CAMBRIDGE CLIMATE ACTION PLAN

JUNE 2018

City of Cambridge,
Massachusetts

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGEMENTS

City of Cambridge

Louis A. DePasquale, *City Manager*

Lisa Peterson, *Deputy City Manager*

Susanne Rasmussen, *Director of Environment & Transportation Planning*

John Bolduc, *Senior Environmental Planner*

Bronwyn Cooke, *Sustainability Planner*

Owen O'Riordan, C*ommissioner of Public Works*

Kathy Watkins, *Asst. Commissioner of Public Works*

Michael Orr, *Recycling Director*

Seth Federspiel, *Net Zero Energy Planner*

Lead Consultant, BuroHappold

Chris Rhrie, *Project Manager*

Josh Margul, *Technical Lead*

Consultant, Kleinfelder

Nathalie Beauvais, *Project Manager*

KEY TERMS AND ABBREVIATIONS

BAU Business as Usual

BEUDO Building Energy Use Disclosure Ordinance

CBE Consumption Based Emissions

CCPR Climate Change Preparedness and Resilience Plan

CCVA Climate Change Vulnerability Assessment

CDD Community Development Department

CPAC Climate Protection Action Committee

CNCA Carbon Neutral Cities Alliance

DPW Department of Public Works

EUI Enegry Use Intensity

GCoM Global Covenant of Mayors

GFA Gross Floor Area

GHG Greenhouse Gas Emissions

GPC Global Protocol for Community GHG Inventories

IPCC Intergovernmental Panel on Climate Change

LCESS Low Carbon Energy Supply Study

MBTA Massachusetts Bay Transportation Authority

MFIP Municipal Facilities Imporvement Plan

NZAP Net Zero Action Plan

PTDM Parking and Transportation Demand Management

ZWMP Zero Waste Master Plan

CONTENTS

EXECUTIVE SUMMARY

THE CLIMATE ACTION PLAN BUILDS UPON CAMBRIDGE'S EFFORTS TO REDUCE GREENHOUSE GAS EMISSIONS AND FORMALIZES THE CITY'S COMMITMENT AND EFFORT TO BECOME CARBON NEUTRAL BY 2050.

2.1 CAMBRIDGE VISION FOR CLIMATE ACTION

This Climate Action Plan builds upon Cambridge's efforts to reduce greenhouse gas (GHG) emissions and formalizes the City's commitment and approach to becoming carbon neutral by 2050. Based on a community wide GHG inventory that reflects current methods, protocols and data sources for measuring emissions in the community, the CAP identifies specific strategies and actions across the buildings, transportation, and waste sectors necessary for the City to achieve deep carbon reductions. This Plan also identifies the emerging policy discussions that Cambridge will need to continue to monitor and engage in as the methodology for greenhouse gas accounting evolves. It is expected that the Climate Action Plan will continuously evolve to reflect the best available knowledge about emissions sources and strategies to eliminate them.

While the Climate Action Plan focuses on strategies and actions to reduce the GHG emissions that occur primarily within its geographic boundaries, the City has deep-rooted interest in emission reduction actions that also positively contribute to other community values, have additional restorative environmental impacts, and go beyond the measured emissions within the City's geographic boundary to address activities that cause emissions outside of Cambridge. As part of this Climate Action Plan, the City Manager appointed Climate Protection Action Commitee (CPAC) adopted the following vision statement:

> *"Cambridge will achieve carbon neutrality and strive to have an even greater impact beyond its borders in order to have a restorative impact on the Earth's natural systems. Cambridge will take action to reduce greenhouse emissions and enhance its resilience to climate risks through equitable and just economic development, meaningful stakeholder engagement, and research and innovation."*

This report details the Climate Action Plan development process, describes the major sources of emissions and the actions necessary to achieve deep carbon reductions, and outlines the key considerations for implementation moving forward. While there are certain sectors and strategies that demonstrate an outsized potential to reduce GHG emissions, such as energy efficiency in existing buildings, becoming a carbon neutral city will require Cambridge to pursue every available opportunity to dramatically reduce greenhouse gas emissions. The challenge is immense, but so too is Cambridge's resolve to address it.

2.2 BACKGROUND

The City of Cambridge has been committed to reducing greenhouse gas (GHG) emissions for nearly two decades, since the City Council voted to join the Cities for Climate Protection consortium in 1999 and adopted a Climate Protection Plan in 2002. The Climate Protection Plan laid out multi-sector strategies for reducing emissions

20 percent below 1990 levels by 2010 – a target that was not met, primarily due to new development in the energy-intensive life sciences sector and a lack of action at the federal level. However, improvements in building energy efficiency were made and urban infill was promoted; while emissions within Cambridge's boundaries increased, regional emissions would have been even higher if, for example, life science jobs had been established in suburban office parks.

Recognizing the tremendous challenge of reducing greenhouse gas emissions, the City has embarked on several new and ambitious initiatives that reflect the lessons learned during the tenure of the City's first Climate Protection Plan. In December 2013, the City created a Getting to Net Zero Task Force with the objective of setting Cambridge on the trajectory to becoming a net zero emissions community. The Task Force focused on the largest source of GHG emissions – building operations – and studied the technical aspects of reducing energy use intensity and deploying renewable energy resources, in addition to studying best practices in public engagement, education and training, and behavior change. Their findings are summarized in the Net Zero Action Plan (NZAP) which was adopted by City Council in June 2015. As a part of NZAP, the City also commissioned and published a Low Carbon Energy Supply Strategy study (LCESS) in April 2018 which lays out several scenarios for meeting all building energy needs with renewable energy - a critical strategy to reducing emissions beyond what can be achieved through energy efficiency alone. Additionally, the City is in the process of finalizing its Zero Waste Master Plan, which is intended to supply recommendations for how the City can achieve its goals to reduce waste and greenhouse gas emissions associated with waste. The City's transportation plans and initiatives are focused on supporting active and public modes of transportation. While the goals of these plans and initiative are not specific to emissions reductions, they also have a substantial impact on the emission reductions potential.

Cambridge's greenhouse gas reduction efforts also support, and are supported by, planning initiatives that seek to enhance the City's resilience, improve quality of life, and ensure equitable outcomes. Cambridge is currently engaged in a Climate Change Preparedness and Resilience planning process which, based on the best available science, aims to prepare the community for the unavoidable impacts of climate change. The City is paying particular attention to actions that support both greenhouse gas emissions reduction and climate change preparedness, such as improved insulation in buildings.

The Climate Action Plan is also being coordinated with Envision Cambridge, the City-wide plan for a more livable, sustainable, and equitable Cambridge. The City's strong commitment to reducing GHG emissions has been a major driver informing the City-wide plan, and actions introduced in the Envision Cambridge process have also been incorporated into the Climate Action Plan.

THE CLIMATE ACTION PLAN IS BEING COORDINATED WITH ENVISION CAMBRIDGE, THE CITY-WIDE PLAN FOR A MORE LIVABLE, SUSTAINABLE, AND EQUITABLE CAMBRIDGE.

2.3 THE CLIMATE ACTION PLAN

The Cambridge Climate Action Plan brings together existing initiatives and actions being implemented or planned for throughout the City and introduces new actions that address additional opportunities to reduce GHG emissions. Together these actions represent a pathway for Cambridge to meet its goal of becoming a carbon neutral community by 2050. The amount of effort required to achieve this goal will be considerable, but Cambridge is well prepared with a track record of successful climate programs and policies, such as green building zoning, the Building Energy Use Disclosure Ordinance (BEUDO), sustainable transportation infrastructure investments, and the Parking and Transportation Demand Management (PTDM) ordinance. With careful consideration and detailed analysis, a strategic list of actions has been prepared for each of the three major GHG emitting sectors including Buildings, Transportation, and Waste. The graph below illustrates the impact that Cambridge's commitment to implementing the Climate Action Plan is expected to have in reducing GHG emissions from the year 2015 to 2050.

The buildings sector is the largest GHG contributor representing nearly 82% of Cambridge's emissions. To mitigate these emissions, the City will implement strategies and actions that achieve higher energy efficiency in existing buildings, net zero emissions new construction, and low carbon energy supply sources. Establishing a local carbon fund and promoting engagement and capacity building within the wide range of stakeholders in the building sectors are also included as key enabling actions in the plan.

Transportation represents 11% of Cambridge's emissions. As a community, Cambridge already has high utilization of sustainable transportation options, but there is room for improvement. Emissions reductions in the transportation sector can be addressed through a focus on active transportation and public transit, low and zero carbon mobility solutions, and a reduction of vehicle miles travelled, especially in single occupancy vehicles. In planning for transportation initiatives, it is important to remember the role that land use choices play in supporting sustainable transportation. For example, while not a strategy that will directly reduce emissions, and therefore not included explicitly in this CAP, ensuring that new development is located near transit access enables mode shift away from single occupancy vehicles and towards shared mobility, which does reduce emissions. The City of Cambridge acknowledges and continues to support land use decisions that complement the City's sustainable transportation goals.

Waste contributes a modest 7% of Cambridge's GHG emissions, but this includes only the end of life emissions associated with incineration and landfill of waste, and not the life cycle emissions associated with the manufacturing and transportation of the products that eventually become waste. All the strategies to reduce emissions from waste will have emission reduction benefits beyond the end of life emissions we measure by avoiding either all or some emissions associated with product manufacturing and transport. The strategies for reducing waste-related GHG emissions include source reduction and reuse, recycling and composting, and sustainable materials management.

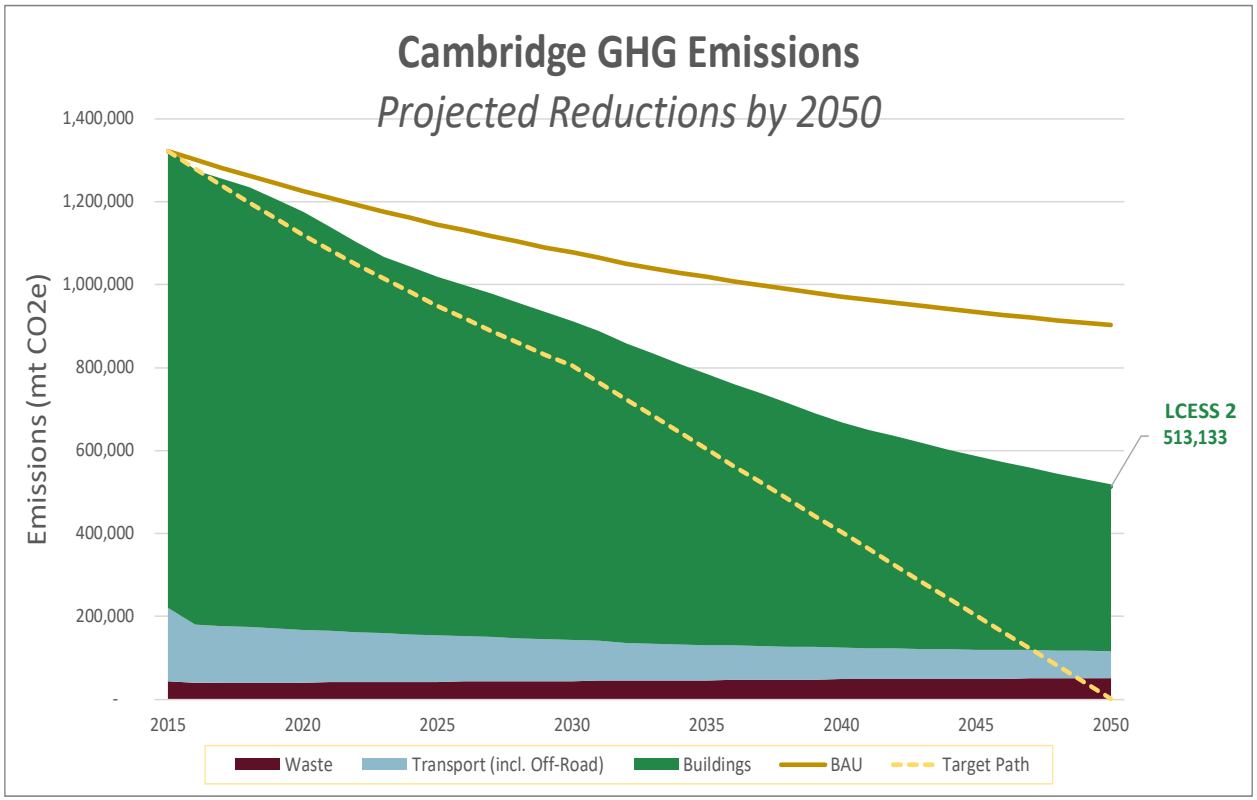


Fig. 1 **Cambridge Projected Emissions in 2050**
(Source: City of Cambridge Climate Action Plan, 2019)

LOW CARBON ENERGY SUPPLY SCENARIOS (LCESS)

The Low Carbon Energy Supply Study developed different scenarios for low carbon enegry supply to buildings in Cambridge. The builidng emissions reductions trajectory in Figure 1 is based on the LCESS 2 scenario.

LCESS 1

Individual builidng electrification (all buildings individually transition to an all-electric energy supply).

LCESS 2

Individual building electrification with district heating/cooling where viable (some building group together to generate electricity on site and use waste heat from that electricity generation to provide some heating).

LCESS 3

District heating/cooling with multiple supply technologies.

A BETTER UNDERSTANDING OF THE EMISSIONS ASSOCIATED WITH MANUFACTURE AND TRANSPORT OF PRODUCTS WOULD ALLOW THE CITY TO IDENTIFY STRATEGIES AND MAKE CHOICES THAT COULD HELP REDUCE EMISSIONS CAUSED BY THE CITY'S ACTIVITY.

Even with the strategies and actions summarized above, Cambridge would still fall short of achieving the net zero emissions goal. The Climate Action Plan requires progress monitoring and periodic updates to allow for newfound opportunities and technologies in the buildings, transportation and waste sectors that can support Cambridge's goal to achieve net zero emissions.

Another consideration is the quantification of Cambridge emissions, as it is difficult to measure every source. Some sources lack reliable data and present challenges to targeting net zero emission goals. However, there are some actions the City can take to better understand the relative magnitude of impact these sources have on GHG emissions, and the prospective strategies and actions that would mitigate these emissions as well. For example, the City does not currently measure and track Scope 3 emissions from the manufacturing and transport of materials and products used in the City. A better understanding of the emissions associated with the manufacture and transport of products would allow the City to identify strategies and make choices that could help to reduce emissions caused by the City's activity.

While the priority is to reduce emissions directly from the activity that causes them, the City should also continue to explore if and how carbon offsets could help to meet the 2050 net zero emissions goal. Generation or purchase of offsets should enable transparency and accountability, and should follow international best practice and the P.A.V.E.R. criteria (permanent, additional, verified enforceable, and real). Permanent means emissions reductions should last in perpetuity. Additional means that the emissions reductions from an offset project would not have happened in a "business as usual" scenario and required funding from the sale of the offsets in order to make the emissions reduction project happen. Verified means that the performance of an emissions reduction project must be measured and confirmed through monitoring. Enforceable means that the emissions reductions must be backed by contracts or legal agreements that define the creation of offsets and ensure exclusive rights or ownership of the offsets. Real means that offsets must represent actual emissions reductions that are not artifacts of incomplete or flawed accounting.

INTRODUCTION

LIMITING GLOBAL WARMING TO 1.5C ABOVE PREINDUSTRIAL LEVELS WOULD PROVIDE CLEAR BENEFITS TO PEOPLE AND NATURAL ECOSYSTEMS AND WOULD HELP ENSURE A MORE SUSTAINABLE AND EQUITABLE SOCIETY.

