

A Community-Wide
Greenhouse Gas Emissions Inventory
for Pacifica, California
for 2005

Prepared by

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Pacifica Climate Committee

www.pacificaclimate.org

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Introduction

The Pacifica Climate Committee is a citizens group in Pacifica, California working to address climate change issues in our community. In 2008 the committee successfully urged the City Council and mayor to sign the U.S. Mayors Climate Protection Agreement ^[1]. The Climate Committee then began working in conjunction with City government on a community-wide greenhouse gas (GHG) emissions inventory to complement the City's inventory for government operations. The community-wide inventory can help guide Pacifica's efforts to reduce emissions from the community as a whole. A community-wide focus is necessary for emissions reductions efforts because city operations account for less than four percent of total Pacifica emissions. Greenhouse gas inventories indicate the major sources of emissions and their relative size, and therefore help identify opportunities for emissions reductions.

We have updated our original Pacifica inventory to bring it into compliance with new guidance from the Bay Area Air Quality Management District issued since our inventory was first produced in 2009. ^[2] The changes are relatively minor and do not affect any of our conclusions. We have added estimates of emissions from off-road equipment, and from Direct Access purchases of electricity and natural gas. Emissions from transportation are now calculated based on vehicle miles traveled, rather than on fuel sales. Finally we have taken community air travel out of the inventory tables and charts to make the results more comparable with other cities which typically do not include air travel, however we still include air travel in the discussion of Pacifica emissions.

Methods

A greenhouse gas inventory is an accounting of emissions sources that can be tracked over time to help an entity achieve its emissions reduction goals. An inventory thus covers fewer emissions sources than a "carbon footprint" analysis, which aims to include all sources of emissions. For example the current inventory does not include emissions associated with all the goods purchased by Pacificans, the food we eat, nor does it include the life-cycle emissions associated with electricity generation.

The World Business Council for Sustainable Development and the World Resources Institute define three 'scopes' of reporting for greenhouse gas inventories. The first scope covers direct sources of GHG emissions that are owned or controlled by an entity, including the release of refrigerants and natural gas used in residences and city buildings. The second scope covers imported sources of energy, such as electricity. The third scope refers to transportation and solid waste. This inventory covers all three scopes for the year 2005. We chose the year 2005 to match the city operations inventory conducted by the city. Due to lack of data we were not able to calculate a 1990 base-year inventory.

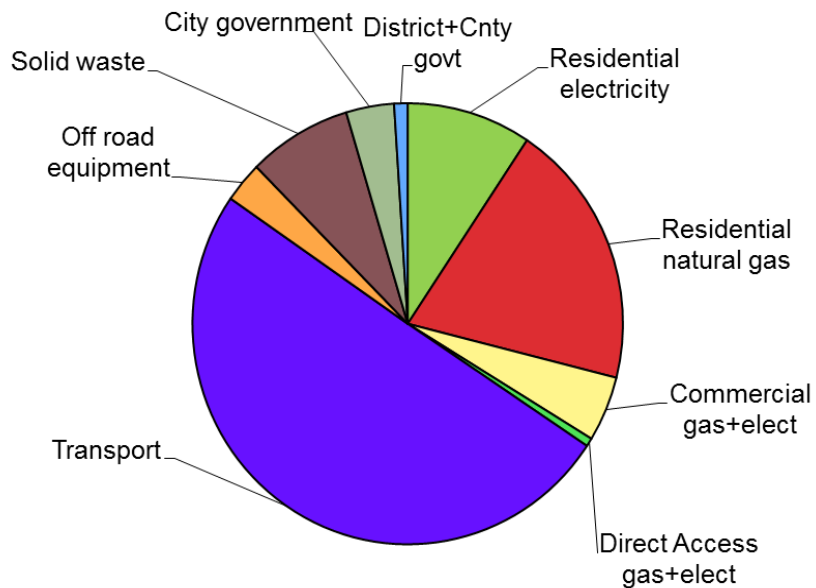
To complete the inventory we used the Clean Air and Climate Protection greenhouse gas inventory calculator version 1.1 developed by the International Council for Local Environmental Initiatives (ICLEI). For air travel and solid waste calculations we also made use of a second inventory calculator developed by the organization Clean Air Cool Planet ^[3].

