# A COMMUNITY APPROACH TO DECARBONIZING EXISTING BUILDINGS

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# THE POWER OF LOCAL

In the face of global climate challenges, local initiatives have emerged as powerful forces for change. Cities and states are taking the lead in climate action, demonstrating that grassroots efforts can make a significant impact. We'll explore how local commitments are shaping a sustainable future.

# THE POWER OF LOCAL

# WHAT'S MY LOCAL?

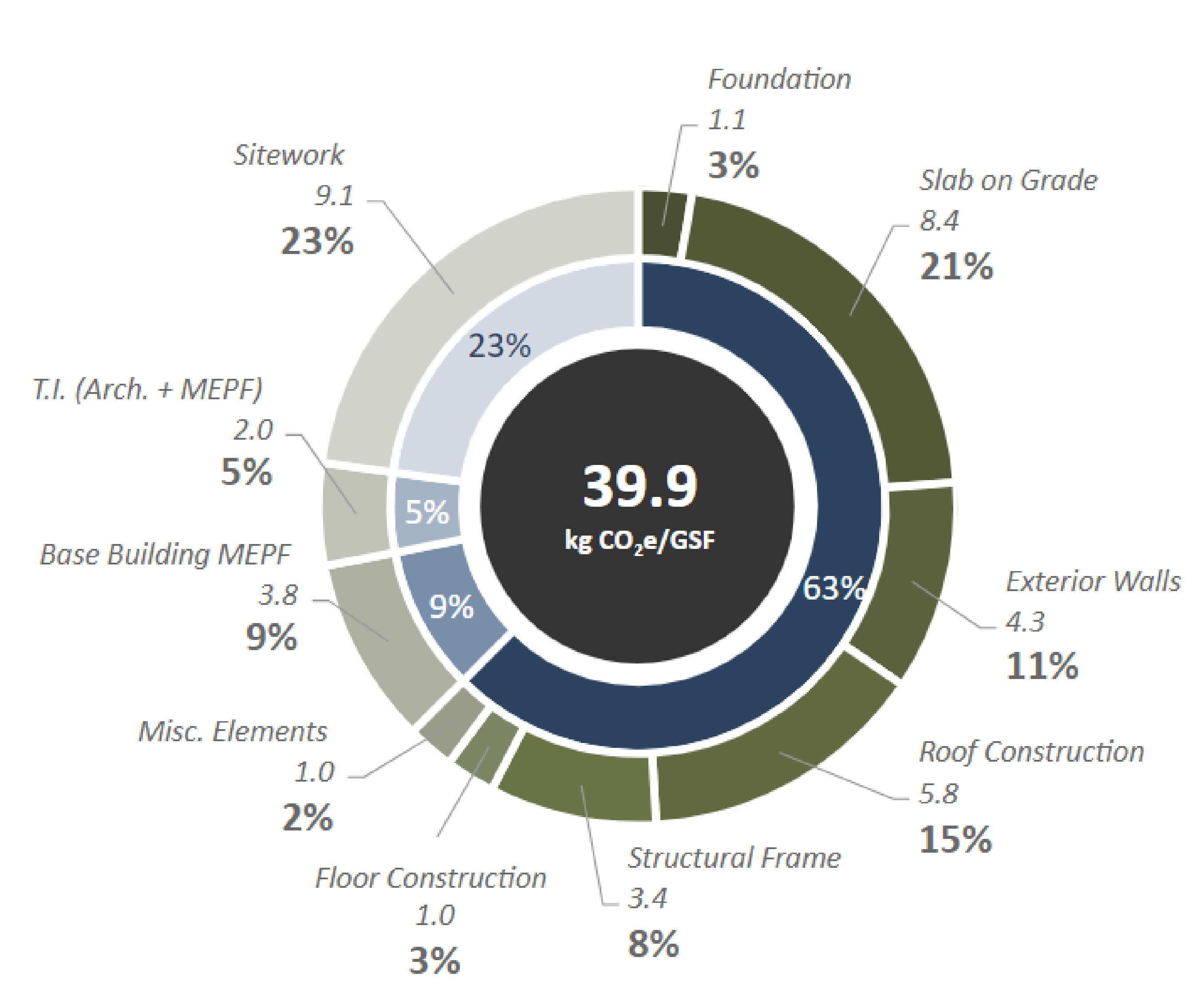
# WHAT'S YOUR LOCAL?

