PLANTING THE SEEDS OF SUCCESS.

Urban Forestry Carbon Protocols

March 12, 2008

Center for Urban Forest Research

Agenda

- Overview protocol and carbon calculator
- Review timetable
- Forest Scoping Process, CCAR

Protocol Overview

- Why should we care?
- Current Protocol
  - Process
  - Sections
  - Guiding Principles
  - Key Concepts
- Carbon Calculator

Should We Care?

- CAT Reductions (AB 32)
  - CA 1990 emissions 427 MMT
  - CA 2020 emissions 600 MMT
  - 173 MMT reduction
- CCAT – 5 million trees by 2020
  - 0.26 MMT
- CUFR – 50 million trees by 2025
  - 4.5 MMT (2-3% of target)

Should We Care?

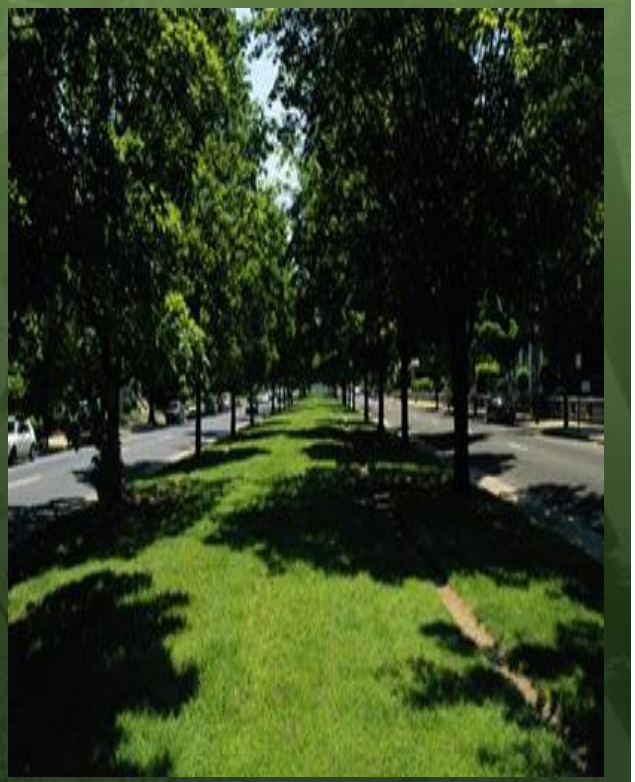
- Costs
  - STF offset project (40 yrs)
    - $170/tree site
    - 4.2 MT/tree site CO_2
    - $41/MT
  - CCAT $150/MT
  - Case Studies
    - Utility - $140/MT
    - Campus - $272/MT
    - Municipal - $553/MT
- Other Benefits

Current Urban Forest Protocol Process

- Final Outline – June 2007
  - Entity and Project
  - 3 Project types
- Case Studies and Draft
- Drafting & Steering Committee
  - Project protocol only
  - Energy and Bioenergy to Annex
  - Include tree care emissions
  - Wood products/Verification
  - Performance standards
  - Reserves and permanence

Current Urban Forest Protocol Sections

- User Guide
- Introduction & Background
  - Background of the protocol
  - Key concepts
  - Accounting and reporting process
- Urban Forest Protocol
  - Overview of reporting process
  - Initial project report
  - Annual monitoring report
- Verification Protocol
- Annexes



Annexes

- Urban forests & climate change
- Inventories and sampling
- Calculating biomass and carbon
- Energy conservation and bioenergy protocols
- CUFR carbon calculator
- Emissions tree maintenance
- Reporting forms
- Case studies
- Glossary
- References
- Contributors

Eric Petersen / The Livingston Enterprise

Guiding Principles

- Best available science
  - Biomass formulas
  - Energy conservation
- Simplify reporting process
- Precepts
  - Relevance
  - Completeness
  - Consistency
  - Transparency
  - Accuracy
  - Conservativeness

Key Concepts

- GHG Tree Projects
- Direct and Indirect Emissions
- Boundaries
- Eligibility and Ownership
- Baselines and Additionality
- Permanence and Buffers
- Tree Planting, Maintenance, Level of Service
- Leakage - TMP
- Co-Benefits and Negative Impacts
- Monitoring and Verification
- Reporting Process

