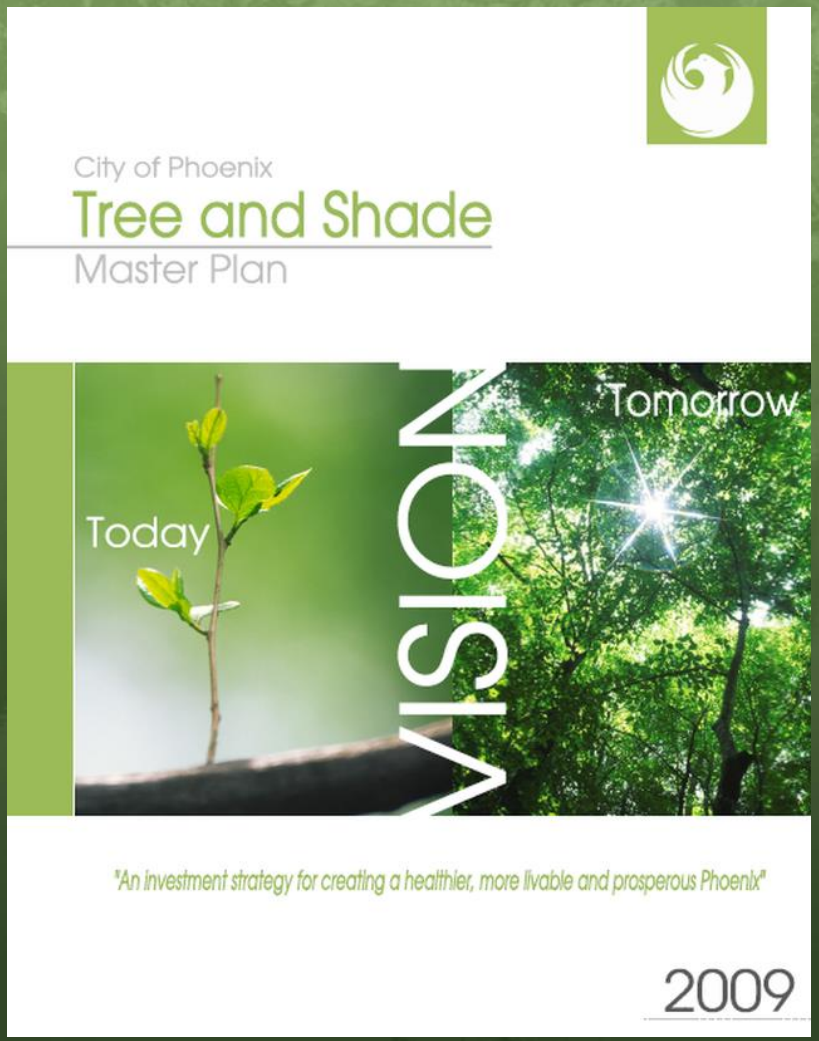


Climate-Proofing Arizona's Urban Forests, One Community at a Time

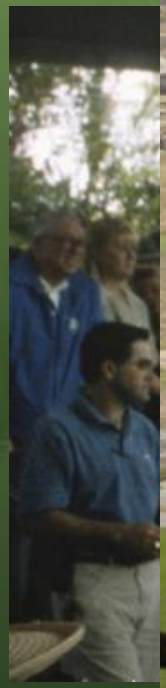
Dr. Greg McPherson
US Forest Service, PSW
Davis, California

U.S. Department of Agriculture
Pacific Southwest Research Station
Science that makes a difference

Regional Tree & Shade Summit, Phoenix, AZ
March 9, 2016

Traditional Zoos

Wild Animal Park



Habitat for Humans?

Urban Forests Don't Happen by Chance

Today

- Urban Forest Structure & Services
- Threats
- What Do Climate-Proof Urban Forests Look Like?
- Lessons Learned

Benefit-Based Approach

Glendale, AZ Reference City (2003)

- Measured 21 species, 827 trees
- Analyzed growth rates and dimensions
- Estimated magnitude of annual benefits
- Priced benefits
- Priced tree care costs
- Calculated net annual benefits, benefit-cost ratios

Products

http://www.fs.fed.us/psw/programs/uesd/uep/

- Municipal Forest Resource Assessment
- Community Tree Guide
  - Benefits And Costs for Tree Planting Projects
  - Examples
  - Guidelines For Selecting And Placing Trees
  - Trees in Our City PPT
- i-Tree Streets data


We've just installed 2,500 air conditioners.

Conserving Energy

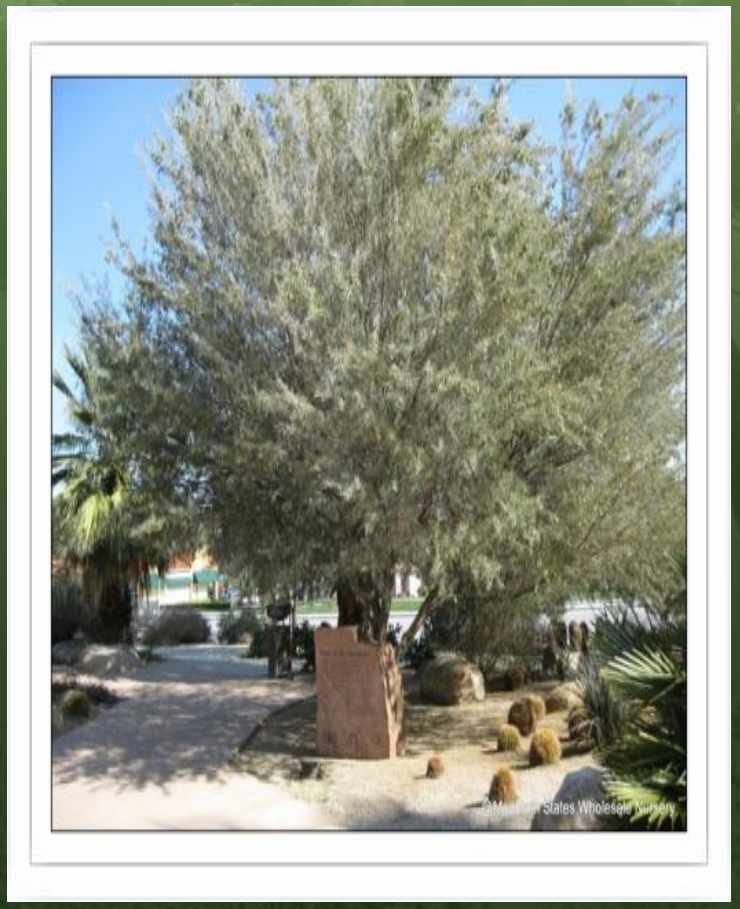
Conserving Energy

- Mesquite, 20 years, Opposite west wall
  - Save AC: 388 kWh, $37/yr
  - Heating costs: -$1/yr
  - Save $36/yr total

Plant Strategically
Summer Shade

- West is the best
- Closer is better
- Large, dense crown

Choose Species Wisely: Bigger is Better



Plant Lots of Trees

Shade Paved Surfaces

Reducing Atmospheric Carbon Dioxide

Reducing CO_2

- Mesquite, 20 years, Opposite west wall
  - Total Net = 155 kg
  - Total Value = $3

