

Literature Supporting Claims Regarding the Economic Benefits of Green Industry Products (flowers, shrubs, trees, etc.)

Listed in chronological order

Sawka, M., et al. (2013). "Growing summer energy conservation through residential tree planting." *Landscape and Urban Planning* 113(0): 1-9.

Energy conservation strategies are now at the forefront of electrical utility demand-side management planning. Residential shade trees extenuate the heating of buildings in the summertime by intercepting insolation and by evapotranspirative cooling of their immediate surroundings. By modifying location-specific climate data and tree growth characteristics, we adapt the Sacramento Municipal Utility District's (SMUD) Tree Benefits Estimator for application in Toronto, Canada. We then use our tool to model the air conditioning energy conservation savings delivered by 577 trees planted in Toronto backyards between 1997 and 2000. In urban residential neighbourhoods, where houses are closely spaced, the energy conservation benefits of planting a tree depend on species, on pre-existing canopy, and on placement of the tree with respect to distance and orientation from buildings. Study trees contributed 77,140 kWh (167 kWh/tree) of electricity savings as of 2009, 54.4% of which was due to shading of neighbouring houses. Twenty-five years following planting, we estimate that each study tree will have delivered, on average, between 435 and 483 kWh in energy conservation benefit. Our findings indicate that residential tree-planting programmes in densely settled urban areas should not focus exclusively on location-driven strategic planting to yield large energy conservation benefits. Instead, we argue that priority should be given to selecting planting locations that will maximize tree survival as neighbourhood energy conservation benefits of a tree that achieves mature stature often outweigh the homeowner-specific benefits of a strategically planted tree.

Panduro, T. E. and K. L. Veie (2013). "Classification and valuation of urban green spaces—A hedonic house price valuation." *Landscape and Urban Planning* 120(0): 119-128.

In this paper we propose a categorization of green space into eight different types and quantify their impact on housing prices in the city of Aalborg using the hedonic house price method. The categorization was made manually according to an idealized description of the eight types of green space and a rating system in which each green space was rated according to accessibility, maintenance levels and neighboring negative land-use. The hedonic house price schedule for each of the green spaces was estimated using a generalized additive model, which allows for a data driven adjustment of underlying omitted spatial processes. To our knowledge the use of a spatial generalized additive model is novel to the hedonic valuation literature. We find that types of green space, which are rated highly in terms of accessibility and maintenance level, have high implicit prices whereas types with low ratings are not identified or provide ambiguous results. Green space buffering unattractive land-use such as infrastructure and industry is found to provide negative implicit prices despite controlling for the negative neighboring land-use. Our results clearly indicate that green space is not a uniform environmental amenity but rather a set of distinct goods with very different impacts on the housing price.

Saphores, J.-D. and W. Li (2012). "Estimating the value of urban green areas: A hedonic pricing analysis of the single family housing market in Los Angeles, CA." *Landscape and Urban Planning* 104(3-4): 373-387.

We analyze 20,660 transactions of single family detached houses sold in 2003 and 2004 in the city of Los Angeles, CA, to estimate the value of urban trees, irrigated grass, and non-irrigated grass areas. To deal with spatial autocorrelation and unobserved neighborhood characteristics, we contrast two models: a geographically weighted regression model, and a Cliff–Ord model with spatial lags in the dependent variable, the exogenous variables, and the disturbances as well as submarket fixed effects and an extensive set of covariates. We find that Angelenos like lawns: over 88% of the properties examined would gain value with additional irrigated grass on their parcel, and even more (89%) in their neighborhood. Although more non-irrigated grass/bare soil on parcels typically hurts property values, it often has the opposite effect at the neighborhood level. Moreover, additional parcel trees would decrease the value of almost 40% of the properties examined and they would have only a small positive impact on most of the others. By contrast, additional neighborhood trees would slightly increase the value of over 97% of the properties analyzed. This suggests that while Los Angeles residents may want additional trees, they are unwilling to pay for them. These results have implications for urban tree planting programs that rely primarily on private property owners.

Kovacs, K. F. (2012). "Integrating property value and local recreation models to value ecosystem services from regional parks." *Landscape and Urban Planning* 108(2–4): 79-90.

Multiple ecosystem services of parks may be capitalized into the property values of nearby houses. A joint hedonic housing price model and recreation demand model evaluates how park services are capitalized into property values for two regional parks in Portland, Oregon. The hedonic model suggests parks are an amenity of bundled positive and negative services. A non-linear variable for the percentage of park land surrounding a home explains how parks affect property values the best. The optimal percentage within a half-mile neighborhood is around 20%. An improvement in the quality of parks for recreation by 30% increases the property value of homes five to ten miles away by 0.04–0.06%. Thus, programs that improve recreation access to parks can increase the property values of a community.

Kadish, J. and N. R. Netusil (2012). "Valuing vegetation in an urban watershed." *Landscape and Urban Planning* 104(1): 59-65.

This study uses the hedonic price method to examine if land cover types-trees, shrubs, water and impervious surface areas-affect the sale price of single-family residential properties in Multnomah County, Oregon. We combine detailed structural and location information for 36,753 single-family residential property sales with the percentage of land cover on each property and within three buffers surrounding each property. Trees contribute positively to a property's sale price, but the estimated increase may be less than the costs of planting and caring for trees. Benefits received by nearby property owners may justify actions by government agencies to expand canopy coverage.

Hui, E. C. M., et al. (2012). "The impact of landscape views and storey levels on property prices." *Landscape and Urban Planning* 105(1–2): 86-93.

The relationship between a property's transaction price and its landscape views has attracted scholarly attention over the years. The Spatial Durbin model, which can provide an unbiased estimate in all types of true spatial data-generation, is introduced in this study to discuss the impact of these landscape view factors on property prices. The emphasis of this paper is on various landscape view influences on different submarkets (i.e. storeys) of high-rise buildings in a compact city such as Hong Kong. The findings indicate that while the availability of garden view is found to be positively correlated with transaction prices of flats in all three submarkets, varying degrees of differences are observed as to the impact of landscape attributes (such as seaview and proximity to avenue/street) and of the spatial lag effect on transaction prices of flats in these submarkets. In particular,

contrary to popular beliefs, the availability of seaview is not considered a positive attribute to the transaction prices of high-storey flats. These differences indicate the importance of vertical spatial influence which has not been considered in conventional spatial models, but is useful in studying the situations in other cities which are also compact and consist mainly of high-rise buildings.

Vandermeulen, V., et al. (2011). "The use of economic valuation to create public support for green infrastructure investments in urban areas." *Landscape and Urban Planning* 103(2): 198-206.

Increasing urbanization has created pressure on land use. Today more and more land in urbanized areas is used for housing, industry, community services or other economic functions. However, green spaces have a proven positive effect on people living in the neighborhood of green spaces, as well as on people working or recreating in the urbanized area. Therefore, green infrastructure investments have been put high on the agenda in many European countries. In order to convince the public and other stakeholders of the usefulness of these kinds of green investments, it is necessary to give a correct, understandable and easily repeatable method to value the investment. The current article describes a model that can be used to put the value of green infrastructure investments into economic terms. Evaluating the project at site scale and regional scale will give a complete overview of all direct, indirect and use values of the investment. By using cost–benefit as well as multiplier analyses the monetary values can be estimated. The article shows that using this model helps to justify policy's support for and investment in green space.

