

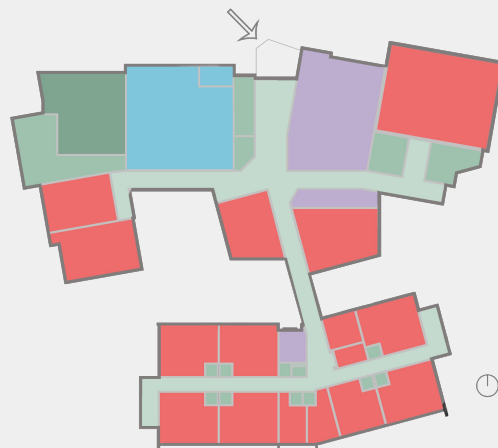


EOS

"ee-ose" [Greek]: dawn

# BASELINE

## PROJECT INTRODUCTION



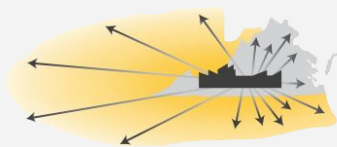
<b>Location</b>	Rural Virginia
<b>Climate Zone</b>	Climate Zone 4A
<b>Building Type</b>	Educational (E)
<b>Construction Type</b>	Type II-B *
<b>Design Occupancy</b>	350 Students + Faculty
<b>Design Floor Area</b>	38,500 sq. ft.
<b>Design Story/Height</b>	2 stories, max height 39'-0"

- learning spaces
- administration
- cafeteria/stage
- circulation/mech/  
storage

WE SEE OUR DESIGN AS AN OPPORTUNITY TO DEVELOP A NET ZERO PROTOTYPE FOR SCHOOLS ACROSS VIRGINIA AND OTHER STATES IN THE MIXED HUMID CLIMATE ZONE.

# DESIGN GOALS

PROJECT INTRODUCTION

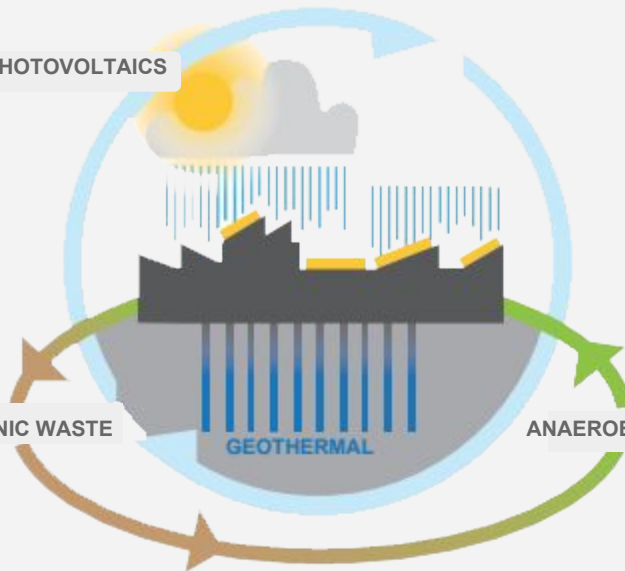


REGIONAL REPLICABILITY



COMMUNITY ENGAGEMENT

PHOTOVOLTAICS

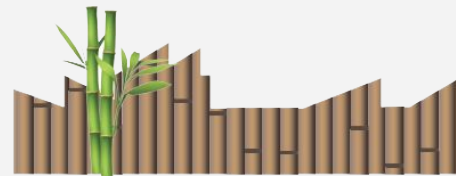


ORGANIC WASTE

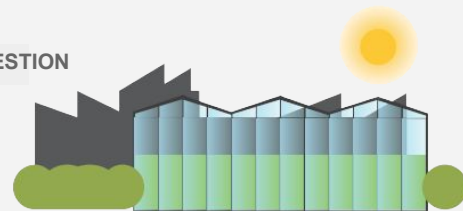
GEOTHERMAL

ANAEROBIC DIGESTION

## CYCLICAL SYSTEMS



SUSTAINABLE MATERIALS



LIVING CLASSROOM

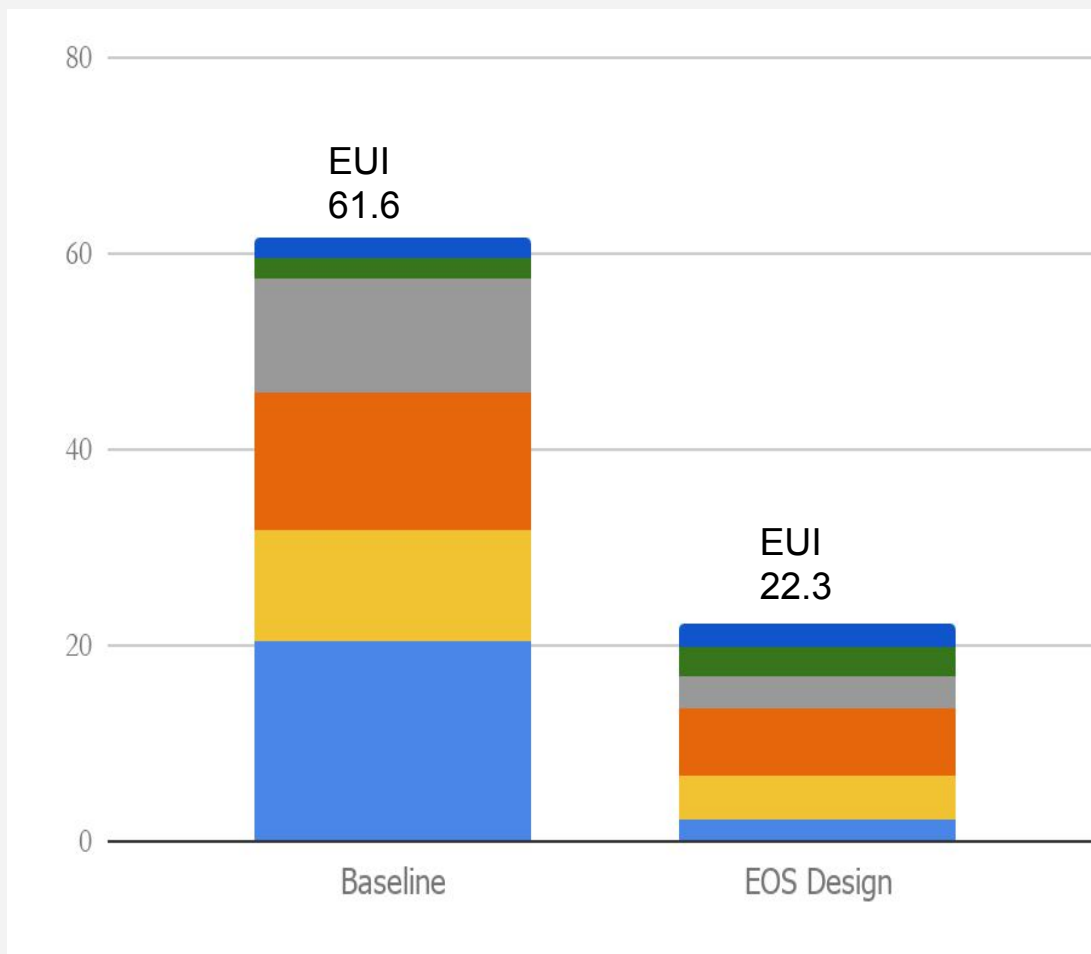
PROJECT INTRODUCTION





# FROM LEED TO NET ZERO

DESIGN CONSTRAINTS



- Water Systems
- Interior Equipment
- Heating
- Interior Lighting
- Fans
- Cooling

