

Quantifying Urban Forest Project Costs and Offsets



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

Greg McPherson

Urban Ecosystems & Social Dynamics, Davis, CA
Carbon Offsets & the Urban Forest June 6, 2012



Today



Today

- Protocol issues
- Modeling example
- Protocol alternative



Protocol Issues

- 100 year permanence
- Unfavorable economics
 - Urban trees expensive
 - Transaction, monitoring, reporting costs
- Eligibility limited
 - NGOs, developers
 - Planting only
 - Fully-stocked (excludes canopy conservation)
 - Avoided conversion
 - NTG standard
- Lack of tools



Santa Monica's GHG Tree Project

Model Future Offset Revenues & Project Costs

- To what extent can urban forest projects recover their costs?
- Where are the leverage points?

Types of Project Costs

- Site preparation, tree, planting
- Young tree care: prune, water, stake
- Mature tree care: prune, pest, water
- Remove, dispose and replace
- Monitoring & reporting
- Transaction costs
 - Initial fees & verification
 - Annual account fee
 - Annual registration fee
 - Verification fee

Modeling Assumptions

- \$10 & \$25 per t CO₂
- 1,000 & 5,000 trees planted
- 75- & 20-yr rotations, 100 yrs
- Biomass eqs: Tree Carbon Calculator
- Growth curves: Santa Monica species
- Tree care emissions: 4.2 kg CO₂/yr/tree
- Energy effects: west tree, 30-ft, post-1980 construction, state EFs

Project Cost Assumptions

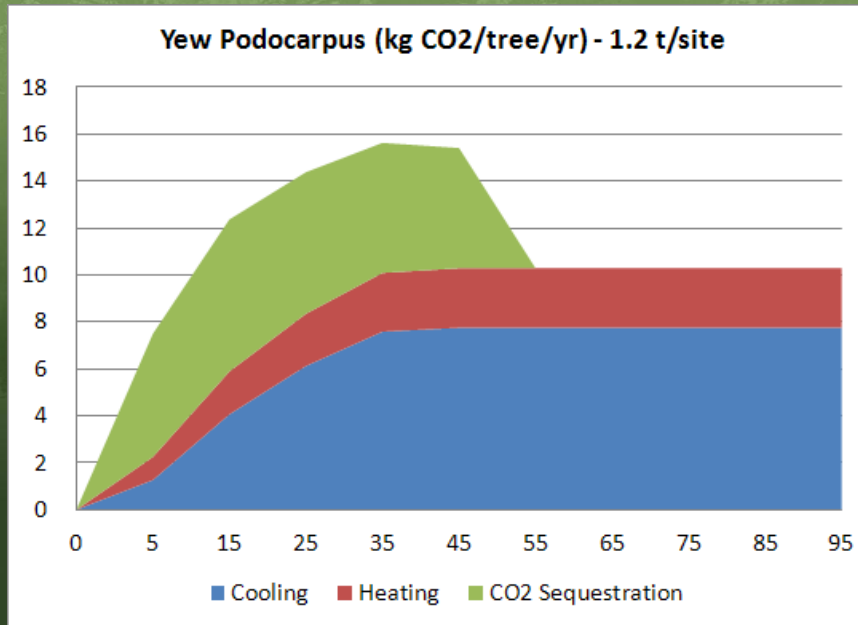
- Site Prep & Plant: \$95 per tree
- Young tree care: \$2.50/yr/tree (5-yr)
- Mature tree care: \$4 & \$6/yr/tree
- Remove: \$75 & \$175/tree
- Monitoring/reporting \$0.67/yr/tree
- Transaction Costs
 - Initial fees: \$8,000
 - Annual account fee: \$400
 - Annual registration fee: \$0.20/t
 - Verification fee: \$5,000

