Kern County

Communitywide Greenhouse Gas Emission Inventory
2005 Baseline Year - 2020 Forecast
***Final Report*– May 2012**

Prepared by

San Joaquin Valley Air Pollution Control District

For

Kern County
Planning and Community Development

Staff of the San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) contributed to various aspects of developing this document.

Document prepared by:

David Garner, Senior Air Quality Specialist

Kou Thao, Air Quality Specialist

Yu Vu, Air Quality Specialist

Matthew Cegielski, Air Quality Specialist

Georgia Stewart, Air Quality Specialist

Document reviewed by:

David Warner, Director of Permit Services

Arnaud Marjollet, Permit Services Manager

Leland Villalvazo, Supervising Air Quality Specialist

Questions and comments may be directed to:

GHGInventory@valleyair.org

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Executive Summary

On May 3, 2011, the Kern County Board of Supervisors signed a memorandum of understanding (MOU) with the San Joaquin Valley Air Pollution Control District (District) to develop a communitywide greenhouse gas (GHG) emission inventory for the County of Kern.

The MOU requires a GHG emissions inventory be developed for a base year and forecasted year. During a pre-project kickoff meeting it was agreed that 2005 would be the base year and 2020 would be used as the forecast year. These inventories are summarized below and more detail is provided in the GHG Emissions Inventory Summary section.

As part of the District's GHG emissions inventory development process, five key principles (*Transparency, Consistency, Data Source Priority / Relevance, Accuracy, and Completeness)* were implemented to ensure that the best possible inventory was developed. To provide transparency to the process and to allow the County of Kern to update each individual methodology as needed in the future; clear and detailed methodologies were developed and are included in Appendix A through I for each sector and subsector. For consistency, sources having similar data requirements and similar data availability utilized comparable methodologies. Throughout the inventory development process, priority was given to data provided by local sources (Kern County COG or survey data from local businesses) versus state or national data. In completing the inventory process, the District deployed a multi-tiered quality assurance and quality check process for reviewing each of the methodologies to ensure consistency, accuracy and completeness.

The GHG emissions inventories were estimated for nine primary sectors (Electricity Production and Consumption, Residential/ Commercial/ Industrial Combustion, Transportation, Fossil Fuels Industry, Industrial Processes, Waste Management, Agriculture, Forestry and Land Use, and Other Sources). A detailed listing of all the sectors and subsectors are included on page 15.

The 2005 base year GHG emissions inventory was estimated to be 27 million metric tons of CO_2 equivalent (CO_2e) of which the Fossil Fuel Industry sector represents 40% followed by the Electricity Consumption sector at 22%. The 2020 forecasted GHG emissions inventory was estimated to be 27 million metric tons of CO_2e of which the Electricity Consumption sector represents 31% followed by the Fossil Fuel Industry sector at 26%. A detailed breakdown of each sector and subsector's emissions and contribution to the overall GHG emissions inventory is provided in the Report Summary section.

Please note that the 2005 and the 2020 CO_2e emission inventories are projected to be similar. This particular outcome is due to a projected decrease in heavy oil production between years 2005 and 2020 resulting in a GHG emissions reduction that offsets the projected increase of GHG emissions related to the County's population growth. If emissions from petroleum production are excluded from the inventory, the remaining sectors would show a 27% increase in emissions from 2005 (16,117,791 metric tons CO_2e) to 2020 (20,473,713 metric tons CO_2e).

GHG Background

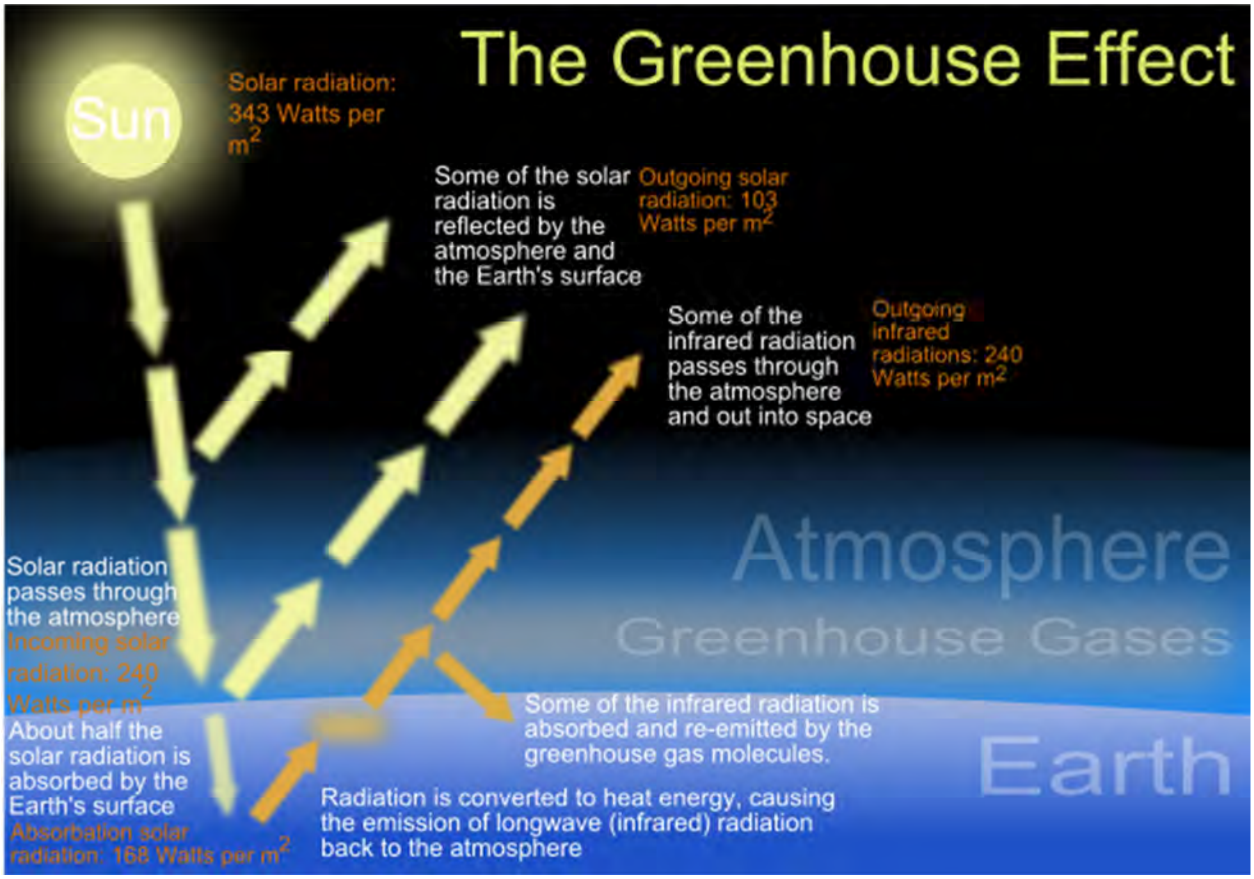
In 1988, an Intergovernmental Panel on Climate Change (IPCC) was created by the World Meteorological Organization and the United Nations Environment Program (UNEP). The IPCC issued a first assessment report in 1990 which reflected the views of 400 scientists and in 1995 IPCC published the second assessment report.

