Draft

Napa County Climate Action Plan

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Acronyms and Abbreviations

AB	Assembly Bill
ARB	California Air Resources Board
BAAQMD	Bay Area Air Quality Management District
BAU	business as usual
BDR	Napa County Baseline Data Report
C&D	construction and demolition
CAP	Napa County Climate Action Plan
CEQA	California Environmental Quality Act
DEIR	Environmental Impact Report
District	Bay Area Air Quality Management District
DPW	Napa County Department of Public Works
ERP	Emissions Reduction Plan
FEIR	Final Environmental Impact Report
GHG	greenhouse gas
GWP	Global warming potentials
IPCC	Intergovernmental Panel on Climate Change
LGOP	Local Governments Operations Protocol
$MTCO_2e$	carbon dioxide equivalents
NCTPA	Napa County Transportation & Planning Agency
Plan, or CAP	Napa County Climate Action Plan

Executive Summary

The Napa County Climate Action Plan (Plan or CAP) describes the current (2005) greenhouse gas (GHG) emissions, forecasted emissions for 2020, and identifies feasible measures Napa County (County) intends to implement to reduce emissions by 2020 to a level 15% below the 2005 levels. The County's intent in doing so is to meet commitments in the Napa County General Plan (General Plan), to promote the County doing its *fair share* to help meet the state goals in Assembly Bill (AB) 32, and to provide a comprehensive approach to reducing GHG emissions to provide streamlining of the California Environmental Quality Act (CEQA) as allowed by current state and Bay Area Air Quality Management District (BAAQMD) CEQA guidelines. The Plan identifies the GHG reductions that are possible through the application of state, local, and project-level reduction measures. Current and future GHG emissions, the County's reduction target, and the estimated overall effectiveness of the Plan are shown in Table ES-1. Identified reductions measures are listed in Table ES-2.

Table ES-1. GHG Community Emissions & Planned Emission Reductions

Line		2005	2020
	General Plan Development Assumptions		
1	Housing (units)	11,492	13,393
2	Employment (jobs)	23,050	26,765
3	Approved Vineyards (acres)	40,439	47,176
	Community GHG Emissions	**Metric Tons of Carbon Dioxide Equivalent ($MTCO_2e$)**	
4	Residential Buildings	48,220	55,940
5	Commercial/Industrial Buildings	95,320	111,060
6	Waste	9,240	10,630
7	On-Road Vehicles	191,270	230,110
8	Off-Road Vehicles (lawn/garden)	750	870
9	Off-Road Vehicles/Equipment (Commercial/Industrial)	15,870	18,830
10	Agricultural Vehicles	31,820	38,390
11	Wastewater and Septic	5,632	6,478
12	Land Use Change Emissions (from Line 19)		27,534
13	Total	398,122	499,832
14	Carbon Sequestration	(391,648)	(386,954)
15	Carbon Sequestration in New Vineyards	(140)	(160)
16	Land Conversion for Development (Stock Loss)	7,218	7,218
17	Land Conversion for Vineyards (Stock Loss)	38,188	61,047
18	Net Annual Sequestration + Carbon Stock Loss	(346,382)	(318,849)
19	*Change in Emissions due to Land Use*		*27,534*
20	AB 32 Community Target (15% below 2005)		338,404
21	State Emission Reduction Measures		96,262
22	Napa County Emission Reduction Measures		65,209
23	Total Community Reductions		161,471
24	*2020 Emissions with CAP Implementation*		*338,361*

Table ES-2. Summary of Community Emission Reduction Measures

Proposed Reduction Measures	Estimated Effectiveness ($MTCO_2e$)
State Measures	96,262
Implementation of AB 1493 (Pavley I & II)	
Low Carbon Fuel Standard	
Other Vehicle Efficiency Measures	
Renewable Portfolio Standard	
Landfill Methane Regulation	
Napa County Measures	20,498
Title 24 Local Implementation	
Implement Energy Efficiency/Renewable Energy Financing District	
Implement weatherization of low income homes	
Adopt Water Efficiency Ordinance (completed)	
Increase availability of recycled water	
Education and outreach related to agricultural water conservation	
Expand/start kitchen waste compost program	
Expand/start construction and demolition (C&D) waste program	
Waste minimization public outreach	
Renewable Energy Finance District	
Support waste to energy efforts at Clover Flat	
Remove barriers to renewable energy development	
When rezoning, ensure walkable mixed-use developments	
Integrate below market housing with other housing	
Implement traffic calming measures where feasible	
Add bike lanes consistent with General Plan commitment	
Assist Napa County Transportation & Planning Agency (NCTPA) w/improved transit	
Assist NCTPA w/station bike parking, park and ride, etc.	
Facilitate employer-based commute trip reduction program	
Encourage employer sponsored vanpool/shuttle	
Reduce parking requirements and adopt maximums	
Assist NCTPA/others with network improvements	
Measures for Implementation by Discretionary Development Projects	10,936
Replace all trees slated for removal (2:1 replacement ratio) and revegetate the site after construction so that 100% of carbon stock/annual carbon sequestration loss is replaced.	
Reduce other GHG emissions by at least 5.5% via one or more of the options listed on the voluntary GHG emission reduction checklist in Appendix B	
Measures for Implementation by Discretionary Vineyard Projects	33,774
Operational best practices (cover crop, mulching instead of burning, biofuels, etc.)	
Calculate and offset carbon stock/annual sequestration loss by at least 51.5% via one or more of the options listed on the worksheet in Appendix B	
Total of State, County, and Project-Level Measures	161,471

Chapter 1
Introduction

This document describes the Napa County Climate Action Plan (Plan, or CAP). This document contains: a description of legal and regulatory activity motivating climate action planning in California; an inventory of GHG emissions in Napa County in 2005; an inventory of projected emissions in 2020, and a list of actions that the County will take to reduce GHG emissions. Appendices are provided which detail the assumptions, methodologies, and calculations used to formulate the CAP (Appendix A Methodology and Appendix B Project Level Worksheets).

1.1 California's Goals to Reduce Greenhouse Gas Emissions (AB 32)

In 2006, the California legislature passed AB 32, the Global Warming Solutions Act of 2006. The law establishes a state-wide GHG emissions reductions goal for the year 2020. Executive Order (EO) S-03-05 established California's 2050 GHG reductions goal. The state's GHG emissions reductions goals are:

- Return to 1990 levels of GHG emissions by 2020 (AB 32)
- Reduce GHG emissions to 80% below 1990 levels by 2050 (EO S-03-05)
- Support achievement of the above goals by: increasing transit oriented development, reducing VMT, and promoting the development of sustainable communities (Senate Bill [SB] 375)

The California Air Resources Board (ARB) has estimated that statewide GHG emissions for the years 1990 and 2002–2004 were 427 million metric tons of carbon dioxide equivalents ($MTCO_2e$[1]) and 469 million $MTCO_2e$, respectively. ARB also determined that in the absence of action to reduce or mitigate GHG emissions, in 2020 the state would emit 596 million $MTCO_2e$. ARB's 2020 projection is known as a *business as usual* (BAU) projection.[2] To achieve the 2020 GHG emission reduction goals set out by ARB, the state of California would have to reduce 2020 BAU emissions by approximately 30%, which is equivalent to reducing current [3]emissions by 15%.

1.2 Local Governments and Assembly Bill 32

AB 32 directed ARB to develop a roadmap for achieving California's 2020 GHG reduction goal. The roadmap, known as the *AB 32 Scoping Pla*n, lists and describes actions and programs by sector that

[1] Carbon dioxide equivalent refers to the combined level of GHG emissions due to different GHGs, including carbon dioxide, methane, nitrous oxide, and other gases. These gases have different global warming potentials (GWP). Thus, in order to combine the totals of all GHGs, each gas is adjusted by a GWP factor to account for the difference in their effect on the atmosphere. The level for carbon dioxide is set at 1. As an example, the GWP for methane is 21, which means that pound for pound, methane is has a global warming potential 21 times greater than carbon dioxide.

[2] *Business as usual* refers to future emissions including future growth, but not taking into account the effect any actions taken by the state or the County to reduce emissions. This scenario provides a basis by which to evaluate the reductions possible from different reduction strategies.

[3] According to the state of California, as regards local GHG inventories *current conditions* means 2008 or earlier. For the purposes of this inventory *current conditions* refers to the baseline GHG inventory year, 2005.

the state will undertake to reduce its GHG emissions (California Air Resources Board 2008). The AB 32 Scoping Plan discusses how the Pavley standards (AB 1493), the low carbon fuel standard (EO S-01-07), the renewable portfolio standards (AB 1078 and AB 107), the landfill methane capture rules, and other initiatives and policies combine and work in concert to result in GHG emission reductions. The Scoping Plan also identifies a unique role for local governments stating that local governments have broad influence and sometimes exclusive authority over activities resulting in GHG emissions in California.

The Scoping Plan encourages local governments to use their authority to implement policies to reduce GHG emissions within their jurisdictions. The Scoping Plan recommends, but does not require, that municipalities reduce existing emissions by 15% (compared to current levels) to be consistent with AB 32 objectives. Many local governments have completed or are in the process of completing a GHG inventory and GHG reduction plan (also known as a Climate Action Plan or CAP) consistent with the recommendations of the AB 32 Scoping Plan.

1.3 Napa County Activities

In 2008, Napa updated its General Plan (Napa County 2008). Consistent with AB 32 guidance, the Napa General Plan states that the County will reduce its existing GHG emissions by 15% by the year 2020. The baseline year for Napa County GHG emissions is 2005, consistent with baseline conditions used in the General Plan EIR (Napa County 2007) and the baseline year for the Napa County Baseline Data Report (BDR) (Watershed Information Center & Conservancy of Napa County 2005). The General Plan states that the County will undertake an inventory and climate action planning process to quantitatively evaluate existing and projected GHG inventories and identify and quantify policies which will result in GHG reductions. Napa County has completed a GHG inventory and a CAP, both described in this report.

Since 2005, the County has taken several major actions towards reducing Napa County emissions. In 2005, the incorporated cities and the unincorporated portions of Napa County contracted an outside consultant, MIG Consulting Engineers and the Climate Protection Campaign, to perform a GHG inventory for community-wide emissions[4] in all jurisdictions (Unincorporated Napa County, City of Napa, City of Calistoga, City of St. Helena, City of American Canyon and City of Yountville). In 2007, the Napa County Department of Public Works (DPW), together with Kenwood Energy, performed a separate inventory of and reduction plan for the GHG emissions associated only with the County's municipal operations[5]. DPW and Kenwood Energy identified a suite of actions (the Emissions Reduction Plan or ERP) (Napa County Department of Public Works and Kenwood Energy 2007) that would result in the County reducing municipal emissions by 15%. In 2010, Napa County contracted ICF to assist in developing a GHG reduction plan for the community emissions associated with the unincorporated County. This plan also includes an inventory of carbon stocks (carbon stored in plants) in the County, an estimate for the loss in carbon storage in the County that will result from several development scenarios, and a framework for mitigating loss of carbon sequestration in the County between now and 2020. The resulting plan, described herein, is the compilation of these

[4] Community-wide emissions refer to those emissions that result from all activities within the jurisdictional boundary, including activities of residents, businesses, visitors as well as activities associated with municipal operations. Municipal operations emissions refer to those emissions that result only from the County government's operations and provision of services and include but are not limited to operation of County buildings, fleet, landfills and wastewater treatment facilities. The municipal inventory overlaps in part with the community inventory where County operations occur within unincorporated areas. Where municipal operations occur within incorporated City areas, they are outside the community inventory. Napa County is taking action to reduce both community emissions (through this Plan) and County municipal emissions (through the ERP).

[5] See above

efforts, and charts a clear path to reducing community emissions in the unincorporated portions of the County.

Chapter 2
2005 GHG Inventory and 2020 GHG Emissions Projection for Napa County

2.1 Methods and Data Sources

GHG emissions were estimated for the unincorporated portions of Napa County for the baseline year 2005 and projected for the BAU year 2020 using the following protocols:

- Local Governments Operations Protocol (LGOP) for the quantification and reporting of greenhouse gas emissions inventories (California Air Resources Board 2010)
- 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Intergovernmental Panel on Climate Change 2006)
- Protocols contained in ICLEI Clean Air Climate Protection Software (ICLEI 2010a, b)
- Guidance for apportioning vehicle miles travelled between trip origins and destination from the SB 375 Regional Targets Advisory Committee (Regional Targets Advisory Committee 2009)

These protocols were used in conjunction with Napa County specific data as provided by the County and from the following publications: Napa County General Plan (June 2008); Napa County General Plan Draft Environmental Impact Report (DEIR) and Final Environmental Impact Report (FEIR); Napa County Baseline Data Report; 2050 Napa Valley Water Resources Study; Napa/Solano Travel Demand Model; and the Bay Area Regional Transportation Plan. A complete description of the methods used to develop the GHG inventory and BAU forecast can be found in Appendix A.

2.2 Scope 1 and 2 Emissions [6] in 2005 and Projected Emissions in 2020[7]

Table 1 lists the GHG emissions by sector for the baseline inventory year 2005 and GHG emissions projected in 2020 under a business as usual scenario. Table 1 represents the GHG emissions that

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[6] Standard GHG inventory protocols for local governments (California Air Resources Board 2010), as well as other entities that might perform an inventory, generally classify GHG emissions sources into broad categories called *Scopes*.

Scope 1 emissions are direct emissions which include but are not limited to: stationary combustion within the jurisdictional boundary; mobile combustion within the jurisdictional boundary or for trips attributed to the jurisdictional boundary; process emissions other than fuel combustion that occur within the jurisdictional boundary (e.g. cement production emissions); fugitive emissions within the jurisdictional boundary (e.g. leaks from fuel storage); and refrigerant leaks and methane (CH_4) emissions from landfills under the jurisdiction's control).

Scope 2 emissions are indirect emissions and can be thought of as emissions that may occur outside of the jurisdictions boundary but as a result of activity within the jurisdiction and for which the jurisdiction can exert control or influence. These emissions are related to: the consumption of electricity within the jurisdiction (where generation of the electricity is often outside the jurisdiction); the consumption of water within the jurisdiction (that includes electricity consumption); and the generation of waste within the jurisdiction that goes to a landfills not under the County's jurisdiction.

