Valuing the Potential Economic, Social, and Environmental Impacts of the Philly Tree Plan

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1. Introduction

1.1. Purpose of Report

The Philly Tree Plan (the "Plan") is a strategic plan for the equitable growth and care of Philadelphia's urban forest, commissioned by the City of Philadelphia (the "City") and led by Philadelphia Parks & Recreation ("PPR"). Developed in partnership with the urban planning consultancy Hinge Collective, and in alignment with the Philadelphia City Planning Commission's Philadelphia 2035 Comprehensive Plan and the Greenworks sustainability plan, the Philly Tree Plan calls for a sizable investment in tree planting and care across Philadelphia, with a primary focus on communities determined to be in highest need of additional tree cover. The ultimate goal of the Plan is to reduce disparities of tree canopy distribution within Philadelphia to allow all residents to be able to directly benefit from a renewed investment in trees as public health infrastructure. Achieving 30 percent tree canopy cover by the year 2050 was identified as a benchmark in the Philly Tree Plan because of the supporting body of research that projects significant health impacts associated with 30 percent cover. This also aligns the Philly Tree Plan with the canopy cover goal stated in both the Greenworks Plan and the Philadelphia 2035 Plan.

PPR engaged Econsult Solutions, Inc. ("ESI"), a Philadelphia-based urban economics consultancy, to evaluate the potential economic, social, and environmental benefits that could accrue to the City of Philadelphia and its residents if the Philly Tree Plan were to be implemented as proposed. The following report describes estimates of these potential benefits. ESI developed estimates of the monetary value of the social and environmental benefits from the Philly Tree Plan, based on economic and scientific research. ESI estimated the economic output, employment, and tax revenue impacts from capital investments and operations of the Plan using IMPLAN input-output modeling software and industry-standard procedures and assumptions.

1.2. Overview of the Philly Tree Plan

The Philly Tree Plan, created by Philadelphia Parks and Recreation in collaboration with Hinge Collective in 2022, describes in detail a plan that would significantly increase tree cover in the City of Philadelphia over the next three decades. The city's tree cover currently sits at about 20 percent, requiring an additional 10 percent of tree cover to realize health benefits as supported by research.

Maintaining and increasing tree cover in the city has long been a priority for the City and PPR, and the investments described in the Plan would instantiate that priority via intentional growth and maintenance of the city's tree canopy. The Plan's intent is to expand tree canopy across land ownership (public and private) and land use (residential, commercial, institutional, and recreational) categories.

The Plan's headlining promise is that, by planting more than one million total trees in three phases over a three-decade period, Philadelphia would achieve the goal of 30 percent tree cover by the year 2050. The Plan also includes other initiatives related to Philadelphia's tree canopy, including enhanced maintenance to ensure the upkeep of existing tree cover in parks and natural lands.

The Philly Tree Plan is the product of years of research and community engagement by PPR and Hinge Collective. The Plan is based around a set of goals for the city's urban forest, and it recommends specific actions intended to contribute to these goals and meet community needs. The Plan's focus on environmental justice includes an assessment of sections of the city that are in highest need of additional tree cover, based on the City's tree canopy assessment and other environmental and demographic variables; the final list of high-need communities, including Cobbs Creek, Point Breeze, and Kensington, among others, would be prioritized for tree planting.

The Plan's implementation would lead to direct, indirect, and induced economic benefits from tree planting and maintenance, and more broadly, would lead to impacts on various environmental, social, and health factors citywide. ESI will enumerate these benefits in the report below.

1.3. Key Findings

The primary benefits from the Plan's implementation are its anticipated social and environmental benefits to Philadelphia and its residents. ESI generated approximate estimates of these benefits based on economic and scientific research, and these estimates indicate that the Plan's implementation could bring broad social and economic benefits worth millions and perhaps even billions of dollars.

Estimated environmental benefits from the Plan include $12.5 million per year in reduced air pollution benefits, $1.2 million per year in carbon sequestration, $32.9 million in total carbon storage, $3.6 million per year in residential energy cost savings, $700,000 per year in reduced carbon emissions from residential energy use, and $2.8 million per year in stormwater uptake. The Plan's estimated health effects include reductions in obese and overweight BMI, improved mental health, and the avoidance of hundreds of premature deaths, and a potential decrease in major crime categories including robbery, burglary, and theft worth millions per year.

In addition, the economic activity from tree planting and tree care related to the Plan is projected to bring more than $1 billion of economic impact to the City of Philadelphia over the roughly 30-year tree planting period. ESI estimates a total economic impact of more than $1.6 billion to Philadelphia from capital investments in the Plan (including tree planting and canopy maintenance), including about $1 billion in direct economic activity and more than $600 million in indirect and induced impacts on the Philadelphia economy. In addition, ESI estimates an annual economic impact of about $20 million from tree care staffing and contracting, with more than $17 million of that impact accruing within Philadelphia.

External tree care contracting could also represent an opportunity to support Philadelphia-based minority, women, and disabled-owned business enterprises (MWDSBEs) in forestry, tree care, and landscaping, which would have a potentially substantial impact on socioeconomic equity in Philadelphia.

