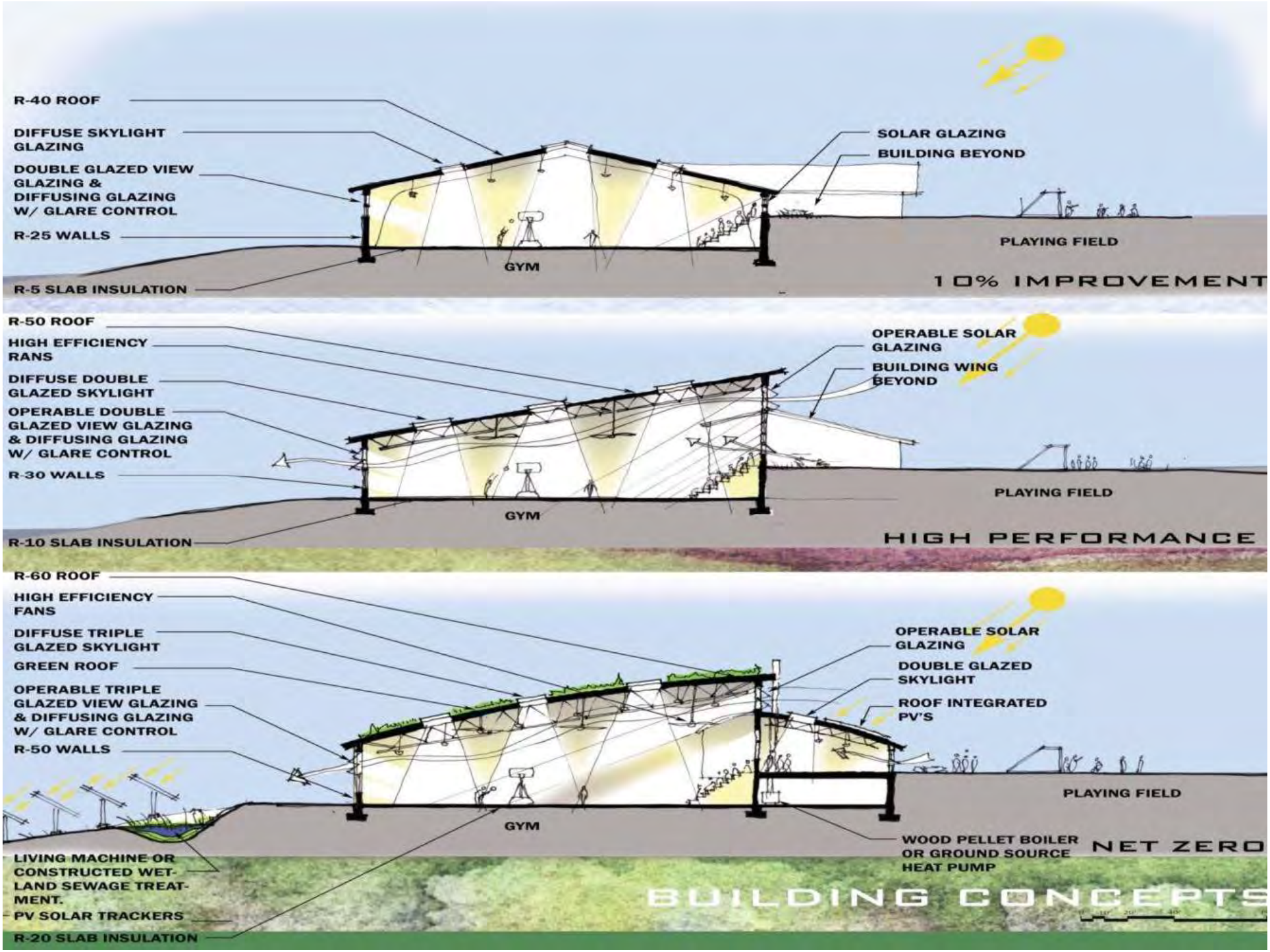
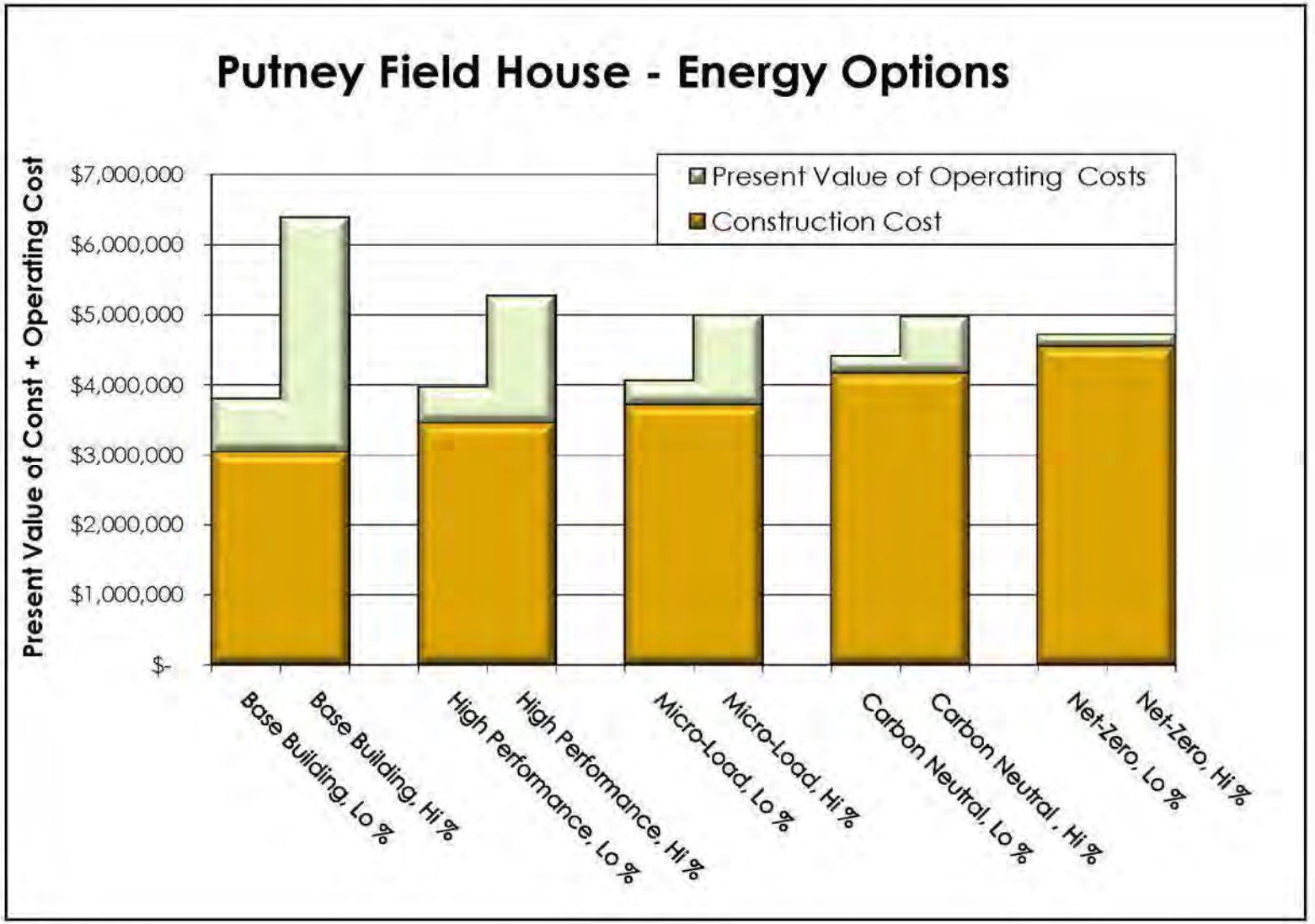
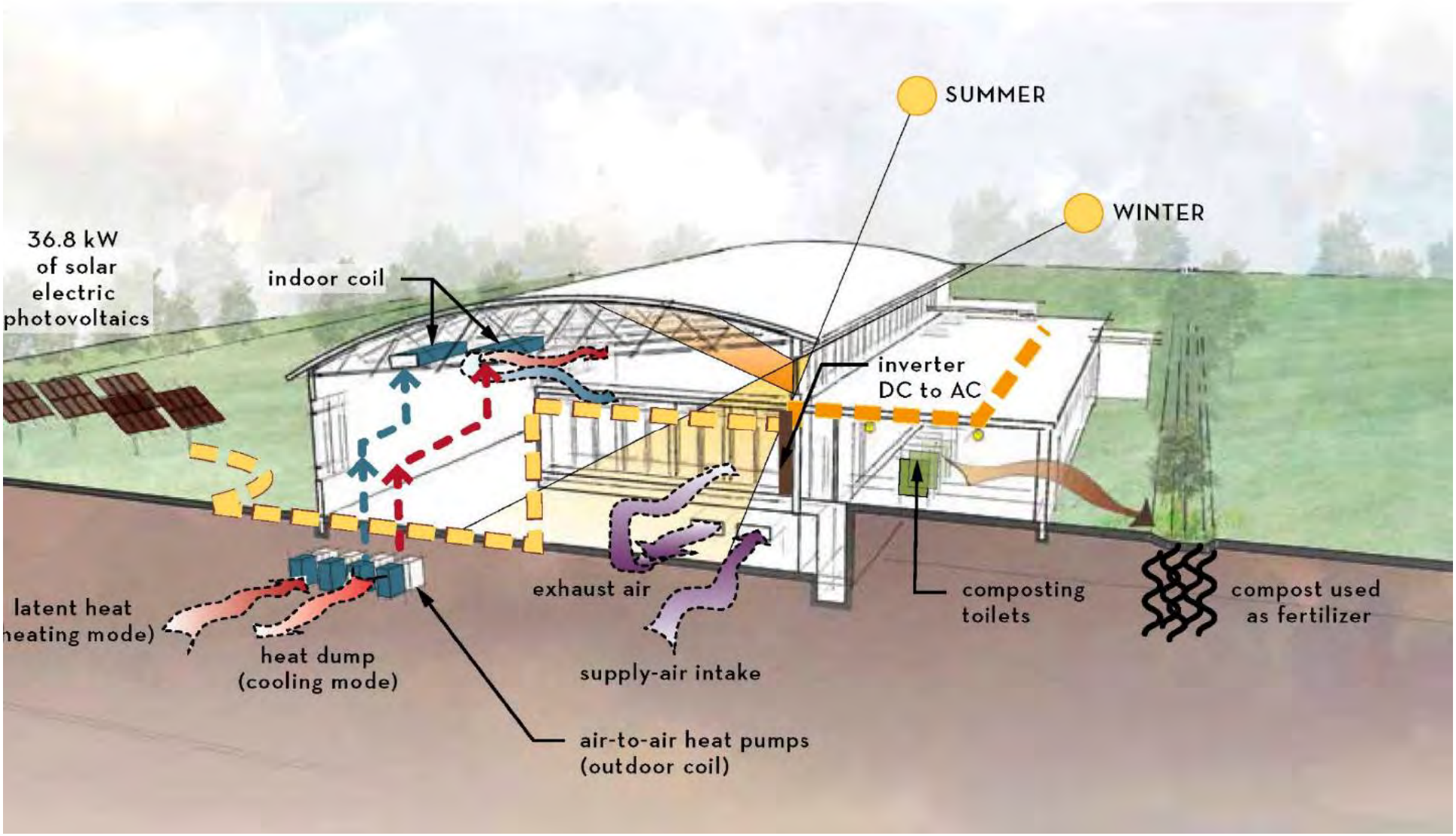

