The Green Engineer
Sustainable Design Consulting

Westwood Hanlon Elementary School

Sustainability Charrette

January 30, 2020

The Green Engineer
Sustainable Design Consulting

Agenda

1) Welcome and Introduction

2) Project Overview & Filing Schedule Overview

3) Team Visioning and Project Priorities

4) Sustainability Commitments & Other Goals/Requirements

5) Utility Incentives

6) Sustainability Strategies

7) LEED Scorecard Review

8) Logistics & Next Steps

Project Overview / Filing Schedule

- 15 Options reviewed – currently obtaining estimates
- PDP: Submission to MSBA March 25, 2020
- PSR: Submission to MSBA July 8, 2020
- SD: Submission to MSBA Feb 2021 (Tentative)

Project Goal Setting: Exercise 1 Visioning

- What would you want the Westwood Press to say about this project when the new school is complete and occupied?
- What's important to you if your child were attending?

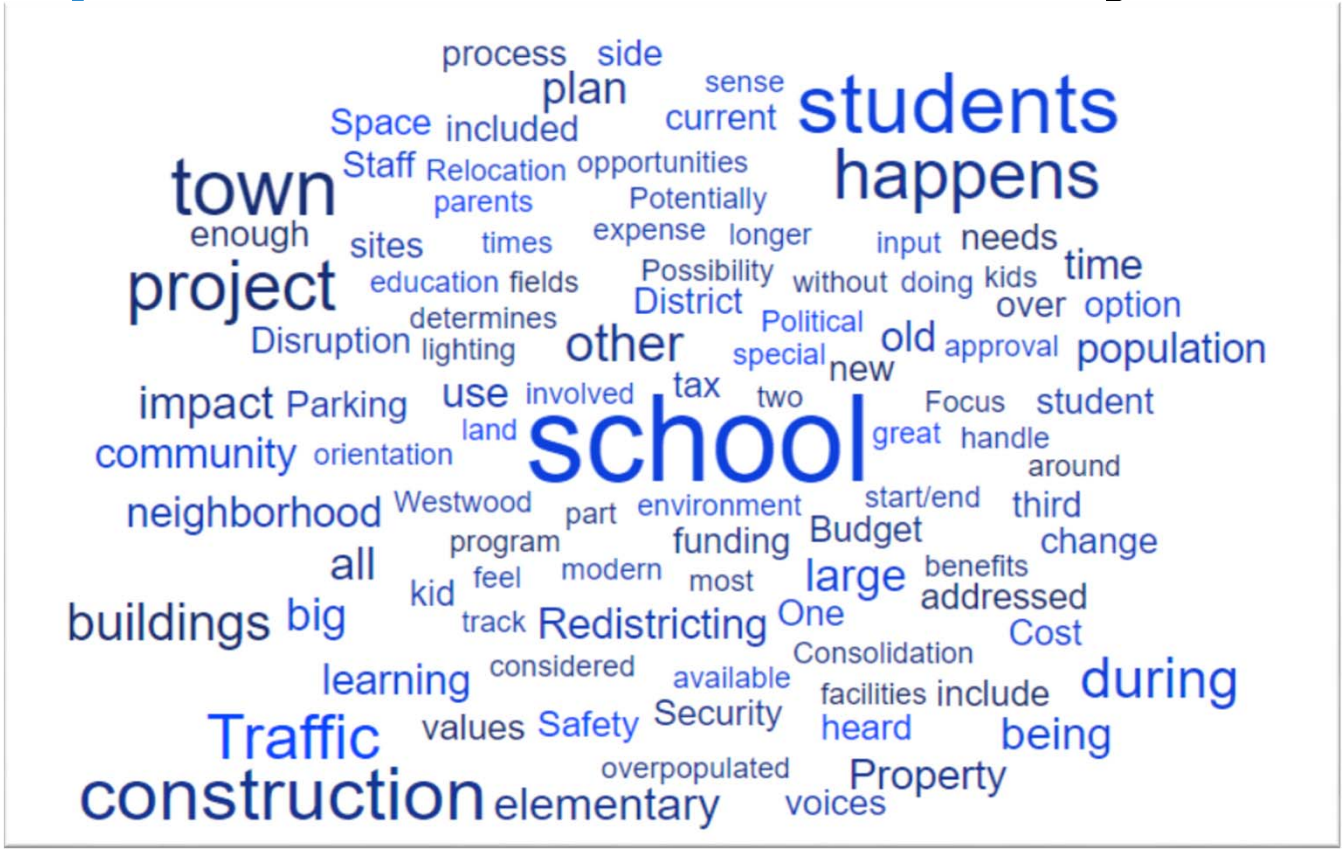
Steps:

1. Group up by firm / organization
2. Review question
3. Each Person write down 2-3 headlines/aspirations

What are you most excited about?

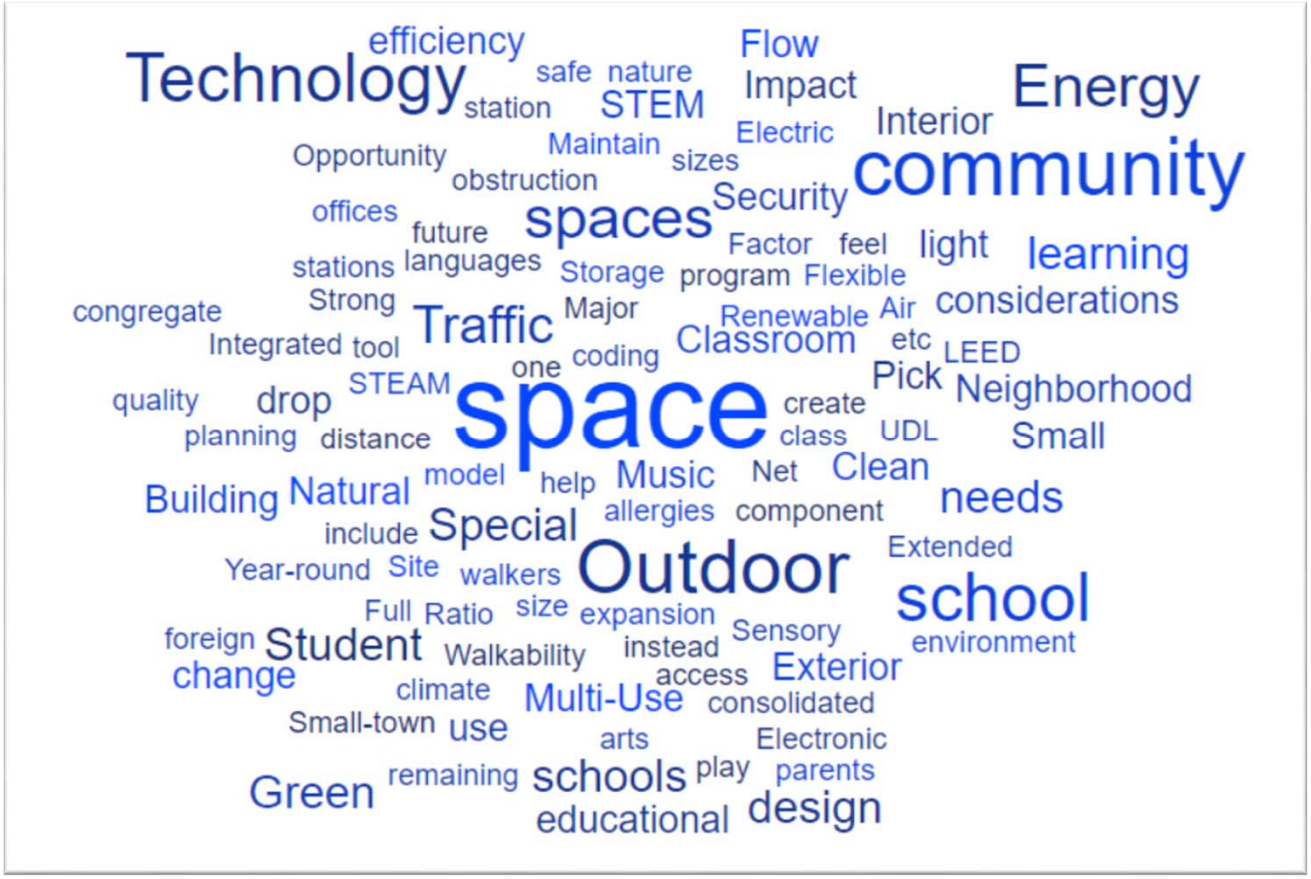
- Opportunity to improve education and experience for our children
- Creating a school that considers how children learn in a contemporary environment.
- Child Centered learning spaces / Break out spaces
- New modern spaces / new technology
- Collaborative learning spaces
- Having educational program drive the building and not the other way around
- Accessibility /Sustainability

What questions or concerns do you have?



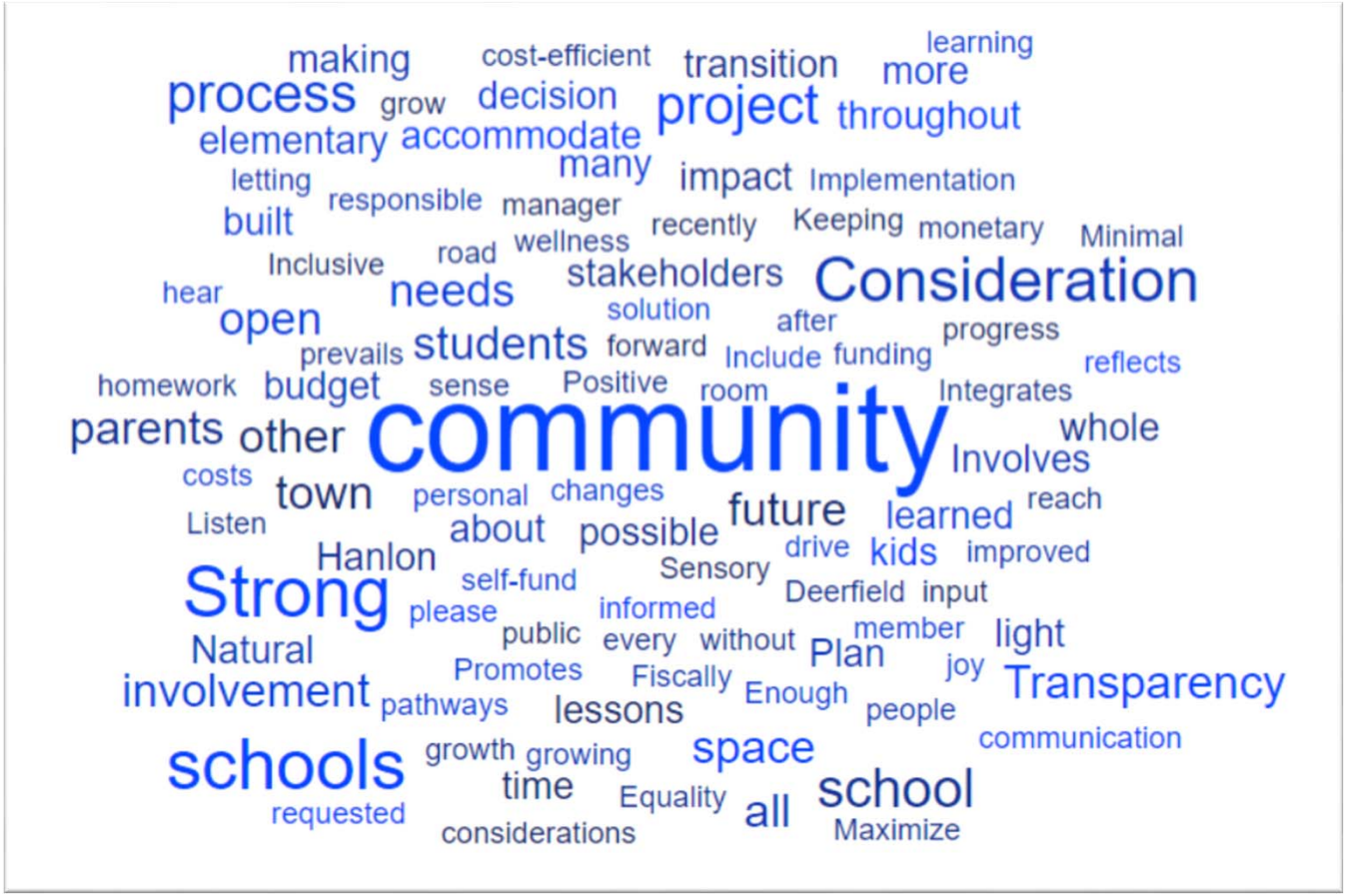
- Redistricting and location change
- Traffic + impact on neighborhood during/after construction
- Concern around which schools get selected when all 3 have big needs
- Cost and impact to taxpayers
- Disruption, safety and security of students during construction
- Don’t want a school that is “too big”
- Not enough money to do all of the projects
- Feelings of inequity between schools, neighborhood and sides of town

What features should this project consider?



- Technology
- Interior flexible space / Maker spaces + STEAM learning/Coding
- Outdoor spaces for play and learning
- Staying a community / neighborhood school / Student numbers / capacity / population
- Safety / Air quality / Comfort
- Traffic flow / Pick up and drop off
- Special Needs / Accessibility
- Sustainable / Energy Efficient
- Full size gym / multi-use / community spaces

How would you define a successful process?



