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Rose Kennedy Greenway Greenhouse Gas Mitigation Report

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The Rose Kennedy Greenway Conservancy

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Executive Summary

The Rose Kennedy Greenway Conservancy has undertaken a project to understand current sources of greenhouse gas (GHG) emissions associated with the administration and operation of their parks and to explore options to decrease their carbon footprint. The analysis was developed using data from 2019 and focuses on emissions related to fossil fuel combustion in heating and vehicles and emissions associated with the use of electricity. The analysis shows that the Conservancy's 2019 emission were 172 metric tons of CO_2, which is roughly equivalent to 37 cars driven for one year.

The Conservancy's carbon footprint is primarily driven by electricity consumption, which accounts for 82% of GHG emissions. Heating fuel and vehicle fuels use make up the remaining emissions, accounting for 12% and 6%, respectively. While these data reflect 2019 emissions, it is important to note that the Conservancy has since taken measures to reduce their GHG footprint. Particularly, they have transitioned most of their vehicle fleet to electric vehicles. The resulting change is not reflected in this report, but it is anticipated that overall emissions would decrease, with vehicle fuels seeing a significant decrease and electricity seeing a modest increase in emissions.

Various mitigation options are presented and discussed relative to several evaluation criteria. These criteria qualitatively assess the potential GHG reduction, the cost effectiveness, the ease of implementation, the degree of autonomy, and the educational value for each of the mitigation options. Based on an assessment of these criteria, it is recommended that the Conservancy take several actions across their operations to reduce their carbon footprint moving forward. The Conservancy should seek to:

- Participate in Boston's high-renewable community choice aggregation program;
- Work with Massachusetts Department of Transportation (MassDOT) to implement sustainability features into a new maintenance facility that is currently in the design process and will be used by the Conservancy to store vehicle;
- Ensure that all new vehicle purchases are electric, where there is a viable electric option considering the constraints of use-case and cost; and
- Work with MassDOT to introduce energy efficiency measures in their office space to reduce heating and electricity use.

Introduction

The Rose Kennedy Greenway is one of the most visible and publicly accessible institutions in Boston. While its emissions are much smaller than some of its towering neighbors, its actions in emissions assessment and mitigation can help educate the greater community on the need and methods to mitigate greenhouse gas emissions. As a sizable urban ecosystem in Boston's core, the Greenway can serve as a reminder that natural landscapes in the urban environment can be both a source and a sink of greenhouse gases. The Conservancy, as the organization that manages the Greenway, strives to promote local environmental stewardship and education. To show leadership in the community, the Conservancy is seeking a feasible greenhouse gas emissions reduction strategy that aligns with their organizational mission to promote environmental stewardship while adhering to their institutional capabilities.

In developing a feasible emission mitigation strategy for the Conservancy, it is important to consider the Conservancy's existing infrastructure, operations, and assets. It is also important to recognize the Conservancy's unique relationship with MassDOT, who owns the land on which the Conservancy's Greenway parks are sited and the building in which the Conservancy runs its administrative operations. MassDOT leases its land to the Conservancy and provides the organization with in-kind donations in the form of office, parking, and maintenance space, along with paying the Conservancy's utility bills. The Conservancy's utility meters are, therefore, under MassDOT's name and charged accordingly. Given these circumstances, it is difficult for the Conservancy to move unilaterally on decarbonization activities. The successful implementation of any mitigation actions will need to involve close communication and collaboration with MassDOT. The GHG reduction recommendations outlined in this report recognize this relationship and speak to possible avenues for coordination.

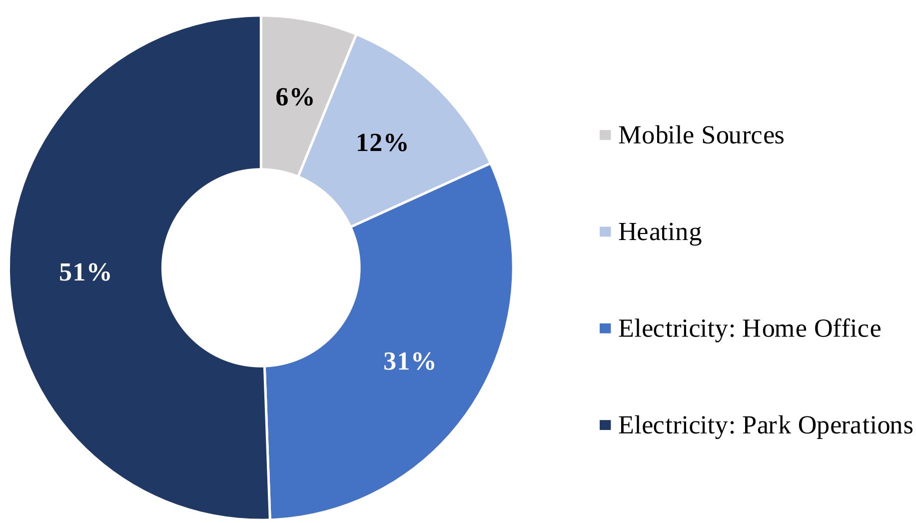
This section of the report presents an assessment of GHG emissions from the Conservancy's activities, including heating fuel combustion, mobile sources, and electricity consumption. This section of the report also provides an assessment of GHG mitigation options and a recommended emissions mitigation management strategy along with how the management strategy integrates with the proposed resiliency plan.

Conservancy's GHG Footprint

The analysis of the Conservancy's greenhouse gas footprint included both Scope 1 and Scope 2 emission sources, focusing on carbon outputs. Scope 1 emissions encompass those released through on-site combustion of fossil fuels, including combustion needed for heating, cooling, or vehicle use. Scope 2 emissions represent the emissions associated with purchased electricity, meaning the indirect emissions from the power plants where the Conservancy's electricity is generated. Scope 3 emissions, which arise from sources beyond the ownership or control of an entity, were not included in the scope of this assessment and therefore not quantified. Scope 3 emissions include emissions from travel, waste, third-party vendors, and consumption of material goods. It is additionally worth mentioning that the Greenway's total natural carbon stock is approximately 113 tonnes of carbon, which is equivalent to 465 tonnes of CO_2. This is about 2.4 times the Greenway's 2019 emissions from energy consumption.

To develop a comprehensive assessment of the Conservancy's Scope 1 and 2 emissions, the analysis includes the carbon footprint of the Conservancy's heating fuel combustion, vehicle fuel use, and electricity consumption. The data used to develop this GHG inventory was from calendar year 2019. The Conservancy's total Scope 1 and 2 emission were estimated to be 172 metric tons in 2019. Electricity consumption is the largest contributor (82%), followed by heating fuel combustion (12%), and vehicle fuel use (6%).

Figure 1. Share of Emissions by Source



Electricity

The Conservancy's emissions are driven largely by electricity usage, including energy consumption in park operations and the office. Most electricity usage is driven by seasonal park operations. The Conservancy provided annual utility data for six electricity meters located throughout the Greenway. In 2019, these six meters consumed 263 MWh of electricity.

MassDOT manages and pays for the heating needs of the building (185 Kneeland Street, Boston, MA) in which the Conservancy's office is located. As a result, specific electricity usage data was unavailable. Electricity use within the Conservancy's office was estimated using the square footage of the space and the average electricity intensity of an office building in the Northeast. The Conservancy's office space was estimated by MassDOT to be 14,000 square feet within the 140,000 square foot building. According to the EIA, the average annual electricity usage of an office building in the Northeast is 11.6 kWh per square foot.[1] These two factors were multiplied to estimate the Conservancy's annual electricity usage in their office, which is estimated to be 162 MWh.

To calculate the emissions of the Conservancy's electricity usage, the estimated electricity consumption was multiplied by the emissions factors provided by the EPA's eGrid, which provides state and regional emissions factors for electricity grids throughout the US.[2] Based on the eGrid estimates of Massachusetts' electricity supply, the Conservancy's annual electricity usage produces approximately 140 metric tons of CO_2, accounting for 82% of the Conservancy's overall emissions.

