

# Boardwalk Campus



West Acton  
Boardwalk  
Welcome



## OVERVIEW

1,120 STUDENTS

PK-6 GRADES

175,000 GSF

3 STORIES

\$545/SF

OPENED 2022



Athletic Field

Boardwalk

Gates School  
L2

Huebner ECP  
L1

Parking

Parking

Courtyard

Play Ground

Main Entries

Learning Trail

Bus Drop Off

Douglas School  
L3



- Net Zero Energy
- Net Zero Water
- Healthy Indoor Environment
- Teaching Tool
- NE-CHPS

# HEALTHY INDOOR ENVIRONMENT

ERGONOMIC  
FURNITURE

ACOUSTICS

DIMMABLE  
INDIRECT  
LIGHTING

OPERABLE  
WINDOWS

DAYLIGHT  
& VIEWS

NATURAL  
LOOK  
MATERIALS

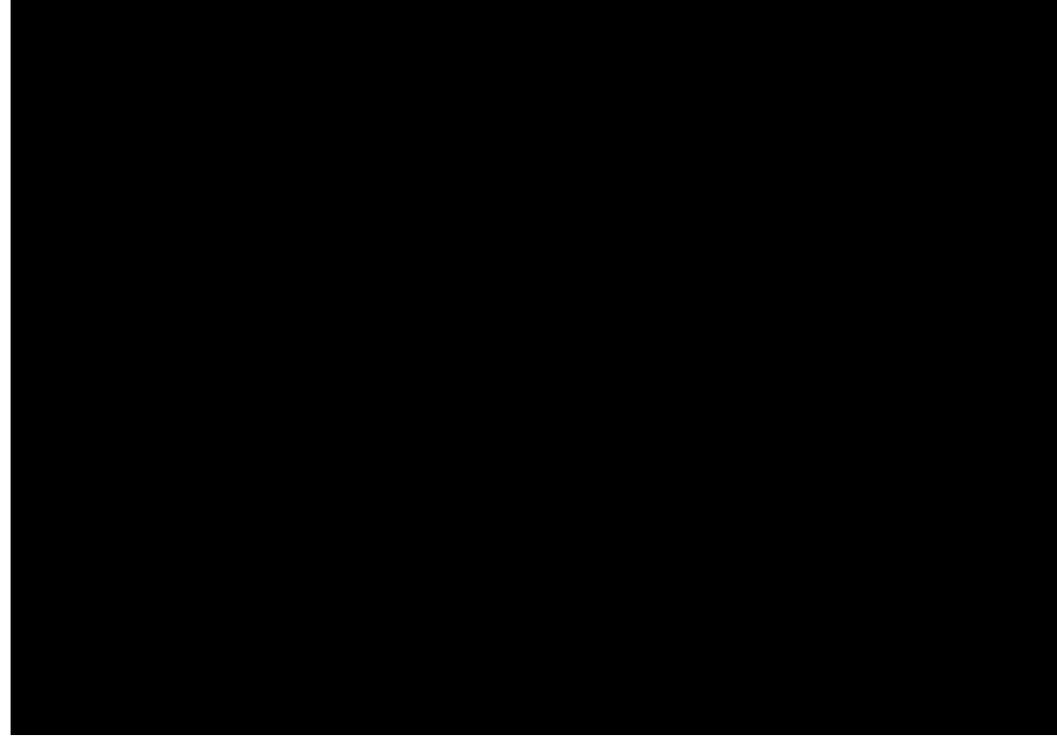
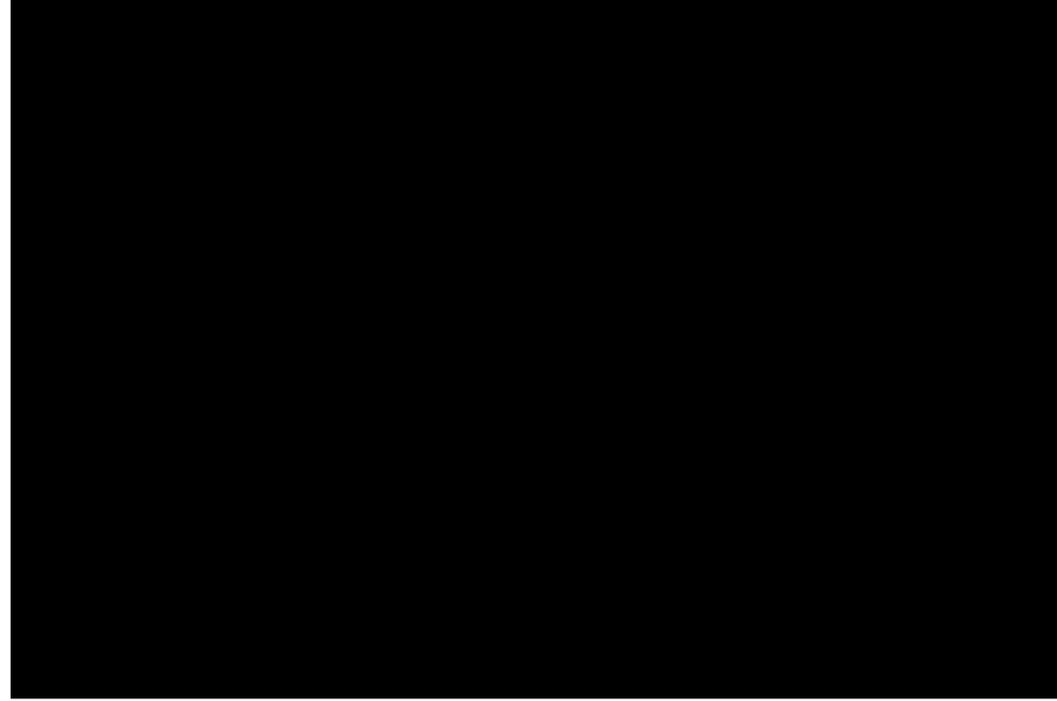
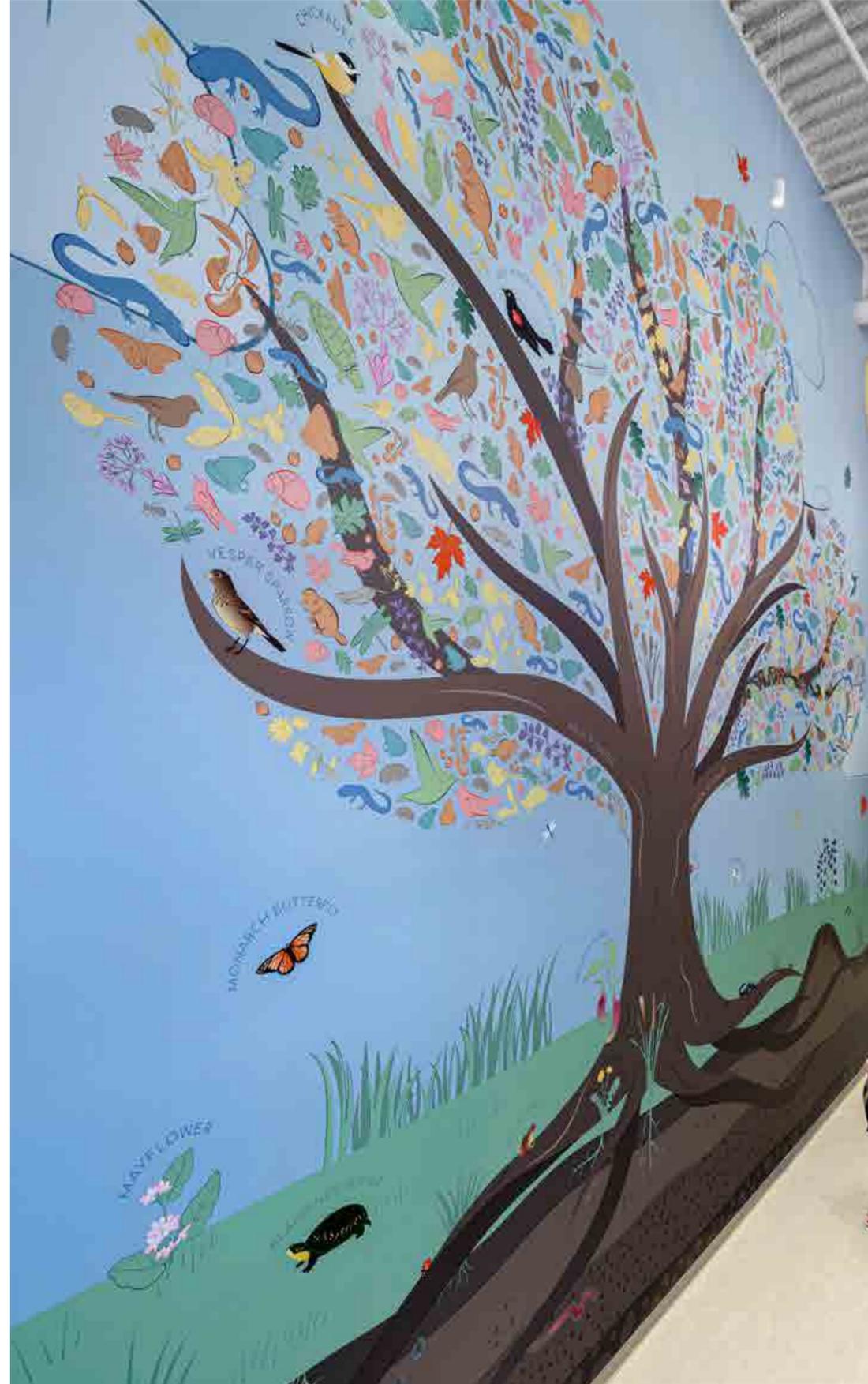
DISPLACEMENT  
VENTILATION FOR  
THERMAL  
COMFORT & AIR  
QUALITY