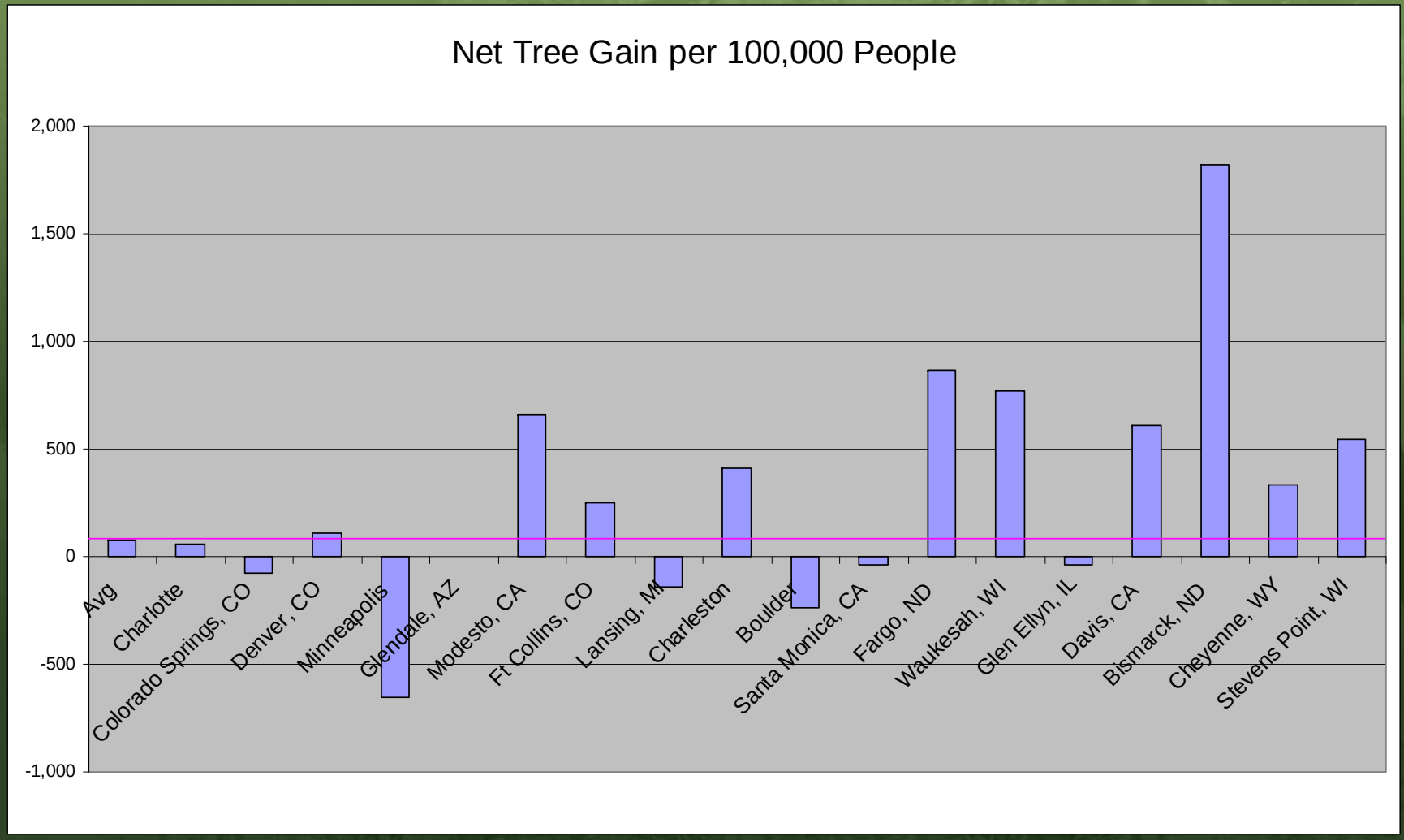
Eligibility and Ownership

- Eligibility
  - Urban Area or Cluster
    - Forest Protocols for forested tracts in cities
  - Plant at least 1,000 trees
    - Does not include closely-spaced seedlings
  - Exceed baseline and mandated planting
  - Start date January 1, 2002
- Ownership
  - Demonstrate clear and defensible rights to ownership - contract
  - Disclose if property ownership changes

