
LEADING THE WAY
CampusEnergy2022
Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

University of Colorado Boulder

AECOM

ENERGY MASTER PLAN

Developing the Roadmap to a Decarbonized and Resilient CU Boulder

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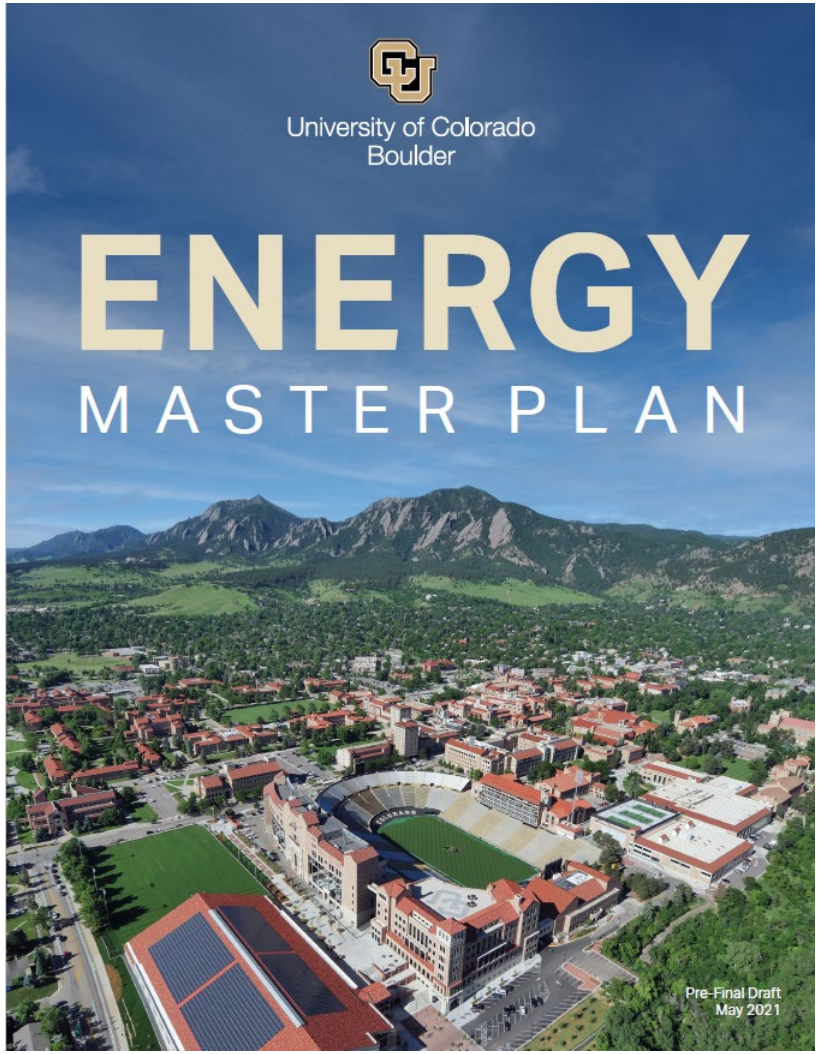
OUTLINE

1. Role of the EMP
2. Development Process
3. Goals
4. Strategies
5. Implementation Roadmap
6. Path Forward

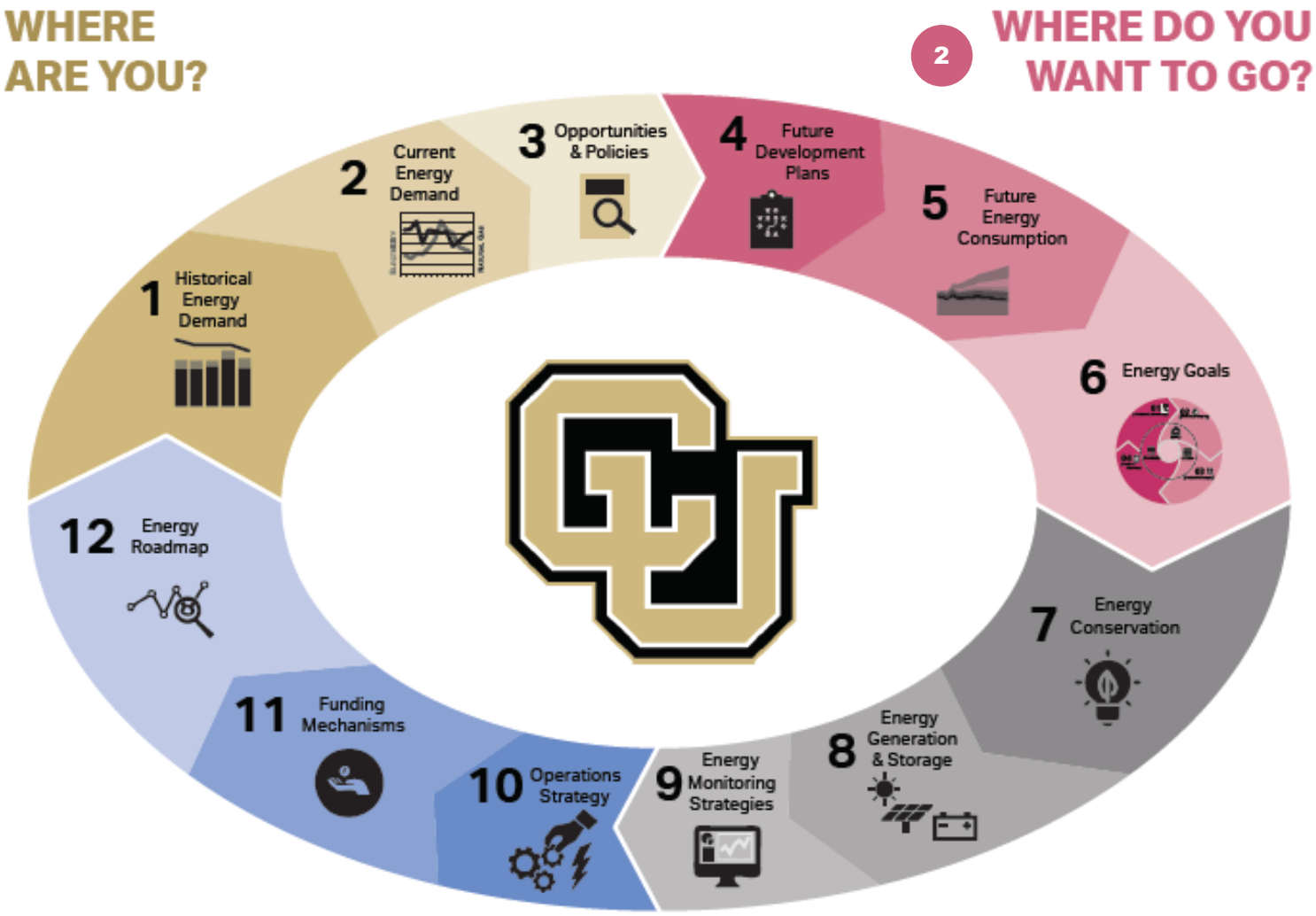
ROLE OF THE EMP

The EMP is intended to:

- **Articulate a vision** for the next 30 years.
- **Outline a framework** for a financially sustainable energy program that enables the campus to meet its goals and commitments without compromising its mission.
- **Align campus stakeholders** and planning efforts.
- **Be a guide** to a dedicated energy action group, providing action plans and timeline to support achieving the goals.
- Serve as a **justification** (through leadership-adopted goals) for enhanced design requirements and energy-related funding requests.