**Local** is close to you.

**Local** affects your everyday life.

Gradual changes are more evident within your **local**.

Historical context is more prevalent and applicable at the **local** level.




# UNDERSTANDING WHOLE-LIFE CARBON

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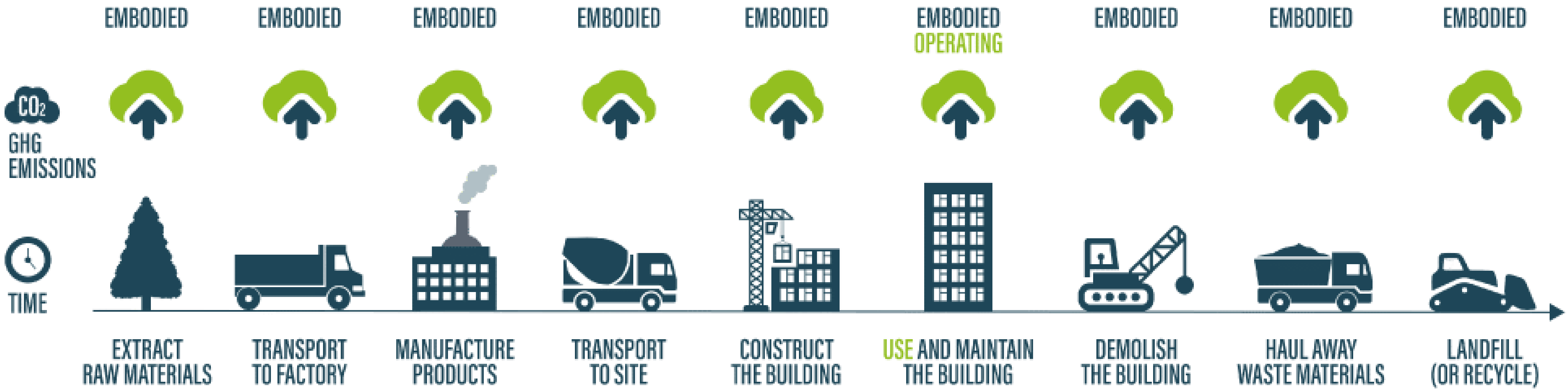


**Operational Carbon**
Carbon emissions from the building's energy use during its operational life.

**Embodied Carbon**
Carbon emissions associated with materials and construction processes, including extraction, manufacturing, transportation, demolition, disposal, and potential recycling or reuse of materials at the end.

**Refrigerants**
Technical included in operational carbon, but often overlooked as a significant contributor to building emissions. Refrigerants, particularly HFCs, have a very high GWP, meaning even small leaks can contribute significantly to greenhouse gas emissions.

# OPTIMIZATION REQUIRES AN UNDERSTANDING OF THE INTERACTIONS BETWEEN DIFFERENT TYPES OF CARBON

# IT'S COMPLICATED

**WHOLE BUILDING LIFE-CYCLE ANALYSIS** means all the parts of the building for the life of the building.

Reference Study Period

Study Boundaries | A1-A3, A-D

Assemblies | Core+Shell, Site, MEP

Lack of data | EPDs

Future weather patterns

Future Grid Emissions

Refrigerant Leakage Rates

Interdependencies between OC | EC | Refrigerants

**REDUCTION** is the key.

# THE SIGNIFICANCE OF WHOLE-LIFE CARBON

## Climate Impact

Buildings account for nearly 40% of global carbon emissions, making whole-life carbon reduction crucial for mitigating climate change.

