The Cambridge Carbon Fund
Program Design Recommendations

Harvard Kennedy School
Policy Analysis Exercise

Submitted By:

Annika Brink
Master Degree Candidate 2011
Public Policy

Submitted To:

Vice Mayor Henrietta Davis
City of Cambridge

Supported By:

Professor William C. Clark
Faculty Advisor
Professor Julie Boatright Wilson
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Acknowledgements

This report was made possible by the patient cooperation of interviewees in the business, government, nonprofit, and activist communities. I would especially like to thank my contacts at the City of Cambridge: John Bolduc, Susanne Rasmussen, and my project sponsor, Vice Mayor Henrietta Davis.

I would also like to thank my colleagues at the Harvard Kennedy School; my PAE seminar leader, Professor Julie Boatright Wilson; and my advisor, Professor William C. Clark.

THANK YOU to everyone who took the time to talk with me, to share ideas, and to answer questions.

Acronyms

ACR	American Carbon Registry
ACUPCC	American College and University Presidents' Climate Commitment
CAR	Climate Action Reserve
CCB	Climate, Community, and Biodiversity Standards
CCF	Cambridge Carbon Fund
CCURB	Community Carbon Use Reduction at Brown
CCX	Chicago Climate Exchange
CDM/JI	Community Development Mechanism/Joint Implementation
CEA	Cambridge Energy Alliance
CFCs	Chlorofluorocarbons, potent greenhouse gasses
CO_2	Carbon dioxide
DPW	Department of Public Works
e.e.	Energy efficiency
EPA	United States Environmental Protection Agency
GHG	Greenhouse gas
GS	Gold Standard
HCFCs	Hydro-chlorofluorocarbons, potent greenhouse gasses
HEET	Home Energy Efficiency Team
HH	Household
ISO	International Standards Organization
LEED	Leadership in Energy and Environmental Design
LFG	Landfill gas
MEPA	Massachusetts Environmental Policy Act
MIT	Massachusetts Institute of Technology
$mtCO_2e$	Metric ton of carbon dioxide equivalent
NP/MUSH	Nonprofit, Municipal, Schools, and Hospitals
ODS	Ozone depleting substances (e.g. CFCs and HCFCs)
REC	Renewable Energy Certificate
RGGI	Regional Greenhouse Gas Initiative
RGGI COATS	Regional Greenhouse Gas Initiative CO_2 Allowance Tracking System
SBLP	Sustainable Business Leader Program
UF	University of Florida
VCS	Verified Carbon Standard (Voluntary Carbon Standard before 2011)
VER+	VERplus
WWF	World Wildlife Fund

Table of Contents

SECTION I
Executive Summary

Introduction

The local carbon fund is an innovative, yet challenging program type that has emerged in a few cities and states over the past five years to capitalize on growth in the voluntary carbon markets. A local carbon fund administers carbon reduction projects and offers local institutions and individuals the opportunity to invest in carbon offsets or donations that support these projects.

Cambridge is home to several institutions, including Harvard University, with ambitious greenhouse gas (GHG) reduction goals that may require offset purchases. But, many potential purchasers are skeptical that distant offset projects are achieving the promised GHG reductions. This provides an opportunity for a potential "Cambridge Carbon Fund" to produce tangible carbon reductions from local projects. In theory, purchasers of local carbon products get positive green publicity, help local governments fund GHG reduction goals, and generate local co-benefits.

Purpose

The purpose of this report is to answer two central questions:

(1) Is a local carbon fund a viable option for the City of Cambridge?
(2) If it is viable, which program design options will maximize its success?

Assessment Strategy

This report's analysis relies heavily on interviews with potential purchasers and the managers of existing local carbon funds. I also consulted documents published by the City of Cambridge, the State of Massachusetts, the Regional Greenhouse Gas Initiative (RGGI), nonprofit and for-profit carbon market experts, voluntary offset standard organizations, and potential purchasers.

The Problem: Why it's hard to design a successful local carbon fund

Cambridge must make decisions about a potential local carbon fund in the context of nascent, evolving voluntary carbon markets and an uncertain regulatory future. This creates the central problem that this report addresses.

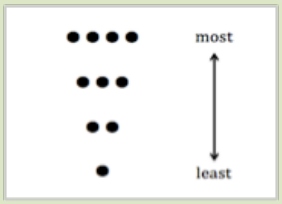
> **Central problem: Is anybody buying? When and under what conditions?** Without demand from purchasers/donors, the carbon fund model cannot function.

Guiding Criteria

I applied the following criteria, which I created in collaboration with City staff, to analyze program design options. The recommended carbon fund is designed to maximize the ability of the program to:

(1) produce high-quality carbon reductions,
(2) have a significant impact,
(3) produce attractive and affordable carbon products,
(4) be administratively feasible, and
(5) be politically acceptable.

Throughout this report, I rate program design options according to these five guiding criteria. These ratings are summarized in Criteria Scorecards, which rank options according to each criterion on a scale from most (••••) to least (•) desirable. These points are then added up for each option and the highest-scoring option is highlighted in green.



Areas of Recommendation

The guiding criteria are applied to the following areas in order to make recommendations.

(1) First, this report addresses whether or not a carbon fund is viable.

Overall program viability, including timeline and fund type

(2) It then considers a variety of practical and strategic questions, in order to ultimately provide analysis and recommendations in the areas of:

- **Program administration**
- **Partners**
- **Number of projects and project types**
- **Project types**
- **Price**
- **Targeting carbon products toward potential purchasers**
- **Offset verification**

Analysis of Options and Recommendations

Overall program viability, including timeline and fund type

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Immediate carbon offset fund rollout	••••	•	•	•	••	9
Immediate carbon benefit fund rollout	•••	••	••	•••	•••	13
Phased carbon benefit-to-offset rollout	••••	•••	•••	•••	•••	16
No carbon fund; pursue other programs	•••	•	•	••••	•••	12

Cambridge should create a phased benefit-offset fund, the Cambridge Carbon Fund (CCF), to prepare for future growth in carbon prices and local demand. Beginning with a benefit fund is lower risk and will:

- **Allow CCF to gain specialized administrative experience**
- **Allow CCF to prove the concept** of a carbon fund and to establish a positive reputation
- **Buy time** until Harvard and other potential purchasers are ready to offset

Program administration

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
City (municipal and/or other projects)	—	••	••	•	•••	8
City + carbon nonprofit	—	•••	•••	••••	••	12
City + local nonprofit(s)	—	•••	•••	•••	•••	12

The Cambridge Carbon Fund should be administered jointly by the City and a nonprofit. Nonprofit involvement will assure donors of tax-deductibility, while allowing CCF greater administrative flexibility, such as the ability to recruit volunteers. CCF will need outside carbon market expertise, either through a partnership or a consulting relationship with a specialty carbon organization.

Partners

The Cambridge Carbon Fund should engage multiple partners, including potential purchasers, in order to increase buy-in and credibility and attract in-kind donations. It should found an advisory team that includes potential purchasers, local experts, and environmental/scientific institutions. CCF should pro-actively craft partnership and co-development plans tailored to the missions and preferences of its partners.

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
No partners beyond administrative partners	••	••	••	•	•••	10
Partner and/or co-develop program with... Purchasers/donors Scientific experts In-kind donors	••••	•••	••••	•••	••••	18

Number of projects and project types

The Cambridge Carbon Fund should either run a few projects of one to two types, or one project at a time. These options minimize the crucial factors of administrative hassle and cost.

CRITERIA / OPTIONS	High-Quality Offsets	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Many projects, a variety of types	—	—	••	•	••••	7
Many projects, 1-2 types	—	—	•	••	•••	6
Few projects, 1-2 types	—	—	•••	•••	•••	9
One project at a time	—	—	••	••••	•••	9

Project types

During its benefit fund phase, the Cambridge Carbon Fund should pursue project types that are also eligible to produce offsets during the offset fund phase. It should choose from ODS destruction in appliances, residential weatherization, commercial boiler efficiency for multifamily and NP/MUSH, and landfill gas. Except for residential weatherization, these projects produce low-cost carbon reductions and represent at least moderately large volumes of reductions. These projects will have to be relatively large, especially if landfill gas offsets cannot be acquired.

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Ozone depleting substances (ODS)	••••	••	•• ••••	••••	••••	20
Postconsumer composting	••	•••	••• ••	••	••	14
Residential weatherization	••••	••	•••• ••	•••	•••	18
Comm. weatherization (NP/MUSH)	•••	••	••• ••	•••	••	15
Commercial boiler efficiency (NP/MUSH)	•••	•••	•• ••••	••	••	16
Solar PV or Solar thermal	•	•	•••• •	••••	••	13
Urban forestry	••••	•	•••• •	••	••	14
Bike share	••	••	••• ••	••••	••	15
Landfill gas (LFG)	••••	••••	• ••••	••	•••	18
Wastewater treatment plant methane	••••	•	• ••••	•••	•	14

Price

The Cambridge Carbon Fund should publicize a premium price of $20-$25 for casual purchasers and negotiate larger purchases privately. There is generally an inverse relationship between a project's cost and its "charisma" or attractiveness to investors. CCF should create a blended carbon product that uses low-cost carbon reductions to subsidize higher-cost, more attractive carbon reduction projects.

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Affordable*	Admin. Feasible	Politically Acceptable	TOTAL
Market price; varies by project	—	••••	•••	•	••	10
Moderate price; blended product	—	•••	•••	••	•••	11
Premium price; blended product	—	•••	••	•••	••••	12

* Attractiveness was not considered for this analysis

Targeting carbon products toward potential purchasers

CCF should, with its advisory board, quickly begin to incorporate purchaser and donor preferences into the CCF program design. During its benefit fund phase (gray), CCF should explore low-effort methods of appealing to individuals and reach out to medium and large locally-based businesses with charitable giving programs. It should also begin to court *offset* purchasers, exploring co-development opportunities that align CCF projects with purchasers' missions. During the offset phase (green), CCF should target purchasers with large emission reduction goals: universities and large non-local businesses.

CRITERIA / OPTIONS	High-Quality Offsets	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Individuals	—	••	—	••	••••	8
Small local businesses	—	•	—	•	••••	6
Universities	—	••••	—	••••	•••	11
Medium and large locally-based businesses	—	•••	—	•••	•••	9
Large non-local businesses w/local sites	—	••	—	••	•••	7
Large non-local businesses w/GHG goals	—	••••	—	•••	•••	10

Offset verification

During its carbon benefit fund pilot, the Cambridge Carbon Fund should not commit to using a certain offset verification standard in the future. Instead, CCF should commit to a set of quality principles, which should be transparent and prominently posted on its website. Certain offset standards can already be placed on a short list for monitoring and future consideration: they are ACR, CAR, VCS, Green-e Climate Protocol for Renewable Energy, and ISO 14064/65.

Potential Impact

CCF's significant impact goal is to reduce citywide emissions in 2020 by 27,200-36,300 $mtCO_2e$.

Potential Project Type	Citywide Emission Reduction in 2020	Percent of CCF Goal (27,200-36,300 $mtCO_2e$)	
		Countable Benefits	Countable Offsets
ODS destruction (482 appliances/year; 1% of HH)	Countable as benefits: 2,416 $mtCO_2e$** Countable as offsets: 627 $mtCO_2e$*	6.7-8.9%	1.7-2.3%
Residential weatherization (100 homes/year)	Countable as benefits: 928 $mtCO_2e$ Countable as offsets: 432 $mtCO_2e$	2.6-3.4%	1.2-1.6%
Commercial boiler efficiency (5 boilers/year)	7,560 $mtCO_2e$	20.8-27.8%	20.8-27.8%
Landfill gas (equal to annual waste emissions)	24,424 $mtCO_2e$	67.3-89.8%	67.3-89.8%
Total	**33,043-35,328 $mtCO_2e$**	**97-130%**	**91-122%**
Total without landfill gas	**8,619-10,904 $mtCO_2e$**	**30-40%**	**24-32%**

This table shows the potential of different project types, using conservative estimates of project size. These numbers demonstrate that CCF's ability to meet its goal is highly dependent on its ability to secure landfill gas offsets. If this is not possible, CCF will need to increase the size of its other projects, which may or may not be possible given local capacity constraints.

Next Steps

To move forward in creating the Cambridge Carbon Fund, the City should:

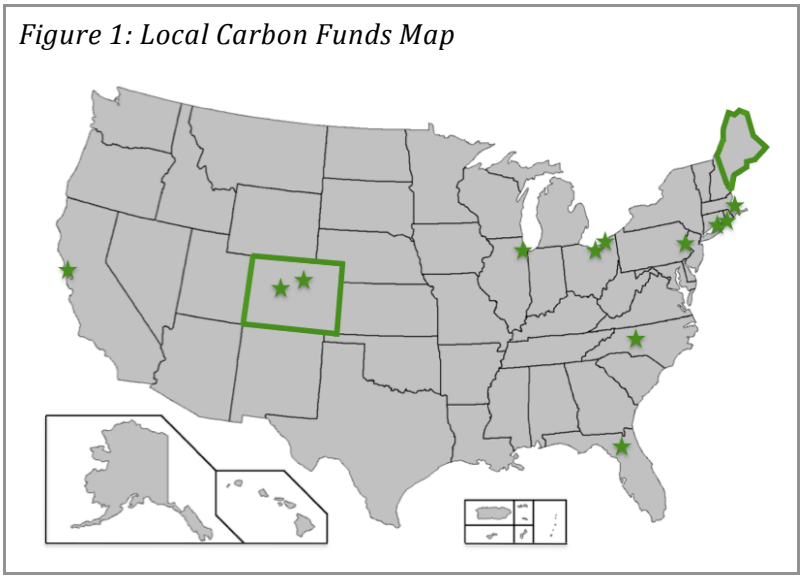
- Reach out to potential administrative partners
- Form an advisory board
- Reach out to potential local project contractors to determine local capacity
- Assess administrative/project costs and funding sources
- Monitor regulatory developments related to EPA boiler rules and MA waste regulations

SECTION II
Introduction

Context: Local Carbon Funds

The local carbon fund is a relatively new concept, which debuted in the United States in the last five years. It has been attempted in fewer than a dozen municipalities, a handful of universities, and only two states. Local carbon funds face multiple challenges and many of the local carbon funds attempted thus far have had to scale back expectations. Cambridge has the opportunity to apply its environmental program expertise to create a successful program model and act as a leader for others in this emerging field. Please refer to *Appendix A: Local Carbon Funds* for more information on existing programs.

Figure 1: Local Carbon Funds Map



The premise of a local carbon fund is to offer local businesses, institutions, and individuals the chance to fund quantifiable carbon reduction projects that take place locally. Many businesses and institutions are already considering purchasing carbon offsets as a way to meet internal greenhouse gas reduction (GHG) goals. Cambridge is home to several such institutions, some of which are considering purchasing or are already purchasing offsets from projects outside the City of Cambridge. Specifically, Harvard University has said it is unlikely to reach its ambitious greenhouse gas reduction goals without purchasing offsets.[1]

But, many potential purchasers are skeptical that offset projects, which are difficult to monitor from afar, are actually achieving the promised carbon reductions. This provides a niche opportunity for local actors to offer more tangible offsets from local projects. In theory, by purchasing local carbon products, purchasers get positive green publicity, help the local community achieve GHG reduction goals, and generate local co-benefits. These co-benefits include job creation; lower energy costs for low-income households, nonprofits, and small businesses; and higher awareness of actions that can be taken to reduce carbon emissions.

1 "Report of the Harvard University Task Force on Greenhouse Gas Emissions," 2008, 8. http://news.harvard.edu/gazette/wp-content/uploads/2008/07/GHG_TF_finalreport.pdf.

Generally, the purchasers/donors investing in a local carbon fund either receive nothing in return *or* receive voluntary carbon offsets to cancel out their own emissions. According to the nonprofit Offset Quality Initiative, "An offset represents the reduction, removal, or avoidance of GHG emissions from a specific project that is used to compensate for GHG emissions occurring elsewhere. One offset credit represents one metric ton of CO_2 equivalent."[2] In this report, "offsets" refers to voluntary offsets, which are not mandated by the Kyoto Protocol, the Regional Greenhouse Gas Initiative (RGGI) or any other government regulatory scheme.

Purchasers of voluntary offsets fall into two categories:

> **Pre-compliance purchasers.** These entities, generally power producers or large industrial businesses, anticipate having their emissions capped under future climate legislation. They purchase and stockpile voluntary offsets as a hedge against future regulation, and are thus only interested in offsets that are likely to be recognized under future regulation.
>
> **Purely voluntary purchasers.** These entities do not anticipate having their emissions capped in the future. These purchasers include individuals and mission-motivated organizations that just want to do the right thing or are motivated by the prospect of receiving positive green publicity. Some wish to fulfill the obligations of voluntary climate programs such as EPA Climate Leaders or the Chicago Climate Exchange (both now discontinued). Other entities, such as universities, face pressure from their peers: over 650 university presidents have signed the American College and University Presidents' Climate Commitment, committing their campuses to climate neutrality (Harvard University and MIT are not signatories).

This report will henceforth refer to a potential local carbon fund as the Cambridge Carbon Fund (CCF).

Purpose and Client Needs

Purpose

The purpose of this report is to answer two central questions:

(1) Is a local carbon fund a viable option for the City of Cambridge?
and
(2) If it is viable, which program design options will maximize its success?

2 The collaborative Offset Quality Initiative was founded by six environmental nonprofits: The Climate Trust, California Climate Action Registry, Environmental Resources Trust, Greenhouse Gas Experts Network, Pew Center on Global Climate Change, and The Climate Group.

Client Needs

The City of Cambridge is interested in creating the Cambridge Carbon Fund as a way to help reach its citywide emission reduction goals and to provide leadership in an emerging field. But, because the local carbon fund is still a largely unproven model, the City recognizes the need to exercise caution before committing to create a fund.

The City has commissioned this report to provide a frank assessment of a local carbon fund's ability to facilitate emission reductions given municipal resource constraints (a desire for program self-sufficiency), the preferences of purchasers/donors, and available local capacity to carry out reduction projects. These constraints are not insubstantial and are sometimes in conflict. Additionally, Cambridge wishes to produce a high-quality, model program with a large enough impact to prove the local carbon fund concept.

This interplay of competing concerns generated the specific City-approved criteria used in this report, which are intended to provide guidance on the desirability of different fund types and program design options. These guiding criteria are described in the *Guiding Criteria* section.

Assessment Strategy

Given the pragmatic nature of the City of Cambridge's assessment needs and the lack of literature on this emerging program type, this report's analysis relies heavily on the best practices reported by existing local carbon funds. The field of comparison is U.S. local carbon funds administered by municipalities, nonprofits, or universities. Model funds in Canada and Australia were considered, but not included because of their large size. This report brings in perspectives from 17 carbon funds, which are current, prospective, or abandoned. Interviews focused on program structure, operating methods, technical offset specifications (if any), interactions with purchasers/donors and partners, and lessons learned.

I consulted environmental reports from the City of Cambridge as well as state laws and regulations, including MEPA and RGGI. I also reviewed publications by nonprofit and for-profit carbon market experts, which were mostly concerned with voluntary offset quality, rather than local carbon funds, specifically. I drew information on existing offset protocols and projects from the websites of voluntary offset standard organizations (e.g. VCS and CAR). One indispensable resource that provided information on the voluntary carbon markets was "Building Bridges: State of the Voluntary Carbon Markets 2010."[3]

I further examined market demand by interviewing representatives from Harvard University, MIT, and Lesley University, as well as from 9 locally active businesses or business groups, which were selected from among businesses that have publicly committed to tracking their greenhouse gas emissions and/or that have strong environmental goals. I also spoke with representatives from one state government agency, five climate-oriented nonprofits, and two offset verification organizations. I spoke with two local climate activists.

Many of the calculations in this report build on data from the U.S. Environmental Protection Agency, the U.S. Census Bureau, and City of Cambridge publications.

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3 Katherine Hamilton, Milo Sjardin, Molly Peters-Stanley and Thomas Marcello, "Building Bridges: State of the Voluntary Carbon Markets 2010," *Bloomberg New Energy Finance and Ecosystem Marketplace*, June 14, 2010. http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/vcarbon_2010.2.pdf.

The Problem: Why it's hard to design a successful local carbon fund

Introduction

Local carbon funds rely for their success on market demand for the products they supply; yet, these programs operate within voluntary carbon markets that are still nascent. There is no clearly preferable standard for voluntary carbon products, and there are few clear regulatory signals for those potential purchasers that anticipate being affected by future regulation. Additionally, there are few existing local carbon funds to reassure potential purchasers or donors that local carbon offsets/donations are wise investments.

These circumstances create the central problem that this report addresses.

Central Problem

Is anybody buying? When and under what conditions? Potential purchasers/donors may not be sufficiently interested in carbon products, generally, and the product CCF supplies, specifically. Some contributors to this demand risk—such as evolving preferences in the voluntary carbon markets—are out of Cambridge's control. If Cambridge makes large capital investments in carbon reduction projects based on demand that fails to materialize, it could face an embarrassing and inconvenient scramble to cover its debt. If the CCF failed due to lack of demand, Cambridge would face sunk start-up and administrative costs.

Without demand from purchasers/donors, the carbon fund model cannot function. Thus, a main focus of this report is the hypothetical relationship between the Cambridge Carbon Fund and its purchasers and/or donors. This report presents program design options and predicts each option's implications for purchaser/donor participation and for the guiding criteria listed below. The problem facing the Cambridge Carbon Fund is how to produce offsets or donation options that are attractive compared to potential funders' other carbon reduction alternatives. These alternatives include focusing on internal reductions and purchasing offsets from a different source.

Guiding Criteria

The intent of this report is to formulate a program design that will earn the support of key Cambridge stakeholders, including policymakers, citizens, and institutional partners. The following criteria, which I devised with the cooperation of City staff, will be applied in analyzing program design options. This report will recommend a carbon fund design intended to maximize the ability of the program to:

(1) produce high-quality carbon reductions,
(2) have a significant impact,
(3) produce attractive and affordable carbon products,
(4) be administratively feasible, and
(5) be politically acceptable.

For the purposes of this report, I define the above criteria as follows:

(1) High-quality carbon reductions. In the voluntary carbon market, a single quality standard has yet to emerge as dominant. For this report, I define offsets as high-quality if they satisfy two tests. First, they must conform to the emerging industry consensus that offsets be real, additional, permanent, independently verified and unambiguously owned.[4] I list the standard carbon industry definitions for these terms below.

Real and Additional. Carbon reductions must actually occur, and must be in addition to the business as usual baseline. A project is generally not additional if law requires it or if it is the most financially attractive option.[5] A developer may also need to prove that the project is not common practice or that it faces additional barriers.

Permanent. The issue of permanence is mostly relevant in the case of forestry offsets, when an adverse event such as a forest fire could undo the carbon reductions achieved.

Independently Verified. A third party must verify that the emission reductions claimed by the project have actually occurred.

Unambiguously Owned. To ensure that offsets are not double counted, offsets should be assigned unique numbers and listed in a public registry.

Some guidelines also suggest that offsets be transparent, measurable, synchronous, cause no net harm, account for leakage, and have co-benefits. These are also worthy aspirations for offsets.

4 Top organizations defining offset quality include the Environmental Defense Fund, the Offset Quality Initiative, the International Carbon Offset and Reduction Alliance, the Stockholm Environment Institute, WWF, and the American College & University Presidents Climate Commitment.

5 However, if other institutional or cultural barriers exist, such projects may still be deemed additional. For example under the CAR standard, postconsumer composting is additional even if it is mandated by *municipal* ordinance. Also, many energy efficiency projects are judged to be additional, despite their financial attractiveness, because energy efficiency faces significant implementation barriers.

