

Roadmap for Carbon Free Boston

Introduction

The City of Boston has pledged to be carbon neutral by 2050, with interim goals of a 25 and 50 percent reduction by 2020 and 2030, respectively, relative to a 2005 baseline. As part of its mitigation effort, the City is collaborating with the Green Ribbon Commission (GRC) and Boston University's Institute for Sustainable Energy (ISE) and Department of Earth and Environment (E&E) to produce a *Carbon Free Boston* report in 2018. This report will quantify the most effective combination of technologies and policies to reduce greenhouse gas (GHG) emissions across the energy, buildings, transportation, and waste sectors. *Carbon Free Boston* will also inform the GHG strategies that will be articulated in the City's *Climate Action Plan Update* that will be released in 2018.

Producing the *Carbon Free Boston* Report

The *Carbon Free Boston* report will result from a large, collaborative effort (Figure 1). The lead organizations are the City of Boston, the GRC, and Boston University's ISE and E&E. Their work is guided by a Steering Committee, Technical Advisory Groups, and Implementation Advisory Groups. Technical consultants and staff of the ISE will perform the quantitative work that underlies the *Carbon Free Boston* report.

The work behind the *Carbon Free Boston* report will generate four distinct "outputs" or "products." Parties contributing to the project will play various roles in each product category (Figure 2). The foundation of the technical work is a modeling platform with individual models for the electric power, transportation, buildings and waste sectors (Figure 3). Sector models will generate scenarios of energy use and GHG emissions based on combinations of policy choices (Exhibit A). An integrating model will pull together sector results to produce a coherent "big picture" for the City as a whole. The model outputs are scenarios of energy use and GHG emissions given inputs of different policy packages. The model results will lead to specific policy recommendations to the City, which will then define the path of implementation.

Steering Committee

The Steering Committee provides strategic operational direction for the *Carbon Free Boston* project. The Steering Committee will include individuals in leadership capacities from City, the Commonwealth, the GRC, the ISE, and from funders of the project. The Scope of Work for the Steering Committee is included as Exhibit B.

The City of Boston

The City has multiple Departments whose responsibilities intersect with GHG mitigation. The Cabinet of Environment, Energy and Open Space (EEOS) manages many of the City's

environmental resources, many of its activities that generate GHG emissions, and communication regarding sustainability. Within the EEOS Cabinet, the Environment Department oversees the protection of the City’s air, water, climate, and land resources. The Environment Department also maintains the City’s GHG inventory. The Public Works Department constructs and maintains the City’s roadways and streetlights, and manages the City’s solid waste and recycling programs. The Boston Planning & Development Agency (BPDA) is the planning and economic development agency for the City, and thus connects to GHG mitigation through multiple channels, including land use and the size, density, and composition of the building stock. The Transportation Department oversees traffic management and planning, street lighting, parking, biking and pedestrian infrastructure.

Institute for Sustainable Energy, Boston University

Boston University’s Institute for Sustainable Energy is a University-wide institute that assists and promotes faculty research, and enhances BU’s curricular offerings and communication products related to sustainable energy. The ISE is the technical coordinating lead in the development of a modeling platform that will identify a set of policies and technologies that effectively and efficiently meet the City’s emissions reductions targets. In that role, the ISE will coordinate the work of consultants, staff working with the City and the Commonwealth, academics, and others with expertise in specific sectors.

Department of Earth and Environment, College of Arts and Sciences, Boston University

The mission of the Department of Earth and Environment is to understand a changing Earth, its relationships with humankind, and to develop strategies for a sustainable future. A central, overarching theme in the Department is climate science, which represents the defining and unifying earth and environmental science issue of the 21st century. The Department has three major research areas: Earth System Sciences, Coupled Human and Natural Systems, and Remote Sensing and Geospatial Sciences. Undergraduate students can earn Bachelor’s degrees in Earth and Environmental Science, Environmental Analysis and Policy, Geophysics and Planetary Sciences, and Marine Science. The Department emphasizes the integration of teaching and research in the classroom and by including undergraduates in faculty research. The Department’s professional Master’s programs engage students with the foundational principles, analytical skills, and professional competencies that prepare them for careers in the private, public, and non-profit sector.

