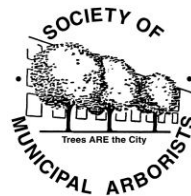




# Urban Trees & Carbon

## Measuring & Managing the Urban Forest For Carbon

43<sup>rd</sup> Annual Society of Municipal Arborists  
Conference & Trade Show  
Hollywood, Florida  
September 15-19, 2007



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Urban Forestry South  
Athens, Georgia

September 19, 2007



*(1) urban  
forests have the  
capacity to both  
sequester and emit  
carbon dioxide*





*(2) urban forests  
provide many other  
ecosystem services  
(net benefits)*





*(3) direct  
and indirect costs  
are associated  
with all levels of  
urban forest  
management*





*(4) carbon  
sequestration and  
urban forest  
management can be  
complementary*





# Urban Trees & Carbon

- Definitions
- Carbon & Carbon Storage
  - How & where
- Urban Forest Benefits
  - A package of benefits
- Measurements
  - UFORE & Tools
  - STRATUM & Tools
- Growing trees for carbon ?
  - Management Issues
  - Carbon market synergy





# Definitions for Carbon Growers

Carbon pool (stock, reservoirs, sinks): - A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass. Oceans and soil are other large pools of carbon.

Sequestration: -The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of CO<sub>2</sub> from the atmosphere through land-use changes and changes in forest management.



# Definitions for Carbon Growers

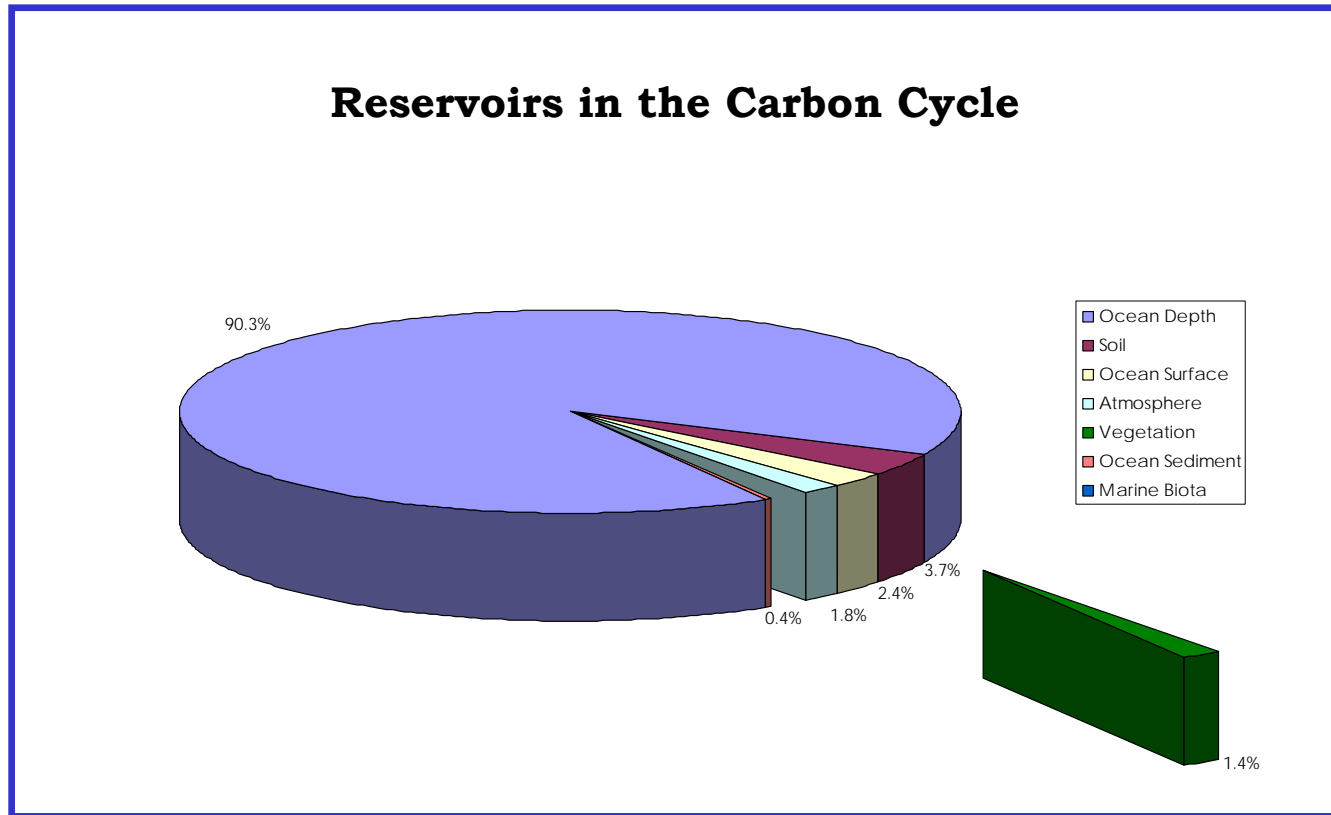
Greenhouse Gases: (GHG) For the purposes of the [CA] Registry, GHGs are the six gases identified in the Kyoto Protocol: Carbon Dioxide (CO<sub>2</sub>), Nitrous Oxide(N<sub>2</sub>O), Methane(CH<sub>4</sub>), Hydroflourocarbons (HFCs), Perflourocarbons (PFCs), and Sulphur Hexafluoride(SF<sub>6</sub>).

