Urban Forests and Climate Change: Another Reason to Hug a Tree

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Desert Horticulture Conference
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Center for Urban Forest Research
Demonstrate new ways that trees add value - quality of life - to communities.

Convert research results into financial terms to stimulate community investment in trees.
Today

• Urban Forests & Climate Change
• Urban Forest Protocol
• Tree Carbon Calculator
• Pilot Project
Approximately 50% of the rise in near surface air temperatures since the 1960s is attributable to land use change.
Urban Heat Islands

- Physical form
- Materials
- Urban activities
Impacts

- Energy
- Air Quality
- Health
- Water
- Tree Species & Health
Mitigating NYC’s Heat Island

“Street trees... have the largest cooling potential per unit area...”
Carbon Storage

- Vary by species
- Vary by region
  - Mature size
  - Growth rate
- Sequestered/yr
  - 50 to 200 lb
Energy Conservation
Reduced GHG Emissions

- Climate
- Building
- Utility
- Tree
- Reduced/yr
  - 0 to 300 lb
Other GHG Benefits

- Fuel for biopower
- Wood products
- Biomass/yr
  - 25 to 100 lb
Emissions from Tree Care

- Vehicles
- Equipment
  - Aerial lift
  - Chipper
  - Chain saw
- Emissions/yr
  - 10 to 50 lb
50 Million Trees in California

- You’re wrong, and I’ll prove it
- You’re right, but doesn’t matter
- You’re right, but too late
You’re Wrong, No Room

- 177 million trees
- 5 trees per capita
- 242 million empty sites
- 120 million plantable
Future Growth

• 48 million people 2030
  – 50 million more trees

• 50% of built environment we will see in 2025 did not exist in 2000 (Nelson, 2005)

• New template
  – Only 25% with children
  – Compact
You’re Right, But No Effect

- 50 million trees, 15 yr
- 6,400 GWh/yr, $485M
- Reduced emissions 1.8 Mt/yr
- Sequester 4.5 Mt/yr
- Total 6.3 Mt/yr
- 4% of CAT target
You’re Right, But Too Late
Urban Forest Protocol: Worldwide Interest

- Over 4,000 visits to the Urban Forests & Climate Change Website
- Over 2,300 CUFR Tree Carbon Calculator downloads
What’s a Carbon Offset?

• Sequesters Carbon Reduction Ton (CRT)
  – 1 metric ton (t) (2,205 lb)
  – Compensates for emissions
  – Real and verifiable

• Purchased via Registries to:
  – Offset emissions, carbon neutral
  – Fulfill corporate targets
  – Gain experience
  – Enhance branding
Why an Urban Forest Protocol?

- Reduce Risk & Increase Value
  - Rigorous Standards
  - Independent Verification
- Registered & Tracked
- Credibility for Offsets
What is the Protocol?
Guiding Principles

• Best available science
  • Biomass formulas
  • Energy conservation

• Simple reporting process

• Scope
  • Mandatory: carbon stored and emitted
  • Optional: energy, bioenergy, wood products
Am I an Eligible Project Developer?

• Eligibility
  • Utilities
  • Municipalities
  • Educational Campuses
  • 1,000 tree sites (trees 5-m apart)

• Ownership
  • Demonstrate clear and defensible rights to ownership - contract
Can I Meet the Baseline Performance Standard?

- **Utilities**: Additional if not a power line replacement
- **Others**: must maintain stable population of existing trees
  - Net tree gain (NTG, avg. 1 tree planted for 1 tree removed)
- **Exceed Mandatory Planting Requirements**
Where Will My Tree Sites be Located?

- Tree/site longevity - 100 year reporting
- Efficient maintenance and monitoring
- How minimize risk of tree loss?
  - Site selection
  - Species selection
  - Planting and stewardship practices
Can I Shift Funds from Existing Tree Care to Project Tree Care?

• No, must maintain existing tree program!
• 10% decrease in funding by program area
How Much Reporting?

- Initial Submittal Form
  - Summarize the project
    - Eligibility, Activity, TMP, Monitoring
  - Boundaries and Eligibility
  - Risk of Reversals
  - Co-benefits and Negative Impacts
  - Tree Maintenance Plan
  - Tree Monitoring Plan

- Annual Reporting Online
  - Compliance w/ TMP
  - Quantify CRTs
What Monitoring is Required?

- Monitoring
  - Full inventory every 10 yrs
- Tree Maintenance Plan
  - Annual expenditures & levels of service
  - Planting
  - Young tree care
  - Mature tree care
  - Tree removal
  - Admin/other
How Will I Quantify Carbon?

