

PLANTING THE SEEDS OF SUCCESS.



Trees Pay Us Back -- Benefits of Trees in Utah

Greg McPherson
Utah Green Annual Conference
Sandy, Utah
January 28, 2008

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

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

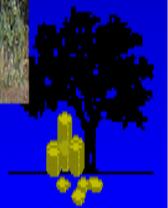
- Bradford Pear
- 9 years old
- 9 inch dbh
- 28 ft. tall
- 19 ft. spread
- Number of leaves ?? (#)
- Total leaf area ?? (sq.ft.)
- H₂O retainment capacity ?? (ga)

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

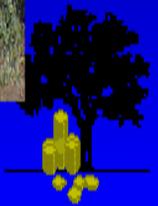
- Number of leaves 88,908
- Total leaf area 3,846 sq ft
- H₂O retainment capacity 55 g

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

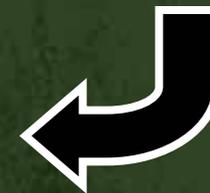
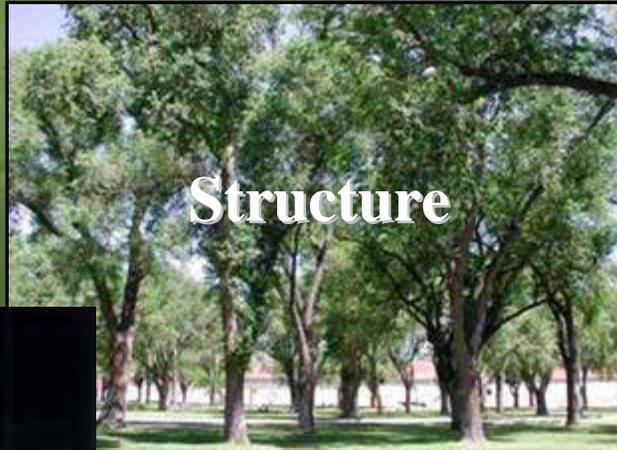


Today

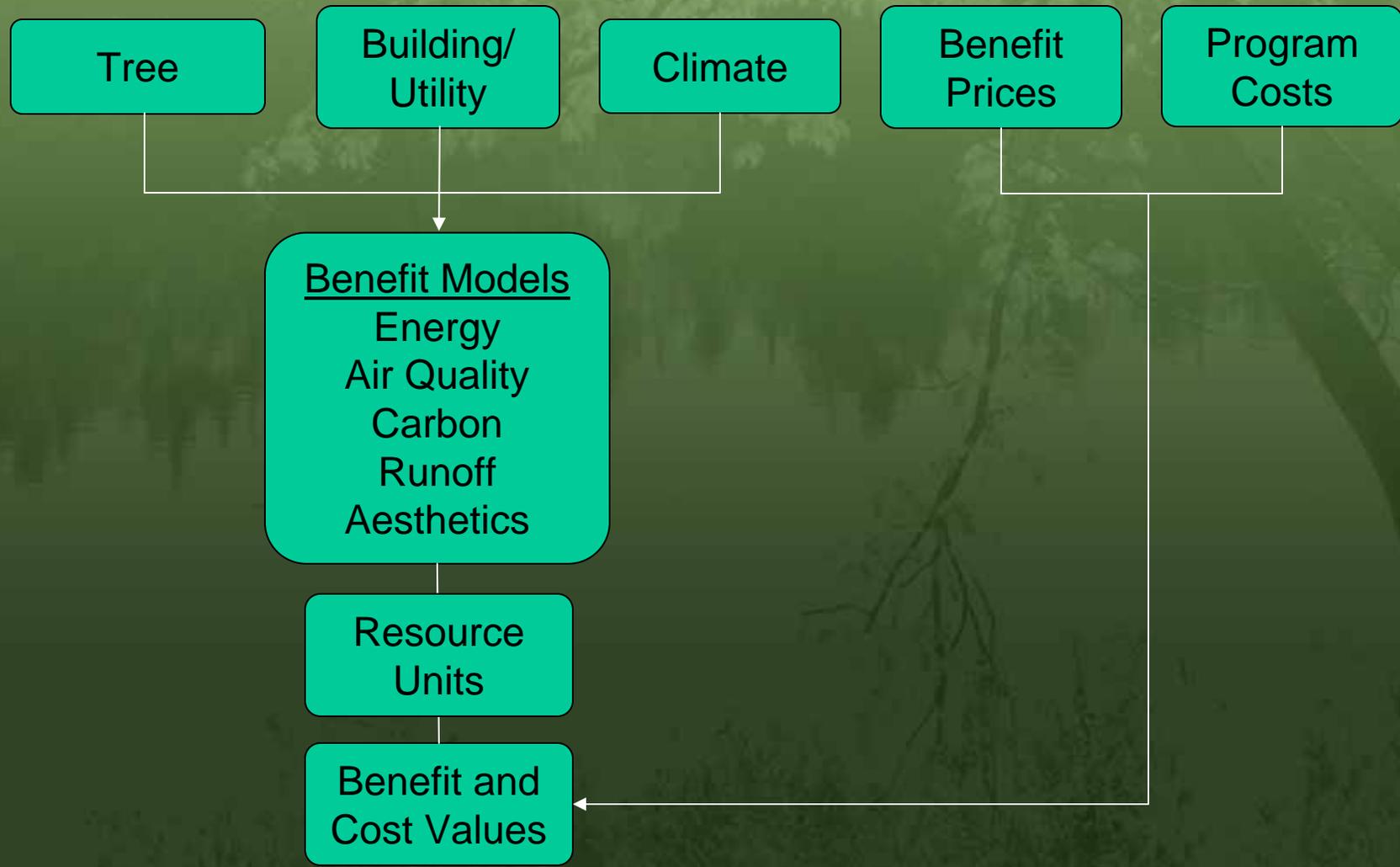
- Value of urban trees from a research perspective.
- What you can do.
- i-Tree and STRATUM.