1.4. Report Scope and Methodology

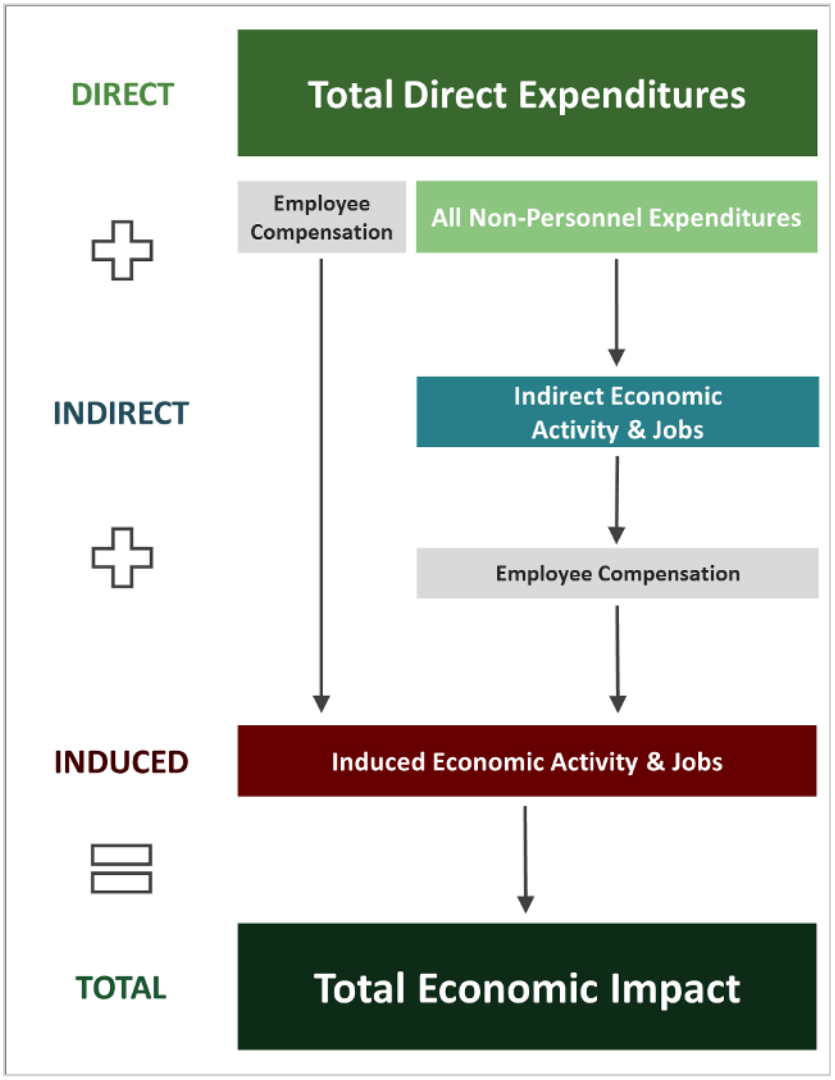
Within this report, ESI employs industry-standard economic modeling techniques to translate direct economic activity generated by the Plan into total economic impact within the city, and Commonwealth. Data inputs on direct activity are largely provided by PPR and Hinge Collective and are verified and supplemented with other third-party data sources and assumptions, as needed.

Economic impact estimates are generated by utilizing input-output models to translate an initial amount of direct economic activity into the total amount of activity that it supports, which includes multiple waves of spillover impacts generated by spending on goods and services as well as spending of labor income by employees. The economic impacts from organizational expenditures are modeled using IMPLAN, an industry standard input-output model software program. Such models are designed to estimate two sets of spillover impacts from organizational expenditures:

- The **indirect effect**, which measures the multiplier effect from the purchase of goods and services from local vendors (i.e., supply chain impacts); and
- The **induced effect**, which measures the multiplier effect from the spending of labor income by employees within a geography (i.e., labor income impacts).

The total economic impact of the Plan is the sum of its own direct economic footprint, plus the indirect and induced effects generated by that direct footprint (see Figure 1.1). Economic impacts are estimated for the City of Philadelphia, as well as the Commonwealth of Pennsylvania (impacts are inclusive of smaller geographies).

Figure 1.1: Economic Impact Methodology



Source: ESI (2022)

IMPLAN also generates fiscal impacts using tax models specific to each taxing body, including the City of Philadelphia and the Commonwealth of Pennsylvania. In the case of public and non-profit entities, modeling is adjusted to ensure that tax-exempt status is accounted for, while still including any economic activity that is tax-generating. For example, City employees generate wage and income tax, and the indirect and induced activity generated by City activities largely accrues to private firms, and therefore is broadly tax-generating.

2. Valuing Social and Environmental Benefits of the Philly Tree Plan

2.1. Section Overview

The two previous sections have considered the economic impacts of the Philly Tree Plan to the city and Commonwealth from the capital investment of tree planting and maintenance and the expanded staffing and contracting from the Plan. This section will consider the Plan's social and environmental benefits.

