FALL BROOK ELEMENTARY SCHOOL

LEOMINSTER, MA

Fall Brook Building Committee

January 14, 2025

MDS

TODAY'S AGENDA

1. Sustainability Goals
2. Overview of the MSBA Green Program
3. LEED Scorecard Review
4. HVAC Systems Life Cycle Analysis (LCCA) Overview
    a. Overview of Options
    b. Pros and Cons for each of the systems
    c. HVAC LCCA Results
5. Questions and Discussions

SUSTAINABILITY GOALS

OVERALL PROJECT GOALS

SITES

- Protect Habitat
- Protect Fall Brook
- Restore open space
- Mitigate Stormwater runoff
- Celebrate the natural beauty of the site
- Investigate reduction of impervious areas

WATER RESOURCES

- Reduce outdoor water Low flow fixtures
- Native plantings that are easy to maintain
- Minimize or eliminate irrigation – target 30% reduction

ENERGY

- Meet all LEED prerequisites
- Reduce energy consumption, aim for <25 EUI.
- Systems Commissioning and the envelope
- All electric systems and kitchen equipment
- PV Ready roof

MATERIALS AND CARBON

- Life Cycle Impact Reduction Credit- CO_2 limits
- Avoiding chemicals of concern
- Product transparency- EPDs and HPDS
- Same durability, no cost impact

INDOOR AIR QUALITY AND WELLNESS

- Building Orientation to maximize daylight and views
- MERV 14 filters
- Low VOC materials for interior finishes
- Mechanical ventilation will improve air quality

EQUITY

- How to provide learning spaces for all learners
- Third Party standards to look at supply chain and manufacturer labor practices

MSBA GREEN SCHOOLS PROGRAM

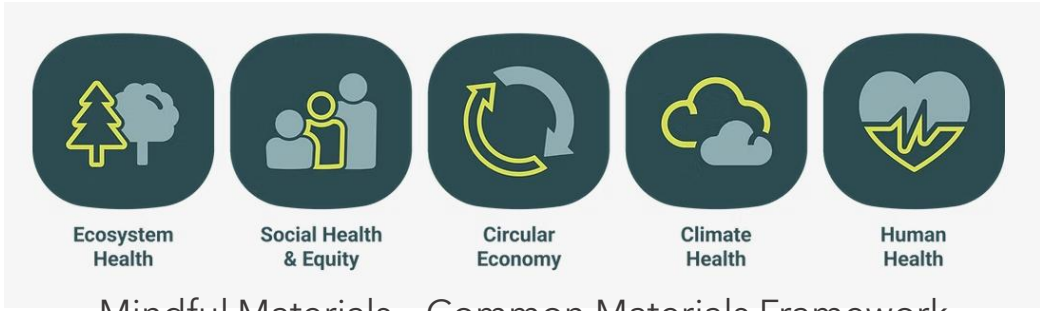
OVERVIEW

- MSBA GREEN SCHOOLS PROGRAM POLICY 2023
- PROJECT ADVISORY 81- LEED and Reimbursement requirements were revised in 2023
- PROJECT ADVISORY 69
- Per MSBA **Project Advisory 69**: House Bill 4900, Chapter 21A of the MA General Laws prohibits the use of flame retardants in carpets and Window coverings.
- MSBA Sustainability policy have been updated to correspond to the changes to the State's building code, energy code, and indoor air quality improvements
- Student and occupant health and wellness is a top priority for the MSBA. The school's design should reduce energy consumption and reduce dependency on fossil fuels

MDS is a leader in selection of healthy materials that reduce or eliminate the use of certain classes of chemicals used in construction materials.

We will work with the City of Leominster to select materials that improve indoor air quality and we aim to eliminate chemicals of concern in interior, touchable surface products

Our team will develop clear goals and will provide transparency of this process



Mindful Materials – Common Materials Framework

MSBA GREEN SCHOOLS PROGRAM - LEED

ENERGY PERFORMANCE

REQUIRED

Meet the minimum energy efficiency requirements must meet the **MA Stretch Energy Code** for Commercial Buildings

- High Performance Envelope
- Air Tightness
- EV Ready
- PV Ready

ADDITIONAL FUNDING

For an **Additional 3%** Reimbursement projects must meet the MA "Opt-in Specialized Code"

