Inventory of New Mexico Greenhouse Gas Emissions: 2000 - 2007

Prepared by the New Mexico Environment Department

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List of Figures

List of Tables

Appendices

List of Acronyms and Key Terms

Ag	Agricultural
BACT	Best Available Control Technology
BBER	Bureau of Business and Economic Research
CaO	Calcium Oxide
$CaCO_3$	Calcium Carbonate
CAA	Clean Air Act
CAMD	Clean Air Markets Division
CARB	California Air Resources Board
CCAG	Climate Change Advisory Group
CBM	Coal Bed Methane
CCR	California Code of Regulations
CCS	Center for Climate Strategies
CEMS	Continuous Emissions Monitoring
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalence
EPA EGRID	Environmental Protection Agency Emissions & Generation Resource Integrated Database
EE	Energy Efficiency
EI	Emissions Inventory
EIA	Energy Information Administration
EIIP	Emissions Inventory Improvement Project
EO	Executive Order
EPA	US Environmental Protection Agency
FF	Fossil Fuel

GHG	Greenhouse Gases
GTE	Gas to Energy
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
LFGTE	Landfill Gas to Energy
MCF	Methane Conversion Factors
$MMTCO_2$	Million Metric Tonnes Carbon Dioxide
$MMTCO_2e$	Million Metric Tonnes Carbon Dioxide Equivalent
$MTCO_2e$	Metric Tonnes Carbon Dioxide Equivalent
MPG	Miles per Gallon
MSW	Municipal Solid Waste
MW	Megawatt
N	Nitrogen
NASS	National Agricultural Statistics Service
NM	New Mexico
NMDOT	New Mexico Department of Transportation
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMOG	Non-methane Organic Gas
N_2O	Nitrous Oxide
NOx	Nitrogen Oxides
O_2	Oxygen
O&G	Oil and Gas Sector
ODS	Ozone Depleting Substances
PFCs	Perfluorocarbons
PRC	Public Regulation Commission
RCI	Residential Commercial Industrial
REC	Renewable Energy Certificate
RPS	Renewable Portfolio Standard
SB	Senate Bill
SCR	Selective Catalytic Reduction
SEDS	State Energy Data System
SIT	State Inventory Tool
SF_6	Sulfur Hexafluoride
TCR	The Climate Registry
TEPPCO	Texas Eastern Products Pipeline Company
TWG	Technical Work Group
US	United States
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
USGS	United State Geological Survey
WCI	Western Climate Initiative
WRAP	Western Regional Air Partnership

Executive Summary

This document, Inventory of New Mexico Greenhouse Gas (GHG) Emissions: 2000-2007 (hereafter referred to as 2007 Update), is a statewide compilation and analysis of GHG emissions data. The 2007 Update has been compiled as mandated in Governor Bill Richardson's Executive Orders (2005-033 & 2006-69) to provide an update regarding trends of greenhouse gas emissions in the state. This report will be updated on a quadrennial basis to evaluate statewide GHG emissions on a sector basis, providing information for decision makers to gain a broad perspective about the relative contribution of each sector as it relates to the State's GHG portfolio. The data, analysis and trends derived from this report will help inform future climate change policy.

Governor Richardson's Administration is at the forefront of states that are addressing climate change. The Governor convened a Climate Change Advisory Group (CCAG) in 2005 that made 69 recommendations to address climate change. The development of a statewide emissions inventory every four years is required by Executive Order 2006-69.[1] The impact that climate change has on the state's economy, environment and public welfare is paramount. Data collected from GHG emitting sectors and their relative contribution to New Mexico's total GHG emissions is important for future policy making. The data, analysis and comparison to the CCAG Report (hereafter referred to as the CCAG Report) facilitate this understanding.

This report discusses GHG emissions, significant issues, trends, and uncertainties from each of the following primary sectors of GHG emissions:

- Fossil fuel combustion
- Fossil fuel industry
- Electricity production
- Transportation
- Residential, commercial and industrial energy consumption
- Industrial processes
- Agriculture
- Waste management

As an initial step to identify trends and to evaluate the last four years of data, the report authors reviewed the methodologies used in the 2004 inventory developed for the CCAG under contract by the Center for Climate Strategies (CCS). However, for some sectors it was difficult if not impossible to mirror the original report methodology because of the proprietary nature of the tools used by the contractor. This 2007 Update relies heavily on the United States Environmental Protection Agency (US EPA or EPA) State Inventory Tool (SIT) and input data from the Energy Information Administration (EIA). The use of these data will ensure that future updates to the State Inventory are compiled with similar methods so that trend analyses and comparisons are meaningful. For purposes of

[1] For information regarding New Mexico's Climate Change efforts and links to the Governor's Executive Orders, see http://www.nmenv.state.nm.us/cc/

comparison, the CCAG emissions estimates for 1990 and 2000 are provided in Table 2 alongside updated estimates for 2000 and 2007. Since the release of the CCAG Report, EPA has made several changes to the SIT, and EIA data are routinely revised. This trend will continue as EPA and states refine emissions data and calculation methodologies.

Although the focus of this report is to provide a top-down inventory, bottom-up data are included. Top-down data (e.g. statewide fuel consumption) are used to estimate emissions from a broad cross section of GHG emitting sources, whereas bottom-up data are estimated from specific emitting unit(s) (e.g., a facility with an air permit). The year 2008 marked the first year for which NMED received GHG reporting data from the largest sources of air pollutants that it regulates (e.g., sources that are subject to the Title V air permitting program[2]). A list of NMED regulated Title V sources emitting 10,000 metric tons or greater CO_2 from combustion and a pie chart highlighting relative contributions of the electric, oil and gas and industrial sectors are found in Section 9 of this report. The development of more robust mandatory reporting required by state and federal rules will facilitate enhanced understanding of the GHG emitting sectors where data can be gathered by source operators.

New Mexico's total GHG emissions are dominated by electricity production and consumption, fossil fuel industry and transportation sectors. Emissions from the residential, commercial and (non-fossil fuel production) industrial sectors are also proportionally significant, with an increase in the use of Ozone Depleting Substitutes (ODS) and relatively steady production in the semi-conductor industry. The Industrial, Agriculture and Waste Management sectors are relatively small contributors to total GHG emissions.

<u>Summary of New Mexico GHG Emissions Trends 2000 – 2007</u>

- After a 3% annual GHG emissions growth rate experienced from 1990 to 2000, the total (gross) direct emissions in New Mexico remained essentially level from 2000 to 2007. The variation in the updated emissions estimates for 2000 and 2008 (about a 1% total decrease over that period) is well with in the margin of error associated with the data (see Table 2). Emissions remained level despite a 6.7%[3] growth in New Mexico's population over that period.
- The largest sources of GHG emissions in 2007 were electricity production (41%), the fossil fuel industry (22%) and transportation fuel use (20%).
- 2007 per capita emissions on a consumption basis were 35 $MtCO_2e$ per person.
- Fossil fuel industry (production, processing and transportation of natural gas, oil and coal) 2007 emissions were 16.9 $MMTCO_2e$, a decrease of 13% from emissions year 2000.
- Approximately 90% of electricity production emissions are from coal-fired power plants.

[2] A Title V source has the potential to emit 100 or more tons per year of any criteria pollutant, or 10 tons per year of any one hazardous air pollutant, or 25 or more tons of combined hazardous air pollutants listed in Section 112b of the Clean Air Act.

[3] From the US Census Bureau's annual population estimates from 4/1/00 to 7/1/07 (NST-EST2007), released 12/27/07

- $MTCO_2e$/MW-hr production decreased by 7.5% from 2000 to 2007 reflecting increases in electricity production from lower emitting renewable and natural gas electric generating sources.
- GHG emissions from the transportation sector increased 12% reflecting increased freight traffic and increased state population.
- Both the waste management and agricultural sectors showed small total increases in GHG emissions (0.6 and 0.4 $MMtCO_2e$), respectively).
- The total emissions from energy consumption in the commercial sector fluctuated, ending with 2007 emissions at 2000 levels.
- The use of ODS substitutes is now the leading source of GHG emissions from the industrial sector.

1 Inventory of New Mexico Greenhouse Gas Emissions, 2000-2007

1.1 Introduction

This report presents estimates of historical New Mexico anthropogenic GHG emissions for the period from 2000 to 2007. This information has been compiled to support and inform efforts to address anthropogenic climate change, including those of the Climate Change Action Implementation Team, which was created by Executive Order 2006-69 – *New Mexico Climate Change Action*[4]. In some cases, estimates of emissions from 1990 to 2000 have also been included for purposes of evaluating longer term trends. Emissions by sector are reported in Sections 2 through 8. Key findings and summaries of trends are reported in Sections 1.2 to 1.5. The emissions estimation approaches and variations from methods used in the CCAG Report are discussed in Section 1.6.

This analysis updates the historical data available in the report *New Mexico Greenhouse Gas Inventory and Reference Case Projections, 1990-2020*, released by the New Mexico Climate Change Advisory Group (CCAG) in November 2006[5]. That report included historical GHG emissions data through 2003 and projections of emissions for 2004 through 2020. Executive Order 2006-69 directed the New Mexico Environment Department (hereafter referred to as the Department) to update the statewide greenhouse gas emissions estimate every four years. This report includes four additional years of now historical information. Historical data required to estimate emissions for the year 2008 was not available when this report was written.

This report covers the six gases included in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these greenhouse gases are presented using a common metric, CO_2 equivalence (CO_2e), which indicates the relative contribution of each gas to global average radiative forcing by weighting them using the Global Warming Potential (GWP) established for each gas. The CCAG Report included an extensive discussion of global warming potentials in Attachment D-9 of that report. Table 1 lists the GWP used in this report.

[4] See link at http://www.nmenv.state.nm.us/cc/
[5] See link at http://www.nmenv.state.nm.us/cc/

Table 1 Global Warming Potentials Used in this Report

Gas	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
HFC-23	11,700
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,000
C_6F_{14}	7,400
SF_6	23,900

Source: IPCC (1996)

Unlike the CCAG Report, this estimate does not include emissions sinks. The only sink considered in the CCAG Report was net sequestration by forested lands, and the key source of data for this estimate was a Forest Inventory Analysis survey conducted by the USDA Forest Service. The most recent survey conducted was in 1997, and therefore the available data does not reflect the impact of major fires and forest dieback in more recent years. NMED therefore concluded that simply repeating the earlier value from the CCAG Report would be misleading.

Also unlike the 2006 report, this estimate does not include emissions projections. Projections are developed based on a range of assumptions, which assume that past trends can predict future activities. In some cases these predictions are met. However, current uncertainties regarding the federal GHG program and instability of fuel prices and the economy do not allow the Department to develop valid projections regarding future GHG emissions.

This report and the CCAG report are among several that include emissions estimates related to New Mexico sources. Other reports include:

- The Draft Albuquerque City-wide and Bernalillo County Greenhouse Gas Emissions Inventory (2009 Update)[6].
- The US Environmental Protection Agency's annual Inventory of US Greenhouse Gas Emissions and Sinks[7].

In addition to GHG emissions inventories developed by local, state and federal agencies to estimate regional emissions, a growing number of companies are developing GHG emissions inventories either voluntarily[8] or to meet regulatory reporting requirements. In

[6] http://www.cabq.gov/airquality/
[7] http://www.epa.gov/climatechange/emissions/index.html#inv
[8] Voluntary reporting may be accomplished under a number of programs. The most comprehensive is The Climate Registry (http://www.theclimateregistry.org/).

New Mexico (exclusive of Indian Lands and Bernalillo County), larger emissions sources have reported 2008 CO_2 combustion emissions to the New Mexico Environment Department. A summary of these emissions reports is included here as Section 9. Reports of 2009 CO_2 and methane emissions will be submitted in 2010. The US EPA has recently promulgated a mandatory GHG reporting rule that applies to emissions beginning with emissions year 2010, to be reported in 2011.

1.2 Summary of Key Findings and Trends

As with the CCAG report, this report utilizes several approaches to evaluate emissions of greenhouse gases in New Mexico. As discussed in Sections 1.3 to 1.5, emissions can be evaluated on a production basis, consumption basis or per capita basis. Each approach can offer insights regarding emissions patterns and trends in the state. In addition, sector-specific information may be found in Sections 2 through 8.

In summary, for the period 2000-2007:

- The largest sources of GHG emissions in 2007 were electricity production (41%), the fossil fuel industry (22%) and transportation fuel use (20%). This ranking is consistent with emissions estimations for the years 1990 and 2000.
- After a 3% annual GHG emissions growth rate experienced from 1990 to 2000, the total (gross) direct emissions in New Mexico remained essentially level from 2000 to 2007. The variation in the updated emissions estimates for 2000 and 2008 (about a 1% total decrease over that period) is well with in the margin of error associated with the data (see Table 2). Emissions remained level despite a 6.7% growth in New Mexico's population over that period.
- Consistent with the CCAG Report, this report estimates the per capita emissions for the state on a consumption basis (see Section 1.4). For 2007, the per capita emissions for New Mexico were 35 $MtCO_2e$ per person (see Section 1.5).
- Estimations for emissions from the fossil fuel industry (production, processing and transportation of natural gas, oil, and coal) showed a slight decrease from 2000 (19.1 $MMTCO_2e$) to 2007 (16.9 $MMTCO_2e$). However, significant uncertainty exists regarding emissions estimates for this sector due to inadequate data. In addition, the 2007 estimate may also reflect changes in estimation methodology and data sources for some subsectors. Emissions estimates for this sector are described in Section 2. One trend noted is a five-fold increase in methane emissions from coal mining, which now comprise about 6.5% of the estimated emissions from the fossil fuel industry sector.
- Emissions from electricity generation are due predominantly to coal-fired power plants, which contribute approximately 90% of the total GHG emissions for this sector (see Section 3). However, the emissions per megawatt-hour of electricity produced have decreased by almost 7.5% since 2000, due to increases in the use of natural gas, wind and solar energy to produce electricity.
- GHG emissions from the transportation sector increased 12% (see Section 4). This increase was due to a combination of factors, including increased freight traffic and increased state population. Emissions from diesel fuel use increased by 28% during this period, and the estimated emissions from gasoline consumption increased by 4%.

- While the state population grew 6.7% from 2000-2007 (see Sections 1.4 and 1.5), New Mexicans reduced their average (per capita) emissions from gasoline use by 2.5% and increased their consumption of energy in heating, cooling and power residential buildings by 6%. Over time, energy use in residential and commercial buildings has shifted away from fossil fuel combustion (predominantly natural gas) in favor of electricity use. The increase in electricity use may be the result of a greater use of air conditioning, electric heat, and appliances.
- The total emissions from energy consumption in the commercial sector fluctuated, ending with 2007 emissions at 2000 levels.
- The estimates for 2007 total emissions from industrial processes (i.e., emissions not associated with combustion) are only slightly higher than the 2000 emissions, 1.5 $MMTCO_2e$ vs. 1.4 $MMTCO_2e$, respectively. The use of ODS substitutes is now the leading source of GHG emissions from the industrial sector, replacing GHG emissions from semiconductor manufacturing. The contribution from the various sub-categories is reported in Section 6.
- Both the waste management and agricultural sectors showed small total increases in GHG emissions (0.6 and 0.4 $MMTCO_2e$, respectively). These estimates do not include emissions from consumption of fossil fuels (e.g., transportation, equipment operation, heaters, etc.).