The Philadelphia metropolitan area ranks among the U.S. urban regions with the worst air quality.[1] The city itself has been called a "quintessential heat island", and environmental injustice is on display in the unequal distribution of dangerous temperatures.[2] The City's Heat Vulnerability Index shows that heat exposure is highest in some of the city's most socioeconomically disadvantaged communities, including Upper North Philadelphia, Kensington, Cobbs Creek, and Point Breeze.[3]

The significant expansion of the city's tree canopy represented by the Philly Tree Plan would improve the sustainability and environmental quality of the City of Philadelphia, leading to substantial benefits for Philadelphians. The Plan builds in a focus on repairing environmental injustice by focusing on neighborhoods of highest need, including the heat-vulnerable communities mentioned above.

Additional social benefits have been associated with increased tree cover and can be anticipated to accrue to the city's residents if the Plan is implemented as intended. These social benefits include a reduction in premature deaths, reduced obesity rates, improved mental health, and decreased crime rates.

To ensure that these benefits are considered in tandem with the economic benefits described in Sections 2 and 3, **the section below applies economic and scientific research to achieve approximate estimates of the monetary value of the social and environmental benefits that could accrue to Philadelphians after the Plan's completion.**

2.2. Environmental Benefits of the Plan

The implementation of the Philly Tree Plan is anticipated to have an impact on air quality, carbon emissions, energy use, and stormwater management, among other environmental factors. The following section will estimate monetary values for these environmental benefits.

ESI's analysis of the environmental benefits of the Philly Tree Plan builds on an analysis of Philadelphia's tree canopy conducted by the U.S. Forest Service in 2012, which provided estimated direct valuations of

[1] Philly Has an Air Pollution Problem. These Researchers Think Its Neighborhoods May Hold a Solution | Villanova University

[2] Understanding the Inequality of the Urban Heat Island Effect | Earth Refuge

[3] Philadelphia Heat Vulnerability Index (arcgis.com)

the environmental benefits of the city's tree canopy.[4] ESI applied estimates from this study in the areas of reduced air pollution, carbon benefits, and reduced energy use to estimate the benefits of the Philly Tree Plan, adjusted for 2022 dollars.

Reduced Air Pollution

The tens of thousands of trees intended to be planted under the Plan is anticipated to reduce air pollution from pollutants including ozone, nitrogen dioxide, sulfur dioxide, and fine air particulate matter in the City of Philadelphia. ESI applied estimates of the per-tree cost savings of air pollution based on the 2012 U.S. Forest Service survey of Philadelphia's tree canopy to estimate the cost savings that this air pollution reduction could bring to Philadelphia (adjusted for 2022 dollars).[5]

This analysis determined that the full implementation of the plan (expected in 2050) could bring an estimated value of about $12.5 million per year from reduced air pollution benefits (see Figure 2.1).

Figure 2.1: Air Pollution Benefits of the Philly Tree Plan at Completion by Pollutant

Pollutant	Amount Removed (tons/year)	Annual Value ($M)
Ozone	170	$2.6
Nitrogen Dioxide	60	$0.1
Sulfur Dioxide	10	$9.8
Fine Air Particulate Matter	30	<$0.1
Total	270	$12.5

Source: U.S. Forest Service (2012)[6], BLS (2022), ESI (2022)

Carbon Benefits

Trees also offer several carbon benefits, including reducing carbon emissions and storing and sequestering carbon. Stored carbon refers to the carbon contained within a tree's existing tissue, while sequestered carbon refers to the new carbon sequestered within a tree as it grows new tissue. ESI applied estimates of per-tree carbon benefits based on the 2012 U.S. Forest Service survey of Philadelphia's tree canopy to estimate the cost savings that this air pollution reduction could bring to Philadelphia (adjusted for 2022 dollars).[7]

[4] The urban forests of Philadelphia (itreetools.org)

[5] Using these estimates from The urban forests of Philadelphia (itreetools.org) accounts for the composition of the new tree canopy from the Plan, which is assumed to be roughly similar to the composition of Philadelphia's existing tree canopy.

[6] ESI has applied U.S. Bureau of Labor Statistics estimates to adjust all 2012 U.S.F.S. estimates to 2022 dollars to account for inflation.

[7] The urban forests of Philadelphia (itreetools.org)

This analysis determined an estimated value of $1.2 million per year from carbon sequestration and $32.9 million total from carbon storage after the completion of the Plan (see Figure 2.2).

Figure 2.2: Carbon Benefits of the Philly Tree Plan at Completion

	Amount	Value ($M)
Carbon sequestration (Annual)	14,000 tons	$1.2
Carbon storage	366,000 tons (total)	$32.9

Source: USFS (2012), ESI (2022)

Residential Energy Use Benefits

The addition of tree canopy represented by the Plan would cool urban temperatures, leading to reductions in urban energy use that would provide cost savings for consumers and would also lead to reduced carbon emissions from power plants. ESI applied estimates of per-tree energy benefits based on the 2012 U.S. Forest Service survey of Philadelphia's tree canopy to estimate the cost savings that this air pollution reduction could bring to Philadelphia in reduced building energy use from heating and cooling and reduced energy-related carbon emissions (adjusted for 2022 dollars).[8]

This analysis determined an estimated value of $3.6 million from reduced residential building energy use after the completion of the Plan – savings that could directly impact energy bills for Philadelphia residents. In addition, the Plan could lead to cost savings of about $700,000 from reduced residential heating and cooling-related carbon emissions (see figure 2.3).

