Benchmarking Energy Performance: Comparative Analysis of a Laboratory Project with Operated Buildings (TRB)

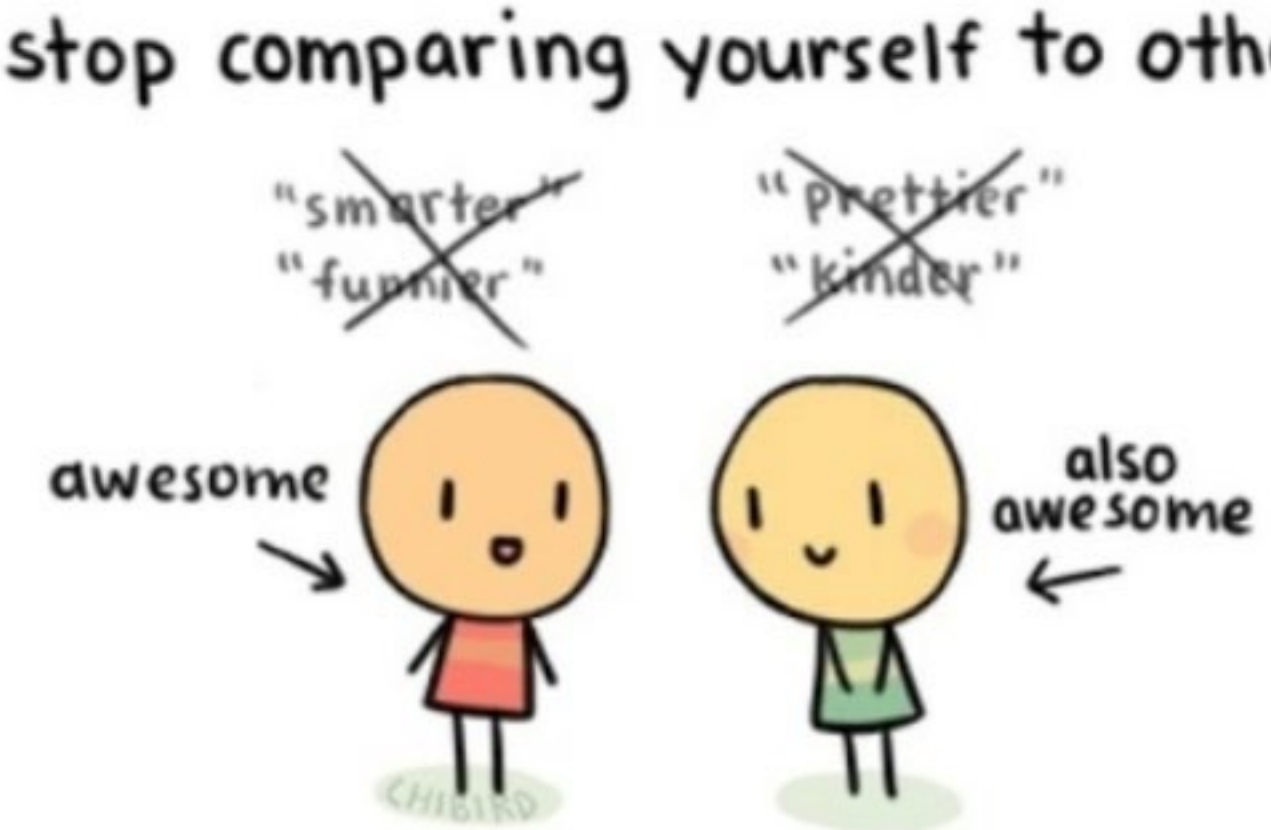
Speakers:
Amy Dean, Lord Aeck Sargent
Masoome Haghani (MaHa), Lord Aeck Sargent

Oct. 21, 2025

Session G1

Comparison is the thief of JOY!

-Theodore Roosevelt



EXCEPT when Benchmarking…

Learning Objectives

1. Identify challenges in setting energy targets for laboratory buildings with complex programs and high process loads.

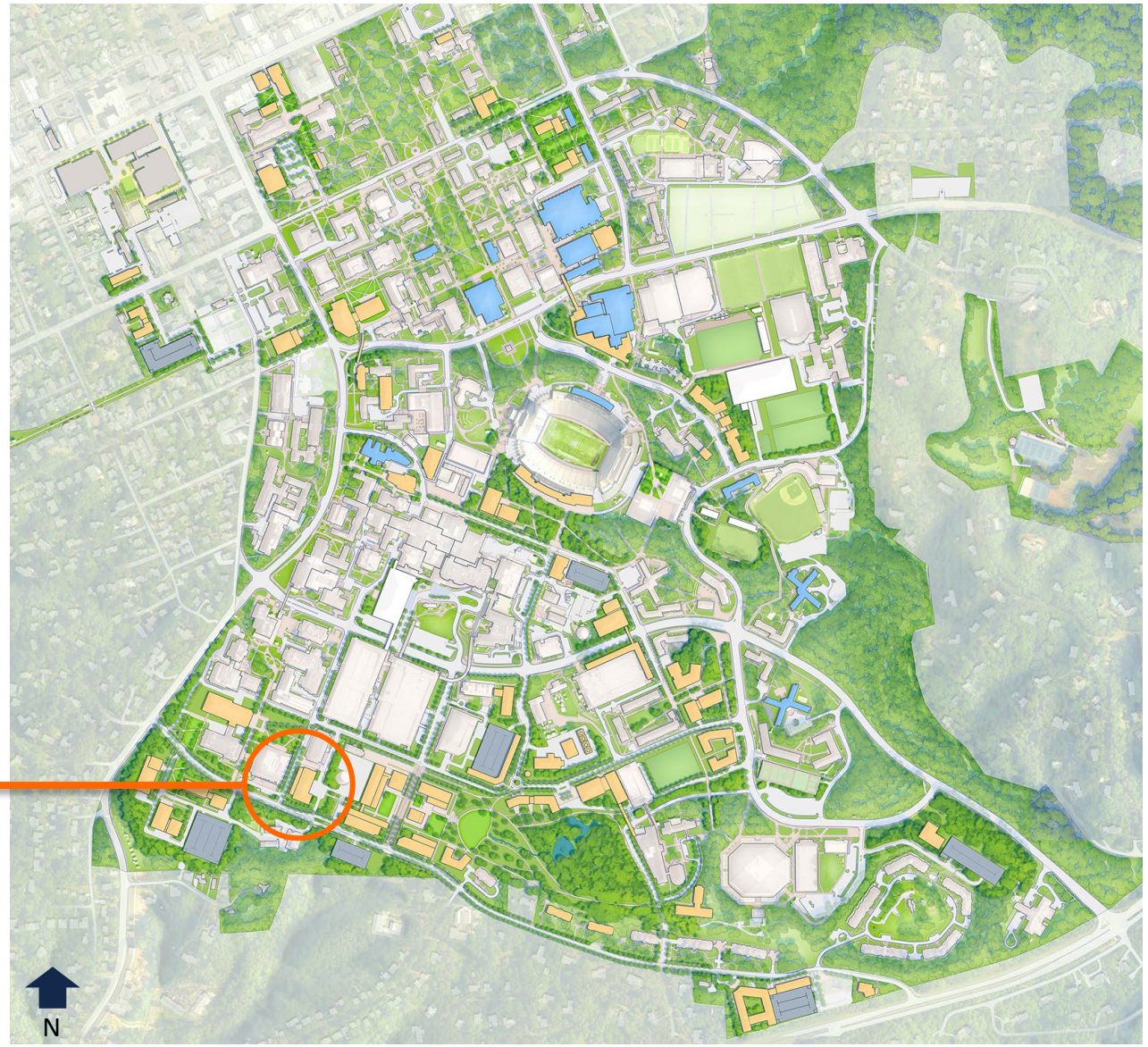
2. Understand the impact of campus-supplied utilities on EUI calculations and benchmarking

3. Learn how analyzing actual energy performance data from existing campus buildings can inform energy targets for new facilities.

