Appendix A: International Local Government GHG Emissions Analysis Protocol (IEAP) Community Scopes Framework

Emissions sources can be categorized according to where they fall relative to the geopolitical boundary of the community. Using this method, emissions sources are categorized as direct or indirect emissions--Scope 1, Scope 2, or Scope 3-- in accordance with the World Resources Institute and the World Business Council for Sustainable Development's *Greenhouse Gas Protocol Corporate Standard.* This standard is important as it helps a local government better understand the sources of emissions and the extent to which they can directly control those emissions.

The Scopes framework identifies three emissions scopes for community emissions:

Scope 1: All direct emissions from sources located within the geopolitical boundary of the local government. Typical Scope 1 emissions include natural gas combustion emissions, emissions from fuel combustion by vehicles and off-road equipment, and methane emissions from biodegrading waste in landfills within community boundaries.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the geopolitical boundary of the local government, but that occur at sources located outside of the government's jurisdiction.

Scope 3: All other indirect or embodied emissions not covered in Scope 2, that occur as a result of activity within the geopolitical boundary. Common Scope 3 emissions are future emissions from organic waste disposed of in the base year, emissions from air travel or ports, and "upstream" emissions (emissions generated in the production of materials used in the community).

Scope 1 and Scope 2 sources are the most essential components of a community greenhouse gas analysis. This is because these sources are typically the most significant in scale, and are most easily impacted by local policy making. The IEAP also includes, in its *Global Reporting Standard,* the reporting of Scope 3 emissions associated with the decomposition of solid waste and sewage waste-water produced within the geopolitical boundaries of the local government.

Scopes and Double Counting

One of the most important reasons for using the scopes framework for reporting greenhouse gas emissions at the local level is to prevent "double counting" for major categories such as electricity use and waste disposal. Double counting occurs if a set of emissions could be considered twice within an inventory. For example, if a local government produced its own power, it would be

considered a Scope 1 emission at the point of generation and a Scope 2 emission at the point of consumption, and it would be inappropriate to add these emissions together. This may also occur if a local government has an active landfill within its boundaries to which community waste is sent. This report sums, or "rolls up" emissions from many scopes into one number, but is very clear to identify the types of emissions included in the rollup numbers. ICLEI strongly encourages local governments to do the same whenever they report a rollup number, as they can be very misleading and easily misquoted by policymakers or others when referring to the inventory.

Macro Sector (IPCC)		Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions
Energy	Stationary Combustion	Utility-delivered fuel consumption	n/a	Upstream/downstream emissions (e.g., mining/transport of coal)
		Decentralized fuel consumption		
		Utility-consumed fuel for electricity / heat generation		
	Electricity / Heat Consumption	n/a	Utility-delivered electricity / heat /steam consumption Decentralized electricity / heat /steam consumption	Upstream/downstream emissions (e.g., mining/transport of coal)
	Mobile Combustion	Tailpipe emissions from on-road vehicles Tailpipe emissions from rail, sea, airborne and non-road vehicles, operating within the community	Electricity consumption associated with vehicle movement within the community (e.g., light rail)	Tailpipe emissions from vehicles used by community residents
				Upstream/downstream emissions (e.g. mining/transport of oil)
				Tailpipe emissions from rail, sea, and airborne vehicles departing from or arriving into the community
	Other Energy	Fugitive emissions not already accounted for	n/a	Upstream/downstream emissions
Industrial Processes and Product Use		Decentralized process emissions	n/a	Upstream/downstream emissions
Agriculture, Forestry and Other Land Use		Livestock methane, managed soils	n/a	Upstream/downstream emissions from fertilizer/pesticide manufacture
		Net biogenic carbon flux	n/a	n/a
Waste	Solid Waste Disposal	Direct emissions from landfill, incineration and compost facilities located inside the community	n/a	Landfill, incineration and compost emissions occurring in present-year from waste produced to date inside the community Future emissions associated with waste disposed Upstream/downstream emissions (e.g. transport to the landfill)
	Wastewater Treatment and Discharge	Direct emissions from wastewater facilities located inside the community	n/a	Wastewater emissions occurring in present year from wastewater produced to date inside the community Future emissions associated with wastewater treated Upstream/downstream emissions

Appendix B: Community Inventory Methodology Summary

Residential, Commercial, Industrial Energy Sector Notes

Data Inputs / Outputs Summary:

Sector	Fuel	Quantity	Units	Emissions (metric tons CO2e)
Residential	Electricity	73,389,689	(kWh)	16,407
	Natural Gas	5,297,949	(therms)	28,335
TOTAL				**44,742**
Commercial / Industrial	Electricity	117,035,770	(kWh)	26,164
	Natural Gas	3,129,995	(therms)	16,741
	Direct Access Electricity	24,454,518	(kWh)	10,676
	Direct Access Natural Gas	1,723,863	(therms)	9,156
TOTAL				**62,737**

Emission Factors:

Emission Source	GHG	Emission Factor	Emission Factor Source
PG&E Electricity	CO_2	489.16 lbs/MWh	California Climate Action Registry Power/Utility Protocol Public Reports; http://www.climateregistry.org/CARROT/public/reports.aspx; also see Local Government Operations Protocol, Table G.5
	CH_4	0.029 lbs/MWh	Local Government Operations Protocol, Table G.6
	N_20	0.011 lbs/MWh	Local Government Operations Protocol, Table G.6
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) 1.0 g/MMBtu (industrial sector)	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_20	0.1 g/MMBtu	
Default Direct Access Electricity	CO_2	958.49 lbs/MWh	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 In Local Government Operations Protocol, Appendix G, Table G.6, pages 174
	CH_4	0.029 lbs/MWh	
	N_20	0.011 lbs/MWh	

Data Sources:

1. PG&E electricity and natural gas: GHGDataRequests@pge.com

2. Direct access electricity estimates: California Energy Commission (CEC): Andrea Gough, agough@energy.state.ca.us

Additional Notes:

Estimations of electricity purchased through Direct Access (DA) contracts are derived from county level DA consumption figures, provided by the California Energy Commission. The countywide ratio of DA to utility-supplied-electricity is multiplied by a community's utility-supplied energy use to determine the amount of DA in a given community. According to the CEC, DA was 20.89% of "non-residential" electricity consumption and 55.08% of "non-residential" natural gas consumption in San Mateo County in 2005.

Formula: $DA_c / (DA_c + u_{c)} = DA / (DA + u)$

Transportation Sector Notes

On-Road Emissions

Data Inputs / Outputs Summary:

Sector	Sub Sector	Quantity (millions)	Units	Emissions (metric tons CO2e)
Transportation	Local Roads	117	(vehicle-miles traveled)	56,890
	State Highways	195	(vehicle-miles traveled)	94,976
TOTAL				**151,866**

Emission Factors:

County	CH_4 Rates (grams/mile)		N_2O 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

Emission Factors Source: Bay Area Air Quality Management District (BAAQMD), using EMFAC 2007

Data Sources:

1. Local Roads Vehicle Miles Traveled (VMT) 2005 data: 2005 California Public Road Data, Highway Performance Monitoring System, State of California, Department of Transportation, http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php

2. State Highways Vehicle Miles Traveled (VMT) 2005 data: Data was created using GIS, by dividing a GIS file of Caltrans road segments for State Highways into jurisdictions using a jurisdictional boundary layer. VMT was divided proportionally between each segment, and VMT was split equally between jurisdictions for areas where the highway was on the border of two jurisdictions.

Additional Notes:

Local Road and state highway VMT data provided by MTC is in Daily VMT (DVMT); Annual VMT = DVMT x 365.

VMT is converted into gas and diesel, based on VMT mix. Then it is converted into gallons of fuel using fuel efficiency. CO2 is calculated from resulting fuel consumption.

Methane and nitrous oxide is calculated directly from VMT by fuel type. It is separated into fuel by VMT mix.

Off-Road Emissions

Category (see Additional Notes below)	Unit of Measure	Total Countywide Emissions	Total Units Countywide	Emissions Per Unit	Units in Jurisdiction	Jurisdiction's Emissions (metric tons CO2e)
Lawn and Garden Equipment	Households	14,182	260,000	~0.055	12,090	659
Construction, Industrial, and Light Commercial Equipment	Jobs	255,468	337,350	~0.757	14,230	10,776
Total						**11,435**

Data Sources:

Total countywide emissions: "Source Inventory of Bay Area Greenhouse Gas Emissions," Bay Area Air Quality Management District. Report base year: 2007. http://www.baaqmd.gov/Divisions/Planning-and-Research/Emission-Inventory-and-Air-Quality-Related/Emission-Inventory/~/media/64A8751292F44BEEAD56B7569B68DB27.ashx

(Table Q, pg. 25)

2. Jobs and households data: Projections 2007 report, Association of Bay Area Governments, Jason Munkres, Regional Planner, ABAG, jasonm@abag.ca.gov, (510) 464-7929

Additional Notes

Data on total countywide emissions from off-road equipment came from the BAAQMD's report with a base year of 2007, as there is no report for 2005 and no other reliable way to quantify off-road emissions in 2005 (the California Air Resources Board's Off-Road Calculator is not currently functioning - http://www.arb.ca.gov/msei/offroad/offroad.htm). Emissions were divided into two categories – emissions from lawn and garden equipment and emissions from construction, industrial, and light commercial equipment.

Emissions per household were calculated using BAAQMD's data on countywide emissions from lawn and garden equipment and the total amount of households countywide. To calculate emissions from lawn and garden equipment generated in the County, emissions per household were multiplied with the number of households in the unincorporated community.

