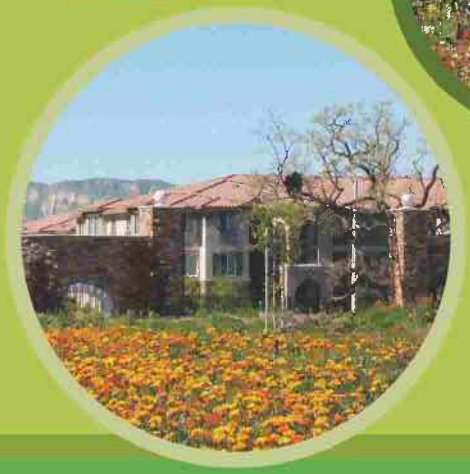
CITY OF SIMI VALLEY



Greenhouse Gas Inventory
POLICY

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This policy supports the California Long Term Energy Efficiency Strategic Plan Goal 4: "Local governments lead their communities with innovative programs for energy efficiency, sustainability and climate change." The policy specifically implements Strategic Plan Task 4.1.4: "Conduct the energy savings analysis for annual Greenhouse Gas Inventory for the City." The policy meets the Task 5 requirements as described in the "Strategic Plan Strategy Program" Statement of Work as approved by the Simi Valley City Council.

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Table of Contents

EXECUTIVE SUMMARY 1

GREENHOUSE GAS INVENTORY POLICY STATEMENT 3

- Policy 3
- Relation to Other City and State Policies 4
- Implementation Plan 4

GREENHOUSE GAS INVENTORY OVERVIEW 7

- Definition of a Greenhouse Gas Inventory 7
- Benefits of a Greenhouse Gas Inventory 7
- California's Greenhouse Gas Emission Policy 7

GREENHOUSE GAS INVENTORY PROCESS 9

- Process Overview 9
- Challenges 9
- Inventory Reporting Methodologies 9
- Data Collection 10
  - Mandatory Activity Data Collection Requirements 10
  - Optional Scope 3 Data Collection Requirements 13
- Calculation Methodologies 15
  - General Calculation Guidance 15
  - Natural Gas Stationary Combustion 16
  - Municipal Transportation (Mobile Combustion) 16
  - Community Transportation 16
  - Off-Road Equipment Emissions 18
  - Electricity 18
  - Municipal Refrigerants 19
  - Municipal Fertilizer 20
  - Renewable Energy Generation 20
  - Trees and Urban Forests 20
  - Solid Waste 21
- Update Frequency 21
- Reporting 21
- Team Roles and Responsibilities 23

MUNICIPAL ENERGY AND GREENHOUSE GAS EMISSIONS ANALYSIS 25

- Purpose of Analysis 25
- Total Energy and Greenhouse Gases (Electricity and Natural Gas) 25
- Total Electricity Use and Greenhouse Gases 31
- Total Natural Gas Use and Greenhouse Gases 35

Municipal Building Greenhouse Gas Emissions 38
Municipal Building Energy Conservation Measures and Greenhouse Gas Emission Reductions 39
Total Municipal Facility Greenhouse Gas Emission Reduction Potential 42
REFERENCES 55
APPENDIX A-RENEWABLE ENERGY SYSTEMS 59
Solar Photovoltaic and Greenhouse Gas Emission Reductions 59
Cogeneration and Greenhouse Gas Emission Reductions 61

EXECUTIVE SUMMARY

As part of the 2012 General Plan, the City conducted a greenhouse gas (GHG) inventory to form the foundation of its Climate Action Plan (CAP), which was adopted with the General Plan, as required by the State of California. The GHG inventory used 2006 as the baseline year, so that future GHG inventories could be developed to identify progress on GHG reductions, in compliance with California regulations regarding GHG emissions. Through the City's partnership with Southern California Edison (SCE), funding from the California Public Utilities Commission (CPUC) was provided to update the 2006 GHG Inventory to a 2011 GHG Inventory, including development of an energy savings analysis of the energy efficiency improvements put into place in the intervening five years, and a projection of necessary savings to meet the GHG reduction goals established in the CAP.

A GHG inventory accounts for GHG emissions (and where applicable atmospheric carbon removal, or sequestration) based on established GHG accounting principles. For cities, the "Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories" (LGOP) [2] provides specific guidance for reporting municipal GHG emissions. The LGOP has been adopted by the California Air Resources Board (CARB), is the methodology used by most California municipalities to calculate their emissions, and is described as part of this GHG Inventory Policy. The City of Simi Valley tracks it GHG emissions using the Climate Registry and will use this process going forward.

City staff from the Environmental Services Department will coordinate with the Administrative Services, Community Services, and Public Works Departments to implement this Greenhouse Gas Inventory Policy, with oversight by the City Manager. The Policy is designed to be used by City staff to track current and future GHG reductions as a result of energy use reductions, to establish an inventory that can be updated regularly and simply using existing tools and staff resources, and to identify strategies that can further reduce GHG emissions. The 2006 inventory is included in the City of Simi Valley Climate Action Plan (Table 1). An analysis of GHG emissions associated with electricity and natural gas used in municipal operations is included in this document.

This policy also defines required data collection methodologies, intervals for updating the GHG inventory, and key personnel and departments responsible for various aspects of the GHG inventory. The City will update its inventory in 2015 and 2020. This will support California's goal for cities and counties to reduce GHG emissions to 1990 levels (deemed to be equivalent to 15% below 2006 baseline-year emissions) [3]. The results of the 2015 and 2020 GHG inventories will be reported to the City Council, as part of the policy implementation.

By establishing this GHG Inventory Policy, the City is leading an effort that will assist other local governments and the Simi Valley community in better understanding and reducing GHG emissions.

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GREENHOUSE GAS INVENTORY POLICY STATEMENT

Policy

The City of Simi Valley has adopted a Climate Action Plan as part of its 2012 General Plan. The Climate Action Plan (CAP) was prepared to reduce and encourage reductions in GHG emissions from all sectors within the City. The CAP established a 2006 baseline GHG inventory. This 2006 GHG inventory was the initial step necessary to develop measures and procedures to reduce GHG emissions as required by the State of California. In order to monitor and review progress in GHG reductions, additional GHG inventories of similar scope are required. These GHG inventory updates will provide the metrics needed to track the success of the GHG reduction measures in the CAP, and to evaluate the relationship between energy savings and GHG reductions.

The City will systematically update the City's municipal and community-wide GHG emissions. The City's goal, as established through the CAP and General Plan, is to reduce GHG emissions by 15% by 2020 as compared to 2006 [1]. The City will collect and compare GHG emissions data for its municipal operations using established tools including the "Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories" (LGOP), and the Climate Registry, as applicable. The City will track general community-wide GHG emissions broken down into residential, non-residential and municipal components.

The City will establish a GHG Inventory team that will gather annual emissions data to be assembled into the inventory. The types of emissions data, and individuals that will provide the data, are stated in this document as shown in the Activity Data Collection Requirements section. The GHG Inventory team will identify municipal GHG reductions that are a result of energy efficiency and conservation measures that are implemented as part of other City policies and practices. The City's municipal GHG reduction efforts will include a focus on water use reduction and conservation measures, based on findings in this document that electricty purchases related to water use accounts for more than half of the City's energy-related GHG emissions.

The City GHG Inventory team will compile the annual municipal data that will be collected as part of the City's GHG Inventory Policy and produce milestone GHG Inventory reports in 2015 and 2020. These reports will be presented to the City Council for consideration. The reports will include an evaluation of the various GHG reduction measures identified in the CAP, and the efficacy of energy conservation and reduction measures in reducing GHG emissions. The City Council may authorize publication of these reports, and make them available to other local governments as well as the State of California.

The GHG Inventory team will also collect aggregate community-wide utility data to establish community-wide emissions, accounting for population growth and possible reductions in electricity and gas use from roof-top solar power installations. These emissions will include those from purchased electricity and natural gas, and will be

broken down into sectors to compare to the 2006 community emissions as established by the CAP.

The City will endeavor to share best practices, strengths, and limits of the GHG Inventory Policy to assist other local governments to better understand and use GHG Inventory tools.

Relation to Other City and State Policies

Other policies that are related to the Greenhouse Gas Inventory Policy and should be referred to for further information are:

1. **City of Simi Valley Energy Action Plan (EAP)**. The EAP measures municipal energy use and GHG emissions from 2006 to 2011. Strategies for further energy and GHG reductions are outlined in the EAP.
2. **City of Simi Valley Benchmarking Policy**. Accounts in EPA's ENERGY STAR Portfolio Manager have been established for eight main municipal facilities and contain monthly utility data from 2006 to the present. These accounts are automatically updated with utility data and can be used to measure the GHG emissions in these facilities as compared to the 2006 baseline year.
3. **City of Simi Valley Retro-commissioning Policy (RCx)**. RCx is a systematic process for improving an existing facility's performance by identifying and implementing relatively low-cost operational and maintenance improvements. RCx is one of the tools that can be implemented to help achieve GHG reduction goals.
4. **City of Simi Valley Climate Action Plan (CAP)**. The CAP, adopted July 2012, created a baseline for community-wide GHG emissions. This benchmark will be used to measure future GHG reductions from. The CAP also provides a plan for implementing specific measures that will reduce GHG emissions.
5. **California Greenhouse Gas Reduction Goals**. The State of California has enacted an interconnected set of executive orders, legislation, policies, codes, and programs that are intended to work together to achieve the overall goal of reducing GHG emissions. This GHG Inventory Policy helps the City meet State GHG policy goals.

Implementation Plan

In order for the City of Simi Valley to fulfill the goals of the Greenhouse Gas (GHG) Inventory Policy, the following measurable objectives will be implemented. These actions apply to the City's community-wide GHG emissions.

Community-wide GHG emissions data shall be collected and compared to a baseline year of 2006 (Table 1). Baseline total emissions will be broken down into municipal, residential and non-residential components. Scope 1 and 2 emissions will be reported to the Climate Registry.

Table 1. Simi Valley community-wide GHG emissions by land use category for the baseline year of 2006 [1].

Net Total Community Emissions	
Land Use Category	Metric
Municipal	16,907
Residential	595,536
Non-Residential	573,683
Total	1,186,126

1. GHG emissions data will be collected annually. The types of data and parties responsible for collecting it are given in Table 2.
2. Specific energy conservation measures (ECMs) that reduce municipal GHG emissions will be tracked as part of the City's Energy Action Plan, Retro-Commissioning Policy and Benchmarking Policy. A standardized spreadsheet will be used to track ECM GHG emissions reductions (Table 21).
3. Other specific GHG mitigation actions will be described and quantified when possible.
4. The City will implement ECMs where practical, prioritized by project economics. A list of potential ECMs, generated as part of the City's Energy Action Plan, is provided in Table 22 – Table 25.
5. The City will make water conservation a key component of its municipal GHG reduction strategy, as 54% of total energy-based emissions in 2011 were found to be associated with the delivery and treatment of the City's water.
6. The City will investigate the feasibility of incorporating renewable energy systems on City property.
7. The GHG Inventory team will consist of City staff as described in Table 2, Data Collection section. Consultants will be hired to support Inventory efforts if needed.
8. Updates to the GHG Inventory shall be performed in 2015 and 2020. Reports will be presented to the City Council corresponding with these updates, documenting the findings that result from the actions described above.

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GREENHOUSE GAS INVENTORY OVERVIEW

Definition of a Greenhouse Gas Inventory

A greenhouse gas (GHG) inventory accounts for GHG emissions (and where applicable atmospheric carbon removal, or sequestration). GHG inventories can be used to track emission trends, develop strategies and policies to reduce emissions and assess the effectiveness of emission reduction strategies.

Benefits of a Greenhouse Gas Inventory

The reduction of GHG emissions is intended to avert the negative environmental and economic consequences of climate change.

A GHG inventory can provide a full and accurate knowledge of a city's GHG emissions. This is a critical first step to developing effective GHG reduction strategies. Ongoing GHG inventories are necessary to measure GHG reductions, evaluate GHG reduction strategy effectiveness and demonstrate compliance with the State's GHG reduction goals and related policy.

Some GHG emission reduction strategies can reduce operating costs, especially when associated with reductions in energy and water use consumption.

California's Greenhouse Gas Emission Policy

Statewide GHG reduction goals are established by the California Global Warming Solutions Act of 2006 (AB 32), which directs the California Air Resources Board (CARB) to set reporting requirements for GHG emissions and develop rules and regulations needed to reduce state-wide emissions to 1990 levels by 2020. This roughly translates to a reduction of 15% below 2006 GHG emission levels. Executive Order S-3-05 provides an additional long-term target to reduce GHG emissions 80% below 1990 levels by 2050.

In December 2008, CARB approved the "Scoping Plan" as a state-level roadmap to implement the mandates of AB 32 and achieve state-wide emissions reductions. As part of the Scoping Plan, a significant portion of anticipated emissions savings from the building sector will come from more stringent building codes and appliance efficiency standards. California's Building Energy Code (California Code of Regulations (CCR), Title 24, Part 6), and the Green Building Code or "CALGREEN" (CCR Title 24, Part 11) are designed to improve building energy efficiency and are on a nominal three year update cycle. The goal of future updates is to dramatically improve energy efficiency and reduce GHG emissions. California's Appliance Efficiency Regulations (CCR, Title 20, Sections 1601 through 1608) work in tandem with the building energy code to improve appliance efficiency and reduce plug loads (a significant and growing source of energy use and GHG emissions)
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GREENHOUSE GAS INVENTORY PROCESS

Process Overview

Conducting a GHG inventory is relatively straightforward. The inventory involves collection of relevant GHG emissions data, identification of appropriate GHG emission factors, and analysis to calculate GHG emissions and reporting. This GHG Inventory Policy breaks the GHG inventory process into two steps: A) the standardization of ongoing data collection activities, and B) the inventory analysis and reporting.

The first step of this process involves creating reporting structures to ensure that relevant departments and personnel consistently and continuously collect the GHG emissions data so that it is readily available to conduct the GHG inventory.

At regular intervals, as specified in this policy, a GHG inventory shall be produced. This involves collecting all the GHG emissions data, identifying the appropriate GHG emissions factors, calculating the GHG emissions, and developing a GHG inventory report.

Challenges

The primary challenges and difficulties in developing a GHG inventory include:

1. Lack of necessary GHG emissions data. Certain GHG emissions data are readily available through typical data collection efforts, while other data can be difficult or time-consuming to obtain.
2. Lack of staff designated to develop the inventory.
3. Lack of a system to develop the GHG inventory-resulting in subsequent inventories having to be "developed from scratch" at significant time expense.

Inventory Reporting Methodologies

There are sector-specific methodologies and protocols used to guide a GHG inventory. For cities, the "Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories" (LGOP) [2] provides specific guidance for reporting municipal GHG emissions. The LGOP has been adopted by the California Air Resources Board (CARB) and is used by most California municipalities to report their emissions.

Six internationally recognized greenhouse gasses are typically accounted for: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions are classified as either direct or indirect emissions, and are referred to as "Scopes."