Our inventory calculations include emissions of three greenhouse gases: carbon dioxide, methane and nitrous oxide. Rather than reporting emissions of each gas separately, greenhouse gas inventories typically report emissions in metric tonnes of carbon dioxide equivalents (tonnes CO₂e) in which the amount of methane and nitrous oxide are converted to carbon dioxide equivalents based on how much they contribute to climate warming. Following State of California and international convention our inventory reporting is in metric tonnes. One metric tonne is 1000 kilograms or 2,205 pounds.

Inventory Results

Pacifica Community-wide Greenhouse Gas Emissions 2005

Source	1000 metric tonnes CO ₂ e	Share
Transport	92.0	50.3%
Off road equipment	5.5	3.0%
Solid waste	14.3	7.8%
Residential electricity	17.1	9.4%
Residential natural gas	35.9	19.6%
Commercial electricity	4.5	2.5%
Commercial natural gas	4.3	2.3%
Direct Access electricity	0.5	0.3%
Direct Access natural gas	0.6	0.3%
City government operations	6.6	3.6%
County + District govt Gas+Elect	1.9	1.0%
Total	183.1	



Activity Levels for Pacific Community-wide GHG Inventory 2005

Source	activity level
Residential electricity kWh	76,532,423
Residential natural gas therms	6,740,995
Transport vehicle miles traveled	188,500,542
Solid waste (short tons)	15,784
Commercial electricity	20,147,118
Commercial natural gas	802,038
Direct Access electricity	1,125,794
Direct Access natural gas	118,167
County govt. electricity	120,024
County govt. natural gas	3,032
Special district electricity	4,048,866
Special district natural gas	171,520

Key Findings

Including city government operations, Pacifica's community-wide greenhouse gas emissions in 2005 were 183,090 metric tonnes of carbon dioxide equivalents. City government operations accounted for 3.6 percent of total emissions. Reducing greenhouse emissions from Pacifica will therefore require the city government and the community to work together to reduce emissions from city operations, and more importantly, from the community as a whole.

The single largest source of emissions was transportation, at 92,033 tonnes CO₂e, accounting for 50.3 percent of total emissions. This highlights that significant emissions reductions will require addressing transportation – both encouraging use of public transit and ride sharing, and encouraging use of high fuel efficiency and alternate fuel vehicles.

We did not formally include air travel by Pacificans in the inventory, but if we had it would have been the second largest source of emissions, at 58,830 tonnes CO₂e. If air travel was in the inventory it would have accounted for 24 percent of total emissions. Most community level inventories do not include air travel, in part because it is not clear how city government can effect changes in air travel. The Pacifica Climate Committee felt it was important to calculate and discuss emissions from air travel because it is a large share of total emissions. Our hope is that discussing air travel will help educate the public and encourage Pacificans to fly less.

Residential natural gas use accounted for 19.6 percent of total emissions, and residential electricity was 9.4 percent of total emissions (35,850 and 17,120 tonnes CO₂e respectively). From 2003 to 2007 Pacifica residential electricity use grew 7.7 percent and natural gas use increased 1.9 percent, while Pacifica's population was roughly unchanged. Reducing residential energy use will require programs such as encouraging and incentivizing home energy audits for existing buildings, help with financing for home insulation, and solar water thermal, or photovoltaic systems. The city has already taken an important step with the development of a new green building ordinance for new buildings and remodels. Pacifica city government can play a leadership role by setting high energy and environmental standards for all new city buildings and retrofits.

