GHG PLAN LEVEL QUANTIFICATION GUIDANCE

April 15, 2010

This guidance is intended to assist local governments in developing GHG emission inventories and projections, and in quantifying emission reductions from various policies and mitigation measures. In drafting this guidance, the Air District has drawn from established methodologies and practices, rather than creating new protocols or quantification methods. This guidance should be interpreted as recommended approaches rather than a protocol. This guidance will be continually updated as new tools, methodologies and protocols are developed.

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1. GHG Inventories

1.1 Basic parameters

1.1.1 Emissions to include

Carbon dioxide (CO_2) must be inventoried across all sectors. It is also highly recommended that methane (CH_4) from landfills be included in GHG inventories (see more detail in section 1.5 below). Accounting of N_20, SF6, HFC and PFC emission sources can also be included where reliable estimation methodologies and data are available.

1.1.2 Sectors to include

The inventory should reflect the legal geographic boundary of the jurisdiction. The table below lists the sectors that should be included in GHG inventories, as well as the emission sources within each sector and recommended energy types to include.

Sector	Emission sources	Energy types
Residential	Energy and water use in residential buildings	Electricity Natural gas
Commercial	Energy and water use in commercial, government and institutional buildings	Electricity Natural gas
Industrial	Energy and water use in industrial buildings, facilities and processes	Electricity Natural gas

Sector	Emission sources	Energy types
Transportation	All road vehicles Public transportation Light rail Off-road vehicles/equipment	Gasoline Diesel CNG LNG Bio-diesel
Waste	Landfills Waste stream	Landfill gas

It is the local government's discretion to determine which, if any, additional energy types to include in its inventory. It is highly recommended that any energy type contributing a measurable amount to the overall GHG picture in any sector should be included.

Local governments may want to add additional sectors to their inventories, such as agriculture. If this is done, the assumptions, methodologies and data sources should be clearly identified.

1.1.3 Emission sources to include/exclude

All greenhouse gas emission sources within the geographic scope of the inventory should be accounted for.

If an emissions reduction is to be claimed through a mitigation measure, the correlating emission source must be included in the inventory. For example, a jurisdiction cannot take credit for installing an emissions capture facility at a closed landfill site unless the baseline emissions inventory includes that site as an emissions source.

If any specific exclusion is made, it should be disclosed, along with a justification of the exclusion.

1.1.4 Biogenic carbon emissions

Biogenic CO_2 emissions result from materials that are derived from living cells, as opposed to CO_2 emissions derived from fossil fuels, limestone and other materials that have been transformed by geological processes. Biogenic CO_2 contains carbon that is present in organic materials that include, but are not limited to, wood, paper, vegetable oils, animal fat, and food, animal and yard waste. Biogenic CO_2 emissions should be excluded from the GHG inventory because these emissions are the result of materials in the biological/physical carbon cycle, rather than the geological carbon cycle.

1.1.5 Units to report in

All GHG emissions should be reported in metric tons of CO_2 equivalent (CO_2e), per the international convention of using "global warming potentials." To convert emissions into CO_2e, use the guidance provided in Equation 6.5 of ARB's Local Government Operations Protocol, version 1.0 (page 34).

A list of standard conversion factors for units of measurement is included in the Local Government Operations Protocol, Appendix F.

1.1.6 Base year to choose

The baseline inventory should include one complete calendar year of data for 2008 or earlier, depending on the jurisdiction's GHG emission reduction target (see Section 2.7.2 of the CEQA Guidelines, under Standard Elements of a GHG Reduction Strategy for further guidance).

Discussion note: ARB recommends that GHG inventories use a three-year baseline. A three-year average baseline tends to dampen unusual aspects in any given year that would not be representative of a good baseline. For example, in years of severe drought, CO_2 electricity coefficients may be more carbon intensive than in other years due to the need to supplant diminished hydroelectric power capacity with fossil fuels to produce electricity. Taking a three year average can smooth over some of these anomalies. However, it is recognized that this approach requires an additional level of effort, and so is considered optional rather than recommended.

1.1.7 Emission coefficients to use

Jurisdictions should use electricity coefficients listed in the Local Government Operations Protocol, Appendix G. The Protocol contains utility-specific coefficients, or emission factors, for carbon dioxide (CO_2) (table G.5) and region specific emission factors for methane (CH_4), and nitrous oxide (N_2O) emissions for electricity consumption. GHG emission inventories should use the CO_2 emission factors for the jurisdiction's specific utility, and use the sub-region designation CAMX, WECC California, for calculating CH_4, and N_2O emissions (table G.7), if those emissions are being included in the inventory. Refer to the Local Government Operations Protocol for more detailed guidance and emission factors.

