

# EXAMPLE OF URBAN TREE CANOPY ASSET NET BENEFIT (RETURN ON INVESTMENT) AGGREGATION

Supplemental Resource to the Natural Capital  
Investment: Urban Forest Canopy Benefits Guide.

UNIVERSITY OF MARYLAND ENVIRONMENTAL FINANCE CENTER  
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### Why aggregate net benefits?

Most reports for urban tree canopy (canopy) benefits discuss total benefits only. The importance of reporting net benefits is the accounting for costs and benefits of trees. The lack of funding in urban canopy programs is informed by the tracking and documentation of both costs and benefits. When net benefits (benefit minus cost) are tracked and reported, gaps in funding are more evident as the net benefit value may be negative, meaning there are few benefits for the cost (or budget) provided for tree canopy and care.

The net benefit calculation shows return on investment per capita in a simple way. Compared to the benefit, the budget expenditures or allocations show how the estimated benefits accrue per capita across a particular municipal or urban area (herein, benefit estimates are reported using i-Tree Landscape). The resulting net benefit may be positive or negative. The negative result may support the need for more investment in the canopy to provide canopy benefits to a particular urban area.

The steps below show a “benchmark area” of a municipal boundary. Benchmark and smaller canopy asset net benefit per capita examples are in the “Natural Capital Investment: Urban Forest Canopy Benefits” guidance document. This document provides an example of how net benefits can be summed (aggregated) across municipal or urban areas. Summing one benefit category separate from other benefit categories within the urban boundaries allows comparing that benefit across cities. It also provides a picture of the per capita positive and negative net benefits, nationally. The recommendation to add only one benefit category for comparison attempts to avoid the idea that the cost per capita is - in reality - distributed among all the canopy benefits. This makes the cost difficult to partition among the benefits. The summing within one benefit category for comparison also attempts to avoid the fact that some benefits overlap; that is how humans experience the benefit. For example, particulate matter less than 2.5 microns (PM 2.5) reduction provides airquality benefits of health care cost reduction. However the health care cost reduction may also be attributed to decrease of multiple pollutants (e.g., ozone, PM 10) that the canopy helps reduce.

The steps below follow the steps within “Natural Capital Investment: Urban Forest Canopy Benefits” guidance document. The detailed data for each municipal area are in Appendix A. The examples below demonstrate monetizing benefits per-capita of stormwater runoff reduction and air quality improvement. A description of potential benefits to track is in Appendix B.

**Step 1 Collect information on current costs, funding sources, and amounts for urban canopy**

The University of Maryland Environmental Finance Center scoured budget reports and collected budget (cost) data from municipalities to provide a synopsis of the urban canopy management budget. The data was collected from varied parts of the country with diverse populations. Multiple departments such as public works, planning, and either the capital budget and/or the executive budget for each city was retrieved for the cities from the web. Key word search within the budget included the words: urban forest/forest/tree/tree canopy. The line item and total budgets were attempted to be categorized and totaled. For eight cities the urban forest budget data appeared relatively complete. The summary of the budget scan is below. The budget lines for each city are in Appendix A.

*Table 1 Community comparison of per capita investment*

<b>Municipality</b>	<b>Municipal Population (2019)</b>	<b>Total Budget (2019)</b>	<b>Per Capita Budget (2019)</b>	<b>Per Capita Budget (2021)*</b>
City of Atlanta, GA (2019)	488,000	\$4,158,341	\$8.94	\$10.10
City of Baltimore, MD	586,000	\$8,477,863	\$13.68	\$15.46
City of Denver, CO	727,000	\$475,596	\$0.70	\$0.79
City of Detroit, MI	670,052	\$6,940,910	\$10.21	\$11.54
City of Frederick, MD	67,421	\$87,475	\$1.26	\$1.42
City of Lancaster, PA	59,344	\$286,102	\$4.80	\$5.42
City of Philadelphia, PA	1,584,064	\$5,474,649	\$3.49	\$3.94
City of Portland, OR	645,291	\$6,257,872	\$9.93	\$11.22

\*Consumer Price Index 2019 to 2021 1.13

**Step 2**

**Create an assessment area(s) (Benchmark Example: Municipal Boundary)**

*Table 2 Atlanta Benchmark*

<b>Census Place</b>		
<b>Atlanta population (2019)</b>	<b>Canopy Acres (2011 i-Tree Landscape)</b>	<b>Persons per canopy acre</b>
488,000	42,117	12

\*Persons per canopy indicates "intensity of use" by each canopy acre - that is the more people the higher the use value of each acre of canopy. This metric provides comparative acre use across urban forest areas.