[7] Emissions due to land use change are discussed in greater detail in the next section.

resulted from activities by Napa residents, businesses, and employees in 2005 and which are forecasted for 2020.

Table 1. 2005 GHG Inventory and 2020 BAU GHG Forecast

GHG Emission Sources	2005 Baseline ($MTCO_2e$)	2020 BAU Forecast ($MTCO_2e$)
Residential Building Energy Use	48,220	55,940
Commercial/Industrial Building Energy Use	95,320	111,060
Waste	9,240	10,630
On-Road Vehicles	191,270	230,100
Off-Road Vehicles (Lawn and Garden)	750	870
Off-Road Vehicles (Commercial/Industrial)	15,870	18,830
Agricultural Vehicles[1]	31,820	38,390
Wastewater and Septic[2]	5,632	6,478
Emissions due to Land Use Change[3,4]	--	27,534
TOTAL COMMUNITY EMISSIONS[5]	398,122	499,832
Municipal Community Emissions[6]	7,940	9,133

1 Agricultural emissions from manure management and enteric fermentation were assumed to be negligible in Napa County. Emissions from fertilizer use are unknown at this time, although fertilizer application for vines is small relative to other crops.

2 Wastewater is included in community inventory as these are the wastewater emissions at Napa Sanitary District facilities due to County population. Septic included for County population.

3. Emissions due to changes in carbon stock and sequestration are calculated relative to the baseline year 2005. Although land was converted in 2005, no emissions are listed for the baseline year since the inventory methodology (see Appendix A) assesses the change in annual carbon sequestration and carbon stock loss between that in 2005 and in 2020.

4. Emissions resulting from a loss in sequestration/carbon stock reflect a range of the three potential vineyard expansion scenarios described in the Napa County General Plan (see Appendix A tables A7 and A8). The average is shown above and is the average of the high and low scenario.

5. Column totals may not reconcile completely with individual values due to rounding errors with Excel.

6. Municipal emissions include emissions from County fleets, buildings, and employee commute. The focus of this plan is community emissions. Municipal emissions are addressed separately in the County's ERP for municipal operations.

Total GHG emissions in 2005 were approximately 398,000 $MTCO_2e$. The largest source of emissions was on-road transportation (48%), with the second largest source being energy consumed by residential and commercial buildings (36%). The remaining sources included agricultural vehicles (8%), other off-road vehicles (4%), waste (2%) and wastewater and septic (1%). Emissions listed in Table 1 represent approximately 0.09% of California's emissions in 2005. In 2005 average per capita emissions for the state as a whole were 15.5 $MTCO_2e$ per person. In Napa County, 2005 per capita emissions were 13.9 $MTCO_2e$ per person.

The GHG inventory and forecast presented in this report detail Scope 1 and Scope 2 emissions associated with the unincorporated portions of Napa County. The GHG inventories presented in this report are based on best available data, projections, and protocols. As revised data, forecasts, and protocols become available, the County will revise its GHG inventories. The state GHG emissions reductions goal (15% below current levels) and the AB 32 Scoping Plan are generally directed at Scope 1 and 2 emissions sources (emissions related to mobile or stationary fossil fuel combustion, and waste generation, etc.). Although a variety of alternative approaches are valid, the County has decided that to be consistent with AB-32 Scoping Plan recommendations, the Napa inventory should include only Scope 1 and Scope 2 emission sources and not include sources such as lifecycle emissions or emissions associated with changes in land use (changes in carbon stock). To ensure full disclosure, and to highlight the polices that the County is implementing to address GHG emissions associated with land use conversions, Scope 1, Scope 2, and carbon cycle analyses are presented in this report.

Napa County's GHG emissions are projected to be approximately 500,000 $MTCO_2e$ in 2020 under a BAU scenario. The growth in GHG emissions in 2020 relative to 2005 generally parallels projected growth in population, jobs, and housing in the County.

As stated in the General Plan, the County intends for year 2020 emissions to be 15% below existing emissions by the year 2020. As such, the County's 2020 emission goal is approximately 338,000 $MTCO_2e$. To achieve the GHG reduction goal, the County needs to reduce 2020 BAU emissions by approximately 161,000 $MTCO_2e$.

Table 2. Target Tracking – GHG Reduction Requirements for Community Emissions

Target Tracking	($MTCO_2e$)
2005 Community Emissions	398,122
2020 Community BAU Emissions	499,832
2020 Emissions Target (15% below 2005 Levels)	338,404
Emissions Reductions Needed to Reach Target in 2020	161,428

2.3 Emissions Due to Changes in Land Use

As part of photosynthesis, vegetation takes in carbon dioxide and the carbon is stored in plant matter as well as in organic matter in soils (through roots and buried vegetation), which is referred to as carbon sequestration. When vegetation is removed for agricultural or urban development, then the stored carbon can be released back to the atmosphere if the vegetation is burned or is otherwise transformed in a state that allows the degradation of the plant matter. Similarly, carbon stored in organic matter in soils can also be released back to the atmosphere due to erosion, grading, or deep ripping. Conversely, the sequestration of land can be increased through activities that increase the opportunity to store carbon, including tree planting and agricultural soil conservation, among other approaches.

The net carbon flux (sum of CO_2 emissions and CO_2 releases from plants and/or plant removal) in Napa County was estimated for 2005 and forecast for 2020. In 2005, including the uptake of carbon by natural vegetation as well as the release of carbon due to land use and vineyard conversions of natural land covers, there was an estimated net sequestration of approximately 346,000 $MTCO_2e$. Using three of the vineyard scenarios from the General Plan EIR[8], 2020 net sequestration was estimated to range from 292,000 to 345,000 $MTCO_2e$, depending on scenario with an average of the low and high scenario being 319,000 $MTCO_2e$. Compared to 2005, in 2020 it is estimated that there could be an additional release of 1,177 to 53,891 $MTCO_2e$ (with an average of 27,534 $MTCO_2e$) due to land use and vineyard conversions, depending on vineyard scenario. This average additional emissions amount was added to the 2020 inventory as shown in Table ES-1 line 12. The methodology for preparing these estimates is described in Appendix A.

[8] The General Plan identifies three potential patterns of vineyard development, vineyard development scenarios 1–3. These scenarios result in the conversion of a different total number of acres to vineyards by 2020 as well as a different mix in the type of acres that are converted. The low and high scenarios were averaged to present an average condition as the basis for this Plan.

Chapter 3
Emissions Reduction Measures

3.1 State Reduction Measures

The state of California has already committed to a suite of actions that will result in GHG reductions within Napa County that do not require additional action by the County. These measures are listed as *State Measures* in Table 3 and include:

- AB 1493: Pavley I and II – GHG Vehicle Standards
- Other Vehicle Fuel Efficiency Measures
- SB 1078 and SB 107: Renewable Portfolio Standard
- EO S-01-07: Low Carbon Fuel Standard
- Landfill Methane Regulation

As shown in Table 4, statewide reduction measures are expected to reduce 2020 BAU emissions in the County by approximately 96,000 $MTCO_2e$. The statewide reduction measures are primarily associated with reductions in on-road and off-road GHG emissions, increased energy efficiency, and the increased use of renewable power. Statewide reduction measures will achieve approximately 60% of the total reductions needed by Napa County to meet its target for 2020 (Table 4).

Table 3. Napa County Climate Action Plan Measures

State Measures	
S-1	AB 1493 Pavley I and II
S-2	Low Carbon Fuel Standard
S-3	Other Vehicle Efficiency Measures
S-4	Renewable Portfolio Standard
S-5	Landfill Methane Regulation
Energy Efficiency Measures	
EE-1	Green Building Ordinance (Meet Title 24, including Cal-Green)
EE-2	Energy Efficiency Financing District (California FIRST or equivalent program)
EE-3	Weatherization of Low-Income Homes
EE-4	Plant Trees for Shading for Discretionary Projects
EE-5	Passive Design for Discretionary Projects
Water Measures	
W-1	Comprehensive Water Efficiency Ordinance
W-2	Landscape Ordinance
W-3	Recycled Water
W-4	Agricultural Water Conservation Programs
Waste Measures	
WST-1	Expand/start a kitchen waste composting program
WST-2	Expand/start C&D waste program (C& D benefits are accounted for as part of Cal-Green [EE-1])
WST-3	Waste Minimization and Public Outreach
Renewable Energy Measures	
RE-1	Renewable Energy Financing District (California FIRST program or equivalent)
RE-2	Biofuels and Landfill GTE at Clover Flat
RE-3	Remove Barriers to Renewable Energy Development
Transportation Measures	
T-1	When Rezoning, Promote Dense, Mixed-Use Developments
T-2	Integrate Below Market Rate Housing
T-3	Requirements for Use Permit Applicants
T-4	Traffic Calming Improvements
T-5	Bicycle Network and Bicycle Parking
T-6	Assist NCTPA to Improve Transit Network
T-7	Assist NCTPA with Station Bike Parking
T-8	Assist NCTPA with Park-and-Ride Lots
T-9	Require Contributions for Transit Access Improvements when relevant

T-10	Facilitate Employer-Based Commute Trip Reduction Program
T-11	Encourage Employer Sponsored Vanpool/Shuttle
T-12	Reduce Parking Requirements and Establish Parking Maximums
T-13	Preferential Parking
T-14	Assist NCTPA & Others with Improved Traffic Flow
Project Level Measures	
PL-1	Project Level Program for Vineyard Conversion Projects
PL-2	Project Level Program for Development Projects

3.2 County Reduction Planning

The County of Napa evaluated conventional and innovative ways to reduce County GHG emissions as part of the development of this Plan. This section describes the unique characteristics and opportunities to reduce GHG emissions in Napa County and the process by which reduction measures were selected for inclusion in the Plan.

The pattern of GHG emissions differs greatly from community to community, reflecting the predominant economic activities, land use patterns, transportation needs and lifestyle of a community. The process of identifying GHG reduction measures is also unique to each community and reduction planning must reflect not only the emissions sources in the community but also what solutions are available and feasible in a particular community.

GHG emissions in Napa County include these features which are different than other more urban parts of the greater Bay Area:

- Due to the primacy of agricultural preservation and the focus of growth within the incorporated cities, the annual growth in population, jobs and housing in the County is projected to be approximately 1% or less. As a result, new construction (and opportunities to build new and more energy efficient buildings) in the County will be minimal.
- Napa County does not currently rely on water imports and thus the energy intensity of each gallon of water used in the County is relatively low. Water conservation in Napa County therefore does not result in the same GHG savings as it would in southern California communities. Further, the County already had in place in 2005 notable programs for residential, commercial and agricultural water conservation.
- The rural character of the County means the nature and pattern of vehicle trips are not easily substituted by mass transit.
- Unlike larger municipalities, the County does not have sole control over large stationary emission sources such as landfills and cement production that can yield significant GHG reductions through the one-time installation of control technology.
- In 2005, Napa County was already diverting approximately 71% of its waste (CalRecycle 2010) which is much higher than the state average (52% in 2005), and thus significant reductions in this sector are not as readily possible in the short-term through new or expanded programs.

Although implemented for other purposes, Napa County already had in place numerous policies and programs that act to reduce GHG emissions in the County prior to conducting a formal GHG inventory in 2005. These measures have helped to control emissions in the County in the past.

However, at a local, state, and global level, further reduction is needed, and the target of this plan is to reduce emissions further from 2005 levels consistent with the ambitions of AB 32.

The science and policy of reducing GHG emissions has generally been focused on urban and suburban areas. Thus, the suite of feasible solutions for predominantly rural areas is quite different than for urban communities. The measures listed below reflect Napa's unique character and capitalize on the best locally-appropriate opportunities to assist the state in meeting the goals of AB32.

3.3 County GHG Emission Reduction Measures

Through the climate action planning process, the County has identified and will implement the measures listed in Table 3 in order to reduce community-wide GHG emissions consistent with the County's General Plan GHG target. Programs and policies implemented by the County will result in a reduction of 2020 community BAU emissions by approximately 65,000 $MTCO_2e$ (Table 4). Project level reductions related to development and vineyard projects (including mitigating for carbon stock and sequestration loss) would provide the largest reductions (~45,000 $MTCO_2e$). Other reductions efforts would occur in the transportation sector (~13,000 $MTCO_2e$), energy efficiency and renewable energy measures (~5,000 $MTCO_2e$). Modest reductions are also achieved in the waste and water sectors. A detailed list of measures, the individual GHG reductions expected and the key assumptions used to estimate the reductions can be found in Appendix A.

The AB 32 Scoping Plan also expresses a goal to maintain the current amount of carbon sequestration in forests in the state of California. To date, sequestration analysis has not commonly been included in city of county GHG inventories.

The carbon stocks located in Napa County afford a unique mitigation opportunity so the County studied sequestration in detail. Because more than 500,000 acres in Napa County are covered by forest, woodland, scrubland, grassland or other natural land covers, stewardship of these lands represents a unique opportunity for Napa County to do its part to help the state maintain sequestration capacity and achieve its GHG emissions reductions goals. Therefore, in addition to reducing other sources of GHG emissions, the Napa County Climate Action Plan includes a quantitative framework for offsetting loss of sequestration in ways that support additional GHG reductions in the County.

Measure PL-1 requires project-level calculations and reductions or offsets for carbon stock loss associated with new vineyard development. This measure requires that project proponents complete a series of worksheets to calculate the carbon stock loss, and reduce or offset 51.5% of the emissions as part of the project, demonstrating that the project is consistent with this Plan. The full inventory of Napa's existing carbon stocks, projections of stock loss before 2020 under various vineyard expansion scenarios, the underlying analysis and the approach for project level offset requirements is described in detail in Appendix A (Methodology) and Appendix B (Project Level Worksheets).

Measure PL-2 will also require project-level calculations of GHG emissions for development projects using the standard methodology and tools promulgated by BAAQMD (which does not quantify emissions associated with carbon stock loss and loss of annual sequestration due to conversion of natural land to urban use). This Plan establishes a requirement for development to fully replace on-site vegetation (including replacement of trees at a 2:1 ratio) so as to offset the carbon stock loss/loss of annual sequestration associated with the project. In addition, projects are required to reduce their calculated emissions by a fixed percentage (5.5%), and applicants are given the flexibility to determine how to do this using the voluntary checklist in Appendix B.

