

University of California, Irvine

Tree Benefits

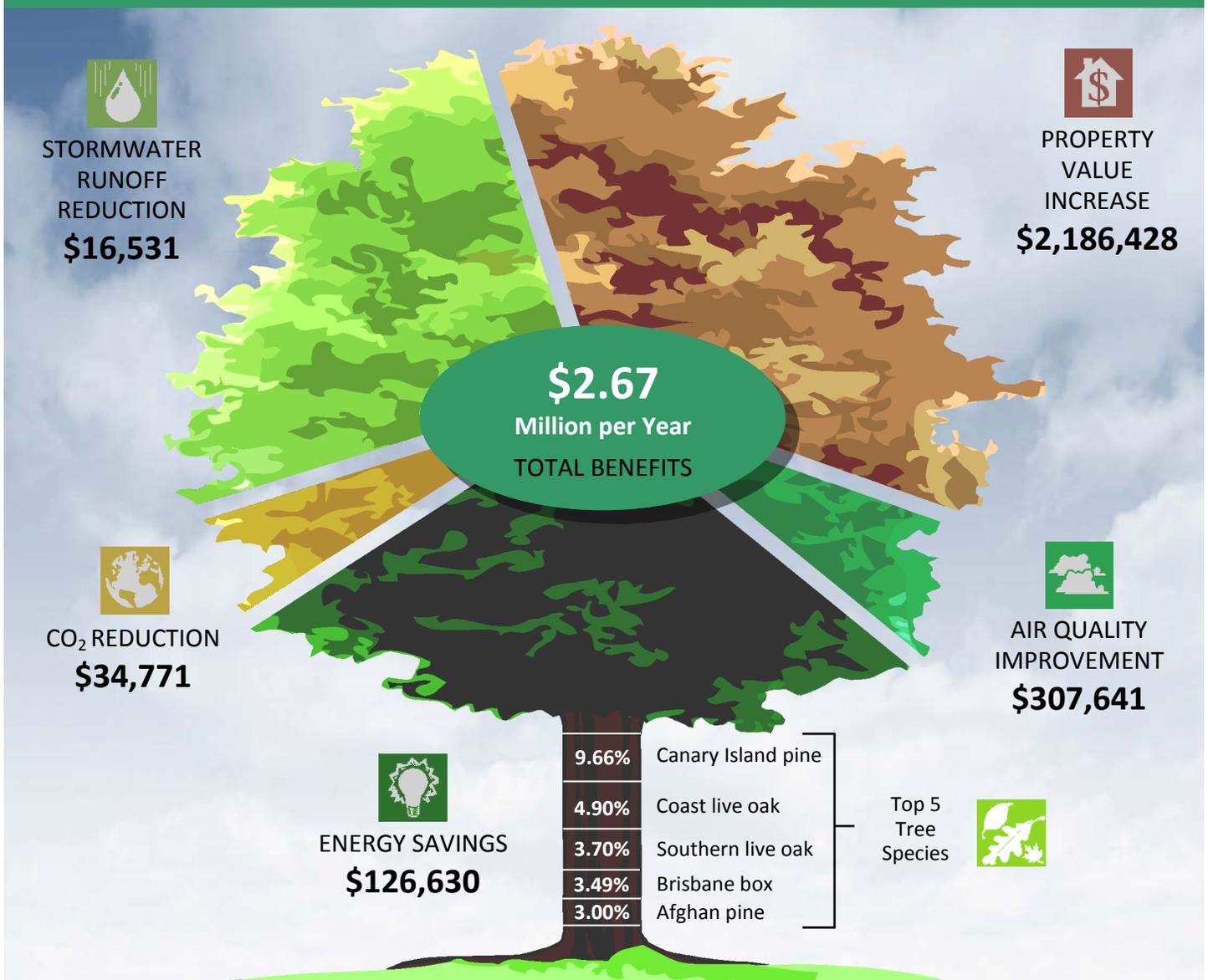


UCI's trees provide millions of dollars of environmental, economic and aesthetic benefits to the community. Over their lifetime, tree benefits exceed the costs of planting and care, representing a 300 percent return on investment. Tree benefits increase over time highlighting the importance of not only planting trees, but of providing ongoing maintenance and protection. These benefits are a reminder of the worthwhile investment in our community forestry program.

Trees:

- Reduce stormwater runoff
- Lower summer air temperatures
- Reduce air pollution
- Reduce heating and cooling costs
- Reduce atmospheric carbon dioxide (CO₂)
- Enhance property values
- Provide wildlife habitat
- Improve health and wellbeing
- Improve learning and concentration
- Provide aesthetic benefits

Annually University of California, Irvine trees provide¹...





