Understanding and Accessing Voluntary Carbon Offset Markets: a New Source of Funding for Community Forestry?

Final Report and Appendices

for
FOREST SERVICE GRANT NO. 08-DG-11420004-293

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By

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List of documents combined in this PDF:

1. Final Report
2. Website homepage screenshot and URL
3. Austin TreeFolks and City case study
4. CarbonPlus Calculator Case Study
5. Cascade Land Conservancy (now ForTerra) case study
6. Michigan State University case study
7. Sacramento Tree Foundation case study
8. Quick Guide – review draft
9. CarbonPlus Calculator draft journal manuscript
10. Barriers and Opportunities journal manuscript concept
11. Barriers and Opportunities table

For other project outputs see links in Final Report and on website:
http://www.uvm.edu/forestcarbon/UCF/

FINAL REPORT
FOREST SERVICE GRANT NO. 08-DG-11420004-293

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Project Name: UNDERSTANDING AND ACCESSING VOLUNTARY CARBON OFFSET MARKETS: A NEW SOURCE OF FUNDING FOR COMMUNITY FORESTRY?

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Project abstract (as defined by initial proposal and contract):

In consultation with community groups, we will conduct original research and adapt existing information on how the voluntary carbon offset market is evolving, how forest carbon plays a role, and the barriers and opportunities for local communities to help fund urban and community forestry through carbon offsets. This project will identify and profile models in which communities have or could access carbon offset funding to help fund their forestry efforts. Products include a full report and a condensed guide for community members and local governments, which will both be disseminated nationally through established networks and made available on our websites.

Project objectives (tasks by year, from proposal timeline**):**

Year 1 – Gathering resources, information and input
(covered in previous progress reports)

Year 2 – Detailed data collection and analysis
(covered in previous progress reports)

Year 3 – Development and dissemination of final products

- Full draft report compiled and fact-checked against changes in protocols and other market rules
- Quick Guide drafted from full report
- Scholarly journal article prepared for submission
- Draft reports shared with community networks and feedback solicited
- Final reports made available on the web and announcement circulated through community networks with national scope and local reach
- Webcast or powerpoint presentation prepared for distribution
- SurveyMonkey (or equivalent) evaluation tools developed

Deliverables proposed (from the proposal)

"We anticipate five principal products (which could change somewhat in response to needs of community groups):"

- Easy-to-read report geared towards for community groups and local government
- A brief guide to carbon markets for urban and community forestry groups and local government, likely in the 8 page format of the Communities Committee's Quick Guides (http://www.communitiescommittee.org/publications.html).
- Visual outreach material, perhaps a webcast and/or PowerPoint, highlighting key elements of interest to local communities.
- An article for an academic or professional journal to report on and bring attention to the equity and access issues for small-scale urban and community forestry efforts, with hopes of influencing the debate about and development of the emerging regulated carbon markets.
- A project website where reports and relevant links are made available to all (www.uvm.edu/forestcarbon).

Listed elsewhere in the proposal:

- Three cases studies – one in Vermont, one in California, one eastern urban area (e.g. New York, Boston or DC)

Objectives met successfully to date:

We successfully completed all grant objectives for providing both general and case specific information for urban forestry groups regarding options for participation in carbon markets. Over 40 urban forestry professionals and experts in carbon markets were interviewed for the five-plus case studies and for gaining a detailed understanding of barriers and opportunities from both participants and nonparticipants in the carbon market. Our findings have been synthesized into a number of user-friendly written products and professional presentations. While i the specific

products have varied somewhat from those originally indicated in the proposal, in many respects our team exceeded original expectations. The proposal noted that products might change due to feedback from community groups. In addition, the overall economic and political climate has changed considerably since this project was initially proposed, and the voluntary market has continued to evolve. These changes also affected our methods and final products, as discussed below.

Deliverables accomplished:

In the third year of the project, we chose not to write one, single overarching general report for practitioners and instead focused on expanded and additional separate products for the following reasons:

- Need for models, not generalities: Interviews with practitioners and experts highlighted the need for specific models. They most wanted to know how other groups pursued carbon market opportunities.
- Market immaturity: In this emerging market with so much innovation and yet few appropriate and affordable protocols, we found that writing a general "how-to" guideline was premature. Case studies illustrate the breadth of approaches and allow interested parties to choose examples that best match their specific situations.
- Recommendations for policy & practice: While a "how-to" may not yet be appropriate, our research has led us to several ideas for how barriers could be overcome and opportunities realized that seemed best suited to other written products for other audiences.
- Needs changed: Some of the topics we originally planned to include in a general report, such as ecological issues, are covered well elsewhere. Other topics, such as how federal climate legislation addresses urban forestry, did not come to pass.

Therefore, we put more energy into other written outputs and into the website as a way to provide the needed general information with links to more detailed information produced by our team and others. In particular,

- We completed 5 rather than 3 cases studies. One case, the CarbonPlus Calculator, covered experiences in several cities. A 6th case study, Arcata Community Forest, is nearly complete however because a major partner in that case, ClimateSmart, closed its doors in November, we need to revisit the case before publication.
- We wrote a longer Quick Guide (12 vs 8 pp) that included many of the elements we had anticipated including in the general report. It is still brief enough to be useful, and will likely be disseminated more widely than a longer report.
- We added sections to the website to cover additional areas a general report might have done. For topic areas covered better by others, we link to them directly from the website and Quick Guide.
- We are doing two rather than just one academic journal article: one focuses on the CarbonPlus Calculator and draws on other cases as well, the second focuses on barriers and opportunities. We felt that an academic, peer-reviewed analysis of these issues would provide solid support for policy recommendations.
- We plan to write a general audience article that includes policy recommendations and practices to help overcome the barriers. It will draw on findings from abroad as well as efforts with certification and small landowners in the US to deal with similar barriers. (Not in original proposal and not yet ready for review.)

How will this project increase the knowledge we have about urban forestry? How will the public benefit?

This project is one of the first efforts to collect empirical data on emerging efforts of urban forestry initiatives nationwide to engage voluntary carbon markets. We provide specific information about the opportunities, barriers and models that have been encountered for urban forestry in carbon markets. We have synthesized this information into a number of products that can help urban forestry groups understand the options emerging for funding some of their work through carbon markets. Our brief case studies illustrate the direct participants in the market chain, as well as supporting factors and actors. They fill a need cited by many practitioners for "models" that clarify options they could pursue. This information will not only help interested parties understand what is involved in engaging carbon markets but also how governments (local, state & federal) can help promote carbon markets that are accessible for urban forestry groups and projects.

What specific quantifiable results have been produced?

- Five cases studies, available at :
    - Carbon Offsetting Through Urban Tree Planting: The Sacramento Tree Foundation & Harbison-Mahony-Higgins Builders, Inc.
      Sacramento Tree Foundation Case Study
    - Carbon Mitigation through Restoration of Urban Forests: The Cascade Land Conservancy & its Green City Partnerships
      Cascade Land Conservancy Case Study
      **The Cascade Land Conservancy changed its name to Forterra in late 2011*
    - Local Data to Calculate Local Offsets to Support Local Tree Plantings: The CarbonPlus Calculator
      Carbonplus Calculator Case Study
    - Carbon Emissions Offsets from Urban Forests: Michigan State University and the Chicago Climate Exchange
      Michigan State University Case Study
    - Austin, Texas: Exploring Urban Forestry & Carbon Offsets
      Austin, Texas and TreeFolks Case Study

  These cases were selected because they were among the most developed ones identified in consultation with urban forestry and carbon market practitioner. In addition, ACT members were asked to recommend potential cases via a newsletter announcement. All viable leads were pursued, but a number of projects were not far enough along to be chosen for a case study. We also selected cases that involved a diversity of institutional arrangements and carbon methodologies.

  These cases are complete, however we left the word "draft" on them until mid- January 2012 to encourage comments in the final round of Quick Guide review.

- A 12 page Quick Guide title "Voluntary Carbon Markets for Urban Forestry" is in draft form and ready for review by project partners. It is one of the series of Communities Committee's Quick Guides (http://www.communitiescommittee.org/publications.html). We set the review period to end January 15, 2012. Once completed, it will be available on their website, our ForestCarbon website and will be disseminated by email listserves including Alliance for Community Trees. A brief survey powered by SurveyMonkey will provide evaluation of the QuickGuide and website resources.

- One webinar, Tapping Carbon Markets for Urban Forests, was conducted by Elise Schadler on Jan 20, 2011. It is available at the ACT website and is linked on our website (http://actrees.org/site/resources/events/tapping_carbon_markets_for_urban_forests.php).
- Five professional presentations to date (plus one abstract accepted for Feb 2012), with some powerpoints available online at: http://www.uvm.edu/~cfcm/UCF/?Page=interim_products.html
    - Urban forestry and implications for emerging voluntary carbon markets *(1.72 Mb PDF file)*, by E. Schadler, at the *Northern New England Forests Research Symposium*, Burlington, VT, December 16, 2011.
    - Urban forestry & voluntary carbon markets *(3.48 Mb PDF file)*, by E. Schadler at the *International USA-Ukraine Symposium on Community Forestry & Carbon Science*, Burlington, VT, June 27, 2011.
    - Facilitating carbon market participation in small scale and community-based projects, by C. Danks R. Beddoe, E. Schadler, and J. Wright, at *Association of Environmental Studies and Sciences Annual Meeting and Conference*, Burlington, VT, June 23-26, 2011.
    - Carbon Markets for small scale and community-based forestry in the US, at the *2011 International Symposium on Society and Resource Management*, Madison, Wisconsin, June 4-8, 2011.
    - Understanding the role of urban forests in voluntary carbon markets *(2.58 Mb PDF file)*, by E. Schadler, *Vermont Urban & Community Forestry Council* Meeting, Burlington, VT, March, 2011
    - Opportunities, barriers and models of urban forestry in voluntary carbon markets, by E. Schadler, C., Danks and M., McDermott at American Association of Geographers, New York, NY, February 2012.
- Two articles for an academic/ professional journal are underway:
    - "Carbon calculators and local carbon offset projects: lessons from the case of the CarbonPlus Calculator" co-authored by Elise Schadler, Cecilia Danks and Mark Twery and focuses on the lessons learned from the CarbonPlusCalculator (draft attached)

      ABSTRACT: Local governments have expressed a need for an easy-to-use tool to provide citizens with information on their carbon footprints and ways to reduce or offset their emissions. The CarbonPlus Calculator (CPC) is an online carbon footprint calculation and offset tool funded by the U.S. Forest Service and developed in collaboration with the Davey Institute of Tree Sciences. Between 2008 and 2011, versions of the CPC were created for Boston, Baltimore, Philadelphia, New York City, the state of Vermont, and Westminster, CO. The goal of the CPC is to allow local residents to support local greening and energy efficiency initiatives through the tool, which is customized with region-specific data. Despite its potential for both education and fund-raising, the tool is largely inactive as of late 2011. Through interviews with project developers and municipalities, this study examines barriers for implementation of the CPC. By drawing on the successes and struggles of this and other carbon offset projects in U.S. cities, we identify critical components for implementation, leading to insights and recommendations, which include budgeting for development costs and allocating resources to marketing.
    - "Barriers and Opportunities for Urban Forestry in Voluntary Carbon Markets" co-authored by Elise Schadler, Cecilia Danks and Melanie McDermontt (Rutgers University) (cover page and table attached)

      ABSTRACT: Critiques of market-based solutions to environmental problems generally focus on the perils they pose for rural communities in the global South. In the industrialized North, however, voluntary carbon markets may instead offer pragmatic opportunities for urban and suburban communities to add value to local trees in ways that can be used to fund urban forestry initiatives and enhance local educational and environmental impacts. Based on international literature, over 40 interviews, and 5 case studies on U.S.-based projects, we identify the specific barriers and opportunities for local communities to help fund urban and community forestry through carbon offsets. By identifying barriers and profiling models illustrating specific ways they have been overcome, we explore the features common to successful and struggling

> projects respectively. Our findings suggest that access to forest carbon markets presents special challenges, such as the costs of assuring additionality and permanence for effective climate change mitigation and marketing carbon offsets to urban populations. Moreover, an enabling policy environment and supportive intermediaries will be required for urban participation in forest carbon markets to succeed on a significant scale. Pioneering examples demonstrate that, rather than converting community trees into a globalized commodity, carbon markets can provide an effective way to enhance their local value in a number of ways: by producing multiple 'co-benefits' and educating the public and policy-about them; by providing local accountability through 'carbon credits you can see' (independent of expensive-to-meet global standards); and, finally, by engaging people in acting locally rather than thinking of climate change as a responsibility belonging to 'someone else.'

We do not yet have a draft of this 2md paper to share, but I have attached the barriers and opportunities table in the Appendix to show some of the specific findings.

- A project website, "Carbon Mitigation for Urban and Community Forestry" where reports and relevant links are made available to all at http://www.uvm.edu/forestcarbon/UCF/.

How will the results be disseminated to the public?

The reports described are available free-of-charge in PDF format on our project website (www.uvm.edu/forestcarbon) and through our partners. They will be actively advertised through national and regional listservs, newsletters, meetings and conferences. Through our contacts, we are targeting distribution to a number of groups that are national in scope, but which reach the local level, including the Alliance for Community Trees, American Forests, the National Association of Counties' Climate Protection Program, the Urban Natural Resources Institute, and State Urban and Community Forestry Coordinators. Further, there have been discussions about the urban forestry case studies being presented at the 2010 Partners in Community Forestry Conference in Philadelphia.

Project will be housed in a University of Vermont-based website and selected products will also be available on the Communities Committee of the Seventh American Forest Congress' website (http://www.communitiescommittee.org/COFfunding.html). We will send notices of our products to other websites that have compiled useful links and lists of resources on this topic, such as the USDA Forest Service Ecosystem Services website or Urban Forestry South Expo.

List the active partners (key individuals or organizations) involved in the project to-date:

Research Team:

Cecilia Danks, Ph.D. (PI)
Elise Schadler, Project Coordinator, UVM M.S. student
Rachael Beddoe, UVM M.S. student
Jennifer Wright UVM M.S. student

Partners:

Watershed Research and Training Center
Dr. Melanie McDermott, Rutgers University
The Communities Committee of the 7th American Forest Congress

Comments considered of importance but not covered above:

This project, as well as related forest carbon market work my lab does, has found that there are still opportunities in voluntary carbon markets – especially for local projects such as urban forestry – despite recent backpedaling in both US climate change legislation and international agreements.

While the Great Recession hit all markets hard, voluntary carbon markets are bouncing back and have traded their highest volumes in 2010. I am actually much more optimistic at the close of this project than I was in the middle of it. Institutions that have made sustainability commitments and climate action plans are approaching their target dates for emissions reductions. They are considering anew their options for offsets and current market trends for "buying local" may make urban projects more attractive than distant ones, whether or not they meet globally recognized standards. But local urban forestry groups need help in figuring out how to create, market and maintain high quality offsets. These cases have shown that it is possible, but start-up costs are high. I think specialized regional initiatives, perhaps similar to those in the early days of organic agriculture or forest certification, may be needed to help urban groups and municipalities participate in voluntary carbon markets. We broke down our market analysis into Enabling Environment, Market Chain, and Supporting Institutions to help in understanding the specific needs. We are currently comparing these findings with cases done for small private forest landowners and hope to provide some cross-cutting recommendations soon.

Minor team transition issues:

(Reported in year 2): Towards the end of year two, co-principal investigator Eva Wollenberg took a new position leading an international climate change research team. Because her new work focused on Africa and Asia and did not include the US, she reluctantly had to leave the project. However, by year two, the research team was well-established and the research well underway so we have been able to meet project goals without Dr. Wollenberg's continued involvement.

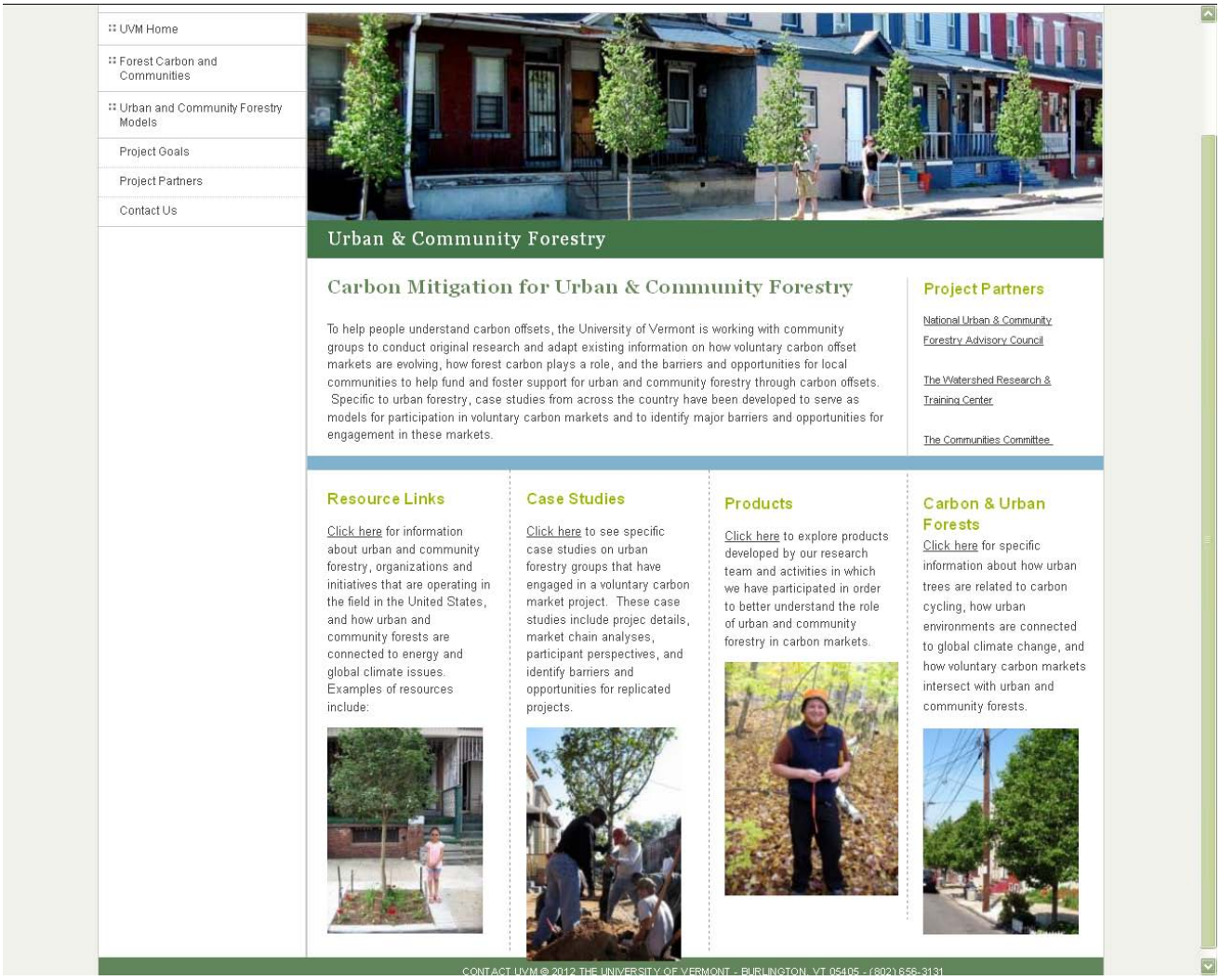
The Communities Committee is undergoing internal changes and the original staff person who was to help with the Quick Guide has left the organization. However the ComCom Board and Board member Dr. Melanie McDermott have stepped up to help with the Quick Guide. This change has led to a delay in releasing the draft Guide, but it is now ready for review.

This report was prepared by:

Name: Cecilia Danks
Title: Principal Investigator
Phone Number: 802-565-0175 and 802-922-0338 (cell)
Date: December 23, 2011

Urban and Community Forestry & Carbon Website Homepage

URL: http://www.uvm.edu/forestcarbon/UCF/



Austin, Texas: Exploring Urban Forestry & Carbon Offsets

Fast Facts

Activity: Carbon footprint calculation and offset through supporting tree plantings

Launch Date: 2007

Purpose: Provide residents and city departments with local options for addressing their carbon footprint.

Tree Ownership: TreeFolks, an Austin-based nonprofit organization, plants trees in both city-owned and privately-owned spaces.

Funding: Initial project development by TreeFolks was approximately $2,000 (out of pocket, plus staff time).

Verifier: No third party verification to date

Payment Mechanism: Online transaction tied to a carbon calculator.

Price: Original Treefolks offsets sold for $14/mtCO2e. As of July 2011 the organization will be engaged in a new carbon offset initiative with the City of Austin and the price of offsets has yet to be determined.

Climate Benefits: The total amount of carbon offset to date was not available at the time this case study was written.

Co-Benefits: Stormwater mitigation, reduced water use, avoided emissions through shading, lowering the urban heat island effect, increasing property values, reducing particulate air pollution, and creating wildlife habitat. TreeFolks' carbon initiatives emphasize the importance of supporting local sustainability and educating and engaging the people of Austin around climate change.

Overview

TreeFolks is an Austin-based nonprofit organization that has been engaged in the sale of carbon offsets to raise funds to plant trees since 2007. Hosting and administering its own carbon footprint calculator and carbon offset program for three years, in 2011 the organization was selected by the City of Austin's Climate Action Team to participate in a pilot project to generate local carbon offsets. The offsets will be quantified, monitored, and sold through the Austin Carbon Footprint Calculator (ACFC), which is one component of an extensive city resolution to promote carbon neutrality throughout the city. Though TreeFolks and the City of Austin have collaborated on projects for many years, this emerging partnership represents an innovative approach to support the growth of the urban forest, the expansion of a voluntary carbon market, and the City's sustainability initiatives.

The Projects

TreeFolks hosted a carbon calculator and carbon offset purchase option on its website under the direction of Scott Harris, the organization's executive director from 1999-2010. Individuals and businesses seeking to purchase carbon offsets associated with the approximately 10,000 trees planted by TreeFolks annually had

periodically approached Harris. After attending a presentation on carbon credits at the Texas Tree Conference in 2006, he "decided that if our carbon credits were valuable for somebody else, they might be valuable to us." Harris spent the next ten months exploring and comparing over 20 existing carbon calculators, choosing the most reliable and credible numbers on carbon sequestration from over 50 references, and vetting his calculations through a group of local environmental and forestry professionals. With the help of a paid web designer, the TreeFolks Carbon Offset Program (TCOP) was launched in August of 2007 and Harris was confident that it had been designed "with enough really credible data to produce numbers that actually meant something."

The TreeFolks carbon calculator was a simple interface that was user friendly and clear about the sources used for the calculations *[see text box 1]*. Users would input information about annual kilowatt-hours of electricity used, miles driven in a year and miles per gallon of vehicles, annual air travel miles, and cubic feet of natural gas used in a year in the household. A carbon footprint would then be generated and the user would have the option of offsetting by paying $14 per ton of carbon dioxide equivalent (this price was decided by Harris and was based on other carbon calculator offset prices). The number of trees that would be planted in order to achieve the offset would also be indicated and was supported by a documented minimum average 80% survival rate of TreeFolks' trees (based on annual tree survival studies performed by the organization). The funds collected through the TCOP would be put into a general fund to support trees planted on public land through the CommuniTrees or CityShade programs or the Urban Orchard Project [*see text box 2]*. When carbon offsets were purchased TreeFolks staff would assign the funds to specific trees from the list of scheduled plantings for the current or upcoming planting season and would offer each user the option of knowing exactly where those trees were located. Some users even requested purchasing the carbon offsets for specific tree planting projects. The program was minimally marketed in the organization's newsletter and on the website and was for the most part targeted at TreeFolks' existing network of volunteers, tree recipients, and partnering organizations and institutions (11).

While Harris is unsure of the total amount of funding acquired through the TCOP, he did indicate that within several months of the launch, the calculator did recover the approximately $2,000 it cost to develop the tool (equivalent to 143 metrics tons of carbon equivalent offset.) Both Harris and TreeFolks board member Chris Searles noted that beyond that the TCOP saw regular activity through 2008. Several domestic urban forestry organizations contacted Harris with interest about the program's design and use. But by 2009, due to a variety of factors such as the lack of capacity for marketing and the state of the economy, the calculator lost its steam. In 2010 only about $300 was raised through the TCOP. In January 2011 Harris retired from Treefolks and April Rose became the new executive director. Rose, who was previously the town forester for nearby Pflugerville and had partnered with Treefolks in the past, took the carbon calculator off of the organization's website within the first few months of her employment with the organization. Acknowledging her unfamiliarity with carbon markets and the calculations associated with the tool, Rose intended to familiarize herself with Harris's design before continuing to offer the TCOP as a service.

Factors and Sources for TreeFolks Carbon Offset Program:

- ***Carbon emitted from gasoline and natural gas from the United States Department of Energy:***

1) Energy Information Administration. 2005. *Documentation for Emissions of Greenhouse Gases in the United States*. DOE/EIA-0638 (2005), October 2007, Tables 6-1, 6-2, 6-4, and 6-5.
2) U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. *Alternative Fuels & Advanced Vehicles Data Center, Fuel Properties* web page (http://www.eere.energy.gov/afdc/fuels/properties.html)

- ***Carbon emitted for air travel (averaged) from a Tufts University study:***

1) Kollmuss, Anja & Bowell, Benjamin. 2006. *Voluntary Offsets for Air-Travel Carbon Emissions: Evaluations & Recommendations of Voluntary Offset Companies.* Tufts Climate Initiative. 53p.

- ***Carbon emitted from electricity based on fuel mix then used by Austin Energy at www.Austinenergy.com.***

- ***Number of trees to offset a user's carbon footprint come from a conservative average of .66 tons of CO2 per mature tree from the American Forests Carbon Calculator webpage at www.americanforetss.org/learn-more/carbon-calculator*** *(page has since been updated).*

Text Box 1: Factors and Sources for the TreeFolks Carbon Offset Program

TreeFolks Programs Linked to Carbon Offsets

When active, the **TreeFolks Carbon Offset Program** (TCOP) supports trees planted in publicly owned spaces through three different channels/mechanisms/institutions/programs:

- ***CommuniTrees*** is a grant program that offers trees and planting expertise to volunteer groups planning tree-planting projects. Since 1992, the program has provided thousands of trees to schools, churches, medians, green-spaces, and housing projects all over the Austin area. The majority of the trees planted through the TCOP were allocated to CommuniTrees.
- Through the ***CityShade*** program, TreeFolks partners with municipalities and organizations to plan events that give citizens hands-on opportunities to improve their communities by planting trees. During the 2010-2011 planting season, 2,391 trees were planted through CityShade at nine sites.
- The ***Urban Orchard Project*** was started in 1999 to plant groves of locally adapted fruit and nut trees and to use those trees as a platform to teach people how to grow fresh fruit using healthy, organic methods. During the 2010-2011 planting season, TreeFolks helped five community groups plant small orchards, up to one acre in size.

A newly planted 5-gallon live oak tree delivered through the Neighborwoods program in February 2009.

The ***Austin Carbon Footprint Calculator's*** offset component will support trees planted along the residential Right of Way through the NeighborWoods program.

- TreeFolks has been contracted by the City of Austin to implement the ***NeighborWoods*** program since 2004. With an annual goal of 3,600 trees, TreeFolks evaluates neighborhoods and offers free street trees to residents who agree to plant and care for the tree(s) for at least two years. The goals of the program are to lower summer temperatures and reduce energy consumption by investing in tree canopy cover that will shade paved streets. This program fits well within the **Austin Climate Protection Program**.

A note on TreeFolks' Trees: TreeFolks generally plants trees in 5 gallon pots that are usually at or less than 1" in diameter and between 5-7' tall. They offer locally sourced native trees that are well adapted to the Austin climate and they deal primarily with two local wholesale nurseries that are within 10 miles of the TreeFolks office. Examples of tree species planted include: live oak, lacey oak, chinquapin oak, Elm, Mexican plum, mountain laurel, and flame leaf sumac.

Text Box 2: TreeFolks Programs Linked to Carbon Offsets

However, before Rose began that task, an opportunity to collaborate with the City of Austin arose that would allow the small organization to be involved with a larger, emerging voluntary carbon market. In 2007 the Austin City Council passed a resolution to become carbon neutral by 2020. Titled the Austin Climate Protection Plan (ACPP), this resolution identifies objectives for reducing emissions and also includes a provision for creating carbon offset opportunities for city departments, Austin residents, and visitors to central Texas (4). In simple terms, said Austin Environmental Program Coordinator Marc Coudert, "the City of Austin is mandated to create a carbon calculator and is also mandated to engage in carbon offsets."

The latter was accomplished in 2010 when the Canadian nonprofit organization ZeroFootprint was hired to build a localized calculator for the city (available at www.ci.austin.tx.us/acpp). For an Austin resident to use the calculator they simply enter their Austin Energy ID number and the tool auto-populates the customer's household energy, water, and salvage services to generate a carbon footprint (Austin Energy is the local municipal energy provider and is also a key partner on the ACPP). The user also has the option to input information about annual travel (car and air) and diet. Visitors to the Austin region (not Austin Energy customers) can manually input their travel information to generate a carbon footprint. Coudert and the City's interdepartmental Climate Action Team began designing the carbon offset purchase component in 2010, which is anticipated to be added to the current calculator design and officially launched by early 2012.

In February 2011 the City of Austin released an RFP for a grant titled "the Austin Climate Protection Challenge Grant" to solicit local projects that could create carbon offsets for the ACPP *[see text box 3*]. While the offsets created by these projects won't be available until mid-2012 and beyond, the City currently has a large pool of renewable energy credits (RECs) from solar and wind projects through Austin Energy that will be sold during the pilot period. "The idea," said Coudert, "is that any money we make off of this project through the sale of offsets we put right back into a pool of money geared towards local offsets projects."

Rose submitted a proposal on behalf of TreeFolks that is

based on the organization's NeighborWoods program (*see text box 2*) and it was one of two initial projects selected by Coudert and the Climate Action Team to pilot the carbon offset program. Two additional projects will be chosen after the official 2012 launch. The $10,000 grant award will be used by TreeFolks to increase the 2011 NeighborWoods tree plantings from 3,600 to 3,800 and to use the National Tree Benefits Calculator (2) to generate data on carbon sequestered and avoided by NeighborWoods trees planted over the course of the year.

As of July 2011, logistics of the ACFC carbon offsets component are still being figured out, such as the price of the offsets per ton of CO2 equivalent, and how the project will be marketed. Coudert knows that there will be a budget for marketing, but the City "hasn't really pushed hard to market the carbon calculator because at this point [July 2011] there is neither the carrot nor the stick -- but it's a fun tool for people to gauge how well they're doing. Until we can really connect the carbon calculator to the projects and the offsets, we haven't marketed." Additionally, Coudert and Rose have began to consider options for having the carbon offsets from NeighborWoods trees verified by a third party, and exploring the possibility of registering the program through the Climate Action Reserve's *Urban Forest Project Protocol* in the future (5).