Taking into account the full effect of state, local, and project-level measures, the amount of reductions for new development projects and for new vineyard projects is roughly equivalent as shown in Appendix A.

Table 4. Target Tracking – With CAP Implementation

Target Tracking	**($MTCO_2e$)**
2005 Emissions	398,122
2020 BAU Emissions	499,832
2020 Emissions Target (15% below 2005 Levels)	338,404
Reductions Needed to Reach Target	*161,428*
State Level Reduction Measures	(96,262)
County Level Reduction Measures 1, 2	(65,209)
Identified Reduction Measures	*161,471*

Chapter 4
CEQA Considerations and Tiering

This CAP is consistent with General Plan Goals CON-15 (requiring reduction of local GHG emissions), CON-16 (promoting energy conservation, energy efficiency, and local renewable energy) and Policy CON-65 (requiring study of GHG emissions, study and preservation of carbon sequestration, promotion of alternative transit, and consideration of GHG emissions and carbon sequestration in project review) as well as other relevant goals and policies. This Plan implements General Plan Action Items CON CPSP-1 (development of a GHG inventory) and CPSP-2 (development of a reduction plan). This Plan also fulfills Mitigation Measure 4.8.7a in the adopted EIR for the General Plan (which required General Plan Action Item CON CSPS-2).

As a discretionary action, prior to adoption of the Plan by Napa County, CEQA review will be required. The Plan does not change the level of development or agricultural activity in the County compared to that disclosed in the EIR for the General Plan. The community measures in the Plan, in most cases, mirror adopted General Plan measures calling for energy efficiency, water conservation, waste minimizations and diversion, reduction of vehicle-miles travelled, and preservation of and compensation for loss of natural vegetation land covers. As such, many of the potential effects of implementation of this Plan were covered broadly by the EIR analysis in the General Plan. The County will review the specific actions in this Plan relevant to the prior EIR analysis. If necessary, additional CEQA evaluation will be conducted to disclose any new or substantially more severe impacts not already disclosed in the prior EIR, including any required public notification and review requirements.

Amendments to the CEQA guidelines in March 2010 describe that CEQA project evaluation of GHG emissions can tier off a programmatic analysis of GHG emissions provided that the plan includes the following (CEQA Guidelines Section 15183.5): (a) quantifies baseline and projected emissions; (b) established a level below which cumulative emissions would not be cumulatively considerable; (c) identify and analyze GHG emissions from actions within the geographic area; (d) identify measures that would collectively achieve the specified emissions level; (e) establish a mechanism to monitor the plan's progress to achieving its target and require amendment if the plan is not making such progress; (f) be adopted in a public process following environmental review.

This Plan meets all the requirements of the CEQA Guidelines and will be adopted in a public process following environmental review. Once adopted, subsequent project-level CEQA evaluation of greenhouse gas emissions can tier off of this Plan provided the Plan is being fully implemented by the County and the specific project is consistent with all applicable requirements from this Plan.

The Bay Area Air Quality Management District (District) adopted new CEQA Guidelines in June 2010, including recommended significance thresholds for project and plan evaluation. The District encourages local governments to adopt a qualified GHG reduction strategy consistent with AB 32 goals. The District recommends that projects consistent with an adopted qualified GHG reduction strategy that meet the standards described in the CEQA guidelines can be presumed to not have significant GHG emissions and do not need to be evaluated against the District's recommended mass emissions or efficiency thresholds. The District provides specific criteria for interpreting the broader language of the CEQA guidelines concerning what defines a qualified GHG reduction strategy. The District recommends that a GHG reduction strategy must meet one of three targets, one of which is reduction of emissions 15% below 2008 or earlier levels by 2020.

This Plan meets all of the guidance in the BAAQMD's June 2010 CEQA Guidelines for a qualified reduction strategy consistent with AB 32. As such, projects that are consistent with this Plan can be found to be less than significant for greenhouse gas emissions.

Chapter 5
Monitoring and Adaptive Management

In order to monitor progress toward achieving the 2020 reduction target, the County will annually review and report to the Board of Supervisors on the progress of implementation of this plan, including assessment of how new development projects have been incorporating the Plan's requirements. The County will monitor GHG emissions every three years, starting in 2013. If GHG emissions are not trending toward achieving the 2020 reduction target, the County will amend this Plan, as necessary to more effectively promote GHG reductions. Any substantive amendments will be subject to environmental review and will be adopted in a public process by the Board of Supervisors.

The County Conservation, Development & Planning Department will be the lead department in implementation of the Plan in regards to community emissions, but implementation will require the participation of many of the County's departments, other agencies, private individuals and employers, as well as permit applicants.

The Public Works Department will be the lead department in implementing the separate ERP for municipal emissions. Public Works will provide periodic reporting in regards to progress in implementing the ERP, monitor municipal GHG emission every three years starting in 2013, and will support and monitor implementation of specific municipal reduction measures in cooperation with other County Departments.

Chapter 6
Conclusions

As shown in Table 4, the Napa County CAP would achieve the 15% GHG reduction goal through a combination of state measures and County reduction actions to reduce Scope 1 and 2 emissions and policies designed to offset loss of carbon sequestration. This Plan will be implemented through the programs and policies in Table 3 that the County has full jurisdiction over to implement or support as well through project level requirements (Appendix B). Many of the measures listed in Table 3 have already been implemented by the County.

Napa County has developed a plan that truly reflects its unique character, economic base, natural resources, and unique strengths with respect to assisting the state to reduce GHG emissions. This Plan is a quantitative and practical plan and fulfills commitments made with the County's General Plan that will result in real GHG reductions. This Plan lays the foundation for a continued commitment to GHG mitigation in Napa County.

Chapter 7
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Appendix A

Methodology

Appendix A
Methodology

A.1 Introduction

This appendix describes the analyses performed in support of the Napa County Climate Action Plan (Plan or CAP). This appendix covers the following topics in the order presented:

- Methods used to inventory current year GHG emissions and future year BAU emissions for non-transportation sectors[1].
- Methods used to inventory current year GHG emissions and future year BAU emissions from the on-road transportation sector.
- Methods used for estimating existing carbon stocks and future loss of carbon stocks.
- Methods used to estimate GHG emissions that would be avoided in the future due to actions taken by the state or County.

A.2 Summary of Previous GHG Inventory Efforts

In 2005, the incorporated cities and the unincorporated portions of Napa County prepared an initial GHG inventory for community-wide emissions[2] in all jurisdictions of Napa County (unincorporated Napa County, City of Napa, City of Calistoga, City of Yountville, City of St. Helena, and City of American Canyon). In 2007, Napa County prepared an inventory and reduction plan for GHG emissions associated only with the County's municipal operations (Napa County 2007a)[3]. Napa County identified a suite of actions, defined as the Emissions Reduction Plan for County Operations (ERP), which would result in a 15% reduction of operational GHG emissions. Readers are referred to the ERP for a description of the assumptions and methodologies used.

In 2010, Napa County updated their initial community inventory and developed a GHG reduction plan for the community as a whole (unincorporated portions only). As part of this effort, it was necessary to update and expand upon the draft 2005 GHG inventory effort. The main text of this report describes the key findings of the 2010 analysis. This appendix describes the key assumptions, methodologies, and findings of the 2010 analysis.

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[1] Future year emissions are projected for a *business as usual* (BAU) scenario i.e. conditions where no action to curb emissions is taken and current emissions grow in response to projected growth in population, jobs, housing or other metrics

[2] Community-wide emissions refer to those emissions that result from all activities within the jurisdictional boundary, including activities of residents, businesses, visitors as well as activities associated with municipal operations. Municipal operations emissions refer to those emissions that result only from the County government's operations and provision of services and include but are not limited to operation of County buildings, fleet, landfills and wastewater treatment facilities. The Municipal inventory is a sub-set of the community inventory where County operations occur in unincorporated areas; where County operations occur within incorporated cities the municipal inventory does not overlap with the community inventory.

[3] See above for municipal emissions.

A.3 GHG Inventory Methodology

GHG emissions were analyzed for the unincorporated portion of Napa County for the years 2005 and 2020 based on the following protocols:

- Local Governments Operations Protocol (LGOP) for the quantification and reporting of greenhouse gas emissions inventories (California Air Resources Board 2010);
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Intergovernmental Panel on Climate Change 2006); and
- Protocols contained in ICLEI Clean Air Climate Protection Software (CACP) (ICLEI 2010a).

Sectors considered were:

- Residential and Commercial Building Energy Use
- Waste
- On-road Vehicles
- Off-road and Agricultural vehicles
- Wastewater and Septic
- Land Use Change (carbon stock and carbon sequestration changes)

Transportation emissions were analyzed in detail and the methodology used is described in *Section A.4* of this appendix. Addressing carbon sequestration is key to the CAP. A detailed description of carbon sequestration methodology is found in *Section A.5*.

A.3.1 2005 Baseline Inventory

2005 baseline GHG emissions for the following sectors were estimated as part of the initial inventory effort in 2005 by MIG and the Climate Protection Campaign and were not revised: building energy use, commercial building energy use, off-road transportation and waste. Data was collected and used in concert with the ICLEI CACP software to estimate emissions in 2005 for these sectors. Underlying data and a complete description of the methodologies used can be obtained by request from the County.

As part of this effort emissions from the following sectors were added or revised: on-road transportation, wastewater and septic, and changes in carbon stock/carbon sequestration. Methods used for estimating GHG emissions in 2005 due to on-road transportation are described in detail in *Section A.5*. Methods used for estimating GHG emissions due to loss of carbon stocks in 2005 are described in *Section A.4*. Fugitive emissions from wastewater were estimated using methodologies as recommended in the LGOP (California Air Resources Board 2010) with data provided by the County for volumes of treated water and populations served. Fugitive emissions from septic were based on population and per capita emissions factors as determined by the U.S. Environmental Protection Agency (2010). GHG emissions for the 2005 baseline year are shown in Table 1 of the main document.

A.3.2 2020 Business as Usual Inventory

Based on projected growth in jobs, housing and population in the County as described in the Napa County General Plan Housing element and methodologies listed in the previous section, a BAU GHG inventory for the year 2020 was performed for the following sectors: building energy use, commercial building energy use, off-road transportation, waste and municipal operations. Methods and data used to estimate BAU emissions in 2020 due to on-road transportation are described in *Section A.5*. Methods and data used to estimate BAU emissions in 2020 that result from changes in land use are described in *Section A.4*.

Economic conditions and future projections for the Bay Area changed dramatically between 2005, when the initial/draft GHG inventory was performed and 2010, when this effort began. Therefore it was necessary revise projections of GHG emissions to better reflect the new economic outlook for the region. To update the 2020 BAU, growth factors for all sectors were developed based on population, housing and jobs growth data as provided in Table 9 of the Napa County General Plan DEIR and shown here in Table A-1 (Napa County 2007b). Respective annual growth factors for each sector were applied to the baseline emissions level in 2005 for each sector and emissions increased out to 2020. Scaling factors are based on a linear growth pattern. The scaling factors used are presented in Table A-2.

Table A-1. Population, Housing, and Jobs in Napa County (2005–2020)

	Napa County Projections [a]			
	2005	2015	2020 [b]	2030
Population	28,600	31,397	33,290	36,114
Housing	11,492	12,687	13,393	14,718
Jobs	23,050	25,524	26,765	29,234

[a] Napa County General Plan Housing Element Table 9
[b] Data for 2020 are linearly extrapolated from other data years

Table A-2. Growth Factors used for estimating GHG emissions in 2020

GHG Emission Source	Growth Factor (%/year)	Scales With
Residential Building Energy Use	0.99	Households
Commercial/Industrial Building Energy Use	1.02	Total Jobs
Waste	0.94	Population
Off-road Vehicles (Lawn and Garden)	0.99	Households
Off-road Vehicles (Commercial/Industrial)	1.15	Manufacturing/Other Jobs
Agricultural Vehicles	1.26	Agricultural Jobs
Wastewater and Septic	0.94	Population

GHG emissions for the 2020 BAU year are shown in Table 1 of the main document.

A.4 GHG Inventory and BAU Forecast for On-Road Transportation

To update the previous GHG inventory and 2020 BAU forecast to be consistent with RTAC/SB-375 consistent approaches, a transportation origin/destination modeling approach was used to determine VMT attributable to the County in place of the ICLEI geographic-based approach. For on-road emissions, a select link analysis was used with the Napa-Solano Transportation Demand Model (TDM) in order to more accurately attribute GHG emissions based on trip origin and destination. A complete description of the traffic modeling effort including a comparison of VMT by Napa County jurisdiction using the origin/destination approach is provided below (Tables A3-A6).

Base year and future business as usual VMT were estimated by Fehr & Peers as part of the County of Napa Climate Action Plan. The Solano-Napa Travel Demand Model was used to develop the VMT estimates. Estimation of on-road transportation emissions and future emissions required the following main tasks:

- Modifications Made to the Solano-Napa Model
- Base Year (2008) VMT Estimates
- Base Year Comparison to ICLEI Report
- Future Year (2020) Business as Usual VMT Estimates

A.4.1 Modifications Made to the Solano-Napa Model

The Solano-Napa Model was validated in 2008 to existing conditions at that time. Land use and roadway networks were calibrated to existing conditions and then adjusted appropriately to validate to current traffic counts. No modifications were made to the 2010 model. The 2030 model was then evaluated for its appropriateness for use in the Napa County CAP. The relative growth in land use was comparable to that of the Napa County General Plan. For this reason, it was determined that the 2030 model was adequate for VMT forecasts.

A.4.2 Base Year (2008) VMT Estimates

Fehr & Peers conducted a model run to calculate base year daily VMT by speed bin and VHT/VHD estimates for following jurisdictions:

- American Canyon
- Calistoga
- City of Napa
- Saint Helena
- Yountville
- Unincorporated County

Using select link analysis, three types of vehicle trips were tracked separately for AM and PM peak periods for each of the above listed jurisdictions within Napa County.

- Vehicle trips that remained internal to the location.
- Vehicle trips with one end in the location and one end outside of location (IX/XI trips).
- Vehicle trips with neither end in the location (XX trips).