Damigos, D. and F. Anyfantis (2011). "The value of view through the eyes of real estate experts: A Fuzzy Delphi Approach." *Landscape and Urban Planning* 101(2): 171-178.

So far, numerous studies have established that view plays a significant role in the market price of a dwelling. The vast majority of those studies have been conducted by means of the hedonic pricing method, which is generally considered to be time-consuming and expensive. In addition, several issues such as model specification and interpretation of results are also argued to be important in the relative literature. This paper presents the results of a study aimed at exploring the effect of pleasant and unpleasant views, e.g. green areas, seashore, cultural monuments, cemeteries, and industrial facilities, on property prices in the broader area of Athens, Greece. The survey was carried out using an alternative approach, which is based on an expert judgment technique, namely the Fuzzy Delphi method. The results indicate that a pleasant view could considerably increase the price of a house, up to about 50%, while an unpleasant view could lead to a decrease in the house price even by about 25%. The implementation of the Fuzzy Delphi method in the field of scenic view valuation seems to be promising, at least from a practical point of view. The method is fast, flexible and inexpensive and could be used as an alternative to hedonic analysis. However, the method faces some shortcomings and further research would be necessary before any firm conclusions could be drawn.

Niu, H., et al. (2010). "Scaling of Economic Benefits from Green Roof Implementation in Washington, DC." *Environmental Science & Technology* 44(11): 4302-4308.

Green roof technology is recognized for mitigating stormwater runoff and energy consumption. Methods to overcome the cost gap between green roofs and conventional roofs were recently quantified by incorporating air quality benefits. This study investigates the impact of scaling on these benefits at the city-wide scale using Washington, DC as a test bed because of the proposed targets in the 20–20–20 vision (20 million ft² by 2020) articulated by Casey Trees, a nonprofit organization. Building-specific stormwater benefits were analyzed assuming two proposed policy scenarios for stormwater fees ranging from 35 to 50% reduction for green roof

implementation. Heat flux calculations were used to estimate building-specific energy savings for commercial buildings. To assess benefits at the city scale, stormwater infrastructure savings were based on operational savings and size reduction due to reduced stormwater volume generation. Scaled energy infrastructure benefits were calculated using two size reductions methods for air conditioners. Avoided carbon dioxide, nitrogen oxide (NO_x), and sulfur dioxide emissions were based on reductions in electricity and natural gas consumption. Lastly, experimental and fugacity-based estimates were used to quantify the NO_x uptake by green roofs, which was translated to health benefits using U.S. Environmental Protection Agency models. The results of the net present value (NPV) analysis showed that stormwater infrastructure benefits totaled \$1.04 million (M), while fee-based stormwater benefits were \$0.22–0.32 M/y. Energy savings were \$0.87 M/y, while air conditioner resizing benefits were estimated at \$0.02 to \$0.04 M/y and avoided emissions benefits (based on current emission trading values) were \$0.09 M–0.41 M/y. Over the lifetime of the green roof (40 years), the NPV is about 30–40% less than that of conventional roofs (not including green roof maintenance costs). These considerable benefits, in concert with current and emerging policy frameworks, may facilitate future adoption of this technology.

Mayer, M., et al. (2010). "The economic impact of tourism in six German national parks." *Landscape and Urban Planning* 97(2): 73-82.

Tourism in protected areas can create considerable income for adjacent communities. Based on face-to-face visitor surveys, the present study measures the structure, size and economic impact of tourist expenditure in the six German national parks Niedersächsisches Wattenmeer, Bayerischer Wald, Eifel, Müritzer, Hainich and Kellerwald-Edersee. We find that mean daily expenditure per person of national park visitors is considerably below the national averages for tourists in Germany: day-trippers spend between EUR 7 and 13 per day (national average: EUR 28), whereas overnight visitors spend between EUR 37 and 57 (national average: EUR 120). The proportion of visitors with high national park affinity varies between a maximum of almost 46% in Bayerischer Wald and a minimum of nearly 11% in Niedersächsisches Wattenmeer. Between 49% and 51% of tourist expenditure is captured as direct and indirect income. The total impact of tourism ranges between EUR 525 million in Niedersächsisches Wattenmeer and EUR 1.9 million in Kellerwald-Edersee, reflecting the national parks' distinct trajectories as tourist destinations. In order to increase the economic benefits accruing from national parks regional policy could aim at a qualitative upgrading of tourist services, increased marketing of the unique national park label and the promotion of a diverse regional supply base.

Joye, Y., et al. (2010). "The effects of urban retail greenery on consumer experience: Reviewing the evidence from a restorative perspective." *Urban forestry & urban greening* 9(1): 57-64.

Over the last three decades solid empirical evidence for the positive influence of greenery on human psychological and cognitive functioning has been steadily accruing. Based on this evidence, researchers and practitioners increasingly realize the importance of urban greening as a strategic activity to promote human wellbeing. Although commercial and retail activities constitute a significant and influential component of urban contexts, a concern is that the stakeholders involved (e.g. merchants) can sometimes be reluctant to integrate vegetation in commercial districts. This can be an important stumbling block for the process of urban greening. In this paper we introduce the concept of Biophilic Store Design (BSD) as the retail design strategy to consciously tap the beneficial effects of vegetation. The central aim of this paper is to demonstrate that the reluctance of certain retail stakeholders to integrate greening practices like BSD is unjustified. Two lines of evidence in support of this claim will be discussed. On the one hand, we sketch a conceptual framework which supports the view that BSD can have restorative effects for those implied in store environments. On the other hand, we review Wolfs multi-study research program on the effects of urban greening on consumer behavior, attitudes, and perceptions. These two

lines of evidence show that commercial activities and urban greening are not to be considered as antagonistic but as mutually reinforcing practices. (C) 2009 Elsevier GmbH. All rights reserved.

Sagoff, M. (2009). "The Economic Value of Ecosystem Services." *Bioscience* 59(6): 461-461.

Appleseed, I. (2009, May 2009). "Valuing central park's contributions to New York City's economy." from <http://www.appleseedinc.com/reports/centralpark-may2009.pdf>.

In May 2009, the Central Park Conservancy released a report on Central Park's impact on the economy of New York City. The report, which was prepared by Appleseed, highlights the multiple ways in which the Park contributes to the City's economic vitality – as a major enterprise in itself; as a magnet for visitors, a location for film and TV production and a venue for major events; as a resource for New York City residents; and through its impact on property values and City tax revenues. Most of the research and analysis presented in the report was completed in 2008, before New York City began to feel the full impact of the current recession. Some of the details of our analysis would of course be different if we had been using 2009 data. Retail and office rents in the area around the Park have declined, for example, and a sharp slowdown in the sale of apartments and commercial properties has meant less revenue from real property transfer taxes. On the other hand, because changes on taxable assessed values always lag behind changes in real market values (both on the way up and on the way down), the real property tax revenues that the City derives from properties near the Park (and in effect, from the Park itself) are actually higher in 2009 than they were in 2007. In other ways as well, Central Park's contribution to the City's economy is probably even more important today than it was at the height of the boom. Spending by Central Park enterprises and visitors to the Park directly and indirectly accounted for \$395 million in economic activity in New York City in 2007; and that this economic activity, along with the increase in real property values attributable to proximity to the Park, generated \$656 million in tax revenues for the City in 2007.

Younis, A., et al. (2008). "Case Study: Impact of a Well-Planned Landscape in Delivering Quality of Life to City Dwellers." *Proceedings of the International Symposium on Horticultural Practices and Therapy for Human Well-Being* (775): 147-154.