- A community that was listened to / ideas valued
- Involves all people / stakeholders
- Good communication with parents and community
- Cost-efficient project without a strong monetary impact on community
- A process that doesn't have a pre-determined outcome / ORGANIC
- Equality of schools after build out / Consider the individual needs of every elementary school

Project Goal Setting: Exercise 1 Visioning

- What would you want the Westwood Press to say about this project when the new school is complete and occupied?
- What's important to you if your child were attending?

Steps:

1. Group up by firm / organization
2. Review question
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Project Goal Setting: Exercise 2
Project Priorities

<u>Steps:</u>

1. **Stay in groups**
2. **TGE to Introduce Categories**
3. **Discuss**
4. **Each Person Votes on 3 priorities**

User Experience

- Views & Access to Outdoors
- Building as Teaching Tool
- Biomimicry
- Promotes Wellness & Active Design

Outcomes

- 3rd Party Certifications
- Net Zero Energy
- Embodied Carbon Reduction
- Efficient Water Use & Reuse

Site Features

- EV Charging Stations
- Preservation of Natural Landscape
- Pedestrian & Cyclist Infrastructure
- Rainwater Management & Reuse

Building Features

- Renewable Energy
- Healthy Materials
- Improved Air Quality
- Resilient (Passive Survivability)

Team Aspirational Goals

Project Goal Setting: Exercise 1
Visioning

And the winners are…

MSBA Requirements

1. Green Schools Program: Achieve LEED-S v4 “Certified” and exceed MA Energy base code by 10%. (Team has decided to use LEED not NE-CHPS “Verified”)

2. Additional 2% reimbursement: Achieve above, AND exceed MA Energy base code by 20%.

Westwood

Requirements / Commitments / Goals

(per 1/2/20 Handout)

1. Passive House Design Standard as goal
2. Orientation of building
3. Orientation of roof / eliminating penetrations to maximize PV
4. Minimize thermal bridging between exterior wall and inside to passive house standard
5. Super Insulation – closed cell foam topped off with open cell foam to achieve R60 roof and R43 walls
6. Slab design insulated from building
7. Triple pane argon filled windows
8. Daylighting
9. HQ Air Exchange System
10. Ground Source Heat Pump heating
11. Integration of existing on-site solar into project

Team Aspirational Goals

Priorities

And the winners are…

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Sustainability Strategies

Energy – Utility Incentives

- Eversource Presentation

EVERSOURCE

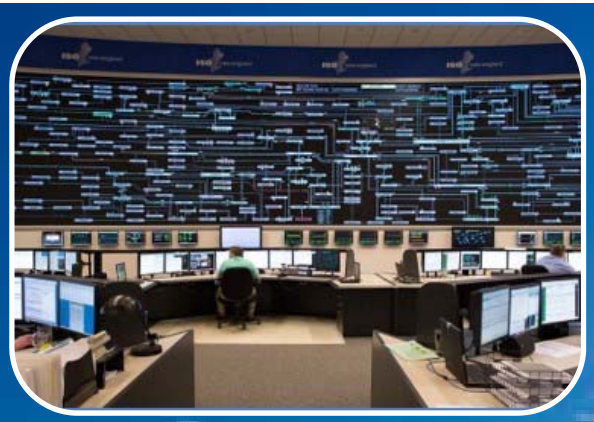
COMMITTED TO ENERGY EFFICIENCY
ACROSS NEW ENGLAND

Westwood – Hanlon Elementary School

January 30, 2020

Driving Broad Innovation

EVERSOURCE ENERGY



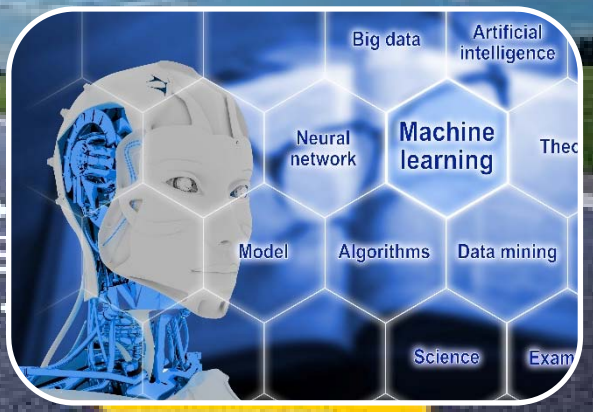
Peak Demand

In-Home Devices

Storage

Resiliency

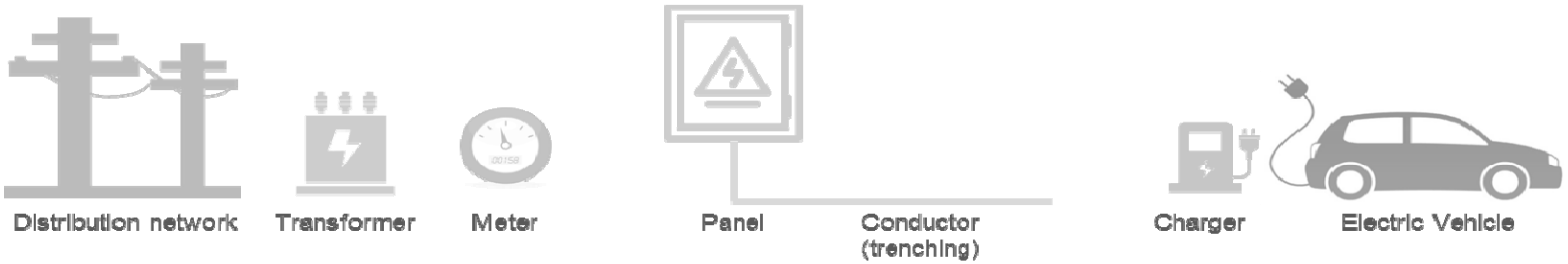
Electric Vehicles



Technology

Electric Vehicle Make Ready Program

- For approved projects, Eversource:
  - Reimburses EV charging infrastructure between grid and the chargers (e.g., dedicated service, running feeders, new panel, concrete pad, protective bollards, etc.
    - Intent is to set up service for 5% of parking area spaces plus capacity for additional 5% of spaces.
  - Dedicated Eversource service required
  - May reimburse soft costs if design changes are needed to accommodate program
- Site Host:
  - Selects charging stations from Qualified List
  - Installs and maintains charging stations themselves



Demand Response: Energy Storage

Earn incentives for helping reduce peak demand and carbon emissions with energy storage

	DAILY DISPATCH (summer only)	SUMMER TARGETED DISPATCH	WINTER TARGETED DISPATCH
Incentive payment (per average kW reduction per season)	**$200**	**$100**	**$50**
Season dates	June 1 – September 30	June 1 – September 30	December 1-March 31
Maximum number of events	60	8	5
Event timing	Between 2:00 p.m. – 7:00 p.m. on non-holiday weekdays	Between 2:00 p.m. – 7:00 p.m. on non-holiday weekdays	Between 2:00 p.m. – 7:00 p.m. on non-holiday weekdays
Event duration	2-3 hours	3 hours	3 hours
Notification	Day before the event by phone, email and/or text	Day before the event by phone, email and/or text	Day before the event by phone, email and/or text

Traditional Energy Efficiency: Financial & Technical Support

- As part of the Massachusetts Green Communities Act, a system benefit surcharge is applied to all gas and electric utility bills

  - Funds are collected and turned around to customers in the form of technical assistance and incentives

  - Residential, C&I Retrofit/New Construction incentives, and Technical Assistance

PEAK CHARGES:							
DISTRIBUTION	0.008201	X	61045	KWH	=	500.68	
TRANSITION*	0.003120	X	61045	KWH	=	190.46	
RENEWABLE ENERGY	0.000500	X	61045	KWH	=	30.52	
ENERGY CONSERVATION	0.002500	X	61045	KWH	=	152.61	
OFF PEAK CHARGES:							
DISTRIBUTION	0.008201	X	126875	KWH	=	1,040.62	
TRANSITION*	0.003120	X	126875	KWH	=	395.85	
RENEWABLE ENERGY	0.000500	X	126875	KWH	=	63.44	
ENERGY CONSERVATION	0.002500	X	126875	KWH	=	317.19	
TOTAL KWH			187920	TOTAL KWH CHARGE			2,691.37

Eversource New Construction Program Elements

Energy Charrette participation	• Today
Technical Assistance	• Early TA support (new) • Mass Save energy modeling
Customer Incentives	• Based on energy savings compared to Mass Save baseline
Design Team Incentives	• Capped at $15k per project • Paid to design team lead (architect)

Peer Schools

Cambridge: ZNE schools x 2: (1) Dr. Martin Luther King, Jr. School operating at 24 EUI, (2) King Open/Cambridge Street Upper School. Predicted EUI is 25.

Worcester: Nelson Place opened Fall 2017. Target EUI of 25.3. R45 roof, R27 walls. Gas boilers. Goal net zero electricity, but not yet achieved.

Boston – Boston Arts Academy – VRF all electric heating and cooling. Predicted EUI of 24.

Brookline: Coolidge Corner ES (K-8) opened Fall 2018. Projected EUI 23-26.

Brookline New Cypress Academic Building – predicted EUI is 28.

Lexington: Hastings ES under construction, ZNE w geothermal. Predicted EUI is 24.9.

Westborough: Fales Elementary School underway, ZNE w geothermal (predicted EUI low 20s).

Belmont MS & HS: Broke ground Summer 2019 on new ZNE middle & high school (300 geothermal wells) info here. Predicted EUI is 34.

Lincoln ES: Predicted EUI is 23, ASHP (75% renovation, 25% new)

Arlington HS: 400,000 sf. Town Meeting June 2019 approved construction funding for a carbon neutral all-electric high school (400 geothermal wells). Design indicates 33-34 EUI.

Wellesley: Hunnewell ES. EUI target 26-28, all-electric, ASHP.

Acton-Boxborough: "Twin" building w 2 elementary schools. EUI target 28. Ground source heat pumps.

Northbridge Balmer Elementary School – Predicted EUI is 21.

Concord: New school feasibility study underway; language included that school to be ZNE & fossil fuel-free.

Watertown – two new elementary schools in design**.** VRF/ASHP for both, and both are ZNE intended.

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Early Design Analysis

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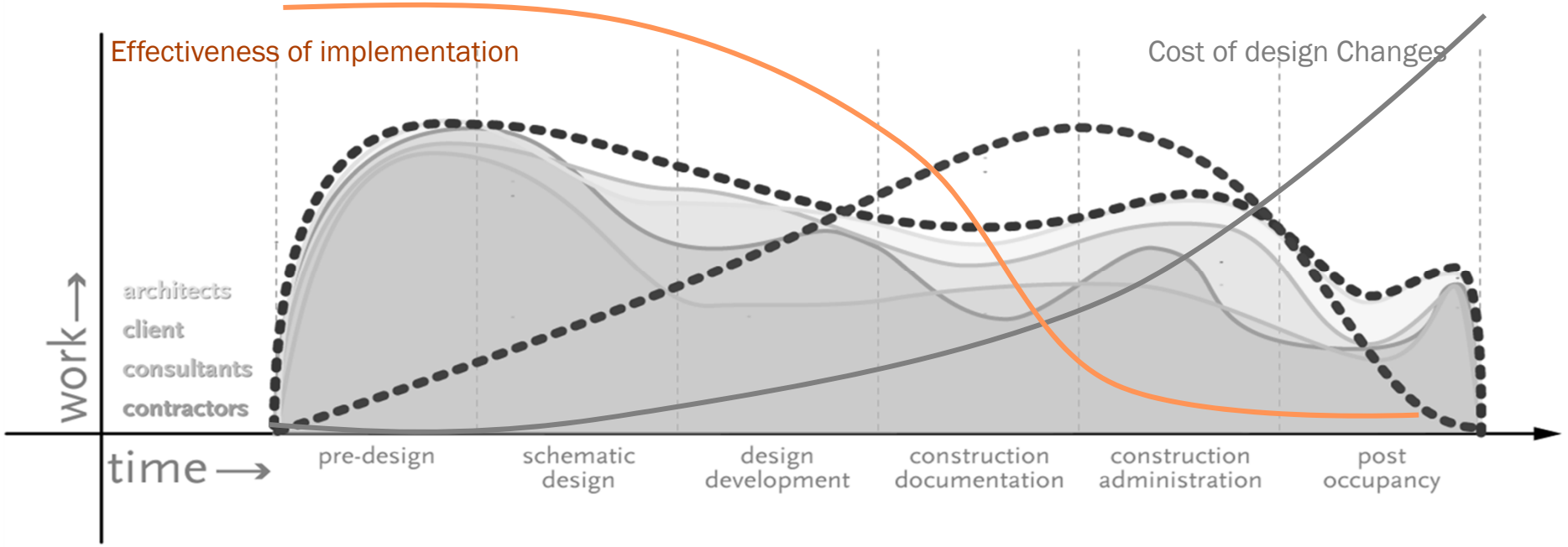
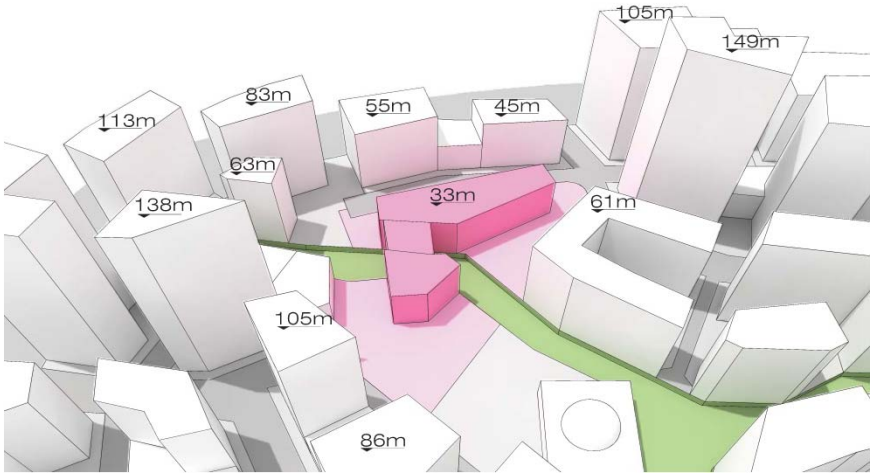
Early Design Analysis