Project requirements indicated in the RFP for the Austin Climate Protection Challenge Grant include:

- The project must occur within the five Austin-area Counties,
- it must either avoid the release of greenhouse gases (GHGs) into the atmosphere or permanently reduce a specific amount of GHGs,
- it must demonstrate additionality (the GHG emission reductions achieved with the grant award must be greater than what would occur under business as usual circumstances)
- the amount of GHG reduced by the project must be quantifiable (in metric tons of GHG emissions), and over the life of the project, must be quantified,
- the project should act as a prototype for other projects in the Austin area and is repeatable,
- the project should be visible to the general public and is easily identifiable,
- preference will be given to projects that provide co-benefits like education and increased awareness of climate change issues and benefits to populations that are vulnerable to the effects of climate change, and
- the awardee must establish criteria and procedures for monitoring. These procedures must have a high level of accuracy and transparency and provide monitoring methodologies and monitoring roles and responsibilities.

Text Box 3: Austin Climate Protection Challenge Grant offsets requirements.

3,600 trees delivered to homeowners' front doors through the Neighbor-Woods Program each year lead to greener neigborhoods, cleaner air, and happier residents!

Participant Perspectives

The staff of TreeFolks and the designers of the ACPP have both recognized the potential market for local carbon offset projects in the Austin area. Coudert said, "it's harder for people to connect to [carbon offsets generated through] wind towers in western Texas, which is a 10-hour drive from here, than to something that is happening in their own neighborhood . . . so when people visit the carbon calculator and at the end they want to become carbon neutral, they can look at these local projects as way to do it, so it's just a good feeling all around." Coudert continued, "it's not just about making money through carbon offsets, it's also about promoting local projects that are green." Searles noted, "Austin has developed a really neat cultural thread over the last three or four years that has to do with trees and water, which is pretty scarce, and we've built a community around that." This community and the city's tree planting initiatives support the idea that "we should all be really serious about planting as much as we possibly can right now."

Those involved with the TCOP and the ACPP also recognize challenges around implementing carbon projects through urban forestry. Coudert noted, "these local projects will never really produce a large amount of carbon" and Searles said that after the economic downturn in 2008, the TCOP "just kind of went out of fashion," leading to decreased traffic on TCOP webpage. Harris, who designed the TCOP, acknowledged that through his research he "noticed that there was a low level of accountability" in different online carbon

calculator tools and offset projects. Further, he said, "some of the things that groups were counting as credits were just really questionable to me . . . some of them were so simple that you really had to question the credibility of the numbers that you got off of them . . . and [at the time] nobody had a real local and verifiable option for offsets." While Harris ultimately developed a carbon calculator "that he felt was really good and that drew attention from other people in the tree planting industry," in the absence of recognized protocols for urban forestry carbon projects, concerns about accountability will likely persist. Harris also pointed out, "the only restricting factor for it [the TCOP] was marketing . . . we essentially didn't have the resources to market it adequately" but, despite the challenges emphasized, "everyone who was exposed to it I think had favorable impressions of it, but we just weren't able to reach the audience."

April Rose, current executive director of TreeFolks, removed the TCOP from the TreeFolks website based on "the rationale that if the city has one that we are participating in, do we really need one too?" Rose recognizes that "the carbon offsets option that we're just fleshing out with the city is really right up here on the forefront of a new part of what we'll be doing to help the City. The City of Austin's goal is to be carbon neutral by 2020 but they're already realizing that offsets will have to be included in their neutrality goal . . . so why not offset a portion locally to improve our residents' quality of life and support proven local initiatives?"

Looking Forward

There is obvious enthusiasm around the TreeFolks partnership with the City through the Austin Climate Protection Challenge Grant. TreeFolks will be able to plant more trees through its Neighborwoods program in 2011 with the grant funding and potentially in the future through direct funds from the sale of carbon offsets on the ACFC. Further, the City will meet key objectives of the ACPP. But the benefits of this pilot project don't end there. "My long term vision," said Coudert "is to use this project with TreeFolks as a sort of prototype that goes through the process of becoming viable according to the CAR [Climate Action Reserve] protocol and then eventually take our City as a whole and go through the protocol." In order for the City departments to be carbon neutral by 2020 they will "have to have some kind of sink and this is where the trees could come in on a larger scale," noted Coudert, "and hopefully within the next five years we will be able to do it full-blown for the whole city."

Rose also expressed excitement about the potential of this project and noted, "there's a lot of interesting things happening in Austin right now." While the future of the TCOP is unclear, the focus on the carbon benefits of the organizations trees remains pertinent. Rose emphasized, "we [Austin residents] want to be a green city", and mentioned that she recently submitted a significant proposal to a large business that is establishing a branch in Austin to "help them achieve some carbon offsets through tree plantings in riparian corridors to fruit tree orchards to expand NeighborWoods beyond the scope of the Austin Energy service area."

Lessons Learned

TreeFolks' efforts to be engaged in carbon offsets through its own carbon offset program and subsequently through that of the City of Austin offer significant lessons about urban forestry and voluntary carbon markets. Further, the carbon offset components of the Austin Climate Protection Plan demonstrate localized efforts to support carbon neutrality and sustainability at a municipal level. Specific lessons learned from this case study include:

- *Opportunities for collaboration exist in voluntary carbon market mechanisms*: As institutions and organizations consider ways to incorporate carbon offsets into their sustainability initiatives there are likely partnerships that can strengthen these efforts. TreeFolks and the City of Austin will collaborate in the pilot year of the ACPP's carbon offset component, both entities benefiting from the abilities and assets of each other. It is important to note the importance of all collaborators having confidence in carbon accounting methods and the project guidelines.

- *The experience that TreeFolks had in developing and implementing the TCOP better prepared them to partner with the City of Austin in its emerging carbon offset project*: Even though April Rose stopped offering the TCOP as a service of TreeFolks, the foundation that Scott Harris laid by establishing the program provided the experience that primed the organization to be open and ready to partner with the City in the pilot cycle of its carbon project. By partnering with the City of Austin, TreeFolks' "product" (the carbon offsets provided by the trees) will be available to a much larger market than was accessed through the TCOP.

- *Municipalities are meeting their sustainability goals through urban forestry*: As cities across the country develop their own sustainability agendas, places like Austin are demonstrating that trees can play a substantial role.

- *Involving local utilities in carbon offset projects is important:* Austin Energy is a vital partner in the Austin Climate Protection Plan and the carbon offset initiatives, both in the calculation of Austin residents' footprint and in actually providing offsets through its investments in renewable energy. Partnering with local utilities can link residents and cities with energy providers in innovative ways.

- *The lack of broadly accepted protocols applicable to urban forests in U.S. voluntary carbon markets is an obvious barrier:* Because he had no recognized protocols or models on which to base his program, Scott Harris went through an intensive research process to develop a carbon calculator to which he felt comfortable attaching the TreeFolks name; in other words, there were high up-front costs. Despite this, when he left the organization and April Rose took over as executive director, she was not confident in the tool, both because of her lack of knowledge about carbon markets and Harris's TCOP design. Had the TCOP been vetted or verified according to an established protocol, it would have had more weight.

- *Marketing is an important piece of any sustainability initiative:* The former executive director of TreeFolks admitted that the most limiting factor of the TCOP was the lack of marketing. Simply put, if people don't know about an initiative, they won't participate, and allocating resources to marketing is essential for emerging carbon offset projects. It should be noted that marketing can be achieved through effective partnerships and that the City of Austin intends to design a marketing campaign for the launch of the offset component of the ACFC in 2012.

- *Urban forestry groups seek models for carbon offset projects:* Scott Harris noted that multiple urban forestry organizations across the country contacted him after he launched the TCOP in 2007 seeking guidance in developing their own carbon projects.

- *Carbon offset projects can be incorporated into existing programs:* TreeFolks has experience with implementing a carbon project and familiarity with the carbon benefits of its trees. Rose incorporated the existing Neighborwoods program into her proposal for the Austin Climate Protection Challenge Grant, recognizing the potential to build on a program already offered by the organization and to demonstrate additionality.

Project Partners

Treefolks

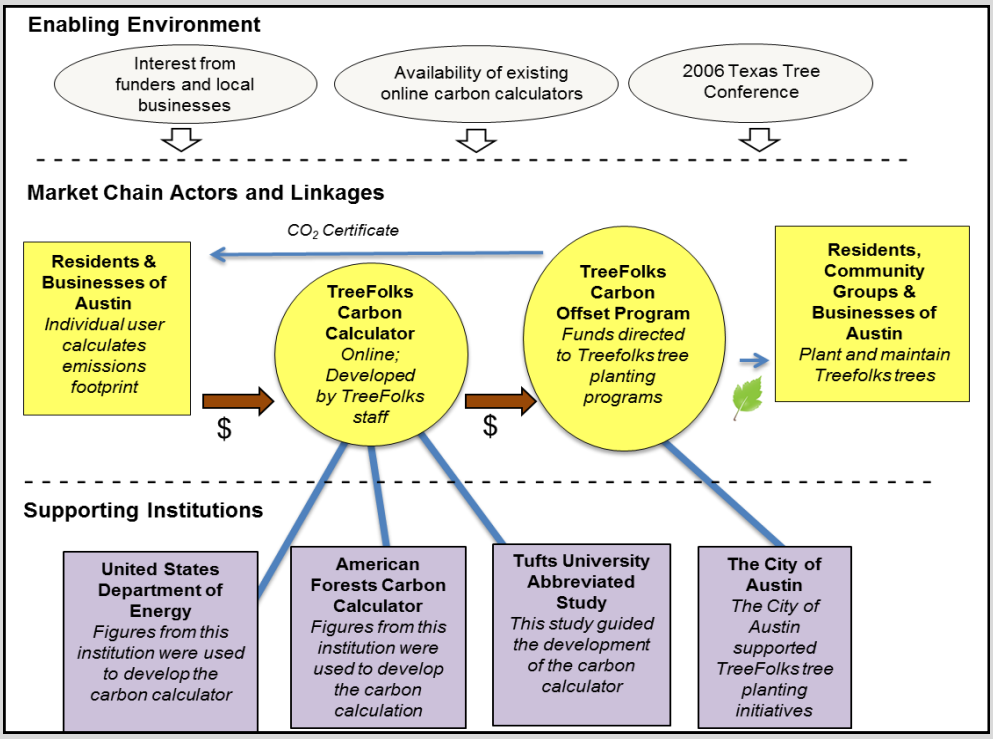
Treefolks is a nonprofit organization that was established in 1989 in Austin, Texas. With a staff of under five (give or take a seasonal worker), Treefolks has planted tens of thousands of trees at schools, churches, retirement homes, and housing projects, and in medians, residential right-of-ways, community gardens, parks, preserves, and green belts. Treefolks offers a variety of tree planting programs, classes and workshops, and volunteer opportunities. Information about the organization can be found on its website at www.treefolks.org (11).

City of Austin

The Austin City Council passed a resolution in February 2007 creating the Austin Climate Protection Program, which is administered by an interdepartmental Climate Action Team, headed by Environmental Program Coordinator Marc Coudert. The overarching goal of the ACPP is to make Austin *(continued on page 8)*

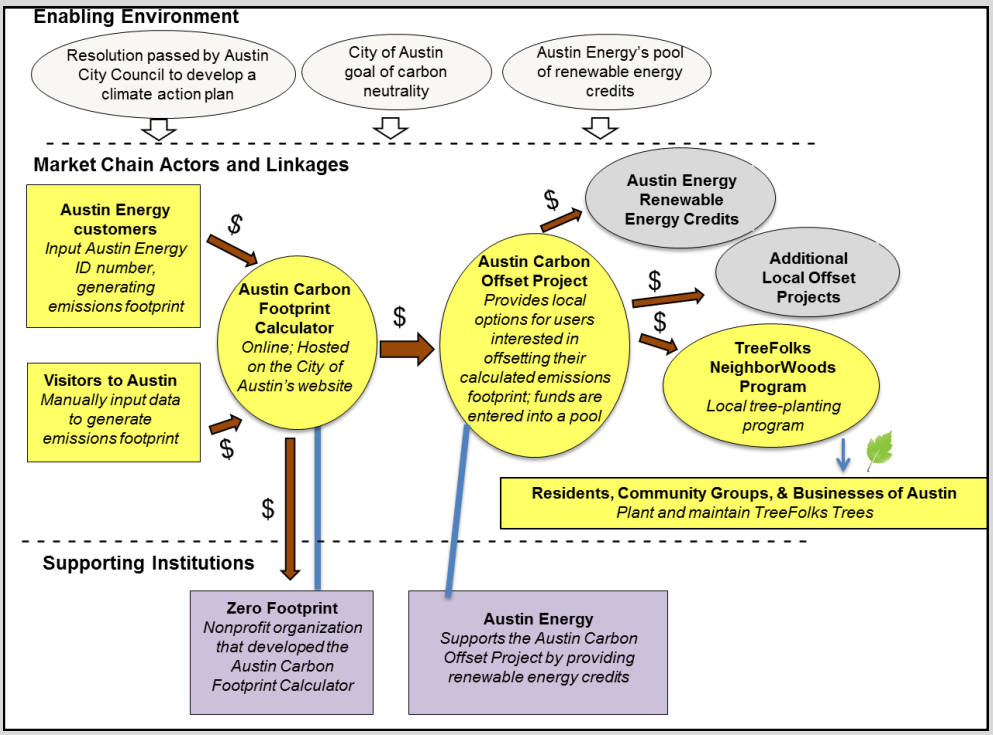
Market Chain Maps

The market chain map summarizes the roles of participants and contributors to market-based initiatives (8). The Enabling Environment section indicates the external factors that facilitated the development of this urban forest carbon program. The Market Chain Actors and Linkages section includes the producers, purchasers, facilitating intermediaries and flow of funds. The Supporting Institutions section lists entities that provided critical support, but were not part of the market transaction. Because forest carbon markets are newly emerging, the same organizations may show up in more than one capacity as they work to develop all of the components needed for a successful, market-based program. The dollar signs indicate flow of funds and the leaves indicate trees planted.



In the top map, interest from funders and local businesses, availability of existing online carbon calculators, and the presentation on carbon offsets that Scott Harris saw at the 2006 Texas Tree Conference were all conditions that contributed to the decision of TreeFolks staff to pursue its program. The TreeFolks online Carbon Calculator and the corresponding *Carbon Offset Program* linked residents and businesses of Austin that wanted to offset their emissions locally to tree plantings in the area. Information available online from the U.S. Department of Energy, American Forests, and Tufts University was used to develop the carbon calculator and the City of Austin supported TreeFolks' planting initiatives.

Above: Market Chain Map for the TreeFolks Carbon Offset Program; Below: Market Chain Map for the Austin Carbon Offset Project.



In the lower map, the City of Austin's policy around climate and its carbon neutrality goal paired with the local utility company's investment in renewable energy sources make up the Enabling Environment. The Austin Carbon Footprint Calculator and the Austin Carbon Offset Project direct funds from Austin residents and businesses, as well as from visitors to the city, to local projects that produce carbon offsets, such as the TreeFolks NeighborWoods Program. The City of Austin hired a nonprofit organization, Zero Footprint, to develop its carbon calculator and is also supported by Austin Energy, which is the local community-owned utility company that is providing renewable energy credits as offsets for the pilot year of the program (2011).

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the leading city in the nation in the fight against climate change and to make all City facilities, vehicles, and operations carbon-neutral by 2020. The ACFC, the Austin Climate Protection Challenge Grant, and the emerging carbon offsets program are part of the ACPP. Information about the ACPP can be found at http://www.ci.austin.tx.us/acpp/ (4).

Austin Energy

Austin Energy is Austin's community-owned electric utility. The company serves more than 400,000 customers and powers the capital city of Texas through a diverse generation mix including coal, natural gas, and a variety of renewable energy sources. Austin Energy's Renewable Energy Program, GreenChoice, allows subscribers to buy energy produced from 100% renewable sources such as wind power and methane gas from landfills. As of 2011, GreenChoice program customer subscriptions number over 750 million kilowatt-hours. Austin Energy is a partner to the City of Austin in its Climate Protection Plan and will provide renewable energy credits as carbon offsets in the pilot year of the carbon offset project (1).

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All photographs taken from either the TreeFolks or City of Austin webpages or have been submitted from one of the project participants.

Local Data to Calculate Local Offsets to Support Local Tree Plantings: The CarbonPlus Calculator

Fast Facts

Activity: Carbon footprint calculation and carbon offsetting

Launch Date: Philadelphia launched its version of the CarbonPlus Calculator (CPC) tool, *Erase Your Trace*, in August 2009. The Westminster, CO version of the CPC will be launched in 2011. The four other regional versions of the tool have yet to be officially made available to the public.

Purpose: The CPC is an online tool that pairs greenhouse gas emissions calculation and carbon offsets with support for local greening and sustainability projects.

Tree Ownership: Ownership of trees planted varies based on the organizations and agencies involved with each city or state's version of the CPC.

Funding: The CPC was funded by the U.S. Forest Service. Total expenditures amount to approximately $250,000, about evenly divided between external agreements providing support to collaborators and salaries of Forest Service employees working on the project.

Protocol: The CPC is modeled on the U.S. Environmental Protection Agency's (EPA) Personal Emissions Calculator with customized parameters for each region's specific version. No official protocol was used.

Verifier: Each region's CPC project administrators have the liberty to separately address verification of actual offsets. Only one out of the six sites has a plan to do so, through the Regional Greenhouse Gas Initiative (RGGI).

Payment Mechanism: In the five out of six cases where payment collection is an objective, each city or state's specific version has a payment mechanism that is dependent upon the nonprofit and municipal partners within that region that will receive that donations from the CPC and also upon each version's administrative structure.

Price: $20/mtCO2e for the Philadelphia and Westminster versions (both launched as of 2011).

Climate Benefits: While the nonprofit organizations and municipal sustainability initiatives that are supported through donated funds are specific to each city, in general the CPC has been designed to address climate change by increasing the storage of carbon through urban tree planting and other greening projects. Each CPC version's website also provides information and tips pertaining to energy conservation in an urban environment.

Co-Benefits: In addition to the benefits addressing actual greenhouse gas (GHG) emissions, the CPC aims to support local economies and communities by allocating donated funds to local nonprofit organizations and municipal sustainability initiatives. Green jobs creation, cleaner air, aesthetic enhancement of urban areas, and avoided GHG emissions through shading are just examples of the potential co-benefits, or the "Plus", associated with the CPC.

Overview

The CarbonPlus Calculator (CPC) is an online emissions offset tool. It has been funded by the U.S. Forest Service and developed in collaboration with the Davey Institute of Tree Sciences (Davey Institute). While the first version of the CPC was created for Boston, MA, subsequent versions were created for Baltimore, MD, Philadelphia, PA, New York City, NY, Westminster, CO, and the state of Vermont. The goal of the CPC is to allow residents of each respective region to support local greening and other sustainability projects through an online carbon footprint offset tool. Modeled after the U.S. EPA's Personal Emissions Calculator, each version of the CPC is further customized to best represent the GHG emissions, energy usage, and specific data about greening and existing urban canopy cover of that region. Specific nonprofit organizations, municipal sustainability initiatives, and, in the case of Vermont, state agencies are the intended recipients of donations from the CPC, promoting both climate change action as well as community development and supporting local economies through green jobs creation. As of 2011 Philadelphia is the only city to have officially launched its version of the CPC, which has resulted in roughly $900 towards tree planting in its parks system. All CPC versions can be accessed at http://www.itreetools.org/carboncalculator/entry.cfm.

The Program

In early 2007 at a Northeast Urban Research Organizational Network (NEURON) meeting in Boston, that city's Chief for Environment and Energy Services, Jim Hunt, was the keynote speaker and introduced an idea to gain support for urban tree planting through engaging residents and businesses in offsetting their carbon footprints. The participants of the meeting, mostly representatives from nonprofit organizations, municipal offices, and universities of the major northeastern cities and U.S. Forest Service employees, brainstormed and came up with the CarbonPlus Calculator, an online tool that would be based on local data to support local greening projects with local funds.

The Forest Service's Northern Research Station pledged financial support to develop an initial version for Boston since the City was in the process of developing the *Grow Boston Greener* initiative to increase the city's overall tree canopy. The Davey Institute and the National Center for Digital Government were contracted to develop the model, the calculations, and the website design for the CPC while the partners in Boston and at the Forest Service collaborated to brand the tool, write the accompanying text, and determine how it would be implemented. By the fall of 2007 an initial edition of the CPC was complete and soon thereafter, in response to interest from other NEURON participants, the Davey Institute began to work on versions for Baltimore, New York City, Philadelphia, and the state of Vermont. By early 2009 the additional versions were finished and had been passed on to the local project leads. In late 2010 a version was developed for the City of Westminster, CO after its urban forestry committee discovered the tool, became interested, and contacted Mark Twery, Forest Service research scientist and CPC project lead (16, 17, 30, 37).

The CPC follows the concept and much of the actual programming of the U.S. EPA's Personal Emissions Calculator. Additionally, parameters for each specific city/state such as electricity emission factors and regional natural gas rates are customized. Currently, each version varies based on the specific objectives of the partners. For example, the New York City CPC version has not been set up to accept financial contributions since its intended use was to educate about GHG emissions and track reductions.

The basic structure of the CPC is set up to give users the option of calculating household emissions, car emissions, air travel emissions, and/or business emissions. Household emissions calculations are based on the number of people in the household, the main method of house heating, average electricity, gas, and fuel oil bills, and types and amounts of waste recycled. By providing vehicle type, average miles per gallon, and annual driving miles per vehicle, car emissions are calculated. Similarly, air travel emissions are calculated by inputting estimated miles traveled by air annually. Business emission calculations are based on business type, heating methods, number of employees, square footage of the facility, details of energy usage (such as Kwh of electricity or gallons of propane used over a time period), waste generated and recycled, subsidized commuters, vehicle and air travel, freight emissions, and business equipment emissions. Business emissions can also be calculated and compiled for multiple sites.

Thorough descriptions of how every calculation has been determined are included on CPC version websites under the heading "How it Works"(4, 27, 30).

While the calculation features of each version are standard, what happens after a user determines an emissions total depends on the end-use goals of each city/state's CPC project leads. Where the funds that are used to offset the emissions go and how they are tracked are up to the organizations and city agencies involved with the separate CPC versions.

CPC Versions

Boston

The *Grow Boston Greener* campaign was developed based on data collected from a 2005 tree inventory (14). Boston's Department of Environment and Energy Services, the U.S. Forest Service, and the Urban Ecology Institute (UEI) were collaborating on raising funds and awareness for the initiative's goal to plant 100,000 trees in the city by 2020 and were eager to use the CPC in this endeavor. The UEI became the project lead in Boston and as the development of the CPC progressed throughout 2007 the need to support other emergent city sustainability initiatives was evident. Thus, in addition to *Grow Boston Greener* the Boston CPC incorporated the *Solar Boston* project to support the increase of solar technologies in the city and *The Boston Energy Alliance* (this has since been renamed *Renew Boston*), which was focused on improving energy efficiency throughout the city. Also, in 2008 Conservation Law Foundation Ventures, Inc. (CLF Ventures), an environmental consulting nonprofit, was hired to perform programming and accounting services for the Boston CPC (16, 18, 33, 34).

The Boston Urban Forest Coalition was formed in 2007 to support *Grow Boston Greener* and transform Boston's urban forest in order to improve the urban forest ecosystem, public health, and quality of life for Boston's residents. The above picture was taken from that group's website.

After months of communication and collaboration, in 2008 the mechanics of the Boston CPC were finalized. This is how it would work: When users had calculated their emissions, they would be given the opportunity to offset them by purchasing any number of tax-deductible Boston Green Certificates. Each Boston Green Certificate would represent 1 ton of CO2 equivalent (tCO2e) and would cost roughly $20. $3-$5 from each certificate could go towards the purchase of a verified carbon offset on the Regional Greenhouse Gas Initiative (RGGI) market, which would be administered by CLF Ventures and the remainder would be entered into a Boston Green Fund. This fund would then be dedicated to supporting the three previously mentioned initiatives (2).

By 2009, the parties involved were all comfortable with the design, validity, and transparency of the Boston CPC and an advisory board was established. Despite this, after June of that year the momentum for officially introducing the tool to the public slowed and as of early 2011 the website has yet to be launched. Most Boston partners interviewed for this case study remain hopeful that the Boston CPC will be used in some capacity in the future (16, 18, 28).

Philadelphia

Mayor Michael Nutter took office in 2007 and introduced his ambition for Philadelphia to become the "greenest city in America". The Mayor's Office of Sustainability was established in 2008 and in early 2009 the city's sustainability plan, *Greenworks Philadelphia*, was released. With a goal to plant 300,000 trees by 2015, the CPC was seen as a way to increase education and awareness about energy use as well as a means to raise funds for tree planting (5, 13).

The CPC project lead at the Forest Service, Mark Twery, corresponded with staff from the Mayor's Office of Sustainability and the Fairmount Park Conservancy, a nonprofit organization that supports Philadelphia's park system and a CPC version was soon created for the city, using local parameters and different mechanics from the Boston CPC. When a user or business chooses to offset their GHG emissions on the Philadelphia CPC they will automatically be directed to the Fairmount Park Conservancy website, where they could make a tax-deductible donation to a general carbon fund. Those funds would then be sent on to the city's Parks and Recreation department for tree planting in parks and along streets. The cost to offset was set at $20 per tCO2e (10, 30).

In August of 2009 Mayor Nutter officially launched the Philadelphia CPC, which had been renamed *Erase Your Trace* (available at www.eraseyourtrace.org). The launch received minor press coverage at the time and since then no further marketing has occurred. The Fairmount Park Conservancy reports that roughly $900 has been donated through *Erase Your Trace*. In 2010, restructuring in the Mayor's Office of Sustainability resulted in the hiring of Alex Dews, the current Policy and Program Manager. He became the lead on *Erase Your Trace* and sees potential for the tool being better incorporated into the Greenworks Philadelphia plan in the future (5, 8, 15).

Philadelphia's expansive park system covers roughly 9,200 acres and claims 10% of the city's land. 63 regional and neighborhood parks are managed through Philadelphia's Parks & Recreation Department, assisted by numerous stewardship associations and nonprofit organizations. The Philadelphia CPC aims to raise funds to support the planting of trees throughout the city's parks.

New York City

Staff from the City of New York Parks & Recreation Department requested a version of the CPC soon after work on the original Boston version began. Jacqueline Lu, Director of Research & Analysis for Forestry, Horticulture, & Natural Resources for the department was assigned to take the lead on the project. At the time, the *MillionTreesNYC* Initiative to plant and care for a million trees across the five boroughs of the city within the next decade was taking shape and those involved were open to ideas about garnering support for the urban canopy (19, 21).

The New York City CPC was from the beginning intended to be a tool to raise awareness about the need to reduce emissions through changes in behavior and about the role of trees in energy conservation and climate change mitigation. Aligned with Mayor Bloomberg's long-term sustainability plan, *PlaNYC,* the CPC was never considered a mechanism for fundraising but was seen as a tool for public education. The City's general stance regarding sustainability, says Ms. Lu, is about real reductions of emissions and that selling offsets would not fit within the *PlaNYC* framework.

A New York City CPC version was developed by the US Forest Service and the Davey Institute but as of 2010, the City of New York Parks & Recreation Department and the Mayor's Long Term Planning & Sustainability Office had not moved forward with adopting or launching the CPC. Ms. Lu noted that significant changes would needed to be made to the appearance of the site to align with *PlaNYC* and the capacity to achieve this does not currently exist. There were talks of hiring an intern to adapt the site to the *PlaNYC* branding, but this has yet to occur (19, 23, 25).

New York City's ambitious goal to plant and care for one million trees in a decade was officially launched in December 2007. The NYC CPC would not raise funds for actual tree plantings but, if officially adopted, rebranded, and launched, would be used as an educational tool. Real emissions reductions and a greater awareness of trees' role in energy conservation would be the main objectives.

Baltimore

Similar to the New York City story, a Baltimore version of the CPC was requested soon after Boston had its tool. Staff from the Parks & People Foundation, a leading non-governmental organization thought that the CPC would fit well for Baltimore, so after contacting the Forest Service, a version was developed. Anne Draddy, coordinator for the city's urban forestry initiative, TreeBaltimore was designated the Baltimore CPC project lead and has had contact with the Forest Service's Mark Twery since late 2009 regarding the best way to move forward with the tool (1, 9, 30).

Westminster

Members of Westminster's Green Team Committee, a group of municipal employees, were approached in 2010 by a local company interested in offsetting its carbon footprint by contributing funds to support tree planting. The partnership was a success and prompted the Green Team Committee to implement a permanent carbon offset service to residents and local businesses. After only a few

months of considering options, researching what other groups were doing, and speaking with Forest Service employees, the team decided that the CPC was the best fit for their city and by the end of the year they had a CPC version developed (provided free of charge by the Forest Service) it passed through City Council, and was posted on the municipal website. Each tCO2e offset through the Westminster CPC costs $20 and funds are directed to the *Living Legacy Program* to support memorial tree plantings. Individual donors have a choice of purchasing enough offsets to cover the entire cost of planting one tree ($250) or having their offset funds combined with others to reach the necessary amount. As of early 2011 the Green Team is considering ways to move forward with marketing and officially launching the tool (17, 36).

Vermont

Danielle Fitzko, Urban & Community Forestry State Coordinator, first heard of the CPC at a time when funding for her department's community grants program had been cut. The CPC was seen as a novel mechanism for raising funds to support communities throughout the state in their greening efforts through the *Trees for Local Communities Program*. A CPC version was developed but by 2009, the Urban & Community Forestry Program had decided not to move forward with exploring options for the tool in Vermont. One reason for this decision was the lack of organizational capacity to administer and adapt the CPC for statewide use. Additionally, the Urban & Community Forestry office received unexpected funding for the *Trees for Local Communities Program* and no longer had an immediate need to use the CPC. Though Ms. Fitzko remains interested in the potential for using the CPC as an educational emissions reduction tool, as of early 2011 there is no one assigned to the task and there are no resources available for project development (12, 35).

Participant Perspectives

The lead author of this case study conducted twelve interviews with individuals that have been closely involved with the development of the CPC, both at the federal level and as city and state partners. While the progression of each version of the tool has followed its own path, it is clear that everyone involved has seen great potential in what the CPC could offer local populations, businesses, and urban forestry efforts.

The Forest Service's Mark Twery, the overall project lead for the CPC said that "the real initial driver was the idea of getting people to think that they could buy voluntary offsets for local projects. . . and there was the possibility of incorporating urban forestry and getting more trees out there."

