

Town of Concord

Concord Middle School Project

Sustainability Subcommittee

January 13, 2021

Agenda – Designer Sustainability Update

- NZE Ready and Stretch Code “Givens”
 - SSC Sustainability Recommendations (April 2020)
 - Predicted EUI Goals: 25 pEUI target
 - Sustainability Analysis Phasing Process
 - MEP Systems
 - Design Concepts
 - Next Steps
- 

Net Zero Ready & MA Stretch Code “Givens”

Energy Performance

- MA Stretch Code (Nov. 7th, 2020)
 - 10% better -IECC 2018/MA Amendments
- Net Zero Ready
 - All-Electric Heating and Cooling System, Kitchen exception: Emergency Generator
 - 25 pEUI Target **PH principle**
 - NZE Highly Insulated Building Enclosure **PH principle**
 - NZE Air Infiltration Reduction Goal, incl. Testing **PH principle**
 - High Efficiency Lighting and Controls Systems: low LPD, Task Tuning, Monitoring/Programming
 - Plug Load Management and Controls Systems

Green Building Certifications

LEEDv4 for Schools Silver - Certifiable

- IAQ Design and Construction Criteria
- Enhanced Indoor Air Quality Criteria
- Sustainable Materials Tracking: (3 equals required)
 - C&D recycling waste
 - Low-emitting materials (VOCs)
 - EPDs (Environmental Product Declaration) – 40 products goal
 - HPDs (Health Product Declaration) – 40 products goal
 - Embodied Carbon Reduction Assessment (LCA) – goal for 5% reduction (LEEDv4.1)

PH principle

PH principle

Embodied Carbon Data

LBC Declare Equivalent

SSC Sustainability Recommendations (April 2020)

1. Deliver a Healthy Indoor Environment
2. Inspire a Passion for Learning
3. Achieve High Energy Efficiency* (Energy Use Intensity target of 25)
4. Reduce Embodied Carbon During Construction
5. Be All-Electric*
6. Be Solar Ready*

* These specific goals align with the Town Meeting Amendment

SSC Sustainability Recommendations (4-2020)

1. Deliver a Healthy Indoor Environment
→ LEEDv4 Certifiable
2. Inspire a Passion for Learning
→ Educational Displays
3. Achieve High Energy Efficiency* (Energy Use Intensity target of 25)
→ 25 pEUI target (25-30)
supported with NZEready Base Design
4. Reduce Embodied Carbon During Construction
→ Confirm in SD
5. Be All-Electric*
→ NZEready Base Design
6. Be Solar Ready*
→ Code + NZEready

