AUGUST 9, 2023

Burlington Fox Hill Elementary School

SBC Sustainability Sub-Committee

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AGENDA

1. Introductions
2. Project status overview (DiNisco)
3. What makes a sustainable school?
4. MA energy code, MassSave, MSBA
5. Energy: Roadmap to Zero Net Energy (ZNE)
6. Other sustainability considerations
7. Certification options: LEED vs CHPS
8. Wrap-up and next steps

PROJECT UPDATE (DINISCO)

WHAT MAKES A SUSTAINABLE SCHOOL?

WHAT MAKES A SUSTAINABLE SCHOOL?

1. Reduces environmental impacts and costs

- Increases energy efficiency – 100% electric, net zero energy
- Reduces water use and waste generation
- Triple net zero (energy, water, waste)

2. Improves occupant health and performance

- Maximizes natural light, connections to nature, fresh air
- Minimizes exposure to hazardous materials

3. Increases environmental and sustainability literacy

- The school as a teaching tool

NET ZERO ENERGY, WATER, WASTE

Douglas Elementary School

Action-Boxborough School District

WELLBEING AND INCREASED PERFORMANCE

DAYLIGHT

Increased student performance

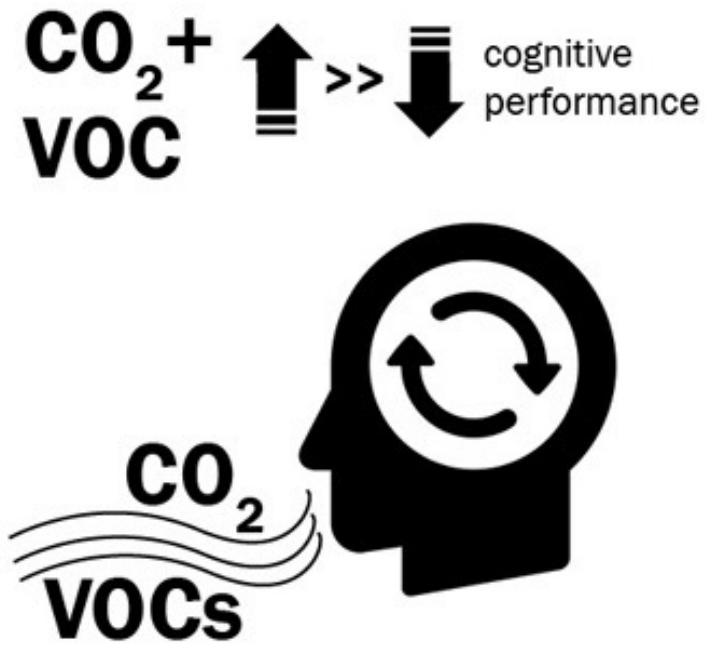
THERMAL COMFORT

Greater ability to focus

VIEWS

Reduction in stress, higher performance

INDOOR AIR QUALITY



basic activity	applied activity	focused activity
task orientation	crisis response	information seeking
information usage	breadth of approach	strategy

Cognitive scores were ...

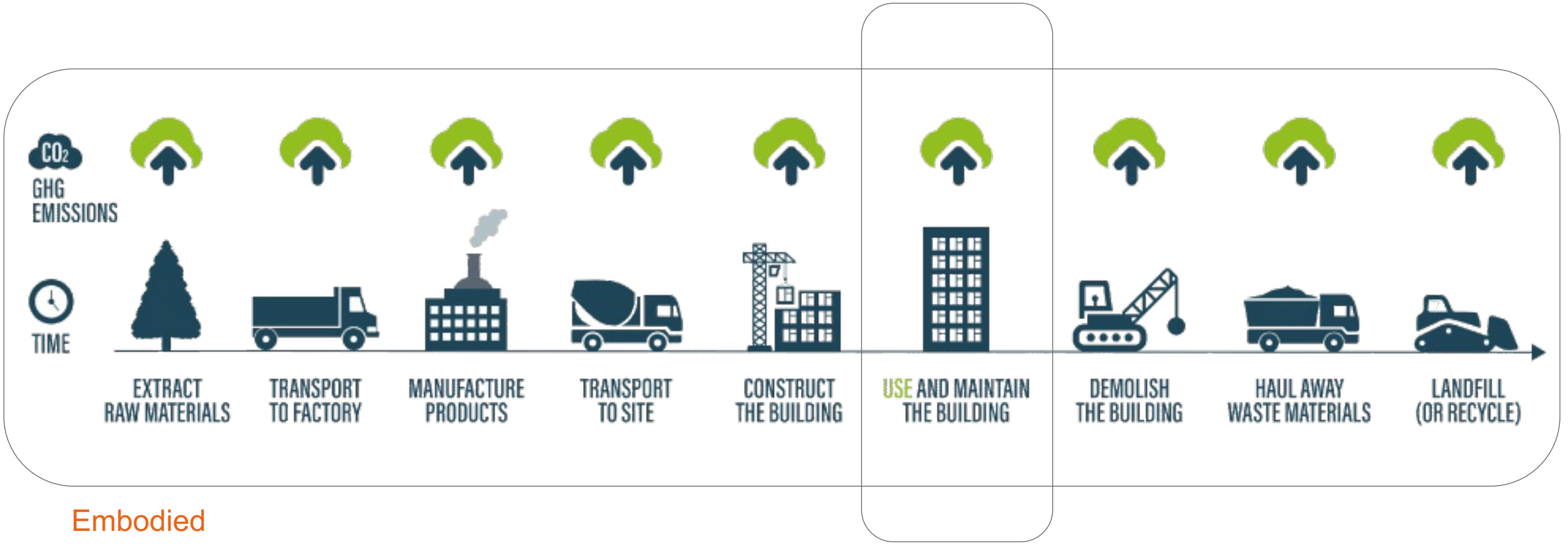
61% better in green v. conventional

101% better in green+ v. conventional

All icons from the Noun Project: Gregor Cresnar, Cole Perkins

Joseph G. Allen, Piers MacNaughton, Usha Satish, Suresh Santanam, Jose Vallarino, and John D. Spengler, "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments," Environmental Health Perspectives, accessed November 30, 2015. doi: 10.1289/ehp.1510037.