The quality of life in the cities is constantly declining due to increasing urbanization, industrialization and mechanization. Noise, dust, gaseous pollution and summer peak temperature are major problems in urban areas. The value of green spaces within the urban fabric is increasingly being rediscovered. The present study was conducted to explore the possibilities of sustainable establishment of landscape in accordance with the perception of the people's and local conditions. Planting design was made considering soil condition, local environment and people's choice. The design received a quick response from the community and had great impact on the Faisalabad environment. All the wasteland in the interior city has been greatly improved and it helped to curb pollution, enhance biodiversity and beautify the city at the same time. The results of the present study showed that 71% of the respondents mentioned that the landscape enhanced the beauty of the area, 17.5% opined that it controls pollution. Regarding the types of plants they liked in the central spine, 45% chose flowering plants followed by 33.3% shrubs. In road-side green spaces 51.7% wished to see shady trees followed by flowering plants (25%). In squares, 50% of the respondents chose flowering plants while 30.8% liked seasonal plants.

Wolf, K. L. (2008). "Community Context and Strip Mail Retail Public Response to the Roadside Landscape." *Transportation Research Record* (2060): 95-103.

Strip malls (or mini-malls) are a common land use, historically promoted by U.S. zoning practices that concentrate retail and commercial development in a narrow band along urban arterials and major streets. They are an entry-level retail niche offering opportunity for independent, start-up businesses that serve a limited market. Communities have begun to question land uses that enable efficient ingress and egress of vehicles in retail and commercial districts but give little attention to multimodal motility. Some communities are redeveloping small mall zones on the basis of "complete street" principles, expanding landscape plantings, and redeveloping the character of a business district. This study, assessed public response to one element of small mall (re)development: landscape and vegetation. Prior studies indicated that consumer behavior is positively associated with city trees (urban forest) on multiple cognitive and behavioral dimensions. In mail surveys depicting varied roadside treatments, residents of three major cities in the Pacific Northwest were asked to indicate preferences and perceptions about proposed changes. Survey stimulus materials addressed visual quality, retail perceptions, patronage behavior, wayfinding, and willingness to pay for goods and services. Combined econometrics and psychometrics indicated that respondents prefer landscaped roadsides and report positive retail behavior, such as willingness to pay 8.8% more for goods and services in well-landscaped malls. Redevelopment and roadside management guidelines are proposed based on the research results, with implications for the economics of local communities.

Sagoff, M. (2008). "On the economic value of ecosystem services." *Environmental Values* 17(2): 239-257.

The productive services of nature, such as the ability of fertile soil to grow crops, receive low market prices not because markets fail but because many natural resources, such as good cropland, are abundant relative to effective demand. Even when one pays nothing for a service such as that the wind provides in pollinating crops, this is its 'correct' market price if the supply is adequate and free. The paper argues that ecological services are either too 'lumpy' to price in incremental units (for example, climatic systems), priced competitively, or too cheap to meter. The paper considers counter-examples and objections.

Payton, S., et al. (2008). "Valuing the benefits of the urban forest: a spatial hedonic approach." *Journal of Environmental Planning and Management* 51(6): 717-736.

This paper measures the benefits of the urban forest by examining its effect on housing prices. A Geographic Information System is used to develop a measure of the urban forest, the Normalised Difference Vegetation Index, from satellite imagery and to construct other variables from a variety of sources. Spatial hedonic housing price models for the Indianapolis/Marion County area are estimated. The models indicate that greener vegetation around a property has a positive, significant effect on housing price, holding everything else constant. This effect is dominated by measures at the neighborhood level. These findings indicate that property owners value the urban forest, at least in part, by the premium they pay to live in neighborhoods with greener, denser vegetation. These findings also indicate that public action to maintain and enhance the urban forest may be warranted. Planners and urban foresters can use these findings to inform public and policy debates over urban forestry programs and proposals.

Criley, R. A. (2008). "Ornamentals - More than just beautiful." *Proceedings of the International Workshop on Ornamental Plants* 788: 23-28.

The myriad of cultures around the world differ from continent to continent and within continents, regions, and even cities themselves. The cultural expectations are often aesthetics-based, but there are more reasons than just beauty for the popularity of ornamental plants. Growers and garden centers feature the new, the different, the plant breeder introductions, and the tried-and-true heritage varieties, but keeping up with change is difficult. Across America, and to a certain extent, Europe, the traditional customers are retiring and the next

generation of customers is not willing to spend the time gardening that their parents did. In both the USA and Europe, increasing attention is paid to marketing and how to attract the 25- to 45-year-old customer. The market is changing from "Do It Yourself" to "Do It For Me," as the new generation, brought up on instantaneous gratification, wants it Now. In addition to the appeal of something new, the markets are promoting and sharing the knowledge of how valuable plants are in a home or workplace as stress relievers, air purifiers, environmental modifiers, health benefits, and symbols of feelings, friendship, and comfort. The support behind the commercial ornamental industries includes plant breeders and university and government researchers, but also industry organizations, marketplace gurus, psychologists, and social scientists. As cities reinvent their aging downtowns, the green industries play a huge role in enhancing the quality of life the urban dwellers experiences. Different strategies are needed for different target groups, but basic themes include "providing solutions," and contributing easy and instant applications. Growers must be able to choose among the many new plants introduced each year to produce enough plants for the demand, but they must also be ready to switch to new products when that demand weakens. Keys to this include knowing the customer better and keeping up with the trends that influence plant selection and use.

Clark, C., et al. (2008). "Green Roof Valuation: A Probabilistic Economic Analysis of Environmental Benefits." *Environmental Science & Technology* 42(6): 2155-2161.

Green (vegetated) roofs have gained global acceptance as a technology that has the potential to help mitigate the multifaceted, complex environmental problems of urban centers. While policies that encourage green roofs exist at the local and regional level, installation costs remain at a premium and deter investment in this technology. The objective of this paper is to quantitatively integrate the range of stormwater, energy, and air pollution benefits of green roofs into an economic model that captures the building-specific scale. Currently, green roofs are primarily valued on increased roof longevity, reduced stormwater runoff, and decreased building energy consumption. Proper valuation of these benefits can reduce the present value of a green roof if investors look beyond the upfront capital costs. Net present value (NPV) analysis comparing a conventional roof system to an extensive green roof system demonstrates that at the end of the green roof lifetime the NPV for the green roof is between 20.3 and 25.2% less than the NPV for the conventional roof over 40 years. The additional upfront investment is recovered at the time when a conventional roof would be replaced. Increasing evidence suggests that green roofs may play a significant role in urban air quality improvement. For example, uptake of NO_x is estimated to range from \$1683 to \$6383 per metric ton of NO_x reduction. These benefits were included in this study, and results translate to an annual benefit of \$895–3392 for a 2000 square meter vegetated roof. Improved air quality leads to a mean NPV for the green roof that is 24.5–40.2% less than the mean conventional roof NPV. Through innovative policies, the inclusion of air pollution mitigation and the reduction of municipal stormwater infrastructure costs in economic valuation of environmental benefits of green roofs can reduce the cost gap that currently hinders U.S. investment in green roof technology.

Rexhausen, J. and A. Dubey (2007). *The economic impact of the Cincinnati zoo & botanical garden on greater Cincinnati*, Economics Center for Education & Research, University of Cincinnati.

