PLANTING THE SEEDS OF SUCCESS.

Benefit-Based Tree Appraisal

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Midwest Chapter ISA Annual Conference

Center for Urban Forest Research

Today

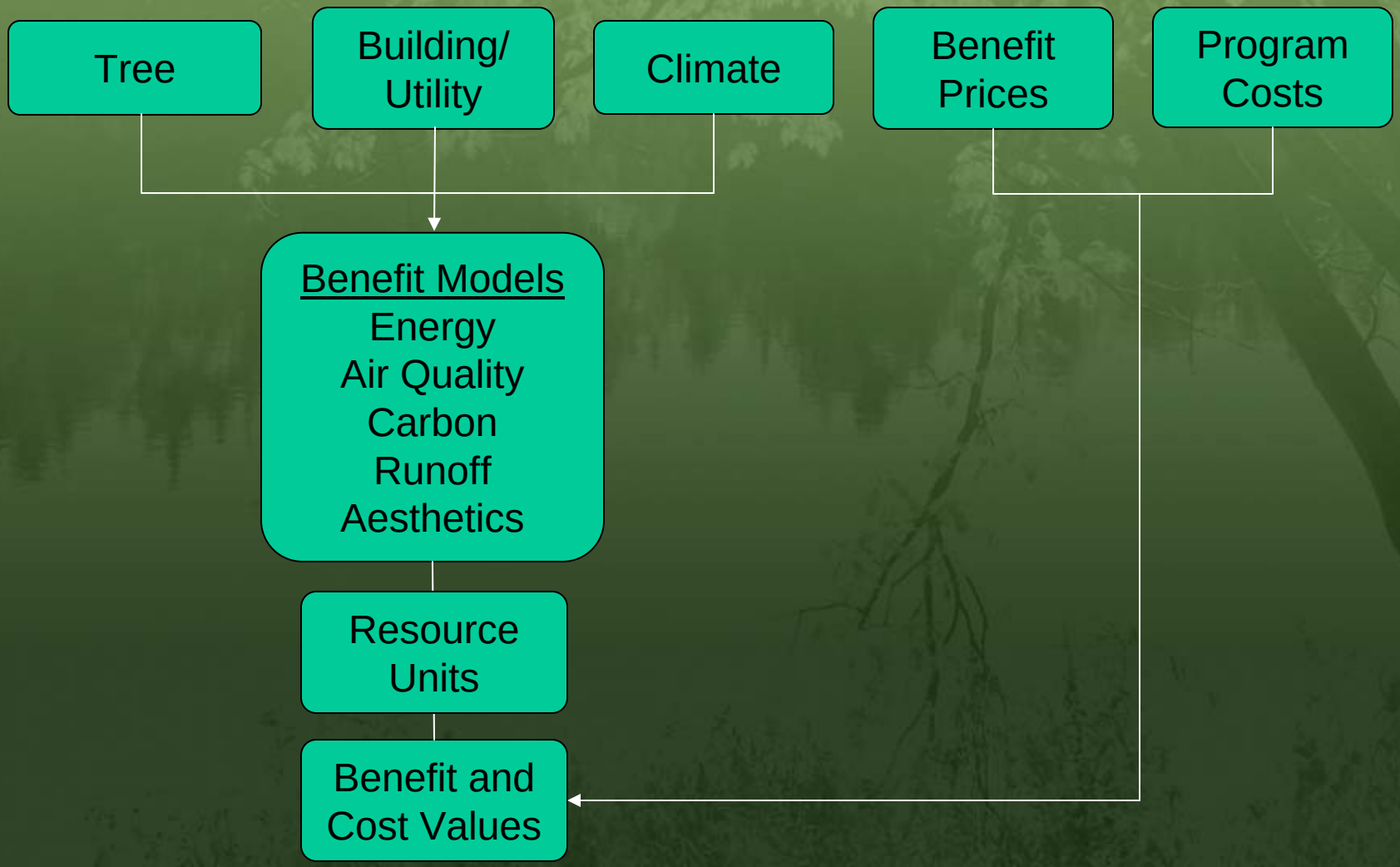
- Tree valuation
- Yard tree comparison
- Street trees example
- Tree Effects Calculator
- Other Research & Tools

Tree Valuation Approaches

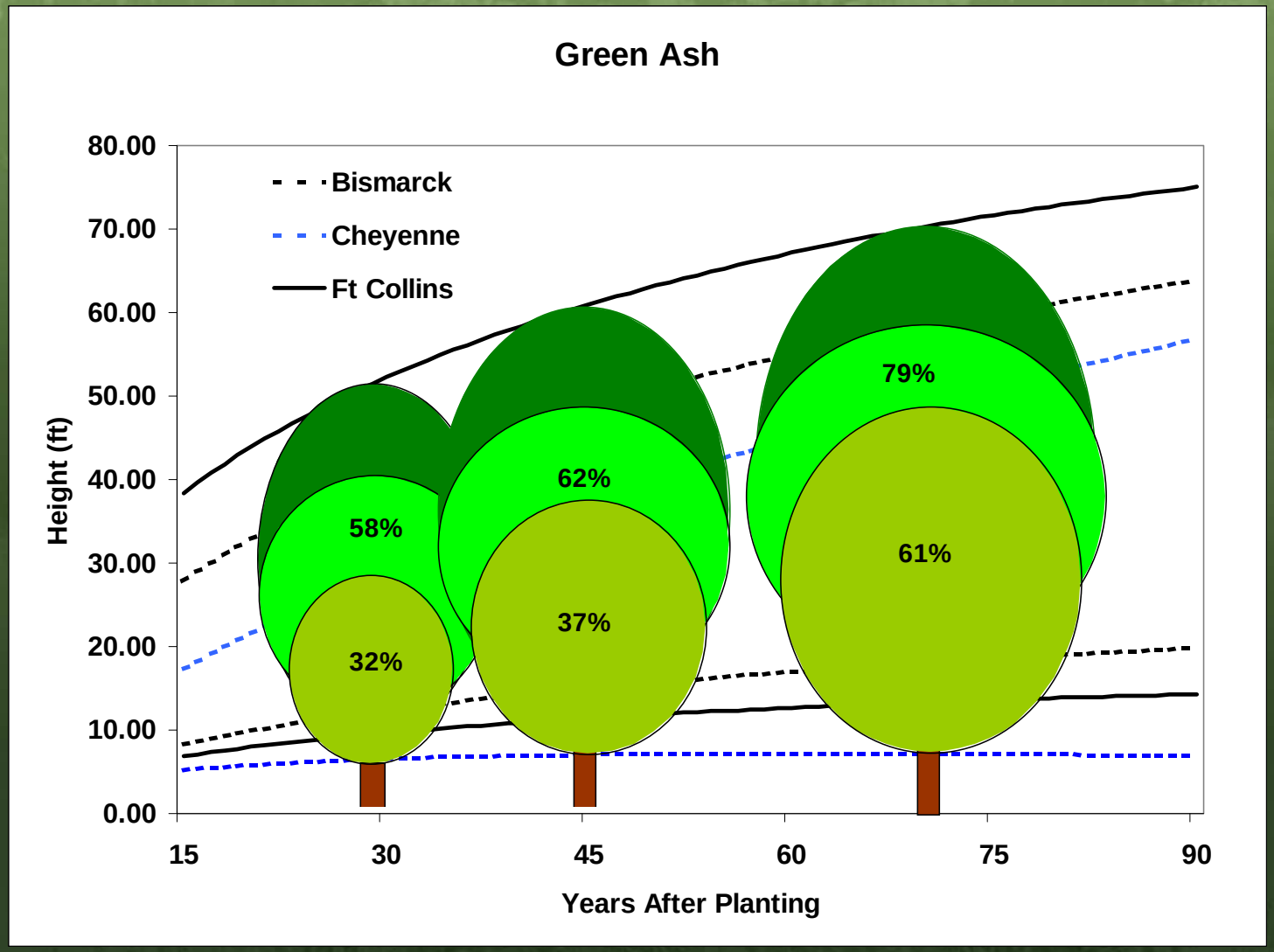
- Cost Value
- Income Value
- Market Value