Figure 2.3: Reduced Residential Energy Use Benefits of the Philly Tree Plan at Completion

	Annual Reduction	Annual value ($M)
Heating energy, Million British Thermal Units (MBTU)	96,000 MBTU	$1.4
Heating and cooling energy, Megawatt-hours (MWU)	17,000 MWH	$2.2
Reduced heating and cooling-related carbon emissions	6,000 tons	$0.7

Source: USFS (2012), i-Tree (2022), ESI (2022)

[8] The urban forests of Philadelphia (itreetools.org)

Stormwater Benefits

Urban trees take in large amounts of stormwater annually, keeping this stormwater from flooding combined sewer systems (common in older cities) and causing damaging sewage overflows. ESI applied estimates of per-tree stormwater interception per year from the 2012 U.S. Forest Service survey of Philadelphia's tree canopy, as well as estimates of the value of stormwater interception from i-Tree, to estimate the total value of the stormwater benefits of the Plan.

This analysis determined that the Plan's completion could result in an estimated $2.8 million per year in stormwater capture benefits from 1.5 million cubic yards per year of additional stormwater uptake.

2.3. Health Benefits of the Plan

The Plan's health benefits would not be limited to the economic and environmental arenas. Health benefits are among the most important social benefits of tree planting.

Reduction in Overweight and Obesity Rates

A 10 percent increase in urban tree canopy has been associated with a 19 percent reduction in levels of overweight or obese Body Mass Index.[9] In Philadelphia, 68 percent of all adults are either overweight or obese; ESI applied Johns Hopkins University estimates of lifetime cost avoidance of overweight and obesity reduction (including avoidance of increased third-party costs, productivity losses, and other social costs) to determine the overall lifetime cost savings from the reduction in overweight and obesity levels that could be created by the Plan.[10]

This 19 percent decrease in overweight or obese Body Mass Index, if realized at a citywide scale, would be equivalent to approximately 150,000 Philadelphians. Using estimates of societal cost savings of obesity reduction from the Johns Hopkins Bloomberg School of Public Health and the population distribution of Philadelphia by age, the societal lifetime cost savings for an overweight or obese BMI Philadelphian achieving a "normal" BMI can be approximately estimated at about $59,000 per person for those going from obese to normal BMI and about $27,000 for those going from overweight to normal BMI.

Based on the estimates of lifetime cost avoidance of overweight and obesity reduction, and the estimates of the number of Philadelphians who could be impacted by reduced levels of overweight and obese BMI, more than $6 billion in cumulative lifetime cost savings from reduced obesity could result from implementation of the Plan. This represents the cumulative costs saved across the entire lifespan of each resident of Philadelphia who would be expected to leave the obese and/or overweight category due to this increased tree cover.

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[9] Ulmer et al., "Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription", *Health & Place* 42 (2016) 54-62, Multiple health benefits of urban tree canopy The mounting evidence for a green prescription (fs.fed.us).

[10] https://onlinelibrary.wiley.com/doi/10.1002/oby.21965; https://www.cdc.gov/nccdphp/dch/programs/communitiesputtingpreventiontowork/communities/profiles/both-pa_philadelphia.htm#:~:text=Philadelphia%2C%20Pennsylvania%2C%20which%20is%20home,17%20are%20overweight%20or%20obese.

Mental Health Benefits

Though it is difficult to assign a monetary value to the mental health benefits of the Plan, these benefits are profound, and they have the potential to significantly reduce the burden of mental illness in Philadelphia. In a city where about half of all adults "reported experiencing poor mental health at least one day within the past month", per a 2015 survey, increased street tree density has the potential to improve mental health.[11] Individuals living within 100 meters of "higher density of street trees" have been found to be less likely to be prescribed antidepressants,[12] and residents of neighborhoods with 30 percent or higher tree canopy have been found to have lower levels of psychological distress.[13] An increase in urban tree canopy has also been associated with increased social cohesion.[14] These improved mental health outcomes could lead to improved well-being and productivity for Philadelphians.

Avoidance of Premature Death

A study published in *The Lancet Planet Health* concluded that the implementation of a tree cover increase plan in Philadelphia would lead to 403 fewer premature deaths per year.[15] The U.S. Department of Transportation's Value of a Statistical Life, adjusted for inflation, places the statistical value of a life at roughly $12.4 million in 2022.[16]

According to these estimates, the premature deaths avoided under the Plan could lead to benefits of about $5 billion per year.

