Net Zero Energy Ready
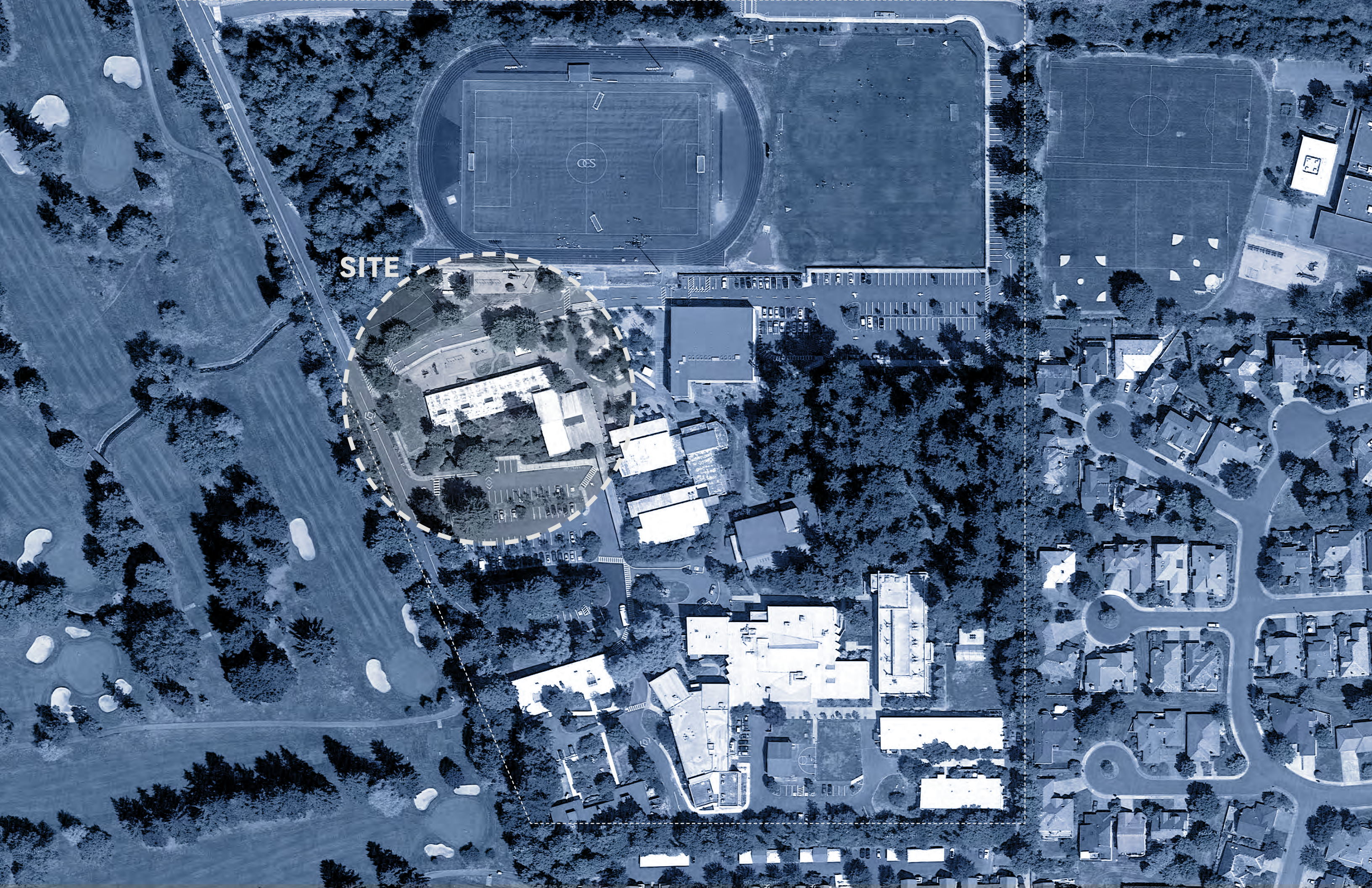
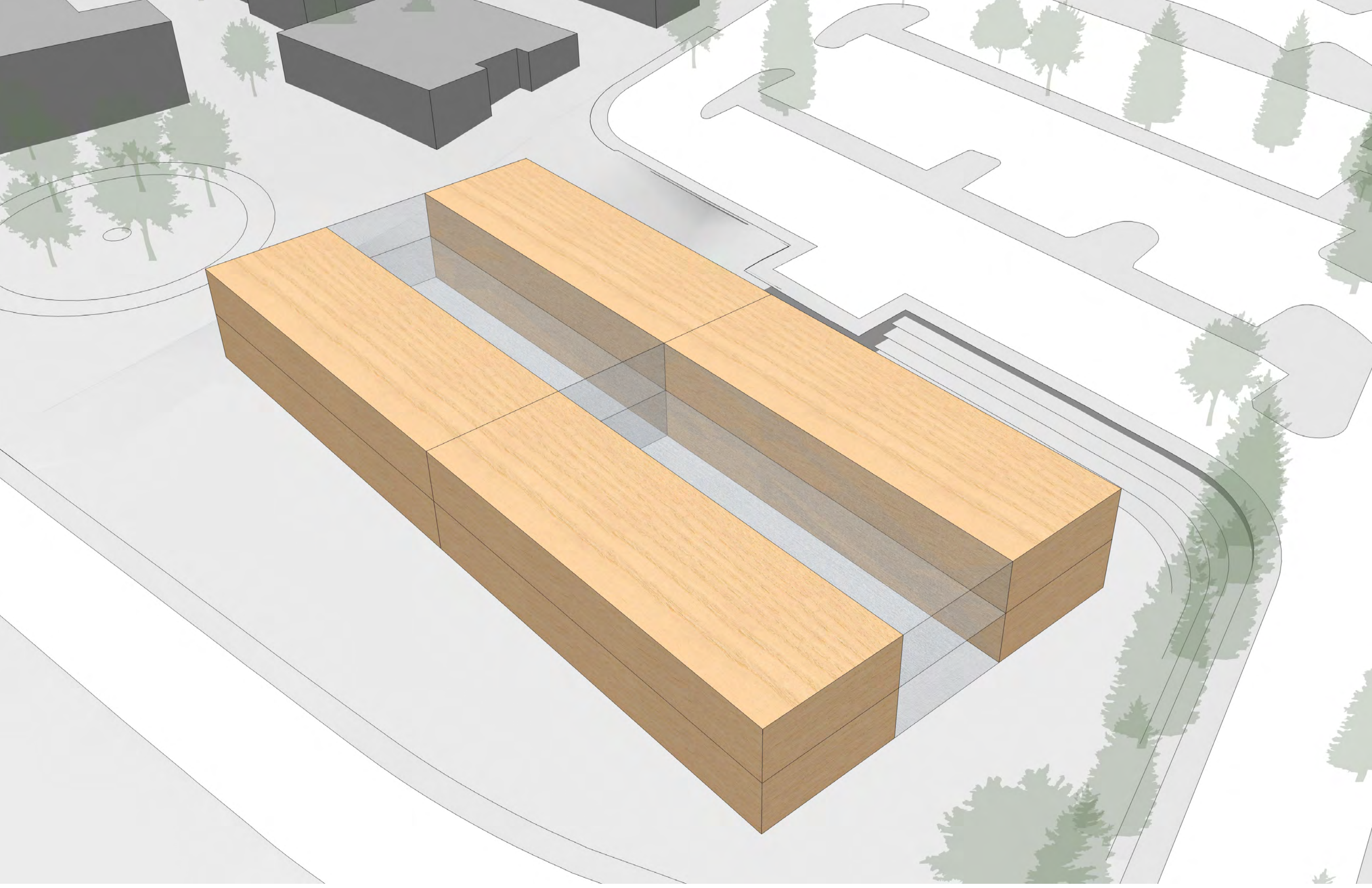## How Early Collaboration leads to a Passive Building
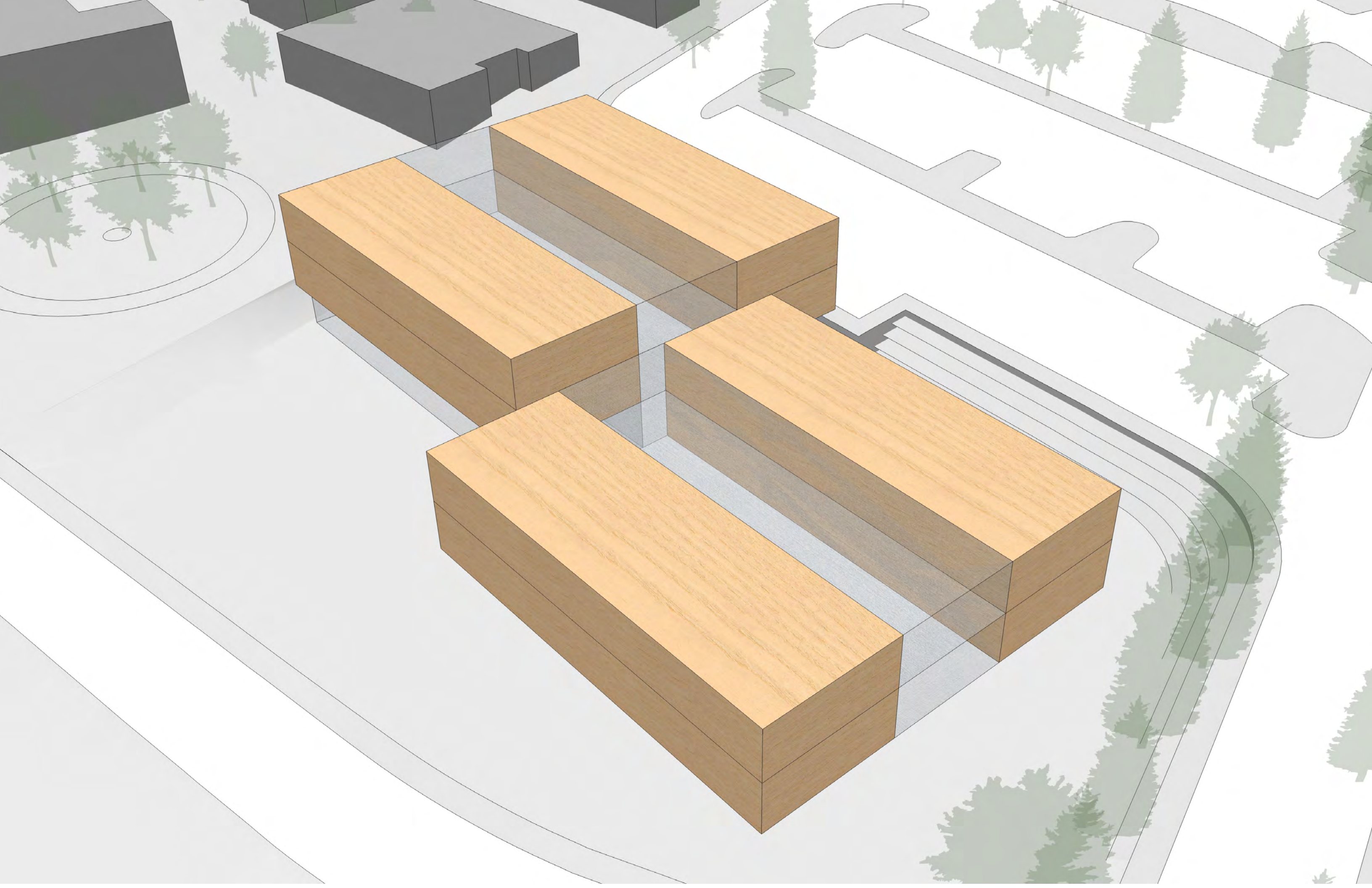
APEM Forum
February 16, 2018

