Ten-Year Urban Forestry Action Plan: 2016-2026

The U.S. Forest Service (Forest Service) works across our nation's forested lands to proudly serve the citizens of United States and its territories. We continue our mission as we announce the release of the National Urban and Community Forestry Advisory Council's (NUCFAC) 2016- 2026 Ten Year Urban Forestry Action Plan. The plan complements the Forest Service's Strategic Plan, and will serve as a reference guide for all communities, stakeholders and individuals interested in the development and management of their urban and community forests.

This plan was developed by national cooperators and interested stakeholders in partnership with NUCFAC. We greatly appreciate our partnership with NUCFAC and the annual recommendations they present to the Forest Service and the Secretary of Agriculture.

NUCFAC worked closely with the American Forest Foundation to provide an extensive assessment of partners' current urban forestry activities. This plan reflects input from 1,000 stakeholders across the nation.

The last two decades of urban and community forestry actions have set the groundwork for the next ten years—including how urban forest systems provide vital services that sustain and improve the resiliency of our communities—economically, socially, and environmentally.

We invite you to read the Action Plan and see the opportunities that lie ahead for implementing its goals in the next ten years. Thanks go to the American Forest Foundation, the National Urban and Community Forestry Advisory Council, Forest Service staff, and our valued partners and cooperators for compiling this comprehensive document that captures past efforts, recognizes current issues and opportunities, and identifies goals and strategies to move urban and community forestry programs forward across the nation.

THOMAS L. TIDWELL, CHIEF

U.S. Forest Service

Dear Partners,

In 1990, the Food Agriculture Conservation and Trade Act amended the Cooperative Forestry Assistance Act to expand authorities for Urban and Community Forestry, ushering in a new appreciation of urban trees and creating the National Urban and Community Forestry Advisory Council. Countless seedlings have been planted thanks to that legislation, seedlings that have taken root and are now beginning to reach their full potential. And it's not just trees that have flourished over this period. Research, technology, public policy, professional management, citizen scientists programs, and stewardship in support of urban trees have grown tremendously as well, setting the stage for an unprecedented expansion of the social and environmental benefits associated with urban forestry.

The 2016–2026 National Ten Year Action Plan that we introduce here, is built on sound principles and challenging goals, supported by rigorous science and research. Those principles, goals and benefits will not be realized without an investment commensurate with the enormous value of the urban forest. Even with a $2.4 trillion structural value delivering $17 billion in annual benefits, the urban forest remains an underappreciated asset. Increasing the annual investment in urban and community forestry to $85 million, as recommended in the plan, is an important first step towards unlocking its true value and one we all need to support.

The world has changed dramatically since 1990 and no one can be sure what the next twenty-five years has in store. We do know that urban communities will continue to grow and grapple with development and the impacts of climate change will be felt more keenly in our daily lives. Urban forestry, and the full range of ecosystem services it encompasses, responds to those challenges with a unique set of resources and attributes that can make communities across the country more sustainable, resilient and equitable. Thanks to contributions from thousands of people representing all corners of the urban forestry community and a talented consultant team, the 2016-2026 National Ten-Year Urban Forestry Action Plan offers an innovative, ambitious and comprehensive roadmap for creating a bright green future in the cities and towns where over 80% of Americans live and work. As members of the National Urban and Community Forestry Advisory Council, we are proud of this plan and embrace the opportunity it presents us. We urge everyone interested in a future where people and nature prosper together to join us in bringing this plan to life.

Sincerely,

Liam Kavanagh

Chair, National Urban and Community Advisory Forestry Council

*Title page photo credit: Kathleen Wolf

FSC

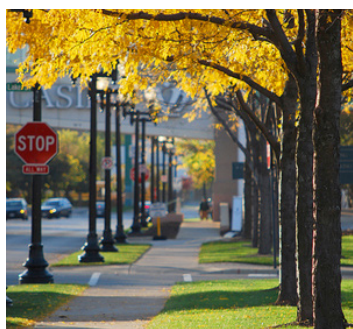paper certified by Forest Stewardship Council- (FSC)

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*Also available as a separate document

Acknowledgments

*Please note that the bibliographies for each Goal section may be found at the end of the Action Plan, and additional actions, programs, tools, resources, and resources for each goal may be found in the Appendices, as well as other key information.

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Executive Summary

The National Ten-Year Urban and Community Forestry Action Plan is developed by and for the urban forestry community. The Plan's purpose is to expand awareness of the benefits that our urban forests, as a green infrastructure system, provide to communities throughout the nation, and increase investments in these urban forest resources for the benefit of current and future generations. The Plan provides specific goals, actions, and recommendations for improving the status of urban and community forestry for the United States and its territories. The Plan also identifies research needs, messaging and communications needs, and innovative funding and collaborative opportunities for urban forestry initiatives. Notably, this Plan also serves as a framework for funding and recommendation priorities to be developed by the National Urban and Community Forestry Advisory Council (NUCFAC) for the USDA Forest Service's National Urban and Community Forestry program and the program's National Challenge Cost Share Grants. The urban forestry community, including the USDA Forest Service and other applicable Federal agencies, are to use the Action Plan as a guide to implement and expand urban and community forestry for the next ten years (2016 -2026).

Plan Vision

Urban and Community Forests Increase Sustainability, Wellness, and Resilience in All Communities.

Plan Mission

Help All Communities Create Urban and Community Forests that are Diverse, Healthy, and Accessible for All Citizens.

Goal 7. Education and Awareness

Goal 1. Planning

Goal 6. Funding

Overarching Principles

1. Advance health and wellness of forests, ecosystems and people.

2. Maximize community and ecosystem sustainability.

3. Build community and natural ecosystem resilience

Goal 2. Human Health

Goal 5. Management

Goal 3. Diversity, Equity and Leadership

Goal 4. Environmental Health

Goal 1. Integrate Urban and Community Forestry Into all Scales of Planning

A: Support inclusion of trees and forests as elements of all community comprehensive and master planning efforts.

B: Support the integration of urban forestry into all scales of city, regional, and state-scale master plans.

C: Launch a public awareness and education campaign to elevate recognition of the value of urban trees and urban forests ecosystems as essential contributors to community sustainability and resilience.

D: Increase community capacity to use urban trees and forestry in public space planning, infrastructure, and private development.

Goal 2. Promote the Role of Urban and Community Forestry in Human Health and Wellness

A: Expand opportunities for collaboration with the health community.

B: Champion a nationwide marketing campaign that links trees to human health and wellness.

C: Plan, design and manage urban forests to improve human health and wellness.

D: Develop tools to improve and highlight the relationship between improved public health, wellness, and urban and community forestry and green infrastructure.

Goal 3. Cultivate Diversity, Equity, and Leadership Within the Urban Forestry Community

A: Increase diversity, equity, and accessibility in urban and community forestry.

B: Engage underserved communities in urban and community forestry.

C: Develop effective leadership at all levels to build a national voice for urban forestry.

D: Increase workforce development opportunities and green jobs in urban and community forestry, with particular attention to underserved communities.

E: Promote expanded collaboration, training and communication within the field of urban and community forestry to build workforce professional development.

Goal 4. Strengthen Urban and Community Forest Health and Biodiversity for Long-Term Resilience

A: Increase the biodiversity, health, and resilience of trees in urban and community forests.

B: Foster resilience, restoration, and sustainability of urban and community forests facing climate change challenges.

C: Support use of urban forests for increasing community food resilience and access to local foods.

Goal 5. Improve Urban and Community Forest Management, Maintenance, and Stewardship

A: Improve urban and community forest management, maintenance, and arboricultural practices.

B: Develop comprehensive programs, policies, and resources for enhancing urban forestry stewardship.

C: Promote better use of technology and tools in urban forestry.

D: Facilitate expanded research and delivery of scientific findings to all stakeholders. (See Research Needs)

Goal 6. Diversify, Leverage, and Increase Funding for Urban and Community Forestry

A: Increase funding and grants for urban and community forestry.

B: To leverage and diversify funding, expand collaboration between urban forestry and related fields, agencies, and sectors.

Goal 7. Increase Public Awareness and Environmental Education to Promote Stewardship

A: Create environmental education programs that focus on urban and community forestry issues.

B: Create a nationwide urban forestry public awareness and education campaign.

C: Increase engagement of undeserved and minority communities in urban forestry establishment and stewardship.

Introduction To the Ten-Year Action Plan
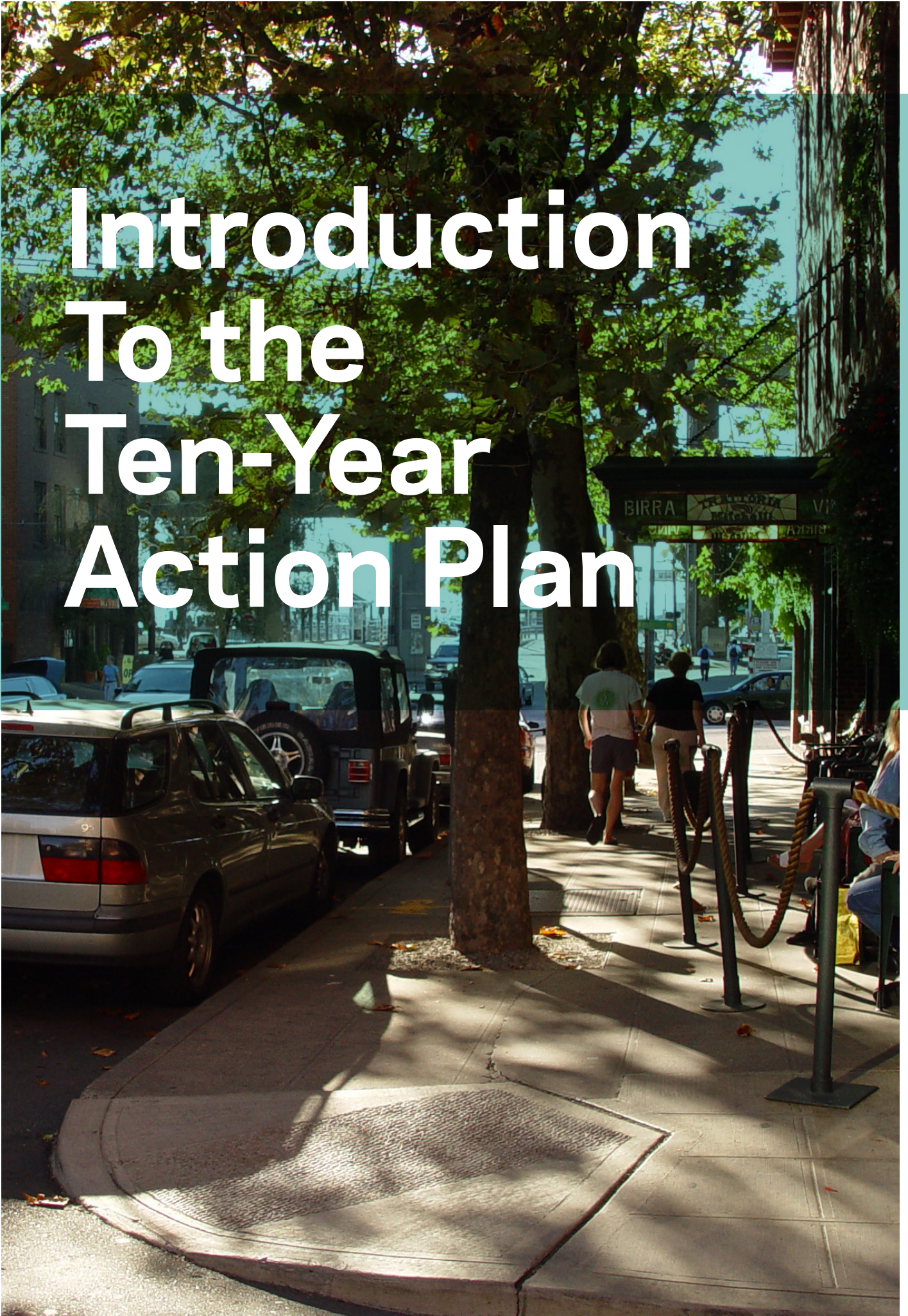
Overarching Principles

1 Advance Health and Wellness of Forests, Ecosystems, and People

Public and private health costs, for the full range of preventive to curative health services, are soaring, now representing about 18% of U.S. Gross Domestic Product. Daily environmental settings are important contributors to positive health outcomes, and urban and community forests are a crucial and cost-effective tool that the nation can use in the next ten years to address major public health challenges. Human and natural systems are interconnected and synergistic, and actions that improve one naturally leads to an improvement in the other. However, trees, forests, and green spaces are not self-managing and will require consistent and thoughtful maintenance and stewardship over the next ten years to assure ecosystem health. These improvements in urban and community forest health will also improve human health and wellness as highlighted under Action Plan Goal 2.

2 Maximize Community and Ecosystem Sustainability

Sustainability, as defined by the 1987 Brundtland Commission, is now commonly understood as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability has become a core tenet of 21st century community development and planning, noted by the many community sustainability plans across America. To achieve sustainability, all three legs of the "sustainability stool" – environmental, social, and economic – must be equally strong. In the next decade, as communities develop strategies to manage local ecosystems, improve local quality of life, and strengthen local economies, urban and community forestry offers a core cost-effective tool for achieving all three. Sustainability is woven throughout this plan by growing community forests across the nation in size, diversity, and health and creating tools and technologies that enhance effective citizen maintenance and stewardship.

3 Build Community and Natural Ecosystem Resilience

Resilience is a central element in the Action Plan, reflecting the need for urban and community forests to help address the rising stressors on communities from natural, human, and economic pathways. Resilience is defined as a community's ability to recover from a stressor in a way that equals or surpasses its previous condition. Urban and community forestry is a core contributor to community and natural ecosystem resilience, as it provides an important "buffering" capacity against multiple natural, social and economic stressors. Thus, to increase overall community and natural resiliency, this plan envisions the need to increase urban and community forestry resiliency itself. This theme is expressed in the plan's strategy to build forest biodiversity and health, as well as community leadership, consistent and diversified funding, equitable access to the benefits of our forests, diversification of the profession, and increased public engagement and social networks.

Action Plan Goals

Goal 7. Education and Awareness

Goal 1. Planning

Goal 6. Funding

Goal 2. Human Health

Goal 5. Management

Goal 3. Diversity, Equity and Leadership

Goal 4. Environmental Health
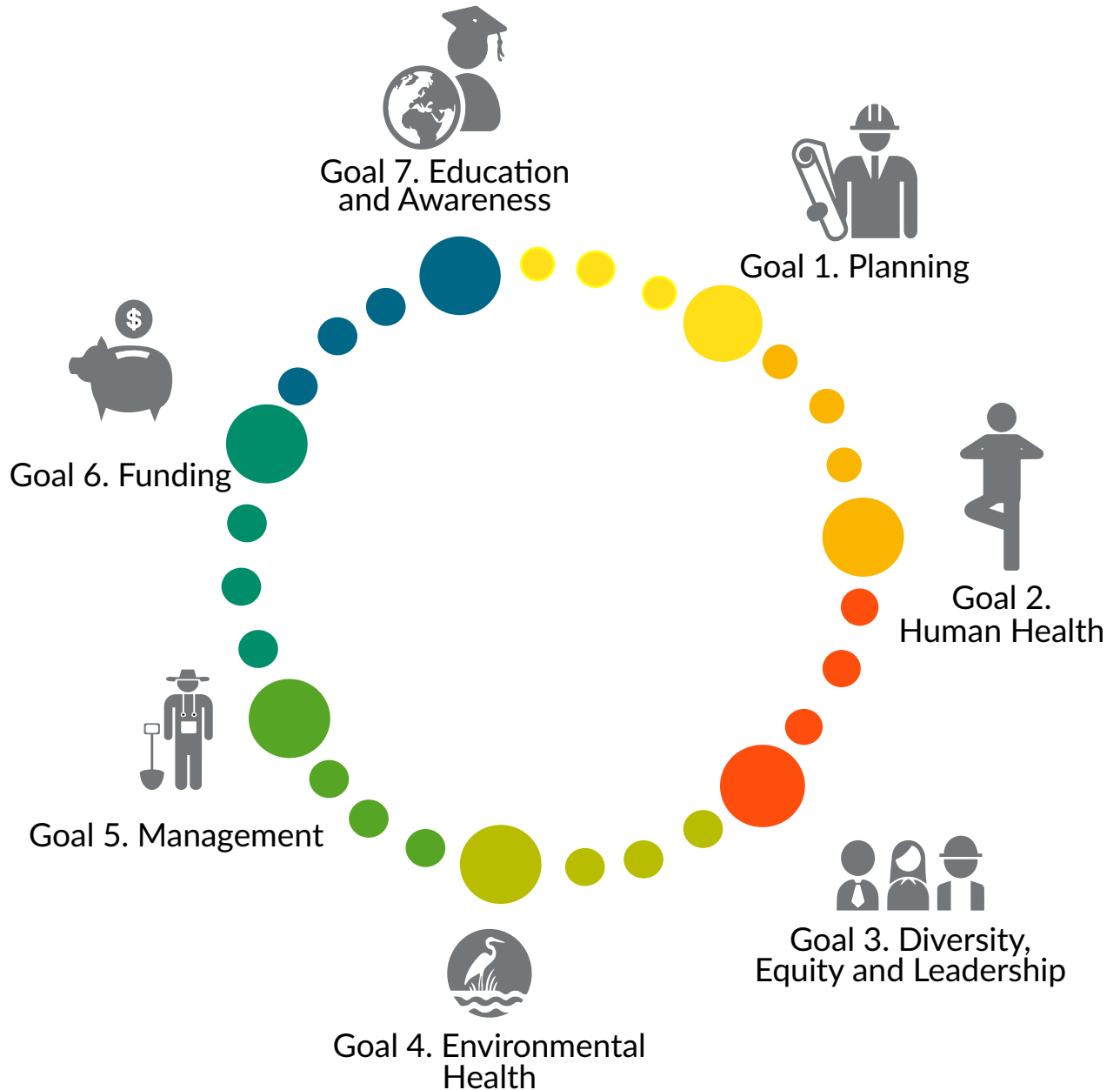
1. Integrate Urban and Community Forestry into All Scales of Planning

2. Promote the Role of Urban and Community Forestry in Human Health and Wellness

3. Cultivate Diversity, Equity and Leadership within the Urban Forestry Community

4. Strengthen Urban and Community Forest Health and Biodiversity for Long-Term Resilience

5. Improve Urban and Community Forest Management, Maintenance and Stewardship

6. Diversify, Leverage and Increase Funding for Urban and Community Forestry

7. Increase Public Awareness and Environmental Education to Promote Stewardship

Action Plan Research Needs

Science, analytics and metrics are essential for effective and efficient operations of all urban built and natural systems. In recent decades urban forest planning, planting, and management have evolved from being informed by expert experience to adoption of widely shared, evidence-based best practices. Tree planting practices that promote longer lived, healthier trees have emerged from decades of arboriculture science. Full city assessments of tree canopy and tree inventories, used by many urban forest managers and their collaborators (such as community non-profits), have become a standard data set from which to set policy, create management plans, and sustain programs.

> **Scientists representing many disciplines have discovered the functions and benefits that trees and urban forest ecosystems provide for urban residents.**

In addition, scientists representing many disciplines have discovered the functions and associated benefits that trees and urban forest ecosystems provide for urban residents. Original research has been used to construct analytic models (such as i-Tree) that define and reveal ecosystem services (such as air quality, stormwater management, and human health) to help citizens and decision makers understand why investing in the urban forest is important.

This report presents a framework of research needs for urban forest ecosystems and metro nature for the next decade. The recommendations were derived from extensive document review, interviews with scientists, and listening sessions with national representatives of local communities and organizations. It should be noted that not all of the research needs align directly with the program goals and strategies of the core Action Plan. Nonetheless, the science recommendations, in total, continue the development of a knowledge base that demonstrates why and how urban forest ecosystems are essential in all cities.

Research Needs

What are the key science needs? What are the research questions that synchronize with the guiding principles? Distilled from a multi-modal national outreach, each Research Need is described in greater detail, with listed science strategies, in the pages that follow.

A Understand Ecosystem/Ecological Services

B Promote Human and Community Health

C Planting, Inventory, and Analysis for Forest and Environmental Health

D Prepare for Pests, Threats, Climate and Associated Changes and Risks

E Enable Civic Stewardship and Improved Local Governance

F Integrate Knowledge Networks and Data for Urban Socio-Ecological Systems

Guiding Principles

In order to deliver the greatest return for the nation's investment in urban socio-ecological studies, new research initiatives must carefully consider the full field of science opportunities. Several key ideas should guide decision making and implementation concerning future research and assessments:

■ Means to the End - Build Local Capacity

■ Build on Strength and Explore New Needs

■ Replicate and Confirm

■ Expand and Connect Science from Local Needs to National Programs

■ Synthesize and Amplify Existing Knowledge

> The Research Needs and Guiding Principles, explained in greater detail in this report, generally support the core Action Plan. Urban forestry program goals are supported by diverse, integrated research activity.

Action Plan Funding Needs

The development of strategies like the National Urban and Community Forestry Advisory Council's Ten-Year Action Plan result in important guiding documents for advancing urban and community forestry. These planning documents become even more powerful when they include a discussion of the resources necessary for implementation, as well as the benefits associated with these investments.

The landscape of urban and community forestry includes vast and intricately entwined layers of federal, state, local, nonprofit, and private sector organizations with little standardization in how funding investments and benefits are scaled, recorded, tracked, and communicated. Attempting to assign a line item cost to the activities associated with each of the Action Plan's seven goals and build a "from the ground up" overall cost estimate with the data currently available would have required a level of extrapolation, estimates, and assumptions that could potentially impact the credibility and integrity of the Plan as the data is not currently available to support this.

> "Considering just a few of the additional needs outlined in the Ten Year Action Plan where cost estimate data is available suggests annual funding needs in the range of approximately $85 million.

Two existing trends tied closely to urban and community forestry, however, offer an intriguing proxy for developing a ten-year funding needs estimate that adapts current and advocated funding levels to the anticipated increased urban land area demand scenarios.

The United States is rapidly becoming more urban. It is estimated that in the first half of the 21st century, urban land in the United States will increase to 8.1% of total land, or an area larger than the state of Montana. This rate of urban growth suggests, and feedback from participants received in the goal development process confirms, that integrating urban and community forestry into all levels of planning will be needed to sustain the ecosystem services and products growing urban population require, and this translates to a need for additional investment.[2]

The scope of urban forestry needs and the significance of urban forestry services appear to be increasing in communities. The number of communities receiving urban and community forestry assistance over the past ten years has remained relatively flat, yet current data indicates an almost 15% transition of these communities from "developing" their urban and community forestry program to actually "managing" these natural resources.[3] This suggests programs that may have been established as beautification efforts are gradually shifting to programs that focus on providing greater community services and ecosystem benefits.

Using urbanization as an indicator of at-minimum future needs, the analysis suggests the USDA Forest Service's

Urban and Community Forestry program will require annual funding levels in the range of approximately $32 million. This funding is required just to maintain the existing level of service in the face of anticipated increases in urbanization and does not account for any desired increase in the level of service that may be associated with implementation of the Ten-Year Action Plan. Looking at a sampling of Action Plan activities that are above and beyond existing Urban and Community Forestry Program Budget, where reliable cost estimates were available, begins to suggest the scale at which the current level of urban forestry funding is insufficient. **Considering just a few of the additional needs outlined in the Ten-Year Action Plan where cost estimate data is available suggests annual funding needs in the range of approximately $85 million.** While the urban and community forestry community has proven highly effective at leveraging USDA Forest Service dollars with state, local, nonprofit, and private sector funding streams – in fact, some sources indicate a match of 2:1 or in many cases significantly more[4] – this estimate suggests that scale to which current funding is clearly insufficient.

The critical need to increase investment in urban and community forestry, or at the very least maintain existing levels, can be well-supported by a discussion of the multiple benefits derived; however, given the emerging state of ecosystem service benefits valuation and accounting, calculating return on funding investment applicable at a national scale is not currently possible. There is a strong body of existing research, technology-based tools, and ongoing initiatives within the urban and community forestry community that could inform the standardization process and be built upon, much of which owes its origins to USDA Forest Service support. What is lacking, however, is a consensus driven process for how these data points can be aggregated to a national, community of practice-wide scale. Broadly adopted standard metrics would allow for the systematic allocation of budgets and the ability to more precisely determine return on investment and future funding needs.

If urban and community forestry programs are to keep pace with urbanization and the resulting expanded need for urban forestry services, identifying, diversifying, and leveraging additional sources of funding will be needed. Being able to more precisely discuss true costs, ecosystem services, and associated benefits will enable urban and community forestry's strong network of implementers to better communicate the value of community impact and return on investment to the urban forestry community, external stakeholders, and the breadth of funding sources.

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2 Nowak and Walton. Projected Urban Growth and Its Estimated Impact on the US Forest Resource
3 CARS data 2005 – 2014, See Table 1, in Appendix
4 Sustainable Urban Forest Coalition Fiscal Year 2016 House Interior Appropriations Testimony, March 25, 2015.

Who is the National Urban and Community Forestry Advisory Council?

The National Urban and Community Forestry Advisory Council (NUCFAC) is an appointed advisory council to the Secretary of Agriculture on urban forestry and related issues. The 1990 Farm Bill created NUCFAC to bring together the wide variety of voices raised about a common concern: the present health and future preservation of America's urban forests. NUCFAC was founded to synthesize the full spectrum of views into a consistent vision, as a foundation for practical policy on urban forestry. Current membership of NUCFAC can be found here:

NUCFAC Membership

The NUCFAC Mission

The Council is established to encourage all sizes of towns and cities to properly plant, maintain and preserve trees in greatly increasing number so that America's communities will have:

Enhanced energy savings; clean air and water; quieter streets and neighborhoods; stronger urban economies; and overall improved environment for all Americans.

Photo credit: Amigos de los Rios

NUCFAC's Purpose

Congress created the National Urban and Community Forestry Advisory Council in the 1990 U.S. Farm Bill to advise the Secretary of Agriculture on matters relating to the protection, planting, and care of trees and forests in our nation's cities and communities. The Council's specific purpose is to:

1 Develop a National Urban and Community Forestry Action Plan and every ten years thereafter. The Plan is to include:

- An assessment of the current status of urban forest resources,

- A review of urban and community forestry programs and activities, including education and technical assistance,

- Recommendations for improving the status of the nation's urban and community forest resources, including education and technical assistance;

  - A review of urban and community forestry research;

  - Recommendations for new and expanded research efforts; and

  - A summary of Research needs and an estimate of the funds needed to implement such research, on an annual basis, for the next ten years.

- Proposed criteria for evaluating proposed projects under the urban and community forestry challenge cost share grant program

- An estimate of the resources needed to implement the National Urban and Community Forestry Action Plan for the succeeding ten fiscal years

2 Evaluate how the Plan has been put into effect.

3 Develop criteria and recommendations for the USDA Forest Service's Urban and Community Forestry Challenge Cost Share Grant Program.

What are Urban and Community Forests?

Urban forests are trees for people, where they live, work and play. Each person has a different way of thinking about the urban forest. In this Action Plan, and for many professionals, the urban forest includes all trees in the city, on public and private property, and within the many land uses one finds in cities and towns - homeowners' yards, school campuses, tree-lined streets, government properties, parks, and green spaces.

Urban forests and vegetation are an urban ecosystem that is aesthetically pleasing, contributes to quality of life, supports community development and green infrastructure, and provides a wealth of benefits and values to cities and towns. Routine management is essential, and special care and practices

> **In this report, the urban forest includes all trees in the city, on public and private property.**

are needed when trees are damaged following storms or other catastrophic events.
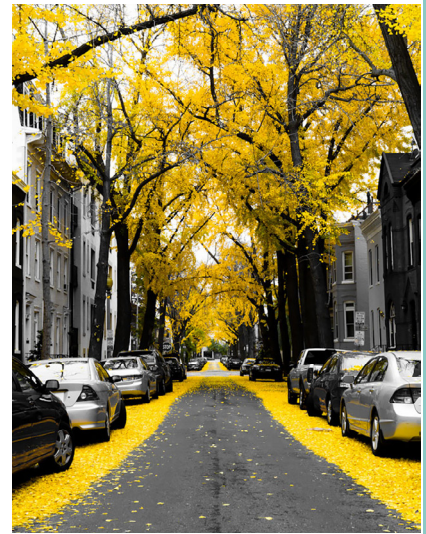
Why Should We Maintain These Forests?

Trees are important assets to communities of all sizes and geographies. They offer a core, cost-effective foundation for community and ecosystem health, strengthening green infrastructure, sustainability and resilience. Green infrastructure, including urban forests, provides many more benefits than gray infrastructure including improving stormwater management, protecting drinking water, reducing energy costs and stress, as well as creating a sense of place in communities. Like any other community asset, a community's forest requires ongoing care and stewardship.

An urban forest that is maintained will function the way it was intended, and thereby make a meaningful difference in protecting and enhancing people's lives, property, natural resource value, and community quality of life. The return on investment for community forests is demonstrably high, yet until this fact is widely understood, communities may continue to place higher priority on other assets. In the next ten years, urban and community forestry will need to build new 21st century solutions to the imperative for ensuring healthy, vibrant community forests. The time is now to invest in these assets.

> **If not properly maintained the health of trees can diminish and potentially become the source of risk and liability.**

This Plan envisions community forests supported by public and private tree professionals working in collaboration with local citizen stewards, who are in turn supported by local champions and leaders. It envisions collaborative partnerships and strategies that leverage funding for specific purposes, such as diversity and equity, targeted environment challenges, or climate resilience. While the shape of these partnerships and strategies cannot be predicted, civic engagement and stewardship will be core strategies that will ensure our urban forests make our communities sustainable and resilient.
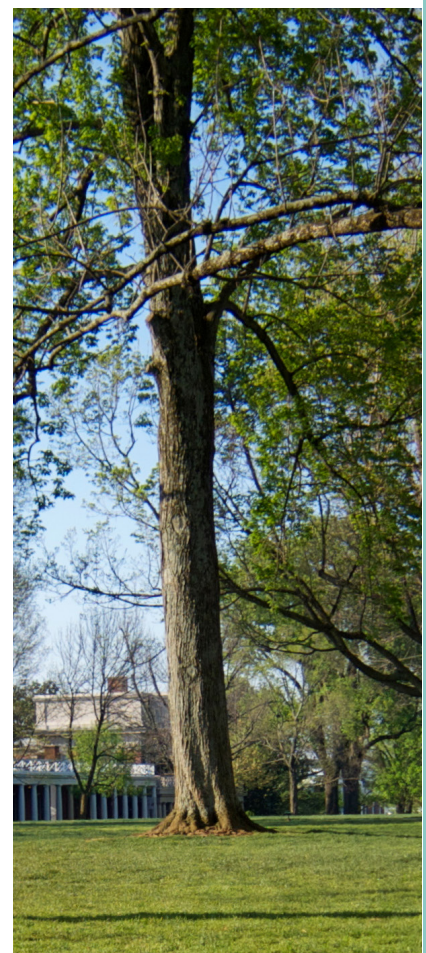
How do Urban and Community Forests Benefit Us?

