The Marin Carbon Project

CARBON FARMING:
Increasing Carbon Capture on California's Working Lands

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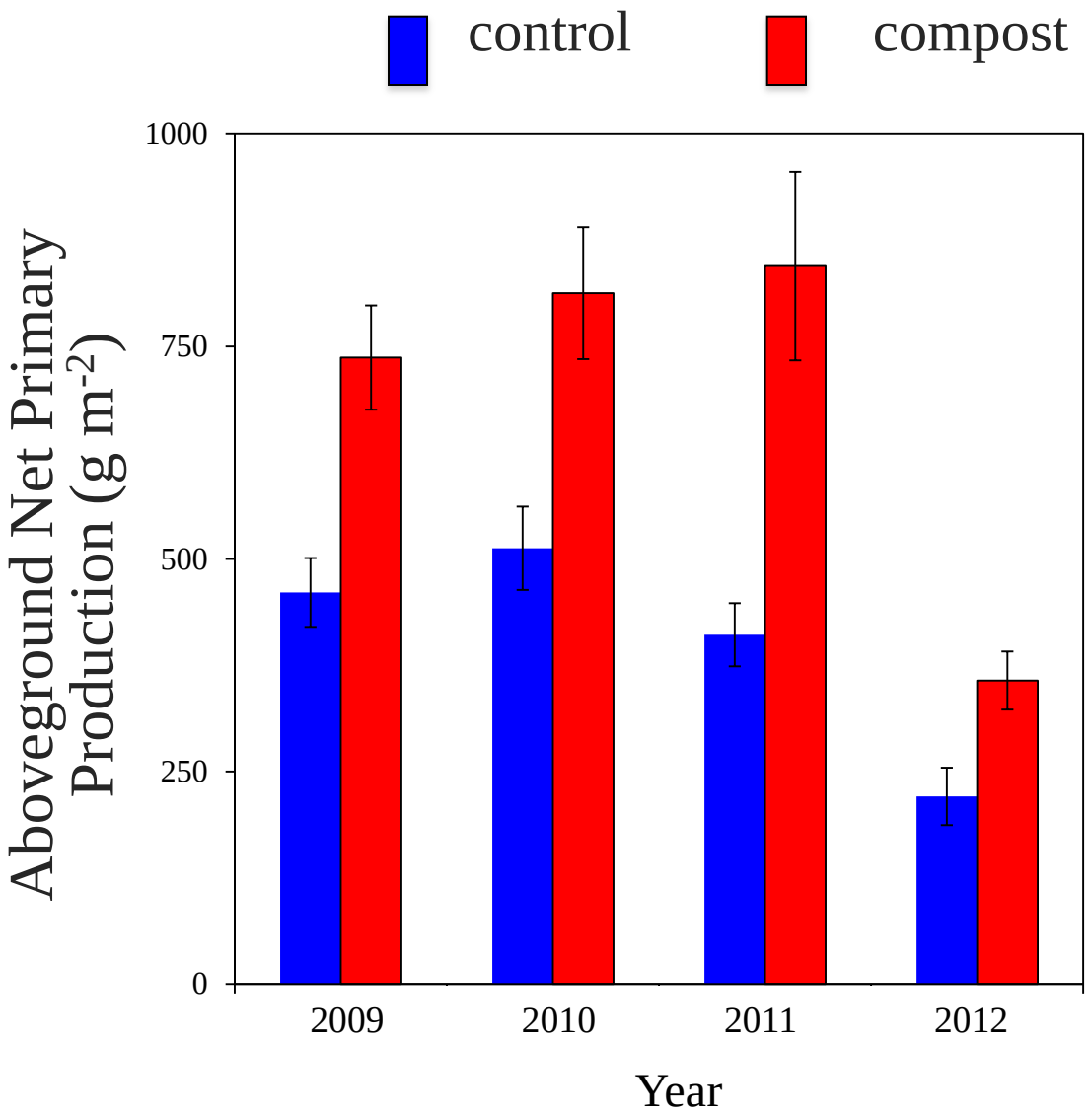
Nicasio Native Grass Ranch

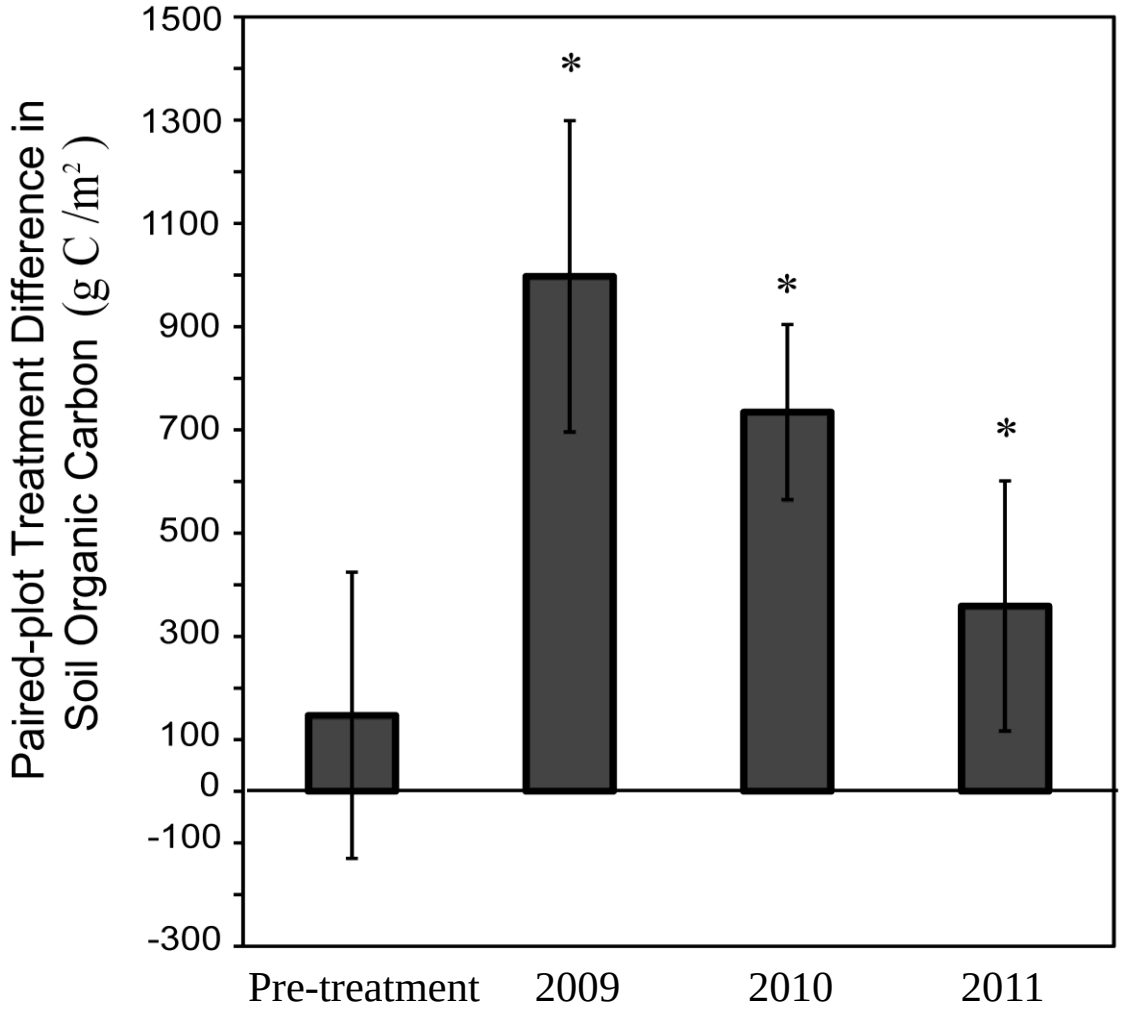
Can management ***measurably*** increase soil carbon; ***and what happens if we succeed?***

Results: Above-ground production (forage) has exceeded controls by 40-70% ***every year*** following the single ½" compost application in 2008