HACKER + PAE

SITE

Energy Use Goal Setting and Solar Resource

EUI (kBtu/sf/year)

80

70

60

50

40

30

20

10

0

Existing | Typical | Good (Code) | Better | Best | Solar Resource

Arch 2030 and Net Zero Energy Goal

270 kW Array

Energy Use Breakdown

Energy Use Breakdown

- EXT USAGE 4%
- DOMEST HOT WTR 7%
- LIGHTS 20%
- VENT FANS 18%
- PLUG LOADS 15%
- PUMPS & AUX 3%
- SPACE COOLING 4%
- SPACE HEATING 30%

PAE
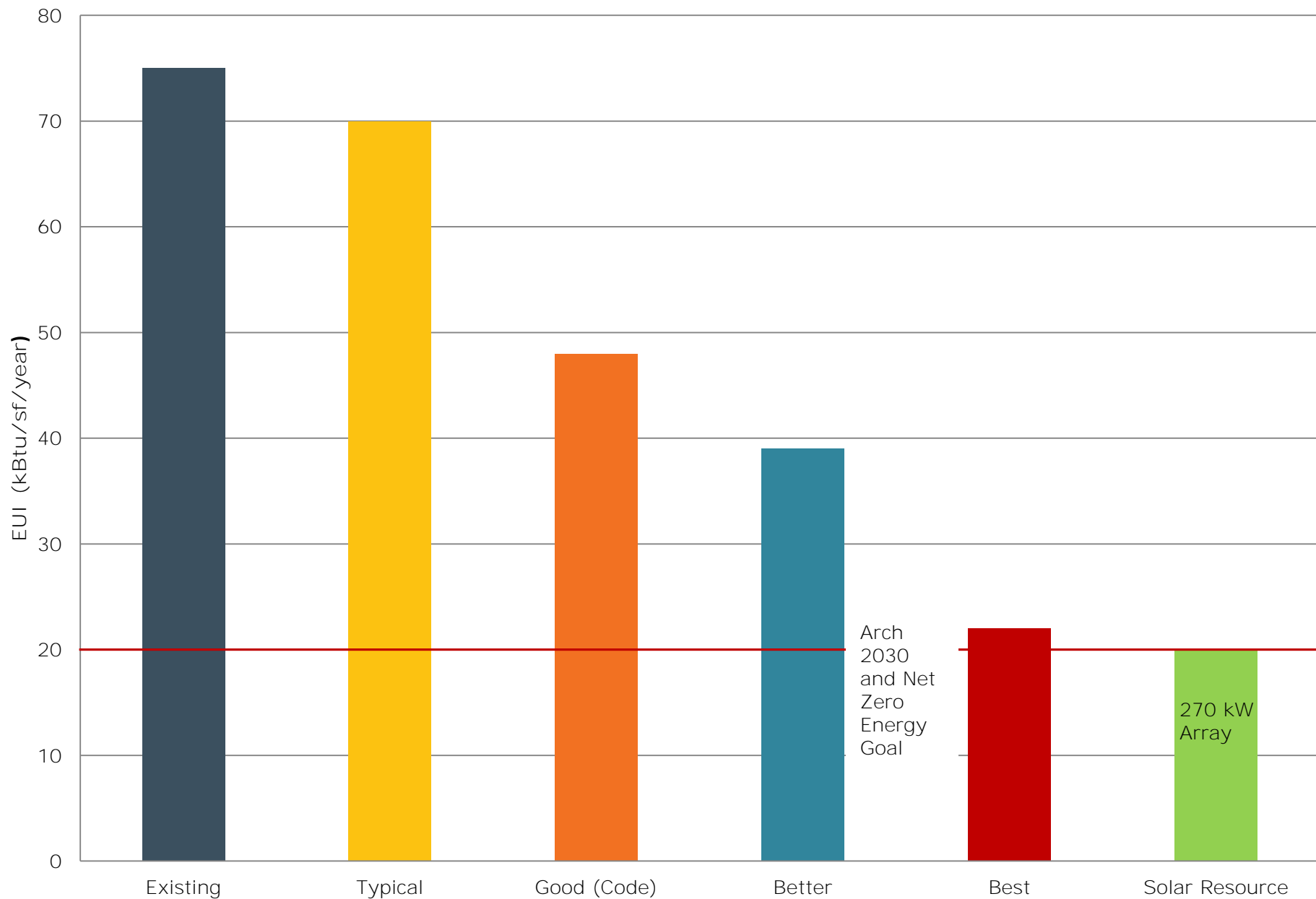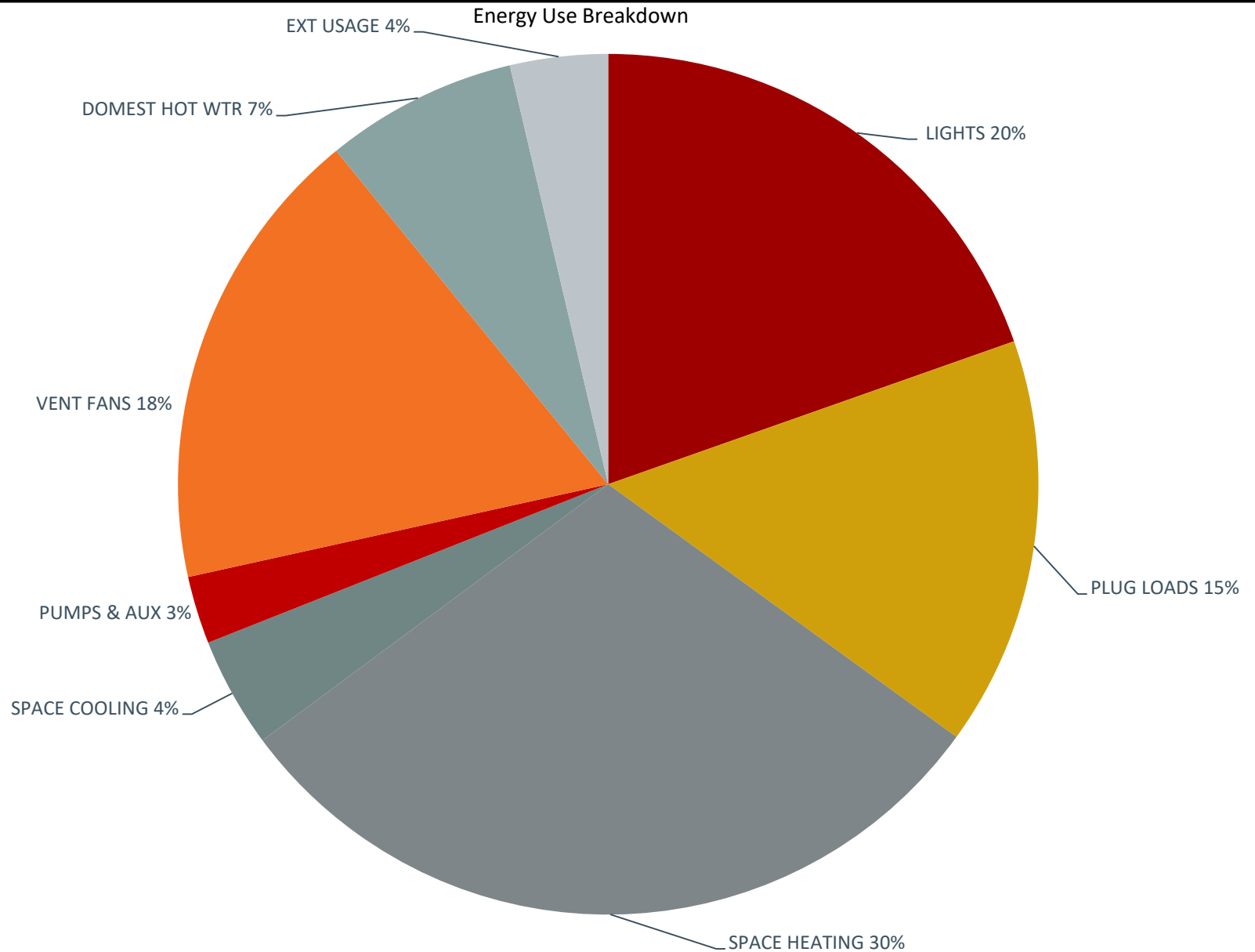
Heating Energy Breakdown

WALL HEATING ENERGY
9%

WINDOW HEATING ENERGY
32%

ROOF HEATING ENERGY
6%

EXPOSED FLOOR
3%

INFILTRATION
18%

VENTILATION HEATING ENERGY
32%
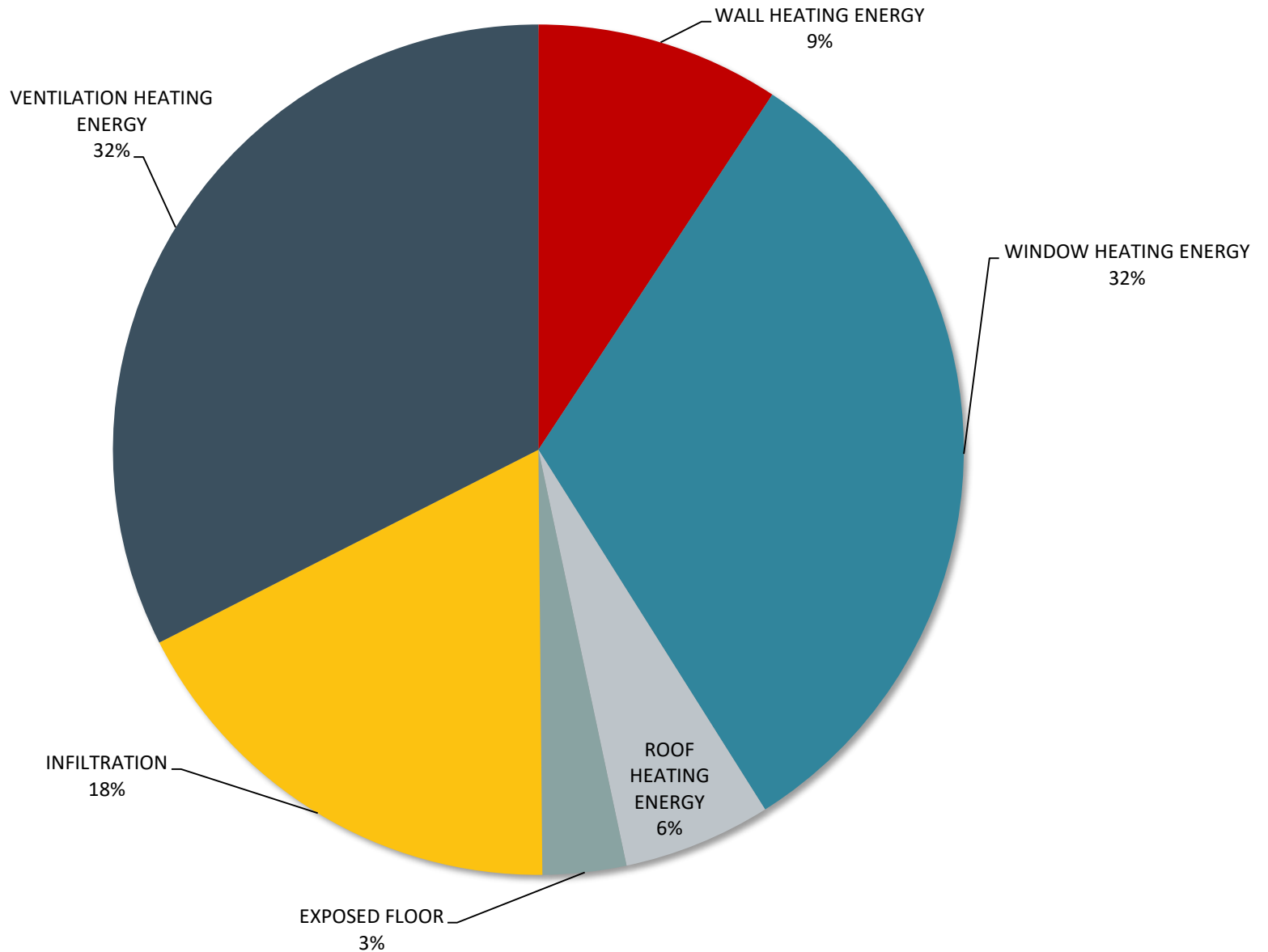
Passive Design – Costs

