

### 2022/23 Efficient and Healthy Schools Decarbonization Case Study | Buckley Elementary School

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# 9.9+ Million

Square Feet of Zero Energy / Carbon Facility Design

175+ Zero Energy Capable Projects Operating Under 35 kBtu/sf/yr

### **200+ ENERGY STAR Projects**

69 with Perfect 100 Scores

75+ Megawatts

**Renewable Power Designed / Installed** 







### **Buckley Elementary School – Manchester CT**





#### **Buckley ES "Before" Stats**

- ✓ 58,600 sf
- ✓ 1950's vintage
- ✓ Poor Building Envelope
- ✓ Natural Gas Heating Steam Boilers
- ✓ Limited A/C
- ✓ No Mechanical Ventilation

### **Buckley Elementary School – Manchester CT**



#### **Buckley ES Goals**

- ✓ 21<sup>st</sup> Century Learning w/ 9,000 sf of additional program space
- ✓ Renovate-As-New
- ✓ Net Zero Energy w/ EUI
  < 25 kbtu/sf/yr</li>
- ✓ Provide Excellent IAQ and Daylighting
- ✓ Electrification and Renewal of Systems
- ✓ Upgrade Building Envelope

### What is Energy Use Intensity?



### What is Net Zero Energy?



### **Data Driven Process**

"You cannot manage what you do not measure."

- W. Edwards Deming



### Benchmarking

#### PARTIAL SCHOOL DISTRICT ENERGY USE INTENSITY



### **Follow the Energy**

#### **Drastic Energy Reduction is Needed**

- HVAC ~45%
- Kitchen ~20%
- Lighting ~20%
- Plug Loads ~10%
- IT ~5%



### What's the Process for Net Zero Energy?



## Passive & Active Strategies

#### **Building Orientation**

Maximize daylighting and control solar heat gain

#### Envelope

Tight envelope for low infiltration, reduced heating and cooling loads – to a point

#### **High Performance MEP Systems**

Quality equipment, right-sized design

#### **On-Site Renewable**

Off set energy consumption with PV

### **Building Envelope**



### **Building Envelope Testing is Critical!**

#### **Pressure Testing Standards**



#### **Air Infiltration Rate**

#### **Air Infiltration**

- Code Minimum
- Federal Mandate
- Industry Standard

#### **Testing Standards**

- ASTM E779
- ASTM E1827

### **Building Envelope Testing is Critical!**

#### **Blower Door Pressure Testing**





### **Building Envelope Testing is Critical!**

#### **Thermal Scanning & Imaging**



#### **COMPETING PRIORITIES**



#### ELECTRIFICATION



#### ELECTRIFICATION



#### **GEOTHERMAL HVAC – WELLFIELD & PUMPING**





#### **GEOTHERMAL HVAC – HEAT PUMP UNITS & DOAS**





#### **GEOTHERMAL HVAC**

- ✓ Distributed Heat Pump Units throughout – took advantage of existing crawlspace
- ✓ Dedicated OA System with Demand Control Ventilation
- ✓ MERV 13 Filtration & UV Lighting



### **Renewable Energy – Solar PV**

- ✓ 391 kw PV -> 18 EUI
- $\checkmark$  All on the Roof
- ✓ Predictive Energy Model Needed





What did it Cost?

### <u>Owner's Total Budget</u> \$24,392,000 \$360/SF

Actual Bid	<u>Results</u>	
Building	\$20,920,000	\$309/SF (Feb.2021)
<b>PV Array</b>	\$1,100,000	\$17/SF (Nov.2021)
Total	\$22,020,000	\$326/SF

### **Don't forget about Utility Incentives!**

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- ✓ Leverage Available Incentives
- ✓ Contact Utility Company Early in Process
- ✓ Inflation Reduction Act Potential
- ✓ \$266,789 Incentive for the Owner

# THANK YOU



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