Park Operations vs. Home Office Electricity Usage

The park's operations are responsible for 87 metric tons of CO_2, while office operations account for 54 metric tons of $CO_{2.}$ As mentioned above, the emissions produced from electricity usage represent 82% of the Conservancy's carbon footprint. Within this 82%, park operations are responsible for 51% of overall emissions while office operations account for 31% of overall emissions.

Seasonal Variation

The Conservancy's park-based electricity usage is influenced by seasonal drivers, with a clear summer spike coinciding with a peak in events and other park-related activities. An increase in energy consumption in warmer months is inherent to the idea of outdoor recreational areas, but also suggests that a considerable portion of this consumption can be attributed to larger, active features of the Greenway, such as fountains, play-areas, and recreational machinery (i.e. the carousel).

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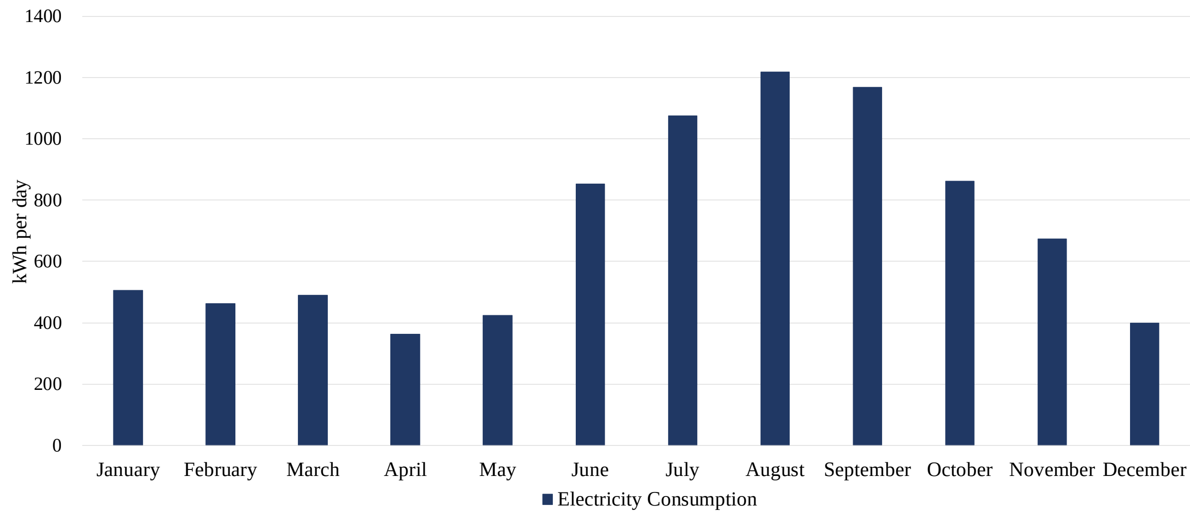
[1] "Commercial Buildings Energy Consumption Survey." (2012). US Energy Information Administration. https://www.eia.gov/consumption/commercial/data/2012/index.php?view=consumption#c23-c32

[2] "Emissions & Generation Resource Integrated Database (eGRID)." US Environmental Protection Agency. https://www.epa.gov/egrid/emissions-generation-resource-integrated-database-egrid

Figure 2. Park-related Electricity Consumption by Month (Does not include the Conservency's office).



Meter-Specific Data

As illustrated in the figure below, the meters at 199 State Street and 200 Hanover Street have the highest rate of electricity usage, respectively. Representing 87% of the Conservancy's electricity consumption in its park operations, these two meters hold significant opportunity for energy efficiency and renewable energy measures. It is assumed that these meters are powering some of the Greenway's larger, active features. It is important to note that the meter at 199 State Street is driven by seasonal park operations, whereas the meter at 200 Hanover Street is not (see figure 4). The 199 State Street meter appears to provide electricity for the carousel and the Rings Fountain, which would correlate with the increase of electricity usage in warmer months.

Figure 3. Share of Electricity Usage by Meter

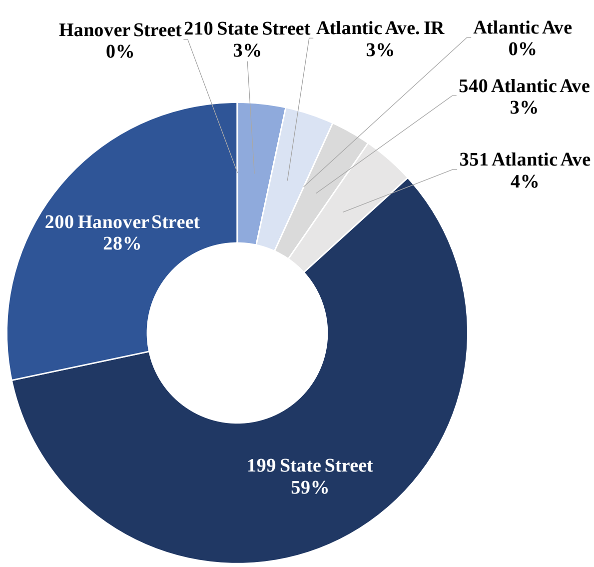
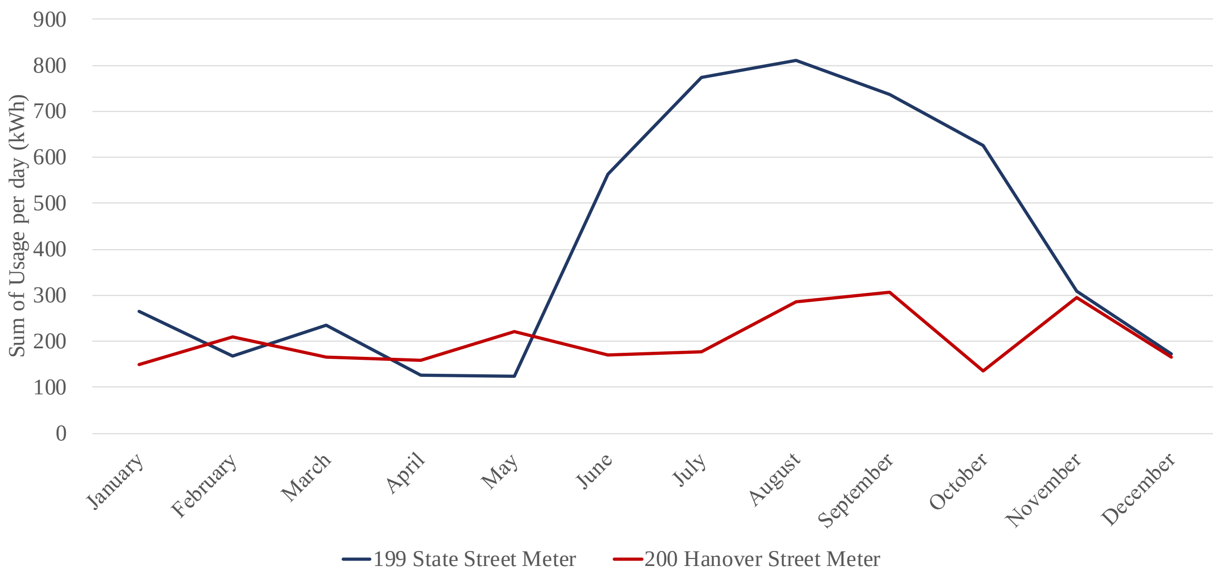


Figure 4. 2019 Electricity Usage for Two Meters



Heating Fuel Combustion

Heating fuel combustion can be a significant factor in an organization's carbon output, especially in the Northeast's cold climate. Fortunately, the Conservancy has relatively low heating needs because the only space that needs heating is their administrative office in the MassDOT building. This space is heated using natural gas, which is a common heating fuel used throughout New England.

As mentioned earlier, MassDOT manages and pays for the heating needs of the building in which the Conservancy's office is located. As a result, specific natural gas usage data was unavailable. For this inventory, emissions from the Conservancy's office were estimated based on the square footage of the office and standard energy-use intensity factors from the Energy Information Administration (EIA). The Conservancy's office space was estimated by MassDOT to be 14,000 square feet within the 140,000 square foot building. According to the EIA, the average annual natural gas usage of an office building in the Northeast is 28.1 cubic feet of natural gas per square foot.[3] These two factors were multiplied to estimate the Conservancy's annual heating needs, which are 393,400 cubic feet of natural gas (equivalent to 114 MWh of electricity).