Benefit-Based Approach

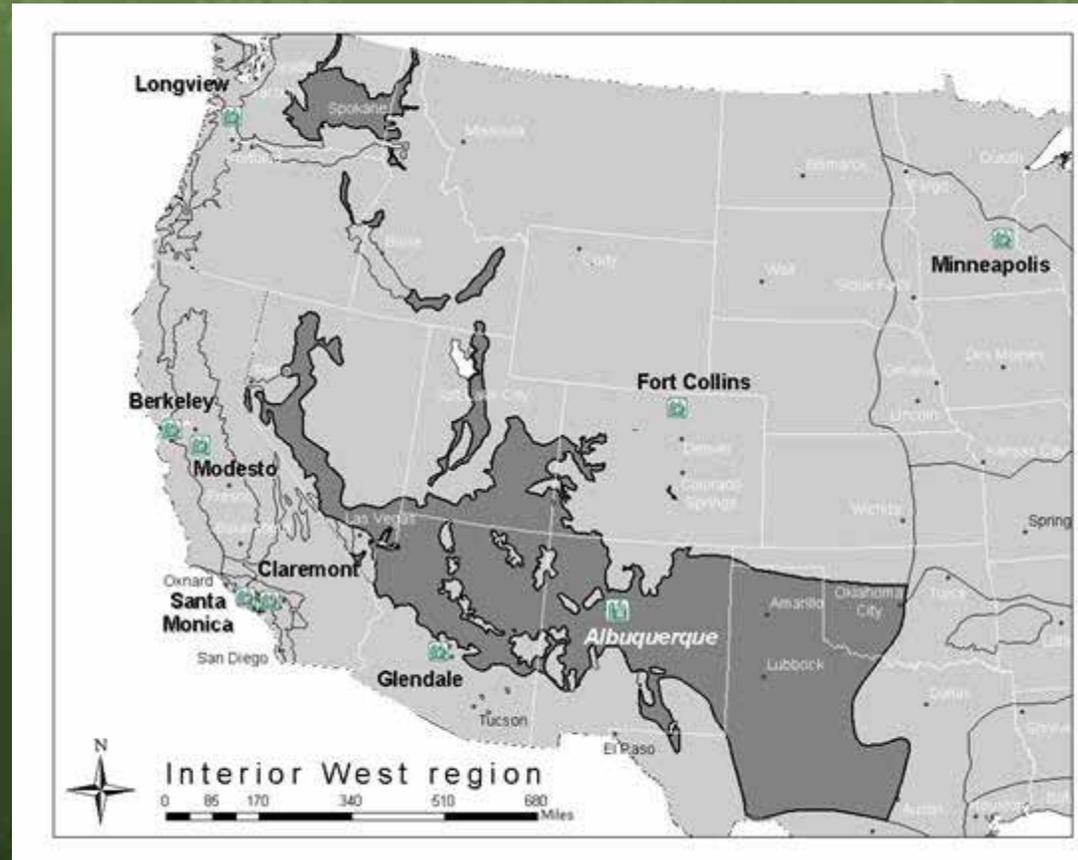


Benefit-Cost Modeling

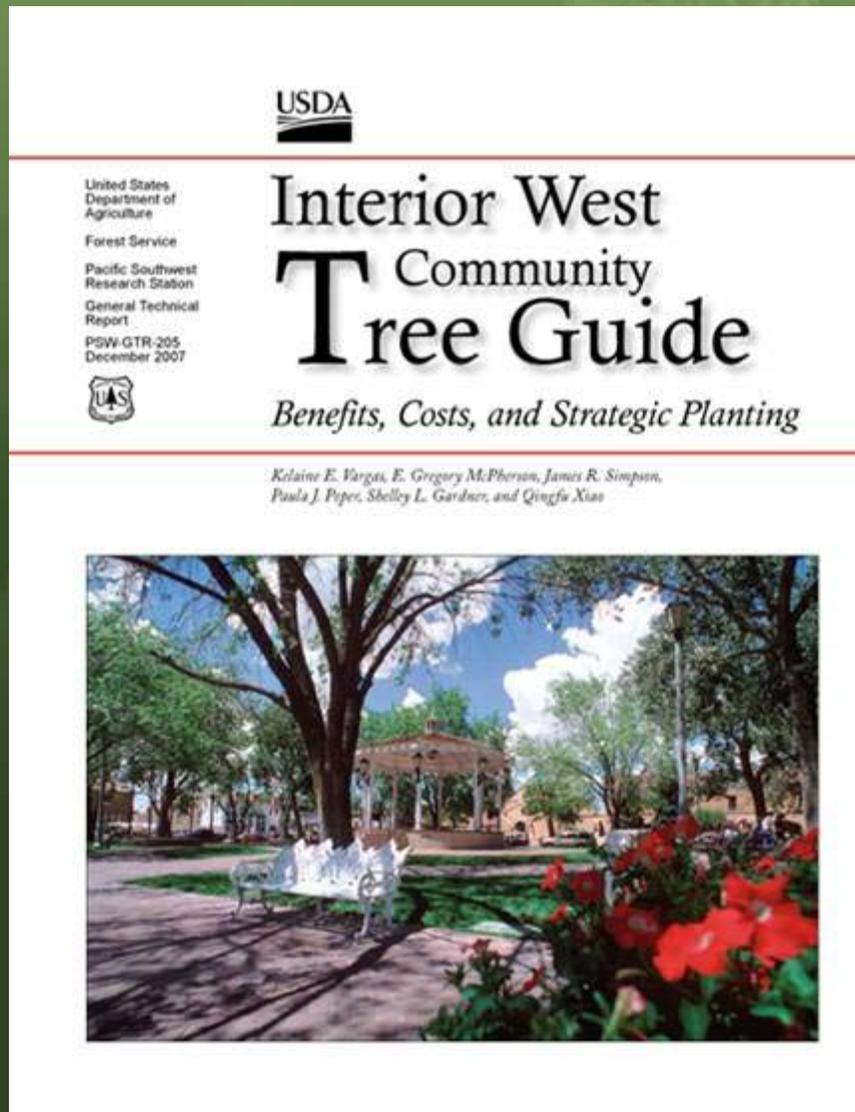


Reference City Research

- Collected data –
Albuquerque park/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



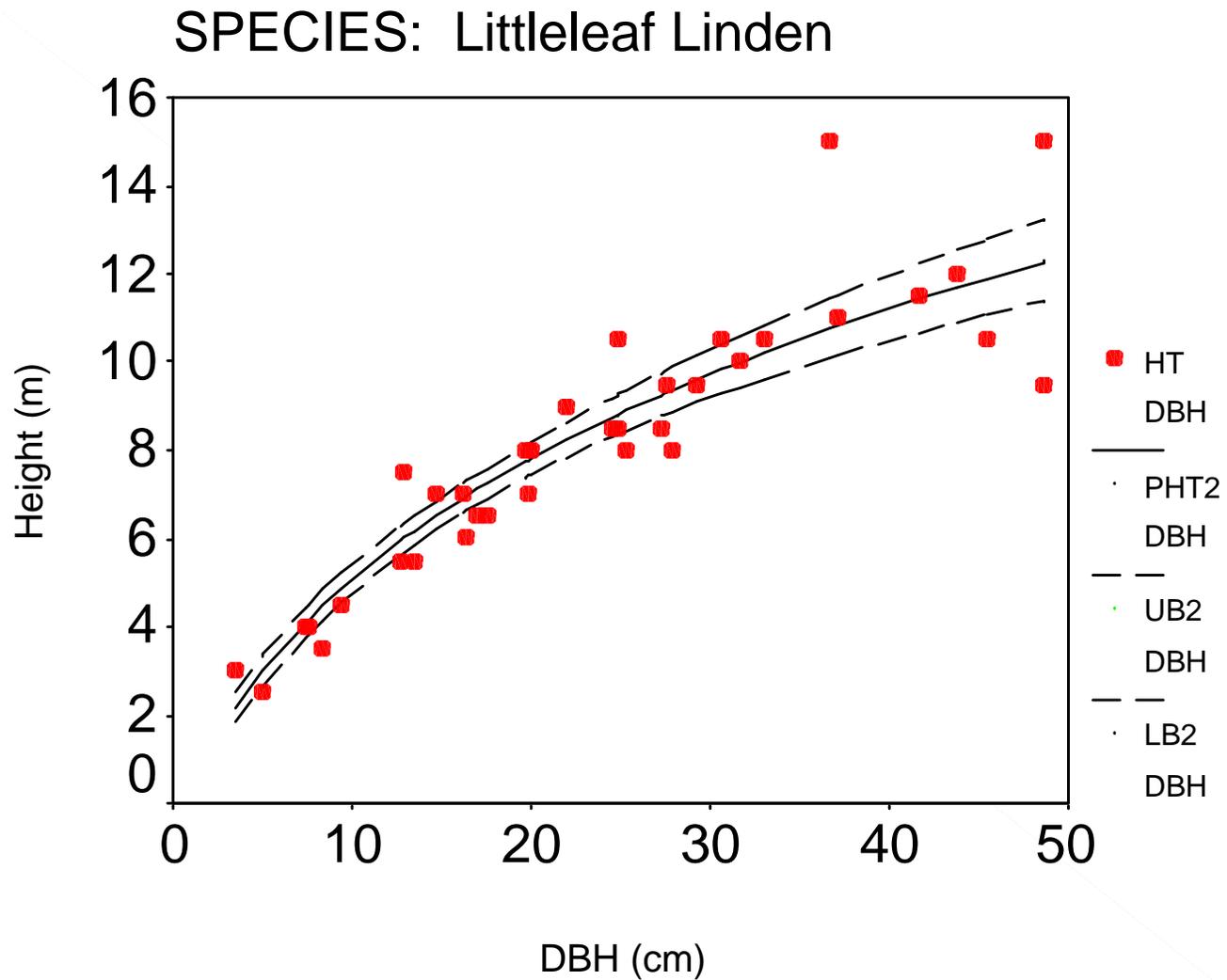
- 1000's of communities
- Contents
 - Regional Benefits And Costs Calculated
 - Examples of Estimating Benefits And Costs Of Tree Planting Projects
 - Guidelines For Selecting And Placing Trees
- Interior West Tree Guide
 - rschneider@fs.fed.us
 - (970) 498-1392

City Tree Survey

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



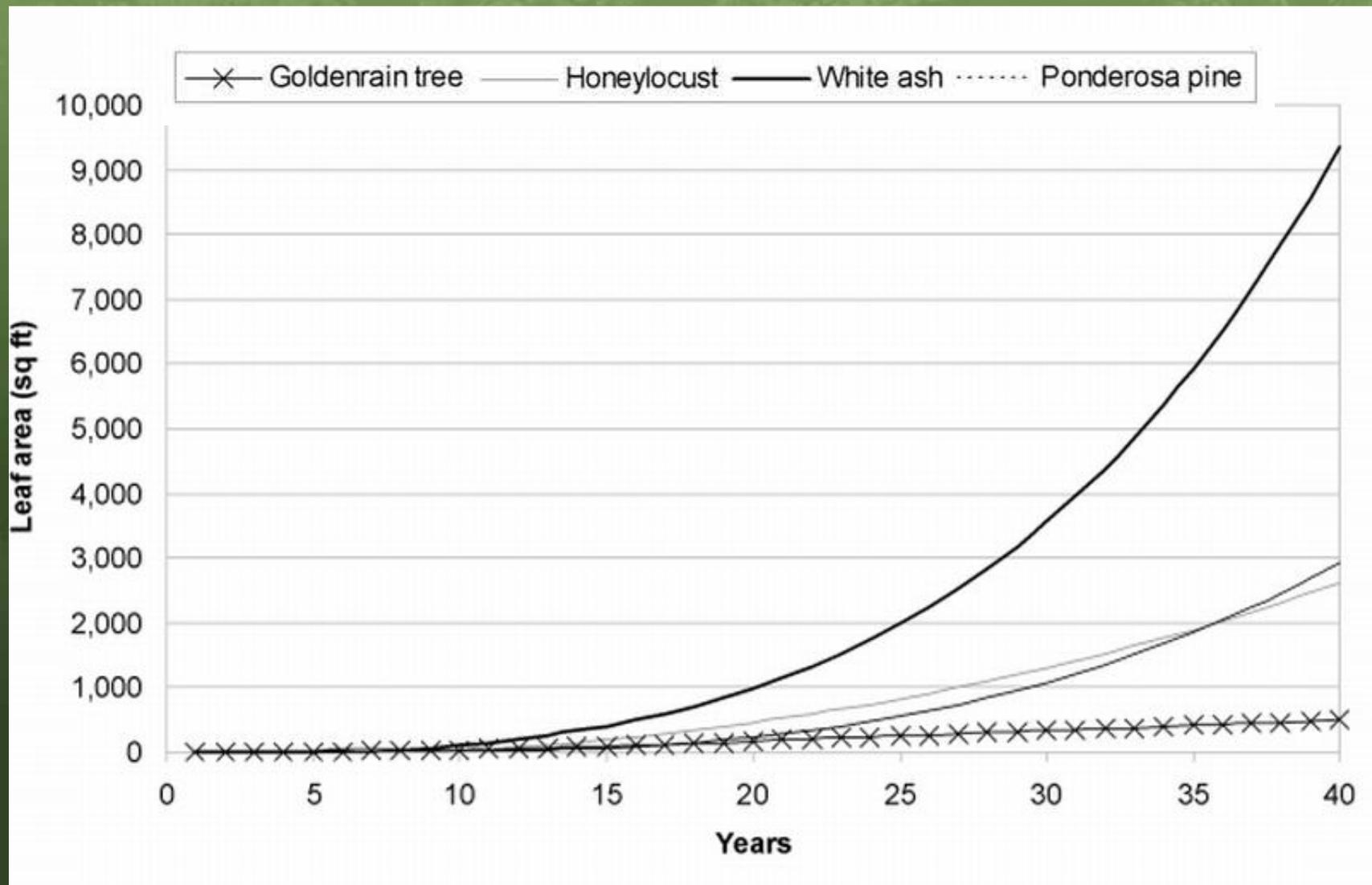
Fit Curves for Growth



Reporting Results

- For “typical” large, medium, small, and conifer tree.
 - White ash
 - Honeylocust
 - Goldenrain tree
 - Ponderosa pine
- Dimensions at maturity differentiate tree size.
- For public (street/park) and private property locations (east, south, west).