The Kyoto Protocol adopted in Kyoto, Japan, in 1997 is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), with binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions.

In 2006, the California Legislature passed and Governor Schwarzenegger signed Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006, which set the state’s first greenhouse gas emissions reduction goal into law. AB 32 requires that the State reduce emissions to 1990 levels by the year 2020, and it directed the California Air Resources Board (CARB) to begin developing discrete early actions to reduce greenhouse gases while also preparing a scoping plan to identify how best to reach the 2020 target.

What is the “Greenhouse Effect” and “Global Warming”.

Atmospheric GHGs and clouds within the Earth's atmosphere influence the Earth's temperature by absorbing most of the infrared radiation rising from the Earth's sun-warmed surface that would otherwise escape into space, a process known as the "greenhouse effect". The resulting balance between incoming solar radiation and outgoing radiation from both the Earth’s surface and atmosphere keeps the planet habitable. Current life on Earth could not be sustained without the natural greenhouse effect.

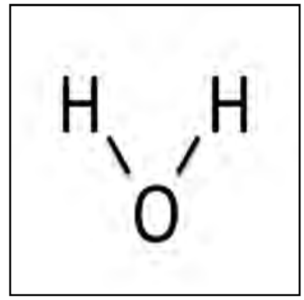


Simplified diagram of the GHG effect

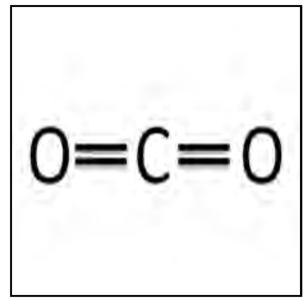
But the greenhouse effect is becoming stronger, and this increasing effect is generally thought to be as a result of human activities, primarily through the burning of fossil fuels for transportation and electricity generation, and the deforesting of large areas of land. The IPCC attributes humanity's global warming influence primarily to the increase of three key heat-trapping gases in the atmosphere: carbon dioxide, methane, and nitrous oxide. Human-produced emissions of these GHGs into the atmosphere enhance the greenhouse effect by absorbing additional radiation that would otherwise escape into space. This traps more heat in the atmosphere, causing temperatures to rise. This rise in global average temperatures is referred to as global warming. According to the IPCC, "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations".

Some greenhouse gases such as water vapor occur naturally and are emitted to the atmosphere through natural processes as well as through human activities. As noted above, the most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide. GHGs as a whole can include:

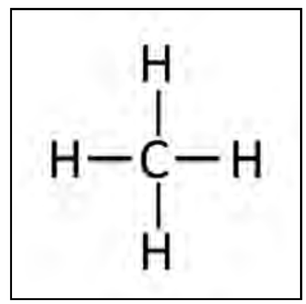
Water Vapor. Although not considered a pollutant, water vapor is the most important, abundant, and variable GHG. In the atmosphere, it maintains a climate necessary for life. The main source of water vapor is evaporation from the ocean (approximately 85 percent). Other sources include sublimation (change from solid to gas) from ice and snow, evaporation from other water bodies, and transpiration from plant leaves. Human activities are not thought to directly affect the average global concentration of water vapor.



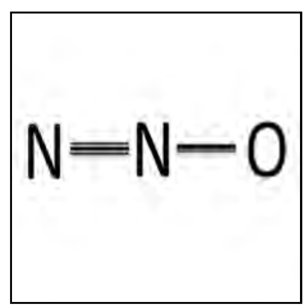
Carbon dioxide. Carbon dioxide (CO_2) is an odorless, colorless gas, which has both natural and anthropogenic sources. Natural sources include respiration of bacteria, plants, animals, and fungus; evaporation from oceans; volcanic out gassing; and decomposition of dead organic matter. Anthropogenic sources of carbon dioxide include the burning of coal, oil, natural gas, and wood. Concentrations of CO_2 were 379 parts per million (ppm) in 2005, which is an increase of 1.4 ppm per year since 1960.

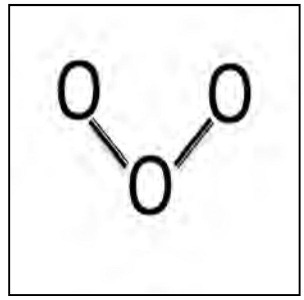


Methane. Methane (CH_4) is a flammable gas and is the main component of natural gas. When one molecule of CH_4 is burned in the presence of oxygen, one molecule of carbon dioxide and two molecules of water are released. There are no direct ill health effects from CH_4. Methane is primarily produced through anaerobic decomposition of organic matter in biological systems. Geological deposits, known as natural gas fields, also contain CH_4, which is extracted for fuel. Other sources are from cattle, fermentation of manure, and landfills.



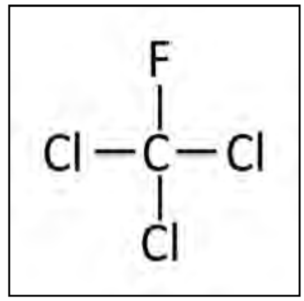
Nitrous oxide. Nitrous oxide (N_2O), also known as laughing gas, is a colorless greenhouse gas. Higher concentrations of N_2O can cause euphoria, dizziness, and slight hallucinations. N_2O is produced by microbial processes in soil and water, including those reactions that occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (nitric acid production, nylon production, fossil fuel-fired power plants, and vehicle emissions) also contribute to the nitrous oxide atmospheric load. It is used in racecars, rocket engines, and as an aerosol spray propellant.