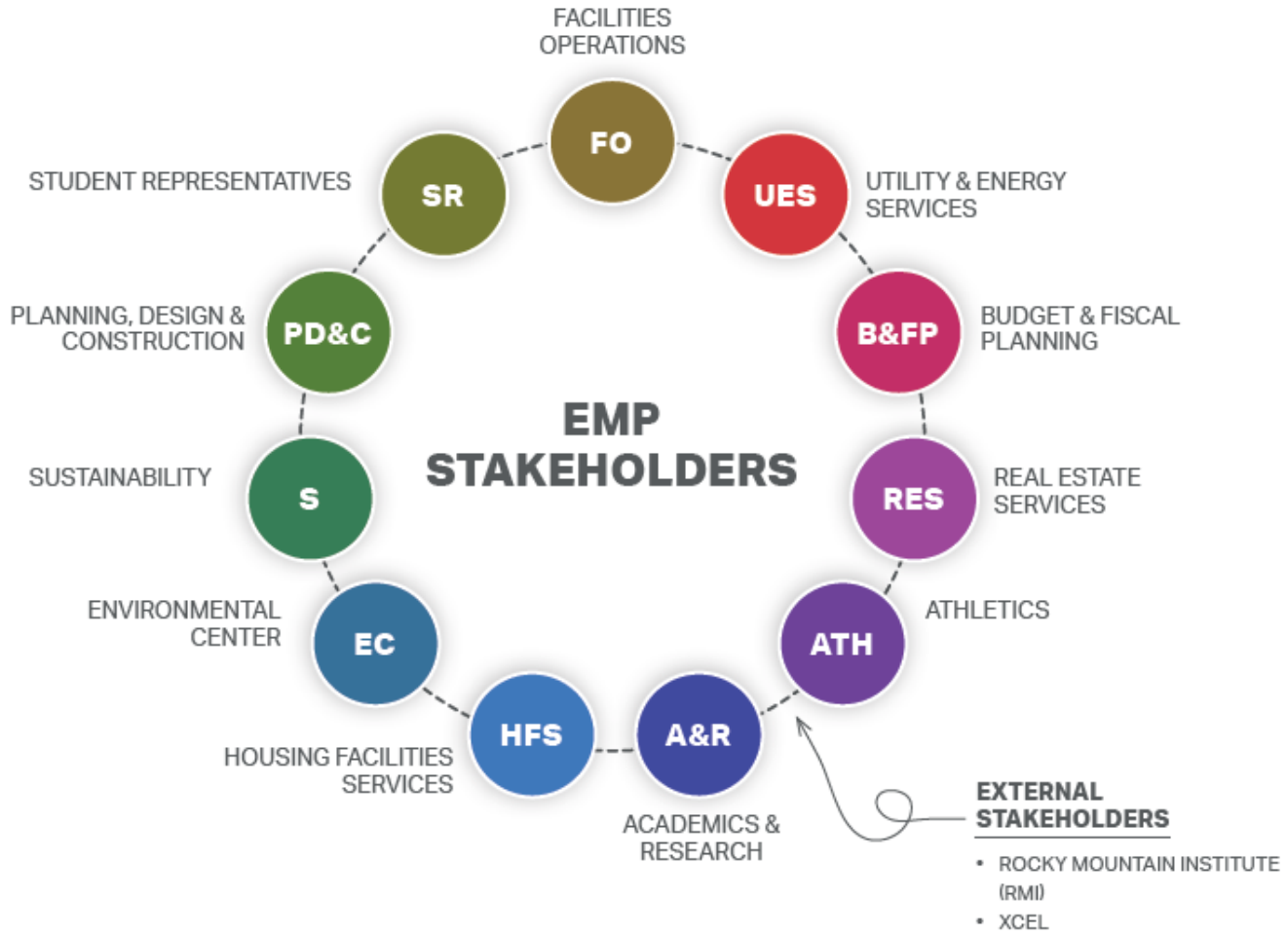
ENERGY PLANNING PROCESS



STAKEHOLDER ENGAGEMENT

Stakeholder engagement was a key focus in the EMP development.

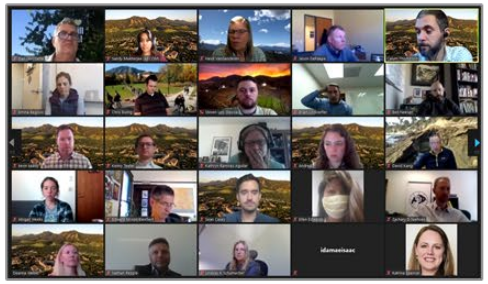
- **Staff, faculty, and students** from across the campus actively contributing throughout the process.
- Conducted a **site visit, 7 workshops, 3 rounds of focus sessions** with stakeholders in order to **build consensus on the plan.**
- Additional meetings with Boulder Faculty Assembly, Campus Master Plan team, Xcel Energy, and others for input and feedback.