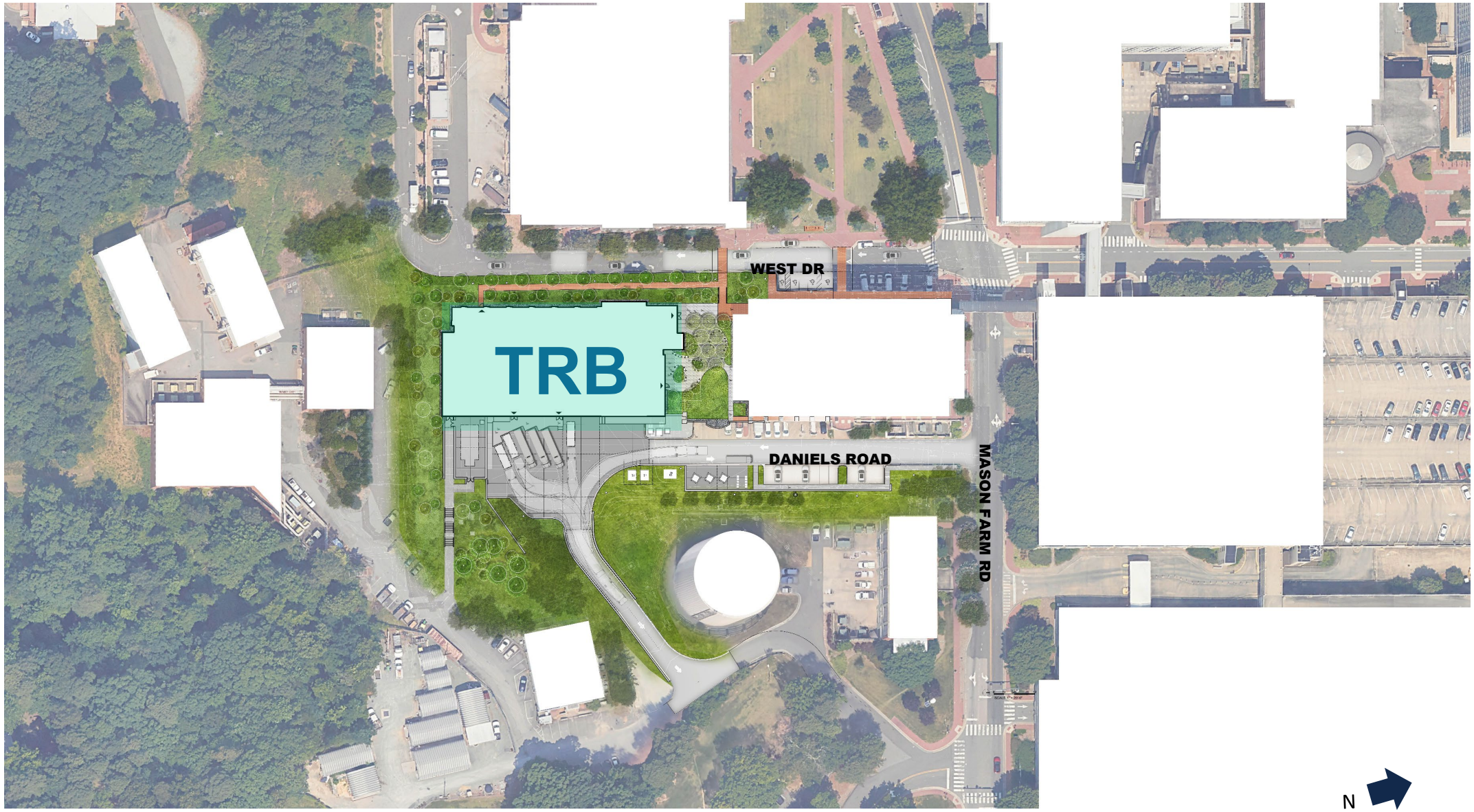
4. Evaluate the effectiveness of industry benchmarking tools versus campus-specific data in establishing realistic energy performance goals.

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Translational Research Building (TRB)



Translational Research Building (TRB)



Translational Research Building (TRB)

UNC | RESEARCH

9th
top-ranked university

in the United States for federal research, totaling $907M annually

$1.55B

sponsored research from all sources annually, making it the 7th largest public US research university in research volume and annual expenditures

*2024 Data

Translational Research Building (TRB)

50%

Assigned Space

UNC | RESEARCH

Division of Comparative Medicine

50%

Assigned Space

UNC | SCHOOL OF MEDICINE

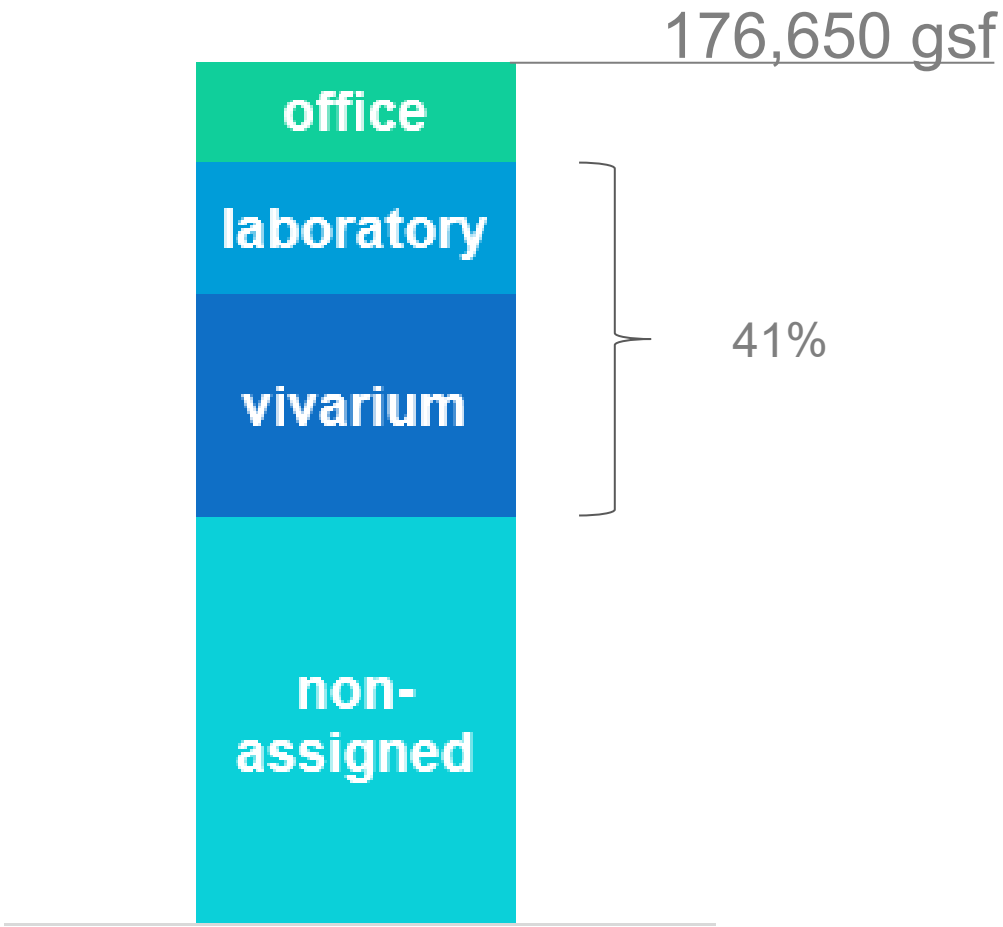
UNC | COLLEGE OF ARTS AND SCIENCES

UNC | ESHELMAN SCHOOL OF PHARMACY

UNC | GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH

Translational Research Building (TRB)

- Biology Labs
- Chemistry Labs
- BSL3 Facility
- Imaging Suite
- Cyclotron Suite
- Vivarium
- Cage Wash
- Offices
- Conference Rooms



WHY BENCHMARK?

EUI Introduction

Energy Use Intensity:

$$\text{EUI} = \frac{\textit{Total annual energy consumption (kBtu)}}{\textit{Total gross floor area } (ft^2)}$$

INITIAL DETAILED INPUT

Basic Filters

Clear | Edit

% Lab Area (Net Lab Area / Total Gross Area)

0.00 to 41.00 %

Building Status

Real Building

Type of Record

In Operation

Climate Zones

3A Warm - Humid

Data Type

Data Type
Estimated

Building Properties

Clear | Edit

Organization Type

Academic: Higher Ed
Government: State Or Local

Predominant Lab Use Types

R&D: Basic Research

Gross Floor Area (sf)

500 to 176500

Total Number of Occupants per sf

0.0000 to 0.0030

Region

North And Central America

Fume Hoods

Clear | Edit

Ducted Fume Hoods per sf of Lab Space

0.0000 to 0.0010

Filtering Fume Hoods per sf of Lab Space

0.000 to 0.000

Linear ft of Fume Hoods per sf of Lab

0.000 to 0.006

Fume Hood Operating Sash Height (inches)

6 to 18

Fume Hood Face Velocity (ft/min)

80 to 99

Predominant Fume Hood Control Type

Variable Volume

Automatic Sash Closers ✖

Hood Face Velocity Setback ✖

Laboratory Occupied Minimum Air Change Rate (ACH)