# DAYLIGHTING ISSUES

DESIGN CONSTRAINTS

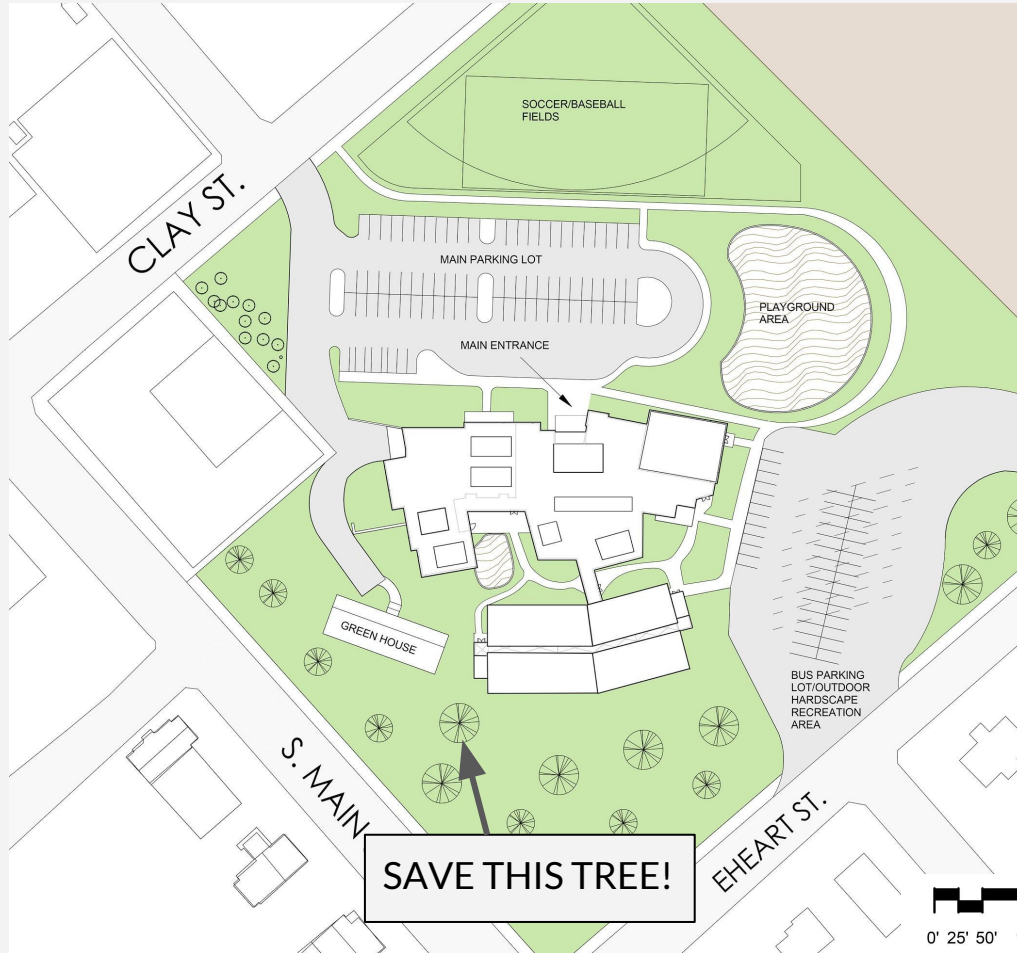


Glazing covered by paper



# NEW SITE: BLACKSBURG, VA

DESIGN CONSTRAINTS



## THE BURGHS

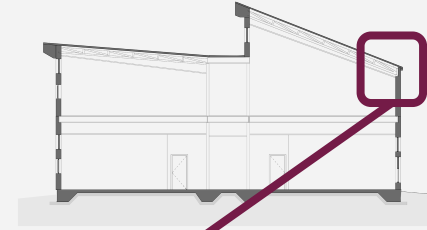
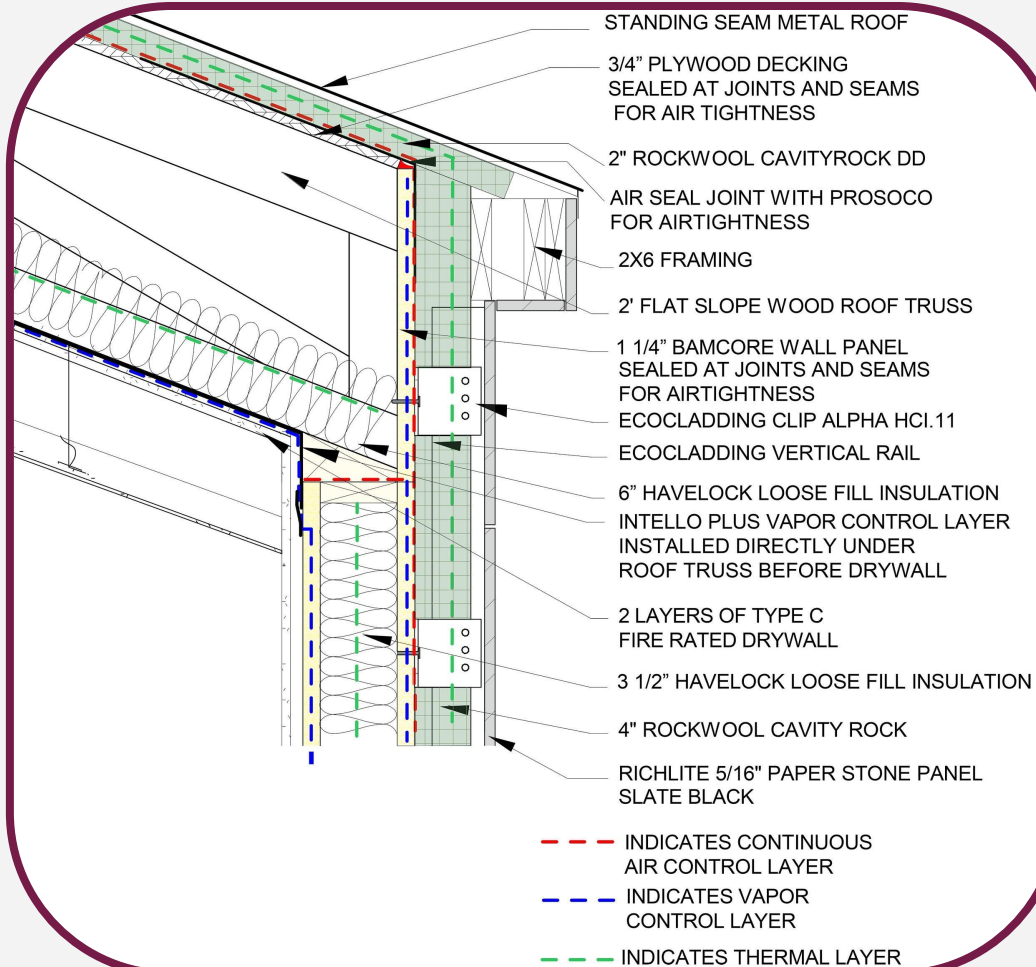
Serving Blacksburg, Christiansburg and the New River Valley

*"The future of the well-known oak tree on the form Blacksburg Middle School site is in jeopardy."*  
Wednesday March 14, 2018