Emissions: Greenhouse gas emissions from sources that are owned or controlled by the reporting entity.

- Direct
- Biological



# Carbon: The Big Picture





# Carbon & Carbon Storage

- Trees, Photosynthesis & Carbon
  - $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} + \text{sunlight} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$
  - 1 kg of tree = 0.45 kg of C
  - 1 kg of tree = removes 1.65 kg of  $\text{CO}_2$
- Respiration & Decomposition
  - Storage process works in reverse, also!
- $\log_{10}M = -1.25 + 2.66 \log_{10}D$ 
  - D = diameter in cm
  - M = above ground biomass in kg
  - Then calculate below ground biomass (roots)



# UFORE, STRATUM & UF Carbon

- UFORE Calculations

- Program, output & tools
- Quantifies benefits (CO<sub>2</sub>)
- Individual Tree Calculators (XLS)

<http://www.fs.fed.us/ne/syracuse/Tools/tools.htm>

- STRATUM Calculations

- Program, output & tools
- B/C Model
- Tree Guides

<http://www.itreetools.org/>

# Piedmont: *Acer rubrum*

|                              | Year<br>10     | Year<br>20     | Year<br>30     | Year<br>40     |
|------------------------------|----------------|----------------|----------------|----------------|
| CO <sub>2</sub> lbs (Annual) | 94             | 247            | 469            | 740            |
| Carbon CCX (\$3)             | \$ 0.14        | \$ 0.37        | \$ 0.70        | \$ 1.11        |
| <b>Carbon EU (\$15)</b>      | <b>\$ 0.71</b> | <b>\$ 1.85</b> | <b>\$ 3.52</b> | <b>\$ 5.55</b> |
| Carbon <i>Future</i> (\$30)  | \$ 1.42        | \$ 3.70        | \$ 7.04        | \$ 11.10       |
| <b>Other Benefits</b>        | <b>\$ 35</b>   | <b>\$ 90</b>   | <b>\$ 150</b>  | <b>\$ 204</b>  |
| <b>Costs</b>                 | <b>\$ 16</b>   | <b>\$ 22</b>   | <b>\$ 27</b>   | <b>\$ 30</b>   |
| B/C Ratio                    | 2:1            | 4:1            | 6:1            | 7:1            |



# Management Issues & Carbon

- Which Urban Forest ?
  - Streets
  - Parks
  - Riparian
  - Other
  - Public vs. Private
- How to manage ?
  - Intensity
  - Palette of benefits vs. targeted benefit



# Management Issues & Carbon

- Management
  - Intensity of management
    - Soil management (+C)
    - Growth rate (+C)
    - Pruning/Removals (+C)
  - Equipment Operation
    - Optimization (CO<sub>2</sub>)
- Offsets, Sellers & Buyers



# Carbon & Management Decisions

- Record keeping requirements
  - Better data, better decisions
  - Can improve management
  - Lower operational cost ?
- More intense management
  - Tree health improves
  - Carbon sequestration increases
  - Efficiency (cost/lb decreases)



# Carbon & Management Decisions

- Inventory Standards
  - Shorter cycle
  - Continuous
- Soil Management
  - Tree health improves
  - Tree life cycle increases
  - Soil & tree carbon increases
  - Modest B/C increase





# Management & Community Decisions

- Overall Ecosystem Benefits
  - Manage for a package
  - Significant B/C increase
- Overall Society Benefits
  - US Mayors Climate Protection
  - Support worldwide climate initiatives

# Carbon Markets, Climate Change & Urban Forests

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