R-40 ROOF
DIFFUSE SKYLIGHT GLAZING
DOUBLE GLAZED VIEW GLAZING & DIFFUSING GLAZING W/ GLARE CONTROL
R-25 WALLS
R-5 SLAB INSULATION
SOLAR GLAZING
BUILDING BEYOND
PLAYING FIELD
GYM
10% IMPROVEMENT
R-50 ROOF
HIGH EFFICIENCY RANS
DIFFUSE DOUBLE GLAZED SKYLIGHT
OPERABLE DOUBLE GLAZED VIEW GLAZING & DIFFUSING GLAZING W/ GLARE CONTROL
R-30 WALLS
R-10 SLAB INSULATION
OPERABLE SOLAR GLAZING
BUILDING WING BEYOND
PLAYING FIELD
GYM
HIGH PERFORMANCE
R-60 ROOF
HIGH EFFICIENCY FANS
DIFFUSE TRIPLE GLAZED SKYLIGHT
GREEN ROOF
OPERABLE TRIPLE GLAZED VIEW GLAZING & DIFFUSING GLAZING W/ GLARE CONTROL
R-50 WALLS
LIVING MACHINE OR CONSTRUCTED WET-LAND SEWAGE TREAT-MENT.
PV SOLAR TRACKERS
R-20 SLAB INSULATION
OPERABLE SOLAR GLAZING
DOUBLE GLAZED SKYLIGHT
ROOF INTEGRATED PV'S
PLAYING FIELD
GYM
WOOD PELLET BOILER OR GROUND SOURCE HEAT PUMP
NET ZERO
BUILDING CONCEPTS


Putney Field House - Energy Options
Present Value of Const + Operating Cost
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$-
Present Value of Operating Costs
Construction Cost
Base Building, Lo %
Base Building, Hi %
High Performance, Lo %
High Performance, Hi %
Micro-Load, Lo %
Micro-Load, Hi %
Carbon Neutral, Lo %
Carbon Neutral , Hi %
Net-Zero, Lo %
Net-Zero, Hi %

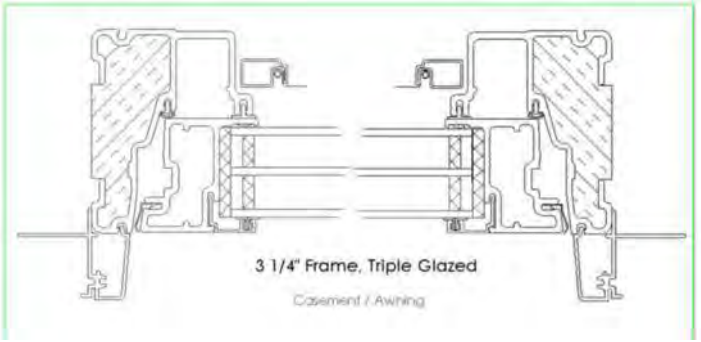

SUMMER
WINTER
36.8 kW
of solar
electric
photovoltaics
indoor coil
inverter
DC to AC
latent heat
heating mode)
heat dump
(cooling mode)
exhaust air
supply-air intake
composting
toilets
compost used
as fertilizer
air-to-air heat pumps
(outdoor coil)

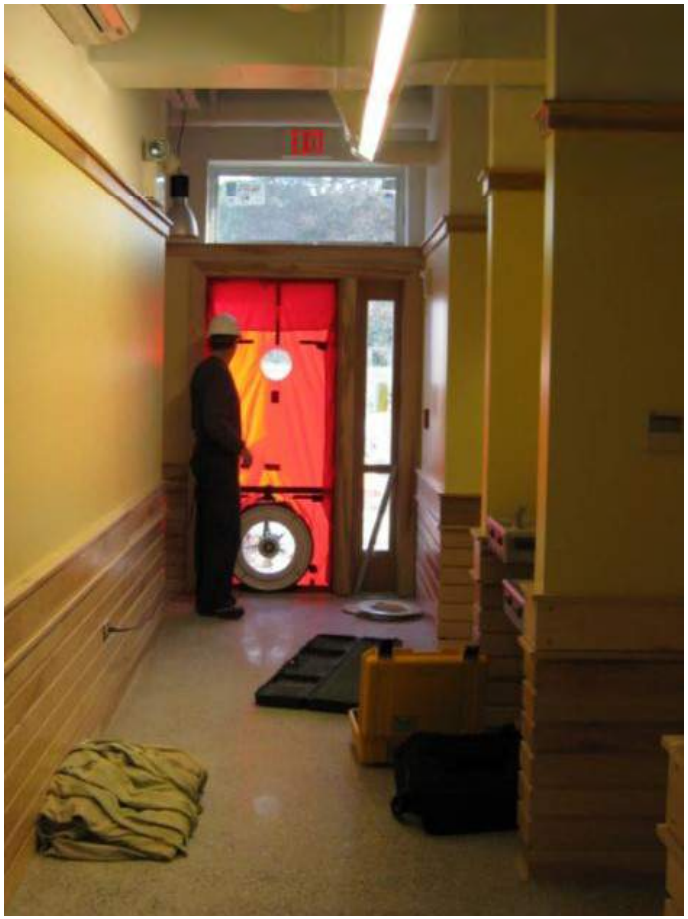
Putney Field House - Enclosure

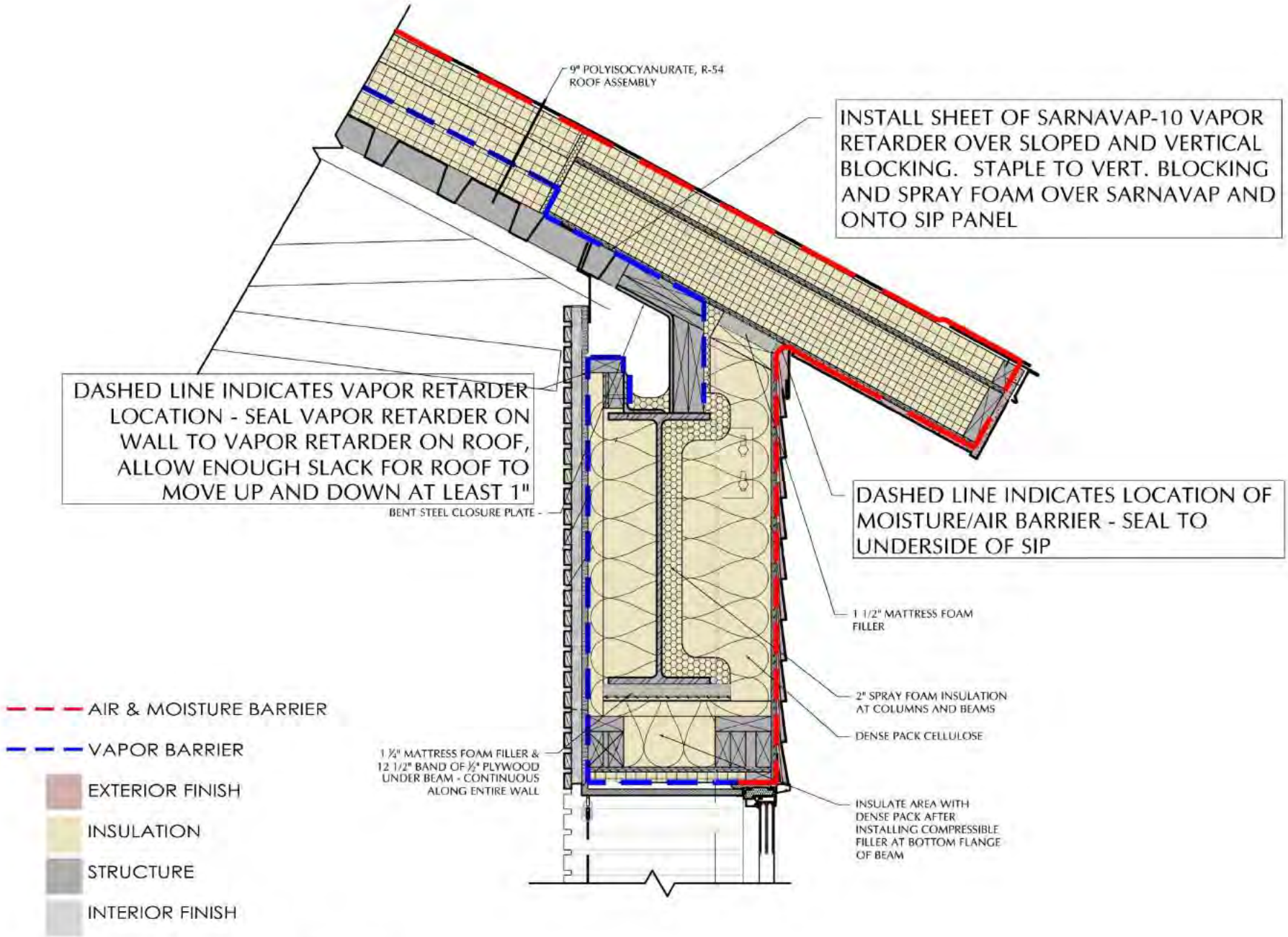
- High efficiency R-5 windows, SHGC-0.26 and R-2.5 skylights
- Super-insulated structure, walls, roof, R/20/45/60
- Very tight construction --- 0.065 cfm50/sq.ft