Benefit-Based Approach

Benefit-Cost Modeling



Fraxinus pennsylvanica



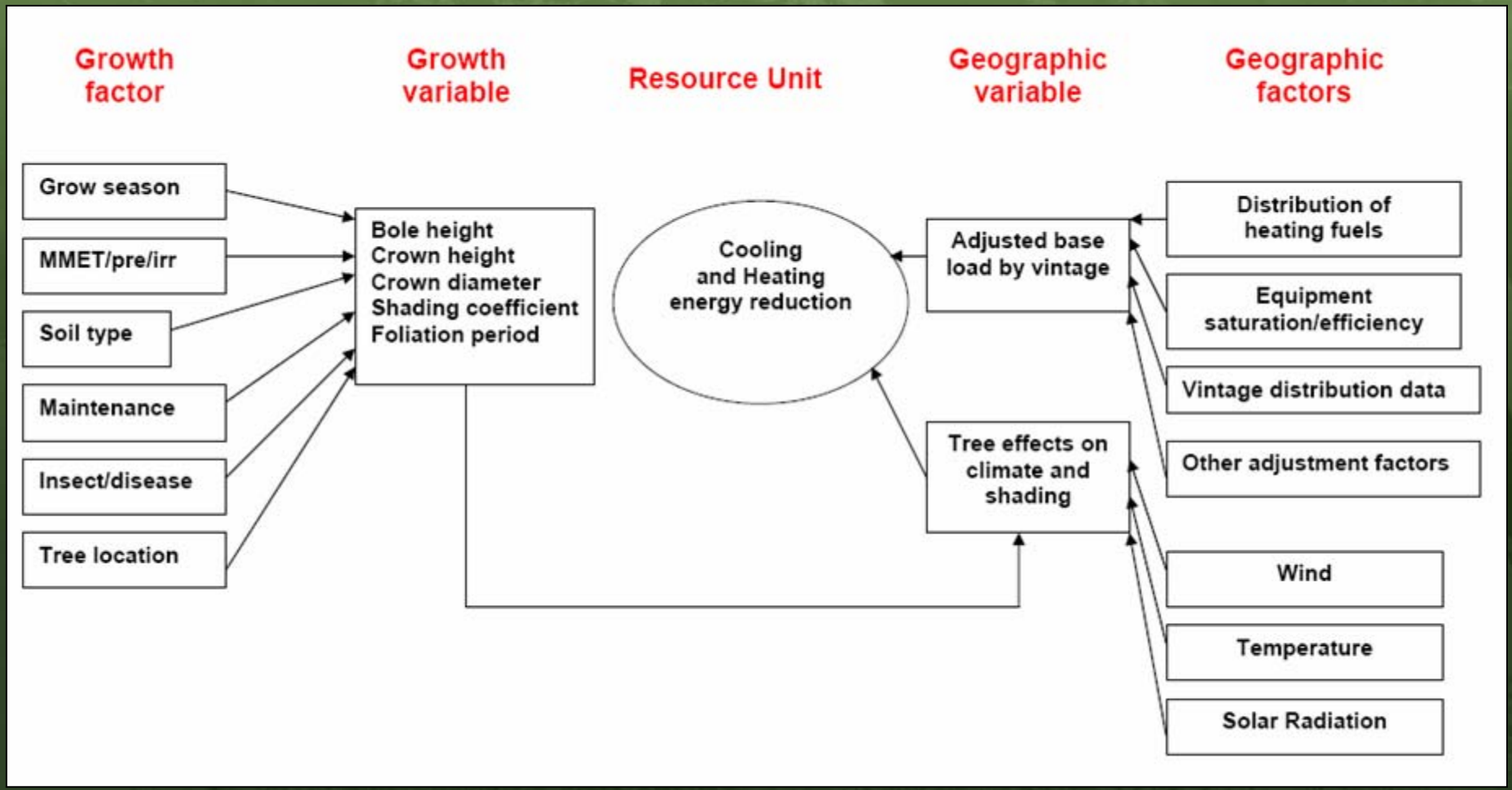
Bismarck

Cheyenne

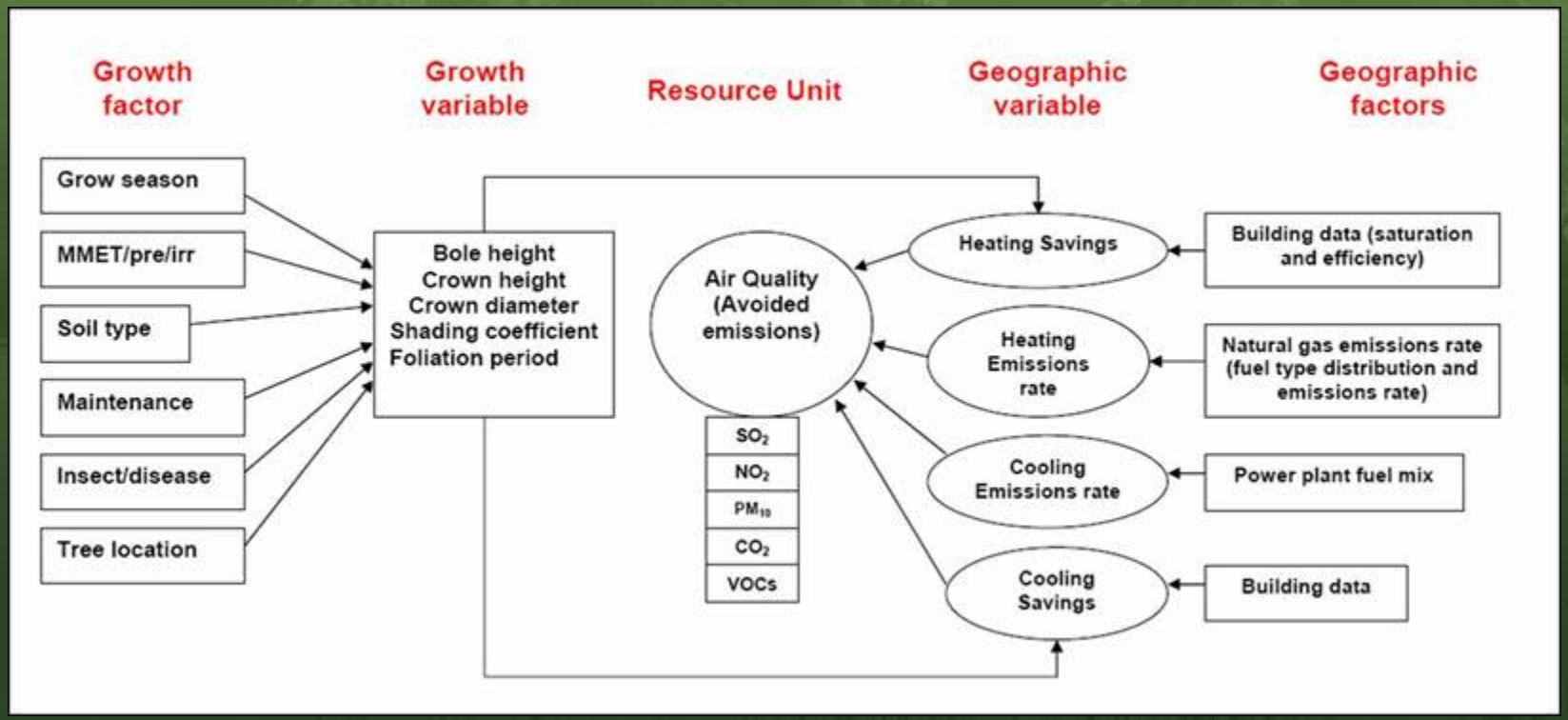
Fort Collins

30 year old green ash

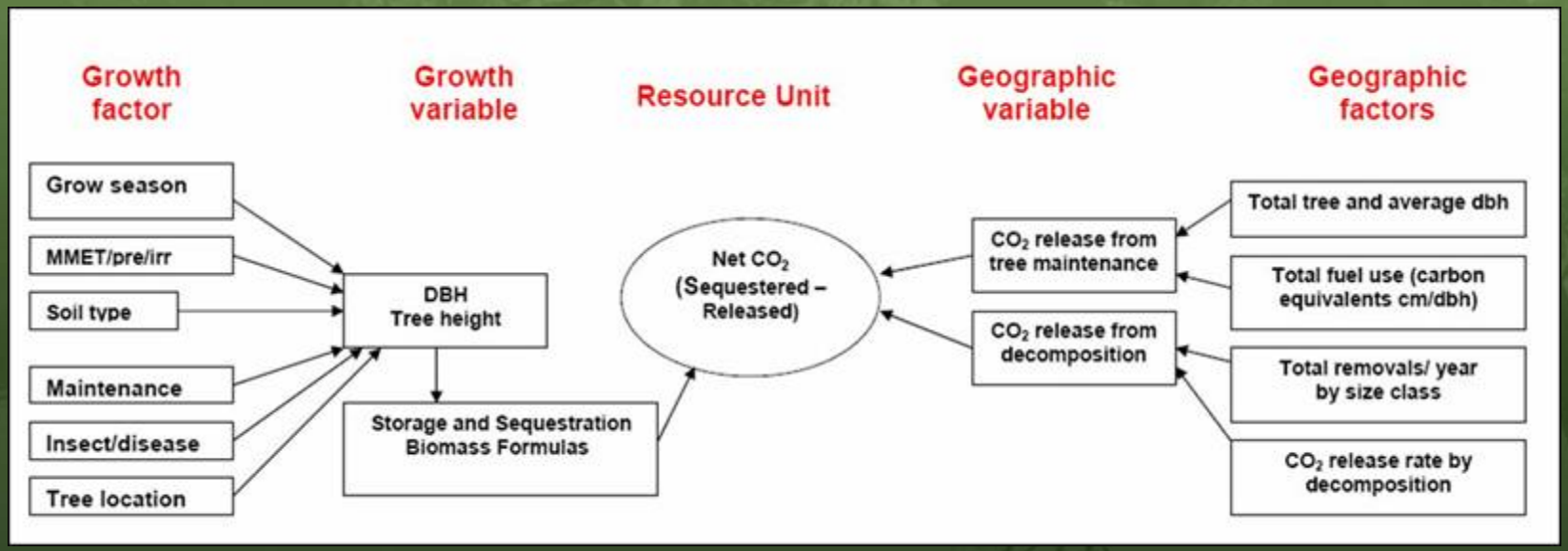
Cooling and Heating Energy Savings



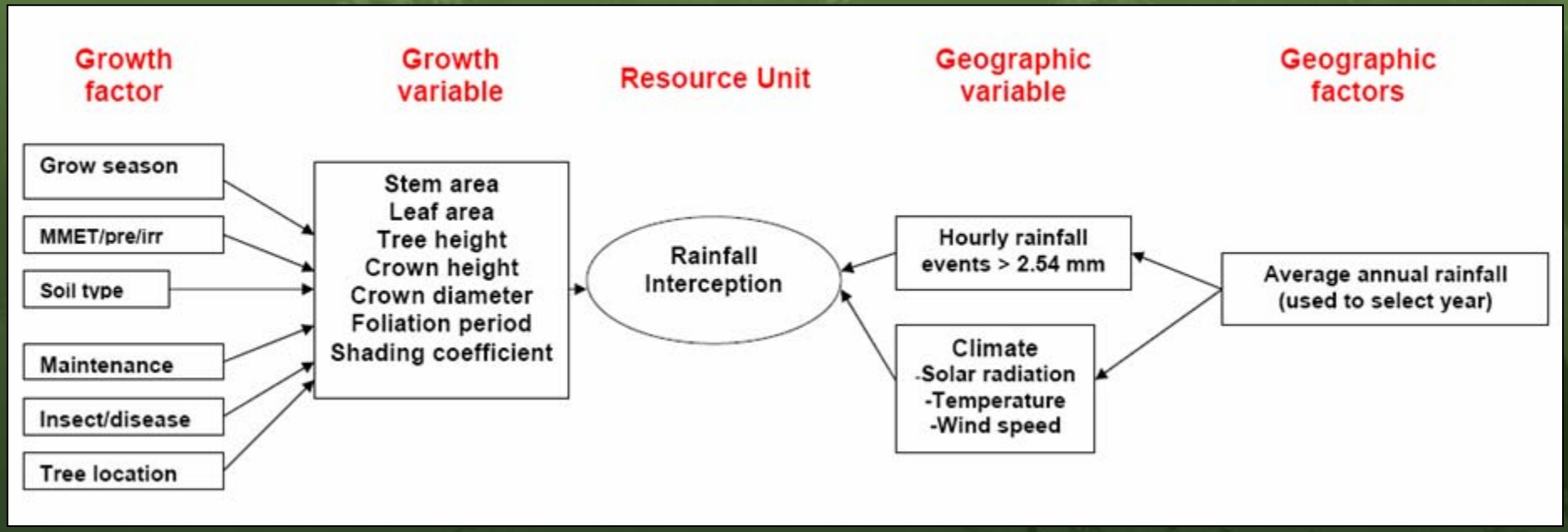
Avoided Emissions



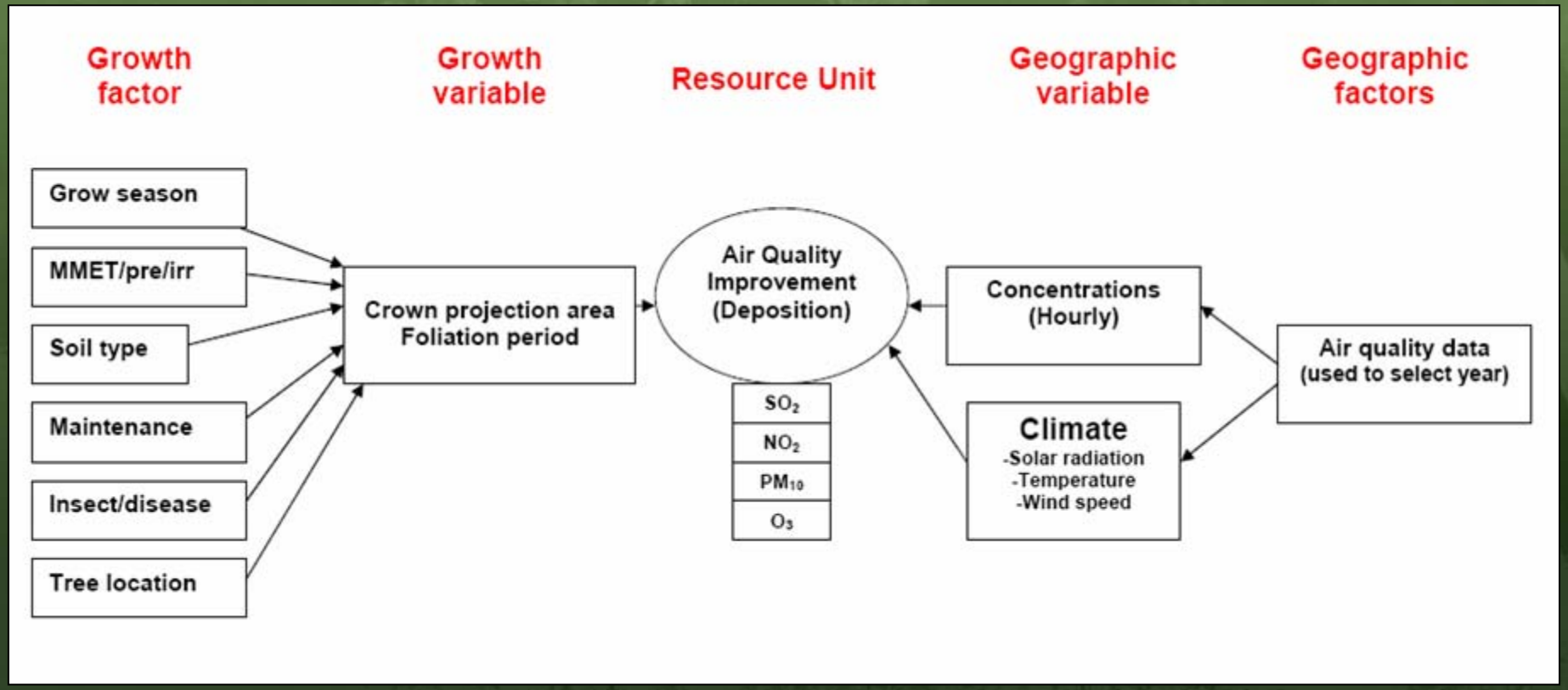
Carbon Dioxide



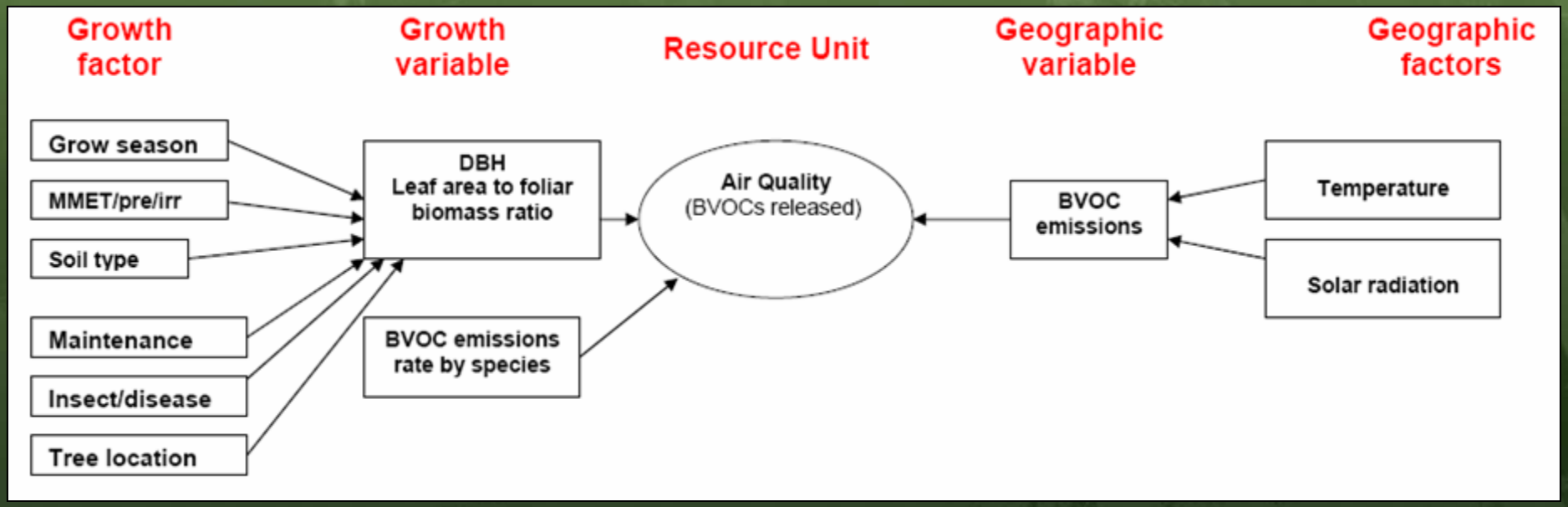
Rainfall Interception



Air Pollutant Uptake



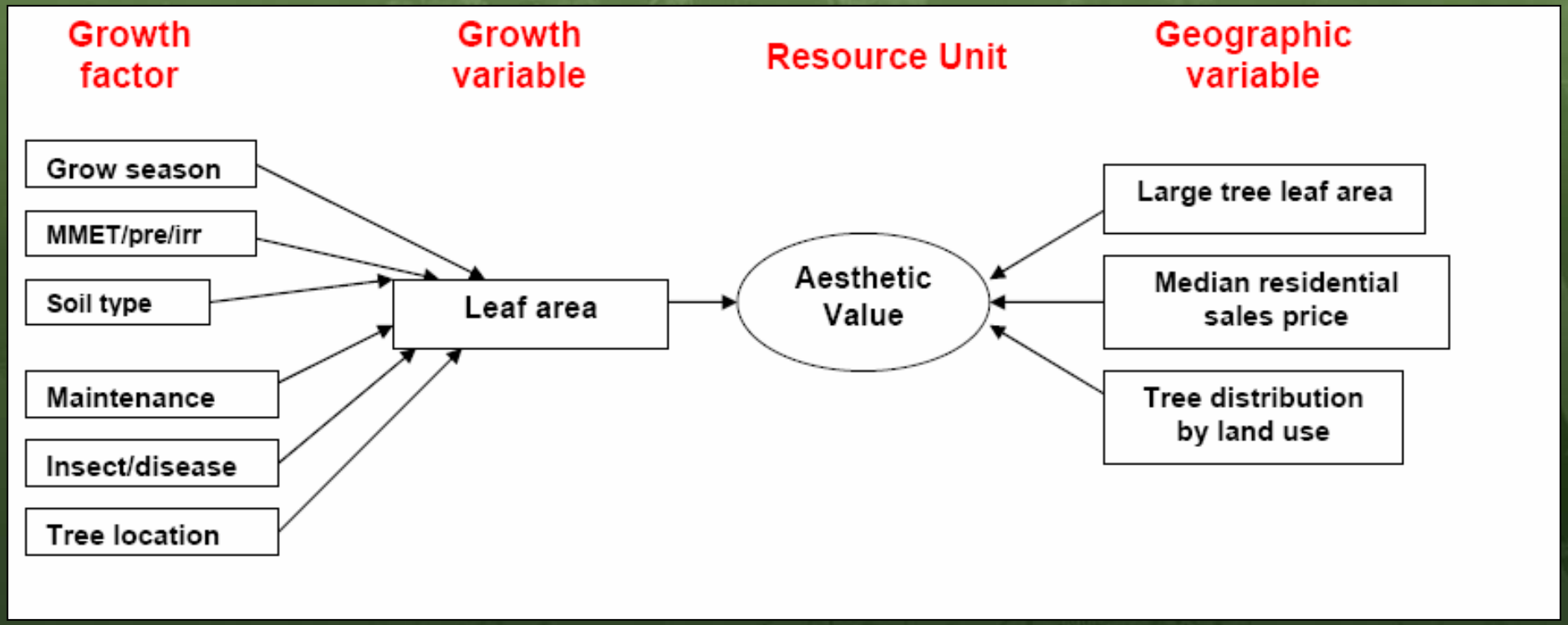
Biogenic Volatile Organic Compounds Release



Aesthetic and Other Benefits

- 844 home sales, Athens, GA
- Large front yard tree adds 0.9%
- A = L x ((T x C) / M)
  - L = Leaf area increase
  - T = Sales price increase by large tree = (0.9% x median home sales price
  - C = Location reduction
  - M = Large tree leaf area

Aesthetic and Other Benefits



Yard Tree Comparison

- Green ash, Fort Collins
- Front yard, west side
- 40 years
  - Cost Approach (Replacement value)
  - Income Approach
    - Cumulative annual benefits (Ft Collins)
    - Cumulative annual benefits (Boulder)

