LANDSCAPE
TOOL SERIES

THE MULTIPLE BENEFITS OF WATER CONSERVATION

Defining the environmental and social benefits of landscape transformation programs

MAY 2020

CALIFORNIA
WATER EFFICIENCY
PARTNERSHIP
A Chapter of the Alliance *for* Water Efficiency

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Prepared by the California Water Efficiency Partnership with funding from the California Department of Water Resources

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DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA ·

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EXECUTIVE SUMMARY

With funding from the California Department of Water Resources, The California Water Efficiency Partnership (CalWEP) conducted a literature review on the various social and environmental benefits attributed to urban water conservation. In particular, CalWEP sought information on benefits attributed to a specific water management strategy: *turf replacement* programs (also known as landscape transformation programs). These programs became the focus since they are ubiquitous across the state, will likely continue into the future, and can achieve multi-objective water management goals (AWE, 2019). This work supplements efforts by the Pacific Institute who, in 2019, released a multi-benefit framework and web-based resource database for examining water management strategies.[1] The intent of this work is to identify metrics and other qualitative measures not traditionally factored into water management decisions for outdoor use efficiency and compile the information to make it readily accessible to water managers, conservation staff and other interested parties.

Findings from the landscape-specific literature review have been synthesized into downloadable cut sheets, as part of CalWEP's landscape tool series, representing a specific benefit theme provided by the Pacific Institute's multi-benefit framework: 1) Water, 2) Energy, 3) Risk & Resilience, 4) Land & Environment, and 5) People & Communities. Each cut sheet has been designed to highlight the following information:

- Summary narrative of findings from academic literature and other studies
- Quantitative benefit
- Qualitative benefits (where applicable)
- Comprehensive bibliography

Together, this report and its associated cut sheets can be utilized by water agency staff to achieve any of the following:

- Develop an appreciation for the breadth of multi-benefits, both environmental and social, associated with landscape transformations;
- Integrate benefits into water management multi-benefit decision making frameworks;
- Improve landscape transformation program pitches to increase uptake by hard-to-reach customers, including the CII sector;
- Improve the business case for landscape transformation using return on investment tools; and
- Source benefits for use in community-based social marketing campaigns.

Straus Family Creamery headquarters community turf sheet mulch event hosted by Daily Acts in Petaluma, CA (2019). Source: Daily Acts

1 More information on the Pacific Institute's Multi-benefit framework and supporting resource library is available at https://pacinst.org/multiplebenefits/

BACKGROUND

Water that is conserved has a value. Most often this value is translated as the avoided costs associated with maintaining and/or expanding infrastructure to meet unmitigated demand. And while avoided cost accounting has helped decision-makers justify continued investments in water conservation and efficiency programs, such an analysis is limited in scope. Nearly a decade ago CalWEP (formerly the California Urban Water Conservation Council, CUWCC) and the Alliance for Water Efficiency developed technical models to help agencies perform value of conserved water analyses within their service areas and accounted for energy savings and greenhouse gas (GHG) emission reductions, and wastewater treatment costs. CUWCC also built an "environmental benefits of water conservation model" in partnership with Lawrence Berkeley National Laboratory to assess environmental flows and subsequent benefits to fisheries from conserved water in the Delta. Although good first steps, none of these models perform a comprehensive analysis of the additional social and environmental benefits that can be attributed to water conservation and efficiency.

In 2015, The California Public Utilities Commission (CPUC) conducted a study that examined avoided costs and environmental benefits of conserved water, but similarly did not incorporate sufficiently broad co-benefits (CPUC, 2015). While the CPUC study helps to expand the benefit and cost considerations integrated into planning and decision-making models for energy and water conservation, a true comprehensive assessment has yet to be realized. And as water management models evolve to adopt principles of "Integrated Regional Water Management" or a "One Water" approach, the need for more wholistic cost/benefit analyses for decision-making is warranted[2,3]. To this end, the Pacific Institute notes in its study *Moving Toward a Multi-Benefit Approach for Water Management*:

> *"Government agencies, businesses, and others have acknowledged the importance of multi-benefit projects and the potential of multiple benefits to assist with building partnerships, leveraging resources, and garnering public support.* **However, there is no standardized methodology for identifying and systematically evaluating the co-benefits of water management strategies.** *As a result, the broad benefits and costs of water management strategies are not routinely or systematically included in decision making, and water managers cannot maximize the benefits of their investments."*

Further, by narrowly focusing on the water saving potential of any conservation management strategy, agencies miss an opportunity to account for the additional performance objectives they are helping to support; objectives like storm water control and flood management, water quality protection, and energy reduction. For example, a recent study by the UC Davis Center for Water-Energy Efficiency found that water conservation programs were more cost-effective at reducing energy usage when compared to direct energy conservation initiatives (Spang et al., 2018). As such, a systematic evaluation of the co-benefits generated by the water/energy nexus can lend to a more equitable distribution of funding by justifying a cost-share framework amongst all beneficiaries, and thereby relieving a single entity from bearing the entire cost-burden of project implementation. Additionally, comprehensive accounting of co-benefits can help water conservation projects qualify for non-traditional grant funding. For example, the City of Santa Rosa was awarded funding from the State Water Resources Control Board's Prop 40 and 84 Stormwater Grant Program for a large landscape conversion project at Santa Rosa City Hall, because, in addition to water savings, the new design was projected to significantly reduced stormwater runoff.