# WALL AND ROOF ASSEMBLY

ENCLOSURE DESIGN

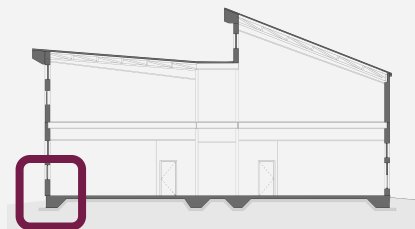
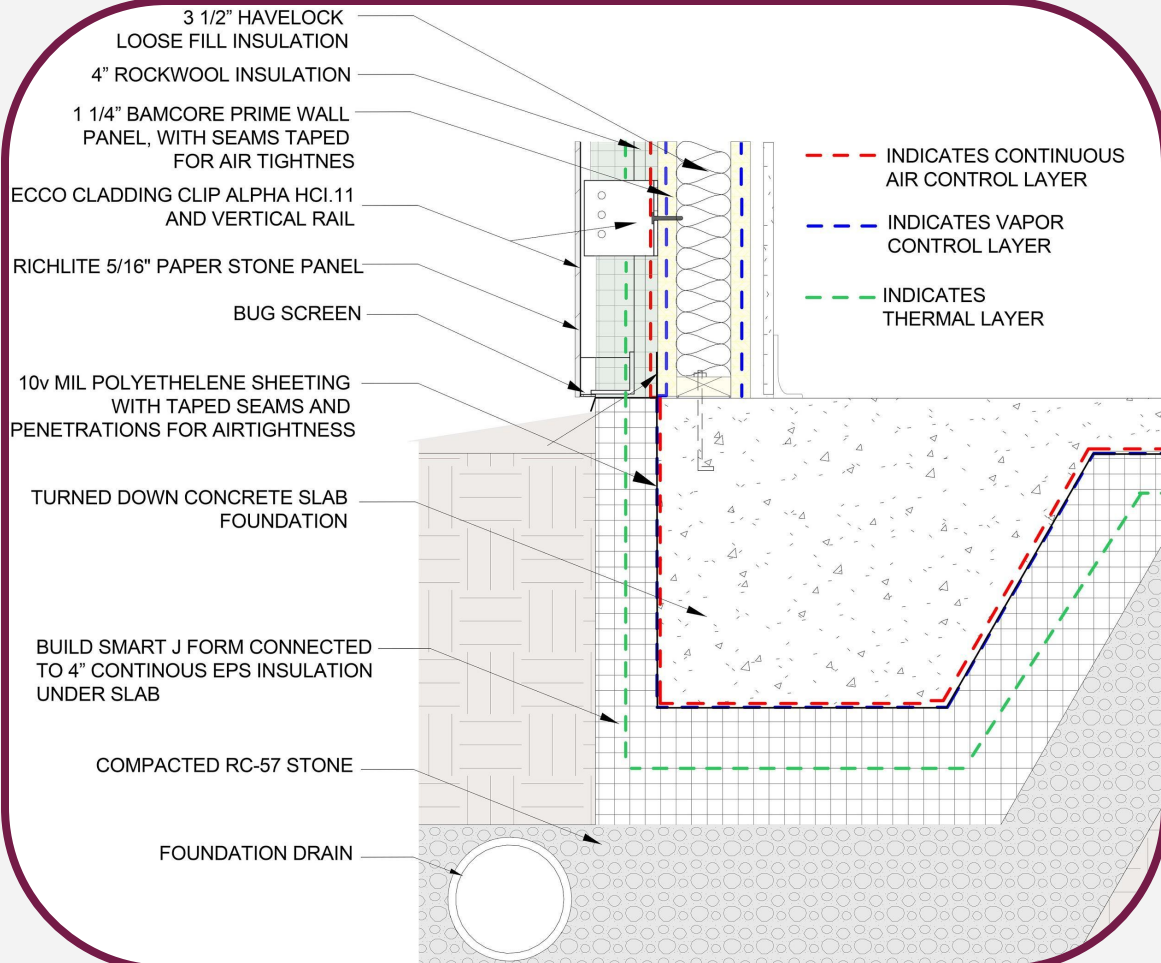


**ROOF R-44**  
**WALLS R-38.5**



# WALL AND FOUNDATION ASSEMBLY

ENCLOSURE DESIGN

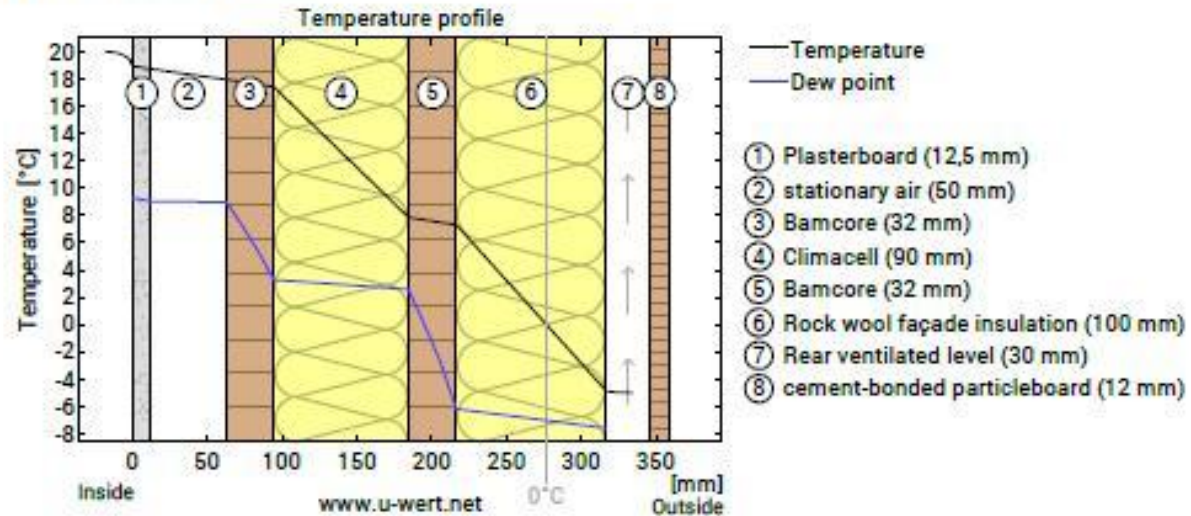


**FOUNDATION R-18**  
**WALLS R-38.5**



# HYGROTHERMAL ANALYSIS

Temperature profile



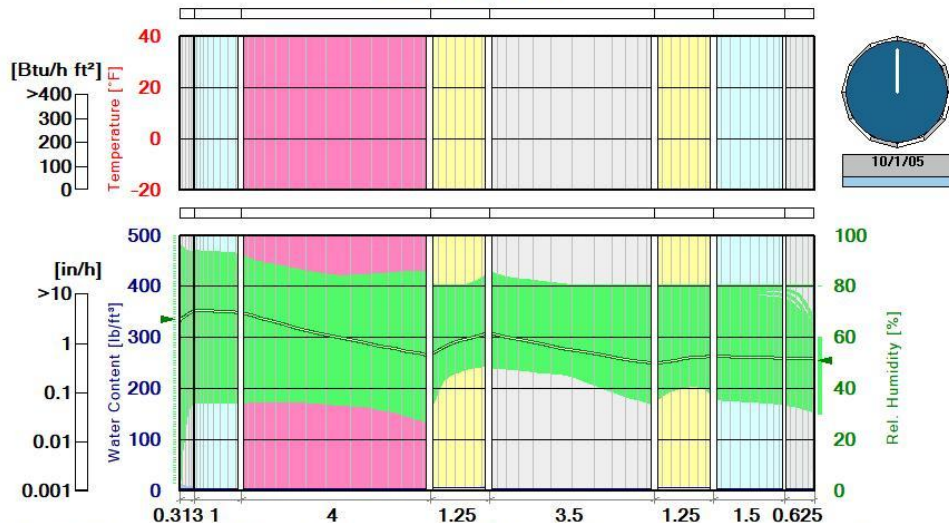
U Wert Analysis of 6" BamCore wall + 4" ROCKWOOL

# HYGROTHERMAL ANALYSIS

ENCLOSURE DESIGN

Location: USA\_VA\_Blacksburg-Virginia.Tech.AP.724113\_TMY3.epw; 0 °F;  
6" Bamcore, No VB