Research Process

Value Analysis

Pricing Benefits

- Albg. market prices –
(\$0.078/kWh, \$1.10/therm)
- Carbon trading credits - CO₂
(\$6.68/ton)
- Damage value and control cost
of emissions – air pollutants
(Wang & Santini)
- Retention/detention costs –
stormwater runoff (\$0.005/gal)
- Median sale price - residential
property = \$145,000



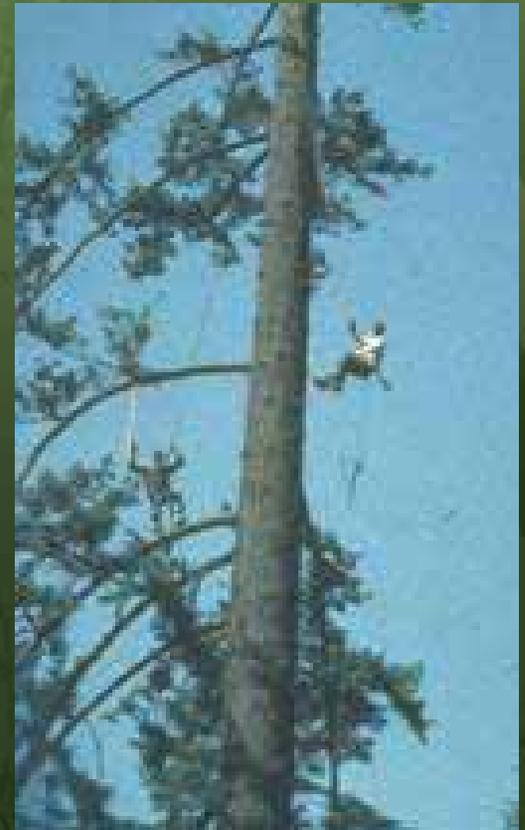
Research Process

Value Analysis

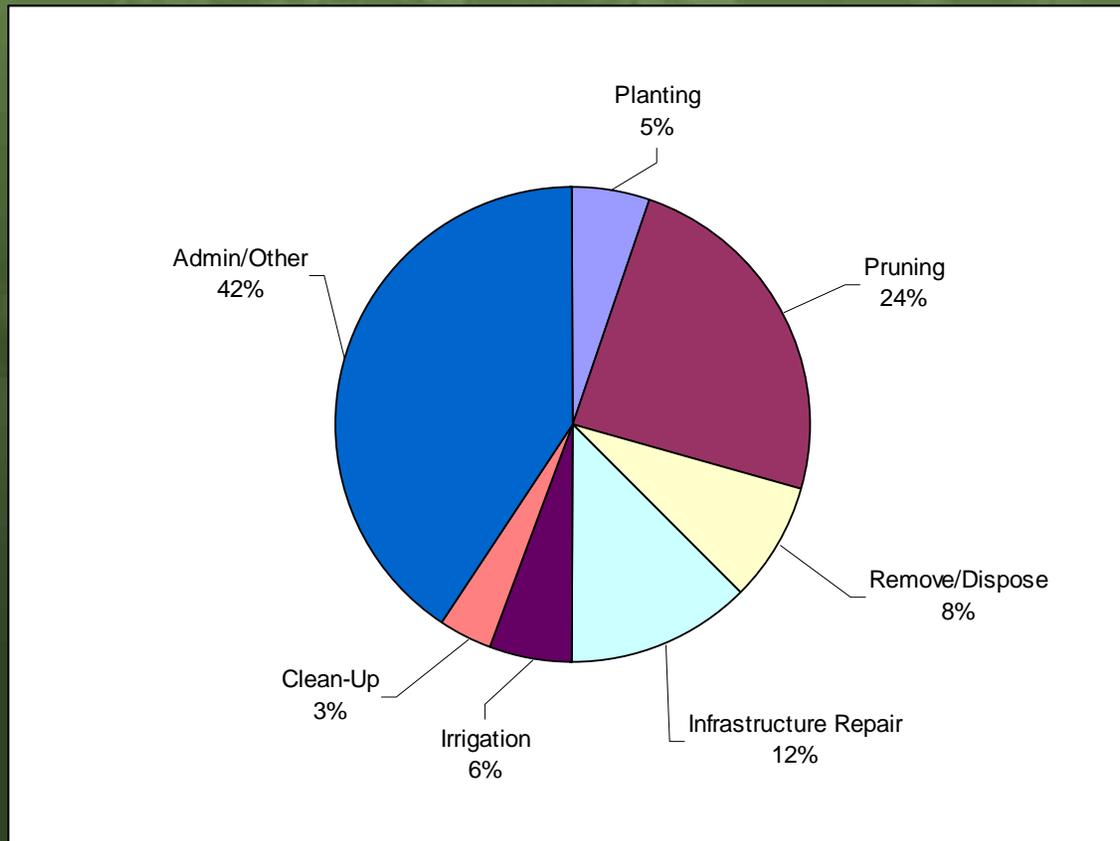
Calculating Costs

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 (\$20/tree)



Research Process

Value Analysis

Calculating Net Benefits

Benefits minus Costs



Trees Improve the Environment

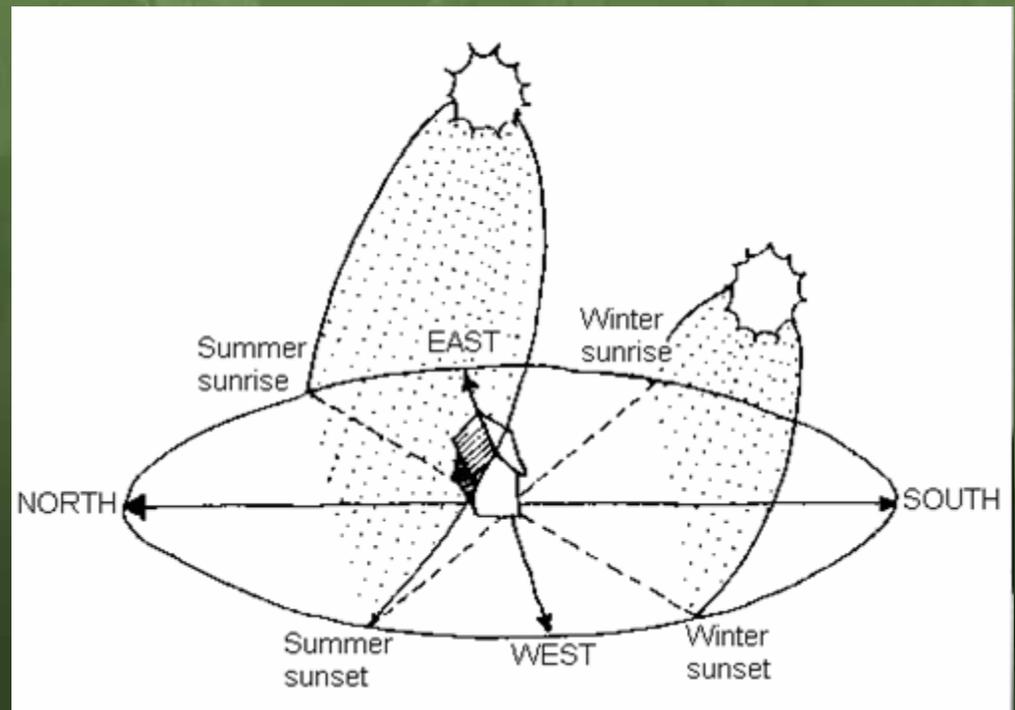


Conserving Energy



Conserving Cooling Energy

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



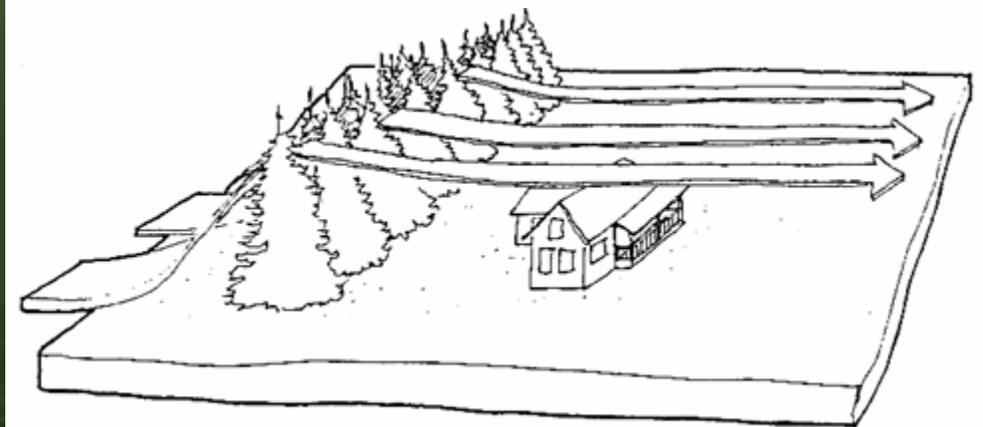
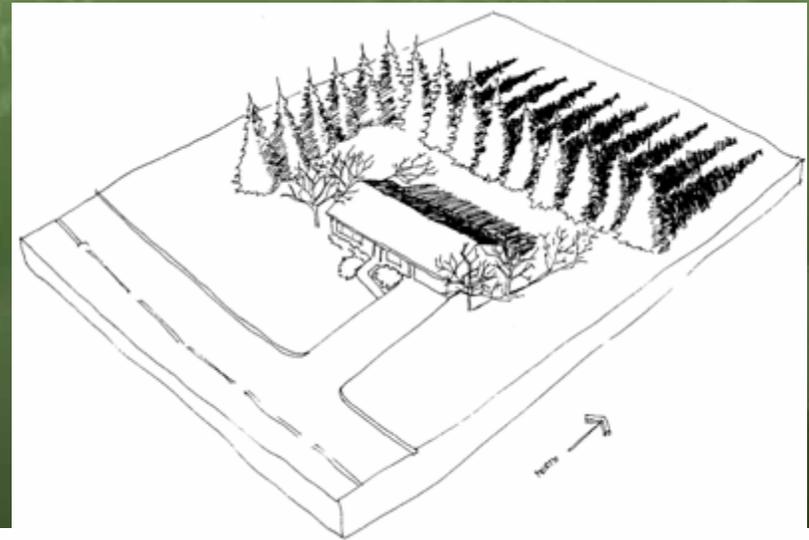
Solar-Friendly Trees