Second, CCF's target market of purchasers/donors must perceive the carbon products as meeting their own standards for acceptable quality. Some purchasers have few preferences and may even be willing to donate without receiving offsets. Others demand offsets and, moreover, will reject otherwise high-quality offsets if they have not also been verified under the most well-respected offset standards. (A standard is essentially an offset "brand.")

(2) Significant impact. The program is deemed to have a significant impact if the program produces total additional greenhouse gas reductions of at least 27,200-36,300 $mtCO_2e$ by 2020. This amounts to 10% of Cambridge's 2020 citywide reduction goal (272,000-363,000 $mtCO_2e$ fewer emissions by 2020), which is currently being set and will be finalized in late 2011.

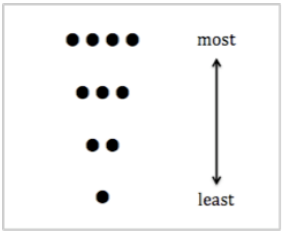
(3) Attractive and affordable. Attractiveness is defined by the preferences of the targeted offset purchasers. Characteristics of attractive offsets may include affordability, localness, visibility to the community, alignment with institutional values, and eligibility to be officially counted against institutional greenhouse gas emissions under future regulation. Affordability is judged in comparison to the cost of internal reductions and/or other available carbon products.

(4) Administratively feasible. An administratively feasible program will minimize complex administrative tasks (e.g. learning new skills or coordinating multiple actors) and make use of existing City and community resources. It will achieve self-sufficiency (i.e. revenues and grants cover expenses) as soon as possible.

(5) Politically acceptable. A politically acceptable program will garner the approval of the City Manager and City Council, and be acceptable to the general public and citizen climate activists. Specifically, a politically acceptable program design will fit well with Cambridge's climate protection strategy and provide co-benefits to desirable beneficiaries, such as low-income residents, renters, nonprofits, schools, and small businesses. It will also successfully address budgetary concerns: the most politically acceptable option would pay for itself.

Criteria Scorecard

Throughout this report, program design options are rated according to these five guiding criteria. These ratings are summarized in Criteria Scorecards, which rank options according to each criterion on a scale from most (••••) to least (•) desirable or advantageous. These points are then added up for each option and the highest-scoring option is highlighted in green.



Areas of Analysis and Recommendation

The five guiding criteria outlined above will be applied to the following key areas in which this report makes practical recommendations.

(1) First, I will address whether or not a carbon fund is viable.

> **Overall program viability, including timeline and fund type.** Should the Cambridge Carbon Fund pursue a carbon offset fund, a carbon benefit fund, a hybrid fund, or a phased benefit-offset program?

(2) I will then consider a variety of practical and strategic questions, in order to ultimately provide analysis and recommendations in the areas of:

> **Program administration.** Is the City or a nonprofit partner best suited to administer the program? Which types of partners will be needed to supplement the City's capabilities and expertise?
>
> **Partners.** Should the Cambridge Carbon Fund form non-administrative partnerships? If so, which types of partnerships will be the most fruitful?
>
> **Number of projects and project types.** How many projects and project types should be developed?
>
> **Project types.** Which types of projects are locally available? Which of these projects should be developed, taking into consideration the availability of verification protocols, purchaser preferences, a project's administrative burden, and the cost per ton of carbon reduced?
>
> **Price.** What price (or prices) should CCF charge for its offsets and/or benefit products? Should price vary by project or should CCF charge an average portfolio-wide price?
>
> **Targeting carbon products toward potential purchasers.** Which types of businesses and institutions are likely to be interested in local carbon products? How can CCF best target carbon products toward them?
>
> **Offset verification.** Which, if any, offset verification standard should be used, taking into consideration the City's minimum quality standards, the demands of potential purchasers, and the cost of various verification standards?

SECTION III
Choice: Is a Local Carbon Fund a Viable Option?

Introduction

Before the "how" questions of which program design options will maximize program success comes the larger "whether or not" question. Is the Cambridge Carbon Fund a viable option for reducing citywide greenhouse gas emissions? Do current market conditions and the needs and preferences of potential purchasers favor the creation of a local carbon fund? Or, is the Cambridge Carbon Fund a novel, but too risky idea?

The answer depends on whether the Cambridge Carbon Fund is created as a carbon offset fund or a carbon benefit fund. These two distinct fund types can also be combined into a hybrid program or into a phased program that begins as a benefit fund and evolves into an offset fund.

Options

Carbon offset fund. A carbon offset fund sells offsets that purchasers can count against their own emissions. Offset funds may be targeted toward "pre-compliance" offset purchasers, who anticipate being regulated under future climate legislation, or toward purely voluntary purchasers that have made public emission reduction commitments and wish to officially count offsets toward their reduction goals. The hybrid fund is a variation that sells offsets and uses some of the proceeds to support carbon benefit projects.

Carbon benefit fund. A carbon benefit fund facilitates donations toward worthwhile projects, but does not produce offsets. It thus incurs no verification costs. Benefit funds often support smaller projects with high co-benefits, projects for which carbon reductions are difficult to quantify as offsets, or projects with high costs per ton of carbon reduced. Benefit funds are generally targeted toward purely voluntary purchasers and individuals.

Phased benefit-offset fund. A phased fund begins as a carbon benefit fund and then transitions to an offset fund (or a hybrid fund).

No carbon fund.

In the next section, *Criteria Scorecard*, I use the rating system presented in this report's *Introduction* section to graphically present my assessment of the options listed above. The Criteria Scorecard attempts to synthesize information from relevant publications, offset protocols, discussions with City staff, and interviews with local carbon fund managers, businesses, and universities. I further explain these ratings in the following section: *Key Tradeoffs Between Options*.

Criteria Scorecard

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Immediate carbon offset fund rollout	••••	•	•	•	••	9
Immediate carbon benefit fund rollout	•••	••	••	•••	•••	13
Phased carbon benefit-to-offset rollout	••••	•••	•••	•••	•••	16
No carbon fund; pursue other programs	•••	•	•	••••	•••	12

Key Tradeoffs Between Options

This section analyzes the desirability of fund type options according to the five guiding criteria outlined in the *Introduction* section of this report. Point values in the above table reflect this analysis. For a complete discussion, refer to the detailed analysis in *Appendix B: Fund Type.*

The immediate offset fund rollout option was eliminated from consideration due to current market conditions. Interviews and market analysis indicate that near-term interest from major offset purchasers (i.e. universities and large businesses) is likely to be low as purchasers delay offset decisions until the voluntary carbon markets settle down or until their internal reduction options have been exhausted. An offset fund also has a much steeper administrative learning curve and higher costs than does a benefit fund or a phased fund.

An immediate benefit fund rollout would not fulfill Cambridge's desire to be an environmental leader. Despite potential demand from individuals, small-to-medium-sized businesses, and the philanthropic divisions of larger businesses, quality *perceptions* are lower for a benefit fund and its potential impact is limited.

The option of no carbon fund was eliminated, because it neglects the opportunity for Cambridge to show leadership and to gain experience in voluntary carbon markets, which have strong growth potential as a future funding source.

This leaves the phased benefit-offset fund, which would take advantage of the attractiveness of benefit products now and of offsets later, as markets strengthen and organizations begin to make offset decisions. For example, Harvard will first consider whether to offset in 2012. A phased benefit-offset fund also has a flatter administrative learning curve, because a subset of offset fund skills will be developed during the benefit fund phase.

Recommendation

The timing is not right for the Cambridge Carbon Fund to operate as a full-fledged carbon offset program. Rather, the Cambridge Carbon Fund should initially establish itself as a phased benefit-offset fund that allows donors to calculate their carbon footprints and accepts donations toward carbon reduction projects. Operating as a carbon benefit fund will allow CCF to gain valuable experience, while still hedging against the risk that demand from major actors like Harvard will prove smaller than expected. Another major U.S. city is adopting the same approach: it is starting with a benefit fund pilot, with the option to produce offsets in the future. Cambridge can continue to fund benefit projects even during its offset phase. Beginning with a carbon benefit fund will:

Allow CCF to gain experience developing carbon reduction projects and marketing the program. Local carbon fund managers indicate that carbon funds have a steep learning curve, especially for finding cost-effective projects and marketing carbon products.

Allow CCF to prove the concept of a carbon fund and to establish a positive reputation.

Buy time until Harvard and other potential purchasers are ready to buy/co-develop offset projects.

Allow the voluntary carbon market to mature before pursuing projects that are expensive to pursue given the currently low price of carbon.

Local institutions that are not yet ready to purchase offsets, including Harvard, seem likely to make offset decisions within the next few years. Refer to *Appendix C: Potential Purchasers/ Donors* for a list of potential purchasers and/or donors, including their greenhouse gas reduction goals, if any.

It will be advantageous to the Cambridge Carbon Fund if, by the time institutional offsetting decisions start being made, it has proven its ability to manage carbon reduction projects and to produce tangible, local benefits. The Cambridge Carbon Fund should be prepared to present Harvard and other local institutions with a clear, well-developed framework for the future of the program and its path toward producing internally and/or independently verified offsets. CCF should tailor partnership proposals to organizational missions and create buy-in by co-developing the second phase of the program with some of these institutions. Refer to the *Partners* section for more details.

Also, if climate legislation is passed, there is likely to be an offset shortage. Depending on which offset standard it chooses and which standards are included in the legislation, the Cambridge Carbon Fund could be well positioned to charge high offset prices and to ramp up its program.

SECTION IV
Design: Which Program Design Options will Maximize Success?

Introduction

Given the choice of a phased benefit-offset fund, this section identifies the available options for each program design element, predicts the likely outcomes of choosing each option, and discusses the tradeoffs of choosing certain options over others. The options for each element are discussed in terms of their implications for this report's five guiding criteria.

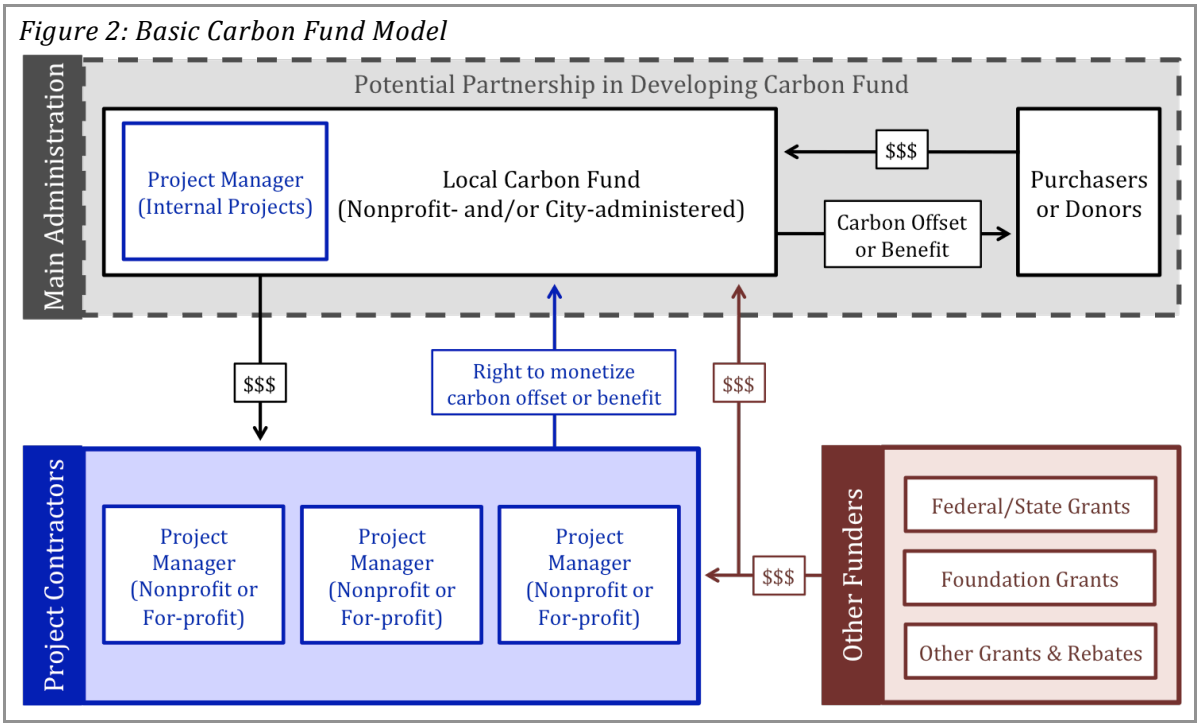
When the text refers to "offsets" or "offset verification," it is referring to the second phase of the program, the offset phase. "Carbon products" designates offsets and/or benefit products.

Program Administration

Introduction

Existing local carbon funds operate under a variety of administrative models, none of which has yet proven clearly preferable. In the basic model, the carbon fund administrator monetizes carbon by contracting with independent nonprofit or for-profit groups to manage existing or proposed carbon reduction projects. The carbon fund may or may not manage its own internal projects as well: for example, municipal projects in a City-administered fund or weatherization projects if the fund is administered by a weatherization nonprofit. Contractors are not the subject of this section, unless they might also help administer CCF. The basic carbon fund model is depicted in Figure 2 below.

Figure 2: Basic Carbon Fund Model



An inventory of necessary skills and capabilities will help clarify the administrative tasks of the Cambridge Carbon Fund. Skills can be accessed either by partnering with the outside organizations, or through in-house development. Many existing local carbon funds have utilized specialty carbon nonprofits or consultants to fill in gaps in expertise.

Figure 3: Skills and Capabilities Inventory

Greenhouse gas accounting. This includes developing a Cambridge-specific carbon footprint calculator and quantifying the GHG reductions of potential and actual CCF projects.

City capability: Substantial, but not in an offset context. Outside expertise needed.

Navigating the carbon market. This includes finding projects, analyzing reduction costs of potential projects, negotiating offset purchase contracts, certifying offsets, monitoring and verifying offsets, and registering offsets. It may also include purchasing low-cost offsets from outside Cambridge in order to create a lower average cost offset portfolio. These skills can be split between organizations: for example, the Colorado Carbon Fund finds its own projects, but relies heavily on The Climate Trust for many of the other activities listed here.

City capability: Limited. Outside expertise needed.

Project management. This includes the day-to-day management of offset projects, such as weatherization or tree planting.

City capability: Limited, except for existing municipal programs/projects.

Fundraising, accounting, and financial management. This includes collecting and distributing the funds from offset purchases or donations. It also includes applying for grants and planning for cash flow shortages when offsets have not yet been verified and thus cannot yet be sold.

City capability: Substantial. May be legally restricted for donations/disbursements.

Branding and messaging. This includes graphic design, website design, and the program's official mission statement and purpose.

City capability: Some. Outside contract likely.

Marketing/outreach. This includes recruitment of partners, donors, and offset purchasers.

City capability: Some, especially in networking and convening stakeholders.

Options

City (municipal & other projects). City staff administer the Cambridge Carbon Fund and fund municipal and/or other types of projects.

City + carbon nonprofit. Administrative duties are split between City staff and staff at a specialized carbon nonprofit that develops and/or sells offsets, such as The Climate Trust or Carbonfund.org. These groups generally have a regional or national scope.

City + local nonprofit(s). Administrative duties are split between City staff and staff at a local nonprofit such as the Cambridge Energy Alliance, New Generation Energy, or HEET.

By empowering a nonprofit to administer the program, the City would lose some control over key factors affecting program success, including branding, offset quality, choosing project beneficiaries, and other features of day-to-day operations. If the City chooses to work with a nonprofit partner, is important that the City choose a partner it can trust. Ongoing financial assistance from the City to the Cambridge Carbon Fund will provide some leverage for control.

Criteria Scorecard

CRITERIA / OPTIONS*	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
City (municipal and/or other projects)	—	••	••	•	•••	8
City + carbon nonprofit	—	•••	•••	••••	••	12
City + local nonprofit(s)	—	•••	•••	•••	•••	12

*Under any of these options local organizations could be contracted to manage ongoing work for specific projects, such as weatherization.

Key Tradeoffs Between Options

This section analyzes the desirability of program administration options according to Cambridge's five guiding criteria. Point values in the above table reflect this analysis. For a complete discussion, refer to the detailed analysis in *Appendix D: Program Administration.*

A wholly municipally-administered fund was rejected, because the City is limited in its ability to apply for grants and offer tax deductions to purchasers. It would also face higher costs than a nonprofit would, and it lacks experience navigating voluntary carbon markets (e.g. negotiating offset contracts; certifying, verifying, and registering projects). Both the City and a local nonprofit would face a steep learning curve in acquiring this experience, while a specialized carbon nonprofit would not. According to local carbon fund managers, municipal involvement provides invaluable credibility, but this also applies to jointly-administered funds.

There is no clear winner between local nonprofits and specialized carbon nonprofits, and, in fact, it may be necessary to partner with both. On the one hand, a local nonprofit has advantages in winning community support, drawing on local connections, and in recruiting volunteers. It also may be more willing than a specialized carbon nonprofit to sacrifice its profit margin for the sake of program success. (However, at least one major carbon nonprofit is currently offering a major U.S. city its services for free as it works to prove the local carbon fund model can work.)

On the other hand, a specialized carbon nonprofit already possesses specialized carbon market experience that local nonprofits would have to painstakingly acquire. The Colorado Offset Fund has partnered with The Climate Trust to ease the steep learning curve of carbon fund administration. The Climate Trust negotiates purchase contracts, collects and distributes offset purchase funds, and handles certification, monitoring, verification, and registration of offsets. The State of Colorado's primary responsibilities are to locate and choose offset projects and to market the program.

Recommendation

A nonprofit partner should run the Cambridge Carbon Fund in cooperation with the City of Cambridge. The City should be closely involved in developing, launching, and promoting the CCF, and in reaching out to potential purchasers. Either the City or a local nonprofit would face a steep learning curve in administering the Cambridge Carbon Fund. If a specialized carbon nonprofit is willing to partner with CCF *at a reasonable price*, it may be advisable to partner with a specialized carbon nonprofit rather than (or in addition to) a local nonprofit without offsetting experience. It is likely that CCF will find it more affordable to partner with a local nonprofit(s) and engage a specialized carbon nonprofit on a consulting basis. The chosen program administration model should be able to grow with the Cambridge Carbon Fund as it transitions from a carbon benefit fund to a carbon offset fund.

A local co-administrator might provide general administration, including interfacing with program contractors (see *Figure 2* above), or it might also serve as a contractor. Some potential administrators, like the Cambridge Energy Alliance (CEA), could adopt CCF as an internal program, while others, such as New Generation Energy might instead provide a CCF staff member with office space and technical support. Others, such as HEET or LiveCooler, might be better suited to roles as program contractors. Some organizations will be most helpful as providers of specific skills or tools: for example, branding by CEA or offset/donation tracking web tools from New Generation Energy.

A partial list of potential Boston-area administrative partners appears in *Figure 4* below. For potential national partners, see *Appendix E: Potential Carbon Specialist Administrative Partners.*

Figure 4: Potential Program Co-Administrators

Potential Co-Administrator	Mission, Activities, and/or Capabilities
Cambridge Energy Alliance	CEA connects Cambridge "homeowners, businesses and institutions" to energy assessment resources. www.cambridgeenergyalliance.org
Green Markets International (defunct?)	GMI works to "increase knowledge about, and access to, the international greenhouse gas reduction market so that it can become more broadly inclusive, especially for small-scale activities and among communities that might otherwise be left out." www.green-markets.org
Home Energy Efficiency Team	HEET "organizes free weatherization parties to teach volunteers how to lower their energy bills and carbon emissions. The work takes place in homes or nonprofits where we improve a building while teaching important skills." www.heetma.com
LiveCooler	LiveCooler sells unverified offsets to support its work "installing free energy-efficient light bulbs (CFLs) in the homes of low-income families that can't afford them." www.livecooler.org
New Generation Energy	NGE runs a micro-donation site that connects donors to "green energy projects that save energy and lower carbon emissions at nonprofits and small businesses." www.newgenerationenergy.org

Partners

Introduction

In addition to administrative partners, many local carbon funds work with community partners that provide program funding or fill advisory or promotional roles. Several potential co-administrators listed in the previous section could instead act as partners, if they do not take on administrative duties, but still contribute time, input, or money. This section presents partnership options, discusses the roles that partners can play in a local carbon fund, and explores the benefits of partnership. There are many arguments in favor of pursuing partnerships and few for avoiding them.

Options

No partners beyond administrative partners.

Partner and/or co-develop program with…

Potential purchasers/donors
Scientific or climate change experts
Potential in-kind donors

Criteria Scorecard

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
No partners beyond administrative partners	••	••	••	•	•••	10
Partner and/or co-develop program with… Purchasers/donors Scientific experts In-kind donors	••••	•••	••••	•••	••••	18

Key Tradeoffs Between Options

The "no partners" option was rejected, because local carbon fund managers universally highly valued their partnerships and the benefits they provided. The downsides to partnership are overshadowed by the benefits, which include:

Early partnership and co-development create buy-in for purchasers. Engaging potential purchasers to choose offset standards and project types exposes them to the high costs of verification and creates buy-in for the eventual offset product. For the benefit phase, partners will understand which quality criteria are at work, even in the absence of verification. For the offset phase, regardless of whether a premium verification standard prevails, partners will be more willing to accept high offset prices.

Partners value the publicity gains from program co-branding. Interviews with local institutions confirmed that many businesses and institutions would highly value having their names closely associated with an innovative local carbon fund.

Partners can become advocates, sources of credibility, and in-kind donors. The Cleveland Carbon Fund's founding businesses and nonprofits (e.g. Cleveland Clinic) are now some of the program's biggest purchasers and advocates. The Cleveland Carbon Fund also sought out a science-based partner, the local natural history museum, to lend the program scientific credibility and help with greenhouse gas calculations. They also had most of its branding and design work done pro bono by a local public relations firm.

The Neutral Gator Initiative was formed to create offsets for a specific purchaser, the University of Florida (UF). This partnership has provided predictable revenue, as the UF Athletic Department has committed to purchasing 2,500 offsets each year to make its football season carbon neutral.

The more broad-based a coalition the Cambridge Carbon Fund assembles, the greater its built-in political support.

There are also reasons to be cautious about unconditionally pursuing partnerships, including:

Coordination of multiple partners may consume large amounts of the CCF administrator's time.

Partners may experience fatigue from participating in multiple City partnerships. The City of Cambridge has many programs that would benefit from the involvement of community partners. The City should consider whether the Cambridge Carbon Fund is its highest priority for recruiting partners.

Having too many partners may inhibit the formation of open, productive partnerships with "game-changing" partners. Arguably, some potential purchasers are "game changers" who might make very large purchases and should be aggressively courted as partners. The City might want to exclude some potentially productive partners in order to customize CCF for the "game changers."

Recommendation

The Cambridge Carbon Fund should engage multiple founding partners in order to increase buy-in and improve credibility. CCF should form an advisory team that includes potential purchasers, local experts, and respected environmental and/or scientific institutions. CCF should craft partnership and co-development plans that respond to the specific missions and preferences of its partners. For example, a co-development plan with Harvard University or the Museum of Science would include substantial educational components and opportunities for student/staff/visitor participation.

Other factors the advisory board should discuss include: quality principles, eventual verification standards, branding, and sponsorship packages.

Number of Projects and Number of Project Types

Introduction

Existing carbon funds vary in the number of projects and project types they administer. Some focus on one project type (e.g. MaineHousing). Others experiment broadly with different project types (e.g. CCURB).

Options

Many projects, a variety of types.

Many projects, 1-2 types.

Few Projects, 1-2 types.

One project at a time.