Case Study: Oregon Episcopal School, new Lower School

- 45,000 sf

- 2 story wing and 3 story wing

- K-5 classrooms

- Media Center

- Commons/Cafeteria

- Administration

Area	Cost
Total	$260/sf
Shell	$60/sf
Interiors	$40/sf
Nat Vent Shafts	$2.50/sf
HVAC	$15/sf
Electrical	$20/sf

Spend money on the envelope and eliminate the HVAC!

NET-ZERO STRATEGIES

VENTED RAINSCREEN

ROBUST INSULATION

PASSIVE COOLING

Options

Good (Code):
- Code building enclosure
- Code lighting
- Connect to campus chilled water/heating water
- Added 170-ton Chiller
- 50,000 CFM VAV Air Handling Unit
- 5,000 CFM VAV AHU for Media and Dining
- Gas water heater
- Code plumbing fixtures

Energy Use Index: ~48
Energy Cost Index: $0.90/sf
Simple Payback: N/A

Better+:
- R-30 wall, R-40 roof
- Better windows
- Tighter building
- 45% reduction in lighting
- Connect to campus chilled water/heating water
- Naturally cooled classrooms
- 25,000 CFM Ventilation unit with heat recovery
- 5,000 CFM VAV AHU for Media and Dining

Energy Use Index: ~38
Energy Cost Index: $0.75/sf
Simple Payback: 17 years

Best:
- R-40 wall, R-50 roof
- Triple glazed windows
- Very tight building
- 60% reduction in lighting
- DOAS w/ heat recovery
- No connection to campus loops
- Natural cooling everywhere
- 25,000 CFM ventilation unit with heat recovery
- Minimal electric heat for warmup and night setback

Energy Use Index: 22
Energy Cost Index: $0.45/sf
Simple Payback: 11 years

3.3 Building Envelope

The OES Lower School is a new two and a half story building which will house classrooms for pre-kindergarten through 5th grade. The building will be oriented along an east west axis, and the glazing along the north and south of the building will allow for plentiful daylighting.

A summary of the modeled building envelope compared to code is shown below:

Building Element	Parameter	2010 Oregon Energy Specialty Code	Model Inputs
Roof	Type		Concrete roof with Closed Cell Polystyrene Insulation
	Minimum Insulation	R-20ci	R-50ci
	Maximum U-Value	0.048	0.019
Walls	Type	Wood Framed	Wood Framing, 24" o.c. R-21 batt R-20ci Plaster Interior
	Minimum Insulation	R-13 + R-3.8ci	R-40
	Maximum U-Value	0.064	0.025
Floors	Type		Assumed to be carpeted unless otherwise noted
Vertical Glazing	Type		Double Paned
	U-value	0.46	0.4
	SHGC	0.4	0.4

Table 1: Summary of Building Envelope

Climate Analysis – Bin Data Typical

Temperature Bins Portland

Active Heating Zone
4719 hours, 54%

3141 hrs,
36%

Active Cooling Zone
900 hours, 10%

HOURS

1400
1200
1000
800
600
400
200
0

-15 TO -10, -10 to -5, -5 to 0, 0 to 5, 5 to 10, 10 to 15, 15 to 20, 20 25, 25 to 30, 30 to 35, 35 to 40, 40 45, 45 to 50, 50 to 55, 55 to 60, 60 to 65, 65 to 70, 70 to 75, 75 to 80, 80 to 85, 85 to 90, 90 to 95, 95 to 100

TEMPERATURES

■ 0 to 20 RH   ■ 20 to 40 RH   ■ 40 to 60 RH   ■ 60 to 80 RH   ■ 80 to 100 RH
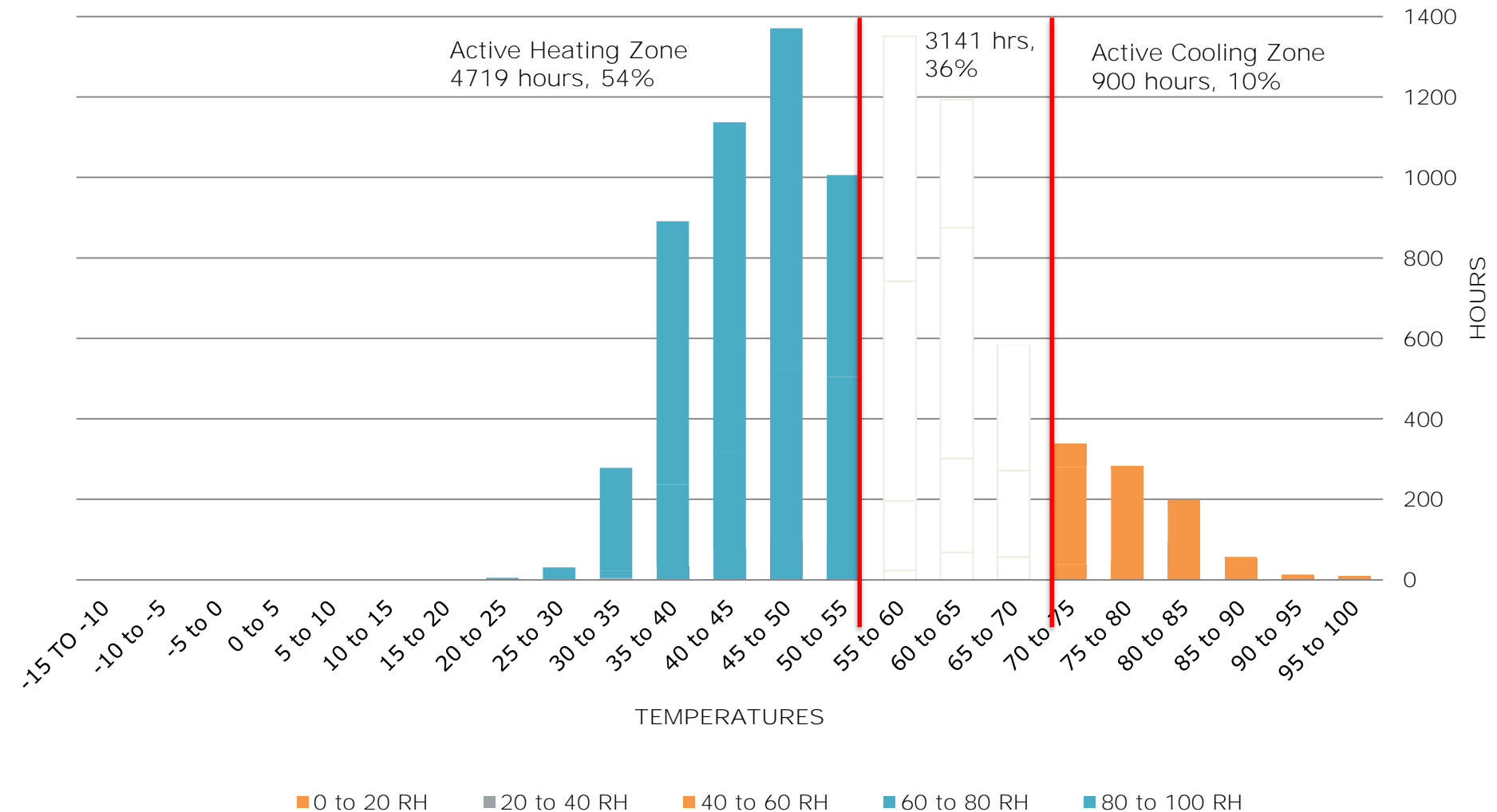
Climate Analysis – Bin Data Passive