0.10 to 6.20

Laboratory Unoccupied Minimum Air Change Rate (ACH)

0.10 to 4.10

Source of Lab Minimum Ventilation Rates

Organizational Policy

Building Systems

Clear | Edit

Predominant HVAC System Type

Variable Volume With Reheat

Predominant HVAC Control Type

Direct Digital Control

Exhaust Air Energy Recovery

High-Performance Glycol Run-Around

Predominant Cooling System Type

District Cooling / CHW From Campus Central Plant

Predominant Heating System Type

District Heating / HW Or Steam From Campus Central Pla

Building-level CHP

None

Renewable Energy Generation at Building

None

Geothermal Heat Pump ✖

Heat Recovery Chiller ✖

Low Pressure Drop Design - Air Side ✔

Low Pressure Drop Design - Water Side ✖

True VAV Exhaust (No Bypass Air) ✖

High-Efficiency ULT Freezers ✖

Cascade Air Use ✖

Water-Cooled Lab Equipment ✖

Supply Air Temperature Reset ✔

Static Pressure Reset - Supply Air ✔

Static Pressure Reset - Exhaust Air ✖

Unoccupied Airflow Setback In Labs ✖

Unoccupied Temp Setback In Labs ✔

Pump Head Reset ✔

Exhaust Fan - Wind Speed Response ✖

Chemical Sensing And Airflow Response In Labs ✖

Energy and Operational Emissions Benchmarking

By default, all buildings are shown on the charts. Use the filters to narrow down your peer group.

Scatter Plot

loading

Select Quantities to Plot

Horizontal Axis Lab Area — **Units** %

Vertical Axis * Site EUI — **Units** kBtu/sf/yr

Summary Statistics for Selected Peer Group Buildings

No Matching Buildings

TRB Challenge

Laboratory

- BSL3 Suite: 9, 850 nsf
- Cyclotron Suite: 3,100 nsf
- Bio/Chem Labs: 14,250 nsf
- Total: 27,200 nsf (15%)

TRB Challenge

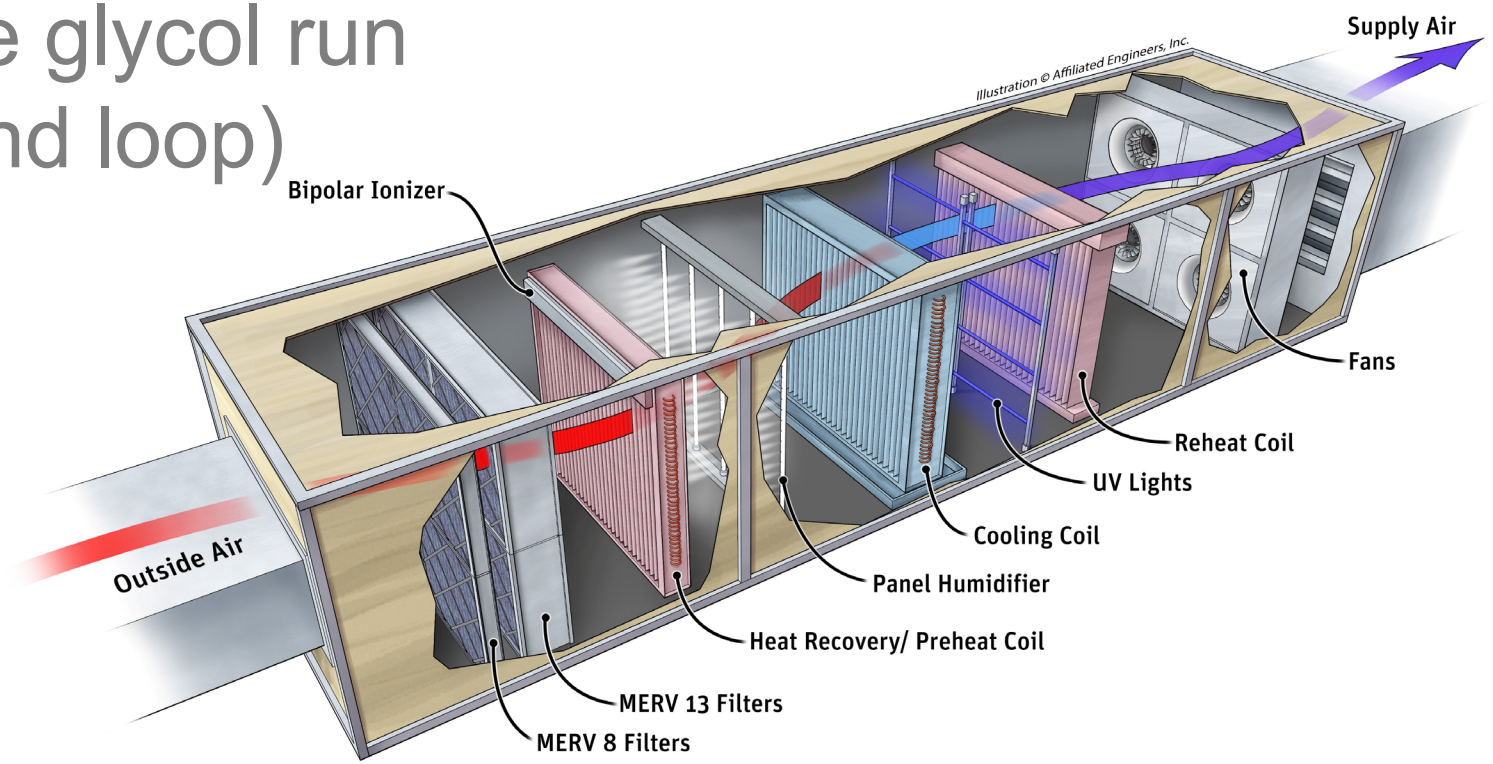
Vivarium

- Cagewash Suite: 5,125 nsf
- Vivarium: 40,500 nsf
- Total: 45,600 nsf (26%)

TRB Challenge

HVAC attributes

- High performance glycol run around (run around loop)



Courtesy of Affiliated Engineers

INITIAL DETAILED INPUT

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% Lab Area (Net Lab Area / Total Gross Area)

0.00 to 41.00 %

Building Status

Real Building

Type of Record

In Operation

Climate Zones

3A Warm - Humid

Data Type

Data Type Estimated

Building Properties

Clear | Edit

Organization Type

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High-Efficiency ULT Freezers✖

Cascade Air Use✖

Water-Cooled Lab Equipment✖

Supply Air Temperature Reset✔

Static Pressure Reset - Supply Air✔

Static Pressure Reset - Exhaust Air✖

Unoccupied Airflow Setback In Labs✖

Unoccupied Temp Setback In Labs✔

Pump Head Reset✔

Exhaust Fan - Wind Speed Response✖

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Vertical Axis * Site EUI — **Units** kBtu/sf/yr

Summary Statistics for Selected Peer Group Buildings

No Matching Buildings

TRB Challenge

I2SL's Laboratory Benchmarking Tool Buildings:

- Met all criteria of TRB: **0**
- BSL3 lab: **2**
- High performance glycol run around: **0**

LABS2ZERO ENERGY SCORE

Alison Farmer, I2SL

This presentation will review the latest demographics of the LBT's database, and will outline some areas where the new data has helped to close gaps that were present when the pilot Energy Score was formulated.

- Attendees will learn about the new, updated scoring formulation, which now includes improved coverage of buildings with significant vivarium space, high fume hood density, and cold climates.

- Speaker will explain which buildings will experience the biggest changes in their Energy Scores due to these updates, and will highlight the building types for which additional data collection is still needed.

- The presentation will include details of the rollout plan for the new Energy Score, and for the new version of the Operational Emissions Score, which uses the same methodology and will be updated at the same time.

“Plans are worthless, but planning is everything.”