For non-electricity energy, jurisdictions should also use coefficients listed in the Local Government Operations Protocol, Appendix G.

1.2 Residential and Commercial Sectors

1.2.1 Emission sources to include

The types of buildings comprising the residential and commercial sectors include single and multi-family housing, commercial buildings, governmental buildings and facilities, and institutional buildings and facilities (hospitals, colleges, etc.).

The GHG inventory should include direct and indirect emissions produced by the operation of residential and commercial buildings. Direct emissions refer to emissions produced due to the onsite combustion of energy, such as natural gas used in furnaces, boilers and hot water heaters. Indirect emissions refer to the emissions produced offsite as a result of energy used in the buildings, such as those emitted by power plants due to electricity use.

There may be a small amount of additional types of energy utilized by buildings that result in GHG emissions, such as propane, heating oil, diesel used by generators, etc. It is recommended that local governments include this data in their GHG inventories if the data is available and reliable. Because this energy use is dispersed and difficult to identify/track, at this time the Air District does not suggest requiring its inclusion in GHG inventories. This recommendation may change in the future as better information becomes available.

1.2.2 Data sources to use

Local power utilities (PG&E, municipal utilities) are the best source of data for electricity and natural gas use by residential and commercial buildings. To access this data from PG&E, the local government must contact PG&E directly and make an information request. All data requests should be sent to GHGDataRequests@pge.com.

1.3 Industrial Sectors

1.3.1 Emission sources to include

The industrial sector is comprised of industrial buildings and facilities. Emission sources from this sector include energy directly used onsite, such as natural gas, combined heat and power, diesel fuel, etc., and also electricity used in buildings and facilities even if it is generated outside the jurisdiction.

Emissions from very large energy intensive industrial facilities (paper and steel mills, industrial chemical plants, petrochemical plants and refineries, metal smelters, large cement making operations) should be represented within the context of the community-scale emissions inventory results in an appropriate fashion, as (1) their emissions may be well documented in other inventory programs, (2) the purpose of a local government analysis is to account for the emissions the jurisdiction has the ability to influence, and (3) their inclusion could skew the results to the point of prohibiting the facilitation of intercity comparisons. Two sets of emission inventory results should be presented – one including the large emission source and one excluding it. By doing this, all emissions in the jurisdiction are accounted for, and at the same time policy relevance is maintained by seeing an inventory that is not highly skewed toward one dominating emission source.

1.3.2 Data sources to use

Consumption data on electricity and natural gas supplied directly from utilities (PG&E or municipal utilities) can be supplied by those utilities directly. To access this data from PG&E, the local government must contact PG&E directly and make an information request. All data requests should be sent to GHGDataRequests@pge.com.

1.3.3 Direct access

In some cases, large industrial facilities may combust and consume energy directly onsite. Because local utilities do not supply this energy, they can not be used as a data source. The Air District can assist local governments in developing and providing non-proprietary GHG emissions data for industrial facilities that are permitted by the Air District.

1.3.4 Transportation Sector

1.3.5 Emission sources to include/exclude

Gasoline and diesel fuel used by on-road and off-road vehicles should be included in the GHG inventory.

1.3.6 Recommended metric: VMT

Vehicle miles traveled (VMT) is the preferred metric for determining GHG emissions from the transportation sector. Fuel sales and vehicle trips have also been

suggested as appropriate metrics, however at this time the Air District recommends using VMT.

GHG emissions can be determined through fuel sales within a jurisdiction. However, it is difficult to develop an accurate number for fuel sales that would be appropriate for a community-wide inventory. In addition, fuel sales may not be as valuable a piece of information as VMT or vehicle trips in terms of policy relevance, as it does not provide any information on driving patterns. Given this, fuel sales is not the preferred metric for determining GHG emissions from the transportation sector.

Vehicle trips can be used as a metric in GHG inventories as long as meaningful VMT and emission factors can be generated. In order to adequately determine GHG emissions from vehicle trips a variety of inputs need to be known: VMT per trip, trip speed, vehicle type, etc. Because of the complexity involved in this exercise, there are currently no protocols or agreed upon methodologies for using vehicle trips to determine GHG emissions in a community inventory. If vehicle trips are used in place of VMT to determine GHG emissions, all assumptions, methodologies and data sources must be clearly identified.

The Air District will continue to research and explore new methods and the possibility of using additional metrics to determine GHG emissions from transportation.

