



Reforestation Hub Assessment

Prepared for the Arbor Day Foundation and the City of Pittsburgh



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Key Terms / Abbreviations

Additionality	Term used when evaluating carbon offsetting projects. An emissions reduction is considered “additional” if would not have occurred without the incentive of a carbon market — that is, the project reflects a departure from business-as-usual, or “additional” carbon capture.
Carbon Offset	A certified reduction of 1 metric ton of carbon dioxide emissions. These “carbon credits” are generated by third party-verified projects that reduce atmospheric carbon and are purchased by entities looking to offset other carbon-emitting activities.
Circular Economy	An economic model focused on the continual reuse of resources. Often contrasted with a "linear economy," where products are used once and then retired to an end-of-life state (e.g., in the landfill).
CO₂e	Carbon dioxide equivalent. This is a standard unit of measuring the global warming potential of greenhouse gases, expressed in relation to carbon dioxide emissions.
DBH	Diameter at breast height, the standard unit for measuring the width of a tree. Breast height is taken at a point 4.5 feet off the ground.
MT	Metric ton, a unit of mass equal to 1,000 kilograms or 2,205 pounds.

Executive Summary

The goal of this assessment is to provide a roadmap for driving new resources into the City of Pittsburgh's urban forest through two central avenues: **urban wood salvage** and **carbon offsetting**. This report looks at the current opportunities and constraints around wood reuse and carbon project development, as identified by key local stakeholders.

Findings suggest that a wood waste recovery program could help capture significant social, environmental, and economic value for the City of Pittsburgh (the City). While more than 2,000 trees are estimated to be removed each year throughout the city, there is at present little salvage of wood as a durable or high-value resource. Instead, most woody debris is chipped for mulch or compost. By centrally aggregating and processing urban wood waste, **the City could capture up to \$403,111 in lost economic value from removed trees annually** while reducing fees paid for wood waste disposal.

In addition, this assessment considers the feasibility of various carbon offsetting projects as a means of protecting and restoring Pittsburgh's urban forest. From preservation projects to new tree planting, we assess the pros and cons of different carbon offsetting protocols and outline the process from project initiation to credit issuance.

This analysis has resulted in the following recommendations for the City of Pittsburgh:

- **Establish an organic recycling center.** A basic cost-benefit model of an urban wood processing site suggests that central aggregation and processing of in-house tree removals could yield a **net present value of \$420,690** over a period of 10 years, accounting for infrastructure investment and the employment of a minimum of three site staff. By overseeing processing of the bulk of its own wood waste, the City stands to realize significant cost and material efficiency gains. In addition, investing in higher-value processing of woody biomass can provide an opportunity to collaborate with local partners to build workforce development programs, resulting in greater operational capacity and increased community impact.
- **Support the market for urban wood.** Large-scale wood reuse often begins as a demand-side challenge in identifying end markets for recycled material. The City can

1,362

Number of tree removals conducted by the Division of Forestry in 2020

937

Estimated number of additional tree removals on private property in 2020

\$27.49 / ton

Disposal fee paid by the City for Wood Waste Recycling

\$317,644.92

Total contract amount paid to Wood Waste Recycling from 2017 to 2019

\$660,000

Estimated carbon revenues from a 200-acre preservation project at Hays Woods

support the development of urban wood markets through a few key avenues. First, it can incentivize use of urban wood in its own projects by developing procurement policies that give preference to local, recycled wood material. From picnic tables and park benches to tree stakes and mulch, the City can advance its zero-waste agenda and cut external costs by increasing the use of salvaged material for its own wood product needs. In addition, by helping to build awareness around urban wood as a local resource with environmental and community benefits, the City can play a role as educator and advocate to help expand urban wood use. Basic communication of the circular economy model for urban wood salvage can go a long way in growing awareness among residents and businesses, thereby improving markets for urban wood products.

- **Improve data collection for wood salvage.** Current records of tree removals are insufficient for precise quantification of salvage potential and may fail to reflect the total annual volume of canopy loss within the city. By recording the size, species, and condition of removed trees, the Forestry Division can generate a more accurate estimate of the environmental and economic value of lost trees, thereby supporting Reforestation Hub development. In addition, by establishing a system in which the City and its private partners — such as Duquesne Light Company and Davey Tree — can report and share upcoming removal plans, the City can open up new opportunities to prioritize tree salvage and make sure valuable material gets into the hands of a processor.
- **Develop a carbon offsetting program.** In Part 2, Cambium Carbon recommends a phased approach in developing urban forest carbon projects. Our strategy suggests that an early emphasis on preservation projects — beginning with Hays Woods — can provide a high return on investment. The result is a sustainable revenue stream that can be used to help subsidize higher-cost new tree planting and improved forest management projects. Due to the learning curve involved in carbon project development, we recommend identification of a regional project operator — such as a local NGO or third-party coordinator — to spearhead administrative and technical development of multiple carbon projects over the coming years.

Ultimately, it is our hope that this study can provide the foundation for new urban forest management programs that will increase material efficiency, generate self-sustaining revenues for forest restoration, and provide triple-bottom-line benefits to the City of Pittsburgh and its residents.

Project Background/Our Team

Cambium Carbon is a social impact venture working to reforest America by enabling local wood economies. The company is born out of the World Resources Institute and was developed through Yale University's entrepreneurship program.

This assessment is prepared for the Arbor Day Foundation and the City of Pittsburgh, as part of a Reforestation Hub development project funded by The Nature Conservancy's Natural Climate Solutions Accelerator Grant Program. Pittsburgh was selected from a pool of over 30 applicants.

Our team draws from a deep network of partners from the fields of environmental science, urban forestry, economic development, and climate finance. Cambium Carbon has leveraged these networks to produce this assessment for the City of Pittsburgh. Our hope is to address the facets of Reforestation Hub development in a way that aligns with the City of Pittsburgh's local goals and complementary initiatives.

Methodology

Cambium Carbon conducted 24 stakeholder interviews with organizations involved in management of Pittsburgh's urban forest, in addition to contacting more than 70 local millers and wood product buyers. Interviewees included city officials, private arborists, and NGO partners. Our conversations were aimed at understanding current wood debris management practices, assessing local capacity gaps, and identifying key opportunities and barriers to wood reuse and new tree planting. The interviews built upon background information provided by the City of Pittsburgh and included questions about data collection practices, organizational goals, and logistical considerations for new programming.

Tree loss estimates were derived from data from the Department of Public Works, Forestry Division, as well as the Department of City Planning. Tree data was accessed from the Western Pennsylvania Regional Data Center's "[City of Pittsburgh Trees](#)" dataset, which was established in 2017 and is updated on a continuous basis (last updated April 5, 2021).

Carbon project recommendations were developed after consultation with Mark McPherson, executive director of City Forest Credits, and are oriented toward creating a high-level evaluation of individual project types. Due to the site specificity of carbon quantification, a more rigorous assessment of site topography, condition, and forest composition will be a critical next step to estimating credit generation potential and input costs associated with developing individual land parcels.

Recommendations were developed and prioritized according to feasibility, impact, and alignment with existing City initiatives. Additionally, research and precedents from peer cities were used to inform our analysis. Cambium Carbon has focused on the development of pilot projects that have minimal upfront infrastructure and capital expenditures, with highest potential return on investment. These smaller pilots can provide specific data points and a proof-of-concept that will be critical for expanding wood reuse and carbon offsetting programs to a regional scale.

Part 1: Roadmap for Wood Reuse

Reforestation Hub Framework

Cambium Carbon's vision for urban wood salvage in the City of Pittsburgh is based on a model that we call the [Reforestation Hub](#). A successful Reforestation Hub diverts urban wood waste from costly grinding and disposal to milling and salvage sites to be sorted and processed. This process creates financial savings in the form of avoided tipping fees and an opportunity to spur economic development through new processing jobs and valuable end products. By creating new value from a waste stream, Reforestation Hubs aim to provide a sustainable revenue source to support regeneration of the urban canopy through new tree planting and maintenance. Reforestation Hubs are not owned and operated by single entities; instead, this circular economy model is the product of individuals and organizations that proactively coordinate activities to realize the full set of values that urban trees have to offer. Four categories of actors are critical to the development of a Reforestation Hub. These actors can be organized according to their specific roles in urban forest management:

1. **Tree Planting & Preservation**

This category includes City government agencies and local NGOs that actively manage urban canopy. These actors are critical to spearheading policies and programs that advance canopy restoration and wood utilization. Additionally, these stakeholders can act as central agents in increasing capacity and technical skills training toward the development of green job pathways and a local workforce for tree planting and salvage.

2. **Tree Care & Removal**

This group is composed of the crews that handle tree service work and removals on both public and private land. As the primary producers of woody debris in Pittsburgh, these stakeholders have a unique opportunity to leverage their role in urban forest management to enable wood reuse. For example, by tracking removal data, coordinating disposal of material with other local actors, or cutting logs to longer lengths capable of being milled, arborist crews can increase the opportunities for secondary use of urban wood. In addition, this category of actors is extremely important to the survival of planted trees. Mortality rates can be reduced through tree care, as well as by collecting tree health data that can be used to inform management plans.

3. **Wood Processing & Reuse**

These organizations create valuable products from urban wood, across a variety of grades (lumber, compost, etc.). Millers and woodworkers can supply expertise in product applications and end markets for various species, ultimately creating the demand for urban wood that fuels the economic engine for Reforestation Hub development. These private companies have an opportunity to communicate the impact of urban wood products to their customers and end users, further driving an urban wood economy.

4. **Implementation Partners**

Although implementation partners often work outside of the realm of urban forestry, these organizations and initiatives are identified as potential allies in advancing specific tree planting and/or wood utilization initiatives. This category includes economic development professionals, incubators, trade organizations, and other experts who can provide their expertise and insight where necessary and support new and existing businesses that underpin Reforestation Hub development. Whether in the public or private sector, implementation partners may support the initiation and funding of program development by forming coalitions that can turn high-level ideas into real projects on the ground.