* These specific goals align with the Town Meeting Amendment

Low EUI SMMA Project Precedents

EUI = Energy consumed per square foot of a building's area – kBtu/SF/yr



Wellesley Hunnewell ES

60% CDs
Target 25 pEUI
Town Requirement: 30 pEUI



Lincoln K-8 School

100% CDs
23.6 pEUI
COVID impact: 27 pEUI



*Existing
Sanborn MS*

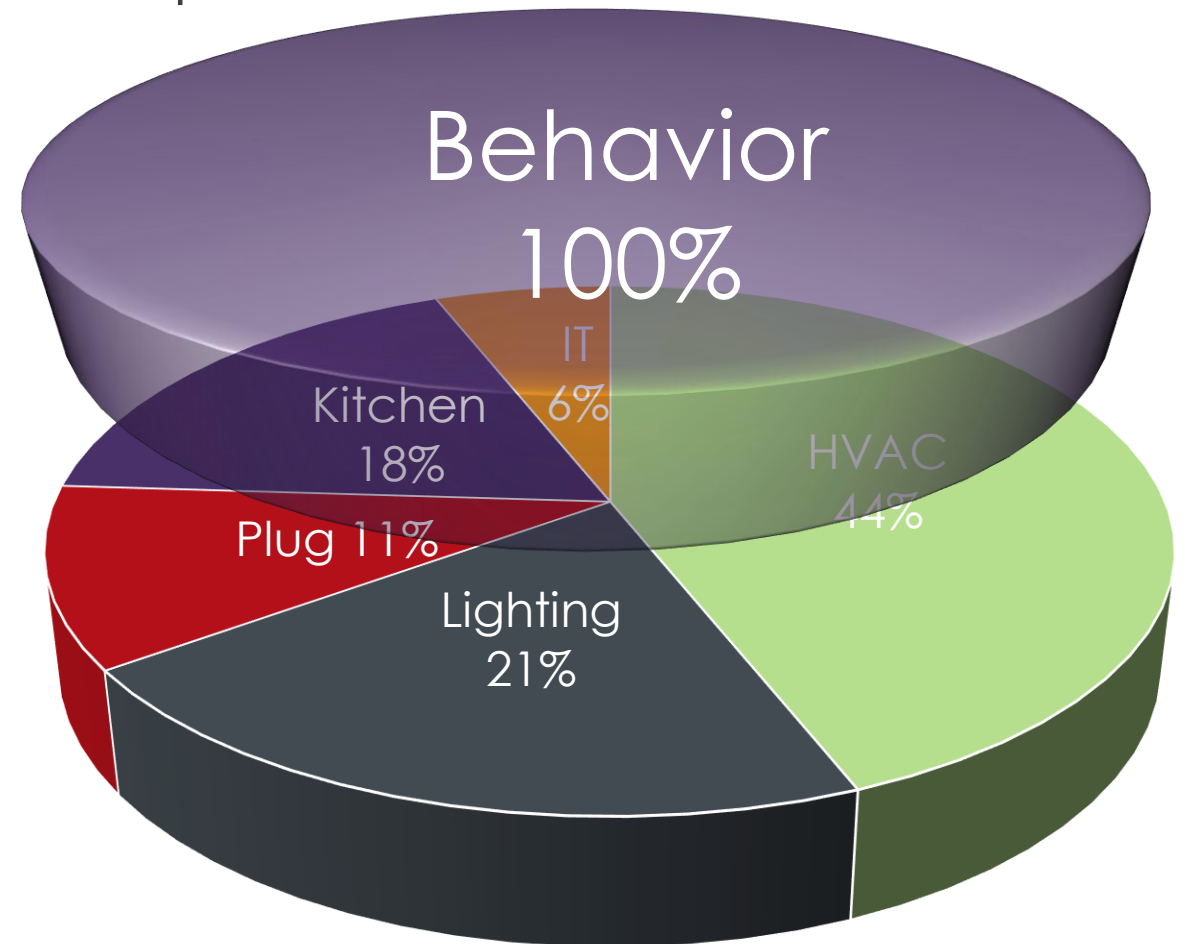
NZE(R) – Massachusetts K-12 Projects

School	Status	EUI goal	All-electric	NZE(R)
Cambridge - King Open Elementary School	Complete	26-28	Yes	60%
Cambridge - MLK Elementary School	Complete	26-28	No	43%
Cambridge – Tobin School	Design (Schematic)	26	Yes	34%
Worcester - Nelson Elementary	Complete	25 (?)	No	No
Brookline - Coolidge Corner K-8 School	Complete	23-26	Yes	Yes
Lexington - Hastings Elementary	Under Construction	25	Yes	Yes
Westborough - Fales Elementary	Under Construction	23	Yes	Yes
Belmont - Middle/High School	Under Construction	30	Yes	Yes (Offsets)
Lincoln - Elementary School	Under Construction	23.6	Yes	100% (PPA)
Arlington High School	Under Construction	30-33	Yes	Yes
Watertown Elementary	Design	24	?	Yes
Wellesley - Hunnewell Elementary	Design (60% CDs)	25-30	Yes	40%
Wellesley – Upham Hardy	Design (Prog.)	25-30	Yes	40%+
Andover West Elementary	Design (Schematic)	25-30	Yes	Yes (Ready)
Lawrence – Oliver Partnership School	Design (Schematic)	25-30	Yes	Yes (Ready)
Acton-Boxborough Elementary	Under Construction	28**	Yes	Yes
Swampscott – Hadley Elementary	Design	25-30	?	?

Operating a Net Zero Energy School

Operations

- Develop and Engage School and Districtwide Champions
- Collect and Use Data
- Develop Environmental Literacy Curriculum
- Plug Load Management
 - Utilize Latest Technology
 - Maximize Wireless Systems
 - Understand Classroom Tech needs
 - Thoroughly Vet Equipment Needs & Uses
 - Unoccupied Building Shutdowns
- User Group Education
 - Thermal Comfort
 - Lighting Controls
 - Signage



Sustainability Analysis Phasing

Feasibility Study

- Eco-Charrette
- Prioritize Sustainable Design Goals
- Energy Performance Goals
- Bldg. Energy Systems Overview
- pEUI Target
- Box Energy Model
- Certifications Opportunities
- Educational Program Opportunities

Schematic Design

- Preferred Bldg. Energy Systems LCCA (3 Systems) – Preferred Selection End of SD
- Confirm Sustainable Design Goals
- Energy Modeling:
 - Support LCCA
 - Support pEUI Target and Systems Selection (end SD)
- PV Readiness Assessment
- Confirm LEED Certification Path and Level:
 - Certifiable or Certified
 - Silver, Gold or Platinum
- Draft Sustainable Educational Program

Sustainability Analysis Phasing

Design Development

- Implement and Document Sustainable Design Goals
- Develop Energy Systems
- Energy Modeling: monitoring pEUI
 - Support Systems Design (sizing)
 - Track pEUI Target to support program's & systems' design
- Implement/Document LEED Criteria with Design, Products/Materials Selection & Documents
- Implement Solar PV, Energy Storage and EV Readiness
- Develop Educational Program (Signage/Monitors)

Construction Documents

- Finalize Sustainable Design Documentation
- Finalize Energy Systems (details and specs)
- Energy Modeling: monitoring pEUI
 - Support Final Systems Design
 - Track pEUI Target to support program's & systems' design
- Final Documentation for LEED Criteria
- Final Documentation for Solar PV, Energy Storage and EV Readiness
- Finalize Educational Program