**Step #3**

**Estimate benefits and benefits per capita using i-Tree Landscape) benchmark area and 2) asset area benefits(Example below: Municipal Boundary). Use consumer and producer price indexes to correct the dollar value.**

***Table 3 Atlanta Benchmark Area Benefits***

Tree Benefit	\$/year (i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)
PM2.5	\$ 4,816,398	\$ 9.87	\$ 11.74
Avoided Runoff	\$ 6,366,574	\$ 13.05	\$ 15.79

CPI 2011 (2021) for Avoided Runoff

1.21

PPI 2011 (2021) for Air Quality PM 2.5

1.19

**Step #4**

**Net Benefits and Return on Investment Estimates for Canopy Assets (Subtract the budget (cost) \$per capita in the Table 1 from the benefit \$per capita above)**

***Table 4 Atlanta Benchmark Net Benefits per Capita***

Tree Benefit	Net Benefit \$/Capita (2021)
PM2.5	\$ 1.64
Avoided Runoff	\$ 5.68

**Step #5**

**Tracking benefits and costs of canopy services for return on investment (Example for select cities)**

- Persons per canopy indicates "intensity of use" by each canopy acre - that is the more people the higher the use value of each acre of canopy.
- Negative net benefits displayed for the cities profiled indicates the net benefit (benefit minus cost per capita) of focus is not positive, that is more spending to increase benefits, and tracking of the benefit is may be indicated.
- Positive net benefits indicates spending is producing benefits greater than costs per capita for that particular benefit.
- The aggregate benefit per capita indicates overall net benefits per capita for stormwater is negative and positive for PM 2.5.
- Benefit and cost tracking helps determine benefit gaps (i.e. potential equity concerns) and where spending to increase benefit may be indicated.

**Table 5 Aggregate Net Benefits (Return on Investment) for Urban Tree Canopy:  
Summary for Select Cities and Two Benefits, PM 2.5 and Avoided Runoff**

	Atlanta, GA	Baltimore, MD	Denver, CO	Detroit, MI	Frederick, MD	Lancaster, PA	Philadelphia, PA	Portland, OR	Aggregate Net Benefit per capita
Persons per canopy acre*	12	40	135	91	26	51	70	37	Return on Investment
PM2.5	\$ 1.64	\$ (1.47)	\$ (0.60)	\$ (8.39)	\$ 1.30	\$ (3.88)	\$ 6.43	\$ 15.96	\$ 10.99
Avoided Runoff	\$ 5.68	\$ (8.62)	\$ 0.13	\$ (7.62)	\$ 1.80	\$ (2.91)	\$ 0.39	\$ 7.91	\$ (3.24)

**Appendix A**  
**Data for Cities Summarized in Table 5**

*Community comparison of per capita investment*

<b>Municipality</b>	<b>Municipal Population (2019)</b>	<b>Total Budget (2019)</b>	<b>Per Capita Budget (2019)</b>	<b>Per Capita Budget (2021)*</b>
City of Atlanta, GA (2019)	488,000	\$4,158,341	\$8.94	\$10.10
City of Baltimore, MD	586,000	\$8,477,863	\$13.68	\$15.46
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City of Lancaster, PA	59,344	\$286,102	\$4.80	\$5.42
City of Philadelphia, PA	1,584,064	\$5,474,649	\$3.49	\$3.94
City of Portland, OR	645,291	\$6,257,872	\$9.93	\$11.22

\*Consumer Price Index 2019 to 2021

1.13

*Aggregate Net Benefits (Return on Investment) for Urban Tree Canopy: Summary for Select Cities and Two Benefits, PM 2.5 and Avoided Runoff*

<i>Summary for Select</i>	<b>Atlanta, GA</b>	<b>Baltimore, MD</b>	<b>Denver, CO</b>	<b>Detroit, MI</b>	<b>Frederick, MD</b>	<b>Lancaster, PA</b>	<b>Philadelphia, PA</b>	<b>Portland, OR</b>	<b>Aggregate net benefit per capita</b>
<b>Persons per canopy acre*</b>	12	40	135	91	26	51	70	37	
<b>PM2.5</b>	\$ 1.64	\$ (1.47)	\$ (0.60)	\$ (8.39)	\$ 1.30	\$ (3.88)	\$ 6.43	\$ 15.96	\$ 10.99
<b>Avoided Runoff</b>	\$ 5.68	\$ (8.62)	\$ 0.13	\$ (7.62)	\$ 1.80	\$ (2.91)	\$ 0.39	\$ 7.91	\$ (3.24)

\*Persons per canopy indicates "intensity of use" by each canopy acre - that is the more people the higher the use value of each acre of canopy.

Negative net benefits displayed for the cities profiled indicates the net benefit (benefit minus cost per capita) of focus is not positive, that is more spending to increase benefits, and tracking of the benefit is may be indicated.

Positive net benefits indicates spending is producing benefits greater than costs per capita for that particular benefit.

The aggregate benefit per capita indicates overall net benefits per capita for stormwater is negative and positive for PM 2.5. Benefit and cost tracking helps determine benefit gaps (i.e. potential equity concerns) and where spending to increase benefit may be indicated.