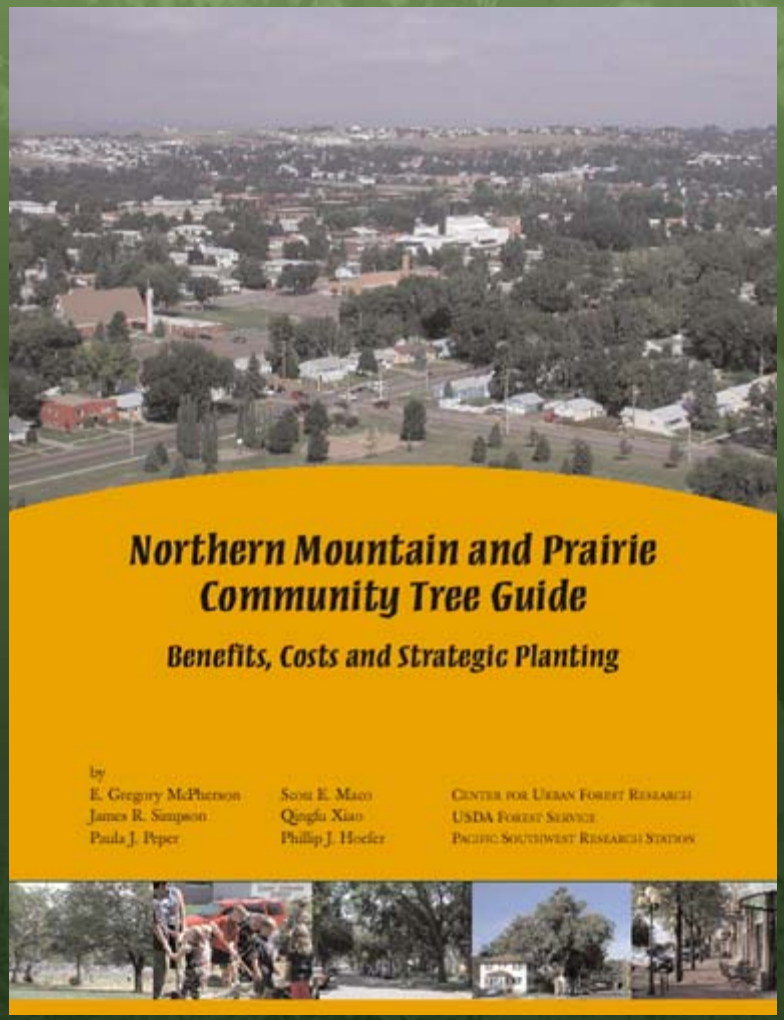
Yard Tree Comparison

- Value = Basic Value x Cond x Loc

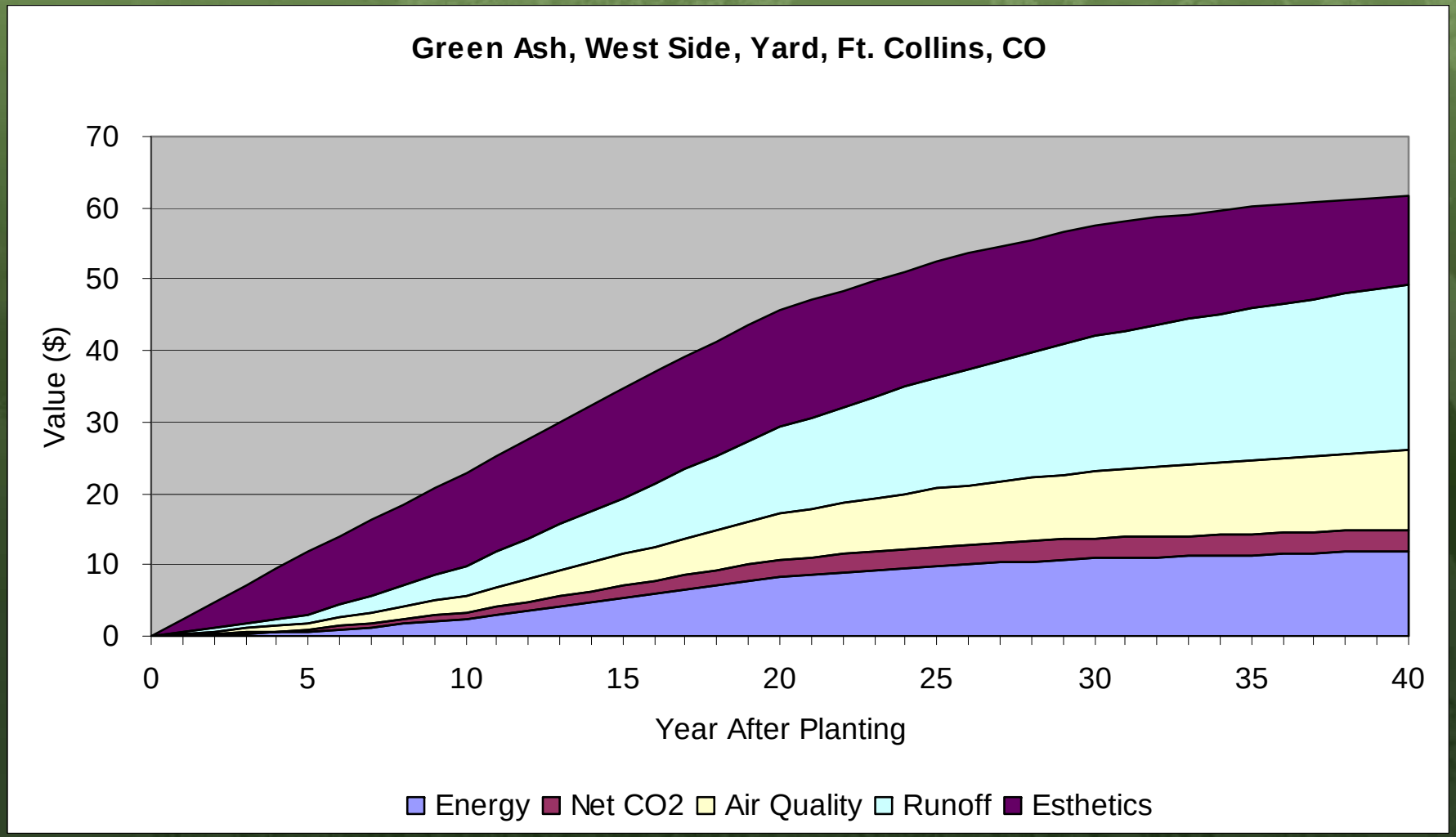
  Basic Value = Replacement Cost + (Basic Price x [TAa - TAr] x Species)
- Replacement Cost = $671
- Basic Price = $49/sq inch
- Species = 60%
- Condition = 70%
- Location = 70%

Benefit Valuation

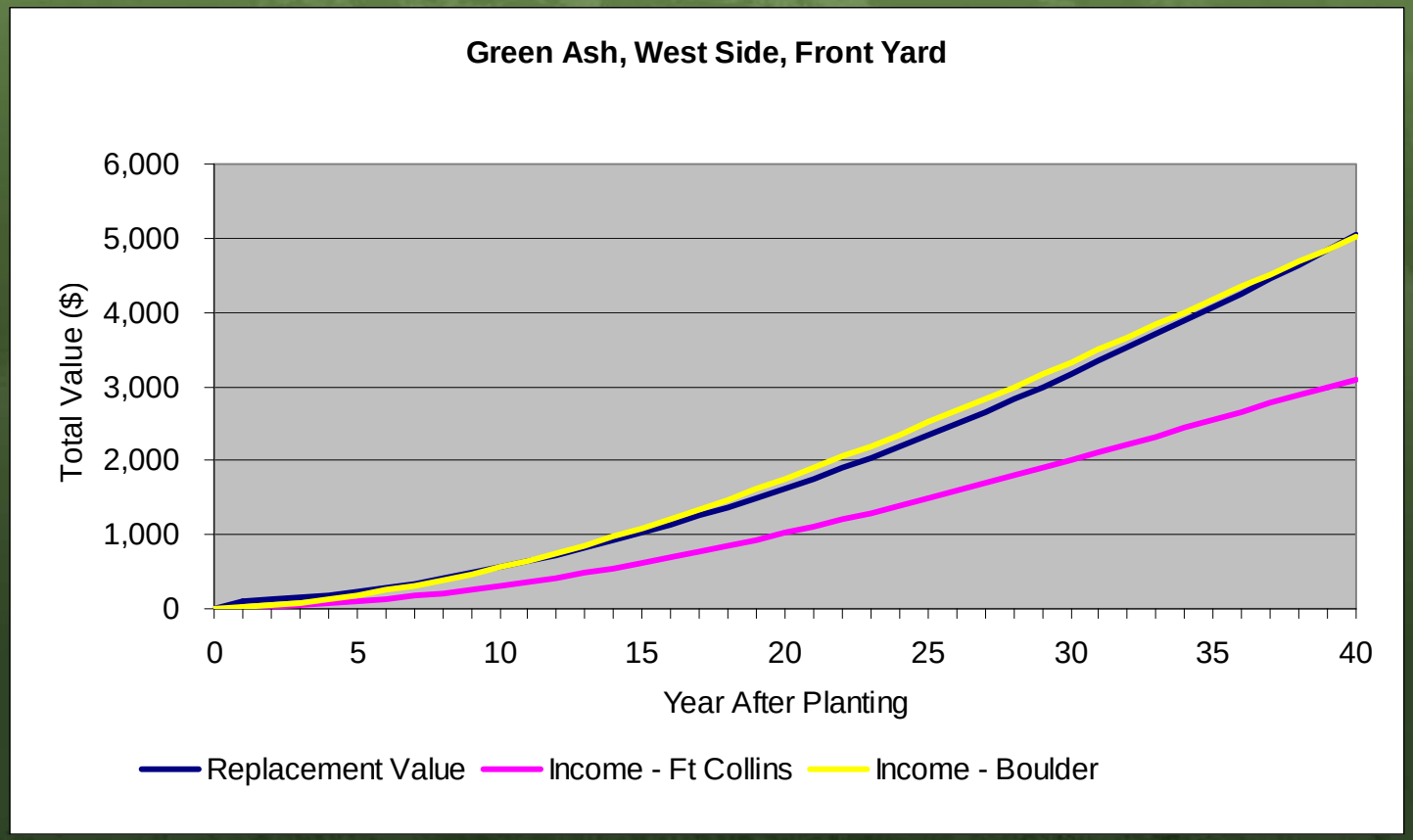
- Energy prices
  - Electricity ($0.78/kWh)
  - Natural gas ($0.0072/kBtu)
- CO_2 reduction
  - $15/ton - CO2e.com
- Pollutant uptake
  - Control costs (Wang and Santini 1995)
    - NO2 & O3 = $3.07/lb
    - SO2 = $7.13/lb
    - PM10 = $5.13/lb
    - VOC = $4.85/lb
- Rainfall interception
  - Control costs based on construction and operation costs of detention/retention basin in Fort Collins ($0.01/gal)
- Aesthetic and Other
  - Median residential sales price
  - Ft Collins = $212,000
  - Boulder = $413,000



Yard Tree Comparison



Yard Tree Comparison



Yard Tree Comparison Summary

- Replacement Value exceeds Income
  - Costs not included
- Income Value
  - Relative importance of each benefit
  - Very sensitive to property values
  - Sensitive to place
  - Tree condition not included

Street Trees Example

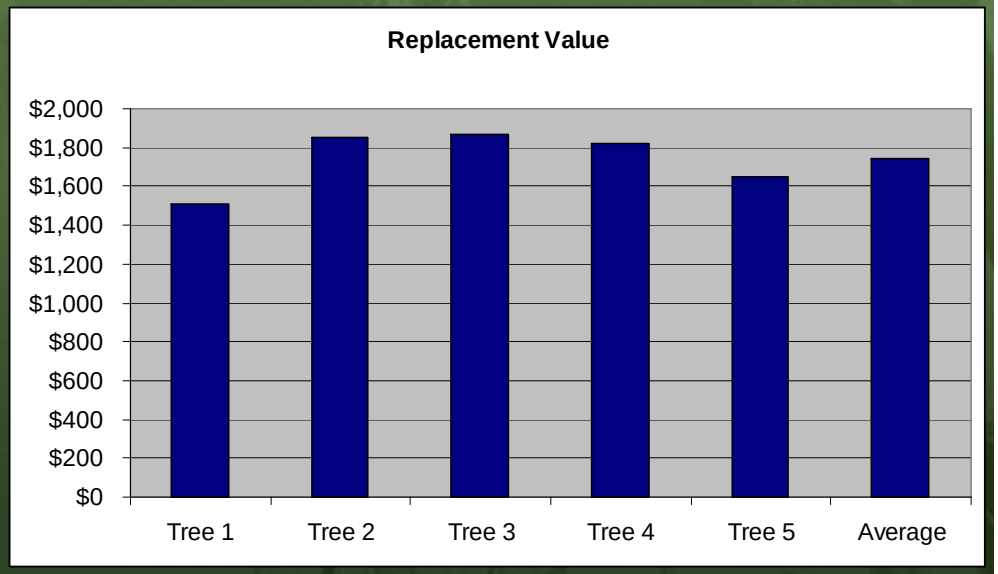
- 5 Pistache planted 15 years ago
- Compare Current Value
  - Replacement value
  - Net present value of benefits for next 25 years
    - Discount rates: 4%, 7%, 10%
- Retain or remove and replace?
  - Remove Pistache and replace with Planes
- Amount saved from optimal planting?

Example in Davis, CA

Current Situation

Compare Current Value

- Trunk formula
  - Avg dbh = 9”
  - Avg condition = 57%
  - Avg location = 67%
    - Site = 80%
    - Contribution = 70%
    - Placement = 50%
  - Species rating = 90%
  - Basic price = $56.50/sq inch
- Replacement Value
  - $1,751 avg/tree ($1,451 to $1,913)



Background

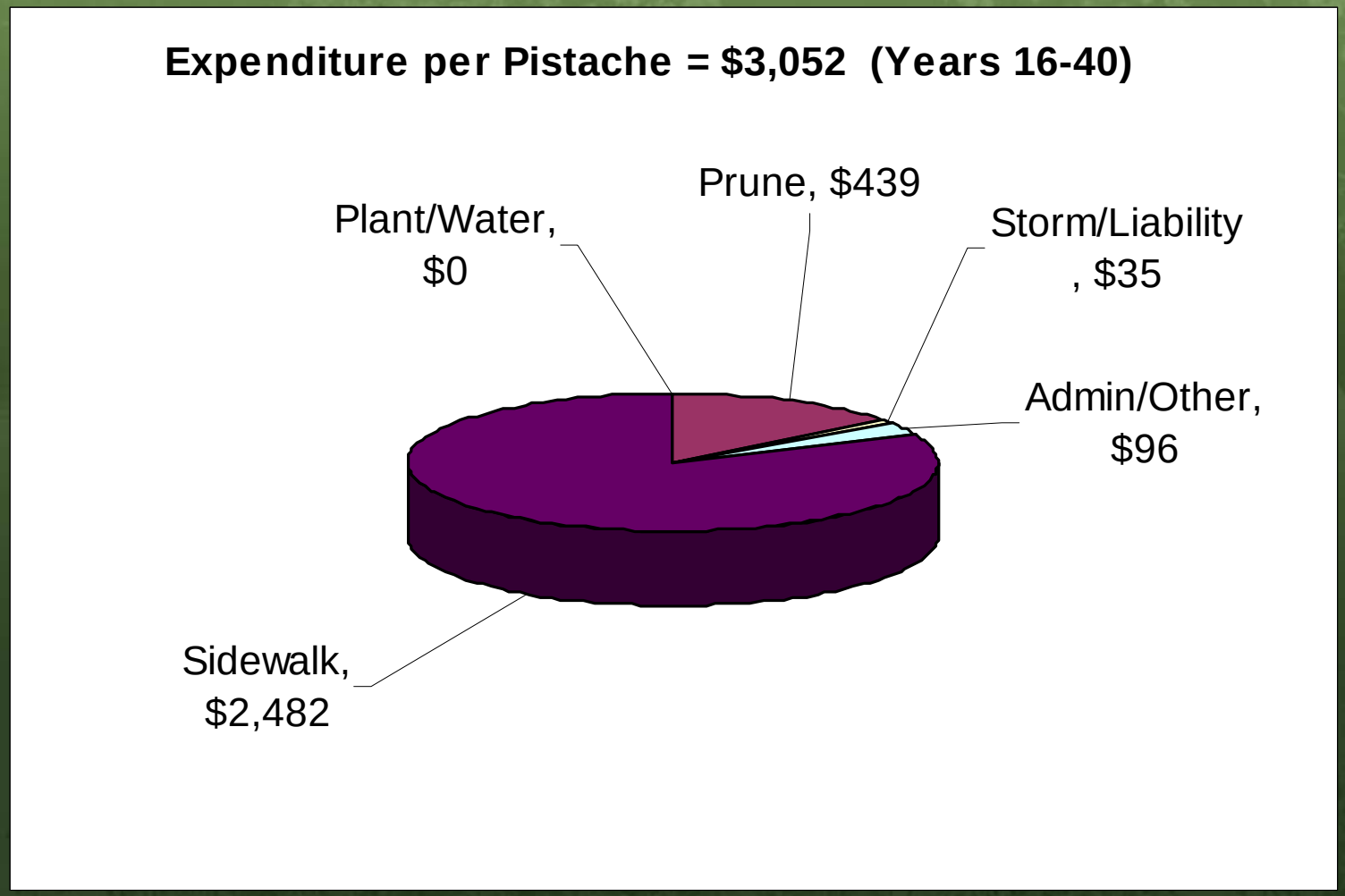
- Modesto tree growth & benefit data for Pistache & Plane
- Davis tree care costs and sidewalk repair schedule

Activity	Unit Cost	$/tree
Plant pistache		75
Plant plane (adds $50 for site prep of shrub bed)		125
Prune small tree (4-yr cycle)		36
Prune 6-12" dbh (8-yr cycle)		113
Prune 12-18" dbh (8-yr cycle)		163
Prune 18-24" dbh (8-yr cycle)		225
Remove pistache 6-12" dbh (at 15 years)		150
Remove pistache 12-18" dbh (at 40 years)		250
Grind sidewalk (5 squares, at yrs 10, 15, 30, & 3	$20/4-ft square	20
Root prune (at years 20, 25, and 40)		30
Remove & replace sidewalk (at yrs 20 and 40)	12/sq ft, 3 sq/tree (48 sq ft)	576
Remove & replace curb/gutter (at yrs 25 and 40)	$50/linear ft, 12 ft/tree	600