Solid waste generated 14,267 tonnes CO₂e, accounting for 7.8 percent of total emissions. In landfills food and other organic waste generate methane, a potent greenhouse gas. Pacifica has the opportunity to easily reduce emissions from solid waste. The best approach is to prevent organic material from going to the landfill. Hopefully, Pacifica's new curbside pickup of compostables will result in a large share of organic waste being diverted from the landfill.

Commercial natural gas and electricity use together accounted for 4.8 percent of total emissions. Commercial gas and electric is a relatively small share of total emissions so it is not a potential source of large emissions reductions. However commercial business' commitment to energy use reductions can in some cases be a model for patrons and therefore can contribute to overall community commitment to reduce emissions.

Goals

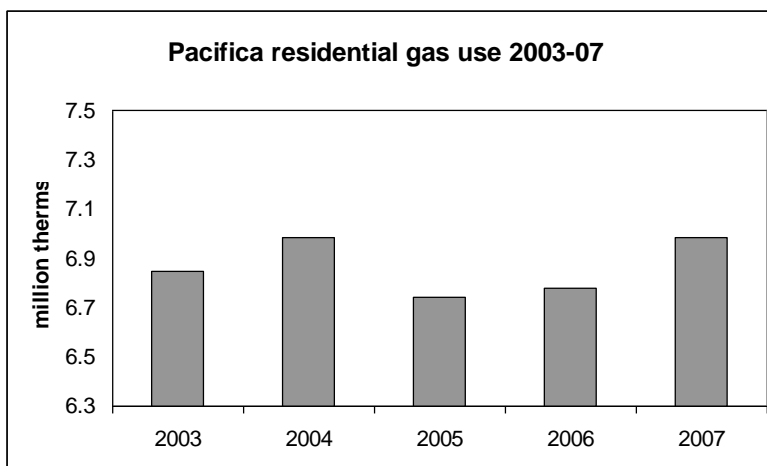
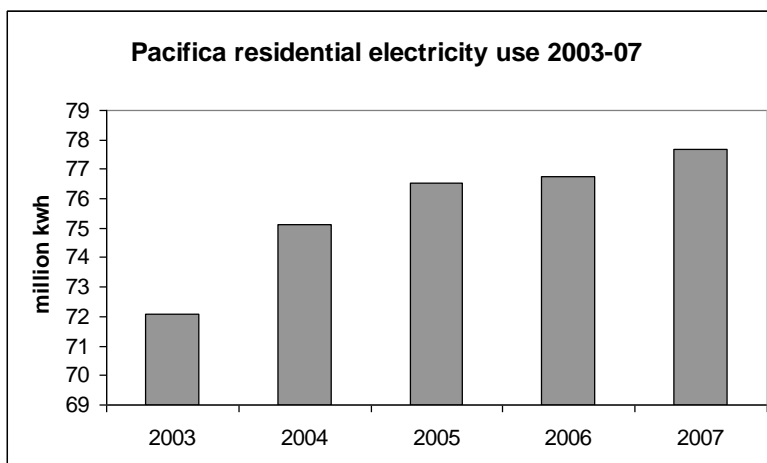
The city of Pacifica signed on to the U.S. Conference of Mayors Climate Protection Agreement ^[1], which committed the city to “strive to meet or beat the Kyoto Protocol targets.” The Kyoto Protocol targets call for seven percent emissions reductions from 1990 levels by 2012. Due to lack of data we have not been able to calculate 1990 baseline emissions for Pacifica. However if we assume that Pacifica’s emissions have increased since 1990 at the same rate as for the state of California as a whole, then Pacifica’s emission levels in 2005 would be approximately 15 percent above 1990 levels. Thus Kyoto Protocol goals imply a 22 percent reduction below 2005 levels by 2012. The state of California has set a greenhouse gas emissions reduction target of returning to 1990 emissions levels by the year 2020 (equivalent to a 15% reduction from 2005 levels), and 80% below 1990 levels by 2050 ^[4]. The Intergovernmental Panel on Climate Change in its 2007 assessment concluded that globally we need emissions reductions between 25-40 percent below 1990 levels by 2020 in order to reduce the risk of catastrophic climatic changes. We believe Pacifica should take a leadership role and commit to reducing total community-wide emissions by 20 percent below 2005 levels by 2020, and 80% below 1990 levels by 2050. To be a leader we have to aim to do more than simply meeting the state of California goals of 15% reduction from 2005 levels by 2020.

