

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

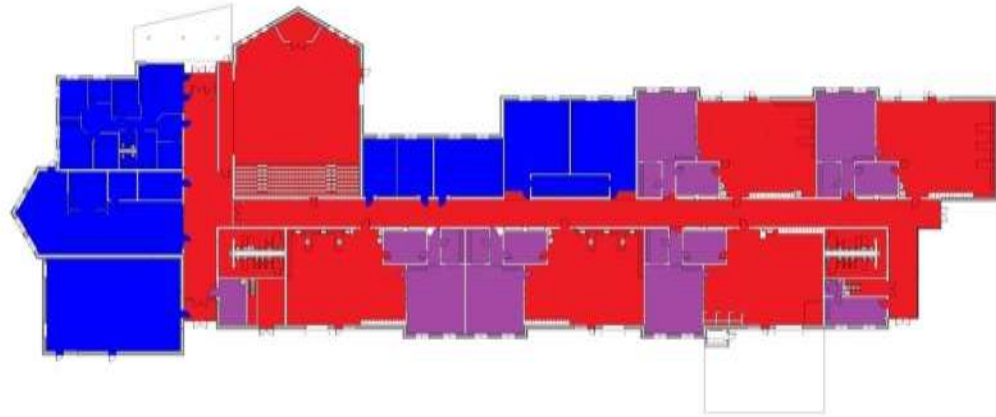
- 🌱 Third Net Zero Energy School in Kentucky
- 🌱 70,000 Square Feet: Classrooms, Labs, Offices, Riding Arena
- 🌱 3rd Largest Solar Thermal Array in the U.S.
- 🌱 Net Zero Waste - Wetlands
- 🌱 Rainwater Catchment for Site Irrigation and Animal Watering
- 🌱 Natural Water Well for Backup
- 🌱 Permeable Pavers



Locust Trace AgriScience Campus

Operational Strategies

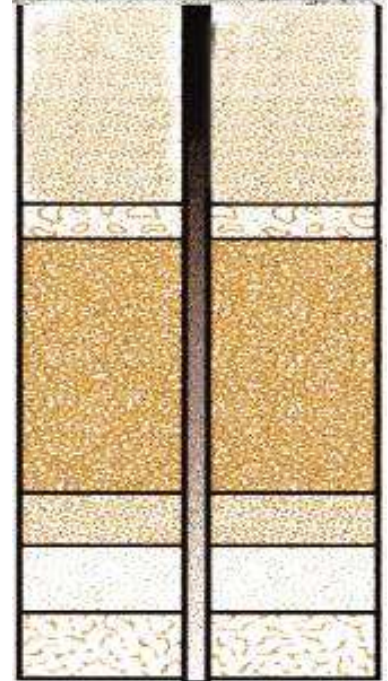
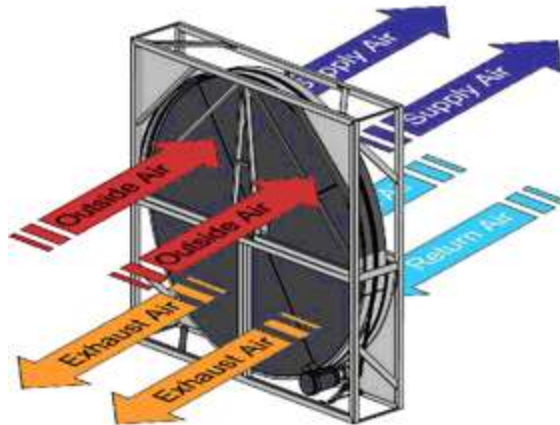
- 🌿 Year Round Occupancy
- 🌿 Classroom Function vs. Real World
- 🌿 Energy Declaration
- 🌿 Result....Cultural Change...