Using the set of *accounting rules* recommended for VMT inventories in Climate Action Plans by the Bay Area Regional Transportation Advisory Committee (RTAC), VMT from trips of type 1, 2 and 3 were counted 100%, 50%, and 0% respectively towards jurisdiction-generated VMT.

The Solano-Napa model is validated to AM and PM peak hour traffic counts. These volumes were then converted into daily trips based on historical count data on Napa County roadways. An estimate for daily volumes was calculated with the following equation: daily VMT = (AM VMT + PM VMT) * 5. In addition, off-peak volume estimates were distributed amongst the speed bins based on Napa County off-peak speed curves to more accurately represent the off-peak travel characteristics.

Table A-3 shows the 2008 Baseline VMT estimates by 5 miles per hour (mph) speed bin. Table A-4 shows the estimated daily vehicle hours traveled (VHT) and vehicle hours of delay (VHD) using the same accounting rules. Column and row totals may not completely reconcile with associated individual values due to rounding errors with Excel. 2008 VMT data was scaled linearly to 2005.

Table A-3. 2008 Baseline Daily VMT Estimates by Speed Bin

Speed (mph)		American		City of	Saint			
From	To	Canyon	Calistoga	Napa	Helena	Yountville	Unincorp.	Total
0	5	1,872	281	6,203	285	197	5,357	14,195
5	10	1,402	341	6,489	212	177	4,334	12,955
10	15	1,663	802	10,656	413	325	7,172	21,031
15	20	1,281	806	5,288	497	196	4,104	12,172
20	25	5,526	1,917	37,015	4,109	1,446	32,526	82,540
25	30	36,073	20,485	224,762	34,610	8,540	245,951	570,420
30	35	18,668	32,453	174,844	29,537	6,248	199,584	461,332
35	40	14,645	7,148	79,955	8,766	3,273	93,174	206,961
40	45	14,798	9,224	148,188	23,353	6,512	134,123	336,198
45	50	14,362	8,752	52,945	13,125	4,035	73,621	166,839
50	55	46,828	35,316	227,385	48,651	16,133	297,712	672,025
55	60	7,008	2,183	67,618	4,664	5,639	61,715	148,827
60	65	27,667	5,706	183,700	11,682	17,849	127,208	373,811
65	70	35,091	6,477	102,449	6,232	4,369	100,033	254,652
70	75	810	85	1,786	194	85	6,823	9,783
75	80	-	-	-	-	-	-	-
80	+	827	908	3,266	855	143	6,189	12,188
Total		228,520	132,885	1,332,550	187,185	75,165	1,399,625	3,355,930

Source: Fehr & Peers 2010.

Table A-4. 2008 Baseline Daily VHT/VHD Estimates

		American Canyon	Calistoga	City of Napa	Saint Helena	Yountville	Unincorp.	Total
	II	600	370	12,280	575	25	6,135	19,985
VHT	IXXI1	12,345	5,390	51,070	7,120	3,000	71,810	150,735
	Total	12,945	5,760	63,350	7,695	3,025	77,945	170,720
	II	100	90	860	20	-	575	1,645
VHD	IXXI1	7,135	2,120	28,220	2,710	1,275	40,815	82,275
	Total	7,235	2,210	29,080	2,730	1,275	41,390	83,920

Source: Fehr & Peers 2010.
Note: IXXI counted 50%

A.4.3 Conversion to CO_2 Emissions

After obtaining VMT estimates by speed bin, the data was post-processed to convert to estimated CO_2 emissions. Emissions factors were obtained from EMFAC for year 2008 for Napa County. EMFAC provides emissions factors only up to speed bin 70–75 mph. For VMT with speeds greater than 75 mph, the emission factor for 70–75 mph were used. Previous research with the emissions factors has also shown some error in the EMFAC factors for speeds in excess of 65 mph. These results must be interpreted cautiously. Note that the emissions results are only for CO_2 and not for CO_2e.

A.4.4 Future Year (2020) Business as Usual VMT Estimates

Fehr & Peers ran the 2030 Solano-Napa model and obtained a Year 2030 BAU VMT estimate, representing the future VMT without any specific greenhouse gas-reduction measures. The 2020 forecast was subsequently calculated by linearly interpolating between the 2008 base year results and the 2030 BAU results. Tables A-5 and A-6 show the results of this run:

Table A-5. 2020 BAU Daily VMT Estimates by Speed Bin

Speed (mph) From	To	American Canyon	Calistoga	City of Napa	Saint Helena	Yountville	Unincorp.	Total
0	5	3,353	768	15,536	813	500	11,645	32,614
5	10	2,759	998	14,566	777	393	11,045	30,537
10	15	2,580	818	13,539	1,236	377	10,496	29,046
15	20	2,667	1,090	12,440	1,544	447	13,012	31,199
20	25	6,733	2,307	45,026	4,671	1,766	39,776	100,279
25	30	38,431	23,720	267,032	40,848	10,299	289,750	670,079
30	35	28,362	34,278	235,953	36,281	7,851	271,956	614,681
35	40	18,799	10,264	100,768	9,666	4,208	112,651	256,356
40	45	23,467	13,374	179,850	26,628	8,004	155,782	407,106
45	50	11,709	9,004	52,480	12,574	4,325	73,878	163,970
50	55	48,767	38,889	268,764	50,049	18,340	344,089	768,899
55	60	6,171	2,200	47,065	4,288	5,088	50,871	115,684
60	65	33,602	7,189	203,841	14,089	19,522	150,769	429,011
65	70	33,903	9,988	118,332	7,525	4,921	114,541	289,210
70	75	379	42	887	91	41	3,133	4,573
75	80	160	6	655	17	18	419	1,275
80	+	1,045	960	4,099	864	164	6,617	13,750
Total		262,886	155,898	1,580,830	211,960	86,265	1,660,431	3,958,270

Source: Fehr & Peers 2010.

Table A-6. 2020 BAU Daily VHT/VHD Estimates

		American Canyon	Calistoga	City of Napa	Saint Helena	Yountville	Unincorp.	Total
	II	567	463	13,799	804	33	8,183	23,850
VHT	IXXI[1]	20,516	9,375	97,164	12,032	4,887	124,798	268,771
	Total	21,083	9,837	110,963	12,836	4,920	132,981	292,621
	II	81	125	1,471	154	-	1,576	3,407
VHD	IXXI[1]	14,455	5,600	68,633	7,011	2,895	87,839	186,432
	Total	14,536	5,725	70,104	7,165	2,895	89,415	189,839

Source: Fehr & Peers 2010.
Note: IXXI counted 50%

Tables A-3 and A-5 show that in the absence of any GHG reduction strategies, VMT for the County would increase by 18% from 2008 to 2020 and Tables A-4 and A-6 show that VHT would increase by 71% and VHD would increase by 126%.

A.5 Carbon Stock, Carbon Sequestration, and Land Use

As part of this inventory and climate action planning effort, Napa County accounted for existing carbon stock and carbon sequestration in the County and the consequences of land use change patterns that might result in a loss of carbon stock and annual carbon sequestration. Although protocols are available for assessing carbon stocks at the national level, recommended protocols are not yet available for county-level inventories and inclusion of carbon stocks and sequestration is not yet standard practice for local level inventories and climate action plans. Background information and a detailed description of the carbon stock and sequestration analysis conducted for the Napa Climate Action Plan is described below.

A.5.1 What are Carbon Stock and Carbon Sequestration?

Through the process of photosynthesis, plants remove CO_2 from the atmosphere, converting a portion of the CO_2 to organic compounds that form structural components of the plant such as roots, leaves and branches. The carbon that was removed from the atmosphere is thus stored or *sequestered*, until the plant dies and decays or is removed. [4] Within this context, two specific terms are used: 1) carbon stock and 2) annual carbon sequestration.

Carbon stock refers to the total amount of carbon stored in the existing plant material including trunks, stems, branches, leaves, fruits, roots, dead plant material, downed trees, understory and soil organic material. Carbon stock is expressed in units of metric tons of carbon per acre (t C ac^{-1}). When land is cleared, some percentage of the carbon stored is released back to the atmosphere as CO_2. Land clearing or the loss of carbon stock is thus a type of GHG emission.

A*nnual carbon sequestration* is the amount of CO_2 that plant material, within a specified boundary, removes from the atmosphere within a single year. The sequestration rate is expressed in units of metric tons of C per acre per year (t C ac^{-1} yr^{-1}) and can essentially be thought of as the plant's growth rate. Different species of plants remove CO_2 from the atmosphere at rates that vary by several orders of magnitude. The rate at which plants within a single species grow (i.e. take up CO_2) is also highly variable over the lifetime of the plant. Carbon stock and annual sequestration are correlated as a loss in stock results in a loss in annual CO_2 uptake.

Methods and standard protocols are available for assessing carbon stocks and annual carbon sequestration at the national level (Intergovernmental Panel on Climate Change 2006; U.S. Environmental Protection Agency 2010) and carbon sequestration is accounted for in the U.S. and California GHG inventories.[5] Assessment protocols are not included in commonly used GHG Inventory software such as ICLEI Clean Air and Climate Protection (CACP) software. Several protocols for assessing carbon stocks and changes in stock for forests/woodlands are available for use in the voluntary carbon market (Climate Action Reserve 2010).This analysis relies on methodologies recommended by the IPCC and is described below.

[4] Carbon can also be sequestered in several other biological, chemical or physical processes, but for the purposes of this CAP, the term sequestration refers only to carbon stored in plant material.

[5] In 2008, the CO_2 uptake associated with forests and natural lands were equivalent to 13% of total U.S. emissions, even when considering GHG emissions associated with these lands. In California, CO_2 uptake in 2008 was equivalent to approximately 1% of the state's annual emissions (U.S. Environmental Protection Agency 2010; California Air Resources Board 2010).

A.5.2 2005 Inventory and 2020 Forecasts of Napa County Carbon Stocks and Annual Sequestration

The primary loss of natural land cover types in Napa County is due to vineyard development[6]. The Napa County General Plan outlines several scenarios for vineyard development up to 2030 (vineyard expansion scenarios 1-3 or VE 1-3). Carbon stocks and annual sequestration on the following natural land cover types was estimated for 2005 and for three vineyard development scenarios and one urban development scenario (Alternative A in the General Plan) in 2020: Oak Woodlands, Riparian Woodlands, Coniferous Forests, Grasslands, Shrublands (Chaparral), Non-vineyard croplands and Vineyards (Table A-7). Acres covered by each land cover type were taken from GIS data included in the Napa County Baseline Data Report (WICC 2006).

[6] Natural lands are also lost to development that is not related to vineyards.

Table A-7. Acres, Carbon Stocks and Sequestration by Land Cover Type in 2005 And 2020

	Grasslands	Chaparral/ Shrublands	Oak Woodlands	Riparian Woodlands	Coniferous Forests	Croplands Not Vineyards	Vineyards	Total
2005 BASELINE CONDITIONS								
2005 Area (Acres)[a]	53,706	107,583	161,976	8,060	42,984	23,984	40,439	438,732
2005 Carbon Stock (MT C)	76,071	1,741,530	15,410,991	652,367	2,497,977	91,857	49,096	20,519,890
2005 Annual Sequestration (MT C/ yr)	215	430	68,828	3,425	28,615	1,372	3,928	106,813
2020 VINEYARD EXPANSION SCENARIO 1								**Net Loss/Gain**
Area Lost/Gain by 2020 (Acres) [b]	(1,569)	(210)	(1,535)	(74)	(196)	(1,862)	6,003	
Carbon Stock Lost/Gain by 2020 (MT C)	(1,222)	(2,550)	(137,455)	(5,442)	(10,275)	(6,568)	7,288	(156,224)
Loss/Gain in Annual Sequestration ($MTCO_2e$/yr) by 2020	(6)	(1)	(652)	(32)	(130)	(106)	583	(345)
2020 VINEYARD EXPANSION SCENARIO 2								**Net Loss/Gain**
Area Lost/Gain by 2020 (Acres) [b]	(1,416)	(514)	(2,153)	(73)	(566)	(1,076)	6,046	
Carbon Stock Lost/Gain by 2020 (MT C)	(1,103)	(6,236)	(192,802)	(5,311)	(29,753)	(3,797)	7,341	(231,661)
Loss/Gain in Annual Sequestration ($MTCO_2e$/yr) by 2020	(6)	(2)	(915)	(31)	(377)	(62)	587	(805)
2020 VINEYARD EXPANSION SCENARIO 3								**Net Loss/Gain**
Area Lost/Gain by 2020 (Acres) [b]	(706)	(350)	(1,785)	(54)	(3,439)	(863)	7,470	
Carbon Stock Lost/Gain by 2020 (MT C)	(550)	(4,254)	(159,863)	(3,950)	(180,659)	(3,044)	9,069	(343,250)
Loss/Gain in Annual Sequestration ($MTCO_2e$/yr) by 2020	(3)	(1)	(758)	(23)	(2,290)	(49)	726	(2,399)

[a] Areas for natural land cover types are taken from data presented in the Napa County BDR (2005). Land cover types assessed in the BDR but not presented here include: wetlands, developed land and rock outcrop/other. The carbon content of developed lands and rock outcrop/other was assumed to be zero. Pursuant to state policy for wetland replacement, wetlands were also not considered for this analysis (see b below).

[b] The DEIR provides values for converted acres by 2030. A linear relationship was used to estimate lost acres at 2020. Although the DEIR does specify some loss of wetland areas before 2030 and wetland areas contain significant stores of carbon, wetland areas are not included in this analysis. Given existing federal and state law, which require a *no net loss* of wetlands, it is assumed that wetlands will be replaced along with their sequestration value

[c] For parcels that do not undergo conversion to another land cover type, annual uptake was assumed to be in steady-state for the period 2005-2020, reflecting a balance of growth, death and disturbance in the stand. Mature stands are characterized by a broad age distribution. While individual trees may be of different age and removing carbon at different rates, the average age of the stand as a whole and the carbon removal of the stand as a whole are constant through time. Thus change in annual sequestration is due only to land conversion as default values inherently account for variability as a function of age, death and disturbance.