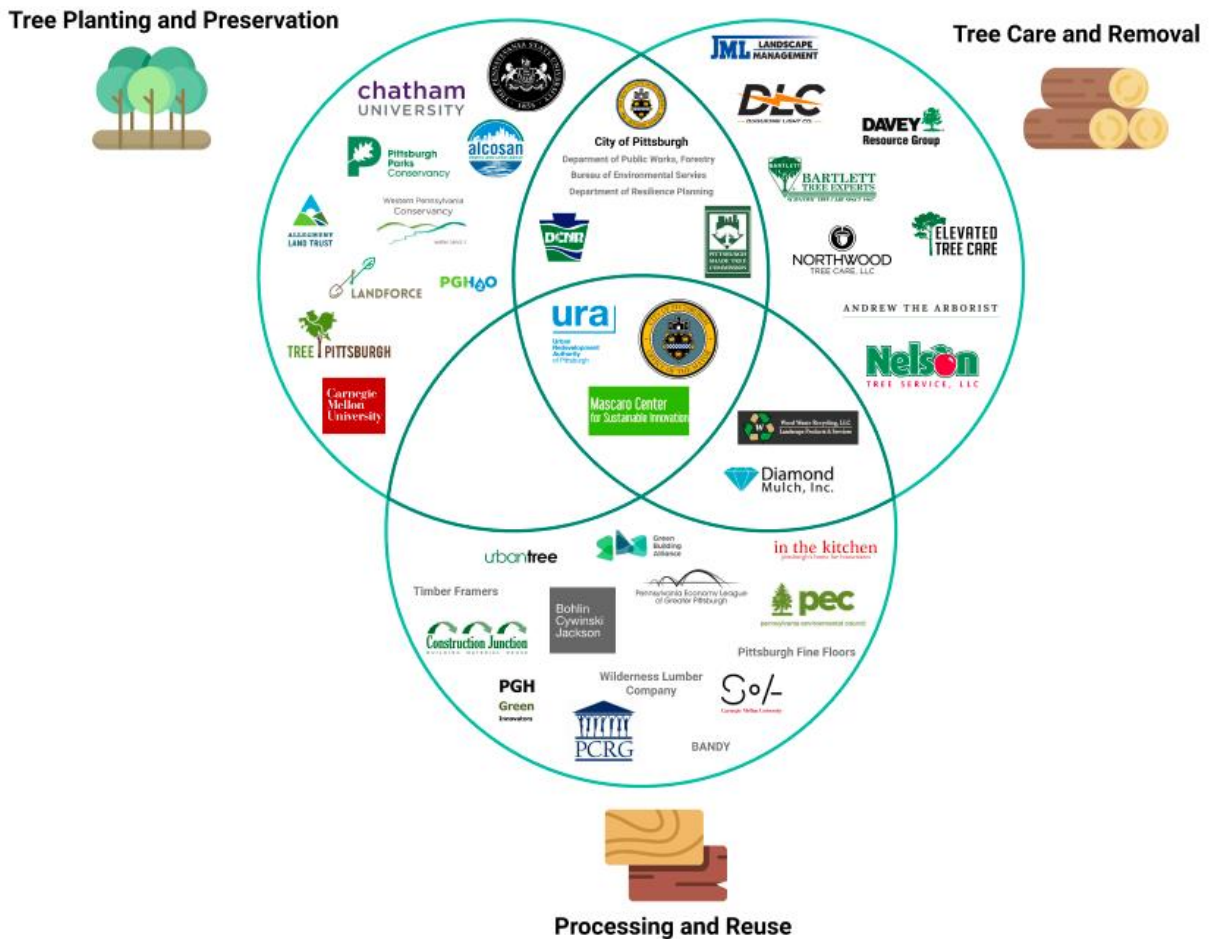
A sample of local stakeholders in each of these categories is summarized in **Table 1** and **Figure 1**, following.

Table 1: Reforestation Hub Stakeholders in Pittsburgh



	Tree Planting and Preservation	Tree Care and Removal	Processing and Reuse	Implementation Partners
Government	<p>PA Department of Conservation and Natural Resources</p> <p>City of Pittsburgh Department of Public Works Forestry Division</p>			<p>City of Pittsburgh Department of Resilience Planning</p> <p>Urban Redevelopment Authority</p> <p>City of Pittsburgh Mayor's Office</p> <p>Pittsburgh Water & Sewer Authority</p> <p>Housing Authority City of Pittsburgh</p> <p>Bureau of Environmental Services</p>
NGO	<p>Tree Pittsburgh</p> <p>Allegheny County Parks</p> <p>Western Pennsylvania Conservancy</p> <p>Pittsburgh Parks Conservancy</p> <p>Landforce</p> <p>Allegheny Land Trust</p>		<p>Trade Institute of Pittsburgh</p> <p>Construction Junction</p> <p>Project RE_</p> <p>Pittsburgh Center for Creative Reuse</p>	<p>Pennsylvania Environmental Council</p> <p>Pennsylvania Economy League of Greater Pittsburgh</p> <p>Pittsburgh Community Reinvestment Group</p>
University	<p>Chatham University Arboretum</p> <p>Pennsylvania State University</p> <p>Carnegie Mellon University</p>		<p>Carnegie Mellon University School of Architecture Woodshop</p> <p>Carnegie Mellon University Remaking Cities Institute</p>	<p>University of Pittsburgh Mascaro Center for Sustainable Innovation</p>
Private Sector		<p>Duquesne Light Co. ↔ Nelson Tree Service</p> <p>Davey Tree Elevated Tree Care</p> <p>Northwood Tree Care Bartlett Tree Experts</p> <p>Andrew the Arborist</p>	<p>Wood Waste Recycling</p> <p>Diamond Mulching</p> <p>Pittsburgh Fine Floors</p> <p>Timber Framers</p> <p>Wilderness Lumber Company</p> <p>Urban Tree</p> <p>BCJ Architects</p> <p>APLS, Inc.</p> <p>BANDY Woodworks</p>	<p>Green Building Alliance Pittsburgh</p> <p>American Institute of Architects (AIA) Pittsburgh Chapter</p>

Figure 1: Reforestation Hub Stakeholder Map for the City of Pittsburgh



Quantifying Wood Waste in Pittsburgh

To determine the potential for wood salvage in Pittsburgh, the first step is to identify the primary producers and handlers of wood waste (the tree care and removal stakeholders, above). In Pittsburgh, most tree care work and removals are conducted by three categories of actors:

- City Crews:** The Forestry Division's in-house crews reported **1,362 tree removals** and the pruning of another 1,299 trees in 2020, with an additional \$200,000 budgeted for outsourced tree work performed by contracting arborists. The City's wood waste management contract is currently held by **Wood Waste Recycling**, a wholesale mulch manufacturer that runs two processing facilities in Allegheny County. The contractual

dollar amount for the 2017–2019 Wood Waste Recycling agreement was **\$317,644.92**.¹ Wood Waste Recycling receives 2–3-foot log sections and smaller-diameter material from the City via roll-off containers. This material is primarily ground for mulch, compost, or boiler fuel, resulting in an estimated **1,703 metric tons** of direct annual CO₂ emissions from tree removals alone.² The Wood Waste Recycling agreement estimates that an average 3,000–5,000 tons of organic material will be processed annually under the contract and entitles the city “to receive a percentage of the finished compost at no additional charge... up to 10%, by weight.” Yet at present only a small portion of the mulch/compost to which the city is entitled is claimed, primarily due to a lack of a standardized process or a convenient city storage site. At the same time, the City currently purchases \$2,500 of shredded bark mulch annually, a cost that might be avoided if more of its own material were able to be utilized.

- **Duquesne Light Company (DLC)**: This organization manages roughly 1,300 miles of power lines within Pittsburgh, as regulated by the Pennsylvania Utility Commission. DLC subcontracts its tree work to **Nelson Tree Service**, a private arborist company. Removed logs are cut into handling lengths and left for individual property owners to dispose of. Anything up to 8 inches in diameter is chipped and hauled off-site. DLC generates a large volume of chips, which can present a significant cost burden due to the share of sites that charge a fee for chip disposal. While Nelson Tree Service currently takes wood debris to APLS, Inc., **DLC has noted that alternative disposal options would be of interest if the transport distance and/or disposal costs were favorable**. Additionally, the company plans its tree removals roughly a year in advance, providing a potential opportunity for outside parties to intervene and express interest in specific logs, if that information was readily available.
- **Private Arborists: Davey Tree Expert Company** and **Bartlett Tree Service** are the two largest national operators that work in Pittsburgh. Davey Tree disposes the bulk of its smaller material at a variety of wood waste recycling outposts or occasionally to local residents and community gardens. The company currently takes larger logs to a local firewood seller on Route 910, as anything over 4 feet in length has to be cut into shorter sections for Wood Waste Recyclers to accept it. Robert Kruljak, a regional manager for Davey Tree, noted that if longer-length logs were able to be transported by a third party interested in milling that material, the company would happily deposit logs on-site to avoid the time and cost currently borne for disposal. Bartlett Tree Service specializes in pruning and scientific assessments, so their number of removals are limited. They cited that many private removals are done by smaller local operations. Bartlett chips or mulches most of the trimmings they generate.

¹ <https://onbasesecure.city.pittsburgh.pa.us/PublicAccess/> Contract #52149

² Calculated as the product of total estimated annual biomass removed and the resulting carbon emissions associated with transportation, decomposition, and/or combustion.

These interviews found that currently there is little reclamation of millable logs in Pittsburgh. While Wood Waste Recycling receives some larger-length logs from private arborists, it is a small fraction of its inflow and is subsequently cut down into short pieces for grinding. **Urban Tree**, the city's largest local wood shop and urban wood salvage operation, coordinates some removals with private arborists but is estimated to capture less than 5% of the city's total volume.