Sustainability Analysis Phasing

Construction Administration

- Review and Track Sustainable Design Documentation
 - Energy performance
 - Commissioning
 - LEED certifiable (Site, Water, Energy, IAQ, Material)
 - CA meetings and reports
- Energy Modeling: monitoring pEUI
 - VM Support & impact
- Air Infiltration Reduction – Whole Building Air Infiltration Testing (end of construction)

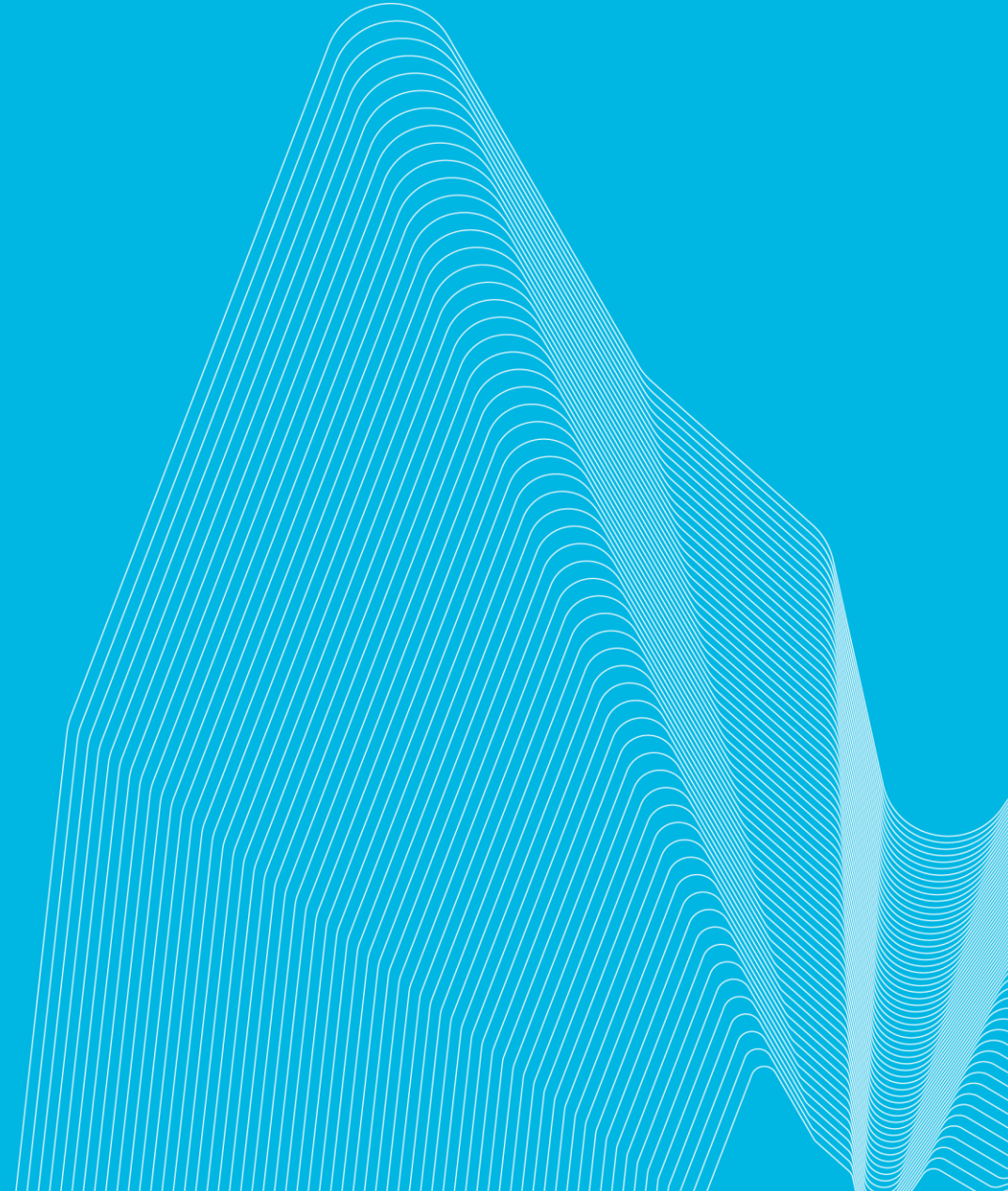
Post-Occupancy (1-2 yrs)

- Final Commissioning
- Finalize LEED Certifiable Results
- Energy Modeling: monitoring pEUI & measured EUI
 - Calibrate to final system/monitoring pEUI
 - Measured EUI
- Educate & Observe Users' Behavior