Environmental

The earliest research about tree benefits, dating back to the 1970s, has been about environmental services. Multiple studies across multiple regions in the U.S. show that having a well-maintained, high-quality urban forest contributes to better air quality and improved stormwater management. Strategically placed trees can reduce building energy use in hot climates, and reduce urban heat island effect which helps with improved air quality. These studies are the reason that some cities are using tree planting programs to meet the performance standards of clean air and water regulations.

Social
Improved Human Health and Wellness

More recent studies have found that having nearby nature, including trees, may be more important than trips to 'big nature' beyond the city for human health and well-being. Simply being able to see trees, parks, and gardens while in the city has been scientifically linked to faster healing in hospitals, reduced mental and physical stress, better student performance in school, and better attention to tasks while at work. Public health officials and healing centers, such as hospitals, are now starting to plan for urban nature as an important contribution to disease prevention and health promotion.

Better Communities

The urban forest creates environments that support quality of life and better human habitat. Tree-lined streets are more walkable, leading to more active and health lifestyles, rather than being accident risks. Carefully planned roadside tree plantings can reduce both the number of traffic accidents, and severity of injury for car and pedestrian or cyclist crashes. Some studies indicate that well-managed vegetation in neighborhoods may reduce both personal and property crime. Finally, having a well-managed tree canopy can create business districts that attract shoppers, and commercial centers that attract the best talent and workers.

Economic

When thinking of trees and economics, many people will think of timber harvest, lumber, plywood, and other forest products. But the highest economic values of trees in cities are from living, thriving trees! Valuation studies for urban forest benefits are the most recent field of research. If we think about all the benefits described above, the return-on-investment potential becomes obvious. Research confirms cost savings for trees as green infrastructure, including reduced investments in air and water quality 'gray' infrastructure. Recent monetizations of health benefits show cost savings across the human life cycle from children to elders. Finally, numerous studies show increased property values associated with having nearby trees and parks, and these values can be converted to local government revenues to support tree programs.

Ten-Year Progress Overview

Americans Understand Threats Facing American Forests

Public awareness and understanding around the need for and benefits of urban and community forestry is one of the greatest opportunities for support for improving the health of urban forestry in the coming decade. Based on a nationwide survey of voters to assess key public perceptions and values related to forests, voters report strongly valuing the nation's forests for its sources of clean air and water (Public Opinion Strategies, 2011).

92% 92 percent of voters surveyed believe that helping to keep the air clean is at least a "very" important benefit of forests, including 58 percent who believe it is "extremely" important.

91% A nearly identical 91 percent of voters assign similar importance to forests' role in filtering water to keep it clean.

67% Two-thirds of voters (67 percent) say they live within ten miles of a forest or wooded area.

60% At least three in five voters see major threats to forests from wildfire, development, and insects and diseases.

Urban and Community Forestry Progress Overview
(Amount and percent change between 2005 and 2014)

- ■ 2005
- ■ 2014
- ↑ Percent Change

	2005	2014	Percent Change
Number of Volunteer Hours Logged	4.3M	1.5M	-66%
Number of Communities with Management Plans	2,996	5,062	69%
Number of Communities with Professional Forestry Staff	3,729	5,708	53%
Federal Funding ($)	$19.8M	$15.1M	-24%
Number of Communities with Advocacy/ Advisory Organizations	4,867	7,256	49%
Number of Communities with Ordinances/ Policies	5,511	8,710	58%
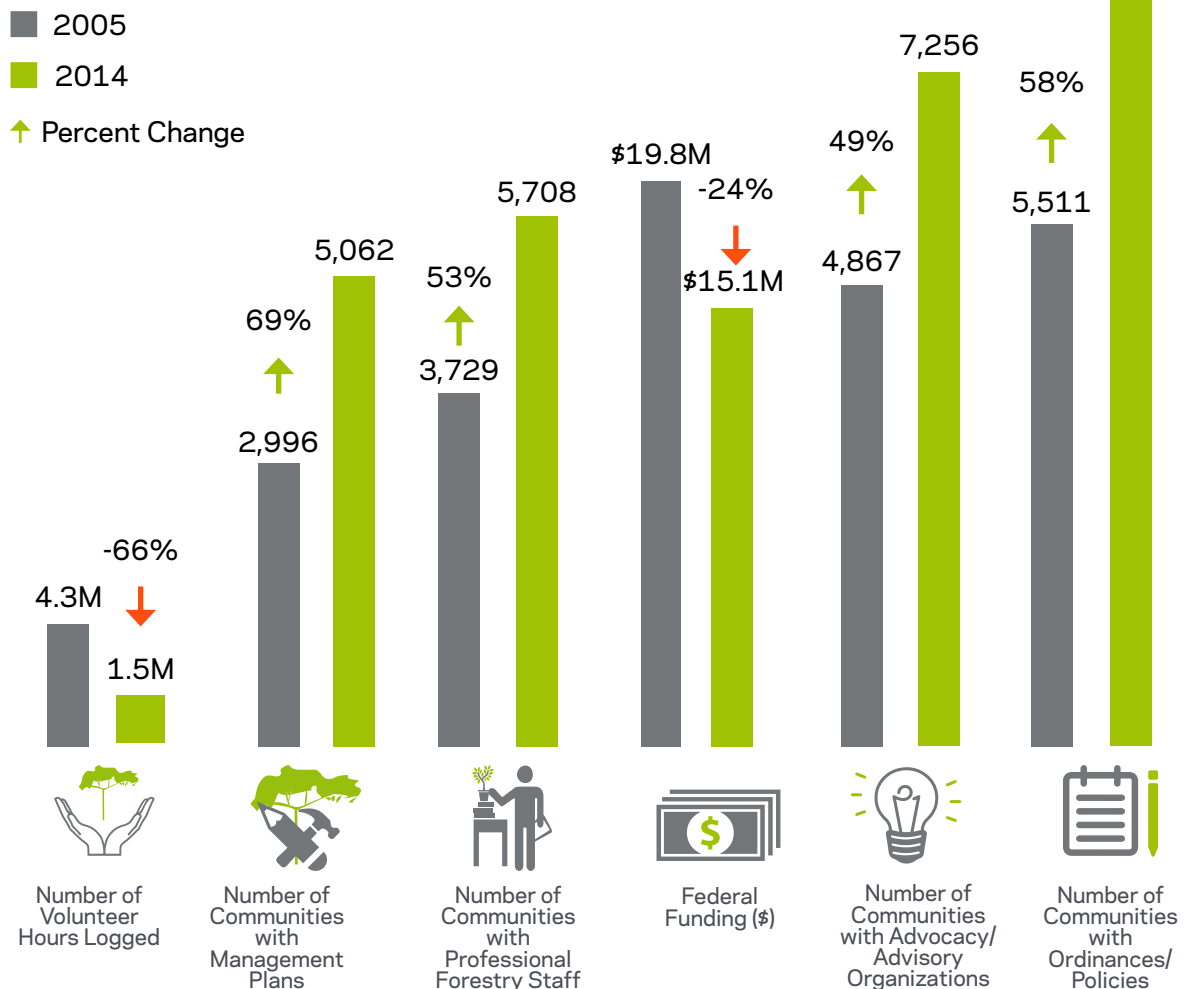
Figure 1: USDA Forest Service Federal Program: Urban and Community Forestry Assistance Program, Community Accomplishment Report System for Urban and Community Forestry (CARS)

Urban Forests Save Us Money

$6.8 Million

Using the iTree software, the city of Minneapolis calculated that not only had they saved approximately $6.8 million in energy expenditure by planting trees, but they had also increased property values by $7.1 million (City Of Minneapolis, Minnesota Municipal Tree Resource Analysis).

i-Tree

By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link urban forest management activities with environmental quality and community livability [USDA Forest Service]
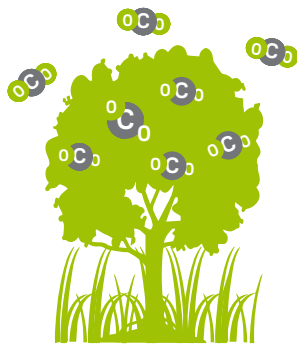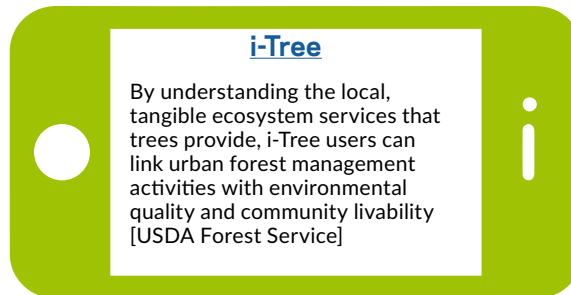
22.8 Million Tons/Year

Based on the field data of 10 USA cities and a national urban tree cover data, it is estimated that urban trees in the contiguous USA currently store 708 million tons of carbon (tC) ($14,300 million value) with a gross carbon sequestration rate of 22.8 million tC/year ($460/million per year) (Nowak et al. ,2002).

$2.4 Trillion

Nationally, urban forests in the United States are estimated to contain about 3.8 billion trees, with an estimated structural asset value of $2.4 trillion (Nowak et al., 2002).*

*Note: Structural asset value is based, in part, on extrapolations of estimated replacement costs of trees of the same size, condition, species, and location.

3.8 Billion Trees

Investment Return: $1.37 - $3.09

A study on the value of street and park trees in five U.S. cities found that for every dollar invested in urban tree management resulted in benefits valued between $1.37 to $3.09 annually (McPherson, et al., 2005).

Ten-Year Action Plan: 2016-2026

Goal 1: Planning

Goal 1
Integrate Urban and Community Forestry Into All Scales of Planning

For the full range of human and environmental benefits of urban forest systems to be realized, cities need to be planned with natural systems as a core feature of community infrastructure, instead of an afterthought, for optimal communities' future growth, health, and well-being. Urban and community forestry systems are an important integral component at all system levels: neighborhood, local, community, regional, watershed, and bioregional. For maximum effectiveness and benefit, urban and community forestry systems need to be planned and managed at the community, state, and regional scales as well as integrated into other city systems, such as transportation, housing, and infrastructure.

Strategy A

Support inclusion of trees and forests as elements of all community comprehensive and master planning efforts.

Strategy B

Support the integration of urban forestry into all scales of city, regional, and state-scale master plans.

Strategy C

Launch a public awareness and education campaign to elevate recognition of the value of urban trees and urban forests ecosystems as essential contributors to community sustainability and resilience.

Strategy D

Increase community capacity to use urban trees and forests in public space planning, infrastructure, and private development.

Relevant Research Needs

Urban planning is informed by analytics of all systems, including transportation, housing, and utility service. Urban forest ecosystems science, past and future, provides the data and robust analytics that enable living natural resources to be integrated with other planned systems. Research needs aimed at better understanding of forest health, threats and resilience, and knowledge networks can provide the working knowledge to sustain urban natural resources systems in cities. In addition, research needs addressing better understanding of ecosystem services and human health help local officials recognize that the urban forest is an essential dimension of the city, deserving of investment and administrative support across city departments.
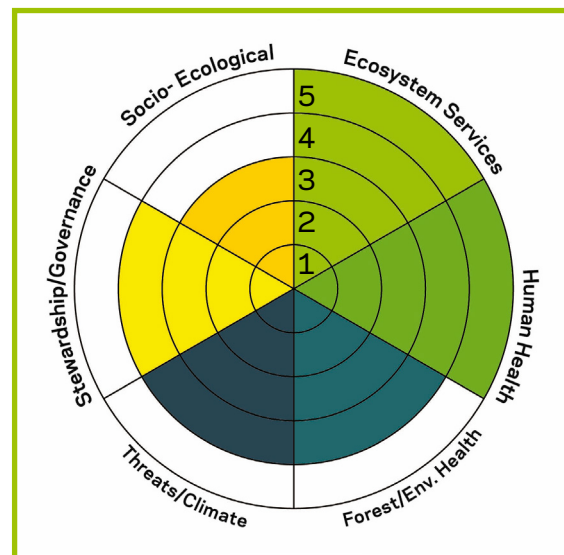
Research Needs Connected to Goal 1

Implementation Targets

1 A suite of regional planning tools are developed and disseminated to assist and encourage regional planning that integrates urban forestry into planning efforts.

Photo credit: Guy Kramer

2 Criteria and benchmarks for measuring sustainability are made available to cities and communities.

3 A standard measure for urban forestry and green infrastructure benefits is adopted and disseminated for widespread use.

Why is it Important?
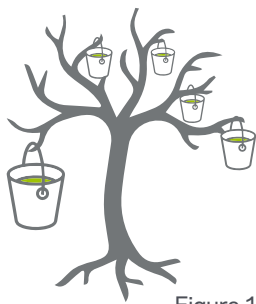
Figure 1.1

$4.7 Billion
Estimated savings by metropolitan Washington D.C. in stormwater management construction costs every 20 years.

The estimated amount saved by Washington D.C. in stormwater management. The region boasts a tree canopy of 46 percent that reduces stormwater retention needs by 949 million cubic feet, saving an estimated $4.7 billion in construction every 20 years (Schwab, 2009).

45%
Costs reduced by integrating green infrastructure into plans.

By incorporating green infrastructure into planned capital improvement projects, versus ad hoc implementation, the City of Lancaster, PA reduced implementation costs by 45 percent (Environmental Protection Agency, 2014).

$1 Million
Estimated amount saved by Frederick, Maryland from the cooling benefits of trees.

The estimated amount saved by Frederick, Maryland from the cooling benefits of trees. Residents collectively save $1 million per year from existing trees, and with more strategically placed trees; the city would save an addition $2 million per year (Schwab, 2009).

Reduce Air Temperatures up to 10 °

Reduce Surface Temperatures up to 20-45 °

Figure 1.2

Figure 1.3

$1.95 Billion
Real dollar benefits of planting trees.

Los Angeles' Million Trees Initiative provides an estimated $1.3 to $1.95 gross billion dollars in ecosystem benefits over a 35-year period (McPherson, Simpson, Xiao, & Wu, 2011).
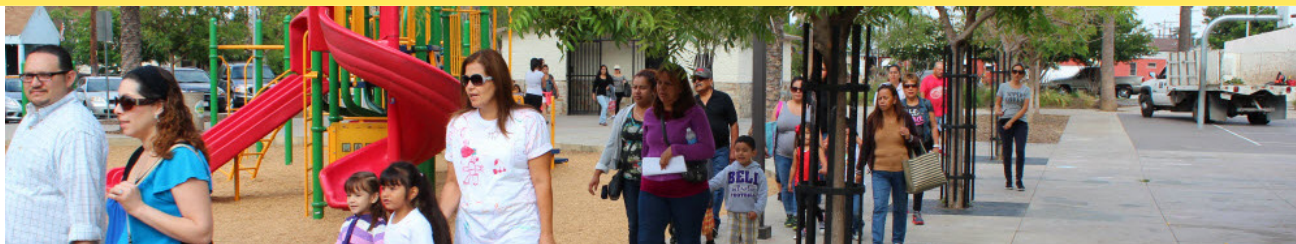
Photo credit: Amigos de los Rios

We've done a good job

Over the last ten years urban and community forestry has made significant inroads in the realm of community planning. Community leaders now frequently consider their tree canopy and urban forests in planning efforts, whereas ten years ago many did not see the need or relevance. The following is a summary of gauges of progress made in the last decade (2006-2016) which demonstrate increased integration of urban forestry into different scales of planning:

• The number of communities with forestry management plans has risen by 70 percent, and 10 percent more of the nation's population is living in communities with management programs. These numbers vary by region with the Pacific Northwest and Hawaii leading the way (CARS, 2005-2014).

• Community tree policies and ordinances are on the rise, with a 58 percent increase since 2005. New York, Hawaii, and Puerto Rico have experienced the greatest increase in ordinances and policies (CARS, 2005-2014).

The Majority of States Have Urban Forestry Plans
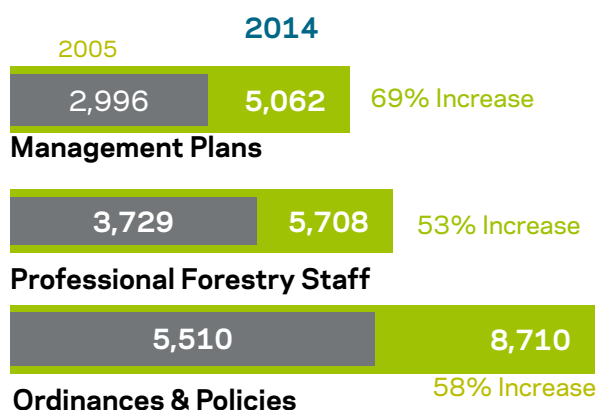
Figure 1.5: Data drawn from CARS, 2005-2014

• The demand for urban forest managers in communities is reaching an all-time high, with an additional 2,000 communities now using professional forestry staff (CARS, 2005-2014).

• Advisory and advocacy organizations increased by 49 percent nationally. The Pacific Southwest and Tropics regions made the highest gains with 130 percent and 500 percent increases, correspondingly (CARS, 2005-2014).

• Another sign that integration of urban forestry in regional planning is gaining steam is a special Roundtable convened in April 2014 by the Maryland Governor to discuss the need for a statewide strategy to protect and expand the state's tree canopy. In addition, in June 2014, the Governors of the Chesapeake Bay states, the Mayor of DC, and the EPA Administrator, signed an agreement to establish the first quantitative urban tree canopy goal as part of the Chesapeake Bay restoration strategy, reflecting a clear recognition of the role of urban forestry in ecosystem health and the importance of approaching the issue at a regional level. [http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3821860.pdf]

Number of Communities With Management Plans
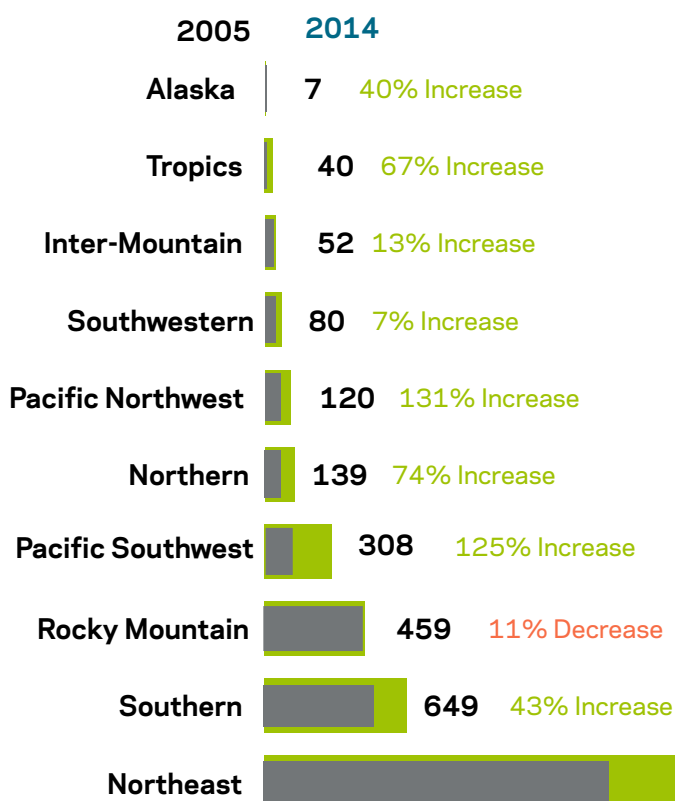
Figure 1.4 : Data drawn from CARS, 2005-2014

We still have a lot to do

Although communities with urban forestry management programs have grown significantly, not even half of the nation (only 47 percent) lives in communities that are managing programs to plant, protect, and maintain their urban forests. (CARS, 2005-2014). In fact, the 2010 Statewide Forest Resources Assessment found the gap in management plans and data to be the top urban and community forestry challenge. Further, some regions have lost community tree ordinances and policies. For example, the Southwest region experienced a 10 percent drop in urban and community forestry ordinances and policies from 196 to 177, while Kentucky reported a decrease of 43 percent. Declines such as this can often be attributed to increased tracking accuracy in CARS.

> **Less than half of America (47 percent) lives in communities with programs to plant, protect and maintain their urban forests.**

The goal of integrating urban forestry into plans is a tremendous opportunity for greater inclusion in the programs, tools, and resources developed in the last decade (see Appendix 1 for urban forestry programs, tools and resources). Of the 54 programs assessed, integration of urban forestry into all scales of planning is mentioned by 20 percent (11 programs). Of 61 tools assessed, integration of urban forestry into all scales of planning is mentioned by 5 percent (3 tools). This suggests there is a significant opportunity, reflective of the growing awareness and need for urban forest planning at the regional and state scales, for development of tools and programs to foster the integration of urban forestry into local, regional and state-level planning.

> **41 percent of Americans report that "more needs to be done" to manage and protect forests and trees in their state.**

Expansion of community tree canopy also has great potential and is critical to document now so communities can create base data to measure the health of our urban forests.

In the coming decade, as the nation grapples with the impacts of climate change and the need to offset heat island effects from the continuing growth of gray impervious infrastructure, tree canopy cover will be increasingly important to communities as a cost-effective tool to offset these impacts. In 2009, Schwab estimated that impervious surfaces had increased by 20 percent over the past twenty years, costing taxpayers more than $100 billion. American Forests reports that, using the i-Tree tool, current U.S. urban forests offset the impacts of community development and climate change through cooling temperatures, removing pollutants, respiration, avoided emissions, and more, to the tune of saving 15.6 billion dollars per year, or $760 per acre of tree cover.

Lastly, while more communities have urban forestry ordinances and policies, there is still room for significant advancement in policies that include community forestry as a core tool to address emerging challenges. For example, states such as Hawaii (2007), Minnesota (2007), and California (2006) are mandating reductions in greenhouse gases. Trees and urban forests are recognized cost-effective tools for this effort. California's bill requires a reduction in greenhouse gas emissions to 1990 levels by 2020, and its strategy includes urban forestry as an explicit tool in many key recommended actions, such as creating a Forest Carbon Plan and expanding urban forestry and green infrastructure programs and investments, particularly in California's environmental justice communities. As more states follow this path, communities will address their increasingly complex challenges with plans that recognize urban forestry as a vital tool.

Tree cover in urban areas in year 2000*
*Understanding that all states have different climate conditions and urban forest potential

12%	12%	35%	48%	54%	66.5%
Nevada	New Mexico	U.S. Average	North Carolina	Maine	Connecticut
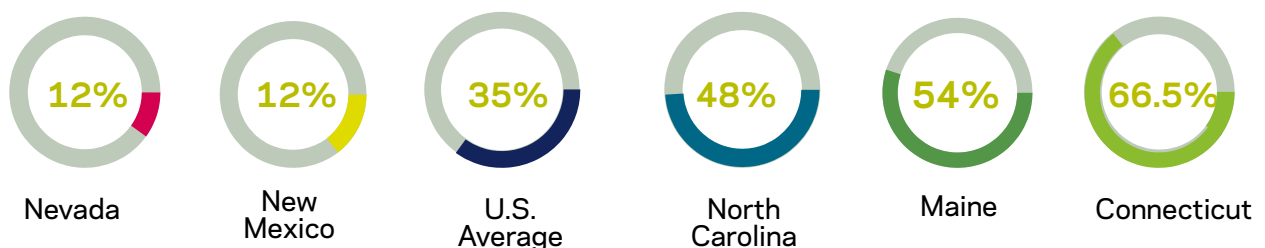
Figure 1.6: Data drawn from Dwyer, Nowak, Noble, & Sisinni, 2000

How can we get there?

Goal 1 Strategies and Actions

Strategy A: Support inclusion of trees and forests as elements of all community comprehensive and master planning efforts.

☐ **Action 1:** Create measurable targets for optimal urban forest health, site preparation, and Best Management Practices (BMPs), such as the SITES certification, to be an integral part of a city's planning process.

☐ **Action 2:** Train existing foresters to become part of the decision-making process at the local level.

☐ **Action 3:** Champion inclusion of trees in all community comprehensive or master plans, and develop benchmarking for sustainability goals.

☐ **Action 4:** Support urban forestry development and planning that reflects available and projected water resources.

Strategy B: Support the integration of urban forestry into all scales of city, regional, and state-scale mater plans.

☐ **Action 1:** Support collaboration to develop a national hierarchical planning template that integrates urban forest ecosystems (natural resources) into regional, state and local planning.

☐ **Action 2:** Facilitate development and implementation of regional urban forestry master plans that foster connectivity of green spaces and address the region's specific human health, equity and environmental health issues.

☐ **Action 3:** Assess and assist State Forestry Agencies' updates of their State Comprehensive Plan and State Forestry Action Plans to integrate a natural resources/ urban forest /green infrastructure component as needed.

☐ **Action 4:** Support use of site-appropriate species in regional urban forests, with a focus on species that are adaptable to climate change threats, can foster resilience, build biological diversity, and are resistant to insect and disease damage.

☐ **Action 5:** Facilitate development of model zoning codes, policies, and maintenance requirements that support resilient urban forests at the regional and community scale.

☐ **Action 6:** Encourage tracking and monitoring of progress of urban forest health on a regional, community and neighborhood scale.

Strategy C: Launch a public awareness and education campaign to elevate the value of urban trees and urban forests ecosystems as essential contributors to community sustainability and resilience.

☐ **Action 1:** Develop and implement key messages to communicate the importance of having one comprehensive regional master plan that includes urban forests.

☐ **Action 2:** Facilitate educational workshops at national conferences that build capacity for the integration of urban forest planning and management into regional master plans.

☐ **Action 3:** Partner with regional-focused groups and organizations to help promote integration of urban forestry into all levels of planning.

Strategy D: Increase community capacity to use urban trees and forestry in public space planning, infrastructure, and private development.

☐ **Action 1:** Develop training opportunities in urban forestry for planners (e.g., through American Planning Association (APA) chapters), for communities that don't have an urban forester.

☐ **Action 2:** Promote the use of trees and urban forests for effective stormwater management, wastewater treatment, and green infrastructure.

☐ **Action 3:** Identify financing opportunities for urban forest ecosystems for local, regional, state, and national elected officials and community leaders.

☐ **Action 4:** Develop assessment tools and conservation strategies to protect existing urban woodlands and create urban forests, parks, and open spaces.

See Appendix 3 for the full suite of actions related to Goal 1.

Case Study: Best Practices for Tree Ordinances

In 2009, the American Planning Association developed a document "Planning the Urban Forest: Ecology, Economy, and Community Development" (Schwab, 2009). Through a collaborative process with foresters and planners, they identified lessons and strategies for integrating urban forestry into the planning process. In that report, planners and urban foresters identified ordinance best practices, two of which are provided below. For the full set of best practices go here.

- Leverage tree planting by linking trees to good community development practices, such as new urbanism, smart growth, low-impact and conservation development, walkable neighborhoods, multimodal transportation systems, and transit-oriented development.
- Ensure that trees are maintained and that maintenance is enforced. For example, an ordinance that states that "all tree, landscaping, and vegetative buffering requirements should be part of a checklist used in the final site plan approval process before a certificate of occupancy can be granted", is likely to ensure enforcement.

Photo credit: Mike Kuhns

Case Study: Philadelphia Integrates Urban Forestry to Address Stormwater Overflows

Like more than 800 other communities nationwide, according to a report by Valderrama, each year Philadelphia's rainwater rushes off impervious structures and strains the city's combined sewer system, causing approximately 13 billion gallons of untreated sewage mixed with polluted runoff to cause overflow issues. To alleviate this, Philadelphia's Green City, Clean Waters created a 25-year plan to protect and enhance local watersheds using green infrastructure. Their ambitious goal, to transform 10,000 acres of impervious area into green spaces, required numerous partners as well as new regulations and zoning. The City's 2015 annual report indicates that since 2007 the city has successfully transformed 1,455 acres into green spaces. Without the regional plan and partners, none of this would have happened.

Photo credit: forestsforwatersheds.org

Case Study: Intertwine Alliance Creates Regional Plan Integrating Urban Forestry

The Intertwine Alliance, a unique coalition of more than 120 public, private and nonprofit organizations in the Portland/Vancouver region, created a Regional Conservation Strategy that integrates urban forestry into its vision and Action Plan. To provide significant nesting opportunities for avian species, the Alliance envisions "a healthy urban forest canopy that contributes to improvements in stormwater management and air quality". An exemplary part of the Strategy is Chapter 3, which outlines how it fills the gaps and integrates with existing local, regional, state, and federal plans. The Strategy identifies priorities of mutual interest, while providing a snapshot of relevant environmental laws and other federal information pertaining to the region's Federal lands. (Source: http://theintertwine.org/Conservation)

Focus Area > 40th Street Station Area

Goal 2: Human Health

Goal 2
Promote the Role of Urban and Community Forestry in Human Health and Wellness

Due to the high costs of disease treatment and therapies, health professionals are becoming more interested in innovative strategies for health promotion and disease prevention. An extensive range of research demonstrates significant relationships between experiences of nearby nature in cities, including trees, and positive health response. The depth of evidence supports the need for actively improving human health and welfare through urban and community forestry.

Strategy A
Expand opportunities for collaboration with the health community.

Strategy B
Champion a nationwide messaging campaign that links trees and urban forests to human health and wellness.

Strategy C
Plan, design and manage urban forests to improve human health and wellness.

Strategy D
Develop tools to improve and highlight the relationship between improved public health, wellness and urban and community forestry and green infrastructure.

Relevant Research Needs

Many factors contribute to human health, including individual behaviors and access to healthcare. Public health and medical officials are increasingly interested in the role of community environment for health promotion and disease prevention. Ecosystem services of trees and urban forest systems have been studied for decades. The first wave of evidence revealed that trees contribute environmental services that have health consequences, such as air quality, and reduced urban heat island effect. More recent studies align with epidemiology, revealing contributions to cognitive, emotional, and physiological health (such as weight management and stress reduction). Ongoing research will reveal practical ways that the urban forest can promote human health and quality of life.
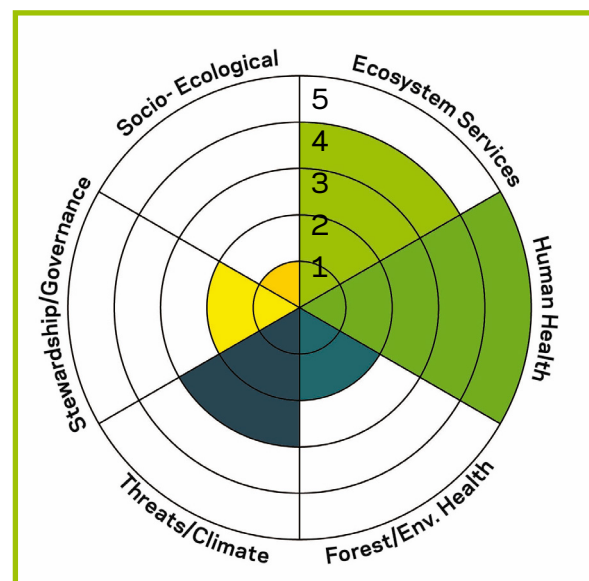
Research Needs Connected to Goal 2

Implementation
Targets

1   Major social media providers (such as Facebook) advertise the benefits of urban forests. Federal, state and local urban forestry interests participate in providing web-based advertising on benefits of urban forestry and green infrastructure.