[3] "Commercial Buildings Energy Consumption Survey." (2012). US Energy Information Administration. https://www.eia.gov/consumption/commercial/data/2012/index.php?view=consumption#c23-c32

Using EPA-provided emissions factors[4] and conversion rates for natural gas fuel, the heating emissions of the office were estimated to be 20.7 metric tons of CO_2. This accounts for about 28% of the office's emissions, and 12% of the Conservancy's total emissions.

Mobile Sources (Vehicles & Lawncare and Maintenance Equipment Fuel Use)

The Conservancy currently owns an inventory of eleven vehicles, including four Vantage electric vehicles for maintenance and horticulture and one electric work truck. The rest of the vehicles rely on gasoline or diesel for fuel. All vehicles labelled as "off-road" are included within the mobile source calculations. Vehicle fuel usage data was derived from the Conservancy's monthly fuel invoices. Based on these documents, it is estimated that 128 gallons of diesel and 1,058 gallons of unleaded gasoline were purchased for Conservancy vehicles in 2019.

Emissions from this fuel usage was calculated using EPA emission factors for diesel fuel (10.21 kg CO_2 per gallon) and motor gasoline (8.78 kg CO_2 per gallon).[5] Using these emissions factors, the Conservancy vehicles and equipment emitted 10.6 metric tons of CO_2 in 2019, including 1.3 metric tons of CO_2 from diesel use and 9.3 metric tons of CO_2 from gasoline use. Fuel use associated with mobile sources account for about 6% of the Conservancy's overall emissions. Looking closer at mobile source outputs, gasoline claims 88% of these emissions while diesel only accounts for 12%. The majority of emissions driven by mobile sources, come from the Conservancy's off-road maintenance and off-road horticulture vehicles, responsible for 34% and 19% of transportation emissions, respectively. In 2019, the Conservancy replaced a number of vehicles with electric equivalents, including most of their off-road maintenance and off-road horticulture vehicles. As a result, emissions from mobile sources are expected to be lower in future years, while emissions from electricity will see a modest increase.

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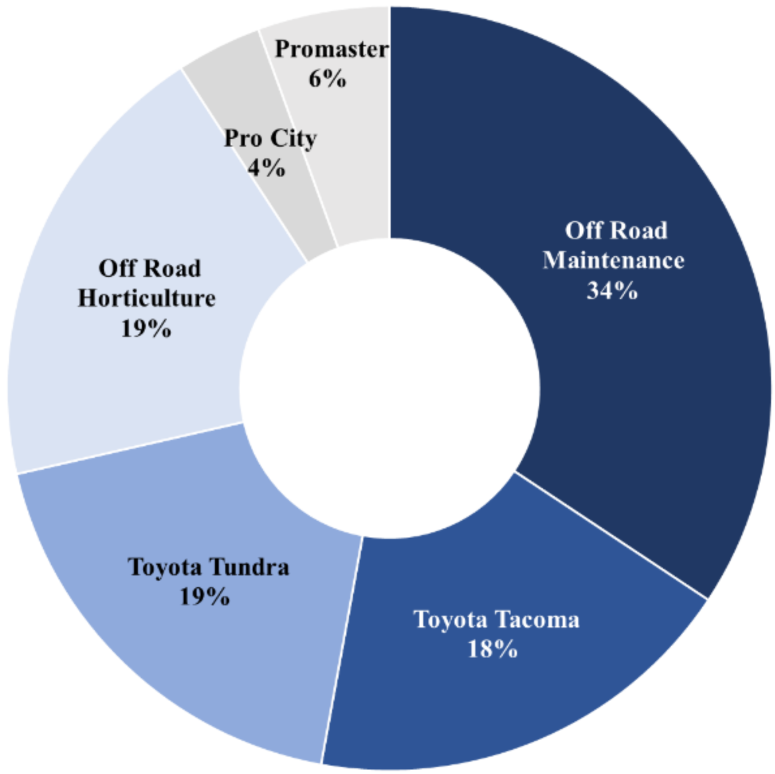
[4] "Emissions Factors for Greenhouse Gas Inventories." (2018). US Environmental Protection Agency.https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

[5] "Emissions Factors for Greenhouse Gas Inventories." (2018). US Environmental Protection Agency. https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Figure 5. Share of Emissions from Conservancy Vehicles



CO_2 Emissions Mitigation Management Strategies

The greenhouse gas inventory developed with the data and methodology outlined above reveal that the total estimated CO_2 emissions in 2019 for the Conservancy were 172 metric tons. In comparison, the City of Boston emitted 6.1 million metric tons of greenhouse gases in 2017,[6] meaning that the Conservancy's CO_2 emissions make up roughly 0.003% of the City's annual GHG output. For additional context, the Conservancy's 2019 CO_2 emissions are equivalent to about 37 passenger vehicles driven for one year or 20 homes' annual energy use.[7]

At 6% of total emissions, mobile sources offer little opportunity to lower overall emissions. The opportunity of reducing emissions from heating fuel combustion are only slightly more promising, at 12% of total emissions. The largest opportunity to reduce greenhouse gases come from the Conservancy's electricity usage for both park operations and usage associated with the Conservancy's office space, which together account for 82% of the Conservancy's overall emissions.

Despite limited opportunities in several areas, there are still a number of potential GHG mitigation strategies the Conservancy can consider as they strive towards greater sustainability throughout the operation and maintenance of their parks. From simple behavioral consumer choices to investing in on-site solar photovoltaic (PV) arrays, the Conservancy has several options to consider. The mitigation strategies detailed below were deliberated and researched for the Conservancy's consideration and include a variety of options to reduce emissions in their building spaces, from their mobile sources, and across their electricity use.

Evaluation Criteria

To examine the relative merits of the mitigation options, each option is assessed based on several criteria, including:

- GHG reduction potential;
- cost-effectiveness;
- ease of implementation;
- the degree to which the Conservancy can act independently from MassDOT (degree of autonomy); and
- the educational value of the action.

The definition of each of these assessment criteria are described below.

GHG Reduction Potential

The ability of a mitigation option to effectively lower the Conservancy's GHG emissions, compared to the current baseline. Assessment of each option's GHG reduction potential will be based on estimated

[6] "Boston's Carbon Emissions." City of Boston. https://www.boston.gov/departments/environment/bostons-carbon-emissions

[7] "Greenhouse Gases Equivalencies Calculator." US Environmental Protection Agency. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

emissions that are avoided by implementing the mitigation option, according to academic literature, subject matter expertise, and other relevant sources. Mitigation opportunities that are identified to have the most potential to reduce the Conservancy's emissions will be scored as "High," with additional scorings accordingly scaled with decreasing potential.

Cost-Effectiveness

The expected cost per ton of CO_2 reduced, calculated as the total cost of implementing the mitigation options divided by the total CO_2 reduced. Assessment of each option's cost-effectiveness will be based on estimated costs according to academic literature, subject matter expertise, or other relevant sources. In the case that actual cost data is not available, options are assigned a qualitative ranking of "Low," "Medium," and "High" based on a consideration of lifespan, upfront, maintenance, and operational costs in comparison to its GHG reduction potential.

Ease of Implementation

The level of effort required by the Conservancy, and any relevant parties, to successfully implement the mitigation option. Options that require minimal to low effort for the Conservancy will be ranked "High" under this criterion, with options taking a large amount of effort receiving "Low" scores and options with a moderate amount of effort being assigned a "Medium" score.

Degree of Autonomy

The ability of the Conservancy to act unilaterally on implementing a mitigation option. Based on a ranking scale consisting of "Low," "Medium," and "High," the rankings correspond to the feasibility of implementing each option without dependence on MassDOT's approval or adoption. Such dependency can limit the likelihood of an option being fully and successfully implemented.

Educational Value

The ability to promote public education on sustainability and environmental stewardship among patrons of the Greenway. The Conservancy's image will also be closely tied to the educational value of each option, as its public sustainability image will be bolstered with increased public interaction. Each mitigation option will be assigned a ranking of "Low," "Medium," or "High" based on the physicality, visibility, and educational opportunities associated with each GHG reduction method presented below.