HEALTHIER  
MATERIALS

# ECOSYSTEM LEARNING



# ECOSYSTEM LEARNING



# NET ZERO LEARNING



ARROWSTREET

**NET ZERO WATER**



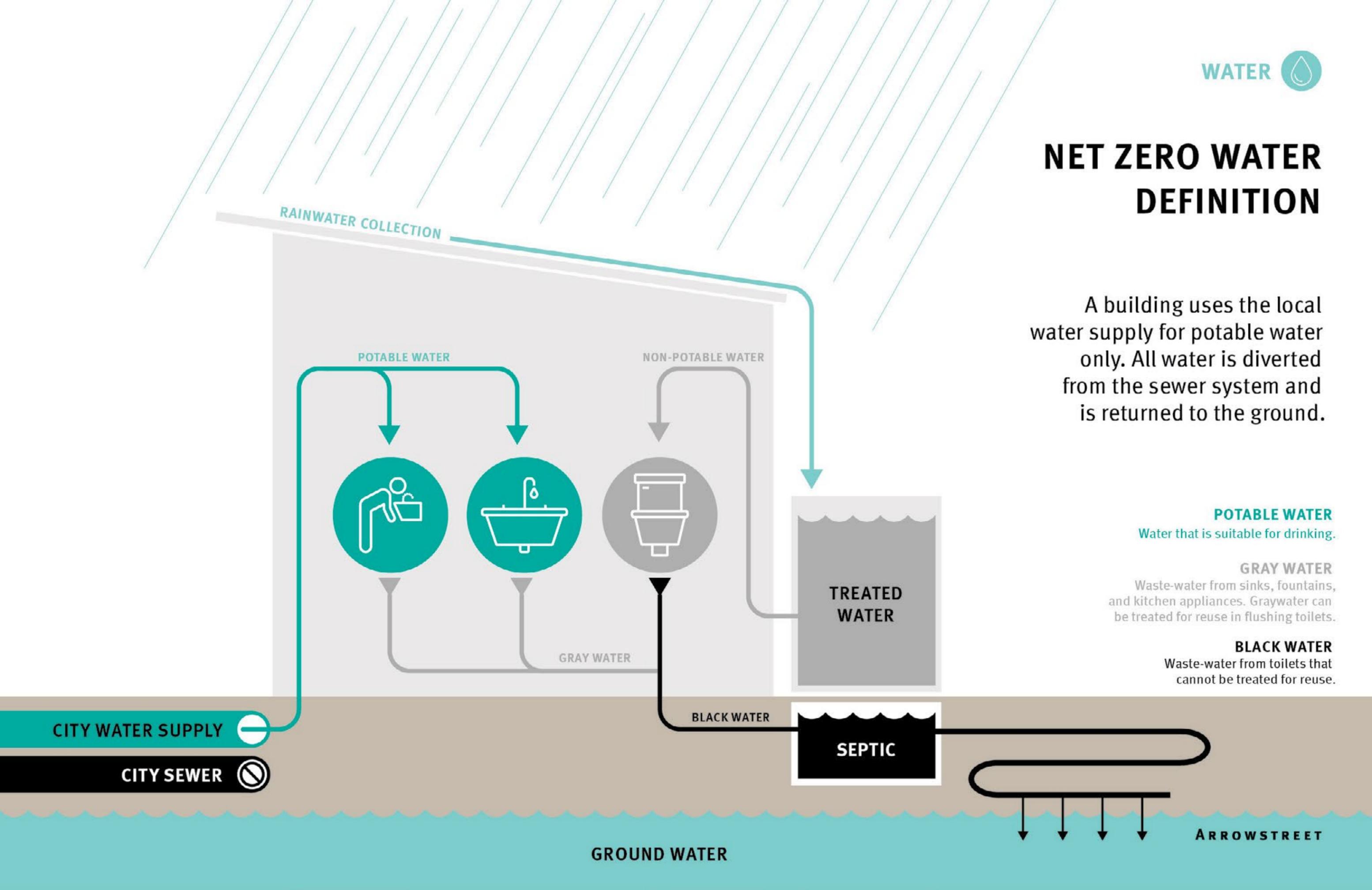
# TYPICAL WATER USAGE



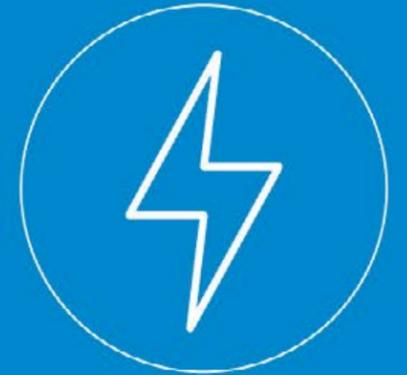
NON-POTABLE WATER  
POTABLE WATER

# NET ZERO WATER DEFINITION

A building uses the local water supply for potable water only. All water is diverted from the sewer system and is returned to the ground.



