Appendix B – Greenhouse Gas Emissions Inventory and Forecast Methodology

GHG Inventory Methodology

This appendix contains an explanation of the methodology used to calculate GHG emissions for Monterey County unincorporated area in 2006, 2030, and at buildout with implementation of the 2007 GP.

2006 GHG Inventory

GHG emissions were estimated for vehicle use, natural gas consumption, electricity consumption, industrial processes, annual solid waste landfilled, and agricultural equipment fuel use. The methodology used for to estimate GHG emission from each source is described below.

Vehicle Emissions

Emissions from on-road vehicle use, including heavy duty trucks and buses were quantified using average annual vehicle miles traveled (VMT) for the unincorporated areas of Monterey County. VMT data for 2006 was obtained from the California Department of Transportation (Caltrans) Highway Performance Monitoring System (HPMS) 2006 public road data (California Department of Transportation 2007) for unincorporated County roads and state highways. Modeled average traffic speeds were calculated based on daily VMT and daily vehicle hours of travel data provided by Kimley-Horn Associates. The ARB emission factor model (EMFAC2007 Version 2.3, hereafter referred to as EMFAC) was used to estimate CO2 and CH4 emissions from vehicle activity in the unincorporated areas of Monterey County for 2006. Default vehicle fleet profile for Monterey County was used in calculating GHG emissions. The temperature and relative humidity selected for modeling were 60°F and 30% respectively. All of the miles on the County roads were included and 25% of the miles on state highways (based on unincorporated County having 25% of the population of the County as a whole).

Building Natural Gas and Electricity

Electricity and natural gas consumption for all residential, commercial, and industrial buildings within the unincorporated area of Monterey County in 2006 was obtained from Pacific Gas and Electric Company (PG&E) (Bruso pers. comm.). Table B-1 lists the electricity and natural gas consumption for the unincorporated area of Monterey County in 2006 provided by PG&E (Bruso pers. comm.).

Table B-1. 2006 Electricity and Natural Gas Consumption

Fuel Type	Annual Consumption[1]
Electricity	1,008,090,911 kWh
Natural Gas	35,869,687 therms

[1] Source: Forney pers. comm.

Since PG&E is a member of the California Climate Action Registry, an area-specific carbon dioxide emissions factor of 456 pounds per megawatt hours (lbs/MWh) was available (Bruso pers. comm.). California Climate Action Registry emission factors for CH4 and N2O from electricity consumption were used to estimate emissions of CH4 and N2O from electricity consumption (California Climate Action Registry 2008). Natural gas combustion GHG emission factors for residential, commercial and industrial natural gas combustion were obtained from The Climate Registry general reporting protocol (The Climate Registry 2008).

Industrial Processes

GHG emissions from industrial processes for the County of Monterey were provided by the Monterey Bay Unified Air Pollution Control District (MBUAPCD) (Getchell pers. comm.). GHG emissions for industries in Monterey County were provided by zip code. Zip code information was used to determine which GHG emissions from industrial processes occurred within the unincorporated areas of Monterey County in 2006. GHG emissions from electricity-producing industrial processes were not included because these emissions are already accounted for in the emission factor for electricity consumption reported by PG&E.

Landfill Emissions

Monterey County unincorporated area generated 138,428 tons of solid waste in 2006 (California Integrated Waste Management Board 2008b). The deposition of food waste, yard trimmings, paper and wood in landfills results in the production of CH4 and CO2 when anaerobic bacteria degrade the material (Environmental Protection Agency 2006b). CO2 is produced during the natural degradation process; however, emissions of methane are a result of landfilling waste and are therefore considered to be anthropogenic emissions. Some landfills flare off the methane produced, or utilize the CH4 emissions for energy through gas recovery systems; currently utilizes methane flaring technology (California Integrated Waste Management Board 2001).

Most recent available waste stream data for residential and business collection was gathered from the California Integrated Waste Management Board (CIWMB) website and used to develop a uniform waste stream profile (Table B-2) for all waste generated in the unincorporated areas of Monterey County (California Integrated Waste Management Board 2008a).

Table B-2. State Waste Stream Profile

Waste Type	Percent (%)
Paper Products	21.0
Food Waste	14.6
Plant Debris	36.5
Wood/Textiles	12.0
All Other Waste	15.9

Source: California Integrated Waste Management Board 2008a.

