

Gaming for a Resilient Future: **Net-Zero Energy Campus**



presenting today



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overview of today



1 - Background

2 - Case Studies

3 - The Game

4 - Discussion

5 - Conclusion

Who **are you?**



Why **are you here?**



- **Expand technical knowledge**
- **To teach others**
- **Climate action plan goal**
- **Only presentation option at this time**
- **Other**

What's **your** institution type?

University
State College
K-12
Hybrid



Current **requirements**



- ✓ Green building certification
- ✓ Life-cycle cost analysis
- ✓ Benchmarking
- ✓ Climate action plan goal
- ✓ Other

Setting the **Stage**

Your Workbook Includes:

Defining Net Zero Energy
Greenhouse Gas Emissions Inventory
Reference Data

- Typical Energy Use
- Emissions Factors
- Building Type Data

Data Collection Worksheet
Resources

Gaming for a Resilient Future: Net-zero Energy Campuses

8:30am-12:00pm, Clipper-Surf Ballroom

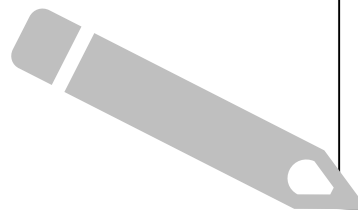
Defining Zero-Energy

- o **Zero Energy Building (ZEB)**: an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
- o **Zero Energy Campus**: an energy-efficiency campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
- o **Zero Energy Portfolio**: same as above, but with portfolio instead of campus.
- o **Zero Energy Community**: same as above, but with community instead of campus.

What about carbon?

Greenhouse gas emissions can be categorized into three buckets, known as Scope 1, 2, and 3 emissions. Emissions factors are available based on the [eGRID](#), a breakdown of utility generation regions in the United States. Data is also available by state. There is some current debate about whether this data is fine grained enough. For some utility networks, like [PJM](#), rates can change by hour, as can emissions factors, depending on the mix of renewable energy and fossil fuel plants in play. A net zero carbon project is different than a net zero energy project, per the ZEB definition presented.

- o **Scope 1**: greenhouse gas emissions from sources that are owned or controlled by the campus entity.
- o **Scope 2**: greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by the campus entity.
- o **Scope 3**: greenhouse gas emissions from sources not owned or directly controlled by the campus entity but related to campus activities. This scope is typically the most difficult to quantify.



Net Zero Energy **and Campuses**

Why?

Mission Alignment

American College and University President's Climate
Commitment

Long-Term Capital and Operations Planning

Opportunities

Utility Providers

Diverse Building Types

Life-Cycle Mindset



Defining **Net Zero Energy**



Zero Energy Building (ZEB)

an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

Zero Energy Campus

an energy-efficiency campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

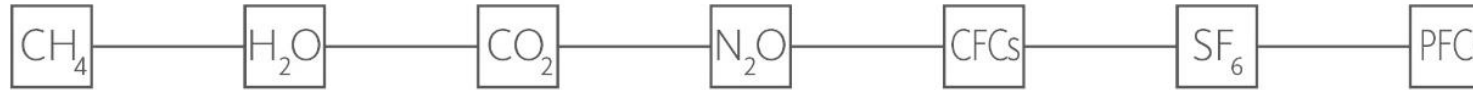
Zero Energy Portfolio

same as above, but with portfolio instead of campus.

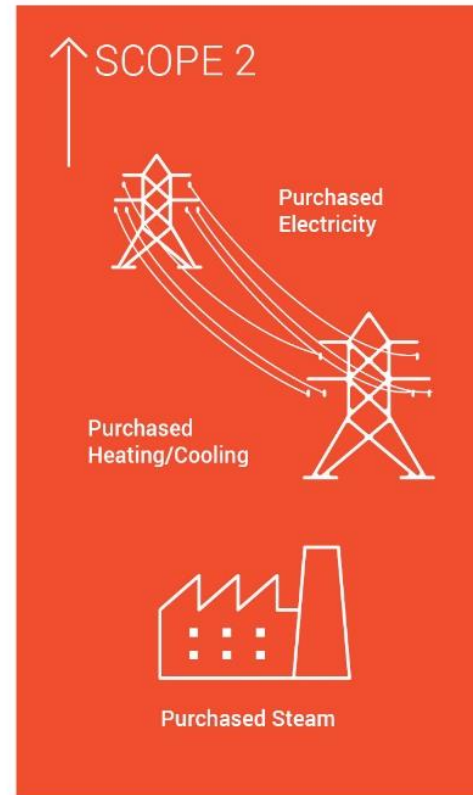
Zero Energy Community:

same as above, but with community instead of campus.

Defining **Net Zero Carbon**



GREENHOUSE GAS EMISSIONS from sources that are owned or controlled by a federal agency.

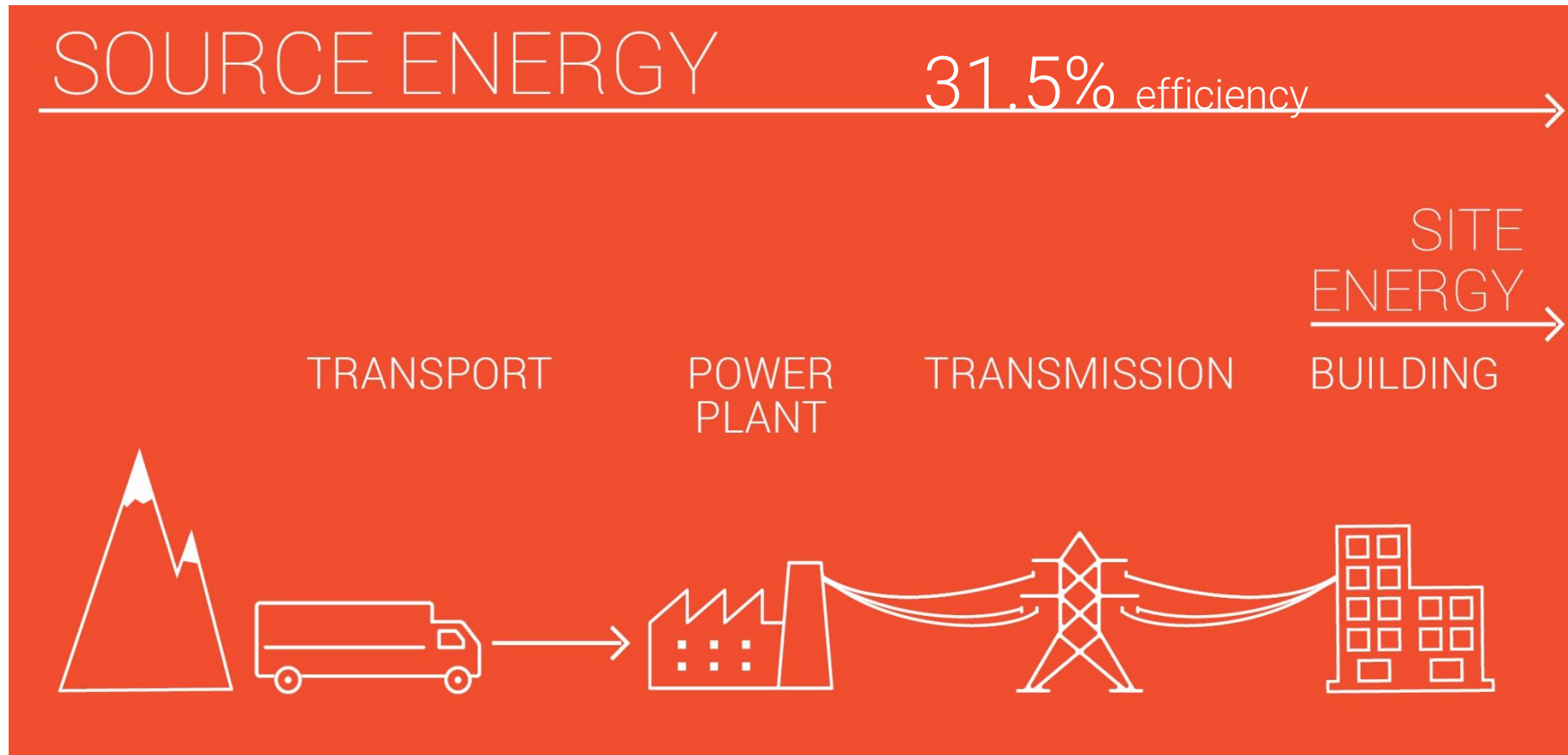


GREENHOUSE GAS EMISSIONS resulting from the generation of electricity, heat, or steam purchased by a federal agency.



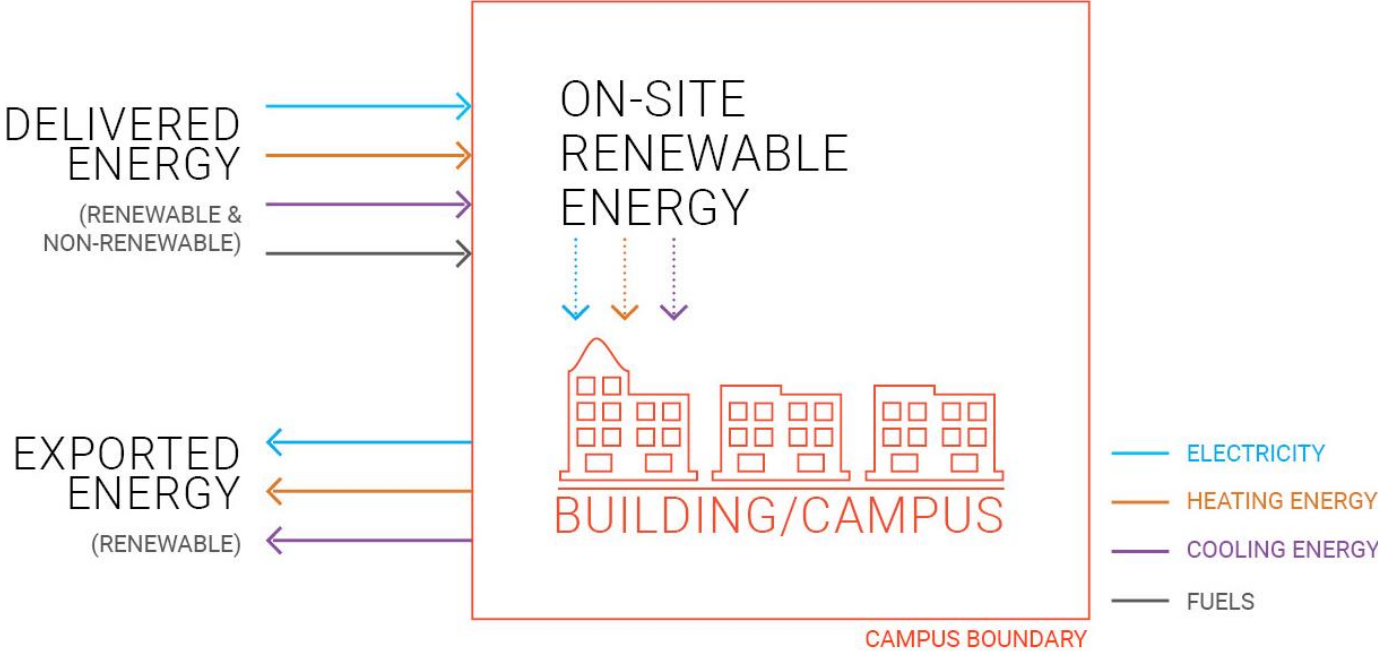
GREENHOUSE GAS EMISSIONS from sources not owned or directly controlled by a federal agency but related to agency activities.

Not all metrics **are created equal**



Zero energy \neq Zero carbon \neq Zero cost
Definitions are key: Boundary driven

boundaries

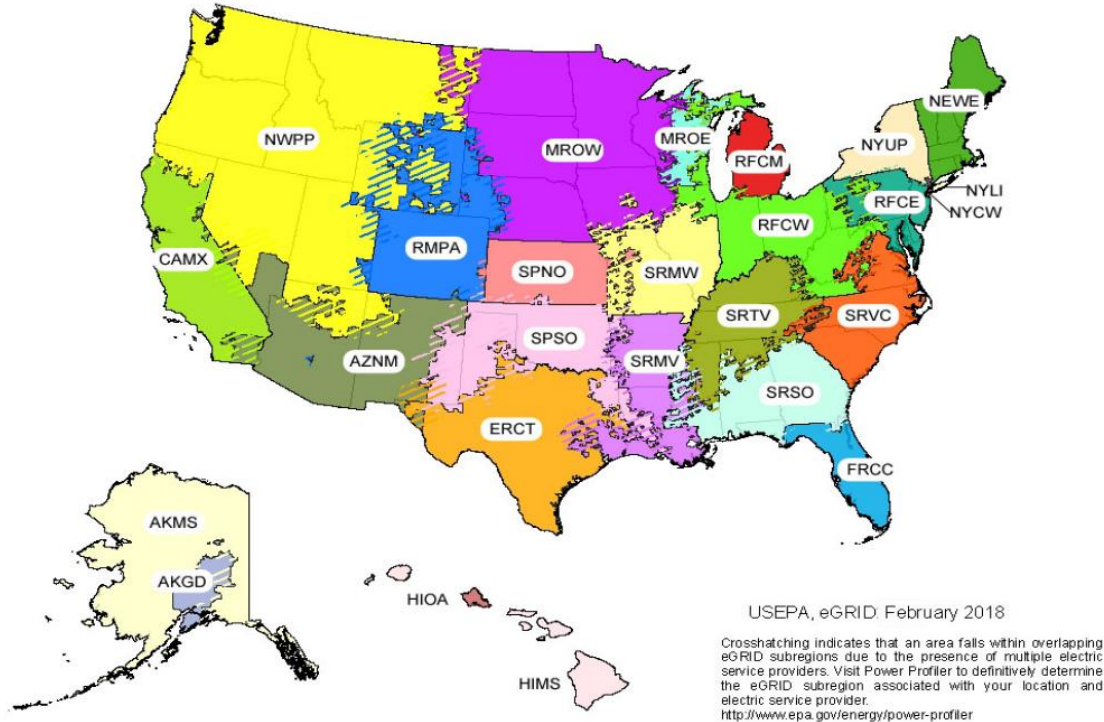


Notes

- 1. The dotted lines represent energy transfer with the boundary
- 2. The solid lines represent energy transfer entering/leaving the boundary used for zero energy accounting

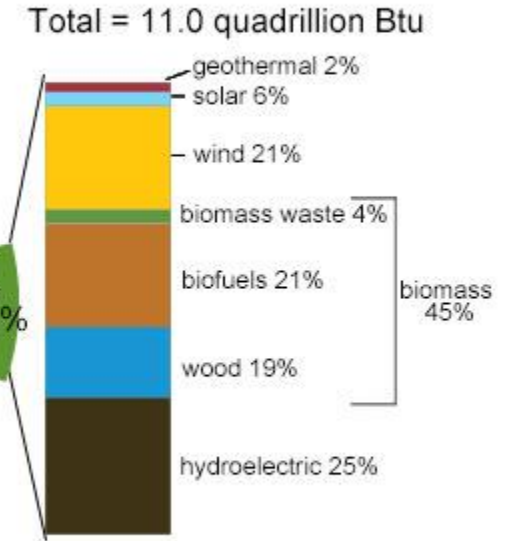
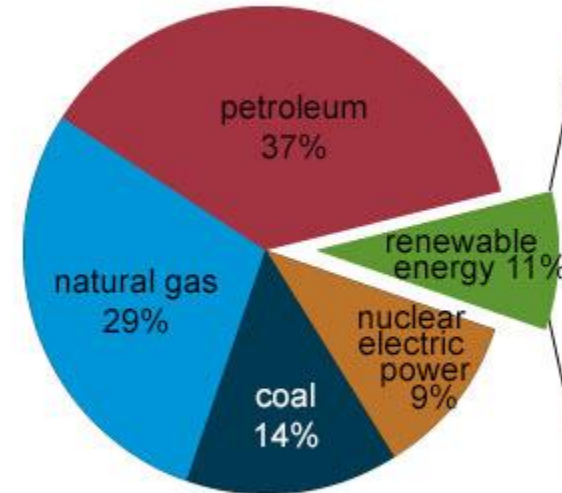
the complexity of **energy**

USEPA eGrid
www.epa.gov/energy/power-profiler



U.S. energy consumption by energy source, 2017

Total = 97.7 quadrillion
 British thermal units (Btu)



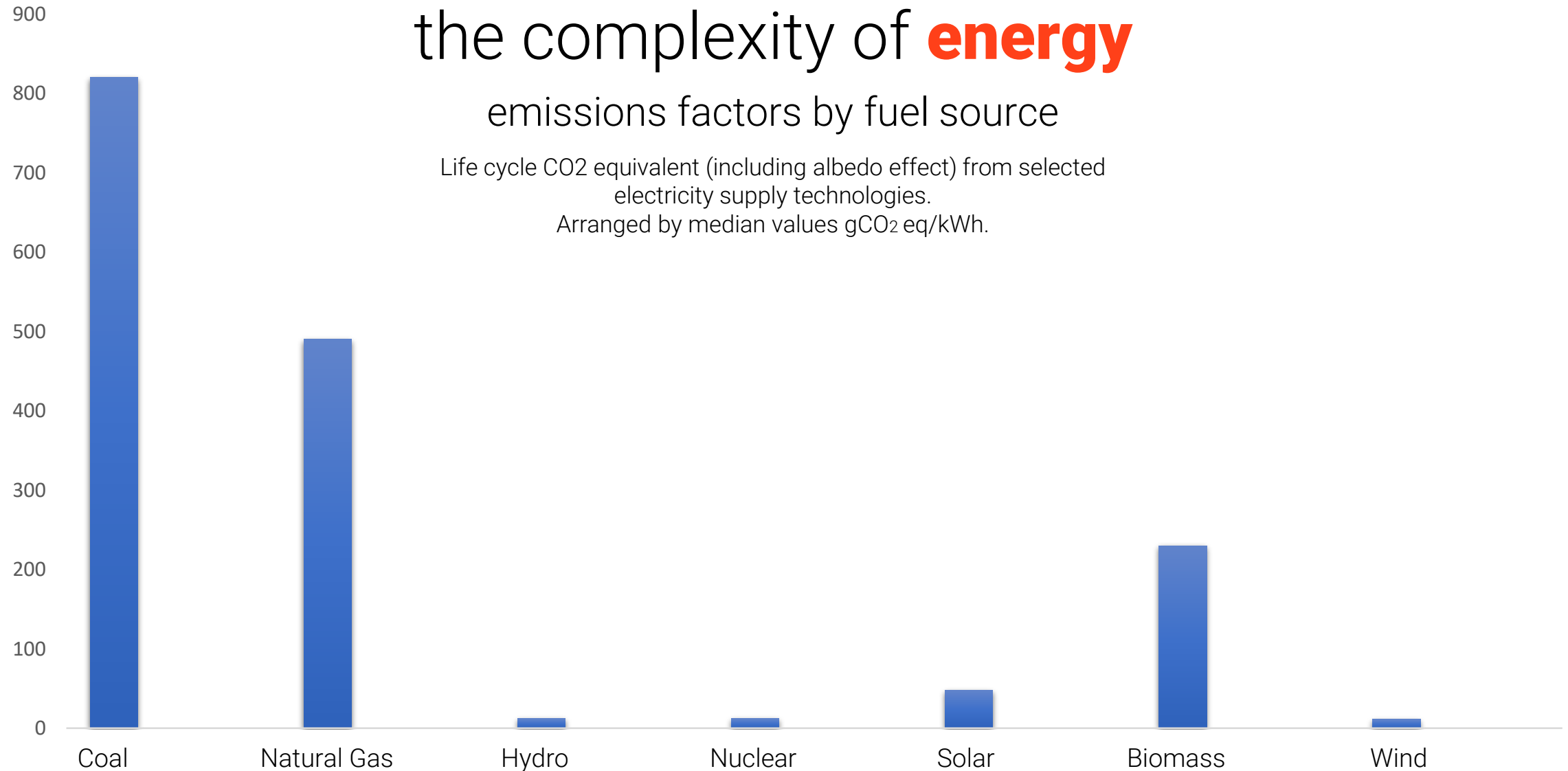
Note: Sum of components may not equal 100% because of independent rounding.
 Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2018, preliminary data



the complexity of **energy**

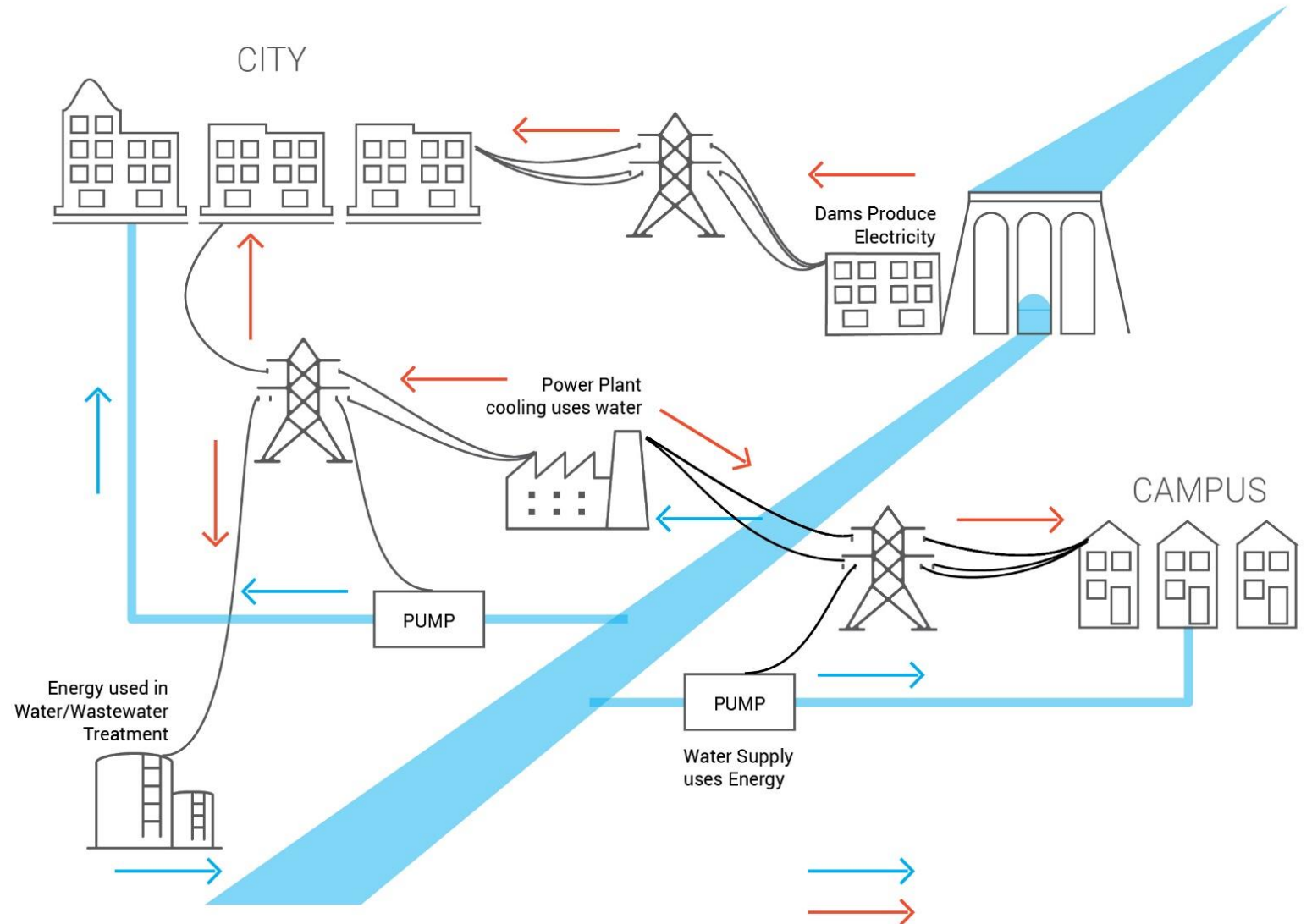
emissions factors by fuel source

Life cycle CO₂ equivalent (including albedo effect) from selected electricity supply technologies.
Arranged by median values gCO₂ eq/kWh.