## Resource Efficiency

Considering whole-life carbon encourage efficient use of materials and energy throughout a building’s life-cycle

## Resilience

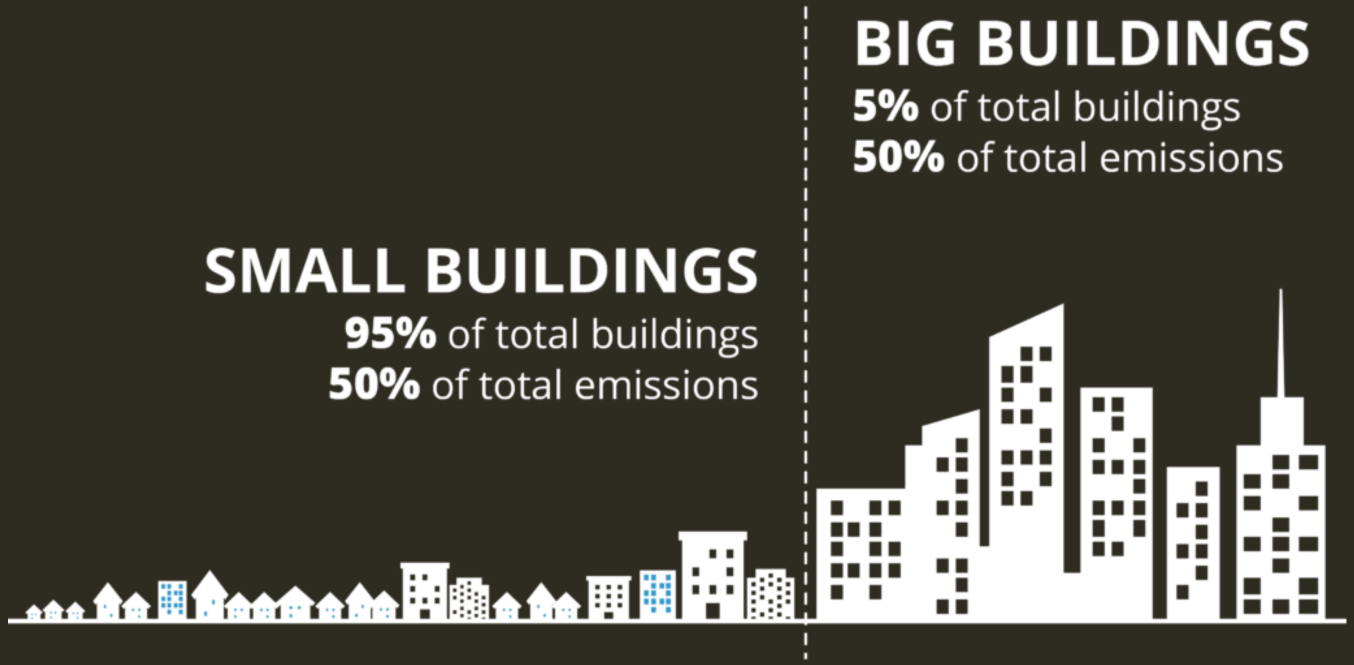
Addressing whole-life carbon ensures buildings contribute positively to sustainability goals over their entire life span.

## Economic Benefits

Reducing whole-life carbon often leads to cost savings through improved energy efficiency and reduce resource consumption.

# 100% OF BUILDINGS ARE EXISTING

# IN 2040, 2/3 OF THE GLOBAL BUILDING STOCK WILL BE BUILDINGS THAT EXIST TODAY. WITHOUT UPGRADES, THEY WILL STILL BE EMITTING GREENHOUSE GAS EMISSIONS.