Scope 1 emissions are direct GHG emissions released (intentionally or unintentionally) through city owned or controlled equipment/activities. For example, burning natural gas in city-owned boilers (stationary combustion emissions), burning gasoline in city-owned vehicles (mobile combustion emissions), methane released from a city-owned wastewater treatment plant (process emissions), and refrigerant leakage from city-

owned air-conditioning systems (fugitive emissions) are all examples of Scope 1 direct emissions. Indirect emissions are broken into "Scope 2" and "Scope 3" emissions.

Scope 2 emissions are the emissions associated with purchased electricity and other purchased energy sources such as steam or chilled water from a district heating system. These emissions are indirect because they are not released directly by city owned or controlled equipment, but by power plants owned and operated by an independent utility.

Scope 3 emissions are all other indirect emissions, such as emissions associated with employee commuting, landfill emissions, embodied emissions from water, transmission and distribution losses associated with purchased electricity, etc.

GHG inventories can be developed for either the entire community, or for just municipal emissions (i.e. only the emissions associated with city-owned equipment and operations, excluding emissions from homes, businesses, industry, general transportation, etc.). The City of Simi Valley conducted a GHG inventory for 2006, summarized in the City of Simi Valley Climate Action Plan [1]. That inventory included both community and municipal emissions.

This policy provides guidance for updating the City's municipal and community GHG emissions on a regular basis and will streamline regularly required GHG inventory updates.

Data Collection

The core of an effective and efficient GHG inventory process is to establish, and implement, a system to regularly collect the necessary GHG emissions, or "activity" data. This GHG inventory policy identifies data collection processes and assigns responsible departments and personnel.

Mandatory Activity Data Collection Requirements

For the municipal GHG inventory component, the specific GHG emissions that must be reported are governed by the LGOP, and include all municipal Scope 1 (direct) and Scope 2 (indirect) emissions. Scope 1 emissions include emissions related to natural gas combustion, emissions from mobile combustion in city-owned vehicles and equipment, CH_4 and N_2O emissions from the wastewater treatment plant, emissions related to refrigerant leakage from City owned building HVAC systems and vehicle air-conditioners, and emissions related to fertilizer use. Scope 2 emissions include emissions related to purchased electricity. Although other indirect (Scope 3) emissions are discussed in the following subsection, reporting of Scope 3 emissions is optional and will not be reported in the City's GHG inventory.

For the community GHG inventory component, similar data must be collected at the aggregate community level. Per guidance in [4], the community-based GHG emissions that will be included in the inventory are: community electricity use, community natural gas use, community transportation, off-road equipment emissions, water treatment emissions, and solid waste emissions. The City will not include industrial process and fugitive emissions, airports, or other large industrial sources where data are not typically available and estimates would be speculative.

The following activity data must be collected on an annual basis, with responsible reporting departments indicated:

Table 2: Mandatory GHG activity data collection requirements (Scope 1 & 2).

Data	Responsible Department	Notes
Municipal electricity consumption	Administrative Services Department, Customer Services Manager	Collect annually from the respective utilities. Data for the City's 8 main facilities are automatically reported for electricity and natural gas. Refer to the City's Benchmarking Policy for additional details.
Municipal natural gas consumption		
Municipal water consumption		
Community electricity consumption	GHG Inventory Team Leader	The City will work with each utility to obtain annual summaries of electricity, natural gas, and water consumption aggregated at the community level.
Community natural gas consumption		
Community water consumption		
Municipal gasoline consumption (for vehicles, maintenance equipment, etc.)	All Departments purchasing fuel, including: Public Works Maintenance Services Division, Police Department and Simi Valley Transit	Vehicle and equipment fuel use shall be reported on an annual basis by each department responsible for fuel purchases.
Municipal diesel consumption (for vehicles, maintenance equipment, etc.)		
Municipal natural gas consumption for Simi Valley Transit (SVT)	Administrative Services Department, Customer Services Manager	Natural gas for SVT busses come from the compressed natural gas (CNG) fueling center in the Transit Facility. This gas use is included in the facility's natural gas meter and shall be automatically reported by the responsible utilities to Portfolio Manager (refer to the City's Benchmarking Policy). Subtract CNG sales to other cities contracted to use the Transit Facility's refueling station.
Average daily vehicle miles traveled (VMT) for the City	GHG Inventory Team Leader	The City plays a key role in influencing community transportation activity and emissions. Data to calculate the City's transportation emissions are currently tabulated by CARB and CalTrans online.
Average county vehicle GHG emissions factor (gram/mile)		
County/regional off road equipment activity data (agricultural equipment, construction equipment, and lawn and garden equipment) and emission factors	GHG Inventory Team Leader	County-level statistics are available online and should be pro-weighted to the City-level.

Data	Responsible Department	Notes
Municipal refrigerant purchases for city-owned buildings and vehicles	Public Works Maintenance Services Division	Implement a system to track refrigerant purchases used to replace leakage is important to performing the City's GHG inventory. Work with vendors and suppliers to make sure that refrigerant purchases are specifically reported on invoices and other documents. Track by volume and refrigerant type.
Municipal fertilizer consumption	Public Works Maintenance Services Division	Fertilizer use results in GHG emissions. Tracking fertilizer use (or purchases, assuming the City does not buy multi-year volumes of fertilizer in bulk) is required to allow emissions to be calculated.
Wastewater treatment plant CH_4, N_2O, CO_2 emissions	Department of Public Works, Sanitation Services	Waste gas quantity and compositions to be reported, per current practice.
Municipal renewable energy generation	GHG Inventory Team Leader	If the City installs solar power or other renewable energy systems, the power generated should be metered and reported. These data will be used to document the GHG savings from these systems.
Community renewable energy generation statistics	GHG Inventory Team Leader	Community statistics available from the California Solar Initiative

Optional Scope 3 Data Collection Requirements

The City may track and report Scope 3 emissions at its own discretion. Reporting Scope 3 emissions under the LGOP is optional, but can help the City better understand its complete GHG emission profile. It also helps to quantify the benefits of various sustainability strategies, such as increasing the City's solid waste diversion rate, carbon sinks and changes in carbon emissions from land use development. The following table summarizes additional annual data collection options, should the City decide to include them.

Table 3: Optional activity data collection (Scope 3).

Data	Responsible Department	Notes
Employee commuting statistics	City Manager	Annual surveys of employee commuting distance, mode and frequency
Business travel	Administrative Services	Annual summaries from the accounting system of: Reimbursements for business use of personal vehicle showing miles Air travel purchases, showing departure & destination Other transportation expenses/trip data if significant.
Municipal and community solid waste, recyclables, and green waste generation tonnages	Public Works Maintenance Services Division Community Services	The landfill serving the community is located just outside of the City limits in Ventura County. Work with solid waste vendors to report solid waste collection statistics.
City-owned trees	Public Works Maintenance Services Division	The City owns and maintains a significant number of trees, which reduce emissions by sequestering (removing) carbon from the air as they grow, and reducing city-wide air-conditioning energy use by shading and evapo-transpiration. Refer to the discussion under calculation methodologies for more details on data collection options.
Municipal consumables	Administrative Services, Purchasing officer	The lifecycle GHG benefits associated with environmentally preferable purchasing policies (e.g., purchasing recycled content photocopy/printer paper) can be estimated by reporting purchase details.

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Calculation Methodologies

General Calculation Guidance

The protocols and methods for developing a municipal GHG inventory are well established. The "Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories" (LGOP) [2] provides detailed guidance on the methods used to estimate GHG emissions from municipal activity data. Specific calculation guidance is provided below.

Through its participation in the Local Government Partnership program with SCE, the City currently registers its GHG emissions with the Climate Registry and will continue to do so in the near future. The Climate Registry is a service where organizations (companies, cities, etc.) can track their GHG emissions using a rigorous GHG accounting protocol, have their GHG emissions reviewed and certified by a third party GHG certification agency, and then "registered" on the inventory. The costs to register emissions and to have the third party review conducted have been underwritten by SCE through 2014. The Climate Registry has its own specific reporting protocol (it does not use the LGOP, although on a high level they are essentially equivalent) and has an online reporting tool that manages all of the data. Reporting organizations simply enter the appropriate data into the online tool, and it calculates the GHG emissions.

In contrast to reporting municipal emissions, developing a community-scale GHG emissions inventory is more challenging. Data is harder to come by, and methodologies for estimating community GHG emissions are still evolving. The guidance and methodologies in the LGOP can be expanded from the municipal-scale to the community-scale. However, there are some emission sources, such as community-scale transportation impacts, that are not addressed in the LGOP.

Currently, there are few specific tools that can be used to track Community-wide GHG inventories. GHG emissions from community sources must be estimated based on utility data and use emissions factors for approximated transportation related emissions. Emissions modeling programs such as the California Emissions Estimator Model™ (CalEEMod) [5] are not appropriate for evaluating GHG emissions based on historical consumption and emission data. CalEEMod can be used to estimate future emissions from planned land use projects to demonstrate compliance with California Environmental Quality Act (CEQA) documents, National Environmental Policy Act (NEPA) documents, pre-project planning, etc. Another source of additional guidance for estimating community-scale GHG emissions is from the Bay Area Air Quality Management District (BAAQMD) [4]. California-specific guidance is provided for some of the more challenging community-level emissions not addressed in the LGOP. It also provides excellent guidance and discussion on developing an effective climate action plan. Specific calculation guidance is provided below.

In general, GHG emissions are calculated by multiplying the activity factor (e.g., kilowatt-hour (kWh) of electricity used per year) by the appropriate emissions factor (e.g., tons of carbon dioxide (CO_2) per kWh). This is repeated for each GHG emission source. Sometimes intermediate calculations are required to incorporate unit

conversions. Currently, most GHG inventory analyses are performed in spreadsheets because the calculations are straightforward and readily implemented, and provide an easy way to integrate emissions data from diverse sources.

Natural Gas Stationary Combustion

GHG emissions related to natural gas combustion are calculated by multiplying the annual natural gas consumption (in Therms) by the natural gas GHG emission factor in Table 4. Natural gas that is resold to other municipalities for contracted CNG vehicle refueling should not be included in the City's GHG inventory. Municipal gas use is being tracked in Portfolio Manager and accessible to City personnel. Aggregate community natural gas use should be obtained from the utility.

Table 4: Natural gas GHG emission factor.

Natural Gas CO_2e Emission Factor (lbs/Therm)	Natural Gas Emissions Factor Source
11.72	LGOP [2]

Municipal Transportation (Mobile Combustion)

Emissions from City-owned vehicles are calculated in a similar manner. The main GHG produced by vehicles is CO_2. CH_4 and N_2O are also emitted in much smaller amounts, but their emissions vary by the age of vehicle, vehicle type, the use of biofuels or biofuel mixes, and related data. For mobile combustion, calculate the CO_2, CH_4 and N_2O emissions separately. Use the emission factors and guidance provided in Chapter 7 of the LGOP [2]. Once the individual emission factors are calculated, multiply each gas's emissions by the appropriate global warming potential to convert them to common units of CO_2-equivalents (CO_2e). Add all of the CO_2e emissions together to get the total mobile emissions. Repeat for all fuels used.

Community Transportation

Community transportation is responsible for the majority of the City's overall GHG emissions. Local governments do have some authority to reduce transportation related GHG emissions. Greenhouse gases from vehicles are primarily emitted on publicly owned roads and right-of-ways, and state and local governments set policies that govern the use of these roads and influence travel behavior. The City also has some authority over land use patterns, which control the density, type of activity and distribution of activities within a community. The length and quantity of passenger vehicle trips can be influenced by a variety of local government policies, land-use and infrastructure decisions. Finally, local governments have control over private off-road parking in new developments, which also provides the City with some influence over vehicle activity.

The California Air Pollution and Controls Officers Association (CAPCOA) provides a detailed set of measures the City can use to reduce transportation-related GHG

emissions [6]. California Senate Bill 375 (SB375), Sustainable Communities and Climate Protection Act of 2008 [7], recognizes the relationship that local planning and related activities have on transportation related emissions and establishes regional GHG emission reduction targets for passenger vehicles through "sustainable communities strategies."

Estimating community transportation GHG emissions is challenging. Tools and approaches for estimating community transportation GHG emissions are evolving and there are currently no standard approaches. However, there are several sources of guidance [4], [6], [8] and [9]. The recommended guidance for estimating community transportation related GHG emissions is from the Bay Area Air Quality Management District, section 1.4 [4]. This method uses vehicle miles traveled (VMT) estimates provided by the CalTrans Highway Performance Monitoring System's "California Public Road Data." This data source provides annual estimates of average daily VMT for Simi Valley for different road types, and is updated on an annual basis. These data provide a good source to track changes in VMT over time on different road types, and will enable tracking the effectiveness of various measures to reduce VMT. To get annual VMT, multiply the daily average VMT by 365 days/year. CARB provides estimates of county-level emission factors (e.g., grams of CO_2/mile) that take into account county-specific vehicle usage, vehicle mix, vehicle speed and ambient temperatures. These estimates are developed through the EMission FACtors (EMFAC) model. Web-based summaries of average emission factors are currently available. Currently, these data provide VMT and a CO_2 emission factors (gram/mile) for multiple classes of vehicles. A weighted average emission factor will need to be calculated from these data (e.g., multiply each vehicle category's VMT by its respective emission factor to calculate total CO_2 emissions for each category, sum the CO_2 emissions for all vehicle types, and then divide by total miles for all vehicle types to get the average GHG emission factor, in grams of CO_2/mile). This average emission factor should then be multiplied by the City's annual VMT to get annual transportation GHG emissions for the City.

Since methodologies and data sources for calculating community transportation emissions are still evolving, the City will check for updates on the preferred methodology or data sources before updating the inventory. The City will check for updates first from CARB, then from the Southern California Association of Governments (SCAG) (specifically, to check for updated regional traffic models developed for calculating city-level and/or regional GHG emissions and related methodologies that align with the Sustainable Communities Strategy), and then with any future community GHG protocol that becomes effective. The "Community GHG Protocol" [9] for estimating community GHG emissions, which complements its "Local Government Operations Protocol" (LGOP) [2], used to estimate municipal GHG emissions, is in development. This Protocol has not been released at the time of writing. Preliminary public review versions of the protocol did provide an extensive discussion of different calculation methods for estimating transportation related GHG emissions and may provide useful background and context. It is anticipated that CARB will review the protocol and endorse this document, with specific methodologies that should be followed for California communities, similar to what was done for the LGOP.

Off-Road Equipment Emissions

Municipal emissions from off-road equipment should be captured under "Municipal Transportation (Mobile Combustion)" discussed above. The City should have detailed fuel purchase records for this equipment. Community GHG emissions from the combustion of fossil fuel in "off-road" equipment, including construction equipment, agricultural equipment, and lawn and garden equipment, will have to be estimated. The best methodology for estimating these emissions are outlined in the May 2012 "GHG Plan Level Guidance" [4], section 1.4.5. County and regional activity data for each of these sources, and appropriate emission factors are available online from various agencies. The activity data must be pro-rated to get city-level emissions.

Electricity

GHG emissions related to electricity consumption are calculated by multiplying annual electricity consumption (in kWh) by the appropriate electric GHG emission factor.