Pick One compliance Path
- Net Zero
- All Electric
- Mixed Fuel

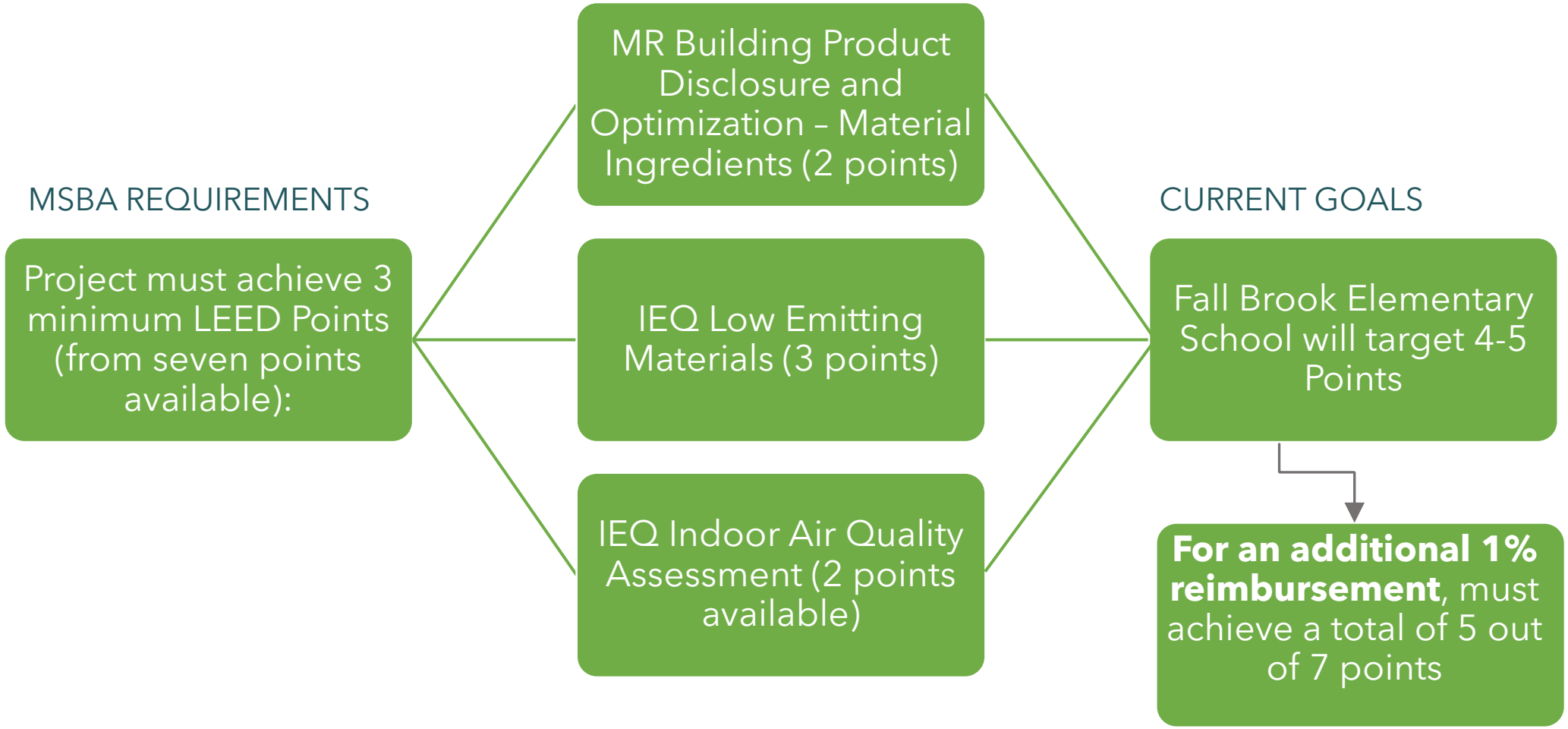
Passive House Certification will meet it

MSBA GREEN SCHOOLS PROGRAM POLICY

LEED FOR SCHOOLS MINIMUM REQUIREMENT

MSBA GREEN SCHOOLS PROGRAM POLICY

LEED FOR SCHOOLS MINIMUM REQUIREMENT AND ADDITIONAL REIMBURSEMENT



LEED CHECKLIST
MSBA REQUIREMENTS

SCHEMATIC DESIGN

New version of LEED will be launched in 2025- MDS will compare both versions before project is registered with the USGBC

Currently meeting LEED Silver, will continue to work towards having more of the maybe credits move to the yes column and achieving LEED Gold without extra cost to the project

LEED v4.1 BD+C: Schools
Project Checklist

Project Name: Fall Brook Elementary School
25 DeCicco Drive, Leominster, MA 01453
Date: 14-Jan-25

Y	?	N			
1			Credit	Integrative Process	1

3	0	12	**Location and Transportation**		15
			Credit	LEED for Neighborhood Development Location	15
1			Credit	Sensitive Land Protection	1
		2	Credit	High Priority Site	2
		5	Credit	Surrounding Density and Diverse Uses	5
		4	Credit	Access to Quality Transit	4
1			Credit	Bicycle Facilities	1
		1	Credit	Reduced Parking Footprint	1
1			Credit	Electric Vehicles	1

5	3	4	**Sustainable Sites**		12
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	Environmental Site Assessment	Required
	1		Credit	Site Assessment	1
	1	1	Credit	Protect or Restore Habitat	2
1			Credit	Open Space	1
1		2	Credit	Rainwater Management	3
1	1		Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
		1	Credit	Site Master Plan	1
1			Credit	Joint Use of Facilities	1