3.1 THE CLIMATE IMPREATIVE

Climate change is a global challenge – with local causes and local impacts. The global community has mobilized around taking action, setting a target of limiting global warming to no more than 2°C above preindustrial levels with the signing of the Paris Climate Agreement in 2016. The most recent Intergovernmental Panel on Climate Change (IPCC) Special Report suggests that limiting global warming to 1.5C above preindustrial levels would provide clear benefits to people and natural ecosystems and would go hand in hand with ensuring a more sustainable and equitable society. In light of weak federal leadership on climate change in the United States, including an intention to withdraw from the Paris Agreement, cities and other sub-national actors will be required to take the lead on reducing greenhouse gas emissions.

This responsibility is not new to the City of Cambridge. In 1999, Cambridge joined the Cities for Climate Protection consortium, releasing a Climate Protection Plan in 2002. Since then, the City has been nationally recognized for its leadership in establishing progressive climate, environmental, transportation, and urban development policies. Of note is the Net Zero Action Plan, which sets Cambridge on a trajectory for net zero emissions from buildings by mid-century, including a transition away from fossil fuels through implementation of a Low Carbon Energy Supply strategy – an essential step to achieve deep carbon reductions. Other prominent initiatives include: the Zero Waste Master Plan, ultimately aiming to reduce Cambridge waste-related emissions by 80% by 2050 with a focus on organics collection; the Parking and Transportation Demand Management (PTDM) ordinance which requires commercial building owners to consider mode splits of their employees and visitors and implement programs to reduce employee and visitor single occupancy vehicle trips. This Climate Action Plan represents the umbrella organization for previous efforts, as well as the blueprint for future efforts.

The City of Cambridge has also joined the Global Covenant of Mayors for Climate and Energy (GCoM), which includes a commitment to update the GHG emissions inventory and produce a Climate Action Plan. In combination with the 2012 community-wide GHG inventory, this Climate Action Plan fulfills the City's commitment to the GCoM by: examining emissions from buildings, transportation, and waste; setting an aggressive GHG emissions reduction target, and; laying out the programs and policies that the City will implement to achieve that target.

3.2 THE CARBON NEUTRALITY VISION

The City of Cambridge has long been a progressive leader on climate action, environmental stewardship, and sustainability at large. Cambridge aspires to look beyond measured GHG emissions to consider how the community can have a restorative impact on the environment and

support its core values of equity, meaningful engagement, and innovation. Informed by the visions from related planning processes, such as Envision Cambridge (see Section 4), the City has developed the following vision statement:

> *"Cambridge will achieve carbon neutrality and strive to have an even greater impact beyond its borders in order to have a restorative impact on the Earth's natural systems. Cambridge will take action to reduce greenhouse emissions and enhance its resilience to climate risks through equitable and just economic development, meaningful stakeholder engagement, and research and innovation."*

Notably, this vision statement formalizes the City's commitment to achieving carbon neutrality in alignment with its external collaborations and commitments. In 2016, Cambridge joined the Metro Mayors Climate Commitment – a commitment by Boston, Cambridge, Somerville, and eleven other area cities to become net zero/carbon free by 2050 (The definition of "carbon neutrality" is explained in detail in Appendix A). Additionally, this vision statement has guided the development of this Climate Action Plan, including its component actions (see Section 6). The selected actions not only reduce GHG emissions, but also realize several co-benefits: enhancing resiliency, improving community health, encouraging local economic development, and directly engaging residents.

GLOBAL COVENANT *of* MAYORS *for* CLIMATE & ENERGY

CAMBRIDGE ASPIRES TO LOOK BEYOND MEASURED GHG EMISSIONS TO CONSIDER HOW THE COMMUNITY CAN HAVE A RESTORATIVE IMPACT ON THE ENVIRONMENT AND SUPPORT ITS CORE VALUES OF EQUITY, MEANINGFUL ENGAGEMENT, AND INNOVATION.

3.3 COMMUNITY-WIDE GHG INVENTORY

To fulfill its commitment to the Global Covenant of Mayors for Climate and Energy (GCoM), the City completed a community-wide GHG inventory in 2016. That inventory analyzed activity data from calendar year 2012, as it was the most recent year with comprehensive data available. It was developed in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC), an accounting and reporting standard that was developed by the World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI—Local Governments for Sustainability. It is important to note that while some emissions resulting from human activity are difficult to measure and are therefor currently excluded from the GPC (such as emissions from air travel and emissions from the manufacturing and distribution of goods consumed in Cambridge), both the GPC and the City of Cambridge recognize the need to update the protocol in future years to incorporate new data and information as it becomes more readily available.

The community-wide GHG inventory calculated that total GHG emissions for Cambridge in 2012 were 1,462,000 metric tons of CO2e (carbon dioxide equivalent, a combined metric of GHG emissions comprised of CO2 and other gases that contribute to global warming). The inventory also provided insight into Cambridge's sources of GHG emissions and the human activities associated with them.

3.3.1 SCOPE ANALYSIS

The GPC categorizes emissions as Scope 1, Scope 2, or Scope 3 based on where they are generated:

Scope 1: emissions generated within the city boundary

Scope 2: emissions generated outside the city boundary from energy used in the city boundary (i.e. grid power)

Scope 3: emissions generated outside the city boundary from activity in the city boundary (i.e. emissions generated from products used in the City)

All Scope 1 and Scope 2 emissions, and some Scope 3 emissions are included in the community-wide GHG inventory.

Other sources of Scope 3 emissions, such as air travel by Cambridge residents and emissions associated with the manufacture and transport of goods and services purchased in Cambridge, are not currently included in the inventory due to lack of or difficulty in collecting accurate and reliable data. The graphic below illustrates the components of each scope category.

Cambridge's emissions largely fall into Scope 1, primarily resulting from fossil fuel combustion that supplies heat and hot water to buildings. Scope 1 also includes the fuels that are used in vehicles, as well as

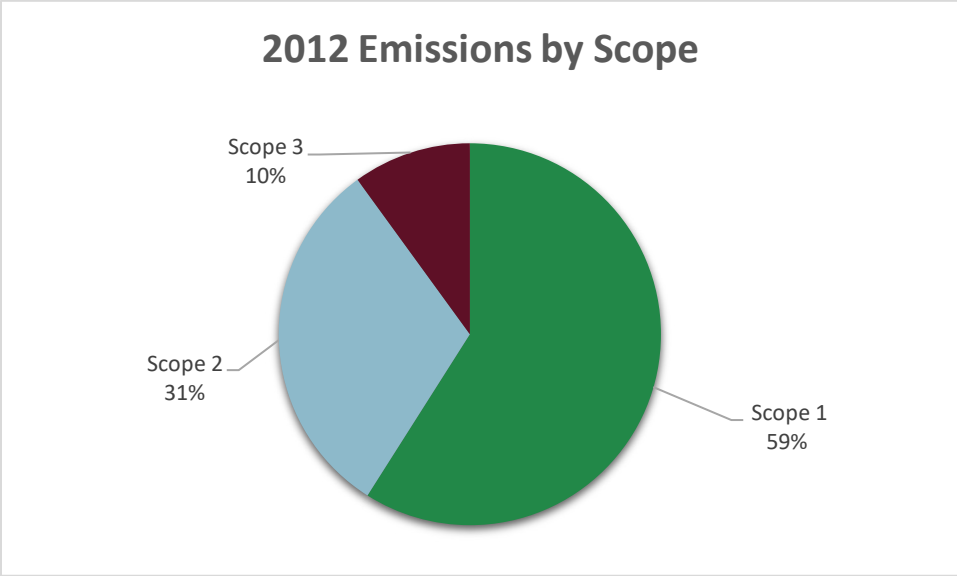


Fig. 2: **Cambridge Emissions by Scope, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016)

some combustion for power generation or combined heat-and-power systems located in Cambridge. Scope 2 comprises the next largest source of emissions, resulting from purchased electricity that is generated outside the city boundary. Scope 3 emissions include the impacts of solid waste disposal and wastewater treatment, as well as the energy lost in the transmission of grid electricity.

3.3.2 SECTOR ANALYSIS

The GPC also categorizes emissions by sector. Each sector can include one or more of the aforementioned scopes; for instance, stationary energy (i.e. building energy use) includes both Scope 1 emissions from direct fuel combustion inside a building, and Scope 2 emissions from purchased energy. The following sectors are assessed in the inventory:

Stationary Energy (buildings): residential and commercial properties

Transportation: on-road and off-road

Waste: solid waste and wastewater disposal and treatment

The 2012 emissions profile shows that the majority of community wide emissions come from the stationary energy sector, at nearly 82% of total Cambridge emissions. The emissions associated with transportation and waste account for 11% and 7% of community wide emissions, respectively. Given this emissions profile, the City has dedicated much of its effort to reducing emissions from buildings. However, other sectors must also be addressed. Emissions reductions in the transportation and waste sectors are required to meet the City's net zero emissions goal, result in important co-benefits, and perhaps most importantly, serve as replicable solutions that can be implemented in other cities.

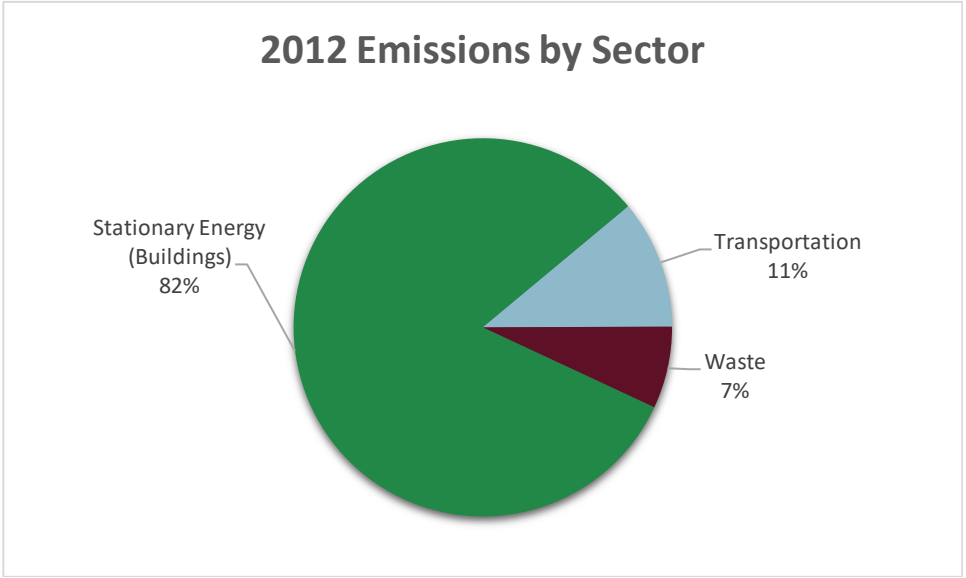


Fig. 3: **Cambridge Emissions by Sector, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016)

3.3.2.1 STATIONARY ENERGY

Stationary energy includes emissions associated with energy used to heat and cool buildings, as well as equipment such as outdoor lighting, water pumps and off-road equipment. Stationary energy use generated 1.2 million mt CO2e in 2012. Within buildings, commercial and industrial buildings represent nearly two-thirds (63%) of the emissions in this sector, followed by residential buildings (17%), and energy industries (16%), which includes district energy generation on campuses, and manufacturing industries and construction (4%).

Electricity and natural gas represent the largest sources of emissions at 41% and 37% percent, respectively, with fuel oil at 2%. Transportation fuels (gasoline, diesel and CNG) used in off-road, stationary applications is the third largest fuel source within Cambridge at 20%. This includes off-road emissions from industrial, lawn and garden, and light commercial equipment.

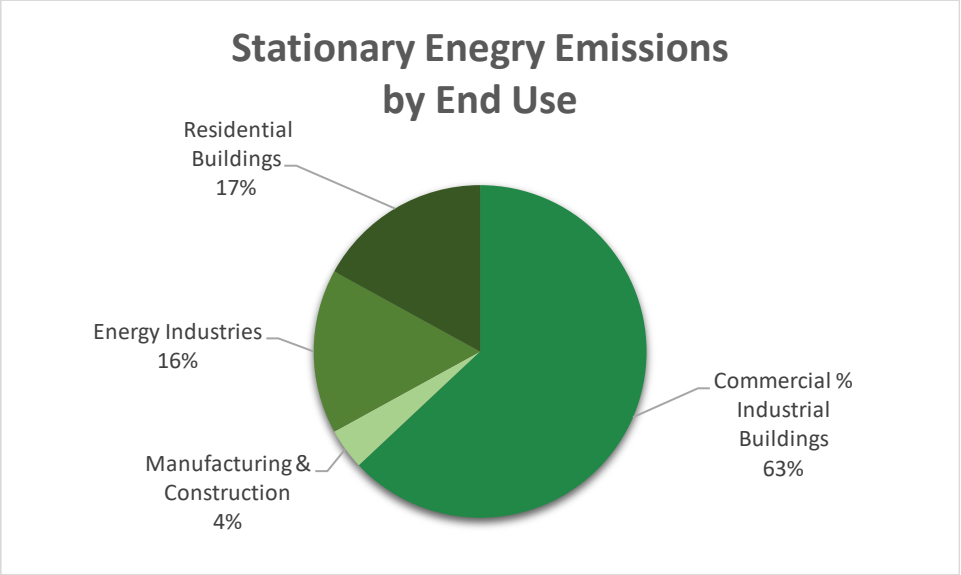


Fig. 4: **Stationary Emissions by End Use, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016)

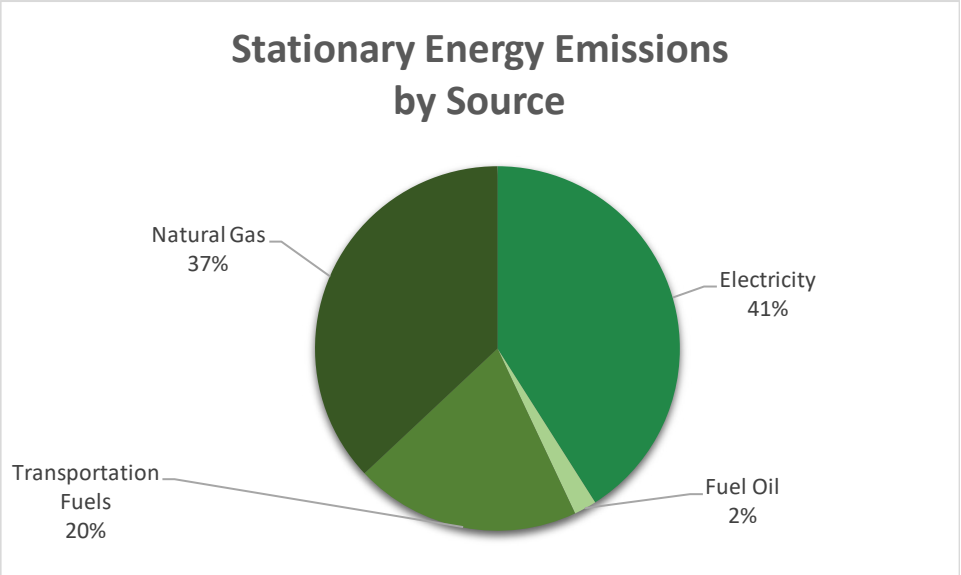


Fig. 5: **Stationary Emissions by Source, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016)