The City's annual electricity consumption comes from municipal electricity bills. Southern California Edison (SCE) provides all electrical service to municipal operations and annual data are available from the City's SCE account representative. Monthly billing data for the City's eight facilities are automatically reported to the Portfolio Manager (see the City's Benchmarking Policy) and can be easily accessed by City personnel to provide summary reports for the GHG inventory.

Community-wide aggregate electricity use data will be obtained from SCE. The City will continue to work with SCE to obtain data by sector (residential, commercial, or industrial), by zip code, by rate schedule, etc. The level of the data from SCE will not be detailed enough to reveal information that could be linked to specific users.

Electricity emission factors change year to year due to the variability in fuels used to generate electricity. The electricity grid is becoming increasingly "clean" as the State's renewable portfolio standard (RPS) is implemented; as well, restrictions are placed on electricity imported from out of State (reducing coal-based electricity imports), etc. The emission factor for the current reporting year (e.g., 2015) should be used when the GHG inventory is performed. If the reporting year emission factor is not available, the most recently reported emission factor should be used as a proxy until a reporting-year emission factor becomes available.

Of the two widely used sources of electricity emission factors, the best and most accurate source comes from utility reports that are third-party verified, and provided to a "climate registry." SCE has reported its GHG emission factors for 2004–2007 to the California Climate Action Registry. These emission factors account for both utility-owned power plant emissions, as well as purchased electricity from generation plants not owned by the utility. Transmission and distribution losses are not included in these emission factors. The California Climate Action Registry has transitioned its reporting to the Climate Registry, which has an analogous electric utility GHG reporting protocol.

City personnel will obtain the latest GHG emission factor from the Climate Registry at the time the GHG inventory is developed. If a current electric GHG emission factor is

not available, the City will contact SCE to determine if a verified emission factor has been generated but is reported elsewhere. If this is not available, the City will contact CARB to determine the latest guidance in emission factors (this will likely continue to evolve).

Current CARB guidance for California communities is to use the California grid average emission factors that CARB has calculated based on the total in-State and imported electricity emissions divided by the State's total electricity consumption. These factors are currently only available through 2007 and are reported in the LGOP [2]. It is anticipated that CARB will provide updated factors in the future. Table 5 summarizes the currently available GHG emission factors available for City use. The table also shows future projected GHG emissions that account for likely changes in the electricity grid based on detailed modeling and analysis conducted on behalf of the California Public Utilities Commission (CPUC). This includes the impacts of increased renewable energy generating supplies and other State level regulatory and policy goals such as the renewable portfolio standard (RPS) and AB32. For planning and projection purposes, these emission factors provide the most accurate estimate available.

Table 5: Electricity GHG emissions factors.

Year	Electricity CO_2e Emission Factor (lbs/MWh)	Source/notes
2006	641.26	LGOP [2]
2007	630.89	
2008	630.89	Assume same as 2007 per LGOP guidance until updated data are available
2009	630.89	
2010	630.89	
2011	626.11	Projected data based on electricity grid modeling to meet AB32 and RPS requirements
2012	606.27	
2013	590.84	
2014	577.61	
2015	562.18	
2016	548.95	
2017	533.52	
2018	518.09	
2019	502.65	
2020	493.84	

Municipal Refrigerants

Refrigerants that leak from air-conditioning systems are potent greenhouse gases, up to 2,000 times more potent than CO_2. Refrigerant leakage from building and vehicle air-conditioning systems is one of the State's fastest growing sources of GHG emissions. Refrigerant losses equal the annual refrigerant purchases that are used to recharge air conditioning systems. It is important to track all refrigerant use. The City

shall work with its Maintenance Department and any relevant vendors to ensure that all refrigerant purchases are explicitly identified on invoices by refrigerant type and amount used, and that these data are aggregated on an annual basis. Sections 6.6 and 7.4 of the LGOP [2] provide more detailed technical discussion of the issues, and tabulated emission factors for various refrigerant types.

Municipal Fertilizer

Fertilizer used in landscaping results in N_2O emissions. It is estimated that approximately 50% of applied nitrogen fertilizer is lost through evaporation to the atmosphere, leaching, and runoff. CARB estimates that approximately 2.8% of the GHG emissions come from fertilizer. CARB is currently researching N_2O emissions from ecosystems under California specific conditions. At the time of the next inventory update, the City will check on the status of CARB research and guidance on fertilizer related GHG emission factors.

Renewable Energy Generation

The City will consider tracking renewable energy generation at both the community and municipal levels. While this will not directly impact the inventory (renewable energy generation will show up in reduced amounts of purchased electricity and/or fuel), it will enable the City to track renewable energy installations and progress towards GHG reduction goals. Renewable energy generation potential has been analyzed in the City's Energy Action Plan.

The City can obtain community-wide renewable energy installation data, including estimated annual kWh generation from the California Solar Initiative's website. The online database can be queried to find current renewable energy installations. All solar photovoltaic (PV) and solar thermal systems that receive state incentive funding are included in this database.

Trees and Urban Forests

If the City decides to quantify the GHG benefits of its urban forests and City-owned trees, there are two options to calculate emissions. The easiest route is to use the U.S. Forest Service, Center for Urban Forest "CUFR Tree Carbon Calculator" [10]. This tool calculates the CO_2 removed from the air and stored in the tree biomass as the tree grows, as well as estimates of the air-conditioning energy impacts. Required inputs include the tree species and average trunk diameter. If detailed inventory data are available, the City may analyze trees on an individual basis. It may be necessary to estimate the average parameters.

The second option is to use CARB's "Compliance Offset Protocol for Urban Forest Projects" [11]. This protocol provides a rigorous methodology to quantify the GHG benefits of urban forests, and includes a detailed accounting of emissions from vehicles and other maintenance equipment required to maintain the trees. Implementing this protocol requires a significant level of effort and costs, and would typically be used if one were to have the GHG savings entered into a registry (e.g., the Climate Action Reserve) and third-party verified. This route provides high quality emission reductions

that have the potential to be monetized (i.e., sell the resulting "carbon credits"). For the typical municipal inventory purposes, this level of effort is not usually required.

Solid Waste

The City contracts out solid waste disposal services to private providers, and waste is taken to a landfill located just outside of the City limits in Ventura County. Since the City does not own or operate the landfill, and the landfill is located outside of the City's boundary, these emissions are classified as "Scope 3" indirect emissions for both municipal and community GHG inventory purposes. While it is currently optional to report these emissions, the City may estimate community level GHG emissions related to solid waste. The City does have some influence over solid waste emissions, including how the solid waste franchise contracts are written and relevant contractual requirements (e.g., the extent and manner to which recycling bins are provided to multifamily and commercial accounts); City policies to encourage recycling, green waste, and composting; policies impacting solid waste source reduction (e.g., restricting the use of plastic shopping bags), educational campaigns, etc. Tracking solid waste emissions will allow the City to track and take credit for any GHG reductions associated with waste management policies and practices.

If the City chooses to quantify its Scope 3 emissions related to solid waste generation and disposal practices, the LGOP [2] provides guidance for methodologies and developing the appropriate emission factors. Data on landfill characteristics (e.g., whether the landfill gas generated is being flared or used for electricity production), waste hauling vehicles and distances will be required. Community-wide collected waste and recycling tonnages will need to be obtained from the solid waste franchisees. Municipal solid waste tonnages should be reported on City waste bills and readily available.

Update Frequency

The GHG emission or activity data shall be collected and reported annually to The Climate Registry, with milestone GHG inventory reports prepared on a five-year basis, with updates in 2015 and 2020. Interim GHG inventory reports may be produced if the City Council desires.

Reporting

The City will use the Climate Registry to create its inventory. Milestone updates to the GHG Inventory shall be performed in 2015 and 2020. The GHG inventory report shall include, at a minimum, the following data:

- GHG emission, or activity data for each major emission source (e.g., total annual municipal electricity purchases in kWh).
  - Note the source of all data (e.g., actual utility bills or purchase records, estimate, extrapolation, assumption, etc.) and any relevant comments on the data quality or source.

- The major emission sources that shall be reported include all Scope 1 and Scope 2 emissions, defined in Table 2. If the City decides to report optional Scope 3 emissions, the selected emissions sources in Table 3 shall be reported.
- GHG emission factor(s) used for each major emissions source.
  - Note the source of the emission factor, and any caveats or relevant notes (e.g., whether a verified electricity utility emission factor is used, State average factor, etc.).
- Calculated CO_2e emissions for each major emission source.
- Total CO_2e emissions.
- Sources of and notes on emission calculation methodologies and emission factors. Specifically, note any changes, modifications or updates to the calculation methodologies described in the preceding section on calculation methodologies.

The City will also report on specific GHG mitigation actions, energy conservation measures and related sustainability measures implemented during the reporting year and period between GHG inventory reports. This should include relevant Climate Action Plan [1] and the City's Energy Action Plan strategies and measures. Where feasible, GHG reductions associated with these measures should be reported. For measures that are difficult to quantify (e.g., policy changes), qualitative reporting on implementation status and effectiveness should be reported.

Team Roles and Responsibilities

The GHG Inventory team primarily consists of City staff. Consultants can be hired to support the efforts if needed. A description of team member roles and responsibilities is described below.

1. **City Manager.** The City Manager shall appoint or delegate appointment of a GHG Inventory Team Leader who shall have direct responsibility for coordinating and leading the GHG inventory. The City Manager shall also ensure that all departments facilitate the GHG inventory and provide any necessary emissions data.
2. **GHG Inventory Team Leader.** The Team Leader will have direct responsibility for coordinating and leading the GHG inventory data collection, leading the analysis, and preparing the report. The Team Leader is responsible for all coordination activities. The team leader would most logically be someone from the Environmental Services Department who is familiar with the Climate Action Plan and related initiatives, but can be appointed from any department.
3. **Administrative Services Department, Customer Services Manager.** The Customer Services Manager handles municipal utility billing, and shall support the Team Leader by reporting annual utility data (electricity, natural gas and water). These data will be sourced from the City's utility account representatives. The Customer Services Manager will also ensure that municipal utility accounts linked to Portfolio Manager are being automatically updated with utility data, and that the Team Leader is provided with Portfolio Manager access.
4. **Public Works Maintenance Services Division**. The Maintenance Services Division shall report: (1) annual gasoline, diesel and other vehicle fuel purchases; (2) annual building and vehicle refrigerant purchases (quantity by refrigerant type); (3) fertilizer use, and (4) renewable energy system installations and renewable energy generation. The Maintenance Services Division shall be responsible for updating any record keeping processes to ensure that the aforementioned data are tracked on an ongoing basis and readily available to provide annual totals.
5. **Police Department**. The Police Department shall report annual gasoline, diesel and other vehicle fuel purchases.
6. **Simi Valley Transit (SVT).** SVT shall report annual gasoline, diesel and CNG consumption used for vehicles. SVT shall also provide annual summaries of CNG sales to other municipalities who have contracted with the City for refueling services.
7. **Department of Public Works, Sanitation Services.** Sanitation Services shall track and report waste gas generation and gas characteristics, and fate of the waste gas (e.g., quantity flared, quantity released un-flared, quantity used in cogeneration equipment).

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MUNICIPAL ENERGY AND GREENHOUSE GAS EMISSIONS ANALYSIS

Purpose of Analysis

The following analysis demonstrates how a GHG inventory is approached and explains some of its outcomes. The purpose is to help make the inventory process tangible, provide measurements of GHG emissions and to identify strategies for making further reductions. "Municipal energy and GHG emissions" in the following analysis is defined as the total electricity and natural gas used in municipal operations and their associated GHG emissions. This is only a subset of total municipal GHG emissions; the analysis provides valuable insight into the process of conducting an inventory.

The analysis focuses on historic measurements of energy and GHG emissions in 2006 and 2011 and also provides projections out to the target year of 2020. The emission factors used in the analyses are given in Table 4 and Table 5. Energy and GHG emissions are measured across all municipal operations "total" and further sub-divided into a "building" category.

First total energy and GHG emissions are presented, followed by individual breakdowns for electricity and natural gas. Next, emissions from municipal facilities are investigated along with strategies for reducing them, including energy conservation measures and renewable energy generation. For the inventory described in the previous policy sections of this document, only the total energy and GHG emissions need to be measured (addressed in the next section). However, the more refined analysis of specific municipal facilities helps define real actions that can be taken to reduce emissions. Even though the 15% reduction target applies to community-wide emissions, these specific measures can contribute to the overall success of the Climate Action Plan.

Further details related to the energy and GHG emissions analysis can be found in the City's Energy Action Plan.

Total Energy and Greenhouse Gases (Electricity and Natural Gas)

The City of Simi Valley provides many services to the community that require the use of energy. The source of this energy is predominantly carbon-based fossil fuels that produce GHG emissions. This section focuses on total energy and associated GHG emissions from the electricity and natural gas consumed in municipal operations. The City has a total of 344 service accounts for electricity and 13 service accounts for natural gas. Energy use is broken down into "building" and "non-building" related services (Table 6).

Table 6. Municipal building and non-building categories.

"Building"	"Non-Building"
City Hall	Waterworks-Operations
Cultural Arts Center	Street Lighting
Development Services	Traffic Signal Lighting
Police Department	Landscape Irrigation
Public Services Facility	Other
Sanitation/Waterworks	
Senior Center	
Transit Facility	

Each facility in the "building" category has a building associated with it. However, the electrical service account at the Sanitation/Waterworks facility serves the Sanitation Plant's process loads, as well as the following buildings: Sanitation/Waterworks, Public Services Facility and Transit Facility. This facility is also referred to as the Sanitation/Public Services Complex (PSC) in the analysis. The Transit Facility's electricity and natural gas service accounts are associated with fueling equipment (electric) and public transit fueling (natural gas), respectively. For simplicity, these service accounts are categorized as "buildings."

Building energy use is distinct from non-building energy use, which mainly consists of water delivered as part of the municipal water utility (commonly referred to as the Waterworks), street lighting, traffic signal lighting, landscape irrigation and other.

Monthly electricity and natural gas usage data spanning 2006–2011 for all City of Simi Valley service accounts was analyzed. 117,026 million British thermal units (MMBTU) were consumed in 2011, with 66% of use related to electricity consumption and 34% of use related to gas consumption (Table 7).

Table 7. Total City of Simi Valley energy use by fuel type for 2011.

Fuel Type	2011 Energy Use (MMBTU/Year)	Percent of Total (%)
Total Electricity Use	77,155	66%
Total Gas Use	39,871	34%
Total	117,026	

GHG emissions, in the amount of 8,541 metric tons of CO_2e, were produced in 2011 due to total energy use, with 75% of emissions related to electricity consumption and 25% of emissions related to gas consumption (Table 8).

Table 8. Total City of Simi Valley greenhouse gas emissions by fuel type for 2011.