types of **energy**

- Non-renewable vs. Renewable
- Embodied Energy
- Water-Energy Nexus



campus **energy**



- Benchmarking (ENERGY STAR)
Median Site EUI: 130.7 kBTU/yr-gsf
Median Source EUI: 262.6 kBTU/yr-gsf
- Variables
Campus Utility System
Building Types
Academic Calendar
Building Stock Vintage
Submetering

2030 challenge

U.S. Medians for Site Energy Use and 2030 Challenge Energy Reduction Targets by Space/Building Type ¹									
From the Environmental Protection Agency (EPA): Use this chart to find the site fossil-fuel energy targets									
Building Use Description ²	Available in Target Finder ³	Median Source EUI ⁴ (kBtu/Sq.Ft./Yr)	Average Percent Electric	Median Site EUI ⁴ (kBtu/Sq.Ft./Yr)	2030 Challenge Site EUI Targets (kBtu/Sq.Ft./Yr)				
					50% Target	60% Target	70% Target	80% Target	90% Target
Education		144	63%	58	29.0	23.2	17.4	11.6	5.8
K-12 School	X								
College / University (campus-level)		244	63%	104	52.0	41.6	31.2	20.8	10.4

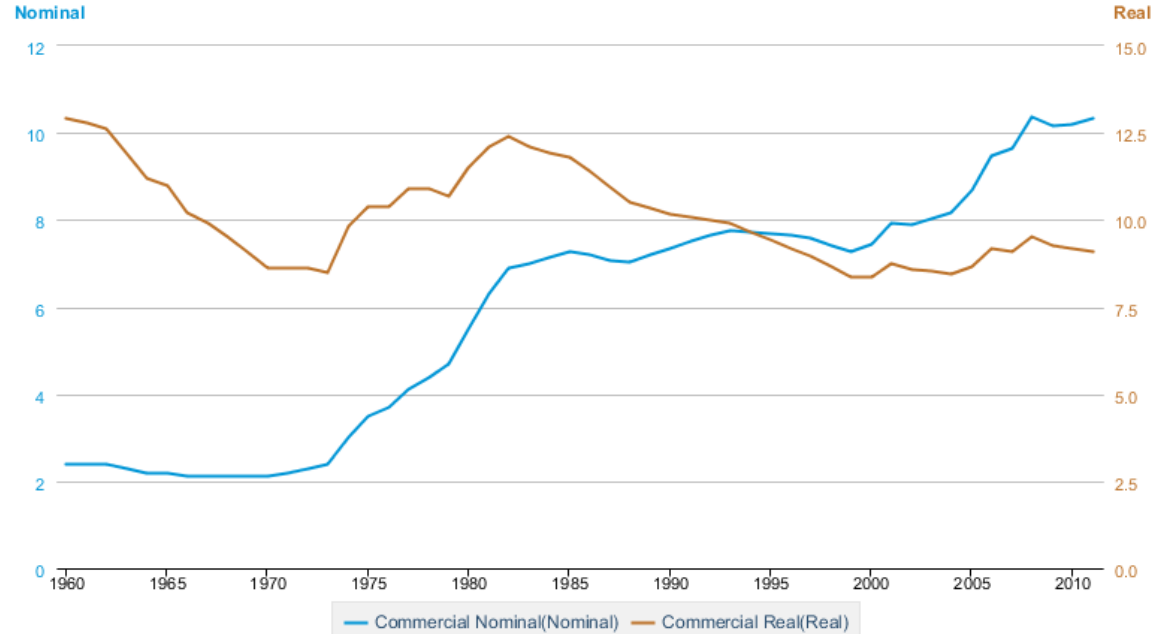


www.architecture2030.org



campus **energy** cost trends

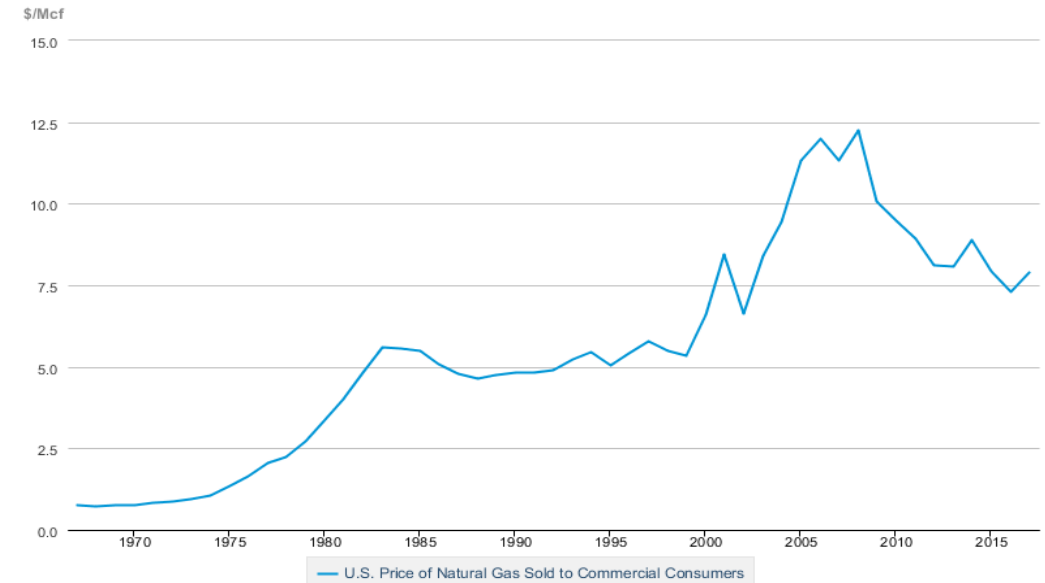
Electricity – average retail price



eia Source: U.S. Energy Information Administration

www.eia.gov/dnav

Natural Gas – average retail price

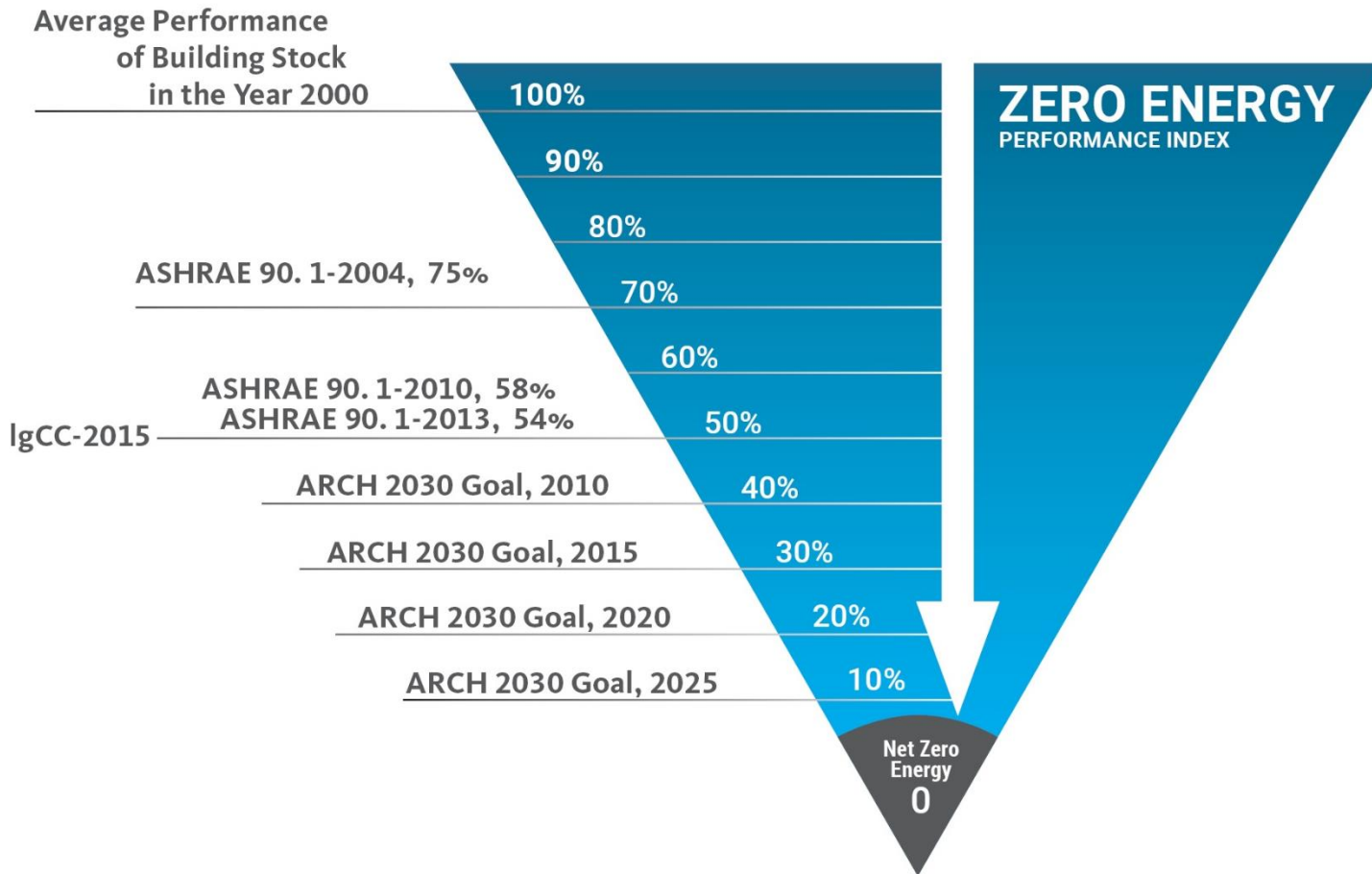


eia Source: U.S. Energy Information Administration

www.eia.gov/electricity

standards alignment

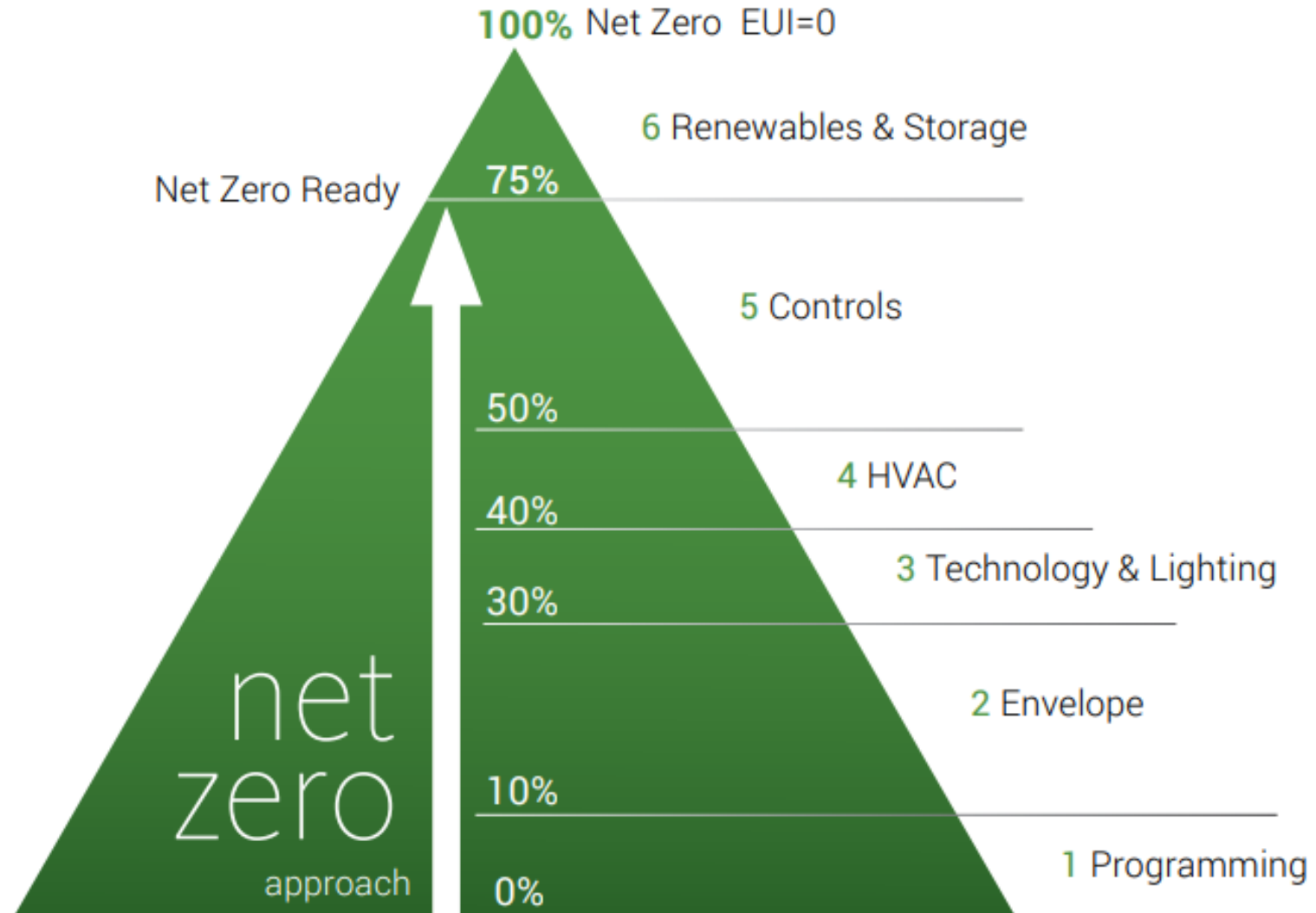
Zero Energy Performance Index – zEPI



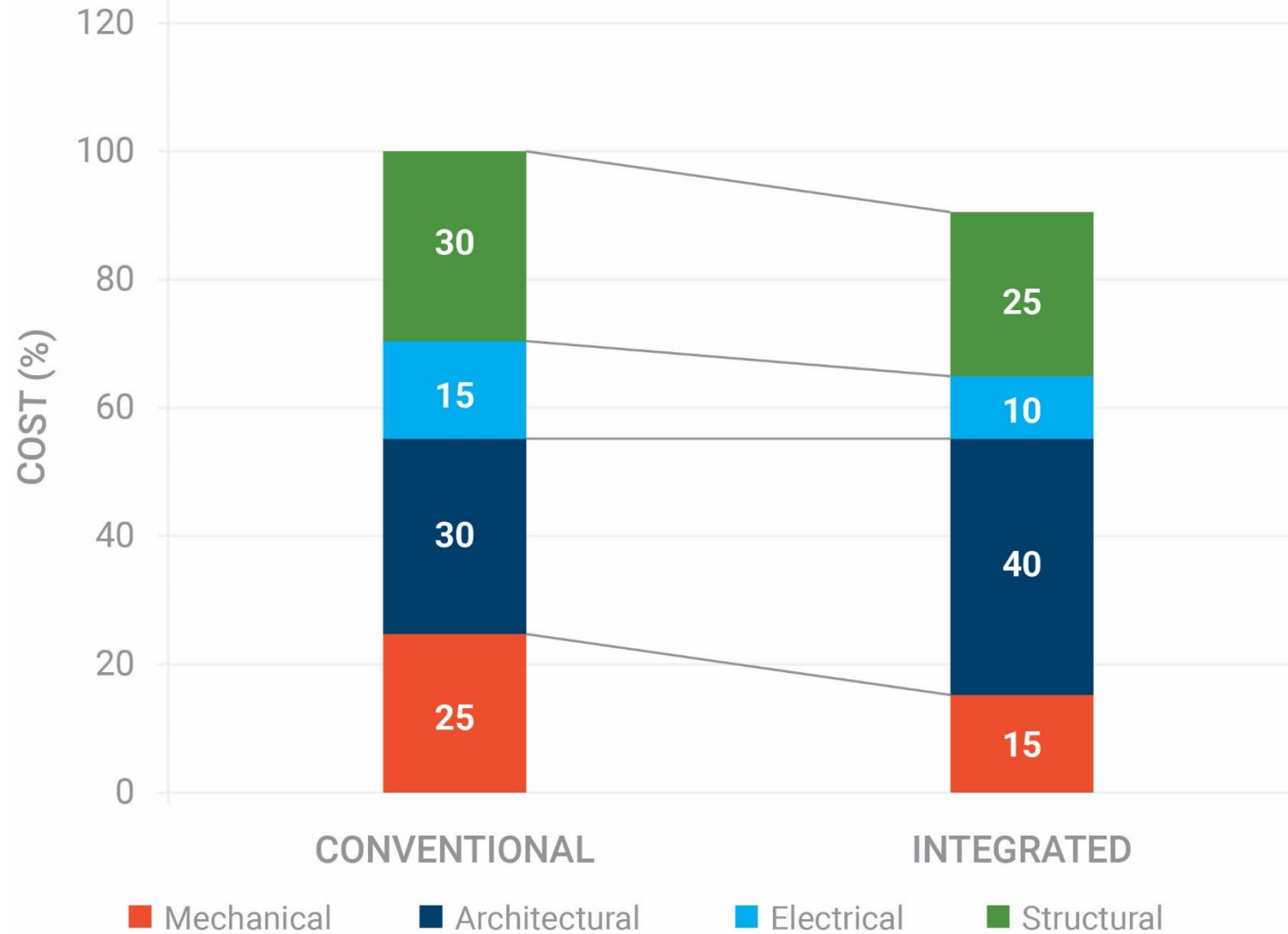
- Normalized Scale to 2003
CBECS = 100, Zero Energy = 0
- Goal was to index code/standard to scale to allow easier comparison
- Source energy basis

design for **net zero**

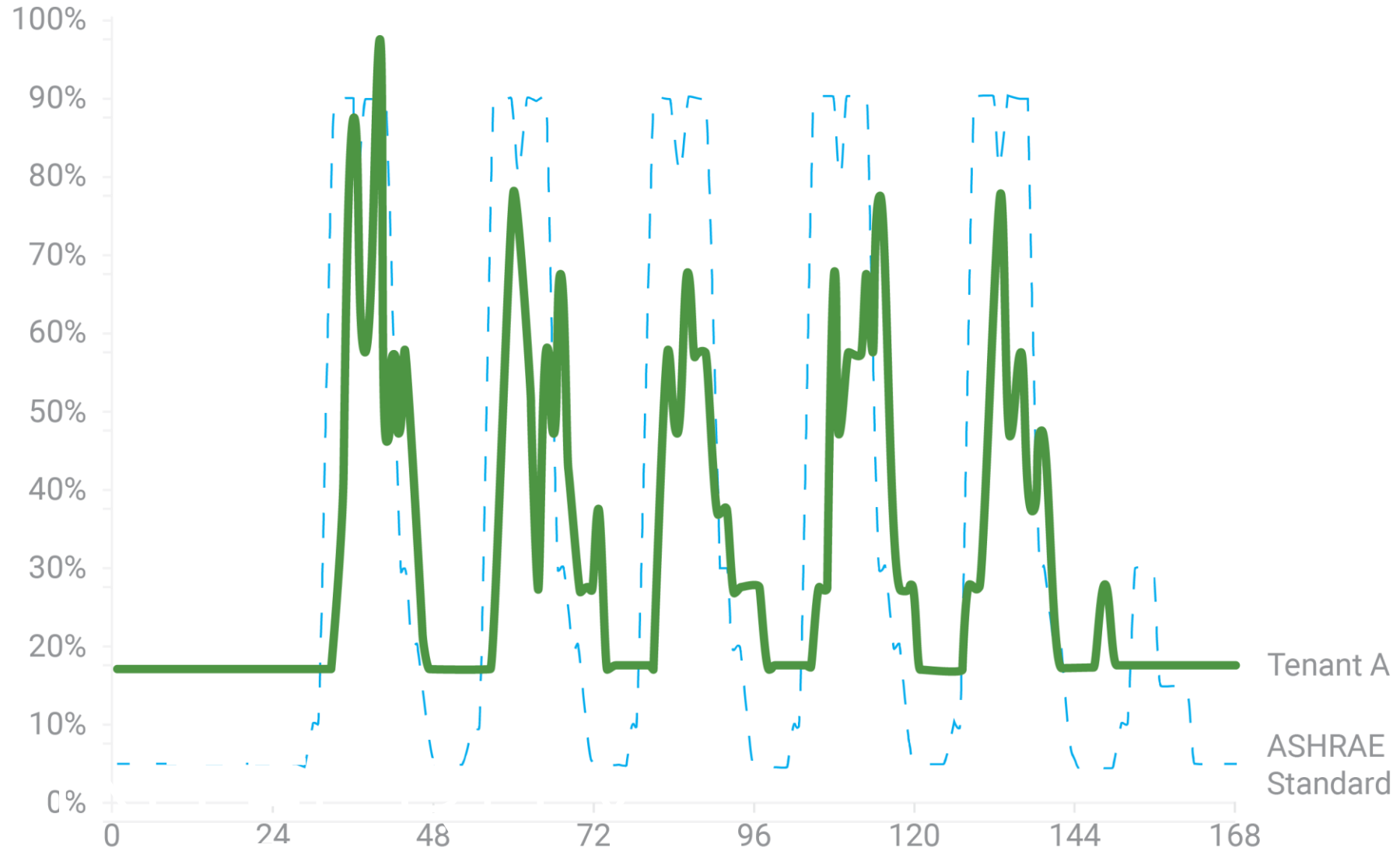
net zero approach



integrated design **matters**

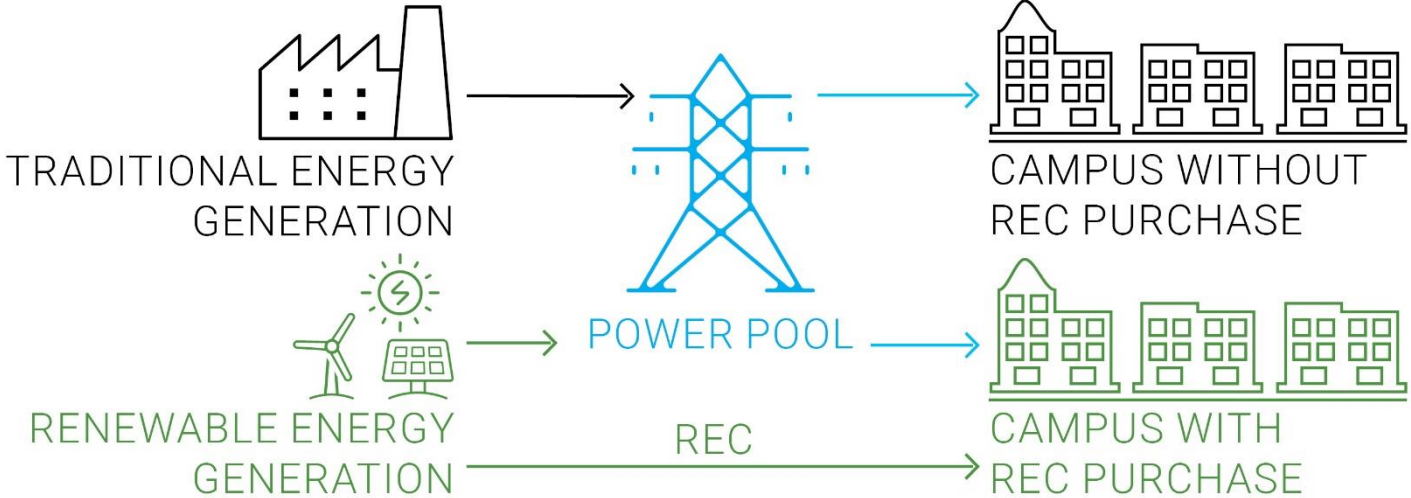


operations **matter**



food for **thought**

REC RENEWABLE ENERGY CREDITS



- Electrification
 - District Utility + GSHP
 - PV Cost
- Value of carbon for life-cycle cost analysis: \$20/ton
- The role of renewable energy credits (RECs)