California's waste stream profile, obtained from the California Integrated Waste Management Board (CIWMB) website, was used, along with CH4 emission factors for a managed landfill obtained from the International Council for Local Environmental Initiatives (ICLEI) Clean Air and Climate Protection Software (Version 1.1), to calculate annual CH4 emissions resulting from the waste generated by Monterey County unincorporated area in 2030 (California Integrated Waste Management Board 2008b; International Council for Local Environmental Initiatives 2005). Ninety-seven percent of the waste generated in the unincorporated area of Monterey County was sent to Crazy Horse, Johnson Canyon and Monterey Peninsula landfills, which have methane flaring or landfill gas to energy technologies. The EPA default estimate for methane flaring efficiency is 75%, which results in 75% of the CH4 emissions being converted to CO2 emissions as a consequence of the flaring (California Integrated Waste Management Board 2007). This efficiency factor was used to estimate net CH4 emissions from waste generated in 2006 for Monterey County unincorporated area.

Agricultural Equipment Fuel Use

GHG emissions from agricultural equipment fuel use were estimated using the California Energy Commission (CEC) 2004 GHG inventory and comparing agricultural acreage for California to agricultural acreage in Monterey County. CEC estimates that in 2004, 3.86 million metric tons of CO2e were emitted as a result of agricultural use of gasoline and diesel (CEC 2006a). The ratio of Monterey County crop acreage to California crop acreage was used to apportion statewide GHG emissions from agricultural fuel use to Monterey County accordingly (United States Department of Agriculture 2006).

Additional GHG emissions from agriculture are related to fertilizer use and methane emissions from livestock. The specific nature of these emissions must be based on detailed inventory of fertilizer type and application and livestock management practices. These emissions are not included in the estimate prepared for this document but will be included in the inventory prepared per Policy OS-10.11.

On an average basis, agricultural and grazing lands in the U.S. are currently considered near neutral on an annual basis with respect to their soil carbon balance (USCCSP 2007) and thus no annual GHG emissions related to changes in soil carbon basis are included in the estimate.

2030 and Buildout GHG Inventories

Vehicle Emissions

Emissions from on-road vehicle use, including heavy duty trucks and buses were quantified using average annual vehicle miles traveled (VMT) for the unincorporated areas of Monterey County. VMT data and modeled average traffic speeds for 2030 and buildout under business as usual conditions were calculated based on daily VMT and daily vehicle hours of travel data provided by Kimley-Horn Associates. VMT for the unincorporated area of Monterey County was apportioned based on 2006 VMT data for the unincorporated area and for the County. The ARB emission factor model EMFAC was used to estimate CO2 and CH4 emissions from vehicle activity in the unincorporated areas of Monterey County for 2030 and 2040 for buildout. EMFAC does not model emissions past 2040 so this final model year was used to emulate a worst case GHG emissions scenario under buildout conditions. Default vehicle fleet profile for Monterey County was used in calculating GHG emissions. The temperature and relative humidity selected for modeling were 60°F and 30% respectively.

The adoption of AB 1493 is expected to reduce GHG emissions from passenger vehicles by 11% by 2016 (California Air Resources Board 2008). This GHG reduction was applied to the GHG emissions from light duty vehicles output by EMFAC.

Under the ARB Draft Scoping Plan, AB 1493, Pavley I, and a more stringent fuel efficiency standard, Pavley II, would be implemented by 2020 and would reduce GHG emissions from passenger vehicles by 20% in 2020 (California Air Resources Board 2008). Furthermore, a Low Carbon Fuel Standard would be required, which would reduce GHG emissions from passenger vehicles by a further 10%. Other proposed regulations to reduce GHG emissions from heavy-duty vehicles were proposed but are not quantified in this analysis.

Building Natural Gas and Electricity

The proposed project would receive electricity generated by Pacific Gas and Electric Company (PG&E), which has a lower CO2 emissions factor than the statewide average emissions factor. The CO2 emissions factor for electricity provided to Monterey County in 2030 and at buildout was estimated assuming that PG&E's reported 2006 CO2 emission factor remained constant under business as usual conditions (Bruso pers. comm.). The increased electricity demand due to increased residential, commercial and industrial development was estimated through use of the California Energy Commission Residential Appliance Saturation Survey and Commercial End Use Survey (CEC 2004; CEC 2006b). Energy intensities of kWh per square foot were assumed for residential, commercial, and industrial square footage for 2030 and buildout. Where 2006 energy intensities per square foot were higher based on electricity use data provided by PG&E, the higher number was used.