The Cincinnati Zoo & Botanical Garden is one of the premier recreational and cultural attractions in the Cincinnati Tri-state region, creating adventure through its exhibits and special events, conveying knowledge through its educational programs, conserving nature through its conservation efforts and serving community through various programs. In addition to its international reputation as an environmental and educational institution, it creates economic benefits for numerous households and businesses in the Greater Cincinnati community through its employment and business activity. This report estimates the economic impact of the Zoo on Greater Cincinnati's employment, household earnings, and business sales for 2006. The impact of The

Cincinnati Zoo on Greater Cincinnati is multi-faceted. Through its spending, its contracted services, and spending by visitors from outside the area, it benefits the regional economy. Through its plant and animal exhibits, programs, special events, and continuing development, it has an impact on the surrounding community in many other ways.

Wolf, K. L. (2006). "Assessing public response to freeway roadsides - Urban forestry and context-sensitive solutions." *Highway Facility Design 2006(1984): 102-111.*

Social science methods can be used to assess how the public values context-sensitive solutions. The roadside landscape is a public lands resource that has many functions and provides many benefits. Diverse stakeholders may have varied expectations for roadside design. The urban forest is often a contested component of the urban roadside. Two research surveys based on landscape assessment literature were used to assess and quantify public preferences and perceptions with regard to trees in highspeed and freeway roadsides. One photo questionnaire was distributed in urban areas nationally and the other in Washington State. To elicit public attitudes about visual quality and community image, each survey included design visualizations constructed with digitally edited photographs. Research results were consistent across both studies. Respondents judged images with increasing amounts of roadside vegetation, including trees, to have a higher amenity value. The presence of more extensive community greening was associated with positive consumer inferences and greater willingness to pay for goods and services. There was little variation in responses across respondent demographics. Results provide an empirical basis for flexible highway design and promote planning options for roadside urban forests that address multiple stakeholder interests.

Cho, S. H., et al. (2006). "Measuring the contribution of water and green space amenities to housing values; An application and comparison of spatially weighted hedonic models." *Journal of Agricultural and Resource Economics 31(3): 485-507.*

This study estimates the influence of proximity to water bodies and park amenities on residential housing values in Knox County, Tennessee, using the hedonic price approach. Values for proximity to water bodies and parks are first estimated globally with a standard ordinary least squares (OLS) model. A locally weighted regression model is then employed to investigate spatial nonstationarity and generate local estimates for individual sources of each amenity. The local model reveals some important local differences in the effects of proximity to water bodies and parks on housing price.

Wolf, K. L. (2005). "Business District Streetscapes, Trees, and Consumer Response." *Journal of Forestry 103: 396-400.*

A multistudy research program has investigated how consumers respond to the urban forest in central business districts of cities of various sizes. Trees positively affect judgments of visual quality but, more significantly, may influence other consumer responses and behaviors. Survey respondents from all regions of the United States favored trees in business districts, and this preference was further reflected in positive district perceptions, patronage behavior, and product pricing. An overview of the research is provided, with implications for the economics of local communities.

Wolf, K. L. (2005). "Trees in the small city retail business district: Comparing resident and visitor perceptions." *Journal of Forestry 103(8): 390-395.*

Many small cities and towns are located near resource lands, and their central business districts serve both residents and visitors. Such quasi-rural retail centers face competitive challenges from regional shopping malls, online purchasing, and big box discount retailers. District merchants must strategically enhance their market position to prevent outshopping. Streetscape trees are a physical improvement that can be used to attract and welcome consumers. A national survey evaluated public perceptions, patronage behavior intentions, and product willingness-to-pay in relationship to depictions of trees in retail settings. Results suggest that consumer behavior is positively associated with the urban forest on multiple cognitive and behavioral dimensions. Forest amenities of both wildland and built environments can be used to strengthen local economies.

Nowak, D. J. and G. M. Heisler (2005). "Trees in the city: Measuring and valuing the urban forest." NE Forest Science Review 4: 1-6.

Trees do more than just provide aesthetic benefits, they provide important cooling effects, reduce the urban heat-island effect, reduce incident UV rays and help keep pavement and parked cars cooler. In addition, in properly planted barriers, they can reduce wind and traffic sounds. They can actually reduce air pollution and absorb carbon dioxide (CO₂), the predominant greenhouse gas. Given current concerns about global climate change increasing temperatures, anything that helps to ameliorate the urban heat-island effect and reduce atmospheric CO₂ levels certainly merits attention and action. However, for the greatest benefits to occur from planting trees, two important details need to be right: species choice and location.

McPherson, G., et al. (2005). "Municipal forest benefits and costs in five US cities." Journal of Forestry 103(8): 411-416.

Increasingly, city trees are viewed as a best management practice to control stormwater, an urban-heat-island mitigation measure for cleaner air, a CO₂-reduction option to offset emissions, and an alternative to costly new electric power plants. Measuring benefits that accrue from the community forest is the first step to altering forest structure in ways that will enhance future benefits. This article describes the structure, function, and value of street and park tree populations in Fort Collins, Colorado; Cheyenne, Wyoming; Bismarck, North Dakota; Berkeley, California; and Glendale, Arizona. Although these cities spent \$13-65 annually per tree, benefits ranged from \$31 to \$89 per tree. For every dollar invested in management, benefits returned annually ranged from \$1.37 to \$3.09. Strategies each city can take to increase net benefits are presented.

McPherson, E. G. and J. Muchnick (2005). "Effects of Street Tree Shade on Asphalt Concrete Pavement Performance." Journal of Arboriculture 31(6): 303-310.

Forty-eight street segments were paired into 24 high and low-shade pairs in Modesto, California, U.S. Field data were collected to calculate a Pavement Condition Index (PCI) and Tree Shade Index (TSI) for each segment. Statistical analyses found that greater PCI was associated with greater TSI, indicating that tree shade was partially responsible for reduced pavement fatigue cracking, rutting, shoving, and other distress. Using observed relations between PCI and TSI, an unshaded street segment required 6 slurry seals over 30 years, while an identical one planted with 12 crape myrtles (*Lagerstroemia indica*, 4.4 m [14 ft] crown diameter) required 5 slurry seals, and one with 6 Chinese hackberry (*Celtis sinensis*, 13.7 m [45 ft] crown diameter) required 2.5 slurry seals. Shade from the large hackberries was projected to save \$7.13/m² (\$0.66/ft²) over the 30-year period compared to the unshaded street.

Mansfield, C., et al. (2005). "Shades of Green: Measuring the value of urban forests in the housing market." *Journal of Forest Economics* 11(3): 177-199.

Urban areas can contain public parks, protected forests, unprotected (or undeveloped) forest areas, and trees growing around a house or in the neighborhood surrounding the house. Each type of forest cover provides different amenities to the homeowner and to society at large. In particular, while trees on a parcel of land or in a neighborhood may add value for homeowners, the ecological value of these trees as habitat is far less than large, unbroken parcels of forest. We explore different definitions of forest cover and greenness and assess the relative value of these various types of forest cover to homeowners. Using data from the Research Triangle region of North Carolina, we test the hypothesis that trees on a parcel or in the neighborhood around that parcel are substitutes for living near large blocks of forest. The findings have implications for land-use planning efforts and habitat conservation in particular.