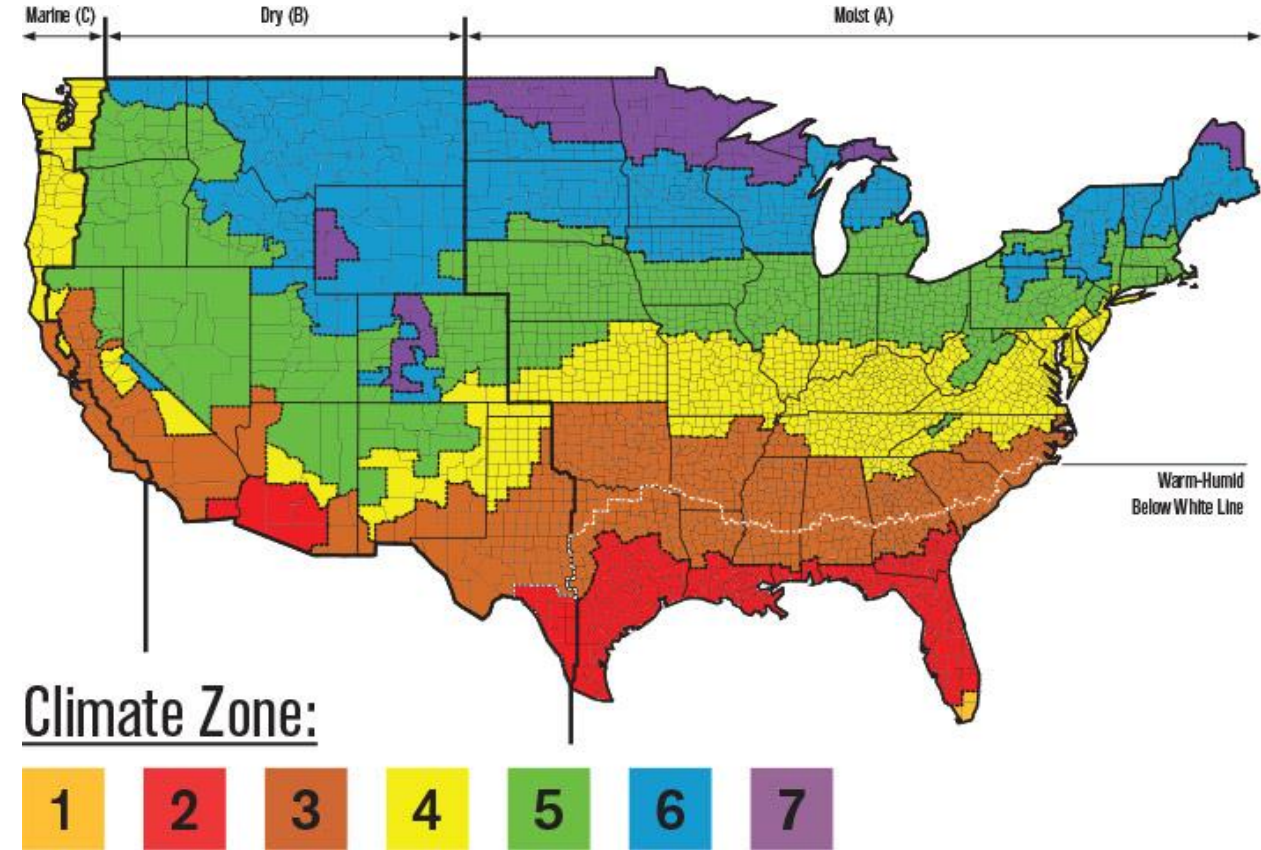
the **game**



the **game**

Hypothetical Hi-ED campus

- Total built area: 2,000,000 SF
- Climate zone: ASHRAE 4A
- Sustainability: LEED certified equivalent
- Energy performance: At least 5% better than code



building **types**

BUILDING TYPE PROGRAM: CLASSROOMS

AREA RATIO | **30%** 50% existing, 50% new

SITE FUEL RATIO - GAS | **17%**

SITE FUEL RATIO - ELECTRIC | **83%**

BUILDING TYPE PROGRAM: LABORATORIES

AREA RATIO | **20%** 50% existing, 50% new

SITE FUEL RATIO - GAS | **33%**

SITE FUEL RATIO - ELECTRIC | **67%**

BUILDING TYPE PROGRAM: RESIDENTIAL

AREA RATIO | **20%** All existing

SITE FUEL RATIO - GAS | **13%**

SITE FUEL RATIO - ELECTRIC | **87%**

building **types**

! BUILDING TYPE PROGRAM: ! COMMUNITY

AREA RATIO | 20% All existing

SITE FUEL RATIO - GAS | 50%

SITE FUEL RATIO - ELECTRIC | 50%

! BUILDING TYPE PROGRAM: ! ADMINISTRATION

AREA RATIO | 10% All existing

SITE FUEL RATIO - GAS | 12%

SITE FUEL RATIO - ELECTRIC | 88%

! CAMPUS PROGRAM: ! TOTAL CAMPUS

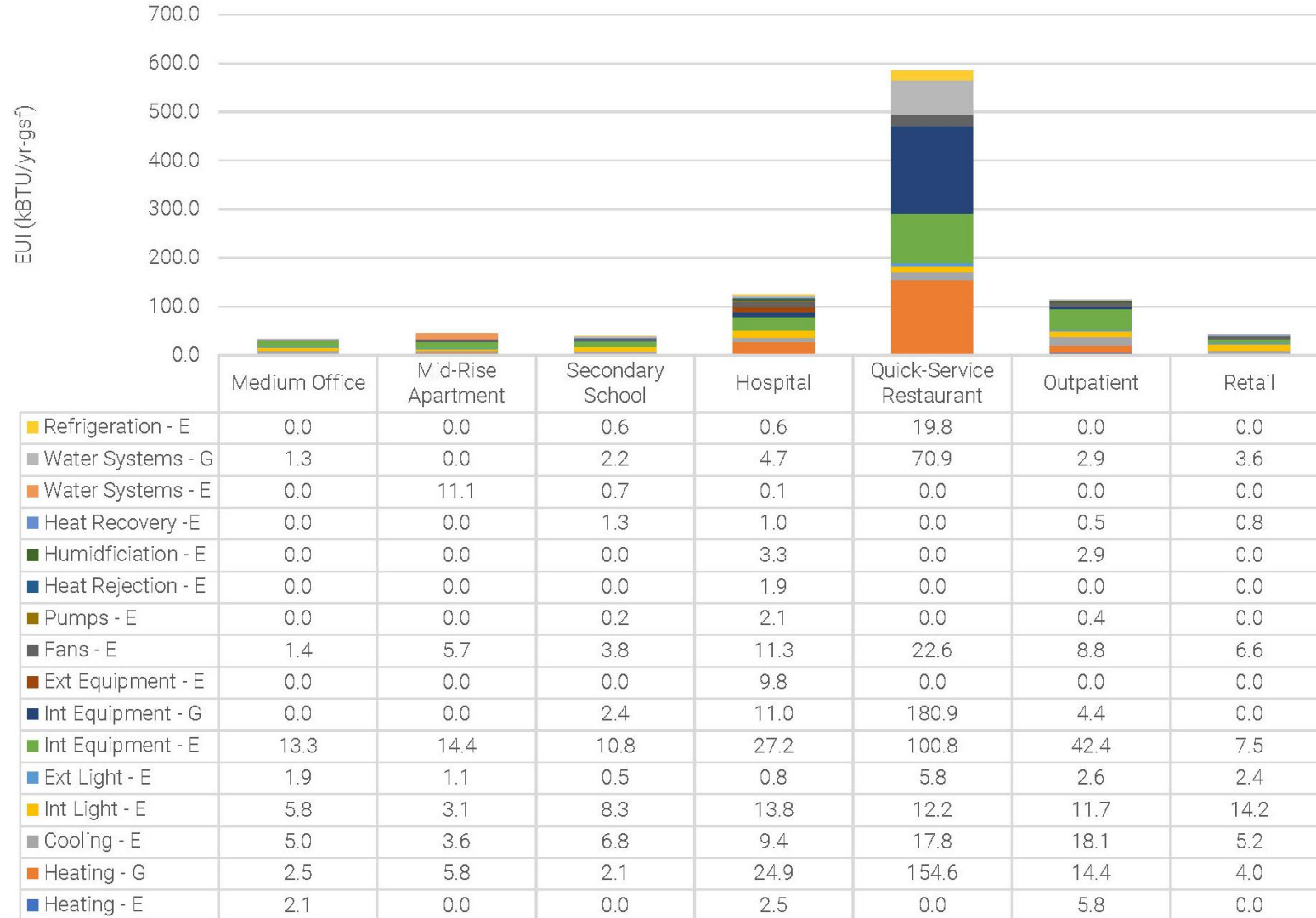
AREA RATIO | 100% 65% existing, 35% new

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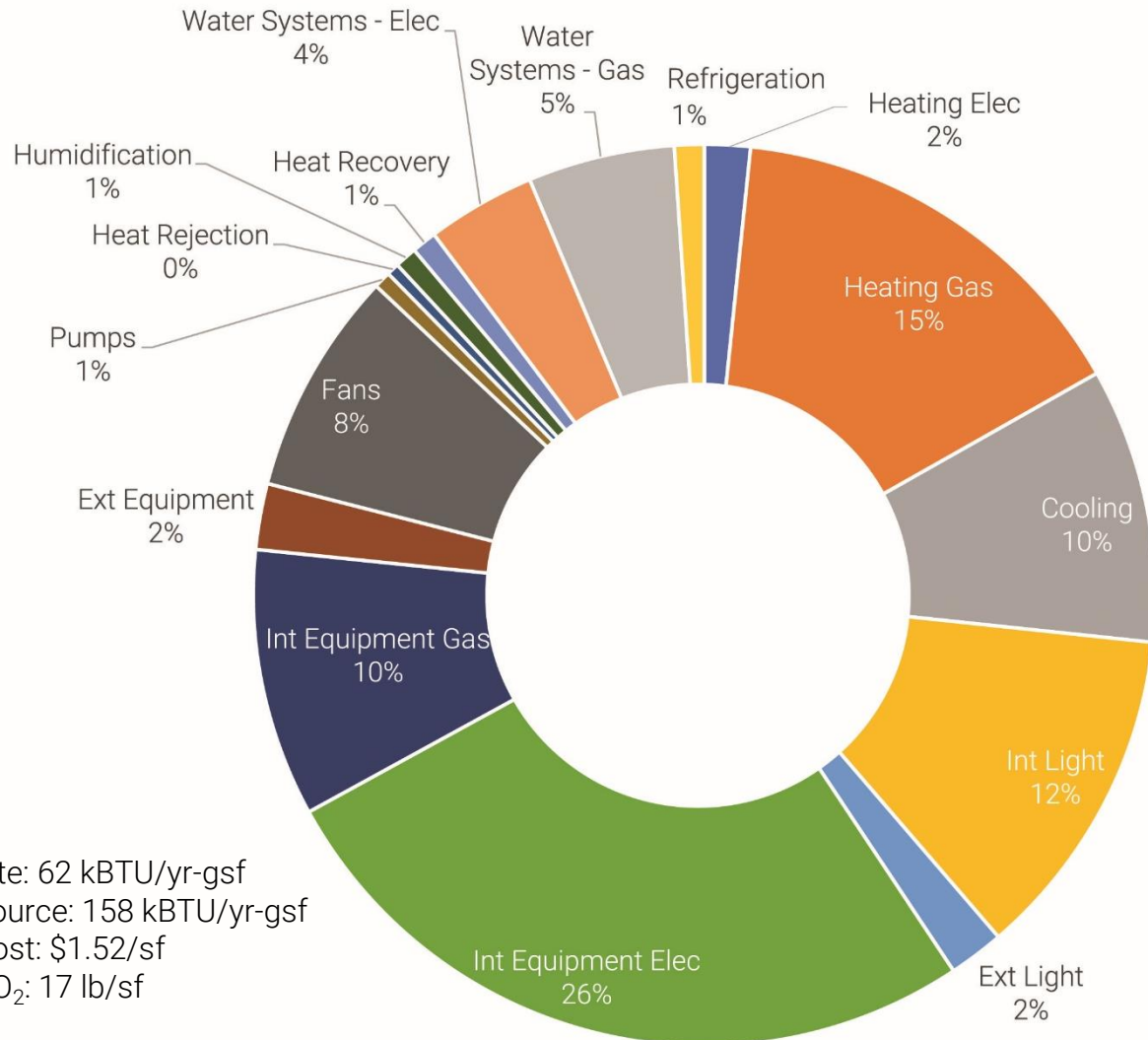
prototype data

Energy Use Intensity Breakdown by Building Type (ASHRAE 90.1-2013)



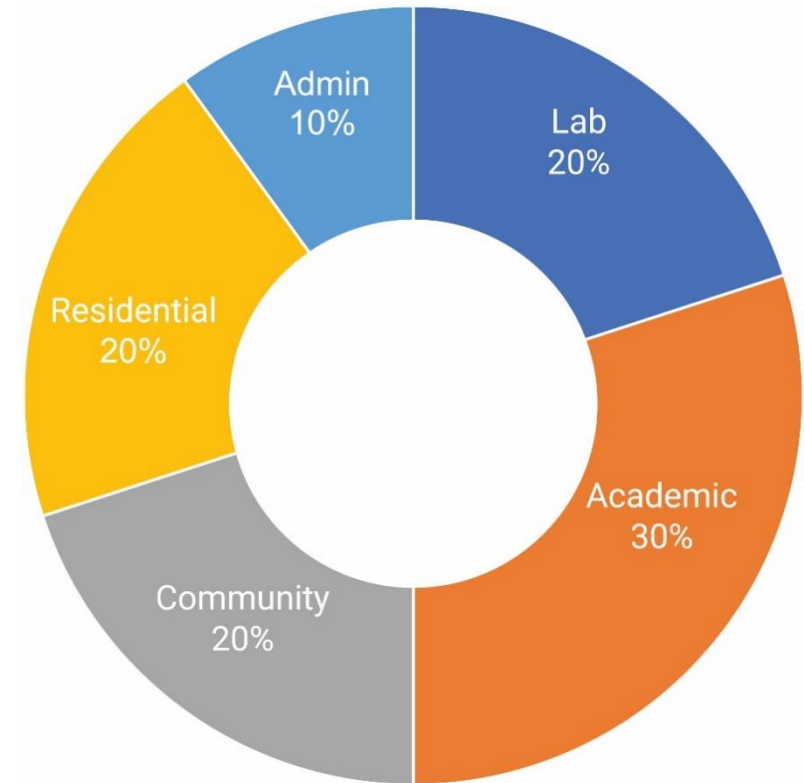
data by **metric** 90.1-2013

Usage by system type



Site: 62 kBTU/yr-gsf
Source: 158 kBTU/yr-gsf
Cost: \$1.52/sf
CO₂: 17 lb/sf

Usage by campus building type

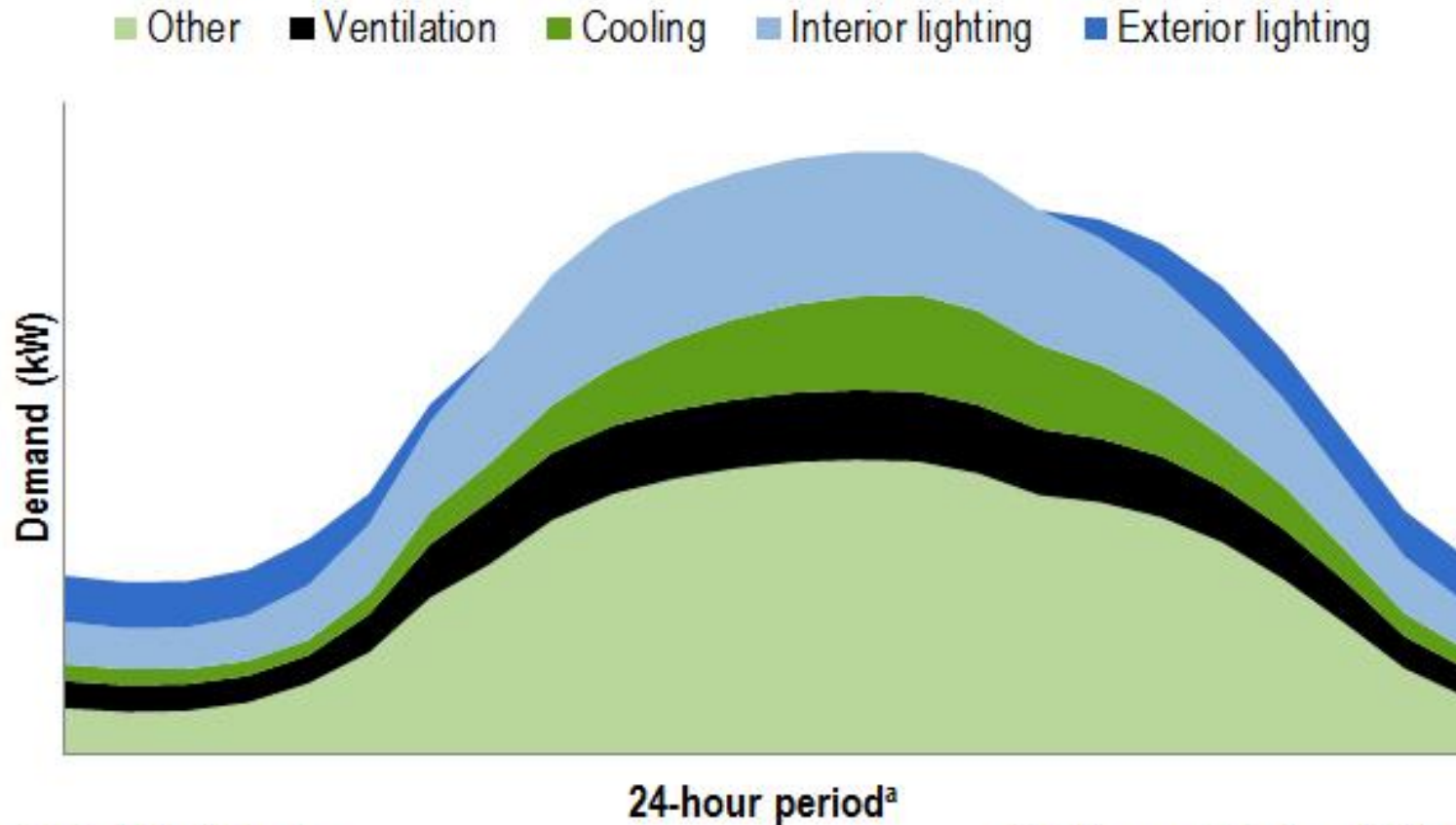


three **activities**



- Step 1: demand profiles
 - **when** is energy used?
- Step 2: energy use / cost
 - **how** is energy used?
- Step 3: net-zero strategy
 - **what** do you do to achieve the goal?

step 1: demand **profiles**



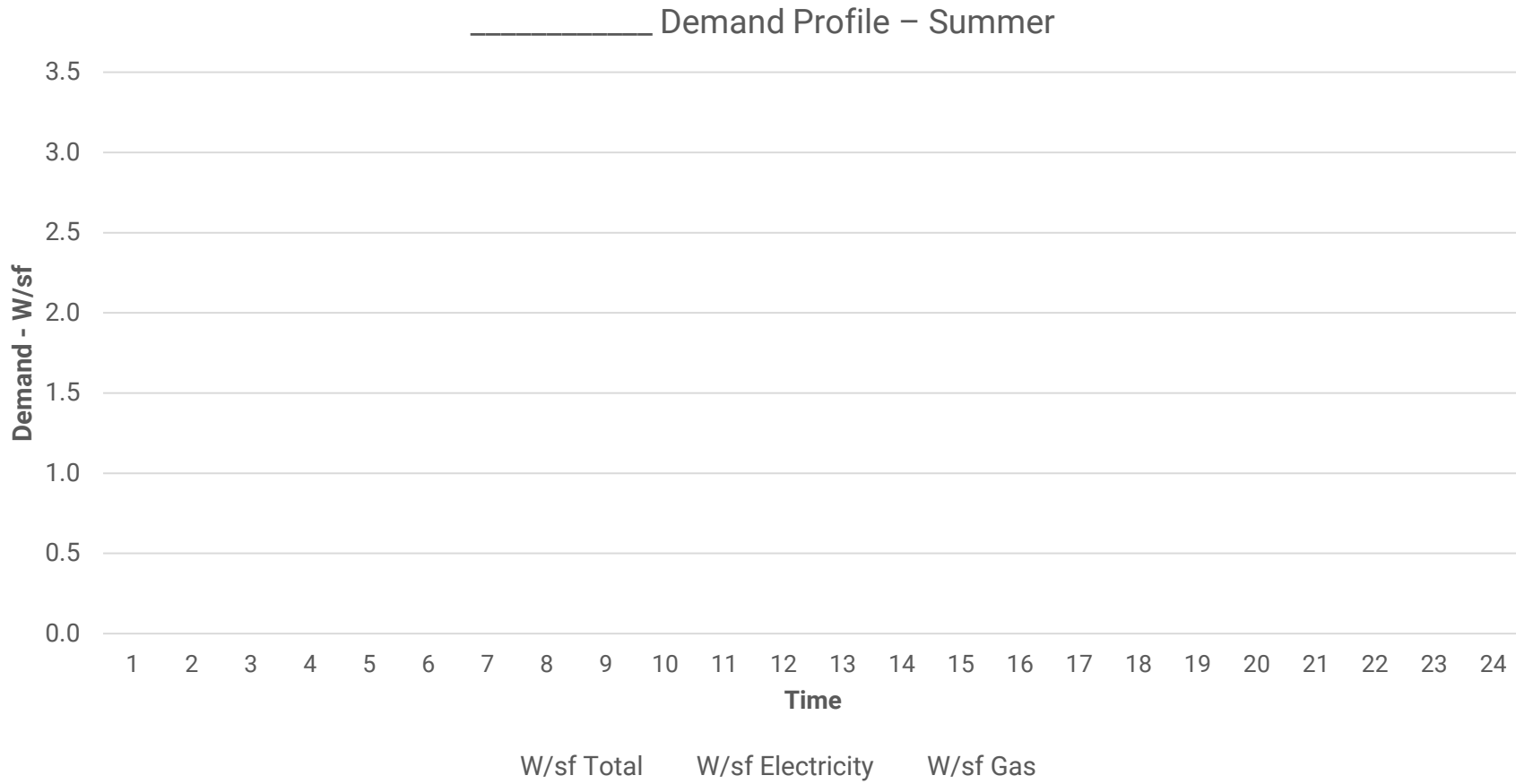
- Load profile for a typical college building in California

Note: kW = kilowatt.

a. 24-hour period = midnight to midnight.

