

PLANTING THE SEEDS OF SUCCESS.



Trees Pay Us Back -- Benefits of Trees in the Midwest

Greg McPherson
Midwest ISA Annual Conference
Topeka, Kansas
March 1, 2007

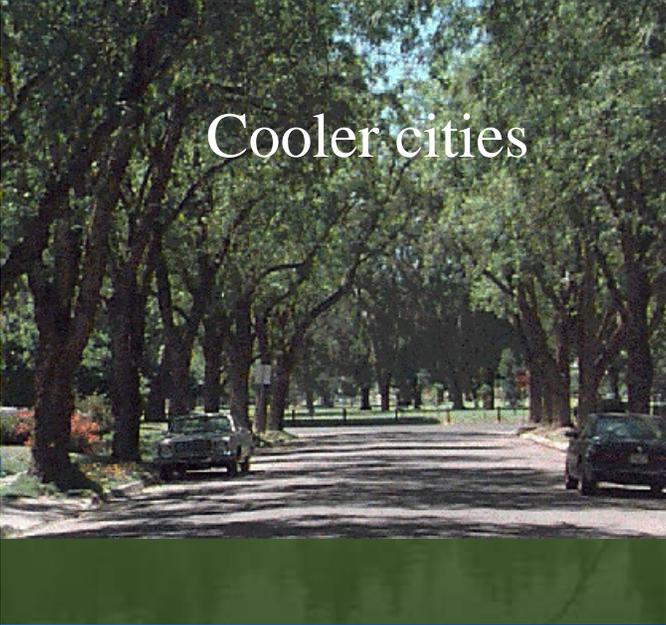


Center for Urban Forest Research

Cities Without Trees



Cities With Trees



Cooler cities



Lower energy bills



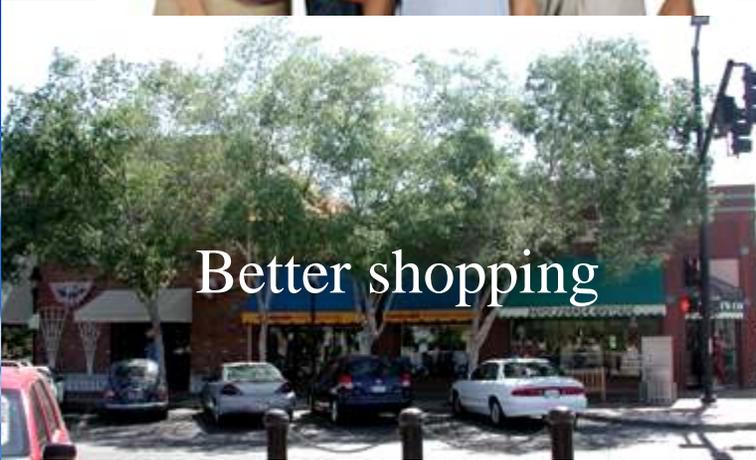
Safer cities



Happy people
Less stress



Clean air



Better shopping



Clean water



Urban
Advantage



Urban
Advantage

Cause for Concern?



Value goes down

Today

- Value of urban trees from a research perspective.
- What you can do.
- i-Tree and STRATUM.



Tree Quiz

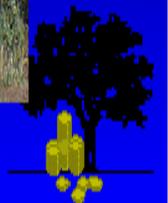
- Bradford Pear
- 9 years old
- 9 inch dbh
- 28 ft. tall
- 19 ft. spread
- Number of leaves ?? (#)
- Total leaf area ?? (sq.ft.)
- H₂O retainment capacity ?? (ga

Tree Quiz



- › Bradford Pear
- › 9 years old
- › 9 inch d.b.h.
- › 28-ft tall
- › 19-ft spread

- › Number of leaves
- › Total leaf area (sq ft)
- › Fresh weight of leaves (lb)
- › Fresh weight of wood (lb)



Tree Quiz

- Bradford Pear
- 9 years old
- 9 inch dbh
- 28 ft. tall
- 19 ft. spread
- Number of leaves 88,908
- Total leaf area 3,846 sq ft
- H₂O retainment capacity 55 g

Tree Quiz



- ▶ Bradford Pear
- ▶ 9 years old
- ▶ 9 inch d.b.h.
- ▶ 28-ft tall
- ▶ 19-ft spread

- ▶ Number of leaves
- ▶ Total leaf area (sq ft)
- ▶ Fresh weight of leaves (lb)
- ▶ Fresh weight of wood (lb)



Center for Urban Forest Research

USDA Forest Service
PSW Research Station
Davis, CA

To demonstrate new
ways that trees add
value - quality of life -
to communities.

We convert research
results into financial
terms to stimulate
community
investment in trees.



Areas of Research

Investment Value

Benefits *and Costs*

- Energy Conservation
- Air Quality Improvement
- Reducing Runoff
- FireWise Landscapes



Who We Are



Today

- Value of urban trees from a research perspective.
- What you can do.
- i-Tree and STRATUM.



