Appendix B

Emissions Reduction Quantifications

Appendix B describes the emissions reduction quantification for 2020 and 2030. The quantification for each year is described in a separate subsection. Unless noted, all reduction percentages, participation rates, and other scale factors are applied to the relevant sector or subsector emissions in the specified year.

2020 EMISSIONS REDUCTIONS

Table B-1: Summary of Emission Reductions per Measure in 2020

Measure	Description	MT CO_2e/year reduced in 2020
A-1	Reduce nitrogen fertilizer application rates	4,132
A-2	Reduce fossil fuel consumption in field equipment	1,142
A-3	Reduce energy use in agricultural irrigation pumping	9,396
A-4	Reduce confined livestock manure methane emissions	12,370
A-5	Reduce methyl bromide application	36
A-6	Sequester carbon in agricultural landscapes	2,527
Transportation and Land Use	General Plan Policies contained in the Land Use and Circulation Elements	42,018
E-1	Pursue a community choice aggregation program	117,285
E-2	Reduce energy consumption in existing residential and non-residential buildings	3,948
E-3	Reduce energy consumption in new residential and nonresidential buildings	31,852
E-4	Increase on-site renewable energy generation to reduce demand for grid energy	24,870
E-5	Promote on-farm renewable energy facilities	316
E-6	Reduce water consumption in existing buildings through increased plumbing fixture efficiency	2,103
E-7	Promote weather-based irrigation systems and water efficient turf management	51
WR-1	Expand landfill methane capture systems	9,366
Total		**261,412**

AGRICULTURE

A-1: Reduce nitrogen fertilizer application rates

This measure assumes that nitrogen fertilizer application rates in Yolo County will decrease by an average of 6% below 2008 application rates by 2020. UC Davis research identifies a potential to reduce nitrogen fertilizer application rates 25% below current (2008) levels. The County assumes a conservative 6% reduction for 2020.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
6%	29.3% (agriculture)	24.4% (fertilizer)	0.4%	**4,132**

Source: De Gryze, Steven, Rosa Catala, Richard E. Howitt, and Johan Six (University of California, Davis). 2008. Assessment of Greenhouse Gas Mitigation in California Agricultural Soils. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2008-039.

A-2: Reduce fossil fuel consumption in field equipment

Operation and Maintenance Improvements: This measure component assumes 5% of farm equipment increases fuel efficiency by 6% through improvements to operation and maintenance.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
6%	29.3% (agriculture)	25.4% (farm equipment)	5%	0.0%	221

Source: Svejkovsky, Cathy. 2007. Conserving Fuel on the Farm. ATTRA—National Sustainable Agriculture Information Service, National Center for Appropriate Technology.

Engine Conversions*:* This measure component assumes that 25% of farm equipment increases fuel efficiency by 5% through improvements to engines (conversion from older model to Tier IV engines).

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
5%	29.3% (agriculture)	25.4% (farm equipment)	25%	0.1%	921
Total					**1,142**

Source: Alternative Energy Newswire. 2010. New Holland Agriculture and Fiat Powertrain Launching Tier4 Tractors Based on SCR Technology. Available at: www.alternativeenergynewswire.com/new-holland-agriculture-and-fiat-powertrain-launching-tier4-tractors-based-on-scr-technology

Combined, the operation and maintenance improvements and engine conversion components have the potential to reduce field equipment GHG emissions by 1,142 MT CO_2e/year.

A-3: Reduce energy use in agricultural irrigation pumping

Agricultural Irrigation Pump Efficiency: This measure component assumes that 10% of agricultural groundwater pumps ranging from 50-175 horsepower would improve pump bowl efficiency for an average of 33% reduction in energy (electricity or diesel) consumed.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
33%	29.3% (agriculture)	13.9% (agricultural pumps)	10%	0.1%	1,331

Source: Peter Canessa and John Weddington. 2006. Program Thesis and Design for a Diesel Pumping Efficiency Program. Center for Irrigation Technology - California State University, Fresno.

Solar agricultural irrigation pumps: This measure assumes that 40% of agricultural irrigation return pumps (around 10 horsepower) would switch to solar power for 100% of energy consumed.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
50%	29.3% (agriculture)	13.9% (agricultural pumps)	40%	0.8%	8,065

Source: Information regarding solar provided by stakeholders at the Yolo County Climate Action Plan – Agriculture, Rural, and Open Space Stakeholders Workshop, 2010.

Combined, the agricultural irrigation pump efficiency and solar agricultural irrigation pump components have the potential to reduce field equipment GHG emissions by **9,396** MT CO_2e/year.

A-4: Reduce confined livestock manure methane emissions

This measure assumes that 100% of confined livestock facilities (i.e., dairies) in Yolo County will implement biogas control systems that reduce methane emissions by 90% by 2020.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
90% (methane control efficiency)	29.3% (agriculture)	14% (livestock)	33.9% of livestock (100% of dairy cattle)	1.2%	**12,370**

Source: Ascent Environmental Inc, 2010.