Details of findings, methods, and data sources

Residential Natural Gas and Electricity Use

Pacific Gas and Electric Company (PG&E) provided us with total meter readings for residential electricity and natural gas use for the years 2003-2007. For 2005, total residential electricity use was 76.5 million kWh and total natural gas use was 6.7 million therms. When natural gas is burned in residential stoves, furnaces, clothes dryers and other appliances it releases greenhouse gases. Electricity use in residences does not result in GHG emissions at the site. Greenhouse gas emissions from electricity result from electricity generation and are determined by how the electricity is generated (e.g., coal or wind power). For our inventory calculations we used electricity and natural gas emissions factors from the California Air Resources Board’s Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories. ^[5]

While Pacifica’s population was little changed from 2003 to 2007, residential electricity use increased 7.7 percent. This is a disturbing trend. We would have hoped that with the recent increase in public awareness of the need for energy conservation, and the now easy availability of compact florescent light bulbs and energy efficient appliances that residential energy use per capita would be declining. Instead Pacificans are using more and more electricity each year in their homes.



Transportation

Estimating GHG emissions from vehicles was the most challenging part of the inventory. Ideally we would want to know how far Pacificans drive and what type of vehicles they use, but this information is not available. Instead we used data on vehicle miles traveled within the geographic boundaries of Pacifica, provided to us by ICLEI from their analysis of data from the Metropolitan Transportation Commission. There were a total of 188 million vehicle miles traveled in Pacifica in 2005. Vehicle miles were converted into GHG emissions based on county wide data on the mix of diesel and gasoline vehicles, and fuel efficiency - see Appendix C for details.

A downside of our estimation method is that it does not allow us to track changes in Pacificans' commuting behavior as the method only counts travel within Pacifica. In the future it would be helpful to

explore use of trips based approach that could be tracked over time to measure progress in reducing emissions.

Air Travel

We estimated Pacifica air travel emissions based on Pacifica's share of U.S. population and total passenger air travel miles in the U.S. in 2005. In 2005 Pacifica's population according to the Census Bureau^[6] was 37,010, and the U.S. population was 285,107,923^[8], so Pacifica's share of national population was 0.013 percent. There were a total of 583,689,304,000 passenger miles flown in 2005^[9]. Pacifica's share of the national total is 75,768,996 passenger air miles. Passenger air miles for Pacifica were entered into the Clean Air Cool Planet calculator to determine total emissions from air travel.

This is likely an underestimate of Pacificans' air travel and associated greenhouse gas emissions. First, Pacificans have easy access to a major airport making air travel more convenient than for most Americans, and Pacifica's average income is much higher than the national average so we can afford more air travel. In 1999 median family income in Pacifica was \$78,361 a year, while the U.S. median was \$50,046^[10].

Scientists have noted that greenhouse gases emitted at higher altitudes from airplanes have a greater warming effect than would the same emissions at ground level. The extent of this effect is still unclear. It is estimated that emissions from airplanes have between 2 and 4 times the warming effect of ground level emissions. Accordingly, the Clean Air Cool Planet calculator we used includes a 2.8 multiplier for estimating emissions from air travel.

Solid Waste

In 2005 Pacifica sent 15,784 tons of solid waste to the landfill at Ox Mountain, Half Moon Bay^[12]. The ICLEI carbon calculator required breakdowns on the percentage of waste by category (food, paper, etc.) which was not available from Coastside Scavenger. We therefore calculated emissions from solid waste using the Clean Air – Cool Planet calculator which does not require waste category data (and therefore implicitly assumes some average waste composition). The Clean Air – Cool Planet calculator estimates 15,784 tons of solid waste in a landfill without methane capture would produce 14,267 metric tonnes CO₂e emissions.