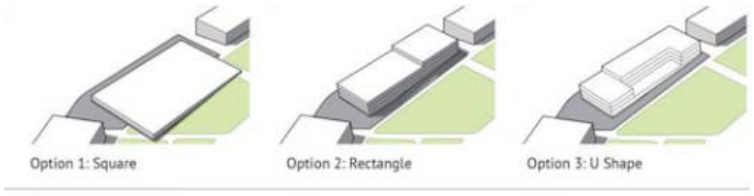


Early Design Analysis

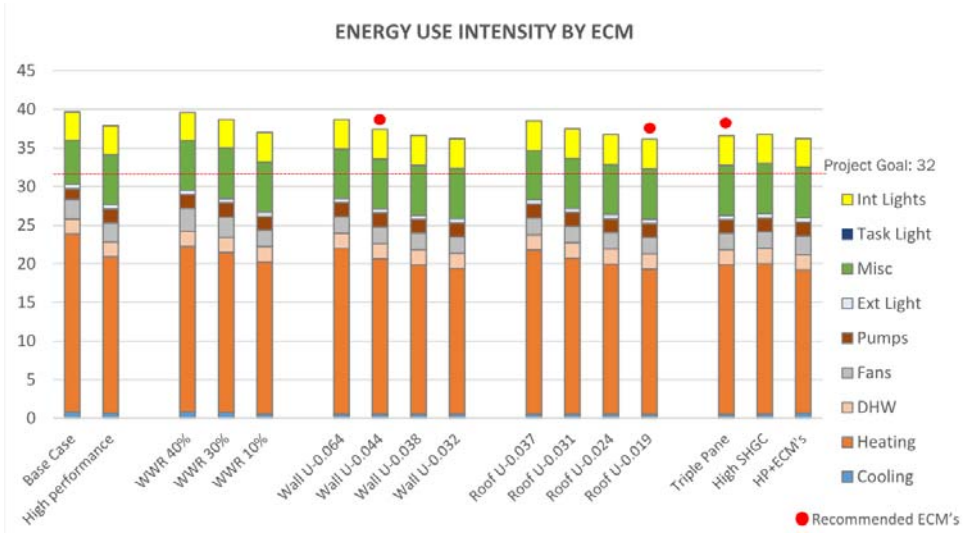
- Energy Programming
- Climate Analysis
- Massing Studies
- Radiation/Shade Analysis
- Natural Ventilation Studies
- Daylighting
- Thermal Comfort Analysis
- Cost Benefit Analysis
- Alternative and Renewable Energy Analysis



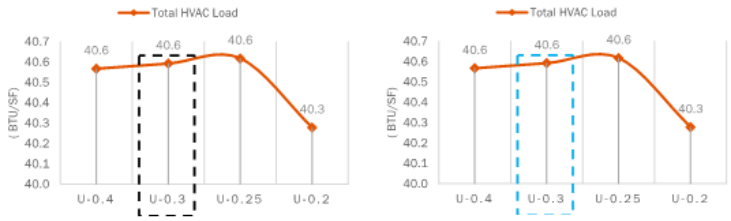
Design Optimization- Energy



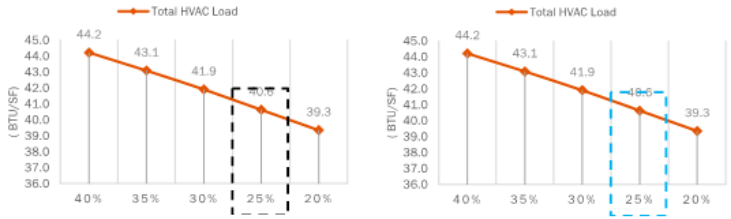
Predicted Energy Use Intensity (pEUI)



Window U-Factor: Basis of Design **U-0.3**, Recommended **U-0.3**



Window to Wall Ratio: Basis of Design **25%**, Recommended **25%**



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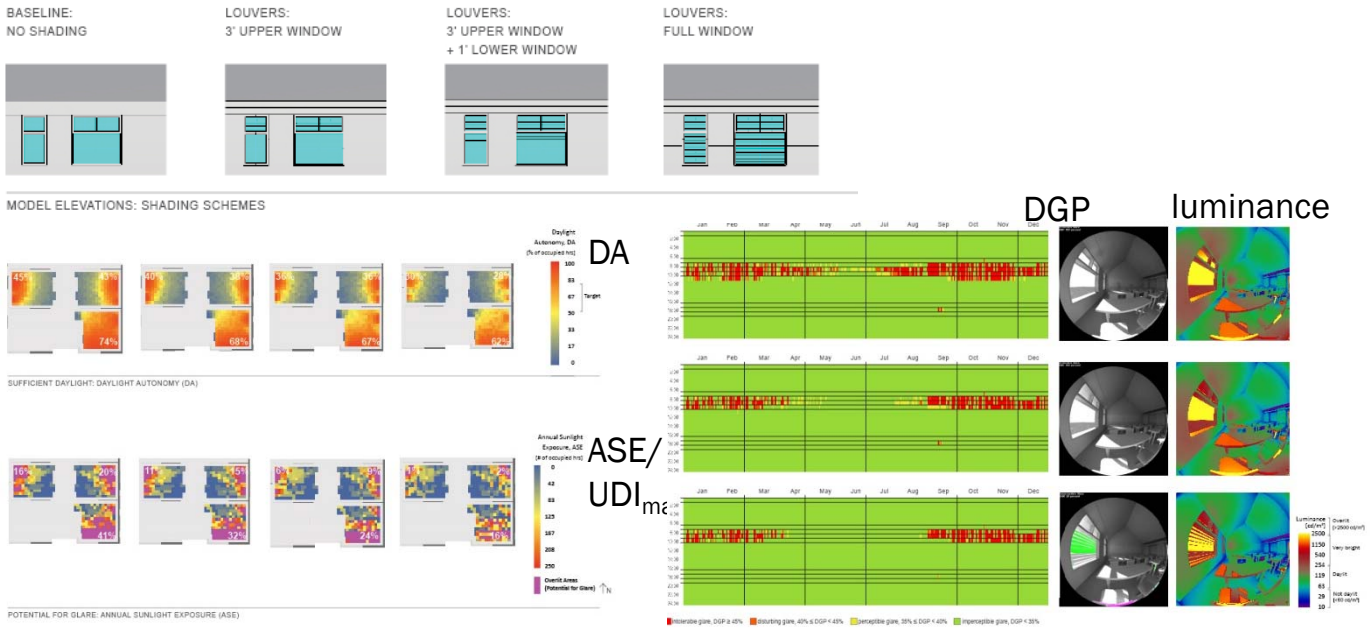
Design Optimization- Daylight

Metrics:
1) Quantity - DA/UDI_{custom} or sDA
2) Quality - maxDA/UDI_{max}, DGP (point-in-time & annual), luminance renderings

At this stage, more pointed metrics should be used: metrics specific to the problem and program at hand
Facade optimization: evaluate design alternates for specific shading and glass design



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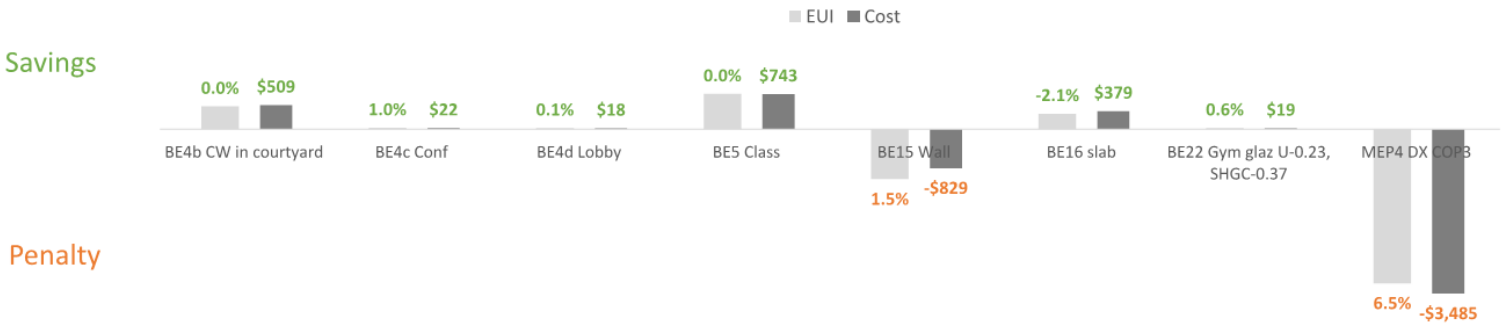
Cost Analysis

VE Item Energy Impact

BP-4, BE-15, BE-16, BE-22, MEP-4



	BE4b CW in courtyard	BE4c Conference Glazing	BE4d Lobby Glazing	BE5 Classroom Glazing	BE15 Wall Insulation	BE16 Slab Insulation	BE22 Gym Glazing U-0.23, SHGC-0.37	MEP4 DX Cooling - COP3
Comments	Reducing glazing area helps lower heat loss in the winter and heat gain in the summer, therefore, these measures reduce cooling and heating energy use. TT has no reservations with these VE Items				Reducing wall insulation from 6in to 4in increases heating load and heating energy.	Reducing slab insulation from fully-insulated under slab to only on perimeter increases heating energy slightly but it's compensated by reduction in cooling and fan energy.	Replacing gym clerestory curtain wall with CPI daylighting UniQuad system shows slightly energy savings because UniQuad system can have better U-value than curtain walls. Other than energy, UniQuad can provide a more diffused and uniform light that helps with visual comfort.	Using DX cooling shows energy penalties because DX cooling usually has lower efficiency than chillers. COP-3 was assumed for DX Cooling and COP-4 was assumed for chillers for this analysis.
Recommendations	✓	✓	✓	✓	⊘	✓	✓	⊘

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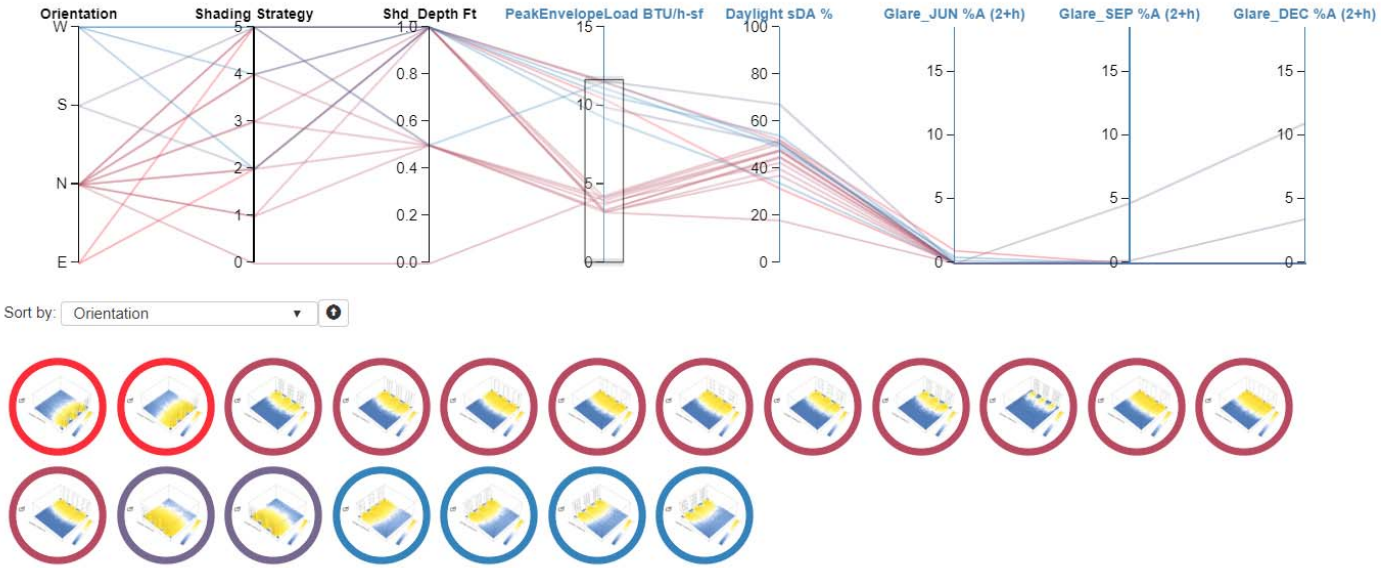
Design Optimization- Post Processing Tool

Design parameters

Output metrics



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Design Optimization- Post Processing Tool