Leading by Example

While the Conservancy's relationship with MassDOT may complicate its ability to implement GHG mitigation strategies, it also provides opportunities. One opportunity is MassDOT's eligibility to leverage the Leading by Example (LBE) Program. Overseen and run by the Massachusetts Department of Energy Resources (DOER), departments, and divisions, LBE collaborates with state agencies and public institutions to develop robust sustainability practices, emphasizing climate and energy efforts throughout state operations. From waste reduction and water conservation to alternative fuels and green buildings, LBE seeks to implement identified best practices in state-owned and leased buildings and infrastructure.[8]

Through LBE, MassDOT can work closely with the Division of Capital Asset Management and Maintenance (DCAMM) to implement clean energy and energy efficiency initiatives in its properties and participate in the Commonwealth Building Energy Intelligence (CBEI) program. The CBEI program seeks to reduce energy consumption and costs by improving building energy management practices throughout the Commonwealth. To do so, the program offers whole building energy metering and analytics in real-time which assists facility managers in improving energy consumption efficiency. The LBE program offers grant opportunities, technical expertise, and resources for renewable thermal (heating) and energy efficient technologies, as well as support for energy and building performance projects. This opportunity should be kept in mind when considering the financial and technical feasibility of the strategies below.

Renewable Electricity Procurement

Accounting for 82% of all emissions, electricity consumptions offers the largest opportunity for greenhouse gas reductions. There are several options that the Conservancy could implement to procure renewable energy for their operations. These options are discussed below.

Unbundled Renewable Energy Credit Purchase

Renewable Energy Credits (REC) represent the environmental attributes or benefits associated with one megawatt hour (MWh) of renewable electricity production. These credits are tradable market-based instruments that demonstrate legal rights to those environmental attributes. Put in simpler terms, RECs are used for tracking and verifying renewable energy production. For each MWh of electricity produced from a renewable energy source, such as a solar panel, the production facility also generates one REC. However, RECs can be separated, or unbundled, from the underlying renewable energy they are associated with and sold separately from the electricity. Therefore, unbundled RECs are not tied directly to the purchase of electricity. The Conservancy could purchase RECs separately from their electricity, provided they have the funding to do so. If purchased, a REC signifies that the owner supported the production of a MWh of renewable energy. When matched with electricity consumption, RECs are considered the equivalent of sourcing electricity from renewable sources. Some notable advantages of unbundled RECs include the ability to purchase a large number of RECs in a single contract, flexibility in procuring domestic clean energy, and short-term contracts.[9] Purchasing unbundled renewable energy credits presents a convenient option for the Conservancy to offset the majority or the entirety of their electricity usage.

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[8] "Leading by Example Grants." Massachusetts Department of Energy Resources. https://www.mass.gov/service-details/leading-by-example-grants

[9] "Unbundled Renewable Energy Certificates." EPA Green Power Partnership. https://www.epa.gov/greenpower/unbundled-renewable-energy-certificates-recs

GHG Reduction Potential

The purchase of RECs can be scaled to match an organization's electricity consumption. Therefore, the Conservancy could offset all of its electricity production through a REC purchase if the volume of the purchase matches their overall electricity consumption. This would equate to about 140 metric tons of CO_2.

Cost-Effectiveness

Acquiring RECs tends to be more expensive than other renewable electricity procurement pathways, but purchasing prices range greatly by location and year. As renewable energy technology becomes more advanced and widespread, the market is seeing a consistent decline in the price of solar installations and RECs. Voluntary REC prices are made up of several factors, from geographic location and technology, to generation date and certification. These voluntary wholesale RECs have been on a continuous decline trend over the past decade, starting at $1.20 per MWh in 2010 to less than $0.35 per MWh in 2016.[10] These prices tend to fluctuate. For example, as of August 2018 the prices of a REC in the voluntary market was $0.70 per MWh.[11] Using this 2018 estimate, the total cost for the Conservancy would be about $298 a year or $2.13 per metric ton of CO_2.

Ease of Implementation

Purchasing voluntary RECs is a relatively straightforward process, mitigating the need for specialized knowledge.

Degree of Autonomy

Given the Conservancy's complicated situation with MassDOT, purchasing unbundled RECs may be the most straightforward option to help mitigate the Conservancy's electricity-based emissions. The Conservancy can purchase RECs independently of their electricity, forgoing the need for MassDOT's approval.

Educational Value

REC purchases can be publicized in Conservancy marketing and informational materials, as well as throughout the Greenway. However, because the renewable energy developments associated with the purchased RECs will most likely be outside the Boston-area, there will be little physical evidence to serve as an educational component.

Table 1. Renewable Electricity Procurement

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
High	Low	Medium-High	High	Low-Medium

[10] "Green Power Pricing." EPA Green Power Partnership. https://www.epa.gov/greenpower/green-power-pricing#one

[11] "US EPA. U.S. Renewable Electricity Market." EPA Green Power Partnership. https://www.epa.gov/greenpower/us-renewable-electricity-market

Virtual Power Purchase Agreement (VPPA)

VPPAs are a popular method of emissions management chosen by non-profit, academic, and cultural institutions across the nation.[12, 13] Buyers within a VPPA enter into a "contract for differences" between them and a power generator, typically located in different transmission grids.[14] The buyer and project owner agree upon a fixed price for electricity and RECs. The renewable energy project sells clean power into its local wholesale electricity market and the buyer is still supplied with electricity from its typical utility. Essentially, a VPPA serves as a financing guarantee for the developers of a renewable energy project while also assuring that the buyer receives a set rate for electricity. Recognizing that this is complicated, please review Figure 1 for further clarification on how VPPAs function. VPPAs are currently the fastest-growing renewable energy transaction structure in the United States and empower buyers without extensive energy trading knowledge to enter into the renewable energy market.[15]

However, because the Conservancy has a relatively small electricity consumption, the organization would likely need to enter such an agreement with partners in order to find a suitable renewable energy project and mitigate additional risk. The Conservancy can look towards a successful local example of a joint VPPA as a model for a future agreement. In 2015, the Massachusetts Institute of Technology (MIT), the Boston Medical Center (BMC), and the Post Office Square Redevelopment Corporation (POSRC) teamed up to collaboratively purchase renewable energy for their institutions. The team received technical and legal consultation and successfully entered into a 60 MW VPPA with Summit Farms in North Carolina in 2016.[16] The Summit Farms project serves as a model for other organizations looking to enter into a similar structured agreement by showing that aggregation can allow entities with smaller electricity loads to benefit from the economies of scale associated with renewable energy projects and participate in otherwise unattainable market opportunities.

A VPPA is a great option for the Conservancy from both a sustainability and cost standpoint, however it may not satisfy the organization's goals to encourage local emission reductions. However, the

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[12] *Innovation Through Aggregation: A Case Study of Partnership to Purchase Renewable Energy.* (2017). A Better City. https://www.abettercity.org/docs-new/Innovation_Through_Aggregation.pdf

[13] "Cultural Institutions Working Group." Boston Green Ribbon Commission. https://www.greenribboncommission.org/work/cultural-institutions-working-group/

[13] *Institutional Renewable Energy Procurement: Guidance for Purchasing and Making Associate Environmental Impact Claims.* (2016). Higher Education Working Group Boston Green Ribbon Commission. https://www.greenribboncommission.org/wp-content/uploads/2016/10/Institutional-Renewable-Energy-Procurement-Guidance_REV.pdf