Photo credit: Guy Kramer

2   Tools to measure the positive impacts of urban forestry on human health and wellness are made widely available to communities.

3   The benefits of urban forestry and green infrastructure for human health, wellness and productivity are promoted through partnerships with the health community.

4   Investments in urban forestry are made by health organizations to reduce healthcare costs and improve health outcomes.

5   A minimum daily dose of "Vitamin Tree" is developed and disseminated through health practitioners.

Why is it Important?
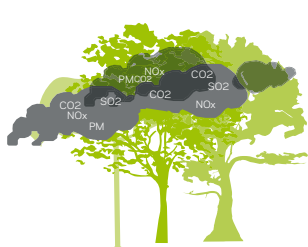
Figure 2.1

$60.1 Million

Value of annual particulate pollution removed by trees in New York City, reducing human mortality

Removal of fine particulate pollution from the air by trees improves human health. Values vary from 5.2 tons removed annually in Syracuse to 71 tons in Atlanta, with values from $1.1 million in Syracuse to $60.1 million in New York City (Nowak, et.al., 2013).

6 Minutes

A study found that briefly viewing videos of tree canopy reduced self-reported stress.

Tree canopy goals count! People viewing a 6-minute video with canopy density of about 60%, reduced their stress levels by 60 % compared to others who watched a video with about 2 percent tree cover (Jiang, B., D. Li, L. Larsen, and W.C. Sullivan, 2014.).

Figure 2.2

1 Day

The average reduced length of stay in a hospital for patients with bedside windows with leafy views.

The average reduced length of stay in a hospital for patients with bedside windows with leafy views. Additionally, patients need less pain medication and have fewer post-surgical complications (Ulrich, R.S, 1984).

Figure 2.3

Photo credit: Amigos de los Rios

We've done a good job

Over the last ten years the connection between urban and community forestry and human health and wellness has become better understood, providing yet more reasons to plan, plant, and maintain urban forests. We now know, for example, that the urban forest – including parks, gardens and open spaces – is recognized as an important factor in human health promotion and disease prevention. Research is gathering data on nature's ability to reduce stress responses, heart rates, and blood pressure as well as improve mental health, social cohesiveness (including reduced crime), and community economics. As our understanding of the linkages between nature and health has increased, community and school programs have increased their focus on tree plantings, community gardens, and urban foraging.

Health industry leaders, such as Kaiser Permanente, are also increasingly making a connection to urban natural resources. Health care settings are incorporating more urban forest ecosystem design and programming to address health issues, such as nature prescription programs, workplace wellness initiatives, and therapy gardens.

On a national level, initiatives that connect the built environment with public health and wellness have grown significantly in the last decade. The Urban Land Institute started a Building Healthy Places Initiative in 2013. The Centers for Disease Control and Prevention (CDC) launched a Built Environment and Health Initiative in 2011. The Robert Wood Johnson's Active Living Program promotes activity-friendly communities. The American Planning Association started its Planning and Community Health Center, and in 2010 California passed "Health in All Policies" to improve health in multiple ways, an approach later adopted by other states across the country (Rudolph, et al., 2013).

These trends are also represented in urban ordinances and plans. Napa, California offers an example of how city tree ordinances support actions that promote health and quality of life by creating cleaner air, conserving soil and energy, creating scenic beauty, and enhancing property values (Diaz, et al., 2008). In Baltimore, another example of increasing awareness is a poll in which city public agencies ranked public health and safety and water quality as the most important social and ecological criteria for decision-making related to tree planting (Figure 2.6) (Locke, et al., 2013).

Expressed Preferences for Major Criteria Related to Urban Forests

Figure 2.4: City Agencies in Baltimore Think Health-Related Criteria are Most Important When Making Tree Canopy Decisions. Note: Major criteria are summary categories that represent clusters or groupings of variables. Data drawn from Locke, et al., 2013.

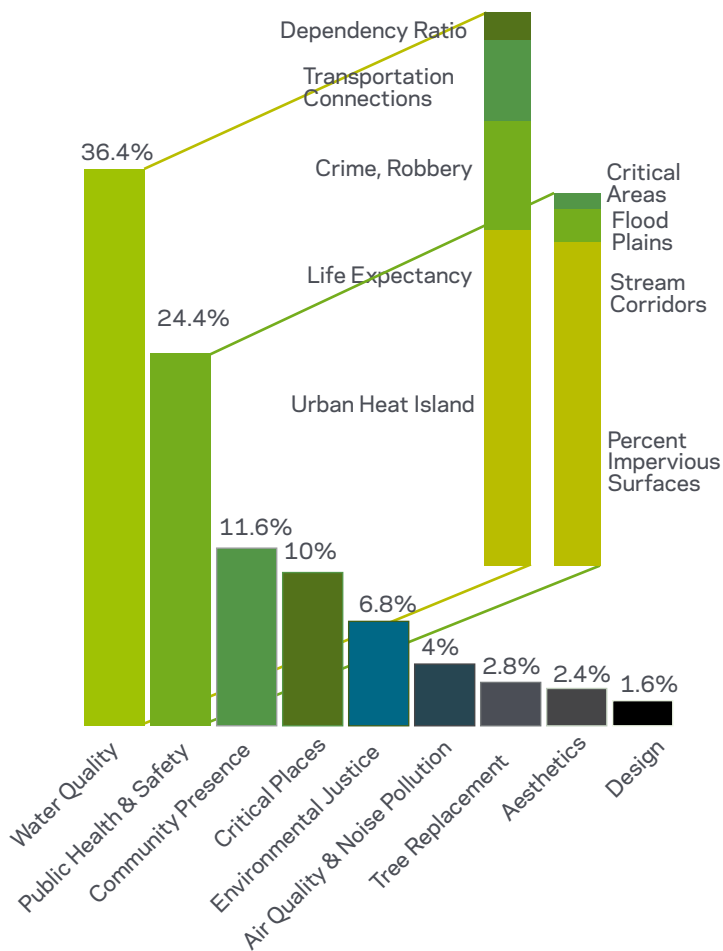# We still have a lot to do

Science will continue to link urban and community forests to health outcomes over the next decade. The next challenge will be to design and implement programs that reflect this linkage, followed by assessments and measurement to sharpen program effectiveness.

Moving forward, numerous gaps need to be filled. Specific and measurable health targets for both the field of public health and urban and community forestry need to be aligned. Research is needed to better understand how much, how often, and what kind of urban and community forest ecosystems contribute to specific health effects. Some innovative prescription programs have been piloted, such as RxPlay, NatureRx, and Doctor Walks, all of which prescribe doses of nature to improve health issues. Even as these programs expand across the nation, however, more research is needed to understand the baseline "dosage" needed to achieve specific health impacts.

Another significant gap relates to increased awareness of the linkage between environmental justice and human health. Studies using remote sensing and aerial photographs of tree canopy and parks distribution have revealed that underserved neighborhoods often have access to fewer trees and green space. In the next decade, as cities target underserved neighborhoods for greening programs, new policy is needed that incorporates environmental justice principles to ensure that the benefits of urban and community forests are distributed more equitably.

> **The urban forestry field must now develop ways to assess, measure, and implement programs that relate community health and wellness to forestry.**

A third gap relates to the need for more tools, technologies, and programming for improving human health and wellness through urban and community forestry. During the assessment for this ten-year plan, scientists and thought leaders identified numerous needs including i-Tree for health and wellness, urban forest design guidelines for walkable, multimodal and safe communities, guidelines for urban and community forest networks, and pilot studies that translate health benefits research into urban and community forestry programs.

Finally, mental health is a significant aspect of human health and wellness that merits attention in urban and community forestry, as nearly one in four adults experiences a mental health illness each year, including depression, anxiety, or elder cognitive disorders. Urban and community forest ecosystems are a possible tool worthy of study to facilitate reduced stress and address mental health issues in specific therapeutic settings such as hospitals, elder care facilities, community gardens and broader community settings.

Connections to the health and wellness industries offer exciting opportunities for new collaboration and funding sources for urban and community forestry. New partners might include facility planners, architects and designers of health-related facilities as well as other nontraditional partners such as school districts, health insurance companies, and community-based clinics. Over the next decade, improved data, measurement and communication of urban and community forest benefits for human health and wellness will likely open up untapped avenues of awareness and funding.

Nature Dosage

2 minutes stress is relieved within minutes of exposure to nature (as measured by muscle tension, blood pressure and brain activity).

2 days levels of cancer fighting white blood cells increase 50% after spending two or more consecutive days in nature.

2 hours memory performance and attention span improves 20% after spending an hour interacting with nature.
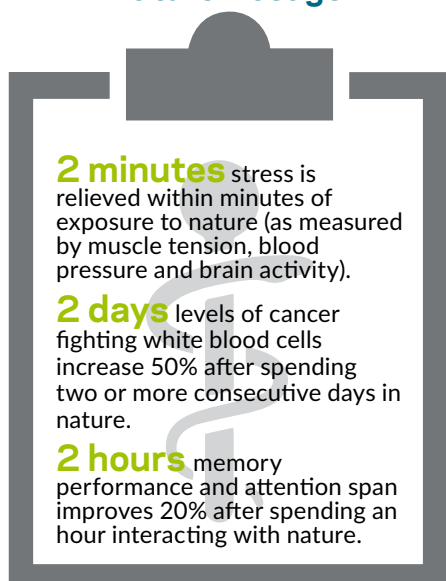
Figure 2.5: Contact with nature can be an affordable, accessible and equitable form of preventative and restorative medicine. Data drawn from Shepley et al., 2013.

Health Benefits of Urban Forests

Stress Reduction

Clean Water

Faster Healing

Mental Wellness

Figure 2.6: Drawn from Wolf, K.L., and A.S.T. Robbins. 2015

How can we get there?
Goal 2 Strategies and Actions

Strategy A: Expand opportunities for collaboration with the health community.

☐ **Action 1:** Foster new funding opportunities to support use of urban forestry and green infrastructure as a critical therapeutic tool for improving community health and quality of life.

☐ **Action 2:** Support the creation and dissemination of a prescription formula (or dosage) for urban parks and forests for health professionals to use.

☐ **Action 3:** Support and promote additional research into the benefits of urban forests and green infrastructure for human health and wellness.

Strategy B: Champion a nationwide messaging campaign that links trees and urban forests to human health and wellness.

☐ **Action 1:** Facilitate funding for a nationwide messaging campaign that links urban forestry and green infrastructure to preventative care and health promotion.

Strategy C: Plan, design and manage urban forests to improve human health and wellness.

☐ **Action 1:** Endorse modifications in urban infrastructure to better facilitate the planting of large shade trees and other vegetation in areas most where they are absent and most needed to improve health and wellness.

☐ **Action 2:** Connect urban forestry with urban agriculture to support healthy eating.

☐ **Action 3:** Connect urban forestry with healthy lifestyles and active living.

Strategy D: Develop tools to improve and highlight the relationship between improved public health, wellness and urban and community forestry and green infrastructure.

☐ **Action 1:** Facilitate increased funding for the development of tools (such as i-Tree) to evaluate and document improvements in human mental and physical health and wellness contributed by urban forestry.

☐ **Action 2:** Facilitate increased funding for research that quantifies the economics of both environmental and social benefits of tree canopy and green spaces, to provide more quantifiable data on the impacts of urban forests on health and crime outcomes.

☐ **Action 3:** Develop effective means for delivering science and research findings that make the connection between urban forestry and community health and wellness, to elected officials, communities, the public health community, and urban forestry practitioners.

Case Study: Active Design Guidelines by Center for Active Design

Published in 2010 by this New York City nonprofit, this guide provides architects and urban designers with a manual of strategies for creating healthier buildings, streets, and urban spaces, based on the latest academic research and best practices in the field. While it is aimed at designers, the guide provides strategies for parks, open spaces, and recreational facilities that could be used by all groups designing community and urban forests. The nonprofit has published other toolkits relevant to community forestry such as "Building Healthy Places Toolkit" and "Active Design Toolkit for Schools." (Center for Active Design 2015).

Photo credit: Guy Kramer

Case Study: Nonprofit Creates Worldwide Resource Hub for Connecting Children and Families to Nature

The Children & Nature Network believes that information is power. The Network is a leader in the movement to connect children, families, and communities to nature through innovative ideas, evidence-based resources and tools, collaboration, and grassroots leadership. In 2014, the network supported 369 grassroots campaigns that connected 3.5 million children to nature experiences worldwide. A database of literature enables decision-makers to make the case about the impact that nature has on children's development. This data is supplemented by training programs that aim to build a growing team of experts. All of this work is essential as green schoolyards and neighborhoods help to alleviate stress, increase physical activity levels, and increases socialization in children (Children & Nature 2015).

Photo credit: Greg Mannion

Case Study: Edible Forest in Seattle Connects Ecosystems and Healthy Eating

Called an edible forest ecosystem, Seattle's Beacon Food Forest is located in one of Seattle's urban neighborhoods and is designed for the community to plant, grow, and gather in the edible urban forest. Designed by students who were inspired by a permaculture design course, the forest will consist of seven acres, and will include an edible arboretum, a berry patch, nut grove, community garden for families to grow their own food, a gathering plaza, and a kids' area. The project coordinators hope that the forest will inspire the community to both grow its own food and rehabilitate the local ecosystem (Beacon Food Forest 2015).

Photo credit: beaconfoodforest.org

Goal 3: Diversity, Equity and Leadership

Goal 3
Cultivate Diversity, Equity and Leadership Within the Urban Forestry Community

The urban forestry community should embody the changing demographics of our nation, and its cities, towns and counties. The next Ten-Year Urban Forestry Action Plan must continue to focus on addressing the needs of underserved communities. There is an urgent need to increase diversity within the urban forestry community, both at the professional level and among the citizen leadership that drives the urban and community forestry agenda forward. Urban and community forestry needs to be seen as a progressive, innovative and inclusive profession at all levels, from entry level to senior leadership. Over the next ten years, a new professional cadre that is culturally, ethnically and economically diverse must emerge from an expanding network of vocational programs in high school, community colleges and professional certified university programs. Vocal and visible champions need to be developed at all levels in the next decade to bring attention to the ability of urban forests to offer comprehensive and cost-effective solutions to critical community issues and to apply those solutions within their own communities. In the federal structure, urban and community forestry need to deliver strategies and programs for existing and anticipated challenges by coordinating the work of multiple agencies and leveraging their resources to promote equity and diversity in urban and community forestry.

Strategy A

Increase diversity, equity and accessibility in urban and community forestry.

Strategy B

Engage underserved communities in urban and community forestry.

Strategy C

Develop effective leadership at all levels to build a national voice for urban forestry.

Strategy D

Increase workforce development opportunities and green jobs in urban and community forestry, with particular attention to underserved communities.

Strategy E

Promote expanded collaboration, training, university-based learning, and communication within the field of urban and community forestry to build workforce professional development.

Relevant Research Needs

While the earliest research about trees in cities focused on biophysical topics, social science studies have gained momentum in recent years. The National Science Foundation has funded two Urban Long Term Ecological Research projects and each is premised on the idea of socio-ecological systems. Such studies attempt to understand the linkages and feedback loops that are inevitable within ecosystems that are occupied by high-density human populations. Research also explores stewardship and local governance, addressing important issues of engagement and environmental equality for all residents of cities and towns. In addition, leadership that includes natural resource professionals and other sectors, is essential for social sustainability and resilience.
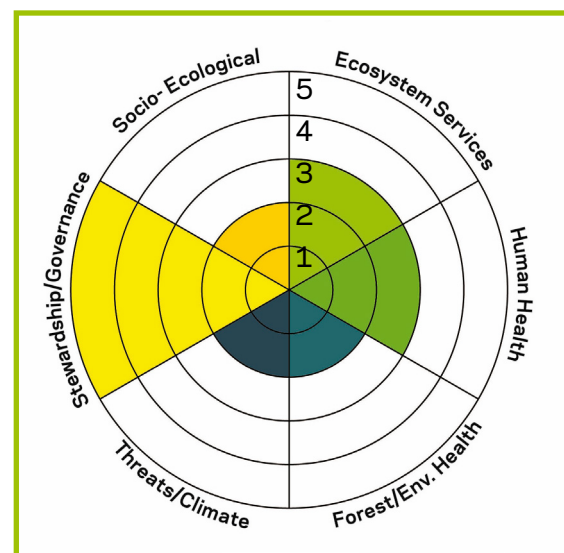
Research Needs Connected to Goal 3

Implementation Targets

1 The principles of diversity and inclusion are widely adopted by local, state, federal government offices managing urban forestry, as well as foundations and non-profit organizations.

Photo credit: Dr. Jianbang Gan

2 Tools to measure deficiencies in ecosystem services across communities are developed and used by government agencies and community organizations to target urban forestry investments.

3 Youth are introduced to the full range of education, employment and community development opportunities available in the urban forestry sector.

4 The range of jobs offered in urban forestry that are publicly characterized as "green jobs" has measurably increased.

Why is it Important?
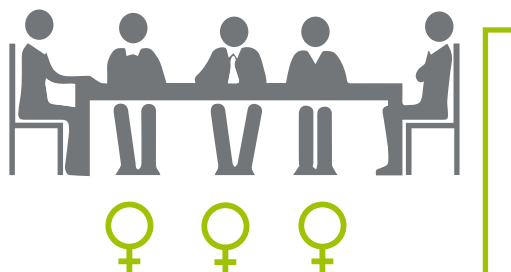
Figure 3.1

16.8% Return on sales for companies with at least three women serving on the boards of directors.

Outperforms the average 11.5 percent return. These companies show a similar 16.7 percent return on equity, outperforming the average 11.5 percent return, and a 10 percent return on invested capital, outperforming the average 6.2 percent return (Nelson, 2014).

Many studies reveal that the distribution of trees and park space often disproportionately benefits predominantly White and more affluent communities (Wolch, J.R., J. Byrne, and J.P. Newell, 2014).

Figure 3.2

Figure 3.3

75% Percent of municipal arborists engaged in managing green space assets to produce ecosystem services.

Community forestry provides leadership in ecosystem services, with 75 percent of municipal arborists reporting their organization is moderately to very engaged in managing green space assets to produce ecosystem services.

In the past ten years...

Photo credit: Amigos de los Rios

We've done a good job

> The widespread nature of this rise in professional forestry staff suggests that urban forestry is impacting more geographically and demographically diverse communities.

In the last ten years, the urban and community forestry profession has made progress by generating jobs and by encouraging diversity, equity and leadership. With an upsurge of staff, there also has been movement in programs, tools, and resources that are more progressive, innovative, and inclusive at all levels, from entry level to senior leadership. For example, i-Tree tool has opened opportunities for underserved communities to assess their urban canopy by reducing costs and providing something that is easy to use. Additionally, in the past decade, forestry professionals have

Number of Communities with Professional Forestry Staff Percent Change from 2005-2014

<-50%
-49%-0%
1%-50%
51%-100%
101%-200%
>200%
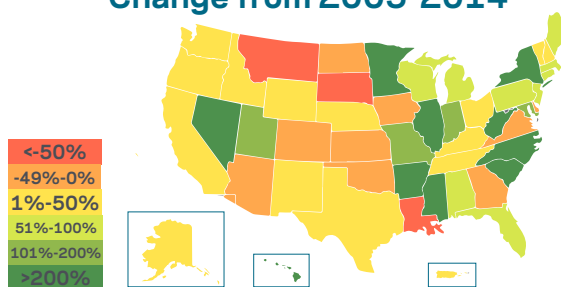
Figure 3.4: Data drawn from CARS, 2005-2014

increasingly identified the importance of cultivating diversity, equity, and leadership through stated goals, objectives, and benchmarks. Accomplishments in the last ten years include:
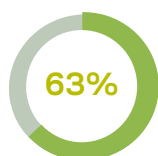
63% Out of 135 cities surveyed in 2007, 63 percent report having staff at, or who report to, the executive level of city government to coordinate multiagency and public-private efforts to preserve or enlarge the tree canopy. This example demonstrates how urban forestry is now being seen as a leadership issue (Diaz, et al., 2008).
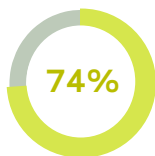
74% From 2005-2014, 37 states (74 percent) have increased the number of communities with forestry staff. The widespread nature of this rise in professional forestry staff suggests that urban forestry is impacting more geographically and demographically diverse communities (CARS 2005-2014).
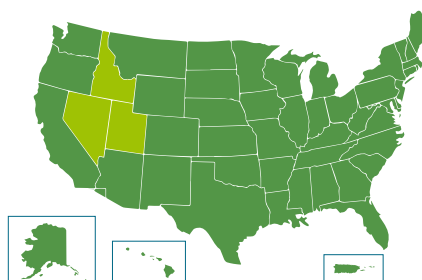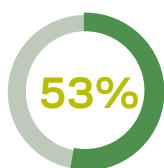
Figure 3.5: Nearly 2,000 additional American communities have employed or retained professional forestry staff, a gain of 53 percent. The Intermountain Region has experienced the greatest increase of all, with a remarkable 222 percent increase in forestry staff. Data drawn from CARS, 2005-2014.

In the next ten years...

We still have a lot to do

Despite progress, much work is still needed to intentionally strengthen opportunities for diversity and leadership. A 2007 report by Bonta and Jordan acknowledged that "our diversity crisis is a systemic problem," and so requires a systematic approach to address the issue. A 2014 study by Taylor on the state of diversity in environmental organizations found that gender diversity has improved, but the gains have gone mostly to white women. Men are more likely than women to hold leadership positions. Organizations who participated in Taylor's study reported that the biggest barriers to hiring are few job openings and lack of diverse applicants.

Moving forward, improvements to expanding vocational programs will be one avenue for creating greater access to the urban forestry field for underserved communities. This is essential as a 2002 nationwide U.S. study found that only 10 percent of urban forestry professionals were women and 5 percent minorities. Although these two underrepresented groups have been growing, much more needs to be done.

Progress can be activated by increasing access to learning and development opportunities. Of the 48 Accredited and Candidate Degree Programs by the Society of America Foresters, only 11 have an accredited option in Urban Forestry. More accredited programs in urban forestry are needed in more geographically diverse locations. Also, increasing workforce development opportunities, such as youth, training, and green job placement opportunities, can expand diversity in the field.

Effective and vocal leaders who are engaged corroboratively with other fields are greatly needed to help guide and inspire diversification in urban and community forestry. These champions can expand the urban forestry circle of influence to other fields while also highlighting the ability of urban forests to offer comprehensive and cost-effective solutions to critical community issues.

To improve their effectiveness in the next decade, urban foresters will need to cultivate leadership, communication and networking skills. Creating reciprocal relationships of trust and value with all constituencies will be important for broadening the pipeline of green jobs, as well as increasing diversity and equity in urban forestry.

> **There is a strong need to increase both programs, tools and resources that focus on increasing diversity, equity and leadership, as well as making them a core component of Action Plan implementation in the next ten years.**

Further, the urban forestry ecosystem is not equally distributed across cities, and is disproportionately present in affluent neighborhoods. There is a large gap in programs and tools that can help address this issue. For example, out of 54 programs assessed in 2015, diversity, equity, and leadership were mentioned only seven times, and in only 1.6 percent of all tools assessed. There is a strong need to increase both programs, tools and resources that focus on increasing diversity, equity and leadership, as well as making them a core component of Action Plan implementation in the next ten years.

Additionally, in the next ten years, the urban forestry field must better engage a diverse stakeholder group when making decisions. As Ostoic reported in 2015, public participation that is representative leads to programming that is better suited to community preferences. The Green 2.0 Working Group has identified several barriers to increasing diversity in the environmental and natural resource professions, as well as several opportunities for increasing leadership. More information may be found in the first case study on page 47.

Percentage of Minorities in Leadership Positions in Environmental Organizations

Foundations	Government Agencies	NGOs
4.6%	6.9%	13.3%

Figure 3.6: Data drawn from Taylor, 2014

How can we get there?

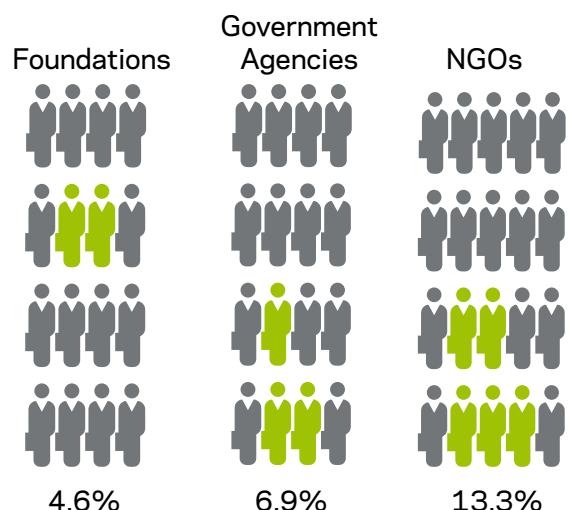## Goal 3 Strategies and Actions

Strategy A: Increase diversity, equity and accessibility in urban and community forestry.

☐ **Action 1:** Promote diversity in the urban forestry community by developing metrics and outreach training.

☐ **Action 2:** Translate key urban forestry materials and resources into other languages to make them more accessible through social media. Identify avenues for introducing urban forestry to more diverse audiences.

☐ **Action 3:** Create partnerships to promote urban and community forestry with media, sports and entertainment organizations that communicate effectively with diverse communities.

Strategy B: Engage underserved communities in urban and community forestry.

☐ **Action 1:** Target urban forestry funding and other resources specifically to underserved communities and low-canopy neighborhoods.

☐ **Action 2:** Work through existing networks, community groups and organizations to create dialogue with underserved communities, learn their needs and goals, and build opportunities for urban and community forestry around those needs.

☐ **Action 3:** Develop relationships, build partnerships, and identify opportunities to collaborate with organizations to advance urban forestry in underserved communities.

Strategy C: Develop effective leadership at all levels to build a national voice for urban forestry.

☐ **Action 1:** Expand and clarify NUCFAC's congressionally authorized leadership role in advancing urban forestry nationally.

☐ **Action 2:** Build leadership through collaboration and increased collective impact by local, state, federal, nonprofit, and industry partners.

☐ **Action 3:** Offer programs to nurture the leadership talents of students and young professionals.

☐ **Action 4:** Support the development of a central source for all interested parties to find the latest information and efforts pertaining to urban forestry to share ideas, projects, etc.

☐ **Action 5:** Improve communication between federal agencies, the urban forestry community, and the lay audience.

☐ **Action 6:** Build on existing and new partnerships to innovate urban forestry educational, planning and management opportunities with allied professionals such as planners, landscape architects, and engineers.

☐ **Action 7:** Support building nonprofit leadership capacity for effective outreach and networking efforts.

☐ **Action 8:** Cultivate national leaders to highlight the importance of urban forestry in the political arena.

Strategy D: Increase workforce development opportunities and green jobs in urban and community forestry, with particular attention to underserved communities.

☐ **Action 1:** Focus on youth across various demographics to increase exposure to and professional opportunities in urban forestry.

☐ **Action 2:** Promote training and education opportunities in urban and community forestry.

☐ **Action 3:** Encourage development and adoption of consistent national standards for certified arboricultural professionals.

☐ **Action 4:** Develop green job placement and training opportunities in urban forest tree planting, maintenance, and data collection for unemployed and underemployed residents of low-income communities.

Strategy E: Promote expanded collaboration, training, university-based learning, and communication within the field of urban and community forestry to build workforce professional development.

☐ **Action 1:** Build professionalism and broader access to the field by increasing the number of urban forestry professional training programs.

☐ **Action 2:** Distribute an annual survey to understand and connect to urban forestry needs at the grassroots level.

☐ **Action 3:** Develop opportunities to work as interdisciplinary teams at local, city, state and federal levels. Focus on urban forestry program development, installation, and maintenance. National efforts should be localized for greatest possible effectiveness where possible.

☐ **Action 4:** Improve communication between the urban forestry community and lay audiences.

☐ **Action 5:** Work through existing umbrella organizations to boldly and effectively communicate the top needs, opportunities, and actions for the field.

☐ **Action 6:** Consider the unique collaboration and communication that is taking place in the Islands' networks; there could be important sharing and learning between island and national audiences. Site-based collaborative opportunities may also be appropriate for many island communities.

See Appendix 3 for the full suite of actions related to Goal 3.

Case Study: Report Examines Why Decades of Promises to Diversify are Falling Short in the Mainstream Environmental Movement

Green 2.0 Report findings include three highlights about why diversity promises are falling short: 1. The "Green Ceiling"; 2. Unconscious bias, discrimination, and insular recruiting; and 3. Lackluster effort and disinterest in addressing diversity that results in an overwhelmingly white "Green Insiders' Club."

Leaders Identify Factors That Make Diversity Initiatives Successful including:
1. Adequate and stable funding. 2. Adequate and committed leadership.
3. Adequate organizational buy-in. 4. Ability to communicate across race, class, gender, and cultural lines. 5. Institutionalizing diversity, equity, inclusion goals.
6. Translate diversity training into action. (Source: http://diversegreen.org)
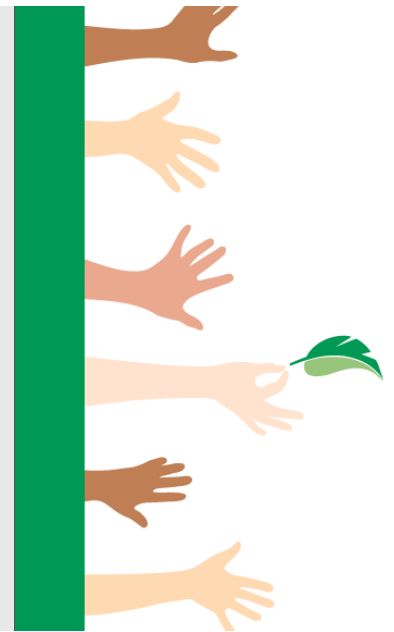
Case Study: Principles of Environmental Justice Can Guide Urban Forestry Leadership

Adopted in 1991 by the First National People of Color Environmental Leadership Summit, the 17 principles of environmental justice serve as a defining and guiding document for the growing grassroots movement for environmental justice. As urban and community forestry organizations seek to address the needs of underserved neighborhoods in the next decade, an important first step can be to gain fluency in environmental justice via these principles. Formal adoption of these principles as a guide for organizing and networking can demonstrate a meaningful commitment to increasing diversity in the field. (Source: http://www.ejnet.org/ej/principles.html)

Case Study: Society of Municipal Arborists Exchange Program Encourages Idea-Sharing Internationally

In an effort to exchange urban forestry expertise, management ideas, and technology, The Society of Municipal Arborists (SMA), has hosted an international exchange program since 2003. SMA and contributing sponsors provide funding for airfare and basic expenses to spend at least one week visiting and working with another city's forestry department. Exchange cities range from as far as Turin, Italy and Cape Town, South Africa to as local as Charlotte, North Carolina. In 2013, Simon Wallace visited Kildare County, Ireland and shares his valuable experiences in an article, which all participants write. He writes, "While building the urban forestry program in Lexington, I apply the wealth of knowledge I've received from these amazing experiences every day". Not only does the program facilitate the transfer of knowledge, but it also helps create an international community of urban forestry. (Source: http://www.urban-forestry.com/arborist-exchange)
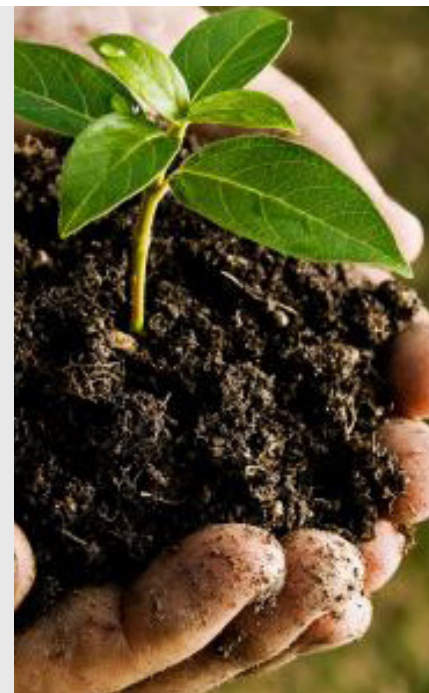
Goal 4: Environmental Health

Goal 4

Strengthen Urban and Community Forest Health and Biodiversity for Long-Term Resilience

Increasing urban and community forest and green infrastructure health, biodiversity and resilience are urgent needs, particularly as invasive species, pests, drought and challenges associated with climate change, such as extreme weather events, will offer both key challenges and opportunities in the next ten years. Native and drought tolerant street trees are important to create stability and functional food webs for a diverse array of animals, insects, birds and people. Knowledge of regionally-adapted pest and insect-resistant species needs to be developed and disseminated.