**NET ZERO ENERGY**





# SYSTEM HIGHLIGHTS

pEUI 23.1

Ground Source Heat Pumps  
-65 geothermal wells

Radiant Heating & Cooling

Displacement Ventilation w/  
Heat Recovery & Demand Control

Point-of-use Hot Water

Daylight Controls & LED Lighting

On-site PV & Battery Storage

# ABRSD Boardwalk Campus

## Geothermal, All-Electric, Solar+Storage, Net Zero



Kate Crosby, Energy Manager  
Acton-Boxborough Regional School District  
February 9, 2024

# ABRSD Douglas Gates – Boardwalk Campus

- 175,000 s.f.
- Energy target: 23.1 kBtu/sf
- Geothermal heating/cooling (*electric boiler backup*)
- All-electric (*emergency diesel generator*)
- Solar+Storage
- Zero Net Energy (*when solar+storage completed*)
- EV chargers
- Rainwater collection



# Early essential support: Mass Save, NGRID, Eversource and MSBA

- “Start early!” >> set EUI target early in the process
- Credibility, momentum, technical assistance
- Substantial incentives confirmed ahead of time



New Construction or Major Renovation-  
Commercial Pathways  
Energy Efficiency Solutions

## Path 1: Zero Net Energy (ZNE)/Deep Energy Savings

(Solutions for buildings over 20,000 square feet)

Comprehensive technical expertise and financial incentives for ZNE, ZNE Ready, very low energy use intensity (EUI) and Passive House projects. [Learn more.](#)

**nationalgrid**



**EVERSOURCE**  
ENERGY

# Douglas Gates ~ Solar radiation benefit study

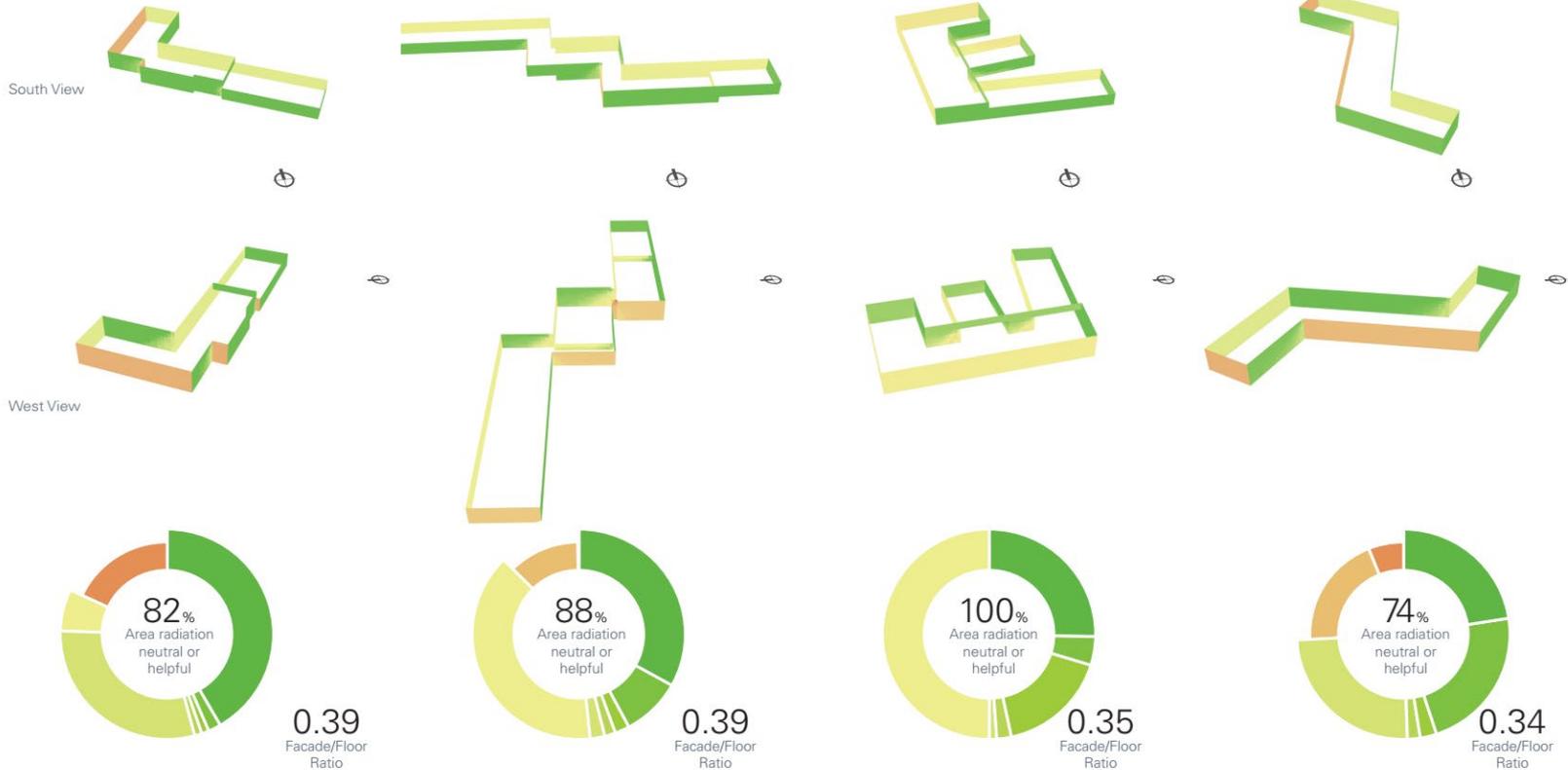
## IMPACT OF BUILDING MASSING ON SOLAR RADIATION BENEFIT

#1 DOUGLAS/DOUGLAS SITE

#2 DOUGLAS GATES/ELM SITE

#3 DOUGLAS GATES/GATES SITE

#4 DOUGLAS CONANT/CONANT SITE



The purpose of this radiation benefit study to understand how different building massings differ in the amount of beneficial / harmful solar radiation on their facades. "Helpful radiation" is colored in green, and corresponds to any solar incidence that occurs when the outdoor air temperature is below 64 F (heating season). "Harmful radiation" is colored in red, and corresponds to any solar incidence during the cooling season (outdoor air temperature higher than 64F). Any facades with predominantly harmful radiation would require exterior shading to maintain a low energy consumption. Results indicate that massings 1 and 4 receive more harmful radiation than massing 2 and 3.  
 Note: Balance point used in this study is 64 F.