Commercial Natural Gas and Electricity Use

Pacific Gas and Electric Company provided us with total meter readings for commercial electricity and natural gas use for the years 2003-2007. For 2005 total commercial electricity use was a 20.1 million

kWh and total natural gas use was 802,038 therms. Emissions were calculated using the methods described in the residential natural gas and electricity section above. Like residential electricity use, commercial electricity use increased 8.5 percent from 2003 to 2007. Commercial natural gas used increased 8.8 percent over the same time period. We did not have the necessary information to allow us to determine if increased commercial energy use was due to an expansion of commercial business activity, or increased energy intensity (greater energy use for a given level of activity). PG&E reported no private industrial energy use in Pacifica in 2005.

Direct Access Purchases of Gas and Electricity

Most non-residential users get their natural gas and electricity from PG&E, however some, mostly large industrial users, have Direct Access agreements between the user and a provider. Although PG&E distributes and measures Direct Access energy, when there are few purchasers the identity of the purchaser and the quantity are suppressed from the public information provided by PG&E. In the data we received from PG&E the quantities of Direct Access electricity and natural gas use were suppressed. We estimated Direct Access energy use for Pacifica based on county wide average ratios of Direct Access to non-Direct Access energy use, and the Pacifica ratio of manufacturing to total employment compared to the county. See Appendix B for details.

County and Special Districts Natural Gas and Electricity

Pacific Gas and Electric Company provided us with total meter readings for electricity and natural gas use for the years 2003-2007 for county government and special districts in Pacifica. Special districts include the two school districts and the North Coast County Water District. For 2005 total electricity use by county government was 120,024 kWh and total natural gas use was 3,032 therms. For 2005 total electricity use by special districts in Pacifica was 4,048,866 kWh and total natural gas use was 171,520 therms. Emissions were calculated using the methods described in the residential natural gas and electricity section above.

Off-road Equipment

Emissions from mobile off-road sources in Pacifica were estimated based on shares of countywide emissions from lawn and garden equipment and from Construction, Industrial, and Light Commercial Equipment, following the methods in the San Mateo County Community-scale GHG Inventory template produced by ICLEI and the City and County Association of Governments of San Mateo County.^[11] Pacifica's share of county-wide lawn and garden equipment emissions was estimated based on Pacifica's share of households in the county. Pacifica's share of Construction, Industrial, and Light Commercial

Equipment emissions was based on Pacifica's share of employment in the county. See Appendix B for details.

Conclusions

The next step is for Pacifica to develop a climate action plan stating its emissions reductions targets and actions to achieve those targets. This inventory identifies the major sources of GHG emissions and can be used to estimate the possible emissions reductions achievable by specific actions. Developing an action plan requires identifying a set of actions that together can meet Pacifica's emissions reduction targets.

Reducing greenhouse gas emissions is an enormous challenge. Pacifica has already made the commitment to reduce greenhouse gas emissions by signing on to the U.S. Mayors Climate Protection Agreement, and by completing this inventory as well as an inventory for city operations. And the city has already begun to reduce emissions from city operations by installing solar panels on the wastewater treatment plant and at City Council Chambers/Sharp Park Pump Station. With a concerted effort from the entire community, Pacifica can reach its goals of significantly reducing its GHG emissions. A number of analyses indicate that in the long run there are very little net-costs to taking the actions required to reduce emissions ^[13]. Actions to reduce emissions can have tremendous economic benefits by reducing energy costs, and can improve public health by reducing emissions of particulates and other pollutants that are co-emitted along with greenhouse gases.