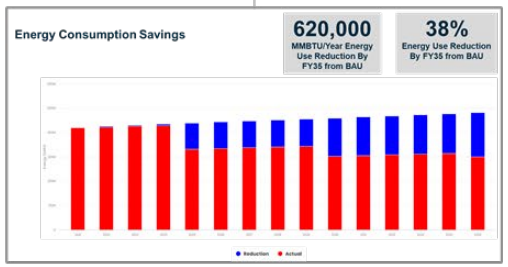


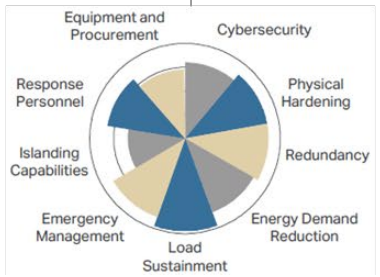
STAKEHOLDER ENGAGEMENT

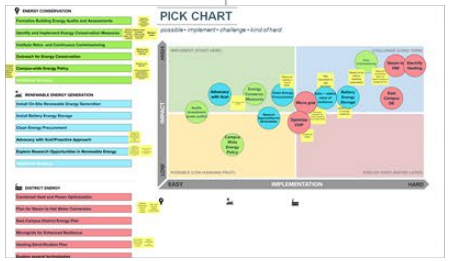
JANUARY 2020 — **JUNE 2021**

KO	W1	W2	W3	W4 W5	W6 W7	F
Kick-Off	Existing Conditions	Define Resilience	Goal Setting	Strategy Development	Roadmap Development	Final Presentation







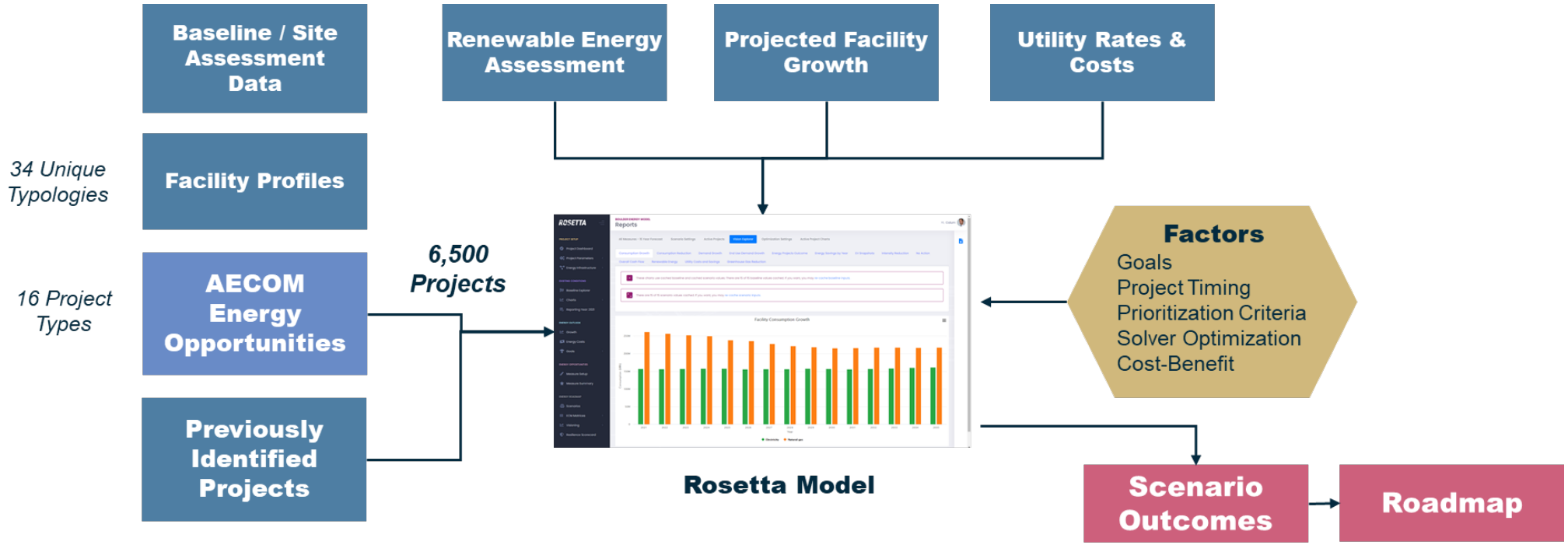


GOALS OF THE EMP

Goal	Targets	Description
Increase Campus Energy Efficiency Reduce energy use intensity by an average of 2% per year	**Energy use intensity (EUI) reduction:** • **5% reduction by 2025** • **15% reduction by 2030** • **30% reduction by 2035** **From FY20 baseline – calculated as a weighted average of building typology**	Commit first to minimizing campus energy consumption, meeting ambitious benchmarks for both existing and new facilities, and avoiding additional consumption where possible through optimized use of space and infrastructure and engaging the campus community in a culture of energy conservation.
Reduce Facility Energy-Related Emissions Target zero energy emissions by 2050	**Emissions reduction (from CY05 baseline)** • **25% by 2025** • **50% by 2030** • **100% by 2050** **Electricity from clean sources:** • **50% by 2025** • **80% by 2030 (including 10% on-site)** • **100% by 2050**	Decarbonize campus facility-tied energy use by 2050 through transition to clean thermal energy and implementation of a financially viable mix of on-site and regional clean electricity.
Enhance Critical Mission Resilience		Enhance energy resilience for mission critical facilities, research, and operations.
Lead in the Industry and the Community		Establish CU Boulder as a world-leading living laboratory focusing on collaboration with students, faculty, and local experts.

TECHNICAL ANALYSIS

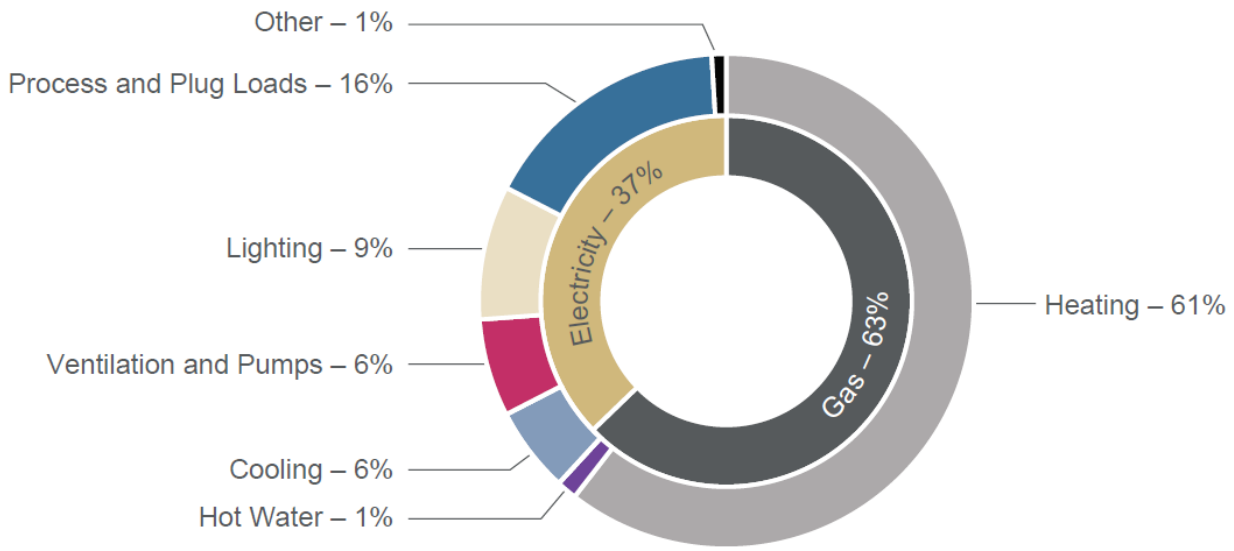
In parallel to the stakeholder engagement, an **in-depth technical analysis** was undertaken to evaluate opportunities and develop a roadmap. This also **serves as an evidence base** for EMP goals.

