

characteristics, costs, and design features of

net zero ready schools

are you

net zero
ready?

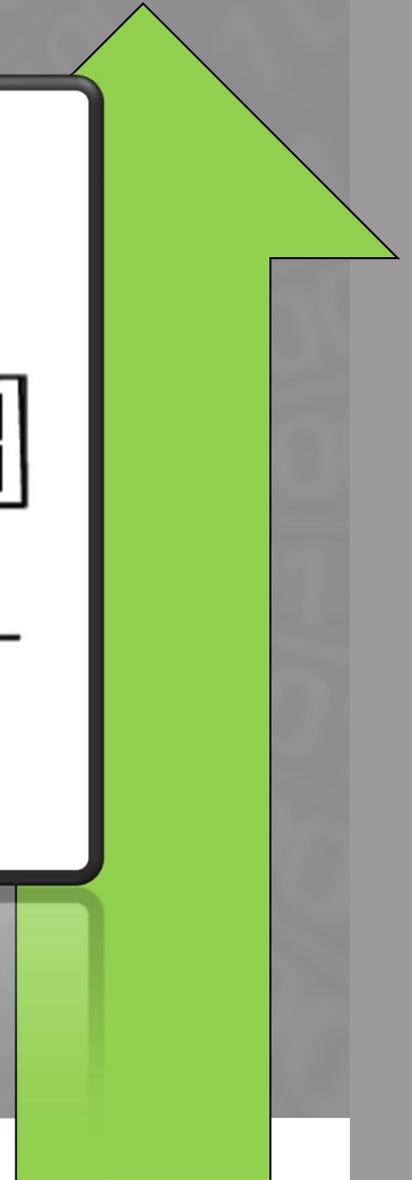
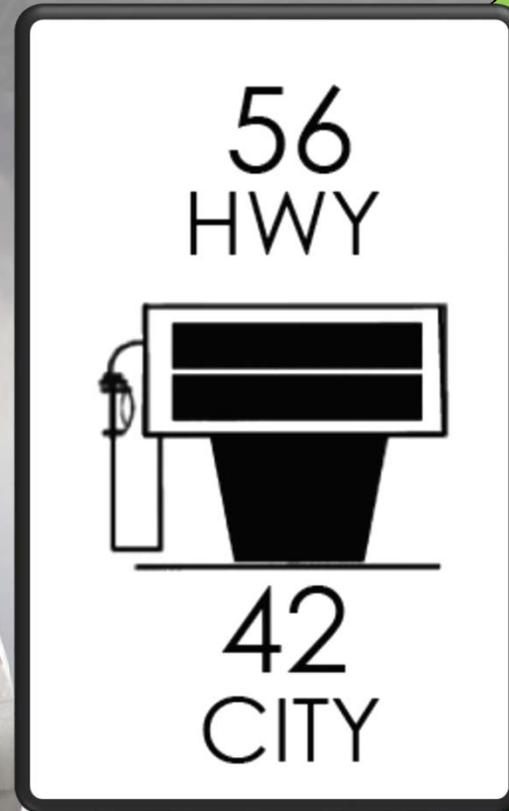


Sherman-Carter-Barnhart PSC

kenny stanfield, AIA, CID, LEED AP
principal

An automobile's energy performance is measured in miles per gallon (MPG) – the **HIGHER** the BETTER, or more EFFICIENT.

CarShow.com

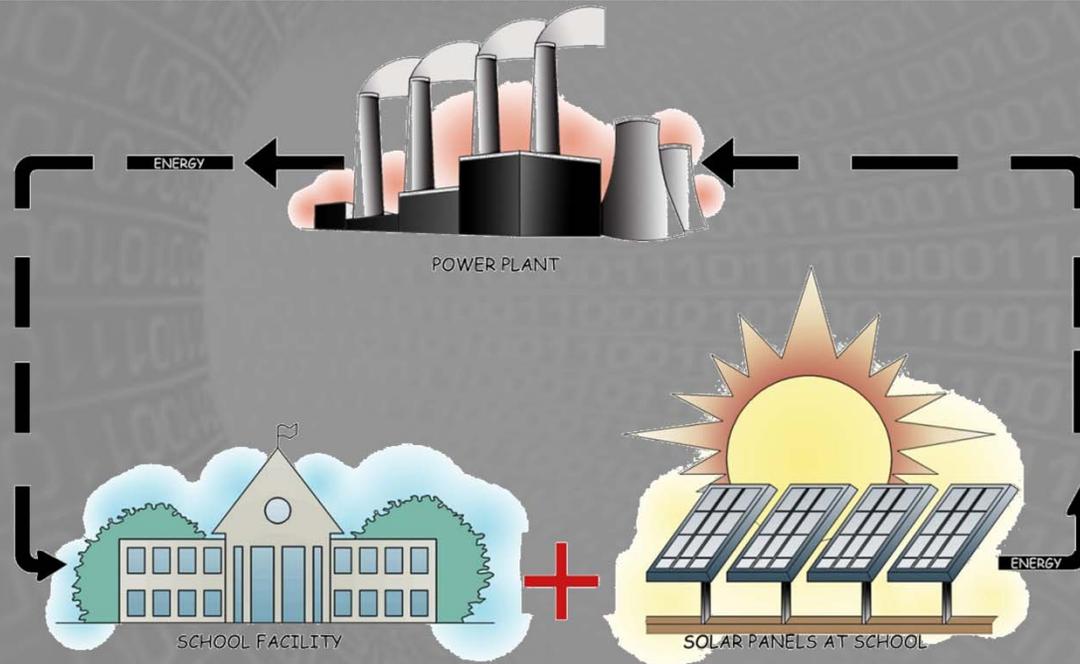


A building's energy performance is measured in 1,000 British Thermal Units (kBtu)- the **LOWER** the BETTER, or more EFFICIENT.



Net Zero Energy

A Net Zero Energy Building Has A Net Site Energy Consumption Of Zero Over A Typical Year Of Operation (25 kBtu Max)



A Net Zero Ready/Achievable Building Consumes 25 kBtu's Or Less Of Energy And Has The Ability To Add Renewables (PV Or Wind) In The Future.