Criteria Scorecard

CRITERIA / OPTIONS	High-Quality Offsets	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Many projects, a variety of types	—	—	••	•	••••	7
Many projects, 1-2 types	—	—	•	••	•••	6
Few projects, 1-2 types	—	—	•••	•••	•••	9
One project at a time	—	—	••	••••	•••	9

Key Tradeoffs Between Options

The "many projects, a variety of types" option provides maximum customization to different purchasers' preferences and maximum *distribution* of benefits among community subsets. It was rejected, however, because it is complex to administer. Also, during the offset phase, each offset-producing project would incur its own verification expenses. The "many projects, 1-2 types" option was eliminated for similar reasons. Having many projects but fewer project types would make the program marginally less customized; yet, it would do little to cut expenses.

Several interviewees emphasized that finding appropriate projects was difficult and time-consuming. A representative from the Colorado Carbon Fund recommended building expertise in one project type and using this reputation to recruit additional project developers in that field. Additionally, administrative and verification expenses are lower with fewer projects and project types. Having "few projects, 1-2 types" allows for slightly more customization than "one project at a time," while being slightly more difficult to administer.

Recommendation

The Cambridge Carbon Fund should either run a few projects of one or two types, or one project at a time. These options minimize the crucial factors of administrative hassle and cost.

Project Types

Introduction

Interviews with local offset and benefit fund managers revealed widespread frustration with the difficulty of finding projects capable of producing high-quality, attractive, *and* low-cost carbon reductions. This is illustrated by the Colorado Carbon Fund's experience: at one point, Colorado had 184 project leads, only five of which were deemed "promising." Colorado rejected projects that reduced indirect (i.e. electric) emissions, were in beginning stages, or were judged to be too small (<40,000 $mtCO_2e$/year) to be economically developable.[6] Cambridge would be very lucky to find projects that reduce 40,000 $mtCO_2e$/year. In general, the larger the project, the lower the administrative (and verification, where applicable) costs per ton.

CCF must balance municipal goals, such as reducing emissions from commercial buildings, with the City's preference that projects benefit certain recipients, such as the low-income. Potential purchasers indicate more willingness to pay a premium for a local carbon product with a good story behind it. Unfortunately, charismatic projects, such as low-income weatherization and tree planting, tend to be expensive per ton of carbon reduced (moderately or extremely so). And, many of the more cost-effective project types are rural (e.g. landfill methane, livestock methane).

Cost per ton of carbon reduced is only one factor CCF should consider in choosing project types. CCF can choose to use low-cost offset projects to subsidize projects (offset or benefit) with higher per-ton reduction costs. For example, when a business purchases an offset from the Colorado Carbon Fund, it pays not only for verified reductions from landfill methane, but also for unverified projects with high per-ton reduction costs and high co-benefits.

Earth Givers' Neutral Gator/Gainesville program operates similarly. It develops residential energy efficiency projects, but also buys low-cost offsets from a nearby landfill project. This lowers the price of its offsets and provides a reliable supply of offsets during periods when it is waiting to have its own offsets verified. In Boston's program, each offset purchase will retire a RGGI emission allowance, with the balance going toward unverified local projects.

Options

Ozone depleting substances (ODS) destruction. This report considers an appliance take-back program that destroys the ODS (CFC-11 and CFC-12) found in refrigerators, freezers, window air conditioners, or dehumidifiers. Appliances may only be sent to facilities on an approved list, which may differ from common practice. The carbon reductions *that may be counted as offsets* from ODS projects are from destroying CFC-12, *not* from CFC-11 or reduced electricity use.[7]

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6 Susan Innis and Monica Thilges, "Update on Colorado Carbon Fund." *Governor's Energy Office*, October 20, 2009, 3. http://www.coloradocarbonfund.org/images/uploads/October_CCF_Update_to_AC.pdf.

7 ODS destruction may only occur at certain approved facilities. This is based on: "U.S. Ozone Depleting Substances Project Protocol v 1.0: Protocol Summary," *Climate Action Reserve*. http://www.climateactionreserve.org/wp-content/uploads/2010/02/U.S._and_Article_5_ODS_Project_Protocol_v1.0_Summaries.pdf.

Postconsumer composting. This report considers a residential food scrap collection program.[8] State law already bans yard waste from landfills, so it is not eligible.

Residential weatherization. This includes weatherization and replacement of appliances (refrigerators, air conditioning units, lamps, and showerheads) and central heating/cooling components.[9] For benefit projects, reductions could come from thermal and electric savings. Due to RGGI, *offsets* cannot come from electric savings.

Commercial weatherization. This includes weatherization, and replacement of appliances and central heating/cooling components. Properties may be nonprofit, municipal (including schools), multifamily residential, or strictly commercial/industrial.

Commercial boiler efficiency (space and water heating). Eligible improvements occur from retrofitting, updating boiler technology, purchasing a more efficiency boiler to meet new demand, or switching to a lower carbon fuel.[10] Eligible boilers have an input capacity of 125,000-12.5 million Btu per hour, depending on the protocol used.

Solar PV or solar thermal.

Urban forestry. This is limited to local governments, utilities, and universities.

Bike share. The organization CityRyde has proposed a VCS offset protocol that uses CityRyde's Inspire software to quantify carbon reductions from bike share programs. If the protocol is not approved, the software can still be used to track emission reductions.

Landfill gas (LFG). This includes on-site methane destruction (flare, electricity generation, or thermal production), methane transported off-site for destruction (pipeline injection), and methane used as vehicle fuel (on-site or off-site).[11]

Wastewater treatment plant methane. This includes on-site methane destruction through digestion, and methane transported off-site for destruction (pipeline injection) or used as vehicle fuel.[12]

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8 Waste streams may include non-industrial food waste, co-mingled non-recyclable food soiled paper, and *new* grocery store waste streams. This is based on: "Organic Waste Composting Project Protocol v 1.0: Protocol Summary," *Climate Action Reserve*. http://www.climateactionreserve.org/wp-content/uploads/2011/02/OWC_protocol_summary1.pdf. In Cambridge, most grocery stores already divert compostable waste through a voluntary MassDEP program.

9 This definition of measures comes from: "Methodology for Weatherization of Single and Multi-Family Buildings, Version 3.2," *Maine State Housing Authority*, June 2010. http://www.v-c-s.org/docs/Methodology%20for%20Weatherization%20of%20Single%20and%20Multi-Family%20Buildings.pdf.

10 This definition of measures for commercial boilers (industrial boilers are covered under a different standard) is from the now defunct EPA Climate Leaders program: "CLIMATE LEADERS GREENHOUSE GAS INVENTORY PROTOCOL OFFSET PROJECT METHODOLOGY for Project Type: Commercial Boiler Efficiency (Space and Hot Water Heating), Version 1.3." *U.S. Environmental Protection Agency*, August 2008. http://www.epa.gov/climateleaders/documents/resources/comm_boiler_proto.pdf.

11 This definition of measures is from: "Landfill Project Protocol v 3.0: Protocol Summary," *Climate Action Reserve*. http://www.climateactionreserve.org/wp-content/uploads/2009/03/Landfill_Project_Protocol_3.0_Summary.pdf.

12 This definition of measures is from: "Organic Waste Digestion Project Protocol v 1.0: Protocol Summary," *Climate Action Reserve*. http://www.climateactionreserve.org/wp-content/uploads/2009/10/OWD_Version_1.0_Summary.pdf.

Criteria Scorecard

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Ozone depleting substances (ODS)	••••	••	•• ••••	••••	••••	20
Postconsumer composting	••	•••	••• ••	••	••	14
Residential weatherization	••••	••	•••• ••	•••	•••	18
Comm. weatherization (NP/MUSH)	•••	••	••• ••	•••	••	15
Commercial boiler efficiency (NP/MUSH)	•••	•••	•• ••••	••	••	16
Solar PV or Solar thermal	•	•	•••• •	••••	••	13
Urban forestry	••••	•	•••• •	••	••	14
Bike share	••	••	••• ••	••••	••	15
Landfill gas (LFG)	••••	••••	• ••••	••	•••	18
Wastewater treatment plant methane	••••	•	• ••••	•••	•	14

Notes:

(1) High-*Quality Reductions.* A project type is ranked highly if it has an existing offset protocol, is unlikely to be impacted by foreseeable upcoming regulation, reduces direct emissions, and is not already part of City plans.

(2) *Significant Impact.* Impact is estimated for the year 2020 and judged based on an estimate of probable project size. Generally: • = <500 $mtCO_2e$/year, •• = 500-2,000 $mtCO_2e$/year, ••• = 2,000-10,000 $mtCO_2e$/year, & •••• = >10,000 $mtCO_2e$/year.

(3) *Attractiveness/Affordability.* Both attractiveness and affordability vary widely by project type. The first line rates attractiveness based on project charisma, while the second rates affordability.

(4) *Administrative Feasibility.* Listed for the offset phase.

Key Tradeoffs Between Options

This section analyzes the desirability of project type options according to Cambridge's five guiding criteria. Point values in the above table reflect this analysis. For a complete discussion, refer to the detailed analysis in *Appendix F: Project Types.*

Project types were generally eliminated as possibilities for one of four reasons: lack of local opportunities, lack of premium verification protocol, high regulatory risk, or high cost.

Wastewater treatment plant methane was rejected, because the Deer Island Wastewater Treatment Plant in Boston already has anaerobic digesters in place. Urban forestry and solar PV/solar thermal were eliminated, because local opportunities would yield very low volumes of reductions at a very high per-ton cost. Commercial weatherization was eliminated, because it does not yet have a premium offset protocol. While CCF may decide not to verify its carbon products to premium standards, it is desirable to choose an option that does not immediately cut off this option. Commercial weatherization may become a viable option in the future.

Bike sharing also lacks an offset protocol, although VCS may soon approve one. It also may not be "additional," since Cambridge already intends to institute a bike share program. Postconsumer composting poses similar additionality concerns and was eliminated, because

Massachusetts may soon ban food scraps from landfills. This would make composting an ineligible offset project (a *municipal* ban would not). Commercial boiler efficiency offsets face partial ineligibility due to new EPA rules, but may still be viable: further research is needed.

The remaining project types are the most promising: ODS destruction, residential weatherization, commercial boiler efficiency, and landfill gas. There are moderate-to- high-volume local opportunities for these project types, and they have low-to-moderate per-ton estimated reduction costs. The table below provides additional insight, including the following:

> **There are few local opportunities for projects that produce low-cost carbon reductions.** The only low-cost options *in Cambridge* are ODS and commercial boiler efficiency.
>
> **Most locally available project types are small and disaggregated, and thus have high administrative costs.** The only simple, single-site projects are landfill gas and wastewater treatment plant methane, both of which are outside Cambridge.

Figure 5: Potential Offset Projects for Cambridge.
Adapted from the assessment, "Potential Domestic Urban Offset Activities" by The Climate Trust.

Project Type Relevant Criteria	**Many Opportunities in Cambridge** (2)	**Large Volume of Tons** (2) (4)	**Reasonable Cost/Ton** (3) (4)	**Charisma** (3)	**Fit with City Priorities** (5)
Ozone depleting substances (ODS)	Unlikely	Yes	Yes	Possibly	Yes
Postconsumer composting	Possibly. Not eligible if MA bans organics from landfills.	Unlikely	Unlikely	Yes	Yes
Residential weatherization	Yes	Possibly	Possibly	Yes, esp. for low-income	Yes
Commercial weatherization	Yes	Possibly	Possibly	Some, for NP/MUSH.	Possibly; for small biz and NP/MUSH
Commercial boiler efficiency	Possibly, but new federal rules limit eligible measures.	Yes	Yes	Possibly	Possibly; depends on beneficiary.
Solar PV or Solar thermal	Unlikely	No	Unlikely	Yes	Possibly; depends on beneficiary.
Urban forestry	No	No	No	Yes	Yes
Bike share	Possibly	Unlikely	Unlikely	Yes	Yes
Landfill gas (LFG)	City uses 3 landfills with non-offset-producing LFG projects. Still opportunities?	Yes	Yes	No	No
Wastewater treatment plant methane	No; facility already captures methane. Also, wastewater not part of GHG inventory.	Unlikely	Yes	No	No

Recommendation

During its benefit fund phase, the Cambridge Carbon Fund should pursue project types that have the potential to also produce offsets during the offset fund phase. It should choose from ODS destruction in appliances, residential weatherization, commercial boiler efficiency for multifamily and/or NP/MUSH, and landfill gas. With the exception of residential weatherization, these projects produce low-cost carbon reductions and represent at least moderately large volumes of reductions. These projects also fit with City beneficiary preferences, except for landfill gas, which is included as a way to reduce the price of a blended carbon product. (For a discussion of blended products, refer to the *Price* section below.)

The table below shows the potential carbon reductions from these four project types, given that CCF can find suitable projects and contractors. The amounts listed result from conservative estimates of project size. The second column shows the amount by which citywide emissions would be lower in 2020 (not the number of carbon products the project would generate). For more detail, refer to the *Section V: Potential Impact*.

Figure 6: Impact Summary for Four Selected Projects

Potential Project Type	Citywide Emission Reduction in 2020	Percent of CCF Goal (27,200-36,300 $mtCO_2e$)	
		Countable Benefits	Countable Offsets
ODS destruction (482 appliances/year; 1% of HH)	Countable as benefits: 2,416 $mtCO_2e$** Countable as offsets: 627 $mtCO_2e$*	6.7-8.9%	1.7-2.3%
Residential weatherization (100 homes/year)	Countable as benefits: 928 $mtCO_2e$ Countable as offsets: 432 $mtCO_2e$	2.6-3.4%	1.2-1.6%
Commercial boiler efficiency (5 boilers/year)	7,560 $mtCO_2e$	20.8-27.8%	20.8-27.8%
Landfill gas (equal to annual waste emissions)	24,424 $mtCO_2e$	67.3-89.8%	67.3-89.8%
Total	**33,043-35,328 $mtCO_2e$**	**97-130%**	**91-122%**
Total without landfill gas	**8,619-10,904 $mtCO_2e$**	**30-40%**	**24-32%**

*Assumes 2.21 $mtCO_2e$ per appliance: 59% (1.30 $mtCO_2e$) is from CFC-12 and can be monetized as ODS offsets.
**Includes electric savings and CFC-11 from ODS foam recovery, neither of which cannot be monetized as ODS offsets.
Note: The variation in percentage of CCF goal is due to uncertainty about the size of the City's new GHG reduction goal. The lower percentage assumes a goal of 373,000 $mtCO_2e$, while the higher percentage assumes 272,000 $mtCO_2e$.

This table demonstrates that CCF's ability to meet its significance goal is highly dependent on its ability to secure landfill gas offsets. If this is not possible, CCF will need to increase the size of its other programs. This applies doubly, because CCF should only undertake 1-2 of the listed project types. Larger projects may be feasible: further research into local capacity is needed.

Benefit Phase: ODS, residential weatherization, and commercial boiler efficiency

ODS destruction would generate low-cost carbon reductions from ODS destruction *and* electric savings. (Only savings from ODS can be counted as *offsets*.) It would also lower participants' energy bills. Low-cost reductions from ODS could be used to lower the price of a blended carbon product. In the basic model, CCF would contract with a group to collect refrigerant from appliances, sell the refrigerant to an ODS destruction facility, and then purchase that facility's offsets. The big advantage of an ODS program is that CCF would pay no verification costs (except as internalized in offset price).

An ODS program is only viable *if* state and local laws and common practice do not negate additionality for the offset phase. A professional verifier needs to determine this.

Figure 7: Potential Impact of an ODS Destruction Program

Reduction in citywide emissions in 2020 (Year 8) for a 482 HH/year program[13]:

From CFC-12 (ODS refrigerant destruction):	627 $mtCO_2e$
From CFC-11 (ODS foam destruction):	439 $mtCO_2e$
From electricity use:	1,350 $mtCO_2e$
Total reduction:	**2,416 $mtCO_2e$**

Co-benefits: $2,568,096 in electric savings over the period 2013-2020

13 For more information on how these numbers were calculated, refer to the *Potential Impact* section and its footnotes.

Residential weatherization is more expensive per ton of carbon reduced than are the other chosen projects, but it provides substantial co-benefits in the form of reduced heating costs. If the HEET retrofit model (thermal and electric measures) were used for 100 homes per year, thermal *and electric* consumer savings would total $1,335,600 ($371/household/year) over the period 2013-2020. A residential weatherization program is only feasible if enough local project managers can be recruited to run a large program (at least several hundred homes per year). It is not clear that this local capacity exists. For carbon reduction estimates, refer to *Figure 6* above.

Commercial boiler efficiency has the potential to provide a large volume of carbon reductions at a reasonable price. However, the EPA published new draft rules in 2011 that will in effect limit the types of boiler projects that are eligible to produce offsets. (Offsets cannot come from legally required measures.) More research is needed to determine whether enough eligible opportunities will remain to make commercial boiler efficiency offsets viable. For carbon reduction estimates, refer to *Figure 6* above.

Lay the groundwork for landfill gas in Offset Fund Phase

Offset Phase: Projects from benefit phase + landfill gas, if possible

Landfill gas would produce a large volume of low-cost carbon reductions that could be used to lower the price of a blended carbon product. However, landfill gas projects lack charisma: they are not visible in the community and they do not provide community co-benefits. With a blended product, however, purchasers/donors can focus stakeholder attention on the more charismatic project.

In order to access landfill gas offsets, the Cambridge Carbon Fund will need to coordinate with the landfills to which Cambridge's waste is sent. These three landfills currently produce energy, but not offsets, from their gas. They may or may not have additional untapped resources that could be tapped for offset projects. If CCF wishes to encourage the development of offset projects, it will require extensive conversations with these facilities and probably capital and/or verification cost-sharing.

Alternatively, Cambridge could purchase landfill gas offsets from a project without Cambridge ties, or work with its waste contractor, Waste Management, to have its waste sent to offset-producing landfills. For carbon reduction estimates, refer to *Figure 6* above.

Refer to *Appendix F: Project Types* for a more detailed explanation of these project types.

Price

Introduction

For most urban carbon reduction projects, carbon revenues are only one of multiple funding streams, which conflicts with Cambridge's desire for the Cambridge Carbon Fund to be financially self-sufficient. In Maine, for example, offset revenue will merely subsidize weatherization activities. This section presents precedents for pricing carbon products and predicts which pricing scheme will maximize CCF's carbon revenue.

CCF will face different market demands during its two phases: many benefit fund donors will not differentiate between the two phases, but many potential *offset* purchasers will be only minimally interested in benefit products. The price discussion in this section pertains to both phases, but lessons from the voluntary carbon markets are less applicable to the benefit phase.

Local carbon fund prices. Most local carbon funds base carbon product prices on purchasers' willingness to pay, rather than on project economics. Prices in current funds range from $10-$20, with many around $20. Refer to *Figure 8* below for a summary of local carbon fund prices.

Figure 8: Offsets/Benefit Product Prices in Local Carbon Funds

Program	Fund Type	Purchase price/ton*	Started (Planned)
Aspen/Pitkin Canary Tags	Benefit	$20	2007
Boston CarbonPlus Calculator	Hybrid	$20	(2009)
Chicago Offset Fund run by the Delta Institute	Hybrid	$10	(2009)
Cleveland Carbon Fund	Benefit	$20	2009
Colorado Carbon Fund	Hybrid	$20	2008
Community Carbon Use Reduction at Brown	Benefit	Internal (Cost is $63; $36 after grants)	2008
Duke Carbon Offsets Initiative	Offset	$10	2009
MaineHousing	Offset	$25**	2010
Major U.S. City Climate Benefit Fund	Benefit	$15-20 goal	(2011)
Neutral Gator/Gainesville run by Earth Givers	Offset	$12	2008
Oberlin POWER Fund	Benefit	$20	2009
Philadelphia Erase Your Trace (CarbonPlus Calc.)	Benefit	$20	2009
San Francisco Carbon Fund	Benefit	13% added onto City air travel	2007
Westminster CarbonPlus Calculator	Benefit	$23	2010
Yale Community Carbon Fund	Benefit	Internal ($20 goal)	2009
**Based on Chevrolet's $1 million purchase of 40,000 tons of CO_2e: http://www.mainehousing.org/NEWS.aspx.			

Carbon market prices. Experts expect voluntary carbon markets to grow in the long term, but they lost value in 2009, as both prices and trading volumes declined. Average over-the-counter (OTC) offset prices fell from $7.3/mt$CO_2e$ in 2008 to $6.5/mt$CO_2e$ in 2009. Offset prices varied widely according to project location, project size, project type, offset standard, and even accompanying co-benefits.[14] At some point, if federal climate legislation allows conversion of voluntary offsets into compliance-grade offsets, prices for certain offset brands could skyrocket.

14 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 19 and Sections 6.2, 6.4, 6.5, and 7.4..

Most large OTC purchases are arranged before the carbon reduction occurs. This mitigates the risk CCF will incur running projects *in anticipation of* carbon revenue. For more information on pricing and voluntary carbon markets, refer to *Appendix G: Background on the Voluntary Carbon Markets*, which is largely drawn from the invaluable resource, "Building Bridges: State of the Voluntary Carbon Markets 2010." *Appendix G* addresses market trends, prices, and mechanics.

Can an urban local carbon fund achieve self-sufficiency? The Cambridge Carbon Fund will probably need City funding for the first several years. The Climate Trust estimates that local carbon funds do not generally break even until "at least their fifth year of operation." This is due to start-up costs, the necessary time to establish the program and find purchasers, relatively low carbon prices, and the high per-ton cost of most urban carbon reduction projects.

A feasibility study conducted by The Climate Trust for a benefit fund in a major U.S. city predicted the fund would receive only $0.33 in revenue for every dollar it spent, with this ratio improving each year until a break even point around the fifth year. The study found that similar utility programs received $0.35 for every dollar spent on "start-up and the first two years of operation." It also estimated that six months of start-up costs for a pilot would total $140,800 and the operations budget would be $235,000 per year, for total two-and-a-half year pilot costs of $610,800. Revenues during the same period were projected to be only $200,000.[15]

Strategies for minimizing carbon product price. The economics of local carbon funds are challenging, especially for offset funds, which faces verification costs. Strategies for maintaining quality while lowering price include: operating as a benefit fund; selling unverified offsets; selling offsets verified using less well-respected offset brands; verifying offsets infrequently; selling a blended product; securing grants; and accessing pro bono help, in-kind donations and volunteer labor. For details, refer to *Appendix H: Strategies for Minimizing Carbon Product Price*.

Options

Market price; varies by project. This price would be the going market price for over-the-counter offsets of the given project type and offset standard, taking into account any premium that purchasers assign to project location, project size, or co-benefits. The average over-the-counter offset price was $7.3/mt$CO_2$e in 2008 and $6.5/t$CO_2$e in 2009.[16] Likely range, based on project types and sizes considered: $2 to $17/mt$CO_2$e.

Moderate price; blended product. A blended product is possible in a fund that has a portfolio of projects with different per-ton reduction costs. The blended product price is based on a weighted average of the different per-ton costs. The goal is to subsidize high co-benefit projects that produce high-cost reductions. Likely range: $10 to $17/mt$CO_2$e.

Premium price; blended product. This price would be set near the maximum a buyer might pay for a local carbon product, based on project location, size, and co-benefits. Compared to a moderately-priced blended product, a premium blended product would fund a higher percentage of high-cost carbon reductions *and/or* direct a higher percentage of carbon revenue to fund operations. Likely range: $20 to $25/mt$CO_2$e.

15 Sheldon Zakreski, "(Major U.S. City) Carbon Fund Design: Program Administrator Scope Report," *The Climate Trust*, September 2010, 11-12.
16 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 19

Criteria Scorecard

CRITERIA / OPTIONS	High-Quality Reductions	Significant Impact	Affordable*	Admin. Feasible	Politically Acceptable	TOTAL
Market price; varies by project	—	••••	•••	•	••	10
Moderate price; blended product	—	•••	•••	••	•••	11
Premium price; blended product	—	•••	••	•••	••••	12
* Attractiveness was not considered for this analysis.						