Strategy A

Increase the biodiversity, health and resilience of trees in urban and community forests.

Strategy B

Foster resilience, restoration and sustainability of urban and community forests facing climate change challenges.

Strategy C

Support use of urban forests for increasing community food resilience and access to local foods.

Relevant Research Needs

Several research activities address this program need. First, ongoing refinement of a robust body of knowledge about tree planting, inventory, and analysis will continue to inform the management best practices that support forest health and biodiversity. More emergent in recent years, is the science about pests, threats, and change, including climate. Ongoing science about these topics will aid communities and managers in optimizing forest planning and investment for health and biodiversity. Finally, ecosystem services readily recognize the importance of forest health and biodiversity in order to optimize the functions and services that forest systems and other ecosystems provide in cities and regions.
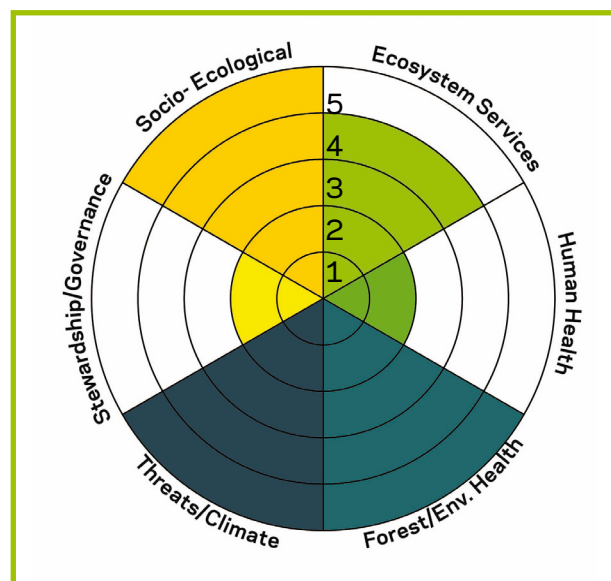
Research Needs Connected to Goal 4

Implementation Targets

1 Tools and comprehensive data are developed and widely disseminated that enable communities to map projected climate change, create management plans for increased resilience, and plan for the use of native and regionally adopted trees, shrubs and perennials.

2 An integrated network of training technology and talent helps communities respond to and recover from severe storm events.

3 Food forest plans (including fruits, berries, nuts and foraged foods) are made widely available to communities.

Why is it Important?

Figure 4.1

5.6 Million
The estimated number of trees lost in communities across Texas.

5.6 million trees were killed in urban areas due to the drought in 2011. This figure may represent as much as 10 percent of the total number of trees, decreasing the ecosystems services the urban forests provide (Texas A&M Forest Service).

20,000 Trees

The estimated number of public trees destroyed as a result of Hurricane Sandy (USFS Northern Research Station, NYC Urban Field Station).

45,000 Trees

In 2008, Galveston, Texas was severely hit by Hurricane Ike and lost nearly 50% of its total canopy. An estimated 45,000 trees were destroyed due to wind and salt-water storm surges (Riley, 2014).

Figure 4.2

Figure 4.3

$2.7 Billion
The estimated cost for municipalities and homeowners to remove trees killed by non-native pests.

Homeowners lose another $1.5 billion in property values (Campbell, 2014).

In the past ten years...

Photo credit: Morgan Housden

We've done a good job

Over the last decade there has been increasing work to address the health of urban and community forests. Past events and current issues show us that there are plenty of ways a forest can be crippled, fragmented and destroyed, whether it is from invasive species, pests, drought, hurricanes or any other side effect of climate change and urbanization. Along with increasing public recognition of the challenges affecting forest health and long-term resilience, there are many governmental programs and initiatives that have made significant progress in addressing these problems. The following is a summary of gauges of progress made in the last decade (2006-2016), all of which demonstrate increased efforts to strengthen urban and community forestry health and biodiversity.

• President Obama's Climate Action Plan is pushing forward to tackle the imminent threat of climate change.

• Nearly 1,000 communities in the United States have signed a climate action agreement (Nowak et al., 2010).

• The Chesapeake Bay Agreement has identified the development, retention and enhancement of urban tree canopy as an effective strategy to improve the health of the Chesapeake Bay.

• As part of a multinational effort, a knowledge sharing

website on emerald ash borer was developed. This is a great model for knowledge sharing and networked information delivery; a future need.

> **Since 2000, 31 states have developed comprehensive Climate Action Plans.**

• Tools like i-Tree tool have evolved impressively in the last 10 years.

• The USDA Forest Service is working on incorporating invasive pest risk maps into i-Tree.

• i-Tree Pest Detection Module is a portable, accessible and standardized protocol for observing a tree for possible insect or disease problems. It is currently available within the i-Tree Streets and i-Tree Eco programs; Pest Detection can be adapted to other external tree inventory programs.

• i-Tree Storm provides a method for a community to assess widespread storm damage in a simple, credible, and efficient manner immediately after a severe storm. It is adaptable to various community types and sizes and provides information on the time and funds needed to mitigate storm damage.

• STEW-MAP is a tool for understanding stewardship networks in a city. Having this info in a city helps managers/leaders know which areas of the city are neglected, and the networks help a city know the strength of partner relationships, which they can use in times of disaster or for rebuilding.

38% Thirty-eight percent of those with a sustainability or climate protection plan report that their plan specifically cites the contribution of trees or tree canopy to achieving the plan's goals (Diaz, Nickels, Kautz, & Cochran, 2008).

62% Percentage of states that have developed comprehensive Climate Action Plans that often use urban forestry techniques as a tool to both mitigate and adapt to a changing climate ("State and Local," 2015).

84% Of 135 cities surveyed, 84 percent viewed their activities relating to trees as part of their overall sustainability and climate protection efforts (Diaz, Nickels, Kautz, & Cochran, 2008).

In the next ten years...

We still have a lot to do

Climate disruptions, as well as vulnerability to crisis and disaster, have increased over the past 40 years and are projected to continue increasing in the future (Rodin, 2014) (U.S. Global Change Research Program, 2014). In 2007, cities reported that their tree resource management efforts had been hindered recently by serious storms (53 percent), infestations (41 percent), and drought (55 percent). However only 57 percent of those cities reported that they have plans in place to respond to large or sudden disturbances. This gap suggests that, at the time, nearly half of our cities still don't have plans in place that will enable managing the inevitable urban and community forest crises easier and more cost-effective.

> " Climate disruptions have increased over the past 40 years and are projected to continue increasing in the future.

How can we address and improve the health of urban forests? Professionals working within the natural environment in our cities and communities, such as urban foresters, park managers, and planners are not the only ones who can and should maintain and nourish our urban and community forests. This task will take everyone's involvement, including new program leadership, governance, institutions, policies, and incentives. All of which will need to innovate and adapt to keep up with a changing climate, rising populations, aging infrastructure, and limited funding. As water becomes limited, for example, the height and density of tree canopies will be reduced. In some areas, these dry conditions also will likely exacerbate and spur more large and intense wildfires in the wild land-urban interface, consequently increasing risks of erosion and reducing the carbon storage potential of trees. Along with changes in temperature, the frequency of extreme weather events will increase, such as high winds, ice storms, hurricanes, flooding and landslides, which all have devastating effects on trees.

Additionally, the potential for urban areas to contain significant amounts of biodiversity must continue to be recognized by city planners and urban foresters so that management practices aimed to preserve and promote diversity can be accomplished. Management should focus on increasing biodiversty in all aspects of the urban and community forest, from street trees to urban parks and woodlots (Alvey, 2006).

Non-native invasive species will continue to threaten urban and community forests, such as emerald ash borer, Asian long-horned beetle, gypsy moth, hemlock woolly adelgid, sudden oak death, and thousand cankers disease ("States and Accomplishments", 2013). One study estimates that approximately 12 percent of plants imported from other countries, during the study period, had reportable pests (Campbell, 2015). This is meaningful as Americans import 3 to 4 billion plants per year. In fact, in the past ten years, 28 new tree-killing pests have been detected in the United States (Campbell, 2014).

These greater risks call for thorough planning and management needs in the next ten years. Improvements in tree inventories and assessments (such as a standard protocol for maintaining data over time, managing issues on a regional scale, early detection to find and manage infestations, and developing management plans in all communities) will all be increasingly important in the next ten years.

The effects that urbanization, globalization, land use and climate change will likely have on urban and community forestry are daunting, but with the right leadership and messaging, the task can increase opportunity and recognition for the urban and community forestry field. For example, the Kresge Foundation awarded $1.35 million to an initiative in Indianapolis called Reconnecting to Our Waterways. A key aspect of this initiative, led by non-profit partner; Keep Indianapolis Beautiful, is the strategic greening and planting of trees to improve the urban and community forest.

The Urban Heat Island Effect

Surface Temperature (day)
Air Temperature (day)
Surface Temperature (night)
Air Temperature (night)

Rural   Suburban   Pond   Warehouse / Industrial   Urban Residential   Downtown   Urban Residential   Park   Suburban   Rural
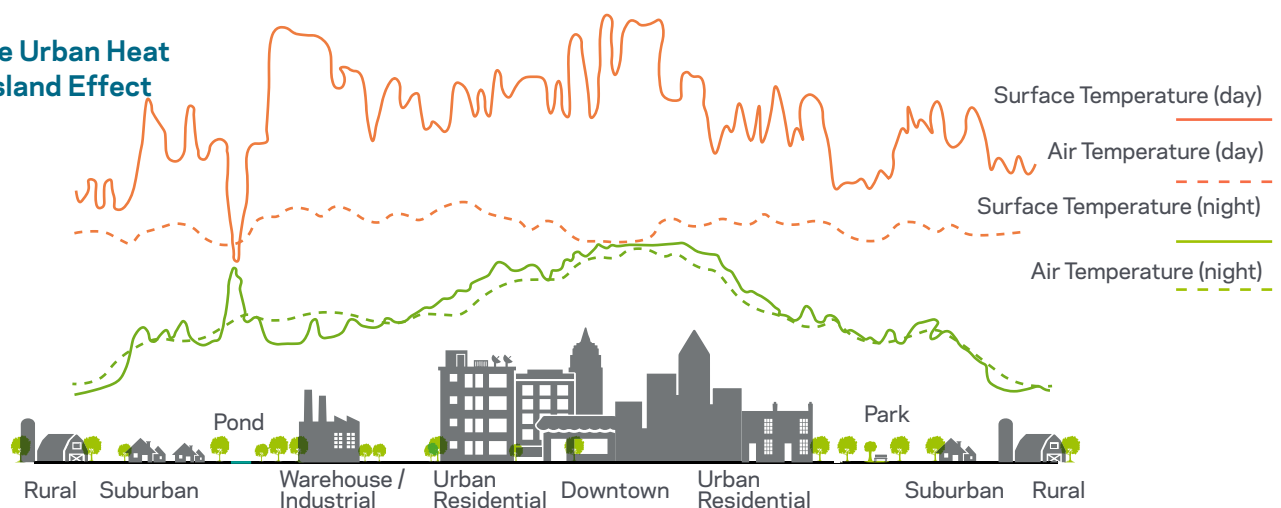
Figure 4.4 Data drawn from EPA 2015

How can we get there?
Goal 4 Strategies and Actions

Strategy A: Increase the biodiversity, health and resilience of trees in urban and community forests.

☐ **Action 1:** Support the use of more locally grown, regionally-adapted, insect and pest-resistant, and diverse native or site-appropriate species.

☐ **Action 2:** Focus on trees as a priority at the beginning of all new design and infill development efforts, with a focus on opportunities for preservation of existing trees.

☐ **Action 3:** Facilitate funding and direct resources for proper site preparation to address soil and water needs for urban trees and forests.

☐ **Action 4:** Determine areas at greatest risk from threats from invasives and threats of climate change, and take proactive measures to reduce and mitigate risks.

☐ **Action 5:** Focus on the Right Tree, Right Place in urban forestry establishment.

Strategy B: Foster resilience, restoration and sustainability of urban and community forests facing climate change challenges.

☐ **Action 1:** Facilitate funding to develop "urban forestry first responders" to respond after a storm or disaster to manage urban trees and forests and develop hazard mitigation strategies.

☐ **Action 2:** Support the development of region-specific climate change plans for both the short- and long-term, building on existing federal interagency plans.

☐ **Action 3:** Develop standards and Best Management Practices (BMPs) to foster resilience and sustainability for urban forests. Standards and BMPs should be developed for different bioregions (desert, tropical, eastern forest, etc.).

☐ **Action 4:** Promote the restoration of degraded urban forests and increase the capacity of other degraded urban lands to support tree growth.

☐ **Action 5:** Conduct more technical long-term studies to address the effects of climate change planning on a 10, 20 to 30-year horizons instead of only a 6 to 12-month horizon.

Strategy C: Support use of urban forests for increasing community food resilience and access to local foods.

☐ **Action 1:** Support the design and creation of urban orchards and edible forests with partners from the permaculture, urban food, and agroforestry communities.

☐ **Action 2:** Connect private landowners with tools and resources to grow fruit trees on private lands (such as the Arbor Day Foundation Tree Wizard tool).

☐ **Action 3:** Promote the reduction of lawn area in America and replacement of lawns with orchard trees, vegetable gardens, rain gardens, and locally-appropriate trees and vegetation.

☐ **Action 4:** Create a public awareness campaign that connects the planting of trees to our national security (increasing food supply security, providing urban food, feeding pollinators, reducing urban heat island effect, etc.).

See Appendix 3 for the full suite of actions related to Goal 4.

Case Study: White House Priority for Climate Resilience Supports Forest Health and Biodiversity

The Climate and Natural Resources Priority Agenda represents the United States' first comprehensive commitment across the Federal Government to support resilience of our natural resources. It identifies how federal agencies will work together to increase resilience. The agenda identified four priority strategies: foster climate-resilient lands and waters; manage and enhance U.S. carbon sinks; enhance community preparedness and resilience by utilizing and sustaining natural resources; and modernize federal programs, investments, and delivery of services to build resilience and enhance sequestration of biological carbon. Urban forestry is integrated throughout the report in a variety of ways, including the need to improve monitoring systems for carbon sinks, control invasive species, and increase ecosystem connectivity.

Case Study: Urban Forest Products Alliance Puts All Wood From Urban Trees to Good Use

Leaders and experts from a variety of disciplines, including forestry tree care, wood processing and green building, formed the Forest Products Alliance with the mission of advancing the sustainable recovery and the highest and best use of the products of urban forests. The Alliance operates under five basic beliefs, the first is described below:

Urban trees have their highest value while living. When they come down, urban trees should be put to their highest and best uses to maximize their economic, environmental, and societal benefits for people in urban areas and beyond.

(Source: http://www.urbanforestproducts.org/)

Case Study: Vermont's Forest Pest Detector Program Trains Volunteers to Control the Emerald Ash Borer

In response to a growing threat of invasive pests, Vermont's Forest Pest Detector Program trains volunteers to help communities control the devastating emerald ash borer. As of 2013, 118 volunteers have been trained to increase public awareness of tree pests, serve as local experts, and help coordinate local volunteer efforts to survey pests. With training they are able to teach others about pest signs, symptoms, and screening protocols. One volunteer called this an "ingenious program to get volunteers to help our overworked State Agencies! Great job by all those involved, and the inter-agency cooperation is very impressive." (VT Invasives, 2015)
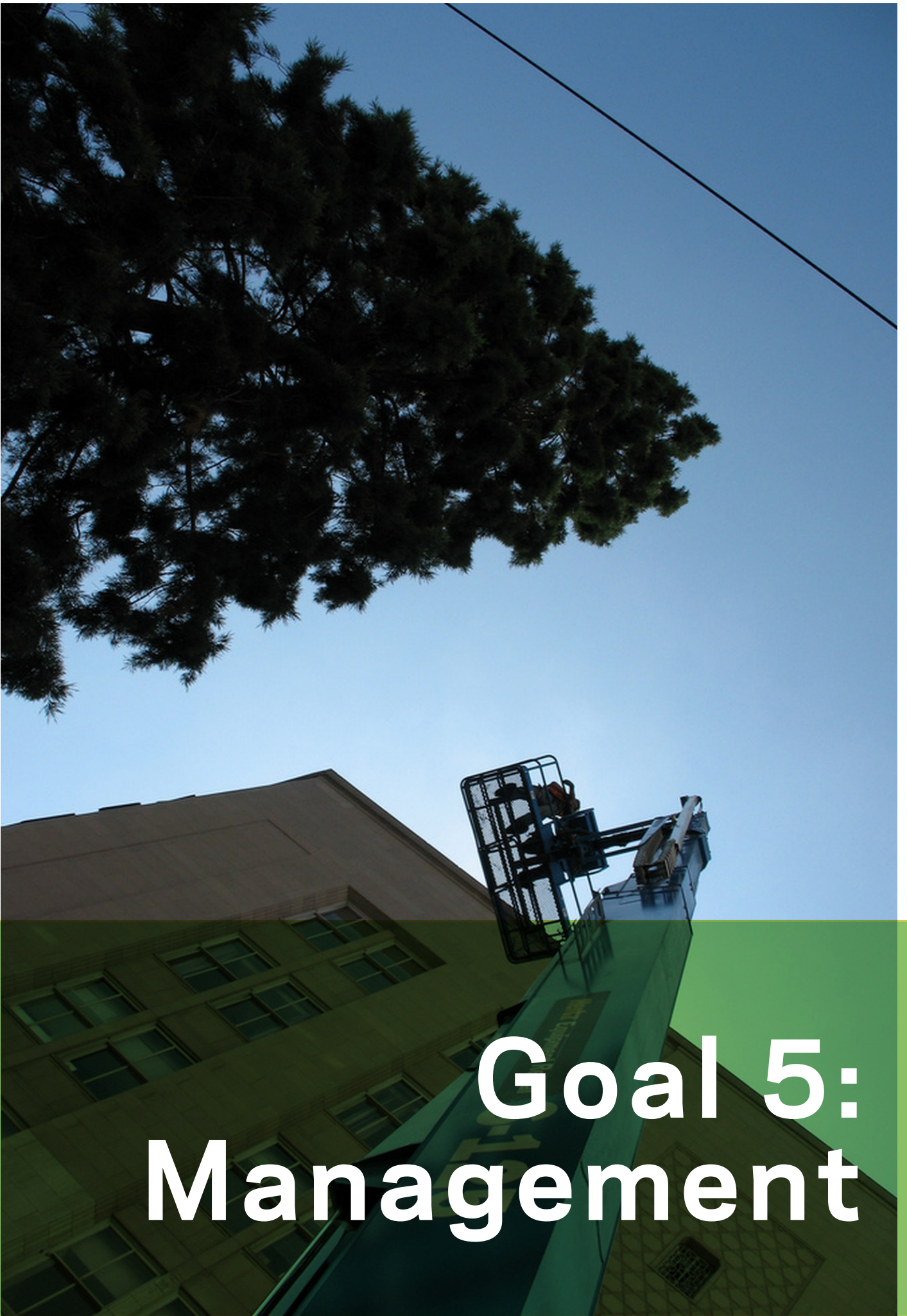
Goal 5: Management

Goal 5
Improve Urban and Community Forest Management, Maintenance and Stewardship

The expansion of innovative technologies in the last decade is expected to continue, and will provide new important opportunities for improving the urban and community forest management, arboricultural practices and increased urban natural resources stewardship skills. Appropriate design and maintenance are core needs for optimizing urban and community forest ecosystem services. As our urban and community forests continue to grow, stewardship in future decades will require community engagement and support, which in turn will require the development of new stewardship programs. Additionally, key research findings and new technologies need to be made more accessible and relevant to leaders, decision makers, educators and practitioners for enhancing more effective and responsive urban natural resources stewardship.

Strategy A

Improve urban and community forest management, maintenance and arboricultural practices.

Strategy B

Identify mechanisms and resources for enhancing citizen urban forestry stewardship.

Strategy C

Promote better use of technology and tools in urban forestry.

Strategy D

Facilitate expanded research and delivery of scientific findings to all stakeholders
(See Section D on Research Needs).

Relevant Research Needs

All of the research recommendations serve to support this goal. Some of the research activity is aimed at better understanding the forest resource, that is, 'what do we have?' Other research recommendations focus on knowledge that supports best practices and efficient management strategies, that is, 'how do we steward it?' Additional research is intended to determine forest functions and benefits, that is, to answer the question of 'why is this important?' Finally, studies of stewardship, governance, and knowledge networks all address the human dimensions and social dynamics that assure better connection of people with nearby nature and natural systems.
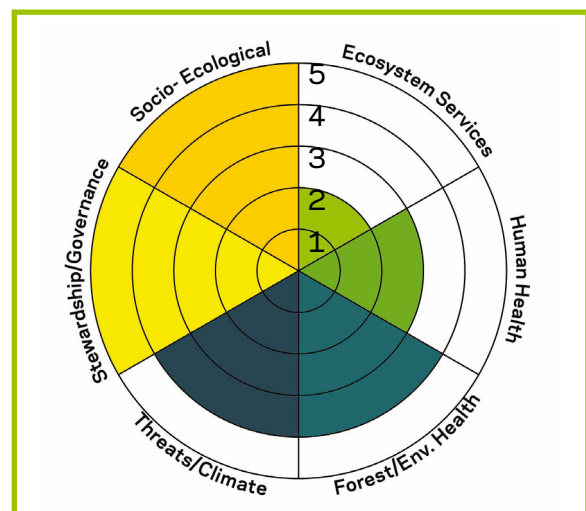
Research Needs Connected to Goal 5

Implementation Targets

1 An urban Forestry and Green Infrastructure "scorecard" is developed and widely disseminated to enable communities to measure progress and success.

Photo credit: Ryan Jackson from Edmonton Journal

2 A nationwide urban tree census is conducted in 2020.

3 Tools are created to project tree growth patterns and measure structural soundness to improve maintenance decisions and reduce risks associated with urban trees.

4 National nonprofits provide recognition to cities, towns and counties with certified community forestry management.

Why is it Important?

Figure 5.1

47.5 Million

The value of volunteer hours logged for urban and community forestry in 2014.

The value of volunteer hours logged for urban and community forestry in 2014 was estimated at 47.5 million dollars. Although between 2005 and 2014, there was a 66% loss in the number of volunteer hours logged (from 4.3 million hours logged to 1.5 million hours), volunteerism still significantly contributes to urban forestry stewardship (USDA z Public-Private Partnership Strategy, 2011).

$79/Tree

An i-Tree analysis of Minneapolis found that the municipal street tree resource provides approximately $15.7 million, or $79 per tree, in net total annual benefits to the community.
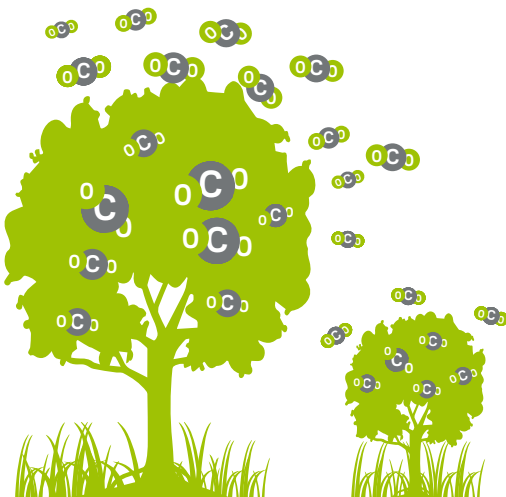
Figure 5.2

90 Times

Additional carbon sequestered by large trees compared to small trees.

The additional carbon sequestered annually by large trees as compared to small trees (Talking trees, 2006).

Figure 5.3

Photo credit: Stephen Gorman

We've done a good job

The tools, resources, programs and activities to support the growing urban and community forestry field have greatly expanded in the last decade. These new suites of tools and programs have assisted a variety of groups from private landowners to national urban forestry planners make better-informed decisions that improve maintenance practices such as tree planting techniques and tree species selection (Roman, Bartens, McPherson, & Scharenbroch, 2013).

Innovative tools developed or improved in the last ten years include: i-Tree Tool, a suite of tools from the USFS that provides urban and community forest analysis and benefits assessment capabilities to communities; The Urban Tree Canopy (UTC) Assessment Program, which provides canopy maps for communities to assess tree cover and canopy extent in their communities;

> **Stewardship has made progress in the last ten years through large-scale urban tree planting programs.**

EnviroAtlas, created by the EPA as a collection of interactive tools and resources that allows users to explore ecosystem services in American communities; and LiDAR (LIDAR—Light Detection and Ranging), a remote sensing method used to examine the surface of the Earth and which increases accuracy and precision. These technologies have become more readily available in the last ten years, helping urban foresters get a more accurate depiction of urban canopy cover when using geographic information systems.

Urban and community forestry stewardship has also made progress in the last ten years through large-scale urban tree planting programs. In the last decade initiatives such as Million Trees NYC initiative, Million Trees Los Angeles, Tree Pittsburgh, and Casey Trees all initiated large-scale tree plantings. Aside from progress in tree quantity, these initiatives have also forged public-private partnerships, heightened recognition of the urban and community forestry field, increased social media usage, and energized volunteerism.

Percent Change in Number of Communities with Management Plans Between 2005 and 2014
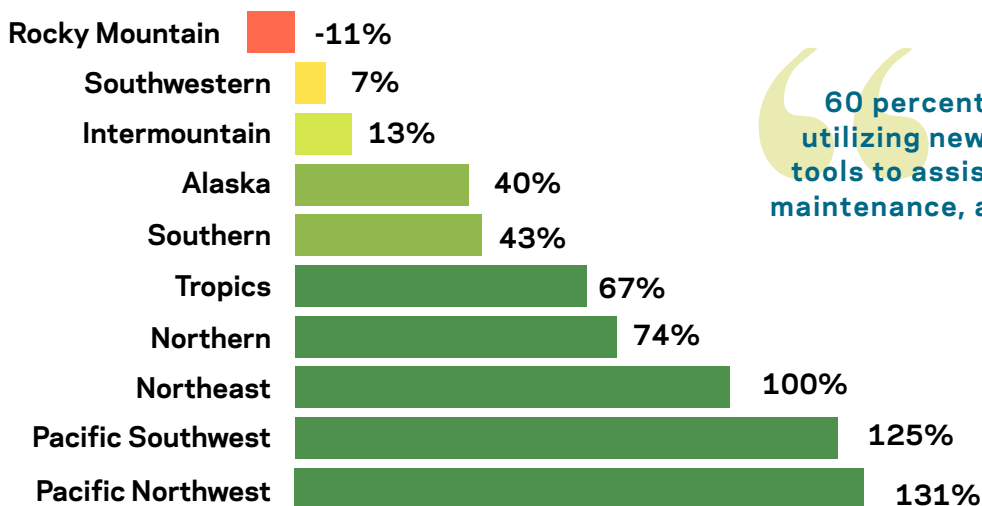
> **60 percent of cities are utilizing new and emerging tools to assist management, maintenance, and stewardship.**

Region	Percent Change
Rocky Mountain	-11%
Southwestern	7%
Intermountain	13%
Alaska	40%
Southern	43%
Tropics	67%
Northern	74%
Northeast	100%
Pacific Southwest	125%
Pacific Northwest	131%

Figure 5.4: Data drawn from CARS, 2005-2015

In the next ten years...
We still have a lot to do

Despite significant progress developing tools and strategies to better maintain the urban and community forest, work still remains to strengthen these tools in the next ten years. For example, the Statewide Forest Resource Assessments and Strategies Report found that, to meet their urban forest objectives, 42 percent of states report that they needed to expand the use of technology, improve technical training, and provide more support in disciplines related to urban and community forestry management (SAFRAS Report, 2010). Further, the 2010 USFS urban and community forest national assessment found that the most frequently reported challenge (35 percent) was the lack of data or management plans.

> **The most frequently reported challenge is the lack of data or management plans.**

To assist with these gaps in the next ten years, improved long-term monitoring data is needed to better understand the change of urban and community forestry over time, such as canopy loss. This can be most impactful and cost efficient if coordinated on a national or regional level by developing protocols for data collection. A 2013 study found that data protocols are currently a big challenge for 28 percent of urban and community forestry organizations, supporting the need for more initiatives to develop such data protocols over the next ten years (Roman, et al., 2013).

Maintenance of large-scale tree plantings will also need to put greater focus on the right tree in the right place. Community forest management will increasingly need to reflect regional soil and environmental conditions as well as be strategically planned for wildlife corridors, urban orchards, air quality, water quality, and stormwater management. Moving forward, to be as strategic as possible, increased technical assistance that addresses needs of specific

ecosystem regions will be essential. Maintenance efforts can be magnified with increased volunteer stewardship, but continued education initiatives about the importance of urban and community forestry will continue to be important to energize this stewardship and volunteerism.

Urban and community foresters will also need to create and promote opportunities for homeowners to plant and maintain trees on their property. This is essential as 56 percent of America's forests are privately owned and contribute to cleaner water, air, and wildlife habitat (Stein, et al., 2009). Some community programs offer micro-grants as in Hillsborough County, Florida, which provides $2,500

Number of Communities With Advocacy Organizations [Percent Change Since 2005]

Legend:
- <-50%
- -50%-0%
- 1%-50%
- 51%-100%
- 101%-200%
- >200%
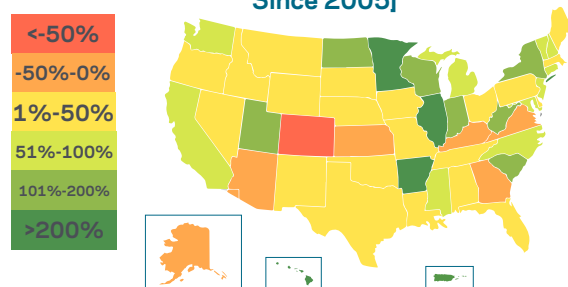
Figure 5.6: Data drawn from CARS 2005-2015

to neighborhood and homeowner associations to encourage increased planting of trees ("Tree Program Mini-Grant", n.d). On a smaller scale, design standards can assist with mandating trees on commercial and residential properties. For example, Minnesota's Minimal Impact Design Standards (MIDS) aim to improve stormwater management by setting performance goals for new and redevelopments, in which trees can provide important stormwater management services (Minimal Impact Design Standards, 2013).