Acknowledgements

This greenhouse gas inventory for Pacifica was a large undertaking and would not have been possible without the support and help of many people. We wish to thank the Pacifica City Council for signing the Mayor's Climate Protection Agreement and City Manager Steve Rhodes for his strong support for the inventory process, and help obtaining PG&E and solid waste data. Betty Seto and KEMA reviewed our earlier inventory and provided helpful comments on revisions. Elizabeth Claycombe of the City of Pacifica Planning Department helped with the update process and provided us with the ICLEI- C/CAG inventory template. Xico Manarolla of ICLEI arranged access to their carbon calculator software. David Ory, Harold Brazil and Benjamin Espinosa of the Metropolitan Transportation Commission answered questions about vehicle miles traveled data. Amruda Sulkhalkar of ICLEI was invaluable in sharing transport data. Caitlin Steele of San Francisco State University, and Charlotte Ely of the U.S. Environmental Protection Agency provided helpful information on emissions from solid waste. Chris Porter of Coastside Scavenger provided solid waste data. Barbara Hubler and Mary Keitelman did editorial and layout work

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Appendix A. Pacifica inventory emissions factors for electricity and natural gas

This table is adapted from the San Mateo County Community-wide GHG Inventory Template. We took all emissions factors directly from the California Air Resources Board, Local Government Operations Protocol for GHG Inventories.

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity	CO ₂	489.16 lbs/MWh	Local Government Operations Protocol, Table G.6. See also the California Climate Action Registry Power/Utility Protocol Public Reports; http://www.climateregistry.org/CARROT/public/reports.aspx
	CH ₄	0.03 lbs/MWh	Local Government Operations Protocol, Table G.7
	N ₂ O	0.011 lbs/MWh	Local Government Operations Protocol, Table G.7
Natural Gas	CO ₂	53.06 kg/MMBtu	U.S. EPA, Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005; see also Local Government Operations Protocol, Table G.1
	CH ₄	5.0 g/MMBtu (residential & commercial sectors)	EPA Climate Leaders, Stationary Combustion Guidance (2007), Table A-1, based on U.S. EPA, Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005 (2007), Annex 3.1; see also Local Government Operations Protocol, Table G.3
	N ₂ O	0.1 g/MMBtu	
Direct Access Electricity	CO ₂	958.49 lbs/MWh	CO ₂ emissions factor calculated from total in-state and imported electricity emissions divided by total consumption in MWh. Emissions from California Air Resources Board, Greenhouse Gas Inventory, 1990-2004 (November 17, 2007 version), available at http://www.arb.ca.gov/cc/inventory/data/data.htm Consumption data from California Energy Commission, http://www.energy.ca.gov Factors for CH ₄ and N ₂ O from Local Government Operations Protocol, Appendix G, Table G.7
	CH ₄	0.03 lbs/MWh	
	N ₂ O	0.011 lbs/MWh	

Appendix B Details of Transportation, Direct Access Energy, and Off-road emissions

Transportation

Emissions from transportation were calculated from vehicle miles traveled using methods and data from the San Mateo County Community-wide GHG Inventory Template. Vehicle miles traveled were first split into Gas and Diesel miles traveled based on the VMT mix for San Mateo County in the table below. Methane and Nitrous Oxide emissions were calculated directly by multiplying gas or diesel VMT by the appropriate emissions factors and then converting to carbon dioxide equivalents based on global warming potential (21 times for methane and 310 times for nitrous oxide). For carbon dioxide emissions VMT was divided by San Mateo County average fuel efficiencies to get gallons of gas and diesel used, and these were then multiplied by the appropriate CO₂ emissions factor.

Emissions factors for calculating GHG emissions from vehicle miles traveled. This table is adapted from the San Mateo County Community-wide GHG Inventory Template. The original data source is the Bay Area Air Quality Management District, EMFAC 2007 model.