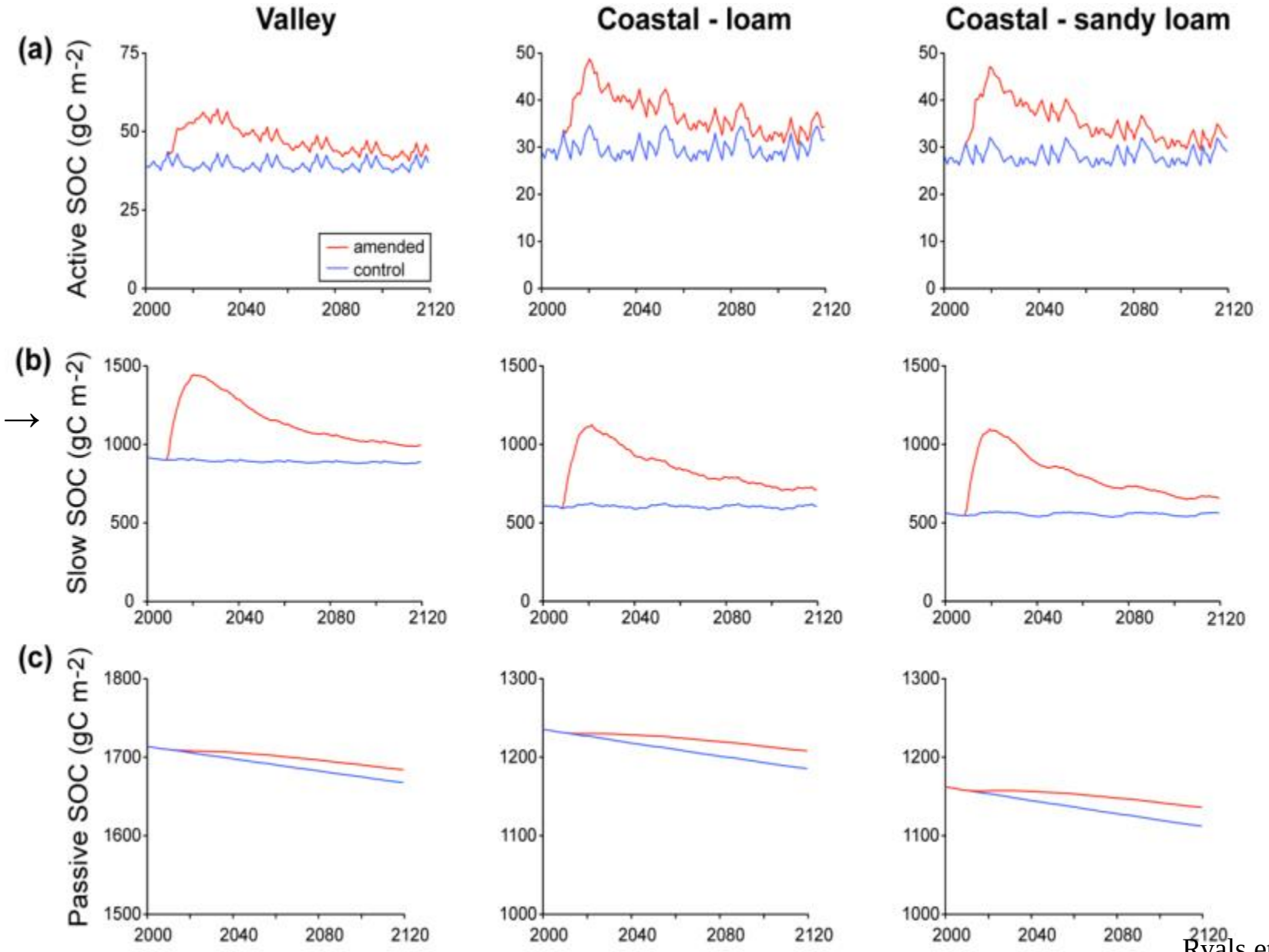
Ryals and Silver 2012

Compost increased soil C (above compost C alone)



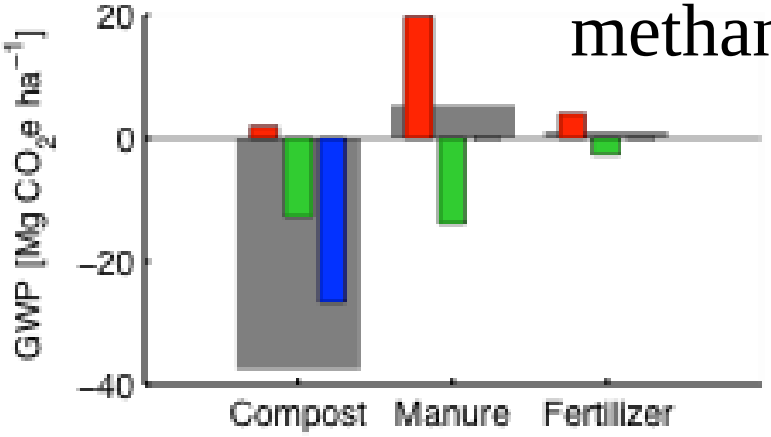
Ryals et al. 2013

Models suggest that the C increase effect persists for 30-100 years

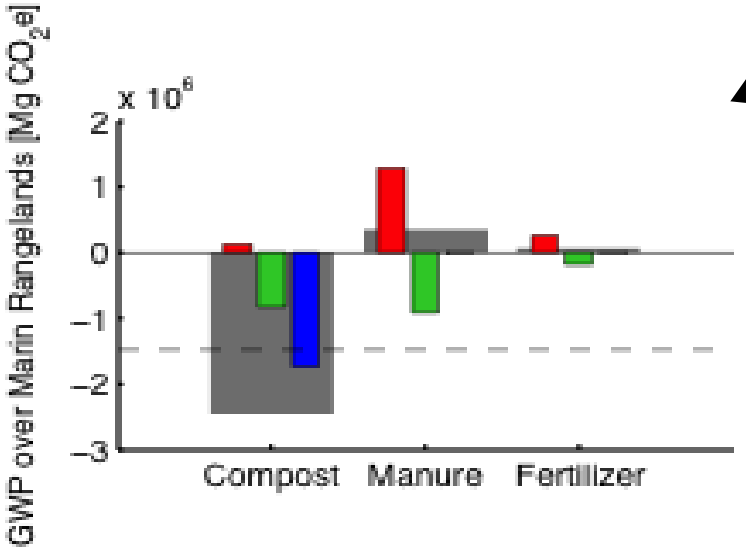


Ryals et al 2013

Lifecycle Assessment: diverting organic materials from anaerobic storage and disposal to aerobic composting and land application leads to large offsets from avoided methane emissions