2 Integrated Regional Water Management, as defined by the California Department of Water Resources, is a collaborative effort to identify and implement water management solutions on a regional scale to deliver higher value for investments by considering all interests, providing multiple benefits and working across jurisdictional boundaries. See: https://water.ca.gov/Programs/Integrated-Regional-Water-Management

3 One Water is an approach developed by the U.S. Water Alliance that emphasizes a collaborative cross-sector platform among various stakeholders for advancing integrated approaches to water resource management. See: http://uswateralliance.org/one-water

The literature review findings appended to this report in easy to read cut sheets, coupled with the Pacific Institute's work (Cooley et al., 2019; Diringer et al., 2019), exemplify the need for a *comprehensive evaluation framework* that can more accurately account for the true value of water conservation management strategies. Such a framework that helps to compare performance across benefit categories (i.e. water savings, energy reductions, air quality, etc.), can help prioritize alternative project solutions that otherwise would not have been considered for implementation. This includes more cost-effective, decentralized water management strategies like low impact development (LID)[4] (collectively known as Green Infrastructure) that can achieve multiple performance objectives.

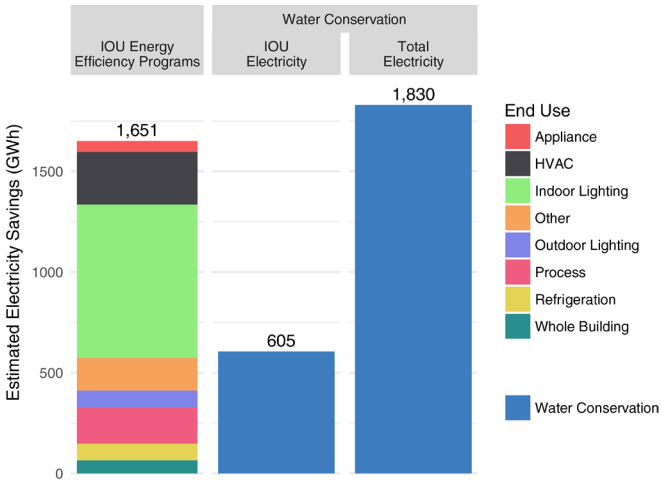

Fig. 1 Comparison of estimated electricity savings from Investor Owned Utilities (IOU) energy efficiency programs and water conservation under the CA urban water conservation mandate (July 2015-June 2016). Source: Spang et al., 2018

Images clockwise (top) City of Santa Rosa City Hall Sustainable Education Garden, post installation of the turf conversion and low impact development project. Features include CA native and low water use plants, swales, bio-retention, drip irrigation and weather-based irrigation amongst others; (bottom right) 1,200 gallon rainwater harvesting tank on display in outdoor classroom and gathering area; (bottom left) swale capturing, cleaning and infiltrating stormwater runoff. Source: City of Santa Rosa

4 Low Impact Development (LID), as defined by the U.S. EPA, refers to systems and practices that use or mimic natural processes to protect water quality and aquatic habitats. Example practices include vegetated swales, rain gardens, permeable pavement and rainwater harvesting features such as rain barrels. Green Infrastructure refers to the collection of LID features for any particular area or region. See: https://www.epa.gov/nps/urban-runoff-low-impact-development and https://www.epa.gov/green-infrastructure/what-green-infrastructure

RESOURCES FOR WATER AGENCIES

The Pacific Institute report, *Moving Toward a Multi-Benefit Approach for Water Management,* provides a framework to assist water managers and businesses with intentionally incorporating the multiple benefits of water projects into decision making across contexts and scales. The framework outlines a process for:

1. identifying the benefits, trade-offs, and beneficiaries of water management investments,
2. characterizing co-benefits quantitatively or qualitatively, and
3. incorporating co-benefits into decision making.