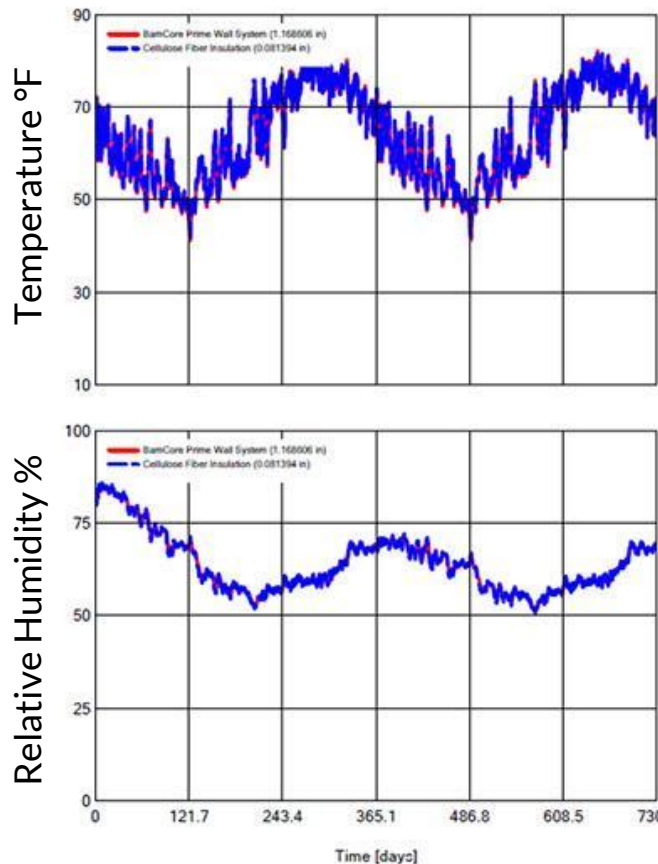
WUFI®



Wufi Pro 6.1 Analysis of  
6" BamCore Wall + 4" ROCKWOOL

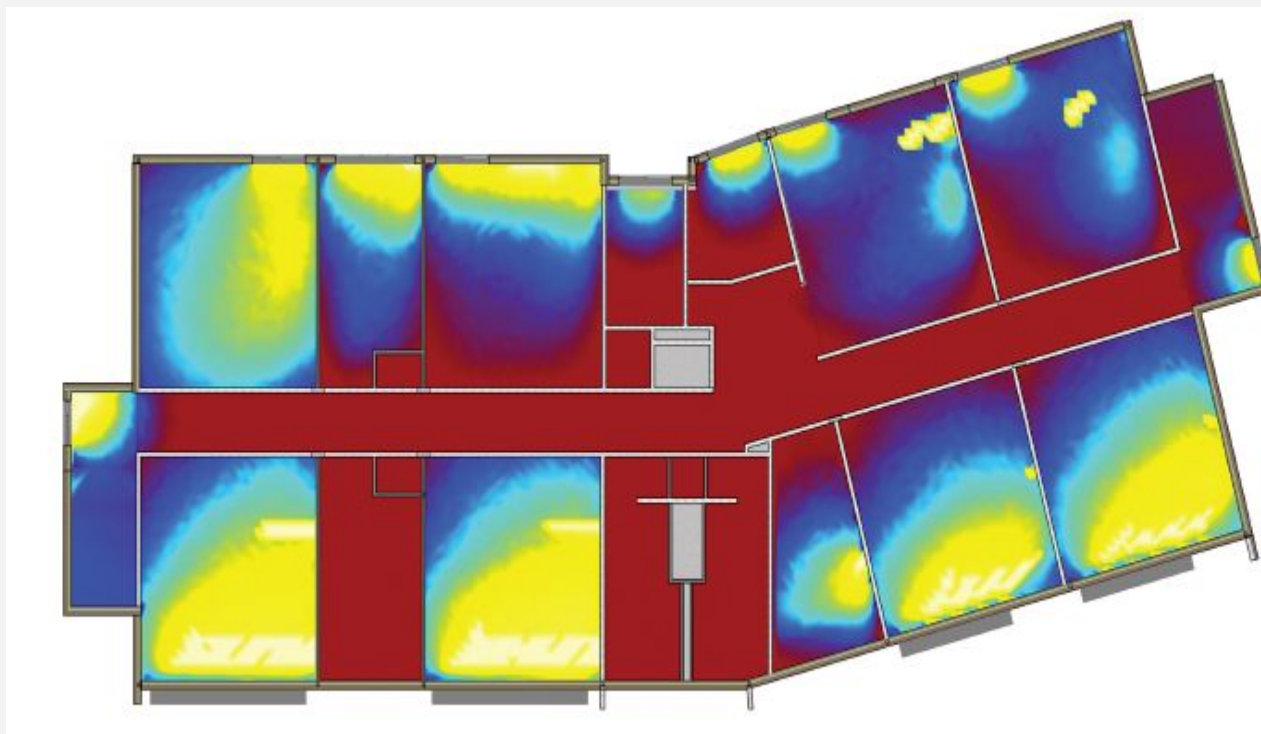


Temperature, RH (Monitor Position 3, 4)

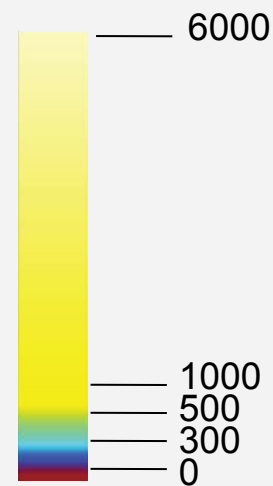


# ILLUMINANCE LIGHTING ANALYSIS

DAYLIGHTING



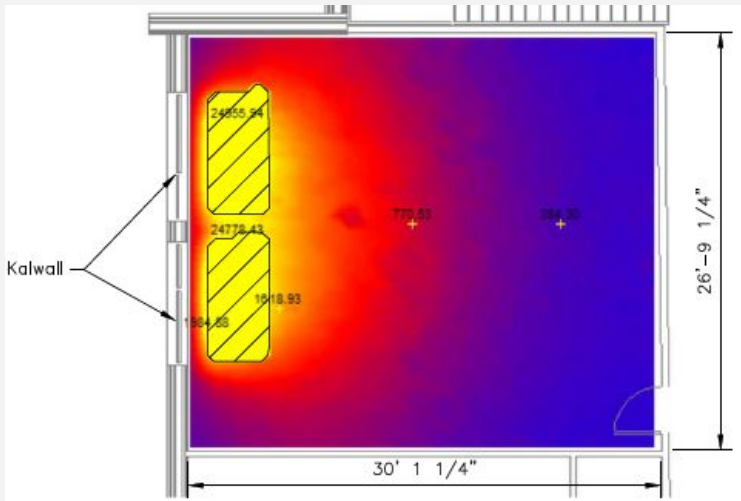
Winter Solstice 12.21



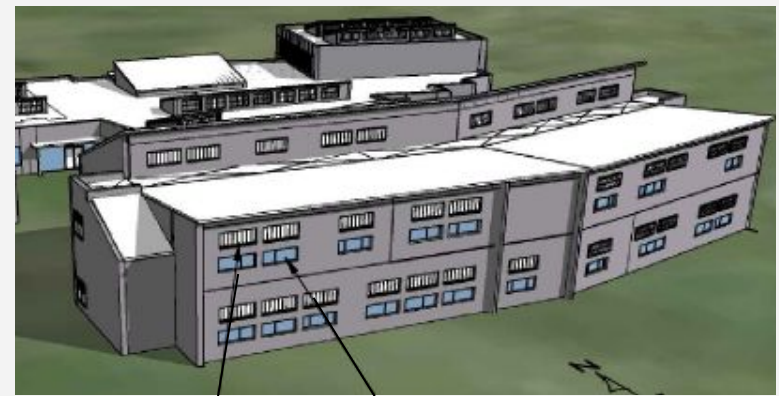
Illuminance  
Index (LUX)

# ILLUMINANCE LIGHTING ANALYSIS

DAYLIGHTING



Radiance Illuminance for December 21st at 12:00 pm during sunny sky  
 10.76 Lux = 1 fc. Task height is 2'-6"  
 Average Value is 209.9 fc (2259 lux)  
 Illuminance (300-3000 lux) = 67.7% of the area

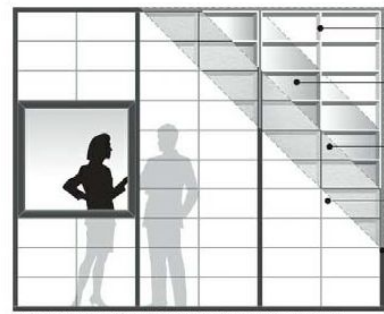


Kalwall  
10%VLT

Yaro Glass  
73%VLT

# KALWALL®

high performance translucent building systems



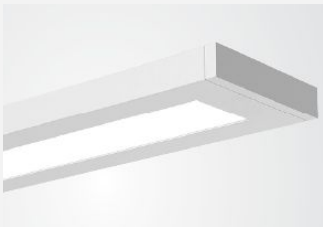
Kalwall's Translucent Sandwich Panel Technology is backed by over 60 years of experience.