  0.37 ACH-50

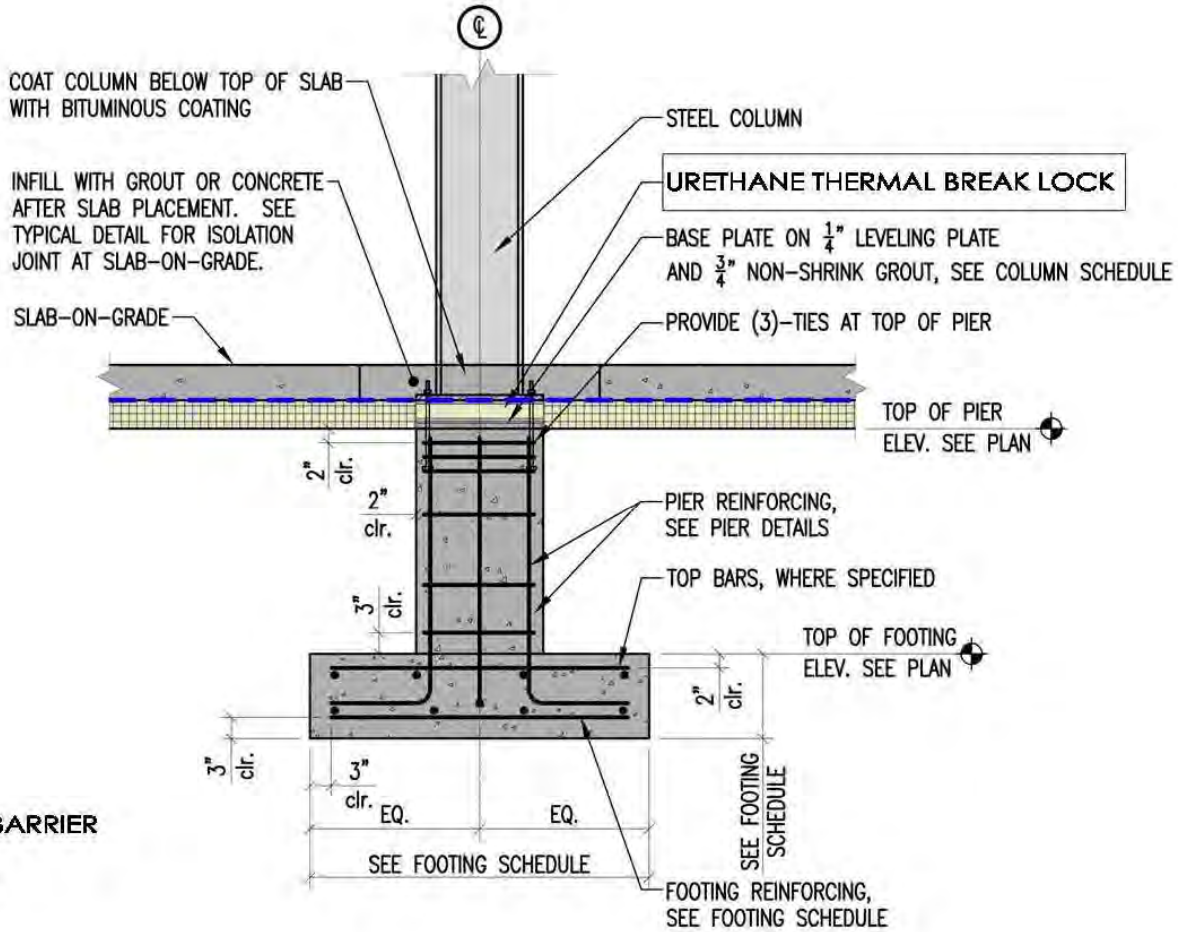
  0.024 ACH natural estimated







EAVE WINDOW HEAD DETAIL



AIR & MOISTURE BARRIER

VAPOR BARRIER

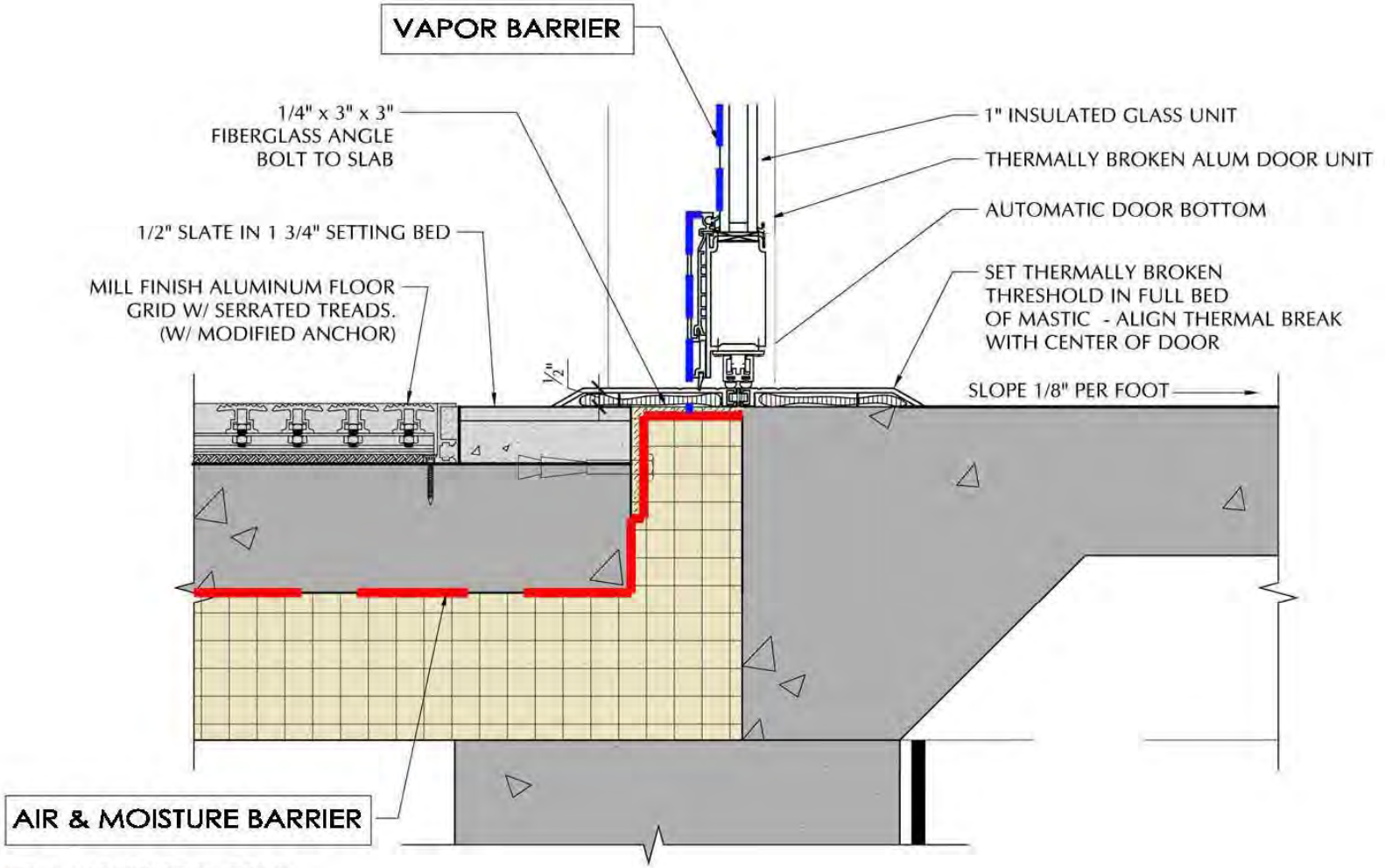
EXTERIOR FINISH

INSULATION

STRUCTURE

INTERIOR FINISH

PIER DETAIL



AIR & MOISTURE BARRIER

VAPOR BARRIER

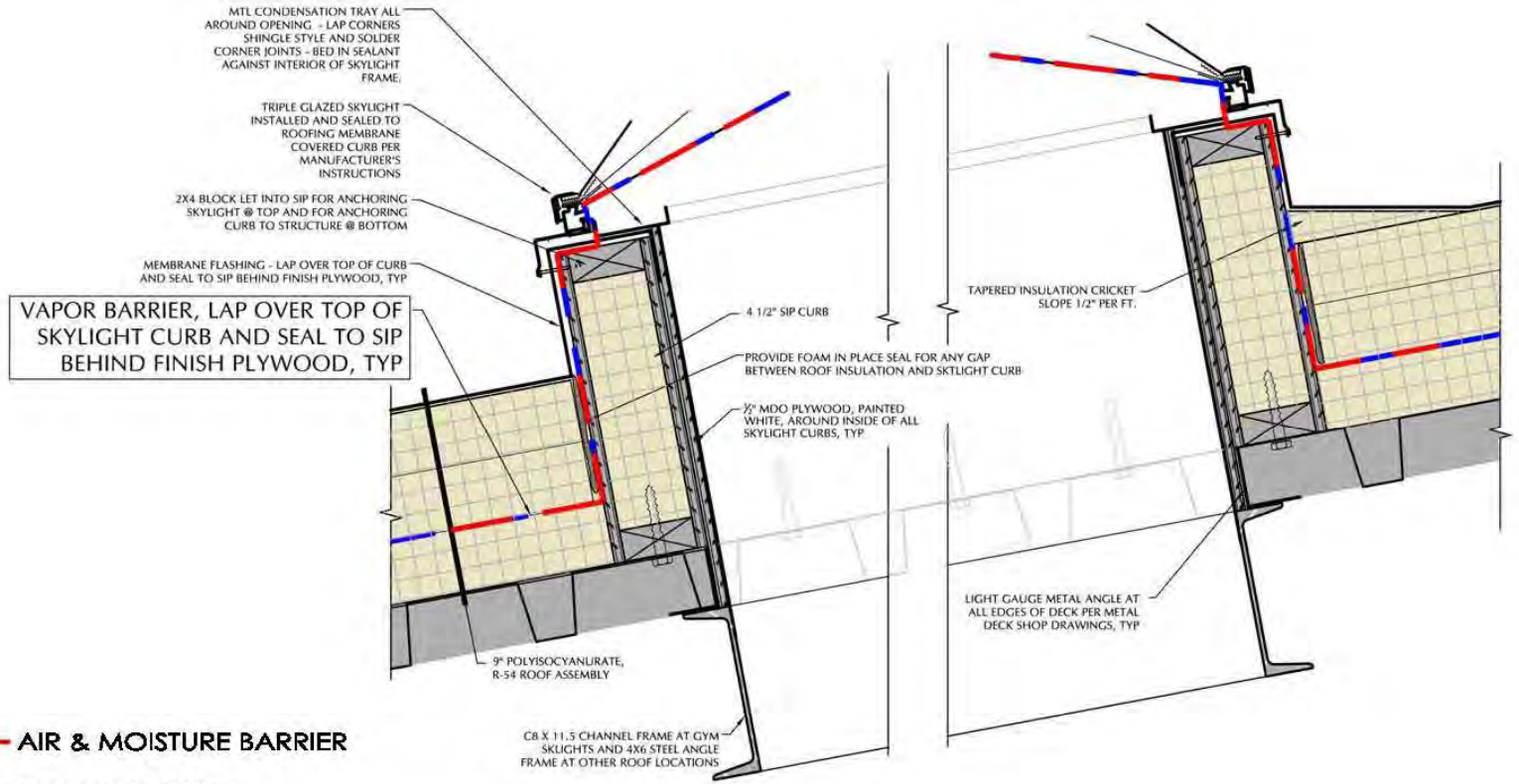
EXTERIOR FINISH

INSULATION

STRUCTURE

INTERIOR FINISH

DOOR SILL DETAIL



AIR & MOISTURE BARRIER

VAPOR BARRIER