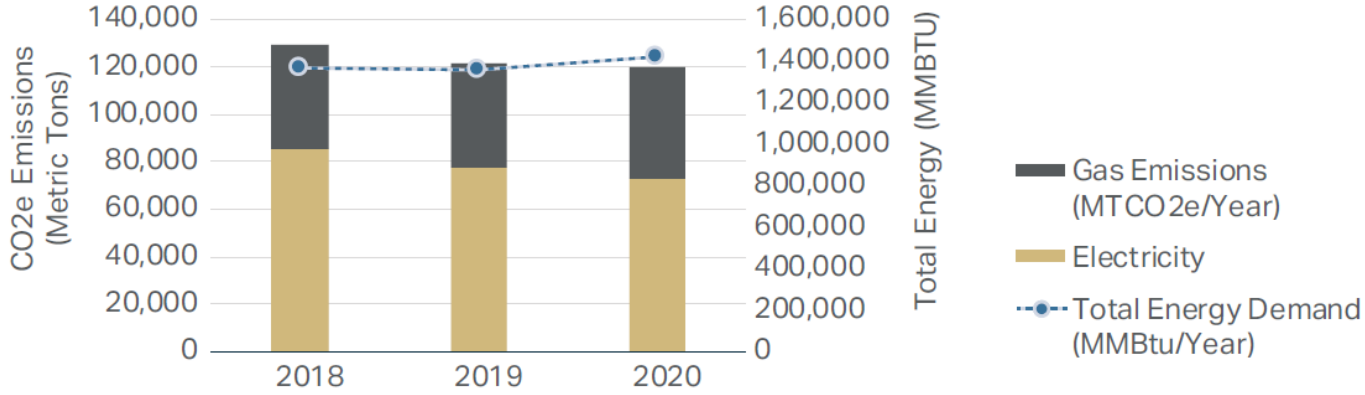


EXISTING PERFORMANCE

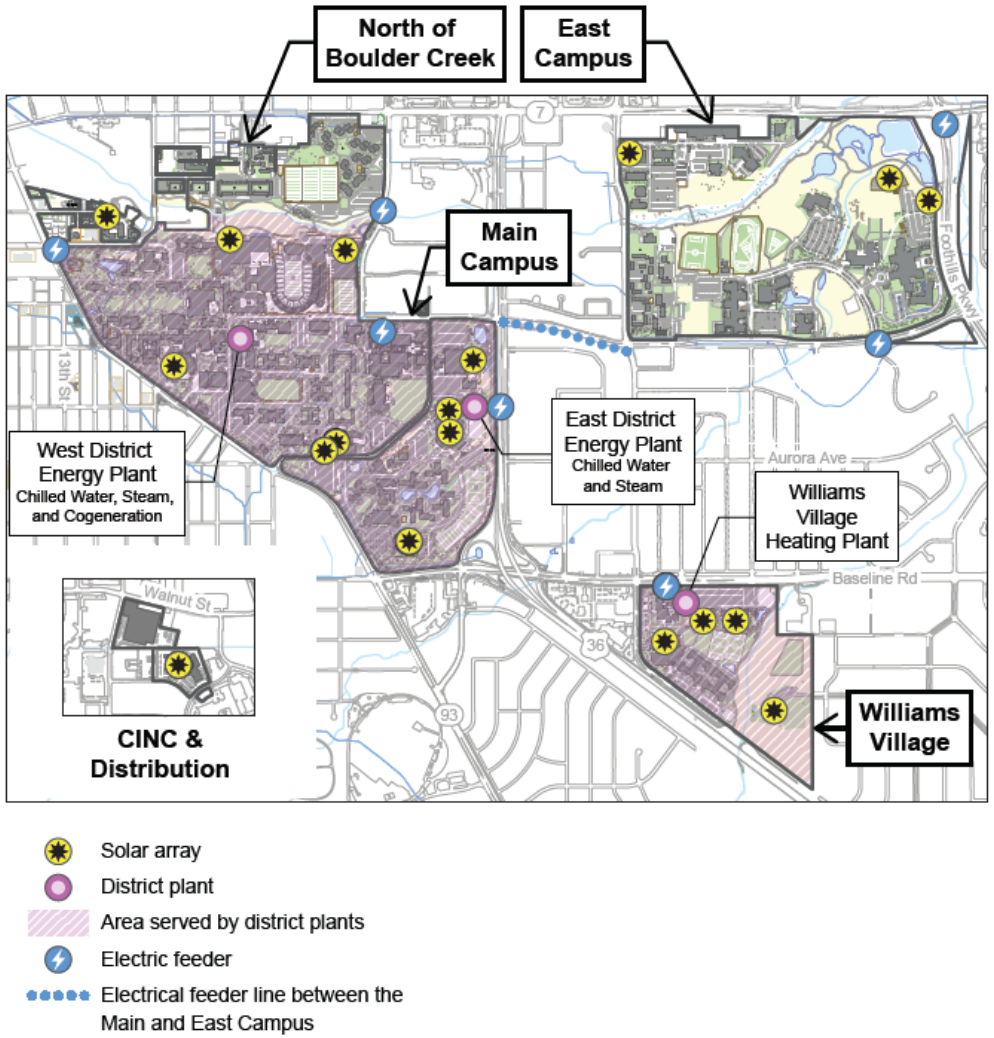
The EMP describes the existing energy use and the campus systems that support it.

This acts as the **basis for goal setting and the evaluation** of prospective energy actions.





