
City of Cambridge
Getting to Net Zero Action Plan
Fiscal Year 2018 Progress Report

April 2019





City of Cambridge
CLIMATE PROTECTION ACTION COMMITTEE

Dear Mr. DePasquale:

The City of Cambridge's Climate Protection Action Committee (CPAC) is tasked with overseeing the City's Net Zero Action Plan (Plan) and reporting on its progress on an annual basis. This letter serves as the third annual progress assessment, which includes themes and recommendations for the Plan and the Cambridge Community Development Department (CDD) which is managing the Plan.

CPAC appreciates the meaningful achievements that have been made in the third year of the Plan's implementation. These include significant progress towards both a stakeholder-driven consensus straw proposal with pathways for performance requirements within the Building Energy Use Disclosure Ordinance (BEUDO) and a separate compliance track for laboratories developed by the Net Zero Laboratory Working group. Also notable are Cambridge's participation and leadership in the Zero Cities project and the ongoing regional collaboration with surrounding municipalities on district energy and renewable energy.

CPAC would like to note the following items which are critical to achieving the plan's implementation objectives:

1. Legislative Action in FY2019: Green Building Requirements and BEUDO

- Proposed ordinance language is about to be presented to the City Council that would amend Article 22 of the Zoning Ordinance to increase green building requirements for new buildings (Action 2.3 in the Plan) and remove barriers to increased insulation (Action 2.5). CPAC urges swift passage and implementation of the amendments, which have already undergone an extensive stakeholder process and represent a consensus proposal.
- The status of BEUDO is moving from data gathering/measurement to managing/reducing emissions in existing buildings. The straw proposal noted above for additional BEUDO requirements should serve as a basis for amending the BEUDO ordinance to introduce performance requirements for BEUDO buildings. Performance requirements such as these were proposed in the original BEUDO ordinance, and it was ultimately decided to implement those requirements through the Plan. We expect the amendments to come before the City Council in Spring 2019 and recommend swift implementation once passed.

Passage of both sets of amendments will have a critical impact on overall emissions reduction for the City because energy use by buildings is responsible for over 80% of Citywide emissions. Moving to LEED Gold from LEED Silver for new buildings achieves greater carbon reductions, which are not insignificant given the expected lifetime of these buildings. And the approximately 1,100 existing BEUDO buildings contribute the majority of emissions within the buildings sector.

2. Legislative Action in FY2020: Continue Zero Cities Initiative

- The City has been exercising its carbon neutrality leadership through the Urban Sustainability Directors Network Zero Cities Initiative, sharing best practices learning from what others are doing around the country. Participation in this initiative has enabled significant progress on two critical Plan actions: a Floor Area Ratio bonus policy for new buildings which achieve net zero emissions ahead of the requirements and a rooftop solar installation requirement for new buildings (Actions 2.2 and 3.2). We expect these items to come before City Council in early FY2020 and recommend swift implementation once passed.
- A feasibility assessment for upgrades at the time of renovation or sale (Action 1.1.3) is being carried out by the Zero Cities team, including stakeholder engagement. The resulting report is expected to serve as the basis for policy recommendations that could be adopted as new requirements in FY2020.

3. 5 Year Review and Planning in 2020: Low Carbon Energy Supply Strategy:

The Net Zero Action Plan called for development of a Low Carbon Energy Supply Strategy. The resulting Study concluded that (1) because of limited renewable energy supply resources within Cambridge, clean energy resources would need to be imported from outside the City, and as such electrification of buildings with grid-supplied renewable electricity is recommended, and (2) regional collaboration on district energy systems is recommended to increase system efficiency, resilience and flexibility of energy sources while lowering implementation expenses. Through the five-year review process that will occur in FY 2020, the City should establish a schedule and determine what resources are necessary to implement the Low Carbon Energy Supply Strategy. We urge the City Manager to continue to support the recommended strategies to move forward towards implementation, and provide the necessary resources to make this happen.

In conclusion, we commend the City for its work thus far in determining the best courses of action to achieve net zero building emissions. The Plan is now moving from developing strategies to their implementation, and unless the necessary recommendations are acted upon, the Plan will not achieve its aims. We urge the City to follow the findings and strategies noted above and in the current Net Zero Action Plan report with the necessary legislative actions and implementation. As such, we urge you and the City Council to move quickly on these initiatives.

Very Truly Yours,



Melissa Chan, Chair

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INTRODUCTION

Background

The City of Cambridge shares increasing global concerns about the crisis of climate change and the many challenges it presents. This crisis threatens the ability of the planet to support secure, healthy, productive, and enriching lives for current and future generations. The City of Cambridge has long been steadfast in addressing climate change. In 2002, the City adopted the Climate Protection Action Plan, our first attempt at proposing emissions reduction targets and recommendations to reduce greenhouse gas (GHG) emissions. Since then, the City has committed to a range of initiatives to support sustainable lifestyles and move the community toward greater resilience to climate change. In 2016, the City made a commitment through the Metro Mayors Coalition¹ to achieve carbon neutrality by 2050. In Cambridge, buildings are both the problem and the solution for addressing climate change: more than 80% of our greenhouse gas emissions result from building operations and, as a sign of our thriving economy, new building development steadily continues. If the city can get to net zero emissions in the building sector, we will have made major progress towards achieving the U.N.'s goal of carbon neutrality in our cities.

In 2013, in response to community concern that continued construction activity would make the goal of reducing greenhouse gas emissions harder, the City convened the Getting to Net Zero Task Force to foster a deep conversation among stakeholders to advance the goal of setting Cambridge on a trajectory to becoming a “net zero community,” with a focus on carbon emissions from building operations. **For Cambridge, ‘net zero’ refers to a building or a community of buildings for which, on an annual basis, all greenhouse gas emissions resulting from building operations are offset by carbon-free energy production.** Achieving the net zero objective relies on a combination of energy efficiency improvements, renewable energy production and, where necessary, purchase of carbon offsets or, potentially, credits (that meet specific criteria). After fifteen months of intensive discussions, outside expert analysis, and consultation across sectors including the general public, the Task Force delivered a 25-year framework for setting Cambridge on the trajectory to becoming a net zero community.²

¹ <http://www.mapc.org/metro-mayors-coalition>

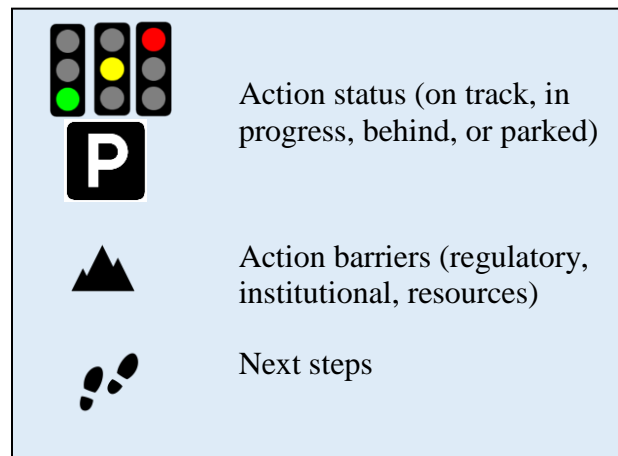
² This language is drawn from the Getting to Net Zero Framework report, which can be found along with additional materials about the Cambridge Net Zero Action Plan at <http://www.cambridgema.gov/CDD/Projects/Climate/NetZeroTaskForce>

Annual Report Purpose and Structure

In accordance with the recommendations of the Net Zero Action Plan (see Action 5.2), the Cambridge Community Development Department (CDD) has committed to conduct ongoing monitoring and reporting of progress towards the Net Zero Action Plan goals. In collaboration with the Climate Protection Action Committee (CPAC) which has agreed to provide oversight of the Plan, CDD committed to providing an annual report to CPAC and the public to summarize progress towards each action slated for the previous fiscal year.³ This is the third such report.

Net Zero Action Plan annual reports are intended to provide an overview of each action planned for that year, including the action items, progress made, and next steps to reach the annual goals. The annual report will also provide quantitative outputs as appropriate for each action, for example the number of green buildings permitted during the past year, as well as broader outcomes such as changes in community-wide GHG emissions. The first citywide GHG Community Inventory was completed in early 2017 and serves as a baseline indicator for the Net Zero Action Plan. Because GHG emissions are measured at the community scale in Cambridge, however, attributing changes in GHG emissions to individual Net Zero actions will likely be challenging. Therefore, annual building performance measured by the Building Energy Use Disclosure ordinance and individual action outputs and their alignment with the assumptions of the Net Zero GHG Model⁴ will serve as an indicator of the direction and magnitude of potential GHG reductions that can be attributed to the Plan.

This report is structured to parallel the Net Zero Action Plan, with actions falling into five categories. In addition to detailed information, a summary box such as the one to the right is provided for each action. The green, yellow, or red light indicates the overall status of the action and whether it is on track, making progress but delayed, or behind, respectively. New for FY18 is the parking symbol which represents actions that are “parked” because they are completed or no longer being pursued. They will remain parked in future reports unless it is determined that they should be reinvestigated. Note that the progress status is based on what was accomplished towards the FY18 action items up to the writing of this report in December 2018. The mountain symbol represents key challenges to successful implementation of the action including regulatory, institutional, and resource barriers. The footprints represent next steps for the action.



Following discussion of qualitative progress towards each of the actions is a section summarizing quantitative indicators and their change over time.

³ For the full Plan schedule, see Appendix 1 ; City of Cambridge fiscal years run from July 1-June 30

⁴ http://www.cambridgema.gov/CDD/Projects/Climate/~/_media/89814C94911A49388ECDBAAEAE7366A6.ashx

FISCAL YEAR 2018 ACTION PROGRESS UPDATES

Fiscal Year 2018 is the third year of Net Zero Action Plan implementation. Actions initiated in FY16 and FY17 are beginning implementation, while a new set of actions commence study of feasibility and design. FY18 included actions in all five categories: Action 1 – Energy Efficiency in Existing Buildings, Action 2 – Net Zero New Construction, Action 3 – Energy Supply, Action 4 – Local Carbon Fund, and Action 5 – Engagement and Capacity Building.

Legislative Action

As the Net Zero Action Plan moves from an emphasis on feasibility and design to the implementation of recommendations, there is an increased need for legislative action by the Cambridge City Council and related stakeholders in order to advance implementation of the actions. Legislative actions may include amendments to existing Zoning or City Ordinances or the creation of new regulations. To identify the need for such measures, **Legislative Action** has been flagged within each individual action as appropriate. Below is a summary of these actions in approximate chronological order of potential adoption:

- FY19: Amend Article 22 of the Zoning Ordinance to Increase Green Building Requirements (Action 2.3) and Remove Barriers to Increased Insulation (Action 2.5)
- FY19: Submit Building Energy Use Disclosure Ordinance amendments to introduce performance requirements for BEUDO buildings (Action 1.1.2)
- FY20: Implement recommendations for a Height and FAR Bonus through zoning for buildings that achieve net zero emissions ahead of the required schedule (Action 2.2.2)
- FY20: Adopt a Rooftop Solar Installation Requirement for new buildings (Action 3.2)
- FY20: Adopt Net Zero Requirement for New Construction of Municipal Buildings (Action 2.4.1)
- FY20: If feasible, implement policy recommendations for Upgrades at Time of Renovation or Sale (Action 1.1.3)

Action 1 – Energy Efficiency in Existing Buildings




The intent of this action is to ensure that all buildings are operating optimally and, where necessary, are retrofitted to maximize efficiency. In FY18, there was continued pilot implementation of the Custom Retrofit Program for residential buildings and stakeholder engagement around potential additional Building Energy Use Disclosure Ordinance requirements along with Operations and Maintenance Planning. New for this year was the start of the process to consider policy options for required Upgrades at Time of Renovation or Sale.

Action 1.1.1: Custom Retrofit Program

Introduction

Because Cambridge’s housing stock is dominated by multi-family buildings, which make up over 90% of residential units, the City has focused on strengthening utility retrofit programs for multi-family buildings. Beginning in 2013, the Cambridge Energy Alliance partnered with MIT’s Department of Urban Studies and Planning and NSTAR (now Eversource) to design a pilot program to

overcome barriers to achieving energy efficiency in medium size (5-50 unit) multi-family buildings. Key conclusions of the resulting study⁵ to inform the pilot program are to (1) build trust between building occupants/owners and the utilities/energy efficiency providers by adopting a performance-based approach to building upgrades and payments; (2) ease administration of the assessment and retrofit process by assigning each building owner a single owner’s agent to manage all aspects of the process; (3) connect building owners to accessible financing options, including existing state and utility incentives; (4) integrate renewable energy solutions such as solar PV into the energy efficiency retrofit process to streamline the renovation process; and (5) conduct a targeted marketing process to efficiently identify and enroll prospective building owners, with a focus on condominiums and renter-occupied properties with master-metered heating/hot water systems as well as landlord-occupied rental properties to reduce split incentive barriers. Lessons from a multi-family program could be applied to a large commercial custom retrofit program in the future.

	Multi-Family Energy Pilot in implementation
	Low conversion of building intakes to retrofits
	Pilot program evaluation and Custom Retrofit Program design

FY18 Action Items

Continue implementation and monitoring of the Multi-Family Pilot program.