1.3.7 Highway VMT

The percentage that a city contributes to overall county-wide VMT is also the percentage that the city should use to apportion its share of highway VMT occurring in the county. For example, if the City of Oakland contributes 30% to all VMT in Alameda County, then the City should apportion 30% of all highway VMT in Alameda County to its own community inventory.

1.3.8 Data sources to use

The recommended data source for city and county VMT data is "2008 (or most recent) California Public Road Data" (http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php), a publication of CalTrans' Highway Performance Monitoring System. This provides daily VMT (DVMT) numbers, which account for decreased traffic volumes on the weekends.

The Air District can provide assistance to agencies to determine localized emission factors, vehicle mix, fuel usage and fuel efficiency for each county. The Air District generates CO_2, and CH_4 emission factors using the EMFAC model. The Air District compiles data on N_2O emissions. The basis for the estimates are CO_2 emission rates (grams/mile), which are based on engine testing at different speeds, and county-wide vehicle registration data obtained from DMV. Estimates are available for years 1970-2040. The model also provides estimates of criteria air pollutants, as well as methane emissions (CH_4). In addition, it produces an estimate of fuel usage, and fuel economy. County variations in emission factors are due to the use of county-specific vehicle usage, vehicle mix, vehicle speed and ambient temperatures. For more information on EMFAC, please refer to the California Air Resources Board website: http://www.arb.ca.gov/msei/onroad/latest_version.htm.

Discussion note: ARB has developed a post-processing tool for EMFAC2007

that incorporates the emissions impacts of Pavley I and II into the tool. In addition, ARB will be releasing EMFAC2010 by the end of the year, with Pavley I and II fully integrated.

1.3.9 Off-road emissions

The Air District can work with local governments to provide emissions data for off-road sources, which include lawn and garden equipment, construction equipment, industrial equipment and light commercial equipment. Emissions for off-road sources is estimated using ARB's OFFROAD2007 (or most recent year) emissions model.

1.4 Waste Sector

1.4.1 Emission sources to include/exclude

There are two sources of emissions associated with the landfilled waste that should be included in the GHG inventory. The first is methane being produced at landfills located within the jurisdiction's boundary, and the second is the estimated future generation of methane associated with waste being produced by entities residing in the jurisdiction during the base year (community generated waste).

1) Direct landfill emissions
   This includes methane emissions released from any landfills located within the jurisdiction in the baseline year, whether closed or open. It also includes any methane emissions from the alternative daily cover (ADC) used in the landfills where the waste generated within the jurisdiction is disposed.

2) Future emissions from waste generated in the base year
   Waste breaks down and releases emissions over time. In order to fully account for emissions due to lifetime decomposition, future emissions are estimated and attributed up front to waste going to landfill in any given year. This should include methane emissions from all solid waste generated within the jurisdiction in the base year that was sent to landfills regardless of whether the landfills are located within or outside of the jurisdiction's community boundary.

Emissions from stationary combustion of fossil fuels at the site of the landfill should be included in your GHG inventory but this consumption will be catalogued in the commercial and industrial sectors. Composting and the burning of biofuels (the biogenic portion of biodiesel, for example) are typically not included in GHG inventories. Some communities have opted to note these biogenic emissions as information items, without bundling them into any emission total.

At the community level, electricity use associated with the operation of landfills within the jurisdiction should be included in data for the industrial or commercial sectors. You will not need to duplicate the reporting of emissions from electricity consumption in the community Waste Sector.

1.4.2 Methane Recovery Factors

Emissions from landfills must be multiplied by a methane recovery factor, which is based on the amount of landfill gas that is retained (not emitted) due to the facility's landfill gas capture system. Even if a landfill has determined its specific methane recovery factor, all landfills should use the recommended recovery factor of 75%.

The 75% recovery factor is the default value recommended in the Local Government Operations Protocol which has been adopted by ARB, The Climate Registry and ICLEI.

For landfills with no gas capture systems, a first order decay (FOD) method should be used to determine onsite emissions. In the Bay Area, it is most likely that the only landfills without gas collection systems are older, closed facilities. Local governments with such landfills should use ARB's Landfill Emissions Tool to model landfill gas emissions (http://www.arb.ca.gov/cc/protocols/localgov/pubs/pubs.htm).

1.4.3 Sewage and wastewater treatment

Carbon dioxide, nitrous oxide and methane emissions are created through sewage and wastewater treatment processes. Carbon dioxide emissions associated with these processes are considered biogenic in nature and should only be included as information items. Methane and nitrous oxide emissions, however, should be included. The methodology included in the Local Government Operations Protocol (Chapter 10) for determining methane and nitrous oxide emissions from sewage and wastewater treatment should be followed.