**Atlanta GA**

Census Place		
Atlanta Pop. (2019)	Canopy Acres (2010 i-Tree Landscape)	Persons per canopy acre
488,000	42,117	12

Tree Benefit	\$/year (i-Tree Landscape )	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita (2021)
PM2.5	\$ 4,816,398	\$ 9.87	\$ 11.74	\$ 1.64
Avoided Runoff	\$ 6,366,574	\$ 13.05	\$ 15.79	\$ 5.68

CPI 2011 (2021) 1.21

PPI 2011 (2021) 1.19

**Baltimore, MD**

Census Place		
Baltimore Pop. (2020)	Canopy Acres (2010 i-Tree Landscape)	Persons per canopy acre
586,000	14,750	40

Tree Benefit	\$/year (i-Tree Landscape )	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita (2021)
PM2.5	\$ 6,885,999	\$ 11.75	\$ 13.98	\$ (1.47)
Avoided Runoff	\$ 3,311,449	\$ 5.65	\$ 6.84	\$ (8.62)

CPI 2011

(2021) 1.21

PPI 2011 (2021) 1.19

**Denver, CO**

Census Place		
Denver Pop. (2020)	Canopy Acres (2010 i-Tree Landscape)	Persons per canopy acre
727,000	4,475	135

Tree Benefit	\$/year (i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita (2021)
PM2.5	\$ 118,458	\$ 0.16	\$ 0.19	\$ (0.60)
Avoided Runoff	\$ 554,218	\$ 0.76	\$ 0.92	\$ 0.13

CPI 2011 (2021) 1.21  
 PPI 2011 (2021) 1.19

**Detroit, MI**

Census Place		
Detroit Pop. (2019)	Canopy Acres (2010 i-Tree Landscape)	Persons per canopy acre
670,052	7,339	91

Tree Benefit	\$/year (i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita (2021)
PM2.5	\$ 1,022,376	\$ 1.53	\$ 1.82	\$ (8.39)
Avoided Runoff	\$ 1,432,992	\$ 2.14	\$ 2.59	\$ (7.62)
CPI 2011 (2021)		1.21		
PPI 2011 (2021)		1.19		

**Frederick, MD**

Census Place (2010)		
Frederick Pop. (2019)	Canopy Acres (i-Tree Landscape)	Persons per canopy acre
67,421	2,619	26

Tree Benefit	\$/year(i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita(2021)
PM2.5	144,967	\$ 2.15	\$ 2.56	\$ 1.30
Avoided Runoff	170,319	\$ 2.53	\$ 3.06	\$ 1.80

CPI 2011 (2021) 1.21  
 PPI 2011 (2021) 1.19

**Lancaster, PA**

Census Place		
Lancaster Pop. (2015)	Canopy Acres (i-Tree Landscape)	Persons per canopy acre
59,344	1,171.40	51

Tree Benefit	\$/year(i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita(2021)	Net Benefit \$/Capita (2021)
PM2.5	45,995	\$ 0.78	\$ 0.92	\$ (3.88)
Avoided Runoff	92,672	\$ 1.56	\$ 1.89	\$ (2.91)

CPI 2011 (2021) 1.21  
PPI 2011 (2021) 1.19

**Philadelphia, PA**

Census Place		
Philadelphia Pop. (2019)	Canopy Acres (i-Tree Landscape)	Persons per canopy acre
1,584,064	22,615	70

Tree Benefit	\$/year(i-Tree Landscape)	\$ Benefit/Capita(2011)	\$ Benefit/Capita(2021)	Net Benefit \$/Capita(2021)
PM2.5	13,210,822	\$ 8.34	\$ 9.92	\$ 6.43
Avoided Runoff	5,077,481	\$ 3.21	\$ 3.88	\$ 0.39

CPI 2011

(2021) 1.21

PPI 2011

(2021) 1.19

**Portland, OR**

Census Place		
Portland Pop.	Canopy Acres (i-Tree Landscape)	Persons per canopy acre
645,291	17,389	37

Tree Benefit	\$/year (i-Tree Landscape)	\$ Benefit/Capita (2011)	\$ Benefit/Capita (2021)	Net Benefit \$/Capita (2021)
PM2.5	14,036,645	\$ 21.75	\$ 25.89	\$ 15.96
Avoided Runoff	9,516,433	\$ 14.75	\$ 17.84	\$ 7.91