A-5: Methyl bromide reduction

This measure assumes that use of the pesticide methyl bromide eliminated out by 2020 per the requirements of the Montreal Protocol.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
100%	29.3% (agriculture)	0.0% (pesticide application)	0.0%	**36**

Source: The Phase-out of Methyl Bromide. US Environmental Protection Agency. Accessed October 1st 2010. http://www.epa.gov/ozone/mbr/

A-6: Sequester carbon in agricultural landscapes

Riparian Forest Restoration: This measure component assumes that 1,100 acres of riparian forest will be planted within Yolo County between 2010 and 2020.

Average Carbon Storage Rate (MT C/acre/yr)	Acres Restored between 2010 and 2020	Annual Carbon Storage Potential (MT C/year)	Ratio of MT CO_2e to MT C	Annual Carbon Storage Potential (MT CO_2/year)
0.54634	1,100	600.97	3.66667	2,204

Wood Carbon Stock at Saturation (MT C/hectare)	Wood Carbon Stock at Saturation (MT C/acre)	Years at Riparian Forest C Saturation	Average Carbon Storage Rate (MT C/acre/yr)
108	43.71	80	0.54634

Source: The Carbon Online Estimator: COLE 1605(b), Report for California filtered for Forest Type: Cottonwood, Willow, Cottonwood / willow. COLE Development Group. USDA. Accessed October 7th 2010. http://www.ncasi2.org/COLE/

Hedgerows: This measure component assumes that 7.27 acres (5 miles x 12 feet wide) of hedgerow have been or will be established per year within Yolo County and a total of 174.5 acres are established between 1997 and 2020.

Average Carbon Storage Rate (MT C/acre/yr)	Acres Restored in between 1996 and 2020	Annual Carbon Storage Potential (MT C/year)	Ratio of MT CO2e to MT C	Annual Carbon Storage Potential (MT CO_2/year)
0.50587	174.5	88.3	3.66667	324

Wood Carbon Stock of Hedgerows in Smukler Study (MT C/hectare)	Wood Carbon Stock of Hedgerows in Smukler Study (MT C/acre)	Estimated age of Hedgerows in Smukler Study	Estimated Years to Hedgerow C Saturation	Wood Carbon Stock at Saturation (MT C/acre)	Average Carbon Storage Rate (MT C/acre/yr)
18.75[+]	7.59	15	30	15.18	0.50587

Source: Smukler, S.M. et al. 2010. Biodiversity and multiple ecosystem functions in an organic farmscape. Agriculture, Ecosystems and Environment. 139 (80–97); Estimate of hedgerow establishment provided by Yolo County Resource Conservation District, 2010.

Combined, the components of Measure A-6 have the potential to store **2,527** MT CO_2/year. The carbon storage potential of permanent crops was not applied toward the 2020 reduction target.

TRANSPORTATION

Reduction potential of General Plan transportation and land use policies

The County's General Plan set a performance standard for new development of 44 vehicle miles traveled per household per day (VMT/HH/day). Exhibit IV.C-3 of the County's GP EIR showed 83 VMT/HH/day in 2005, forecast to reduce to 77 VMT/HH/day in 2035 under no project (Exhibit IV.C-4). The County assumed the following levels of compliance with the performance standard for new development within each community:

Area	% of GP growth	% compliance with VMT standard	VMT/HH/day	% reduction	weighted % reduction
Dunnigan SP	44.4%	100%	44	42.9%	19.0%
Elkhorn SP	17.7%	33%	70	9.1%	1.6%
Esparto	8.4%	50%	64	16.9%	1.4%
Madison SP	7.6%	60%	67	13.0%	1.0%
Knights Landing	5.0%	25%	73	5.2%	0.3%
Covell	0.0%	0%	77	0.0%	0.0%
Total					23.3%

The anticipated VMT reduction associated with this performance standard was estimated at 23.3%.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
23.3%	28.7% (transportation)	63.1% (transportation emissions from new growth)	4.2%	**42,018**

Source: VMT Data from Fehr and Peers. 2010. Growth allocation assumptions from Yolo County Planning Staff.

ENERGY

E-1: Pursue a community choice aggregation program

This measure assumes that 10% of the customers in Yolo County would stay with PG&E's portfolio, which was assumed to have complied with the 20% renewable electricity standard by year 2020. 75% of the county would purchase a "light green" portfolio with 50% renewable electricity, and 15% of the county would purchase a "deep green" portfolio at 100% renewable electricity.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
30%	34.4% (electricity)	75%	7.7%	76,490
80%	34.4% (electricity)	15%	4.1%	40,795
Total			12.1%	**117,285**

Source: Participation rates are based on County Staff estimates. Light Green percent reduction mirrors efforts of the proposed San Francisco CCA program (51% renewable by 2017). The Deep Green percent reduction mirrors Marin County's current Deep Green tier (100% renewable).

E-2: Reduce energy consumption in existing residential buildings

Note that this measure applies the scaled reduction to 2008 energy sector emissions to isolate existing building energy from total 2020 building energy.

Existing Residential Buildings: This measure component assumes that 20% of existing (2008) residential units in the county would implement efficiency improvements that reduce energy consumption by 15%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	5.4% (residential energy)	20%	0.2%	959

Source: Coito, Fred and Mike Rufo. 2003. California Statewide Residential Sector Energy Efficiency Potential Study, Study ID #SW063, Final Report, Volume 1 of 2, Main Report. Prepared for Pacific Gas & Electric Company by KEMA-XENERGY Inc. Oakland, California. Participation rates are based on estimates made by County staff and consultants.