Choose Species Wisely

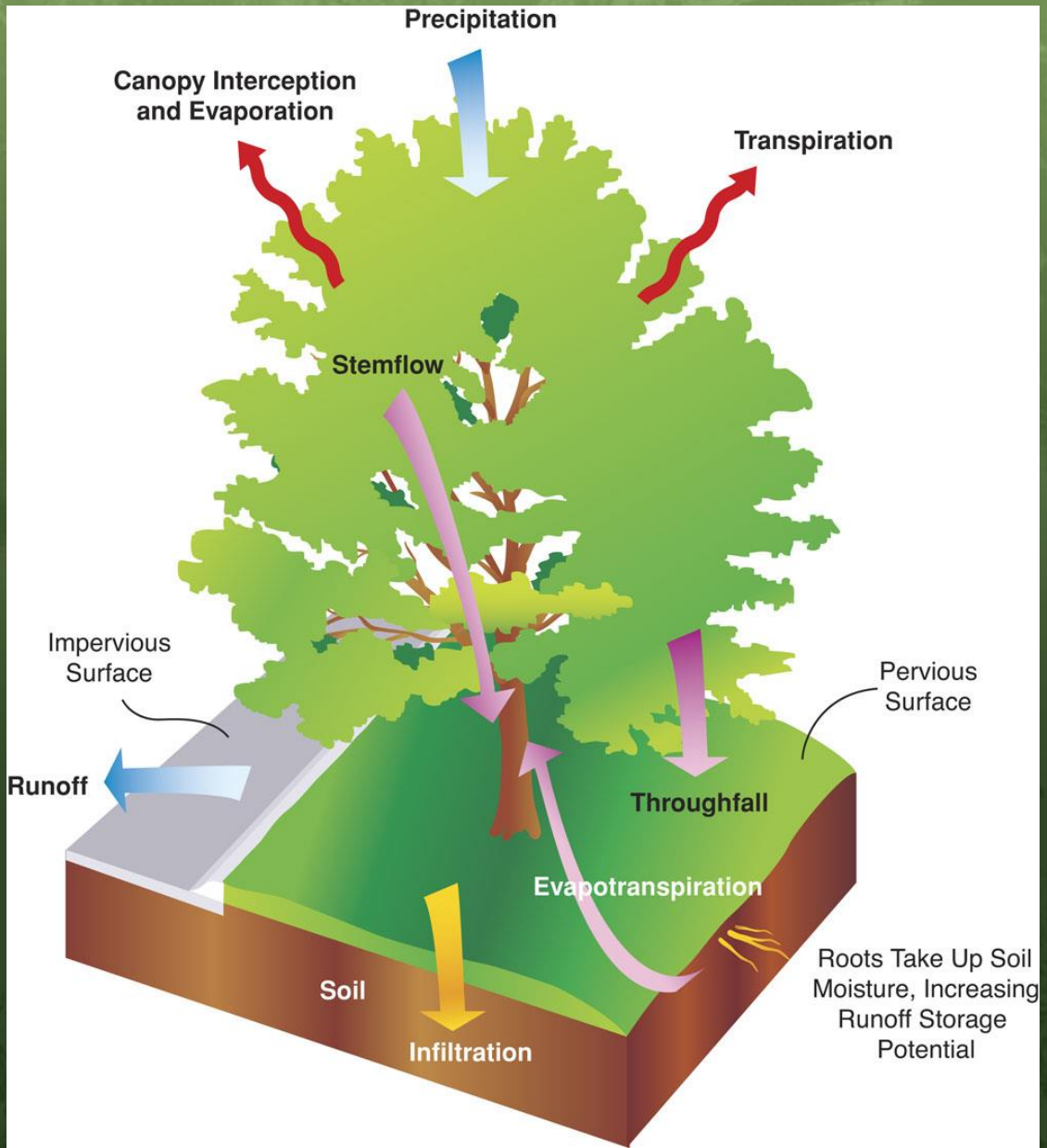
Small and short-lived

Large and long-lived

Plant and Maintain More Trees

Make Use of Wood

Reducing Stormwater Runoff



Intercepting Rainfall & Reducing Runoff

- Mesquite, 20 years
  - Intercepted = 1,604 gal
  - Value = $8

Choose Trees Wisely

Little leaf & stem surface

Lots of surface area, wide crown

Choose Trees Wisely

Complex structure, rough surface

Evergreen foliage

Locate Trees Wisely

PREV

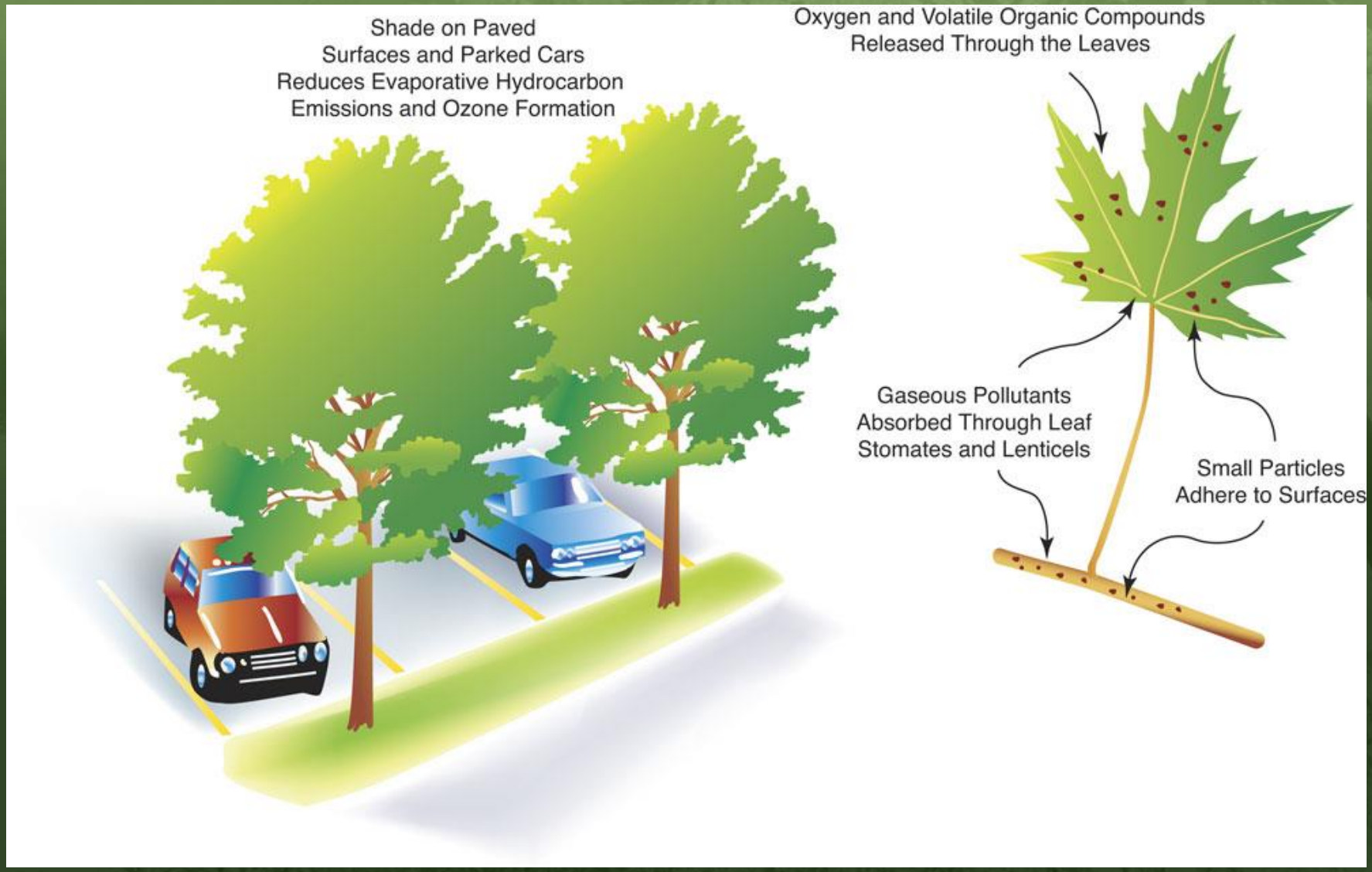
NEXT

No. 10:

Americal
summer
gets wor
through
evening,

git
problem
from May
or in the

Improving Air Quality



Improving Air Quality

- Mesquite, 20 years, Facing West Wall (kg)
  - NO_2 = 0.31, $2.75
  - SO_2 = 0.21, $7.23
  - PM_{10} = 0.19, $2.54
  - Ozone = 0.14, $1.23
  - VOCs = 0.04, $0.33
  - BVOCs = -0.85, -$7.53
  - Net Value = 0.03, $6.54

Choose Trees Wisely

Large and tolerant to pollutants

Evergreens for particulates

Others Things Trees Do

Trees are 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

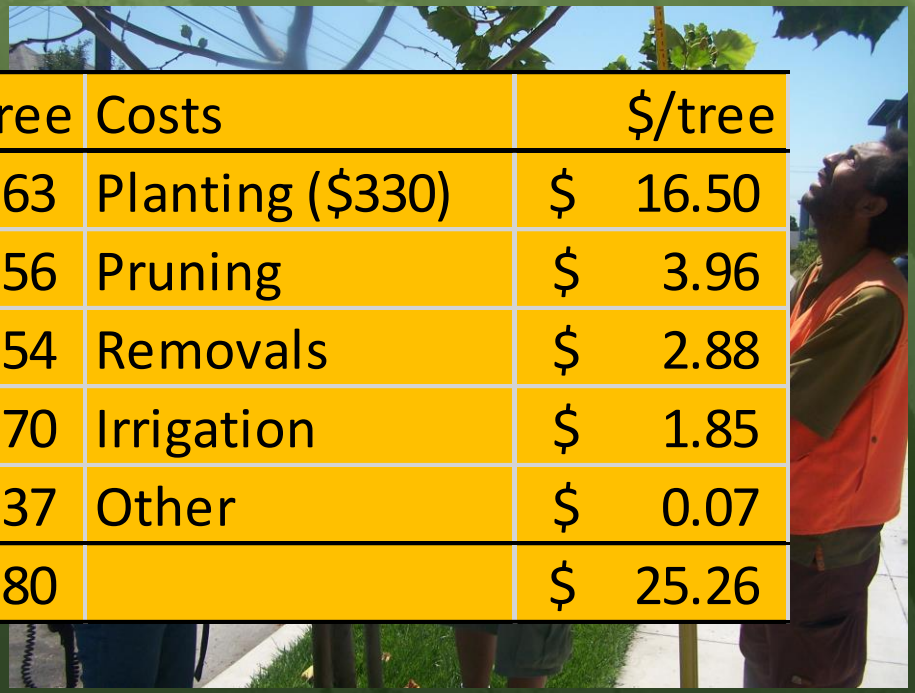

TWO OLD
CROWS
LIVE HERE!

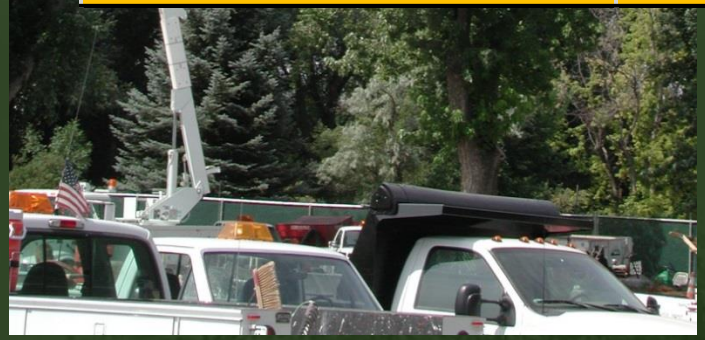
Aesthetic and Other Benefits

- Mesquite, 20 years
  - $9/yr

Benefit-Cost Analysis
20-Year Old Mesquite

Benefits	$/tree	Costs	$/tree
Energy	$ 35.63	Planting ($330)	$ 16.50
Carbon	$ 2.56	Pruning	$ 3.96
Air Quality	$ 6.54	Removals	$ 2.88
Rain Interception	$ 7.70	Irrigation	$ 1.85
Property Values	$ 9.37	Other	$ 0.07
Total	$ 61.80		$ 25.26