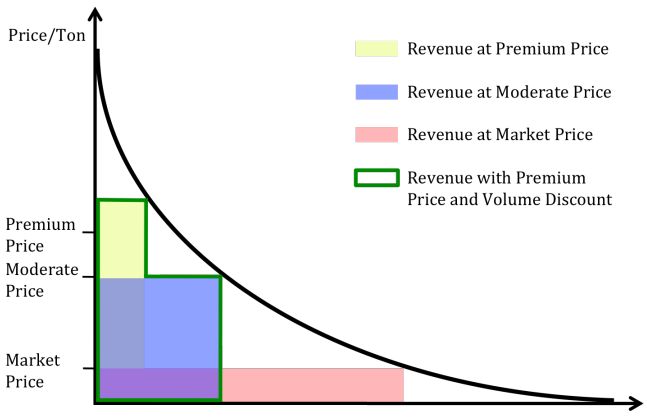
Key Tradeoffs Between Options

If CCF sets its price too high, its field of potential purchasers will be very small; if it sets it too low, it may have very low revenues, even if it has many purchasers. The goal is to set a price that covers CCF's costs when combined with other funding, and which maximizes revenue.

The market price option was eliminated, because it fails to capture purely voluntary buyers' willingness to pay, as judged by prices at other local carbon funds, which routinely charge $20-$25/ton. The moderately priced product was eliminated for the same reason, although it is more feasible than the market price option.

CCF could institute a volume discount in order to capture potential high-volume purchasers who would be willing to pay moderate, but not premium prices. Many offset retailers do this by instructing high-volume purchasers to contact the retailer directly rather than buy through the online portal. Some do not even publish prices online. *Figure 9* provides a conceptual illustration of the carbon revenues at different prices and the gains that can be captured using a volume discount.

Figure 9: Revenue potential at different prices



Recommendation

The Cambridge Carbon Fund should publicize a premium price of $20-$25 for casual purchasers and negotiate larger purchases privately. This is most important during the offset phase, when potential purchasers include pre-compliance and purely voluntary purchasers that are likely to compare CCF prices to those in the voluntary carbon markets. However, this strategy can also be used during the benefit phase.

In general, there is an inverse relationship between a project's cost and its "charisma" or attractiveness to purchasers/donors. This report recommends that CCF create a blended carbon product that uses low-cost carbon reductions to subsidize higher-cost, more attractive carbon reduction projects.

Targeting Carbon Products toward Potential Purchasers

Introduction

This section discusses marketing strategies and recommends the types of purchasers CCF should target during its two phases. Thousands of institutions are tracking their greenhouse gas emissions with groups such as the Carbon Disclosure Project or the Climate Registry, and many have set GHG goals. Most local institutions with high goals and thus potentially high demand for offsets, such as Harvard University and Lesley University, have only recently conducted GHG inventories and are still focused on cost-effective internal reductions. These institutions are likely to make offset decisions within the next few years. Harvard has given the clearest signals, but will not consider its position on offsets until its GHG task force convenes in 2012. MIT has not set a GHG reduction goal, and is focusing exclusively on internal reductions.

Local institutions may not be ready to purchase offsets, but interviews with businesses and local carbon fund managers suggest that there *would* be local interest in donating to a carbon *benefit* fund as part of corporate charitable giving programs. Competition for these grants varies with the focus of the giving program. In the offset niche, CCF might compete (or collaborate!) with the local nonprofit LiveCooler, which sells unverified offsets from local CFL installation.

Experience shows that online carbon footprint calculators alone are not powerful marketing tools (e.g. Philadelphia). And, even big marketing campaigns may produce small results. (e.g. Aspen). Most local carbon fund managers underestimated the necessary degree of marketing effort. Offsetting is not self-explanatory and most potential purchasers know little about offsets. Even those that buy RECs to earn LEED points may not differentiate between RECs and offsets.

The Cambridge Carbon Fund will benefit from the current trend of voluntary carbon product purchasers seeking out "charismatic carbon" that is visible in the community and can tell a good story. On the other hand, many institutions are not familiar with offsets, while others are wary of the idea. In light of these factors, CCF can apply the following marketing strategies:

Match the project to the organization's mission or charitable focus. For example, match a school boiler project to an educational focus and low-income weatherization to a poverty focus. Universities find hands-on learning/research opportunities appealing.

Offer positive publicity and project sponsorship. In addition to blended carbon products, CCF can allow institutions to sponsor projects (e.g. weatherize an apartment complex). Businesses will expect robust purchase or sponsorship publicity packages.

Offer standardized "event," "car," or "flight" products. TerraPass and the Aspen Canary Tags Initiative both offer activity-specific products. Refer to *Section V: Potential Impact* for Cambridge-specific examples.

Program co-development and partnership. The more closely institutions are involved in developing CCF, the more likely they are to invest in its success.

Promote an "avoid, reduce, *then* offset" message. Institutions are sensitive to the idea that they are "buying indulgences" when they offset. CCF can curb such accusations with public "avoid, reduce, *then* offset" messaging and by actively promoting tools, resources, and programs (such as SBLP) that help institutions reduce their own emissions first.

Options

This section lists potential targets of marketing efforts. For a list of potential purchasers, including their GHG reduction goals, refer to *Appendix C: Potential Purchasers/Donors.*

Individuals. Cambridge's population is relatively environmentally aware; local climate activists have convened three Climate Emergency Congresses in the past two years.

Small businesses. This includes members of Sustainable Business Network-Boston (SBN), SBLP participants, and businesses such as coffee shops, retail stores, and offices.

Universities. This includes Harvard University, Lesley University, and MIT.

Medium and large locally-based businesses. This includes firms with headquarters or major operation centers in or relatively near Cambridge. Examples include Biogen (Weston), Draper Lab (Cambridge), EMC (Hopkinton), Genzyme (Cambridge), Raytheon (Waltham), Staples (Framingham), and Wainwright Bank (Boston).

Large non-local businesses with local sites. Examples include Amgen, IBM, Novartis, Pfizer, Supervalu (Shaw's), Starbucks, and Whole Foods.

Large non-local businesses with greenhouse gas reduction goals. This includes Fortune 500 companies, such as General Motors.

Criteria Scorecard

Recommendations for the benefit phase are in gray, and those for the offset phase are in green.

CRITERIA / OPTIONS	High-Quality Offsets	Significant Impact	Attractive & Affordable	Admin. Feasible	Politically Acceptable	TOTAL
Individuals	—	••	—	••	••••	8
Small local businesses	—	•	—	•	••••	6
Universities	—	••••	—	••••	•••	11
Medium and large locally-based businesses	—	•••	—	•••	•••	9
Large non-local businesses w/local sites	—	••	—	••	•••	7
Large non-local businesses w/GHG goals	—	••••	—	•••	•••	10

Key Tradeoffs Between Options

The Cambridge Carbon Fund will have limited time and resources to dedicate to the intensive marketing local fund managers have found to be necessary. Administratively speaking, the most desirable composition of donors and/or purchasers is a small number of entities, each with high

emissions. This is why the options of targeting individuals and small local businesses were eliminated. Marketing to these groups is labor-intensive, because there are so many distinct entities; yet, the potential purchase volumes are relatively small.

Compared to small businesses, there are fewer medium/large local businesses (e.g. Genzyme) and large non-local businesses with local sites (e.g. Whole Foods): this makes these groups slightly simpler to market to. The businesses I interviewed from these two categories expressed a strong preference for making internal emission reductions, but most were open to the idea of purchasing carbon products. These businesses were generally *less interested in offsets* and *more interested in benefit fund products* that could be treated as charitable donations. Large non-local businesses with local sites expressed some interest in CCF products, but the "local" factor is less of a draw. They seem likely to restrict purchase amounts to local emissions.

Local universities expressed interest in carbon reduction projects that engage the university community and align with their educational missions. CCF and universities could partner on pilot benefit projects, but the real impact would come from offsets, which both Harvard and Lesley are likely to need to reach their GHG reduction goals. Large non-local businesses with GHG goals are similarly unlikely to make large investments in benefit projects. The CCF might struggle to find interested non-local businesses, but just one purchase on the scale of Chevrolet's $1 million MaineHousing purchase would make up for this administrative effort.

Recommendation

Benefit Fund Phase

> **Individuals.** CCF should explore low-effort methods of appealing to individuals, such as a check-off on its tax form. Long term, individuals should not be a major marketing focus.
>
> **Medium and large locally-based businesses.** CCF should look for alignment between its projects and these businesses' charitable giving programs.
>
> ***Court future purchasers.*** CCF should begin outreach to institutions with ambitious GHG reduction goals and an openness to offsets. CCF should propose clear, well-developed project and co-development plans tailored to these institutions' missions/preferences.

Offset Fund Phase

The following targets are few in number and have large potential volumes of GHGs to offset. This simplifies outreach and creates opportunities for deep partnerships with purchasers.

> **Universities.** Harvard has previously said it will need to buy $2-4 million of offsets/year to reach its goal. From 2006-09, Harvard reduced emissions by over 22,000 $mtCO_2e$; as of 2009, it was 73,000 $mtCO_2e$ short of its 2016 goal.[17]
>
> **Large non-local businesses with greenhouse gas reduction goals.** This type of purchaser could easily purchase CCF's entire annual stock of carbon products.

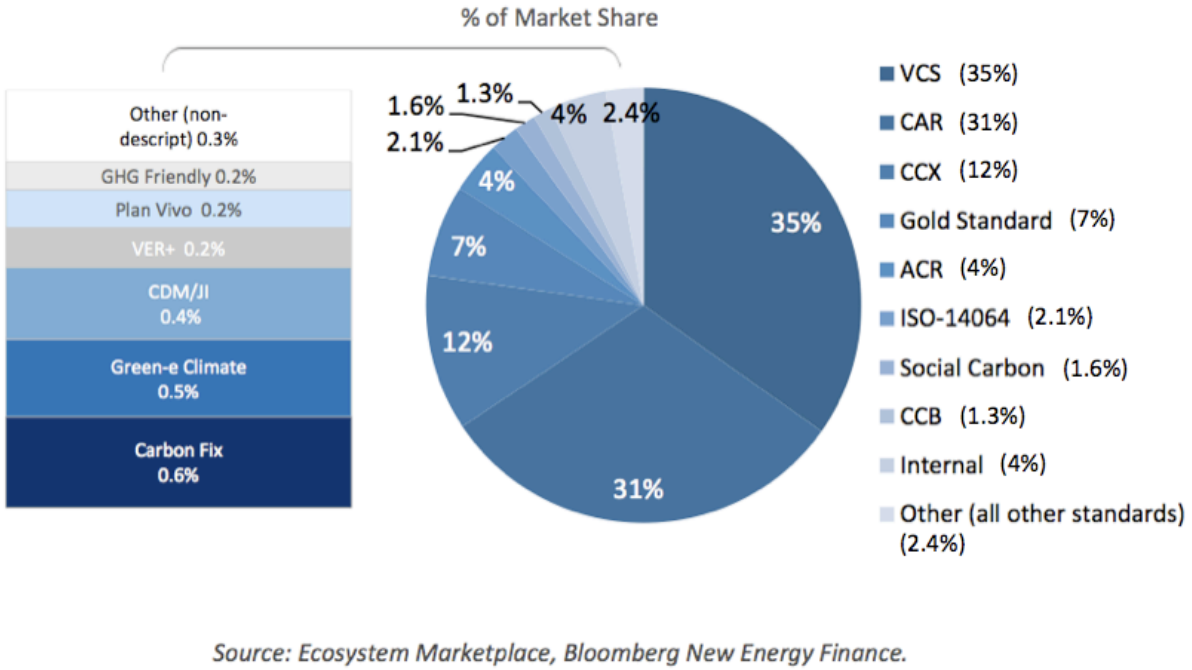
17 "Harvard's Greenhouse Gas Reduction Commitment," *Harvard University Office for Sustainability*, http://green.harvard.edu/greenhousegas. Also: "Harvard University Fact Book: 2006-2007." *President and Fellows of Harvard College*, 2007, 35. http://www.provost.harvard.edu/institutional_research/archive/2007OnlineFactbook.pdf.

Offset Verification

Introduction

While there is no single dominant voluntary offset standard, certain standards are emerging as preferable. In 2009, Verified Carbon Standard (VCS) captured 35% of the market, Climate Action Reserve (CAR) captured 31%, and the Chicago Climate Exchange standard (CCX) captured 12%. An additional 7% of offsets were verified under the Gold Standard (GS), 4% were verified under the American Carbon Registry (ACR), and 2.1% were verified according to ISO-14064/65 accounting rules. An additional 5% of offsets were verified by one of several competing standards, with the few remaining offsets generally verified internally.[18] See *Figure 10* below.

Figure 10: from "Building Bridges: State of the Voluntary Carbon Markets 2010"
*Transaction Volume by Standard, OTC 2009***



Source: Ecosystem Marketplace, Bloomberg New Energy Finance.

*Percentage labels at far right added for this report.

Each standard has a set of project-specific protocols, which means that some types of projects may only be verified under certain standards (e.g. VCS is the only standard with a residential weatherization protocol). Since there are several high-quality offset standards and no clear winner, many project developers and retailers work with a handful of different standards. The Cambridge Carbon Fund could do the same, but certain offset standards are not appropriate for CCF, as explained below.

18 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," viii.

Options

The following offset standards were not considered, because they are for forestry or land-based projects, or must be applied in addition to another standard (called "stacking"): Carbco Platinum Carbon Standard, the CarbonFix Standard, the Climate, Community, and Biodiversity Standards, Plan Vivo, and SOCIALCARBON Standard. EPA Climate Leaders was not included, because the program has been discontinued. I considered the offset standards listed in *Figure 11* below, which replaces the Criteria Scorecard for this section.

Figure 11: Assessment of Selected Offset Standards

Standard	Current Relevant Protocols (for many standards, new ones may be created)	Monitoring, Verification, Accounting, & Preparation Costs*	Reputation / 2009 Market Share	Assessment
ACR Registry: ACR	Anaerobic digester methane, energy efficiency, landfill gas	Expensive.	Good / 4% Relatively lower additionality hurdle	Place on short list for further consideration.
CAR Registry: CAR	Landfill gas, composting, urban forestry, organic waste digestion, ODS	Expensive.	Best / 31%	Place on short list for further consideration.
CCX Registry: CCX	Landfill gas, energy efficiency, fuel switching, renewable energy, urban forestry, ODS.	Expensive.	Poor / 12% Transparency and additionality concerns.	No: declining brand, quality concerns, and uncertain future.
GS Registry: GS	Landfill gas, renewable energy, energy efficiency	Very expensive. "complicated, time-consuming"[19]	Best / 7%	No: process is too onerous and expensive.
Green-e Climate Protocol for Renewable Energy Not RECs/not overlay No official registry	Landfill gas, renewable energy	Less expensive.	Unclear / 0.5% Clear RECs leader; for some, this reputation may transfer to offsets	Place on short list for further consideration.
ISO 14064/65 Registry: GHG Clean Projects & others (no official registry)	Many/any.	Less expensive.	Unclear / 2.1% Many standards are based on ISO methods, but it is not a full standard..	Place on short list for further consideration.
RGGI Registry: RGGI COATS	Landfill gas, energy efficiency	Unclear	Unclear (No RGGI offsets yet exist.)	No: demand is unproven and prices are low.
VER+ Registry: Blue Registry	Renewable energy, energy efficiency, landfill gas, fuel switching, etc.	Very expensive	Unclear / 0.2% Developed by one verifier, not a coalition	No: demand is low.
VCS Registry: VCS	Many including weatherization and all CAR methodologies. Bike sharing in development.	Very expensive	Best / 35% Developed by an industry coalition. Enjoys broad support.	Place on short list for further consideration.
* Annual costs may be lower for standards that allow bi- or triannual verification (e.g. VCS weatherization standard).				

19 Anja Kollmuss, Helge Zink, and Clifford Polycarp, "Making Sense of the Voluntary Carbon Market: A Comparison of Carbon Offset Standards," *WWF Germany, the Stockholm Environment Institute, and Tricorona*, March 2008, 58. http://assets.panda.org/downloads/vcm_report_final.pdf.

Key Tradeoffs Between Options

I eliminated the Chicago Climate Exchange (CCX) from consideration, because of its declining brand value and persistent quality concerns. I eliminated the Gold Standard (GS), because of its onerous and expensive validation and verification processes. The Regional Greenhouse Gas Initiative standard (RGGI) was eliminated, because demand for RGGI offsets is unproven (no RGGI offsets yet exist). CCF could consider RGGI offsets in the future, if demand develops and the price of RGGI allowances rises.[20] VER+ was eliminated, because it faces very low demand.

The Cambridge Carbon Fund may be tempted to adhere to one of the most well-respected offset standards, but verifying to these standards is very expensive. It may not make sense to use one of these standards, especially if purchasers do not demand it and are not willing to pay a premium for it. CCF will have to monitor the evolution of purchaser sophistication over time.

The Colorado Carbon Fund and the Duke Carbon Offsets Initiative are the only local offset funds that produce offsets under a premium offset standard (CAR; for others, refer to "Reputation" in *Figure 11*). However, both of these funds were able to find large non-urban methane projects that produce low-cost offsets. This option is not necessarily available to the Cambridge Carbon Fund (pending discussions with landfill owners). For a model more relevant to urban areas, CCF should look to MaineHousing, which will soon begin producing VCS weatherization offsets.

The Earth Givers' Neutral Gator/Gainesville program is an urban carbon fund that cuts costs by using a less expensive, non-premium standard. Earth Givers has its energy efficiency offsets independently verified to ISO-14064/65 guidelines, which are the accounting basis for many well-respected standards. However, since ISO-14064/65 is an offset *protocol* rather than a full-fledged *standard*, independent verification is a choice rather than a requirement. If CCF takes this route, it will be important to publicize the fact that its offsets *are* independently verified. For Earth Givers, using ISO-14064/65 standards (in combination with low overhead and volunteer labor) enables it to sell offsets at a price of $\$12/mtCO_2e$. This price is comparable to Colorado's price for landfill offsets and lower than that charged by many benefit funds.

Interviews with businesses revealed few preferences in terms of offset standards. Of course, stronger preferences may develop when these businesses begin to research and seriously consider offsetting. This is a good reason to delay selecting specific standards. However, some types of offsets are more likely to be deemed eligible for conversion to compliance offsets under future climate legislation. The most likely to be eligible are, in order of likelihood: CAR, VCS, and ACR. If CCF begins to see purchaser interest in compliance-grade offsets and lack of interest in cheaper, non-premium offsets, it should consider restricting its offsets to these three brands.

Many businesses were familiar with Renewable Energy Certificates (RECs), because they had purchased RECs to gain LEED points. They voiced a clear preference for RECs with Green-e certification, which is required by LEED. For these businesses, trust in the Green-e brand might make Green-e offsets (which are different from Green-e RECs) appealing. LEED also just began permitting offsets to be used in lieu of RECs to earn LEED points, which opens up a new source of local offset demand.[21]

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20 Since 2010, the price of a RGGI allowance has been at the price floor, $1.86.

21 "Haworth Turns to Offsets Over RECs to Earn LEED Green Power Points." *ClimateBiz*, April 27, 2010. http://www.greenbiz.com/news/2010/04/28/haworth-turns-offets-over-recs-earn-leed-green-power-credits.

Recommendation

During its carbon benefit fund phase, the Cambridge Carbon Fund should not commit to using a certain offset verification standard in the future. Instead, CCF should commit to a set of quality principles, which should be transparent and prominently posted on its website. Offset standards can be tested against these principles. Certain offset standards can already be placed on a short list for future consideration: they are ACR, CAR, VCS, Green-e Climate Protocol for Renewable Energy, and ISO 14064/65. These standards should be monitored for: popularity, market value, and likelihood that future climate legislation will deem their offsets eligible for conversion to compliance-grade offsets. CCF should also publicize its baseline and carbon reduction calculation methodologies. By committing to transparency and quality principles rather than to specific offset standards, CCF:

> **Signals its high standards to potential co-developers and purchasers**, while still allowing flexibility to meet these parties' demands for specific offset standards.
>
> **Avoids prematurely committing to standards** that, after the voluntary carbon markets have stabilized, may prove to be unpopular with purchasers. It also prevents CCF from committing to offset standards that may prove unsustainably expensive.
>
> **Leaves the door open for internally-created standards to be negotiated between CCF and potential purchasers.** These standards would meet CCF's quality principles, but might avoid some of the costs of verification, allowing a higher percentage of money to be spent on carbon reduction projects themselves.

Quality principles. The voluntary carbon markets have not yet rallied around a single offset standard, but stakeholders have largely agreed on a set of offset quality principles. These principles are that offsets should be: real, additional, permanent, independently verified and unambiguously owned. CCF might officially adopt the quality guidelines published by a trusted organization, or write its own, similar guidelines. Organizations that have published quality principles include: the Environmental Defense Fund, The Offset Quality Initiative, the International Carbon Reduction and Offset Alliance, the Stockholm Environment Institute, WWF, and the American College & University Presidents Climate Commitment (ACUPCC).

The ACUPCC, which Harvard may be looking to for guidance (although it is not a signatory), has issued guidelines that express a preference for offsets that produce co-benefits, such as "providing jobs to the local community, preserving wildlife habitat, or creating healthy buildings."[22] Thus, the Cambridge Carbon Fund may also wish to set standards for co-benefits.

Refer to ***Appendix I: Summary of Recommendations*** for a summary of the recommendations made in:
Section III. Choice: Is a Local Carbon Fund a Viable Option? and
Section IV. Design: Which Program Design Options will Maximize Success?

22 "Investing in Carbon Offsets: Guidelines for ACUPCC Institutions v 1.0," *American College & University Presidents Climate Commitmen*t, November 2008, 22. http://www2.presidentsclimatecommitment.org/documents/CarbonOffsetsGuidelines_v1.0.pdf.

SECTION V
Potential Impact

The following two tables provide estimates of the potential impact of various purchasing and project choices. The footnotes clarify the specific numbers used. For additional discussion of potential project impacts, refer to *Appendix F: Project Types*.