4	2	6	**Water Efficiency**		12
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
1	1		Credit	Outdoor Water Use Reduction	2
2	1	4	Credit	Indoor Water Use Reduction	7
		2	Credit	Optimize Process Water Use	2
1			Credit	Water Metering	1

18	7	6	**Energy and Atmosphere**		31
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
5	1		Credit	Enhanced Commissioning	6
10	2	4	Credit	Optimize Energy Performance	16
1			Credit	Advanced Energy Metering	1
	2		Credit	Demand Response	2
2	1	2	Credit	Renewable Energy Production (V4.1)	5
	1		Credit	Enhanced Refrigerant Management	1

7	4	2	**Materials and Resources**		13
Y			Prereq	Storage and Collection of Recyclables	Required
2	1	2	Credit	Building Life-Cycle Impact Reduction (V4.1)	5
2			Credit	EPDs (V4.1)	2
1	1		Credit	Sourcing of Raw Materials (V4.1)	2
1	1		Credit	Material Ingredients (V4.1)	2
1	1		Credit	Construction and Demolition Waste Management	2

10	3	3	**Indoor Environmental Quality**		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
Y			Prereq	Minimum Acoustic Performance	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
3			Credit	Low-Emitting Materials (V4.1)	3
1			Credit	Construction Indoor Air Quality Management Plan	1
	2		Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
2			Credit	Interior Lighting	2
	1	2	Credit	Daylight (V4.1)	3
1			Credit	Quality Views (V4.1)	1
		1	Credit	Acoustic Performance (V4.1)	1

6	0	0	**Innovation**		6
5			Credit	Innovation	5
1			Credit	LEED Accredited Professional	1

4	0	0	**Regional Priority**		4
1			Credit	Regional Priority: Optimize Energy (8 pt min)	1
1			Credit	Regional Priority: Open Space	1
1			Credit	Regional Priority: Renewable Energy (2pt)	1
1			Credit	Regional Priority: (Building LC impact red. 2 pts)	1

58	19	33	**TOTALS**	Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

HVAC SYSTEM
LIFECYCLE COST ANALSYSIS (LCCA)
OVERVIEW
for

FALL BROOK ELEMENTARY SCHOOL

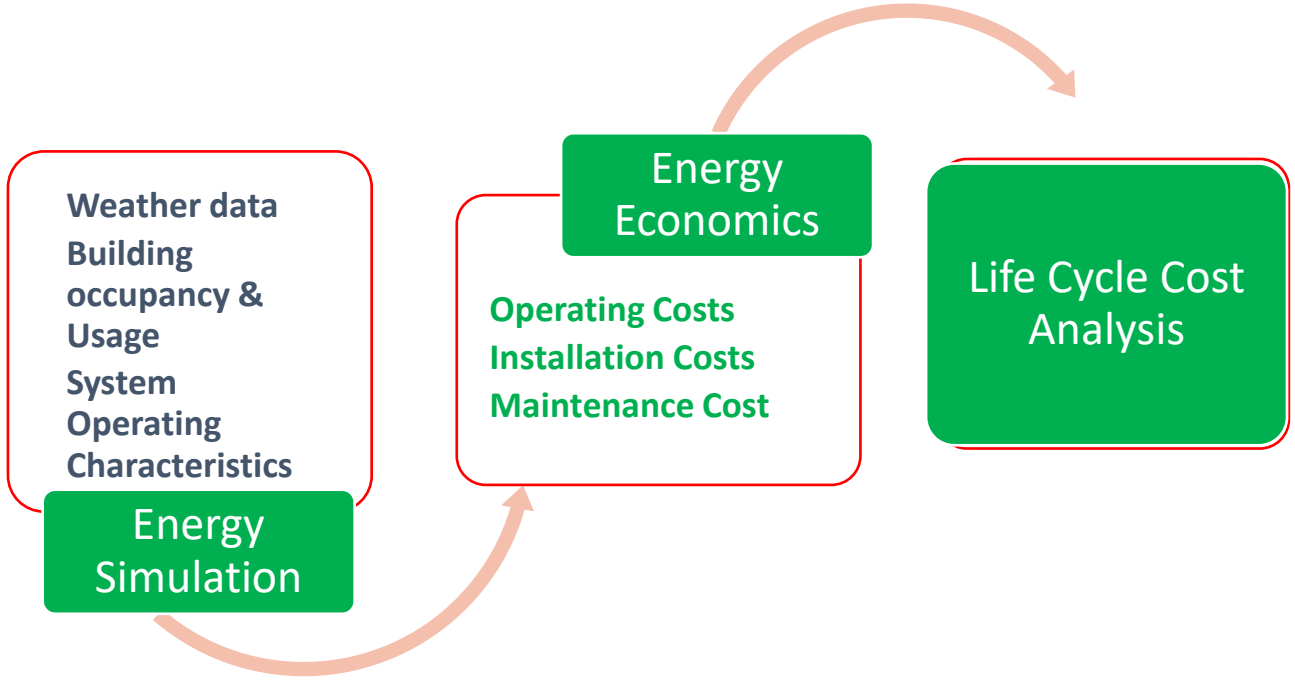
LEOMINSTER
PUBLIC SCHOOLS

GGD Consulting Engineers, Inc.
375 Faunce Corner Road, Suite D
Dartmouth, MA 02747