Existing Non-Residential Buildings: This measure component assumes that 10% of existing (2008) commercial buildings in the county would reduce their energy consumption by 20%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
20%	25.2% (commercial energy)	10%	0.5%	2,989

Source: Coito, Fred and Mike Rufo. 2003. California Statewide Commercial Sector Energy Efficiency Potential Study, Study ID #SW039A, Final Report, Volume 1 of 2, Main Report. Prepared for Pacific Gas & Electric Company by KEMA-XENERGY Inc. Oakland, California. Participation rates are based on estimates made by County staff and consultants.

Combined, the components of Measure E-2 have the potential to reduce **3,948** MT CO_{2e}/year.

E-3: Reduce energy consumption in new residential and non-residential buildings

Note that this measure applies the scaled reduction to new building 2020 energy emissions. To obtain this value, 2008 building energy emissions are subtracted from total 2020 building energy emissions.

New Residential Buildings: This measure component assumes that 88% of new buildings in the County would exceed Title 24 standards by 15% (i.e., California Green Building Code [CGBC] Tier I standards), and that 10% of new residential units would be larger than 3,500 square feet and thus be required to exceed Title 24 standards by 30% (i.e., CGBC Tier II standards). Finally, this assumes that 2% would voluntarily exceed Title 24 standards by 30% (i.e., CGBC Tier II standards).

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	24% (residential energy in new construction)	88%	0.7%	7,019
30%	24% (residential energy in new construction)	12%	0.2%	1,914
Total			0.9%	8,933

Source: The 15% reduction is based on proposed County Building Standards for all residential and non-residential construction. A County Building Standard will require all residential units over 3,500 square feet to exceed Title-24 by 30%. The participation rates and the voluntary performance level are based on estimates made by County Staff and consultants.

New Non-Residential Buildings: This measure component assumes that in compliance with the County's building energy standards, 98% of new commercial construction in the County would exceed Title 24 standards by 15% and that 2% of new commercial buildings would voluntarily exceed Title 24 standards by 30% (i.e., CGBC Tier II standards).

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	76%(commercial energy in new construction)	98%	2.2%	21,898
30%	76% (commercial energy in new construction)	2%	0.1%	1,021
Total			2.3%	22,919

Source: The 15% reduction is based on proposed County Building Standards for all residential and non-residential construction. The assumption that 2% of new commercial buildings will voluntarily exceed current Title-24 by 30% is an estimate made by County staff and consultants.

Combined the components of Measure E-3 have the potential to reduce **31,852** MT CO_2e/year.

E-4: Increase on-site renewable energy generation to reduce demand for grid energy

Solar Water Heaters: This measure component assumes 100% of new residential and commercial units in the County would reduce 70% and 40% of water-heating-related energy use by installing solar water heaters, respectively. The measure also assumes while 15% of existing residential units would install solar water heaters and reduce water-heating-related energy use by 70% and that 5% of existing commercial units would reduce water-heating-related energy use by 40% each.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
70%	1.5% (residential natural gas)	100%	44% (portion of natural gas used for water heating)	0.1%	1,025
70%	1.5% (residential natural gas)	15%	44% (portion of natural gas used for water heating)	0.1%	125
40%	14.5% (commercial natural gas)	100%	44% (portion of natural gas used for water heating)	0.5%	5,000
40%	14.5% (commercial natural gas)	5%	44% (portion of natural gas used for water heating)	0.1%	232
Total				0.7%	6,382

Source: Del Chiaro, Bernadette. 2007. Solar Water Heating: How California Can Reduce Its Dependence on Natural Gas. Environment California Research & Policy Center. Los Angeles, CA. The 100% participation rate for new construction reflects the establishment of a proposed requirement to include SHW systems on all new development. The voluntary participation rates are estimates made by County staff and consultants.

Photovoltaic Systems: This measure component assumes that 100% of new residential and commercial units within the County would replace 10% of their grid-derived electricity consumption with on-site solar photovoltaic generation. This measure component also assumes that 5% of existing residential units within the County would replace 10% of their grid-derived electricity consumption with on-site solar photovoltaic generation. It is also assumed that owners of existing commercial buildings install 200,000 square feet of solar photovoltaic panels.

% Reduction	Portion of Energy Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
10%	22.3% (residential electricity)	100%	0.5%	4,984
10%	22.3 % (residential electricity)	5%	0.1%	202
10%	61.7% (commercial electricity)	100%	1.2%	12,056
Total			1.8%	17,242

Source: The 100% participation rate for new construction reflects the establishment of a proposed requirement to include PV systems in all new development that provides 10% of the total electricity demand. The voluntary participation rates and percent reduction are estimates made by County staff and consultants.

System Efficiency (W/sq ft)	Annual System Efficiency (kWh/sq ft/yr)	Square feet of solar panels	Estimated generation (MWh/yr)	Emissions factor (MT CO_2e/MWh)	GHG Reduction Potential (MT CO_2e/year)
10.00	21.60	200,000	4,320	0.288488	1,246

Combined, the components of Measure E-4 are expected to reduce GHG emissions by **24,870** MT CO_2e/year.