Figure 12. Estimates: Potential Impact of Selected Carbon Reduction Projects

Category	Project Type	Project size	Annual carbon products created ($mtCO_2e$)	Annual Carbon Revenue at $20/ton	Reduction in 2020 citywide emissions (8-year program) and % of CCF goal	
Significant impact (CCF goal)	—	—		—	27,200-36,300 $mtCO_2e$/year (10% of new City goal)	
Residential	Home weatherization—HEET 10 year project lifetime Benefit : 1.16 $mtCO_2e$/home/yr[23] Thermal + Electric Offset: 0.54 $mtCO_2e$/home/yr Thermal only	100 homes Countable benefits	1,160 100 homes • 10 yrs	$23,200	928	2.6-3.4%
		100 homes Countable offsets	540 100 homes • 10 yrs	$10,800	432	1.2-1.6%
	Composting of food scraps (EPA Waste Reduction Model)[24] Annual tons and revenues.	20 tons/day	2,187	$43,740	2,187	6.0-8.0%
		30 tons/day	3,281	$65,620	3,281	9.0-12.1%
		40 tons/day	4,374	$87,480	4,374	12.0-16.2%
	ODS destruction in appliances 10 year appliance lifetime Benefit: 2.56 $mtCO_2e$/appliance[25] CFC-11 + CFC-12 + Electric Offset: 1.30 $mtCO_2e$/appliance** CFC-12 only	1% of HH (482) Countable benefits	2,752 10 yrs for electric 1 yr for CFC-11/12	$33,740	2,416	6.7-8.9%
		1% of HH (482) Countable offsets	627 1 yr for CFC-11/12	$12,532	627	1.7-2.3%
Commercial	Commercial boiler efficiency (189 $mtCO_2e$/boiler/yr)[26] 10 year project lifetime	5 boilers	9,450 5 boilers • 10 yrs	$189,000	7,560	20.8-27.8%
		20 boilers	37,800 20 boiler • 10 yrs	$756,000	30,240	83.3-111.2%
	Solar photovoltaic (0.50 $mtCO_2e$/kW/yr)[27] Annual tons	100 kW	50	$1,000	50	<0.2%
		300 kW	150	$2,000	150	<0.6%
		1,000 kW	500	$10,000	500	1.4-1.8%
Transport	Bike share (I assume 1-4 $mtCO_2e$ /bike)[28] Annual tons	200 bikes	200-800	$4,000-16,000	200-800	0.6-2.9%
		400 bikes	400-1,600	$8,000-32,000	400-1,600	1.1-5.9%
		600 bikes	600-2,400	$12,000-48,000	600-2,400	1.7-8.8%
Other	Landfill gas (EPA Landfill Methane Outreach Program data) Annual tons	Half of portfolio[29]	13,600-18,150	$272,000-363,000	13,600-18,150	50%
		All Camb. Waste	24,424[30]	$488,480	24,424	67.3-89.8%
		Fitchburg	68,000[31]	$1,360,000	68,000	187-250%

*Explanation of project lifetime: A home is only weatherized once, but the annual tons are counted for a 10-year project lifetime. For example: 0.76 $mtCO_2e$/home/year • 10 year project lifetime = 7.6 $mtCO_2e$/home. So, if one home is weatherized per year, to simplify I count the $mtCO_2e$ of carbon products produced in that year as 7.6 $mtCO_2e$, because no additional future investments must happen for reductions to continue. For annual projects, such as bike share, no project lifetime is used. For reductions in 2020, project lifetime is not considered.

23 HEET's average reduction per home is 2,550 lbs. CO_2e (1.16 $mtCO_2e$): of this, 0.62 $mtCO_2e$ was from electric savings and 0.54 $mtCO_2e$ was from thermal savings. Data are from: "HEET Summary Data sheet," *HEET*, February 2011.

24 This assumes food scraps are sent 50/50 to the Saugus incinerator and the Rochester, NH landfill. The hypothetical compost facility is sited 45 miles from Cambridge. Calculations were made using: "Waste Reduction Model (WARM) Version 11," *U.S. Environmental Protection Agency*, August 2010. http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html

25 Average reduction: CFC-11 (0.91 $mtCO_2e$/unit), CFC-12 (1.30 $mtCO_2e$/unit), and electricity (0.35 $mtCO_2e$/unit). The electricity average is for refrigerator replacement. The ODS averages assume collection of: 90.1% refrigerators, 9.3% freezers, <1% window AC and dehumidifiers. The ODS reductions are calculated with data from: "RAD Environmental Benefits," *U.S. Environmental Protection Agency*. http://www.epa.gov/Ozone/partnerships/rad/envbenefits.html.

26 The 189 number = total emissions reduction potential of commercial boilers (22,673,929 $mtCO_2e$) divided by the total number of commercial boilers (119,790). This assumes boilers of 300,000 to 10 million BTU/hour. Numbers are based on: SAIC, "Boiler Efficiency Projects: Development of Issues Papers for GHG Reduction Project Types: Boiler Efficiency Projects," *California Climate Action Registry*, January 7, 2009, 41. http://www.climateactionreserve.org.

27-31 Footnotes continue at the bottom of the next page.

Figure 13. Estimates: Potential Impact of Selected Carbon Product Purchases

Category	Emissions being offset	% of pop. offsetting	# of people or entities offsetting	Total tons being offset ($mtCO_2e$)	Price per purchase at $20/ton	Carbon Revenue
Significant impact (CCF goal)	27,200-36,300 $mtCO_2e$/year (10% of new City goal)	—	—	27,200 to 36,300	—	$600,000 to $800,000
Residential (2010 emissions estimate* = 535,494 $mtCO_2e$)	Total annual residential emissions per capita (4.92 $mtCO_2e$)[32]	0.5%	544	2,676	$98	$53,520
		1%	1,088	5,353		$107,060
		10%	10,877	53,515		$1,070,300
	Annual refrigerator use (1.01 $mtCO_2e$)[33] 48,194 HH in Camb.[34]	0.5%	241 HH	243	$20	$4,860
		1%	482 HH	487		$9,740
		10%	4,819 HH	4,867		$97,340
Commercial (2010 emissions estimate* = 1,104,529 $mtCO_2e$)	Building energy use of small office (20 people; 36 $mtCo_2e$)[35]	—	10 offices	360	$720	$7,200
		—	20 offices	720		$14,400
		—	200 offices	7,200		$144,000
	Building energy use of large office (200 people; 364 $mtCo_2e$)	—	10 offices	3,640	$7,280	$72,800
		—	20 offices	7,280		$145,600
		—	200 offices	72,800		$1,456,000
	Flight to DC (0.5 $mtCO_2e$)	—	100 flights	50	$10	$1,000
		—	200 flights	100		$2,000
		—	2,000 flights	1,000		$20,000
Transport (2010 emissions estimate* = 221,094 $mtCO_2e$)	Passenger car (5.19 $mtCO_2e$)[36]	—	100 vehicles	519	$104	$10,380
		—	200 vehicles	1,038		$20,760
		—	2,000 vehicles	10,380		$207,600
	Light truck (7.27 $mtCO_2e$)	—	100 vehicles	727	$145	$14,540
		—	200 vehicles	1,454		$29,080
		—	2,000 vehicles	14,540		$290,800

*These 2010 emission estimates come from the 2002 report: "City of Cambridge Climate Protection Plan: Local Actions to Reduce Greenhouse Gas Emissions," *City of Cambridge*. Section 2-2. I converted short tons to metric tons.

27 "Renewable Energy System Locations," *City of Cambridge*, http://www2.cambridgema.gov/CDD/et/climate/clim_renew_map/clim_renewmap.html.

28 Felix Salmon, "How much carbon does bike-sharing save?" *Reuters Blog*, December 2, 2010. http://blogs.reuters.com/felix-salmon/2010/12/02/how-much-carbon-does-bike-sharing-save/

29 The entire carbon portfolio aims to provide at least 27,200-36,300 $mtCO_2e$. So, if landfill gas makes up half the portfolio (to produce a blended product) then landfill gas should be 13,600-18,150 $mtCO_2e$.

30 This is a 2002 estimate of Cambridge's 2010 waste emissions (26,923 short tons = 24,424 metric tons). "City of Cambridge Climate Protection Plan: Local Actions to Reduce Greenhouse Gas Emissions," *City of Cambridge*, Section 2-2. http://www2.cambridgema.gov/CDD/et/climate/clim_plan/clim_plan_full.pdf.

31 This is the size of the smallest existing landfill gas-to-energy project at a landfill used by Cambridge. Information is from the Massachusetts Excel file: lmopdatama.xls found at: "Landfill Methane Outreach Program: Energy Projects and Candidate Landfills," *U.S. Environmental Protection Agency*, December 15, 2010. http://www.epa.gov/lmop/projects-candidates/index.html.

32 590,281 short tons = 535,494 metric tons, 2010 residential emissions and 108,771 is the 2009 population estimate for Cambridge. 535,494/108,776 = 4.92 metric tons per capita (residential only). Source of emissions estimate: "City of Cambridge Climate Protection Plan," Section 2-2. Source of population estimate: "Cambridge city, Massachusetts. ACS Demographic and Housing Estimates: 2009," *U.S. Census Bureau*. http://www.factfinder.census.gov.

33 "City of Cambridge Climate Protection Plan," Section 2-5.

34 "Cambridge city, Massachusetts. Selected Social Characteristics in the United States: 2009," *U.S. Census Bureau*. http://www.factfinder.census.gov.

35 Building energy use is derived from "Site Emissions" using: "Business Carbon Footprint Calculator," *TerraPass*, http://www.terrapass.com/business. (Accessed February 2011). I assume 200 sq. ft./employee and no web servers.

36 "Emission Facts," *U.S. Environmental Protection Agency*. http://www.epa.gov/oms/consumer/f00013.htm.

SECTION VI
Next Steps

Reach out to potential administrative and advisory partners

The first step the City of Cambridge should take is to begin partnership discussions with potential administrative partners. Concurrently to or after this step, the City of Cambridge should form an advisory board made up of potential purchasers, environmental/scientific partners, and potential sources of pro bono help (e.g. graphic design, public relations). This advisory committee should begin its work by establishing CCF's quality principles.

Reach out to potential local project contractors

In order to reach the desired scale (10% of the new citywide goal) and to keep down per-ton verification costs, the Cambridge Carbon Fund will need to run its projects at relatively large scales. Before CCF chooses which projects to undertake, it must determine local contractors' capacity (or ability to ramp up capacity). The City of Cambridge should also assess its own ability to expand programs (e.g. convert DPW's appliance service into an ODS program).

Outreach should target the potential contractors listed below. The listed contractor tasks may be split between the contractor and CCF where appropriate.

- **Appliance take-back contractors.** Possible tasks include administration of rebates (if applicable), collection of appliances, collection of refrigerant, shipping of refrigerant to ODS destruction facility, and receipt of payment from ODS facility.
- **Residential energy efficiency contractors.** Possible tasks including recruiting building owners (and tenants where applicable), recruiting volunteers, and performing weatherization. Nonprofit contractors are preferred, because they would be more willing to work with volunteers.
- **Commercial boiler efficiency contractors.** Possible tasks include locating eligible boilers, recruiting boiler owners, and performing efficiency assessments and upgrades. Alternatively, CCF could reach out directly to the owners of large boilers.
- **Landfill owners.** CCF must determine whether the three landfills that receive Cambridge's waste have the potential to produce offsets, either from existing or new projects. If this is possible, CCF should begin partnership discussions. Alternatively, CCF could work with Waste Management to divert its waste to an offset-producing landfill.

Assess costs and funding sources

The City needs to estimate CCF's potential administrative and project costs, as well as available funding opportunities, including grants, partner donations, and City fees. Feasibility studies and the budgets of other local carbon funds provide a limited amount of guidance.

Monitor regulatory developments

The Cambridge Carbon Fund needs to monitor emerging regulations and rules to assess their impact on CCF's proposed projects. It should monitor:

- **U.S. EPA's new boiler rules**, which have not yet been finalized, but which will limit the types of commercial boiler efficiency projects that will be eligible to produce offsets.
- **MA task force considering a ban on food scraps in landfills**, which would make composting projects ineligible to produce offsets. If the chances of a ban seem low, composting should be reconsidered as a potential carbon reduction project.

SECTION VII
Appendices

Appendix A: Examples of Local Carbon Offset/Benefit Funds

This table displays basic information about the local carbon funds featured in this report.

Program	Administrator	Major Partners	Fund Type	Independent Verification	Purchase price/ton*	Started (Planned)	Projects to Date	Other Notable Features
Aspen/Pitkin Canary Tags	City	—	Benefit	No	$20	2007	Tree planting	Shifting to tourist focus
Boston CarbonPlus Calculator	City	—	Hybrid	Retires RGGI allowances	$20	(2009) No launch	None. (Urban forestry and e.e.)	May launch when big sponsors are secured
Chicago Offset Fund run by the Delta Institute	Nonprofit	Delta Institute City of Chicago	Hybrid	CCX (CAR and ACR possible)	$10	(2009)	None. (Many types possible incl. ODS)	Program in limbo after CCX collapse
Cleveland Carbon Fund	Nonprofit	George Gund Fdn. Cleve. Comm. Fdn. Museum of Nat. Hist. City of Cleveland	Benefit	—	$20	2009	CFLs, shower heads, and weatherization	Focus on projects that are too small to be offset projects
Colorado Carbon Fund	State/Nonprofit	The Climate Trust	Hybrid	CAR (VCS, GS, and ACR possible)	$20	2008	Landfill methane	Special license plates for offsetting car travel
Community Carbon Use Reduction at Brown	University	—	Benefit	No	Internal (Varies; $63/$36)	2008	Many, incl. tire inflation and residential e.e.	Staff, faculty & students apply for funds to run their own projects
Duke Carbon Offsets Initiative	University	Duke students and departments	Offset	CAR (VCS and ACR possible)	$10	2009	Swine farm methane	Internal to Duke; officially counted
MaineHousing	State	—	Offset	VCS	$25**	2010	Residential weatherization	Extremely large purchase from GM
Major U.S. City Climate Benefit Fund	City/Nonprofit	Board of Trade Carbonfund.org	Benefit	—	$15-20 goal	(2011)	—	Business-initiated; likely tourist focus
Neutral Gator/Gainesville run by Earth Givers	Nonprofit	—	Offset	ISO 14064 (CleanProjects Registry)	$12	2008	Multifamily energy efficiency	University depts and City buy offsets; volunteers do work
Oberlin POWER Fund	Nonprofit	—	Benefit	—	$20	2009	Residential energy efficiency	Many local churches donate; college offers guests event offsets
Philadelphia Erase Your Trace (CarbonPlus Calculator)	City	Fairmount Parks Conservancy	Benefit	—	$20	2009	Urban forestry	Program has not been marketed; one donation made
San Francisco Carbon Fund	City	3Degrees (gives SF $1.50 per offset sold in airport kiosks)	Benefit	No	13% added onto City air travel	2007	Biodiesel, orchards	Mostly internal; airport kiosks sell 3Degrees' hybrid CAR/City offsets
Westminster CarbonPlus Calculator	City	—	Benefit	—	$23	2010	Urban forestry	Program developed & launched in weeks
Yale Community Carbon Fund	University	—	Benefit	No	Internal ($20 goal)	2009	Programmable thermostats	Internal to Yale; *not* officially counted

* The purchase price/suggested donation per ton of CO_2e reduced does not necessarily reflect the true cost of the reduction (usually true costs are higher). This is because carbon funds generally provide additional funding to projects with multiple funding streams.
** Based on Chevrolet's $1 million purchase of 40,000 tons of CO_2e: http://www.mainehousing.org/NEWS.aspx.

Non-Urban Offset Funds: Colorado and Duke

Projects undertaken by non-urban offset funds generally produce lower-cost offsets than would the urban projects available in Cambridge. The Colorado Carbon Fund and the Duke Carbon Offsets Initiative offer competitively priced, verified offsets. (Technically, the Colorado Carbon Fund is a hybrid fund, since it uses offset proceeds to fund other worthwhile projects for which offsets would be inefficient/difficult to verify.) It is difficult to draw lessons for Cambridge from these programs, because both operate in non-urban contexts. Cambridge contains neither landfills (Colorado's first project is landfill methane) nor swine farms (Duke). Cambridge could still try to monetize carbon from the landfills to which its waste is sent.

Urban Offset Funds: MaineHousing, Earth Givers, and Boston

MaineHousing, while not strictly an *urban* offset fund, is running home weatherization projects, which are possible in Cambridge's urban context. It is the only offset fund running urban-style offsets that will produce "premium brand" offsets: VCS. This is possible, because:

- **Offsets are being produced by activities with which MaineHousing already has experience.** Initially, no offset protocol existed for residential weatherization. So, MaineHousing used substantial ARRA and Ford Foundation funding to write a new VCS offset protocol. (This protocol could be adapted for commercial weatherization, at considerable expense.)
- **MaineHousing received a large donation from an "angel" purchaser: GM (Chevrolet).** This significantly reduced the administrative effort needed for marketing.

Many carbon funds become benefit funds rather than incur the expense of verifying premium-brand offsets. Rather than giving up, Earth Givers and Boston have each adopted unique approaches to producing verified reductions.

- **Earth Givers verifies its offsets using a non-premium standard.** Earth Givers uses ISO-14064/65 guidelines to calculate carbon reductions and lists them in the CleanProjects Registry. Offsets are still independently verified.
- **Earth Givers uses volunteer labor to conduct its energy efficiency projects.**
- **When Boston launches its fund, each purchase will pay for RGGI allowances and City projects.** The RGGI allowance accounts for the full ton of emission reductions, while the more expensive (per ton) City projects will not be officially verified.

CarbonPlus Calculator Programs: Boston, Philadelphia, and Westminster

The CarbonPlus Calculator is an online carbon footprint calculator and donation platform that evolved out of conversations between several northeastern cities and the U.S. Forest Service. The Forest Service developed the calculator based on the EPA's Personal Emissions Calculator. By early 2009, versions had been developed for Boston, New York City, Philadelphia, Baltimore, and Vermont.[37] Vermont decided not to launch the Calculator and New York City decided to use it as a calculator rather than an avenue for offsetting. It is unclear when or if the Boston and Baltimore programs will be launched. Philadelphia launched its CarbonPlus program in 2009, but the program is not very active, according to City staff. Westminster, Colorado adapted and launched its own version of the CarbonPlus Calculator within a few weeks in 2010.

37 Elise Schadler and Professor Cecilia Dank, "CarbonPlus Calculator Case Study: Draft 2, 8/13/2010," *Rubenstein School of Environment and Natural Resources. University of Vermont.*

This is a turnkey program that Cambridge could launch quickly. Alternatively, the calculator could be embedded within the Cambridge Carbon Fund without adopting the rest of the CarbonPlus website's graphic interface. However, making the calculator available online is not sufficient to attract traffic and donations. The Philadelphia calculator, which launched in 2009, but has not otherwise been marketed, has attracted only one donation thus far.

Benefit Funds: Aspen, San Francisco, Major U.S. City, Oberlin, Cleveland

Many local carbon funds focus on locally valuable projects that cannot feasibly produce carbon offsets, either because the projects are too small, or the reductions are too costly. These programs try to attract donors by leveraging the support of specific sub-communities such as tourists (Aspen Canary Tags Initiative and San Francisco Carbon Fund), sympathetic business groups (Major U.S. City Climate Benefit Fund), churches (Oberlin POWER fund), or founding partners (Cleveland). Early results indicate that these strategies can drive a limited number of donations, but it is not yet clear whether these results can be enhanced and sustained.

Internal Programs: San Francisco, Yale, Duke, and Brown

A minority of local carbon funds are internally funded and produce carbon reductions that are officially or unofficially counted against the administrator's *own* carbon emissions. (Compare this to the general model of using outside sales/donations to produce carbon reductions that are counted against the *purchaser's* carbon emissions.) San Francisco, Yale, Duke, and Brown all run funds that produce carbon reductions, but none seek external funding to pay for these reductions. (Caveat: The offset organization 3Degrees recently rolled out San Francisco airport kiosks that pay the San Francisco Carbon Fund $1.50 for each ton purchased.) Significantly, these programs *only reduce emissions that are not counted as part of the fund administrator's carbon footprint*. For example, the Duke Carbon Offset Initiative counts carbon reductions from swine farm methane, but not from internal reductions undertaken by Duke University (e.g. dormitory energy efficiency).

Appendix B: Fund Type

This appendix contains detailed criterion-by-criterion analysis of the potential fund types explored in *Section III. Choice: Is a Local Carbon Fund a Viable Option?*

1. Discussion of Options
2. General Lessons

1. Discussion of Options

This section analyzes the desirability of fund type options according to Cambridge's five guiding criteria.

Carbon offset fund

(1) High-quality Carbon Reductions. Reductions from offset projects are not necessarily higher quality than those from benefit projects. The main advantage of a carbon offset fund is that many purchasers and environmental leaders will perceive the offsets to be high-quality. The verification required to produce offsets also provides administrators with higher confidence in the level of carbon reductions achieved.

(2) Significant Impact. Near-term interest from major offset purchasers (i.e. universities and large businesses) is likely to be low as purchasers delay offset decisions until the voluntary carbon markets settle down and internal reduction options are exhausted. None of the local institutions interviewed for this report indicated impending offset investments. Many have only recently conducted GHG inventories and are focused on internal reductions. For example, despite positive statements about its need to offset emissions, Harvard University will not assemble its next greenhouse gas task force until 2012—and this group may recommend that Harvard *not* pursue offsetting.

Absent an "angel" offset purchaser such as MaineHousing has found with GM (Chevrolet), an offset fund is likely to result in limited offset sales during the first several years.[38] Local demand is not well enough developed, and the offsets will probably be too expensive to plausibly compete in general voluntary carbon markets, where a "local to Cambridge" label is unlikely to inspire purchasers to pay a premium price.

(3) Attractiveness/Affordability. Offsets are the only products that are attractive at a large scale to pre-compliance purchasers (they might make token benefit product purchases). Purchasers that have made public commitments to reduce emissions (e.g. through EPA Climate Leaders or the American Association for Sustainability in Higher Education), are also likely to demand offsets, because of peer pressure. Pre-compliance and peer-influenced purchasers have the highest potential volume of offset purchases. However, offsets are

38 "Chevrolet Clean Energy Initiative to Fund Home Energy-Efficiency Upgrades as First Project." *General Motors*, January 26, 2011. http://media.gm.com/content/media/us/en/news.detail.brand_gm.html/content/Pages/news/us/en/2011/Jan/0126_chev.

currently less attractive to these types of purchasers than are internal reductions, which often also result in energy cost savings.

The purchasers who might make nominal near-term investments in offsets are individuals and small- to medium-sized businesses. However, these purchasers are less concerned that their money go toward offset rather than benefit projects. They generally do not intend to count offsets toward emission reduction goals and are less subject to pressure from broader peer groups.

(4) *Administrative Feasibility.* An offset fund will require more staff time and more assistance from outside experts. In comparison to a benefit fund, an offset fund also has considerable extra verification expenses in the range of $7,000-$13,500/project/year plus transaction fees.[39] MaineHousing estimates verification costs at $10,000-$15,000 per project per *verification cycle*: to economize, this can occur bi- or triannually rather than annually. None of the proposed fund types are likely to cover their costs in the first few years.

(5) *Political Acceptability.* An offset fund is likely to face criticism from the City Manager and City Councillors for producing a more expensive product (compared to a benefit product), the production costs of which do not seem justified given current demand levels.

There are no major anticipated problems from local citizens and businesses. Although some offset purchasers may face opposition from their stakeholders for purchasing offsets, the fear of opposition to offset and benefit funds is overblown. All local carbon fund administrators interviewed indicated that they had experienced no local opposition to their programs.

Carbon benefit fund.

(1) *High-quality Carbon Reductions.* Reductions from offset projects are not necessarily higher quality than those from benefit projects. However, major offset purchasers and environmental experts (e.g. WWF) perceive benefit products to be lower quality.

(2) *Significant Impact.* In the near term, Cambridge has several promising donor prospects, including environmentally conscious businesses with environmental focuses to their charity activities (e.g. Whole Foods or Wainwright Bank). In the case of benefit fund donors, uncertainty in voluntary carbon markets does not provide a dampening effect on demand. However, the potential impact from a benefit fund is much smaller, because donation volume is not driven up by a desire to meet GHG reduction goals.

(3) *Attractiveness/Affordability.* Benefit products are not attractive to major offset purchasers, who are accountable to larger peer groups. Existing local carbon funds have discovered that local benefit products are attractive to individuals and to small- to mid-sized businesses as a way to give back or receive positive green publicity.

(4) *Administrative Feasibility.* A benefit fund will have a steep learning curve and require assistance from outside experts, but to a lesser extent than would an offset fund. Costs are

39 Sheldon Zakreski, "Colorado Carbon Fund Webinar," *The Climate Trust*. February 22, 2011.

much lower, but none of the proposed fund types are likely to cover their costs in the first few years.

(5) *Political Acceptability.* A benefit fund is likely to face less criticism from the City Manager and City Councillors on cost grounds, but the program is still likely to operate a deficit for the first few years. Because a benefit fund is able to support multiple politically popular projects rather than strictly low-cost (and low charisma) projects, it might have a broader set of local proponents.