- Open winter crown, dense summer shade
- Foliage early to drop, late to leaf-out
- Examples:
 - Maples, Hackberry, Coffeetree, Honeylocust, Pagodatree, Crabapple



Conserving Heating Energy

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



Conserving Energy

- White ash, 20 years (23-ft tall), West
- Save 11% of annual AC costs (232 kWh, \$18/yr)
- Save 0.7% of winter heating costs (\$3)
- \$21/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 minimize home cooling. However, Dr. Greg McPherson, Director, Center for Urban Forest Research, Pacific Northwest 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:

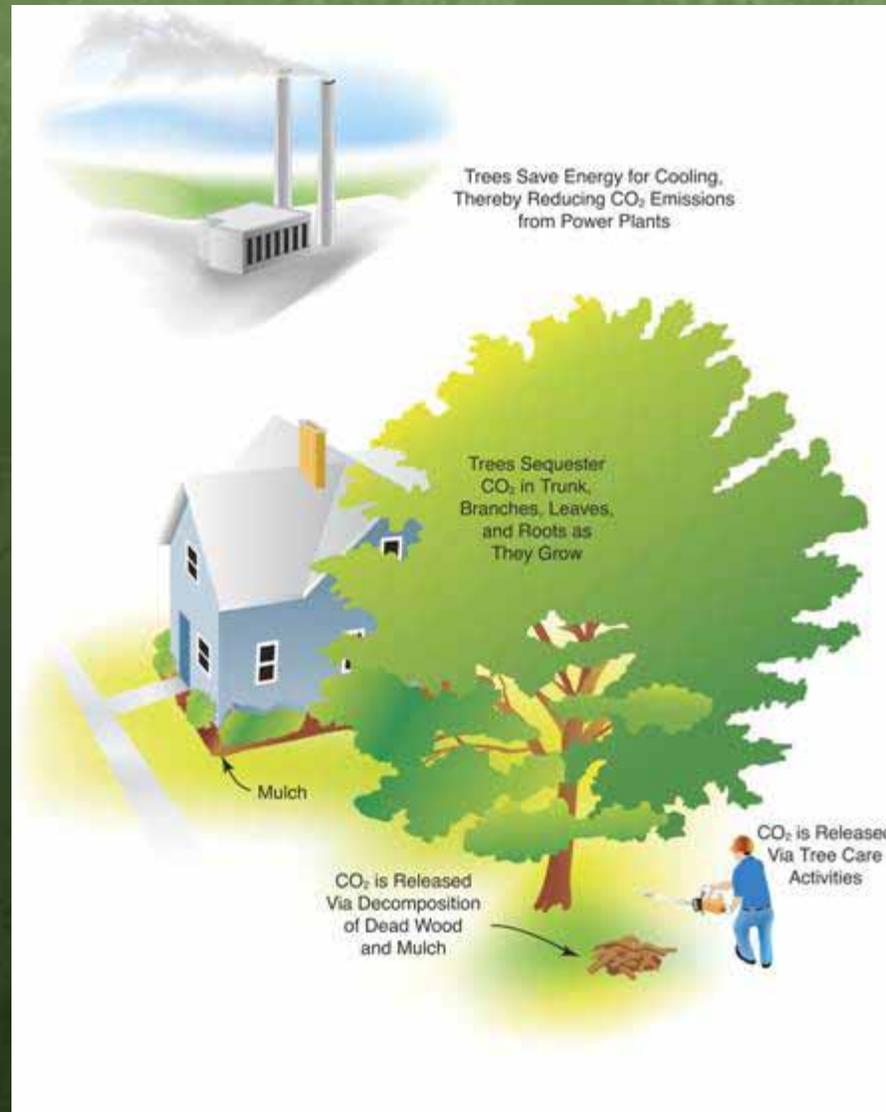
- Shading, which reduces the amount of radiant energy absorbed and stored by built surfaces.
- Evapotranspiration, which converts liquid water in leaves to vapor, thereby cooling the air.
- Reducing the velocity of wind, which slows the infiltration of outside air into inside spaces.

Where would you rather live?

Strategically Placed Trees Save Energy Dollars

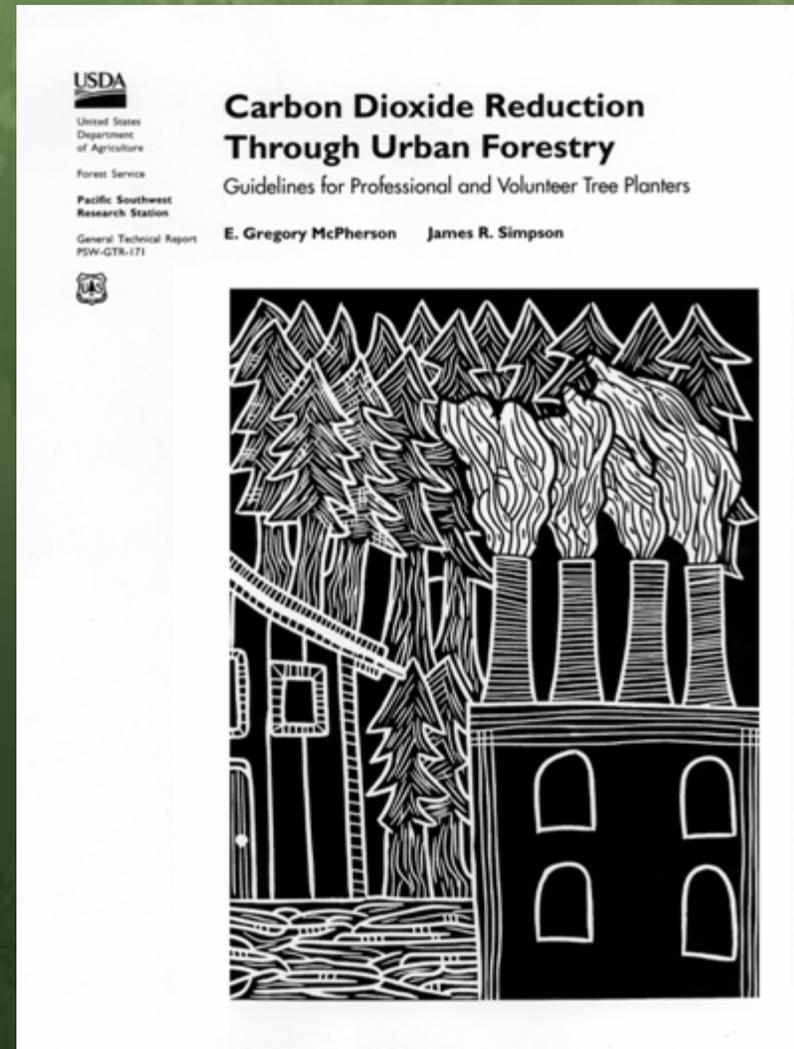
Center for Urban Forest Research
Pacific Northwest Research Station
USDA, Forest Service
7 Shattuck Avenue, Suite 1101
Davis, CA 95618-0101
Telephone: 530.752.7628
http://www.cufor.org

Reducing Atmospheric Carbon Dioxide



Reducing Atmospheric Carbon Dioxide

- Increase tree stocking levels
- Create diverse habitats
- Select well-adapted, long-lived trees
- Locate to maximize energy savings
- Utilize removed trees
 - Wood products
 - Bioenergy

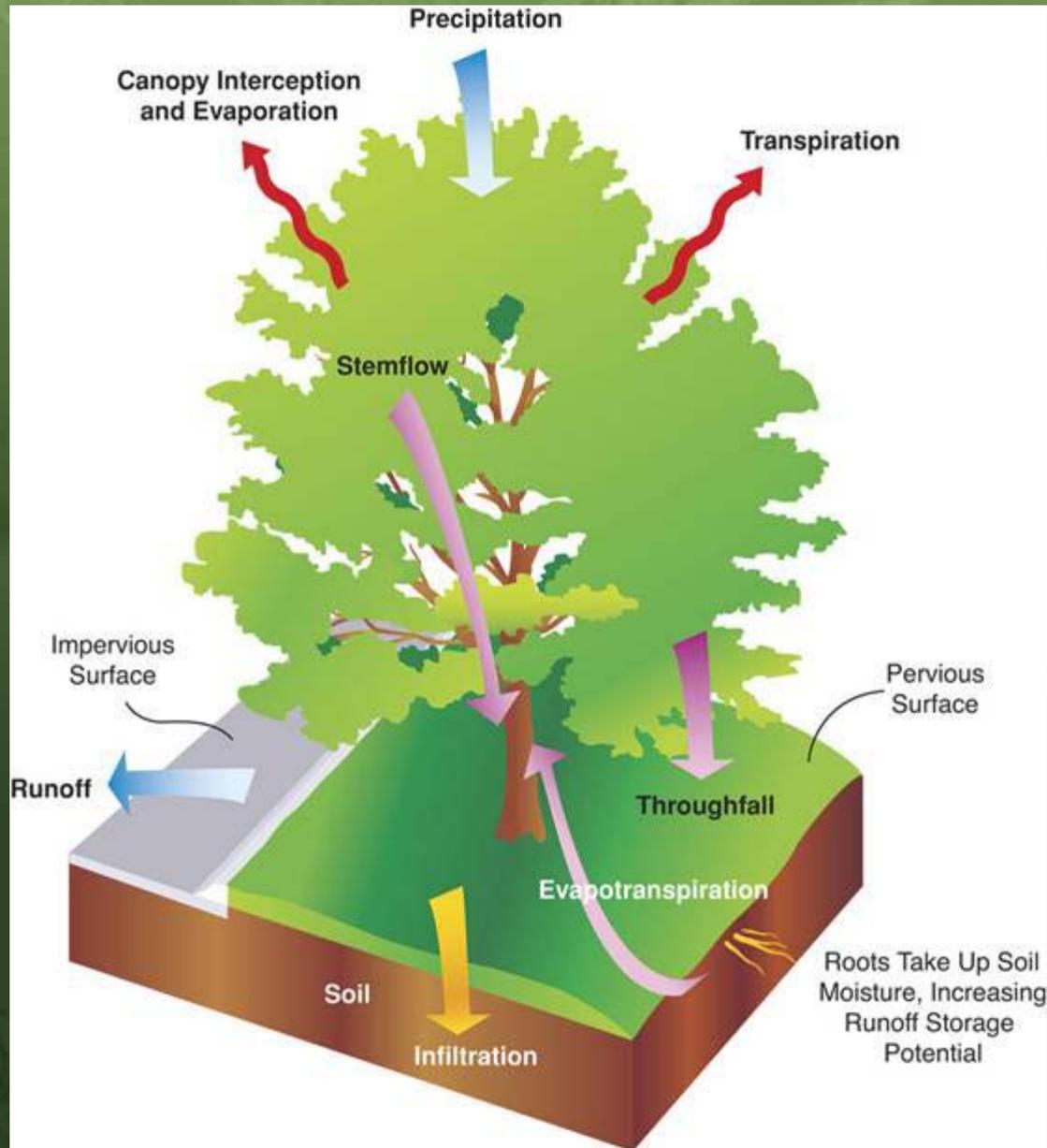


Reducing CO₂

- White ash, 20 years, Opposite west wall
 - Total Net = 634 lb
 - Total Value = \$2.12