Progress Towards FY18 Action Items

The Cambridge Multi-Family Energy Pilot continued to be offered in FY18 in coordination with Eversource and their multi-family contractor, CLEAResult. The pilot program is meant to provide multi-family buildings with 5-49 units comprehensive energy assessment and retrofit

⁵ See http://web.mit.edu/energy-efficiency/docs/EESP_Michaels_PathwaysInMultiFamilyHousing.pdf

services with a single point of contact. Building owners and tenants can enroll in the program directly with Eversource/CLEAResult or through the Cambridge Energy Alliance.⁶ They are then assigned a Principal Point of Contact who schedules the energy assessment and provides the results along with a comprehensive energy retrofit package. Cambridge contracted with Zapotec Energy to provide a parallel solar assessment and proposal for properties which express interest. **New for FY18 is a no-cost Retrofit Advisor service provided by New Ecology, Inc. which assists participating buildings in understanding the retrofit package recommendations and consider options for implementation,** including energy efficiency, solar PV, and fuel-switching such as replacing oil or gas with air-source heat pumps. Ongoing outreach includes online media, street signs, BlueBikes station posters, flyers, and postcards, as well as canvassing through the Cambridge summer high school internship program. **As of December 2018, 40 properties, encompassing 1350 units, have enrolled in the program.** Nearly all enrolled buildings have taken advantage of the opportunity to get a solar assessment through the pilot, collectively identifying a total of 1.2 MW of solar potential. The City is continuing to work with Eversource and CLEAResult to streamline the enrollment and communication process with property owners to make sure the process is as user-friendly as possible. While City involvement has led to coordinated solar assessments, retrofit guidance, and marketplaces for solar and renewable thermal technologies, the uptake of these measures has been low, particularly those measures that are more intrusive or have longer payback periods. Reasons for this could include limited identified cost-effective measures and decision-making barriers; these obstacles should be evaluated further in the FY19 Pilot program evaluation.

Next Steps

The Multi-Family Pilot is continuing to be offered through FY19 as the Cambridge Energy Alliance continues to track the results of the Pilot and coordinate with Eversource, CLEAResult, Zapotec, and New Ecology to analyze the program impacts and develop case studies from successful retrofits. The City may be able to partner with researchers to assist with program evaluation and data analysis. A state grant for FY20 will enable the City to make changes to the Pilot based on evaluation results such as earlier engagement by the Retrofit Advisor to facilitate greater commitment from participants to follow through on retrofit recommendations. This review period coincides with the design of a potential custom retrofit program for larger residential and commercial buildings which report to BEUDO (see Action 1.1.2 below). These processes could lead to the launch of an independent Multi-Family Retrofit Program and a large building Custom Retrofit Program Pilot in FY20.

⁶ <http://www.cambridgeenergyalliance.org>

Action 1.1.2: Additional BEUDO Requirements

Introduction

The Cambridge Building Energy Use Disclosure Ordinance (BEUDO), enacted in 2014, requires parcels with non-residential buildings totaling 25,000 square feet or greater as well as parcels with residential buildings totaling 50 or more units to annually report and disclose their energy and water use.⁷ BEUDO did not initially include any required actions for buildings to reduce their energy or water use beyond the annual reporting because the Net Zero Action Plan was in development. This action aims to determine

potential required actions for BEUDO to target savings among the least efficient buildings.

Actions initially contemplated by the Net Zero Action Plan include audits, retro-commissioning, and operations and energy management plans to be completed on a regular basis.



Stakeholder process produced retrofit requirements straw proposal for ordinance amendment



Determining policy details and implementation logistics



Complete lab working group and begin regulatory process

Legislative action: Submit BEUDO amendments in FY19

FY18 Action Items

Continue the two-year process to design additional BEUDO requirements. Engage BEUDO stakeholders in the potential requirement design, including consideration of triggers, compliance pathways, and exemptions for participating buildings.

Progress Towards FY18 Action Items

FY18 BEUDO requirement design built off of the FY17 “phase 1” study which included research of the structure of requirements in other jurisdictions, analysis of the impact of different performance tiers within the BEUDO dataset, and examination of the impact of requirements for these buildings.⁸ In FY18, CDD worked with a consultant to conduct “phase 2” of the project through a stakeholder-driven process to build consensus around requirements and program structure for BEUDO buildings, establish operations and maintenance plan templates for new and existing buildings, and begin development of a comprehensive retrofit program design and structure to enable all buildings subject to BEUDO reporting to achieve the requirements established for the ordinance as well as voluntary energy and GHG savings. This scope of work combines elements from Action 1.1.2 (Additional BEUDO Requirements), 1.1.1 (Custom Retrofit Program), and 1.1.4 (O&M Plan Requirement) of the Net Zero Action Plan. It makes

⁷ 2015 reporting applied to parcels with 50,000 square feet or greater; Disclosure not required in 2015; for more details, see

<http://www.cambridgema.gov/CDD/zoninganddevelopment/sustainablebldgs/buildingenergydisclosureordinance.aspx> ; See also the 2015 BEUDO Summary Report:

http://www.cambridgema.gov/CDD/zoninganddevelopment/sustainablebldgs/~/_media/809369A43E674BA485E6C546E1C11D8.ashx; For the full reported data set for 2016, see the Cambridge Open Data Portal:

<https://data.cambridgema.gov/Planning/2016-Cambridge-Building-Energy-and-Water-Use-Data-/72g6-j7aq>

⁸ See the full report and analysis at: http://cambridgeenergyalliance.org/wp-content/uploads/Memo_MasterCambridgeBEUDOPhase1.pdf

sense to take a coordinated approach to these actions because they will affect an overlapping set of buildings, can share resources, and through parallel implementation can provide building owners with a full set of options to maximize their energy savings in as streamlined and cost-effective a manner possible.

Over the course of four stakeholder workshops, a straw proposal for potential BEUDO requirements was developed. The straw proposal offers a “performance” and a “prescriptive” pathway for BEUDO buildings to comply with requirements on a 5-year basis by either achieving a demonstrated 10-15% energy savings or completing an energy audit and implementing cost-effective measures within that time period. New and “high-performance” buildings would be exempt from the requirements. A specific pathway for laboratory buildings is being considered to accommodate their unique operational constraints. Operations and Maintenance Plan requirements for new buildings were also considered (see Action 1.1.4 below).

Next Steps

The Net Zero Laboratory Working Group (see Action 5.3 below) is working to propose a laboratory compliance pathway in early 2019. Additional questions such as how to define campuses and the role of renewable energy are also being considered. As an extension of this stakeholder engagement, in FY19 an additional set of meetings is being held to brainstorm needs and opportunities to design a Custom Retrofit Program for large residential and commercial buildings that can help buildings achieve new BEUDO requirements along with deeper energy retrofits (see Action 1.1.1, above).

Legislative Action

The straw proposal for additional BEUDO requirements can serve as the basis for additional policy development and initiation of a regulatory process to amend the BEUDO ordinance starting in winter 2019. In order to adhere to the Net Zero Action Plan calendar, the proposed changes would need to be submitted to City Council before the end of FY19.

Action 1.1.3: Upgrades at Time of Renovation or Sale

Introduction

Building renovations or sales can be valuable opportunities to increase the energy performance of the building in coordination with upgrades that are being undertaken. Typically, any requirements at time of renovation or sale are modest and target poor performers within a building class, though such transaction points may also represent opportunities for deeper energy retrofits. In the analysis of potential policies, careful consideration will be given to ensure that any proposed program or regulation will not result in adverse unintended consequences, such as decreases in housing affordability or further disinvestment in poorly maintained buildings



Time of Renovation or Sale requirement feasibility assessment initiated through Zero Cities project



Avoid unintended consequences for property owners/tenants



Complete feasibility assessment in FY19 with policy recommendations
Legislative Action: If feasible, implement policy recommendations in FY20

FY18 Action Items

Initiate a study to explore a requirement for energy upgrades at the time of renovation or, if appropriate, sale of a property. To assess the feasibility of such requirements, a market analysis should be undertaken to determine an appropriate scope of renovation to regulate, which building types would be included in the requirement, what measures are appropriate to require and over what time period, and whether the retrofit would be the responsibility of the buyer or seller when properties are sold.

Progress Towards FY18 Action Items

In Spring 2018, Cambridge committed to taking part in the Zero Cities project, an initiative organized by the Urban Sustainability Directors Network⁹ to enhance cities' planning and implementation efforts to achieve carbon neutrality. Participating cities receive technical support to develop a range of common metrics around building energy and GHG trajectories, and then pursue custom projects to advance the goals of each city. Cambridge chose for its primary custom project to focus on the design of potential requirements for Upgrades at Time of Renovation or Sale to leverage Zero Cities consultant expertise in completing the feasibility assessment called for by the Net Zero Action Plan. Architecture 2030¹⁰ will lead this work with support from the Rocky Mountain Institute¹¹ to a) assess current building transaction and renovation activity, b) develop projections for future building transactions and renovations, c) assess potential energy savings and emission reductions from existing buildings to meet potential energy upgrade requirements, d) assess potential economic impacts of requirements for upgrades at time of renovation or sale.

⁹ www.usdn.org

¹⁰ www.architecture2030.org

¹¹ www.rmi.org

Next Steps

The feasibility assessment is being carried out by the Zero Cities team over the course of FY19. The resulting report can serve as the basis for stakeholder engagement and policy recommendations to follow.

Legislative Action

If requirements at time of renovation or sale are determined to be feasible, policy recommendations could be adopted as new requirements in FY20, in line with the Net Zero Action Plan schedule.

Action 1.1.4: Operations and Maintenance Plan Requirement

Introduction

This action recommends that the City require, as a condition of building occupancy, that applicants submit energy management plans detailing how the building will be operated to meet the intent of the energy efficient design. While the requirement would apply to new construction, its objective is to ensure future existing buildings are operated to their maximum potential.



BEUDO process included the creation of O&M plan template
O&M plans are implemented on a case-by-case basis after occupancy



O&M planning is captured through Green Building Requirements; no need for further action

FY18 Action Items

The City should establish a template for operations and maintenance (O&M) plans based on existing frameworks that are common in the commissioning industry and are designed for simplicity and effectiveness. The intent is for these proposed O&M plans to align with those contemplated as a mechanism for buildings as part of the new BEUDO requirements in action 1.1.2, above.

Progress Towards FY18 Action Items

As part of the BEUDO “phase 2” process, in FY18 the consultant developed an O&M plan template by drawing from industry best practices such as O&M techniques described in the LEED Fundamental and Advanced Commissioning Credits. This template was shared with stakeholders for feedback. Stakeholders with large building portfolios explained that they generally have a custom O&M plan template and that such plans cannot be completed until after buildings are operating and occupied in order to take actual operating conditions into account. Furthermore, the LEED Enhanced Commissioning Credit being required through the Article 22 increased Green Building Requirements (see Action 2.3, below) includes O&M planning as a Fundamental Commissioning prerequisite, so any new building in Cambridge subject to Article 22 will have an O&M plan. Therefore, a separate O&M requirement for new buildings is not necessary.

Next Steps

While a separate O&M requirement for new buildings will not need to be established, the BEUDO phase 2 report includes an O&M plan template that could be voluntarily used by new and existing buildings. Furthermore, retro-commissioning with O&M plan updates remains a strategy that existing buildings could use to achieve the BEUDO requirements being advanced through Action 1.1.2, above.

Action 2 – Net Zero New Construction

While newly constructed buildings contribute a small portion of Cambridge’s total GHG emissions, targeting net zero for new buildings is a bold step that will stimulate investments in net zero innovation that can benefit both new and existing buildings. The process and governance framework for new requirements is to ensure that meaningful financial analysis can take place and industry capacity is commensurate with the requirements. It is important to note that the recommended net zero target years will be evaluated at regular intervals and regulatory changes will be proposed at least 24 months prior to final enactment.

Table 1 - Targets for net zero new construction by sector

Type:	Municipal	Residential	Multi-Family	Commercial	Institutional	Labs
Target Year:	2020	2022	2025	2025	2025	2030




The following set of actions are designed to support and incentivize achievement of net zero GHG emissions performance in newly constructed buildings in Cambridge.

Action 2.2.1: Market Based Incentive Program

Introduction

In order to achieve net zero buildings in less than ten years, Cambridge should explore the use of financial mechanisms to motivate the market and accelerate innovation. MIT and Harvard have agreed to collaborate with the City on this investigation in order to determine the most effective incentives for the

Cambridge context. These could include tools such as green building bonds, “green banks”, and adjusting pricing of permit fees (or rebates) based on performance.

	Completed feasibility study of market incentives for new buildings
	Policy constraints of revenue neutrality and no additional penalties
	Prioritize height and FAR bonus for new buildings and consider market mechanisms for existing buildings

FY18 Action Items

Continue piloting a market based incentive approach for new construction and major renovations in the residential sector and study the feasibility of market based incentives in the commercial and laboratory sectors.

Progress Towards FY18 Action Items

In FY18, a Harvard master’s student researcher conducted a comprehensive feasibility study of market based incentive approaches for new residential, commercial, and laboratory buildings in Cambridge. The study considered which market incentives could be applied in Cambridge, how

other jurisdictions have used market incentives to achieve higher performing buildings, what the key barriers to net zero new construction are in Cambridge, and which incentives could best be employed in the Cambridge context to overcome these barriers. Key policy constraints on the incentive structure were that it not penalize buildings meeting minimum existing requirements and that it be revenue neutral. Based on these considerations and constraints, it was concluded that market incentives are likely not the most effective way to drive higher performing new buildings in Cambridge.¹² Instead, the height and FAR bonus proposed in Action 2.2.2, below, is likely to be more impactful while better aligning with the City’s policy goals. It is possible that market approaches such as cap-and-trade could be used as tools to incentivize emissions reductions among both new and existing buildings, with potential integration of the BEUDO requirements (Action 1.1.2) and Local Carbon Fund (Action 4).