EXISTING CONDITIONS



STRATEGIES: OVERVIEW

For each goal, the EMP has a dedicated section that includes:

- Overview of the goal area
- Metrics and targets for this goal
- Focus areas / strategies that support this goal
- Implementation Plan

>40
Program and strategy areas

>140
Actions to Support EMP

1 Increase Campus Energy Efficiency

A. Energy Monitoring Strategy
B. Energy Management Program Reporting
C. Energy Performance Benchmarking
D. Energy Auditing and Conservation Measures
E. Commissioning
F. Staff Development
G. Outreach, Education, and Engagement
H. Campus Building Operations Standards
I. Deferred Maintenance
J. Energy Performance
K. Design Standards Update
L. Performance-Focused Design Process
M. Space Optimization
N. Funding Mechanisms
O. Campus Energy Policy

2 Reduce Facility Energy-related Emissions

A. On-Site Clean Energy Generation
B. Community Solar
C. Clean Energy Procurement
D. Plan for Heating Decarbonization
E. Power Plant Optimization
F. East Campus District Energy

3 Enhance Critical Mission Resilience

A. Energy Resilience Design Requirements
B. On-Site Energy Generation and Storage
C. Campus Microgrid

4 Lead in Energy Innovation

A. Living, Learning Laboratory
B. Energy Research Opportunities
C. Engagement with Community Partners in Energy and Sustainability Goals
D. Periodic Energy Master Plan Validation

STRATEGIES: ACTION PLAN

Each section has a dedicated Implementation Plan – describing the **specific actions, responsibility, and timeframe** to progress each strategy.

Strategy	Action Number	Action	Responsibility	Time Horizon
A. On-Site Clean Energy Generation	A.1	Validate locations identified in previous studies (NREL and AMERESCO).	ESO + PD&C	Short
	A.2	Identify and enlist stakeholders for potential partnerships at key locations to identify priority sites, including sites with resilience benefits.	PD&C + EC + A&R + SR	Short
	A.3	Select project(s) for implementation and determine preferred funding mechanism(s).	ESO + UES + PD&C + B&FP	Medium
	A.4	Work with Xcel to define incentive opportunities. Investigate alternatives to 'single account' limits and stand-by charges.	ESO + UES + B&FP	Short
	A.5	Establish concept design(s) and request required approvals.	ESO + UES + PD&C	Medium
	A.6	Develop Request for Proposal (RFP) for selected system(s).	ESO + UES + PD&C + B&FP	Medium
	A.7	Identify set-aside areas for approximately 10 MW of future solar capacity.	PD&C + ESO + UES	Short
	A.8	Install solar PV system(s) with a combined capacity of 10 MW.	PD&C + UES	Long

A STRATEGY QUANTIFICATION

Based upon review of past energy assessments, site visits, and data review, the opportunity for energy conservation measures was parametrically quantified across the campus.

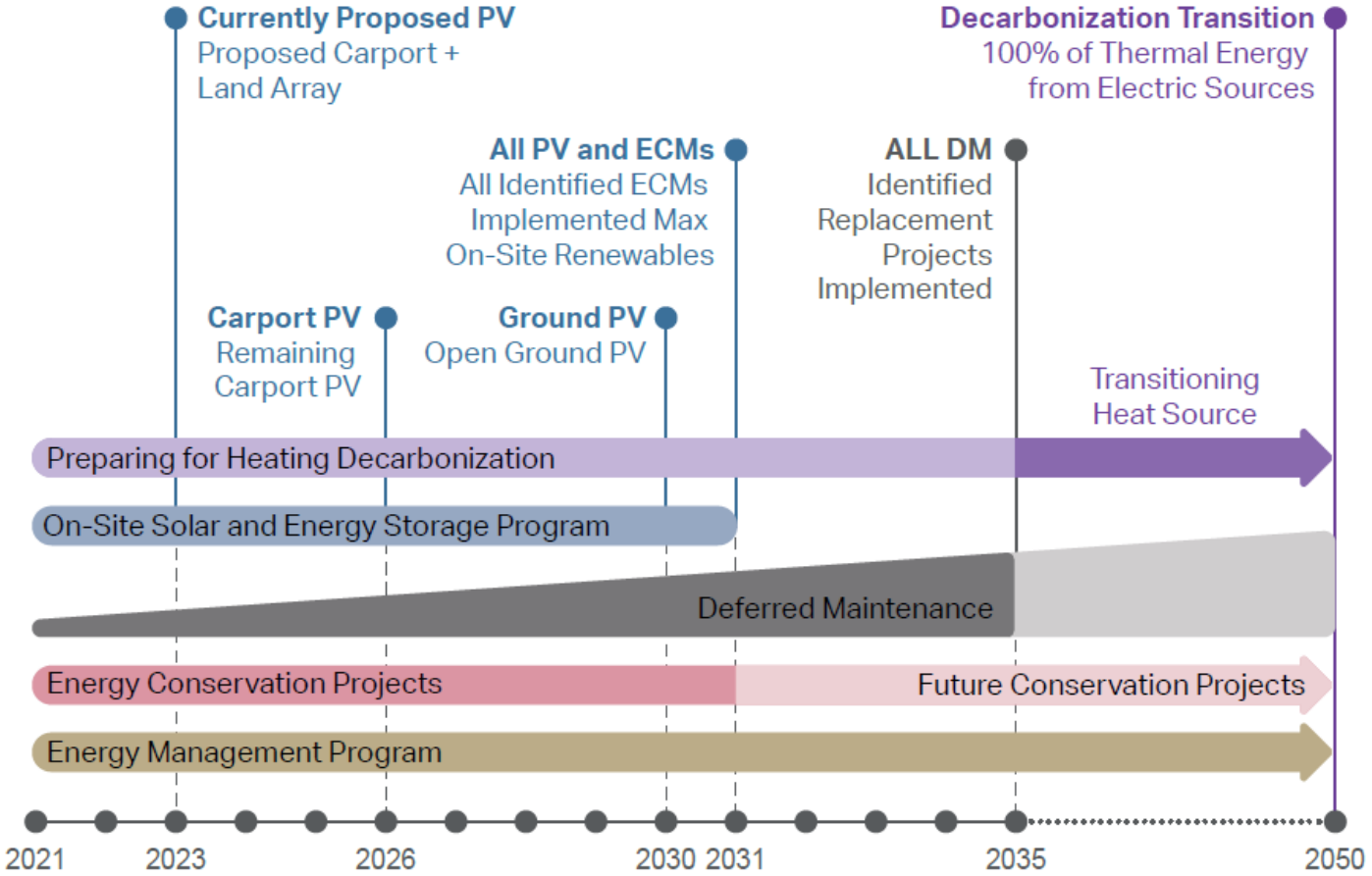
For the larger opportunities, typically requiring major renovation, the analysis assumes that this would be aligned with the capital renewal program timeline.