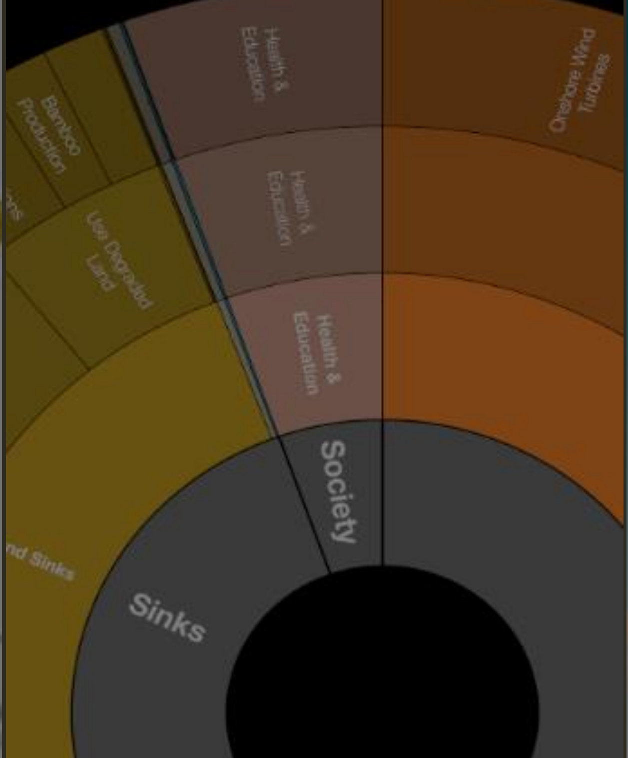
## Adaptive reuse of existing buildings is the carbon “easy-button”

“Retrofitting existing buildings with envelope, interior, and MEP upgrades can be up to 60% less carbon intensive than building a new high-performance building.”

State of Decarbonization (USGBC/ARUP)

## High performance design begins with reduction

Passive design measures reduce a building’s heating and cooling loads, resulting in smaller HVAC systems and lower energy consumption, which are critical for achieving net-zero energy targets.




## Decarbonization requires a layered approach

To decarbonize the built environment, we must switch to a “whole-life carbon” mindset – optimizing between embodied and operational carbon, including refrigerants.

## Renewable energy and verification close the loop

"Renewable energy adoption, combined with rigorous commissioning and sub-metering, ensures that building systems operate as designed and intended.”

LEED v4 O+M Reference Guide (USGBC)

# NET POSITIVE OPERATIONAL CARBON PHILOSOPHY

**Existing Buildings**

**New Construction**

| Assess | Reduce | Decarbonize | Offset + Verify |
|---|---|---|---|
| **Existing Conditions**<br>PEAU<br>Retro-Commissioning<br>Eqp End-of-Life Analysis | **Passive Load Reduction**<br>Passive House Principles<br>Envelope<br>**Active Load Reduction**<br>Lighting+Plug Loads<br>**Right-Size Equipment**<br>Reduce Demand<br>Energy Modeling<br>**Controls**<br>Reduce consumption | **Electrify**<br>Geothermal<br>Heat Pumps<br>**Decarbonize**<br>Time-Based Energy use<br>Battery Storage | **Offset**<br>Renewables<br>Grid Interoperability<br>**Verification**<br>Sub-metering<br>Commissioning |

