

Design Problem

- 🌿 An owner approaches you with the following program:
 - 60,000 square foot school with a goal of 35 kBtu/sqft-yr
- 🌿 How do you approach the owner's energy goals?

Targeting Net Zero Buildings

“A Kentucky Success Story”

Stephanie Febles, PE, LEED AP, CGD
CMTA Consulting Engineers

About Us

- **Top 60 MEP Engineering Firm Nationally**
- **Offices in Kentucky, Indiana and Texas**
- **Specializes in sustainable design for education and health care**
- **Four Net Zero Energy projects completed, eight in design or under construction**



About Us

27 LEED Projects

- 13 Gold
- 3 Silver
- 4 Certified
- 17 Registered



87 ENERGY STAR Awards

- Eight buildings with perfect scores of 100 – including the CMTA Louisville (Kentucky) office building



What is Net Zero?

- 🌱 Annual Energy Cost
- 🌱 Carbon Footprint
- 🌱 Source Consumed vs. Site Produced
- 🌱 Site Consumed vs. Site Produced
 - *Annual energy use expressed*
- 🌱 Net Zero Ready (Capable)



Integrated Design Process

🌿 **“Begin with the End in Mind”**

🌿 **Stakeholders all involved**

- **School District**
 - Students
 - Teachers
 - Faculty
 - Operations/Facilities
- **A/E**
- **Utility**

🌿 **Architects’ design was in response to energy goal**



“... the best part was the whole collaborative with various ways of looking at the out of the box project

... - Susan Hill, THJ Architects

Locust Trace AgriScience Campus

Locust Trace AgriScience Campus

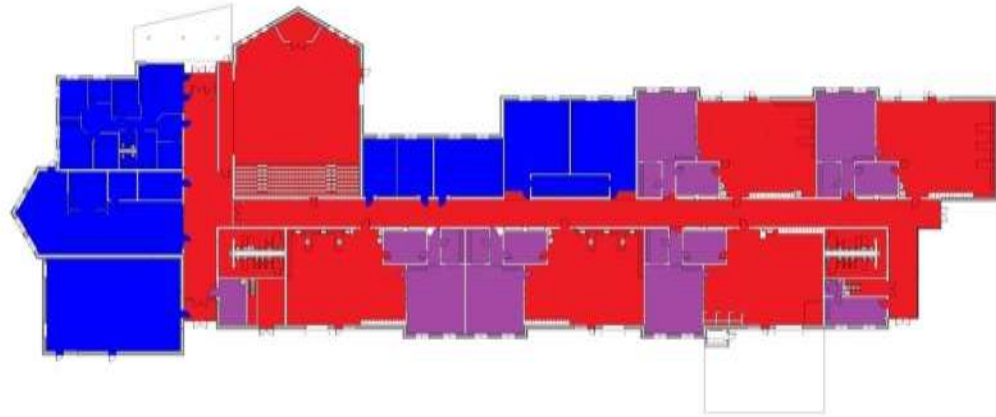
- 🌱 Third Net Zero Energy School in Kentucky
- 🌱 70,000 Square Feet: Classrooms, Labs, Offices, Riding Arena
- 🌱 3rd Largest Solar Thermal Array in the U.S.
- 🌱 Net Zero Waste - Wetlands
- 🌱 Rainwater Catchment for Site Irrigation and Animal Watering
- 🌱 Natural Water Well for Backup
- 🌱 Permeable Pavers



Locust Trace AgriScience Campus

Operational Strategies

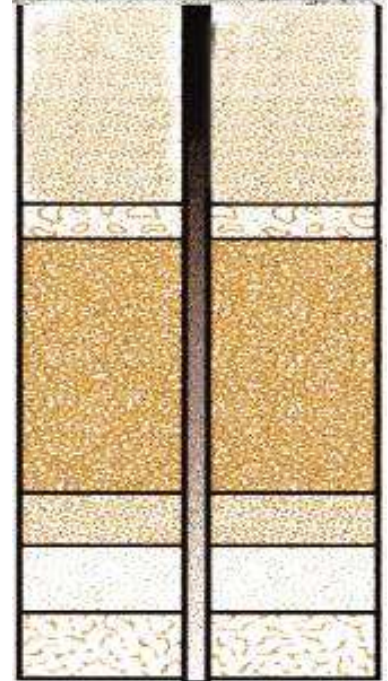
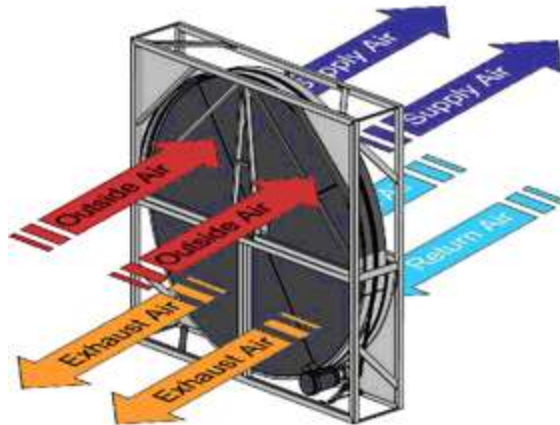
- 🌿 Year Round Occupancy
- 🌿 Classroom Function vs. Real World
- 🌿 Energy Declaration
- 🌿 Result....Cultural Change...