Benefit-Based Approach



Structure



Management



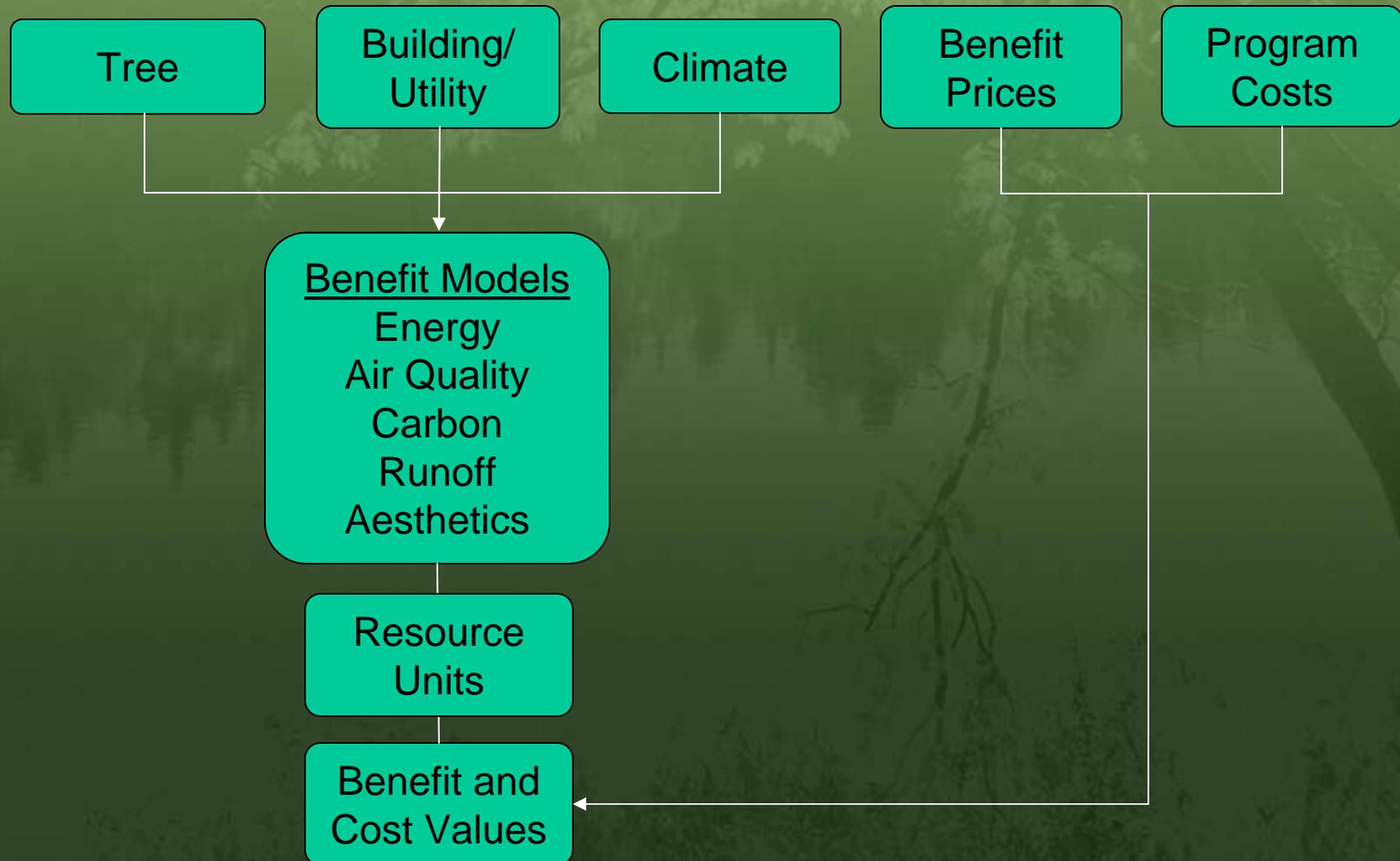
Function



Value

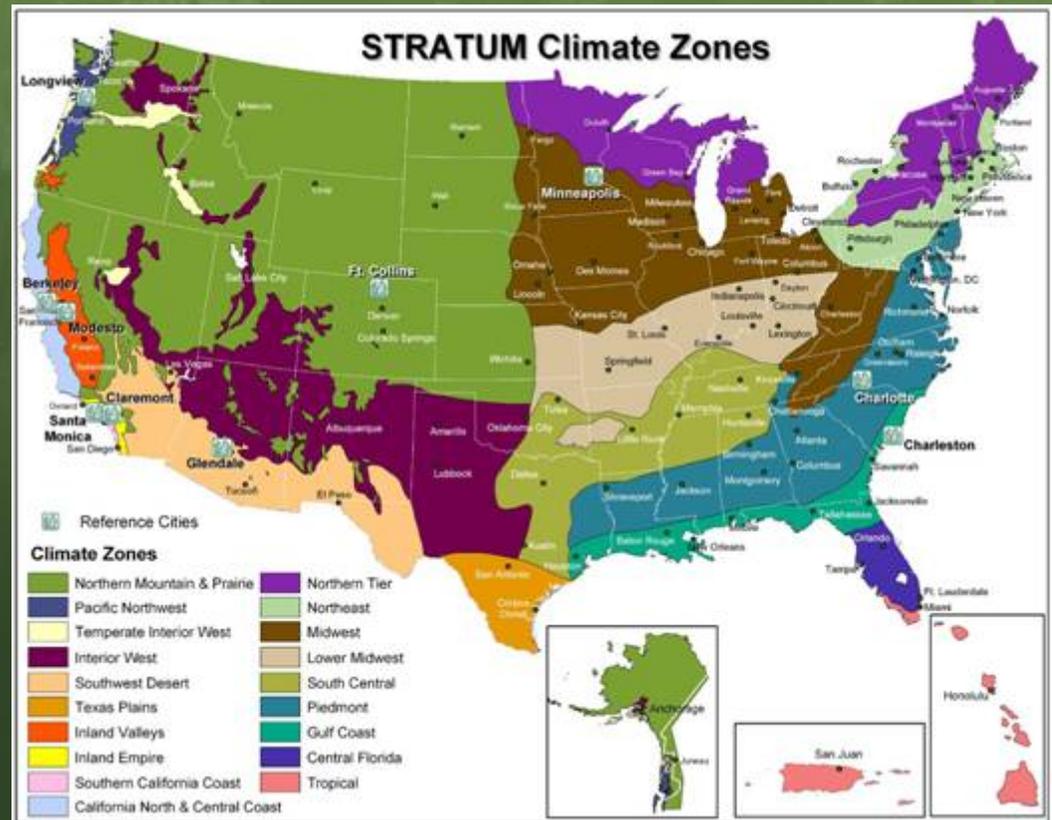


Benefit-Cost Modeling

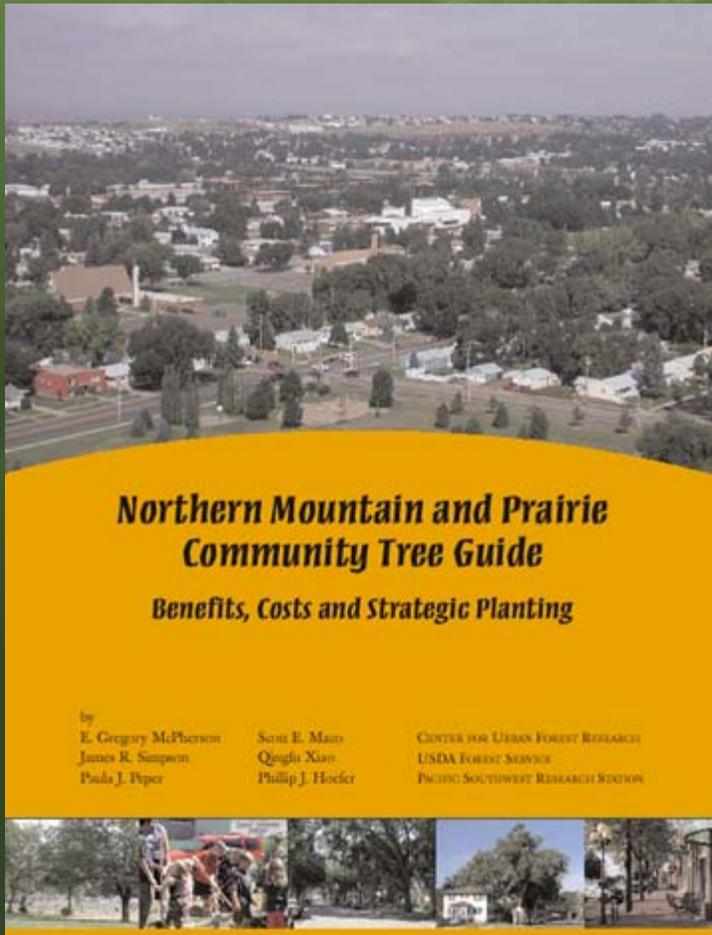


Reference City Research

- Collected data – Minneapolis street trees
- Analyzed growth rates and dimensions
- Estimated magnitude of annual benefits
- Priced benefits
- Priced tree care costs
- Calculated net annual benefits, benefit-cost ratios



Tree Guide for Midwest Communities



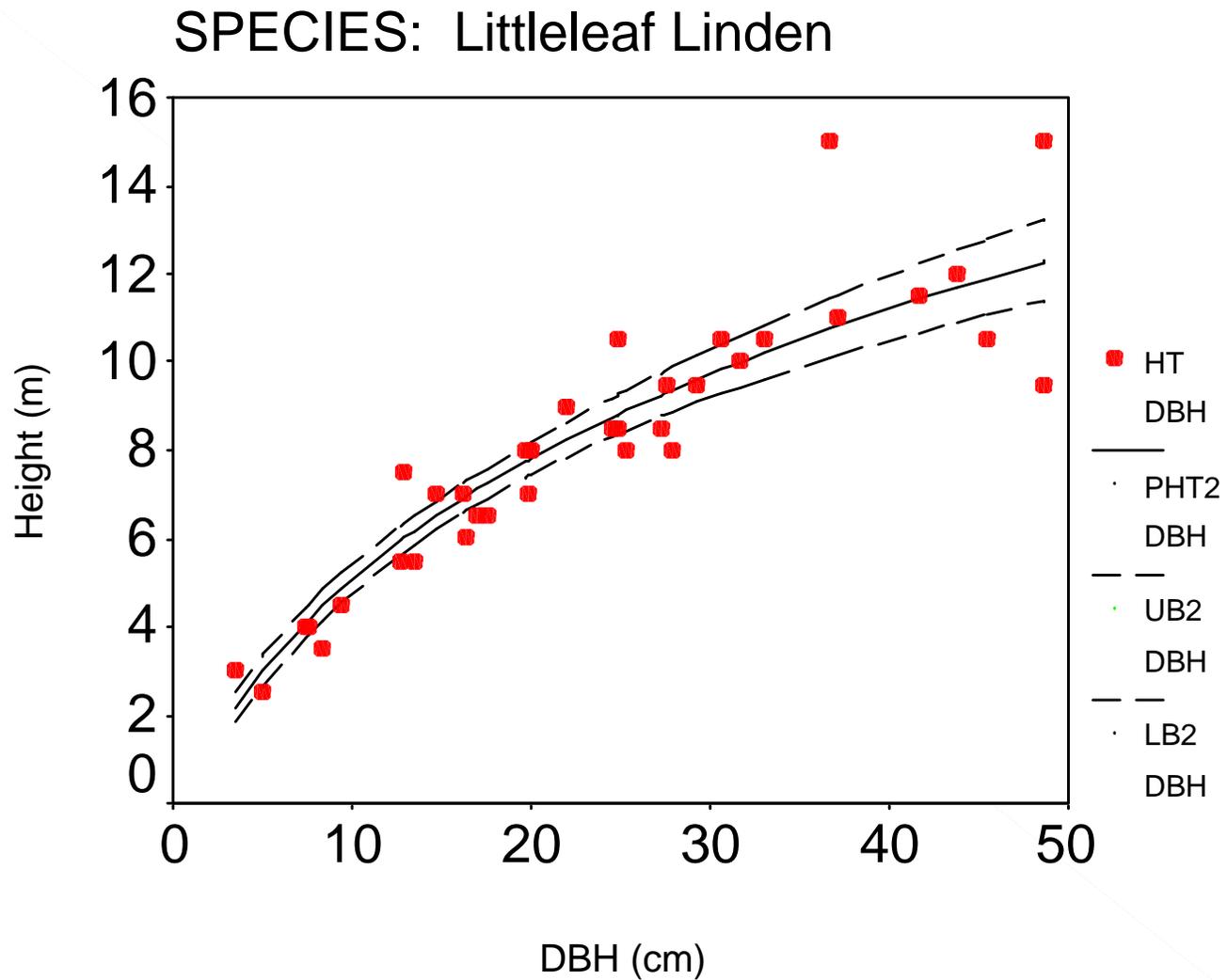
- 1000's of communities
- Contents
 - Regional Benefits And Costs Calculated
 - Examples of Estimating Benefits And Costs Of Tree Planting Projects
 - Guidelines For Selecting And Placing Trees
- Midwest Tree Guide
 - rschneider@fs.fed.us
 - (970) 498-1392
- Northern Mt & Prairie Guide
 - Susan Ford (sbford@fs.fed.us)

City Tree Survey

- Stratified random sample
 - Predominant species
 - » 22 species representing ~75% of forest
 - 35 – 70 trees per species
 - Minimum 40 year age range



Fit Curves for Growth



Reporting Results

- For “typical” large, medium, and small tree.
 - Hackberry
 - Red oak
 - Crabapple
- Dimensions at maturity differentiate tree size.
- For public (street/park) and private property locations (east, south, west).



Typical Tree at 20 yrs

	Small	Medium	Large
Height (ft)	22	40	47
Spread (ft)	21	27	37
LSA (sq ft)	75	343	688

Research Process

Value Analysis

Pricing Benefits

- Minneapolis market prices – (\$0.07/kWh, \$0.98/therm)
- Carbon trading credits - CO₂ (\$15/ton)
- Damage value and control cost of emissions – air pollutants (Wang & Santini)
- Retention/detention costs – stormwater runoff (\$0.0048/gal)
- Average resale price - residential property increase (median sales price = \$154,403)



Research Process

Value Analysis

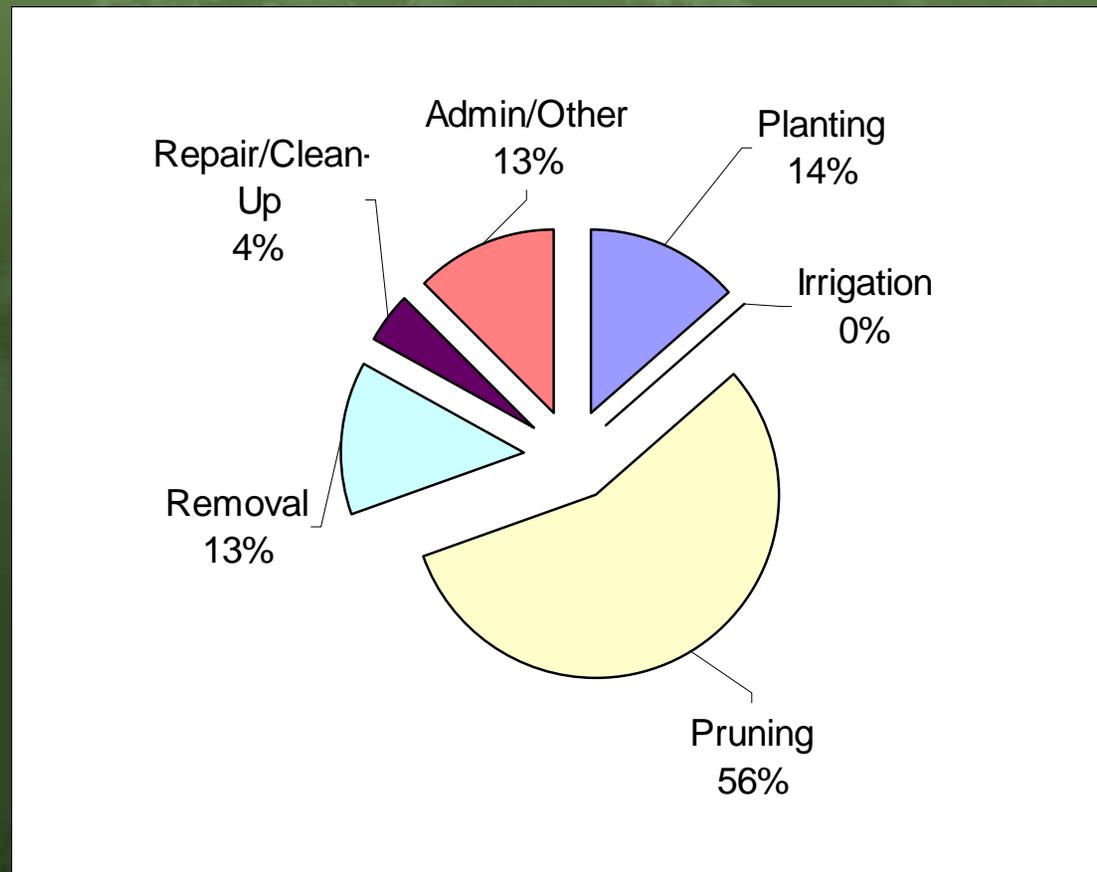
Calculating Costs

Surveyed 9 commercial and municipal arborists:

- Planting
- Pruning
- Removal and disposal
- Pest and disease control
- Irrigation
- Infrastructure
- Leaf litter cleanup
- Liability
- Administration



Average Annual Street Tree Management Costs (\$36/tree)



Research Process

Value Analysis

Calculating Net Benefits

Benefits minus Costs



Trees Improve the Environment

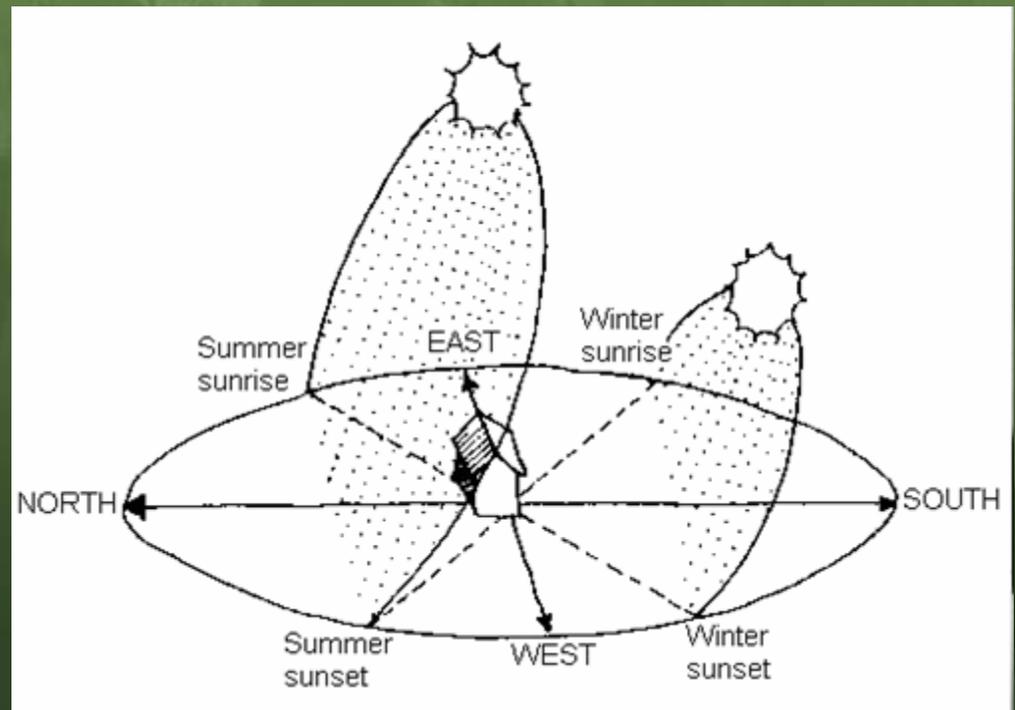


Conserving Energy



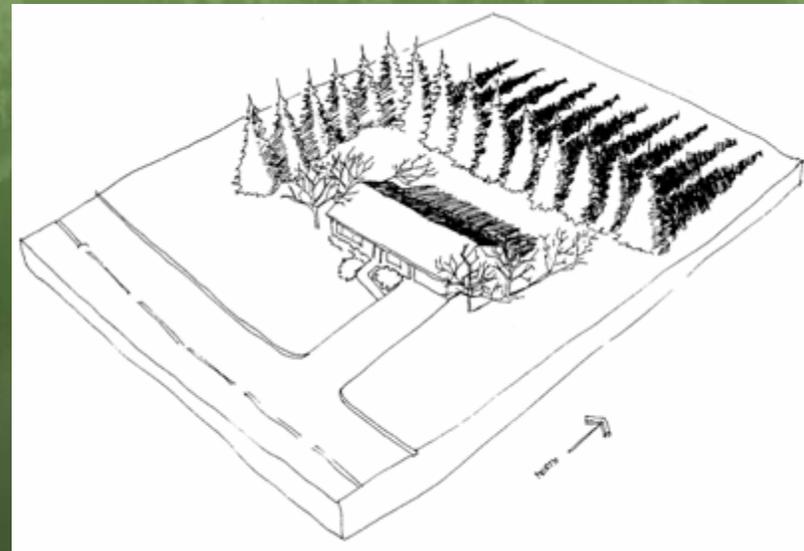
Conserving Cooling Energy

- West is the best
- South solar access
- Shade heat sinks
- Increase canopy citywide to reduce heat island



Conserving Heating Energy

- Windbreaks (25-50 ft from building)
 - Longer than building
 - Perpendicular to wind
 - Multi-row if space



Conserving Energy

- Hackberry, 20 years (47-ft tall), West
- Save up to 20% of annual AC costs (\$23/yr)
- Save 2% of winter heating costs (\$33)
- \$56/yr total savings

Save Dollars With Shade
A Community Tree Planting Solution to Conserve Energy

Just Plant Trees
Imagine a solution to rising energy prices as simple as planting trees. We've all grown up with trees, climbed in them, and probably even planted a few. But how many of us know that they significantly contribute to cooling our homes, businesses and communities?

Millions of Trees Still Needed
Studies in various parts of the West show that many communities have trees that produce shade and summer time cooling. However, Dr. Greg McPherson, Director, Center for Urban Forest Research, Pacific Southwest Research Station in Davis, California, points out that "over 100 million tree planting sites exist on the east and west side of buildings in the western U.S. with high energy saving potential. These sites need to be filled. Planting these sites will save billions of energy dollars and should be a high priority for all communities."

Trees Conserve Energy By:

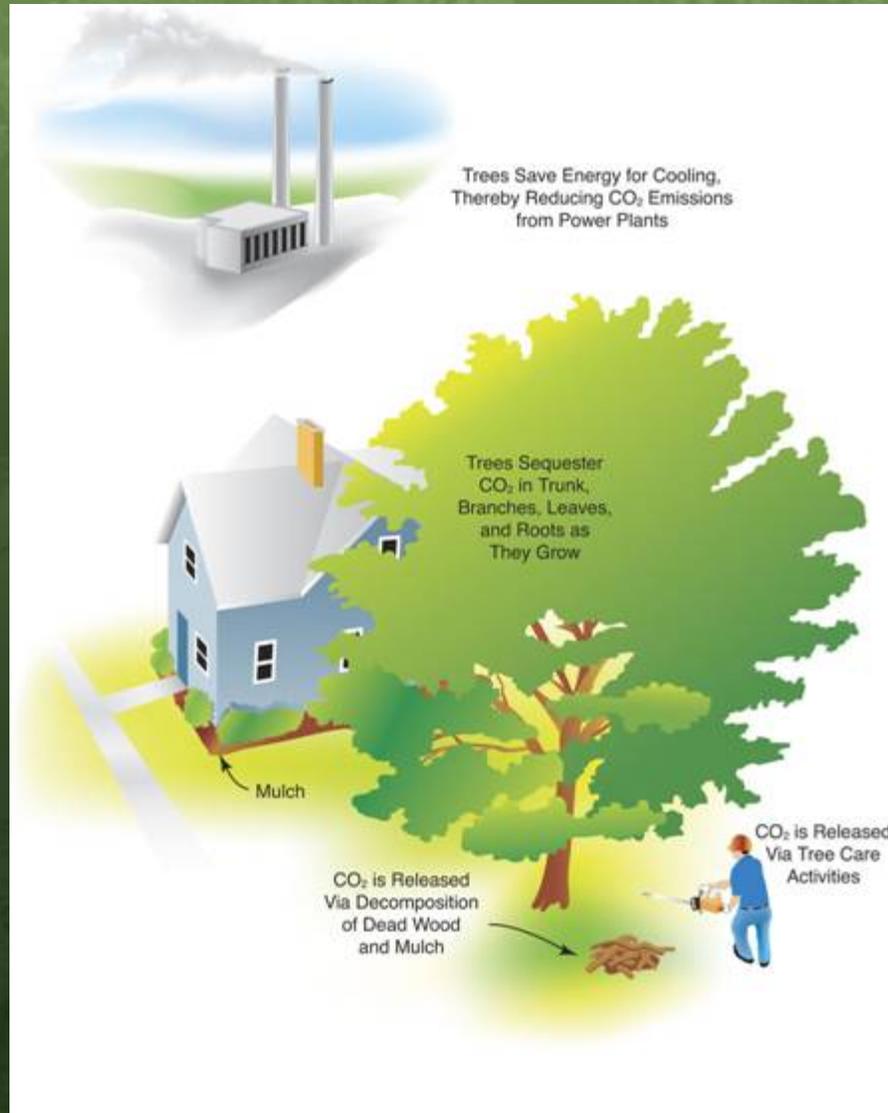
- Shading, which reduces the amount of radiant energy absorbed and stored by built surfaces.
- Evapotranspiration, which converts liquid water in leaves to vapor, thereby cooling the air.
- Reducing the velocity of wind, which slows the infiltration of outside air into inside spaces.

Where would you rather live?

Strategically Placed Trees Save Energy Dollars

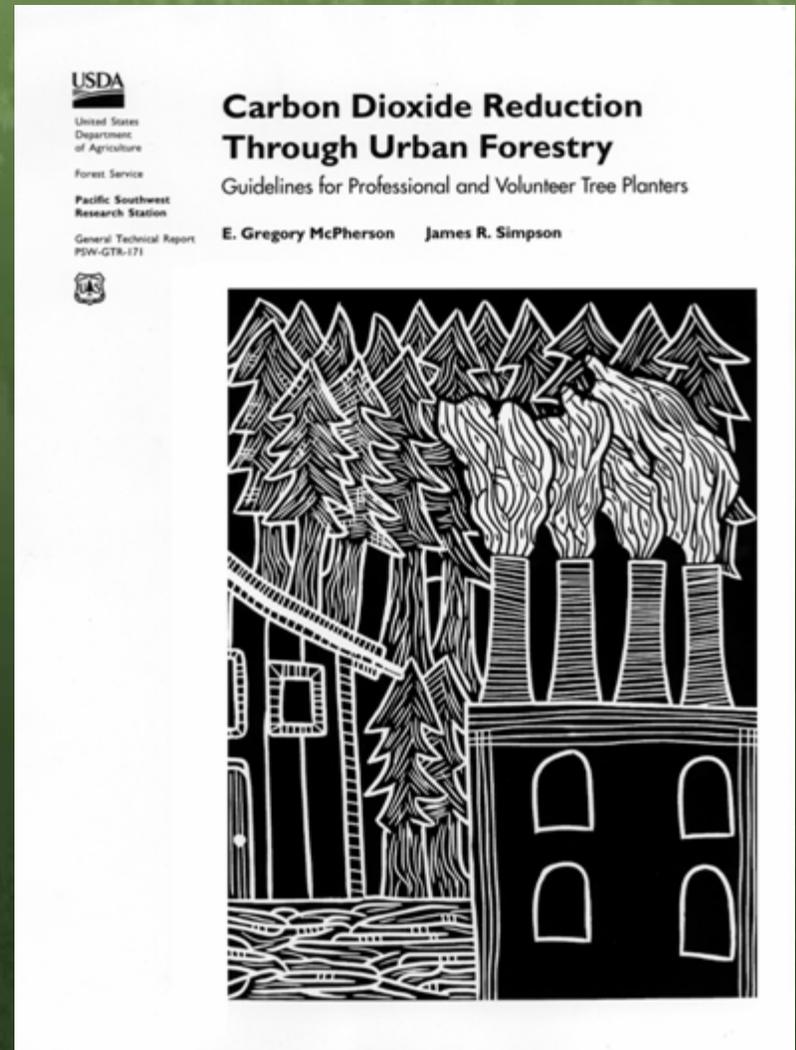
Center for Urban Forest Research
Pacific Southwest Research Station
USDA Forest Service
1 Shields Avenue, Suite 1301
Davis, CA 95616-8507
Telephone: 530.752.7628
http://www.cufwr.fs.fed.gov