While step one demands a more holistic view of the value of conserved water, step two requires an additional level of investment as highlighted within the Pacific Institute report: "finding context-relevant, good-quality data to adequately assess each benefit is a common challenge." To help address this challenge, CalWEP, with funding from the California Department of Water Resources, conducted a literature review on the various environmental and social benefits attributed to *turf replacement* programs (also known as landscape transformation programs). These programs became the focus since they are ubiquitous across the state, will likely continue into the future, and can achieve multi-objective water management goals (AWE, 2019). Thus, the intent of this work was to identify metrics not traditionally factored into management decisions and compile the information to make it readily accessible to water managers, conservation staff and other interested parties. Select research and reports from the literature review have been organized into the Pacific Institute's comprehensive and searchable multi-benefit resource library[5]. To further synthesize the information, cut sheets offering detailed information on specific benefits have been prepared and appended to this report. The cut sheets can also be accessed via the CalWEP Toolbox[6].

We hope that by utilizing these collective resources, water managers can begin to explore more comprehensive decision-making models that integrate the multiple benefits of water conservation, including landscape transformation, to achieve any of the following objectives:

- Justify continued investments in conservation. programs as an effective water management strategy.
- Seek alternative funding sources.
- Prepare more competitive grant applications.
- Recruit diverse partners to help leverage funds.

5 The Pacific Institute's Multi-Benefit Resource Library provides a curated collection of studies and reports addressing the multi-benefits of water management strategies. See: https://pacinst.org/multi-benefit-resource-library/

6 See: http://toolbox.calwep.org/wiki/Multi-Benefits_of_Water_Conservation

BENEFITS OF LANDSCAPE TRANSFORMATION

Well-designed landscape transformation programs have the potential to yield benefits beyond water savings. Specifically, when landscapes are designed and managed like healthy watersheds, they can exploit natural processes that foster both environmental and human health. Several landscape design guides have been established to help codify *the watershed approach to landscaping*, they include ReScape California's Bay-Friendly Landscape Guidelines, Surfrider Foundation's Ocean Friendly Gardens principles, Seattle's Green Factor design guidelines, and Sustainable SITES®, as well as the best practices identified within the U.S. EPA WaterSense's certified Watershed Wise Landscape Professional training. Examples of standard watershed approach features include: Bioswales and rain gardens, rain barrels, cisterns, downspout disconnections, mulch and compost, efficient irrigation, and climate-adapted plants. As is generally accepted, a landscape that conforms to the watershed approach can generate any or all of the following outcomes:

1. reduced resource inputs like potable water, fuel and fertilizer;
2. improved environmental quality such as filtering pollutants from air and water; and
3. improved public health and wellbeing by increasing access to green space and reducing toxins in the environment.

Today, water agencies offer a host of outdoor conservation incentives, rebates and services ranging from simple irrigation upgrades to more sophisticated landscape transformation programs. Now in their second, or third roll-out, agencies have revamped the design criteria for landscape transformation programs to help maximize the number of benefits, or ecosystem services, per project. For instance, in order to receive rebate dollars from the Los Angeles Department of Water and Power's Turf Replacement Program, property owners must install a rainwater harvesting element and ensure 50 percent vegetated coverage by native or California Friendly® plants at maturity. While both of these elements can help save water they also capture and treat rainwater and increase regional biodiversity respectively, and thus help maximize a customer's investment.

Be on California native sage. Source: Ben Grangereau

A number of direct and indirect benefits have been observed by end-users who have converted their traditional turf dominated landscapes to less water intensive, sustainable models. Perhaps one of the earliest studies to monitor and document these benefits was the City of Santa Monica's garden/garden experiment. Over a nine-year period (2004-2013), garden/garden recorded substantial reductions in water use, green waste generation, and labor for a single-family residential landscape consisting of native, drought tolerant vegetation and efficient irrigation, in comparison to an adjacent landscape with mostly turf (City of Santa Monica, 2013). Southern California based non-profit Tree People demonstrated the multi-functionality of sustainable landscapes as early as the late 1990's, through the design and installation of three demonstration sites (TreePeople, 2007). Although the impetus for these projects was to reduce stormwater runoff and alleviate heat impacts from hardscape, TreePeople documented numerous co-benefits that included carbon sequestration from trees and social benefits for students attending an upgraded school site. More recently, regional studies that evaluated post-installation impacts found that sustainable landscapes were also responsible for establishing new social norms within neighborhoods (IRWD, 2016; AWE, 2019). The phenomena known as the "peer effect" has been observed in neighborhoods spanning geographically distinct regions of the state, whereby residents taking social cues from a landscape

transformation within their neighborhood willfully adopt similar changes within their own landscape. Thus, while landscape transformation programs have the proven potential to maximize investments, as demonstrated by the studies cited here, the need to develop a standardized methodology for quantifying and evaluating these benefits remains.