EMBODIED VS OPERATIONAL CARBON

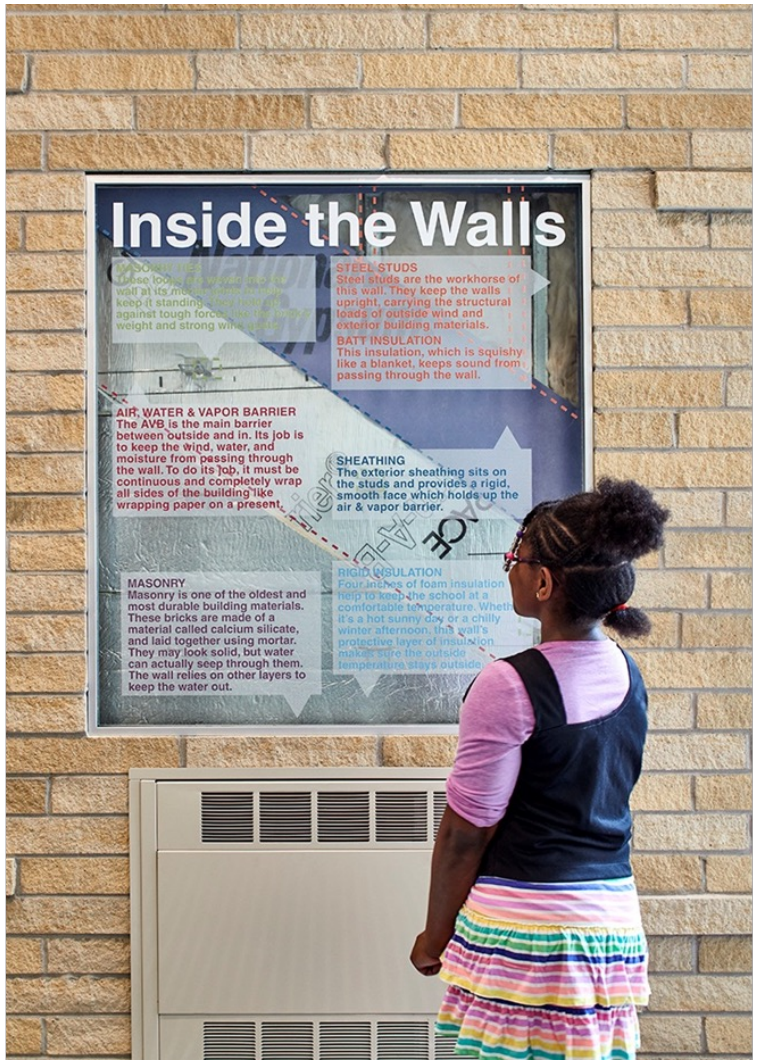


Embodied

Embodied + Operational

Source: Architecture 2030

SCHOOL AS A TEACHING TOOL



MLK Elementary School

Cambridge, MA

SUSTAINABLE SCHOOL CONSIDERATIONS

1. Establishing minimum goals

1. Resource efficiency: energy, water, waste, embodied carbon
2. Healthy indoors: materials, daylight, air quality

2. Going above and beyond

1. Net zero energy or triple net zero
2. Striving for higher levels of certification (LEED or CHPS)
3. Showcasing particular sustainability features of the school

3. Using the certifications/policy/code as a baseline

1. MA energy code requirements
2. MSBA requirements
3. MassSave energy incentives
4. Certifications: LEED or CHPS

ENERGY CODE, MSBA, MASSSAVE

REGULATORY AND POLICY REQUIREMENTS

1. **MA Energy Stretch Code (mandatory)**
    1. Energy performance target: TEDI (or Passive House)
    2. Envelope thermal performance
    3. Additional requirements (EV charging, solar ready, etc.)
2. **MassSave Incentives (prioritizes electric HVAC)**
    1. Energy use intensity (EUI): 25 kBtu/sf/yr
3. **MSBA Green Schools Program (optional)**
    1. Minimum LEED Silver or CHPS Verified
    2. Additional material and environmental quality requirements
    3. Meet new energy code requirements

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TEDI = Thermal Energy Demand Intensity
Focus on thermal performance of the school

-vs-

EUI = Energy Use Intensity
Focus on whole building energy use of the school

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Certification system as guardrails for guiding the sustainability goals