E-5: Promote on-farm renewable energy facilities

This measure assumes that 1 megawatt of renewable energy generation capacity will be developed on farms and ranches within Yolo County. This measure does not include the solar irrigation pumps indentified in Measure A-3.

Generation Capacity (MW)	Hours of Generation per Year	Efficiency	Annual Generation (MWh)	Emissions factor (MT CO_2e/MWh)	GHG Reduction Potential (MT CO_2e/year)
1	2,190	50%	1,095	0.288488	**316**

Source: The 1 MW of generation capacity by 2020 is an estimate made by County staff and consultants. No sources available.

E-6: Reduce water consumption in existing buildings through plumbing fixture efficiency

Plumbing Fitting and Fixture Efficiency Retrofits: This measure component assumes that 100% of existing built prior to 1990 residential units would improve water fixture and fitting efficiency by 15%.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	1.2% (residential water consumption)	100%	92% (% of households build prior to 1990)	0.164%	1,618

Water leak repair: This measure component assumes that 40% of residential and commercial units in the County would repair water leaks, which would reduce water consumption by 6%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
6%	1.2% (residential water consumption)	40%	0.028%	281
6%	0.9% (commercial water consumption)	40%	0.021%	204
Total			0.049%	485

Source: Gleick, Peter H. et al. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute. Oakland, California. Participation rates are estimates made by County staff and consultants.

Combined, the components of Measure E-6 are expected to reduce GHG emissions by **2,103** MT CO_2e/year.

E-7: Promote weather-based irrigation systems and water efficient turf management

This measure assumes that 2% of residential and 5% of commercial units in the County would reduce landscape-related water consumption by 20% through use of weather-based irrigation systems that detect and manage soil moisture.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
20%	1.2% (residential water consumption)	2%	39% (portion of outdoor water use)	0.0%	18
20%	0.9% (commercial water consumption)	5%	39% (portion of outdoor water use)	0.0%	33
Total				0.0%	**51**

Source: Hunt,Theodore et al. 2001. Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study. Irvine Ranch Water District; Chesnutt, Thomas and Dana Holt. 2006. Commercial ET-Based Irrigation Controller Water Savings Study. Prepared by A & N Technical Services, Inc. for Irvine Ranch Water District and The U.S. Department of the Interior's Bureau of Reclamation. Participation rates are estimates made by County staff and consultants.

SOLID WASTE

WR-1: Expand landfill methane capture systems

This measure assumes that methane capture of 90% efficiency would be implemented at the County landfill, which is a 15% increase over the existing assumption of 75% capture.

Solid Waste GHG Emissions in 2020 (75% methane capture) (MT CO_2e/yr)	% Reduction	GHG Reduction (MT CO_2e/yr)
12,660	73%	9,366

2030 EMISSIONS REDUCTION QUANTIFICATION

Table B-2: Summary of Emission Reductions per Measure in 2030

Measure	Description	MT CO_2e/year reduced in 2030
A-1	Reduce nitrogen fertilizer application rates	10,054
A-2	Reduce fossil fuel consumption in field equipment	2,903
A-3	Reduce energy use in agricultural irrigation pumping	18,949
A-4	Reduce confined livestock manure methane emissions	12,035
A-5	Reduce methyl bromide application	36
A-6	Sequester carbon in agricultural landscapes	60,033
Transportation and Land Use	General Plan Policies contained in the Land Use and Circulation Elements	84,035
E-1	Pursue a community choice aggregation program	145,884
E-2	Reduce energy consumption in existing residential and non-residential buildings	12,322
E-3	Reduce energy consumption in new residential and nonresidential buildings	67,200
E-4	Increase on-site renewable energy generation to reduce demand for grid energy	52,032
E-5	Promote on-farm renewable energy facilities	632
E-6	Reduce water consumption in existing buildings through increased plumbing fixture efficiency	4,100
E-7	Promote weather-based irrigation systems and water efficient turf management	862
WR-1	Expand landfill methane capture systems	13,649
Total		**484,727**

AGRICULTURE

A-1: Reduce nitrogen fertilizer application rates

This measure assumes that nitrogen fertilizer application rates in Yolo County agriculture will decrease by an average of 15% below 2008 application rates by 2030. UC Davis research identifies a potential to reduce nitrogen fertilizer application rates 25% below current (2008) levels.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	20.3% (agriculture)	24.4% (fertilizer)	0.7%	**10,051**

Source: De Gryze, Steven, Rosa Catala, Richard E. Howitt, and Johan Six (University of California, Davis). 2008. Assessment of Greenhouse Gas Mitigation in California Agricultural Soils. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2008-039.

A-2: Reduce fossil fuel consumption in field equipment

Operation and Maintenance Improvements: This measure component assumes 5% of farm equipment increases fuel efficiency by 6% through improvements to operation and maintenance. The assumptions are the same for 2020 and 2030.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
6%	29.3% (agriculture)	25.4% (farm equipment)	5%	0.0%	215

Source: Svejkovsky, Cathy. 2007. Conserving Fuel on the Farm. ATTRA—National Sustainable Agriculture Information Service, National Center for Appropriate Technology.