Ref.	Project	Capital Cost ($)	Total Cost Savings ($)	Payback	Payback (Aligned)*
1	Building Envelope Upgrades	5,790,000	219,000	26	5
2	Commissioning	1,660,000	300,000	6	-
3	Energy Recovery Systems	17,180,000	182,000	94	19
4	Energy Storage (4 MWh)	2,400,000	365,000	7	-
5	Fenestration Upgrades	44,450,000	226,000	197	40
6	Fume Hood Controls	4,050,000	118,000	34	7
7	HVAC Control Upgrades	17,180,000	248,000	69	14
8	HVAC Setbacks and Scheduling	1,910,000	261,000	7	-
9	HVAC/AHU Replacement	17,180,000	107,000	161	32
10	Lighting Daylight Controls	13,730,000	457,000	30	6
11	Lighting Occupancy Controls	11,690,000	434,000	27	5
12	Lighting Upgrades	6,470,000	675,000	10	-
13	Performance Standards	N/A	746,000	-	
14	Piping and Equipment Insulation	430,000	14,000	32	6
15	Solar PV	18,340,000	1,103,000	17	-
16	Weatherization	2,540,000	184,000	14	3

*'Green Premium' payback when aligning with capital renewal

Energy Saving Potential by Project Type

ROADMAP: WHAT AND WHEN

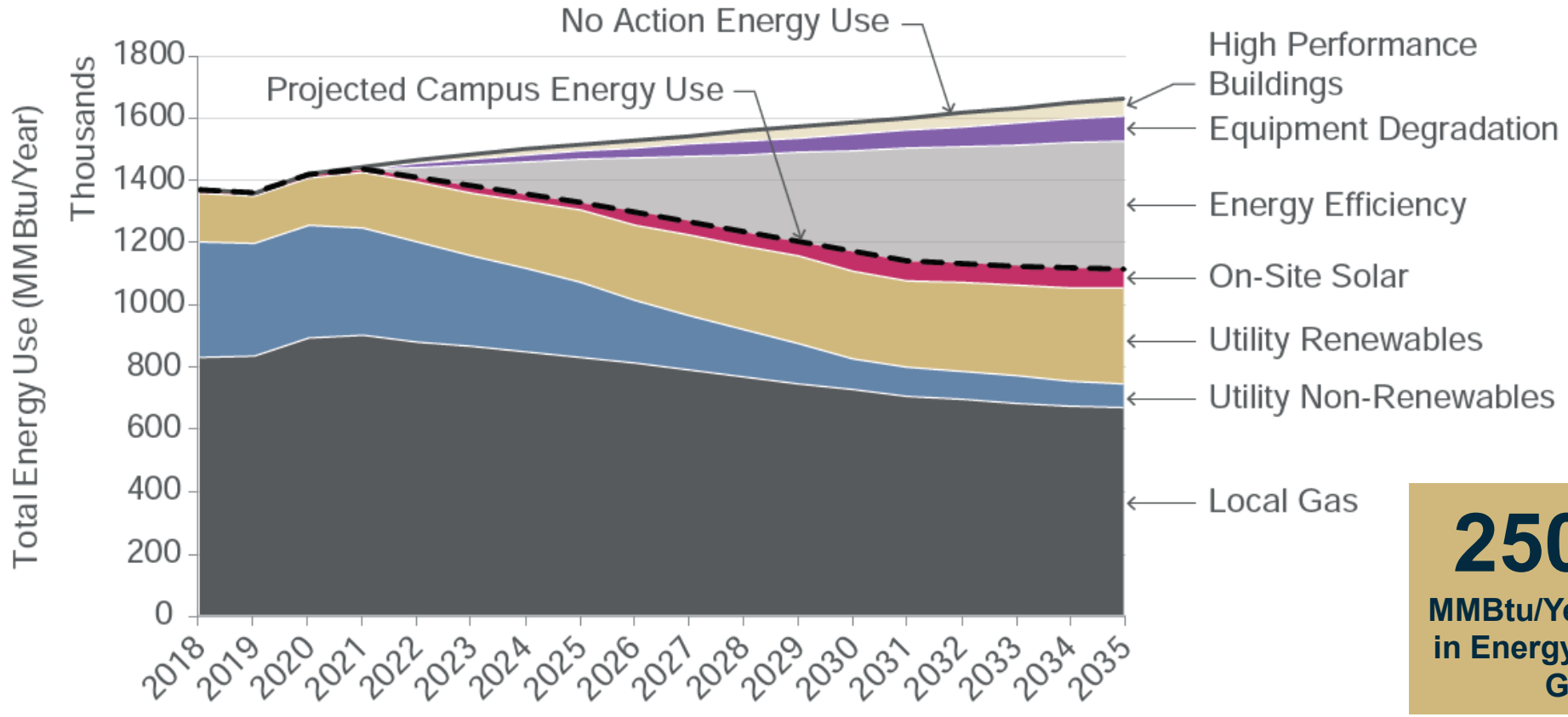


DM = Deferred Maintenance
ECM = Energy Conservation Measure
DE = District Energy

The EMP lays out a pathway to realizing CU Boulder's goals.