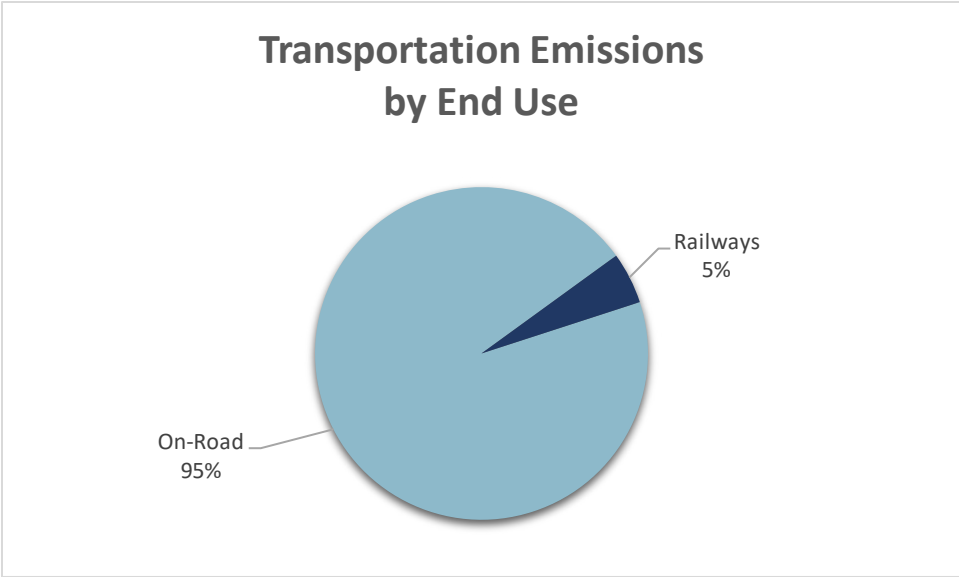


Fig. 6: **Transportation Emissions by End Use, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016)

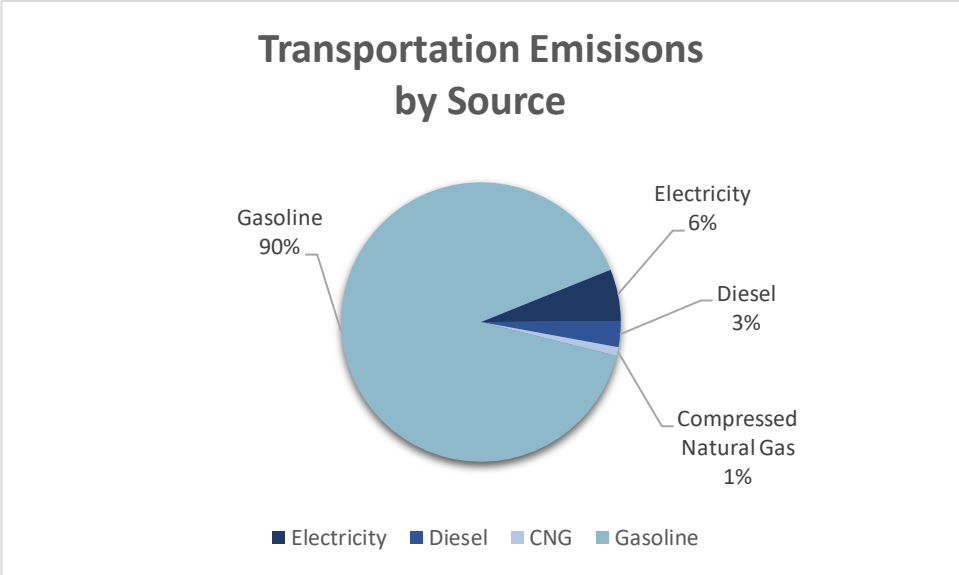


Fig. 7: **Transportation Emissions by Source, 2012**
(Source: Cambridge Community-wide GHG Inventory, 2016

3.3.2.2 TRANSPORTATION

Transportation includes emissions associated with on-road transportation including private vehicles, commercial vehicles, public transit vehicles (buses and trains), and rail travel including heavy rail, light rail, and trackless trollies (electric buses that draw power from overhead wires). Transportation emissions included in this report are estimated, based on the number of trips generated by different land use types in Cambridge, and include only the portion of trip segments that occur within Cambridge's geographic boundary. It does not include emissions from through trips. Transportation energy use generated 162,358 metric tons of CO2e in 2012. Within transportation, on-road transportation is the largest contributor at 92% of sector emissions with rail systems contributing 8% of the total. As for fuel sources, gasoline contributes nearly 91% of the GHG emissions with electric vehicles (6%), diesel vehicles (3%), and CNG vehicles (1%) contributing the balance.

3.3.2.3 WASTE

Waste includes emissions associated with solid waste disposal, as well as wastewater treatment and disposal. Emissions generated by the waste sector totaled 96,000 mt CO2e in 2012. The majority of these emissions comes from solid waste disposal (96%), due to methane release that occurs when waste is left in landfills. Emissions related to incineration facilities and open burning generally come from a combination of methane, CO2, and N2O.

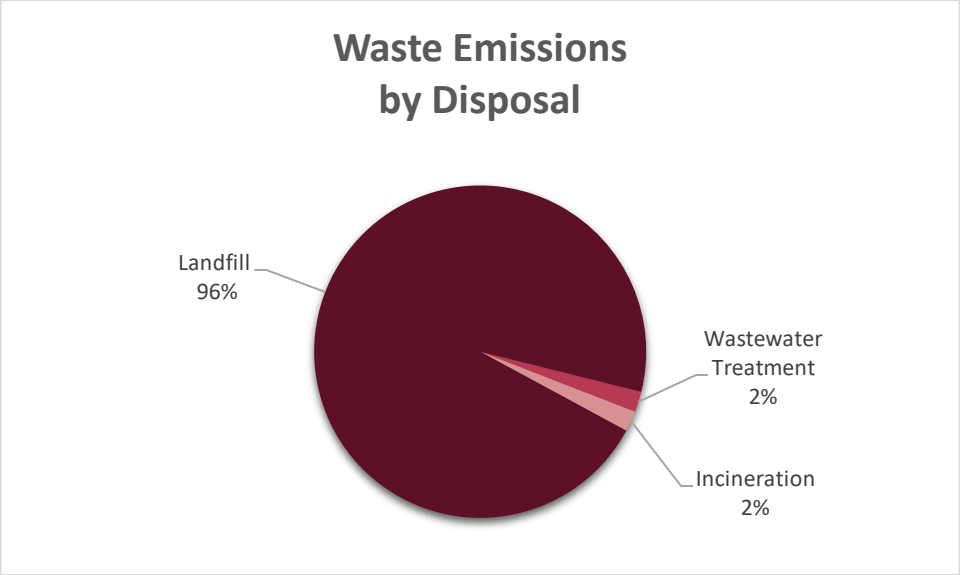


Fig. 8: **Waste Emissions by Disposal, 2012**
(Cambridge Community-wide GHG Inventory, 2016

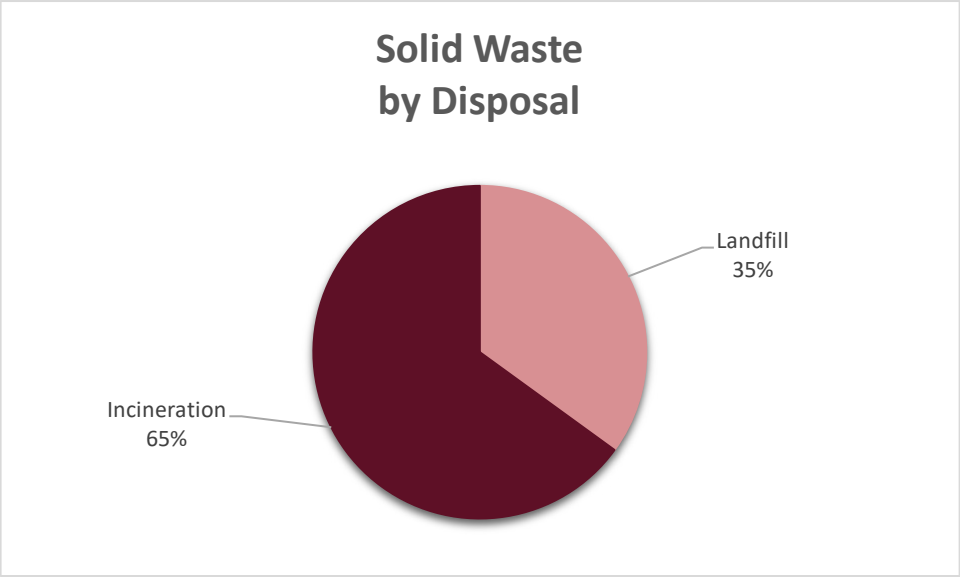


Fig. 9: **Solid Waste by Disposal, 2012**
(Cambridge Community-wide GHG Inventory, 2016)

3.4 LIMITATIONS OF GHG PROTOCOLS

The 2012 inventory is markedly more precise than the inventory that the City completed in 2002. However, the GPC is continuously evolving to reflect the best available data, information, and knowledge. The City of Cambridge will closely monitor the evolving nature of the GPC, particularly as it may expand to include a wider swath of emissions-generating activities not currently accounted for in the Community-wide inventory. In the case that new, large sources of emissions are quantified, Cambridge will need to be prepared to expand the Climate Action Plan and introduce new strategies and actions to reduce any new or previously unaccounted for sources of GHG emissions.

Generally speaking, the accounting protocol for Scope 1 and 2 emissions is well-developed. These emissions sources are well-documented and the data are easily tracked and managed. On the other hand, Scope 3 emissions are less straightforward and data availability is lacking. For example, we do not have a reliable method to track the air travel from Cambridge residents or Cambridge-based employees. Similarly, we do not have data on the goods purchased in Cambridge and the emissions associated with the manufacturing and distribution of those goods. There have been efforts by some large-scale goods producers, who have a full inventory of their production processes and goods movement, to track emissions throughout their supply chains. Some large-scale consumers, including the Massachusetts Institute of Technology, are also embarking on efforts to understand their Scope 3 emissions. At the moment, this is an extraordinarily difficult exercise for cities, given their scale and complexity of public and private sector actors.

There are ongoing research and development efforts by third-party groups to model community-wide Scope 3 emissions. One such effort is development of the Consumption Based Emissions (CBE) method for completing GHG inventories, as an alternative to the traditional sector-based analysis. This method is focused on the consumption of goods by residents of a city, whereby emissions are organized and reported based on consumption categories as opposed to sectors. A consumption-based GHG inventory allows quantification of the full lifecycle emissions of goods and services, including emissions resulting from the harvesting of raw materials, manufacturing, distribution, and user disposal. The CBE method circumvents challenges of collecting specific goods comnsumption data across the community by using financial flow models. The financial flow models used by CBE calculate GHG emissions based on market share of dolars spent on a particular type of good, and an emissions factor for the type of goods/services consumed, and where they are produced. At the moment, there is a high degree of uncertainty around these models, which make them less precise than the sector-based method.

However, the CBE method may be useful in providing the City insigts on the relative order of magnitude of GHG emissions generated by different consumption sectors. Preliminary analysis basd on the CBE method could be useful in preparing the City to qickly adopt new inventory methods or emission reduction opportunities related to Scope 3 emissions. The City of Cambridge can be classified as a "consumer" city, as it is a net importer of goods and services and bears responsibility for their associated Scope 3 emissions and their impacts. While these emissions are difficult to track, the conversation is evolving quickly and methodologies like the CBE method will undoubtedly improve and allow for a fuller picture of Cambridge's carbon footprint.

CITY ACTIONS

MANY OF THE STRATEGIES AND ACTIONS INCLUDED IN THE CLIMATE ACTION PLAN ARE ALREADY EXISTING OR PLANNED THROUGH OTHER SECTOR SPECIFIC PLANS, SUCH AS THE NET ZERO ACTION PLAN, ENVISION CAMBRIDGE, THE CLIMATE CHANGE PREPAREDNESS AND RESILIENCE PLAN, AND THE ZERO WASTE MASTER PLAN.

The City of Cambridge has a long history of leadership with regards to climate, transportation, and environmental plans, policies, and programs. It is important to note that this Climate Action Plan does not supersede those initiatives, but rather acts as an umbrella plan for reducing GHG emissions. The majority of strategies and actions described in Section 5 are already existing or planned, with direct connections to the Net Zero Action Plan, Envision Cambridge, the Climate Change Preparedness and Resilience Plan, and the Zero Waste Master Plan. Each of these planning efforts included extensive public engagement; for instance, the thirteen-member Getting to Net Zero Task Force included residents, community advocates, business and property owners, developers and representatives of local universities. Envision Cambridge convened multiple working groups – including one focused on transportation and another focused on climate and environment – that each met at least five times over the course of a year to develop long-term goals, strategies, actions, indicators, and targets.

New strategies and actions that are not already part of existing plans are noted where they occur. The new strategies and actions were developed in consultation with City staff and technical consultants, in addition to input from stakeholder engagement efforts conducted as part of the Climate Action Plan and concurrent planning initiatives.

In 2002, the Cambridge City Council adopted a Climate Protection Plan that made the case for local action to reduce GHG emissions. The vision for the plan revolved around making smarter decisions with regards to building energy use, transportation of people and goods, and waste management. The CPP was the result of a long history of climate awareness in Cambridge, and directly initiated in 1999 when the City Council voted to join Cities for Climate Protection. The Climate Protection Plan set forth a goal of reducing GHG emissions by 20% from 1990 levels by the year 2010.

An update report was released in 2011, acknowledging that the City fell short of this goal while laying out lessons learned and establishing a new path forward. A major challenge for Cambridge's climate efforts was the significant growth the City was experiencing, particularly in the energy-intensive life sciences sector. Each of the seven GHG reduction strategies proposed in the 2002 plan are described in the updated report with current actions and future trends to provide the community with an understanding of how the City is progressing in achieving its climate protection goals.

This Climate Action Plan is intended as an update to the CPP and the plan sets forth additional strategies that are actionable and achievable. Public engagement was woven throughout the process, with CAP presentations delivered to and input received from the Climate Protection Action Committee (CPAC) and Envision Cambridge's Climate and Environment Working Group.

4.1 ENVISIONS CAMBRIDGE

Envision Cambridge, initiated in 2015, is the City's comprehensive plan, created through extensive engagement and community-wide process. The plan's vision and core values provide the overarching framework for six key focus areas: (1) Urban Form (2) Economy (3) Community Wellbeing (4) Climate and Environment (5) Mobility, and (6) Housing. For each of these focus areas, Envison Cambridge developed forward-looking goals, strategies and actions to ensure future growth in Cambridge is well aligned with the Community's core values and results in a more livable, sustainable, and equitable Cambridge.

The vision and core values, as well as focus area goals, strategies, and actions that were developed through the community-wide Envision Cambridge process have been considered in the formation of this Climate Action Plan.

Envision Cambridge planning topics.

LIVABILITY
We value a vibrant built and natural environment and support sustainable transportation with affordable and convenient access to daily needs and recreational resources.

DIVERSITY AND EQUITY
We are a welcoming community that celebrates our diversity and ensures access to affordable housing choices and opportunities to succeed.

ECONOMIC OPPORTUNITY
We provide opportunity and stability through access to quality jobs, workforce development and training, and livable wages that support economic security for residents.

SUSTAINABILITY AND RESILIENCE
We take responsible action to reduce our impact on the environment and build a resilient city and strong community.