Rod Larsen, the Westminster CPC project lead, expressed that he and his colleagues were looking for something "that people could understand and that wasn't very complicated. None of us here are scientists so we needed to rely on the system itself to provide the scientific background . . . to use something that was developed by the Forest Service added a lot of credibility." Jacqueline Lu from NYC Parks & Recreation noted that "we had some big idea that this could definitely be leveraged as an educational tool as part of the mayor's larger sustainability plan." Vermont's Danielle Fitzko "heard about it and loved it" and the CPC's appeal for the Mayor's Office of Sustainability was "giving Philadelphians the chance to offset their carbon locally with a cause that's local."

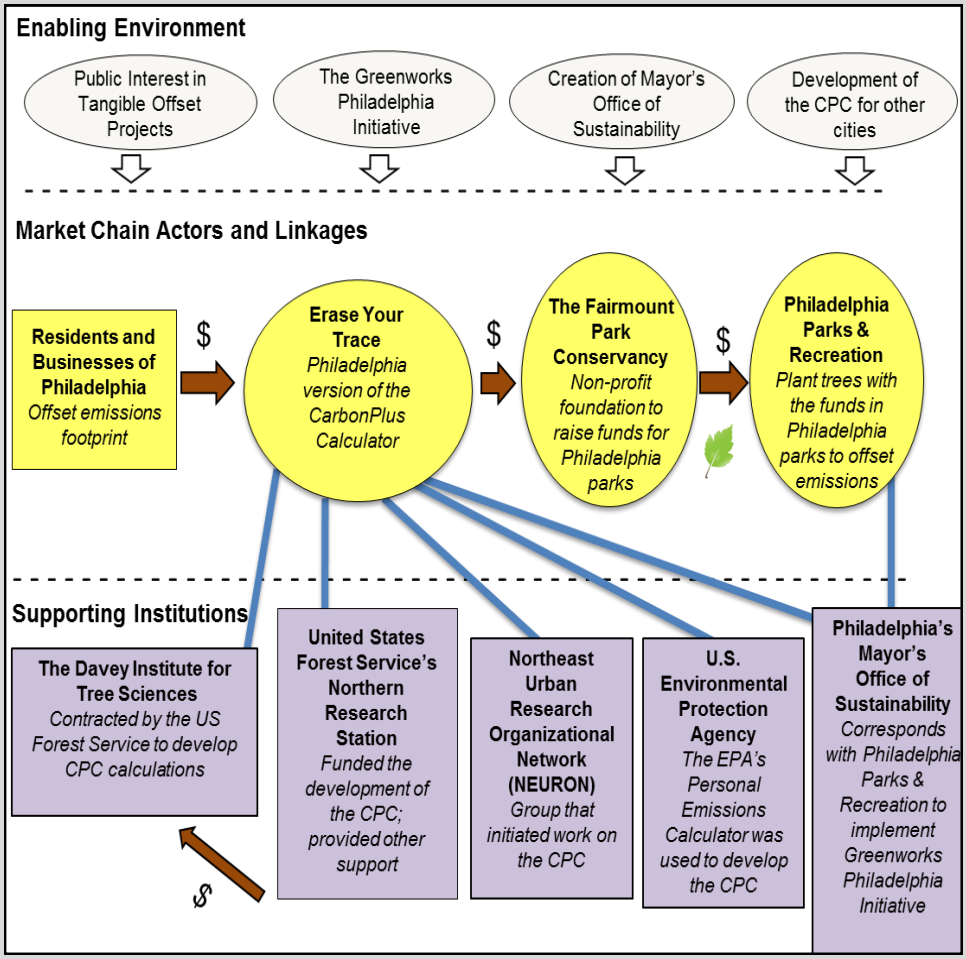
The various challenges facing each CPC version can perhaps be summed up by Lynne Westphal, Forest Service collaborator on the project, who considered "how do you start a market for something that hasn't had one before?" Also, the Forest Service's Mark Twery has recognized that "there are a variety of things that stand between a finished piece of software and it actually being used."

Alex Dews from the Philadelphia Mayor's Office of Sustainability noted that, while he understands that the CPC is designed to collect contributions, it is difficult now to consider allocating resources to redesigning the appearance of the site and marketing it, especially since funds for actual tree plantings have been scaled back in recent years. Additionally, Meg Holscher from the Fairmount Park Conservancy said that "one challenge we all faced with this program is that there was no budget for any marketing. I think that it's a wonderful program . . . but if people don't know about it then it's really limited." TreeBaltimore's Anne Draddy stated that it would be helpful to have prepared materials and guides on the voluntary carbon market, comparable projects, and marketing methods to aid the city partners in getting the CPC off the ground. For the Boston CPC, CLF Ventures' Jasmine Tanguay noted that "it was just a challenge from a financial perspective to get the money to really

launch the program properly and so we lost a lot of momentum." However, Boston's Department of Environment and Energy Services' Jim Hunt still considers the CPC to be an active project and there are hopes to resume work on it in the future. Similarly, Jacqueline Lu said that NYC's Mayor's Office of Long Term Planning and Sustainability is still planning to use the CPC, but that logistical issues exist "around how we could take the CPC as it exists and incorporate it and brand it as part of the *PlaNYC* initiative." For Vermont's UCF coordinator Danielle Fitzko, "I think the economy is what hurt it the most. . . . we lost a lot of state employees . . . and really had to pick and choose what we could do and we already had enough on our plate". Fitzko also noted concerns that the price of planting and maintaining urban trees would not be covered by the sale of carbon offsets.

Market Chain Map

The market chain map summarizes the roles of participants and contributors to market-based initiatives (26). The Enabling Environment section indicates the external factors that facilitated the development of this urban forest carbon program. The Market Chain Actors and Linkages section includes the producers, purchasers, facilitating intermediaries and flow of funds. The Supporting Institutions section lists entities that provided critical support, but were not part of the market transaction. Because forest carbon markets are newly emerging, the same organizations may show up in more than one capacity as they work to develop all of the components needed for a successful, market-based program. The dollar signs indicate flow of funds and the leaves indicate trees planted.



Since the Philadelphia CPC is the only version of the tool that has officially and publicly been launched as of 2011, it is the focus of this case study's market chain mapping exercise. The creation of the Mayor's Office of Sustainability and the Greenworks Philadelphia Initiative paired with the availability of a CPC version and a general public interest in local and tangible offset projects were all conditions that contributed to the development of Erase Your Trace, Philadelphia's version of the CPC. Residents and businesses of the city use Erase Your Trace to calculate their emissions and have the option of paying $20 per tCO2e to offset; the funds are directed to the Fairmount Park Conservancy, a foundation that raises money for Philadelphia's parks. From there, the funds are allocated to plant trees throughout the city. Erase Your Trace was developed by the U.S. Forest Service and the Davey Institute for Tree Sciences, who worked with the Philadelphia Mayor's Office of Sustainability. The developers of the tool were supported by the Northeast Urban Research Organizational Network and used resources from the U.S. EPA.

Common Barriers

While each of the six CPC versions developed between 2007 and 2010 has its own story, there are commonalities between them all. It is evident that the people and organizations involved have seen potential in the CPC and have invested significant time and resources to its development. However, the fact remains that as of early 2011, the tool is for the most part inactive. Factors that have played a part in the loss of momentum

of the CPC include:

- *The state of the economy:* As the domestic economy slowed in the late 2000s and funding for staff and projects became tighter, the development of the CPC versions slowed as well. That economy also affected the ability of individuals and businesses to spend money on voluntary carbon offsets.

- *Lack of resources and low prioritization:* Directly related to the state of the economy, when resources became stretched and groups were not able to hire interns or employees to work on the CPC, it became less of a priority.

- *Employee turnover:* Since the CPC was developed over a multi-year period, some of the original interested parties no longer hold the same position with the office or group at which they worked when they first heard of the tool. In Boston, Philadelphia, Baltimore, and Vermont employee turnover, restructuring, and the fact that new employees have been put in charge of a CPC version without being familiar with it have been significant factors in slowing its progress.

- *Project management:* A major logistical issue that each CPC version's local leads have had to consider is how the tool would be administered: who would receive the funds, how the money would be directed to the appropriate party, how the contributions would be accounted for, and who would monitor the projects associated with the CPC. With small staff sizes and stretched resources, the accounting and administration tasks have weighed heavy on the non-profits and agencies involved.

- *Readiness and defining end-use goals:* Since each version of the CPC is ultimately associated with local institutions, the project leads in each city and also in Vermont have stressed the importance of incorporating the CPC into local sustainability objectives and branding models. Well defined end-use goals and clear ideas for how the tool will contribute to local sustainability initiatives for each specific version should be in place before making it available to the public.

- *Marketing:* In Philadelphia, the CPC was officially launched in August 2009. Yet, the tool has seen minimal use. A major reason for that is the lack of marketing. If local residents and businesses do not know about the CPC they will not use it. Effective marketing requires funding, professional experience, and user testing; these elements have largely been missing for the CPC.

- *Accountability:* While collaboration between the federal, public, and private sectors has been key in the overall development of the CPC, lack of shared accountability may have hindered its progress. Since the Forest Service funded the development of each version of the CPC and no real financial investment has been made by the municipal and state offices and their local nonprofit partners, the latter may have felt little pressure to launch the site and see a return on the investment. Further, as mentioned earlier, some of the CPC versions are now the responsibility of employees that are unfamiliar with it and have no real motivation to prioritize the project.

- *Ambivalence with offsets as a climate action strategy:* Some CPC partners and individual staff had ethical, political, or strategic concerns regarding the use of carbon offsets in the project, including worries about how the public would receive the tool in a particular locale. These and other uncertainties that surround the use of voluntary carbon markets to address climate change have been factors in the slow development and unsure outcome of the CPC.

Looking Forward

Through interviews with project participants it is clear that those involved continue to think that the CPC, in theory, is a good idea, despite its current generally idle state. The potential remains for the CPC to motivate urban residents to learn about and respond to climate change through personal and business emissions calculations that are based on local data and to offset those emissions by supporting local greening and sustainability initiatives. In 2010 officials from the City of Westminster recognized that potential and within a short amount of time had a CPC version developed, passed through City Council, and linked to the municipal website. The availability of the CPC model and the fact that it has been supported by the US Forest Service since the beginning may appeal to other municipalities that are interested in adopting a voluntary carbon market mechanism.

The story of the CPC is not over. While as of 2011 each version's development is at a slightly different stage and has been influenced by a mix of factors, the participants have all at least considered appropriate next steps, which for many of them include dedicating the financial resources to interns, marketing, rebranding, or administration.

The home page for the Boston CPC. Options exist for offsetting household, car, air travel, and business emissions and the site offers extensive information on the science behind the calculations as well as tips for

Lessons Learned

The CPC is an innovative tool, demonstrating that:

- *Federal leadership and support can produce results:* Despite the CPC's general inactivity between 2009 and 2011, the development of the model, the calculations, and the website and the recruitment of city/state participants occurred over an impressively short period of time: the idea was introduced in January of 2007 and within the year the initial Boston version was complete.

- *To fund urban forestry, premium offsets are necessary:* The trading price of carbon on voluntary markets can be low while the costs involved with planting and maintaining urban trees are considerable. By recognizing and advertising the multiple environmental, economic, aesthetic, and social benefits trees provide, the Boston, Philadelphia, and Westminster CPC versions promote premium offsets that sell for a higher price ($20/tCO2e).

- *Logistical details will require time and resources:* One reason there has been slow progress on the CPC at the local level is that after the Forest Service and the Davey Institute completed each version, it was left up to the local project leads to decide how the tool would be used, the funds administered and tracked, and how the projects would be monitored. This is an extremely important aspect to which significant resources do need to be allocated up front.

- I*dentified end-use goals for each specific version of the CPC are essential:* Since the intended users of the CPC versions are local residents and businesses, the end-use goals of the tool should be appealing to that audience and consistent with the overall environmental policies, practices, and sustainability initiatives of each city/state.

- *Determine the level of accuracy and traceability desired:* In terms of accounting for each tCO2e offset, how important is it to the agencies, the nonprofit organizations, and, ultimately, the users to be transparent and valid? The Boston CPC would (if launched) address concerns around validity by using a portion of each tCO2e to purchase a verified carbon credit from the RGGI market, but there has been little indication of how the other versions would address this element. This approach could present a good model providing accountability in offset projects.

Project Partners

Boston
The City of Boston's Department of Environment and Energy Services
This office provides services in the areas of natural and built resource management, program and policy development related to the environment, and advocating for energy efficiency and

reliability. Jim Hunt, the chief of the department, was involved with the development of the CPC from the beginning (16).

The Urban Ecology Institute

The UEI is a nonprofit organization that was established in 1998 to develop, organize, and participate in education and community action to promote a healthy ecosystem in Boston. Formerly linked to Boston College, now the UEI is affiliated with Lesley University and provides students with opportunities to become involved in its programs. The UEI was a driving force for the development of the Boston CPC; its Executive Director at the time, Charlie Lord, worked diligently with a group of graduate students on the project. Mr. Lord has since left the organization (18, 33).

Conservation Law Foundation Ventures, Inc.

CLF Ventures is a nonprofit environmental consulting group that is affiliated with the Conservation Law Foundation. Since 1997, CLF Ventures has provided a wide range of services to assist with the development and implementation of sustainability initiatives, programs, and businesses. CLF Ventures was hired to assist in the development and administration of the CPC, including presenting the project to various stakeholders. Jasmine Tanguay was the staff member most intimately involved in this process (6, 28).

Boston's Urban Forest Coalition

The BUFC is comprised of city, state, and federal government, universities, and nonprofit organizations. It was formed in 2006 to support the Greater Boston Forest Inventory and was involved with the development of the *Grow Boston Greener* campaign (3).

The *Urban Ecology Collaborative*

The UEC was formed in 2002 and is a partnership between municipal, state, and federal entities, nonprofit organizations, and universities from Boston, MA, Baltimore, MD, New Haven, CT, New York, NY, Philadelphia, PA, Pittsburgh, PA, Providence, RI, and Washington, DC. Partners from these eight urban areas collaborate on sustainability initiatives. Resource sharing and partnerships through the UEC played a part in the development of the CPC (32).

The *National Center for Digital Government*

NCDG was established in 2002 and is based at the University of Massachusetts (UMass) Amherst in the Center for Public Policy and Administration and the College of Social and Behavioral Sciences. NCDG aims to support and encourage research capacity and practice at the intersection of governance, institutions, and information technologies. Charles Schweik, Associate Director of NCDG and professor at UMass Amherst, was involved in the development of the Boston CPC calculations and also ensured that the Boston CPC website would be hosted by UMass (the other cities' sites are hosted by the Davey Institute) (22).

Philadelphia

Philadelphia's Mayor's Office of Sustainability

The office was established in 2008 and has focused on developing, fostering collaborations for, and implementing the *Greenworks Philadelphia* six-year sustainability plan. Previous staff at the office were instrumental in developing the Philadelphia CPC and now the Policy and Programs Manager, Alex Dews, is the main contact for the Forest Service regarding the tool (20).

The Fairmount Park Convservancy

Since 2001 the Fairmount Park Conservancy has raised more than $19 million for Philadelphia's park system. The Conservancy accepts tax-deductible private donations and actively supports initiatives that improve the environment and spark community revitalization. For the Philadelphia CPC, *Erase Your Trace*, the Conservancy acts as the intermediary between the individual user and the actual tree planting in Philadelphia: carbon offset contributions are donated to the organization and put into a general tree planting fund, to be utilized by Philadelphia Parks and Recreation (11).

Philadelphia Parks & Recreation

In July 2010 the Fairmount Park Commission and the Philadelphia Recreation Department merged to form *Philadelphia Parks & Recreation*. In addition to over 9,200 acres of citywide parkland, this department manages all street trees in the city of Philadelphia. With a goal to plant 300,000 trees by 2015 and to work towards 30% urban forest canopy by 2025, the *Greenworks Philadelphia* plan will rely upon Philadelphia Parks and Recreation to increase tree planting. The Philadelphia CPC, *Erase Your Trace*, is intended to support these efforts (24).

New York City

The City of New York Parks & Recreation Department

This department oversees about 29,000 acres of land across the five boroughs and maintains over 600,000 street trees and 2,000,000 park trees. The Department's Jacqueline Lu has been the project lead on the New York City CPC (19).

Baltimore

TreeBaltimore

TreeBaltimore is a mayoral initiative to increase the urban tree canopy throughout the city. TreeBaltimore operates through the Baltimore Department of Recreation & Parks and works with local communities and nonprofit organizations to foster stewardship. Anne Draddy was the TreeBaltimore Coordinator and contact for the CPC, but is no longer in the position as of late 2011 (29).

Westminster

The City of Westminster, CO

Westminster is a suburb of Denver and home to roughly 110,000 residents with roughly 15% of the land set aside as conserved Open Space. Members of the Green Team Committee include municipal employees working to maintain and promote the city's open space, parks, urban forests, and sustainability initiatives. Rod Larsen, Parks Supervisor, was the lead in the development of the Westminster CPC (17).

Vermont

Urban & Community Forestry Program

Founded in 1991, the UCF is run through the Vermont Department of Forests, Parks, & Recreation. UCF promotes stewardship of and raises awareness for trees along municipal streets, in city parks and on town greens, and in community and town forests. Danielle Fitzko is the State Coordinator for UCF and has been the main contact for the Vermont CPC (12).

Project Partners for all CPC Versions

The U.S. Forest Service's Northern Research Station

The NRS covers the 20-state Northeast and Midwest regions and has its headquarters in Newton Square, PA. With laboratories in each of the 20 states, NRS engages in programming and research to better understand and manage the regions' forests. NRS has been involved with the CPC from the beginning and has funded the development of the CPC versions. Research social scientist Lynne Westphal and research scientist Mark Twery have both served as the Project Lead for the CPC. Much of the scientific analysis of urban trees included in the CPC is the work of David Nowak, Forest Service research scientist. Dan Golub adapted the EPA calculator structure to the CPC, researched and modified all calculations necessary, and assisted in writing the text explaining how the CPC works and David Bloniarz, biological scientist, also played a role in the CPC development. *The Urban Natural Resources Institute* (UNRI) is an initiative of the NRS and its research and scientists have been incorporated into the CPC as well (30, 31, 37).

The *Davey Institute for Tree Sciences*

The Davey Institute was established in 1909 as a research branch of the Davey Tree Expert Company. The Davey Institute specializes in scientific advancements and research and development in trees sciences. It offers carbon project verification services, technical services, and a range of trainings and educational opportunities. Lianghu Tian and Greg Ina were contracted by the Forest Service's NRS to program the local calculations for each CPC version (7).

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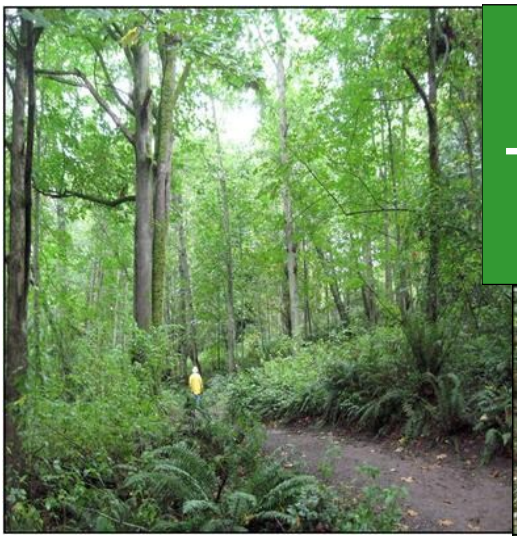


Carbon Mitigation through Restoration of Urban Forests: The Cascade Land Conservancy and its Green City Partnerships

Fast Facts

Activity: Restoration of forested natural areas

Launch Date: March 2010

Purpose: To mitigate carbon emissions by improving urban forest condition and vigor through removal of invasive species and planting of native conifers.

Tree Ownership: Targeted acres of forested natural areas are located in and owned by the cities of Seattle, Kent, Kirkland, and Redmond, WA.

Funding: The price per acre restored for carbon mitigation depends on the percent of current invasive species cover and native tree composition. The pilot project for the Carbon Mitigation Program totaled $210,000, paid in full up front.

Protocol: The Climate Action Reserve's *Urban Forest Project Protocol* (3) was used to guide methodology .

Verifier: None used

Payment Mechanism: Funds for the Carbon Mitigation Program are paid in full before restoration work is commenced and placed in a restricted account.

Price: Price per metric tonne of carbon dioxide equivalent (mtCO2e) ranges from $30-$125 (see page 3 for details)

Climate Benefits: When completed, the pilot project (and only project as of January 2011) will result in 7,000 mtCO2e mitigated through the restoration of 33 acres.

Co-Benefits: Restoration of these urban forests will increase their benefits: reduction of stormwater runoff, erosion control, improved water quality, wildlife habitat, noise and heat reduction in the cities, community involvement through volunteerism, and recreation.

Overview

The Cascade Land Conservancy's (CLC) innovative Carbon Mitigation Program was launched in the spring of 2010. Building upon the organization's Green City Partnerships Program, carbon emissions are mitigated through restoration of forested natural areas in, as of 2011, four municipalities in the Puget Sound region. Calculations and methodology for the program were developed internally but were guided by the Climate Action Reserve's *Urban Forest Project Protocol* (3) and the U.S. Forest Service report *Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types in the United States* (12). The Carbon Mitigation Program's pilot project was a collaborative effort with the band Pearl Jam to mitigate its 2009 world tour carbon footprint of 7,000 mtC02e for $210,000 through the restoration of 33 acres spread throughout Seattle, Kent, Kirkland, and Redmond, WA. Invasive species removal and planting of native conifers are for the most part completed by contracted groups while citizen volunteers assist with maintenance and monitoring activities.

The Program

With the experience of two smaller carbon projects under their belt, CLC staff began developing their *Carbon Mitigation Program* in late 2009. In 2004 the organization partnered with Vivace Coffee Roasters to mitigate 50 tCO2e through the planting of 4,000 trees and in 2008 800 trees were planted for Kennedy & Associates to help them reach their carbon mitigation goal. Motivated by an interest from longtime partner Pearl Jam, however, the *Carbon Mitigation Program* was intended to be an established service offered by CLC and to incorporate rigorous carbon calculations. With the help of a consultant from EcoFor LLC, a firm that assists in carbon accounting and project implementation in the Pacific Northwest, CLC staff developed a methodology for estimating carbon figures and to price tonnes of carbon dioxide equivalent mitigated appropriately. The Climate Action Reserve's (CAR) *Urban Forest Project Protocol* (3) was used as a guide throughout this process. However, since that protocol is intended for carbon accounting of individual street trees and CLC's program focuses on carbon mitigation in urban forest stands and park spaces, the CAR protocol was not entirely applicable.

The basis of the *Carbon Mitigation Program* is that without restoration, forested natural areas in Seattle-area cities will succumb to aggressive non-native vegetation such as English ivy, Scot's broom, and Himalayan blackberry as the aging tree population dies. By removing the invasive species and replanting native shrubs and coniferous trees, the health of the urban forests will be restored and their carbon storage and carbon dioxide sequestration capacities will increase greatly over time (4).

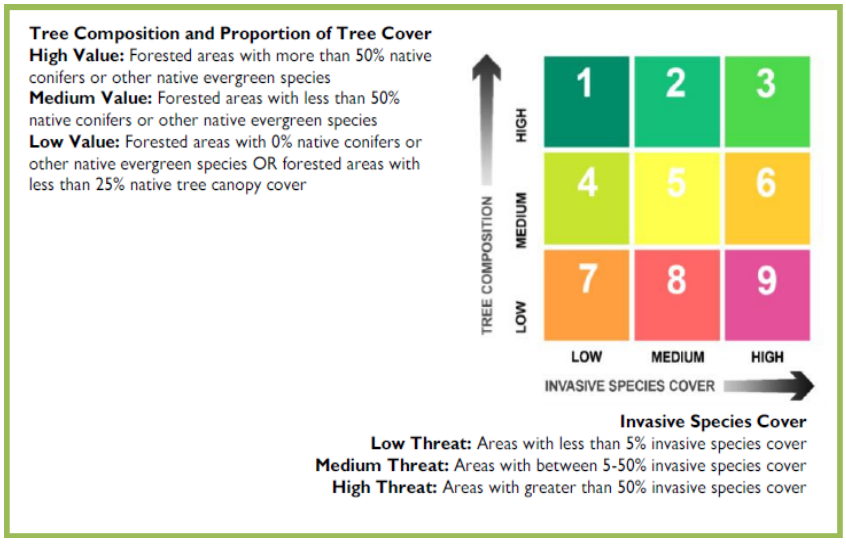


Figure 1: The *Tree-iage* model used to categorize forested acres for restoration priority in Green City Partnerships.

Through CLC's *Green City Partnership Program*, which started in 2004, forested natural areas can be prioritized and restored. The first *Green City Partnership*, the Green Seattle Partnership, was formed with the city of Seattle in 2004 and since then the cities of Kent, Kirkland, Redmond, and Tacoma have also committed to long-term conservation planning through the program. CLC currently has funding to perform restoration on approximately 10-30 acres annually throughout the five cities but would like to increase that acreage, which is where the *Carbon Mitigation Program* comes in. Funds solicited through the program are intended to fill the funding gap and allow for additional restoration work that would not be otherwise possible.

The 20-year strategic plans developed for each Green City Partnership involve an assessment of the current state of forested natural areas. Land is classified according to the *Tree-iage* model, a system developed by the Green Seattle Partnership staff. Acres are categorized by value and threat level based on the current tree composition and current percentage of invasive species cover. The details of the *Tree-iage* model are highlighted below in Figure 1. Acres that fall into categories 1, 2, or 3 are well stocked with native conifers, are already considered high value, and have good existing tree cover so they have been excluded from the *Carbon Mitigation Program's* priority restoration efforts. Restoration of acres in categories 4 through 9 have been priced based on field costs, such as the physical removal of invasive species, site preparation, plant material, planting and irrigation tools, and other maintenance necessary to ensure plant establishment and survival. Also included in the price is the CLC staff time needed to administer the program and to coordinate and manage contractor and volunteer activities for the acres anticipated to be restored through the *Carbon Mitigation Program* annually. Prices per acre per *Tree-iage* category can be found in Table 2 on page 3 (1, 4, 8).

To calculate the existing, future, and additional carbon associated with restored forest acres in

each *Tree-iage* category, CLC staff referred to the US Forest Service's General Technical Report NE-343, *Methods for calculating forest ecosystem and harvest carbon with standard estimates for forest types in the United States* (12). Using estimates of carbon stocks for the Douglas-fir and alder-maple forest types (the two generalized forest types in the report applicable to the region) combined with the general forest stocking level and percent of invasive species cover associated with each Tree-iage category, total existing carbon was found to range from 73.5 tonnes/acre for category 4 to 86 tonnes/acre for category 9. Projecting out 125 years and assuming that the forests have been restored to 100% native conifer and evergreen shrub cover, each category's projected future carbon stock was estimated to be 169.5 tonnes/acre. Finally, to estimate the additional carbon stored in the forested natural areas through restoration activities, existing carbon stocks were subtracted from future carbon stocks for each *Tree-iage* category. To account for assumptions and overestimations, CLC staff was conservative on all estimates and reduced the final additional carbon figure by 30%. Table 1 below shows each category's additional carbon stored as well as the associated additional CO2 sequestered, which is determined by multiplying the carbon by 44/12 to convert it to CO2 (13).

The trees planted through the *Green City Partnership* restoration efforts are small seedlings and whips, generally bought as bare root or in 1-gallon pots. Plantings consist of roughly one quarter western red cedar and three quarters mixed Douglas-fir, grand fir, and western hemlock. Locally sourced trees are preferable but most likely CLC will purchase from other nurseries when they are heavily planting. Contracted nonprofit restoration groups such as Earthcorps, Washington Conservation Corps, and the Student Conservation Association are hired by CLC do to the majority of the restoration work. According to CLC staff

Volunteers assist with maintenance activities to restore urban forests through the Cascade Land Conservancy's Green City Partnership Program.

roughly 90% of tree plantings are contracted and 10% are volunteer-driven through high profile events. Additional volunteer activities focus on maintenance and monitoring, which are mostly performed by residents trained as Forest Stewards through the individual *Green City Partnerships* (4).

When an entity is interested in participating in CLC's *Carbon Mitigation Program*, they are by default also assisting the five cities involved with the *Green City Partnerships*. The first step is to calculate the amount of emissions desired to be mitigated. CLC provides a link to the *Seattle Climate Now Calculator* on their website to aid in determining a figure. From there, collaboration with CLC staff will determine how many acres to be restored to achieve the target and in which *Tree-iage* categories the restored acres would fall, based on price and available or desired locations (8).

	Additional Carbon *all carbon numbers are in tonne/acre*			
"Tree-iage" Categories (4-9)	Preliminary additional tonne/acre (future - existing)	Deduction for uncertainty	Total additional carbon sequestered	Total additional CO_2 sequestered
4	96.0	30%	**67.2**	**246.3**
5	91.0	30%	**63.7**	**233.5**
6	76.5	30%	**53.5**	**196.3**
7	103.0	30%	**72.1**	**264.4**
8	98.0	30%	**68.6**	**251.6**
9	83.5	30%	**58.5**	**214.4**

Table 1: Total additional carbon sequestered through restoration in each *Tree-iage* category

Table 2: Costs associated with the Cascade Land Conservancy's Carbon Mitigation Program based on *Tree-iage* category and cost per tonne of CO2 mitigated through restoration of forested natural areas.

	Cost	
"Tree-iage" Categories (4-9)	Average cost per acre	Cost per tonne of CO_2
4	$7,309	$30
5	$14,278	$62
6	$19,056	$98
7	$12,581	$48
8	$22,287	$89
9	$26,701	$125

The Pilot Project: Pearl Jam

CLC has partnered with Seattle-based band Pearl Jam for years on traditional conservation projects. Guitarist Stone Gossard expressed interest in collaborating on a carbon project to mitigate the band's 2009 world tour footprint after participating in a city park tree planting and becoming aware of the problems facing urban forests. Both Pearl Jam and CLC staff recognized that they were entering new territory and that there were few models to guide the idea, but both parties were up for the challenge.

While CLC staff developed the program, Pearl Jam had their carbon footprint calculated by an external entity, Conservation International. The band's 2009 world tour had 32 dates and approximately 484,000 concert attendees (9). The final carbon footprint was calculated based on band travel and equipment transport, hotel rooms, venue emissions, and attendee travel. Figure 2 below shows Conservation International's emissions breakdown.