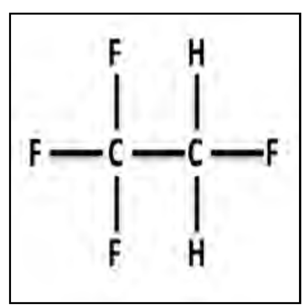
Ozone. Ozone is present in both the upper stratosphere, where it shields the Earth form ultraviolet radiation, and at lower concentrations in the lower atmosphere, where it is the main component of photochemical smog. Unlike other GHGs, ozone is relatively short- lived and, therefore, is not global in nature. It is difficult to make an accurate determination of the contribution of ozone precursors (nitrogen oxides and volatile organic compounds) to global climate change.

Halocarbons. Halocarbons are synthetically produced gases in which one or more of the hydrogen atoms in a hydrocarbon has been replaced by a halogen (primarily fluorine, chlorine, or bromine). For regulatory purposes, halocarbons are classified as either ozone depleting, or non-ozone depleting.



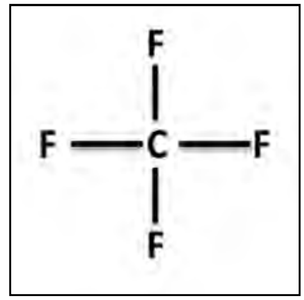
- **Ozone depleting halocarbons**. Ozone depleting halocarbons include hydrocarbons where one or more hydrogen atoms have been replaced by chlorine (chlorofluorocarbons or CFCs; hydrochlorofluorocarbons or HCFCs; methylchloride; and carbon tetrachloride) or bromine (methyl bromide; hydrobromofluorocarbons or HBFCs). The halocarbons have the ability to react with ozone in the stratosphere and degrade it. Since stratospheric ozone is a greenhouse gas, this results in a reduction in global warming potential. However, many of these ozone depleting halocarbons are potent greenhouse gasses themselves, so the net effect is uncertain. Ozone depleting halocarbons are regulated under provisions of the Montreal Protocol and subsequent Copenhagen Amendments. As a signatory, the United States agreed to phase out production and importation of these compounds. Although some of these compounds are potent greenhouse gasses, they are not covered by the United Nations Framework Convention on Climate Change (UNFCCC).

- **Non-Ozone depleting halocarbons.** Some halocarbons are powerful greenhouse gasses and are not regulated by the Montreal Protocol. These include the hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

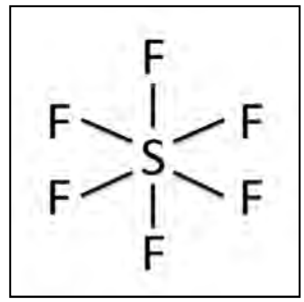
  

  - **Hydrofluorocarbons**. Hydrofluorocarbons (HFCs) are man-made organic compounds that contain only one or a few fluorine atoms. CFCs include compounds such as Freon 134a that are used as a substitute for ozone depleting refrigerants.

- **Perfluorocarbons**. Perfluorocarbons (PFCs) have stable molecular structures and do not break down through the chemical processes in the lower atmosphere. High-energy ultraviolet rays, roughly 60 lulometers above the earth's surface are able to destroy the compounds. PFCs have long lifetimes, ranging between 10,000 and 50,000 years. Two common PFCs are tetrafluoromethane and hexafluoroethane. Concentrations of tetrafluoromethane in the atmosphere are over 70 parts per trillion (ppt). The two main sources of PFCs are primary aluminum production and semiconductor manufacture.



- **Sulfur hexafluoride**. Sulfur hexafluoride (SF_6) is an inorganic, colorless, odorless, nontoxic, nonflammable gas. Concentrations in the 1990s were roughly 4 ppt. SF_6 is used for insulation in electric power transmission and distribution equipment, in semiconductor manufacturing, the magnesium industry, and as a tracer gas for leak detection.



Others. A number of other gasses have indirect effects on global warming. These include:

- Carbon monoxide (CO) which can interfere with the natural atmospheric decomposition of methane and tropospheric ozone.
- Nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOCs) which promote the formation of ozone.
- Aerosols which can warm the atmosphere by absorbing and emitting heat, and can cool the atmosphere by reflecting light. Regulation has been lowering concentrations of these pollutants in the United States; however, global concentrations are likely increasing.

Global Warming Potential (GWP)

Under Assembly Bill 32 (AB 32) GHGs are defined as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). The global warming potential (GWP) of the various GHGs is assigned as a measure of their relative average global radiative forcing effect, the potential of a gas or aerosol to trap heat in the atmosphere. Individual GHG species have varying GWP and atmospheric lifetimes. The carbon dioxide equivalent is a consistent methodology for comparing GHG emissions since it normalizes various GHG emissions to a single metric. The reference gas for GWP is carbon dioxide with a GWP of one and GWP weighted emissions are measured in terms of CO_2 equivalent (CO_2e). For example, methane has a GWP of 21; methane has a 21 times greater global warming effect than carbon dioxide on a weight basis. Several GWPs of other GHGs are shown in Table 1 below:

Table 1. Global warming potentials (100 year time horizon) as reported in the IPCC Second Assessment Report (SAR).

Greenhouse Gas	Abbreviation	Global Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Trifluoromethane	HFC-23	11,700
Difluoromethane	HFC-32	650
Pentafluoroethane	HFC-125	2,800
1,1,1,2-tetrafluoroethane	HFC-134a	1,300
1,1,1-trifluoroethane	HFC-143a	3,800
1,1-difluoroethane	HFC-152a	140
1,1,1,2,3,3,3- heptafluoropropane	HFC-227ea	2,900
1,1,1,3,3,3-hexafluoropropane	HFC-236fa	6,300
1,1,1,2,2,3,4,5,5,5- decafluoropentane	HFC-4310mee	1,300
Perfluoromethane (tetrafluoromethane)	CF_4	6,500
Perfluoroethane (hexafluoroethane)	C_2F_6	9,200
Perfluorobutane (decafluorobutane)	C_4F_{10}	7,000
Perfluorohexane (tetradecafluorohexane)	C_6F_{14}	7,400
Sulfur hexafluoride	SF_6	23,900

California GHG Legislation

AB32 Timeline

- **By Jan 1, 2009** - CARB adopts plan indicating how emission reductions will be achieved from significant sources of GHGs via regulations, market mechanisms and other actions.
- **During 2009** - CARB staff drafts rule language to implement its plan and holds a series of public workshop on each measure (including market mechanisms).
- **By Jan 1, 2010** - Early action measures take effect.
- **During 2010** - CARB conducts series of rulemakings, after workshops and public hearings, to adopt GHG regulations including rules governing market mechanisms.
- **By Jan 1, 2011** - CARB completes major rulemakings for reducing GHGs including market mechanisms. CARB may revise the rules and adopt new ones after 1/1/2011 in furtherance of the 2020 cap.
- **By Jan 1, 2012** - GHG rules and market mechanisms adopted by CARB take effect and are legally enforceable.
- **December 31, 2020** - Deadline for achieving 2020 GHG emissions target.