Assembly Bill 1078, accelerated by SB 107, requires that all electric utilities increase their renewable energy resources by 1 percent per year until 20 percent of retail sales are procured from renewable energy resources. PG&E's current energy mix (12 percent) is assumed to reach 20 percent by the year 2030, which is an 8 percent increase the renewable energy mix (Pacific Gas and Electric Company 2007). This 8 percent increase was assumed to correspond to an 8 percent decrease in the CO2 emission factor. Using

this methodology, the estimated 2030 emissions factor is 450.1 pounds of CO2 per MWh. This emission factor was used to estimate increased GHG emissions for 2030 with adopted regulations.

The Scoping Plan calls for an increase in RPS standards to 33%, which would result in a reduction of 21% in the GHG emissions related to electricity production by PG&E. The reduced GHG emissions under the Scoping Plan were estimated for 2030 and buildout using the expected 21% reduction in GHG emissions per kWh.

The URBEMIS 2007(Version 9.2.4) model was used to estimate natural gas GHG emissions from increased residential, commercial, and industrial buildings in 2030 and at buildout. There are currently no anticipated regulations to reduce GHG emissions from the use of natural gas in buildings.

Industrial Processes

GHG emissions for industrial processes for 2030 and buildout were scaled from the 2006 inventory based on the percentage growth in industrial employment estimated in the traffic model.

Landfill Emissions

GHG emissions for landfills for 2030 and buildout were scaled from the 2006 inventory based on the percentage growth in population.

Agricultural Emissions

Based on trends in agricultural employment (AMBAG 2004; AMBAG 2008), no net expansion in agricultural development is projected for 2030 as virtually no increase in agricultural employment is forecast by AMBAG to 2030 for the Monterey County in the most recent (2008) and the immediately prior (2004) economic forecasts. Thus, no estimate of additional agricultural emissions was made for 2030. For buildout, agricultural conditions are unknown and thus are not estimated.

Emissions Associated With Land Use Changes

As described in Chapter 4.9, *Biological Resources*, there will be three areas of net land use change by related to the development allowed by the 2007 GP: urban conversion of farmland, urban conversion of natural landcovers, and agricultural conversion of natural landcovers (dominated by annual grassland, with smaller areas of oak woodland and other vegetation communities).

Farmland net carbon balances depend on the cropping and tillage practice. Depending on the tillage practices, farming can sequester soil carbon on an annual basis or can be a net generator of carbon due to losses of soil carbon. On an average basis, agricultural and grazing lands in the U.S. are currently near neutral on an annual basis with respect to their soil carbon balance (USCCP 2007). Thus, conversion of farming land to urban land on average would not be expected to result in a loss of annual net carbon sequestration but could result in the reduction of soil carbon stock due to grading and development activities. As calculation of soil carbon loss is subject to numerous uncertainties at an abstract level, it was not included in the total GHG emission estimated for the EIR. However, calculation of potential changes in carbon stock due to urban conversion of farmland will be included, as feasible, in the detailed inventory to be prepared pursuant to Policy OS -0-11.

Urban or agricultural conversion of natural landcovers would also result in the loss of the stock carbon in soils, grasses, scrub, and trees as well as the loss of the annual sequestration value of existing soils and vegetation. Where converted to urban losses, the loss in sequestration would be near total. Where converted to agricultural use, the net change in carbon sequestration would depend on the nature of the crops planted and tillage practices compared to the sequestration value of the prior natural landcover. On an average basis, agricultural and grazing lands in the U.S. are currently near neutral on an annual basis with respect to their soil carbon balance. Thus, conversion of farming land to urban land on average would not be expected to result in a loss of annual net carbon sequestration but could result in the reduction of soil carbon stock due to grading and development activities. The net impact of soil erosion on carbon emissions to the atmosphere remains highly uncertain (USCCP 2007). Development is unlikely to result in the entire loss of carbon stocks. As calculation of soil carbon loss is subject to numerous uncertainties at an abstract level, it was not included in the total GHG emission estimated for the EIR. However, calculation of potential changes in carbon stock due to urban conversion of farmland will be included, as feasible, in the detailed inventory to be prepared pursuant to Policy OS 10-11.

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