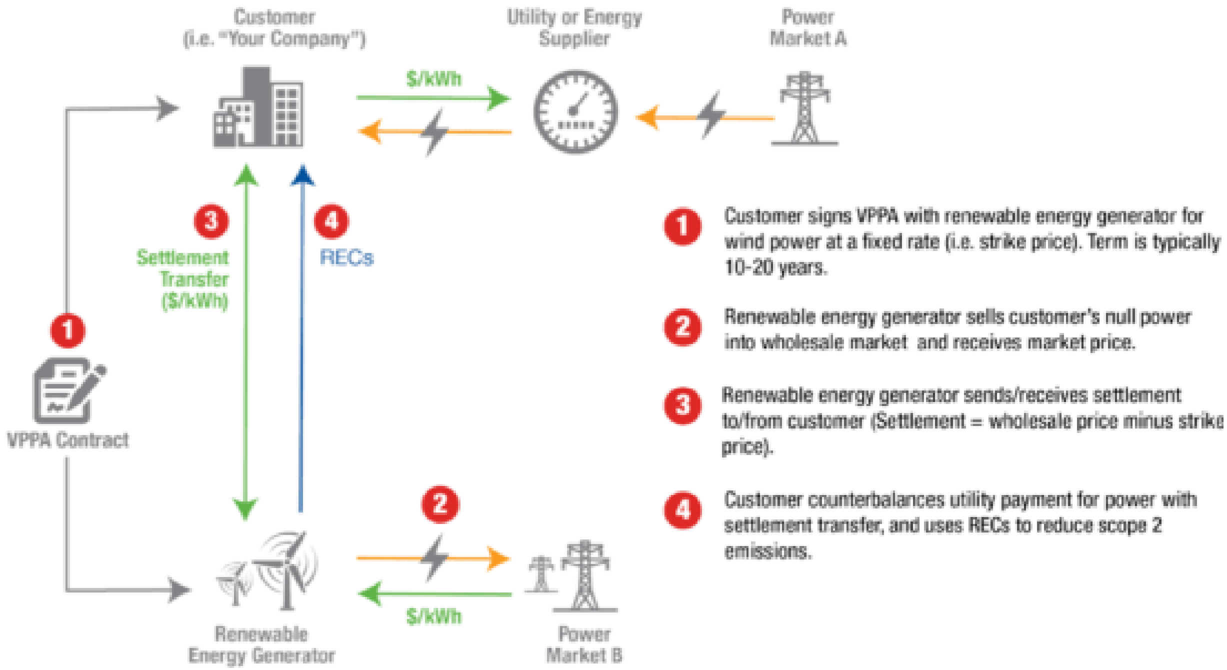
[14] *Institutional Renewable Energy Procurement: Quantitative Impacts Addendum.* (2016). Higher Education Working Group Boston Green Ribbon Commission. https://www.greenribboncommission.org/document/institutional-renewable-energy-procurement-quantitative-impacts-addendum/

[15] "Introduction to the Virtual Power Purchase Agreement." Rocky Mountain Institute. https://rmi.org/insight/virtual-power-purchase-agreement/

[16] *Innovation Through Aggregation: A Case Study of Partnership to Purchase Renewable Energy.* (2017). A Better City. https://www.abettercity.org/docs-new/Innovation_Through_Aggregation.pdf

coordination with other local groups to enter into a joint agreement will creates logistical and implementation challenges.

Figure 6. Virtual PPA Diagram[17]



GHG Reduction Potential

The Conservancy has a relatively low energy consumption rate, meaning that a VPPA would be able to account for all of the Conservancy electricity usage. This would be about 140 metric tons of CO_2.

Cost-Effectiveness

If the Conservancy is able to enter into a joint agreement, a VPPA could be a valuable cost-effective measure to address their sustainability goals. While exact numbers will depend on a number of factors, including contract terms, the current cost of electricity, and level of consumption, the report outlining the findings of the joint VPPA mentioned above indicated that, "the partners in this solution expect to realize meaningful savings over the next 25 years."[18]

Ease of Implementation

VPPAs are complex agreements that likely require external technical and legal consultation to implement an effective transaction.

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[17] *Introduction to Virtual Power Purchase Agreements.* (2016). EPA Green Power Partnership. https://www.epa.gov/sites/production/files/2016-09/documents/webinar_kent_20160928.pdf (Slide 20)

[18] *Innovation Through Aggregation: A Case Study of Partnership to Purchase Renewable Energy.* (2017). A Better City. https://www.abettercity.org/docs-new/Innovation_Through_Aggregation.pdf

Degree of Autonomy

This pathway will also likely require coordination with other local groups to enter into a joint agreement, but approval from MassDOT will not be necessary for the Conservancy to pursue a VPPA.

Educational Value

Similar to other potential pathways, the energy procured from a VPPA can be used as a marketing and educational strategy but lacks a physical presence. A successful collaboration among local nonprofit or NGO groups can also be used as a case study for entities who are in a similar to the Conservancy.

Table 2. Virtual Power Purchase Agreement (VPPA)

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
High	High	Low-Medium	Low-Medium	Low-Medium

Community Solar

Community solar is a virtual net metering initiative that has been legal in Massachusetts since 2008, under the Green Communities Act. Community solar, also known as shared solar, enables households and organizations to purchase or subscribe to a solar installation, typically 1-10 megawatts, within their utility service territory. Participating utility customers, including residents, small businesses, and municipalities, receive full bill credits at the retail electricity rate for the energy produced by their shares of the project.[19] Community solar offers equal access to the benefits of renewable energy, such as cost savings (accruing to MassDOT), electricity rate stabilization, energy independence, lower GHG emissions, and local economy stimulation, regardless of a property's onsite solar potential.

Community solar projects are also eligible for federal and state tax incentives, including the Solar Massachusetts Renewable Target (SMART) Program. In Massachusetts, community solar options are commonly provided through power companies, solar providers, and private equity firms, and often offer two contracting options. Participants can enter into an ownership model, in which they directly purchase a number of PV panels within the solar project and own the energy that is produced from those panels. Alternatively, participants can enter into a subscription model, where the customer pays a fixed monthly rate for energy from the array.

GHG Reduction Potential

Based on available community solar projects, the Conservancy would be able to offset most of their electricity-based emissions through this pathway, or 140 metric tons of CO_2. It is also important to

[19] *Institutional Renewable Energy Procurement: Guidance for Purchasing and Making Associated Environmental Impact Claims.* (2016). Boston Green Ribbon Commission Higher Education Working Group. https://www.greenribboncommission.org/wp-content/uploads/2016/10/Institutional-Renewable-Energy-Procurement-Guidance_REV.pdf

recognize that, as opposed to many other mitigation pathways, community solar often results in local emissions reductions.

Cost-Effectiveness

Incentives and contract flexibility allow community solar to be a viable cost-effective option. In addition to general rate stabilization, the economics of renewable energy also open up the opportunity for potential cost savings for participating members (i.e. MassDOT). Actual energy rates will be dependent on the pricing model that the program offers. This could include discount over utility rate, escalating solar rate, flat per-kWh solar rate, flat monthly fee, lease to own, partial up-front payment, and full up-front payment.[20] As a result of the differing pricing models, it is difficult to calculate the expect costs or savings associated with participating in a community solar project for the Conservancy.

Ease of Implementation

Both the ownership and subscription models offer a straightforward path towards renewable energy procurement, with the subscription method being the simplest. Implementation of community solar consists of finding an eligible project and entering into a procurement contract.

Degree of Autonomy

The Conservancy's participation in a community solar program would be dependent on MassDOT, however it can be marketed as a sustainable solution that provides consistency and potential cost savings for MassDOT.

Educational Value

Because community solar is a local-based strategy, this pathway presents an opportunity to educate surrounding entities and Greenway patrons about steps they can take to reduce their carbon footprints. The Conservancy would also have a physical representation of their efforts in the area as well.

Table 3. Community Solar

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
High	Low-Medium	Medium-High	Low	Medium

Community Choice Aggregation

The US Environmental Protection Agency (EPA) provides a succinct definition of Community Choice Aggregations (CCA), which is as follows:

"Community choice aggregation (CCA), also known as municipal aggregation, are programs that allow local governments to procure power on behalf of their residents, businesses, and municipal accounts from an alternative supplier while still receiving transmission and distribution service from their existing utility

[20] "Community Solar: Pricing Models." EnergySage. https://www.energysage.com/solar/community-solar/pricing-models/

provider. CCAs are an attractive option for communities that want more local control over their electricity sources, more green power than is offered by the default utility, and/or lower electricity prices. By aggregating demand, communities gain leverage to negotiate better rates with competitive suppliers and choose greener power sources."[21]

CCAs typically manifest as an optional alternative to standard electricity service and sometimes include an option for 100% renewable energy. However, the exact options available depend on how the municipality chooses to structure the CCA. In July 2020, Boston received approval from the Department of Public Utilities to move forward with their proposed plan for Community Choice Electricity.[22] Once Boston's CCA is established, the Conservancy and MassDOT will be able to participate, through an automatic enrollment process for all Eversource Basic Service customers. This will provide access a cleaner electricity supply, inherently lowering electricity-based emissions.