Next Steps

Based on the feasibility study findings, it has been determined not to directly pursue market-based incentives for new buildings at this time, but instead to prioritize implementation of height and FAR bonuses for new buildings that achieve net zero emissions in advance of the requirements, and to consider cap-and-trade and other market mechanisms as part of future city-wide emission reduction approaches.

Action 2.2.2: Height and FAR Bonus

Introduction

To generate early action, the City should explore the potential impact of offering additional floor area allowance (FAR) and extra height to projects that achieve net zero emissions. Projects will need to demonstrate and commit to net zero emissions through their design in order to meet eligibility requirements for additional FAR award.

Projects should also have to agree to share lessons on how net zero was achieved in their projects. FAR incentives have proven effective in other dense jurisdictions where building space is at a premium. For example, in Arlington County, Virginia, nearly all new “site plan” (similar to Cambridge Special Permit) projects have voluntarily pursued LEED certification since additional FAR was offered as an incentive beginning in 2008.¹³ The CDD Community Planning Division has also observed, however, that density bonuses are limited in nature and run the risk of being over-utilized by competing program priorities. The incentive would phase out as the net zero requirements are adopted.



Delayed by Envision Cambridge but now moving forward independently



Needs to be prioritized in context of other density-related policies



Complete technical study in FY19
Legislative Action: Pursue recommended density bonus in FY20

¹² See full report at: http://cambridgeenergyalliance.org/wp-content/uploads/7.24.18_Market-Based-Incentives-for-Net-Zero-New-Construction-Final_CLEAN.pdf

¹³ <https://environment.arlingtonva.us/energy/green-building/green-building-bonus-density-program/>

FY18 Action Items

Complete consideration of the feasibility of offering height and/or FAR bonuses to new Cambridge buildings which commit to pursuing net zero emissions. This action is to occur as part of the “Envision Cambridge” citywide planning process.¹⁴ Begin program implementation.

Progress Towards FY18 Action Items

As described in Action 2.2.1 above, the Market Based Incentive Program feasibility study determined that FAR and height bonuses could be a key tool to incentivizing high performance new buildings. In FY18, the Envision Cambridge planning project studied the potential amount of FAR needed to incentivize net zero buildings and included an “environmental performance” FAR bonus in a list of potential development scenarios. It was decided not to advance these incentives through the Envision Cambridge process, but to instead pursue a separate FAR bonus for net zero buildings as a zoning amendment.

Next Steps

The details of an FAR bonus policy for buildings that achieve net zero in advance of the requirements are being further developed in FY19 through a technical study with consultant support linked to the Zero Cities project. Key aspects to be determined with stakeholder input during the study include the energy efficiency and renewable energy standards for net zero buildings, along with the amount of FAR granted based on the Envision Cambridge study recommendations.

Legislative Action

The technical study and stakeholder feedback will lead to a recommended FAR bonus policy which can be considered and advanced by City Council in early FY20, potentially in coordination with the Rooftop Solar Installation Requirement (see Action 3.2, below).

¹⁴ <http://envision.cambridgema.gov/>

Action 2.3: Increase Green Building Requirements in Cambridge Zoning Ordinance

Introduction

Article 22 of the Cambridge Zoning Ordinance, *Sustainable Design and Development*, promotes environmentally sustainable and energy-efficient design and development practices in new construction and renovation of buildings in the city.¹⁵

Article 22 currently requires that new buildings 25,000-50,000GFA (gross floor area) meet the requirements of the Leadership in Energy and Environmental

Design (LEED) Green Building Rating System at the level ‘Certified’ or better, and that new buildings 50,000GFA or greater meet the requirements of LEED ‘Silver’ or better. Increasing the Green Building Requirements in the Cambridge Zoning Ordinance was identified by the Net Zero Task Force as a measure with significant potential impact on future GHG emissions.

FY18 Action Items

Implement the Cambridge Green Building Requirement that all new construction and major renovation projects over 25,000GFA to meet LEED criteria at the ‘Gold’ level or better. Projects should also achieve a minimum of 6 points under LEED’s Optimize Energy Performance credit and the requirements of the Enhanced Commissioning credit to ensure superior energy efficient design and operation.

Progress Towards FY18 Action Items

Staff have continued work to draft a revised Article 22 to be submitted to City Council as a zoning amendment. It was determined that the state building stretch energy code which came into effect on January 1, 2017 meets the 6-point improvement targeted by the Net Zero Action Plan. However, some new buildings in Cambridge that are subject to Special Permit requirements are smaller than the thresholds that trigger the amended Stretch Code; these are being strongly encouraged to meet the same energy performance voluntarily through the design review process. In fall 2016, Cambridge adopted the latest version of LEED (Version 4) under the current Article 22 permitting requirements, increasing the stringency of building energy performance. New buildings are also being asked to present a decarbonization pathway plan along with their application, which acknowledges that while the buildings may not achieve net



Previously delayed requirements are ready for implementation following additional stakeholder engagement



Finalizing compliance pathway criteria details and review process



Legislative Action: Zoning amendment package will be brought to City Council before the end of FY19

¹⁵ See <http://www.cambridgema.gov/CDD/zoninganddevelopment/Zoning/Ordinance> for the full Zoning Ordinance

zero emissions today, developers should plan for a technically achievable pathway to do so within the life of the building.¹⁶

In FY18, 12 projects were permitted following Green Building Review.¹⁷ Eight of the twelve are certifiable at the level of LEED Gold, and four at the level of LEED Silver. In aggregate, the projects represent almost 2.5 million square feet of development, 1.8 million of which is residential with over 1,700 units.

In FY18, staff continued to refine the proposed Article 22 revisions to incorporate Passive House and Enterprise Green Communities as optional standards and to improve the efficiency and quality of the Green Building Review process,¹⁸ including mechanisms to give input earlier in the design process and options for cost-effective third-party review of energy models. The draft zoning language is now ready for legal and stakeholder review.

Next Steps

Staff have initiated a stakeholder review process to solicit input on this zoning amendment package including requirements for LEED Gold, enhanced commissioning, and eliminating barriers to increased insulation (see Action 2.5, below). In anticipation of the next round of green building requirements due in FY21, staff are researching options for performance-based building requirements that would not conflict with the state building code. The Zero Cities Project (see Action 1.1.3 for details) will devote additional resources to developing performance-based models for cities. There is also activity at the state level that could provide alternative pathways, such as a voluntary net zero stretch code, that staff will follow moving forward.

Legislative Action

The zoning amendment package for LEED Gold, enhanced commissioning, and eliminating barriers to increased insulation will be brought to City Council for potential adoption before the end of FY19.

¹⁶ For examples of such pathways for different building types, see the New York “One City Built to Last” technical working group report: *Transforming New York City Buildings for a Low-Carbon Future*; http://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/TWGREport_04212016.pdf

¹⁷ For more information, see the Green Building Dashboard: <https://app.powerbi.com/view?r=eyJrjoiZTk0OWZmYTctZDljNy00N2MxLTg0OWUtYTEyYzZiZWY1YTNkIiwidCI6ImMwNmE4YmU3LTg0NzktNGQ3My1iMzUxLTkzYmM5YmE4Mjk1YyIsImMiOiN9>

¹⁸ <http://www.cambridgema.gov/CDD/zoninganddevelopment/sustainablebldgs/greenbldgrequirements>

Action 2.4.1: Net Zero Requirement for New Construction of Municipal Buildings

Introduction

To demonstrate leadership it is important that the City establish policies to pursue net zero emissions in municipal buildings. Specifically, new construction should target net zero or be ‘net zero ready’ in the near term. Net zero ready buildings achieve maximum energy savings (e.g. >80% more efficient than code requirement) and are designed to accommodate 100% of annual energy consumption by on or off-site

renewable sources through zero on-site combustion, recognizing that constraints such as site area or location may preclude access to sufficient onsite renewable energy to meet 100% of energy demand.¹⁹ This policy would also be applicable to “gut renovations” where a building is being completely renovated with new electrical, mechanical, interior, and envelope systems.



New municipal buildings being constructed to achieve net zero-ready



Detailing net zero definitions in anticipation of requirements



Continued development of definitions for net zero standard for 2020

Legislative Action: Adopt muni net zero new construction standard in FY20

FY18 Action Items

Implement the established policy that new construction of municipal buildings should target net zero readiness.

Progress Towards FY18 Action Items

The Net Zero Action Plan adopted by City Council in 2015 serves as the policy guiding new municipal building construction. Staff have defined net zero-ready construction as highly efficient buildings that are fossil fuel-free to enable the consumption of renewable electricity. Current municipal construction projects are pursuing net zero readiness: the King Open School continued construction throughout FY18 and will be fossil fuel free, and 859 Mass Ave was completed in September 2018 including a variable refrigerant flow system along with solar hot water and PV panels.

Next Steps

The City will continue to pursue net zero-readiness for its new construction projects in FY19 as the details of the net zero requirement are being developed, to take effect in 2020. Continued definition of this requirement is being conducted by staff incorporating findings from the Net Zero Density Bonus design (Action 2.2.2) and Local Carbon Fund feasibility study (Action 4).

Legislative Action

Net Zero Requirements for new municipal buildings should be adopted in FY20 for buildings permitted beginning in calendar year 2020.

¹⁹ As defined on page 16 of the Net Zero Action Plan Summary of Proposed Actions:

<http://www.cambridgema.gov/CDD/Projects/Climate/~media/BF531928BB7D4526AE2D8538E025E0BA.ashx>

Action 2.4.2: Renewal of Municipal Buildings

Introduction

Cambridge also seeks to set an example by showing leadership in the energy efficient renewal of existing municipal buildings. The Task Force recommends introducing greenhouse gas reductions as a key component throughout the municipal facilities improvement strategy and integrating it with other priorities, such as life safety, and accessibility.



Continued implementation of Municipal Facilities Improvement Plan



Resource limits to achieve multiple institutional goals



Continue implementation and tracking of results

FY18 Action Items

Continue design and begin implementation of a phased municipal building improvement strategy where (1) greenhouse gas reduction is a priority when constructing facility improvement projects and (2) operational improvements are implemented to achieve targets established and tracked by the Cambridge Department of Public Works. The strategy will involve continuous self-evaluation requiring increased performance levels as technology and local capacity is improved.

Progress Towards FY18 Action Items

In FY17, the initial Municipal Facilities Improvement Plan (MFIP) was completed to (1) assist the City in developing performance metrics and goals for its building portfolio in key facility disciplines; (2) perform and document a needs and condition assessment of 41 municipal facilities; (3) develop and document a phased Capital Improvement Plan of identified facilities; and (4) develop a GHG emissions reduction plan for municipal facilities. The City has committed \$5 million per year for 5 years to implement the plan recommendations.

Implementation of improvements to municipal buildings is in progress: **11 energy efficiency were upgrades completed in FY18 and another 13 projects are underway. These include installation of HVAC upgrades and optimization, LED lighting retrofits, and buildings controls and retrocommissioning resulting in annual savings of over 400,000 kWh, 1,000 therms, and \$75,000 in energy costs to the City. A major Variable Frequency Drive/Pump upgrade at the Water Treatment Facility completed in December 2017 started showing kWh savings immediately. For the period of January – June 2018 the Water Treatment Facility reduced 292,000 kWh in total electric use. Water pumping electricity decreased by 22% and could save almost \$175,000 per year.**




Next Steps

Implementation of MFIP improvements will continue throughout FY19. The nature and impact of these renovations on energy use will be tracked and reported.

Action 2.5: Removal of Barriers to Increased Insulation

Introduction

One strategy to improve building efficiency is to increase the amount of insulation on the exterior of buildings. Because the addition of insulation effectively increases the footprint of a building and may incur into side yard set-back requirements, the Zoning Ordinance can introduce regulatory barriers to this retrofit. Currently, Article 22 of the Zoning Ordinance allows Yard Exceptions for existing buildings to install exterior insulation as long as it does not increase the thickness of the exterior wall by more than 4 inches or result in the wall being less than 7 feet, 2 inches from the nearest property line.²⁰ This action calls for development of an approach to remove barriers in the Zoning Ordinance to enable the addition of exterior insulation with the purpose of improving the energy efficiency of residential buildings.

	Previously delayed requirements are ready for implementation following stakeholder engagement
	Potential opposition to reducing setback limitations
	Legislative Action: Zoning amendment package will be brought to City Council before the end of FY19

FY18 Action Items

Implement a potential new policy through amendments to the Cambridge Zoning Ordinance to remove barriers to increased exterior insulation during residential building renovations.

Progress Towards FY18 Action Items

In FY17, staff completed a study of the technical options for exterior insulation, the compatibility of potential insulation approaches with the current Cambridge Zoning Ordinance, and the feasibility and impacts of potential revisions to the Zoning Ordinance to allow for additional exterior insulation.²¹ It was found that many buildings are out of conformance with yard setbacks and therefore additional changes to the Zoning Ordinance would be needed to allow additional exterior insulation. Potential language that would allow for this flexibility has been drafted as part of the Article 22 amendment package.