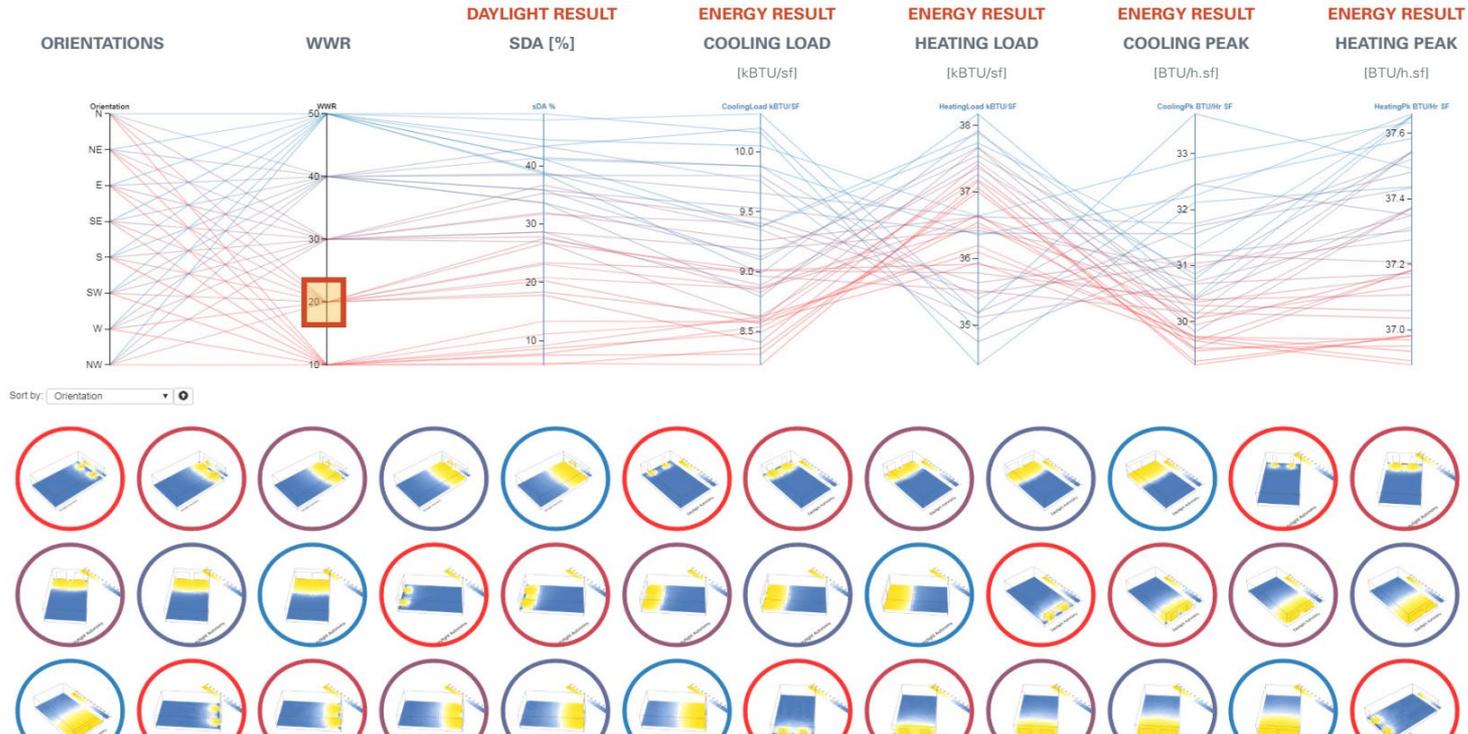


# Douglas Gates ~ Daylight study

## DESIGN EXPLORER

### PARAMETRIC DAYLIGHT STUDY

Link: <https://goo.gl/FPfqvE>



Parametric studies were run for a typical classroom (40' x 25' x 12'). Window-to-wall ratio and orientation were the two input variables, and daylighting penetration and HVAC annual and peak loads were evaluated as outputs.

ASHRAE  
baseline EUI

40.1

Douglas  
Gates  
EUI  
(modeled)

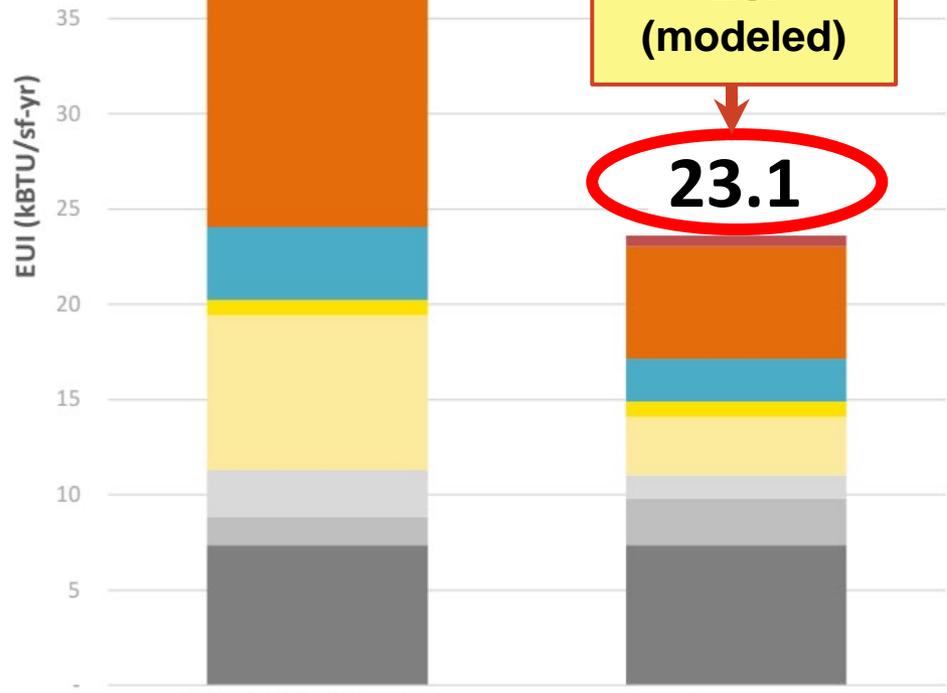
23.1

# Thornton Tomasetti

## DOUGLAS-GATES ELEMENTARY SCHOOL

### ENERGY ANALYSIS

September 4th, 2020



ASHRAE 2013 Baseline

Proposed

DHW	0.7	0.6
Heating	15.1	5.9
Cooling	3.8	2.3
Ext. Lights	0.8	0.8
Int. Lights	8.2	3.1
Fans	2.5	1.2
Pumps	1.5	2.4
Equipment	7.4	7.4
<b>Total</b>	<b>40.1</b>	<b>23.6</b>



# Life Cycle Cost Analysis (LCCA) x 50 years

## 2019 pre-IRA legislation:

Geothermal vs high efficiency gas  
cost-over-time = a wash

## Now with Inflation Reduction Act tax credits

## & big MassSave incentives:

**Geothermal cheaper to build  
AND cheaper to operate**

- <https://www.undauntedk12.org/schools-and-the-ira>
- <https://www.irs.gov/credits-and-deductions-under-the-inflation-reduction-act-of-2022>
- <https://www.edweek.org/leadership/schools-can-use-these-little-known-unlimited-funds-to-make-their-buildings-greener/2023/10>
- <https://education.vermont.gov/sites/aoe/files/documents/education-school-construction-aid-tf-ma-public-schools-ditch-boiler-systems-for-geothermal-energy.pdf>

## Douglas Gates LCCA study:

[https://drive.google.com/file/d/1y41\\_8ctZkAh9psoJJ9Es-CkeXyCltgW3/view?usp=share\\_link](https://drive.google.com/file/d/1y41_8ctZkAh9psoJJ9Es-CkeXyCltgW3/view?usp=share_link)

Option	System
1	1. Displacement ventilation diffusers with passive chilled beam cooling/heating radiation 2. Hot water coil heating/chilled water cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls 3. Geothermal wells with high-efficiency water-to-water source heat pump chillers
2	1. Displacement ventilation diffusers with passive chilled beam cooling/heating radiation 2. Gas-fired heating/dx cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls 3. High efficiency gas-fired condensing boiler plant 4. High efficiency air-cooled chiller plant
3	1. Variable refrigerant flow (VRF) terminal evaporator units with air-cooled condensing units 2. Air-cooled dx heat pump heating/cooling 100% O.A. ventilating units with energy recovery with terminal VAV boxes with CO2 controls serving VRF units 3. Air-cooled dx heat pump heating/cooling VAV AHU systems with energy recovery with terminal VAV boxes with CO2 controls serving the cafeteria
4	1. Displacement ventilation diffusers with passive chilled beam cooling/heating radiation 2. Hot water coil heating/chilled water cooling VAV ventilating units with energy recovery with terminal VAV boxes with CO2 controls 3. Geothermal wells with high-efficiency water-to-water source heat pump chillers 4. Supplemental electric boiler plant

GGD Consulting Engineers, Inc.