MEETING AGENDA

- HVAC System Life Cycle Cost Analysis (LCCA) Overview
- HVAC LCCA Results
- HVAC Related Topics, Questions & Discussion

GOAL OF LIFE CYCLE COST ANALYSIS



- Goal is to assess the performance of **various mechanical system options** in comparison to a baseline mechanical system.
- Options compared to the baseline system over a 50-year cycle to determine the most advantageous system considering **utility costs, maintenance costs, replacement costs, and initial construction costs**.
- The Option with the **greatest total life-cycle savings** is generally recommended.

LIFE CYCLE COST ANALYSIS

Proposed Design Criteria Temperature Conditions (Baseline & All Options)

Notes:
DB = Dry Bulb
RH = Relative Humidity
WB = Wet Bulb

Design Outdoor Temperature Data

Per ASHRAE (Fitchburg/Leominster) Tables:

Heating 99.6% @ 4°F Heating &

Cooling 0.4% @ 91°F db, 73.5°F wb

All Occupied areas, including Classrooms, Teacher Planning, Office, Cafeteria, Gym are proposed to provide:

Heating 70°F +/- 2°F db and

Cooling @ 75°F +/- 2°F db with 55% RH

Entryways, storage rooms:

Heating & Ventilation: 68°F db

Unoccupied temperature setback of **65°F db Heating** and **85°F db Cooling** is provided for **all options**.

LCCA – PROPOSED HVAC SYSTEM OPTIONS

ALL HVAC OPTIONS ARE BASED ON FOSSIL FUEL FREE, ELECTRIFIED HEATING SYSTEMS THAT WILL BE COMPARED TO A MASSACHUSETTS OPT-IN CODE COMPLAINT BUILDING & HVAC SYSTEM.

ALL OPTIONS SHALL MEET OR EXCEED: MSBA Requirement for Additional Reimbursement, LEED, and MA Opt-in Stretch Energy Code Requirements

BASELINE: Air Source Heat Pump Plant - Mixed-Air Overhead VAV System and High Efficiency Air-Source to Hydronic Heat Pump Chiller/Heating Plant for Chilled/Heating Hot Water

OPTION 1: Air-Source VRF (Variable Refrigerant Flow) and DOAS (Dedicated Outdoor Air Systems w/ Air Source Heat Pump) for Classrooms/Office areas & Air Source Heat Pump Rooftop Units for Gym, & Cafeteria with Supplemental electric heating for entryways, storage, and utility rooms.

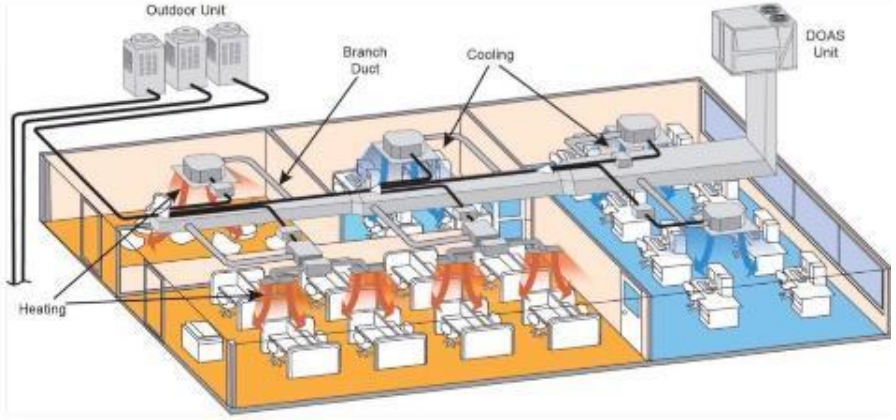
OPTION 2: Air Source Heat Pump Plant - VAV Displacement System w/ Passive Radiant Cooling/Heating Panels and High Efficiency Air-Source to Hydronic Heat Pump Chiller/Heating Plant for Chilled/Heating Hot Water