COMMUNITY HEALTH AND WELLBEING
We promote healthy and active lifestyles in a supportive, safe community with diverse opportunities to connect with our neighbors and nature and to engage in civic life.

LEARNING
We embrace lifelong learning and celebrate art and creativity in our culturally rich community.

4.2 NET ZERO ACTION PLAN (NZAP)

In 2015, the City of Cambridge introduced a 25-year action plan to phase out GHG emissions for buildings throughout the community by mid-century. The plan includes the bold new policy target of achieving net zero emissions for all newly constructed buildings beginning in 2020, starting with municipal buildings and phasing in requirements for other building types between 2022 and 2030. Accompanying this strategy are targeted improvements for the existing building stock, low carbon energy supply strategies to accelerate the adoption of renewable energy, and coordinated communications and engagement. The focus areas for the plan are: (1) Energy Efficiency in Existing Buildings (2) Net Zero New Construction (3) Low Carbon Energy Supply Strategy, (4) Local Carbon Fund, and (5) Engagement and Capacity Building. The Net Zero Action Plan sets out clear actions for achieving a net zero community of buildings through quantifiable GHG impacts and detailed short, medium, and long term implementation plans.

4.3 MUNICIPAL FACILITIES IMPROVEMENT PLAN (MFIP)

In 2017, the Municipal Facilities Improvement Plan (MFIP), recommended in the Net Zero Action Plan as Action 2.4.2, was completed to assess the needs of municipal facilities throughout Cambridge, and to create a Capital Improvement Plan to address those needs. The potential for GHG emissions reductions in municipal facilities was included in the assessment. Cambridge has committed $5 million per year for five years to implement the recommendations of the plan, which includes improvements that will reduce emissions significantly. Eight energy efficiency and renewable energy projects were completed in FY17 and nine projects were underway as of the time this report was published.

4.4 ZERO WASTE MASTER PLAN (ZWMP)

The ongoing Zero Waste Master Plan, to be released in 2019 lays out a plan and strategy for achieving the City's waste diversion and reduction goals. The City has committed to reducing municipal waste by 30% by 2020 (to 16 lbs. of trash/household/week) and by 80% by 2050 (to 4 lbs. of trash/household/week). The plan's focus is on diverting organics from the waste stream by expanding the organics collection program.

ZERO WASTE
CAMBRIDGE

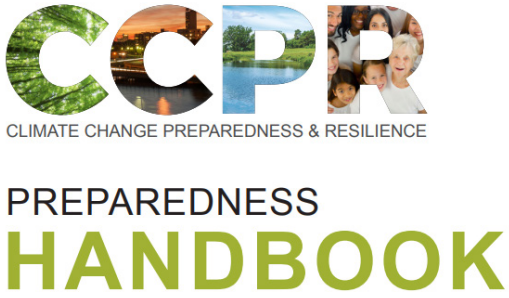
4.5 TRANSPORTATION INITIATIVES

Cambridge has multiple transportation policies and programs that contribute to reducing GHG emissions. The 2015 Transit Strategic Plan, for example, focuses on how to provide better public transportation that meets economic development, livability, social equity, and environmental objectives. The plan lists several goals, including prioritizing transit funding, increasing efficiency and reliability of transit service, expanding service, improving usability, accessibility, and safety. The Cambridge Bicycle Plan looks at Cambridge through the lens of a bicyclist, aiming to create a city that is safe for anyone, no matter their age, to be able to bike independently.

Similarly, the City's Complete Streets initiative policy seeks to build an integrated street network in Cambridge that enables safe access for all users, including pedestrians and bicyclists. The Parking and Transportation Demand Management (PTDM) Ordinance made permanent in 2006, requires commercial property owners seeking to expand parking lots to implement transportation demand management measures and make a commitment to reducing single occupancy vehicles. Additional transportation initiatives are described in Section 5.3.

4.6 CLIMATE CHANGE RESILIENCY AND PREPAREDNESS (CCPR) PLAN

The Climate Change Preparedness and Resilience (CCPR) Plan is being developed as a practical guide for the City of Cambridge to implement specific strategies in response to climate change threats including heat, flooding from precipitation, flooding from sea level rise and storm surge. Proposed strategies are for protecting people, buildings, infrastructure and ecosystems against projected climate change impacts and designing for a speedy return to normal operation in the case of an extreme weather event. Many of the proposed strategies will not only enhance resiliency but will also contribute to the reduction of GHG emissions citywide.



SECTION STRATEGIES AND GHG IMPACTS

A BUSINESS AS USUAL EMISSIONS SCENARIO FALLS FAR SHORT OF ACHIEVING CARBON NEUTRALITY BY 2050, INDICATING THAT CURRENT STATE AND FEDERAL POLICIES ARE NOT ENOUGH TO ACHIEVE CARBON NEUTRALITY BY 2050.

5.1 BUSINESS AS USUAL FORECAST

As part of the process for developing this Climate Action Plan, the City commissioned a technical consultant to develop a forecasting model to project the predicted impacts of GHG emissions reduction actions across sectors. The first step in the model's development was to understand how GHG emissions would change over time in the absence of a Climate Action Plan – in other words, what the City's GHG emissions would be in a do-nothing or "business as usual" (BAU) scenario.

The BAU scenario represents what would happen if Cambridge did not act to reduce GHG emissions with existing programs, if climate initiatives were halted and if future, planned programs were not implemented. Even though this is not a realistic scenario, it is important to consider its outcome in order to further emphasize the need for local climate action. The BAU scenario assumed that no improvements in building energy efficiency would be made over time, but that the current electricity supply would become cleaner due to the States Renewable Portfolio Standard and the Regional Greenhouse Gas Initiative regulations. It did include the expected impacts from CAFÉ standards on transportation fuel efficiency and associated emissions, but not any emissions reductions from changes in the way we move people and goods around Cambridge. Finally, it assumes no decrease in how much waste we produce and what proportion of that waste is diverted from landfill.

Under business as usual, we could expect total emissions to decrease between 2015 to 2050, from 1.3 million to 900,000 mt CO2e, based on current trends. While there would be upward pressures from a growing population and workforce (and their associated increase in energy demand and waste generation), emissions reductions would be achieved primarily from the electricity supply grid becoming cleaner and supplying lower carbon electricity to buildings. Improved fuel economy standards for internal combustion vehicles would also achieve some emissions reductions despite the upward pressure on transportation emissions from workforce commutes.

The BAU scenario falls far short of achieving carbon neutrality by 2050, indicating that current State and Federal policies are not enough to achieve carbon neutrality by 2050; Cambridge will have to implement policies and programs to negate its current emissions footprint while considering low carbon growth to achieve this goal. In the following sections, strategies to reduce emissions in each sector (buildings, transportation, and waste) are described and presented with their estimated 2050 emissions reduction potential[1].

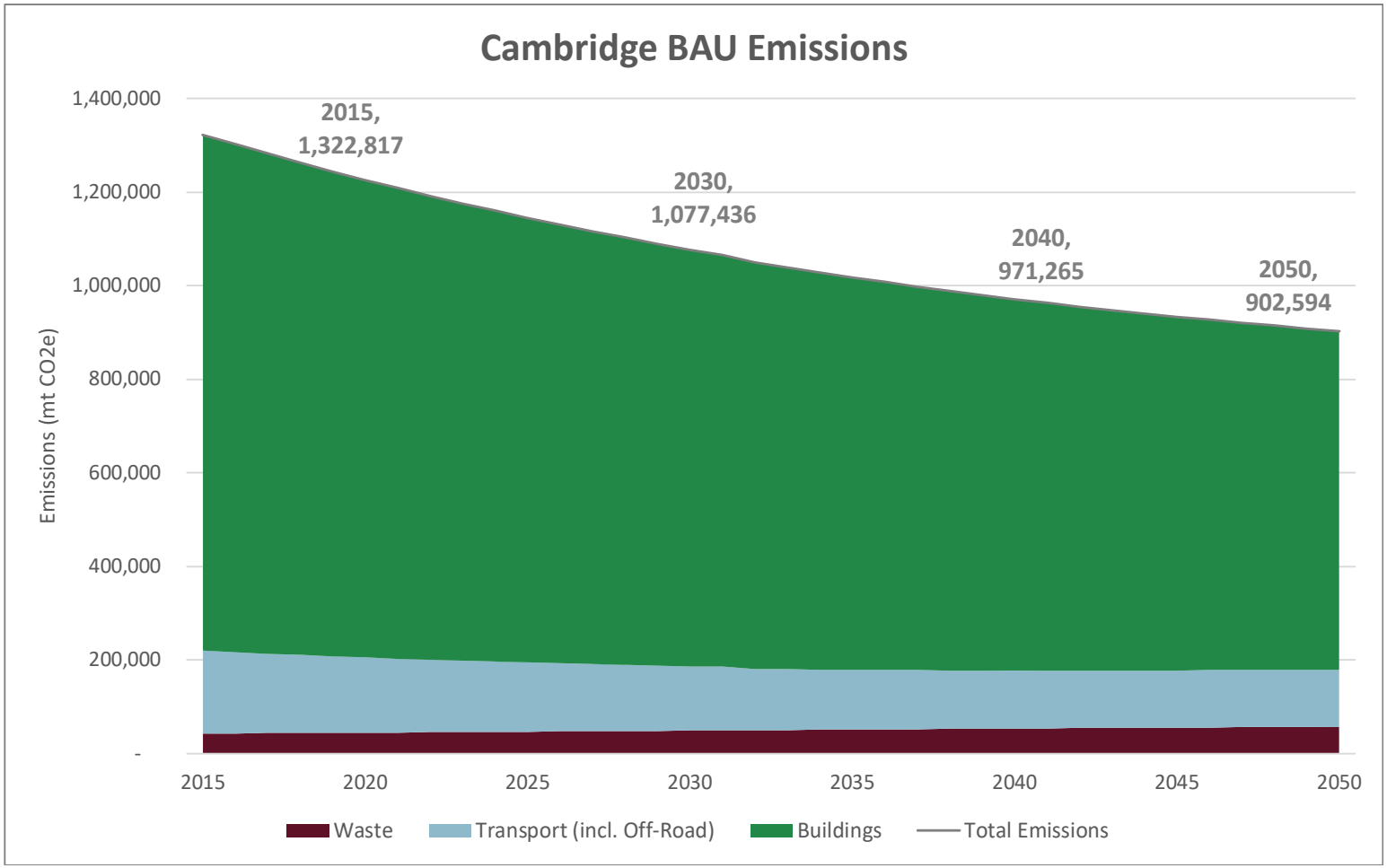


Fig. 10 **Cambrigde Business As Usual Emissions**
(Source: Cambridge Community-wide Greenhouse Gas Inventory, 2016)

[1] The emissions reduction potential has been estimated for each strategy in isolation; these figures are not additive. For instance, the potential for reducing emissions through energy efficiency in existing buildings does not factor in low carbon energy supply strategies.

5.2 BUILDINGS

Buildings are the largest source of emissions in the community-wide inventory and the City has spent considerable effort addressing energy use in buildings through the Net Zero Action Plan. The NZAP actions are the basis of this section and the overall approach to reducing emissions in the buildings sector with support from Climate Change Preparedness and Resilience Plan's building-related actions. Generally speaking, reducing emissions from buildings requires a two-pronged approach: demand-side approaches (reducing consumption through behavioral changes and energy efficiency), and supply-side approaches (fuel switching to renewable energy, or using more efficient energy generation systems).. Figure 11 illustrates the impact of three key buildings strategies and the resulting projected 2050 emissions for the building sector, assuming a LCESS Scenario 2: district energy electrification path.

The building strategies and actions leave a remaining 397,000 mtCO2e in the year 2050 based on the City's current emissions projections. This heightens the urgency for ramping up buildings sector actions and regularly updating the NZAP to reflect improvements in building technologies and policies that may further accelerate emissions reductions. The City will also need to consider how and when carbon offsets should be used to achieve net zero emissions.

REDUCING EMISSIONS FROM BUILDINGS REQUIRES A TWO-PRONGED APPROACH: REDUCING ENERGY USE THORUGH EFFICIENCY, AND SWITCHING THE ENERGY SUPPLY TO RENEWABLE SOURCES.

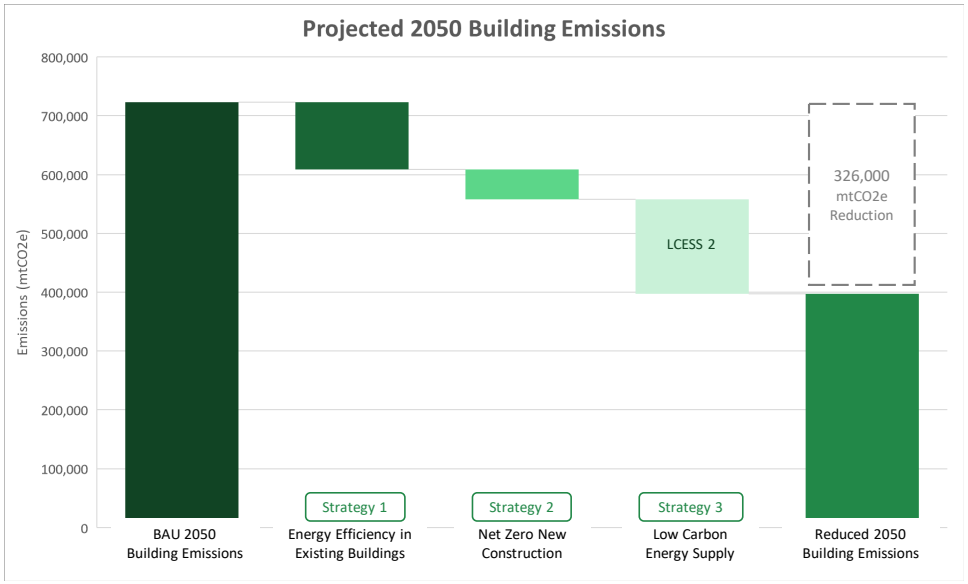


Fig. 11 **Projected Building Sector Emissions Reductions**

5.2.1 ENERGY EFFICIENCY IN EXISTING BUILDINGS

Significant changes are required within Cambridge's existing building stock in order to realize significant GHG reductions. Existing buildings have the opportunity to be the leaders in reducing GHG emissions through retrofits and energy management plans. This section outlines NZAP initiatives to increase energy efficiency.

5.2.1.1 Explore the development of a custom retrofit program that expands on current utility retrofit incentives

A custom retrofit program would re-align existing utility incentive programs to better meet the needs of Cambridge buildings and could take a performance-based approach to determine incentive levels for projects based on the total tons of GHG savings related to the retrofit ($/ton). (NZAP)

5.2.1.2 Introduce additional requirements to BEUDO

Building upon the existing Building Energy Use and Disclosure Ordinance (BEUDO), Cambridge should introduce requirements for buildings to achieve certain levels of energy or emissions savings. For example, (1) a required energy audit and retro-commissioning process every 5 years for buildings that perform below a certain threshold or (2) required energy management plans outlining energy-related actions every 5 years for those buildings that score below a certain percentile performance rating (based on Portfolio Manager values). (NZAP)

5.2.1.3 Explore a requirement for energy updates at the time of renovation or sale

The occurrence of a building sale or renovation provides a valuable investment opportunity to achieve energy upgrades as part of the sale or renovation process. Further investigation and analysis is needed to determine what retrofits should be required at these times and to which buildings it would apply. (NZAP)

5.2.1.4 Require energy management plans detailing new building operations and maintenance

As a condition of building occupancy, buildings should be required to submit energy management plans detailing how the building will be operated to meet the intent of energy efficient design. The City should generate a template that can be used for simplicity and effectiveness. (NZAP)

5.2.2 NET ZERO NEW CONSTRUCTION

Similar to existing buildings undergoing retrofits, new buildings will be held to much higher standards of energy efficiency. The gains from this strategy are significant in the long term, and also less challenging, as it is easier to build to a new standard from scratch than it is to retrofit an existing building. In this section, actions from both NZAP and the Climate Change Preparedness and Resilience Plan (CCPR) are included.