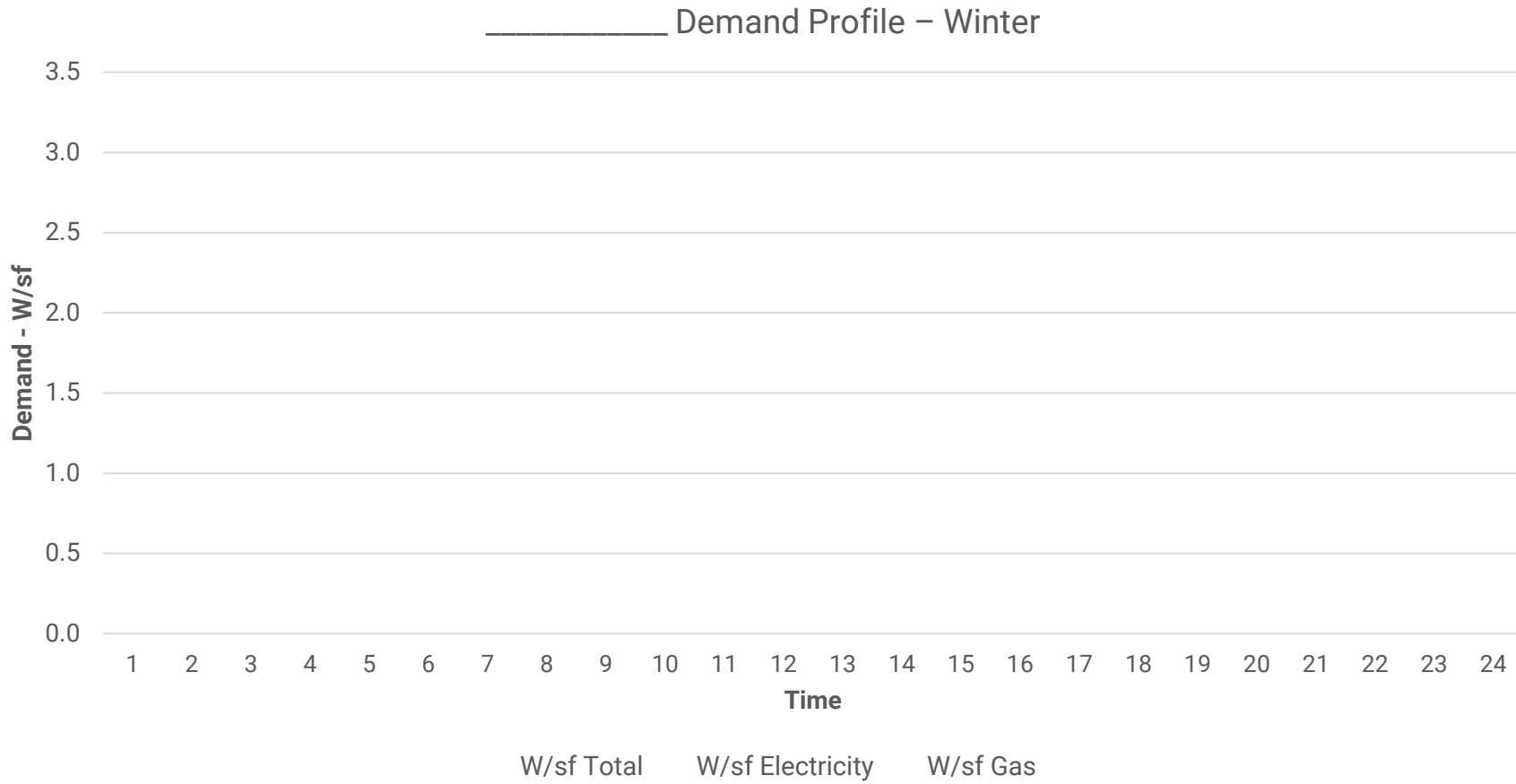
© E Source; data from ITRON

step 1: demand **profiles**



- Develop a load profile per building and accumulate for the whole campus.

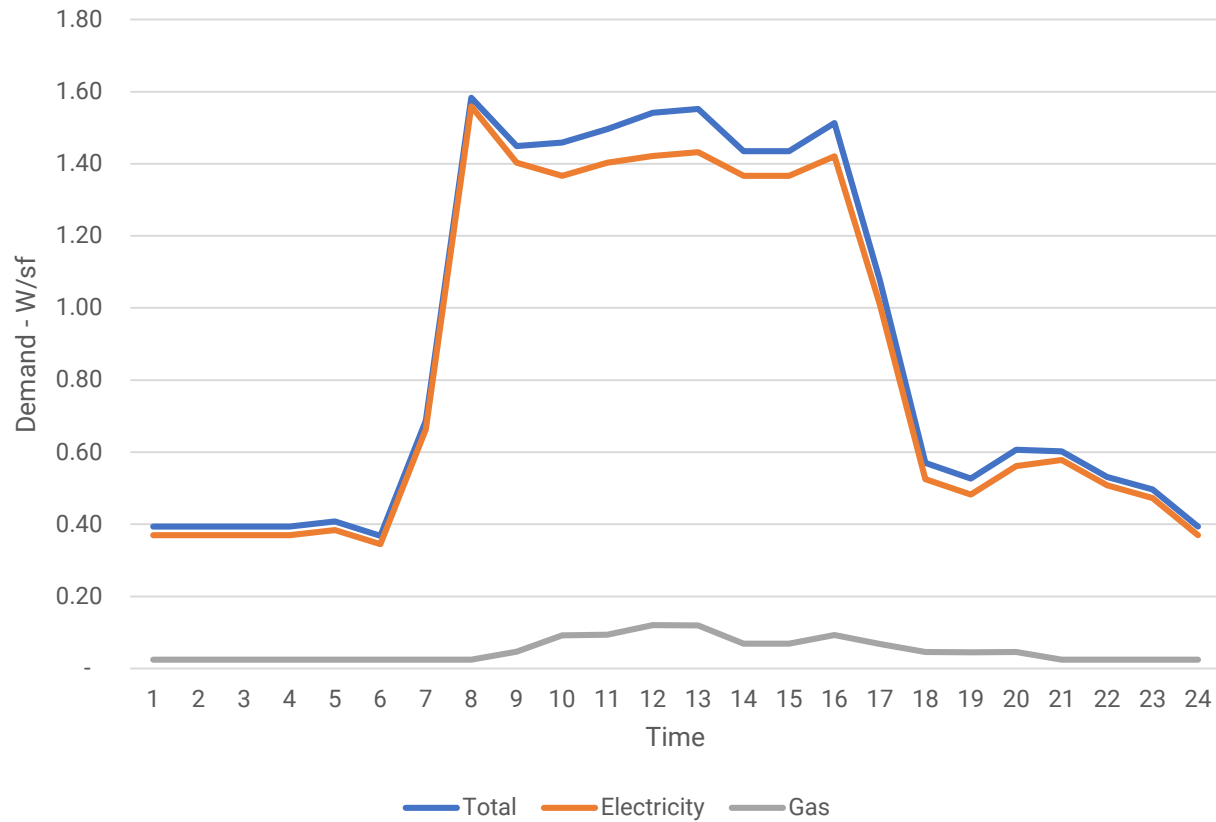
step 1: demand **profiles**



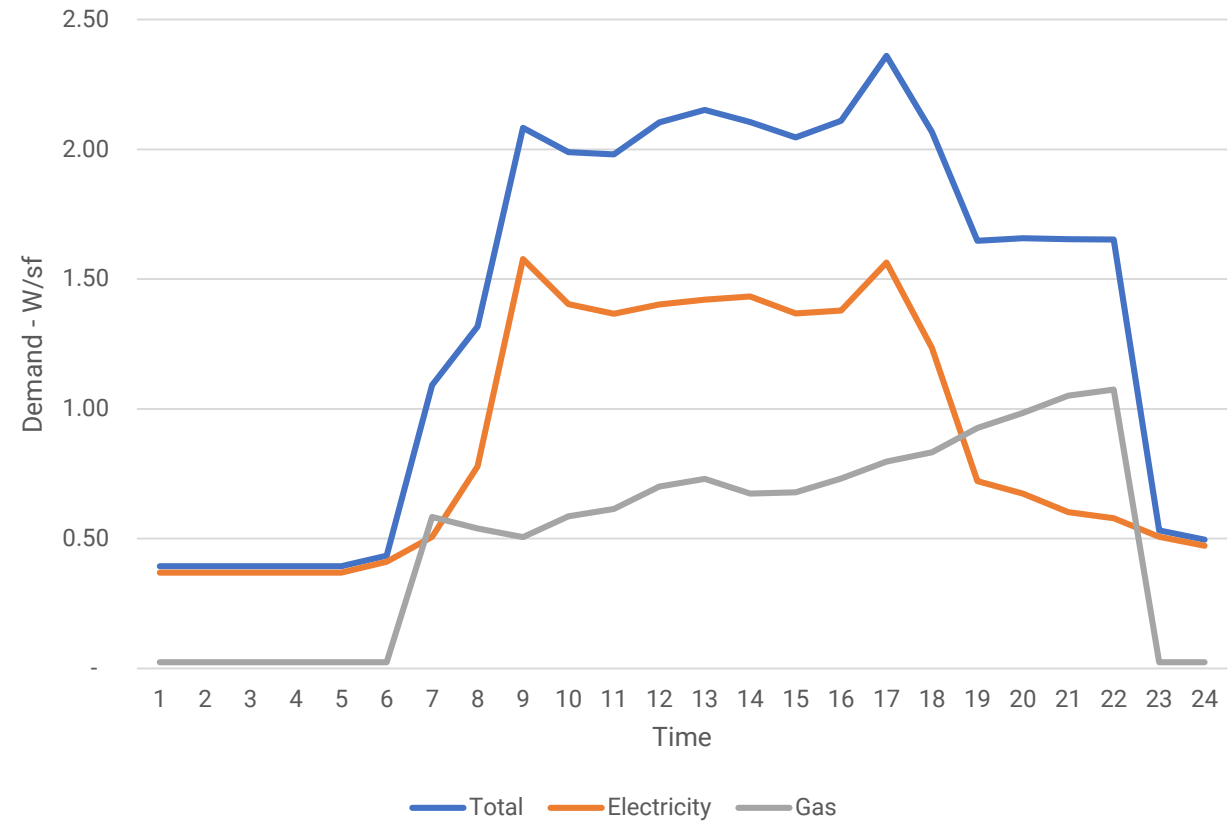
- Develop a load profile per building and accumulate for the whole campus.