The band was consulted throughout the development of the Carbon Mitigation Program and when both parties were comfortable and confident in the calculations Pearl Jam ultimately decided that it would fund the mitigation of an even 7,000 mtCO2e. Drawing from category 4 of the *Tree-iage* model, Pearl Jam donated $210,000, which was dedicated to 33 selected acres across four of the five cities involved with the Green City Partnership Program. The project was officially announced in March of 2010 and restoration work began that fall. The project's anticipated completion date is December 2013. The $210,000 was paid up front and was placed in a restricted account (4).

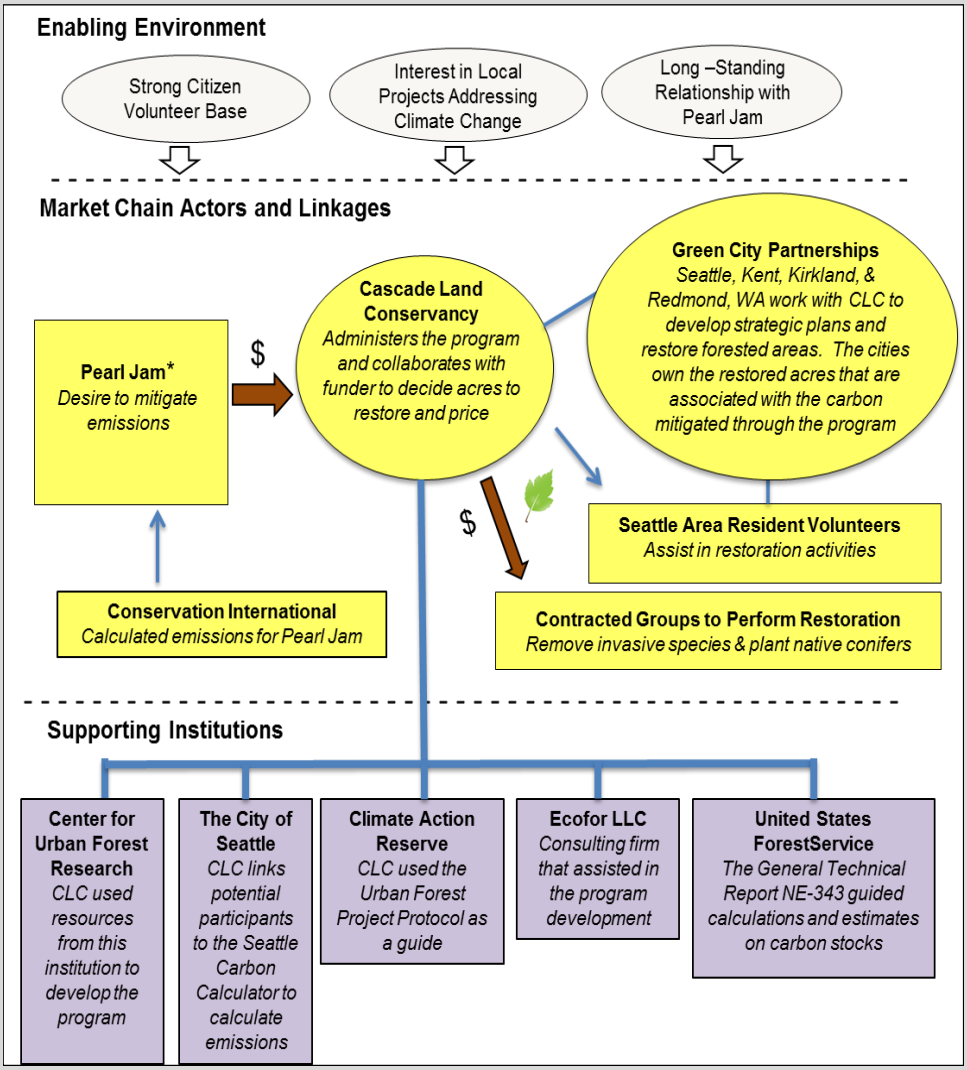
Top: Invasive species such as English ivy are a serious threat to forested natural areas in the Puget Sound region. By aggressively choking out trees and leaving no room for native species to regenerate, this image demonstrates the damage that can be done. Bottom: The Green City Partnerships promote restoration of forests by removing invasive species and planting native conifers. Restored forests are full of trees and that store carbon and sequester CO2, providing many other benefits as well.

Activity	Metric Tons CO_2	Key Assumptions
BAND & CREW (3,135 tons CO_2)		
Trucks and Buses Freight Shipment	22 1,630	55,000 miles, 14 trucks, 6 buses, 8,209 gallons, ALL biodiesel fuel 1.98 million air ton-miles (1588 tons), 103,473 sea ton-miles (42 tons), and 568 ground ton-miles (0.28 ton)
Air travel – band and crew	1,182	899,525 passenger miles for crew and band, plus 40.7 tons jet fuel for band members in domestic AU/NZ flights
Hotel rooms – band and crew	114	3,183 hotel room-nights (951 band and 2232 crew)
Arenas	187	32 venues (28 sheds and 4 amphitheaters), total of 484,800 kiloWatt-hours (kWh) electricity consumption
FANS (2,339 tons CO_2)		
Driving to and from concerts Using Public Transit	2,180 159	380,000 fans, 2 fans per car, 23.6 miles round trip travel, 21.9 miles per gallon average fuel economy 100,000 fans, each 15.5 miles roundtrip on public transit
TOTAL metric tons CO_2-equivalent emissions	**5,474**	Calculation includes global warming factor of 2.3 applied to air travel (previous tour offsets used factor of 2), and factor of 1.2 applied to non-aviation emission activities that account for all other greenhouse gas emissions in addition to direct carbon dioxide (CO_2) emissions. This is based on estimates from the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Figure 2: Greenhouse gas emissions (in carbon dioxide, CO2, equivalents) released during Pearl Jam's 2009 world tour.

Market Chain Map

The market chain map summarizes the roles of participants and contributors to market-based initiatives (11). The Enabling Environment section indicates the external factors that facilitated the development of this urban forest carbon program. The Market Chain Actors and Linkages section includes the producers, purchasers, facilitating intermediaries and flow of funds. The Supporting Institutions section lists entities that provided critical support, but were not part of the market transaction. Because forest carbon markets are newly emerging, the same organizations may show up in more than one capacity as they work to develop all of the components needed for a successful, market-based program. The dollar signs indicate flow of funds and the leaves indicate trees planted.



CLC's strong citizen volunteer base, its long-standing relationship with Pearl Jam, and an increasing interest in local projects addressing climate change impacts were all conditions that contributed to the decision of CLC staff to pursue its *Carbon Mitigation Program*. A funder comes to CLC (indicated by the * on the map) with an idea of how much carbon they'd like to offset and enters into an agreement with the organization based on the *Tree-iage* model. Funds are appropriately allocated to perform invasive species removal and native tree species tree plantings through the *Green City Partnerships Program*. Information available from the Center for Urban Forest Research, the Climate Action Reserve, and the U.S. Forest Service was used in developing the program. CLC was also supported by a strong relationship with the City of Seattle and by staff from Ecofor LLC, who assisted in program development.

Participant Perspectives

At CLC, Ara Erickson administers the *Carbon Mitigation Program* and works closely with Marketing Director Natalie Cheel, Conservation Policy Program Director Dan Stonington, and each of the *Green City Partnership* project managers to design and implement the program. CLC was concerned with the validity of the carbon calculations from the beginning and recognized early on that "there has been an assumption that a [carbon] project has to be perfect, verified by a third party, and tradable on the market but with the voluntary carbon markets there is still not a clear way for a project to be designed". The team had to work through the details one at a time, exploring and experimenting, and knew that they were on the cutting edge of incorporating urban forestry and a voluntary carbon market mechanism.

Erickson cited two major challenges with the development of the *Carbon Mitigation Program*. The first was figuring out all of the carbon and pricing calculations and feeling entirely comfortable with them. As mentioned earlier, CLC staff were very conservative with their estimates given the assumptions made about forest age, composition, and timber volume in the present and future. Further, they needed to be careful about the wording used; there is a difference between

"offset" and "mitigation" and since they were not going to be matching each dollar with a specific tonne of carbon dioxide equivalent, they were not comfortable with using the former term.

The second major challenge was fostering and maintaining good relationships with the funder and each of the city partners, especially in light of the uncertainties around carbon mitigation and how it really works. This challenge was echoed by Tracy Morgenstern, Climate Protection Advisor with the Seattle Office of Sustainability & Environment, and participant in the Green Seattle Partnership with CLC. Morgenstern also mentioned how constant communication throughout the development of the *Carbon Mitigation Program* was essential since restoration work performed to mitigate the carbon will be done on land owned by the *Green City Partnership* cities.

Erickson and her colleagues at CLC have devoted much time to developing the *Carbon Mitigation Program*. However, as Erickson noted, this would probably be the case for any organization developing an idea from bare bones to a fully functioning program in a short period of time. CLC was motivated by Pearl Jam's interest and worked hard to put together a scheme that would be easily applicable to the interest of future funders. Further, they wanted to make sure that they were providing information about climate change and educating their website visitors about other ways to address or reduce greenhouse gas emissions.

Erickson is confident in the program and thinks that there is a market for tangible, local projects that address climate change and provide opportunities for people to participate. There are individuals motivated by climate change, there are those that just want to take part in something novel and taking place in their community, and then there are those that are preparing for a real regulated market in the future. Considering the high price per tonne of CO2 mitigated, especially in the higher categories of the *Tree-iage* model, CLC staff anticipate that they will appeal to all three of these populations. Erickson knows that they are not going to be getting calls from people that want an inexpensive offset program but rather from local groups, businesses, and residents who already have the knowledge of CLC and the great work it accomplishes.

In a 2010 article titled *Pearl Jam Touring Less, Planting Trees to Cut Carbon Footprint* (9), band guitarist and co-founder Stone Gossard was quoted as saying

> "businesses have an opportunity to lead the way in becoming a more conscious economy, one that views the health of our environment as inseparable from our personal and economic well-being. Tracking and mitigating the band's carbon footprint is a big first step that our business is taking in that direction, and we hope other businesses will join us in this effort. Pearl Jam is a band but we're also a business. More importantly, we're also a Washington business".

Personal communication with the Pearl Jam liaison Natalie Cheel at the Cascade Land Conservancy reflected a similar perspective from the band; Cheel relayed a statement from Stone Gossard that, "since 2003 we have elected to mitigate our carbon output by tracking and calculating our emissions and contributing money to projects that strategically work to improve the environment. We view this simply as a cost of doing business."

Looking Forward

Since the 2010 launch of the *Carbon Mitigation Program*, CLC has received a number of inquiries, particularly from individuals interested in small contributions. However, the organization is currently focused on bringing in large donors and local businesses to replicate the type of collaboration it saw with Pearl Jam. Eventually CLC staff would like to have the capacity to take individual donations or to aggregate single donors into groups. While the pricing scheme of the *Tree-iage* model currently assigns higher costs per tonne of carbon equivalent mitigated to higher priority restoration areas, CLC is not committed to this system and has begun to explore a single cost for all categories or bulk discounts for large purchases (4).

The March 2010 launch incorporated web-based marketing and detailed information can be found on the organization's website, www.casecadeland.org. As the program grows and evolves, CLC staff members anticipate moving into the world of paper-based marketing as well. In the spring of 2011, there were several opportunities for local volunteers to plant trees through the Pearl Jam pilot project.

Lessons Learned

CLC's *Carbon Mitigation Program* is an innovative approach to participating in a voluntary carbon market. Through detailed planning, thoughtful utilization of available resources, and consideration of aligning with existing strengths and activities, CLC staff have developed a program that is not only science-based but interesting and relevant to the region and the large base of citizens and businesses in the Puget Sound region that are concerned with the health and future of the Pacific Northwest forests. While the impetus for the *Carbon Mitigation Program* was Pearl Jam's interest in addressing its world tour emissions, CLC staff were interested in developing a program that would be applicable to future funding partners and would be publically offered by the organization as a service. This approach, in contrast with one-off forestry carbon projects that represent a single agreement between a tree planting group and a funder, is proactive and demonstrates CLC's ability to push the envelope. Specific lessons learned from the *Carbon Mitigation Program* include:

- *It is worth putting in the work to ensure that all parties involved are comfortable with the methodology of a carbon project as well as the science behind the carbon accounting.*

- Similarly, though it might increase the front-end workload for a project, *projecting future costs as accurately as possible and accounting for uncertainty is important.*

- As mentioned earlier in this case study, the materials that CLC staff used to develop the *Carbon Mitigation Program* were all available, free of charge, on the Internet. *The accessibility of US Forest Service's General Technical Reports, the US Forest Service's Center for Urban Forest Research website, and the Climate Action Reserve's Urban Forest Project Protocol contributed greatly to the development of the program.*

- *Building upon existing programming (in this case, CLC's Green City Partnerships Program) is a good way to approach developing an urban forest project for a voluntary carbon market*, though the concept of *additionality* must be considered. A group should be able to demonstrate that in the absence of the funds acquired through the carbon mitigation (or offsetting), the trees planted or work done would not be possible.

- CLC staff suggests that future *funders should have their emissions calculated independently* so that they can approach the organization with specific numbers, facilitating a more efficient and personalized partnership.

- *It is important to consider and plan for marketing of an urban forest carbon project*. CLC staff incorporated a marketing plan of the Carbon Mitigation Program throughout its development and ensured that the details of the program were established before introducing the pilot project with Pearl Jam.

Program Partners

The Cascade Land Conservancy was founded in 1989 and is Washington's largest conservation, stewardship, and community-building organization, focused primarily in the Puget Sound and Olympic Peninsula area. The organization works in traditional land conservation, acquisitions, and policy development and is also focused on community-based stewardship. CLC has led efforts to conserve more than 158,000 acres of parks natural areas, forests, shorelines, and farms. The *Carbon Mitigation Program* is administered as a compliment to the *Green City Partnership Program*, to which approximately ten employees are dedicated (1).

Many of the Cascade Land Conservancy's programs involve volunteer opportunities; local residents and businesses are encouraged to participate in restoration activities that contribute to the overall goals of the organization.

The *Green City Partnerships Program* has established a network of public-private partnerships with municipalities to develop strategic plans and to promote community-based stewardship programs for forested natural areas in the Puget Sound region. The program also provides the foundation for the *Carbon Mitigation Program*. Each *Green City Partnership* is administered by the Cascade Land Conservancy but officials from each city are integral to the success of the partnership. Four of the five existing *Green City Partnerships* (with Seattle, Kent, Kirkland, and Redmond) were incorporated into the pilot project of the *Carbon Mitigation Program*. Information about these specific Green City Partnerships follow (1).

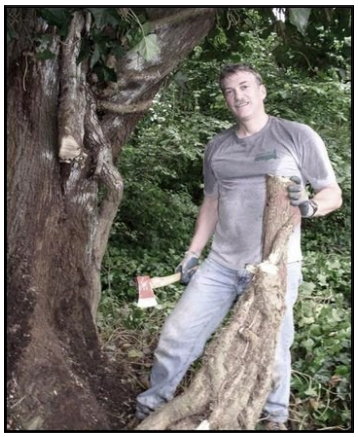
The Green Seattle Partnership was established in 2004 and involves CLC, Seattle Parks and Recreation, the Seattle Office of Sustainability and Environment, and Seattle Public Utilities. A nine-member executive council governs the partnership and thousands of community volunteers have actively worked to restore and maintain the city's forested parklands. The 20-year strategic plan developed through the partnership represents dedication and investment to the restoration of Seattle's urban forest and is available on CLC's website. The Green Seattle Partnership staff are currently advertising the Pearl Jam Carbon Mitigation Project and are soliciting volunteer groups to host restoration events to support the project (8).

Through the Green Kirkland Partnership a 20-year strategic plan was developed with the Kirkland Department of Parks and Community Services and was officially adopted in 2008. The main objectives of the Green Kirkland Partnership are to tackle the growing invasive species problem in the city's urban forests and to promote community stewardship (6).

Established in 2007 the Green Redmond Partnership aims to build a sustainable network of healthy urban greenspace by actively managing over 1,000 acres of Redmond's forested parkland. The Redmond Parks and Recreation Department will work with CLC and the city's dedicated community volunteers to remove invasive species and plant native trees and shrubs throughout the city's 21 parks (7).

The Green Kent Partnership is the newest Green City Partnership and, as of the start of 2011, is still finalizing its 20-year strategic plan. CLC and the City of Kent have focused on training citizens to become Green Kent Stewards in its first year to aid in leading restoration activities throughout the city's parks (5).

Each of the Green City Partnerships are based on the idea that through public-private collaboration and by fostering citizen stewards, forested parklands and natural areas can be restored. Here a volunteer in Kirkland removes invasive species, which, paired with the planting of native coniferous trees and evergreen shrubs, will not only increase the health of the forest but is the key to CLC's *Carbon Mitigation Program*.



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Carbon Emissions Offsets from Urban Forests: Michigan State University and the Chicago Climate Exchange

Fast Facts

Activity: Carbon Accounting and Urban Forest Management

Launch Date: 2009

Purpose: To offset the greenhouse gas emissions from Michigan State University's T.B. Simon Power Plant.

Tree Ownership: All trees included in the project are on land owned by Michigan State University.

Funding: A small grant was awarded to an undergraduate research assistant to work on the project. Otherwise, no direct funding was involved.

Protocol: The Chicago Climate Exchange's (CCX) *Forest Carbon Sequestration Protocol* was used for this project. Specifically, the CCX Afforestation/Reforestation: Widely Spaced Tree Plantings guidelines were used for the campus trees and the CCX Sustainably Managed Forest Project guidelines were used for the forested natural areas.

Verifier: The project was audited internally by CCX staff.

Payment Mechanism: There was no payment mechanism for this internal offset project. The total carbon sequestered by the MSU trees was subtracted from the emissions of the campus power plant and put towards the annual emissions reduction target of the university.

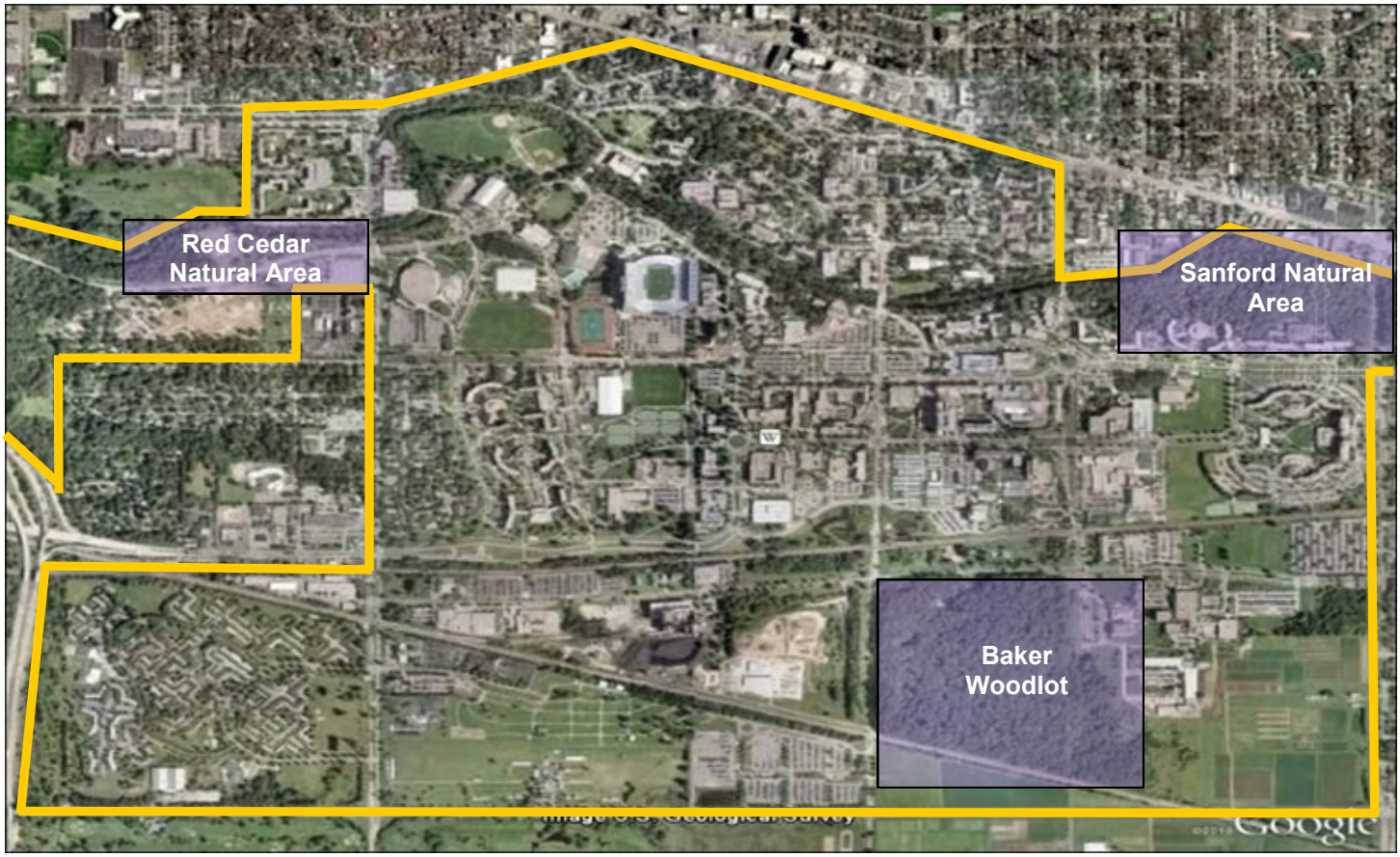
Price: The project did not involve the sale of carbon offsets.

Climate Benefits: In 2009 221.8 tons of CO2 equivalent (tCO2e) were reported as sequestered by the campus trees from 2003—2009 and in 2010 54 tCO2e were sequestered by the campus trees and 54 tCO2e were sequestered by the forested natural areas.

Co-Benefits: MSU students gained forestry methodology experience and MSU demonstrated the applicability of the CCX protocol for urban forests.

Overview

In November 2009 Michigan State University (MSU) submitted the first ever proposal to the Chicago Climate Exchange (CCX) for an urban forestry project. Under the lead of Dr. David MacFarlane, Associate Professor of Forestry at MSU and member of the CCX's forestry committee, the project's focus was to quantify the carbon sequestered by trees planted on campus since 1990 and those managed in three large university natural areas. MSU, a CCX institutional member since 2007, then used the carbon offsets internally towards its overall greenhouse gas (GHG) emissions reduction target of 6%, compared to 2000 emissions. This project incorporated an extensive existing campus tree inventory and database, undergraduate researchers, collaboration across campus, and an expansion of the CCX carbon sequestration look-up table for individual tree species (14).



Michigan State University is located in East Lansing, MI and consists of 5,239 contiguous acres with over 550 buildings and 18 miles of roads. The developed main campus, shown above and outlined in yellow is about 2,100 acres with the remaining 3,139 acres as experimental farms, outlying research facilities, a golf course, and natural areas. The student population for the 2009-2010 year was approximately 47,100 (2, 14). Background picture taken from @Google Earth.

The Project

Michigan State Univeristy supports over 47,000 students and 10,000 employees (14). Over 90% of the university's emissions come from the T.B. Simon Power Plant, producing both electricity and steam for campus heating and cooling. MSU has been an institutional member of the Chicago Climate Exchange since 2007, which means that the administration voluntarily made a legally binding commitment to reduce its GHG emissions by 6% compared to the year 2000 by 2010 (4). Each April, MSU was required to submit an annual report on its emissions reductions. The CCX membership is consistent with and corresponds to MSU's *Be Spartan Green* initiative to reduce GHG emissions by 15%, reduce energy use by 15%, and reduce landfill waste by 30%, all by the year 2015 (2, 7, 12, 13).

In 2009, the same year that the CCX released its *Forest Carbon Sequestration Project Protocol*, MSU submitted a project proposal for its campus tree and natural areas, encompassing a suggested strategy of "urban managed forests". Dr. David MacFarlane, Associate Professor of Forest Measurements and Modeling in MSU's Department of Forestry and technical advisor to the CCX on matters relating to carbon sequestration in forests, was the lead on the project and essentially wanted to demonstrate the applicability of the CCX protocol's. The basis of the project was to quantify the carbon sequestered both by MSU's campus trees and by the natural forested areas owned and managed by the university. The total carbon offset would then be put towards MSU's emissions reduction target. The offsets vwould not be registered for public sale but instead would be included in the university's annual report to the CCX (4, 5, 9, 14).

The CCX *Forest Carbon Sequestration Project Protocol* includes guidelines for both Afforestation/Reforestation projects and Sustainably Managed Forest projects; as previously mentioned MSU implemented both through its overall urban managed forests project (3). Dr.

MacFarlane decided to involve student researchers to complete both components of the roughly one-year project. Undergraduate Lisa Parker received a small grant from the Undergraduate Research Office at MSU to assist with the afforestation portion while Dr. MacFarlane's Forestry Biometry class, Ms. Parker, and graduate student Neil VerPlanck were involved with the sustainably managed forest piece.

Trees located within the boundaries of the urban main campus were the focus of the afforestation component, which followed the guidelines detailed under the CCX heading "Widely Spaced Tree Plantings". MSU houses over 2,300 species of flora from around the globe and also has many woodland and wetland areas. The Campus Planning and Administration (CPA) office has maintained a rigorous plants database since 1989, which , for the purposes of the project ,means that every tree planted on campus since that time has a record (18). In accordance with approved CCX methodologies, trees that met three specific requirements were included in the afforestation component:

1) Those at least 1" in diameter at breast height,
2) Those planted on or after January 1, 1990, which is the baseline date for the CCX protocol, and
3) Those in fair or good general health.

From the CPA plants database, MacFarlane and Parker identified 4,987 campus trees that were eligible, representing 361 unique species and 75 genera. However, the CCX look-up table for "Widely Spaced Tree Planting" afforestation projects, titled *Tree Types and Growth Rates Applied to Urban and Suburban Tree Plantings* (included in the appendix of the protocol) at the time included only 100 tree species and 41 genera (3). These 100 species represented the most commonly planted in the U.S. but Dr. MacFarlane felt that the look-up table should be expanded to encompass the range of species on MSU's campus. With the assistance of Ms. Parker and using primarily M.A. Dirr's *Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation, and uses* (6) and the USDA Plants Database (19), each additional species was assigned a growth rate depending on its membership in one of six classes: fast, medium, or slow growing and hardwood or softwood. This method was consistent with the existing CCX look-up table and if there was a conflict between different sources in the literature regarding growth rates or if there was insufficient information then the slowest growth rate was applied to account for assumptions made (see Figure 1 for the expanded look-up table).

The sustainably managed forests project component was focused on quantifying the carbon sequestered in three of eight forested natural areas on MSU's campus. The Sanford Natural Area is a 34-acre floodplain forest, the Red Cedar Natural Area has 46.7 acres of native floodplain forest (3 of which were a previous campus tree nursery), and the Baker Woodlot is a 78-acre beech-maple forest (11). Together they total 158.7 acres, or

MSU's Campus Planning and Administration office maintains a relational plants database that is tied to GIS and holds records on the location and condition of over 25,425 plants on campus. The image to the left depicts the database for an unidentified area on campus: each plant is uniquely identified and indicated on the map.

MSU is committed to the maintenance and creation of green space in its overall sustainability objectives. The drawing above depicts a proposed central campus park to replace five parking lots, included in the most recent Campus Master Plan. As of May 2011 this particular project is on hold due to funding constraints (2).

CCX	mT Co2	MSU	mT Co2	CCX	mT Co2	MSU	mT Co2
Abies	0.5432	Abies	0.5432	Larix	0.1757	Larix	0.1757
Acer	5.5962	Acer	5.5962	Liquidambar	1.0213	Liquidambar	1.0213
Aesculus	0.2401	Aesculus	0.2401	Liriodendron	0.3228	Liriodendron	0.3228
Ailanthus	0.0450	Ailanthus	0.0450			*Maackia*	0.0566
Alnus	0.2922	Alnus	0.2922			*Maclura*	0.0047
		Amelanchier	0.1094	Magnolia	0.2013	Magnolia	0.2013
		Araucaria	0.0052	Malus	4.4058	Malus	4.4058
Betula	1.2082	Betula	1.2082			*Metasequoia*	0.0613
		Carpinus	0.1572			*Nyssa*	0.6166
Carya	0.0128	Carya	0.0128	Ostrya	0.0697	Ostrya	0.0697
		Castanea	0.0346			*Paulownia*	0.0063
Catalpa	0.0318	Catalpa	0.0318			*Phellodendron*	0.1476
		Cedrus	0.0036	Picea	3.1694	Picea	3.1694
Celtis	0.4977	Celtis	0.4977	Pinus	2.1713	Pinus	2.1713
		Cercidiphyllum	0.4961	Platanus	1.0595	Platanus	1.0595
Cercis	0.6904	Cercis	0.6904	Populus	0.0138	Populus	0.0138
		Chamaecyparis	0.3937	Prunus	0.2655	Prunus	0.2655
		Chionanthus	0.0240			*Pseudolarix*	0.0051
		Cladrastis	0.0701	Pseudotsuga	0.3190	Pseudotsuga	0.3190
Cornus	1.0715	Cornus	1.0715			*Pyrus*	0.9452
		Corylus	1.0499	Quercus	4.0883	Quercus	4.0883
		Cotinus	0.1131			*Rhus*	0.0919
		Cotoneaster	0.4809	Salix	0.4383	Salix	0.4383
Crataegus	0.0641	Crataegus	0.0641	Sassafras	0.0830	Sassafras	0.0830
		Cryptomeria	0.0633			*Sequoiadendron*	0.0132
		Diospyros	0.0061			*Sophora*	0.1656
		Eucommia	0.1704	Sorbus	0.2004	Sorbus	0.2004
Fagus	0.1138	Fagus	0.1138			*Stewartia*	0.0077
Fraxinus	3.6788	Fraxinus	3.6788			*Styrax*	0.0253
Ginkgo	0.8092	Ginkgo	0.8092			*Syringa*	0.1393
Gleditsia	0.4533	Gleditsia	0.4533	Taxodium	0.6981	Taxodium	0.6981
Gymnocladus	0.2505	Gymnocladus	0.2505			*Taxus*	0.0493
		Halesia	0.1749	Thuja	1.9123	Thuja	1.9123
Ilex	0.0064	Ilex	0.0064			*Thujopsis*	0.0019
Juglans	0.1065	Juglans	0.1065	Tilia	2.3108	Tilia	2.3108
Juniperus	0.0504	Juniperus	0.0504	Tsuga	0.1459	Tsuga	0.1459
		Koelreuteria	0.1129	Ulmus	0.9982	Ulmus	0.9982
						Zelkova	0.5332
				CCX Sum	**39.8325**	**MSU Sum**	**46.1687**

Figure 1: The table to the right illustrates the expanded look-up table for urban tree growth rates and carbon sequestration developed by Dr. MacFarlane and his assistants. Using the existing CCX table with 41 genera, the total sequestered carbon in MSU's campus trees would have been 39.8 tCO2e but with the additional 34 genera added by Dr. MacFarlane and Ms. Parker, the quantified carbon sequestered was 46.2 tCO2e . The look-up table was expanded in order to provide more accuracy for a wider range of species.

or 64.2 ha, and all three are Category 1 natural areas, meaning that they are managed at the highest level of protection and the lowest level of usage. In 2009 Dr. MacFarlane's Forest Biometry undergraduate students collected data from the natural areas using traditional forestry methods to establish a baseline. Subsequently, master's student Neil VerPlanck did the carbon accounting and converted the totals to CO2 using approved CCX biomass equations, such as those included in Jenkins et al.'s *National-scale biomass estimators for United States tree species* (8).