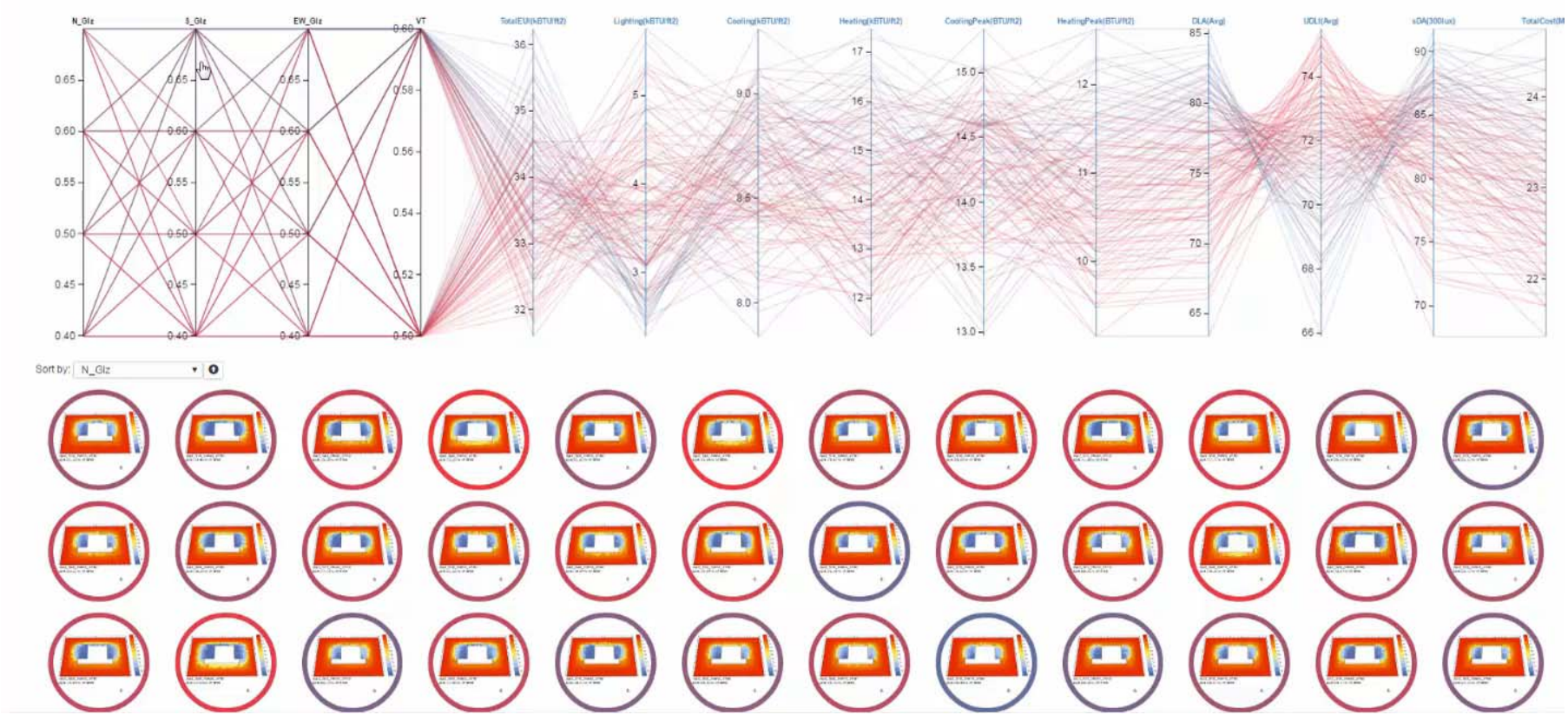
Design parameters

- Massing options
- Building orientation
- Wall insulation
- Roof insulation
- WWR
- Glazing u-factor
- Glazing SHGC
- Glazing Tvis
- Shading measures
- Infiltration
- HVAC
- etc

Output metrics

- Heating demand
- Cooling demand
- Heating load
- Cooling load
- Site EUI
- Source EUI
- Daylight metrics
- Glare metrics
- Cost metrics
- Comfort metrics
- etc

Design Optimization- Demonstration



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Sustainability Strategies

Overall Performance Goals:

- Net Zero?
- Cost / Carbon / Water / etc.?
- EUI Target?

Getting to Zero

Final Report of the Massachusetts Zero Net Energy Buildings Task Force

March 11, 2009

MA Definition

"A zero net energy building is one that is optimally efficient and, over the course of a year, generates energy onsite, using clean renewable resources, in a quantity equal to or greater than the total amount of energy consumed onsite."

Definitions

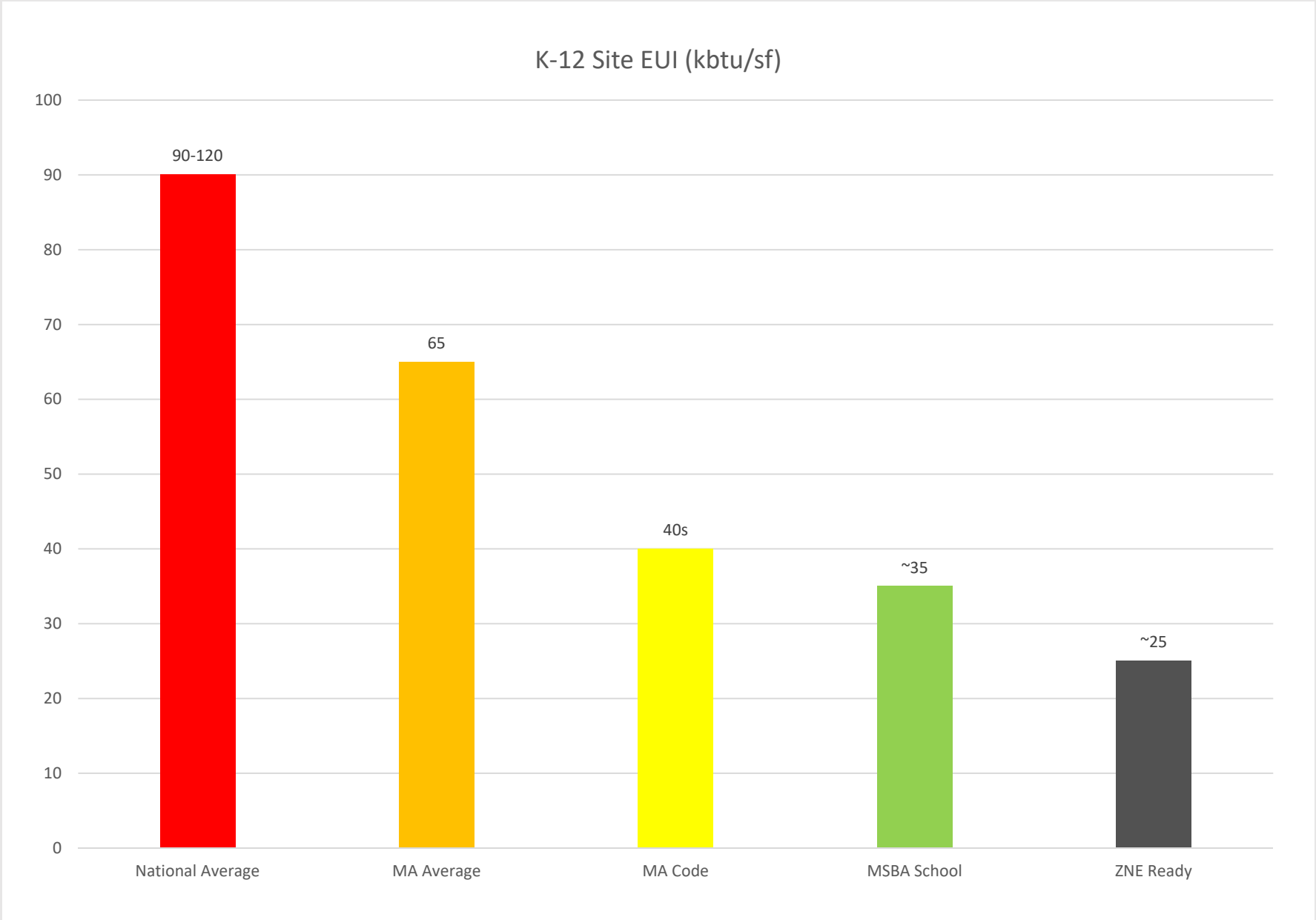
- Off the Grid – produces all its own energy
- Zero Net – at end of the year, the meter reads zero
- Carbon Neutral – buys offsets to balance energy consumption

Image credit: itpeernetwork.intel.com/smart-grid-tools-integrating-distributed-energy-resources

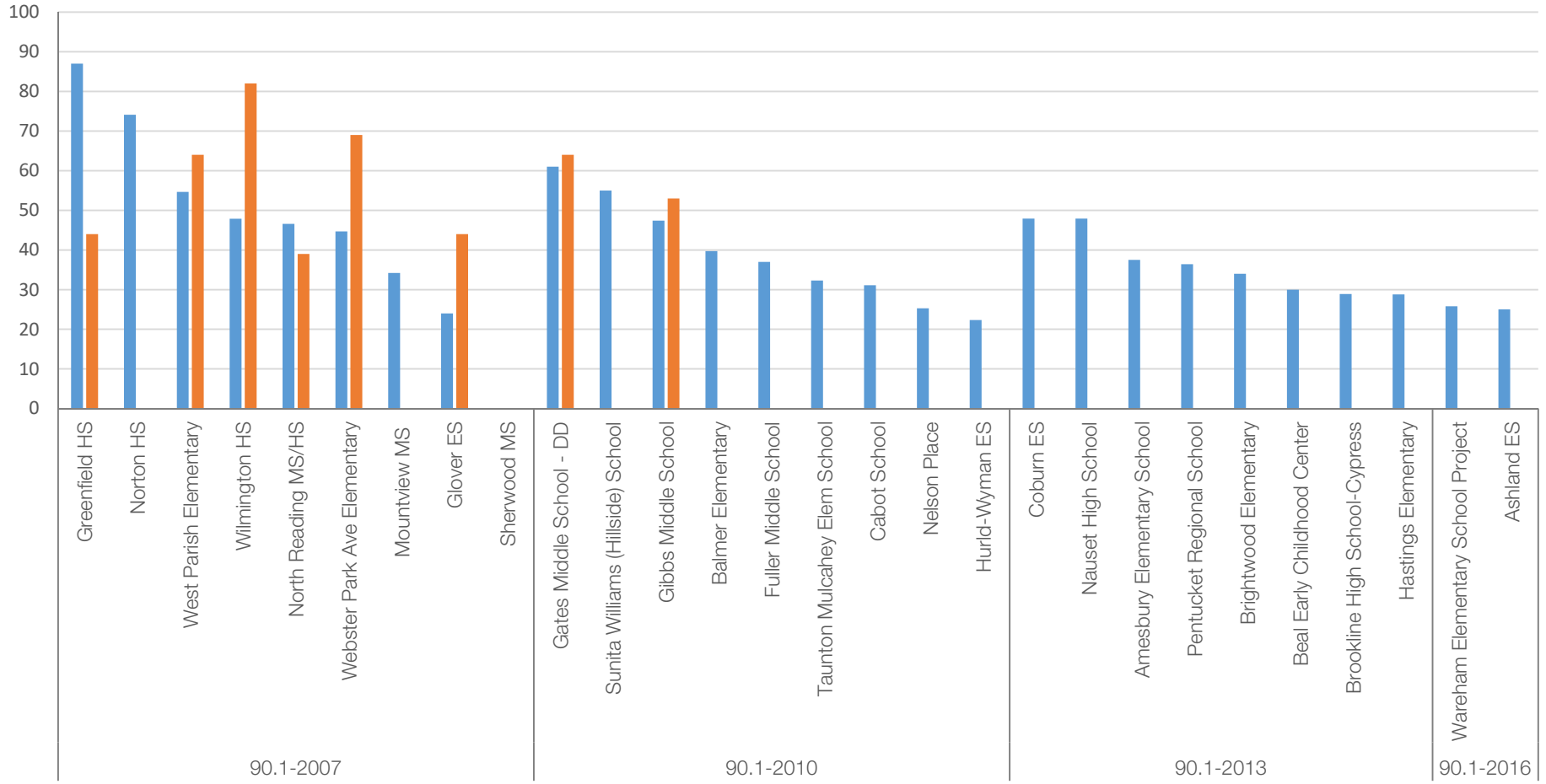
Zero Net Energy Building Types (ZNEB)

- Class A – renewables with building footprint
- Class B – renewables on building site
- Class C – off site renewables
- Class D – RECs or renewable energy purchased

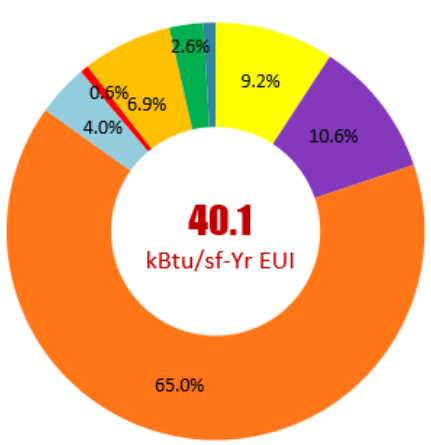
https://www.ge.com/reports/size-matters-next-big-thing-wind-turbines/


K-12 Site EUI (kbtu/sf)
100
90
80
70
60
50
40
30
20
10
0
90-120
65
40s
~35
~25
National Average
MA Average
MA Code
MSBA School
ZNE Ready