Urban Wood Potential

An estimation of the potential annual economic value of Pittsburgh's removed trees is summarized in **Table 2**. Calculations are based on the total number of tree removals conducted by City of Pittsburgh crews in 2020, excluding contracting arborists. Because the size and species of removed trees are not presently recorded, estimates were generated according to citywide tree inventory data (e.g., trees are sized according to species averages throughout the city, and the most prevalent tree species are likewise assumed to be the most commonly removed).

The calculations in **Table 2** represent an upper-bound potential for milling of Division of Forestry removals, assuming all trees removed in-house are eligible for salvage — this is likely not the case, given that a portion will inevitably be unmillable due to rot or other structural flaws. This estimate will also vary if diameters of removed trees skew higher or lower than inventory averages. In addition, it should be noted that this breakdown focuses on merchantable lumber and firewood as end products. Additional value may be recouped through the processing of low-grade or small-diameter material into mulch, bioenergy, or other lower-value, less durable products.

It should be noted that more specific measurement and record keeping surrounding tree removals would allow for a more precise assessment of the economic and environmental value of removed trees. Additionally, not all trees are able to be removed at millable lengths. For example, trees behind buildings with narrow access will not be able to be removed as whole logs and instead will necessarily be cut into shorter rounds. By identifying and recording which trees are able to be salvaged for milling, the City can better understand the wood product potential of salvaged logs.

Table 2: Analysis of Estimated Economic and Embodied Carbon of Removed Trees (Annual)

Tree Inventory Data						Total Annual Tree Loss				1362
Species	Count	Average Diameter (DBH)	% total	estimated weight per tree (MT)	CO ₂ storage per tree (MT)	Annual removals (estimated)	CO ₂ in removed trees (MT)	BF per log*	\$ per BF	estimated \$ value per tree
Norway Maple	3,717	14.3	9.20%	1.04	0.48	126	60.25	70	\$3.00	\$210.00
Red Maple	3,422	9.5	8.50%	0.36	0.18	116	20.8	20	\$3.00	\$60.00
London Planetree	3,238	23.6	8.00%	2.95	1.78	109	194.64	180	\$3.00	\$540.00
Callery Pear	2,969	8.6	7.40%	0.27	0.14	100	14.04	unmillable; firewood		\$18.77
Littleleaf Linden	2,413	17.9	6.00%	1.72	0.59	81	48.08	125	\$2.50	\$312.50
Thornless Honeylocust	2,019	8.9	5.00%	0.32	0.15	68	10.23	unmillable; firewood		\$21.90
Pin Oak	1,672	25.9	4.10%	3.72	1.51	56	85.26	200	\$3.00	\$600.00
Flowering Crabapple	1,310	6.1	3.20%	0.2	0.06	44	2.65	unmillable; firewood		\$14.08
Gingko	1,218	14.1	3.00%	0.99	0.34	41	13.98	70	\$3.00	\$210.00
Northern Red Oak	978	22.5	2.40%	2.81	1.34	33	44.26	175	\$3.00	\$525.00
Sweetgum	892	16.5	2.20%	1.43	0.34	30	10.24	95	\$3.00	\$285.00
Other	16,484	12.9	40.90%	0.83	0.54	557	299.59	55	\$2.50	\$137.50
Estimated total biomass of annual removals (MT)				1,546		Annual Economic Loss (Material Value):				\$266,784
Estimated emissions from annual removals (MT CO₂e):				2,436		Annual Embodied Carbon Loss (MT CO₂)				804.1

Sources:

Tree Inventory Data: Western Pennsylvania Regional Data Center, "City of Pittsburgh Trees"

Estimated weight calculated from diameter per "Landowner's Guide to Determining Weight of Standing Hardwood Trees":

<https://www.uaex.edu/publications/pdf/FSA-5021.pdf>

*BF per log assumes a 10-ft length, using avg. DBH for species with 1 inch minimum taken off for bark:

<https://www.extension.purdue.edu/extmedia/fnr/fnr-191.pdf>

\$ per board foot based on market research and estimates from <https://www.hoppetreeservice.com/lumber-pricing>

Small-diameter timber best suited for firewood and woodworking. Firewood value estimated as \$200 a cord (based on competitive market prices) and a conversion of 2.9 tons per cord of mixed hardwood (<http://extension.msstate.edu/publications/hardwood-timber-volume-weight-conversions#:~:text=Historically%2C%20hardwood%20pulpwood%20volume%2Dto,75%2D27%2D39>).

"Other" carbon storage calculated as [average of CO₂ storage for the most common species G4:G14] x [ratio of actual average diameter for all trees in Pittsburgh (12.9) to average DBH of top species D4:D14 (15.1)]

MT CO₂ per tree calculated using i-Tree Ecosystem Analysis and average DBH per species

Annual Estimated Carbon Emissions calculated using Cambium Carbon model according to data from the US EPA's WARM model and McPherson et al 201

Cambium Carbon created a financial model to project costs, revenues, and an operations overview for an urban sawmill in Pittsburgh. A total investment of **\$301,500** in capital expenditures for key infrastructure is depreciated over a period of 10 years for the following equipment:

Vehicles/Fleet	\$45,000
Metal Detector	\$500
Forklift	\$20,000
Milling Equipment – Woodmizer, dust collector, straight line rip saw, resaw, planer	\$100,000
Kiln	\$35,000
Log Splitter	\$1,000
Tub Grinder	\$100,000

The model accounts for staffing by a yard master and an equipment operator, with an initial individual rotational labor trainee to provide site support, increasing to two trainees in year 5. The model estimates an initial 75% of material produced by the urban wood recycling center/sawmill is sold, scaling up to a maximum 90% in year 5. Cambium Carbon’s projections show the operation breaking even in its second year, with a net present value of **\$420,690.91** over 10 years (assuming a discount rate of 6%). Total carbon benefit from processing of in-house removals is estimated at **4,602 metric tons** of carbon dioxide equivalent over 10 years. Complete details for the urban milling model can be found in the Appendix.

Urban Wood Market Analysis

A key to successful scaling of an urban wood salvage program is development of a market for that reclaimed and processed material. The following section addresses the opportunities and barriers of fostering an urban wood economy.

Lessons from the National Network

Over the past year, Cambium Carbon has worked with urban wood millers and buyers in eight U.S. cities. As a result, our needs assessments are informed by both national-level trends and specific local context. While each city’s regional landscape varies, a few universal themes have emerged in characterizing the state of urban wood utilization. We believe these trends can provide valuable context in setting the stage for a wood salvage program in Pittsburgh:

- **Small-scale urban wood utilization exists in communities across the country.** These boutique outfits access a small portion of available supply and reach a small number of high-end wood product buyers.

- **Education is a key driver of market development.** Our research and interviews have found that wood product buyers have an overwhelmingly positive response to the local and sustainable impact of urban wood. Yet awareness of reclaimed wood (either from deconstruction or fresh-cut salvage) is low, and buyers from architects to individual homeowners struggle to access this sustainable material consistently.
- **Urban wood millers and woodworkers are resource-constrained.** These small businesses can very rarely scale their salvage, milling, and drying operations while simultaneously developing the comprehensive sales and marketing plans to meet increased production.

Local Advocacy

A few key players are central to the development of a thriving market for urban wood in Pittsburgh. The woodworking team at Urban Tree could play a critical role in scaling Pittsburgh's tree salvage efforts, as the primary local miller of urban wood. Through its success and local network, the company has developed a regional name and worked on larger projects for corporate clients such as Uber and Google. Urban Tree could scale its operational capacity and volume of logs utilized if connected to larger projects and able to develop its supply chains. Because working with the City has been challenging and inconsistent in the past, the company relies on private relationships for the majority of its supply. In their experience, they work with higher-level city officials that want to support reuse, but when it comes down to the day of removal, Urban Tree usually gets a call from a removal crew telling them they have two hours to come pick up the tree or they will take it away. From an operations perspective, they cannot respond on such short notice.

Many Pittsburgh businesses and organizations are eager for increased access to urban wood as a local, renewable resource. The **Pittsburgh Circular Economy Working Group** may provide additional support for infrastructure build-out and demand creation; they represent one of the first cross-sector initiatives bringing more stakeholder groups to the table. The Working Group has the opportunity to provide a forum for the many diverse organizations committed to reducing waste in the city. The City and its partners could benefit from a unified agenda and action plan to more effectively advance its goal of [Zero Waste by 2030](#).

Another key organizer of Pittsburgh's circular economy movement is **Construction Junction**. Led by Mike Gable, the nonprofit promotes the reuse of building materials and hosts several organizations at their facility, each of which specialize in the reuse of a different type of material. Sustainable materials advocacy groups such as **The Green Building Alliance** and **Monmade** are active in the space but struggle with wider adoption due to push back from the contracting community that is largely concerned with the lowest price point.

Potential Buyers

In considering end markets for urban wood products, the following table identifies a few primary categories of buyers that can help to catalyze consistent demand for recycled wood materials.

Target Buyers for Urban Wood Products

Category	Potential Urban Wood Applications
Universities	Interior paneling, general furniture, fixtures, equipment for campus buildings
Furniture Makers	Benches, tables, chairs
Artisans	Woodworking (sculpture, toys, bowls)
Construction and Development	Architectural applications, picnic tables and park benches, landscaping

Architects and interior designers can provide an important intermediary in specifying urban wood into the design of specific projects. The national architecture firm **Bohlin Cywinski Jackson (BCJ) Architects** has shown early interest in integrating urban wood into current and future projects. We believe there is a significant opportunity to develop a robust regional market for the city's urban wood.

Finally, the City of Pittsburgh could be a central agent in catalyzing demand for urban wood products. By creating a preference for local, recycled material in the City's own projects, it could work to incorporate urban wood into a number of municipal applications. These opportunities will be explored further in the following recommendations.