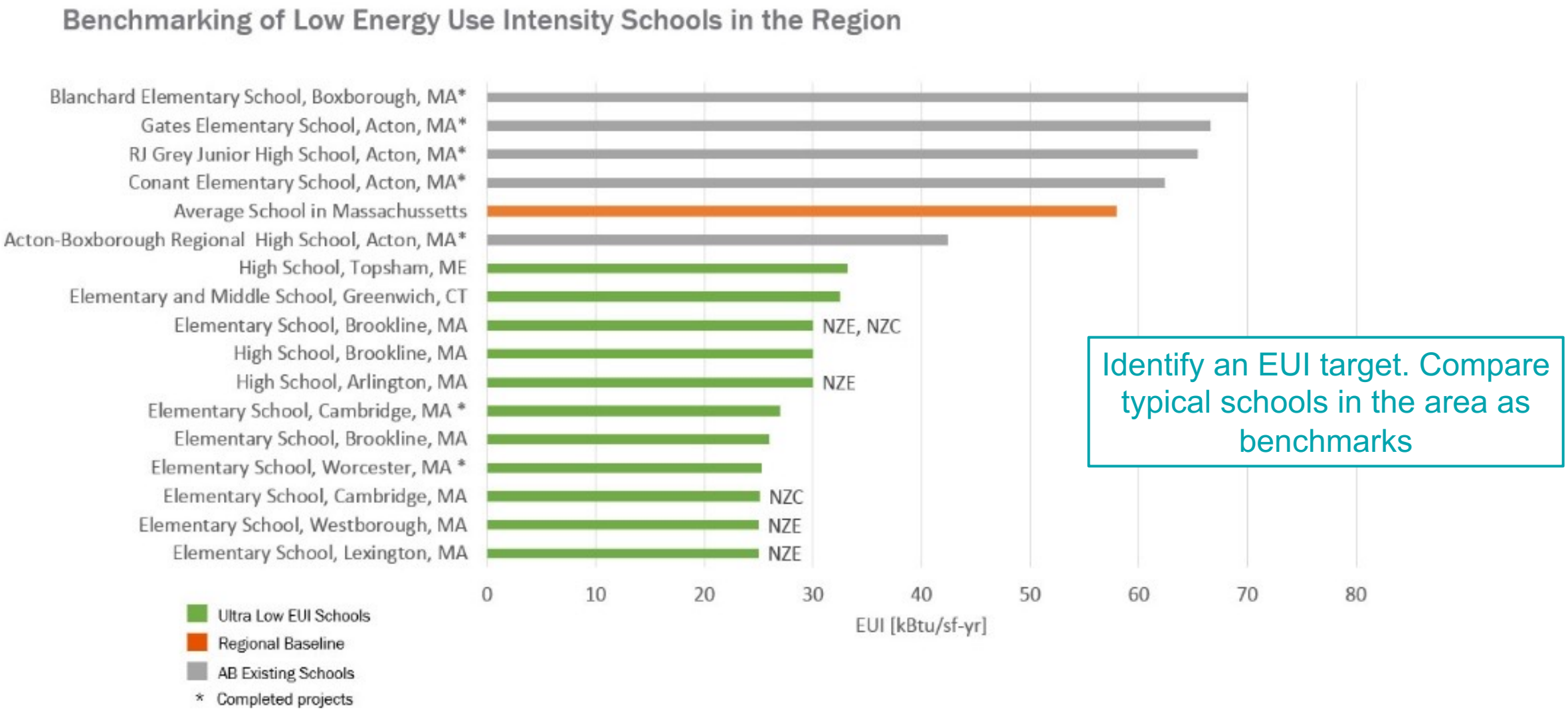
MSBA GREEN SCHOOLS PROGRAM – 2023 POLICY

Minimum Requirements	Additional Reimbursement
Minimum Certification: Achieve LEED for Schools Silver Minimum or NE-CHPS Verified Minimum	
Specific Req's for LEED: Achieve a minimum total of 3 points out of 7 possible points from the following categories: • MR Building Product Disclosure & Opt - Material Ingredients • IEQ - Low Emitting Materials • IEQ – Indoor Air Quality Assessment	For LEED: For an additional reimbursement of 1% of the Estimated Basis of Total Facilities Grant, projects must achieve a minimum total of 5 points out of 7 possible points in the LEED indoor air quality points
Specific Req's for CHPS: Achieve a minimum total of 5 points out of 10 possible points from the following categories: • EQ 5.1.3 Indoor Air Quality Management – Building Flush Out • EQ 7.0 Low Emitting Materials • EQ 7.1 Additional Low Emitting Materials • MW 10.1 Health Product Information Reporting	For CHPS: For an additional reimbursement of 1% of the Estimated Basis of Total Facilities Grant, projects must achieve a minimum total of 8 out of 10 possible points in the NE-CHPS indoor air quality points
Energy Efficiency: Meet the minimum energy efficiency requirements described in the MA DOER "Stretch Code Green Community" standards	For an additional reimbursement of 3% of the Estimated Basis of Total Facilities Grant (and in addition to the minimum requirements) projects must meet the minimum energy efficiency requirements described in the MA DOER "Opt-in Specialized Code" standards

HOW DO WE GET THERE?