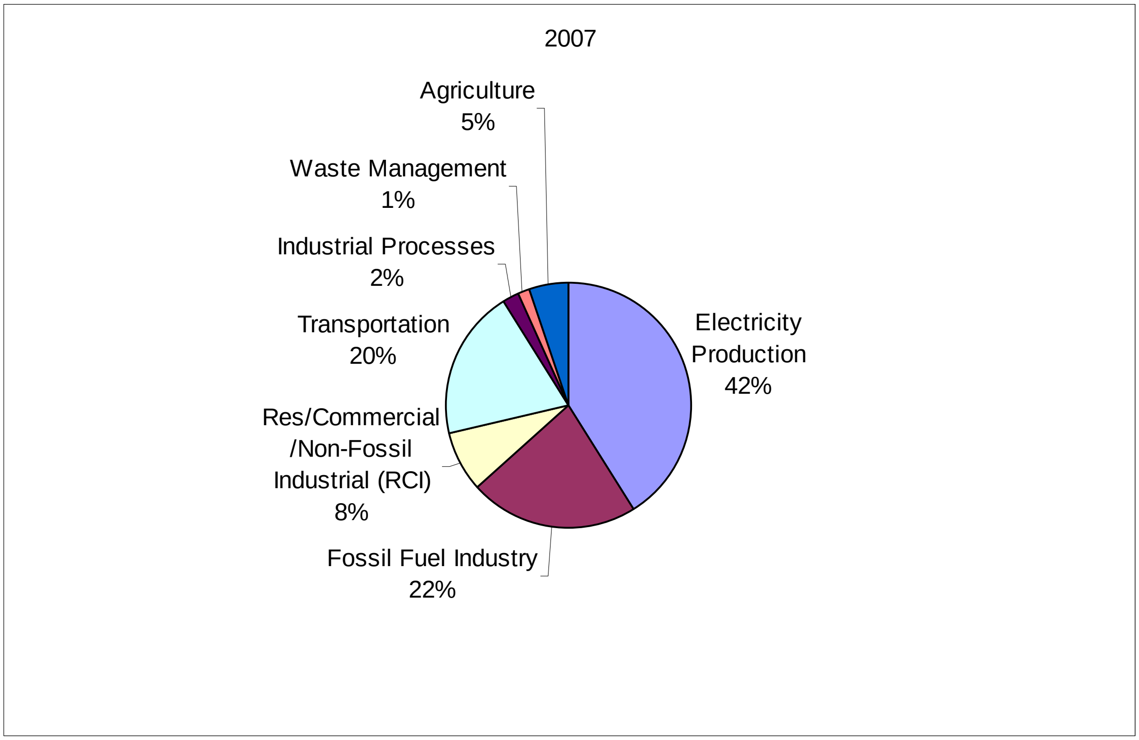
1.3 Evaluating Emissions on a Production Basis

To evaluate emissions on a production basis one must consider the total (gross) direct emissions from the activities of all sources in the state. A production-based analysis does not take into consideration the GHG emissions produced during the manufacture and transportation of products to the state, or adjust for the GHG emissions associated with electricity imported or exported across state lines. Table 2 summarizes the total direct emissions estimated in Sections 2 through 8 for each sector and Figure 1 illustrates the GHG emissions by sector. Note that while the estimates are rounded to one decimal point, the sums are based on the estimates prior to rounding and so might not reflect the sum of the rounded estimates. Table 1 provides the CCAG emissions estimates for 1990 and 2000, as well as the updated estimates for 2000 and 2007 using the methods described in this report.

Table 2 GHG Emissions for New Mexico Production Basis

GHG Emissions for New Mexico - Production Basis (Million Metric Tons CO2e)	1990 CCAG Estimate	2000 CCAG Estimate	2000 NMED Estimate	2007 NMED Estimate
Electricity Production	29.3	33.0	31.9	31.4
Coal	27.9	30.5	29.0	28.1
Natural Gas	1.4	2.5	2.9	3.3
Petroleum	0.0	0.0	0.0	0.0
Residential/Commercial /Non-Fossil Industrial (RCI)	7.0	7.3	6.6	6.2
Coal	0.1	0.2	0.2	0.2
Natural Gas	3.8	4.6	4.6	3.9
Petroleum	3.1	2.5	1.8	2.2
Transportation	11.0	14.2	13.5	15.1
Fossil Fuel Industry	15.2	19.5	19.3	16.9
Natural Gas Industry	12.7	17.0	17.2	13.9
Production	3.7	5.4	5.3	4.3
Processing	3.4	7.9	8.4	7.6
Transmission	5.2	3.3	3.3	1.6
Distribution	0.4	0.4	0.3	0.4
Oil Industry	2.3	2.3	1.9	1.9
Production	0.7	0.7	0.9	0.9
Refineries	1.6	1.6	1.0	1.0
Coal Mining (Methane)	0.2	0.2	0.2	1.1
Industrial Processes	0.5	1.5	1.5	1.5
ODS Substitutes	0.0	0.5	0.5	0.7
PFCs in Semi-conductor Ind.	0.1	0.5	0.5	0.2
SF6 from Electric Utilities	0.2	0.1	0.1	0.1
Cement & Other Industry	0.2	0.4	0.4	0.5
Waste Management	0.1	1.3	0.5	1.1
Solid Waste Management	0.0	1.0	0.3	0.9
Wastewater Management	0.1	0.3	0.2	0.2
Agriculture	2.3	6.0	3.6	4.0
Manure Management Mgmt & Enteric Fermentation (CH4)	1.8	3.5	3.1	3.5
Agricultural Soils (N2O)	0.5	2.4	0.5	0.5
Total Gross Emissions	65.3	82.7	77.0	76.2

Figure 1: 2007 New Mexico GHG Emissions by Sector



1.4 Evaluating Emissions on a Consumption Basis

The majority of GHG emissions in New Mexico are the result of the coal-based electricity generation and fossil fuel industries, a significant fraction of which meets the needs in other states. As noted in the CCAG Report, this situation raises an important question with respect to how these emissions should be addressed from an accounting and policy basis. Section 1.3 presents New Mexico emissions on a production basis, which is to say the total gross emissions of GHG from New Mexico. Another approach is to evaluate New Mexico emissions on a consumption basis, which would reflect the emissions resulting from the consumption of energy (both fossil fuels and electricity) in each sector.

Reporting on a consumption basis has the advantage of showing the extent to which GHG reduction initiatives and other influences have changed energy consumption patterns in the state, to better inform policy makers who may be evaluating future initiatives. In addition, the 'carbon footprint' of each sector is more accurately presented by including the emissions that occurred as a result of the electricity consumption by that sector[9], along with each sector's direct emissions from combustion and process emissions. In a consumption-based evaluation of emissions, the emissions from electricity production are attributed to the sectors within the state that consume the electricity, with the emissions

[9] The 'carbon content' of electricity used in New Mexico is estimated in this report (as in the CCAG report) as the total emissions from electricity production in the state in a given year, divided by the total electricity produced in the state during that year. While the carbon content of imported electricity may be different, data are not available for estimating imported electricity. However, imported electricity accounts for only a small portion of electricity use in New Mexico.

that occurred during production of exported electricity reported as a separate category within the industrial sector. Thus the total emissions reported in Section 1.3 are included in this evaluation, although the attribution shifts.

Figure 2 illustrates the consumption based emissions in New Mexico for the years 1990, 2000 and 2007. This figure divides emissions into (1) transportation emissions (which include emissions from fleets, farm equipment, and personal transport), (2) emissions from energy use in buildings, and (3) emissions from the industrial sector (not including fleets). These represent the three general areas of activity that result in GHG emissions.

Figure 2 Consumption Based GHG Emissions

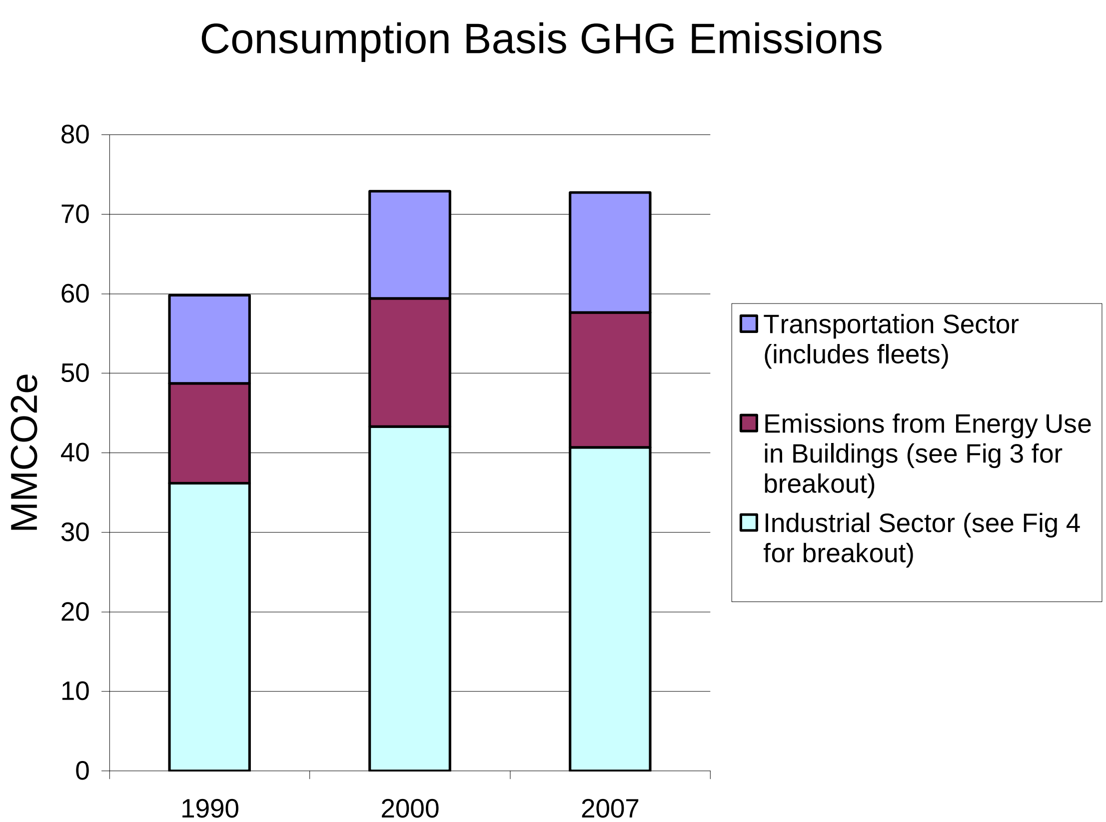


Figure 15 (in Section 4, which further discusses the transportation sector) compares emissions from diesel, gasoline and aviation fuels from 2000 to 2007. During the period 2000-2007, the estimated emissions from gasoline consumption increased by 4%. However, during this time, the state population grew 6.7%[10], resulting in a 2.5% drop in per capita emissions from gasoline use. Several factors may have contributed to this drop of average gasoline usage per person. As newer vehicles are purchased, the average gas mileage rate for vehicles in the state may have improved, and increases in gasoline prices

[10] From the US Census Bureau's annual population estimates from 4/1/00 to 7/1/07 (NST-EST2007), released 12/27/07.

and use of public transportation may have resulted in less driving. However, data that would support or quantify such trends is not available at the time of this report.

Emissions from diesel fuel use rose by 28% between 2000 and 2007. This rise reflects the increase in freight traffic anticipated in the New Mexico 2025 Statewide Multimodal Transportation Plan (released in 2005) and reflected in CCAG projections. The Transportation Plan estimated that 85% of commercial traffic on I-10 and I-40 was simply crossing the state, without delivering or picking up any freight, and anticipated that such freight traffic would increase over time because these interstate highways connect to Southern California.

Figure 3 provides greater detail regarding emissions that result from energy use in buildings. These emissions are attributed to the residential and commercial sectors, which consume energy to heat and cool buildings and to power lights and appliances. As shown in Figure 3, electricity use accounts for a larger share of GHG emissions in these sectors than the direct combustion of fossil fuels. Between 2000 and 2007, the indirect emissions from the consumption of electricity in the residential and commercial sectors increased by 22% and 1%, respectively, and the indirect emissions from the consumption of electricity in the industrial sector (including the fossil fuel industry) increased by 19%. Taking electricity consumption into account, the residential sector increased emissions from energy use by a total of 13% (taking into account the state's growing population, this is a per capita increase of 6%). During the same period, the total emissions from energy consumption in the commercial sector remained constant. The RCI sector is further discussed in Section 5.

Figure 4 provides greater detail regarding emissions that result from activities in the industrial sector. These activities are further discussed in Section 2 (Fossil fuel Industry), Section 5 [Emissions from Fossil Fuel Combustion in the Residential, Commercial, and (Non-Fossil Fuel Industry) Industrial Sectors] and Sections 6 through 8 (which estimate process emissions). Emissions from the production of electricity are addressed in Section 3.

Figure 3 Consumption Basis Emissions from Energy Use in Buildings

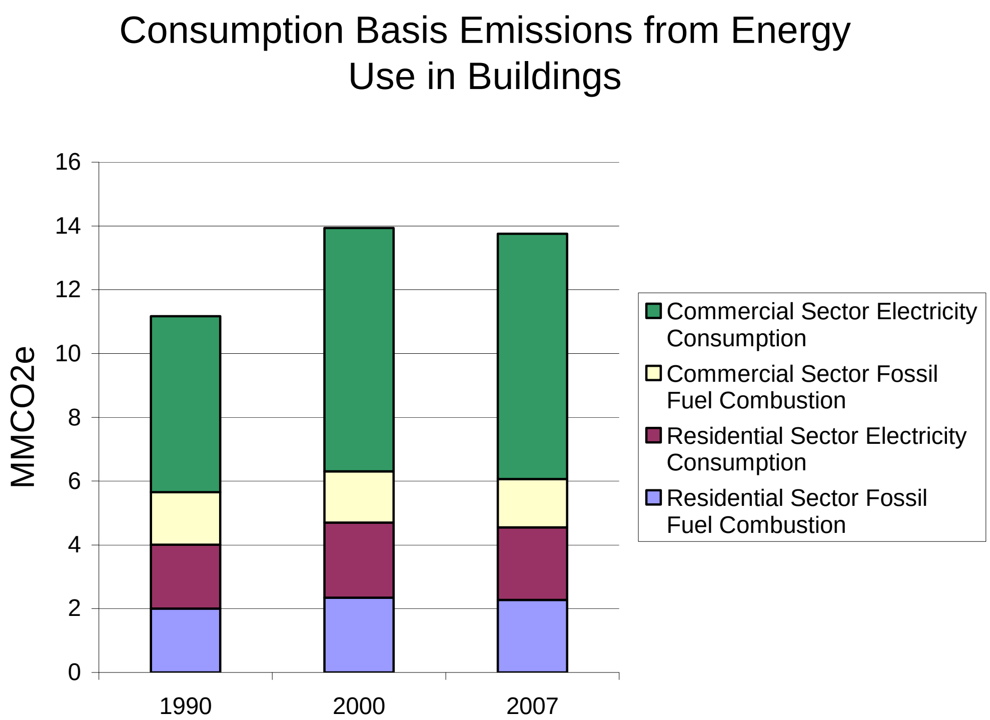
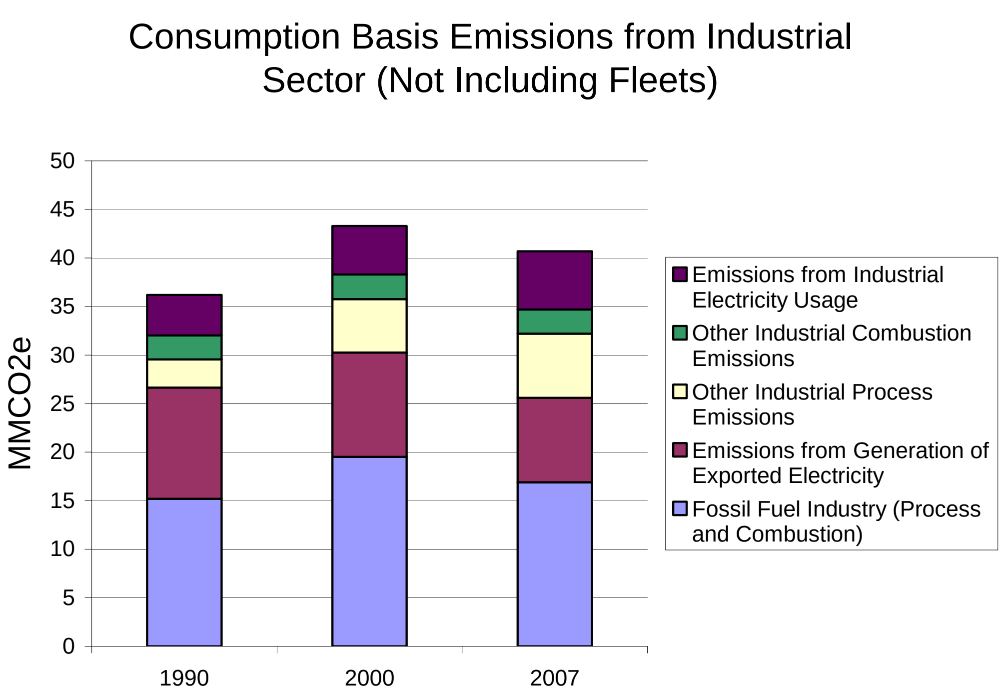