- Benefit-Cost Ratio = 2.45

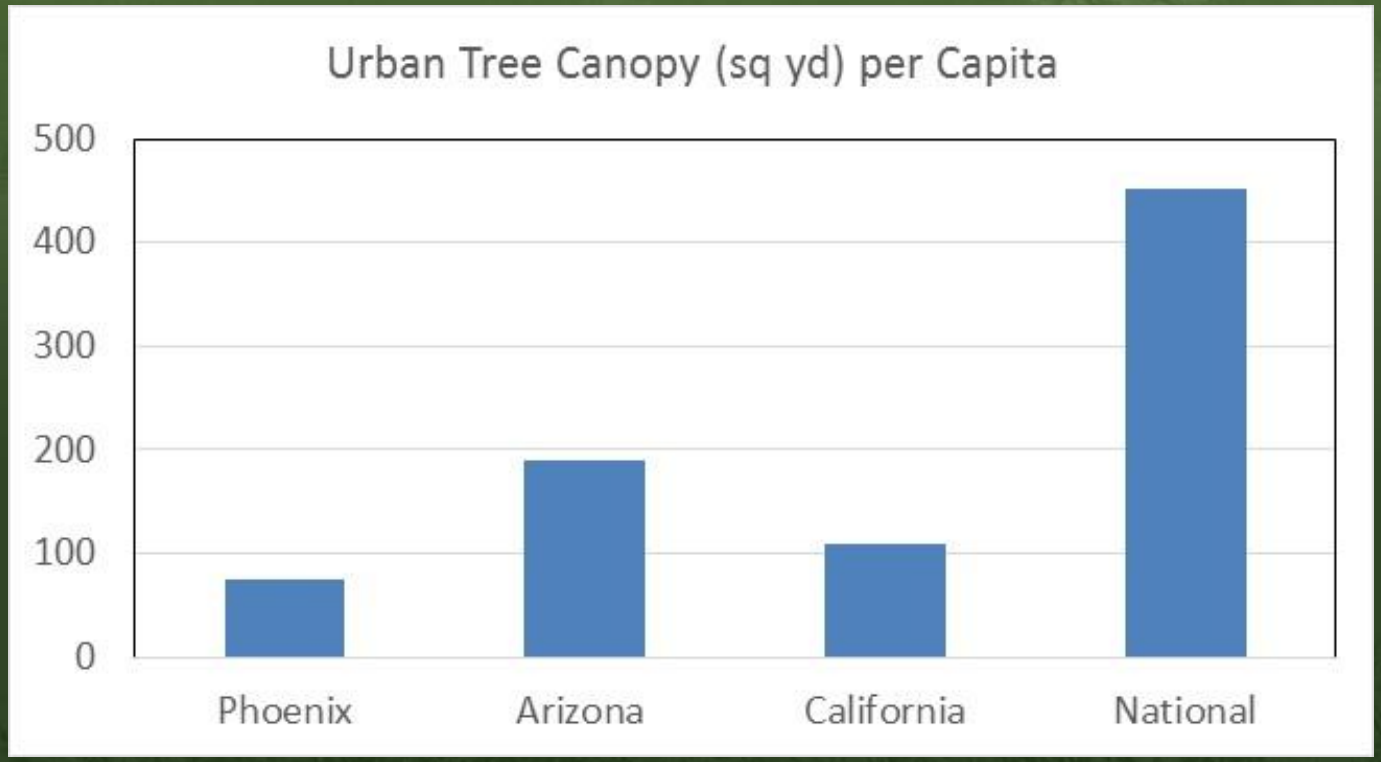
Phoenix Urban Forest

i-Tree Eco Plot Data

- 204 plots (1/10th acre)

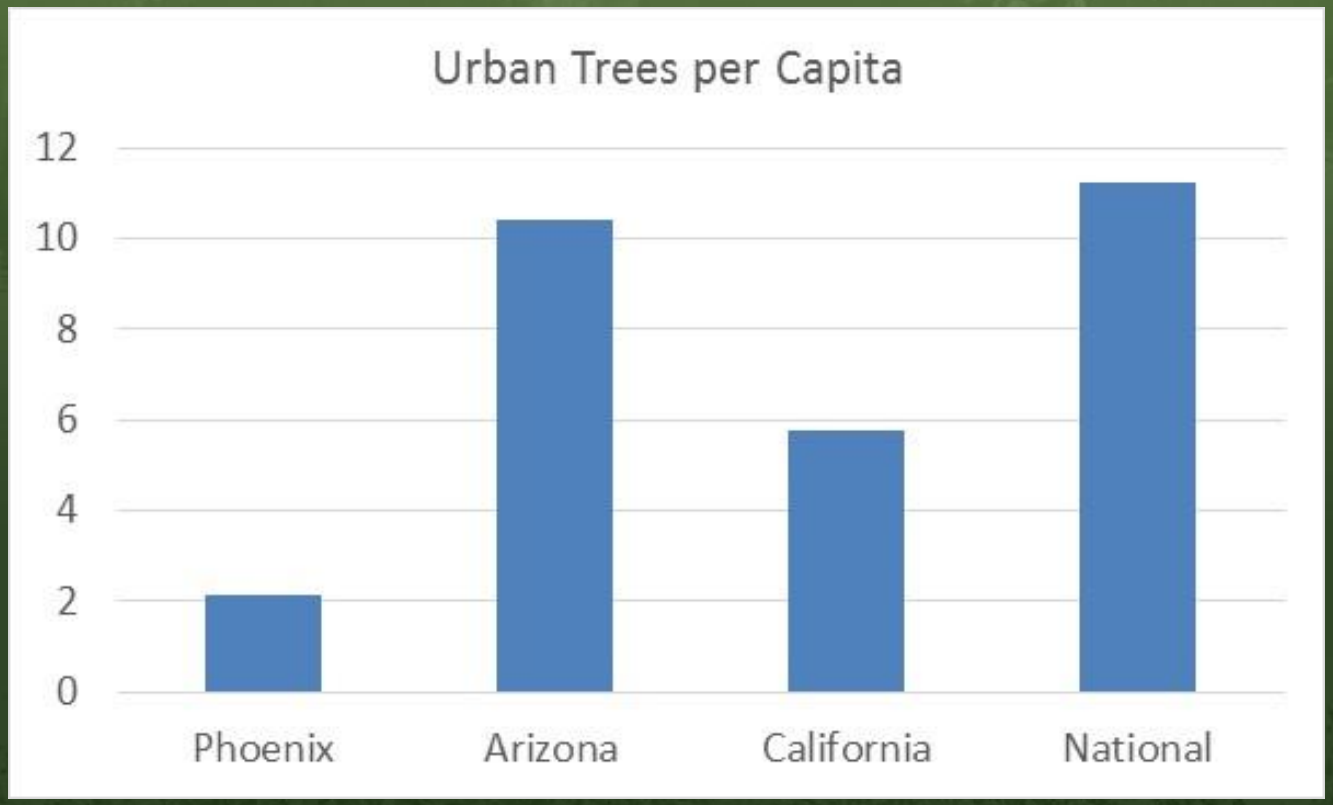
Phoenix's Urban Tree Canopy (9%)

- 34.6 sq miles UTC
- 73 sq yds/capita (US avg 451 s.y.)