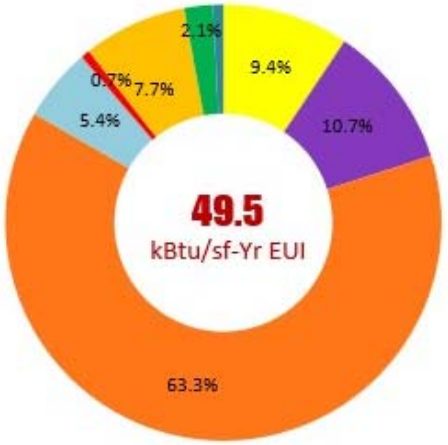
K-12 Example Projects Site pEUI (kBTU/SF)



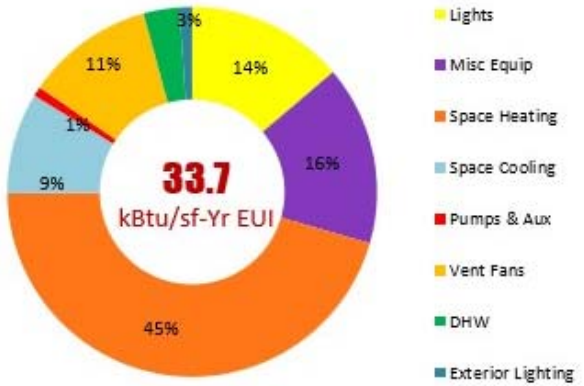
Taunton ES w/ Optimized Envelope



Taunton ES



Taunton With Westwood Hour of Operation



Taunton with Westwood Hours of Operation, Passive House Envelope

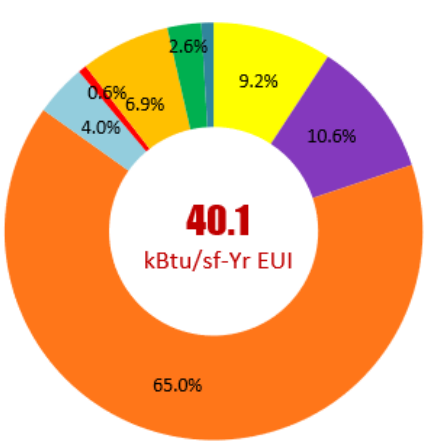
<u>Taunton Elementary School</u>: As designed – no updates. Occupied 5 days per week and limited summer use.

Building space types include: Classrooms, Commercial Kitchen, Gym, Library, Offices, and Support Spaces.

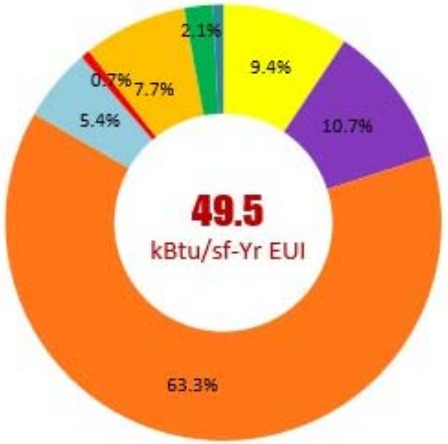
<u>Updated Design Case</u>: The Taunton school design, but with weekend, evening and full summer use.

<u>Passive House Case</u>: The Updated Design Case, but with Passive House-like Envelope.

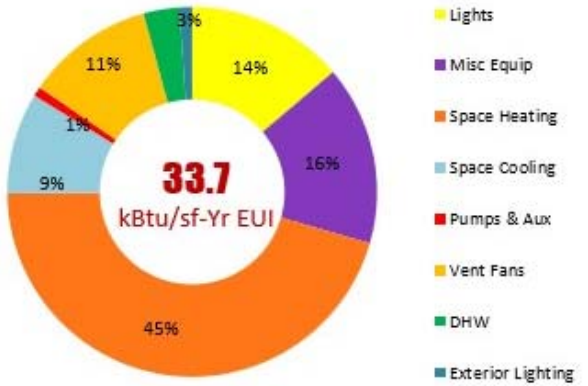
Taunton ES with PH Envelope



Taunton ES



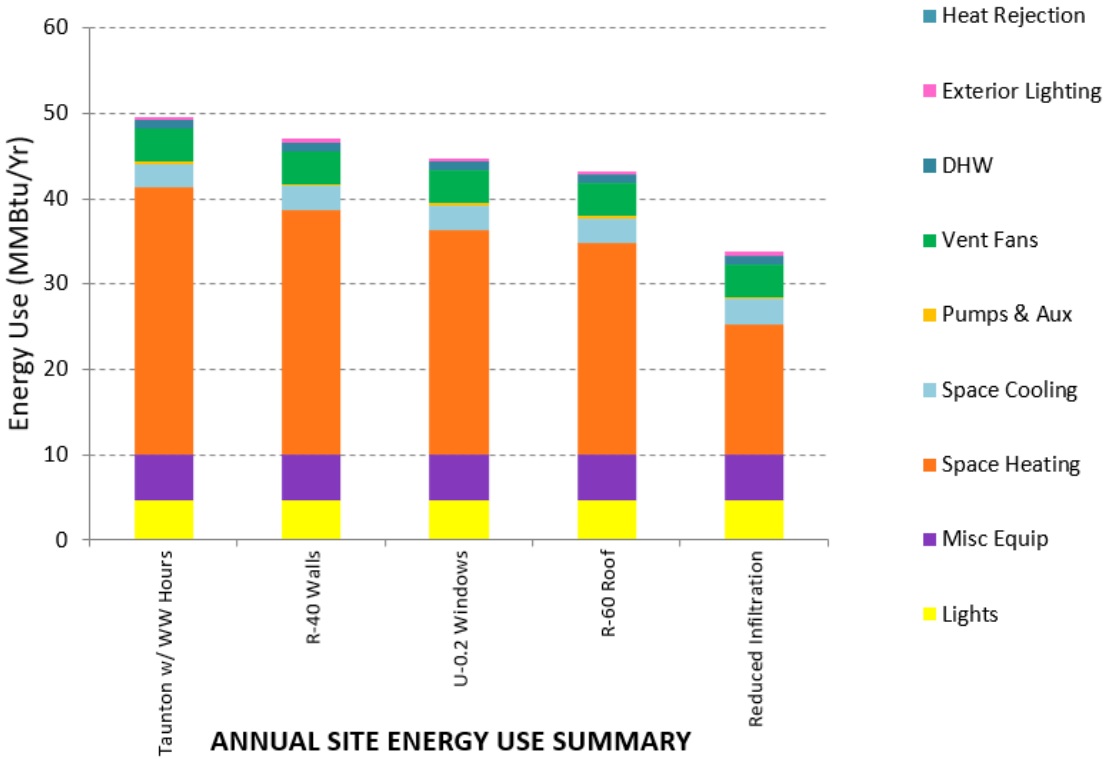
Taunton With Westwood Hour of Operation



Taunton with Westwood Hours of Operation, Passive House Envelope

EUI (kBTU/SF/YR) Per End-Use									
	Lights	Equip	Heating	Cooling	Pumps	Fans	DHW	Ext Lt	Total
Taunton ES	3.7	4.3	26.1	1.6	0.3	2.8	1.0	0.4	40.1
Taunton w/ WW Hrs	4.6	5.3	**31.3**	**2.7**	0.3	3.8	1.0	0.4	49.5
Taunton w/ WW Hrs PH	4.6	5.3	**15.3**	**3.0**	0.3	3.8	1.0	0.4	33.7

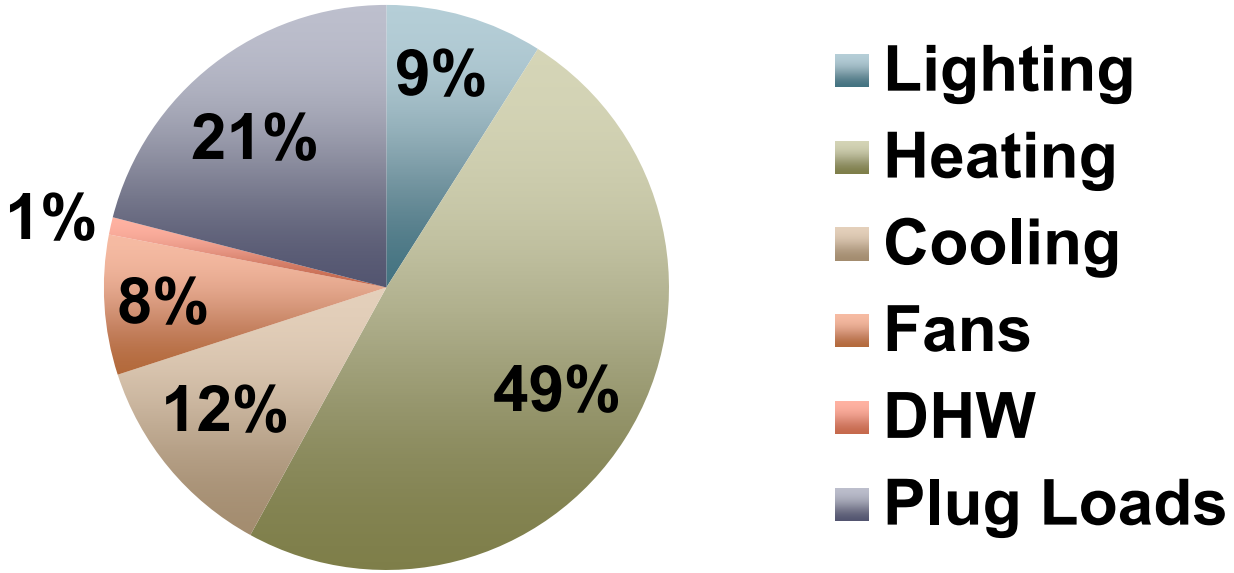
Taunton ES with PH Envelope



- Wall Insulation: Increasing from R-15 to R-40 reduced the EUI by **2.6**.
- Windows: Decreasing the U-value from 0.4 to 0.2 reduced the EUI by **2.3**.
- Roof Insulation: Increasing from R-30 to R-60 reduced the EUI by **1.5**.
- Airtightness: Reducing the infiltration from 0.4 ACH in perimeter spaces and 0.2 ACH in core spaces to 0.1 ACH and 0.05 ACH respectively reduced the EUI by **9.5**.

Energy Use Savings (EUI kBTU/yr)									
Description	Lights	Misc Equip	Space Heating	Space Cooling	Pumps & Aux	Vent Fans	DHW	Exterior Lighting	Total
Taunton w/ WW Hours	4.6	5.3	31.4	2.7	0.3	3.8	1.1	0.4	49.6
R-40 Walls	4.6	5.3	28.8	2.7	0.3	3.8	1.1	0.4	47.0
U-0.2 Windows	4.6	5.3	26.4	2.8	0.3	3.8	1.1	0.4	44.7
R-60 Roof	4.6	5.3	24.9	2.8	0.3	3.8	1.1	0.4	43.2
Reduced Infiltration	4.6	5.3	15.3	3.0	0.3	3.8	1.1	0.4	33.7

Typical Cold Climate School Energy Consumption



Plug Loads and Lighting make up 30% of the Total Energy Consumption

Sustainability Strategies

Step 1 - Reduce Demand

Challenge assumptions to right size equipment, reduce plug and lighting loads, and improve the building shell.

Step 2 - Harvest Site Energy

Orient the building to maximize passive solar, and daylighting opportunities. Harvest “waste” energy on site, through heat recovery and other means.

Step 3 - Maximize Efficiency

After you’ve done your best to reduce loads, use efficient equipment to maximize benefit.

Step 4 – Efficient Operations and Maintenance

The best design concepts won’t deliver performance if they are not installed and maintained correctly.

To get to ZNE, we must go beyond simply reducing consumption. No matter how efficient we make systems, some energy must be consumed. Once we have reduced loads and consumption, we must generate enough energy for our needs in a renewable way. Therefore, ZNE requires a fifth step:

Step 5 – Renewable Energy

Generate enough energy on-site to meet all energy demands for the facility.