CPI 2011 (2021) 1.21

PPI 2011 (2021) 1.19



Community	Department	Project Type ("Buckets")	Project/Task	Funding	Annual Budget
City of Atlanta, GA FY 2019 Budget	Office of Resilience (Executive Office)	Project Implementation	Urban Food Forest at Browns Mill (Nation's largest municipal "food forest park")	Grant (\$120,000 from Turner Foundation; secured \$4,800 from Cherokee Garden Club)	\$124,800
	Office of Resilience (Executive Office)	Project Implementation	Urban Food Forest at Browns Mill	Intergovernmental Grant Fund	\$11,256
	Office of Resilience (Executive Office)	Tree Assessment	Secured services of Trees Atlanta through support of philanthropic partners to draft a tree assessment along the corridor and do an initial clearing along the first segment of the trail.	Philanthropic Partners	Unknown
	Department of Parks and Recreation 11	Tree Removal/Maintenance	Park arborists and forestry crews are responsible for street trees on 1,724 linear miles/right-of-way. Tree limb removal and park maintenance		
	Department of Parks and Recreation/City Infrastructure	Tree Planting	Planted over 1,500 community-based, small tree plantings within the City of Atlanta. The Department also utilized ruminants to clear invasive species from park land.	General Fund	\$39,087,190
	Department of Parks and Recreation/City Infrastructure	Education & Outreach	Contracted with Trees Atlanta to offer a series of free arboricultural programs including pruning classes, educational tours along Atlanta's Beltline linear arboretum and a free speaker series.		
	Department of City Planning/Office of Commissioner	Study/Planning and Ordinance Update	Completion of the Urban Ecology Framework. The study will determine what aspects of nature in Atlanta should be protected, restored, and enhanced as well as provide a framework that protects greenspace alongside development in the City. The project also includes an update to the Tree Ordinance that helps to preserve and enhance the tree canopy.	General Fund	\$23,617,717
	Department of City Planning/Office of Buildings	Tree Permitting	This Office is responsible for issuing tree removal permits for trees on private property.		
	Assume Department of Parks & Recreation	Tree Removal	Tree Removal Protection - 600013	Capital Budget: Trust	\$3,768,057
	Assume Department of Parks & Recreation	Education & Outreach/Tree Removal	Edu. Outreach/Tree Removal - 600307	Capital Budget: Trust	\$254,228
<b>City of Atlanta Total</b>					<b>\$4,158,341</b>
City of Philadelphia, PA FY 2019 Budget (Book 1)	Department of Public Property	Tree Removal	Facilities Management - Field Operations Program; Contract with Townscapes/Eden Corporation for tree removal.	General Fund	\$89,000
City of Philadelphia, PA FY 2019 Budget (Book 2)	Managing Director's Office/Community Life Improvement Program	Tree Maintenance	Lanscaping services, Davey Tree Expert	General Fund	\$2,000
	Managing Director's Office/Community Life Improvement Program	Tree Maintenance	Lanscaping services, Jimmy's Tree & Landscaping	General Fund	\$30,000
	Department of Parks & Recreation/Infrastructure & Property Management	Tree Removal	Contract with Jimmy's Tree & Landscaping for tree/trunk/stump removal	General Fund	\$70,000
	Department of Parks & Recreation/Infrastructure & Property Management	Tree Maintenance	Contract with The Davey Tree Expert for tree pruning	General Fund	\$200,000
	Department of Parks & Recreation/Infrastructure & Property Management	Tree Plantings	Tree Vitalize Watershed Program Phase X: tree planting along stream corridors, adjacent upland areas, headwaters, and green SW basins	Grant	\$50,000
	Department of Parks & Recreation/Infrastructure & Property Management	Tree Maintenance	30 staff positions under <b>Tree Maintenance</b> ; Line items for: Heavy Equipment Operator, Park Projects Technician, Tree Maintenance Crew Chief, Tree Maintenance Worker	General Fund	\$1,350,029
	Department of Parks & Recreation/Infrastructure & Property Management	Urban Forestry	20 staff positions under <b>Urban Forestry</b> ; Line items for: Clerk 3, Greenhouse/nursery attendant, Park manager, Park Projects Tech, Parks & Rec Grounds Maintenance, Parks & Rec Operations Manager, Parks Operations Director, Service Representative	General Fund	\$1,147,564
	Department of Planning and Development/DHCD Contract Obligations	Tree Maintenance/Tree Plantings/Education & Outreach	Professional services contract with PA Horticultural Society for greening projects that include tree maintenance, tree plantings, and education and technical assistance to support community	General Fund	\$2,390,000
	Department of Water/Operations	Sewer Maintenance: Tree Maintenance Worker	2 staff positions	Water Fund	\$90,056