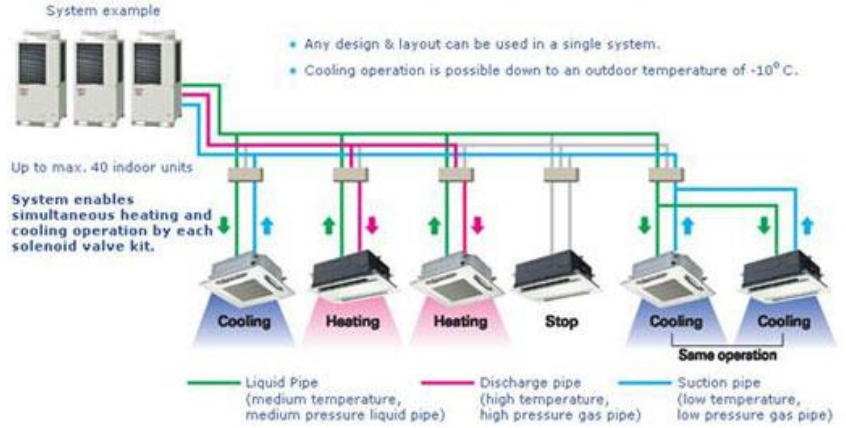
OPTION 3: Geothermal Heat Pump Plant - VAV Displacement System w/ Passive Radiant Cooling/Heating Panels and Geothermal Hydronic Heat Pump Chiller/Heating Plant for Chilled/Heating Hot Water

OPTIONS 1 – AIR SOURCE VRF (Variable Refrigerant Flow) with DOAS (Dedicated Outside Air System) UNITS

Pros:

- Lower piping installed costs due to refrigerant piping system only
- **Boiler/chiller plants and distribution not required**
- Single cabinet can be utilized for both heating and cooling applications
- **Simultaneous heating and cooling**
- **Smaller central ventilation ductwork**
- **High energy efficiency**
- Modular design allows for level of redundancy
- No fossil fuel site emissions
- **Utility Incentives**

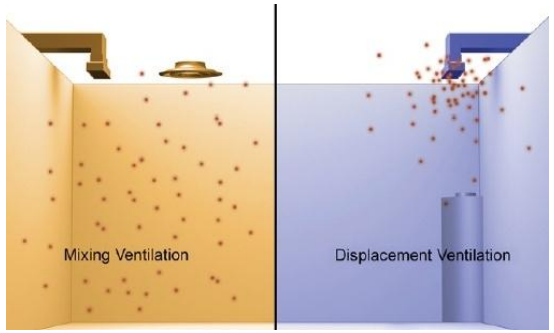




Cons:

- **Uses Overhead Airflow Distribution (No Displacement)**
- **Individual fan motors in space**
- **Slightly higher noise levels in occupied space**
- **Quarterly filter changes per unit**
- **Condensate drain maintenance for terminal units**
- **Maintenance of equipment in occupied area**
- **Higher electrical energy use due to increased electric heating and lower efficiency vs. other system options**
- **Larger Emergency Generator**
- **Refrigerant Equipment & Piping in/thru Occupied Building Areas**

OPTIONS 2 & 3 – DISPLACEMENT VENTILATION



Mixed Systems

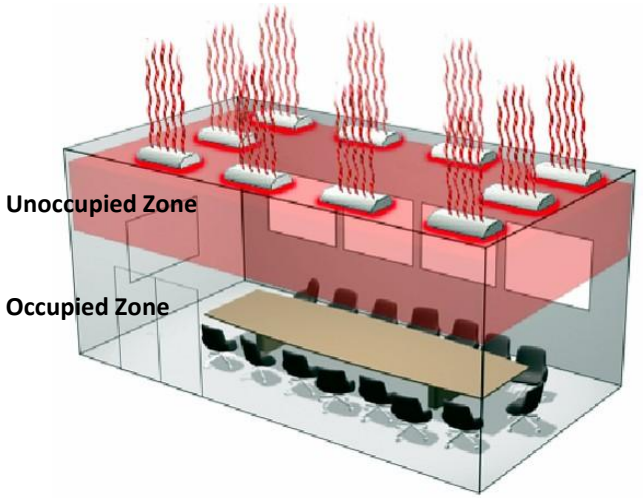
E_c= 0.8

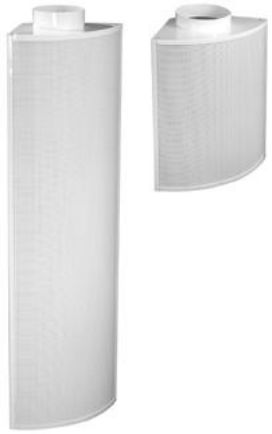
Options 3&4

DV Systems

E_c=1.2 - 1.4

Options 1&2





Displacement Diffuser Options

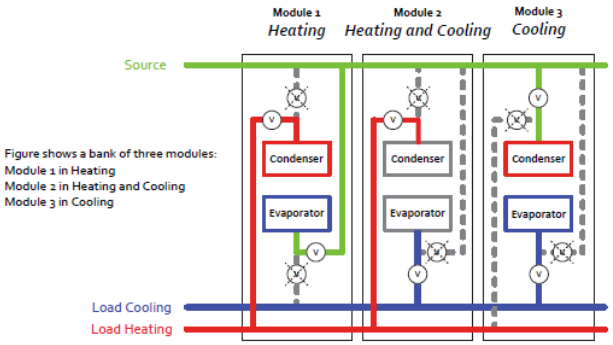
PROS:

- Excellent pollution removal
- Higher Ventilation Effectiveness
- **Low noise levels** & low air velocity
- **High thermal comfort**
- **Reduced cooling loads**
- **Increased energy savings**
- **Reduced initial cost**
- Space level Reheat is not required
- **VAV (Variable Air Volume) and Demand Ventilation Control**
- **No Condensate Drains, or Refrigerant Equipment/Piping in occupied spaces**

CONS:

- **Requires additional cost for perimeter passive radiant heating and cooling to maintain full heating and AC setpoints**.
- May require slightly higher airflow versus DOAS units for Multi-Zone Areas

OPTION 2 – AIR SOURCE HYDRONIC HEAT PUMP w/ DISPLACEMENT SYSTEM AND PASSIVE HEATING/COOLING PANELS



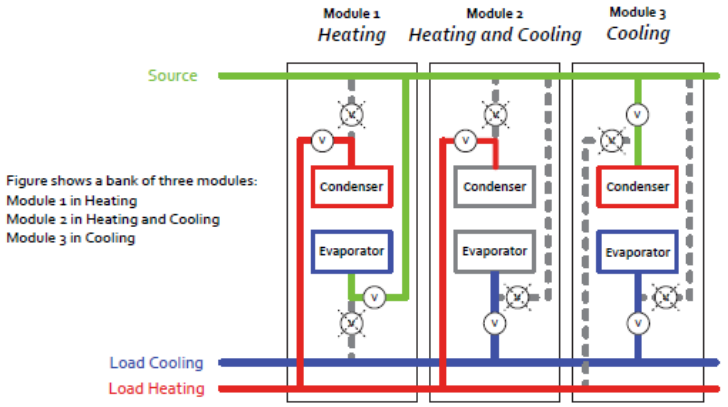
Pros:

- High-efficiency
- Modular design provides level of redundancy & individual module control
- Heat recovery provides reheat during cooling season
- Maneuverable – All modules fit through 36” door and have low center of gravity with base cutouts for pallet jacks/forklifts
- Durability & Reliability
- Service friendly with easy access to all major components
- Zero combustion design
- Environmentally friendly with low refrigerant charge
- Incentives Available
- Compatible w/Displacement - No Condensate Pumps for Terminal Units

Cons:

- Supplemental + Backup Boiler Required
- Increased Piping Costs
- Large Roof or Enclosed Grade Area Required
- Larger Emergency Generator

OPTION 3 – GEOTHERMAL HYDRONIC HEAT PUMP W/ DISPLACEMENT AND PASSIVE HEATING/COOLING PANELS



BENEFITS:

- Highest-efficiency
- Modular design provides level of redundancy & individual module control
- Heat recovery provides reheat during cooling season
- Maneuverable – All modules fit through 36" door and have low center of gravity with base cutouts for pallet jacks/forklifts
- Durability & Reliability
- Service friendly with easy access to all major components
- Zero combustion design
- Environmentally friendly with low refrigerant charge
- With Displacement – No Condensate Pumps for Terminal Units
- Quiet Design – No Outdoor condensers or cooling tower; & no associated Roof Screen
- No Roof area or associated structural required for Heat Pumps or Cooling Towers

GEOTHERMAL CLOSED LOOP WELLFIELD

Pros:

- **Higher Energy Efficiency**
- **Lower Operating Costs**
- **Eliminate noise from Condensing Equipment**
- Long lifespan of underground piping
- Wells used for Heating and Cooling
- **Lower maintenance costs**
- **Lower future replacement costs**
- **Potential Incentives & Federal Tax Credits**

Cons:

- **High First Cost of Well Field**
- **Additional Maintenance (Reduced with Closed loop design)**
- Large site area requirement
- Potential Construction Phasing Impacts

Ground source water from:
Approx 75 @ 600’ deep closed loop type vertical ground source geothermal wells, which typically requires 20’ center to center distance between wells.
Actual number of wells shall be determined in DD/CD phase by Geothermal Engineer

Mechanical System Payback Summary

Baseline	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Electric Cost	Annual Utility $/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	20 Year Equipment Replacement Cost	30 Year Equipment Replacement Cost	40 Year Equipment Replacement Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
-	1. Mixed-Air Overhead CHW/HHW VAV AHU's w/ ERV & Terminal VAV's w/ Hot Water Re-Heat Coils 2. High-Efficiency ASHP Chiller/Heater Plant	$10,840,340	888,666	$149,554	$1.38	**28.0**	$62,122	$1,365,000	$2,221,000	$1,365,000	$211,676	-	-	-