- Dwight D. Eisenhower

Plan B…

COMPARABLE UNC BUILDINGS

Building 1
BUILT: 2014

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✓
IMAGING SUITE	✓
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✗

Building 2
COMPREHENSIVE RENOVATION: 2019

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✗
IMAGING SUITE	✗
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✓

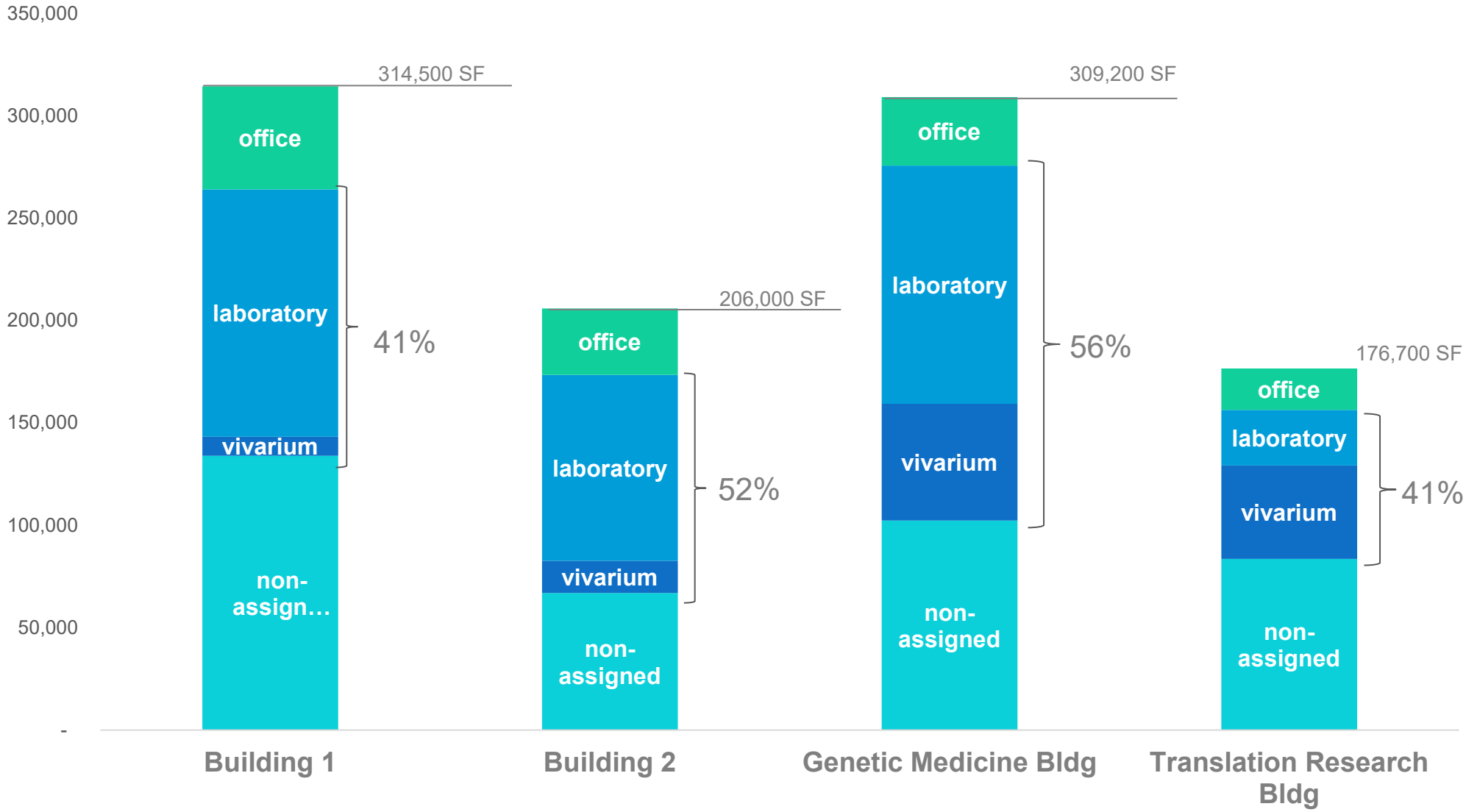
Building 3
BUILT: 2008

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✗
IMAGING SUITE	✗
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✗

TRANSLATIONAL RESEARCH BUILDING
UNBUILT

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✓
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✓
IMAGING SUITE	✓
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✓

BUILDING USE BY AREA

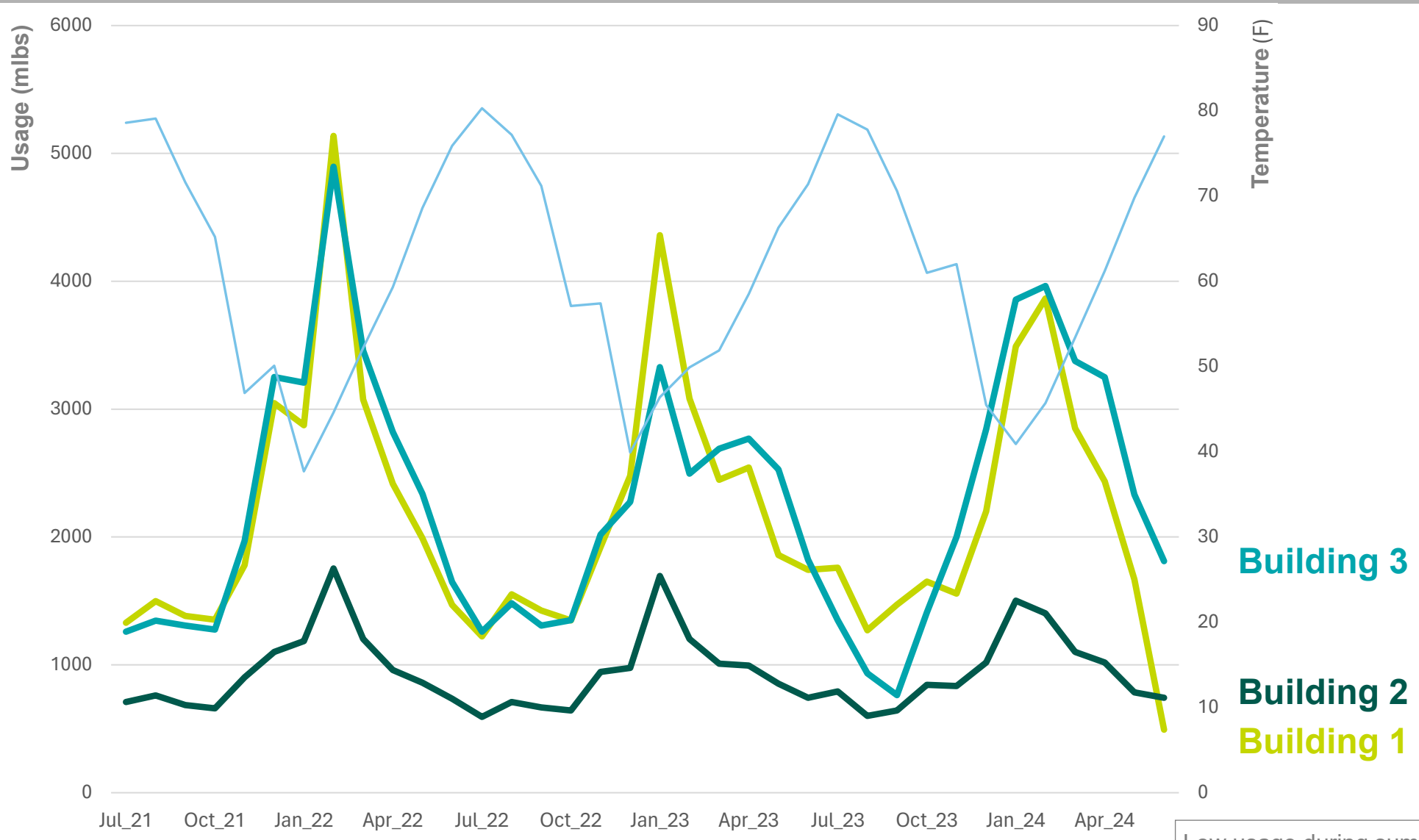


UNC ENERGY DATA

Utility Historical Report Account:01012221 StartBilling Month:Jul-2021 EndBilling Month:Jun-2024