Figure 4 Consumption Basis Emissions from Industrial Sector



1.5 Evaluating Emissions on a Per Capita Basis

Per capita emissions estimates do not reflect the sum of the carbon footprints of the residents of that locality. In addition to in-state electricity and fuel use, the carbon footprint of an individual or family includes emissions that result from out-of-state travel and the emissions that result from the manufacture and transport of products purchased by that individual or family[11]. Conversely, a per capita estimate of emissions in a state divides the total emissions from residential, commercial, transportation and industrial emissions by the population of the state. By doing so, per capita emissions estimates remove the factor of increasing state population from emissions comparisons.

In New Mexico, the total State GHG emissions includes those that result from producing significant amounts of electricity used by consumers in other states, and significant emissions from the production, refining and transport of oil and natural gas. When comparing the per capita emissions of different states, to include emissions associated with exported electricity in the per capita estimate for New Mexico may cause those emissions to be double counted, because the per capita emissions for electricity importing states are likely to take into account the emissions from production of the imported electricity[12]. Thus, this report, consistent with the CCAG Report, estimates per capita emissions as the sum of the total emissions less the emissions associated with production of exported electricity, divided by the state population. For 2007, the per capita emissions for New Mexico were 35 metric tons of CO_2e per person.

Data indicate that between 2000 and 2007, New Mexicans reduced their average emissions from gasoline use by 2.5% and increased their consumption of energy in heating, cooling and powering residential buildings by 6% (see Section 1.2 above). Over time, energy use in buildings has trended towards a reduction in fossil fuel combustion (predominantly natural gas) and an increase in electricity use. The increase in electricity use may be the result of a greater use of air conditioning, electric heat, and appliances.

1.6 Emissions Estimation Approach and Variations from Methods in the CCAG Report

In its simplest form, emissions inventories are performed by summing the calculated emissions estimates for the specific source categories that are present. Emissions for specific source categories are estimated by multiplying activity factors (e.g., gasoline purchased, coal consumed) by emissions factors. Emissions factors can be developed using information about chemical properties (e.g., the amount of carbon in a given amount of a particular type of coal) and studies (e.g., the percentage of carbon that is retained in fly ash after combustion of coal). The assumptions used in developing emissions factors can introduce significant uncertainty. Additional uncertainty can be introduced in the activity factors, due to inaccuracies that can be inherent in the measurement process (e.g., vehicle miles traveled in the state, percentage of yard waste in land fills).

[11] http://www.epa.gov/climatechange/emissions/ind_calculator.html
[12] New Mexico both imports and exports electricity, with a net export of electricity produced. See Section 3.

In order to maintain consistency to the extent possible with other emissions estimates, NMED has used the US EPA SIT for state inventories[13] as a starting point. The approach used by the US EPA in its national GHG emissions inventory and guidelines for states was developed based on guidelines from the Intergovernmental Panel on Climate Change[14], the international organization responsible for developing coordinated methods for national GHG inventories. The initial estimates based on the US EPA SIT were then augmented to conform to local data and conditions, as informed by New Mexico-specific source data, experts, and methodologies developed for the CCAG Report.

In cases where data sources may conflict, a higher priority was placed on local and state data analyses, with national data used as defaults where necessary. Priority was also given to larger emissions source categories, such as the fossil fuel production sector, and as a result sectors with relatively small emissions levels may not be reported in the same level of detail as other activities. Specific details regarding estimation of emissions from specific sectors are included in the following sections.

2 Fossil Fuel Industry (Oil, Gas, and Coal)

2.1 Emissions 2000-2007

Total NM GHG emissions from this sector decreased by 2.2 MMTCO_2e from 2000 (19.1 MMTCO_2e) to 2007 (16.9 MMTCO_2e). This reduction is primarily attributable to decreases in methane emissions from natural gas production, processing and transmission.

2.2 Estimation Methodology & Data Sources

The general approach used for this update was to follow the methodologies used in the original CCAG inventory where possible, using updated data for recent years and in some cases recalculated data for years prior to 2004.

For methane emissions from the natural gas and petroleum industries, it was not possible to follow exactly the CCAG methodologies because not all the necessary spreadsheets used in the CCAG inventory were provided to NMED by the contractor. In these cases, we attempted to follow as closely as possible the methods and data sources as generally described in the narrative text of CCAG report.

For the updated emissions in this report, methane emissions from oil and gas operations were calculated for five subsectors:

1) Natural gas production;
2) Natural gas processing;
3) Natural gas transmission;
4) Natural gas distribution; and
5) Oil production and refining.

[13] http://www.epa.gov/climatechange/emissions/state_guidance.html
[14] http://www.ipcc-nggip.iges.or.jp/

For the natural gas subsectors 1 through 3 above, emissions were calculated using the following formula:

Equation 1

$$NM\ emissions = US\ emissions \times \left(\frac{NM\ \ activity}{US\ activity} \right)$$

The activity measures for each subsector are given in Table 3.

Table 3: Activity Measures Used in Calculation of Natural Gas Subsector Methane Emissions

Natural Gas Subsector	**Activity Measure (NM and US)**
Natural Gas Production	Marketed Production Volume
Natural Gas Processing	Volume of Natural Gas Processed
Natural Gas Transmission	Transmission Pipeline Mileage

Data source: US Department of Energy, Energy Information Administration (EIA).

This method is based on the simplistic assumption that emissions per unit of activity are always the same in New Mexico as at the national level, and does not account for any differences in gas reservoir characteristics, operational practices, or implementation of emissions reductions measures.

The values for U.S. emissions in Equation 1 are derived from the US EPA annual GHG emissions inventories. As described in the most recent report[15], methods for estimating methane emissions from the oil and gas industry are periodically revised and emissions values for some earlier years are recalculated. This recalculation of national values alters the values for earlier years in the NM inventory when Equation 1 is used.

The CCAG report described the method for calculating methane emissions from natural gas distribution as following Eq. 1, with natural gas consumption as the activity metric. However, none of the EIA consumption metrics we tested would reproduce the CCAG data for this subsector. Therefore, for this update we used the methods in the SIT. Input data obtained from the US Department of Transportation Pipeline and Hazardous Materials Safety Administration[16] included miles of distribution lines and number of services.

Methane emissions from oil production, refining and transportation (aggregated under the category "Oil Production" in the CCAG report) were calculated using the SIT, which followed the method stated to have been used for the CCAG report. Input data obtained from EIA included oil production and refinery input, with the amount transported assumed to be the same as refinery input.

[15] Annex 3 of the US EPA report "Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007" (April 2009).

[16] http://www.phmsa.dot.gov/portal/site/PHMSA/menuitem.ebdc7a8a7e39f2e55cf2031050248a0c/?vgnextoid=a872dfa122a1d110VgnVCM1000009ed07898RCRD&vgnextchannel=3430fb649a2dc110VgnVCM1000009ed07898RCRD&vgnextfmt=print

Methane emissions from coal mining were obtained from state-specific data in the US EPA report "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007".[17]

Carbon dioxide emissions from fuel combustion were calculated for the following subsectors:

1) Natural gas production;
2) Natural gas processing;
3) Natural gas transmission; and
4) Petroleum refineries.

Key input data for the natural gas industry sources were obtained from EIA: Lease Fuel Consumption (production), Plant Fuel Consumption (processing), and Natural Gas Consumed as Pipeline Fuel (transmission). For petroleum refinery fuel use, the CCAG Report assumed a constant level of fuel use CO_2 emissions (1.6 $MMTCO_2e$ based on permit limits. However, emission reporting of actual fuel use CO_2 emissions for 2008 gave a smaller value of 1.0 $MMTCO_2e$ for estimated total refinery emissions. For this report, we also assumed that fuel use levels were constant, and estimated emissions for 2000 and 2007 at 1.0 $MMTCO_2e$.

An additional source of CO_2 emissions is the venting of CO_2 removed from natural gas during processing. This source is especially significant in the processing of coal bed methane, which in New Mexico commonly contains in excess of 10% CO_2. NMED followed the CCAG methodology in estimating these emissions using a mass balance approach. Emissions were calculated as the product of volume of coal bed methane produced from the San Juan Basin (data from the Oil Conservation Division of the New Mexico Energy, Minerals and Natural Resources Department) and the estimated concentration of CO_2 at the gas plant inlet. CO_2 concentration was estimated by the CCAG inventory using a linear fit to concentration values over the period 1998-2002. NMED was unable to obtain updated CO_2 concentration data for this report, and therefore continued use of the extrapolated values based on the CCAG regression.

2.3 Comparative Analysis

The most significant change in the contribution of major sectors (natural gas, oil, and coal mining methane) from the CCAG Report data to the 2007 Update is the increase in the percentage of fossil fuel industry emissions from coal mining methane (see Figure 5).This source of emissions had already begun a sharp increase from 2000 to 2003, and the increase continued through 2005 (see Figure 6). Total coal production in New Mexico has decreased slightly since 2000,[18] but a new underground mine was developed at the site of a former surface mine[19]. Underground mine production rose from near zero in 2000 to around 27-28% of total production in 2004-2008[20]. Ventilation and degasification

[17] Annex 3 of the US EPA report "Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007" (April 2009).

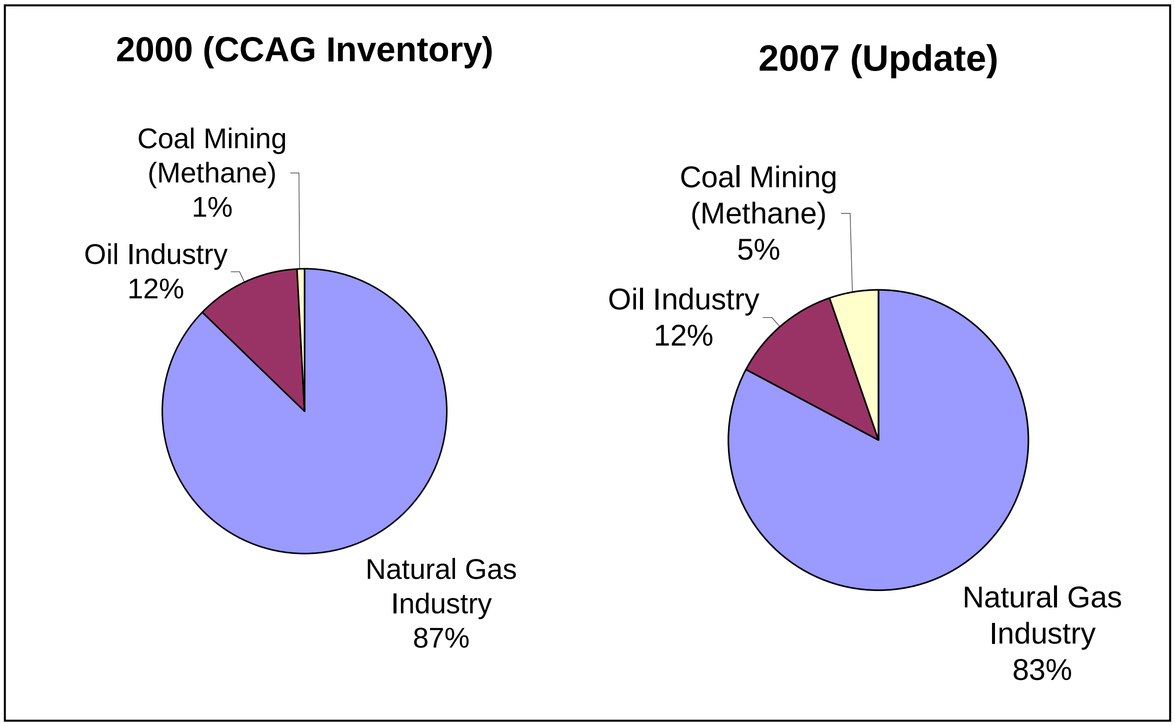
[18] EIA Coal Industry Annuals, www.eia.doe.gov/cneaf/coal/page/acr/backissues.html

[19] [BHP Billiton, New Mexico Coal, www.bhpbilliton.com/bb/ourBusinesses/energyCoal/newMexicoCoal.jsp].

[20] EIA Coal Industry Annuals, www.eia.doe.gov/cneaf/coal/page/acr/backissues.html.

