

Kentucky's Net Zero Energy Schools

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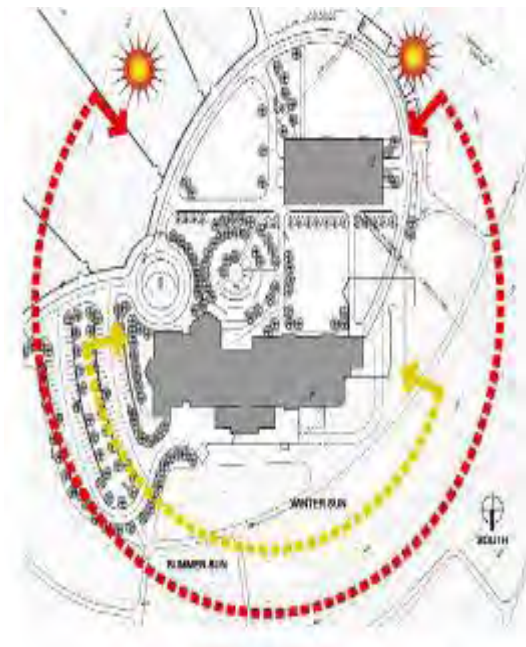
Turkey Foot Middle School

- 🌿 133,000 sf
- 🌿 Consuming 22 kBtu/sf yr before renewables
- 🌿 400 kW solar PV
- 🌿 **\$210/sf w/solar PV**
- 🌿 Kenton County (Kentucky) School District
- 🌿 PCA Architecture
- 🌿 CMTA MEP Engineers
- 🌿 Opened Fall 2010



Locust Trace AgriScience Campus

- 70,000 Square Feet:
Classrooms, Labs, Offices,
Riding Arena
- 1 MBtu Solar Thermal Array
- 180 kW Solar PV System
- \$180/sf w/solar PV**
- Fayette County (Kentucky)
School District
- Tate Hill Jacobs Architects
- CMTA MEP Engineer
- Opened Fall 2011



Richardsville Elementary School

- 🌿 First Net Zero Energy School in the U.S.
- 🌿 73,000 sf
- 🌿 348 kW solar PV
- 🌿 **\$204/sf w/solar PV**
- 🌿 Warren County (Kentucky) School District
- 🌿 Sherman-Carter-Barnhart Architects
- 🌿 CMTA MEP Engineers
- 🌿 Opened Fall 2010



Richardsville Elementary



2011 AS&U's Special Citation –

*This is an exceptional demonstration
of a net-zero school—they have
delivered on this commitment.*

***It simply puts to rest the
statement 'It can't be
done.'”—2011 jury***



Richardsville Elementary

Energy Reduction Strategies

- 🌿 **Site design and building orientation**
- 🌿 **High performance thermal envelope**
- 🌿 **Daylight harvesting**
- 🌿 **Geothermal HVAC**
- 🌿 **Behavior changes**
 - Healthy kitchen
 - Information technology
 - Night lighting
- 🌿 **Renewable energy**



High Performance Thermal Envelope

- 🌿 **Insulated concrete form (ICF) exterior walls and high performance roof system**
- 🌿 **ICF system reduces external air infiltration**
- 🌿 **Compact building volume reduces areas of exposed exterior surfaces**



Compact in Volume and Size



Lower Level



Entry Level

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



Geothermal HVAC System

- 🌿 **Two-speed compressors to increase part load efficiency**
- 🌿 **Distributive geothermal loop water pumping to reduce energy**
- 🌿 **ECM motors to reduce fan energy**
- 🌿 **One heat pump per two classrooms to minimize maintenance**