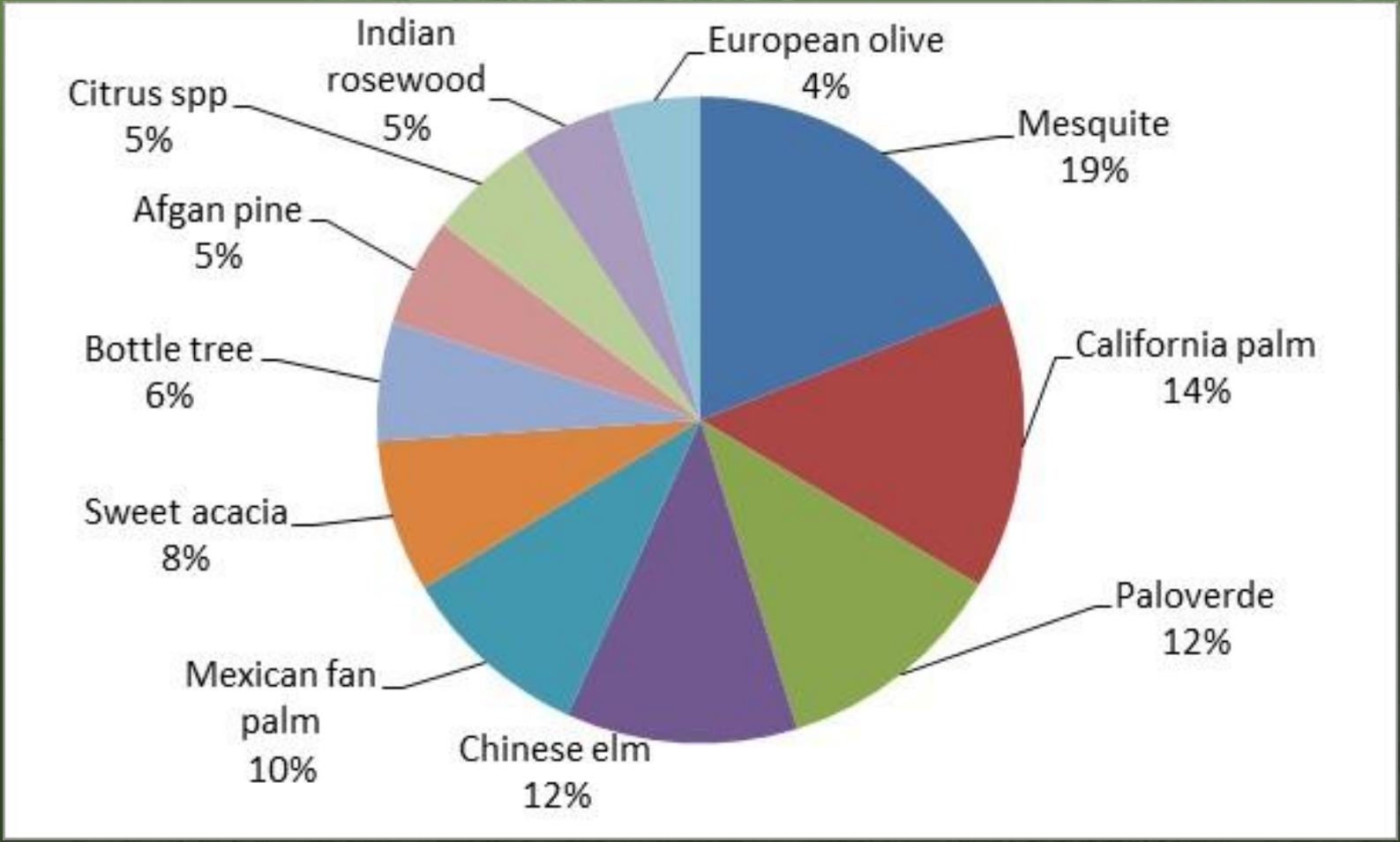


Tree Numbers

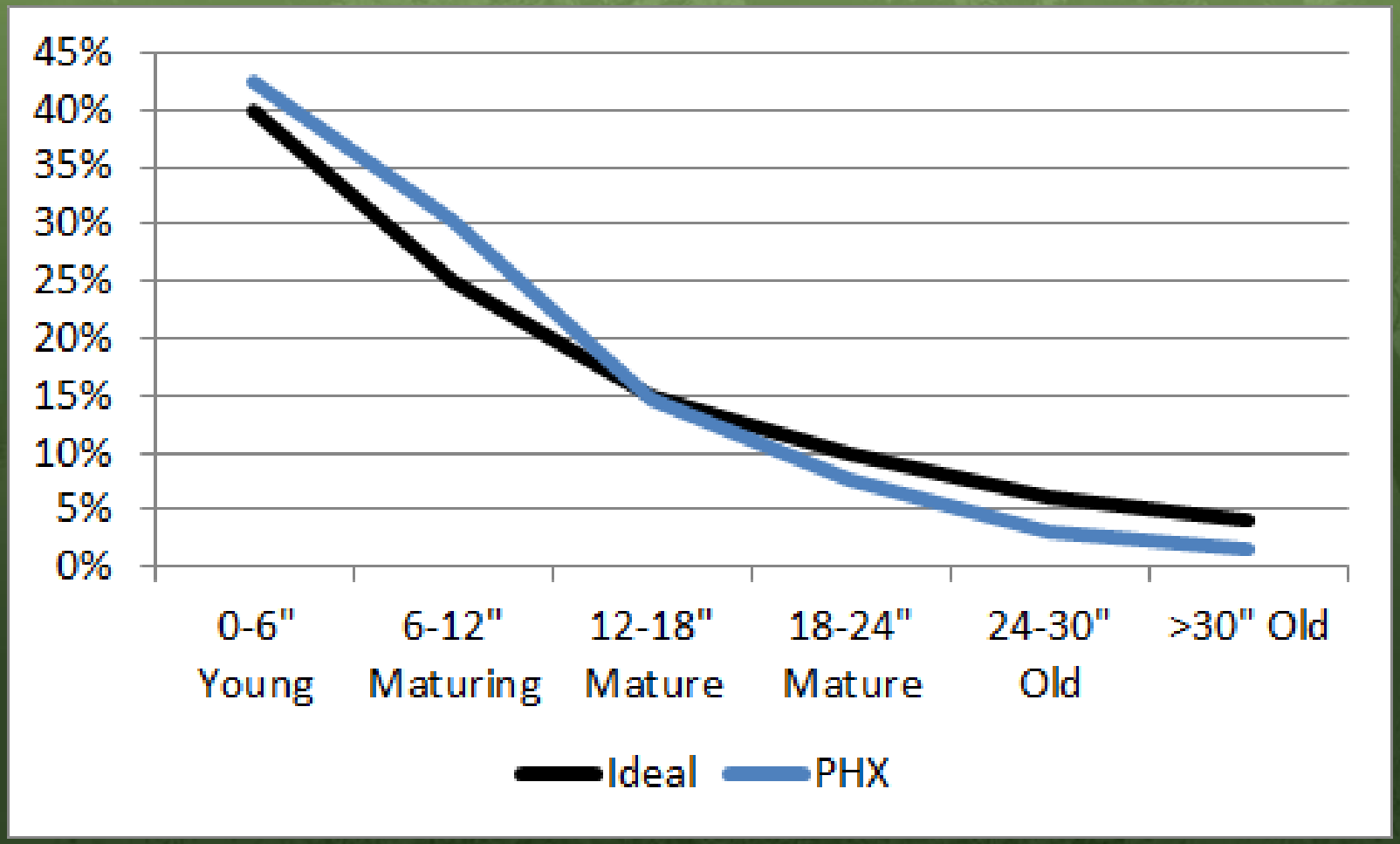
- 60 species
- 3.2 million trees (77% Resid.)
- 2.26/capita



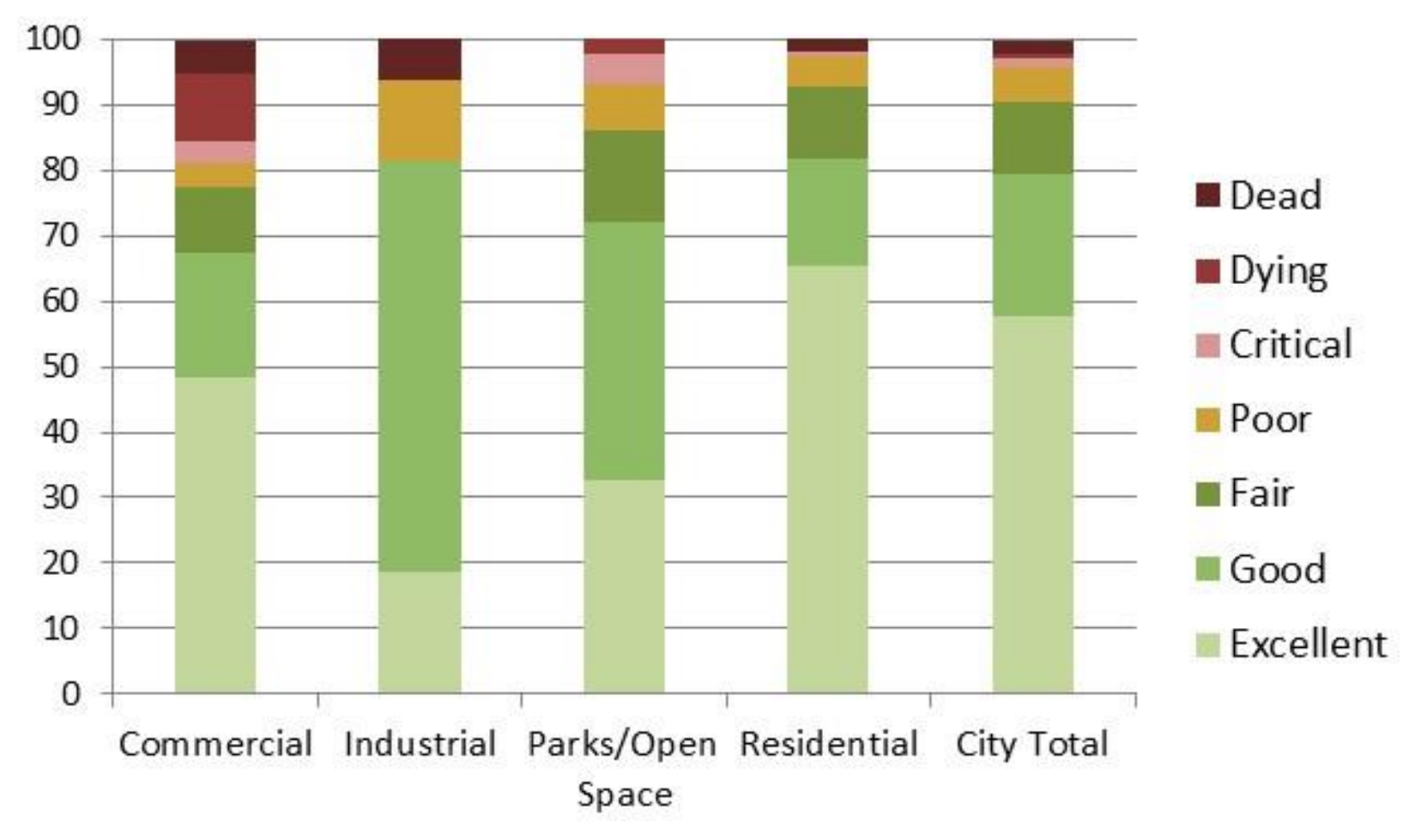
Dominance (Number+Leaf Area)