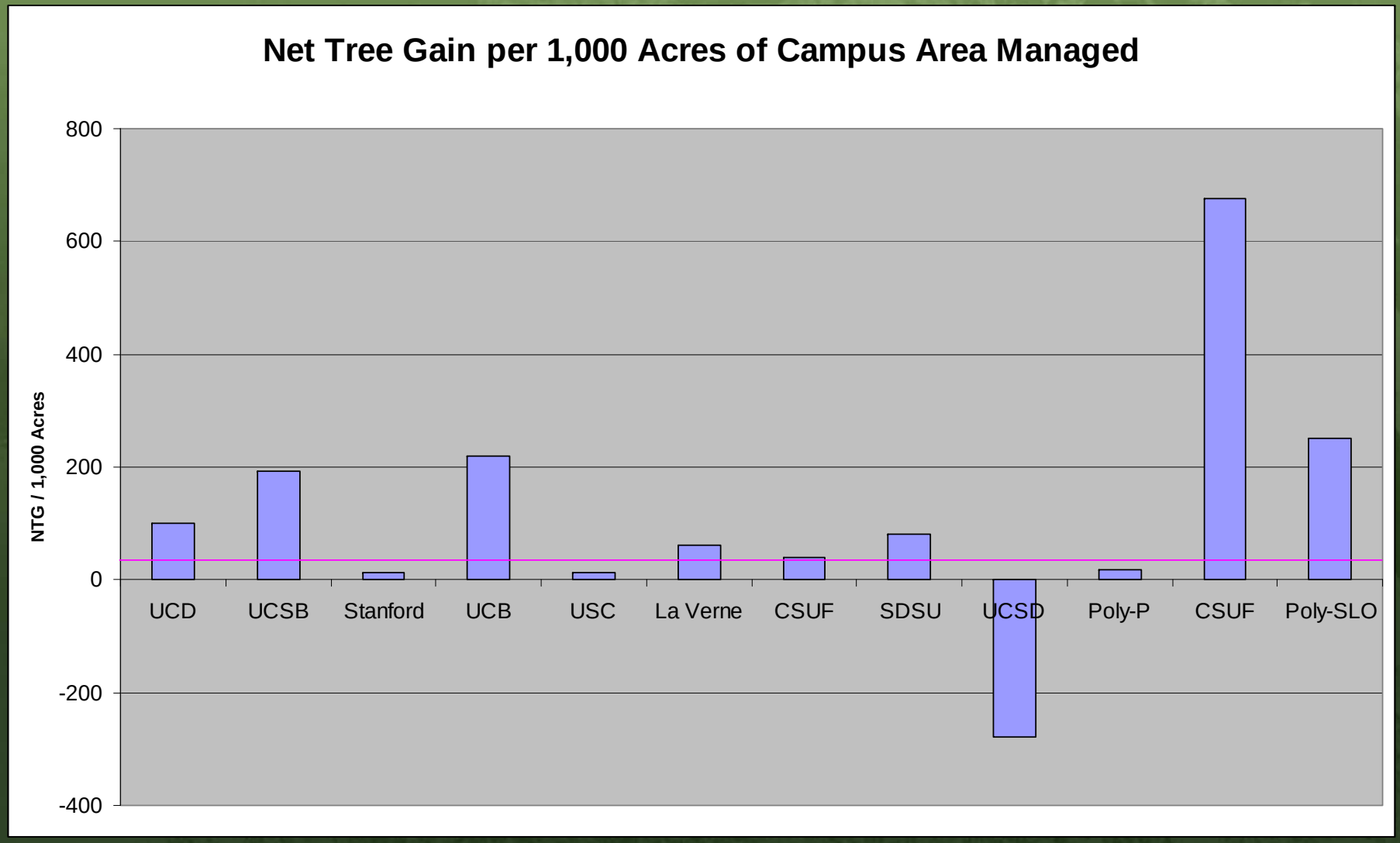
Baselines and Additionality

- Performance Standards
  - Net tree gain (NTG, Tree Planting – Tree Removal)
- Municipal Standard
  - 18 city mean: 1.16 NTG
  - Normalized per capita: 0.001 NTG/capita
- Campus Standard
  - 12 campus mean: 1.33 NTG
  - Normalized per acre managed: 0.03 NTG/ac
- Utility Standard
  - 0