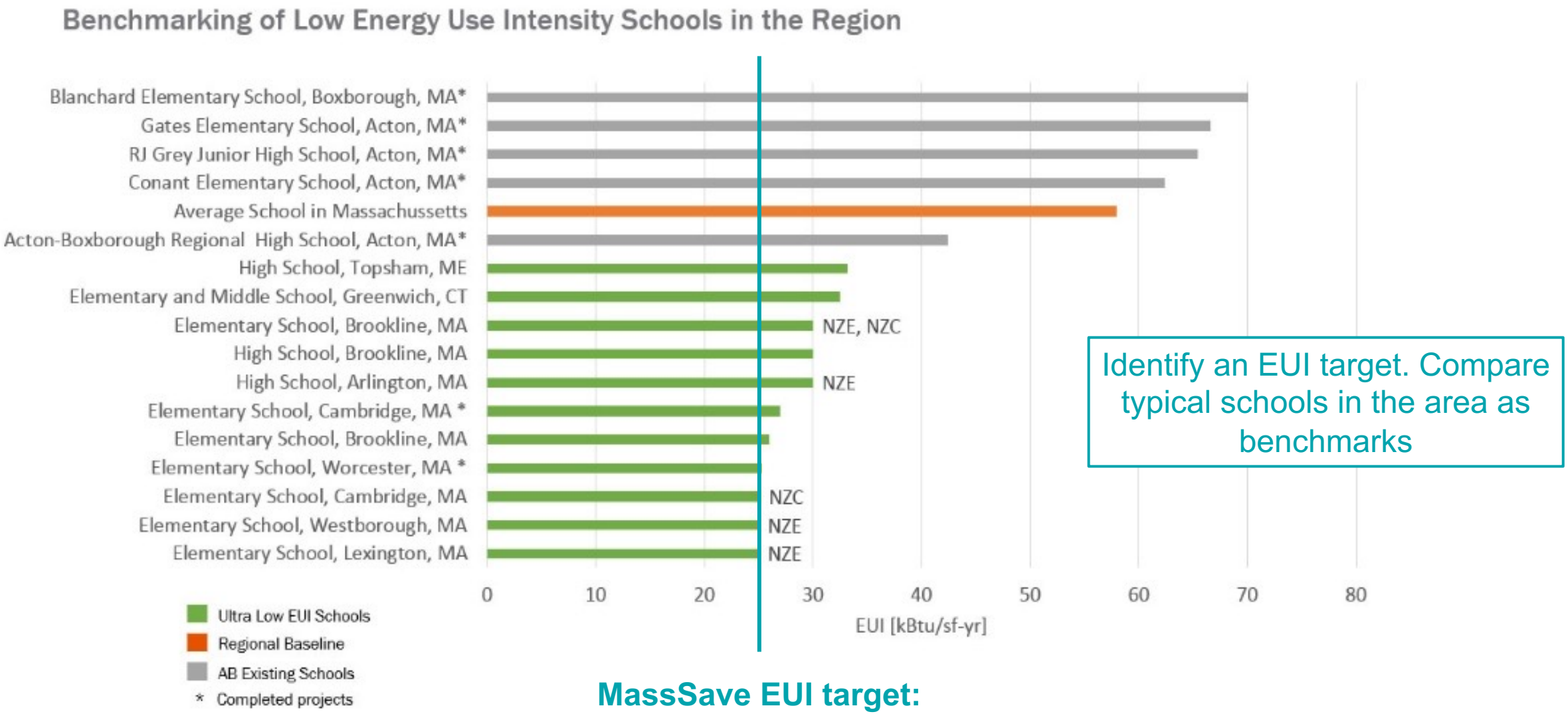
ENERGY: ROADMAP TO ZNE

IDENTIFY AN ENERGY (EUI) GOAL



Identify an EUI target. Compare typical schools in the area as benchmarks

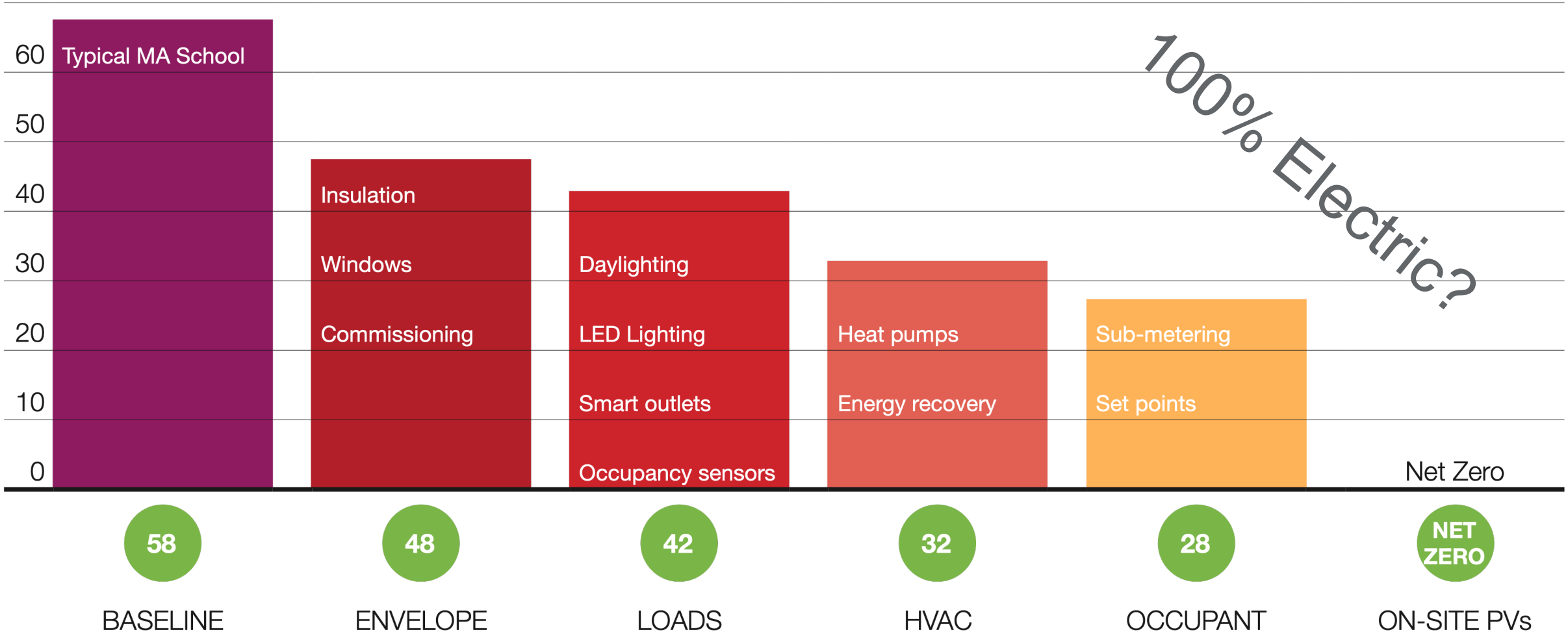
IDENTIFY AN ENERGY (EUI) GOAL



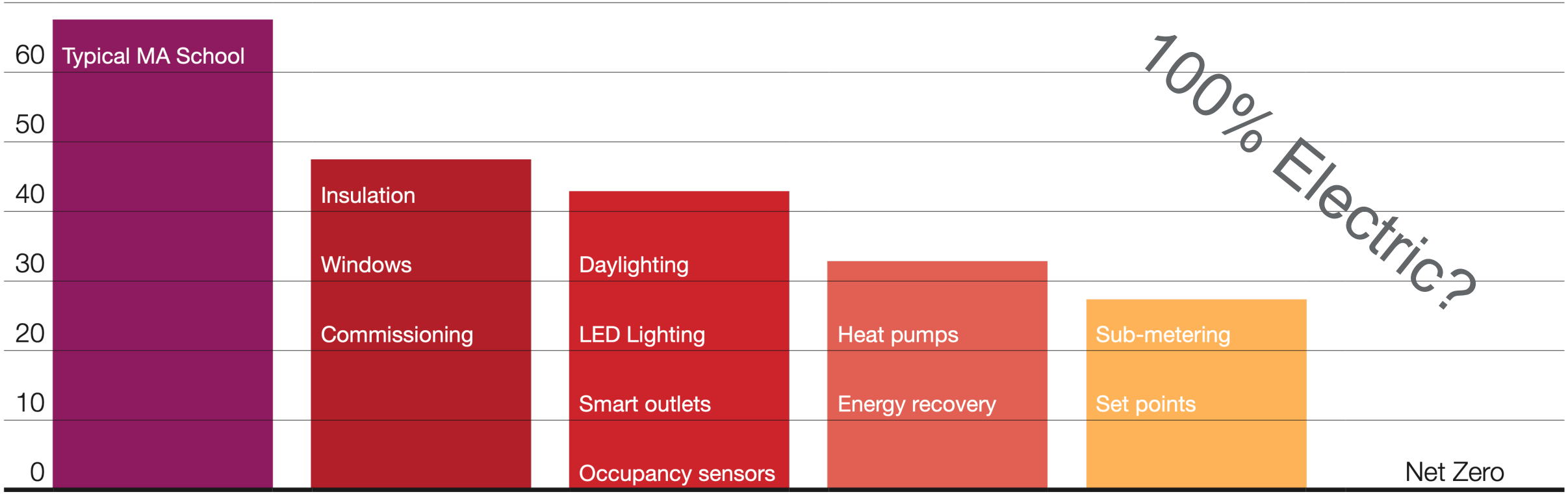
Identify an EUI target. Compare typical schools in the area as benchmarks

MassSave EUI target:
25 kBtu/sf/yr

ROADMAP TO ZNE

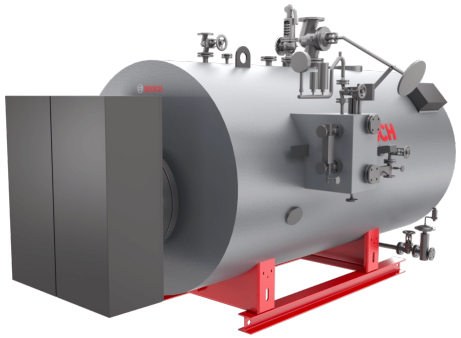


ROADMAP TO ZNE