Green Ribbon Commission

The Boston Green Ribbon Commission is a group of business, institutional, and civic leaders in Boston working to develop shared strategies for fighting climate change in coordination with the City’s *Climate Action Plan*. The GRC established the Carbon Free Boston Working Group to advise and collaborate with the City and the ISE in the development of the *Carbon Free Boston*

report that will be completed in 2018. The charter and membership of the Carbon Free Boston Working Group is included as Exhibit C.

Technical Consultants

The ISE will manage technical consultants in the transportation and buildings sectors. The ISE consultants have subject matter expertise and experience with energy systems analysis, GHG avoidance calculations, and various economic valuation methods. Consultants will iteratively analyze specific GHG reduction strategies, separately and in bundles, identified by the ISE and the City for their impact on energy use and GHG emissions in transportation between now and 2050 (Figure 4). Technical analysis in the waste and energy sectors will be done by ISE staff.

Advisory Groups

Technical Advisory Groups (TAGs)

Individual TAGS will provide strategic advice on the development and application of the quantitative models in the energy, waste, buildings, and transportation sectors. The TAGS will (i) insure that the structure, techniques, and data that underlie the models are state-of-the-art; (ii) identify relevant studies performed or underway in other urban areas, and which results from those studies are relevant; (iii) identify the key polices to be investigated, (iv) identify key connections and feedbacks among sectors; and (iv) provide an open and transparent forum to discuss issues related to the reduction of GHG emissions in each sector. The Scope of Work for the TAGs is included as Exhibit D.

Policy Advisory Committees (PAGs)

Individual PAGS will provide feedback to the City regarding the most suitable ways to implement the GHG mitigation strategies identified by the technical analysis. The PAGs will include community members, NGOs related to energy and sustainability, local business owners, public interest groups, industry, developers, educational institutions, and faith-based groups, to name just a few. The City will oversee the engagement of this group of stakeholders.

Project Timeline

The Carbon Free report will take approximately one year to complete; the final report will be produced by August 1, 2018. This schedule will enable the City to use the report as input to its *Climate Action Plan Update* that will be released in late 2018. A detailed work plan is shown in Figure 5.