Fuel Type	2011 GHG Emissions (MT CO_{2e}/Year)	Percent of Total (%)
Total Electricity GHG Emissions	6,422	25%
Total Natural Gas GHG Emissions	2,119	75%
Total	8,541	

For the total energy consumed in 2011, 66% fell into the building category and 34% fell into the non-building category (Table 9). However, as noted previously, energy use associated with some of the operations in the building category, such as the Sanitation Plant and the Transit Facility, are not actual buildings.

Table 9. Total City of Simi Valley energy use by use type for 2011.

Use Type	2011 Energy Use (MMBTU/Year)	Percent of Total (%)
Total Building Energy	77,645	66%
Total Non-Building Energy	39,381	34%
Total	117,026	

As part of its Energy Action Plan and Green Community Action Plan, the City has established a goal that municipal facilities use 20% less energy than in 2006 by 2020. This effort will also support the City's Climate Action Plan goal of reducing community-wide GHG emissions by 15% by 2020 as compared to 2006.

The City's total and municipal building energy use measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was measured (Figure 1). For total energy use, a 2.5% reduction was achieved from 2006 to 2011. To meet the 20% reduction target in 2020, an additional 17.5% reduction must be made.

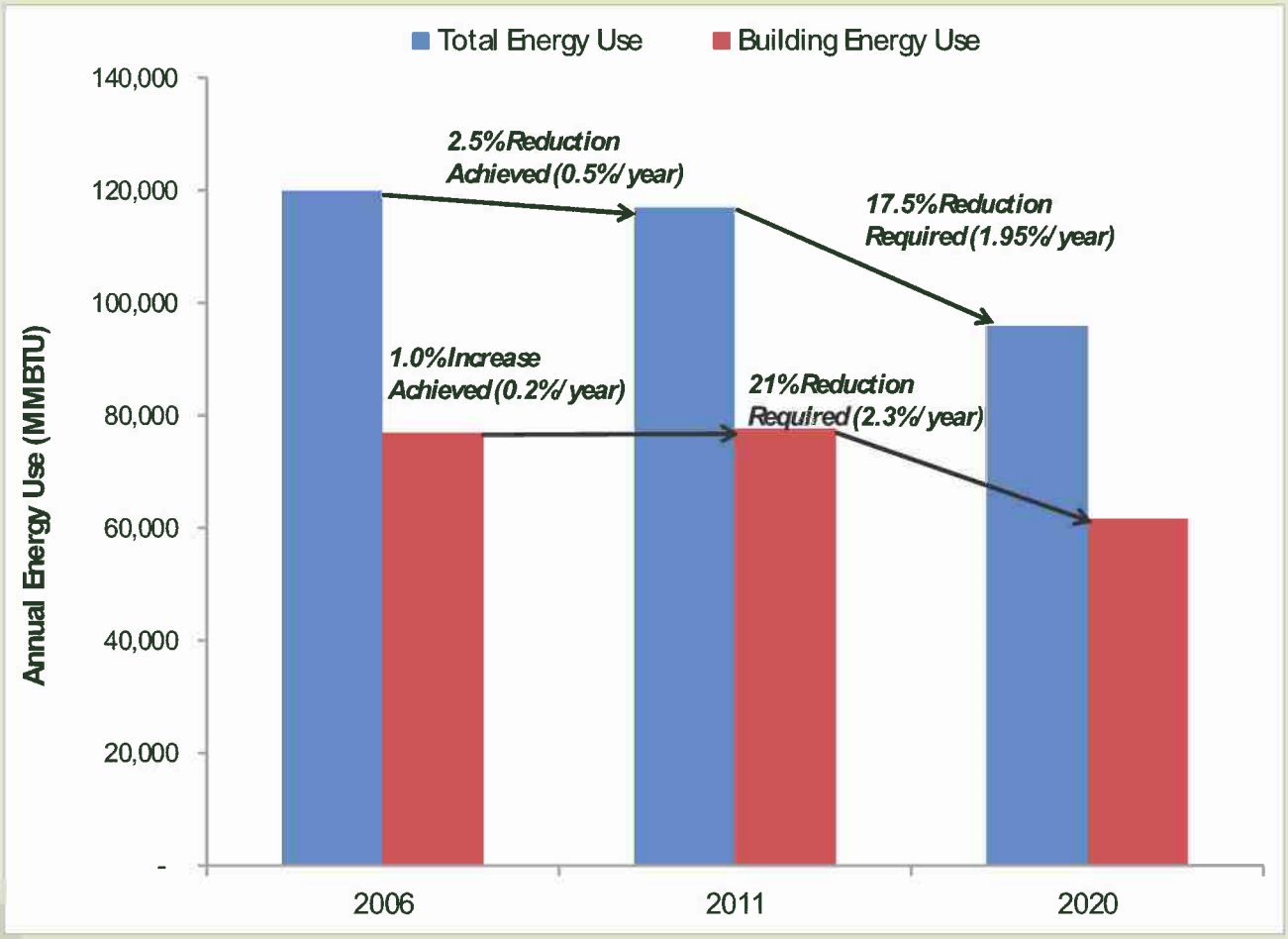

Figure 1. Total and building related annual energy use for 2006, 2011 and 2020 target.

The City's total and municipal building GHG emissions measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was investigated (Figure 2). For total GHG emissions, a 6% reduction was achieved from 2006 to 2011. To meet the 15% reduction target in 2020, an additional 9% reduction must be made.

Since GHG emissions reductions are a result of both energy reductions and changes in emission factors, GHGs have been reduced by a greater percentage than energy use. This is due to reductions in electrical emission factors. This analysis assumes that emission factors for electricity are the same in 2020 as they were in 2011. However, due to policy and regulations to reduce GHG emissions at the State level, it is projected that emission factors will be substantially less in 2020 as compared to 2011 [13]. If the GHG emission factor predicted for electricity in 2020 is used, a 21% GHG reduction will be achieved for total energy as compared to 2006, even if no further energy use reductions are made after 2011. A 14.7% reduction will be achieved for municipal buildings, under the same assumptions.

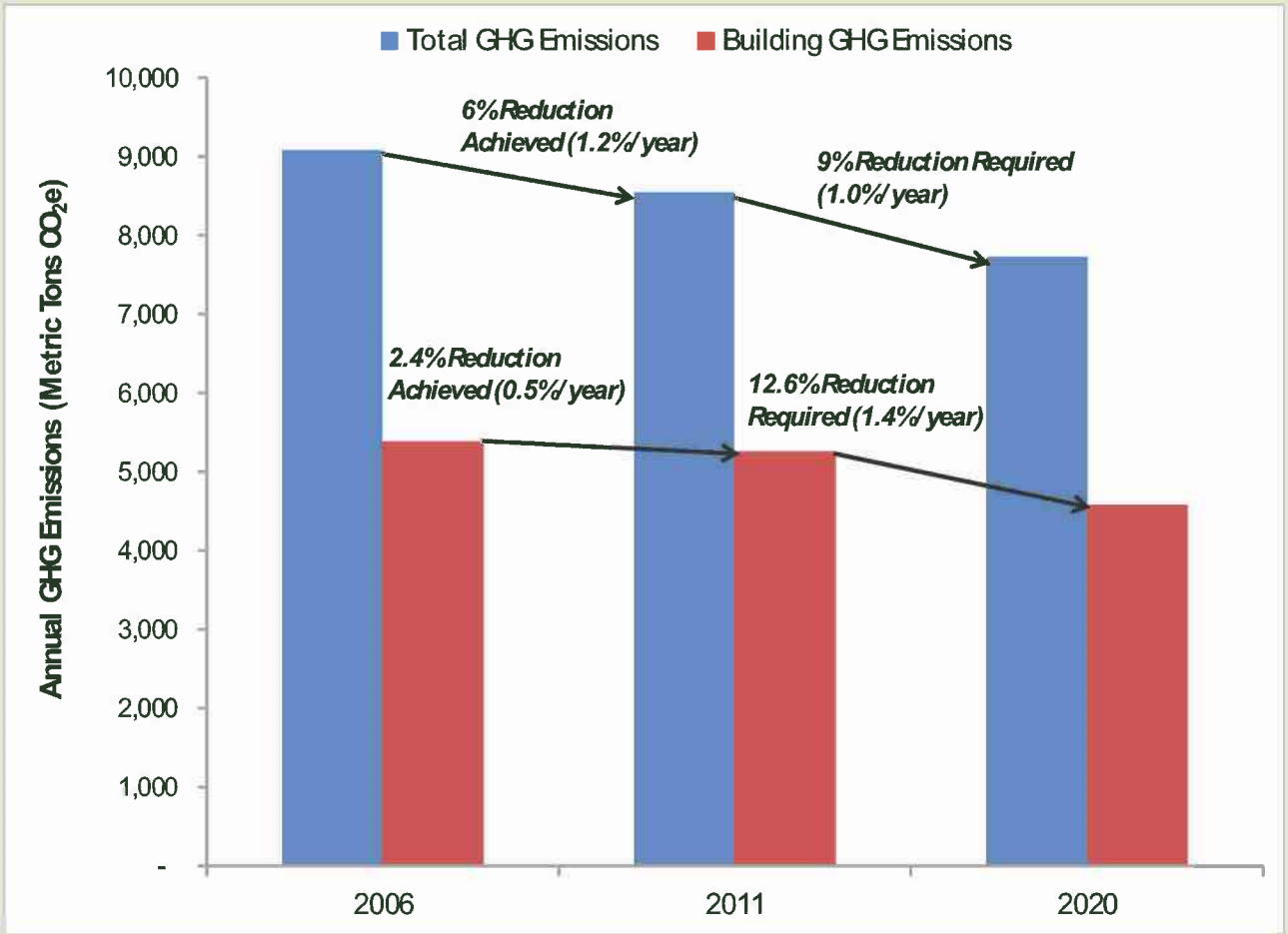

Figure 2. Total and building related annual GHG emissions for 2006, 2011 and 2020 target (assuming no change in 2020 emissions factor compared to 2011).

The City has a total of 344 electrical service accounts and 13 natural gas service accounts. Breaking down the total energy based GHG emissions by source in 2011 (Figure 3, where blue denotes 'building' and black denotes 'non-building'), it was found that the Sanitation/PSC facility is the single largest emitter at 28.4% of emissions; then the Waterworks at 25.2% of emissions; then the Transit Facility at 17.9% of emissions; then street and traffic lighting at 11.9% of emissions; the remaining 16.6% of emissions are mostly associated with five other building accounts. **Since 54% of total energy-based emissions in 2011 were found to be associated with water usage, efforts to conserve water will be instrumental in reducing GHG emissions**.

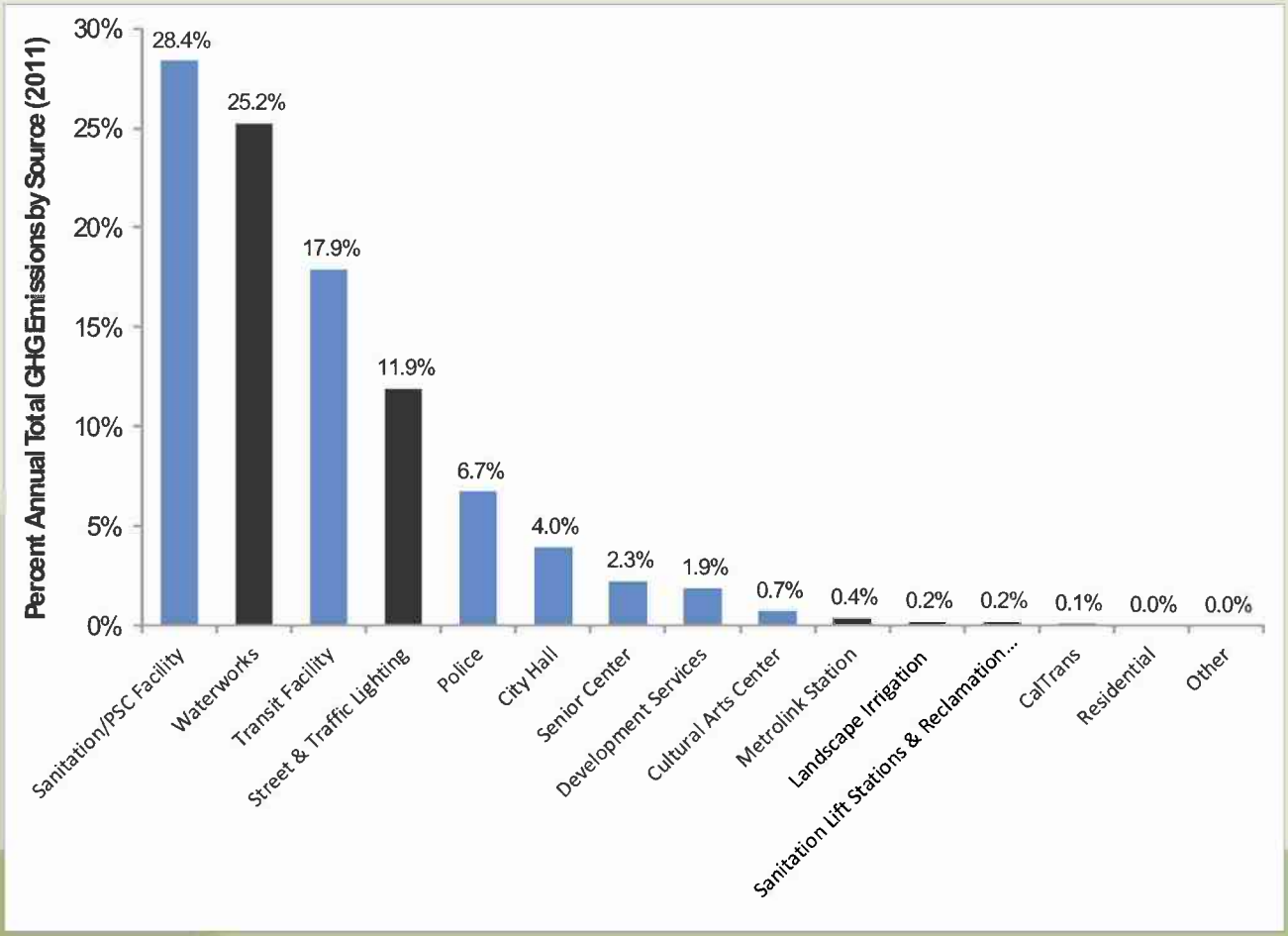

Figure 3. City of Simi Valley percent annual energy based GHG emissions by source (2011).

Total Electricity Use and Greenhouse Gases

For the total electricity consumed in 2011, 51% fell into the building category and 49% fell into the non-building category (Table 10). However, as noted previously, electricity use associated with some of the operations in the building category, such as the Sanitation Plant and the Transit Facility, are not actual buildings.

Table 10. Total City of Simi Valley electricity usage by use type for 2011.

Use Type	2011 Electricity Use (kWh/Year)	Percent of Total (%)
Total Building Electricity	11,075,116	49%
Total Non-Building Electricity	11,536,799	51%
Total Electricity Use	22,611,915	

The City's total and municipal building electricity use measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was investigated (Figure 4). For total electricity use, a 7.1% reduction was achieved from 2006 to 2011. To meet the 20% reduction target in 2020, an additional 12.9% reduction must be made. Electricity reductions have been successful and if reduction rates occur at roughly the same pace as in past years, the City is on track to meet its 20% reduction target.