1.4.4 Data sources

The methane emission factors for lifetime decomposition associated with waste generation should be taken from the EPA WARM model. For quantification of emissions only methane generation is taken into account. More information on the WARM Model is available at:
http://epa.gov/climatechange/wycd/waste/calculators/Warm_home.html

The Air District can provide information on emissions produced directly from landfills that are permitted by the Air District.

Waste disposal and alternative daily cover tonnage is reported by permitted facility operators and compiled by county/regional agency disposal reporting coordinators and published in the Disposal Reporting System (DRS) for every county/jurisdiction from 1995 to 2006. This data can be accessed through the Department of Resources Recycling and Recovery – CalRecycle – formerly the California Integrated Waste Management Board.
(http://www.calrecycle.ca.gov/LGCentral/Reports/DRS/)

Discussion note: Determining lifecycle emissions from consumption and waste is a developing area of research. Some local governments are currently considering altering their GHG inventories to account for lifecycle emission impacts of consumption from their communities. Because this is a very new area of research without generally accepted methodologies, the Air District is not recommending this approach at this time. However, this emerging trend provides added reason to include emissions from the waste stream in GHG inventories.

1.5 Regional emissions sources

1.5.1 Water utilities

Electricity use associated with processing and pumping water by water utilities is embedded in data provided to each jurisdiction by PG&E or municipal utilities.

1.5.2 Transit (BART, CalTrain, AC Transit, etc.)

Emissions from energy used for transportation by transit systems within a community should be included in the inventory. In many cases local transit systems will be operated as part of a larger regional transit system. In these cases, the local government must count the emissions that result from the movement of the transit system within the geographic boundaries of the community apportioned on a distance traveled basis.

Emissions from electric transit vehicles, such as BART, will appear as part of the commercial sector, as this electricity consumption will be embedded in the community electricity data.

1.5.3 Airports and sea ports

Emissions from the operations of sea ports and airports (building energy use, ground fleet vehicles, etc.) should be included in the inventory. In addition, fuel used by vehicles (planes, ships) in dock should also be included in the inventory. Emissions from providing electricity to ships and planes in port should be counted in the community inventory as utility provided electricity.

1.5.4 Non-road vehicle use (planes, trains, ships)

Rail: These systems are generally operated as part of a larger regional system. At this time the Air District does not recommend that emissions from heavy duty rail be included in community GHG inventories.

Air travel: Methods to apportion emissions from air travel to community inventories are currently inconsistent and highly speculative. At this time the Air District does not recommend that emissions from air travel be included in community GHG inventories. Ground emissions from an airport would still be included in the inventory, however.

Water travel: Emissions from water travel occurring entirely within the local government's geographic boundary should be included in the inventory. Emissions from water travel largely occurring outside the geographic boundaries of the community (such as with sea travel) should not be included.

1.5.5 Pass-through highway traffic or inter-regional travel

Vehicle travel on highways or other forms of inter-regional travel should be included in the GHG inventory to the extent that VMT occurs within the geographic boundary of the jurisdiction. The Air District can assist local governments in developing and providing VMT data for highway travel with their jurisdictions' geographic boundaries.

1.5.6 Large industrial facilities

See discussion of large industrial facilities in section 1.3 above.

1.6 Recommended Tools

The following tools can help local governments assess baseline inventory GHG emissions, and/or GHG reductions from project characteristics and mitigation measures. While many tools exist that can assist with GHG quantification, the Air District recommends these particular tools due to their long-term use as industry standards and well-vetted methodologies. Many other quantification tools draw from the methodologies and assumptions embedded in these tools.

1.6.1 ICLEI Clean Air – Climate Protection Software

The Clean Air and Climate Protection Software (CACP 2009) created by ICLEI is a one-stop emissions management tool to calculate and track emissions of GHG and criteria pollutants associated with electricity, fuel use, and waste disposal. This climate protection software was created to support local governments in developing emission inventories and climate action planning. This software is free for use and may be downloaded at http://www.icleiusa.org/action-center/tools/cacp-software

1.6.2 EMFAC

ARB developed the EMFAC (EMission FACtors) model to calculate emission rates from motor vehicles operating in California. The EMFAC model considers all motor vehicles, from passenger cars to heavy-duty trucks, operating on highways, freeways, and local roads in California. EMFAC and OFFROAD, the ARB model that calculates emissions from off-road vehicles, contain emission estimates for carbon dioxide and methane transportation emissions. EMFAC2007 and OFFROAD2007 represent the most current model versions and may be downloaded at, http://www.arb.ca.gov/msei/onroad/latest_version.htm