FIGURE 1 Parties involved in *Carbon Free Boston*

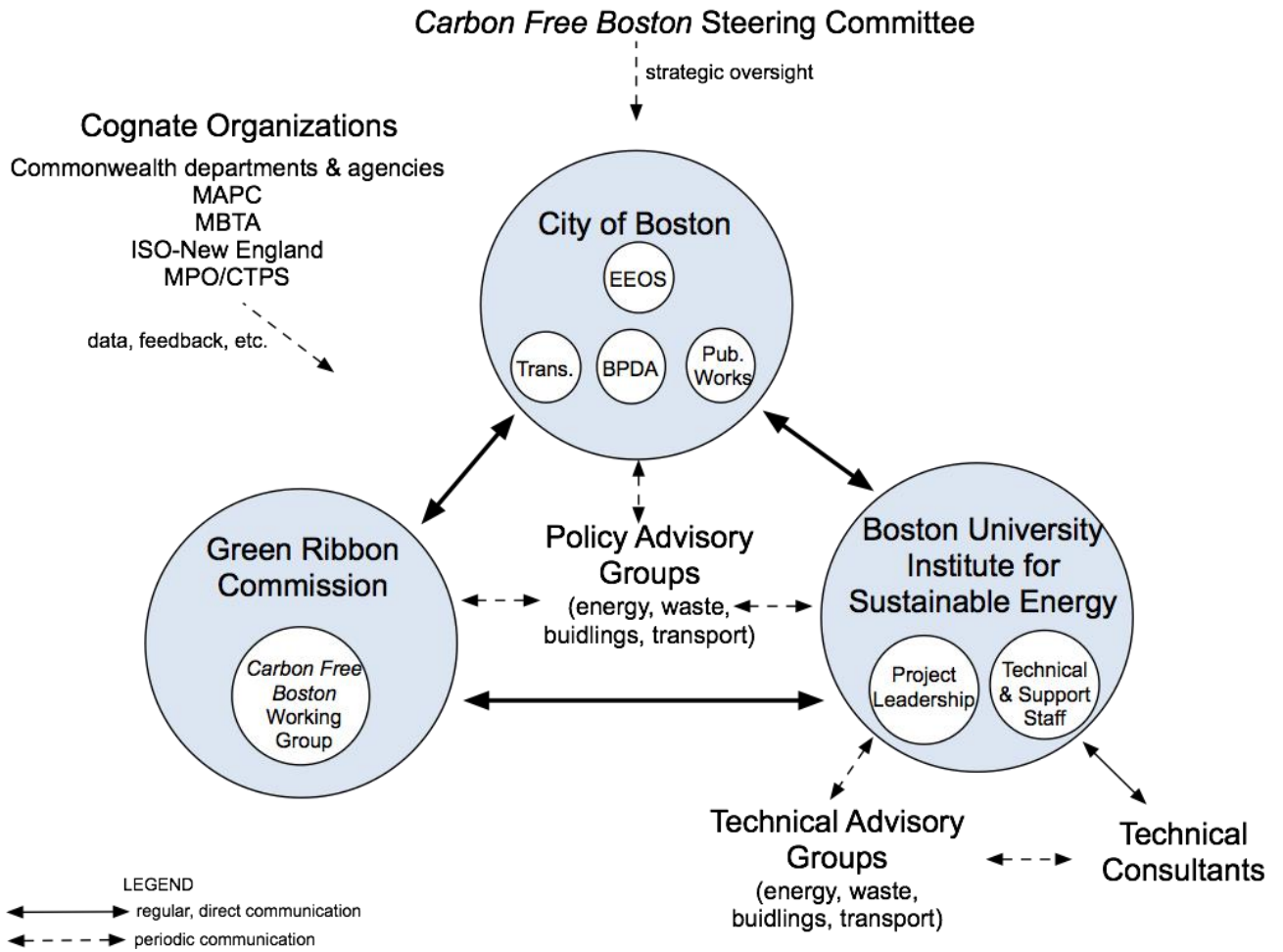


FIGURE 2 Products from the *Carbon Free Boston* project and their contributing parties