Age Diversity

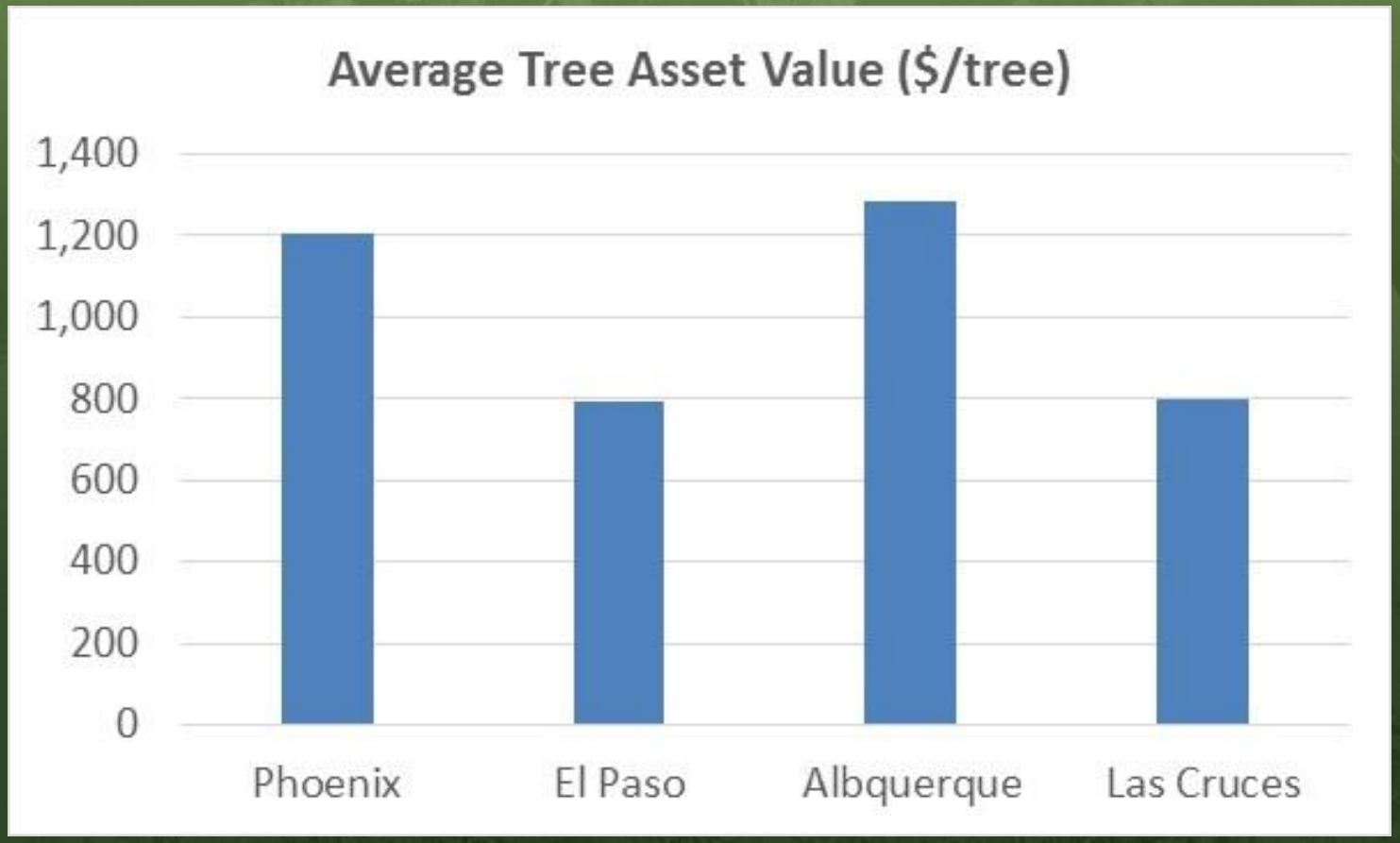


Tree Condition (%)

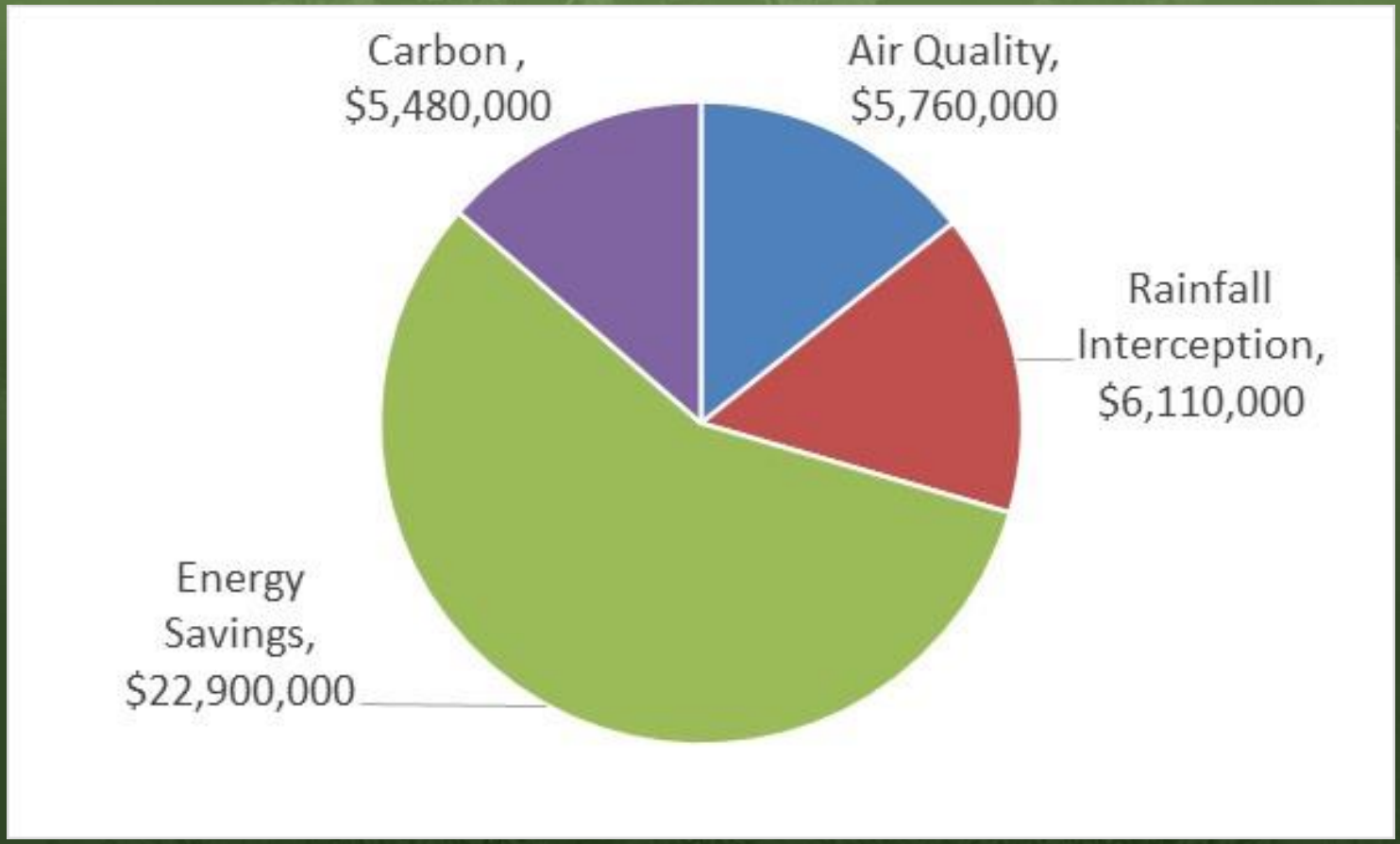


Asset or Replacement Value

- $3.82 billion ($1,207/tree)

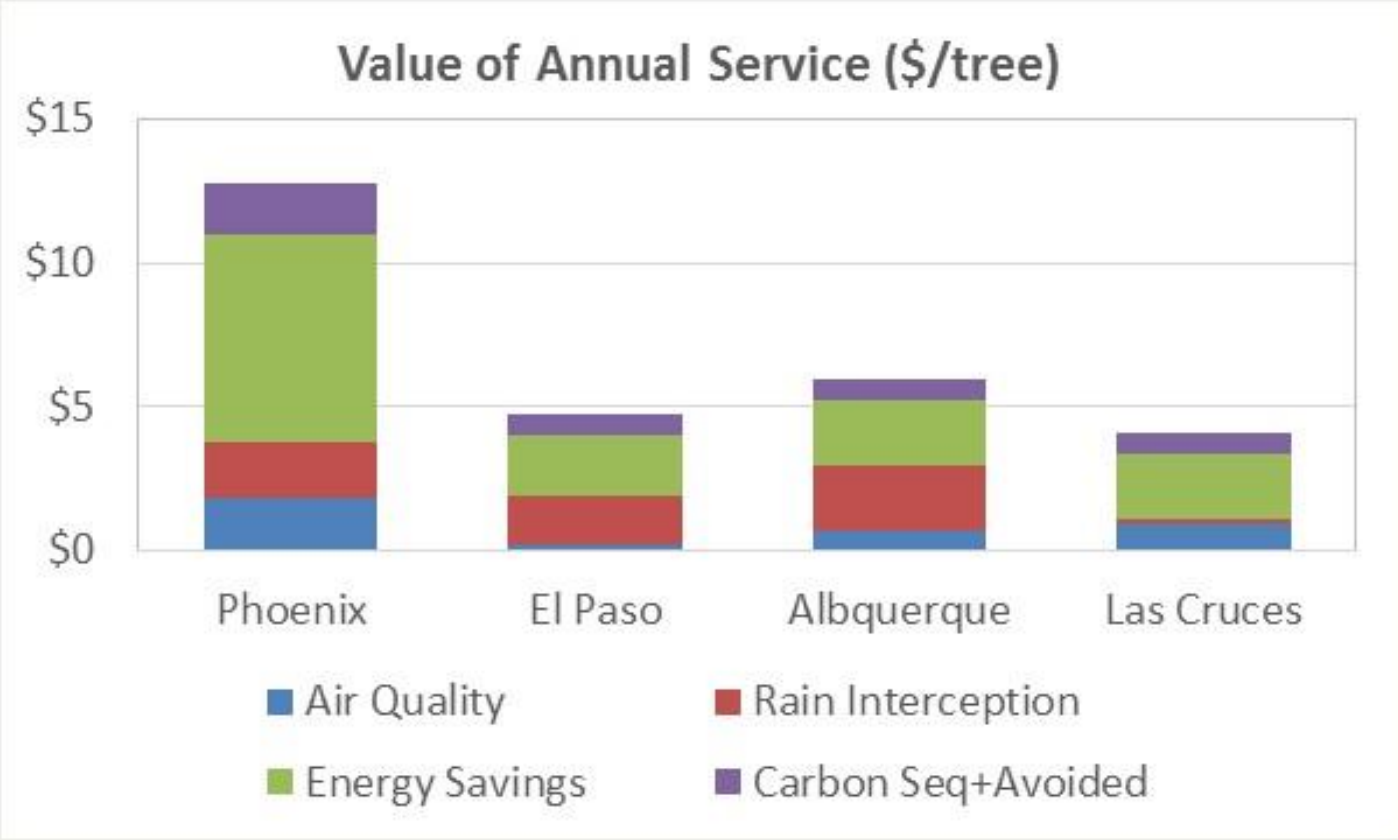


Phoenix's Urban Forest Value of Annual Services ($40 million)