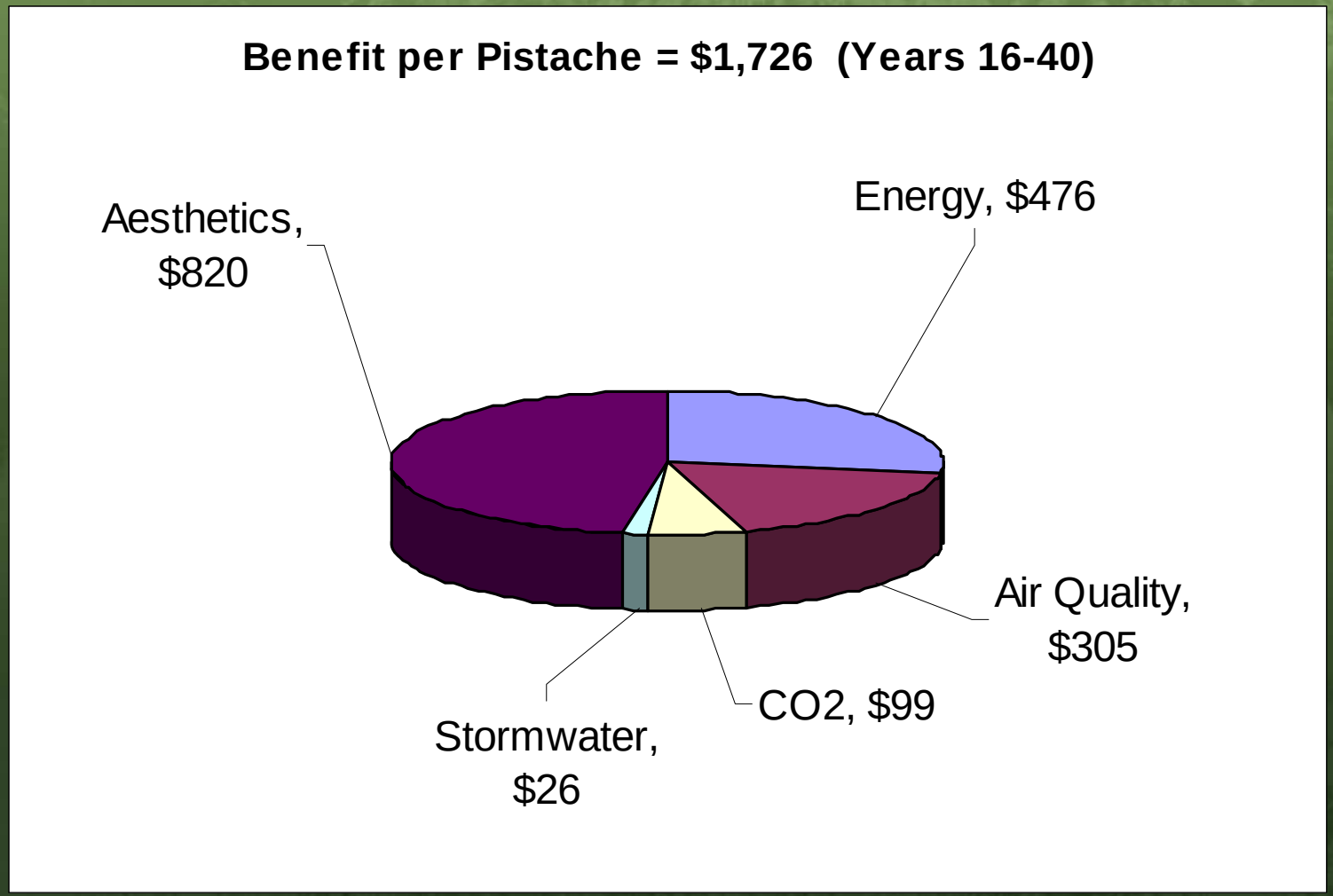
Davis Benefit Valuation

- Energy prices
  - Electricity ($0.116/kWh)
  - Natural gas ($0.0064/kBtu)
- CO_2 reduction
  - $30/ton
- Pollutant uptake
  - Emission reduction credits
    - NO2 & O3 = $3.85/lb
    - PM10 = $4.47/lb
    - VOC = $1.51/lb
- Rainfall interception
  - Annualized capital cost and operations and maintenance ($0.0017/gal)
- Aesthetic and Other
  - Median residential sales price
  - $273,518 in 1999-2000

Compare Current Value - Costs

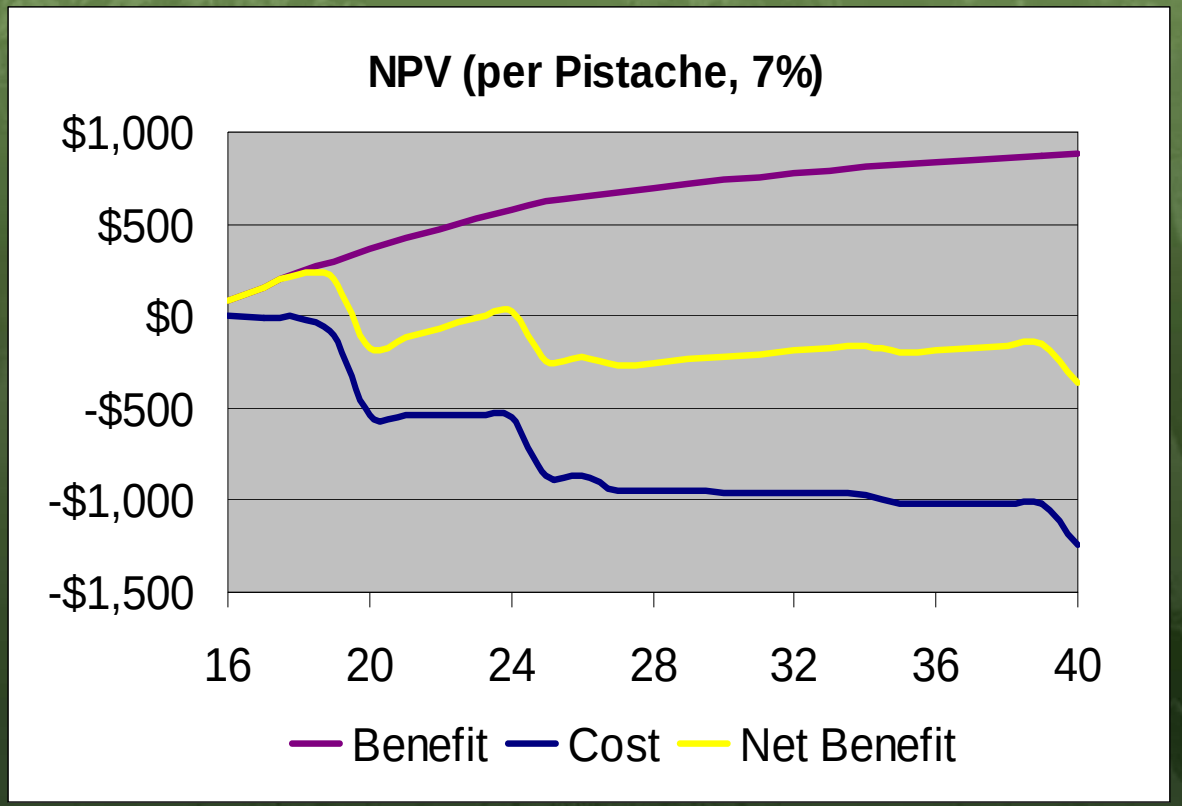


Compare Current Value - Benefits



Compare Current Value

- NPV Yr 16-40
  - 0% = $-1,296
  - 4% = $-608
  - 7% = $-363
  - 10% = $-226
- Replacement Value
  - $1,751

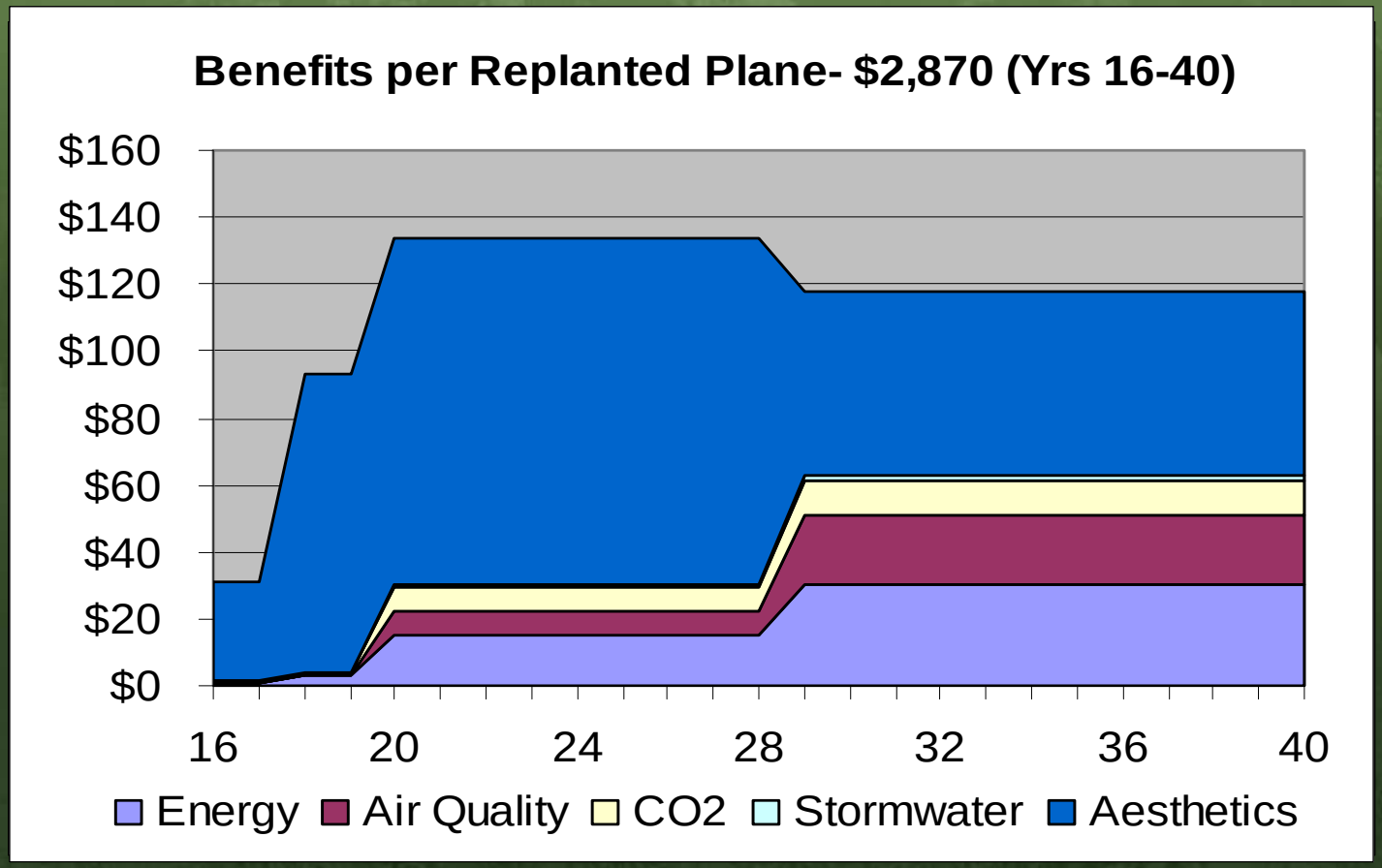


Replant With Plane in Shrub Bed

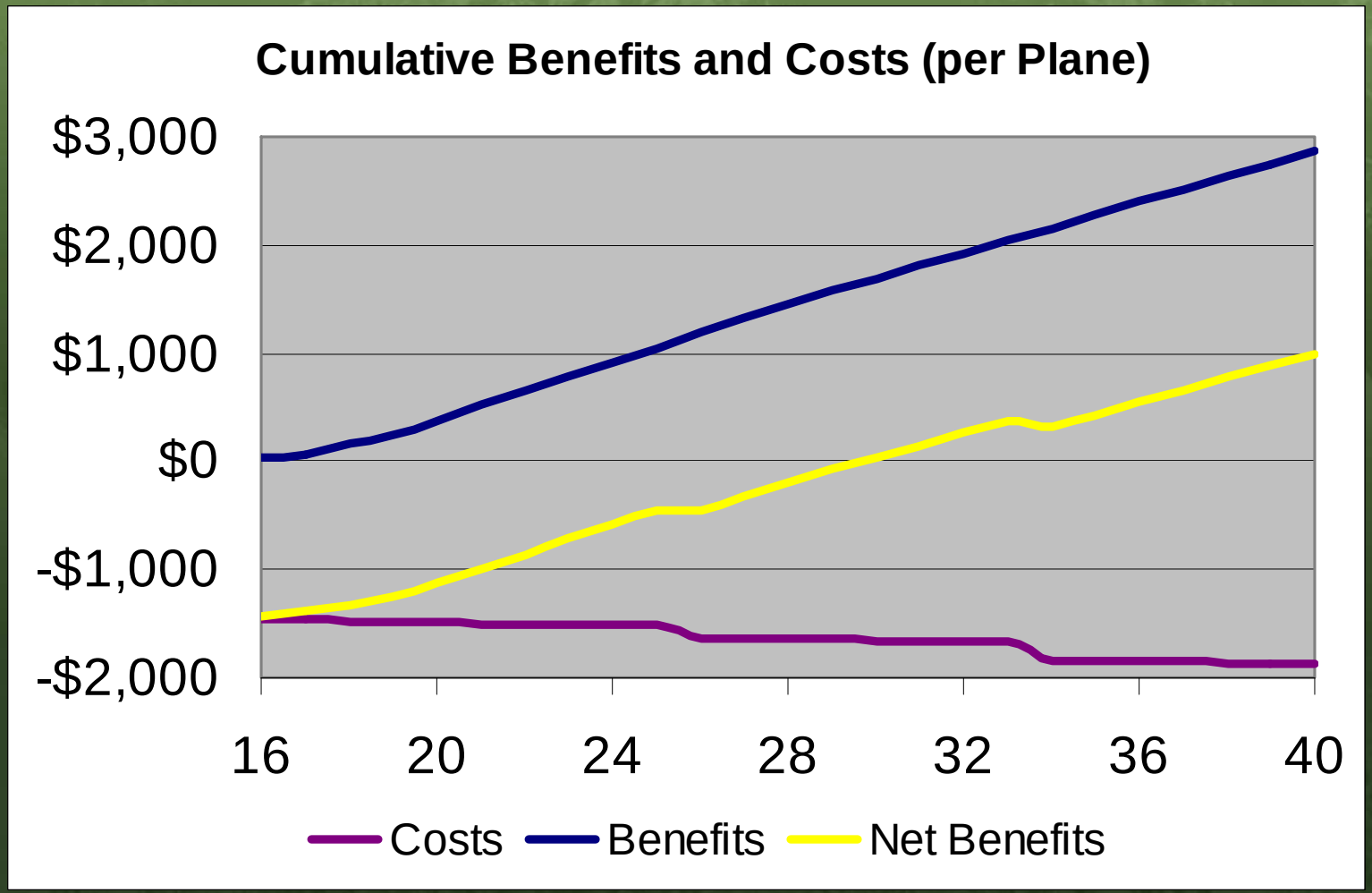
Cost-Effective to Remove and Replace Pistache?