5.2.2.1 Create net zero targets for new construction

New buildings will achieve net zero emissions standards according to the table below. The variation in target years reflects the varying degree of complexity associated with achieving new zero emissions in different building types and specifically recognizes the challenges faced by laboratory buildings in meeting these aggressive targets. The City has committed to a public process to review the technical and economic feasibility of each target two years in advance of its taking effect. (NZAP)

2020 - Municipal builidngs
2022 - Residential builidngs(1-4 units)
2025 - Multi-family (5+ units)
2025 - Commercial & Industrial
2030 - Labratory builidngs

5.2.2.2 Develop a market-based incentive program

To inspire leadership and encourage investment in innovation, it is recommended that Cambridge develop a compelling incentive package for new buildings to achieve net zero emissions in advance of the requirements. Incentives should be offered across all sectors and phased in until net zero construction is mandatory and incentives can shift towards net-positive construction. (NZAP)

5.2.2.3 Explore the impact of offering additional floor area and height allowance to projects that achieve net zero emissions

To inspire early action, the City should explore through the Envision Cambridge planning process the potential impact of offering additional floor area allowances and extra height to projects that achieve net zero emissions. Projects would need to demonstrate and commit to net zero emissions through design in order to meet eligibility requirements for density incentives. Additionally, project leaders should be encouraged to share their expertise in achieving net zero in Cambridge. (NZAP)

5.2.2.4 Increase Green Building Requirements in Cambridge Zoning Ordinance

The Cambridge zoning ordinance is a regulatory tool that the City can use to incrementally require higher standards of

green building and energy efficiency for projects. The Green Building Requirements in the zoning ordinance for special permitting of new construction and major renovations over 25,000 square feet should be increased. This would include a shift to LEED Gold or other green buildings certifications and consider additional mechanisms to require projects to achieve higher levels of GHG savings. (NZAP)

5.2.2.5 Require net zero construction or 'net zero ready' for new City-owned buildings

Cambridge should establish a formal policy that new construction of municipal buildings should target net zero "readiness" in advance of the municipal net zero requirements. Under this policy, buildings would be required to be designed to optimum energy efficiency standards such that all or a high percentage of energy loads could be met by renewable sources. Eventually, this policy should be revised to require net-positive municipal buildings. (NZAP)

5.2.2.6 Require deep energy efficiency retrofits for City-owned buildings undergoing major renovation

Using tracked data on City-owned buildings, Cambridge should develop a building renewal strategy for City-owned buildings, targeting the least energy efficient first. Additionally, the City will develop an action plan for operational improvements and retrofits to meet the energy and GHG reduction target set by the DPW. (NZAP)

5.2.2.7 Remove barriers to increased insulation

One strategy to improve building efficiency is to increase the amount of insulation on the exterior of the building. Extending the footprint of a building to accomodate walls that become thicker with added insulation may conflict with the Zoning Ordinance setback limitations for such retrofits, even though they support the cities climate goals. The City should develop an approach to remove barriers in the Zoning Ordinance to enable additional exterior insulation for more efficient buildings. (NZAP)

5.2.2.8 Establish regulations and design guidelines for new buildings and re-developments to be resilient to future heat risks

Cambridge should enforce regulations and design guidelines for new construction and major renovations to consider future heat risks in design. Such regulations and guidelines can include everything from supporting passive strategies and high-performance building envelopes, to requiring compliance with the LEED Pilot Credit for Resiliency, to requiring green roofs, increased tree canopy, and other green infrastructure. (CCPR)

5.2.2.9 Establish a cool roof requirement for new construction (compatible with solar-ready)

The City should consider establishing a cool roof requirement for new construction and major renovation. This would require a low-cost, reflective white coating or green roof for all new rooftops in an effort to reduce the heat island effect and building cooling costs for reduced GHG emissions. (CCPR)

5.2.3 LOW CARBON ENERGY SUPPLY

The past two sections have focused on demand-side improvements connected with energy efficiency. Significant gains can also be achieved via fuel switching, or transitioning from fossil fuels to low carbon energy sources. This section draws upon the NZAP as well as additional actions newly propsed in this CAP. Some newly proposed actions have been added to address gaps in the GHG emissions reduction strategy for a low carbon energy supply.

5.2.3.1 Create and enact a low carbon energy supply strategy

Achieving net zero emissions and improving community resiliency will require a significant shift in the supply of energy to Cambridge buildings away from fossil fuel based sources and toward low- or zero-carbon sources. To better understand the full potential of renewable energy and low carbon district heating and cooling in Cambridge, the City completed a long-term, low carbon energy supply strategy study. The scope of the study was to determine what the potential is for generating heat and electricity at the block, district, and city scale and where across the City such applications are best suited. The study also looked at the capacity and constraints posed to developing renewable energy on the regional electrical grid. A low carbon energy supply strategy includes realizing a significant portion of the city's solar potential (both PV and thermal), taking advantage of opportunities to harvest waste heat, and expanding and developing additional district energy capacity. The study also defines what role(s) the City can play in advancing low carbon energy generation, distribution, and storage. In the coming years, Cambridge will work to identify the appropriate solutions and begin adoption. (NZAP)

5.2.3.2 Introduce a requirement for onsite renewable energy generation, with a focus on rooftop solar

In order to maximize local renewable energy potential, all new buildings should meet 'solar ready' requirements, and be designed to accommodate the installation of roof-mounted solar panels, potentially including both photovoltaic (PV) and solar thermal systems. These requirements would include but not be limited to enhanced structural loading, pitch and orientation, and a conduit to accommodate pipes and cables. As an extension of this requirement, the City

should explore solar requirements for new construction and roof renovations and what could be feasible and financially viable with the goal of requiring such installations in the future. (NZAP)

5.2.3.3 Develop a memorandum of understanding with local utilities to work closely with the City on taking actions towards net zero emissions

Cambridge should create a platform to collaborate with utilities on projects of mutual interest that may result in energy use and emissions reductions including smart grid projects, incentive programs, and district energy expansion. The formal declaration and definition of this collaboration can impact its effectiveness and is recommended for the City. (NZAP)

5.2.3.4 Support the purchasing of sustainable power with a community electricity aggregation program

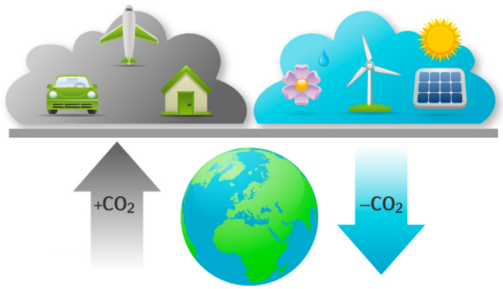
The City launched the Cambridge Community Electricity program in June 2017 to bring the benefits of renewable energy and electricity choice to its residents and businesses. The program works by aggregating the community's purchasing power to negotiate the supplier services portion of electricity bills to include 25% more solar electricity than Eversource's Basic Service, at a competitive rate. Expanding this strategy can leverage the community electricity supply to result in greater levels of renewable energy development.

5.2.3.5 Procure 100% of municipal electricity from renewable energy sources

Cambridge should work to procure 100% of its municipal electricity from renewable sources. Similar to the community aggregation program, the City can leverage its purchasing power to procure energy from renewable sources and lead by example.

5.2.4 LOCAL CARBON FUND

For Cambridge to become a net zero community, it will require an annual emissions balance across the entirety of the community's building stock. To achieve such an objective will require ambitious transformation of the existing building stock and the introduction of aggressive standards for new construction combined with the proliferation of affordable renewable energy. 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 third party managed local carbon fund to enable the use of local carbon offsets to meet net zero goals. The local carbon fund could then invest in other energy saving projects in Cambridge to increase the pace of GHG reductions within the community.



WHILE NOT DIRECTLY IMPACTING EMISSIONS IN THE SAME FASHION AS ENERGY EFFICIENCY RETROFIT PROJECTS OR SWITCHING TO LOW CARBON ENERGY SUPPLY SOURCES, ENGAGEMENT AND CAPACITY BUILDING HAVE BEEN ESSENTIAL TO THE ACCEPTANCE OF CLIMATE LEADERSHIP ACTIONS IN THE CITY OF CAMBRIDGE.

5.2.4.1 Undertake a feasibility study and solicit a third-party organization to administer a local carbon fund

A feasibility study is underway to investigate the creation of a local carbon fund. This fund would provide developers and building owners in Cambridge with a temporary, alternative pathway for meeting new building net zero zoning requirements through the purchase of local offsets. The fund also has the potential to further advance the City's net zero goals by funding local carbon reduction projects in existing buildings that would not occur otherwise. Initial results from the study show that establishing such a local carbon fund is feasible albeit requiring significant upfront investment. The next steps for Cambridge are to create a Local Carbon Fund and define requirements for new construction, conduct extensive outreach to property owners and community for market acceptance, and secure funding for planning and launch. Cambridge's Local Carbon Fund will be the first-of-its-kind, representing a leading and innovative approach to achieving net zero emissions. (NZAP)

5.2.5 ENGAGEMENT AND CAPACITY BUILDING

While not directly impacting emissions in the same fashion as energy efficiency retrofit projects or switching to low carbon energy supply sources, engagement and capacity building have been essential to the acceptance of climate leadership actions in the City of Cambridge. The participation of residents, major institutions, and business owners, is crucial to the successful implementation of the NZAP goals and actions.

5.2.5.1 Develop a long-term communications strategy around the Cambridge Net Zero Action Plan

Cambridge should develop a comprehensive long-term communications strategy around the Cambridge Net Zero Action Plan. The strategy will ensure that key stakeholders including City officials, the building industry, and Cambridge residents remain aware of the progress towards net zero emissions and engaged with the initiative. (NZAP)

5.2.5.2 Develop on-going capacity to manage the Net Zero Ation Plan

The City should assign and commit to specific roles and responsibilities for implementing the Cambridge Net Zero Action Plan over the long term. This includes establishing project management to advance the actions, identifying research and implementation partners, and developing a reporting and governance structure to ensure that the project remains on track and responsive to changes over time. (NZAP)

5.2.5.3 Engage with stakeholders to develop new standards for lab operations that support lower energy use

In order to overcome the unique energy saving challenges faced by laboratories, the City should engage with lab stakeholders such as tenants, developers and owners, and the universities to develop new standards for lab operations that support lower energy use. Building on Cambridge's strength as a center of research and innovation, the development of new industrial hygiene standards that could lower ventilation standards and reduce other energy uses could be critical to net zero labs. (NZAP)

CAMBRIDGE ALREADY HAS HIGH UTILIZATION RATES OF PUBLIC TRANSIT AND ACTIVE TRANSPORTATION (WALKING AND BIKING). HOWEVER, INCREASING USE OF THESE MODES IS AN IMPORTANT STRATEGY FOR MEETING EMISSION REDUCTION GOALS, IN ADDITION TO EQUITY, LIVABILITY, HEALTH ,AND SAFETY GOALS.

5.3 TRANSPORTATION

Transportation represents approximately 11% of overall emissions in Cambridge. There are many successful initiatives within the city that encourage the use of sustainable modes of transportation, as well as state- and federal-level initiatives that are expected to contribute to GHG reductions in the transportation sector. The City and Commonwealth have roles to play in reducing transportation emissions, given regional traffic, growing population and workforce, and emerging technologies, but also in the area with arguably the greatest impact on emissions reductions – behavioral changes by Cambridge residents and workers. The following graph illustrates the impact of each transportation strategy and the resulting projected 2050 emissions for the transportation sector.

Similar to the buildings sector, after implementing the recommended package of transportation actions, there are some GHG emissions remaining, approximately 65,000 mtCO2e in 2050. In order to achieve net zero emissions, Cambridge will need to work harder to ensure these actions are adopted completely and consider scale-jumping efforts to further accelerate emissions reductions through improvements to vehicle technologies and regional transportation policy. As with the building sector, the City will also need to consider if and when offsets would be used to achieve carbon neutrality in the transportation sector.

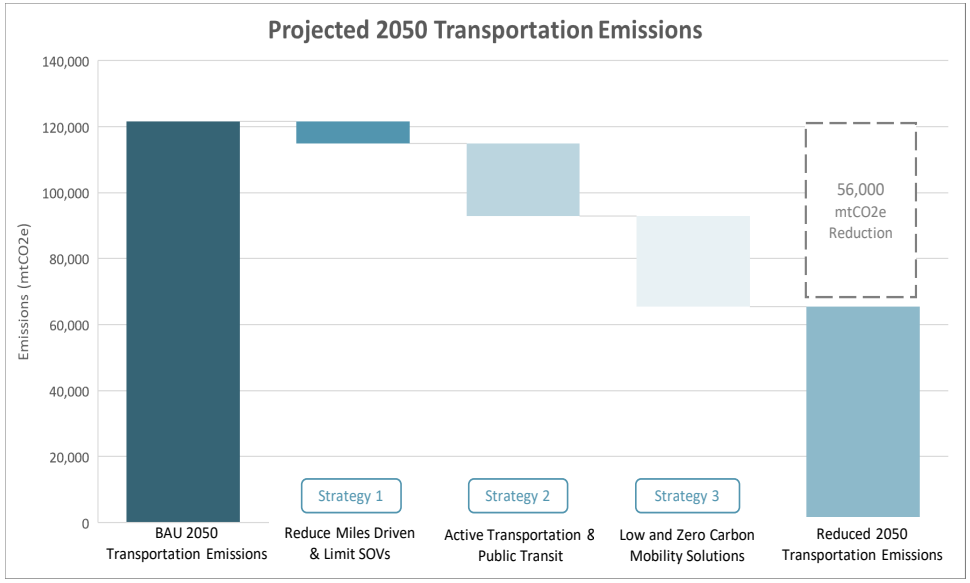


Fig. 12 **Projected Transportation Sector Emissions Reductions**

5.3.1 ACTIVE TRANSPORTATION AND PUBLIC TRANSIT

Cambridge already has high levels of public transit and active transportation (walking and biking) utilization. With increasing popularity of ride-hailing apps (Uber, Lyft, etc.), it is important that Cambridge maintain and increase the use of public transit and active transportation. The City can do so by promoting infrastructure, road design, facilities, and policies which both discourage private vehicle journeys and encourage active or shared/public transportation.

5.3.1.1 Develop a zero emissions transportation plan, addressing both mode shift and zero emissions vehicles

First and foremost, the City needs to study in detail and chart out a roadmap to dramatically reduce transportation emissions. This plan will focus on two major strategies, shifting to sustainable modes and planning for low and zero emissions vehicles. This plan will build upon the CAP actions, developing additional detail on implementation, scheduling/phasing, and the exact locations of infrastructure improvements. (Envision)

5.3.1.2 Formally adopt and communicate long-term mode shift targets

For estimation purposes, the CAP has assumed a significant mode shift away from private vehicles and toward walking, biking, and public transportation (private vehicle trips decrease from 43% in 2015 to 10% in 2050.) However, the City needs to formally adopt mode shift targets. Discrete targets will also allow the city to easily promote to its residents the goal, as well as track and communicate the progress.