Temperature Bins Portland

Active Heating Zone, 1205 hrs, 14%

Passive Zone, 7276 hrs, 83%

Active Cooling Zone, 279 hrs, 3%

HOURS

TEMPERATURES

0 to 20 RH   20 to 40 RH   40 to 60 RH   60 to 80 RH   80 to 100 RH
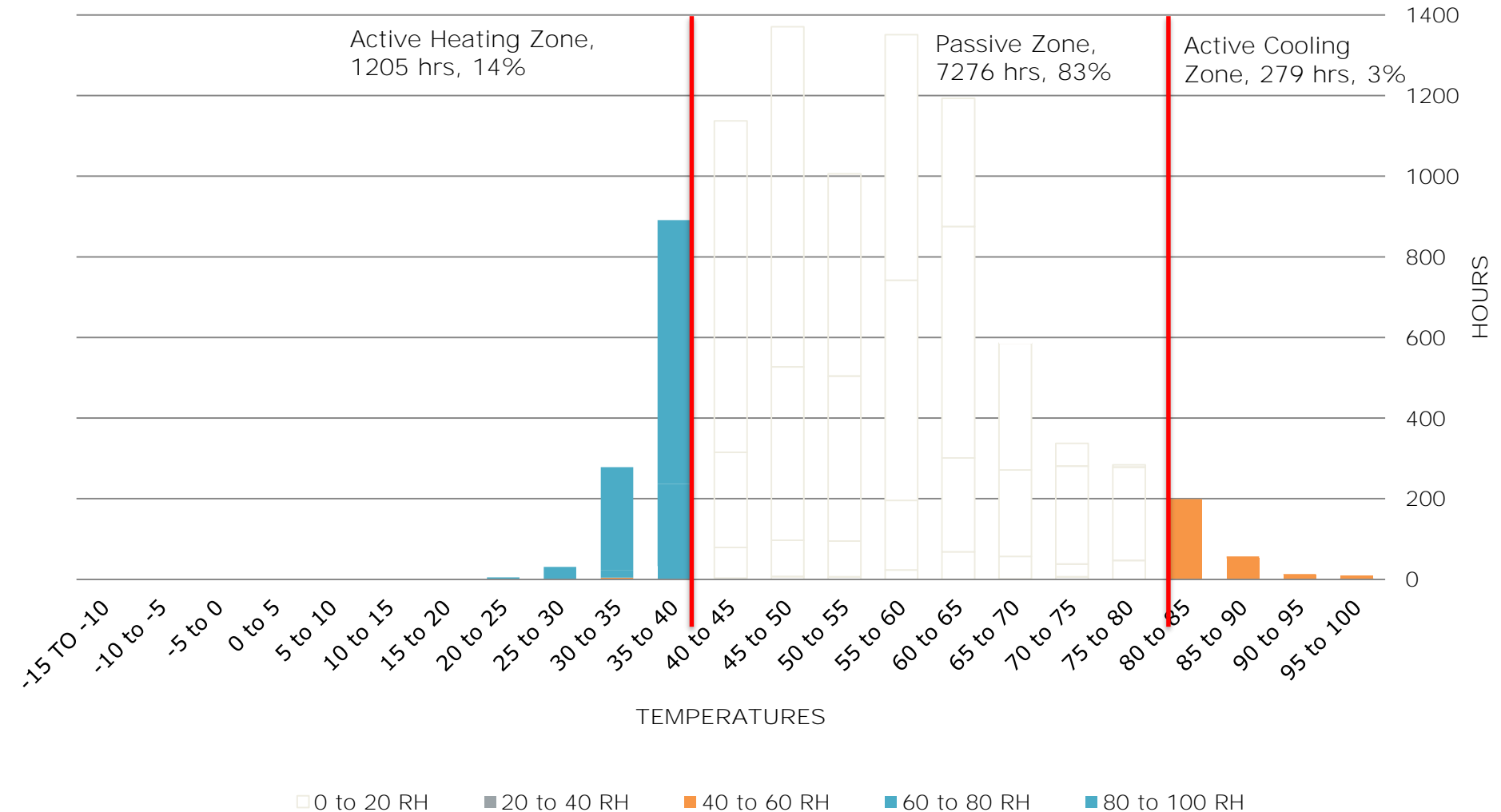
Passive Schools

Things to think about

- Passive classrooms

- Fully conditioned other areas

- Occupant control

- Simplicity

- Maintainability

- Operating Expenses

- Acoustics

- Comfortable learning

- Early design collaboration

- Early modeling and costing

Passive Cooling
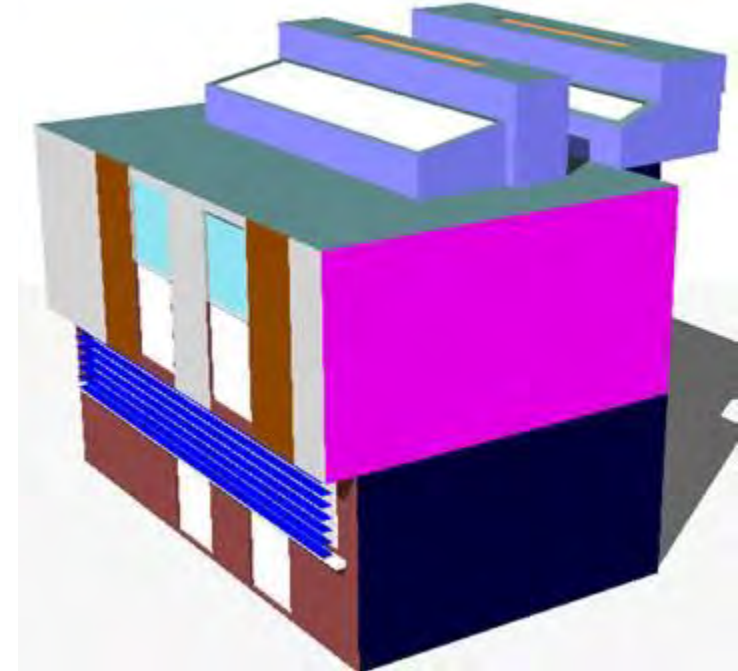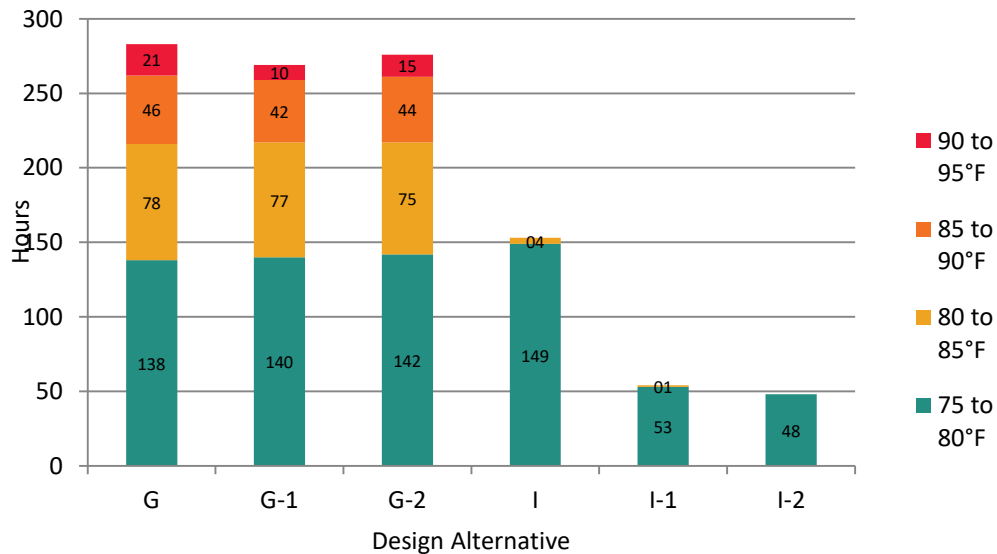
Bulk Airflow Modeling

South Facing 2nd Floor Classroom
Annual Hours Between 7am-5pm Above 75°F

Legend:
- 90 to 95°F
- 85 to 90°F
- 80 to 85°F
- 75 to 80°F

Design Alternative

Hour	September																			
	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep
8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
9	68.0	69.9	70.0	70.0	70.0	71.2	69.8	69.8	68.0	68.0	70.0	68.0	68.1	68.0	68.0	68.0	69.6	70.0	68.0	68.4
10	69.0	70.0	70.0	70.0	70.0	74.0	70.0	70.0	68.0	69.4	70.0	68.3	68.5	69.0	69.9	69.4	71.3	72.1	69.2	69.6
11	70.0	70.1	70.7	70.9	70.0	77.0	70.1	70.0	68.0	70.0	70.0	69.1	69.2	69.1	70.0	70.0	76.4	75.0	69.7	70.0
12	70.1	72.4	74.5	73.4	70.0	78.7	71.2	71.0	68.5	70.8	71.7	68.8	69.5	70.0	70.0	70.1	79.6	75.7	69.9	70.0
13	72.2	75.7	76.6	74.7	70.0	78.0	71.3	71.8	68.0	70.6	72.9	68.0	68.0	68.0	70.0	71.2	79.5	77.1	68.0	68.7
14	74.3	78.2	78.9	77.7	70.5	80.1	73.8	71.8	69.3	74.4	75.0	69.2	69.7	70.0	70.0	72.2	79.8	78.7	69.7	71.0
15	75.3	79.6	79.1	79.2	70.1	80.3	74.7	71.7	70.0	76.1	76.5	69.9	69.9	70.0	70.0	73.9	80.6	77.0	69.9	71.2
16	75.6	76.8	76.7	77.6	70.1	77.9	74.8	71.3	68.0	75.5	76.6	68.3	68.1	69.8	70.0	73.3	80.1	76.3	69.0	71.0
17	72.5	74.0	74.2	75.2	70.0	75.3	72.3	69.9	68.0	72.5	74.7	68.0	68.0	68.0	69.0	70.3	77.2	72.9	68.0	71.2

Passive Cooling Study
Worst Case Classroom

South Facing 2nd Floor Classroom
Annual Hours Between 7am-5pm Above 75°F
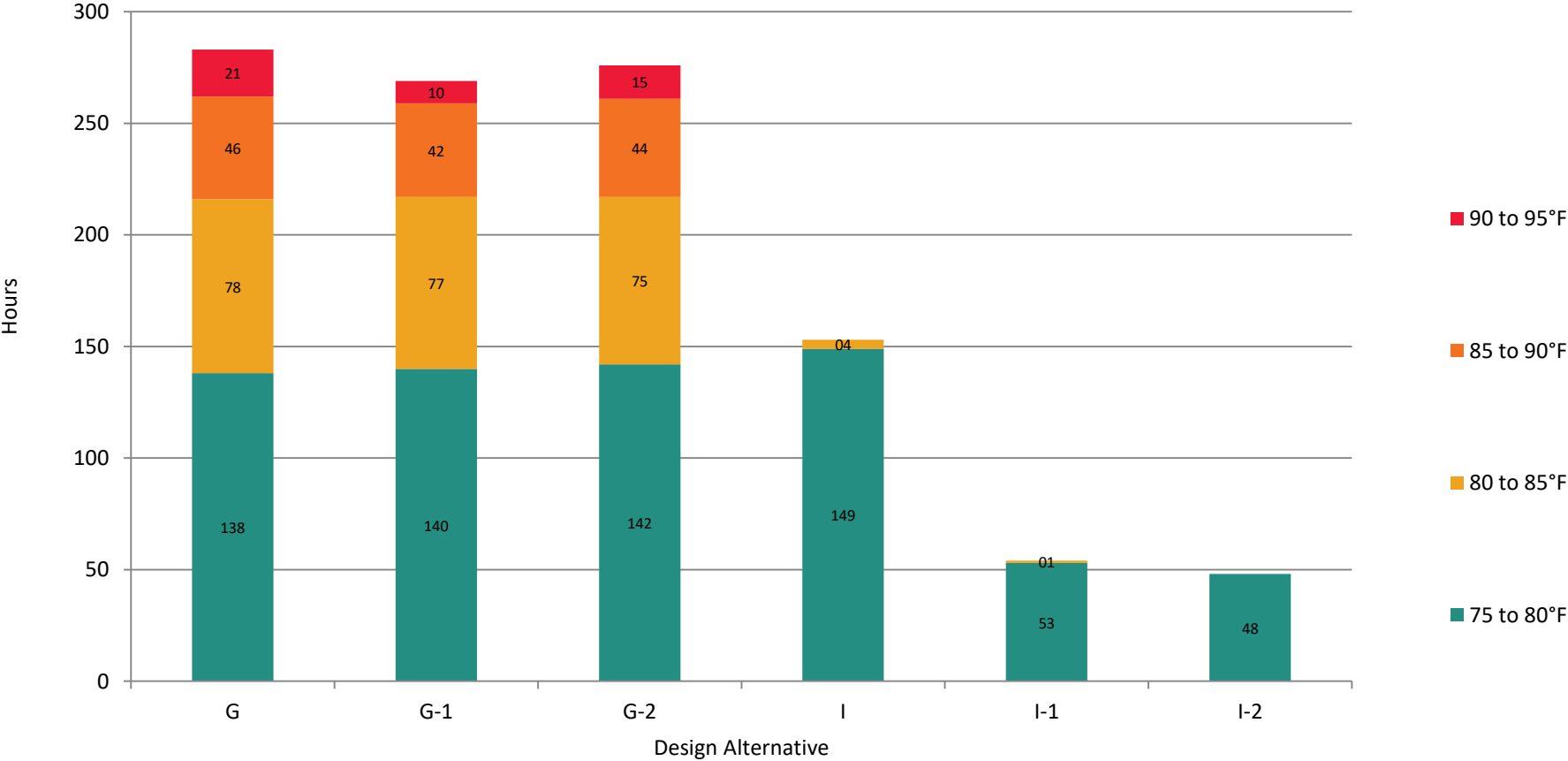
Passive Cooling Scenarios