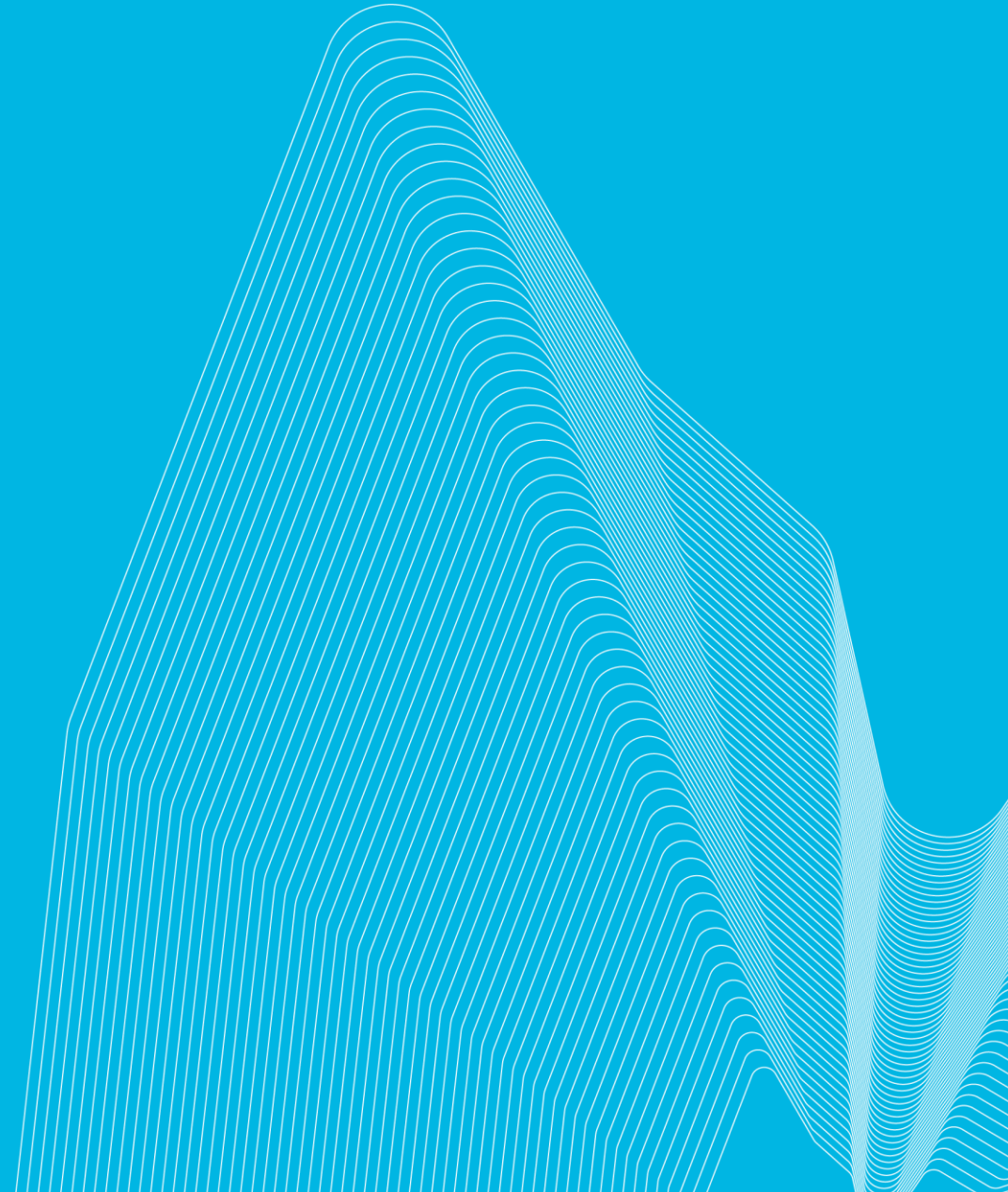
NZE Operational Costs

Estimated Operational Costs	
	Predicted Annual Operational Costs
	(\$/SF)
New Concord Middle School – 144,000 SF (pending update)	
Predicted EUI 25	\$1.17
Predicted EUI 30	\$1.41
Existing Concord Sanborn – 91,654 SF	
EUI 134-139	\$2.01+

MEP/FP Systems



HVAC System Design



HVAC Design

HVAC Systems Discussion

- Project Goals
- System Options
- Next Steps

HVAC Design

Project Goals

- Energy Source – Electric
- Energy Efficiency – low pEUI
- Thermal Comfort – Air Conditioning
- Indoor Air Quality
- Budget
- Ease of Maintenance
- Other?

HVAC Design

System Options

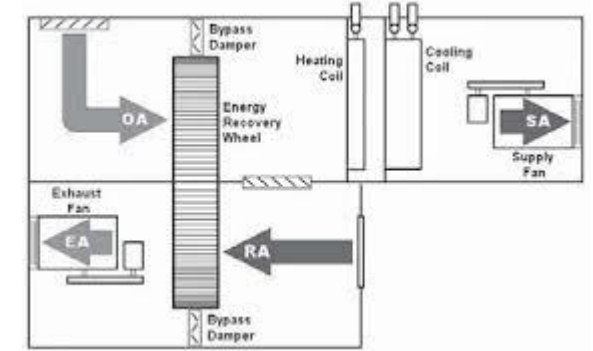
- Ventilation System
 - DOAS Units
- Temperature Control System
 - Variable Refrigerant Flow (VRF)
 - Geothermal and CHW/HW
 - Displacement Ventilation
- Building Automation System