Sustainability Strategies

Energy - Building Envelope

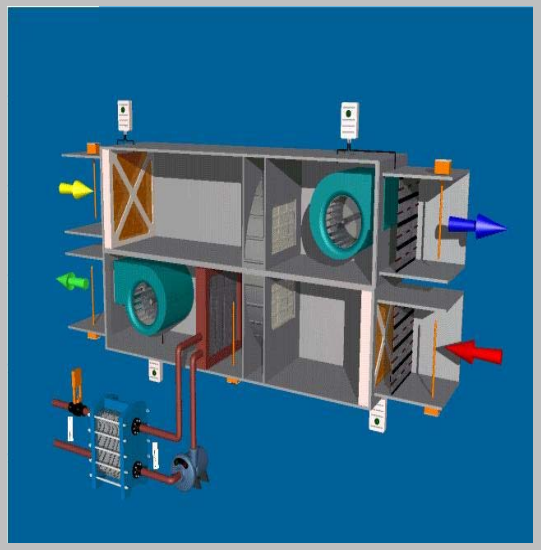
- WWR
  - (14-34% in recent k-12 MA projects)
- Windows and Glazing
  - (triple glazed, SHGC, Int/ext shading, operable)
- Tight Envelope
  - (Increase Cx scope to include infiltration testing?)
- Insulation Values
  - (Explore enhanced insulation options)
- Thermal Bridge Mitigation

Sustainability Strategies

Energy – HVAC Options

- GGD Presentation

100% OUTSIDE AIR CENTRAL VENTILATION ROOFTOP UNIT ENCLOSURES WITH ENERGY RECOVERY FOR DISPLACEMENT AND INDUCTION UNIT SYSTEMS

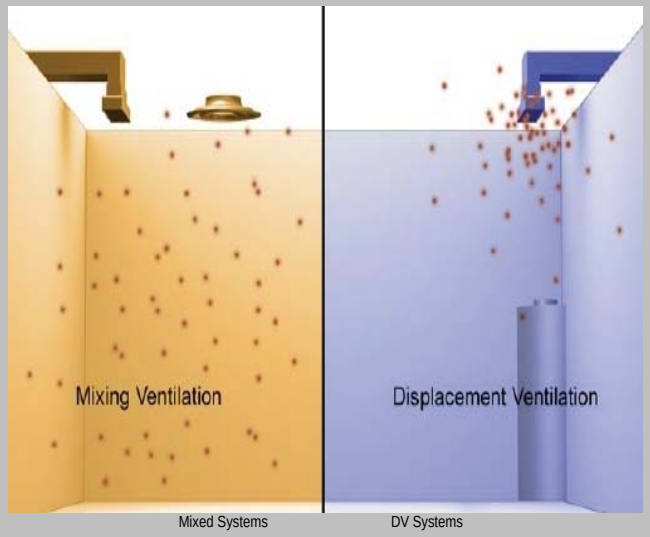


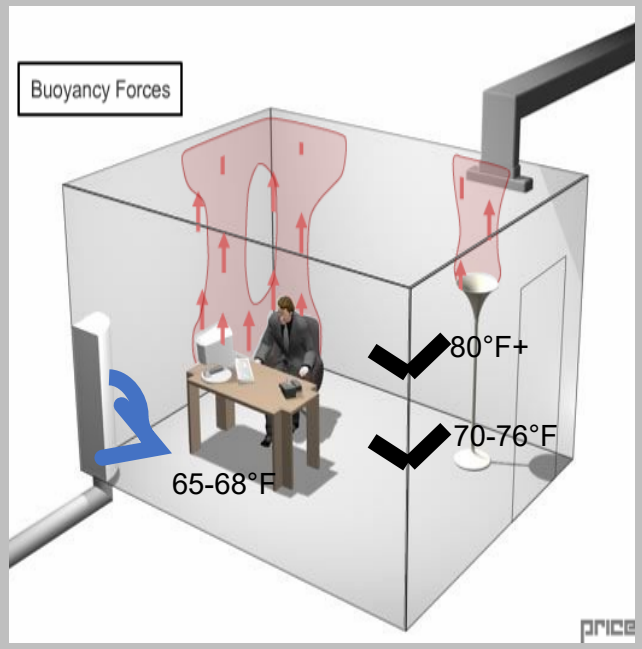
DESCRIPTION:

- Ventilation air is provided from rooftop or indoor air handling units
- Packaged gas-fired heating/dx electric cooling
- Hot water heating and chilled water cooling

DISPLACEMENT SYSTEMS (CLASSROOMS, CAFETERIA, GYMNASIUM, CORRIDORS)

- Ventilation air is provided from high efficiency hot water coil heating/chilled water coil cooling RTU w/ ERV
- Air is delivered at low velocity and at low levels within the space
- The system uses naturally occurring buoyant forces within the space to create a vertical rise of the air throughout the space.
- 2-4˚ F differential supply air to space
- Supply air rises when heat source is contacted
- Displaces room air upward
- Air rises with pollutants to ceiling
- Air returns at ceiling back to air handling unit





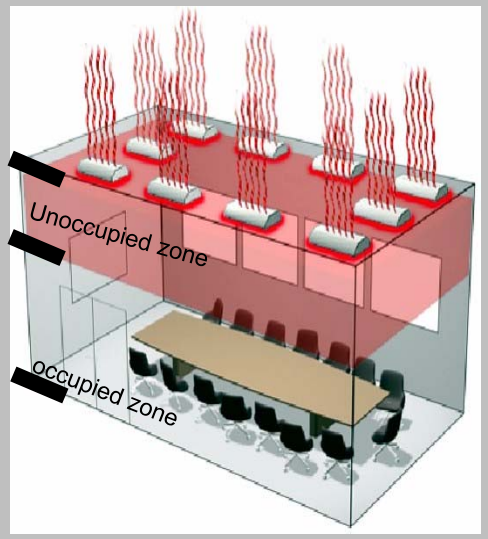
DISPLACEMENT SYSTEMS-ENERGY CONSERVATION

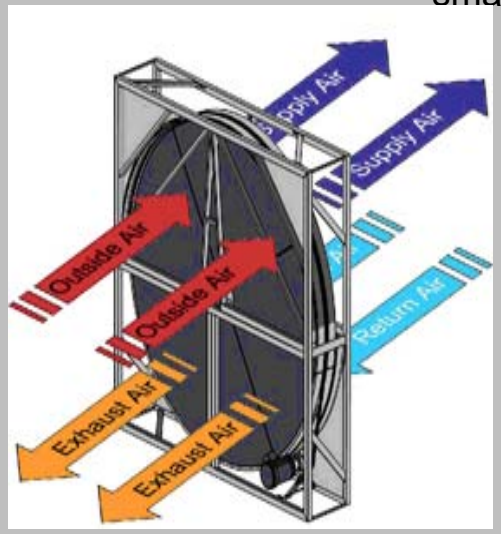
LOAD CALCULATION REDUCTIONS

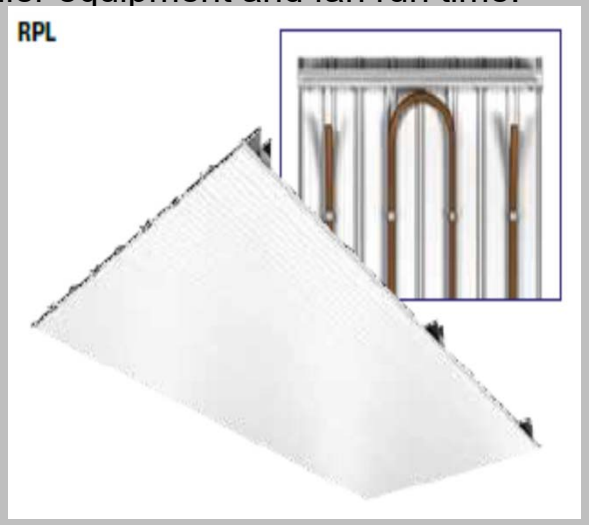
- Conventional System: All heat generated in room is included in air flow calculation since all airflow is mixed.
- Displacement System: Only loads which occur in the Occupied Zone are factored
- Results in: Smaller equipment & systems and lower installed and operating costs for Displacement Systems

ADDITIONAL ENERGY EFFICIENCY MEASURES

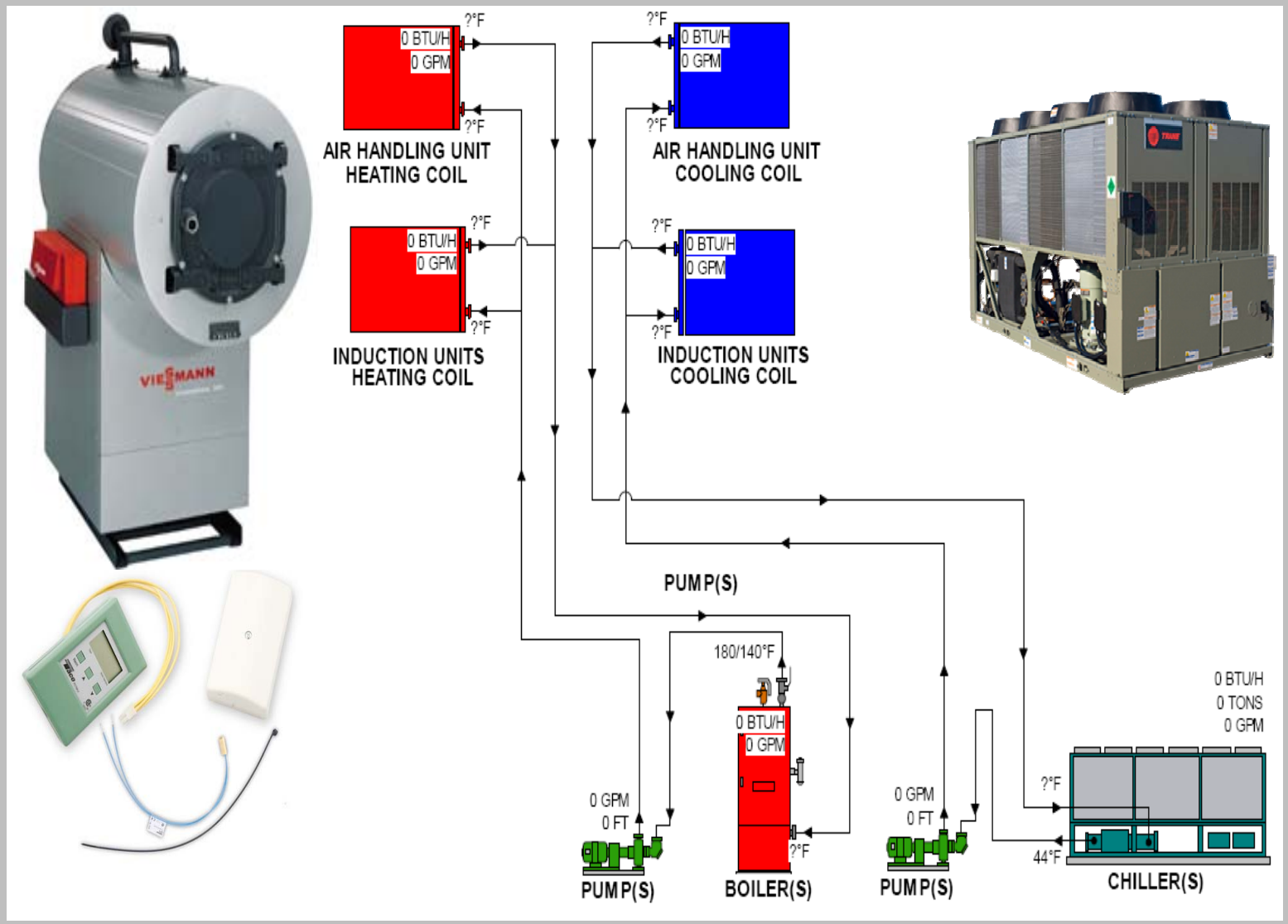
- Energy Recovery: Transfers energy from the return air stream to the supply air stream to pre-heat or pre-cool the outside air.
- Variable Air Volume w/ CO2 Demand Control Ventilation: Modulates the airflow to large single zone areas in accordance to space mounted thermostat and CO2 sensors reducing energy consumption due to reduced air changes.
- Supplemental Radiant Cooling Panels: Provide additional cooling without increasing airflow requirements reducing energy consumption due to smaller equipment and fan run time.