Option	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Electric Cost	Annual Utility $/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	20 Year Equipment Replacement Cost	30 Year Equipment Replacement Cost	40 Year Equipment Replacement Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
1	1. Variable Refrigerant Flow (VRF) Units w/ Air-Source Condensers serving the Classrooms, Administration and Support Areas 2. ASHP DOAS AHU's w/ ERV & Terminal VAV's w/ DCV providing Ventilation to the VRF Units 3. Mixed-Air Overhead AHSP VAV AHU's w/ ERV & DCV serving the Cafe/Stage and Gym areas 4. Supplemental Electric Resistance Heating Units	$9,275,362	753,420	$129,870	$1.20	**23.8**	$69,208	$900,000	$1,929,500	$900,000	$199,078	**$12,598**	**$2,827,990**	**Instant*****
2	1. Displacement Ventilation Diffusers w/ Radiant Cooling/Heating Panels 2. CHW/HHW Dedicated Outdoor Air System (DOAS) AHU's ERV & Terminal VAV's w/ DCV 3. High-Efficiency ASHP Chiller/Heater Plant 4. Backup Electric Boiler Plant	$9,998,685	749,921	$130,186	$1.20	**23.7**	$58,285	$1,365,000	$1,694,000	$1,365,000	$188,471	**$23,205**	**$2,020,498**	**Instant*****
3	1. Displacement Ventilation Diffusers w/ Radiant Cooling/Heating Panels 2. CHW/HHW DOAS AHU's ERV & Terminal VAV's w/ DCV 3. High-Efficiency Ground Source Heat Pump (GSHP) Chiller/Heater Plant w/ Geothermal Well Field 4. Backup Side-Stream Electric Boiler Plant	$13,201,361	687,554	$111,425	$1.03	**21.7**	$58,488	$0	$2,784,000	$0	$169,913	**$41,763**	**$581,444**	**41**

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).

** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.

*** Total life-cycle savings is based on a 50 year study period.

**** Discounted payback years is based upon BLCC5 Life Cycle Analysis.

***** **Discounted payback never reached because system is more efficient and/or less expensive than baseline system.**

Mechanical System Payback Summary
Including Mass Save Incentives

Baseline	System	Gross Capital Investment*	Mass Save Heat Pump Adder Incentive**	Net Investment	Annual Elec. Cons. (kWh)	Annual Electric Cost	Annual Utility $/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	20 Year Equipment Replacement Cost	30 Year Equipment Replacement Cost	40 Year Equipment Replacement Cost	Combined Annual Expense	Combined Expense Savings***	Total Life-Cycle Savings***	Discounted Payback (Years)****
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3	1. Displacement Ventilation Diffusers w/ Radiant Cooling/Heating Panels 2. CHW/HHW DOAS AHU's ERV & Terminal VAV's w/ DCV 3. High-Efficiency Ground Source Heat Pump (GSHP) Chiller/Heater Plant w/ Geothermal Well Field 4. Backup Side-Stream Electric Boiler Plant	$13,201,361	$1,350,000	**$11,851,361**	687,554	$111,425	$1.03	**21.7**	$58,488	$0	$2,784,000	$0	$169,913	**$41,763**	**$1,691,444**	**21**

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).

** Total payment costs indicated for these incentives need to be confirmed by the appropriate providers.

*** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.

**** Total life-cycle savings is based on a 50 year study period.

***** Discounted payback years is based upon BLCC5 Life Cycle Analysis.

****** **Discounted payback never reached because system is more efficient and/or less expensive than baseline system.**

Mechanical System Payback Summary
Including Mass Save Incentives & Federal Tax Credit

Baseline	System	Gross Capital Investment*	Mass Save Heat Pump Adder Incentive**	25.5% IRA Geothermal Federal Tax Credit***	Net Investment	Annual Elec. Cons. (kWh)	Annual Electric Cost	Annual Utility $/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	20 Year Equipment Replacement Cost	30 Year Equipment Replacement Cost	40 Year Equipment Replacement Cost	Combined Annual Expense	Combined Expense Savings***	Total Life-Cycle Savings***	Discounted Payback (Years)****
-	**1. Mixed-Air Overhead CHW/HHW VAV AHU's w/ ERV & Terminal VAV's w/ Hot Water Re-Heat Coils** **2. High-Efficiency ASHP Chiller/Heater Plant**	$10,840,340	$240,000	$0	**$10,600,340**	888,666	$149,554	$1.38	**28.0**	$62,122	$1,365,000	$2,221,000	$1,365,000	$211,676	-	-	-