Trees Reduce Stormwater Runoff and Improve Water Quality

Trees reduce peak stormwater runoff and associated pollutants entering local water bodies. Trees reduce stormwater volumes by intercepting a portion of rainfall, which evaporates and never reaches the ground. Tree roots also increase rainfall infiltration and storage in the soil. And tree canopies reduce soil erosion by diminishing the impact of raindrops on barren surfaces.

Trees at UCI intercept 9,183,777 gallons of water annually for a savings of \$16,531.



Trees Reduce Atmospheric Carbon Dioxide

Trees reduce atmospheric carbon by capturing and storing CO₂ as they grow. By reducing demand for heating and cooling, trees indirectly reduce CO₂ by avoiding power plant emissions associated with energy production.

Trees at the University of California, Irvine capture 1,844,816 tons of atmospheric CO₂ per year. Annual savings including indirect costs are \$34,771. Trees also store approximately 22,382,380 tons of atmospheric CO₂ for a total savings of \$335,736.



Trees Improve Air Quality

Trees improve air quality by trapping particulates, absorbing gaseous pollutants, and releasing oxygen. By cooling urban heat islands and shading parked cars, trees indirectly reduce ozone levels. The Environmental Protection Agency recognizes tree planting as an ozone reduction measure in state implementation plans.

Trees at UCI remove 3,123 lbs. of particulate matter, 5,462 lbs. of ozone, 198 lbs. of sulfur dioxide and 2,483 lbs. of nitrogen oxides annually. Total annual savings including indirect costs are \$307,641.

¹Analysis was conducted using iTree Streets. iTree Streets is a street tree management and analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits. The iTree Suite is a free state-of-the-art peer reviewed software suite from the USDA Forest Service. www.itreetools.org.



Trees Save Energy

Trees reduce the demand for energy to heat and cool buildings by providing shade, lowering summertime temperatures, and reducing windspeeds. Secondary benefits are reduced water consumption and pollutants emissions by local power plants.

Trees at the University of California, Irvine save approximately 744 MWH of electricity and 4,229 Therms of natural gas annually for a savings of \$126,630.



Trees Improve Property Values and Beautify Our Communities

Trees are the single strongest positive influence on scenic quality in our community! They increase the attractiveness of retail business areas. Studies found shoppers are willing to pay up to 11% more for goods and services in a well-landscaped business district. Trees increase property values. People will pay 3-7% more for properties with many trees. Trees foster safer and more sociable neighborhoods. Views of trees ease mental fatigue and stress, help concentration, reduce sickness, and provide settings for recreation and relaxation. Trees also help reduce noise, provide a refuge for wildlife, and help connect residents with their natural environment.

Trees at UCI increase property values annually by \$2,186,428



Diversity Improves Urban Forest Resilience

A diverse palette of trees helps guard against catastrophic loss to insects and diseases or environmental stresses. A general guideline for urban forest diversity is no more than 5% of any one species, 10% of any one genus.

Pines are over-represented at the University of California, Irvine. This jeopardizes \$841,381 of the city's urban forest benefits from pests. Planting less common trees helps increase UCI's urban forest resilience.

University of California, Irvine

01.16.18 i-Tree Streets Environmental Benefit Analysis

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JANUARY 16, 2018



BACKGROUND AND INTRODUCTION

West Coast Arborists, Inc., the tree maintenance contractor for the University of California, Irvine, completed an i-Tree benefits analysis of the University's tree inventory.

i-Tree Streets is a USDA Forest Service tool that estimates ecosystem services and structure of a municipality's or institution's street tree population. This software uses a sample or complete inventory to assess values including reduced energy use, improved air quality, captured CO₂, controlled storm water, and increased property values. It is a tool designed for municipalities or institutions in the i-Tree Tools software suite. i-Tree Streets default benefit prices, which are based on national and climate region prices, were used as inputs in this analysis. More information and the tool itself are publicly available at www.itreetools.org.

At the time the University's inventory data was exported from WCA's web based inventory management program, ArborAccess, for this i-Tree Streets analysis, there were 18,240 total trees in the University of California, Irvine inventory. Tree inventories are management tools for a living natural resource. Ongoing maintenance in the form of removals and plantings occurring as routine work by the University mean that these exact numbers will change as the inventory is updated.

This i-Tree analysis will substantiate ongoing tree management practices and provide quantitative data to guide future tree-related priorities to maximize the environmental benefits of the University's urban forest. Trees have the potential to contribute great returns on investment to an institution, provided they are managed to maximize their full range of services. A major goal of this project is not only to inform decision makers at the University of the benefits and value of urban trees, but to help guide future urban tree management practices.