1.6.3 WARM

EPA created the WAste Reduction Model (WARM) to help calculate GHG emissions reductions from different waste management practices. WARM calculates and totals GHG emissions of baseline and alternative waste management practices such as, source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent (MTCO2E), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste. WARM, last updated in November 2009, is free for use and may be applied as web-based calculator or Excel spreadsheet at, http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html)

1.6.4 Local Government Operations Protocol[1]

The Local Government Operations Protocol is designed to provide standard guidelines to assist local governments in quantifying and reporting GHG emissions associated with their government operations. The Protocol was developed in partnership by ARB, California Climate Action Registry (CCAR), and ICLEI, in collaboration with The Climate Registry and dozens of stakeholders. The Protocol provides the principles, approach, methodology, and procedures needed to develop a local government operations GHG emissions inventory. It is designed to support the complete, transparent, and accurate reporting of a local government's GHG emissions. The Protocol is free and may be downloaded at http://www.arb.ca.gov/cc/protocols/localgov/pubs/pubs.htm

1.6.5 Use of local models and methodologies

The Air District encourages local governments to apply local models and methodologies to quantify GHG emissions where appropriate. For example, using

[1] This guidance includes multiple references to the Local Government Operations Protocol (LGOP), version 1.0. It should be noted that the California Climate Action Reserve is scheduled to release version 1.1 of the LGOP in Spring of 2010. Upon release of version 1.1, all relevant references in this guidance will be revised.

local travel demand model data to inform GHG inventories may be appropriate, depending on the reliability of the data.

2. Projection (Forecast)

GHG emission projections, or forecasts, for communities should reflect a business-as-usual (BAU) approach, in which emissions are projected in the absence of any policies or actions that would occur beyond the base year that would reduce emissions.

2.1 Choosing a future/target year

The projection should include one complete calendar year of data for a future year. The future year should coincide with the year chosen for the jurisdiction's GHG emission reduction target. According to Section 2.7.2 of these Guidelines, the future year will most likely be 2020, but could also be a year farther in the future (see Section 2.7.2 of the CEQA Guidelines, under Standard Elements of a GHG Reduction Strategy for further guidance).

2.2 Growth projections

The Air District recommends consistency with ARB's Business-as-usual Forecasting Method where possible, except as noted below. ARB's 2020 BAU emissions estimate was derived by projecting emissions from a past baseline year using growth factors specific to each of the different economic sectors. For the purposes of the Scoping Plan, ARB used three-year average emissions, by sector, for 2002-2004 to forecast emissions to 2020. At the time the Scoping Plan process was initiated, 2004 was the most recent year for which actual data were available.

Growth factors are sector-specific and are derived from several sources, including the energy demand models generated by California Energy Commission (CEC) for their 2007 Integrated Energy Policy Report (IEPR), business economic growth data developed for ARB's criteria pollutant forecast system (CEFS), population growth data from the California Department of Finance, and projections of vehicle miles traveled from ARB's on-road mobile source emissions model, EMFAC2007. For the electricity and other energy sectors, ARB consulted with CEC to select the most appropriate growth factor.

ARB's forecasting method is similar to other GHG forecasting approaches, including the method used in the Climate Action Team 2006 Report. Where appropriate, ARB used updated and improved growth factors for estimating 2020 emissions sector-by-sector. These future emissions are projected in the absence of any policies or actions that would reduce emissions.

Deviations from ARB's approach:

- Estimating population growth – future growth projections may be based on ABAG's most recent Projections report. ABAG derives its projections based on data from the Department of Finance, but adapts them with local information.
- Estimating VMT growth – ARB uses fuel sales data to develop projections of VMT. As discussed above, fuel sales are not a preferred method for determining GHG emissions locally. The Air District recommends using MTC's county-specific growth estimates to estimate future VMT.

2.3 Future electricity coefficients

The most recently certified electricity coefficient for the jurisdiction's local utility should be used as the projected electricity coefficient for the future/projection year. Jurisdictions should use electricity coefficients listed in the Local Government Operations Protocol, Appendix G (table G.5). Refer to section 1.7 above for more detailed guidance.

2.4 Accounting for state-level actions

Several measures included in the AB 32 Scoping Plan will impact local GHG emissions and may be taken into account in the GHG emission projection. Of particular importance are the Renewable Portfolio Standard and the Pavley I and II regulations. While other Scoping Plan measures are also relevant, such as the Low Carbon Fuel Standard, because the details of the regulation have not yet been developed, assessing GHG impacts at the local level from these measures is fairly speculative at this time.