Municipal Net Tree Gain Rates



Campus Net Tree Gain Rates



Initial Baseline Forecast
Campus Case Study

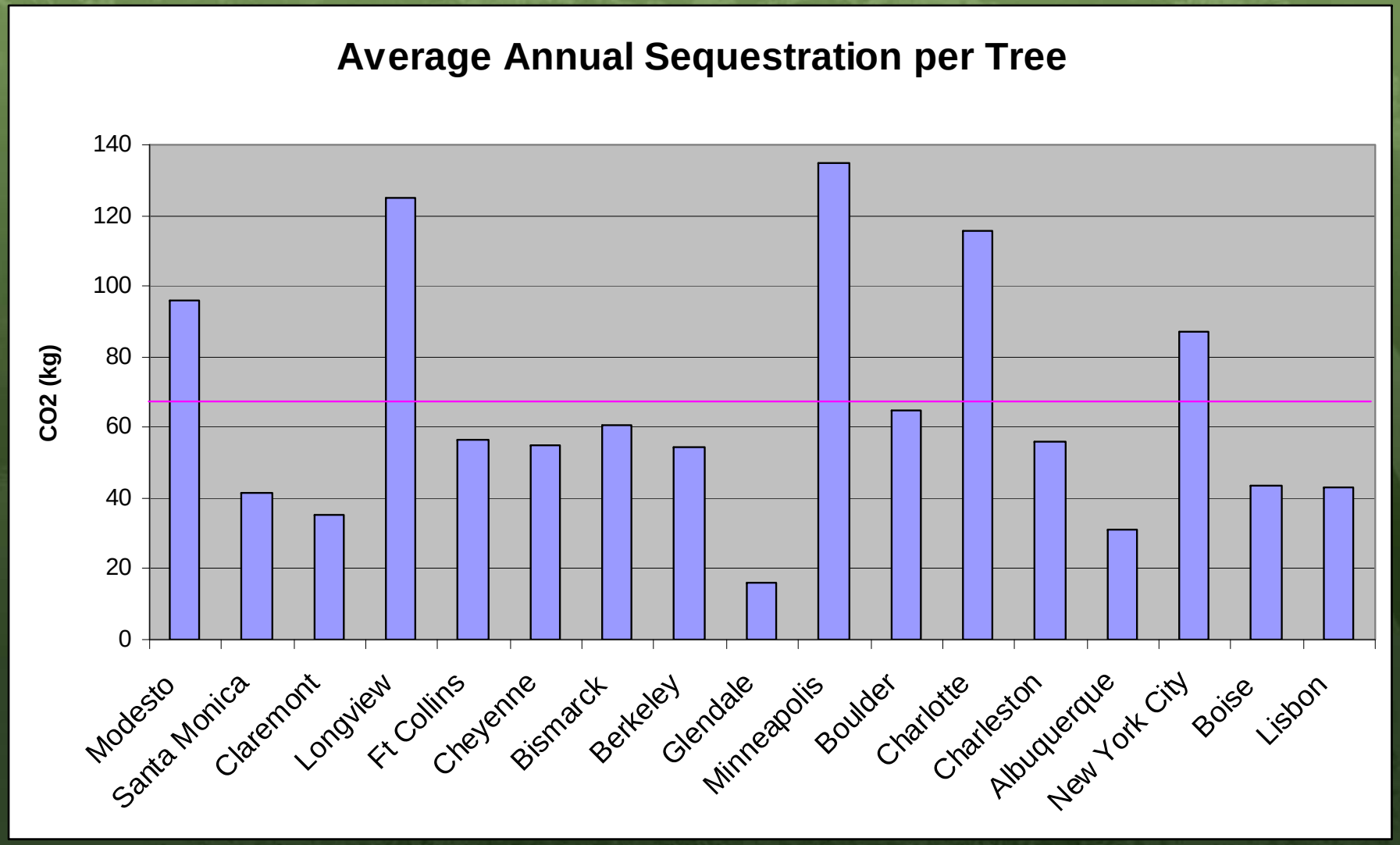
- Baseline Trees (required NTG standard)
  - 750 acres x 0.03 NTG/ac = 23 NTG
- Non-Project Tree Maintenance Plan (NTG forecast)
  - Plant = 100/yr
  - Remove = 75/yr
  - NTG = 25/yr
- TMP greater than Baseline

Baseline – Annual Reporting Municipal Case Study

- Baseline Trees (required NTG standard)
  - 2008: 112,000 x 0.001 = 112 NTG
- Actual NTG
  - Plant = 720/yr, Remove = 600/yr, NTG = 120/yr
- If Actual NTG less than Baseline, CO2 deducted
  - 2012: 1 x 66 kg CO2/tree = 66 kg deduction from sequestered

Year	Population	Baseline NTG	Actual NTG	Difference	Running Tot.	CO_2 deduct (kg)
2008	112,000	112	120	8	0	0
2009	114,240	114	120	6	0	0
2010	116,480	116	118	2	0	0
2011	118,720	119	119	0	0	0
2012	120,960	121	120	-1	-1	66
2013	123,200	123	110	-13	-14	924
2014	125,440	125	128	3	-11	726
2015	127,680	128	139	11	0	0

Per tree CO2 Sequestration for Baseline



Running Baseline Annual Reporting Municipal Case Study

- 2013: Plant = 760/yr, Remove = 650/yr, NTG = 110/yr
  - 14 x 66 kg CO2/tree = 924 kg deduction from sequestered in 2013