The Question:

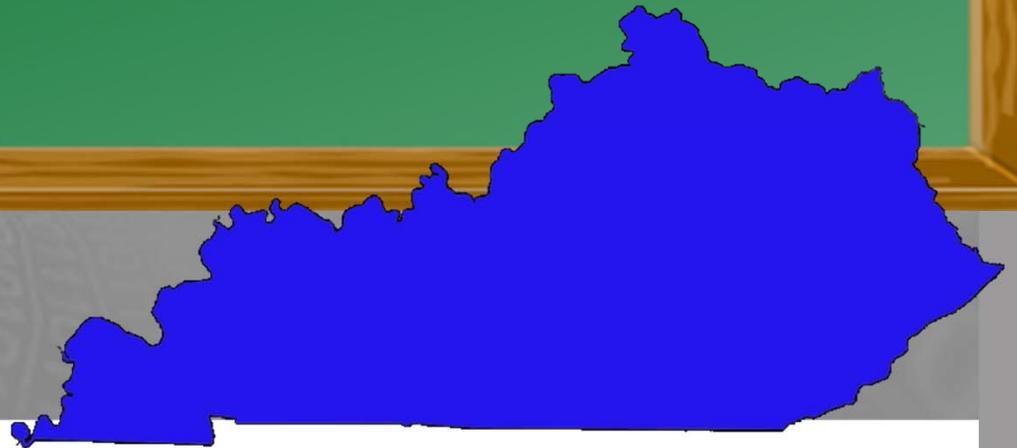
What is the
SIGNIFICANCE of

25 kBtus



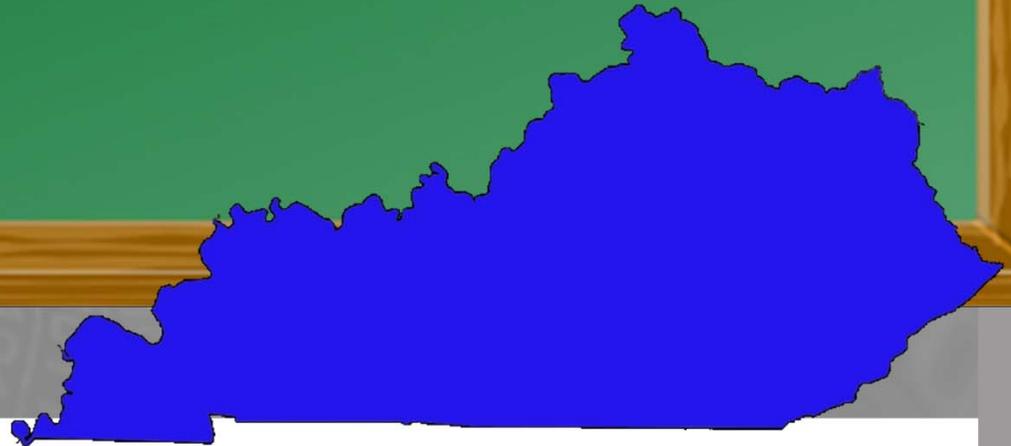
Energy Costs

In Kentucky,
the average cost of
1 kBtu of energy = \$2,500.00



Energy Costs

In Kentucky, the average school consumes **73 kBtus** of energy per square foot per year



The Average Annual Cost Of Energy For A Typical
72,000 SF Elementary School In Kentucky ...

\$182,500.00



**A Net Zero Ready School Operating at 25 kBtus/Yr Can Save
Your School District ...**

\$120,000.00

or more per year



How “Green” is Green?

Kentucky Average School
73 kBtus annually

73



ENERGY STAR
25% Improvement
54 kBtus annually

54



LEED® Certified Buildings
44 kBtus annually

51

How “Green” is Green?

AEDG 50% Reduction
(From ASHRAE 90.1)
36.5 kBtus annually

36.5

NET ZERO
READY

25 kBtus annually

25

Ezra B. Sparrow Early
Childhood Center

25 kBtus

Flaherty
Primary

21.7 kBtus

Richardsville
Elementary

18.2 kBtus

Bristow
Elementary

19.5 kBtus

Jody Richards
Elementary

16.6 kBtus



the
solutions



Site Design & Building Orientation

- north/south building orientation provides active daylighting in academic spaces
- filter storm water run-off
- native, drought-resistant landscaping reduces irrigation
- permeable paving reduces storm water run-off
- reduce or eliminate detention basins
- outdoor educational opportunities for students and faculty

Sherman Carter Barnhart PSC

KENTUCKY HIGHWAY 263
24' P.W.T. - 50' R/W

C/L HIGHWAY 263
24' P.W.T. - 50' R/W



High Performance Thermal Envelope

- 🌿 **Compact Building Volume
Reduces Areas Of Exposed
Exterior Surfaces**
- 🌿 **Super Insulated Exterior
Wall & Roof Systems**
- 🌿 **Reduce External Air
Infiltration**
- 🌿 **Reduce Or Eliminate Large
Mechanical Platforms**



Geothermal HVAC System

- Dual Compressor Or Two-Speed Heat Pump Units
- Part Load Efficiency
- Distributive Pumping
- One Heat Pump Per Two Classrooms