On the positive side, Americans agree that more needs to be done. In a 2011 nationwide survey by National Voter Attitudes Toward America's Forests to assess key public perceptions and values related to forests, 41 percent of Americans reported that "more needs to be done" to manage and protect forests and trees in their state, with 21 percent reporting that they "don't know enough to say," and only 34 percent reporting that "enough" is being done. This suggests that the majority of people who feel knowledgeable enough to voice an opinion would support increased efforts to manage urban and community forests.

Percent Change in Volunteer Hours Between 2005 and 2014

Region	Percent Change
Tropics	-98%
Alaska	-37%
Northern	-31%
Intermountain	-29%
Pacific Northwest	1%
Northeast	35%
Rocky Mountain	36%
Southern	58%
Southwestern	99%
Pacific Southwest	468%
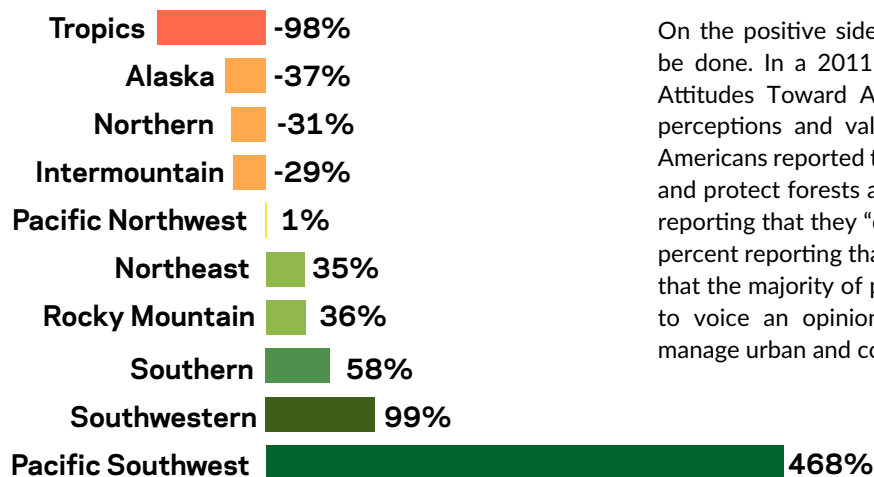
Figure 5.5: Data drawn from CARS, 2005-2015

How can we get there?
Goal 5 Strategies and Actions

Strategy A: Improve urban and community forest management, maintenance and arboricultural practices.

☐ **Action 1:** Facilitate funding to promote planting higher quality trees in urban forests with less emphasis on the quantity of trees planted (such as the published International Society of Arboriculture guidelines).

☐ **Action 2:** Facilitate increased funding for urban forest management and arboricultural practices with special emphasis on preservation and maintenance.

☐ **Action 3:** To foster improved urban forestry, facilitate funding for urban forestry BMPs (design, management, maintenance), including indicators and benchmarks for success.

☐ **Action 4:** Develop programs to increase utilization of urban forest waste and generate revenue (such as production of biofuel, organic soil amendment, mulch, consumer products, etc.).

☐ **Action 5:** Promote opportunities for homeowners to plant and effectively maintain trees in their yards and on private lands.

Strategy B: Identify mechanisms and resources for enhancing citizen urban forestry stewardship.

☐ **Action 1:** Develop multiple pathways for urban forest stewardship including trained volunteers and municipal engagement in collaborative efforts for urban forestry care.

Strategy C: Promote for better use of technology and tools in urban forestry.

☐ **Action 1:** Facilitate funding and opportunities for communities and organizations to better use tools and technologies.

☐ **Action 2:** Promote integrated use of technology by all for stronger decision-making, responses to opportunities and challenges at a regional scale, better placement of trees, and sharing best practices.

☐ **Action 3:** Facilitate funding and development of more technologies to address pests and other climate change threats.

☐ **Action 4:** Consider refining technology tools for different regions, such as for the unique conditions of coastal and tropical areas (e.g., additional reference cities are needed for the i-Tree suite to provide reliable and accurate information, such as for Alaska).

☐ **Action 5:** Support development of technologies for advancing urban forestry monitoring and management.

Strategy D: Facilitate expanded research and delivery of scientific findings to all stakeholders. (See Section D on Research Needs)

☐ **Action 1:** Support and collaborate with USFS Science, technology delivery team, Extension, American Forests and others to expand their research to tech transfer platform. Ensure use of plain and accessible language, availability in multiple-languages, and that is 508 compliant to provide software and website accessibility to people with disabilities.

See Appendix 3 for the full suite of actions related to Goal 5.

Case Study: San Francisco Plant Finder Encourages Community Stewardship of Urban Forest

Developed in the last ten years, SF Plant Finder is a plant database that provides information for community members on the types of plants to plant in different regions of the city. The plants in the database were selected based on biodiversity, water, and conservation practices in mind due to drought and provisions for wildlife. The database allows users to search by plant species, plant community, or by place. For example, when searching "Haight Street," the user can find 109 plants appropriate for the ecology of the neighborhood. The Plant Finder recommends appropriate plants for sidewalks, private backyards and roofs that are adapted to San Francisco's unique environment, climate and habitats. This tool was developed as part of the Green Connections project. (Source: http://sfplantfinder.org)

Photo credit: http://sfplantfinder.org/
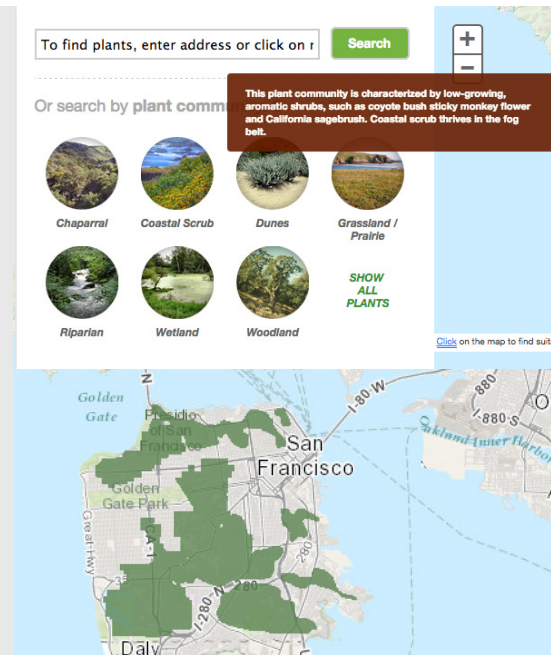
Case Study: "Plant MOre Trees" Fosters More Active Volunteer Stewardship

Forest ReLeaf of Missouri has developed a new tree plotting tool designed to track trees planted by volunteers throughout Missouri. This new application, funded by the Missouri Department of Conservation with technical support from Plan-It Geo, will play a key role in measuring success toward a new statewide community tree planting goal. In January 2016, Forest ReLeaf, along with the Missouri Community Forestry Council, will launch "Vision 20/20 – Plant 1 Million MOre Trees by 2020." Planting groups from throughout Missouri will be encouraged to plot the location, species and other details about their newly planted trees. According to Donna Coble, executive director of Forest ReLeaf, "We see this as a great way to get more volunteers out planting and caring for trees, while also providing us with very valuable data. This is a "call to action" – a way to get the citizens of Missouri to work together toward a big goal that benefits us all."

Photo credit: Guy Kramer

Case Study: Open Tree Map Facilitates Data Collection to Improve Urban Forest Management

Open Tree Map is a crowd sourcing platform map that solicits community members to post tree's geographically. The outcome is a map website that is searchable by tree species, location, tree diameter, date planted, or even tree characteristics. The map administrator also has the capability to customize the search options to match a specific community agenda. This tool engages community stewards and can be easily translated into a useful inventory for urban forest planners. Cities such as San Diego, Philadelphia, Tampa, and Grand Rapids among many others have successfully utilized this tool. (Source: http://opentreemap.github.io)

Photo credit: Kathleen Wolf

In it's lifetime, this tree has "paid us back" an estimated

$1,200

in energy conserved, storm water intercepted, cleaner air & higher property values !! (over)

In it's lifetime, this tree has "paid us back" an estimated

$1,050

in energy conserved, storm water intercepted, cleaner air & higher property values !! (over)

Goal 6: Funding

Goal 6
Diversify, Leverage and Increase Funding for Urban and Community Forestry

The urban forestry community should embody the changing demographics of our nation's cities, towns and counties. The next Ten-Year Urban Forestry Action Plan must focus on addressing the needs of underserved communities. This can be accomplished in three ways – increasing diverse access to the field; increasing the diversity of champions; as well as increasing equitable distribution of trees and other natural amenities across all neighborhoods. There is an urgent need to increase cultural, ethnic and economic diversity within the urban forestry community, both at the professional level and among the citizen leadership that drives the urban and community forestry agenda forward. The field needs to become a progressive, innovative and inclusive profession at all levels, from entry level to senior leadership. Vocal and visible champions need to be developed at all levels in the next decade to bring attention to how community forests offer comprehensive and cost-effective solutions to urgent community issues. In the federal structure, urban and community forestry need to deliver strategies and programs for existing and anticipated challenges by coordinating the work of multiple agencies and leveraging their resources to promote equity and diversity in the profession, as well as equitable access to the trees and forests themselves.

Strategy A
Enhance funding resources for urban and community forestry.

Strategy B
Leverage and diversify funding through expanded collaboration between urban forestry and related fields, agencies and sectors.

Relevant Research Needs

Urban forestry professionals continue to encounter limited public perceptions about the values and functions of trees in cities in some communities. While important for quality of life, common perceptions about tree benefits being limited to beauty and amenities fail to generate the levels of fiscal and political support needed to support quality urban forestry programs. Some research recommendations promote better understanding of the urban forest resource and the ecosystem services and benefits provided by the resource. Such knowledge can help expand residents' and local leaders' understandings, leading to expanded funding and collaborations for trees.
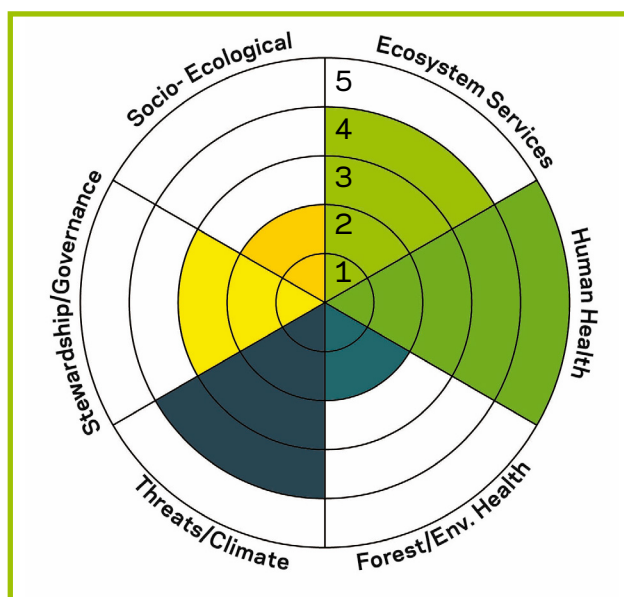
Research Needs Connected to Goal 6

Implementation Targets

1 Funding for urban forestry is broad, deep and stable, reflecting the multiple challenges that it addresses, with a growing percentage funding from nontraditional channels (resilience, climate, health, food, urban forest products).

2 Federal programs relating to urban forestry are working together to increase their collective impact and expand urban tree canopy.

3 The urban forestry community has developed public-private partnerships with major corporations that want to be associated with the environmental, health and community benefits derived from urban ecosystems.

Why is it Important?

Figure 6.1
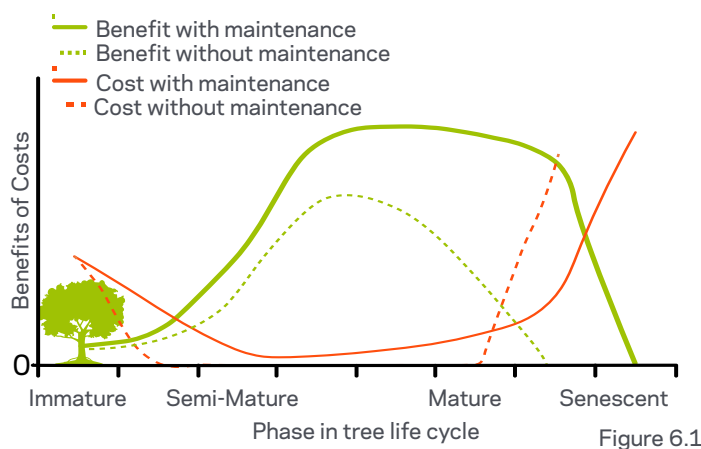
Benefits of Maintenance Demonstrate Importance of Funding

Theoretical costs and benefits profiles over the lifetime of an individual tree, with (solid lines) and without (dashed lines) adequate maintenance. Benefits are maximized during the mature phase of a tree and decline rapidly through senescence, while costs show an inverse pattern. Without sufficient funding for maintenance, benefits are not realized (Hauer et al., 2014).

$7.1 Million — Increased property values in Minneapolis

Using the iTree software, the city of Minneapolis calculated that not only had they saved approximately $6.8 million in energy expenditure by planting trees, but they had also increased property values by $7.1 million (City Of Minneapolis, Minnesota Municipal Tree Resource Analysis).

Figure 6.2
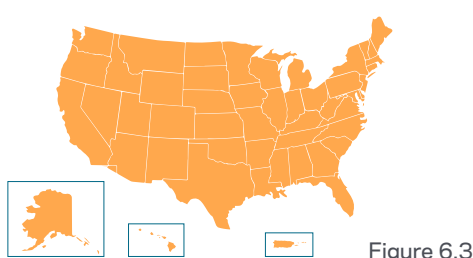
Figure 6.3

-24% — Percent Change in Federal Funding for the Nation

In the last decade, the average percent change between 2005 and 2014 in the 10 USFS regions was negative 19.6 percent. The Pacific Southwest had the greatest percent change with negative 100 percent and the Northeastern Region had the greatest gains with a positive 10 percent change (CARS 2005 – 2014).

In the past ten years...

We've done a good job

In a response to a significant decline in federal funding over the last decade, urban and community forestry continues to seek creative and innovative partnerships and funding sources to support the growth and development of urban and community forestry. For example, planners have increasingly passed ordinances that require developers to incorporate trees and tree maintenance into their designs. This might be characterized as the decade when private-public partnerships came into their own as funders began to set award criteria that favored multi-sector partnerships and as organizations began to see that they could more easily leverage their funding through expanded partnerships. Partnerships for urban and community forestry include every sector of activity imaginable, from water and power utilities, state regulatory authorities, to commercial ski areas and non-governmental organizations.

This trend toward partnerships is evident in the USDA Forest Service Public-Private Partnership Strategy initiated in 2011, which is expanding partnerships to increase social and capital investments. While partnerships often lead to

" **49 percent more communities have advocacy or advisory organizations related to urban forestry, suggesting a rise in leveraged funding.**

increased funding, they also create immense value through increased forged relationships with communities and improved innovation.

The following is a summary of gauges of progress made in the last decade (2006-2016), which demonstrate more diversified and leveraged funding for urban and community forestry:

• There are 49 percent more communities with advocacy or advisory organizations related to urban forestry, and this increase is reported across most the United States, in eight of the ten USDA Forest Service regions. The increasing numbers of advocacy organizations suggest an associated increase in partnerships and, in turn, an associated increase in leveraged funding (CARS 2005 – 2014).

• The value of volunteer hours logged for urban forestry in 2014 was estimated at 47.5 million dollars. Although between 2005 and 2014, there was a 66 percent loss in the number of volunteer hours logged (from 4.3 million hours logged to 1.5 million hours), volunteerism still significantly contributes to urban forestry stewardship (CARS 2005 – 2014).

Federal Funding
(Amount and percent change between 2005 and 2014)

■ 2014   ■ 2005   ↑ Percent Change

Figure 6.4: shows the total funding received (in millions) in 2014 by region. [CARS 2005-2014]

In the next ten years...

We still have a lot to do

In the last decade, the majority of states have lost federal funding for urban and community forestry. Funding fluctuated from state to state, with the State of California losing all of its federal urban and community f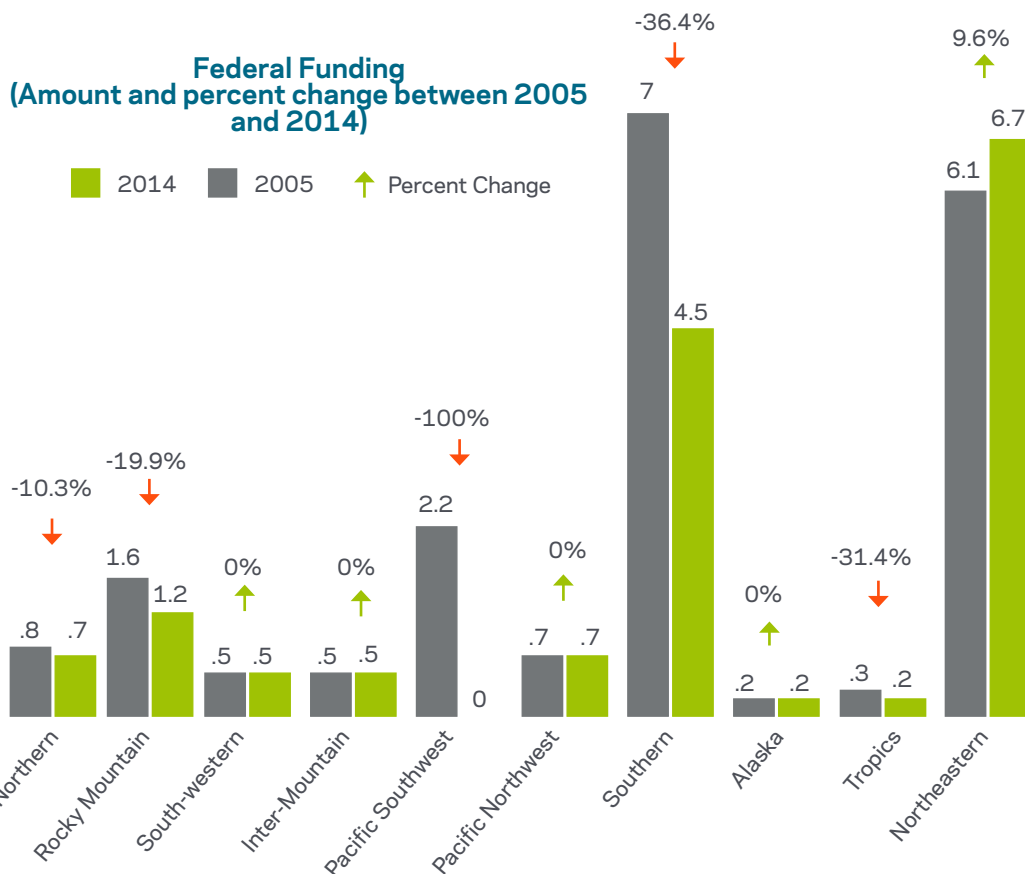orestry funding to fund critical fire fighting efforts. The only state to experience an increase in federal urban forestry funding was the State of New York, with a budget approaching $1 million. In 2014, significantly more federal funding was needed than available to effectively manage and steward our urban and community forests. For example, funding needs for the nation's urban and community forests were estimated at $31 million while funding received was $15.1 million, creating a staggering funding gap of 50 percent. Further, from 2005 to 2014, the amount spent per capita in communities assisted by the USDA Forest Service decreased by as much as 33 percent (CARS 2005 – 2014). To make matters worse, while funds have decreased, needs are continuing to escalate due to urban resilience and climate change challenges. Attention to funding the growing urban forestry needs is essential as the majority of America now live in urban areas, and movement to cities and urbanized areas is expected to continue over the next decade (Nowak, 2010). Lastly, further compounding this challenge is the fact that less than 7 percent of all donated dollars go to environmental issues, suggesting that urban and community forestry is one area where the private donation sector cannot compensate for loss of federal dollars.

Federal Expenditure Per Capita in 2014

-100 % - 50%
-49%-0%
1%-100%
101% - 200%
>200%

Figure 6.7: shows the percent change [from 2005-2014] of Federal expenditure per capita

To facilitate an understanding of why urban and community forestry funding should be a top funding priority, a message must be strategically crafted to communicate how urban and community forestry is a cost-effective, core solution to numerous urgent and complex urban challenges in environmental and human health. Communication is key, as urban and community forestry could and should become a "go-to" tool to help address the myriad issues that are better funded, such as health, economic development, and resilience.

Communication through annual briefings to the USDA Forest Service Chief and outreach to elected officials will also be important. Further, building upon progress in the last ten years, there is a need to expand collaboration between urban forestry and related fields, such as forged partnerships with healthcare professions and community designers and developers. Specifically, there is a need to foster federal inter-agency collaboration to leverage funding and strategies from within the USDA Forest Service, as well as to foster inter-professional collaboration outside of the USDA Forest Service. Funding strategies that will be important to develop in the next decade include supporting young or developing state and local programs, developing incentive programs, rewarding exemplary efforts, and funding public awareness campaigns.

Amount of Federal (USDA Forest Service) Funding to States in The Last Ten Years

Year	Amount
2014	$15,134,008
2013	$16,804,980
2012	$17,614,584
2011	$15,970,300
2010	$15,656,206
2009	$16,593,500
2008	$16,792,035
2007	$18,628,867
2006	$16,792,615
2005	$19,818,215

Figure 65: shows the amount [$] of USFS Funding in the last ten years

How can we get there?
Goal 6 Strategies and Actions

Strategy A: Enhance funding resources for urban and community forestry.

☐ **Action 1:** Hold annual briefings for the USFS Chief on the progress and value of urban and community forestry and the need for increased funding. Emphasize that urban and community forestry funding should not be redirected toward fire control.

☐ **Action 2:** Conduct targeted outreach to elected officials to increase urban forestry funding and to maintain a dedicated source of urban forestry funding.

☐ **Action 3:** Facilitate an increase in federal funding for urban forestry to support young or developing state and local programs.

☐ **Action 4:** Align resources with key agencies (Federal, State, Local) and partnerships (for-profit, non-profit, etc.) in order to recognize diversified and enhanced funding.

☐ **Action 5:** Develop incentive programs to reward and recognize successful urban forestry efforts and actions.

☐ **Action 6:** Cultivate new funding opportunities in conjunction with a national urban forestry public awareness campaign (see goal 7).

☐ **Action 7:** Work with partners to redirect existing funding to urban and community forestry and develop new sources of funding.

☐ **Action 8:** Capture the value of urban forest products in managing urban forests. Develop and connect to urban wood utilization programs (for timber products rather than solely chipping urban trees).

☐ **Action 9:** Develop new innovative sources of stable funding for urban forestry from private sources.

Strategy B: Leverage and diversify funding through expanded collaboration between urban forestry and related fields, agencies and sectors.

☐ **Action 1:** Convene Federal agencies to foster inter-agency links and connections, and to develop a plan for urban forestry coordination and collaboration among federal agencies.

☐ **Action 2:** Align urban and community forestry research with additional research resources (including Federal, State, Local, for-profit and non-profit) to develop research findings that advise strategic investment of enhanced funding resources.

☐ **Action 3:** Foster opportunities for collaborative research between different research arms of the USDA Forest Service, to broaden community applications and impacts.

☐ **Action 4:** Foster connections between urban forestry and related departments in municipalities.

See Appendix 3 for the full suite of actions related to Goal 6.

Case Study: The Urban Waters Federal Partnership Breaks Down Federal Program Silos and Leverages Funding

Founded in 2011, the Urban Waters Federal Partnership focuses on revitalizing urban waters and the communities that surround them while breaking down federal program silos to promote efficiency of resources and improved coordination of investments. The partnership consists of 11 federal agencies that have broad goals from creating local jobs to protecting health. The initial partnership efforts are taking place in seven pilot cities: Baltimore, the Bronx, Denver, Los Angeles, New Orleans, Northwest Indiana and Washington. An example of how these partnerships are leveraging funding, the ground work in Baltimore includes revitalizing the Patapsco Watershed with tree planting around Baltimore to reduce run-off, repaving alleys and streets leading to the river to limit pollution, and developing a Green Infrastructure Plan with the city government. (Source: http://www.urbanwaters.gov/)

Photo credit: http://www2.epa.gov/urbanwaters/what-communities-are-doing

Case Study: Funding for Urban Forestry in California Newly Available in many Communities

According to the National Association of State Foresters, "California, as part of its greenhouse gas reduction initiative, has taken the unprecedented move of allocating a large pot of urban forestry money exclusively to disadvantaged communities plagued by pollution. Advocates for Urban Releaf, an Oakland-based urban forestry company, has applied for the forestry dollars as part of an ongoing statewide grant process. They are hopeful that the new program will go a long way toward adding greenery to historically neglected Oakland neighborhoods. The $18 million urban forestry fund is under the control of the California Department of Forestry and Fire Protection (Cal Fire) and is part of the state's broader cap-and-trade initiative, which was established after the 2006 passage of Assembly Bill 32. That legislation, the California Global Warming Solutions Act, targets climate change by requiring the state to reduce greenhouse gas emissions to 1990 levels by 2020."(Source: http://www.stateforesters.org/news-events/blog/california-communities-receive-urban-forestry-funding#sthash.jhtROWoP.dpuf)

Photo credit: Kathleen Wolf

Case Study: American Public Works Association Outlines Best Management Practices for Urban Forestry Budgeting and Funding

The American Public Works Association (APWA) along with the Society of Municipal Arborists outlines best management practices including typical budget allocation for urban forestry. For example, public works managers can find that The National Arbor Day Foundation requires that a community forestry program be supported by an annual budget of at least $2 per capita for its Tree City USA program. However, they state that the more realistic number is probably $5 per capita. Further the guide summaries sources of funding from federal and private grants to tax districts, capital improvement projects, tree work permits, development, inspection fees, and environmental fines. (Source: https://www2.apwa.net/Documents/About/CoopAgreements/UrbanForestry/UrbanForestry-1.pdf)

Photo credit: Kathleen Wolf

Goal 7: Education and Awareness

Goal 7

Increase Public Awareness and Environmental Education to Promote Stewardship

Urban and community forests are key infrastructure at the regional, municipal, neighborhood, and home scale across America, and more public education is needed to provide informed decision making and support for the development and maintenance of our urban and community forests.

Strategy A

Strengthen environmental education programs that focus on urban and community forestry issues.

Strategy B

Create a nationwide urban forestry public awareness and education campaign.

Strategy C

Increase outreach and educational opportunities for underserved and diverse communities to increase urban forestry stewardship.

Relevant Research Needs

Research has, and will continue to, provide the knowledge that intrigues, engages, and welcomes public awareness and engagement. Prior studies have become widely applied models that reveal to managers and the public the extent and value of the urban forest. i-Tree is an example and new science will inform new assessment models, helping communities to visualize and put a value on their urban forest. Local urban forest managers and collaborators can use such tools for awareness building and education. In addition, residents can be recruited to participate in the data collection, building deeper understanding and commitment to the local urban and community forest ecosystem.
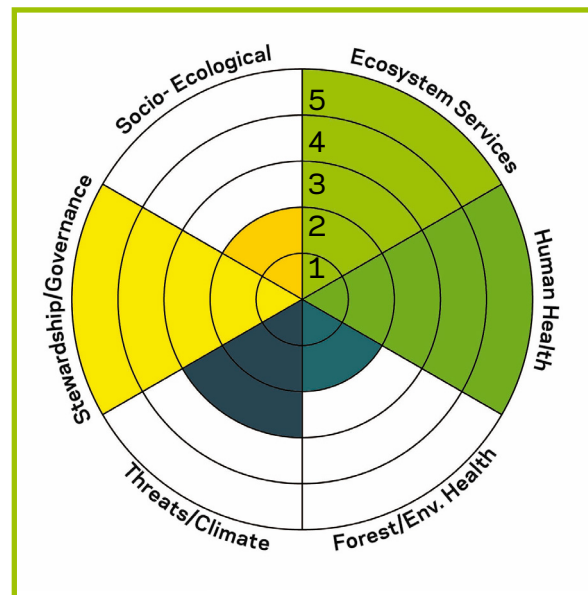
Research Needs Connected to Goal 7

Implementation
Targets

Photo credit: Amigos de los Rios

1 A national education campaign galvanizes political, corporate and popular support for the economic, health and environmental benefits developed by urban and community forestry.

2 An on-line platform is developed and used to track stewardship activities, measure their impacts, aggregate results, and connect stewards locally and nationally.

3 An expanded environmental education curriculum incorporating urban forestry is widely adopted by school systems nationwide.

Why is it Important?

Figure 7.1

4000 **The number of Project Learning Tree GreenSchools across the country.**

Project Learning Tree GreenSchools are engaged in investigating their school site and taking action to maintain and increase the tree cover around their campus.

7 Hours **The average amount of time children engage in media each day.**

Children ages 8 – 18 engage in over 7 hours of media time (e.g., watching TV, listening to music, using the Internet/computer, playing video games) each day (Rideout, Foehr & Roberts, 2010)

Figure 7.2

Annual studies conducted by the Outdoor Foundation reveal a similar pattern. These reports show decreasing participation rates in outdoor activities for youth ages 6-17 each of the past four years, from about 76% of youth participating in 2006 to about 60% participating in 2009 (Outdoor Foundation, 2008, 2009, 2010).

Figure 7.3

Figure 7.4

385

The number of service volunteers recruited to a planting event in Portland, Oregon through tweeting and posting on Facebook.

In the past ten years...

We've done a good job

Over the last ten years, broader considerations such as the human health and urban resilience benefits of trees have garnered attention and importance in both the public and academic research arenas. Prior to this time, attention was focused more on demonstrating and educating the public about the environmental health services of urban forests. Put another way, our understanding of urban forestry benefits has expanded into realms that now touch every aspect of community wellness. Consequently, urban and community forestry now has the potential for a greatly expanded circle of influence, reaching into numerous other health and community development professions. It also offers a far richer and deeper toolbox for raising awareness and educating people about urban forestry. Additionally, as understanding of the impacts of urban forestry has broadened, urban foresters have expanded their roles from traditional functions of tree selection, placement, and management, to engaging their community in creating collaborative partnerships that strive for broader community goals while encouraging public stewardship of the community forest.

To promote stewardship of urban forests, new communications strategies are growing public awareness, such as achieving outreach to new audiences through social media. Another tool is environmental education, a long-term effort that provides age-appropriate instruction for everyone from youth to seniors, which builds knowledge, understanding, critical-thinking, and problem-solving skills. In the past ten years, a combination of communications and education strategies have been used to change people's attitudes and behavior towards urban and community forests.

Using communication tools, non-profit tree organizations now frequently engage the public through social media websites such as Facebook, Twitter, Flickr, Pinterest, and blogs. Exemplary sites include Arbor Day Foundation's Tree Campus USA Pinterest page, which highlights their activities at college campuses across the nation through an interactive picture map. Another example is New York City's Million Trees Initiative, which effectively uses its Facebook page to broadcast events, educate on the importance of trees, and celebrate successes.