Recommendations for Program Development

Having assessed the opportunity for increasing urban wood utilization in Pittsburgh, Cambium Carbon recommends the following steps for program development:

1. **Establish an organic recycling center.** A central sorting yard could support the City in developing three specific programs: in-house composting, urban tree salvage, and reclamation of deconstruction materials. As identified in the Conceptual Compost and Mulch Facility Design prepared for the Department of Public Works by SCS Engineers, an organic recycling yard has the potential to save on costs and improve efficient resource use by bringing wood waste processing in-house. Additionally, the shared infrastructure and equipment required for the processing of both fresh-cut fallen urban logs and reclaimed deconstruction wood would allow the city to leverage an aggregated supply stream to achieve economies of scale in these wood salvage programs.

By providing a central location to handle log collection, the City can act as an intermediary in coordinating removals among private arborists, city crews, and end users of processed urban wood. In addition, investing in higher-value processing of woody biomass provides an opportunity to collaborate with NGO partners in developing

technical training programs. By integrating workforce development into the urban wood milling and tree care sectors, there is opportunity to build operational capacity while increasing community impact.

2. **Support the market for urban wood.** The City of Pittsburgh has a unique opportunity to promote urban wood and other recycled materials, both through its own procurement policies and its external communications. Formal avenues exist to incentivize City projects to prefer recycled materials. These include RFP design, procurement and purchasing policy, tax incentives, and permitting process design and implementation. By using its own material in-house — from durable fixtures such as picnic tables and park benches to lower-grade applications such as small-scale bioenergy, biochar, or tree stakes — the City has the opportunity to increase material efficiency while cutting external costs. Cambium Carbon recommends that the City review its RFP design and procurement policies to explore opportunities to encourage urban wood use.

Education and advocacy can be an influential factor in accelerating urban wood utilization. For example, communications campaigns led by the [Baltimore Wood Project](#) — a collaboration between Baltimore City and the USDA Forest Service — highlight the story of urban wood, its impact, and how individuals and organizations can expand and support urban wood use. Basic promotion and attention raised on social media and other outreach channels can also communicate the value of urban wood and build public support.

3. **Improve data collection for wood salvage.** Cambium Carbon identified several opportunities for the City of Pittsburgh to improve its data collection practices to support wood salvage and reuse. At present, tree removal data is generalized to total work order count. By recording the **size, species, and condition** of removed trees, the Forestry Division can generate a more accurate estimate of the carbon storage and potential economic value of trees removed from the urban canopy. In turn, this information can be the first step in evaluating which trees are worth the cost of salvage. Since cutting logs to millable lengths is a more technically difficult task — thereby generating higher costs for individual removals — it is important to build a system to prioritize wood salvage that weighs potential benefits against these additional costs.

Zoning code requires that removals of trees greater than 12 inches DBH (diameter at breast height) are reported to the City and replaced. Records from a 1-year period (March 2020–March 2021) showed a total of 22,497 inches of diameter loss. Assuming an average tree diameter of 24 inches, this would equate to 937 removed trees on private land. This estimate does not include several entries missing diameter specifications; it is likely that this number is an underestimation.

Collecting data on the size, species, and condition of upcoming removals can provide an opportunity to develop a simple formula to assess whether a tree should be salvaged for lumber, based on its ability to be milled and estimated worth. Data collection can be

extended to cases where the City uses outside contractors to complete removals by including reporting of species and diameter data as a requisite component of contract fulfillment. By collecting this information from private contractors, the City can better assess the full opportunity for urban wood salvage.

Additionally, tree removal permits handled by the Zoning Department are not currently comprehensively recorded or reported to the Forestry Division. Integration of tree removal records across Forestry and Zoning may allow for more accurate measurement of year-to-year canopy loss and provide opportunities for communicating a salvage opportunity to private landowners and developers. By coordinating salvage activities with Zoning, there is an opportunity to communicate information about sustainable disposal opportunities within the permitting process.

Conclusion: Part 1

The potential for both cost savings and active revenue generation for the City of Pittsburgh, combined with the material efficiency and carbon storage benefits, merit development of a pilot wood salvage program. Upfront costs for infrastructure investment are estimated at roughly \$300,000, generating a total profit of up to \$627,607 over 10 years. Given the potential for financial return and scalable impact, initial investment for the program could likely be supported by grant funding or a program-related investment by a philanthropic foundation. While permanent storage facilities are not factored into our basic financial model, there is additional opportunity to align an urban tree salvage program with initiatives around reclamation of building deconstruction material, thus creating an opportunity to establish shared warehousing infrastructure for a larger supply stream. Ultimately, it is our belief that development of a pilot sort yard and processing site, coupled with active market development and improved data collection, could catalyze a thriving circular urban wood economy in Pittsburgh.

Part 2: Carbon Offsetting

City Tree Planting Landscape

The City of Pittsburgh's [Burgh's Eye View](#) tree inventory platform currently records 39,955 trees throughout the city. Following a 6.2% canopy decline between 2010 and 2015, Pittsburgh recently established a goal to plant **100,000 trees by 2030**. Toward this end, the City works with a coalition of local nonprofits — composed of Allegheny County Parks, Tree Pittsburgh, the Pennsylvania Department of Conservation and Natural Resources, and the Western Pennsylvania Conservancy — to advance community planting efforts through their TreeVitalize Pittsburgh program.

Within the local network of forest stewardship groups, three lead actors supplement the Department of Public Works' Forestry Division in actively restoring Pittsburgh's urban canopy:

- **Tree Pittsburgh:** The largest of the city's local planting partners, Tree Pittsburgh currently plants and gives away **5,000 trees a year**, with goals of doubling that pace in order to meet the mayor's 100,000 tree target. The nonprofit employs a staff of 20 and runs a heritage tree nursery out of its 5-acre campus.
- **Western Pennsylvania Conservancy:** This group plants roughly **1,500 street and park trees** per year, across spring and fall planting seasons. While the organization has previously planted as many as 4,000 trees per season, its current focus is on increasing education among community partners, in coordination with the Tree Tenders program.
- **Pittsburgh Parks Conservancy:** Working to maintain many of the city's parks, this organization has planted **11,000 trees** over the 25 years since its inception. In the past few years, the Conservancy has begun to explore carbon offsetting as a means to financing urban forest preservation and restoration.

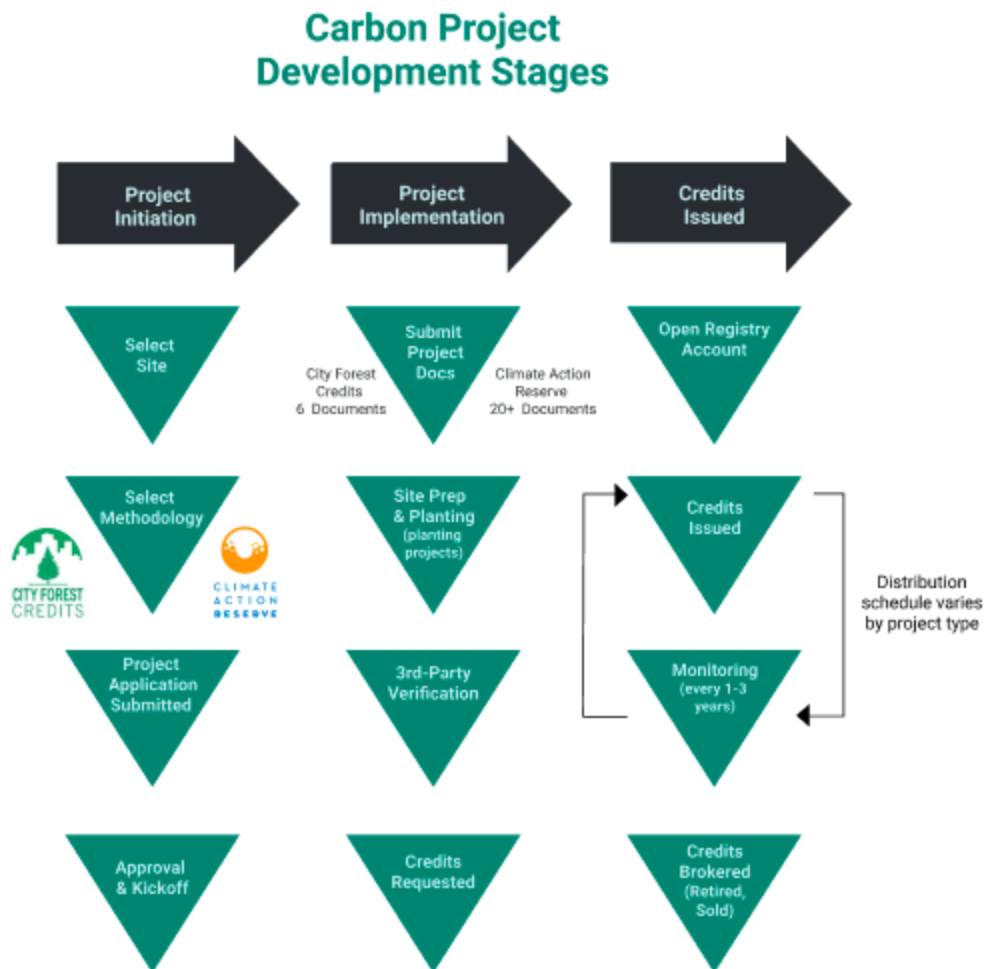
Carbon Offsetting – Background

Carbon offsetting projects present a promising revenue stream to support the maintenance and advancement of Pittsburgh's urban forests. Rapid growth in voluntary carbon markets and a widening interest in the layered community impacts of urban trees have resulted in several emerging projects focused on urban forestry. Getting a carbon project off the ground requires several core components:

- **Protocol/Registry** – There are different types of forest carbon project protocols (or methodologies) to consider. These protocols — to be examined in the following sections — are governed by specific carbon project registries that will ultimately issue carbon credits.