ROADMAP: ENERGY REDUCTION

CU Boulder Meets its Energy Use Intensity Goal

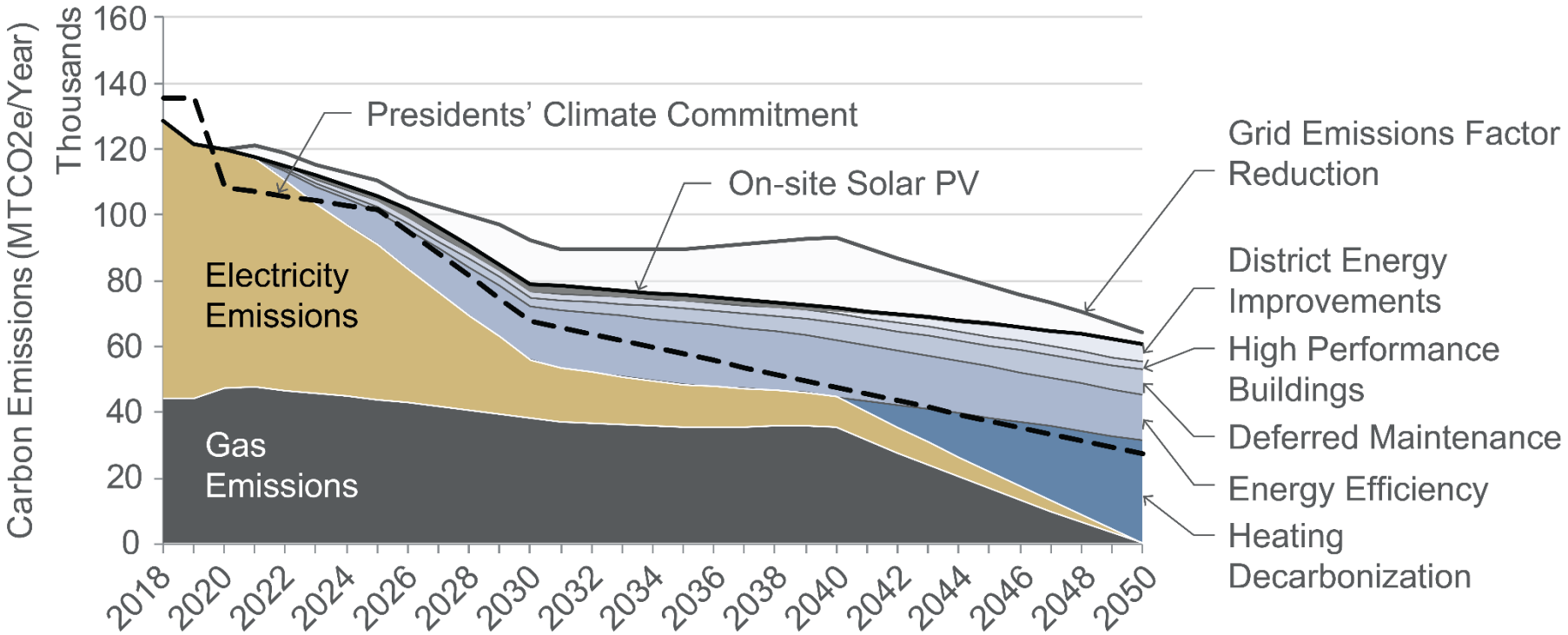


250,000

MMBtu/Year Reduction in Energy Use Despite Growth

ROADMAP: EMISSIONS REDUCTION

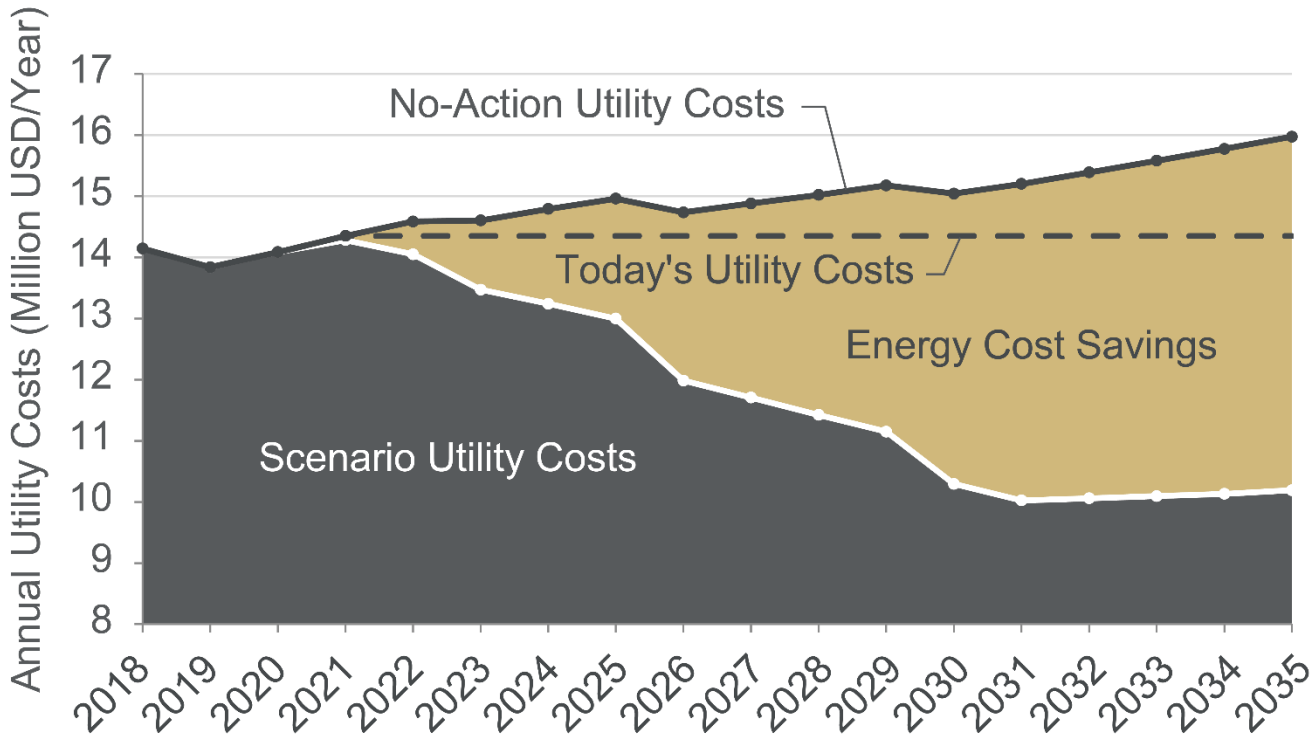
CU Boulder Meets GHG Reduction Goals both in 2030 and 2050



ROADMAP: ENERGY COST

With the implementation of proposed roadmap CU Boulder saves approximately $57 Million in energy costs over 15 years