County	CH ₄ Rates (grams/mile)		N ₂ O Rates (grams/mile)		VMT Mix		CO ₂ Rates- (grams/gallon)		Fuel Efficiency (miles/gallon)	
	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel
San Mateo County	0.058	0.030	0.070	0.050	96.8%	3.2%	8,609	10,216	19.6	8.1

Direct Access Energy

The San Mateo community-wide GHG inventory template estimated Direct Access energy use for cities based on the San Mateo county-wide ratio of Direct Access energy use relative to non-residential energy use. In the county as a whole Direct Access electricity use was 20.89 percent of non-residential electricity use, and Direct Access natural gas use was 55.08 percent of non-residential natural gas use. The template applied these county-wide percentages to local area non-residential energy use to estimate local Direct Access use. For Pacifica, the template approach produces an overestimate of Pacifica Direct Access energy use. Direct Access energy is mainly purchased by large industry, and Pacifica has little industry. PG&E data for energy use for Pacifica indicated no PG&E industrial electricity or natural gas use.

To account for the amount of industry in Pacifica relative to the county as a whole, the estimate of Direct Access energy use in Pacifica was scaled using the Pacifica share of manufacturing, wholesale and

transport employment to total employment compared to the county-wide share. Ideally we would have done the scaling with just manufacturing employment as manufacturing is the sector most likely to use Direct Access energy, but data on just manufacturing jobs was not available. Jason Munkres (jasonm@abag.ca.gov, (510) 464-7929), Regional Planner at the Association of Bay Area Governments, provided us with estimated employment data for Pacifica for 2005 from their Projections 2009 report. In 2005 Pacifica had 350 jobs in manufacturing, wholesale and transport out of a total of 6,190 jobs (5.65 percent), while the county had 71,310 jobs in manufacturing, wholesale and transport out of a total of 337,350 jobs (21.14 percent). So Pacifica had about a quarter ($5.65/21.14 = 26.75$ percent) as much employment in manufacturing, wholesale and transport as the county as a whole and we scaled our estimate of Pacifica Direct Access energy use with this factor. Our estimate of Pacifica Direct Access electricity use was calculated as Pacifica commercial electricity use times 20.89 percent (county average Direct Access electricity use) times 26.75 percent (Pacifica manufacturing jobs scaling factor). Direct Access natural gas use was calculated in an analogous manner. Emissions from Direct Access electricity were calculated based an average emissions factor for Direct Access electricity in California (See Appendix A). Emissions from Direct Access natural gas were calculated using the same emissions factor as PG&E natural gas (See Appendix A).

Off-road equipment

Emissions from mobile off-road sources were estimated based on shares of countywide emissions. We had to use emission data for 2007, as data for 2005 was not available. The San Mateo County community scale inventory template provided total county emissions from lawn and garden equipment of 14,182 metric tonnes CO₂e and Construction, Industrial, and Light Commercial Equipment of 255,468 metric tonnes CO₂e. The original data source was Table Q of the Bay Area Air Quality Management District report titled “Source Inventory of Bay Area Greenhouse Gas Emissions.” Pacifica’s share of county-wide lawn and garden equipment emissions was estimated based on Pacifica’s share of households in the county, and Pacifica’s share of Construction, Industrial, and Light Commercial Equipment emissions was based on Pacifica’s share of employment in the county. Jason Munkres at the Association of Bay Area Governments provided use with number of households and estimated employment data for Pacifica and San Mateo County for 2005 from their Projections 2009 report. In 2005 Pacifica had a total of 14,190 households and the county had a total of 260,070 households. In 2005 Pacifica had a total of 6190 jobs and the county had a total of 337,350 jobs.

Appendix C: Biography for Carlos Davidson

Carlos Davidson is a Professor and Director of the Environmental Studies Program at San Francisco State University where he teaches courses on a variety of environmental topics including sustainability and climate change. He is co-author of a greenhouse gas inventory report for the San Francisco State

University campus and is a member of the university's sustainability committee. He has a Ph.D. in ecology from the University of California, Davis, and a masters degree in economics from U.C. Berkeley.

Appendix D: Membership of the Pacifica Climate Committee

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