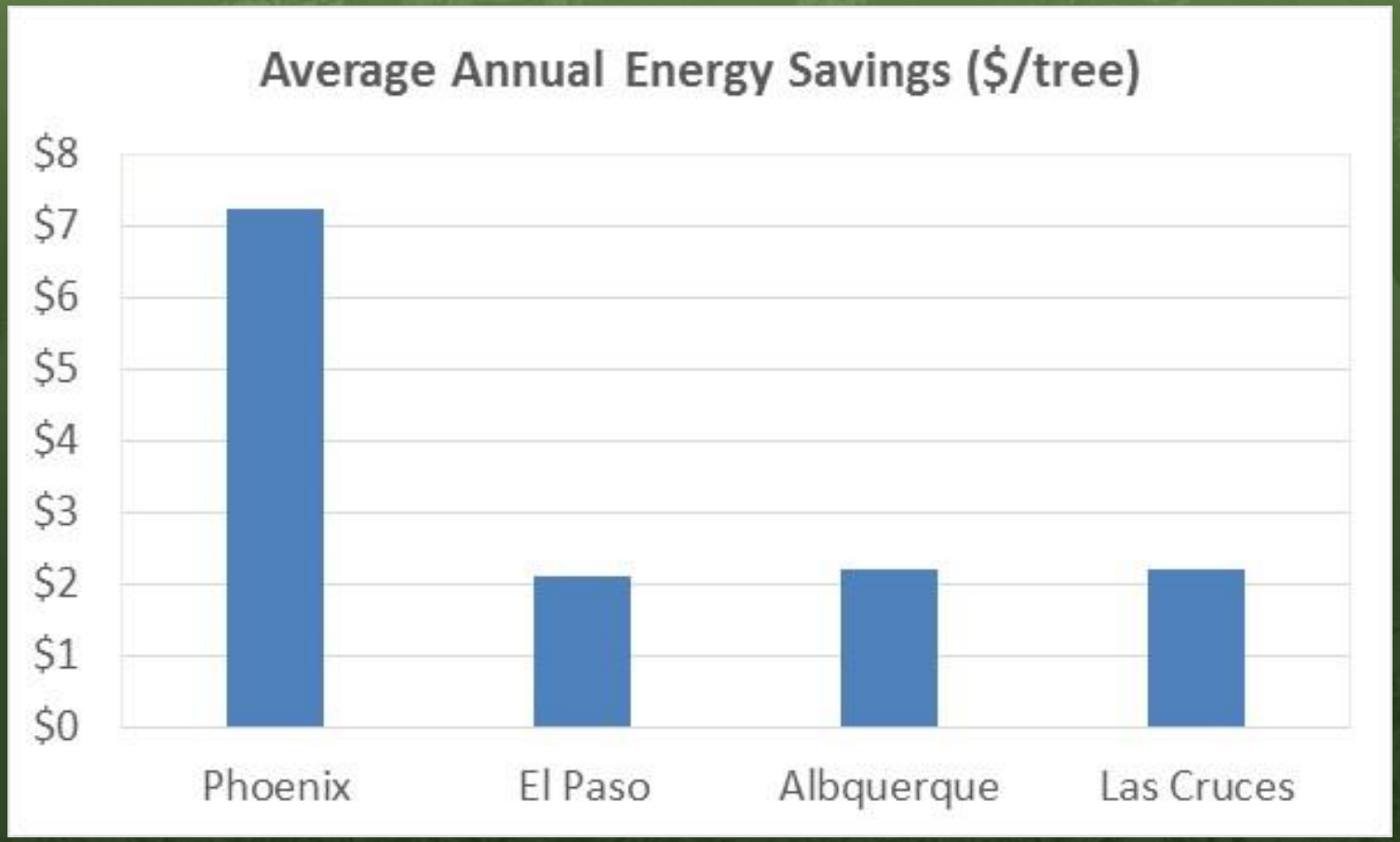
Value of Annual Services

- $27.84/capita
- $12.71/tree



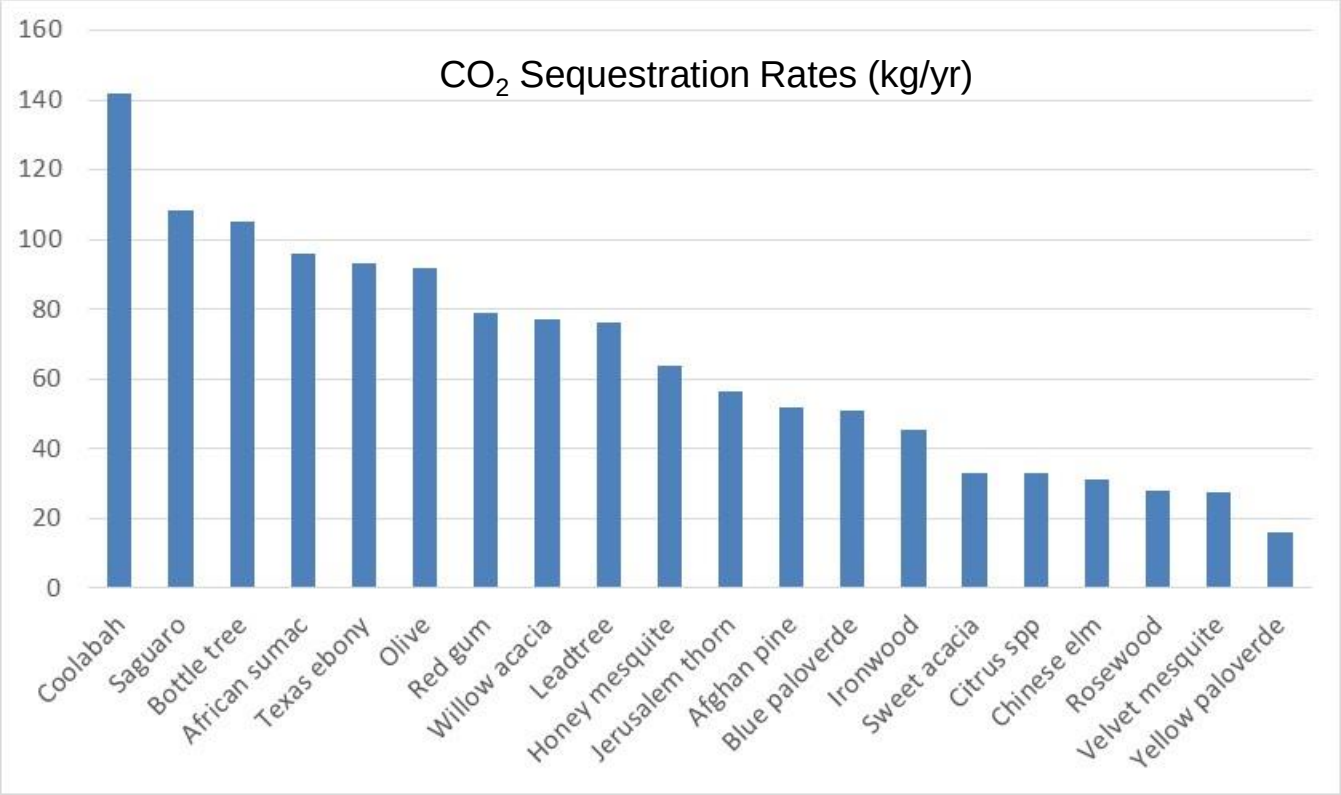
Value of Annual Energy Services

- 215,470 MWh = $22.9 million (net)
- AC use 40,000 households (7% 600k)



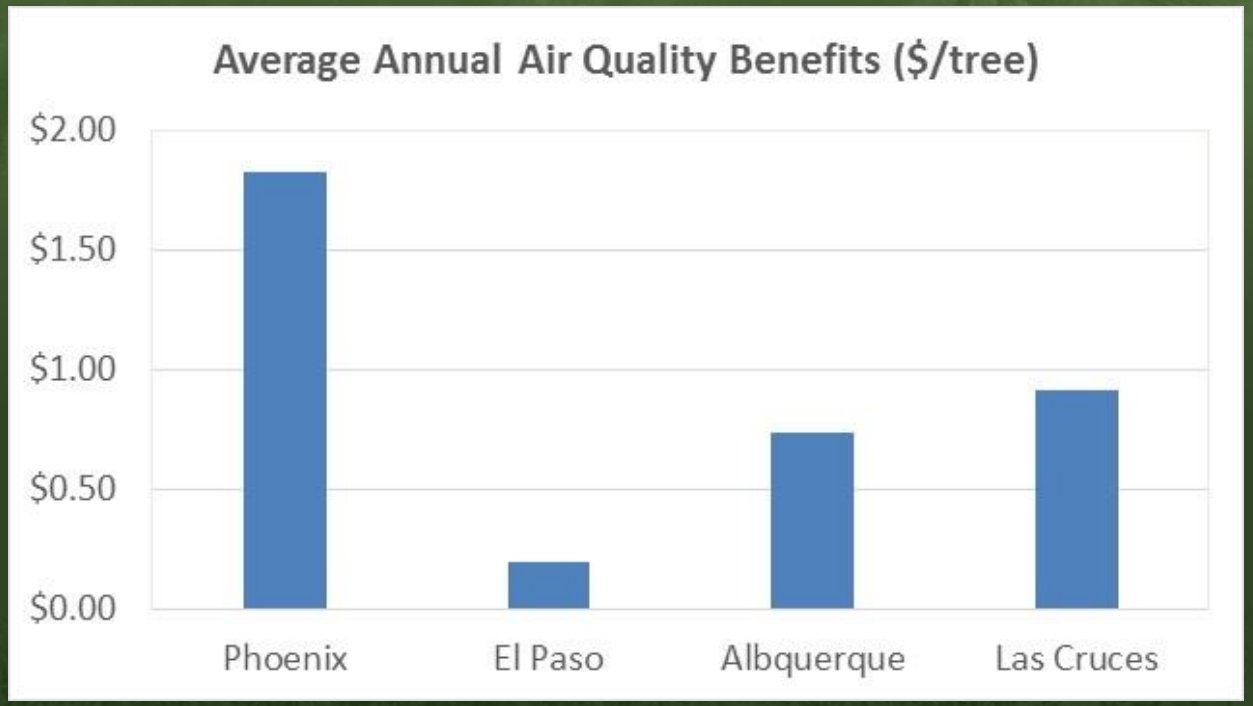
Value of Annual CO_2 Services

- 256,245 MT = $5.46 Million (56% avoided)
- Offsets emissions from 54,520 vehicles