40%
Energy Cost Reduction By FY35 from BAU

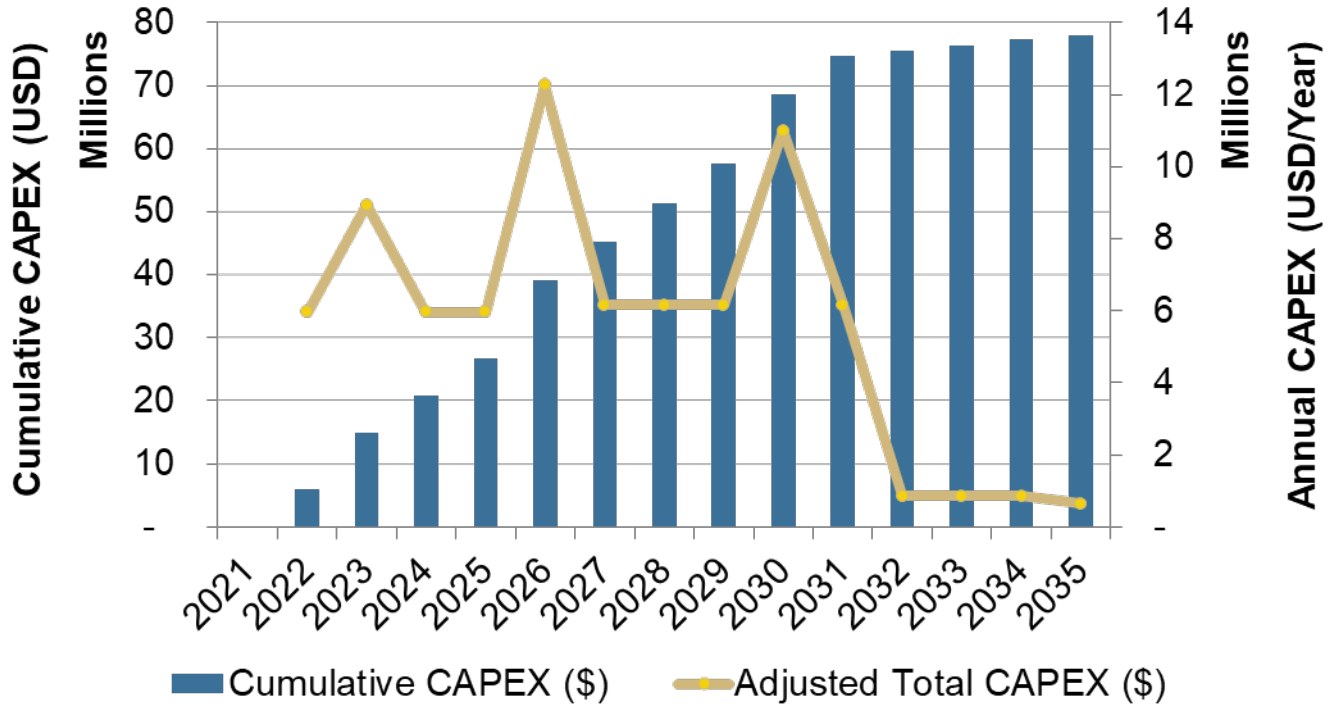


Savings in 2035 over current costs $1.7M / Year

Note:
No financial commitments have been made regarding energy project implementation

A ROADMAP: INVESTMENT

There is a financial analysis to support this roadmap



~$80 Mil
Total Program Cost by 2035

~$6 Mil
Average annual premium

Notes:

- No financial commitments have been made
- CU will look to align EMP goals with other strategic priorities (such as DM and the CMP) for more effective and efficient implementation which will impact investment type, scale, and timeline

ENERGY MANAGEMENT ORGANIZATION

Energy Action Group (EAG)

- Key stakeholder group in an advisory capacity for policy and goal setting/updates.
- Budgetary authority for implementation of campus wide energy projects.
- Drives energy program outreach & engagement.

Energy Services Organization (ESO)

- Manages the campus energy program (data analytics and reporting).
- Technical support for project development.
- Facilitates the EAG and alignment toward achieving campus wide goals.

A VISION FORWARD

CU Boulder has developed a **strong vision for establishing a more sustainable and resilient campus energy profile** to better serve students, faculty, staff, and the surrounding community.

The EMP:

- **Sets targets** that are supported by technical and financial analysis
- Is a **framework to support stakeholder coordination** to implement energy projects.
- Does not **define/dictate any financial commitments** nor recommend strategies which are financially unviable.
- Is envisioned to be a **flexible, 'living' document** which evolves with the campus mission and available technologies.

Execution and implementation of the actions contained in the EMP, led by the newly formed EAG and ESO, will ensure that this larger vision and supporting goals are realized.

QUESTIONS?

THANK YOU!

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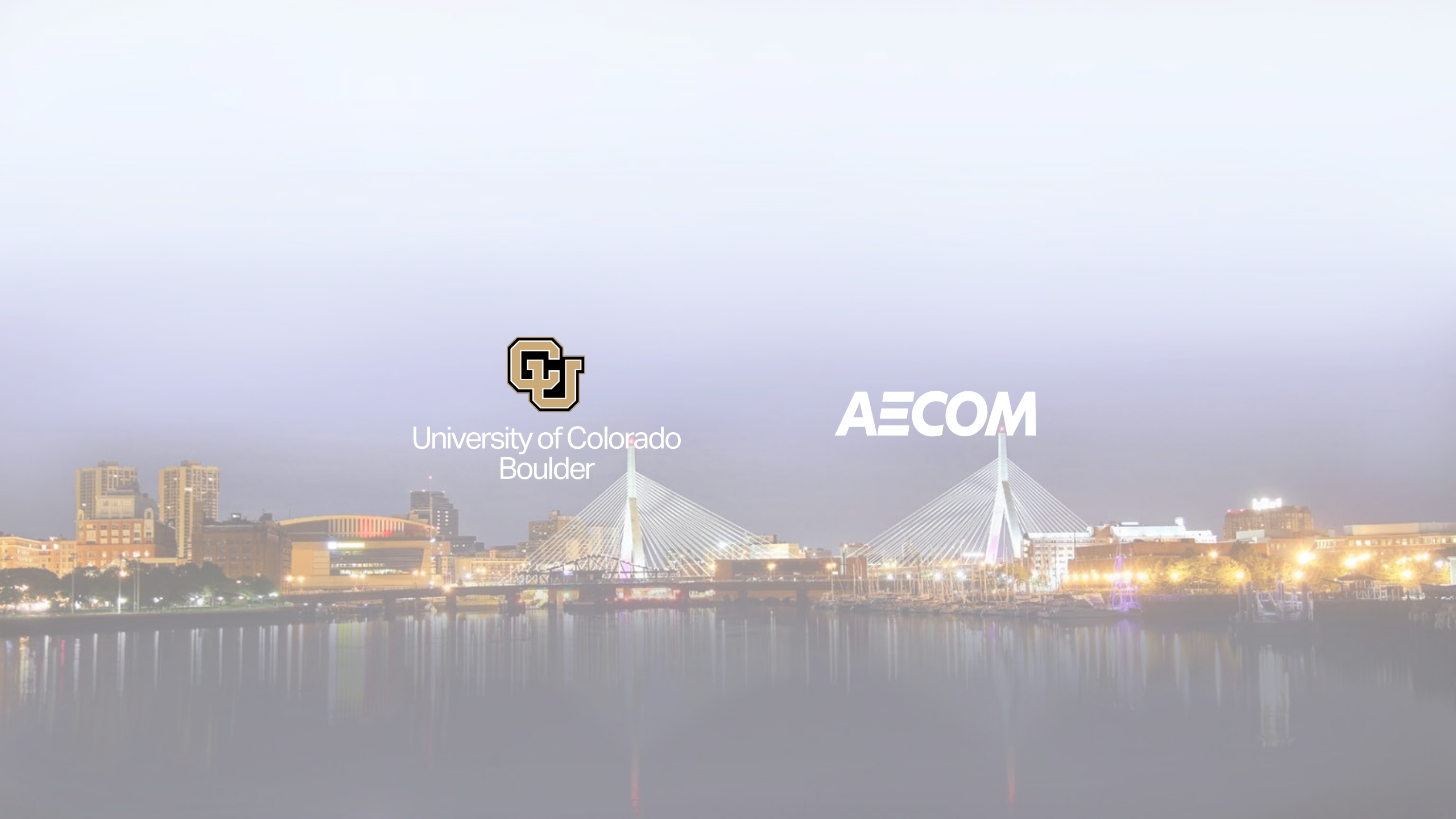
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