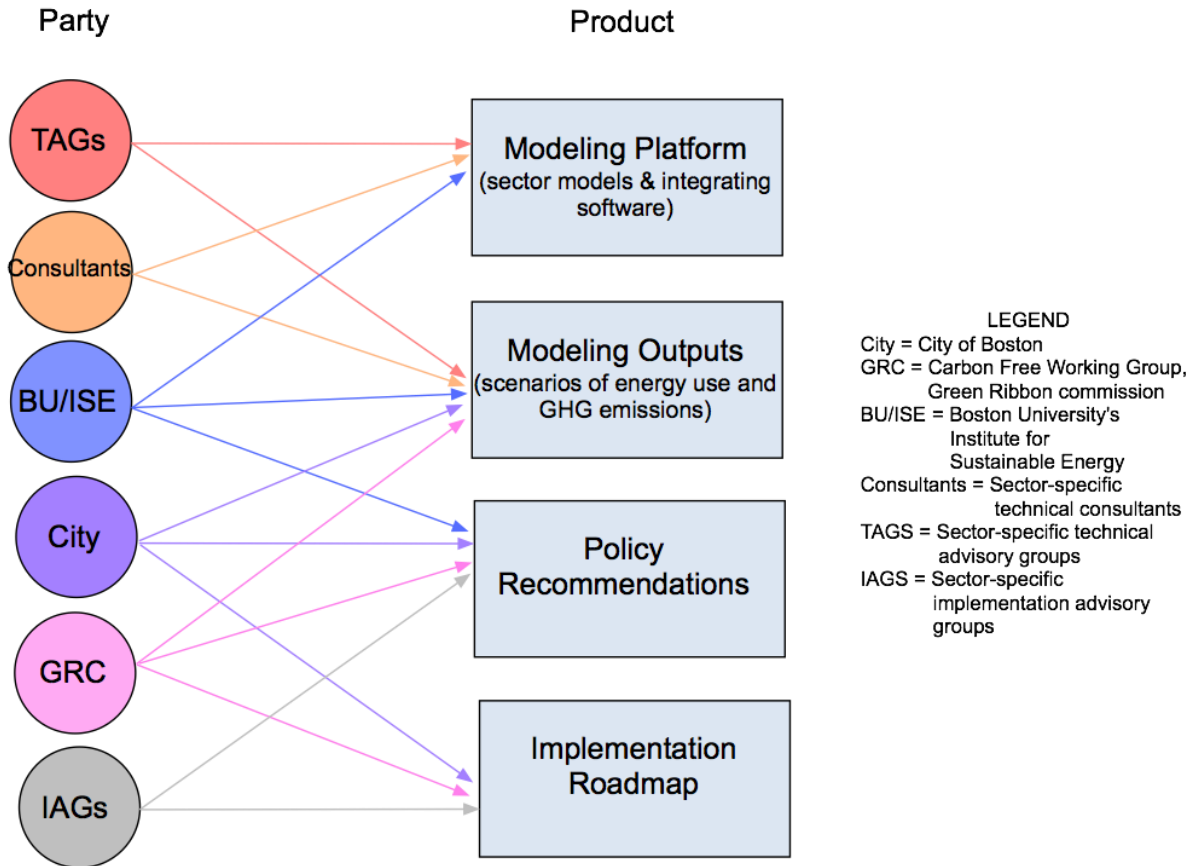


FIGURE 3 Structure of Modeling Platform Underlying *Carbon Free Boston*

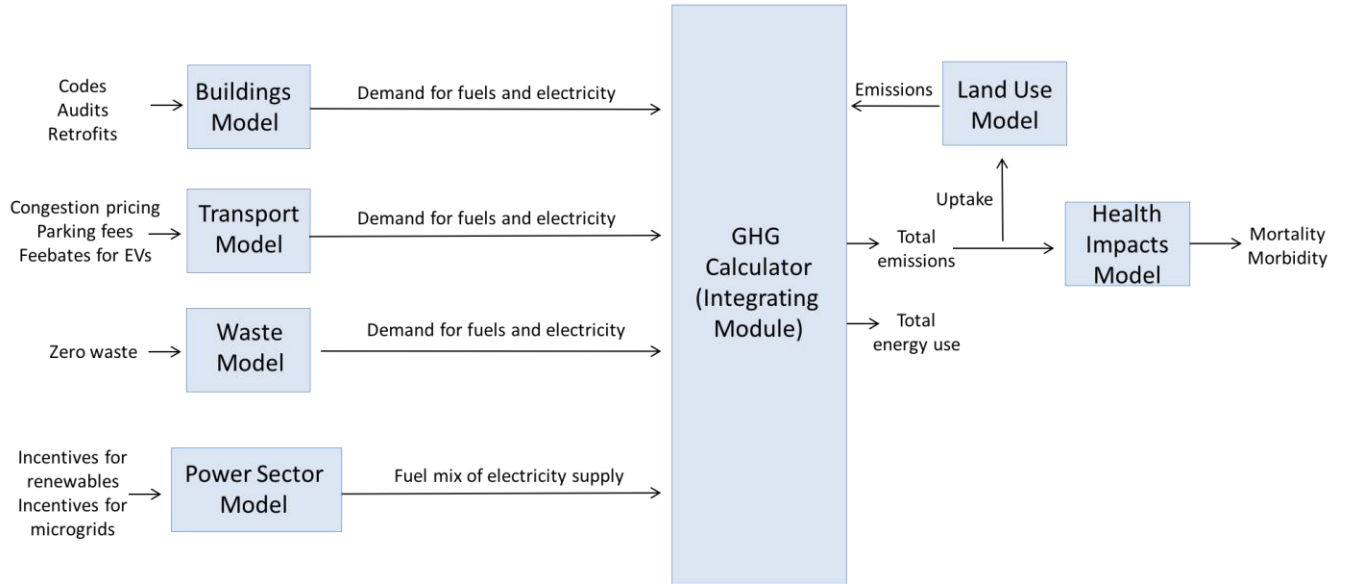


FIGURE 4 Timeline for consultant work

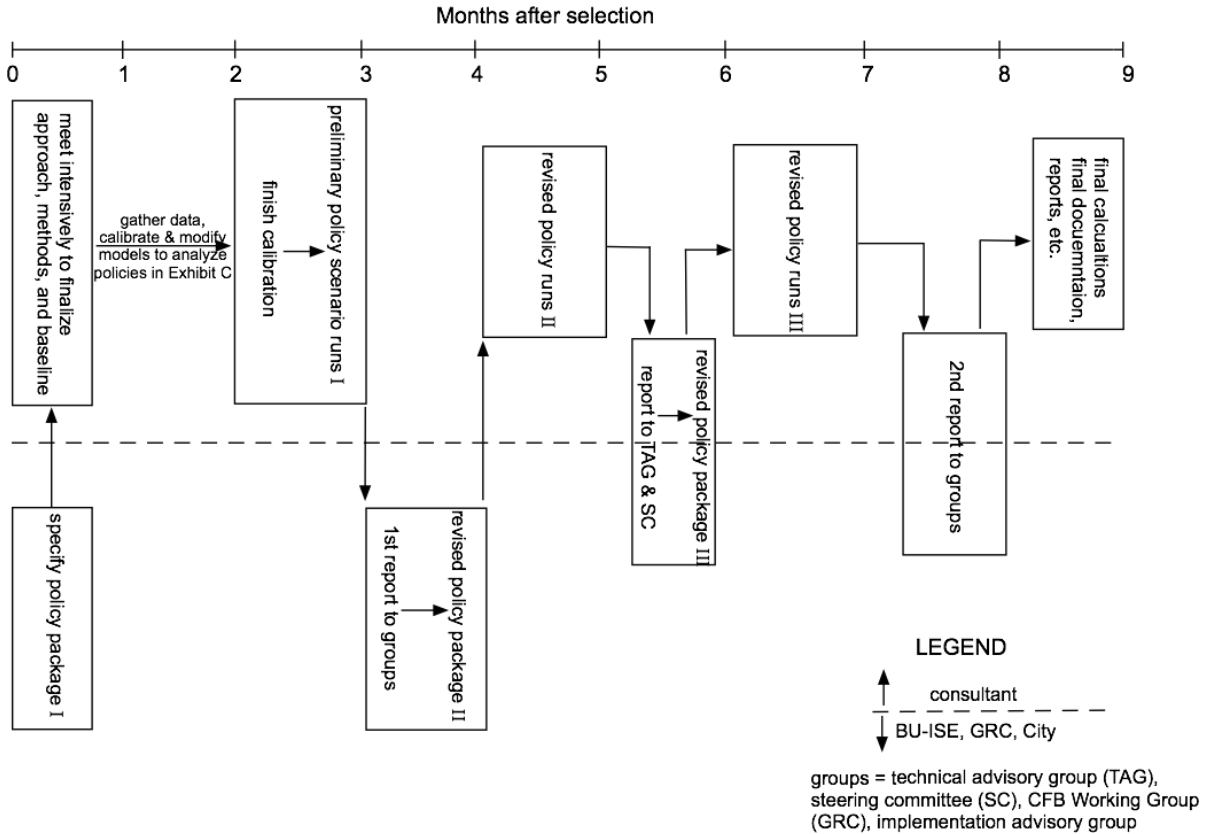


FIGURE 5 Project timeline

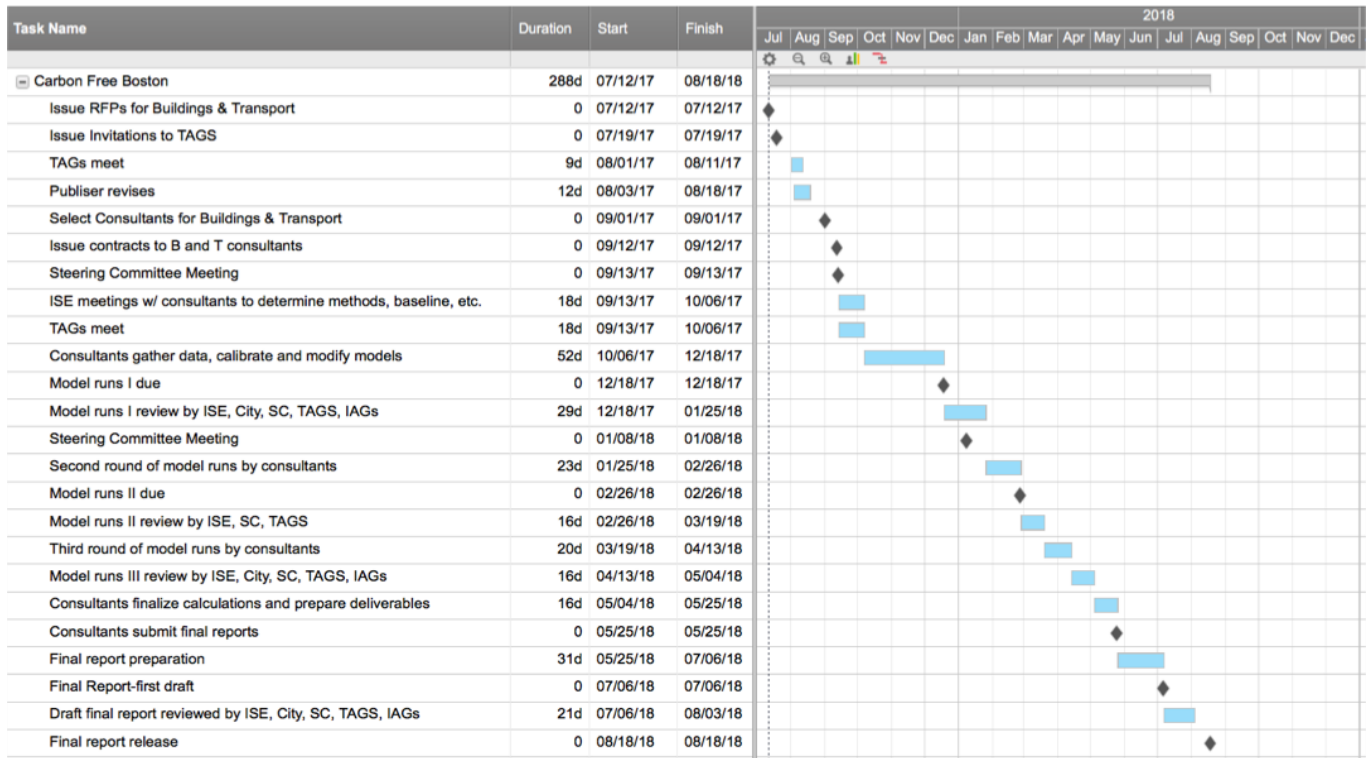


EXHIBIT A

STRATEGIES TO REDUCE GHG EMISSIONS IN BUILDINGS

- Implement zoning, building and energy conservation codes based on carbon neutral, zero net energy, and other cost-effective approaches that improve energy efficiency and increase the use of renewable energy
- Require deep retrofitting of buildings at designated intervention points: time of sale/purchase, financing, major renovation of building or space, and rebuilding
- Require energy storage and electric vehicle charging requirements for new and retrofitted buildings