Next Steps

Staff have initiated a stakeholder review process to solicit input on this zoning amendment package including eliminating barriers to increased insulation along with requirements for LEED Gold and enhanced commissioning (see Action 2.3, above).

Legislative Action

The zoning amendment package for LEED Gold, enhanced commissioning, and eliminating barriers to increased insulation will be brought to City Council for potential adoption before the end of FY19.

²⁰ Article 22.43.2: Yard Exceptions for Added Exterior Insulation

²¹ See full report at: http://cambridgeenergyalliance.org/wp-content/uploads/A22_InsulationStudy_FullReport.pdf

Action 3 – Energy Supply

While maximizing building efficiency is the first priority of the Net Zero Action Plan and will lead to the most GHG savings, to achieve net zero and improve community resiliency will also require a significant shift in the supply of the remaining energy needs of Cambridge buildings away from fossil fuel-based sources and toward low- or zero-carbon sources. This will include realizing a significant portion of the city’s solar potential (both PV and thermal), taking advantage of all opportunities to harvest waste heat, and expanding and developing additional district energy capacity. As part of a regional grid served by a regional utility, it is also important for Cambridge to engage with this utility in order to secure its cooperation and support to help Cambridge achieve its Net Zero goals.




Action 3.1: Low Carbon Energy Supply Strategy

Introduction

The Low Carbon Energy Supply Strategy enables the City to understand the opportunities and pathways to achieve a transformation of its energy supply system.

Key conclusions of the Low Carbon Energy Supply Strategy study include:

- Limited renewable energy supply resources within Cambridge requires the import of clean energy resources from outside the city
- Electrification of buildings with grid-supplied renewable electricity is a key means of enabling this transfer of clean energy
- Use of district energy systems in high energy demand areas increases system efficiency, resilience, and flexibility of energy sources, while lowering implementation expenses
- Regional collaboration is essential to achieve the clean energy supply transition

	Implementation of multiple study recommendations in progress
	Coordination among regional entities for successful action
	Continued implementation

FY18 Action Items

Begin implementation of Low Carbon Energy Supply Strategy study recommendations.

Progress Towards FY18 Action Items

Following completion of the Low Carbon Energy Supply Strategy study in fall 2017,²² staff have taken a number of actions to advance the key findings listed above:

- Study findings have been shared with regional and state entities including the cities of Boston and Somerville, the Metropolitan Area Planning Council, and the Massachusetts

²² See the full report at www.cambridgema.gov/low-carbon

Clean Energy Center and Department of Energy Resources to identify and advance opportunities for collaborative implementation

- To set the regulatory groundwork for district energy systems, Cambridge, Boston, and Somerville applied for and were selected to receive a District Local Technical Assistance award to study state and local governance frameworks for water-based district energy systems. The study included an international literature review, expert interviews, and a half-day stakeholder workshop. The final report will be completed in 2019.
- The City engaged Ramboll to complete a high-level district energy system design schematic for the Alewife neighborhood. In 2019, this design will be used as the basis for engaging landowners in the neighborhood to consider opportunities to pursue a shared district energy system, supported by additional technical and economic analysis.
- Electrification and installation of solar on residential and commercial buildings in Cambridge continued to be supported by existing City programs such as the Multi-Family Energy Efficiency Pilot²³ and Sunny Cambridge.²⁴ The City also engaged with the multi-city Building Electrification Initiative²⁵ to consider longer-term strategic approaches to comprehensive building stock electrification. Staff held a series of meetings with affordable housing managers to understanding barriers and opportunities to electrification of the affordable housing sector.
- The Cambridge Community Electricity municipal aggregation program was redesigned in fall 2018 in order to directly support the development of new solar projects within Cambridge.²⁶

Next Steps

In FY19, staff are continuing to implement the regional collaboration, electrification and renewable energy supply, and district energy initiatives described above. Through the Cambridge Climate Change Preparedness and Resilience Plan, the City is working with consultants to study opportunities for increased energy resilience, which could lead to clean energy-enabling technologies such as microgrids and electricity storage. Staff are pursuing development of a citywide renewable thermal strategy for buildings in FY19 and 20.

²³ <http://cambridgeenergyalliance.org/current-efficiency-promotions>

²⁴ <http://www.sunnycambridge.org>





²⁵ <https://www.beicities.org/>

²⁶ See <https://masspowerchoice.com/cambridge> for more details

Action 3.2: Rooftop Solar Ready Requirement

Introduction

The Rooftop Solar Requirement is intended to help meet the Net Zero goal by encouraging additional onsite renewable energy generation, with a focus on solar. The Action should begin with the exploration of a requirement that all roofs on new construction projects must be solar ready. “Solar ready” means that buildings are designed to accommodate the future installation of roof-mounted solar panels including either photovoltaic or solar thermal. In the future, the City will consider options to require onsite solar installations for new buildings and major roof replacements.

	Solar Ready adopted in state building code requirements and being included in Special Permit proposals
	Solar installation requirement under initial consideration
	Not all buildings subject to state code
	Complete solar installation requirement technical study in FY19 Legislative Action: Pursue recommended solar installation requirements in FY20

FY18 Action Items

Implement solar ready requirements for new buildings in Cambridge based on recommendations made in the FY16 Solar Ready study.

Progress Towards FY18 Action Items

In spring 2017, the Massachusetts State Board of Building Regulations and Standard adopted a solar ready provision in the state building code that requires solar readiness in buildings of three or fewer stories.²⁷ While this does not cover all new construction in Cambridge, projects going through the Green Building Review process are encouraged to consider including solar and most are being designed at a minimum to be solar ready. Therefore, this part of the Action is considered to be complete.

Next Steps

The Net Zero Action Plan calls for the adoption of potential solar installation requirements in FY20. In FY19, staff are conducting additional technical and stakeholder analysis building off of the Solar Ready study to inform potential solar installation requirements.

Legislative Action




The technical study and stakeholder feedback will lead to a recommended solar installation requirement policy which can be considered and advanced by City Council in early FY20, potentially in coordination with the Height and FAR bonus (see Action 2.2.2, above).

²⁷ <http://www.mass.gov/ocabr/government/oca-agencies/dpl-lp/opsi/consumer-prot-and-bus-lic/license-type/csl/building-codebbrs.html>

Action 3.3: Develop a Memorandum of Understanding with Local Utilities

Introduction

Cities can collaborate with utilities on projects of mutual interest to result in energy use and emissions reductions. City-utility data sharing is particularly essential to understanding where and how energy is used in the city and what opportunities exist to decrease and green this energy use. The declaration and definition of this collaboration can impact its effectiveness, so a formal agreement on how the City of Cambridge, Eversource and Veolia can work together on the following areas is recommended:

	Pursue project-specific collaboration in place of overarching MOU
	Privacy concerns around data sharing
	Leverage Energy Allies collaboration with utilities

- Investigating and piloting smart grid projects
- Investing in incentive programs
- Data sharing
- Investigation, development and expansion of district energy systems
- Interconnection issues that limit deployment of solar PV and co-generation
- Using solar PV to strategically address distribution congestion
- Work to increase resiliency of the electric, gas, and steam systems

FY18 Action Items

Continue implementation of a memorandum of understanding (MOU) with Eversource and Veolia based on areas of mutual interest and have senior officials meet regularly to monitor and manage progress. Explore if there is benefit to including the state government and regional partners to this collaboration.

Progress Towards FY18 Action Items

Given ongoing challenges to secure an overarching MOU with local utilities, in FY18 staff determined that a more effective approach is to collaborate with the utilities on a project-by-project basis. For example, the Cambridge Energy Alliance continued to work closely with Eversource on implementation of the Multi-Family Pilot Program (see Action 1.1.1), despite some barriers around privacy which limits data sharing. Both Eversource and Veolia participated in the Low Carbon Energy Supply Strategy (LCESS) Advisory Committee along with Eversource (see Action 3.1) and through this forum participated in regular conversations about the future of energy planning in Cambridge.

Next Steps

New in FY19 is Cambridge's participation in the Energy Allies exchange program which aims to foster collaboration between government and civil society organizations such as utilities in the

clean energy transition through a series of international peer-learning workshops.²⁸ Cambridge chose Eversource as one of its partners in this exchange program, and through the workshop process the City and utility are identifying areas of targeted collaboration. Potential focus areas would align with the newly adopted state 3-year energy efficiency plan,²⁹ including strategic electrification. Cambridge and Eversource will meet to flesh out collaborative actions and report back to the Energy Allies organizers on their progress.

Eversource is also an active partner in the design of comprehensive retrofit program pathways for BEUDO buildings (see Action 1.1.2, above).

²⁸ <http://www.gmfus.org/energy-allies-transatlantic-multi-stakeholder-dialogues-local-energy-transition>

²⁹ <http://ma-eeac.org/wordpress/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no-bulk.pdf>

Action 4 – Local Carbon Fund

For Cambridge to become a net zero community, it will require an annual energy balance across the entirety of the city’s building stock. Where it is not possible or is exceptionally challenging for individual projects to achieve net zero emissions through the combination of efficiency and renewable energy generation, an alternative approach is to introduce a locally managed carbon fund that provides an option to purchase carbon offsets on a voluntary basis. The money collected would go into a local carbon fund, the proceeds of which will support Cambridge-based greenhouse gas reduction initiatives and renewable or low-carbon energy projects. Ideally, a locally based carbon fund would be developed and operated independently or at arm’s length of the City.

Action 4: Investigate Local Carbon Fund

Introduction

A Local Carbon Fund would serve as a vehicle that is easy to use as an alternative method to achieve net zero emissions over the short and medium term. The preliminary analysis should explore issues such as the development of a methodology for determining validity of offset projects. The offsets need not be “gold level” certified, but the accreditation methodology should be robust. In contrast to traditional offset frameworks, which typically are limited to supporting large-scale projects, a local carbon fund should be structured such that it can support a range of Cambridge-based emission reduction projects regardless of the scale of the project.



Feasibility study complete but behind implementation schedule



Uncertainty regarding Fund utilization and scale of administrative costs



Conduct “virtual pilot” to test Fund concepts and inform design

FY18 Action Items

Complete feasibility assessment of a Local Carbon Fund for Cambridge, with an emphasis on potential standards for carbon offsets including project scope, additionality, ownership and verification. Prepare for potential FY19 implementation.

Progress Towards FY18 Action Items

In FY18, phase two of the Local Carbon Fund feasibility assessment was completed with a focus on program design with input from stakeholders. In fall 2017, MCG interviewed stakeholders who may be interested in participating in a Local Carbon Fund, including members of the Net Zero Task Force and the Cambridge Compact for a Sustainable Future to determine their key goals and barriers to participating in a Fund. Administrative costs were estimated for a range of project types to establish a potential budget for the Fund that balances demand and supply. Then, with ongoing stakeholder engagement through focus groups, MCG considered program design elements including operational structure, institutional management, financing, and verification. An implementation plan including resource needs, timing, and risk management served as a final project deliverable to inform next steps for the City moving into FY19.

Next Steps

The Local Carbon Fund feasibility assessment concluded that a local carbon offset fund could be an effective mechanism to increase flexibility for buildings complying with upcoming Net Zero Emissions standards which enabling local emissions reductions. The establishment of such a program would be the first of its kind in the United States and require significant resources to design and launch. In order to further gauge the likelihood of Fund utilization by local stakeholders and answer outstanding questions about offset price points, duration, and other logistics, in FY19 the City is conducting a “virtual pilot” of the local carbon fund concept. In the virtual pilot, 3-4 existing buildings will be analyzed for their energy system design tradeoffs, and a hypothetical offset market will be applied to the fossil fuel emissions of the building. This will provide a realistic test of the Fund’s potential effectiveness which can be used to inform potential next steps for its development. However, this places the Fund behind the original Net Zero Action Plan schedule which recommended potential implementation beginning in FY19.

Action 5 – Engagement and Capacity Building




The strength of the Net Zero Action Plan is built on the comprehensive stakeholder engagement which led to its formation. Therefore, continued engagement of stakeholders throughout Cambridge and related interest groups is crucial to the successful implementation of the plan. The Task Force recommended that the City continue to invest staff time and resources into identifying tools, innovative ideas, training opportunities, grants and other resources to support residents and commercial property owners in working toward the aggressive goals of the Plan.

Action 5.1: Communication Strategy

Introduction

To maintain a high level of stakeholder engagement around the Net Zero Action Plan, the City should develop a comprehensive long-term communications strategy around the Cambridge Net Zero objective. The strategy will ensure that key stakeholders including City officials, the building industry, and Cambridge residents remain aware of the progress

toward net zero and engaged with the initiative as needed or desired. The strategy will also enable the Net Zero Action Plan to serve as a touchpoint for broader energy and climate education in Cambridge, encouraging residents to take personal responsibility for helping Cambridge to meet its ambitious climate change mitigation and adaptation goals.

	Implementation of multi-faceted communication strategy ongoing
	Broaden community awareness of Net Zero Action Plan
	Action-specific stakeholder engagement activity

FY18 Action Items

Continue implementation of a comprehensive communications strategy around the Net Zero Action Plan objectives and components. Integrate stakeholder engagement and public communications into each Action as appropriate.