- Removal and replacement costs
  - $150 remove, $125 plant = $275/tree
  - Remove & replace sidewalk/curb & gutter = $1,176/tree
- Reduced benefits from smaller trees
- Increased air quality benefit (VOCs)
- Reduced costs for tree care and sidewalk repair
- Greatest NPV of benefits

Benefits and Costs for Replacing

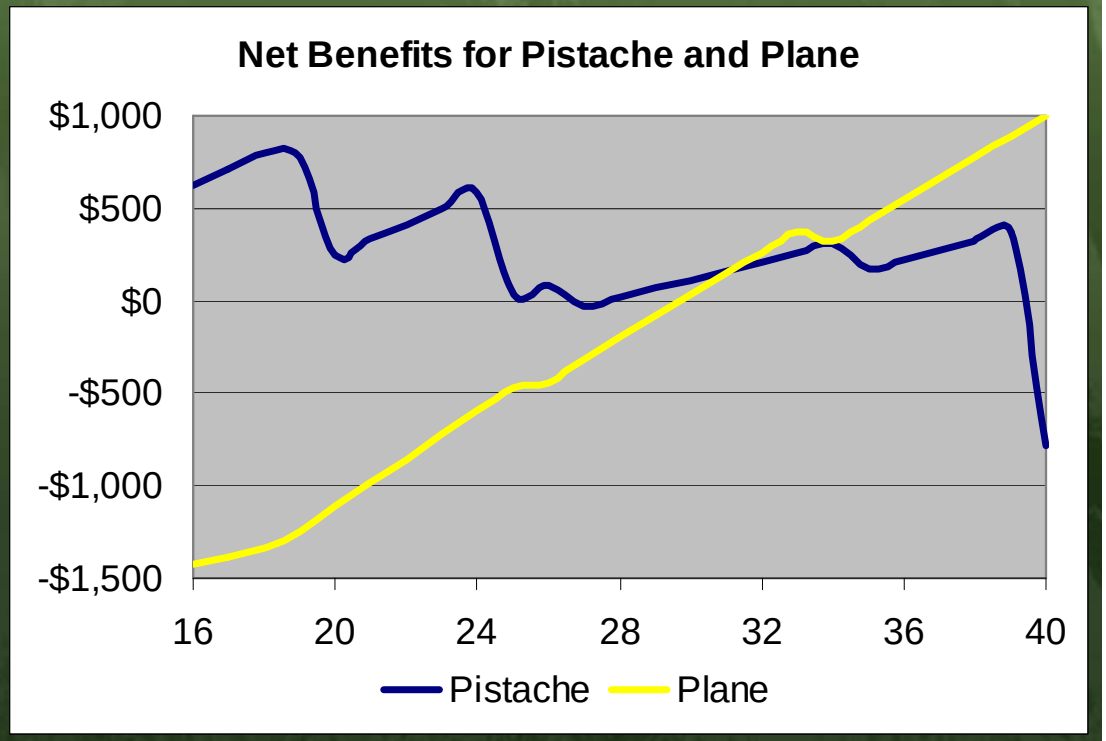


Benefits and Costs for Replacing



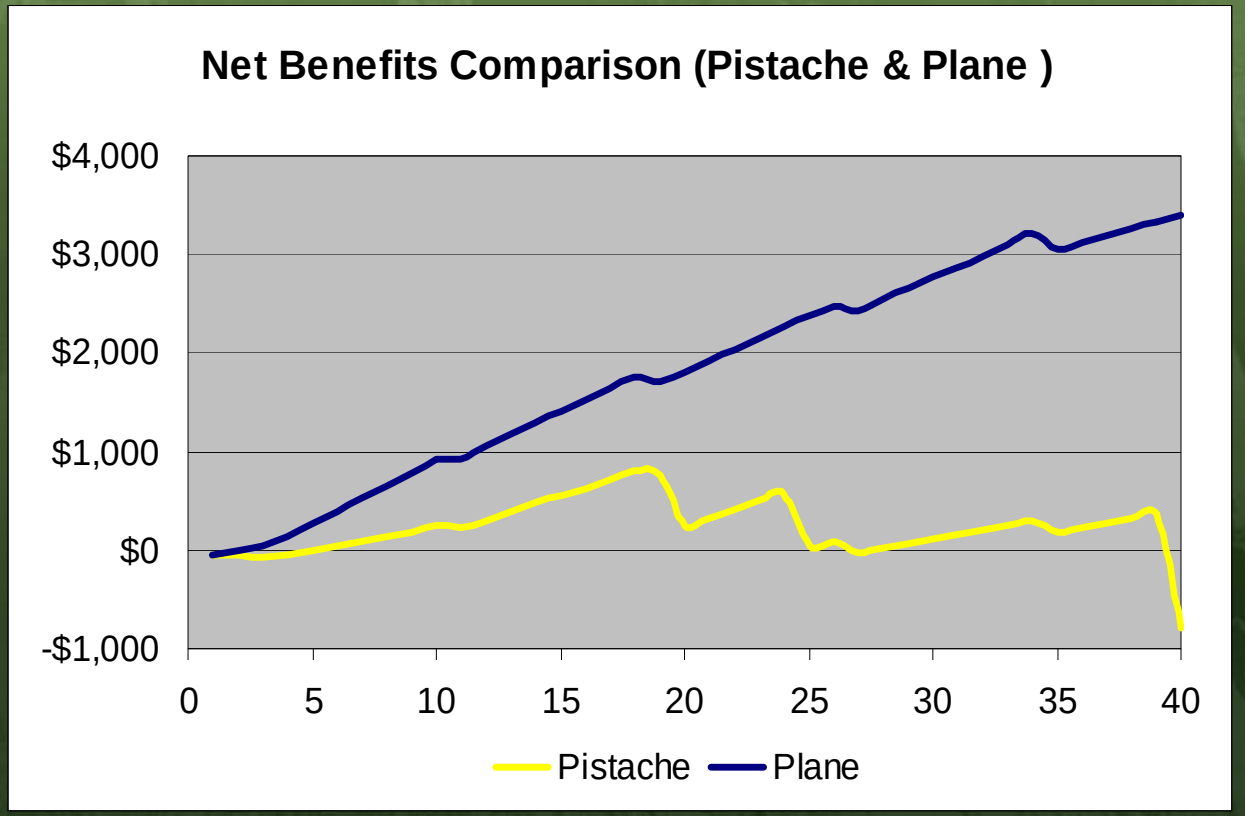
Cost-Effective to Remove Pistache and Replace?

- Net Present Value of Benefits per tree (Yrs 16-40)
- NPV Benefit (0%)
  - Retain Pistache $-1,326
  - Replace w/ Plane $994
- NPV (7%)
  - Retain Pistache $-363
  - Replace w/Plane $-270
- Remove-Replace cost-effective at lower discount rates



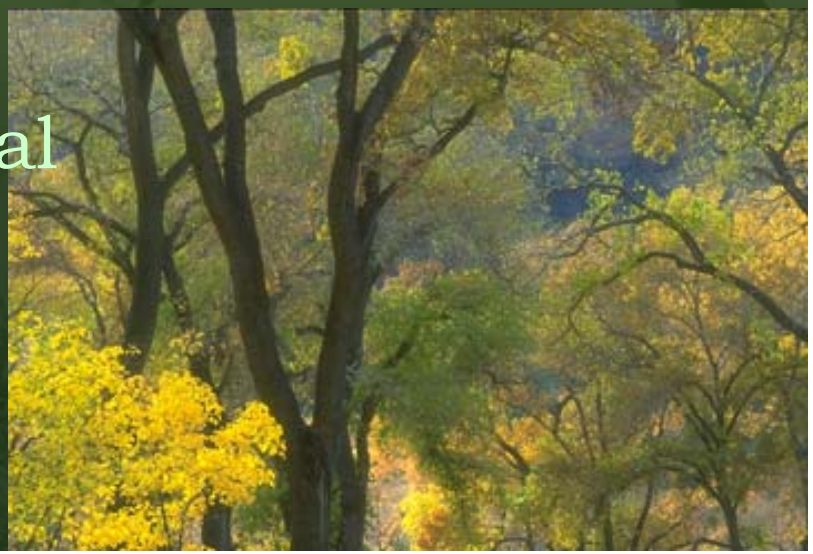
Amount Saved With Optimal Layout for 40 Years

- NPV Benefits (0%)
  - Pistache $-783
  - Plane $3,409
- Amount saved:
  - $4,192/tree
- Decision effects future value



Summary

- Compare Current Value Pistache
  - Replacement Value > Benefit-based
    - Future sidewalk repair costs
- Retain or Remove & Replace?
  - Depends on discount rate
  - Retain more cost-effective at higher rates
  - Decision-support tool
- Amount Saved with Optimal Planting (40 yrs)
  - $4,192/tree



Benefit-Based Approach

- Considers future stream of costs & benefits
- Breaks out specific benefits
- Unsuitable for tree appraisal now
  - specific tree species, size, location, condition, longevity
- Principles can inform contribution and placement ratings
- Long-term implications of planting and management

Tree Effects Calculator

- Enter Region
- Enter Tree Data
- Enter Site Data
- Calculate Replacement Value
- Calculate Value of Current Benefits
- Calculate Value of Future Benefits

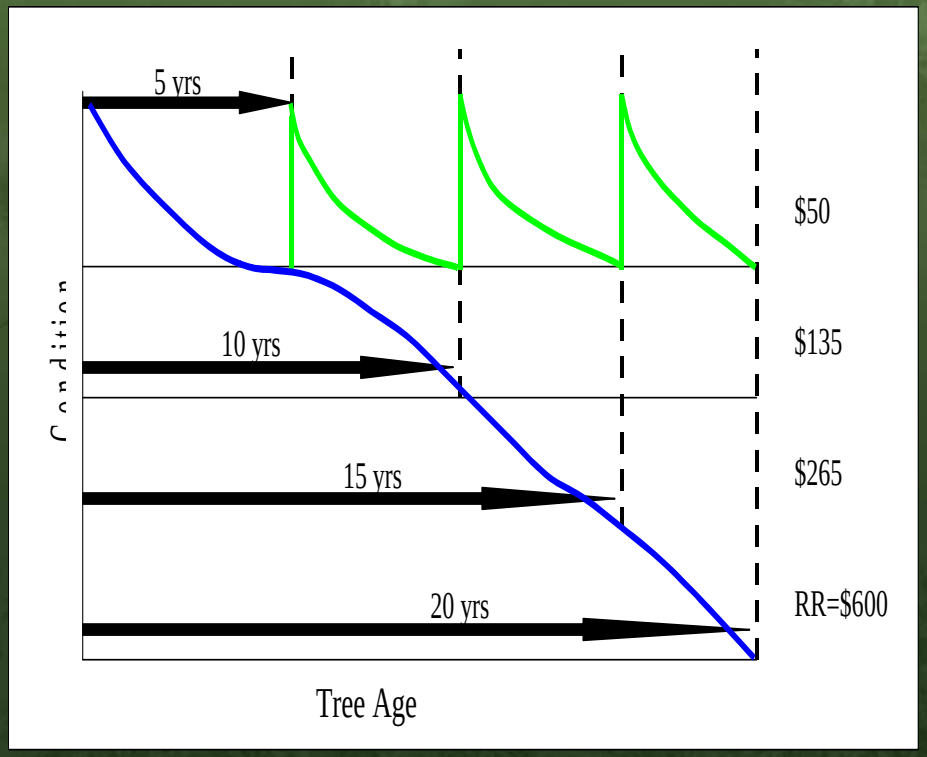
U&CF Tipping Point

- New Leadership & Awareness
  - At the Top
  - Grass Roots
- New Investment & Responsibility
  - Los Angeles
  - Sacramento: Energy & Air Quality
  - Green Streets & Carbon
  - Making it Pay!
- New Tools for Project Planning, Budgeting, & Monitoring

Street Tree Simulator

User Interface Design

DeVine Consulting

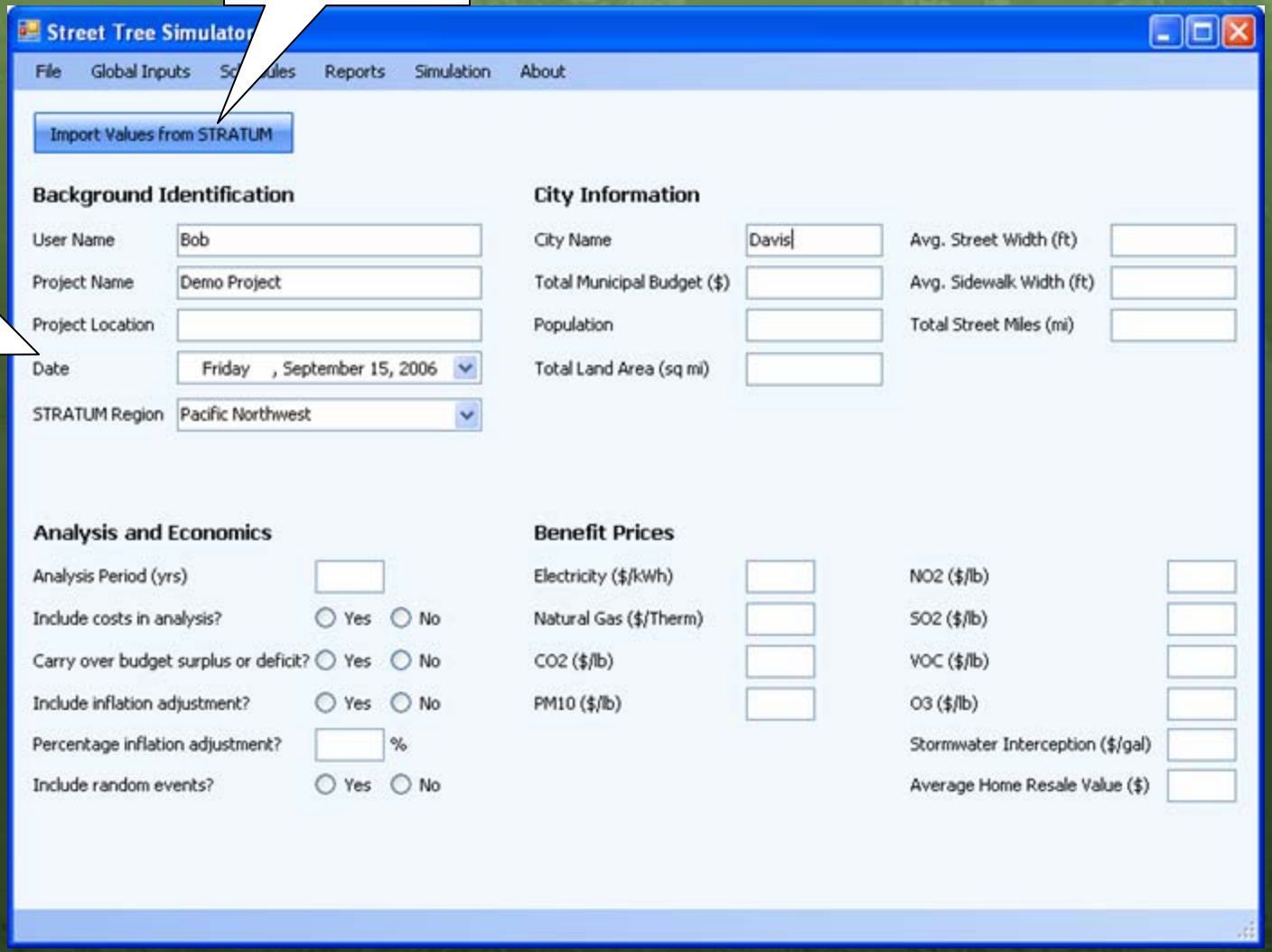


September 19, 2006

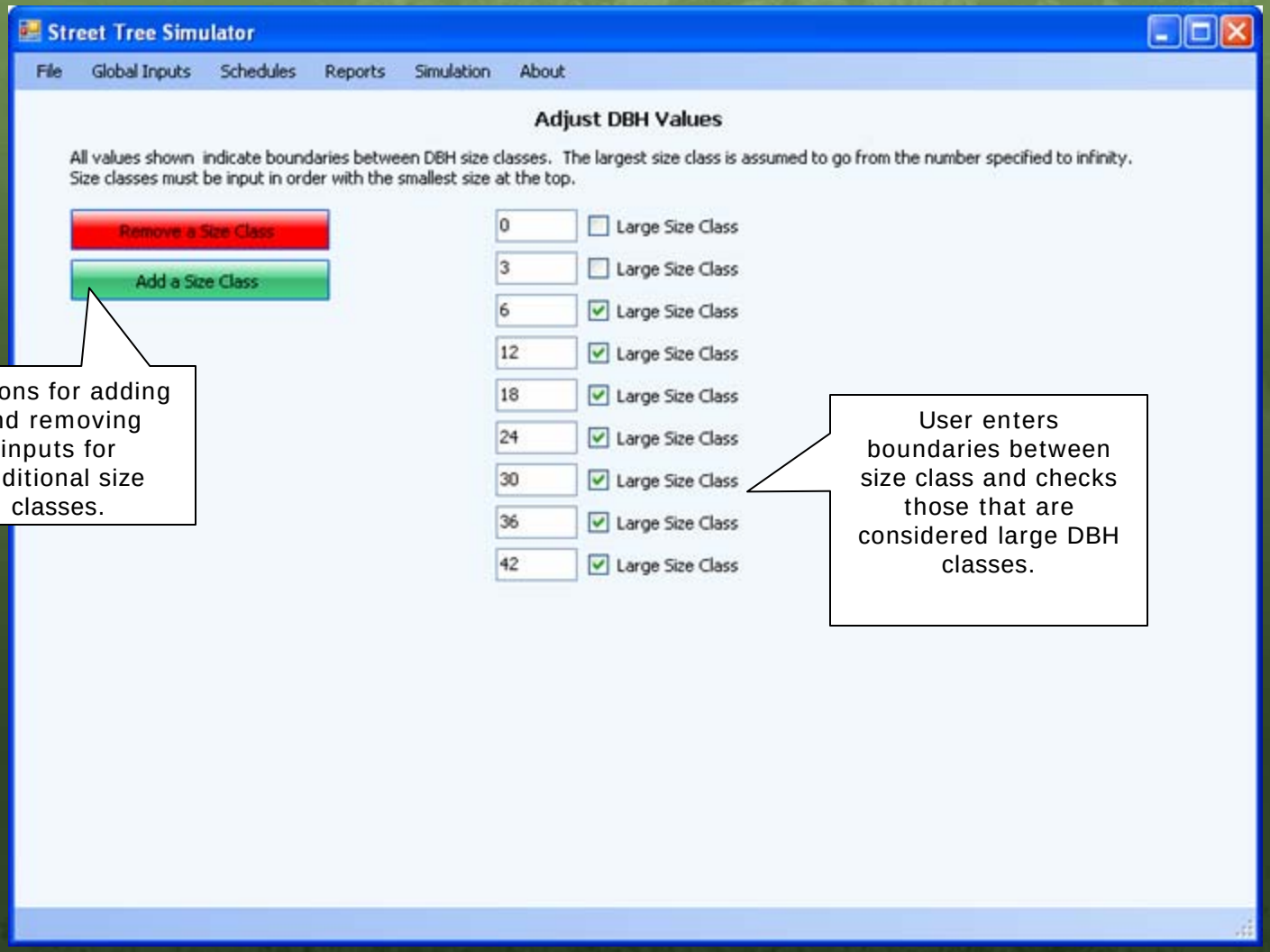
Global Inputs

Button for importing data from STRATUM.