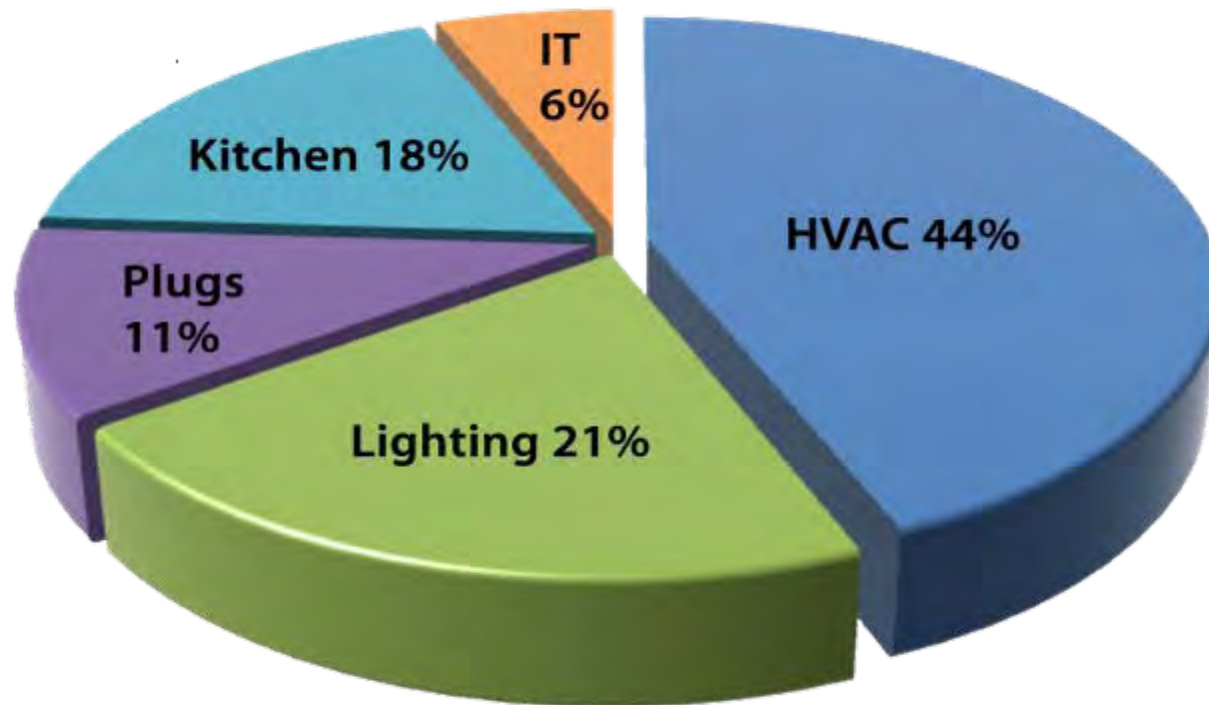
Behavior Changes

- 🌿 Food preparation process
- 🌿 Building IT system
- 🌿 Outdoor lighting
- 🌿 State regulatory agencies