# DAYLIGHTING FOR CLASSROOMS

**Peerless®**  
Lighting for People®

Bruno LED Softshine®  
BRM9L | LED | I/D or Direct | Suspended



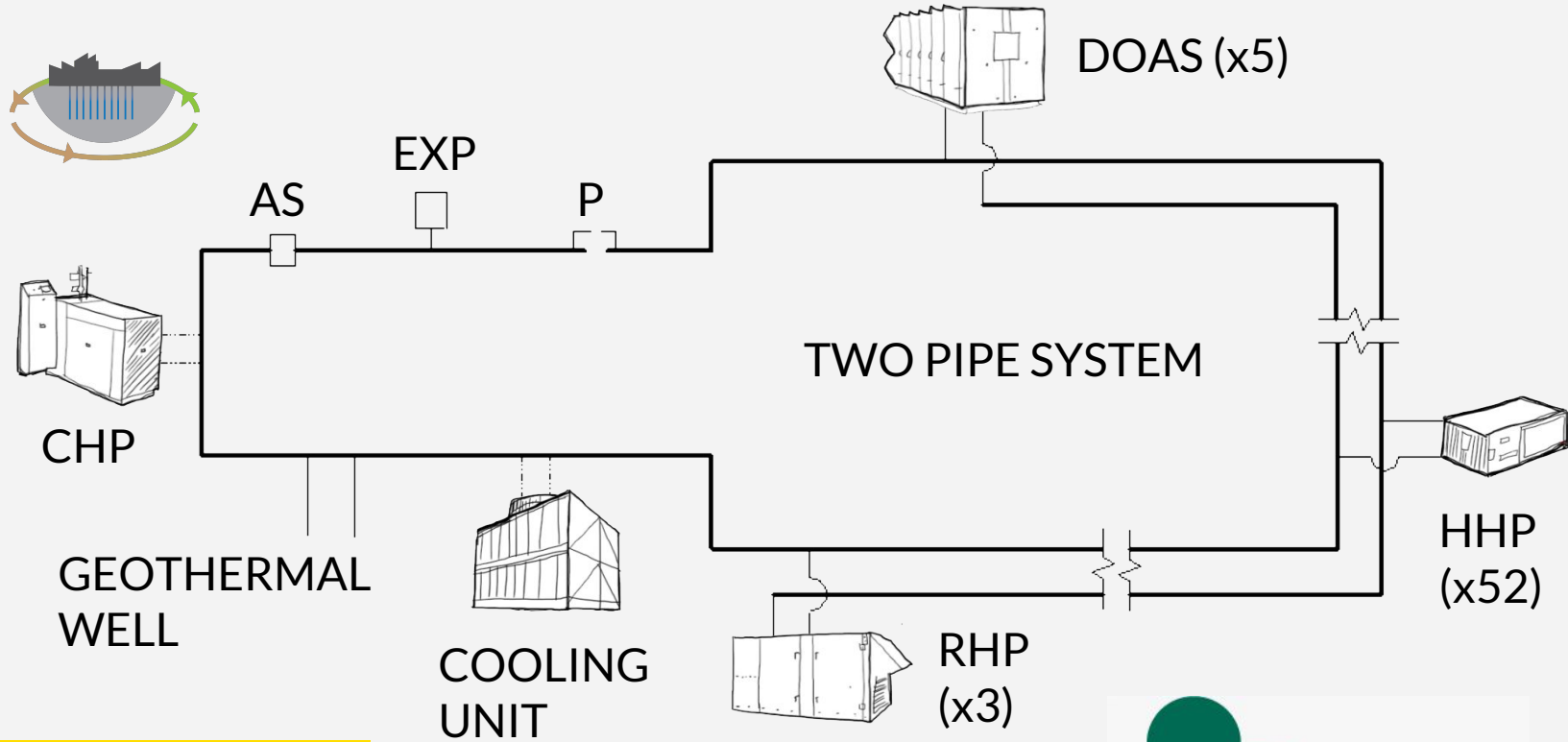
eldoLED



DAYLIGHTING



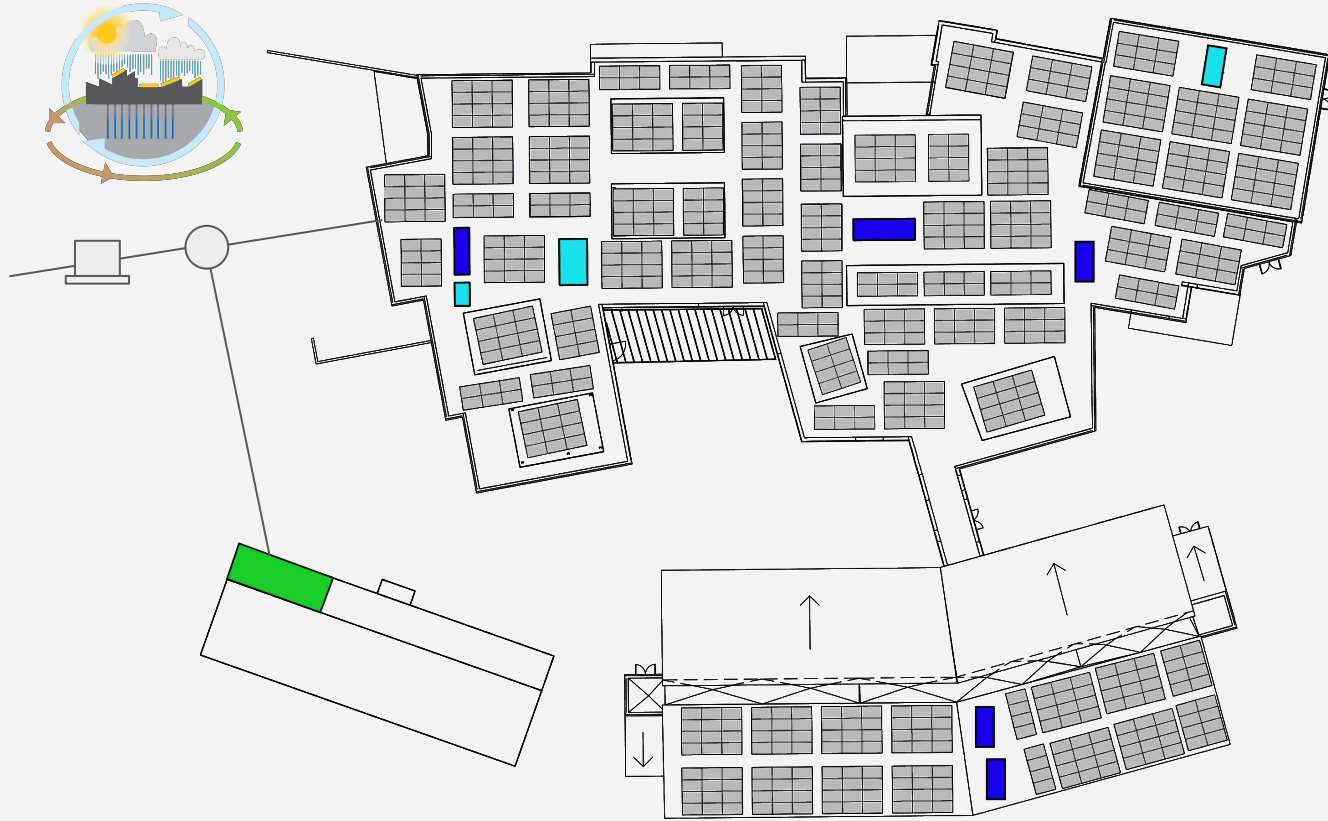
# MEP DESIGN







MEP DESIGN



# MEP DESIGN



-  RHP
-  DOAS
-  PV
-  CHP



MEP DESIGN

# PHYTOREMEDIATION

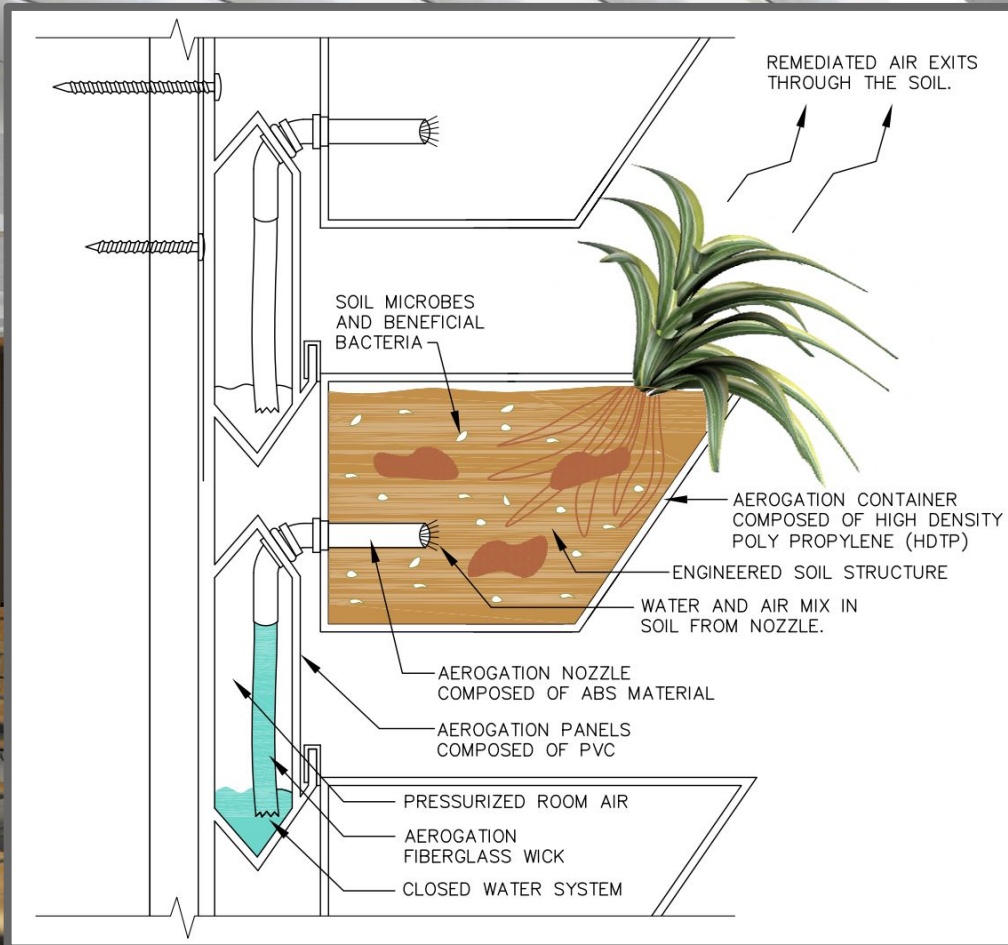