For 2009, the total amount of carbon sequestered by the campus trees within the CCX contract period (2003-2009) was calculated to be 221.8 tCO2e, which was subtracted from MSU's internal emissions and reported in the annual report to the CCX. In 2010 54 tCO2e were sequestered by the campus trees and 53 tCO2e from the campus natural areas. The 2010 figures represent less than 1% of the approximately 600,000 tCO2e emitted from the T.B. Simon Power Plant that year (4, 14).

Since the CO2 offsets were used in MSU's internal emissions accounting processes and were not in any way released for public sale, the CCX determined that there was little to no public risk associated and decided to verify the project internally. Regarding the afforestation component, since it was essentially a census using the comprehensive existing CPA plants database, the verification procedures were based on data analysis and auditing. For the sustainably managed forests piece, the three campus natural areas are under permanent restrictions regarding forest management practices and there is an extremely low risk that they will be managed in any way that will increase or decrease CO2 sequestration in the foreseeable future (11, 14).

Participant Perspectives

Dr. MacFarlane expressed overall satisfaction with the urban managed forests project and noted that it received significant accolade across campus. Additionally, he noted that the project has generated discussions on campus about the value of trees and carbon. Logistically speaking, MacFarlane said that it took about a year of "academic time" to finish the project. On one hand, it could have been finished much faster if MSU had hired a consultant to focus on the project instead of depending on the intermittent work of

MacFarlane (who was not paid specifically for this project) and his students. On another hand, however, the nearly complete tree census in the form of the CPA plants database provided an important foundation that other similarly sized institutions or communities might not have, which could effect the timing and cost of a similar project elsewhere.

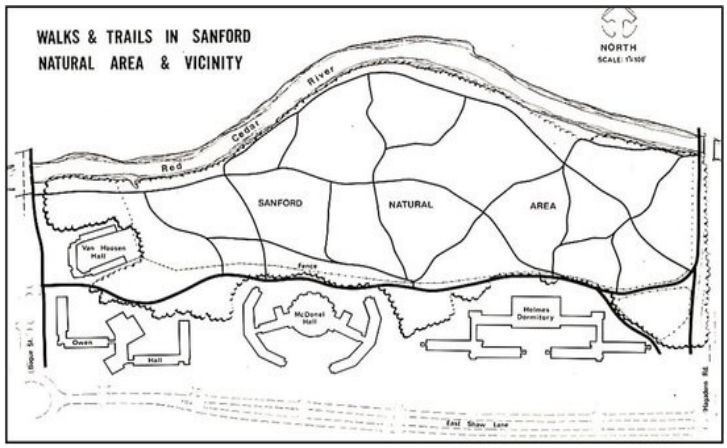
As noted earlier, the emissions offset by MSU's campus trees and natural areas represents an extremely small portion of the institution's total annual emissions. "The bottom line", said MacFarlane, "is that it takes a lot of trees to offset the emissions of a large power plant. Even with the high densities of trees on the MSU campus, the numbers just don't add up".

That being said, however, MacFarlane noted that the MSU community was very excited about this project and he recognizes that people nationwide are committed to greening initiatives and their multiple benefits. That sentiment was echoed by Lynda Boomer, who said that it was worth the effort of implementing the project to drive home the point that MSU highly values its tree resource. Dr. David Skole noted that while the carbon offsets from the trees was a small fraction of the overall campus emissions, it was still a good thing to do and that it compliments university policy regarding no net loss of green space on campus. He believes that forestry offsets play an important role in emissions reductions: they can be implemented relatively quickly and can be a compliment to the upgraded facilities, emissions reductions, and alternative energy sources that may take significant time and money to implement. In a recent article from MSU's online newspaper, Skole stressed the importance of offsets "as a way to facilitate the transition to a greener future".

MacFarlane noted two major problems with urban forestry carbon projects at this point in time. The first is a general uncertainty in carbon markets and the low trading price of carbon in those markets. "Right now we're planting trees for a lot of other purposes and then there's an additional carbon benefit but that carbon piece doesn't really have an economic value. That doesn't mean that it's not valuable, it's just that there isn't a considerable monetary value. If the price per ton of carbon was really high", said MacFarlane, "then you'd certainly have a lot more people at MSU thinking about how to bring in more trees". The second is the issue of being an early adopter: in a time when many are anticipating federal regulation of GHG emissions, knowing that projects or initiatives that are implemented now might not count in the future can be a disincentive. As an example, prior to its involvement with the CCX, MSU had removed several old apartment buildings and replaced them with a park and a significant number of trees but couldn't include the offsets from the project since it fell outside of the CCX contract period.

Along the same lines, Dr. Skole expressed that the biggest issue for forestry's role in carbon markets at this point is the need for legislation to be passed to address these problems. Ultimately, said MacFarlane, "to see wide-scale replication of this type of a project there would need to be the incentive to go through the steps, which means that we would have to make a much greater commitment to planting trees for the purpose of mitigating emissions and we would have to be willing to pay more for that service in order to achieve a large carbon value from it".

MSU's woodlands and wetlands encompass more than 700 acres in 27 sites. These areas are used for research, demonstration, recreation, and provide resources for teaching. The Campus Natural Area Committee heads stewardship of the areas and use of the areas falls under the Office of Land Management. For the CCX carbon project, carbon sequestered by three natural areas was quantified. Above: the Red Cedar River flows through campus and adjacent to the Red Cedar Natural Area. Below: Trail maps of the natural areas, such as the Sanford Natural Area, are available online to provide the community with recreation opportunities (11).



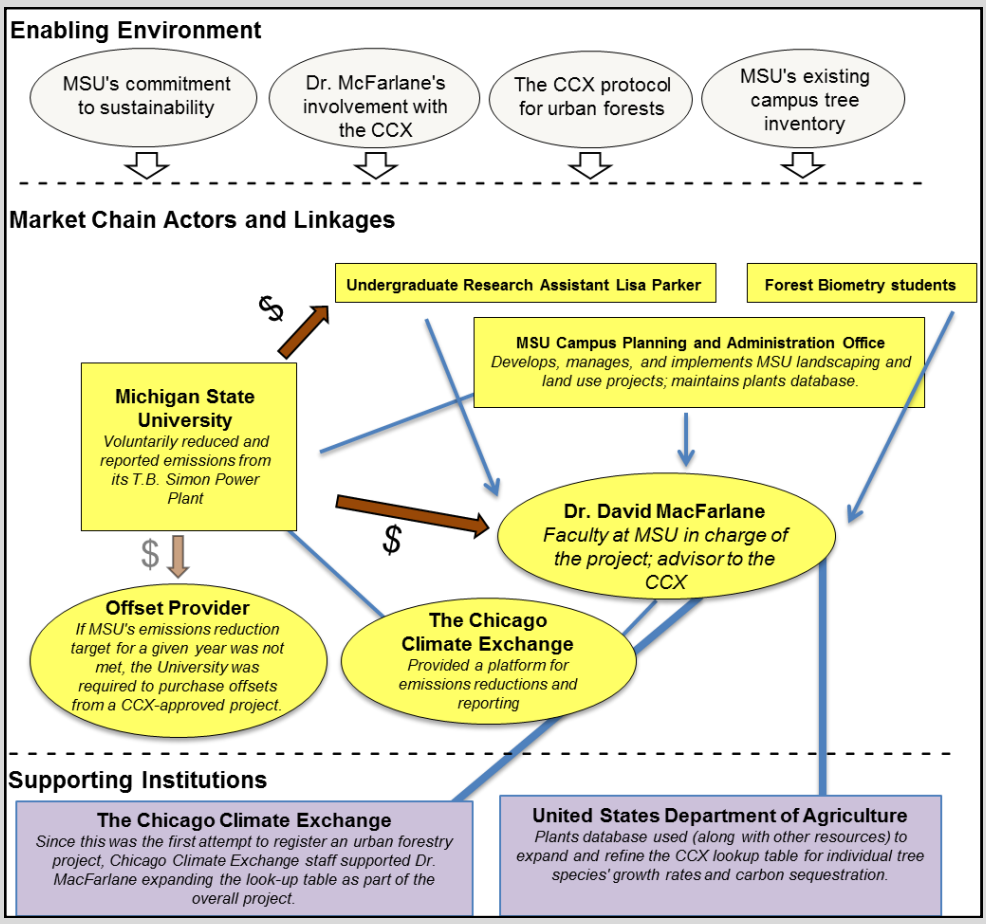
Looking Forward

At the close of 2010, Phase II of the CCX completed as scheduled, marking the end of the cap-and-trade and offsets program. In late 2010, shortly after being acquired by IntercontinentalExchange, CCX staff announced that they would implement a new program geared towards registering offsets (but not trading them) for 2011 and 2012. For its institutional members, such as MSU, this change means that the platform for voluntary emissions reductions no longer exists within the CCX (5). According to Lynda Boomer, MSU did reach its emissions reduction target of 6% by 2010, actually surpassing the goal to reach 9% of the 2000 baseline. This was achieved primarily through switching fuels at the T.B. Simon Power Plant from coal to a mixture of natural gas and biomass.

While MSU will no longer be contractually committed to reducing emissions through the CCX, Boomer noted that since the university emits over 25,000 tCO2e annually, it will be required to report emissions under the Environmental Protection Agency's Greenhouse Gas Reporting Program (1, 19). Hence, the carbon accounting that was central to the project will likely still have a place within MSU's overall sustainability policy. Steve Troost, Campus Planner for the CPA at MSU pointed out that in the last two years, nearly 2,000 trees have been planted on the main campus. The value of trees and the educational opportunities around the "campus carbon inventory" are certainly recognized at MSU.

Market Chain Map

The market chain map summarizes the roles of participants and contributors to market-based initiatives (8). The Enabling Environment section indicates the external factors that facilitated the development of this urban forest carbon program. The Market Chain Actors and Linkages section includes the producers, purchasers, facilitating intermediaries and flow of funds. The Supporting Institutions section lists entities that provided critical support, but were not part of the market transaction. Because forest carbon markets are newly emerging, the same organizations may show up in more than one capacity as they work to develop all of the components needed for a successful, market-based program. The dollar signs indicate flow of funds.



MSU's commitment to sustainability, its membership in CCX, the existence of CCX's protocol suitable for urban forests and a pre-existing campus tree survey were all conditions that contributed to the decision of MSU to pursue this project. One individual, Dr. MacFarlane, played a critical role due to his desire to demonstrate application of CCX protocols and ability to engage student researchers. Although no credits were sold, transaction participants are shown in the market chain section because the carbon sequestered was verified by CCX and applied towards MSU's commitment to reduce carbon emissions. As in many other cases, U.S. Forest Service research reports supported the carbon accounting process.

Lessons Learned

MSU's tree inventory and carbon accounting project represents the only approved CCX urban forestry project. Since the CCX officially ended its carbon offsets program in 2010, no other institutions will have the opportunity to register a similar project on that specific platform. However, the applicable and replicable potential of the MSU project is evident. With a large residential population, buildings and facilities, a structured governing system, and its own power plant, the university is much like a small city and as municipalities, states, and regions continue to adopt and implement climate policy, there is much to be taken from the institution's approach to trees and emissions reductions. Specific lessons learned include:

MSU's trees light up the campus in yellows, oranges and reds in the fall. By exploring the MSU's campus it is evident how important the campus urban forest is to administrators and the MSU community at large. This carbon project reflects the high valuation of campus trees.

- Dr. MacFarlane and the other key players at MSU were able to implement this project with relative ease and timeliness largely due to the availability of the comprehensive and regularly updated Campus Planning and Administration office's plants database. A specific feature of the inventory that has proven key for accurate carbon accounting is having the year that each tree was planted, which serves as a base-line. *Maintaining a tree inventory in an urban setting is important for many reasons, but this project demonstrates its applicability—and necessity—in voluntary carbon market participation*.

- Whether in a classroom or community setting, *the MSU project demonstrates an opportunity to incorporate people into a successful carbon project that might not have had knowledge of carbon markets before.* This type of experiential learning is fundamental in communicating climate science, policy, and institutional approaches to reducing emissions.

- Since the MSU project was the first registered through the CCX, its designers were able to test out the protocol its applicability in urban forestry. Recognizing room for improvement, Dr. MacFarlane and his MSU students expanded the CCX carbon look-up tables, which resulted in a larger final carbon figure for the university's trees. *MSU's experience with this project can inform similar institutions considering a carbon project.*

- *The current state of the carbon market presents challenges for urban forestry projects.* At the time of this project, the trading price of carbon on the CCX was extremely low. This paired with the high costs of urban tree planting and maintenance in cities creates a challenging situation for urban forestry. How can a group expect to raise adequate funds for tree plantings through carbon markets if the offsets are perceived to have no value? To have actual climate impact and to be financially feasible, either the market for carbon will need to change or groups will need to become creative in the design of carbon projects for urban trees.

Project Partners

Michigan State University

Michigan State University is a public research institution with nearly 50,000 students. MSU operates like a small city in order to support its population; the T.B. Simon Power Plant co-generation facility produces 100 megawatts of energy to provide electricity and heat for the institution. In 2005 the administration began to focus on sustainability and lowering MSU's environmental impact through the *Boldness By Design Environmental Stewardship Initiative* (13). One of the priority action areas was energy and in 2007 University President Lou Anna K. Simon and Vice President for Finance Operations Dr. Fred Poston signed an agreement with the Chicago Climate Exchange, committing MSU to reduce its GHG emissions by 6% by 2020 from a year 2000 baseline . The CCX membership was the impetus for multiple emissions reduction initiatives on campus, including the urban managed

forests carbon project. In April of 2008, 2009, 2010, and 2011 MSU was required to submit a report to demonstrate its adherence to an emissions reduction schedule of 1-2% reduction per year; if reductions weren't met the university would need to purchase carbon offsets from Michigan forest owners or other institutions, such as it did from the University of Iowa to achieve its 2007 target reduction of 25,000 tCO2e (1, 17, 21).

The urban managed forests project proposal was submitted in late 2009 by Dr. MacFarlane, Dr. Poston, Lynda Boomer, Energy and Environmental Engineer with the MSU Physical Plant Division, and Assistant Vice President for the Physical Plant Ronald Flinn. Dr. David Skole, Professor of Global Change Sciences in the Department of Forestry, also sits on the Offsets Committee of the CCX, is an advisor to the CCX Forestry Committee, and has played a lead role in MSU's membership (14).

The Chicago Climate Exchange

The Chicago Climate Exchange was established in 2003 and was the first voluntary GHG reduction and offset trading platform in the United States. Through 2010, verified emissions reductions of over 450 CCX members totaled nearly 700 million metric tons of CO2e. Industrial emissions reductions accounted for nearly 90% of the overall total while just over 10% was mitigated by carbon offsets purchased through the CCX. Projects registered through the offsets program were guided by a set of ten established protocols, ranging from Agricultural Methane to Renewable Energy Systems to Sustainably Managed Rangeland. The CCX *Forest Carbon Sequestration Protocol* was released in 2009, including guidelines for urban forestry projects under the heading of "Afforestation/ Reforestation: Widely Spaced Tree Plantings" (5).

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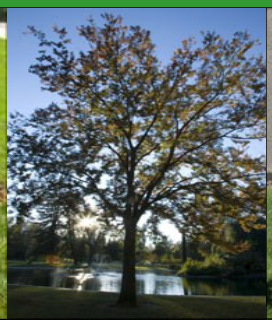
Carbon Offsetting Through Urban Tree Planting: The Sacramento Tree Foundation and Harbison-Mahony-Higgins Builders, Inc.






Fast Facts

Activity: Urban Forestry

Launch Date: 2008

Purpose: To offset five years of the carbon dioxide (CO_2) emissions of the vehicle fleet of a local building contractor by planting trees on private property in Sacramento, CA.

Tree Ownership: The Sacramento Tree Foundation (STF) allocates the trees to private landowners in Sacramento. They are planted and cared for by residents and are monitored yearly by the STF.

Funding: The local building contractor pays the STF $10,000 each year for five years (2008-2012).

Protocol: No protocol used; calculations guided by the U.S. Forest Service publication by McPherson et al. (see page 5).

Verifier: None used

Price: $18.76 per tCO_2e

Payment Mechanism: The contractor directly pays the STF, who purchases and distributes the trees.

Climate Benefits: An estimated project total of 2,665 tCO_2e offset from 2008-2012 through 580 trees planted; 2,132 tCO_2e offset as of the completion of the 2010 planting season (533 tCO_2e/year).

Co-Benefits: Air pollutant removal, prevention of air pollution through reduced energy use due to shading, stormwater runoff mitigation and other water benefits, wildlife habitat, reductions in home cooling costs through direct shading, property value increase, and enhanced quality of life (see page 5 for more details).

Overview

In 2008 a local building contracting business entered into a five-year voluntary contract with the nonprofit organization the Sacramento Tree Foundation (STF) to offset the emissions of the company's new vehicle fleet. By the end of the fourth planting season (2011), funds from the agreement will have resulted in the planting of 464 trees on private property throughout the Sacramento region, translating into 2,132 tons of carbon dioxide equivalent (tCO_2e) offset. The details of the agreement were developed internally. This project highlights a mechanism for carbon offsetting that incorporates an interest in supporting local sustainability with urban forestry. It involves a private and nonprofit collaboration, engaging residents of Sacramento in the care of the planted trees.

The Project

In 2008 Harbison-Mahony-Higgins Builders, Inc. (HMH) acquired 66 new vehicles for its fleet and approached the nonprofit organization the Sacramento Tree Foundation with a desire to offset the vehicle emissions. The leaders of HMH were motivated not only by the company's dedication to its community but also by the emerging prominence of tangible carbon offset mechanisms. On its 50th anniversary in 2007, the general contracting company had announced that it had reduced its overall emissions by 15% that year and had a goal to continue to do so for each year thereafter (4). Recognizing the potential in a partnership to provide the area with direct benefits through tree planting while offsetting the vehicle emissions, HMH and STF quickly drafted a voluntary five-year, $50,000 carbon offset agreement.

The details are fairly simple: based on the five-year expected lifespan of the 66 vehicles, the agreement is renewed and resigned annually. Each year (2008-2011), HMH provides STF with the vehicle mileage to calculate the estimated emissions using U.S. Environmental Protection Agency (EPA) determination for miles per gallon for the vehicle model and then using EPA figures for average carbon emissions per gallon of gas (9). From 2008 to 2011 the total desired amount of CO_2 equivalent to be offset through the agreement was estimated to be 2,132 tCO_2e (533 tCO_2e per year). Then, using the U.S. Forest Service report titled *Tree Guidelines for San Joaquin Valley Communities* (5), a baseline of 4.6 tCO_2e offset per tree over its lifetime has been used to determine that 116 trees be planted to achieve the annual desired offset. STF estimates that the 2012 tCO_2e quantity and number of trees planted will be similar. Finally, HMH donates $10,000 by April 1st of each of the five years to cover the costs associated with planting and establishing the trees throughout the spring and the fall (and replacing those that do not survive). Of the annual funding STF spends roughly $1,700 on trees, ties, and stakes, $3,300 on oversight, marketing, and evaluation, and $5,000 on outreach, site selection, instructions, education, stewardship, and monitoring (staff time). The annual funding breaks down to $86 per tree planted and $18.76 per tCO_2e offset (1).

HMH carbon offset funds are allocated to providing trees in areas that do not qualify for tree planting through existing programs, such as the *Sacramento Shade Program*. Through *Sacramento Shade*, a partnership with the Sacramento Municipal Utility District (SMUD), property owners in the SMUD service area are offered free trees (up to 10 for residents and then for businesses and nonprofit organizations it depends on available space) and are given the proper instruction and guidance on how to plant and maintain them. The residents have a choice of over 30 species, which come in #5 containers;

This map details a 2009 tree-planting that was conducted by the Sacramento Tree Foundation through HMH CO_2 Offset Agreement funds at the Mt. Vernon Mortuary in Sacramento. The exact location of the 31 trees planted at the site are indicated, including 3 replacement trees.

STF purchases the trees, which average $12—$15 each, from five California nurseries. To date, the trees planted through the HMH offset funding have been done so on private property that does not qualify for the Sacramento Shade Program (properties not within the SMUD service district), filling a funding gap to help provide trees to all interested Sacramento residents, businesses, and nonprofit organizations. This also addresses the concept of additionality since these trees would not have been planted by STF if not for the HMH offset project (1).

Other elements of the HMH CO2 Offset Agreement are that STF must provide HMH with the exact location of each tree planted, provide a certificate of CO2 offset participation for HMH's office, recognize HMH on the nonprofit organization's website, and provide employees of HMH with the opportunity to participate in volunteer tree planting events.

Participant Perspectives

Angel Purpura, the Leadership in Environmental and Energy Design (LEED) Coordinator for HMH, states that "we at HMH Builders are continually motivated and strive to 'do the right thing', whether it involves our buildings, or community, or our environment. We feel that the STF partnership has been a great success; we are continually informed of new plantings and locations". Mr. Purpura also notes that HMH hopes to continue working with STF and to become more involved with the actual tree planting process as a volunteer opportunity for its employees.

According to Jacobe Caditz of STF, after its initial setup, this carbon offset mechanism has been relatively easy to implement, primarily because of the large demand for shade trees in the Sacramento region. STF would strongly consider participating in a similar agreement with another interested entity. Since the trees planted through the agreement (464 by the end of the 2011 planting season) are leveraged against existing programs, tree and delivery costs are marginal since the trees are part of a larger bulk order. Also, since residents voluntarily plant and care for the trees, there are minimal labor costs and the maintenance costs (watering, mulching, fertilizing) are not included in STF's project budget. The majority of cost for the program lies in STF staff time. Specifically, 17% of the overall funding for the project is spent on trees, ties, and stakes while 33% is spent on overall marketing and evaluation and the remaining 50% is allocated to staff time for outreach, education, monitoring, and resident assistance with planting and maintenance.

Caditz, who heads the HMH collaboration and is also the director of the *Sacramento Shade Program*, says that the organization is interested in incorporating carbon offsets into its operations regularly but is aware of the obstacles for urban forestry's participation. Specifically, because of permanence issues, under the Climate Action Reserve's *Urban Forest Project Protocol*, only universities, utilities, and municipalities can register projects: where do nonprofits fit in? Another of Caditz's concerns is that of additionality: how do urban forestry groups demonstrate that the trees planted through a carbon offset project would not have been otherwise planted? Though not required under their voluntary agreement, STF has been able to address this issue in the HMH CO2 Offset Agreement by specifically allocating the project's trees to landowners and residents whose properties do not fall under the guidelines of their other programs (2).

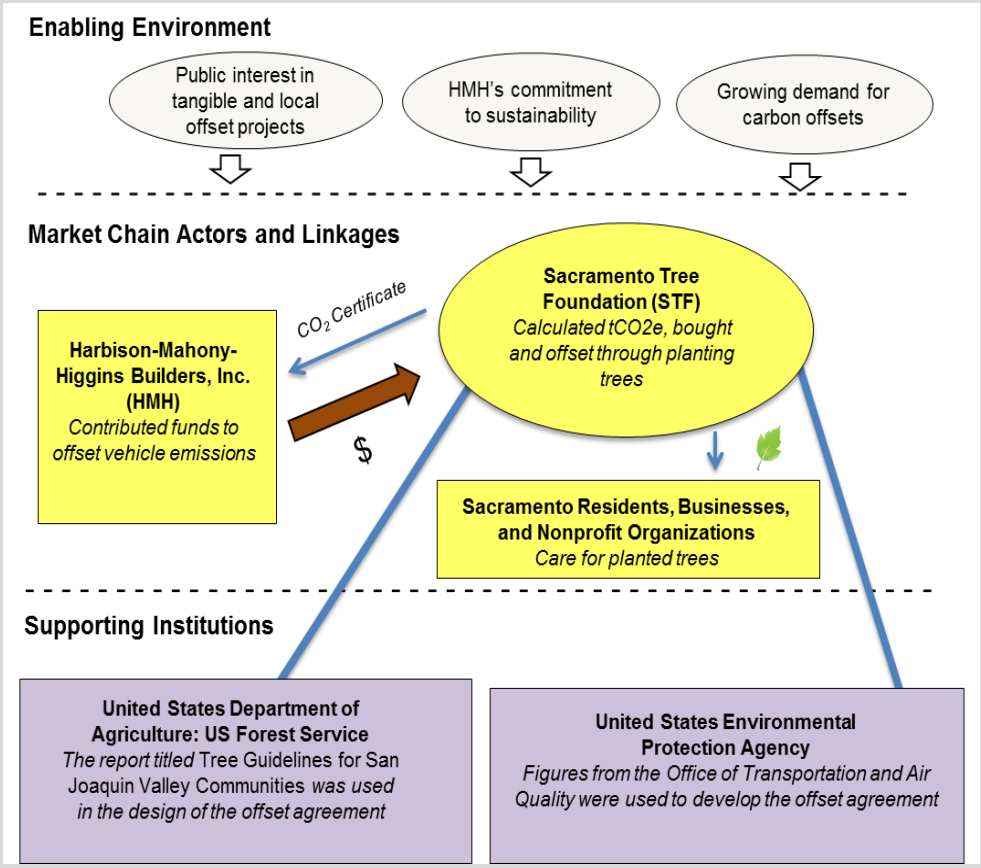
Lessons Learned

The carbon offset project between the Sacramento Tree Foundation and HMH Builders is an example of an effective and relatively simple collaboration between two entities with interests in local sustainability and community. The table on page 5 was provided by STF and outlines major environmental and economic benefits of the 580 trees estimated to be planted by the end of the project (2012). Specific lessons that can be taken from the HMH CO2 Offset Agreement include:

- While there are carbon offset mechanisms that incorporate aggregators, verification by third parties, and registries, *this project demonstrates the possibilities for success found in less complex options for participation in voluntary carbon markets.*

Market Chain Map

The market chain map summarizes the roles of participants and contributors to market-based initiatives (6). The Enabling Environment section indicates the external factors that facilitated the development of this urban forest carbon program. The Market Chain Actors and Linkages section includes the producers, purchasers, facilitating intermediaries and flow of funds. The Supporting Institutions section lists entities that provided critical support, but were not part of the market transaction. Because forest carbon markets are newly emerging, the same organizations may show up in more than one capacity as they work to develop all of the components needed for a successful, market-based program. The dollar signs indicate flow of funds and the leaves indicate trees planted.



HMH's commitment to sustainability, a growing demand for carbon offsets, and increased interest in tangible and local offset projects were all conditions that contributed to the decision of the Sacremanto Tree Foundation to enter into the carbon offset agreement with HMH. HMH directs funds to STF, which identifies residents, businesses, and nonprofit organizations to plant and maintain trees provided by the organization, resulting in carbon offsets. Information available online from the U.S. Forest Service and the U.S. Environmental Protection Agency were used to develop the 5-year offset agreement.

- *Useful tools and information required to develop carbon offset projects may be accessible and free of cost* (such as the U.S. Forest Service report, *Tree Guidelines for San Joaquin Communities,* and data from the EPA's Office of Transportation and Air Quality website).

- *By incorporating this carbon offset project into its current programming, STF staff has been able to minimize costs*.

- By providing trees to residents who would not have qualified without the additional funding, *the project demonstrates additionality.*

- This project was initiated by a business that was eager to voluntarily collaborate with a local group for tangible carbon offsets. *This initiative on behalf of the contractor both enhances the company's image and benefits the community in which it operates*.

- This carbon offset project was developed by a reputable Sacramento area business and nonprofit organization. *The fact that both are well established in the community and have reputations for integrity is likely to have contributed to the ease of the project's implementation*. The desire of local institutions to maintain or develop a good reputation can imply a level of accountability and confer a form of legitimacy on participants in voluntary carbon offset markets. This advantage is missing for would-be players that are non-local, obscure, or perceived as short-term in their local involvement.

These overall messages demonstrate that one-off projects such as the STF-HMH CO2 Offset Agreement can be designed to suit the capacities of the participants and meet their particular objectives. The benefits to the community, STF, and HMH are evident. Although STF has not been approached by any other businesses interested in a similar arrangement as of 2011, the HMH project could be replicated with relative ease.

Sacramento Tree Foundation

How 580 Trees Work for Us

to Save Energy and Improve Our Air and Water*

	Units		Dollars
Energy Saved			
Reduced Electricity Use	2,363,987	kWh (1)	$283,685
Effect on Natural Gas Used to Heat Homes	(1,072,738)	kbtu (2)	($8,786)
Net Energy Saved Through Trees	**22,567,686**	**kbtu**	**$274,899**
Air Benefits			
Air Pollutants Avoided Though Reduced Energy Consumption (3)	14,384	lbs	$69,368
Air Pollutant Uptake (4)	135,488	lbs	$586,728
Air Quality Subtotal: Air Pollutants Avoided & Uptake	*149,872*	lbs	*$656,096*
Net CO2 (Carbon Dioxide) Absorbed	5,244,147	lbs	$78,625
Total Air Benefits from Trees			**$734,721**
Water Benefits			
Stormwater Reduction and other Hydrology Benefits	12,803,152	gal	**$102,312**
Environmental Benefits (Water and Air) Subtotal			**$837,033**
Property and Other Benefits (Energy Included)			**$465,856**
Total Tree Benefits			**$1,302,889**
Total Tree Cost			**($238,728)**
580 Trees: Total Lifetime (40 Years) Net Benefits:			**$1,064,161**

Notes:

* Based on an average mix of tree size, tree location, and compass orientation for the Sacramento region.

(1) kWh : Kilowatt hour = one kilowatt of electricity supplied for one hour

(2) kbtu : one thousand british thermal units = measure of gas energy used to heat homes

(3) Pollutants Avoided: NO2, PM 10, VOC's

(4) Pollutant Uptake: O3, NO2, PM 10, O2

Data Source: *Tree Guidelines for San Joaquin Valley Communities* by McPherson, Simpson, Peper, and Xiao, U.S. Forest Service Center for Urban Forest Research. March 1999.