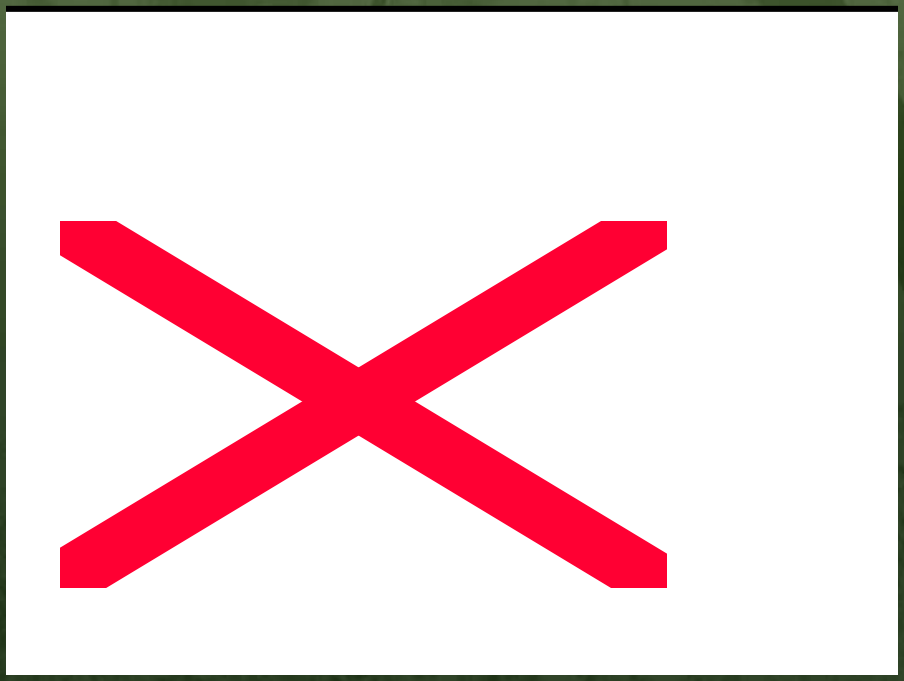
Year	Population	Baseline NTG	Actual NTG	Difference	Running Tot.	CO_2 deduct (kg)
2008	112,000	112	120	8	0	0
2009	114,240	114	120	6	0	0
2010	116,480	116	118	2	0	0
2011	118,720	119	119	0	0	0
2012	120,960	121	120	-1	-1	66
2013	123,200	123	110	-13	-14	924
2014	125,440	125	128	3	-11	726
2015	127,680	128	139	11	0	0

Tree Care Emissions

- Forecast
  - 2.6 kg CO2/tree/yr
- Vehicles
  - CO2 = (TG × EF)
  - CO2 = (VMT x EF)
- Equipment
  - CO2 = (TG × EFg) + (TD × EFd)
  - CO2 = HRS x LF x HP x EF