Reducing Atmospheric Carbon Dioxide



Reducing Atmospheric Carbon Dioxide

- Increase tree stocking levels
- Create diverse habitats
- Select well-adapted, rapid growing trees
- Locate to maximize energy savings

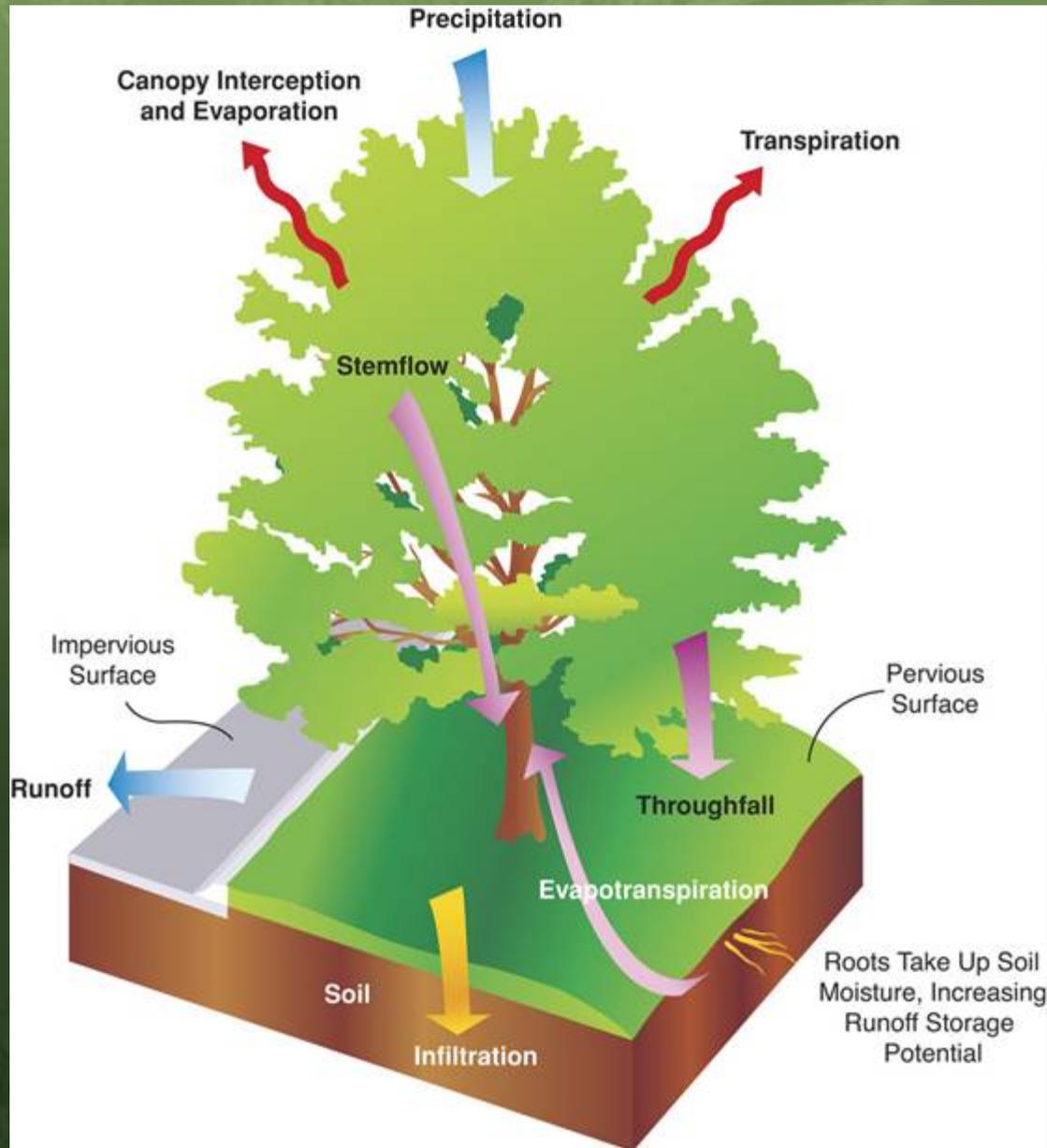


Reducing CO₂

- Hackberry, 20 years, Opposite west wall
 - Sequestered = 109 lb
 - Avoided = 882 lb
 - Release: Tree care = 4 lb
 - Release: Decomp. = 8 lb
 - Total Net = 979 lb
 - Total Value = \$7.34



Reducing Stormwater Runoff



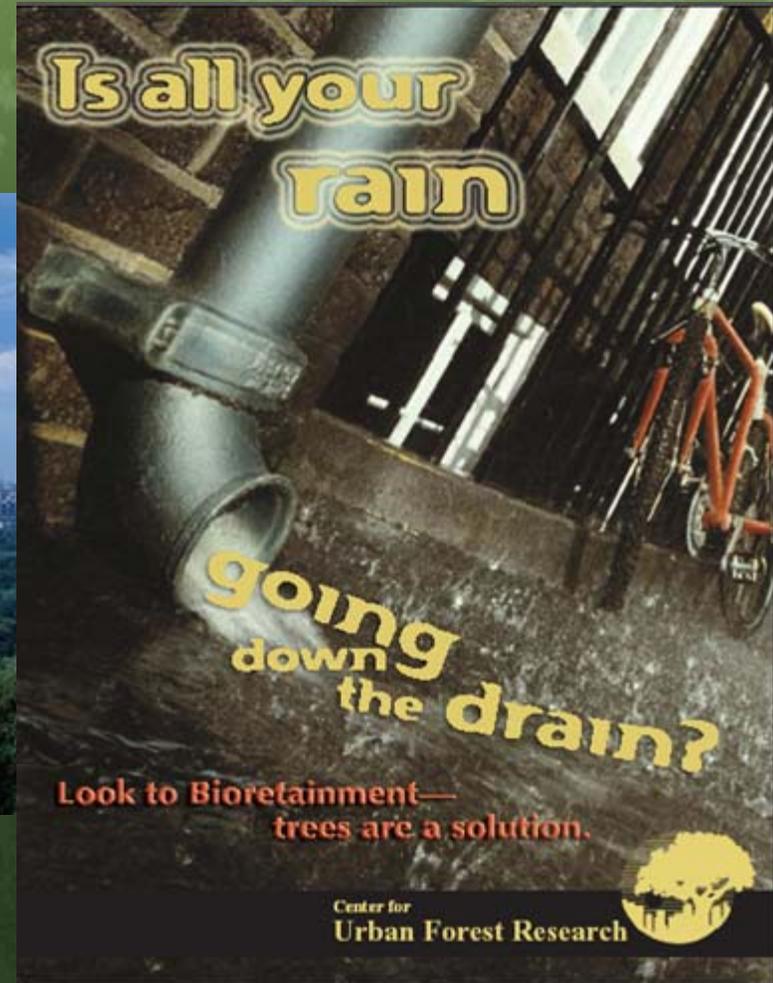
Reducing Stormwater Runoff

- Watershed benefits can exceed irrigation costs
- Water quality benefit can exceed flood control benefit
- To maximize interception:
 - Large leaf and stem surface areas
 - Coarse textured surfaces
 - Match foliation period to rainfall pattern