Locust Trace AgriScience Campus

Mechanical Strategies

- 🌿 Geothermal HVAC
- 🌿 Solar thermal
- 🌿 Fin tube radiators
- 🌿 High volume/low velocity fans
- 🌿 Demand controlled ventilation
- 🌿 Energy recovery
- 🌿 Natural Ventilation



Locust Trace AgriScience Campus

Electrical Strategies

- **Highly Efficient Lighting design 0.6 W/sq ft. vs 1.3**
- **Natural daylight harvesting**
- **Tubular daylighting devices**
- **Lighting controls**
- **Occupancy sensors**
- **Reduce phantom plug loads**



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Renewable Energy Strategies

🌿 16 kBtu/sf yr vs. 78 kBtu/sf yr

🌿 175 KW Solar PV

- 572 – 305 Watt Power Panels

🌿 7400 Square Feet of Solar Thermal Panels

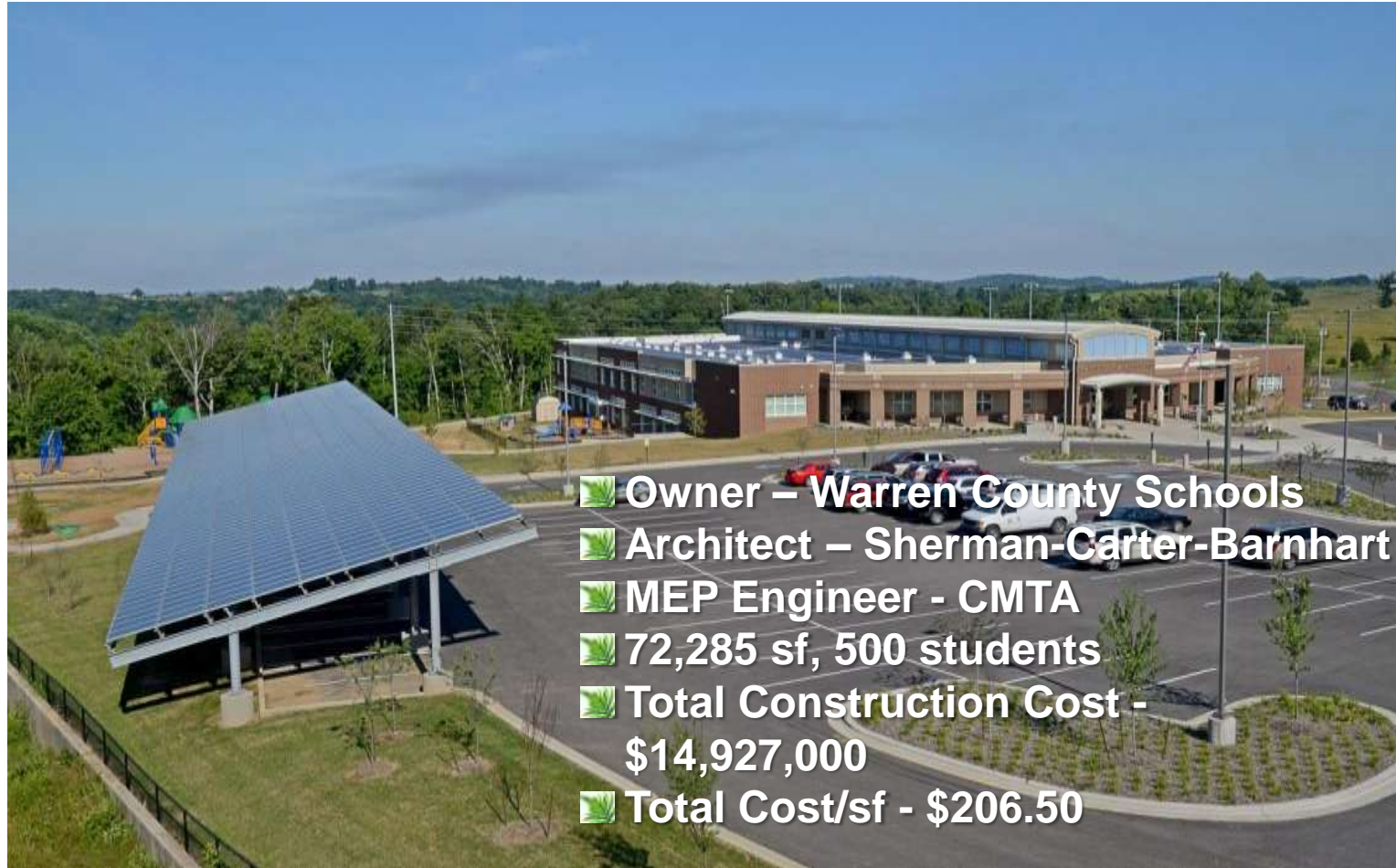
- 168 Panels – 1 Million BTU's



Locust Trace AgriScience Campus

Net Zero Academic Building Energy MWh Summary			
Read Date	MWh Consumed	MWh Generated	MWh difference
7/1/2012	9.7	15.35	-5.69
8/1/2012	7.2	25.48	-18.31
9/1/2012	6.4	20.18	-13.79
10/1/2012	9.0	18.29	-9.29
11/1/2012	19.7	12.75	6.97
12/1/2012	24.2	6.24	17.92
1/1/2013	28.8	8.60	20.23
2/1/2013	24.7	14.15	10.58
3/1/2013	25.1	13.92	11.18
4/1/2013	18.0	25.97	-7.99
5/1/2013	12.9	24.38	-11.53
6/1/2013	7.1	21.42	-14.31
Total	192.71	206.73	-14.02

Richardsville Elementary – First Net Zero Energy Public School in the United States



- Owner – Warren County Schools
- Architect – Sherman-Carter-Barnhart
- MEP Engineer - CMTA
- 72,285 sf, 500 students
- Total Construction Cost - \$14,927,000
- Total Cost/sf - \$206.50