2.4. Other Social Benefits of the Plan

Decreased Crime Rate

More than two-thirds of Philadelphians surveyed by the Pew Charitable Trusts in 2022 cited crime and violence as Philadelphia's primary livability issue.[17] Research has established an association between increased tree cover and decreased metropolitan crime rates. A literature review of relevant research on the relationship between urban green space and violence found that "large trees and high levels of vegetation demonstrate consistent decreases in crime and violence".[18] A study of tree cover and crime

[11] Community Health Profile: Current State of Behavioral Health in Philadelphia | Drexel Urban Health Collaborative | Drexel University

[12] Marselle, Melissa R., Diana E. Bowler, Jan Watzema, David Eichenberg, Toralf Kirsten, and Aletta Bonn, "Urban street tree biodiversity and antidepressant prescriptions," https://economyleague.org/providing-insight/leadingindicators/2021/09/08/homeowners2021.

[13] Urban trees found to improve mental and general health (phys.org)

[14] Ulmer et al., "Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription", *Health & Place* 42 (2016) 54-62, Multiple health benefits of urban tree canopy The mounting evidence for a green prescription (fs.fed.us).

[15] Kondo et al., "Health Impact Assessment of Philadelphia's 2025 tree canopy cover goals", *The Lancet Planetary Health* 4:4 (2020) e149-e157,Health impact assessment of Philadelphia's 2025 tree canopy cover goals (usda.gov)

[16] Putnam, John and Christopher Coes, "Guidance on the Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses – 2021 Update." https://www.transportation.gov/sites/dot.gov/files/2021-03/VSL%20Update%202021%20-%20Transmittal%20Memo.pdf

[17] Pew Poll: Gun Violence, COVID-19 Have Hit Philadelphians Hard | The Pew Charitable Trusts (pewtrusts.org)

[18] Bogar, Sandra and Kirsten M. M. Beyer, "Green Space, Violence, and Crime: A Systemic Review", *Trauma Violence & Abuse* 17:2 (2015), (PDF) Green Space, Violence, and Crime: A Systematic Review (researchgate.net).

in Baltimore by U.S. Forest Service and University of Vermont researchers associated a 10% increase in tree cover (precisely the increase proposed by the Plan) with a 12% overall crime reduction (specifically in robbery, burglary, theft, and shootings).[19]

Based on scientific estimates of the social cost of various categories of crime[20], **a 12% decrease in robbery, theft, and burglary alone could yield an estimated nearly $50 million per year in social benefits.**

2.5. Employment Opportunities Available to Disadvantaged Residents

The tens of thousands of jobs created by the Philly Tree Plan would include numerous potential employment opportunities for workers with less than a bachelor's degree. These workers would be eligible for various direct employment opportunities related to the Plan, including numerous public-sector tree care and customer service positions. In addition, many of the thousands of indirect and induced jobs expected to be supported by the Plan would be available to less educated workers.

This economic impact of the Philly Tree Plan is vitally important in a city where more than half of the civilian labor force does not have a bachelor's degree.

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[19] Troy, Austin, J. Morgan Grove, and Jarlath O'Neil-Dunne, "The Relationship between tree canopy and crime rates across an urban-rural gradient in the greater Baltimore region", *Landscape and Urban Planning* 106:3 (2012), p. 262-270, The relationship between tree canopy and crime rates across an urban–rural gradient in the greater Baltimore region.

[20] Analysis applied crime valuations from The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation - PMC (nih.gov) and Philadelphia 2021 crime statistics from Crime Incidents 2006 - Present (phila.gov).

Figure 2.4: Labor Force Educational Attainment in Philadelphia

Highest Education Level Attained	Number of workers (est.)	Percentage of labor force
Less than high school diploma	52,380	8.1%
High school diploma or equivalent	178,940	27.5%
Some college or associate's degree	159,560	24.5%
Bachelor's degree or higher	259,440	39.9%
Total	*650,390*	

Source: U.S. Census Bureau (2020 ACS 5-Year Estimates)

Jobs created and supported within Philadelphia could contribute to closing the gap in unemployment rates between the city and the metropolitan area and Commonwealth.

Figure 2.5: Average Annual Unemployment Rates by County, Metropolitan Area, and State for April 2022

Location	Unemployment Rate
Philadelphia	6.0%
Philadelphia-Camden-Wilmington MSA	4.1%
Pennsylvania	4.8%

Source: Local Area Unemployment Statistics, U.S. Bureau of Labor Statistics (2022)

In addition, contracting work associated with the Plan could be used to support new or existing Minority, Woman, or Disabled-Owned Business Enterprises (MWDSBEs) in Philadelphia. This is a critically important opportunity in a majority-minority city where diversity, equity and inclusion in the private sector is a core concern. Philadelphia currently has only three registered MWDSBEs in the forestry and landscaping industries, according to the City's MWDSBE registry.[21] Contracting work could support one of these businesses or could help create a new local business.