Table A-7 shows that the majority of carbon stocks in Napa County are located on lands covered by coniferous or oak woodlands and shrublands. Although on a per acre basis, shrublands contain significantly less carbon than forested areas, more than 100,000 acres of shrublands were present in 2005. Of all land cover types considered in this analysis, vineyards and grasslands contain the least carbon per acre. Also shown in Table A-7 are the numbers of acres lost by 2020 under each VE scenario, the resulting GHG emissions due to stock loss (one-time release) and the loss in annual sequestration. The values listed in Table A-7 account for both the loss in carbon when plant material is removed as well as the addition of carbon when vines are planted.

Table A-7 also displays the annual sequestration by land cover type in 2005. Total annual sequestration in Napa County in 2005 was estimated to be 106,813 MT C or 391,648 $MTCO_2e$. The annual sequestration on California forests and grasslands in 2005 was estimated to be 4.17million $MTCO_2e$, and thus Napa County provides approximately 1% of the state's total carbon sequestration. In 2020, the loss of annual sequestration on natural lands in Napa County ranges from 345 $MTCO_2e$ to 2,399 $MTCO_2e$, dependent on the pattern of vineyard development.

For any given parcel of vegetated land cover, in any given year, several processes may add carbon to the parcel (e.g. natural growth or planting) and several processes may result in a loss of carbon from the parcel (e.g. natural disturbance, death, land use change, harvesting). These processes are displayed separately in Table A-7. IPCC inventory methodology (IPCC, 2006) directs these processes to be combined, representing the net flux in any given year and then referenced to the net flux in carbon at the baseline year. This methodology accounts for the fact that land was also cleared during the baseline year (2005) and accounts for the change in the pace and pattern of carbon stock removal. Table A-8a presents a summary of the change in carbon stocks in Napa County according to IPCC methodology between the baseline (2005) and forecast year (2020 for 3 VE scenarios). IPCC methodology is described in greater detail in the following section. Table A-8a includes the net changes in annual sequestration between 2005 and 2020 from conversion of natural lands to urban use, the conversion of natural lands to vineyards, and the addition of sequestration on new vineyards.

Table A-8a. Net Loss in Carbon Flux under Development Alternative A and Vineyard Development Scenarios 1-3 (IPCC Methodology)

	2005 [c]		2020 (VE 1)		2020 (VE 2)		2020 (VE 3)	
	1- YEAR FLUX (+ / -)		1- YEAR FLUX (+ / -)		1- YEAR FLUX (+ / -)		1- YEAR FLUX (+ / -)	
	(MT C yr -a)	($MTCO_2e$ yr -a)	(MT C yr -a)	($MTCO_2e$ yr -a)	(MT C yr -a)	($MTCO_2e$ yr -a)	(MT C yr -a)	($MTCO_2e$ yr -a)
Natural Lands Remaining in the Same Category	(106,813)	(391,648)	(106,492)	(390,469)	(106,062)	(388,894)	(104,574)	(383,438)
Growth on New Vineyard Lands	(38)	(140)	(39)	(143)	(39)	(144)	(48)	(177)
Conversion of Lands to Urban Uses	1,968	7,218	1,968	7,218	1,968	7,218	1,968	7,218
Conversion of Lands to New Vineyard Lands	10,415	38,188	10,415	38,188	15,444	56,628	22,883	83,906
Net C or CO_2e Flux	(94,468)	(346,382)	(94,147)	(345,205)	(88,689)	(325,191)	(79,771)	(292,492)
Change in CO_2e Flux (2020–2005)				**1,177**		**21,191**		**53,891**

[a] Negative values represent a removal of CO2 from the atmosphere by plants (e.g. carbon sequestration).

[b] Positive values represent an emission of CO2 to the atmosphere due to a loss of carbon stock (conversion).

[c] Areas of different land cover types as listed in the BDR were used to estimate the flux on lands remaining in the same category. Total acres of land converted to vines or urban uses in 2005 were provided by the County. Exact acres of each land cover type lost to urban development in 2005 is unknown. It was assumed to be the same as Alternative A. Although the acres of each land cover type lost to vineyard development in 2005 is known, due to the high variability in the pattern of land conversion from year to year, this one year snapshot was not considered to be an appropriate baseline. Ideally an average of 5 or more years around the time period 2005 would be used. This data was not available. The pattern of development in VE1 was used as a proxy as it is derived from the average pace and pattern of development over the period 2005-2030. VE1 represents a conservative estimate for this analysis as it results in the largest project level mitigation commitments for all VE scenarios.

Table A-8b. Net Change in Carbon Flux under Development Alternative A and Average of Vineyard Development Low (VE1) and High (VE3) Scenarios (IPCC Methodology)

	2005 [c] 1- YEAR FLUX (+ / -)		2020 (VE Average) 1- YEAR FLUX (+ / -)	
	(MT C yr $^{-a}$)	($MTCO_2e$ yr $^{-a}$)	(MT C yr $^{-a}$)	($MTCO_2e$ yr $^{-a}$)
Natural Lands Remaining in the Same Category	(106,813)	(391,648)	(115,533)	(386,954)
Growth on New Vineyard Lands	(38)	(140)	(44)	(160)
Conversion of Lands to Urban Uses	1,968	7,218	1,968	7,218
Conversion of Lands to New Vineyard Lands	10,415	38,188	16,649	61,047
Net C or CO_2e Flux	(94,468)	(346,382)	(86,959)	(318,849)
Change in CO_2e Flux (2020–2005)				**27,534**

According to Table A-8a, removal of carbon stock and loss in annual sequestration due to vineyard and urban development is equivalent to 1,177 to 53,891 $MTCO_2e$ of GHG emissions in 2020 (dependent on VE scenario). According to Table A-8b, removal of carbon stock and loss in annual sequestration due to vineyard and urban development is equivalent on average to 27,534 $MTCO_2e$ of GHG emissions in 2020 (dependent on VE scenario). The average case is used as the basis for this plan.

Measure PL-1 establishes a program by which emissions associated with vineyard conversions can be mitigated. Step-by-step procedures for this program are available in Appendix B. Consistent with other County policies, Measure PL-2 will require replacement of all lost carbon sequestration from urban conversion (Appendix B).

A.5.3 IPCC Methods for Accounting for Change in Carbon Stock

Emissions and removals of CO_2 on natural lands are the result of changes in carbon stock. Changes in carbon stock can result from growth, planting, death, disturbance or removal. Changes in carbon stock (and associated emissions and/or removals of CO_2) that result from patterns of development outlined in the Napa County General Plan and General Plan FEIR were calculated. The analysis used generic methods applicable to multiple land use categories as recommended by the IPCC (IPCC 2006) in the Guidelines for National Greenhouse Gas Inventories.

Changes in carbon stock were estimated for:

- Lands that remain in the same land use category.
- Land that is converted to another land use category.

A.5.3.1 Land that Remains in a Land Use Category

Changes in carbon stock on land that remains in a land use category are due essentially to vegetative growth, death and disturbance. Equation 1 was used (Equation 2.7 in Intergovernmental Panel on Climate Change 2006) to estimate the changes in carbon stock on land remaining in the following land use categories in Napa County: Grasslands, Shrublands, Oak Woodlands, Riparian Woodlands, Coniferous Forests, Croplands (not Vineyards) and Vineyards.

Eq. 1 $\Delta C_B = \Delta C_G - \Delta C_L$

ΔC_B = annual change in carbon stocks for each land cover type, considering the total area, tonnes C yr^{-1}

ΔC_G = annual increase in carbon stocks due to biomass growth for each land cover type, considering the total area, tonnes C yr^{-1}

ΔC_L = annual decrease in carbon stock due to biomass loss for each land cover type, considering the total area, tonnes C yr^{-1}

To estimate ΔC_B on lands remaining in the same land cover type, the default factors listed in Table A-9 were multiplied by the acres of each land cover type. The default factors represent the combination of gains and losses (ΔG-ΔL), essentially the net carbon change each year that on average is expected (i.e. the annual sequestration). ΔC_B was calculated for the baseline year 2005 and for land remaining in the same land use category in 2020 following vineyard development scenarios 1-3 and Alternative A. Carbon loss or gain was converted to emissions or sinks of GHGs by multiplying MT C by 44/12[7].

Table A-9. Default Factors for Calculating Annual Carbon Sequestration

	Annual Sequestration Factors	
Land Use Category	**Source**	**Factor (MT C /acre/ year)**
Oak Woodlands	CEC [a]	0.425
Riparian Woodlands	CEC [a]	0.425
Coniferous Forest	CEC [a]	0.666
Grasslands	CEC [a]	0.004
Shrublands	CEC [a]	0.004
Croplands Not Vineyards	Kroodsma and Field 2006 [b]	0.057
Vineyards Only	Kroodsma and Field 2006 [b]	0.097

[a] Brown, S., T. Pearson, A. Dushku, J. Kadyzewski and Y. Qi. 2004. Baseline Greenhouse Gas Emissions for Forest, Range and Agricultural Lands in California. CEC-500-04-069F. Prepared for the California Energy Commission by Winrock International.

[b] Kroodsma, D. and C.B. Field, 2006. Carbon Sequestration in California Agriculture. Journal of Ecological Applications, 16 (5). pp 1975–1985.

[7] This ratio is the ratio of the molecular weight of carbon dioxide (44) to that of carbon (12).

A.5.3.2 Land That is Converted to another Land Use Category

To estimate the change in carbon stocks associated with land use change—in this case the change of Grasslands, Shrublands, Oak Woodlands, Riparian Woodlands, Coniferous Forest or Croplands to vineyards or urban lands – equation 2 was used (Equation 2.15 in IPCC 2006).

Eq. 2 $\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$

ΔC_B = annual change in carbon stocks in biomass on land converted to other land-use category, in tonnes C yr^{-1}

ΔC_G = annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tonnes C yr-1

$\Delta C_{Conversion}$ = initial change in carbon stocks in biomass on land converted to other land-use category, in tonnes C yr^{-1}

ΔC_L = annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tonnes C yr^{-1}

The quantity ΔC_G - ΔC_L was calculated as described above using default values listed in Table A-9 that represent the net of all gains and losses occurring on a per acre basis for each land cover type. To calculate $\Delta C_{Conversion}$ acres lost of each land cover type were multiplied by the default carbon stock factors listed in Table A-10 and summed to yield a county-wide value of carbon stock lost as a result of land conversion in vineyard expansion scenarios 1, 2 or 3 and Alternative A as well as the carbon gained through planting of vines in vineyard expansion scenarios 1, 2 or 3. These values are then compared against the pace and pattern of land conversion that was occurring in 2005 i.e. accounting only for the change in carbon stock loss relative to the baseline year. To estimate existing carbon stocks in the baseline year, values with 100% soil carbon were used. Carbon loss or gain was converted to emissions or sinks of GHGs by multiplying MT C by 44/12.

Table A-10. Default Carbon Stock Factors

		Carbon Stock Factors	
Land Use Category	**Source**	**Factor w/ 100% Soil Loss (MT C /acre)**	**Factor w/ 50% Soil Loss (MT C /acre)**
Oak Woodlands	EPA [1]	95.1	89.6
Riparian Woodlands	EPA [1]	80.9	73.1
Coniferous Forest	EPA [1]	58.1	52.5
Grasslands [c]	CEC [2]	1.4	0.8
Shrublands [c]	CEC [2]	16.2	12.1
Croplands Not Vineyards [c]	CEC [2]	3.8	3.5
Vineyards Only	CEC [2]	1.2	1.2

[a] U.S. EPA. 2010. 2010 U.S. Greenhouse Gas Inventory Report–Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008 (Annex 3). U.S. EPA # 430-R-10-006. Released April 2010.

[b] Brown, S., T. Pearson, A. Dushku, J. Kadyzewski and Y. Qi. 2004. Baseline Greenhouse Gas Emissions for Forest, Range and Agricultural Lands in California. CEC-500-04-069F. Prepared for the California Energy Commission by Winrock International.

[c] Soil loss percentage estimated by ICF

A.5.3.3 Key Assumptions

At the time of writing of this document, inclusion of GHG emissions related to land use change is not yet standard in community GHG inventories. When assessing carbon stock and sequestration rates in natural land covers, national GHG inventories and state GHG inventories rely on detailed measurements and sophisticated models (IPCC—Tier 3 methods). Data at this level of detail is often not available for local jurisdictions. Collection of data at this level of detail was beyond the scope of this work. Default stock values as available from the U.S. EPA and California Energy Commission were used for this analysis (IPCC—Tier 1 and 2 methods).

Because a detailed field study of carbon content in natural land covers was not possible as part of this work, this analysis relied on pre-existing data sources to the extent possible, primarily the Napa County Baseline Data Report (WICC of Napa County 2005), the CEC's report assessing GHG emissions from forest and agricultural lands in California (Brown et al. 2004) and the U.S. National GHG inventory (U.S. Environmental Protection Agency 2010). The following key assumptions were made in estimating carbon stocks and annual sequestration:

- The County assumed that all acres listed in the BDR for each land cover type are located in the unincorporated County.
- The BDR specifies acreages for developed lands, rock outcrops and wetlands. The County assumed that the carbon content of developed lands and rock outcrop/ other was 0 MT C/acre. Although the DEIR indicates that some acres of wetlands will be lost to vineyard development, state and federal law requires *no net loss* of wetlands. It was assumed that wetlands areas as well as their sequestration value would be replaced.
- Default carbon stock and sequestration rate factors available from several sources including EPA, California Energy Commission (CEC), and scientific literature were used. Species groups incorporated into the default factors were not always a perfect match for the species listed for each BDR land cover type. When several default factors were available, the default factor with the closest species match was selected.
- Lacking age distribution data for individual stands, an evenly mixed age distribution for all forested acres was assumed. Because trees grow at different rates over their lifetime, the annul sequestration and the total amount of carbon stored on site at any given time depends highly on the age of the stand. The default factors listed in Tables A-8 and A-9 reflect average conditions i.e. a mix of young trees growing rapidly but with less total carbon per tree and mature trees growing more slowly but with more total carbon per tree. Further, because an even age distribution was assumed, the annual sequestration was assumed to be constant on a per acre basis.
- Default factors in Tables A-9 and A-10 reflect average conditions across California such that they inherently account for the annual fluctuations in stock and sequestration due to natural and man-made disturbance as well as the continual presence of both standing dead trees, down dead trees and seasonal changes in understory growth. For a specific stand in a particular year that for example experiences a fire, the above factors would grossly over estimate carbon stock and sequestration. Consistent with Tier 1 and Tier 2 IPCC approaches, the default factors can be appropriately applied at a course level of scale.
- Default factors encompass carbon stock and stock change in all pools.