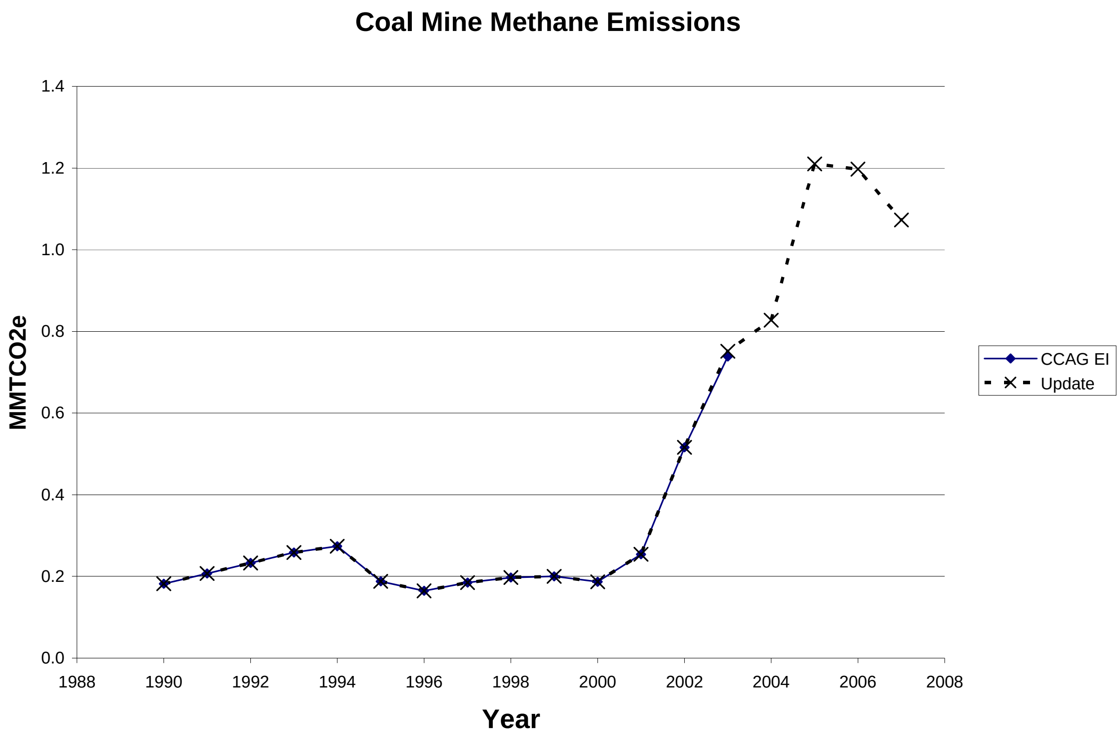
of underground mines results in higher methane emissions per ton of coal produced[21]. Therefore the increase in methane emissions from coal mining has resulted from the increase in underground mining in New Mexico over the last 7 years (see Figure 5).

Figure 5 Contributions of Major Sectors to Fossil Fuels Industry Emissions



[21] EPA, Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007, Annex 3.

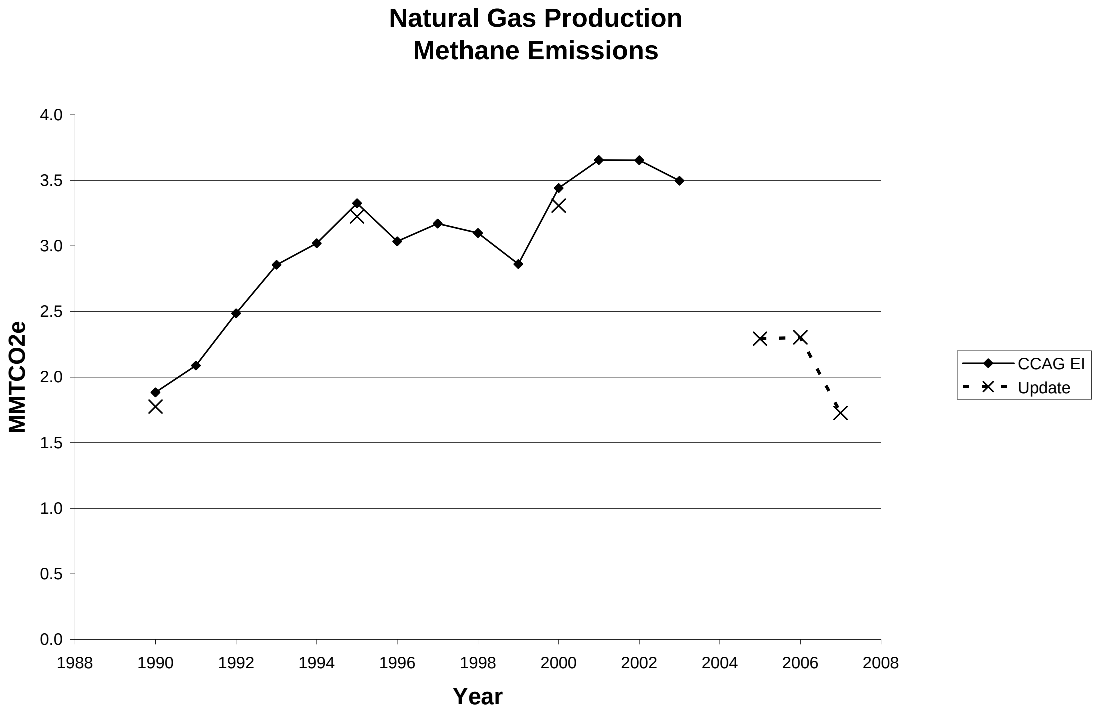
Figure 6 Coal Mining Methane Emissions: Comparison of CCAG Report to 2007 Update



Methane emissions from natural gas distribution appear to have decreased substantially since 2000 (see Figure 7). This decrease is primarily due to the decrease in national emissions from this source rather than in the proportional contribution of NM to US production (see Eq. 1).

The US EPA may be overestimating methane emissions reductions from natural gas production. Their methodology is 1) calculate an updated baseline emissions value based on an earlier study, and then 2) subtract the industry-reported emissions reductions from the Natural Gas STAR program. Although the baseline emissions study estimated that well completion emissions were negligible, reduced emissions from well completions have been a substantial fraction of reported Natural Gas STAR reductions in recent years. This indicates that emissions from this source were substantially underestimated in earlier years, and the decrease in emissions in recent years has been overestimated. Since the NM inventory for this source is calculated as a fraction of the US emissions, this error in the EPA inventory would also affect the NM trends.

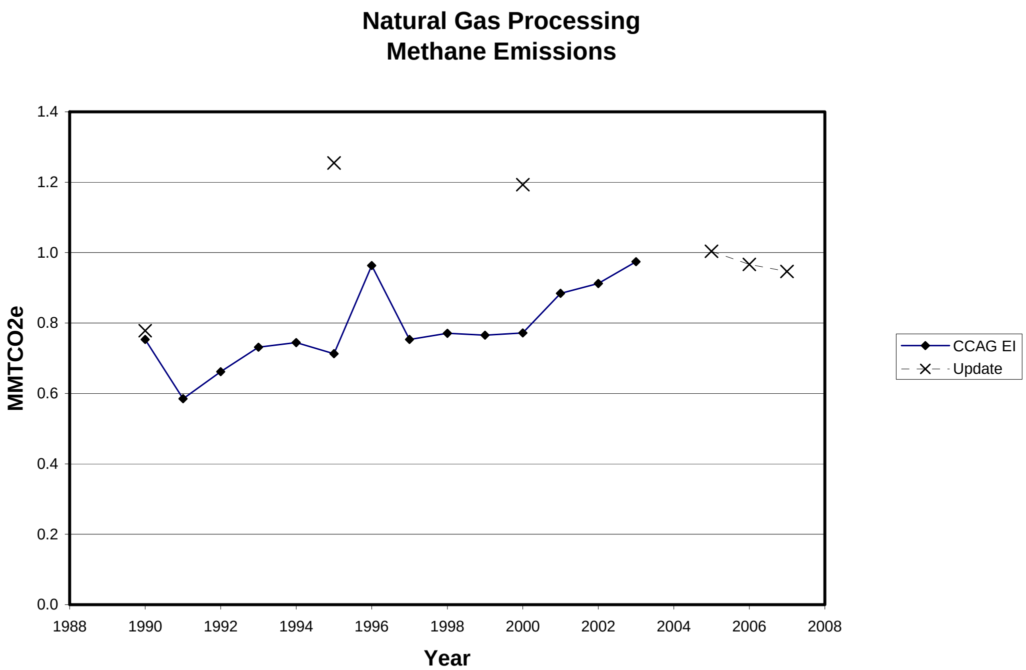
Figure 7 Natural Gas Production Methane Emissions: Comparison of CCAG Report and 2007 Update



Methane emissions from natural gas processing have also decreased, relative to the recalculated 2000 value (see Figure 8).

Figure 8 Natural Gas Processing Methane Emissions: Comparison of CCAG Report and 2007 Update

Differences between the inventory values for 2001-2003 reflect differences in methods used by EPA to calculate national emissions from this category, on which the calculation of New Mexico emissions is based.

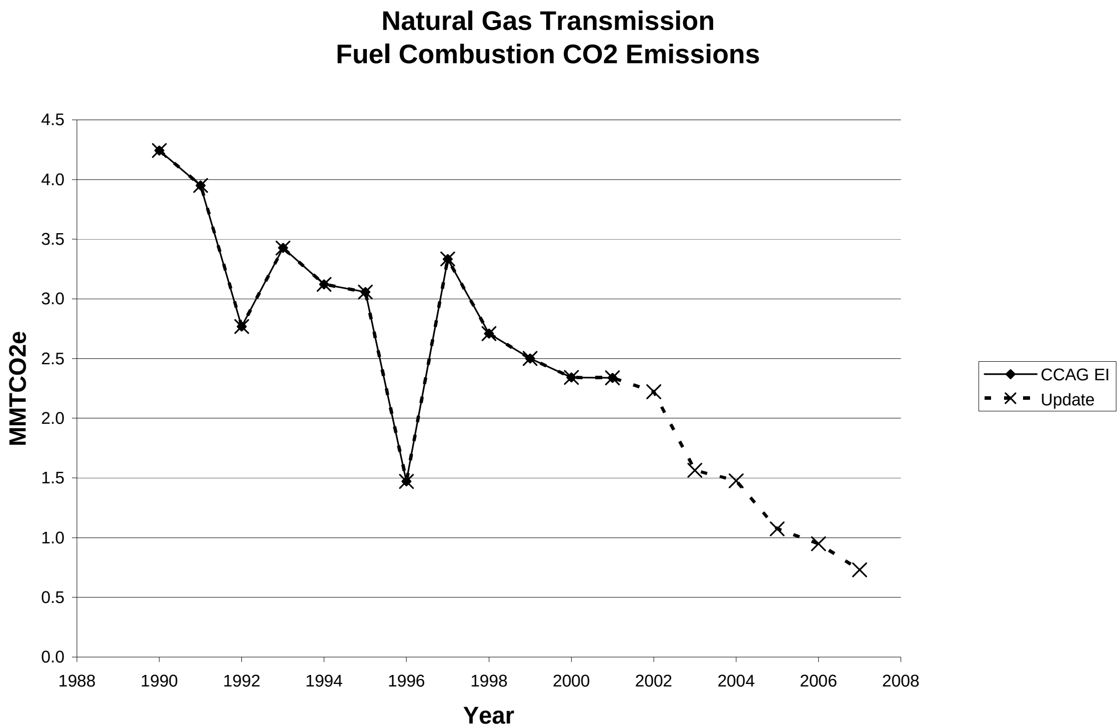


Among fossil fuel industry combustion CO_2 sources, the most dramatic long-term trend in emissions has been the apparent decrease in estimated emissions from natural gas transmission (see Figure 9). We do not believe these data accurately reflect trends in this emissions source. Gas production and processing volumes have not decreased dramatically, and the New Mexico Air Quality Bureau has not noted such a great decrease in the number or activity of large compressor stations. Emissions calculation methods are simple; the only data input is the fuel consumption reported by EIA, which is in turn compiled from company reports to that agency.

NMED examined company reports to EIA and found that in earlier years (such as year 2000), some upstream and midstream companies were reporting a significant portion of compressor fuel use, but in more recent years these companies did not report consumption in this category. One midstream company reported disposition of about 25 billion cubic feet of gas (equivalent to about 1.75 $MMTCO_2$) as "Other – vented and flared" rather than as Lease Fuel, Processing Plant, or Pipeline Fuel Use; this gas consumption would not be accounted for by the current inventory methods, which use Lease Fuel, Processing Plant, or Pipeline Fuel Use as specific data inputs from EIA. We conclude that reliance on EIA data as the input for calculation of fuel combustion emissions in the oil and gas industry sector is likely to result in significant error.

Figure 9 Natural Gas Transmission Methane Emissions: Comparison of CCAG Report to 2007 Update

Decreases since year 2000 resulted in large part from changes in how data were reported to EIA.



2.4 Significant issues

Coal mining methane emissions primarily from ventilation and degasification have grown considerably over the last seven years. This source was relatively insignificant in earlier years, but now deserves more attention in regard to emissions inventory and possible emissions controls.

2.5 Key Uncertainties

Natural gas industry methane emissions are calculated by simplistic methods which are incapable of responding to state-specific factors that might cause emissions intensity (emissions per unit of activity) in NM to be higher or lower than the national average.

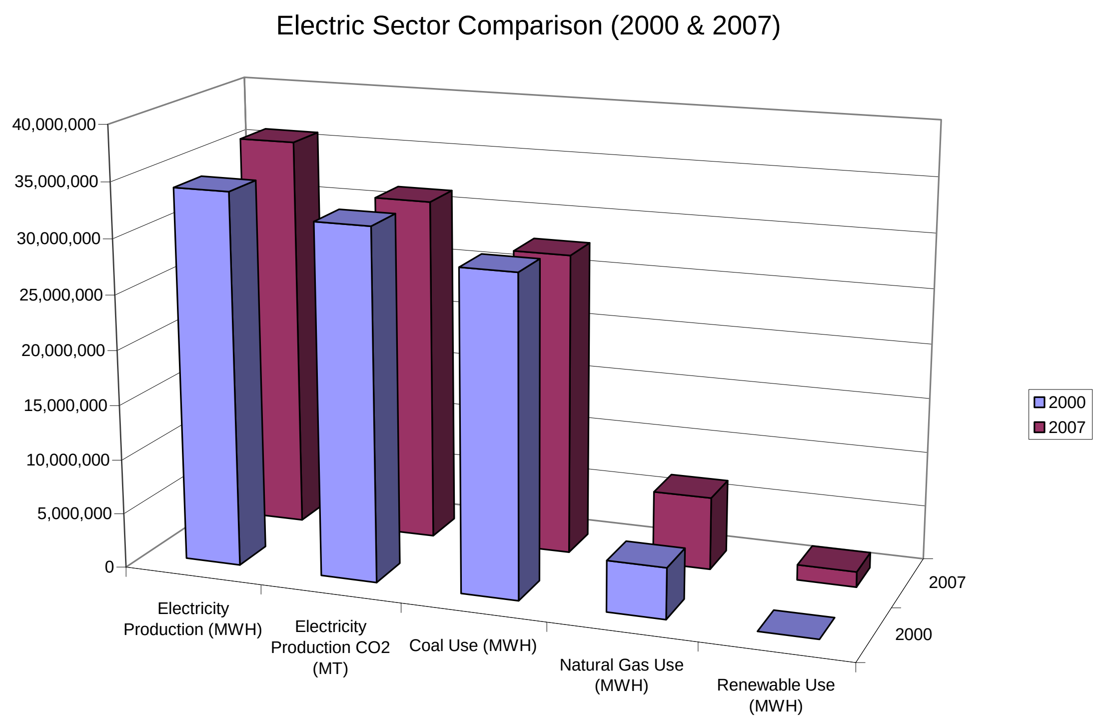
Reliance on EIA data to calculate fuel combustion emissions for the sector as a whole and for individual subsectors is likely to result in significant error, because of inconsistencies in company reporting to EIA and in EIA classification of fuels use.