Engine Conversions*:* This measure component assumes that by 2030 75% of farm equipment increases fuel efficiency by 5% through improvements to engines (conversion from older model to Tier IV engines or better).

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
5%	29.3% (agriculture)	25.4% (farm equipment)	75%	0.2%	2,688

Source: Alternative Energy Newswire. 2010. New Holland Agriculture and Fiat Powertrain Launching Tier4 Tractors Based on SCR Technology. Available at: www.alternativeenergynewswire.com/new-holland-agriculture-and-fiat-powertrain-launching-tier4-tractors-based-on-scr-technology

Combined, the operation and maintenance improvements and engine conversion components have the potential to reduce field equipment GHG emissions by **2,903** MT CO_2e/year.

A-3: Reduce energy use in agricultural irrigation pumping

Agricultural Irrigation Pump Efficiency: This measure component assumes that 10% of agricultural groundwater pumps ranging from 50-175 horsepower would improve pump bowl efficiency for an average of 33% reduction in energy (electricity or diesel) consumed. The assumptions are the same for 2020 and 2030.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
33%	29.3% (agriculture)	13.9% (agricultural pumps)	10%	0.1%	1,295

Source: Peter Canessa and John Weddington. 2006. Program Thesis and Design for a Diesel Pumping Efficiency Program. Center for Irrigation Technology - California State University, Fresno.

Solar agricultural irrigation pumps: This measure assumes that 90% of agricultural tailwater-return pumps (around 10 horsepower) would switch to solar power for 100% of energy consumed.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
50%	29.3% (agriculture)	13.9% (agricultural pumps)	90%	1.25%	17,654

Source: Information regarding solar irrigation pumps provided by stakeholders at the Yolo County Climate Action Plan – Agriculture, Rural, and Open Space Stakeholders Workshop, 2010.

Combined, the agricultural irrigation pump efficiency and solar agricultural irrigation pump components have the potential to reduce field equipment GHG emissions by **18,949** MT CO_2e/year.

A-4: Reduce confined livestock manure methane emissions

This measure assumes that 100% of confined livestock facilities (i.e., dairies) in Yolo County will implement biogas control systems that reduce methane emissions by 90% in 2030. The assumptions are the same for 2020 and 2030.

% Reduction	Inventory Sector	Inventory Sub-sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
90% (methane control efficiency)	29.3% (agriculture)	14% (livestock)	33.9% of livestock (100% of dairy cattle)	0.9%	**12,035**

Source: Ascent Environmental Inc, 2010.

A-5: Methyl bromide reduction

This measure assumes that use of the pesticide methyl bromide eliminated out by 2020 per the requirements of the Montreal Protocol. The assumptions are the same for 2020 and 2030.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
100%	29.3% (agriculture)	0.0% (pesticide application)	0.0%	**36**

Source: The Phase-out of Methyl Bromide. US Environmental Protection Agency. Accessed October 1st 2010. http://www.epa.gov/ozone/mbr/

A-6: Sequester carbon in agricultural landscapes

Riparian Forest Restoration: This measure component assumes that 2,000 acres of riparian forest will be planted within Yolo County between 2010 and 2030.

Average Carbon Storage Rate (MT C/acre/yr)	Acres Restored between 2010 and 2020	Annual Carbon Storage Potential (MT C/year)	Ratio of MT CO_2e to MT C	Annual Carbon Storage Potential (MT CO_2/year)
0.54634	2,000	1092.68	3.66667	4,006

Wood Carbon Stock at Saturation (MT C/hectare)	Wood Carbon Stock at Saturation (MT C/acre)	Years at Riparian Forest C Saturation	Average Carbon Storage Rate (MT C/acre/yr)
108	43.71	80	0.54634

Source: The Carbon Online Estimator: COLE 1605(b), Report for California filtered for Forest Type: Cottonwood, Willow, Cottonwood / willow. COLE Development Group. USDA. Accessed October 7th 2010. http://www.ncasi2.org/COLE/

Hedgerows: This measure component assumes that 7.27 acres (5 miles x 12 feet wide) of hedgerow has been or will be established per year within Yolo County and a total of 247.3 acres are established between 1997 and 2030.

Average Carbon Storage Rate (MT C/acre/yr)	Acres Restored in between 1997 and 2020	Annual Carbon Storage Potential (MT C/year)	Ratio of MT CO_2e to MT C	Annual Carbon Storage Potential (MT CO_2/year)
0.50587	247.3	125.08	3.66667	459

Wood Carbon Stock of Hedgerows in Smukler Study (MT C/hectare)	Wood Carbon Stock of Hedgerows in Smukler Study (MT C/acre)	Estimated age of Hedgerows in Smukler Study	Estimated Years to Hedgerow C Saturation	Wood Carbon Stock at Saturation (MT C/acre)	Average Carbon Storage Rate (MT C/acre/yr)
18.75+	7.59	15	30	15.18	0.50587

Source: Smukler, S.M. et al. 2010. Biodiversity and multiple ecosystem functions in an organic farmscape. Agriculture, Ecosystems and Environment. 139 (80–97); Estimate of hedgerow establishment provided by Yolo County Resource Conservation District, 2010.