A.6 Quantification of GHG Reduction Measures (non-transportation sectors)

To quantify the GHG emissions that are avoided in 2020 due to implementation of the measures listed in the CAP (state, energy efficiency, waste, water, renewable energy and municipal), a combination of in-house Excel based tools and ICLEI's CAPPA software (ICLEI 2010b) was used. A further description of methods used to estimate reduction in the transportation sector is provided in *Section A.7*. Table A-11 lists all GHG reduction measures, the unique quantity of $MTCO_2e$ associated with each measure and the key assumptions used to quantify the GHG reductions.

County specific data was used wherever possible and often cross referenced with CAPPA software defaults which are based on beta-testing in several U.S. cities of varying sizes. These data sources are listed in Table A-11 and include: Napa County General Plan and supporting appendices; Napa County General Plan DEIR and FEIR; 2050 Napa Valley Water Resources Study; Napa County ERD for County Operations; Napa County Baseline Data Report; Napa County Agricultural Report and personal communication with County departments. To calculate GHG reductions from state-level policy, expected state-wide reductions as reported in available ARB or CEC reports were scaled to Napa's emissions.

Table A-11. Napa County Cap Measures Detailed Summary

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
A. STATE MEASURES			
S-1	AB 1493 Pavley I and II	50,789	• EMFAC fleet distribution for 2020. • Adjusted emission factors developed by ICF based on ARB Technical Assessments. http://www.arb.ca.gov/cc/ccms/ccms.htm
S-2	Low Carbon Fuel Standard	19,309	• Applied expected statewide reductions as estimated for the AB32 Scoping Plan to Napa County's 2020 emissions (all vehicles). http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm
S-3	Other Vehicle Efficiency Measures	4,602	• Applied expected statewide reductions as estimated for the AB32 Scoping Plan to Napa County's 2020 emissions. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm
S-4	Renewable Portfolio Standard	17,310	• Followed methodology in the ARB Scoping Plan Appendix I. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm • Accounted for all kwh gained through energy efficiency, water efficiency, and renewables before applying the RPS.

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
S-5	Landfill Methane Regulation	4,252	• Waste generated in Napa County currently goes to Clover Flat Landfill and Keller Canyon Landfills. Both of these landfills are listed in the ARB's databases as currently flaring methane gas. A 75% destruction efficiency was assumed for the inventory and BAU forecast. • Assumed that both landfills will have a destruction efficiency of 85% either through GTE or other technologies as specified in the ARB's rule by 2020. http://www.arb.ca.gov/regact/2009/landfills09/isor.pdf
TOTAL STATE MEASURES:		96,262	
B. ENERGY EFFICIENCY MEASURES			
EE-1	Green Building Ordinance (Meet Title 24, including Cal-Green)	3,667	• Assumed 1341 D.U. constructed between 2005 and 2020 (based on 2235 built by 2030 -DEIR Alt A p 3.0-14). • Assumed 2.87e6 sqft of commercial space constructed between 2005 and 2020 (Keyser Marston- Land Use Study DEIR Appendix B). Used an average of yearly construction rate for the period 1985-2005 (p.12). • Used ICF's calculation of the average increase in efficiency for buildings built over this time as Title 24 updates relative to the baseline year.
EE-2	Energy Efficiency Financing District (California FIRST or equivalent program)	977	• At this time, the CA FIRST program is not available in Napa County. The program is in its early stages and data about penetration and energy efficiency achieved, even for pilot communities, is not available. The EE gains depend on several unknown factors including: age of houses retrofit, aspects of building envelope that are eligible, and community response to financial incentives. • Assume program (or like program) is available in Napa County before 2020 and 2,500 retrofits completed with the program by 2020 (equivalent to approximately 25% of the existing building stock). • Assumed retrofits achieved energy efficiency gains similar to those of Title 24 as a conservative estimate.

		GHG Reductions in 2020 (MTCO$_2$e)	Key Assumptions and Data Sources
EE-3	Weatherization of Low-Income Homes	52	• Assume 60 units weatherized by 2020. • Assume CAPPA (ICLEI CAPPA software, http://www.icleiusa.org/cappa) default values for the increase in efficiency achieved for typical retrofits.
EE-4	Plant Trees for Shading for Discretionary Projects	240	• 65 Use Permit Applications per year + 35-40 vineyard projects per year assumed as a minimum for discretionary projects per year. (personal communication, October 4, 2010). • Assume a requirement of 10 trees per project ((65+40)*10 = 1,050 trees per year). (As a point of reference, the CAPPA default is 500 trees/year for municipalities that are slightly larger than Napa County). • Assume the policy is active beginning in 2010 (2010-2010 = 10,500 total trees planted). • Assume 50% = mature trees providing shade in 2020 (5,025 trees). • Use CAPPA defaults for energy savings achieved.
EE-5	Passive Design for Discretionary Projects	0	• This measure is not quantifiable alone although it undoubtedly results in energy savings. Further, energy savings due to passive design are highly dependent on site location, other design features and end-use of the building and thus vary project to project. • ICF has assumed that passive design supports a project's ability to exceed the Title 24 Standard. • Because our analysis assumes that all future construction meets Title 24, an individual project that can demonstrate the kwh saved through passive design would represent additional GHG reductions relative to those achieved by the CAP.
TOTAL EE SECTOR:		***4,936***	

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
C. WATER EFFICIENCY MEASURES			
W-1	Comprehensive Water Efficiency Ordinance	19	• Use 2020 Residential Water Use as reported in 2050 Napa Valley Water Resources Study, Tech Memo 3 (3640 afa). (http://www.countyofnapa.org/Pages/Search.aspx?keywords=Water%20Resources%20Study) • Assume that this measure applies to indoor and outdoor use in existing homes. • Assume that the plan resulted in a 10% decrease in use in 2020 compared to BAU.
W-2	Landscape Ordinance	5	• Assume this applies only to new residential construction (1341 D.U. by 2020 -based on 2235 built by 2030 -DEIR Alt A p 3.0-14). • Expected water savings per home estimated from study performed by the California Home Builders Assoc. January 2010. http://www.cbia.org/go/cbia/?LinkServID=E242764F-88F9-4438-9992948EF86E49EA
W-3	Recycled Water	0	• Because Unincorporated Napa County obtains much of its needed water from groundwater supplies and does not use State Water Project Water (or at least was not assumed to use SWP water in the inventory and forecast), the energy intensity of water use is very low in the County i.e. it is not a major source of GHG emissions. • Because current energy use per gallon consumed is already very low, construction of the recycled water infrastructure (although crucial to a sustainable water supply) may not result in energy savings. Rather- they may represent new (modest) municipal energy demands for distribution. • The 2020 BAU projection assumed that the unincorporated County would continue to be able to meet water demands without water imports. If in the future, the County does require water imports to meet demand, then the energy intensity of water used in the County would increase significantly. Water demand that can be met locally with recycled water would then result in energy savings and GHG reductions.

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
W-4	Agricultural Water Conservation Programs	156	• County actions include: education materials (mail, web, through agencies), efficiency workshops specifically for agriculture/winery, coordination with other agencies, advertising rebate programs (personal communication, October 4, 2010). • County water conservation efforts target both agriculture end-use, winery end-use and residential/ commercial end use. • Assume that above listed efforts result in a 5% reduction in water consumption in agriculture and winery sectors as compared to BAU.
TOTAL WATER SECTOR:		***180***	
D. WASTE MEASURES			
WST-1	Expand/start a kitchen waste composting program	25	• This program was started in 2009 (i.e. after the GHG inventory baseline year). • Calculations based on original waste generation data collected by MIG and CalRecycle's waste profile which indicates ~330 lbs kitchen waste per person is available for diversion. As a point of reference, CAPPA defaults suggest a program would achieve ~ 300 lbs per person. • Assume a 75% capture rate on the 330/person i.e. the program will result in 250 lbs of kitchen waste diverted per person per year in 2020. • Assume 2020 Population of 33,290 (Housing Element Table 9).
WST-2	Expand/start C&D waste program	0	• C& D benefits are accounted for as part of Cal-Green [EE-1]
WST-3	Waste Minimization and Public Outreach	0	• Assume this measure supports all other measures. Not quantifiable alone.
TOTAL WASTE MEASURES		***25***	

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
F. RENEWABLE ENERGY MEASURES			
RE-1	Renewable Energy Finance District (California First or equivalent program)	1,680	• At this time, the CA FIRST program is not available in Napa County. The program is in its early stages and data about community response to financial incentives for residential solar installations is not yet available. Participation in this program will likely vary by a large amount across California. • Assume California First Program is available in Napa County and results in 2,500 solar PV installations before 2020 (approx. 25% of existing single family building stock). • Assume the average CA solar PV installation = 1.5kw or 3000 kwh/year.
RE-2	Biofuels and Landfill GTE at Clover Flat	465	• Assume maximum power output for the biofuels component as specified in the CFL MOD (1MW) for all weekdays, 8 hours per day. • Clover Flat is estimated to have 1589315 tons of WIP in 2020. •Assume 0.5MW generation based on landfills of comparable size described in the ARB's study of energy potential in CA landfills http://www.energy.ca.gov/reports/2002-09-09_500-02-041V1.PDF. • Assume all power generated is NOT going back to the grid but is used locally to power Napa County local government facilities or other facilities within unincorporated Napa County.
RE-3	Remove Barriers to Renewable Energy Development	127	• Permit streamlining for solar was done in 2004 (personal communication, October 4, 2010). This is prior to the baseline inventory year. At this time, ICF has not included resulting solar installations in the CAP. •Data Source–IS/ND for Small Wind Energy Ordinance (Napa Planning commission website). IS/ND indicates small wind projects allowed on 2 acre parcels and no greater than 25kw. 437 acres with winds higher than 11.2, >700 acres with winds between 10-11 mph. • Assume that the ordinance passes and results in 10 small wind energy projects (25kw) by 2020. Used the CAPPA default calculation for the # of kwh produced.
TOTAL RENEWABLE SECTOR:		**2,272**	

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
G. TRANSPORTATION MEASURES			
		($MTCO_2e$)	
T-1	Promote Dense, Mixed-Use Developments	4,400	• As few rezoning are expected, this is a reasonable (though low) estimate of effectiveness
T-2	Integrate Below Market Rate Housing	50–100	
T-3	Requirements for Use Permit Applicants	0	• Not quantified as a standalone strategy but important as a complementary strategy to parking strategies.
T-4	Traffic Calming Improvements	100	• Since few specific opportunities have been identified, this will have low effectiveness. A more aggressive strategy will increase effectiveness. Also keep in mind, traffic calming has many other benefits beyond CO_2 reductions.
T-5	Bicycle Network and Bicycle Parking	10	• 753 square miles (Napa county) • 40 miles of new bike plans (per general plan) • Literature suggests a 1% increase in bike commuters for each mile of bike lane (per square mile). This equates to 0.05% increase given the large square miles of Napa county, and that employers are spread throughout the county. Bike lanes will promote increased recreational trips (though these likely will be new trips).
T-6	Improve Transit Network	500-2,200	• Assumed 5-10% increase in network • Assumed 25-50% reduction in headways • 1.4% existing transit mode share (Napa short range transit plan fy2008-2014) • Conservative assumptions on overall transit improvements since more detailed information will not be provided until the 2011 revisioning
T-7	Station Bike Parking	0	• Not quantified as a standalone strategy but important as a complementary strategy to Transit Network.

		GHG Reductions in 2020 (MTCO$_2$e)	Key Assumptions and Data Sources
T-8	Park-and-Ride Lots	0	• Not quantified as a standalone strategy but important as a complementary strategy to Transit Network and commute based strategies.
T-9	Required Contributions for Transit Access Improvements	0	• Not quantified as a standalone strategy but important as a complementary strategy to Transit Network.
T-10	Employer-Based Commute Trip Reduction Program	3,500–6,000	• Assume 50-100% of employees are eligible. • 22% of trips are work trips (Bay Area Travel Survey). • Literature assumes a combination of carpooling, ride-matching, transportation coordinator, end-of-trip facilities, vanpool assistance, flex schedule for carpoolers. • Note that this will only be effective if the measure reaches the majority of employers in the county (though this does NOT assume it is a mandated and monitored program).
T-11	Provide Employer Sponsored Vanpool/Shuttle	100–2,400	• Assume all small employers • Assume 5-25% of employers will implement • 22% of trips are work trips • This measure can provide greater benefits if the strategy was required for majority of employers in the county.
T-12	Reduce Parking Requirements and Establish Parking Maximums	500–1,600	• Assume 5–25% of employers will implement. • Also applicable to rezonings. • Assume 10% reduction in parking. • Low impact due to this strategy only being applied to small parts of the County.
T-13	Preferential Parking	0	• Not quantified as a standalone strategy but important as a complementary strategy to parking strategies
T-14	Improve Traffic Flow	< 100	• Assumed only the Flosden/Newell Rd and Devlin Rd additions. • Compared the travel model runs with and without these 2 improvements.
TOTAL RENEWABLE SECTOR:		***9,260 – 16,910 (Avg. of 13,085)***	
TOTAL LOCAL MEASURES:		**20,498**	**Does not include Project-Level Mitigation**

		GHG Reductions in 2020 ($MTCO_2e$)	Key Assumptions and Data Sources
H. PROJECT LEVEL MEASURES			
PL-1	Vineyard Conversions	33,774	• Require reductions or offsets totaling 51.5% of carbon stock loss and annual sequestration loss. Possible strategies include habitat restoration, reforestation, avoided deforestation, and offsets. Amount determined to establish rough parity between overall mitigation percentage for new vineyard development projects and new development projects.
PL-2	Development Projects		• Require replacement of 100% of lost carbon stock/annual sequestration.
	Urban Land Use Change	7,218	
	Other Emissions Mitigation	3,718	• Require offset of 5.5% of other (non land use change) project GHG emissions.
TOTAL PROJECT LEVEL MEASURES:		**44,711**	

A.7 Quantification of GHG Reduction Measures (transportation sector)

Quantification of the selected GHG reduction measures was conducted using broad tools and factors rather than more labor-intensive tools/models given that the overall amount of reductions was expected to be limited and thus the effort was assumed to not require a highly refined level of quantification. A major report utilized for the quantification efforts was the recently released Quantifying Greenhouse Gas Mitigation Measures report authored by the California Air Pollution Control Officers Association (CAPCOA), ENVIRON, and Fehr & Peers. Fehr & Peers conducted an extensive literature review for the transportation related strategies to provide accurate and reliable quantification methods to be used throughout California.