Richardsville Elementary School

Richardsville Highlights

- 72,000 sf
- High Efficiency Geothermal HVAC System with Distributed Pumping
- Demand Control Ventilation
- Insulated Concrete Form (ICF) Construction
- Daylighting Controls and Tubular Daylighting Devices
- Wireless School (Utilizing Laptop Carts)
- 18.2 kBtu/sf yr**



Richardsville Energy MWh Summary

Read Date	MWh Consumed	MWh Generated	MWh Difference
12/16/12	30.2	20.1	10.1
11/16/2012	37.1	29.7	7.4
10/16/2012	33.2	34.6	(1.4)
9/15/2012	45.6	45.1	0.5
8/16/2012	36.9	54.2	(17.3)
7/16/2012	26.6	56.0	(29.4)
6/15/2012	28.0	57.5	(29.5)
5/16/2012	38.2	45.0	(6.8)
4/16/2012	29.8	35.3	(5.5)
3/15/2012	30.6	31.9	(1.3)
2/14/2012	33.8	19.5	14.3
1/16/2012	26.0	14.9	11.1
Total	396	443.8	(47.8)

Energy Reduction Strategies

	Operational	Geothermal HVAC	Lighting Controls	ICF Walls	Daylighting	Photovoltaics
Locust Trace – NZE	2012 New	✓	✓	✓	✓	✓
Richardsville - NZE	2010 New	✓	✓	✓	✓	✓
Turkey Foot Middle – NZE	2010 New	✓	✓	✓	✓	✓
Flaherty Primary - NZC	2012 New	✓	✓	✓		
Bristow Elementary – NZC	2011 New	✓	✓	✓	✓	
Foster Heights Elementary - NZC	2012 Reno	✓	✓		✓	

Summary

- 🌱 **Net Zero Energy has to be set as a goal early in the design process**
- 🌱 **Net Zero Energy depends on an integrated design process involving the design team, the owner and the building user**
- 🌱 **Reducing energy use is key to successful Net Zero Energy design**
- 🌱 **Energy models have to encompass every aspect from envelope to operations**



Questions?

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