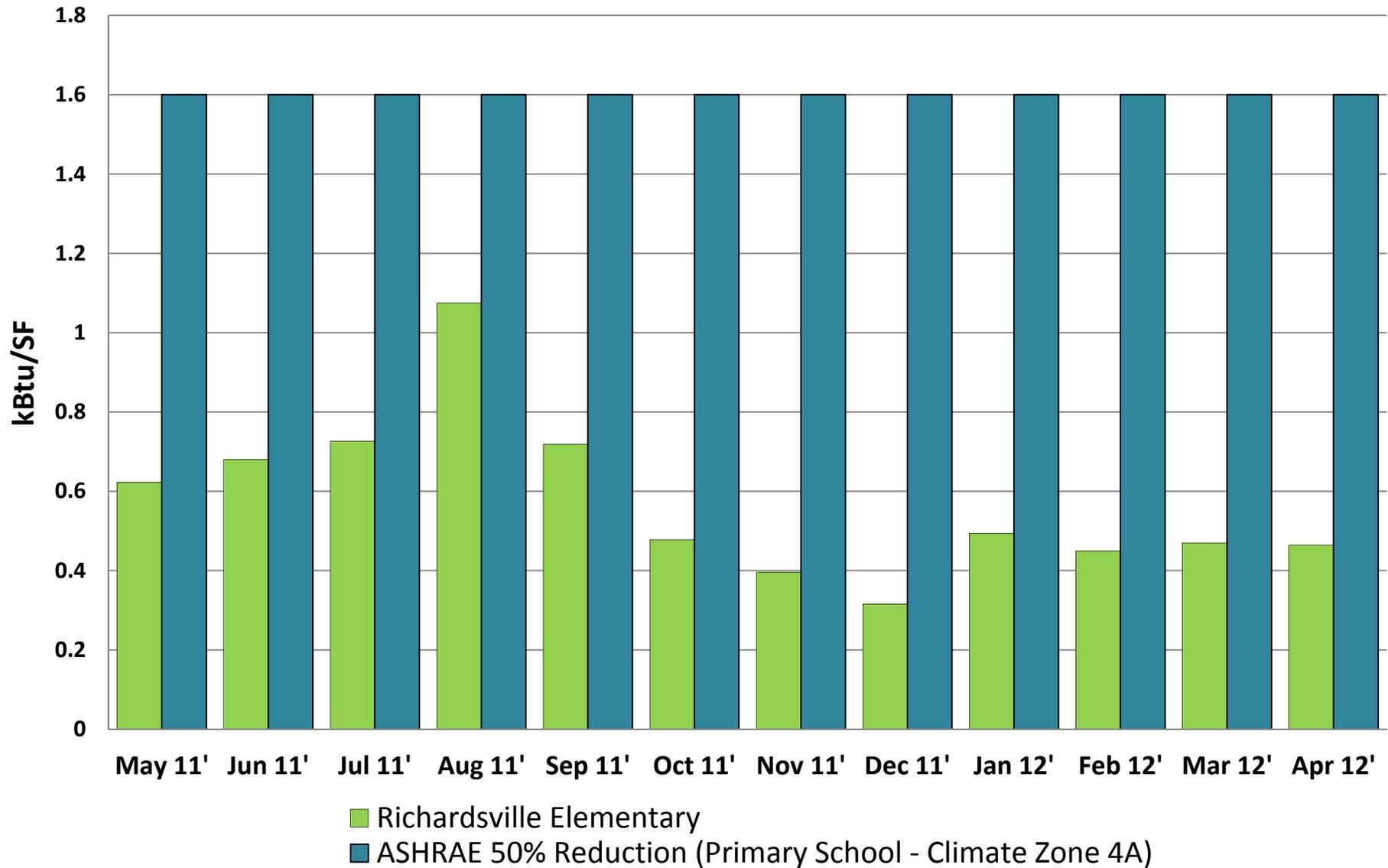


Outside Air Ventilation

- 🌿 **Dedicated Outside Air Systems (DOAS)**
- 🌿 **Heat Recovery Wheel**
- 🌿 **Demand Control Ventilation Based On CO₂ And Occupancy**
- 🌿 **Occupant Diversity**



HVAC – Monthly





Daylight Harvesting

- reflect natural light into classrooms
- reduce glare at work surfaces
- automated dimming reduces artificial lighting requirements
- interior solar tubes supplement daylighting
- sloped ceilings project natural light into the classroom
- super-insulated glazing reduces solar heat gain

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South Classroom Daylighting

- Daylight Glass (20' X 2')
With Interior Light Shelf
- View Glass Has Exterior
Shade Shelf
- Two Supplemental Tubular
Daylighting Devices
- 0.75 watts/SF Artificial
Lighting With Digital
Control System

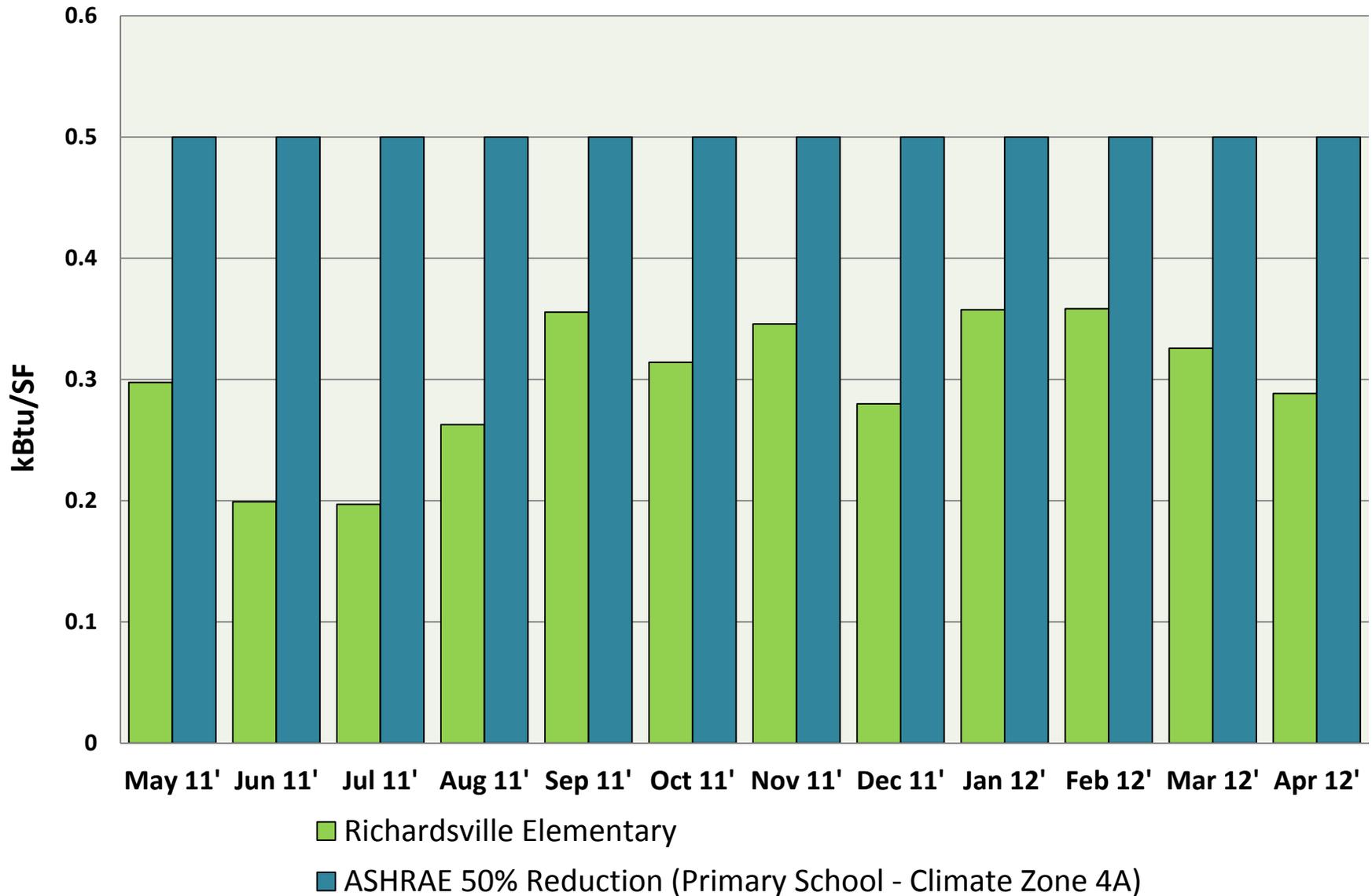


North Classroom Daylighting

- View Glass (5' X 5')
- Four Tubular Supplemental Daylighting Devices
- 0.75 watt/SF Artificial Lighting With Digital Control System



Lighting - Monthly





Healthy Kitchen Design

- ENERGY STAR rated equipment minimizes energy consumption
- eliminate Type I Hood
- energy conscious operations plan
- variable speed Type II Hoods
- healthy foods and locally grown products

Sherman Carter Barnhart PSC

Healthy Kitchen Design

- 🌿 **Test Kitchen Evaluation & Recommendations**
- 🌿 **ENERGY STAR Appliances**
- 🌿 **Eliminate Type I Hood – Type II Hoods**
- 🌿 **Healthy Foods & Locally Grown**



Energy Free Lunches



ED EFFICIENCIES

ENERGY TAKES A LUNCH BREAK

Warren County's energy-free lunches promote fun and responsibility



By Jennifer Wohleb
Staff Writer

Sam Dorris, who will be a second-grader at Natcher Elementary in Warren County, spent a happy lunch period toward the end of this past school year, spelling out his name with a bag of Scrabble Cheez-it crackers while munching through the rest of his lunch.