AEROGATION™

38%

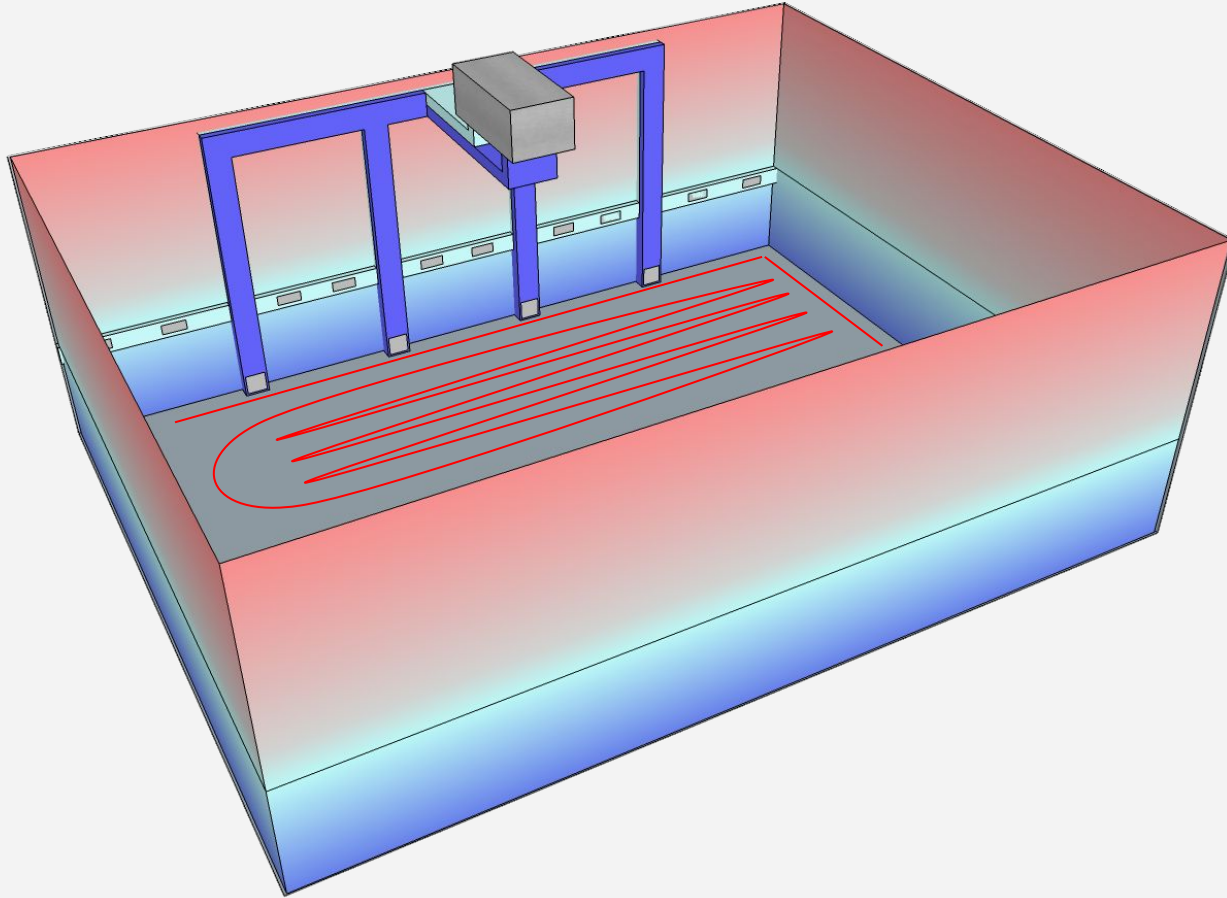


INDOOR AIR QUALITY



# DISPLACEMENT COOLING & VENTILATION

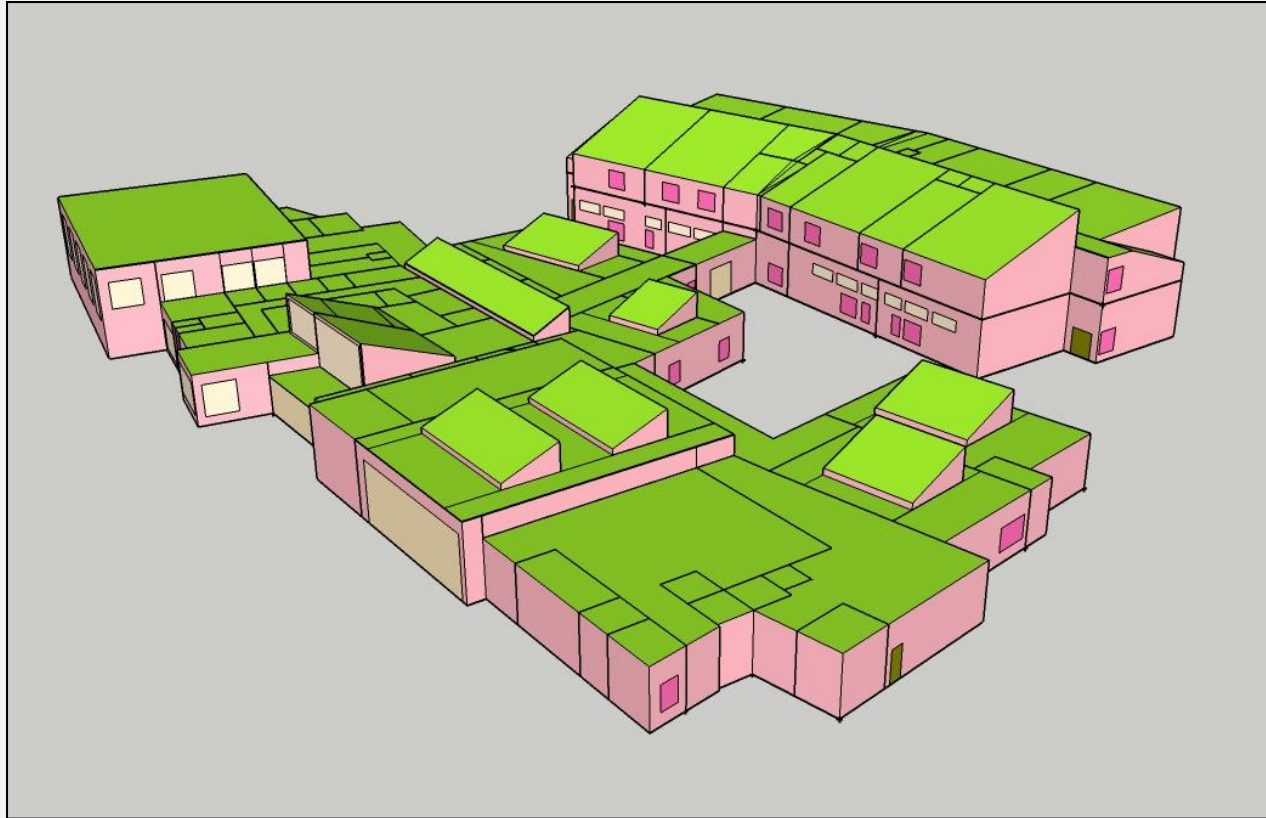
INDOOR AIR QUALITY



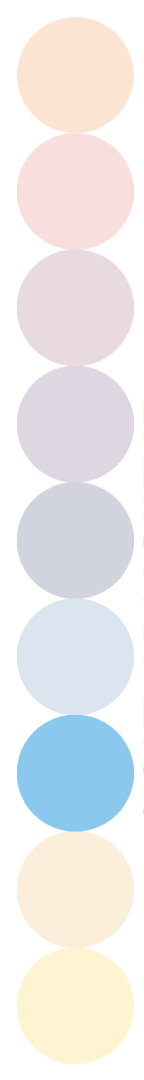
# ENERGY ANALYSIS



# BASELINE ENERGY MODEL

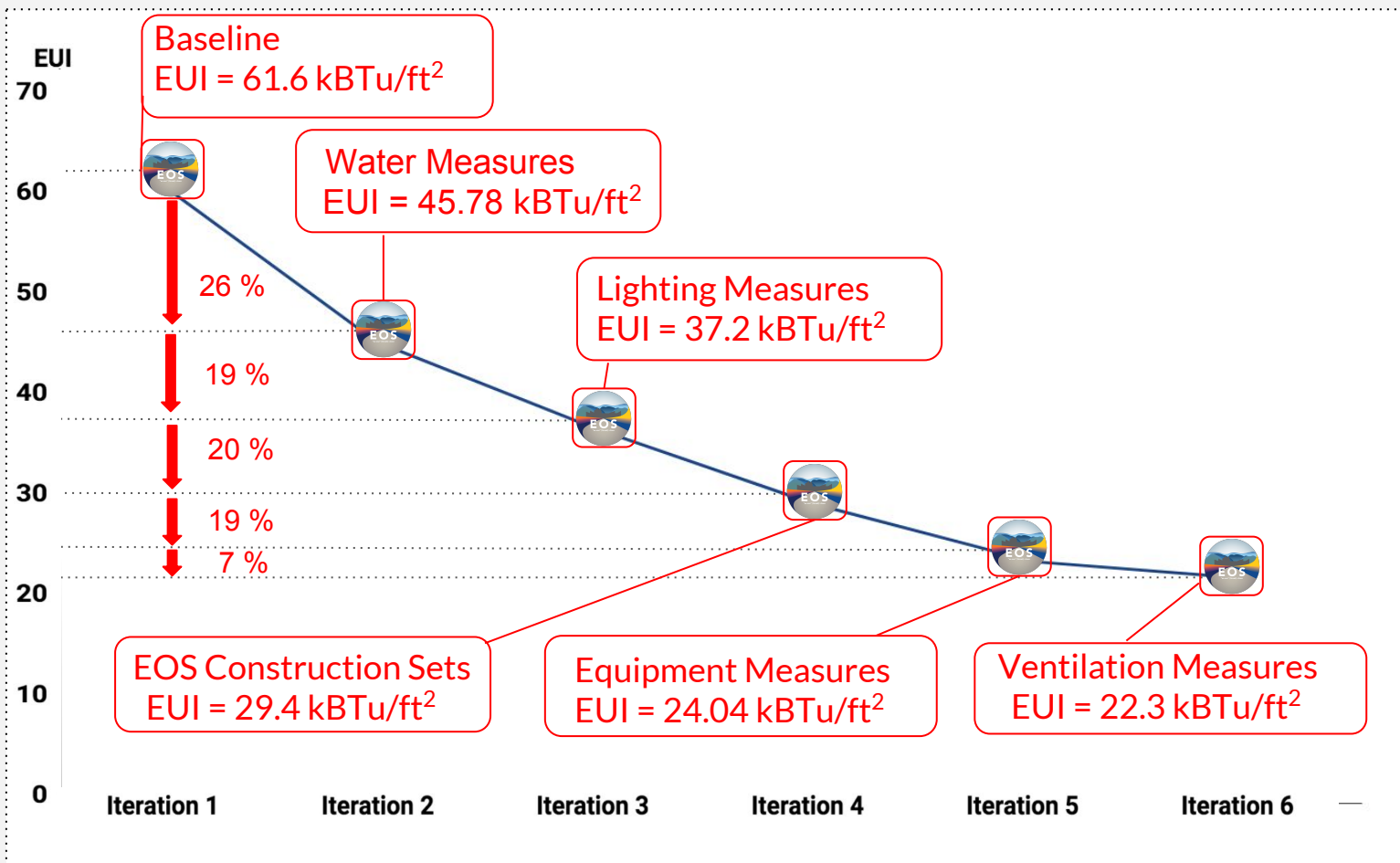


ENERGY ANALYSIS



# ENERGY MODELING PROGRESSION

ENERGY ANALYSIS



RSMMeans data

from **GORDIAN**<sup>®</sup>

+

QUOTES FROM INDUSTRY PARTNERS

# FINANCIAL ANALYSIS

National Medians	\$/Sq. Ft.	\$/Per Student	Sq. Ft./Per Student	No. of Students	Building Size (Sq. Ft.)	Building Cost
Elementary Schools	\$211	\$44,800	173	624	84,700	\$16,269,543
Middle School	\$229	\$43,600	173	612	118,500	\$26,500,000
High Schools	\$229	\$43,600	180.0	1,000	173,727	\$45,000,000