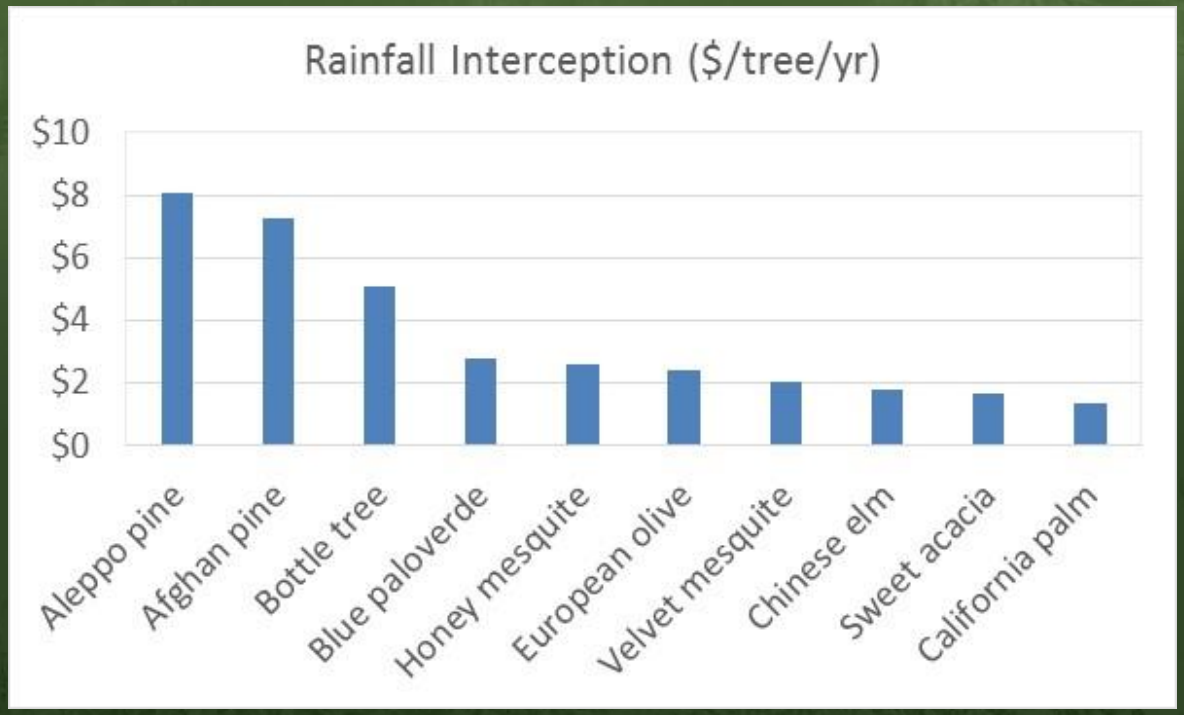
Value of Annual Air Quality Services

- 1,600 t = $5.8 million (80% PM_{10})
- NO_2 uptake offsets emissions of 14,400 vehicles (25%)



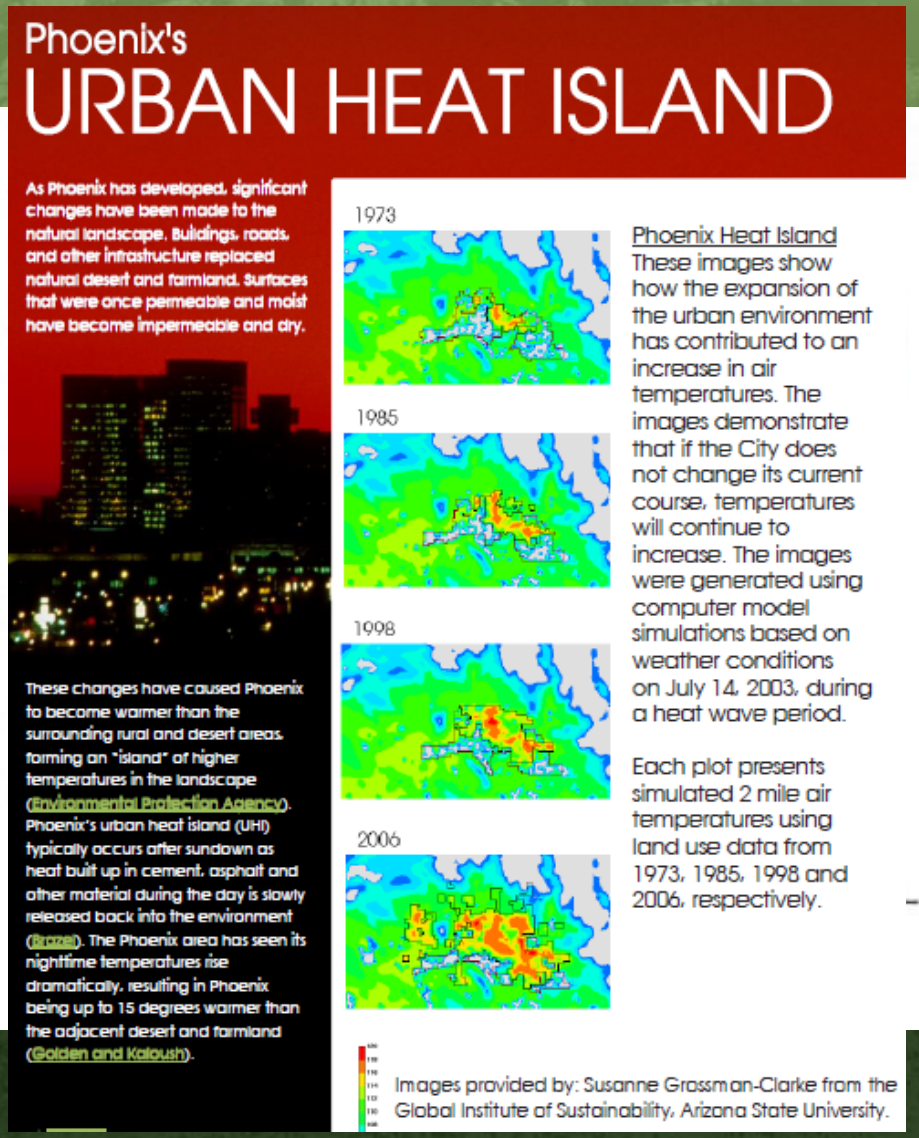
Value of Annual Rainfall Interception Services

- 686 Million gals = $6.1 Million
- equals potable water used in 7,700 households (1.3%)