	Department of Water/Operations	Tree Removal	Contract TBD for tree and stump removal	Water Fund	\$51,000
Department of Water/Planning & Environmental Services	Tree Maintenance	Contract with The Davey Tree Expert Company for tree pruning and cutting to care for BLS property	Water Fund	\$5,000	
<b>City of Philadelphia Total</b>					<b>\$5,474,649</b>
City of Baltimore, MD FY 2019 (Volume II)	Comptroller Agency/ Real Estate Acquisition & Management	Tree Removal (hazardous)	Increase funding for hazardous tree removal on City-owned properties	General Fund	\$20,000
City of Baltimore, MD FY 2019 (Volume II)	Recreation and Parks Agency/Park Maintenance	Tree Trimmer	6 staff positions	General Fund	\$235,564
	Recreation and Parks Agency/Urban Forestry Division	Tree Maintenance/Removal/Planting/etc.	20 staff positions for Urban Forestry Division: Provides general maintenance of city street and park trees, including inspecting, planting, removing, pruning, watering and mulching. This service manages trees on public property and rights of way, and on private property through the TreeBaltimore initiative.	General Fund	\$4,429,451
	Transportation Agency/Public Rights-of-Way Landscape Management	Tree Maintenance	15 staff positions total; This service provides for the mowing and maintenance of 870 median strips in City roadways; mulching and cleaning of tree pits; etc.	General Fund	\$3,790,941
City of Baltimore Six Year Capital Program FY 2019	Recreation and Parks Agency/Forestry Division	Tree Planting	Purchase and install tree through TreeBaltimore. TreeBaltimore staff determine locations for trees. In FY2019 also complete the renovation for the TreeBaltimore Nursery.	Capital Budget: General Funds	\$500
	DPW/Erosion Control	Tree Mitigation	To address MS4 Permit	Capital Budget: Stormwater Revenue Funds, Stormwater Utility Funds	\$1,107
	Downtown Partnership of Baltimore	Tree Maintenance	Upgrade curbs, sidewalks, streetlights and enhance/improve crosswalks, enlarge tree pits, and provide additional landscaping to improve and enhance the pedestrian experience.	Capital Budget: General Obligation Bonds	\$200
	Planning Department/Forest Conservation Program	Forest Management	Implement the Forest Conservation Program across the City. Support the reforestation, afforestation, and forest management in the city including forest inventories or assessments, site identification, acquisition, preparation, management and maintenance.	Capital Budget: Forest Conservation Funds	\$100
<b>City of Baltimore Total</b>					<b>\$8,477,863</b>
City of Denver, CO FY 2019 Budget (Volume I)	Department of Parks and Recreation	Tree Removal/Planting	The Public Tree Canopy Fund removes and replaces trees lost or damaged during City and private construction projects on street rights-of-way.	Funded by private donations, project incomes, and reimbursements. Culture & Recreation SRF	\$275,596
	Department of Parks and Recreation	Tree Planting/Maintenance	Citywide Tree Program: Funding is for purchase of new replacement trees to maintain and refurbish Denver's tree canopy and to meet the sustainability program objectives of the City.	Capital Improvement Funds	\$200,000
	Department of Parks and Recreation	Tree Equipment	Parks and Recreation includes Parks Forestry equipment in the Capital Planned Fleet Detail by Fund and Department for the replacement of 1 or 2 of each: Parks Forestry Pickup Truck, Loader, Dump Truck, Overhead Service, Stump Grinder, Chipper, Tree Spader	Planned Fleet Fund: funding for fleet replacement on an annual cycle, and new/expansion vehicles are budgeted here as well. Revenues to this fund come from a General Fund transfer and interest income.	Does not breakdown individual vehicle/equipment costs
		Tree Maintenance	Charges for tree trimming mentioned in the "Charges for Services" section explaining the city revenues	Tree trimming services	N/A
City of Denver, CO FY 2019 Budget (Volume II)	Department of Parks and Recreation	Tree Planting/Maintenance	Trees planted and treated are increasing with the funding for Emerald Ash Borer so parks can stay ahead of this natural disaster and maintain Denver's valued tree canopy.	Emerald Ash Borer Funds	Unknown
	Department of Parks and Recreation	Staffing	Extension of 11 limited positions, consisting of four Arborist Technician I's, three Forestry Inspectors, two Operations Assistants, one Accounting Technician II, and one Operations Supervisor for forestry operations in parks. The positions were limited through the end of 2019 and have been extended to the end of 2023. No increase in FTE count or dollars in 2019.	General Fund	Lays this out to say no change in expenditures; does not breakdown personnel costs only shows entire dept.
<b>City of Denver Total</b>					<b>\$475,596</b>