Lohr, V. I. and C. H. Pearson-Mims (2005). "Urban Residents Rate the Benefits of Trees in Cities Highly and Are Unconcerned with Problems Associated with Trees." *HortScience* 40(4): 1136-a-

In a survey, residents of the largest metropolitan areas in the continental United States rated the social, environmental, and practical benefits from trees in urban areas highly. They ranked the ability of trees to shade and cool surroundings highest. The potential of trees to help people feel calmer was ranked second highest. Survey respondents were not very concerned about potential problems with trees in cities, and felt that trees should be planted in cities regardless of any annoyance. Practical problems with trees, such as causing allergies, were bigger concerns than were financial issues. Responses varied slightly, based on childhood background and current demographic factors. For example, people who grew up with a garden near their home or actively worked with plants during childhood were more likely to appreciate the potential benefits of trees than were those who did not have such early experiences. People who strongly agreed that trees were important to their quality of life and those who did not strongly agree ranked the tree benefits and problems similarly, however. Those who strongly agreed that trees were important to their quality of life rated the benefits of trees more highly than people who did not strongly agree.

Crompton, J. L. (2005) How cities use parks to promote tourism.

Public parks are often the "engine" that drives tourism in many communities. In a simplified tourism model, visitors use some mode of transportation to leave their homes and travel to attractions, which are supported by various kinds of services, such as hotels/motels, restaurants, and retailing. The attractions and support services provide information and promote their offerings to target groups they have identified as potential visitors. Attractions activate this tourism system. Rarely do people leave their homes and travel some distance because they want to stay in a particular hotel or dine at a particular restaurant in a different locale. Most of the time, the desire to go to a destination on a pleasure trip is stimulated by its attractions. Many of these attractions are located in parks, while some parks are themselves attractions. This leads to the conclusion that in many communities, parks drive the tourism industry..

Blaha, K. (2005, 08/06/2010). "How cities use parks for smart growth." from <http://www.planning.org/cityparks/briefingpapers/index.htm>.

Parks are commonly thought of as the venue for "fun and games," but that is only one role they play in a metropolitan environment. Urban parks, which broadly include parkland, plazas, landscaped boulevards, waterfront promenades, and public gardens, significantly define the layout, real estate value, traffic flow, public events, and the civic culture of our communities. With open spaces, our cities and neighborhoods take on

structure, beauty, breathing room, and value. Public understanding of the pivotal role that parks play in enhancing the quality of life in our cities is growing, along with an understanding of the links between the quality of city parks and sprawling growth on the fringe of cities. City parks are an important element of smart growth that addresses both the public's need for greenspace and the role of greenspace in mitigating higher development density. The smart growth concerns of the public create opportunities for both public agencies and private foundations to leverage support for smart growth, "by making and "re-making" city parks that both strengthen urban cores and protect the fringe.

Behe, B., et al. (2005). "Landscape plant material, size, and design sophistication increase perceived home value." *Journal of Environmental Horticulture* 23(3): 127-133.

Little consumer research is available to help landscape design and installation businesses develop service marketing strategies. We investigated the effect of three components of a landscape design on the perceived value of a home. This information would be useful in marketing lawn and landscape services to prospective clients. Our objective was to provide a consumer perspective on the value of the components in a 'good' landscape and determine which attributes of a landscape consumers valued most. Using conjoint design, 1323 volunteer participants in seven US states (Delaware, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Texas) viewed 16 photographs that depicted the front of a landscaped residence. Landscapes were constructed using various levels of three attributes: plant material type, design sophistication, and plant size. Results showed that the relative importance increased from plant material type to plant size to design sophistication. Across all seven markets, study participants perceived that home value increased from 5% to 11% for homes with a good landscape.

Wolf, K. L. (2004). " Trees and business district preferences: a case study of Athens, Georgia, U.S." *Journal of Arboriculture* 30(6).

As a National Main Street program participant, Athens, Georgia, U.S., has included streetscape tree plantings in economic development efforts. The Main Street program assists downtown merchant groups with physical improvements planning in order to create vital retail environments. If comprehensively managed, the urban forest can be a beneficial long-term improvement. Nonetheless, business people and merchants often have negative perceptions about trees (such as debris and reduced sign visibility) and may influence local policy and budget support for urban forest programs. This study utilized an on-site survey to elicit preference and perceptual response from visitors of the Athens central business district. The presence of a full-canopy forest was found to be associated with higher visual quality ratings of the retail district. District visitors also perceived the streetscape canopy to be an integral amenity of the city's shopping environment. Quantitative and qualitative research outcomes are reported.

Wolf, K. L. (2004). "Nature in the Retail Environment: Comparing Consumer and Business Response to Urban Forest Conditions." *Landscape Jnl.* 23(1): 40-51.

Most research addressing public response to the urban forest has occurred in residential settings; little is known about consumer response to trees in retail places. This study evaluated both potential shoppers' and business people's preferences and perceptions of trees in inner-city business districts. Trees are highly preferred by both groups, although business people express slightly lower liking for visual categories containing trees. Differences in attitudes regarding tree benefits and annoyances were found, with business people rating tree benefits significantly lower than shoppers. Research outcomes suggest best practices for urban forest planning and stewardship in neighborhood retail environments of large cities.

Martin, C. A. and L. B. Stabler (2004). "Urban horticultural ecology: Interactions between plants, people and the physical environment." *Expanding Roles for Horticulture in Improving Human Well-Being and Life Quality*(639): 97-101.

Growing interest in the ecology of cities is providing a unique opportunity for horticultural scientists to study plant processes in an environmental setting that is foreign to most ecologists. Past studies in urban plant ecology have been limited to inventories and distribution of the plants present or have focused on areas of remnant native vegetation and impacts of urbanization on those remnant patches. Classic ecological pedagogy depicts exotic species as invaders, and human manipulations of the geo-surface as disturbance events. The real essence of urban vegetation as a system that has been carefully designed and is intensively managed to serve human interests has been overlooked. While the concepts of human/plant interactions are common and inherent to horticultural research, they may present a difficult obstacle to be overcome for those trained in conventional ecological circles. In conjunction with the Central Arizona Phoenix Long Term Ecological Research initiative, we have approached plant ecological studies in an urban system as an interacting triad of plants, people, and the physical environment. People arrange and manage plants in cities for aesthetic as well as practical purposes. Plant viability is predicated on horticultural practices, and the anthropogenic environment in which landscape plants grow can be physiologically stressful. At the same time, the arrangement of plants affects the biophysical environment of the city and the quality of life of the people living there. We propose that a better understanding of urban plant ecology is attained using a landscape horticultural perspective, one that is familiar with the interactions between plants, people, and the physical environment. Understanding the ecology of urban plants might lead to design and management strategies that maximize benefits associated with plants in cities and improve human well being and quality of life.

Crompton, J. L., et al. (2004). *The proximate principle: the impact of parks, open space and water features on residential property values and the property tax base*. Ashburn, Va., National Recreation and Park Association.

Communities are often confronted with the difficult decision of land use development. Often the assumption is that developing the land for residential homes offers more revenue to the community than developing parks and open spaces. Several factors show that this assumption is in error. The evidence shows that preserving open space can be a less expensive alternative to development. The evidence clearly indicates that preserving open space can be a less expensive alternative to development. Hence, a number of communities have elected to purchase park and open space land, rather than allow it to be used for residential development, because this reduces the net tax deficit for their residents, which would occur if new homes were built on that land. The conclusion is that a strategy of conserving parks and open space is not contrary to a community's economic health, but rather it is an integral part of it.