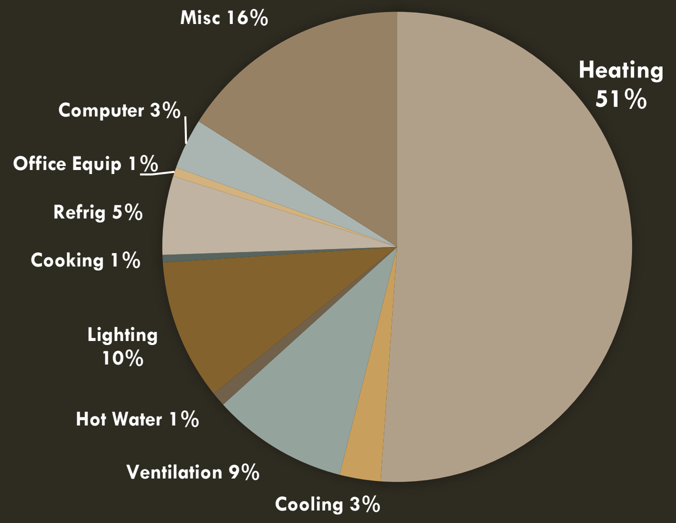

Image: Climate Positive Design

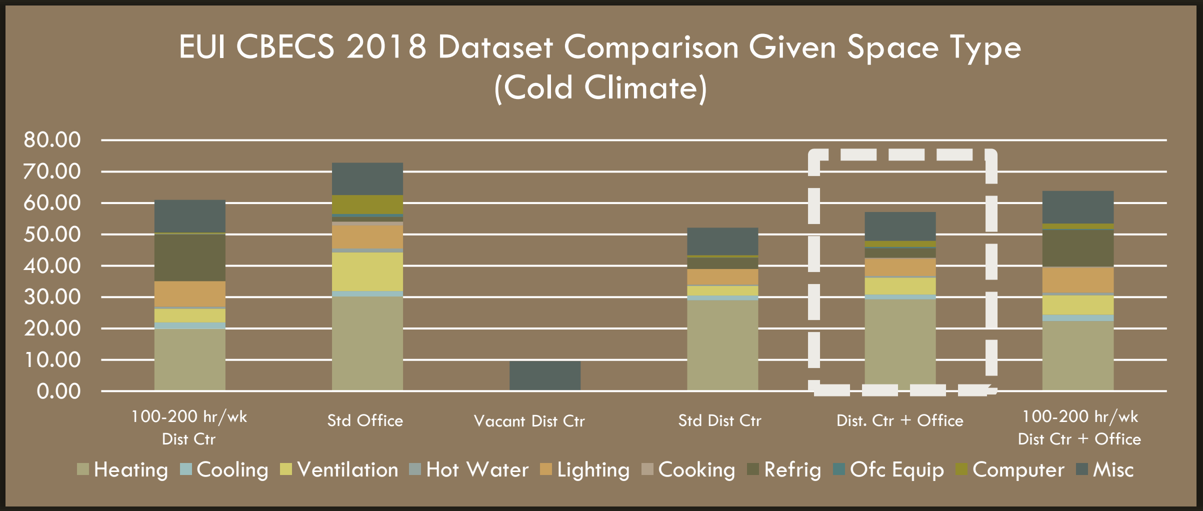
The key lies in mindful planning, addressing current limitations, and charting a course that aligns with the evolving landscape of decarbonization.