Organizations have also increasingly recognized the importance of communicating messages that are visually appealing, appropriate for specific populations, and that convey a simple message. Exemplary campaigns include The Intertwine Alliance's "Our Common Ground" campaign, Northern Kentucky Urban Forest Council's "Kentucky Roots" campaign, and Minnesota's "Trees Pay Us Back" campaign.

Through environmental education, schools, non-profit organizations, and community groups are intentionally and systematically emphasizing the importance of understanding the many values of urban trees and of getting students outside to learn. Environmental education is a process that increases the learner's awareness and knowledge about the environment and related issues. It helps to develop the necessary skills and expertise to address these issues, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

The following gauges of progress in the last decade (2006-2016) demonstrate increased public awareness and environmental education:

- More than 200,000 educators have participated in Project Learning Tree's professional development to help educate PreK-12 students about the importance and value of trees in our lives (AFF, 2015).

- Project Learning Tree (PLT) has designed, developed, tested, published, distributed, and formally evaluated an array of environmental education activities for PreK-12 students focused on trees and forests. Each activity is intentionally aligned with current state and national academic standards to ensure use in schools. From 2006-2016 alone, 200,000 copies of PLT's PreK-12 Environmental Education Activity Guide, 50,000 copies of PLT's Environmental Experiences for Early Childhood, 17,000 copies of PLT's high school module Focus on Forests and 21,000 copies of Places We Live have been distributed to educators across the country through in-person PLT professional development workshops.

- Project Learning Tree's GreenWorks! grant program has supported more than 520 service-learning projects specifically related to enhancing students' knowledge of trees through planting trees and gardens on school grounds and in communities.

Solid majorities of voters found benefits of forests to be "very important" such as...

Providing a place for wildlife to live	86%
Providing a source of good-paying jobs	73%
Supplying products like wood and paper	73%
Providing a place for recreation	71%
Reducing global warming	60%

Figure 7.5: Data drawn from Public Opinion Strategies, 2011

Photo Credit: Amigos de los Rios

We still have a lot to do

Repositioning urban forestry is more important now than ever. Urban forestry is growing as a recognizable field with much to offer in the way of solutions and tools for addressing urgent community human and environmental health challenges. Building upon this momentum to communicate what urban forestry has to offer would lead to improved research, funding, political support, and professionalism in the field.

While much has been accomplished, there is still much more to do. In a 2011 nationwide survey by National Voter Attitudes Toward America's Forests, key public perceptions and values related to forests were assessed. A large 21% reported that they "don't know enough to say." This suggests that the public would strongly benefit from an awareness and education campaign.

There is also an alarming lack of awareness from mayors in small towns on the importance of trees in cities. In a 2008 study, over 500 Southern mayors in small towns in 13 states ranked tree maintenance lowest among community initiatives. Interestingly, the initiatives ranked highest by the mayors, such as crime and economic development, could easily be supported by urban forestry. When these mayors were asked to rank the values of trees, mayors ranked their aesthetic qualities highest, indicating a lack of understanding of the many human and ecosystem health services provided by community trees. With appropriate campaign messages, decision makers and community members will gain understanding and appreciation that the value of community trees is real, far beyond aesthetic qualities, and can be measured in billions of dollars.

More specifically, the benefits of urban and community forestry include improved physical and mental health, ecosystem health, recreational opportunities, urban resilience, and economic development. However, communication campaigns and environmental education initiatives in the coming years will need to align well with each of these distinct interests and be targeted to their specific stakeholder communities. In addition to targeting

> " With appropriate campaign messages, we will gain understanding and appreciation that the value of community trees is real, far beyond aesthetic qualities.

specific topical interests, messages and education programs will also need to be targeted for specific professional interests. Audiences that should be considered include elected officials, city managers, planners, public health policy makers, health delivery professionals, public and private K-12 school teachers and students, allied professional organizations, legislators, homeowners, recreationists, parents, and the general public.

For example, Project Learning Tree is developing new online educational units about trees and forests that support the teaching of STEM (science, technology, engineering, and math) and also address Common Core State Standards and the new Next Generation Science Standards. Teachers who aren't able to find the time to attend workshops can instead take self-paced online courses. Communication and environmental education strategies can also build on the growing Green Schools movement, and encourage tree planting and stewardship on their school campus.

In the coming decade, messages will need to mature from communicating the scientific facts about trees to demonstrating how urban forests are related to the things that matter most to a specific intended audience. Effective persuasion consists of sharing how individuals will benefit. If the target population was neighborhood associations, then an important message could be about the role of the community tree canopy and how trees absorb water runoff and pollutants so that citizens can breathe cleaner air, drink cleaner water, and fish, swim or paddle in cleaner streams. For town planning boards, the message might be targeted to address more complex concepts, such as the role of a community tree canopy in the carbon cycle, how trees can mitigate climate change and improve community resilience. For other audiences, the messages might be more narrowed and specific. For example, if the target population were real estate developers, then an important message could be about homes selling for higher prices in the presence of trees.

How can we get there?

Goal 7 Strategies and Actions

Strategy A: Strengthen environmental education programs that focus on urban and community forestry issues.

☐ **Action 1:** Cultivate urban forestry educational programs and resources for environmental and outdoor education.

☐ **Action 2:** Foster the development of urban forestry education from the elementary to graduate school level.

☐ **Action 3:** Facilitate funding for mini-grants for education, including educational art.

Strategy B: Create a nationwide urban forestry public awareness and education campaign.

☐ **Action 1:** Re-brand urban forestry with pop culture, social media, radio, TV, billboards, and advertising.

☐ **Action 2:** The national awareness campaign should connect citizens with civic engagement opportunities locally.

Strategy C: Increase outreach and educational opportunities for underserved and diverse communities to increase urban forestry stewardship.

☐ **Action 1:** Engage underserved and diverse communities with educational programs.

☐ **Action 2:** Connect underserved and diverse communities with programs that distribute edible trees (fruits, berries, nuts).

☐ **Action 3:** Connect underserved and diverse communities with urban forestry through groups they are already connected to, e.g. existing civic, school and church groups. Use health benefits of urban forests to interest and engage underserved and minority communities.

See Appendix 3 for the full suite of actions related to Goal 7.

Case Study: Trees are Good Website is an Accessible Platform for Learning About Trees

The International Society of Arboriculture operates the "Trees are Good" website. This site provides an accessible platform for those looking to learn more about trees, stay up to date on the latest news, or find tools to help understand trees and urban forestry. The site also provides a list of community activities, games, and online resources to promote Urban and Community Forestry education. Source: http://www.treesaregood.com/

Photo credit: Vanessa Bullwinkle

Case Study: Urban School Tree and Garden Plantings Educate Students and the Community About the Value of Trees

Barnard Elementary (Washington, DC) students, in partnership with Project Learning Tree and the Casey Tree Foundation, planted over a dozen fruit trees on the school campus. Both students and the community take pride in maintaining and caring for the trees and gardens, which enhance student achievement and health. Students apply their math and science skills while planting the seeds of stewardship in the next generation.

Photo credit: Christine Gyovai

Case Study: Creative, Effective, and Lasting (CEL) Suggest Six Tips for an Effective Urban Forestry Communication Campaign

CEL recommends the following six tips when implementing an urban forestry campaign:

1. Good partners are "not usually the regular suspects for foresters" because often your best partners are people not like you.

2. When approaching a potential partner, come prepared with a sample so that the partner can clearly understand what they may gain from the partnership.

3. Address a hot issue related to the target community at that point in time. In general, energy and money savings talk to people and the connection between human health and urban and community forestry is increasingly important.

4. To create clear messages, choose one key message and three to five sub-messages (See Kentucky Roots Campaign)

5. Choose how to measure success. This measure may be adapted to make sense to a consumer, not a forester.

6. Celebrate successes. When urban foresters go into the community and do something that works well, they should bring it back to the field as a case study and show their stakeholders what they have been doing rather than moving on to the next thing.

Photo credit: Kathleen Wolf

Ten-Year Urban Forestry Research Needs

Research for Action

Communities are coming to understand the importance of natural processes and ecosystems in cities as the source of solutions for urban challenges, and the urban forest is a key element. Urbanization pressures threaten both ecology and biodiversity, as well as human wellness and quality of life. Urban planning and design principles of the past are

> **Ongoing research, assessment, and science delivery is absolutely necessary to inform emerging urban planning approaches, as well as sustainability and resiliency policy. Research must inform alternative approaches and translate findings to practical solutions.**

evolving to meet challenges and demands posed by both human and natural systems changes, often happening rapidly. The functions and benefits of natural systems within cities are increasingly recognized as being essential, not just nice to have. Traditional, predominantly gray infrastructure is being replaced by innovative, exploratory combinations of gray and green systems.

Tremendous challenges are encountered by community leaders and the 240 million residents of American cities. In most U.S. communities the scientific understanding of nature as a solution has either lagged or not been effectively integrated into local policy, programs or best practices. The solutions offered by urban forestry and ecosystems do not pertain only to specific natural spaces in cities, such as parks, gardens, and open spaces. In fact, recent research suggests that the presence of urban green contributes to solutions of some of the most important concerns of cities, such as air and water quality, transportation planning, human health, crime, high heat events and climate change, and community resilience.

Compared to traditions of wildland and rural landscape research, researchers must work together with local stakeholders and communities to address urban problems and solutions. When local stakeholders collaborate with experts and scientists, they become more aware of community systems and can initiate evidence-based solutions. Also, experts gain meaningful insight when they collaborate with community members to set up research projects.

> **While "urban forestry" is the focus of the Action Plan, the scientific community does research at two general levels. Some research provides ongoing, better knowledge about trees - their planting, growth, and management. Other research focuses on the urban forest as a component of more comprehensive city systems. Such studies explore green infrastructure, urban ecology, and/or socio-ecological systems.**

Photo Credit: Rich Hallet

What is Science?

Basic and applied research is conducted by a science community that partially engages with the professional, civic and local government communities. Science questions are often formulated in collaboration with urban forestry and program-based professionals, and science projects are often conducted in the communities and contexts where urban forest planning and management occur.

Yet, the process and products of science are distinct from most program and professional activities. There are important interrelationships, yet research, being a process of discovery, is often conducted with an acceptance of uncertainty of outcomes and some level of risk. Some science may generate practical conclusions

" **Basic research (also called fundamental research or discovery research) is a systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena, and may not apply to the real world in a direct way. Applied research is used to answer a specific question that has direct application, and may solve a problem. Urban ecosystems studies are often a blend of these two research functions.**

in a fairly short time frame; the 'payback' from other studies may extend into a greater time in the future or may not play out at all.

Analytic methods are important for solving problems, adding new knowledge, and decision support. Yet, applying measures, metrics or statistics to a situation or objects is not always a science activity. New, rigorous science projects can be costly, but can produce widely usable knowledge. Some analytics are applied to more specific situations, and at lower cost. Research findings can also be translated to some situations without use of new measures, again at a cost savings. Communities should carefully consider the types of analytics and research that will best support their urban forest programs.

Science Planning

> **What are the best analytic products to support urban forestry actions and programs? Stakeholders and agencies should consider these distinctions in future planning and budgeting:**
>
> ### Science/Research
>
> The pursuit of new knowledge and understanding (for basic or applied purposes) by systematically developing research question(s) or hypotheses that reference theory and prior studies, propose appropriate methods, and apply analytic methods to discover original findings that are reported in peer-reviewed publications, particularly journals.
>
> ### Assessment
>
> The applied, repeated use of research that has been standardized as a best practice, often including guidelines for measures, field protocols, and technical reporting.
>
> ### Science Delivery (aka Technology Transfer)
>
> The process of translating either original research or assessments into products that enable practical application of findings, or display findings in ways that support local policy or programs.

An example of this distinction is the i-Tree suite of tools. Basic and applied research over the past two decades was published in scientific journals and informed the construction of models and tools, such as i-Tree Streets and Eco. Initial tools were field tested and validated across multiple regions of the U.S. They are now applied in cities and communities as assessments, and a standardized technical report is the product used by many communities to better understand their urban forest resource. Ongoing communications about the cumulative findings of the assessments, as well as the technical reports, is an example of science delivery. New basic and applied research

continues to support development of new assessment models and resulting tools.

Urban Tree Canopy (UTC) Assessments are the outcome of a similar evolution. Initiated by original research using remote sensing data, agency labs and consulting firms now provide technical support for assessments in communities. Ongoing research continues to inform new versions of UTC. Considering the social sciences, Stewardship Mapping (Stew-Map) is in transition from original research launched in New York City to use as a standardized assessment across multiple cities in the U.S.

Research Guiding Principles

Any planning for future research should recognize both past work and anticipate future needs. Budgets within the USDA Forest Service (and other agencies) have not kept pace with the demand for urban natural resources (UNR) research and city-based application. In order to deliver the greatest return for the nation's limited investment in UNR studies, new research initiatives must be carefully considered in light of all potential science opportunities. These key ideas should guide decision making and implementation concerning future research and assessments:

Means to the End - Building Local Capacity

Some outreach responses imply that science is a process of problem solving or data collection for a specific outcome. As research resources are limited, a potential litmus for developing and supporting science programs is a discussion about how potential products can build the capacity of decision-makers, managers, professionals, local agencies and NGOs to generate and sustain local urban forest ecosystems. Science delivery is also important to build community capacity.

Build on Strengths and Explore New Needs

Some research and assessment activities are momentum science that serves increasingly broader sets of populations and communities. Such a research program or series of studies has generated a critical knowledge base that supports assessment or management, and merits ongoing support. i-Tree and Stewardship Mapping are examples. Other topics represent emergent needs that will require resources to expand in effectiveness (such as urban wood utilization or environmental equity); to date there may be little evidence available to support programs or increase their effectiveness, but communities recognize increased need for knowledge.

Replicate and Confirm

The stakeholders and professional partners seek new research approaches and resources to support urban forest decision making and programs. In other instances, urban forestry community requests are for replicate studies to confirm that findings are specifically relevant in their own bioregions or urban megaregion. Such local research can have national significance if scaled up into networked knowledge that can be shared across regions or communities.

Expand and Connect Science from Local Needs to National Programs

Efforts should be made to standardize research programs and practices. So while a study may be conducted within a city or region, developing standard protocols (rather than one-off studies) will enable the resulting knowledge and data to become part of a larger effort (such as i-Tree and Stewardship Mapping) to build a better knowledge base.

Synthesize and Amplify Existing Knowledge

Effective science delivery will be just as important to the urban forestry community as are original studies. Focused, periodic review of current science - by theme, geographic or regional relevance, or in response to high priority issues - can then be distributed using effective, multi-mode process and products to assure that good science is put to good use. Educational institutions, including K-12 and higher education, can be engaged as both collaborating creators and users of science-based products.

Expanding the Scale of Science

The scale of research has become increasingly important in recent scientific publications, and was reinforced by expert contributions to this framework. The first suggestion concerning scale is to expand on trees as the focus of research. City trees and the urban forest are an important functional element across many urban places and urban systems. Yet a research focus on trees alone may restrict the value of research investments, and limit potential collaborations.

Broader opportunities are possible. For instance, a healthy, extensive urban forest contributes to green infrastructure (GI). The study and design of GI networks in metropolitan areas is an emerging interdisciplinary science that integrates local needs with diverse agency mandates (including air and water quality, and environmental justice). Interdisciplinary research teams, building knowledge that spans diverse needs, can help to create robust green infrastructure networks for our nation's cities, and then ensure systematic application of science in an equitable manner within and across cities.

The networking potential for multicity, regional, and national studies is another consideration of scale. Place-based urban social-ecological research is immensely valuable in providing science to inform local programs and decision-making, including planning and land-use decisions, conservation policies, and urban forestry, parks, and public health programs. Place-based, or city-based, research efforts that are nationally networked are even more meaningful; this is when research and applications are replicated across an engaged network of cities and new knowledge is shared. Multicity data sets and shared methodologies allow for cross-comparative study, identification of broader scale patterns and trends, generalized knowledge and tools, peer learning, and diverse communities of practice.

Initial efforts at cross-city networked science are supporting advances in urban sustainability, resilience, and practical problem solving. The Forest Service's urban field stations, the National Science Foundation's network of Urban Long-Term Research Area Exploratory projects (ULTRA-Ex; now ceased), the Urban Waters Federal Partnership, and The Nature Conservancy's new North American urban network are milestone opportunities for nationally networked, place-based research.

> **City trees and the urban forest are an important functional element across many urban places and urban systems.**
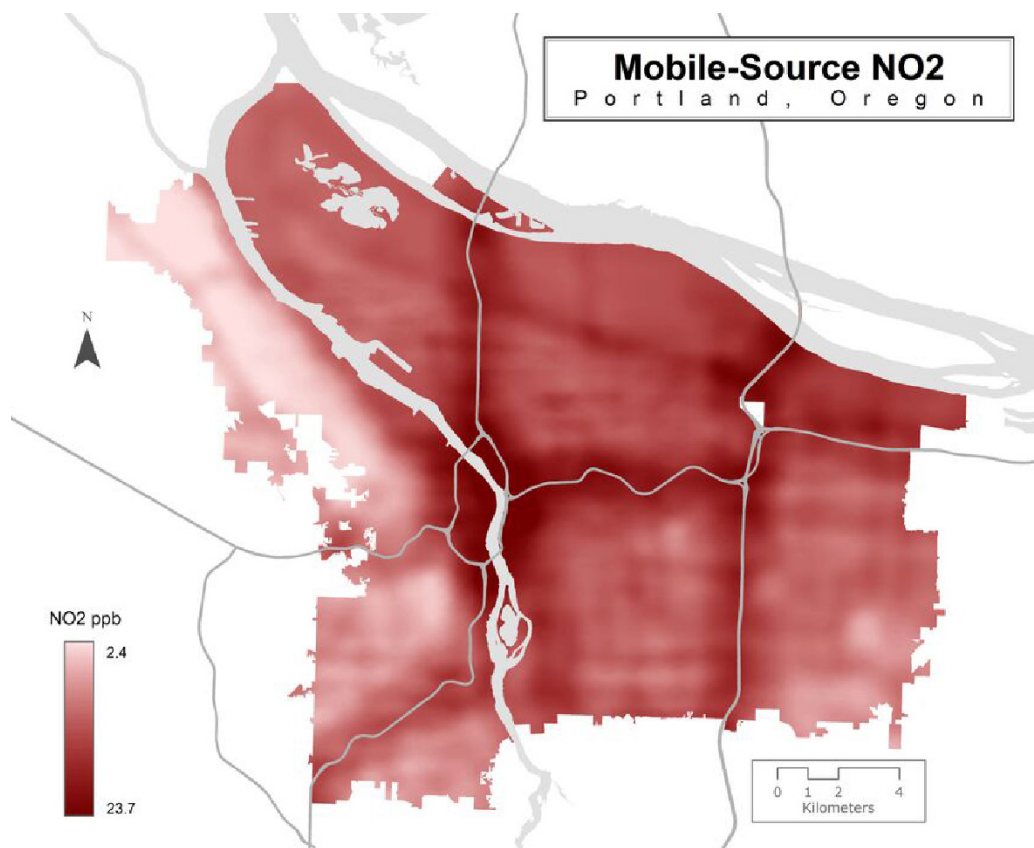

Photo Credit: Kathleen Wolf

Research Needs Framework

A framework of urban forest research needs is provided below. This framework is not intended to address every research or assessment need in every community. Its intent is to guide programs of science that respond to high priority needs in communities, and from a national perspective. Many entities support or conduct research on urban socio-ecological systems; the framework can also be used by the USFS, other national agencies, and cooperating scientists (at universities and other institutions) in collaborative efforts to establish research and funding priorities over an extended time frame.

A   **Understand Ecosystem/ Ecological Services**

B   **Promote Human and Community Health**

C   **Planting, Inventory, and Analysis for Forest and Environmental Health**

D   **Prepare for Pests, Threats, Climate and Associated Changes and Risks**

E   **Enable Civic Stewardship and Improved Local Governance**

F   **Integrate Knowledge Networks and Data for Urban Socio-Ecological Systems**

Key to Objectives

Momentum Objective
Research activity is well established and needs sustained support.

Emergent Objective
Research activity either has begun recently and results hold high promise for urban forest planning, programs and management, or has been underway for some time but needs greater effort.

Photo credit: Rich Hallet

A Understand Ecosystem/Ecological Services

Within several decades our understanding about the reasons to have trees in cities has moved from aesthetics to recognition of a wide array of human benefits and ecosystem services. Fact-based knowledge about urban forest ecosystem services and benefits often supports the first wave of messaging that builds local community support for urban forestry programs. Still, much of the U.S. population has relatively little knowledge about or understanding of how urban resources and nature provide critical benefits to communities and improve human well-being. Even fewer people may recognize how ecosystem threats (such as climate change and invasive species) may diminish quality of life by reducing or eliminating current

> " Science focused on biogeographic regions can provide information that is suitably generalized across multiple communities.

services. Ongoing research can boost the effectiveness of urban forest planning and management in achieving local policy initiatives (such as tree canopy goals), regulatory requirements (such as federal or state clean water laws), market-based conservation approaches, and environmental literacy. Additional study should address scale. For instance, science focused on biogeographic regions can provide information that is suitably generalized across multiple communities; science can also be applied to site-specific service benefit opportunities, such as use of plant materials to remove urban soils toxins.

Momentum Objectives

- Develop indicators for urban forest promotion and maintenance of urban environments and biogeochemical systems (air, water temp, carbon).

- Continue to translate evidence-based knowledge about urban forest ecosystem services to regionally relevant assessment models (e.g. i-Tree) that indicate urban forest structure, benefit, and value.

- Continue research on energy sourcing or savings related to trees, particularly in collaboration with organizations in the energy sector.

Emergent Objectives

- ☐ Study how urban forest structure and functions can best meet regulatory requirements.

- ☐ Assess and communicate regional ecosystem profiles across the U.S. (to include climate, weather, hydrology, and plant selections) to promote optimal urban forest ecosystem services outputs for diverse locations.

- ☐ Explore the use of plant materials in bioremediation to mitigate toxins and pollutants.

- ☐ Expand recognition of and develop metrics for the full range of urban ecosystem services (e.g. cultural services, urban wood utilization).

Photo credit: Kathleen Wolf

B Promote Human and Community Health

Cities are places of concentration of humans and their activities; they are the places where more than 80% of the U.S. population lives, works, learns, and seeks quality of life. A body of research representing many disciplines - including psychology, environmental health, epidemiology and anthropology - hints at the positive associations between urban forest ecosystems and human health and wellness. The Green Cities: Good Health web site, a catalog of such research, shows that nature supports disease prevention and health promotion.

> **Urban forestry stewardship helps to build the social networks and capacities that enable people to be 'first responders' and cope with dramatic changes in their communities.**

Additional research can address several needs. Communities need more knowledge about how benefits play out across social scales, from individuals to households, to neighborhoods, and even entire cities. Also, additional information about vegetation character and exposure dosage (time and activity) can help communities better plan the places and nature-based programs that will promote health. In some instances urban vegetation can contribute to health concerns, such as pollen and asthma or harboring disease vectors like mosquitos, so science about disease prevention is also important. Finally, concerning resilience, studies should explore the initial findings suggesting that urban forestry stewardship helps to build the social networks and capacities that enable people to be 'first responders' and cope with dramatic changes in their communities.

Momentum Objectives

- Develop focused studies concerning public health benefits and concerns regarding tree canopy, urban ecosystems, and green infrastructure, to include health promotion and disease prevention, particularly in collaboration with public health and epidemiology organizations (such as the CDC and NIH).

- Expand knowledge of nature and community well-being and economy (such as crime prevention, transportation safety, and business and worker attraction).

- Continue studies about mitigation of negative health influences of vegetation, such as air quality in some settings, or habitat for disease vectors.

Emergent Objectives

- Provide evidence of improved human function and performance associated with presence of nearby nature (such as schools, offices, and workplace).

- Continue studies of individual and community resilience through civic ecology and nature-based recovery.

- Provide knowledge to promote environmental justice/equity and cultural relationships in urban forest and ecosystem programs.

Photo credit: Lance Davisson

C Planting, Inventory and Analysis for Forest and Environmental Health

As one scientist pointed out, if communities don't have healthy trees, they can't capture the health, energy, ecological, and other benefits that urban forests provide. Creating or conserving an urban forest in a community - in order to provide benefits and ecosystem services and enhance quality of life - requires several data supported activities. First, a community must be able to understand the character, extent, and health of the current urban forest. Standard canopy assessment or tree inventory practices are widely used; these were informed by early research and should be expanded as studies continue. Second, choices must be made about tree selection, care, and maintenance and research has helped to shape best practices, and scientific

> **If communities don't have healthy trees, they can't capture the health, energy, ecological, and other benefits that urban forests provide.**

support should continue to inform on-the-ground urban forest management. Lastly, the urban forest is a dynamic, living resource that is being recognized as an important element across other urban systems. Additional research is needed to better understand how the urban forest, as a green infrastructure element, can be integrated with other urban systems, such as stormwater management installations, and with grey infrastructure like roofs and parking lots. Science-based assessment and decision support tools are also needed to more rapidly recognize and respond to threats that may negatively impact the essential contributions of trees and forest patches across the entire urban to rural landscape gradient.

Momentum Objectives

■ Continue to develop strategies & protocols to measure and monitor extent and condition of urban forests and canopy cover, locally as well as nationally (e.g. urban FIA, UTC), with attention to cost and data collection efficiencies for communities.

■ Continue original research to support development of additional assessment models and tools (such as LIDAR and hyperspectral remote sensing for forest canopy and health condition assessments, and i-Tree).

■ Expand knowledge of tree selection, placement, and growth factors (including soils), specifically to promote resilience (especially in response to climate change).

■ Provide evidence to continue to develop, establish and promote standards & best practices for urban forest sustainability.

Emergent Objectives

☐ Expand diagnostics for urban forest health and threats and construct protocols for early detection, as well as routine and systematic assessment & reporting.

☐ Develop models and decision tools to support optimal urban forest, other green infrastructure, and gray infrastructure integration and configurations.

☐ Expand initial implementations of Urban FIA (USFS Forest Inventory and Analysis) for forest condition assessment and monitoring.
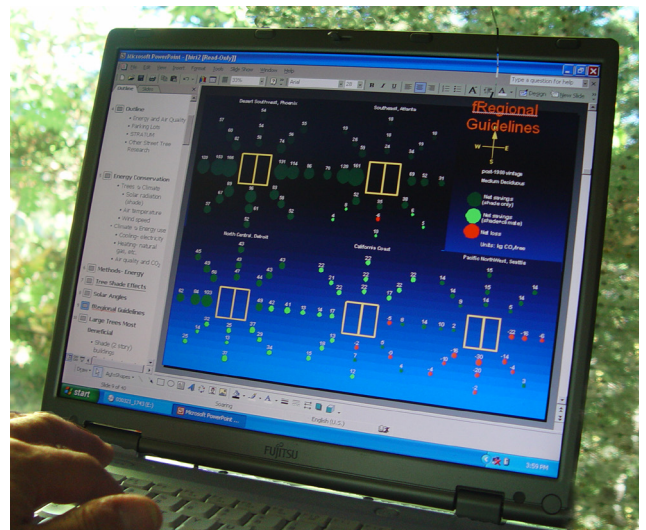

Photo credit: Guy Kramer

D Prepare for Pests, Threats, Climate and Associated Changes and Risks

Cities and regions are encouraged to conduct tree canopy assessments or tree inventories, set urban forest goals and policies, and adopt management plans to promote consistent, stable urban forest programs. Yet ever more communities are experiencing abrupt changes and threats. Some change transcends the urban forest system, such as a hurricane or tornado damage that impacts all city systems, including the urban forest. The 2014 National Climate Assessment summarized the impacts of climate change in the United States, now and in the future, and called out the wide-ranging changes and threats for all communities, including natural resources. Other changes are tree-focused, threatening the health or productivity of the forest, such as an insect pest or virulent disease. Some threats are abrupt, showing consequences in

> **Some threats are abrupt, showing consequences in hours or days, and others simmer for years with gradual implications (such as invasive plant species).**

hours or days, and others simmer for years with gradual implications (such as invasive plant species). Research is needed to better understand and monitor current threats, to diminish tree loss, maintain urban forest health, and to sustain ecosystem services. Studies are also needed to help anticipate emergent threats or negative conditions to enable proactive management response. For example, the Urban Resilience to Extremes Sustainability Research Network (UREx SRN) is a NSF funded project involving an international network of diverse cities and scientists that will study integrated topics including flooding, extreme heat, and drought. Finally, social or policy studies can help to reveal the institutional best practices that can be put in place for threat response and community engagement for forest sustainability.

Emergent Objectives

☐ Given likely changes of the Anthropocene, effort is needed to better understand and work within change trending to anticipate and integrate Urban Forestry goals with likely futures, and study of vulnerable situations (such as found in tropical forestry) can provide insight for broader patterns and responses.

☐ Continue and expand studies of climate change and urban ecosystems implications to develop better, prioritized community response policy and programs.

☐ Clearly define and describe, then quantify urban forest threats and impacts from national to local scales, to include invasive plant species, insect pest invasions, land use development, urban wildfire, and climate scenarios.

☐ Create models and decision tools to support urban threat forecasting and management response, including trade-offs analysis for policy and budget scenarios.

☐ Use current and new evidence to construct best practices for tree/forest/ecosystem threat planning and management.

Photo credit: Rich Hallet

E Enable Civic Stewardship and Improved Local Governance

Unlike a more traditional forest reserve (such as a National Forest) an urban forest spans a complex mosaic of land uses, parcel sizes, and ownership types (including private, public, and institutions). In many instances tree canopy goals, a common expression of urban forest planning and management, can not be achieved solely by plantings on public properties so engagement of private property owners is necessary. At one level the funding and budget dynamics of this complex social and administrative situation are little understood. In addition, local governance of all urban systems, including the urban forest, is highly participatory as residents demand government transparency and a voice in the policies that shape their communities. Finally, few local governments have adequate resources to maintain and manage their urban forest resources so they are relying increasingly on the services of volunteer civic stewards and

> **Residents are being engaged as citizen scientists to help build local knowledge; youth participate and learn about natural resources careers and the importance of urban forest ecosystems in their communities.**

the organizations that support them. Residents are being engaged as citizen scientists to help build local knowledge; youth participate and learn about natural resources careers and the importance of urban forest ecosystems in their communities. All of these social dynamics point to a need to continue and expand recent research initiatives in the realm of urban natural resources stewardship. The complex dynamics of social participation and engagement that are aligned with urban natural resources programs should be studied to both optimize the efforts of contributors, and to better understand human relationships to urban ecosystems. Finally, research is needed to address the needs and disparities of underserved groups or communities, and to actively engage them in urban forestry for community benefit and jobs development.

Momentum Objective

■ Develop detailed cost-benefit analysis, including capital asset estimations, for local government budgets, to include tree maintenance and other direct tree costs, stewardship, civic engagement, and urban forest governance.

Photo credit: Amigos de los Rios

Emergent Objectives

☐ Study how to enlist and support citizens & property owners to plant trees and improve natural resource management on private properties.