Permanent Crops: This measure component reflects the trend toward permanent crops (e.g., orchards) and away from some field crops. According to the Agricultural Commissioner, John Young, this trend is expected to continue through 2030. County staff estimated the percent increase in permanent crops expected over the planning horizon, which is summarized in the following table:

Permanent Crop Growth Assumptions

Increase in permanent crops type	Percent increase by 2030	# acres	# trees/ac (or vines)	# new trees (or vines)	# of new permanent trees (or vines)[1]
Almonds	10%	1,146	200	229,200	114,600
Walnut	10%	891	26	23,166	23,166
Olives	new establishment	2,860	1,000	2,860,000	2,860,000
Wine Grapes	20%	2,401	470	1,128,470	1,128,470

[1] It was assumed that the fates of walnut and olive orchards and wine grape vineyards was chipping and compost at the end of the orchard's life. It was also assumed that 50% of almond orchards are chipped and composted at the end of life, and the other 50% is used for firewood. Thus, 50% of almond trees were treated as permanent crops.

Source: Yolo County Agricultural Commissioner 2010.

A method from the U.S. Department of Energy-Energy Information Administration was used to calculate the quantity of carbon that would be permanently sequestered in the new orchard trees within the County during the CAP planning horizon. The methodology did not include sequestration potential of vines, thus, carbon sequestration from wine grapes could not be calculated at this time. The method for fast-growing hardwoods was followed for almonds, walnuts, and olive trees, and the sequestration rate for walnut trees was used as a surrogate for almond and olive trees, since rates specific to those species were not available. It was assumed that the total net increase of 2,997,766 almond, walnut, and olive trees would be planted evenly over the next 20 years (approximately 142,751 new 15-gallon trees per year). The carbon sequestration method includes statistical Survival Factors for trees of different ages (assuming that a 15 gallon tree is age 0). Thus, the potential for trees to die (i.e., "reversals") was accounted for in this methodology. The following table summarizes the method to calculate the net increase in the County's orchard-related carbon sequestration through 2020 and 2030.

According to this methodology, the increase in orchard crops anticipated in Yolo County would sequester approximately 17,660 MT CO_2e/year in year 2020 and approximately 55,570 MT CO_2e/year in 2030. This methodology provides a simple, conservative estimate of carbon sequestration in orchard crops, but is not intended to be used for carbon offset purposes. The research and methods for calculating carbon sequestration are dynamic and controversial. For these reasons the sequestration potential was not applied to the 2020 GHG reduction target.

Permanent Crop orchard-related carbon sequestration

Year	Tree Age	# Trees Planted	Survival Factor	# Surviving Trees	Annual sequestration rate (lb carbon/tree)	carbon sequestered (lb carbon)
2010	0	142,751	0.873	124,621	2.7	336,478
2011	1	142,751	0.798	113,915	4.0	455,660
2012	2	142,751	0.736	105,065	5.4	567,349
2013	3	142,751	0.706	100,782	6.9	695,396
2014	4	142,751	0.678	96,785	8.5	822,673
2015	5	142,751	0.658	93,930	10.1	948,693
2016	6	142,751	0.644	91,931	11.8	1,084,792
2017	7	142,751	0.630	89,933	13.6	1,223,089
2018	8	142,751	0.616	87,934	15.5	1,362,984
2019	9	142,751	0.602	85,936	17.4	1,495,286
2020	10	142,751	0.589	84,080	19.3	1,622,748
2021	11	142,751	0.576	82,224	21.3	1,751,381
2022	12	142,751	0.563	80,369	23.3	1,872,590
2023	13	142,751	0.551	78,656	25.4	1,997,854
2024	14	142,751	0.539	76,943	27.5	2,115,923
2025	15	142,751	0.527	75,230	29.7	2,234,321
2026	16	142,751	0.516	73,659	31.9	2,349,735
2027	17	142,751	0.505	72,089	34.1	2,458,239
2028	18	142,751	0.495	70,662	36.3	2,565,017
2029	19	142,751	0.484	69,091	38.6	2,666,927
2030	20	142,751	0.474	67,664	41.0	2,774,218
Total at 2030		2,997,766	-	1,821,500	-	33,401,351
					Total CO_2 sequestered at 2030 (MT CO_2/year)	**55,568**

Notes: carbon sequestered from 2010-2020 was summed and converted from carbon to CO_2 using a factor of 44/12 (the molecular weight of CO_2/C).
Assumes trees are 15 gallons at age 0.
Does not include sequestration by 50% of almond orchard trees or by wine grape vines.

Source: U.S, Department of Energy, Energy Information Administration. 1998 (April). Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings.

Combined, the components of Measure A-6 have the potential to store **60,033** MT CO_2/year.