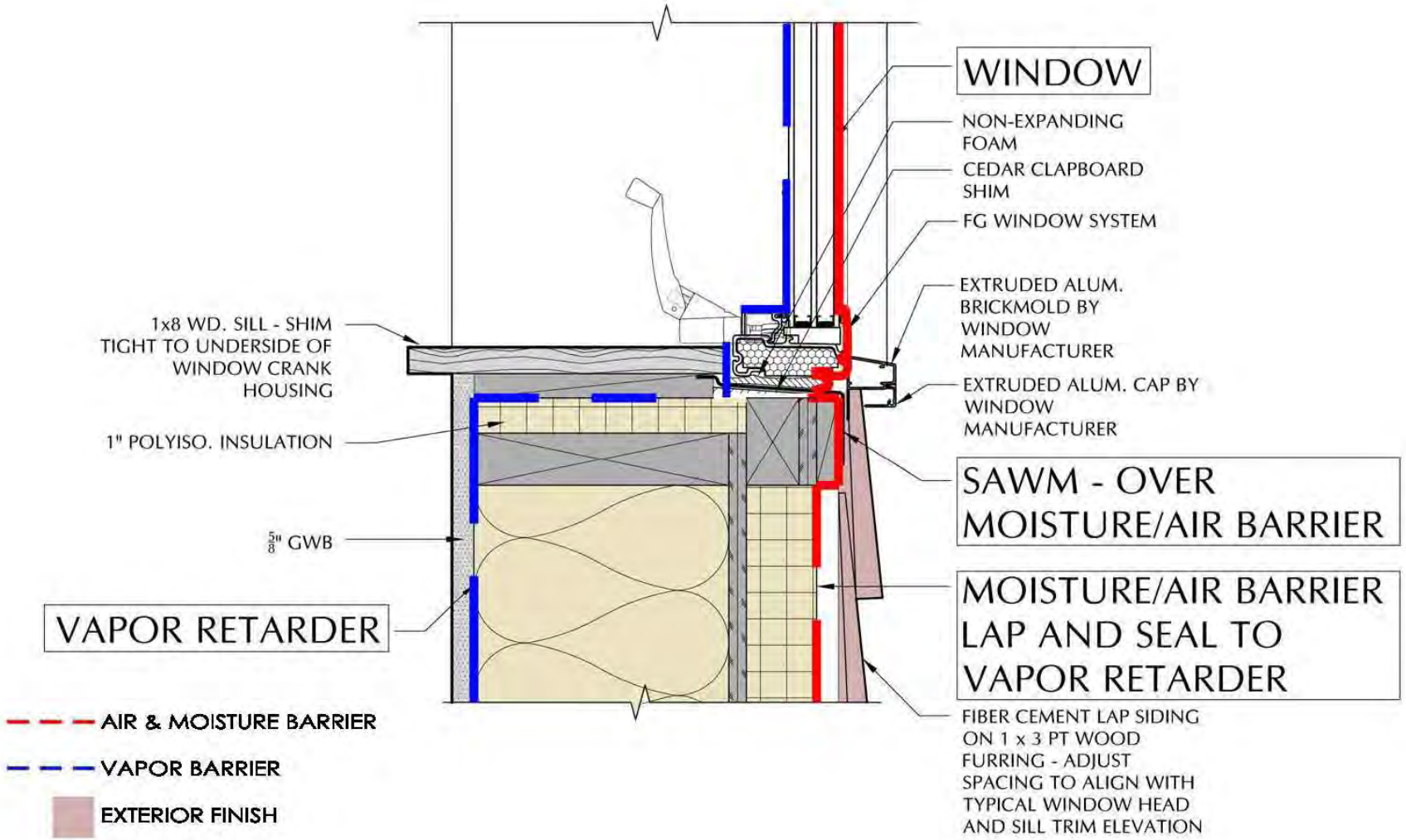
EXTERIOR FINISH

INSULATION

STRUCTURE

INTERIOR FINISH

SKYLIGHT DETAIL



WINDOW SILL DETAIL

1 INSTALL SILL BLOCKING, FIBERGLASS ANGLES, BRICK TIES, & OTHER SHEATHING PENETRATIONS

2 INSTALL FLEX WRAP @ SILL

3 INSTALL MEMBRANE FLASHING @ SILL

4 INSTALL WINDOW

5 INSTALL MEMBRANE FLASHING @ JAMBS

6 INSTALL FLEX WRAP @ HEAD

7 INSTALL METAL FLASHING @ HEAD

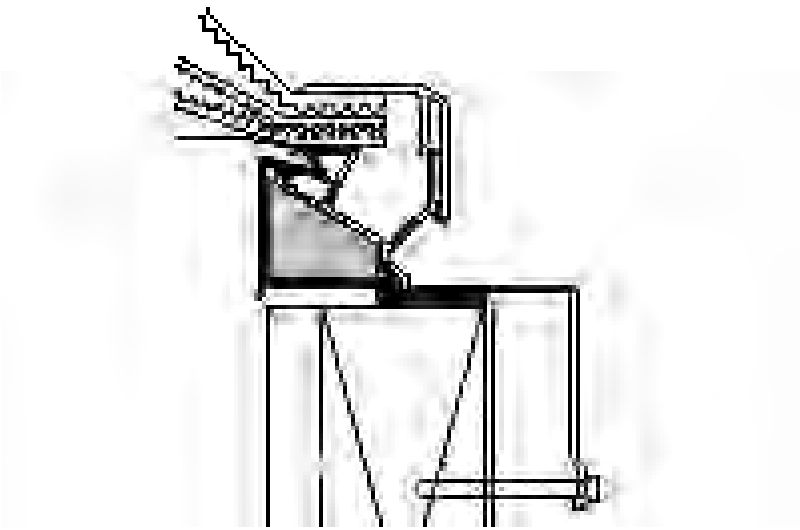
8 INSTALL MEMBRANE FLASHING @ HEAD