- **Implementation Partner** – This is the boots-on-the-ground implementor (whether the city, a local NGO, utility, etc.) that will manage site work and any required planting.
- **Administrator** – The organizing entity responsible for project documentation, monitoring, and reporting serves as the administrator. This role can be filled by the implementation partner or a regional operator with specific carbon project expertise.
- **Broker (optional)** – This third-party seller of carbon credits will connect the project to a market/buyer.
- **Buyer** – This is any end purchaser of carbon credits generated by the project.

An outline of the key stages of carbon project development is provided below:



Selecting a Site

As the City of Pittsburgh looks to maximize the benefits of its urban forest, two classes of properties may be considered for development of a carbon offsetting project: protection of existing forests and the active generation of new canopy through planting and restoration efforts.

Among existing forested parcels, **Hays Woods** has been the focus of many early conversations. The 626-acre stretch of undeveloped natural land is held by Pittsburgh's Urban Redevelopment Authority and provides significant environmental benefit to its surrounding community. Many smaller green parcels are found in the City's network of **Greenways**, 12 parcels comprising 1,200 acres of public land along steep hillsides. While Hays Woods is currently not protected from development, the less-forested Greenways are under conservation easement. Currently unmanaged, the Greenways have suffered significant environmental degradation over the past few decades and are a prime candidate for restoration efforts. A final informal category of parcels under consideration for inclusion in the Greenways system (classified here as "**hold for Greenways**" sites) has been identified as another property type for potential carbon project development.

Selecting a Protocol

Choosing a project protocol is a critical first step in initiating a carbon project. Protocols (or project methodologies) govern a project's duration and administrative requirements, set the timeline for credit issuance, and determine the type of credits that will be received. While there are several forest carbon project protocols, City Forest Credits (CFC) is the only registry focused specifically on *urban* tree planting and preservation. City Forest Credits' commitment to high-impact projects with layered community co-benefits — combined with a more streamlined administrative process — make it the preferred registry and certification body for municipal projects.

City Forest Credits offers two urban forest carbon protocols: Preservation and Planting. There are a few considerations to think about when weighing these two types of carbon projects:

- **Preservation:** Preservation projects require a longer permanence commitment. Projects must demonstrate a protection of trees and avoided conversion of biomass — through easement, zoning designation, or development regulation — for a period of 40 or 100 years. Additionally, preservation projects may be harder to sell than planting projects, as some view their carbon benefit to be less explicit. At the same time, the upfront costs and resource requirements are minimal compared to a planting project, resulting in a higher return on investment for the project. This revenue stream may in turn support more expensive tree planting projects.
- **Planting:** Planting projects require a shorter project timeline (25 years). While planting projects do not face the additionality concerns of preservation projects (each new tree being a new carbon sink on the landscape), the cost of site preparation, tree

procurement, and installation mean that carbon revenues will likely only cover a small portion of total project costs. As a result, the carbon project may act as one layer of a blended finance stack that supports project development.

City Forest Credits' Preservation protocol would be best suited for protection of an urban forest property such as Hays Woods or properties currently designated under consideration for incorporation into the greenways system ("hold for greenways" sites). Development of a preservation project will require:

- **Identifying** unprotected trees under threat of development.
- **Imposing** protections on the specific project acreage for the duration of the project.

Because of the size and density of Hays Woods' canopy cover, this property holds the potential to generate substantial carbon credits. Similarly, "hold for greenways" parcels should be prioritized according to the extent of existing canopy coverage and carbon storage.

Another protocol that might be considered is the **Improved Forest Management** methodology offered by the Climate Action Reserve (CAR). An Improved Forest Management protocol would be most suitable for restoration of Pittsburgh's existing greenways, as the methodology is focused on increasing carbon storage on existing urban forestland. The Climate Action Reserve's rigorous procedures have been recognized by the California Air Resources Board and provide thorough accounting for additionality and verification requirements. However, the Climate Action Reserve's carbon quantification methodology requires extensive project documentation and a complex calculation against city baselines, making data collection a challenge. The technical barrier and the long-term implementation commitment (100 years) can be a deterring factor for project developers to adopt Climate Action Reserve protocol.

A comparison of different project types is summarized in **Table 3**. A final noncarbon project type noted is City Forest Credits' Impact Certification. This program is designed as an alternative financing pathway to promote corporate sponsorship of tree planting projects. Impact certification does not require the same legal or timeframe commitments of a carbon project, and projects are scored according to human health, social equity, and environmental impacts. This scoring and certification process is intended to help communicate the multifaceted value of specific tree planting efforts to potential corporate funders. This project type can provide an alternative financing mechanism for greenway restoration or for other projects not well-suited to the specific requirements of a carbon project.

Table 3: Carbon Project Evaluation Matrix

Project Type	Example Sites	Duration	Minimum Size	Administrative Requirements	Credit Issuance Schedule	Pros	Cons
Preservation Project (City Forest Credits)	Hays Woods or "Hold for Greenways" Parcels	40 or 100 years	20 acres	Six documents for project certification. Monitoring report submitted every three years	<p>Project areas > 200 acres: Credits are issued in equal amounts in the five years after third-party verification</p> <p>Projects between 50– 200 acres: Credits are issued in the equivalent of 50 acres per year</p> <p>Projects < 50 acres: All credits are issued after third-party verification.</p>	<ul style="list-style-type: none"> • Cheapest to set up and best financial return on investment • Relative ease of application • Credits are bundled with other environmental benefits and can be traded or retired as needed. • Relatively quick distribution of all project credits (5 year max) 	<ul style="list-style-type: none"> • Long permanence requirement • Additionality concerns: critics may argue that imposed protections did not cause a change in management behavior or carbon stocks
Improved Forest Management (Climate Action Reserve)	Greenways (e.g., Hazelwood)	100 years	25 acres	20+ documents for project certification	Crediting period for an IFM Project is 25 years. Projects may be renewed for additional crediting periods with the prospect of incorporating updated technology into the project analysis	<ul style="list-style-type: none"> • Rigorous procedures provide very thorough accounting for PAVER requirements • Credits can be traded or retired • Protocol recognized by CARB 	<ul style="list-style-type: none"> • High commitment needed for monitoring and long-term implementation • IFM has received criticism from some organizations due to additionality concerns; buyers may be less interested in purchasing credits

Tree Planting Protocol (City Forest Credits)	URA-owned property adjacent to Frick Park	25 years	1,000 trees Two carbon quantification methods: “riparian” (high- density restoration) and street tree planting	6 documents for project certification, monitoring report submitted every three years	10% after planting 40% after Year 3 30% after Year 5 Remaining credits at end of project duration (Year 26)	<ul style="list-style-type: none"> • Highest impact • Directly advances tree planting goals • Riparian quantification system (high-density planting) yields highest credit returns for planting (vs. street trees) 	<ul style="list-style-type: none"> • Smaller return on investment than a preservation protocol • High-density planting of smaller saplings require protection from deer, etc., higher expected mortality rates
Impact Certification (City Forest Credits)	Greenways	None	Minimum budget: \$10,000–\$20,000	Project developer presents a project framing to CFC built around impact scorecard	No carbon credits issued. Rather, project implementation is funded by an external sponsor to provide community health, social, and environmental benefits in accordance with UN Sustainable Development goals.	<ul style="list-style-type: none"> • No time commitment • Opportunity to fund an urban tree planting project without undergoing the long-term crediting process 	<ul style="list-style-type: none"> • No carbon credits generated for sale — revenues based on identifying a project sponsor

Carbon Project Costs

Cambium Carbon developed a project finance model to estimate key costs and revenues for a Planting Protocol project. The following list details major cost drivers:

Project Administration	
CFC Application Fee	\$1,000
CFC Credit Issuance Fee Per Credit	\$2
CFC 3rd Party Verification Cost (Per Issuance)	\$500
Planting Costs	
Average Price Per Tree (tubelings)	\$5
Planting Day Truck Rental/Lease	\$100
Planting Equipment (purchase)	\$200
Site Preparation: Mow/Bush Hog (cost per acre)	\$150
Trees Planted Per Hour Per Person	17
Hourly Wage for Planting	\$15
Initial Tree Prep Material: Stakes (Per Tree)	\$4
Initial Tree Prep Material: Tubes (Per Tree)	\$5
Deer Protection/Site Enclosure	TBD
Maintenance Costs	
Watering	TBD
Mulching	
Replanting	
Labor	

These costs were developed with input from Tree Pittsburgh and City Forest Credits. Total cost will be largely determined by project size (acreage), existing site condition, density of planting, and mortality rate for newly established trees. One concern raised was that the prevalence of deer on Greenways parcels could pose a serious risk to tree survival. Enclosure of a project site may be necessary to protect against this risk of tree loss.

Projected costs and revenues for a 16.67-acre project stocked at a density of 300 trees per acre (5,000 trees total) is estimated below, using a carbon credit sale price of \$30 per metric ton:

Example Planting Project: Summary of Revenue and Expenses					
	<i>Year 1</i>	<i>Years 2–4</i>	<i>Years 5–6</i>	<i>Years 7–25</i>	Total
Carbon Project Revenue					
After Planting (10% of Credits)	\$5,225				\$5,225
After Year 3 (40% of Credits)		\$20,900			\$20,900
After Year 5 (30% of Credits)			\$15,675		\$15,675
Remaining Credits at Year 25				\$10,450	\$10,450
Gross Revenue	\$5,225	\$20,900	\$15,675	\$10,450	\$52,250
	<i>Year 1</i>	<i>Years 2–4</i>	<i>Years 5–6</i>	<i>Years 7–25</i>	Total
Project Expenses					
Legal	-\$1,000				-\$1,000
Labor/Contractors	-\$7,578	-\$4,500	-\$1,500		-\$13,578
Equipment & Rentals	-\$1,500	-\$200			-\$1,700
Inputs	-\$70,000	-\$3,750	-\$1,250		-\$75,000
Carbon Standard Fees	-\$1,500	-\$500	-\$500	-\$500	-\$3,000
Total Expenses	-\$81,578	-\$8,950	-\$3,250	-\$500	-\$94,278
Net Income	-\$76,353	\$11,950	\$12,425	\$9,950	-\$42,028

Note that total expenses for project development are estimated at \$94,278, with a net loss of \$42,028 after carbon revenues. Consequently, alternative financing will be required to support project implementation.