G: Natural ventilation during operating hours, no external shading, night flush with DOAS, tile ceiling, and ventilation shafts with fan assist

G-1:   Natural ventilation during operating hours, 3.5' external shading, night flush with DOAS, tile ceiling, and ventilation shafts with fan assist

G-2:   Natural ventilation during operating hours, no external shading, night flush with DOAS, exposed concrete floor(2.5"), and ventilation shafts with fan assist

I: Natural ventilation during operating hours, no external shading, night flush with DOAS, tile ceiling, ventilation shafts with fan assist, and 60 F ventilation air

I-1:   Natural ventilation during operating hours, 3.5' external shading, night flush with DOAS, tile ceiling, ventilation shafts with fan assist, and 60 F ventilation air

I-2:   Natural ventilation during operating hours, no external shading, night flush with DOAS, exposed concrete floor (2.5"), ventilation shafts with fan assist, and 60 F ventilation air

Heat Maps – Option G
July thru September

July

Hour	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	30-Jul	31-Jul
8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	69.1	68.0	70.0	70.0	68.0	68.0	69.5	68.0	68.0
9	69.6	69.9	68.7	69.9	69.7	70.0	70.0	69.8	69.7	69.9	70.0	70.0	70.0	70.4	70.0	72.3	71.2	70.0	70.0	70.4	70.0	69.7
10	70.0	70.0	70.0	70.0	69.9	70.0	70.1	70.0	70.0	70.0	70.0	70.1	70.2	73.8	70.0	75.3	73.7	70.0	72.4	73.1	71.7	70.0
11	70.0	70.0	70.0	70.0	70.0	70.1	70.1	70.0	70.0	70.1	70.5	71.4	72.8	77.0	70.1	79.2	76.4	70.1	76.5	75.2	74.8	70.0
12	70.0	70.0	70.0	70.1	70.0	72.5	70.1	70.0	70.1	70.1	72.7	73.8	75.5	80.1	71.8	83.2	79.1	71.2	80.7	77.3	77.8	70.0
13	70.0	70.1	70.0	70.4	70.0	75.2	70.3	70.0	70.3	70.4	74.5	75.9	77.8	82.8	74.1	86.6	81.7	72.8	84.4	78.6	80.2	70.0
14	70.0	70.1	70.3	71.5	70.1	78.1	70.5	70.1	71.1	71.5	76.2	77.6	79.8	84.5	75.4	88.3	81.7	73.9	86.1	80.5	82.6	70.8
15	70.0	70.1	72.4	72.4	70.1	80.2	70.4	70.1	71.6	71.7	77.5	78.9	81.5	85.7	76.3	89.6	81.5	74.6	87.0	81.9	84.3	73.7
16	70.1	70.0	73.8	72.9	70.1	81.8	70.1	70.1	71.6	71.9	78.1	79.7	82.6	86.5	76.7	90.4	80.8	74.9	87.7	82.4	85.2	75.9
17	70.0	70.0	72.5	71.4	70.0	79.8	70.0	70.0	70.3	70.8	77.2	78.3	81.3	84.2	75.0	88.4	78.2	73.8	85.7	79.7	82.7	74.6

August

Hour	1-Aug	2-Aug	3-Aug	6-Aug	7-Aug	8-Aug	9-Aug	10-Aug	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug
8	68.6	68.0	68.0	68.4	68.7	68.0	68.0	68.0	70.1	70.1	69.6	75.9	70.1	68.0	68.0	68.0	70.0	72.6	68.0	68.0	68.0	68.0	68.0
9	70.1	70.0	70.0	70.0	70.0	70.0	70.0	70.0	76.1	74.4	70.1	78.4	73.5	70.0	69.9	70.0	72.8	74.2	70.0	69.9	70.0	70.0	70.0
10	70.1	70.1	72.0	71.9	70.0	70.0	70.1	70.0	83.2	77.5	71.7	80.6	76.9	70.0	70.0	70.7	75.8	77.4	70.0	70.0	70.1	70.0	70.1
11	70.1	72.8	76.3	75.7	70.0	70.6	71.3	70.0	87.4	82.2	74.7	84.4	81.8	70.0	70.1	73.8	80.3	78.1	70.0	70.1	71.8	70.1	72.4
12	73.5	73.2	80.1	77.9	70.0	72.6	72.8	73.0	88.7	86.2	78.1	85.7	84.5	70.1	70.1	76.6	86.0	80.0	72.1	71.7	74.6	70.2	73.3
13	73.9	74.3	81.6	80.3	70.0	72.9	73.0	72.1	90.5	88.7	81.2	88.5	88.6	70.1	70.2	81.6	86.7	81.1	74.7	73.2	76.5	70.7	74.8
14	74.4	77.4	84.8	83.1	70.3	75.3	74.4	74.1	92.0	90.9	84.1	88.9	90.9	73.2	71.5	85.1	90.2	82.6	75.5	75.3	80.5	71.4	75.5
15	74.7	78.7	85.8	85.4	70.1	75.5	73.4	74.9	92.5	93.0	85.2	90.0	93.0	74.5	72.8	87.8	92.2	82.7	76.1	76.1	79.7	71.2	76.6
16	76.5	77.4	86.4	85.7	70.0	75.9	72.5	75.7	90.9	92.9	85.7	89.7	92.8	74.1	74.4	87.7	92.5	82.0	77.0	76.4	79.8	74.5	77.8
17	73.7	75.8	85.2	82.9	70.0	74.5	71.3	75.5	90.5	91.5	85.5	88.5	90.5	72.8	74.8	86.4	90.5	80.3	73.7	75.7	78.9	72.7	75.9

September

Hour	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep
8	68.0	68.0	68.0	68.0	68.0	70.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
9	68.0	70.0	70.0	70.0	70.0	73.3	70.0	70.0	68.0	68.2	69.9	68.1	68.6	68.0	68.0	68.5	70.0	70.1	68.5	68.9
10	69.5	70.0	70.1	70.0	70.0	76.5	70.0	70.0	68.0	69.9	70.0	68.7	69.1	69.4	69.8	69.5	72.7	73.3	69.9	69.8
11	70.0	71.1	72.1	72.1	70.0	80.8	70.2	70.1	68.5	70.1	70.1	69.7	70.0	69.5	70.0	70.0	77.5	76.4	69.4	70.0
12	70.1	73.8	76.1	74.9	70.1	83.1	72.5	72.0	69.1	72.0	72.9	69.3	70.0	70.0	70.0	70.1	80.5	77.9	69.7	70.0
13	73.0	77.7	78.9	77.7	70.1	85.3	73.0	73.0	68.0	71.9	74.4	68.0	70.0	68.0	70.0	72.4	80.4	78.9	69.1	70.1
14	75.2	80.8	83.4	79.0	71.2	86.5	76.1	73.1	69.7	75.8	76.8	69.6	70.0	70.0	70.0	73.1	80.7	80.2	70.0	72.2
15	76.4	82.3	85.9	81.4	70.8	88.5	76.8	73.1	69.8	77.5	78.5	70.0	70.0	70.0	70.0	75.2	81.8	78.5	70.0	72.3
16	76.8	83.2	86.4	78.9	70.3	87.8	76.3	72.6	68.0	77.6	78.3	68.6	69.8	70.0	70.0	74.4	81.5	78.1	70.0	71.9
17	76.5	81.8	86.9	76.7	70.0	84.7	75.9	70.0	68.0	76.3	75.9	68.0	68.0	69.2	70.0	71.1	78.8	76.9	68.6	72.4

Heat Maps – Option I
July thru September

July

Hour	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	30-Jul	31-Jul
8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.5	68.0	68.0	68.0	68.0	68.0
9	69.3	69.6	68.2	69.5	69.2	70.0	69.8	69.6	69.8	69.1	69.8	69.5	70.0	70.0	69.6	70.9	70.1	70.0	69.7	70.0	70.0	69.4
10	69.8	70.0	69.4	70.0	69.6	70.0	70.0	69.6	70.0	70.0	70.0	70.0	70.0	72.0	70.0	73.7	72.3	70.0	71.1	71.4	70.4	69.8
11	70.0	70.0	69.9	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.1	70.3	71.5	74.8	70.0	75.1	74.9	70.0	74.6	73.3	73.1	70.0
12	70.0	70.0	70.0	70.0	70.0	71.3	70.0	70.0	70.0	70.1	71.3	72.6	74.0	75.7	70.8	76.6	77.5	70.1	75.1	75.2	75.7	70.0
13	70.0	70.0	70.0	70.0	70.0	73.4	70.0	70.0	70.0	70.0	72.8	74.3	73.4	74.7	72.9	75.7	75.7	71.3	74.1	74.7	74.7	70.0
14	70.0	70.0	70.1	70.6	70.0	75.9	70.1	70.0	70.2	70.6	74.5	76.1	75.6	76.8	74.2	77.8	77.4	72.6	76.3	77.7	76.9	70.1
15	70.0	70.0	71.0	71.5	70.1	75.7	70.1	70.0	70.5	70.9	75.6	77.1	75.9	77.0	75.1	77.9	77.7	73.4	76.7	77.4	77.1	72.1
16	70.0	70.0	71.6	71.9	70.0	73.7	70.0	70.0	70.4	71.1	73.4	73.9	73.9	75.0	75.3	75.8	75.7	73.6	74.8	75.1	75.0	72.7
17	69.7	69.7	70.7	70.6	69.9	71.8	69.3	69.7	69.9	70.0	71.5	71.7	72.1	73.1	73.7	73.8	73.7	72.6	73.0	72.9	72.9	71.4