☐ Conduct social marketing studies to more effectively present knowledge of physical, mental, and societal benefits of urban forestry and ecosystems, and urge positive behavior.

☐ Generate better knowledge about civic environmental stewardship motivations by volunteers and community organizations.

☐ Understand and develop collective impact stewardship networks & governance systems at the landscape scale, including stewardship mapping (Stew-Map), social networks and including knowledge-action networks.

☐ Promote concepts and evaluation approaches concerning how the urban forestry NGO community of practice can initiate and optimize partnerships, resources, and programs.

F Integrate Knowledge Networks and Data for Urban Socio-Ecological Systems

This goal was expressed by most scientists, but is a broader science 'ecosystem' idea, rather than a collection of research questions or topics. Most of the scientists are anticipating the necessity for 'big data' to address the complexity of both biophysical and social challenges in cities. Many spoke of cities as socio-ecological systems, also described (by the National Science Foundation) as coupled human and natural systems.

Regional Data Platform

Scientists envision the possibility of a common data platform that would be constructed across a region (including city/county jurisdictions) or geoclimate zone to consolidate research and science management. In this way efficiencies of data collection and analysis are gained as standardized measures and metrics enable more consistent and efficient problem solving. Computational power and access is rapidly making this vision possible. This approach is being explored and incrementally underway within the Urban Long Term Ecological Research projects funded by the National Science Foundation (in Baltimore and Phoenix). The EnviroAtlas project (sponsored by the Environmental Protection Agency) is generating place-based data platforms for cities, and incorporates USDA Forest Service data.

> **Scientists envision the possibility of a common data platform that would be constructed across a region (including city/county jurisdictions) or geoclimate zone to consolidate research and science management.**

Example of Regional Science

To illustrate this vision, consider this scenario for 'Big City'. One team collects routine urban FIA (Forest Inventory and Assessment) data and enters it into a shared data platform, hosted and managed by a local university. Another does a thorough parks and open space assessment, including social data on users. Another team collects Stewardship Mapping data about stewardship groups and their project sites. Another uses LIDAR data to analyze tree stress and incidence of Emerald Bad Bug. The city and county contribute their data layers, such as parks locations, parcel ownership, crime statistics, etc. All data sets are accessed from a shared data portal (having protocols for inputs and use).

After some time there is a 'critical mass' of data sets that enables more complex research questions and analysis. Scientists with a focus on modeling advance i-Tree analysis, generating new models with both biophysical and social metrics. Other modelers explore the socio-ecological relationships of stewardship activity, urban forestry management practices, and climate outcomes. A steering committee reviews new data layer proposals, and also reaches out to scientists across multiple agencies (such as USFS, EPA, NASA, or HUD) that can leverage the existing data to enhance their analytic contributions.
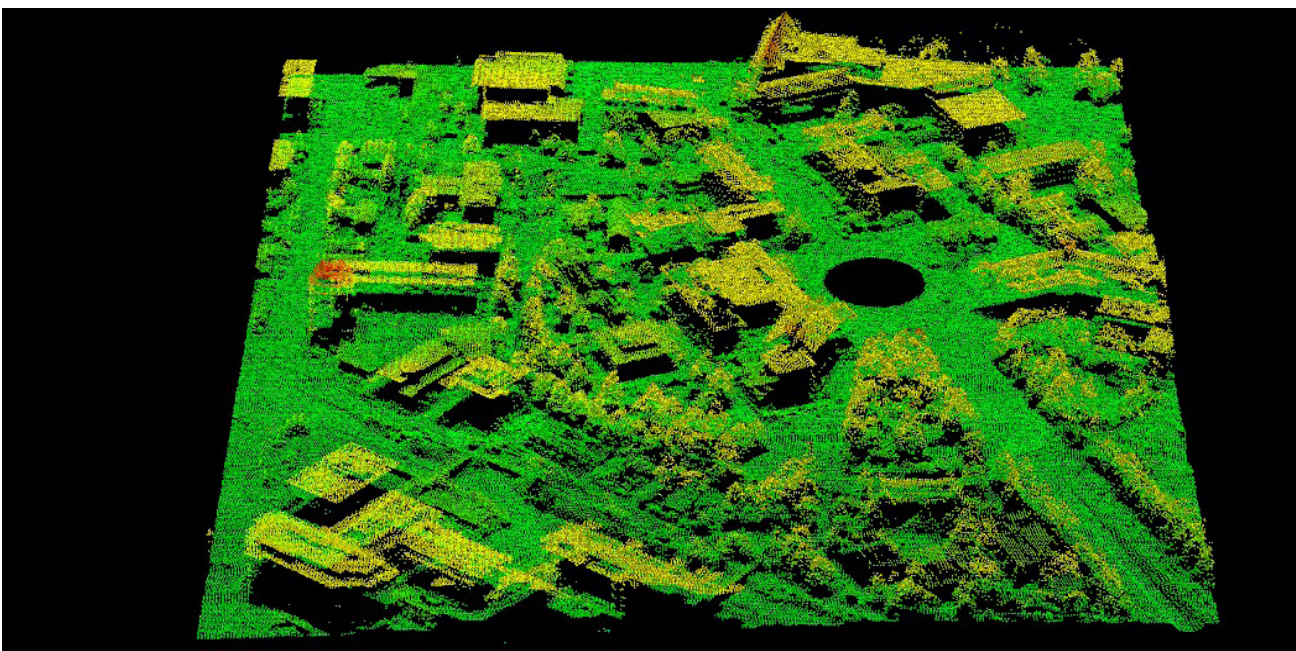

Photo credit: Kathleen Wolf

Research Framework Discovery Process

How were these research needs identified? Who helped craft the urban and community forestry research framework?

A multi-step process was used to formulate then finalize this framework of current and future science needs concerning urban ecosystems. The ongoing focus of the outreach and synthesis was to discover and communicate the practical science and evidence that can help communities to better plan, manage and sustain their urban forests, and make their communities more resilient.

In an exploratory phase key documents were identified. There are several scientific reviews that make research recommendations, including a report from a National Academy of Sciences workshop. Second, science needs have been identified by several working groups (such as the Sustainable Urban Forests Coalition (SUFC) and the Vibrant Cities Task Force. The USDA Forest Service also has a research needs briefing.

The Action Plan is intended to reflect the needs of professional, management, NGO, and urban forestry communities. The second discovery phase involved professional and manager inputs. Numerous research suggestions were sorted from the national outreach for the core plan. In addition, a research needs brainstorming workshop was conducted at the national Alliance for Community Trees members meeting in November 2014 (> 100 participants).

Based on document inputs and urban forestry community engagements a research framework was drafted. The framework was vetted in several ways. It was discussed by a group of scientists that participate in monthly USDA Forest Service Urban Field Station calls, and the National Program Lead for Urban Research with the USDA Forest Service. Confirmatory interviews were scheduled with 12 scientists representing the USDA Forest Service, universities, private sector, and arboreta. The framework was also reviewed by the Research Committee of the Sustainable Urban Forests Coalition and the National Urban and Community Forestry Action Plan Advisory Team.
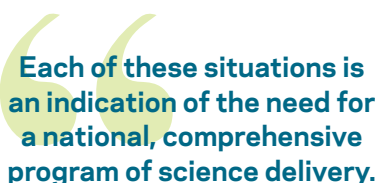
Science Delivery Needs

The national outreach and synthesis process revealed a very complex and dynamic scientific and technical 'ecosystem' concerning urban forest ecosystems and urban ecology. Given the pace of urbanization of the U.S. (and the world) the past decade seems to have brought forth much greater interest and activity in urban based science.

There were paradoxes in both the written and verbal inputs:

- **Needs Disparities** - Some informants would call out the need for additional science about a topic, and other informants would say, 'no, we know enough to do good'. In some instances a person claiming a need seemed to not be aware of existing science.

- **Regional Replication** - Some informants may be able to call out the need to replicate a study in their community, to address the specific biophysical and/or social aspects of their place. Others would respond that work had already been done in the bioregional location, though in a different city. And there was some discussion of the understanding of the generalizability of science, in that research design is often intended to address a question that is salient to many situations though the field work may be conducted in one place.

> **Each of these situations is an indication of the need for a national, comprehensive program of science delivery.**

- **Science Sourcing** - In some instances informants called for new science for a place, and others observed that the question may have been answered locally by an agency, municipal technical department, or NGO. Ever-more local entities have science and technical capacity and their products may be the on-the-ground information that is needed by the urban forest managers. Often this information is not found in peer-reviewed publications; the technical reports are often of high quality, yet not widely known.

Each of these situations supports the need for a national, comprehensive program of science delivery. The collection and translation of scientific and technical evidence should be made available for easy distribution and access. While USDA Forest Service products should be highlighted, local community partnerships are also important. For instance, local agencies and non-profits may be able to distill findings that are particularly relevant in their community, translate key points into multiple languages, and more effectively distribute materials within their communities.

Acknowledgments and Credits

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The Action Plan Funding Needs

Introduction

Endeavors like the development of the National Urban and Community Forestry Advisory Council's Ten-Year Action Plan result in important guiding documents for advancing urban and community forestry. These planning documents become even more powerful when they include an examination of the scale of resources necessary for implementation, as well as the benefits associated with these investments. While the breadth and depth of both the actions included in this plan and the community of practice members who will ultimately carry out those actions precludes a discussion of exactly where implementation dollars for each action may flow from, the University of Maryland's Environmental Finance Center (EFC) offers the following funding discussion, particularly in the context of future urbanization, designed to inform funding and budgeting decision-making.

Benefits of Maintenance Demonstrate Importance of Funding

The figure to the left demonstrates theoretical costs and benefits profiles over the lifetime of an individual tree, with (solid lines) and without (dashed lines) adequate maintenance. Benefits are maximized during the mature phase of a tree and decline rapidly through senescence, while costs show an inverse pattern. Without sufficient funding for maintenance, benefits are not realized
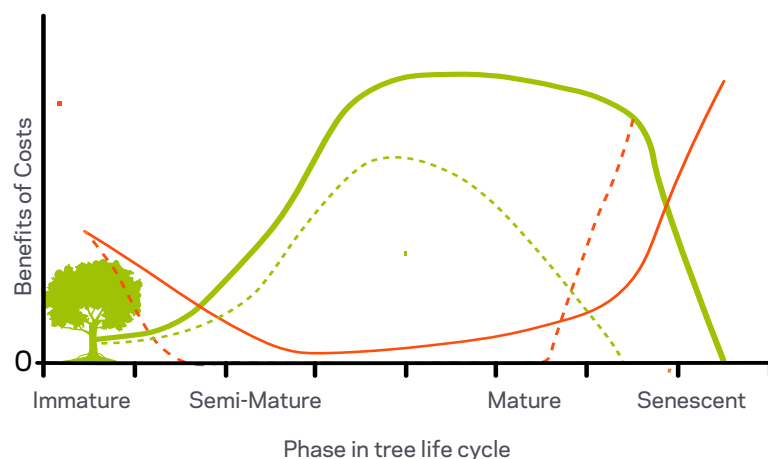
Figure data drawn from Hauer et al., 2014.

Key
— Benefit with maintenance
··· Benefit without maintenance
— Cost with maintenance
··· Cost without maintenance
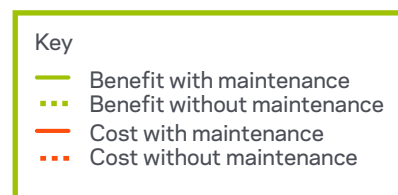
Investment Return: $1.37 - $3.09

A study on the value of street and park trees in five U.S. cities found that for every dollar invested in urban tree management resulted in benefits valued between $1.37 to $3.09 annually (McPherson, et al. 2005).

$1.95 Billion Dollars in Ecosystem Benefits

Los Angeles' Million Trees Initiative provides an estimated $1.3 to $1.95 billion dollars in ecosystem benefits over a 35-year period (McPherson 2011).

Photo credit: Kristina Brezanso

Approach to Funding

Typically, budgeting is a process which starts at the per unit level, assigning line item cost estimates to programmatic activities that are aggregated into sub-budgets and finally summed into an overarching agency, plan, or organizational budget. For the Ten-Year Action Plan, however, the EFC used an approach that considered historical levels of urban and community forestry funding and examined those in the context of emerging trends and potential return on investment. This was used to develop an estimated range of funding needed to support the advancement and implementation of the Ten-Year Action Plan.

This approach was chosen for several reasons. First, it seemed to be best aligned with USDA Forest Service's traditional approach. While there are a few methods of forecasting future programmatic costs, USDA Forest Service tends to plan future funding allocations based on historical spending and existing formulaic calculations.

Second, the landscape of urban and community forestry includes vast and intricately entwined layers of federal, state, local, nonprofit, and private sector organizations with little standardization in how funding investments and benefits are scaled, recorded, tracked, and communicated. Undertaking an exercise of attempting to assign a line item cost to the activities associated with each of the Action Plan's seven goals and build a "from the ground up" overall cost estimate based on currently available data would have required a level of extrapolation, estimates, and assumptions that would potentially impact the credibility and integrity of the Plan.

There is a growing and compelling collection of good urban and community forestry research that includes a discussion of costs and associated benefits. However, these studies have not occurred at the national, urban forestry community-wide scale in which the Ten-Year Action Plan is founded, nor have they used a consistent set of protocols for data collection and analysis. Extrapolating this data to a national scale, over a ten year time period, across multiple participation groups would result in a funding needs estimate that would be difficult to defend, and any ensuing discussion of the validity of the estimate would distract energy and resources from implementation of the Plan.

Finally, the Ten-Year Action Plan is designed for the full urban and community forestry community, and as such, actions within the plan could ultimately be carried out by any one of a number of stakeholders. The existing knowledge, capacity, location, and resources of the urban forestry community responsible for implementation of a given action could have significant impacts on the level of funding needed to carry the action out, and assigning actions to specific implementers was outside the scope of this project.
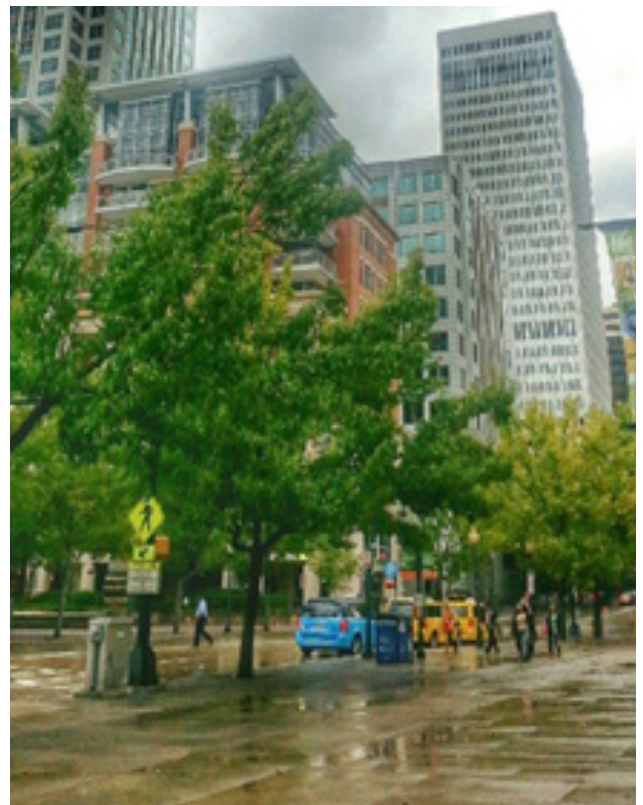

Photo Credit: Eric Reed

Influential Trends

Two existing trends tied closely to urban and community forestry formed the core of the analysis – the increasing rate of urbanization and the growing significance of urban and community forestry services.

The United States is rapidly becoming more urban. It is estimated that in the first half of the 21st century, urban land in the United States will increase to 8.1% of total land, or an area larger than the state of Montana. It is also estimated that by 2050, four states – Rhode Island, New Jersey, Massachusetts, and Connecticut – will be more than 50% urban, and the amount of US forestland estimated to be subsumed by urbanization is an area roughly the size of Pennsylvania. This rate of urban growth suggests that integrating urban and community forestry into all levels of planning will be needed to sustain the ecosystem services and forests products required by a growing urban population and will require an associated increased investment of resources.[2]

The scope of urban forestry needs and the significance of urban forestry services appear to be increasing in communities. While the number of communities receiving urban and community forestry assistance over the past ten years has remained relatively flat, at approximately around 7,200 communities, data seems to indicate that there has been an almost 15% transition of communities from "developing" their urban and community forestry program to actually "managing" these natural resources.[3] This suggests that community programs which may have had an emphasis on beautification have gradually shifted to programs which are more robust and provide greater community services and ecosystem benefits.

The very nature of urban forestry, as well as the USDA Forest Service's broader mission of "Caring for the Land and Serving the People," speaks to investments made and benefits derived "where the people are" – in urban areas. So, in the absence of any other codified projections of the scale and responsible parties for future urban and community forestry needs, and for the purposes of Ten-Year Action Plan implementation discussions, urbanization was used as a proxy for developing a ten-year funding needs estimate that adapts current and advocated funding levels to the anticipated increased urban land area demand scenarios.[4]

Using currently available data and making minimal assumptions, this analysis suggests that simply adjusting to future urbanization, funding in the range of approximately $32 million annually is needed for the USDA Forest Service's Urban and Community Forestry program. This estimate was developed by examining current urban land data and research projections of future urbanization patterns; developing an implied annual urbanization growth rate; and, applying this annual growth rate to current and advocated funding levels to derive an estimate of the funds necessary to maintain current levels of service to manage future increases in urban forestry area. This estimate does not account for supporting important existing urban forestry research and efforts or the many new and urgently needed activities outlined in the Ten-Year Action Plan. In other words, this is a bare bones estimate of the funding required just to maintain the existing level of service in the face of anticipated increases in urbanization and does not account for any desired increase in the level of service that may be associated with implementation of the Ten-Year Action Plan.

Looking at a sampling of actions related to the goals of the Ten-Year Action Plan that are above and beyond existing Urban and Community Forestry Program budget where reliable cost estimates were available begins to suggest the scale at which the current level of urban forestry funding is insufficient.

> **The United States is rapidly becoming more urban. It is estimated that in the first half of the 21st century, urban land in the United States will increase to 8.1% of total land, or an area larger than the state of Montana.**

> **While the number of communities receiving urban and community forestry assistance over the past ten years has remained relatively flat, at approximately around 7,200 communities, data seems to indicate that there has been an almost 15% transition of communities from "developing" their urban and community forestry program to actually "managing" these natural resources.**

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2 U.S. Urban Forest Statistics, Presentation to the 2014 Partners in Community Forestry Conference, Charlotte, NC, David Nowak.
3 CARS data 2005 – 2014, See Table 1, in Appendix.

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4 This estimate relies on a change of one variable, i.e. urbanized area. Our judgment is that this is a factor and a variable that impacts the discussion of urban forestry at all levels. We acknowledge that the rate of urbanization may change when viewing locally; however, we believe that given the granularity of census data, organizations of a local nature may be able to understand and employ the method for planning discussion purposes. This estimate does not include other future factors which may have an effect on program delivery, such as, inter alia, technological efficiencies, economies of scale in program delivery, dissemination of information, efficiencies from increases in standards or level or professionalism, availability of funding, rate of program funding, or rate of program adoption.

Table 1: Base Funding Items

Action Plan Activities	Base Funding (millions)	Associated Action Plan Goal
UC&F Program Funding	$ 31.30	Funding, Management, Multiple
Forest Health Management	$ 7.97	Management
Inventory Analysis	$ 20.00	Planning, Multiple
Tools - iTree	$ 1.30	Planning, Multiple
Urban Tree Canopy	$ 2.80	Planning
Stewardship mapping	$ 1.20	Management
Trees + Crime	$ 1.60	Human Health
Trees + Health	$ 1.00	Human Health
Trees + Water	$ 1.00	Human Health, Environmental Health
Urban Forest Products	$ 1.20	Management
Estimate of additional urban research and action items	$ 14.48	Multiple
Total of Items	**$ 83.85**	

An estimate of funding needs for a sampling of Ten-Year Action Plan activities outside the Urban and Community Forestry Program was developed by examining input from USDA Forest Service and other urban forestry researchers and data from a review of current funding requests in the context of current urban land area.[2] **Considering this in addition to the baseline Urban and Community Forestry Program needs and then adjusting for the impacts of future urbanization suggests annual funding needs in the range of approximately $85 million.** This estimate was developed by examining current urban land data and research projections of future urbanization patterns; developing an implied annual urbanization growth rate; and, applying this annual growth rate to the combination of current and advocated funding levels and the Action Plan activity estimates (see Table 1)

> " Considering this in addition to the baseline Urban and Community Forestry Program needs and then adjusting for the impacts of future urbanization suggests annual funding needs in the range of approximately $85 million.

to derive an estimate of the funds necessary to maintain current levels of service to manage future increases in urban forestry area.

Again to be clear, this estimate does not represent a comprehensive price tag for implementation of the full Ten-Year Action Plan, it merely uses data available on a sampling of actions to indicate the scale of the urban forestry funding gap. In addition, the extent to which the more than $50 million in additional funds needed would come from direct budget increases to the Urban and Community Forestry or other USDA Forest Service programs, or through further leveraging of the other federal, state, local, nonprofit, and private sector funding streams at play in urban and community forestry will be an important discussion for the urban forestry community moving forward.

2 Please see methodology for detail on sources, estimation method, and caveats.

Limitations, Benefits, Emerging Research, and the Need to Standardize Accounting

As previously indicated, there are multiple levels and organizational units within the urban forestry community, including roughly 7,200 communities, more than 50 states and territories, and over 4,000 service, advocacy, and community organizations. The challenges of developing a detailed, accurate, and lasting estimate of funding needs across this scale and diversity of organizational units, along with the lack of a universally accepted accounting framework are real and there is a risk that a funding estimate of incorrect scope could quickly become outdated or distract from the overall message of the Ten-Year Action Plan.

> **Urban and community forestry is only now being more widely recognized as a public infrastructure service essential for addressing the needs of a nation having more than 80% of residents living in urbanized areas.**

One reason this challenge exists is that urban and community forestry, and the role it plays more broadly as a critical component of urban green infrastructure networks, is only now being more widely recognized as a public infrastructure service essential for addressing the needs of a nation having more than 80% of residents living in urbanized areas. City programs have had to quickly adapt from beautification goals, management, and reporting practices to a focus on the delivery of critical ecosystem goods and services. Meanwhile, the accounting and benefits measurement remain an emerging stage of research, development, and implementation.

The critical need to increase investment in urban and community forestry, or at the very least maintain existing levels, can be well-supported by a discussion of the multiple benefits derived; however, given the emerging state of ecosystem service benefits valuation and accounting, developing a simple equation or mathematical formula to calculate return on funding investment applicable to a national scale is not currently possible across all types of benefits.

To be clear, that is not to suggest that benefit values cannot or have not been calculated. There is a body of strong existing research, technology-based tools, and ongoing initiatives within the urban and community forestry community that could inform the standardization process and be built upon, much of which owes its origins to USDA Forest Service support. In fact, the Ten-Year Action Plan document is rife with examples from across the country that span human health and wellness, water and air quality, energy conservation, recreation, economic development, transportation, and public safety, often in the most vulnerable and underserved communities. While there is currently research into this area, currently what is lacking, as discussed earlier, is a consensus driven process for how these data points can be aggregated to a national, community of practice-wide scale.

Broadly adopted standard metrics would allow for the systematic allocation of budgets and the ability to more precisely determine return on investment and future funding needs. Standardization could also open access to other sources of urban forestry funding to support operations, growth, and the delivery of services. Codified systems for benefit measurement and accounting would enable access to emerging "green" financial markets, socially responsible investment funds, foundations, and impact investing capital pools.

While it may sound like a daunting undertaking, developing an "industry standard" for urban and community forestry accounting could likely build upon existing tools and technologies already in place, but identifying a process with the greatest potential for efficiency, effectiveness, and accuracy would require additional investigation. The complexities of such a task will likely require a collective approach managed by an independent, neutral party that would begin with assembling a diverse panel of experts to evaluate existing data, technologies, and methodologies that can be built upon, determine associated gaps and limitations, and suggest methods for filling data gaps; and then, using this group's findings to serve as the basis for recommendations for developing a more standardized accounting system for both urban forestry investments made and benefits derived.

National Benefits and Funding

While only a few benefits, such as pollution removal, carbon sequestration, and energy conservation, have actually been quantified, those benefits have been conservatively estimated at $17 billion per year. In other words, the millions invested in urban forestry represent a fraction of a percent of the return on this investment.

To sustain the benefits communities receive from urban forestry requires an investment in the maintenance of the resource, as well. The urban forest is continually evolving and faces constant threat from development, climate change, insects and diseases, invasive plants, and more. Given the number of additional benefits, such as those related to health, drinking water, and the like that have not yet even been quantified on a national scale, the urban forest is clearly a resource that is substantially undervalued.

-- Based on communications with Dr. David Nowak, USFS
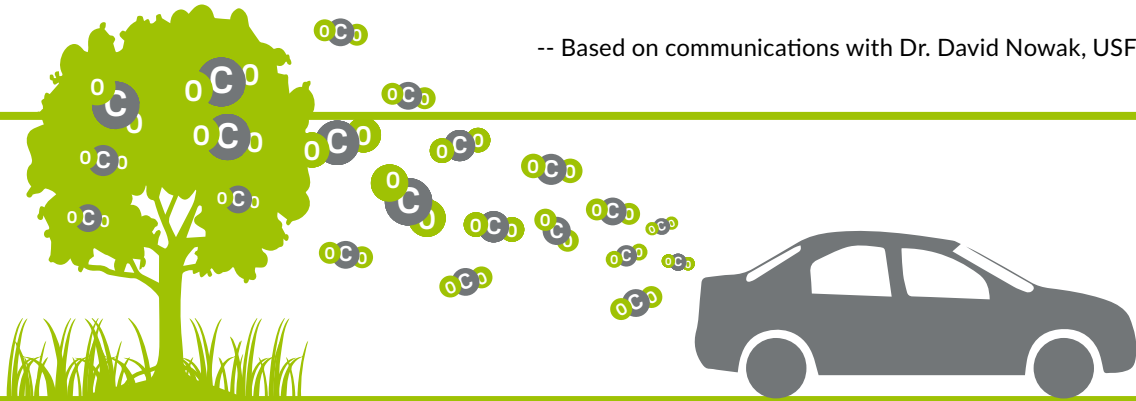
28.2 Million Tons/Year

Based on the field data of 10 USA cities and a national urban tree cover data, it is estimated that urban trees in the conterminous USA currently store 708 million tons of carbon ($14,300 million value) with a gross carbon sequestration rate of 22.8 million tC/year ($460/million per year) (Nowak et al., 2002).

20 Million Automobiles

This equals annual carbon emissions from about 20 million automobiles. Thus urban forests annually remove carbon equivalent to about 8% of U.S. registered vehicles (Nowak et al., 2010).

Conclusion

Ensuring that Urban and Community Forestry Programs keep pace with urbanization and the resulting expanded need for urban forestry services will require identifying, diversifying, and leveraging additional sources of funding. In addition, continuing support is needed to standardize, account for, and communicate both the funding investments being made in urban and community forestry, as well as the ecosystem services and benefits that urban forests provide. On a regional and national level, being able to more precisely speak to true costs, ecosystem services, and benefit measurements will enable urban and community forestry's strong network of implementers, policy makers, and grassroots support organizations to better communicate urban and community forestry's value, community impacts, and return on investment, to the urban forestry community external stakeholders, and the breadth of funding sources.

Photo Credit: Eric Reed

Methodology

Background

Background. The USDA Forest Service's Urban and Community Forestry program provides technical and financial assistance to cities, suburbs, and towns across the nation to maintain and enhance urban tree and forest cover, respond to storm and other disturbance events, support integrated containment of invasive pest threats, and manage risks. The program also supports valuation work and cost-benefit analysis, enabling communities to better understand the benefits provided by urban forests to non-forest sectors, such as public health energy conservation, and economic development.

The Urban and Community Forestry program's contribution to moving communities towards greater economic, environmental, and social sustainability has been significant. In FY 2014 alone, the program delivered assistance to over 190 million people, or 60% of the US population, in over 7,000 communities across the country. A key reason for the program's extended reach is that the federal investment made through the Urban and Community Forestry program leverages non-federal

funding – often at a match of 2:1 or in many cases significantly more.[2]

Given the leveraged nature of funding deployed by the Urban and Community Forestry program, the University of Maryland Environmental Finance Center elected to focus on urban and community forestry funding data which seemed the most widely accepted and could provide examples when planning for urbanization within the community of practice.

This included data from:

• USDA Forest Service Annual Budget Requests and Justifications

• Studies of Urbanization by USDA Forest Service Researchers

• 2010 United States Census Data

• Advocated Consensus Budget

2 Sustainable Urban Forest Coalition Fiscal Year 2016 House Interior Appropriations Testimony, March 25, 2015.

Photo credit: Bettina Ring

Step One: Estimating Change in Urban Land Area

To conduct the analysis, state estimates of the percentage of land by state that will be urban in 2050 were gathered from the study Projected Urban Growth (2000 – 2050) and Its Estimated Impact on the US Forest Resource.[2] The 2010 Census data on total land area and total urban area for fifty states and the District of Columbia was gathered and organized by state.[3] Census data expressed in square meters was converted to square miles.

2 Projected Urban Growth 2000 - 2050 and Its Estimated Impact on the Forest Resource. Nowak, David and Walton, David. Journal of Forestry. December 2005
3 United States Census Bureau, Geography, 2010 Census Urban Lists Record Layouts, 2010 Percent Urban and Rural by State, File Name PctUrbanRural_State.xls, https://www.census.gov/geo/reference/ua/ualists_layout.html, accessed February 7, 2015

The estimated percentage of 2050 urban land by state was then applied to current total state land area to derive an estimated "2050 urban area square mile by state." The difference between estimated 2050 urban land area by state and 2010 Census Urban Land Area was then calculated and expressed as a percentage of 2010 Census Urban Land Area by state. The total 2010 Census Urban Land Area by state and the Estimated 2050 Urban Land Area by state was aggregated to arrive at totals for the fifty states and the District of Columbia.[4]   Table 1: Estimating Change in Urban Land Area below provides this data.

4 Please note that the table does not include United States territories as data on future urban land areas was unable to be located.