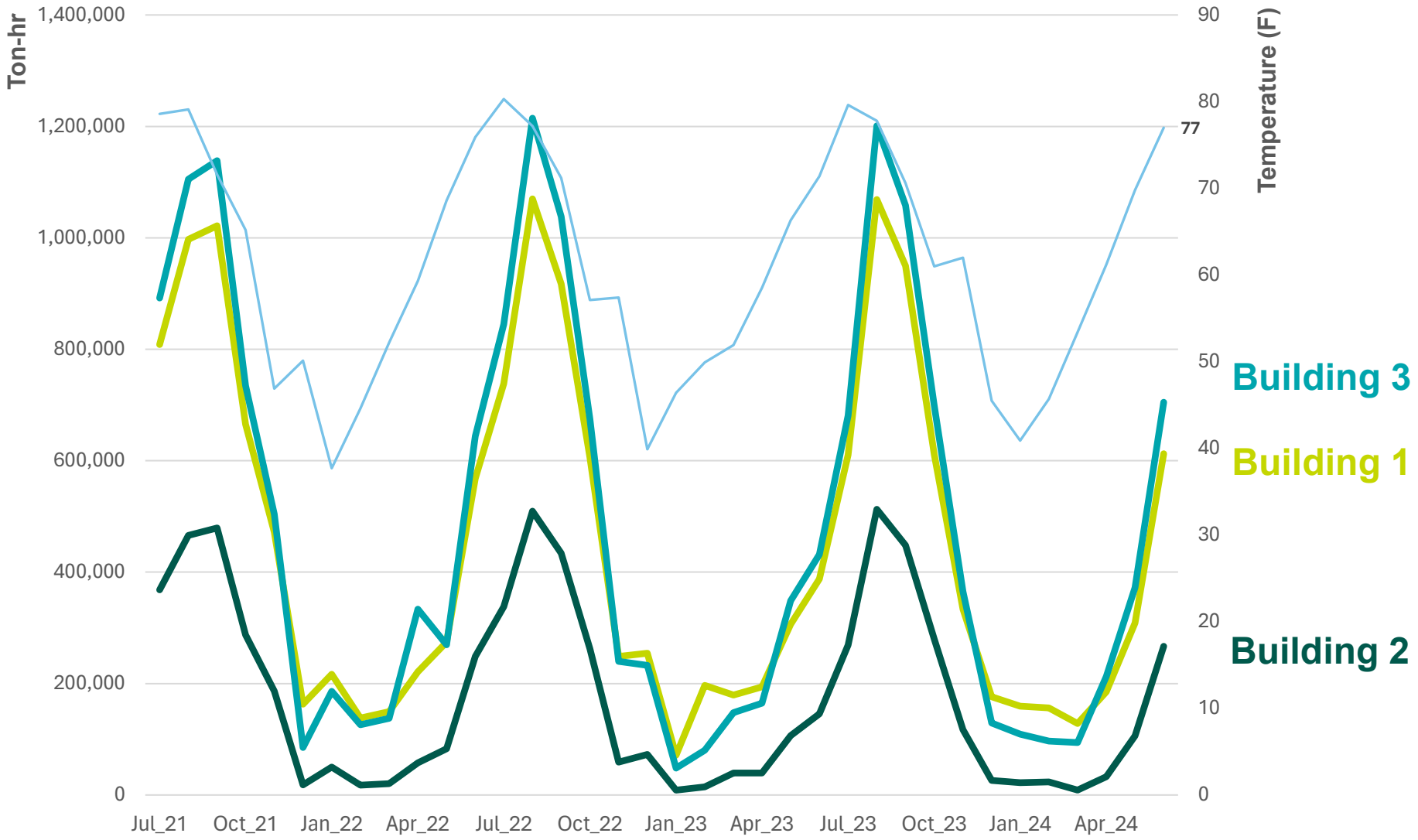
Bill Month	Service Ty	Name	SU #	Description	Meter	Service Subtype	Start Time	Stop Time	Metered Units	% Alloc	Units Billed	Usage $$$ Billed
Utility Historical Report Account:01001991 StartBilling Month:Jul-2021 EndBilling Month:Jun-2024												
Bill Month	Service Ty	Name	SU #	Descriptio	Meter	Service Su	Start Time	Stop Time	Metered U	% Alloc	Units Billed	Usage $$$ Billed
Jul-21	CW		360	Actual Cor	11-0807	CW	6/1/2021	7/1/2021	808240	100	808240	$71,448.42
Aug-21	CW		360	Actual Cor	11-0807	CW	7/1/2021	8/1/2021	997406	100	997406	$88,170.69
Sep-21	CW		360	Actual Cor	11-0807	CW	8/1/2021	9/1/2021	1021740	100	1021740	$90,321.82
Oct-21	CW		360	Actual Cor	11-0807	CW	9/1/2021	10/1/2021	665471	100	665471	$58,827.64
Nov-21	CW		360	Actual Cor	11-0807	CW	10/1/2021	11/1/2021	471886	100	471886	$41,714.72
Dec-21	CW		360	Actual Cor	11-0807	CW	11/1/2021	12/1/2021	163016	100	163016	$14,410.61
Jan-22	CW		360	Actual Cor	11-0807	CW	12/1/2021	1/1/2022	216888	100	216888	$19,172.90
Feb-22	CW		360	Actual Cor	11-0807	CW	1/1/2022	2/1/2022	138055	100	138055	$12,204.06
Mar-22	CW		360	Actual Cor	11-0807	CW						
Apr-22	CW		360	Actual Cor	11-0807	CW						
May-22	CW		360	Actual Cor	11-0807	CW						
Jun-22	CW		360	Actual Cor	11-0807	CW						
Sep-21	CW		359	Actual Cor	06-0204	CW	7/31/2021	8/31/2021	1138688	100	1138688	##########
Oct-21	CW		359	Actual Cor	06-0204	CW	8/31/2021	9/30/2021	734512	100	734512	$64,930.86
Nov-21	CW		359	Actual Cor	06-0204	CW	9/30/2021	10/31/2021	503920	100	503920	$44,546.53
Dec-21	CW		359	Actual Cor	06-0204	CW	10/31/2021	11/30/2021	85264	100	85264	$7,537.34
Jan-22	CW		359	Actual Cor	06-0204	CW	11/30/2021	12/31/2021	186256	100	186256	$16,465.03
Feb-22	CW		359	Actual Cor	06-0204	CW	12/31/2021	1/31/2022	126216	100	126216	$11,157.49
Mar-22	CW		359	Actual Cor	06-0204	CW	2/1/2022	3/1/2022	137465	100	137465	$12,151.91
Apr-22	CW		359	Actual Cor	06-0204	CW	3/1/2022	3/31/2022	333384	100	333384	$29,471.15
May-22	CW		359	Actual Cor	06-0204	CW	3/31/2022	4/30/2022	269784	100	269784	$23,848.91
Jun-22	CW		359	Actual Cor	06-0204	CW	4/30/2022	5/31/2022	644168	100	644168	$56,944.45
Jul-22	CW		359	Actual Cor	06-0204	CW	5/31/2022	6/30/2022	844728	100	844728	$85,486.47
Aug-22	CW		359	Actual Cor	06-0204	CW	6/30/2022	7/31/2022	1214744	100	1214744	##########
Sep-21	CW		231	Actual Cor	Apr-96	CW	7/3					
Oct-21	CW		231	Actual Cor	Apr-96	CW	8/3					
Nov-21	CW		231	Actual Cor	Apr-96	CW	9/3					
Dec-21	CW		231	Actual Cor	Apr-96	CW	10/3					
Jan-22	CW		231	Actual Cor	Apr-96	CW	11/30/2021	12/31/2021	50002	100	50002	$4,420.18
Feb-22	CW		231	Actual Cor	Apr-96	CW	12/31/2021	1/28/2022	17747	100	17747	$1,568.83
Mar-22	CW		231	Actual Cor	Apr-96	CW	1/28/2022	2/23/2022	20560	100	20560	$1,817.50
Apr-22	CW		231	Actual Cor	Apr-96	CW	2/23/2022	3/31/2022	57718	100	57718	$5,102.27
May-22	CW		231	Actual Cor	Apr-96	CW	3/31/2022	4/30/2022	83086	100	83086	$7,344.80
Jun-22	CW		231	Actual Cor	Apr-96	CW	4/30/2022	5/31/2022	248535	100	248535	$21,970.49
Jul-22	CW		231	Actual Cor	Apr-96	CW	5/31/2022	6/30/2022	338104	100	338104	$34,216.12