Thornton Tomasetti

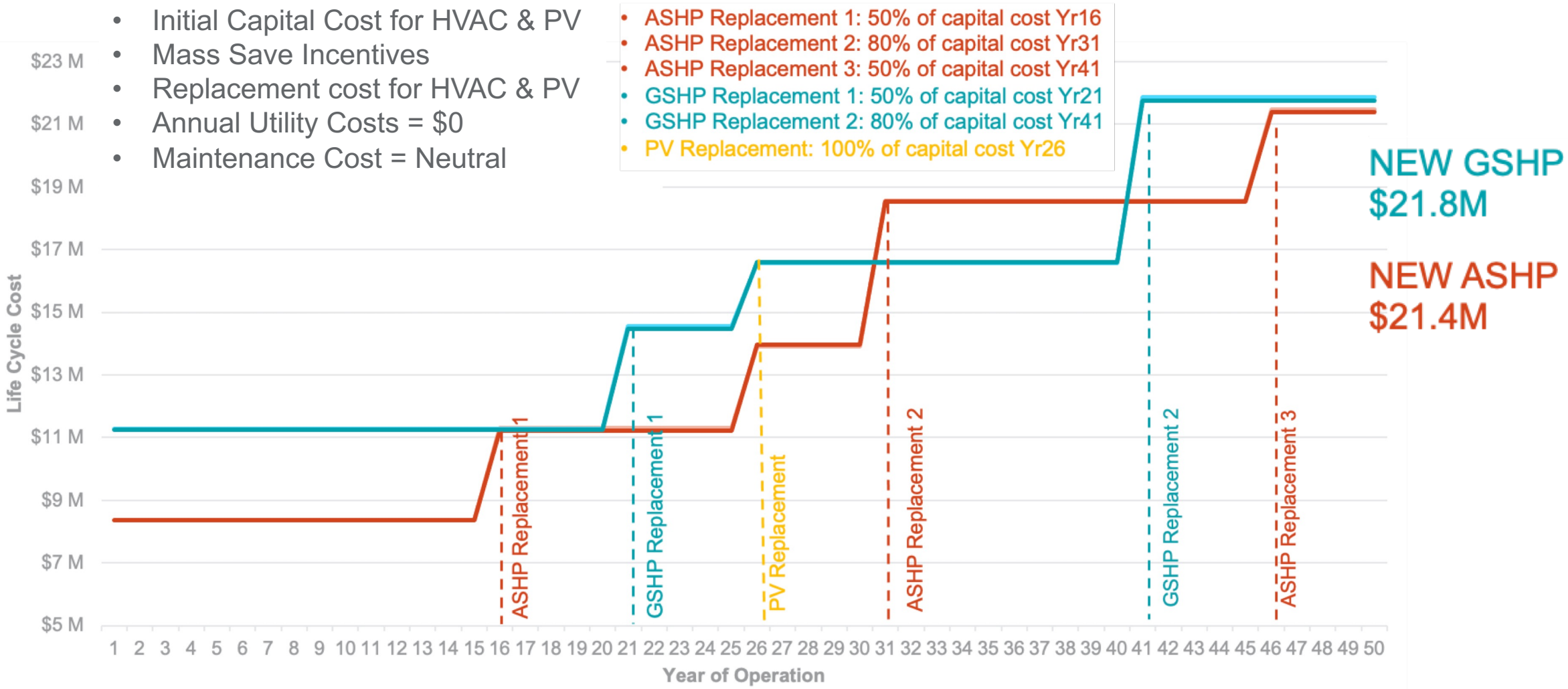
PLANT CHOICE MATTERS

	BOILER	HEAT PUMP
		
Fuel source	Gas / Electric	Electric (ASHP or GSHP)
Efficiency	Up to 98%	300%
EUI (schools)	27-32	23-25
Can be Net Zero Energy?	Yes (more PV)	Yes (less PV)
Can be Net Zero Carbon?	Only with electric boiler	Yes
Access to Utility / incentives	Very limited	Wide
Cost savings	First cost of boiler	Annual energy savings Additional financial incentives First cost of PV

