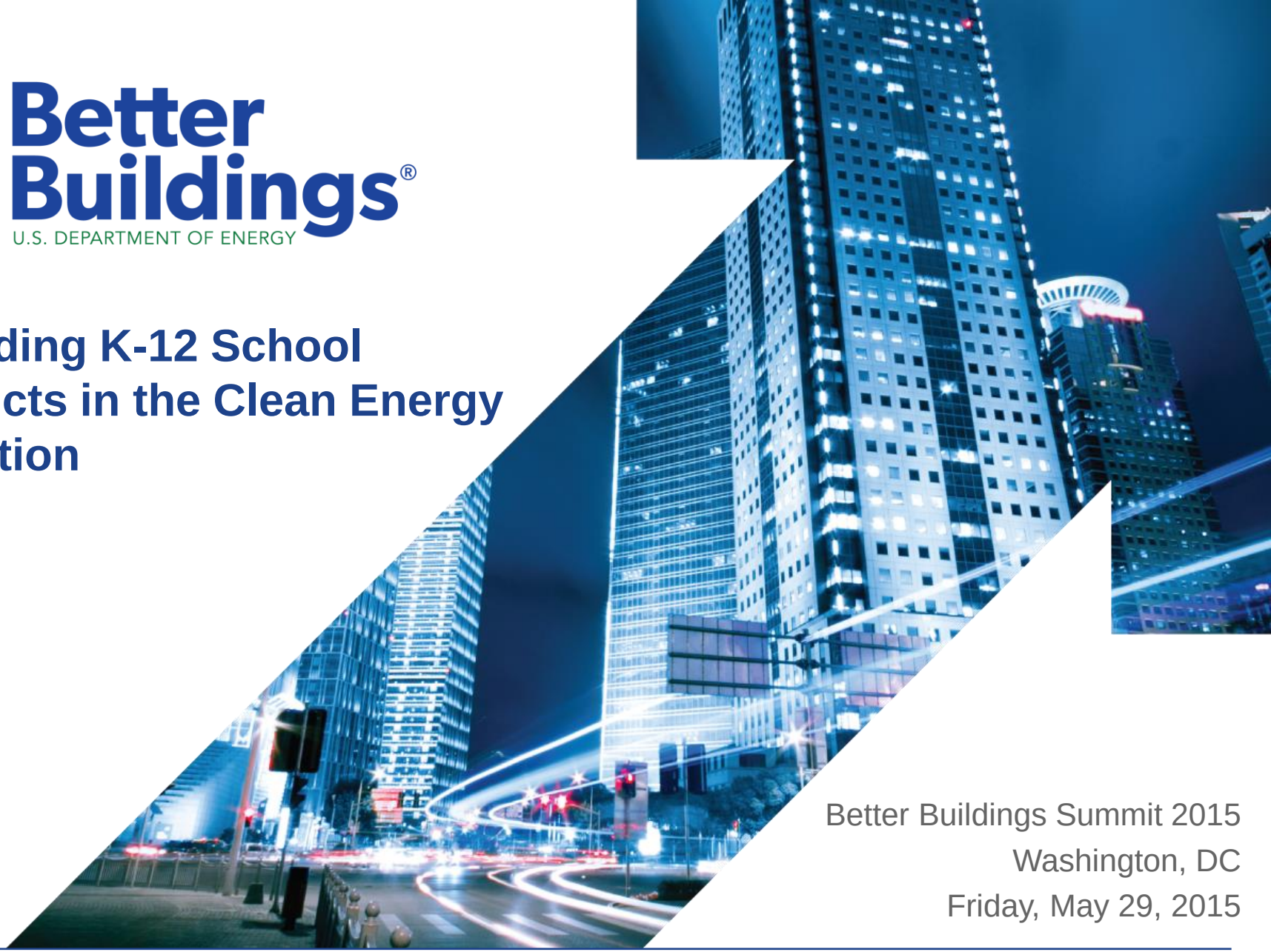


Including K-12 School Districts in the Clean Energy Equation

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
discover
how?
where?
why
challenge
who?
clues
ask
who?
what?
when?
investigation
clues
how
why?
ask
knowing

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

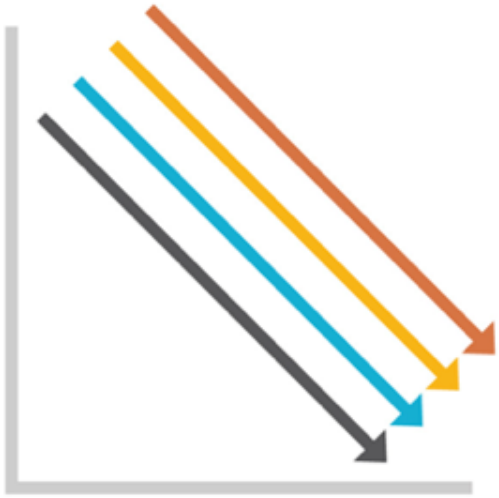
Thank you!

- 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

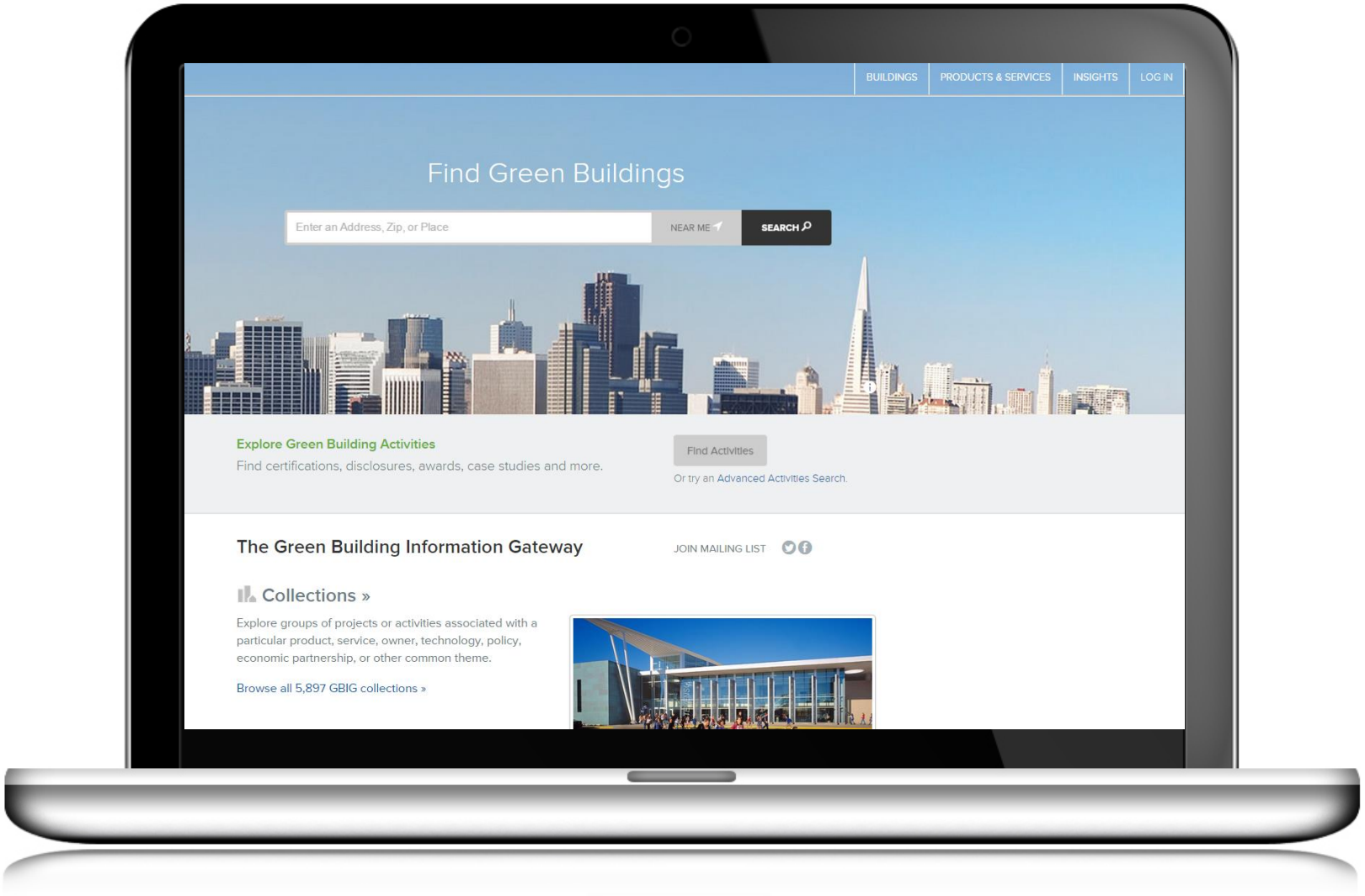
Every child in a green school within this generation

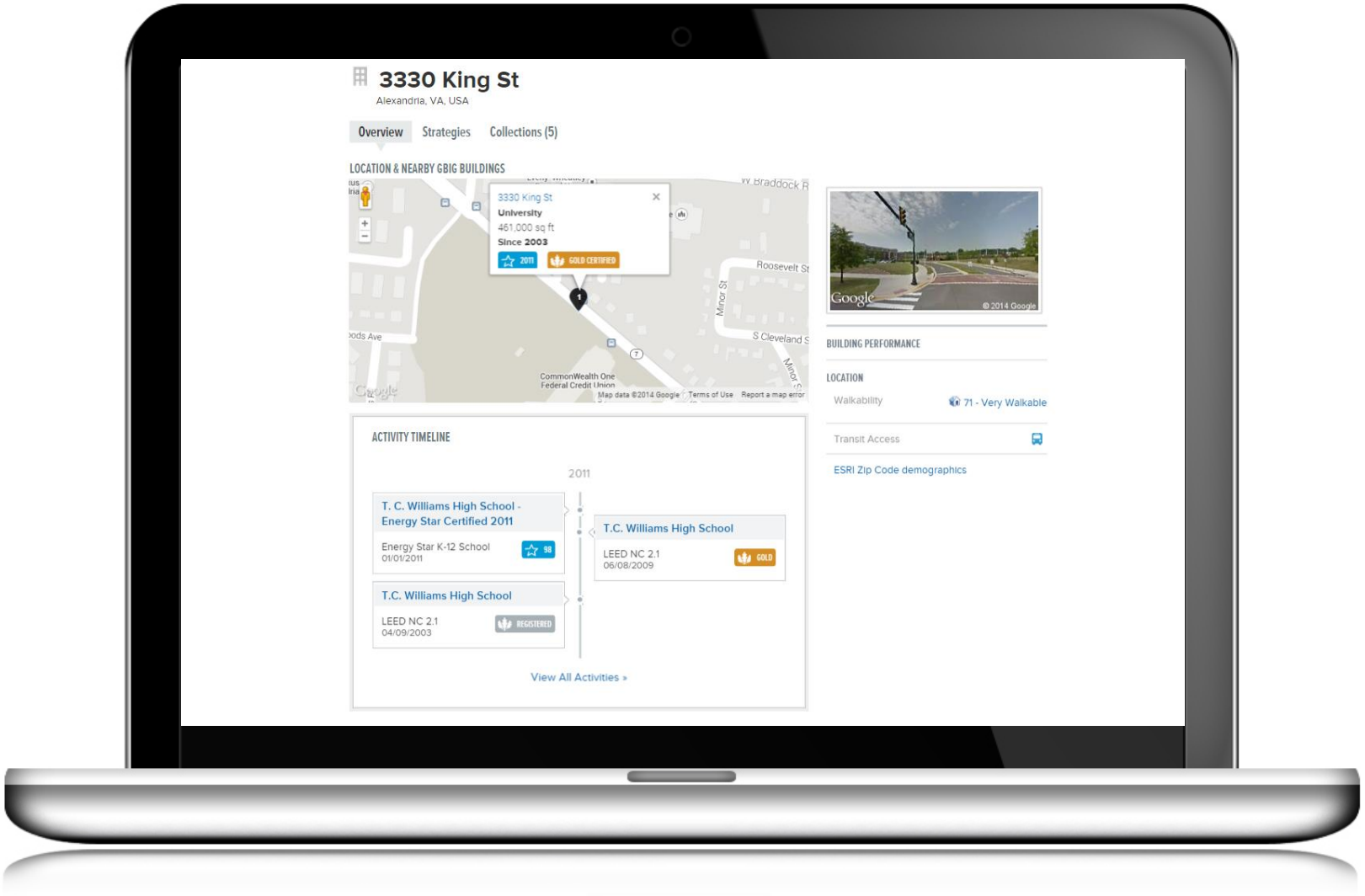


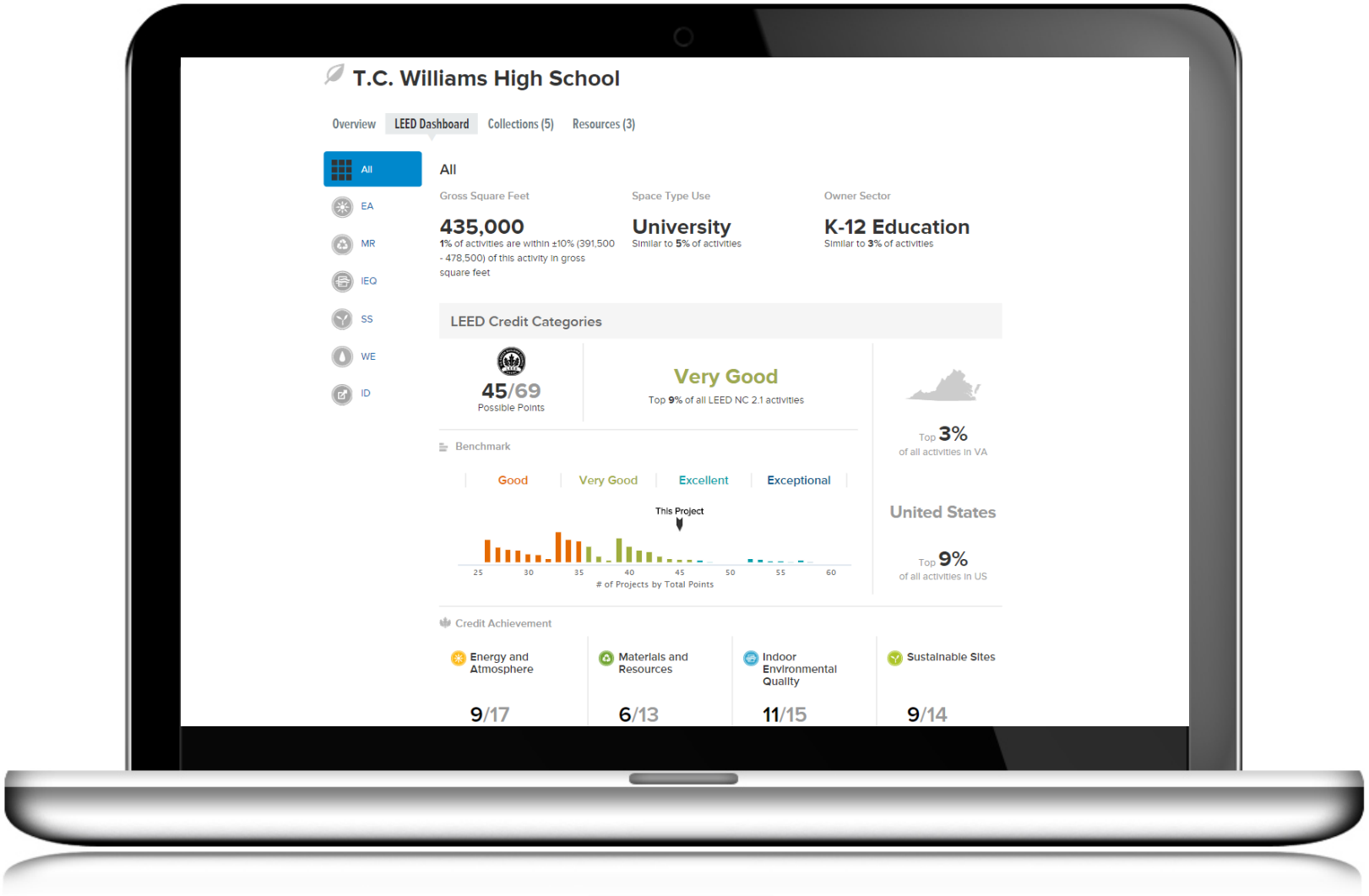
Net impact
(waste, water, energy, CO_2)