To help visualize the breadth of potential benefits from landscape transformation, the Pacific Institute developed several "mind maps" of the direct and indirect economic, environmental, and social benefits associated with specific sustainable landscaping features that collectively embody the watershed approach (Pacific Institute, February 2019). These mind maps, comprised of multi-tiered benefits resembling a complex spiderweb, are impressive and helpful for visually demonstrating the myriad number of benefits beyond water savings that could be factored into decision-making models. In its companion report, the Pacific Institute grouped these benefits into five categories: Water, Energy, Risk & Resilience, Land & Environment, and People & Communities (Cooley et al., 2019). To help supplement this work and make the information readily available to water agencies, CalWEP has generated a sub-set of benefit specific cut sheets which are appended to the back of this report.

ReScape California's 8 principles for regenerative landscapes promote designs that reap multiple benefits. These same benefits can be included in water management decision making frameworks. Source: ReScape California[7]

7 ReScape California, an environmental workforce and marketplace development non-profit that educates about and advocates for a whole-systems approach to landscaping that works in harmony with the natural world and addresses the changing environment.

BENEFITS TO CII CUSTOMERS

Landscape transformation programs become cost effective water management strategies when they are scaled to maximize impact. The relatively large parcel sizes of commercial, industrial and institutional (CII) properties and the large acreage they comprise collectively, make these sites good candidates for landscape transformation projects (Cooley et al., 2019). The potential water savings from replacing irrigated turf on CII properties alone is often worth the investment in targeted outreach, education and rebate and incentive programs. Yet, except for a relatively small subset of motivated property owners, agencies have struggled to increase CII customer uptake in landscape transformation programs. Various explanations have been offered for this disinterest, including messaging that does not appeal to their primary motivations and a lack of understanding of the full menu of benefits afforded businesses including things like achieving sustainability goals, improving reputation and status, and even employee satisfaction. For example, a survey administered to the business community residing within Southern California's Santa Ana River watershed revealed different priorities when it came to landscape transformation: "Some are motivated by the need to maximize their return on investment, whereas others are motivated by sustainability or reputational benefits. Likewise, challenges range from uncertainty about the costs and benefits of the practices to limited incentives." (Cooley et al., 2019). Thus, if program pitches are to resonate with this customer segment, they need to account for more than just water savings. Marketing methods rooted in social and behavioral science, such as Community-Based Social Marketing (CBSM), can help agencies identify primary motivators and perceived benefits and barriers for targeted customer groups. Additionally, CBSM offers a menu of tools to help enhance benefits and mitigate barriers often via social norming messaging and program redesign[8]. Where "enhancing benefits" should entail a presentation of the most relevant benefits to CII customers. The benefit cut sheets offered at the end of this report can assist water agencies in making informed decisions about which quantitative and/or qualitative benefits might best appeal to any particular customer segment.

8 As part of its Landscape Tool Series, CalWEP published several resources on Community-Based Social Marketing including a detailed case study and a customer survey. See: http://toolbox.calwep.org/wiki/Community_based_social_marketing

TOOLS THAT APPEAL TO CII CUSTOMERS

The number and magnitude of co-benefits actualized by any single landscape transformation is a function of the design features installed and local environmental conditions (i.e. average rainfall, peak evapotranspiration, topography, etc.). For instance, programs that require both replacement of turf with climate-appropriate plants and installation of rainwater harvesting features will help lower the irrigation demand and enable potable water offsets respectively. Yet, those areas within California that have the highest peak water demand, are likely to benefit the most. And that's just the water savings, these same features can help to increase biodiversity while also providing stormwater management benefits. Landscape return-on-investment (ROI) calculators are tools that enable various end-users (i.e. planners, designers, landscape industry workforce, and water conservation staff and agency customers) to optimize their sustainable landscape designs in order to generate the most attractive ROI. Examples include the City of Santa Rosa Landscape Water Management ROI Calculator, Sonoma State University's Integrated Water and Land Management Tool, Utah State University's Value Landscape Engineering Model and the Center for Neighborhood Technologies National Green Values Calculator[9]. The calculators have been programmed to conduct multi-benefit assessments for various combinations of user-selected sustainable landscaping design elements, while taking into account regional conditions. By reporting typical business-decision metrics that tend to resonate with the CII sector, such as net present value and years to pay-back, calculators can be useful tools of persuasion that, in-theory, should help increase the CII sector's participation in landscape transformation programs. Yet the tools themselves are only as good as the data they rely on to compute the ROI. In recent years, environmental economists have sought to improve the quality and quantity of data by establishing metrics for the breadth of ecosystem services generated by urban landscapes. This data, coupled with qualitative data provided by social- and health-science studies that document the human health benefits of landscapes, can help inform the design of more robust calculators that reflect the true cost of conserved water in the landscape. As the developers of the Utah State University calculator note: ". . . existing information is dispersed among scientific and university Cooperative Extension sources, vendors, and landscape professionals, and is not organized or synthesized to support decision making by property owners." The metrics reported within the cut sheets appended to this report can serve as a resource for updating landscape ROI calculator input data, and thus specifically tackle the issues noted by the Utah researchers.