HVAC Design

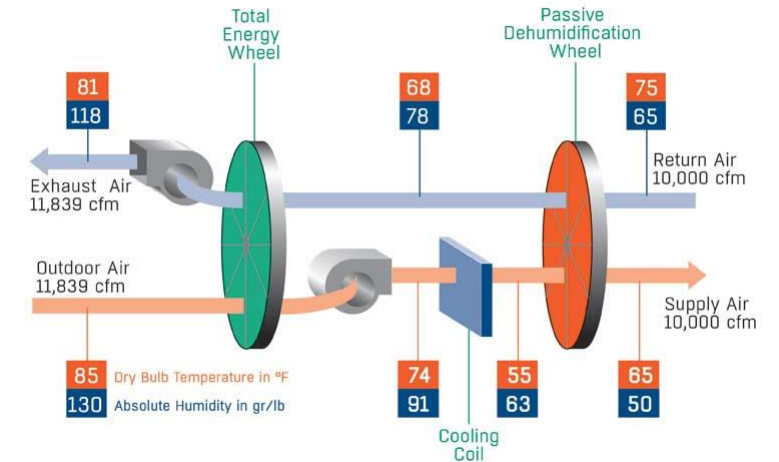
Ventilation System – DOAS Units

Dedicated Outdoor Air Systems

- Improved ventilation control
- Simplified pressurization control
- Meets IECC requirement



Single Wheel ERU



Dual Wheel ERU

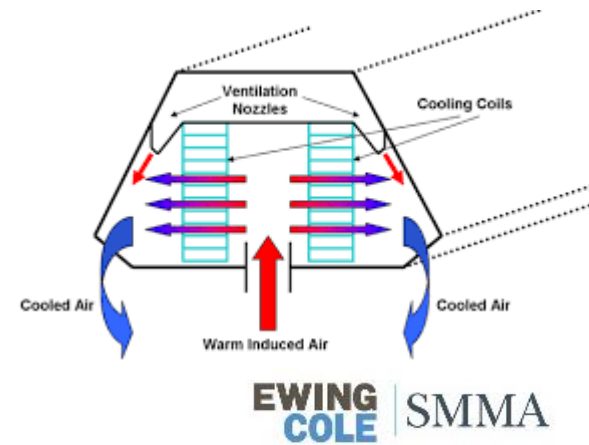
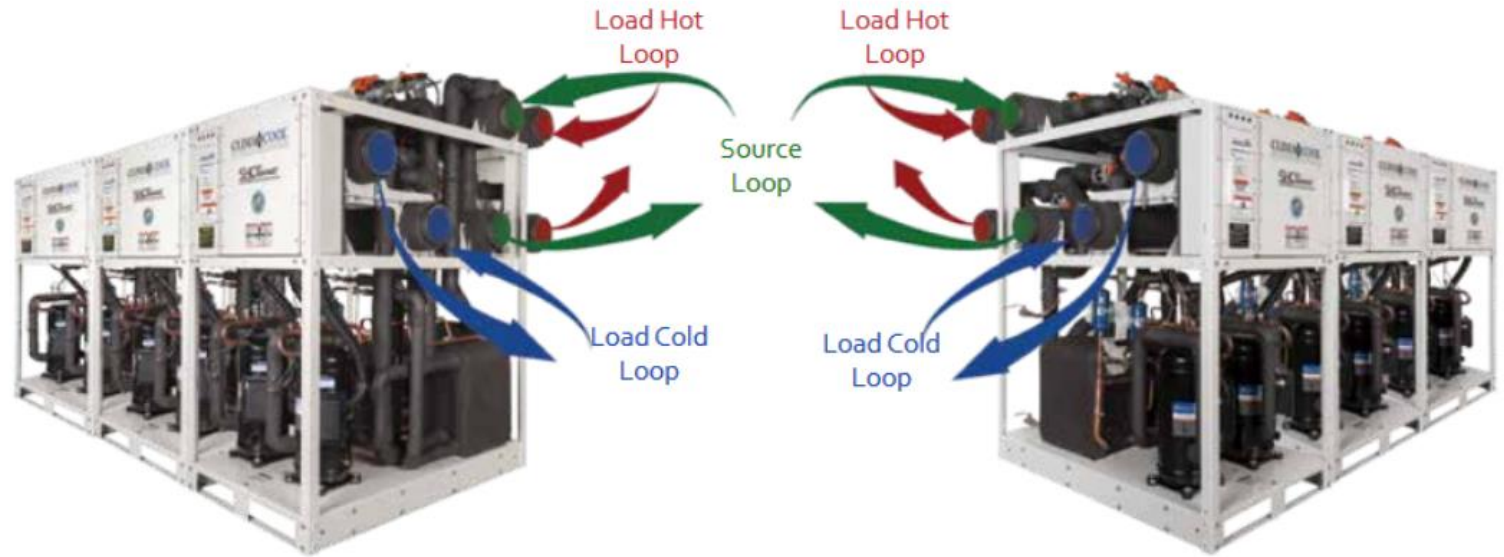
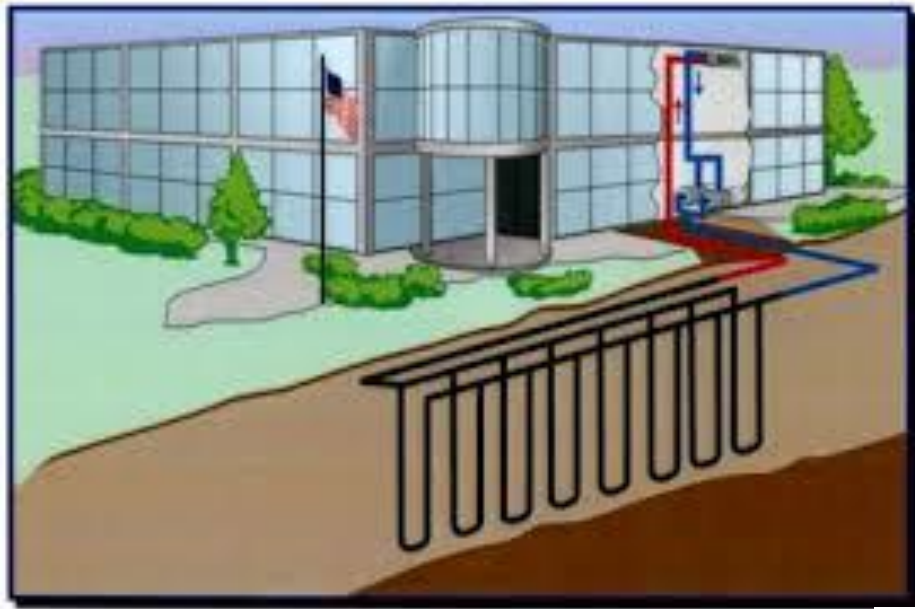
HVAC Design