The methodologies and calculations described in the report were applied to the Napa County specific strategies. The calculations were additionally refined to provide more accuracy based on the context of the strategy and environment. For example, in many cases, estimated reductions were discounted if they had limited application such as applying only to work trips or new development areas. Estimated reductions were also adjusted to account for their implementation in a more rural community, whereas much of the literature is based on research conducted in urban or suburban areas.

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Appendix B

Project Level Worksheets

Appendix B
Project Level Worksheets

B.1 Introduction

This appendix describes the need and framework for CAP Measure PL-1 *Project Level Mitigation for Vineyard Conversion Projects*. This appendix also contains project level worksheets and step-by step instructions for using the worksheets.

B.2 Project Level Mitigation Program for Vineyard Conversion Projects

The Napa County Climate Action Plan (Plan or CAP) is a comprehensive and programmatic approach to ensuring that the County reduces its GHG emissions consistent with its General Plan target and with AB 32. Per BAAQMD CEQA guidance, individual projects that demonstrate consistency with a qualified GHG reduction strategy can be determined to have a less than significant impact on climate change. CAP measure PL-1 *Project Level Mitigation for Vineyard Conversion Projects* establishes processes whereby (1) vineyard conversion projects demonstrate consistency with the CAP and (2) a portion of the losses in annual carbon sequestration/stock loss due to vineyard conversion in the County are offset.

Napa County CAP Measure PL-1 *Project Level Mitigation for Vineyard Conversion Projects* requires vineyard development projects to account for the loss in annual carbon sequestration/stock associated with the project using approved methodologies and offset 51.5 % of GHG emissions through approved offset and mitigation mechanisms.

Implementation of Measure PL-1 measure accomplishes the following goals:

1. Allows for the County to track actual land conversion and loss in sequestration relative to projections made in the General Plan.
2. Encourages responsible land use conversion, encourages replanting and preservation, and promotes sustainability in vineyard construction and operation.
3. Demonstrates Napa's commitment to be consistent with the AB-32 GHG reduction goals and BAAQMD guidance while simultaneously providing consistent and transparent guidance to all vineyard expansion projects.
4. Provides a quantitative connection between individual projects GHG emissions and the County's CAP. Individual projects that demonstrate consistency with the CAP and Measure PL-1 will benefit from a simplified CEQA compliance process.

B.3 Implementing Measure PL-1 at the Project Level

As part of the permit approval process, vineyard projects will be required to complete and adhere to PL-1 compliance worksheets to demonstrate consistency with the CAP. The PL-1 compliance worksheets are Excel-based worksheets that will be available free of charge from the County. The worksheets assess the following:

1. A project's adherence with current BAAQMD CEQA Guidance related to GHG emissions.
2. A project's adherence to reduction measures listed in the CAP.
3. The calculation of one time emissions associated with tree/vegetation removal.
4. A methodology to encourage and credit development projects that include GHG mitigation measures in excess of those required by the CAP
5. A transparent determination of the GHG impact of a project's effect on GHG emissions and, if necessary, a determination of GHG emission offsets required by the project for CAP consistency.

Project Level Mitigation Measure PL-1 Compliance Tables

Table 1. PL-1 worksheet color coding convention

County data (not to be changed by the applicant)	
Numeric input cell	
Text input cell	
Model output cell	

Table 2. Project description

Project name :		
Project location :		
Project contact name :		
Project contact e/mail :		
Project contact phone :		
Date submitted :		
Additional notes :		
Total acres on site suitable for vineyard development		
Total acres on site expected to be developed		

Table 3. Net loss of carbon stocks on site

VEGETATION THAT WILL BE REMOVED			
VEGETATION TYPE	**AREA CONVERTED**	**STOCK FACTOR**	**GHG EMISSIONS**
	(acres)	(MT C $acre^{-1}$)	(MT CO_2e)
Oak Woodlands		89.6	0
Riparian Woodlands		73.1	0
Coniferous Forest		52.5	0
Grasslands		0.8	0
Shrublands		12.1	0
Croplands Not Vineyards		3.5	0
Vines		1.2	0
Totals for Land Removed	0		0

Table 4. Net gain of carbon stocks on site

VEGETATION THAT WILL BE PLANTED			
VEGETATION TYPE	**AREA PLANTED**	**STOCK FACTOR**	**GHG SINK**
	(acres)	(MT C $acre^{-1}$)	(MT CO_2e)
Oak Woodlands		-95.1	0
Riparian Woodlands		-80.9	0
Coniferous Forest		-58.1	0
Grasslands		-1.4	0
Shrublands		-16.2	0
Croplands Not Vineyards		-3.8	0
Vines		-1.2	0
Totals for Land Planted	0		0

Table 5. BAAQMD CEQA guidelines and Napa CAP compliance determination

Compliance Question	Supporting Table	Answer (Yes/No)
Question 1: Per BAAQMD CEQA Guidelines (2010), have all construction related GHG emissions been calculated and disclosed?		
Question 2. Per BAAQMD CEQA Guidelines (2010), have all BMPS for reducing GHGs during construction as listed in section 8.2 been incorporated?	Complete Table A	
Question 3. Will County-recommended BMPs for vineyard operations be implemented?	Complete Table B	

Table 6. Sum of GHG mitigation measures implemented by the project in excess of those required in Table 7

Compliance Question	Supporting Table	GHG REDUCTIONS (MT CO2e)
Sum of additional GHG measures implemented by the proposed project in excess of those required by BAAQMD and the Napa County CAP	Complete Table C	0

Table 7. NAPA County CAP mitigation requirement for vinyard expansion projects

Fraction of carbon stock loss GHG emissions requiring mitigation	52%

Table 8. Summary of GHG emissions sources, sinks, and mitigation requirements

GHG emissions (positive is a source, negative is a sink)	(MT CO2e)
Total emissions associated with land conversion	0
Net emissions that require mitigation	0
Additional project level mitigation identified for vineyard expansion	0
GHG emissions that need to be offset through offsite mitigation	0

Table 9. Potential Offsite offsets available for project mitigation

Potential offset options
Energy efficiency retrofit fund (payment based on carbon price at time of project approval or time of payment)
Agricultural Vehicle engine retrofit program (payment based on carbon price at time of project approval or time of payment)
Conservation of land within Napa County (must demonstrate it is avoided conversion consistent with CARB/CAR Forestry Protocol)
Restoration of land within Napa County (must demonstrate carbon credit consistent with CARB/CAR Forestry Protocol)
Purchase of forest credits in California - can be purchased in a single year vintage or many years (must be Forestry Protocol validated credits)
Purchase of forest credits outside of California - can be purchased in a single year vintage or over many years (must be Forestry Protocol, Clean Development Mechanism, or equivalent

Project Level Mitigation Measure PL-1 Supporting Tables

Table A. BAAQMD Recommended Measures for reducing GHG emissions related to Vineyard Construction

ID	Compliance question	Response (Yes/No/NA)	Comments
1	Use alternative fueled (e.g., biodiesel, electric) construction vehicles/equipment for at least 15% of the fleet		
2	Minimizing the idling time of diesel powered construction equipment to two minutes.		
3	All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.		
4	Other- to be provided by applicant		

Table B. Recommended practices for vineyards

ID	Compliance question	Response (Yes/No)	Comments
1	Use of cover crop		
2	Mulching not burning		
3	Minimal use of fertilizers, organic fertilizer use when needed		
4	No tillage or reduced tillage		
5	Plant hedgerows and native vegetation		
6	Other		

NOTE: Soil best management practices (BMPs) are difficult to quantify in terms of carbon sequestration benefit at present, but as scientific understanding and acceptable protocols for quantifying become available, then project proponents will be able to quantify and receive credit for BMPs.

Table C. Additional quantifiable measures implemented by the project in excess of those required by BAAQMD and the CAP (see Tables A & B)

Note that the project proponent must calculate the GHG reduction measures listed below with conventional protocols and detail all calculations in an attachment

ID	Compliance question	GHG Reduction (MT CO2e)	Comments
1	Achieve exceptional water conservation for agricultural use		
2	Install other renewables on-site		
3	Use of electric agricultural vehicles		
4	Use of biodiesel agriculture vehicles		
5	Use of electric landscape equipment		
6	Use of electric vehicles for short trips		
7	Other (*documentation provided by proponent*)		
Total	Sum of all measures listed above	0	

Checklist of Voluntary
Greenhouse Gas Emission Reduction Measures

A Tradition of Stewardship
A Commitment to Service

An addendum to the Entitlement Application and a supplement for Initial Studies as required by CEQA

PROJECT NAME ______________________

PROJECT ADDRESS ______________________

APPLICANT ______________________

CONTACT INFO ______________________
email phone

		yes	no	I don't know
1	Have you designed to U.S.G.B.C.™ LEED™ or Build It Green™ standards? If yes, please include a copy of their required spreadsheets.			
2	Do you have an integrated design team? if yes, please list: ______________________			
3	**SITE DESIGN**			
3.1	Does you design encourage community gathering, pedestrian friendly?			
3.2	Are you building on existing disturbed areas, or preserving high quality ag land?			
3.3	Landscape Design			
3.31	native plants?			
3.32	drought tolerant plants?			
3.33	Pierce Disease resistant planting?			
3.34	Fire resistant planting?			
3.35	Are you restoring open space and/or habitat?			
3.36	Are you harvesting rain water on site?			
3.37	large trees to act as carbon sinks?			
3.38	using permeable paving materials for drive access and walking surfaces?			
3.4	Does your site provide access to alternative transportation? If yes, what kind: ______________________			
3.5	Does your parking lot include bicycle parking?			
3.6	Do you have on-site waste water disposal?			
3.7	Do have post-construction stormwater on site detention/filration methods designed?			
3.8	Have you designed in harmony with existing natural features, such as preserving existing trees or rock outcroppings?			
3.9	Does the project minimize the amount of site disturbance, such as minimizing grading and or using the existing topography in the overall site design, such as cave design?			
4	Is the structure designed to take advantage of natural cooling and passive solar aspects?			
4	**ENERGY PRODUCTION & EFFICIENCY**			
4.1	Does your facility use energy produced on site? If yes, please explain the size, location, and percentage of off-set: ______________________			
4.2	Does the design include thermal mass within the walls and/or floors?			
4.3	Do you intend to commission the performance of the building after it is built to ensure it performs as designed?			
4.4	Will your plans for construction include:			
4.41	High density insulation above Title 24 standards?			
4.42	Zone your heating and cooling to provide for maximum efficiency?			
4.43	Energy Star™ or ultra energy efficient appliances?			
4.44	A "cool" (lightly colored or reflective) or a permeable/living roof?			
4.45	Timers/time-outs installed on lights (such as the bathrooms)? If yes, please explain: ______________________			
5	**WATER CONSERVATION**			
5.1	Does your landscape include high-efficiency irrigation?			
5.2	Does your landscape use zero potable water irrigation?			
5.3	Is your project in the vicinity to connect to the Napa Sanitation reclaimed water?			
5.4	Will your facility use recycled water?			
5.41	If no, will you prepare for it by pre-installing dual pipes and/or purple lines?			
5.5	Will your plans for construction include:			
5.51	a meter to track your water usage?			
5.52	ultra water efficient fixtures and appliances?			
5.53	a continuous hot water distribution method, such as an on-demand pump?			
5.54	a timer to insurer that the systems are run only at night/early morning?			

		yes	no	I don't know
6	**MATERIAL RECYCLING**			
6.1	Are you using reclaimed materials?			
	If yes, what and where: ____________________			
6.2	Are you using recycled construction materials-			
	6.21 finish materials?			
	6.22 aggregate/concrete road surfaces?			
	6.23 fly ash/slag in foundation?			
6.3	Will your contractor be required to recycle and reuse construction materials as part of your contract?			
6.4	Does your facility provide access to recycle-			
	6.41 Kitchen recycling center?			
	6.42 Recycling options at all trash cans?			
	6.43 Do you compost green waste?			
	6.44 Provide recycling options at special events?			
7	**NATURAL RESOURCES**			
7.1	Will you be using certified wood that is sustainably harvested in construction?			
7.2	Will you be using regional (within 500 miles) building materials?			
7.3	Will you be using rapidly renewable materials, such as bamboo?			
7.4	Applying optimal value engineering (studs & rafters at 24" on center framing)?			
7.5	Have you considered the life-cycle of the materials you chose?			
8	**INDOOR AIR QUALITY**			
8.1	Will you be using low or no emitting finish and construction materials indoors-			
	Paint?			
	Adhesives and Sealants?			
	Flooring?			
	Framing systems?			
	Insulation?			
8.2	Does the design allow for maximum ventilation?			
8.3	Do you plan for a wood burning fireplace (US EPA Phase II certified)?			
8.4	Does your design include dayling, such as skylights?			

9 Are there any superior environmental/sustainable features of your project that should be noted?

____

____

____

____

____

10 What other studies or reports have you done as part of preparing this application?

1 ____________________

2 ____________________

3 ____________________

4 ____________________

		yes	no	I don't know
11	If your project involves an addition or modification to an existing building, are you planning to improve energy conservation of existing space (such as insulation, new windows, HVAC, etc.)?			
	If yes, please describe: ____________________			
12	Once your facility is in operation, will you:			
	12.1 calculate your greenhouse gas emissions?			
	12.2 implement a GHG reduction plan?			
	12.3 have a written plan to reduce your vehicle miles traveled of your operations and employee's commute?			
13	Does your project provide for education of green/sustainable practices?			
	If yes, please describe: ____________________			

14 Any comments, suggestions, or questions in regards to the County's efforts to reduce greenhouse gases?

____

____

____

____

Form filed out by: ____________________

Benefiting the environment, the community and high quality grapes and wine

Vineyard Management Practices and Carbon Footprints

CSWA would like to thank the California Department of Food and Agriculture, the U.S. Department of Agriculture Specialty Crop Innovation Grant Program, and the University of California, Davis for making this publication possible.