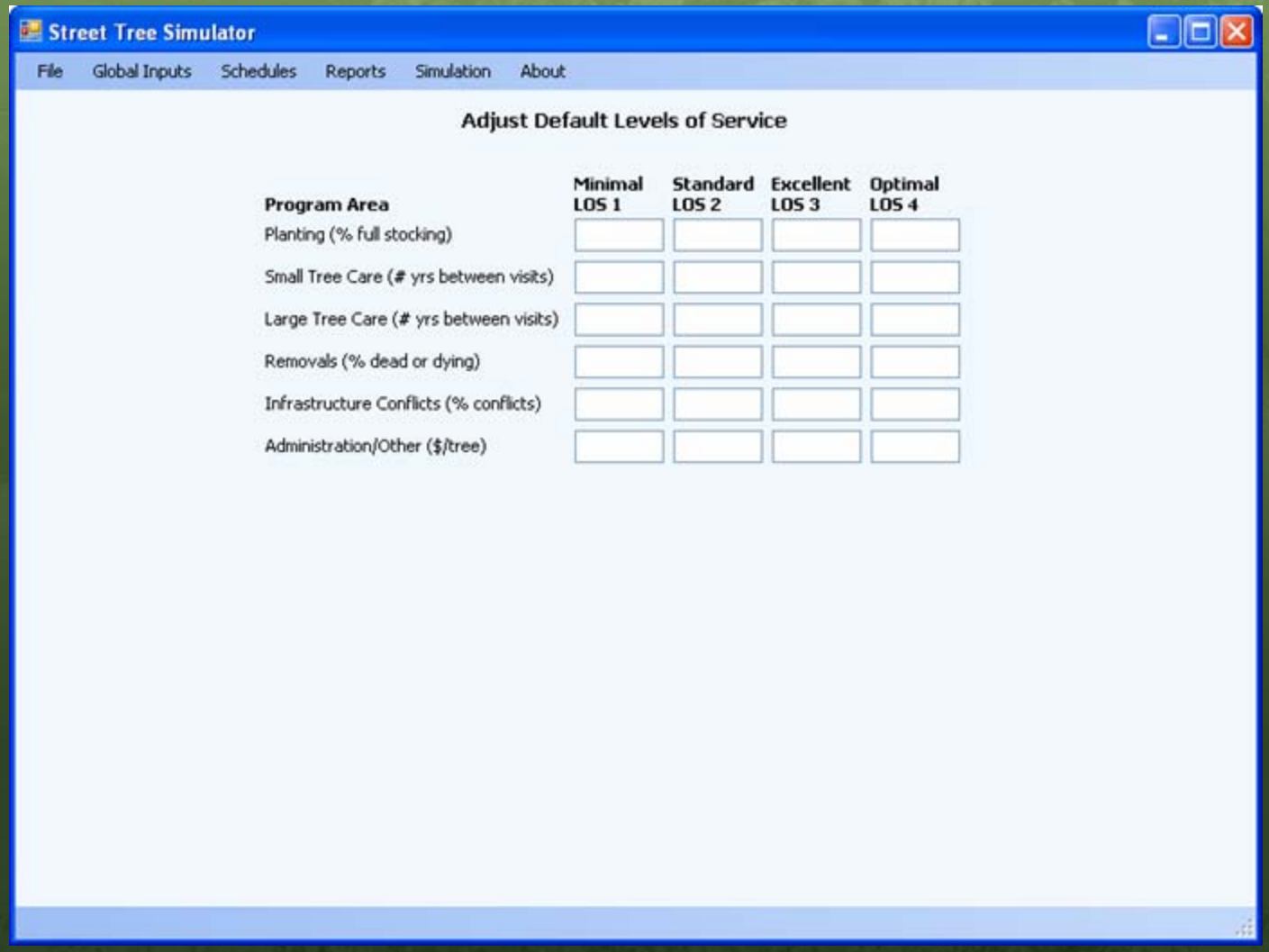
Dropdown region selection. This can be made a graphical selection if necessary.



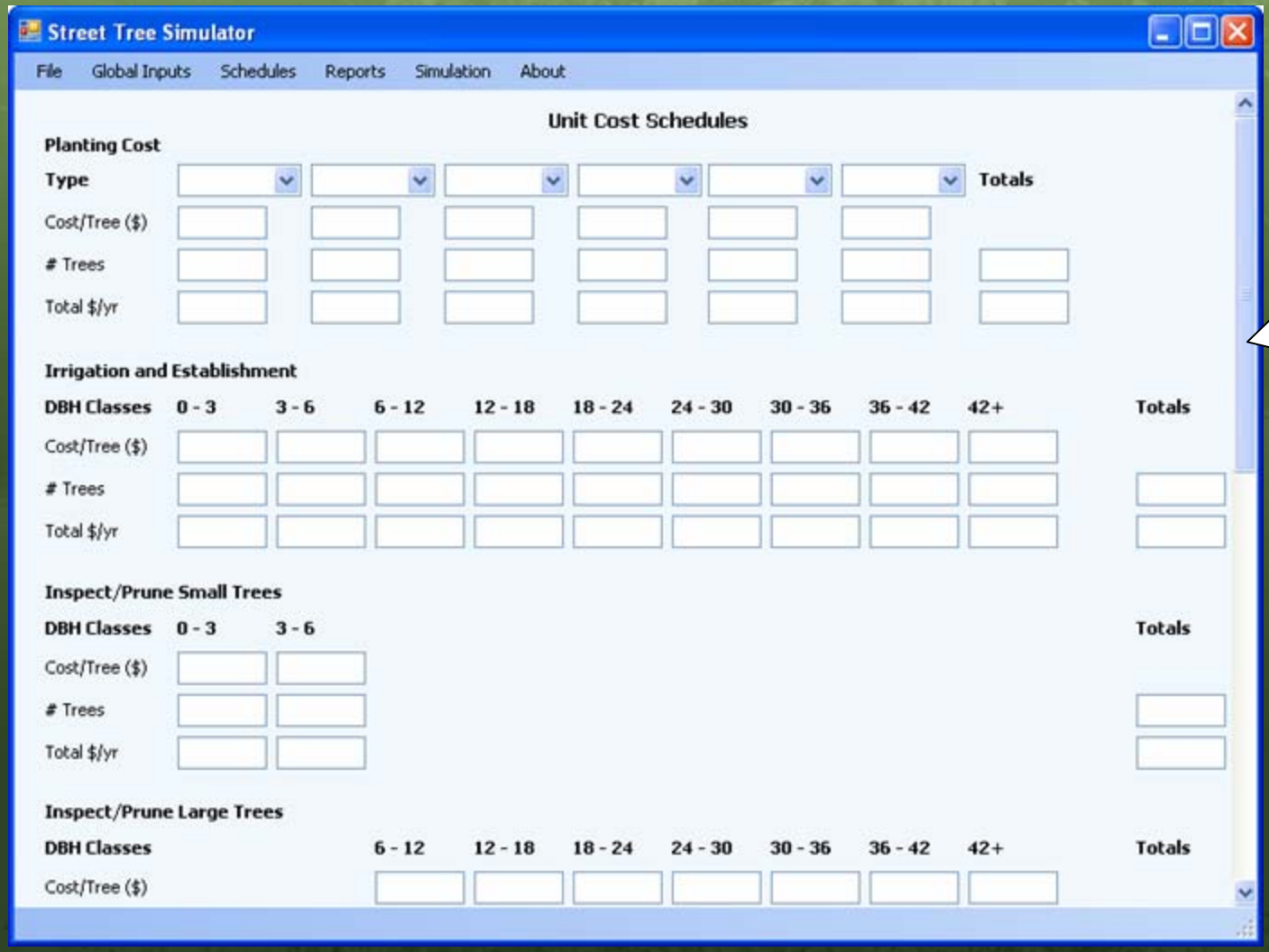
Adjust DBH Values



Adjust Default LOS

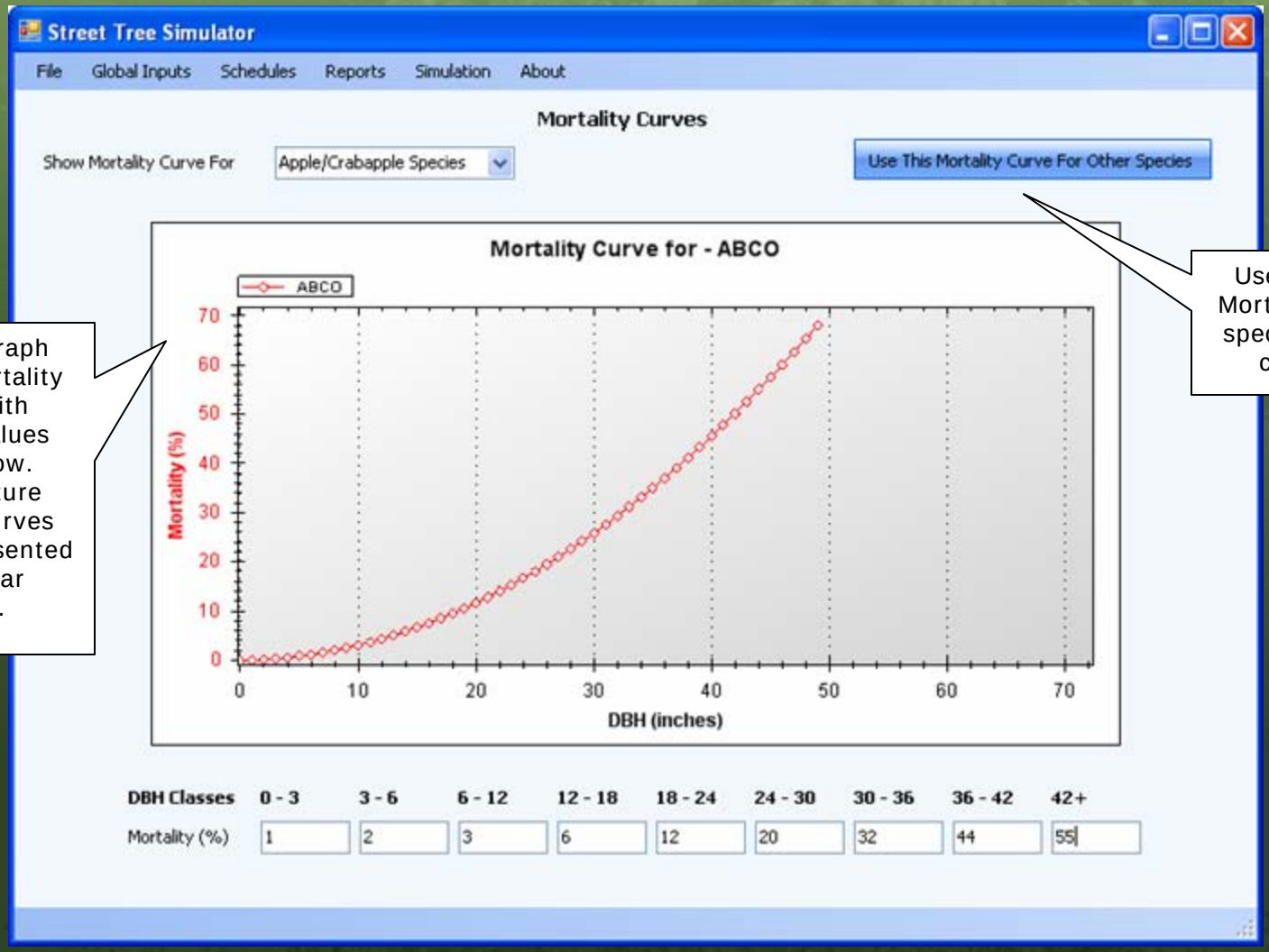


Unit Cost Schedules



All program areas included on scrollable (and resizable) window.

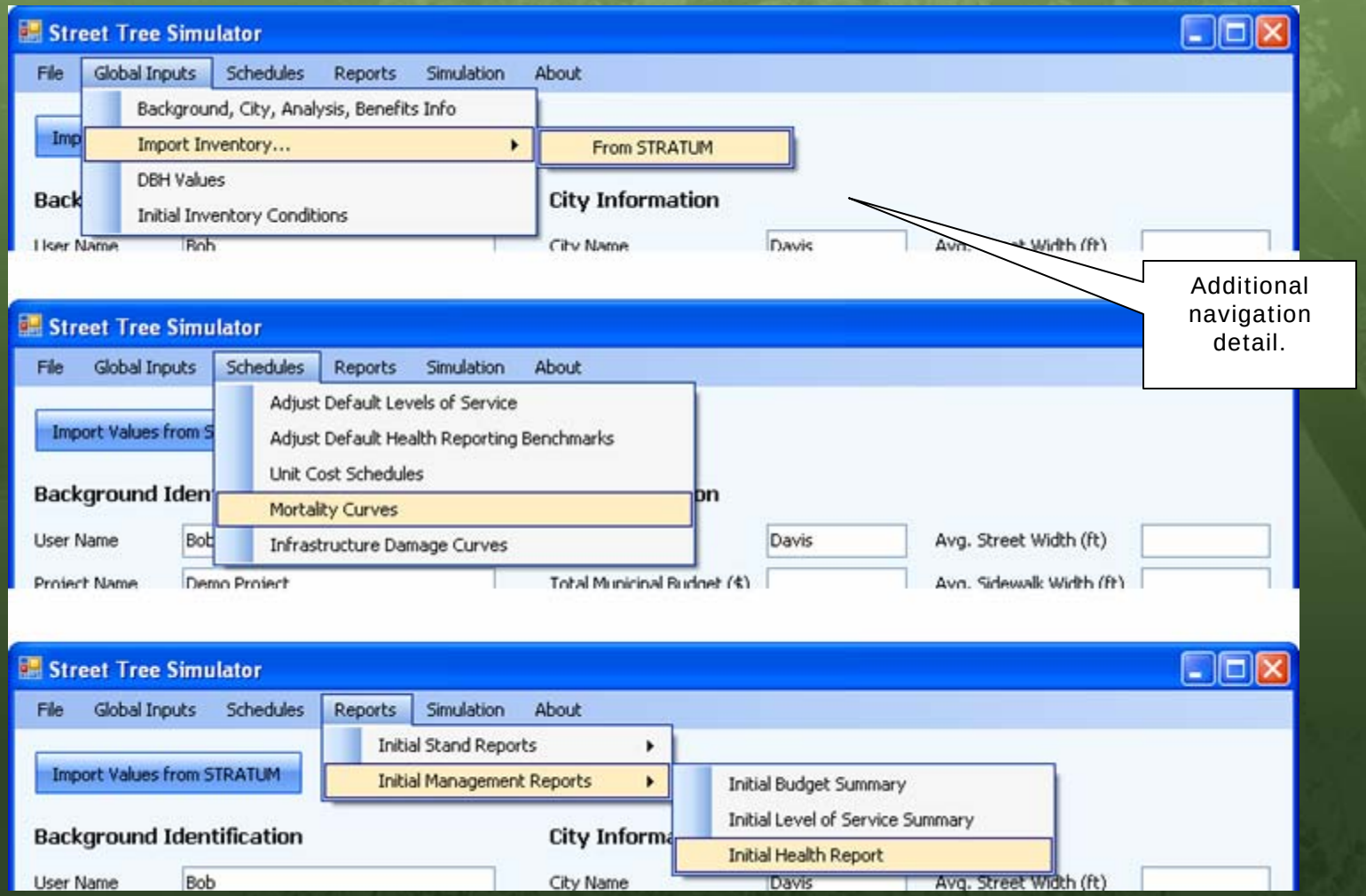
Mortality Curves



Dynamic graph displays Mortality Curves with numeric values listed below. Infrastructure Damage Curves will be represented in a similar fashion.