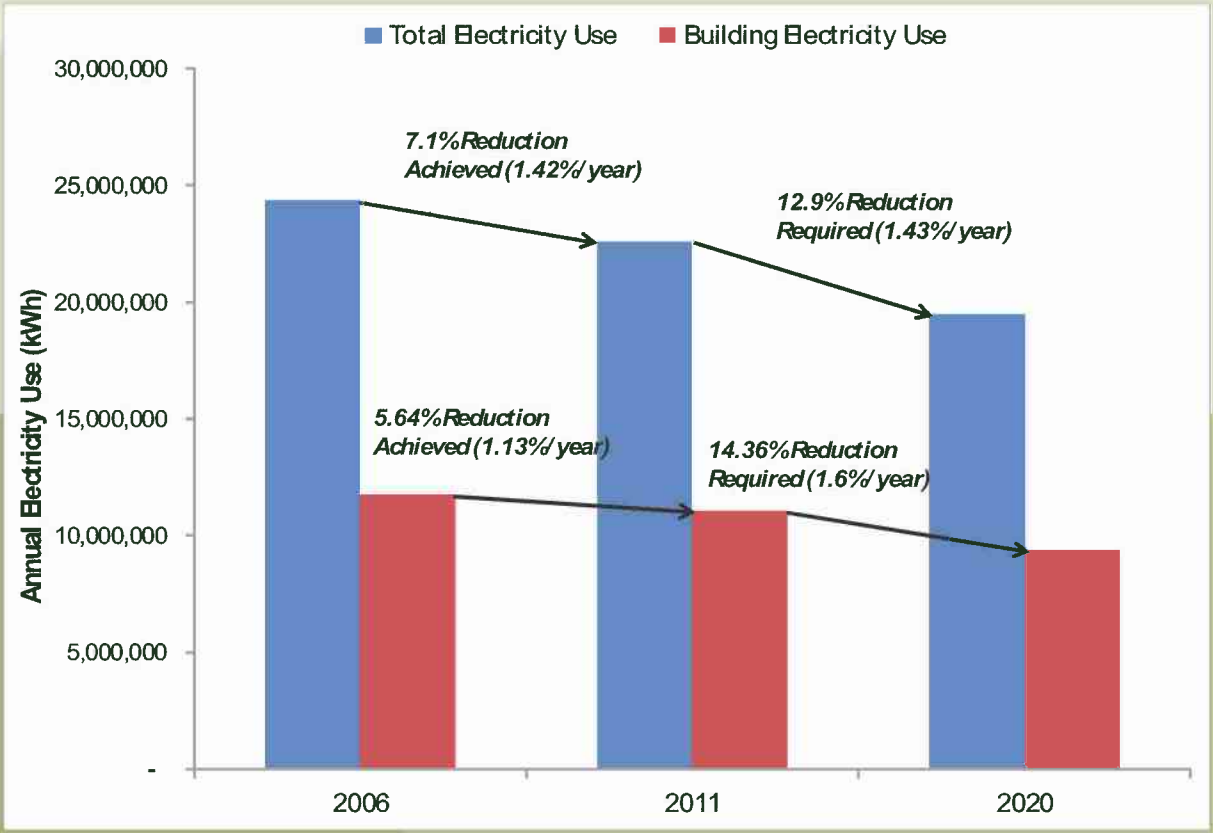

Figure 4. Total and building related annual electricity use for 2006, 2011 and for 2020 target.

The City's total and municipal building electrical GHG emissions measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was investigated (Figure 5). For total electrical GHG emissions, a 9.78% reduction was achieved from 2006 to 2011. To meet the 15% reduction target in 2020, an additional 5.22% reduction must be made.

This analysis assumes that emission factors for electricity are the same in 2020 as they were in 2011. However, due to policy and regulations to reduce GHG emissions at the State level, it is projected that emission factors will be substantially less in 2020 as compared to 2011 [13]. If the GHG emission factor predicted for electricity in 2020 is used, a 28.8% GHG reduction will be achieved for total electricity as compared to 2006, even if no further electricity use reductions are made after 2011. A 27.7% reduction will be achieved for municipal buildings under the same assumptions.

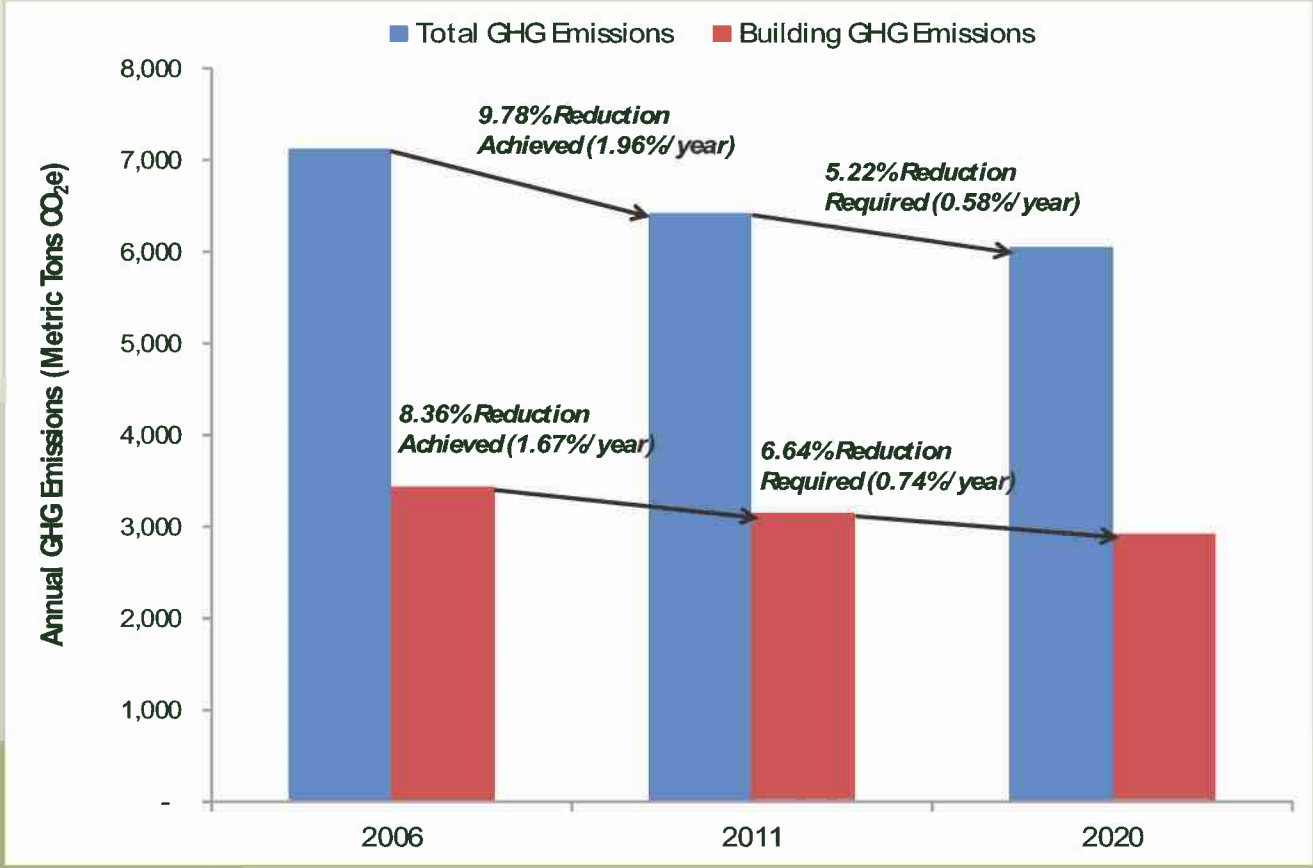

Figure 5. Total and building related annual electrical GHG emissions for 2006, 2011 and 2020 target (assumes no change in 2020 emissions factor after 2011).

The City has a total of 344 electrical service accounts. Breaking down electricity-based GHG emissions by source in 2011 (Figure 6, where blue denotes 'building' and black denotes 'non-building'). The use-types with the highest GHG emissions are:

- Waterworks at 33.8% (43 service accounts).
- Sanitation/PSC facility at 32.6% (1 service account).
- Street and traffic signal lighting at 15.9% (14 service accounts for street lighting and 125 service accounts for traffic signal lighting).
- The remaining 17.7% of use is spread across 7 other building accounts and 154 non-building accounts (136 of which are associated with landscape irrigation).

Because 66% of total electricity based emissions in 2011 were found to be associated with water usage, efforts to conserve water will be instrumental in reducing GHG emissions.

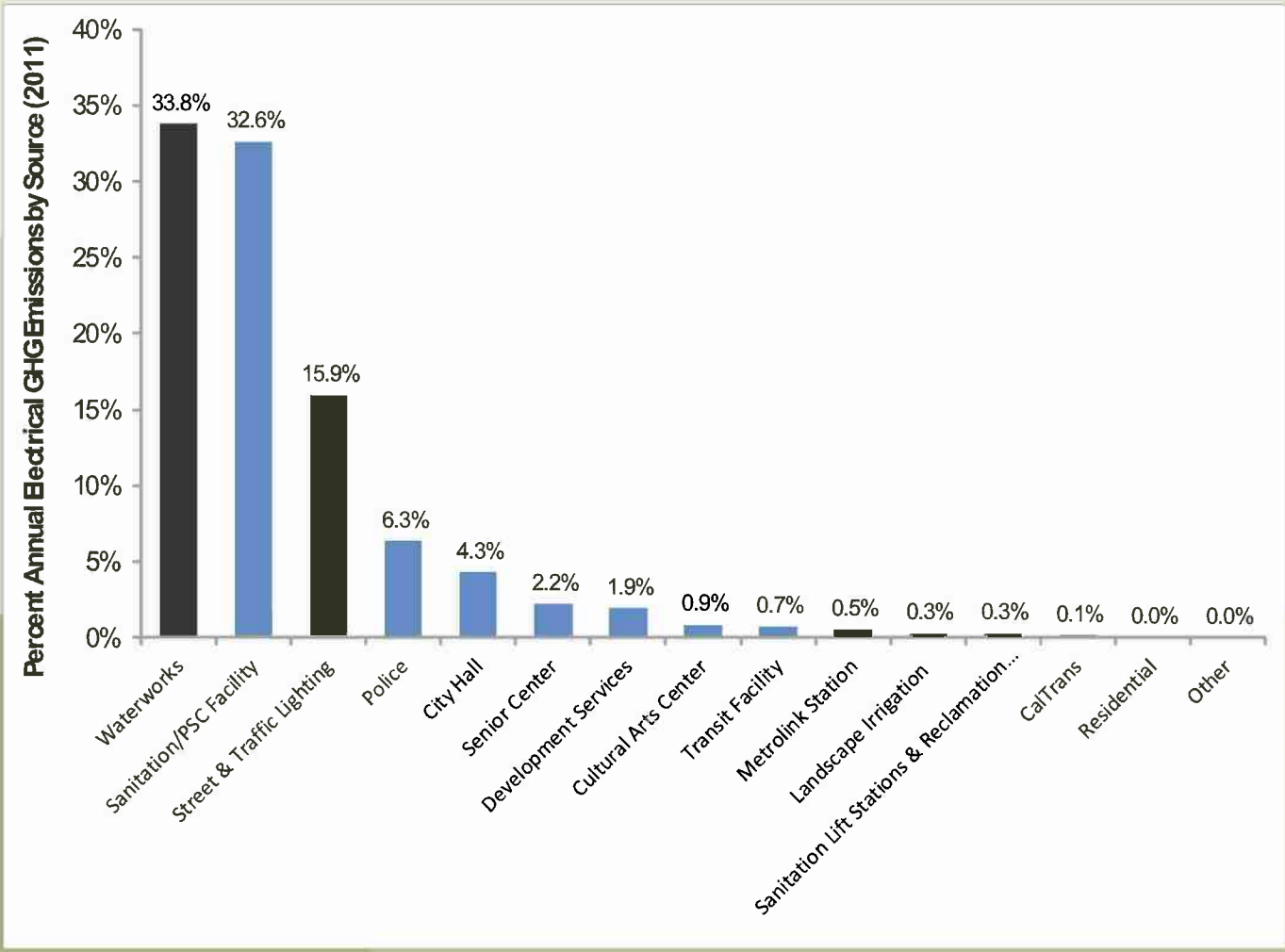

Figure 6. City of Simi Valley percent annual electricity based GHG emissions by source (2011).

The 20 service accounts with the highest GHG emissions in 2011 are shown in (Figure 7, where blue denotes 'building,' black denotes water pumping within the Waterworks, yellow denotes street lighting and green denotes the other 324 service accounts). The service accounts with the highest emissions are:

- Sanitation/PSC facility (1 service account).
- SCE owned and operated street lights (1 service account).
- Buildings (5 service accounts).
- Water pumping stations (12 service accounts).
- City owned street lights (1 service account).

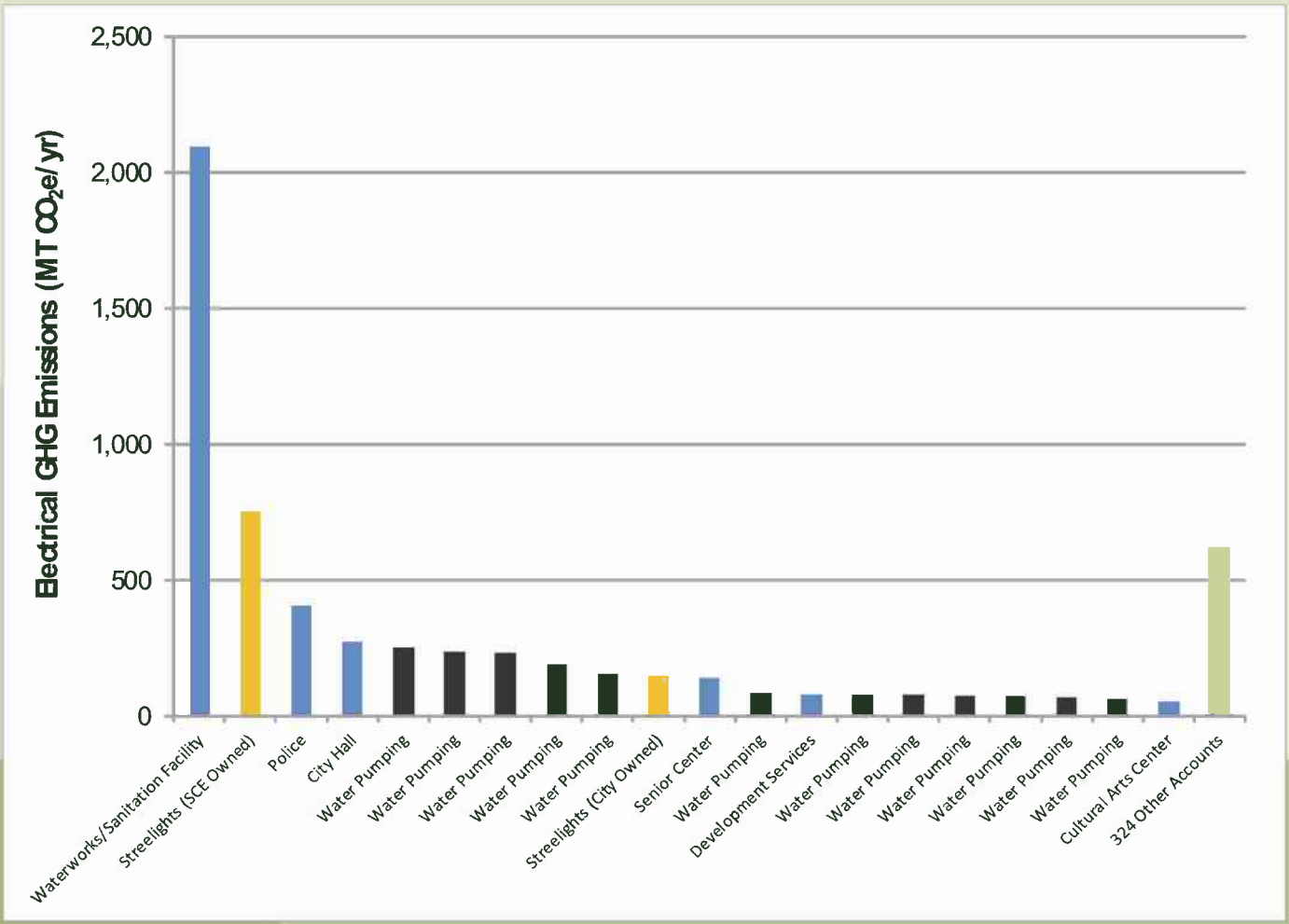

Figure 7. Top 20 electricity service accounts with the highest GHG emissions by source for 2011.