Financing Mechanisms

The current valuation of carbon on the voluntary market typically falls in the range of \$5–\$30 per metric ton. As a result, carbon credits will likely only support a portion of the up-front costs involved in a tree planting project. Upon modeling various scenarios for a new planting project, Cambium Carbon estimates that breaking even would require a carbon price close to \$100 per credit.

This does not mean such projects are financially infeasible; rather, there is an opportunity to layer multiple financing mechanisms to implement projects and realize community co-benefits.

Cities have approached carbon project financing in several ways. The Houston Parks and Recreation Department applied for a series of grants — specifically state riparian water quality grants and National Wildlife Foundation grants — to pay for the up-front costs associated with site preparation and tree planting. They have subsequently used revenues from carbon credits to finance further tree planting and maintenance. In Washington D.C., DC Water partnered with the firm Quantified Ventures to create the first-ever Environmental Impact Bond to finance the implementation of green infrastructure through an approach that shared performance risk with investors by linking their returns to the project’s success. This pay-for-success model could be used to engage local stakeholders (such as ALCOSAN or the Pittsburgh Water & Sewer Authority) that would stand to benefit from the water quality and stormwater management benefits provided by specific tree planting projects. More information on specific regional and federal grant opportunities to finance tree planting — as well as a list of potential regional offset buyers — is provided in the Appendix.

Layered Financing: Stormwater Credits as a Funding Mechanism in Pittsburgh

Stormwater credits offer an opportunity for additional revenue generation for tree planting projects. While not directly tied to carbon offsetting, stormwater crediting could provide a symbiotic pathway for increasing funding to support a planting project.

Many cities around the country offer rebates for private stormwater remediation efforts. In considering large-scale project opportunities, one notable example is [Washington D.C.’s Stormwater Trading System](#).

The timing is good to explore stormwater fees in Pittsburgh. Despite support for the ideas from local stakeholders, implementation prospects have been kicked down the road for years, given difficulty financing the efforts. Further, players such as the Pittsburgh Water and Sewer Authority have been reluctant to take on the burden of monetizing project cobenefits or finance the up-front capital investment.

It is likely that Pittsburgh Water and Sewer Authority will likely begin to implement stormwater fees within the coming years. Once the program is up and running, credits may be offered to individual homeowners.

Recommendations for how the City can support a Stormwater Credit pilot:

- Credits typically center on impervious surface areas. Accordingly, the City might consider advocating for modified language in stormwater credit protocols to preference natural climate solutions and their accompanying noncarbon cobenefits. In addition, the City should advocate for larger-scale projects to occupy a component of the market such that stakeholders exceed individual property owners.

Carbon Project Revenues

Table 4 outlines a number of previous urban forest projects developed using the City Forest Credits protocols. Carbon credit generation per acre is determined according to a site-specific survey conducted by the project operator and verified by a third party. Factors influencing carbon credit generation include forest composition, age of tree population, and zoning. On average, **\$8.44** was recouped per tree in carbon revenues for a Planting project and **\$4,223** was generated per acre of a Preservation project.

Table 4: Reference Projects from City Forest Credits

PLANTING								
Project Operator	Location	# of Trees	Acreage	Trees Per Acre	Carbon+ Credits	Estimated Revenue @ \$30/ton	Estimated Revenue per Tree	Estimated Trees per Credit
Pierce Conservation District	Pierce County, WA	20,000	100	200	4,587	\$137,610	\$6.88	4.4
Tree Folks	Austin, TX	1251.3	4.3	291	539	\$16,170	\$12.92	2.3
Tree Folks	Travis County, TX	47,279	85.92	550	8,709	\$261,270	\$5.53	5.4
PRESERVATION								
Project Operator	Location		Acreage		Carbon+ Credits	Estimated Revenue @ \$30/ton	Estimated Revenue per Acre	Estimated Credits per Acre
Western Reserve Land Conservancy	Cleveland, OH		32		5,062	\$151,860	\$4,746	158.2
St. Elmo Trail Preservation Project	Chattanooga, TN		56		10,127	\$303,810	\$5,425	180.8
King County Department of Natural Resources	King County, WA		15		3,025	\$90,750	\$6,010	200.3
Evergreen and East End Preservation	Richmond, VA		65		5,375	\$161,250	\$2,481	82.7
Buena Vista Heights Urban Forestry Conservation Area	Allegheny County, PA		124		13,966	\$418,980	\$3,379	112.6
Hays Woods (estimated)	Pittsburgh, PA		200		22,000	\$660,000	\$3,300	110.0

It should be noted that the most analogous precedent for Pittsburgh-based projects is that of Buena Vista Heights, a 124-acre property protected by the Allegheny Land Trust. The CO₂ index for this project was calculated as 112.6 tons of CO₂ stored per acre, resulting in a total of 13,966 carbon credits. Assuming a similar carbon storage/credit generation value of 110 credits per acre, a 200-acre preservation project at Hays Woods could generate a total of \$660,000 in carbon revenues.

By contrast, evaluation of the three precedent planting projects shown here reveal an average \$8.44 of carbon revenue generated per tree. Given Tree Pittsburgh's quoted input costs of \$5 per tree for small tubelings, \$5 per tree for grow tubes (providing protection to the seedling from damage by deer, rabbits, etc.), and \$4 per tree for tree stakes, it is clear that the input costs for a single tree would be only partially subsidized by carbon revenues — even excluding costs distributed over the project such as equipment and labor. As a result, as previously mentioned, revenues for planting projects should be considered only one of multiple financing mechanisms for project implementation.

Selling Credits

Participants in the voluntary carbon market — including individuals, corporations, and institutions — are electing to purchase credits rather than acting in compliance with mandatory environmental regulations. These buyers are not necessarily looking for the cheapest credits; instead, they are often making an investment in specific initiatives to further their own environmental or social impact agenda. As a result, carbon credit prices on the voluntary market are quite variable, with potential to sell high-impact credits at a premium. Buyers may be inclined to pay more for a project that brings tangible value to their own communities over a lower-cost project in another country or region. Because of the premium cobenefits of an urban forest project — combined with significant growth in demand for carbon credits and the trend toward a supply-constrained market — the City of Pittsburgh should have no trouble selling any carbon credits generated in the next decade. Furthermore, it is Cambium Carbon’s belief that credits can be sold at a price of \$20–40 per ton, consistent with past City Forest Credits projects.

Piloting Offsets in Pittsburgh – Recommendations

Given the variation in parcels of interest for a carbon offsetting pilot in Pittsburgh, there is no one-size-fits-all pathway to follow for citywide implementation. Certain opportunities require little effort and offer the highest return on investment (e.g. Hays Woods) but do not provide the additional community impacts of new tree canopy, nor do they advance Pittsburgh’s larger 100,000 tree goal. Yet other opportunities to catalyze new tree planting will require significant up-front financing.

Accordingly, the following phased approach is recommended to develop a large-scale carbon program in Pittsburgh. By focusing on developing high-return preservation projects, the City of Pittsburgh can create additional funding streams to support later-stage afforestation and canopy restoration.

Phase 1: Preservation of Hays Woods

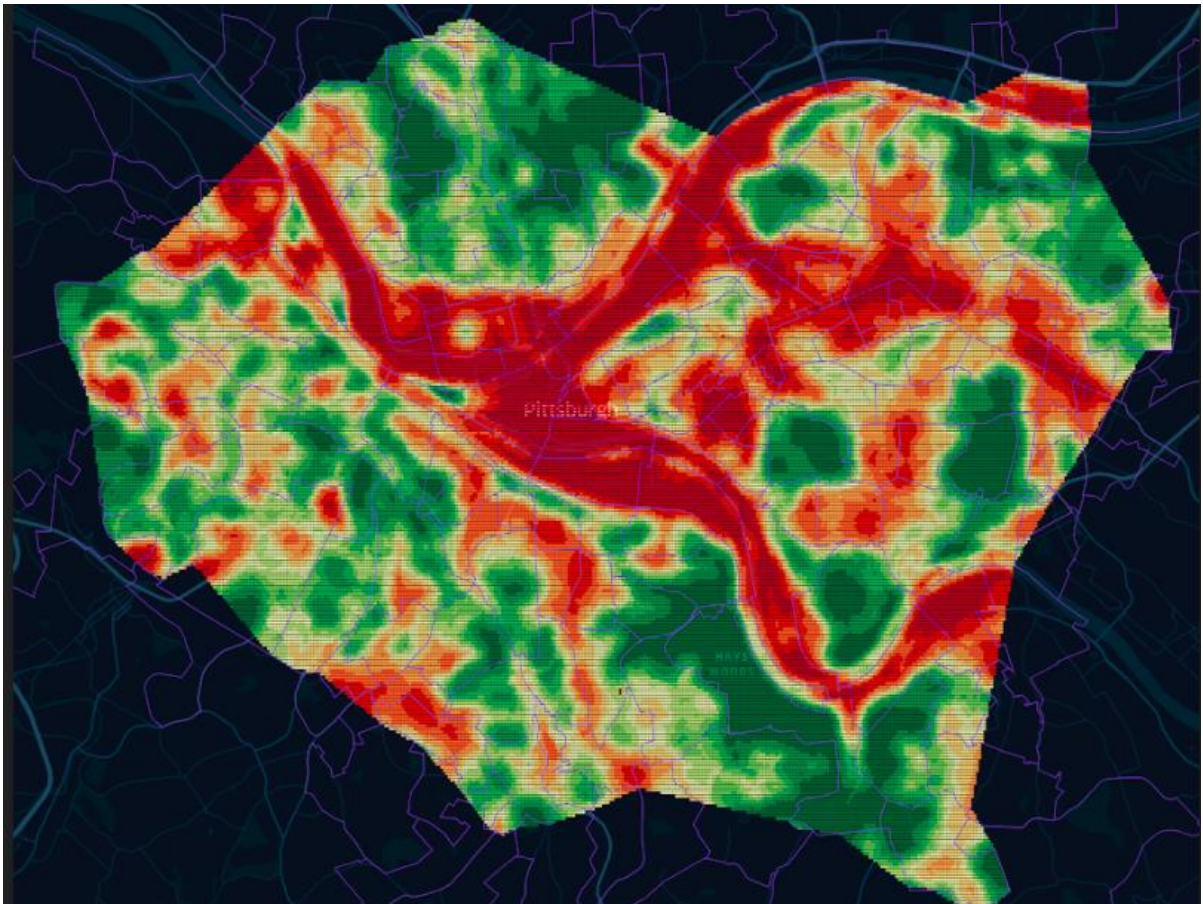
Hays Woods presents the greatest opportunity for a high-return preservation pilot project. As identified previously, if 200 acres of developable canopy could be protected under the project, with an estimated carbon storage index of 110 tCO₂e/acre, the project would generate **22,000 carbon credits**. At a price of \$30 per credit (metric ton), that would amount to **\$660,000** in carbon revenues distributed over a period of five years following third-party verification. Given this high return on investment, any residual revenue after park maintenance and stewardship could potentially be put toward subsidizing a tree planting carbon offsetting pilot elsewhere in the city that would likely require stacked funding to be economically feasible.