9 INSTALL MONOLITHIC LIQUID-APPLIED AIR/MOISTURE BARRIER

10 INSTALL INSULATION, INSULATION RETAINER CLIPS, & METAL PANEL FURRING

11 INSTALL VENEER MASONRY AND METAL PANELS

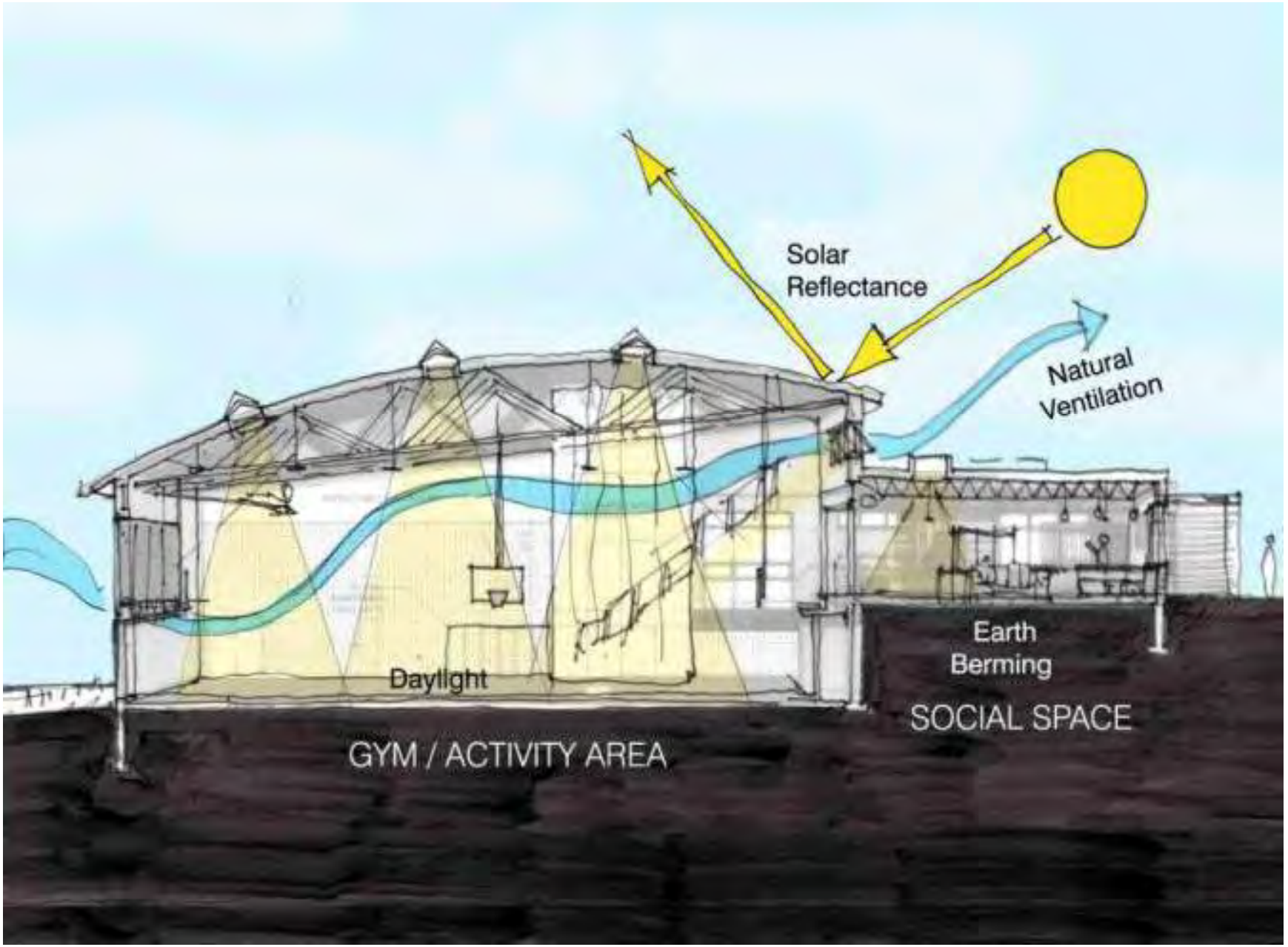
- “Light Louvers”
- Sun-Optics clear prismatic skylight

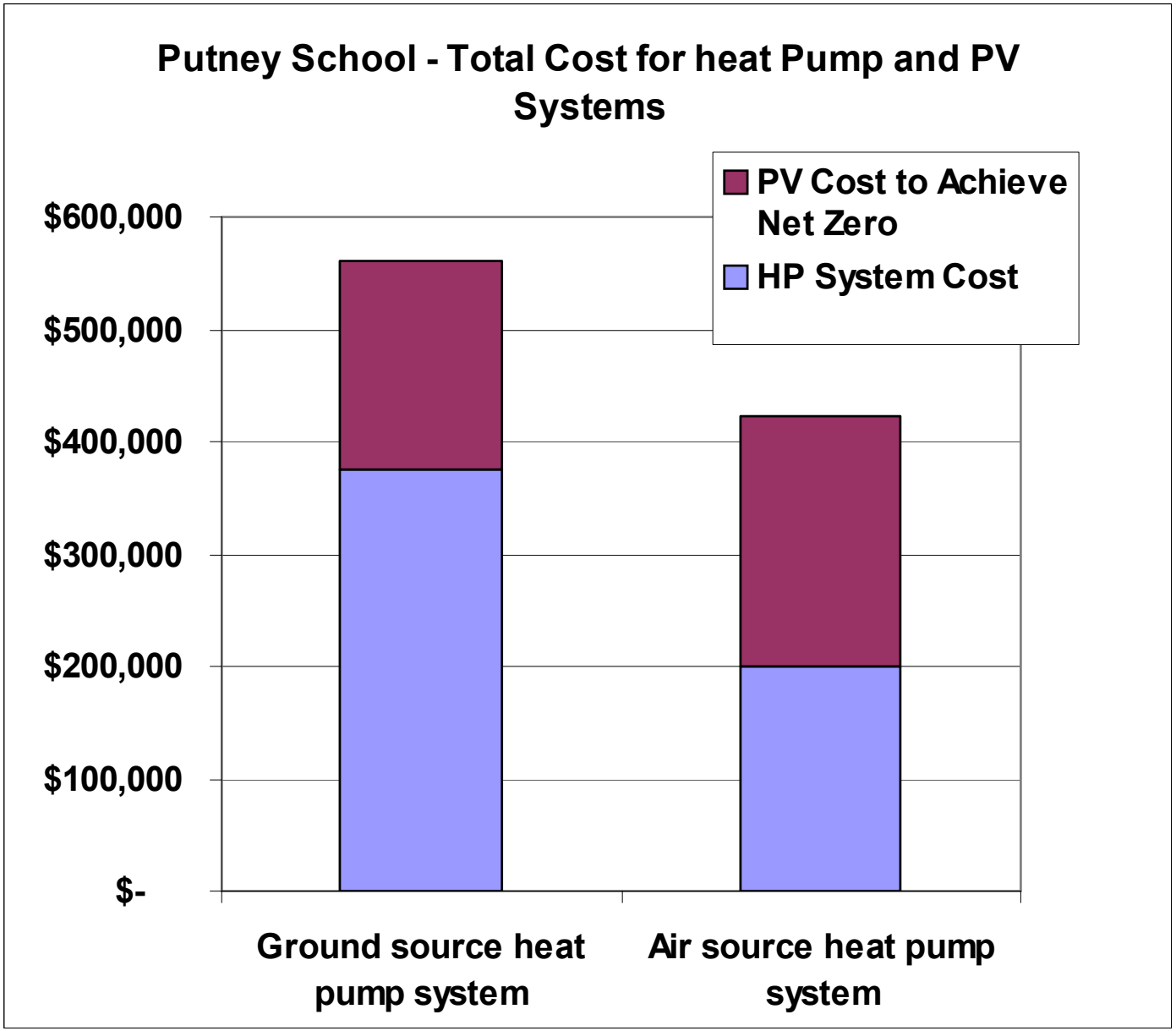


Putney Field House - Lighting

- High efficiency lighting
- Automatic daylight harvesting controls
- Three step auto dimming in gym
- Occupancy sensors everywhere