Threats & Challenges

- Climate Change

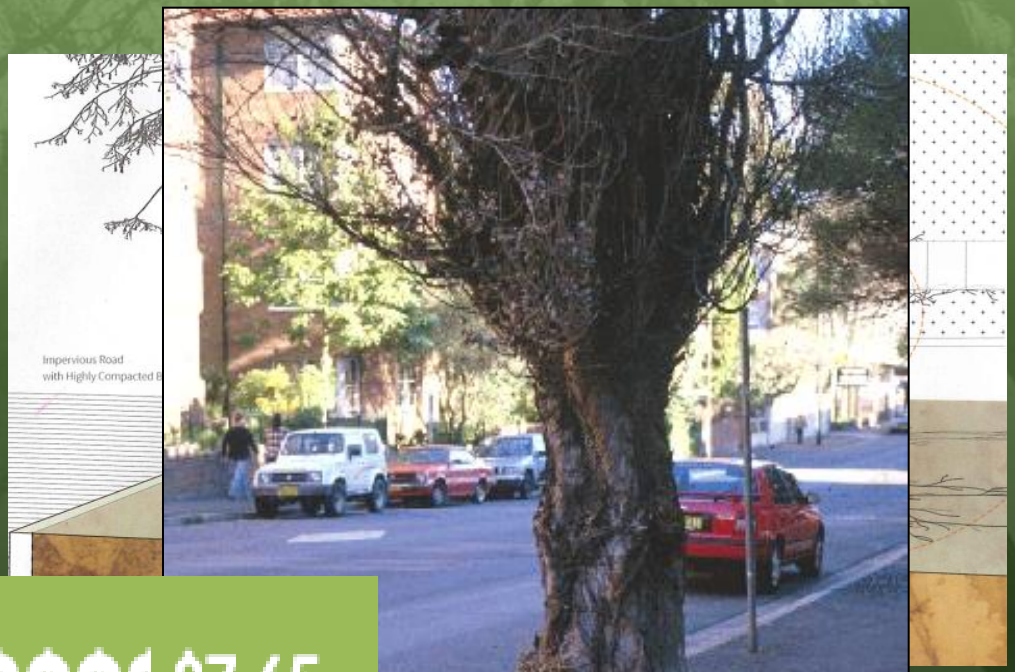


Threats & Challenges

- Climate Change
- Water
- Air Quality

Threats & Challenges

- Climate Change
- Air Quality
- Water
- Infrastructure, Infill & Funding



National Average $$$$$$$$ $7.65 Per Capita

Phoenix $$$$ $3.48 Per Capita

Summary

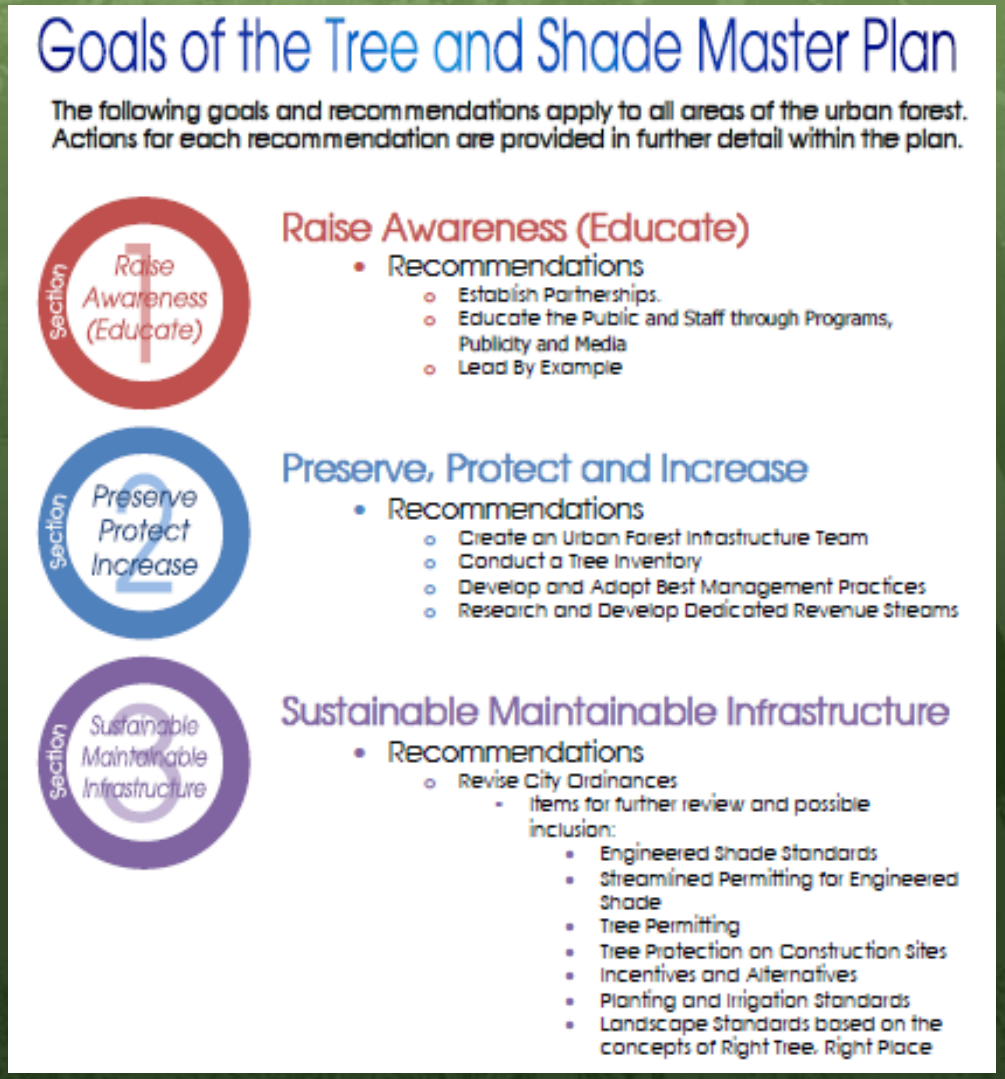
- Phoenix's urban forest 3.2 million trees, $3.8 billion asset
- $40 million annual services
- 9% UTC, low per capita
- Relatively sparse & fragile resource
- Threats: drought, root space, $
- Call to Action
  - increase canopy, education, and funding for tree planning and care

What Does A Climate-Proof Urban Forest Look Like?

- Resilient Resource
  - Delivering high level of services
- Mindful Management
  - Appling science and best practices in support of a resilient resource
- Civic Connections
  - Embeding tree literacy and activism in all aspects of civic life

Phoenix Tree & Shade Plan

- Vision – 25% UTC
- Goals
  - Educate
  - Preserve, Protect & Increase
  - Sustainable & Maintainable Infrastructure



Resilient Resource

- Abundance
  - UTC targets sustained
  - Fully stocked streets & parks
- Species Composition & Age Structure
  - Diverse mix of climate-ready species
  - Juvenile and maturing trees dominate
- Health
  - Excellent and good health dominate
  - Monitoring in-place
  - Capable of rapid response to threats

A Resilient Resource Doesn't Happen by Chance

Continued Commitment

Mindful Management

- UTC Campaigns
  - Integrate with policy
  - Ordinances to protect & expand
  - Funding
- Master Plans
  - Prioritize
  - Protect veteran trees
  - Planting
  - Young tree care
  - Removal and reuse
  - Optimize benefits, minimize costs

Mindful Management Doesn't Happen by Chance

Continued Commitment

Civic Connections

- Informed and active citizenry
  - NGOs and advocacy groups
- Youth education
- Skilled workforce and quality products
  - Landscape professionals
  - Jobs and career opportunities

Civic Connections Don't Happen by Chance

Continued Commitment

Green Infrastructure

- Available
- Effective
- Economical
- Sustainable

Incremental Implementation

"[S]mall, piecemeal patches created by individual developers rather than an integrated effort by the whole community…"

(Cities of the Future, 2007)

Lessons Learned

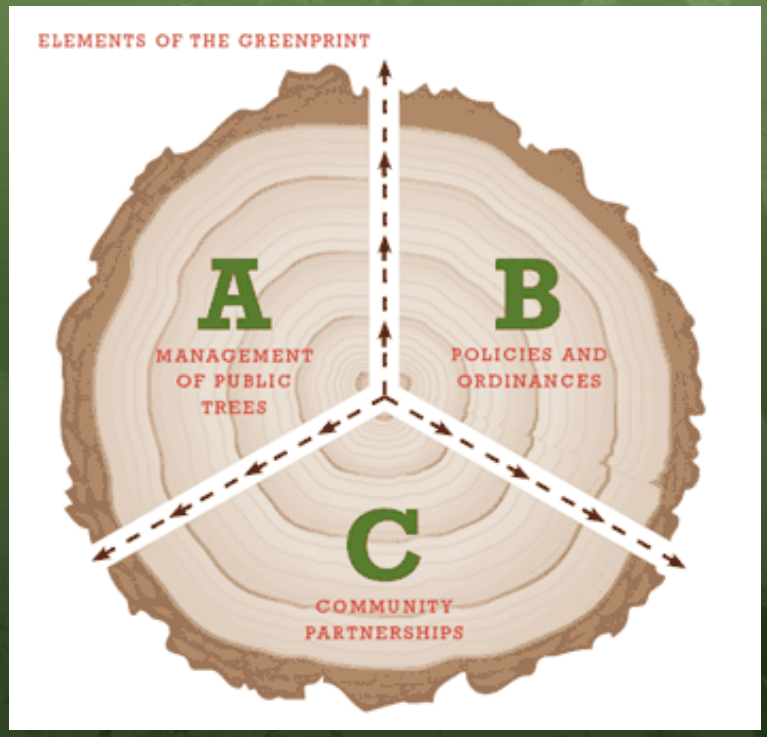
- Tree Planting Initiatives
  - 9 of 12 largest US cities
  - 20 million trees
- Sacramento Greenprint
  - National Greenprint Workshop

Greenprint Lessons Learned

- Engage public officials
  - Credibility: Proven partnerships & science
  - Steering committee – meet regularly
- Use your Board of Directors
  - Build bridges to key groups
- Celebrate your volunteers

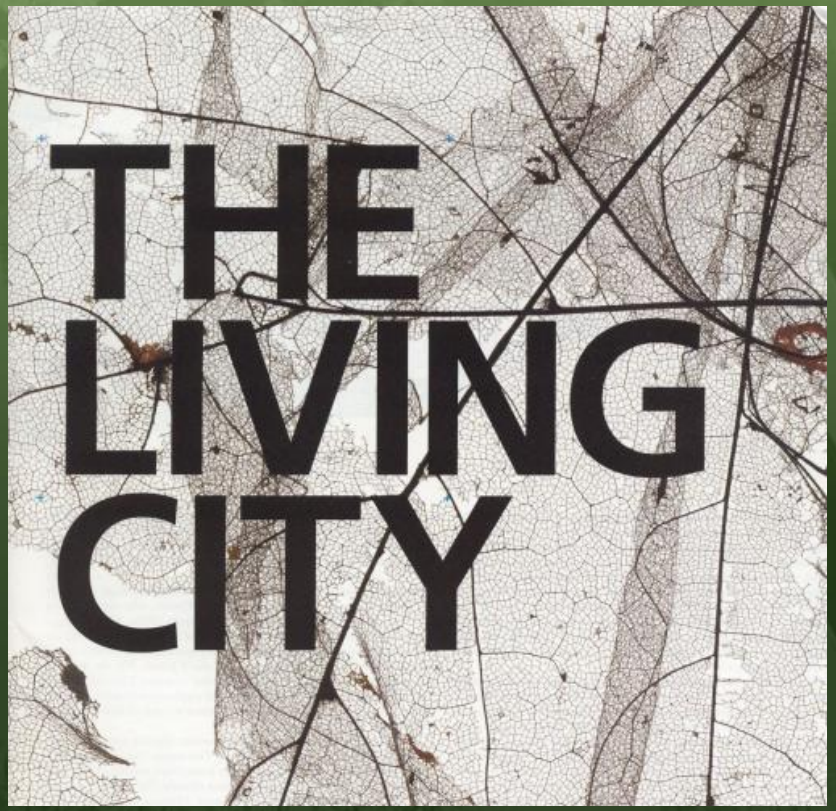
Greenprint Lessons Learned

- Be leaders
  - Take risks, benefits will come
- Be visible
  - Tell your story
  - Use symbols to inspire action & report progress
- Be patient
  - Perseverance pays off



TPIs: Initial Conclusions

- Beautification or GI?
  - Presence of overarching goals
  - Collaborative constituencies
- Effective planning?
  - Some approaches work
  - Science-based planning
- TPIs mainstreamed?



BMPs
Executive Management

- Set realistic goals
- Champion TPI with public & politicos
- Demand interdepartmental coordination
- Lead fund-raising effort

BMPs
Management Team

- Create early successes
- Establish strategic partnerships
  - planting/stewardship
  - public relations
  - funding
- Develop a plan
- Report TPI accomplishments

Regional Greenprints Don't Happen by Chance

Continued Commitment

Summary

Summary

- Trees are **PRICELESS**
- Urban Forests Don't Happen by Chance: See the Future, Be the Future
- Lessons Learned: Continued Commitment is Required
- More Treehouses: Tell the Stories

The tree in front of my home is a **word**

The trees on my street are a **sentence**

The trees in my neighborhood are a **paragraph**

All the trees in my community are a **story**

This story tells us about our relationship to nature past and present. The next chapter is ours to write. Our challenge is to reveal the connections between **my trees** and **my forest**.

Questions?