# CASE STUDY:
W.P. CAREY
ELECTRIFICATION
STUDY

# BENCHMARK

### ESTIMATED END USE CATEGORIES (%)
COLD WEATHER DISTRIBUTION CENTER/OFFICE

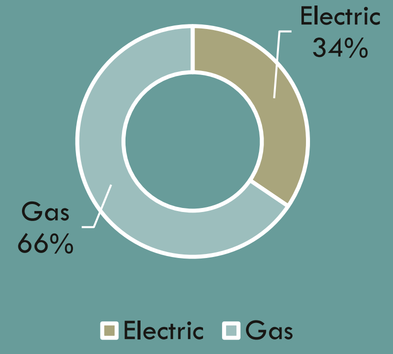


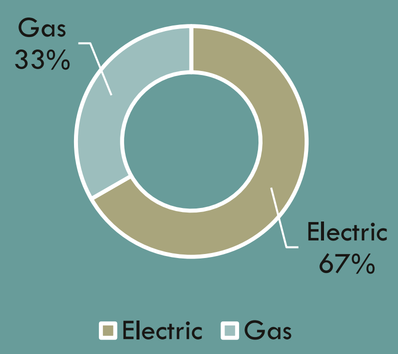

# EXISTING FACILITY

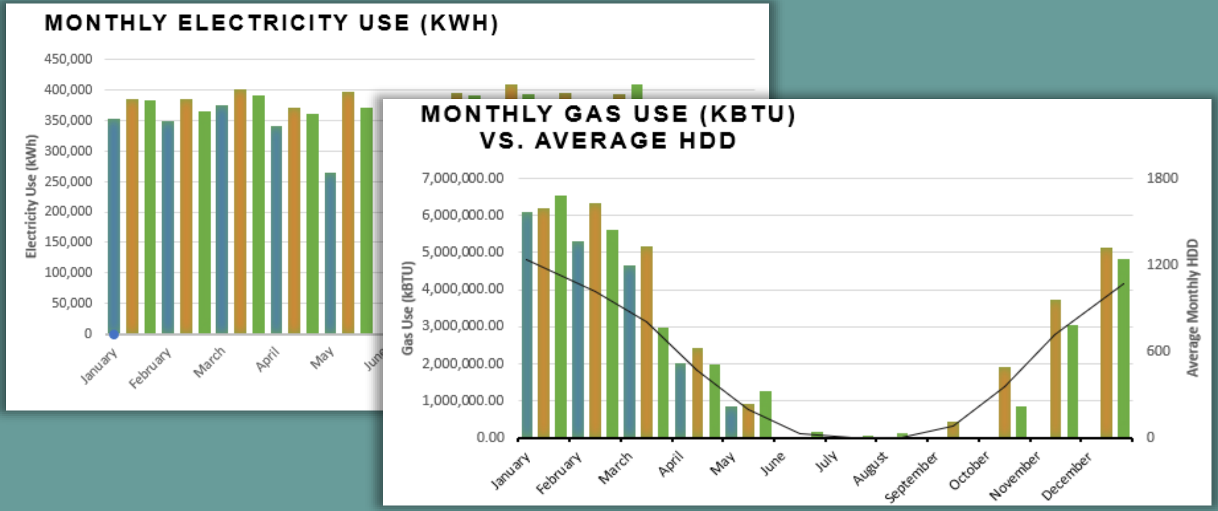
**163** kBtu/sf-yr
Site Energy Use Intensity

### Fuel Mix Use (kBtu)




### Annual Fuel Cost (%)



# ENERGY SAVINGS OPPORTUNITIES

## HVAC Update

Replace existing equipment for similarly-sized modern equipment.

## HVAC Electrification

Replace existing equipment with electric alternatives. Heat pumps offer a good solution here!

## LED Lighting / Controls

Switch all lighting fixtures to LED to maximize efficiency, include occupancy sensors and daylight controls.

## Enclosure Upgrades

Increase insulation values, especially for the roof. Mitigate infiltration with high-speed doors, air curtains, or vestibule air locks.

## Renewable Energy

Accommodate a solar array on the roof.

The following table summarizes the energy consumption, energy cost and environmental performance for each ECM and values, and that the project has not yet been executed.

| | Description | EUI (kBtu/sf/yr) | Potential Utility Costs ($/yr) | 20-yr Savings ($) with 6% discount rate | GHG Emissions (MT CO2e/yr) | GHG Intensity (kg CO2e/sf/yr) |
|---|---|---|---|---|---|---|
| | Calibrated Model | 163 | Electricity: $459,300<br>Gas: $229,800<br>**Total: $688,100** | | 3,750 | 13.4 |
| ECM-01 | Preventive maintenance | 147 8%↑ | Electricity: $ 447,300<br>Gas: $ 204,800<br>**Total: $ 652,100** | $417,500 | 3,529 | 12.6 6%↑ |