2.4.1 Renewable Portfolio Standard

The State of California Renewable Portfolio Standard (RPS) requires electricity providers to increase the portion of electricity they deliver that comes from renewable energy sources to 20% by 2010 and by 33% by 2020. Local governments can develop assumptions on the impact of the RPS on their communities based on information from their local utilities. Most utilities in California (including PG&E) have reported their GHG emissions data to the California Climate Action Reserve (CCAR). The 2006 Power/Utility Reporting Protocol, version 1.0 (PUP) provides information for each utility, including the amount of power produced by renewable energy for any given year. Guidance on how to use this information to estimate the impact of the RPS on a community's future GHG emissions is in development by the Air District and will be forthcoming.

2.4.2 Pavely I and II

Assembly Bill 1493 (Pavley), signed into law in 2002, will require automakers to reduce greenhouse gas emissions from new passenger cars and light trucks beginning in 2011. ARB will implement the law in two phases of increasingly stringent standards. ARB has developed a post-processing tool for EMFAC2007 that incorporates the emissions impacts of Pavley I and II into the tool. In addition, ARB will be releasing EMFAC2010 by the end of the year, with Pavley I and II fully integrated.

2.4.3 SB 375

Although SB 375 is expected to reduce vehicle trips and transportation-related emissions, it should not be included as an emission reduction measure in GHG Reduction Strategies for two reasons: 1) the intent and implementation of SB 375 is likely to overlap with mixed use and transit-oriented development measures included in the Strategy (thus to avoid double-counting), and 2) a technical, defensible analysis of the bill's projected impact on the state or the Bay Area is not available at this time.

3. GHG Mitigation Measures

This guidance applies to addressing project characteristics, as well as mitigation measures. It is recommended that GHG reductions from appropriate policies and measures be applied to projects before entering the mitigation phase.

3.1 Residential and commercial buildings

3.1.1 Green building codes

3.1.1.1 Exceeding Title 24

New California buildings must be designed to meet the building energy efficiency standards of Title 24, also known as the California Building Standards Code. Title 24 Part 6 regulates energy uses including space heating and cooling, hot water heating, ventilation, and hard-wired lighting. By committing to a percent improvement over Title 24, a development reduces its energy use and resulting GHG emissions.

GHG reductions from a percent improvement over Title 24 can be quantified by calculating baseline energy consumption using methodologies based on the California Energy Commission's (CEC) Residential Appliance Saturation Survey (RASS) and Commercial End-Use Survey (CEUS). The CEUS is based on a survey conducted in 2002 for existing commercial buildings in various climate zones. Electricity and natural gas use per square foot for each end use in each building type and climate zone is extracted from the CEUS data. Since the data is provided by end use, it is straightforward to calculate the Title 24 and non-Title 24 regulated energy intensity for each building type.

Data from RASS is used to calculate the total electricity and natural gas use for residential buildings on a per dwelling unit. The RASS study estimates the unit energy consumption (UEC) values for individual households surveyed and also provides the saturation number for each type of end use. The saturation number indicates the proportion of households that have a demand for each type of end-use category. As the data is provided by end use, it is straightforward to calculate the Title 24 and non-Title 24 electricity and natural gas intensity for each building type.

RASS and CEUS data are based on CEC Forecasting Climate Zones (FCZs); therefore, differences in project energy usage due to different climates are accounted for. The percent improvement is applied to Title 24 built environment energy uses, and overall GHG emissions are calculated using local utility emission factors. This methodology allows project applicants flexibility in choosing which specific measures they will pursue to achieve the percent reductions (for example, installing higher quality building insulation, or installing a more efficient water heating system), while still making the mitigation commitment at the time of CEQA analysis.

3.1.1.2 LEED and GreenPoint Rated

Local building codes that use requirements referencing LEED building standards and/or GreenPoint Rated may look to those two programs for direction on how to quantify GHG emissions impacts of their respective standards.

With support from the Air District, Build It Green has developed a Climate Calculator (http://www.stopwaste.org/docs/calculator_report-spring_09_update.pdf) to generate data on GHG emissions avoided and other savings. The Climate Calculator produces four sets of data:

1) CO_2e data derived from the building's green design features;
2) CO_2e data related to the recycling of construction and demolition waste;
3) CO_2e data related to the project's location, which quantifies the potential reduction in miles driven by residents who live in more compact, transit-oriented, mixed-use developments; and
4) Non-CO_2 savings, including gallons of water, tons of waste, kilowatt-hours of electricity, and therms of natural gas.