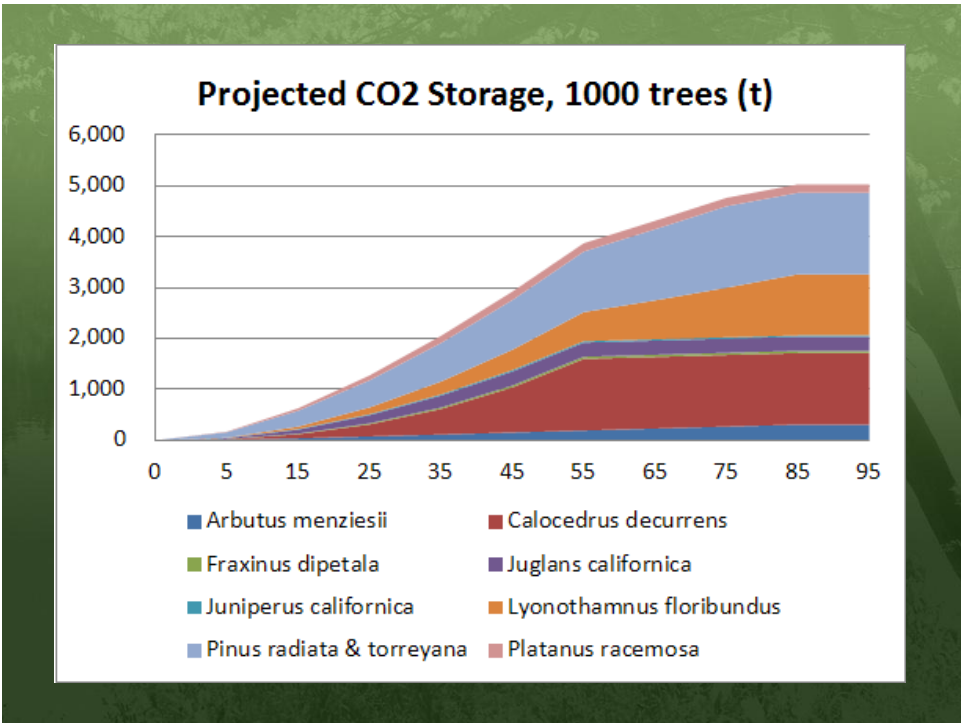
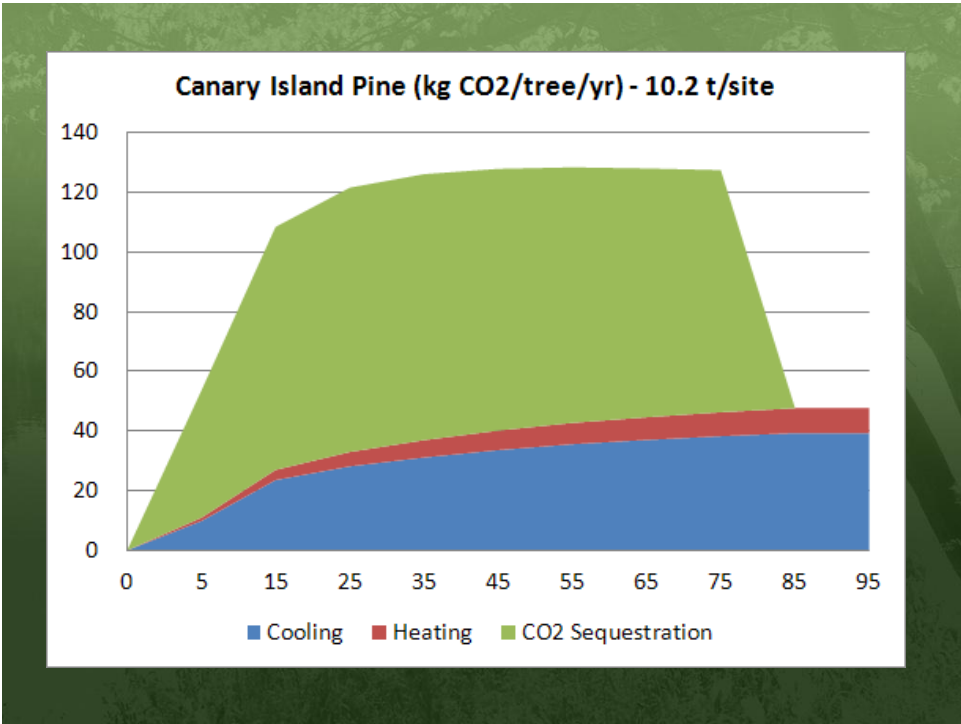
Investment Decision Points