Progress Towards FY18 Action Items

Regular communication and outreach around the Net Zero Action Plan continued in FY18. Ongoing interest in net zero planning among communities across the greater Boston region led to multiple requests for presentations and consultation to support planning processes. Particular promising are collaborative efforts to enable net zero-related initiatives as the regional and state level, such as by advocating for a stronger state energy code.

The Visual Identity package created for the Net Zero Action Plan in FY17 was utilized for a number of campaigns, including the establishment of a new Net Zero electronic newsletter to be

sent to a broad range of stakeholders twice per year. The first newsletter was sent in June, 2018.³⁰

The Low Carbon Energy Supply Strategy study (Action 3.1) completed in fall 2017 was publically launched with a joint Cambridge-Ramboll press release³¹ and a complementary website³² to educate residents about their energy sources and encourage them to act to decarbonize their energy supply.

Extensive stakeholder engagement was undertaken in the design of Additional BEUDO Requirements (Action 1.1.2) and Net Zero Lab Standards (Action 5.3).

Next Steps

In FY19, staff will continue to implement outreach and communication for the Net Zero Action Plan in collaboration with the CDD Communications Director. A project to establish city-wide messaging frameworks around climate change is being undertaken in collaboration with the Cambridge Climate Change Preparedness and Resilience Plan.³³ Action-specific stakeholder engagement is important to continued development to actions including the Custom Retrofit Program (Action 1.1.1), Heigh and FAR Bonus (Action 2.2.2), and Rooftop Solar Installation Requirement (Action 3.2). The second newsletter will be sent in spring 2019 in conjunction with the release of this report.

³⁰ See the newsletter at

<https://www.cambridgema.gov/CDD/Projects/Climate/~media/695191E5583D41C395DE3D7A704B9928.ashx>

³¹ <https://ramboll.com/media/rgr/ramboll-points-the-way-to-low-carbon-energy-supply-in-the-city-of-cambridge>

³² <http://www.cambridgema.gov/low-carbon>

³³ <https://www.cambridgema.gov/CDD/Projects/Climate/climatechangeresilienceandadaptation.aspx>

Action 5.2: Develop Ongoing Capacity to Manage Getting to Net Zero Project

Introduction

While the Cambridge Net Zero Action Plan was completed by the Getting to Net Zero Task Force in early 2015, in the years that follow the initiative will be led by the City of Cambridge along with partners and community stakeholders. As such, it is essential that the initiative be resourced accordingly so that its objectives will be met over the duration of the project.



On track with implementation of NZAP management and reporting structure



Ensure continued coordination among partner institutions



Complete annual report review prepare for Program Wide Review

FY18 Action Items

Continue monitoring roles and responsibilities for implementing the Cambridge Net Zero initiative over the long term. This includes assigning project leads for each of the actions, identifying research and implementation partners, and maintaining a reporting structure and a governance structure to ensure that the project remains on track and consistent.

Progress Towards FY18 Action Items

In FY18, the Cambridge Climate Protection Action Committee (CPAC) continued to serve as the governing body responsible for ongoing oversight of the Plan. Staff provide NZAP updates at monthly CPAC meetings. CPAC also received and reviewed the FY17 annual report outlining progress towards actions for the previous year and results of these actions on clean energy measures and GHG emissions in Cambridge. As laid out in the Plan, Program Wide Reviews are scheduled for every five years to involve a wide range of stakeholders in a comprehensive review of progress along the Plan and necessary adjustments moving forward based on changes in technology, policy, and other influential factors. The first of these reviews is due to occur in FY 2020.

The Cambridge Net Zero Energy Planner continued to oversee daily implementation of the Plan, including scoping projects, hiring consultants, and managing projects throughout their timelines. Research and implementation partners were engaged as appropriate, for example Harvard and MIT to facilitate the Market Based Incentive Program study (Action 2.2.1) and the Cambridge Compact for a Sustainable Future to investigate Net Zero Lab Standards (Action 5.3).




Next Steps

This report should be reviewed and received by CPAC, including any feedback on program management and communications. In FY 2020, a comprehensive Program Wide Review will be organized to make necessary adjustments to the Plan trajectory. Individual actions will be monitored and managed on an ongoing basis to provide opportunities for CPAC and outside stakeholder feedback and guidance, including periodic engagement of the Net Zero Task Force.

Action 5.3: Net Zero Lab Standards

Introduction

Commercial and academic laboratories are responsible for approximately one third of the current energy demand in Cambridge. Given this large impact, the challenges for laboratories to significantly reduce their energy use while meeting operational, health, and regulatory standards, and the lack of net zero lab examples, the Net Zero Action Plan includes a stakeholder-based process to research and develop new standards for lab operations that support lower energy use.

	In progress through Compact for a Sustainable Future workplan
	Diversity of laboratory uses and energy needs
	Proposal for laboratory pathway for BEUDO compliance and additional benchmarking

FY18 Action Items

Continue work by a coalition of industry stakeholders, research institutions and industrial hygienists to collaborate on new standards for reducing energy use that can be trialed without compromising safety or research integrity. Develop initial standards to be piloted in future years.

Progress Towards FY18 Action Items

The Cambridge Compact for a Sustainable Future³⁴ continued a productive working group to consider the feasibility of potential standards for reducing energy use in Cambridge laboratories, with support from City staff. The working group met regularly to discuss a variety of related topics including the US Department of Energy Better Buildings Smart Labs Accelerator program,³⁵ performance assessments for existing lab buildings, and energy efficiency techniques and technology for newly constructed labs.

Following the Additional BEUDO Requirement stakeholder workshops in summer 2018 (Action 1.1.2), it was determined that separate requirements should be established for laboratories given their unique operational constraints. Over the course of fall 2018, the labs working group has been collaborating towards a proposed compliance track for labs including laboratory definitions, tenant engagement, performance requirements, and monitoring and compliance.

Next Steps

In FY19, the laboratory working group will complete its recommendations for a lab-specific pathway for BEUDO requirement compliance. The working group is also pursuing an updated round of energy benchmarking study that will create a richer dataset to inform future performance standards and pilot program opportunities.

³⁴ <https://cambridgecompact.org/>

³⁵ <https://betterbuildingsinitiative.energy.gov/accelerators/smart-labs>

FISCAL YEAR 2018 QUANTITATIVE INDICATORS

While the bulk of this first-year report has focused on the progress toward each of the Net Zero Plan Actions, data from the 2012 Community GHG Inventory and the 2017 Building Energy Use Disclosure Ordinance reports serve as initial quantitative indicators of building energy use and emissions in Cambridge. These indicators serve as a helpful baseline for measuring progress towards Cambridge becoming a net zero community and evaluating the effect of the Net Zero Action Plan in future years.

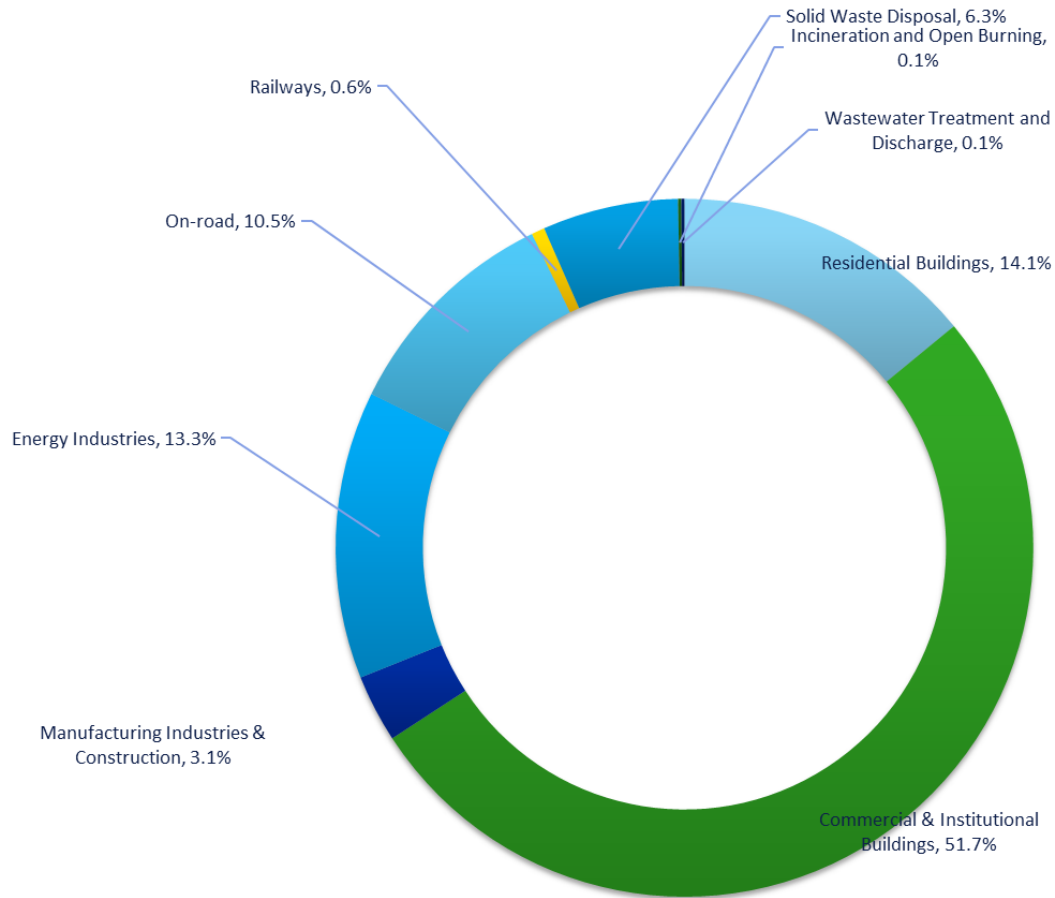
Community Greenhouse Gas Inventory

In FY17, the City of Cambridge completed a community-wide GHG inventory to meet its commitment as a participant in the Compact of Mayors³⁶ to mitigate climate change. A comprehensive GHG inventory helps the City better understand where GHG emissions are generated and then develop strategies for reducing these GHG emissions. The inventory was completed for 2012 because of data availability and alignment with the municipal inventory. External limits to data prevent annual updates to the Inventory, so this analysis has not changed from the FY16 Annual Report. Staff are working to develop a process to achieve more regular updates and hope to complete a 2016 GHG inventory in FY19.

As seen in the summary graph below, the majority of GHG emissions generated in Cambridge are related to building energy use, including residential buildings, commercial and institutional buildings, manufacturing industries and construction, and energy industries such as combined heat and power plants that provide energy to buildings in Cambridge, for a total of 82%. This emphasizes the importance of the Net Zero Action Plan's goal of eliminating GHG emissions from building operations in Cambridge. Total stationary 2012 GHG emissions are 1,202,956 MT CO₂e.

³⁶ <https://www.compactofmayors.org/>

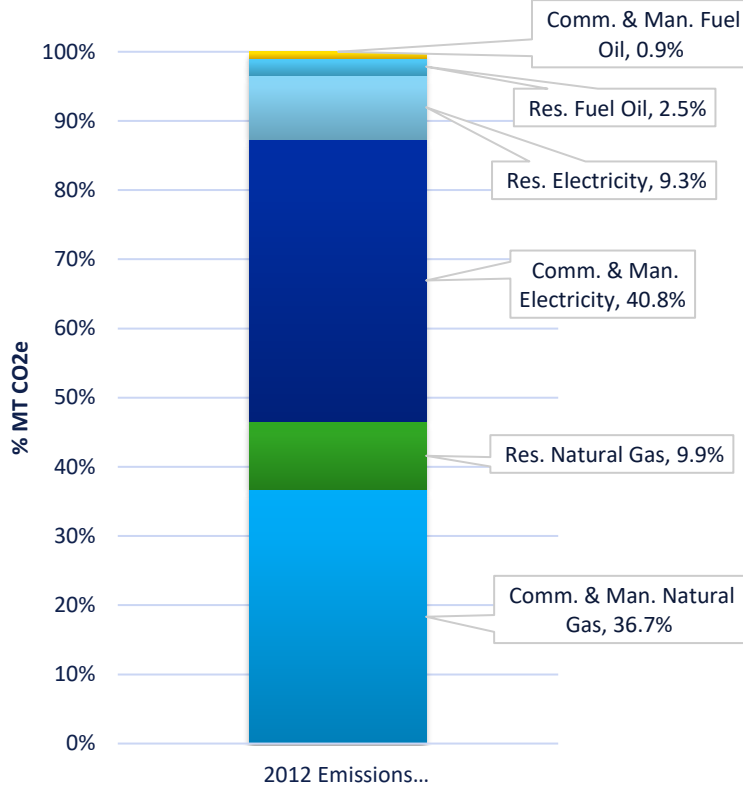
2012 Cambridge Community GHG Inventory



A deeper dive into the emissions data related to building operations shows that natural gas and electricity are each responsible for a little under than half of building energy emissions, and fuel oil for less than 1%. Natural gas consumed on-site currently has a lower emissions factor than electricity generated off-site,³⁷ but does not have the long-term potential to eliminate these GHG emissions. Therefore, transitioning to cleaner electricity sources, as is being explored in the Low Carbon Energy Supply Study (Action 3.1), is crucial both to reducing GHG emissions from the current electricity demand and providing a carbon-neutral energy supply option to replace natural gas in the long term.