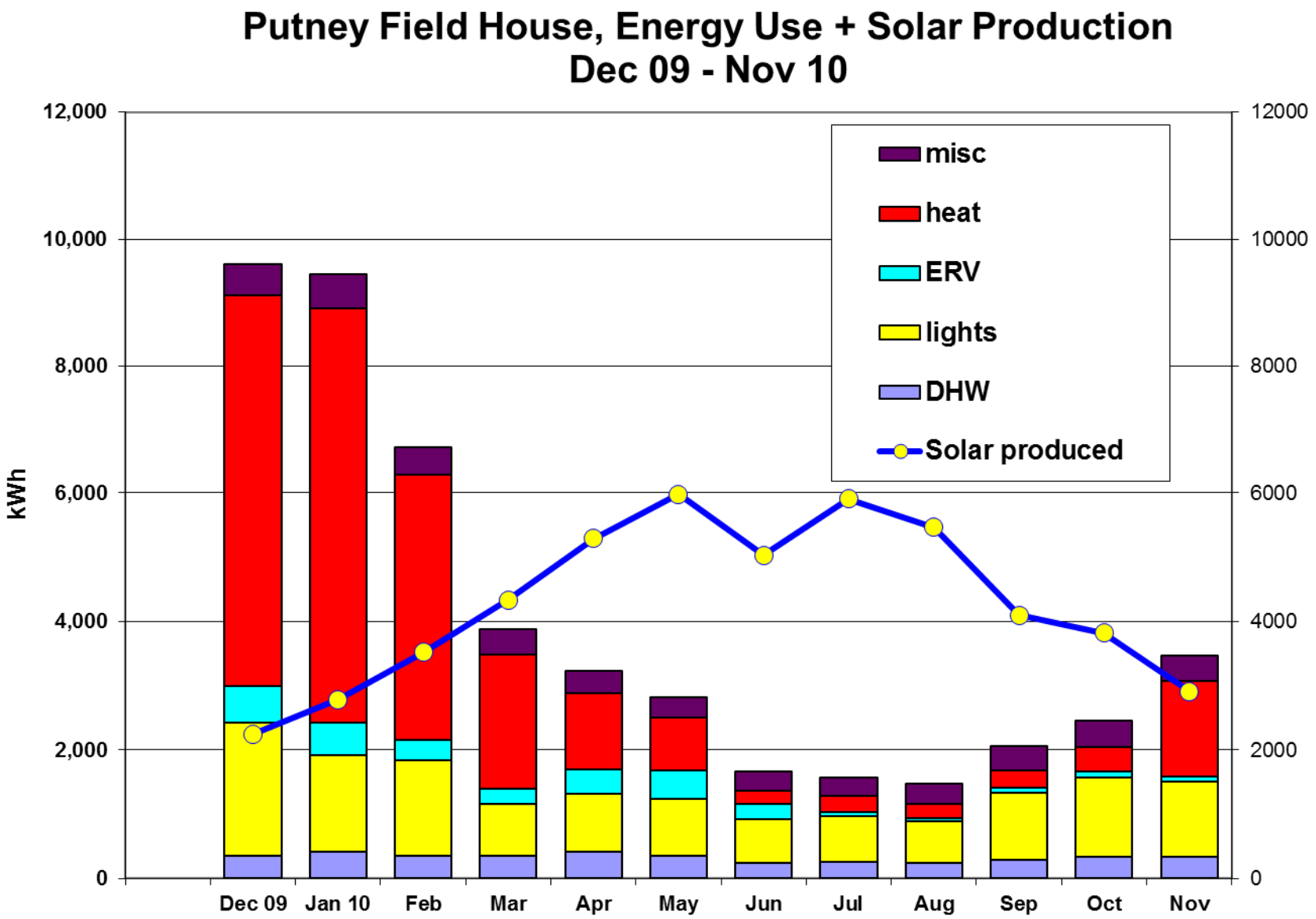
Natural cooling




Putney School - Total Cost for heat Pump and PV Systems
PV Cost to Achieve Net Zero
HP System Cost
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$-
Ground source heat pump system
Air source heat pump system

Energy sources

- PV electricity production!
- 16 Zomeworks 2.3 kW tracking arrays
- 36.8 kW / Expect ~avg of 45,000 kWh/yr


Putney Field House, Energy Use + Solar Production
Dec 09 - Nov 10
kWh
12,000
10,000
8,000
6,000
4,000
2,000
0
12000
10000
8000
6000
4000
2000
0
misc
heat
ERV
lights
DHW
Solar produced
Dec 09
Jan 10
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov

OUTCOME

- Paradigm Shift in Net-Zero Financial Analysis
- Strengthen Fundraising Support
- Environmental leadership

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Building Enclosure

Building Envelope Schedule - MASTER 3-21-2011.pdf

Step 10 - Detail & Build

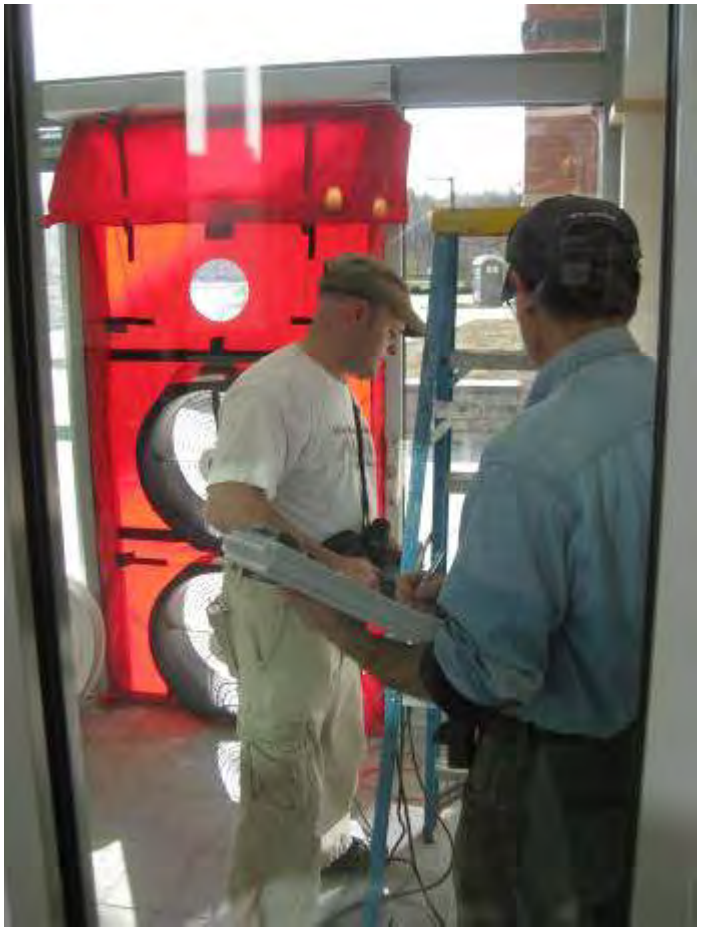
Commissioning & Monitoring

Commission *everything*

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*



Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Building Enclosure --

Why bother?

- Critical to meeting energy goals
- Critical to meet peak load, equipment sizing and comfort requirements
- Risk reduction!

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Show up

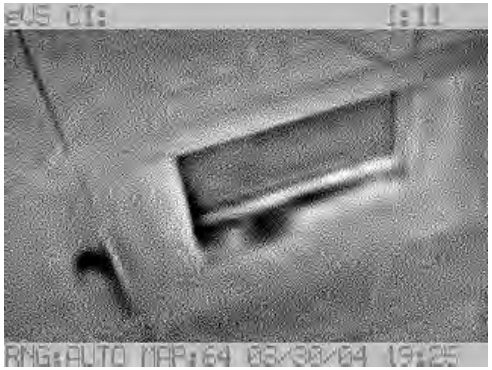
- *Who: Architect, Engineers, Energy Champion, Owners' Rep, Clerk*
- *When: Construction*

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Show up



Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

- *Who: Commissioning Authority, Architect, Engineers, Energy Champion, Owners' Rep, Clerk*
- *When: Construction*

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

- Enclosure
- Mechanicals
- HVAC controls
- Lighting controls
- electrical systems
- Other (e.g., rainwater)

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Lighting controls

- ***Critical*** for commissioning
- Highly visible and constant interaction with occupants
- Not always straightforward

Step 10 - Detail & Build

Commissioning & Monitoring

Commission *everything*

Building Enclosure

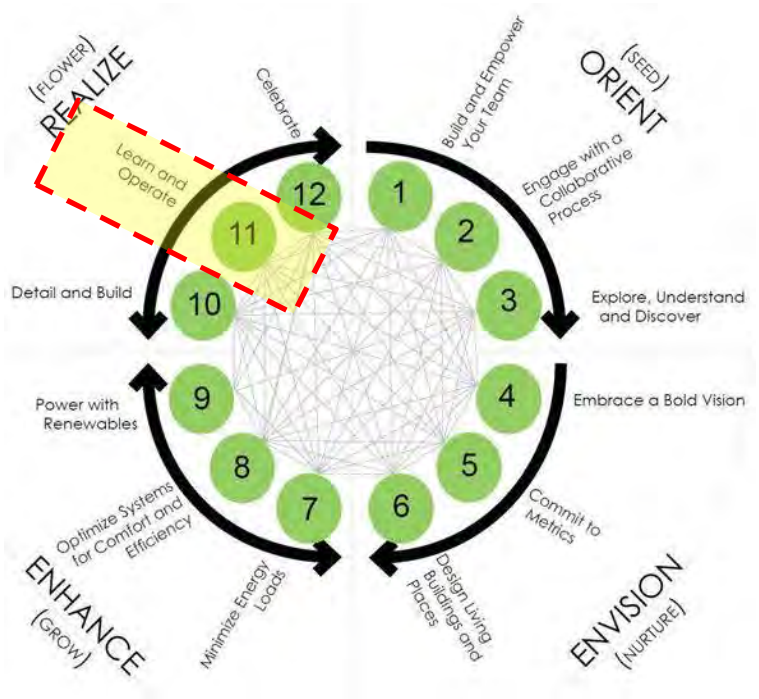
- Systematic review of CD's
  - Clear drawings and details
  - Clear, complete specifications

- Meeting with contractor and subs about building enclosure
  - Specs
  - Drawings
  - Testing schedule and requirements

- Submittal review
  - Compatibility matrix
- On site observation and testing

REALIZE

- Step 11-Learn & Operate
    1. Operation
    2. Post Occupancy Monitoring
    3. Tabulate Actual Energy Performance