Health & performance

Environmental literacy


BUILDINGS
PRODUCTS & SERVICES
INSIGHTS
LOG IN
Find Green Buildings
Enter an Address, Zip, or Place
NEAR ME
SEARCH
Explore Green Building Activities
Find certifications, disclosures, awards, case studies and more.
Find Activities
Or try an Advanced Activities Search.
The Green Building Information Gateway
JOIN MAILING LIST
Collections »
Explore groups of projects or activities associated with a particular product, service, owner, technology, policy, economic partnership, or other common theme.
Browse all 5,897 GBIG collections »


3330 King St
Alexandria, VA, USA
Overview
Strategies
Collections (5)
LOCATION & NEARBY GBIG BUILDINGS
3330 King St
University
461,000 sq ft
Since 2003
2011
GOLD CERTIFIED
Roosevelt St
Minor St
S Cleveland St
CommonWealth One Federal Credit Union
Map data ©2014 Google
Terms of Use
Report a map error
Google
© 2014 Google
BUILDING PERFORMANCE
LOCATION
Walkability
71 - Very Walkable
Transit Access
ESRI Zip Code demographics
ACTIVITY TIMELINE
2011
T. C. Williams High School - Energy Star Certified 2011
Energy Star K-12 School
01/01/2011
98
T.C. Williams High School
LEED NC 2.1
06/08/2009
GOLD
T.C. Williams High School
LEED NC 2.1
04/09/2003
REGISTERED
View All Activities »


T.C. Williams High School
Overview
LEED Dashboard
Collections (5)
Resources (3)
All
EA
MR
IEQ
SS
WE
ID
All
Gross Square Feet
435,000
1% of activities are within ±10% (391,500 - 478,500) of this activity in gross square feet
Space Type Use
University
Similar to 5% of activities
Owner Sector
K-12 Education
Similar to 3% of activities
LEED Credit Categories
45/69
Possible Points
Very Good
Top 9% of all LEED NC 2.1 activities
Top 3%
of all activities in VA
Benchmark
Good
Very Good
Excellent
Exceptional
This Project
25
30
35
40
45
50
55
60
# of Projects by Total Points
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

HEALTH

CDC School Health Policies and Practices
USDA People's Gardens
KaBOOM Map of Play
EPA outdoor pollution data

LITERACY

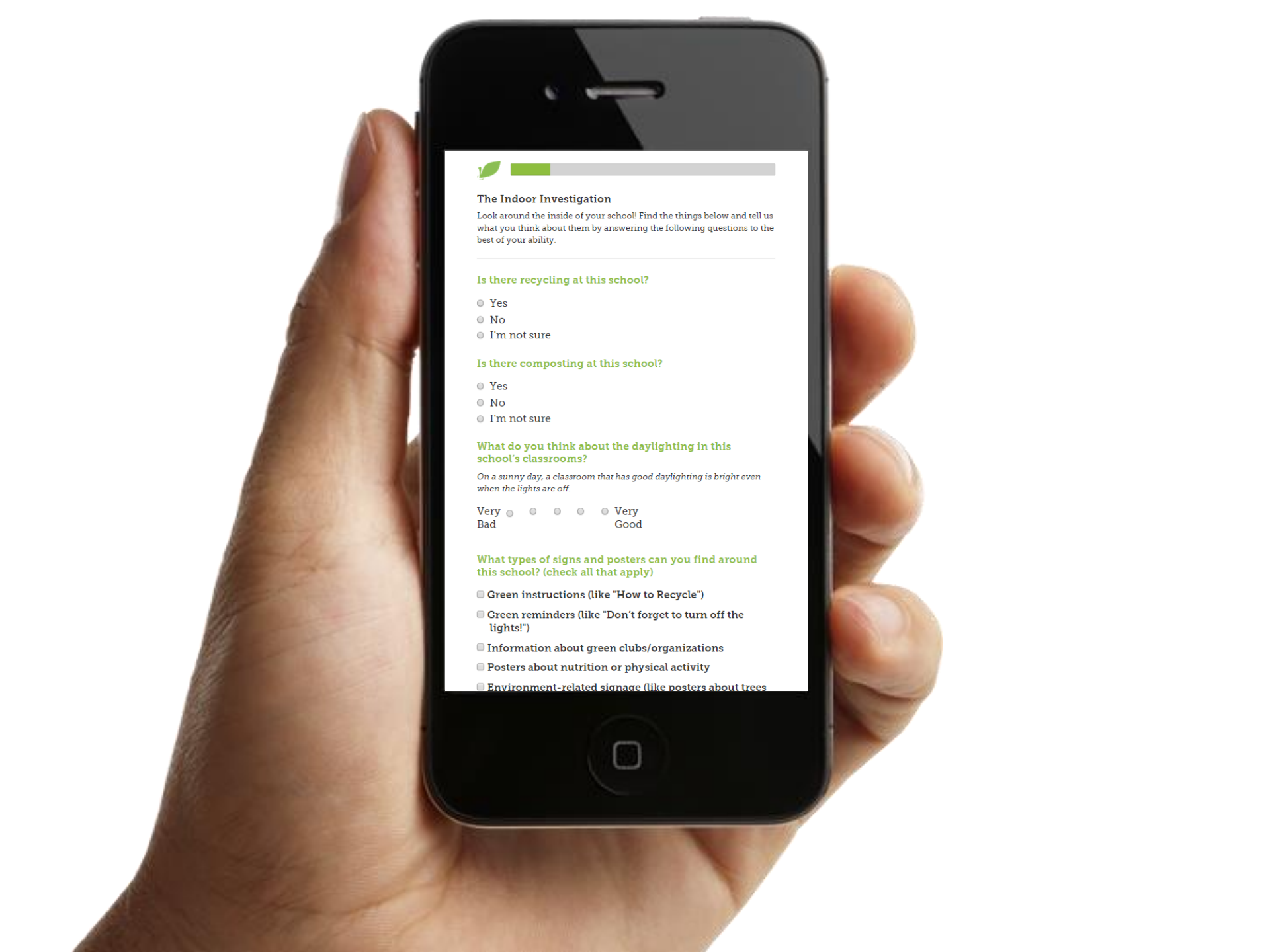
AP Environmental Science offerings
Green Classroom Professional Certificate

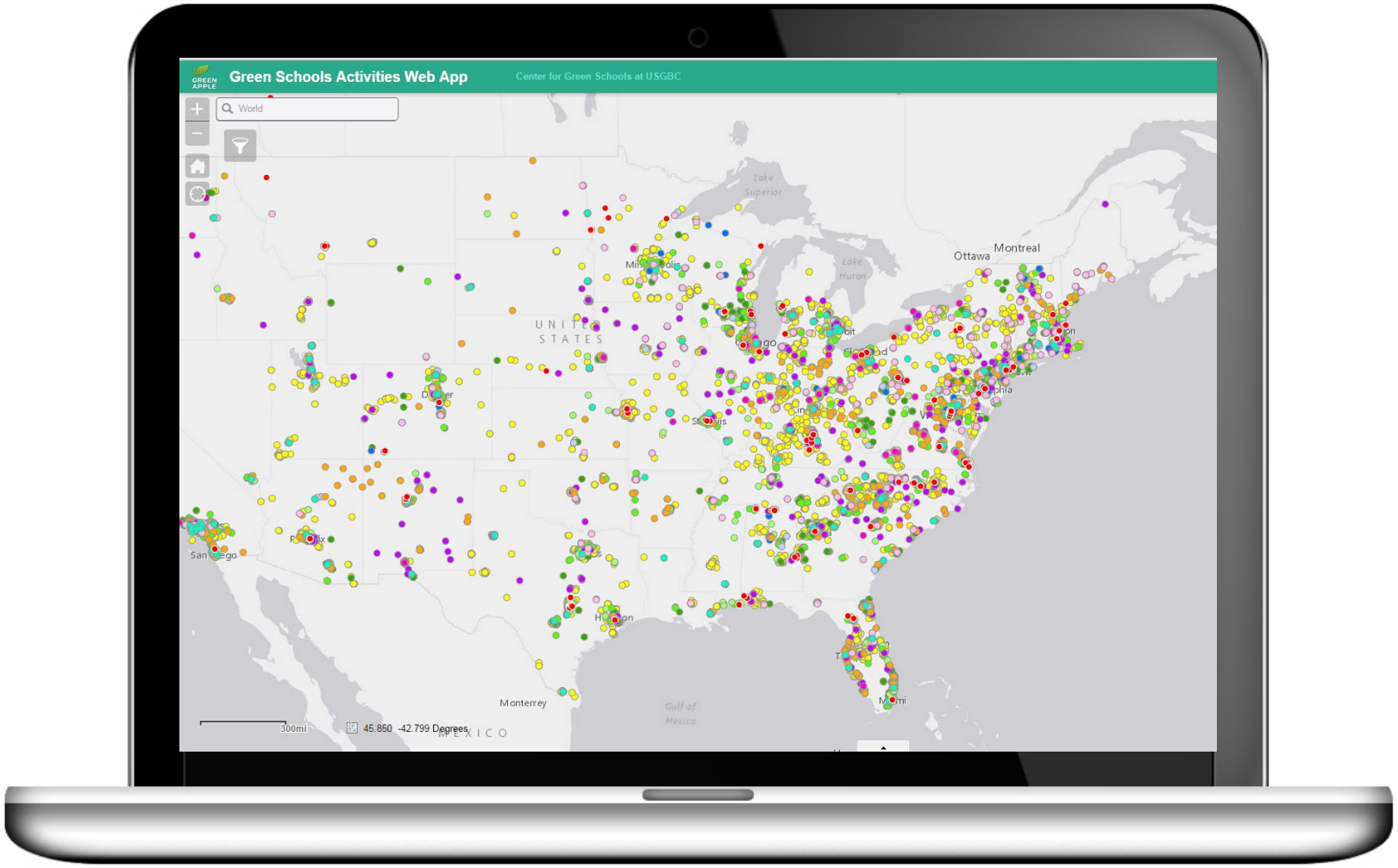
Green Ribbon Schools
NWF Eco-Schools
Green Apple Day of Service projects

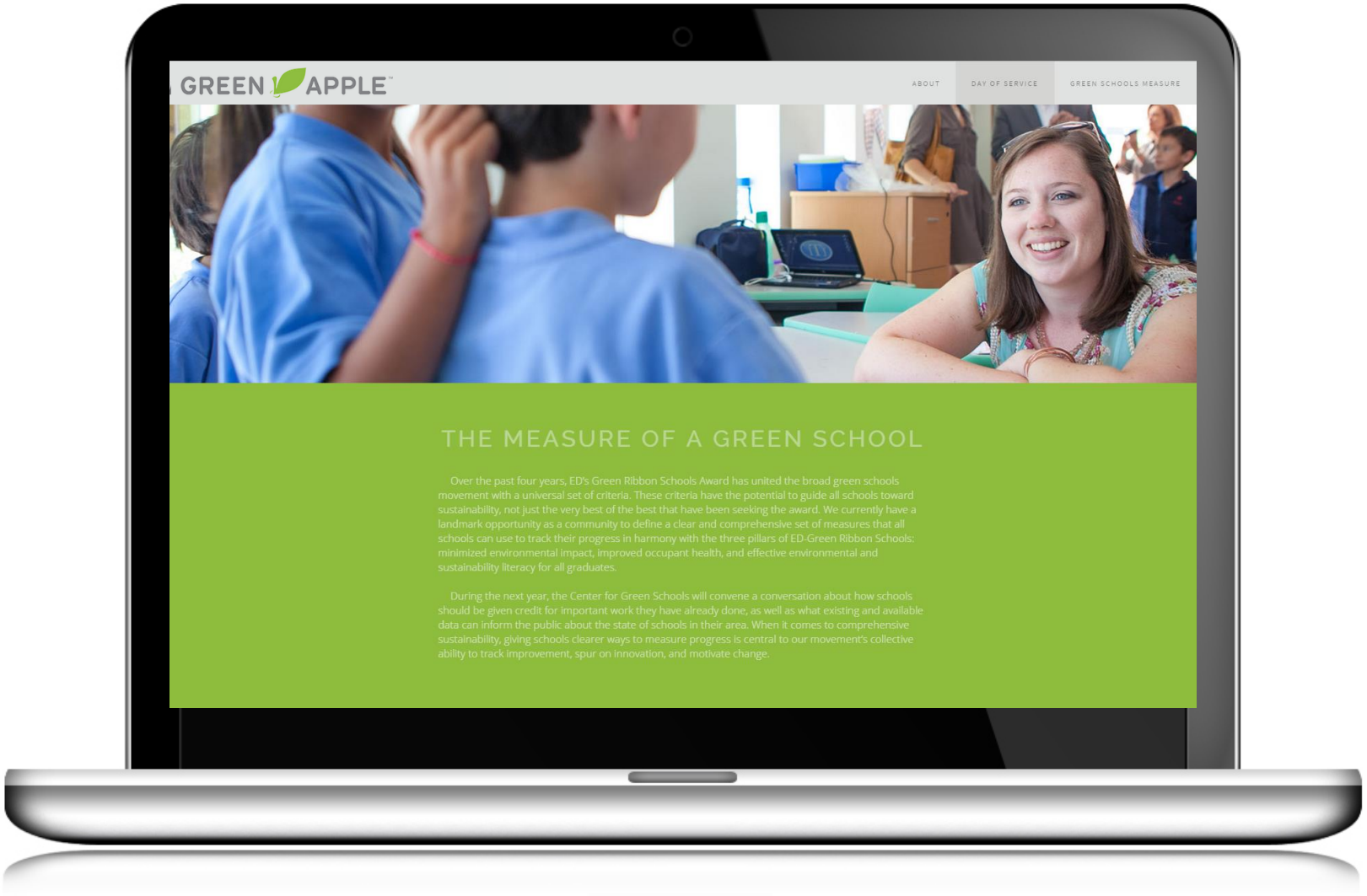
LEED Certification
CHPS Designed and Verfied
USDA Farm to School Census