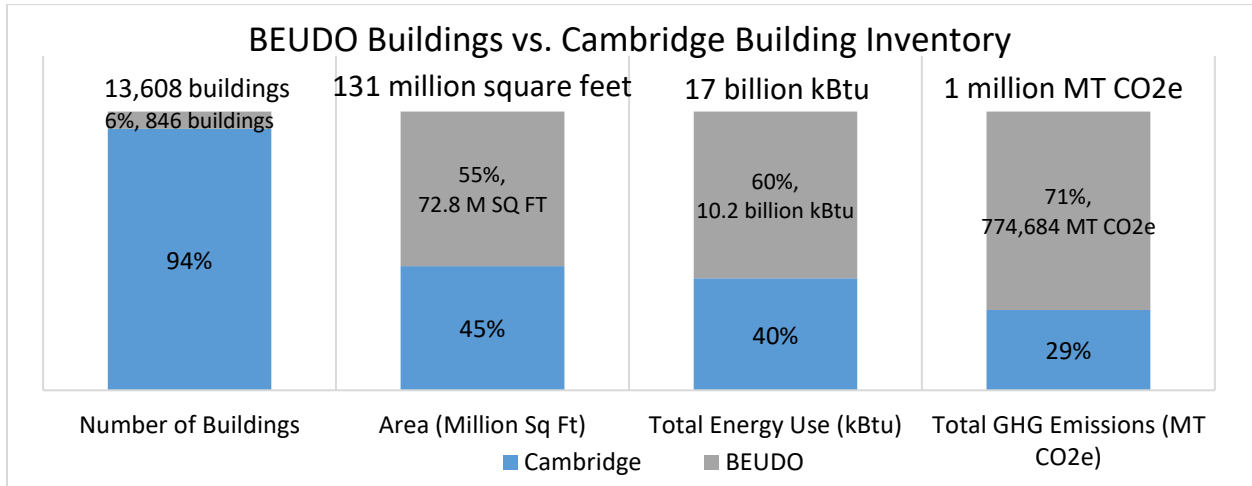
³⁷ There are concerns about GHG emissions from fugitive methane emissions due to leaks in the natural gas production process and transmission infrastructure, for example: <http://www.nrel.gov/docs/fy16osti/62820.pdf>

Total Annual Consumer Energy-use Emissions



Building Energy Use Disclosure Ordinance

The Cambridge Building Energy Use Disclosure Ordinance (BEUDO) requires parcels with non-residential buildings of a total of 25,000 square feet or greater as well as parcels with residential buildings totaling 50 or more units to annually report and disclose their energy and water use.³⁸ By requiring the largest buildings to report their energy use, Cambridge can gain important information about the majority of the energy consumption and GHG emissions in the City while streamlining the data collection process to the largest energy consumers, as illustrated by the graph below.³⁹



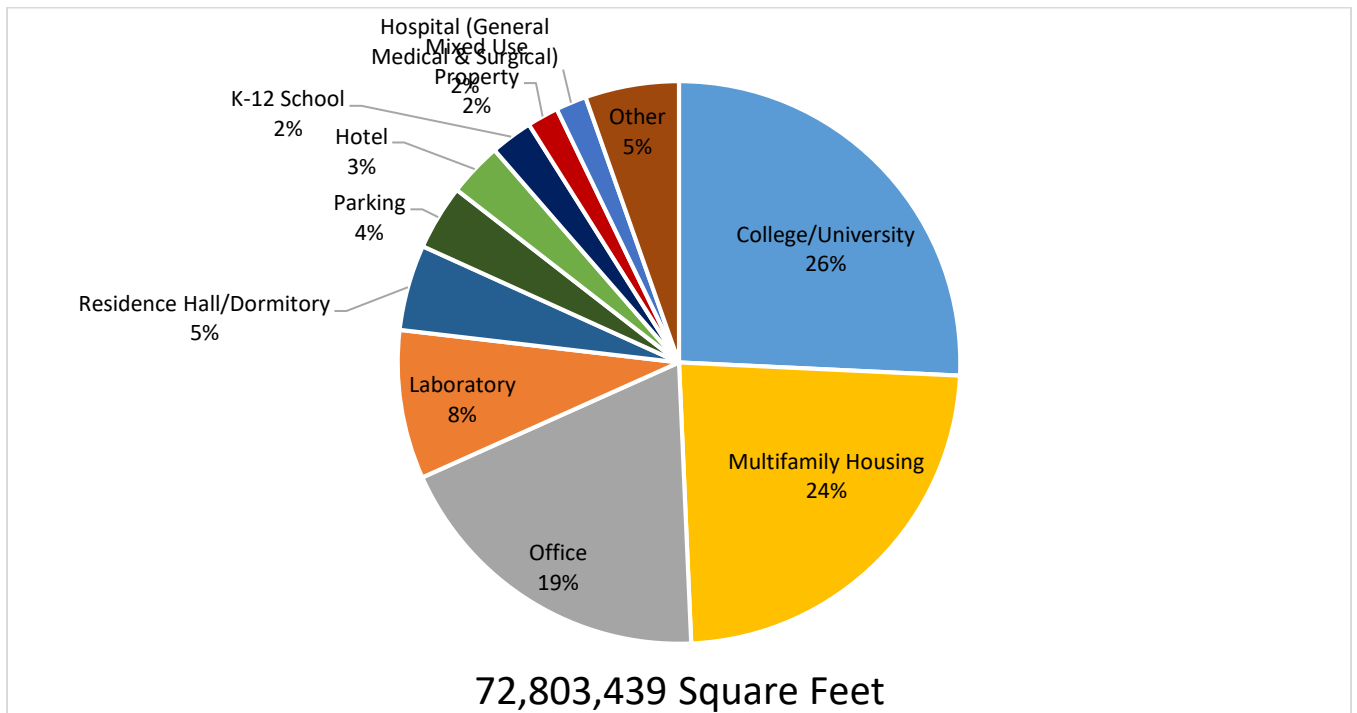
The graphs below summarize the data collected in the 2017 BEUDO reports.⁴⁰ Academic properties make up the largest proportion of BEUDO reporters by area, followed by multifamily housing and office buildings. However, energy use for laboratories, even though they consist of only 8% of the reported building area, is 22% of the total energy use, illustrating the much higher energy intensity of laboratories.

³⁸ 2015 reporting applied to parcels with 50,000 square feet or greater; Disclosure not required in 2015; for more details, see <http://www.cambridgema.gov/CDD/zoninganddevelopment/sustainablebldgs/buildingenergydisclosureordinance.aspx>

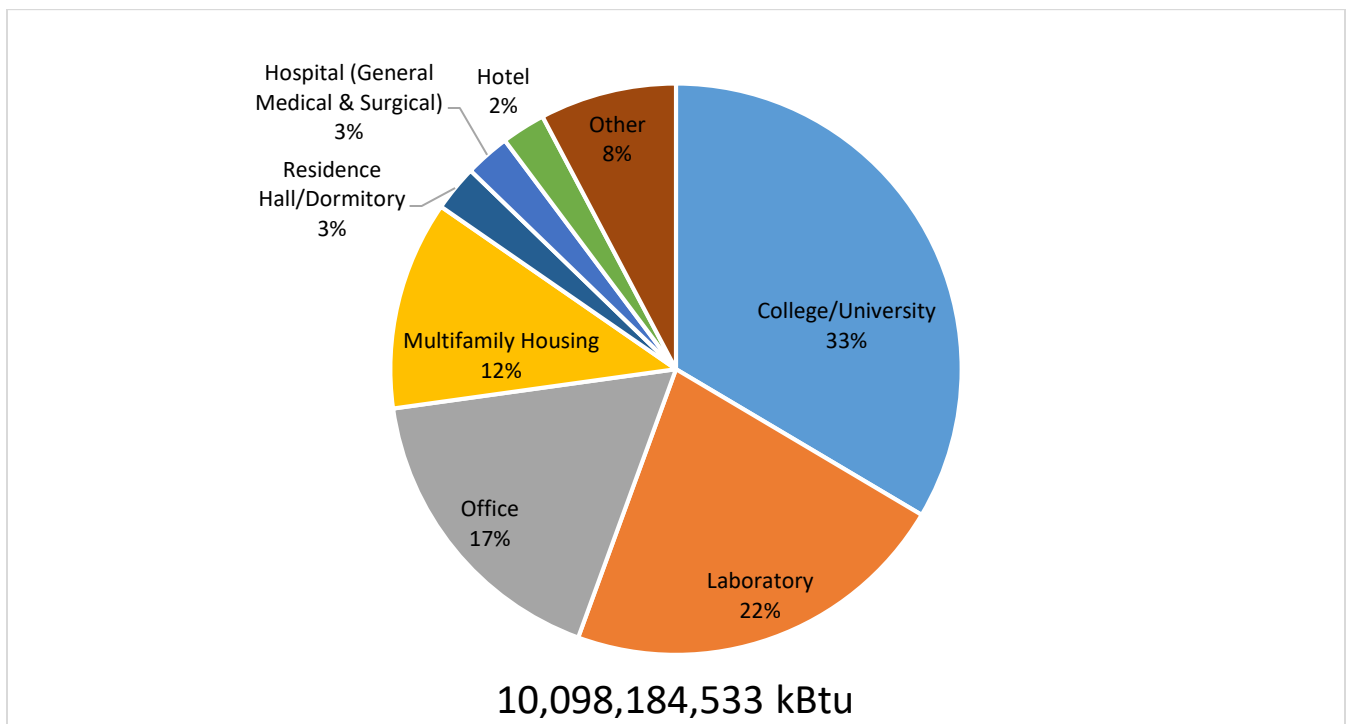
³⁹ Data sources: 2012 Cambridge GHG inventory, including co-generation serving Cambridge buildings; 2017 BEUDO reports

⁴⁰ Calendar year 2017 data is reported to the City in summer 2018

Total Area (Square Feet) by Property Type in 2017 BEUDO Analysis⁴¹



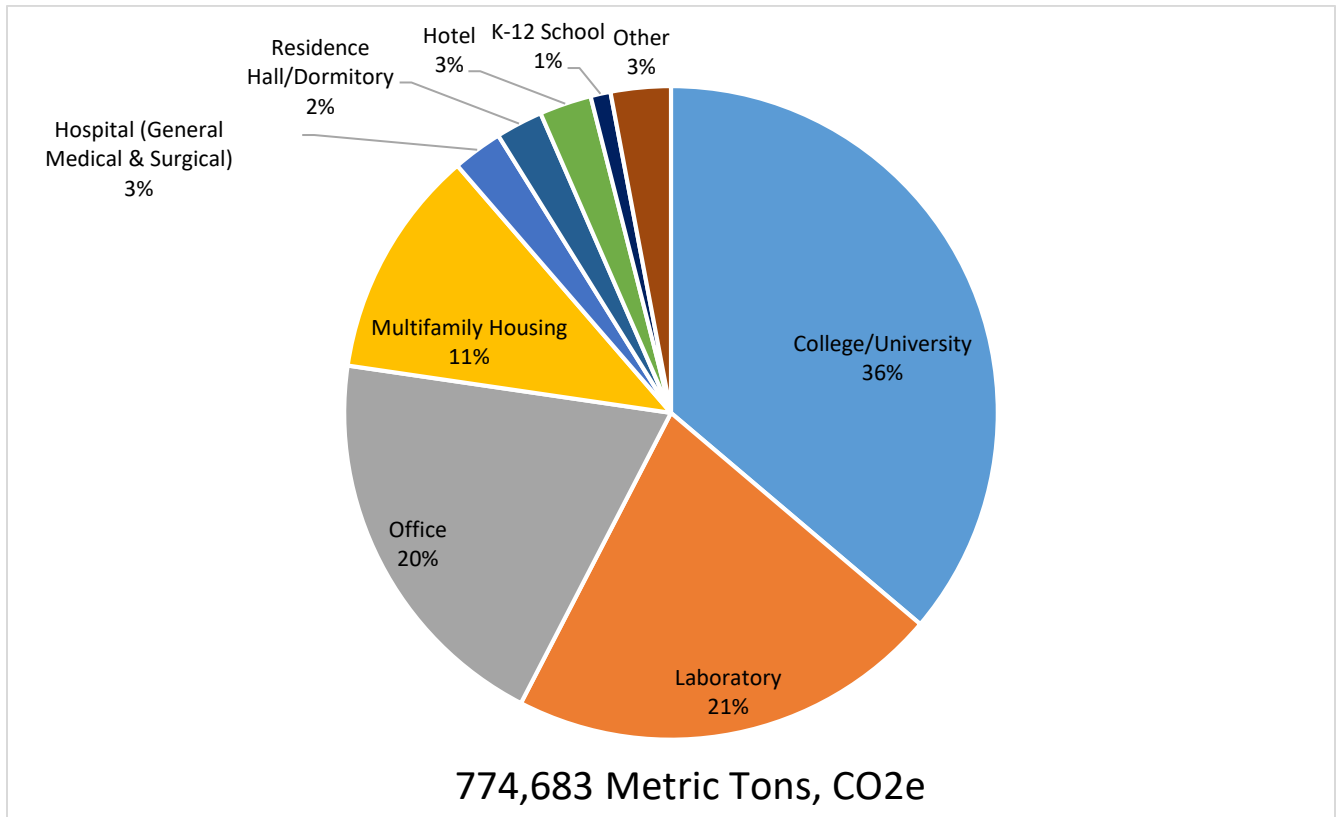
Total Site Energy Use (kBtu) by Property Type in 2017 BEUDO Analysis