Temperature Control – VRF System



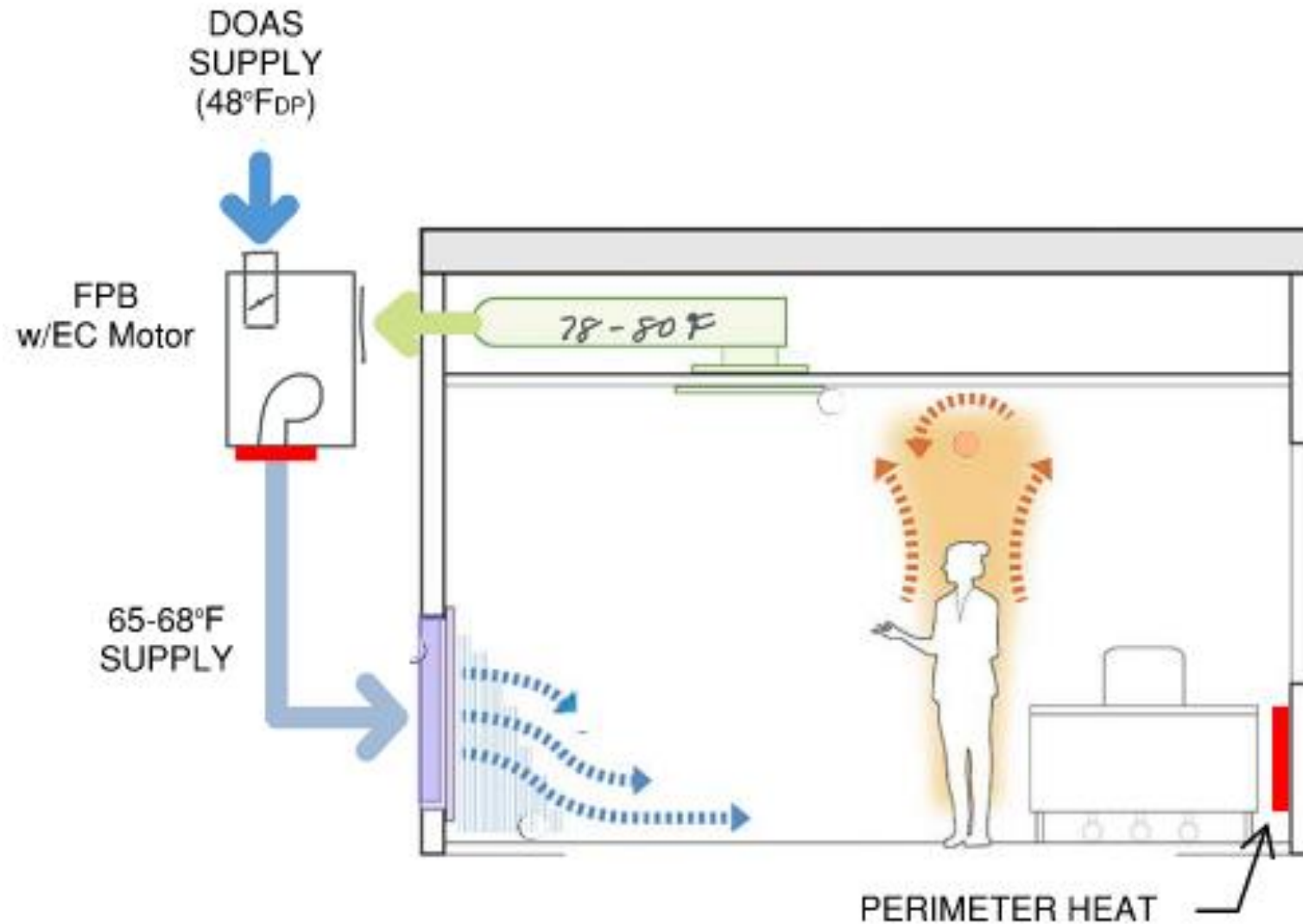
HVAC Design

Temperature Control – Geothermal + CHW/HW + Chilled Beams

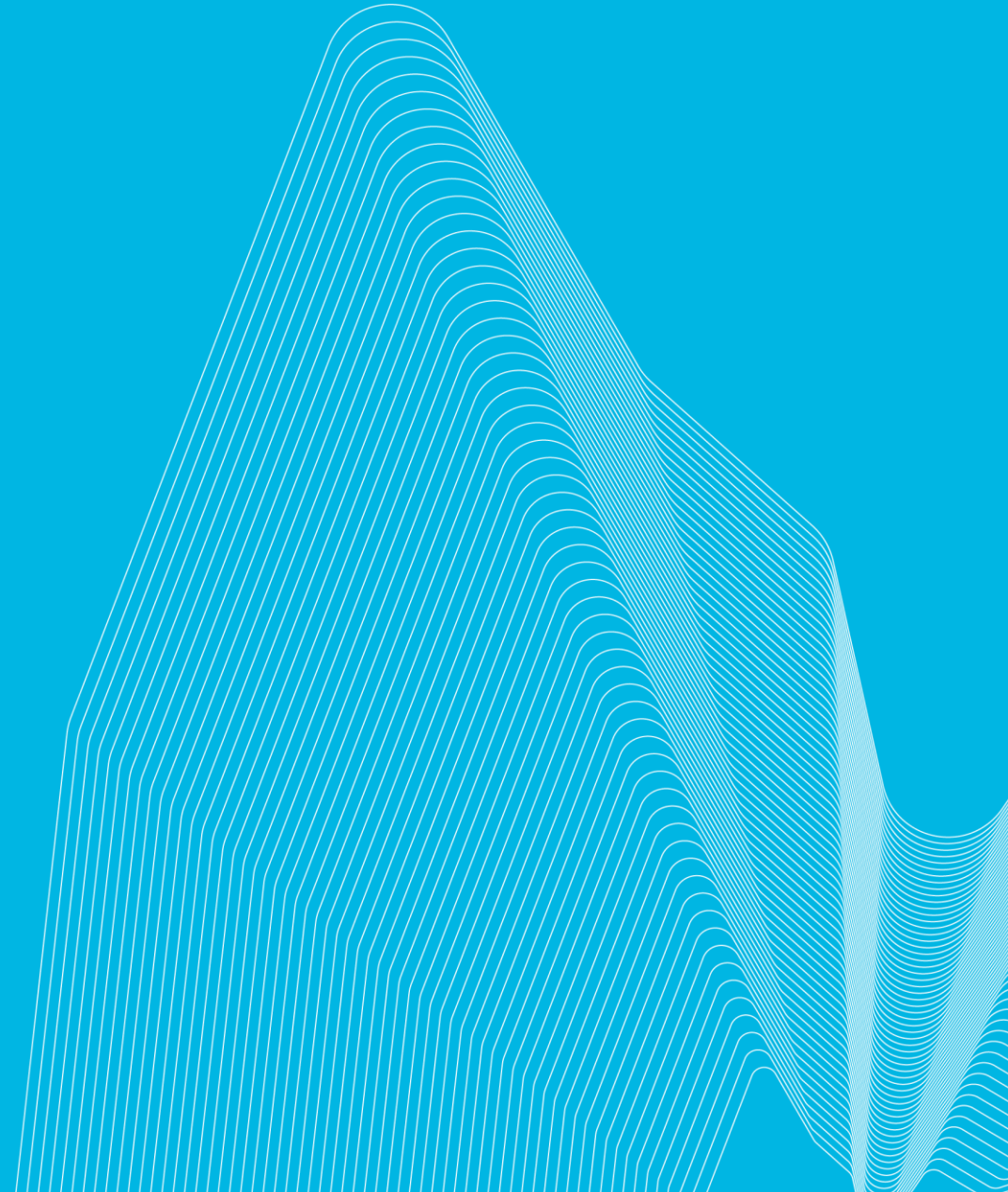


Mechanical Systems

Temperature Control – Displacement Ventilation



Electrical System Design



Lighting Power Density

1. Base Code

IECC 2018 is the base Code adopted by Massachusetts

Massachusetts adopted additional criteria Amendments to the IECC 2018

- Amendments become part of the base code.
- Lighting power density requirements to ASHRAE 90.1-2019 standards.
(School- .72 W/SF)

2. Massachusetts Stretch Code:

- 10% overall building energy performance better than New MA Energy Code (IECC 2018) with Amendments.

Enhanced Digital Lighting Control System



- Compliant with IECC C406 and ASHRAE 90.1
- Fully addressable lighting control system
- Significant level of controllability on individual luminaires
- Conducting lighting systems energy consumption reports by date range, room, or timely period.
- Integration with Building Management System (DDC) and reporting each lighting control system component ON/OFF status.