LOW PRESSURE STEAM



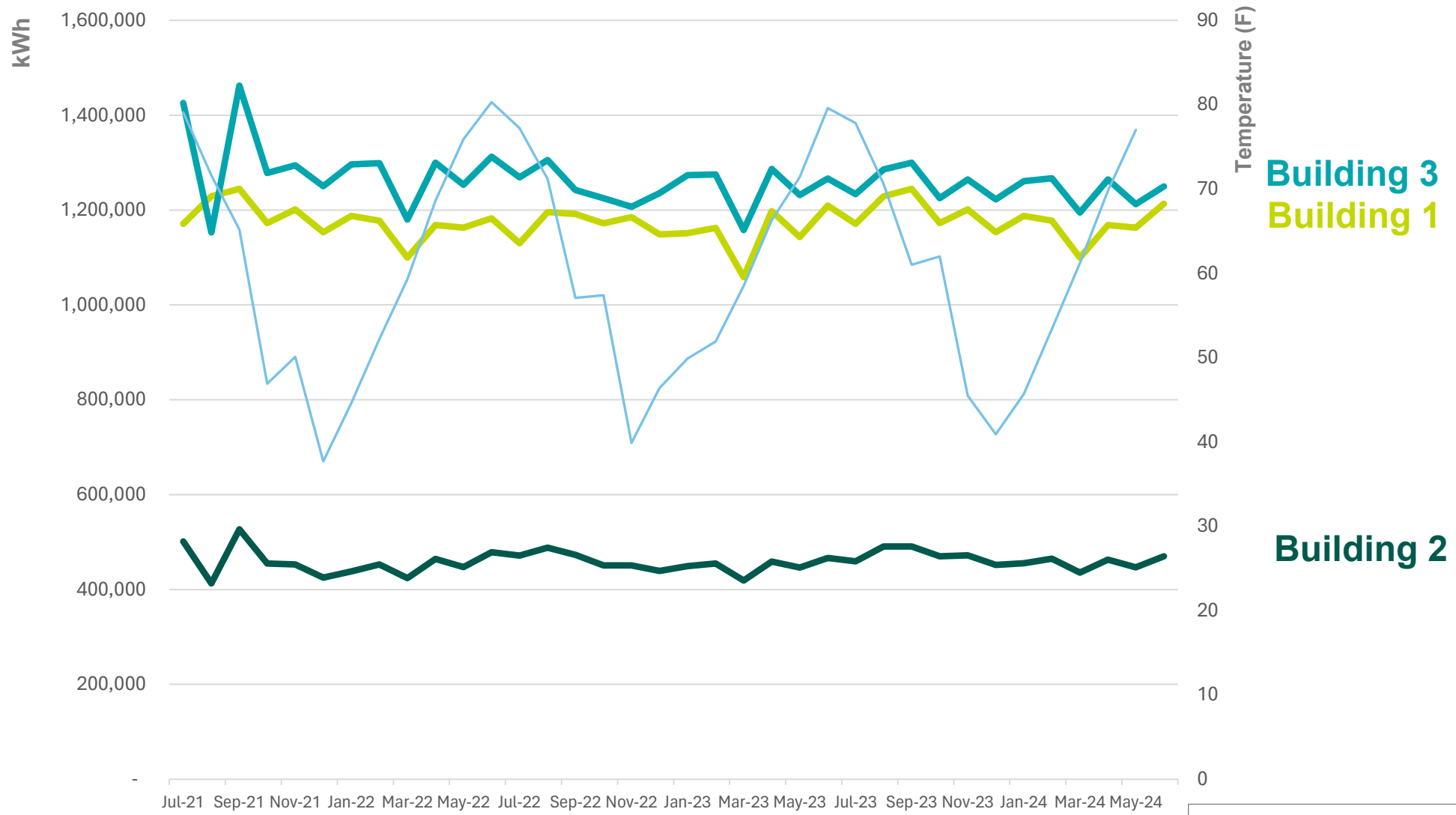
Low usage during summer months

CHILLED WATER



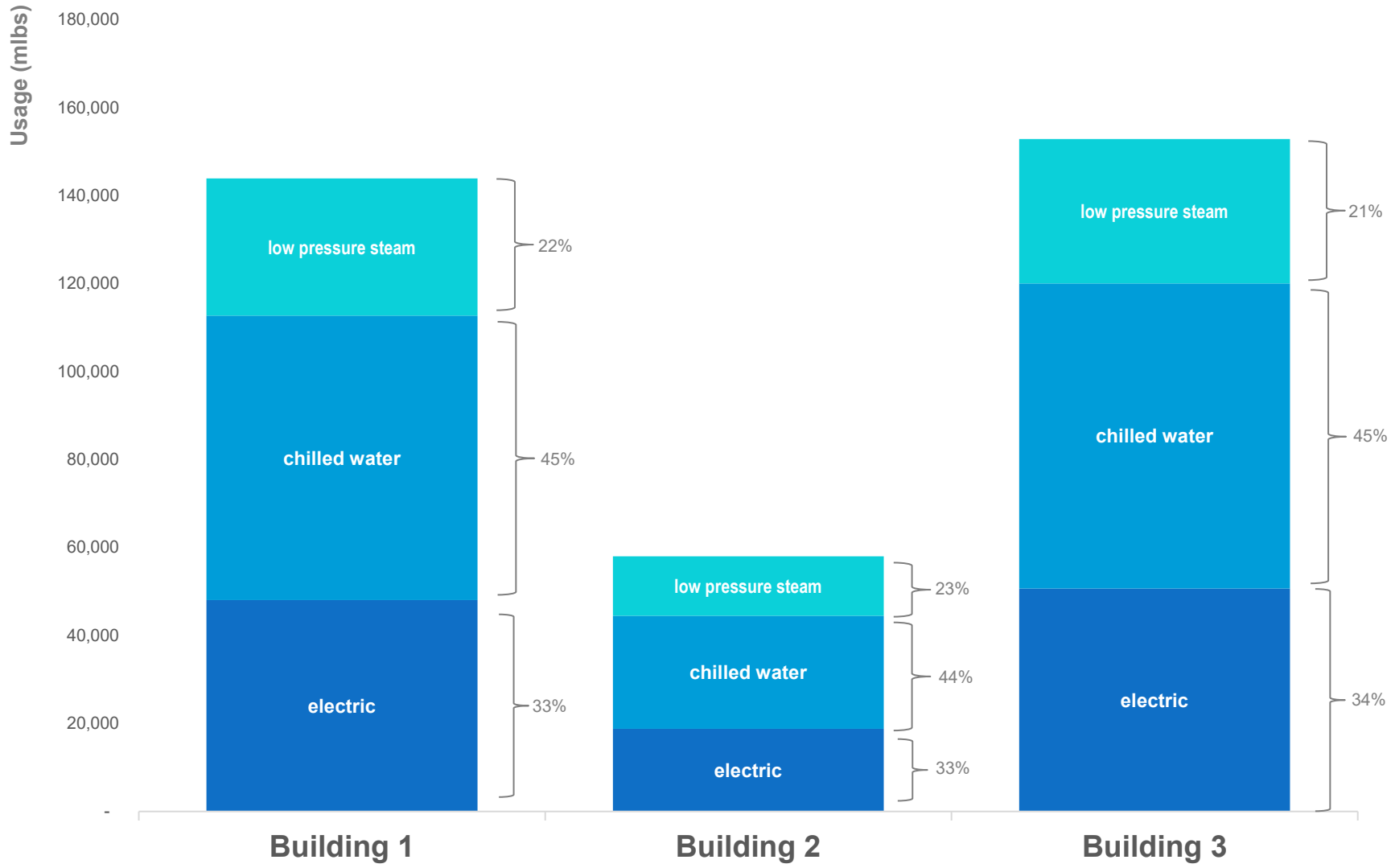
low usage during winter months

ELECTRICITY

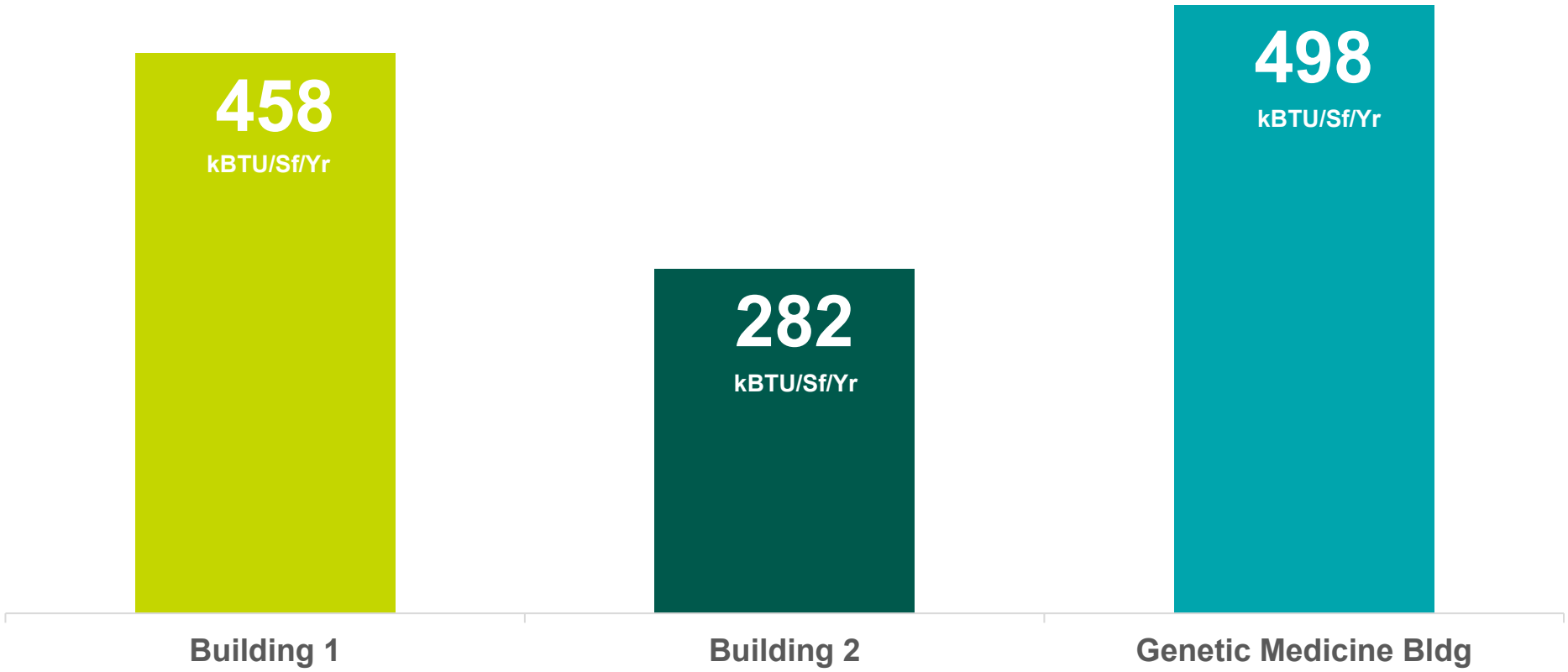


Usage consistent across all months

ENERGY CONSUMPTION



ENERGY USE INTENSITY



ENERGY USE INTENSITY TARGET

458 kBtu/sf/yr

Building 1
BUILT: 2015

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✓
IMAGING SUITE	✓
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✗

Building 2
BUILT: 1945
COMPREHENSIVE RENOVATION: 2019

PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✗
IMAGING SUITE	✗
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✓

Building 3
BUILT: 2008

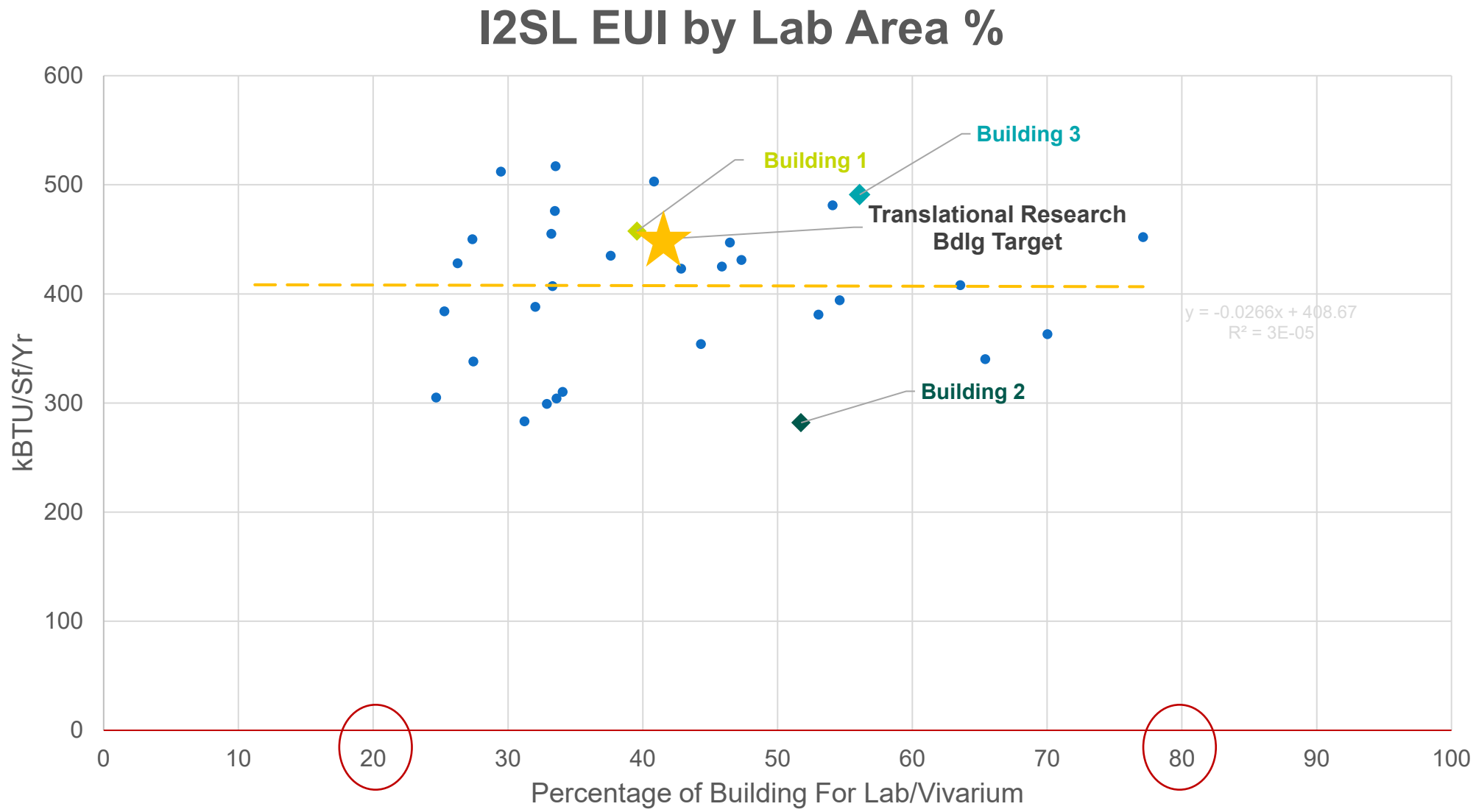
PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✗
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✗
IMAGING SUITE	✗
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✗

TRANSLATIONAL RESEARCH BUILDING

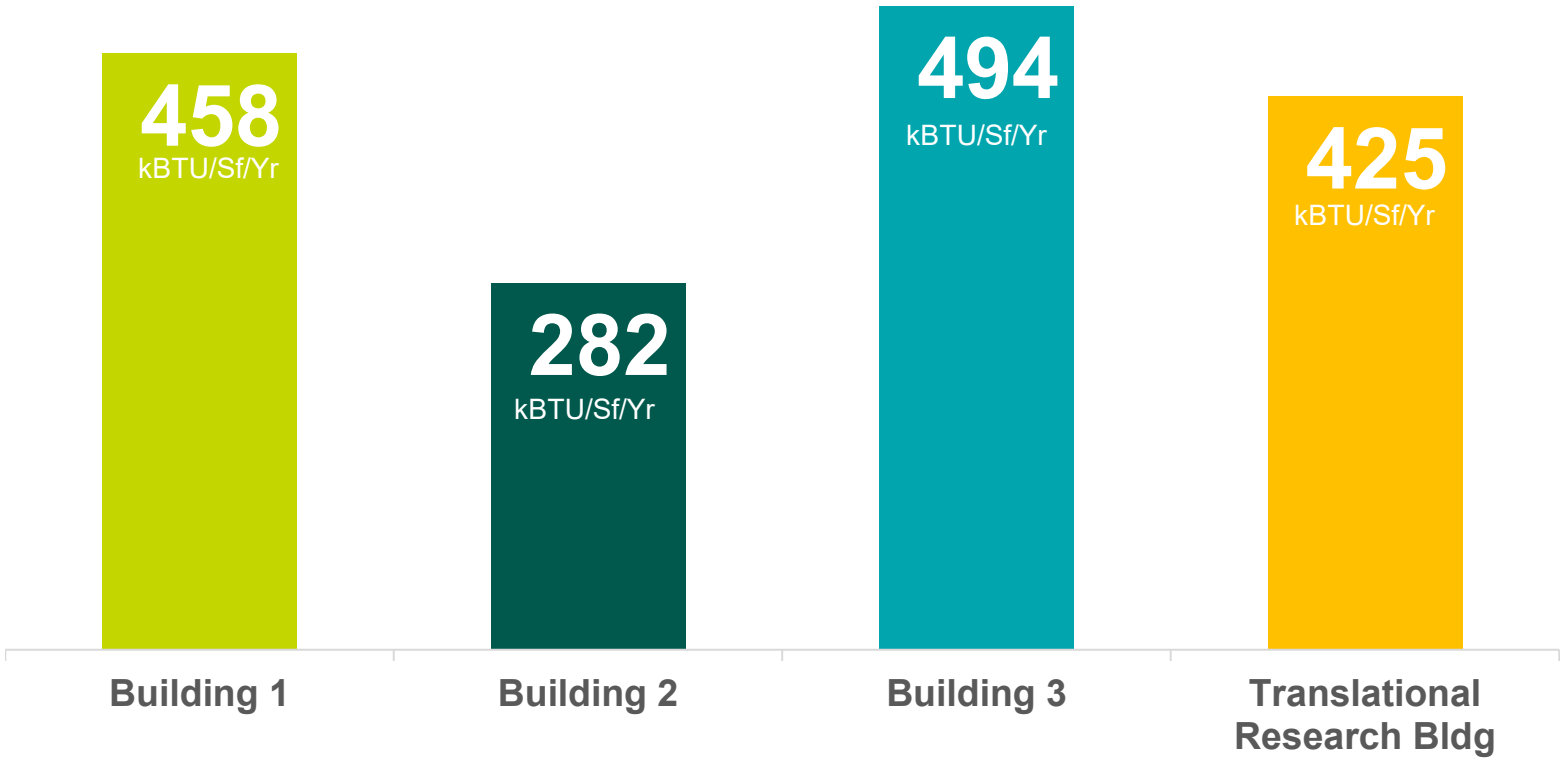
PROGRAM	
BIOLOGY LAB	✓
CHEMISTRY LAB	✓
BSL3	✓
VIVARIUM	✓
CAGEWASH	✓
CYCLOTRON SUITE	✓
IMAGING SUITE	✓
HVAC	
HIGH-PERFORMANCE GLYCOL RUN-AROUND	✓