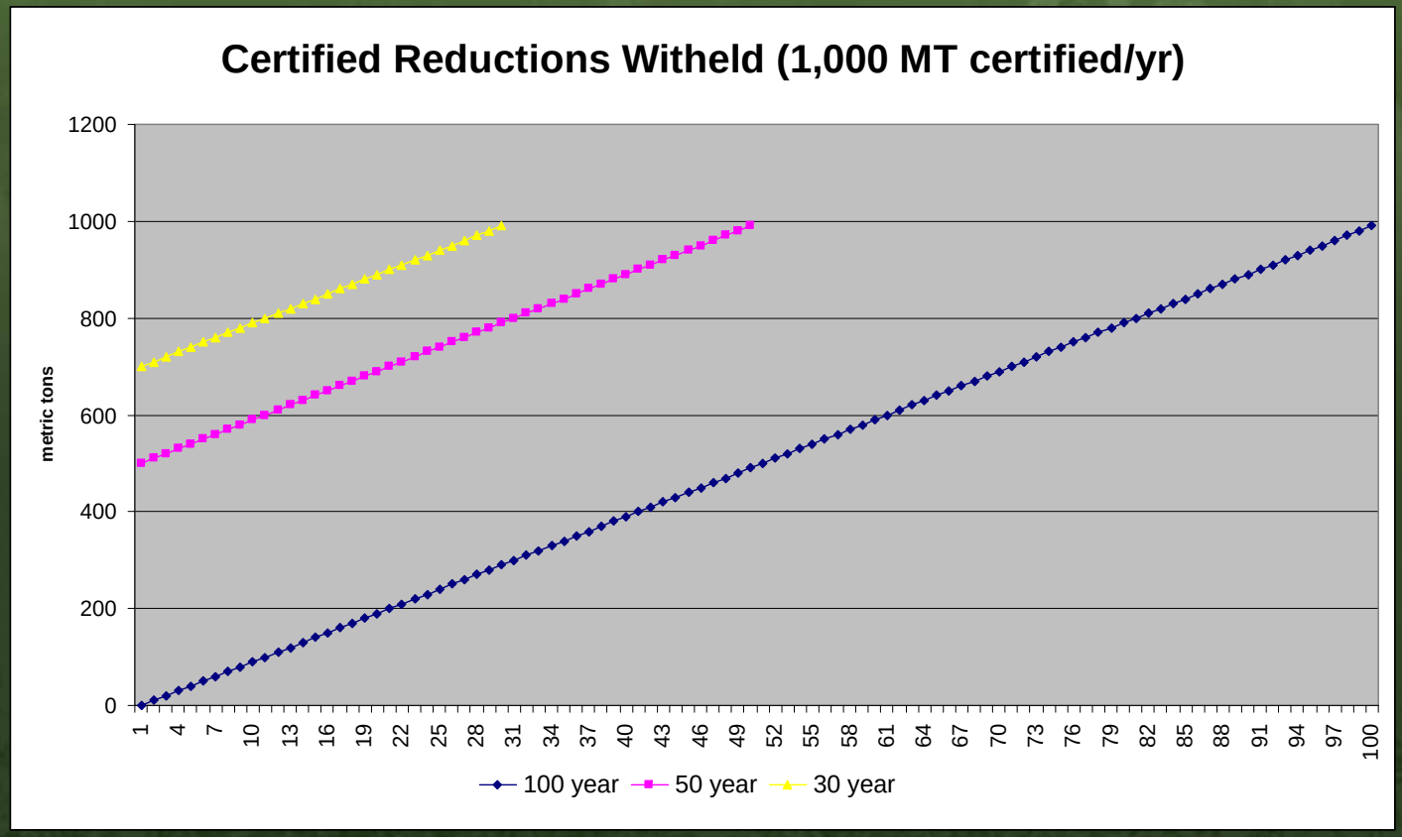
Additionality

- Carbon Reduction Unit = Cseq + Cwood
- Cseq = Cproj – Cdeduct – Cemis
- Cwood = Cprod – Cemis