Total Natural Gas Use and Greenhouse Gases

For the total natural gas consumed in 2011, 99.96% fell into the building category and 0.04% fell into the non-building category (Table 11). However, as noted previously, natural gas use associated with some of the operations in the building category, such as the Sanitation Plant and the Transit Facility, are not actual buildings.

Table 11. Total City of Simi Valley natural gas usage by use type for 2011.

Use Type	2011 Natural Gas Use (Therm/Year)	Percent of Total (%)
Total Building Natural Gas	398,548	99.96%
Total Non-Building Natural Gas	161	0.04%
Total	398,709	

The City's total and municipal building natural gas use measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was investigated (Figure 8). For building natural gas use, an 8.14% increase was observed from 2006 to 2011. To meet the 20% reduction target in 2020, an additional 28.14% reduction must be achieved.

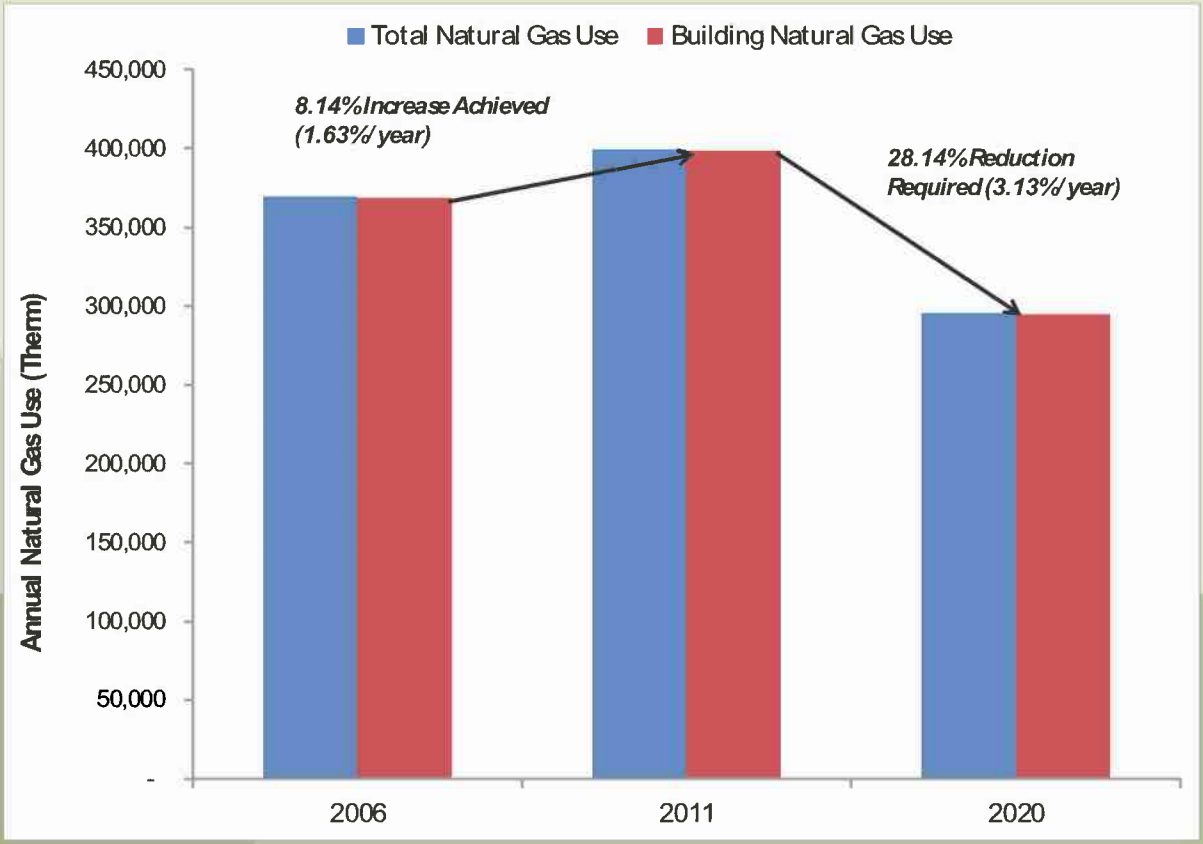

Figure 8. Total and building related annual natural gas use for 2006, 2011 and for 2020 target.

The City's total and municipal building natural gas-based GHG emissions measured in 2006 and 2011, and the reduction necessary to meet the 2020 target was investigated (Figure 9). For building natural gas GHG emissions, an 8.14% increase was observed from 2006 to 2011. To meet the 15% reduction target in 2020, an additional 23.14% reduction must be made. Since natural gas-based GHG emissions are tied primarily to natural gas fuel composition and this composition is relatively static, it is assumed that emission factors are unchanged over time.

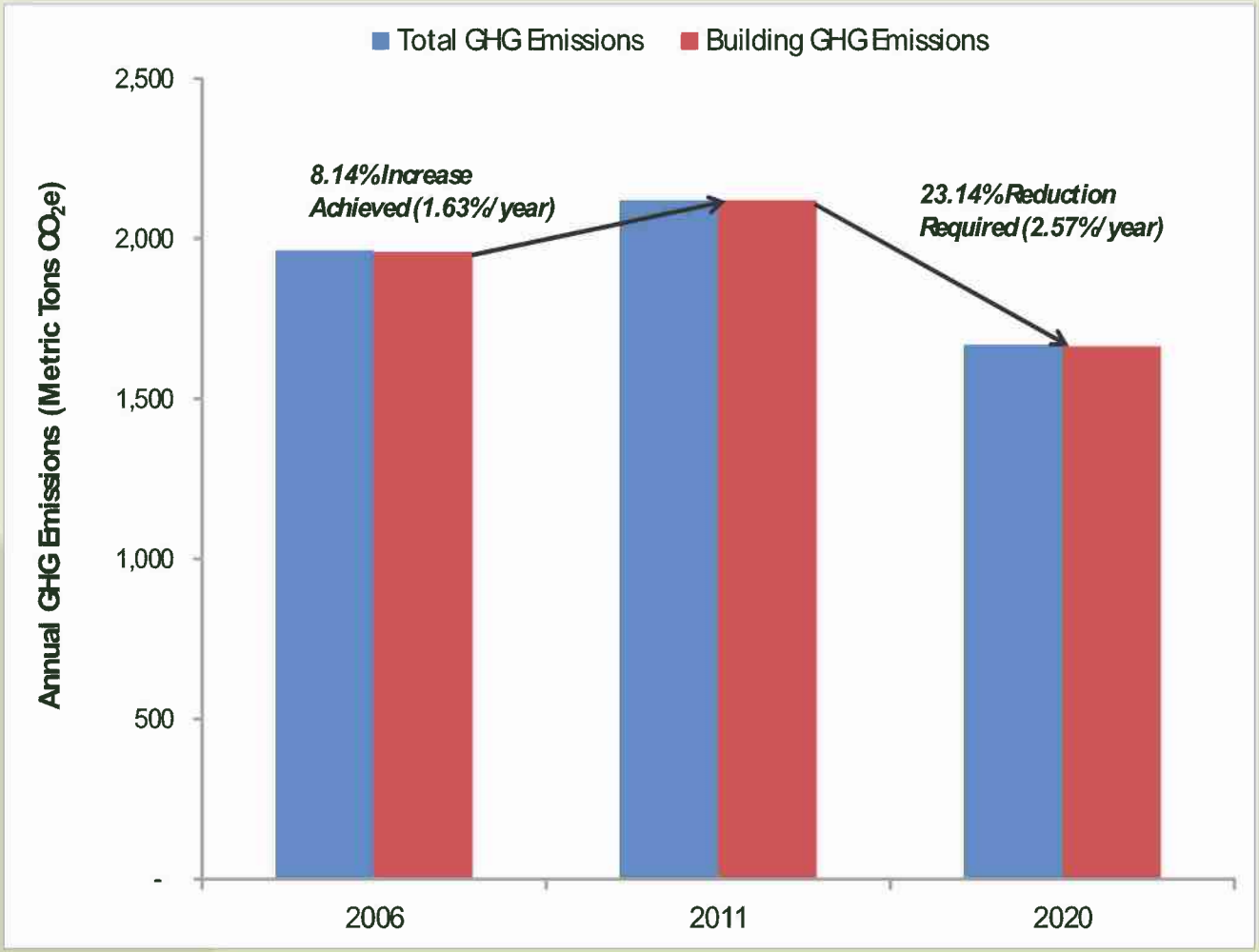

Figure 9. Total and building related annual natural gas GHG emissions for 2006, 2011 and 2020 target.

Breaking down natural gas based GHG emissions in 2011 (Figure 10), it was found that the Transit Facility is the single largest emitter, at 68.8% of emissions. This gas is used for the City's natural gas fueled public transportation fleet. The Sanitation Plant is the second highest emitter, at 14.9% of emissions. This gas is used primarily in process heating applications within the plant. The remaining 16.3% of gas is predominantly used in building space heating applications.

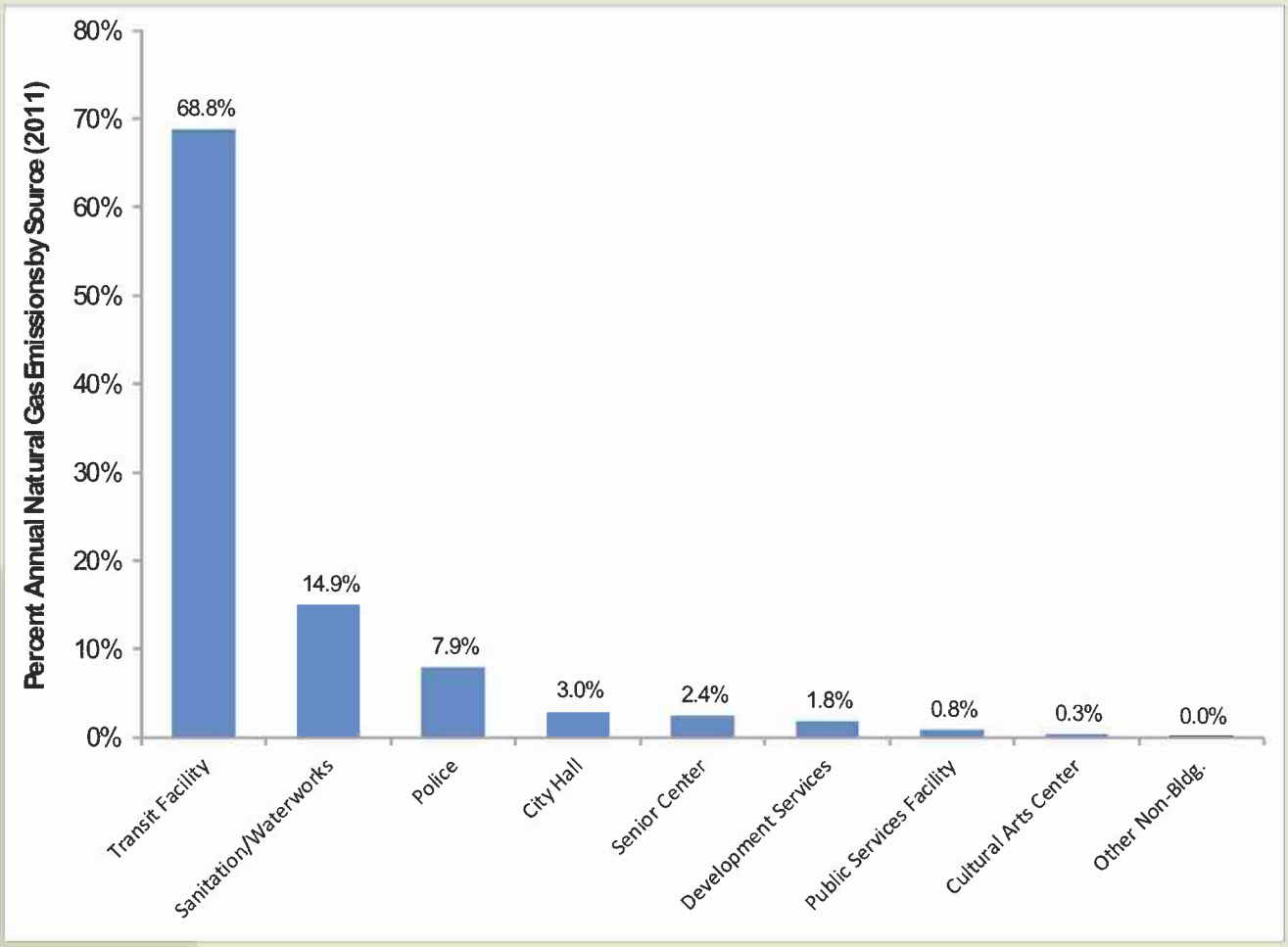

Figure 10. City of Simi Valley percent annual natural gas based GHG emissions by source (2011).

Municipal Building Greenhouse Gas Emissions

GHG emissions were measured in the municipal "buildings" described in Table 12. Overall, from 2006 to 2011 there has been a 2.4% reduction in GHG emissions associated with total building energy use, an 8.4% reduction in GHG emissions associated with total building electricity use and an 8.1% increase in GHG emissions associated with total building natural gas use (Table 12).

Table 12. Building GHG emissions in 2006 and 2011 and percent change from 2006 baseline.