He and his classmates were enjoying the novelty of eating a bag lunch in the cafeteria instead of the usual hot plate lunch on a tray. And the fact that this lunch was saving energy?

"I like that, too," he said. Elementary schools in Warren County held four "energy-free lunch" days this spring, which had the cafeterias shutting down ovens and fryers, turning off heat lamps and running other kitchen equipment at minimal levels.

"We found that 22 percent of the energy in our schools was being consumed by the kitchens," said Food Services Manager Gina Howard, who said the district made that discovery as it planned and built Richardsville Elementary, the nation's first public school built to be net-zero energy, completed last year.

Howard said the idea for energy-free lunches came from an article in the *School Nutrition Journal*, and students and staff have eaten it up.

"It's actually a lot easier (to make) than a regular menu," said Plano Elementary Cafeteria Manager Paula Hale.

"Other than making the sandwiches, everything else is less time consuming. It's easier and the kids have more fun. It's like a picnic lunch for them."

Instead of picking up a tray when they go through the lunch line, students get a brown paper bag and fill it with a sandwich, fresh fruits and vegetables, cracker packs, or even a salad in a bag that has proven wildly popular with students.

"Salad is one of the harder things to get kids to eat," Howard said. "The last time we did this, we sold 200 salads in a bag. It's presented to them in a different way and students like that. They just open it, pour in their dressing and eat it out of the bag."

School board Chairman Mike Wilson said the program has been successful on several levels.

"Students know why we're doing this," he said. "They understand the rationale behind not having the kitchen all fired up that day. And this is also a new way to engage in nutrition. You may not like one item, but if it's presented to you in a different way or in a different setting, you may try something you previously thought you didn't like and find out you do like it. It broadens students' horizons."

Natcher Elementary fourth-grader Melek Muradova said there are several things she likes about the energy-free lunches.

"I like the energy savings," she said. "I like how they give out the carrots (in little bags) because carrots are really



Above, students of Natcher Elementary fill their brown bags as part of an energy-free lunch day.



Right, Plano Elementary student Elijah Burkhardt, relies on an apple during lunch. Students say the fresh fruits and vegetables are one of their favorite parts of the energy-free lunches.

good. It's more fun to eat this way and you don't have to do trays."

Jay Wilson, Warren County's energy manager, said the energy savings from these few days can't be determined, but efforts like these are still important.

"Definitely, it is important for our food services to serve such meals for the nutritional-educational benefits," he said. "It also displays the overall support from Mrs. Howard and her food service personnel for the district's ever-evolving energy conservation program."

Board member Mike Wilson said being energy conscious is just good policy for school boards.

"You build a building one time, but you heat it, cool it, and equip it every day for the next 40 or 50 years," Wilson said. "Seven or eight years ago when we entered into our energy education program, we wanted to be good stewards for the taxpayers' dollars and be as efficient as possible. Every dollar we save in energy costs goes back into teachers, salaries, textbooks, and other areas that directly impact students' learning." ❖

DARK IS THE NEW GREEN

At Walton-Verona Independent Schools, green isn't only the color of money and conservation, but it is also becoming the color of safety. By turning off the lights at night, the district is both turning on savings and increasing safety.

All the district's lights, from the classroom to the parking lots, are on motion sensors at night.

"When police come by doing their patrol and they see lights on in the building they know that there's a problem because it should be dark," said Superintendent Bill Boyle.

The district has had a dark campus since 2008.

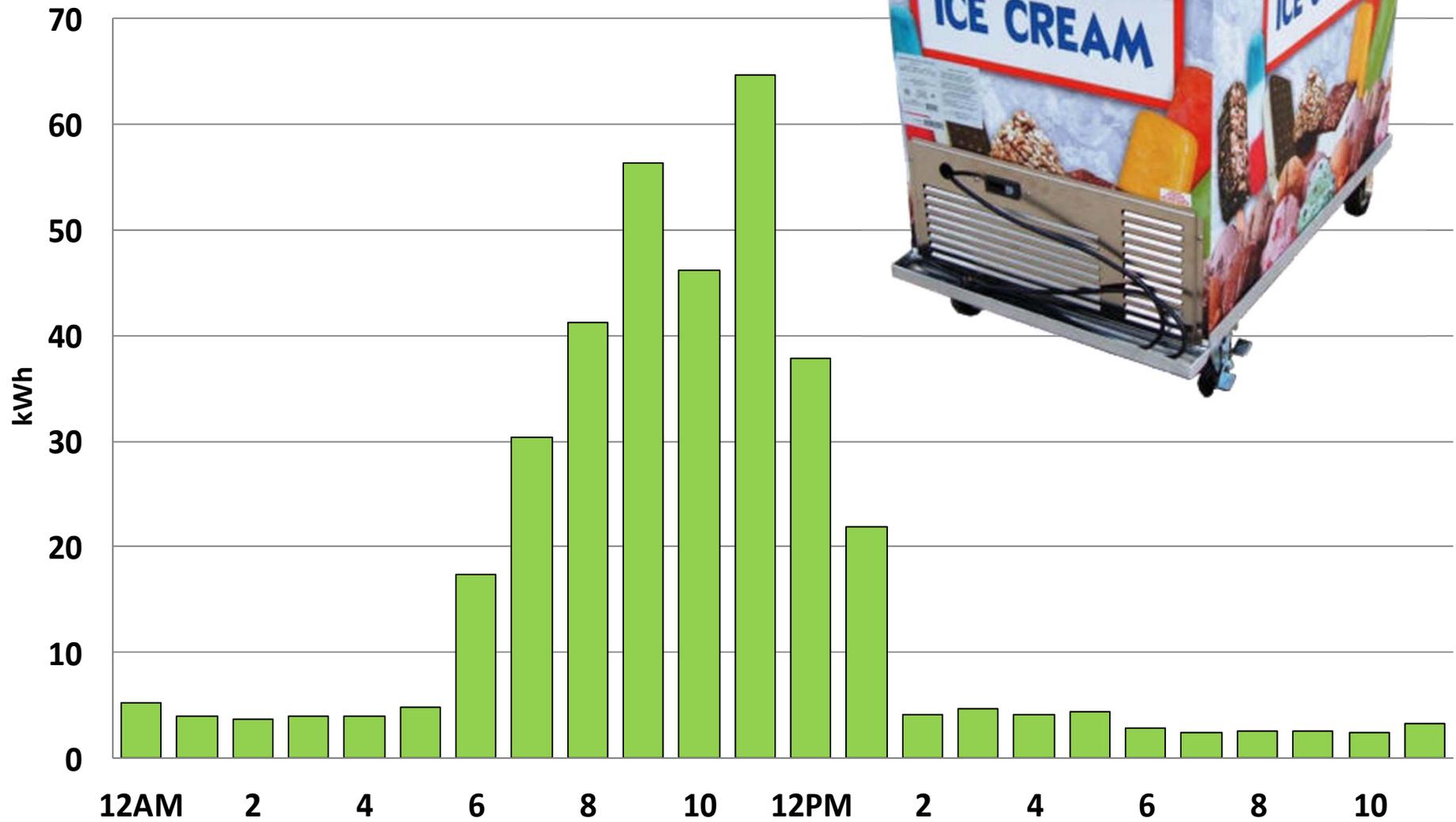
"We wanted to do it years ago, but back then, building codes required a certain amount of light in buildings at night," he said. "That's changed. The building codes have caught up with energy savings. We can now have all lights off in the building when it's closed, except for the ones by an entrance. So 99 percent of our building is dark. When someone walks into our building, it trips the motion sensor."