It is important to note i-Tree Streets is region specific when it comes to inventory analysis. Trees not common to a particular region (in this case, the Southern California Coast) will not be included in the region's default species list. A closely matched species code based on family, genus, or tree type is therefore substituted in the analysis for certain species and used to calculate benefits results.



This i-Tree Streets written analysis will give an overview of the energy, stormwater, air quality, carbon dioxide, and aesthetic/other benefits of the University's urban forest. Summary results tables will be included in the Appendix. All of the results tables and the packaged i-Tree Streets project were submitted with this written report to be used and manipulated as needed by the University.



ANALYSIS

The 18,240 total trees in the University of California, Irvine tree inventory convey an annual environmental benefit to the University valued at \$2,672,000/per year, or about \$146.50/tree (Table 1). The greatest annual benefits from trees at UCI are from aesthetic benefits, followed by air quality, then energy.

Benefits	Total (\$)	\$/tree
Energy	126,630	6.94
CO2	34,771	1.91
Air Quality	307,641	16.87
Stormwater	16,531	0.91
Aesthetic/Other	2,186,428	119.88
Total Benefits	2,672,000	146.50

Table 1: Total Annual Benefits for All Trees (\$).

The benefits provided by each tree vary widely depending on size, species, location, etc. However, on average, certain species provide much higher benefits than others. The numbers in Table 2 are a direct reflection of the most environmentally valuable species of the University’s trees. Loss of trees of the species listed in Table 2 would result in the loss of some of the University’s largest per tree environmental values. Larger and mature specimens of these species on UCI’s campus could contribute these high per tree benefits.

Table 3 shows the average annual benefits per tree for the top ten most abundant species at the University of California, Irvine. These trees make up the largest percentages of the University’s urban forest. The top two most abundant trees are Canary Island Pine and Coast live oak. The average benefits from these species is likely lower than the species in Table 2 because of the large size range of these trees on the University’s campus.



Species	Energy (\$/tree)	CO ₂ (\$/tree)	Air Quality (\$/tree)	Stormwater (\$/tree)	Aesthetic/ Other (\$/tree)	Total (\$/tree)
Morton Bay Fig	24.49	17.50	58.27	4.89	611.82	716.98
Kaffirboom coral tree	22.80	15.97	54.28	4.44	552.61	650.11
Italian stone pine	20.14	5.82	56.46	3.97	480.64	567.03
Ribbon gum eucalyptus (Manna gum)	18.40	11.77	44.01	3.08	367.29	444.55
Aleppo pine	15.92	4.47	44.33	2.92	366.17	433.82
Torrey pine	17.20	4.58	46.55	2.83	344.81	415.98
Coast redwood	18.16	4.53	47.66	2.48	285.68	358.51
Flooded gum eucalyptus	15.54	9.43	37.13	2.43	286.45	350.98
Monterey pine	15.77	3.90	41.41	2.15	261.75	324.98
Norfolk Island pine (NCN)	17.08	4.12	44.10	2.15	252.20	319.65

Table 2: Top ten species by highest average annual benefits per tree (\$/tree).

Species	Energy (\$/tree)	CO ₂ (\$/tree)	Air Quality (\$/tree)	Stormwater (\$/tree)	Aesthetic/ Other (\$/tree)	Total (\$/tree)
Canary Island pine	8.00	2.03	16.20	1.11	170.93	198.28
Coast live oak	3.15	1.44	7.55	0.42	65.85	78.41
Southern live oak	2.43	1.07	5.86	0.33	57.67	67.36
Brisbane box	2.91	0.58	7.72	0.30	26.48	37.99
Afghan pine	10.25	2.33	26.18	1.22	182.82	222.79
CA sycamore	14.25	2.03	36.71	1.72	214.09	268.80
Shiny xylosma	0.75	0.47	1.71	0.12	18.31	21.36
Sugargum	12.95	7.77	30.92	2.04	245.11	298.79
Mexican sycamore	4.72	0.98	11.32	0.51	216.30	233.85
Australian willow	2.20	0.29	6.26	0.28	25.78	34.82

Table 3: Average annual benefits per tree for the top ten most abundant species overall (\$/tree).



Energy

Trees can affect building cooling costs by shading them and lowering ambient temperature through evaporative cooling. It is important to note that these energy savings are annual benefits. Maintaining healthy and growing trees results in increased benefits each year until the trees are removed. Trees at UC Irvine benefit the University and University's population in a savings of \$126,630 (744 MWh) for electricity costs and \$5541 in natural gas (4229 Therms). These estimates were created by i-Tree Streets using the average national rates of \$0.1628/kWh and \$1.31/Therm¹.