Phase 2: Preservation of Potential Greenways

City parcels currently designated as “hold for greenways” are also eligible for the City Forest Credit Preservation Protocol and could use carbon offsetting as a mechanism for financing their acquisition (and/or justifying their preservation) to avoid potential development by the Urban Redevelopment Authority. To proceed, the city would need to designate the specific parcels of interest as officially preserved for greenways to enable crediting of the project.

The preservation of these currently undeveloped parcels presents a further opportunity to advance social equity goals by targeting “hold for greenways” parcels in lower-income and BIPOC communities. Cambium Carbon recommends that the City prioritize those areas with lowest canopy cover and nature access in selection of parcels for preservation. This strategy presents a unique opportunity to address the heightened urban heat island effect and public health impacts borne by lower-canopy neighborhoods. A map of Pittsburgh prepared by [NatureQuant](#) (**Figure 2**) highlights areas with the highest access to nature and correlated health outcomes in green and lowest nature access in red.

Figure 2: NatureQuant Heat Map of City of Pittsburgh



Phase 3: Restoring Pittsburgh’s Greenways

The City’s Greenways are the most complex set of properties on which to implement a carbon offsetting project. There are two potential directions available, both of which require the city to further consider its priorities, values, and desired commitment.

Opportunity A: Climate Action Reserve Improved Forest Management Protocol

Given the poor baseline condition of the Greenways, the CAR Improved Forest Management Protocol offers the best fit, as credits are offered to management activities including but not limited to:

- Increasing the urban forest productivity by removing diseased and suppressed trees.
- Reducing emissions by avoiding tree removals.
- Planting additional trees on available and appropriate sites.
- Monitoring, protecting, and treating trees to avoid premature mortality from stressors such as drought, pests, storm damage, and abiotic agents.
- Reducing the vulnerability of trees to impacts of climate change by increasing resilience.³

That said, given the 100-year time commitment and complex administrative process involved in the CAR protocol, this opportunity will likely be the most difficult project type to implement. It should also be noted that the protocol has received some criticism and may be harder to sell than a tree planting project.

Opportunity B: Impact Certification for Greenways Restoration

City Forest Credits's Impact Certification matches planting projects with an external donor to bring social, environmental, and health benefits to namely lower-income and BIPOC communities while furthering United Nations Sustainable Development goals.

This protocol differs from a traditional planting project in that a project operator can present a project design to City Forest Credits, who will then calculate an impact score based on the extent to which the project provides community health, social, and environmental benefits. The project operator will then be responsible for selling these goals to a corporate buyer with aligned values to finance the project costs. The impact protocol would not provide ongoing revenue through carbon crediting. However, an impact project would allow the City and its partners to seek sponsorship of the upfront investment required for site preparation (due to the presence of invasives) and tree procurement.

Given the presence of many notable private institutions and corporations operating in Pittsburgh, a focus for impact certification could be on science-based health impacts of a planting project. This lens may provide specific opportunity to engage hospitals and research institutions in project financing and development; the Arbor Day Foundation's [Tree Campus Healthcare Program](#) may provide a unique partnership opportunity toward this end. Further, emphasizing any local tax benefits for tree planting in lower-income communities should be leveraged to further incentivize corporate buy-in.

Conclusion

Cambium Carbon's examination of carbon offsetting opportunities suggest that the City of Pittsburgh and its tree planting partners can realize significant revenues for advancing the city's urban forestry goals by instigating a phased carbon project program that relies on multiple protocol types. Beginning with preservation of existing forest and progressing to proactive restoration of natural landscapes, a carbon program could provide significant revenues to support city budget and philanthropic funding in advancing Pittsburgh toward its 100,000-tree goal.

³https://www.climateactionreserve.org/wp-content/uploads/2019/04/Urban_Forest_Management_Project_Protocol_V1.1.pdf

Appendix

Table 5: Financing Mechanisms
Regional Private/ Philanthropic Grant Opportunities

Philanthropy/ Fund	Description	Funding Priorities	Eligibility	Past Projects	Funding Amount
<u>Pittsburgh Mayor's Fund: OnePGH</u>	501(c)(3) that coordinates government, private, and philanthropic capital to leverage additional value from public assets for the benefit of all Pittsburghers. The Peduto administration's grand vision for a streamlined Pittsburgh, one in which government, nonprofits, and corporations pool resources into a separate tax-exempt organization to fund agreed upon commitments by 2030 — to the tune of \$3.5 billion. Concept: 'payment in lieu of taxes.'	10 focus areas: affordable housing, climate and environment, arts and culture, workforce development, early childhood, mobility, water delivery, stormwater, government performance and innovation, and critical communities.	Nonprofit work in one of city priority areas and connection with the City.	Since 2018, the Division of Sustainability and Resilience, housed within the Department of City Planning, has assembled more than 125 partners into working groups to identify the most critical projects ready for implementation, with the intention to put our existing plans and analyses into action.	\$730 million for Green Infrastructure in total
<u>TreeVitalize Grant Program</u>	Managed by TreePennsylvania, an independent nonprofit. Funding is provided by the Pennsylvania Department of Conservation and Natural Resources to promote and develop sustainable urban forestry programs within the Commonwealth of Pennsylvania.	Three types of grants: Community Forestry Management Grants, Tree Planting Grants, and Urban Riparian Buffer grants.		\$120,000 in funding to 17 communities to increase urban tree canopy.	\$2,000–20,000
<u>The Pittsburgh Foundation</u>	The Pittsburgh Foundation, established in 1945, works to improve the quality of life in the Pittsburgh region by evaluating and addressing community issues, promoting responsible philanthropy, and connecting donors to the critical needs of the community.	<u>Funding Priorities</u> include Healthy Communities (projects that encourage safe, diverse, creative, ecologically conscious communities), and Community Projects (projects that advance a community agenda and	Nonprofit organization located within Allegheny County or which demonstrates service to Allegheny County residents. Designated by the IRS as a 501(c)(3) organization. (If	Numerous grants to Conservation and Tree Planting organizations.	\$1,500–\$50,000, Environmental Grants

		encourage philanthropy through matched giving opportunities).	your organization does not have 501(c)(3) status, you may apply utilizing a fiscal sponsor.)		
<u>Richard King Mellon Foundation</u>	Seeks to improve the competitive position and strengthen the vitality of southwestern Pennsylvania, particularly the City of Pittsburgh and its neighborhoods, and protect precious green and natural infrastructure, particularly in western Pennsylvania.	<u>Funding Priorities</u> include Conservation (education and promotion; watershed restoration; wildlife and habitat protection; general conservation; and preservation of 11 landscapes deemed to be priorities by the Foundation's leaders) and Regional Economic Development (the balance of grants focused on community development, arts and culture beyond the cultural district, innovation and manufacturing, rural development, and start-ups and incubators).	Applicants must be a charitable, tax-exempt organization with a valid IRS Tax ID Number or be a government entity to qualify for funding. Gives priority to projects and programs that have clearly defined outputs, outcomes, and an evaluation component.	Provides capital support, general operating support, land acquisition, program support, and technical assistance grants.	\$5,000–\$4,000,000
<u>Colcom Foundation</u>	Principal funding interests reflect a primary concern for quality of life. Through strategic grantmaking, the Foundation focuses its philanthropic program on environmental sustainability, natural resource preservation, land and water conservation, and responsible balance for humankind in a fragile, yet resilient ecosystem.	<u>Funding Interests:</u> Environment (committed to ensuring quality of life and environmental sustainability in southwestern Pennsylvania, Colcom Foundation favors programs addressing watershed remediation, protecting natural resources, preserving air and water quality, and conserving farmland and		Helped protect more than 1 million acres of forest and planted more than 4 million trees. Recent priority to immigration-focused organizations.	\$35,000–\$40,015,000 (2018 Statistic)

		<p>wildlife habitat) and Community (Colcom Foundation directs community grantmaking to programs enhancing Pittsburgh's vitality and livability. Examples include programs to enhance parks and trails, expand public gardens and streetscapes, create and maintain art for public spaces, provide environmental education, and sustain recreational facilities).</p>			
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Table 6: Federal Grant Opportunities

USDA Forest Legacy Program	Cities can use this funding to acquire (specifically, property interest in privately owned forestlands) or conserve forest areas that provide wildlife habitat, water protection, and recreational opportunities.
Land & Water Conservation Fund	Program provides matching funding to local governments to acquire and develop public outdoor recreation areas and facilities. This may include inner-city parks, playing fields, picnic areas, or support facilities such as roads or water supplies. 50% match requirement.
EPA Nonpoint Source Implementation Grants	Funds projects that reduce nonpoint source pollution or pollution caused by runoff. This can include technical and financial assistance, education and training, water quality monitoring, and applying best management practices. Grant can be applied to planting trees, adding green roofs and other vegetation, and implementing permeable pavement, among other projects. Nonfederal funds must be used for at least 40% of project cost.
USDA Community Forest and Open Space Conservation Program	Helps communities acquire and protect private lands to conserve forests and make them more accessible to communities. Funds can go toward purchasing land, developing a community forest plan, and paying legal or closing costs.
USDA Forest Health Protection Grant	Grants to help plan or carry out measures to protect community forest health. Matching requirement is typically roughly 50%.