The same goes for parking lots, making it easy for police and others to spot anyone who shouldn't be there at night.

Boyle said because Walton-Verona is a growth district, trying to determine the savings from this is like trying to hit a moving target. But he said the change has been effective.

"We've gone the opposite way in terms of the old prevailing wisdom that said the more light the better, and we haven't had any incidents so far. We didn't want the lights on for the criminals to be able to see what they are doing," Boyle said, laughing. ❖

Kitchen – Energy





Living Building Strategies & Life Cycle Evaluation

- 24/7 building operation plan
- user-friendly automated building control system
- security lighting with motion detection minimizes energy consumption
- recycling program for students, faculty, and the community
- life cycle cost evaluations on materials, finishes, and equipment
- monitor to minimize plug loads

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Computers

- 🌿 **TVA Test Case**
- 🌿 **7.5% Of Energy In “Tested” School Was Consumed By Computers**
- 🌿 **Wireless Technology Throughout**
- 🌿 **Laptop Carts In Lieu Of Computer Labs**
- 🌿 **Equipment Off At Night**
- 🌿 **Reduces Power Consumption By 50%**





Renewable Energy Infrastructure

- optimize building orientation for maximum performance of future solar panels
- provide infrastructure for future renewable energy source
- roof system designed for future solar panels

Sherman·Carter·Barnhart PSC

Solar Electric Generation Cost

Richardsville Elementary:

Operates at **18.2 kBtus**

Has a 348 kw PV array

Today's rate of \$3.50 per watt

\$1.2 million investment



Avg. KY Elementary:

Operates at **73 kBtus**

Requires a 1395 kw PV array

Today's rate of \$3.50 per watt

\$4.9 million investment



Three Dimensional Teaching Tool

- opportunities for students to access, monitor, and learn about building performance
- energy-based curriculum
- introduce students to careers in environmental sciences
- create lifelong environmental stewards

Sherman Carter Barnhart PSC

Three Dimensional Teaching Tool



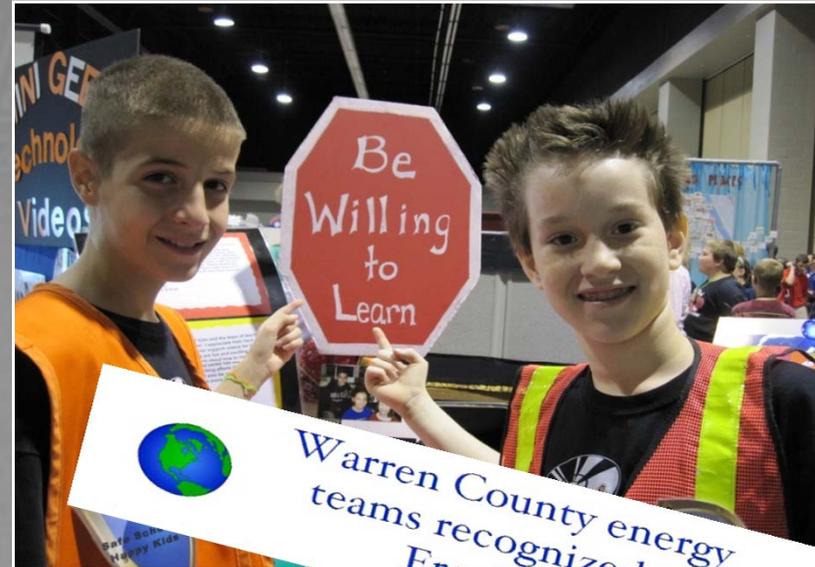
Every hallway has an energy related theme. The **Geothermal Hall** demonstrates how the water heats and cools the school.

The **Green Screens** demonstrate the school's daily energy use.



Growing Minds... Energy Teams

- 🌍 The Energy Initiative Is Spreading District Wide.
- 🌍 Each School Has An Energy Team With An Energy Kit To Monitor Consumption & To Perform Energy Audits For Efficiency
- 🌍 Teams Focus On Energy Awareness, Student Achievement (Math And Science) And Building Energy Leaders



Warren County energy teams recognized in Frankfort

Bristow Elementary
Kentucky's first a net zero achievable/ready school
Bowling Green, Kentucky

SUSTAINABLE FEATURES

- North-South Orientation
- ICF Interior Walls
- ICF Exterior Walls
- Precast hollow core plank 2nd floor structure
- A fully-adhered fleece-back white TPA
- Roof System With 6' Insulation
- Occupancy Controls
- Motion Controls
- CO₂ Monitoring Controls
- Daylighting
- Exterior Light Shelves