Table 1: This table was created by the Sacramento Tree Foundation to highlight quantified benefits from the CO2 Offset Agreement with Harbison-Mahony-Higgins Builders, Inc. The 580 trees estimated to be planted through the five year agreement will provide over $1 million in benefits over their expected lifetime.

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Project Partners

The Sacramento Tree Foundation (STF) was founded in 1982 and is a national leader in urban forestry. Through collaborations with community partners, local businesses, and volunteers, the nonprofit organization runs multiple programs throughout the Sacramento region to increase the tree canopy and awareness of the benefits and importance of urban trees. Its *Greenprint Initiative* to increase overall tree canopy cover, the *Sacramento Shade Program* in partnership with SMUD, a native tree planting program, environmental education efforts, and the opportunities provided for citizen involvement in tree planting and care illustrate the multiple ways in which the organization has a positive impact on its community (8).

Harbison-Mahony-Higgins Builders, Inc. (HMH) is a commercial general building contractor that has operated in Sacramento since 1957. A prominent business in the area, HMH's dedication to community has been exemplified by participation in community initiatives, positions on local nonprofit boards, and substantial financial donations to organizations in the area. HMH has also been active in the green building movement, employing LEED-accredited professionals, promoting the use of hybrid vehicles, and reducing the environmental impacts of its operations. This carbon offset project is a part of their commitment to achieving sustainable practices (3).

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A Quick Guide for Community Forestry Practitioners

Voluntary Carbon Markets for Urban Forestry

A product of The Communities Committee of the 7th American Forest Congress and the University of Vermont

The purpose of this Quick Guide is to provide urban and community forestry groups and their partners with information about how they might participate in voluntary carbon markets. It is a based on research conducted by a team from the University of Vermont in 2008-2011, which was funded by the USDA Forest Service through the National Urban and Community Forestry Advisory Council. This Guide highlights lessons learned from pioneering forays by urban forestry groups into voluntary carbon markets. Findings are drawn from interviews with over 40 practitioners and other experts working on urban forestry and carbon markets nationwide to identify opportunities and barriers based on practice. Five detailed case studies (Box 1), which are available online, illustrate the diversity of approaches taken by urban forestry initiatives seeking to engage carbon markets. Researchers found two recurrent themes: 1) both urban forestry groups and potential funders have expressed considerable interest in developing or supporting local forest carbon projects, and 2) community groups lack knowledge about how to participate in carbon markets. This Quick Guide seeks to address these information needs by summarizing key aspects of voluntary carbon markets and describing the innovative ways in which some urban forestry initiatives have engaged in them.

The cases to date have shown that participation in carbon markets has the potential to enhance the mission of urban and community forestry efforts in three areas: education, audience, and fund-raising. Depending on how it is conducted, a carbon offset program can educate people and organizations about climate change, their own greenhouse gas emissions and the role of forests in sustainability efforts. It can help an urban forestry group extend its message about the multiple values of urban forests beyond its traditional supporters to those interested in sustainability initiatives, "buy local" campaigns and climate solutions. In doing so, it can tap new sources of funds for additional tree planting and the maintenance of urban forests.

However early efforts by urban forestry groups to engage carbon markets have met with significant challenges related to internal capacity and market maturity. These challenges are inter-related, because market immaturity for urban forestry offset projects – exemplified by lack of broadly accepted protocols, trading mechanisms, and supportive intermediaries – were overcome only by the creative initiative and hard work of partnerships dedicated to urban forestry. USDA Forest Service researchers and their publications were often quite helpful in providing for technical information needed for quality assurance. Non-profits often found the marketing and sale of credits most challenging. These challenges and approaches to overcoming them are described further in this Quick Guide.

Box 1. Cases of Urban and Community Forestry Carbon Market Initiatives

See website for complete case studies: http://www.uvm.edu/~cfcm/UCF/?Page=case_studies.html .

Sacramento Tree Foundation (STF) Offset Contract, launched 2008.

- ***Local business pays non-profit to offset specific emission through private tree planting program***

A local building contractor entered into a five-year voluntary contract with the non-profit Sacramento Tree Foundation (STF) to offset the emissions of the company's new vehicle fleet. By the end of the fourth planting season (2011), funds from the agreement will have resulted in the planting of 464 trees on private property throughout the Sacramento region. This one-off project highlights a mechanism for carbon offsetting that responds to local interest in supporting local projects.

Forterra (formerly Cascade Land Conservancy) Carbon Mitigation Program, launched 2010.

- ***Donors pay non-profit for carbon mitigation that finances restoration of municipal forests***

This program mitigates GHG emissions through restoration of forested natural areas under municipal ownership with an innovative fee structure that reflects the varying costs incurred in different mitigation activities. Its carbon accounting methodology was developed internally with the assistance of a consultant. Invasive species removal and planting of native conifers are largely completed by contracted groups, while citizen volunteers help with maintenance and monitoring. The program evolved from a one-off effort to mitigate the GHG emissions of Pearl Jam's 2009 world tour. The pilot effort was developed in such a way as to set the stage with for similar arrangement with other major companies and, down the road, with groups of smaller contributors.

TreeFolks and City of Austin, initially launched 2007.

- ***A partnership between local government and an established non-profit aligns carbon neutrality goals with the creation of carbon offsets through local greening initiatives.***

The Austin-based non-profit Treefolks initially developed, hosted and administered an online carbon footprint calculator which raised awareness and funds for tree planting among Austin residents. In part because of these pioneering efforts, the City of Austin's Climate Action Team selected Treefolks to provide carbon offsets through a new online Austin Carbon Footprint Calculator, which is just one component of an extensive city resolution to promote carbon neutrality in Austin. This partnership represents an innovative approach to support the growth of the urban forest and the City's sustainability objectives.

CarbonPlus Calculator (CPC), launched 2010 (Philidelphia).

- ***U.S. Forest Service offers a customized, online carbon calculator to cities to educates users and raises funds for tree planting by local non-profits.***

The CarbonPlus Calculator (CPC) is a web-based tool to help individuals and businesses determine their carbon footprint, identify steps to reduce emissions, and donate money for local projects, including urban forestry, to offset any remaining emissions. It was developed and funded by the U.S. Forest Service in collaboration with the Davey Institute of Tree Sciences. The first version was created for Boston in 2009 and others followed for Baltimore, Philadelphia, New York City, Westminster, CO, and Vermont. Each version of the CPC was customized to represent the energy use, urban canopy cover and other features of each locality. As of 2011, only Philadelphia had officially launched its version of the CPC. While most CPC's lost steam due largely to a lack of resources and marketing, in each case, proponents express interest in revitalizing the program.

Michigan State University Campus Offset, proposed 2009.

- ***Carbon sequestered by campus trees used internally to help meet institution's climate commitments***

Michigan State University (MSU) submitted the first proposal to the Chicago Climate Exchange (CCX) for an urban forestry project. Using inventory data and CCX protocol, the project quantified the carbon sequestered by trees planted since 1990 and those managed in natural areas on campus. MSU, a CCX member since 2007, then used the carbon offsets internally towards its overall GHG reduction target.

What are Voluntary Carbon Markets?

A voluntary carbon market is a mechanism for 'buyers' to compensate for their emissions (say from holiday air travel) by paying 'sellers' to reduce the amount of carbon dioxide in the atmosphere in some other way –for example, through renewable energy projects or by planting trees. This reduction of carbon dioxide through one activity to compensate for emissions from another is called a carbon offset**.** Some offsets have been purchased from a formal trading platform, like the Chicago Climate Exchange, but many other are purchased from retailers and in direct transactions with producers, collectively called the "over-the-counter" (OTC) market. Other terms relevant to carbon markets are defined in Box 2.

As the name implies, voluntary carbon markets do not include transactions that the purchaser may make to meet mandated emissions targets. When this study was initiated in 2008, it was widely expected that the federal government would soon issue climate change legislation that would have created a formal, **r**egulatory market in the U.S. by setting a mandatory 'cap' on the amount of greenhouse gas (GHG) emissions. While such federal regulation has yet to happen (as of 2011), pre-existing voluntary carbon markets have continued to expand and evolve. In 2010, an estimated $424 million was paid for 131 million tons of carbon equivalent (Mt(CO2e)) in voluntary markets worldwide, the highest volume ever traded and up 34% from 2009.[i] Price per ton varied considerably but ion average was slightly lower in 2010 than 2009.

Quality Assurance in Voluntary Market

Because voluntary purchasers are typically individuals, institutions and businesses that genuinely want to address climate change, often as part of a broader sustainability commitment, they seek assurance that their carbon credits are real and effective. Even a buyer only interested in the public relations value of a green image needs a high quality product or its PR strategy could backfire. High quality projects typically address four areas -- additionality, permanence, leakage and verification – as described in Box 3.

Box 2. Some carbon terminology

Greenhouse gas (GHG) is any of the gases found in the atmosphere that contribute to the "greenhouse effect" by absorbing and re-emitting the energy produced by the warming of the earth's surface by the sun. The leading GHGs include water vapor, carbon dioxide, methane and ozone.

Carbon dioxide equivalent – GHG emissions and carbon offsets are measured in metric tons of carbon dioxide-equivalent or t(CO_2e). Each t(CO_2e) = 2204.6 pounds of CO_2, and 1 Mt(CO_2e) = 1 million t(CO_2e).

C**arbon footprint** is the total amount of carbon dioxide (and other GHG) emissions caused by an organization, event, product or person. Personal usage of transportation, heating, cooling, food, consumer goods are all elements of an individual's carbon footprint.

Carbon sequestration is the removal and storage of carbon from the atmosphere through either organic (e.g. photosynthesis) or inorganic (e.g. subsurface injection) processes.

C**arbon credit** is any tradable certificate representing a specific volume of GHG sequestered or emissions avoided, usually one metric ton of carbon dioxide, or 1mt(CO_2e). A carbon project may be registered for a certain number of carbon credits corresponding to its potential to offset emissions by that amount.

Carbon accounting is a rigorous method of calculating carbon emissions and reductions. For offsets, calculations include not just the total tCO2e sequestered or avoided, but also specify amounts reserved or discounted to meet requirements for additionality and permanence.

BOX 3. What makes for a high quality carbon offset?

When the carbon in fossil fuels is released into the atmosphere, it can be there forever, not just in the year it was emitted – which means offsets must meet a high standard for quality. The following factors are considered basic features of a high quality carbon offset:

Additionality – be above business as usual. Requires the project to sequester carbon above a specified "baseline," which is set differently by different protocols.

Permanence – remove carbon from atmosphere more or less permanently. Requires provisions for how reduction is maintained and how unexpected releases (e.g. tree death) are handled.

Leakage – the displacement of emissions from one activity to another. Requires evidence that such leakage is not occurring.

Verification – assurance that carbon accounting is done correctly and the 3 factors above are addressed. Requires documentation, monitoring and oversight by a third party.

Different protocols set the rules for addressing these concerns somewhat differently. They may require specific procedures and/or reduce the countable carbon to meet the goals. Because many of the early urban forestry offset initiatives were started in the absence of protocols for urban forestry, these initiatives invested time into developing appropriate carbon accounting procedures and assuring the longevity of their projects, guided by these broader principles.

Quality assurance can be provided by compliance with a rigorous voluntary standard which specifies protocols, or procedures and accounting methods for a given activity. A number of widely accepted carbon standards and procedures have been compiled by experts with broad input. Specific protocols have been developed for a variety of projects including organic waste digestion, agricultural methane collection & combustion, renewable energy systems, managed rangeland soil carbon sequestration, afforestation and improved forest management. Protocols vary significantly in scientific rigor and requirements across the industry and they continue to evolve.

Once a project has been developed according to protocols, and verified by an independent third party, it can be listed on a carbon market registry, which is a platform for the tracking and recording of GHG emissions reductions through specific projects. Registries specify which protocols they will accept.

Many transactions in the over-the-counter market, however, are not listed on a registry. Some are not even verified to meet specific standards. This is particularly true in urban forestry, in which there are few approved protocols. In these cases, project developers typically seek to demonstrate quality by using or developing carbon accounting procedures that are guided by the principles behind existing protocols and that use credible scientific data. Transparency in such accounting and the sponsorship of a credible organization can provide some quality assurance for some purchasers. As the market matures, however, and institutional purchasers need to justify their choices, there is increasing demand for voluntary carbon credits verified to meet well-accepted standards.

Urban Forestry as Carbon Mitigation

What makes it special?

Urban and community forests do sequester carbon and thus can play a valuable role in climate change. In addition, their co-benefits (see Box 4), which include energy savings, an engaged community and environmental awareness, could indirectly provide long term climate benefits that may outstrip their immediate carbon sequestration potential. Urban forestry practitioners and carbon market experts have listed many reasons why urban forest carbon

projects are especially promising -- from their strong, pre-existing partnerships to a demand for local offsets. ii

However those same experts and practitioners have noted special challenges that urban forestry efforts face in accessing carbon markets. Urban forestry is not considered one of the "low hanging fruit" among carbon offset options, i.e. not providing the most carbon for the lowest cost such as tropical forest protection or methane capture might. Therefore, the emerging carbon markets have not yet developed the infrastructure to specifically support urban forestry projects. There are few standards with protocols that specify carbon accounting for urban forestry projects, and those that do exist have had limited application.

The urban forestry groups that have participated in carbon markets to date have been pioneers, forging new trails by working out each of the components needed for a viable carbon project and playing multiple roles that might be carried out by different players in a more mature carbon market. For example, urban forestry groups are often very skilled at assembling the donors, growing stock, planting sites, equipment, volunteers and other inputs and partners needed for a successful tree planting project. However, selecting the best carbon accounting methods, shepherding a project through the steps needed to meet quality standards, and marketing it as a carbon offset enters new territory, an area which is typically handled by a carbon project developer and retailer in other sectors. These roles can strain the organizational capacity of urban forestry groups and may require new partnerships to carry them out.

Components of a Carbon Offset Project

Executing a carbon offset project involves roughly five inter-related sets of activities:

1) Project Design
2) Finance and Administration
3) Quality Assurance
4) Marketing and Sale
5) Implementation and Maintenance.

Each is discussed below, noting the special opportunities and challenges for urban forestry, and drawing on the case studies to illustrate how specific programs have handled these components. (Refer to online case studies for more details.)

1) Project Design

Project design might not be very different than any other urban forestry project, but should be done in reference to what may be required by protocols or other aspects of quality assurance. Establishment and growth or urban and peri-urban natural areas may be most productive in terms of carbon (e.g. Forterra and Michigan State University (MSU)), but street tree planting and maintenance have also been included (e.g. Sacramento Tree Foundation (STF)). Note that education, about urban forests and/or climate impacts, may be a main project goal that could affect design.

2) Finance and Administration

Securing upfront funding and allocating funds collected were often cited as challenges by urban forestry groups, even for those that may have well established ways of funding their planting projects through donations or grants. Carbon projects typically require additional start up funds – not only to cover all of the documentation, consultants and other costs incurred in meeting quality standards, but also to market a new product to a potentially new consumer base – all before any credits are sold. Added to these direct project costs are those associated with developing a whole new program in

the absence of models and standards, as is the case of urban forestry, which can be even more daunting. [*** insert quote from interviews]

In practice, a several urban forestry groups have been approached by purchasers or partners who have wanted to fund or assist in those upfront activities. For example, the Forterra was approached by the Seattle-based band Pearl Jam to offset a world concert tour. The band funded Forterra to develop a carbon mitigation program from scratch, which once established, has the ability to utilize funds from other donors. Similarly, STF's program development costs were covered by the local business requesting the offset. While such generous purchasers or "angel donors" may be hard to find, just one in each area – or a revolving loan fund for a region – may be required to get a program off the ground. Talented labor is also a valuable contribution. MSU was able to use existing inventories and student labor through service learning, which kept their costs low. Both MSU and Austin's TreeFolks relied on the expertise and long, unpaid hours put in by individual project leaders to work out the details of project development.

In some cases, groups were asked to propose carbon projects to be paid from a pool of funds collected via an online calculator or other methods. The CarbonPlus Calculator (CPC) is a case in which the USDA Forest Service offered cities an online tool that provides a strong educational role and a platform for retail sale of carbon credits. However, this opportunity presented cities with a new challenge of determining how to manage the funds and choose appropriate projects, an issue that other institutions like universities have encountered when choosing offsets. In other (non-urban forestry) offset initiatives, this issue has been handled by issuing a request for proposals, which usually call for compliance with established standards. Urban forestry projects have difficulty responding to such opportunities due to the dearth of appropriate protocols to assure quality.

3) Quality Assurance

While many carbon projects assure the quality of their offsets by complying with a well-accepted standard, there are few options for urban forestry. The Climate Action Reserve (CAR) did release its Urban Forest Project Protocol in 2010, however no projects were registered as of the end of 2011. Urban forestry groups cite the complexity and expense of compliance as well as specific rules such as restricting tree planting only to lands owned by municipalities, universities and utilities, as reasons for not using the CAR protocol. The Chicago Climate Exchange (CCX) did offer a Widely Spaced Trees category, suitable for urban forestry, in its 2009 Forestry Carbon Sequestration Protocol, but only one project was submitted – the Michigan State University case (Box 1).

While most of the carbon programs studied here were initiated before there were any urban forest protocols, all were keen to provide high quality offsets. In the absence of appropriate or affordable standards, programs often used the best available science from USDA Forest Service publications (see Useful Resources), or in the case of the Forterra, the CAR Urban Forest Project Protocol itself, as guidelines for carbon accounting. As one USFS researcher said, "[***INSERT QUOTE – we have all the tools..]" Carbon standards typically specify that compliance with that standard be verified by a third party. If not actually verified, the project should at least be verifiable, i.e. carbon calculations, data and other program processes and assumptions should be readily available. Transparency can go a long way

towards creating trust in the absence of formal mechanisms for verification. Having a program reviewed or sponsored by another organization with a strong reputation can also support quality claims, even if that second party is a partner and not an independent third party. For example, the Carbon Plus Calculator is trusted by cities because it was created by researchers from a trusted government agency, the USDA Forest Service, that annotated all of their calculations with buttons right in the calculator.

Long term monitoring and contract length both contribute to permanence needed for a high quality carbon offset. Urban forestry groups are often well suited to do long term monitoring given that they may already be conducting periodic inventories. If carbon payments are set up to trickle in over time, then such monitoring may even be supported as trees grow and continue to sequester carbon. While the space should be occupied with growing vegetation, that does not mean that a single tree needs to live for the length of a contract. Damaged and dead trees must be replaced and therefore maintenance funding should be included in the project. Contract lengths in the protocols to date vary from 15 years (CCX) to 100 years (CAR) and continue to evolve. While 15 years is too short to provide the permanence necessary for an effective offset, 100 years is a long time to effectively and fairly bind many landowners and organizations. For whatever contract length is specified, both trees and monitoring should be in place for the length of the contract, s well as back up plans for both.

If a carbon project site is later slated for development, carbon could be replaced by new plantings elsewhere or perhaps by purchasing carbon credits to replace those lost. While it has not been tested in courts, a long term carbon contract may provide leverage with developers to replace the carbon benefits lost to development. Options built into carbon offset programs to handle unanticipated losses include a reserve (e.g. 20% subtracted from project total in CCX), insurance, and a fund for replacement purchases.

Box 4. "Co-benefits" of Urban & Community Forestry Projects

Activities that reduce GHG emissions often have other positive outcomes, called **co-benefits**, which can contribute to the attractiveness of an offset on the voluntary carbon market. Beyond their contribution to countering climate change, urban forestry can provide:

- energy and money savings from reduced heating and cooling needs
- property value increases
- storm water mitigation
- air quality enhancement
- urban habitat creation
- crime rate mitigation
- community economic revitalization
- fostering volunteerism and community
- environmental education and stewardship

In addition, buyers often value the localness of an urban forestry offset because it can support their community, enhance their green image, and offer greater accountability than a more distant project. All of these co-benefits can lead to a higher price for urban offsets in a voluntary market than might be found in a regulatory market, where buyers are typically seek to meet mandated goals at the lowest cost.

4) Marketing and Sale

For groups skilled at grant writing and fund-raising from patrons, selling a product may call for a new set of capacities. For carbon offsets, that includes bringing a new product to new audiences such individuals concerned with climate change, institutions that have made sustainability commitments, or even all residents of a municipality.

Selling a service vs. a product

Groups considering offsets often feel they have to design a product, figure out a competitive price point, and advertise it before they make the first sale. The urban pioneers in carbon markets often found that they were asked to sell a service, carbon mitigation, rather than a just product, a carbon offset. While it is not common for customers to ask a vendor how much they should buy, this has been the case in the emerging markets for carbon offsets. When Pearl Jam came to Forterra asking how much it should purchase to offset its tour, Forterra turned to a well-known environmental group to calculate the amount of carbon produced by the tour. Forterra then focused just on calculating the carbon offsets they could produce. Austin Treefolks and the cities associated with the CarbonPlus Calculator have used an online calculator as a way to provide that carbon footprint service. A group may just be asked to provide a an urban forestry carbon project to a pool of projects marketed by a third party. In other cases, however, groups should know there are resources and partners who can help a client determine the amount to purchase.

Price

The expectation of low economic returns based on published prices such as those on CCX (as low as $0.05 per tCO2e), is cited by many groups as a deterrent from pursuing carbon markets. Urban forestry can have high costs relative to the low hanging fruit of carbon mitigation, but its many co-benefits (Box 4) are can be very attractive to some purchasers who will pay much more per pound. The Forterra developed an innovative, nine-tiered pricing system (dubbed "treeiage) that takes into account the varied costs and co-benefits of urban forestry activities as well as the differences in willingness to pay among potential clients. In this way, Forterra offers offsets for as high as $125 per tCO2e. The price set need not cover all project costs because carbon sequestration is just one of many ecosystem services provided by the urban forest. Additionality should still be shown no matter what the price.

Marketing = Education

Education about climate change, energy conservation and the value of urban forests can be a primary reason for urban forestry groups to enter carbon markets. These education goals are typically achieved through the marketing of carbon offsets. The launch of an innovative offset program can attract media attention and marketing materials can be largely educational in content. For example, the "Plus" in the CarbonPlus Calculator refers to the education users receive about ways to reduce their energy use and the many benefits of urban forests. Even if a carbon program nets a relatively small amount of dollars, it may ultimately provide indirect climate and urban ecosystem benefits

A perfect role for partners

Even carbon calculators, which cover many marketing tasks, need to be marketed to potential users. Austin TreeFolks' first calculator was shared with their base supporters on their website, but an urban forestry carbon offset project has the potential to attract many more constituencies. Urban forestry groups often cited their ability to form partnerships as both an organizational strength and a motivation in

pursing carbon market opportunities. Partners can help with every aspect of a carbon project – especially education through marketing. Rather than attempting to retail to the masses, approach other institutions with a commitment to environmental sustainability as a way to reach a new audience. Resorts, conference centers, local gift registries and retailers of all kinds might want to offer carbon mitigation as a service to their customers. Institutions that have climate plans such as universities and municipalities might be open to local offsets to help meet their goals. Pitch the idea to local sustainability consultants who advise companies on how to green their businesses. Board members and other friends of urban forestry may help make those connections. Providing good online program descriptions with transparent carbon accounting can help back up outreach efforts. If a group's ability to develop such web resources is limited, consider contacting a local college or university for skilled interns or help through service learning courses.

5) Implementation & Maintenance

Urban forestry groups often excel in this area, because they can assemble the growing stock, volunteer and site access needed for successful projects. Many municipalities conduct inventories and provide maintenance once trees are planted. As discussed above, a high quality offset needs a long term maintenance plan that is agreed upon from the outset. In the cases of the STF and Treefolks, individual homeowners, churches and schools agreed to maintain trees planted as part of their programs.

Box 5. Effectiveness of Offsets? Just one step – and not the 1st one

Carbon offsetting can reduce greenhouse gases in the atmosphere and can be a valuable component of a climate action plan. They are, however a 3rd step -- often a temporary one -- in an effective plan to reduce climate impacts for both individuals and institutions. Such steps can include:

1) Assess "carbon footprint" of activities
2) Reduce direct and indirect emissions
3) Offset those emissions which cannot be reduced at present, applying due diligence in choosing offset activities. (See Box 3 What makes for a high quality offset.)

To emphasize that offsets are a 3rd step, the Carbon Plus Calculator asks users to calculate the carbon equivalent of their activities – and then suggests ways they can reduce impacts and asks for their commitment to do so – before offering the option to buy offsets for the remaining emissions. For example, some organizations and businesses have determined that air travel or shipping is essential to their goals, and while it may be substantially reduced, it cannot at present be eliminated. Offsets may be an appropriate way to have immediate climate impact while waiting for the travel, communication and transportation sections to adjust to a lower carbon future.

Some groups use the term "mitigation", which emphasizes that a project such as urban tree planting is reducing carbon in the atmosphere, but need not be tied to any specific emissions by the funder. While not offered as an offset per se, emphasizing the climate change mitigation benefits of a project may make it attractive to a broader pool of funders than has typically supported urban forestry.

Looking forward

Climate change is not going away, even if political attention to it has waned for the moment. While carbon markets have not grown as quickly as they were expected to in 2008, they have not gone away either. On the contrary, after an initial drop associated with the Great Recession and closure of the CCX, voluntary markets have continued to rise internationally. Many organizations continue to pursue sustainability commitments for which local offsets can be attractive. While offsets are only one small part of the efforts needed to address climate change, they can play an important role because effects of sequestration are immediate and they can support additional climate actions through the awareness and policy flexibility they offer. (See Box 5).

Urban forestry carbon projects can serve dual goals: to help fund urban forestry and to educate people about energy use, climate change and the many benefits of urban trees. However, engaging in carbon markets is new ground for most non-profit groups and municipalities. The Guide has outlined some issues to consider and ways that urban carbon programs have handled some of the challenges of this emerging market. Anyone interested in further exploring urban forestry carbon markets is strongly encouraged to look at the case studies online and to contact the project leaders listed at the end of each one. The people who developed the carbon projects can share give more detail on the challenges encountered, resources utilized and outcomes achieved.

Our research has identified some pathways to success - but also some serious barriers. The lack of a widely accepted yet broadly applicable protocol for urban forestry carbon projects means that most groups to date have been tasked with developing their own version of a credible carbon methodology . While the science of how much carbon is sequestered in urban trees may be fairly clear, feasible ways for showing additionality and permanence remain to be worked out.

Lacking also are “project developers” for urban forestry projects who have specialized knowledge in carbon standards and the steps needed to bring a project to market. Individual urban forestry groups may be analogous to the situation of small scale forest landowners. The latter have benefitted from for-profit and non-profit entities, often working at the regional level, that aggregate ownerships for economically viable forest certification and/or carbon offset projects. If such support organizations were to arise in urban forestry, community groups would not have to develop the specialized (and quickly changing) knowledge of carbon protocols and could focus on project implementation and local marketing.

The emergent nature of the market for urban forest carbon credits goes a long way to explaining the current diversity of practice and high start-up costs, as well as the false starts by some practitioners. Even when the market does mature, we do not expect that carbon credits will fully fund urban forestry projects. Just as carbon is one of many ecosystem services and social benefits provided by [the] urban forest[s], so too should carbon be just one of several revenue streams supporting urban and community forestry.

USEFUL RESOURCES

Climate Action Reserve and the Urban Forest Project Protocol (www.climateactionreserve.org)

With over 400 account holders and over 115 carbon offset projects registered, the Climate Action Reserve promotes the reduction of greenhouse gas emissions by pionerring credible market-based policies and solutions. In 2010 the organization released its first version of its Urban Forest Project Protocol, which is available on the website.

Urban Forestry South (www.urbanforestrysouth.org/resources/collections/urban-forests-carbon-credits/)

This site provides a collection of resources about urban forestry and carbon markets, including registration (registry), certification, monitoring, potential for markets, carbon trading, and carbon credits. Carbon market case studies are also included.

US Forest Service Urban Ecosystem and Social Dynamics Program (www.fs.fed.us/psw/programs/uesd/uep/)

Formerly called the Center for Urban Forest Research, the Urban Ecosystem and Social Dynamics Program was established in 1992 and its website provides information and relevant research on urban forestry, often focusing on the community benefits of trees in cities. The site includes a link to a Tree Carbon Calculator that was developed by the US Forest Service.

Urban Forests and Climate Change (www.fs.fed.us/ccrc/topics/urban-forests/)

US Forest Service website on urban forests and climate change, which includes background, research documents, tools and links.

Alliance for Community Trees (www.actrees.org)

The Alliance for Community Trees is a nonprofit organization that supports grassroots, citizen-based nonprofit organizations that engage in urban and community forestry tree planting, care, conservation, and education. ACT is the only national organization solely focused on the needs of nonprofit and community organizations engaged in urban forest protection. In January, 2011, ACT organized a webcast presentation focused on carbon markets and urban forestry, which can we found here:

Box 6. What happened to the Chicago Climate Exchange?

The Chicago Climate Exchange (CCX) was a GHG emission reductions program that operated a comprehensive, voluntary cap-and-trade program from 2003 through 2010. A number of state and local governments, businesses and universities were among CCX members. Through that program, institutional members signed a legally-binding commitment to reach targeted annual emissions reductions. Approved offsets could be used to meet a portion (up to 15%?- CHK) of those reductions. CCX developed the first forest carbon protocols established for offset trading in the US, including one for "Widely-Spaced Tree Plantings" appropriate for urban forestry. Some buyers purchased CCX offsets even though they were not CCX members because it was the most well known carbon trading platform in the US.

CCX was originally due to sunset in 2012 when the Kyoto Protocol was expected to be superseded by a new international agreement – one, unlike Kyoto, which the US might have signed. In 2010, when it was clear that neither post-Kyoto talks nor US legislation would produce a new US carbon trading system by 2012, CCX needed to decide what to do. In 2011, the cap-and-trade component ceased, and CCX launched the Chicago Climate Exchange Offsets Registry Program. CCX carbon prices dropped from a high of about $7.40 per tCO2e to a low of $0.05 per tCO2e -- some of the lowest carbon prices in the world. These prices reflect a specific market and are not representative of all voluntary carbon prices which averaged above $6 per tCO2e worldwide in 2009 and 2010.

http://actrees.org/site/resources/events/tapping_carbon_markets_for_urban_forests.php

i-Tree (www.itreetools.org)

i-Tree is a peer-reviewed software suite from the US Forest Service that provides urban and community forestry analysis and benefits assessment tools.

Carbon storage and sequestration by urban trees in the USA by David J. Nowak and Daniel E. Crane (YEAR) (www.fs.fed.us/ccrc/topics/urban-forests/docs/Nowak_urban_C_seq.pdf)

Based on field data from 10 USA cities and national urban tree cover data, it is estimated that urban trees in the conterminous USA currently store 700 million tonnes of carbon ($14,300 million value) with a gross carbon sequestration rate of 22.8 million tC/yr ($460 rnillion/year).