City of Indianapolis, IN FY 2019 Budget						Seems that this is the budget for Indianapolis and Marion County; 0 reference to tree, urban forest/forest/forestry, planting)					
City of Sacramento, CA FY 18/19 Budget. Way off an estimate; does not breakdown budget enough but does identify program costs		Tree Funding	Tree Funding	Tree Funding	Tree Funding						
		Tree Planting	Tree Planting	Tree Planting	Tree Planting						
	Department of Public Works	Tree Maintenance	Tree Maintenance	Tree Maintenance	Tree Maintenance						
	Department of Public Works	Tree Planning/Maintenance/Planting	Tree Planning/Maintenance/Planting	Tree Planning/Maintenance/Planting	Tree Planning/Maintenance/Planting						
	Department of Public Works	Tree Policy/Ordinance	Tree Policy/Ordinance	Tree Policy/Ordinance	Tree Policy/Ordinance						
	Department of Public Works	Staffing	Staffing	Staffing	Staffing						
	DPW/Maintenance Services Division/ Urban Forestry Program	Tree Canopy	Tree Canopy	Tree Canopy	Tree Canopy						
	Resolution Approving Operating & Capital Budget										
City of Sacramento Total										\$23,118,971	
City of Portland FY 18/19 Budget (Volume I)	Portland Parks and Rec (PP&R) /Urban Forestry Division	Tree Funding	Tree Funding	Tree Funding	Tree Funding						
		Tree Planting/Maintenance/Outreach and Education/etc.	Tree Planting/Maintenance/Outreach and Education/etc.	Tree Planting/Maintenance/Outreach and Education/etc.	Tree Planting/Maintenance/Outreach and Education/etc.						
		Tree Maintenance Facility	Tree Maintenance Facility	Tree Maintenance Facility	Tree Maintenance Facility						
		Philanthropy	Philanthropy	Philanthropy	Philanthropy						
		Staffing	Staffing	Staffing	Staffing						
		Staffing	Staffing	Staffing	Staffing						
		Staffing	Staffing	Staffing	Staffing						
	Strategic Planning	Strategic Planning	Strategic Planning	Strategic Planning							
	Tree canopy	Tree canopy	Tree canopy	Tree canopy							
	Tree maintenance	Tree maintenance	Tree maintenance	Tree maintenance							
Bureau of Environmental Services/Public Utilities Service Area	Tree Planting	Tree Planting	Tree Planting	Tree Planting							
	Tree planting	Tree planting	Tree planting	Tree planting							
	Tree planting	Tree planting	Tree planting	Tree planting							
	Urban Forest Canopy	Urban Forest Canopy	Urban Forest Canopy	Urban Forest Canopy							
Bureau of Planning & Sustainability, Community Development Service Area	Planning/Performance Measures	Planning/Performance Measures	Planning/Performance Measures	Planning/Performance Measures							
Portland Bureau of Transportation, Transportation and Parking Service Area	Interagency Agreement Balancing	Interagency Agreement Balancing	Interagency Agreement Balancing	Interagency Agreement Balancing							
City of Portland FY 18/19 Budget (Volume II)	PP&R Capital Improvement Plan	Capital project	Capital project	Capital project							
City of Portland Total										\$6,257,872	
City of Lancaster, PA FY 2018 Budget	Department of Public Works										
	Department of Public Works/Bureau of Operations	Tree Planting/Maintenance/Ordinance Implementation	Tree Planting/Maintenance/Ordinance Implementation	Tree Planting/Maintenance/Ordinance Implementation	Tree Planting/Maintenance/Ordinance Implementation						
	DPW/Traffic Expenses	Tree Trimming	Tree Trimming	Tree Trimming	Tree Trimming						
	DPW/Park Admin Expenses	Tree Program Advertising	Tree Program Advertising	Tree Program Advertising	Tree Program Advertising						
	DPW/Park Admin Expenses	Tree Program Postage	Tree Program Postage	Tree Program Postage	Tree Program Postage						
	DPW/Parks Expenses	Tree Planting	Tree Planting	Tree Planting	Tree Planting						
	DPW/Parks Trees	Tree Department	Tree Department	Tree Department	Tree Department						
	DPW/Stormwater Management	Tree Landscaping	Tree Landscaping	Tree Landscaping	Tree Landscaping						
City of Lancaster Total										\$286,102	
City of Asheville, NC FY 18/19 Budget		Tree Recognition	Tree Recognition	Tree Recognition	Tree Recognition						
	Department of Public Works	Tree Canopy Study	Tree Canopy Study	Tree Canopy Study	Tree Canopy Study						
	Department of Public Works	Tree Department	Tree Department	Tree Department	Tree Department						
City of Frederick, MD FY 19/20 Budget	Department of Public Works	Tree Planting	Tree Planting	Tree Planting							
City of Frederick, MD FY 19/20 Budget Details	Funds	Tree Program Revenue	Tree Program Revenue	Tree Program Revenue	Tree Program Revenue						
	Sustainability	Tree Program Revenue	Tree Program Revenue	Tree Program Revenue	Tree Program Revenue						
	Sustainability/ General Supplies	Tree Canopy	Tree Canopy	Tree Canopy	Tree Canopy						
	Street Maintenance Dept.	Tree Maintenance	Tree Maintenance	Tree Maintenance	Tree Maintenance						
	Street Maintenance Dept.	Tree Maintenance	Tree Maintenance	Tree Maintenance	Tree Maintenance						
	Parks Division	Tree Planting	Tree Planting	Tree Planting	Tree Planting						
	Parks Division	Tree Planting and Maintenance	Tree Planting and Maintenance	Tree Planting and Maintenance	Tree Planting and Maintenance						
City of Frederick, MD FY 20-25 Capital Improvements Program	Department of Public Works/ Sustainability	Tree Canopy	Tree Canopy	Tree Canopy	Tree Canopy						
City of Frederick Total										\$87,475	
City of Detroit, MI FY19-22 Overview (Sec A)	Capital Program	Tree Removal	Tree Removal	Tree Removal	Tree Removal						
City of Detroit, MI FY19-22 Departments (Sec B)	General Services Department (Detroit Parks and Rec Dept. was merged here effective FY 19)	Tree maintenance and removal	Tree maintenance and removal	Tree maintenance and removal	Tree maintenance and removal						
	General Services Department	Staffing	Staffing	Staffing	Staffing						
City of Detroit, MI FY19-22 Legal Budget (Sec C)	DPW	Tree maintenance	Tree maintenance	Tree maintenance	Tree maintenance						
	General Services Department	Tree Removal	Tree Removal	Tree Removal	Tree Removal						
City of Detroit Total										\$6,940,910	