TRANSPORTATION

Reduction potential of General Plan transportation and land use policies

The County's General Plan set a performance standard for new development of 44 vehicle miles traveled per household per day (VMT/HH/day). Exhibit IV.C-3 of the County's GP EIR showed 83 VMT/HH/day in 2005, forecast to reduce to 77 VMT/HH/day in 2035 under no project (Exhibit IV.C-4). The County assumed the following levels of compliance with the performance standard for new development within each community:

Area	% of GP growth	% compliance with VMT standard	VMT/HH/day	% reduction	weighted % reduction
Dunnigan SP	44.4%	100%	44	42.9%	19.0%
Elkhorn SP	17.7%	33%	70	9.1%	1.6%
Esparto	8.4%	50%	64	16.9%	1.4%
Madison SP	7.6%	60%	67	13.0%	1.0%
Knights Landing	5.0%	25%	73	5.2%	0.3%
Covell	0.0%	0%	77	0.0%	0.0%
Total					23.3%

The anticipated VMT reduction associated with this performance standard was estimated at 23.3%.

% Reduction	Inventory Sector	Inventory Sub-sector	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
23.3%	33.6% (transportation)	77.4% (transportation emissions from new growth)	6.1%	**84,035**

Source: VMT Data from Fehr and Peers. 2010. Growth allocation assumptions from Yolo County Planning Staff.

ENERGY

E-1: Pursue a community choice aggregation program

This measure assumes that 5% of the customers in Yolo County would stay with PG&E and that the utility achieves the 33% renewable electricity generation portfolio required by Executive Order # S-14-08. It is also assumed that 80% of the County would purchase a "light green" portfolio with 50% renewable electricity, and 15% of the County would purchase a "deep green" portfolio at 100% renewable electricity.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
22%	34.4% (electricity)	80%	6.7%	92,859
67%	34.4% (electricity)	15%	3.8%	53,025
Total			10.5%	**145,884**

Source: Participation rates are based on County Staff estimates. Light Green percent reduction mirrors efforts of the proposed San Francisco CCA program (51% renewable by 2017). The Deep Green percent reduction mirrors Marin County's current Deep Green tier (100% renewable).

E-2: Reduce energy consumption in existing residential buildings

Note that this measure applies the scaled reduction to 2008 energy sector emissions to isolate existing building energy from total 2020 building energy.

Existing Residential Buildings: This measure component assumes that 70% of existing (2008) residential units in the county would implement efficiency improvements that reduce energy consumption by 15%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	5.4% (residential energy)	70%	0.6%	3,357

Source: Coito, Fred and Mike Rufo. 2003. California Statewide Residential Sector Energy Efficiency Potential Study, Study ID #SW063, Final Report, Volume 1 of 2, Main Report. Prepared for Pacific Gas & Electric Company by KEMA-XENERGY Inc. Oakland, California. Participation rates are based on estimates made by County staff and consultants.

Existing Non-Residential Buildings: This measure component assumes that 30% of existing (2008) commercial buildings in the county would reduce their energy consumption by 20%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
20%	25.4% (commercial energy)	30%	1.5%	8,966

Source: Coito, Fred and Mike Rufo. 2003. California Statewide Commercial Sector Energy Efficiency Potential Study, Study ID #SW039A, Final Report, Volume 1 of 2, Main Report. Prepared for Pacific Gas & Electric Company by KEMA-XENERGY Inc. Oakland, California. Participation rates are based on estimates made by County staff and consultants.

Combined, the components of Measure E-2 have the potential to reduce **12,322** MT CO_2e/year.

E-3: Reduce energy consumption in new residential and non-residential buildings

Note that this measure applies the scaled reduction to new building 2020 energy emissions. To obtain this value, 2008 building energy emissions are subtracted from total 2030 building energy emissions.

New Residential Buildings: This measure component assumes that 88% of new buildings in the county would exceed Title 24 standards by 15% (i.e., California Green Building Code [CGBC] Tier I standards), and that 10% of new residential units would be larger than 3,500 square feet and thus be required to exceed Title 24 standards by 30% (i.e., CGBC Tier II standards). Finally, this assumes that 2% would voluntarily exceed Title 24 standards by 30% (i.e., CGBC Tier II standards).

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	24% (residential energy in new construction)	88%	1.0%	14,124
30%	24% (residential energy in new construction)	12%	0.3%	3,852
Total			1.3%	17,976

Source: The 15% reduction is based on proposed County Building Standards for all residential and non-residential construction. A County Building Standard will require all residential units over 3,500 square feet to exceed Title-24 by 30%. The participation rates and the voluntary performance level are based on estimates made by County Staff and consultants.

New Non-Residential Buildings: This measure component assumes that in compliance with the County's building energy standards, 98% of new commercial construction in the County would exceed Title 24 standards by 15% and that 2% of new commercial buildings would voluntarily exceed Title 24 standards by 30% (i.e., CGBC Tier II standards).

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
15%	76% (commercial energy in new construction)	98%	3.4%	47,185
30%	76% (commercial energy in new construction)	2%	0.1%	2,039
Total			3.5%	49,224

Source: The 15% reduction is based on proposed County Building Standards for all residential and non-residential construction. The assumption that 2% of new commercial buildings will voluntarily exceed current Title-24 by 30% is an estimate made by County staff and consultants.

Combined, the components of Measure E-3 have the potential to reduce **67,200** MT CO_2e/year.