Methods for Calculating Forest Ecosystem & Harvested Carbon with Standard Estimates for Forest Types by James E. Smith, Linda S. Heath, Kenneth E. Skog and Richard A. Birdsey (2006) (www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf)

This report (GTR-343) presents techniques for calculating average net annual additions to carbon in forests and in forest products. Nonprofit organizations like Forterra in Seattle have used this publication to develop the carbon accounting piece of their carbon mitigation programs.

The Potential of Urban Tree Plantings to Be Cost Effective in Carbon Credit Markets by Melissa R. McHale, E. Gregory McPherson and Ingrid C. Burke (2007) (www.fs.fed.us/ecosystemservices/pdf/urban-tree-planting.pdf)

Compares the cost efficiency of four case studies located in Colorado, and uses a model sensitivity analysis to determine what variables most influence cost effectiveness of urban forestry in carbon markets. The authors conclude that some urban tree planting projects in specific locations may be cost effective investments.

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This Quick Guide is available at http://www.communitiescommittee.org/publications.html and http://www.uvm.edu/~cfcm/UCF/ .

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[i] From *Back to the Future: State of Voluntary Carbon Markets 2011* Peters-Stanley, M. et al. (2011) http://www.forest-trends.org/documents/files/doc_2828.pdf

[ii] Both opportunities and challenges for urban forestry in carbon markets are described in greater detail on webpage http://www.uvm.edu/forestcarbon/UCF/ and in Schadler, E., C. Danks and M. McDermott, 2012. "Barriers, Opportunities and Strategies of Urban Forestry Carbon Projects"

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The following journals are being considered for this manuscript:

- Environmental Science & Policy
- Human Ecology
- Journal of Urban Affairs

Carbon calculators and local carbon offset projects: lessons from the case of the CarbonPlus Calculator

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ABSTRACT

Local governments have expressed a need for an easy-to-use tool to provide citizens with information on their carbon footprints and ways to reduce or offset their emissions. The CarbonPlus Calculator (CPC) is an online carbon footprint calculation and offset tool funded by the U.S. Forest Service and developed in collaboration with the Davey Institute of Tree Sciences. Between 2008 and 2011, versions of the CPC were created for Boston, Baltimore, Philadelphia, New York City, the state of Vermont, and Westminster, CO. The goal of the CPC is to allow local residents to support local greening and energy efficiency initiatives through the tool, which is customized with region-specific data. Despite its potential for both education and fund-raising, the tool is largely inactive as of late 2011. Through interviews with project developers and municipalities, this study examines barriers for implementation of the CPC. By drawing on the successes and struggles of this and other carbon offset projects in U.S. cities, we identify critical components for implementation, leading to insights and recommendations, which include budgeting for development costs and allocating resources to marketing.

Keywords: Carbon footprint, Carbon Calculator, Local Carbon Offsets, Carbon Neutrality, Urban forestry

1. Introduction

In recent years, online carbon calculators have emerged as a means for independent users to calculate their carbon emissions, better understand the sources of emissions, and, in many cases, offset these emissions through an online transaction. A range of carbon calculators currently exist on the websites of nongovernmental organizations such as American Forests[1], the Nature Conservancy[2], and Conservation International[3], utility providers such as

[1] www.americanforests.org/learn-more/carbon-calculator/

[2] www.nature.org/greenliving/carboncalculator/index.htm

[3] www.conservation.org/act/live_green/carboncalc/

Green Mountain Energy[4] and Duke Energy[5], private businesses such as TerraPass[6] and the Carbon Neutral Company[7], and government entities such as the Environmental Protection Agency[8] and the City of Seattle[9]. In general, these online tools can serve to increase public awareness of carbon dioxide (CO_2) levels and global climate change, they can influence individual behavior change by promoting carbon emissions reductions, and they can support a variety of projects that produce carbon offsets.

Online carbon footprint calculators could be a particularly good option for cities and institutions with comprehensive and ambitious sustainability plans. Initiatives such as the Cities for Climate Protection though ICLEI (formerly the International Council for Local Environmental Initiatives), which currently lists over 250 North American local governments[10], the 1,054 mayors that have signed on to the U.S. Conference of Mayors' Climate Protection Agreement to reduce carbon emission levels below 1990 levels[11], and the 674 institutions that have pledged to become carbon neutral through the American College & University Presidents' Climate Commitment[12] represent a growing concern and desire to address emissions locally. Carbon calculators can be designed to link residents and businesses to local projects that generate offsets, which can be appealing because of a suite of additional, or co-benefits. For example, local tree-planting initiatives provide stormwater mitigation services and enhance overall air quality (Nowak et al. 2010) and renewable energy projects can create local jobs in addition to addressing carbon emissions (*need to find a source for this*).

Despite these opportunities, there are notable challenges in developing and implementing a quality carbon calculator and offsets program. A study by Padgett et al. compared ten carbon calculators to evaluate consistency in output values of metric tons per activity given similar inputs for individual behavior. The researchers found that there was little consistency among calculators and that most calculators lack transparency about emissions estimates and sources (2008). Additionally, the complexities of the voluntary carbon market, range of origination and price of offsets, and uncertainties about the promoting payment for pollution (versus focusing on actual emissions reductions) have been identified as barriers (Businesses for Social Responsibility 2006, Hamilton 2006). For small non-profit organizations and municipal offices that are interested in developing local offset options, these factors could be daunting.

This study presents the case of the CarbonPlus Calculator, a calculator that was developed to support local efforts to address climate change and, specifically, local tree-planting carbon offset projects. By focusing on this specific case study, identifying these obstacles, and considering how other similar carbon offset initiatives have overcome these barriers, we can

[4] www.greenmountainenergy.com/green-mountain-energy-company-store/carbon-calculator
[5] www.balanceyourequation.com
[6] wwww.terrapass.com
[7] www.carbonneutral.com
[8] www.epa.gov/climatechange/emissions/ind_calculator.html
[9] seattle.co2challenge.com
[10] http://www.iclei.org/index.php?id=11454
[11] http://www.usmayors.org/climateprotection/revised/
[12] http://www.presidentsclimatecommitment.org/

consider models for successful projects, informing decisions about the role that carbon calculators can play in climate policy and local sustainability initiatives.

2. Methodology

This study is part of a larger effort focused on opportunities and barriers for urban and community forestry's participation in voluntary carbon markets. Key informed interviews with twelve project developers and participants were conducted both over the phone and in-person between January and August 2010. Interviews were semi-structured and were based on an interview guide developed by a University of Vermont graduate student[13]. Participants ranged from USFS employees, employees of the Davey Institute, and the main contacts from each of the partnering organizations in Boston, Baltimore, Philadelphia, New York City, Vermont, and Westminster: each region's version was represented through the interviews. Interviewees were asked questions about project history, project details and deliverables, their individual level of involvement, their organization's level of involvement, challenges they encountered, if and how they plan to overcome these challenges, and their hopes for implementation of the CPC. A case study on the CPC was developed in the fall of 2010, which is available at www.uvm.edu/forestcarbon.

3. Results & Discussion

3.1. The CarbonPlus Calculator tool

The CarbonPlus Calculator is modeled after the Environmental Protection Agency's Personal Emissions Calculator[14]. Parameters for each specific region such as electricity emission factors and regional natural gas rates are customized. Currently, each regional version varies slightly; for example, the New York City version has not been set up to accept financial contributions. The basic structure of the CPC is set up to give users the option of calculating household emissions, car emissions, air travel emissions and/or business emissions and then offsetting the total emissions or a select amount through an online transaction. For household emissions calculations are based on number of people in a household, the main method of house heating, average electricity, gas, and fuel oil bills, and types and amounts of waste recycled. By providing vehicle type, miles per gallon, and annual driving miles per vehicle, car emissions are calculated. Similarly, air travel emissions are calculated by inputting estimated miles traveled by air for a given time period. Calculations for emissions of businesses are based on business type, heating methods, number of employees, square footage of the facility, figures of energy usage such as Kwh of electricity or gallons of propane used over a time period, waste generated and recycled, subsidized commuters, vehicle and air travel, freight emissions, and business equipment emissions, which is based on gallons of fuel type used over a time period. Business emissions can also be calculated and complied for multiple business sites. Each regional version includes tips on reducing emissions; for example, the Boston version gives users the option to take a Boston Carbon Pledge to participate in specific emission reduction activities. Detailed information

[13] Interview guide was developed by former UVM graduate student Rachael Beddoe and was used by members of the Forest Carbon and Communities Research Group in interviews about voluntary carbon market participation for urban and small-scale forestry.

[14] www.epa.gov/climatechange/emissions/ind_calculator.html

on major GHGs and how emissions contribute to global climate change, resources and links, and a section dedicated to the environmental benefits of trees are also included on the generic CPC page.

3.2. The CarbonPlus Calculator in each region

Work on the CPC began shortly after a Northeast Urban Research Organizational Network (NEURON) meeting in 2007 when the USFS Northern Research Station pledged financial support for the development of the tool. The idea was that instead of donations from an online calculator going to another country, this would be a way to support local sustainability projects with local funds. The first regional version of the CPC was designed for the City of Boston, which had established a goal to plant 100,000 trees by 2020 through the *Grow Boston Greener*[15] campaign. The Davey Institute for Tree Sciences (Davey Institute) and the National Center for Digital Government (NCDG) were both contracted to work on the model, calculations, and website design. Partners from Boston included the City of Boston's Department of Energy and Environmental Services, The Urban Ecology Collaborative, Conservation Law Foundation Ventures (CLF Ventures), the Boston Urban Forest Coalition, and the Urban Ecology Institute (UEI). Regular correspondence occurred between the partners and the USFS project lead around how the CPC would operate, how concerns of scientific validity would be addressed, and what types of project would be supported by the funds raised through the CPC. By the end of 2007, the Boston version had been scientist-reviewed, had gone through a round of revisions, and the partners involved had determined the mechanics.

This is how it would work: when a user had calculated their carbon footprint, they would be given the opportunity to offset their emissions by purchasing any number of tax-deductible Boston Green Certificates (depending on how much of their carbon footprint they wished to address). Each Boston Green Certificate would represent 1 ton of CO2 equivalent (tCO2e) offset and would cost roughly $20. $3-$5 from each Boston Green Certificate would go towards the purchase of a verified retired tCO2e on the Regional Greenhouse Gas Initiative (RGGI) market and then the remainder of the money would be entered into the Boston Green Fund. This fund would then be dedicated to supporting three initiatives (tree planting, solar panel installation, or energy efficiency renovations) that would provide real and local CO2 reductions. The specific activities of these three initiatives that would be financially supported by CPC contributions would not receive funds from other sources and would not happen without the project; hence addressing the concept of additionality[16]. Despite the work on the website, a series of planning meetings, the creation of a board of

[15] www.growbostongreener.org/gbg/

[16] Additionality is demonstrating implementation beyond business as usual.

overseers and an advisory board, and interest from local businesses to provide initial contributions as part of their sustainability portfolios, by the summer of 2009 the momentum for launching the Boston CPC slowed and the site has yet to be made available to the public.

Some similarities can be seen in the stories of the other regional versions of the CPC. Staff from the Philadelphia Mayor's Office of Sustainability expressed interest in the CPC as it considered ways to raise funds for tree plantings to meet the City's goal of 300,000 trees by 2015 (identified in the 2009 Greenworks Philadelphia[17], a six-year sustainability plan). For the Philadelphia regional version, which was renamed *Erase Your Trace*, when a user chose to offset their carbon footprint, they would automatically be directed to the website of Fairmount Park Conservancy, a nonprofit organization dedicated to raising funds for the city's parks, where they could make a tax-deductible donation to a general tree planting fund. Taking a cue from Boston, the Philadelphia coordinators decided to price the offsets at $\$20/tCO_2e$. *Erase Your Trace* was officially launched in August of 2009, had no budget for marketing and received little visibility, raised approximately $900, and as of late 2011 is no longer listed on any of the partnering organizations' websites.

New York City's Parks & Recreation Department was drawn to the CPC as the *MillionTreesNYC Initiative*[18] to plant and maintain one million trees across the five boroughs of the city within a decade was taking shape. Increasing tree stewardship was a major part of the initiative and the CPC was seen as a way to highlight the benefits of urban trees, particularly those related to carbon sequestration and energy savings. The New York City regional version of the CPC was never considered as a mechanism for fundraising and was not developed to take contributions; instead it was seen as a tool with the end-use goal of public education. Before it could be used, however, the New York City partners wanted to adapt the CPC site to align with the branding of the City's overall sustainability initiatives. As of late 2011, neither the New York City Parks & Recreation Department nor the Mayor's Long-Term Planning and Sustainability Office are actively working on the CPC.

In Baltimore, staff working on *TreeBaltimore*[19], a mayoral initiative to increase urban tree canopy, and Parks and People, a local non-profit organization, began conservations about a Baltimore CPC version in 2008. Though the Davey Institute did develop the basic site for the Baltimore CPC, its structure and administration have yet to be determined.

Staff from Vermont's Urban and Community Forestry Program was initially eager to use the CPC as a mechanism for raising funds to support communities in their greening efforts. A CPC version for the state was developed by 2009 but Vermont decided against moving forward with development of the tool when departmental restructuring occurred and the office received alternate funding for its community grants program, addressing the original impetus for considering adopting the CPC.

Despite the general inactivity of each regional version, the websites are available and are currently hosted by the Davey Institute; a number of urban forestry professionals and others

[17] www.phila.gov/green/greenworks/
[18] www.milliontreesnyc.org
[19]www.baltimorecity.gov/Government/AgenciesDepartments/RecreationandParks/TreeBaltimore.aspx

involved with municipal sustainability initiatives are familiar with the existence of the CPC and have contacted project participants with inquiries. *Table 1* shows the partners from each region and provides the websites of the regional versions that have been launched. In 2010 a company in Westminster, Colorado was interested in offsetting its carbon footprint by contributing funds to support tree planting and subsequently worked with city employees to develop a carbon offset agreement. The partnership was a success and prompted Westminster's Green Team, a committee of municipal employees and residents, to pursue a permanent carbon offset service, which would be available to residents and local businesses. After only a few months of considering options, researching what other groups were doing, and speaking with USFS employees, the team decided that the CPC was the best fit. By the end of the year a CPC version was developed, free of charge, by USFS and the Davey Institute for Westminster. Following suit, each tCO2e offset through the Westminster CPC costs $20 and funds are directed to the *Living Legacy Program* to support memorial tree plantings. Individual donors have a choice of purchasing enough offsets to cover the entire cost of planting one tree ($250) or having their offset funds combined with others to reach the necessary amount. As of 2011 the Green Team is considering ways to move forward with marketing the tool to the public.

Region	**Local Entities Involved**	**Website**
Baltimore	TreeBaltimore, Parks & People	Website not yet officially launched
Boston	City of Boston's Department of Energy and Environmental Services, The Urban Ecology Collaborative, Conservation Law Foundation, the Boston Urban Forest Coalition, the Urban Ecology Institute, the National Center for Digital Government	Website not yet officially launched
New York City	New York City Parks & Recreation Department	Website not yet officially launched
Philadelphia	Philadelphia Mayor's Office of Sustainability, Fairmont Park Conservancy, Philadelphia Parks & Recreation	www.eraseyourtrace.org
Vermont	Vermont Urban and Community Forestry Program	Website not yet officially launched
Westminster	City of Westminster Green Team	http://www.itreetools.org/carboncalculator/index.cfm?state=CO&cityname=Westminster

Table 1: Regional versions of the CarbonPlusCalculator with local entities involved and URL to reach the version, if it has been launched as of late 2011.

3.3. Barriers identified by project participants

Twelve interviews were conducted in order to develop a case study about the CPC[20]. Each interview included logistical questions around the status of the CPC regional versions and also included detailed questions about the major obstacles the CPC has faced. Each interview participant identified at least one factor and most listed several; a total of 62 stated factors were coded and *Table 2* breaks down the general categories of obstacles identified,

[20] Available at www.uvm.edu/forestcarbon

indicates which region's participants mentioned an obstacle in the category, and gives specific examples of obstacles in each category.

Obstacle	Regions represented by responses	Specific examples
Concerns around managing the logistics of the CPC	Baltimore, Boston, Vermont, U.S. Forest Service	"There would have to be a lot of energy put into deciding who would be the recipients of the money."
		"We spent a lot of time thinking about administration; where would the money go and when someone donated, who would deal with it? How would we make sure it was properly accounted for?"
Concerns that offsets aren't the best way to address climate change	Baltimore, Boston, New York City	". . . the Wild West of voluntary carbon markets. There is little transparency to where the investments are actually going."
		"Our mayor has a policy that offsets aren't the answer; we need to focus on real emissions."
Lack of organizational capacity, both in staff and financial resources, to develop and implement the CPC	Baltimore, Boston, New York City, Philadelphia, Vermont	"The CPC is not a huge priority for an organization that is small and is struggling for funding just to get trees in the ground."
		"The lack of organizational capacity and funding. How would the program have been staffed?"
The perception that carbon offsets can't cover the costs of urban forestry	Boston, Davey Institute, Vermont, U.S. Forest Service	"It is much more expensive to offset carbon in cities than in rural projects. The price for implementation, the price per ton you can actually charge, and the amount sequestered just doesn't match up."
		"Getting the price per ton needed to plant trees in cities down to something that is reasonable for residents and local businesses."
Inadequate marketing resources	Baltimore, Boston, Philadelphia, Westminster, Vermont	"Lack of funding for marketing. If people don't know about it then it's really limited."
		"We would need help with marketing materials. Both marketing materials for urban residents and also for businesses and corporation."
Challenges of working within bureaucratic system	Boston, New York City, U.S. Forest Service	"You need to be aware of the political cache; if a project is dependent on decisions at a city level, the political cycle or special interests can affect the way any initiative goes."
		"Being linked to a city puts you at the mercy of that bureaucratic system."
Lack of models up on which to define the logistics of the CPC	Davey Institute, New York City, Philadelphia, U.S. Forest Service	"There is not a clear path for urban and community forestry projects in terms of registering, carbon accounting, and verification."

		"There aren't enough examples and models out there with urban trees and carbon projects from which to base opinions and make future plans."
Lack of federal legislation and leadership	Davey Institute	"We need cap-and-trade legislation. With that you get a single registry system and a protocol for developing projects that will be common to the entire United States."
The complexities of developing a high quality offset	Boston, Davey Institute, New York City, Vermont, U.S. Forest Service	"If you're going to ask people for money for offsets, how can they be certain that one, you're doing with the money what you're promising to do and two, you are keeping track of the carbon so they can document what has been accomplished with their funds?"
		"I wanted to make sure that this calculator-plus-offset met the rigorous test of third party scrutiny around offset programs. A real, verifiable, additional offset that is not double-counted and meets that offset test."
The state of the economy	Boston, Philadelphia, Vermont, U.S. Forest Service	"Because of the economic downturn, carbon and global warming really weren't at the top of peoples' minds as much."
		"Funding for actual tree planting has been scaled back significantly so it's hard to funnel more resources into developing a project like this right now."

Table 2: Categories of obstacles and specific examples of the challenges identified by interviewees from Baltimore, Boston, the Davey Institute, Philadelphia, New York City, the USFS, Vermont, and Westminster.

The individuals involved in the design of the CPC had a vision to create a tool that could educate, have an actual climate impact through behavior influence, and support local tree-planting projects (and other sustainability initiatives, in the case of Boston) that, among other things, would generate carbon offsets. However, *Table 2* shows the range of the challenges facing the CPC before it can reach its potential. Nearly every obstacle category was identified by multiple interview participants, with issues such as inadequate marketing resources and lack of organizational capacity (notably small staff size) echoed by most of the regional partners. These, along with concerns around managing the logistics of the CPC and complexities of developing a high quality offset, represent concerns that are largely internal to the specific organizations involved with implementing the CPC. Issues such as the state of the economy, concerns that offsets aren't the best way to address climate change, challenges of working within a bureaucratic system, the lack of models, and the lack of federal legislation and leadership are generally concerns that are influenced by public opinion and conditions external to the control of the local organizations involved with the tool.

Overall, it is clear that there are a variety of barriers that have contributed to the idle status of the CPC. It should be noted, however, that nearly all interview participants indicated that they thought the CPC was a great idea and saw some utility for it within their region/organization.

So what does this all mean?

- Ultimately these groups are involved in the complicated process of creating a market for something that hasn't been on a market before: carbon.
- These groups are positioned as the retail offset providers, providing the small transactions of carbon, but in the CPC model they're also considered to be the project developers, figuring out the details of the projects that will generate the offsets.
- The USFS played a large part in developing the carbon accounting piece but partners didn't have the expertise or capacity to figure out the rest of the details. USFS was able to provide significant financial support and leadership on the front end and give legitimacy to the calculator tool itself but the take home message is that the actual tool (the calculator) is only part of that package! Getting all the other pieces together can't be the responsibility of the small local groups that lack capacity and resources, could have other priorities, etc.

3.4. Lessons from similar projects

Despite these challenges, potential solutions can be drawn from other local carbon offset projects. As part of a larger study on urban and small-scale forestry's role in voluntary carbon markets conducted by members of the Forest Carbon and Communities Research Team at the University of Vermont, a number of these types of projects have been identified. Though not identical to the CPC model, these projects have linked the sale of carbon offsets to local tree planting projects and offer insights to shared challenges and innovative approaches to some of these barriers.

Take the case of the Cascade Land Conservancy's (CLC) Carbon Mitigation Program. After partnering with two local businesses to implement small carbon offset projects and being approached by a large funder to assist in addressing its carbon emissions, the nonprofit organization responded to a demonstrated local market by developing a program that would allow future funders to participate as well. CLC partnered with the City of Seattle and encourages funders to calculate their emissions with the Seattle Climate Partnership Calculator[21] on their own; not developing, administering, and hosting its own carbon calculator has saved CLC resources.

CLC staff spent a considerable amount of time figuring out the details of their program and used USFS technical reports and the Climate Action Reserve's *Urban Forest Project Protocol*[22] to guide program design and ensure legitimacy and scientific validity. These resources and others have also been used by groups like the Sacramento Tree Foundation in the development of a 5-year carbon offset agreement with a local building contractor and the City of Austin in developing a carbon offsets option for residents, businesses, and city departments. In early 2011, the Alliance for Community Trees, a nonprofit organization that supports urban and community forestry through member group services, hosted a webcast on carbon offsets and urban trees and developed a list of resources on the topic as well.

[21] http://www.seattleclimatepartnership.org/resources/index.html
[22] http://www.climateactionreserve.org/how/protocols/urban-forest/

In Austin, TX, the nonprofit organization TreeFolks developed and administered a small carbon calculator and offsets programs for several years. They marketed the program mostly to groups and community members that were already involved in TreeFolks' tree planting efforts. Staff from TreeFolks noted that, at the time, the calculator and offsets program was easy to implement because they kept the program small, were aware of the market, and incorporated it into existing programs. When the City of Austin announced that it was seeking local partners to pilot an offsets project as part of its Austin Climate Protection Plan (ACPP) in 2011, TreeFolks staff submitted a proposal: their experience with their own small offsets project prepared them to participate in the city-wide initiative. The ACPP itself was adopted in 2007 and includes a timeline for all city departments to reach carbon neutrality by 2020 and for outreach, education, and opportunities for residents and local businesses to lower overall carbon emissions. Recognizing that offsets will be part of this effort, a carbon calculator[23] was developed through the ACPP and has been functional since 2010, with the offsets component piloting in 2011. A marketing budget has been established and the City is also partnering with the local community-owned utility company, Austin Energy, to implement the project.

3.5. Recommendations

From these examples, some potential recommendations for the CPC can be drawn, including:

- Define the market and allocating resources for marketing before determining the design for the implementation of the CPC,
- Draw on emerging models and free resources (i.e., USFS technical reports, EPA resources) to align the legitimacy of the CPC itself with a scientifically valid offsets component,
- Consider offering the CPC as an educational tool at first, recognizing the possibilities for incorporating an offsets component in the future,
- Consider how the CPC can be incorporated into existing programs or campaigns, and
- Use existing partnerships with other local organizations or existing volunteer support to increase organizational capacity

4. Conclusion

In 2010, the over-the-counter voluntary carbon market traded nearly 128 metric tCO_2e, up from 55 metric tCO_2e in 2009 (Peters-Stanley et al. 2011). According to a recent study, of 404 of the world's largest financial institutions, 68% are currently integrating climate change initiatives into their overall business strategies, up from 48% in 2011 (Carbon Disclosure Project 2011a). A survey of 42 large cities across the globe that are dedicated to climate change leadership showed that 62% have adopted a climate change action plan. These facts point to a voluntary carbon market that is growing and increased opportunities for tools like the CPC to be successful. The lessons learned from the CPC are important foundations for an emerging market of local offsets; they can inform future projects and are valuable

[23] http://austin.zerofootprint.net/

resources for cities and other institutions as they continue to consider ways to address climate change locally.

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The following journals are being considered for this manuscript:

- Journal of Environmental Management
- Environmental Management

Opportunities and Barriers for Urban Forestry's Participation in Voluntary Carbon Markets

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ABSTRACT

Critiques of market-based solutions to environmental problems generally focus on the perils they pose for rural communities in the global South. In the industrialized North, however, voluntary carbon markets may instead offer pragmatic opportunities for urban/suburban communities to add value to local trees in ways that can be used to fund urban forestry initiatives and enhance local educational and environmental impacts. Based on international literature, over 40 interviews, and 5 case studies on U.S.-based projects, we identify the specific barriers and opportunities for local communities to help fund urban and community forestry through carbon offsets. By identifying barriers and profiling models illustrating specific ways they have been overcome, we explore the features common to successful and struggling projects respectively. Our findings suggest that access to forest carbon markets presents special challenges, such as the costs of assuring additionality and permanence for effective climate change mitigation and marketing carbon offsets to urban populations. Moreover, an enabling policy environment and supportive intermediaries will be required for urban participation in forest carbon markets to succeed on a significant scale. Pioneering examples demonstrate that, rather than converting community trees into a globalized commodity, carbon markets can provide an effective way to enhance their *local* value in a number of ways: by producing multiple 'co-benefits' and educating the public and policy-about them; by providing local accountability through 'carbon credits you can see' (independent of expensive-to-meet global standards); and, finally, by engaging people in acting locally rather than thinking of climate change as a responsibility belonging to 'someone else.'

OVERVIEW OF DATA AND CONTENT

Table 1 and Table 2 below show categories of barriers and opportunities identified by over 40 interview participants between 2009 and 2011, aligned with the frequency each category was mentioned. These tables represent our initial efforts of data analysis and we do anticipate to further collapse and/or edit these categories as we continue to analyze the interview data. Further, we will categorize interview participants as:

1) individuals that have participated in the implementation of a carbon project,
2) individuals who are engaged in carbon markets,
3) individuals who are experts in urban forestry, or
4) a combination of one or more of these categories.

We will then align interview participant categories with the data in the tables below to analyze which groups of participants most frequently identified which barriers and opportunities, respectively.

BARRIERS	FREQUENCY
Complexities of developing a high quality offset/project	**35**
Lack of organizational capacity to develop and administer a project	**17**
Inadequate Marketing Resources	13
The perception that carbon offsets can't cover the costs of urban and community forestry	12
Lack of models	12
Uncertainties about offsets and the voluntary carbon market	12
Lack of federal regulation	11
Concerns about up-front costs and effort	10
Concerns about accounting and ensuring funds are directed to the right place	9
Challenges of working within a bureaucratic system	8
The state of the economy	8
Concerns about existing protocol (CAR)	8
Lack of uniformity and standards	8
The limited potential of urban forests to sequester carbon	7
Employee turnover	2
The pitfalls of being an early adopter	2
Difficulties around maintaining good relationships with partners	2

Table 1: Barriers identified by interview participants, with frequency mentioned indicated.

OPPORTUNITIES	FREQUENCY
Supporting local initiatives and targeting local populations	**23**
Institutional sustainability goals and initiatives	**23**
Interest within the urban forestry community and from the public	**17**
Highlighting the cobenefits of urban trees	15
Resources are increasingly available	15
Using existing or creating new partnerships	15
Without uniform standards, ability to use creativity and liberty in project design	12
Existing organizational capacity	11
Promoting sustainability education and behavior change	7
The pre-compliance market	6
Leveraging and raising funds for urban and community forestry	6
Fostering small-scale and bottom-up approaches to climate change	6
Greening new spaces	4

Table 2: Opportunities identified by interview participants, with frequency mentioned indicated.

Barriers and Opportunities
for urban forestry participation in carbon markets

Raw data table: Quotes selected from 42 interviews with urban forestry and carbon market practitioners and professionals in the US.

Table 1. Barriers to participation

CATEGORY: BARRIERS	*SUB-CATEGORIES*	INTERVIEWEE RESPONSES
The perception that carbon offsets can't cover the costs of urban and community forestry		"There hasn't been any real information about at what scale it becomes economically feasible to go through the verification process and register a project."
		"There are huge economics of scale because of the substantial verification costs -- where do urban forests fit in?"
		"The TreeFolks carbon calculator was never a significant source of revenue."
		"A tree won't create that much of an offset."
		"Assume a city is using the Climate Registry reporting protocols for urban forestry. If this is the case, the modeled sequestered carbon of what I'll term an "average urban tree" (a 12 inch DBH American Elm) only amounts to about 1 metric ton of CO2. If it costs upwards of $250 (stock, equipment, labor, maintenance) to plant a viable B&B street tree in a city this amounts to a very high cost per ton of CO2. How can one make the numbers work such that it makes sense to go forward with a planting program that is truly funded by the sale of offsets?"
		"CCX was pretty loose and not at all rigorous and then CAR is very very rigorous and so rigorous that an urban forester was just like 'that is impossible and not worth it'. I would agree that when carbon is worth pennies, it is not worth it."
		"Getting the price per ton needed for trees down to something that is reasonable for residents and local businesses."
		"Trees in municipal areas need maintenance and care and I don't care how much carbon it's sequestering, you won't make up that cost with just the cost of carbon."
		"The trading price of carbon on the CCX would not support urban tree plantings. There is not an economic incentive to plant trees just for the carbon benefits."
		"It is much more expensive to offset carbon in cities than in rural projects. The price for implementation, price per ton you can charge, and amount of carbon sequestered by each tree just doesn't match up."
		"It is ultimately not economically feasible to fund urban tree planting with carbon offsets."