5.3.1.3 Implement bus priority treatments on key bus corridors

An important part of encouraging public transit utilization is improving the rider experience. Priority bus treatments refers to a series of street design improvements and modifications which allow buses to run faster than regular traffic, as well as making the boarding/alighting and waiting experience safer and more welcoming. Bus-only lanes, signal priority for buses, and improved bus shelter design are some of the options which can achieve this. (Envision)

5.3.1.4 Collaborate with MBTA to support bus-only lanes, off-board fare payment, and all-door boarding on key corridors

Some of the changes to promote bus ridership listed in Action T3 could be implemented by the City alone. However, prioritizing buses (and bus riders) requires a detailed understanding of how buses run and how people use them. The MBTA tracks bus operation and ridership data and is an essential implementation partner. Additionally, changes such as off-board fare payment and all-door boarding require infrastructure changes (payment machines at street level) that the MBTA will need to implement. (Envision)

5.3.1.5 Increase funding to improve multimodal access to key public facilities

Certain public facilities in Cambridge attract a lot of visitors: public schools, libraries, parks, and the Charles River Esplanade, just to name a few. The City already encourages visitation to these facilities, but this should be complemented by promoting better multimodal access (such as protected bike lanes and enhanced/integrated bus drop off/pick-up areas and shelters). The City can lead by example with its own facilities, much as it has with reducing buildings emissions. (Envision)

5.3.1.6 Create a development impact fee to support multimodal infrastructure and safety improvements

Development impact fees paid by developers to offset the cost of infrastructure improvements exist throughout the country. The City of Cambridge can levy such fees and place a portion of the revenue in a reserve fund for multimodal infrastructure and safety improvements. Multimodal access not only benefits visitors, but is also linked to higher returns on investment for developments. (Envision)

5.3.1.7 Complete gaps in the Bicycle Network Plan and pedestrian network

The 2015 Bicycle Network Plan laid out a Network Vision, entailing road speed/traffic volume reductions, new off-street paths, and new separated bike lanes. Insofar as it is possible, the Vision should be implemented in full, prioritizing the implementation of links that "close the gaps" between existing bike lanes/paths. This will facilitate safe and comfortable mid-distance bicycle trips that will help shift people away from private vehicles and onto bicycles. (Envision)

5.3.1.8 InvestigateAdvocate for road pricing programs to manage congestion and encourage low carbon travel choices

One of the most effective ways to reduce congestion and limit private vehicle usage is through road pricing (also known as congestion pricing). Electronic toll gates can be set up at the "entry points" to the metropolitan core, with vehicles being charged a fee much in the same way they are charged to use the Massachusetts Turnpike. This would provide a financial incentive to choose low carbon travel choices, while also reducing congestion. Importantly, this strategy would need to be deployed at a regional scale in collaboration with surrounding cities and towns.

5.3.2 LOW AND ZERO CARBON MOBILITY SOLUTIONS

Acknowledging that private passenger vehicles will continue to play a role in Cambridge's transportation system, actions must be taken to ensure that these vehicles are low or zero carbon. Mostly, this consists of preparing both private and public infrastructure for the uptake of electric vehicles.

5.3.2.1 Mandate electric vehicle charging infrastructure for large-scale developments

For potential buyers of electric vehicles, one of the major barriers is not knowing how and where they will charge those vehicles; this is especially true for urban dwellers who rent apartments and/or do not have dedicated parking spaces. Much in the same way large-scale developments have accessibility requirements in their parking structures, electric vehicle charging infrastructure can be required which can be accessed by residents, employees, and/or visitors. (Envision)

5.3.2.2 Develop public electric vehicle charging infrastructure

Complementing the electric vehicle charging infrastructure in large-scale developments, the City's own parking lots can be retrofitted to provide publicly-accessible electric vehicle charging capability. It is easier to install charging infrastructure in parking lots than on the street. Additionally, the City may decide to repurpose curb space or otherwise discourage on-street parking in the future, so a focus on parking lots as opposed to curbside charging will afford the City more flexibility. (Envision)

5.3.2.3 Accelerate the electrification of the municipal fleet and phase out fossil fuel use

While the municipal fleet of vehicles, including Police and DPW vehicles, is small compared to the amount of vehicles owned privately throughout the city, it is important for the City to lead by example. Electrification of the municipal fleet, much like net zero municipal buildings, is one way in which the City can do this. It is also highly visible – the more electric vehicles that residents see, the more likely they are willing to consider one for themselves. (Green Fleet Policy)

5.3.2.4 Work with the Commonwealth to link vehicle registration fees to vehicle fuel efficiency

The Commonwealth already offers incentives for purchasing electric vehicles, such as the MOREV rebate. However, it can similarly offer disincentives for vehicles with lower fuel efficiency. Vehicle registration and inspection fees in Massachusetts are comparatively modest at $60 (biennial) and $35 (yearly). More significant fees could be adopted and linked to vehicle efficiency (and income, so as not to burden low income individuals). This change can be executed by the Governor/ Registry of Motor Vehicles, but would likely require legislative approval.

ACKNOWLEDGING THAT PRIVATE PASSENGER VEHICLES WILL CONTINUE TO PLAY A ROLE IN CAMBRIDGE'S TRANSPORTATION SYSTEM, ACTIONS MUST BE TAKEN TO ENSURE THAT THESE VEHICLES ARE LOW OR ZERO CARBON.

5.3.2.5 Continue to work with the MBTA to electrify transit fleets

MBTA buses and trains account for approximately 5% of transportation emissions in Cambridge. At present, the MBTA's fleet is predominantly comprised of diesel and compressed natural gas (CNG) vehicles, and only 3% electric buses. Cambridge has some overhead electric cables (from Harvard Station to Mass Ave) allowing for electric trackless trolley buses, but this system is not ideal for all roads. Cambridge, alongside Boston, Somerville, and other cities serviced by MBTA, can continue to advocate for a fully electrified bus and train fleet .

5.3.3 REDUCE MILES DRIVEN AND LIMIT SINGLE-OCCUPANCY VEHICLE TRIPS

Finally, while the remaining private vehicles in Cambridge will be targeted for electrification and increased fuel efficiency, a series of policy changes can help reduce the actual amount of miles driven by shortening trips, improving vehicle occupancy rates, and discouraging single-occupancy vehicle trips.

5.3.3.1 Promote Transit-Oriented Development for decreased travel distances to work, home, retail, and other services

Transit-Oriented Development (TOD) refers to concentrating development around transit nodes, generally accompanied with a mixture of uses; when housing, retail, offices, and public space are in the same area – and accessible by transit – unnecessary vehicle trips are removed. Cambridge is compact, dense, and rich with transit options, presenting the ideal built environment to continue promoting transit-oriented development. (Cambridge Growth Policy Document)

5.3.3.2 Work to expand PTDM programs and incentives citywide

Cambridge has a Parking and Transportation Demand Management (PTDM) Ordinance (1998), which requires non-residential developments over a certain size to encourage active, public and transportation options, and report on their success. Examples include subsidized MBTA passes, market-rate charging for employee parking, indoor bike parking and access to showers and lockers, and preferred parking for carpoolers low/zero emissions vehicles. These programs could be expanded to cover more developments, and the range of options expanded/modernized.

5.3.3.3 Lower parking requirements, especially near transit nodes and in key squares and corridors

For a city as dense as Cambridge, outfitted with excellent active and public transportation infrastructure, minimum parking requirements are largely unnecessary. Not only do they mandate infrastructure for private vehicles rather than discourage their use, they can increase the cost of construction and negatively impact housing affordability.

Parking requirements should be lowered, if not eliminated, especially near transit nodes. (Envision Cambridge)

5.3.3.4 Improve carpool ride-hailing as alternatives to single-occupancy vehicle trips

Carpooling is generally less popular and Cambridge has had difficulty promoting it in the past, but it does allow for more efficient use of private vehicles and lower emissions per passenger-mile. Ride-hailing services have the potential to shift trips away from active and public transportation, thus increasing the negative impacts associated with private passenger vehicles. However, if managed correctly, the "carpool" services offered by ride-hailing services (Uber Pool, Lyft Line, etc.) could reduce single-occupancy vehicle trips. A combination of incentives and mandates could encourage the utilization of these services .

5.4 WASTE

The waste sector contributes a relatively modest share of overall emissions, but it is a tangible topic that people interact with every day as waste is generated and decisions about where and how to dispose of it are made. Waste sector actions are extremely important for fostering a culture of reducing consumption and waste. Organics separation is especially important, as organics represent the bulk of waste sector emissions. In this section, Zero Waste Master Plan (ZWMP) actions are included, as well as some that are new to the CAP. The following graph illustrates the impact of each waste strategy and the resulting projected 2050 emissions for the waste sector.

The waste sector is particularly challenging for reducing GHG emissions, given the current rates of waste generation and population growth. Approximately 50,700 mtCO2e remain in 2050 after implementation of the strategies and actions recommended as part of the Climate Action Plan. It is extremely important that in applying these actions, Cantabrigians are aware of their reuse, recycling, and disposal options and ultimately take ownership and behave with a zero-waste mentality. Cambridge will need to continuously consider additional strategies and actions, including offsets.

WASTE SECTOR ACTIONS ARE EXTREMELY IMPORTANT FOR FOSTERING A CULTURE OF REDUCING CONSUMPTION AND WASTE, AND PROMOTING ENVIRONMENTAL ACTION AT A PERSONAL AND COMMUNITY LEVEL.

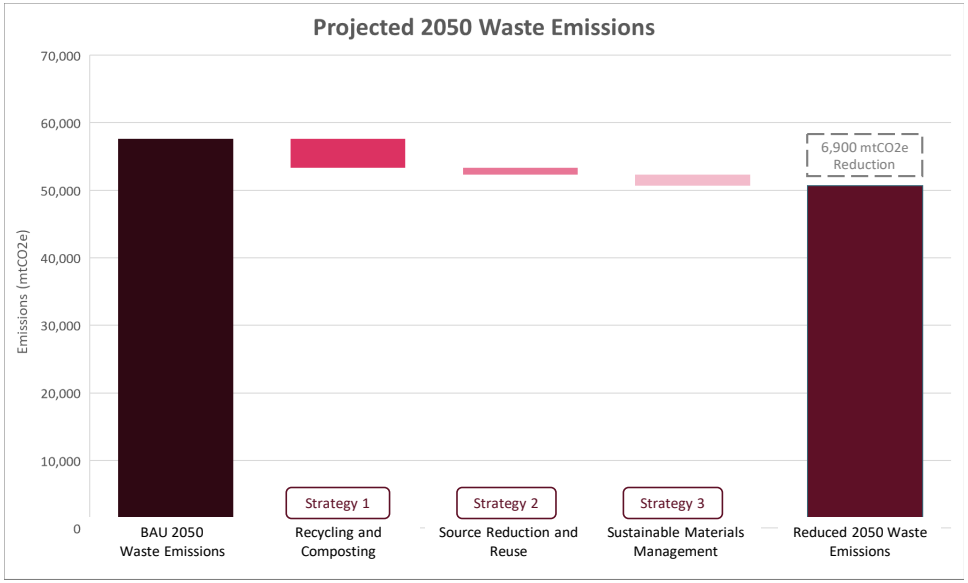


Fig. 13 **Projected Waste Sector Emissions Reducitons**

5.4.1 RECYCLING AND COMPOSTING

Enhanced communication, education and support structures could be implemented to encouraging residents to divert recyclable and compostable materials from the waste stream. This would reduce the amount of trash requiring disposal and reduce emissions associated with disposal of waste.

5.4.1.1 Implement a standard trash container

One of the challenges to successful waste disposal stems from waste containers and their varying designs and availability which becomes complicated by additional waste streams. To alleviate this, Cambridge should work to standardize waste containers, especially those for residential organic waste collection. The City should conduct a waste study to assess volume in residential buildings to understand effective container size and frequency of collection and work to roll-out these containers across Cambridge neighborhoods. (ZWMP)

5.4.1.2 Implement a hybrid pay-as-you-throw (PAYT) program

Volume-based pay-as-you-throw (PAYT) programs charge users for how much trash they throw out. Such programs incentivize reduced waste production and encourage users to think twice about what they throw away. As an intermediary to a full PAYT program, the City is considering a hybrid system that utilizes standard containers with special bags for excess trash for which users would pay to throw. The City should consider updating rates for organics, recyclables, and trash waste streams as a method to incentivize participating in other waste reduction programs and prompt community behavior change. (ZWMP and Envision)

5.4.1.3 Expand organics collection for residential and small commercial customers

The City of Cambridge has been diverting recyclables since the 1990s. Since organic waste makes up the largest share of the City's trash stream – and represents the largest proportion of waste sector emissions – expanding the organics diversion pilot is Cambridge's next big opportunity to reach its waste and GHG reduction goals. The City has recently rolled out a full-scale program for residential and small commercial customers by providing curbside green bins for organics collection. (ZWMP and Envision)

5.4.1.4 Mandate and enforce residential front-of-house food waste diversion

To build upon the Cambridge residential curbside organics collection program, the City should begin to mandate organics collection for residential customers. Through a front-of-house food waste diversion program, the City can address gaps in the state's mandate to divert organics (which largely applies to back-of-house operations), and ensure that these customers are properly collecting and disposing of organics with an easy curbside collection structure. This program would

IN ADDITION TO IMPROVING THE DIVERSION OF WASTE INTO APPROPRIATE RECYCLING AND COMPOSTING STREAMS, EMISSIONS REDUCTIONS CAN ALSO BE ACHIEVED BY REDUCING CONSUMPTION.

also support the introduction of biweekly trash collection by requiring the separation of organic and inorganic waste. (ZWMP and Envision)

5.4.1.5 Mandate and enforce small commercial food waste diversion

Similarly to residential front-of-house food waste diversion, small commercial buildings, including restaurants and small grocery stores, should be targeted for a food waste diversion program. It is important that smaller commercial facilities, in addition to large commercial and residential buildings, are properly collecting and disposing of organics with east curbside collection. (ZWMP and Envision)

5.4.1.6 Require building-scale waste prevention and management plans

Waste diversion starts with the individual and the City should allocate resources to helping building owners and managers develop building-scale waste prevention and management plans. Not only can these plans help to reduce waste production in buildings, they can help to educate and inform the wider community on smarter waste decisions. (Envision)

5.4.1.7 Maximize recycling rates across all sectors by stepping up education and enforcement

Cambridge has ample trash and recycling bins and supporting waste collection structure to meet the City's goals. The limiting factor to success is utilization of these services. Within the City commercial customers are required to separate recycling waste but the City lacks an enforcement agency to ensure these requirements are being met. The City should not only verify that these City regulations are being successfully adopted through enforcement by hiring a compliance officer, but should also advocate for waste diversion with increased education and learning opportunities for community members. For a successful waste management plan, the City needs well-educated community members that are held accountable for their contributions. (Envision)

5.4.1.8 Implement a mattress recycling program

The Coalition for the Homeless collects usable mattresses and furniture items in Cambridge. Given the transient student population in Cambridge, surplus volume is a consideration in meeting zero waste goals. In the short term, the City should continue with the bulky waste collection program while monitoring annual volume of mattresses disposed by hotels, residences, and student dormitories. Based on annual volumes and the cost effectiveness of recycling, the City can either contract vendors to collect mattresses, or establish a collection and storage facility for mattress foam and bed frames that can be diverted to the appropriate recycling facilities. (ZWMP)

5.4.1.9 Implement textile collection and

recycling

In addition to donating and reusing clothes, recycling other textiles (including curtains, blankets, stuffed toys and other fabric products) can significantly reduce landfill waste. In addition to the exiting donation and drop-off facilities managed by non-profits, the City can pilot curbside collection for textiles alongside the existing residential recyclable collection. Collected materials could be diverted to a recycling center or to manufacturers that reuse textiles. (ZWMP)

5.4.2 SOURCE REDUCTION AND REUSE

In addition to improving the diversion of waste into appropriate recycling and composting streams, emissions reductions can also be achieved by reducing consumption.