- Offset revenues > transaction costs (TC)
- Offset revenues > TC + monitoring costs
- Offset revenues > TC + MC + planting
- Offset revenues > TC + MC + PC +
prune + remove + replace

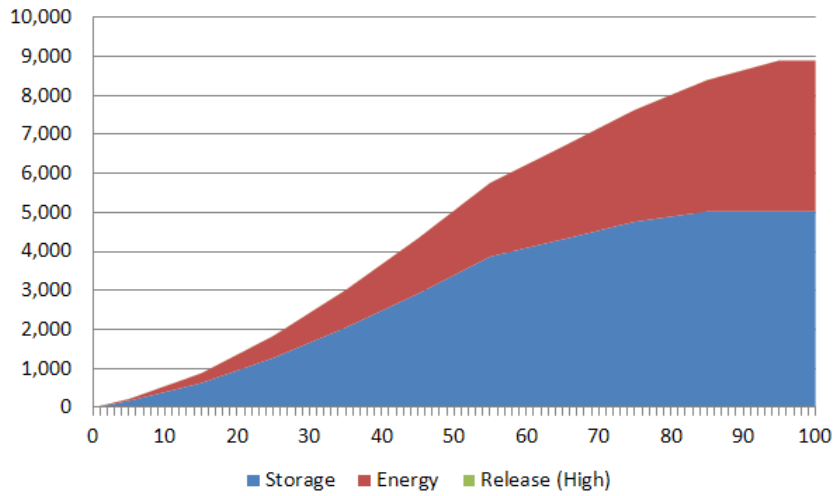
Planting List

Scientific Name	Life Form	Number	Modeled as	Life Form
<i>Arbutus menziesii</i>	BEM	80	<i>Metrosideros excelsus</i>	BEM
<i>Calocedrus decurrens</i>	CEL	155	<i>Cedrus deodara</i>	CEL
<i>Fraxinus dipetala</i>	BDM	55	<i>Liquidambar styraciflua</i>	BDS
<i>Juglans californica</i>	BDL	100	<i>Platanus hybrida</i>	BDL
<i>Juniperus californica</i>	CES	100	<i>Podocarpus macrophyllus</i>	CES
<i>Lyonothamnus floribundus</i>	BEM	200	<i>Melaleuca quinquenervia</i>	BEM
<i>Pinus radiata</i>	CEL	100	<i>Pinus canariensis</i>	CEL
<i>Pinus torreyana</i>	CEL	150	<i>Pinus canariensis</i>	CEL
<i>Platanus racemosa</i>	BDL	60	<i>Platanus hybrida</i>	BDL
Total		1,000		