- Require energy audits, rating, and disclosure
- Require higher standards for energy efficiency of appliances
- Establish minimum energy efficiency standards for rental housing
- Reduce urban heat island effect via cool roofs and cool pavements (adopt cool roof mitigation policy, cool roof codes, etc.).
- Develop and expand low- to no-carbon district heating and cooling systems

STRATEGIES TO REDUCE GHG EMISSIONS IN ENERGY SECTOR

- Force the retirement or conversion of fossil-fuel plants
- Increase renewable portfolio standards (RPS) for utilities
- Provide clean power purchasing option (e.g., allow consumers to participate in wholesale market, Community Choice Aggregation)
- Carbon tax
- Provide financial incentives for on-site and off-site renewable generation
- Reduce regulatory barriers and increase incentives for combined heat and power (CHP), microgrids, district energy, tri-generation, and energy storage
- Invest in large- and medium-scale distributed generation (district energy for heating and cooling, micro-grids, CHP, tri-generation districts),
- Continued lowering of the cap on greenhouse gas emissions through RGGI
- Electric grid modernization
- Increased locally produced and community-owned renewable power
- Install solar panels on all municipal properties
- Implement measures to ensure that PV owners can interconnect to the grid with standardized rules, minimized fees, and reasonable feed-in tariffs;
- Install distributed renewable energy generation on city facilities
- Impact of plausible and specific decisions that impact ISO New England grid (more hydro from Canada, more offshore wind, new natural gas pipelines, major generator retirements, increase in storage, etc.)