Air Resources Board Scoping Plan

The California Air Resources Board's (CARB) Climate Change Scoping Plan establishes the foundations for how the State will achieve the GHG emissions targets set in Assembly Bill 32 (AB 32). AB 32 requires that the State reduce emissions to 1990 levels by the year 2020. The CARB prepared a 1990 and 2020 GHG inventory and identified that the State will need to reduce GHG emissions by approximately 30 percent from business-as usual (BAU) by 2020 to achieve the 2020 target of AB 32, which correlates to approximately a 15 percent reduction from existing conditions at the time the Scoping Plan was adopted (2002-2004 emissions inventory). Because local land use decisions affect how people relate to their environment, CARB recommends that cities and counties adopt a similar GHG reduction goal. Actions taken by CARB and other State agencies, including, but not limited to, the California Energy Commission (CEC) and Public Utilities Commission (CPUC), are the primary drivers behind the statewide mandatory GHG reduction measures that are being implemented to date. While actions of counties and cities were not calculated, or included in the list of actions to achieve the target of AB 32 in the Scoping Plan, local actions are important to success of long-term GHG reductions in the State.

Local Agencies

Reducing GHG emissions from the transportation sector will be critical to the success of statewide GHG reductions. Transportation emissions account for about 38 percent of the statewide GHG emissions inventory, and passenger vehicles account for about 74 percent of the total transportation sector emissions. While much transportation planning takes place on a regional level, land-use changes occurring on a local level can also improve transportation and reduce overall GHG emissions. Based on this principal, Senate Bill 375 (SB375) was adopted to reduce passenger vehicle miles traveled and associated GHG emissions. GHG reduction measures associated with implementation of SB375 are under the purview of California's 18 Metropolitan Planning Organizations (MPOs). GHG emission reduction targets of 7 to 8 percent in 2020 and between 13 to 16 percent in 2035 from 2005 base year for the MPOs was adopted by CARB on September 29, 2010.

MPOs are required to identify strategies to reduce passenger vehicle miles traveled (VMT) and trips that achieve these targets in a Sustainable Communities Strategies (SCS). If the SCS is unable to achieve the regional GHG emissions reduction targets, than the MPO is required to prepare an Alternative Planning Strategy (APS) that shows how the GHG emissions reduction target could be achieved through alternative development patterns, infrastructure, and/or transportation measures. MPOs have no land use authority at the local level as the majority of land use decisions are vested with local governments. Therefore, local-level participation in regional efforts will be critical to the success of any SCS or APS.

Inventory Development Basics

For community-scale inventories [Local government (LGO), communitywide (city, county, or region)], emissions can be categorized according to the degree of control community members, organizations, or agencies have over the emissions sources. These categorizations (developed by the World Resources Institute and the World Business Council for Sustainable Development) are called emissions scopes. The scopes framework helps communities to:

- Determine which emissions should be inventoried.
- Organize emissions by degree of control and therefore the potential for reduction.
- Avoid "double counting" of emissions, i.e., summing up of different emissions sources that may result in reporting these emissions twice.

The emissions scopes are defined as follows:

Scope 1: All direct emissions sources located within the geopolitical boundary of the agency. This includes stationary combustion to produce electricity, steam, heat, and power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; leaked refrigerants; and other sources.

Scope 2: Indirect emissions that result as a consequence of activity within the local government's geopolitical boundary limited to electricity, district heating, steam and cooling. Electricity purchased from a utility that lies inside or outside the geopolitical boundary is considered Scope 2.

Scope 3: All other indirect and embodied emissions that occur as a result of activities within the geopolitical boundary are included as Scope 3. Scope 3 emission sources include (but are not limited to) emissions resulting from the decomposition of community-generated solid waste, materials flows and other lifecycle analyses.

Inventory Purpose

The objective of the communitywide inventory is to identify the sources and quantities of greenhouse gas emissions resulting from activities within a jurisdiction in a chosen base year (see below for more on base year). The communitywide inventory is a necessary first step in addressing greenhouse gas emissions, serving two primary purposes:

- To create an emissions baseline against which your jurisdiction can set emissions reduction targets and measure future progress.
- To provide insight into the scale of emissions from the various sources within the community, underpinning informed and strategic emissions reductions, commonly called "climate action planning."

Conducting a communitywide inventory is the first step to an emissions reduction strategy. Communitywide emission inventories are important for a variety of reasons including:

- A local agency has direct control over a significant portion of the emissions that emanate from the community at large.
- A local agency can implement programs to engage the community in numerous ways including education, energy efficiency, waste diversion programs, etc.
- State legislation may soon require community inventories.

Energy efficiency measures can save the community money. Within the context of community activities, local agencies have direct control over their emissions-generating activities and influence over numerous actions taken by residents, businesses and industries. A local agency can reduce energy consumption in buildings and facilities, promote programs to reduce the number of vehicles on the road, inform residents about energy saving programs, work with utilities to provide clean energy options, improve programs that divert recyclables and compostables from the waste stream, and much more. By quantifying the emissions generated by the community, the local jurisdiction will be empowered to choose the most effective approach to reducing its contribution to greenhouse gas emissions. The process of conducting such a quantitative analysis is called a communitywide emissions inventory.

Inventory Boundaries

It is important to note that the communitywide inventory is designed to represent the total quantity of greenhouse gas emissions produced by the community under evaluation as defined by its geographic borders during a given year. Emissions from LGO operations are already embedded in the communitywide inventory. For example, aggregate data for commercial energy used by the communitywide inventory includes energy used for municipal buildings and facilities; communitywide vehicle miles traveled estimates include miles driven by municipal fleet vehicles; and total tons of solid waste landfilled by the communitywide includes municipal waste. Although LGO inventories on occasion include Scope 3 activities that occur outside the geographic communitywide boundary, the LGO inventory can be considered a subset of the communitywide inventory. It is also important to note that, although LGO emissions are incorporated into the communitywide inventory, they cannot be segregated from the community's emissions due to the large scale data sources upon which a communitywide inventory is based. For that reason, LGO inventories must be completed separately from communitywide inventories.

Inventory Sectors

The purpose of this section is to help understand the sectors that may be included in a communitywide inventory. When proposing to conduct a communitywide inventory the following questions should be considered:

- What scopes is the inventory going to cover?
- What sectors are to be included in the inventory?
- What is the purpose of the inventory? (Required by regulation, support an agency's climate change planning efforts, etc.)