HVAC SELECTION: LIFE CYCLE COST ANALYSIS

LCCA Cost includes:

- Initial Capital Cost for HVAC & PV
- Mass Save Incentives
- Replacement cost for HVAC & PV
- Annual Utility Costs = $0
- Maintenance Cost = Neutral



*LCCA for an example school

INCENTIVES FOR HIGH EFFIENCY SYSTEMS

MassSave

Incentives available for projects with low EUI (≤ 25) and high-efficiency electric heating/cooling equipment

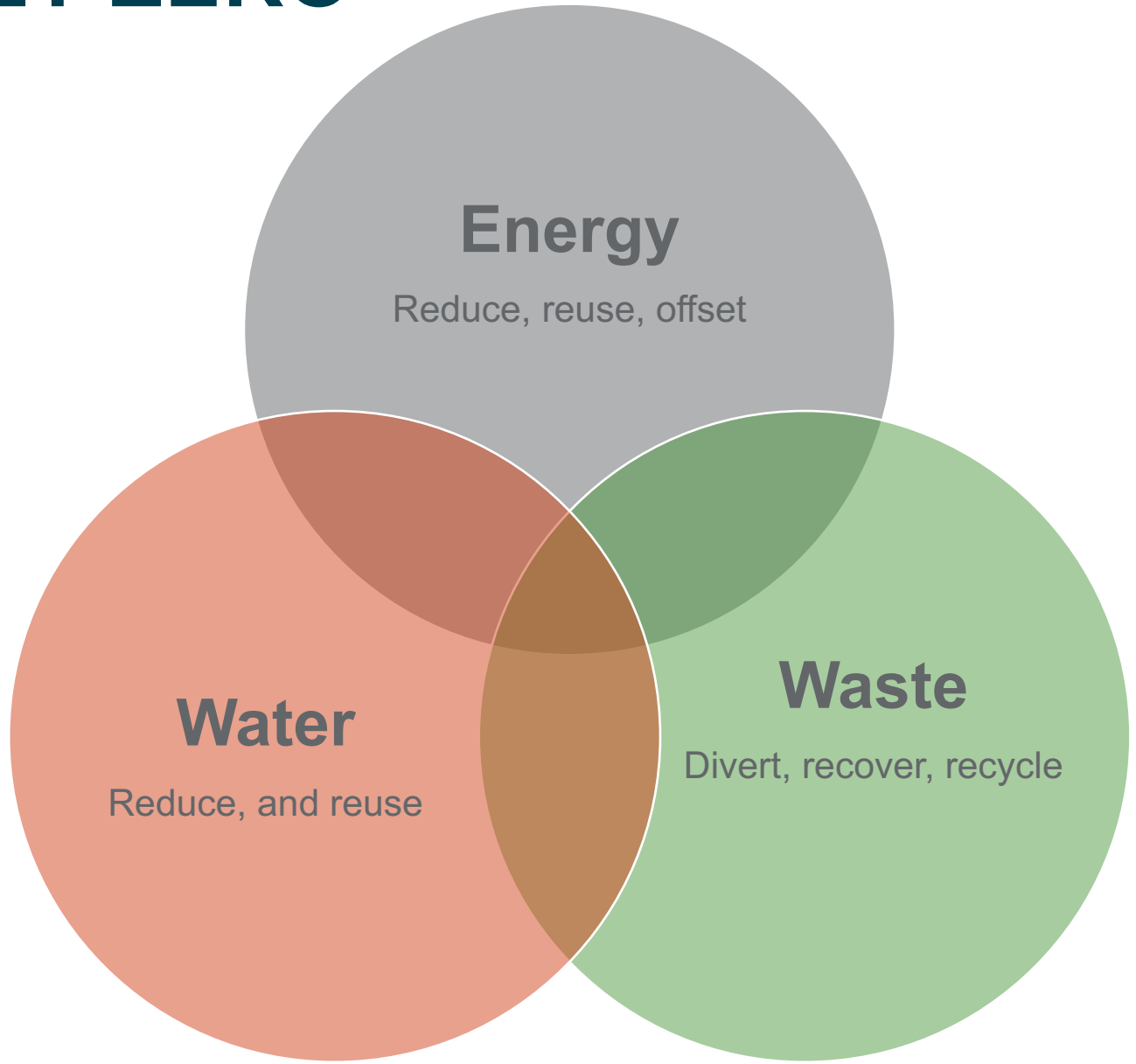
K-12 Schools	Site EUI Range	Incentives				
		Payable at end of Construction		Payable at end of 1 yr. post occupancy		
		Construction Incentive $/sf	Heat Pump Adder*	Post Occ. Inc. $/sf	Adder for getting under ZNE EUI target	Certification Incentive
Tier 2 (high schools only)	26-29	$1.50	Air Source Heat Pumps: $800/ton Variable Refrigerant Flow (VRF): $1200/ton Ground Source Heat Pumps: $4500/ton	$ 1.50	Not applicable	$3,000
Tier 1 - Net Zero Level (all Schools)	25 or less	$2.00			$0.05/ EUI point reduction/sf	

*Additional revenue potentially available through **the Inflation Reduction Act** (IRA). Tax credits available for alternative energy and high-efficiency electric equipment like ground source heat pumps (GSHP)