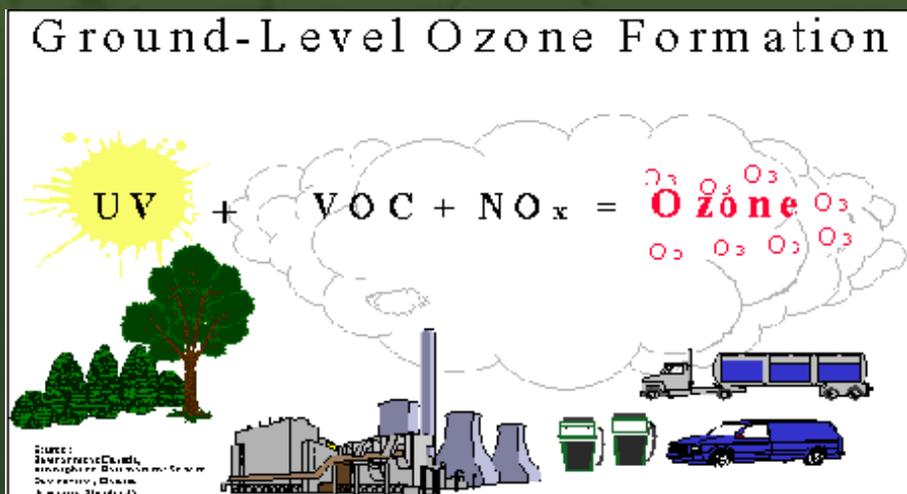
Reducing Runoff

- Hackberry, 20 years
 - Intercepted = 1,394 gal
 - Value = \$6



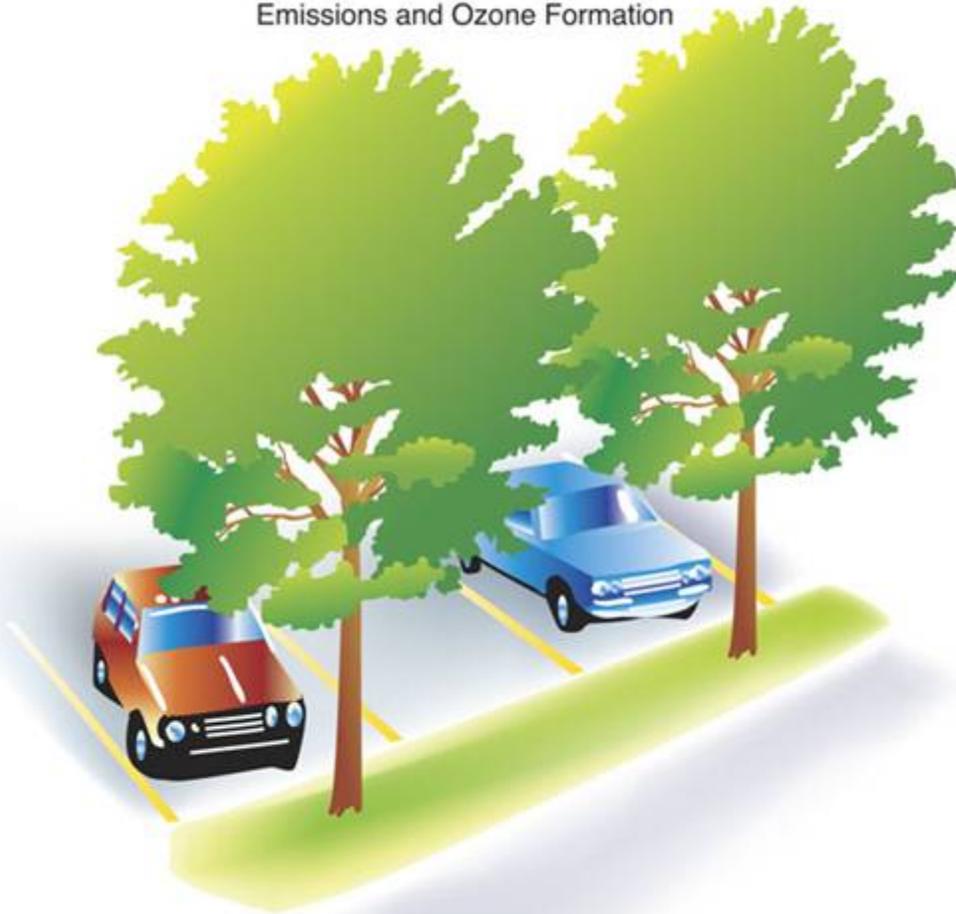
Improving Air Quality

- Ozone: 160 million people
- Particulates: 100 million people

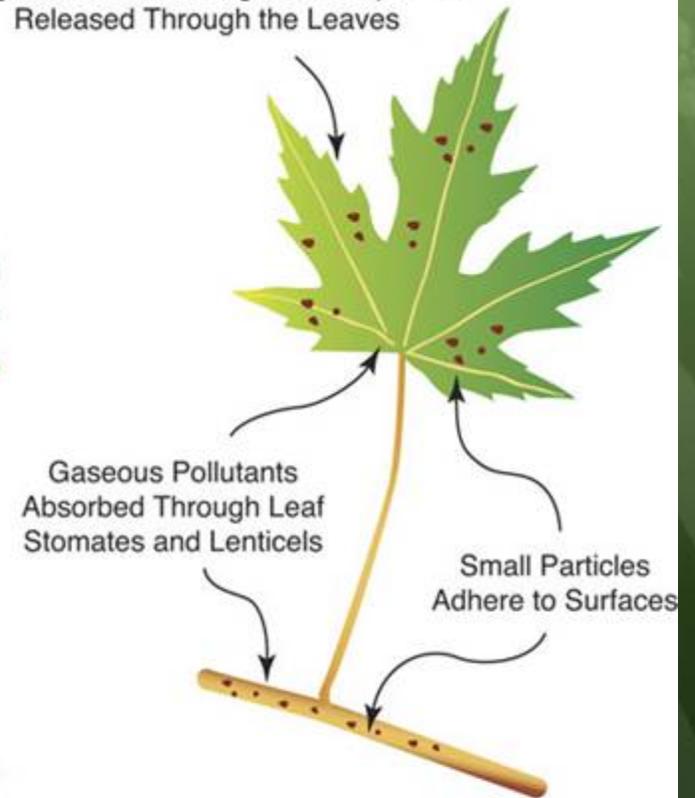


Improving Air Quality

Shade on Paved
Surfaces and Parked Cars
Reduces Evaporative Hydrocarbon
Emissions and Ozone Formation



Oxygen and Volatile Organic Compounds
Released Through the Leaves



Improving Air Quality

- Plant tolerant species
 - Not ash, tulip tree, Austrian pine
- Conifers
- Hairy plant parts, long petioles
 - Oak, birch, sumac, maple, ash
- Locate close to and downwind of source, plant multiple rows
- Sustain large, healthy trees
- Shade parked cars



Improving Air Quality

Parking Lots

- Lots 3 F degrees cooler
- Cabin 40-50 degrees cooler
- Gas temp 4-8 degrees cooler
- Reduce VOC 1ton/day



On a hot summer day, would you rather sit down in a nice shady spot or broil unprotected in the blazing sun? Your car feels the same way. And you know how uncomfortable it is to climb back into the driver's seat after it's been baking in the heat. But...

Where are all the cool parking lots?

Center for
Urban Forest Research

A graphic with a background image of a car parked in a shaded area under a wooden structure. The text is overlaid on the image. At the bottom right, there is a logo for the Center for Urban Forest Research, which includes a stylized tree.

Improving Air Quality

- Hackberry, 20 years, Facing West-Wall (lbs)
 - NO₂ = 1.16, \$3.88
 - SO₂ = 0.73, \$1.51
 - PM₁₀ = 0.25, \$0.71
 - Ozone = 0.18, \$0.60
 - VOCs = 0.16, \$0.59
 - BVOCs = 0.0, \$0
 - Net Value = 2.48, \$7.29



Others Things Trees Do



Trees. Vital to Human Health.

- Tree-filled neighborhoods:
 - Lower levels of domestic violence
 - Are safer and more sociable
- Tree-filled landscapes reduce stress
- Trees decrease need for medication and speed recovery times



Trees Sell Houses. (At higher prices.)



- Each large front yard tree adds 1% to sales price
- Large specimen trees can add 10%, or more, to property values.

Trees Mean Better Business.



In tree-lined commercial districts...

- More frequent shopping
- Longer shopping trips
- Shoppers spend more for parking
- Shoppers spend 12% more for goods

Trees Improve Pavement Performance.

More shade means more time between repaving.

20% shade improves pavement condition by 11%.
60% savings for resurfacing in 30 years

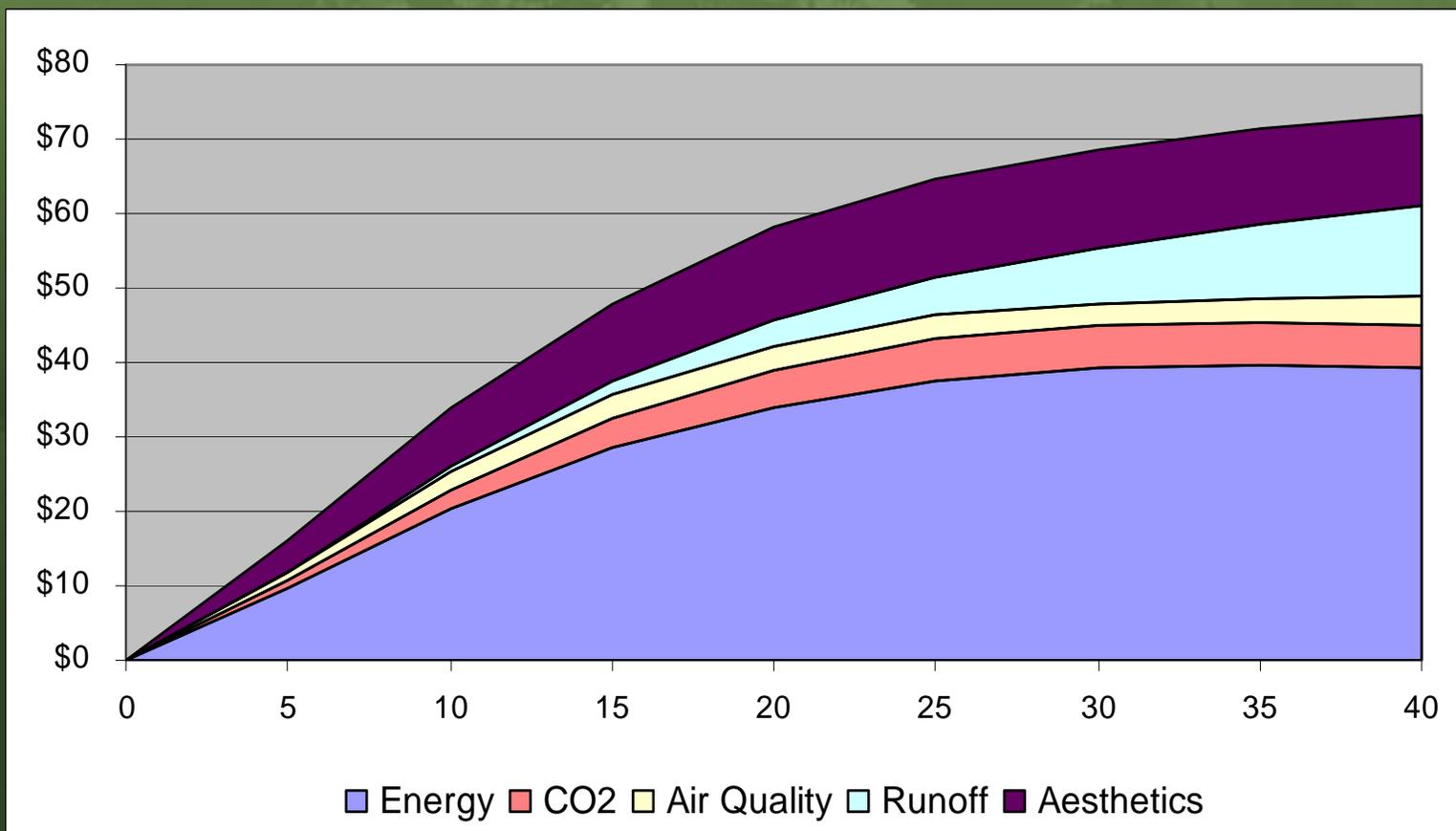


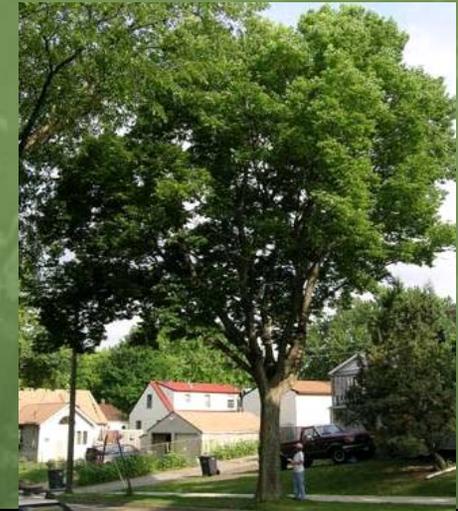
Aesthetic and Other Benefits

- Hackberry, 20 years
 - \$25
 - \$0.16/sq ft LA x
155 sq ft LA/year



Benefits in Midwest Red Oak, West Yard





Total Costs	\$8.47	\$13.11	\$15.11
Total Benefits	\$28.34	\$58.05	\$102.04
Total Net Benefits	\$19.87	\$44.94	\$86.93

Minneapolis Benefit-Cost Summary

- \$2.71 in benefits for every \$1 spent
- Net annual benefit = \$15.7 million
 - \$79/tree, \$8/capita

	Ft Collins	Cheyenne	Bismarck	Berkeley	Glendale	Minneapolis	Boulder
Total benefits	2,170,799	686,029	979,094	3,247,545	665,856	24,934,226	2,740,907
Total costs	-997,638	-327,897	-316,640	-2,372,000	-276,436	-9,209,041	-752,606
Net benefits	1,173,161	358,133	662,454	875,545	389,421	15,725,185	1,988,301
Benefit-cost ratio	2.18	2.09	3.09	1.37	2.41	2.71	3.64

Today

- Value of urban trees from a research perspective.
- What you can do.
- i-Tree and STRATUM.