Users can adjust Mortality Curves by species or use one curve for all.

Navigation Detail



Los Angeles One Million Trees Initiative Canopy Cover Assessment

- Study Goals
  - Current tree canopy cover
  - Number and type of potential tree planting sites
  - Value of ecosystem services for 40 yrs
- Final Products
  - Report (results by city and council district)
  - GIS database

Remote Sensing and GIS Data

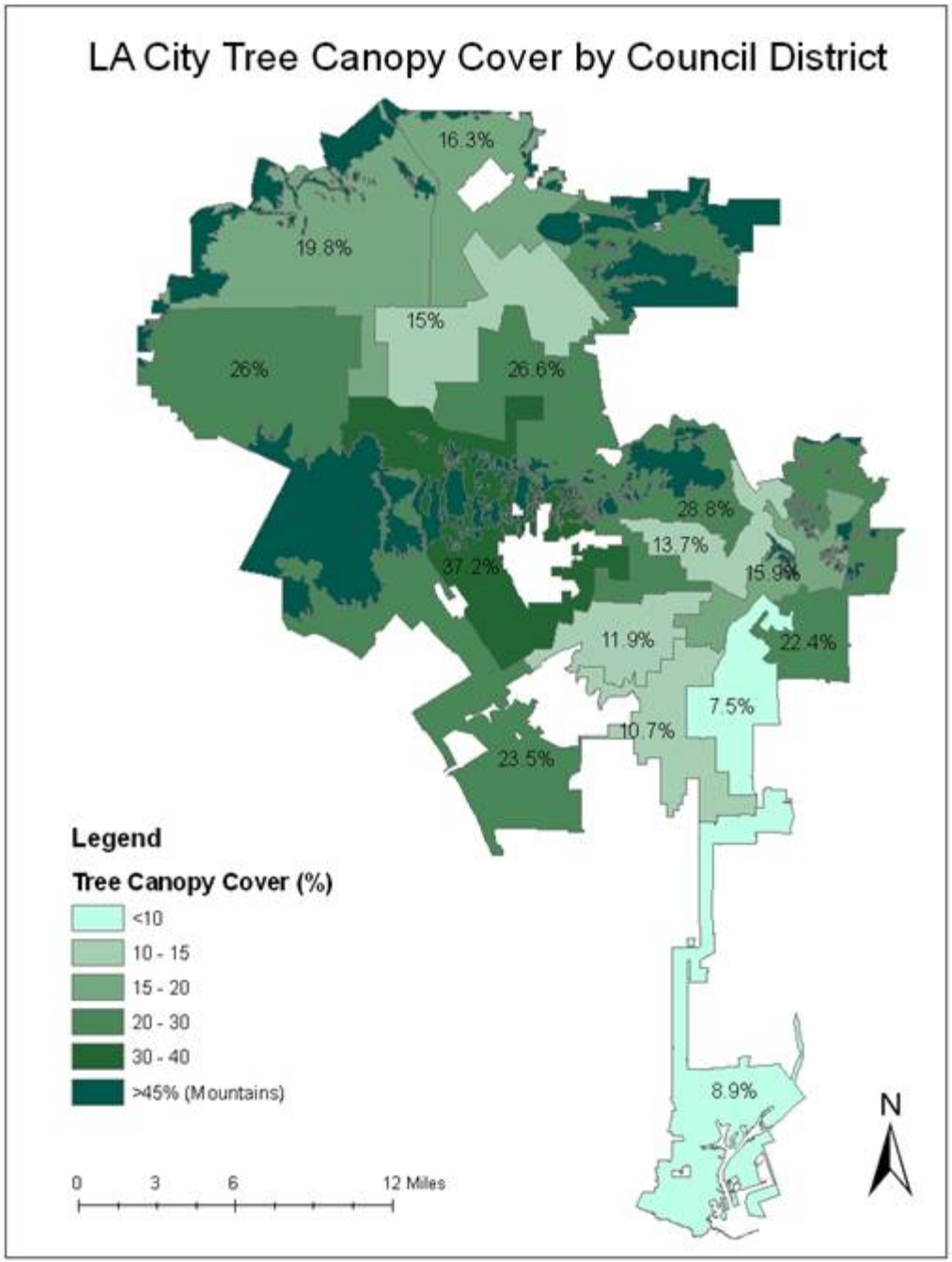
- QuickBird Imagery (2002-2005)
- Digital Aerial Imagery (2000 & 2006)
- Digital Land Use Maps
- Base Maps
  - Council districts & Neighborhoods
  - Census data
  - Highways, major streets

Method for Existing Canopy

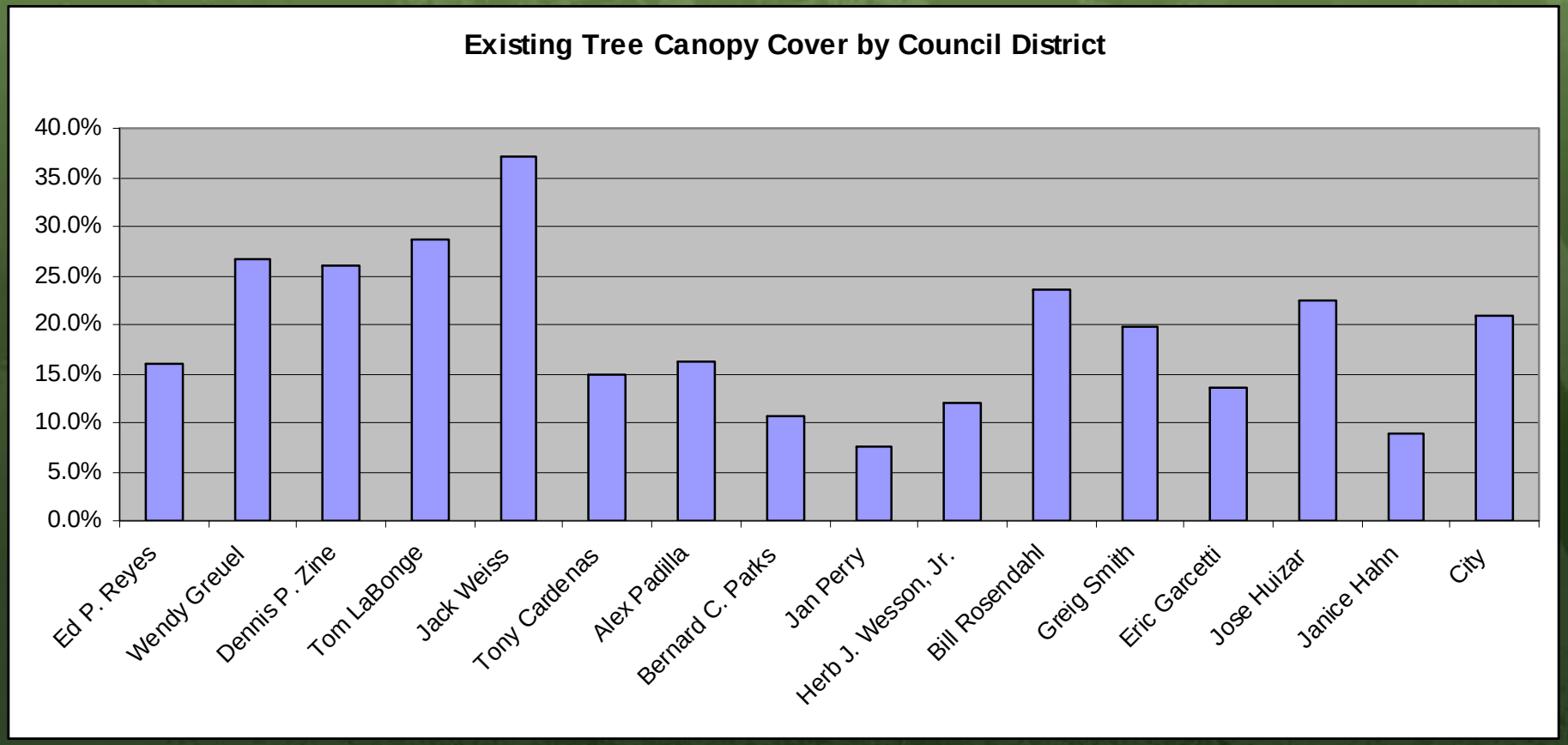
- Masking
  - Mountains
- Classification
  - Non-vegetation (paving, buildings, rock, water)
  - Vegetation
    - Tree/shrub
    - Irrigated turf
    - Un-irrigated grass/herbs
- Accuracy Assessment (9% overestimate)

Results – Existing Canopy

- –21%
- –10.7 million trees
- – 8%-37%



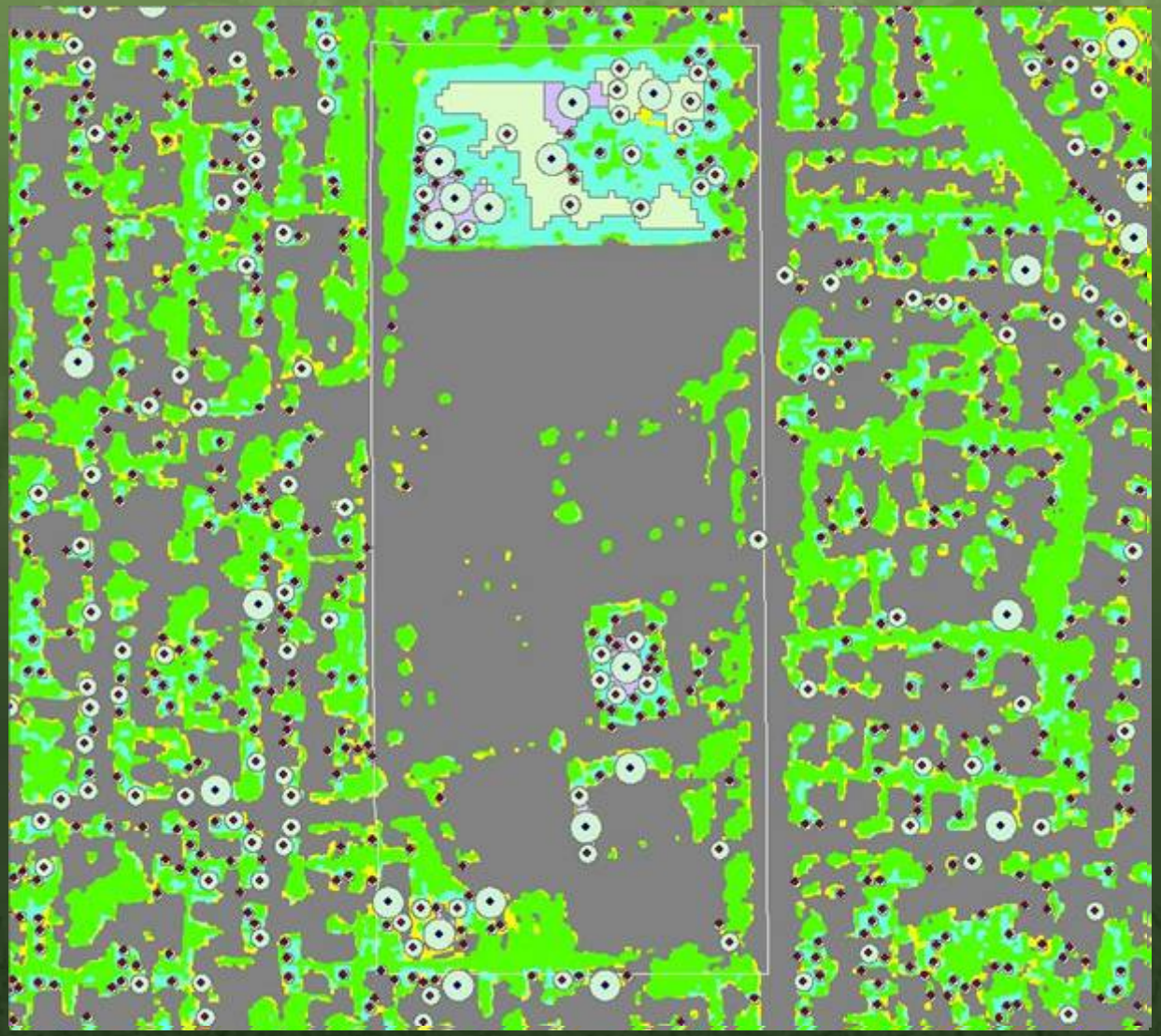
Results – Existing Canopy



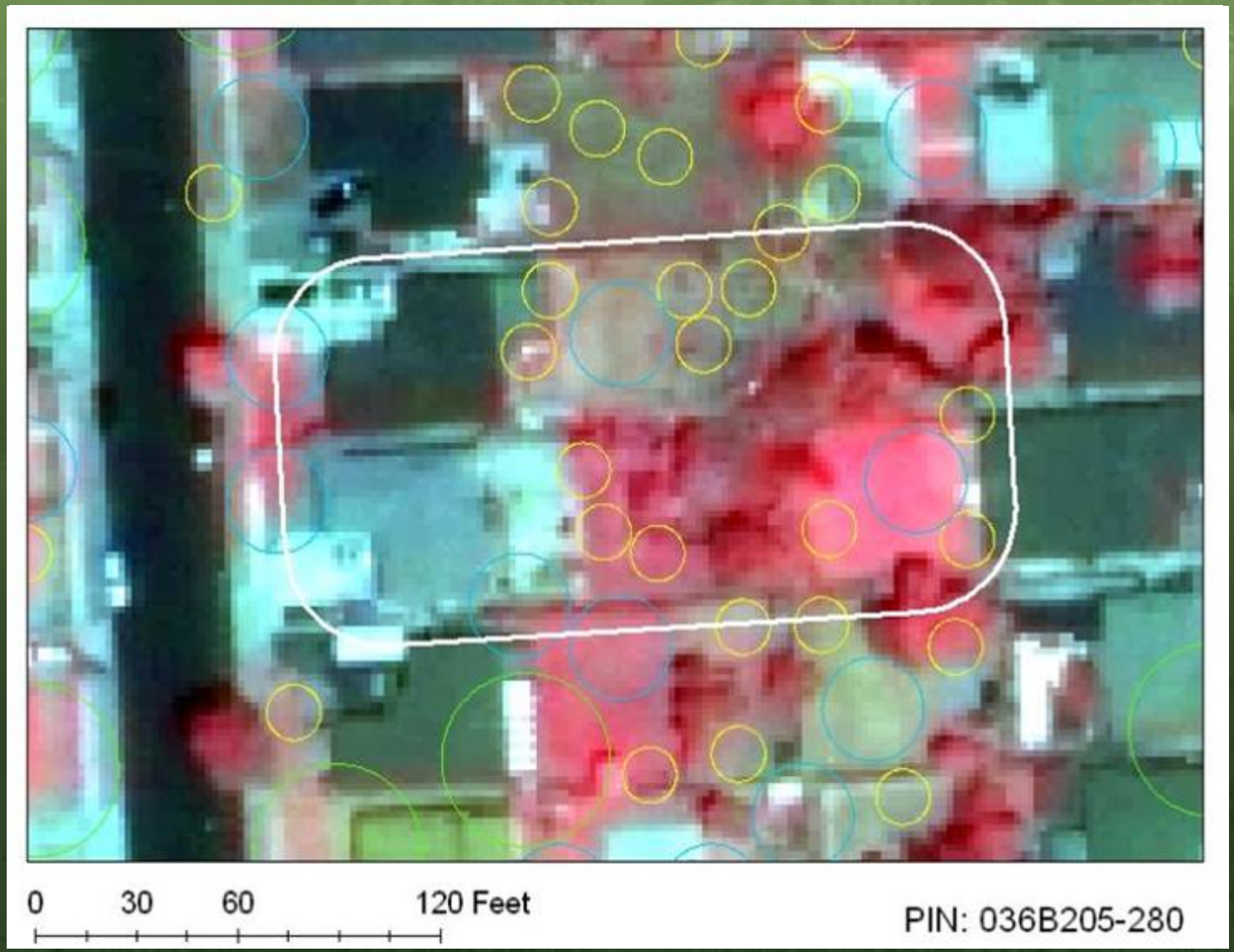
Method for Potential TCC

- Potential Tree Canopy Cover
  - Grass area without tree canopy
  - Tree trunk 2-ft min from paving & building
  - Tree crowns don't overlap
  - Largest stature trees first
  - Reiterate for each tree type
- Mature Tree Crown Diameters
  - 50 ft, 30 ft, 15 ft
- Large Parking Lots (Ind, Comm, Institutional)
  - Sample % area paved in each Council District by Land Use
  - Assume 25% TCC for Industrial (30' Crown Diameter)
  - Assume 50% TCC for Others
- Accuracy Assessment
  - 50 sample plots
  - Ground Truthing