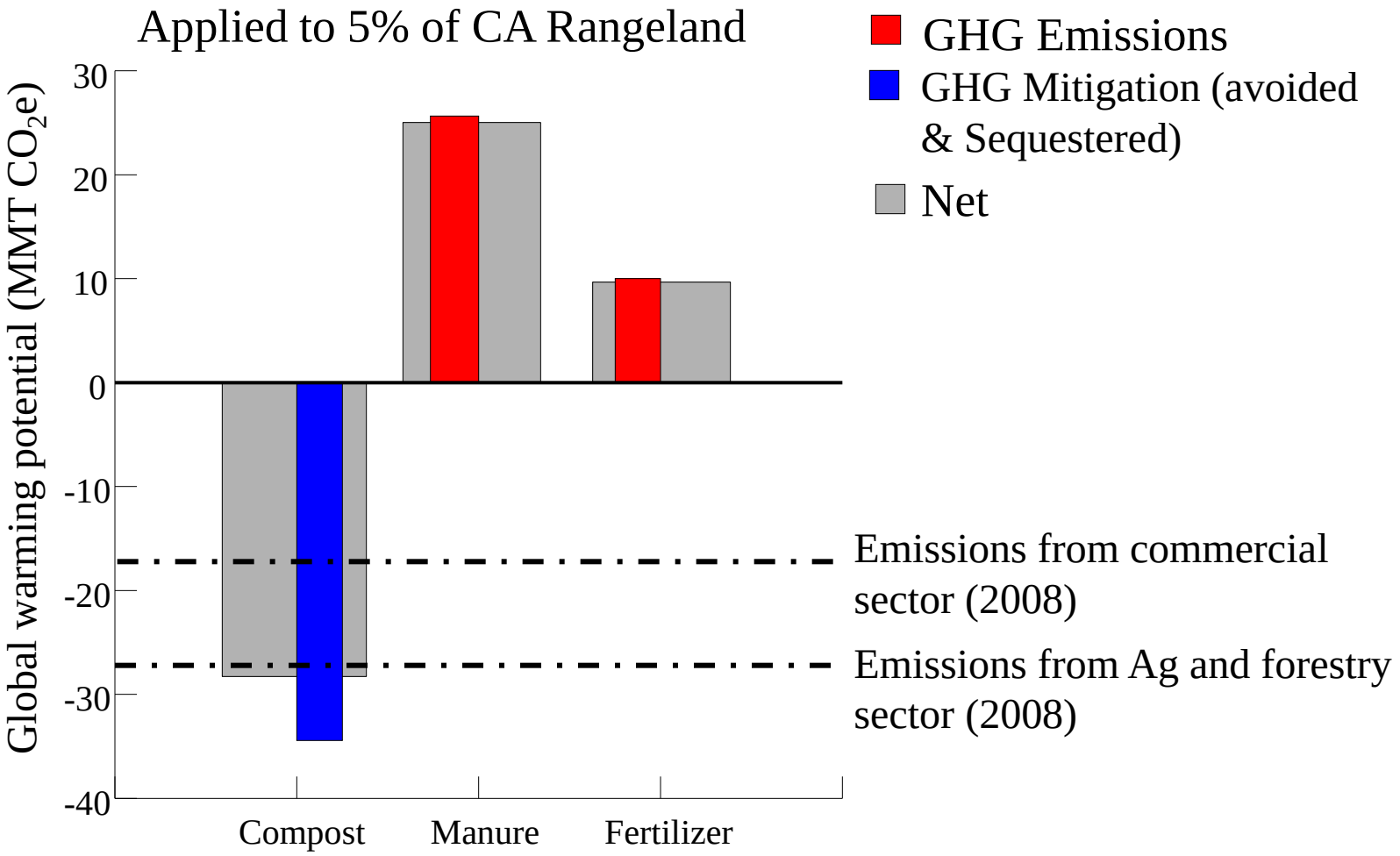


65,000 ha Marin Rangelands



Delonge et al. 2013

Life Cycle Assessment suggests significant GHG mitigation potential statewide

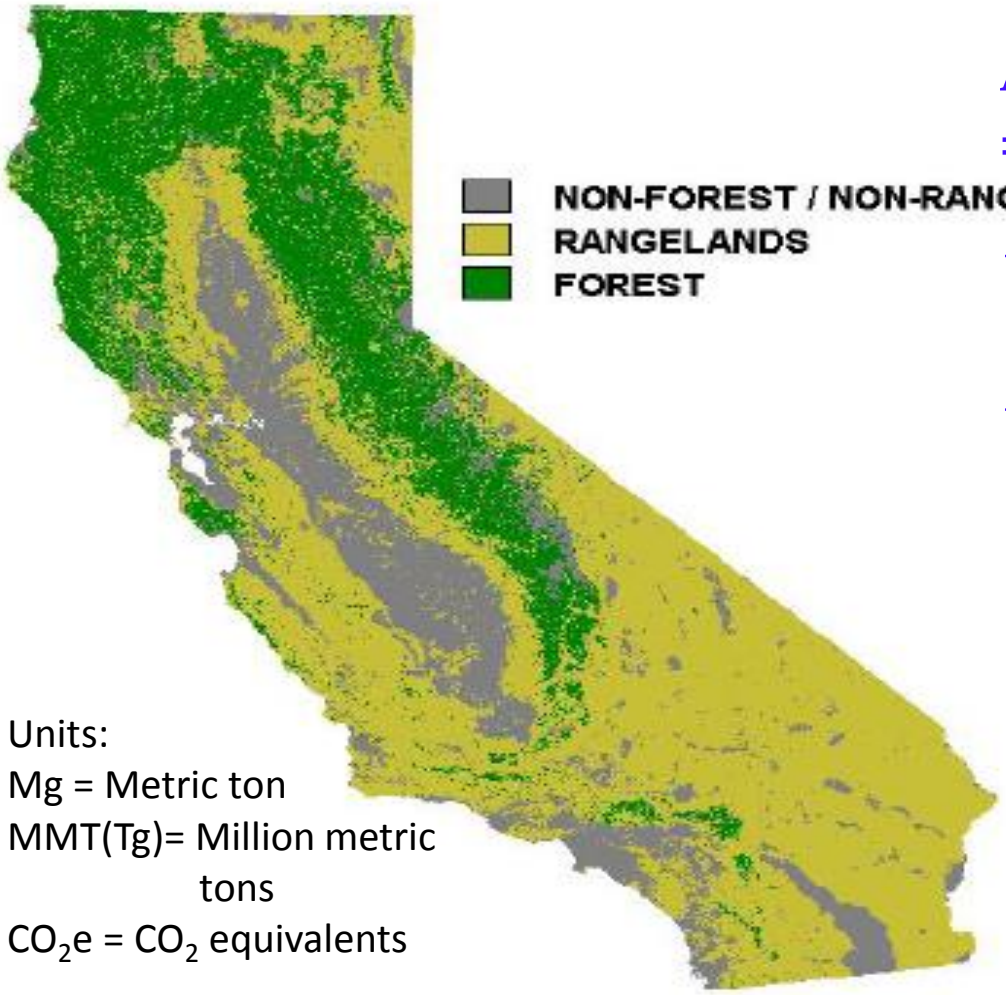


Redrawn from DeLonge et al. 2013

California Rangelands Carbon Sequestration Potential With Compost Additions

23 million hectares (57 million acres) of rangeland in California: 67% (38 million acres) is grasslands and pastures.

(Without avoided methane emissions)



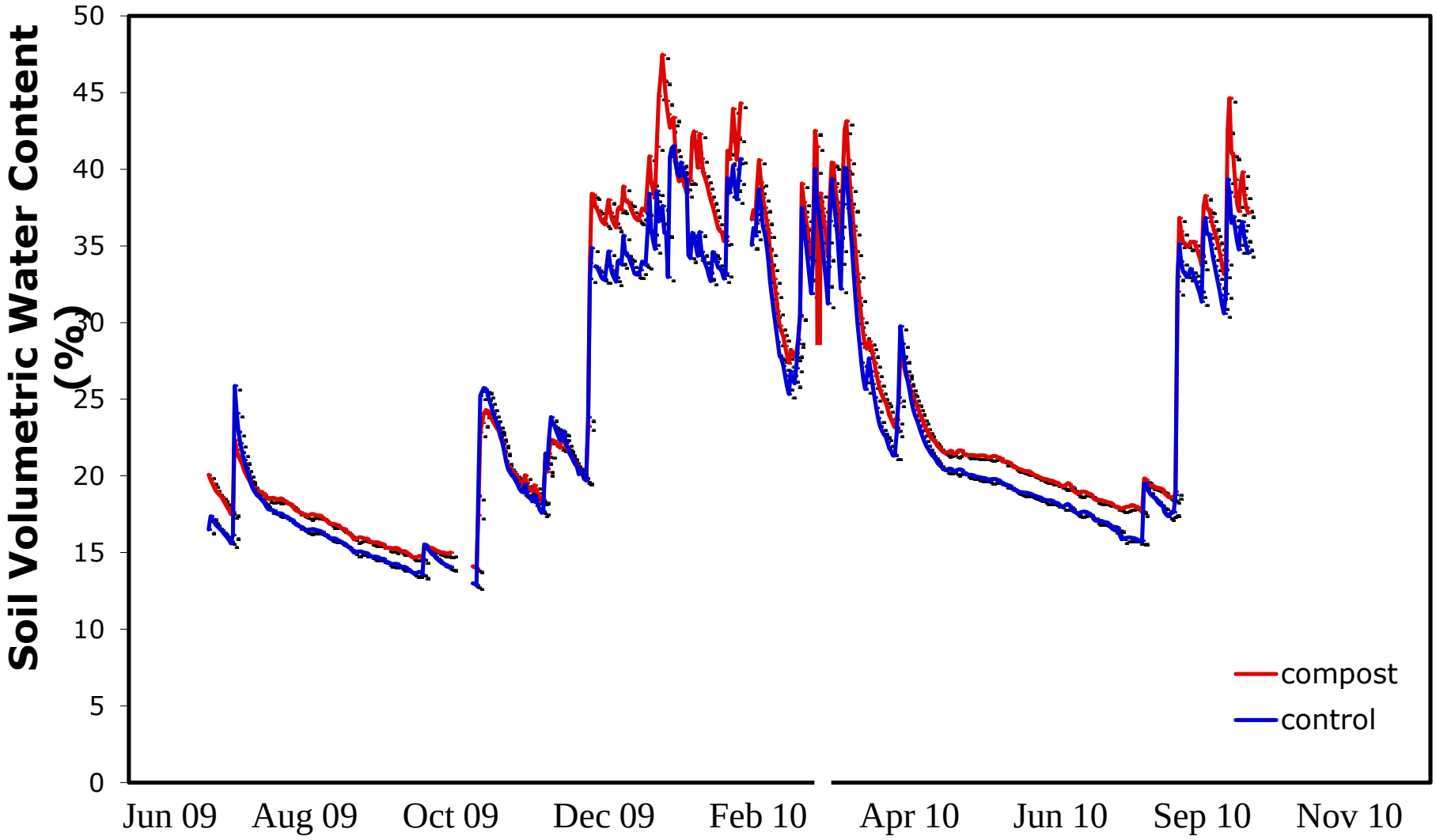
At a rate of 0.5 Mg C ha^{-1} y^{-1}
= 28 MMT(Tg) CO_2e y^{-1}
At a rate of 1 Mg C ha^{-1} y^{-1}
= 56 MMT(Tg) CO_2e y^{-1}
At a rate of 3 Mg C ha^{-1} y^{-1}
= 169 MMT (Tg) of CO_2e y^{-1}

- Livestock
  ~ 15 MMT CO_2e y^{-1}
- Commercial/residential
  ~ 42 MMT CO_2e y^{-1}
- Electrical generation
  ~112 MMT CO_2e y^{-1}

Units:
Mg = Metric ton
MMT(Tg)= Million metric tons
CO_2e = CO_2 equivalents

Emissions data: CA GHG Inventory 2010

Compost also increased soil moisture….