Maintain Existing Trees



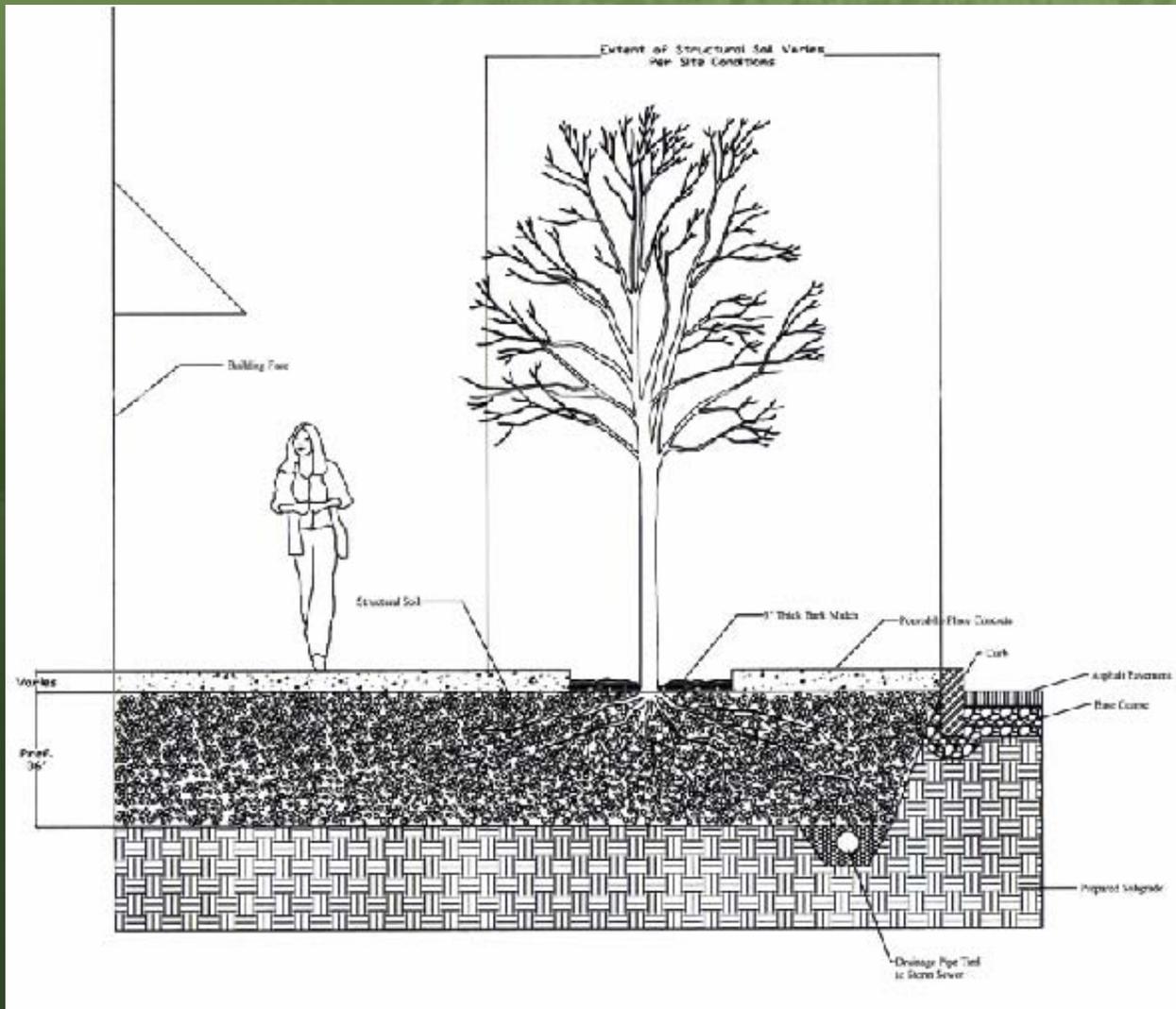
Plant More Trees



Plant Larger Growing Trees



Make More Space For Trees



Today

- Value of urban trees from a research perspective.
- What you can do.
- i-Tree and STRATUM.





i-Tree & STRATUM

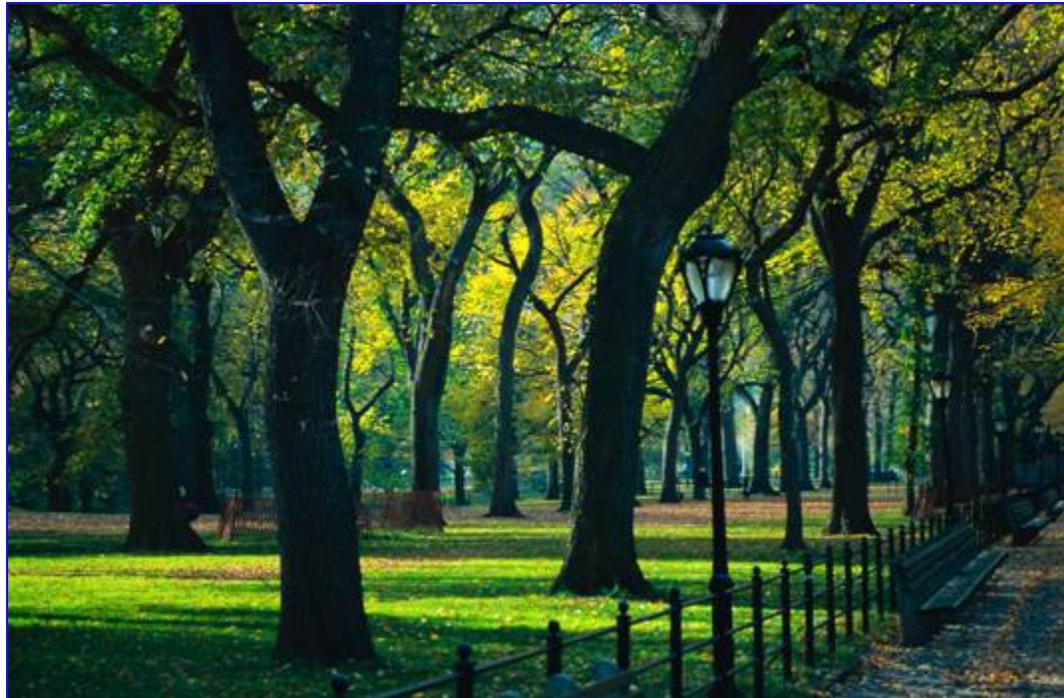
Greg McPherson
USDA Forest Service
Center for Urban Forest Research
Davis, CA

Midwest ISA Annual Conference
Topeka, KS, March 1-2, 2007



Common Goal

“To improve the condition and extent of the urban and community forest”



Public/Private Partnership

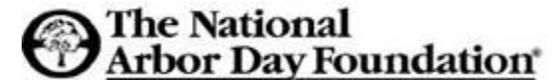
- 🌳 USDA Forest Service
 - ✓ Research and Development
 - ✓ State and Private Forestry



- 🌳 Davey Tree Expert Co.



- 🌳 National Arbor Day Foundation



- 🌳 Society of Municipal Arborists



Pulling it Together

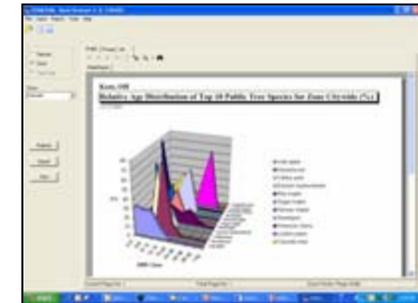
i-Tree Cooperative was formed to deliver all Forest Service applications in a single software suite:



-  Credible, USDA FS peer-reviewed tools you can trust
-  Public Domain Software
-  Accessible
-  Technical Support
-  Training Workshops

What's Included?

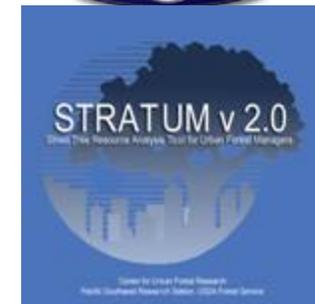
- 🌳 Two urban forest assessment tools:
 - ✓ Assessing street tree populations
 - ✓ Assessing urban ecosystems
- 🌳 Multiple Utilities:
 - ✓ Data collection & transfer
 - ✓ Inventory management
 - ✓ Storm damage assessment



Assessing Street Tree Populations

STRATUM assesses:

- ✓ Structure
- ✓ Function
 - Energy
 - Air pollution
 - Stormwater
 - Carbon
 - Property Value
- ✓ Value
- ✓ Management needs



	Total (\$)	\$/capita	\$/tree
Benefit	501,064	11.31	93.64
Cost	94,000	2.12	17.57
Net Benefits	407,064	9.19	76.07
Benefit-Cost Ratio	5.33	5.33	5.33

Assessing Urban Ecosystems

UFORE assesses:

- ✓ Structure
- ✓ Function
 - Energy
 - Air pollution
 - Carbon
- ✓ Value
- ✓ Management
 - Health
 - Pest impacts



i-Tree Management Utilities

 MCTI—Mobile Community Tree Inventory



 SDAP—Storm Damage Assessment Protocol



i-Tree Supports Local U&CF Programs

- 🌳 Highlight value of trees
- 🌳 Justify investment in tree programs
- 🌳 Leverage funds from other sources
- 🌳 Develop management plans
- 🌳 Manage data
- 🌳 Baseline for tracking progress



How do I get i-Tree?

🌳 Visit: <http://www.itreetools.org>

- ✓ Install CD will be mailed
- ✓ Sign up for e-mail newsletter

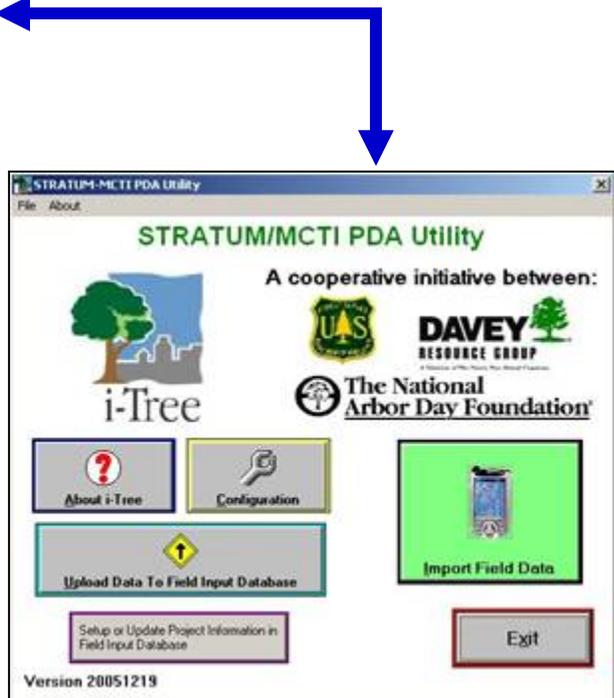
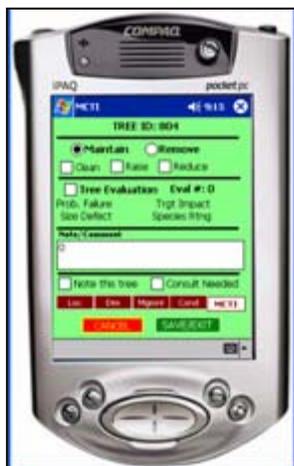
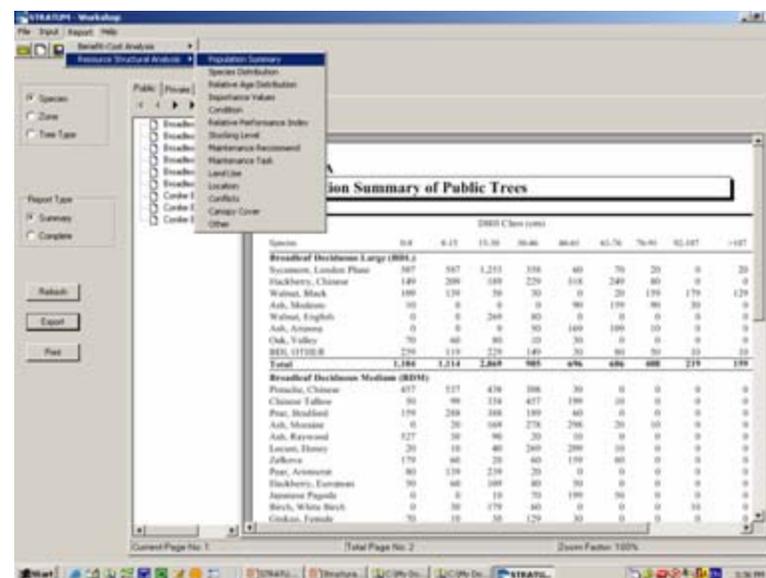
🌳 Telephone & on-line support available.