Reducing Stormwater Runoff



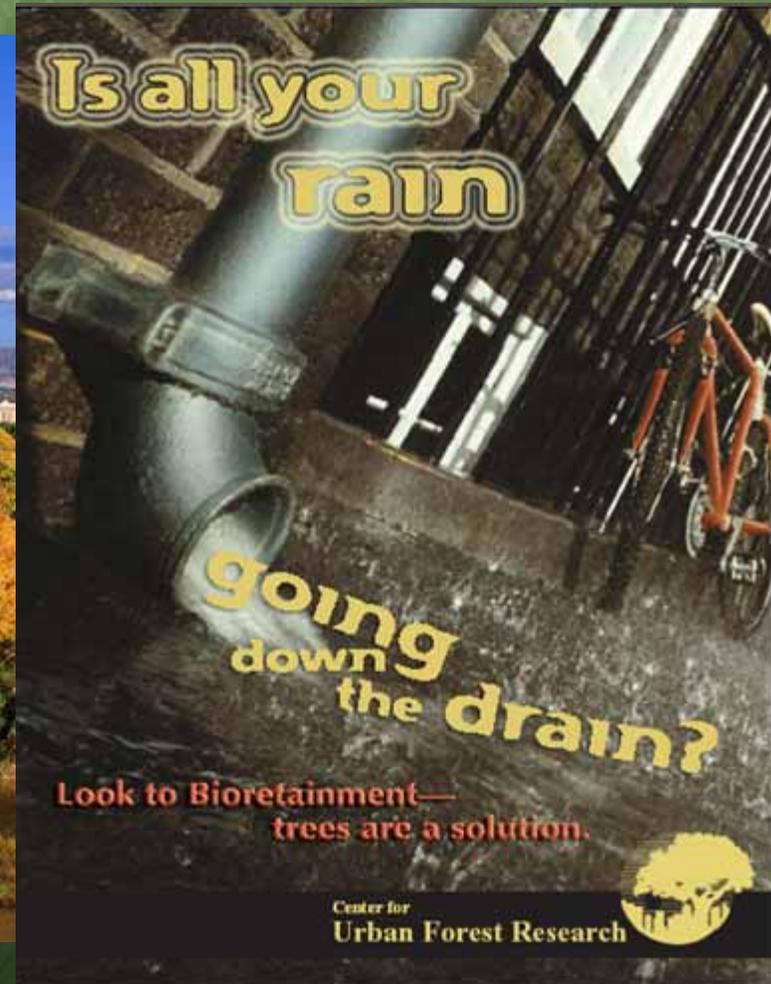
Reducing Stormwater Runoff

- 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



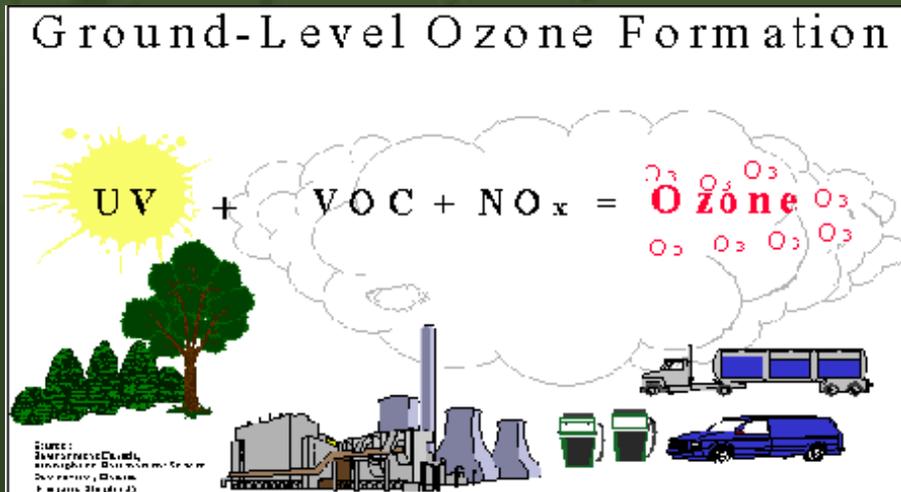
Reducing Runoff

- White ash, 20 years
 - Intercepted = 638 gal
 - Value = \$3.19



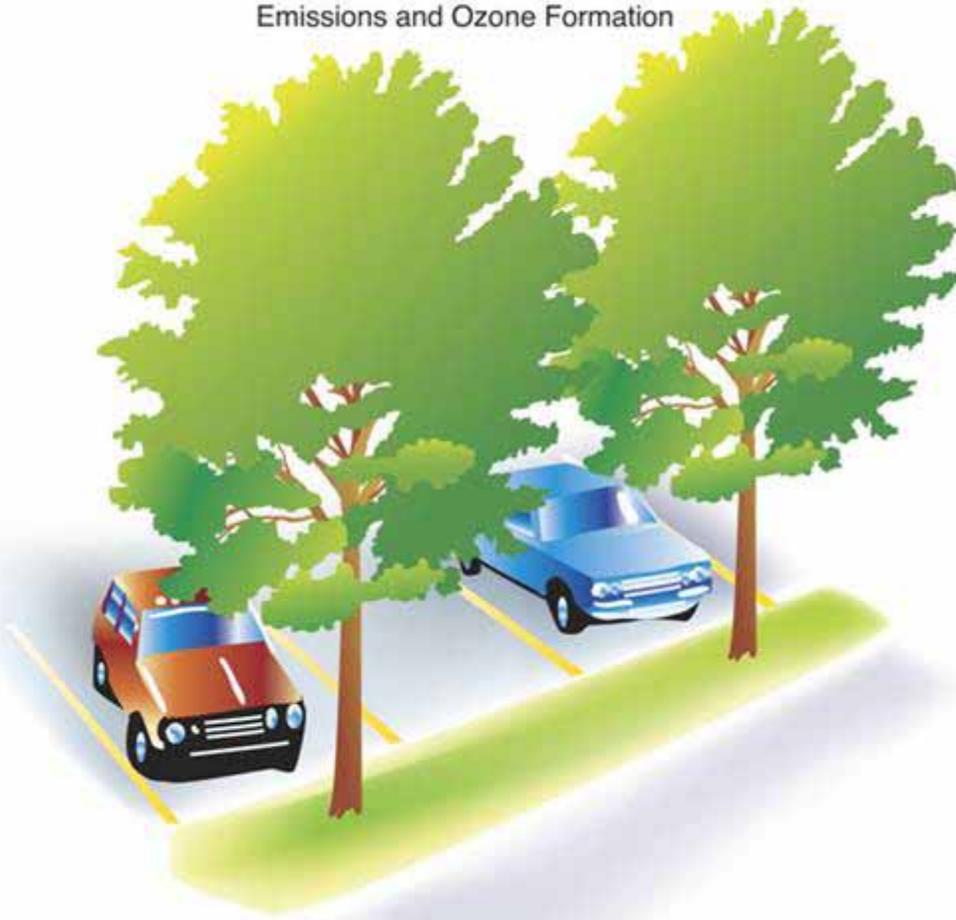
Improving Air Quality

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

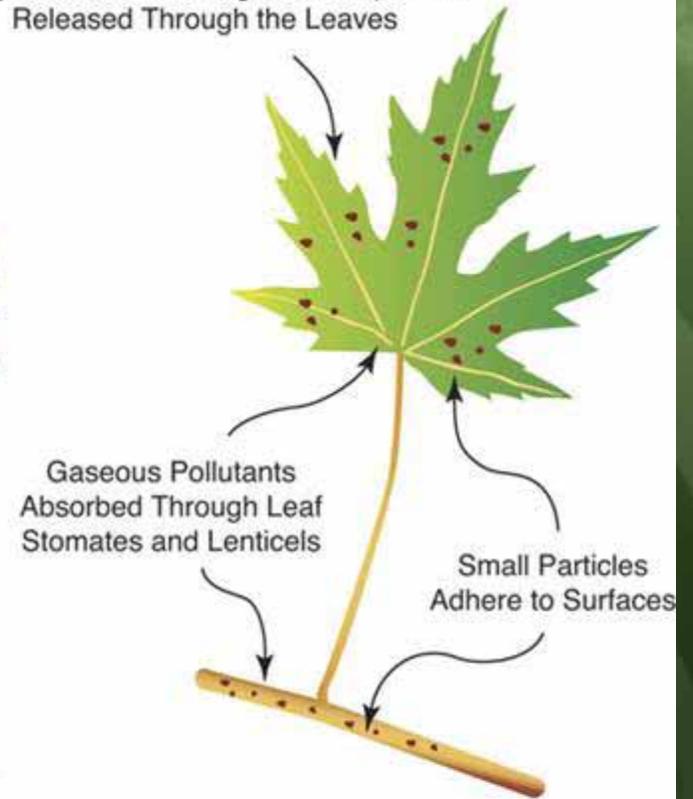


Improving Air Quality

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

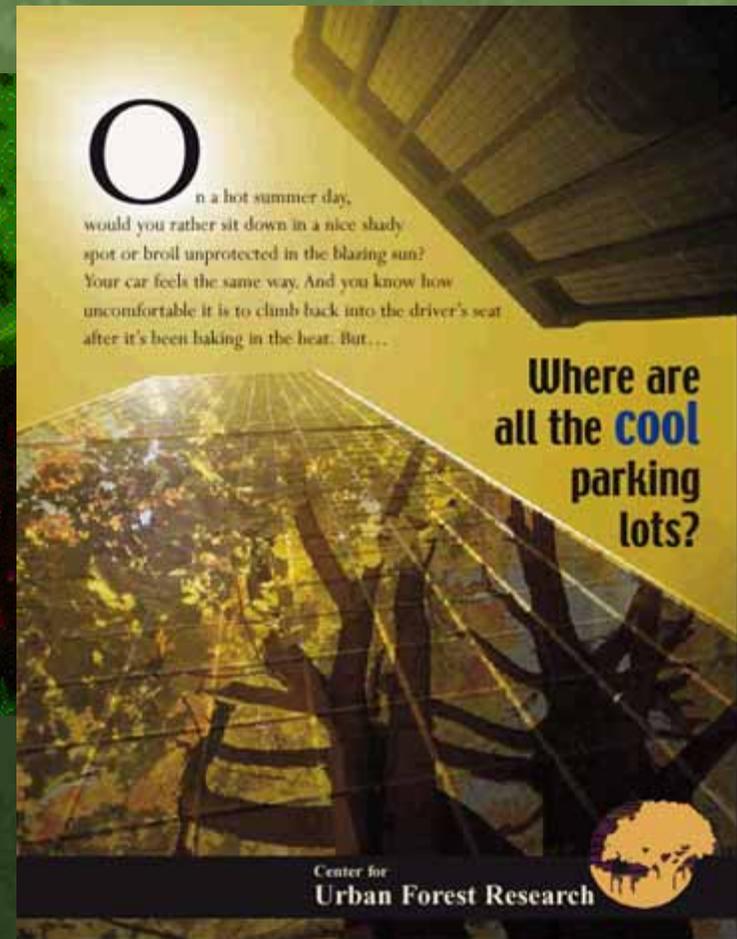
- Plant tolerant species
 - Not ash, Austrian pine
- Conifers
- Hairy plant parts, long petioles
 - Oak, birch, sumac, maple, ash
- Locate close to and downwind of source, plant multiple rows
- Sustain large, healthy trees
- Shade parked cars