5.4.2.1 Support sharing libraries

Sharing libraries can help the City of Cambridge accelerate its efforts towards reducing GHG emissions through a community-oriented network of borrowing and renting that outshines typical patterns of buying and consuming. Sharing libraries can house many types of goods from tools and materials to clothes and appliances. These centers not only reduce waste and emissions associated with the production of new goods but decrease the burden on existing landfills. Cambridge should work to maintain its current sharing libraries and expand to incorporate the network of sharing libraries through incentives and programs with community organizations, non-profits, traditional libraries, as well as building owners. (ZWMP)

5.4.2.2 Support reuse events

Reuse events can significantly reduce material consumption in Cambridge by encouraging the purchase of recycled goods through easily accessible events and community engagement. These events are an endless opportunity for the City and other partnering organizations to hold garage sales, swap events, and curbside giveaways. DPW should maintain and expand the offering of such events, which could include seasonal collective sale events throughout Cambridge. Not only could these events encourage product reuse but they could act as a platform for repairing, exchanging, and redistributing used materials to charities, recyclers, art suppliers, and other organizations. (ZWMP)

5.4.2.3 Explore opportunities for waste exchange, including a Resource Recovery Center

In addition to scheduled reuse events, DPW should establish permanent waste exchange centers for the purpose of collecting used materials throughout the year. Providing the community a go-to location for all used items can significantly increase usership and awareness. Beyond a City-organized Resource Recovery Center, DPW could

support and build upon existing donation centers, whether general or specific material collectors, and inform the community of the suite of drop-off locations across Cambridge. (ZWMP and Envision)

5.4.2.4 Develop a food waste reduction strategy

In the effort to reduce food waste, the City of Cambridge has a robust food rescue program for commercial waste collection as well as food donation centers throughout the City. Not to mention, the City has previously piloted a curbside composting program for residences. To enhance these programs, the City should work to provide support and incentives for Cambridge business and community members and reward those who are leading the effort. For instance, the City should consider tax deductions to business that donate fresh food, roll out a voluntary program for collecting and separating food waste to support food waste management, and enforce food waste separation at commercial institutions in Cambridge. This action will likely require a study in the short term, to be followed by program implementation. (ZWMP and Envision)

5.4.3 SUSTAINABLE MATERIALS MANAGEMENT

Finally, Cambridge can become a national leader in considering the full waste stream, from "cradle to grave," by diverting additional materials and engaging in lifecycle assessments. These actions, from the ZWMP, will also indirectly help reduce the city's Scope 3 (indirect) emissions.

5.4.3.1 Advocate for State-wide Extended Producer Responsibility (EPR) programs and policies

In order to manage materials that are difficult to collect, process, or divert, the City should advocate for the Commonwealth to introduce Extended Producer Responsibility (EPR) – a policy under which producers are tasked with the responsibility (financial or operational/physical) of treatment and disposal of post-consumer products (currently waste). Stewardship programs can target disposal for electronic waste, appliances, mattresses, carpets, pharmaceutical drugs, and even packaging materials. (ZWMP)

5.4.3.2 Implement lifecycle assessment for municipal purchasing

Based on municipal solid waste generation, DPW should conduct a lifecycle assessment study of municipal assets which lead to high volumes of waste, such as office furniture. This study can help the City improve its own material procurement and waste disposal policies, setting an example for other business owners in the City. (ZWMP)

THE PATH TO A CARBON NEUTRAL CAMBRIDGE

THE CLIMATE ACTION PLAN IS MUTUALLY REINFORCING OF OTHER PLANNING EFFORTS INCLUDING ENVISION CAMBRIDGE, THE CLIMATE CHANGE PREPAREDNESS AND RESILIENCE PLAN, AND OTHER INITIATIVES THAT SEEK TO ACHIEVE SUSTAINABLE, RESILIENT, AND EQUITABLE OUTCOMES FOR ALL CANTABRIGIANS.

This Climate Action Plan represents the policy roadmap for Cambridge to address its largest sources of emissions and set itself on a path to becoming a carbon neutral city. Achieving the goal will require dedicated effort, commitment of City resources, and full engagement of and participation from residents, businesses, institutions, and organizations throughout the City, as well as political will to continue supporting deep carbon reductions, especially as the City begins to pluck the last of the low-hanging fruit and moves towards more demanding climate actions. While the Climate Action Plan is primarily focused on the largest measurable sources of emissions within Cambridge, the Climate Action Plan is also mutually reinforcing of other planning efforts including Envision Cambridge, the Climate Change Preparedness and Resilience Plan, and other initiatives that seek to achieve sustainable, resilient, and equitable outcomes for all Cantabrigians.

Throughout the development of the Climate Action Plan, several actions were mentioned which have an indirect impact on emissions or are otherwise difficult to quantify. For instance, it was suggested that the City address the energy-water nexus by expanding its water conservation program and studying greywater supply assets and non-potable demand. Natural resources were also considered by way of requiring green space to be built as part of new development and major renovations, and incorporating green infrastructure into city sidewalk and street reconstruction projects as conditions and space allow. The City is currently developing an urban forest master plan, and it was recommended that it study the potential for high albedo pavement and warm mix asphalt to reduce the heat island effect. While these actions cannot be tied directly to measurable GHG emissions and are not specifically called out in this plan they are nonetheless important improvements for Cambridge's built environment.

The City of Cambridge will continue to utilize the best available data, information, and knowledge, which includes updating the community-wide GHG inventory as well as revisiting this Climate Action Plan at least every five years. Cambridge will continue to track the evolving discussion around inventory methodologies, including consumption-based emissions and other methods to track Scope 3 emissions. This would include a survey of best practices related to green purchasing policies and lifecycle carbon assessment for municipal purchasing. Additionally, advancements in technology and changes in the policy landscape may also present new opportunities for climate action, which will be evaluated on an ongoing basis. Likewise, the City will closely monitor the protocols related to carbon offsets, which may be required to achieve carbon neutrality.

Along these lines, Cambridge will adopt a flexible mindset in order to ensure carbon neutrality can be realized. In the case that the actions listed in this report are not as successful as initially conceived, Cambridge will reevaluate their inclusion in the Climate Action Plan and will enact new actions to

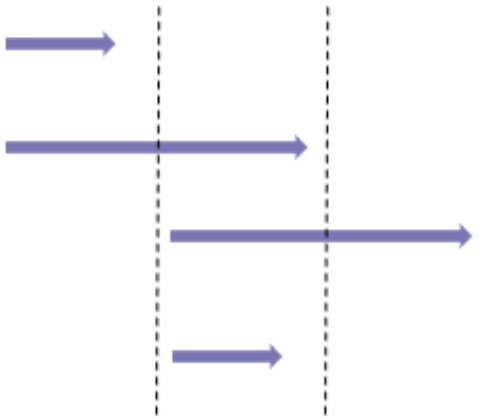
get back on track. Where carbon emissions cannot be reduced, carbon offsets would need to be incorporated. Ideally, offsets will be minimal, but it is likely that some emissions will be difficult to mitigate and the City should be prepared to invest in meaningful offsets that help to meet its goals.

Challenges aside, the City has tremendous assets at its disposal, including world-renowned universities, an innovative private sector, and residents with immense local knowledge and experience with realizing ambitious environmental visions. This report is being led by the City of Cambridge, but it belongs to all Cantabrigians – and we are all needed to realize its vision.

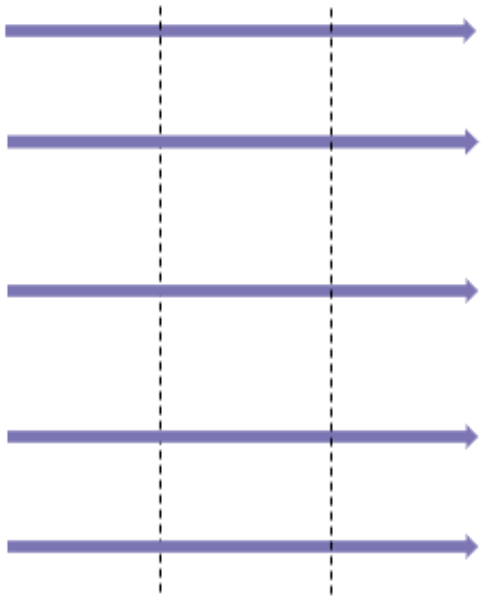
IMPLEMENTATION PLAN

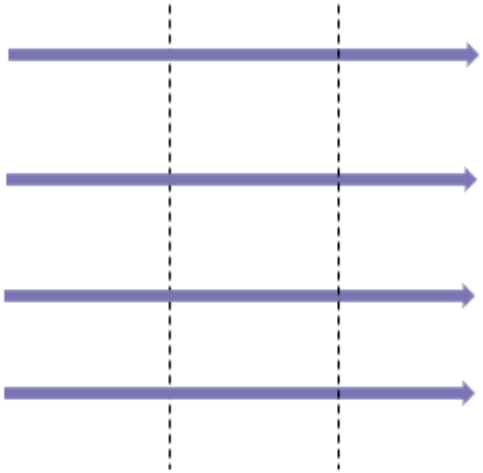
The actions within this Climate Action Plan can only be effective if they are properly managed, with clear roles and responsibilities, funding and resources. The implementation matrix on the following pages regroup all actions identified in Section 5 for Buildings, Transportation and Waste and outline an implementation plan taking into account:

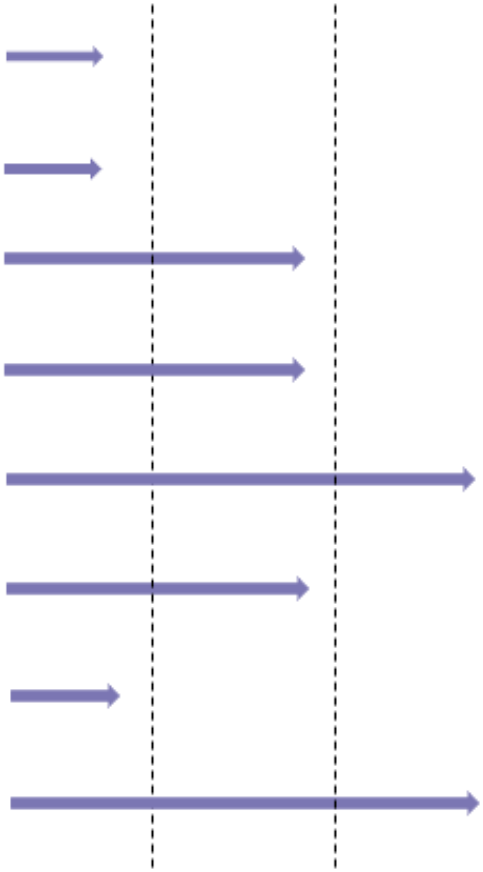
- The timeframe (short, mid, or long term for initial implementation and continuation of the action)
- The responsible agency
- The key partners that will be engaged by the lead agency
- The funding requirements, relative to each sector (buildings, transportation, waste)
- The estimated GHG impacts
- The matrix is presented in the pages that follow, by sector.

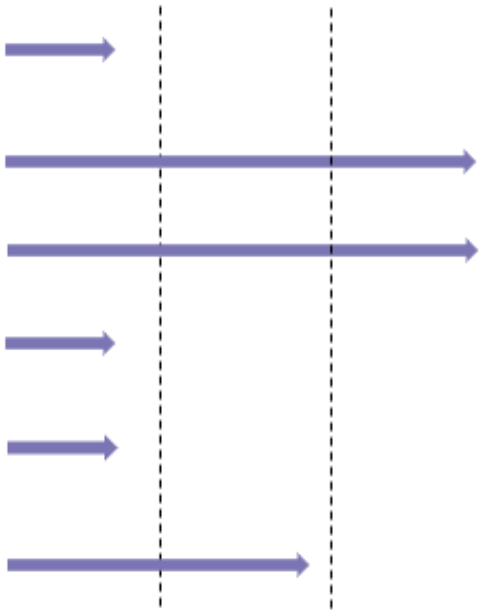
ENERGY EFFICIENCY IN EXISTING BUILDING	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.2.1.1 Explore the development of a custom retrofit program that expands on current utility retrofit incentives.	NZAP Action 1.1.1		CDD	
5.2.1.2 Introduce additional requirements to BEUDO	NZAP Action 1.1.2		CDD	
5.2.1.3 Explore requirement for energy upgrades at the time of a renovation or sale	NZAP Action 1.1.3		CDD	
5.2.1.4 Require energy management plans detailing new building operations and maintenance	NZAP Action 1.1.4		CDD	

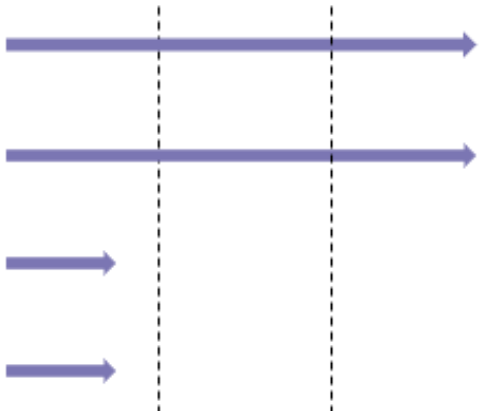
NET ZERO NEW CONSTRUCTION	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.2.2.1 Create net zero targets for new construction	NZAP Action 2.1		CDD	
5.2.2.2 Develop a market based incentive program	NZAP Action 2.2.1		CDD	
5.2.2.3 Explore the impact of offering additional floor area allowance and height allowance to projects that achieve net zero emissions	NZAP Action 2.2.2 Envision Cambridge		CDD	
5.2.2.4 Increase Green Building Requirements in Cambridge Zoning Ordinance	NZAP Action 2.2.3		CDD	
5.2.2.5. Require net zero construction or 'net zero ready' for new City-owned buildings	NZAP Action 2.4.1		CDD	
5.2.2.6 Require deep energy efficiency retrofits for City-owned buildings undergoing major renovation	NZAP Action 2.4.2		CDD	
5.2.2.7 Remove barriers to increased insulation	NZAP Action 2.5.1		CDD	
5.2.2.8 Establish regulations and design guidelines for new buildings and re-developments to be resilient to future heat risks	Climate Change Preparedness & Resilience Plan		CDD	
5.2.2.9 Establish a cool roof requirement for new construction (compatible with solar-ready)	Climate Change Preparedness & Resilience Plan		CDD	