ENVIRONMENT

ENERGY STAR Certification
DOE Wind for Schools
The Solar Foundation: Solar Schools Census


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
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

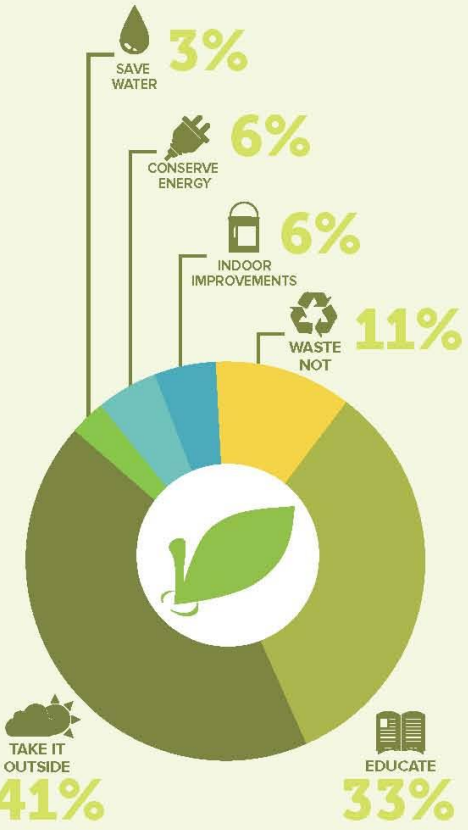

Green Schools Activities Web App
Center for Green Schools at USGBC
World
Ottawa
Montreal
Monterrey
Gulf of Mexico
300mi
45.850 -42.799 Degrees


GREEN APPLE
ABOUT
DAY OF SERVICE
GREEN SCHOOLS MEASURE
THE MEASURE OF A GREEN SCHOOL
Over the past four years, ED's 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 ED-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, giving schools clearer ways to measure progress is central to our movement's collective ability to track improvement, spur on innovation, and motivate change.

GREEN APPLE™ DAY OF SERVICE

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.

www.mygreenapple.org

THE CENTER FOR GREEN SCHOOLS

FOUNDING SPONSOR: United Technologies

THE CENTER FOR GREEN SCHOOLS

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.

COLORADO
It's our nature.™

Energy Performance Contracting

Earning an A in public schools

COLORADO
Energy Office

Jeanna M. Paluzzi
EPC Program Manager

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.

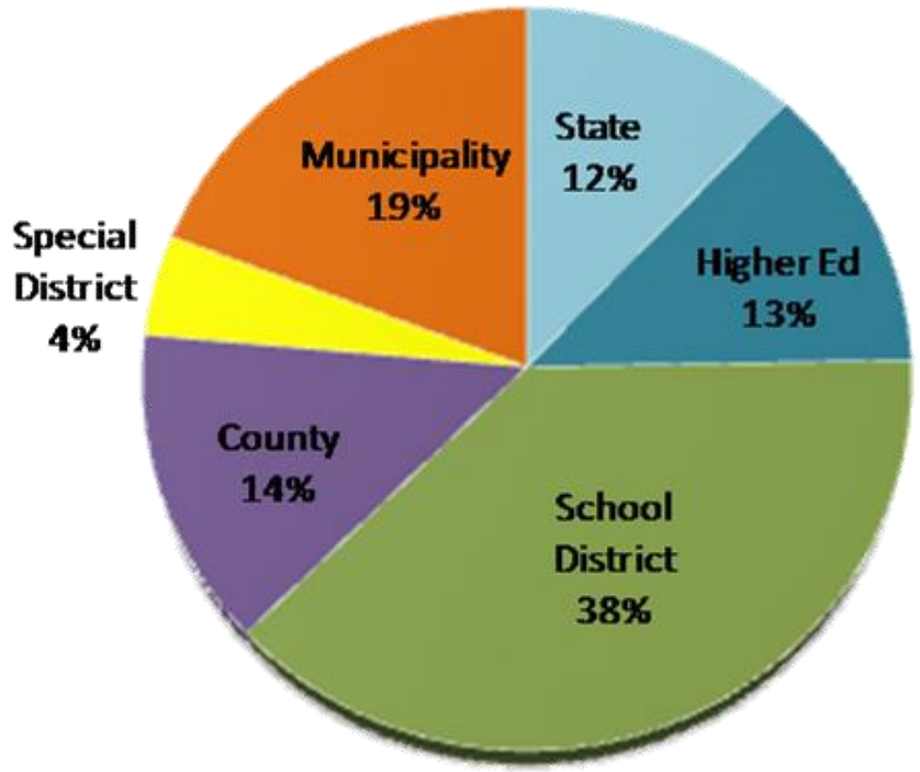
COLORADO
Energy Office

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

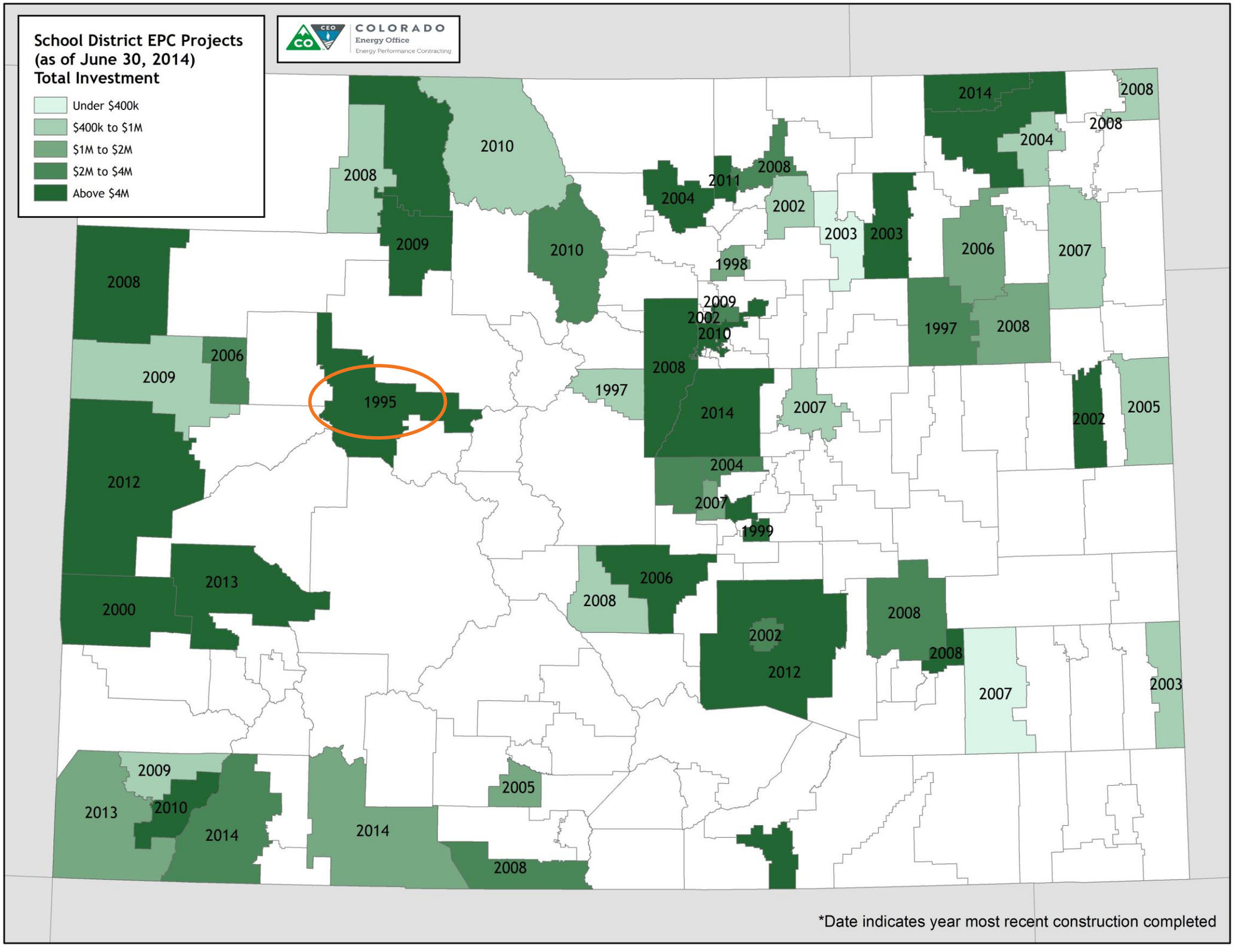
Colorado public sector EPC performance

- 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



Total investments

COLORADO
Energy Office
Energy Performance Contracting



COLORADO
Energy Office
Energy Performance Contracting

Public school districts is a key market

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

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

COLORADO
Energy Office

Jeanna M. Paluzzi, EPC Program Manager
303.866.3464
jeanna.paluzzi@state.co.us

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.

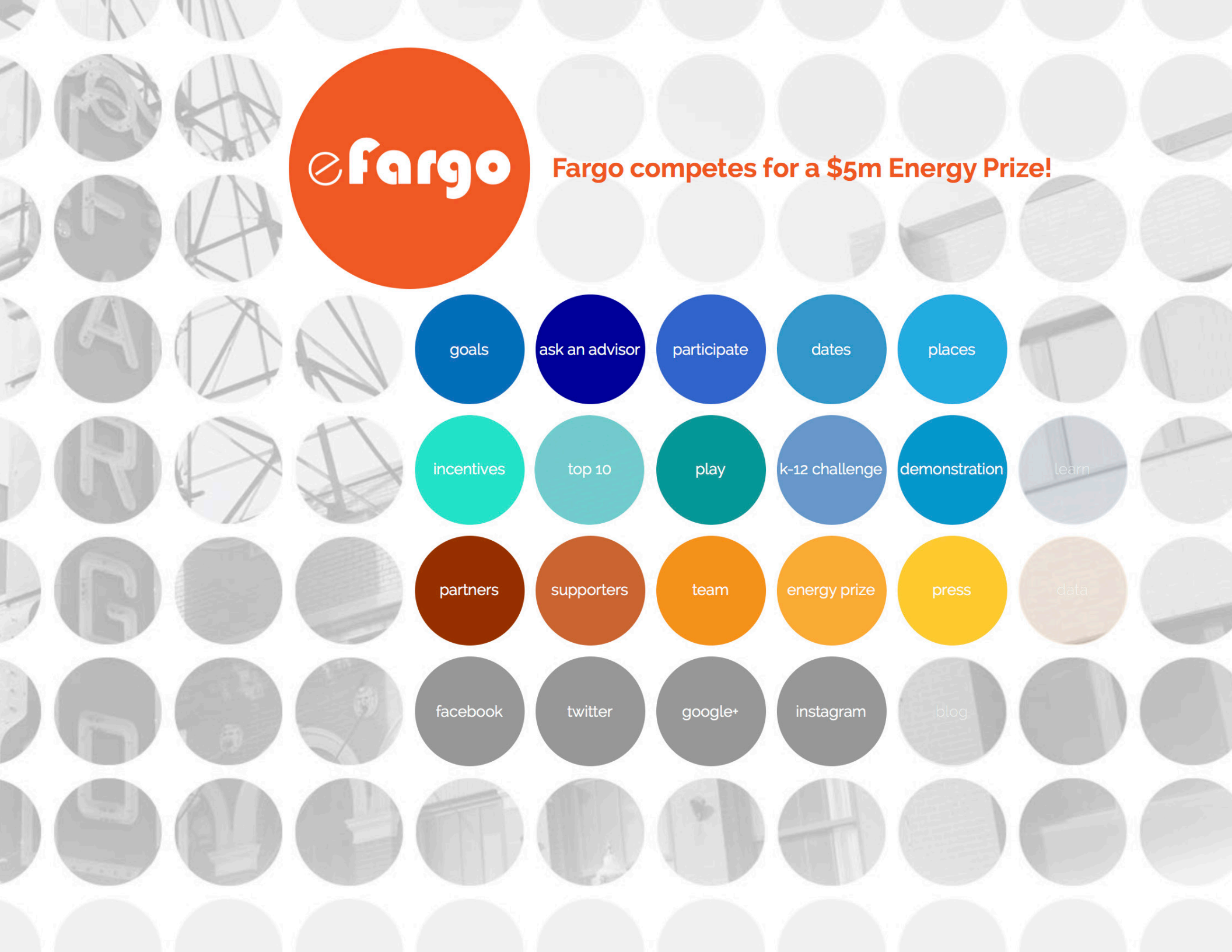

efargo

efargo

"e" is for energy-efficient, enterprising Fargo!