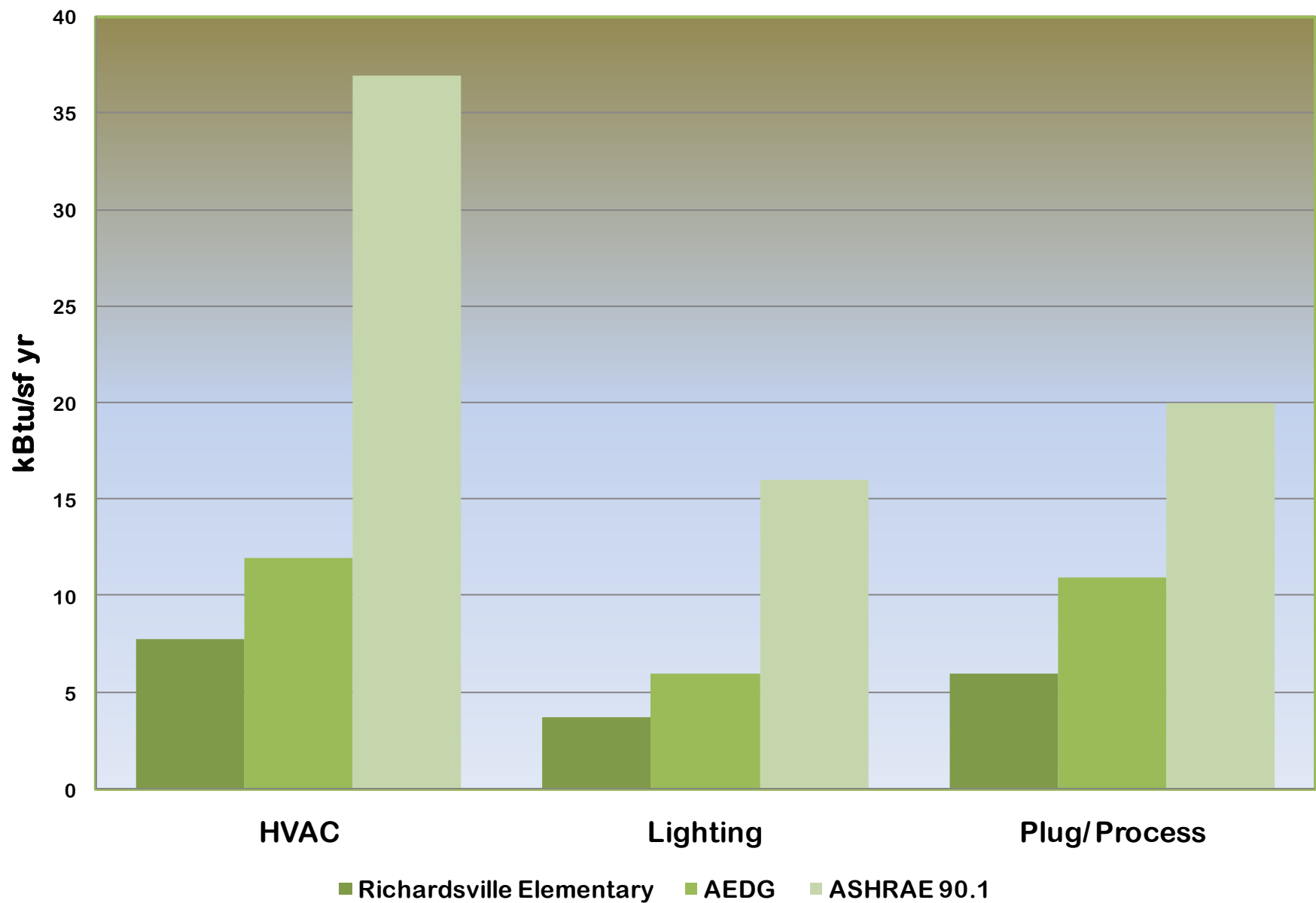


Results

Richardsville: Energy Usage



Actual: 17.6 kBtu/sf yr



Solar Photovoltaic System

- 🌿 208 kW thin film – operational February 2011
- 🌿 138 kW crystalline – operational December 2011
- 🌿 408 MWh/yr electric production
- 🌿 \$2,766,000 cost (bid January 2010 @ \$7.93/kW)



Electric Utility Summary

Read Date	Days of Service	Amount Due	Energy Cost	Demand Cost	Total Cost	Generation Credit
12/14/11	29	(\$622)	\$2,612	\$1,595	\$4,207	(\$1,640)
11/17/11	29	(\$3,189)	\$2,694	\$1,440	\$4,135	(\$2,618)
10/17/11	32	(\$4,705)	\$2,915	\$1,840	\$4,755	(\$4,169)
9/15/11	30	(\$5,252)	\$3,544	\$2,274	\$5,819	(\$5,215)
8/16/11	29	(\$5,857)	\$3,162	\$2,301	\$5,464	(\$6,728)
7/18/11	32	(\$4,592)	\$2,355	\$1,274	\$3,629	(\$6,665)
6/16/11	30	(\$1,555)	\$2,846	\$1,953	\$4,799	(\$6,288)
5/17/11	32	(\$66)	\$2,887	\$1,788	\$4,675	(\$4,440)
4/15/11	30	(\$301)	\$2,427	\$1,511	\$3,938	(\$4,239)
3/16/11	30	\$2,376	\$2,755	\$2,153	\$4,908	(\$2,532)
2/14/11	31	\$4,102	\$2,766	\$2,721	\$5,487	(\$1,385)
1/14/11	30	\$4,897	\$2,475	\$2,422	\$4,897	\$0

No utility payment for 9 months!

Richardsville Elementary Financial Model

Year	Annual Energy Cost 65 kBtu School	Richardsville 17 kBtu Energy Cost	Richardsville PV Revenue	Annual Savings
1	\$109,039.00	\$46,080.00	\$84,183.00	\$147,142.00
2	\$112,310.00	\$47,462.00	\$86,708.00	\$151,556.00
3	\$115,679.00	\$48,886.00	\$89,310.00	\$156,103.00
4	\$119,150.00	\$50,353.00	\$91,989.00	\$160,786.00
5	\$122,724.00	\$51,863.00	\$94,749.00	\$165,610.00
6	\$126,406.00	\$53,419.00	\$97,591.00	\$170,578.00
7	\$130,198.00	\$55,022.00	\$100,519.00	\$175,695.00
8	\$134,104.00	\$56,673.00	\$103,534.00	\$180,965.00
9	\$137,127.00	\$58,373.00	\$106,641.00	\$185,395.00
10	\$142,271.00	\$60,124.00	\$109,840.00	\$191,987.00
11	\$146,539.00	\$61,928.00	\$113,135.00	\$197,746.00
12	\$150,935.00	\$63,785.00	\$116,529.00	\$203,679.00
13	\$155,464.00	\$65,699.00	\$120,025.00	\$209,790.00
14	\$160,127.00	\$67,670.00	\$123,626.00	\$216,083.00
15	\$164,931.00	\$69,700.00	\$127,334.00	\$222,565.00
	\$2,027,004.00	\$857,037.00	\$1,565,713.00	\$2,735,680.00

Questions?

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