🌳 Workshops

🌳 User Forum for feedback



PDA to Desktop Data Transfer STRATUM

Species	0-6	6-15	15-30	30-45	45-60	60-75	75-90	90-105	>105
Broadleaf Deciduous Large (BRDL)									
Systemic London Plane	387	557	1,215	358	60	70	20	0	30
Hackberry, Chinese	149	208	559	229	616	249	60	0	0
Walnut, Black	189	139	50	30	0	20	170	170	120
Ash, Medium	0	0	0	0	0	100	90	30	0
Walnut, English	0	0	349	80	0	0	0	0	0
Ash, Missouri	0	0	0	0	0	669	100	0	0
Oak, Valley	70	40	80	20	30	0	0	0	0
BRDL UT008-B	750	119	229	149	30	60	30	0	0
Total	1,196	1,114	2,669	965	676	446	408	210	190
Broadleaf Deciduous Medium (BRDM)									
Fraxinus, Chinese	677	577	438	396	30	0	0	0	0
Chinese Elm	50	49	339	477	199	0	0	0	0
Prun, Broadleaf	179	269	369	199	60	0	0	0	0
Ash, Missouri	0	20	169	279	299	20	0	0	0
Ash, Kentucky	527	30	90	30	0	0	0	0	0
Lecyth, Honey	30	10	40	349	209	0	0	0	0
Zelkova	179	40	20	40	199	60	0	0	0
Prun, Amur	60	179	239	20	0	0	0	0	0
Hackberry, European	30	40	169	80	30	0	0	0	0
Amorpha, Papada	0	0	10	70	199	30	0	0	0
Beryl, White Birch	0	30	179	40	0	0	0	0	0
Cedrus, Florida	70	10	30	179	30	0	0	0	0



- Species
- Zone
- Tree Type

Zone
[Dropdown menu]

- Refresh
- Export
- Print

Public Private All

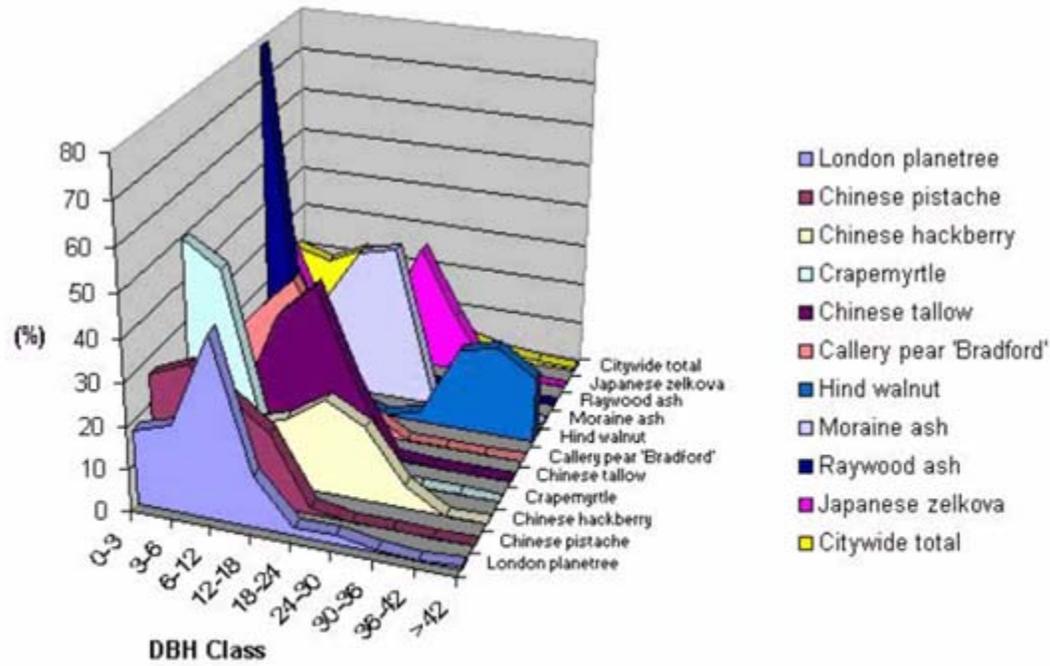


MainReport

Davis, CA

Relative Age Distribution of Top 10 Public Tree Species (%)

1/6/2006



- Species
- Zone
- Tree Type

Public Private All

MainReport

Davis, CA

Total Annual Benefits, Net Benefits, and Costs for Public Trees

1/6/2006

Benefits	Total (\$)	Standard Error	S/tree	Standard Error	S/capita	Standard Error
Energy	313,889	(±14,065)	13.32	(±.6)	4.89	(±.22)
CO2	29,033	(±1,301)	1.23	(±.06)	0.45	(±.02)
Air Quality	300,944	(±13,484)	12.77	(±.57)	4.69	(±.21)
Stormwater	105,520	(±4,728)	4.48	(±.2)	1.64	(±.07)
Aesthetic/Other	1,703,082	(±76,311)	72.28	(±3.24)	26.52	(±1.19)
Total Benefits	2,452,468	(±109,889)	104.08	(±4.66)	38.19	(±1.71)
Costs						
Contract Pruning	281,500		11.95		4.38	
Tree & Stump	31,500		1.34		0.49	
Pest Management	32,250		1.37		0.50	
Irrigation	9,000		0.38		0.14	
Inspection/Service	22,500		0.95		0.35	
Planting	36,000		1.53		0.56	
Administration	78,750		3.34		1.23	
Litter Clean-up	6,317		0.27		0.10	
Infrastructure	24,818		1.05		0.39	
Liability/Claims	22,447		0.95		0.35	
Other Costs	0		0.00		0.00	
Total Costs	545,082		23.13		8.49	
Net Benefits	1,907,386	(±109,889)	80.95	(±4.66)	29.70	(±1.71)
Benefit-cost ratio	4.50	(±.2)				

Who will use i-Tree?



i-Tree in use:

- 🌳 State-wide projects (Idaho; Illinois)
- 🌳 Municipal projects (Portland, OR; Casper, WY)
- 🌳 Non-profits (Tree People; Trees Forever)

A screenshot of the Trees Forever website from September 2006. The page has a green header with the date "September, 2006". Below the header is a navigation bar with links: Home, About, Trees, What We Do, News & Materials, Calendar, Gallery, Affiliates, Survey, Contact, Support. The main content area features the "TREES FOREVER" logo on the left and the headline "A Call To Action!" on the right. Below the headline is a sub-headline "News at Trees Forever, The i-Tree Project" which is circled in red. Underneath this headline is the date "September 8, 2006". To the left of the main text is a small icon of a tree and the text "i-tree". The main text describes the i-Tree Project, mentioning Sunny McDonald and a baseline street tree inventory in Cedar Rapids, IA, starting on September 25. To the right of the main text is a section titled "Trees Forever Volunteer Opportunities" with two entries: "September 25, i-Tree, Cedar Rapids, IA" and "September 27, SPLASH, Decatur, IL".

September, 2006



A Call To Action!

Home About Trees What We Do News & Materials Calendar Gallery Affiliates Survey Contact Support

News at Trees Forever, The i-Tree Project

September 8, 2006

 i-tree

The **i-Tree Project**, being conducted by Sunny McDonald will be responsible for **taking a baseline street tree inventory** from a sampling of neighborhoods across Cedar Rapids. The project officially begins on **September 25**, and runs through October 21, in Cedar Rapids, IA.

Trees Forever Volunteer Opportunities

September 25, i-Tree, Cedar Rapids, IA

September 27, SPLASH, Decatur, IL

Minneapolis Pilot Project

- 🌳 Summer of 2004,
i-Tree software
tested using
volunteers
- 🌳 Professionals
collected
information along
with volunteers



Training Components

- 🌳 Classroom Tree ID
- 🌳 Outdoor Tree ID
- 🌳 Tree Characteristics
- 🌳 Measurement
- 🌳 Software/PDA Operation



Summary

🌳 Using volunteers can be successful, evaluate if it is the right choice for your community.



i-Tree: Demonstrating That Trees Pay Us Back!

 Trees are assets, management adds value by increasing return on investment



Minneapolis Tree Advisory Commission

selected portions of

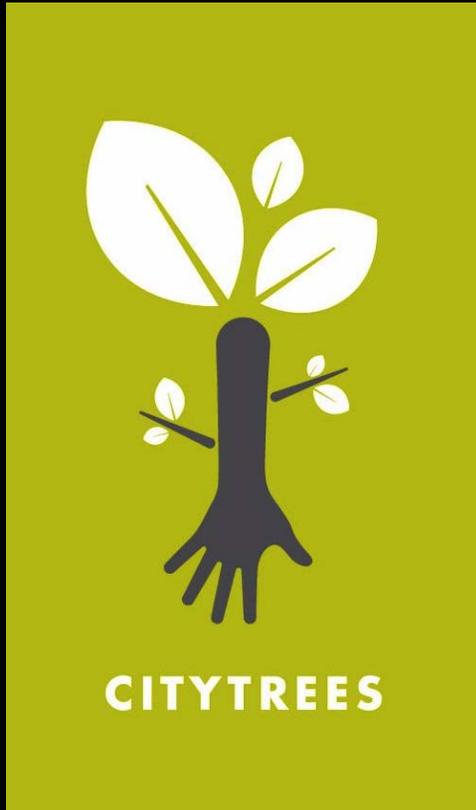
Annual Report

to the

Minneapolis Park & Recreation Board

Minneapolis City Council & Mayor

January 2006



The Benefits of the Urban Forest

The trees of Minneapolis are THE growing capital asset that benefits everyone in the City.