Moderating Climate Change with Soil Carbon Management

CARBON CYCLE INSTITUTE

MARIN CARBON PROJECT

USGS science for a changing world

INTRODUCTION

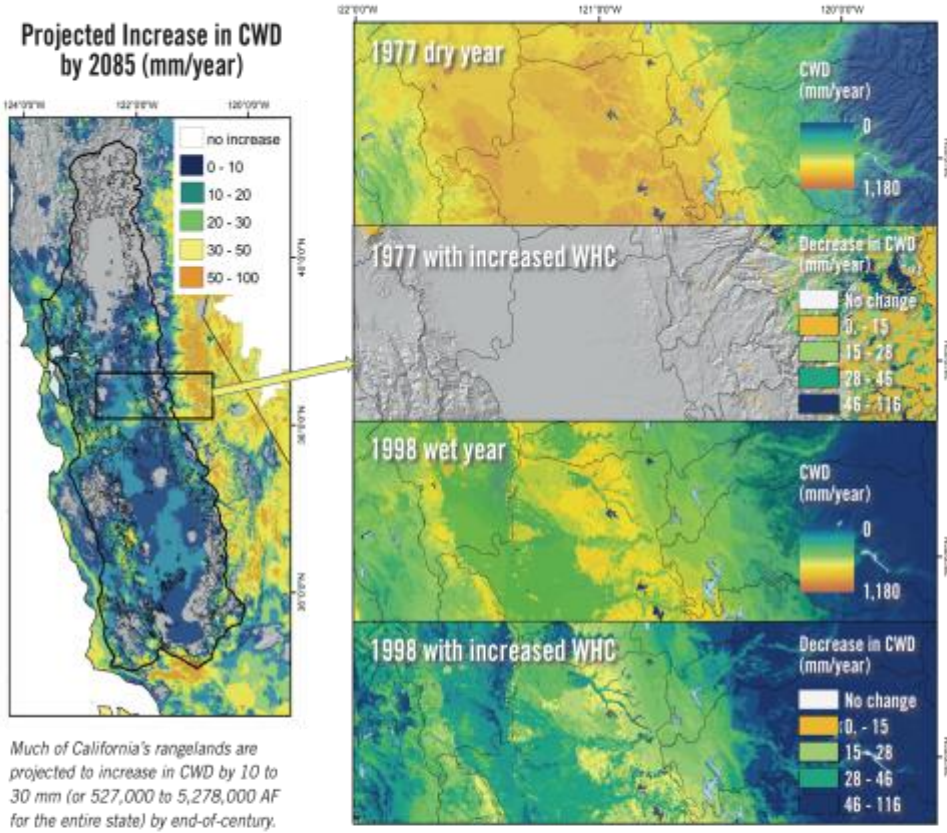
- Climate change is ongoing with changes in weather patterns and increases in extreme events, such as the current California drought.
- Biosequestration removes carbon from the atmosphere and stores it in plants and soil, increases soil water holding capacity, increases net primary productivity, and enhances other ecosystem services.
- Marin Carbon Project (MCP)research showed increases in soil water holding capacity (WHC) associated with topical applications of compost.
- The 25% WHC increase modeled here is based on first year increases in soil carbon on MCP treatment plots. (Ryals, R and W. Silver, 2013. Ecological Applications, 23(1), pp. 46–59).
- Composting is a particularly powerful biosequestration strategy due to both the avoidance of methane production by diversion of organic materials away from anaerobic decomposition in landfills and manure lagoons, and through enhanced NPP resulting from soil quality improvement following compost application. (DeLonge et al, 2013, Ecosystems 16: 962–979).

CLIMATE CHANGE AND HYDROLOGY

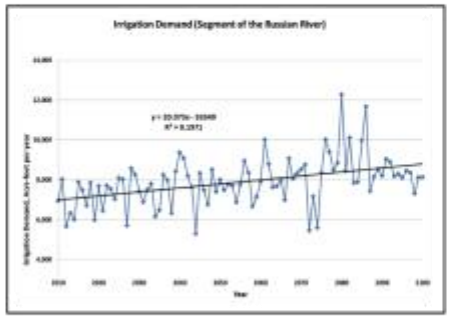
- The hydrologic impacts of climate change include changes in water availability and increases in demand for water.
- This translates into environmental stress that relates to wildfire, forest die-off, desertification, and loss of riparian zones and groundwater.
- Climatic water deficit is a key indicator of landscape stress.

CLIMATIC WATER DEFICIT (CWD)

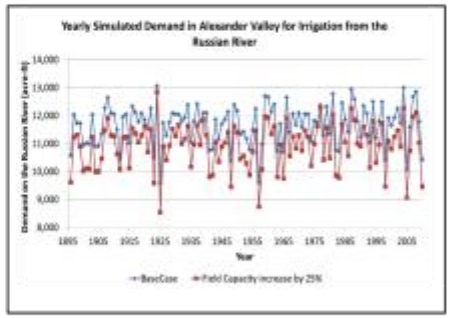
- Annual evaporative demand that exceeds available water
- CWD = potential – actual evapotranspiration
- Defines the level of hydroclimatic stress on the landscape
- Integrates climate, energy loading, drainage, and available soil moisture storage and addresses irrigation demand



Much of California's rangelands are projected to increase in CWD by 10 to 30 mm (or 527,000 to 5,278,000 AF for the entire state) by end-of-century.



CWD has been shown to correlate to irrigation demand in the Russian River's Alexander Valley. Projections indicate a potential increase in demand of nearly 2,000 ac-ft/yr by the end of the century.



If we increase water holding capacity of the soil by 25%, we reduce CWD and correlated losses due to demand from the Russian River by approximately 6.6% or 776 AF/year.

Climatic water deficit is shown for a wet year, 1998, and dry year, 1977, for a slice across the Central Valley and up into the Tuolumne River basin. Also shown is the change in CWD when soil water holding capacity is increased by 25%. Whereas in a dry year compost only contributes to reducing CWD in relatively shallow soils (because there isn't enough precipitation to fill the increased WHC in deeper soils), in wetter years all soils see a big decrease in CWD due to filling of soils including the increased WHC. Thus, all else being equal, benefits of increased WHC accrue primarily in shallower, non-irrigated soils in drier years. In addition, when rainfall occurs in less frequent, more intense events, as expected in CA under climate change scenarios, the effects of increased soil organic matter, including increased rates of infiltration, increased pore space, and increased hydraulic conductivity, result in the capacity to absorb and hold more rainfall, and sustain the landscape through the season.

IMPLICATIONS AND NEXT STEPS

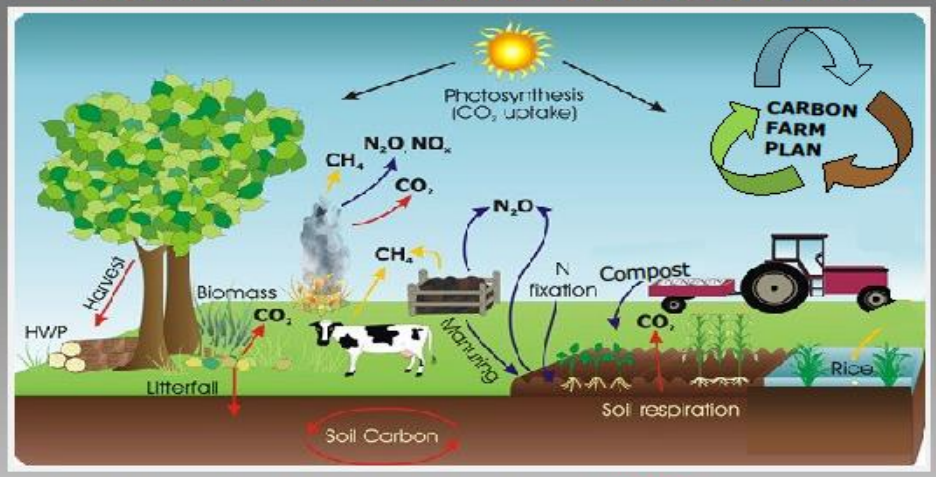
- Climate change is likely to reduce the extent and productivity of both rangelands and arable lands due to increases in climatic water deficit.
- Increases in evaporative demand and irrigation demand will reduce groundwater and surface water availability.
- Increases in soil water holding capacity and infiltration rate can increase ecosystem resilience by reducing the climatic water deficit, increasing productivity and available water, and helping to compensate for changing climatic conditions, including drought, increased rainfall intensity, and decreased rainfall predictability.
- Amendments of compost to rangelands can sequester carbon in soils, mitigate greenhouse gas emissions and increase soil water holding capacity and infiltration rate.
- Sensitivity analyses can help identify soil types that may benefit the most from strategic soil management and addition of compost.
- Local experimentation is needed to provide confidence in the mapping of climatic water deficit and changes due to compost amendments.
- These quantification and mapping methods can be applied to regions, river basins, or continents.