It is important to note that a communitywide emissions inventory based upon the sectors identified below will differ from project level emissions inventories prepared for California Environmental Quality Act (CEQA) or for Local Government Operations (LGO) purposes. For example, a CEQA GHG emissions inventory prepared for a wind farm project may contain greenhouse gas emission estimates from construction (off-road vehicles and equipment), and operation (off-road vehicles and equipment, on-road vehicles, and backup generators). On the other hand, when addressing a sector based communitywide emissions inventory, the appropriate *Transportation* subsectors would include all of the mobile sources emissions (on-road and off-road vehicle) and the *In-County Electricity Production/Renewable* subsector would include the emissions associated with the production of electricity only. For instance, for a wind farm, the emissions associated with the production of electricity would be insignificant.

Table 2 below describes nine primary sectors and 69 subsectors that may be part of a communitywide inventory depending on the answer to the above questions.

Table 2 – GHG Inventory Sectors and Subsectors

Sector ID	Sector Name and Subsector ID		
A.	**Electricity**		
	1.	In-County Electricity Production	
		a.	Coal/Coke
		b.	Natural Gas
		c.	Petroleum
		d.	Waste/Biogas
		e.	Renewable
	2.	In-County Electricity Consumption	
B.	**Residential/Commercial/Industrial Combustion**		
	1. Residential		
		a.	Coal/Coke
		b.	Natural Gas
		c.	Oil
		d.	Wood
		e.	LPG
		f.	Kerosene
	2. Commercial		
		a.	Coal/Coke
		b.	Natural Gas
		c.	Oil
		d.	Wood
		e.	LPG
	3. Industrial		
		a.	Coal/Coke
		b.	Natural Gas
		c.	Oil
		d.	Wood
		e.	LPG
C.	**Transportation**		
	1.	On-road Gasoline	
	2.	On-road Diesel	
	3.	Off-road Gasoline	
	4.	Off-road Diesel	
	5.	On-road CNG	
	6.	On-road LPG	
	7.	Marine Vessels/Water Craft	
	8.	Rail	
	9.	Airports	
D.	**Fossil Fuels Industry**		
	1.	Oil & Gas Industry - Refining	
		a.	Natural gas & waste gas

Sector ID	Sector Name and Subsector ID		
		b.	Residual oil
		c.	LPG
	2.	Fugitives - Oil & Gas Refining	
	3.	Venting - Petroleum Production	
	4.	Fugitives - Natural Gas Transmission/Distribution	
	5.	Refining Processes	
E.	**Industrial Processes**		
	1.	Cement Manufacturing	
	2.	Lime Manufacturing	
	3.	Semiconductor Manufacturing	
	4.	Substitutes for Ozone Depleting Substances (ODS)	
	5.	SF6 from Electrical Distribution and Transmission	
	6.	CO_2 Consumption	
	7.	Limestone & Dolomite Consumption	
	8.	Soda Ash Consumption	
	9.	Hydrogen Production	
	10.	Coal Mining Operations	
F.	**Waste Management**		
	1.	Landfills	
	2.	Wastewater Management	
G.	**Agriculture**		
	1.	Fuel Combustion	
	2.	Enteric Fermentation	
	3.	Manure Management	
	4.	Ag Burning	
	5.	Ag Soils - Livestock	
	6.	Ag Soils - Liming	
	7.	Ag Soils - Fertilizer	
	8.	Ag Soils - Crops	
	9.	Carbon Flux	
H.	**Forestry and Land Use**		
	1.	Forested Landscape	
	2.	Non-Farm Fertilizer (Settlement Soils)	
	3.	Wildfires	
	4.	Range Improvement	
	5.	Prescribed Burn	
	6.	Hazard Reduction Burn	
I.	**Other Sources**		
	1.	Composting	
	2.	Resource Recovery	
	3.	US Parks/Forests	
	4.	Military Bases (Aircraft)	
	5.	Nitrogen Deposition	

Inventory Baseline Year

Part of the communitywide inventory process requires the selection of a baseline year for the focus of the analysis. This year will provide a "performance datum" against which you will be able to compare current and future emissions or to track community's progress in reducing GHGs. To establish a base year one should examine the range of data available and select a year that has the most accurate and complete data for all key emission sources. Other considerations may play a part in selecting a base year. For example, a base year may be selected based on a regulator-determined year or it may be established several years in the past to be able to account for the emissions benefits of recent actions. A communitywide inventory should comprise all greenhouse gas emissions occurring during the selected calendar year.

Many California agencies have chosen to use 2005 as a baseline year – this is increasingly becoming the standard for inventories in the state. Due to a lack of available data, a 1990 baseline year is usually difficult for most local governments to complete and would not produce as accurate an inventory.

Inventory Forecasting

To forecast future year emissions, estimates of the changes in the level of emission producing activities, known as "activity indicators", are used to grow the base year emission inventory. In addition, emission reductions resulting from rules and regulations adopted by an agency or from statewide regulations adopted by the California Air Resources Board (CARB) are estimated and accounted for in the future year projection.

Forecasting quantities of emissions in future years is accomplished by assuming that the amount of emissions is related to activity levels of a selected ***activity indicator***. Examples of activity indicators include population, housing, employment, oil production, number of producing oil wells, daily vehicle miles traveled, and daily vehicle starts. The Kern County Association of Governments is a source of several activity indicators. The California Air Resources Board, and other state and local agencies also contributed activity data. These data represent the best available estimates of future activity levels for the county. The ***activity factor or growth factor*** is the ratio of the 2020 forecast levels of activity to the 2005 base year level of activity. A growth factor greater than one would indicate an increase in growth; while a growth factor of less than one would indicate a decline in activity relative to 2005.

To forecast a future year's uncontrolled emissions, the quantity of emissions from each sector in 2005 is multiplied by the growth factor of its assigned activity indicator. The assignments of activity indicators to emission sector are documented in Appendix A through I.

GHG Emissions Inventory Summary

Both the base year and the forecasted GHG emissions inventories were developed by collection of data for nine primary sectors which are made-up of 69 subsectors, as listed in Table 2 above. Emissions inventory methodologies were developed for each subsector and are presented in Appendix A through I.

Baseline GHG Emissions Inventory

The base year GHG emissions inventory was developed using 2005 as the baseline year for consistency with other agencies and state regulations. Data was collected from a variety sources (county departments, internal / external agencies, businesses, and organizations) to develop each methodology found in Appendix A through I. The resulting GHG emissions have been summarized by sector and are presented in Tables 3, below.