ADDITIONAL SUSTAINABILITY CONSIDERATIONS

WATER & WASTE

TRIPLE NET ZERO

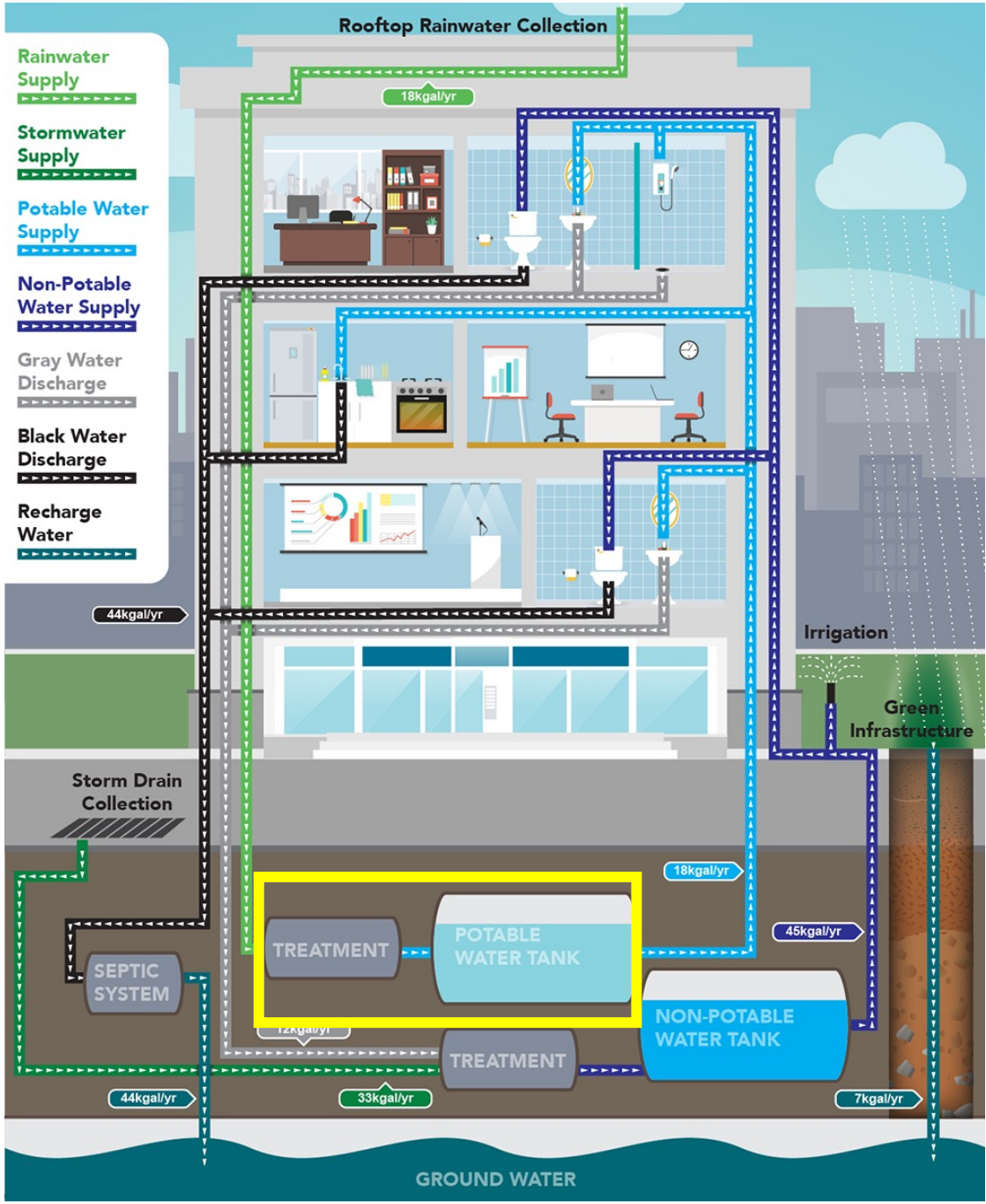


NET ZERO WATER (NZW)

The ideal NZW Building

100% of the project's water needs must be supplied by:

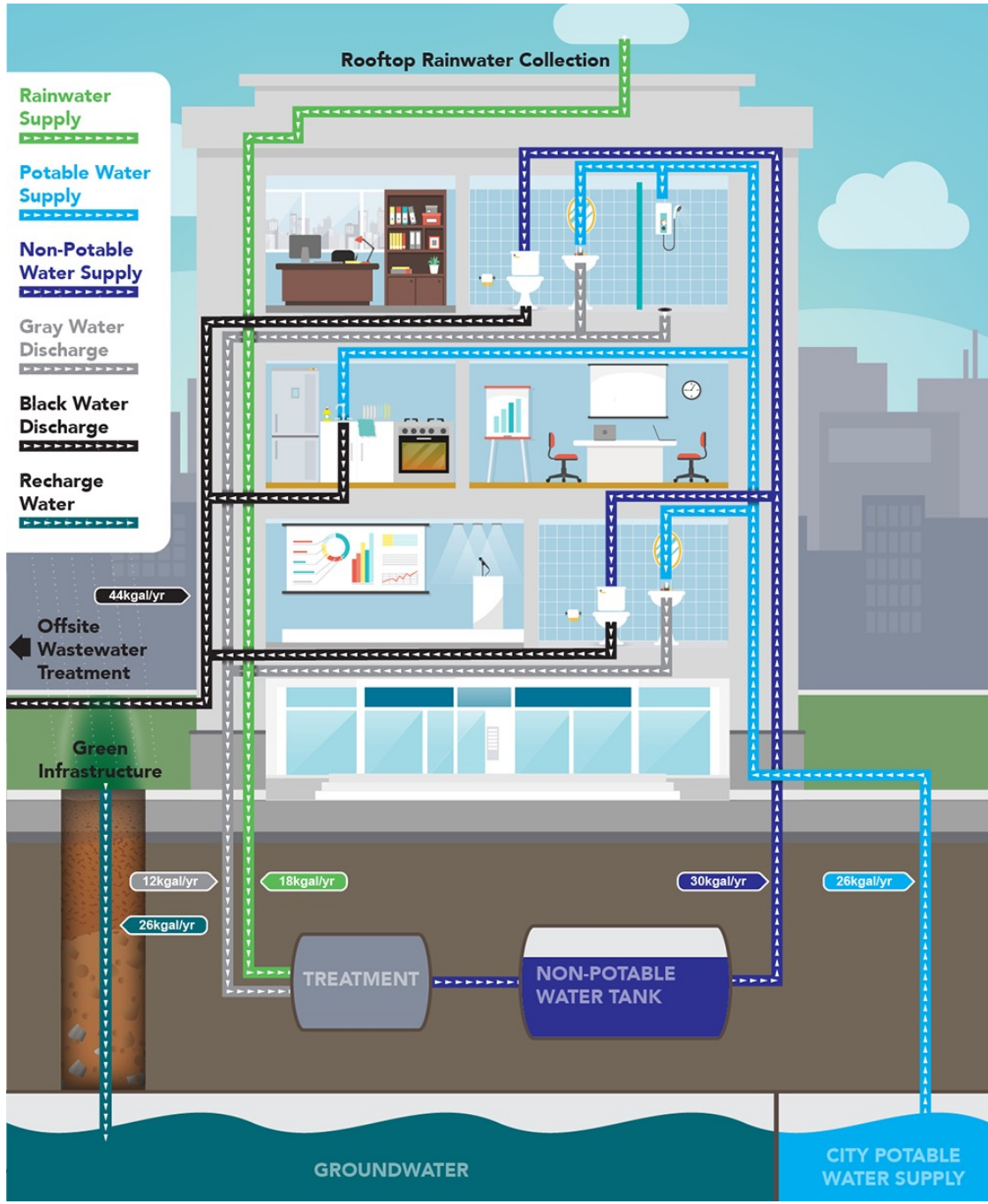
- captured precipitation and/or
- other natural closed loop water systems
- and/or by recycling used project water without the use of chemicals.



NET ZERO WATER (NZW)

The mainstream NZW Building

- **Potable** water needs (faucets, playground irrigation):
  - Met by municipal supply
- **Non-potable** water needs (flushing, landscape irrigation):
  - Met by on-site treatment of water collection from rooftop rainwater and greywater
- Treatment for blackwater:
  - Septic tank (on-site)
  - Blackwater treatment (on-site)
  - Wastewater treatment facility (off-site)



MATERIALS / WASTE CYCLE

Operational Waste

is generated by building occupants through day-to-day activities.

These wastes includes paper, food scraps, plastic.

Construction and demolition waste (C&D)

is generated during the construction, renovation, and demolition of buildings.

These wastes include materials such as concrete, bricks, wood and roofing, drywall, and landscape waste.

MATERIALS / WASTE CYCLE

Hierarchy of decision making

HEALTHY MATERIALS

COGNITIVE FUNCTION

Conventional:

Typical volatile organic compound levels (506-666 µg/m^3) and 20 cfm outdoor air per person

"Green":

VOC levels reduced to approximately 50 µg/m^3 and 20 cfm outdoor air per person

"Green +":

VOC levels reduced to approximately 50 µg/m^3 and 40 cfm outdoor air per person

On average, cognitive function scores were:

61 percent higher in green building conditions

101 percent higher in "green +" building conditions

Source: *The Harvard T.H. Chan School for Public Health; Center for Health and the Global Environment.*

HEALTHY MATERIALS

- Target select material categories to have the greatest impact
- Select products that declare environmental impact and chemicals of concern

Health Product DECLARATION™

EPD® ENVIRONMENTAL PRODUCT DECLARATION

Image: Parsons Healthy Materials Lab

CERTIFICATION: LEED VS CHPS

LEED FOR SCHOOLS VS. CHPS RATING SYSTEMS

LEED	CHPS
“Name Brand” Recognition	Less Well-Known
Well-Established Green Building Rating System Adapted for K-12 Schools	Green Building Rating System Specifically Designed for K-12 Schools
Global System w/ 4 Regional Priority Point Opportunities	National Program with Regionally Specific Versions Available (i.e. NE-CHPS)
Strongest Emphasis on Energy	Strongest Emphasis on Indoor Environmental Quality
Stronger Emphasis on Water	Stronger Emphasis on Integration and Innovation
Location and Transportation Is an Entire Category	No Recognition for Location and Transportation
Operations and Maintenance Not Included (Different Rating System)	Significant Emphasis on Operations and Maintenance
Very Limited Requirements for Commitments	Requires Significant District Level Commitment
Highest value is given to credits that reduce contribution of carbon emissions	Highest value is given to credits that enhance student health and well-being
4 Levels of Certification (Certified, Silver, Gold, Platinum)*	3 Levels of Certification (Designed, Certified, Verified Leader)*

* Underline indicates levels recognized by MSBA Green Schools Program – 2023 Policy

WRAP-UP

SETTING SUSTAINABILITY GOALS

1. What are the project's minimum goals?

1. Resource efficiency: energy, water, waste, embodied carbon
2. Healthy indoors: materials, daylight, air quality

2. Where to go above and beyond?

1. Net zero energy or triple net zero
2. Striving for higher levels of certification (LEED or CHPS)
3. Showcasing particular sustainability features of the school

3. Use certifications/policy/code as guardrails

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NEXT STEPS

1. Identify additional sustainability priorities for the school

1. Energy: 100% electric or NZE?
2. Triple net zero?
3. Daylight, water, waste, materials, embodied carbon, etc…

2. Where to go further -- MSBA, MassSave, and LEED/CHPS?

3. Identify energy system options to test in LCCA