GHG Reduction Potential

The efficacy of this option will depend on the final design of the Boston CCA program. As it stands, high-renewable option will include electricity that is source from 75-100% renewable energy. Opting into the high-renewable option will allow the Conservancy to reduce its emissions between 105 to 140 metric tons of CO_2, depending on the final percent of renewable energy procured from renewable sources.

Cost-Effectiveness

It is important to note that CCA electricity rates can be more expensive than standard electricity rates. CCA rates vary across location, supplier, energy source, and the structure of the program. It is common for CCAs to have lower electricity prices than the standard retail rates, with up to a 15-20% discount.[23] To determine the cost-effectiveness of joining the Boston CCA program, the Conservancy will need to assess their average annual electricity usage and their electricity supply rate on existing bills to estimate future costs, and compare that to the expected rates of the incoming CCA plan.

The following Massachusetts-based examples can give an idea of local CCA rates:

Brookline Green Electricity[24]

- Brookline Basic: Minimum required renewable energy – $0.10715 cents per kWh
- Brookline Green: 30% local renewable energy – $0.11615 cents per kWh
- Brookline Green 65: 65% local renewable energy – $0.12665 cents per kWh
- Brookline All Green: 100% local renewable energy – $0.13715 cents per kWh

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[21] "Community Choice Aggregation." US EPA Green Power Partnership. https://www.epa.gov/greenpower/community-choice-aggregation

[22] "Mass. Department of Public Utilities Approves City's Community Choice Electricity Program." City of Boston. https://www.boston.gov/news/mass-department-public-utilities-approves-citys-community-choice-electricity-program

[23] "Cost of Community Choice Aggregation." EnergySage. https://www.energysage.com/other-clean-options/community-choice-aggregation/cca-cost/

[24] "Brookline Green Electricity." Town of Brookline. https://www.brooklinema.gov/1340/Brookline-Green-Electricity

Arlington CCA[25]

- Arlington Basic – $0.10631 per kWh
- Arlington 5% Green – $0.10756 per kWh
- Arlington 50% Green – $0.11881 per kWh
- Arlington 100% Green – $0.13131 per kWh

For context, the Eversource basic utility rate in Arlington is $0.13704 per kWh, or $0.00573 more expensive than the 100% renewable energy CCA. Boston's CCA has not been finalized. However, based upon other local CCAs like Arlington and Brookline, experience suggests that 100% green rates could range from approximately -5% to 30% of current rates.

Ease of Implementation

CCA is considered the easiest proposed action to take, however it is dependent on the implementation of a program in Boston, which is expected to launch in early 2021.

Degree of Autonomy

MassDOT will need to make the final decision on whether or not to participate in the program because it pays for the Conservancy's utility bills as in-kind donations. As mentioned above, CCA rates are sometimes higher than current standard rates, which may present a barrier to MassDOT's participation.

Educational Value

While there is no physical evidence of enrollment in a CCA, the Conservancy would be able to market its participation as a commitment to environmental stewardship. It would also allow the Conservancy to exhibit support for a local program accessible to Boston's residents, businesses and institutions.

Table 4. Community Choice Aggregation

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Medium-High	Medium	High	Medium	Medium

On-Site Solar Development

Installation of solar PV systems throughout the Greenway and on MassDOT buildings is also an option to green the electricity powering the Conservancy. The Conservancy has expressed interest in exploring the possibility of systems on park grounds and on the incoming MassDOT maintenance building. While the size of such systems will be limited, smaller PV installations would be able to offset some of the Conservancy's electricity use. Visible on-site solar systems can be utilized by the Conservancy to promote sustainability, educate the public on renewable energy, and boost the organization's public image as a green-focused group.

[25] "Arlington 100% Green Electricity Cheaper than Eversource Basic. Town of Arlington. https://www.arlingtonma.gov/Home/Components/News/News/9057/354?arch=1

GHG Reduction Potential

On-site solar's ability to help the Conservancy reach its climate goals are limited based on the availability of appropriate space to install panels. The average residential solar PV array is about 5 kW, which is estimated to be a similar size viable for the Conservancy to install. It is estimated that 5 kW PV systems produce about 150 MWh of electricity throughout its life. If the lifetime of the equipment is assumed to be about 25 years, this equates to about six MWh per year, which is only about 1.4% of the Conservancy's electricity consumption, resulting in about two metric tons of CO_2 emissions avoided annually.

Cost-Effectiveness

Based on August 2020 data, the average solar panel is $3.20 per Watt in Massachusetts. Under the assumption of a 5 kW PV system, the average Massachusetts solar installation varies from $13,600 to $18,400, with an average gross price of $16,000.[26]

MassDOT-owned solar systems would be eligible for the Solar Massachusetts Renewable Target (SMART) Program, a state-run solar incentive, with additional benefits for being a public entity. There are additional local, state, and national incentives for solar installation as well. It would be critical for the Conservancy and MassDOT to thoroughly assess the efficiency of potential systems, accounting for aspects like shading, orientation, tilt, and system size, to ensure the financial effectiveness of investing in on-site solar developments.

Ease of Implementation

The process of installing solar on the Greenway would be relatively easy, again, depending on suitable space. The Conservancy would need to select a solar installer based on quoted pricing and design. The Conservancy would be able to consult several installers and review their proposals ahead of this decision. Solar installation and connection is a fast process that would likely be fully completed in less than two weeks.

Degree of Autonomy

The Conservancy may need to receive approval from MassDOT to install solar panels in the Greenway, given that MassDOT owns the land. Additionally, if the Conservancy plans to use MassDOT funding to procure on-site solar arrays, further communication and planning may become necessary.

Educational Value

On-site solar can promote the sustainability image of the Conservancy and serve as a community model of active urban renewable energy. Of all of the pathways, on-site solar offers the most opportunity for public education.

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[26] "Solar Panel Cost in Massachusetts." EnergySage. https://www.energysage.com/local-data/solar-panel-cost/ma/#:~:text=Average%20solar%20panel%20cost%20by%20system%20size%20in,%20%20%2414%2C208%20%204%20more%20rows%20

Table 5. On-Site Solar Development

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Low-Medium	Medium	Medium	Low-Medium	High

Energy Efficiency and Green Building Design

Energy Efficiency Measures in Current Office Space

The Conservancy's office space has limited opportunities for near-term emissions reduction. As a tenant within MassDOT's office building, the Conservancy has little control over the building's heating and cooling technologies. Currently, the building uses forced air heating and cooling systems, with additional heaters on the perimeter of the office space. The Conservancy has indicated that it has little control over the temperature systems within their office, including the heaters. While the MassDOT building has been continually upgraded over the past ten years, full retrofits of a building's heating system of that size and age are difficult, disruptive, and costly. It may be difficult to gain MassDOT's support for such a significant undertaking, despite the cost and emissions savings of such actions.[27] However, as Boston continues to implement its Climate Action Plan and move towards net-zero buildings citywide, MassDOT may be forced to take more significant steps towards carbon neutrality.[28]

Despite these limitations, the Conservancy can still make progress towards their sustainability goals by implementing energy efficiency measures, such as installing (or optimizing existing) smart or programmable thermostats, using energy efficient appliances and office technologies, implementing behavior-based energy consumption reduction efforts, and installing motion sensors for office lighting. The following energy efficiency mitigation options will be discussed separately to allow for a clear explanation of the options and their associated merits. However, they will receive an aggregated score for each criterion because even if aggregated, they will have a limited impact on the organization's overall emissions.