Straus Family Creamery removed 14,500 square feet of turf at their headquarters in Petaluma, CA estimated to save nearly 200,000 gallons of water annually. Sited adjacent to a busy thoroughfare, passersby can appreciate the company's commitment to sustainable practices. Source:Daily Acts

9 See under separate Cover CalWEP's review of landscape return on investment tools, including findings from a roundtable discussion with agency experts and tool developers to address calculator upgrades in March of 2017.

BRINGING IT ALL TOGETHER

When water agencies adopt a multi-benefit decision making framework for evaluating water management strategies they can benefit in the following ways:

1. Access to non-traditional funding opportunities (i.e. stormwater management or greenhouse gas reduction funds);
2. Development of more robust, and thus more competitive, grant proposals;
3. Justification for leveraging funds amongst all project beneficiaries;
4. A process that supports increased collaboration between beneficiaries as recommended by Integrated Regional Water Management and One Water.
5. Justification for investing in more decentralized, less capital-intensive, water management strategies that have traditionally been dismissed including Low Impact Development and Green Infrastructure;
6. A process for evaluating both equity and social impacts per each water management strategy;
7. Public relations opportunity for highlighting community investments, including things like reduction of flood risk, beautification and enhancing local biodiversity and habitat.

Source: Daily Acts

By creating a repository of the quantitative and qualitative benefits linked to landscape transformation programs that utilize the watershed approach, and making this information readily accessible, as through the multi-benefit cut sheets and the Pacific Institute's multi-benefit resource database, water agencies can benefit in the following ways:

1. Update their program design criteria to help maximize landscape investments;
2. Improve program pitches, by highlighting select benefits that tend to resonate with target customers including the CII sector;
3. Access to information that can help inform a community-based social marketing approach for improving program uptake;
4. Update landscape ROI calculator input data to generate more attractive business-decisions metrics that appeal to the CII sector, like net present value and years-to-payback.

Further, this same repository of multi-benefit resources can be utilized to help improve customer awareness of the plethora of benefits available to them via landscape transformation programs. For CII customers in particular, water agencies can highlight the following benefits that appeal to their primary motivators including:

- Reduced material and maintenance costs
- Achieving sustainability goals and corporate stewardship commitments
- Improved status and reputation
- Increased employee satisfaction

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APPENDICES

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MULTI-BENEFITS OF LANDSCAPE TRANSFORMATION

PEOPLE & COMMUNITY: HUMAN HEALTH & WELL-BEING

Introduction

Sustainably designed landscapes, especially those that replace hardscaped areas with vegetation, can positively impact human health. The following elements are known to generate public health benefits when they are integrated into the urban landscape: trees, regionally adapted plants, living soils and rainwater harvesting features such as bioswales and raingardens. Collectively these landscape elements directly improve environmental health and indirectly improve human health by performing such services as filtering particulates from the air and reducing carbon dioxide, filtering pollutants from stormwater runoff and in turn improving surface water quality, generating oxygen, and cooling off the ambient temperature (Polonsky et al. 2018; CNT 2010). In short, as Tzoulas, et al. (2007) notes: "The link between ecosystem health and public health is the set of ecosystem services provided by the Green Infrastructure."

Time spent in urban nature, such as parks or other areas that integrate GI, is correlated with a number of public health benefits, including improved physical health, mental health and well-being, and community related benefits like social cohesion, defined by Hartig et al 2014 as "shared norms and values, the existence of positive and friendly relationships, and feelings of being accepted and belonging". For example, by making cities more walkable, Wolf et al. (2008) explains that "urban greening" can prompt exercise because "people make more walking trips when they perceive that there are many natural features in their neighborhood. In less green neighborhoods, people judge distances to be greater than they are, perhaps leading to decisions not to walk." White, et al. 2014, evaluated data from more than 10,000 panelists and found that, "on average, individuals have both lower mental distress and higher well-being when living in urban areas with more green space." Similarly, Wolf et al. 2008 claims that studies have shown, "views of nature rapidly reduce physiological stress response," and relatedly, others have demonstrated, "heart rate, blood pressure, and other body function measures return to normal levels more quickly when people view nature after a stressful experience." De Vries et al. (2003) found that both the quality and quantity of greenery along streets were associated with perceived social cohesion within neighborhoods, with quality being responsible for the strongest association.