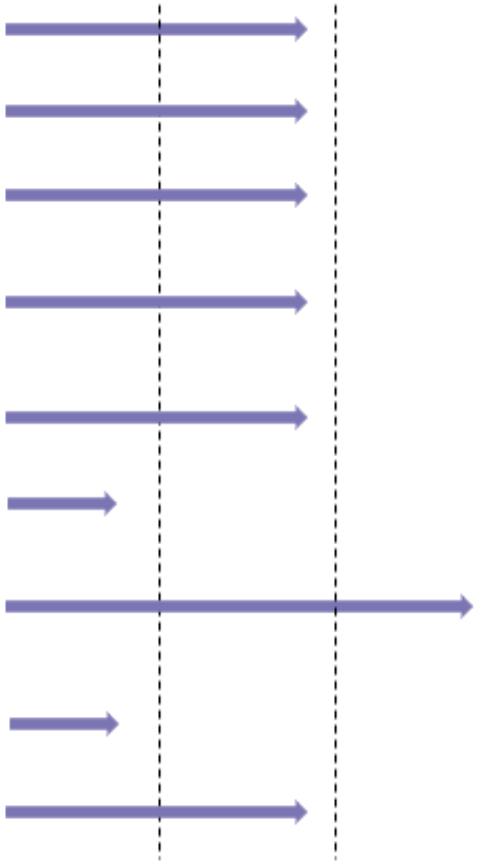
LOW CARBON ENERGY SUPPLY	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.2.3.1 Create and enact a low carbon energy supply strategy	NZAP Action 3.1		CDD	
5.2.3.2 Introduce a requirement for onsite renewable energy generation with a focus on rooftop solar	NZAP Action 3.2		CDD	
5.2.3.3 Develop a memorandum of understanding with local utilities to work closely with the City on taking action towards net zero emissions	NZAP Action 3.3		CDD	
5.2.3.4 Support the purchasing of sustainable power with a community electricity aggregation program	Cambridge Community Aggregation		CDD	
5.2.3.5 Procure 100% of municipal electricity from renewable energy sources	Envision Cambridge		CDD, DPW	

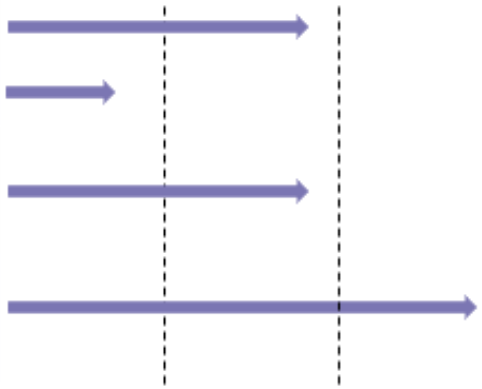
LOCAL CARBON FUND & ENGAGEMENT AND CAPACITY BUILDING	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.2.4.1 Undertake feasibility study and solicit a third-party organization to administer a local carbon fund	NZAP Action 4.1		CDD	
5.2.4.2 Develop a long-term communications strategy around the Cambridge Net Zero objective	NZAP Action 5.1		CDD	
5.2.4.3 Develop on-going capacity to manage the Net Zero Action Plan	NZAP Action 5.2		CDD	
5.2.4.4 Engage with stakeholders to develop new standards for lab operations that support lower energy use	NZAP Action 5.3		CDD	

ACTIVE TRANSPORTATION AND PUBLIC TRANSIT	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.3.1.1 Develop a zero emissions transportation plan, addressing both mode shift and zero emissions vehicles	Envision Cambridge		CDD, T,P&T	
5.3.1.2 Formally adopt and communicate long-term mode shift targets	Envision Cambridge		T,P&T	
5.3.1.3 Implement bus priority treatments on key bus corridors	Envision Cambridge		CDD, DPW, T,P&T	
5.3.1.4 Collaborate with MBTA to support bus-only lanes, off-board fare payment, and all-door boarding on key corridors	Envision Cambridge		CDD, DPW	
5.3.1.5 Increase funding to improve multimodal access to key public facilities	Envision Cambridge		CDD	
5.3.1.6 Create a development impact fee to support multimodal infrastructure and safety improvements	Envision Cambridge		CDD, T,P&T	
5.3.1.7 Complete gaps in the Bicycle Network Plan and pedestrian network	*New*		CDD, T,P&T	
5.3.1.8 Investigate travel pricing programs to reduce VMT, manage congestion and encourage low carbon travel choices	*New*		CDD, T,P&T	

LOW AND ZERO CARBON MOBILITY SOLUTIONS	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.3.2.1 Develop a zero emissions transportation plan, addressing both mode shift and zero emissions vehicles	Envision Cambridge		CDD, T,P&T	
5.3.2.2 Mandate electric vehicle charging infrastructure for large-scale developments	Envision Cambridge		CDD	
5.3.2.3 Develop public electric vehicle charging infrastructure	Envision Cambridge		CDD	
5.3.2.4 Accelerate the electrification of the municipal fleet and phase out fossil fuel use	Fleet Plan		CDD	
5.3.2.5 Work with the Commonwealth to link vehicle registration fees to vehicle fuel efficiency	*New*		CDD	
5.3.2.6 Continue to work with the MBTA to electrify transit fleets	*New*		CDD	

REDUCE VEHICLE MILES TRAVELED AND SINGLE OCCUPANCY VEHICLES	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.3.3.1 Promote Transit-Oriented Development for decreased travel distances to work, home, retail, and other services	Cambridge Growth Policy		CDD	
5.3.3.2 Work to expand PTDM programs and incentives citywide	Envision Cambridge PTDM Ordinance		CDD	
5.3.3.3 Lower parking requirements, especially near transit nodes and in key squares and corridors	Envision Cambridge		CDD	
5.3.3.4 Improve carpooling and ridesharing as alternatives to single occupancy vehicle trips	*New*		CDD	

RECYCLING AND COMPOSTING	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.4.1.1 Implement a standard trash container	Zero Waste Plan		DPW	
5.4.1.2 Implement a 'hybrid' pay-as-you-throw (PAYT) program	Zero Waste Plan		DPW	
5.4.1.3 Expand organics collection for residential and commercial customers	Zero Waste Plan Envision Cambridge		DPW	
5.4.1.4 Mandate and enforce residential and restaurant front-of-house food waste diversion	Zero Waste Plan Envision Cambridge		DPW	
5.4.1.5 Mandate and enforce small commercial food waste diversion	Zero Waste Plan Envision Cambridge		DPW	
5.4.1.6 Require building-scale waste prevention and management plans	Envision Cambridge		DPW	
5.4.1.7 Maximize recycling rates across all sectors by stepping up education and enforcement	Envision Cambridge		DPW	
5.4.1.8 Implement a mattress recycling program	Zero Waste Plan		DPW	
5.4.1.9 Implement textile collection and recycling	Zero Waste Plan		DPW	

SOURCE REDUCTION AND REUSE	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.4.2.1 Support sharing libraries	Zero Waste Plan		CDD	
5.4.2.2 Support reuse events	Zero Waste Plan		CDD	
5.4.2.3 Explore opportunities for waste exchange, including a Resource Recovery Center	Zero Waste Plan Envision Cambridge		CDD	
5.4.2.4 Develop a food waste reduction strategy	Zero Waste Plan Envision Cambridge		CDD	

SUSTAINABLE MATERIALS MANAGEMENT	RELATED PLAN OR POLICY	TIMEFRAME 1-4 YEARS 4-10 YEARS 10+ YEARS	RESPONSIBLE AGENCY	KEY PARTNERS
5.4.3.1 Advocate for State-wide Extended Producer Responsibility (EPR) programs and policies	Zero Waste Plan		DPW	
5.4.3.2 Implement lifecycle assessment for municipal purchasing	Zero Waste Plan		CDD, Purchasing	

APPENDIX A SETTING THE CLIMATE TARGET

Across the world, cities have committed to different GHG reduction targets. There are three main carbon reduction targets: 80x50, Carbon Neutrality (100x50), and Climate Positive. The City of Cambridge is a leader in both thought and practice in climate action, and is seeking a carbon reduction goal that reflects a position of leadership. In this section, the different GHG reduction targets/definitions are presented, alongside the rationale for the city's adopted target: carbon neutrality, or 100% reduction by 2050.

8.1 80 x 50

Scientific studies featured in the IPCC Fourth Assessment Report (2007) indicate that to have a reasonable chance of limiting global warming to 2°C above preindustrial levels, we must stabilize the concentration of heat-trapping greenhouse gases in the atmosphere at or below 450ppm CO2e equivalent. With the signing of the Paris Agreement in December 2015, 195 nations agreed to limit global temperature increase to no more than 2°C above pre-industrial levels. This implies that industrialized nations will have to reduce their emissions an average of 70 to 80 percent below 2000 levels by 2050.

Pursuant to this, the Carbon Neutral Cities Alliance (CNCA, formed in Copenhagen in June 2014) is a collaboration of leading global cities working to cut greenhouse gas emissions by 80% or more by 2050 ("80x50") to ensure that cities are contributing to this vital global effort. Setting an aggressive GHG reduction target, member cities seek to address how leading cities can achieve these deep emissions reductions and how they can work together to meet their goal.

8.2 Carbon Neutrality (100x50)

The widely-accepted definition of "carbon neutrality" is from the CNCA: the "net greenhouse gas emissions associated with a city is zero," or 100x50. To achieve this status, CNCA defines associated goals that its member cities have set, such as being "fossil-fuel free" or having a "100% renewable energy supply." Some cities have adopted this goal as strictly applying to an electricity generation target, while others intend it to be for all energy sources powering activities within their boundaries.

For example, Stockholm's goal of being "fossil-fuel free by 2050" refers to "the energy used within the geographical boundary." This involves meeting the energy needs for Transportation, heating, and electricity with renewable sources. The definition excludes embodied energy and other Scope 3 emissions such as agriculture, forestry, and land use-related GHG emissions. This 100% reduction by 2050 of Scope 1 and Scope 2 emissions is known as 100x50.

Achieving net zero emissions requires substantial structural, economic and policy changes in order to drive an increase in energy efficiency, a decrease in the use of carbon intensive fuel sources, and reductions from other waste sources such as methane and nitrogen dioxide. Due to physical limitations (e.g. lack of available land for renewable energy generation) and jurisdictional challenges (e.g. decisions affecting energy supply and transportation systems that are made at a national or state/regional level), cities typically have to offset some remaining emissions in order to be achieve carbon neutrality.

Thus, in addition to deep decarbonization measures, CNCA also recommends achieving carbon neutrality by generating excess renewable energy and providing it to consumers outside the geographical boundary of the city (e.g., Copenhagen) and/or purchasing carbon offsets (e.g., Melbourne).

8.3 Climate Positive

"Climate Positive" refers to having net-negative carbon emissions, addressing the three main sources of operational carbon emissions: energy, waste, and transportation. This can only be achieved by providing excess renewable power to the grid or excess heating/cooling energy to neighboring geographies.

Developed by C40's Urban Planning and Development Initiative, the certification process for climate positive development projects at the district-scale ensures that at project completion, the emissions profile of the development is net-negative, with continual monitoring and submission of energy consumption and emissions reports to C40.

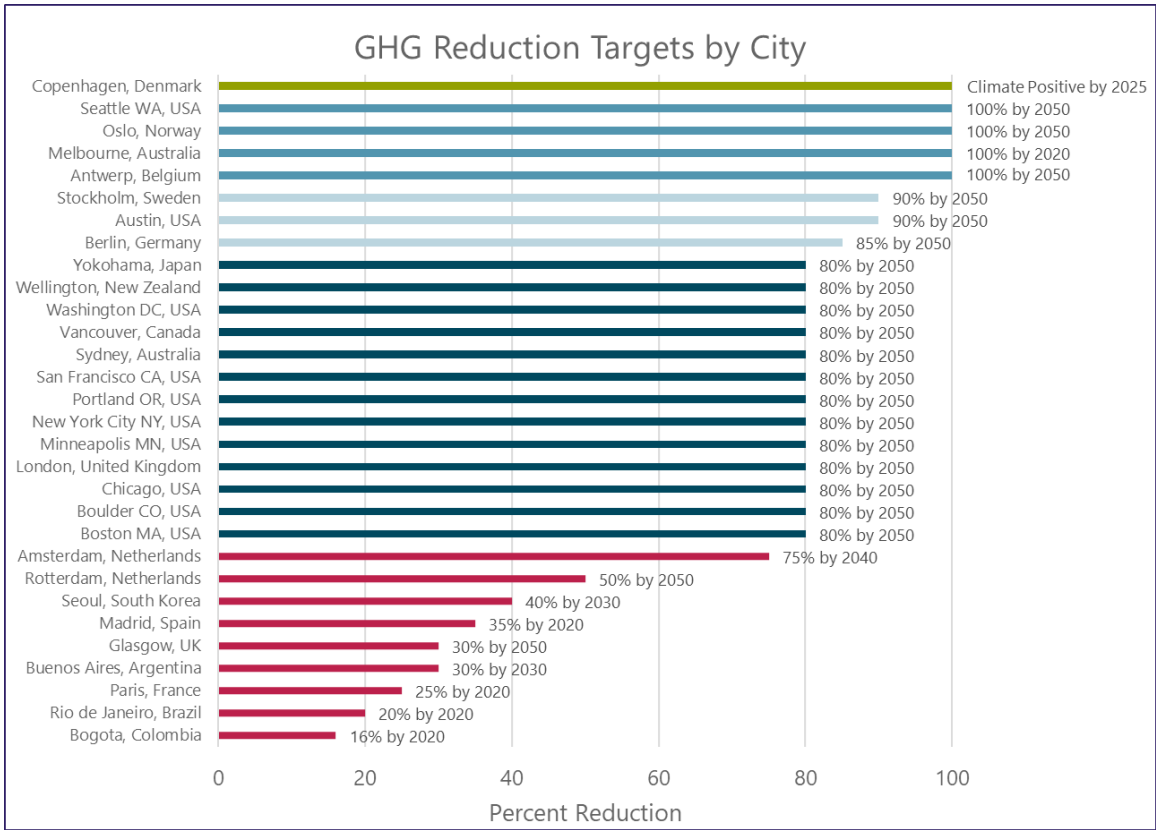
Climate Positive is a designation that applies to individual developments or district developments. In theory, a city could produce enough renewable energy within its borders to supply excess energy to other cities; however, few cities have enough land resources available for renewable energy generation. Cities with climate positive aspirations have unique geographic opportunities such as off-shore wind, hydropower, geothermal, or local biomass resources.

8.4 Global Comparisons

The chart below provides a comparison of carbon reduction targets/timelines for 30 global cities, which are affiliated with C40, the Global Covenant of Mayors (GCoM), and/or the CNCA. Most of these cities have adopted 80x50 targets. The list also includes cities that have set intermediary goals to be met by 2025 or 2030.

The majority of cities listed above have set a target of 80x50, or have gone beyond this target for a 100% reduction (CNCA-defined carbon neutrality) by 2050, such as Seattle and Oslo. Copenhagen, with its unique and vast offshore wind resources, is aiming to be Climate Positive by 2025, but thus far stands alone.

In May 2015, with Cambridge as a founding member, the Metropolitan Mayors Coalition (MMC) adopted the Metro Boston Climate Preparedness Commitment, which sets a regional target of achieving net zero/ carbon-free status by 2050.



8.5 Cambridge: Carbon Neutrality (100x50)

The City of Cambridge and the CPAC have established a target that reflects Cambridge's position as a progressive leader in municipal climate action – 100x50. This also aligns with the MMC's regional commitment to become "carbon-free" by 2050.

Given the substantial structural, economic and policy changes required for deep decarbonization, the City should consider having a portion of energy consumption offset by off-site renewable energy generation or similarly-certified offset credits (refer to the following section).