# Douglas Gates ~ Tight building envelope



Photo 2: Center for EcoTechnology

Field Measured CFM @ 50 Pascals	Square Feet of Building Shell	CFM50/SF
10,403	157,558	0.06
		CFM50/sf
Douglas & Gates		0.06
Passive House Institute United States		<0.06

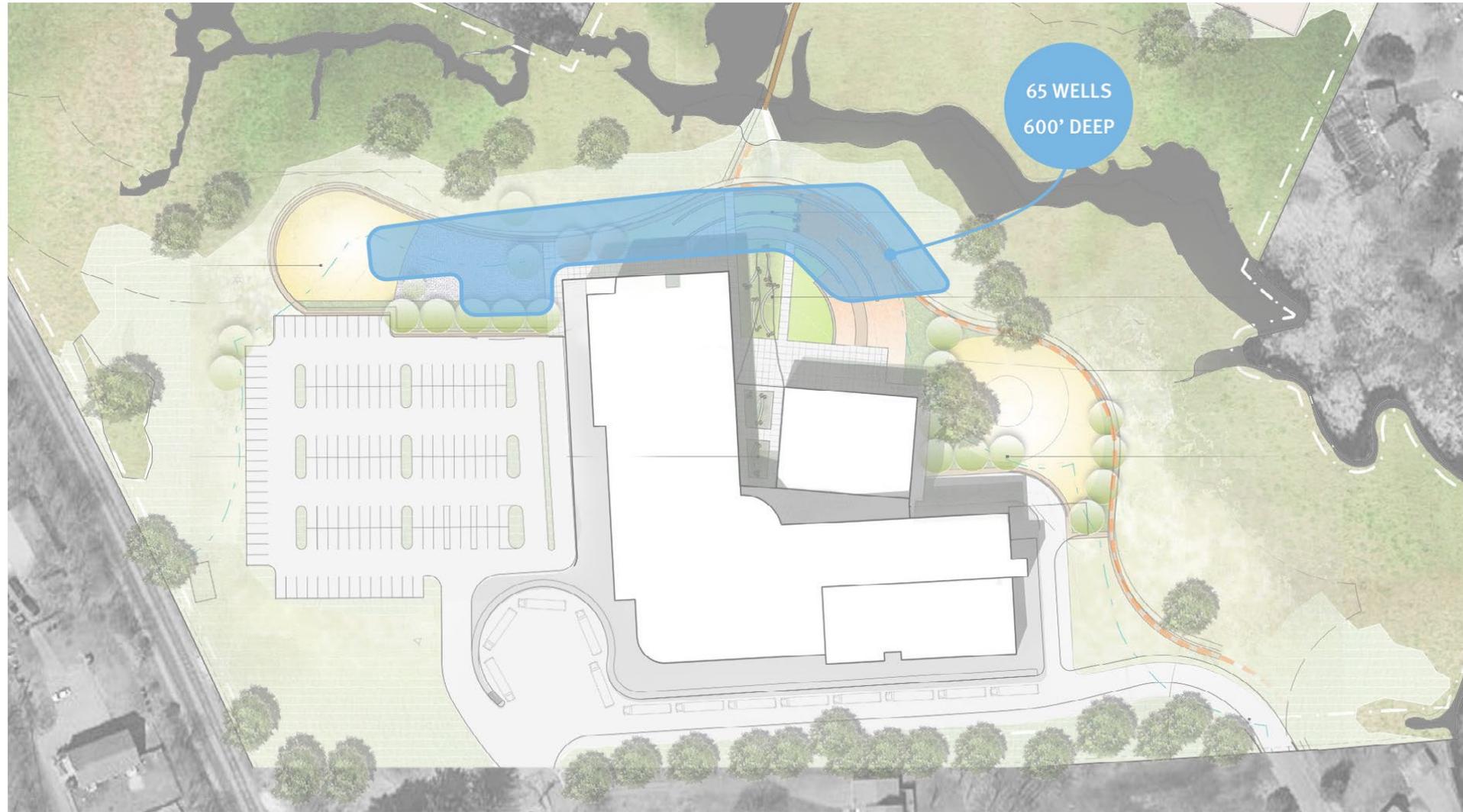
This result indicates that the building's air barrier is meeting the Passive House Standard for air tightness.