GHG Emissions (Metric Ton CO_2e)	2006	2011	Percent Change from 2006
Building Energy Based GHG Emissions (Metric Ton CO_2e)	5,391	5,264	-2.4%
Building Electricity Based GHG Emissions (Metric Ton CO_2e)	3,432	3,145	-8.4%
Building Natural Gas Based GHG Emissions (Metric Ton CO_2e)	1,959	2,119	+8.1%

Major reductions in electricity-based GHG emissions have been achieved from 2006 to 2011. Through its Local Government Partnership with SCE, the City has had a strong focus on electrical efficiency projects. This partnership has been highly successful. However, in many cases, gas use has increased from 2006 to 2011. The City will seek a closer relationship with Southern California Gas (SCG) to make gains in gas use efficiency. However, since 68.8% of total 2011 natural gas consumption was used to fuel the City's public transportation bus fleet, this may be challenging.

Municipal Building Energy Conservation Measures and Greenhouse Gas Emission Reductions

In its effort to reduce energy use and GHG emissions, the City has implemented numerous ECMs.Table 13 gives results for electricity-based GHG emissions measured for each facility in 2006 and 2011, the change in emissions over this period, the potential change in emissions from future ECMs and the overall reduction possible (measured, plus potential ECMs). Overall, an 8.4% reduction has been achieved and an additional 6.3% reduction is possible if all ECMs are implemented. This leads to a total reduction potential of 14.7%.

Table 14 gives results for natural gas-based GHG emissions measured for each facility in 2006 and 2011, the change in emissions over this period, the potential change in emissions for future ECMs and the overall reduction possible (measured, plus potential ECMs). Overall, an 8.1% increase in natural gas-based GHG emissions has occurred and a 0.6% reduction is possible if all ECMs are implemented.

Table 13. Building based historic and potential GHG reductions (electricity).

Site Name & Service Account	Measured Electrical GHG (lbs CO_2e:2006)	Measured Electrical GHG (lbs CO_2e:2011)	Measured Electrical GHG Change 2006-2011 (lbs CO_2e)	Measured Percent Change from 2006 Baseline (%)	Potential Future ECM GHG Reduction (lbs CO_2e)	Potential ECM Percent Reduction from 2006 Baseline (%)	Total GHG Change from 2006 with Historic and Future ECMs (%)
City Hall - 3000962804	684,680	607,998	-76,683	-11.2%	-97,873	-14.3%	-25.5%
Cultural Arts Center - 3010031431	151,324	123,749	-27,575	-18.2%	-3,534	-2.3%	-20.6%
Development Services - 3001158986 & 3012840644	283,282	271,633	-11,649	-4.1%	-6,502	-2.3%	-6.4%
Police Department - 3014319386	970,106	895,874	-74,233	-7.7%	-131,234	-13.5%	-21.2%
Public Services Facility-NA	NA	NA	NA	NA	NA	NA	NA
Sanitation/Waterworks - 3012296523	5,087,942	4,617,448	-470,494	-9.2%	-187,678	-3.7%	-12.9%
Senior Center - 3001159047	286,969	313,607	26,638	9.3%	-27,381	-9.5%	-0.3%
Transit Facility - 3014992925	102,858	103,964	1,105	1.1%	-25,517	-24.8%	-23.7%
Totals (lbs CO_2e)	7,567,161	6,934,272	-632,889	-8.4%	-479,719	-6.3%	-14.7%
Totals (MT CO_2e)	3,432	3,145	-287	-8.4%	-218	-6.3%	-14.7%

Table 14. Building based historic and potential GHG reductions (natural gas).

Site Name & Service Account	Measured Natural Gas GHG (lbs CO_2e:2006)	Measured Natural Gas GHG (lbs CO_2e:2011)	Measured Natural Gas GHG Change 2006-2011 (lbs CO_2e)	Measured Percent Change from 2006 Baseline (%)	Potential Future ECM GHG Reduction (lbs CO_2e)	Potential ECM Percent Reduction from 2006 Baseline (%)	Total GHG Change from 2006 with Historic and Future ECMs (%)
City Hall - 181-213-8600	74,485	117,915	43,430	58.3%	0	0.0%	58.3%
Cultural Arts Center - 028-313-9901	19,887	16,020	-3,867	-19.4%	0	0.0%	-19.4%
Development Services - 128-713-8400 & 130-813-8461	49,032	74,087	25,055	51.1%	-25,055	-51.1%	0.0%
Police - 046-831-1440	320,277	323,875	3,598	1.1%	0	0.0%	1.1%
Public Services Facility - 201-114-2100	48,411	37,665	-10,746	-22.2%	0	0.0%	-22.2%
Sanitation Facility - 007-914-2200	446,490	713,352	266,863	59.8%	0	0.0%	59.8%
Senior Center - 111-913-8700	112,490	101,743	-10,746	-9.6%	0	0.0%	-9.6%
Transit Facility - 163-393-1979	3,247,856	3,285,884	38,028	1.2%	0	0.0%	1.2%
Totals (lbs CO_2e)	4,318,927	4,670,541	351,614	8.1%	-25,055	-0.6%	7.6%
Totals (MT CO_2e)	1,959	2,119	159	8.1%	-11	-0.6%	7.6%

Total Municipal Facility Greenhouse Gas Emission Reduction Potential

The energy savings analysis and 2011 GHG Inventory demonstrate that significant GHG reductions may be achieved through energy efficiency. However, these calculations also show that energy efficiency and conservation alone will not allow the City to meet its GHG emissions goals. A combination of ECMs and on-site renewable energy systems can substantially reduce municipal GHG emissions. As shown in Appendix A - Renewable Energy Systems, substantial reductions can be achieved through the use of solar power and/or co-generation using biogas. Table 15 summarizes this potential. Using aggregate GHG emissions across all municipal "buildings" in 2006 as the baseline, a 2.4% reduction has been achieved in 2011, there is a further 4.2% reduction potential associated with future ECMs, a 14.9% reduction potential associated with solar PV and a 25.3% reduction potential associated with cogeneration. Overall, this leads to a 46.8% GHG reduction potential. Thus, these strategies can exceed the 15% GHG emissions reduction target for the City. Of course, this is only a subset of total municipal GHG emissions. Even though the 15% reduction target applies to community-wide emissions, these specific measures can contribute to the overall success of the Climate Action Plan.

All ECMs that will be implemented in the future as part of the City's Energy Action Plan, Retro-Commissioning Policy and Benchmarking Policy will be documented using a standardized template (Table 16). This spreadsheet quantifies the GHG emissions reduction associated with the ECM.

A list of potential ECMs was compiled as part of the City's Energy Action Plan. The GHG emissions reduction associated with the ECM is shown in Table 17 – Table 21.

Table 15. Building based historic and potential GHG reductions (ECMs and renewable energy potential-total energy).

Site Name	Measured Total Energy GHG (lbs CO_2e: 2006)	Measured Total Energy GHG Change from 2006 Baseline (lbs CO_2e: 2011)	Potential Future ECM GHG Reduction (lbs CO_2e)	Potential Future Solar PV GHG Reduction (lbs CO_2e)	Potential Future Cogen GHG Reduction (lbs CO_2e)	Measured GHG Percent Change from 2006 Baseline (%)	Potential ECM GHG Percent Reduction from 2006 Baseline (%)	Potential Solar PV GHG Percent Reduction from 2006 Baseline (%)	Potential Cogen GHG Percent Reduction from 2006 Baseline (%)	Potential Total GHG Percent Reduction from 2006 Baseline (%)
City Hall	759,165	-33,252	-97,873	-451,911	0	-4.4%	-12.9%	-59.5%	-	-76.8%
Cultural Arts Center	171,211	-31,442	-3,534	0	0	-18.4%	-2.1%	0.0%	-	-20.4%
Development Services	332,313	13,406	-31,557	-207,923	0	4.0%	-9.5%	-62.6%	-	-68.0%
Police Department	1,290,383	-70,635	-131,234	-458,864	0	-5.5%	-10.2%	-35.6%	-	-51.2%
Public Services Facility	48,411	-10,746	0	-156,157	0	-22.2%	0.0%	-322.6%	-	-344.8%
Sanitation/Water works	5,534,431	-203,631	-187,678	-93,818	-3,007,026	-3.7%	-3.4%	-1.7%	-54.3%	-63.1%
Senior Center	399,459	15,892	-27,381	-271,271	0	4.0%	-6.9%	-67.9%	-	-70.8%
Transit Facility	3,350,714	39,133	-25,517	-131,327	0	1.2%	-0.8%	-3.9%	-	-3.5%
Totals (lbs CO_2e)	11,886,089	-281,275	-504,774	-1,771,271	-3,007,026	-2.4%	-4.2%	-14.9%	-25.3%	-46.8%
Totals (MT CO_2e)	5,391	-128	-229	-803	-1,364	-2.4%	-4.2%	-14.9%	-25.3%	-46.8%

Table 16. Standardized template for tracking future energy conservation measures.

Facility Name	SCE Service Account #	SC Gas Service Account #	Measure Name/ Description	Details	Measure Status (Month & Year Imple-mented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO_2/ year)	Annual Energy Cost Savings ($/yr)	Install Cost-Before Rebates ($)	Rebates ($)	Install Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Investment (%)
City Hall	3-000-9628-04	NA	Controls: Optimized scheduling of HVAC operation	EMS used to schedule HVAC to operate on City "flex" schedule	9/2013	5,000	3,173	$ 600	$ 500	none	$ 500	0.8	5	500%
City Hall	3-000-9628-04	NA	Component replacement: Economizer dampers replaced	5 rusted out dampers replaced	9/2013	15,000	9,519	$ 1,800	$ 12,500	$ 1,500	$ 11,000	6.1	7	15%
City Hall	3-000-9628-04	NA	Retrofit: HVAC unit replaced	1 new 5 ton rooftop package unit replaced with 15 SEER unit	9/2013	10,000	6,261	$ 1,200	$ 10,000	$ 1,000	$ 9,000	7.5	15	100%
				Totals & Averages		30,000	18,953	$ 3,600	$ 23,000	$ 2,500	$ 20,500	5		205%
				Current Annual Electricity Usage (2011)		971,067								
				ECM Electricity as a Percent of Current Annual Electric Usage		3.1%								

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
Transit Facility	3-014-9929-25	Lighting Schedule	Schedule site lighting OFF after gates are locked	Future	21,000	12,732	$3,888	$100	$0	$100	0.0	15	58227%
City Hall	3-000-9628-04	Tighten schedule of operation	Schedule HVAC on at 6 AM vs 5 AM and off at 6 PM vs 10 PM. 20 kW reduction on weekdays.	Future	15,600	9,767	$2,061	$100	$0	$100	0.0	5	10205%
Transit Facility	3-014-9929-25	Air Compressor	Decrease air compressor setpoint	Future	1,000	606	$185	$10	$0	$10	0.1	10	18416%
Development Services	3-001-1589-86 & 3-012-8406-44	HVAC controls	Reduce run hours of HVAC equipment by 1300h per year	Future	10,725	6,715	$1,606	$150	$0	$150	0.1	10	10604%
Police Department	3-014-3193-86	10% reduction in baseload power	Reduce unnecessary loads at night by 10% (15 kW reduction from current baseload of 150 kW)	Future	131,400	82,271	$15,712	$2,500	$0	$2,500	0.2	10	6185%

Table 17. Master list of potential ECMs, prioritized by payback period (continued on next page).

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
Sanitation/ Waterworks	3-012-2965-23	Anoxic mixer timing control	Installation of timers for 21 anoxic mixers.	Future	167,846	101,760	$15,961	$6,500	$3,250	$3,250	0.2	10	4811%
City Hall	3-000-9628-04	10% reduction in baseload power	Reduce unnecessary loads at night by 10% (7.5 kW reduction from current 75 kW)	Future	65,700	41,136	$8,680	$2,000	$0	$2,000	0.2	5	2070%
Public Services Facility	3-012-2965-23	Lighting retrofit	Replace outdoor soffit lighting with fluorescent or LED lights. Assume 125W Par 38 to 23W fluorescent	Future	5,018	3,142	$477	$120	$0	$120	0.3	10	3877%
City Hall	3-000-9628-04	De-lamp fixtures in open office area	Open office area has lighting levels of 70 f.c. at work surface - 1/3 of bulbs could be removed or shut off at bi-level switch	Future	21,910	13,718	$2,895	$1,000	$0	$1,000	0.3	10	2795%

Table 17. Master list of potential ECMs, prioritized by payback period.

Table 18. Master list of potential ECMs, prioritized by payback period.

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
City Hall	3-000-9628-04	Automatic shutdown software on computers	Shuts down 167 computers when not in use	Future	50,100	31,368	$6,619	$4,175	$1,500	$2,675	0.4	7	1632%
Police Department	3-014-3193-86	PC auto-shutdown	Shuts down 120 computers when not in use	Future	36,000	22,540	$4,305	$3,000	$1,200	$1,800	0.4	10	2291%
City Hall	3-000-9628-04	Increase thermostat lower setpoint limit	Limit thermostat setpoint to 72°F in cooling mode	Future	1,680	1,052	$222	$100	$0	$100	0.5	5	1010%
Cultural Arts Center	3-010-0314-31	Lighting	Replace 72 incandescents lamps with CFLs	Future	4,147	2,597	$747	$720	$315	$405	0.5	7	1191%
Sanitation/ Waterworks	3-012-2965-23	Lighting retrofit	35 lamp retrofit of 50W HID to 26 W CFLs (Exterior)	Future	6,665	4,041	$634	$364	$0	$364	0.6	10	1641%
Transit Facility	3-014-9929-25	Lighting retrofit	14 lamp retrofit of 7 incandescent exit signs with LED exit signs	Future	1,717	1,041	$318	$385	$189	$196	0.6	15	2333%
Police Department	3-014-3193-86	Lighting retrofit	Replace incandescent bulbs in 4 fixtures with LED or Fluorescent bulbs	Future	1,798	1,126	$215	$140	$0	$140	0.7	10	1435%

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
Police Department	3-014-3193-86	Lighting retrofit	75 lamp retrofit of fluorescent exit signs with LED exit signs	Future	11,826	7,404	$1,414	$2,063	$1,125	$938	0.7	10	1408%
Police Department	3-014-3193-86	Vending machine control	Controllers on 2 refrigerated beverage machines	Future	2,400	1,503	$287	$400	$200	$200	0.7	5	617%
Senior Center	3-001-1590-47	Lighting retrofit	Replace 12x halogen flood bulbs with LED or compact fluorescent flood bulbs	Future	4,920	2,983	$1,096	$1,200	$420	$780	0.7	10	1306%
Cultural Arts Center	3-010-0314-31	Lighting	Replace 12 incandescent exit sign lamps with LEDs	Future	1,682	1,053	$303	$660	$324	$336	1.1	10	802%

Table 19. Master list of potential ECMs, prioritized by payback period.