Table 3 - ***Countywide GHG emissions inventory for 2005***

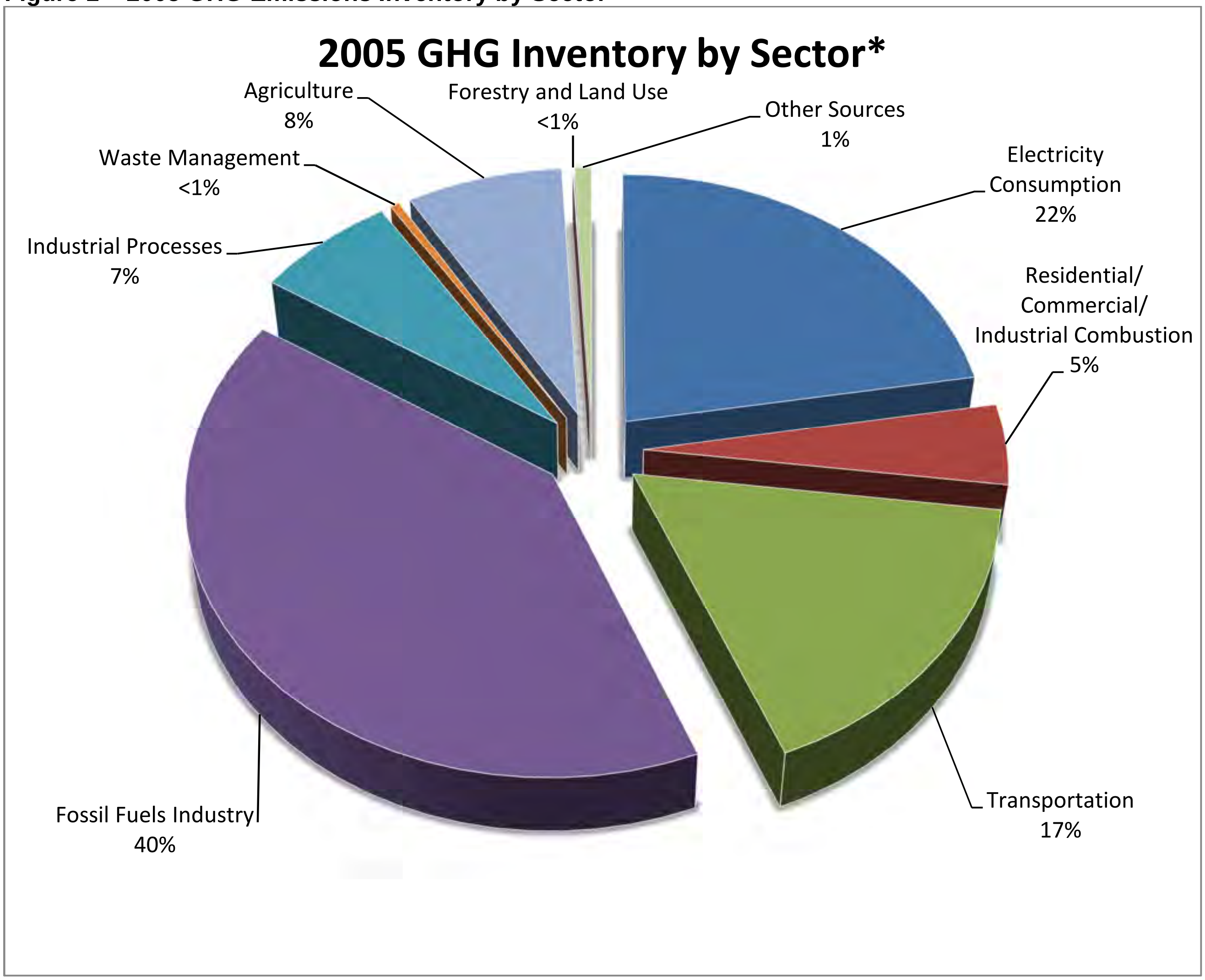
Sector ID	Sector Name	Metric Tons of CO_2e	Percent of Total
Total County 2005		**27,045,617***	
A	Electricity Production	13,002,127**	
	Electricity Consumption	6,039,114	22%
B	Residential/ Commercial/ Industrial Combustion	1,281,498	5%
C	Transportation	4,569,913	17%
D	Fossil Fuels Industry	10,928,153	40%
E	Industrial Processes	1,852,124	7%
F	Waste Management	120,494	<1%
G	Agriculture Fugitives	2,024,470	7%
H	Forestry and Land Use	11,028	<1%
I	Other Sources	218,823	1%
County Total Sequestration		**3,073,572**	
G	Agriculture	412,957	13%
H	Forestry and Land Use	2,073,706	67%
I	Other Sources	586,909	19%

** Does not include the subtraction of sequestering sectors*
*** Included for completeness only, not included in further descriptions of the County's emissions.*

Data present in Table 3 for the Electricity Production sector are included here for completeness only and were not included when determining the county's total GHG emissions. Electricity Production includes emissions from electricity consumption from in and outside of the county. Whereas Electricity Consumption only includes electricity consumed within the county. Electricity consumed from outside of the county would be reported by the end user. Therefore, to ensure that double counting is not done the Electricity Production sector will not be included when describing the County's GHG inventory.

Table 3 shows that a large proportion of Kern County's GHG emissions are attributed to the Fossil Fuels Industry sector. The largest subsector was determined to be Oil & Gas Industry – Combustion. A detailed accounting of each sector and subsector is provided in Table 5.

Figure 1 – 2005 GHG Emissions Inventory by Sector



*Does not include those subsectors that sequester GHG emissions from the Agriculture, Forestry and Land Use, and Other Source sectors. These subsectors sequester or consume carbon and are considered reductions.

Forecasted GHG Emissions Inventory

The forecasted GHG emissions inventory was developed by applying methodology specific growth factor to each of the 2005 base year estimates. A growth factor is a means by which a known value can be projected forward to a given year based on a given indicator, such as a county's population, the number of jobs in a given sector, or other economic factors.

During the methodology development process each approach was evaluated to determine the appropriate growth factor to be used to develop the 2020 forecasted GHG emission inventory. The resulting 2020 forecasted GHG emissions have been summarized by sector and are presented in Table 4, below.