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**



Locust Trace AgriScience Campus

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

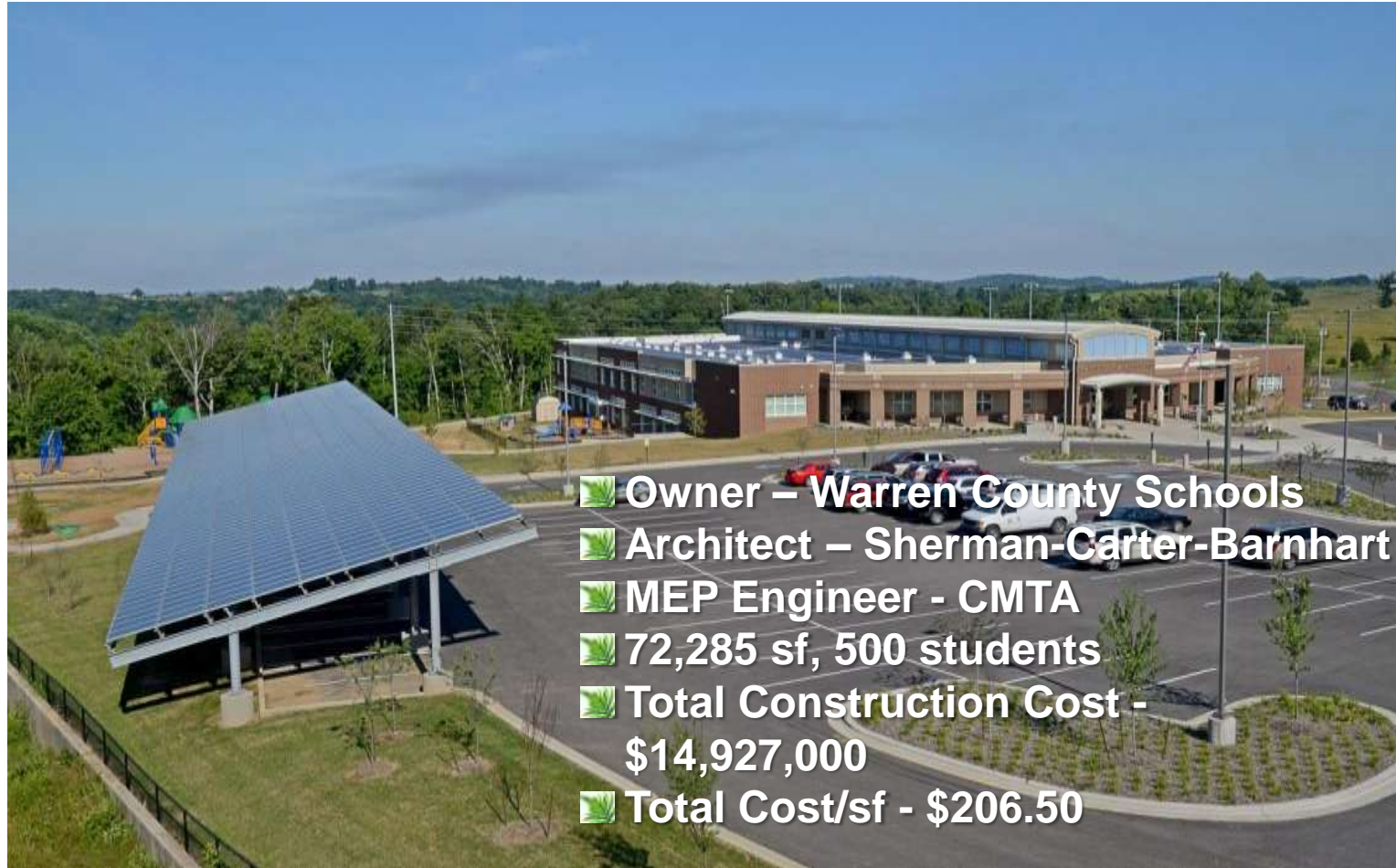
- 168 Panels – 1 Million BTU's



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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