| ECM-02 | Like-for-like HVAC replacement | 152 5%↑ | Electricity: $ 459,100<br>Gas: $ 211,700<br>**Total: $ 670,800** | $203,000 | 3,633 | 13.0 3%↑ |
| ECM-03 | HVAC Electrification | 131 18%↑ | Electricity: $ 1,060,400<br>Gas: $ -<br>**Total: $ 1,060,400** | -$4,265,600 | 5,134 | 18.4 -37%↓ |
| ECM-04 | Lighting improvements | 158 1%↑ | Electricity: $ 370,700<br>Gas: $ 249,300<br>**Total: $ 620,000** | $785,700 | 3,455 | 12.4 8%↑ |
| ECM-04 E | ECM-04 + HVAC electrification | 127 21%↑ | Electricity: $1,024,200<br>Gas: $ -<br>**Total: $1,024,200** | $-3,850,500 | 4,959 | 17.8 -32%↓ |
| ECM-05 | Envelope improvement (roof) | 153 4%↑ | Electricity: $ 458,600<br>Gas: $ 214,900<br>**Total: $ 673,500** | $172,000 | 3,651 | 13.1 3%↑ |
| ECM-05 E | ECM-05 + HVAC Electrification | 127 20%↑ | Electricity: $1,028,000<br>Gas: $ -<br>**Total: $1,028,000** | $-3,894,000 | 4,977 | 17.8 -33%↓ |
| ECM-06 | Envelope improvement (wall)<br>Reduced infiltration | 128 20%↑ | Electricity: $ 458,200<br>Gas: $ 158,600<br>**Total: $ 616,800** | $822,400 | 3,275 | 11.7 13%↑ |
| ECM-06 E | ECM-06 + HVAC Electrification | 92 43%↑ | Electricity: $739,000<br>Gas: $ -<br>**Total: $739,000** | $-579,200 | 3,578 | 12.8 5%↑ |
| ECM-07 | PV System | 126 21%↑ | Electricity: $ 291,000<br>Gas: $ 229,200<br>**Total: $ 520,200** | $1,930,400 | 2,935 | 8.7 35%↑ |
| BUNDLE 01 | **Optimized Loads**<br>ECM-01, ECM-02<br>ECM-04, ECM-05 | 132 18%↑ | Electricity: $ 369,600<br>Gas: $ 191,600<br>**Total: $ 561,200** | $1,460,100 | 3,065 | 11.0 18%↑ |
| BUNDLE 02 | **Electrification**<br>ECM-03, ECM-04<br>ECM-05, ECM-06 | 82 49%↑ | Electricity: $664,600<br>Gas: $ -<br>**Total: $664,600** | $274,131 | 3,218 | 11.5 14%↑ |