August

Hour	1-Aug	2-Aug	3-Aug	6-Aug	7-Aug	8-Aug	9-Aug	10-Aug	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug
8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	69.8	68.0	68.0	68.0	68.0	68.0
9	70.0	69.9	69.8	70.0	69.9	69.1	70.0	69.6	71.1	71.2	70.0	71.3	71.7	69.0	69.5	69.6	71.0	72.2	70.0	69.7	69.9	69.6	69.6
10	70.0	70.0	70.6	70.7	70.0	70.0	70.0	70.0	73.1	73.1	70.3	73.2	74.3	69.8	70.0	70.0	73.5	75.2	70.0	70.0	70.0	70.0	70.0
11	70.0	71.5	74.5	73.9	70.0	70.0	70.3	70.0	75.0	75.2	73.3	75.1	75.6	70.0	70.0	72.3	75.0	75.4	70.0	70.0	70.5	70.0	71.4
12	72.1	71.7	75.5	75.9	70.0	71.4	71.5	71.5	76.8	77.0	76.0	76.9	77.2	70.0	70.0	75.0	76.0	75.2	71.1	70.6	73.4	70.0	72.3
13	71.4	72.5	74.5	75.1	70.0	71.8	71.6	71.0	76.1	76.1	75.5	76.2	76.6	70.0	70.0	74.7	74.6	73.7	73.3	71.8	74.8	69.7	73.6
14	73.0	74.7	76.5	77.3	70.1	73.7	73.1	73.0	78.3	77.8	77.6	78.3	78.7	72.1	70.7	77.1	77.0	75.2	74.4	73.8	77.8	70.4	74.3
15	73.9	76.1	76.7	77.5	70.0	74.0	72.3	74.0	78.6	78.5	77.8	78.5	79.0	72.8	71.7	77.4	77.7	75.4	74.5	74.5	78.0	70.5	75.2
16	72.5	73.5	74.6	75.5	70.0	74.2	71.2	74.4	76.2	76.3	75.7	76.3	76.7	72.9	72.7	75.2	75.9	73.5	74.7	74.7	75.4	73.2	76.1
17	70.7	71.5	72.6	73.7	69.5	73.2	70.0	71.3	74.0	74.1	73.5	74.0	74.3	71.7	70.4	72.9	73.9	71.7	72.9	72.0	72.9	71.5	73.9

September

Hour	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep
8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
9	68.0	69.9	70.0	70.0	70.0	71.2	69.8	69.8	68.0	68.0	70.0	68.0	68.1	68.0	68.0	68.0	69.6	70.0	68.0	68.4
10	69.0	70.0	70.0	70.0	70.0	74.0	70.0	70.0	68.0	69.4	70.0	68.3	68.5	69.0	69.9	69.4	71.3	72.1	69.2	69.6
11	70.0	70.1	70.7	70.9	70.0	77.0	70.1	70.0	68.0	70.0	70.0	69.1	69.2	69.1	70.0	70.0	76.4	75.0	69.7	70.0
12	70.1	72.4	74.5	73.4	70.0	78.7	71.2	71.0	68.5	70.8	71.7	68.8	69.5	70.0	70.0	70.1	79.6	75.7	69.9	70.0
13	72.2	75.7	76.6	74.7	70.0	78.0	71.3	71.8	68.0	70.6	72.9	68.0	68.0	68.0	70.0	71.2	79.5	77.1	68.0	68.7
14	74.3	78.2	78.9	77.7	70.5	80.1	73.8	71.8	69.3	74.4	75.0	69.2	69.7	70.0	70.0	72.2	79.8	78.7	69.7	71.0
15	75.3	79.6	79.1	79.2	70.1	80.3	74.7	71.7	70.0	76.1	76.5	69.9	69.9	70.0	70.0	73.9	80.6	77.0	69.9	71.2
16	75.6	76.8	76.7	77.6	70.1	77.9	74.8	71.3	68.0	75.5	76.6	68.3	68.1	69.8	70.0	73.3	80.1	76.3	69.0	71.0
17	72.5	74.0	74.2	75.2	70.0	75.3	72.3	69.9	68.0	72.5	74.7	68.0	68.0	68.0	69.0	70.3	77.2	72.9	68.0	71.2

Extremes

What happens during a heat wave?

The hottest day on record was August 10th, 1981 at 106F.
This was preceded by four days of temperatures above 100F.
These five days were modeled as a heat wave.

Alt I: Heat Wave August 1981					
Hour	6-Aug	7-Aug	8-Aug	9-Aug	10-Aug
8	68.2	69.9	70.0	70.1	70.0
9	70.0	71.2	72.3	74.3	71.8
10	71.0	73.9	74.0	75.1	74.9
11	74.9	74.8	75.5	76.6	75.9
12	76.6	75.3	76.8	78.1	76.8
13	75.7	73.8	76.0	76.2	75.5
14	77.8	76.6	77.2	78.3	77.4
15	78.2	77.2	78.5	78.8	78.7
16	76.4	75.9	76.8	77.1	77.1
17	74.7	74.3	75.3	75.5	75.4

Natural Daylighting Strategy:
Borrowed daylight from the atrium's skylight naturally lights the interior facade of the classrooms

Natural Daylighting Strategy:
Wall to wall windows in classrooms

Natural Ventilation Strategy:
Stack ventilation system directly communicates via sensors to the user-operable windows and mechancial system
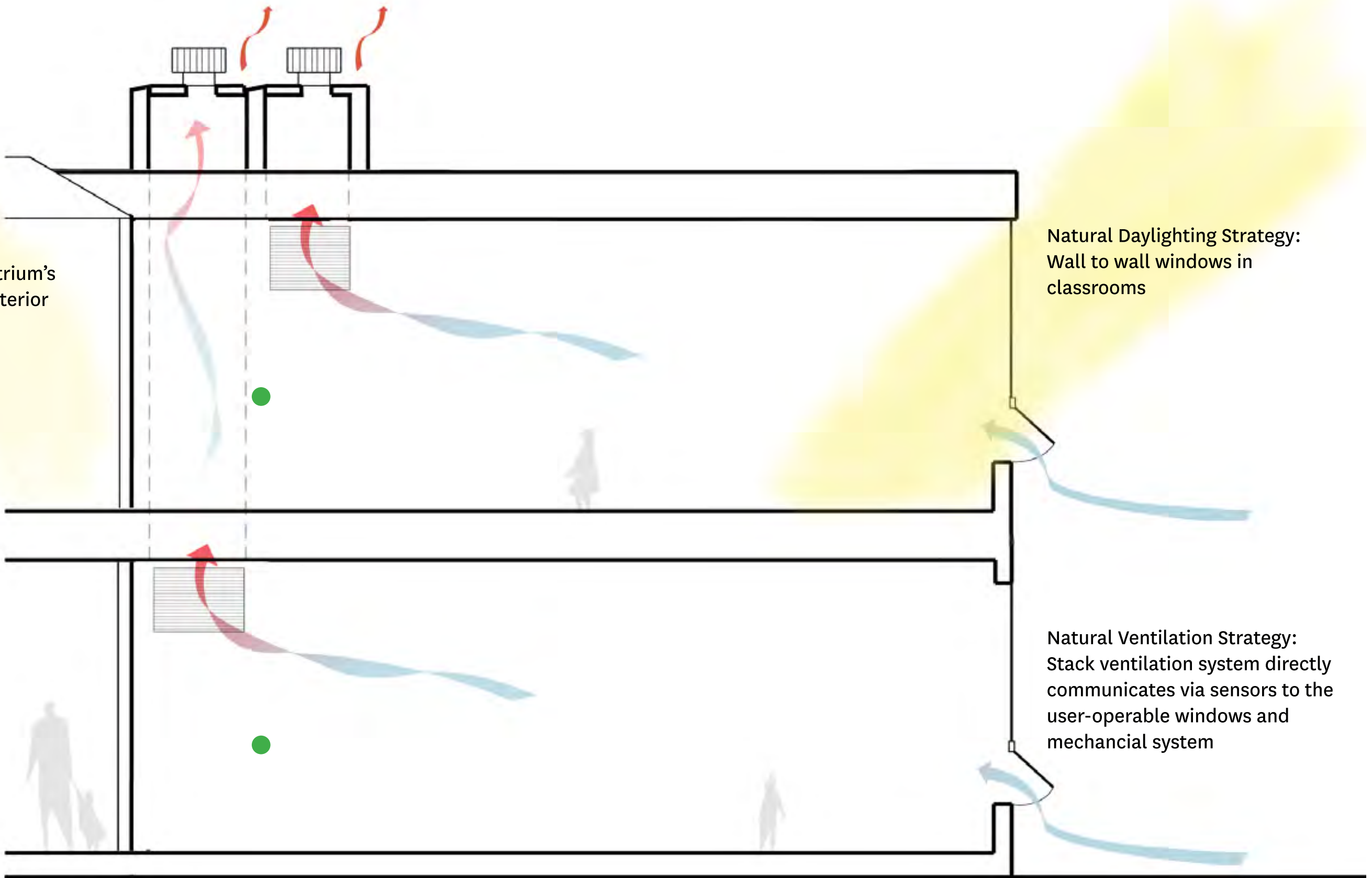
PASSIVE DESIGN STRATEGIES - Natural Daylighting & Ventilation