[21] Office of Economic Opportunity :: MWDSBE Inclusion Works Compliance Reporting System

2.6. Summary of Social and Environmental Benefits

The estimated social and environmental benefits that could accrue from the Philly Tree Plan, based on benefit estimates from economic and scientific research, are summarized below. **Note that these all of the benefits listed below are approximate estimates of the benefits of the Plan, based on existing research estimates which were not tailor-made for the specifics of the Plan. As such, they should be considered with appropriate context.**

Figure 2.6: Estimated Environmental Benefits of the Philly Tree Plan

Benefit	Estimated Amount	Estimated Value
Reduced Air Pollution	270 tons/year *(see Figure 2.1 for breakdown by pollutant)*	$12.5 million per year
Carbon Sequestration	14,000 tons per year	$1.2 million per year
Carbon Storage	366,000 tons	$32.9 million total
Reduced Residential Energy Use for Heating and Cooling	96,000 MBTU and 17,000 MWH per year	$3.6 million per year
Reduced Carbon Emissions from Residential Energy Use	5,700 tons per year	$700,000 per year
Stormwater Uptake	1.5 million cubic yards per year	$2.8 million per year

Figure 2.7: Estimated Social Benefits of the Philly Tree Plan

Benefit	Estimated Amount	Estimated Value
Reduction in Overweight and Obese BMI	19% reduction in overweight and obese BMI levels	$59,000/$27,000 in lifetime cost savings per obese/overweight BMI person who achieves normal BMI
Avoided Premature Death	403 deaths avoided	$12.4 million per life saved per year
Reduced Crime	12% reduction in robbery, theft, and shootings	$50 million per year from reduced robbery and theft

3. One-Time Economic Impact from Green Capital Investments

3.1. Section Overview

Capital investments from the Philly Tree Plan (including tree planting in areas of low canopy and retention of existing tree canopy levels in areas of strong but endangered canopy) would generate an economic impact in the local and state economies. Direct economic activity would employ tree planting workers and professional service providers for the thirty-year span of the Plan's development; those workers in turn would spend a portion of their salaries and wages within the local and state economies. This capital activity also would catalyze the procurement of a wide range of goods and services translating into new economic opportunities for local and state vendors.

3.2. Direct Capital Investment

The Philly Tree Plan calls for an investment of approximately $1 billion[22] for the implementation of green capital investments related to the Philly Tree Plan over a thirty-year period, with tree planting costs expected to be split between the City and the private and nonprofit sectors. These capital investments, which would not occur unless the Plan is implemented, include planting new tree canopy and investing to retain existing canopy on neighborhood parks and natural lands. These estimates do not include additional City staffing dedicated to tree care, nor do they include additional expenses from an anticipated increase in the City's tree maintenance contract (estimates of these staffing and contracting impacts will be discussed in Section 3 of this report). PPR and Hinge Collective organized planned investments into three phases coinciding with the three decades of the Plan's intended span (see Figure 3.1). These capital investments would provide a one-time economic impact to the local and state economy.

[22] Though Plan capital investments are expected to be completed in three phases between 2022 and 2050, all projected capital impacts below are expressed in 2022 dollars.

Figure 3.1: Estimated Potential Total Upfront One-Time Investment in Philly Tree Plan[23] ($M)

Category	Phase 1, 2022-2030	Phase 2, 2031-2040	Phase 3, 2041-2050	Total
New Tree Canopy ($M)	$281.0	$283.9	$303.2	$868.1
Hard costs - New Canopy	*$101.9*	*$101.8*	*$106.9*	*$310.7*
Soft costs - New Canopy	*$179.1*	*$182.0*	*$196.3*	*$557.4*
Canopy Retention: Neighborhood Parks	$17.3	$19.2	$19.2	$55.8
Hard costs - Neighborhood Parks	*$5.7*	*$6.3*	*$6.3*	*$18.4*
Soft costs - Neighborhood Parks	*$11.6*	*$12.9*	*$12.9*	*$37.4*
Canopy Retention: Natural Lands ($M)	$24.1	$26.7	$26.7	$77.5
Hard costs- Natural Lands	*$7.9*	*$8.8*	*$8.8*	*$25.6*
Soft costs - Natural Lands	*$16.1*	*$17.9*	*$17.9*	*$51.9*
Total costs	**$322.4**	**$329.8**	**$349.2**	**$1,001.4**

Source: Philadelphia Department of Parks and Recreation (2022), Hinge Collective (2022), ESI (2022)

3.3. Potential Economic Impact

The capital investments from the Plan would generate a significant one-time cumulative impact on the local and state economies:

- Within Philadelphia, the Plan capital investments would be projected to generate about $1 billion in total direct economic impacts and about $635 million in total indirect and induced economic impacts over the full three-decade span of the Plan, with economic impacts increasing during each phase of the Plan. The Plan capital investments would be projected to generate more than 1,000 total direct annual jobs[24], and an additional 90 total indirect and induced annual jobs. [25]
- In the Commonwealth of Pennsylvania, the Plan capital investments would be projected to generate a total of $2 billion in direct, indirect, and induced economic impacts (inclusive of the aforementioned impacts inside the City of Philadelphia).