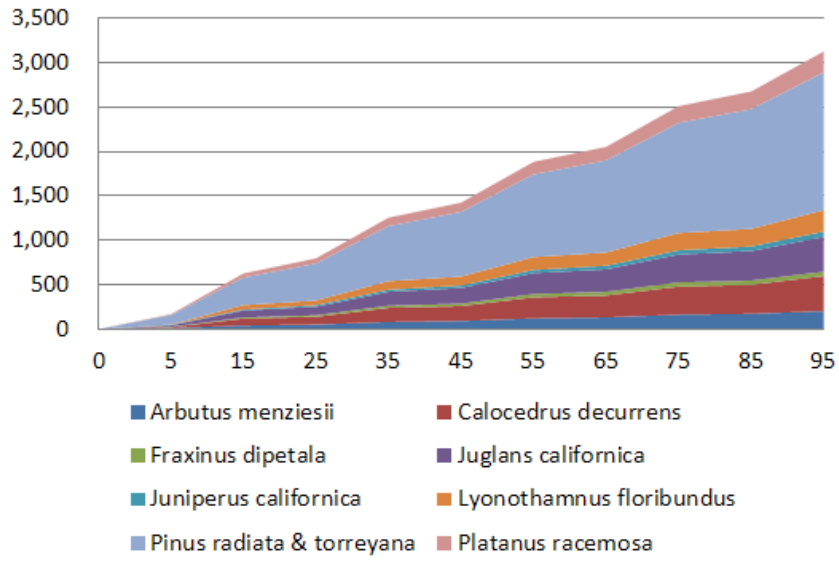


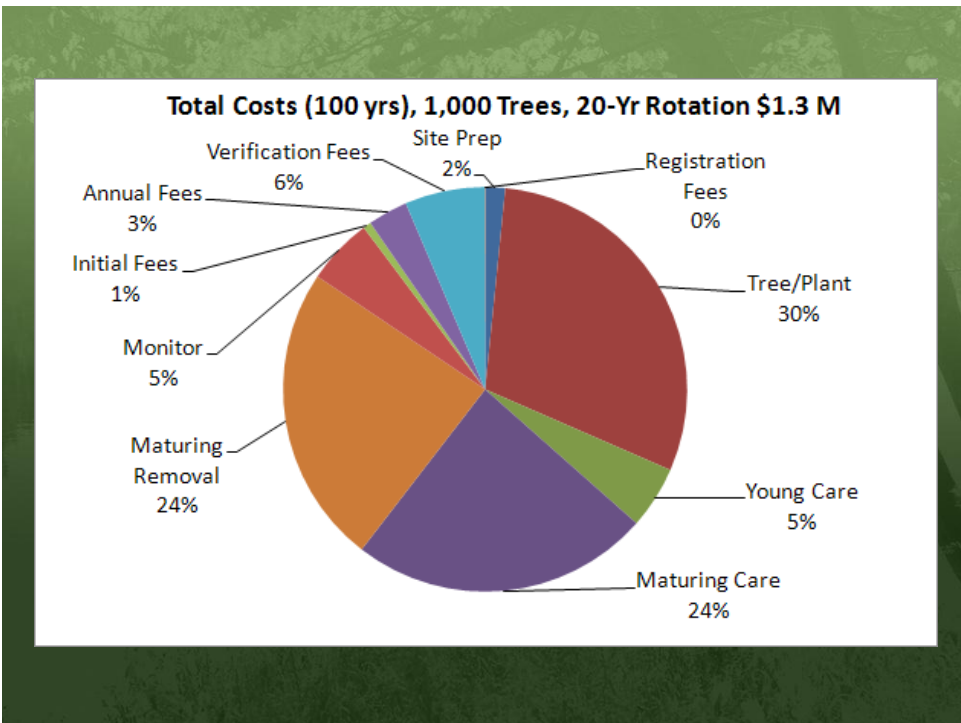
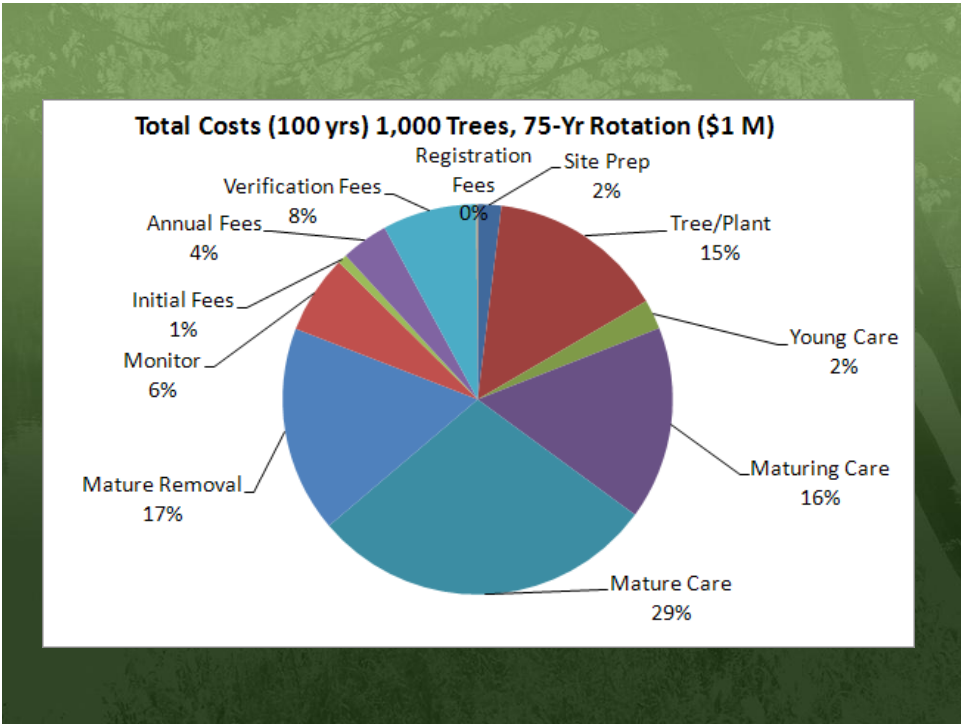