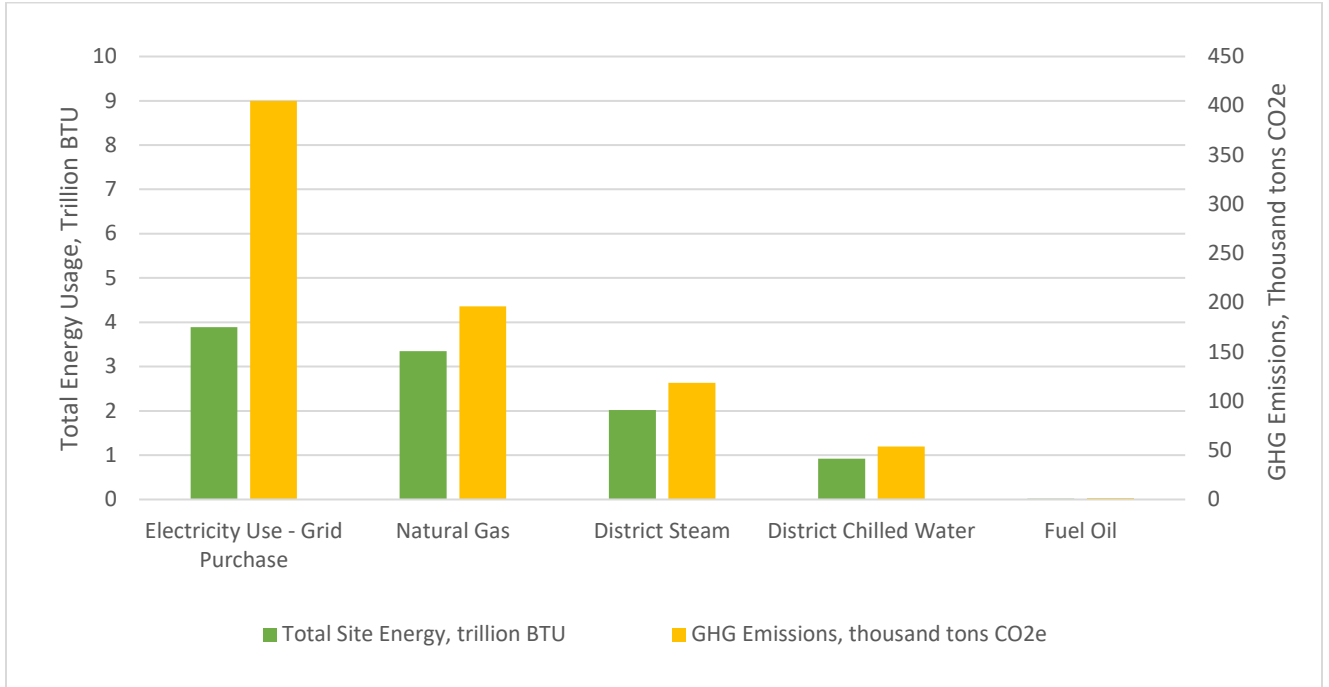
⁴¹ "Residence Hall" or dormitories are not included in college/university to distinguish between residential building energy use profiles and those of academic, administrative, and research buildings on campuses.

Greenhouse gas emissions are tied not only to total energy usage, but also to the mix of fuel types used at each property type. The pie chart below shows the share of total emissions contributed by each property type. Emissions are a product of energy use and the GHG intensity of each fuel. Electricity currently has a higher GHG emissions factor than natural gas, as seen in the first bar graph. A comparison of fuel mix across property types is located in the second bar graph.

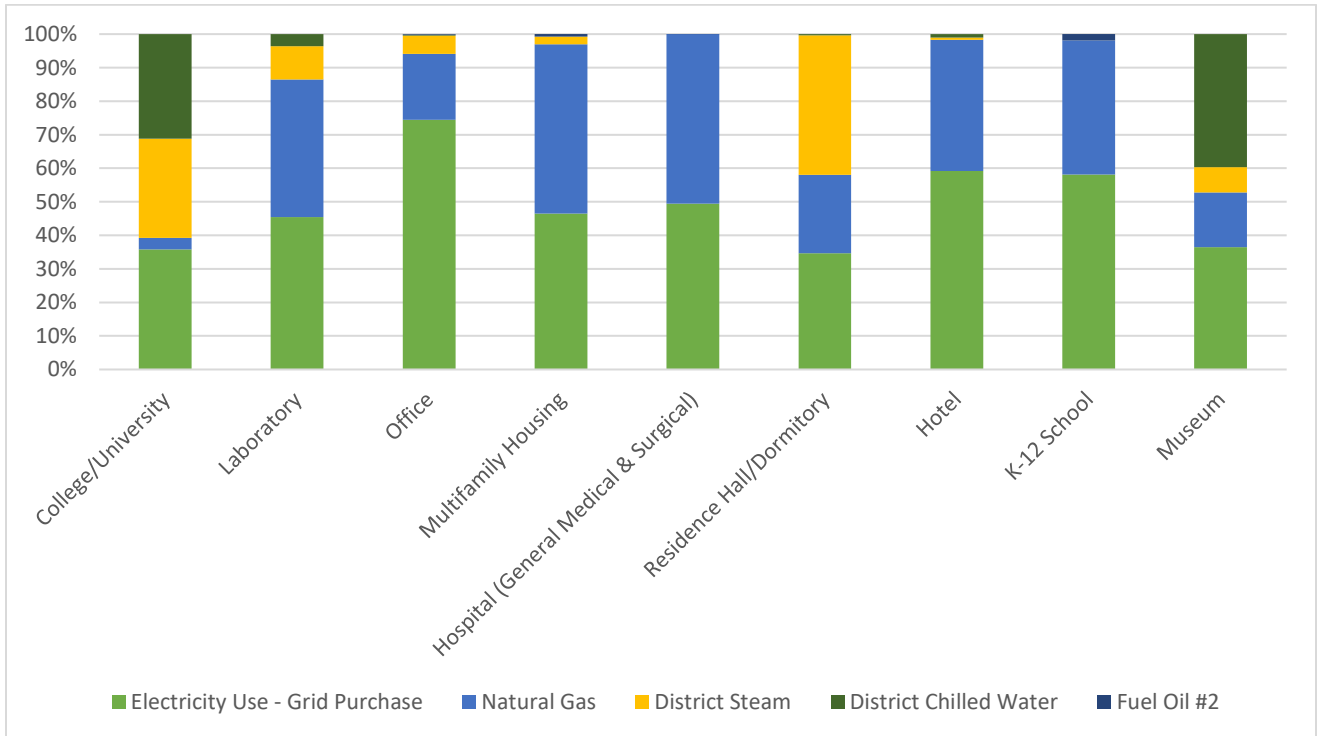
Total Greenhouse Gas Emissions (Thousand Metric Tons, CO₂e) by Property Type in 2017
BEUDO Analysis



Total Energy Use and GHG Emissions by Fuel Type

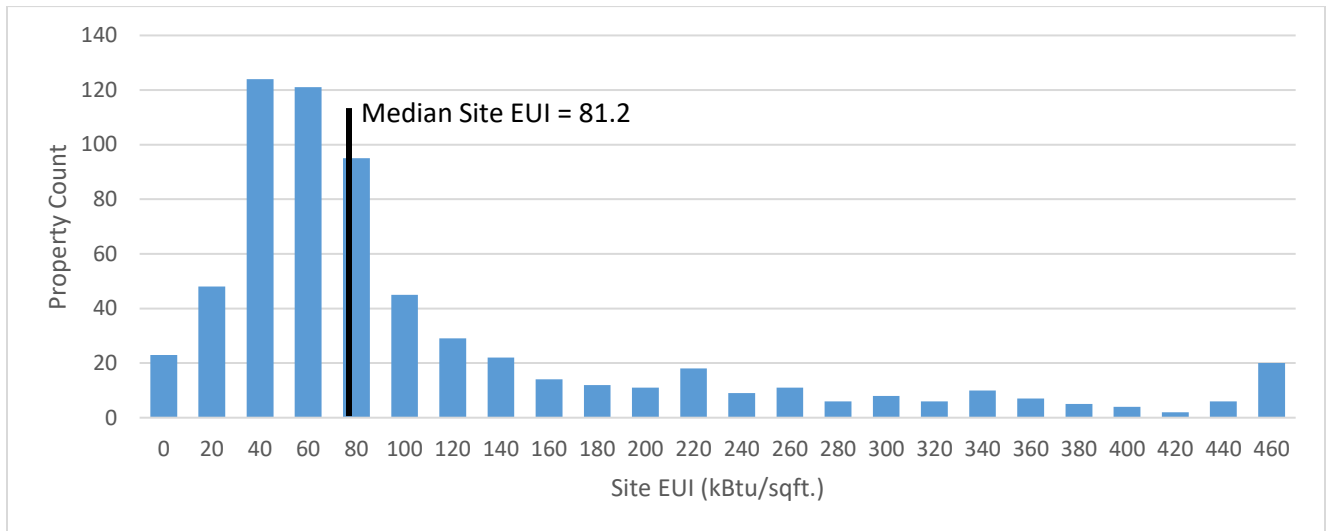


Fuel Mix by Property Type



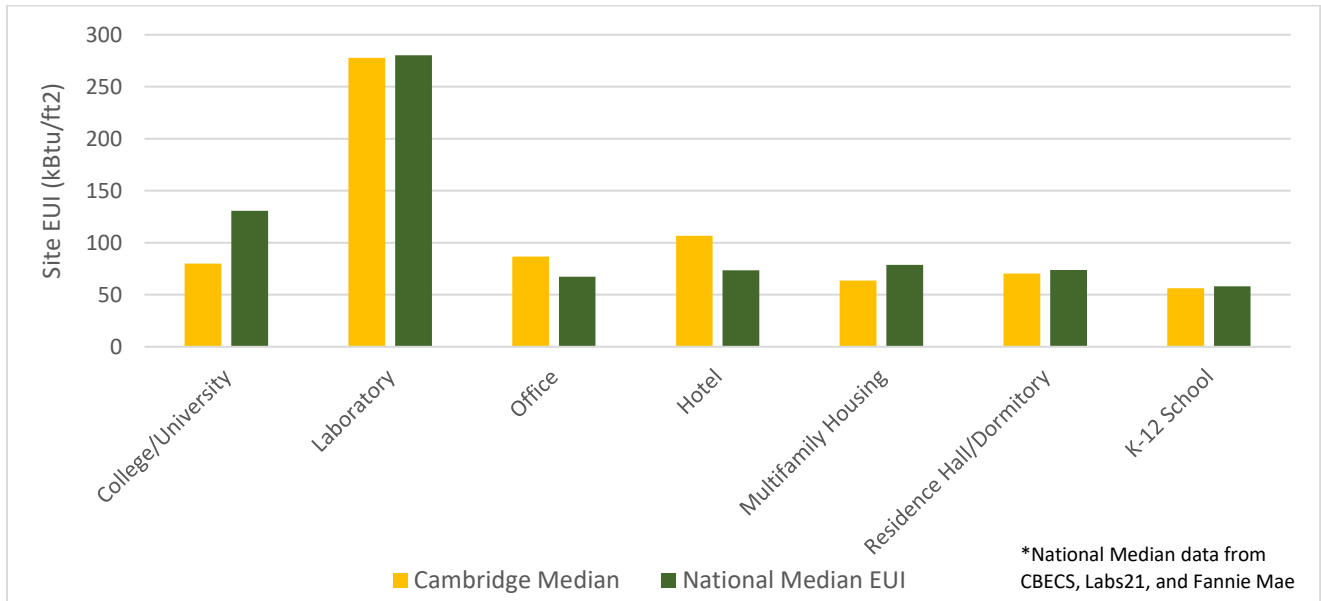
The energy use intensity, or EUI, of buildings is a helpful metric to normalize energy use across buildings of different sizes, much like an MPG sticker on a car. As illustrated in the graph below, most buildings reporting to BEUDO have an EUI below 100 kBtu/ft², with a handful of buildings consuming much more energy (i.e. energy dense buildings like laboratories).

Site EUI Distribution



In order to contextualize the results of the Cambridge analysis, median energy use intensities for various property types included in the Cambridge data are compared to the national median energy use. The national median EUI data primarily comes from the Commercial Building Energy Consumption Survey (CBECS). Differences in median EUI may be due to more intensive activities, different climate and weather patterns, or differences in energy performance. Overall, BEUDO reporter site EUIs are quite close to the national medians.