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



Improving Air Quality

- White ash, 20 years, Facing West-Wall (lbs)
 - NO₂ = 1.06, \$0.65
 - SO₂ = 0.87, \$1.23
 - PM₁₀ = 0.45, \$0.51
 - Ozone = 0.52, \$0.32
 - VOCs = 0.16, \$0.59
 - BVOCs = 0.0, \$0
 - Net Value = 3.06, \$3.30



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

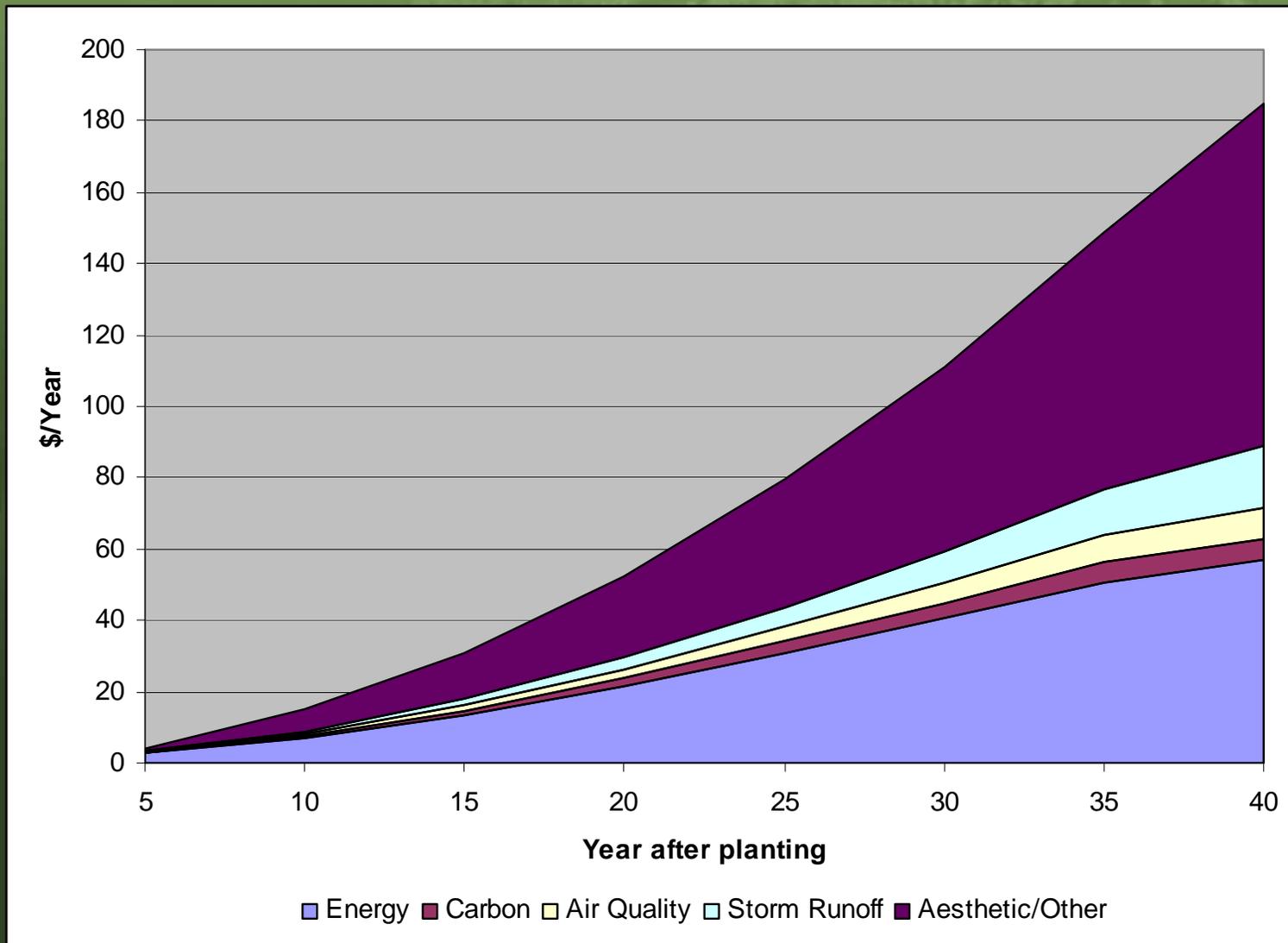


Aesthetic and Other Benefits

- White ash, 20 years
– \$23



Benefits in Interior West White Ash, West Yard





Total Costs	\$2.31	\$5.19	\$5.75
Total Benefits	\$15.31	\$31.27	\$52.57
Total Net Benefits	\$13.01	\$26.08	\$46.82

Albuquerque Benefit-Cost Summary

- \$1.31 in benefits for every \$1 spent
 - 21,500 trees
 - \$429,000 expenditures
 - \$561,000 benefits
- Net annual benefit = \$132,000
 - \$6/tree, \$0.27/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