5/5/5 by 2016

P	**PARTNERSHIP**	**NDSU** Expertise Resources Time	**City of Fargo** Seed Funding Networking	**Utilities** Data Solar Parks Dashboard	**Plains Art Museum** Bakken Boom Edu. Programs	**K-12 School** STEM Curriculum
A	**ACTION**	**Weekly Meetings** Team & Community	**Online** Website Social Media Mapping	**Events** Kick-off Alley Fair Hodo, etc.	**Presentations** NDARE City Comm. CERTS, ect.	**Outreach** Partners Supporters Volunteers
C	**COMPETITION**	**K-12 Challenge** Provide a limited and intense activity period to meet the 5% goal.			**Urban Game** Close the energy efficiency gap based on educational.	
E	**EDUCATION**	**Top Ten** Strategies for various building typologies.		**Demo House** Create, expertise, demand and capacity.	**K-12** Educate children so they can educate adults.	


efargo
Fargo competes for a $5m Energy Prize!
goals
ask an advisor
participate
dates
places
incentives
top 10
play
k-12 challenge
demonstration
learn
partners
supporters
team
energy prize
press
data
facebook
twitter
google+
instagram
blog

K-12 SCHOOLS

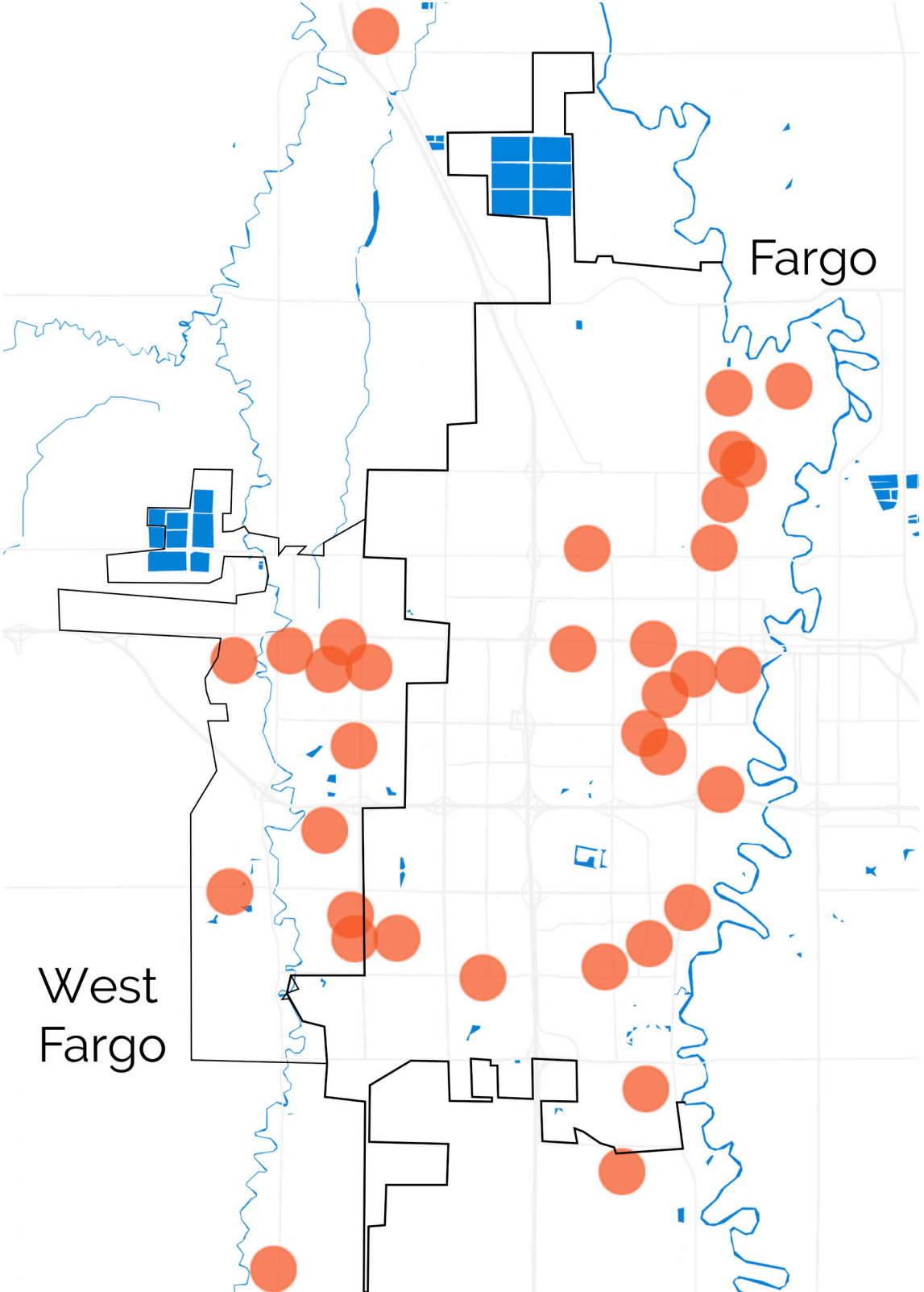
Buildings

Fargo

Bennett Elementary
Centennial Elementary
Clara Barton Hawthorne Elementary
Horace Mann Roosevelt Elementary
Jefferson Elementary
Kennedy Elementary
Lewis & Clark Elementary
Lincoln Elementary
Longfellow Elementary
Madison Elementary
McKinley Elementary
Washington Elementary
Ed Clapp Elementary
Davies High
North High
South High
Woodrow Wilson High
Ben Franklin Middle
Carl Ben Eielson Middle
Discovery Middle
Eagles Education Center Support

West Fargo

Horace Elementary
Aurora Elementary
Eastwood Elementary
Freedom Elementary
Harwood Elementary
Independence Elementary
L.E. Berger Elementary
South Elementary
Westside Elementary
WF High
Sheyenne High
Cheney Middle
Liberty Middle



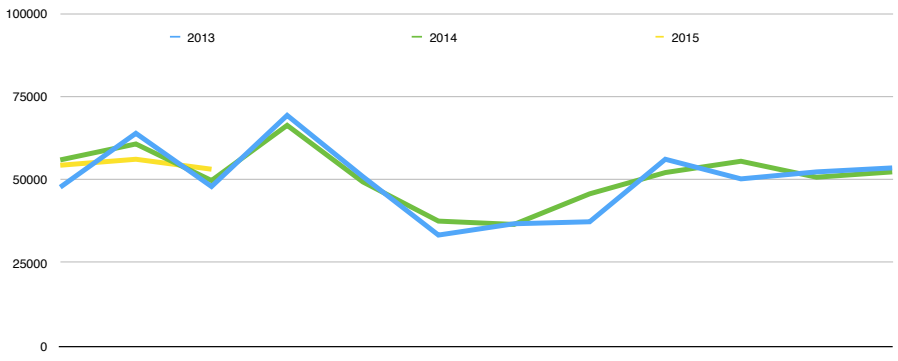
K-12 SCHOOLS

Energy data tracking

Aurora Elementary

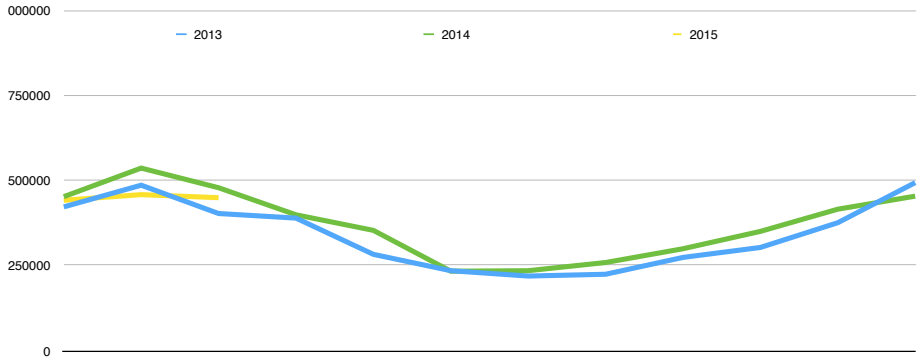
Aurora

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



Davis High School

	2013	2014	2015
1	423000	453000	442500
2	486750	537000	459000
3	403500	479250	450000
4	390000	399750	
5	283500	354000	
6	235500	234000	
7	219750	235500	
8	225000	259500	
9	274500	300000	
10	303750	351000	
11	376500	416250	
12	494250	454500	



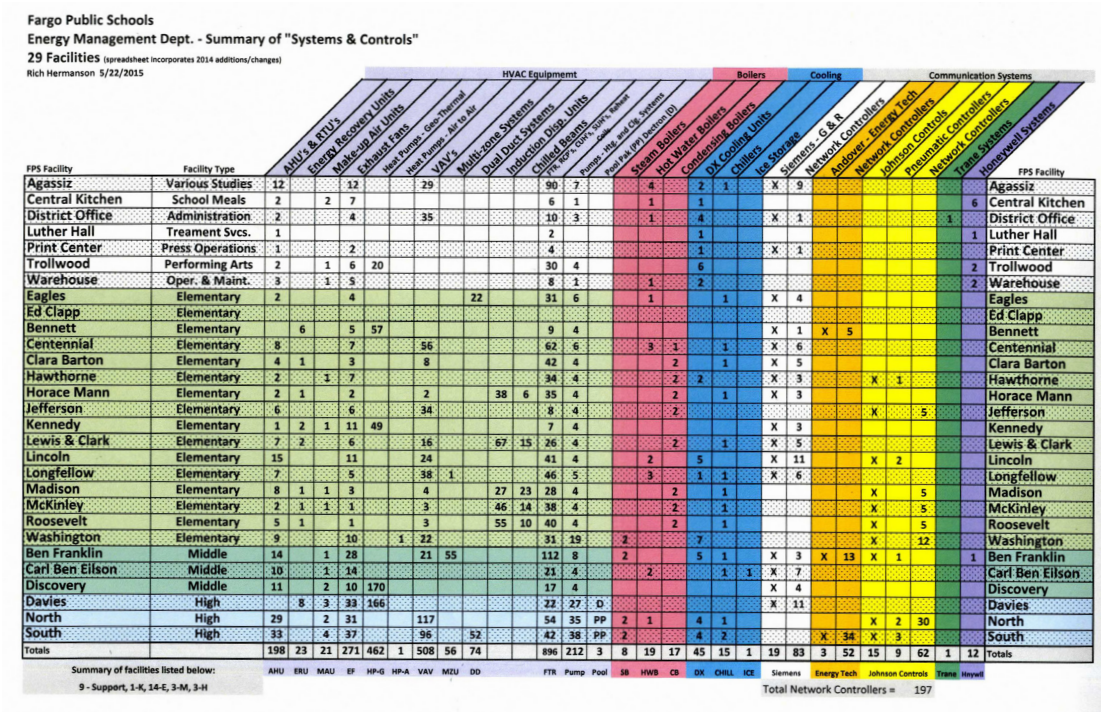
K-12 SCHOOLS

Efficiency through facilities improvements

K-12 SCHOOLS

Energy assessment

10 year maintenance assessment overview



Fargo Public Schools
Energy Management Dept. - Summary of "Systems & Controls"
29 Facilities (spreadsheet incorporates 2014 additions/changes)
Rich Hermanson 5/22/2015

HVAC Equipmemt | Boilers | Cooling | Communication Systems

FPS Facility	Facility Type	AHU's & RTU's	Energy Recovery Units	Make-up Air Units	Exhaust Fans	Heat Pumps - Geo-Thermal	Heat Pumps - Air to Air	VAV's	Multi-zone Systems	Dual Duct Systems	Induction Disp. Units	Chilled Beams	FTR, AQP's, CUH's, Kick's, Exhaust	Pumps, Htg. and Clg. Systems	Pool Pak (PP) Decmon (D)	Steam Boilers	Hot Water Boilers	Condensing Boilers	DX Cooling Units	Chillers	Ice Storage	Siemens - G & R	Network Controllers	Andover - Energy Tech	Network Controllers	Johnson Controls	Pneumatic Controllers	Network Controllers	Trane Systems	Honeywell Systems	FPS Facility
Agassiz	Various Studies	12			12			29				90	7			4			2	1		X	9								Agassiz
Central Kitchen	School Meals	2		2	7							6	1			1			1											6	Central Kitchen
District Office	Administration	2			4			35				10	3			1			4			X	1							1	District Office
Luther Hall	Treament Svcs.	1										2							1											1	Luther Hall
Print Center	Press Operations	1			2							4							1			X	1								Print Center
Trollwood	Performing Arts	2		1	6	20						30	4						6											2	Trollwood
Warehouse	Oper. & Maint.	3		1	5							8	1			1			2											2	Warehouse
Eagles	Elementary	2			4					22		31	6			1				1		X	4								Eagles
Ed Clapp	Elementary																														Ed Clapp
Bennett	Elementary		6		5	57						9	4									X	1	X	5						Bennett
Centennial	Elementary	8			7			56				62	6			3	1		1			X	6								Centennial
Clara Barton	Elementary	4	1		3			8				42	4				2		1			X	5								Clara Barton
Hawthorne	Elementary	2		1	7							34	4				2		2			X	3			X	1				Hawthorne
Horace Mann	Elementary	2	1		2			2			38	6	35	4			2		1			X	3								Horace Mann
Jefferson	Elementary	6			6			34					8	4			2									X		5			Jefferson
Kennedy	Elementary	1	2	1	11	49							7	4								X	3								Kennedy
Lewis & Clark	Elementary	7	2		6			16			67	15	26	4			2		1			X	5								Lewis & Clark
Lincoln	Elementary	15			11			24					41	4			2		5			X	11			X	2				Lincoln
Longfellow	Elementary	7			5			38	1				46	5			3		1	1		X	6								Longfellow
Madison	Elementary	8	1	1	3			4			27	23	28	4				2		1						X		5			Madison
McKinley	Elementary	2	1	1	1			3			46	14	38	4				2		1						X		5			McKinley
Roosevelt	Elementary	5	1		1			3			55	10	40	4				2		1						X		5			Roosevelt
Washington	Elementary	9			10		1	22					31	19		2			7							X		12			Washington
Ben Franklin	Middle	14		1	28			21	55				112	8		2			5	1		X	3	X	13	X	1			1	Ben Franklin
Carl Ben Eilson	Middle	10		1	14								21	4			2			1	1	X	7								Carl Ben Eilson
Discovery	Middle	11		2	10	170							17	4								X	4								Discovery
Davies	High		8	3	33	166							22	27	D							X	11								Davies
North	High	29		2	31			117					54	35	PP	2	1		4	1						X	2	30			North
South	High	33		4	37			96		52			42	38	PP	2			4	2				X	34	X	3				South
Totals		198	23	21	271	462	1	508	56	74			896	212	3	8	19	17	45	15	1	19	83	3	52	15	9	62	1	12	Totals

Summary of facilities listed below:	AHU	ERU	MAU	EF	HP-G	HP-A	VAV	MZU	DD	FTR	Pump	Pool	SB	HWB	CB	DX	CHILL	ICE	Siemens	Energy Tech	Johnson Controls	Trane	Hnywl
9 - Support, 1-K, 14-E, 3-M, 3-H																			Total Network Controllers =	197			

No long term master plan for district maintenance and replacements had be 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 current has about $2.8 million allotted each year.

K-12 SCHOOLS

Energy efficiency efforts

	What	Result
Heat Pumps	Heat pumps in many of the new schools are over 20 years old.	New replacement heat pumps are 47% more efficient.
Air Conditioning	Older schools had ineffective systems resulting in poor air quality in classrooms.	Efficient induction air systems installed to bring in more fresh air for classrooms.
Building Automation	Old pneumatic or electronic controls ineffective at achieving optimal performance.	New digital controls installed resulting in a reduction of wasted energy.
LED lighting	Lighting demands are approximately 50% of electricity use in district facilities each year.	Brand new schools have all LED lighting and exterior exterior lights are also LED.
Roofing Upgrades	Roofing replacements identified as immediate concerns during the start of the next 10 years.	Replacement work includes adding insulation to meet modern energy codes.
Pool System Upgrades	Ventilation in pool systems identified as being ineffective at handling pool demands.	Energy savings resulting from first upgrade initiated second pool upgrades.
Experimental Classroom	Classroom features like lighting are tested in a single room before wider application.	For example new dimmable LED lighting with in-class controls are being tested.