• CRT = Cproj – Cemis
  – Tree measurements
  – Carbon storage equations
  – CUFR Tree Carbon Calculator
  – Amount and type of fuel
    • Vehicles
    • Equipment
Will This Pay? Santa Monica

• Value of Carbon Offset
  – Now $5-10/t
  – 2020 = $50-60/t

• 1,000 trees, offset emissions, 100 yr

• Costs - $3,175/site, $3,175,000
  – Plant: $600/site
  – Remove/replace: $150/site
  – Other: $2,425/site

• Benefits – 15,000 t, 1,500 t/site
  – Reductions: 16,000 t
    • 330 lb (0.15 t) /site/yr
    • No wood utilization
  – Emissions: 1,000 t

• $3,175,000/15,000 t = $212/t
Will This Pay? STF

- 533 t/yr, offset fleet of 63, 5 yr contract
- Benefits – 533 t (40 yrs)
  - 254 lb/site/yr (0.12 t)
  - 4.6 t/site 40 yrs = 116 sites/yr
- Costs - $86/site for 5 yrs, $9,965
  - Plant: $50/site
  - Remove/replace: $10/site
  - Other: $26/site
- $9,965/533 t = $18.70/t
How Do I Play?

• Utilities – shade tree programs
• Cities – projects in parks, buffers, streets, new development
• Campuses – integrate w/ sustainability
• Non-profits – partner w/ cities & utilities
AIR HERE IS FREE
The Least You Can Do Is Roll The Damn Hose.
- Excel workbook -
  [http://www.fs.fed.us/ccrc/topics/urban-forests/ctcc/](http://www.fs.fed.us/ccrc/topics/urban-forests/ctcc/)

- Calculates
  - Annual carbon sequestration and total carbon storage
  - Effect of tree shade on residential heating and cooling energy use and GHG emissions
  - Aboveground biomass for estimating other GHG benefits

- Single tree calculator
**Entering project data**

![Excel Sheet for CUFR Tree Carbon Calculator](image)

**Figure 1**

<table>
<thead>
<tr>
<th>Data name</th>
<th>Data entry</th>
<th>Units</th>
<th>Description</th>
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<tbody>
<tr>
<td>Flag1</td>
<td>0</td>
<td></td>
<td>Tree age selected</td>
</tr>
<tr>
<td>Flag2</td>
<td>1</td>
<td></td>
<td>Shade &amp; climate selected</td>
</tr>
<tr>
<td>Climate Zone</td>
<td>2</td>
<td></td>
<td>South Coast</td>
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<tr>
<td>Electricity CO2 emissions factors</td>
<td>483</td>
<td>(kg/MWh)</td>
<td></td>
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<tr>
<td>Electricity CH4 emissions factors</td>
<td>0.0030</td>
<td>(kg/MWh)</td>
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<tr>
<td>Electricity N2O emissions factors</td>
<td>0.0017</td>
<td>(kg/MWh)</td>
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</tr>
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</table>

$ required for energy project
## Results

### Figures 7-10

#### Carbon Calculator Results (annual)

<table>
<thead>
<tr>
<th>Energy reductions</th>
<th>Emission reductions (CO₂ equivalents)</th>
<th>CO₂ Sequestration</th>
<th>Total CO₂ Stored</th>
<th>Above ground biomass</th>
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<tbody>
<tr>
<td></td>
<td>Cooling kWh/tree</td>
<td>Heating MBtu/tree</td>
<td>(kg/tree)</td>
<td>(kg/tree)</td>
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<tr>
<td>140.10</td>
<td>67.7</td>
<td>11.7</td>
<td>120.7</td>
<td>3560.2</td>
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<td></td>
<td>Heating MBtu/tree</td>
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</tr>
<tr>
<td>0.219</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>kW/h/tree</td>
<td>Cooling kWh/tree</td>
<td>Heating MBtu/tree</td>
<td>(kg/tree)</td>
<td>(kg/tree)</td>
</tr>
<tr>
<td>140.10</td>
<td>149.4</td>
<td>25.7</td>
<td>266.1</td>
<td>7,848.9</td>
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<tr>
<td></td>
<td>Heating MBtu/tree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.231</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(A value of 0.0 indicates no tree growth)
Results

Large tree – West, 20-40ft

Stored CO2 and Emissions Reductions for Large Tree (Camphor Tree)
Starting a GHG Tree Project: Santa Monica’s Pilot Project
Santa Monica’s Rationale for a GHG Tree Project

- Sustainable cities goals
- Adds another element to emissions inventory
- Offset corporate emissions
- Quantify value of the urban forest
- Raise public awareness
Baseline Performance Standard

✓ Existing Trees:
  Maintain stable population & Net tree gain (NTG)