Carbon Farm Planning and Implementation

Implementation Activities

- Identify demonstration C-Farms and conduct farm assessments, including soil sampling (2013).
- Apply compost on rangelands at scale (2013)
- Develop list of other carbon beneficial NRCS practices, plus;
- Complete 3 C-Farm Action Plans
- Calibrate GHG accounting models with COMET-Farm/CSU and C-Farm data.
- Provide C-Farm permit assistance, technical expertise, implementation funding and monitoring assistance.
- Implement C-Farming workshops for farmers and ranchers (2015)
- Confirm roles of project partners and scalability to other counties.

Carbon Farm STEWARDSHIP FUNDING



Sources and sinks of GHG emissions in agriculture, forests, and other land use systems (IPCC 2006)

Carbon Farming:

We are pleased to announce the availability of funds to develop and implement Carbon Farm Action Plans on up to 3 ranches. Projects will focus on the implementation of carbon beneficial practices on predominantly permanent pasture based livestock systems in Marin County.

Participation Requirements:

- Producers must be eligible for USDA Natural Resources Conservation EQIP programs.
- Must maintain interest and involvement throughout project and maintain conservation practices a minimum of 10 years or duration of EQIP contract.
- Willing to be a demonstration Carbon Farm.
- Private land

The Project will Fund:

1) Ranch Planning and Permitting
2) Technical/Engineering Expertise
3) Construction of Conservation Practices

Conservation Practices:

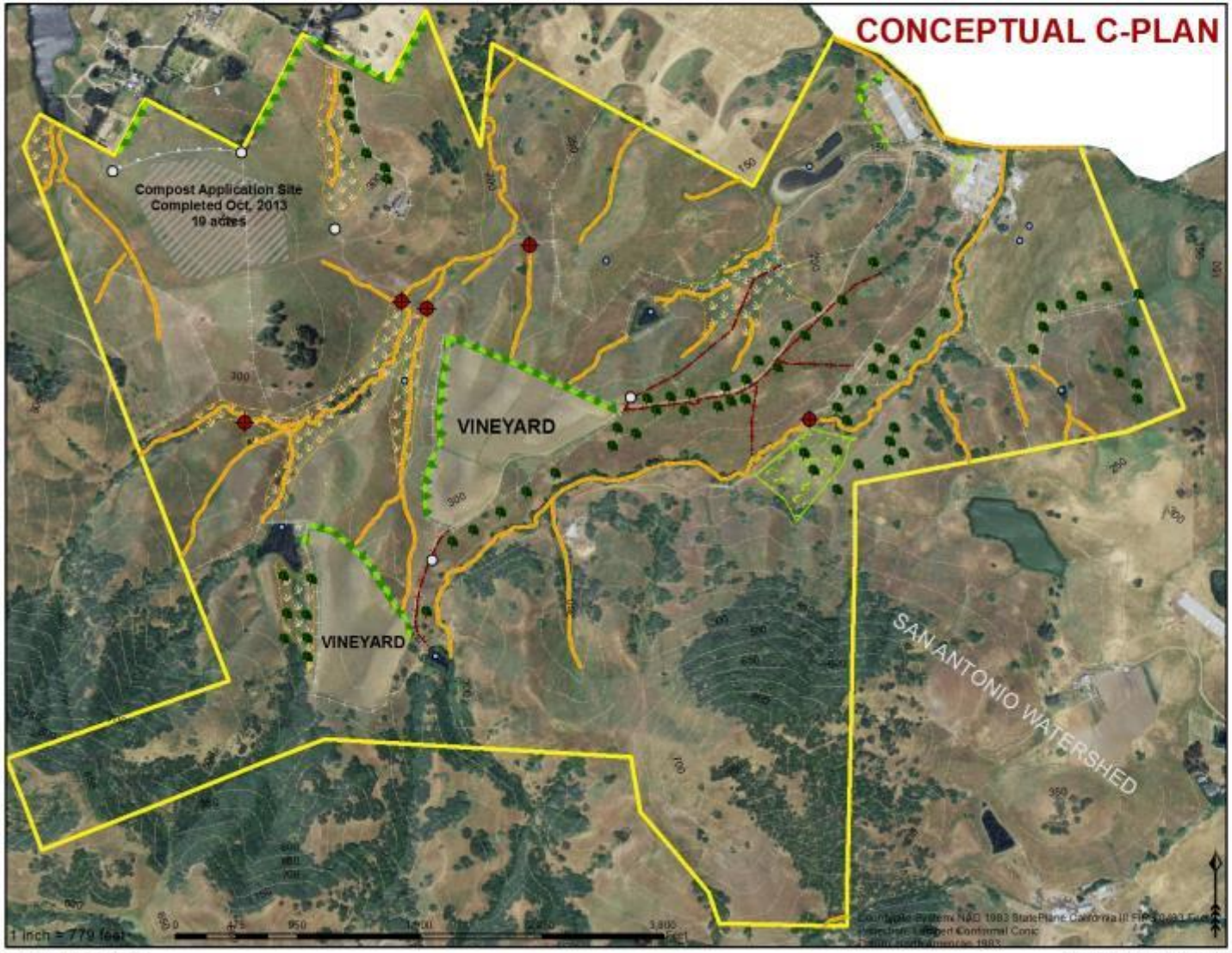
- Compost Application, Purchase
- Erosion Protection Planting: Grasses, Shrubs and Trees
- Crop Rotation and Cover Crop
- Hedgerows and Windbreaks
- Filter Strips and Grassed Waterways
- Forest Establishment
- Nutrient Management, Fertilizer Alternatives
- Pasture and Hay Planting
- Rangeland Management: Prescribed Grazing, Range Planting
- Residue management: No-Till, Strip Till, Seasonal Tillage, Mulch Till
- Creek and Wetland Restoration

DEADLINE IS AUGUST 1ST!!! CONTACT:

Marin Resource Conservation District
Nancy Scolari or Lynette Niebrugge
Phone: (415) 663-1170
Email: marinrcd@marinrcd.org

Support for this program was provided by grants from the Marin Community Foundation, Sara and Evan Williams Foundation and the 11th Hour Project.

Marin Carbon Project
DRAFT
Carbon Farm Plan
CORDA RANCH



Legend

Parcel Boundary

Corda Ranch: 856 acres

Ranch Infrastructure

Fencing, Existing

Water Developments, Existing

Completed Practices

Compost Application/ Mulching

Planned Practices

Silvopasture: 6 acres

Field/Riparian Forest Buffer: 20 acres

Stream Crossing Repairs: 4

Stream Restoration and/or Planting: 6.7 miles

Riparian Buffer Planting: 34 acres

Hedgerow/Windbreak: 7205 linear ft

Fencing/Access Control: 6500 linear ft/ 1.2 miles

Water Development

Pipeline: 1730 linear ft

Troughs: 4

Proposed Conservation Practices (NRCS Practice #)

1. Compost Application/ Mulching (484) (initiated, fall 2013)
2. Critical Area Planting/Riparian Herbaceous Cover (342/390)
3. Fencing/Access Control (382/472)
4. Field Border (386)
5. Range Management Plan/ Prescribed Grazing (110/528)
6. Hedgerow Planting/ Windbreak/Shelterbelt (422/380/601)
7. Livestock Pipeline/ Water Facility (516/614)
8. Nutrient Management (590)
9. Pasture Planting (512)
10. Range Planting (550)
11. Riparian Forest Buffer (391)
12. Silvopasture: Establish Trees & Native Grasses (381/612)
13. Structure for Water Control (587)
14. Wetland Restoration (657)