step 1 results: demand profiles

Admin Demand Profile - Summer

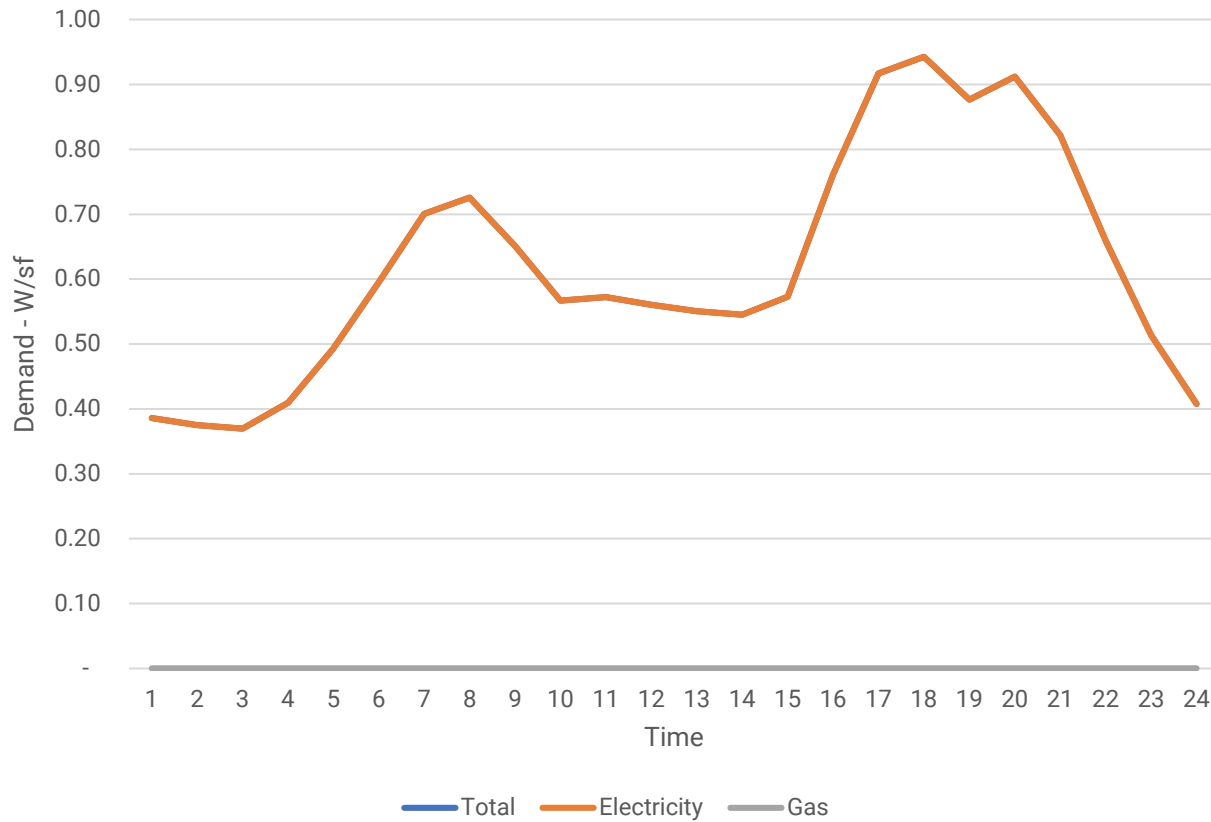


Admin Demand Profile - Winter

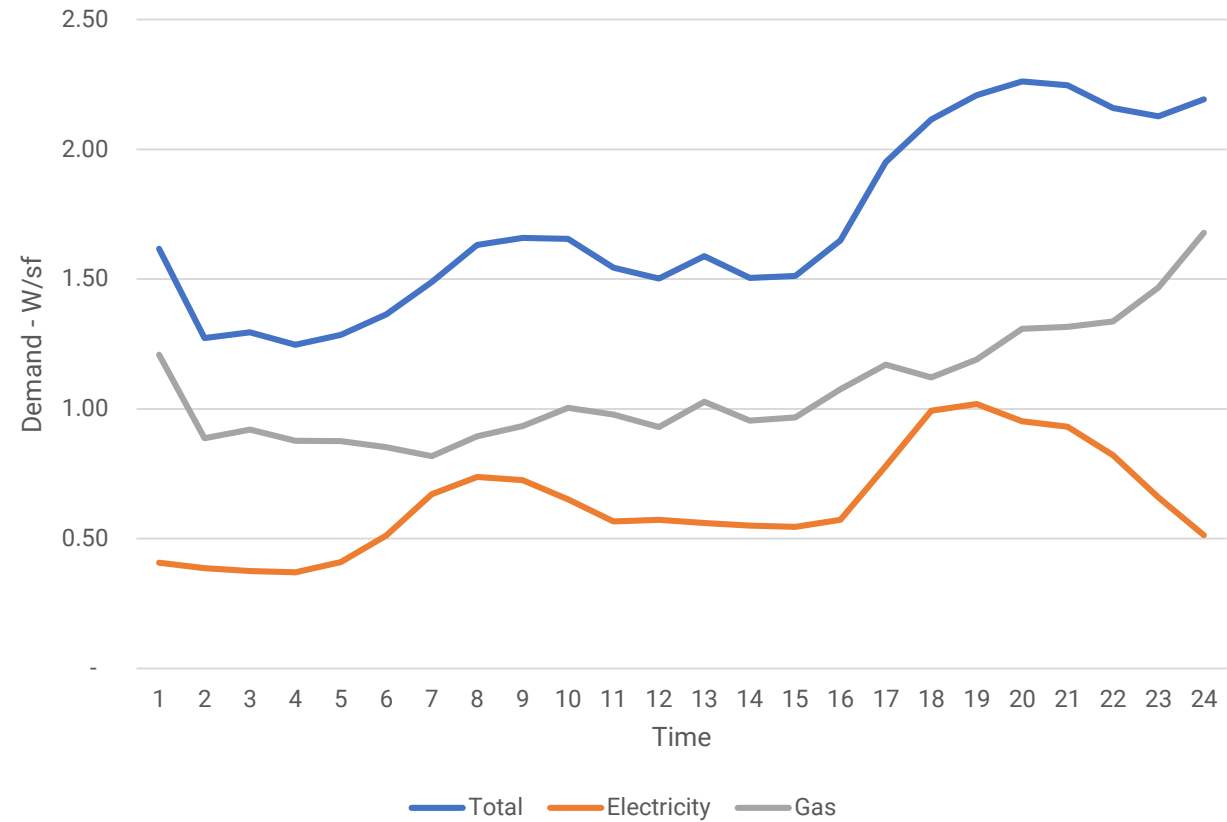


step 1 results: demand **profiles**

Residential Demand Profile - Summer

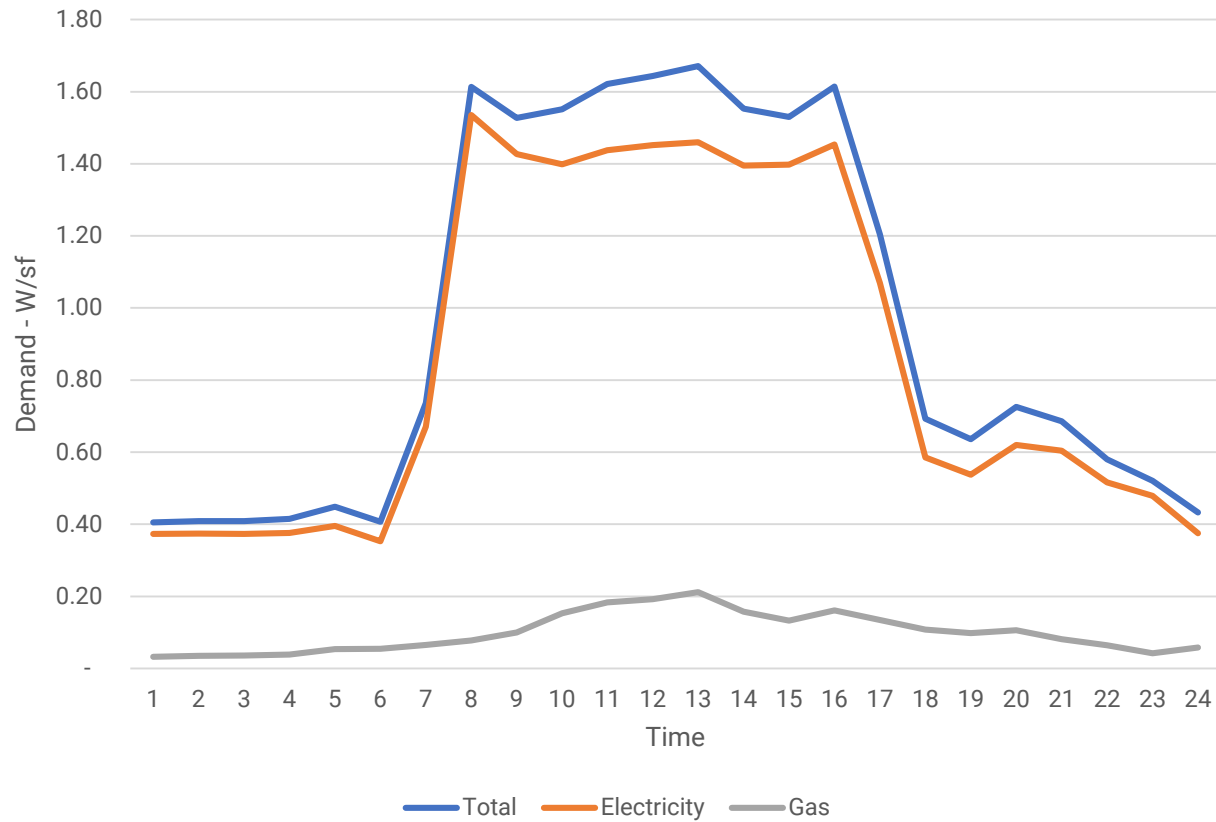


Residential Demand Profile - Winter

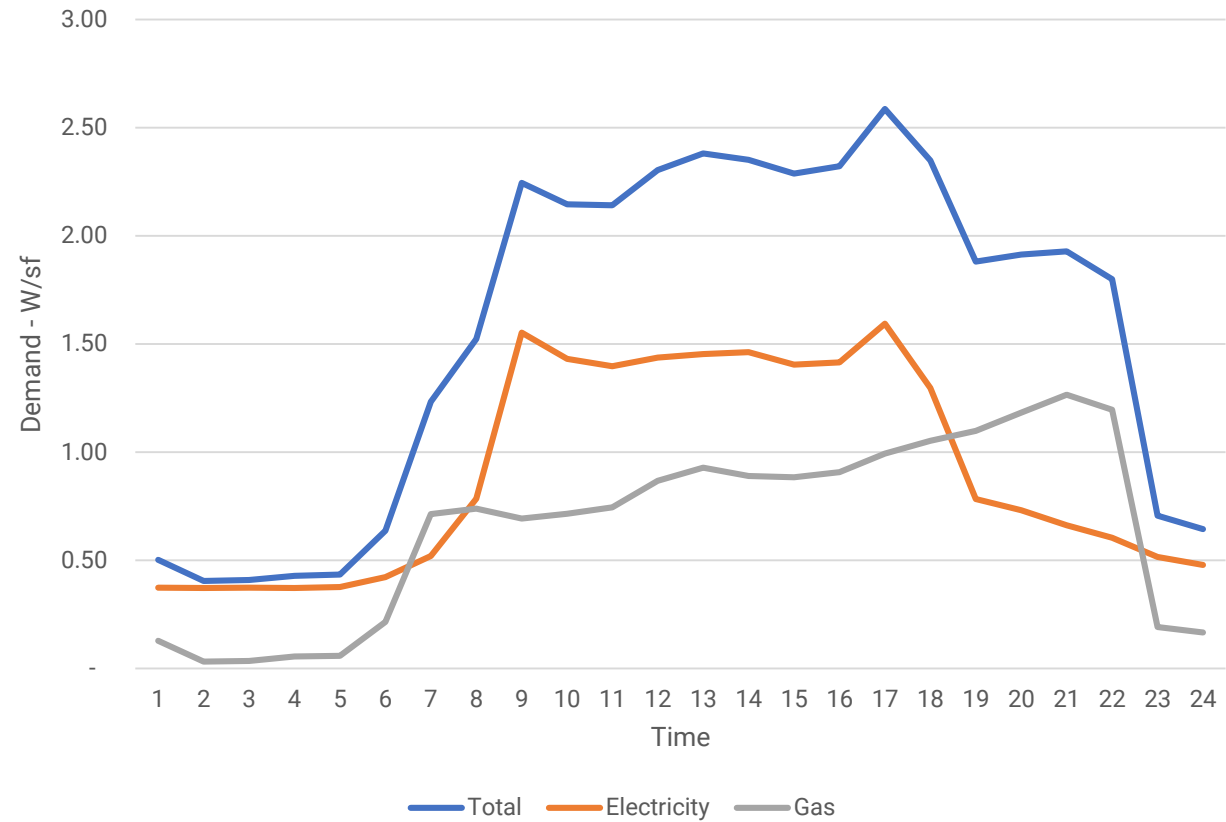


step 1 results: demand **profiles**

Community Demand Profile - Summer

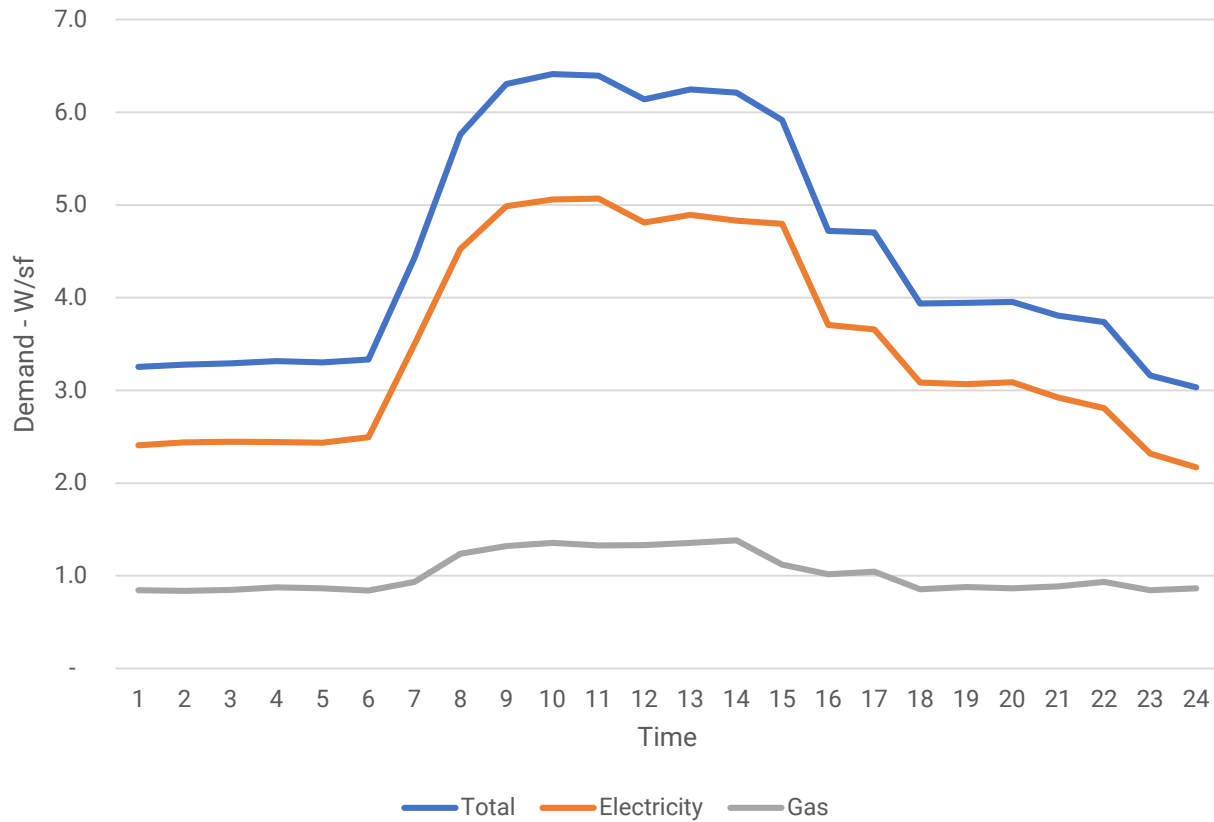


Community Demand Profile - Winter

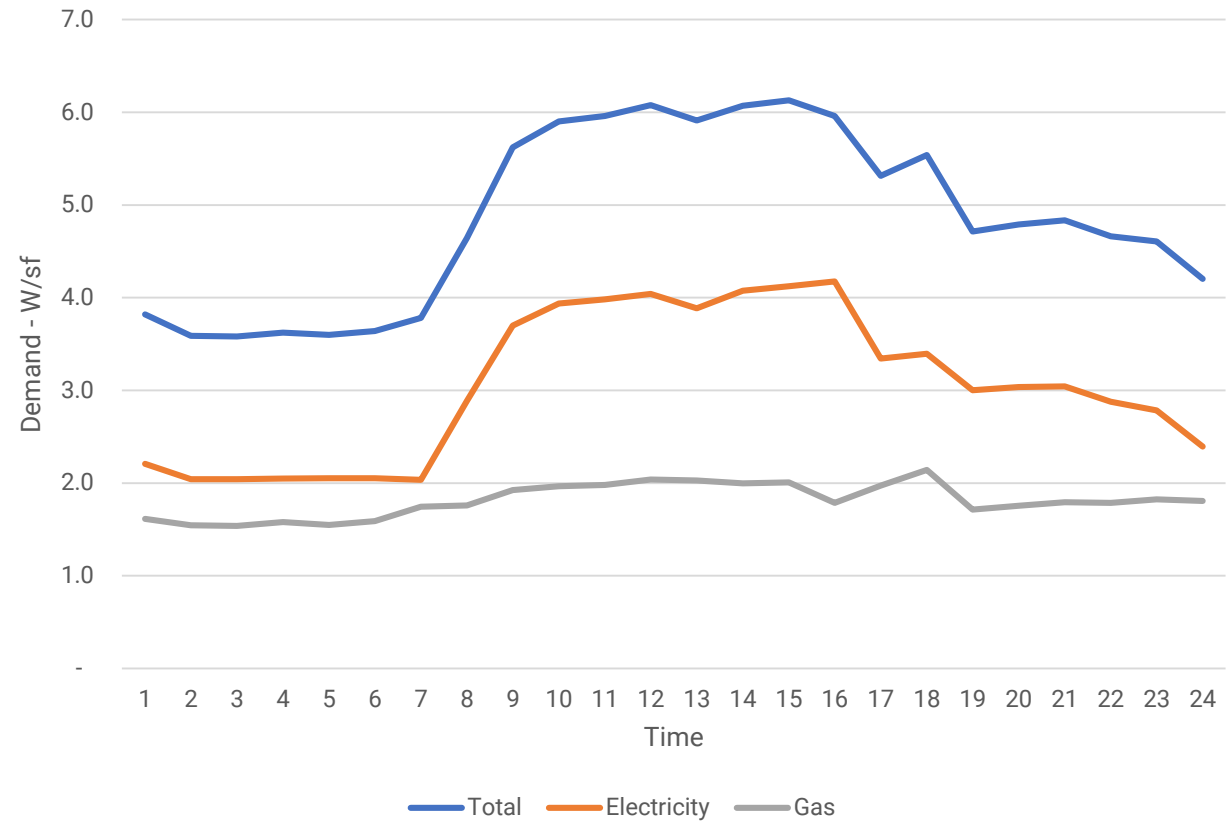


step 1 results: demand **profiles**

Laboratory Demand Profile - Summer

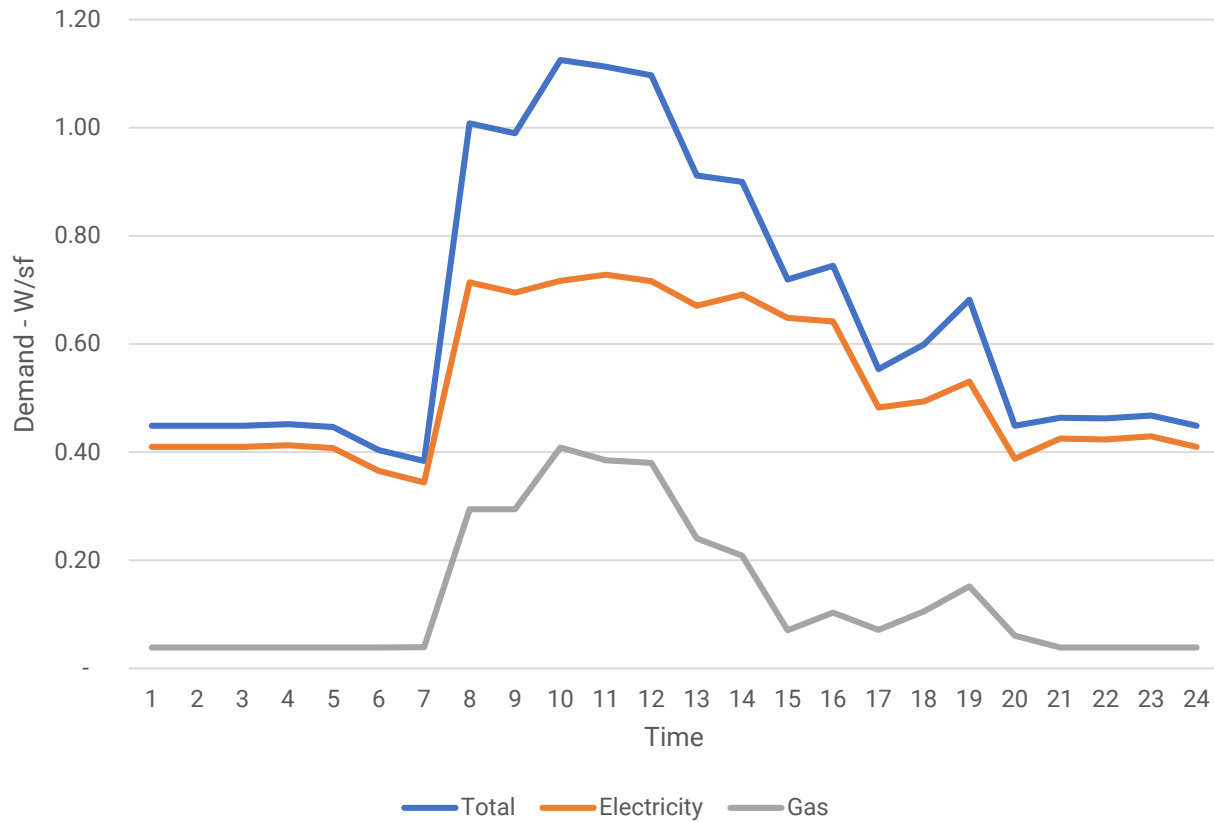


Laboratory Demand Profile - Winter

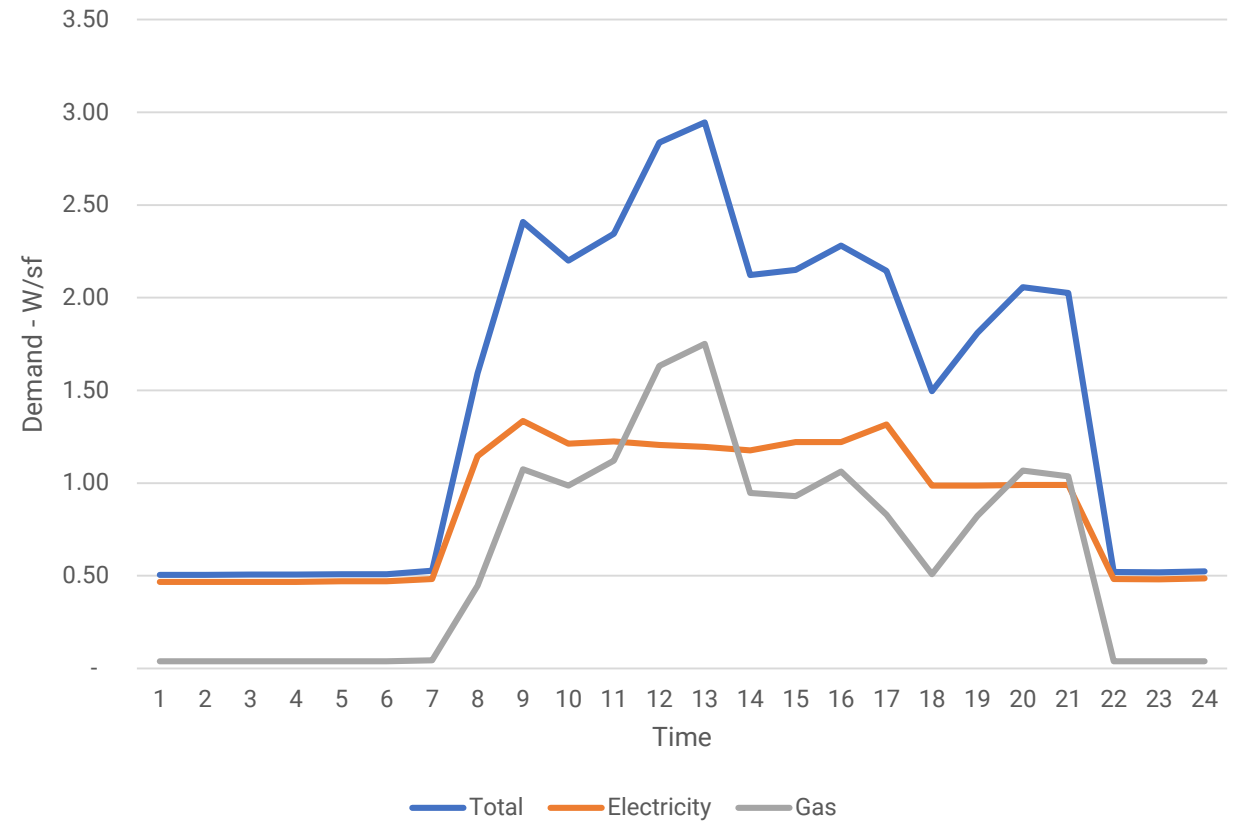


step 1 results: demand **profiles**

Classroom Demand Profile - Summer

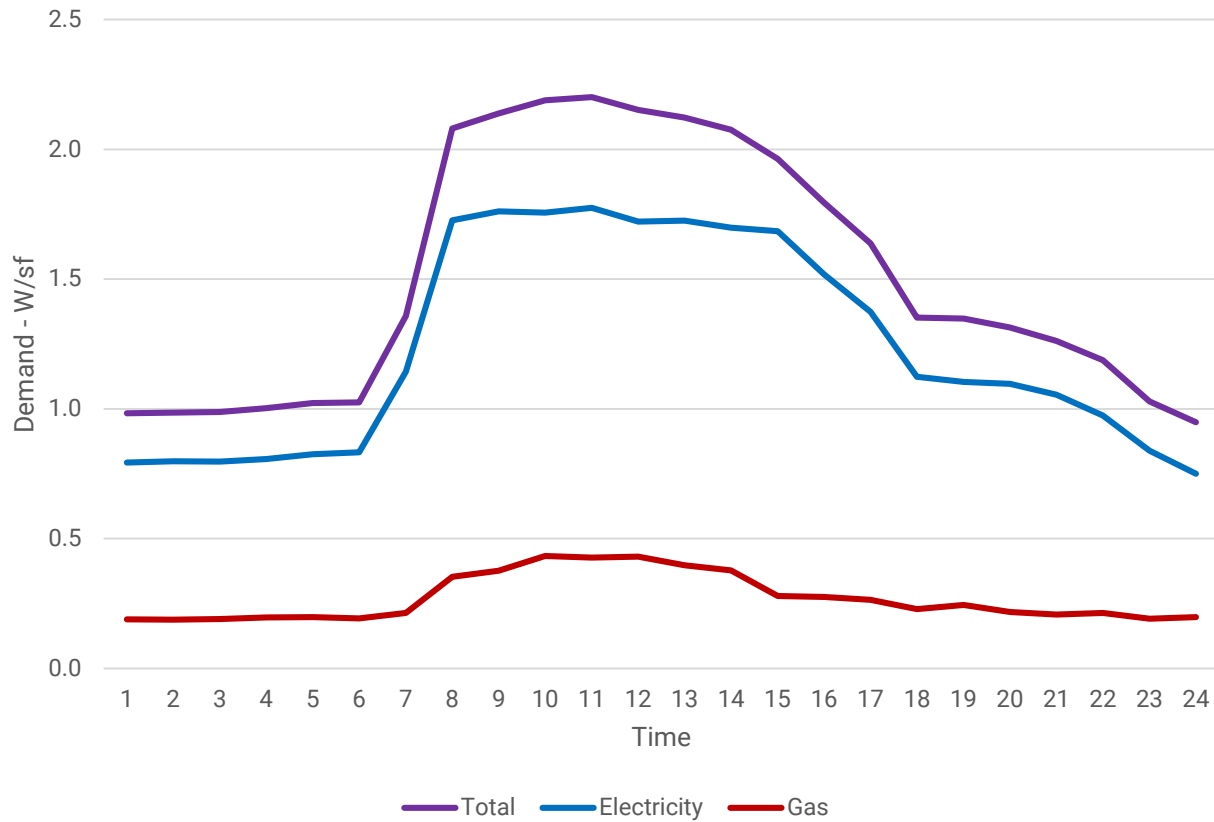


Classroom Demand Profile - Winter

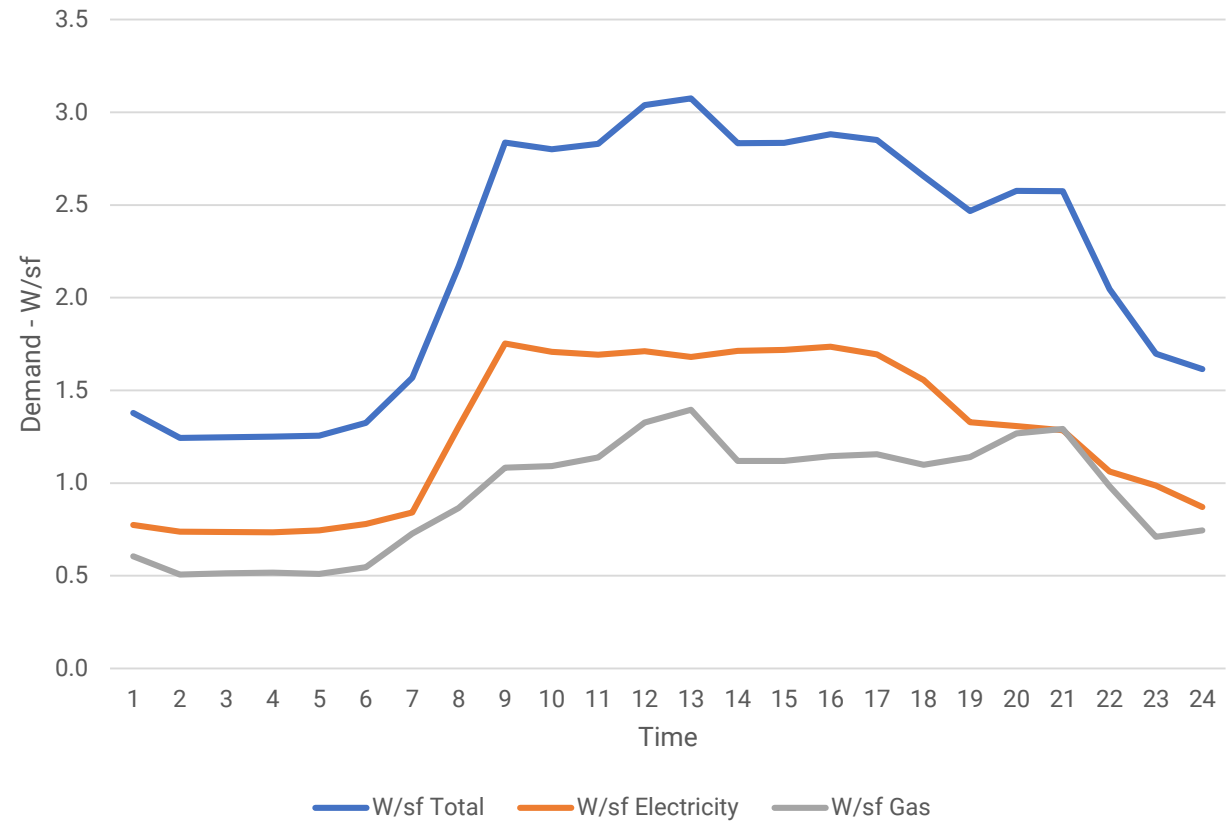


step 1 results: demand **profiles**

Campus Demand Profile - Summer



Campus Demand Profile - Winter



break



case **studies**



West-MEC SW Campus

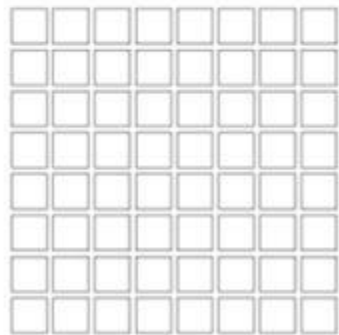


entry 34

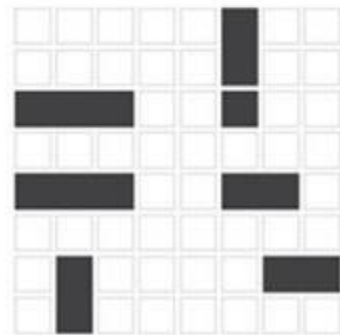
master plan

The new Western Maricopa Education Center (West-MEC) Southwest Campus is a first-of-its-kind innovative partnership between a public utility; Arizona Public Service, a community college; Estrella Mountain Community College and a joint technical education high school district; West-MEC. The primary goal of this triumvirate of industry, higher education and secondary education is to encourage and provide a career pathway into the energy industry and augment an aging workforce. **The West-MEC Southwest Campus is a unique Career and Technical Education campus with a specialized focus on sustainable energy**, ranging from solar, water conservation, to geothermal strategies to minimize dependence on the nation's 'Energy Grid'

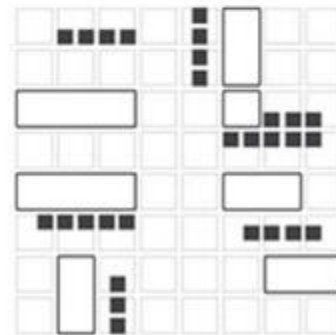
The 'National Energy Grid' is the inspiration for the campus physical plan and is symbolic of a didactic educational curriculum; the photovoltaic canopy becomes a tool to teach students about renewable energy systems.