Stormwater

An estimated 9,183,777 gallons in stormwater runoff is prevented each year by the University's trees. This avoided runoff has saved approximately \$ 16,531 in expenses per year, using an estimated value of \$0.0018 (\$/gallon) of avoided runoff, a conservative national average for stormwater related costs and damages.² i-Tree Streets uses local climate data to compute these numbers. In general, bigger trees with larger leaf areas had a larger impact per tree than smaller trees with smaller leaf areas.

Air quality

i-Tree Streets calculates the amounts and values of pollutant removal by trees using a model based on local hourly pollution and weather. The model simulates how pollutants interact with leaf surfaces via deposition and gas exchange. The monetary value estimates due to improvements in air quality are derived using an adaptation of the United States Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program³.

In total, 5,853 lbs of air pollution are removed each year by trees at the University of California, Irvine, with a value from improved health outcomes of \$307,641. This is made up of removed ozone (O₃), sulfur dioxide (SO₂), carbon monoxide (CO), nitrous oxide (NO₂), particulate matter 10-2.5 microns (PM₁₀), and volatile organic compounds (VOCs).

¹ i-Tree Tools, 2017

² i-Tree Tools, 2017.

³ US EPA BenMAP. iTree Tools, 2015.



Carbon

Carbon storage is the amount of carbon currently being held in trees. As trees grow and increase their biomass, the amount of carbon they store increases. Carbon sequestration is the yearly rate at which trees remove carbon from the atmosphere. The University's trees store a total of 22,382,380 lbs of carbon and sequester 1,844,816 lbs each year. Looking at both numbers is important because carbon sequestration tells you how much trees are currently affecting how much carbon is in the atmosphere, while carbon storage is an indication of how much would be returned to the atmosphere if the trees died and decomposed.



CONCLUSIONS

The 18,240 trees at the University of California, Irvine, represent a large, multi-faceted, environmental benefit to the University. Areas for further growth include planting shade tree species and preserving existing tree canopy. This i-Tree Streets analysis was intended to give the University decision makers a more complete assessment of the overall environmental benefits of their urban trees. This work informs future tree management practices and creates a precedent of valuing the environmental benefit of ongoing urban forestry efforts at the University.



APPENDIX TABLES

1. Annual CO₂ benefits of all trees by species.
2. Stored CO₂ benefits of all trees by species.
3. Annual stormwater benefits of all trees by species
4. Annual aesthetic and other benefits of all trees by species.
5. Annual energy benefits of all trees by species.
6. Annual air quality benefits of all trees by species.



BIBLIOGRAPHY

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i-Tree Streets User's Manual v. 5. Retrieved at
http://www.itreetools.org/resources/manuals/Streets_Manual_v5.pdf



ASSUMPTIONS AND LIMITING CONDITIONS

1. Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, the Consultant can neither guarantee nor be responsible for the accuracy of information provided by others. Standard of Care has been met with regards to this project within reasonable and normal conditions.
2. The Consultant will not be required to give testimony or to attend court by reason of this report unless subsequent contractual agreements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.
3. Loss or alteration of any part of this report invalidates the entire report.
4. Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior written consent of the Consultant.
5. This report and any values expressed herein represent the opinion of the Consultant, and the Consultant's fee is in no way contingent upon the reporting of a stipulated result, a specified value, the occurrence of a subsequent event, nor upon any finding to be reported.
6. Unless expressed otherwise, information contained in this report covers only those items that were examined and reflects the condition of those items at the time of analysis. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the tree(s) or property in question may not arise in the future.
7. Arborists are tree specialists who use their education, knowledge, training, and experience to examine trees, recommend measures to enhance the beauty and health of trees, and attempt to reduce the risk of living near trees. It is highly recommended that you follow the arborist recommendations; however, you may choose to accept or disregard the recommendations and/or seek additional advice.
8. Arborists cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that fail in ways we do not fully understand. Conditions



are often hidden within trees and below ground. Arborists cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specific period of time.

9. Any recommendation and/or performed treatments (including, but not limited to, pruning or removal) of trees may involve considerations beyond the scope of the arborist's services, such as property boundaries, property ownership, site lines, disputes between neighbors, and any other related issues. Arborists cannot take such considerations into account unless complete and accurate information is disclosed to the arborist. An arborist can then be expected to consider and reasonably rely on the completeness and accuracy of the information provided.
10. The author has no personal interest or bias with respect to the subject matter of this report or the parties involved. He/she has inspected the subject tree(s) and to the best of their knowledge and belief, all statements and information presented in the report are true and correct.