# SCHOOL

## Planning & Management

### REGION 3 MEDIAN NEW SCHOOLS (DC, DE, MD, VA, WV)

	Elementary	Middle	High
\$/sq. ft.	\$236.67	\$198.07	\$224.47
\$/student	\$59,102	\$46,879	\$63,333

The median elementary school in Region 3 cost \$236.67 per square foot or \$59,102 for each of the 700 students accommodated. The



### 20TH ANNUAL SCHOOL CONSTRUCTION REPORT

Size (sq. ft.)	10,000	20,000	300,000
Total cost (\$000)	\$25,000	\$21,450	\$80,000

200 square foot per student.



FINANCIAL ANALYSIS

# Our Cost \$184/SF

# FINANCIAL ANALYSIS

## RESULTS



# 333,766 kWh/Year\*

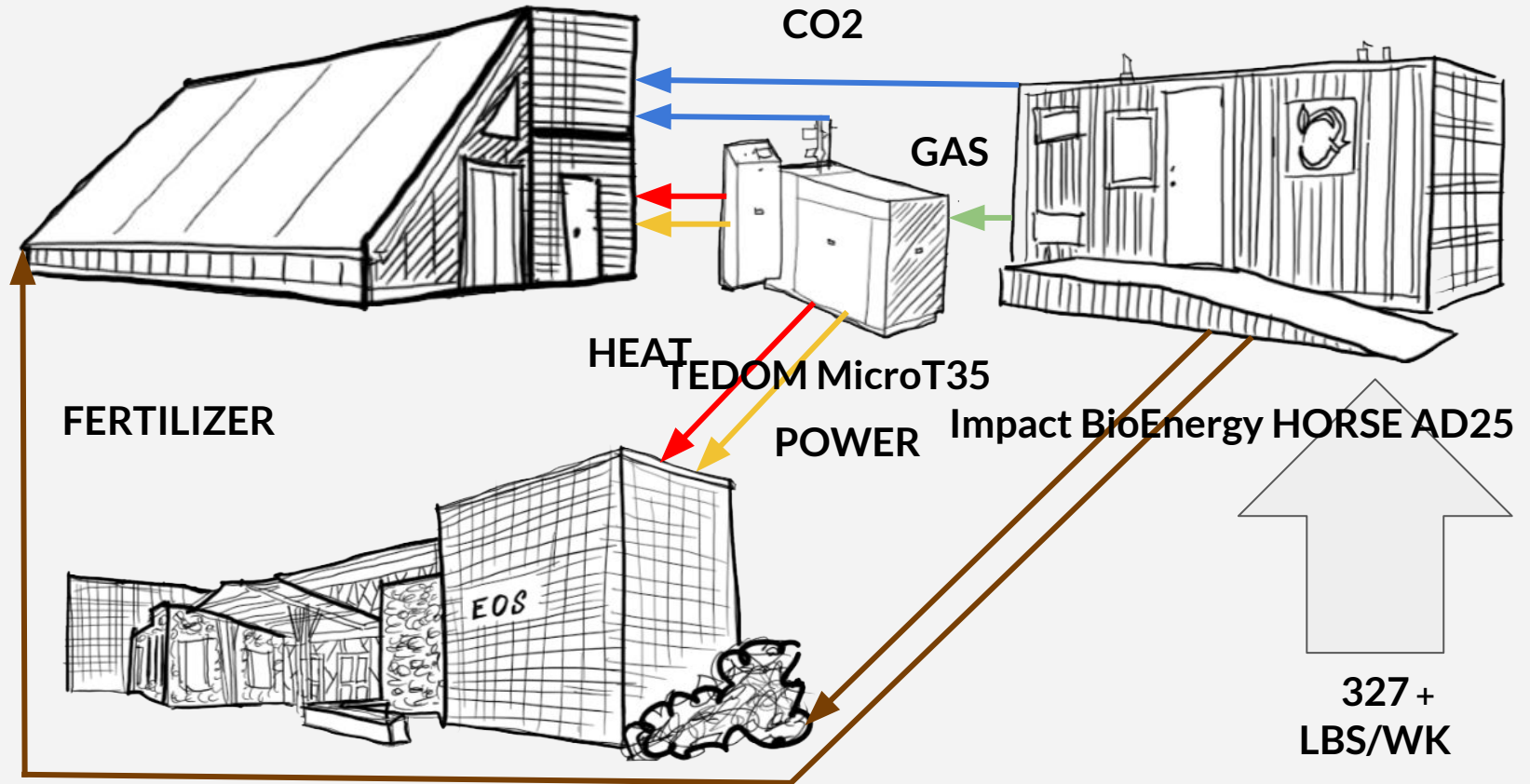
System output may range from 320,082 to 344,680kWh per year near this location.

Click [HERE](#) for more information.

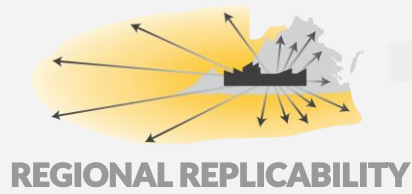
Month	Solar Radiation ( kWh / m <sup>2</sup> / day )	AC Energy ( kWh )	Energy Value ( \$ )
January	2.33	16,643	1,425
February	3.56	22,187	1,899
March	3.63	25,177	2,155
April	5.87	37,088	3,175
May	5.74	36,457	3,121
June	6.03	36,298	3,107
July	5.55	34,159	2,924
August	6.01	37,026	3,169
September	4.40	27,034	2,314
October	3.97	25,514	2,184
November	3.01	19,383	1,659
December	2.39	16,799	1,438
<b>Annual</b>	<b>4.37</b>	<b>333,765</b>	<b>\$ 28,570</b>



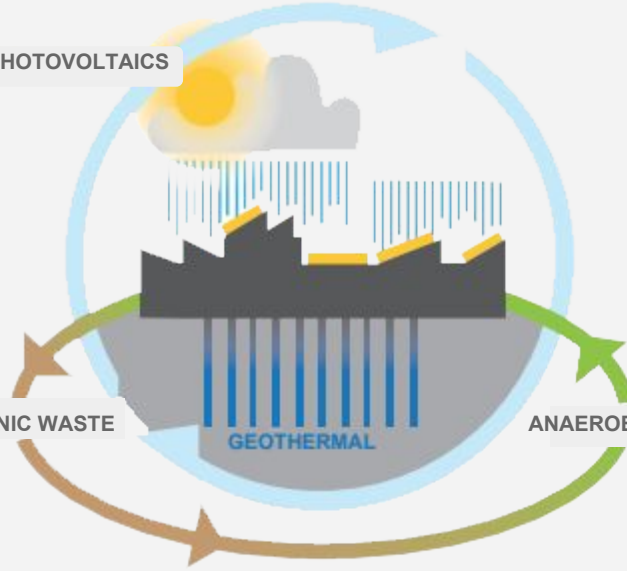
# GREENHOUSE + ANAEROBIC DIGESTION



# A NEW DAWN IN ZERO ENERGY SCHOOL DESIGN



PHOTOVOLTAICS



LIVING CLASSROOM





EOS

"ee-ose" [Greek]: dawn