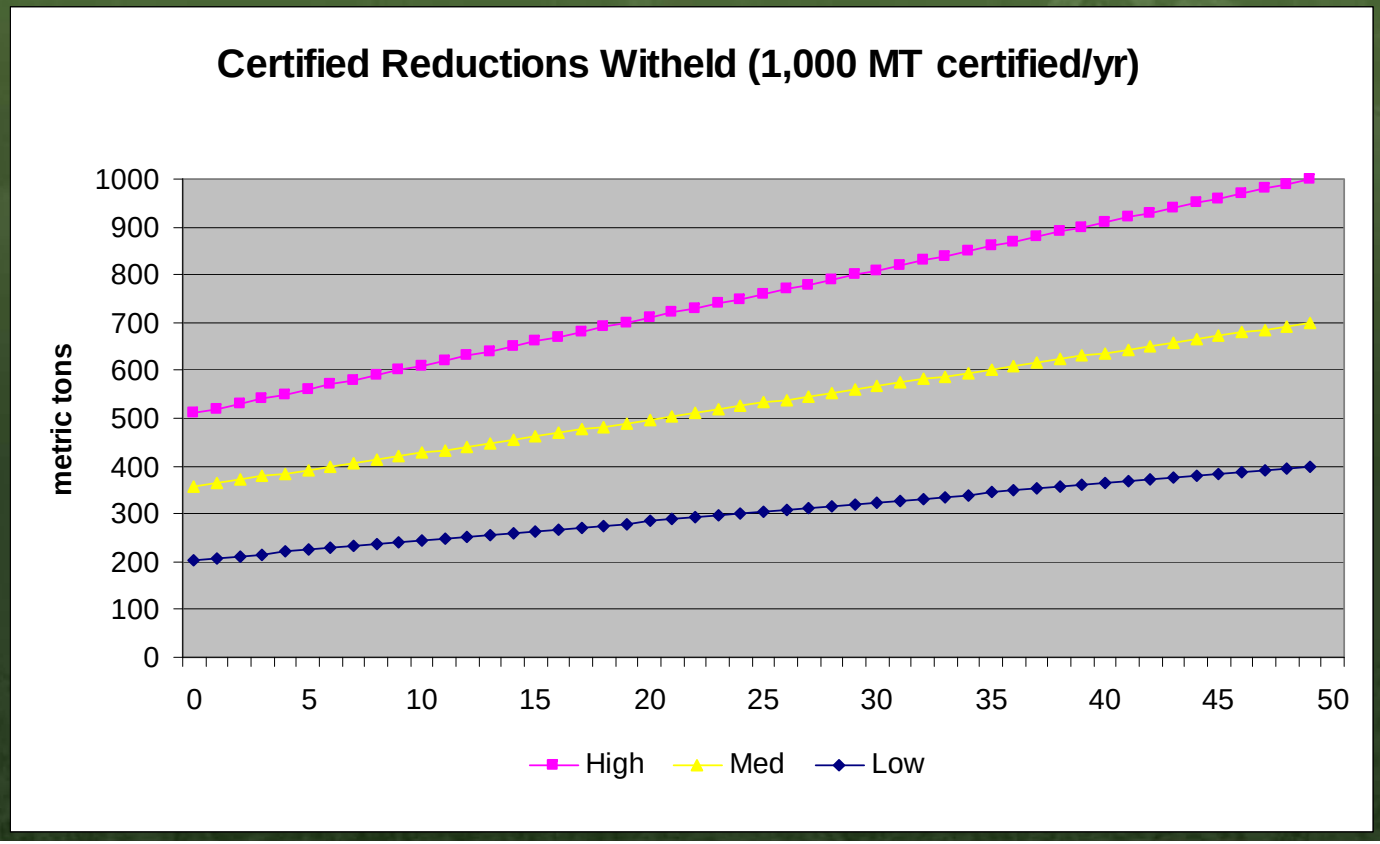
Permanence and Reserves

- Reversibility
- 100 year standard
- Duration of reporting



Buffer Reserve

- Adjustment: risk assessment
  - Land use change
  - Human disturbance potential
  - Natural disturbance potential



Monitoring and Verification

- M & V Plan
  - Field survey & remote sensing
  - Inventory/Sampling design
  - Data collection (how, when, who, accuracy)
- CRUs and Leakage
- Full inventory every 10 yrs
- 6 year verification

Initial Reporting

- Entity
  - Describe tree resource – existing
    - Inventory, maintenance, budget
    - Carbon stocks optional
  - Create TMP – future NTG, levels of service, $
- Project
  - Characterize the project
    - Eligibility, Activity, Project TMP, M & V
  - Quantify baseline and project activity
  - Assess additionality
  - Assess leakage and impacts (optional)

Annual Monitoring Reporting

- Entity
  - Document compliance with non-project TMP
- Project
  - Document compliance with project TMP
  - Quantify baseline
  - Quantify annual project activity
  - Assess additionality
  - Explain differences, document disturbances, true-up forecasts
  - Assess leakage and impacts (optional)
  - Describe inventory/calculation methodologies
  - Have report reviewed each yr, verified every 6th

PLANTING THE SEEDS OF SUCCESS.

The CUFR Carbon Calculator

Jim Simpson & Greg McPherson

Center for Urban Forest Research

Introduction

- Excel workbook
- Calculates
  - biomass and carbon stored, annual sequestration
  - Effect of tree shade on residential heating and cooling energy use and GHG emissions
- "Proof of concept" software still in the testing phase
- Single tree calculator in present form

California climate zones

California Climate Zones

Climate region	Reference City	CDD[1]	HDD[2]
North and Central coast	Berkeley	142	2862
South Coast	Santa Monica	679	1274
Inland Empire	Claremont	1863	1475
Central Valley	Modesto	1248	2666
Desert	Glendale, AZ	4364	1027
Mountains	Fort Collins, CO	696	6128

[1]CDD=Cooling Degree Days
[2]HDD=Heating Degree Days
Western Regional Climate Center 1971-2000 normals, 65°F baseline

Project Data entry

Project Data entry			
Data name	Data entry	Units	Description
Flag1	**0**	tree age or dbh	Tree age selected
Climate Zone	**1**		North and Central coast
Electricity CO_2 emissions factor§	**241**	(kg/MWh)	
Electricity CH_4 emissions factor§	**0.0030**	(kg/MWh)	
Electricity N_2O emissions factor§	**0.0017**	(kg/MWh)	
§required for energy project			

Uses either tree age or size (dbh) (“Flag1”)

6 climate zones

Emissions factors

Utility	Electrical generation Average emissions factor (kg/MWh)			Natural gas Heating emissions factor (kg/MBtu)			Fuel oil Heating emissions factor (kg/MBtu)		
	CO_2	Methane	Nitrous Oxide	CO_2	Methane	Nitrous Oxide	CO_2	Methane	Nitrous Oxide
LADWP	727	0.0030	0.0017	53.1	0.0059	0.00010	73	0.0014	0.00010
SCE	483	0.0030	0.0017	53.1	0.0059	0.00010	73	0.0014	0.00010
SDG&E	511	0.0030	0.0017	53.1	0.0059	0.00010	73	0.0014	0.00010
PG&E	241[a]	0.0030	0.0017	53.1	0.0059	0.00010	73	0.0014	0.00010
California	395[a, b]	0.0030	0.0017	53.1	0.0059	0.00010	73	0.0014	0.00010

[bi]includes irrigation districts and municipal utilities

[a]results for PG&E include Sacramento Municipal Utility District (SMUD).

