

# Hunnewell Elementary School Feasibility Study



# Sustainability Update



# Sustainability & MEP Considerations: What makes Schools different from other building typologies?

Ventilation Requirements

Code regulated (higher occupancies than other buildings)

Northeast Climate

Cold Humid

- people comfort & building protection (moisture)
- Heating dominant energy use
- Limited (8-10 weeks) use in summer

Study, Design, Construction Duration

Typically 4 Years

- Building and Energy Codes Change (1/2020 & 1/2022)
- Energy/Stretch code gap is narrowing (fast) vs. Net Zero Ready

User Variability

Building Life Expectancy 50+ Years

Public Bidding Procedures

3 manufacturers for all products, Filed Sub Bid laws, etc.

Variety and Variability of Space Types

Specialty spaces

- auditoriums/stages, media centers, gymnasiums, kitchens

Complex Zoning Requirements

Such as, 25% Lot Coverage limit

More and More Technology

High Security Demands

Impacts electrical usage

Operational Systems Complexity

# Sustainability & MEP Considerations: Hunnewell Specific NZR Design Strategies

## Maximize Envelope Insulation and Air Tightness

R-60 Roof, R-34 Walls,  
U-0.23 Triple Glazing Systems (*3 equals*)  
25-30% WWR (Window to Wall Ratio)  
Air Infiltration Reduction Strategies  
(*commission, commission, commission!*)

## Maximize Mechanical System Efficiency

(Partially) Offsets Envelope Costs  
Final Systems type selection impacts pEUI

## Efficient Lighting Systems

Light Power Density goal: 0.55 w/SF or better  
Advanced Digital Network Lighting Controls

## Limit or eliminate gas fuel systems for heating and cooking

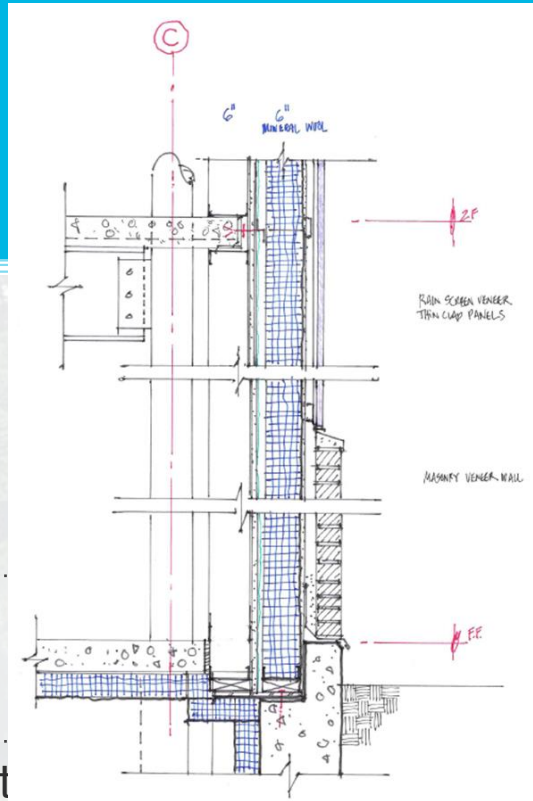
FMD review – Schematic Design decision

## Maximize space available for Solar PV on school rooftop

PV Ready Structural System  
Allow additional space for Equipment  
Extend PV locations to adjacent site (TBD)

## Plug Load Reduction and Management

75%+ outlets controlled/programmed (beyond Code)  
Train all users of building to support the energy goals



# Sustainability and MEP Considerations: Systems Approaches

- Heating / Cooling Sources
  - VRF
  - Geothermal
  - Boiler / Chiller (Gas & Electric)
- Heating / Cooling Applications
  - Displacement Ventilation
  - Chilled Beams
  - VRF
  - Radiant Heating – Floor vs Ceiling
- Ventilation Source / Applications
  - DOAS
  - Displacement
  - Overhead
- Analysis of an all Electric building continues through SD
- SMMA is not recommending Simple Ductless Split Systems
- Cost models include rooftop penthouse: improves units' efficiency adds available roof area for PV