VENT TYPE 1

VENT TYPE 2

14
A-522

6
A-522

LEVEL 2

CLASSROOM

CLASSROOM

CLASSROOM

LEVEL 1
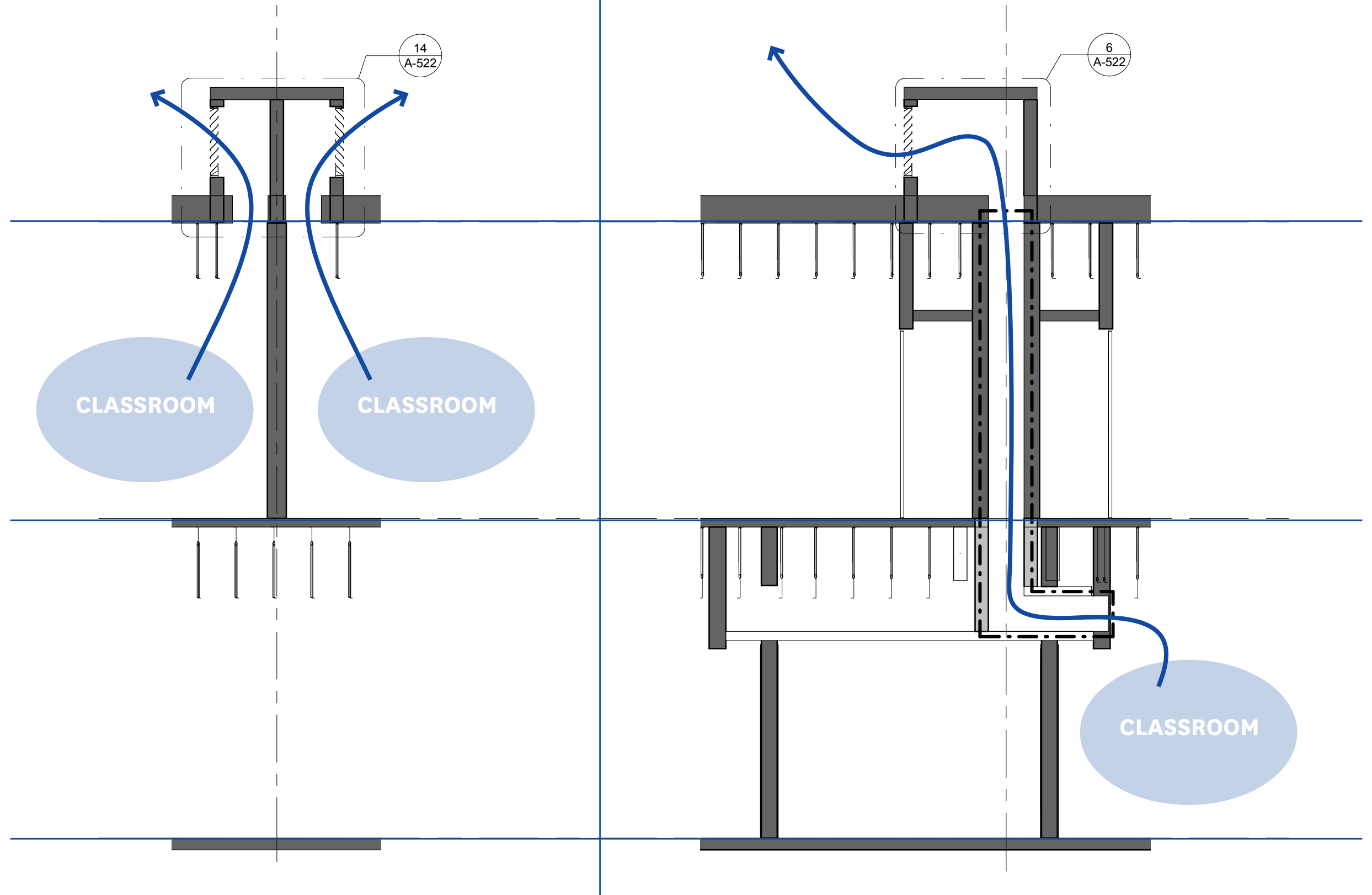
Passive Heating

Heat Load in Passive Buildings

Wall 11%
Window 17%
Roof 7%
Infil 65%

■ Outside Temp ■ Wall ■ Window ■ Roof ■ Infil
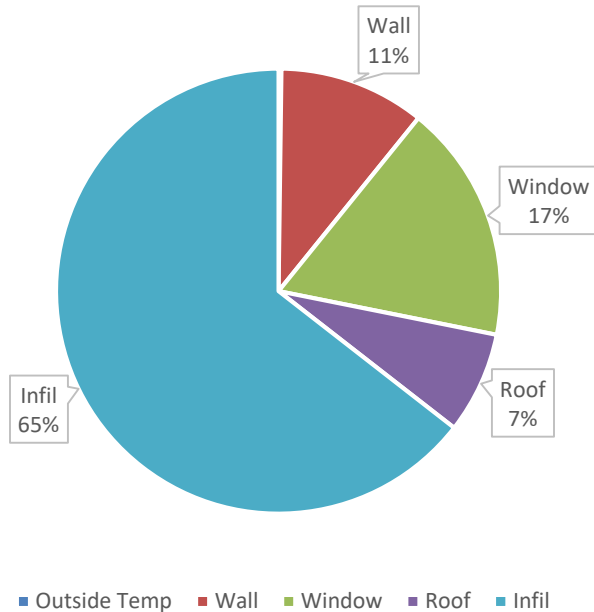
Roof = R-50
Wall = R-34
Window = U-0.30, 40% wwr
Infiltration = 0.18 cfm/sf
1000 sf floor, 900 sf wall
20 people
1 w/sf Plugs and Lights

Balance Point Temperature

Heat (Btu/h)

Outside Air Temp (F)

—— Total Heat Gain (Btu/h)   —— Total Load (Btu/h)
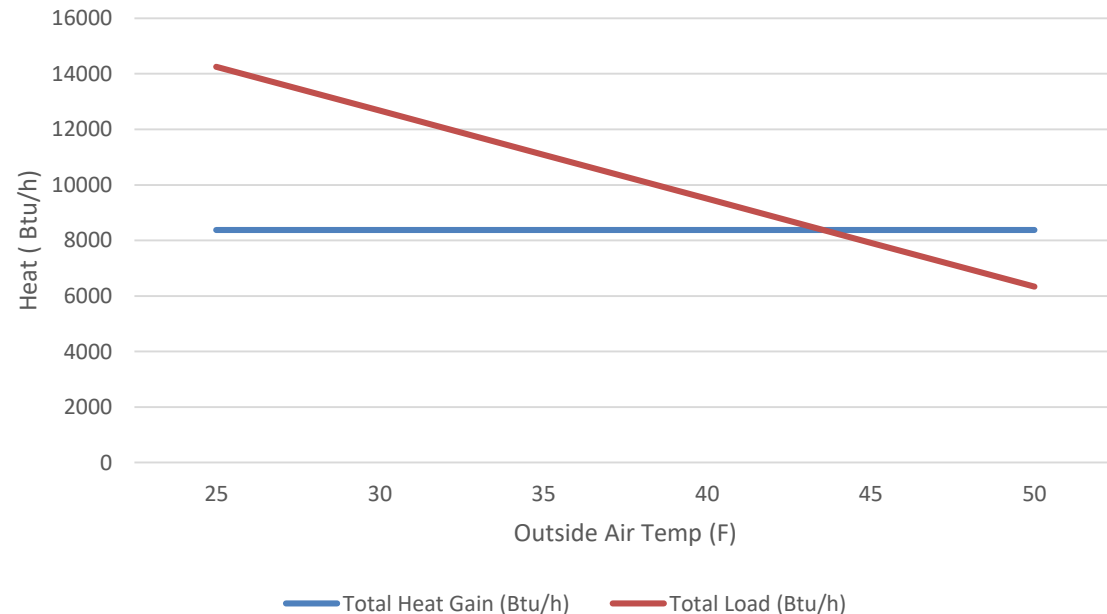
AIR VENT

SHADES

PHOTOCELL

GREEN LIGHT

OPERABLE
WINDOW

ROOM 34
3rd Grade

GETTING INTO THE DETAILS

EQ   EQ

INSUL 1A FIREBLOCKING INSTALLED
VERTICALLY TO CREATE ISOLATED
SPACES NOT EXCEEDING 100 SF

R-40 BATT INSULATION

WD FURRING, 3/4

EDIT

INSUL 1A **MINERAL WOOL**

PLYWD SIDING PNL

FLUID APPLIED AIR /
MOISTURE BARRIER

CLADDING SUPPORT SYS WITH
INTERMITTENT CLIP PLACEMENT

WD BATTEN
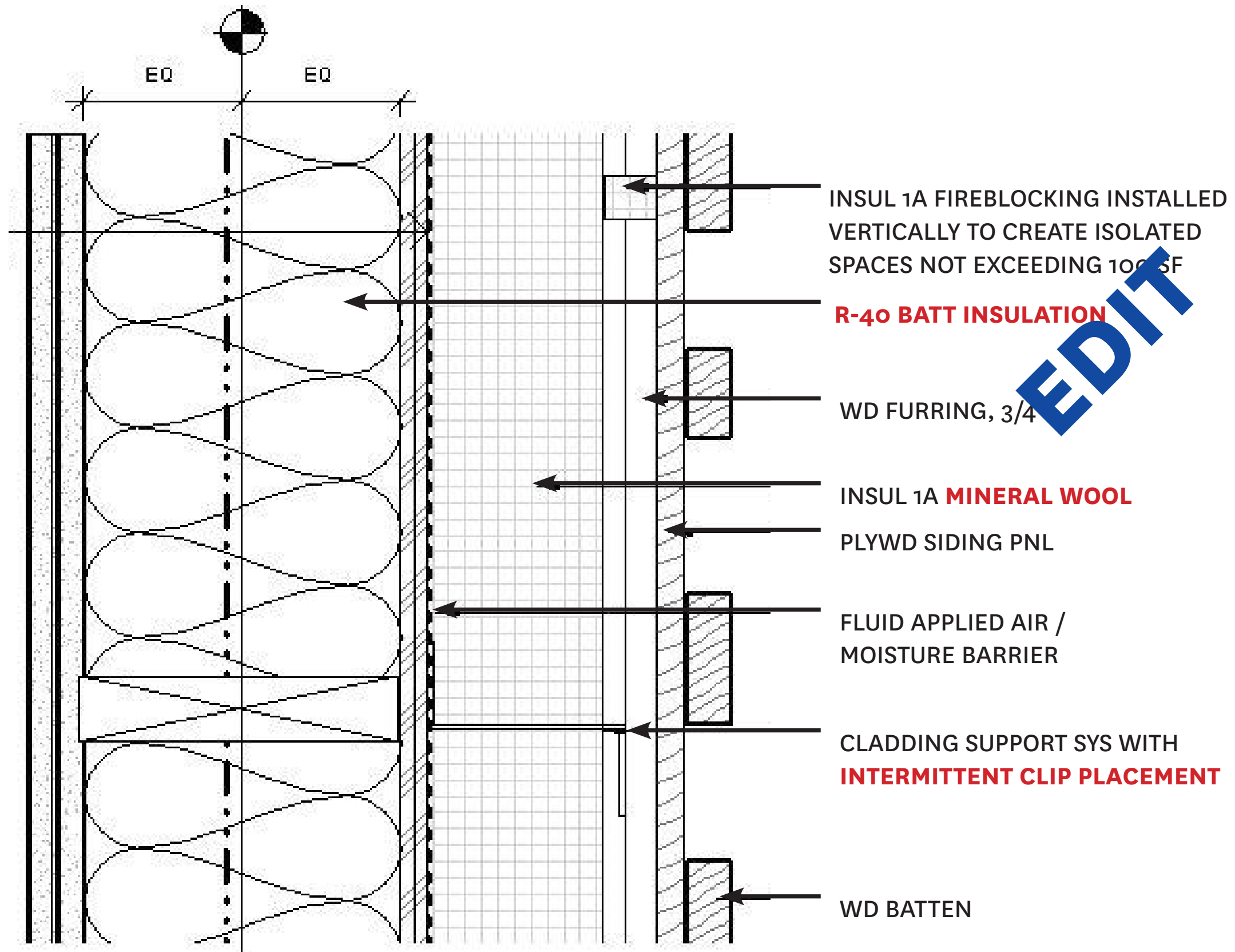
EXTERIOR WALL ASSEMBLY - PLAN

Passive Heating – Wall Details and Mockups
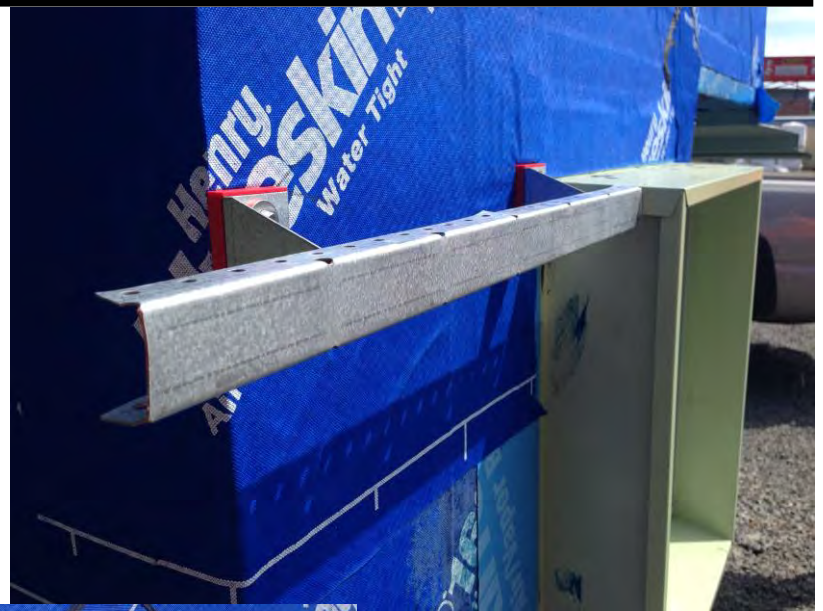
Passive Heating – Wall Details and Mockups