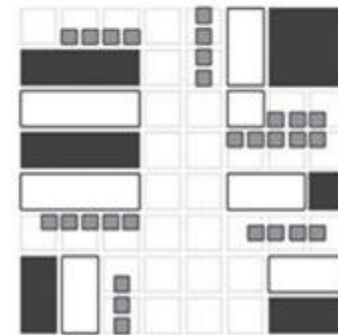
FRAMEWORK



LAB SPACES



CLASSROOMS



OUTDOOR SPACES



SPECIALIZED PROGRAMS

master plan

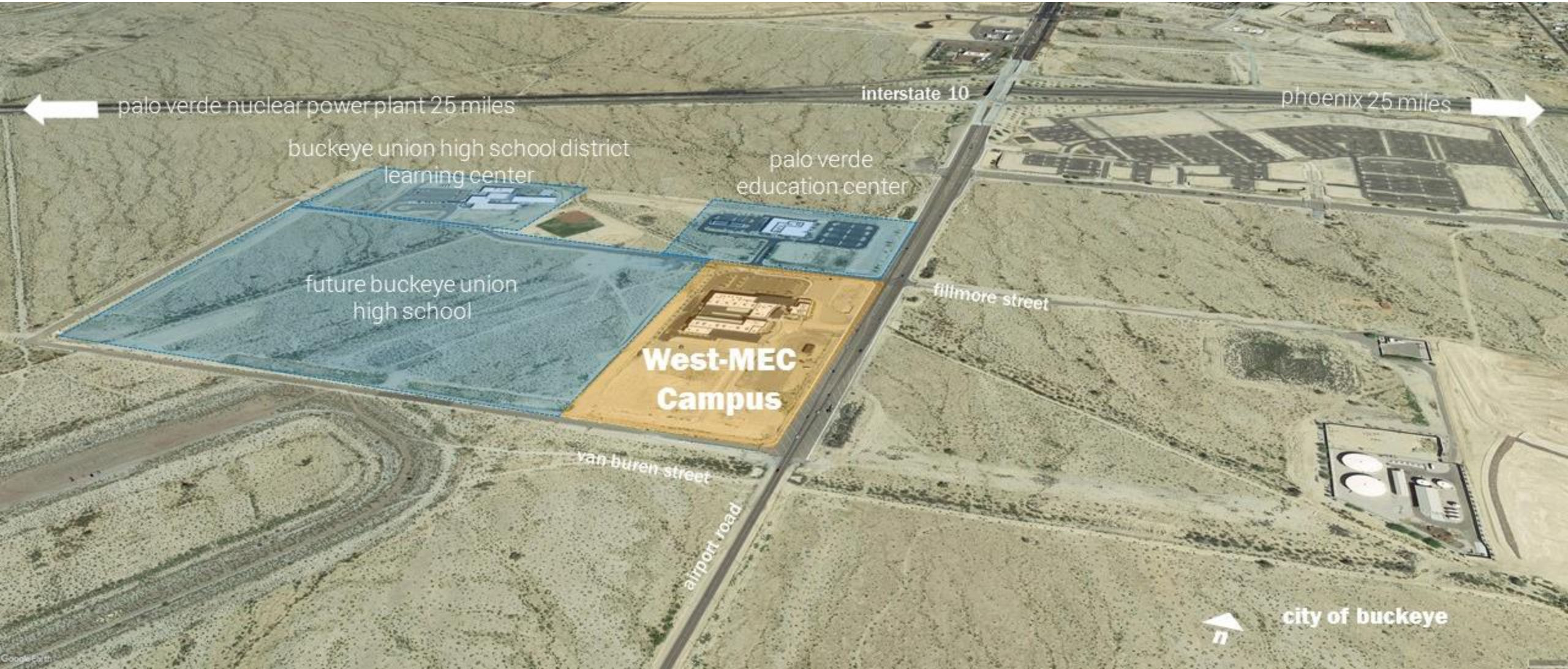
the BIG idea

... what if an education campus not only taught about the **energy industry**, but incorporated energy related concepts into **every aspect** of the curriculum and environment?

... what if it created the **first off-the-grid** high school building in the nation **as a teaching tool**?

... what if it harvested the power of the **sun** while providing protective shade to the inhabitants below?

context

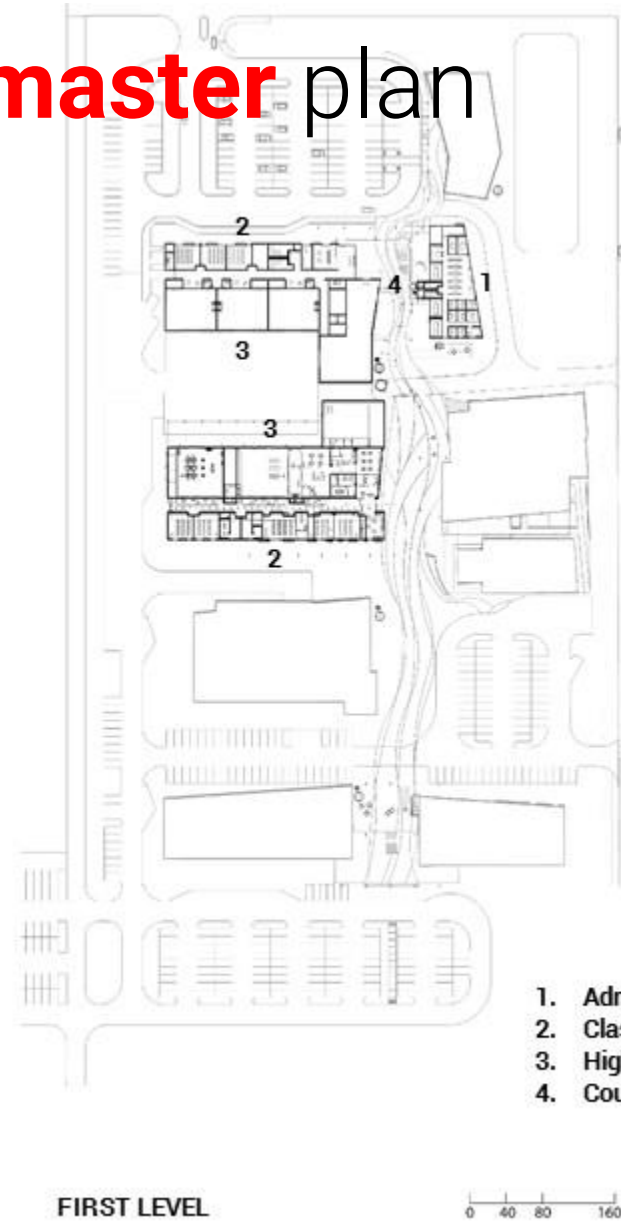




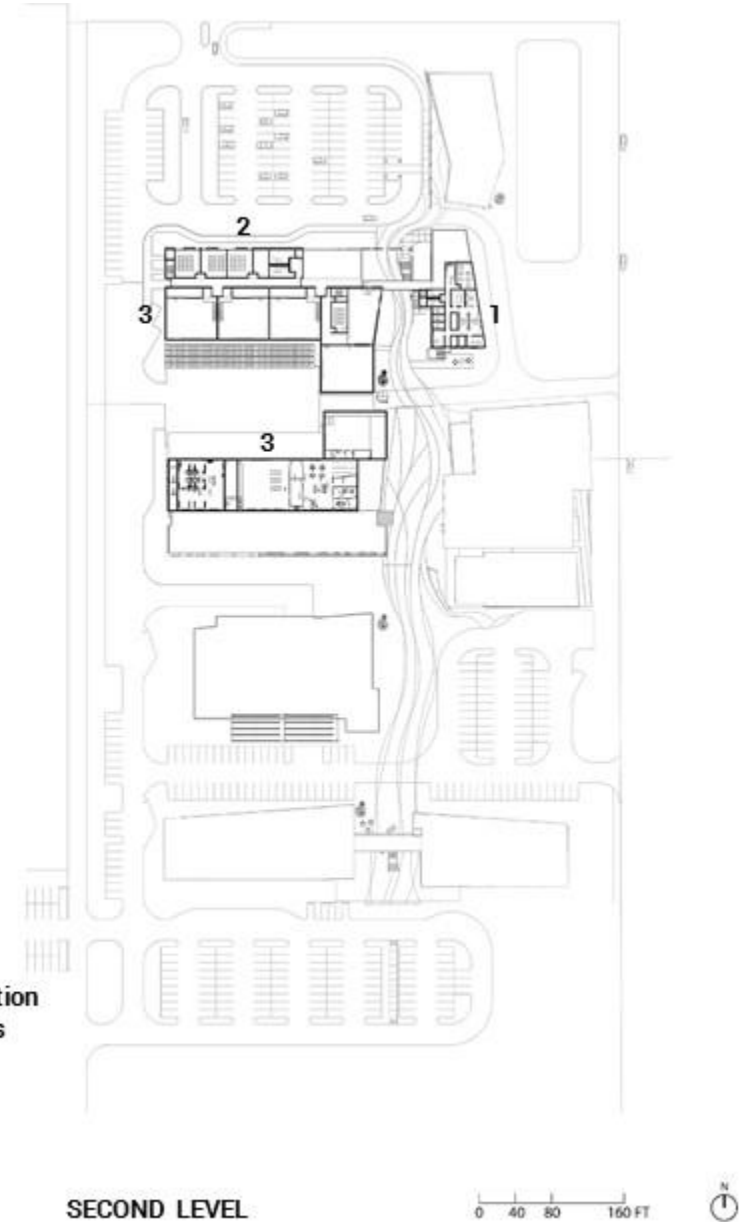
master plan



- Solar Canopy
- Outdoor Collaboration
- Educational Facilities



1. Administration
2. Classrooms
3. High-Bay
4. Courtyard



design concept



active

contemplative

passive

collaborative

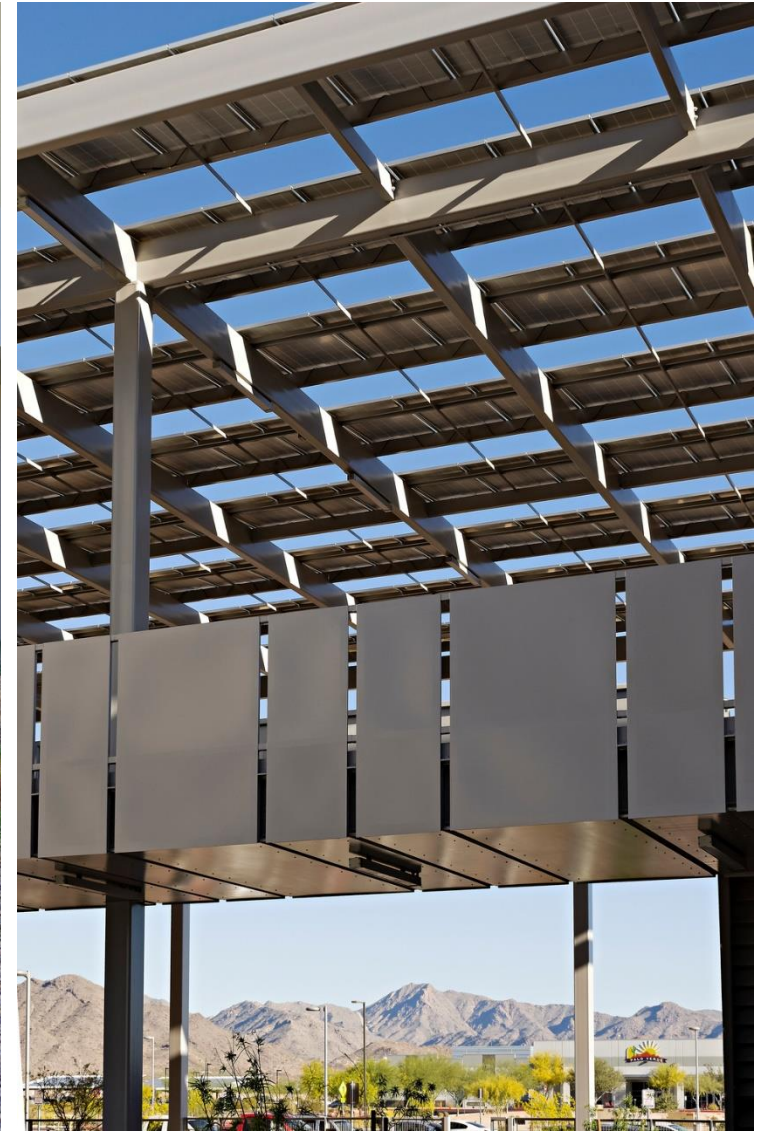
cognitive

active

design concept



active learning



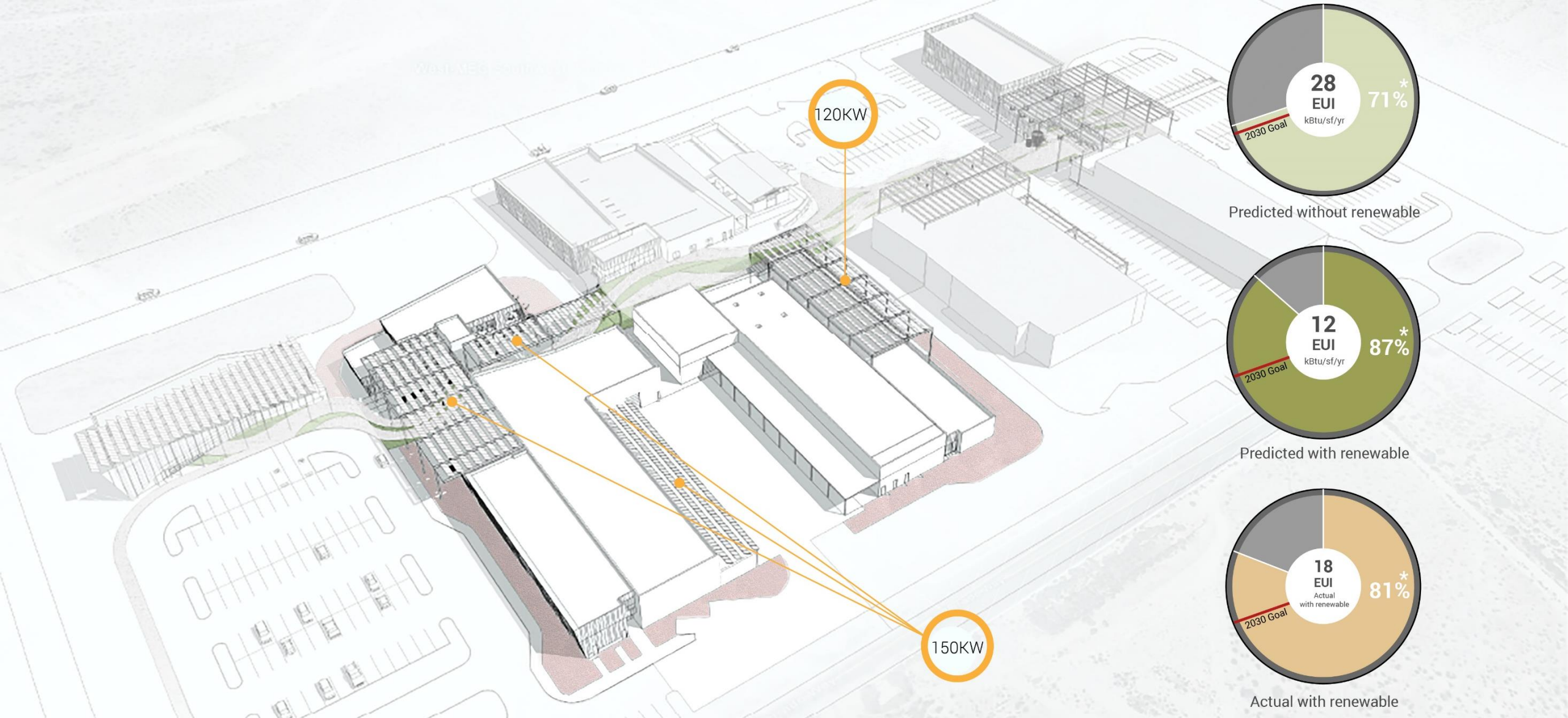
cognitive learning



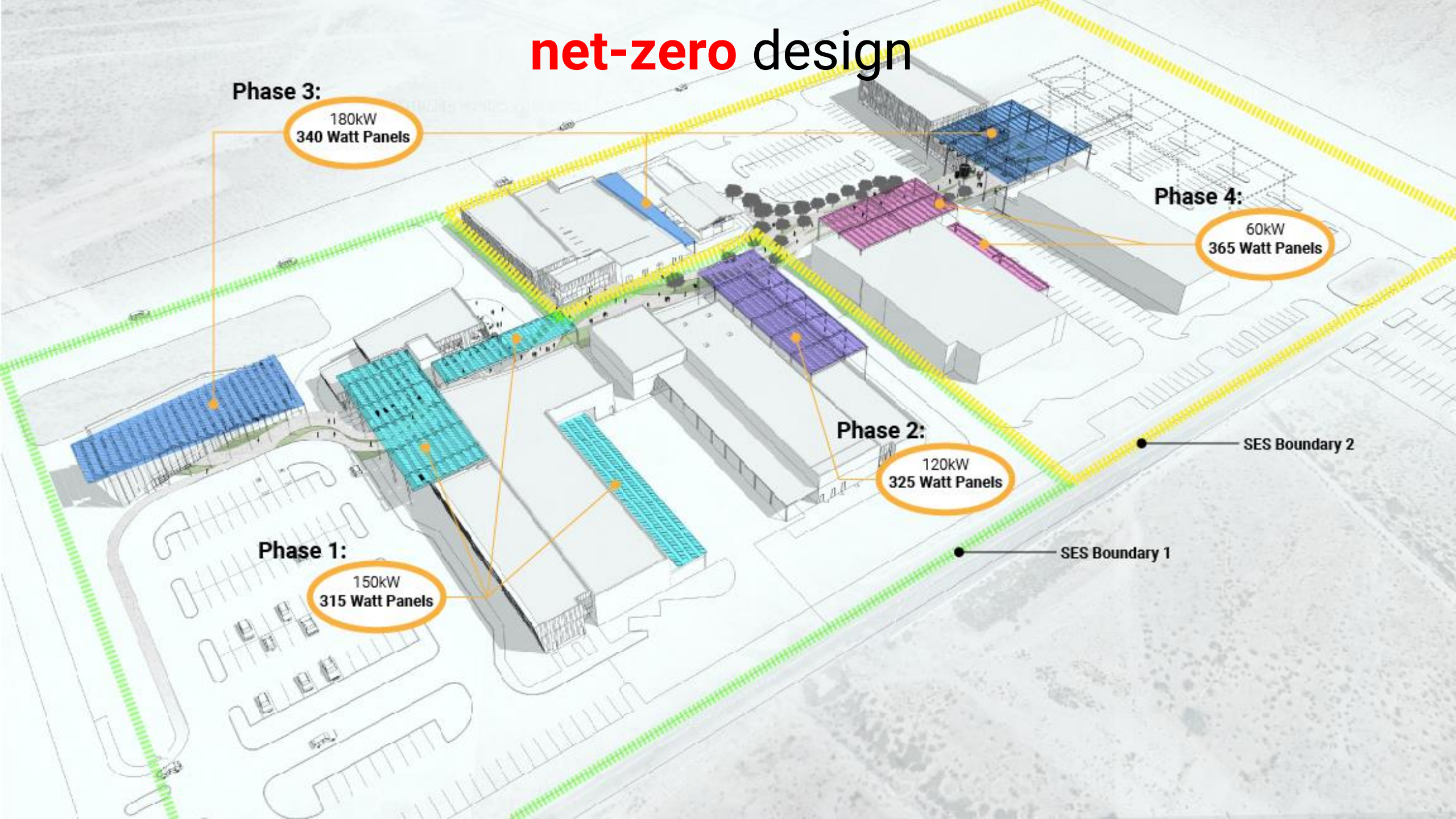
collaborative learning



net-zero design



net-zero design



net-positive design



lessons learned

Creating a 'microgrid' – **scale down**

- **Establish the electrical load** and its upstream electrical utility impact
- **Recognize** the infrastructure limitations - medium voltage service in lieu of a series of 3000 Amp services as determined by utility company
- Solar technology **advancements are advantageous**

Building Usage Changes – good to do post-occupancy reviews to adjust master planning for future phases

We were able to balance the additional need in energy through a much more aggressive passive design and optimized solar design.

If micro-grid is the vision, explore a variety of strategies:

- Diversity in usage between buildings
- Ownership of individual buildings over the period of development if it is not under one management
- Development agreements to include load shedding, connected utilities and utility purchase and sale costs
- Energy recovery between various building usages
- Maintenance agreements on centralized energy sources

step 2: energy **use/cost**



- this exercise is to establish an energy budget per building type
- Bag of Legos at each table
- 5 building type cards
- **goal**: how much source energy does each building consume in gas and electricity?
- **total** campus source energy use / site energy cost budget should equal to **100**.

step 2 results: energy **use/cost**

BUILDING TYPE PROGRAM: CLASSROOMS

AREA RATIO | 30% 50% existing, 50% new

SITE FUEL RATIO - GAS | 17%

SITE FUEL RATIO - ELECTRIC | 83%

source energy units: **18** (E - 17, G - 1)

energy cost units: **19** (E - 18, G - 1)

BUILDING TYPE PROGRAM: LABORATORIES

AREA RATIO | 20% 50% existing, 50% new

SITE FUEL RATIO - GAS | 33%

SITE FUEL RATIO - ELECTRIC | 67%

source energy units: **34** (E - 29, G - 5)

energy cost units: **33** (E - 29, G - 4)

BUILDING TYPE PROGRAM: RESIDENTIAL

AREA RATIO | 20% All existing

SITE FUEL RATIO - GAS | 13%

SITE FUEL RATIO - ELECTRIC | 87%

source energy units: **17** (E - 16, G - 1)

energy cost units: **17** (E - 16, G - 1)

step 2 results: energy **use/cost**

BUILDING TYPE PROGRAM: COMMUNITY

AREA RATIO | 20% All existing

SITE FUEL RATIO - GAS | 50%

SITE FUEL RATIO - ELECTRIC | 50%

source energy units: **25** (E - 18, G - 7)

energy cost units: **24** (E - 19, G - 5)

BUILDING TYPE PROGRAM: ADMINISTRATION

AREA RATIO | 10% All existing

SITE FUEL RATIO - GAS | 12%

SITE FUEL RATIO - ELECTRIC | 88%

source energy units: **6** (E - 6, G - 0)

energy cost units: **7** (E - 7, G - 0)

CAMPUS PROGRAM: TOTAL CAMPUS

AREA RATIO | 100% 65% existing, 35% new

SITE FUEL RATIO - GAS | 31%

SITE FUEL RATIO - ELECTRIC | 69%

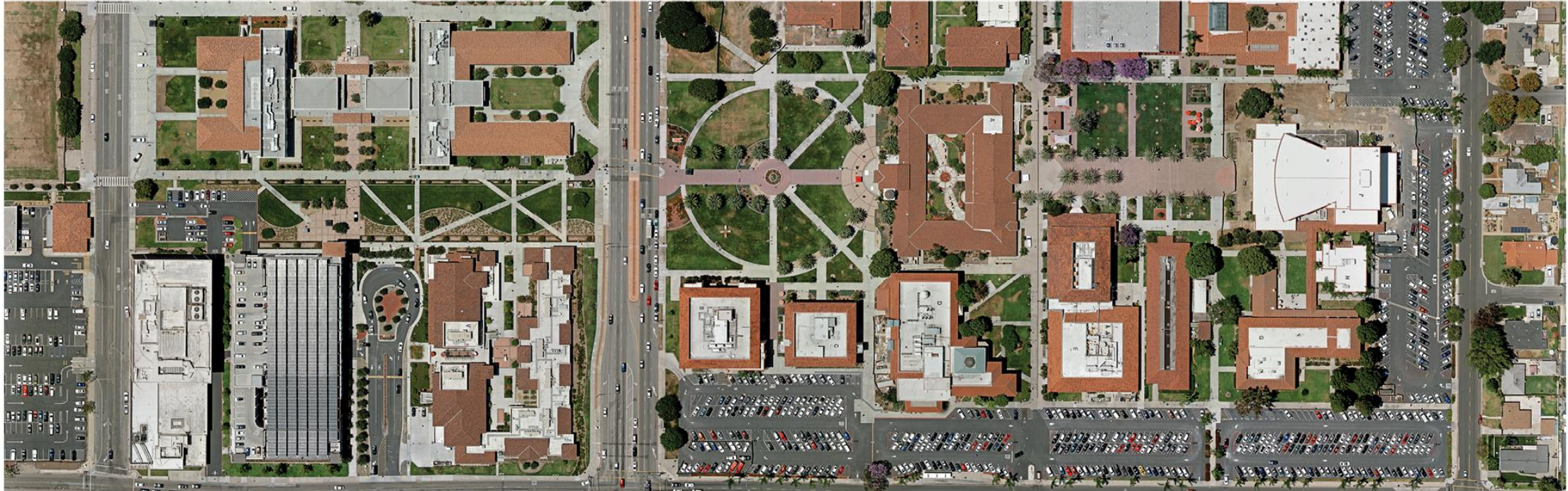
source energy units: **100** (E - 87, G - 13)

energy cost units: **100** (E - 89, G - 11)



INTEGRATED ENERGY MASTER PLAN

LONG BEACH COMMUNITY COLLEGE DISTRICT | JUNE 2018



LONG BEACH
CITY COLLEGE



CORDOBA CORPORATION
SACRAMENTO • SAN FRANCISCO • CHATSWORTH
LOS ANGELES • SANTA ANA • SAN DIEGO

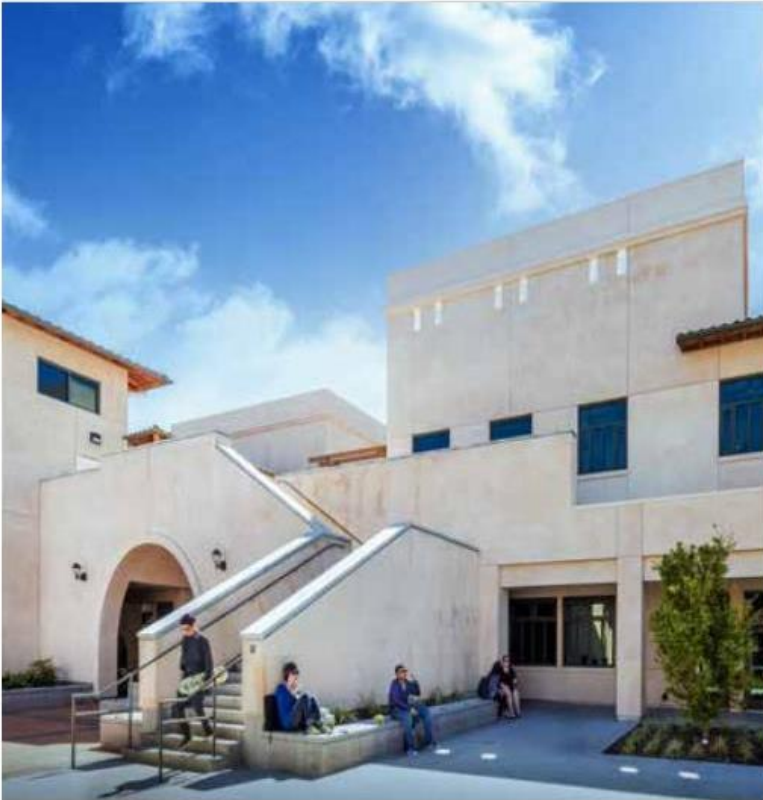











DLR Group

Architecture Engineering Planning Interiors



LBCC IEMP



	District	LAC	PCC
 No. of Buildings	48	30	18
 Gross SF of Buildings	1,581,982	1,293,419	288,563
 Staff	1282	1105	177
 Students	25,811	20,642	5161
 Electricity (kwh)	14,597,844	11,018,909	3,578,935
 Natural Gas (therms)	369,315	307,085	62,230
 Water (gallons)	21,120,452	14,246,408	6,874,044
 Utility Costs	\$2,592,418	\$1,869,657	\$722,761
 Vehicles	127	/	/

steps in **energy master planning**

Step 1: Vision

- Identify drivers and set goals with timelines
- Convert goals into measurable KPIs (Key Performance Indicators)

Step 2: Macro-scale Plan

- Implementable plan that identifies
 - Strategies to achieve set goals.
 - Projects that includes Strategies with acceptable ROI.
 - Timelines with funding opportunities.