Building Envelope Commissioning Field Report - Final Blower Door Test

# Geothermal well field construction

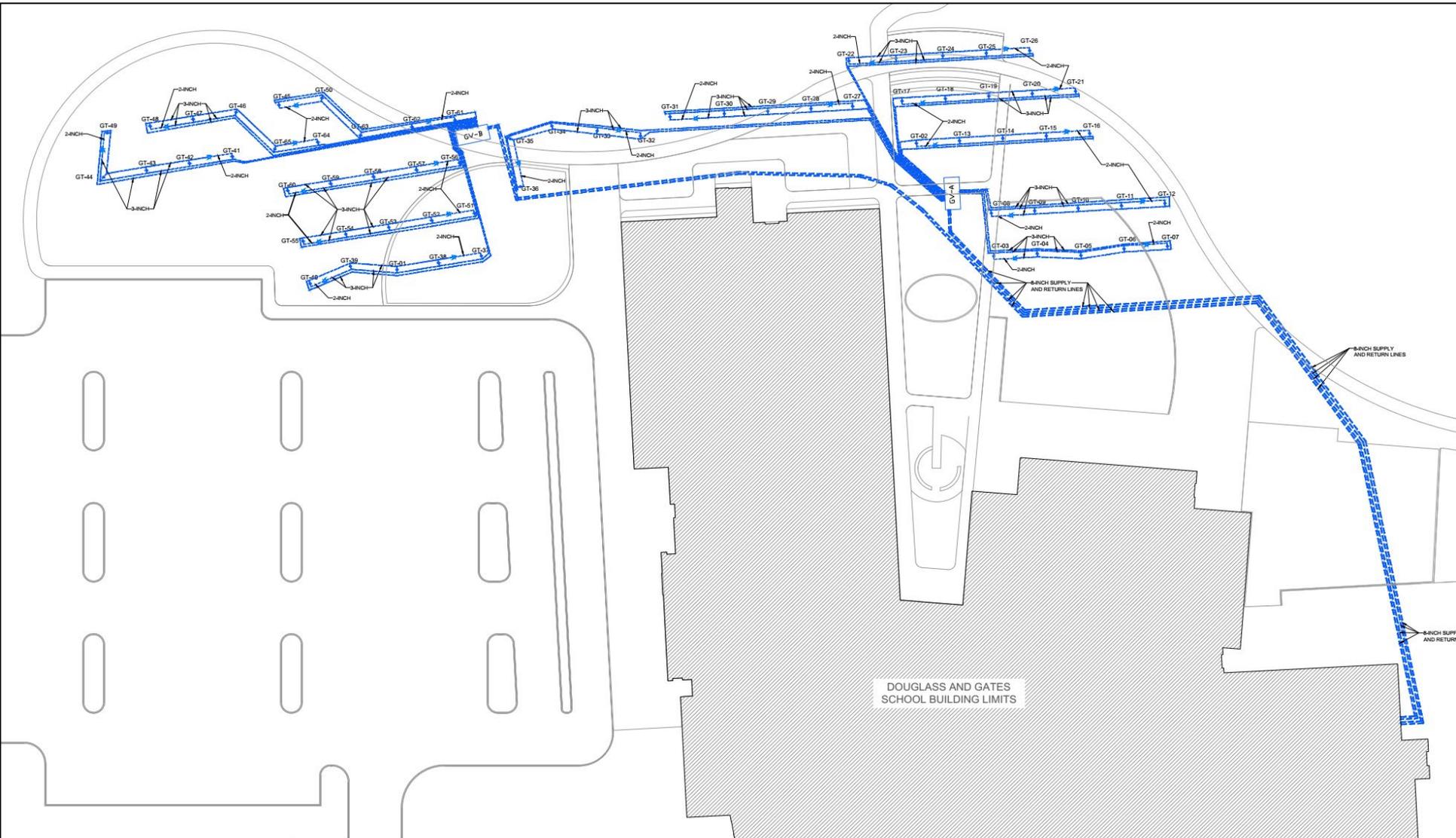


# Geothermal well field overview



**ARROWSTREET**

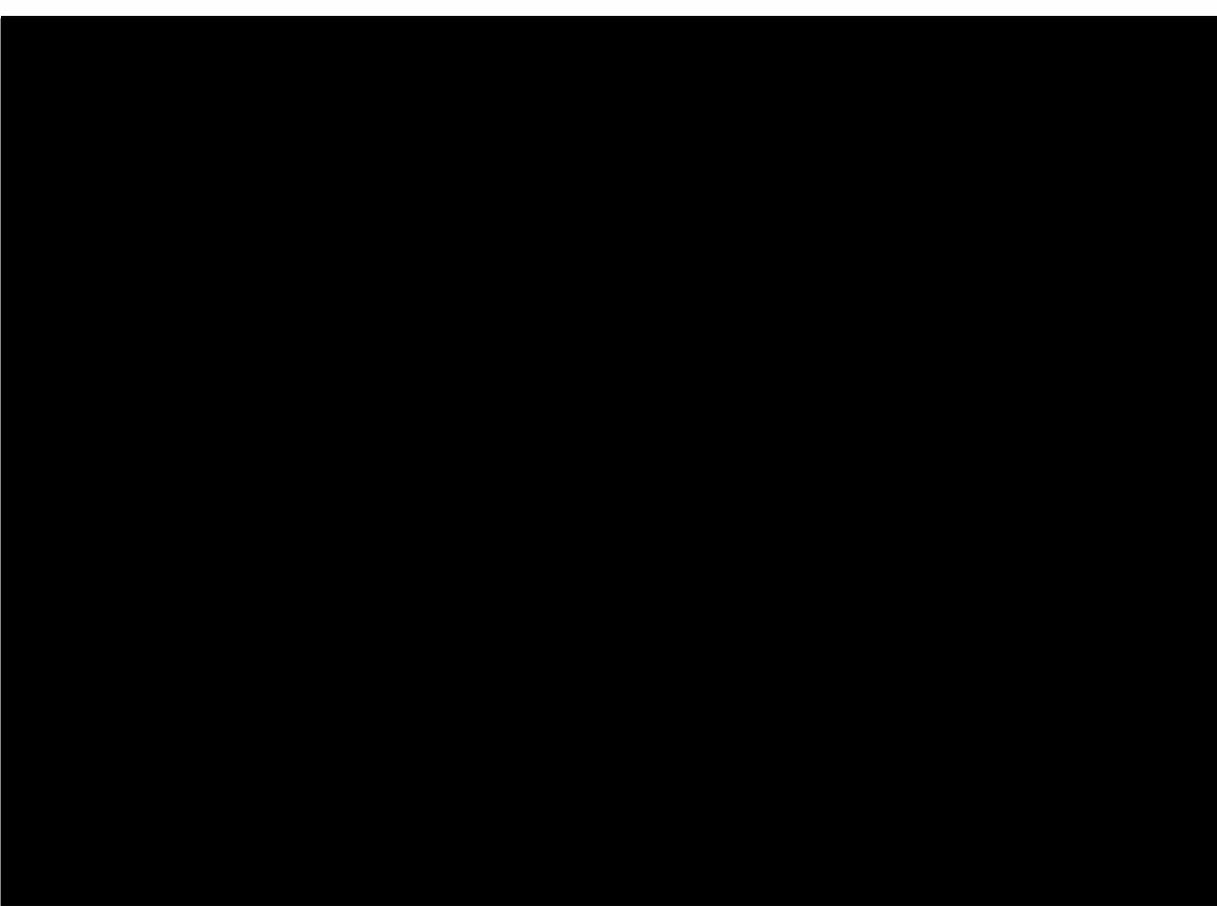
# Geothermal well field as-built



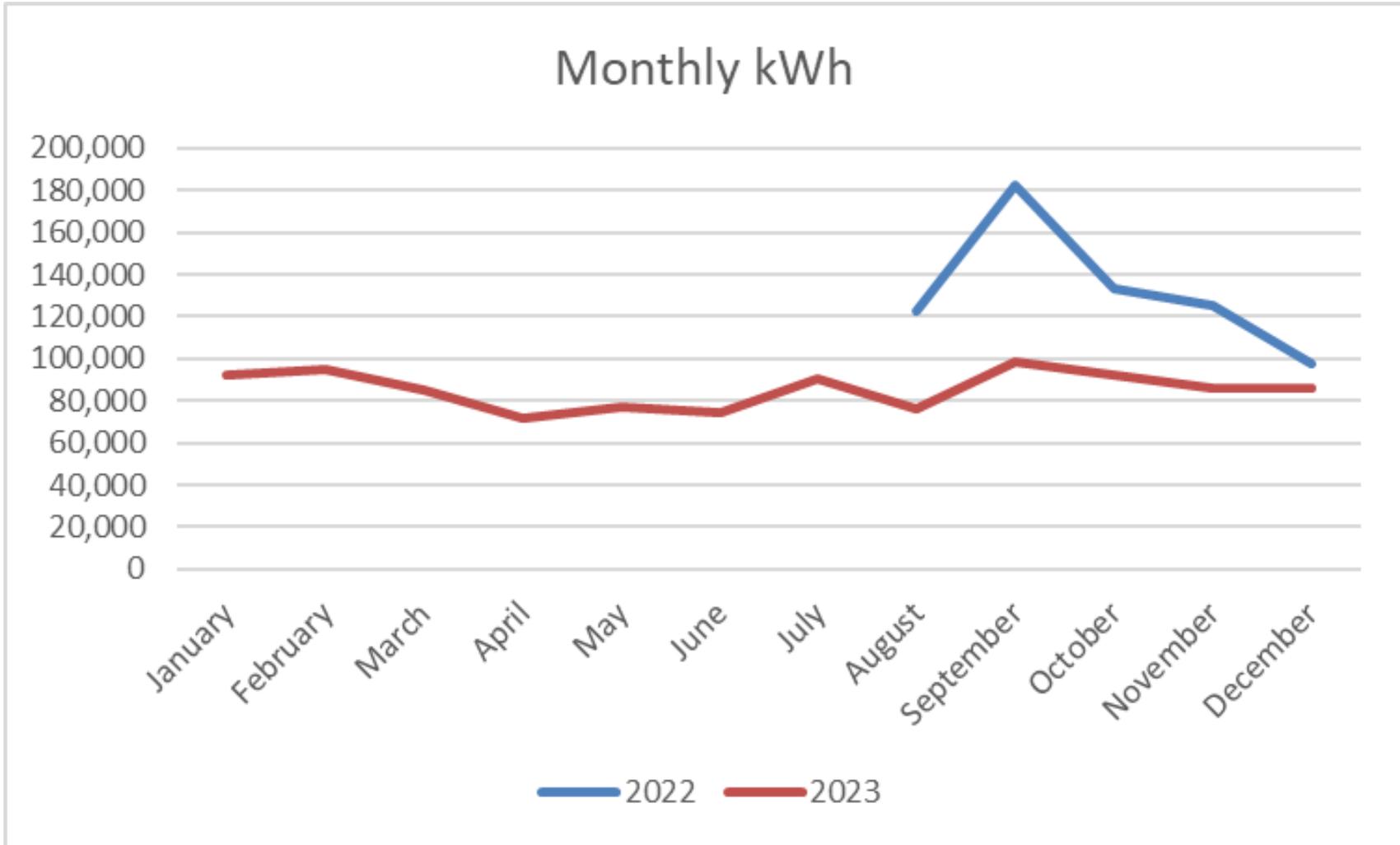
WELL LOCATION AND HORIZONTAL PIPING LAYOUT PLAN

NOTES:  
1. THIS PLAN WAS DEVELOPED USING THE PROVIDED PDF BASE PLAN NAMED "20180101.DWG".