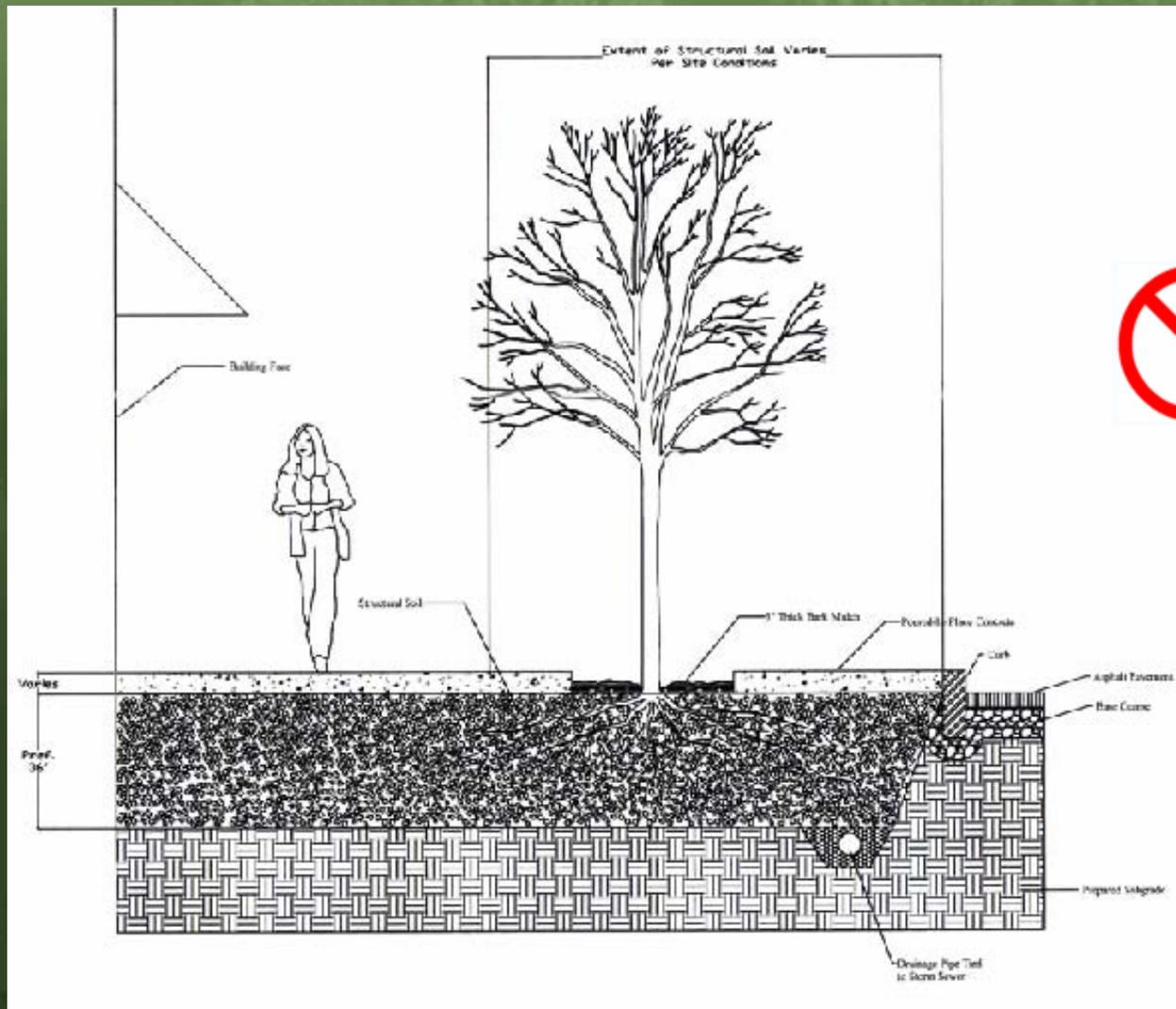
Plant More Trees



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

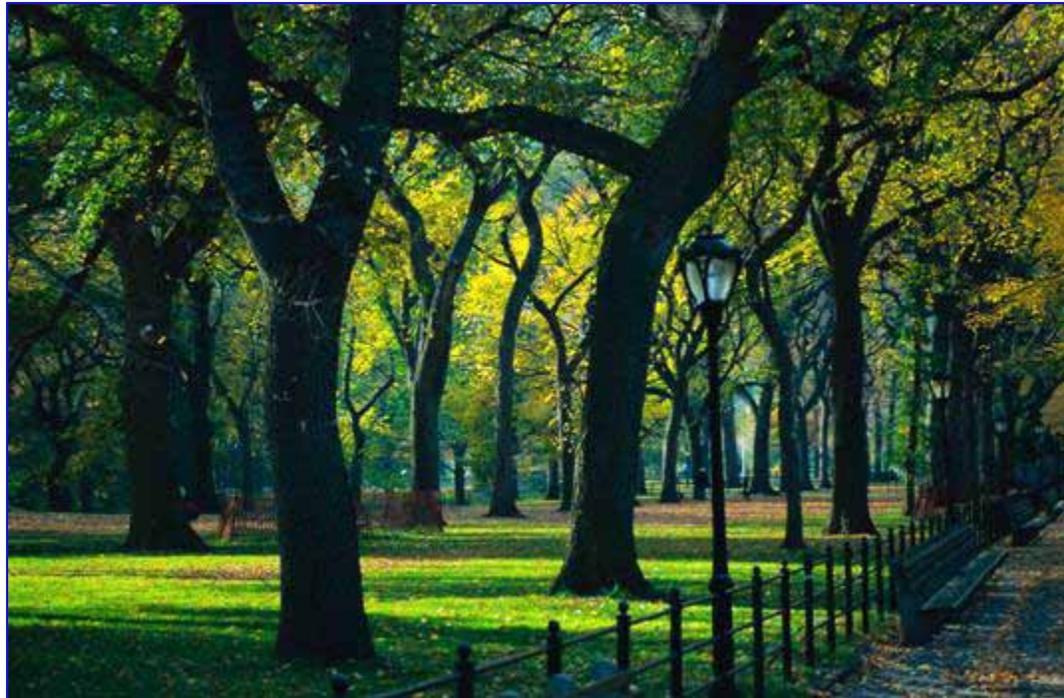
Greg McPherson
USDA Forest Service
Center for Urban Forest Research
Davis, CA

Utah Green Conference
Sandy, Utah Jan. 28, 2008



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

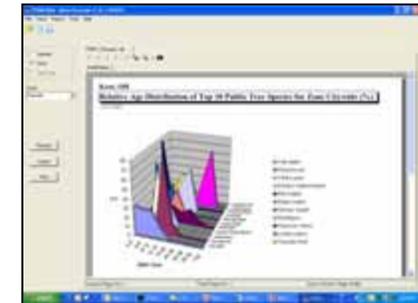
i-Tree Cooperative was formed to deliver all Forest Service applications in a single software suite:



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

What's Included?

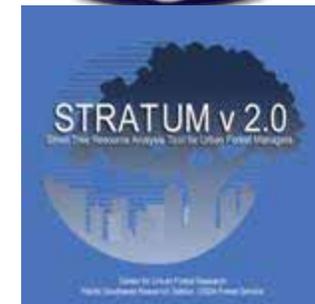
- 🌳 Two urban forest assessment tools:
 - ✓ Assessing street tree populations
 - ✓ Assessing urban ecosystems
- 🌳 Multiple Utilities:
 - ✓ Data collection & transfer
 - ✓ Inventory management
 - ✓ Storm damage assessment



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 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



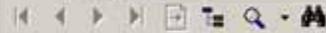


- Species
- Zone
- Tree Type

Zone
[Dropdown menu]

- Refresh
- Export
- Print

Public Private All

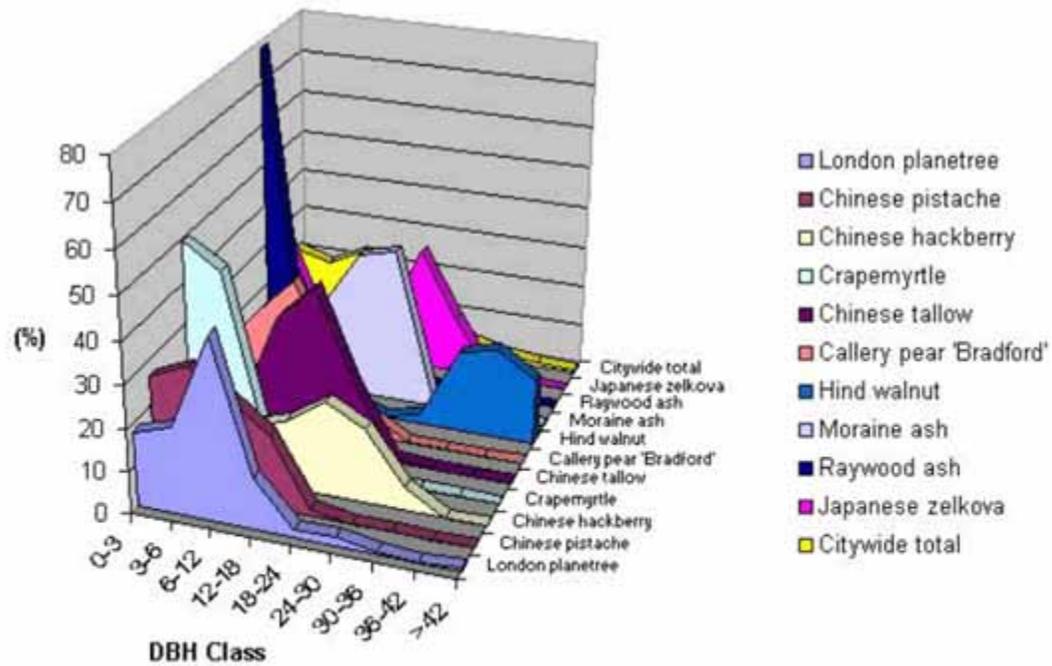


MainReport

Davis, CA

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

1/6/2006



- Species
- Zone
- Tree Type

Public Private All

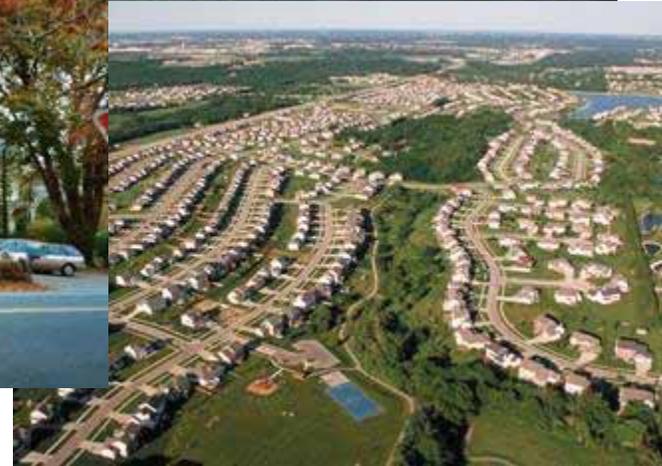
MainReport

Davis, CA**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

1/6/2006

Benefits	Total (\$)	Standard Error	\$/tree	Standard Error	\$/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/Servic	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 (NY City; 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" on the right. Below the header is a large green tree logo and the text "TREES FOREVER". A navigation bar contains links: Home, About, Trees, What We Do, News & Materials, Calendar, Gallery, Affiliates, Survey, Contact, Support. The main content area features a headline "News at Trees Forever, The i-Tree Project" with "The i-Tree Project" circled in red. Below the headline is the date "September 8, 2006" and a small "i-tree" logo. The text describes the project: "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." To the right is a sidebar titled "Trees Forever Volunteer Opportunities" with two entries: "September 25, i-Tree, Cedar Rapids, IA" and "September 27, SPLASH, Decatur, IL".