*Results in annual estimated energy costs for electric, chilled water, low pressure steam ~ $1.1 million at 2023-24 rates

ENERGY TARGET



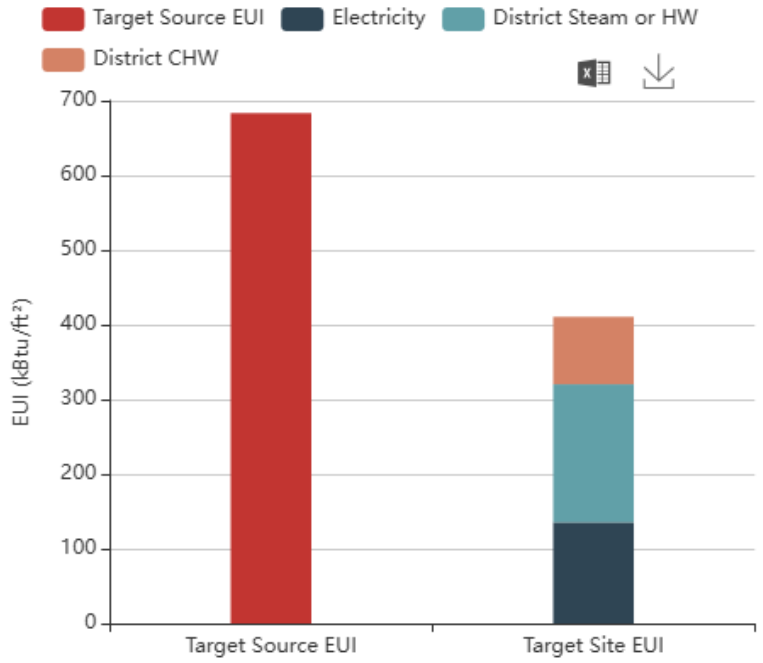
ENERGY USE INTENSITY TARGET



TARGET LABS2ZERO ENERGY SCORE

Target Setter Results

This chart shows the **energy use intensity targets** (Source and Site EUIs) corresponding to your chosen target Pilot Energy Score. The chart is displayed after you click Calculate. Use the Fuel Amounts box below to adjust the fuel mix to match your building.



Target Source EUI: 683 kBtu/ft²
Target Site EUI: 411 kBtu/ft²

Building Information

Please complete all fields.

* **Location**	Chapel Hill, NC, USA
* **Gross Floor Area (sf)**	176650
* **Lab Type**	Bio/Chem Combination
* **Predominant Lab Use Type**	R&D: Basic Research
* **Lab % Area**	41
* **Occupied Hours per Week**	168

* **Fuel Types Used by Building (check all that apply):**

- [x] Electricity
- [ ] Natural Gas
- [x] District Steam or Hot Water
- [x] District Chilled Water

* **Target Labs2Zero Energy Score**	40

Calculate

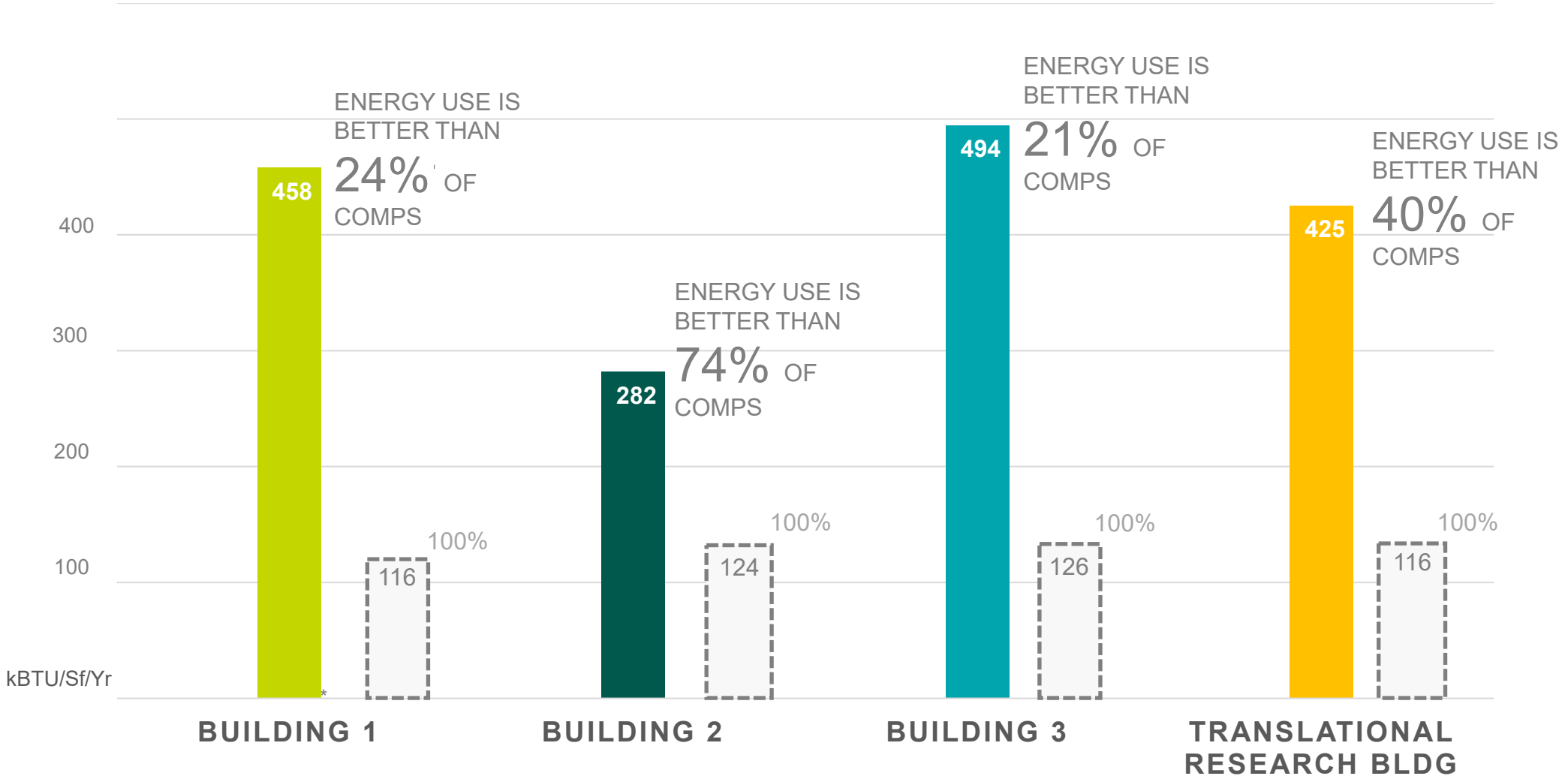
Adjust Individual Fuel Amounts

Adjust the breakdown of fuel types to customize your results then click Update Chart. The default is an even split of Site EUI between fuel types. Because different fuel types have different site to source ratios, your target Site EUI may change if you change your fuel mix for a given target score (but your target Source EUI will stay the same).

Electricity	33	%	7,015,851 kWh
District Steam or HW	45	%	32,643 MMBtu
District CHW	22	%	15,959 MMBtu

Update Chart

TARGET LABS2ZERO ENERGY SCORE



Thank YOU!

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Questions?