3 Electricity Production

3.1 Emissions 2000-2007

The electric generating sector continues to be the dominant source of GHG emissions in New Mexico. Although the contributions from coal-fired power plants hovers around 90% of the total GHG emissions from this sector, the State has realized an increase in the supply of low- or zero-GHG emitting electric power during the past four years. The supply of electricity from natural gas and renewable energy as a percent of the total energy produced increased by approximately 36 and 156 percent respectively from 2000 to 2007[22] (see Figure 10) This trend is explained in part by the increase of natural gas generating capacity that was constructed in the early part of the decade and efforts by electric generating utilities to comply with the state's Renewable Portfolio Standard (RPS). The trend of additional electricity generated from low- or zero-emitting sources may be enhanced further with the establishment of a carbon cap and trade regulatory scheme.

Figure 10 Electric Sector Comparison



The supply of electricity produced increased approximately 8% from the four year periods 2000 – 2003 and 2004 – 2007[23]. Total retail sales increased by approximately 11% over the same time period (see Figure 11). Commercial and industrial sector electricity consumption increased by approximately 19% each, and by 16% in the residential sector. Retail sales continue to constitute approximately 60% of supply, reflecting the fact that New Mexico exports a significant amount of power to other western states (see Figure 11).

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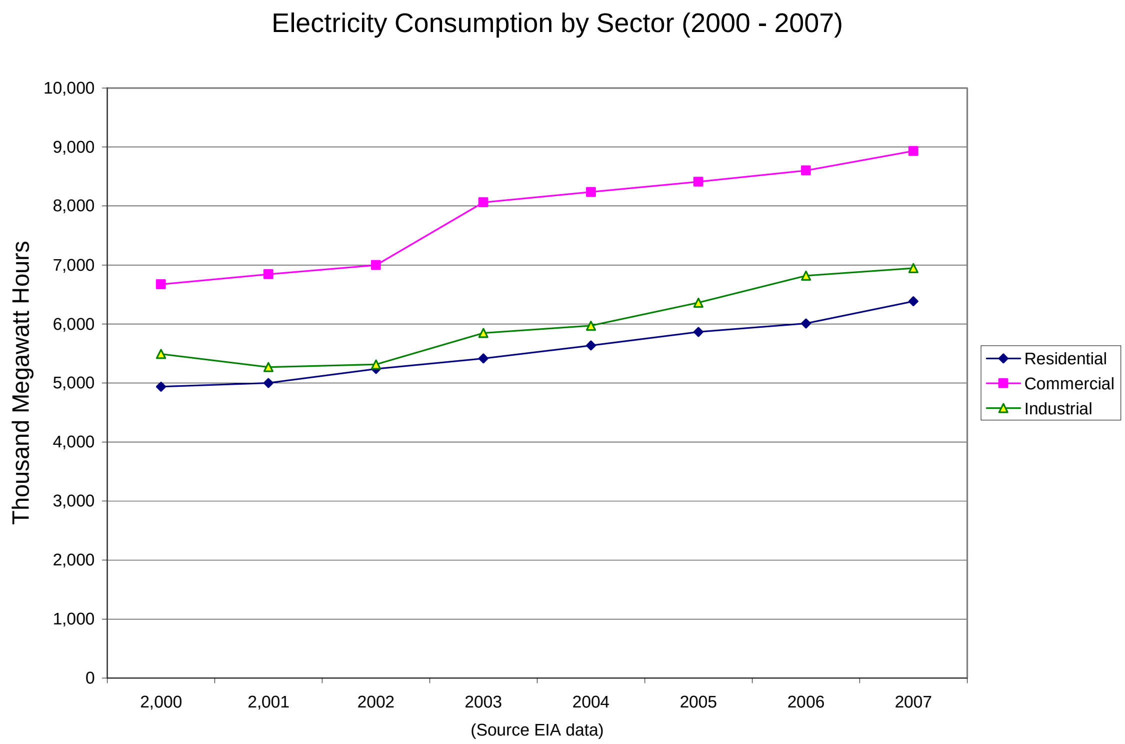
[22] 2007 - New Mexico Electricity Profile DOE/EIA-0348(01)/2

[23] Ibid.

Figure 11 Electricity Consumption by Sector



New Mexico continues to export 30-40% of the total net electricity generated (see Figure 12)[24]. Electricity exports as a percent of total electricity supply peaked at 40% at the beginning of the decade, declined to a low of 30% in 2003, and has generally risen towards 2000 levels. Consumption data include an adjustment to reflect 10% power losses from transmission and distribution. In the near term, it's expected that New Mexico will continue to export significant power to the western electric grid.

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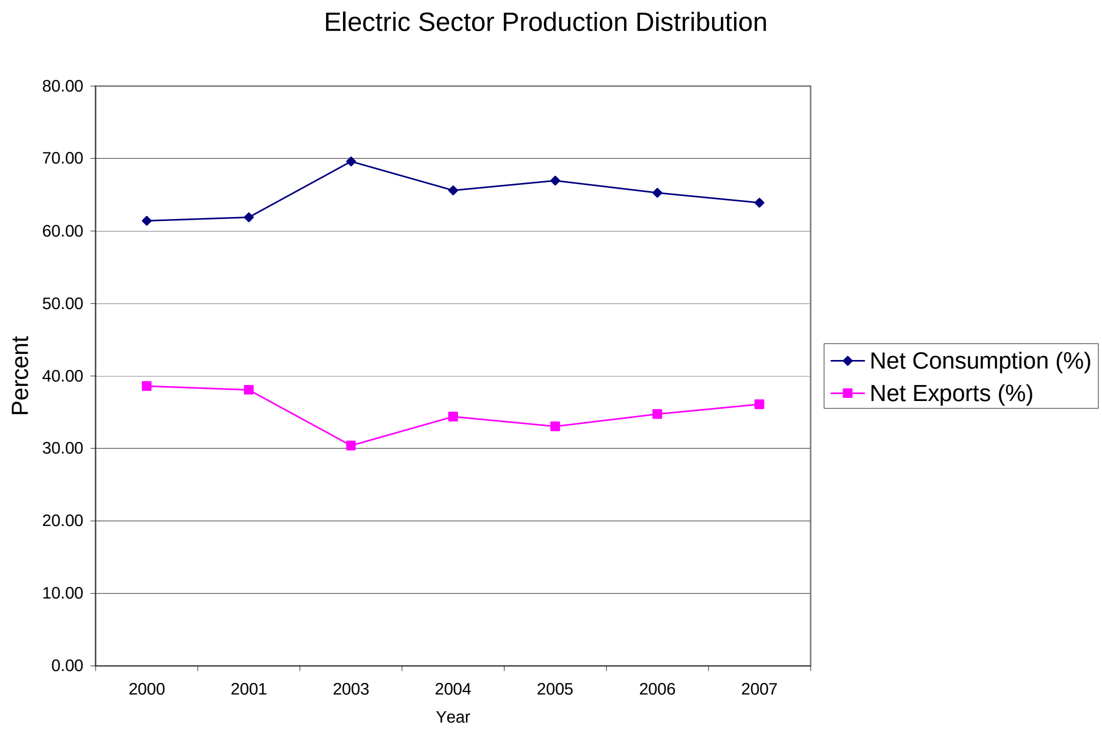
[24] Ibid.

Figure 12 Electric Sector Production Distribution



3.2 Estimation Methodology & Data Sources

The data sources in Table 4 were considered to evaluate electric sector GHG emissions: EPA EGRID, EIA's New Mexico SEDS and 923 data reports, EPA's Clean Air Markets Division, and EPA's State Emissions Tool. EGRID data were not used for this analysis as it did not include 2006 and 2007 data. EIA's SEDS data resulted in emissions estimated approximately 3% greater than EPA's SIT and 6.5% greater than EPA's Clean Air Markets data (CAMD). EIA's SEDS emissions data were chosen for this analysis because of the comprehensive nature of the data source (EIA data includes electricity production, exports, consumption and emissions by fuel type) which facilitated a relative comparison to the approach used in the CCAG report for those parameters[25].

Table 4 Electric Sector Data Source Comparison 2004-2008

$MMTCO_{2e}$	**2004**	**2005**	**2006**	**2007**	**2008**
EPA Clean Air Markets	29.4	30.57	31.18	29.28	29.87
State Inventory Tool [26]	30.43	31.76	32.37	30.83	31.27
EPA EGRID [27]	32.81	34.1	--	--	--
EIA Estimated [28]	31.27	32.74	33.05	31.45	NA

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[25] Ibid.
[26] 2008 SIT estimate from EIA 923 monthly time series files.
[27] Data not available 2006 – 2008
[28] Data source http://www.eia.doe.gov/cneaf/electricity/st_profiles/sept07nm.xls

The apparent consistency between the SIT and EIA emission estimates is reflective of the fact that EIA energy consumption data are used as data input for the SIT. The difference between EIA data and EPA CAMD data is that EPA's Acid Rain Program does not apply to all sources required to report to EIA.

3.3 Comparative Analysis

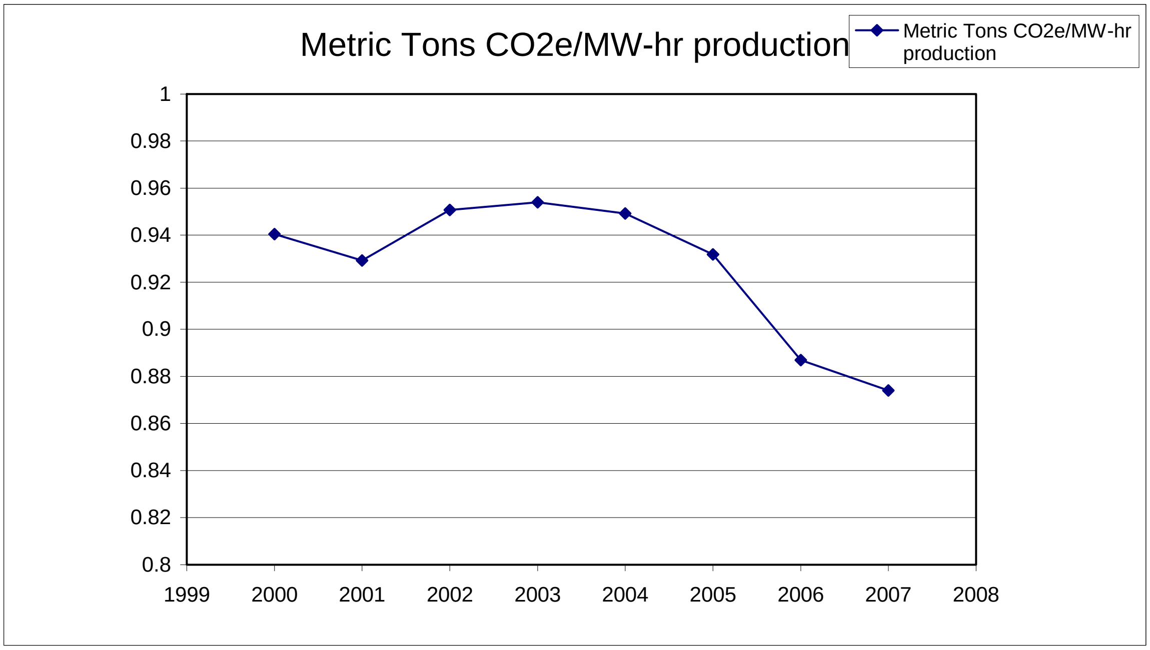
The CCAG report noted there was approximately 2500 MW of proposed new power plants, with the majority of those projects using coal to generate electricity. Two of the major power projects in development were Desert Rock (1500 MW) and Mustang Generating Station (350 MW). It was expected that the approval and construction of these two projects would result in emissions increases upwards of 15 $MMtCO_2$. However, the Mustang project application was withdrawn by the permit applicant on October 4, 2006, and the Desert Rock permit remanded by EPA's Environmental Appeals Board back to EPA Region IX on September 25, 2009 to require the consideration of carbon sequestration technology as BACT. EPA's recent New Source Review proposed rule change requiring the installation of BACT to address GHG emissions from major stationary sources such as Desert Rock will likely impact additional near-term coal based electric generation, as the technology has been applied on a very limited basis.

Non-coal derived electric generation in New Mexico has been on the rise since 2003. Natural gas capacity increased by approximately 600 MW; wind generation capacity nearly doubled to approximately 600 MW; and two significant solar projects totaling 122 MW are planned to be implemented by 2011. Additional renewable energy projects will be forthcoming in the next decade as New Mexico has positioned itself well to capitalize on these resources. New Mexico law (Title 17, Chapter 9, Part 573) requires regulated utilities to diversify their generation portfolios.

3.4 Significant Issues

The continued development of renewable energy sources, availability of clean coal technology, and state and national economic conditions will affect near and long term growth and subsequent emissions from this sector (see Figure 13).

Figure 13: Metric Tons CO2e/MW-hr Production[29]



Unlike smaller sources of GHG emissions, significant resources and time are required to obtain environmental permits to construct and operate power plants. Near term lower natural gas prices may foster increased utilization of existing capacity and perhaps spur new natural gas power generation projects. Increased natural gas and renewable energy projects would continue to reduce carbon intensity from this sector.

However, development of electric grid infrastructure to connect renewable sources of energy to end users will continue to be a factor. The uncertainties related to the availability, acceptance and reliability of clean coal technologies in light of the vast supply of coal in New Mexico are also noteworthy.

3.5 Key Uncertainties

According to the uncertainty discussion associated with the SIT, "many different factors introduce uncertainties into estimating emissions from imports and exports of electricity. The precise fuel mix used to generate the power crossing state lines is very difficult to determine due to the highly complex nature of electricity flow through the US power grid. Therefore, an average fuel mix for all electricity generation within a specific region of the grid must usually be used. Moreover, these emission factors are generated by emission monitors (rather than carbon contents of fuels), which may overestimate CO_2 emissions to a small extent." [30] This inventory update did not attempt to differentiate between the fuel type and associated emissions from electricity exports and did not include an evaluation of electricity imports for the reasons stated above. However, it's likely that a large amount of exported electric generation is coal based.

[29] Ibid.
[30] SIT 2008, Electricity Sector Uncertainties Discussion

4 Transportation

4.1 Emissions 1990-2007

As noted in the CCAG report, the transportation sector is the third largest source of GHG emissions in New Mexico. Large distances and a dispersed population lead to high transportation demand.

Figure 14 Transportation Sector Emissions includes the total transportation sector emissions for the years 2000 to 2007 (see Section 4.2 below for a discussion of data sources). Between 2000 and 2007, GHG emissions from the transportation sector increased 12%. This increase was due to a combination of factors, including increased freight traffic and increased state population.