Additional Metering

Loads to be Metered Separately ASHRAE

- Total Building
- HVAC
- Interior Lighting
- Exterior Lighting
- Receptacle Circuits

Design Goals

- Tie metering into the BMS system
- Meters to record consumption and demand.
- Data to be stored for 18 months

Plug Load Controls

ASHRAE Requirement

Automatically control 50% of receptacles in the following areas:

- Offices
- Conference Rooms
- Print/Copy Rooms
- Break Rooms
- Classrooms
- Individual Workstations

Design Goals

Goal of 75%+ controls to support achieving NZER pEUI 25-30 kBtu/SF/yr



PV Ready Structural System

- Conduit Raceways in-place
- Allotted space for equipment and infrastructure (Electrical rooms)
- Discussion with Utility company for metering and interconnect requirements
- System size and location shall be coordinated with sustainability.
- Prelim estimates 0.8 MW – 1.3 MW

Standby Generator Loads

Life Safety Loads

Emergency Lighting

Fire Alarm System

Fire Pump System

Recommended Standby Loads

Portions of HVAC System Required for Freeze Protection

Elevator

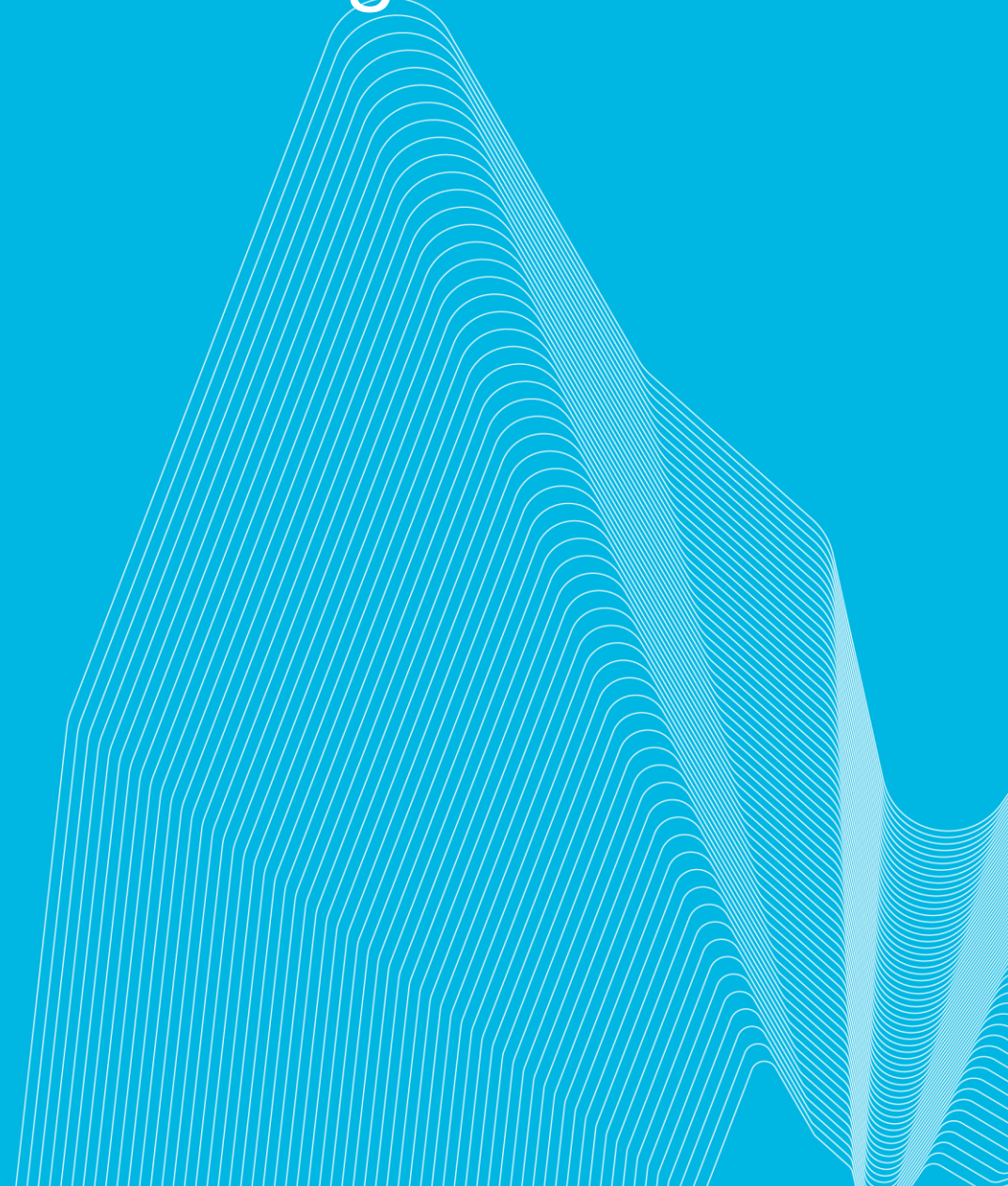
Tel/Data/Security

Kitchen reach-in freezers

Nurse and Admin areas

Custodian Area

Plumbing/Fire Protection Systems Design



Plumbing

Domestic Cold Water



Domestic Hot Water



Fire Protection

1. Fully Sprinklered
2. Fire Pump
 - Hydrant Flow Test



NFPA Compliant Sprinkler System



Thank You