Methods

Studies that report nature's effects on human health utilize methods that yield both quantitative and qualitative results. Typically, these methods can be summarized as follows:

- *Quantitative* methods utilize a number of metrics reported by the health field (i.e. measures of heart rate and blood pressure reported in epidemiological studies)
- *Qualitative* methods rely on self-reporting by surveyed populations (i.e. descriptors of personal wellbeing)

In 2013, Hartig et al., conducted an extensive "review of reviews "and summarized findings from 59 review articles addressing the link between nature and human health. They made the following key observations:

- Researchers "represent nature with diverse physical and spatial variables, encountered in diverse activity contexts," where, "much research does not accept exclusion of the artificial as a basis for defining nature or natural environment. The nature of interest is often situated in built environments, as with indoor plants and trees."
- Human health is assessed in many ways, including forms of morbidity, causes of mortality, longevity, self-reported health, and changes to emotional and mental health.
- The following *effect modifiers* can influence health impacts derived from contact with nature: gender, age, socioeconomic status, occupation, societal/ cultural context.

Hartig et al. (2014), notes that more recent studies have utilized digital technologies to advance studies that investigate the association between contact with nature and health. For example, MacKerron and Mourato (2013) using a smartphone app that signaled, "participants at random moments, presenting a brief questionnaire while using satellite positioning (GPS) to determine geographical coordinates," were able to generate over one million data points from more than

20,000 participants. This data was utilized to develop a model relating land cover to subjective wellbeing.

Additional Considerations

Although sustainable landscape design principles encourage either complete removal of turf or limited use of turf in the landscape, urban nature, such as parks, utilize turf in the landscape. Therefore, health benefits attributed to urban greenery in general, rather than a specific landscape features, are likely influenced by the presence of turf.

The quality and design of a landscape can moderate associations between urban greenery and social benefits like perceived well-being and social cohesion. For example, parks must be maintained to help facilitate social ties within a community (Hartig et al. 2014). Fleming et al. (2016) demonstrated that judgements of neighborhood safety directly impact the psychological benefits derived from access to green space, where neighborhoods deemed "unsafe" to "very unsafe" diminished these benefits almost entirely.

Primary Resources

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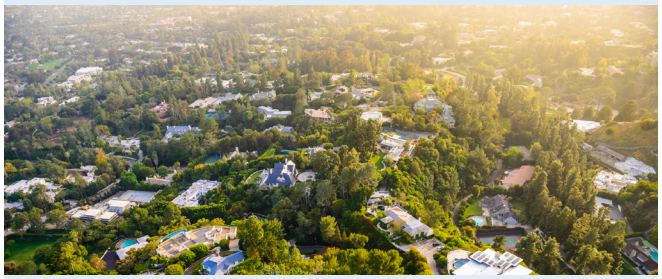
PEOPLE & COMMUNITY: PROPERTY VALUE

Introduction

A number of economic benefits are available to property owners who apply the watershed approach to their landscapes. As Clements and St. Julianna (2013) explain in their publication *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value*, the integration of Green Infrastructure (GI) can help property owners save on their utility bills while also reaping "higher rents and property values," and "increased retail sales" among other environmental and social benefits. Primary research conducted by Laverne and Winson-Geideman (2003) found "landscaping with a good aesthetic value added approximately 7 percent to the average rental rate of a building" for 85 commercial office buildings in Cleveland, OH. Wolf (2003) analyzed 270 survey responses from city dwellers within revitalized business districts and found that the presence of trees within a commercial retail setting were associated with a willingness to travel more often, as well as farther and longer to patronize businesses. These same respondents were also willing to stay at the commercial space longer and pay more for parking. Finally, the same study reported a 12 percent increase in willingness to pay for goods when the retail space contained vegetated streetscapes. Kaplan (2007) analyzed nature preferences from 49 surveyed employees of 41 businesses along a main corridor in Ann Arbor, MI and found those who could readily look outdoors were the most satisfied. These same individuals, "appreciated that they could see birds and other animals, the general appearance of the area outside, as well as the number and size of trees." Also, noteworthy was that manicured lawns at the place of employment "had no bearing on participants' satisfaction with any aspect of the natural environment, or its general appearance."

Data also suggests that residential property owners prefer smarter designed landscapes, as was observed more recently by the National Association of Home Builders. In their 2019 report *What Home Buyers Really Want*, the second ranked green preference by 4,000 recent home buyers or those looking to own a home within the near future, was "low-maintenance landscaping that grows in the local climate with minimal watering, weeding or mowing." Similarly, Ward et al. (2008) found that the installation of GI within select Seattle neighborhoods helped increase property values between 3.5 and 5 percent. Sustainable landscapes therefore can impact home sales, as was also documented by one Sacramento, CA news outlet. In 2014, CBS Sacramento reported that home prices were taking a hit because green lawns could not be sustained on drought watering restrictions, in one instance this accounted for a $9,000 loss. Another buyer was reported to have backed out of a home purchase when the cost of maintaining the landscaped was

Trees



The presence of trees within urban landscapes can influence property value.