SIZE

79,817 SF/700 Students

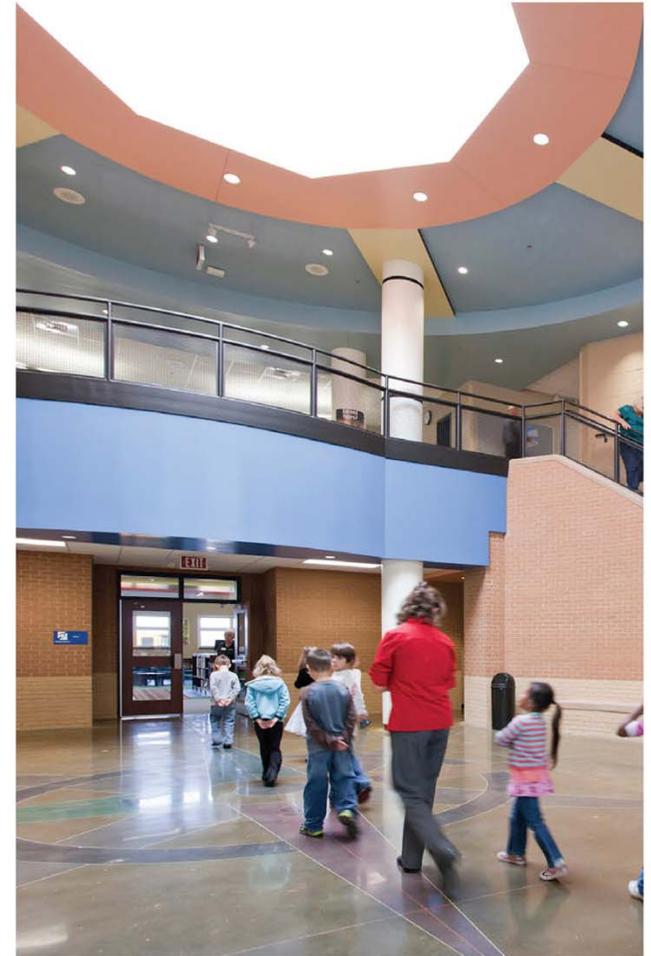
COST

\$12.8 million

STATUS

Complete, 2010





AWARD WINNING & ENERGY EFFICIENT DESIGN

2011 Outstanding Project - Sustainability & Learning

American School Board Journal - Learning By Design



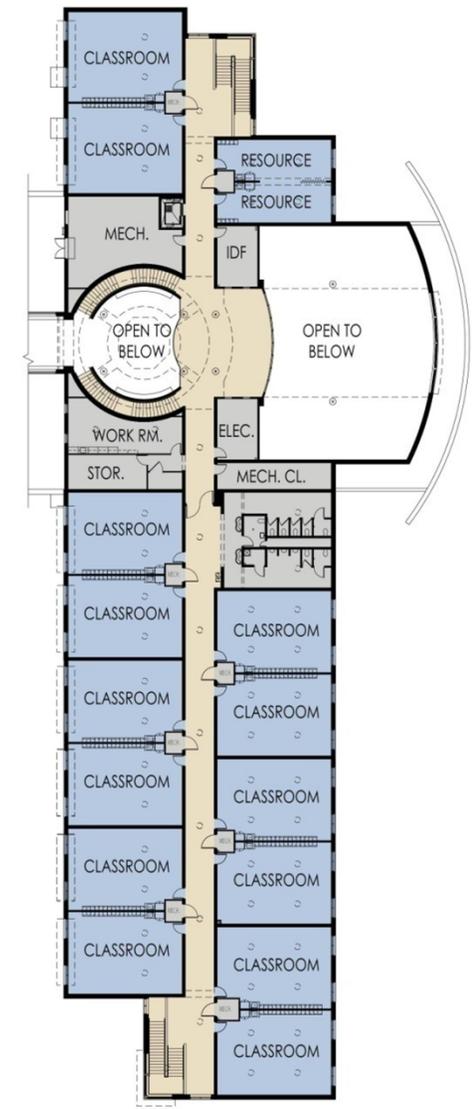
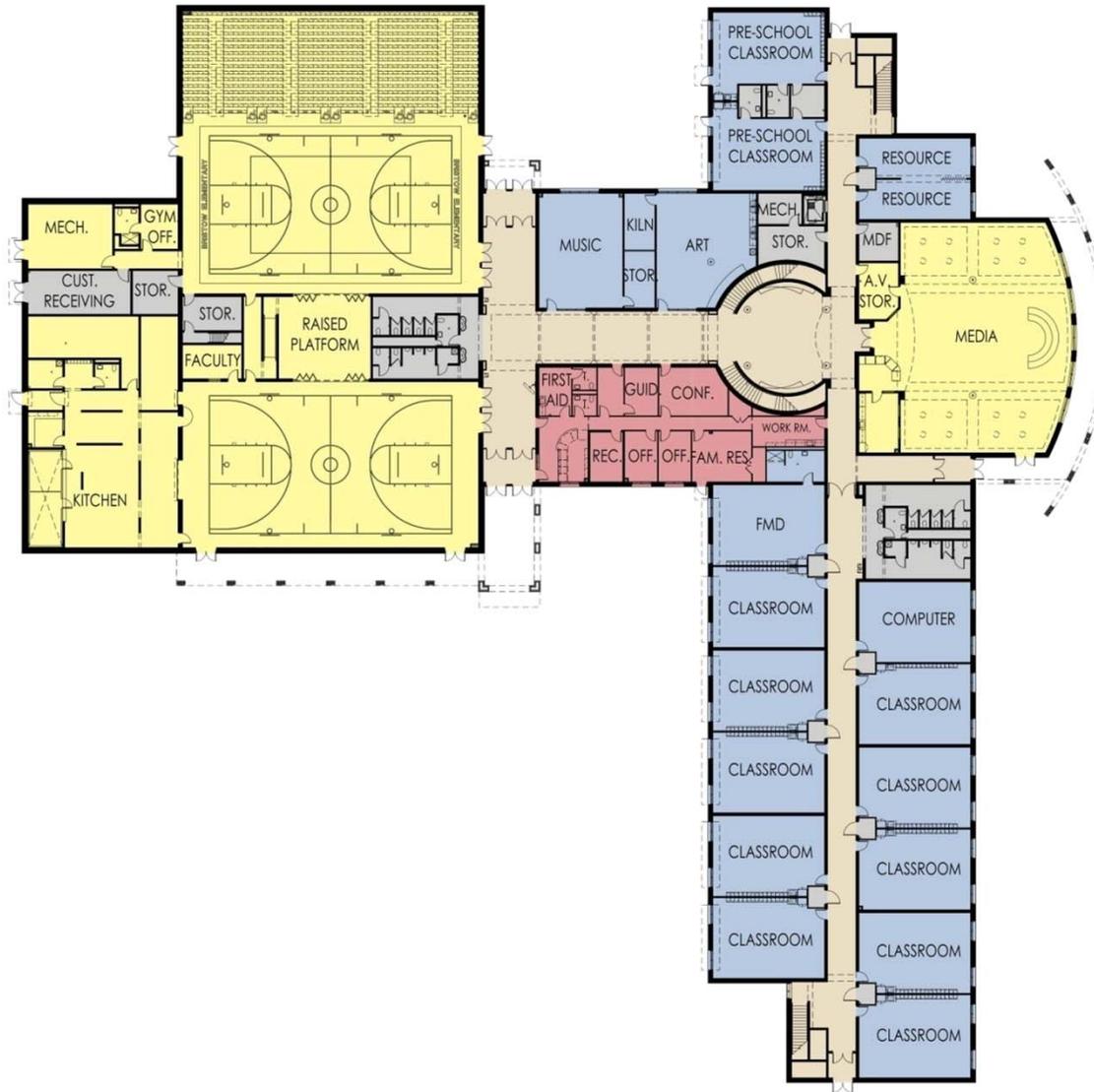
ENERGY STAR School

Recipient of the U.S. Environmental Protection Agency's prestigious ENERGY STAR for superior energy efficiency



LEED Silver Certified

U.S. Green Building Council Silver Certification



Jody Richards Elementary
a net zero achievable/ready school
Bowling Green, Kentucky