EPA Community Action for a Renewed Environment (CARE) Grants	Helps communities reduce risk from toxic pollutants. Funds can be used to create community partnerships among interested parties, determine sources of toxic pollution, create a plan, and implement projects to reduce people's exposure to them. Depending on the sources, cities may be able to apply funds to green infrastructure that traps and filters air and water pollution such as trees, other vegetation, and green roofs.
EPA State and Local Air Quality Management Grants	Helps states plan and execute programs for air pollution prevention and control. Funds may be used for supplies, equipment, and training and may be applied to tree planting projects. Local governments must provide 40% of project funds.
Department of Agriculture	Funding opportunity for community forestry projects on nonfederal public land (funds planning, preparedness, implementation, management practices, recovery, reforestation).
Clean Water State Revolving Fund	Provides financial assistance for water conservation projects that reduce the demand for POTW capacity through reduced water consumption (i.e., water efficiency), as well as water reuse and precipitation harvesting.
National Fish and Wildlife Foundation	Supports more than 70 grant programs to protect and restore our nation's wildlife and habitats.

Potential Carbon Offset Buyers

Table 7 describes potential purchasers of offsets from a Pittsburgh carbon project, with a focus on local companies with a sustainability agenda. If the City of Pittsburgh opts to proceed with City Forest Credits, CFC will likely serve as the broker and connect the project with a corporate buyer.

Table 7: Potential Carbon Offset Buyers

Company	Description	Sustainability Agenda
Alcoa	Industrial corporation: the world's eighth-largest producer of aluminum, with corporate headquarters in Pittsburgh	Sustainability focus , Pledge to reduce carbon footprint
FedEx	HQ in Allegheny County	Ambitious Sustainability Goals
Covestro	German company which produces a variety of polyurethane- and polycarbonate-based raw materials	Aligned with UN Sustainable Development Goals, goal to reduce GHG emissions by 50% by 2025
Google	HQ in Pittsburgh	Carbon-neutral since 2007, aiming for Carbon-free by 2030.

<u>Kraft Heinz</u>	Food company co-headquartered in Chicago and Pittsburgh	<u>Sustainability Commitments</u> – Pledged to carbon reductions by 2020; likely in the process of setting targets for the next decade
<u>Highmark Health</u>	Healthcare company based in Pittsburgh	<u>Sustainability focus:</u> Three-time winner of the Sustainable Pittsburgh Challenge (2014–15, 2016–7, 2018–19) for its energy and water-conservation and active sustainability/social impact work. Goals include 50% reductions of transportation emissions + energy and water consumption by 2030
<u>Tetra Tech</u>	California-based consulting and engineering services firm	<u>Sustainability Plan</u> – has a rigorous GHG emissions monitoring system, could be quite interested in offsets, won two awards in <u>Sustainable Pittsburgh Challenge</u>
<u>University of Pittsburgh</u>	University	<u>Commitment to carbon neutrality by 2037</u>
<u>Carnegie Mellon University</u>	University	<u>Commitment to reducing carbon footprint</u>
<u>Duquesne University</u>	The School of Business MBA Sustainability program <u>sponsored</u> carbon offsets for attendees of a climate conference, so there may be interest in larger scale university carbon offsetting; carbon credits donated by WGL Energy (from landfill carbon capture)	<u>Member</u> of <u>Pittsburgh Climate Initiative</u>
<u>Chatham University</u>	Key player in Pittsburgh afforestation/ reforestation community	<u>Commitment</u> to carbon neutrality by 2025
<u>Cloverly</u>	Private-sector broker of carbon offsets for corporate and individuals buyers; purchased credits from many small-scale offset projects, including Allegheny Land Trust reforestation pilot; willing to finance small-scale projects at a premium	Numerous offset <u>projects around the world</u> of varying scales and project types

CITY CASE STUDIES

Buena Vista Heights Urban Forestry Conservation Area/Allegheny County

Project Size: 124 acres, 13,966 credits

Key Players

- Allegheny Land Trust – Owns the credits, facilitated reforestation
- Bluesource – Provided carbon expertise and connection to Cloverly
- Cloverly – Carbon offsets purchased by Cloverly at \$30 a piece, triple the price of a typical offset

Key Challenges & Lessons Learned

- Significant learning curve understanding how to complete required paperwork and undergo data gathering such as a 'stand analysis'.
- For the next projects, Allegheny Land Trust plans to save money and skip hiring a broker and leverage standing relationships with Cloverly and the Allegheny Conference to sell credits.
- The Allegheny Land Trust did not consider a planting project due to resource intensity (financial and administrative).

Austin, Texas

Project Size: 4.3 acres, 1,302 trees, 539 credits

Key Players

- Tree Folks – Local nonprofit that facilitated planting with a group of volunteers; saplings planted on private land (near rivers and streams across the city) and on school district land
- City of Austin – Credits purchased by the city of Austin to help reach its goal of carbon neutrality by 2020

Key Challenges & Lessons Learned

- Contended with high notary fees.
- Difficulty with landowner onboarding, specifically concerns over financial penalty for cutting down trees. Landowners signed a deed that their land would not be disturbed for 25 years.
- The project was only able to get Carbon+ credits because the project was in the riparian corridor — the process was much easier than container trees would have been.
- Carbon credits are considered a secondary outcome. It was unlikely that carbon credits could sustain the program entirely; outside fundraising was necessary.

Houston, Texas: T.C. Jester Restoration Project

Project Size: 7.70 acres, more than 200,000 trees, 5,015 credits

Key Players

- Houston Parks and Recreation Department – Project operator. Completed 10-year project to restore forested riparian buffers in all city parks adjacent to waterways; funds from carbon credits will support the Houston Parks and Rec Department's Natural Resources Management Program in habitat restoration projects and land preservations efforts throughout the City of Houston
- Credit Buyer TBD

Key Challenges & Lessons Learned

- Most of the upfront planting and maintenance costs have been covered by grants (mostly state riparian water quality grants, as well as the National Wildlife Foundation).
- To address the concern about trees being cut down within the 25-year project period, leave a certain amount of money in a credit fund to cover financial penalties so that the payment wouldn't be covered by the city but rather a carbon credit account. Education and outreach campaigns and on-site signage were leveraged as well to ensure the number cut down is small.
- The carbon offsetting contract is still in the legal phase due to the large project size (more than 200,000 trees). No decided buyer or price set yet. There has been talk of the City's sustainability office taking the credits to put towards the goal of carbon neutrality, however this would disable further tree planting from a financial side (need money to exchange hands). Could be viable if a preservation protocol could get off the ground as well and contribute revenue.
- The City is working on a natural preserve ordinance to officially protect city parks from development in order to enable a CFC preservation project.

Sample Financial Model: City Forest Credits Planting Project

Example Riparian Tree Planting Project Summary of Revenue and Expenses

	Launch	After Planting	After Year 3	After Year 5	At Year 25	Total
Revenue						
After Planting (10% of Credits)		5,068.20				\$ 5,068.20
After Year 3 (40% of Credits)			20,273.10			\$ 20,273.10
After Year 5 (30% of Credits)				15,204.90		\$ 15,204.90
Remaining Credits at Year 25					10,136.40	\$ 10,136.40
Project Gross Revenue	\$ -	\$ 5,068.20	\$ 20,273.10	\$ 15,204.90	\$ 10,136.40	\$ 50,682.60
Expenses						
CFC Application Fee	(1,000.00)					\$ (1,000.00)
CFC Credit Sales Fee		(337.88)	(1,351.54)	(1,013.66)	(675.76)	\$ (3,378.84)
Third-Party Verification Fee		(500.00)	(500.00)	(500.00)	(500.00)	\$ (2,000.00)
CFC Registry Account Fee		-				\$ -
Project Operator Staff Time						\$ -
Project Operator Supplies						\$ -
Project Operator Travel						\$ -
Project Operator Other Expense						\$ -
Total Expenses	\$ (1,000.00)	\$ (837.88)	\$ (1,851.54)	\$ (1,513.66)	\$ (1,175.76)	\$ (6,378.84)
Net Income (or loss)	\$ (1,000.00)	\$ 4,230.32	\$ 18,421.56	\$ 13,691.24	\$ 8,960.64	\$ 44,303.76

Total Acreage Planted:	16.67
CO2 Index, tCO2e/acre:	106.7
Total Credits Attributed to the Project, tCO2e:	1778.33
Registry Reversal Pool (5%), tCO2e:	89
Total Credits Issued to the Project, tCO2e:	1,689

Credit Schedule	
After Planting (10% of Credits)	169
After Year 3 (40% of Credits)	676
After Year 5 (30% of Credits)	507
Remaining Credits at Year 25	338
Credit Sub-total	1,689

Price Per Credit:	\$ 30.00
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