Step 3: Micro-scale Initiatives

- Measurable and verifiable implementation projects
 - At campus level
 - At building level

driving factors

- Energy codes getting more stringent – driving toward zero net energy.
- Student population expecting stewardship.
- Develop an integrated energy master plan (IEMP) to primarily meet the requirements of Executive Order (EO) B-18-12.
- Align the IEMP with other energy policies such as EO B-30-15, EO S-3-05, AB 32 etc.
- Include recommendations for larger sustainability goals as part of the IEMP as an additional scope.



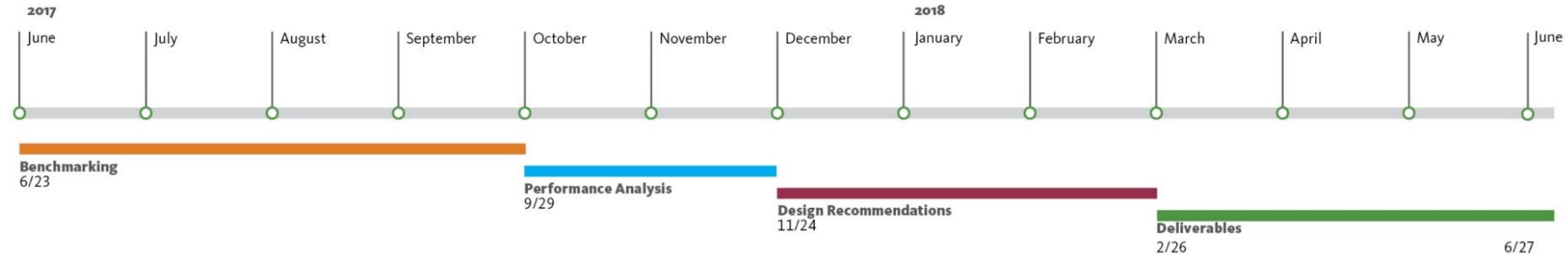
IEMP **goals**



→ Sustainability

-  Education & Research
-  Utilize Green Building Practices
-  Climate Change Management
-  Sustainable Food & Dining
-  Renewable Energy
-  Sustainable Land Use
-  Purchase Sustainable Goods & Services
-  Alternative Fuel
-  Waste Management
-  Manage Water Resources
-  Improve Social & Economic Factors
-  Energy Use Optimization

scope and **schedule**



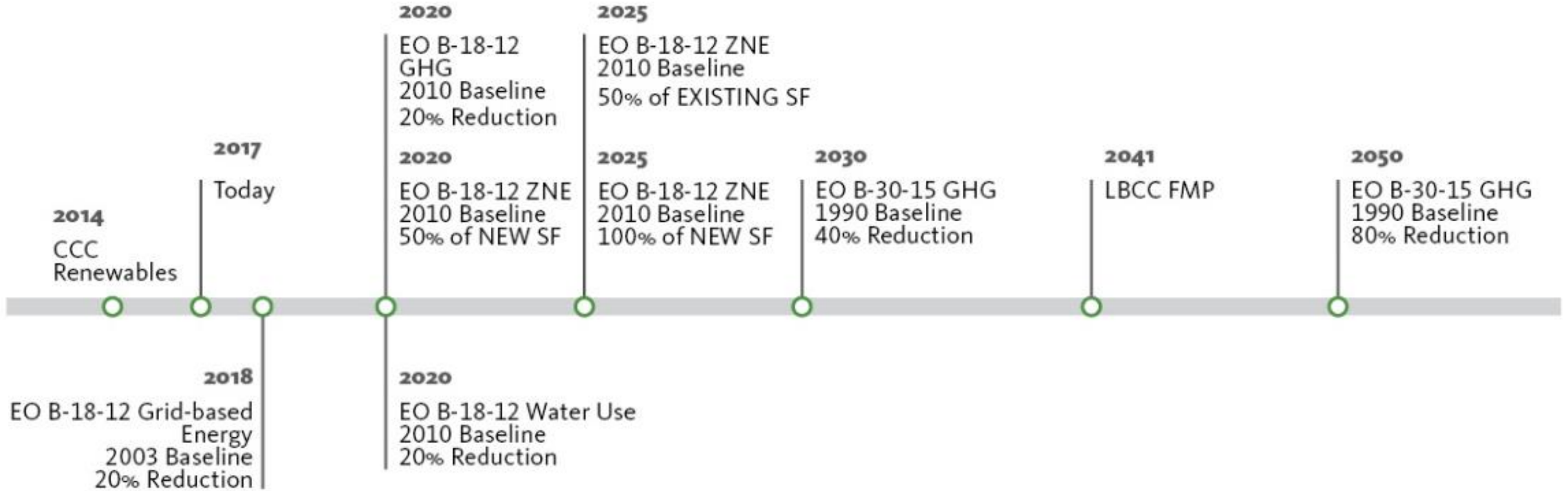
PLANNING PROCESS



key performance indicators

Focus Area	Topic	Driving Factors	Metric	Baseline	Timeline	Scale
1	Management of Climate Change					
	Entity-wide Greenhouse Gas reduction	EO B-18-12	10% Reduction	2010	2015	District Level
	EO B-18-12; AB 32	20% Reduction	2010	2020	District Level	
	EO B-30-15	40% Reduction	1990	2030	District Level	
	EO B-30-15; EO S-3-05	80% Reduction	1990	2050	District Level	
2	Optimization of Energy Use					
	2a ZNE for new buildings	EO B-18-12	50% of SF	Avg. Building EUI	2020 to 2025	District Level
	2b ZNE for new buildings and major renovation	EO B-18-12	100% of SF	Avg. Building EUI	2025 onwards	District Level
	2c ZNE for existing buildings	EO B-18-12	50% of SF	Avg. Building EUI	2025	District Level
	2d Reduce grid-based energy purchases for buildings	EO B-18-12	20% Reduction	2003	2018	District Level
	2e Reduce grid-based energy purchases for non-buildings	EO B-18-12	20% Reduction	2003	2018	District Level
	2f Participate in demand response programs	EO B-18-12			2012 onwards	Building Level
3	Renewable Energy					
	On-site energy generation for new or major renovation	EO B-18-12	> 10,000 SF		2012 onwards	District Level
	Purchase electricity from renewable energy sources	ACUPCC	15% of total electricity purchase			
4	Manage Water Resources					
	Water use reduction	EO B-18-12	10% reduction	2010	2015	District Level
		EO B-18-12	15% reduction	2010	2020	District Level
5	Use Green Building Practices					
	5a LEED Silver or higher on new and major renovation	EO B-18-12	> 10,000 SF	current version	2012 onwards	Building Level
	Comply with Cal Green Building Standards' Tier 1 measures	EO B-18-12	< 10,000 SF	current version	2012 onwards	Building Level
	LEED EBOM certification on existing buildings	EO B-18-12	> 50,000 SF, Energy Star >75	Avg. Building	2015	Building Level
	5b Building commissioning on new or major renovation	EO B-18-12	>5,000 SF		2012 onwards	Building Level
	Building commissioning on existing buildings	EO B-18-12	As needed	Avg. Building EUI	2012 onwards	Building Level
	Monitoring based commissioning on existing buildings	EO B-18-12	>5,000 SF as needed	Avg. Building EUI	2012 onwards	Building Level
	5c Develop operation and maintenance policies and guidelines	EO B-18-12		2013	Building Level	
6	Indoor Environmental Quality					
	Implement Division A5.5 of Cal Green Building Std code	EO B-18-12		current version	2012 onwards	Building Level
7	Use Alternative Transportation & Fuels					
	7a Electric vehicle charging station	EO B-18-12	Plan for future demand		2012 onwards	Campus Level
8	Sustainable Land Use					
	Develop sustainable land use planning principles		Address in the future			Campus Level
9	Purchase Sustainable Goods and Services					
	Purchasing policy EO B-18-12	Public Contract Code 12400		2012 onwards	District Level	
10	Waste Management					
	Participate in waste minimization measures	ACUPCC	Adopt 3 or more reduction measures			

key metrics + **timelines**

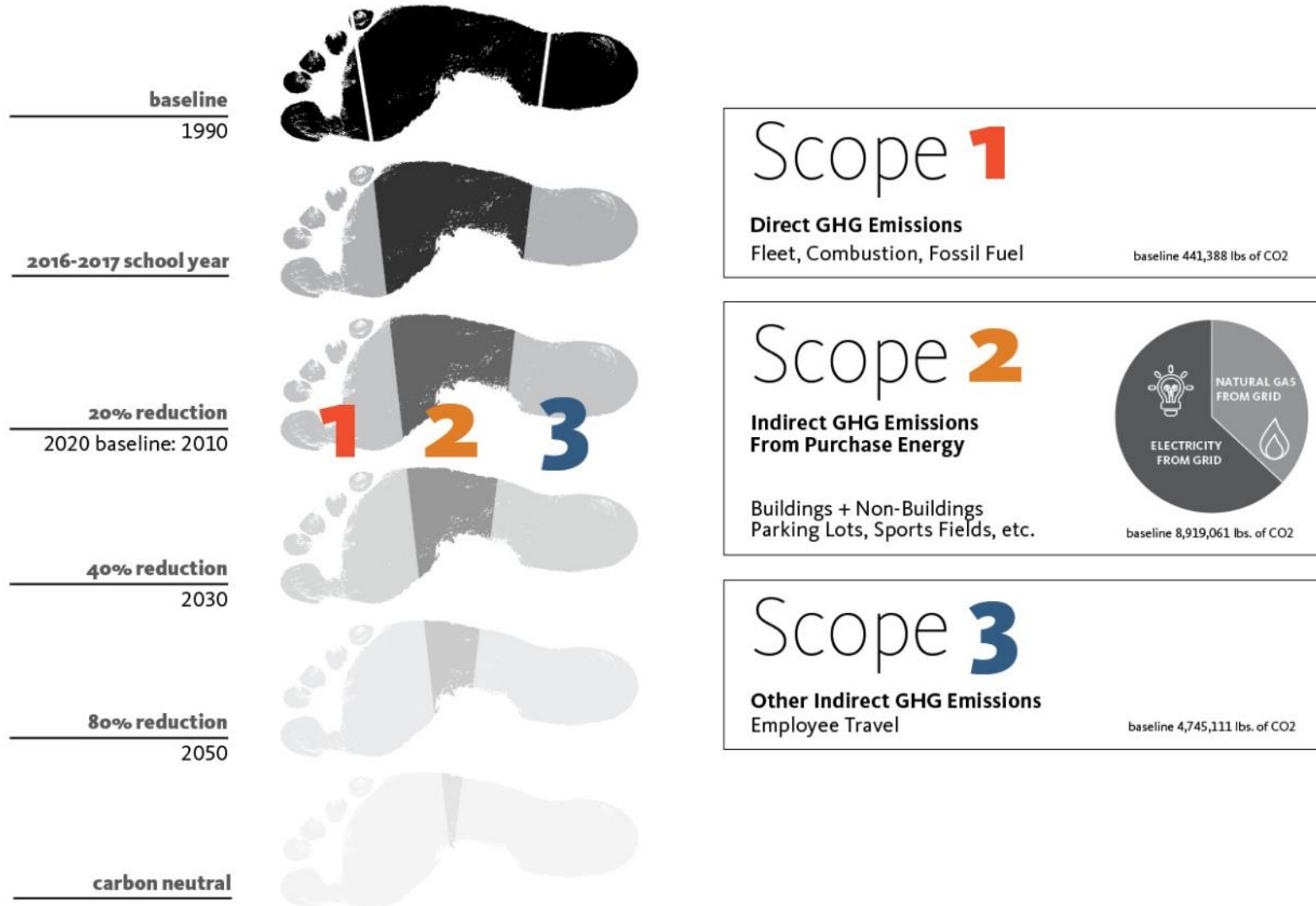


setting **targets**



○ Projections ● Historical Data ☆ Target

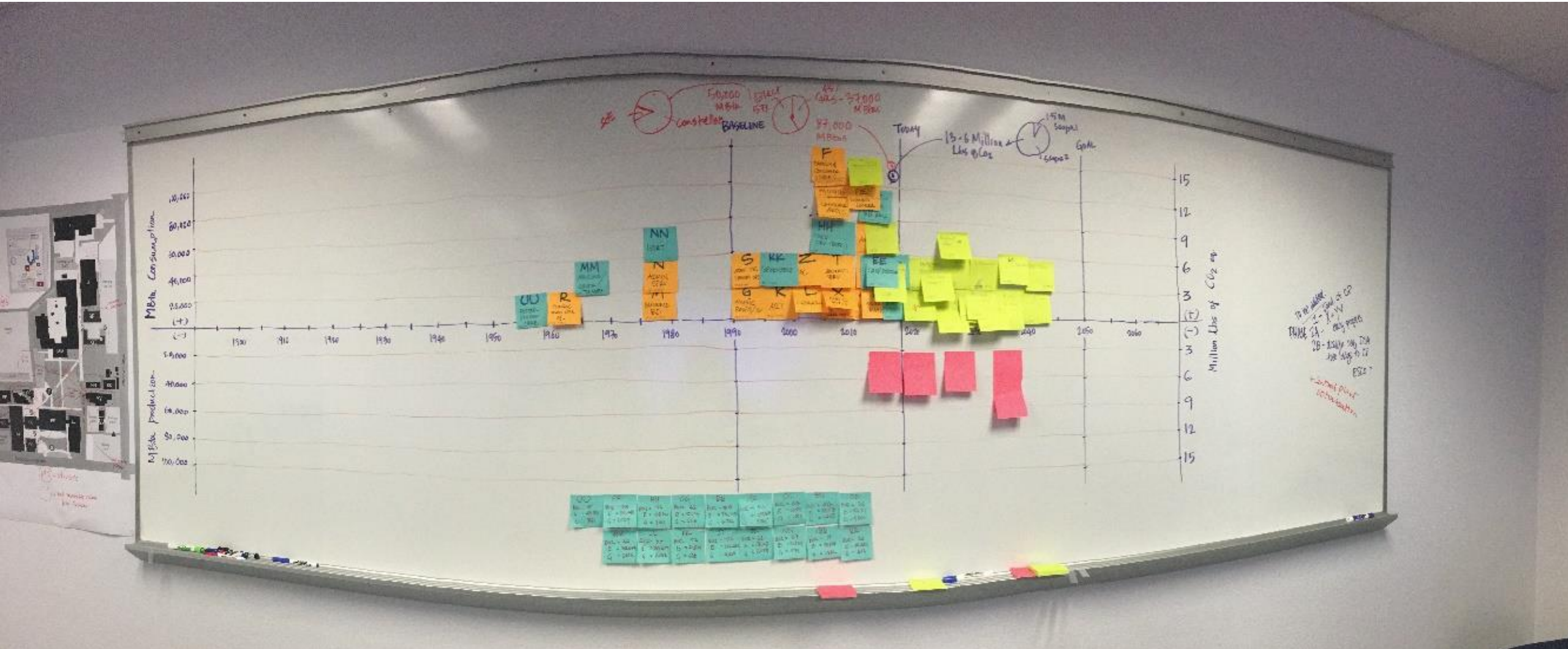
anticipate **results**



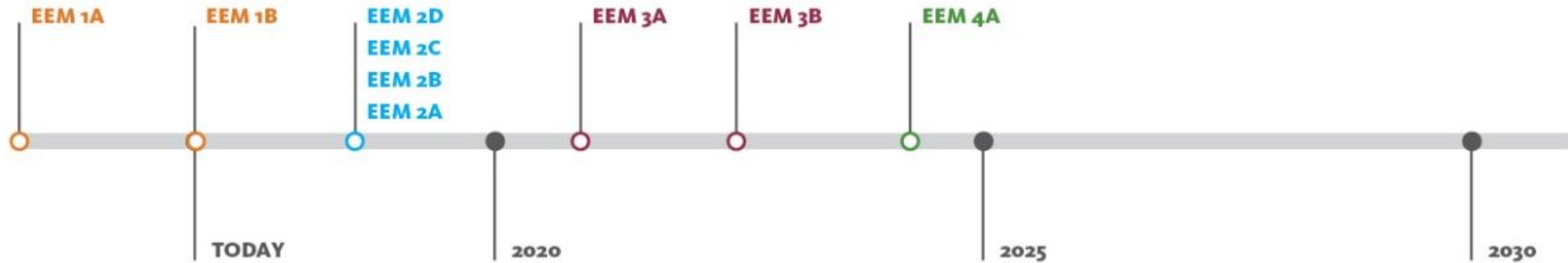
performance analysis – **lenses**



performance analysis – lenses



design **recommendations**



EEM 1A

- Measures taken in the past.
- Measure E and Prop 39 Projects

EEM 1B

- Measures currently pursuing to continue best practices in travel offsets, water efficiency and design standards.

EEM 2A

- Energy Use Reduction Strategies
- Implementing retro-commissioning and ASHRAE Level 1 & 2 recommendations including additional metering and reclaimed water conversion at LAC cooling tower.

EEM 2B

- Renewable Energy Production Strategies
- Solar system installations in phases.

EEM 2C

- Thermal Storage Strategies within buildings.
- Phase Change Material Technology implementation pilot at PCC followed by full implementation.

EEM 2D

- Clean energy use strategies for transportation.
- Install electric vehicle charging stations District wide.

EEM 3A

- Electric storage strategies at campus level.
- Install battery storage solutions.

EEM 3B

- Share and manage energy for resiliency
- Implement micro-grid solutions utilizing Siemens Controls.

EEM 4A

- Renewable Energy Production Strategies
- Install additional solar systems as needed to accommodate growth.