## Appendix B

### Tracking benefits and costs of canopy services for return on investment <sup>1</sup>

The purpose of tracking costs and benefits of specific urban canopy services (not services in aggregate) is to identify, justify and communicate with potential new funding sources. Governments and non-profits have traditionally relied on municipal, state, or federal dollars to develop and implement many projects and initiatives, including urban and community forestry projects. In this approach, funding for the entirety of the project and all related aspects are allocated and appropriated upfront. Although this approach has its advantages, funding is spent on projects before the expected outcomes being delivered. Therefore, this financing structure usually means that riskier projects, i.e. those with untested approaches or uncertain outcomes, may be less likely to receive funding.

Outcomes-based financing is a relatively new financing model that takes an innovative approach to mitigate this risk. In this structure, investors are providing the upfront capital needed to fund these projects, and the repayment of this funding is tied to the achievement of project outcomes and deliverables. Shifting the financial risk of funding innovative projects onto investors allows governments, non-profits, and other similar entities – who typically have less financial capital – to access. New funding from non-traditional sources based on the multiple benefits projects may create, allows more innovative projects to be implemented. In outcomes-based financing, there are usually several parties involved. Figure 1 maps the responsibilities of each party and the relationships between them.

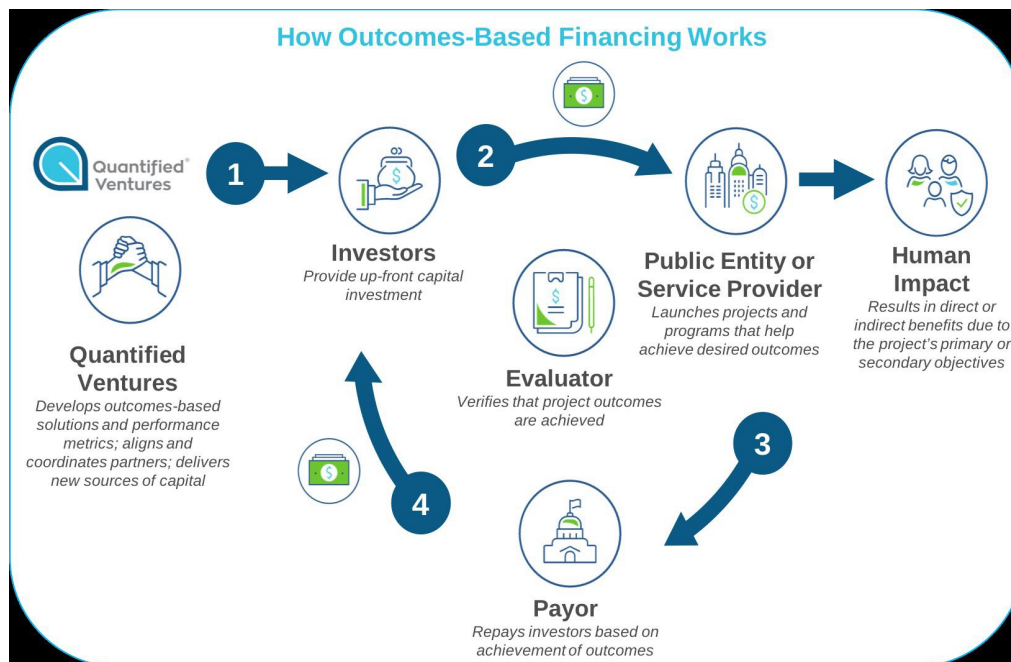


Figure 1 Outcomes-based financing model (Quantified Ventures)

Central to the development of any outcomes-based financing approach is the identification of the various stakeholders that would participate, and stand to benefit from an assessment and accounting

<sup>1</sup> This section written with project partner Quantified Ventures.

of the varied outcomes generated by the projects that are being financed. In the context of urban and community forestry projects, the following types of entities to be the most significant and important types of “users” the accounting framework should target:

1. **Outcomes Payor:** An entity that benefits from the value of urban tree canopies, and thus may be compelled to be a “payor” in an outcomes-based financing entity, or contribute to financing of these projects. For example, based recent project team conversations and the link between urban trees and health, this could potentially be a health plan based in a city like Louisville where urban heat island effects and the ability of tree cover to mitigate them are strong. It could also potentially be a municipality itself.