Option	System	Gross Capital Investment*	Mass Save Heat Pump Adder Incentive**	25.5% IRA Geothermal Federal Tax Credit***	Net Investment	Annual Elec. Cons. (kWh)	Annual Electric Cost	Annual Utility $/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	20 Year Equipment Replacement Cost	30 Year Equipment Replacement Cost	40 Year Equipment Replacement Cost	Combined Annual Expense	Combined Expense Savings***	Total Life-Cycle Savings***	Discounted Payback (Years)****
1	**1. Variable Refrigerant Flow (VRF) Units w/ Air-Source Condensers serving the Classrooms, Administration and Support Areas** **2. ASHP DOAS AHU's w/ ERV & Terminal VAV's w/ DCV providing Ventilation to the VRF Units** **3. Mixed-Air Overhead AHSP VAV AHU's w/ ERV & DCV serving the Cafe/Stage and Gym areas** **4. Supplemental Electric Resistance Heating Units**	$9,275,362	$300,000	$0	**$8,975,362**	753,420	$129,870	$1.20	**23.8**	$69,208	$900,000	$1,929,500	$900,000	$199,078	**$12,598**	**$2,887,990**	**Instant*****
2	**1. Displacement Ventilation Diffusers w/ Radiant Cooling/Heating Panels** **2. CHW/HHW Dedicated Outdoor Air System (DOAS) AHU's ERV & Terminal VAV's w/ DCV** **3. High-Efficiency ASHP Chiller/Heater Plant** **4. Backup Electric Boiler Plant**	$9,998,685	$240,000	$0	**$9,758,685**	749,921	$130,186	$1.20	**23.7**	$58,285	$1,365,000	$1,694,000	$1,365,000	$188,471	**$23,205**	**$2,020,498**	**Instant*****
3	**1. Displacement Ventilation Diffusers w/ Radiant Cooling/Heating Panels** **2. CHW/HHW DOAS AHU's ERV & Terminal VAV's w/ DCV** **3. High-Efficiency Ground Source Heat Pump (GSHP) Chiller/Heater Plant w/ Geothermal Well Field** **4. Backup Side-Stream Electric Boiler Plant**	$13,201,361	$1,350,000	$3,366,347	**$8,485,014**	687,554	$111,425	$1.03	**21.7**	$58,488	$0	$2,784,000	$0	$169,913	**$41,763**	**$5,057,791**	**Instant*****

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).

** Total payment costs indicated for these incentives need to be confirmed by the appropriate providers.

*** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.

**** Total life-cycle savings is based on a 50 year study period.

***** Discounted payback years is based upon BLCC5 Life Cycle Analysis.

****** **Discounted payback never reached because system is more efficient and/or less expensive than baseline system.**

HVAC LCCA Conclusions:

- Without Incentives or Tax Credits…
  - Option 1, Air-Source VRF Heat Pump System, represents the lowest life cycle cost (L.C.C.) of the system options studied by yielding an approximate $2,827,990 savings over the 50 year study period with instant payback compared to the baseline system.
- With Utility Incentives…
  - Option 1, Air-Source VRF Heat Pump System, represents the lowest L.C.C. of the system options studied by yielding an approximate $2,887,990 savings over the 50 year study period with instant payback compared to the baseline system.
- With Utility Incentives & Federal Tax Credits…
  - Option 3, Ground-Source Heat Pump Displacement Ventilation System, still represents the lowest L.C.C. of the system options studied by yielding an approximate $5,057,791 savings over the 50 year study period with an instant payback.

Federal Tax Credit Considerations

Per the 2022 Inflation Reduction Act (IRA), the Federal Investment Tax Credit can range from 6% to 30% if Prevailing Wage and Apprenticeship (PWA) requirements are met. For this study, a 25.5% federal tax credit was factored assuming PWA requirements would be met (accounting for a 15% deduction required by projects funded by tax exempt bonds to the 30% incentive).

Please note that it is recommended that the Town consult with a financial tax advisor or attorney to complete the required IRS documentation if a Geothermal heating system is selected.

The IRS began issuing the first round of payments in November to school districts and a map of all pursuing schools along with their current submission status can be found at https://www.undauntedk12.org/iraprojects.

Note that payments are not received until after project completion and availability could change due to unforeseen factors such a change in government administration.

HVAC System Factor Summary Chart

- **This chart is a summary ranking of the First, Operating, Maintenance, and Replacement Costs and Potential Incentives from the previous LCCA Summary charts.**
- **Each HVAC system option has been ranked based on these cost factors as well as Indoor Air Quality & Acoustics.**
- **An average of these factors have been provided to provide an overall ranking of each HVAC system option with the lowest value being the best.**

Option	Description	First Cost (excluding incentives)	Potential Incentives (Mass Save Heat Pump Adder/IRA)	Operating Cost & EUI	Maintenance Cost	Future Replacement Costs	Indoor Air Quality/ Acoustics	Average of Factors
B	Baseline Mixed Air VAV w/ ASHP HW/CHW Plant	3	4	4	3	4	4	**3.67**
1	Air-Source VRF w/ ASHP RTUs	1	2	3	4	2	3	**2.50**
2	VAV Displacement w/ ASHP HW/CHW Plant	2	3	2	1	3	2	**2.17**
3	VAV Displacement w/ GSHP HW/CHW Plant	4	1	1	2	1	1	**1.67**
Note:	**Scale: 1 = Lowest (Best) & 5 = Highest (Worst)**							
Abbreviations:								
ASHP	Air Source Heat Pump							
HP	Heat Pump							
RTU	Rooftop Air Handling Unit							
VAV	Variable Air Volume							
GSHP	Ground Source Heat Pump							

Questions,
Discussion,
&
System Selection Vote