SUSTAINABLE FEATURES

Designed to Earn Energy Star
Certification

Insulated Concrete Form (ICF) Bldg
Envelope

Active Daylighting Controls/Strategies

Geothermal HVAC

Site-Produced Alternate, Renewable
Energy Source Ready

Efficient Kitchen Cooking Strategies
Operations And Maintenance Plan

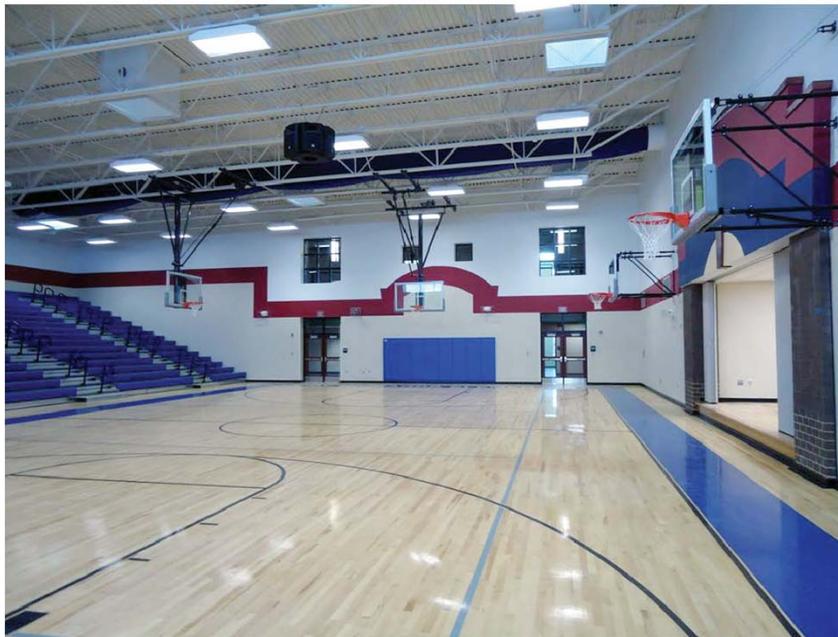
SIZE

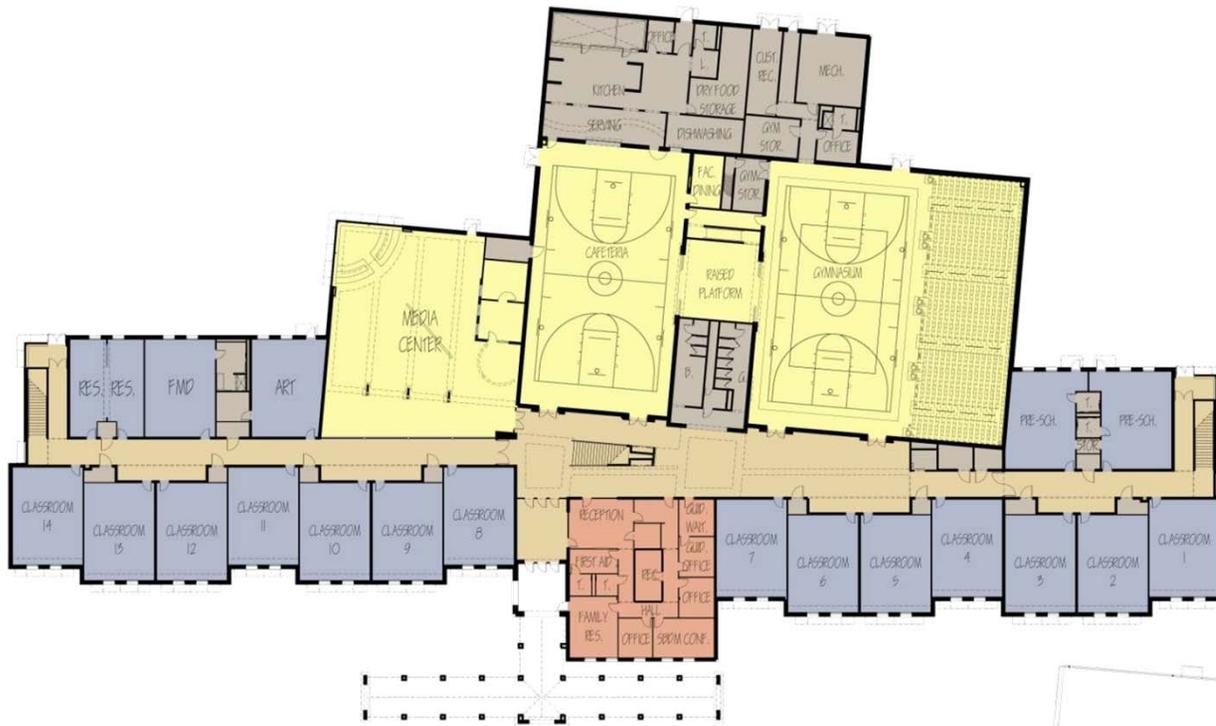
81,000 SF/750 Students

COST

\$11.8 million







Flaherty Primary

a net zero achievable/ready school

Brandenburg, Kentucky

SUSTAINABLE FEATURES

ICF Exterior Walls

Geothermal HVAC

Renewable Materials

Spray applied polyurethane Roof with

4.5" rigid insulation

Occupancy Controls

Motion Controls

CO₂ Monitoring Controls

SIZE

67,473 SF/550 Students

COST

\$13.7 million



Flaherty operates at 21.7 kBtu/sf/yr creating an average savings of over \$82,300 a year in energy costs.



ENERGY SAVING DESIGN



ENERGY STAR School - Performance Rating Of 100
Recipient of the U.S. Environmental Protection Agency's prestigious ENERGY STAR for superior energy efficiency

Ezra Sparrow Early Learning Center

a net zero achievable/ready school

Lawrenceburg, Kentucky

SUSTAINABLE FEATURES

ICF Construction

Geothermal Heat Pump System

R-30 Insulation Value At Roof

Low E Glazing On Windows

Daylighting

Easy to Maintain

Low VOC

Sustainable Materials & Finishes

SIZE

40,000 SF/300 Students

COST

\$5.6 million





ENERGY SAVING DESIGN



ENERGY STAR School

Recipient of the U.S. Environmental Protection Agency's prestigious ENERGY STAR for superior energy efficiency



ENERGY SAVING DESIGN



ENERGY STAR School - Performance Rating Of 100

Recipient of the U.S. Environmental Protection Agency's prestigious ENERGY STAR for superior energy efficiency