STRATEGIES TO REDUCE GHG EMISSIONS IN TRANSPORTATION

- Incentivize adoption of alternative fuel vehicles (use of public transit lanes, free parking, exemption from taxation, feebates)
- Establish taxes/fees on fossil-fuel vehicles (at purchase and/or registration)
- Establish congestion/climate taxes on fossil-fuel vehicles in designated areas
- Set taxes on gasoline/petroleum purchase
- Convert public transit, government fleets, and taxi fleets to no- to low-carbon energy (electric, hybrid, natural gas, hydrogen)
- Invest in infrastructure for low- to no-carbon mobility: electric vehicle charging, hydrogen, fuel cell infrastructure (including incentives for real estate owners to install charging stations)
- Improve bicycle infrastructure
- Improve bus infrastructure
- Improve pedestrian infrastructure
- Expand Travel Demand Management in public and private sectors
- Invest in new public transit capacity (modernization, expansion), choices (e.g., streetcars, light rail lines), reliability, speed, quality, accessibility, convenience, way-finding, and reduced waiting times)
- Establish regional congestion pricing (variably priced lanes, variable tolls on entire roadways, cordon charges, area-wide charges, vehicle-miles-traveled fee, variably priced ramps)
- Institute new parking pricing models (performance-based parking, off-street parking tax, dynamic pricing, variable market rate on-street pricing, unbundle parking costs from the rent or sale price)
- Promote carpooling, ride-sharing, car-sharing, and High Occupancy Vehicle lanes
- Various strategies to improve efficiency in freight transport

STRATEGIES TO REDUCE GHG EMISSIONS IN WASTE

- The City is in the early stages of developing a Zero Waste plan. The strategies identified for analysis in the waste planning process will also be assessed in terms of their impact on GHG emissions. The waste planning process and the GHG mitigation analysis will use a common set of assumptions, data, definitions, etc.

EXHIBIT B

Scope of Work (SOW)

Steering Committee for Carbon Free Boston

Background

Boston is a recognized leader in the global response of cities to climate change. The City has played foundational roles in the Carbon Neutral Cities Alliance, the Global Covenant of Mayors for Climate & Energy, and the C40 Cities Climate Leadership Group. By executive order in 2007, the City of Boston set GHG reduction goals of 25% below 2005 levels by 2020, and 80% by 2050 for municipal operations. In 2011, the City released a *Climate of Progress* in which the same 80x50 GHG reduction goals were extended to the entire City.

Boston strengthened its commitment to reduce emissions when Mayor Walsh signed the Metro Boston Climate Mitigation Commitment in 2016 along with the 13 partner cities and towns in Greater Boston that belong to the Metropolitan Mayors Coalition. Signatories to the Climate Mitigation Commitment pledged to be carbon free by 2050.

The City is collaborating with the Green Ribbon Commission and Boston University's Institute for Sustainable Energy (ISE) to produce a *Carbon Free Boston* report in 2018. This report will quantify the most effective combination of technologies and policies to reduce greenhouse gas (GHG) emissions across the energy, buildings, transportation, and waste sectors. *Carbon Free Boston* will also inform the GHG strategies that will be articulated in the City's *Climate Action Plan Update* that will be released in 2018.

The ISE is the technical coordinating lead in the development of a modeling platform that will identify a set of policies and technologies that effectively and efficiently meet the City's emissions reductions targets. In that role the ISE will coordinate the work of consultants, staff working for the City and the Commonwealth, academics, and others with expertise in specific sectors.

Steering Committee Role and Responsibilities

The Steering Committee provides strategic operational direction for the *Carbon Free Boston* project. Specific responsibilities include:

- Ensure that the project's scope aligns with the City's mitigation goals.
- Provide guidance to the ISE project team in its capacity as the technical coordinating lead.

- Ensure the appropriate level of City staff engagement from both technical and implementation perspectives.
- Prioritize the work of the project.
- Foster communication among government, academia, business, academia, and NGOs such that the expertise, data, and collaboration essential to the project goals is realized.
- Ensure that stakeholder and other communications strategies are incorporated into the project and effectively managed.
- Support additional project fundraising if needed.
- Monitor the timeline of the project.
- Provide advice about changes to the project as it develops.
- Address any issue that has significant implications for the project.

Steering Committee Membership

The Steering Committee will be chaired by EEOS and include individuals in leadership capacities from City, the Commonwealth, the GRC, the ISE, and from funders of the project.