# Preliminary Energy Performance Summary

Description	Units	NEW	ADD / RENO
		NET ZERO READY (NZR) Option*	NET ZERO READY (NZR) Option*
<b>Building Enclosure</b>			
Roof	U-value	0.017 (R-60)	0.017 (R-60)
Walls	U-value	0.029 (R-34)	0.029 (R-34)
Glazing (Assembly Value)	U-value	0.20 – 0.23	0.20 – 0.23
	SHGC	0.25	0.25
Window/Wall Ratio (WWR)	%	25%	25%
Infiltration	CFM/sf	0.15 CFM/sf @ 75 pascals	0.20 CFM/sf @ 75 pascals
<b>Lighting</b>			
Lighting Power Density	w/sf	0.5 [With advanced networked lighting controls]	0.5 [With advanced networked lighting controls]
<b>Equipment</b>			
Equipment Power Density	w/sf	0.75 [75% receptacles automatically controlled]	0.75 [75% receptacles automatically controlled]
<b>HVAC System Type</b>			
VRF	\$46/sf	<b>Fully Electric System</b>	<b>Fully Electric System</b>
Predicted EUI <sup>1</sup>	kBtu/sf	<b>26.4</b>	<b>28.4</b>
Annual Energy Cost <sup>2</sup>	\$	\$76,517	\$81,793
<b>Alternative HVAC System Option</b>			
Ground Source Heat Pumps	\$57-65/sf <sup>3</sup>		
Predicted EUI <sup>1</sup>	kBtu/sf	30.5	31.0
Annual Energy Cost <sup>2</sup>	\$	\$88,126	\$89,141
Boiler Chiller	\$47.50/sf	<b>Stretch Code Level Energy Performance**</b>	
Predicted EUI <sup>1</sup>	kBtu/sf	42.4	42
Annual Energy Cost <sup>2</sup>	\$	\$76,024	\$89,676

1. EUI = Energy Use Intensity
2. Energy cost assumptions - \$0.13/kWh and \$1.18/therm
3. Preliminary estimate provides a range costs, pending a test well (potential well density)

#### NOTES:

\*Net Zero Ready: 30% of renewable Energy provided on site; Diesel emergency generator.  
 \*\*The Stretch Code HVAC system has a predicted EUI of 42, beyond the pEUI 30 mandated for the project. The Massachusetts Energy Code 1/2022 Revision will likely impact the Stretch Code performance and system costs.

# Sustainability and MEP Considerations: Preliminary Energy Model Results

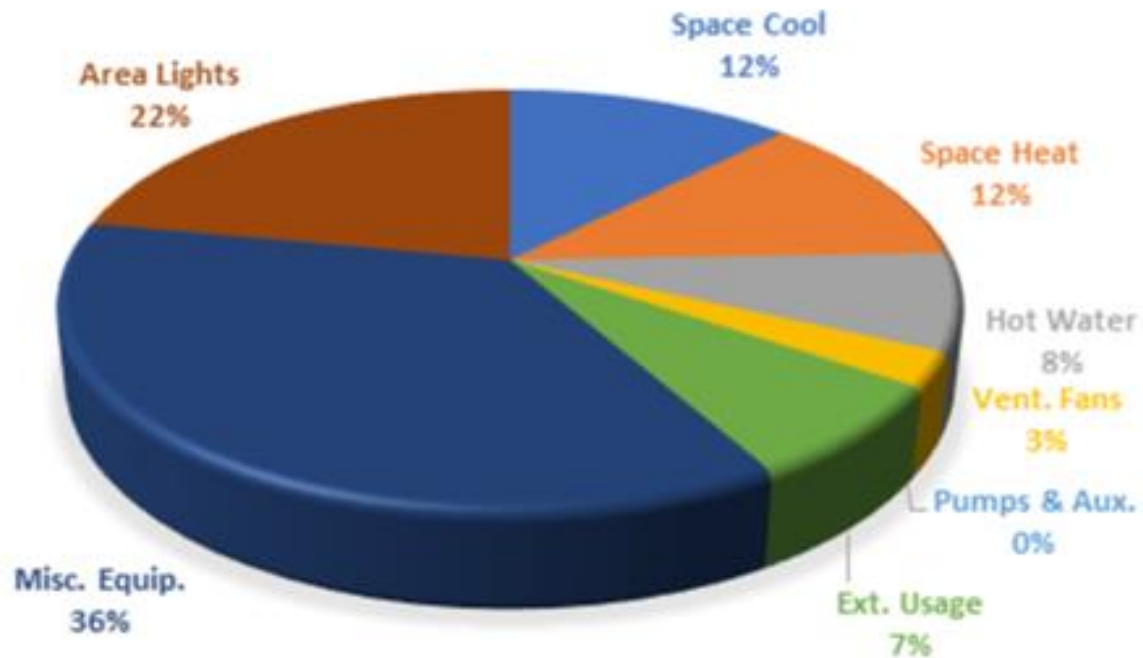
**All New Construction**  
Predicted EUI of 23-27