McPherson, E. G. (2003). "Urban forestry - The final frontier?" *Journal of Forestry* 101(3): 20-25.

Forestry and urban forestry have more in common than practitioners in either field may think. The two disciplines could each take better advantage of the other's expertise, such as foresters' impressive range of scientific theory and technological sophistication, and urban foresters' experience in working with diverse stakeholders in the public arena. The wildland-urban interface is geographic center of convergence, and the nexus of forest ecology and human ecology will become forestry's next frontier-where forestry and urban forestry join together to construct healthier habitats for humans.

Maco, S. E. and E. G. McPherson (2003). "A practical approach to assessing structure, function and value of street tree population in small communities." *Journal of Arboriculture* 29(2): 84-97.

This study demonstrates an approach to quantify the structure, benefits, and costs of street tree populations in resource-limited communities without tree inventories. Using the city of Davis, California, U.S., as a model, existing data on the benefits and costs of municipal trees were applied to the results of a sample inventory of the city's public and private street trees. Results indicate that Davis maintained nearly 24,000 public street trees that provided \$1.2 million in net annual environmental and property value benefits, with a benefit–cost ratio of 3.8:1. The city can improve long-term stability of this resource by managing maintenance, new plantings, and stand rejuvenation on a city zone basis.

Laverne, R. J. and K. Winson-Geideman (2003). "The influence of trees and landscaping on rental rates at office buildings." *Journal of Arboriculture* 29(5): 281-290.

The environmental and economic benefits of trees have been studied relative to a variety of interests including their influence on real estate value. This study investigates the effect of trees and landscaping on office rental rates, based on a comparison of 85 office buildings that comprise 270 individual and unique leases in the Cleveland, Ohio, U.S., metropolitan area. Data that describe the quantity, functionality, and quality of landscaping were gathered from each of the buildings including landscape maturity, the percentage of ground cover (trees, turf, pavement, etc.), and functional attributes (building shade, noise buffer, space definition, recreation, visual screen, and aesthetics). Multiple regression analysis in the form of a hedonic equation was conducted to isolate the economic effects of landscaping. Office attribute data including lease information, physical attributes, and distance variables were used to calibrate the basic model, and landscaping data were added to the hedonic equation to determine if individual and/or interactive variables had any effect on contracted rental rates. The individual analysis of the variables showed a strong positive effect for those buildings with good landscaping aesthetics and building shade provided by trees. Conversely, landscaping that provides a good visual screen produced significant negative impacts on rental rates.

McPherson, E. G. and J. R. Simpson (2002). "A comparison of municipal forest benefits and costs in Modesto and Santa Monica, California, USA." *Urban forestry & urban greening* 1(2): 61-74.

This paper presents a comparison of the structure, function, and value of street and park tree populations in two California cities. Trees provided net annual benefits valued at \$2.2 million in Modesto and \$805,732 in Santa Monica. Benefit-cost ratios were 1.85:1 and 1.52:1 in Modesto and Santa Monica, respectively. Residents received \$1.85 and \$1.52 in annual benefits for every \$1 invested in management. Aesthetic and other benefits accounted for 50% to 80% of total annual benefits, while expenditures for pruning accounted for about 50% of total annual costs. Although these results were similar, benefits and costs were distributed quite differently in each city. Variations in tree sizes and growth rates, foliage characteristics, prices, residential property values, and climate were chiefly responsible for different benefits and costs calculated on a per tree basis.

Lewis, M. (2002) *How cities use parks for economic development.*

Parks provide intrinsic environmental, aesthetic, and recreation benefits to our cities. They are also a source of positive economic benefits. They enhance property values, increase municipal revenue, bring in homebuyers and workers, and attract retirees. At the bottom line, parks are a good financial investment for a community. Understanding the economic impacts of parks can help decision makers better evaluate the creation and maintenance of urban parks.

Harnick, P. (2002) *How cities use parks for community revitalization.*

Parks are complex elements of a city. They can serve scores of different uses, may be specialized in their function, or can simply provide visual appeal for residents. However they work, they act to define the shape and feel of a city and its neighborhoods. They also function as a conscious tool for revitalization. Parks can stem the downturn of a commercial area, support the stabilization of faltering neighborhoods, and provide a landmark element and a point of pride for constituents. For all these things to happen, the city needs to be open and aware of parks' potential to spur revival, and support the elements that are needed to make that happen.

Francis, M. (2002) How cities use parks for community engagement.

Community engagement is the process of working collaboratively with individuals and groups to achieve specific goals. For parks and open spaces, community engagement allows mayors and public officials to directly involve their constituencies in the ongoing design, planning, and management of these resources. This process results in informed and engaged residents that feel better connected to their communities. While sometimes contentious, but more often productive and rewarding, community engagement is an essential ingredient of making successful urban open space. Parks support community engagement by providing residents with a venue for participation in and attachment to their communities. They also provide a sense of place and offer essential life-enhancing qualities that aid community and individual well-being. By understanding the community benefits of parks, decision makers can develop constituencies that can sustain their urban park systems over time.

Des Rosiers, F., et al. (2002). "Landscaping and House Values: An Empirical Investigation." *Journal of Real Estate Research* 23(1/2): 139-161.

This hedonic study investigates the effect of landscaping on house values, based on a detailed field survey of 760 single-family homes sold between 1993 and 2000 on the territory of the Quebec Urban Community. Environmental information includes thirty-one landscaping attributes of both houses and their immediate environment. By and large, a positive tree cover differential between the property and its immediate neighborhood, provided it is not excessive, translates into a higher house value. Findings also suggest that the positive price impact of a good tree cover in the visible surroundings is all the more enhanced in areas with a high proportion of retired persons. Finally, a high percentage of lawn cover as well as features such as flower arrangements, rock plants, the presence of a hedge, etc. all command a substantial market premium.

Meyer, M. H., et al. (2001). "The Economic Impact and Perceived Environmental Effect of Home Lawns in Minnesota." *HortTechnology* 11(4): 585-590.

Six hundred homeowners, equally divided among rural, suburban, and urban areas in Minnesota responded to a 1999 phone survey on their lawn size, maintenance practices, and the perceived environmental impact of their lawns. The average lawn size was estimated to be 0.62 acres (0.25 ha), with an estimated 872,660 total acres (353,427 ha) in home lawns in Minnesota. Annual spending on lawn care per home was about \$200, with an estimated \$150 million spent annually in Minnesota. Participants reported low maintenance practices and pesticide use. A majority thought fertilizers and pesticides were harmful to the environment and public health. Respondents felt strongly that the government has a right to regulate fertilizers and pesticides in public park and lawn areas, but were divided with regard to the appropriateness of regulation on private property. Many (78.9%) disagreed or strongly disagreed with the statement that their lawn was harmful to the environment. Most (60%) felt their lawn could have an effect on the environment and 71% felt they personally could make a difference in the environment by how they maintained their lawn.

McPherson, E. G. (2001). "Sacramento's parking lot shading ordinance: environmental and economic costs of compliance." *Landscape and Urban Planning* 57(2): 105-123.