<table>
<thead>
<tr>
<th>Year</th>
<th>1987</th>
<th>1997</th>
<th>2007</th>
<th>Current</th>
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</thead>
<tbody>
<tr>
<td>Trees</td>
<td>26,767</td>
<td>28,907</td>
<td>33,556</td>
<td>33,816</td>
</tr>
</tbody>
</table>
GHG Project Tree Locations

- Open-growing trees
  - Parks
  - Residential streets
  - Public landscapes (schools, gov’t bldgs)

- Tree/site longevity - 100 year reporting
  - Identify, characterize and prioritize sites
Identifying GHG sites
Permanence and Tree Site Location

- What is the disturbance potential?
- Relative need for tree canopy?
Evaluate “Public Control” of Sites

• Control by Agency Policy
  • Most control = parks, residential areas
  • Moderate control = public landscapes
  • Least control = business districts
• Sites can be affected by various projects
Site Disturbance Potential

- Lowest = residential or parks
Site Disturbance Potential

- Lowest = residential or parks
- Moderate = main streets or medians
Site Disturbance Potential

- Lowest = residential or parks
- Moderate = main streets or medians
- Highest = business districts
Prioritizing Sites

• Longevity of the sites
• Relative need for tree canopy
  • Highest = areas with minimal canopy
Prioritizing Sites

- Relative need for the canopy
  - Highest = areas with minimal canopy
  - Moderate = intermediate canopy
Prioritizing Sites

• Relative need for the canopy
  • Highest = areas with minimal canopy
  • Moderate = intermediate canopy
  • Lowest = good canopy cover
Prioritizing Species

- Start with results of Benefit-Cost Analysis
  - Use proven performers:
    - Cedar (*Cedrus deodara*)
    - Ficus (*Ficus microcarpa*)
    - Canary Island Pine (*Pinus canariensis*)
  - Evaluate new species
- Carbon: largest canopy for the site, long-lived
- Form consistent with existing species
- Evergreens for rainfall interception
Stewardship of GHG Sites
Tree Maintenance & Monitoring Plan

- Establishment (3 yr)
  - 1 crew
  - Water twice/wk (CNG truck)
  - Record daily vehicle mileage
  - Measure once/yr

- Post-Establishment
  - Incorporate into 2-8 yr cycle
  - Record daily fuel use
  - Measure during inspection/prune
Co-Benefits

Cumulative Co-Benefits for Large Tree (Camphor Tree)

Year After Planting

Benefit ($)
Benefit-Cost Analysis

- $6.6M total benefit
- $3.2M cost
- BCR = 2.1:1
Protocol to Practical: High-Performing Urban Forests

- Planning
- Strategic Location
- Tree Selection
- Quality Stock
- Planting
- Maintenance
- Monitoring
- Annual Reporting
What’s Next?

• Obstacles
  – Costs and Risk
  – Lack of Awareness

• Opportunities
  – High-performing urban forests
  – New tools and business models

Shade Trees: Estimated Benefits

<table>
<thead>
<tr>
<th>Climate Area:</th>
<th>Dallas-Fort Worth, Texas</th>
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<tbody>
<tr>
<td>Heating Degree Days (HDD):</td>
<td>7,580</td>
</tr>
<tr>
<td>Cooling Degree Days (CDD):</td>
<td>2754</td>
</tr>
<tr>
<td>Lethal Insect/Bacterial Issues (LIS):</td>
<td>70</td>
</tr>
<tr>
<td>Tree - Common Name:</td>
<td>American Elm</td>
</tr>
<tr>
<td>Tree - Botanical Name:</td>
<td>Ulmus Americana</td>
</tr>
<tr>
<td>Tree Size:</td>
<td>Large</td>
</tr>
<tr>
<td>Tree Type:</td>
<td>Deciduous</td>
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<tr>
<td>Tree Age:</td>
<td>30</td>
</tr>
<tr>
<td>Trees:</td>
<td>2</td>
</tr>
<tr>
<td>Number of Trees:</td>
<td>1</td>
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<tr>
<td>Tree Orientation:</td>
<td>NW</td>
</tr>
<tr>
<td>Distance from the house:</td>
<td>10 ft</td>
</tr>
<tr>
<td>Summer Rate:</td>
<td>5.1</td>
</tr>
<tr>
<td>Winter Rate:</td>
<td>1.1</td>
</tr>
<tr>
<td>Benefits from Existing Tree:</td>
<td>$134</td>
</tr>
<tr>
<td>Benefits from Existing Tree of 8.0 GBH (incorporates tree age and tree growth rate):</td>
<td>$29</td>
</tr>
<tr>
<td>Benefits from Program Tree (trees planted by utilities) - utility perspective (incorporates tree growth rate and assumed tree mortality rate):</td>
<td>$20</td>
</tr>
</tbody>
</table>

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Eric Petersen / The Livingston Enterprise
Closing
Questions?

www.fs.fed.us/psw/programs/cufr