The US Green Building Council (USGBC) provides information on how to equate points on the LEED scale to percentage points exceeding energy efficiency standards in Title 24. For a comparison between LEED-NC and LEED-CS and Title 24's 2005 standard, see the USGBC Information Guidelines at http://www.usgbc.org/ShowFile.aspx?DocumentID=2255. LEED has not yet updated this comparison to the new 2008 Title 24 energy efficiency standards.

3.2 Transportation

Local governments should use URBEMIS to calculate potential GHG emission reductions from different transportation mitigation measures. In order to use URBEMIS effectively, accurate estimations of trip rates and length (VMT per trip) must be made.

3.3.1 Estimating Trip Rates

The majority of transportation impact analysis conducted for CEQA documents in California apply trip generation rates provided by the Institute of Transportation Engineers (ITE) in their regularly updated report *Trip Generation*. This data is typically based on single-use developments, in suburban locations with ample free parking and with minimal transit service and demand management strategies in place. As a result, the ITE trip generation rates represent upper bound trip generation rates for an individual land use type. Local governments can use local models to fine tune the trip rates beyond what ITE provides.

For some large development projects or general plans, the local or regional travel demand model is used to estimate the number of trips generated as well as trip lengths and vehicle speeds at which the individual trips occur. These models account for whether the trip segment occurs on a freeway or local streets as well as the degree of congestion. The values for trip generation rates and trip lengths using ITE and average trip lengths can be used to assess the model estimates of vehicle trip generation and VMT. These comparisons should recognize that the travel demand models explicitly account for various factors that reduce trip-making and VMT, including the demographic characteristics of the site occupants, location and accessibility of the development site relative to other destinations in the region, the mix of land uses within the site and its surrounding area, and possibly the availability of effective transit service. When performing a comparison using the ITE trip rates and average trip lengths, the reviewer should take into consideration that these factors have already been accounted for in the modeling.

3.3.2 Impacts of Transit-oriented development on trip rates

The Santa Clara County Congestion Management agency has produced guidelines suggesting a 9 percent trip reduction for housing within 2,000 feet of a light-rail commuter-rail station.

The results of a literature review of studies documenting the effectiveness of Transit Oriented Development (TOD) in the reduction of vehicle trips show residents living near transit stations are around 5 times more likely to commute by transit as the average resident worker in the same city.

The Robert Cervero study, *Impacts of Transit Oriented Housing*, includes a survey of 17 transit–oriented developments in five U.S. metropolitan areas that show vehicle trips per dwelling unit substantially below ITE manual estimates. According to the study, over a typical weekday, the surveyed TOD housing projects averaged 47 percent fewer vehicle trips than that estimated by the manual (3.55 versus 6.67). The San Francisco Bay area also averaged vehicle trip generation rates substantially below those estimated by the ITE manual.

3.3.3 Estimating VMT

Baseline VMT for projects should be calculated by multiplying ITE trip rates by the typical trip length. MTC is the best source for local trip length data in the Bay Area.

Discussion note: Some mechanisms that reduce trip generation rates and trip lengths below the standard ITE trip rates and current average trip lengths might be considered to be intrinsic parts of the development proposal rather than mitigation measures, such as project location (e.g., infill or transit oriented development), density, mix of uses, and urban design. These intrinsic attributes of a project should be considered part of the baseline condition and quantified as project design features rather than mitigation. This approach highlights all elements of a project that affect trip generation rates and vehicle miles traveled.

3.3.4 Density impacts on VMT

The report “Transportation Research Board Special Report 298: Driving and the Build Environment Effects of Compact Development on Motorized Travel, Energy Use and CO2 Emissions” examines the relationship between land development patterns and vehicle miles travelled. The report suggest that doubling residential density across a metropolitan area might lower household VMT by 5 to 12 percent, and as much as 25 percent if coupled with higher employment concentrations, significant public transit improvements, mixed uses and other supportive demand management measures.

3.3 Waste

The Air District has created a tool to assist local governments in estimating GHG impacts of project-level measures in the waste sector. This tool, the BAAQMD GHG Model Calculator (see description in 6.2 below), draws coefficients for different waste types from the EPA WARM tool and local waste disposal rates from CalRecycle (formerly the California Integrated Waste Management Board).

3.4 Impacts of multiple policies

Some GHG reduction policies/measures, whether applied in project planning or as mitigation measures, are more effective when used in concert with other measures.