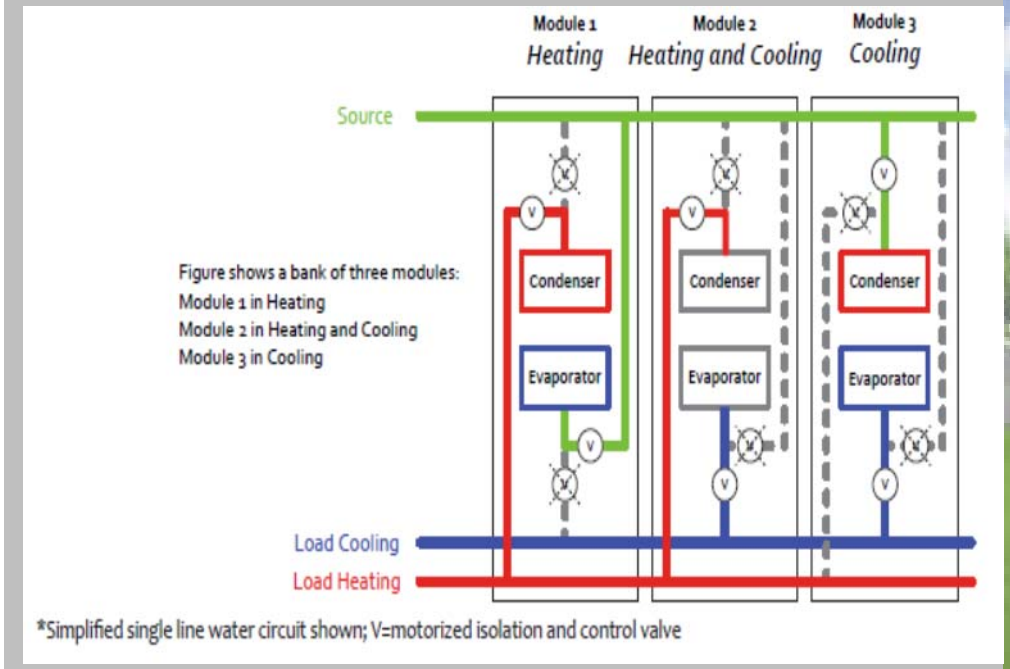




HIGH-EFFICIENCY GAS-FIRED CONDENSING BOILER AND ELECTRIC CHILLER SYSTEMS



CLOSED LOOP GEOTHERMAL FIELD & HEAT-RECOVERY CHILLER SYSTEM

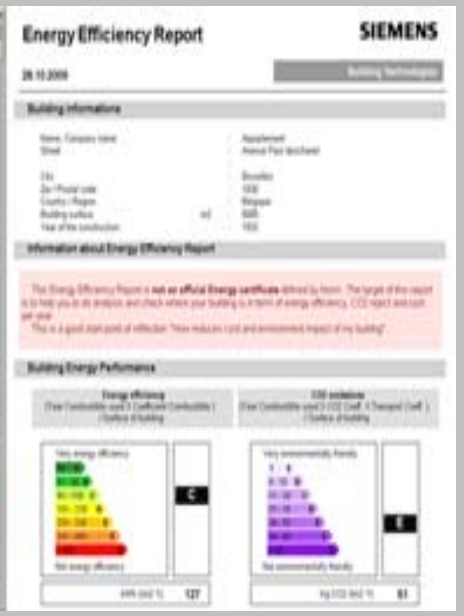


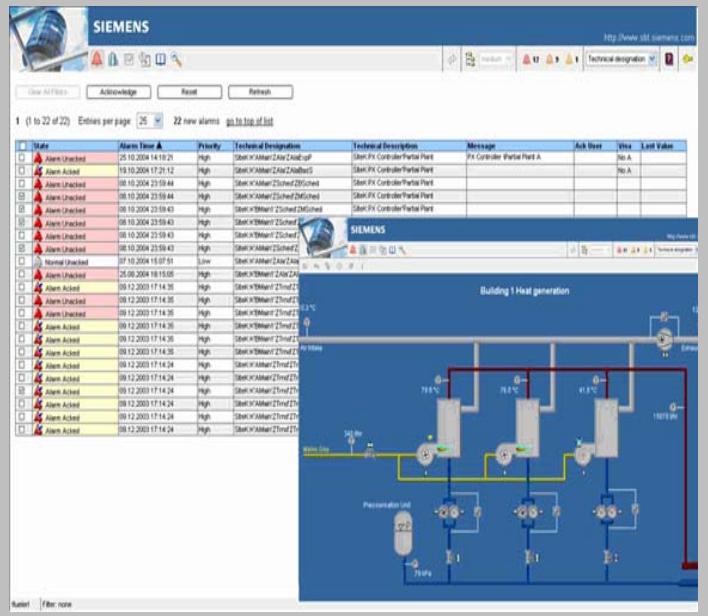
Ground source condenser water from closed loop type ground source geothermal wells.

- High-efficiency (simultaneous Heating and Heat Recovery options)
- 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
- Service friendly with easy access to all major components
- Zero combustion design Potential
- Environmentally friendly with low refrigerant charge

BUILDING DASHBOARD SYSTEM

- Utility Data
- On-Site Generation System
- Submetering
- BACnet IP Integration:
  - Lighting Controls
  - Water & Gas Meters
  - Emergency Generator
  - Fire Alarm System





MECHANICAL SYSTEM PAYBACK SUMMARY

Baseline	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility $/s.f.	Annual kBTU/ s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
-	Overhead Variable Air Volume (VAV) with Hot Water Reheat Coils	$33.7 M	5.8 M	13 K	$700 K	$118 K	$826 K	$1.33	52.7	$89 K	$916 K	-	-	-

Option	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility $/s.f.	Annual kBTU/ s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
1	Displacement Ventilation with Passive Chilled/Hot Water Radiant Panels	$31.7 M	4.9 M	6 K	$832 K	$87 K	$899 K	$1.12	36.4	$88 K	$787 K	$129,030	$6.3 M	Instant*****
2	Active Chilled Beam (Induction) Units	$33.7 M	5.0 M	8.3 K	$858 K	$70 K	$728 K	$1.17	37.9	$125 K	$851 K	$84,584	$3.0 M	Instant******
3	Air-Cooled Variable Refrigerant Flow (VRF) Unit (All Electric)	$30.0 M	5.5 M	1.9 K	$713 K	$21 K	$734 K	$1.18	33.1	$194 K	$927 K	-$11,666	$4.7 M	Instant******
4	Water-Cooled Variable Refrigerant Flow (VRF) Unit	$32.5 M	5.4 M	2.5 K	$705 K	$27 K	$732 K	$1.18	33.7	$195 K	$927 K	-$11,061	$2.7 M	Instant******

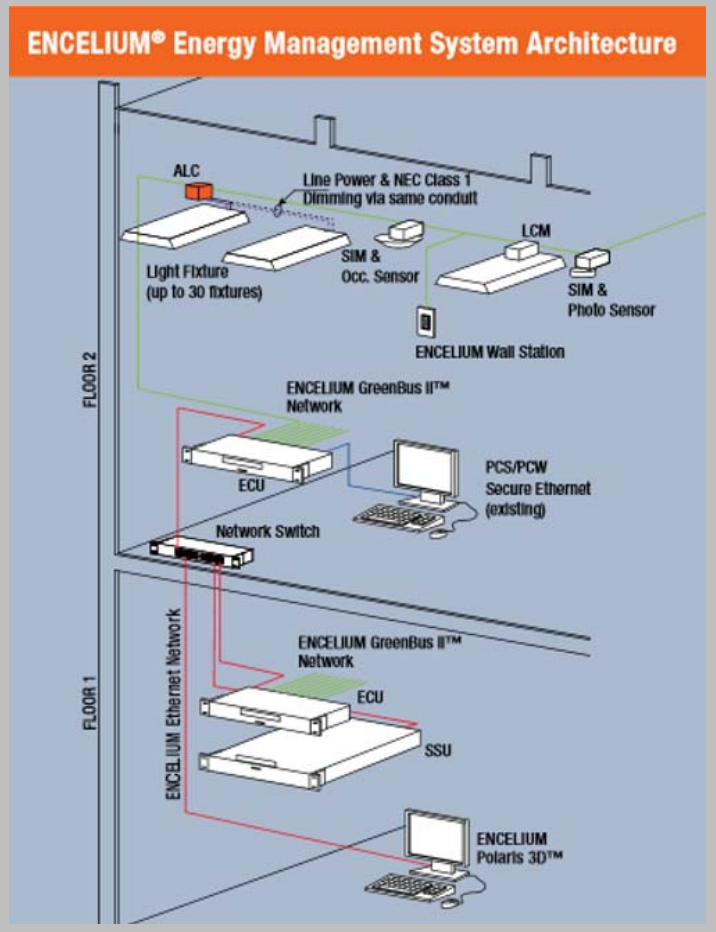
HIGH EFFICIENCY LED LIGHTING

LIGHTING CONTROL SYSTEM

- Occupancy Sensor
- Daylight Sensor
- BMS Integration
- Addressable groups
- Integration to future demand response program

Daylight Sensor

Occupancy Sensor



Sustainability Strategies

Energy – HVAC Options

- Options to study?
- All electric/hybrid/traditional

Sustainability Strategies

Energy – Modeling Process

- Early box model analysis for LEED Integrative Process Analysis
- Design Analysis vs Verification Model

Sustainability Strategies

Energy – Renewables

- Building mounted PV?
- Parking Canopy Structures?
- Adjacent PV farm only?
- Ground Source Heat Pumps (Geothermal)?
- All electric?

MAXIMIZE DAYLIGHT

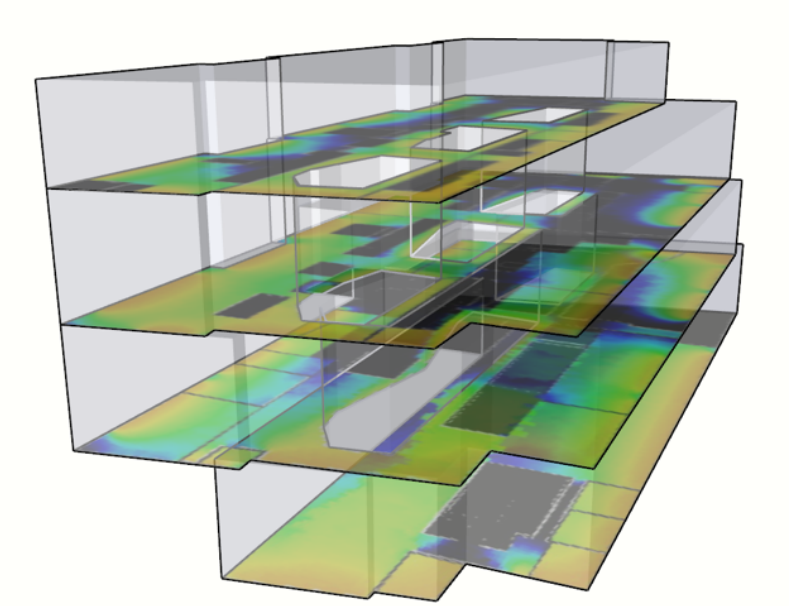
Access to natural light improves health and increases productivity.

1. World Green Building Council. *Health, Wellbeing & Productivity in Offices: The next chapter for green building.* U.S.A: World Green Building Council;2015.
2. McGraw Hill Construction. *The Drive Toward Healthier Buildings: The Market Drivers and Impact of Building Design and Construction on Occupant Health, Well-being, and Productivity.* Bedford, MA: McGraw Hill Construction Research and Analytics; 2014.

Sustainability Strategies

Energy – Daylight Harvesting / Passive Design

- Beyond code lighting controls
- WWR Conflict, Strategic window placement, skylights, color selection
- Lighting Power Density



Sustainability Strategies

Water Conservation

- Indoors
- Outdoors

Sustainability Strategies

Site Strategies

- Rainwater Harvesting
- Low-impact Stormwater Infrastructure
- Transit (bikes and cars)
- Reduced turf grass
- Light Pollution Reduction

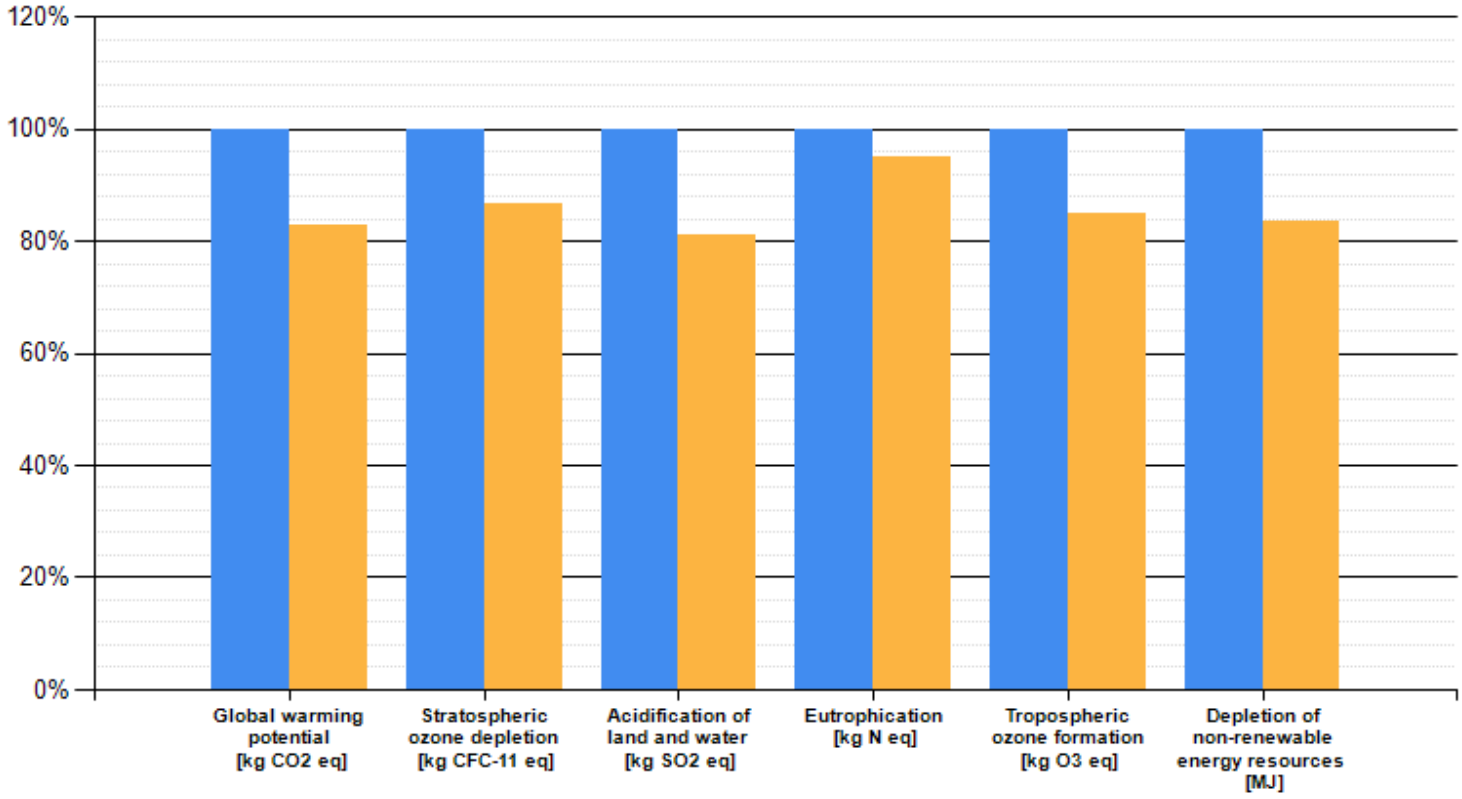
Sustainability Strategies

Materials

- Environmental Impact Transparency
- Health Impact Transparency
- Sustainable Material Selection
- Embodied Carbon

Material Life Cycle Analysis (LCA)