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
Public Services Facility	3-012-2965-23	Lighting retrofit	14 lamp retrofit of 7 incandescent exit signs with LED exit signs	Future	1,717	1,075	$163	$385	$189	$196	1.2	10	733%
Sanitation/ Waterworks	3-012-2965-23	Motor retrofit	Applied Pump #2. Replace 32 year old 50 HP motor with premium efficiency motor	Future	30,336	18,392	$2,885	$3,500	$0	$3,500	1.2	20	1548%
Sanitation/ Waterworks	3-012-2965-23	Motor retrofit	Applied Pump #3. Replace 32 year old 50 HP motor with premium efficiency motor	Future	30,336	18,392	$2,885	$3,500	$0	$3,500	1.2	20	1548%
Sanitation/ Waterworks	3-012-2965-23	Motor retrofit	WAS Pumps #1. Replace 26 year old 15 HP motor with premium efficiency motor	Future	9,101	5,518	$865	$1,050	$0	$1,050	1.2	20	1548%
Public Services Facility	3-012-2965-23	HVAC controls	Replace thermostats or timers	Future	5,000	3,131	$475	$600	$0	$600	1.3	5	296%

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
Senior Center	3-001-1590-47	Lighting retrofit	Replace 12x Incancescent accent bulbs with LED or compact fluorescent	Future	2,460	1,491	$548	$1,200	$420	$780	1.4	10	603%
Senior Center	3-001-1590-47	Lighting retrofit	Replace 85x 50W MR-16 pin base architectural lights with LED bulbs	Future	10,455	6,339	$1,467	$2,125	$0	$2,125	1.4	10	590%
Public Services Facility	3-012-2965-23	Lighting retrofit	Evaluate de-lamping fixtures	Future	13,120	8,215	$1,248	$2,000	$0	$2,000	1.6	15	836%
Public Services Facility	3-012-2965-23	Vending machine control	Controllers on 2 refrigerated beverage machines	Future	2,400	1,503	$228	$600	$200	$400	1.8	5	185%
Transit Facility	3-014-9929-25	Lighting retrofit	Retrofit 8' T-12 fixtures with T-8 28W fixtures	Future	7,921	4,802	$1,467	$2,875	$0	$2,875	2.0	15	665%
Police Department	3-014-3193-86	Lighting retrofit	100 lamp retrofit of 90W metal halide with 70W pulse start metal halide.	Future	8,280	5,184	$990	$3,500	$1,500	$2,000	2.0	5	148%

Table 20. Master list of potential ECMs, prioritized by payback period.

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
City Hall	3-000-9628-04	Replace incandescent cannister lights with LED fixtures	Replace 6x 75W incandescent downlights with 18W LED fixtures	Future	1,636	1,024	$216	$700	$210	$490	2.3	10	341%
City Hall	3-000-9628-04	Vending machine controllers	Controllers on 3 refrigerated beverage machines	Future	1,200	751	$159	$600	$225	$375	2.4	5	111%
City Hall	3-000-9628-04	Replace 8' T-12 fixtures in storage area	Replace 10x 2 bulb 8 foot T-12 fluorescent fixtures with 2x28W 4' T-8 fixtures	Future	1,558	975	$206	$950	$250	$700	3.4	10	194%
Sanitation/ Waterworks	3-012-2965-23	Motor retrofit	Screened Sludge Circulation #1. Replace 22 year old 25 HP motor with premium efficiency motor	Future	4,424	2,682	$421	$1,750	$0	$1,750	4.2	20	381%
Sanitation/ Waterworks	3-012-2965-23	Motor retrofit	Screened Sludge Circulation #2. Replace 22 year old 25 HP motor with premium efficiency	Future	4,424	2,682	$421	$1,750	$0	$1,750	4.2	20	381%

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Installed Cost-Before Rebates ($)	Rebates ($)	Installed Cost-After Rebates ($)	Payback Period (Years)	Estimated Project Lifetime (Years)	Return on Invest-ment (%)
			motor										
Senior Center	3-001-1590-47	Lighting retrofit	41 lamp retrofit of HID fixtures with induction fixtures in parking areas	Future	27,328	16,568	$3,835	$20,500	$3,075	$17,425	4.5	10	120%
City Hall	3-000-9628-04	Install lighting occupancy sensors	Install occupant sensing on additional private offices, conference rooms, and storage areas	Future	2,050	1,284	$271	$2,000	$700	$1,300	4.8	10	108%
Transit Facility	3-014-9929-25	Lighting retrofit	Replace exterior 8' T-12 exterior lighting with T-8 bulbs and ballasts	Future	6,451	3,911	$1,195	$6,000	$0	$6,000	5.0	15	199%

Table 21. Master list of potential ECMs, prioritized by payback period.

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Install Cost-Before Rebates ($)	Rebates ($)	Install Cost-After Rebates ($)	Payback Period (Years)	Est Project Life (Years)	Return on Invest-ment (%)
Police Department	3-014-3193-86	Lighting retrofit	46 lamp retrofit of HID fixtures with induction fixtures in parking areas	Future	24,757	15,501	$2,960	$23,000	$3,450	$19,550	6.6	10	51%
Sanitation/ Waterworks	3-012-2965-23	Lighting retrofit	27 lamp retrofit of 75W mercury vapor lamps with 2 -26 W CFLs	Future	203	123	$19	$170	$0	$170	8.8	10	14%
Transit Facility	3-014-9929-25	Lighting retrofit	28 lamp retrofit of 250 W HPS to 4-lamp T5 HO fixtures	Future	3,998	2,503	$740	$7,000	$0	$7,000	9.5	15	59%
Sanitation/ Waterworks	3-012-2965-23	Lighting retrofit	Retrofit 152 T12 fixtures and magnetic ballats with T8 lighting and electronic ballasts	Future	5,066	3,071	$482	$13,832	$2,100	$11,732	24.4	10	-59%
Public Services Facility	3-012-2965-23	HVAC retrofit	Replace 6 old HVAC with high efficiency package unit	Future	23,905	14,967	$2,273	$57,000	$0	$57,000	25.1	10	-60%
Senior Center	3-001-1590-47	Controls retrofit	Add HVAC points on the building's energy	Future	NA	NA	NA	NA	NA	NA	NA	NA	NA

Facility or Service Type	SCE Service Account	Measure Name/ Description	Details	Measure Status (Year Imp-lemented)	Annual Energy Savings (kWh/yr)	Annual GHG Emission Reduction (Lbs CO2/year)	Annual Energy Cost Savings ($/yr)	Install Cost-Before Rebates ($)	Rebates ($)	Install Cost-After Rebates ($)	Payback Period (Years)	Est Project Life (Years)	Retur n on Inves t-ment (%)
			management system and control HVAC to minimize reheat energy										
			Totals & Averages		791,261	488,640	$94,044	$182,274	$20,842	$161,432	2.9		3259 %
	Current Total Annual Electricity Usage (2011)				11,075,116								
	ECM Electricity as a Percent of Current Annual Electric Usage				7.1%								

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APPENDIX

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APPENDIX A-RENEWABLE ENERGY SYSTEMS

Solar Photovoltaic and Greenhouse Gas Emission Reductions

On-site renewable energy systems can play a major role in GHG reductions. The potential reduction from solar photovoltaic (PV) systems across multiple municipal sites was investigated.

PV produces renewable energy, with no GHG emissions or fuel costs. Both rooftop and carport PV arrays were analyzed. The analysis used the California Solar Initiative (CSI) PV calculator to determine output from a horizontal array under the solar irradiance conditions found in Simi Valley. The base array utilized Sharp 240 Watt (ND-240QCJ) panels and a Satcon 30 kW, 208V inverter. In this scenario, the system produces 11.71 Watts AC per square foot (SF) of array and 18.92 kilowatt-hours per square foot per year (kWh/SF*yr).

Using aerial views of rooftop conditions, a viable area for PV was estimated as a percent of total roof area. Next, annual energy production from the rooftop PV array was compared to annual electricity use in 2006 at the site. The results of the analysis can be found in Table A1.

Table A1. Estimated rooftop solar PV potential by site.

Site Name	Total Roof Area (SF)	Percent Roof Viable for PV (%)	Viable Roof Area (SF)	Rooftop PV Output (kWh/yr)	2006 Facility Electricity Use (kWh/yr)	Rooftop PV Annual Electricity as Percent of 2006 Use (%)
City Hall	43,771	40%	17,508	331,286	1,062,012	31%
Cultural Arts Center	12,105	0%	0	0	234,720	0%
Development Services	18,125	50%	9,063	171,477	439,400	39%
Police Department	50,000	30%	15,000	283,823	1,504,738	19%
Public Services Facility	18,150	15%	2,723	51,514	NA	NA
Sanitation/Waterworks	18,174	15%	2,726	51,582	7,891,940	1%
Senior Center	29,559	0%	0	0	445,120	0%
Transit Facility	12,720	60%	7,632	144,409	159,544	91%

A similar exercise was used to estimate the viable area for PV in carport applications. Parking areas were estimated as a percent of total roof area. Next, annual energy production from the rooftop PV array was compared to annual electricity use in 2006 at the site. The results of the analysis can be found in Table A2.

Table A2. Estimated carport solar PV potential by site.

Site Name	Total Roof Area (SF)	Percent Parking Area Viable for PV (%)	Viable Parking Area (SF)	Carport PV Output (kWh/yr)	2006 Facility Electricity Use (kWh/yr)	Carport PV Annual Electricity as Percent of 2006 Use (%)
City Hall	43,771	50%	21,886	414,108	1,062,012	39%
Cultural Arts Center	12,105	0%	0	0	234,720	0%
Development Services	18,125	50%	9,063	171,477	439,400	39%
Police Department	50,000	50%	25,000	473,039	1,504,738	31%
Public Services Facility	18,150	60%	10,890	206,056	NA	NA
Sanitation/Waterworks	18,174	30%	5,452	103,164	7,891,940	1%
Senior Center	29,559	80%	23,647	447,442	445,120	101%
Transit Facility	12,720	30%	3,816	72,205	159,544	45%

The combined total GHG reduction potential for both rooftop and carport PV arrays as a fraction of annual electricity based GHG emissions in 2006 at the site is shown in Table A3. Solar PV potential is quite good at most sites.

Table A3. Estimated rooftop and carport solar PV GHG reduction potential by site.

Site Name	Total Rooftop & Carport PV GHG Reduction Potential as Percent of 2006 Electrical GHG (%)
City Hall	-68%
Cultural Arts Center	0%
Development Services	-76%
Police Department	-49%
Public Services Facility	NA
Sanitation/Waterworks	-2%
Senior Center	-98%
Transit Facility	-132%

Cogeneration and Greenhouse Gas Emission Reductions

The potential GHG reduction from a cogeneration plant at the Sanitation Plant was investigated. Currently, the biogas generated as part of the plant's anaerobic digestion process is flared. The CO2 emitted from the flare is a significant source of municipal GHG emissions.

Biogas is renewable "opportunity" fuel that contains a significant amount of methane (the primary constituent of pipeline natural gas) and can be used to generate power and heat. The power generated can be used to directly meet site electrical requirements and the heat captured can be used to offset heating requirements within the plant. Three chemical analyses of the biogas, conducted between 2008-2011 show relatively stable methane content, ranging from 56-59% (Table A4). Carbon dioxide content in the fuel is also relatively steady, ranging from 39-40%. The estimated flow rate of the biogas is 180,000 cubic-feet (CF) per day (accuracy of flow rate to be verified). The average heating value of the biogas is 582 BTU/CF. It was assumed that a biogas fired reciprocating engine is used (Make: MAN. Model: Biogas Engine E 2842 LE 322, designed to operate on 60% methane and 40% carbon dioxide). This engine has an electrical efficiency of 37.5% and heat capture efficiency of 53.0%. Under these conditions, it is estimated that the cogeneration plant can reduce 47% of the electricity based GHG emissions on the Sanitation/Waterworks service account in 2006 (Table A5).

The cogeneration plant has the potential to capture waste heat from the power production process to offset Sanitation Plant heating requirements. The anaerobic digesters are the only gas-fired process-heating loads at the plant. It is estimated that the cogeneration plant can meet 479% of the heating requirements of the Sanitation service account in 2006. Therefore, the heat captured in the cogeneration plant can meet all process heating loads within the Sanitation Plant. It may also be possible to utilize available waste heat to meet the building heating loads at the site. It was assumed that 100% of the gas consumed on the Sanitation service account in 2011 could be offset with waste heat captured in the cogeneration plant. In this case, the combined electricity and heat from the cogeneration plant can reduce 56% of the total 2006 energy based GHG emissions on the Sanitation/Waterworks service account.

Table A4. Sanitation plant biogas cogeneration potential.

Test Date	Sample #	Methane Content by Volume (%)	Heating Value of Methane (BTU/CF)	Heating Value of Biogas (BTU/CF)	Estimated Flow Rate of Biogas (CF/day)	Estimated Annual Energy in Biogas (MMBTU/yr)	Estimated Energy Flow in Biogas (kW)	Assumed Electrical Efficiency of Cogen (%)	Assumed Waste Heat Capture Efficiency of Cogen (%)	Electrical Output (kW)	Annual Electrical Energy Output @ 90% Availability (kWh/yr)	Annual Heat Energy Output @ 90% Availability (Therm/yr)
1/30/2008	1	59.33%	1,000	593.3	180,000	38,980	1,304	37.5%	53.0%	489	3,854,581	185,934
1/30/2008	2	59.42%	1,000	594.2	180,000	39,039	1,306	37.5%	53.0%	490	3,860,428	186,216
10/22/2008	1	58.33%	1,000	583.3	180,000	38,323	1,282	37.5%	53.0%	481	3,789,613	182,800
10/22/2008	2	58.14%	1,000	581.4	180,000	38,198	1,278	37.5%	53.0%	479	3,777,269	182,204
8/3/2011	1	55.94%	1,000	559.4	180,000	36,753	1,229	37.5%	53.0%	461	3,634,338	175,310
	Averages	58.23%		582.3	180,000	38,258	1,280	37.5%	53.0%	480	3,783,246	182,493

Table A5. Sanitation/Waterworks account estimated cogeneration GHG reduction potential.

Energy Use or Production	Value	Percent Change from 2006 (%)	Reduction Baseline
Sanitation/Waterworks Measured 2006 Annual Electricity Based GHG (lbs CO_2e/yr)	5,087,942		
Cogeneration Estimated Electricity Based GHG Reduction (lbs CO_2e/yr)	2,368,739	-46.6%	Sanitation/ Waterworks 2006 Electricity Based GHG
Sanitation/Waterworks Measured 2006 Annual Natural Gas Based GHG (lbs CO_2e/yr)	446,490		
Sanitation/Waterworks Measured 2011 Annual Natural Gas Based GHG (lbs CO_2e/yr)	713,352		
Cogeneration Estimated Natural Gas Based GHG Reduction-Assuming 100% of 2011 Gas Use Offset on Sanitation Plant Service Account (lbs CO_2e/yr)	713,352	-100%	Sanitation/ Waterworks 2011 Natural Gas Based GHG
Cogeneration Estimated Total Viable GHG Reduction (lbs CO_2e/yr)	3,082,091	-55.7%	Total Sanitation/Waterworks 2006 Energy Based GHGs