TESTING IN PROGRESS

RESULTS

Results – One Year Later

2017 OES LS Energy Use

Modeled: 22 EUI

1st Year Actual: 28 EUI
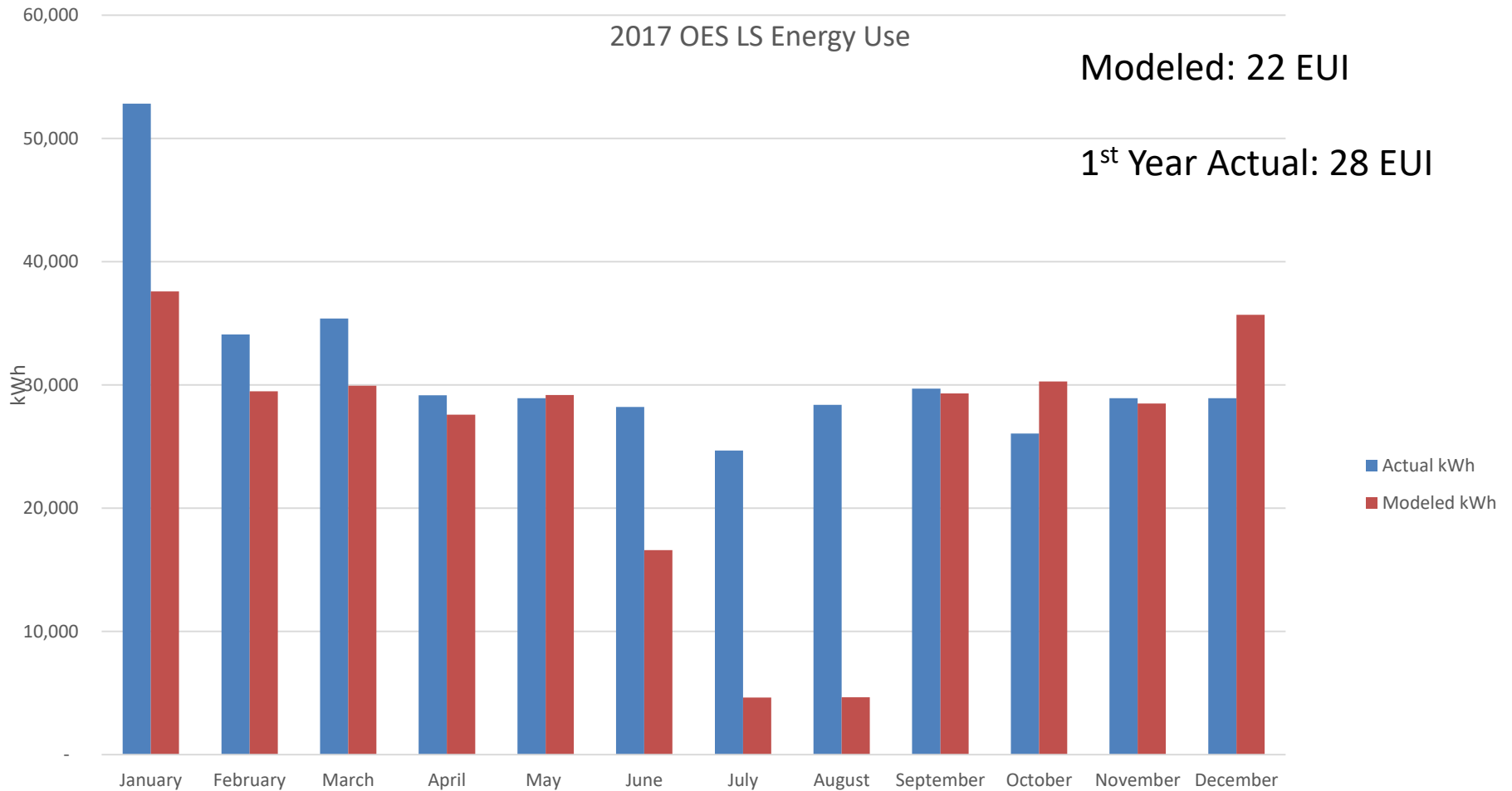
AIA 2030 Design Data Exchange

ⓘ

PROJECT VIEW

2014 - DD ▼

PROJECT SUMMARY

OES Lower School

Non-Residential

PREDICTED	BASELINE	GOAL	SAVINGS	CHALLENGE
28	**75.0**	**30.0**	**63%**	2030 = 100% (Carbon Neutral) 2025 = 90% 2020 = 80% 2015 = 70% 2014 = 60%
kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr		[Architecture 2030 Challenge]
[Predicted Energy Use Intensity]	[Baseline Energy Use Intensity]	[Energy Use Intensity]		

GENERAL INPUTS	BUILDING ENVELOPE	HVAC SYSTEMS

* AIA 2030 Commitment Required Input Fields

1. Input Building Specifications

Note: Basic General Inputs are required to be saved before Building Envelope and HVAC Systems screens can be accessed

Project Name *	OES Lower School	Project ID *	PJCJD1436149742
Project Category *	Non-Residential	Country *	United States of America
Year of Occupancy	2016	State/Province *	
Reporting Year *	2014	Zip/Postal Code *	97223
Office Location	Portland, Oregon, United States of Am·	City	
Climate Zone	4C Mixed – Marine		
Project Phase *	Design Development	Target Certification	1 Target Certification Selected ▼

Use Types *	Area (GSF)		Available ? [Target Finder]	BASELINE [National Avg.] kBtu/sf/yr	GOAL [2030 Challenge] kBtu/sf/yr	LPD Baseline [ASHRAE 90.1-2007] W/sf
Education – K-12 School	45665.0	⊗ ⓘ		75.0	30.0	1.20
⊕	**Total: 45.7K**		WEIGHTED	75.0	30.0	1.20

Building EUI

72 EUI
CBECS Baseline

60% Reduction

28.8 EUI
2030 Target

25 EUI
Modeled

Solar Ready

NZE

80 70 60 50 40 30 20 10 0

kBtu/ft2/YR

28% VENTILATION

15% LIGHTING

24% HEATING

22% PLUG LOADS

11% COOLING

25 Modeled EUI
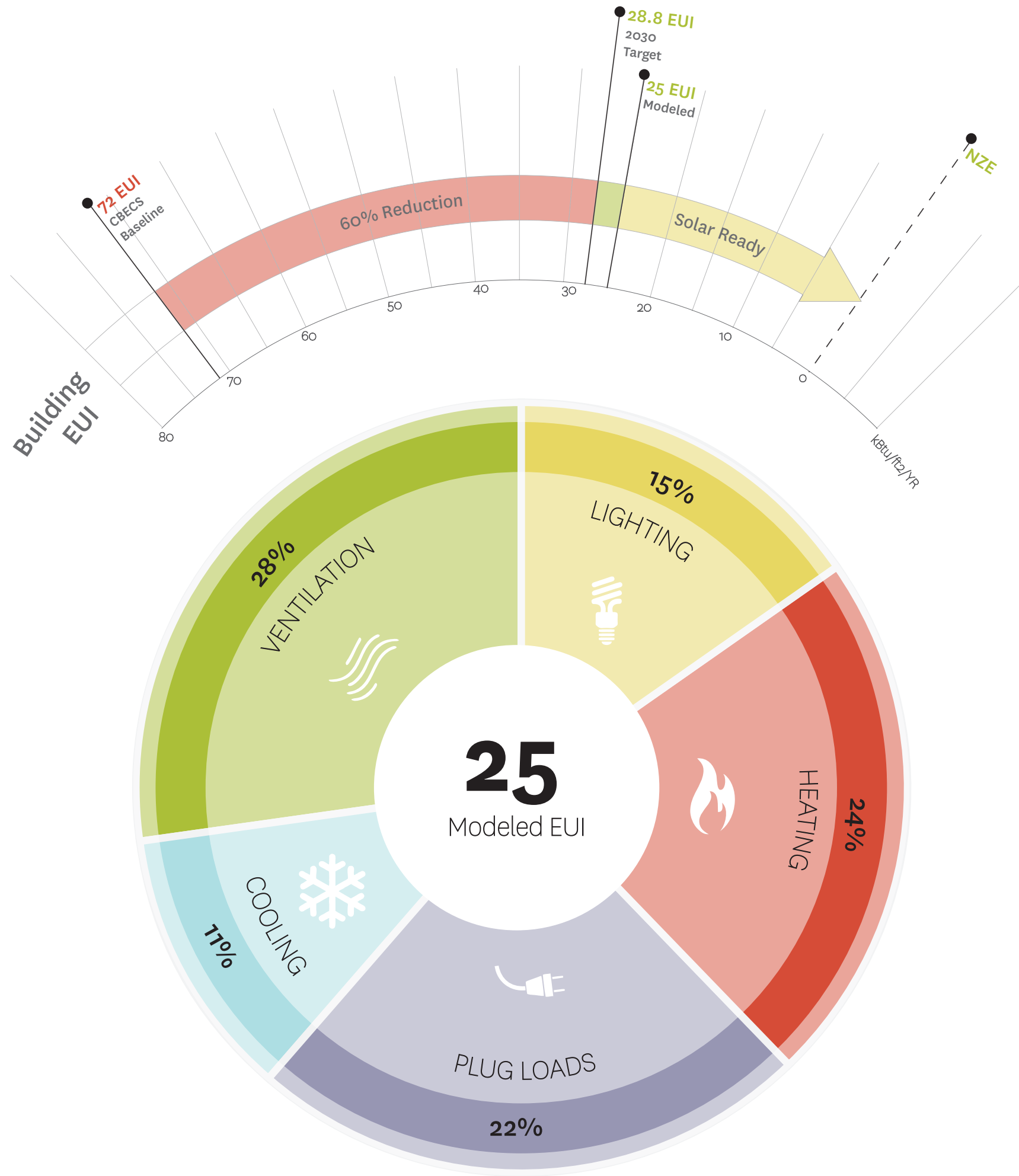
workers

from student

Dear Construction Workers,
Thank you so much for
your blud, svett, and ters. for
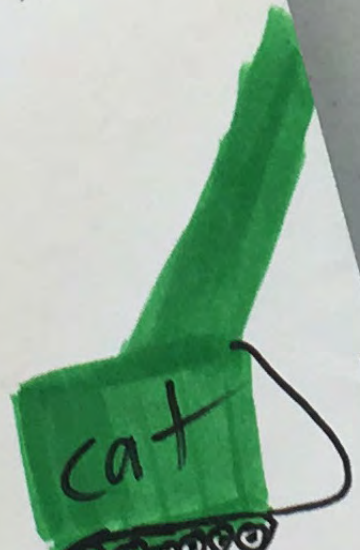are wondorful new shcool
yours trely Annie Phillips

OREGON EPISCOPAL SCHOOL

to: construcktion
workers

OREGON EPISCOPAL SCHOOL
6300 Southwest Nicol Road
Portland, Oregon USA 97223-7566

cat

cat

to construction
Workers

from Reid Kim

thank
W...

OREGON EPISCOPAL SCHOOL
1869

PAE

Creating a better environment

Ruwan Jayaweera, PE, LEED AP

Senior Associate

Ruwan.jayaweera@pae-engineers.com

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