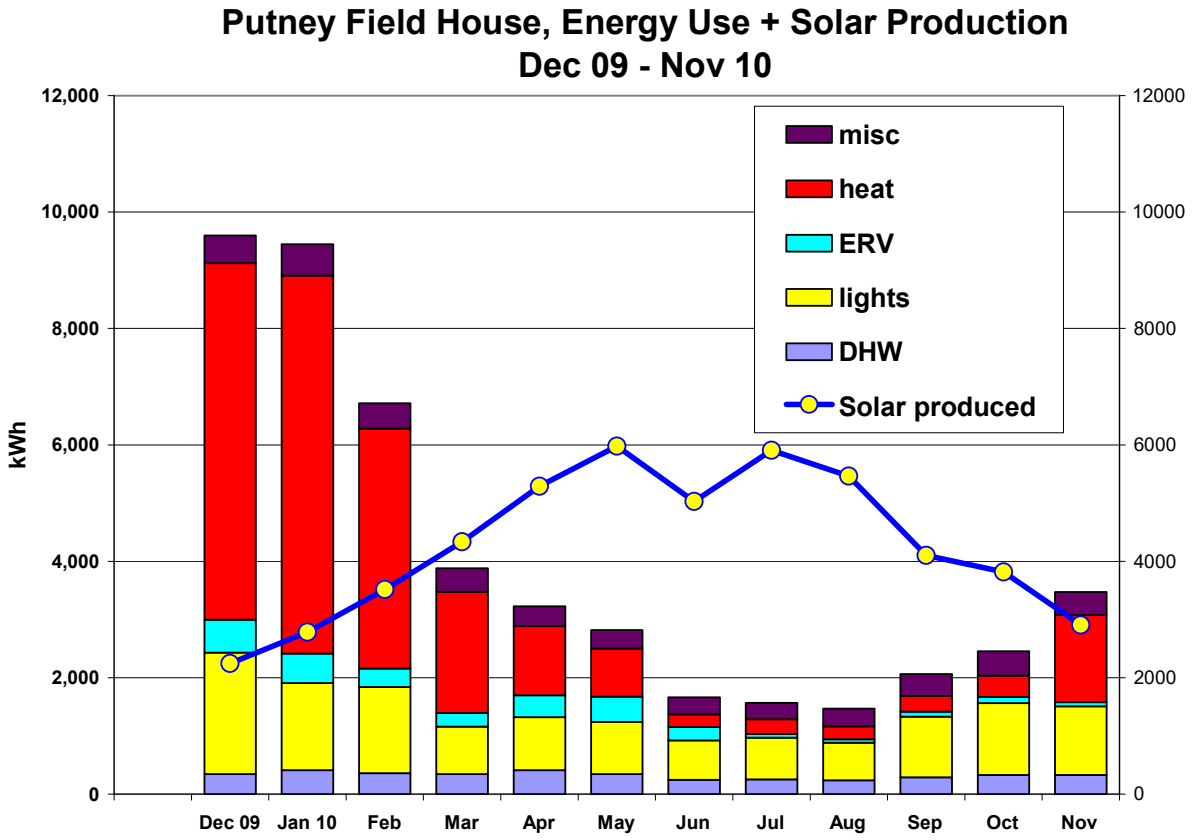
Track the first year of occupancy

- *Who: Architect, Engineers, Energy Champion, Owners*
- *When: First Year*

Step 11-Learn & Operate

Operation & Post Occupancy Monitoring

Track the first year of occupancy



Step 11-Learn & Operate

Operation & Post Occupancy Monitoring

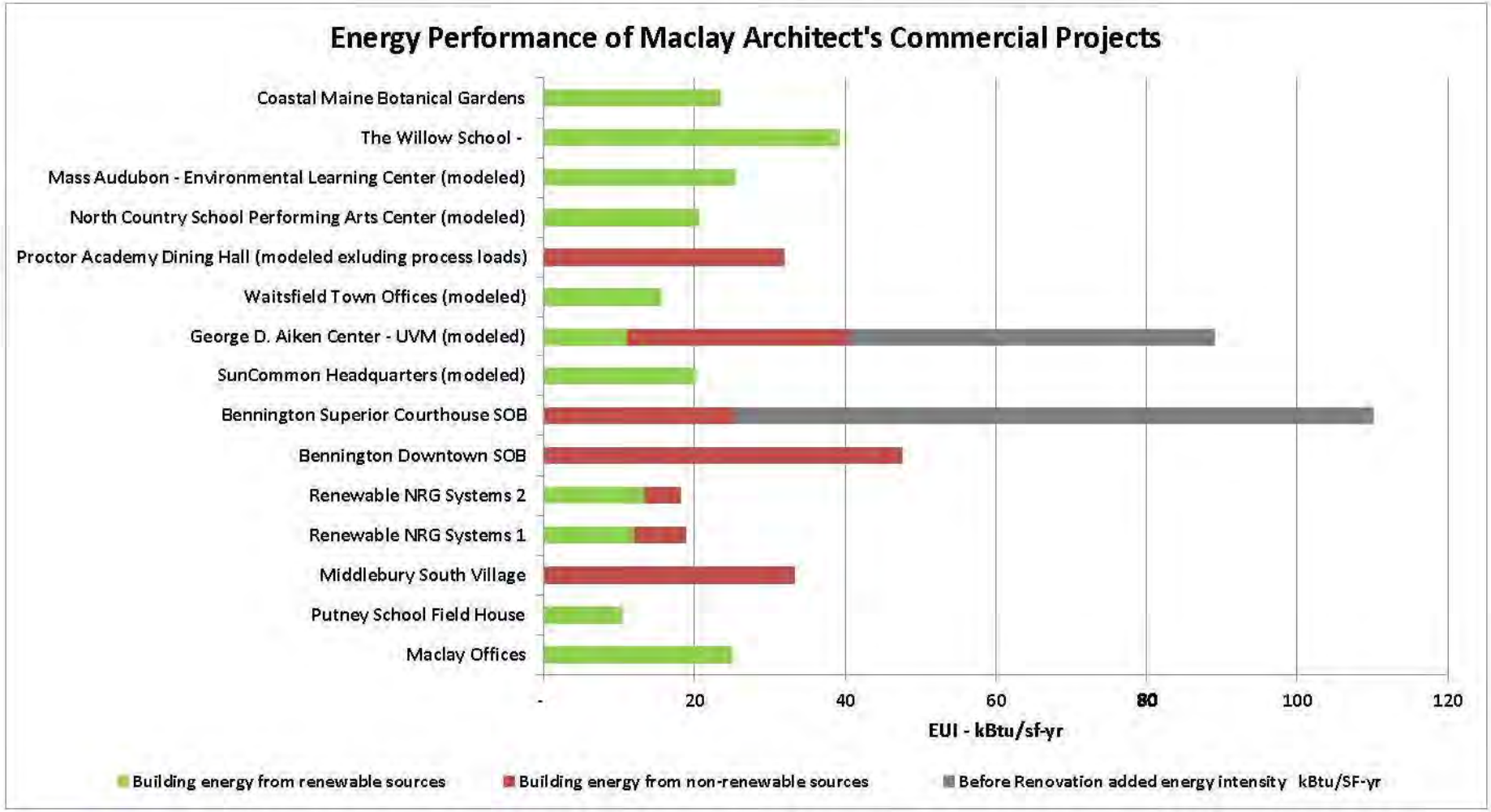
EUI Tabulation 8-Oct-12

Energy Balance, Inc.

				Actual Consumption			Predicted Consumption		
Building number	Building Name	Building Use	Conditioned sq.ft	Fuel Use Start date	Fuel Use End Date	EUI actual kBtu/sq.ft.-yr	Energy Use kBtu/year	EUI predicted kBtu/sq.ft.-yr	Notes effecting energy performance
1	NRG Systems- I	66% office, 34% manufacturing/ warehouse	45,000	1/1/2006	12/31/2006	22		20	Manufacturing not air conditioned
2	Putney Field House	Gym, workout, yoga, social space	17,500	12/1/2009	11/30/2010	10		11	Gym kept at ~60F
3	Aiken Renovation	classrooms, faculty and open offices,	39,544	9/1/2010			998,225	25	
4	Waterfront Housing	Affordable Housing, 40 units	40,000	11/1/2004	10/31/2005	26	1,685,000	42	
5	Pill House	SF home, net zero	2,800	1/10/2008	1/9/2009	7.6	26,545	9.5	
6	CMBG	offices, classrooms	9,500	6/23/2011	5/22/2012	14	153,540	16	
7									