The reaction of Cambridge's peers in environmental and municipal circles will likely be mixed. On the one hand, environmental policy wonks deride carbon benefit products for lacking accountability. On the other hand, many municipalities are likely to admire Cambridge for providing an innovative funding model for environmental projects. The Cambridge Carbon Fund's carbon reduction quality principles and carbon accounting transparency policies will determine which perspective dominates. As noted above, all local carbon fund administrators interviewed indicated that they experienced no local opposition to their programs.

Phased benefit-offset fund.

(1) *High-Quality Carbon Reductions.* The quality/quality perceptions of a phased fund's products match those for benefit products in the benefit fund stage and those for offsets in the offset fund stage.

(2) *Significant Impact.* A phased fund appeals to the type of demand (benefit now, offset later) that is present as it emerges. Thus, its impact is predicted to grow over time, more so than would the impact of a benefit fund. But, a phased fund is likely to have a larger impact during its benefit fund phase than would an offset fund during that time period. This is because it appeals to the donors that are already ready to participate. By waiting for markets to mature, a phased fund would generate greater demand in its offset fund stage than would an immediately launched offset fund.

(3) *Attractiveness/Affordability.* The appeal of benefit and offset products is discussed under those sections. A phased benefit-offset fund would take advantage of the attractiveness of benefit products now and of offsets later.

(4) *Administrative Feasibility.* A phased benefit-offset fund faces the administrative challenges of a benefit fund during its benefit fund phase and those of an offset fund during its offset fund phase. The administrative learning curve for the offset fund phase would be less challenging, however, because CCF would be able to transfer skills and knowledge from the benefit fund phase. None of the proposed fund types are likely to cover their costs in the first few years.

(5) *Political Acceptability*. Initially, a phased fund faces the same potential political challenges as a benefit fund. All local carbon fund administrators interviewed indicated that they experienced no local opposition to their programs.

No carbon fund.

(1) High-Quality Carbon Reductions. Cambridge has a strong reputation on environmental issues and the quality/quality perception of its projects would continue in the absence of a carbon fund. The quality of carbon reductions is not contingent on labeling carbon reductions as offset or benefit products.

(2) Significant Impact. If the City continues its current projects without change, it will produce fewer carbon reductions than if it had created a carbon fund. Estimating the impact of new non-carbon fund projects is beyond the scope of this report.

(3) Attractiveness/Affordability. The City has achieved moderate success motivating local institutions to contribute to innovative municipal carbon reduction projects (e.g. paying for hybrid taxis). These are essentially carbon benefit projects, but without a standardized systems for participation and achieving recognition. To donors, the no-fund option is thus slightly less attractive than a benefit fund.

(4) Administrative Feasibility. The City has already overcome the initial implementation challenges of its existing carbon reduction programs. Business as usual is very feasible.

(5) Political Acceptability. The City regularly receives accolades for its environmental programming, and the City Manager and City Councillors have already approved existing programs. The current set of programs is politically acceptable, except that it has not produced the anticipated carbon reductions. City stakeholders desire some sort of change.

2. General Lessons

Carbon offset funds are generally riskier than carbon benefit funds, because they are more dependent on the ups and downs of the voluntary carbon markets, and because they are more expensive to administer. However, the long-term market for offsets is greater than the market for benefits, so an offset fund has a greater potential payoff in terms of carbon reductions achieved. The main differences in risk between offset and benefit funds are outlined below.

Financial and market risks

More money is at risk if an offset fund underperforms, because offset funds have higher administrative costs than benefit funds. Higher costs include greater costs for finding appropriate projects and costs for monitoring, verification, and auditing.

The desired proportion of administrative and project costs may not be recovered through offset sales. This is a greater risk with offset funds, because they are more costly. (Remember that money from anticipated carbon product sales generally *supplements* other funding sources that have been mobilized to complete specific projects, so it need not cover all administrative and capital costs.)

In contrast to benefit funds, offset funds rely on the voluntary carbon markets. Pre-compliance (and some purely voluntary purchasers) take price cues from markets, where prices dropped in 2009. They may not accept the high offset prices likely for a

local offset fund, which restricts the pool of potential purchasers—*except* for purchasers are willing to pay a premium for "localness" or high co-benefits. This market is untested.

A benefit fund appeals to medium-to-large-sized institutions that will generally make small investments, rather than to major purchasers. On the positive side, these donors would exert less downward price pressure on CCF carbon products, compared to pre-compliance or high-volume purely voluntary buyers. However, there is the risk that the smaller volume of purchases for a benefit fund will not justify the administrative effort.

Reputational risks

The local offset fund is a largely unproven model. Failure could hurt Cambridge's reputation as an environmental leader. Benefit funds are lower risk. A few of the local offset programs focused on *urban projects* have shown promise, but they are too new to have proven their capacity for long-term success (e.g. Earth Givers in Gainesville, FL and MaineHousing). Meanwhile, programs in Chicago and Boston have been postponed indefinitely and programs in Cleveland and Aspen have downgraded their expectations from offset fund to benefit fund.

Peers and the environmental community may perceive carbon reductions from a local benefit fund to be low quality.

Appendix C: Potential Purchasers/Donors

In the following table, the highlighting colors indicate whether institutional practices and positions make a business or institution moderately likely (green), somewhat less likely (yellow), or not very likely (red) to purchase CCF carbon products.

Business/Institution	Cambridge Connection	GHG Tracking	GHG Goal
Akamai	Cambridge HQ	Yes	No
Alexandria Real Estate	1/11 offices in Worcester	No evidence found	—
Amgen	California HQ; 1/many offices in Cambridge	Yes	15% below 2006 base by 2015.
Biogen Idec	Weston HQ	Yes	Non-transparent reduction goal.
BioMed Realty Trust	Property owner; 1/6 offices in Cambridge	No evidence found	—
BJ's Wholesale Club (potentially up for sale)	Natick HQ	No, but has a few initiatives.	No
Boston Green Tourism	Newton-based	No, but has green mission.	—
Boston Properties	Boston HQ	No evidence found	—
Boston Scientific	Natick HQ	Yes, MA Clean Energy Challenge.	10% from 2010 to 2012.
Camb. Health Alliance	1/3 hospitals & 4/16 other sites in Camb.	No evidence found	—
Cambridge Systematics	Cambridge HQ (26 other sites)	No evidence found, but buys offsets.	Unclear.
Charles Hotel	Local	No, but green brand.	No.
CVS	Woonsocket, RI HQ; 6/many stores in Camb.	Yes. Works with MIT.	Currently setting target.
Draper Lab	Cambridge HQ	No evidence found	—
EMC	Hopkinton HQ	Yes	Reduce emissions/square foot 8% from 2005 to 2012.
Equity Partners	Maryland HQ	No evidence found	—
Genzyme Corporation	Cambridge HQ	Yes	Reduce GHG by 25%/$ of revenue from 2007 to 2012.
Global Partners	Waltham HQ	No evidence found	—
Gravestar	1/10 properties in Cambridge	No evidence found	—
Harvard University	Cambridge	Yes	30% below 2006 baseline by 2016, including growth.
IBM	New York HQ; research center in Cambridge	Yes	12% below 2005 baseline by 2012.
Lesley University	Cambridge	Yes	Climate neutrality by 2040.
Liberty Mutual Ins.	Boston HQ	No evidence found	—
MIT	Cambridge	Yes	No specific GHG goals.
Mt. Auburn Hospital	HQ and 4/11 sites in Cambridge	No evidence found	—
New England Devt.	Newton HQ; 1/17 sites in Cambridge	No evidence found	—
Novartis	1/many offices in Cambridge	Yes	Hit Kyoto targets by 2012.
Pfizer	1/many sites in Cambridge	Yes	20% below 2007 base from 2008-12.
Raytheon	Waltham HQ	Yes	Reduce U.S. GHG 10% from 2008-15.
RREEF American Reit II Corp. (Deutsche Bank)	Property owner; nearest office in Westborough	No for RREEF, yes for Deutsche Bank.	Deutsche Bank is committed to carbon neutrality by 2013.
Schlumberger	1/6 research centers in Cambridge	Yes	No specific GHG goals.
Shaw's Supermarkets (Supervalu)	3/2,500 stores in Cambridge	Yes	10% below 2007 base by 2012.
Staples	Framingham HQ; 2 stores in Cambridge	Yes	7% below 2001 base by 2010.
Starbucks	Seattle HQ; 1/15 reg. offices in Newton Center; 8 stores in Cambridge	Yes	Specific environmental goals not tied to GHG inventory.
State Street Corp.	Boston HQ	Yes	5% below 2005 base by 2010.
Sustainable Business Network-Boston	Sustainable Business Leader Program (SBLP) based in Cambridge	No, but green mission.	—
Textron	Providence, RI HQ	Yes	20% below 2007 base by 2015.
Thermo Fisher Scientific	Waltham HQ	Yes	No. In development.
TJX	Framingham HQ	Yes	No. In development.
Twining Properties	Owns Watermark-Cambridge	No evidence found	—
Wainwright Bank (Eastern Bank)	4/12 branches in Cambridge	No, but green branding.	Vague GHG reduction goals.
Whole Foods	Texas HQ; regional office & 3 stores in Camb.	Yes	No

Appendix D: Program Administration

This appendix contains detailed criterion-by-criterion analysis of the program administration options explored in *Section IV. Design: Which Program Design Options will Maximize Success?*

1. Discussion of Options
2. General Lessons

1. Discussion of Options

This section analyzes the desirability of program administration options according to Cambridge's five guiding criteria.

City (municipal and/or other projects)

(1) High-Quality Carbon Reductions. The choice of administrative framework does not necessarily affect offset quality. Instead, quality is contingent on project selection, carbon accounting, and—for quality assurance and perception—proper verification procedures.

(2) Significant Impact and (3) Attractiveness/Affordability. The more attractive and affordable a carbon product is to purchasers, the more significant the program impact. Thus, these two factors are discussed together.

Local businesses and institutions do not perceive tax benefits from a City-administered fund. Donations to a municipality are tax-deductible if the funds are used for public purposes. However, not all potential carbon reduction projects clearly serve public purposes (e.g. small business weatherization). More important is the *perception* that donations would not be tax-deductible, which would deter potential purchasers.

Offset *purchases*, as opposed to benefit *donations*, may not be tax deductible anyway. Generally, when carbon offsets are purchased from a nonprofit, the purchaser does not take title to the offsets, but rather buys and immediately donates the offsets to the nonprofit. In these cases, the question of tax deductibility is irrelevant.

(4) Administrative Feasibility. The City would have a steeper learning curve than a specialized carbon nonprofit, and will have to work harder to assemble a team with all the needed skill sets (e.g. managing offset verification). City administration would also be more costly than nonprofit administration, due to stricter administrative rules and less ability to use volunteer labor.

Administrative Feasibility. If the City chooses to administer the program or work with a committed local partner, CCF staff can, with effort, develop the skills they need. The City could also choose to supplement its primary partnership(s) with specialized consultants on an ongoing basis to fill in any gaps.

(5) *Political Acceptability.* The City Manager might object to the City of Cambridge taking on more program expenses than it would if program responsibilities were shared with another organization.

City + carbon nonprofit

(1) High-Quality Carbon Reductions. The choice of administrative framework does not necessarily affect offset quality. A specialized carbon nonprofit will already have experience producing high-quality offset carbon products.

(2) Significant Impact and (3) Attractiveness/Affordability. Advantages of nonprofit involvement include the provision of tax benefits to purchasers and the ability to operate at lower costs (leading to more affordable carbon products and/or lower City contributions to the program). According to nonprofit administrators of local carbon funds, municipal involvement produces credibility that is critical to recruiting purchasers.

(4) Administrative Feasibility. A specialized carbon nonprofit already possesses many of the technical skill sets needed for a carbon fund (e.g. managing offset verification). It is likely to lack local relationships, however, and may be less willing than a local actor to sacrifice its profit margin for the sake of program success (see counterexample below). It is possible that the City would not even be able to attract a carbon nonprofit to develop the Cambridge Carbon Fund.

The Colorado Carbon Fund has partnered with The Climate Trust to ease the steep learning curve of carbon fund administration. The Climate Trust negotiates purchase contracts, collects and distributes offset purchase funds, and handles certification, monitoring, verification, and registration of offsets. The State of Colorado's primary responsibilities are to locate and choose offset projects and to market the program. Similarly, another major U.S. city currently developing a benefit fund is working with a different carbon nonprofit that is providing some of its services at a reduced rate, with the institutional goal of proving that a local carbon fund can work.

Most government grants for innovative environmental programs are available to both municipalities and nonprofits, but some private grant funding is available only to nonprofits. A nonprofit administrator will be an advantage in applying for grants from foundations and corporations, and will help the City avoid the appearance of quid pro quo treatment for local business and institutional donors.

(5) Political Acceptability. A nonprofit-run program is more stable, because it is less subject to shifts in political priorities. It also allows the City to share administrative costs, which should make it more desirable to the City Manager. By empowering a nonprofit to administer the program, the City would lose some control over key factors affecting program success, including branding, offset quality, choosing project beneficiaries, and other features of day-to-day operations. Ongoing financial assistance from the City to the Cambridge Carbon Fund will provide some leverage for control.

City + local nonprofit(s)

(1) High-Quality Carbon Reductions. The choice of administrative framework does not necessarily affect offset quality. A local nonprofit will likely have less experience with carbon product quality control.

(2) Significant Impact and (3) Attractiveness/Affordability. Advantages of nonprofit involvement include the provision of tax benefits to purchasers and the ability to operate at lower costs (leading to more affordable carbon products and/or lower City contributions to the program). According to nonprofit administrators of local carbon funds, municipal involvement produces credibility that is critical to recruiting purchasers.

(4) Administrative Feasibility. A local nonprofit will have a steeper learning curve than a specialized carbon nonprofit, and will have to work harder to assemble a team with all the needed skill sets (e.g. managing offset verification).

Nonprofits can mitigate high costs by using volunteer labor for self-managed projects, which would not be possible with City administration. The local (in Florida) nonprofit Earth Givers has successfully used volunteer labor to run its energy efficiency offset projects: in combination with low overhead and other cost reduction strategies, this produces offsets that sell for just $\$12/tCO_2e$. A local nonprofit is probably better suited to recruit volunteer labor than is a national nonprofit, since it has local operations and connections. On the other hand, project contractors might handle this task.

Most government grants for innovative environmental programs are available to both municipalities and nonprofits, but some private grant funding is available only to nonprofits. A nonprofit administrator will be an advantage in applying for grants from foundations and corporations, and will help the City avoid the appearance of quid pro quo treatment for local business and institutional donors.

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2. General Lessons

No partner will bring all the needed skills to the table.

A dedicated program staff is necessary. Regardless of the partners chosen and the division of labor, the Cambridge Carbon Fund cannot simply be added to someone's job description—this was a recurring lesson in conversations with local carbon fund managers.

Appendix E: Potential Carbon Specialist Administrative Partners

This list of domestic offset providers, presented here as a potential co-administrators for the Cambridge Carbon Fund, is drawn from the Carbon Catalog website.[40] Nonprofits and New England providers are highlighted in green and bolded.

Domestic Offset Providers

Offset Provider	State	Type	Projects	Average price	Updated
3Degrees	CA	For-profit	3	$15.00	04/2009
Certified Clean Car	CA	For-profit	1	-	09/2007
Live Climate	CA	**NONPROFIT**	3	$15.50a	09/2008
LiveNeutral	CA	For-profit	1	$14.00	03/2010
TerraPass	CA	For-profit	9	$13.12	11/2008
Enpalo	CO	For-profit	1	$25.00	09/2008
Renewable Choice	CO	For-profit	3	-	05/2009
Trees, Water & People	CO	**NONPROFIT**	2	$10.00	12/2008
Earth Givers	FL	**NONPROFIT**	0	$13.20	10/2010
Verus Carbon Neutral	GA	For-profit	7	$2.75	09/2010
Eco2librium	ID	For-profit	1	-	08/2010
Delta Offsets	IL	**NONPROFIT**	1	$8.00	01/2009
ZeroHero	IL	For-profit	1	$10.00	05/2009
Balanced Footprint	**MA**	For-profit	0	-	08/2010
e-BlueHorizons	**MA**	For-profit	3	$5.00	01/2008
LiveCooler	**MA**	**NONPROFIT**	1	$12.95	12/2008
Carbonfund.org	MD	**NONPROFIT**	13	$10.00	08/2010
ClearSky Climate Solutions	MT	For-profit	5	$12.00	08/2010
NC GreeNonprofitower	NC	**NONPROFIT**	0	$17.63	04/2010
Go Neutral	NY	**NONPROFIT**	1	$11.02	02/2008
EcoVoom	OH	For-profit	2	$10.00	04/2008
Sterling Biosciences LLC	OH	For-profit	0	$4.99	04/2010
TIST	OK	For-profit	4	$10.00	07/2009
Bonneville Environmental Foundation	OR	**NONPROFIT**	5	$29.40	08/2010
The Climate Trust	OR	**NONPROFIT**	11	-	08/2010
Carbon Angel	TN	For-profit	0	$17.63	03/2008
BeGreen Now	TX	For-profit	3	$14.00	08/2010
Conservation International	VA	**NONPROFIT**	4	$12.00	03/2008
Go Zero	VA	**NONPROFIT**	1	$8.82	08/2010
The Nature Conservancy	VA	**NONPROFIT**	1	$22.05	04/2008
Brighter Planet	**VT**	For-profit	3	$14.00	01/2009
NativeEnergy	**VT**	For-profit	2	$15.43	12/2010
Standard Carbon	WA	For-profit	2	$16.53	02/2009
Sustainable Travel International	WA	**NONPROFIT**	9	$24.00a	08/2010

40 "Find a Carbon Provider," *Carbon Catalog*, http://www.carboncatalog.org/providers (accessed February 2011).

Appendix F: Project Types

This appendix contains detailed criterion-by-criterion analysis of the potential project types explored in *Section IV. Design: Which Program Design Options will Maximize Success?* For further detail on carbon reduction calculations, refer to *Section V: Potential Impact*.

Ozone-depleting substances (ODS) destruction

Federal law already requires proper disposal of appliance refrigerant (although not of ODS found in appliance foam). However, ODS projects are still eligible to produce offsets (e.g. CCX and CAR). This is because best practices are not uniformly applied in existing appliance take-back programs. It is estimated that retailer take-back programs re-sell 40% of the old appliances collected, placing them back into service. The remaining units may be disposed of in ways that do not fully prevent ODS emissions.[41]

(1) High-Quality Carbon Reductions. Yes, if clearly additional under state and local law.

(2) Significant Impact. Somewhat. A program that reached 1% of households (482 households) each year would produce 2,752 $mtCO_2e$ of *countable benefit* reductions per year, which counts reductions from CFC-11, CFC-12, and electric savings. (This number counts electric reductions for the entire assumed 10-year project lifetime.) Or, the same program could produce 627 $mtCO_2e$ of *countable offsets* per year, which only counts reductions from CFC-12. Counting all reductions, this size program would result in 2020 emissions being lowered by 2,416 $mtCO_2e$, which is 6.7-8.9% of the CCF significance goal.[42]

(3) Attractiveness/Affordability. ODS reductions are relatively affordable, partly because CFC-12, the main appliance refrigerant gas, is several thousand times more potent than CO_2.[43] Additionally, CCF would pay reduced verification costs for ODS projects (see *Administrative Feasibility* below).

An appliance take-back program is relatively attractive to purchasers, especially when participants are low-income, because it also lowers electricity bills. The fact that reduced electricity consumption is not counted toward ODS offset reductions is probably not material to purchasers, who would still have a great story to tell.

(4) Administrative Feasibility. An appliance take-back program would have to pay appliance collection and processing costs, but would require little up-front capital, and its size could be varied as desired. Assuming an average of 4 ounces of CFC-12 per appliance, a program

41 "Appliance Disposal Practices in the United States," *U.S. Environmental Protection Agency*. Last updated March 1, 2011. http://www.epa.gov/Ozone/partnerships/rad/raddisposal_factsheet.html.
42 CFC-11 and CFC-12 numbers assume that 90% of the appliances are refrigerators and that one appliance is taken per household. Electric savings are based on replacing a 1990-92 model 19.0-21.4 cubic feet refrigerator with an Energy Star model: "Refrigerator Retirement Savings Calculator," *U.S. Environmental Protection Agency*. http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator.
43 "Class I Ozone-depleting Substances," *U.S. Environmental Protection Agency*. http://www.epa.gov/ozone/science/ods/classone.html.

should be large enough to collect at least 400 appliances per year. This size program would produce 100 pounds of refrigerant per year, which is generally the minimum amount that an ODS destruction facility will accept.

In a potential program CCF would contract refrigerant recovery to a third party, then sell the ODS refrigerant to a destruction facility and then buy offsets produced by that facility. In this setup, CCF would maintain careful project documentation, but pay no verification costs (except as internalized in offset price). This would result in significantly reduced program operation costs compared to other project types. CCF would be likely to pay $5-$10 for an ODS offset, which is much lower than CCF's likely offset price. Thus, depending on program costs, ODS offsets provide CCF an opportunity to lower carbon product prices across its portfolio (i.e. higher-cost residential weatherization offsets blended with lower-cost ODS offsets).

(5) Political Acceptability. Appliance take-back incentives might attract two of the City's hard-to-reach target populations: low-income residents and renters (for window air conditioners). Some City actors have already begun considering how to boost current local appliance take-back programs, which underfunded and quite small.

Postconsumer composting

(1) High-Quality Carbon Reductions. Yes, but composting will no longer be an eligible offset type if Massachusetts passes a ban on food scraps in landfills. A task force is currently considering whether to recommend a ban that would take effect in 2014. Unless this regulatory risk is favorably and definitively resolved, investment in composting offsets is an unacceptable gamble. A *municipal* ban on food scraps in landfills would not affect the eligibility of composting to produce offsets.

(2) Significant Impact. Somewhat. A residential composting program that collected 30 tons/day of food scraps would lower emissions by 3,281 $mtCO_2e$ per year.[44] This is 9.0-12.1% of CCF's significant impact goal.

(3) Attractiveness/Affordability. Composting carbon products are attractive, because composting will be visible and tangible to the average Cantabrigian. As a food waste-related project, a composting project might be an attractive sponsorship opportunity for a grocery store, such as Whole Foods or Shaw's. Some purchasers may have additionality concerns, because Cambridge is already planning to institute a composting program.

(4) Administrative Feasibility. Cambridge is already planning a residential composting program, but is being delayed by the lack of nearby facilities. Two new facilities large enough to serve Cambridge and other local communities are in early development stages, but are having trouble finding sites and securing funding. Cambridge could fast-track its composting program by helping a developer with project financing.

44 Cambridge Recycling Director Randi Mail estimates Cambridge would collect 20-40 tons of food scraps per day from a residential composting program.

At $20/ton and 30 tons/day, CCF's composting carbon revenues would total $65,620 annually, or up to $524,960 over the period 2013-2020. Cambridge could approach a developer, perhaps in cooperation with another local community such as Boston, and offer capital funding in return for the right to monetize the new facility's carbon reductions.

(5) *Political Acceptability.* Composting carbon products are politically desirable, because they would provide additional funding for (and potentially help fast-track) a priority project.

Residential weatherization

(1) *High-Quality Carbon Reductions.* Yes, for reductions in thermal energy. Electric reductions cannot be counted in RGGI states like Maine and Massachusetts.

(2) *Significant Impact.* Low, unless program is large. If a program weatherized 100 homes per year, it would weatherize 800 homes over the period 2013-2020. Given annual *countable benefits* (thermal + electric savings) of 1.16 $mtCO_2e$ reduced per home, 2020 emissions would be 928 $mtCO_2e$ lower as a result of this program (2.6-3.4% of CCF goal). Counting only *countable offsets* (thermal savings only) of 0.54 $mtCO_2e$ reduced per home, 2020 emissions would be 432 $mtCO_2e$ lower as a result of this program (1.2-1.6% of CCF goal).