EEM 5-10

- Continue best practices periodic assessment of meeting targets every three years until 2050 and applying necessary best practices and technology to close the gap.

ex.: design **recommendations**



- ASHRAE LEVEL 1 & 2 STRATEGIES
- RECLAIMED WATER CONVERSION AT COOLING TOWER
- SITE LIGHTING IMPROVEMENT & WALKWAY/ROADWAY

anticipated **results**

BEFORE:
Energy Use Intensity Graph for LAC



AFTER:
Energy Use Intensity Graph for LAC



anticipated **results**

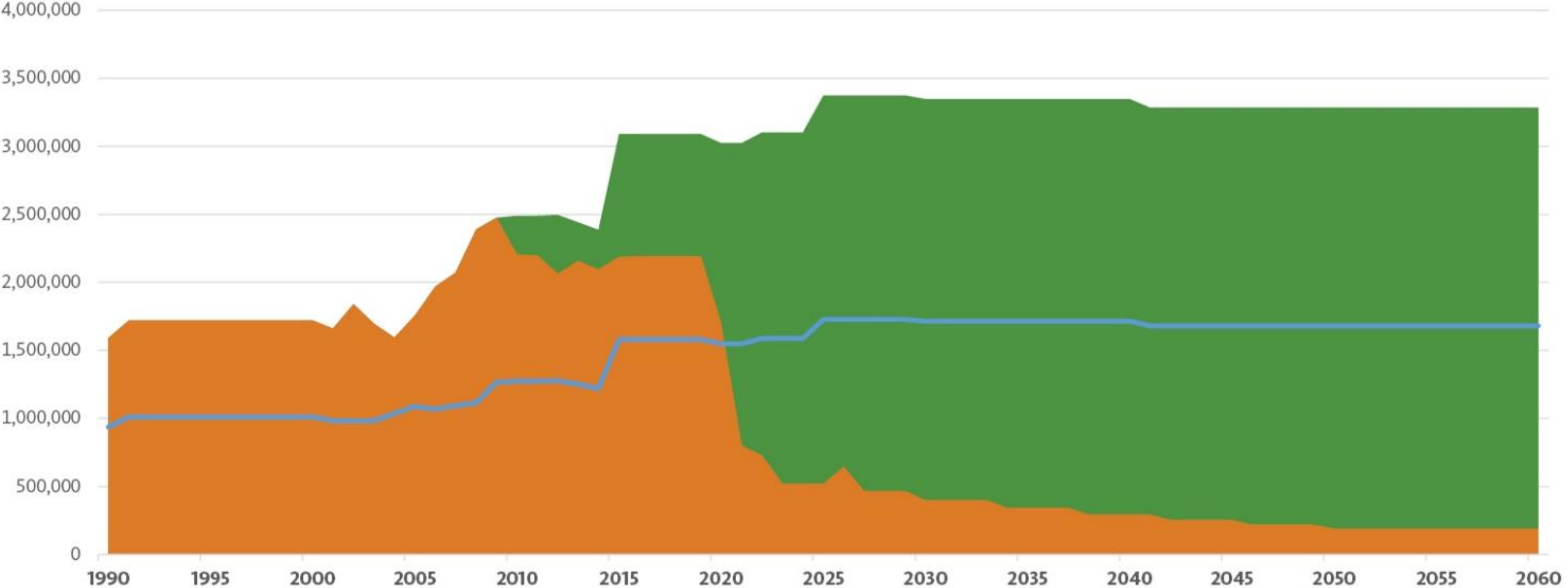
BEFORE:
Energy Use Intensity Graph for PCC



AFTER:
Energy Use Intensity Graph for PCC

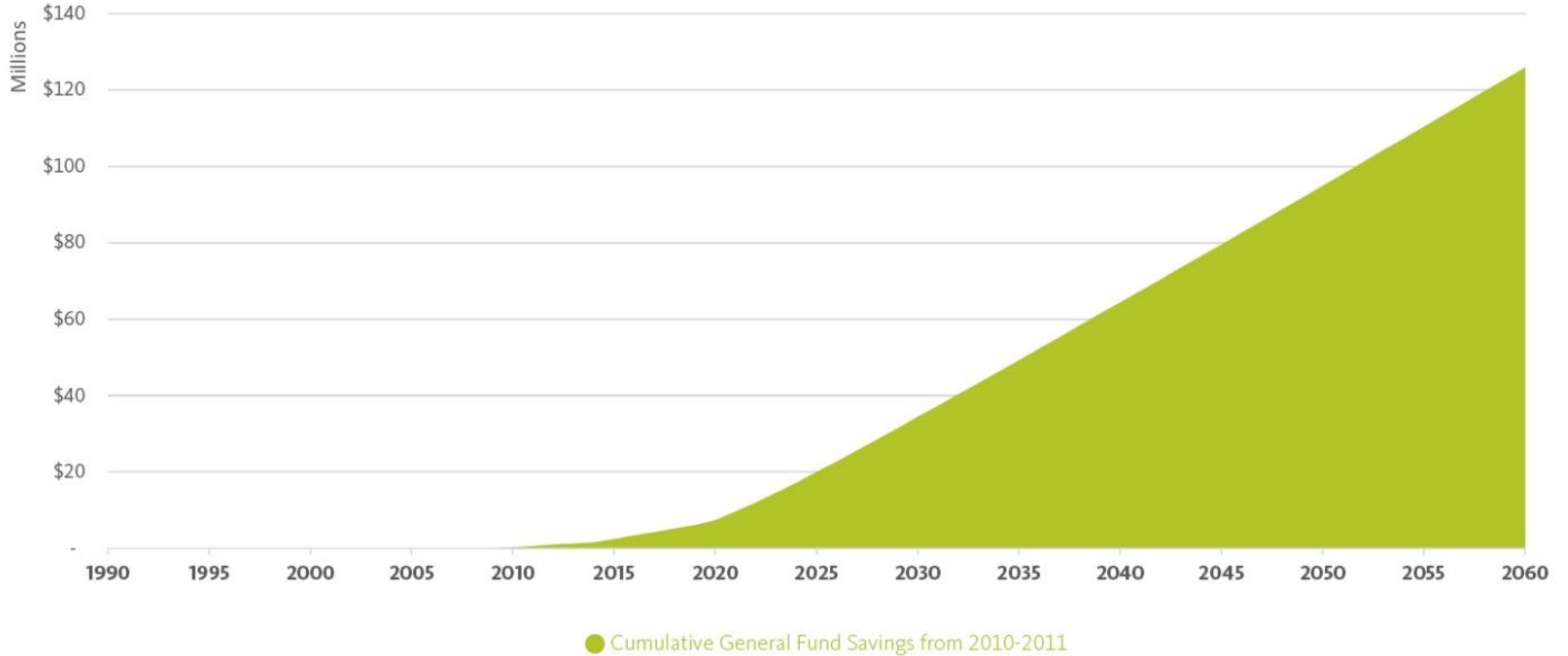


general fund **savings**



● Projected Energy Cost without EEMs ● Total Energy Cost ● Total Gross Square Footage

general fund **savings**



break



step 3: net-zero **strategy**



- this exercise is to apply appropriate strategies to achieve net-zero energy at a campus level
- 87 legos for electricity
- 13 legos for gas
- **goal**: eliminate 100 source energy use units via strategies that have the least capital cost with the most savings on operational costs
- **total** campus energy use blocks left should equal to 0.

step 3: net-zero **strategy**



LIGHTING STATISTICS

SOURCE ENERGY SAVINGS UNITS	8	Each Source Energy Savings Unit is equal to approximately 4,500 MMBtus
ENERGY COST SAVINGS UNITS	5	Each Energy Cost Savings Unit is equal to approximately \$80,000
CAPITAL COST UNITS	6	Each Capital Cost Unit is equal to approximately \$300,000

DJR Group
WORKSHOP
FLASHCARDS

- 16 independent strategy cards
- 2 strategies are cumulative
 - solar – 15%, 30%, 45%
 - battery – 15%, 30%, 45%
- with each card, you can eliminate certain number of source energy units
- you will have to gauge how much of that is electricity and gas
- an estimate on actual numbers provided based on our simulation

step 3 results: net-zero **strategy**

source energy units savings: **100** (E – 87, G – 13)

energy cost units: **114**

capital cost units: **89**

strategies:

- solar thermal
- lighting
- retro-commissioning
- low-cost HVAC
- medium-cost HVAC
- phase change materials
- plug-load control
- PV – 30%
- Cogen

- strategies eliminate both gas and electricity
- energy cost units are higher than 100 as synergies between strategies not taken into account

discussion



climate **commitment**

American College and University Presidents Climate commitment.

The Climate Commitment integrates carbon neutrality with climate resilience and provides a systems approach to mitigating and adapting to a changing climate.

The **Second Nature** website is a resource to help innovative leaders build broader and deeper levels of climate action impact both on and off campuses.

The screenshot displays the Second Nature Reporting Platform interface. It features a search bar, a filters sidebar, and a main table of data. The table columns include Institution, Commitment, State, Carnegie Classification, Total Emissions, % Change Emissions, Total Building Sq. Ft., Enrollment (FT), RE Energy Generation (kWh), and Carbon Neutrality Date. The table lists various institutions such as Adams State University, Alaska Pacific University, and American University, along with their respective commitment details and metrics.

Institution	Commitment	State	Carnegie Classification	Total Emissions	% Change Emissions	Total Building Sq. Ft.	Enrollment (FT)	RE Energy Generation (kWh)	Carbon Neutrality Date
Adams State University	Carbon	CO	MA	18,711	20.93	1,132,787	2,578	233,586	2030
Alaska Pacific University	Carbon	AK	BA	4,637	0.00	244,015	471	0	2023
Alfred State College SUNY College of	Carbon	NY	BA	-7,104	-133.22	1,747,302	3,661	1,215	2040
Allegheny College	Climate	PA	BA	6,931	-62.20	1,436,086	1,856	4,526	2020
American Public University System	Carbon	WV	MA	7,292	225.25	224,564	80,000	425	2050
American University	Climate	DC	DR	-745	-101.34	4,115,069	12,500	34,000	2020
Antioch University Los Angeles	Carbon	CA	MA	1,375	68.70	65,252	990	0	
Antioch University New England	Carbon	NH	DR	2,538	-4.26	90,500	758	0	2020
Appalachian State University	Climate	NC	MA	74,219	-0.14	5,288,095	17,391	608,282	2050
Aquinas College	Carbon	MI	MA	7,556	-21.97	769,113	1,666	14,400	2040
Arizona State University	Climate	AZ	DR	266,653	-31.38	23,179,...	76,194	11,593	2035
Auburn University	Carbon	AL	DR	638,874	170.15	9,265,526	24,019	6,644	2050
Augsburg University	Carbon	MN	MA	8,623	-60.21	1,027,089	4,071	0	2019

http://secondnature.org/climate-guidance/the-commitments/#Climate_Commitment
<http://reporting.secondnature.org/home/>

aashe stars

*Association for the Advancement of Sustainability in
Higher Education*

*Sustainability Tracking, Assessment and Rating
System*

OP1: Greenhouse Gas Emissions

OP3: Building Operations and Maintenance

OP4: Building Design and Construction

OP5: Building Energy Consumption

OP6: Clean and Renewable Energy

<https://stars.aashe.org/>

The screenshot shows the homepage of the AASHE STARS website. At the top, there is a navigation bar with links for 'aashe', 'stars', 'conference', 'community', 'hub', and 'bulletin', along with a 'Log In' link. Below the navigation bar is the STARS logo, which consists of a blue circular icon with a white star and the text 'stars a program of aashe'. To the right of the logo is a description of the system: 'The Sustainability Tracking, Assessment & Rating System™ (STARS) is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance.' A blue button labeled 'Reporting Tool' is positioned to the right of this text. Below the logo and description is a dark blue navigation bar with a 'Register' button and links for 'About', 'Participate', 'Reports', and 'Support'. A search bar is located on the right side of this bar. Below the navigation bar are three main content areas: a green 'Get Started Now' button with the text 'Why Participate?' below it; a 'See the Credits »' button with a thumbnail of a technical manual; a 'Browse all Reports »' button with a circular STARS logo and the text 'Bow Valley College Submitted April 2018'; and an 'Explore the Data »' button with a circular data visualization chart. Below these areas is a 'Latest Updates' section with a list of four bullet points: 'A list of STARS reports that have been shared with Sierra magazine to inform its 2018 Cool Schools ranking has been published. View the list.', 'Food and Beverage Purchasing public comment results have been published. View the results.', 'Improve your submission and earn bonus points with new STARS Review Template. Learn more.', and 'Download the 2017 Sustainable Campus Index to see top performing institutions as measured by STARS.' Below the list is a green button labeled 'Subscribe to the STARS Update'. At the bottom of the page, there is a footer with the AASHE logo, the text '© 2018 Association for the Advancement of Sustainability in Higher Education 2401 Walnut Street Suite 102 Philadelphia, PA 19103 - t: 888-347-9997', and links for 'Contact Us', 'Privacy Policy', 'AASHE API v1.0', and social media icons for Facebook and Twitter.

ENERGY STAR Target Finder

Energy Benchmarking

<http://www.energystar.gov/buildings/tools-and-resources/target-finder-0>

The screenshot shows the 'Target Finder' tool interface. At the top, it says 'ENERGY STAR Portfolio Manager'. Below that, the 'Target Finder' section explains that users can set an energy target and compare estimated energy use to it. The form is divided into several sections: 'About Your Design Project', 'Property Use Details', 'Estimated Design Energy (Optional)', and 'Target'. The 'About Your Design Project' section includes fields for Name, Country (dropdown), Street Address, City/Municipality, State/Province (dropdown), and Postal Code. It also has options for Reporting Units (Conventional EPA Units or Metric Units), Year Planned for Construction Completion, Property Type (dropdown), and Gross Floor Area (with checkboxes for SI, Ft, Temporary, and Usable). The 'Property Use Details' section asks for the number of physical buildings and provides radio button options for 'None', 'One', or 'More than One'. The 'Estimated Design Energy' section has a checkbox for 'I don't have (or don't want to) enter energy estimates' and a table for entering energy data. The 'Target' section allows users to choose a 'Target ENERGY STAR Score' (input field) or 'Target % Better than Median' (radio button). A 'View Results' button is at the bottom right.

About Your Design Project

Name:

Country:

Street Address:

City/Municipality:

State/Province:

Postal Code:

Reporting Units: Conventional EPA Units (e.g., kBtu/ft²) Metric Units (e.g., GJ/m²)

Year Planned for Construction Completion:

Property Type for your Design Project:

Gross Floor Area: Temporary Usable

How many physical buildings will be part of your property? None. My property is part of a building One. My property is a single building More than One. My property includes multiple buildings (Campus Guidelines)

How many?

Property Use Details

In order to provide you with metrics about your design, we need to know how the space in this property will be used. Based on the property type you selected, we are assuming this is how the floor area of this property will be used. If your property has multiple property uses you can add them below in order to correctly identify the square footage of your design property.

Estimated Design Energy (Optional)

If you have an estimate of how much energy your design property will use annually, enter it below. The tool will calculate your ENERGY STAR design score (if applicable) and show how your estimated energy use compares to the target and median property. To get the most accurate results, provide estimates for total annual energy for each energy type to be used for operating the building.

I don't have (or don't want to) enter energy estimates.

Energy Type	Units	Estimated Total Annual Energy Use	Energy Rate (kWh/ft ²)
<input type="checkbox"/> Electric - Grid	<input type="text" value="kWh/Year (thousand Btu)"/>	<input type="text"/>	<input type="text" value="kWh/Year (thousand Btu)"/>

Target

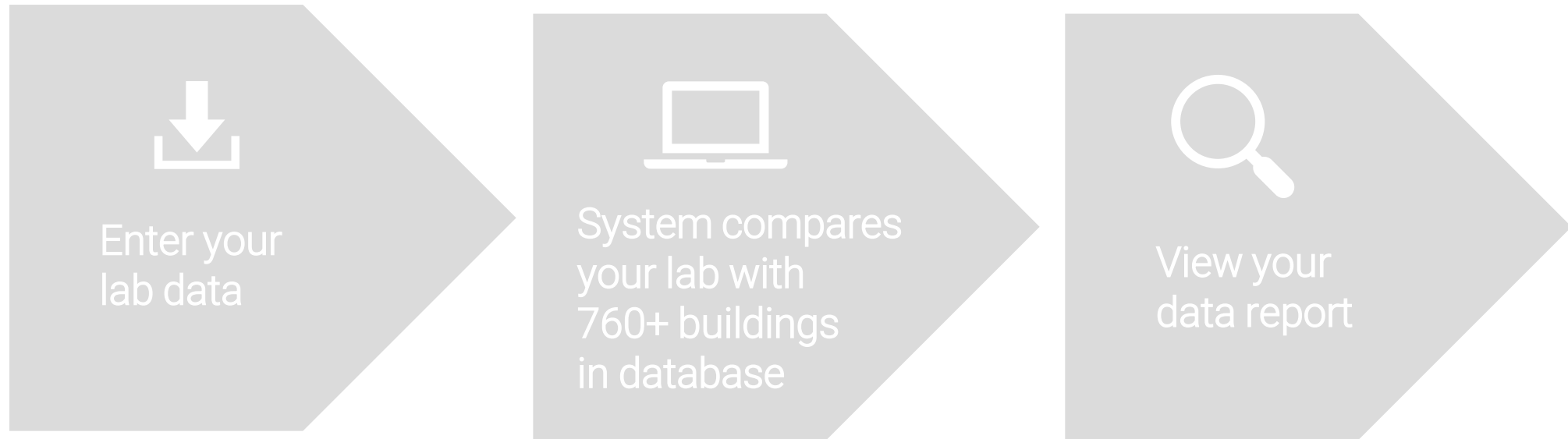
You can choose either a Target ENERGY STAR Score or a Target % Better than Median to see how much energy your property would need to be consuming annually to reach your target. If you have estimated your property's annual consumption, you can compare this against your target.

Target ENERGY STAR Score (1-100)

Target % Better than Median This is calculated based on the median property. For example, you might like your property to be 20% better than a typical property of the same type.

Follow Us [Contact Us](#) [Privacy Policy](#) [Member Requirements](#) [ENERGY STAR Building & Plans Website](#)

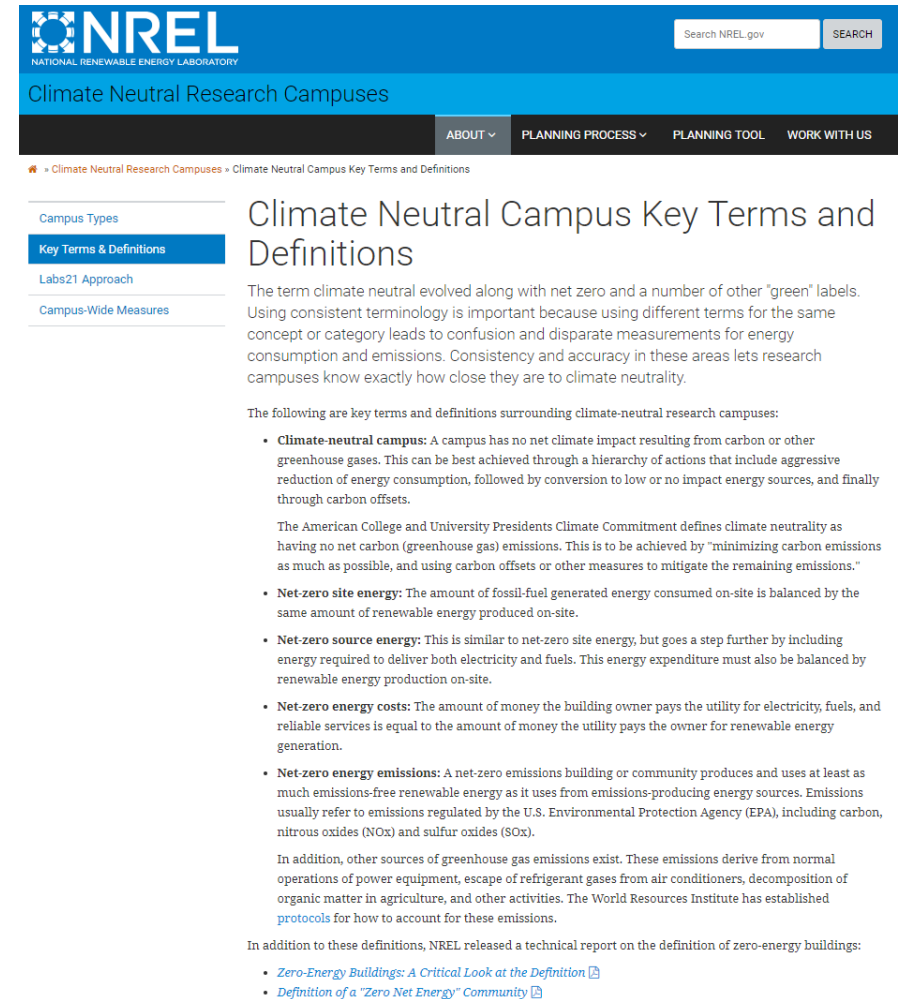
lab **benchmarking**



Labs 21 Benchmarking Tool is hosted by Lawrence Berkeley National Lab (LBNL)
<http://www.labs21benchmarking.lbl.gov>

carbon neutral

NREL Carbon Neutral Campus Key Terms and Definitions



The screenshot shows the NREL website page for 'Climate Neutral Campus Key Terms and Definitions'. The page features a blue header with the NREL logo and a search bar. Below the header is a navigation menu with options like 'ABOUT', 'PLANNING PROCESS', 'PLANNING TOOL', and 'WORK WITH US'. The main content area includes a sidebar with a table of contents and a main text area with a list of key terms and definitions.

Climate Neutral Campus Key Terms and Definitions

The term climate neutral evolved along with net zero and a number of other "green" labels. Using consistent terminology is important because using different terms for the same concept or category leads to confusion and disparate measurements for energy consumption and emissions. Consistency and accuracy in these areas lets research campuses know exactly how close they are to climate neutrality.

The following are key terms and definitions surrounding climate-neutral research campuses:

- **Climate-neutral campus:** A campus has no net climate impact resulting from carbon or other greenhouse gases. This can be best achieved through a hierarchy of actions that include aggressive reduction of energy consumption, followed by conversion to low or no impact energy sources, and finally through carbon offsets.

The American College and University Presidents Climate Commitment defines climate neutrality as having no net carbon (greenhouse gas) emissions. This is to be achieved by "minimizing carbon emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions."

- **Net-zero site energy:** The amount of fossil-fuel generated energy consumed on-site is balanced by the same amount of renewable energy produced on-site.
- **Net-zero source energy:** This is similar to net-zero site energy, but goes a step further by including energy required to deliver both electricity and fuels. This energy expenditure must also be balanced by renewable energy production on-site.
- **Net-zero energy costs:** The amount of money the building owner pays the utility for electricity, fuels, and reliable services is equal to the amount of money the utility pays the owner for renewable energy generation.
- **Net-zero energy emissions:** A net-zero emissions building or community produces and uses at least as much emissions-free renewable energy as it uses from emissions-producing energy sources. Emissions usually refer to emissions regulated by the U.S. Environmental Protection Agency (EPA), including carbon, nitrous oxides (NOx) and sulfur oxides (SOx).

In addition, other sources of greenhouse gas emissions exist. These emissions derive from normal operations of power equipment, escape of refrigerant gases from air conditioners, decomposition of organic matter in agriculture, and other activities. The World Resources Institute has established [protocols](#) for how to account for these emissions.

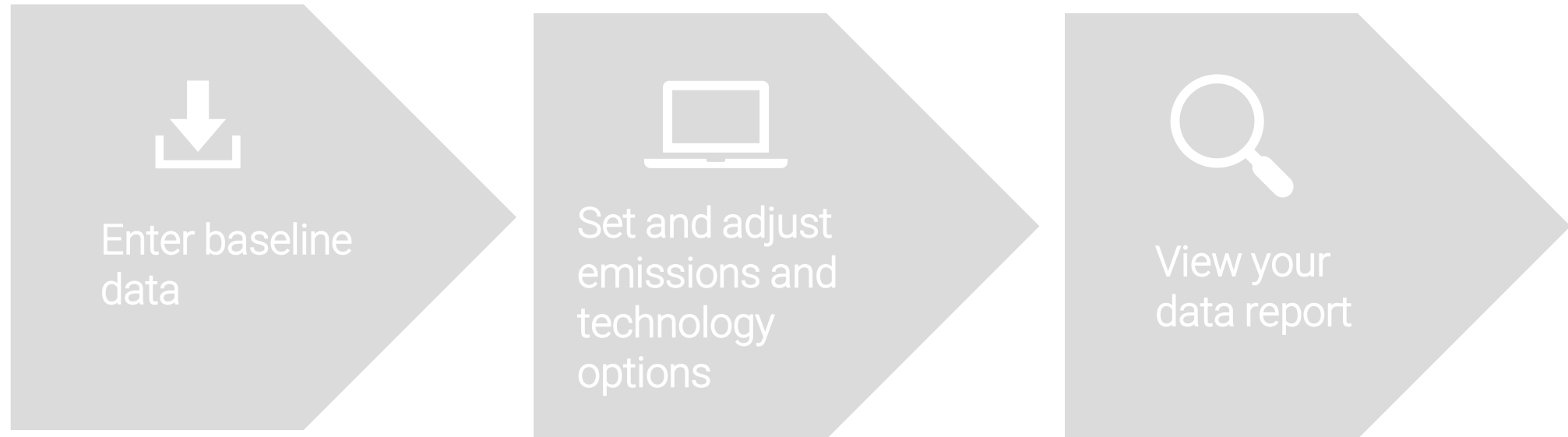
In addition to these definitions, NREL released a technical report on the definition of zero-energy buildings:

- [Zero-Energy Buildings: A Critical Look at the Definition](#)
- [Definition of a "Zero Net Energy" Community](#)

<https://www.nrel.gov/climate-neutral/terms-definitions.html>

carbon **neutral**

NREL's Climate Action Planning Tool provides a quick, basic estimate of how various technology options can contribute to an overall climate action plan for your research campus.



<https://nrel.gov/climate-neutral/planning-tool>

conclusion



Elevate the
human
experience through ***design***