Emissions per job were calculated using BAAQMD's data on countywide emissions from construction, industrial, and light commercial equipment and the total amount of jobs countywide. To calculate emissions from construction, industrial, and light commercial equipment generated in the County, emissions per job were multiplied with the number of jobs in the unincorporated community.

Waste Sector Notes

Generated Waste Emissions

Data Inputs / Outputs Summary:

Sector	Sub Sector	Quantity	Units	Emissions (metric tons CO2e)
Waste	Landfilled Solid Waste	22,698	(tons)	4,144
	Alternative Daily Cover	86	(tons)	9
TOTAL				**4,153**

Emission Factors:

Waste Type	Methane Emissions (metric tons CH4 / metric ton of waste)	Emission Factor Source
Paper Products	2.138	US EPA, provided by the CACP Software
Food Waste	1.120	US EPA, provided by the CACP Software
Plant Debris	0.686	US EPA, provided by the CACP Software
Wood / Textiles	0.605	US EPA, provided by the CACP Software
All Other Waste	0.000	US EPA, provided by the CACP Software

Data Sources:

1. Landfilled Waste: California Integrated Waste Management Board Disposal Reporting System (DRS) - Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility

http://www.ciwmb.ca.gov/LGcentral/Reports/DRS/Destination/JurDspFa.aspx

2. Alternative Daily Cover: California Integrated Waste Management Board Disposal Reporting System (DRS)- Alternative Daily Cover (ADC) by Jurisdiction of Origin and Material Type

http://www.ciwmb.ca.gov/LGCentral/Reports/DRS/Origin/ADCMatlType.aspx

3. Waste characterization: CIWMB 2004 Statewide Waste Characterization Study. This state average waste characterization accounts for residential, commercial and self-haul waste. http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097

Additional Notes:

ICLEI CACP software categories correlate with the CIWMB's waste categories according to the following guidelines:

CACP	CIWMB	% of Total
Paper Products	All paper types	21.0
Food Waste	Food	14.6
Plant Debris	Leaves and Grass, Prunings and Trimmings, Branches and Stumps, Agricultural Crop Residues, and Manures	6.9
Wood/Textiles	Textiles, Remainder/Composite Organics, Lumber, and Bulky Items	21.8
All Other Waste	The other category includes all inorganic material types reported: Glass, Metal, Electronics, Plastics, Non-organic C&D, and Special/Hazardous Waste.	35.7

Emissions from the waste sector are an estimate of methane (CH_4) generation that will result from the anaerobic decomposition of all waste sent to landfill in the base year (2005). It is important to note that although these emissions are attributed to the inventory year in which the waste is generated, the emissions themselves will occur over the approximately 100 year timeframe that the waste will decompose. This frontloading of emissions is the approach taken by EPA's Waste Reduction Model (WARM). Attributing all future emissions to the year in which the waste was generated incorporates all emissions from actions taken during the inventory year into that year's greenhouse gas inventory. This facilitates comparisons of the impacts of actions taken between inventory years and between jurisdictions. It also simplifies analysis of the impact of actions taken to reduce waste generation or divert it from landfills.

While the WARM model often calculates upstream emissions, as well as carbon sequestration in the landfill, these dimensions of the model were omitted for this particular study for two reasons: (1) this inventory functions on an end-use analysis, meaning from disposal to decomposition, rather than a life-cycle analysis, meaning from mining to disposal, which would calculate upstream emissions. (2) This inventory solely identifies emissions sources, and not potential sequestration 'sinks'.

As some types of waste (e.g., paper, plant debris, food scraps, etc.) generate methane within the anaerobic environment of a landfill and others do not (e.g., metal, glass, etc.), it is important to characterize the various components of the waste stream. Waste characterization was estimated using the California Integrated Waste Management Board's 2004 statewide waste characterization study (http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097). Please see above table for a summary of this study according to the waste categories of the Clean Air

and Climate Protection Software. This summary was conducted by staff at ICLEI-Local Governments for Sustainability.

Most landfills in the Bay Area capture methane emissions either for energy generation or for flaring. The US EPA estimates that 60%-80%[1] of total methane emissions are recovered at the landfills. Following the recommendation of the LGOP, the County adopted a 75 percent methane recover factor, which has been used in this inventory.

Recycling and composting programs are reflected in the CACP software model as reduced total tonnage of waste going to the landfills. The CACP model, however, does not capture the associated emissions reductions in "upstream" energy use from recycling as part of the inventory ("upstream" emissions include emissions that may not occur in your jurisdiction resulting from manufacturing or harvesting virgin materials and transportation of them). This is in-line with the "end-user" or "tailpipe" approach taken throughout this inventory. It is important to note that, *recycling and composting programs can have a significant impact on GHG emissions when a full lifecycle approach is taken*. Manufacturing products with recycled materials avoids emissions from the energy that would have been used during extraction, transporting and processing of virgin material.

[1] EPA AP 42 Emission Factors, Solid Waste Disposal, pg. 2, 4-6 (1998), http://www.epa.gov/ttn/chief/ap42/index.html