Programmable Thermostats

While the viability of programmable thermostats is dependent on a building's heating and cooling technology, automatic or programmable thermostats allow heating or air-conditioning to be turned on or set to specific temperatures according to a set schedule. The Department of Energy estimates that

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[27] *Retrofitting Existing Buildings to Improve Sustainability and Energy Performance.* (2016). National Institute of Building Sciences. https://www.wbdg.org/resources/retrofitting-existing-buildings-improve-sustainability-and-energy-performance

[28] "Plan for Carbon Neutrality and Actions for Zero Net Carbon Buildings Released." City of Boston. https://www.boston.gov/news/plan-carbon-neutrality-and-actions-zero-net-carbon-buildings-released

building occupants can save as much as 10% a year on temperature regulation just by turning down the thermostat 7-10 degrees from its normal setting for eight hours a day.[29]

Energy Efficient Appliances

From coffee makers and refrigerators, to printers and computer monitors, everyday office appliances are the culprit of significant energy draws. Switching over to certified energy efficient appliances, such as Energy Star products, can reduce appliance energy usage and costs, lower GHG emissions and water consumption, and increase the efficiency and effectiveness of the appliance. Energy Star-labeled office appliances can provide as much as 75% energy savings, with all available products offering about half the electricity use of standard appliances.[30]

Behavior-based Actions

There are several steps the Conservancy can take to reduce energy dependence through behavior-based efforts: Unplug appliances when not in use, utilize computer sleep mode and power management features, strategically turn off lights, and be conscious about temperature regulation. While the energy savings associated with behavior-based energy efficiency are minimal, they create sustainable habits and should be considered as beginning step in the Conservancy's steps towards significant energy reductions.

Motion Sensors

Motion sensor lighting technology uses movement throughout the space to assess whether lighting is necessary in the moment. Motion sensor technology reinforces behavior-based actions and encourages further energy usage reductions. For example, in moments where staff members step out of the office for lunch or a meeting, the motion sensors will adjust the lights in the office space accordingly.

Table 6. Energy Efficiency Measures in Current Office Space

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Low	Medium-High	Medium-High	Medium	Low

Green Building Design in New Maintenance Facility

MassDOT is currently in the process of designing a building that will be used by the Conservancy as a maintenance facility and vehicle storage area. The Conservancy has expressed interest in incorporating sustainable features into the design and construction of the building. MassDOT has the opportunity to leverage the Leading By Example program to build a state-of-the-art net-zero emission facility, including

[29] "Thermostats." US Department of Energy. https://www.energy.gov/energysaver/thermostats

[30] "Energy Efficient Computes, Home Office Equipment, and Electronics." US Department of Energy. https://www.energy.gov/energysaver/appliances-and-electronics/energy-efficient-computers-home-office-equipment-and

renewable and clean energy technologies such as air or ground source heat pumps, on-site solar panels, and electric vehicle charging infrastructure. Other building efficiency aspects that can be considered range from the building orientation and insulated concrete panels (to maximize passive lighting and heating opportunities), to LED lights and energy efficient appliances and lighting systems. The Conservancy has stated that the design of this building is about 75% completed, so the time to advocate for sustainability additions is now. Even if the building does not achieve net-zero emissions, implementing some of the measures listed above will allow the Conservancy to expand their electric vehicle inventory and benefit from clean energy investments. The building will additionally allow MassDOT and the Conservancy to show themselves to be leaders on sustainability, which aligns with Massachusetts's long-term decarbonization efforts and the Conservancy's overall sustainability goals.

GHG Reduction Potential

Because this is a new building, this action will not primarily result in reduction of GHG emission but would instead result in avoided emissions. Instead of reducing emissions that had happened in previous years, this action would avoid the added emissions that would otherwise accompany the development of a new building. The degree of avoided emissions is uncertain because it depends on how many sustainability features are adopted. Theoretically, the building could achieve net-zero emissions, completely avoiding any potential added emissions. The facility also presents an additional opportunity for the Conservancy to store and charge electric vehicles. A complete inventory transition may become more feasible and have a direct impact on the Conservancy's total carbon output.

Cost-Effectiveness

In general, net-zero buildings, or buildings with above-average efficiency, are more expensive to build. A 2017 study of the commercial net-zero energy building market in Boston found that net-zero or near-net-zero structures had a cost premium ranging from 6-16% above conventional construction costs. While upfront costs of constructing high-tech, high-efficiency buildings are considerable, operation and maintenance costs of such facilities were found to be lower than for code-compliant buildings.[31]

Ease of Implementation

From the Conservancy's side, the implementation of top-tier energy efforts would be tied to communicating and collaborating closely with MassDOT. The Conservancy will most likely need to provide informational materials, cost-benefit analyses, and other persuasive resources to persuade MassDOT to adopt potentially expensive sustainability features.

Degree of Autonomy

Since this is a MassDOT owned and operated building, the Conservancy may have the opportunity to express the sustainability concepts they would like to see in the new design. However, it will ultimately be MassDOT's decision on what is included in the final design of the maintenance facility.

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[31] The Commercial Net Zero Energy Building Market in Boston (2017). A Better City. https://www.greenribboncommission.org/wp-content/uploads/2017/05/abc-rpt-netzero-4.17-final-1.pdf

Educational Value

Designing and developing a state-of-the art facility could boost both MassDOT and the Conservancy's images as sustainability leaders.

Table 7. Green Building Design in New Maintenance Facility

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Low-Medium	Medium	Medium	Low	Medium-High

Mobile sources

Convert Fleet to Electric Vehicles

Fuel use associated with transportation and maintenance equipment represent about 6% of the Conservancy's overall emissions. Looking closer at mobile source outputs, gasoline claims 88% of these emissions while diesel only accounts for 12%. The majority of emissions driven by mobile sources, come from the Conservancy's off-road maintenance and off-road horticulture vehicles and equipment, responsible for 34% and 19% of transportation emissions, respectively. The Conservancy has already taken significant steps towards transitioning their asset inventory to electric vehicles. Since the completion of the inventory, the Conservancy has transitioned towards more electric vehicles. Further actions can include a complete transition to a 100% electric vehicle inventory, with the guarantee that future vehicle purchases will be electric-powered. This would need to occur with the approval of MassDOT and could leverage the Leading By Example program mentioned above, however the Conservancy has indicated that they will be receiving additional vehicle funding in two years. This would also need to be accompanied by a continued expansion of electric vehicle charger infrastructure in the Conservancy's vehicle storage facilities.

GHG Reduction Potential

The GHG reduction potential of electric vehicles is dependent on the carbon intensity of the electricity grid. If the electricity that a vehicle runs on is generated using conventional fossil fuels, then GHG reduction potential remains low. Energy grids with high rates of electricity from renewable sources offer the strongest environmental benefits for switching to electric vehicles. According to the EPA, Massachusetts has a comparatively clean electricity grid. The Union of Concerned Scientists estimates that, from an emissions perspective, driving an electric vehicle is the equivalent of driving a vehicle that gets 103 miles per gallon of gasoline.[32] This is under a quarter of the emissions than the average car.[33] The GHG reduction potential for the Conservancy can further be enhanced by pairing electric vehicle

[32] Reichmuth, D. (2017). New Numbers Are In and EVs are Cleaner Than Ever. Union of Concerned Scientists. Retrieved from https://blog.ucsusa.org/dave-reichmuth/new-numbers-are-in-and-evs-are-cleaner-than-ever?_ga=2.219821017.1933114869.1599497697-1813301242.1597863396

[33] Steve, J. (2019). The 5 Most Fuel-Efficient Cars on the Road Today – and the 4 Least Fuel-Efficient Ones. Business Insider. Retrieved from https://www.businessinsider.com/most-fuel-efficient-cars-vehicles-best-gas-mileage-2019-11

deployment with one of the electricity decarbonization options listed above. By transitioning their entire fleet to electric the Conservancy could reduce emissions from mobile sources, by an estimated 75 to 100% depending on the renewable of renewable energy associate with their electricity use. This would equate to about 9 to 12 metric tons of CO_2 emissions.

Cost-Effectiveness

While electric vehicles are currently more expensive than similar gasoline-powered vehicles, the International Council on Clean Transportation estimates that the five-year total cost of ownership of electric vehicles will be lower than for gasoline-powered vehicles sometime in the 2020-2026 time frame.