Method for Potential TCC

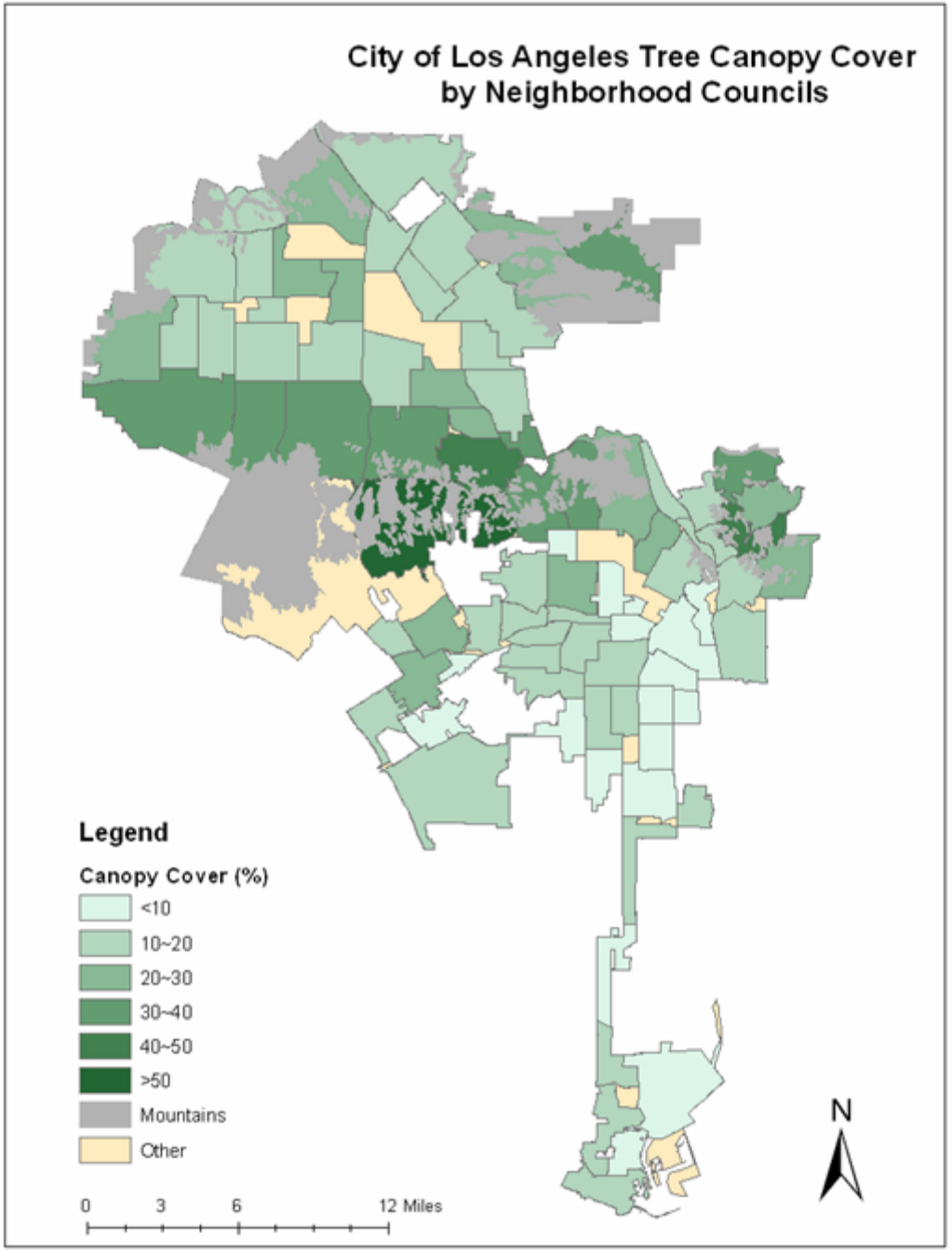


Ground-Truthing

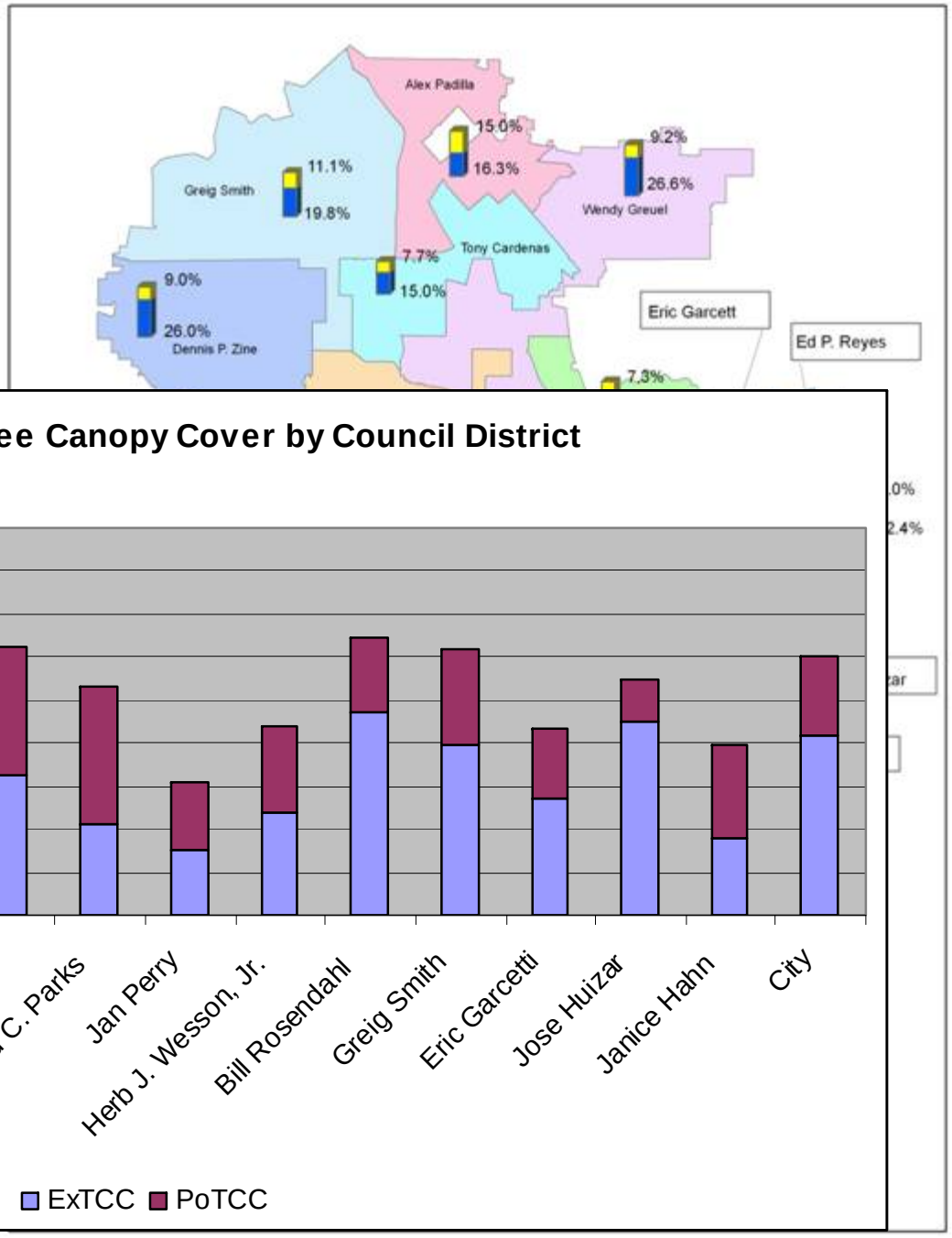


Results – Potential Canopy

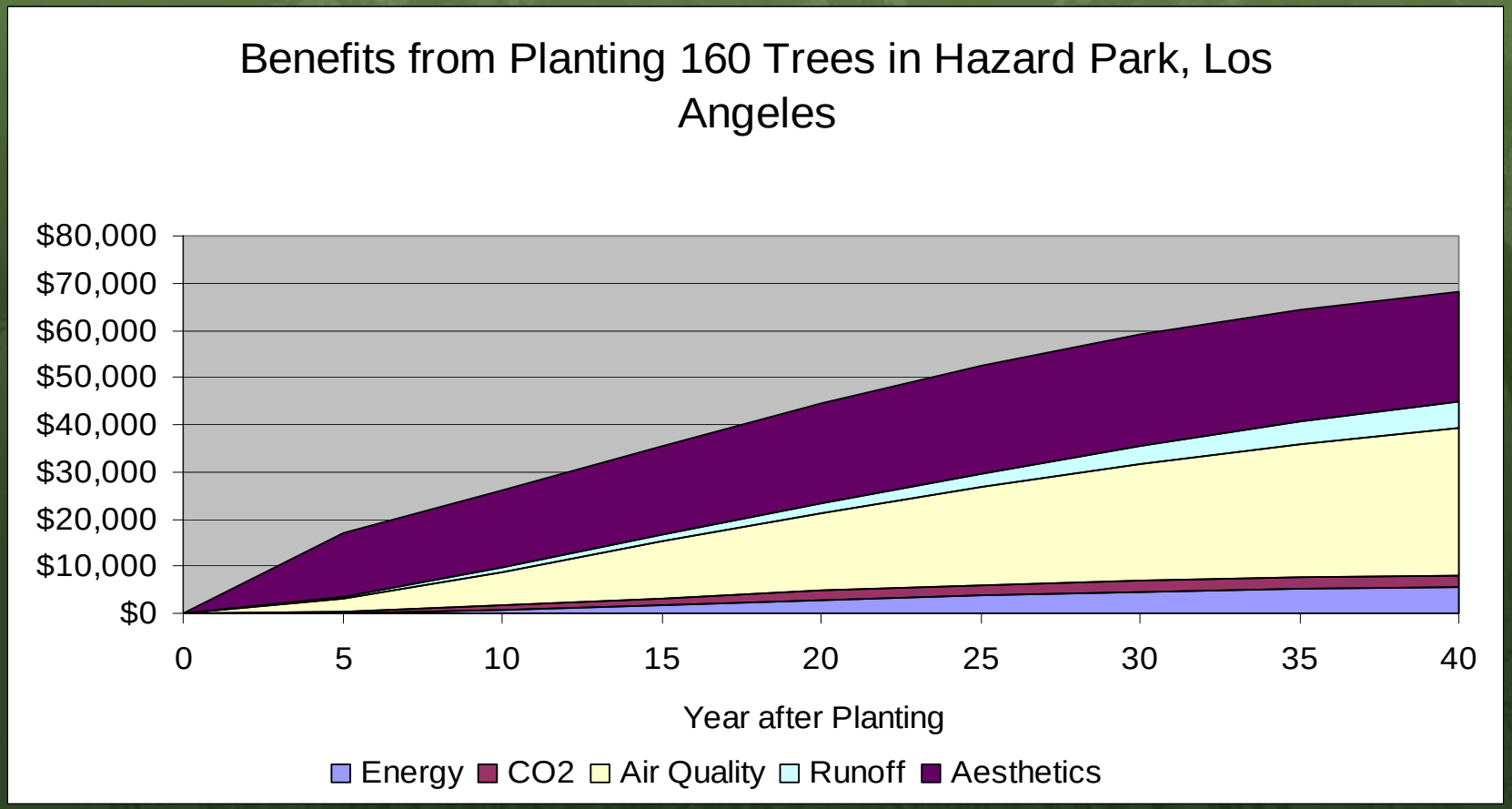
- 9.2% Citywide
  - 23,244 ac
- 2.7 million trees
  - 73% small
  - 20% medium
  - 7% large



Results – Potential TCC



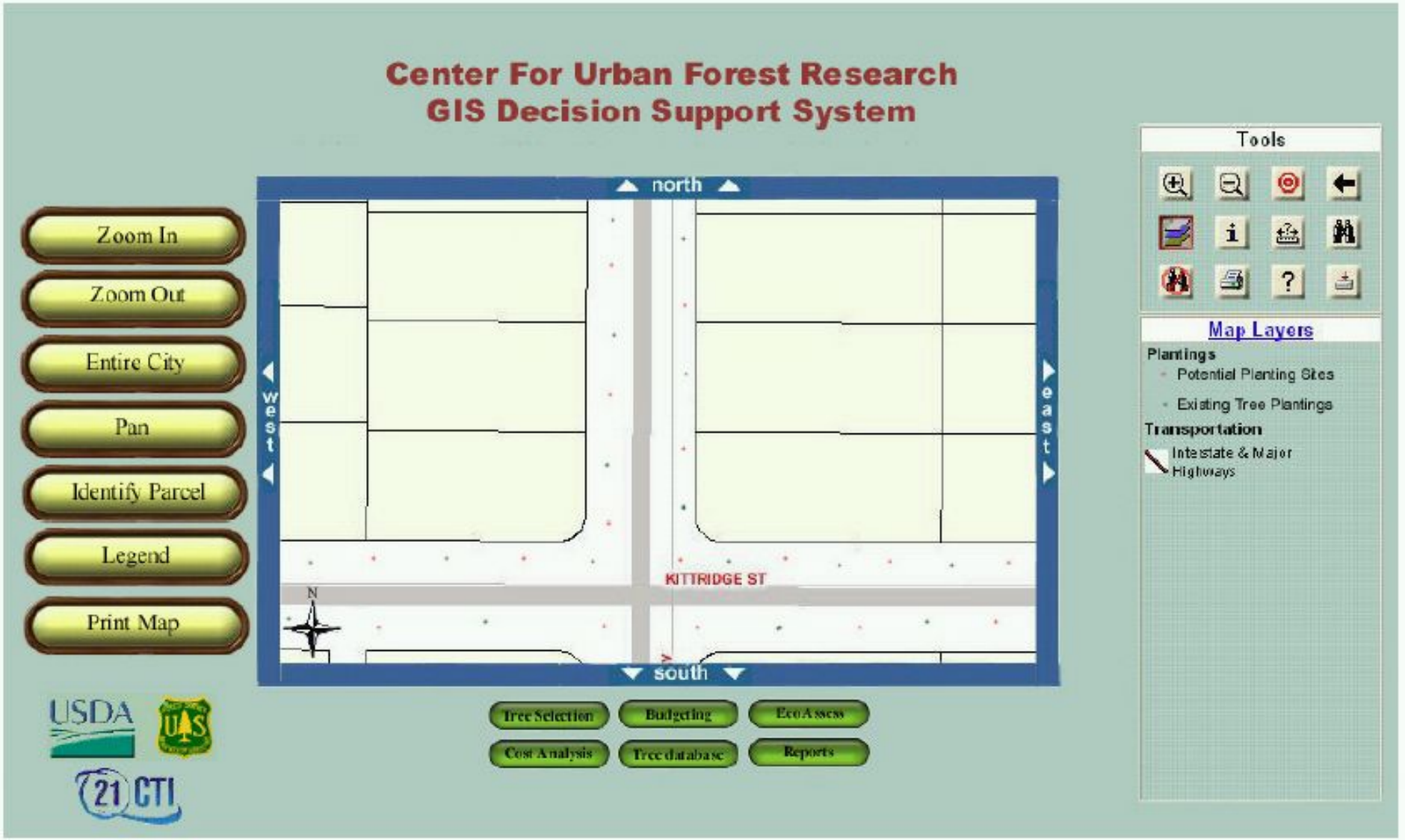
Project Future Benefits



GIS Decision Support System

Conceptual Image of GDSS Main Screen

GIS Decision Support System



Conceptual Image of GDSS Parcel Screen

Questions?