Figure 14 Transportation Sector Emissions

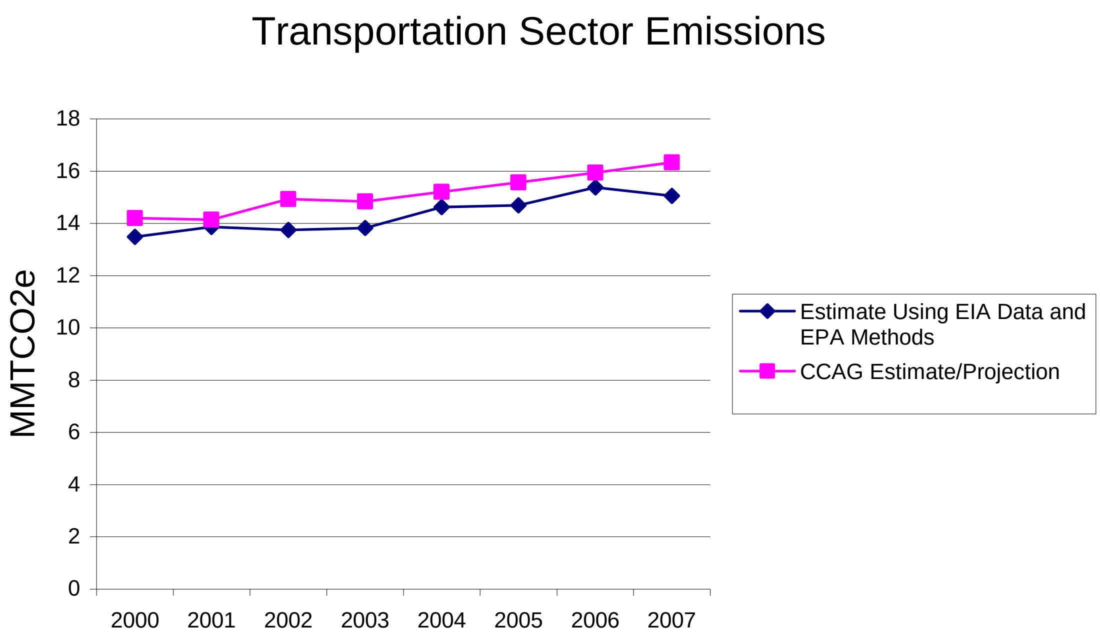
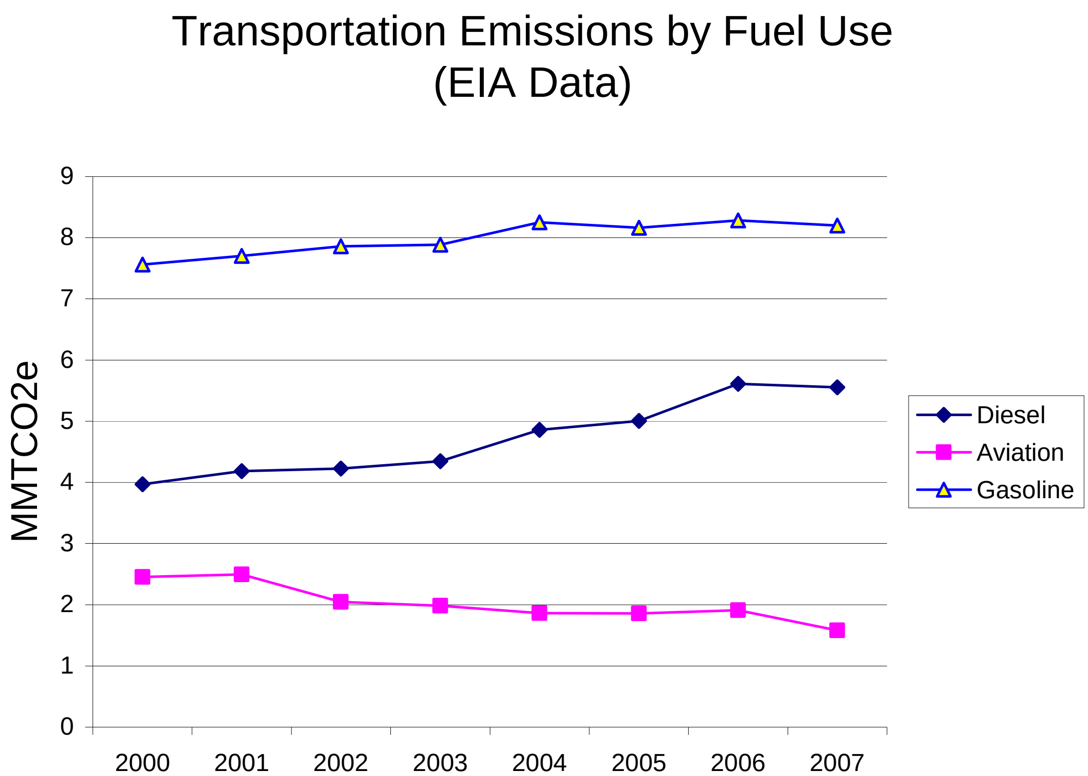


Figure 15 compares the amount of gasoline, diesel, and aviation fuel use from 2000 to 2007, using EIA data (emissions from other fuels are too low to be reflected in this figure). The 28% increase in emissions from diesel fuel use between 2000 and 2007 reflects the increase in freight traffic anticipated in the New Mexico 2025 Statewide Multimodal Transportation Plan (released in 2005) and reflected in CCAG projections. The Transportation Plan estimated that 85% of commercial traffic on I-10 and I-40 was simply crossing the state, without delivering or picking up any freight, and that such freight traffic would increase over time.

Figure 15 Transportation Sector Emissions by Fuel Use



During the period 2000-2007, the estimated emissions from gasoline consumption increased by 4%. However, during this time, the state population grew 6.7%, resulting in a drop of 2.5% in per capita emissions from gasoline use. Several factors may have contributed to this drop of average gasoline usage per person. As newer vehicles are purchased, the average gas mileage rate for vehicles in the state may have improved, and increases in gasoline prices and use of public transportation may have resulted in less driving. However, data that would support or quantify such trends is not available at the time of this report.

EIA data indicates that emissions from aviation fuel use in the state dropped 20% from 2000 to 2007, primarily as a result of a drop in jet fuel consumed. The EIA data reflects consumption of aviation gasoline and jet fuel by both the public sector and the military.

4.2 Estimation Methodology & Data Sources

The transportation data used in this report was derived from EIA data, which is based on reported fuel sales. Note however that, unlike EIA and the SIT, this report does not include the natural gas used by pipeline equipment as part of the transportation sector fuel use. In this report, pipeline emissions are included in the Oil and Gas sector.

Figure 14 includes the CCAG estimate and projection for the transportation sector. The CCAG Report used a combination of data from EIA and the New Mexico Department of Transportation (NMDOT). However, updated data was not available from NMDOT and so could not be used in this report. For consistency, historical EIA data has been used in figures for transportation emissions.

Ethanol consumption has been deducted from the fuel sales reported by EIA in order to calculate GHG emissions from gasoline use. This is consistent with the calculation method used in the CCAG report and the SIT, and reflects an assumption that the CO_2 emitted during combustion of biomass-derived fuels is the same as the CO_2 drawn from the atmosphere during growth of the biomass, and as such results in no net increase in CO_2 emissions. Nonetheless, ethanol, like gasoline, can require significant upstream GHG emissions in production and refining.

4.3 Comparative Analysis

As discussed above, a comparison of CCAG estimates and projections is included in Figure 15. Despite differences in data sources, the trend reflected in the current update is consistent with the sector increase projected in the CCAG report.

Because transportation sector emissions are directly related to fuel use, personal and governmental efforts to reduce transportation fuel use serve to reduce, or at least slow the growth of, GHG emissions from the transportation sector. Such efforts include but are not limited to car and van pooling, increased use of public transportation, increases in average vehicle fuel efficiency, and traffic management to reduce vehicle idling times.

4.4 Significant issues

In 2007, the NM Environmental Improvement Board adopted Emissions Standards for New Motor Vehicles (20.2.88 NMAC), also referred to as the Clean Cars Rule. Section 177 of the CAA allows any State to adopt and enforce new motor vehicle standards that are identical to the California standards. The Clean Cars Rule applies to 2011 and subsequent model year vehicles and requires manufacturers to meet the fleet average non-methane organic gas (NMOG) exhaust emissions and GHG exhaust emissions standards set forth in the California Code of Regulations (CCR), Section 1961, for vehicles produced and delivered for sale in New Mexico. The rule also includes sales requirements for zero emission vehicles. The effects of this rule implementation may be evident in the next update to this report.

4.5 Key Uncertainties

Key uncertainties are included in the discussions of specific aspects of the transportation sector emissions. See also Section 5.5.

5 Emissions from Fossil Fuel Combustion in the Residential, Commercial, and (Non-Fossil Fuel Industry) Industrial Sectors

5.1 Emissions 2000-2007

This section reports the GHG emissions from fossil fuel combustion in the residential, commercial[31], and (non-fossil fuel industry) industrial sectors[32] (RCI). The residential and commercial sectors consume fossil fuels and electricity to heat and cool buildings and to power lights and appliances. The industrial sector consumes fossil fuels and electricity for these purposes and to heat and power industrial processes.

Fossil fuels include natural gas, oil (including gasoline and propane) and coal. While the combustion of fossil fuels results in emissions of N_2O and CH_4, more than 99% of the GHG emissions are in the form of CO_2.

Figure 16 and Figure 17 show the direct emissions from combustion of fossil fuels and the indirect emissions from electricity use in the residential and commercial sectors, respectively. Figure 18 shows the direct emissions from combustion of fossil fuels in the (non-fossil fuel industry) industrial sector. Figure 19 shows the indirect emissions from electricity use in the industrial sector, including the fossil fuel industry. From 2000 to 2007, the direct emissions resulting from combustion of fossil fuels in the residential, commercial and (non-fossil fuel industry) industrial sectors decreased by 3%, 5% and 2%, respectively.

As discussed in Section 1.5, between 2000 and 2007 the indirect emissions from the consumption of electricity in the residential and commercial sectors increased by 22% and 1%, respectively, and the indirect emissions from the consumption of electricity in the industrial sector (including the fossil fuel industry) increased by 19% (see Figure 19). Taking electricity consumption into account, the residential sector increased emissions from energy use by a total of 13% (taking into account the state's growing population, this is a per capita increase of 6%). During the same period, the total emissions from energy consumption in the commercial sector rose and fell, ending with 2007 emissions at 2000 levels.

[31] The commercial sector "consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes [energy consumed at] sewage treatment facilities" EIA 2002. *State Energy Data 2001, Technical Notes*, page 5. http://www.eia.doe.gov/emeu/states/sep_use/notes/use_intro.pdf.

[32] GHG emissions resulting from the fossil fuel industry are reported in Section 2. Industrial sector GHG emissions that result from processes (e.g., leakage, venting and non-combustion chemical processes) are reported in Section 6.

Figure 16 Residential Sector GHG Emissions from Combustion of Fossil Fuels

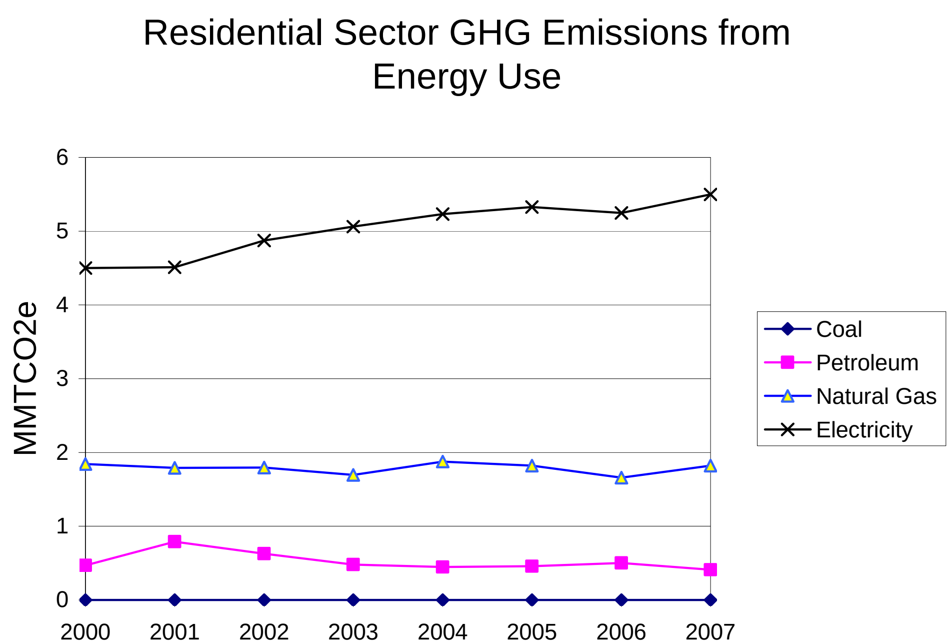


Figure 17 Commercial Sector GHG Emissions from Combustion of Fossil Fuels

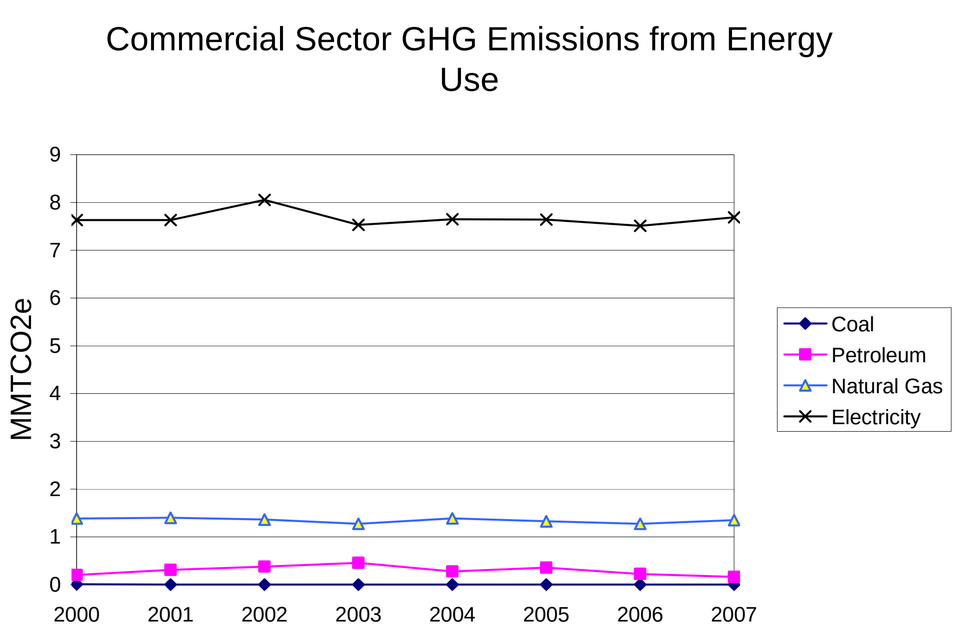


Figure 18 Industrial (Non-Fossil Fuel Industry) Sector GHG Emissions from Combustion of Fossil Fuels