Projected CO2 (t) 1,000 Trees, 100-Yr Rotation



CO2 Storage (t), 1000 trees, 20-Yr Rotation





Total Offset Revenues & Project Costs (100 yrs)

Total Revenues	1000 trees	1000 trees	5000 trees	5000 trees
Current trees (5 t/site avg)	75-yr rot	20-yr rot	75-yr rot	20-yr rot
\$10	49,542	26,908	247,711	134,541
\$25	123,856	67,270	619,278	336,351
High seq (10 t/site avg)				
\$10	99,085	53,816	495,423	269,081
\$25	247,711	134,541	1,238,556	672,703
Total Project Costs	1,023,658	1,252,705	4,606,288	5,751,524



Offset revenues > transaction costs (TC)

Total Revenue - Costs	1000 trees	1000 trees	5000 trees	5000 trees
Current trees (5 t/site avg)	75-yr rot	20-yr rot	75-yr rot	20-yr rot
Offsets > TCs?				
\$10	-79,449	-101,630	114,757	3,850
\$25	-5,135	-61,268	486,324	205,660
High seq (10 t/site avg)				
\$10	-29,906	-74,722	362,468	138,390
\$25	118,720	6,002	1,105,602	542,012



Offset revenues > TC + monitoring costs

Total Revenue - Costs	1000 trees	1000 trees	5000 trees	5000 trees
Current trees (5 t/site avg)	75-yr rot	20-yr rot	75-yr rot	20-yr rot
Offsets > TCs+Monitor?				
\$10	-146,115	-168,297	-218,576	-329,484
\$25	-71,802	-127,935	152,991	-127,673
High seq (10 t/site avg)				
\$10	-96,573	-141,389	29,135	-194,943
\$25	52,054	-60,664	772,269	208,678



Offset revenues > TC + MC + planting

Total Revenue - Costs	1000 trees	1000 trees	5000 trees	5000 trees
Current trees (5 t/site avg)	75-yr rot	20-yr rot	75-yr rot	20-yr rot
\$10	-316,115	-563,297	-1,068,576	-2,304,484
\$25	-241,802	-522,935	-697,009	-2,102,673
High seq (10 t/site avg)				
\$10	-266,573	-536,389	-820,865	-2,169,943
\$25	-117,946	-455,664	-77,731	-1,766,322