A survey of 15 Sacramento parking lots and computer modeling were used to evaluate parking capacity and compliance with the 1983 ordinance requiring 50% shade of paved areas (PA) 15 years after development. There were 6% more parking spaces than required by ordinance, and 36% were vacant during peak use periods. Current shade was 14% with 44% of this amount provided by covered parking. Shade was projected to increase to 27% (95% CI 24-37%) when all lots in the sample were 15-year-old. Annual benefits associated with the corresponding level of tree shade were estimated to be US\$ 1.8 million (CI US\$ 1.5-2.6 million) annually citywide, or US\$ 2.2 million less than benefits from 50% shade (CI US\$ 1.4-2.5 million). The cost of replacing dying trees and addressing other health issues was US\$ 1.1 million. Planting 116,000 trees needed to achieve 50% shade was estimated to cost approximately US\$ 20 million. Strategies for revising parking ordinances to enhance their effectiveness are presented. Published by Elsevier Science B.V.

Shoemaker, C. A., et al. (2000). "Social Science Methodologies for Studying Individuals' Responses in Human Issues in Horticulture Research." *HortTechnology* 10(1): 87-93.

Many of the research questions that have been posed regarding the effects of plants on people can only be answered using methodologies from the social sciences. Lack of familiarity with these methods and their underlying concepts has limited the role that horticulturists have taken in this research. Horticulturists, because of their particular sensitivity to the various aspects of plants and the nature of the ways that people interact with plants, must be involved in this type of research to generate the information that is needed by horticultural industries. This paper reviews many of the common methods that have been used in research on human issues in horticulture and presents examples of studies that have been conducted using these techniques. Quantitative and qualitative methods are discussed.

Shafer, C. S., et al. (2000). "A tale of three greenway trails: user perceptions related to quality of life." *Landscape and Urban Planning* 49(3-4): 163-178.

Urban sprawl and renewed concern for the environment have helped create new policies and initiatives designed to enhance community quality of life. Among these are transportation enhancements mandated in ISTEA and TEA21. Funding through transportation enhancements has helped to spur the designation and development of greenway trails with the intent of fostering alternative transportation and generally making cities more livable. This paper presents research conducted on three greenway trails in Texas. The research was based on the human ecosystem concept and was intended to determine if and how such greenway facilities were contributing to quality of life and how people might perceive such contributions based on the way they used the trail (e.g. for transportation or recreation). Results indicated that most people used greenway h-ails for recreation but that trails differed in user types and activities based on location and policy. Users felt that these urban greenway trails were contributing most to community quality of life through resident health/fitness, the natural areas they provide, better land use and resident pride. They felt that they contributed least to diversifying industry, business development and access to shopping areas or public transportation. Those who used trails for transportation scored trails as contributing more toward reducing pollution, reducing transportation costs and providing better access to work than did those who used trails only for recreation. Implications for understanding use and users in the designation; design and development of urban greenway trails are discussed. (C) 2000 Elsevier Science B.V. All rights reserved.

Pearson-Mims, C. H. and V. I. Lohr (2000). "Reported Impacts of Interior Plantscaping in Office Environments in the United States." *HortTechnology* 10(1): 82-86.

Interiorscaping has been prevalent in office environments in the United States since the 1960s. Historically, proponents of interior plantings have cited numerous benefits, including improved employee morale, increased productivity, and reduced absenteeism when plants are added to the workplace, despite little scientific research to support these claims. Contemporary research is beginning to document some of these purported benefits of interior plantings on human comfort, well-being, and productivity. If researchers continue to provide concrete evidence that interaction with plants is directly linked to improved human health and well-being, this information will provide further justification for the use of interior plants in a variety of indoor work settings. With an ever-increasing emphasis by business managers on minimizing costs, it is important for industry professionals to provide quantifiable justification for the inclusion of plants in modern work environments.

Matsuo, E. (2000). "Education, Research, and Use of Human-Horticulture Relationships in Japan and Korea." HortTechnology 10(1): 14-17.

Plants and horticulture play an integral role in the cultural heritage of eastern societies. Plants are deemed as important in many ways besides being a source of food and shelter. The present study summarizes information on research and trends in the value and application of horticulture collected from professionals in Asian countries, focusing on the work in human-horticulture relationships in Korea and Japan.

Hodges, A. W., et al. (2000). Economic impacts of the Florida Botanical Gardens and related cultural attractions in Pinellas County Florida. Gainesville, FL, University of Florida.

This report estimates the potential regional economic impacts associated with construction, operations and tourism in the Heritage Village, Florida Botanical Gardens and Gulf Coast Museum of Art attractions. All three attractions are housed within a 180 acre site of Pinewood Cultural Park in Pinellas County, Florida and serve as research and public education vehicles on issues related to the arts, history and environment. This analysis estimated the total economic impacts associated with the Heritage Village, Florida Botanical Gardens and Florida Gulf Coast Art Museum attractions. Specifically, the total economic impacts of expenditures on or by overnight visitors, annual operations and construction between the years 2000 and 2002 were estimated for each attraction. This analysis was restricted to the 4-county region of Hillsborough, Hernando, Pinellas and Pasco counties and data assumptions employed in this study were based on information provided by the Pinellas County Cooperative Extension Service. Results revealed that the combined cultural attractions will stimulate output by \$170.1 million, increase employment by 2,409 jobs, stimulate value-added by \$92.1 million and increase labor income by \$63.8 million between the years 2000 and 2002. Additionally, the annual economic impacts of 1000-person overnight visitor expenditures were presented given some level of uncertainty surrounding actual overnight visitor attendance in each attraction. Each 1,000 person grouping will stimulate output by \$156.6 thousand, increase employment by 3 jobs, stimulate value added by \$92.6 thousand and stimulate labor income by \$60.4 thousand.

Simpson, J. R. and E. G. McPherson (1998). "Simulation of tree shade impacts on residential energy use for space conditioning in Sacramento." Atmospheric Environment 32(1): 69-74.

Tree shade reduces summer air conditioning demand and increases winter heating load by intercepting solar energy that would otherwise heat the shaded structure. We evaluate the magnitude of these effects here for 254 residential properties participating in a utility sponsored tree planting program in Sacramento, California. Tree and building characteristics and typical weather data are used to model hourly shading and energy used for space conditioning for each building for a period of one year. There were an average of 3.1 program trees per property which reduced annual and peak (8 h average from 1 to 9 p.m. Pacific Daylight Time) cooling energy use 153 kWh (7.1%) and 0.08 kW (2.3%) per tree, respectively. Annual heating load increased 0.85 GJ (0.80 MBtu, 1.9%) per tree. Changes in cooling load were smaller, but percentage changes larger, for newer buildings. Averaged over all

homes, annual cooling savings of \$15.25 per tree were reduced by a heating penalty of \$5.25 per tree, for net savings of \$10.00 per tree from shade. We estimate an annual cooling penalty of \$2.80 per tree and heating savings of \$6.80 per tree from reduced wind speed, for a net savings of \$4.00 per tree, and total annual savings of \$14.00 per tree (\$43.00 per property). Results are found to be consistent with previous simulations and the limited measurements available. Published by Elsevier Science Ltd.

McPherson, E. G., et al. (1998). "Estimating cost effectiveness of residential yard trees for improving air quality in Sacramento, California, using existing models." *Atmospheric Environment* 32(1): 75-84.