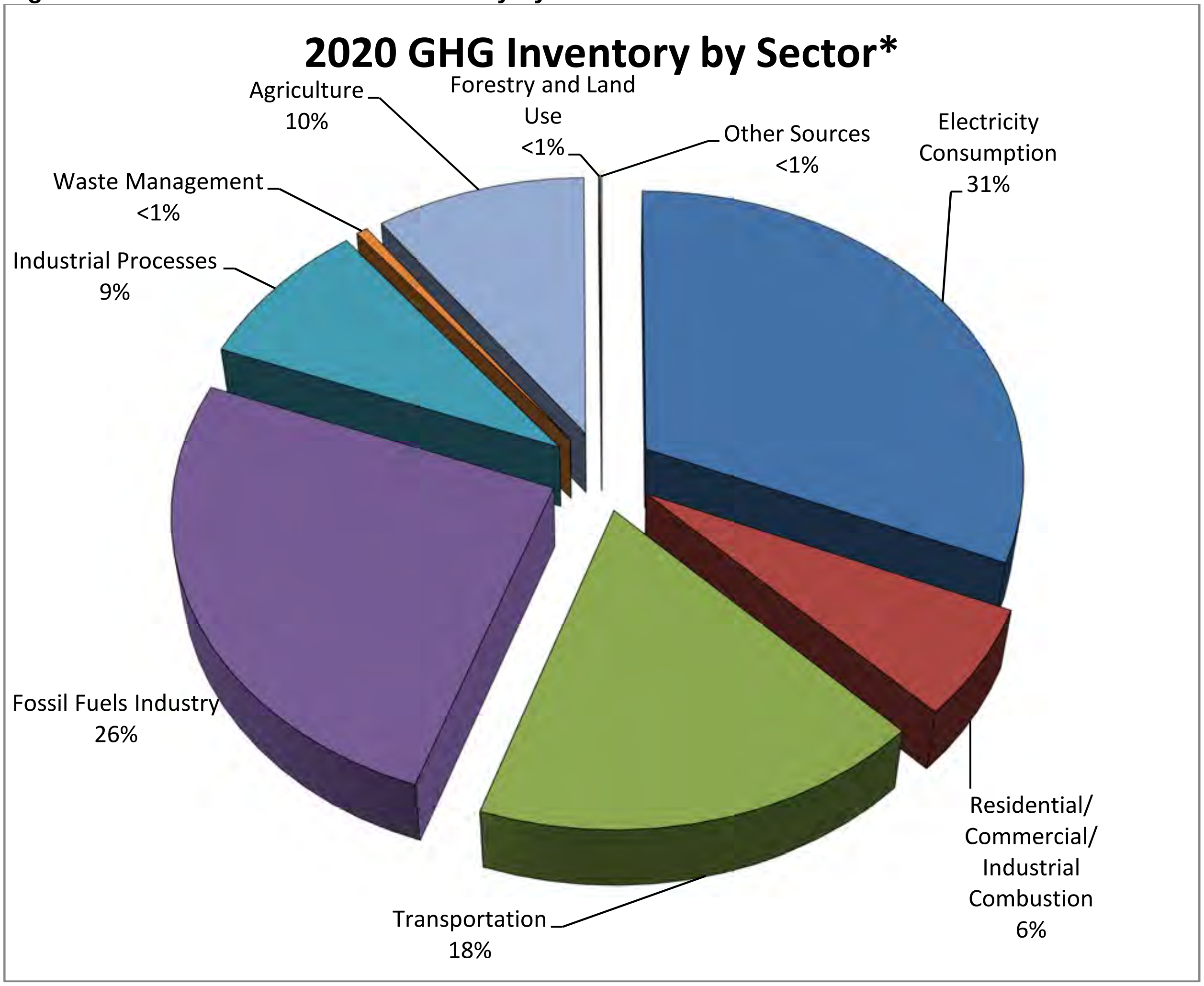
Table 4 - ***Countywide Forecasted GHG emissions inventory for 2020***

Sector ID	Sector Name	Metric Tons of CO_2e	Percent of Total
Total County 2020		**27,272,709***	
A	Electricity Production	18,455,958**	
	Electricity Consumption	8,572,261	31%
B	Residential/ Commercial/ Industrial Combustion	1,689,414	6%
C	Transportation	4,823,756	18%
D	Fossil Fuels Industry	7,002,009	26%
E	Industrial Processes	2,348,754	9%
F	Waste Management	146,788	1%
G	Agriculture Fugitives	2,652,616	10%
H	Forestry and Land Use	14,669	<1%
I	Other Sources	22,442	<1%
County Total Sequestration		**3,293,373**	
G	Agriculture Fugitives	386,575	12%
H	Forestry and Land Use	2,073,706	63%
I	Other Sources	833,092	25%

** Does not include the subtraction of sequestering sectors*
*** Included for completeness only, not included in further descriptions of the County's emissions.*

Table 4 shows that a largest proportion of Kern County's 2020 Forecasted GHG emissions are attributed to Electricity Consumption. A detailed accounting of each sector and subsector is provided in Table 5 below.

Figure 2 – 2020 GHG Emissions Inventory by Sector



*Does not include those subsectors that sequester GHG emissions from the Agriculture, Forestry and Land Use, and Other Source sectors. These subsectors sequester or consume carbon and are considered reductions.

Detailed GHG Emissions Inventory by Sector and Subsector

This section provides a detailed accounting of the 2005 base year and 2020 forecasted GHG emissions inventories prepared for the County of Kern. For a detailed explanation of each subsector and how emissions were derived for each, please refer to Appendix A through I.

Table 5 Detailed accounting for the 2005 base year and 2020 forecasted year by sector and subsector.

Sector ID	Sector Name and Subsector ID			Metric Tons of CO_2e		Increase/Decrease 2005 to 2020	
				2005	2020	Metric tons of CO_2e	Percent
	Total County*			**27,045,617**	**27,272,709**	**227,092**	**0.8%**
A.	**Electricity****			**6,039,114**	**8,572,261**	**2,533,147**	**41.9%**
	1.	In-County Electricity Production***		**13,002,127**	**18,455,958**	**5,453,831**	**41.9%**
		a.	Coal/Coke	1,017,625	1,444,475	426,850	41.9%
		b.	Natural Gas	11,974,819	16,997,739	5,022,920	41.9%
		c.	Petroleum	0	0	0	0.0%
		d.	Waste/Biogas	9,683	13,744	4,061	41.9%
		e.	Renewable	0	0	0	0.0%
	2.	In-County Electricity Consumption		6,039,114	8,572,261	2,533,147	41.9%
B.	**Residential/Commercial/Industrial Combustion**			**1,281,498**	**1,689,414**	**407,916**	**31.8%**
	1.	Residential					
		a.	Coal/Coke	85	121	36	42.4%
		b.	Natural Gas	517,238	734,197	216,959	41.9%
		c.	Oil	421	598	177	42.0%
		d.	Wood	1,350	1,435	85	6.3%
		e.	LPG	51,863	73,617	21,754	41.9%
		f.	Kerosene	787	1,117	330	41.9%
	2.	Commercial					
		a.	Coal/Coke	462	634	172	37.2%
		b.	Natural Gas	304,138	417,246	113,108	37.2%
		c.	Oil	10,249	14,061	3,812	37.2%
		d.	Wood	63	86	23	36.5%
		e.	LPG	7,300	10,015	2,715	37.2%
	3.	Industrial					
		a.	Coal/Coke	66,723	75,115	8,392	12.6%
		b.	Natural Gas	212,590	239,329	26,739	12.6%
		c.	Oil	92,836	104,513	11,677	12.6%
		d.	Wood	998	1,124	126	12.6%
		e.	LPG	14,395	16,206	1,811	12.6%