Author: Lynette K Niebrugge

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Quantifying C-Farm Impacts

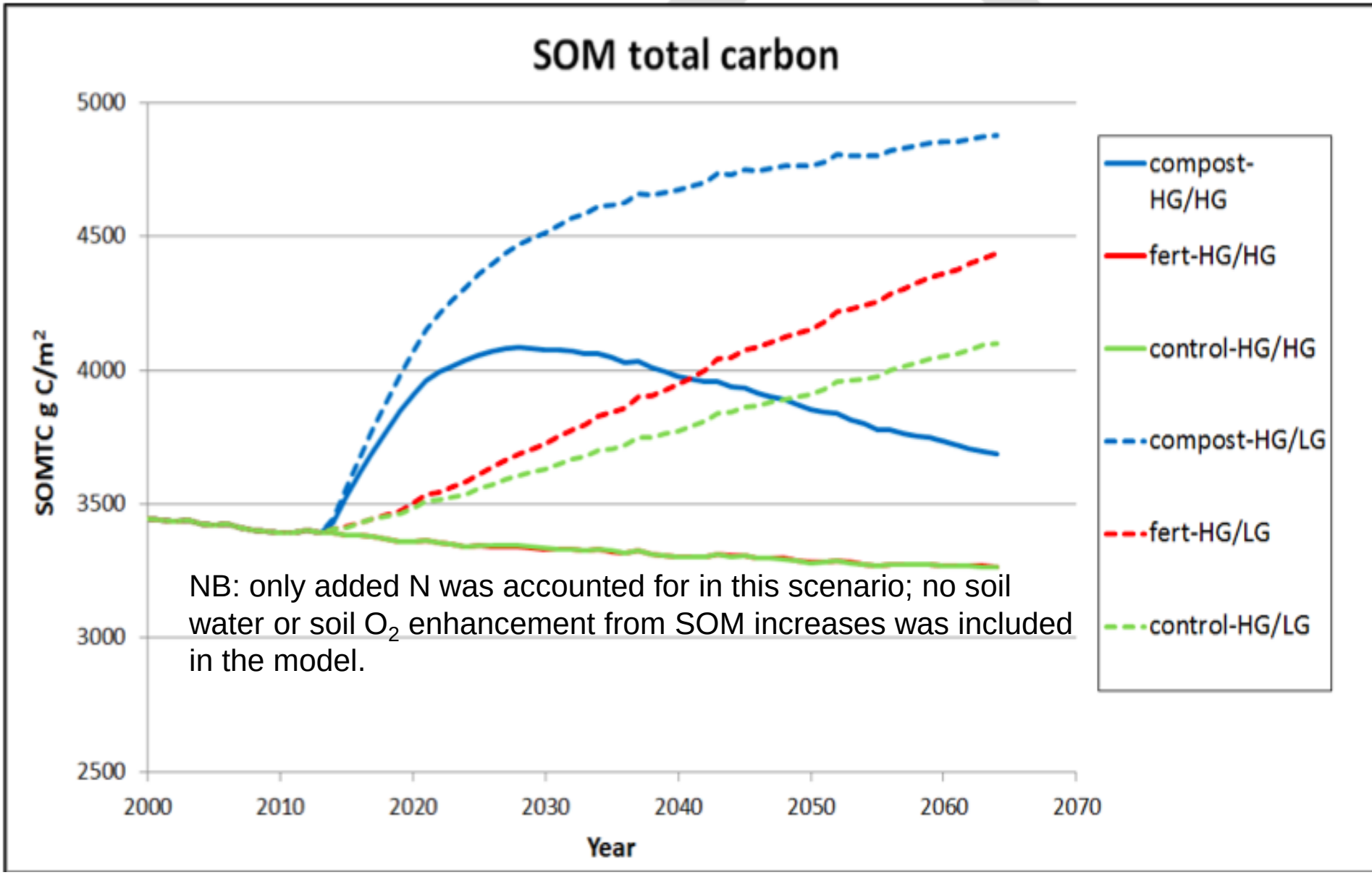
The COMET-Farm Tool
(http://cometfarm.nrel.colostate.edu)
has potential to allow a relatively rapid and thorough assessment of the greenhouse gas benefits of Integrated Carbon Farms

Working with CSU's NREL to use and refine the methods and models behind the COMET-Farm tool to:

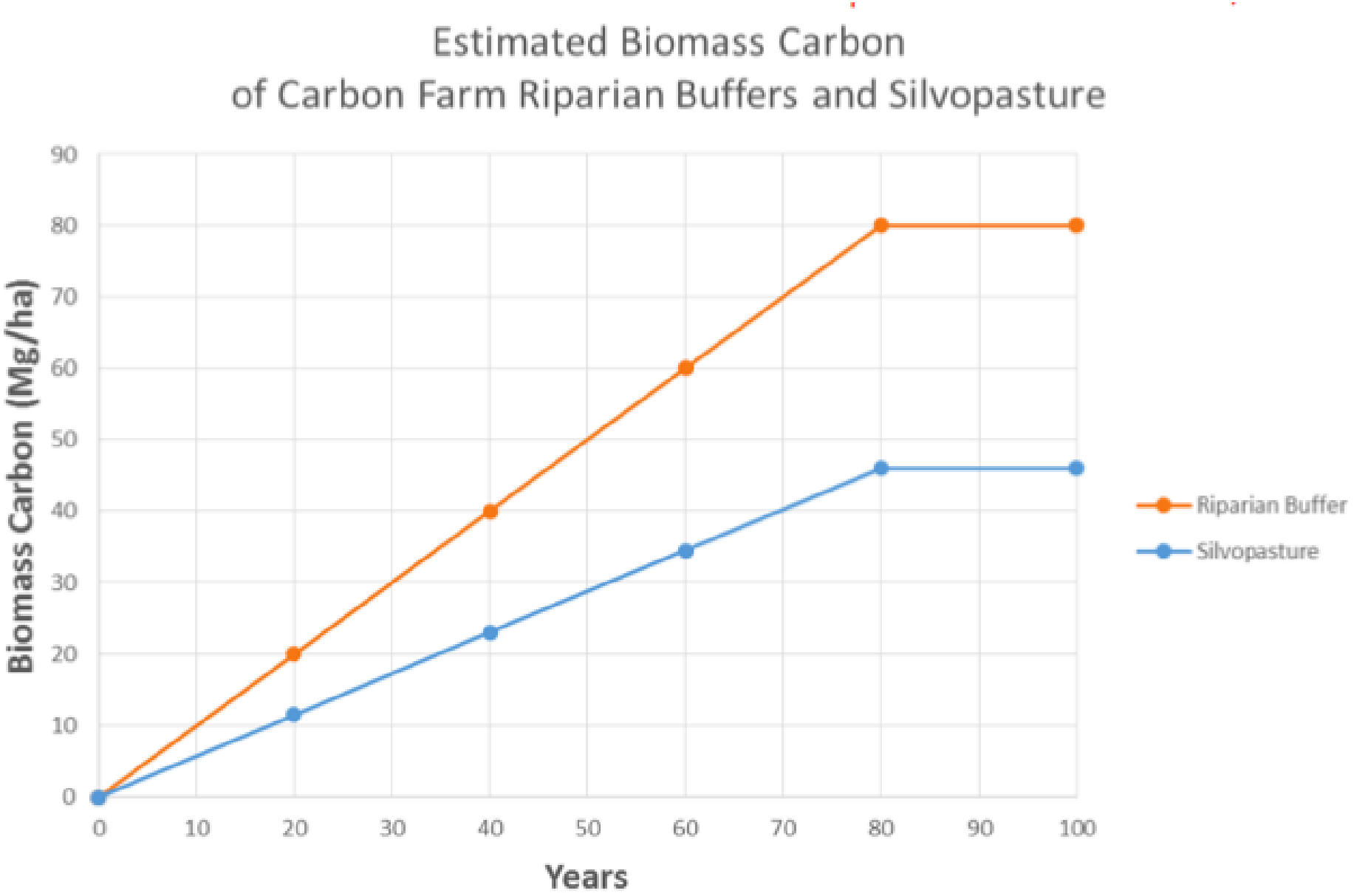
1)calculate the greenhouse gas benefits of proposed practices for our three demonstration carbon farms and;

2)Develop a rapid-assessment on-farm conservation practice carbon capture planning tool:

COMET-Planner Tool
(http://comet-planner.nrel.colostate.edu)



Carbon capture synergies
resulting from “stacking” of compost addition and improved grazing practices


Estimated Biomass Carbon
of Carbon Farm Riparian Buffers and Silvopasture
Biomass Carbon (Mg/ha)
0
10
20
30
40
50
60
70
80
90
0
10
20
30
40
50
60
70
80
90
100
Years
Riparian Buffer
Silvopasture

Questions?

www.marincarbonproject.org

Photo: http://restlesspilgrim.net

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

AGENDA: 5

Local Climate Action Plans

Climate Protection Committee
December 1, 2014

Abby Young
Principal Environmental Planner

Air District and Climate Action Plans

- 2007: 19 Climate Protection Grants to develop climate action plans (CAPs) or integrate GHG reduction into general plans
- 2007-08: work with ICLEI-Local Governments for Sustainability* to provide county-based GHG inventory training
- 2010: CEQA Guidelines and guidance on CAPs
- 2010-14: ongoing technical assistance, review, guidance, tools, feedback
- 2014: 10-Point Climate Action Work Program supports local climate action plan development and implementation

* Formally the International Council for Local Environmental Initiatives

Regional Climate Protection Strategy

Determining regional impact of local CAPs:

- How many are there, which jurisdictions have them?
- What are the similarities across CAPs?
- What are the differences and innovations?
- Do they address all Scoping Plan sectors?
- What is their aggregated impact?