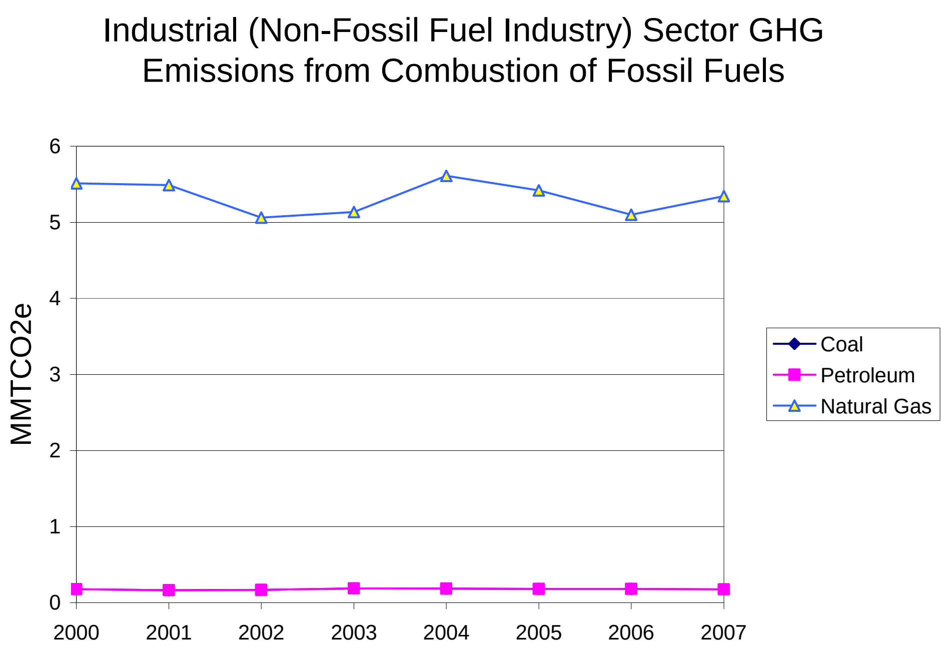
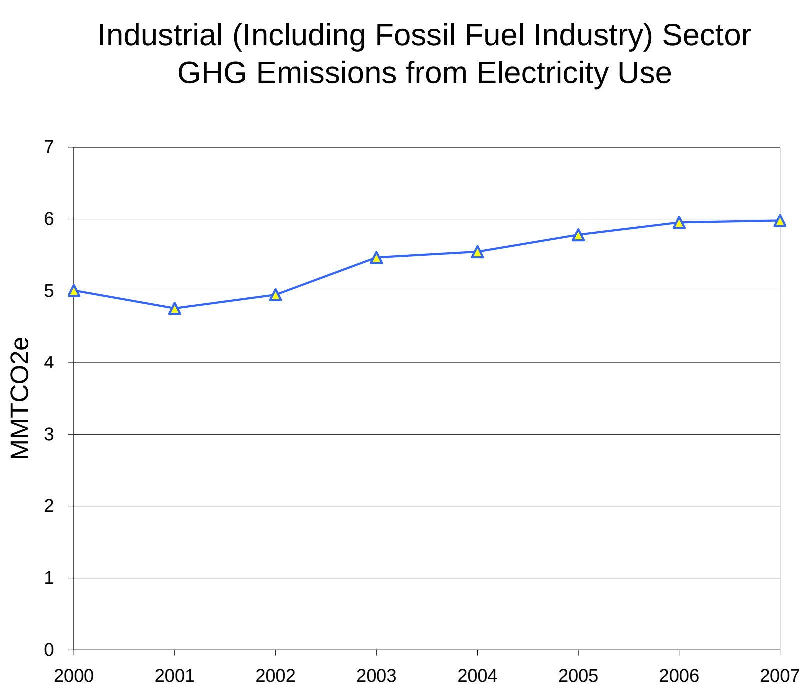


Figure 19 Industrial (Including Fossil Fuel Industry) Sector GHG Emissions from Electricity Use



5.2 Estimation Methodology & Data sources

The estimation methodology used in the CCAG Report and this report for emissions from fossil fuel combustion has been to multiply fuel use by an emissions factor for each fuel use and type of combustion device. Fuel use data is collected by the Energy Information Administration of the US Department of Energy and available to the public.[33] This information is also used as a data source for the SIT.

5.3 Comparative Analysis

In the figures for industrial emissions from energy use, the CCAG report includes the indirect emissions from electricity consumption. In this report, direct industrial sector emissions from the combustion of fossil fuels are reported in Figure 18, and the indirect emissions from consumption of electricity are included in Figure 19. In both reports, the estimated emissions from electricity use for the industrial sector includes the electricity consumed by the fossil fuel industry (not otherwise addressed in this section) as well as the non-fossil fuel related industries.

Emissions trends for these sectors are discussed above.

5.4 Significant issues

Significant issues are discussed above.

5.5 Key Uncertainties

The amount of CO_2 emitted from fossil fuel combustion depends on the type and amount of fuel consumed, the carbon content of the fuel, and the fraction of the fuel that is oxidized. Consequently, the more accurately these parameters are characterized, the more accurate the estimate of CO_2 emissions. Nevertheless, there are uncertainties associated with each of these parameters.

Although statistics of total fossil fuel and other energy consumption are relatively accurate at the national level, there is more uncertainty associated with the state-level data. In addition, the allocation of this consumption to individual end-use sectors (i.e., residential, commercial, industrial, and transportation) at the state level is more uncertain than at the national level.

Uses of fuels for non-energy purposes introduce additional uncertainty to estimating emissions, as the amount or rate at which carbon is emitted to the atmosphere can vary greatly depending on the fuel and use. This guidance and the SIT provide default values for the amount of non-energy use and percentage of carbon stored by fuel type, based on data collected at the national level. State-specific data can reduce these uncertainties.

In comparison with fuel consumption data, the uncertainties associated with carbon contents and oxidation efficiencies are relatively low. Carbon contents of each fuel type

[33] www.eia.doe.gov. Specific NM information may be found at http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=NM#overview and http://www.eia.doe.gov/emeu/states/state.html?q_state_a=nm&q_state=NEW%20MEXICO.

are determined by the EIA by sampling and the assessment of market requirements, and, with the exception of coal, do not vary significantly from state to state. EIA takes into account the variability of carbon contents of coal by state in EIA's Electric Power Annual 2002 (2003b); these coefficients are also provided in the SIT.

6 Industrial Processes

6.1 Emissions 2000-2007

Emissions in this category span a range of activities, and indicate non-combustion sources of CO_2 from industrial manufacturing (cement, limestone and soda ash usage), the release of hydrofluorocarbons (HFCs) from cooling and refrigeration equipment, the use of various fluorinated gases in semiconductor manufacture (perflourocarbons or PFCs as well as HFCs), and the release of sulfur hexafluoride (SF_6) from electric power transmission and distribution.

6.2 Estimation Methodology & Data sources

Common sources of fugitive emissions of SF_6 are a result of leakage from gas-insulated substations and switchgear seals. It can also be emitted during equipment manufacture, installation, servicing and disposal. Emissions of SF_6 from electrical equipment have shown a slow decline from 2000-2007, believed to be a result of price increases during the 1990s and voluntary programs such as the EPA SF_6 Emission Reduction Partnership for Electric Power Systems[34]. The Industrial Process module of the SIT bases emissions on the quantity of SF_6 consumed annually, apportioned by state electricity sales divided by national electricity sales. This method assumes that all SF_6 consumed is used to replace SF_6 that was emitted. The module includes SF_6 consumption up to 2006. For 2007, US emissions of SF6 as CO_2e are apportioned by 2007 electricity sales divided by national electricity sales. This is the method recommended in the Emission Inventory Improvement Project (EIIP)[35]. The US emissions of SF_6 were listed in the Inventory of US Greenhouse Gas Emissions and Sinks: 1990 - 2007.

CO_2 is emitted from cement production during the calcination process, as calcium carbonate ($CaCO_3$) is converted to calcium oxide (CaO). Therefore, process emissions are directly related to the amount of clinker and masonry cement produced. The only cement plant in New Mexico, GCC - Rio Grande (a subsidiary of Grupo Cementos de Chihuahua), is located in Bernalillo County. Instead of using default production data, the CCAG report estimated Portland cement production from two sources (1997 Apparent use of Portland Cement by State and Market"[36] and the US Geological Survey's Cement Annual Report, 1997)[37]. The mean production was multiplied by the SIT emission factor, and then corrected based on production data from the New Mexico Greenhouse Gas Action Plan[38]. The application of this correction factor essentially attributes one-third of

[34] Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007
http://www.epa.gov/climatechange/emissions/downloads09/InventoryUSGhG1990-2007.pdf

[35] Methods for Estimating Non-Energy Greenhouse Gas Emissions From Industrial Processes, August 2004. Prepared by: ICF Consulting. Prepared for: State and Local Climate Change Program, U.S. Environmental Protection Agency & Emission Inventory Improvement Program

[36] Not publically available.

[37] http://minerals.usgs.gov/minerals/pubs/commodity/cement/170497.pdf

[38] http://www.werc.net/outreach/Book.pdf

the combined AZ and NM production to the GCC - Rio Grande facility. For this report, a request for production data was made to the City of Albuquerque's Air Quality Division.

It must be noted that the draft Albuquerque City-wide and Bernalillo County Greenhouse Gas Emissions Inventory includes combustion related CO_2 emissions from GCC - Rio Grande, but does not include process emissions, generated through the calcination of lime, clinker production and masonry cement production. The fuel combustion emissions have been accounted for in the Residential/Commercial/Industrial section of this report.

Emissions from soda ash consumption were estimated from national usage, apportioned to NM by the State's population divided by the US population.

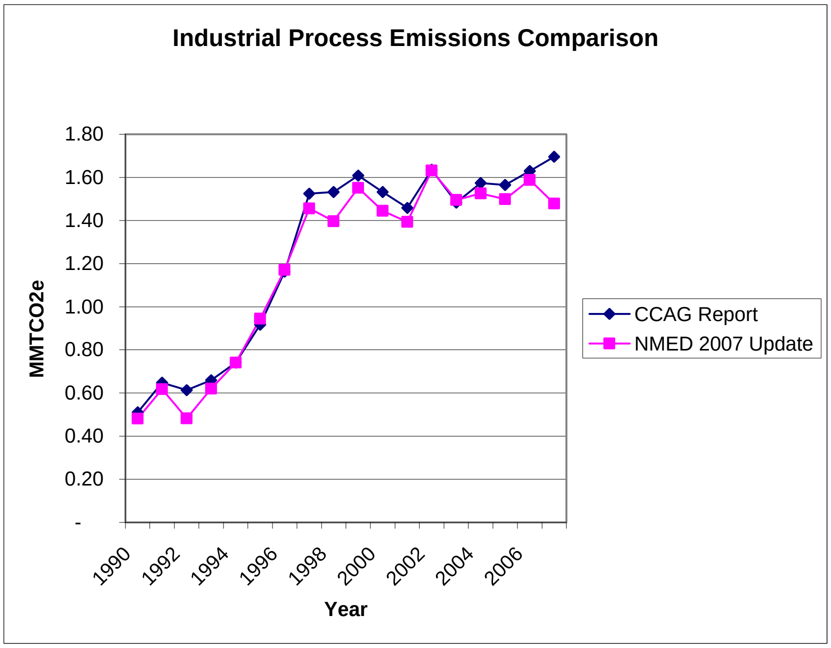
Emissions from lime manufacture, which also emits CO_2 during a chemical conversion, were not estimated for this update. The only lime plant in New Mexico is a chemical lime plant that imports lime manufactured elsewhere to produce hydrated lime. There are no CO_2 emissions generated from this process. Because the lime is actually produced outside of New Mexico, those CO_2 emissions are not attributed to New Mexico.

This update includes emissions from ammonia production and urea use. Although ammonia is not produced in New Mexico, urea is commonly used as the reagent in selective catalytic reduction (SCR) systems for the control of nitrogen oxides (NO_X).

6.3 Comparative Analysis

Figure 20 compares the data from the CCAG Report to the 2007 Update. For the period under review, the actual emissions are generally lower than those projected in the CCAG Report.

Figure 20 Industrial Process Emissions Comparison



The combined emissions related to industrial processes are shown in Figure 21 ($MMTCO_2e$). The trend has been a general increase in emissions from 2000 through 2007, with spikes in 2002 and 2006, mostly attributable to emissions from semiconductor manufacturing. However, the 2007 total emissions from industrial processes are only slightly higher than the 2000 emissions, 1.5 $MMTCO_2e$ vs. 1.4 $MMTCO_2e$, respectively. The contribution from the various sub-categories is shown in Figure 22.

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Figure 21 GHG Emissions from Industrial Processes 2000-2007

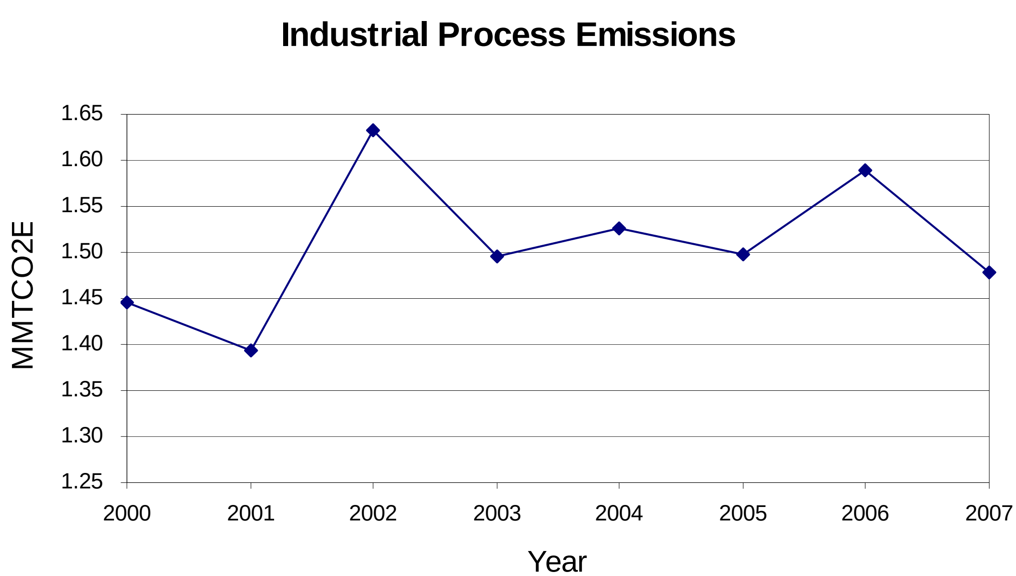
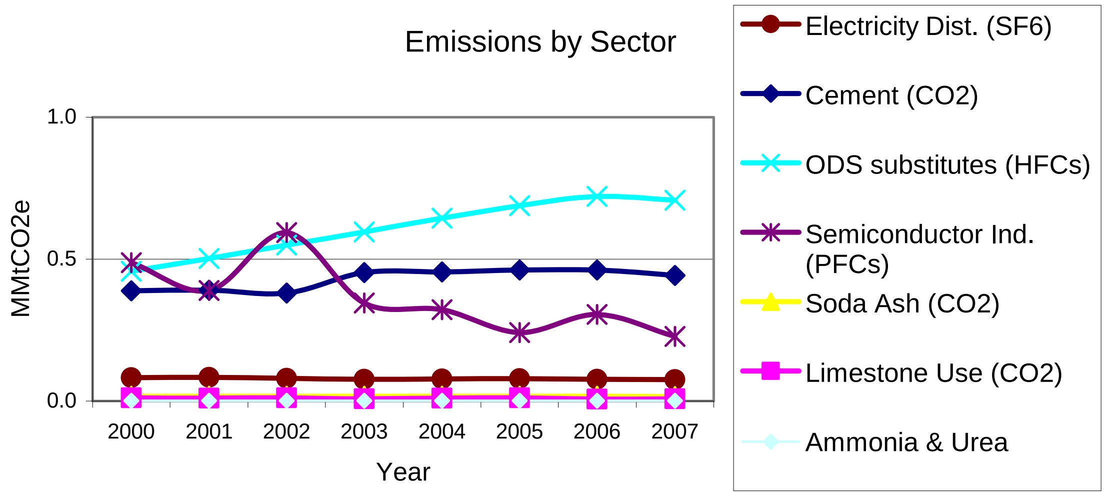


Figure 22 GHG Emissions from Industrial Processes by Sub-Category



In 2001, the use of ODS substitutes overtook the semi-conductor industry as the largest contributor of GHG emissions from industrial processes. Emissions from the use of ODS substitutes has gradually increased since 2000, leveling off in 2005, while semiconductor related emissions have significantly decreased, also leveling off in 2005. As with the previous inventory prepared by CCS, estimates of semiconductor emissions were obtained from Intel Corp.