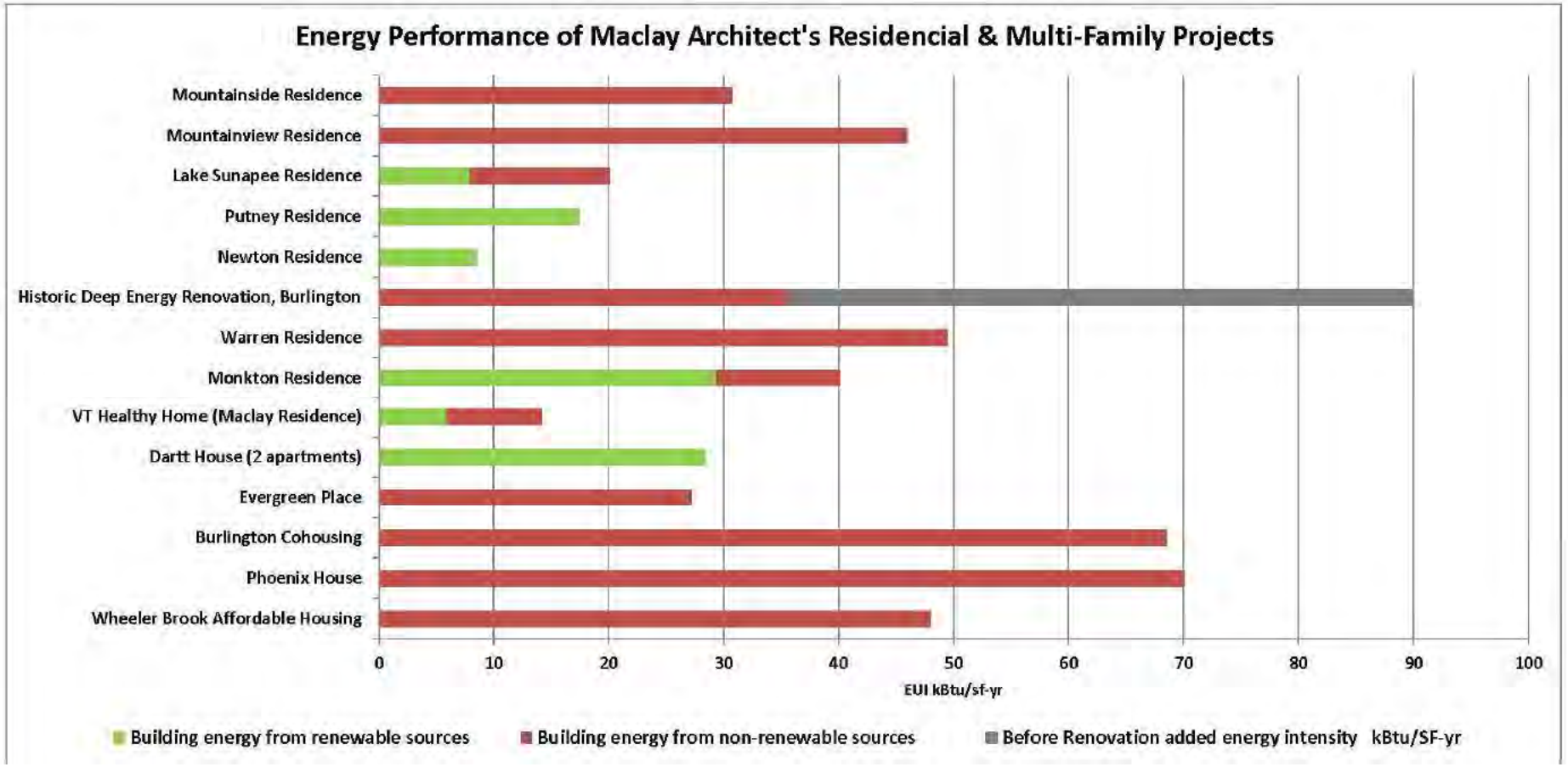
Step 11-Learn & Operate

Tabulate Actual Energy Performance



Step 11-Learn & Operate

Tabulate Actual Energy Performance



Step 11-Learn & Operate

Tabulate Actual Energy Performance

Exercise:

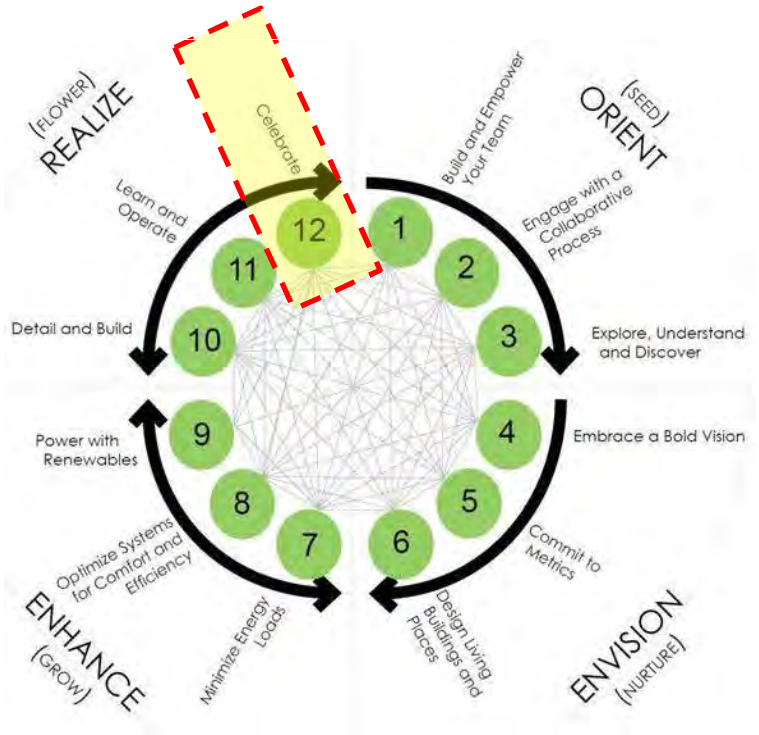
Summary Project EUI Data Sheet.xlsx

Tracking your projects EUI's is a powerful learning tool and powerful marketing tool

Not knowing your EUI is like…

REALIZE

- Step 12 - Celebrate



Join the Energy Challenge to Net-Zero Performance

Maclay Architects
CHOICES IN SUSTAINABILITY

Project Performance Metrics Comparison

Project	SF	Completed	Energy Use Intensity (EUI)								Cost					Air infiltration cmf50/sf (above ground surface area)	Air infiltration cmf50/sf (6-sided surface area)
			Existing	Code	Modeled	Modeled Heating/ Cooling Only	Actual	Heating/ Cooling Only	Project renewable energy production	Net EUI	Actual Air sealing Cost	Actual Commissioning Cost	Additional Captial Cost	Additional Envelope Captial Cost/sf	Total Additional Captial Cost/sf		
			(kBtu/sf-yr)						(kBtu/sf-yr)	(kBtu/sf-yr)							
Bennington Downtown SOB	22,775	2005		88	N/A		40		N/A								
Bennington Superior Courthouse and SOB	65,000	2012	110	39	24		25.6		TBD		$ 39,000	$ 27,000	$372,000	-	$5.72	0.11	
Coastal Maine Botanical Gardens - Bosarge Education Center	8,200	2011	N/A	40	20		19.2	10	23.5	-4.3	N/A	N/A	N/A			0.115	
DVTA, Transit Facility	16,000	2015	N/A	N/A	N/A		83		N/A							0.21	
Environmental Learning Center - Mass Audubon	3,700	projected 2018	N/A	48	25	0.9 H 3.2 C	TBD										
George D. Aiken Center	40,000	2011	89	70	33		TBD		9.4	24						0.11	
Maclay Offices	2568		N/A	88	N/A		23	~7	23	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Middlebury South Village	17,000	2011	N/A	88			28		N/A				$50,000		$3	0.06	
Mooslauke Ravine Lodge	11,000	2017			25												
Moretown Town Offices	1,300	2018	N/A				TBD		N/A							0.068	0.048
North Country School Performing Arts Ctr	10,000	projected 2018	N/A	61	21												
Renewable NRG 1	46,000	2004	N/A				18.2		5.4	12.8						0.18	
Renewable NRG 2	31,000	2008	N/A				17.7		8.3	9.4						0.092	
Proctor Academy Dining Hall	15,000	2016	N/A	220	77		TBD		TBD				$627,000	$6.29	$42	0.0545	0.032
Putney School Field House	16814	2009	N/A		11		9	4.9	11	-2			$1,500,000	-	$89	0.065	
SunCommon Headquarters - warehouse	7,000	2016	N/A	N/A	N/A	N/A	TBD		TBD	0							
SunCommon Headquarters -office	9,000	2016	N/A	62	22	4.7 H 1.7 C	TBD		22	0		$ 1,500				0.09	TBD
The Willow School	20,000	2015	N/A	35.2	21.9	1.8Heat 2.2Cool	25.9		38	-12							
Vermont Creamery Offices	3,000	2015	79	61	19											0.075	
Vermont Land Trust	6,000	2015	51	45	27		30.2		0							0.35	0.23
Waitsfield Town Office	4,700	2016	N/A	40	16	3	TBD		16	0						0.075	0.057

US Energy Information Administration Median Site EUI Comparative

Source: Maclay Architects

Education College/University	kBtu/sf-yr	104	
Education	kBtu/sf-yr	58	68.8
Food Service - Restaurant Cafeteria	kBtu/sf-yr	207	282.7
Lodging	kBtu/sf-yr	88	96.9
Public Assembly	kBtu/sf-yr	119	86.3
Office	kBtu/sf-yr	93	77.8
Warehouse/Storage	kBtu/sf-yr	33	32.8

Source: EIA CBECS 2003 and Architecture 2030 Inc. EIA CBECS 2012

Join the Energy Challenge to Net-Zero Performance

MaclayArchitects
CHOICES IN SUSTAINABILITY

Project Performance Metrics Comparison

Project	SF	Year Completed	Energy Use Intensity (EUI)					Cost			Certifications	Air infiltration cmf50/sf (6-sided surface area)
			Existing	Code	Modeled	Actual	Project renewable energy production	Additional Captial Cost	Total Additional Captial Cost/sf	% Additional Capital Cost of total Building Cost		
			(kBtu/sf-yr)				(kBtu/sf-yr)					

US Energy Information Administration Median Site EUI Comparative

Source: Maclay Architects

Education College/University	kBtu/sf-yr	104	
Education	kBtu/sf-yr	88	68.8
Food Service - Restaurant	kBtu/sf-yr	207	282.7
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