Recapping The Strategies

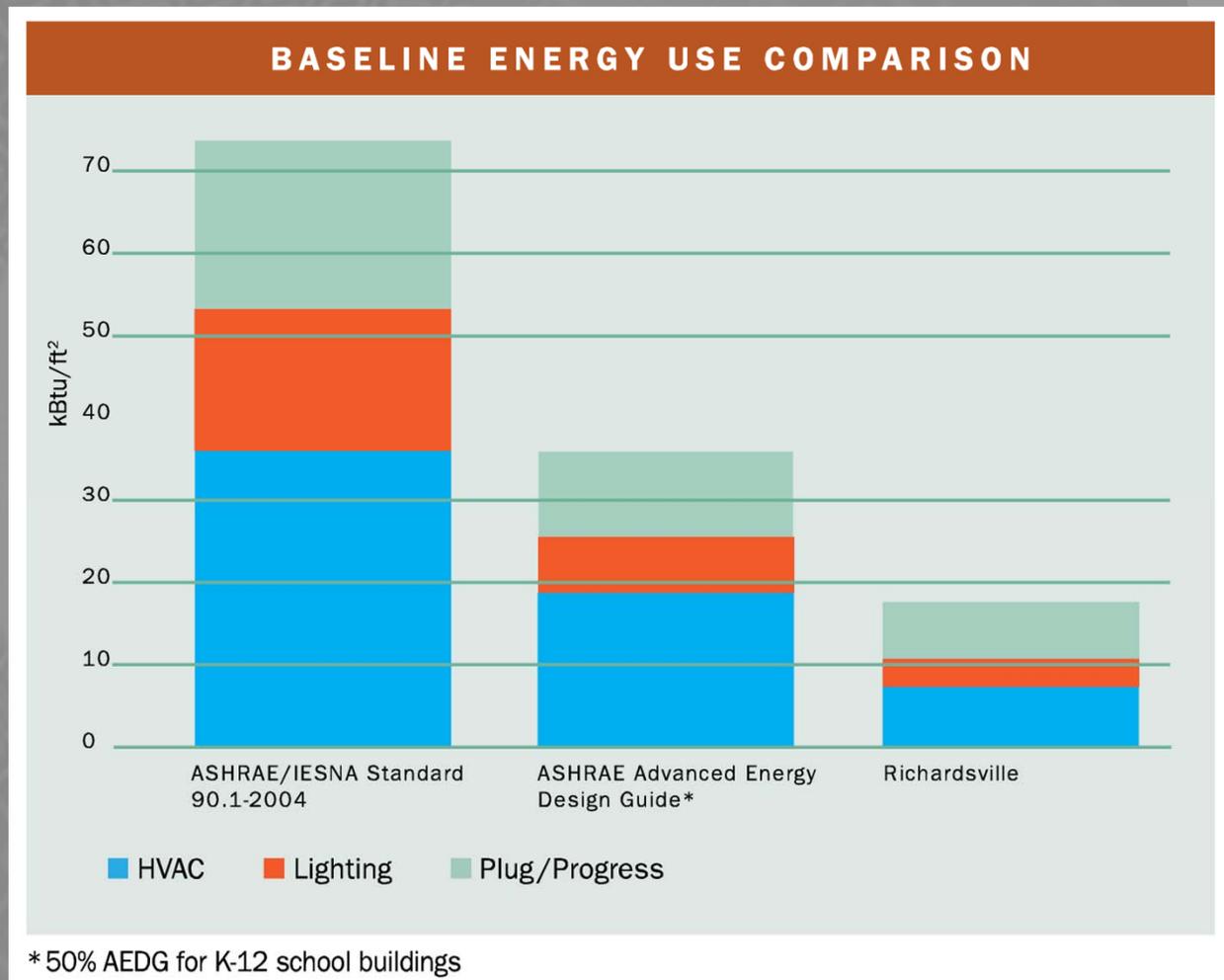
- 🌿 Site Design & Building Orientation
- 🌿 Daylight Harvesting
- 🌿 Healthy Kitchens
- 🌿 Living Building Strategies & Life Cycle Evaluation
- 🌿 Renewable Energy Infrastructure
- 🌿 Three Dimensional Teaching Tool



What Makes Net Zero Ready Schools Different Than...

“The most cost effective way to save energy is to not need it.”

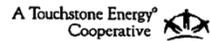
*High Performing Buildings
Fall 2012*



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WARREN RURAL ELECTRIC COOPERATIVE CORPORATION

www.wrcc.com



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(800) 844-1707

Pay by Phone
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(866) 319-3234

ACCOUNT NUMBER		397917042		METER LOCATION		RICHARDSVILLE RD 1775	
SERVICE FROM	TO	NO. DAYS	READING PREVIOUS	READING PRESENT	M U L T	KWH USAGE	CHARGES
07/16/12	08/16/12	31	0	0	1	36894	2,056.30
DEMAND:	READING		ACTUAL	BILLED			
	210.780		210.780	210.780			2,199.47
TVA FUEL COST			0.024300			36894	886.02
DISTRIBUTION CHARGE							40.00
POWER GENERATION CREDIT							-11,901.51
SCHOOL TAX							155.45
CURRENT CHARGES FOR SERVICE							-6,564.27
PREVIOUS BALANCE							-27,009.71

Current Bill Due Date Does Not Apply To The Previous Balance			CR BAL DO NOT PAY	
Customer Name	BILLING DATE	PAYMENT DUE DATE	TOTAL DUE NOW:	-33573.98
WARREN CO BD OF ED	08/22/12	09/05/12	AFTER DUE DATE PAY:	-33573.98

HISTORY GRAPH - COMPARE YOUR USAGE

Failure to receive bill does not relieve customer's payment obligations.
 Any previous unpaid balance is subject to disconnect without further notice.

RETAIN THIS COPY FOR YOUR RECORDS

PLEASE DETACH AND RETURN THIS PORTION WITH PAYMENT

Warren Rural Electric Cooperative Corporation
951 Fairview Avenue, P.O. Box 1118
Bowling Green, Kentucky 42102
ADDRESS SERVICE REQUESTED

Address _____
City _____ State _____ Zip _____
Telephone _____ Email _____

Charge to: MasterCard VISA

Account No. _____
Exp. Date _____
Signature _____

Account Number
397917042

Date Due
09/05/12

Total Due Now
-33573.98

After Due Date Pay
-33573.98

WRCC
PO Box 3200
Hopkinsville, KY 42241-3200



WARREN CO BD OF ED
NEW RICHARDSVILLE SCHOOL
PO BOX 51810
BOWLING GREEN KY 42102-6810



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Peter Kelly-Detwiler, Contributor
I write about energy technologies and policies.
+ Follow (40)

ENERGY | 12/10/2012 @ 8:05AM | 2,423 views

Net Zero Schools in Kentucky: Models for the Future Come from Surprising Places

+ Comment Now + Follow Comments

This week, I asked a close friend to guess which state boasted the nation's first net zero public elementary school. "California?" he ventured. "Vermont?" "Massachusetts?" No, no, and no. How about Kentucky, the nation's third largest coal producer, with \$5 bn in annual coal revenues and the nation's fourth lowest electricity costs (at just over 7 cents per kilowatt-hour)?

(Richardsville School - Architect: Sherman Carter Bernhart Architects; Photo courtesy of CHTA, Inc.)

Metal Architecture
February 2012
www.metalarchitecture.com

Life Cycle Assessments

Also inside:

- Building Profile: A Resourceful Titan Success
- Green Scene: Mind Your Ps and Qs
- Education: K-12 Projects



Net Zero *Ready* schools...

- are affordable.
- can add renewable energy sources later.
- save school districts money.
- improve student achievement.
- teach environmental stewardship.

are you
net zero
ready

The Responsibility Is Ours To Share

In the near future, federal law will require new buildings to make their energy performance visible. Each building will be required to display its energy performance characteristics.





Thank you

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