LEGEND:



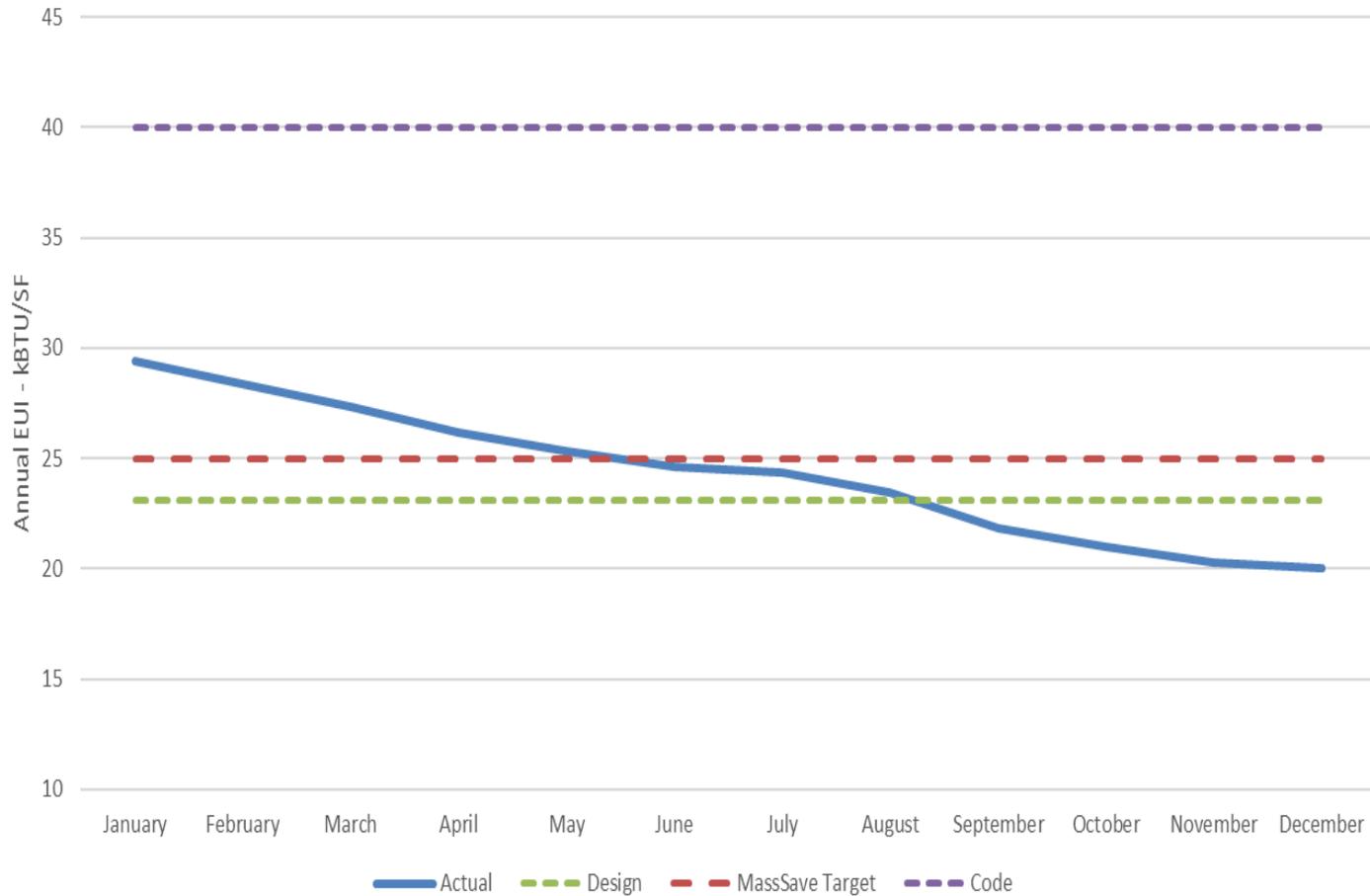
# MONTHLY UTILITY DATA



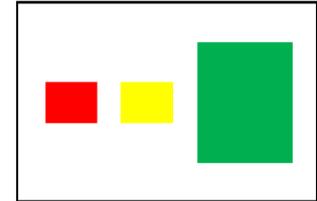


# EUI PERFORMANCE

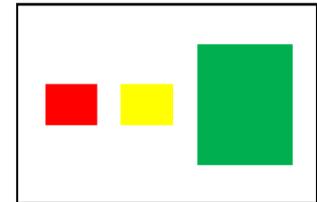
2023 EUI - 12-month Trailing



## Performance



## Trend



● **20% below  
MassSave  
Target**

From geothermal loop >> fluid enters bank of heat pumps in mechanical room.  
**Winter:** Low-Temp Hot Water circulates out to the building via...



...radiant panels

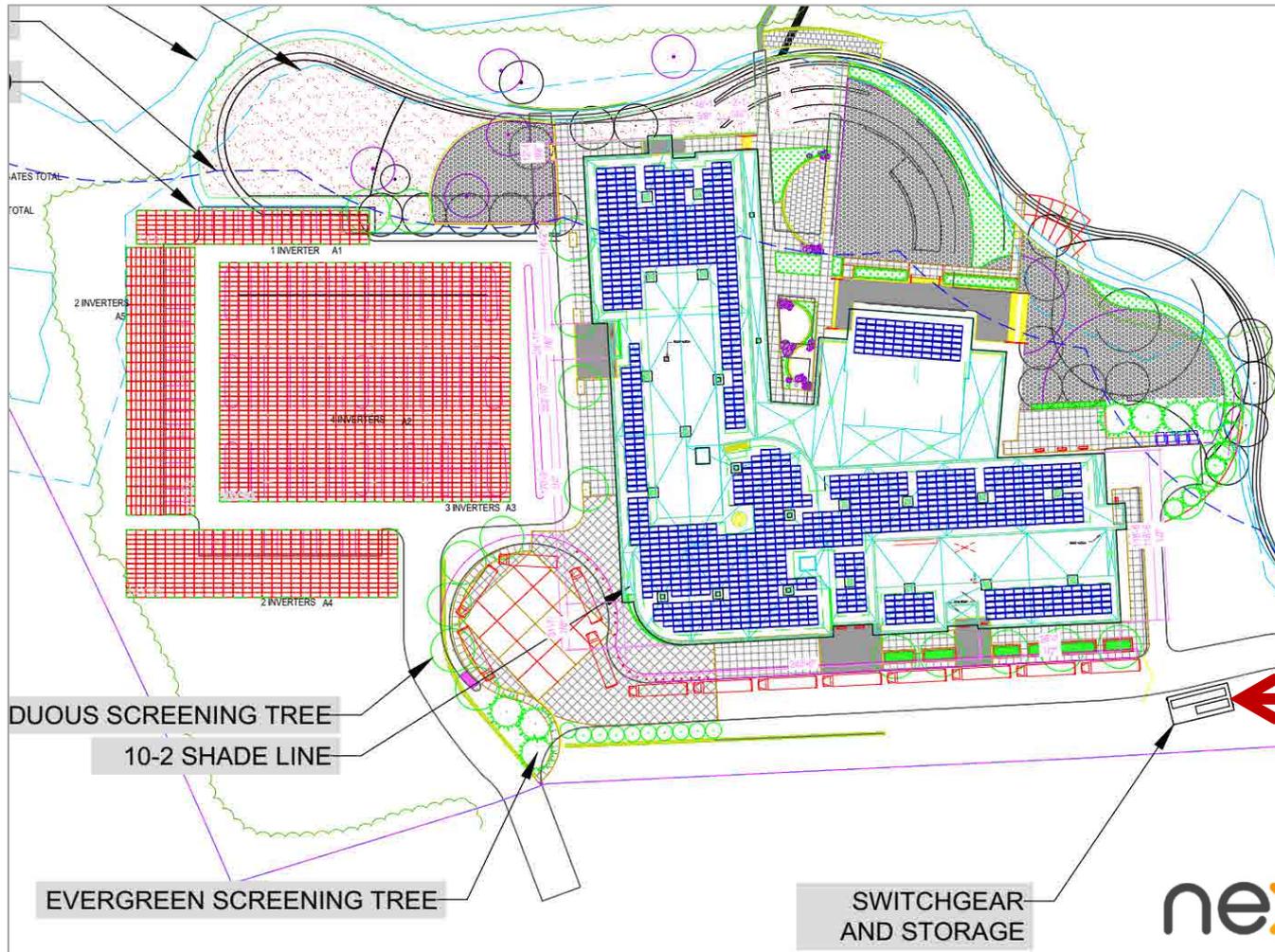
...Roof-Top Units with Energy Recovery Wheels