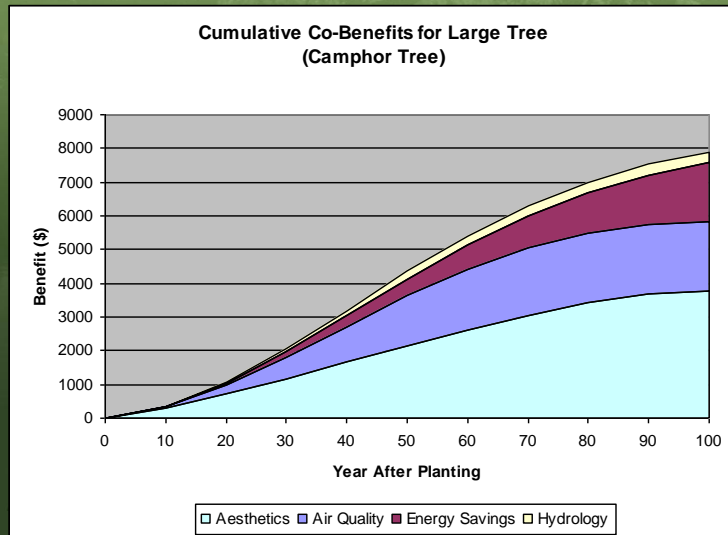
Findings

- Offset revenues = 2-27% of project costs
- Longevity matters: 20-yr rotation had 50% less revenue, 25% greater costs
- Project size matters due to fixed TCs
 - Revenues > TCs for all 5,000 tree scenarios
 - Revenues > TCs only for \$25/t 1,000 tree scenarios
- Tree selection matters
 - Revenues > TCs + Monitoring costs for 4 hi seq scenarios vs. 1 current seq. scenario

Conclusion: Improve Economics

- Reduce costs
 - Project size (economies of scale)
 - Species selection (1.2 to 14.7 t/site)
 - Tree longevity (increased revenues, reduced costs)
 - Monitoring (link w/ tree care, cluster trees)
 - New technologies: remote sensing & growth detection
- Increase revenues
 - Sell other ecosystem services
 - Energy – utilities
 - Engage local partners (corporate, etc.)
 - Cradle to coffin example
 - Micro-local projects

Quantify Co-Benefits



Paradigm Shift Planting to Performance

- Planning
- Strategic Location
- Tree Selection
- Quality Stock
- Proper Planting
- Timely Maintenance
- Periodic Monitoring
- Annual Reporting



Protocol Issues

- 100 year permanence
- Unfavorable economics
 - Monitoring costs
 - Transaction costs
- Eligibility limited
 - NGOs, developers
 - Fully-stocked (excludes canopy conservation)
 - NTG standard
- Lack of tools

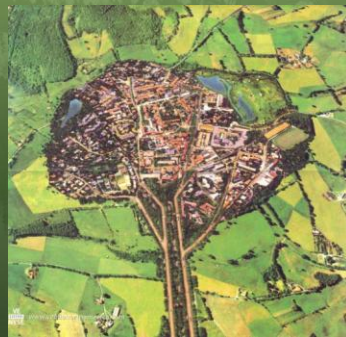
Alternative Approach

- Urban Tree Canopy (UTC)
- Baseline CO₂ storage
 - current UTC by land use
 - CO₂ densities (t/ha UTC)
- Measure UTC change 5-yr intervals
 - NAIP imagery, statewide assessment
 - Field surveys, permanent plots
- Issues
 - Ownership
 - Double-counting planting projects



Conclusions

- Projects unlikely to fully recapture costs
- Can cover TCs & monitoring costs
 - Larger projects
 - Higher seq. rates
 - Longer survival
- Reduce costs & increase revenues, market eco-services
- Pilot projects needed
- UTC alternative



Questions?

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