The State of the
Minneapolis
Urban Forest

The **Benefits** of the Urban Forest

Each year Minneapolis street trees provide:

- \$6.8 million in energy savings
- \$9.1 million in reduced storm water runoff
- \$7.1 million increased property value
- Plus improvements to air quality



The State of the
Minneapolis
Urban Forest

**\$24.9 million TOTAL
value each year!**



To provide **Benefits ...**

Each PUBLIC UTILITY requires ongoing public investments



The State of the
Minneapolis
Urban Forest

**60% of Minneapolis street trees
currently need some maintenance**

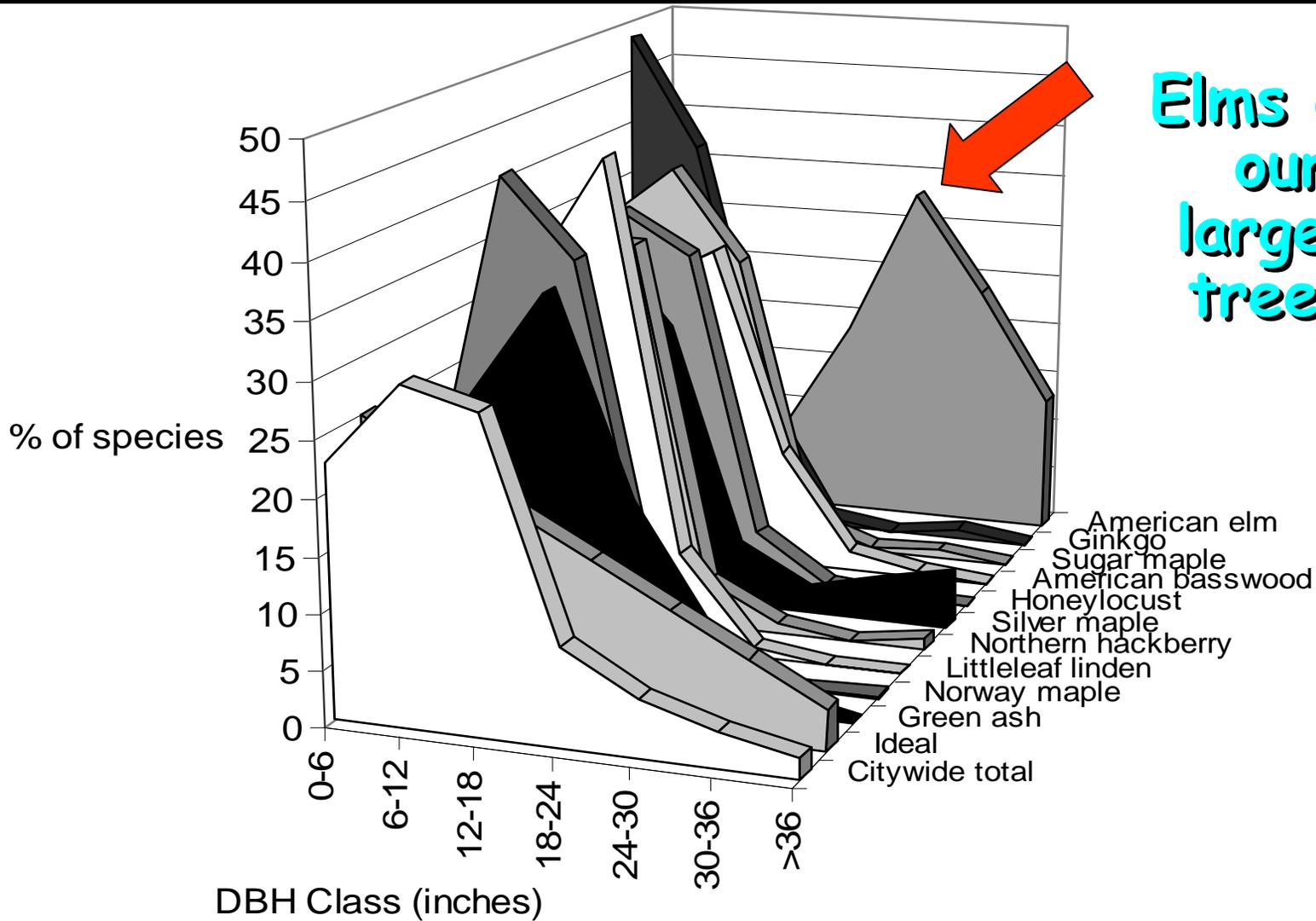
The **Impacts** of Dutch Elm Disease

**Only 10% of Minneapolis street trees are elms.
But they generate 30% of tree benefits.**



**The State of the
Minneapolis
Urban Forest**

The Impacts—why elms matter



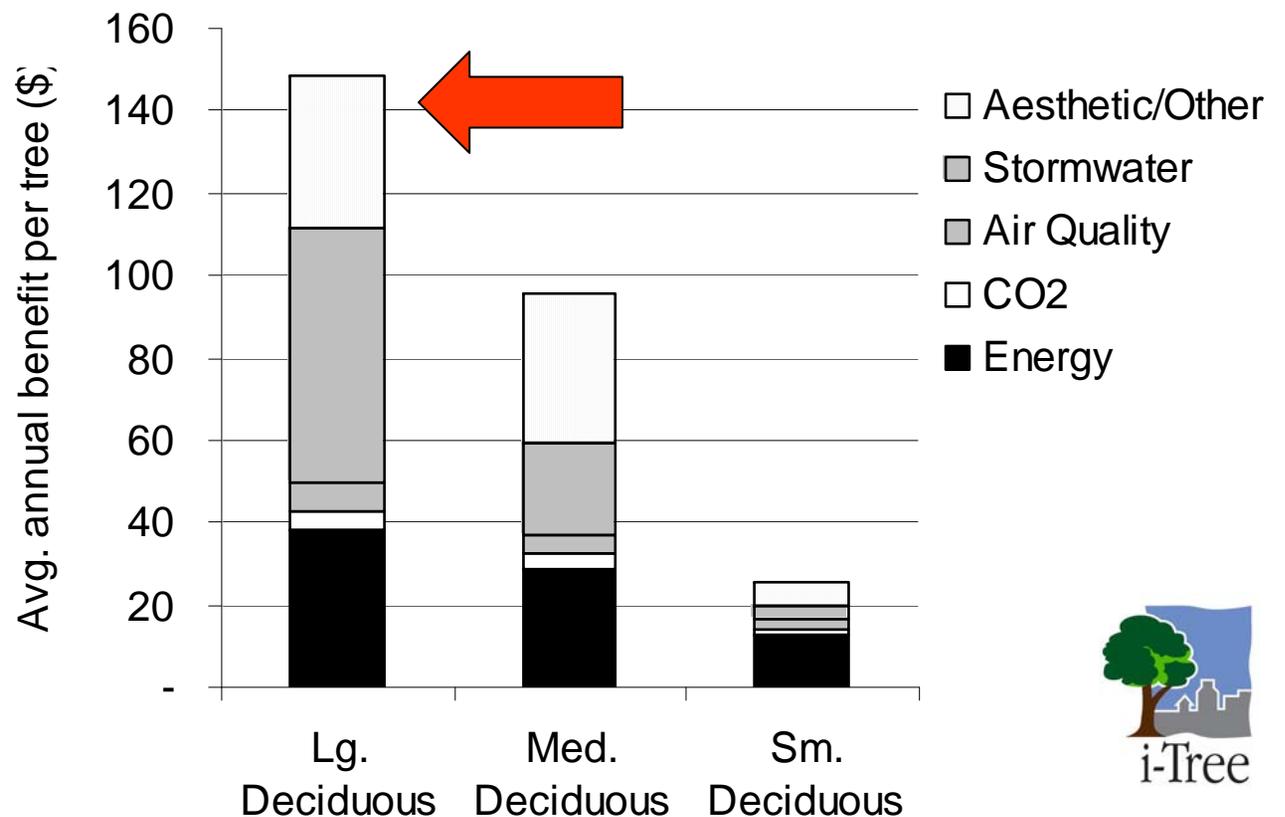
Elms are
our
largest
trees.



The Impacts—why elms matter

LARGE TREES

= MOST BANG FOR BUCK



The State of the
Minneapolis
Urban Forest



The **Impacts** of Dutch Elm Disease

Minneapolis has irretrievably lost:

- In 2004: 10,153 elms
- In 2005: 6,179 elms



The State of the
Minneapolis
Urban Forest

Resources

1. Fund Park Board Forestry to achieve:

- ✓ Timely removals & pruning
- ✓ Stump removal
- ✓ Tree planting
- ✓ Storm response



Minneapolis Tree Advisory
Commission

RECOMMENDATIONS

Policies

1. Adopt urban forestry standards:

- ✓ Incentives for developers
- ✓ Streetscape standards & spec's
- ✓ Private arborist qualifications



Minneapolis Tree Advisory
Commission

RECOMMENDATIONS



Outreach

1. Launch Stewardship Campaign.

- ✓ Inform constituents
- ✓ Promote participation

including **Citizens Tree Academy**



CONCLUSIONS



The State of the Urban Forest

- Benefits
- Impacts
- Threats

Recommendations

- Resources
- Policies
- Outreach



**Minneapolis Tree
Advisory
Commission**

How i-Tree makes a difference:

Through i-Tree ... elected officials see proof of the economics of trees, e.g.:

- Annual \$ benefits of street trees
- Total \$ value of urban forest
- Quantity & cost of maintenance
- Economic losses from DED now
- High % & value of trees threatened
- Costs of deferred vigilance



Minneapolis Tree
Advisory
Commission

**Resulting in funding,
leadership & action.**



Trees Pay Us Back - Volume 1

i-Tree Results from Minneapolis, MN

i-Tree
Overview

Minneapolis
Involvement

Map of the
Midwest
Region

Download
Software to
View Adobe
PDF's

Trees Pay Us Back -
VOLUME 2
contains:

- Tools to Communicate Tree Values
- More Tree Benefits Research and Information

Minneapolis:



Minneapolis Municipal Tree Resource Analysis

USDA Forest Service
Center for Urban Forest Research

This report describes the structure and function of Minneapolis' public trees and compares costs and benefits of management.

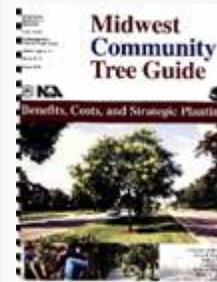


Assessing Urban Forest Effects and Values: Minneapolis's Urban Forest

USDA Forest Service
Northeastern Research Station

This report describes the structure, health, benefits, and values of Minneapolis's urban forest (both public and private) as determined by the Forest Service's Urban Forest Effects (UFORE) model.

Midwest Region:



Midwest Community Tree Guide: Benefits, Costs, and Strategic Planting

USDA Forest Service
Center for Urban Forest Research

This guide outlines how any Midwest community can use the base data collected in Minneapolis to calculate the costs and benefits of planting trees.



Trees in Our City

USDA Forest Service
Center for Urban Forest Research

This Power Point presentation communicates the benefits of trees to community leaders.



Trees Pay Us Back

USDA Forest Service
Northeastern Area

This brochure summarizes the value of trees and invites communities to use the i-Tree results.



Conclusion



Questions?

🌳 Visit: <http://www.fs.fed.us/psw/programs/cufr>

🌳 <http://www.itreetools.org>