A program that weatherized 1,000 homes per year would reach 26-34% of the CCF goal by 2020 (counting thermal + electric savings i.e. *countable benefits*). Based on the experience of other local carbon funds, there may not be sufficient local contractor capacity to operate such a large program. HEET, for example, currently weatherizes just 12 Cambridge homes per year.

(3) *Attractiveness/Affordability.* Home weatherization is relatively attractive to purchasers, especially when participants are low-income, because it also lowers electricity bills. Some potential purchasers have expressed concern, however, that local funding is already available for home weatherization, rendering any CCF home weatherization program non-additional. In this context, a vigorous explanation of barriers to weatherization access will make weatherization more attractive to purchasers. Local carbon funds charge $12-25 for weatherization offsets: these prices underestimate costs, because other funding streams are present.

(4) *Administrative Feasibility.* Scattered site projects are more time-consuming and costly to administer than are single-site projects (e.g. landfill gas). This is especially the case for weatherization, because multiple contractors will likely be needed. Carbon revenues should not be expected to cover the entire cost of weatherization. But, for weatherization, a nonprofit can narrow the funding gap by using volunteer labor to lower costs.

(5) *Political Acceptability.* Weatherization is politically attractive, especially if it benefits low-income residents. Political acceptability probably also depends on CCF's ability to secure additional funding streams.

Commercial weatherization

(1) High-Quality Carbon Reductions. Yes, for reductions in thermal energy. Electric reductions cannot be counted in RGGI states like Maine and Massachusetts. No premium voluntary protocols have been published for commercial weatherization, although the MaineHousing protocol could be altered for this purpose (an expensive process).

(2) Significant Impact. Low, unless program is large. Cambridge's Climate Protection Plan identified energy use in commercial buildings as a focal point for emission reductions. If a commercial weatherization program focused on multifamily housing, which is classified as commercial by utilities and in Cambridge's GHG inventory, the impact might be similar to that listed under *Residential weatherization* above. A conservative estimate places the number of "commercial" (7+ units in a building) multifamily housing units at 27,449, or 55.4% of housing units.[45]

Type of Housing*	All Units		All Properties	
	Count	%	Count	%
Residential: 1-6 units	22,081	44.6%	10,367	93.3%
Commercial: 7+ units	27,449	55.4%	741	6.7%
Total	**49,530**	**100%**	**11,108**	**100%**
*Includes all market rate and affordable housing, including housing owned by nonprofit organizations. Includes family style housing operated as dormitories by Harvard and MIT, which are counted as housing units by the U. S. Census. Note that the method used to develop these differs from that used in previous years and from the method used by the U. S. Census Bureau. Also note that the figures here refer to buildings and not to parcels of land. (Note is from City of Cambridge document.)				
Source: "City of Cambridge, Massachusetts: Housing Profile," *Cambridge Community Development Department*, August 2010, 4. http://www2.cambridgema.gov/cdd/data/housing/hsg_profile_2010.pdf.				

Other potential targets include nonprofits, municipal buildings (including schools), and strictly commercial/industrial buildings. These building types are highly variable, making an impact estimate impossible without considerably more research.

(3) Attractiveness/Affordability. For a multifamily residential program, the same factors apply that are outlined in *Residential weatherization* above. Businesses interviewed also expressed an interest in funding reductions that help schools. More research is needed to determine the attractiveness of weatherizing nonprofits' buildings, which is a focus of the local group, HEET.

(4) Administrative Feasibility. The 27,449 "commercial" housing units occur in just 741 buildings, minimizing points of contact and making projects somewhat easier to manage than residential weatherization projects that target buildings with 1-6 units. Property managers may not be motivated to participate, however, and obtaining residents' permission to do work creates additional complexity. Public and affordable housing are a good place, but not the only place, to look for cooperative property managers: Earth Givers led successful weatherization projects by working with managers in standard large apartment buildings.

45 "City of Cambridge, Massachusetts: Housing Profile," *Cambridge Community Development Department*, August 2010, 4. http://www2.cambridgema.gov/cdd/data/housing/hsg_profile_2010.pdf.

Generally, carbon revenue should not be expected to cover the entire cost of weatherization. But, on this type of project, a nonprofit can narrow the funding gap by using volunteer labor to lower costs.

(5) *Political Acceptability.* Weatherization is politically attractive, especially if it benefits low-income residents. Additionally, a multifamily residential program would reach renters, who are generally neglected by utility weatherization programs. Political acceptability probably also depends on CCF's ability to secure additional funding streams.

Commercial boiler efficiency (space and water heating).

(1) *High-Quality Carbon Reductions.* Yes, but draft rules issued by the EPA in 2011 would require certain boiler improvements, restricting the scope of "additional" offset activities. RGGI has a boiler efficiency offset standard, but no premium voluntary protocols have been published so far.

(2) *Significant Impact.* Yes. The average boiler efficiency project in the U.S. would reduce about 189 $mtCO_2e$/year i.e. produce 1,890 offsets over a 10-year project lifetime (average reduction does not account for new federal rules). If CCF did 5 boiler projects per year, it would complete 40 projects by 2020 and emissions in 2020 would be 7,560 $mtCO_2e$ lower as a result of the program. This is 20.8-27.8% of the CCF significance threshold goal.

(3) *Attractiveness/Affordability.* Attractiveness is highly beneficiary-dependent. Boiler projects in schools, nonprofits, low-income multifamily residential buildings, or municipal buildings are more attractive than those that benefit for-profits. Boiler efficiency carbon reductions are often quite affordable.

(4) *Administrative Feasibility.* Somewhat complex. Projects would occur at relatively few sites, but feasible projects might be difficult to identify. Some types of projects will require large amounts of up-front capital, presumably to be split between CCF and the boiler's owner.

(5) *Political Acceptability.* Similar to attractiveness, political acceptability is beneficiary-dependent: for-profit recipients, except perhaps small businesses, are less desirable. Approval by the City Manager might depend on the division of responsibility for providing up-front capital.

Solar PV or solar thermal

(1) *High-Quality Carbon Reductions.* Low. Electric reductions cannot be counted in RGGI states like Maine and Massachusetts. Solar projects are eligible to produce benefit products or voluntary RECs, but not offsets. Furthermore, there are additionality concerns about counting reductions from projects that are already in the City's solar project pipeline.

(2) *Significant Impact.* Low. The City has identified 1,000 kW of promising solar opportunities on municipal property. Based on City calculations, 1,000 kW of solar PV would reduce emissions by 500 $mtCO_2e$ each year.[46] This is just 1.4-1.8% of the CCF significance impact goal, and a much larger municipal program is not currently foreseeable. I did not explore the

46 "Renewable Energy System Locations," *City of Cambridge*.

potential impact of non-municipal projects for this report, given the general weaknesses of solar as a project type.

(3) *Attractiveness/Affordability.* Solar projects are charismatic, because of their visibility and advanced technology. They are even more attractive, when they benefit schools, low-income households, or other deserving groups. They are not affordable, however: at $33.8/mt$CO_2$e, solar offsets had the highest average *price* of all offset types, compared to the average over-the-counter offset price of $6.5/mt$CO_2$e. Solar carbon products from Cambridge will be even more expensive, due to the small scale of available projects. Some purchasers may be willing to pay higher prices for solar carbon products, but high prices will shrink the pool of potential purchasers.

(4) *Administrative Feasibility.* High. Initial feasibility studies have been completed for the 1,000 kW of solar in question and the City knows how to proceed with the projects. Verification costs are not a concern, since solar projects cannot produce offsets. But, benefit product revenue would be $2,500-$10,000, which is negligible compared the millions these projects entail. Even at $33.8/mt$CO_2$e, this revenue would only amount to $16,900.

(5) *Political Acceptability.* Solar PV carbon products are politically desirable, because they would provide additional funding for priority projects. Citizen activists and knowledgeable purchasers are likely to question the additionality of these carbon reductions, however, which could hurt the program's reputation.

Urban forestry

(1) *High-Quality Carbon Reductions.* Yes, but only with long-term, high-quality maintenance.

(2) *Significant Impact.* No. Current annual carbon sequestration of Cambridge's trees is 135 mtCO_2e, given 20% urban forestry canopy cover.[47] A very rough estimate of offset potential is: if Cambridge dramatically increased canopy cover to 30%, placing it near the top of its peer group, the urban forest would still only sequester 202 mtCO_2e annually. (Carbon storage is a separate calculation.)

(3) *Attractiveness/Affordability.* Tree planting is attractive to purchasers, because it is easy to understand and highly visible. It is also expensive per ton of carbon reduced. It is unlikely that CCF could charge purchasers the full cost of an urban forestry offset, which might optimistically be $53/mt$CO_2$e *before* verification costs.[48] Based on prices in other carbon funds, CCF would probably have to cap the price at $20-25 per mt$CO_2$e reduced.

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47 "Final Report: Cambridge Urban Forest Canopy Assessment," *City of Cambridge: Community Development Department*, August 2005. http://www2.cambridgema.gov/cdd/et/climate/clim_cityinit/clim_cityinit_tree_canopy_rpt.pdf. Annual carbon sequestration of the urban forest is reported as 296,548.6 pounds.

48 Cost depends on many factors, including the stringency of the calculation methodology used. A program in Portland in 1995 achieved reductions at a cost of $31/ton CO_2e or $28/mt$CO_2$e. Assuming annual inflation of 4%, the same reduction today would cost $53/mt$CO_2$e, before accounting for verification costs. Source: E. Gregory McPherson and James R. Simpson, "Carbon Dioxide Reduction Through Urban Forestry: Guidelines for Professional and Volunteer Tree Planters," *Pacific Southwest Research Station: Forest Service (U.S. Department of Agriculture,* 1999. http://www.fs.fed.us/psw/publications/documents/gtr-171/gtr-171.pdf..

(4) *Administrative Feasibility.* Project operations are feasible, because the City already has expertise with tree planting and maintenance. However, monitoring requirements for offsets verified using CAR's Urban Forest Project Protocol are onerous and time-consuming (this does not apply for benefit projects). CAR requires the City to commit to maintaining the trees for the next 100 years, or lose its offsets.[49]

(5) *Political Acceptability.* Trees are valued by constituents and produce non-carbon benefits that help the municipal bottom line, but they are also an expensive source of offsets. Cambridge's urban forest provides annual environmental services (largely by mitigating stormwater runoff) valued at $7.5 million.[50] If Cambridge's financial planning fully internalized the non-carbon benefits provided by trees, the cost of producing an urban forestry offset would be much lower. Since it does not, the City Manager is likely to see urban forestry as unattractive relative to other reduction options.

Bike share

(1) *High-Quality Carbon Reductions.* Maybe. The currently proposed VCS offset protocol is built on proprietary carbon reduction modeling software that has not yet been vetted by a third party. Since the City is already planning a bike share program, the resulting emission reductions may not be additional (except for reductions from a program expansion enabled by carbon revenue).

(2) *Significant Impact.* Extrapolating from CityRyde's statements about its modeling software, a bike share program with 400 bikes would reduce 400-1,600 $mtCO_2e$ per year (1.1-5.9% of CCF goal), i.e. produce 3,200-12,800 $mtCO_2e$ of offsets over the period 2013-2020.[51]

(3) *Attractiveness/Affordability.* Bike share carbon products are attractive, because a bike share is highly visible. Since 2009, Blue Cross Blue Shield has pledged $2.5 million to Minneapolis' bike share program. In return, the bicycles prominently display the Blue Cross Blue Shield logo. CityRyde's co-founder points out that this amount might have been much higher as part of a package deal to also purchase offsets.[52]

(4) *Administrative Feasibility.* Because bike sharing is already planned for, CCF's administrators would not have to coordinate with additional owners or outside contractors.

Assuming the program is not expanded in anticipation of carbon revenues, then the main costs of producing bike share offsets are limited to VCS verification and licensing CityRyde's software. At $20/$mtCO_2e$, a program with 400 bikes would produce carbon revenues of $8,000-$32,000 annually, or $64,000-$256,000 over the period 2013-2020.

(5) *Political Acceptability.* Bike share carbon products are politically desirable on a budgetary level, because they would provide additional funding for a priority project. For the same reason, they might face additionality challenges, which would reflect poorly on the program.

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49 "Urban Forestry Project Protocol v 1.1: Protocol Summary," *Climate Action Reserve*. http://www.climateactionreserve.org/wp-content/uploads/2009/03/Urban_Forest_Project_Protocol_1.1_Summary.pdf.

50 "Final Report: Cambridge Urban Forest Canopy Assessment," *City of Cambridge: Community Development Department*.

51 Salmon, "How much carbon does bike-sharing save?"

52 Salmon, "How much carbon does bike-sharing save?"

Landfill gas

Since waste was included in Cambridge's greenhouse gas emissions inventory, it is an eligible source of carbon reductions. While only 1.3% of Cambridge's 2010 emissions are estimated to come from waste, offsets from landfill methane or postconsumer composting may be some of the lowest cost offsets available.[53]

Cambridge's waste passes through a Waste Management transfer facility before being sent to one of a number of end facilities. The percentage sent to each facility varies at Waste Management's discretion. Currently, Cambridge's waste is sent to the facilities listed below. All three landfills produce energy, but not offsets, from their landfill gas. They may or may not have additional untapped resources that could go toward producing carbon offsets.

Facility	Type	Location	% of Cambridge's waste	Annual $mtCO_2e$ reduced by current energy projects*
Wheelabrator/RESCO	Incinerator	Saugus, MA	About 50%	—
Turnkey	Landfill	Rochester, NH	About 50%	1,068,000 $mtCO_2e$ (3 projects)
Chicopee	Landfill	Chicopee, MA	Smaller amounts	242,000 $mtCO_2e$ (1 project)
Fitchburg-Westminster	Landfill	Westminster, MA	Smaller amounts	293,000 $mtCO_2e$ (3 projects)
*Information from the Massachusetts Excel file: lmopdatama.xls found at: "Landfill Methane Outreach Program: Energy Projects and Candidate Landfills," *U.S. Environmental Protection Agency*, December 15, 2010. http://www.epa.gov/lmop/projects-candidates/index.html.				

In addition to the question of technical capacity, is the question of *eligibility*. These three landfills may or may not be eligible to produce carbon offsets, which is a determination that must be made by a professional verifier in accordance with the additionality requirements of a relevant offset protocol. An initial positive sign is that all three landfills predate 1991[54] and are thus not subject to federal New Source Performance Standards that require landfill gas collection and control systems.

(1) High-Quality Carbon Reductions. Landfill methane is well established as an offset project type and is verifiable under premium offset standards. Additionality is questionable if an actor other than Cambridge develops the offset project, which might lower quality perception.

(2) Significant Impact. Yes. The smallest current project at any of Cambridge's landfills reduces 68,000 $mtCO_2e$ per year. Cambridge could choose to limit investment in waste offsets to the waste emission level in its GHG inventory: 24,424 $mtCO_2e$. A project of this size would account for 67.3-89.8% of the CCF significant impact goal.

(3) Attractiveness/Affordability. Landfill gas offsets lack charisma, but are very attractively priced. As stand-alone offsets they could compete in the open market for pre-compliance and price-sensitive purchasers. Blended with more expensive offsets, they would make the City of Cambridge's offset portfolio more affordable, and thus more attractive. CCF would have to balance the nominal loss in funding for projects within Cambridge with the possibility that a lower offset price would significantly increase offset purchases.

53 "City of Cambridge Climate Protection Plan," Section 2-2.

54 Information is from the Massachusetts Excel file: lmopdatama.xls found at: "Landfill Methane Outreach Program: Energy Projects and Candidate Landfills," *U.S. Environmental Protection Agency*, December 15, 2010. http://www.epa.gov/lmop/projects-candidates/index.html.

(4) Administrative Feasibility. CCF could assemble co-investors (e.g. for-profit developers or other municipalities that use the landfill) to help with capital costs, but doing so is likely to be time-consuming. Absent other investors, Cambridge may not wish to incur the necessary capital costs, despite the high offset revenues. The easiest method for Cambridge to acquire offsets would be to wait for an offset project to be undertaken at one of these landfills, and then to purchase and re-sell the offsets it produces. It could also negotiate with Waste Management to have its waste sent to an offset-producing landfill, or purchase offsets from a nearby landfill without Cambridge ties.

(5) Political Acceptability. Projects that occur outside the City of Cambridge are less politically attractive in terms of their ability to produce local co-benefits. The large up-front capital investment—even if shared with other investors—might be a hard sell to the City Manager. However, landfill gas projects have a very low per-ton cost.

Wastewater treatment plant methane

Cambridge's wastewater is processed at the Deer Island Sewage Treatment Plant, located in Boston. Wastewater emissions were not counted in Cambridge's GHG inventory.

(1) High-Quality Carbon Reductions. No. Wastewater methane carbon reductions would not be additional, because Deer Island is already capturing and digesting its methane.

(2) Significant Impact. There are no additional opportunities to reduce Cambridge's wastewater methane emissions.

(3) Attractiveness/Affordability. In generally, wastewater methane projects lack charisma, but reduce emissions very affordably.

(4) Administrative Feasibility. Wastewater methane projects are single-site and thus easier to manage than some other project types. The Deer Island facility is in Boston, however, so a carbon reduction project there would necessitate intergovernmental coordination.

(5) Political Acceptability. Projects that occur outside the City of Cambridge are less politically attractive in terms of their ability to produce local co-benefits. Also, wastewater emissions are not part of Cambridge's GHG inventory. The large up-front capital investment necessary for a new wastewater methane project might be a hard sell to the City Manager.

Appendix G: Background on the Voluntary Carbon Markets

1. Market trends: growth and maturity, but continued uncertainty
2. Offset prices: project size, project type, and offset standard
3. Market mechanics

This appendix is largely drawn from the invaluable reference "Building Bridges: State of the Voluntary Carbon Markets 2010, published by *Bloomberg New Energy Finance* and *Ecosystem Marketplace* on June 14, 2010.

1. Market trends: growth and maturity, but continued uncertainty

The voluntary carbon market is still a young, volatile market. On the one hand, it shows signs of maturing; on the other hand, it is experiencing a slump that may not quickly end.

The voluntary carbon market has grown in value and trading volume over the past several years. Trading volume increased tenfold from 2002 to 2008, rising from 11 MtCO2e in 2002 to 127MtCO2e in 2008. Trading volume declined by 26% to 94 MtCO2e from 2008 to 2009, but was still 39% higher than 2007 trading levels.[55] Most of this decline can be attributed to declining volumes on the Chicago Climate Exchange, which processed roughly half of the offsets sold in 2009. The other half were what is referred to as "over-the-counter" or OTC offsets. Over-the-counter offsets are negotiated bilaterally and, in contrast to generic CCX offsets, may have specific qualities (e.g. location, project type) as requested by the buyer.

The voluntary carbon market lost value in 2009, the latest year for which data is available, as offset prices declined alongside trading volumes. Offset transactions were worth $728 million in 2008, but only $387 million in 2009. Prices dropped most sharply for generic offsets traded on the CCX, falling from $4.4/tCO2e in 2008 to just $1.2/tCO2e in 2009. Over-the-counter offset prices, in contrast, fell from an average of $7.3/tCO2e in 2008 to $6.5/tCO2e in 2009. Offset prices varied widely according to project type, offset standard, project location, project size, and even accompanying social co-benefits.[56]

Offset quality standards are becoming more widespread, and, continuing recent trends, the market is consolidating around a few preferred standards (essentially "brands" that are attached to specific protocols and methodologies). Fully 93% of voluntary offsets sold in 2009 were verified under third-party offset standards, with 78% of offsets verified under just three verification schemes. The Verified Carbon Standard (VCS) captured 35% of the market, Climate Action Reserve standard (CAR) captured 31%, and the Chicago Climate Exchange standard (CCX) captured 12%. An additional 17% of offsets were verified under one of 11 competing offset schemes, with most remaining offsets verified internally.[57]

55 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," iii.
56 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," Sections 6.2, 6.4, 6.5, and 7.4.
57 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," viii.

The market's strength depends in part on the anticipation of future climate legislation, as many purchasers invest in offsets as a hedge against future regulation. After the collapse of international climate negotiations in Copenhagen and of domestic negotiations in Congress, the market has weakened. Declining offset prices and volumes at CCX, the United States' first voluntary, legally binding cap-and-trade program, culminated in November 2010 with an announcement that CCX was suspending its cap-and-trade program, but would continue to offer offsets. The Exchange's future is uncertain and its offset prices have hovered near $0.05/tCO2e since early 2010.[58] (Purchases of CCX offsets as over-the-counter offsets have continued to some extent, and fetch higher prices.) This may signal a new beginning for the voluntary carbon market, in which high-quality OTC offsets largely displace CCX offsets, which have faced recurring criticism for being nontransparent and non-additional.

2. Offset prices: project size, project type, and offset standard

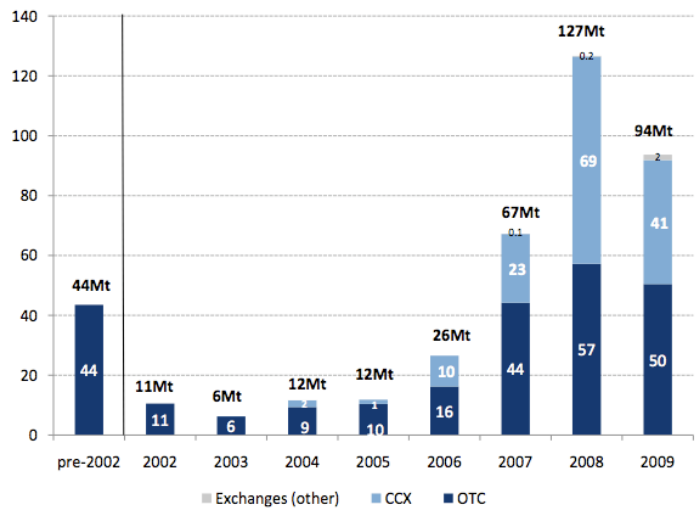
Participants in the voluntary carbon market describe the current market as a buyers' market. Offset purchasers increasingly demand premium offsets that originate in specific countries or from specific types of projects, or which are verified under specific standards. This is reflected in the drop in demand for the generic offsets transacted on the Chicago Climate Exchange.

These trends and preferences are reflected in the following charts, taken from "Building Bridges: State of the Voluntary Carbon Markets 2010."

General volume trends

This chart shows growth trends for the voluntary carbon markets. Note that, while volumes have decreased sharply for CCX offsets, declines have been more modest for the type of over-the-counter offsets that a local carbon fund would offer.

"Building Bridges: State of the Voluntary Carbon Markets 2010"
Transaction Volume Growth for the Voluntary Carbon Markets



Source: Ecosystem Marketplace, Bloomberg New Energy Finance.
Note: CCX bilateral trades included in the OTC volume.

58 Nathan Griswold of ClimateWire, "Chicago Climate Exchange Closes Nation's First Cap-And-Trade System but Keeps Eye to the Future," *New York Times*, January 3, 2011. http://www.nytimes.com/cwire/2011/01/03/03climatewire-chicago-climate-exchange-closes-but-keeps-ey-78598.html.