Energy efficiency through education

K-12 CHALLENGE

Similar competitions

	What	How	Results
Campus Conservation Nationals	The world's largest electricity and water reduction competition for universities and colleges.	Competition for 3 weeks measured again baseline readings. Between Buildings or other schools.	Behavioral change solutions.
San Diego School Energy Conservation Competition	Energy conservation competition to save money and reduce impact on the environment.	Schools compete with each other for 3 weeks to see who can save the most energy.	Turn everything off on weekends. Thermostats to 78 degrees, blackouts.
Igniting Creative Energy Challenge	Contest for students to share their ideas about energy and the environment.	Students share their ideas about how to help conserve energy and promote stewardship.	Any means; artwork, science projects, essays, music, websites.
Battle of the buildings 2014	Annual competition related to buildings and their impact on the environment.	Minnesota schools challenged to reduce energy use by the greatest percentage.	Winning school reduced 29.1% over 6 week through simple means.
The Spirit to Saving	Energy conservation competition to catalyze savings and provide experiences for students.	Schools create "Green Teams" and "Energy Monsters" to help understand energy issues.	Awareness, understanding, accountability.
Global Green Cup Energy Challenge	Challenge to raise awareness about climate change and resource conservation.	Schools are invited to join the challenge to save energy and bring positive change.	In 2013 300 schools saved over 1.5 gigawatt in 4 weeks.

K-12 CHALLENGE

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

K-12 CHALLENGE

When & How

Schedule

Fall 2015	Preparation Orientation, Presentations, Workshops, Q&A
March 1st-4th 2016	Challenge Kick-off Week Super Hero Debut, Take the Pledge, Create a plan, Film Festival
March 7th - April 15th 2016	Challenge Competition Period Host events and activities, Super Hero Designs, Post pictures and storied, energy usage collected
April 22 Earth Day 2016	Challenge Celebrations Each schools can host their own, All schools will be recognized nominations for outstanding efforts

action	your initial cost	% of energy use impacted
turn off the lights	$	%
HVAC settings	$	%
special use rooms	$	%
natural daylight	$	%
sleep mode on	$	%
shading devices	$	%
avoid blockage	$	%
close openings	$	%
off for the holidays	$	%
discard extras	$	%

action	your initial cost	% of energy use impacted
lighting retrofits	$	%
motion sensors	$	%
bulb dimmers	$	%
replace filters	$	%
aerators	$	%
south facade	$	%
seal leaks	$	%
deter winds	$	%
power strips	$	%
xeriscaping	$	%

K-12 CHALLENGE

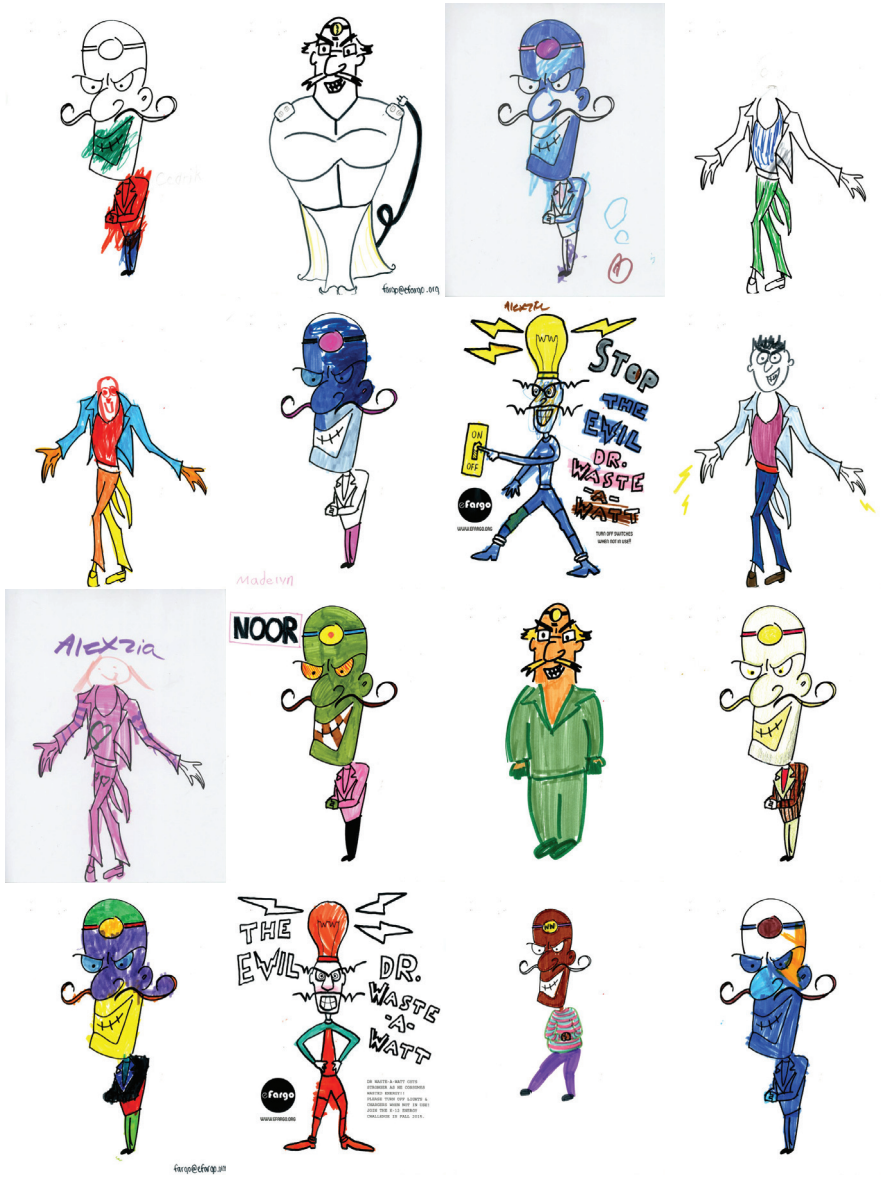
DR. WASTE-A-WATT

PLOT

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
Washington D.C. / May 17–29, 2015

Nora Wang, Ph.D.
Pacific Northwest National Laboratory

What is …?

ENERGY STAR Portfolio Manager

AIA 2030

Building Performance Database

COMCheck

LEED

Building Energy Data Exchange Specification

Many Other Tools…

BuildingSync

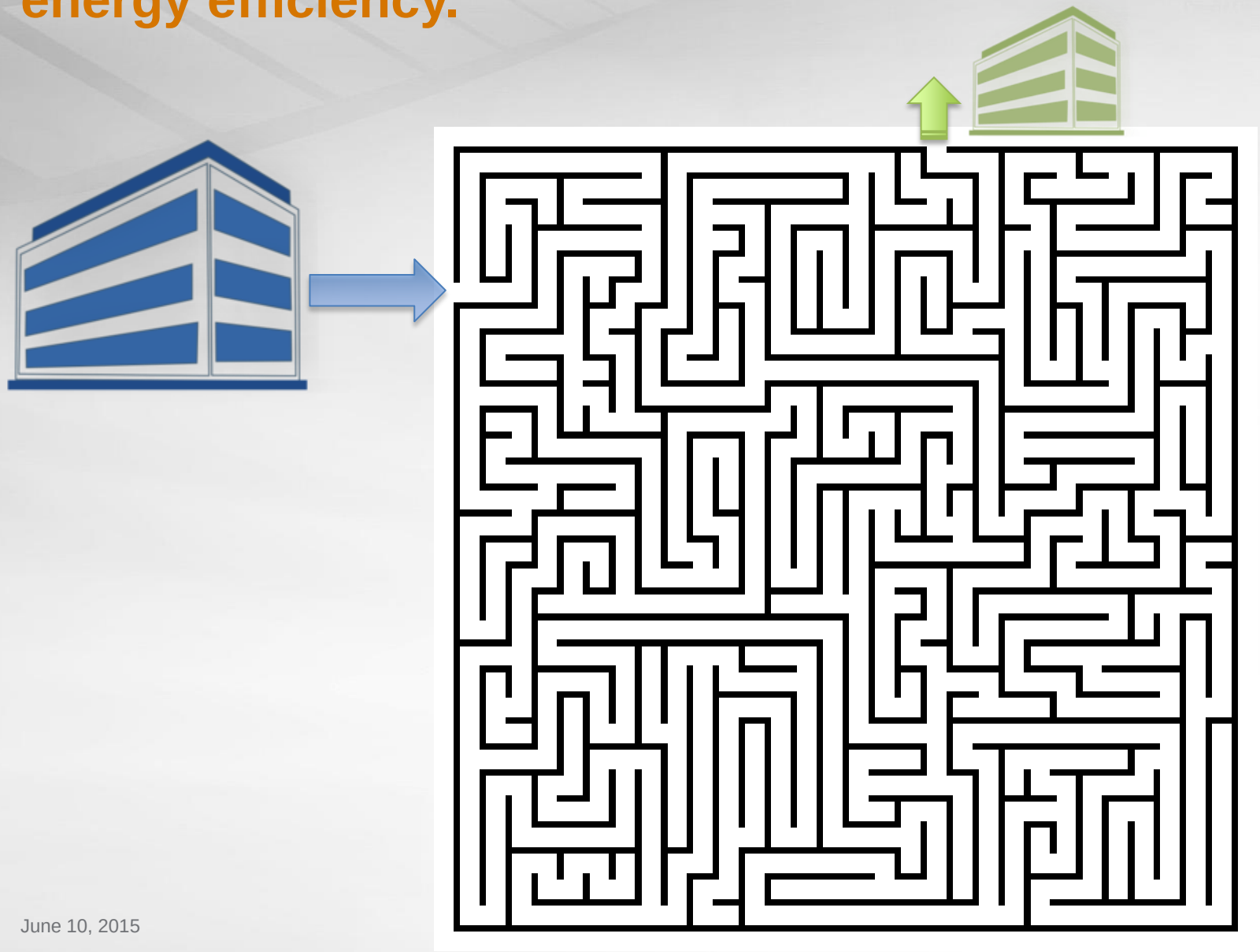
Standard Energy Efficiency Data Platform

EnergyPlus OpenStudio

ASHRAE Energy Audit

Energy Asset Score

We are all trying to show you the paths to energy efficiency.



What is …?