Cambridge Median Site EUI versus National Median by Property Type

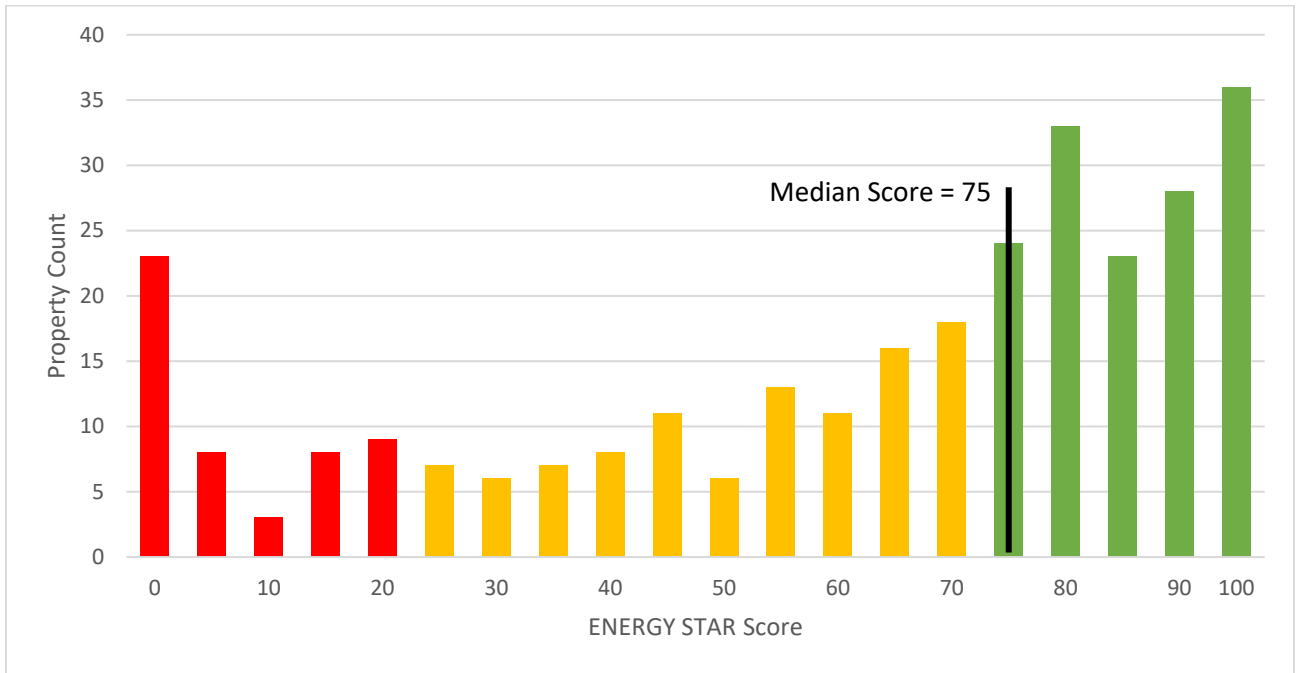


An additional comparison mechanism is the 1 – 100 ENERGY STAR score screening tool that helps property owners and managers assess how a building is performing. A score of 50 is the median; a score of 75 or higher means the buildings performs in the top quartile and may be eligible for ENERGY STAR certification.⁴²

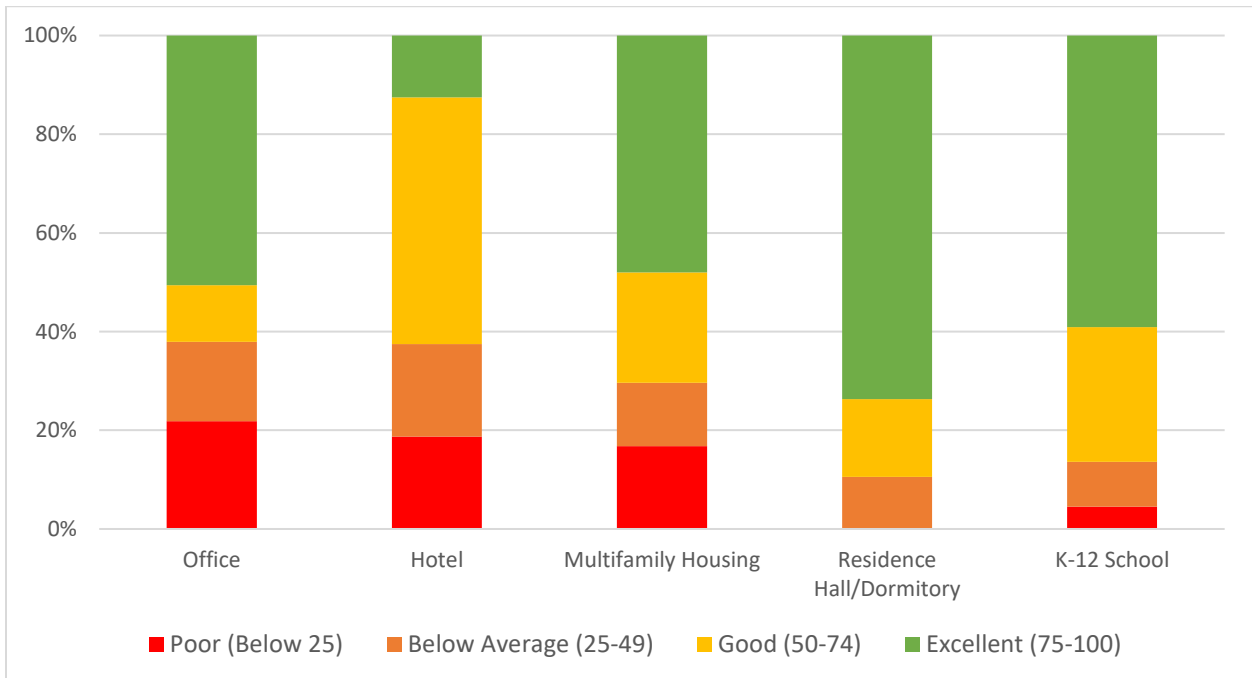
Out of the 668 reports included in the 2017 BEUDO data set, a subset of building categories are eligible for an ENERGY STAR score. The graph below shows the distribution of ENERGY STAR scores for these 305 properties. Across all eligible properties, Cambridge buildings tend to perform better than their peers, with an average score of 64 and a median score of 75. The graph also shows a significant amount of properties with an ENERGY STAR score of zero, which may be due to incomplete information or a mixed use (such as a laboratory in an office building). The second graph shows the ENERGY STAR score by property type.

⁴² Note that Energy Star changed the baseline for Energy Star scores in 2018, which will lead to lower scores for most building types in their 2018 reports.

Distribution of Energy Star Scores



ENERGY STAR Score Distribution by Property Type



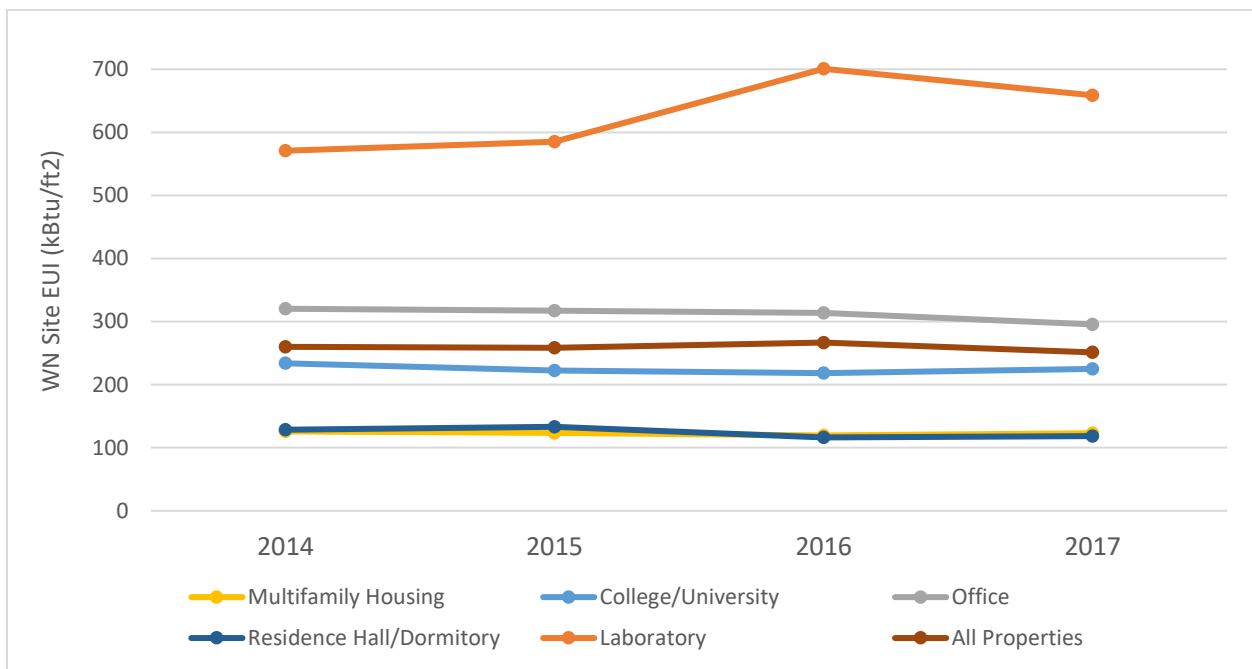
Based on the data in the BEUDO reports, many large building types in Cambridge are already on the way to efficient energy use, while others have a ways to go. Laboratories are clearly a key challenge based on their high EUI and significant proportion of total GHG emissions. It should

be noted that the unique uses of laboratories along with health and safety requirements has much to do with their high emissions, and not necessarily the construction of the buildings themselves. Hotels, while having a lower ENERGY STAR score, only contribute a small proportion of Cambridge’s GHG emissions, so may be less of a priority. The higher GHG emission factor of electricity from the grid illustrates the important of decarbonizing the electricity sector in the short term, which will enable additional emissions reductions by fuel switching from natural gas to electricity in the medium to long term.

Annual BEUDO reports will serve as a key resource to tracking energy and GHG emission trends from large buildings in Cambridge and hopefully demonstrating the progress of the Net Zero Action Plan. Now that four years of BEUDO data have been reported, initial trends in the data over time can be observed in the graph below. Data from BEUDO properties reporting data in at least 3 years is included.⁴³ Most property types see a modest decrease in energy use intensity over the four years, with an average reduction of 1.1% per year.

The evaluation of additional requirements for BEUDO buildings (Action 1.1.2) will consider whether this rate of improvement is sufficient or if greater savings should be required, and how those saving might be achieved and measured.

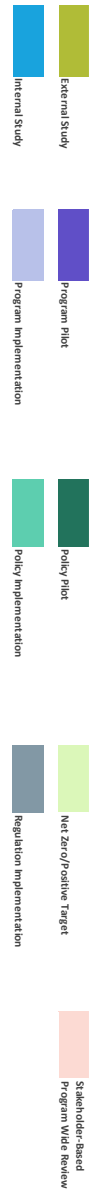
Weather-Normalized Site EUI Over Time by Property Type



⁴³ If a property has fewer than 4 years of reported data, the fourth year value is interpolated by assuming a constant rate of change. Note that only 473 of the properties have 3 or more years of data, limiting the ability to accurately compare performance of all BEUDO properties over time.

APPENDIX 1: NET ZERO ACTION PLAN SCHEDULE

Cambridge Net Zero Action Plan - April 29, 2015



YEAR (fiscal year July - June)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Net Zero + Net Positive Targets					Net Zero Municipal		Net Zero Residential 1-3 Units			Net Zero Commercial Multi-Family Residential					Net Zero Labs					Net + Municipal
Action 1 - Energy Efficiency in Existing Buildings																				
1.1.1 Custom Retrofit Program	Residential	Multi-Family Pilot		Review	Potential Multi-Family Program				Review	Custom Retrofit Program					Potential Multi-Family Program					
1.1.2 Additional RUDCO Requirements	All				Feasibility	Custom Retrofit Pilot			Review											
1.1.3 Upgrades at Time of Renovation or Sale	Comm. + MF	Design			New Building Energy Use Disclosure Ordinance Reqs.				Review											
1.1.4 O&M Plan Requirement	All				Potential TDS/R Requirements				Review											
Action 2 - Net Zero New Construction																				
2.2.1 Market Based Incentive Program	Residential	Feasibility	Pilot (Residential)	Review	Potential Incentive Program				Review	Potential Net Incentive Program										
2.2.2 Height + Park Bonus	Comm. + MF Labs				Feasibility	Pilot Commercial	Review		Review	Potential Net Incentive Program										
2.2.3 Increase Green Building Requirements in Cambridge		Feasibility *			Potential HighRI Incentive Program				Review	Potential HighRI Incentive Program										
2.2.4 Net Zero Requirement for New Construction of Municipal Buildings		Design	Stage 1 - New LEED Requirements	Review	Review	Stage 2 - New LEED Requirements	Review		Review	Potential HighRI Incentive Program										
2.4.2 Renewal of Municipal Buildings		Design/Action Plan	NET Zero Ready	Review	Design/Action Plan	Review			Review	Stage 3 - New LEED Requirements										
2.5 Removal of Barriers to Increased Insulation		Design			New Policy				Review											
Action 3 - Energy Supply																				
3.1 Low Carbon Energy Supply Strategy		ES&S Study **																		
3.2 Rooftop Solar Ready Requirement		Design	Solar Ready Requirement	Review					Review	Potential Solar Requirement Version 1										
3.3 Develop a Memorandum of Understanding with local utilities		Develop MOU			Utility Collaboration				Review											
Action 4 - Local Carbon Fund					Feasibility															
Action 5 - Engagement and Capacity Building																				
5.1 Communication Strategy		Design																		
5.3 Net Zero Lab Standards		Feasibility **	Dev Standard		Pilot Standard 1				Review											

* To occur as part of Cambridge Master Plan process
 ** To happen in conjunction with Kendall Square study
 *** Externally Led