Note: utility specific data for methane and nitrous oxide will be added as data becomes available

Tree data entry

Combined carbon storage and

Enter Tree data in box below one tree at a time, then record results			
Data name	Data entry	Units	Data value
Species	**CICA**		CICA
Tree dbh or age	**40**	Age (years)	
Tree azimuth	**7**		W
Tree distance class	**1**		Adj
Building vintage	**3**		post-1980
air conditioning equip.	**1**		Central air/heat pump
Heating equip.	**1**		natural gas
Heating emissions factor- CO_2§	**53.1**	(kg/MBtu)	
Heating emissions factor CH_4§	**.0059**	(kg/MBtu)	
Heating emissions factor N_2O§	**.0001**	(kg/MBtu)	

- A pre-defined number of azimuth, distance, vintage and equipment values are given in the CCC for the user to select from.
- Heating emissions factors, unlike those for electricity, are likely to vary by building

Example data template

Tree ID	Species code	Dbh (in) or Age	Condition	Azimuth	Distance	Trees //building	Vintage	AC equipmt	Heating Equipment	Energy
1	PICH	10	alive	5	1	1	3	1	1	yes
2	CICA	40	dead	7	1	1	3	1	1	yes
3	CICA	40	alive	7	1	1	3	0	0	yes
4	CICA	40	alive	7	1	1	3	0	1	yes
5	CICA	40	alive	7	1	1	3	1	4	yes
6	PYKA	20	alive	3	1	2	2	1	1	no
7	PIRA	25	alive	3	1	1	2	1	0	yes
8	PIBR2	40	alive	5	3	2	1	1	1	no
9	PICO5	30	alive	7	2	1	3	1	1	yes

Use of a template facilitates data entry

The “Energy” field is intended to indicate an “energy” tree, and could be calculated from template data.

Results

Carbon Calculator Results (carbon storage project only)

Energy reductions		Emission reductions (CO_2 equivalents)			CO_2 Sequestration	Total CO_2 Stored	Above ground biomass
Cooling	Heating	Cooling	Heating	Cooling + Heating			(dry weight)
kWh/tree	MBtu/tree	(kg/tree)	(kg/tree)	(kg/tree)	(kg/tree/year)	(kg/tree)	(kg/tree)
n/a	**n/a**	**n/a**	**n/a**	**n/a**	**70.6**	**1087.2**	**462.1**

Carbon Calculator Results (combined carbon storage and energy project)

Energy reductions		Emission reductions (CO_2 equivalents)			CO_2 Sequestration	Total CO_2 Stored	Above ground biomass
Cooling	Heating	Cooling	Heating	Cooling + Heating			(dry weight)
kWh/tree	MBtu/tree	(kg/tree)	(kg/tree)	(kg/tree)	(kg/tree/year)	(kg/tree)	(kg/tree)
185.29	**-0.108**	**44.7**	**-7.9**	**36.8**	**70.6**	**1087.2**	**462.1**

- Results from two "runs" of the CCC. The top table is for a carbon storage project only, the bottom (record 2 from previous slide) for a combined carbon storage and energy project.
- Results related to energy (shaded) are not certified.

Example summary table

Summary of Carbon Calculator Results

Tree ID	Species code	Energy reductions		Emission reductions (CO_2 equivalents)			CO_2 Sequestration	Total CO_2 Stored	Above ground biomass
		Cooling (kWh/tree)	Heating (MBtu/tree)	Cooling (kg/tree)	Heating (kg/tree)	Cooling + Heating (kg/tree)	(kg/tree/year)	(kg/tree)	(dry weight) (kg/tree)
1	PICH	12.80	-0.010	4.9	-0.4	4.5	24.6	120.0	51.0
2	CICA	185.30	-0.100	44.7	-5.7	39.0	70.6	1087.2	462.1
3	CICA	0	0	0	0	0.0	70.6	1087.2	462.1
4	CICA	0	-0.100	0	-5.7	-5.7	70.6	1087.2	462.1
5	CICA	185.30	-0.100	62.1	-7.7	54.4	70.6	1087.2	462.1
….									
Total		383	-0.3	112	-20	92	307	4,469	1,899

Results from each “run” of the CCC can be stored in a table like this to facilitate subsequent graphing and summary values.

Timeline


Eureka
Redding
South Lake Tahoe
Santa Rosa
Sacramento
Berkeley
San Francisco
Modesto
San Jose
Fresno
Monterey
Bakersfield
Lompoc
Santa Barbara
Los Angeles
Santa Monica
Ridgecrest
Lancaster
Victorville
Claremont
Banning
Palm Springs
Temecula
San Diego
Mountains
Fort Collins, CO
Desert
Glendale, AZ
Central Valley
Desert
Inland Empire
Mountains
North & Central Coast
South Coast & Valley
Reference city
City

Questions?

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