Bay Area Climate Action Plans

60 adopted, community-wide Climate Action Plans

Alameda	El Cerrito	Mountain View	San Leandro
Alameda County	Emeryville	Newark	San Pablo
Albany	Fairfax	Novato	San Rafael
Antioch	Fremont	Oakland	San Ramon
Belvedere	Hayward	Pacifica	Santa Clara
Benicia	Hillsborough	Palo Alto	Santa Clara Co.
Berkeley	Larkspur	Piedmont	Santa Rosa
Burlingame	Livermore	Pleasanton	Solano County
Calistoga	Los Altos	Redwood City	So. San Francisco
Colma	Los Gatos	Ross	Sunnyvale
Concord	Marin County	Saint Helena	Tiburon
Contra Costa Co.	Martinez	San Anselmo	Union City
Danville	Menlo Park	San Carlos	Vallejo
Dublin	Mill Valley	San Francisco	Walnut Creek
East Palo Alto	Milpitas	San Jose	

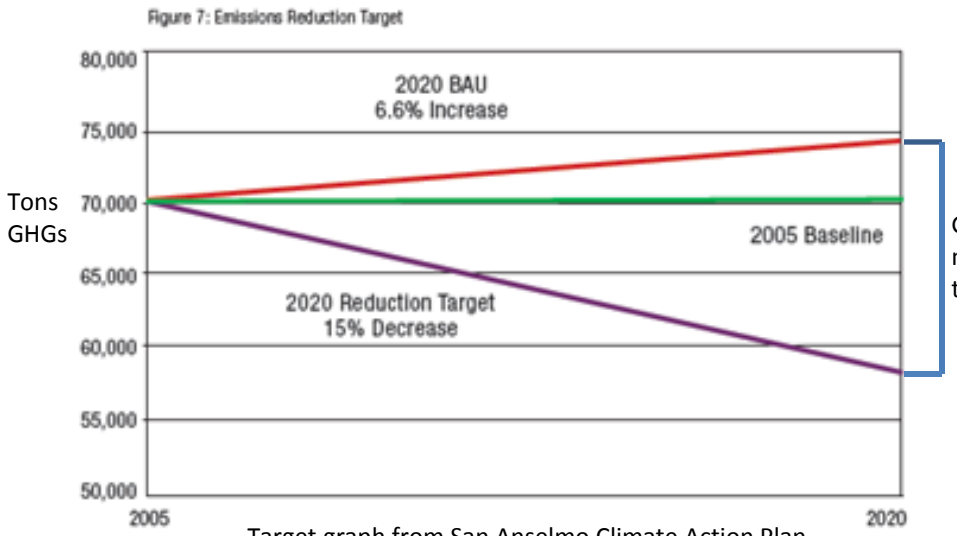
These CAPs cover 80% of the Bay Area population

Targets

AB 32 Scoping Plan: *Community-wide climate action plans should reduce GHG emissions 15% below "current" levels by 2020*

How do Bay Area CAPs measure up to the AB 32 target?

- 32 CAPs use the AB 32 target
- 20 CAPs have more stringent targets
- 4 CAPs have less stringent
- 15 CAPs also include longer targets

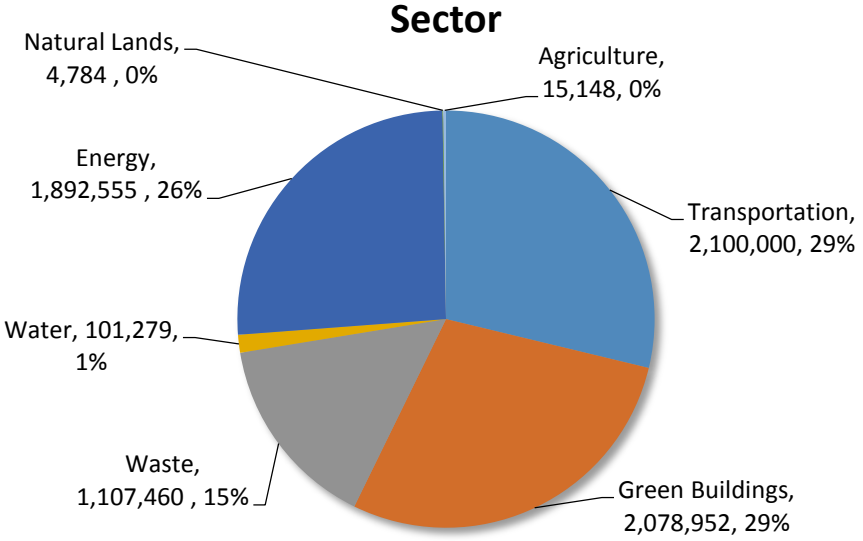


Target graph from San Anselmo Climate Action Plan

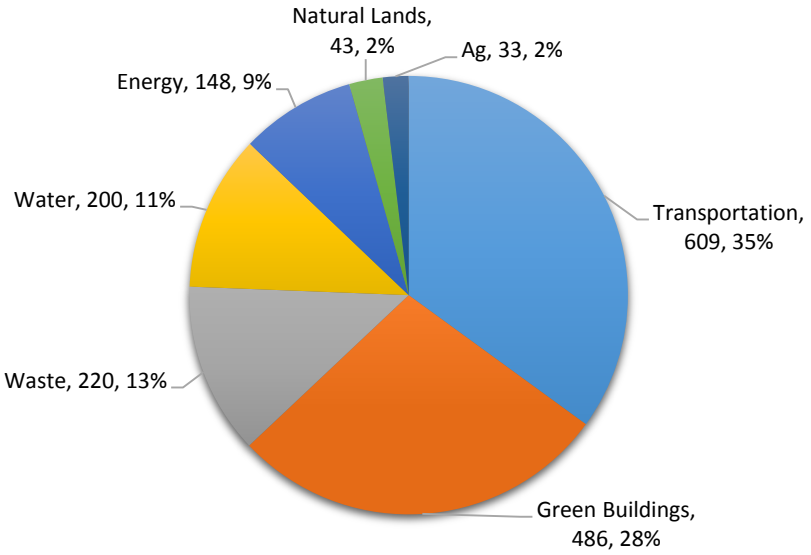
On average, most CAPs rely on state actions to achieve two-thirds of their necessary GHG reductions.