September, 2006



TREES FOREVER

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

- 🌳 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



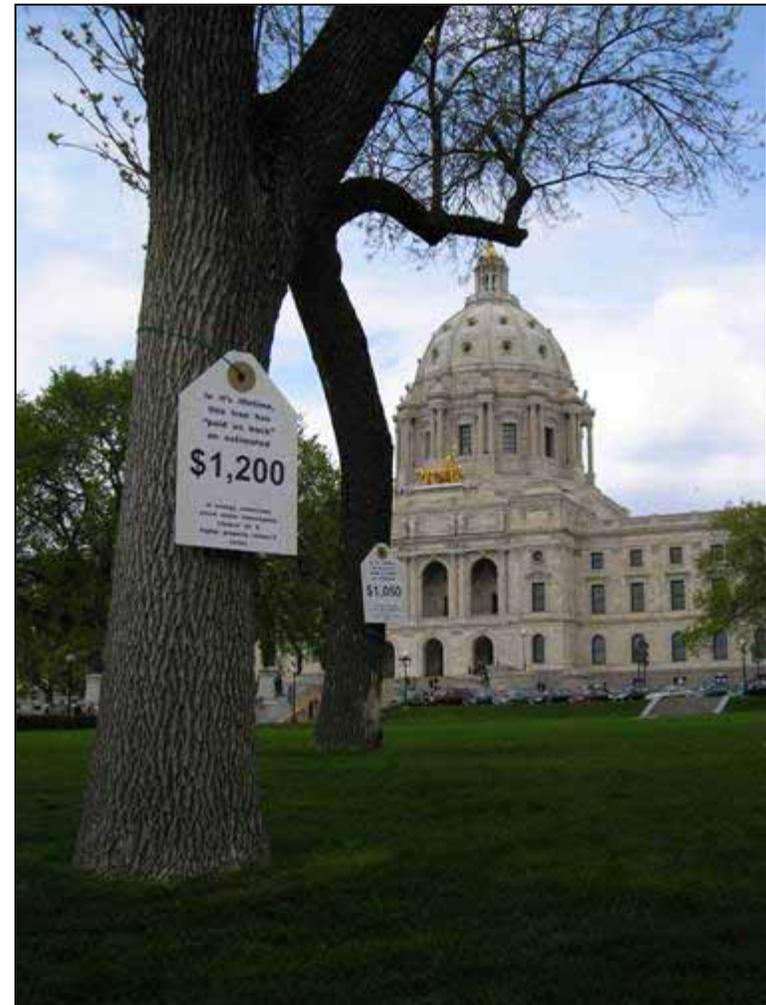
Summary

🌳 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

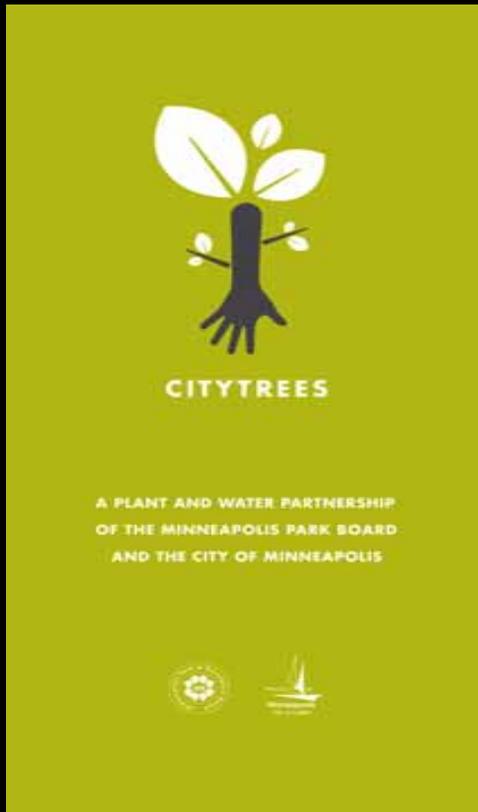
Annual Report

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

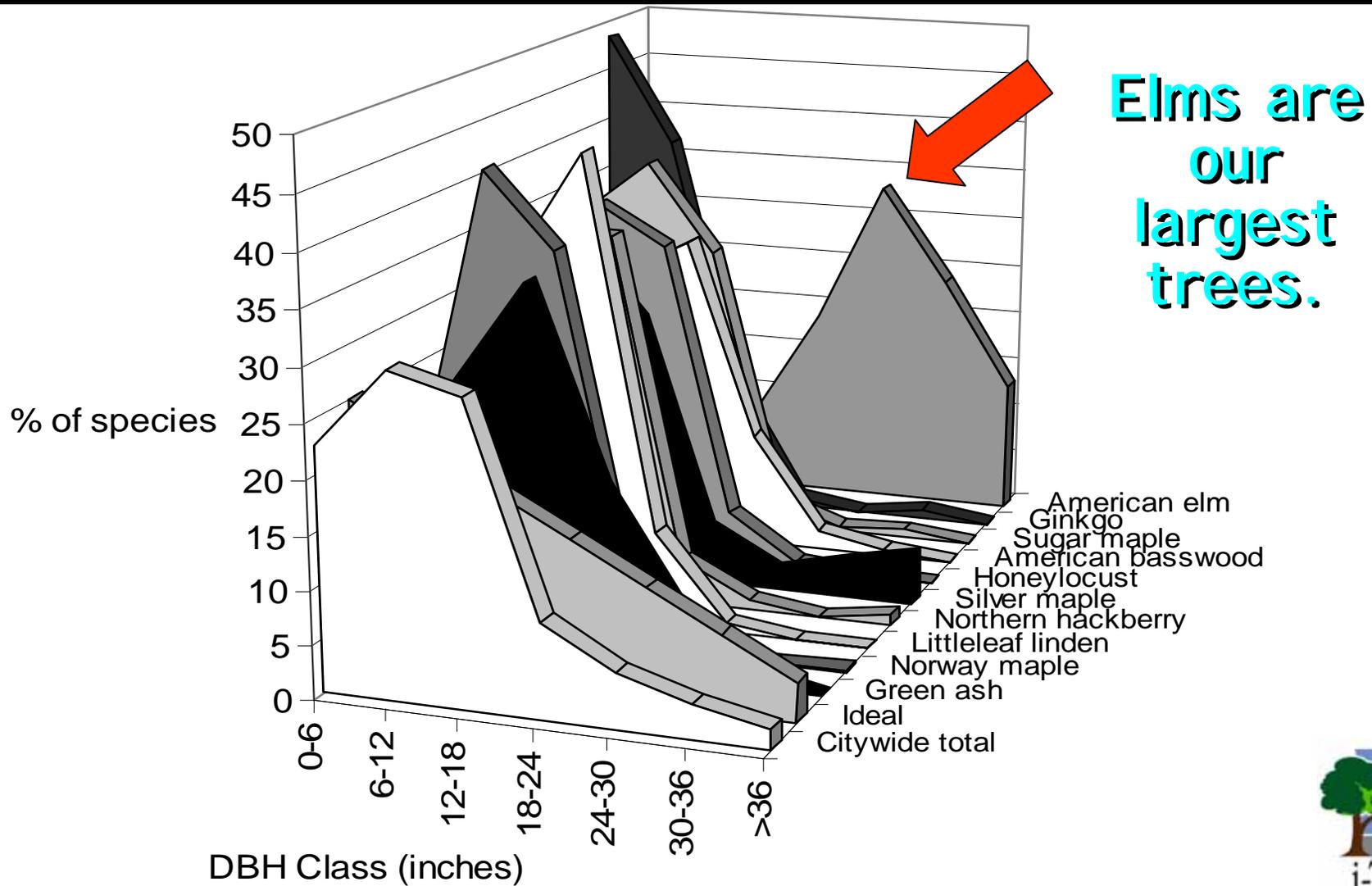
The **Impacts** of Dutch Elm Disease

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



**The State of the
Minneapolis
Urban Forest**

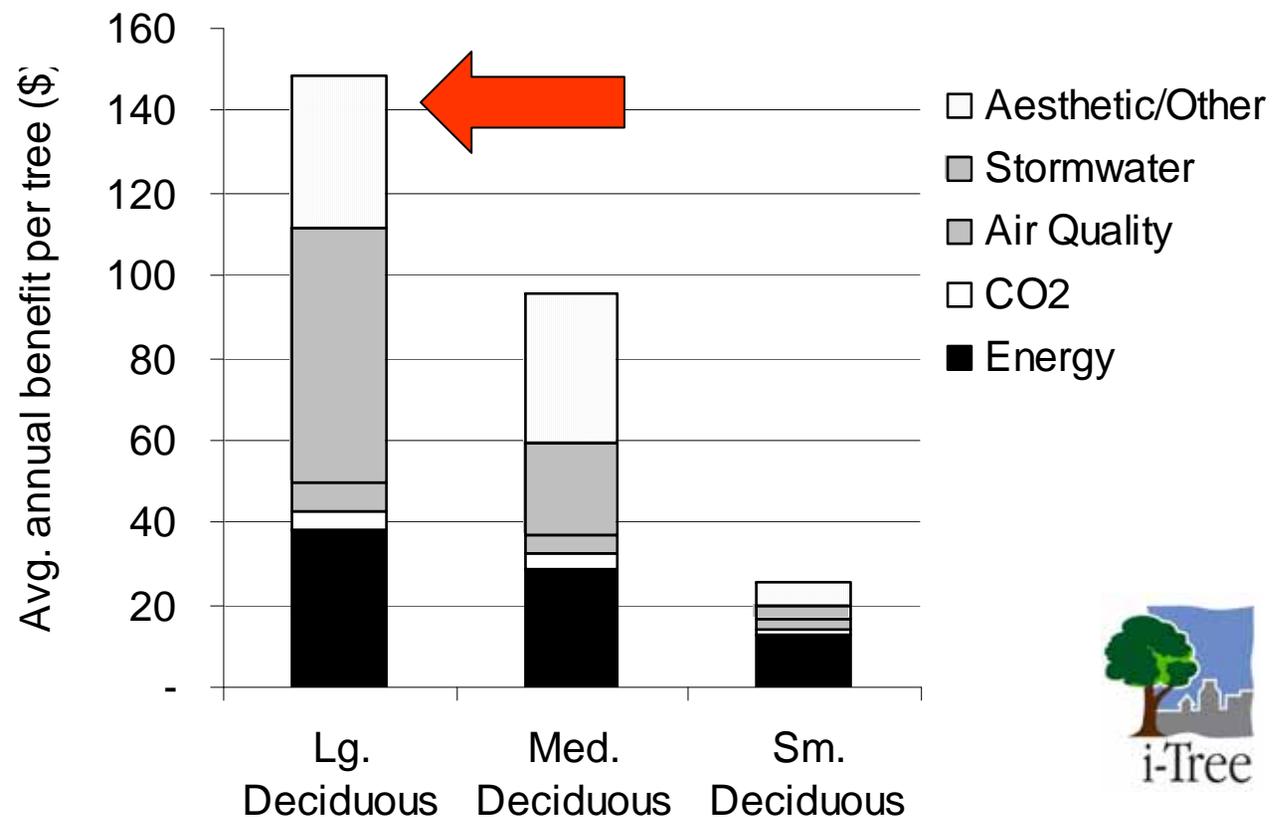
The Impacts—why elms matter



The Impacts—why elms matter

LARGE TREES

= MOST BANG FOR BUCK



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

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



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

Questions?

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- 🌳 Get our e-mail news: <http://www.treelink.org/ufr/>
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