ENERGY STA
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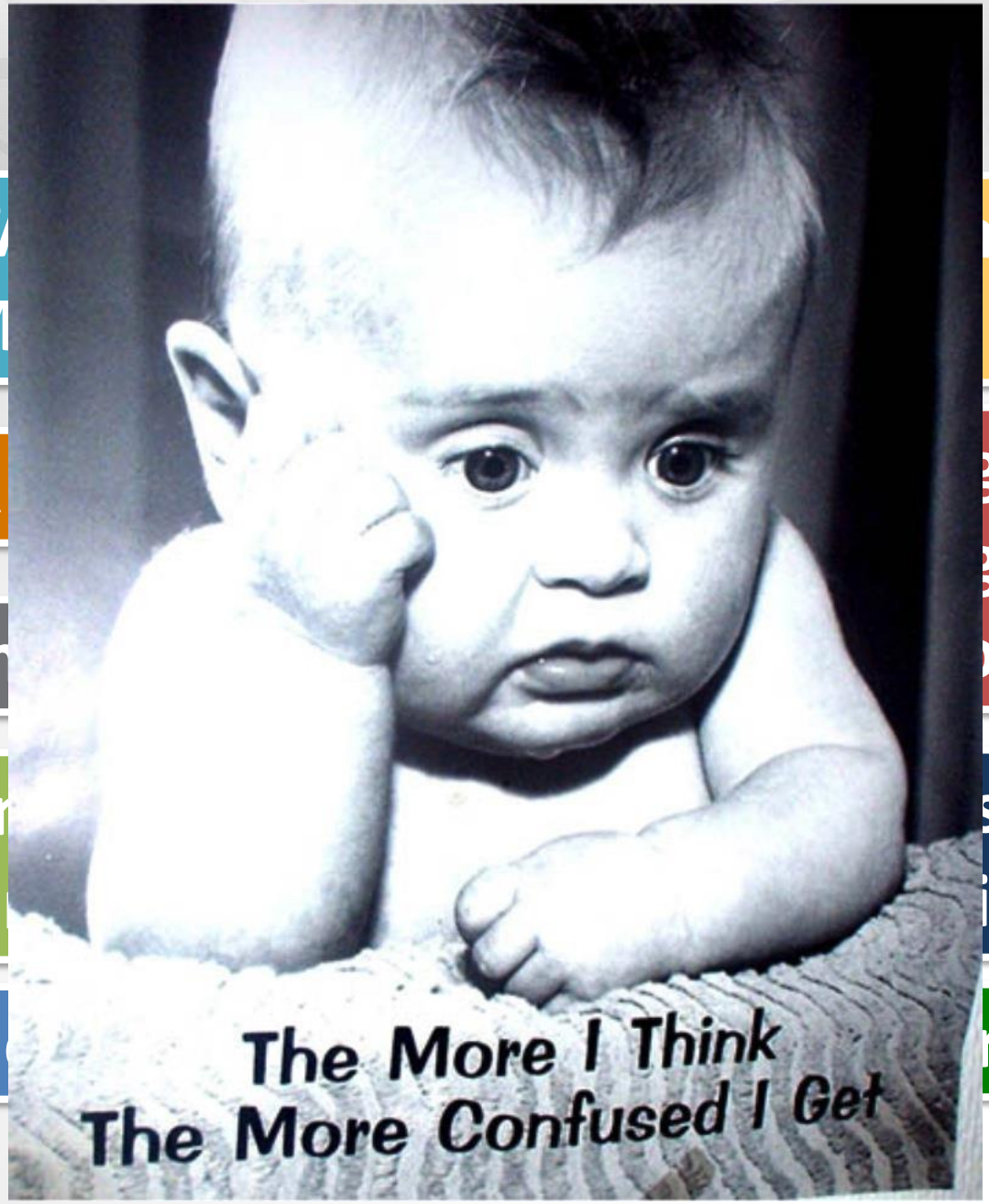
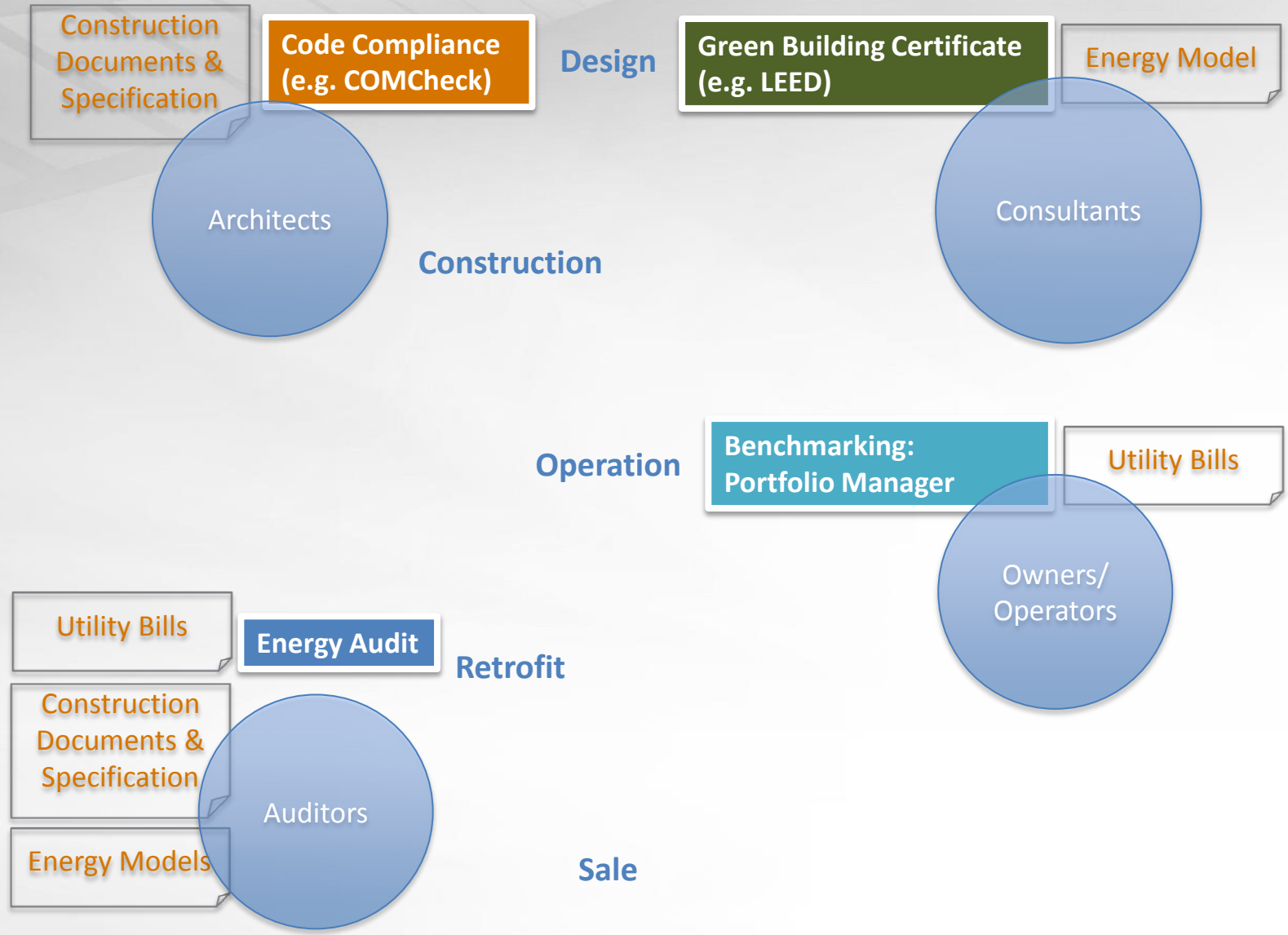
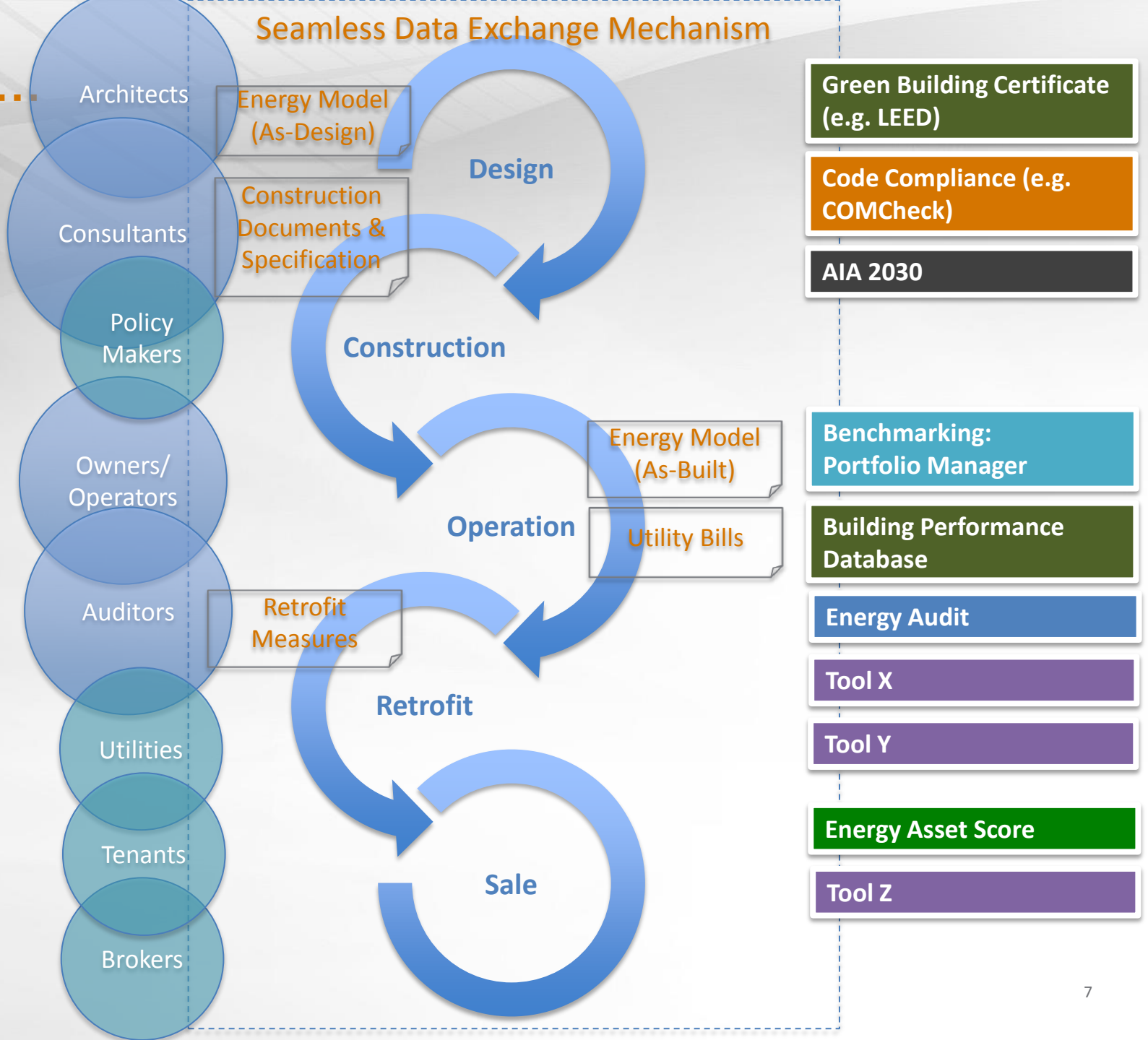
Many Other Tools…



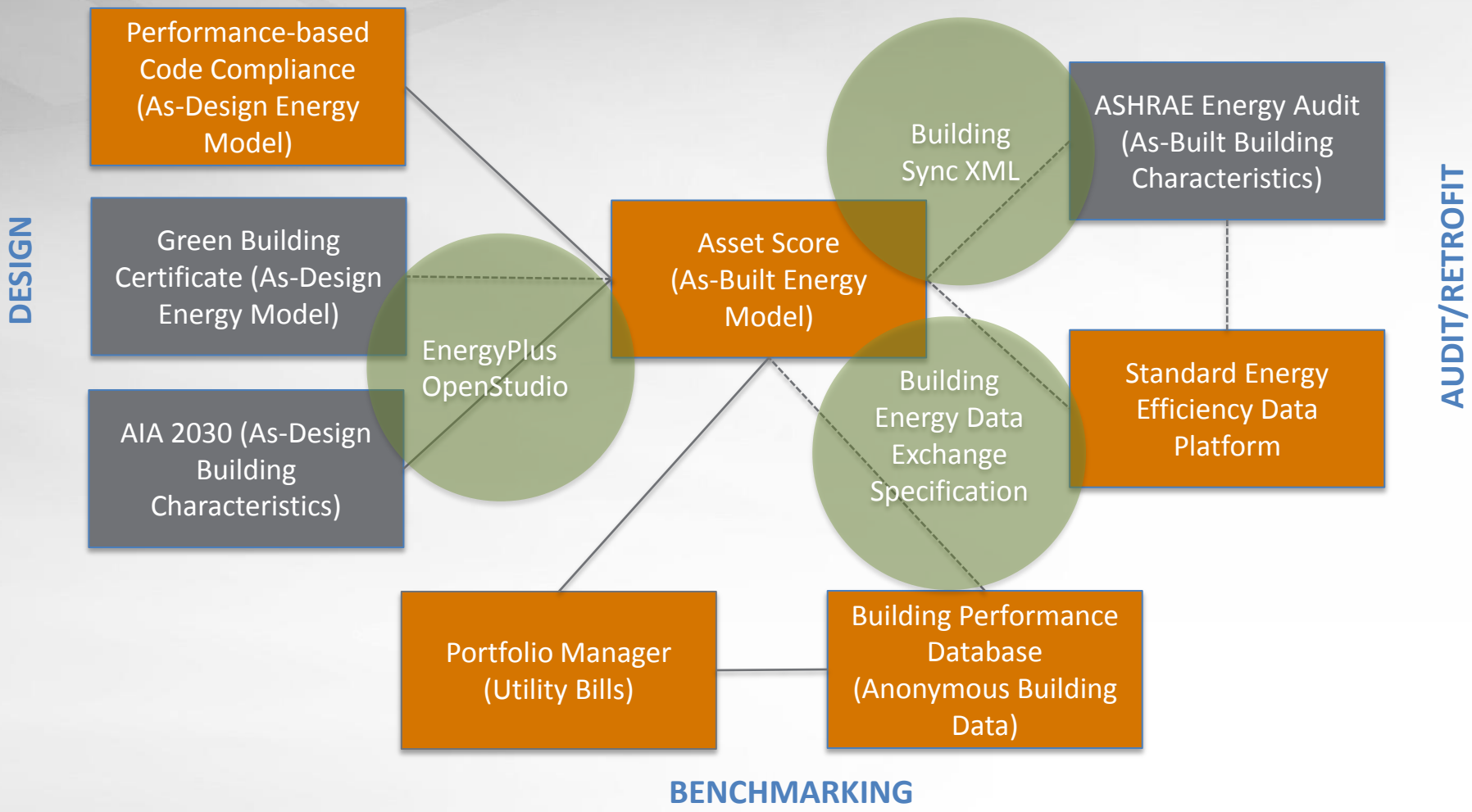
Currently…


Construction Documents & Specification
Code Compliance (e.g. COMCheck)
Design
Green Building Certificate (e.g. LEED)
Energy Model
Architects
Construction
Consultants
Operation
Benchmarking: Portfolio Manager
Utility Bills
Owners/ Operators
Utility Bills
Energy Audit
Retrofit
Construction Documents & Specification
Auditors
Energy Models
Sale

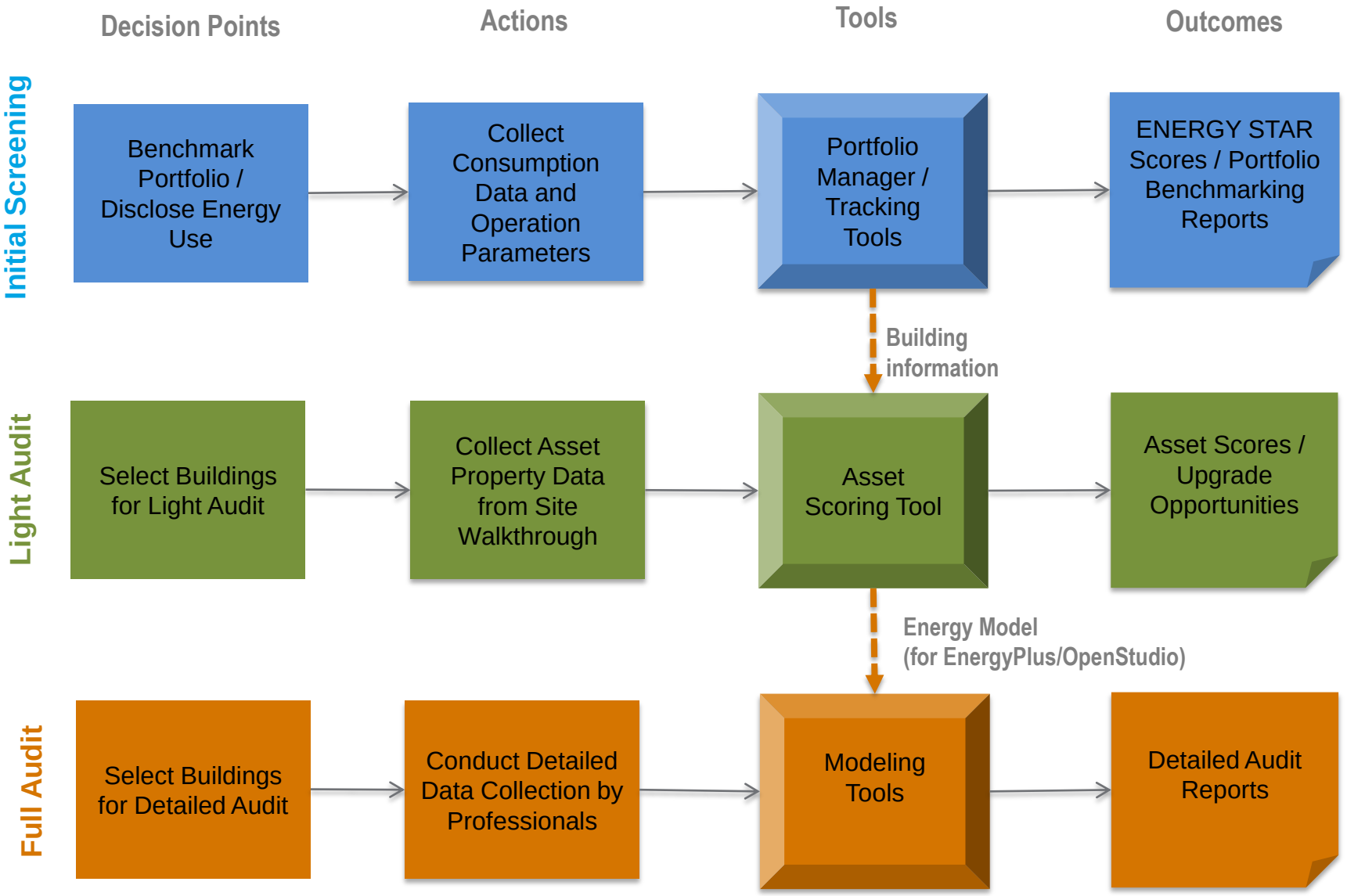
Ideally…


Seamless Data Exchange Mechanism
Architects
Consultants
Policy Makers
Owners/ Operators
Auditors
Utilities
Tenants
Brokers
Energy Model (As-Design)
Construction Documents & Specification
Design
Construction
Energy Model (As-Built)
Utility Bills
Operation
Retrofit Measures
Retrofit
Sale
Green Building Certificate (e.g. LEED)
Code Compliance (e.g. COMCheck)
AIA 2030
Benchmarking: Portfolio Manager
Building Performance Database
Energy Audit
Tool X
Tool Y
Energy Asset Score
Tool Z