The Sacramento Municipal Utility District's (SMUD) shade tree program will result in the planting of 500,000 trees and has been found to produce net benefits from air conditioning savings. In this study we assume three scenarios (base, highest, and lowest benefits) based on the SMUD program and apply Best Available Control Technology (BACT) cost analysis to determine if shade trees planted in residential yards can be a cost effective means to improve air quality. Planting and maintenance costs, pollutant deposition, and biogenic hydrocarbon emissions are estimated annually for 30 years with existing deterministic models. For the base case, the average annual dollar benefit of pollutant uptake was \$895 and the cost of biogenic hydrocarbon emissions was \$512, for a net pollutant uptake benefit of \$383 per 100 trees planted. The uniform annual payment necessary to repay planting and maintenance costs with a 10% rate of interest was \$749. When high biogenic hydrocarbon emitting tree species were replaced with low-emitters, the base case benefit-cost ratio (BCR) increased from 0.5:1 to 0.9:1. The BCR for the "highest" and "lowest" benefit cases were 2.2:1 and -0.8:1, respectively. Although SMUD plantings produce cost effective energy savings, our application of the BACT analysis does not suggest convincing evidence that there is cost savings when only air quality benefits are considered. Published by Elsevier Science Ltd.

Kuo, F. E., et al. (1998). "Fertile ground for community: Inner-city neighborhood common spaces." *American Journal of Community Psychology* 26(6): 823-851.

Research suggests that the formation of neighborhood social ties (NSTs) may substantially depend on the informal social contact which occurs in neighborhood common spaces, and that in inner-city neighborhoods where common spaces are often barren no-man's lands, the presence of trees and grass supports common space use and informal social contact among neighbors. We found that for 145 urban public housing residents randomly assigned to 28 architecturally identical buildings, levels of vegetation in common spaces predict both use of common spaces and NSTs; further use of common spaces mediated the relationship between vegetation and NSTs. In addition, vegetation and NSTs were significantly related to residents' senses of safety and adjustment. These findings suggest that the use and characteristics of common spaces may play a vital role in the natural growth of community, and that improving common spaces may be an especially productive focus for community organizing efforts in inner-city neighborhoods.

Werner, J. E. B., et al. (1996). A study of the economic impacts of trees and forests in the commercial districts of New York City and New Jersey, New York Street Tree Consortium, Inc.

Trees New York (TNY) and Trees New Jersey (TNJ) conducted this research to generate quantifiable data and subjective valuation as related to trees and urban forests in commercial areas within the region. It was hypothesized that over the years there had been a steady loss of forest cover in commercially zoned suburban areas, as well as in downtown urban areas. The study examined the trends of forest loss in commercial districts within the region and sought to quantify the public and private benefits of these forests. This was accomplished through the use of Geographic Information Systems (GIS) software, existing scientific modeling techniques and interviews.

Simpson, J. R. and E. G. McPherson (1996). "Estimating urban forest impacts on climate-mediated residential energy use." 22nd Conference on Agricultural & Forest Meteorology with Symposium on Fire & Forest Meteorology/12th Conference on Biometeorology & Aerobiology: 462-465.

Nowak, D. J., et al. (1996). "Measuring and analyzing urban tree cover." Landscape and Urban Planning 36(1): 49-57.

Measurement of city tree cover can aid in urban vegetation planning, management, and research by revealing characteristics of vegetation across a city. Urban tree cover in the United States ranges from 0.4% in Lancaster, California, to 55% in Baton Rouge, Louisiana. Two important factors that affect the amount of urban tree cover are the natural environment and land use. Urban tree cover is highest in cities that developed in naturally forested areas (31%), followed by grassland cities (19%) and desert cities (10%), but showed wide variation based on individual city characteristics. Tree cover ranged from 15 to 55% for cities in forested areas, 5 to 39% for those in grassland areas, and 0.4 to 26% for cities developed in desert regions. Park and residential lands along with vacant lands in forested areas generally have the highest tree cover among different land uses. Methods of measuring urban tree cover are presented as are planning and management implications of tree-cover data.

McPherson, E. G., et al. (1996). "'Bact" analysis: Are there cost effective air quality benefits from trees?" Ninth Joint Conference on Applications of Air Pollution Meteorology with a&Wma: 355-359.

Simpson, J. R., et al. (1994). "Effects of Vegetative Cover on Climate, Local Scale Evaporation and Air Conditioning Energy Use in Urban Southern California." 21st Conference on Agricultural and Forest Meteorology/11th Conference on Biometeorology and Aerobiology: 345-348.

Sallis, J. F., et al. (1993). "Correlates of Physical-Activity at Home in Mexican-American and Anglo-American Preschool-Children." Health Psychology 12(5): 390-398.

Twenty-two potential correlates of children's physical activity were examined. Two hundred and one Mexican-American and 146 Anglo-American families with 4-year-old children were studied. Children's physical activity was directly observed in the evening at home on 4 visits for 1 hr each time. Anglo-American children and male children were found to be more active. Demographic variables explained 11% of the variance in children's physical activity. After adjusting for demographics, 3 children's variables and 6 social-family variables did not account for significantly more variance. Five environmental variables accounted for 11% additional variance. Variables observed concurrently with physical activity, such as time spent outdoors and prompts to be active, were highly associated with children's physical activity.

Bradshaw, J. and L. Tozer (1993) Enviroscaping to Conserve Energy: a Guide to Microclimate Modification.

Florida homes use approximately 819 trillion Btu (a heat unit called British thermal unit) of energy every year. As much as 80 trillion Btu of this energy could be saved by effective management of the microclimate that surrounds our homes. Eighty trillion Btu is enough energy to power approximately 529,000 homes in Florida. This energy savings would reduce the strain on individual pocketbooks and the state's bank account. Florida currently

imports from other states approximately 98 percent of the petroleum and 100 percent of the coal burned at the power plants to make our electricity. This energy savings would reduce the strain on our environment, too, by reducing the quantities of greenhouse gases and pollutants produced when fossil fuels are burned.

Mcpherson, E. G. (1992). "Environmental Benefits and Costs of the Urban Forest." Proceedings of the Fifth National Urban Forest Conference: 52-54: 264.

Mcpherson, E. G. (1992). "Accounting for Benefits and Costs of Urban Greenspace." Landscape and Urban Planning 22(1): 41-51.

Urban greenspace provides many environmental and social services that contribute to the quality of life in cities. Economic approaches used to estimate value of greenspace services include travel cost, willingness to pay, hedonic pricing, and tree valuation. These methods have limited utility for policy-makers, planners, and managers because the underlying values they estimate only indirectly reflect the flow of multiple benefits and costs. A greenspace accounting approach to partially address this deficiency is described using benefit-cost analysis for a proposed tree-planting project in Tucson, AZ. The approach directly connects vegetation structure with the spatial-temporal flow of functional benefits and costs. Prices are assigned to each cost (i.e. planting, pruning, removal, irrigation) and benefit (i.e. cooling energy savings, interception of particulates, stormwater runoff reduction) through direct estimation and implied valuation of benefits as environmental externalities. The approach can be used to evaluate net economic benefits associated with capital investments in urban forests vs. other investments in the urban infrastructure or traditional environmental control technologies.

Mcpherson, E. G., et al. (1989). "Effects of 3 Landscape Treatments on Residential Energy and Water-Use in Tucson, Arizona." Energy and Buildings 13(2): 127-138.

Mcpherson, E. G. and C. W. Johnson (1988). "A Community Forestry Planning Process - Case-Study of Citizen Participation." Landscape and Urban Planning 15(1-2): 185-194.

Mcpherson, E. G., et al. (1988). "Impacts of Vegetation on Residential Heating and Cooling." Energy and Buildings 12(1): 41-51.

Mcpherson, E. G. (1988). "Functions of Buffer Plantings in Urban Environments." Agriculture Ecosystems & Environment 22-3: 281-298.