E-4: Increase on-site renewable energy generation to reduce demand for grid energy

Solar Water Heaters: This measure component assumes 100% of new residential and commercial units in the county would reduce 70% and 40% of water-heating-related energy use by installing solar water heaters, respectively. The measure also assumes while 15% of existing residential units would install solar water heaters and reduce water-heating-related energy use by 70% and that 5% of existing commercial units would reduce water-heating-related energy use by 40% each.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
70%	1.6% (residential natural gas)	100%	44% (portion of natural gas used for water heating)	0.2%	2,252
70%	1.6% (residential natural gas)	40%	44% (portion of natural gas used for water heating)	0.2%	366
40%	14.4% (commercial natural gas)	100%	44% (portion of natural gas used for water heating)	0.8%	10,685
40%	14.4% (commercial natural gas)	10%	44% (portion of natural gas used for water heating)	0.3%	459
Total				1.5%	13,762

Source: Del Chiaro, Bernadette. 2007. Solar Water Heating: How California Can Reduce Its Dependence on Natural Gas. Environment California Research & Policy Center. Los Angeles, CA. The 100% participation rate for new construction reflects the establishment of a proposed ordinance to require SHW systems in all new development. The voluntary participation rates are estimates made by County staff and consultants.

Photovoltaic Systems: This measure component assumes that 100% of new residential and commercial units within the County would replace 10% of their grid-derived electricity consumption with on-site solar photovoltaic generation. This measure component also assumes that 5% of existing residential units within the county would replace 10% of their grid-derived electricity consumption with on-site solar photovoltaic generation. It is also assumed that owners of existing commercial buildings install 200,000 square feet of solar photovoltaic panels.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
10%	22.3% (residential electricity)	100%	0.7%	9,969
10%	22.3 % (residential electricity)	10%	0.2%	405
10%	61.7% (commercial electricity)	100%	1.9%	26,027
Total			2.8%	36,401

Source: The 100% participation rate for new construction reflects the establishment of a proposed requirement to include PV systems in all new development that provides 10% of the total electricity demand. The voluntary participation rates and percent reduction are estimates made by County staff and consultants.

System Efficiency (W/sq ft)	Annual System Efficiency (kWh/sq ft/yr)	Square feet of solar panels	Estimated generation (MWh/yr)	Emissions factor (MT CO_2e/MWh)	GHG Reduction Potential (MT CO_2e/year)
10.00	21.60	300,000	6,480	0.288488	1,869

Combined, the components of Measure E-4 are expected to reduce GHG emissions by **52,032** MT CO_2e/year.

E-5: Promote on-farm renewable energy facilities

This measure assumes that 1 megawatt of renewable energy generation capacity will be developed on farms and ranches within Yolo County. This measure does not include the solar irrigation pumps identified in Measure A-3.

Generation Capacity (MW)	Hours of Generation per Year	Efficiency	Annual Generation (MWh)	Emissions factor (MT CO_2e/MWh)	GHG Reduction Potential (MT CO_2e/year)
2	2,190	50%	2,190	0.288488	**632**

Source: The 2 MW of generation capacity by 2030 is an estimate made by County staff and consultants.

E-6: Reduce water consumption in existing buildings through plumbing fixture efficiency

Plumbing Fitting and Fixture Efficiency Retrofits: This measure component assumes that 100% of existing residential units built prior to 1990 would improve water fixture and fitting efficiency by 20%.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
20%	1.3% (residential water consumption)	100%	92% (% of households build prior to 1990)	0.24%	3,347

Water leak repair: This measure component assumes that 40% of residential and commercial units in the County would repair water leaks, which would reduce water consumption by 6%.

% Reduction	Inventory Sector	Participation Rate	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
6%	1.3% (residential water consumption)	40%	0.031%	436
6%	1.0% (commercial water consumption)	40%	0.023%	317
Total			0.054%	753

Source: Gleick, Peter H. et al. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute. Oakland, California. Participation rates are estimates made by County staff and consultants.

Combined, the components of Measure E-6 are expected to reduce GHG emissions by **4,100** MT CO_2e/year.

E-7: Promote weather-based irrigation systems and water efficient turf management

This measure assumes that 2% of residential and 5% of commercial units in the County would reduce landscape-related water consumption by 20% through use of weather-based irrigation systems that detect and manage soil moisture.

% Reduction	Inventory Sector	Participation Rate	Scale Factor	Scaled % Reduction	GHG Reduction Potential (MT CO_2e/year)
20%	1.3% (residential water consumption)	25%	39% (portion of outdoor water use)	0.0%	351
20%	1.0% (commercial water consumption)	50%	39% (portion of outdoor water use)	0.0%	510
Total				0.0%	**862**

Source: Hunt,Theodore et al. 2001. Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study. Irvine Ranch Water District; Chesnutt, Thomas and Dana Holt. 2006. Commercial ET-Based Irrigation Controller Water Savings Study. Prepared by A & N Technical Services, Inc. for Irvine Ranch Water District and The U.S. Department of the Interior's Bureau of Reclamation. Participation rates are estimates made by County staff and consultants.

SOLID WASTE

WR-1: Expand landfill methane capture systems

This measure assumes that methane capture of 90% efficiency would be implemented at the County landfill, which is a 15% increase over the existing assumption of 75% capture.

Solid Waste GHG Emissions in 2030 (75% methane capture) (MT CO_2e/yr)	% Reduction	GHG Reduction (MT CO_2e/yr)
18,449	73%	**13,649**

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