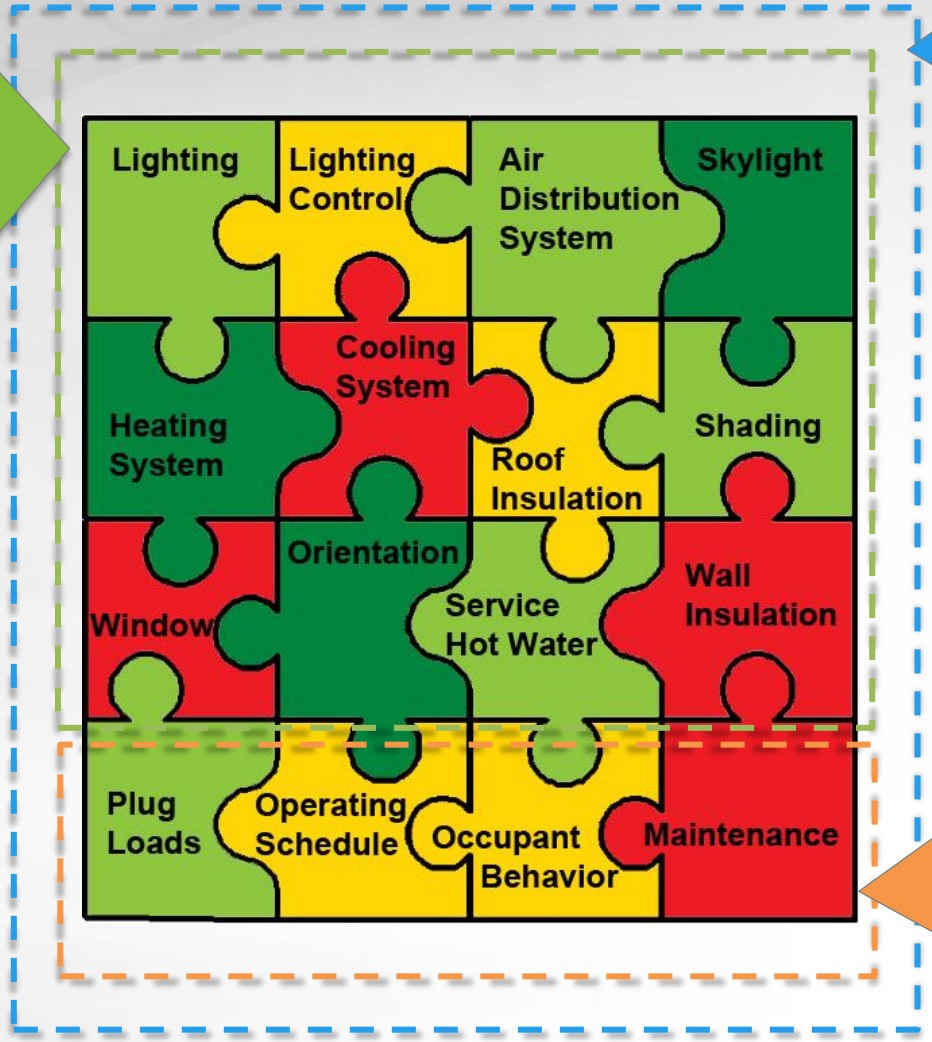
How Does the Eco-System Work?



Screening and Reporting



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.



ENERGY STAR benchmarks the overall building performance against peers.

Operational Assessment evaluates the effectiveness of building operation and maintenance.

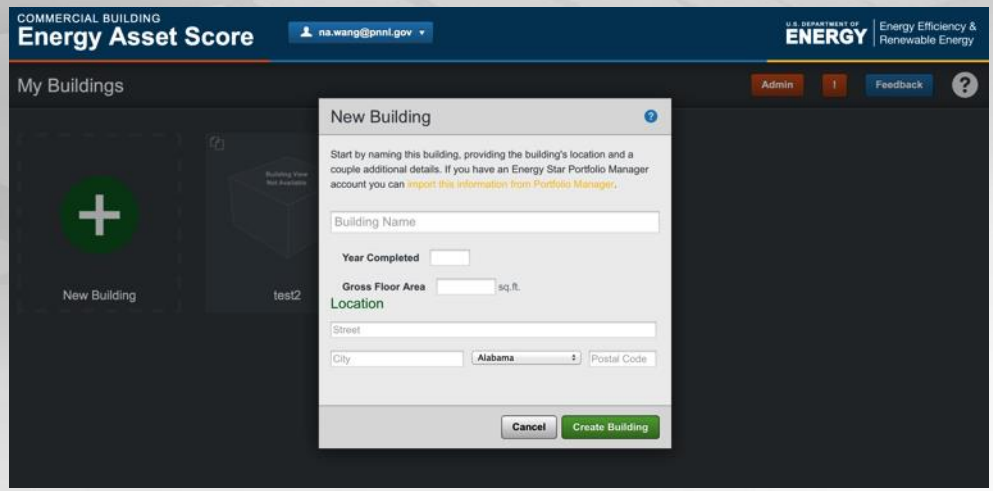
How It Works

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

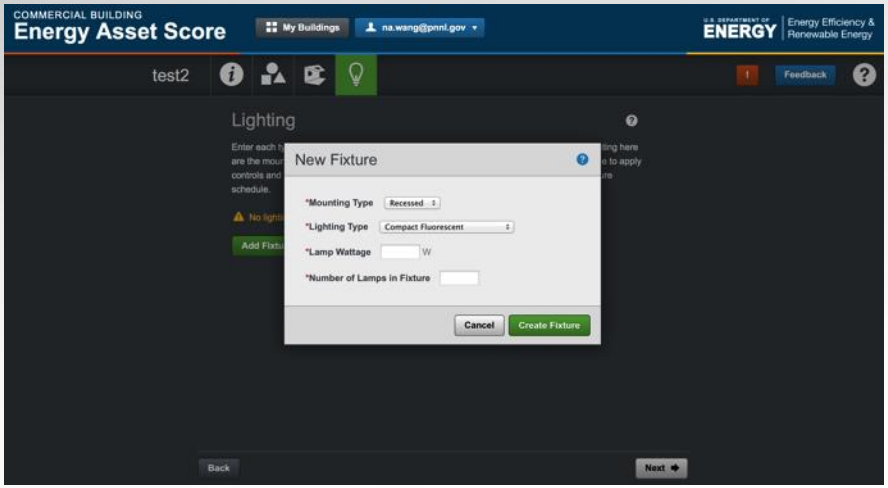
- The simulation normalizes for building operations, occupancy and tenant behavior
- Users (owner, operator, service, provider, etc.) enter building information through an web interface
  - General information: # of floors, footprint dimension, orientation, use type
  - Envelope components: Roof, exterior 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

Asset Scoring Tool

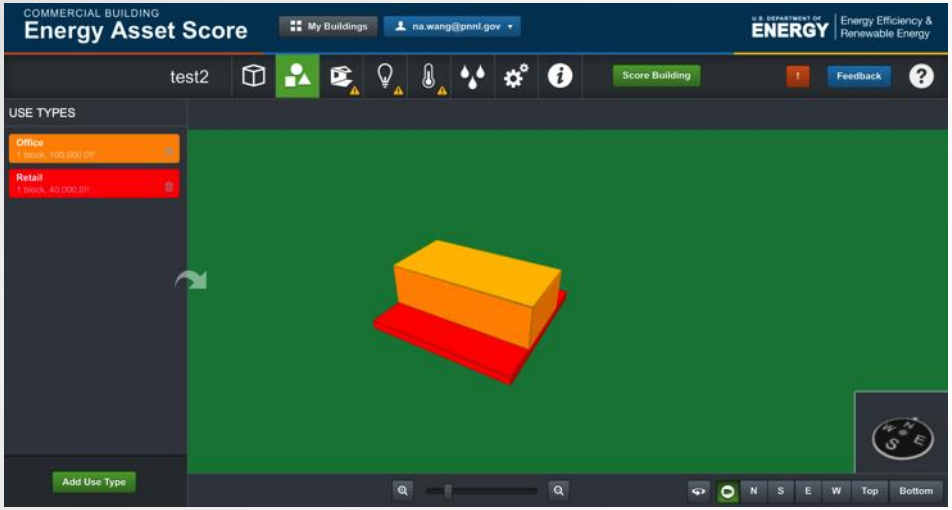
Total registered users (as of today): 421



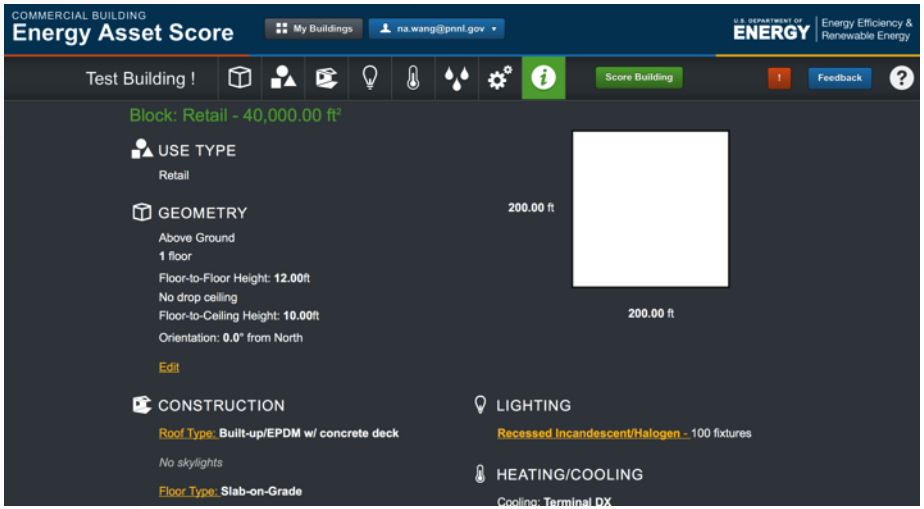
1. Create a new building and enter basic building information



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)

Asset Score Report

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


COMMERCIAL BUILDING
ENERGY ASSET SCORE
OVERALL BUILDING SCORE
1

BUILDING INFORMATION
Example Building
2000 A St.,
Chicago, IL 60601

Building Type: Office
Gross Floor Area: 100,000 ft²
Year Built: 2005

Score Date: 02/21/2013
Building ID #: XXXXX

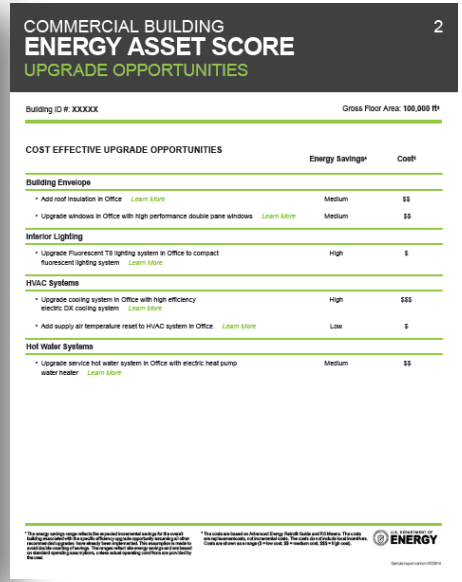
Current Score 6
Potential Score 7.5
Estimated Savings* 33%
1 Uses MORE Energy
10 Uses LESS Energy
High-Efficiency

Assumed Occupancy and Operating Conditions
Number of Assumed Occupants 500
Hours of Operation 49 hrs/wk
Cooling Set Point 75°F
Heating Set Point 70°F
Misc. Energy Loads 0.75 W/ft²

Estimated Source Energy Use¹ (kBtu/ft²)
Current Building 159
Upgraded Building 107

Energy Use Intensity by Fuel Type
Site Energy Use (kBtu/ft²)
Source Energy Use (kBtu/ft²)
Electricity Gas Fuel Oil
District Heating District Cooling

ENERGY

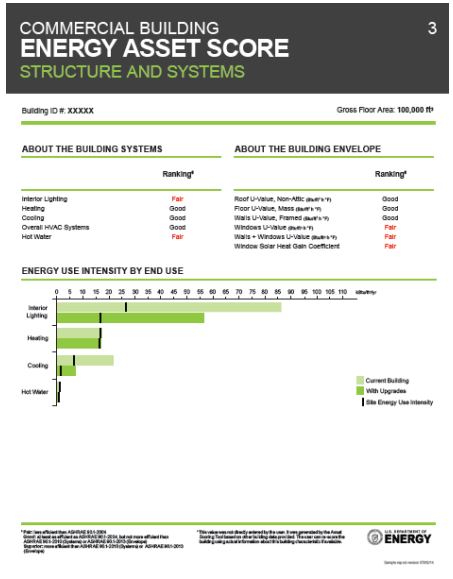

COMMERCIAL BUILDING
ENERGY ASSET SCORE
UPGRADE OPPORTUNITIES
2

Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings²	Cost³
Building Envelope		
• Add roof insulation in Office *Learn More*	Medium	$$
• Upgrade windows in Office with high performance double pane windows *Learn More*	Medium	$$
Interior Lighting		
• Upgrade Fluorescent T8 lighting system in Office to compact fluorescent lighting system *Learn More*	High	$
HVAC Systems		
• Upgrade cooling system in Office with high efficiency electric DX cooling system *Learn More*	High	$$$
• Add supply air temperature reset to HVAC system in Office *Learn More*	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater *Learn More*	Medium	$$