Quantifying the impacts of multiple strategies applied together is a new area of research, without established methodologies. In July of 2010, the California Air Pollution Control Officers Association (CAPCOA) will release a report on GHG mitigation measures quantification that will include a discussion and general approaches for quantifying the "layering" of multiple policies.

3.5 Recommended Tools

3.5.1 URBEMIS

URBEMIS is an emissions model that quantifies construction and operation emissions from land use projects. The Air District recommends URBEMIS as the standard tool for quantifying project related emissions of criteria pollutants and carbon dioxide in proposed land use developments. URBEMIS uses the California Air Resource Board's EMFAC2007 model for on-road vehicle emissions and OFFROAD2007 for off-road vehicle emissions. URBEMIS provides daily and annual emission reports for NOX, ROG, PM2.5, CO, and CO_2. URBEMIS also quantifies a range of construction, transportation, and area source mitigation measures. The model is free and may be downloaded at http://www.urbemis.com/.

3.5.2 GHG Model Calculator

The Air District is developing a model to calculate GHG emissions from land use development projects. Users will be able to import emission results from URBEMIS, an emissions model for land use projects, to quantify GHG emissions not included in URBEMIS such as GHG emissions from electricity use and waste. Users will also be able to apply a range of GHG mitigation measures in the model. The Air District intends for this model to complement URBEMIS in quantifying project related GHG emissions in proposed land use developments. The model will be based as an Excel spreadsheet and will be ready for use in June 2010.

3.5.3 CAPCOA GHG Mitigation Study Report (Environ)

CAPCOA, through a contract with Environ, is producing a technical analysis of GHG reduction estimates for a wide range of mitigation strategies. The final report will contain quantification methodologies, recommended assumptions, GHG reduction estimates, and methodology references for individual measures. The report will provide guidance on how to interpret reduction ranges and assign percentage reductions to characterize land use projects and GHG mitigation measures. The Air District recommends applying any identified emission reductions for a project in URBEMIS and the GHG Model Calculator. Both these models have customizable inputs and a wide range of mitigation measures that may be utilized for GHG reductions. The final report will be for release in June 2010.

3.5.4 Use of local models and methodologies

The Air District encourages local governments to apply local models and methodologies to quantify GHG emissions where appropriate. For example, the URBEMIS model contains a number of customizable inputs for users to apply local conditions and characteristics.

4. Implementation and Monitoring

4.1 Implementation plan

The implementation plan is a critical component of the GHG Reduction Strategy. GHG Reduction Strategies should include two-tiered implementation approaches – one approach for overall implementation of the Strategy, and implementation plans for each individual measure (or groups of measures).

4.1.1 Overall implementation plan

The overall implementation plan should include as much detail as possible on the following:

- identification of the department with oversight of coordination of Strategy implementation;
- identification of lead staff charged with coordination of Strategy implementation;
- integrated timeline of implementation of all measures – timeline should take into consideration economic requirements for measures (fiscal year budget allocations, energy savings from specific measures used to fund other measures, etc.); and
- monitoring and reporting approach (see Items 2 and 3 below) that outlines when update reports on the status of implementation of individual measures will occur, as well as the occurrence of updated GHG inventories.

4.1.2 Implementation of individual measures

Implementation strategies for each individual measure (or groups of measures) should include as much of the following detail as possible:

- estimation of staff requirements, including designation of lead staff (or department);
- capital requirements and payback period;
- budget requirements and fiscal year(s) for which budget requests will need to be made;
- potential financing mechanisms if other than municipal budget;
- legislative actions required for implementation (adoption of ordinances, etc.);
- implementation steps and timeline for implementation; and
- all policies and measures in the Strategy that apply to new development projects should be identified so that it is clear whether or not a new project is consistent with the Strategy.

4.2 Re-inventory every 5 years

The Strategy should specify that the GHG emission inventory will be updated at a minimum every 5 years in order to track overall progress toward meeting the GHG emission reduction target. This process helps to establish the community's emission trends, assess and reprioritize the performance of emission reduction measures currently implemented and better inform the emission forecast. The emission inventory update should consist of a full review of emissions from all sectors included in the original inventory and an assessment of progress toward the target.

4.3 Annual report on implementation of strategy

Apart from the periodic emission inventory, the Strategy should include a schedule for annual reporting on the implementation of individual measures. Annual reporting on measures will assist in determining if new developments are in fact being impacted by the Strategy.

4.4 Review of new project consistency with strategy

The Strategy should include a mechanism for identifying and reporting on how consistently the relevant policies and measures in the Strategy have been applied to new development.