2. **Service Provider:** An organization that plants trees in urban settings and implements urban and community forestry projects, such as Casey Trees in Washington, DC. This is the target entity for scaling from capital provided by outcomes payors. If the service provider is also one that incorporates social and economic goals in their operations, such as workforce development training, a broader set of payors may be incentivized to participate to help pay for projects.

3. **Lobbyist:** Scaling from the local to the national level, an accounting framework that values the benefits of an urban tree canopy could better equip for organizations that lobby for urban trees around the country, such as American Forests. By ensuring buy-in of, and providing tools for, a lobbyist as a “user” of the framework, it would enable easier replication of urban and community forestry projects across the country.

There are different categories used for accounting for urban forest costs and benefits. The costs can fall into direct costs (similar to the costs described above in budgets across departments) in addition to cost savings. These are estimates provided by the benefits, for example, stormwater runoff reduction reducing treatment costs. Revenue can fall into the following categories further described in Table 1.

**Table 1 Urban forest accounting system tracking**

<b>Costs - Direct</b>	Costs associated with creating and maintaining urban/community forest resources.
<b>Costs - Indirect</b>	Costs that are impacted by urban/community forest resources. These costs could be reduced or avoided through an investment.
<b>Revenue</b>	Revenue generated directly or indirectly from urban/community forest resources.
<b>Non-Revenue Benefits</b>	Non-revenue benefits are generated directly or indirectly from urban/community forest resources. <i>In italics below are benefits that may be difficult to quantify, so proxies may have to be developed on a city-by-city basis.</i>

**Table 2 Benefit and Cost connections**

	<b>BENEFITS</b> Types of data that can be tracked related to investments in urban/community forestry projects	<b>COST DIRECT/INDIRECT POTENTIAL</b> Specific illustrative data and metrics that can be tracked to assess value in a pay for success or impact investment transaction
<b>Category</b>	<b>Data Types Relevant to Urban/Community Forestry</b>	<b>Data Examples</b>
Costs - Indirect	Improved water treatment	Avoided water/stormwater treatment through reduced run-off into waterways
Costs - Indirect	Reduced local flood damage and nuisance	Volume capture of (storm)water, as flow or stock/capacity removal from the floodplain
Costs - Indirect	Reduced urban heat island effect	Ambient temperatures before and after installation of urban forestry resources
Costs - Indirect	Reduced health impacts from urban environment	Recreation-obesity surrounding parks/urban forests
Costs - Indirect	Reduced health impacts from urban environment	Air quality-EMS Calls for cardiac and respiratory distress during high heat index days (>103 degrees F)
Revenue	Tax revenues	Taxes associated with tourism, visitation, neighborhood improvement, etc.
Revenue	Productive reuse of fresh cut hardwoods, tree trimmings	Revenue from sales of hardwoods, wood trimming material
Revenue	Carbon	Carbon credits
Non-Revenue Benefits	Property values	Changes in property value (assessed tax value) before & after park creation
Non-Revenue Benefits	Job creation	# park / maintenance employees over time, # employees of contractors engaged
Non-Revenue Benefits	Crime reduction in neighborhoods	Neighborhood crime rates
Non-Revenue Benefits	Stormwater volume captured	Quantity of volume captured
Non-Revenue Benefits	Reduced urban heat island effect	Ambient temperatures before and after installation of urban forestry resources

Non-Revenue Benefits	Reduced health impacts from urban environment	Asthma rates, obesity surrounding parks/urban forests
Non-Revenue Benefits	Reduced health impacts from urban environment	EMS Calls for cardiac and respiratory distress during high heat index days (>103 degrees F)
Non-Revenue Benefits	<i>Neighborhood social cohesion</i>	<i>[To be developed on a city-by-city basis: appropriate proxies]</i>
Non-Revenue Benefits	<i>Improved mental health</i>	<i>[To be developed on a city-by-city basis: appropriate proxies]</i>
Non-Revenue Benefits	<i>Social and environmental equity improvement</i>	<i>[To be developed on a city-by-city basis: appropriate proxies]</i>
Non-Revenue Benefits	<i>Ecosystem services (pollination, biodiversity)</i>	<i>[To be developed on a city-by-city basis: appropriate proxies]</i>

Table 2 shows examples of data types and metrics that urban and community forest managers can collect to value their investments. This data could be used in justifying and structuring new financing sources for urban forestry programs.