Project size

Offsets from smaller projects are rare, because they are more expensive to produce. They can command a price premium, however, especially when they provide communities with high social co-benefits. These graphs show the percentage of offsets sold in 2009 from each project size category, and the average offset price for each project size category. Project sizes are defined as follows:[59]

Micro (<5,000 mtCO2e/year)
Small (5,000 to 19,999 mtCO2e/year)
Medium (20,000 to 99,999 mtCO2e/year)
Large (100,000 to 500,000 mtCO2e/year)
Very large (>500,000 mtCO2e/year)

Potential Cambridge Carbon Fund projects fall into the following categories, according to countable *offsets*:

Micro:
- Postconsumer composting
- Solar PV or solar thermal
- Urban forestry
- Bike share

Micro or Small:
- ODS destruction
- Residential weatherization
- Commercial weatherization

Small:
- Commercial boiler efficiency

Medium:
- See below

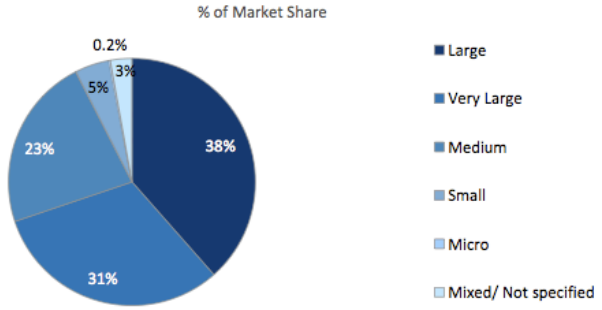
Medium or Large:
- Landfill gas

Large:
- See above

Very large:
- None

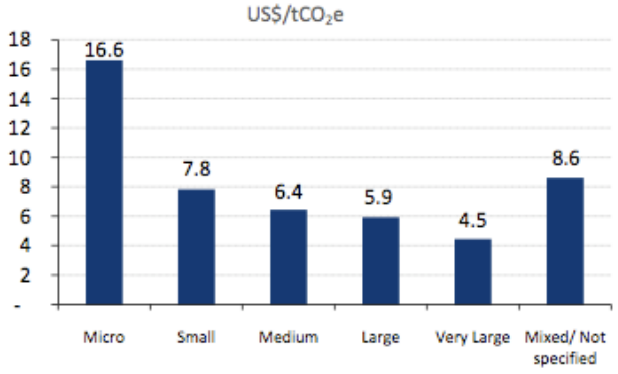
"Building Bridges: State of the Voluntary Carbon Markets 2010"

Transaction Volume by Project Size



Source: Ecosystem Marketplace, Bloomberg New Energy Finance.
Note: Based on 244 observations.

Average Transaction Price by Project Size



Source: Ecosystem Marketplace, Bloomberg New Energy Finance.
Note: Based on 215 observations.

Micro and small projects are the most likely project sizes for the Cambridge Carbon Fund. Projects of these sizes provided just 0.2% and 5%, respectively, of the voluntary offsets sold in 2009. Micro project offsets commanded an average price of $16.6/mtCO2e, while small projects commanded an average price of $7.8/mtCO2e. Large or medium projects commanded $5.9-$6.4/mtCO2e.[60] These numbers demonstrate that smaller projects command a higher average price, but it is not clear how much of this price premium owes to the higher costs of smaller projects and how much is due to high social co-benefits, which may also correlate with smaller project sizes.

59 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 49.
60 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 50.

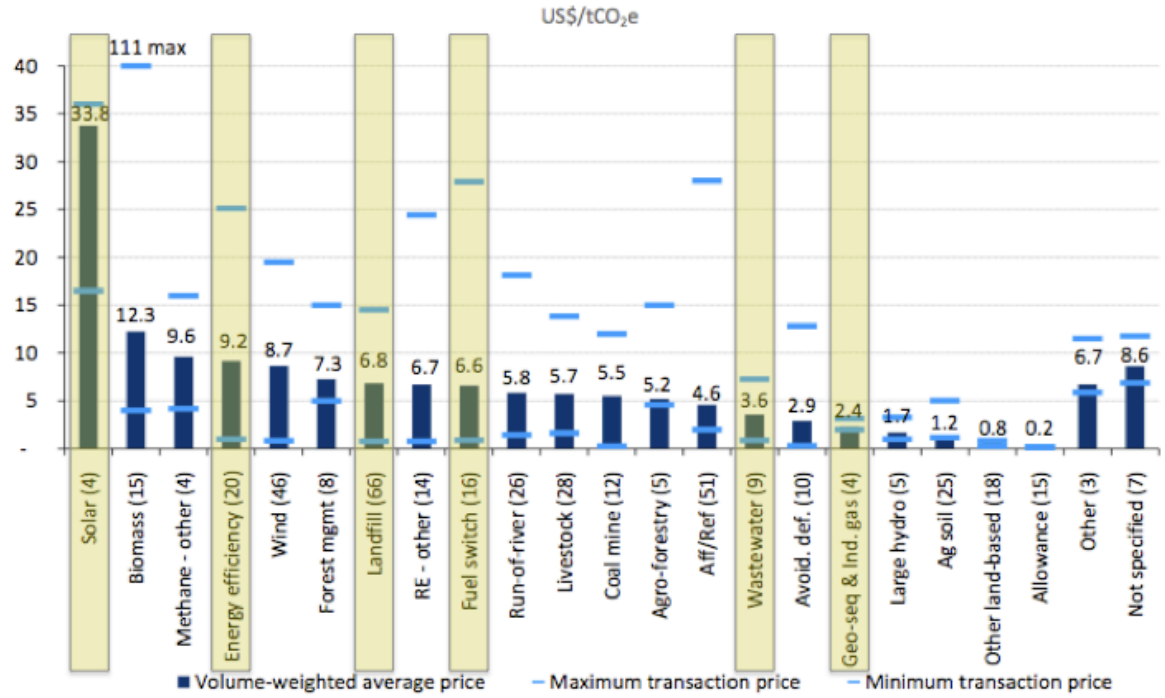
Project type

The chart below shows how the average voluntary offset price varies according to project type.[61] Higher prices reflect both purchaser preferences for certain project types and higher per-ton costs for certain project types.

The project types considered for CCF are highlighted below and classified as follows. Ozone depleting substance destruction is classified as industrial gas and listed in the category "Geo-seq and Ind. gas." Postconsumer composting offsets are not incorporated into this data, because the project type is too new. Urban forestry and bike share projects similarly do not fall into any of the listed categories. Weatherization and boiler efficiency fall under "Energy efficiency," although some boiler efficiency projects could also be classified as "Fuel switch." Solar, landfill gas, and wastewater methane each have their own clearly defined categories.

CCF offsets would be expected to garner above average prices, due to their smaller size and the value purchasers place on funding local projects with local co-benefits.

"Building Bridges: State of the Voluntary Carbon Markets 2010"
Average Credit Price and Price Range by Project Type, OTC 2009

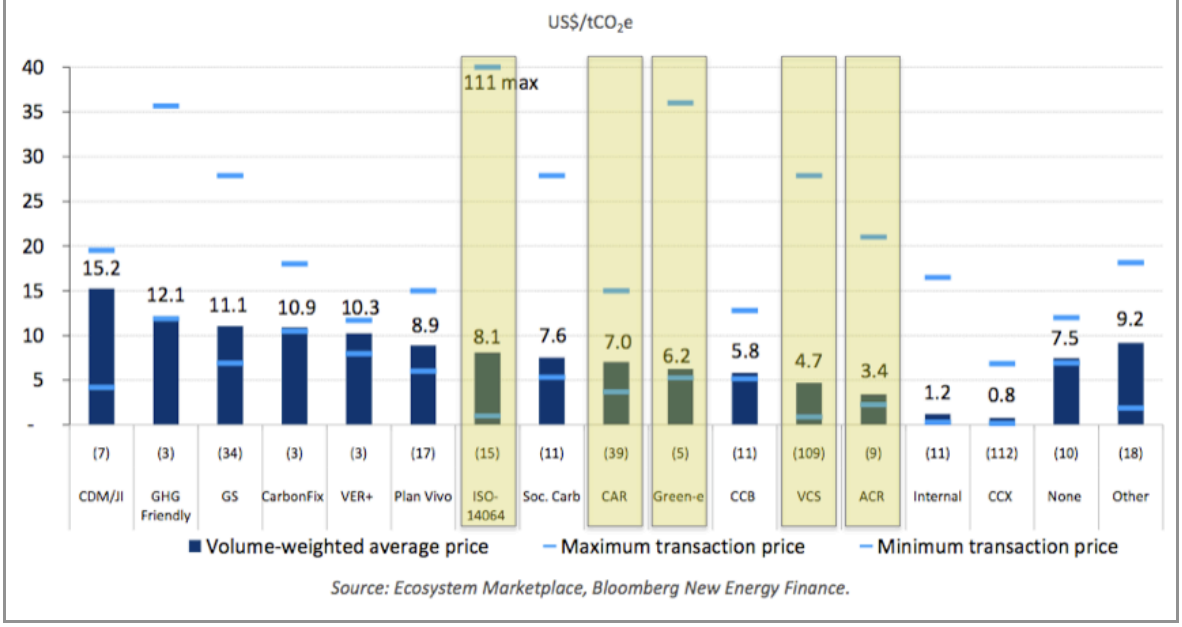


Source: Ecosystem Marketplace, Bloomberg New Energy Finance.
Note: Based on 326 observations.

61 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 37.

Offset standard
The standard under which an offset is verified is also a contributing factor to offset price.[62] This will not affect price during CCF's benefit phase, but it will affect price during the offset phase. In the figure below, I have highlighted the offset standards that are on CCF's "short list."

"Building Bridges: State of the Voluntary Carbon Markets 2010"
Average Price by Standard, OTC 2009



Source: Ecosystem Marketplace, Bloomberg New Energy Finance.

3. Market mechanics

Offsets take many different paths to market, some more complicated than others. In the simplest model, an owner-developer develops an offset project, chooses a verification standard, has the project independently verified, and subsequently sells the offsets to an offset purchaser. For example, the owner of a swine farm might choose to install manure biogas control equipment and sell methane reduction offsets verified under the Climate Action Reserve's Livestock Project Protocol.

In reality, there are often several intermediaries involved in producing and selling offsets. Our swine farmer may be approached by a project developer, who will develop the project, manage verification, and then sell the offsets to a final purchaser or to another intermediary, such as a wholesaler or retailer. Wholesalers sell offsets in bulk to retailers or final purchasers.[63] Retailers are the face of offsetting for most consumers, and include organizations such as 3Degrees, Brighter Planet, Carbonfund.org, The CarbonNeutral Company, The Climate Trust, NativeEnergy, South Pole Carbon Asset Management, and TerraPass.[64]

62 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," 70-71.
63 Hamilton et al., "Building Bridges: State of the Voluntary Carbon Markets 2010," Section 5-4.
64 For a list of offset providers and their average offset prices, refer to: "Find a Carbon Provider," *Carbon Catalog*, http://www.carboncatalog.org/providers.

Appendix H: Strategies for Minimizing Carbon Product Price

1. Challenges
2. Strategies

1. Challenges

Local carbon funds face a number of unique challenges including market uncertainties, the limited availability of projects that produce low-cost offsets; the small, disaggregated nature of urban projects; and verification costs that overwhelm the small scale of local projects.

An important question for local carbon funds is: how can a program maximize carbon product quality—both real and as perceived by purchasers—while minimizing price and attracting purchasers? Facing high verification costs for offsets, this often comes down to a question of choosing between the carbon offset fund and carbon benefit fund models. If local purchasers are receptive to donating to a benefit fund without receiving verified offsets, a carbon benefit fund is a viable option.

2. Strategies

Interviews with local carbon fund managers yielded several strategies that local carbon funds use to maximize offset quality while minimizing offset price. They are:

Operate as a carbon benefit fund. Under this model, donations are accepted to fund local carbon reduction projects, but purchasers are not encouraged to claim that they are "offsetting" their emissions. Verification costs are avoided altogether. Still, carbon benefit funds usually track their progress by quantifying the carbon reductions they have achieved. Examples of programs following this model are the Cleveland Carbon Fund, the Oberlin POWER Fund and the Westminster CarbonPlus Calculator.

Sell unverified offsets. This model is similar to a carbon benefit fund, except that the donations are marketed more loosely as offsets.

Sell offsets verified using less well-respected offset standards. Verification costs are generally highest for the most well-respected voluntary offset standards, among them the Gold Standard, the Climate Action Reserve standard, the Verified Carbon Standard, and the American Carbon Registry standard. However, there are dozens of other offset standards, methodologies, or guidelines, many of which can produce independently-verified offsets. In straying away from a recognized offset "brand," the burden of due diligence is on local offset programs to select an offset standard that will still generate high-quality offsets. The Neutral Gator/Gainesville program is an example of a program that is producing independently-verified (ISO-14064/65) offsets without using one of the most well-respected offset standards.

Verify offsets infrequently. Offset verification costs are charged per 'batch" of verified offsets. While a large project might get batches verified quarterly, a smaller project might get its offsets verified just once per year. A local carbon fund could cut those verification costs further by verifying every 2 or 3 years—but this is only possible for certain protocols, such as the MaineHousing VCS weatherization methodology. Infrequent verification can pose cash flow problems for a local carbon fund, which may be unable to receive payment for offsets that have not yet been verified.

Sell a blended product. Some local carbon funds maintain a portfolio of offsets, the average cost of which is competitive (or *more* competitive) in voluntary carbon markets. In some cases, both low-cost and high-cost offsets are produced internally. In other cases, the low-cost offsets are purchased externally. Offsets are then sold for the average price of the portfolio. Refer to the *Appendix A: Examples of Local Carbon Offset/Benefit Funds* and the *Price* recommendations in Section *IV* for a description of blended products in the Colorado Carbon Fund, Neutral Gator/Gainesville, and in the Boston CarbonPlus Calculator program.

Secure grants. Several existing local carbon funds have received foundation grants to support their work.

Access pro bono services, in-kind donations, and volunteer labor. Some programs have successfully kept program costs low by appealing to local volunteers and organizations for help. For example, the Neutral Gator/Gainesville Initiative runs its weatherization projects almost entirely with volunteer labor. Other organizations, such as the Yale Community Carbon Fund, have determined that using volunteers would pose unacceptable liability risk.

A public relations firm involved in the creation of the Cleveland Carbon Fund provided the Fund's necessary branding and website design services largely free of charge. In another major U.S. city, a carbon services company has been contracted to run much of the local carbon benefit fund and has agreed to provide some of its services at a reduced rate as a way to produce proof-of-concept for recruiting future municipal clients.

Appendix I: Summary of Recommendations

The following table summarizes this report's program design recommendations for the Cambridge Carbon Fund. Refer to *Section I: Executive Summary* for a slightly more detailed summary.

Summary of Cambridge Carbon Fun Program Design Recommendations

Fund Type: Phased		
Area of Recommendation	**Phase I: Benefit Fund**	**Phase II: Offset Fund**
Program Administration	City + Nonprofit	City + Nonprofit
Partners	Yes. Potential purchasers/donors Environmental/scientific experts Pro bono help	Yes. Potential purchasers/donors Environmental/scientific experts Pro bono help
# of Projects	Few; 1-2 types.	Few; 1-2 types.
Project Type(s)	Choose among: Ozone depleting substances Residential weatherization Commercial boiler efficiency *Lay groundwork for landfill gas*	Continue: Ozone depleting substances Residential weatherization Commercial boiler efficiency *Landfill gas, if possible*
Price	Premium price ($20-$25) publicized; volume discounts negotiated privately.	Premium price ($20-$25) publicized; volume discounts negotiated privately.
Verification	None. Practice transparency and publish quality principles.	Refer to short list of possible standards. Practice transparency and publish quality principles.
Targeting Purchasers	Who? Individuals Medium/large locally-based businesses *Court future purchasers* How? Offer partnership/sponsorship Charisma or match to mission Retail operations or tax check-off *Pilot co-developed projects*	Who? Local universities Large non-local businesses w/GHG goals *Retain benefit fund donors* How? Offer partnership/sponsorship Charisma or match to mission Custom, co-developed projects *Continue retail/tax check-off, if successful*

SECTION VIII
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"City of Cambridge Climate Protection Plan: Local Actions to Reduce Greenhouse Gas Emissions." *City of Cambridge*. http://www2.cambridgema.gov/CDD/et/climate/clim_plan/clim_plan_full.pdf.

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"Interim Recommendations on Moving Cambridge Forward on Climate Protection." *City of Cambridge Climate Protection Committee*, June 2009.

"Renewable Energy System Locations." *City of Cambridge*, http://www2.cambridgema.gov/CDD/et/climate/clim_renew_map/clim_renewmap.html.

General/Other

Directory of Offset Projects and Providers

Carbon Catalog. http://www.carboncatalog.org.

General Reference

*"*Carbon Offset Research and Education" website. *Stockholm Environment Institute and Greenhouse Gas Management Institute*. http://www.co2offsetresearch.org.

Harvard University Greenhouse Gas Report

"Report of the Harvard University Task Force on Greenhouse Gas Emissions." 2008. http://news.harvard.edu/gazette/wp-content/uploads/2008/07/GHG_TF_finalreport.pdf.

List/Conversation about University Carbon Initiatives

Valluri, Vinodh. "Local Carbon Offset Initiatives at Colleges and Universities." *Association for the Advancement of Sustainability in Higher Education*, August 2010. http://www.aashe.org/forums/local-carbon-offset-programs-universities-and-colleges.

Voluntary Carbon Markets

Hamilton, Katherine, Milo Sjardin, Molly Peters-Stanley, and Thomas Marcello. 2010. "Building Bridges: State of the Voluntary Carbon Markets 2010," *Ecosystem Marketplace and Bloomberg New Energy Finance*, (June 14), http://www.ecosystemmarketplace.com.

Local Carbon Funds

Aspen/Pitkin Canary Tags Initiative
http://www.canarytags.com

Boston CarbonPlus Calculator
Not yet launched.

Chicago Offset Fund (Delta Institute)
https://sites.google.com/a/delta-institute.org/chicagooffsetfund

Colorado Carbon Fund
http://www.coloradocarbonfund.org

Community Carbon Use Reduction at Brown
http://www.brown.edu/Departments/CCURB

Duke Carbon Offsets Initiative
http://sustainability.duke.edu/carbon_offsets/index.php

MaineHousing
http://www.mainehousing.org/ABOUTGreenCarbon.aspx

Neutral Gator/Gainesville (Earth Givers)
http://www.neutralgator.org and http://earthgivers.org/initiatives

Oberlin POWER Fund
No online presence.

Philadelphia Erase Your Trace (CarbonPlus Calculator)
http://www.itreetools.org/carboncalculator/index.cfm?
state=PA&cityname=Philadelphia

San Francisco Carbon Fund
http://www.sfenvironment.org/our_programs/topics.html?ssi=6&ti=85

Westminster CarbonPlus Calculator
http://www.itreetools.org/carboncalculator/index.cfm?
state=CO&cityname=Westminster

Yale Community Carbon Fund
http://sustainability.yale.edu/carbonfund

Offset Quality

American College & University Presidents Climate Commitment (ACUPCC)

"Investing in Carbon Offsets: Guidelines for ACUPCC Institutions v 1.0." *American College & University Presidents Climate Commitmen*t, November 2008. http://www2.presidentsclimatecommitment.org/documents/CarbonOffsetsGuidelines_v1.0.pdf

Environmental Defense Fund (EDF)

"Energy and Emissions: Suggested Offset Criteria." *Environmental Defense Fund*, 2010. http://business.edf.org/energy-emissions/carbon-offsets/suggested-offset-criteria

International Carbon Reduction Offset Alliance (ICROA)

"Programme and Policy Framework 2009." *ICROA*, 2009. http://www.icroa.org/pdf/ICROA-Programme-and-Policy-Framework-2009-Revised.pdf

Offset Quality Initiative (OQI)

"Ensuring Offset Quality: Integrating High Quality Greenhouse Gas Offsets Into North American Cap-and-Trade Policy." *Offset Quality Initiative*, July 2008. http://www.offsetqualityinitiative.org/pdfs/OQI_Ensuring_Offset_Quality_7_08.pdf

WWF

Kollmuss, Anja, Helge Zink, and Clifford Polycarp. "Making Sense of the Voluntary Carbon Market: A Comparison of Carbon Offset Standards." *WWF Germany, the Stockholm Environment Institute, and Tricorona*, March 2008. http://assets.panda.org/downloads/vcm_report_final.pdf.

Project-specific Resources

Ozone depleting substances destruction

CAR protocol summary: http://www.climateactionreserve.org/wp-content/uploads/2010/02/U.S._and_Article_5_ODS_Project_Protocol_v1.0_Summaries.pdf.

Responsible Appliance Disposal Program (U.S. EPA): http://www.epa.gov/Ozone/partnerships/rad

Postconsumer composting

CAR protocol summary: http://www.climateactionreserve.org/wp-content/uploads/2011/02/OWC_protocol_summary1.pdf

Waste Reduction Model (U.S. EPA): http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html

Residential weatherization

VCS methodology: http://www.v-c-s.org/docs/Methodology%20for%20Weatherization%20of%20Single%20and%20Multi-Family%20Buildings.pdf

MaineHousing: http://www.mainehousing.org/ABOUTGreenCarbon.aspx

Commercial boiler efficiency

U.S. EPA Climate Leaders protocol: http://www.epa.gov/climateleaders/documents/resources/comm_boiler_proto.pdf

New U.S. EPA rules: http://www.epa.gov/airquality/combustion/actions.html

Solar PV or solar thermal

Green-e Climate Protocol for Renewable Energy: http://www.green-e.org/getcert_ghg_re_protocol.shtml

Green-e *RECs*: http://www.green-e.org/getcert_re.shtml

Bike share

Proposed VCS methodology: http://www.v-c-s.org/docs/Methodology%20for%20Bike%20Share%20CityRyde%2026%20NOV%202010%20.pdf

CityRyde: http://www.cityryde.com

Landfill gas

CAR protocol summary: http://www.climateactionreserve.org/wp-content/uploads/2009/03/Landfill_Project_Protocol_3.0_Summary.pdf

Landfill Methane Outreach Program (U.S. EPA): http://www.epa.gov/lmop

Wastewater treatment plant methane

CAR protocol summary: http://www.climateactionreserve.org/wp-content/uploads/2009/10/OWD_Version_1.0_Summary.pdf

Deer Island Sewage Treatment Plant: http://www.mwra.state.ma.us/03sewer/html/sewditp.htm

Unpublished Academic Papers

Abbett, John F. "Achieving Carbon Neutrality at Colby College through Carbon Offsets." Bachelor's thesis, Colby College, 2010.

Curtis, Lisa M. "Creating Carbon Offsets: A New Alternative for Colleges and Universities?" Bachelor's thesis, Whitman College, 2010.

Schadler, Elise and Professor Cecilia Dank, "CarbonPlus Calculator Case Study: Draft 2, 8/13/2010," Paper written at the Rubenstein School of Environment and Natural Resources. University of Vermont, 2010.

Snow, Becky, "Funding Energy Efficiency and Renewable Energy Technologies in Public Schools with Purchases of Carbon Offsets by Corporations," Master's thesis, Harvard University, 2010.

Verification Standards

American Carbon Registry (ACR)
http://www.americancarbonregistry.org/carbon-accounting

Chicago Climate Exchange (CCX)
http://www.chicagoclimatex.com/content.jsf?id=23

Climate Action Reserve (CAR)
http://www.climateactionreserve.org

Gold Standard (GS)
http://www.cdmgoldstandard.org

Green-e Climate Protocol for Renewable Energy
http://www.green-e.org/getcert_ghg_re_protocol.shtml

ISO 14064/65
http://www.iso.org/iso/catalogue_detail?csnumber=38381

Regional Greenhouse Gas Initiative (RGGI)
http://www.rggi.org/market/offsets

VER+ (VERplus)
www.netinform.de/KE/Beratung/Service_Ver.aspx

Verified Carbon Standard (VCS)
http://www.v-c-s.org