Project Partners:

Allied Grape Growers

American Vineyard Foundation

California Association of Winegrape Growers

California Farm Bureau Federation

California Grape and Tree Fruit League

Sun-Maid Growers of California

University of California, Davis

Wine Institute

GHG Estimates from Combustion of Fossil Fuels

- Diesel produces 12 kg CO_2 equivalents (CO_2 + N_2O + CH_4)/gallon
- Gasoline produces 10.5 kg CO_2 equivalents/gallon
- Propane produces 8.5 kg CO_2 equivalents/gallon
- Natural gas produces 1.5 kg CO_2 equivalents/meter^3

Carbon Footprints, Emissions and Sequestration

The California grape and wine community, like many other agricultural and business sectors, is increasingly interested in better understanding its 'carbon footprint'. A carbon footprint can be defined as a comprehensive measure of the amount of greenhouse gases (GHGs) produced and consumed, and is used to determine whether or not individual operations are contributing to the increase of GHGs in the atmosphere and therefore global climatic change. Some vineyard operations, such as tractor driving, "produce" the GHG carbon dioxide (CO_2). Indeed, the key agricultural sources of atmospheric CO_2 are the combustion of fossil fuels and soil management practices that increase the decomposition of soil organic matter. The growing of grapes, however, also "consumes" CO_2 through photosynthesis. For this reason and others, agriculture, including grape growing, is a significantly smaller source of CO_2 than transportation and other industries. However, assessing a carbon footprint for an individual vineyard is somewhat more complex.

Agricultural activities emit two additional GHGs – nitrous oxide (N_2O) and methane (CH_4). The main GHG produced by viticulture is likely N_2O. It is generally believed that the CH_4 footprint in vineyards is insignificant. The importance of N_2O comes from its strong ability to act as a GHG. N_2O is roughly 300 times more effective than CO_2 at trapping heat in the Earth's atmosphere, so a small amount of N_2O can cause as much global warming as a very large amount of CO_2. To calculate a carbon footprint according to the protocol outlined by the International Panel on Climate Change (IPCC) requires the assessment of all GHGs combined into a cumulative, representative number, where non-CO_2 emissions such as CH_4 and N_2O are converted to CO_2 equivalents. For example, this is done for N_2O by multiplying the amount of emissions by its global warming potential (how much better it is at trapping heat than CO_2, or 300). Thus, in terms of equivalents, one kg of N_2O equals 300 kg of CO_2.

Besides being a source of GHGs, agricultural systems can help offset emissions by the long-term storage of carbon in vegetative structures and soils. This process is referred to as carbon sequestration, and according to some models, perennial crops like vineyards and orchards are expected to sequester more carbon than annual crops. Vineyard establishment and management practices can differentially influence the amounts and relative proportions of vineyard GHG emissions and carbon sequestration and, thus, can be adapted to reduce emissions and increase carbon storage to achieve a more desirable balance.

Comparative GHG Impact from Vineyard Nitrogen Management Practices:

Synthetic Fertilizers (CAN, UAN, ammonium nitrate, other nitrate fertilizers, etc.)

- GHG released during manufacture (also applies to pesticides)
- Small percentage directly lost as N_2O on site (currently thought to be about 1%)
- Small percentage indirectly lost offsite through leaching/volatilization to NH_3 followed by conversion to N_2O (currently thought to be roughly 0.3%)
- Potentially higher rate of leaching than organic fertilizers

Organic Fertilizers and Additives (green manure, compost, winery wastes, etc.)

- Small percentage lost directly as N_2O on site
- Small percentage indirectly lost offsite through leaching/volatilization to NH_3 followed by possible conversion to N_2O
- Potentially lower leaching rate than synthetic fertilizers
- Higher rate of volatilization than synthetic fertilizers, in some cases
- More GHG produced by fuel use during tractor operations to apply manures than by fuel use during fertigation
- Effective way to sustainably reduce synthetic fertilizer inputs and recycle winery waste
- Good way to build soil organic matter and thus increase carbon sequestration
- GHG cost of compost and manure transport can be high unless generated on site

Legume Cover Crops

- Small, but unknown percentage probably lost directly as N_2O
- Can decrease between-row leaching rate and better retain nitrogen in soil
- Good way to build soil organic matter and thus increase carbon sequestration
- Not the most efficient way to provide vines with nitrogen

Vineyard Practices and Carbon Footprints

This document details the relationship between vineyard management practices and carbon footprints. For some practices below, GHG and carbon sequestration calculation tools can be used to indicate how farming practices influence the vineyard carbon footprint. For instance, the USDA Voluntary Reporting Carbon Management Tool, known as COMET-VR, shows the carbon equivalent emissions saved from reducing or eliminating tillage in annual crops (http://www.cometvr.colostate.edu/). Another useful tool is the International Wine Industry Greenhouse Gas Protocol and Accounting Tool (http://www.wineinstitute.org/ghgprotocol), developed by Wine Institute and international partner organizations, which allows the calculation of estimated vineyard and winery GHG emissions. Because these tools are in development, and impacts of site-specific factors such as soil type, climate, rootstock, variety, and vineyard age on GHG emissions are not fully understood, it currently is not possible to definitively evaluate the emissions for every management practice. However, use of the tools provides understanding about how carbon accounting works. Nevertheless, a number of vineyard activities clearly affect GHG emissions, for which current understandings and mitigation tactics are described below.

Fossil Fuel Combustion

The combustion of fossil fuels during the operation of tractors, ATVs, irrigation pumps, and other farm equipment often constitutes a large source of the vineyard GHG footprint. Different fossil fuels are associated with different amounts of GHGs. However, all fossil fuels, including cleaner-burning natural gas, combust to produce significant amounts of CO_2 and variable quantities of other GHGs like N_2O. Although it has a greater energy content per unit volume, diesel produces more CO_2 and N_2O than gasoline, natural gas, or propane. Reducing fuel usage is one of the most obvious and effective ways to reduce the vineyard GHG footprint. Any reduction in tractor passes, for example, diminishes the carbon footprint.

Nitrogen Fertilizer Applications

Another important source of vineyard GHG emissions is the use of nitrogen fertilizers. When any nitrogen is added to soil, some of the applied nitrogen can be converted to N_2O. This can happen to any nitrogen-containing additive including synthetic fertilizers (e.g. nitrate and ammonium) and organic materials (e.g. green manures and pomace). All N_2O production associated with vineyards results from soil microbes using the nitrogen instead of the vines. Moreover, some added nitrogen can leach into groundwater and subsequently be converted to N_2O. Minimizing N_2O emissions may be challenging. For instance, in winegrapes where little fertilizer generally is used, it may be difficult to further decrease emissions of N_2O. Use of organic fertilizers and cover crops instead of synthetic fertilizers to supply necessary nitrogen may limit emissions but has not been proven. Timing nitrogen applications to ensure maximum uptake by roots may decrease N_2O emissions and nitrogen leaching but more research is needed.

Irrigation

Vineyard water use can impact GHG emissions and carbon sequestration. The energy used during irrigation to pump water results in GHG emissions. Moreover, a correlation exists between increased irrigation and GHG emissions from soil. At higher moisture, soils have minimal oxygen content and microbes produce more N_2O. Anaerobic soils are optimal environments for microbial production of N_2O (and CH_4 though less important for vineyards). Wet soils, especially when warm, can also increase CO_2 emissions through increased microbial activity and decomposition of organic matter. In contrast, increasing irrigation can offset some GHG emissions by stimulating vines to grow and store carbon in permanent structures. This is a form of above-ground carbon sequestration that is especially effective if vines live for a long time and much of the removed vine biomass is incorporated into the soil to increase organic matter. Various irrigation systems and patterns may differently impact GHG emissions from soils. Drip irrigation is thought to produce less N_2O than flood or furrow irrigation at the vineyard level but more research is needed.

Tillage

The act of tilling soil consumes substantial quantities of fossil fuel. Estimates of fuel usage during tillage operations and potential savings from alternative management strategies can be determined using a general calculator at: http://ecat.sc.egov.usda.gov/. (Use the estimated acreage of a wheat cover crop.) The Wine Industry GHG calculator (http://www.wineinstitute.org/ghgprotocol) also performs this function. By breaking up soil aggregates, tillage increases soil emissions of CO_2 and possibly N_2O by mobilizing carbon and nitrogen, thus allowing microbes to access and consume previously protected organic matter. Each tillage pass causes some loss of soil-sequestered carbon as CO_2. Decreases in tillage not only limit CO_2 emissions but minimize losses of organic matter through erosion. While building up soil organic matter may lead to some additional CO_2 and N_2O production, the net balance will be greater soil carbon storage in the long term. Additional research is needed to clarify these impacts in California.

Cover Crop Management

The use of cover crops can increase the storage of carbon in vineyard soils and decrease CO_2 emissions. Perennial cover crops are most efficient at doing this because of their greater root production. In addition to increasing soil carbon, leguminous cover crops supply nitrogen to the soil, and may be used to decrease applications of synthetic fertilizers. Cover crops also decrease the offsite movement and loss of soil organic matter by erosion and nitrogen by leaching. The relationship between cover crops and GHG production and carbon storage is an area of ongoing research.

GHG Impact from Irrigation Strategy:

- Frequent, low-volume irrigation may produce less N_2O than infrequent, high-volume irrigation
- Drip irrigation likely causes lower N_2O emissions than flood or furrow irrigation at the vineyard level, but if N fertilizers are applied through the drip line, then this could offset this benefit somewhat by concentrating N in soil, which may increase N_2O production under the drip emitter (this is an area of uncertainty)

GHG Impacts of Cover Crops:

- Increased soil carbon storage (especially perennial cover crops)
- Increased soil nitrogen levels (legumes) and may decrease need for synthetic fertilizers
- Potential reduction in leaching of nitrogen through the soil
- Potential decrease in indirect losses of N_2O due to decreased leaching rates
- May require tractor mowing passes which are an additional source of fossil fuel GHG emissions
- May compete with vines for water, possibly resulting in more irrigation and GHG emissions from pumping water
- Potentially decreases losses of soil organic matter to erosion, particularly on hillsides

GHG Impacts of Pruning/ Thinning Practices:

- Some vine material extracted during pruning and thinning may be incorporated into soil organic matter, increasing carbon sequestration
- Fossil fuel used during mechanical canopy management can contribute substantial amounts of CO_2
- Removal of dead vines is a loss of carbon storage unless chipped and left in the vineyard

GHG Impacts of Hedgerows and Native Vegetation:

- Native perennial vegetation is a significant source of carbon storage
- Native oak systems store large amounts of carbon in soil and trees
- Decreased potential for erosion and runoff
- Decreased potential for nitrogen and/or pesticide contamination of surface and ground water

Comparative GHG Impact from Between-Row Tillage Systems:

Conventional Tillage (<30% of crop residues left on surface after tillage)

- Frequent tillage (>1-2 times/year) releases more CO_2 by exposing newly formed organic matter to microbial decomposition
- Potentially increased loss of organic matter to erosion
- Decreased capacity of soil to store carbon
- Generally less carbon entering soil organic matter compared with other tillage systems
- Possibly greater consumption of fossil fuels for tractor operations, resulting in more GHG emissions

Conservation/Reduced Tillage (>30% of crop residues left on surface)

- Fewer tillage passes (1 pass/year or even less under certain conditions) releases less CO_2 due to slowed organic matter decomposition
- Decreased loss of organic matter to erosion
- Increased ability of soil to store carbon
- Generally more carbon enters soil organic matter than with conventional tillage
- Often associated with cover cropping which also enhances soil carbon storage
- Possibly less GHG emissions associated with tractor operations

No-Tillage (no disturbance of soil surface)

- No GHG emission from tractor tillage operations
- Increased ability of soil to store carbon
- Soil aggregates are not broken up, protecting organic matter from microbial consumption
- Greatest rate of carbon entering soil organic matter from row vegetation
- Cover crops often used, including leguminous plants that supply nitrogen and can lower synthetic nitrogen fertilizer needs
- Depending on site specific factors, increased soil carbon can sometimes lead to higher emissions of the more potent N_2O, which may counteract much of the benefit from carbon sequestration

Vineyard Pruning and Thinning

Vineyard pruning and thinning practices may increase soil carbon storage if the extracted biomass remains in the vineyard. Similarly, the dropping of fruit can be a valuable carbon input. The removal of dead vines represents a loss of carbon storage unless these vines are chipped and left in the vineyard.

Hedgerows and Native Vegetation

Planting hedgerows and conserving or restoring natural vegetation may substantially reduce the vineyard GHG footprint. The carbon stored in these woody long-lived perennial plants can represent a large source of sequestered carbon, significantly decreasing overall GHG emissions. Oak woodlands, for example, can store huge amounts of above- and below-ground carbon over their lifetime. Moreover, hedgerows and native vegetation within the vineyard landscape decrease the collective environmental impact of viticultural activities by decreasing soil erosion and the leaching of fertilizers into surface and ground water.

Vineyard Impacts on Atmospheric GHGs

Uncertainty

Model Components	CO_2 (X)	N_2O (300X)	CH_4 (25X)
Carbon Sequestration	− − −	+/−	+
Tillage	+ + +	+/−	+/−
Nitrogen Fertilizer	+/−	+++	−
Biomass			
Vine C Storage	− −	?	?
Vine Decomposition	+ + +	+ +	+
Soil Amendments			
Compost	− −	+ +	+
Manure	− −	+ +	+
Lime	+/−	+/−	?
Cover Cropping	+/−	+/−	+
Irrigation Water	+/−	+ + +	+
Fuel Use			
Vehicles	+ + +	+ +	+
Pumps	+ + +	+ +	+
Electrical Grid	+ + +	+ +	+

Legend: + = Increases − = Decreases ? = Unknown +/− = Site Specific
Number of symbols indicates relative magnitude of impact.

Summary

The diagram above models the relative impact of vineyard practices on the atmospheric GHGs – CO_2, N_2O, and CH_4 – according to scientific understanding. While more research is needed to address knowledge gaps and better understand how practices definitively impact the carbon footprint, this diagram can help practitioners identify and consider practices to continually enhance reductions in their vineyard carbon footprints.