Sector ID	Sector Name and Subsector ID			Metric Tons of CO_2e		Increase/Decrease 2005 to 2020	
				2005	2020	Metric tons of CO_2e	Percent
C.	**Transportation**			**4,569,913**	**4,823,756**	**253,843**	**5.6%**
	1.	On-road Gasoline		2,169,003	2,082,460	-86,543	-4.0%
	2.	On-road Diesel		2,037,828	2,291,179	253,351	12.4%
	3.	Off-road Gasoline		34,578	44,174	9,596	27.8%
	4.	Off-road Diesel		See B.1.c, B.2.c, B.3.c			
	5.	On-road CNG		30,130	40,412	10,282	34.1%
	6.	On-road LPG		5,472	7,339	1,867	34.1%
	7.	Marine Vessels/Water Craft		21,879	27,951	6,072	27.8%
	8.	Rail		169,150	185,637	16,487	9.7%
	9.	Airports		101,873	144,604	42,731	41.9%
D.	**Fossil Fuels Industry**			**10,928,153**	**7,002,009**	**-3,926,144**	**-35.9%**
	1.	Oil & Gas Industry - Refining					
		a.	Natural gas & waste gas	9,031,180	5,685,541	-3,345,639	-37.0%
		b.	Residual oil	361	227	-134	-37.1%
		c.	LPG	115	72	-43	-37.4%
	2.	Fugitives - Oil & Gas Refining		1,263,434	829,832	-433,602	-34.3%
	3.	Venting - Petroleum Production		429,036	288,986	-140,050	-32.6%
	4.	Fugitives - Natural Gas Transmission/Distribution		87,234	123,825	36,591	41.9%
	5.	Refining Processes		116,793	73,526	-43,267	-37.0%
E.	**Industrial Processes**			**1,852,124**	**2,348,754**	**496,630**	**26.8%**
	1.	Cement Manufacturing		1,503,630	1,854,082	350,452	23.3%
	2.	Lime Manufacturing		0	0	0	0.0%
	3.	Semiconductor Manufacturing		0	0	0	0.0%
	4.	Substitutes for Ozone Depleting Substances (ODS)		261,351	370,976	109,625	41.9%
	5.	SF_6 from Electrical Distribution and Transmission		59,128	83,930	24,802	41.9%
	6.	CO_2 Consumption		3,337	4,737	1,400	42.0%
	7.	Limestone & Dolomite Consumption		18,179	25,804	7,625	41.9%
	8.	Soda Ash Consumption		6,499	9,225	2,726	41.9%
	9.	Hydrogen Production		0	0	0	0.0%
	10.	Coal Mining Operations		0	0	0	0.0%

Sector ID	Sector Name and Subsector ID		Metric Tons of CO_2e		Increase/Decrease 2005 to 2020	
			2005	2020	Metric tons of CO_2e	Percent
F.	**Waste Management**		**120,494**	**146,788**	**26,294**	**21.8%**
	1.	Landfills	60,509	71,845	11,336	18.7%
	2.	Wastewater Management	59,985	74,943	14,958	24.9%
G.	**Agriculture*** **		**2,024,470**	**2,652,616**	**628,146**	**31.0%**
	1.	Fuel Combustion	74,511	69,751	-4,760	-6.4%
	2.	Enteric Fermentation	633,214	866,165	232,951	36.8%
	3.	Manure Management	741,173	1,107,528	366,355	49.4%
	4.	Ag Burning	2,306	2,159	-147	-6.4%
	5.	Ag Soils - Livestock	186,310	244,778	58,468	31.4%
	6.	Ag Soils - Liming	3,777	3,536	-241	-6.4%
	7.	Ag Soils - Fertilizer	241,509	226,080	-15,429	-6.4%
	8.	Ag Soils - Crops	141,670	132,619	-9,051	-6.4%
	9.	Carbon Flux	-412,957	-386,575	26,382	-6.4%
H.	**Forestry and Land Use**** **		**11,028**	**14,669**	**3,641**	**33.0%**
	1.	Forested Landscape	-2,073,706	-2,073,706	0	0.0%
	2.	Non-Farm Fertilizer (Settlement Soils)	8,680	12,321	3,641	41.9%
	3.	Wildfires	1,828	1,828	0	0.0%
	4.	Range Improvement	0	0	0	0.0%
	5.	Prescribed Burn	520	520	0	0.0%
	6.	Hazard Reduction Burn	0	0	0	0.0%
I.	**Other Sources**** **		**218,823**	**225,455**	**6,632**	**3.0%**
	1.	Composting	-494,994	-702,623	-207,629	41.9%
	2.	Resource Recovery	-41,681	-59,164	-17,483	41.9%
	3.	US Parks/Forests	-50,234	-71,305	-21,071	41.9%
	4.	Military Bases (Aircraft)	203,013	203,013	0	0.0%
	5.	Nitrogen Deposition	15,810	22,442	6,632	41.9%

* *Does not include the subtraction of sequestering sectors*
** *Does not include the Electricity Production sector as noted previously*
*** *Included for completeness only, not included in further descriptions of the County's emissions.*
****Does not include sequestering sectors noted by a negative sign*

Appendices

Appendix A. Electricity Production and Consumption
Appendix B. Residential, Commercial, Industrial Combustion
Appendix C. Transportation
Appendix D. Fossil Fuels Industry
Appendix E. Industrial Processes
Appendix F. Waste Management
Appendix G. Agriculture
Appendix H. Forestry and Land Use
Appendix I.   Other Sources