Steering Committee Meeting Frequency and Logistics

The Steering Committee will meet at least four times from August, 2017 to August 2018. Committee members may be asked to comment on material circulated electronically, and to participate in conference calls. Meetings and communication will be supported by a Project Management Team within the ISE. Meetings will be held on the campus of Boston University, or at another location designated by the Committee.

EXHIBIT C

Green Ribbon Commission: Carbon Free Boston Working Group Charter – May, 2017

Purpose: Create Deep Decarbonization Policy and Technology Model for Boston

At the GRC's June, 2016 meeting, Mayor Walsh announced the launch of Carbon Free Boston, a partnership between the City and the GRC to analyze the challenges and the choices for the Boston community to meet the goal of carbon neutrality by 2050. Over the next year, the Carbon Free Boston initiative will begin to analyze the likely effectiveness, cost, and benefits of the technology and policy options for deep decarbonization. Based on that work, the City, through its next update of the Boston Climate Action Plan, will make difficult but informed choices about implementation strategies. In some cases, these choices may represent a significant departure from business as usual and will require proactive, long-term leadership from multiple stakeholders, including those represented by the CFB Working Group and the GRC as a whole.

Responsibilities: Provide Guidance, Communication, and Leadership

- Provide periodic strategic and/or technical guidance to the City of Boston, GRC staff, and BU Technical Team as the modeling work progresses.
- Represent, support, and endorse the CFB Working Group's findings to the full GRC and potentially to other key leaders and funders in the City, region, and State.
- Assist with the critical outreach and stakeholder engagement process that will undergird the City's policy planning and implementation.
- As opportunities arise, lead by example and through public statements of support to help move the City toward its targets.

Time Requirements: Three One-Two Hour Meetings per Year (estimated)

Meetings will be held on an as-needed basis over the course of 2017 and 2018, depending on the need of project staff, technical advisors, and the City for guidance and assistance. Three meetings in each of the two years is likely. Key stakeholders (such as the utilities) may also be asked to provide data and/or staff expertise.

Members

Mindy Lubber, Ceres (Chair)
Bob Brown, Boston University
Bill Fahey, Veolia
Joe Grimaldi, Mullen Advertising
Amos Hostetter, Barr Foundation
Katie Lapp, Harvard University
Alex Liftman, Bank of America
Penni McLean–Conner, Eversource
Israel Ruiz, MIT
Austin Blackmon, City of Boston (*ex officio*)
Carl Spector, City of Boston
Brad Swing, City of Boston

EXHIBIT D

Scope of Work (SOW)

Technical Advisory Groups (TAGs) for Energy, Waste, Buildings, Transportation

Background

Boston is a recognized leader in the global response of cities to climate change. The City has played foundational roles in the Carbon Neutral Cities Alliance, the Global Covenant of Mayors for Climate & Energy, and the C40 Cities Climate Leadership Group. By executive order in 2007, the City of Boston set greenhouse gas (GHG) reduction goals of 25% below 2005 levels by 2020, and 80% by 2050 for municipal operations. In 2011, the City released a *Climate of Progress* in which the same 80x50 GHG reduction goals were extended to the entire City.

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Role and Responsibilities

Individual TAGS will provide strategic advice on the development and application of the quantitative models in the energy, waste, buildings, and transportation sectors. The role of the TAGs is to advise and ensure the overall technical quality of the model to reduce GHG emissions in each sector in the City of Boston.

Specific responsibilities include:

- Insure that the structure, techniques, and data that underlie each sector model are state-of-the-art
- Identify relevant studies performed or underway in other urban areas, and which results from those studies are relevant.
- Identify the key polices to be investigated.
- Identify key connections and feedbacks across sectors.
- Provide an open and transparent forum to discuss issues related to the reduction of GHG emissions in each sector.

TAG Membership

Each TAG will include representatives from various agencies in the City, energy utilities that serve the City, energy agencies from the Commonwealth, energy consulting firms, relevant non-governmental organizations, and academia.

TAG Meeting Frequency and Logistics

Each TAG will meet approximately four times from August, 2017 to August 2018. Each TAG will also be asked to comment on material circulated electronically, and to participate in conference calls. Some members may be contacted outside of the scheduled meetings to answer specific questions from the ISE and its transportation consultants. Meetings and communication will be supported by a Project Management Team within the ISE. Meetings will be held on the campus of Boston University.