[23] Tree planting and maintenance costs in the table below are provided and were modeled as given by PPR and Hinge Collective and have not been adjusted for inflation. Economic impacts are also presented in 2022 dollars.

[24] Estimates below are given in jobs per-year over the 29-year construction period (2022-2050)

[25] All employment estimates are given in Full-Time Equivalents (FTEs).

Figure 3.2: Potential Upfront One-Time Economic Impact from Capital Investments Associated with Philly Tree Plan in Philadelphia

Philadelphia	Phase 1, 2022-2030	Phase 2, 2031-2040	Phase 3, 2041-2050	Total
Direct Output ($M)	$322.4	$329.8	$349.2	$1,001.4
Indirect and Induced Impact ($M)	$204.1	$209.7	$221.2	$635.0
Total Impact ($M)	**$526.5**	**$539.5**	**$570.4**	**$1,636.3**
Direct Annual Employment	340	350	370	1,060
Indirect and Induced Annual Employment	30	30	30	90
Total Employment Supported (FTE)	**370**	**380**	**400**	**1,150**
Employee Compensation	**$326.9**	**$333.3**	**$350.7**	**$1,010.9**

Source: IMPLAN (2019), ESI (2022)

Figure 3.3: Potential Upfront One-Time Economic Impact from Capital Investments Associated with Philly Tree Plan in Commonwealth of Pennsylvania (Inclusive of Impacts in Philadelphia)[26]

Pennsylvania	Phase 1, 2022-2030	Phase 2, 2031-2040	Phase 3, 2041-2050	Total
Direct Output ($M)	$322.4	$329.8	$349.2	$1,001.4
Indirect and Induced Impact ($M)	$316.8	$352.5	$371.6	$1,040.9
Total Impact ($M)	**$639.2**	**$682.3**	**$720.8**	**$2,042.3**
Direct Annual Employment	340	350	370	1,060
Indirect and Induced Annual Employment	50	60	60	170
Total Employment Supported (FTE)	**390**	**410**	**430**	**1,230**
Employee Compensation	**$360.6**	**$374.3**	**$393.9**	**$1,128.9**

Source: IMPLAN (2019), ESI (2022)

3.4. Industry Distribution of Potential Economic Impact

The economic impact associated with the upfront capital investment would affect a diverse range of industries far beyond those related directly to growing and planting trees. While these industries are the largest individual beneficiary from these investments, other industries including health care, transportation, and retail would also see significant benefits from the indirect (supply chain) and induced (employee compensation) impacts of the capital activity.

For example, the retail industry is supported when a tree planter purchases materials from a hardware store. Additionally, the accommodations and food service sector is supported when arborists spend their earnings having lunch at a restaurant.

Approximately eight percent of the total employment supported by capital investments in Philadelphia (a total of about 90 annual jobs) would be indirect and induced impacts, distributed across different sectors outside of the landscaping and horticulture industries (see Figure 3.4).

[26] Note that all impacts expressed in this report for the Commonwealth of Pennsylvania include both impacts within the City of Philadelphia (as expressed previously) in addition to impacts throughout the rest of the state.

Figure 3.4: Industry Distribution of City Indirect and Induced Employment Impact Supported by Capital Investments Associated with Philly Tree Plan

Industry	Percentage of all indirect and induced employment
Health Care and Social Assistance	17%
Transportation and Warehousing	11%
Retail Trade	10%
Other Services (except Public Administration)	9%
Accommodation and Food Services	9%

Source: Econsult Solutions, Inc. (2022), IMPLAN (2019)

3.5. Potential Local and State Tax Revenue Impact

The Plan's direct development expenditures, as well as its induced and indirect activity, would produce business, sales, and income tax revenues. Upon completion, the Plan's cumulative capital investments would have generated approximately $31 million in one-time local taxes to the City of Philadelphia and other local taxing bodies. The development would also contribute approximately $42 million in tax revenue to the Commonwealth.

Figure 3.5: Potential One-Time Tax Revenue Impact from Capital Investments of the Plan

	Phase 1, 2022-2030	Phase 2, 2031-2040	Phase 3, 2041-2050	Total
Local (Philadelphia and special districts)	$11.5	$11.8	$8.0	$31.3
Commonwealth of PA	$13.0	$13.9	$14.7	$41.7

Source: IMPLAN (2019)

4. Annual Impact from Tree Care Staffing and Contracting

4.1. Section Overview

In addition to capital investments in tree planting and maintenance, the Plan would also include spending on ongoing staffing and contracting. This would include both an expansion in City staff dedicated to forestry and tree care, and an expansion in the City's tree pruning and removal contract which includes routine repair and maintenance. Like the capital investments associated with the project, the money spent on operations circulates throughout the local economy, creating spillover effects in local, regional, and state economies. To estimate the extent of these spillover effects, the estimated operating expenses at full operations of the staffing plan (expected for 2032) were analyzed and modeled in their relevant industries.[27]

4.2. Current and Projected Direct Operating Activity

The Philly Tree Plan's operations at full capacity would include two portions: additional City staff dedicated to tree care and planting, and an expanded contract for private-sector tree pruning and removal.