# SUMMARY OF KEY FINDINGS

### Big Savings Driver

**Reducing infiltration was the largest driver of savings.** This is due to the assumption that large roll-up doors remain open throughout large portions of the day, increasing he need for heating to maintain the desire setpoint.

### Energy savings ≠ Energy cost

While a lighting upgrade has a relatively small energy savings due to the increased heating load in response to the LPD reduction, **the cost savings was one of the better stand-alone performers due to the high cost of electricity.**

### About Electrification

Electrification has major cost disadvantages when not paired with other ECMs that reduce the overall heating energy. **Electrification should always be coupled with an optimized envelope and high-efficiency heating equipment** to realize the best performance results.

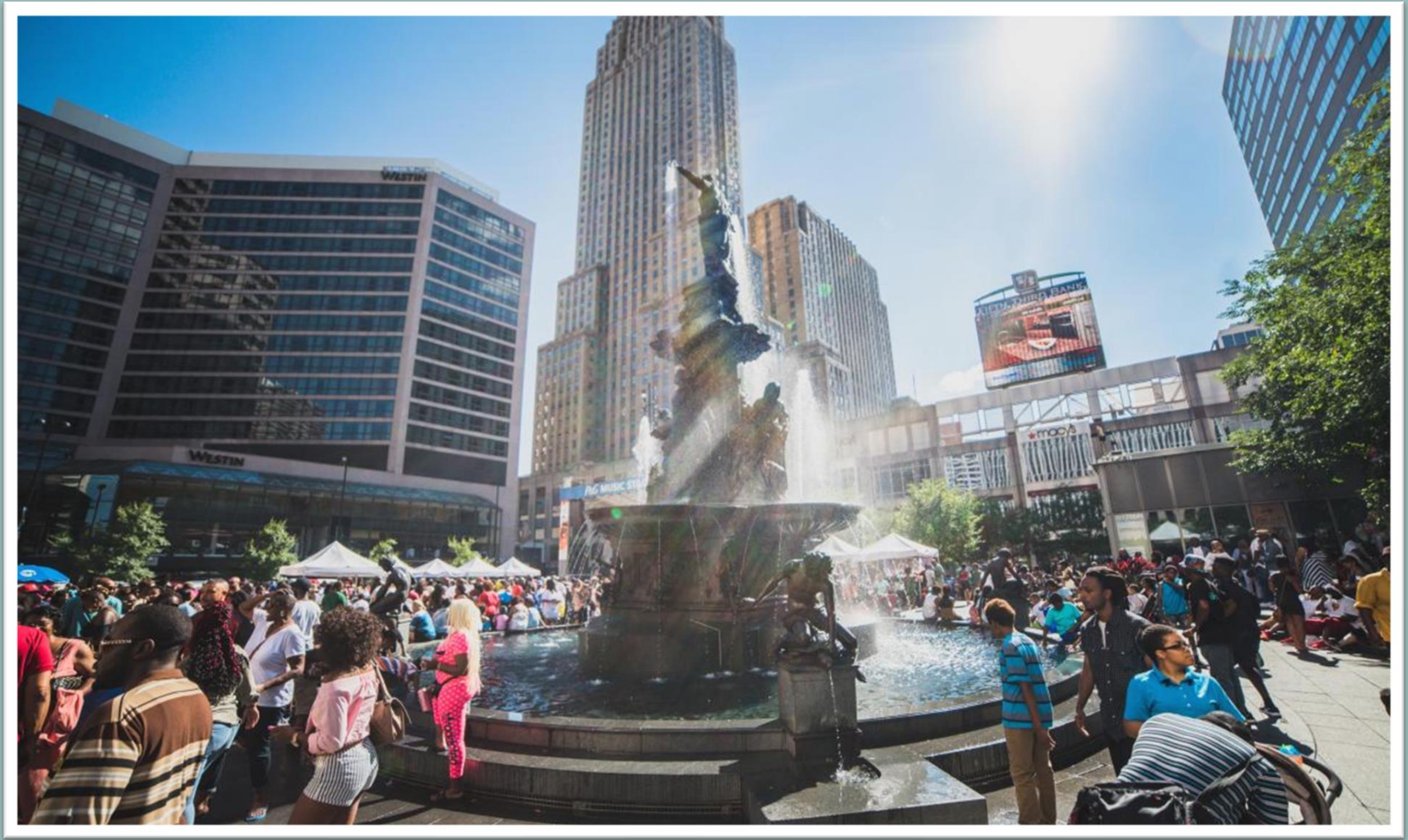
### Not so Simple

**A like-for-like system replacement alone was not a viable route for savings.** Upgrading equipment for better/premium efficiency equipment needs to be coupled with other strategies like increasing envelope tightness and improving lighting infrastructure.


# MULTI-DIMENSIONAL DECARBONIZATION

# WHY SHOULD WE CARE ABOUT MORE THAN JUST CARBON?

https://portal.mindfulmaterials.com




# CINCINNATI IS THE FIRST 2030 DISTRICT TO ESTABLISH A DISTRICT-WIDE HEALTHY BUILDING MODEL

## The Cincinnati Model

The **Cincinnati 2030 District** stands out for its pioneering inclusion of health as a key pillar alongside energy, water, and transportation goals.

### Water

Poor water quality can lead to gastrointestinal illness and neurological disorders.

### Movement

Regular movement increases mental clarity and decreases sick days.

### Light

Light is the main driver of circadian systems, supporting our alertness and sleep cycles.

### Air

Good air quality increases productivity and reduces respiratory disease.

### Mind

The built environment can mitigate adverse cognitive health outcomes by supporting mental health.

### Materials

Chemicals in building materials can be harmful, causing headaches and respiratory issues.

Image: Dan Dugan

# CALL TO ACTION: BUILDING A SUSTAINABLE FUTURE TOGETHER

# THE POWER OF COLLECTIVE ACTION

### Individual Efforts

Each person's actions, from energy-saving habits to sustainable purchasing decisions, contribute to the overall impact.

### Organizational Initiatives

Companies and institutions implementing comprehensive sustainability programs create significant change and set industry standards.

### Community Collaboration

Local partnerships and district-wide initiatives, like the Cincinnati 2030 District, amplify individual and organizational efforts.

### Global Movement

The synergy of actions at all levels drives global progress towards sustainability goals and climate change mitigation.






## Educate + Engage

Share knowledge with colleagues, friends, and family. Spread awareness about the importance of whole-life carbon and sustainable building practices.

## Start Small, Think Big

Begin with simple changes in your own workspace or project, but always keep the bigger picture in mind. Every action contributes to the larger goal of sustainability.

## Collaborate + Innovate

Seek out partnerships and collaborative opportunities within your organization and community. Join or create initiatives to amplify your impact.

## Lead by Example

Whether you're a building owner, manager, or occupant, demonstrate leadership in sustainability. Your actions can inspire others and create a ripple effect of positive change.

"In our every deliberation
we must consider the impact of our decisions on the next seven generations."

~ From the Great Law of the Haudenosaunee Confederacy