Laverne and Winson-Geideman (2003) found that commercial rental rates were positively impacted by approximately 7% for buildings with good shade. Donovan and Butry (2011) found that rental prices for a sample of 985 single family homes in Portland, Oregon increased by $5.62 monthly from an additional tree on the lot, and similarly by $21.00 for an additional street tree located in the public right of way. In 2010 the same researchers found that street trees in front of homes increased the sale by over $7,000 and nearly $13,000 for homes that were within 100 feet of the tree (Donovan and Butry 2010). Placement of trees were found to influence home sales, where Culp (2008) found that trees sited on three sides of a house reduced time on the market by half, while trees who's branches overhung one side of a house reduced the sales price.

disclosed. This same buyer went on to seek out and purchase a property with drought-tolerant landscaping (CBS13 2014). Therefore, sustainable landscapes can help preserve or increase the market value of a property while also expanding the pool of interested buyers.

Methods

In its issue brief, the Natural Resources Defense Council (NRDC) estimated hypothetical monetary returns from GI investments for three typical commercial building types: a medium sized office building, mid-rise apartment building and a retail center (Clements and St. Juliana 2013). The results were reported in total present value over a 40-year analysis period and assumed a 6 percent discount rate. Results ranged from a net benefit of $2 to $24 million. Noteworthy is that property value was only assessed for the apartment building scenario and was attributed to a one-time sale. Additionally, each of the three analyses accounted for the installation of a green roof, which traditionally have not been eligible for water agency rebates, likely due to the high cost of design and installation. Nevertheless, the methodology used in the NRDC analysis could be utilized by water agencies to encourage CII property owners to invest in GI.

The Center for Neighborhood Technologies in partnership with American Rivers also laid out an approach for calculating "a variety of performance benefits gained by implementing GI strategies" on a parcel scale (CNT 2010). The approach utilized value estimates at the time of publication to assess the annual monetary benefits accrued from five GI practices, including: green roofs, tree planting, bioretention and infiltration, permeable pavement and water harvesting. Regarding property value, the study suggests a mean increase of 3.5 percent based on reported values from the literature.

Additional Considerations

As Clements and St. Juliana (2013) suggest, when it comes to making the business case for sustainable landscapes on commercial properties, it's important to account for the potential benefits that accrue over the average lifetime of ownership. This helps to generate a more attractive return-on-investment that reflects the cumulative services provided by GI over a set period. However, as Cooley et al. (2019) note, these sorts of benefit analyses are less appealing to tenants of commercial properties as "investment in sustainable landscaping incurred by the tenant is a sunk cost if the business moves."

While increased property values and rental rates can be attributed to the installation of GI or sustainable landscaping elements, studies have shown that the degree of increase is relative to the quality of the landscape. For instance, as early as 1994 Henry demonstrated that for a sample of 288 homes in Greenville, SC landscapes that were rated as "excellent" by landscape professionals accounted for a 4 to 5 percent increase in property value compared to landscapes that received a "good" rating. Similarly, in their study, Laverne and Winson-Geideman (2003) concluded, "It appears that landscaping does have a positive impact on rental rates, although quality is essential," and cited findings from the 9th Edition of the *Guide for Plant Appraisal* that 20 percent of the value of an improved residential property can be attributed to a well-maintained landscape. Lastly, CNT (2011) cautions that property value is a dynamic measure that will fluctuate over time and is influenced by local variations and pricing uncertainties. Therefore, property value estimates should be calculated with the most up-to-date market figures to not over or under-project benefits generated by landscapes.

Primary Resources

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TOOL SERIES

MULTI-BENEFITS OF LANDSCAPE TRANSFORMATION

ENERGY AND GREENHOUSE GASES

Introduction

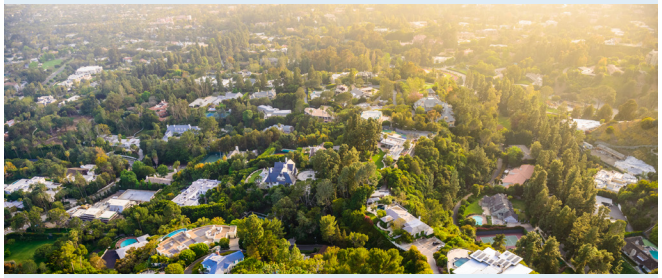
Maintaining landscapes requires energy, which results in releases of greenhouse gases (GHGs). Mowing lawns is fuel-intensive, and the decomposition of green waste, like grass clippings, releases GHGs. The California Air Resources Board (CARB) found that the population of lawn equipment with small engines exceeds the number of light-duty passenger cars by 3 million (16.7 million vs. 13.7 million respectively), and further, running a lawn mower for an hour is the equivalent of driving 300 miles. Collectively, the use of this equipment results in over 50 tons per day of smog forming emissions, and by 2031, CARB estimates that emissions from small engines will be more than double that of passenger cars (CARB 2017).