**Warm weather:** system reverses for efficient cooling  
**Shoulder seasons:** even more efficiencies! (COP 6)

# Douglas Gates ~ Solar + Storage to be installed

- PV solar: 1447 kW DC (2,700 panels)
- Battery storage system (BESS): 1MW/2MWh



# Electricity prices >> more stable, less inflation over time

## Fossil fuel prices are rising far faster than others

Price increases in U.S. from April 2021 to April 2022

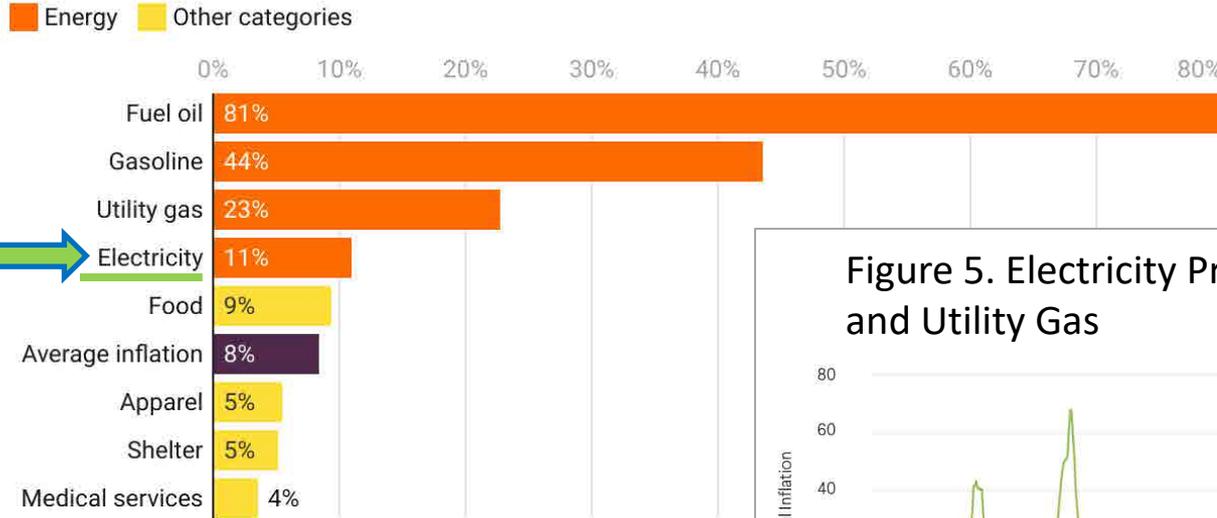


Chart: Canary Media • Source: U.S. Bureau of Labor Statistics

Figure 5. Electricity Prices Less Volatile Than Gasoline and Utility Gas

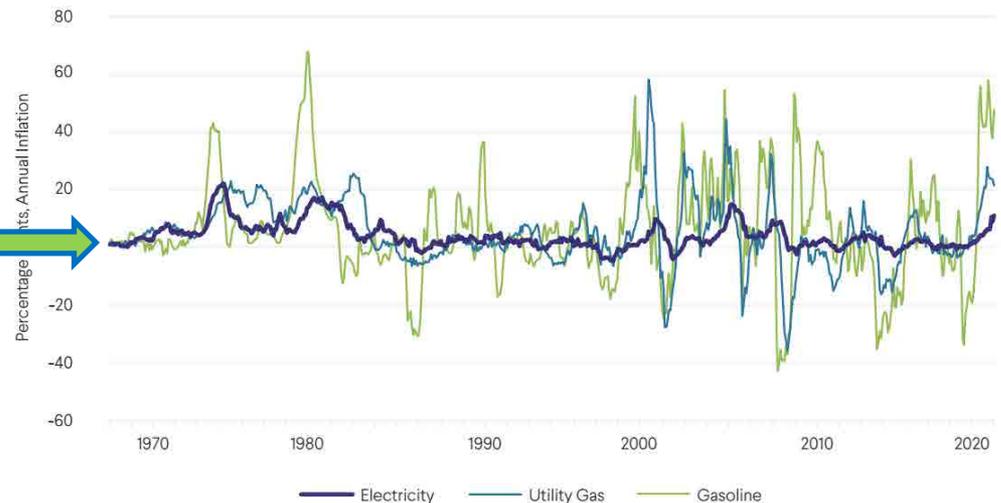


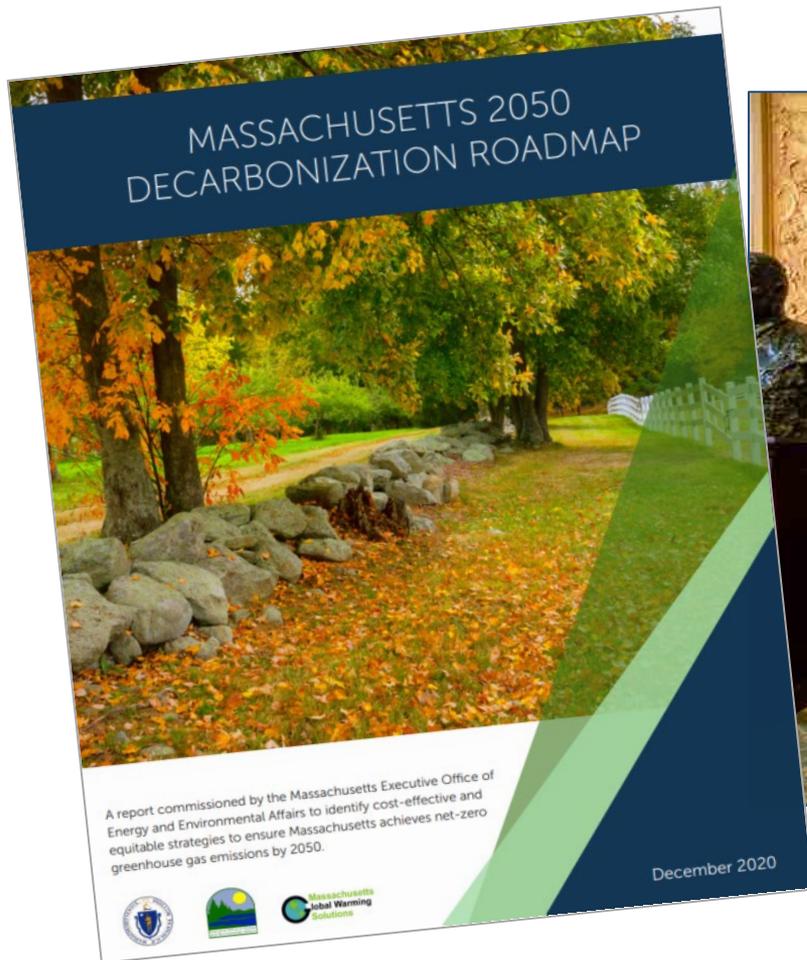
Figure 5 shows the annual rate of inflation of three major consumer energy items (gasoline, utility gas, and electricity service) from 1968 to the present. Gasoline (and utility gas to a lesser extent) prices historically experience large increases and decreases, while electricity service has never had such extreme price volatility. Source: US Bureau of Labor Statistics (2021b), authors' analysis.

<https://www.canarymedia.com/articles/fossil-fuels/chart-fossil-fuels-are-a-big-driver-of-inflation>

<https://rooseveltinstitute.org/publications/energy-price-stability/>

# MA climate legislation >> low carbon economy

- 2030 emissions: 50% below 1990 baseline
- 2040 emissions: 75% below 1990 baseline
- **2050 emissions: net zero GHG emissions**





Thank you!