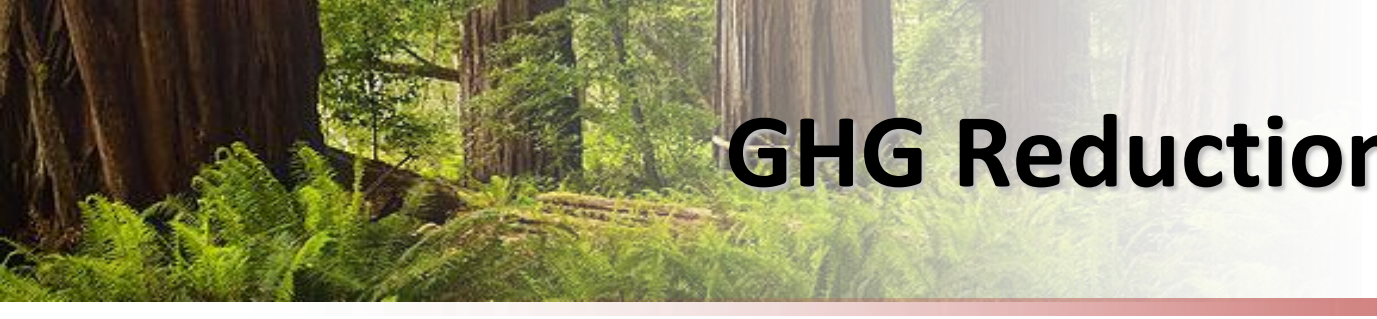
GHG Reduction Measures

Annual Tons GHGs Reduced by 2020 by Sector



of GHG Measures by Sector





GHG Reduction Measures

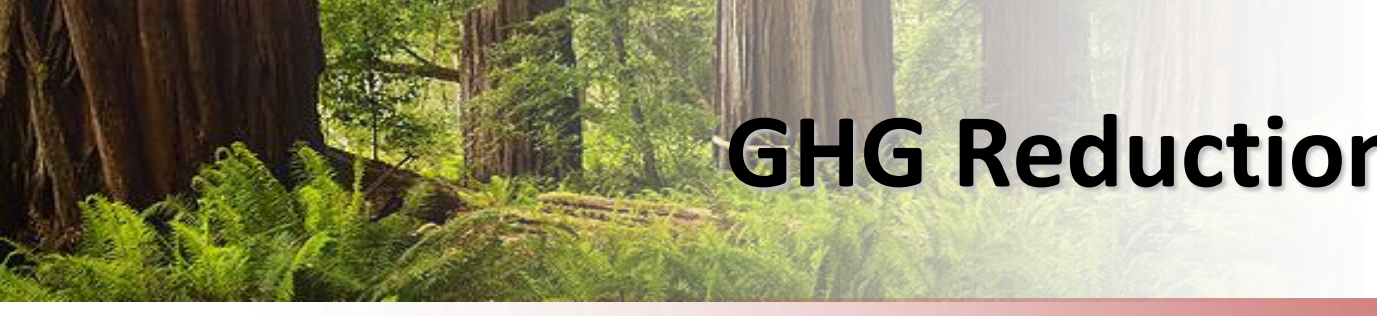
Most common measures by sector

Energy
- Solar financing (PACE)
- Streamline solar permitting, fees
- Investigate community choice aggregation

Transportation
- Mixed use/infill/TOD
- Increase densities
- Bike infrastructure & facilities
- Alternative fuels in municipal fleets

Green Buildings
- Energy efficiency requirements on new development & major remodels
- Promote PG&E and other incentives for existing buildings
- Energy efficiency standards for municipal buildings and facilities

Waste
- “Zero waste” goal
- Expand food waste collection
- Construction & demolition recycling ordinance
- Ban on plastic bags



GHG Reduction Measures

Most common measures by sector

Water

- Conservation requirements on major landscaping projects
- Require greywater for irrigation in new development
- Encourage conservation through tiered pricing

Natural & Working Lands

- Urban tree-planting requirements
- Preserve open space

Agriculture

- Promote farmers markets
- Community gardens
- Reduce fertilizer use

Short-lived Climate Pollutants

- High GWP pesticide alternatives
- Retire refrigerant-leaking equipment/vehicles

GHG Reduction Measures

Particularly innovative/unique measures

- Residential/Commercial Energy Conservation Ordinances (RECO/CECO) (Albany, Berkeley, Burlingame, Hayward, Piedmont, San Francisco, San Pablo)
- Voluntary RECO becomes mandatory if goals are not met (Pleasanton)
- Cool paving ordinance (Santa Rosa)
- Lower GWP refrigerant specifications in municipal purchasing policy (El Cerrito)
- Solar Energy System on Police Station (Tiburon)
- Home-based Business Development Strategy (San Pablo)
- Regionally-produced food for City events (Albany)
- Require recycling as a condition of permit issuance for special events (Fremont, San Carlos, Burlingame)

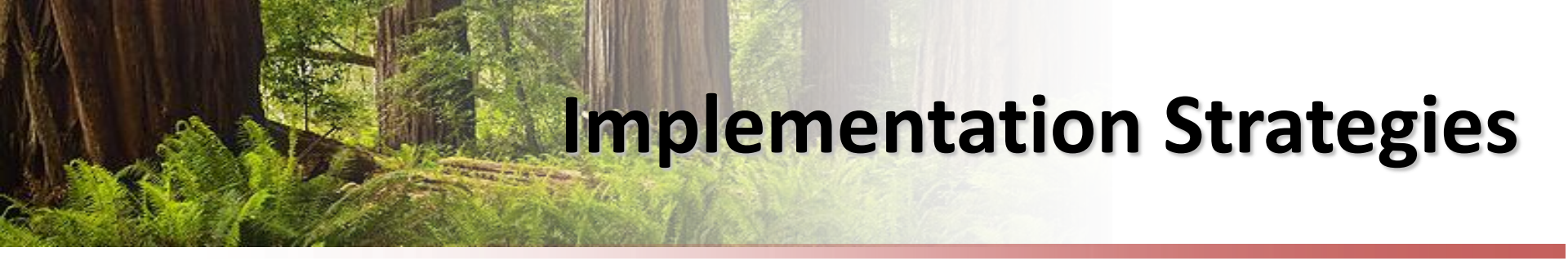
GHG Reduction Measures

What do we mean by voluntary vs. mandatory measures?

Measure	Mandatory	Voluntary
Green Buildings	**Require** energy efficiency upgrades at time of sale	**Promote** PG&E, other incentives
Bicycle Facilities	**Require** large employers to provide bicycle facilities (showers, lockers)	**Encourage** the provision of bicycle amenities in new development
Greywater	Adopt an ordinance **requiring** use of greywater for irrigation	Adopt an ordinance **allowing** greywater systems
Car Share	City **shall/will implement** a car share program	**Explore feasibility** of implementing a car share program
Waste reduction	**Adopt an ordinance** requiring businesses to compost food scraps	**Establish a goal** of zero waste

Key challenge: more mandatory measures in local CAPs

- They are more likely to be fully implemented
- They are more likely to achieve their estimated GHG reductions



Implementation Strategies

Common components of implementation strategies

- Staffing:
  - Internal, inter-departmental “Green Team”
  - Hire climate coordinator
- Monitoring/reporting:
  - Annual reporting on individual measures
  - periodic (every 2-5 years) re-inventory
- Funding/financing:
  - Near-term strategies funded through municipal budget
  - Longer-term strategies funded through grants, financing
  - Cap & Trade funds?

CAPs and Cap & Trade

12 State agencies dispersing $900 million in FY 2014-2015

- 25% (>$200m) must benefit disadvantaged communities
- Each agency will develop its own guidelines
- Guidelines and solicitations expected by end of 2014:

A. Sustainable Communities/Affordable Housing/Sustainable Ag Land (draft guidelines due out Dec. 1, $130m offered in 2015)

B. Low-Carbon Transportation (staggered solicitations starting end of 2014 for total of $200m)

C. Energy Efficiency Financing in Public Buildings (open now for $20m)

D. Agricultural Energy and Operational Efficiency (solicitation due out in Dec., $15m)

E. Water Energy Efficiency (open now, deadline Dec. 12 for $30m)

F. Wetlands Restoration (open now, deadline Dec. 19 for $25m)

G. Waste Diversion Program Organics Loan Program (open now, deadline Dec. 1 for $25m)

CAPs and Cap & Trade

Matching local CAP measures to Cap & Trade funding

- Sustainable Communities/Affordable Housing/Sustainable Ag Land: implement PDA development projects
- Low-Carbon Transportation: launch car-share programs, implement bike master plans
- Energy Efficiency Financing in Public Buildings: upgrade to higher efficiency street and outdoor lighting
- Agricultural Energy and Operational Efficiency: upgrade ag water pumps, off-road equipment
- Water Energy Efficiency: provide home water audits and indoor upgrades
- Waste Diversion Program Organics Loan Program: expand or launch food waste collection program

CAPs and Cap & Trade

Matching local CAP measures to Cap & Trade funding

- **Department of Water Resources' Water-Energy Grant Program**:
  1. City of El Cerrito: *Convert City landscaped areas to 'Bay-Friendly,' drought-tolerant landscapes.*
  2. City of Fremont: *Continue collaborating with the California Youth Energy Services program to conduct residential energy and water audits and to distribute water saving shower heads and faucet aerators to Fremont households.*
- **CAL FIRE's Urban Forestry Grants:**
  1. City of East Palo Alto: *Support efforts to plant trees in East Palo Alto.*
  2. City of San Leandro: *Increase urban canopy cover.*
  3. City of Union City: *Expand the urban forest to sequester carbon and reduce building energy consumption.*

Next Steps

- Continue to support local jurisdictions as they develop and implement local CAPs
- Help jurisdictions find and apply for Cap & Trade funding
- Track and share information on best practices
- Evaluate air quality and public health co-benefits
- Inform the development of the Regional Climate Protection Strategy