The first portion of Plan operations would eventually include a total of 82 new City employees, to be hired in three phases over a ten-year period. This includes new employees in the areas of forestry and science; tree care and maintenance; customer services; and contracting and finance. By the time all three phases are complete (estimated for 2032), the Plan's new staff is expected to receive total employee compensation of $4.1 million.

[27] All economic impacts are expressed in 2022 dollars.

Figure 4.1: Anticipated Direct Employment and Employee Compensation from Philly Tree Plan at Full Operations

	Employee Compensation, 2032 ($M)[28]	Employment
Phase I (expected completion 2025)	$1.3	24
Phase II (expected completion 2027)	$1.0	22
Phase III (expected completion 2032)	$1.8	36
Total City Employment	**$4.1**	**82**
Estimated Tree Maintenance Contract	**$2.5**	

Source: Philadelphia Department of Parks and Recreation (2022), Hinge Collective (2022)

The second portion of Plan operations is the Tree Pruning and Removal contract, which is contracted out rather than conducted by City employees. The current tree pruning and removal contract is for about $800,000 per year; according to PPR and Hinge Collective, this amount has proven to be too low to deal with annual maintenance needs, creating a pruning and removal backlog that PPR and Hinge Collective estimate would cost roughly $5 million to alleviate. PPR and Hinge Collective provided a $2.5 million estimate for annual proactive tree maintenance.

4.3. Current and Projected Economic Impact from Operational Expenditures

In each of the geographies examined, operational expenditures generate economic impacts that spill over to other firms and industries, stimulating business activity and supporting increased employment across a variety of sectors. The Philly Tree Plan's total economic impact from staffing and contracting would be the sum of its staffing and contracting expenditures, the indirect impacts resulting from these additional personnel, and the induced impacts resulting from employees spending their wages locally.[29]

Once the ten-year ramp-up process for employee hiring is complete and the Plan is operating at full capacity, the economic impact of Plan operations is expected to generate an average annual total economic impact of more than $17 million in Philadelphia, supporting 130 direct, indirect, and induced jobs (FTE) with nearly $7 million in annual earnings. In the Commonwealth of Pennsylvania, the Plan's total economic impact is $20 million, supporting 140 total direct, indirect, and induced jobs (FTE) with nearly $8 million in annual earnings (see Figure 4.2).

[28] Figures in this column represent estimated 2032 salaries, including estimated 3% annual raises for employees hired during Phases I and II. For purposes of calculating raises, Phase I employees were assumed to be hired in 2025, and Phase II employees were assumed to be hired in 2027.

[29] See Appendix A for a detailed description of the economic modeling approach in this analysis, which uses IMPLAN modeling software.

Figure 4.2: Potential Ongoing Annual Economic Impact from Philly Tree Plan

	Philadelphia	Pennsylvania
Direct Output ($M)	$11.6	$11.6
Indirect and Induced Impact ($M)	$5.8	$8.3
Total Impact ($M)	**$17.5**	**$20.0**
Direct Employment	100	100
Indirect and Induced Employment	30	40
Total Employment Supported (FTE)	**130**	**140**
Employee Compensation	**$6.9**	**$7.7**

Source: IMPLAN (2019), ESI (2022)

4.4. Current and Projected Fiscal Impact from Operating Expenditures

Although a significant portion of the economic activity associated with Philly Tree Plan operations would be tax-exempt, since it is being conducted by local government, fiscal impacts through expenditures on operations (including indirect and induced expenditures supported by government employment as well as direct, indirect, and induced expenditures from contracting work) would increase Philadelphia and Pennsylvania tax bases directly by employing staff, generating taxable income, and indirectly via spending by vendors and employees. Once full hiring and contracting is completed, it is estimated that the Philly Tree Plan would contribute about $380,000 in local taxes to the City of Philadelphia and other special local taxing districts and $310,000 in state taxes (see Figure 4.3).[30]

Figure 4.3: Potential Ongoing Annual Tax Revenue Impact from Philly Tree Plan

Annual Tax Impact ($M)	
Local (Philadelphia and special districts)	$0.38
Commonwealth of Pennsylvania	$0.31

Source: IMPLAN (2019), ESI (2022)

[30] Economic impact from expanded operations also grows various county and municipal tax bases throughout the state, thus generating ongoing annual tax revenues for local jurisdictions.

5. Appendix

About Econsult Solutions, Inc.

This report was produced by Econsult Solutions, Inc. ("ESI"). ESI is a Philadelphia-based economic consulting firm that provides businesses and public policy makers with economic consulting services in urban economics, real estate economics, transportation, public infrastructure, development, public policy and finance, community and neighborhood development, planning, as well as expert witness services for litigation support. Its principals are nationally recognized experts in urban development, real estate, government and public policy, planning, transportation, non-profit management, business strategy and administration, as well as litigation and commercial damages. Staff members have outstanding professional and academic credentials, including active positions at the university level, wide experience at the highest levels of the public policy process and extensive consulting experience.

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