		"At the MillionTreesNYC meeting last year one of the scientists actually said that there's no money in carbon offsets so we should focus our energy elsewhere."
Concerns about accounting and ensuring funds are directed to the right place		"Who would handle the accounting piece of the CPC?"
		"As a state entity, we really had troubles trying to figure out where the money would go."
		"We spent a lot of time thinking about administration; where would the money go when someone donated and who would deal with it? How would we make sure that it was properly accounted for?
		"What do you do with the money? Which organization does it go to?"
		"No one knows how much money was collected or how much carbon was offset through the program."
		"It is important to have a valid project. If you're going to take money from people and tell them it's going to plant trees then you need to make sure that is where that money actually goes."
		"There would be a lot of energy put into deciding who would be the recipients of the money."
		"How do you maintain and administer this program? How do you cover that cost? Government is't particularly good at managing these types of programs. Finding a third party at a low cost to do it also a challenge, particularly when you don't know how the market will react to it."
		"If you're going to ask people for money for offsets, how can they be certain that one, you're doing with the money what you are promising to do and two, you are keeping track of the carbon so they can document what has been accomplished with their funds?"
Lack of or issues around organizational capacity		"You need to be able to make a long-term commitment to the project."
		"Lack of organizational capacity, which leads to having to prioritize things and this was low priority."
		"For small groups, is it even worth the expense? Unless there is money available, unless you have the carrot and the stick, there is no incentive. There must be an incentive."
		"There is a general lack of technical expertise within small urban forestry nonprofits. How do we provide them with the resources and information to be the most effective?"
		"Limited resources for small nonprofits and lack of organizational capacity."
		"The science behind the carbon calculators can be difficult. Who is doing it? Who is teaching it to the nonprofit groups that could implement these projects?"
		"The project took over a year to complete because it was done in my spare time with just an undergraduate student assistant."
		"Lack of familiarity with the market. While I am a forester and an arborist, I'm not a carbon offset expert."
		"To a certain extent, the images and the data in terms of my techincal expertise --- well I don't think a typical community would have that."
		"We don't have the orgnaizational capacity at this point."

		"The CPC is not a huge priority for an organization that is small and struggling for funding just to get trees in the ground."
		"Lack of organizational capacity and funding. How would the program have been staffed?"
		"The organizations and resources to develop a project: data collection, monitoring, reporting expertise, and the ability to verify. It may not be worth the input for some organizations."
		"Lack of organizational capacity."
		"Do we pay for this or do we put new benches in the city park? Do we pay a community programmer to create a carbon calculator for urban trees or do we do something else with that money?"
		"Lack of organizational capacity to properly launch and run a program."
		"Lack of capacity and resources to really develop a good project in a timely manner."
Challenges of working within a bureaucratic system		"The bureaucracy of working within a city sustainability campagin. When you're doing public education and awareness, you want to be following your city's branding pretty rigidly."
		"Being linked to a city puts you at the mercy of that bureaucratic system."
		"You need to be aware of the political cache; if a project is dependent on decisions at the city level, the political cycle or special interests can affect the way any initiative goes."
		"Each city wants to do its own branding and put their own name to a product, which takes time and resource."
		"Cities are engaged in many different sustainability initiatives and a carbon project may be low on the priority list."
		"Opposition to carbon credits. There is a constituency out there that is kind of actively marketing against it as well so it's not evne a 'starting from zero' thing. There are well-funded groups that fairly actively market against it."
		"If you are trying to implement a project in a city, there may be political challenges. Not everyone is supportive of carbon offsets and these types of project."
		"There may be limitations to what a city can actually commit to. How much authority do those entitites actually have if they are planting in 'public' spaces?"
The limited potential of urban forests to sequester carbon		"Where are all these trees going to go? How are we going to retain enough space for canopy that functions for all of those benefits?"
		"Well, you know, if you're really talking about climate action and emissions, trees are just a miniscule component of this compared to the carbon that is emitted and the potential investments that the city could make to reduce emissions. It's a question of where do you focus your attention."
		"The bottom line is that it takes a lot of trees to offset the emissions of a large power plant and the densities you find, even in the pretty green urban areas -- it's just difficult to think of it as a major mitigation strategy. Relatively limited opportunity and limited space."

		"Yeah, it's a real sexy thing, we're going to offset carbon by planting trees, but when the rubber hits the road, what is it really doing?"
		"The trees on MSU's campus don't actually do that much in terms of sequestering carbon. They only offset about 1% of MSU's total emissions."
		"If you are calculating carbon from individual trees, you are dealing with a very small amount of carbon."
		"There is a small amount of carbon sequestered by the urban trees, according to the recent Portland parks carbon inventory"
Employee Turnover		"When Scott Harris left TreeFolks, he took his knowledge of and enthusiasm for the carbon calculator that he designed with him."
		"Employee turnover has made it difficult to keep the existing carbon calculator going. I didn't really have a clear understanding of it."
The pitfalls of being an early adopter		"There are negatives for being an early adopter. Plantings or projects done prior to a reporting period of a given protocol could be excluded from a future market."
		"The problem is that without that single system, you don't know if all that work will be transferable to that eventual single standard, so people are hesitant to jump in because if the game changes you don't know if everything you had done to date will even count."
Fostering good relationships with partners		"You need to be conscious of relationships and make sure that everyone involved is comfortable with your calculations and project design."
		"You need to continuously touch base with all of the partners to make sure that everyone is on the same page. There is a level of green competitiveness that may come out of multiple partners working on a project."
Concerns about offsets	***Uncertainty in the market***	"The Wild Wild West of voluntary carbon markets -- there was little transparency to where the investments were going."
		"The market for carbon is volatile.There is a lot of uncertainty about carbon markets and about using forests in carbon market."
		"There is tremendous uncertainty about the fate of the market."
		"Uncertainty in the market."
		"In my opinion carbon offset's really aren't that valuable (compared to the cost of planting urban trees.) For us, it's more fruitful to sell a tree planting as a team building or marketing or corporate responsibility event. People are willing to pay more for those things than carbon offsets."
		"We're just not as a society assigning a higher dollar value on carbon offsetting activities."
	Offsets aren't the answer to climate change	"Offsetting your carbon so that you've been absolved of your carbon sins . . .I just totally disagree with that."
		"People have concerns about carbon offsets being the most environmentally responsible choice. Shouldn't we be focusing on emissions reductions."

		"Cities with carbon issues are going backwards. People really have too many quetsions about carbon on its own."
		"There is a weak tie between climate change and the word 'urban'."
		"There's no potential for doubters last I checked there were no "team-building" deniers [urban forestry projects emphasize team building] but there are global warming deniers."
		"New York City's mayor has a policy that offsets aren't the answer; we need to focus on real emissions reductions."
The state of the economy		"The state of the economy in 2008 and 2009 may have been what really took the wind out of the program."
		"The economic downturn weakened the chance for the project to pass through city council. People didn't really care as much."
		"The economic downturn in the late 2000s put these types of projects lower on the priority list."
		"Economic turmoil. We have had to refocus our core missions and so I would say that the CPC is active but less intensively. We had to restrategize as to how to keep the program [Grow Boston Greener] going.
		"Because of the economic downturn, carbon and global warming really weren't at the top of peoples' minds as much."
		"Cities are dealing with the economic crisis so it could come down to a matter of funding and priority."
		"The economic downturn led to budgeting issues and put the Boston CPC lower on the priority list."
		"Funding for actual tree planting has been scaled back significantly so it's hard to funnel more resources into developing a carbon project."
Concerns about the up-front costs and effort	***Market needs to be demonstrated***	"The market really needs to be demonstrated. If groups and municipalities knew that there was a market they would prioritize carbon projects."
		"Finding the right people and funders to talk to might be difficult."
		"You need to demonstrate a market. The link between the corporations and the city and the nonprofits are what need to happen."
		"There is no research or information to demonstrate that there is actually a market for urban forestry carbon projects within the corporate funding world. If we had that information and knew that the market was there, we would put it higher on the priority list."
		"Everybody is sitting on this; the US Forest Service has been staying out of the credit world and not aggressively working on it because we don't even know who we'd send it to if we did work on it."
	Up-front costs of project development	"The costs of developing and hosting the calculator were burdensome for us as a small nonprofit."
		"There are significant costs related to assessing whether or not you even have a project that is viable and will be effective."

		"The up-front costs of inventorying, figuring out the accounting, getting something verified --- these are all substantial."
		"Implementing a carbon project to fund urban forestry on a large scale could be too complicated."
		"There is no funding mechanism to get the funding for urban tree planting groups."
Concerns about existing protocol		"The CAR protocol is technical and most people that work in urban forestry don't have the background or ability to make that happen."
		"I think people are put off a little bit by the issue of 100-year permanence in the CAR protocol."
		"If you want to verify your urban forest project you need to go through CAR, but because of permanence requirements, only universities, utilities, and municipalities can register a project. It is hard for a nonprofit to become engaged there."
		"Nonprofit organizations can't guarantee permanence since you need to demonstrate 100 years to comply with CAR."
		"The CAR protocol was written for the west coast, but other areas -- Florida, for example -- might have problems adhering to the species diversity and varieties of species included in CAR."
		"It is expensive to have projects verified on CAR, which is the only viable registry for urban forestry."
		"The costs of going through the verification process (CAR) is high for a nonprofit organization."
		"The costs of doing CAR are greater than the benefit."
Inadequate Marketing Resources		"Marketing. It has to be in the plans up front."
		"No budget for marketing."
		"Marketing is difficult. Communicating complicated carbon market lingo is difficult."
		"Inability to properly market."
		"Lack of funding for marketing. If people don't know about it then it's really limited."
		"It can be financially difficult to get the funding to properly launch and market a project."
		"Lack of marketing capacity."
		"We would need help with marketing. Both marketing materials for urban residents and also for business and corporations."
		"You need to be able to present a project like this to the public in a way that would make sense to them."
		"We have not marketed it to the public so exposure has been very limited."
		"Effectively marketing and acquiring the funding to market."
		"Marketing is difficult and communicating complicated carbon market lingo is also difficult."

		"The only restricting factor for it was marketing. The marketing of the thing was just very much a backburner thing. We did not have the resources to market it adequately."
Lack of federal regulation		"The incentives are not in place, in terms of a regulatory policy."
		"The lack of federal regulation is hindering projects from development."
		"What just happened in the November elections pretty much assumes more bad news for people interested in seeing things like cap-and-trade and carbon markets move forward."
		"There are no rules, no laws. Someone needs to set the precedent as to who is making the rules. The EPA could play that role. Until someone comes out and says 'we're going to fund urban forestry getting on board', no one is doing it"
		"Lack of policy."
		"The biggest issue for forestry is getting legislation passed. Cap-and-trade is the best approach."
		"The lack of federal regulation. We've gone backwards."
		"People don't see air quality and CO2 concentrations as a local problem; they see it as a state or federal problem that needs to be regulated."
		"We really need to have federal leadership on these types of issues."
		"Lack of federal leadership and regulation."
		"Climate policy has been two years away for 15 years. We need it."
Lack of uniformity and standards		"The fact that the methodology is not standardized at all. We need to move ahead and get protocols established."
		"Lack of uniformity. I looked at a lot of calculators out there and there was a tremendous difference in how they calculated the carbon and a large range of pricing."
		"There is a lot of hesitation because of the lack of uniform models, standardization, and policy."
		"Lack of uniform standards and the variety of protocols is confusing."
		"Carbon calculators need to be standardized."
		"There need to be quality standards for urban forestry projects."
		"Lack of standards."
		"We need cap and trade legislation. With that you get a single registry system and a protocol for developing projects that will be common to the entire U.S. and that will be the pathway."
Lack of Models		"Nonprofit groups need a starting point! There is a lack of examples."
		"In 2007 there was no track record of people successfully and actually sequestering carbon through urban forestry."

		"The lack of existing models of successful projects."
		"It takes a lot of time and resources to develop a project since there aren't models and standards. There need to be models and a 'how-to' guide"
		"There is not a clear path for urban and community forestry in terms of registering, accounting, and verifying."
		"Lack of models --- is it economically feasible?"
		"I think that offsets are interesting but they're very new and I'm a bit learly of them."
		"It is too nebulous. Who is running the show?"
		"There aren't enough models for projects so groups like us don't know what works and what doesn't work."
		"There aren't enough examples and models out there of urban tree carbon projects from which to base opinions and make future plans."
		"How do you start a market for something that hasn't had one before?"
		"How to create a market for ecosystems? These are things that people have not traditionally paid for and how by trying to put a price on it, we create a market for it."
Complexities of developing a high quality offset / project	***Additionality***	"Many cities are setting goals for increases in Urban Tree Canopy. After announcing a goal does increased planting (by a municipality, say) for the purposes of meeting this goal count merely as “business as usual” and not additional? If so, is it best economically to avoid setting enforceable goals so one can participate in a market? The additionality question related to natural resources offsets is one that needs to be resolved."
		"You're asking me if MSU purposefully planted trees and would have planted trees for carbon benefits? The answer to that is 'no'."
		"Additionality"
		"The test of additionality."
		"Additionality."
		"Additionality."
	Permanence	"Most urban forestry non-profits (such that I’m aware) do not own the land on which they facilitate tree planting. Thus, they have no stake in the “permanence” of the trees that they plant. . . the issue of permanence would have to addressed. RGGI has the false premise of a long-term protective instrument on trees planted for credit. However, the market should address permanence – if someone has spent the money to invest in planting and maintenance, they cannot redeem the offsets until they get return on investment so it behooves them to care for the trees until they get to maximum creditable size"
		"There are permanence issues with urban trees and with guaranteeing that the trees will be where they are for the long term."

		"There might be reasons that you need to remove the trees you planted. Cities change over time."
		"The permanence of urban trees."
		"The verification piece is really important, especially around permanence. You could plant one million trees today but if they're all dead tomorrow then what have you done?"
	Verification	"Questions around the verifiability of the carbon calculator and if the money was actually doing what it said it would do."
		"The pitfalls of an offsets program. I wanted to make sure that this calculator-plus-offset met the rigorous test of third party scrutiny around offset programs. A real, verifiable, additional offset that is not double-counted that truly meets that offset test."
		"Verification is important and the costs are high and there is also uncertainty about carbon offsets and urban trees."
		"Some of the things that counted as credits [in looking at carbon calculators and offset programs] were really questionable."
	Carbon Accounting	"How do you calculate the carbon? Are you calculating over 40 years, because you're not getting a real benefit for the first 20-30 years -- are they going to live? Who is going to maintain them? Just a multitude of questions that really chip away at the validity of a program in the urban forest."
		"The complexities of the calculations and the need for verification was too cumbersome."
		"I couldn't even figure out how to structure a conversation [about an offset project]. I do understand the concept but how do you structure a project and how do you do the calculations?"
		"I would have concerns about the carbon accounting being accurate and verifiable."
		"You need to be able to understand and make sure that all the calculations involved are valid and are doing what you say they are doing."
		"Working with the CPC we realized how extremely complicated it was to estimate how much carbon was actually going to be sequestered."
		"A challenge would be the calculations involved and really feeling comfortable with them."
		"The science behind the calculations and keeping the calculations up to date and accurate canbe a challenge."
	Monitoring	"There needs to be a real, long-term monitoring plan. You have to be able to see and count the tree, know its health, and have all of that information in a database."
		"The need for verification and monitoring."
		"The potential for overlap. The municipalities, the nonprofit, the utilities, but they all overlap the same territory so how do you set up a system where people aren't tripping over each other or double-counting? How do you coordinate things around carbon?
		"Monitoring and reporting could be difficult. How do we monitor what is the actual benefit?"

		"Buyers need to know that their product has value. So you really need to be able to document and track the actual environmental impacts of the thing that they're buying."
	Ownership	"There are questions around ownership. Planting trees on city property but then a nonprofit claiming the carbon mitigation services from them."
		"There are issues around ownership of the actual carbon offsets; who owns it is a big question for urban forestry."
		"Legal issues around ownership of trees in cities. Does the city, the homeowner, or the nonprofit get the carbon?"
		"Ownership of the trees. You have trees on private property, you have trees in the right of way, and then you have different entities maintaining them. Then those entities feel like they have the rights to that carbon. Very complicated."
	Wording	"You need to be careful about wording. 'Offset' and 'Mitigation' mean different things."
		"You need to make sure that you are using language that is precise and clear in the project design."
		"The difference between 'mitigation' and 'offset'."

Table 2.
Opportunities for participation

CATEGORY: OPPORTUNITIES	*SUB-CATEGORIES*	INTERVIEWEE RESPONSES
Resources available		"We have the technology and we have the ideas but we're really just waiting for someone to shake things up around carbon credits."
		"The fact that we even have a CAR -- that we even have an exchange that is growing -- is a good thing. It shows that there are models that can be replicated. So the beginnings of a wide implementation of a national platform are there."
		"The U.S. Forest Service could and is feeding some of the support, financially and also via technical reports and resources."
		"It is pretty easy to use local data and create local carbon calculators for specific cities. The basic calculations are already there."
		"This is important work you are doing [to me]; you are giving these projects and this opportunity some exposure."
		"There were a lot of carbon calculators online that we looked at to help figure out our calculations."
		"There are tools and resources available for free to help with carbon accounting and with understanding carbon and urban trees, specifically, i-Tree. There are also a lot of people willing to help and give you support, like the people at Davey Tree Sciences."
		"There was a lot of material that we found online for free that we used to guide the design of the program and to inform our calculations."
		"Models are actually starting to emerge, like the Boston CPC."
		"Having resources available online, for free. It [the CPC] just looked like a very easy tool to use, which I think is very important. The fact that the U.S. Forest Service established the CPC I thought added a lot of credibility to the program and the tool itself."
		"There are models that are beginning to emerge and could be easy to implement."
		"The availability of U.S. Forest Service reports and other research online and also the availability of the carbon calculators to model a project off of."
		"The availability of U.S. Forest Service technical reports and articles is a plus."

		"We used U.S. Forest Service technical reports and the USDA Plants Database."
		"The model of the Sacramento Tree Foundation case could be a good fit for us because we have a lot of contractors in the area and they could be interested."
Partnerships	***Building upon existing partnerships***	"There are opportunities to use existing partnerships to help with things like marketing."
		"Potential to build on existing relationships -- with the Forest Service, for example -- and to forge new partnerships as well."
		"We could build upon the existing Green City Partnerships Program that the Cascade Land Conservancy implements."
		"Existing partnerships between the U.S. Forest Service, cities, and tree planting organizations in those cities can get things moving."
		"We could use our long-standing relationships with certain funders and sponsors to get the project rolling."
		"Opportunity to work off of an existing partnership with the City of Austin."
	Creating new partnerships	"There are opportunities for partnerships with the city and/or local nonprofit organizations."
		"There are lots of organizations and people getting involved with city sustainability that could be pulled in and they could all help with marketing."
		"There are opportunities for collaboration between multiple partners."
		"Opportunities for partnerships within city departments and organizations."
		"There is great potential for valuable partnerships."
		"A carbon project could provide opportunities for innovative and important partnerships."
		"The partnership options and the ways to optimize that community-building potential by having the community organization be the face of the project, opposed to the city entity."
		"Potential for public-private partnerships. Taking advantage of what the nongovernmental organization is the best and what the city is the best at."
		"Opportunities exist for partnerships with municipal sustainability offices."
Education and behavior change		"The opportunity to see more people more aware of their environment and taking better care of it. I see the CPC as a tool that will help with that. It's public education, improving the environment, and trying to deal with climate change as much as possible."
		"There is the potential there for public education about trees and climate change and energy consumption."
		"A project could help increase public awareness about carbon, trees, and climate change."
		"[the CPC] engages residents in understanding their carbon footprints and engages them in participating in efforts to offset their emissions, primarily through tree planting."

		"A way to link urban environments with climate change and to educate the public about that."
		"It would be a way to begin to educate urban residents about the importance of reducing emissions."
		"It is a good way to educate people about emissions, climate change, and trees."
The pre-compliance market		"Utilities and states may make up the pre-compliant market."
		"The Department of Transportation owns a lot of land. Potentially, if and when carbon becomes commoditized, you have an asset here, essentially."
		"The pre-compliance market provides a lot of opportunities, specifically with utility companies."
		"There is a market for utility companies that are interested in participating in something that is pre-compliance."
		"Entities such as auto groups and dealers or utilities could be interested in funding projects, as a pre-compliance measure."
		"There is a pre-compliance market that we can tap into."
Without uniform standards, ability to use creativity and liberty in project design		"The lack of uniform standards and examples of similar urban forestry projects essentially allowed us to design the project quickly and how we wanted to. We were able to quickly develop the project; it was designed and launched in a matter of two months."
		"A project does not have to be as complicated as some people think."
		"TreeFolks designed their own calculator pretty quickly and smoothly."
		"Forest offsets have a role in the sense that they can be implemented very quickly while companies and institutions are getting around to implementing other more permanent systems."
		"There is currently room for creativity and liberty to design a project based on your ability to measure and verify."
		"There are opportunities for creativity to design a project at an organizational level."
		"Because of the lack of uniform standards, you can have a really simple project that you've just designed yourself. You can build a project off an existing program already established in your organization."
		"You can build a project off an existing program already established in your organization."
		"It doesn't have to be very sophisticated. All you're doing is taking some money because you're a bad person and putting it over here to be a good person."
		"Nonprofit organizations can use existing programs; they can support programs that they already have going."
		"The advantage of being a small nonprofit is that you can move quickly and make your own decisions. A project can be built off existing projects. The TreeFolks calculator supported existing programs."
		"The actual development of the formula and the putting it into place was really simple."

Leveraging and raising funds for urban and community forestry		"A carbon project could be a great way to augment other veins of funding."
		"A project is a way to incorporate urban forestry and get more trees in the ground."
		"There is an opportunity to raise funds through a carbon project."
		"if there were a way to garner revenues for maintenance and care of existing stock, we could increase longevity and increase carbon sequestration."
		"When CCX was selling carbon at $7/ton people were excited and we were too, because we thought that this could be a good opportunity."
		"The CPC was seen as a way to raise money for tree planting in major U.S. cities."
Existing organizational capacity		"Parks has a foundation so a project could be tax-deductible."
		"Cities often own a lot of land and can afford the verification costs. Cities can also guarantee permanence."
		"Seattle has an existing pool of Forest Stewards. These volunteers are willing to do the actual labor."
		"Our existing inventories provided a good basis for a carbon project, in terms of accounting."
		"MSU has a nearly complete census on its trees, which made the project easier."
		"We have an existing tree inventory, with a carbon inventory that has been updated annually; this is a place to start."
		"If you already have an inventory and tree survival data, it is helpful in starting a project up."
		"We had existing volunteer support in the form of students in classes to help with inventorying the campus natural areas."
		"Lots of local volunteers to support and help out with projects."
		"We have commitments from the residents that they will maintain the planted trees, which is helpful."
		"MSU has a campaign where we have been actively planting trees. These plantings serve a bunch of other purposes. And we essentially created a system where the university could essentially get credit for something it was already doing."
Greening new spaces		"Philadelphia has 40,000 vacant lots going back to grass, going back to forest."
		"In the Midwest you have a combination of a lot of old industrial areas which are just sitting there and are being considered for potential new green spaces."
		"There is more potential to work on the metro level on this because there is more actual space on the rural-urban interface."
		"There is interest in projects because of an interest in revitalizing urban areas and reclaiming degraded urban land for green spaces."
Institutional sustainability goals and initiatives		"There are all of these different mayors that want to be the greenest, have the greenest city; so there is a level of competition that could drive projects."
		"Well there is a market -- large funders in Philadelphia are interested."

		"When NYC and Baltimore and Philadelphia heard about the CPC they were saying 'when can we have a version, when can we get it?'"
		"This initiative also produces a good news story. 'Hey check out this great tool; Austin is doing these really great things'."
		"Cities want to be the 'most green' so there is this new inter-city sustainability competition. City leaders are cognizant of how they are rated and this could provide opportunities for urban tree carbon projects."
		"There are major supports of us and major institutions in Philadelphia that want to be 'green', so there is a market."
		"There is a lot of interest from large funders and corporations. They gain 'green' points."
		"There are a lot of players, in this region in particular, that are already interested in being in the game."
		"Corporations and local businesses are interested in being involved so they can enhance their 'green' portfolios."
		"Cities need local partners to achieve their sustainability goals."
		"Many cities have sustainability goals and may be willing to support an urban forestry carbon project."
		"The City of Austin has a carbon neutrality goal and they already know that they'll have to offset, which provides an opportunity to us offset producers."
		"Portland has sustainability goals, 2050 climate goals, a Climate Action Now campaign. There are a lot of goals and points around urban forestry so this could fit in well."
		"There is a market for institutions that seek to be more sustainable. MSU, the university, joined CCX as a voluntary member. So we volunteered to take on the additional costs to make the university more sustainable."
		"Carbon and emissions reductions are part of the mayor's climate plan."
		"Our board of directors has been saying 'we've got to do this', regarding carbon offsets."
		"Participating in a carbon offset project is a 'good thing to do' for MSU in terms of sustainability and promoting greening."
		"The CPC could have been a big part of the city's sustainability goals and package."
		"A carbon project could fit well within city initiatives to increase canopy cover."
		"Grow Boston Greener mandates that we're planting 10,000 trees in Boston."
		"Our mayor was interested in sustainability and so our efforts to develop a project were leveraged by overall goals of the city."
		"Universities want to cut emissions and reach carbon neutrality so they will try anything."
		"Seattle has a strong focus on climate change action so there is general support."

Cobenefits of urban trees	***Opportunities to sell premium offsets***	"Because the offsets associated with trees in urban areas are providing multiple benefits, you can charge more for these 'premium' offsets, which could allow you to actually fund a program."
		"A project could really focus on the cobenefits of trees in cities, informing the public and also leveraging more funding."
		"Urban forestry will be a premium offset."
		"There seems to be a premium for offsets in urban areas."
	Highlighting cobenefits	"You can highlight the cobenefits of trees through a project."
		"These types of projects are done for social reasons and not just for greening and air quality reasons."
		"A good project could be a way to draw attention to the multiple benefits of urban trees."
		"You are demonstrating the relationship between the carbon value of trees and their other cobenefits."
		"There are multiple benefits of urban trees that could be highlighted through a public tree program with offsets."
		"The other benefit is the social capital that you get out of it. The awareness factor of people who are out there; 70% of our volunteers never volunteered in their neighborhood before with us and 30% of them volunteer again."
		"Trees are planted for multiple reasons and carbon is just a piece of that. The total value of the trees is more than just its carbon services."
		"We undervalue each of the pieces of trees because we don't look at all the pieces together. That's really where the story needs to be. Giving people the option to donate because that's what they want to do."
		"Opportunities to emphasize the complimentary benefits the trees provide."
		"Highlighting the multiple carbon benefits of trees, such as sequestering plus avoided emissions and shading."
		"This is about going beyond trees. To the cobenefits of trees."
Small-scale and bottom-up approaches		"Cities can take the lead. Urban forestry carbon market projects could fit well in small-scale sustainability initiatives."
		"There are opportunities for small-scale institutions such as universities and municipalities to take the lead on voluntary carbon markets."
		"Rather than the policy and top-down approach, why not open it up and do it through social media and grassroots groups?"
		"What these small groups and nonprofits are doing is important because they might be setting the precedent."
		"I think that there would even be an opportunity for other groups to have a small consortium to see if we could try to figure this all out. At the grassroots level I think the challenges could be overcome, especially with the urban-rural interface expanding."

		"He is a really cool human being and a really good grassrootser. So he is a very relational kind of promoter. He does everything on heart and backbone. That was the success of the program."
Interest	***Personal Interest***	"We are talking with a lot of other organizations about mitigation. Mostly about stormwater, but then there is carbon too."
		"Carbon and urban trees is being talked about, we're looking at it, I've researched it a lot."
	Others have expressed interest	"I've been asked to give a lot of talks on our carbon project. You know, people get very excited about it."
		"There are a lot of people and businesses in cities that are interested in this type of work."
		"People engaged with the voluntary market are really just looking for something to invest in and that presents many opportunities."
		"There is public interest in trees, sustainability, and climate change in Seattle."
		"It drew a lot of attention from other people in the industry, in urban tree planting; it was basically thought of as a good calculator."
		"I decided that if our credits were valuable for somebody else, they might be valuable for us."
		"People started getting excited about the potential for offsets and urban forestry in about 2008. There is interest but no one knew anything. It's not much different now."
		"I was contacted by multiple other urban foresters and other organizations interested in how I developed and implemented the project."
		"We offer a carbon verification service and there has been interest from all across the country from nonprofit groups and municipalities, mostly inquiries."
		"We can tap into the market of people that want to impact climate change."
		"People are interested in innovative sustainability initiatives."
		"Ecosystem services markets are really starting to be talked about and worked on."
		"It is all very interesting and people are eager to see where this is all going."
		"Everyone who was exposed to the TreeFolks carbon calculator had favorable impressions of it."
		"Potentials for emerging ecosystem services markets."
Localness	***Supporting local initiatives***	"Green spaces, parks, and riparian areas could be more viable areas to implement a project and provide a place where you can actually go and look at the tree. It's not some tree in Malaysia where you just don't know ....there's no follow-up on that. There is more support for local projects than for tree planting projects in other countries."
		"There are investments that can be made locally that can both offset emissions and provide other benefits."
		"This offsets project will create a local project that people could then copy."

		"There is a lot of focus on local initiatives right now and this fits right in."
		"There is a lot of interest in supporting local projects."
		"A project is a great outlet for local offsets."
		"There is a market for local offsets."
	Targeting the local population	"For corporations that want to invest in their local community; they want to know what they're getting for their money."
		"Community-based, local initiatives could be tied to a carbon project; people want to support local projects."
		"The opportunity to encourage people to support local sustainability efforts."
		"Opportunities to target local consumers and local residents."
		"Giving Philadelphians the chance to offset locally with a cause that is local."
		"People are really interested in local projects."
		"Westminster started thinking about offsets when they were approached by a local business. That scenario spurred the idea that if there's one business that is willing to do that than maybe we could persuade other businesses to do that also."
		"There were corporations in Boston that were interested in donating to get this local project started."
		"There are people who just want to donate to something for community investment or to feel good about themselves."
		"Everybody loved this project and everyone was really happy with me. I got a lot of accolades. People want to do more in the community, they want to green their communities and they want to do good things for the environment."
		"A carbon project is appealing to the local population that wants to produce change. In Colorado specifically, people are concern about climate change because it could effect ski season."
		"Austin has a lot of festivals and events and there will be opportunities for people traveling to offset their travel and also the carbon calculator and offset options will be visible at those events."
		"There are a lot of local opportunities like cultural events, fairs, arts, etc. where it is effective to talk about these types of projects."
		"There is a market for carbon for local businesses that want to have lower carbon footprints."
		"Getting people to think about buying offsets for local projects. So to do the tree plantings locally rather than having trees planted in, say, Brazil."
		"Communities like Austin would be very receptive to an offset program if they knew about it."