Ease of Implementation

The Conservancy has already completed an impressive transition towards an 100% EV inventory in recent years and is familiar with the process of purchasing electric vehicles. The Conservancy will need to perform thorough research to find viable vehicles for the Conservancy's needs and budget. The Conservancy should also consider existing charging infrastructure and if an expansion of its EV inventory will require further investment in EVSE.

Degree of Autonomy

The Conservancy is dependent on additional funding from MassDOT, which is expected in the next two years. Regarding charging infrastructure, the Conservancy will most likely need to communicate and coordinate with MassDOT about potential EV compatible spaces in existing parking facilities and within the new maintenance building.

Educational Value

Having branded electric vehicles on the Greenway and throughout the surrounding area can promote EV use in green space management and draw attention to the Conservancy as a sustainable leader.

Table 8. Convert Fleet to Electric Vehicles

GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Low-Medium	Medium	Medium-High	Low-Medium	Medium

Scope 3 Emissions

As briefly discussed above, Scope 3 emissions refer to all indirect emissions, including those associated with purchased goods and services, travel, waste management, leased assets, investments, and vendors. In the context of the Conservancy, any emissions produced from contracted food trucks, third-party lawn maintenance, and waste disposal are considered Scope 3 emissions. While these emissions aren't the result of an entity's direct actions, Scope 3 sources can be a significant contributor to an entity's total emissions and present a critical opportunity for action.[34] However, it is also important to recognize that the Conservancy may have limited ability to influence emissions from on-site vendors, such as food trucks.

Scope 3 emissions were not considered in this current assessment of the Conservancy's carbon footprint or in the potential mitigation strategies. However, there are general steps that the organization can take to reduce the emissions from these scope 3 sources. For example, the Conservancy recently published board-approved procurement contract provisions that address the Conservancy's desire to select bidders with explicit sustainability priorities. Within its Procurement Policy, the Conservancy states that it evaluates bidders based on "Best Value." Best value is defined as "the most advantageous combination of multiple criteria, including but not limited to the following: quality, economic value, timely performance, the procurement and use of recycled products and environmentally preferable products and services, minimal administrative burden, expediency, flexibility in developing alternative business relationships and the continuing participation of quality contractors." To demonstrate their qualifications and value to the Conservancy, bidders are required to submit information regarding their use of "recycled products and environmentally preferable products and services including, as applicable, organic products on recent projects and regarding the Contractor's commitment to sustainability practices."[35]

By emphasizing environmentally friendly practices among its contractors, the Conservancy has taken significant steps towards lowering their Scope 3 emissions, while promoting their values and ideals as an organization. Being aware of potential Scope 3 emissions can guide the Conservancy in future partnerships, hiring processes, and organizational decision-making. When indirect emissions are accounted for, sustainability can be highlighted in every aspect of the Conservancy's operation.

[34] "Corporate Value Chain (Scope 3) Standard." Greenhouse Gas Protocol. https://ghgprotocol.org/standards/scope-3-standard

[35] Greenway Procurement Policy.

Emissions Management Strategy

In developing a GHG mitigation management strategy, it is important to evaluate the criteria discussed in this report, but also recognize the constraints in which the Conservancy operates. While a management strategy that reaches net zero emissions would be the desired outcome for the Conservancy, the feasibility of such a strategy is important to consider. The management strategy outlined in this report focuses on developing an approach that will maximize greenhouse gas reductions, while operating within the budgetary and management constraints facing the Conservancy. Table 1 provides a summarized high-level depiction of the GHG management strategies outlined in this section of the report.

The emissions management strategy provides recommendations on the actions that the Conservancy should take to reduce greenhouse gas emissions. The actions are divided into two categories: *High-Priority Actions* and *Other Actions*. The high-priority actions are those that have the largest potential to reduce GHG emissions or have a time-sensitive aspect.

Table 9. Overview of Mitigation Strategies

Mitigation Strategy	GHG Reduction Potential	Cost-Effectiveness	Ease of Implementation	Degree of Autonomy	Educational Value
Unbundled RECs	High	Low	Medium-High	High	Low-Medium
VPPA	High	High	Low-Medium	Low-Medium	Low-Medium
Community Solar	High	Low-Medium	Medium-High	Low	Medium
CCA	Medium-High	Medium	High	Medium	Medium
On-Site Solar	Low-Medium	Medium	Medium	Low-Medium	High
Energy Efficiency Measures	Low	Medium-High	Medium-High	Medium	Low
Green Building Principles	Low-Medium	Medium	Medium	Low	Medium-High
EV Transition	Low-Medium	Medium	Medium-High	Low-Medium	Medium

High-Priority Actions

Community Choice Aggregation

The Conservancy should seek to opt into the community choice aggregation (CCA) program being offered by the City of Boston and should opt up to the high-renewable option. While the design of the CCA is still somewhat uncertain, Boston has indicated that it will offer an option with between 75-100% renewable energy.[36] Opting into the CCA will create significant GHG emissions reductions, while offering the simplest implementation pathway. This action is listed as high priority because of the time-sensitivity associated with the timeline to finalize the plans for the new maintenance facility.

There are two primary challenges that will arise from this action. The first is that that a high-renewable CCA will be more expensive than standard electricity service. The second is that MassDOT will need to approve the selection of the high-renewable CCA for any electric meters that are in its name. If MassDOT is not willing to pay for the additional cost of the high-renewable CCA, the Conservancy could pay for the difference between the standard service the high-renewable CCA. Each year the MassDOT and the Conservancy could calculate the difference between the standard rate and the high-renewable CCA and multiply it by the total kWh consumed by the Conservancy to determine the settlement price between the Conservancy and MassDOT. Based on programs in Arlington and Brookline and on the Conservancy's electricity usage in 2019, this cost is expected to be between $11,000 to $13,000 a year.[37]

New Maintenance Facility

The Conservancy should work with MassDOT to adopt as many sustainability features in the design of the new maintenance facility as feasible. This action is listed as high priority because of the time-sensitivity associated with the timeline to finalize the plans for the new maintenance facility. Sustainability features that could be considered in the design of the facility include:

- Air- or ground-source heat pumps for building heating,
- rooftop or other on-site solar panels for electricity,
- electric vehicle charging infrastructure,
- LED lighting,
- energy efficient appliances, and
- optimize building orientation and utilize insulated concrete panels to maximize passive lighting and heating opportunity.

The Conservancy should encourage MassDOT to leverage the Leading by Example program and Massachusetts' SMART solar incentive program. Implementing these sustainability features into building design will prevent an increase in GHG emissions as the result of adding a building to the inventory and will likely reduce the costs of operating the maintenance facility as less money will need to be spent on heating and electricity.

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[36] *City of Boston – D.P.U. 19-65.* (2019). Department of Public Utilities. https://www.boston.gov/sites/default/files/embed/file/2019-06/dpu_19-65_city_of_boston_letter_petition_6.20.19.pdf (Pg.123)

[37] The final design of Boston's CCA program is still uncertain. These values are estimates based on the difference between the 100% renewable energy option and the standard rates in Arlington and Brookline.

Additional Actions

EV Fleet Conversion

The Conservancy should seek to ensure that all new vehicle purchases are electric, where there is a viable electric option considering the constraints of use-case and cost. The Conservancy has already transitioned most of its fleet to electric vehicles. However, to ensure continued progress on reducing emissions from their fleet it is important for the Conservancy to continue to convert their fleet to electric where it makes sense to do so. To mitigate costs, the Conservancy should replace vehicles in their natural turnover cycle instead of retiring vehicles before the end of their useful life.

Energy Efficiency Measures in Office

The Conservancy should work with MassDOT to implement the energy efficiency actions outlined in this report to reduce heating and electricity use in their office space. These actions include:

- installing motion sensors for lighting;
- purchasing energy efficient appliances and office equipment when equipment needs to be replaced;
- installing a smart or programmable thermostat or optimizing existing smart or programmable thermostat; and
- implementing a behavioral program to encourage energy efficient behaviors.

These actions are described in more detail earlier in this report. These actions are easy to implement but will have small impacts on greenhouse gas emissions. However, as with most energy efficiency measures, there will be cost savings for MassDOT associated with the decreased consumption of heating.