Preliminary Option: **26.4**

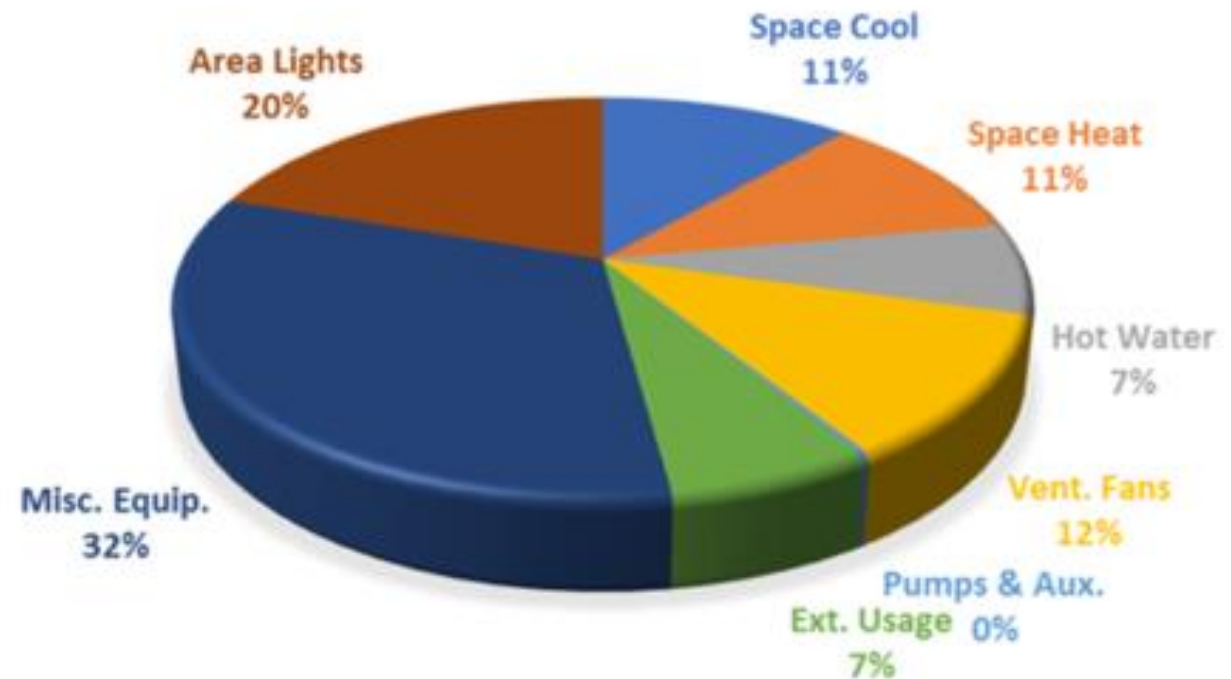
**Addition/Renovation**  
Predicted EUI of 26-30

Preliminary Option: **28.4**

**EUI BREAKDOWN**



**EUI BREAKDOWN**



# Sustainability & MEP Considerations: Solar Photovoltaics

		NEW	ADD / RENO
Description	Units	NZR Option	NZR Option
<b>Preliminary Solar Photovoltaic (PV) Analysis</b>			
<b>Preliminary Solar PV Offset Required<sup>1</sup></b>	<b>kW</b>	<b>735 (VRF) – 857 (GSHP)</b>	<b>785 (VRF)</b>
<b>Solar PV area required<sup>2</sup></b>	<b>SF</b>	<b>73,484 – 85,720</b>	<b>78,531</b>
Available school roof area <sup>3</sup>	SF	30,000	25,000
<i>Additional area required</i>	SF	48,484 – 60,720	53,531
<b>Total Preliminary Solar PV Estimated Cost</b>	<b>\$</b>	<b>\$3,463,750 - \$3,653,701</b>	<b>\$3,491,939</b>
School Roof Array only (\$3.95/w)	\$/w	\$1,185,000	\$987,500

1. Assumes all building loads are electric, using NREL PV harvesting factor of 1.1 AND a 15% contingency (NZE projects size PV 15-20 % larger to account for operational adjustments (schedules/user behaviors, etc)
2. Assumes 10w/SF as preliminary assessment (installed panels efficiency may be up to 12 w/SF)
3. The available roof area is subject to change as the project moves into schematic design and further defines HVAC system roof equipment.

# Sustainability & MEP Considerations: Hunnewell Specific NZR Design Strategies

## **Owner Project Requirements (OPR)**

Draft Complete, Final to be issued with Report

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## **LEEDv4 Recommendations**

Included within Final Report

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## **Preliminary Energy Performance Goals**

Within pEUI 30 goal for both New and Add/Reno Options  
Energy Performance Criteria included in base project budget  
and Modeling Output Included in Final Report  
NZR Financial Analysis – May 2019

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## **Planning for Solar Photovoltaics (NZR)**

PV Ready roof and electrical equipment program space  
30,000 SF area PV system included in project budget  
Optimize PV area design in SD  
Extend PV locations to adjacent site (TBD)

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