In addition to direct energy used for maintaining landscapes, energy is required to pump, treat, and deliver water to landscapes. This is often referred to as the "energy intensity of water," or the energy to pump, treat, and deliver a specific volume of water. For example, the Pacific Institute found energy intensities for four Sacramento County water agencies to range between 300 to 700 kWh/AF (Heberger 2013). Therefore, saving water saves energy. Spang et al. 2018 found that during the 2015 drought, energy savings in California were 11% higher for state-wide water conservation measures compared to all energy efficiency programs run by Investor Owned Utilities during that time.

Landscapes that integrate the watershed approach in both design and maintenance can have a significantly smaller carbon footprint than traditional landscapes. They require less inputs (i.e. water, fuel, and fertilizer), reduce the amount of methane-producing green waste from entering landfills, and they can also cool the air. For example, the City of Santa Monica demonstrated water savings of 83% and green waste reduction of 56% over the course of 9 years for a sustainably designed landscape in comparison to a traditional turf-dominant landscape. Maintenance hours were also reduced by 68% and included discontinued use of lawn mowers. The Alliance for Water Efficiency conducted a survey of more than a dozen agency landscape transformation programs and found a 7% to 39% reduction in outdoor irrigation (AWE 2019). Other indirect energy benefits include:

- rain gardens, bioswales and permeable pavements that help retain and infiltrate stormwater to reduce the need for onsite stormwater pumping;
- carbon sequestration by woody perennial shrubs and trees that help offset GHG emissions;
- vegetative cover that reduces summertime air temperatures and in turn the energy demand for indoor cooling (Dimoudi and Nikolopoulou 2003); and,
- GHG emission reductions can help businesses achieve their sustainability or corporate stewardship goals (Cooley et al. 2019).

Trees



Landscape trees can help reduce peak household energy demand.

Urban trees are responsible for creating microclimates and help to significantly reduce summertime air temperatures. By shading buildings trees help reduce the solar heat gain on windows, walls and roofs and they transpire moisture into the air to help increase latent cooling (Dimoudi and Nikolopoulou 2003). In the summer of 1992 Akbari et al. discovered that shade trees at two Sacramento homes generated a 30% reduction in cooling energy. Additionally, peak energy demand was also reduced by 0.6 and 0.8 kW per household. In a later study Akbari et al. 2001 found that for most hot cities in the U.S. shading a building can save between $5 and $25 per 100m^2 of roof area annually.

Tools

The Pacific Institute developed the River-Friendly Landscaping Calculator, to assess emissions for various landscape designs in Sacramento county by accounting for five maintenance activities: (1) irrigation water treatment and delivery, (2) fertilizer applications, (3) lawn mower usage, (4) green waste transportation and disposal, and (5) green waste biodegradation in landfills (Heberger 2013).

- River-Friendly Landscaping Tool:
  - Comprehensive tool but values restricted to Sacramento County
  - Open source format allows for adaptation to other regions
  - Includes energy embedded in water, but no carbon sequestration
  - Formulas for converting electricity type to GHG emissions
  - Outputs: Annual GHG emission in pounds of carbon dioxide equivalents

Climate Positive Design developed a free web-based calculator in 2019 that analyses the carbon footprint of commercial landscape projects and estimates the number of years until carbon neutrality. A Climate Positive Design Scorecard reports back the total embedded carbon from materials, carbon sequestered by plants, operational carbon from maintenance, and time in years to achieve carbon neutrality.

- Pathfinder Landscape Carbon Calculator:
  - Practical for large commercial landscapes
  - Impacts assessed for a 50-year lifespan
  - Outputs: reported in pounds of carbon dioxide equivalents

Additional Considerations

Typically, landscape energy consumption and GHG emissions are associated with water usage and maintenance and rarely account for energy use attributed to installation and materials. Thus, an energy life cycle assessment of landscapes would more accurately reflect energy consumption over their projected lifetimes. Further, the lack of data on carbon sequestration for specific plant types (except for turf and trees) including perennial low water use varieties, limits a comprehensive analysis of this benefit.

In order to accurately calculate energy savings from landscapes one must rely on site-specific conditions, these include:

- Energy intensities of regional and local water supplies
- Irrigation water requirement (IWR) per hydrozone (IWR is a factor of reference evapotranspiration, plant factor, landscape area and irrigation efficiency)
- Recommended maintenance practices per region (i.e. irrigation and mowing frequencies, fuel used for energy consuming activities, fertilizer applications, mulch dressing)
- Green waste disposal and/or composting

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