Table 1: Estimating Change in Urban Land Area

State	Census 2010 State Area (AREA_ST) (m2) [1]	Census 2010 Urban Area (AREA_URBAN) (m2) [1]	Census 2010 Urban Area (mi2)	Estimated Percentage of State Land that will be urban in 2050 [2]	Estimated 2050 Urban Area (mi2)	Estimated Increase in Urban Land Area (mi2)	Estimated Increase as a % of Census 2010 Urban Area
Alabama	131,170,787,086	5,716,365,701	2,207	10.70%	5,419	3,212	145.53%
Alaska	1,477,953,211,577	673,703,920	260	0.05%	285	25	9.69%
Arizona	294,207,314,414	5,663,221,936	2,187	5.10%	5,793	3,607	164.95%
Arkansas	134,771,261,408	2,841,198,188	1,097	5.80%	3,018	1,921	175.12%
California	403,466,310,059	21,287,926,350	8,219	15.00%	23,367	15,148	184.29%
Colorado	268,431,246,426	3,956,737,225	1,528	3.90%	4,042	2,514	164.58%
Connecticut	12,541,641,427	4,730,500,209	1,826	60.90%	2,949	1,123	61.46%
Delaware	5,046,703,785	1,053,792,304	407	39.50%	770	363	89.17%
District of Columbia	158,114,680	158,114,680	61	100.00%	61	0	0.00%
Florida	138,887,481,596	19,173,902,265	7,403	27.90%	14,961	7,558	102.10%
Georgia	148,959,236,603	12,423,724,190	4,797	14.30%	8,224	3,428	71.46%
Hawaii	16,634,529,975	1,018,212,915	393	6.12%	393	0	0.00%
Idaho	214,044,680,857	1,292,606,730	499	1.80%	1,488	988	198.06%
Illinois	143,793,362,385	10,218,955,838	3,946	14.60%	8,106	4,160	105.44%
Indiana	92,789,193,658	6,540,696,730	2,525	16.70%	5,983	3,458	136.91%
Iowa	144,669,296,857	2,468,980,575	953	4.90%	2,737	1,784	187.11%
Kansas	211,754,095,913	2,519,183,616	973	3.20%	2,616	1,644	168.98%
Kentucky	102,269,141,641	3,653,655,859	1,411	8.80%	3,475	2,064	146.32%
Louisiana	111,897,594,452	5,097,451,640	1,968	11.10%	4,796	2,827	143.66%
Maine	79,882,800,680	931,423,305	360	3.80%	1,172	812	225.90%
Maryland	25,141,638,381	5,191,942,757	2,005	37.50%	3,640	1,636	81.59%
Massachusetts	20,202,057,805	7,735,338,848	2,987	61.00%	4,758	1,771	59.31%
Michigan	146,435,075,220	9,384,151,623	3,623	13.70%	7,746	4,123	113.78%
Minnesota	206,232,309,199	4,416,575,848	1,705	4.80%	3,822	2,117	124.14%
Mississippi	121,530,715,928	2,864,191,371	1,106	7.00%	3,285	2,179	197.02%
Missouri	178,039,716,301	5,320,506,862	2,054	6.90%	4,743	2,689	130.89%
Montana	376,961,878,670	769,702,271	297	0.80%	1,164	867	291.80%
Nebraska	198,973,681,461	1,357,102,386	524	1.80%	1,383	859	163.91%
Nevada	284,331,937,541	1,987,575,459	767	2.20%	2,415	1,648	214.72%
New Hampshire	23,187,259,277	1,668,054,122	644	17.10%	1,531	887	137.70%
New Jersey	19,047,341,691	7,561,624,746	2,920	63.60%	4,677	1,758	60.21%
New Mexico	314,160,748,240	2,141,181,968	827	2.10%	2,547	1,721	208.12%
New York	122,056,806,947	10,597,911,232	4,092	18.50%	8,718	4,627	113.07%
North Carolina	125,919,791,207	11,937,724,456	4,609	19.10%	9,286	4,677	101.47%
North Dakota	178,711,239,147	475,973,352	184	1.00%	690	506	275.46%
Ohio	105,828,706,692	11,448,575,862	4,420	22.90%	9,357	4,937	111.68%
Oklahoma	177,660,021,556	3,384,365,635	1,307	4.70%	3,224	1,917	146.72%
Oregon	248,607,802,255	2,866,510,400	1,107	3.50%	3,360	2,253	203.55%
Pennsylvania	115,883,064,314	12,186,542,023	4,705	22.10%	9,888	5,183	110.15%
Rhode Island	2,677,566,454	1,037,649,938	401	70.50%	729	328	81.92%
South Carolina	77,856,841,944	6,168,413,106	2,382	18.30%	5,501	3,119	130.98%
South Dakota	196,349,580,075	586,090,288	226	1.00%	758	532	235.02%
Tennessee	106,797,885,992	7,524,311,791	2,905	15.30%	6,309	3,404	117.16%
Texas	676,586,997,978	22,651,009,601	8,746	7.00%	18,286	9,541	109.09%
Utah	212,818,329,473	2,369,045,186	915	2.50%	2,054	1,140	124.58%
Vermont	23,871,030,489	404,380,140	156	5.30%	488	332	212.87%
Virginia	102,278,849,309	6,902,790,588	2,665	12.60%	4,976	2,311	86.69%
Washington	172,119,001,610	6,150,546,552	2,375	9.20%	6,114	3,739	157.46%
West Virginia	62,258,675,601	1,658,489,502	640	7.70%	1,851	1,211	189.05%
Wisconsin	140,268,064,888	4,866,498,071	1,879	8.30%	4,495	2,616	139.23%
Wyoming	251,470,069,067	503,865,599	195	0.60%	583	388	199.45%
Total	9,156,460,226,723	279,879,819,054	108,062		238,034	131,648	

Note 1: United States Census Bureau, Geography, 2010 Census Urban Lists Record Layouts, 2010 Percent Urban and Rurual by State, File Name PctUrbanRural_State.xls, https://www.census.gov/geo/reference/ua/ualists_layout.html, accessed and downloaded February 7, 2015.

Note 2: Projected Urban Growth 2000 - 2050 and Its Estimated Impact on the Forest Resource. Nowak, David and Walton, David. Journal of Forestry. December 2005)

Step Two: Derive the Implied Annual Growth Rate

The implied annual growth rate,[2] calculated at 1.99%, was then applied to an estimated annual funding amount in order to approximate additional funding needs related to

annual increases in urban land. Table 2: Estimated Implied Annual Growth Rate demonstrates the application of the growth rate formula to the 2010 and 2050 data using the footnoted calculation.

2 Implied Annual Rate = (2050UrbanArea/2010UrbanArea)^(1/40)–1

Table 2: Estimated Implied Annual Growth Rate

2010 Census Estimated Urban Area (mi2)	Estimated 2050 Urban Area (mi2)	Implied Annual Growth Rate
108,062	238,034	1.99%

Step Three: Compile a List of Current Estimated Funding Needs for Items such as Programs, Actions, Tools, and Research

Table 3: Estimated Funding Needs before Adjusting for Urbanization below lists a sampling of the Ten-Year Action Plan activities in need of funding, the estimated funding needed for each, the associated Ten-Year Action Plan goal, and the basis or source for each estimate. The data builds on the consensus driven Sustainable Urban Forests

Coalition needs estimate with data layers from a number of sources including USDA Forest Service researchers. In the absence of available data, an estimate was derived applying urban land area to 2016 funding levels. When summed, we arrive at total current funding need estimate of $83.85 million.

Table 3: Estimated Funding Needs before Adjusting for Urbanization

Action Plan Activities	Base Funding (millions)	Associated Action Plan Goal	Notes
UC&F Program Funding	$ 31.30	Funding, Management, Multiple	SUFC consensus recommended funding for Urban and Community Forestry Program 1
Forest Health Management	$ 7.97	Management	Line item in federal budget is $99.6 million. The estimate uses assumption that 8% allocated towards urban
Inventory Analysis	$ 20.00	Planning, Multiple	Estimate from Dr. Nowak. Assumes 200 plots in 100 metro areas per year at a cost of $1000 per plot
Tools - iTree	$ 1.30	Planning, Multiple	Estimate from Dr. Nowak
Urban Tree Canopy	$ 2.80	Planning	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Stewardship mapping	$ 1.20	Management	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Trees + Crime	$ 1.60	Human Health	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Trees + Health	$ 1.00	Human Health	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Trees + Water	$ 1.00	Human Health, Environmental Health	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Urban Forest Products	$ 1.20	Management	Northern Research Station Data Multiplied by 4 Research Stations. Please see caveats.
Estimate of additional urban research and action items	$ 14.48	Multiple	This number is total Urban R&D Estimate less the specific research items above. Line item in Federal Budget is $291 million. This estimate makes an assumption that 8% of R&D is allocated to Urban Land. This results in a total R&D budget of $23.28 million annually.
Total of Items	$ 83.85		

The first line item is specifically funding for the USDA Forest Service Urban and Community Forestry Program. The estimate uses a funding base of $31.3 million as was recommended by the Sustainable Urban Forests Coalition (SUFC) in March 2015 when SUFC recommended program funding return to pre-sequestration levels.[2]   In our judgment this represents a consensus funding estimate and represents an increase of more than $7 million when compared to the FY 2016 budget of $23.686 million.[3]

The additional line items in the table represent a sampling of Ten Year Action Plan activities that have traditionally been funded by programs other than the Urban and Community Forestry Program. These include restoring resilient landscapes, forest health management, inventory analysis, tool, monitoring, and research. Urban and community forestry is not always accounted for as a separate funding item within USDA Forest Service budgets making it difficult to discern between urban forestry needs and overall forestry needs.[4]   USDA Forest Service researchers and 2016 budgets data offered a sampling of funding requests which impact urban and community forestry at the national level include:

- Forest health management, which comprises all land areas of forest health management including urban, $99.6 million annually.[5]

- Inventory Analysis, at $90 million annually, includes urban inventory analysis.[6]

- Research and Development, at $291 million annually, includes research focused on urban applications.[7]

- Northern Research Station Research funding needs of $2.35 million annually for items such as urban tree canopy, stewardship mapping, urban forest products, trees and crime, trees and health, and trees and water.[8]

2 Sustainable Urban Forests Coalition Fiscal Year 2016 House Interior Appropriations Testimony, March 25, 2015.
3 USDA, United States Forest Service, Fiscal Year 2016 Budget Justification, Urban and Community Forestry, Page 117 http://www.fs.fed.us/sites/default/files/media/2015/07/fy2016-budgetjustification.pdf accessed March 19, 2015
4 This is not to imply that urban and community forestry was to have been accounted for separately, or should be accounted for separately, rather in our analysis, it was difficult to discern a separation. For some of these items, it is difficult to see where a dividing line between urban and community forestry and general forestry maybe be drawn.

5 United States Department of Agriculture, United States Forest Service, Fiscal Year 2016 Budget Justification, Urban and Community Forestry, Page 84 http://www.fs.fed.us/sites/default/files/media/2015/07/fy2016-budgetjustification.pdf accessed March 19, 2015.
6 United States Department of Agriculture, United States Forest Service, Fiscal Year 2016 Budget Justification, Urban and Community Forestry, Page 57 http://www.fs.fed.us/sites/default/files/media/2015/07/fy2016-budgetjustification.pdf accessed March 19, 2015.
7 United States Department of Agriculture, United States Forest Service, Fiscal Year 2016 Budget Justification, Urban and Community Forestry, Page 57 http://www.fs.fed.us/sites/default/files/media/2015/07/fy2016-budgetjustification.pdf accessed March 19, 2015.
8 Deploying Trees to Improve Quality of Life in Cities: Research Needs. Grove, Rains, Westphal. USDA Forest Service, Northern Research Station. February 2015. The table below was developed by NRS and does not represent all regions in terms of priorities and costs. It does appear to represent national perspectives for bringing urban tree canopy and stewardship mapping to enterprise mode. Please note that these needs do not include i-Tree or investments in place-based research undertaken by the urban field stations/place-based units, etc. This information is offered as an exemplar and is not meant to be an indication of total research needs. These numbers would need to be augmented to avoid underestimating urban research investment recommendations or under-representing southern, western, and other regional research needs.

Table 4: Exemplar Chart of Northern Research Station Research Needs

	Year 1	Year 2	Year 3	Year 4	Year 5
Urban Tree Canopy	$700,000	$700,000	$500,000	$500,000	$350,000
Stewardship mapping	$300,000	$300,000	$250,000	$250,000	$175,000
Trees + Crime	$400,000	$300,000	$250,000	$250,000	$200,000
Trees + Health	$400,000	$400,000	$400,000	$400,000	$400,000
Trees + Water	$250,000	$250,000	$250,000	$250,000	$250,000
Urban Forest Products	300,000	300,000	250,000	200,000	200,000
Total Investment	2,350,000	2,250,000	1,900,000	1,850,000	1,575,000

Step Four: Use the Implied Annual Growth Rate to Estimate Additional Funding Needs Related to Future Urbanization.

Table 5: Estimated Additional Need Based on Future Urbanization and Total Estimate of Annual Funding applies the implied annual urbanization growth rate from Step 2 to the funding need estimate derived in Step 3, resulting in an estimated annual funding need adjusted for urbanization over the next ten years.

Step Five: Estimate Present Value Over the Ten Year Period

As a final step, the EFC made an estimate of the present value of the funding needs over the next ten years. The intent of this exercise is to express estimated plan funding needs in terms of present value for discussion purposes only. The exercise does not assume either the source or recipient of the funding, but applies a 3% discount rate to estimated future funding needs to discount the stream of future funding needs back to present. We are not suggesting this is the case, but a question could arise, how one might compare different funding options to make up a financing gap in the era of sequestered budgets. A present value exercise is one method employed which can advance plan discussion, with the caveat that it is not the only path, with the caveat that estimates of present value become very uncertain and can vary widely the longer into the future projections are made, and with the caveat that the method is not employed, and thus may not be useful, across all organizations in the urban forestry community.

Table 5: Estimated Need Based on Future Urbanization and Total Estimate of Annual Funding

Item	Amount (million)
Total Funding from Table of Items	$83.85

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Present Value of 2016 - 2025 Future Estimated Funding Need
Additional Estimated Funding need above SUFC related to Estimated Urbanization Increase	$1.67	$1.71	$1.74	$1.77	$1.81	$1.85	$1.88	$1.92	$1.96	$2.00	$15.54
Annual Funding Need	$85.52	$87.23	$88.97	$90.74	$92.55	$94.39	$96.28	$98.20	$100.15	$102.15	

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- David Nowak, Ph.D., Research Forester, Northern Research Station, Unites States Department of Agriculture, USDA Forest Service
- Jeffrey Peterson, Northern Arizona University

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1. U.S. Urban Forest Statistics, Presentation to the 2014 Partners in Community Forestry Conference, Charlotte, NC, David Nowak.

2. Nowak and Walton. Projected Urban Growth and Its Estimated Impact on the U.S. Forest Resource.

3. CARS data 2005 – 2014, See Table 1, in Appendix.

4. This estimate relies on a change of one variable, i.e. urbanized area. Our judgment is that this is a factor and a variable that impacts the discussion of urban forestry at all levels. We acknowledge that the rate of urbanization may change when viewing locally; however, we believe that given the granularity of census data, organizations of a local nature may be able to understand and employ the method for planning discussion purposes. This estimate does not include other future factors which may have an effect on program delivery, such as, inter alia, technological efficiencies, economies of scale in program delivery, dissemination of information, efficiencies from increases in standards or level or professionalism, availability of funding, rate of program funding, or rate of program adoption.

Action Plan Implementation

Who Will Implement the Plan?

The Entire Urban Forestry Community!

Forest Health

Stewardship & Community Building

Health & Wellness

Community Resilience

New Partners
Technical Partners
Partners
Leaders

Agents of Change

Technology

Engineering

Urban Planning & Urban Design

Ecosystem Services

Environmental Health

The Urban Forestry Community Includes

Leaders

Entities whose core mission is urban and community forestry. At the core of the urban forestry community are urban and community forestry lead organizations whose responsibility is to "build a fire" of activity strong enough to draw people and organizations to encourage greater participation. Some of these leaders include federal, state, and local representatives; non-profits; and private sector professionals.

Allied Professionals

Entities whose mission is related to ecosystem and human health services provided by urban and community forestry, who are aware of urban and community forestry, and who either work or are willing to work with urban and community forestry. Some of these partners include universities, planning organizations, federal public health agencies, parks and recreation organizations.

Technical Support

Entities that work with trees, although urban and community forestry is not yet explicitly a part of or related to their mission. (See page 114 for a list of federal agencies that can offer technical support).

New Partners

Entities whose work intersects with urban and community forestry, although they may not yet be either aware of urban forestry or be directly connected with the field yet. New partners could be public works offices, urban design college programs, and regional planning commissions.

What Can YOU Do to Implement This Plan?

- Seek a USDA Forest Service grant to implement the Action Plan goals and strategies.

- Share with NUCFAC the goals and strategies that you are working on.

- Check the NUCFAC website to learn about annual priorities and Plan updates.

- Join your community's urban forestry network (local government, private practitioners, non-profits, and grassroots activists).

- Contact NUCFAC if you have ideas about how to implement this plan. 1-800-832-1355
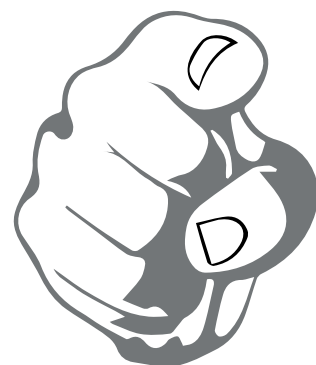
WE WANT YOU

NUCFAC's Facilitation Process

The Council has identified the following goals and strategies for the first couple of years to initiate the Action Plan from their position. The Council reserves the right to change or modify these items listed base on emerging issues and opportunities.

NUCFAC roles:

- ☐ Steward implementation of the plan.
- ☐ Track progress toward reaching goals.
- ☐ Assist with aligning research around the goals in the plan.
- ☐ Identify their goals, and targets.
- ☐ Make annual recommendations to the Secretary of Agriculture.
- ☐ Annually report on the Action Plan's accomplishments made by the urban forestry community

Possible NUCFAC Sub-Team Roles

- ☐ Identify priority goals, develop appropriate targets, track progress, and report continuing needs.

- ☐ Identify and make recommendations regarding the Secretary of Agriculture, USDA Forest Service, and other agencies to the full Council for review, acceptance, and submission.

- ☐ Identify and shape inter-agency collaboration and encourage urban forestry community to implement the Plan for collective impact.

- ☐ Disseminate the Action Plan and communicate progress in implementing the Plan, and provide broad access to products, tools and resources.

Final Action Plan

- ☐ 3 principles
- ☐ 7 Goals
- ☐ 25 Strategies
- ☐ Targets
- ☐ Prioritization
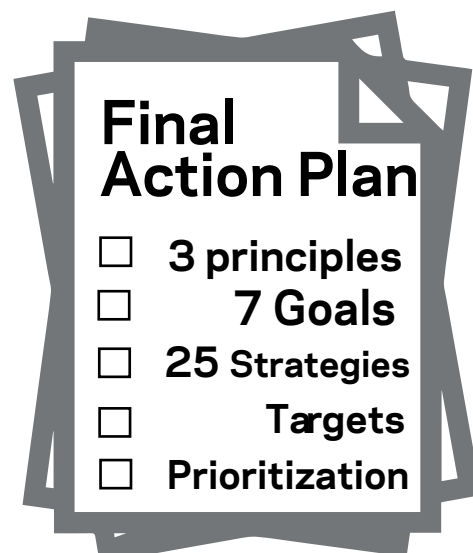
NUCFAC's Timeline

The following graphic represents a broad implementation plan that is intended to be iterative, i.e. reviewed and amended as needed to ensure maximum impact.

Subsequent 3-Year Phases

☐ 1st Quarter (Calendar Year)

- ☐ Align grant categories with priorities.
- ☐ Advertise Grant Request for proposals (annual RFP).

☐ 2nd Quarter

- ☐ Develop grant categories for the following year.

☐ 3rd Quarter

- ☐ Review recommended grant categories and approve them for release in January.
- ☐ Develop presentation on progress for Partners in Community Forestry conference.
- ☐ Work with the USDA Forest Service to develop a Federal Agency Collaboration Strategy.

☐ 4th Quarter

- ☐ Review progress.
- ☐ Present progress at Partners in Community Forestry conference.
- ☐ Develop next 3-year priorities and targets.

☐ Annual Activities

- ☐ Align grant categories with priorities.
- ☐ Advertise Grant Request for proposals (annual RFP).
- ☐ Develop grant categories for the following year.
- ☐ Review recommended grant categories and approve them for release in January.
- ☐ Continue to advance the Federal agency collaboration strategy.
- ☐ Review Progress.
- ☐ Develop presentation on progress for annual Partners Conference.
- ☐ Present progress at Partners Conference.

☐ Third Year

- ☐ All annual activities
- ☐ Consult urban forestry community on priorities for the next three-year period.
- ☐ Develop next 3-year priorities and targets.
- ☐ Conduct national assessment of resources (science/technology tools) available to implement these priorities.
- ☐ Communicate new priorities and resources to implement them.

Federal Agencies Connected to Urban and Community Forestry

Environmental Protection Agency

- Smart Growth Program (Office of Sustainability)
- Our Town (EPA/HUD/DOT)
- Healthy Watersheds Initiative (EPA-Water)
- Community Grants Program (Office of Env. Justice)
- Chesapeake Bay Program (EPA-Mid-Atlantic)
- Greening America's Capitals (Office of Sustainability)
- Integrated Climate & Land Use Scenarios (Global Change Impacts)
- Enviroatlas
- Urban Waters Restoration Grant Program (EPA- Water)
- State Environmental
- Cooperative Agreement (Office of Env. Justice)
- Green Infrastructure Initiative (EPA-Water)
- PestWise (Office of Pesticide Programs)

Department of Agriculture (USDA)

- Financial Assistance Programs (Natl. Resources & Conservation)
- Climate Change Program Office (Office of Economist)
- Forest Research Advisory Council Grant Program (Natl. Institute of Food & Agriculture)
- Conservation Technical Assistance Program (Natl. Resources & Conservation)
- EPOC Forestry and Natural Resources (Institute of Food & Agriculture)
- Landscape Initiatives, Landscape Planning (Natural Resources & Conservation)
- National Agroforestry Center
- USDA Natural Resource Conservation Service
- Resource Conservation Districts on soil health, urban farming and pollinators
- Urban and Community Forestry Technology Transfer (USDA Forest Service)
- Cooperative Forestry (USDA Forest Service)
- Urban and Community Forestry (USDA Forest Service)
- National Urban and Community Forestry Advisory Council (USDA Forest Service)
- USDA Forest Service Research and Development

Department Of Interior

- Land & Water Conservation Fund (National Parks)
- Conservation Study Institute (National Parks)
- Rivers, Trails, & Conservation Assistance Programs (National Parks)
- Landscape Conservation Cooperatives (Fish & Wildlife)
- Coastal Program (Fish & Wildlife Services)
- State and Tribal Wildlife Grant Program (Natl. Wildlife Federation)
- Endangered Species (Fish & Wildlife Service)
- America's Great Outdoors (Multiple)
- Nature Play Corps (Natl. Wildlife Federation)
- U.S. Geological Survey

National Science Foundation (NSF)

- Environmental Sustainability Program
- ULTRA Grants
- Research Collaboration Network (RCN)
- Sustainability Research Networks (SRN)
- Coupled Natural and Human Systems Funding (CNH)

Department of Labor

- Green Infrastructure Training

Department of Defense (DOD)

- Readiness & Environmental Protection Integration Program (REPIP)
- Army Corps of Engineers -Ecosystem restoration

Department of Housing And Urban Development

- Community Development Block Grants (Community Planning & Development)

Recommendations for Aligning Programs and Policies of Relevant Federal Agencies

☑ To accomplish this task, the team first identified all federal agencies and programs relevant to urban and community forestry. The list (shown here) was refined with significant feedback from participants at the 2014 Partners in Urban Forestry Conference, the Advisory Team, and NUCFAC.

☒ Survey these agencies to better understand the overlap and intersection of programs and policies. A survey was attempted, but participation was too low, despite repeated attempts to engage program contacts. Another survey is not recommended.

☐ Convene as many federal agency programs as possible, to explore how programs can work together to avoid redundancies, align activities, and/ or leverage funding for achieving shared goals and increasing collective impact.

Federal Agency Partnerships

Urban Waters Federal Partnership
(14 Federal Agencies)

This partnership will reconnect urban communities, particularly those that are overburdened or economically distressed, with their waterways by improving coordination among federal agencies and collaborating with community-led revitalization efforts to improve our Nation's water systems and promote their economic, environmental and social benefits.

Partnership for Sustainable Communities
(3 Federal Departments)

The Partnership for Sustainable Communities (PSC) works to coordinate federal housing, transportation, water, and other infrastructure investments to make neighborhoods more prosperous, allow people to live closer to jobs, save households time and money, and reduce pollution. The partnership agencies incorporate six principles of livability into federal funding programs, policies, and future legislative proposals.

Department Of Energy (DOE)

- State and Local Solution Center (Office of Energy Efficiency & Renewable Energy)
- Federal Energy Management Program (Office of Energy Efficiency & Renewable Energy)
- Office of Soil & Ground Water Remediation Program (Environmental Management)

Department of Transportation (DOT)

- Sustainable Highway Initiative (Fed. Highway Administration)
- Pipeline and Hazardous Materials Safety Administration
- TIGER Discretionary Grants (Office of Infrastructure Finance & Innovation)

Federal Emergency Management Agency (FEMA)

- Disaster Recovery Framework
- Hazard Mitigation
- Planning for Disaster Resistance Communities

Department Of Education

- Green Ribbon Schools
- Green Strides
- Environmental Education

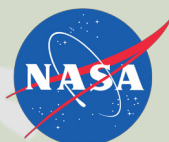### Centers For Disease Control & Prevention (CDC)

- Healthy Communities Program (Community Health)
- Go Green, Get Healthy Initiative (Office of Sustainability)
- National Center for Environmental Health
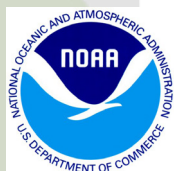- Health Impact Assessment (Healthy Places)

U.S. Botanic Garden

- Sustainable Sites Initiative
- Sustainability Program

National Aeronautics and Space Administration

National Oceanographic Agency

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Definitions

Urban and Community Forest ("Urban Forest"): The term urban and community forest encompasses cities, their suburbs, and large and small towns. It refers to all publicly and privately owned trees within an urban area – including individual trees along streets and in backyards, as well as stands of remnant forest (Nowak et al., 2001). Urban forests are an integral part of community ecosystems, whose numerous elements (such as people, animals, buildings, infrastructure, water, and air) interact significantly to shape the quality of community life at all levels. The urban forest includes street and yard trees, parks, cemeteries, school grounds, and undeveloped green spaces, and green infrastructure. In the Cooperative Forestry Act of 1978, as amended through 2008, and revised in May 2011, urban and community forests provides the following benefits:

(1) the health of forests in urban areas and communities, including cities, their suburbs, and towns, in the United States is on the decline;

(2) forest lands, shade trees, and open spaces in urban areas and communities improve the quality of life for residents;

(3) forest lands and associated natural resources enhance the economic value of residential and commercial property in urban and community settings;

(4) urban trees are 15 times more effective than forest trees at reducing the buildup of carbon dioxide and aid in promoting energy conservation through mitigation of the urban heat island effect in urban areas;

(5) tree plantings and ground covers such as low growing dense perennial turf grass sod in urban areas and communities can aid in reducing carbon dioxide emissions, mitigating the heat island effect, and reducing energy consumption, thus contributing to efforts to reduce global warming trends; and

(6) efforts to encourage tree plantings and protect existing open spaces in urban areas and communities can contribute to the social well-being and promote a sense of community in these areas.

Urban and Community Forestry ("Urban Forestry"): The term urban and community forestry refers to the art, science, and technology of managing trees, forests, and natural systems on public lands in and around cities, suburbs, and towns for the health and well-being of all people. It encompasses the growing professional cadre of programs, activities, tools, resources and research that are needed to manage, maintain and steward the urban forests, for the purpose of ensuring that urban forests are healthy and provide their optimal range of community benefits.

Non-governmental organizations: A non-governmental organization (NGO) is any non-profit, voluntary citizens' group organized on a local, national or international level. Task-oriented and driven by people with a common interest, NGOs perform a variety of service and humanitarian functions, bring citizen concerns to governments, promote and monitor policies and encourage political participation through provision of information. They provide analysis and expertise, serve as early warning mechanisms and help monitor and implement community policies and programs.

Underserved Communities: Underserved communities are communities that do not receive equitable financial and technical assistance as other communities might, in maximizing the benefits from the conservation and management of their natural resources. In this context, the term "underserved" encompasses low income, under-represented racial / ethnic minorities; Native Americans; people with disabilities; and the elderly.
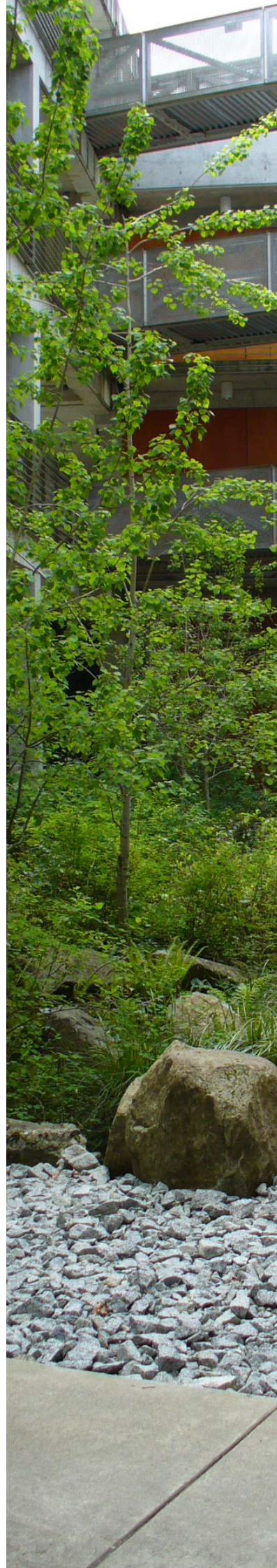
Ecologically Underserved: Communities lacking sustainable ecosystem services due to inadequate urban forest structure and management that diminishes environmental, socioeconomic, and health benefits

Green Infrastructure: Green infrastructure is strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.

Sustainability: As defined by the 1987 U.N. Brundtland Commission, sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability has become a core tenet of 21st century community development and planning, reflected in the rise across America of community sustainability plans. Sustainability typically encompasses three key elements: environmental, social, and economic.

Ecosystem: An ecosystem is a community of people, plants, animals, and microorganisms interacting with one another and their nonliving environment (water, soils, nutrients).

Resilience: Resilience is broadly defined as "the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity" (Walker et al. 2006: 2), with "shock" being another term for a disturbance or pulse effect. Resilience is a relatively new addition to the national lexicon, reflecting the rising stressors on communities from natural, human, and economic pathways. Resilience is the ability of a whole system to be better prepared for bumps, shocks, even disasters. Rather than "bouncing back" from these events and rebuilding in the same way as before, resilience implies that the community will "bounce forward" as it learns from these events and rebuilds in a continual improving process

Community Resilience (CR): Is defined as the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise.

Urban Heat Island: The term urban heat island (UHI) describes the phenomenon in which cities are generally warmer than adjacent rural areas.

Biophilic Cities: Biophilic cities are cities of abundant nature in close proximity to large numbers of urbanites; biophilic cities are biodiverse cities, that value, protect and actively restore this biodiversity; biophilic cities are green and growing cities, organic and natureful. Biophilic cities are cities that provide abundant opportunities to be outside and to enjoy nature through strolling, hiking, bicycling, exploring; biophilic cities nudge us to spend more time amongst the trees, birds and sunlight