ENERGY


COMMERCIAL BUILDING
ENERGY ASSET SCORE
STRUCTURE AND SYSTEMS
3

Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

ABOUT THE BUILDING SYSTEMS

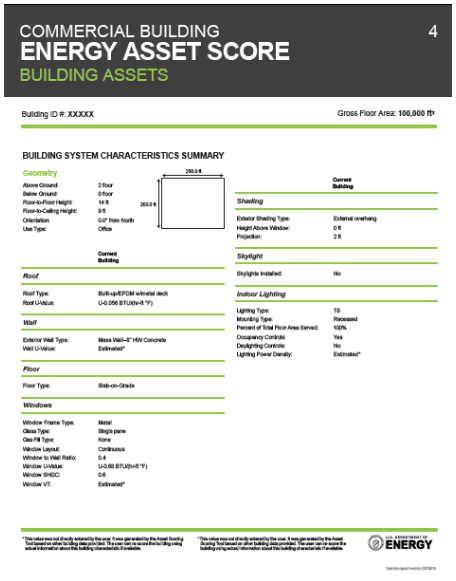
	Ranking⁴
Interior Lighting	Fair
Heating	Good
Cooling	Good
Overall HVAC Systems	Good
Hot Water	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking⁴
Roof U-Value, Non-Attic (Btu/ft²·h·°F)	Good
Floor U-Value, Mass (Btu/ft²·h·°F)	Good
Walls U-Value, Framed (Btu/ft²·h·°F)	Good
Windows U-Value (Btu/ft²·h·°F)	Fair
Walls + Windows U-Value (Btu/ft²·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

ENERGY USE INTENSITY BY END USE
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 kBtu/ft²/yr
Interior Lighting
Heating
Cooling
Hot Water
Current Building
With Upgrades
Site Energy Use Intensity

ENERGY


COMMERCIAL BUILDING
ENERGY ASSET SCORE
BUILDING ASSETS
4

Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

BUILDING SYSTEM CHARACTERISTICS SUMMARY

Geometry
Above Ground: 2 floor
Below Ground: 0 floor
Floor-to-Floor Height: 14 ft
Floor-to-Ceiling Height: 9 ft
Orientation: 0.0° from North
Use Type: Office
200.0 ft
200.0 ft

Current Building

Roof
Roof Type: Built-up/EPDM w/metal deck
Roof U-Value: U-0.056 BTU/(h·ft²·°F)

Wall
Exterior Wall Type: Mass Wall–4" HW Concrete
Wall U-Value: Estimated*

Floor
Floor Type: Slab-on-Grade

Windows
Window Frame Type: Metal
Glass Type: Single pane
Gas Fill Type: None
Window Layout: Continuous
Window to Wall Ratio: 0.4
Window U-Value: U-0.65 BTU/(h·ft²·°F)
Window SHGC: 0.6
Window VT: Estimated*

Shading
Exterior Shading Type: External overhang
Height Above Window: 0 ft
Projection: 2 ft

Skylight
Skylights Installed: No

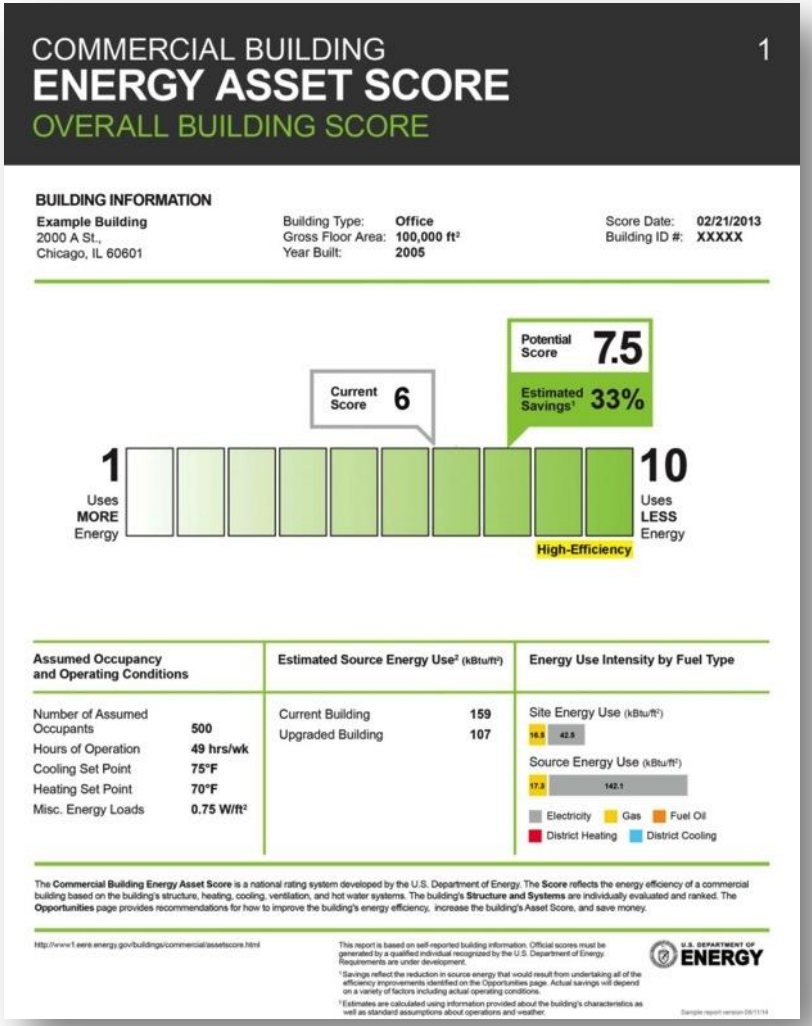
Indoor Lighting
Lighting Type: T8
Mounting Type: Recessed
Percent of Total Floor Area Served: 100%
Occupancy Controls: Yes
Daylighting Controls: No
Lighting Power Density: Estimated*

ENERGY

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



COMMERCIAL BUILDING
ENERGY ASSET SCORE
OVERALL BUILDING SCORE

1

BUILDING INFORMATION

Example Building
2000 A St.,
Chicago, IL 60601

Building Type: **Office**
Gross Floor Area: **100,000 ft²**
Year Built: **2005**

Score Date: **02/21/2013**
Building ID #: **XXXXX**

Potential Score **7.5**
Estimated Savings[1] **33%**
Current Score **6**

1 Uses **MORE** Energy — 10 Uses **LESS** Energy

High-Efficiency

Assumed Occupancy and Operating Conditions	
Number of Assumed Occupants	500
Hours of Operation	49 hrs/wk
Cooling Set Point	75°F
Heating Set Point	70°F
Misc. Energy Loads	0.75 W/ft²

Estimated Source Energy Use[2] (kBtu/ft²)

Current Building	159
Upgraded Building	107

Energy Use Intensity by Fuel Type

Site Energy Use (kBtu/ft²): 16.5, 42.5
Source Energy Use (kBtu/ft²): 17.3, 142.1
Electricity, Gas, Fuel Oil, District Heating, District Cooling

The **Commercial Building Energy Asset Score** is a national rating system developed by the U.S. Department of Energy. The **Score** reflects the energy efficiency of a commercial building based on the building's structure, heating, cooling, ventilation, and hot water systems. The building's **Structure and Systems** are individually evaluated and ranked. The **Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

http://www1.eere.energy.gov/buildings/commercial/assetscore.html

This report is based on self-reported building information. Official scores must be generated by a qualified individual recognized by the U.S. Department of Energy. Requirements are under development.

[1] Savings reflect the reduction in source energy that would result from undertaking all of the efficiency improvements identified on the Opportunities page. Actual savings will depend on a variety of factors including actual operating conditions.

[2] Estimates are calculated using information provided about the building's characteristics as well as standard assumptions about operations and weather.

U.S. DEPARTMENT OF ENERGY

Asset Score Report

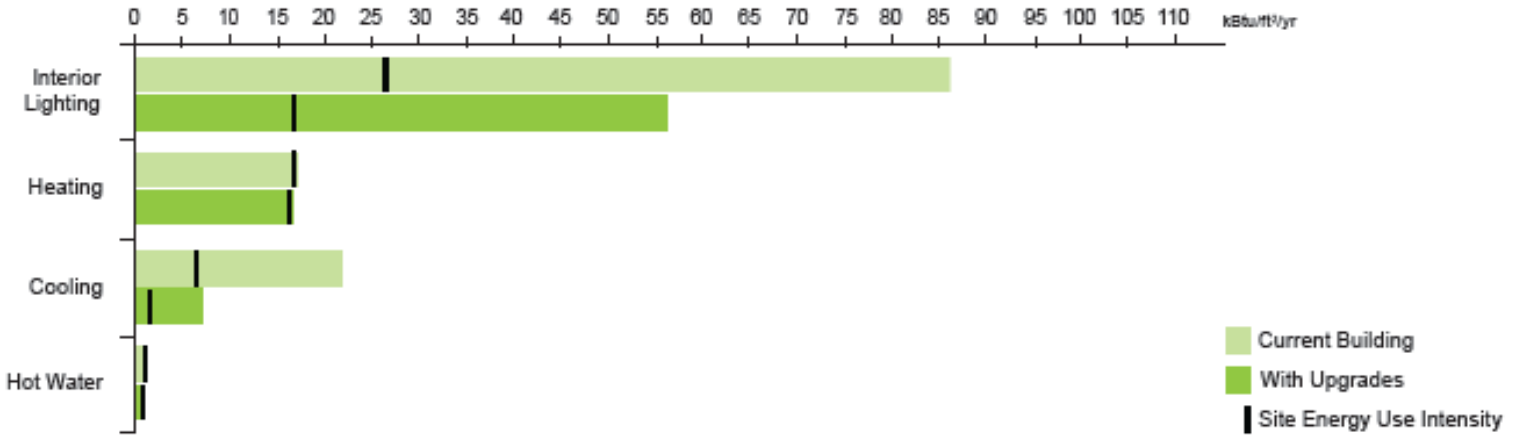
ABOUT THE BUILDING SYSTEMS

	Ranking[8]
Interior Lighting	Fair
Heating	Good
Cooling	Good
Overall HVAC Systems	Good
Hot Water	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking[8]
Roof U-Value, Non-Attic (Btu/ft² h °F)	Good
Floor U-Value, Mass (Btu/ft² h °F)	Good
Walls U-Value, Framed (Btu/ft² h °F)	Good
Windows U-Value (Btu/ft² h °F)	Fair
Walls + Windows U-Value (Btu/ft² h °F)	Fair
Window Solar Heat Gain Coefficient	Fair

ENERGY USE INTENSITY BY END USE

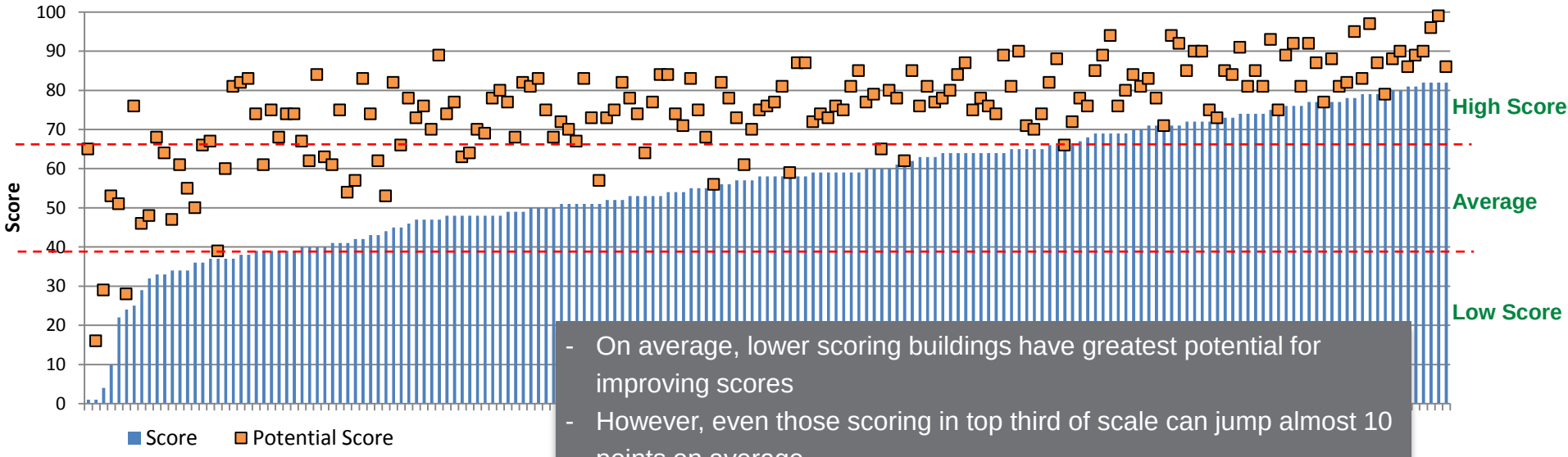


Asset Score Report

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings[4]	Cost[5]
Building Envelope		
• Add roof insulation in Office *Learn More*	Medium	$$
• Upgrade windows in Office with high performance double pane windows *Learn More*	Medium	$$
Interior Lighting		
• Upgrade Fluorescent T8 lighting system in Office to compact fluorescent lighting system *Learn More*	High	$
HVAC Systems		
• Upgrade cooling system in Office with high efficiency electric DX cooling system *Learn More*	High	$$$
• Add supply air temperature reset to HVAC system in Office *Learn More*	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater *Learn More*	Medium	$$

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

Building Rank by Score	Average Score	Average Potential	Average Change in Score	% Change
Low Score (bottom 1/3)	31.7	60.5	28.8	91%
Average Score (mid 1/3)	56.2	75.5	19.2	34%
High Score (top 1/3)	79.1	88.0	8.9	11%

- **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

Building owners:

- Communicate the underlying energy efficiency of your buildings to tenants and investors
- Demonstrate national sustainability leadership and corporate social responsibility
- Ensure the market recognizes your energy efficiency investments
- Guide energy-related investments and reduce operating expenses in a building or across a building portfolio

Real estate managers:

- Strengthen your sustainability service offerings for building ownership clients
- Provide added value to clients by understanding their asset portfolios and opportunities for energy efficiency improvement
- Support building owners in communicating their sustainability leadership to the marketplace
- Demonstrate national sustainability leadership and corporate social responsibility

Architects

- Guide energy-efficient design considerations with a no-cost, standardized tool
- Strengthen your sustainability-related platform for clients
- Demonstrate national sustainability leadership and corporate social responsibility
- Collect energy-related metrics across projects and report metrics to national programs

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

Nora Wang

- 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.