- Building Materials
- Structure and Enclosure



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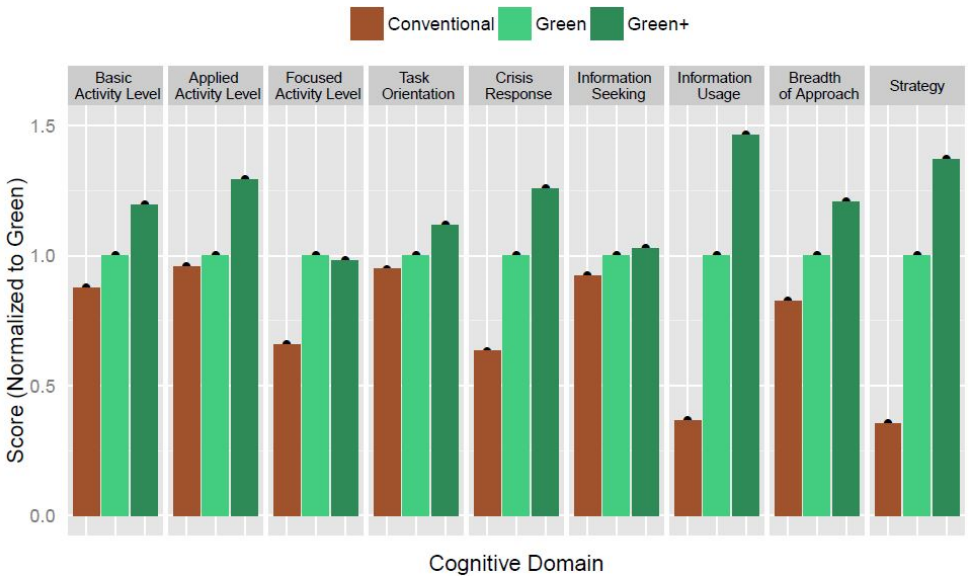
Sustainability Strategies

Indoor Air Quality

- Building Materials – Red List
- Increased Ventilation vs Increased Energy
- IAQP vs VRP Minimum Ventilation Rate
- CO2 levels and Cognitive Function

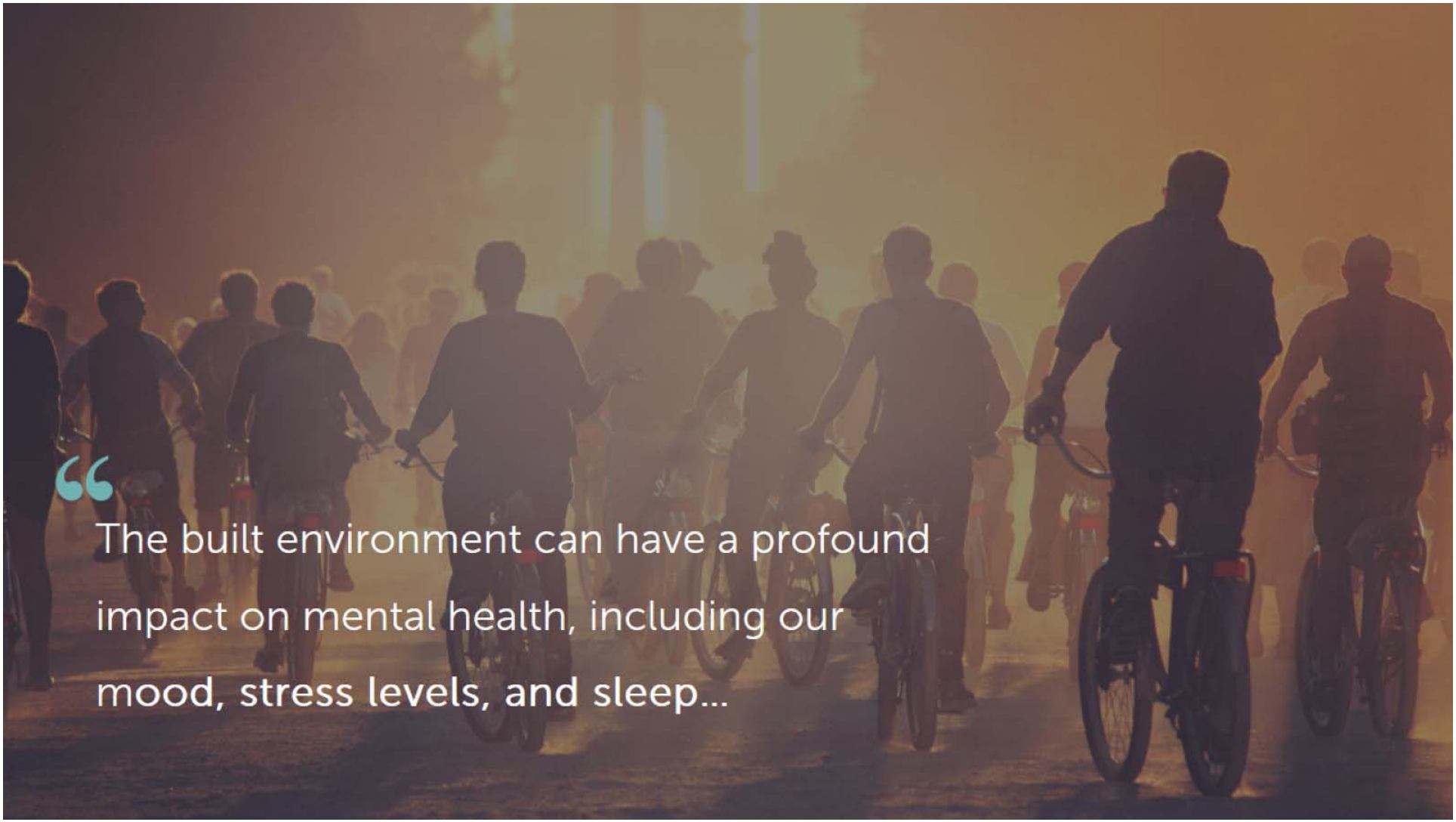
Source: COGfx Study - Harvard T.H. Chan School of Public Health's Center for Health and the Global Environment



Sustainability Strategies

Resilience

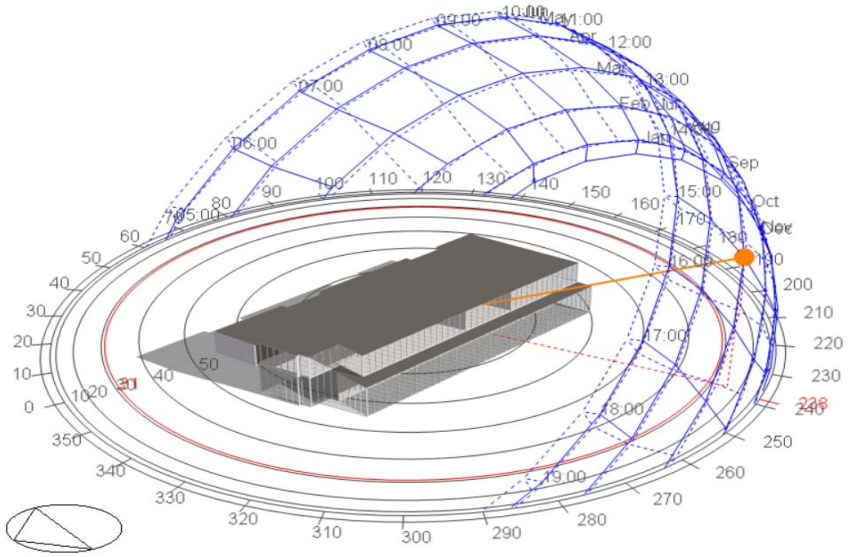
- Passive Survivability
- Energy Storage
- Flood Risk?
- Any functions needed by town? Emergency Response Resources?


“
The built environment can have a profound impact on mental health, including our mood, stress levels, and sleep...

Sustainability Strategies

Health & Wellness

- Biophilic Design – interior indirect access to nature
- Glare Control



Sustainability Strategies

Health & Wellness

- Acoustics – indoor / outdoor
- Drinking Water Access
- Mother’s Room / Rejuvenation Space
- Garden

LEED Scorecard Review

LEED v4 for BD+C: Schools
Project Checklist

Project Name: **Westwood Hanlon ES**
Date: **1/30/2020**

Y	?	N			
1	**0**	**0**	**Integrative Process**		**1**
1			Credit	Integrative Process	1
1	**14**	**0**	**Location and Transportation**		**15**
		N	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 (RP@4)	5
	4		Credit	Access to Quality Transit (RP@1)	4
	1		Credit	Bicycle Facilities	1
	1		Credit	Reduced Parking Footprint	1
	1		Credit	Green Vehicles	1
3	**9**	**0**	**Sustainable Sites**		**12**
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	Environmental Site Assessment	Required
1			Credit	Site Assessment	1
	2		Credit	Site Development - Protect or Restore Habitat (RP@2)	2
	1		Credit	Open Space	1
	3		Credit	Rainwater Management	3
	2		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	**8**	**0**	**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	5		Credit	Indoor Water Use Reduction	7
	2		Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1
22	**9**	**0**	**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
14	2		Credit	Optimize Energy Performance (RP@8)	16
	1		Credit	Advanced Energy Metering	1
	2		Credit	Demand Response	2
3			Credit	Renewable Energy Production (RP@2)	3
	1		Credit	Enhanced Refrigerant Management	1
	2		Credit	Green Power and Carbon Offsets	2

Y	?	N			
3	**9**	**1**	**Materials and Resources**		**13**
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
	5		Credit	Building Life-Cycle Impact Reduction (RP@2)	5
1	1		Credit	BPDO - Environmental Product Declarations	2
	2		Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1		1	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1	1		Credit	Construction and Demolition Waste Management	2
5	**11**	**0**	**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
1	1		Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
	2		Credit	Indoor Air Quality Assessment	2
	1		Credit	Thermal Comfort	1
1	1		Credit	Interior Lighting	2
	3		Credit	Daylight	3
	1		Credit	Quality Views	1
	1		Credit	Acoustic Performance	1
4	**2**	**0**	**Innovation**		**6**
1			Credit	Innovation: Resonsible Purchasing - Lamps	1
1			Credit	Innovation: Economic and GHG Analysis of Mechanical Systems	1
1			Credit	Innovation: Pilot - Integrative Analysis of Building Materials	1
	1		Credit	Innovation: TBD	1
	1		Credit	Innovation: TBD	1
1			Credit	LEED Accredited Professional	1
2	**2**	**0**	**Regional Priority (max of 4 points) Credit Names have been underlined**		**4**
		x	Credit	Surrounding Density and Diverse Uses (RP@4)	
	1		Credit	Access to Quality Transit (RP@1)	1
	1		Credit	Site Development - Protect or Restore Habitat (RP@2)	1
1			Credit	Optimize Energy Performance (RP@8)	1
1			Credit	Renewable Energy Production (RP@2)	1
	x		Credit	Building Life-Cycle Impact Reduction (RP@2)	

45	**64**	**1**	**TOTAL**	Possible Points: **110**

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

45	**64**	**1**	**TOTAL**

Certified: 40 to 49 p

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LEEDv4 Owner Credit Considerations

LEED Registration: LEED Certification Agreement and Confirmation Of Agents Authority forms.

LTc7 Reduced Parking Footprint:
Total number of parking spaces?

LTc8 Green Vehicles: Electric Vehicle Charging Stations (EVCS) to be included?

WEpr2 and WEc2 Indoor Water Use Reduction: Confirm flush/flow rates. Manual vs. Auto-off.

WEpr3 / WEc4 Water Metering
EApr3 / EAc3 Advanced Energy Metering
Owner letter of commitment to tracking and sharing data.

EAc1 Enhanced Commissioning:
Monitor-based Cx? Increased Envelope Cx?

EAc4 Demand Response: Will demand response infrastructure be designed/installed?

MRpr1 Storage and Collection of Recyclables: Recycling narrative provided by Owner.

INc1-4 Innovation: Green Cleaning + IPM Plan, Lamp Purchasing, Green Education, Exemplary Performance, Prevention Through Design, Biophilic Design, Integrative Analysis of Building Materials, etc.

OPR and BOD

The Owner's Project Requirements (OPR) document is a high-level outline of the goals and requirements that are deemed by the owner to be important for the success of the project.

- It summarizes the owner's intent
- Serves as a primary reference for the commissioning agent
- A living document that is updated periodically.

Basis of Design (BOD) document is developed by the design team to define how the OPR is to be achieved in the design

- HVAC+R systems and building envelope narratives, design strategies, and technical information that respond to each category, goal, and requirement specified in the OPR.

TGE Recommendations

- Explore Enhanced Envelope Strategies (increased insulation, triple glazed windows lowE (u0.20), SHGC, direct solar shading devices)
- Elongate massing east-west, minimize glazing on direct southern exposure
- Target EUI of 25 and offset remainder w/ renewables energy (on site and/or offsite and/or carbon offsets)
- Design building and parking areas as PV and/or geothermal “ready”
- Efficient HVAC systems with energy recovery
- Explore electric heating options (HPs)
- Low LPDs
- Understand synergies (enhanced envelope, LPD reductions will result in small HVAC equipment)
- Low flow plumbing fixtures
- Electric Vehicle Charging
- Commissioning of MEP and envelope systems, include envelope infiltration testing in Cx scope
- Take advantage of energy efficiency inventive programs (Mass Save)

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6. Wrap up and next steps

Thank you.

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