HFCs continue to be used to substitute for ozone-depleting substances in compliance with the Montreal Protocol, which explains the steady growth in emissions of HFCs since 2000. Even low amounts of HFC emissions from leaks and normal use can lead to high GHG emissions. The emission estimates for New Mexico during the review period were based on EPA default data, apportioned based on state population. The Industrial Processes module included data up to 2006. To estimate the emissions for 2007, the same method was employed using the US emissions listed in the Inventory of US Greenhouse Gas Emissions and Sinks: 1990 - 2007.

6.4 Significant issues

See discussion above.

6.5 Key Uncertainties

Industrial process emissions continue to be determined by the level of production from a few key industries, and it remains difficult to obtain accurate production information, as such information may affect the competitiveness of New Mexico manufacturers and the specific nature of their production processes. For example, the USGS reports the combined production of the three cement plants in Arizona and New Mexico, and assumptions must be made to apportion production to the GCC - Rio Grande facility in

Bernalillo County. Emissions from other sectors are based on national production apportioned to New Mexico by the ratio of state population to national population.

7 Agriculture

7.1 Emissions 2000-2007

The agriculture sector of the GHG inventory constitutes 5 percent of the overall greenhouse gas emissions for New Mexico. The net emissions were 4 MMTCO2e in 2007.

Agricultural emissions include CH_4 and N_2O emissions from enteric fermentation, manure management, agricultural soils and agricultural residue burning.

CH_4 is produced as a waste product of digestion by ruminants such as cattle, in a process known as enteric fermentation. This CH_4 is released principally by belching. Cattle, buffalo, sheep, and goats account for the majority of methane emissions produced.

Manure management methods include the handling, storage and treatment of livestock waste. CH_4 is emitted when the manure is not stored in a sufficiently oxygenated environment, leading to anaerobic decomposition, while the nitrogen in livestock manure and urine encourages nitrification and de-nitrification, releasing nitrous oxide.

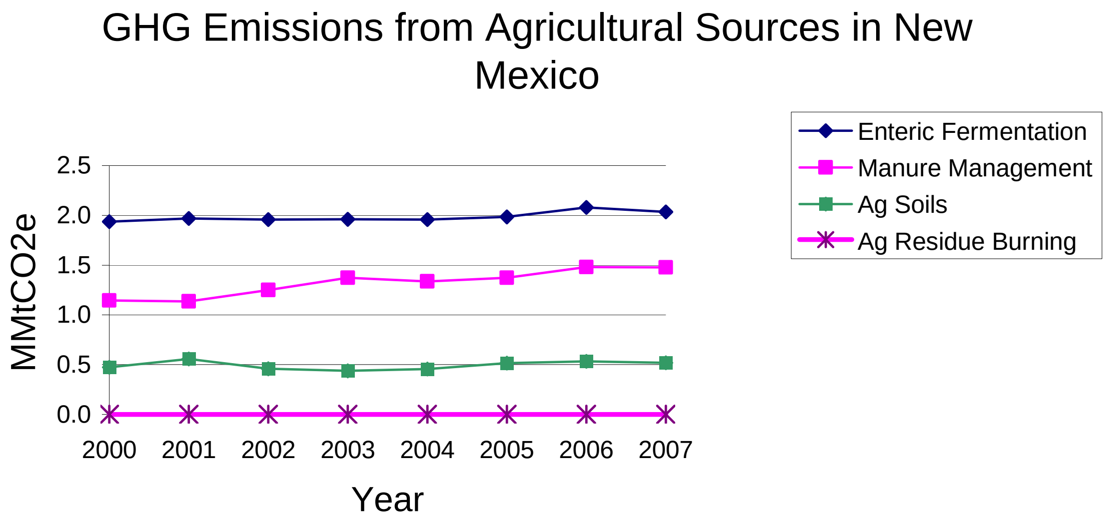
CH_4 and N_2O emissions from the storage and treatment of livestock manure (e.g., in compost piles or anaerobic treatment lagoons) occur as a result of manure decomposition.

Activities that increase the nitrogen in soil and thereby contribute to the category of N_2O emissions include fertilizer (synthetic, organic and livestock) application and production of nitrogen fixing crops.

Agricultural burning contributed a very small amount to the agricultural sector emissions.

Enteric fermentation is the greatest source of agricultural emissions, followed by manure management, agricultural soils and then agricultural residue burning (Figure 23).

Figure 23 GHG from Agricultural Sources in New Mexico



The Agriculture (Ag) module of the SIT was developed using Microsoft® Excel 2000. The SIT was developed in conjunction with EPA's Emissions Inventory Improvement Program.

7.2 Estimation Methodology & Data sources

The 2008 SIT was the primary methodology used for calculating GHG for the agricultural sector.

The sectors included within the Agricultural module are enteric fermentation, manure management, agricultural soils, and agricultural residue burning. Different methodologies exist for calculating the GHG emissions from each sector[39]. The module permits data entry or the selection of default data, which is entered into worksheets with prefabricated formulas. Data from the United States Department of Agriculture's National Agricultural Statistics Service (NASS) along with default data provided by the SIT were used in the SIT to calculate the GHG from the agricultural sector.

NASS conducts hundreds of surveys every year and prepares reports covering almost every aspect of United States agriculture. When available the NASS data were used in the SIT because they are specific to New Mexico and are reported annually. While these data may be coarser in scale, and not include age class, they are accurate and particular to New Mexico.

The default data available through the SIT provide a finer scale of data, including age class; these data are formulated based on national averages and are not factual reported data. Also the default data are only available through 2006 and the NASS data are available through 2008.

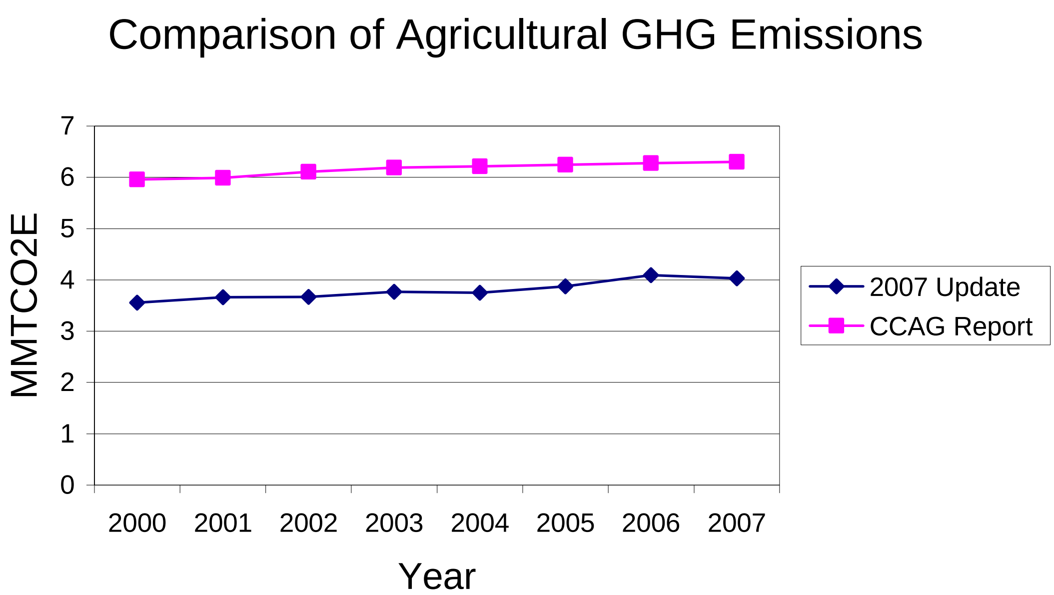
[39] ICF, International, 2008. Draft User's Guide for Estimating Methane and Nitrous Oxide Emissions from Agriculture Using the State Inventory Tool, July 2008.

7.3 Comparative Analysis

A comparison of the overall GHG emissions from CCAG Report to the 2007 Update shows that projections for 2004 through 2007 were slightly higher than the actual level of emissions. The projections showed a gradual increase in the level of emissions; however, the reported data shows more variation over this time horizon, including periods of swift increase and decrease in emissions levels.

The agricultural module of the SIT is regularly modified to include improved accounting methods. While both the CCAG Report and the 2007 Update calculations were completed using the SIT which had been modified and therefore the variation in the past and projected levels of emissions may be due to new methods implemented in the SIT.

Figure 24 Comparison of CCAG Report to 2007 Update: Agricultural GHG Emissions



In comparing the CCAG Report to the 2007 Update (see Figure 24) by agricultural source categories, the most significant change is that ag soils actually produced less tons of emissions than projected by the CCAG Report. The projections for the categories of enteric fermentation, manure management and ag residue burning were consistent with the CCAG Report. These sectors gradually increased over time at a very modest rate.

Nitrous oxide emissions are naturally produced in soils through the microbial processes of nitrification and de-nitrification. It is possible that the CCAG Report anticipated a higher demand for the use of nitrogen fertilizer for the production of high nitrogen consuming crops, like corn. There has been a significant and rapid increase in the construction activities of the nation's ethanol industry as many new plants throughout the

US Corn Belt opened[40]. However, New Mexico has not experienced the same rapid rate of growth in this industry. According to NASS, the production of "corn for grain" in New Mexico has ranged from 160 to 185 bushels from the year 2000 through 2009, but has not experienced rapid rates of growth or decline [41] (see Appendix A).

Another factor that may influence future emissions is New Mexico's Renewable Portfolio Standard's (RPS) program, which mandates greenhouse gas reduction goals through the requirement of the use of renewable energy sources in place of fossil fuel-based energy production.

The RPS recognizes biomass as an eligible source of renewable energy. In the agricultural sector, options for using renewable biomass resources, such as crops and residual material from agriculture, forestry or animal wastes, have been developed as low carbon energy sources for electricity production and/or bio fuels[42].

While biofuels may provide an alternative to fossil fuels, the complexity of this topic must be fully explored in order to deliver a sustainable biofuel industry. Not all biofuels perform at the same rate of efficiency in terms of their impact on climate, energy security and ecosystems. Factors such as population growth, yield improvements, changing diet patterns, climate change, availability of water, and land conversion for biofuels, as well as environmental and social impacts, must be assessed in order to achieve sound planning policies[43] .

7.4 Significant issues

New Mexico is nationally ranked seventh in total milk production and eighth in total cheese production (New Mexico Department of Agriculture 2007). However, the falling prices of milk have led to closure of several dairies in eastern New Mexico. Currently the dairies are receiving a net payment between $10 and $11 dollars per 100 pounds of milk, which is well below the accepted break even point of $16 per 100 pounds of milk. Ten dairies in Roosevelt and Curry counties have gone out of business since wholesale milk prices began dropping in 2008 (Duncan 2009). If the number of dairies continues to decline, then New Mexico may experience a decline in GHG from the agricultural sector.

7.5 Key Uncertainties

A detailed explanation of the key uncertainties according to the Agricultural module of the SIT is located in Appendix B.

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[40] Baker, Allen and Steven Zahniser 2006. Ethanol Reshapes the Corn Market. Amber Waves Volume 4, Issue 2, Economic Research Service/USDA.
http://www.ers.usda.gov/amberwaves/may07specialissue/features/ethanol.htm

[41] USDA National Agricultural Statistics Survey, Quick Stats, New Mexico Crops, 2009.
http://www.nass.usda.gov/

[42] State Action, Climate Change 101: Understanding and Responding to Global Climate Change, published by the Pew Center on Global Climate Change and the Pew Center on the States. January 2009.
www.pewclimate.org/docUploads/Climate101-State-Jan09.pdf.

[43] International Panel for Sustainable Resource Management, 2009. Towards Sustainable Production and Use of Resources; Assessing Biofuels. www.unep.fr.

8 Waste Management

8.1 Emissions 2000-2007

Greenhouse gas emissions from the waste management sector include solid waste management and waste water management. Municipal solid waste includes methane CH_4 emissions from landfilling of municipal solid waste and CO_2 and N_2O emissions from the combustion of municipal solid waste[44].

The following background information is provided by ICF International in the Draft User's Guide for Estimating Emissions from Municipal Solid Waste Using the SIT.

Greenhouse gases are emitted from landfills as CH_4 and CO_2 are produced from anaerobic decomposition of organic matter by methanogenic bacteria. Organic waste first decomposes aerobically (in the presence of oxygen) and is then decomposed by anaerobic non-methanogenic bacteria, which convert organic material to simpler forms like cellulose, amino acids, sugars, and fats[45].

Additionally, some landfills flare recovered landfill gas, which converts the CH_4 portion of the gas to CO_2. Also, there are some landfills that collect and burn landfill gas for electricity production or other energy uses (known as landfill-gas-to-energy projects, or LFGTE), which are treated similarly to landfills that flare their gas[46].

Table 5 identifies the following landfills to have flares or LFGTE systems.

Table 5 Landfills with Flares or GTE systems

Landfill	Flare or LFGTE system
Camino Real Landfill (Sunland park)	LFGTE and Flare
Rio Rancho Landfill (Rio Rancho)	Flare
Cerro Colorado (Albuquerque)	Flare
Los Angeles closed landfill (Albuquerque)	LFGTE

Neither the CO_2 emitted directly as biogas nor the CO_2 emitted from combusting CH_4 at flares is considered an anthropogenic GHG emission. The source of the CO_2 is primarily the decomposition of organic materials derived from biomass sources (e.g., crops, forests), and in the United States these sources are grown and harvested on a sustainable basis. Sustainable harvesting implies that photosynthesis, which removes CO_2 from the atmosphere, is equal to decomposition, which adds CO_2 to the atmosphere. However, some CO_2 is from non-biogenic sources (e.g., plastic and rubber made from petroleum), and is counted in GHG emission inventories.

[44] ICF, International, 2008. Draft User's Guide for Estimating Methane and Nitrous Oxide Emissions from Agriculture Using the State Inventory Tool, July 2008
[45] Ibid.
[46] Ibid.

N_2O is produced at the high temperature found in waste combustors by the combination of nitrogen (contained in both the waste and in the air) and oxygen gas in the air[47].

Waste-related greenhouse gas sinks and carbon storage from landfilled yard trimmings and food scraps are not accounted for in solid waste management[48] .

8.2 Wastewater Emissions

Wastewater management includes methane and nitrous oxide from municipal wastewater treatment facilities. Wastewater emissions were calculated using the SIT. The calculated values are approximately 70% of the values calculated in 2004. The calculation methodology for municipal wastewater N_2O emissions has changed as emissions from this category are approximately 50% less than the values calculated in 2004. The net effect of this change is that total emissions from this category are 30% less than the values calculated in 2004. Therefore 2007 emissions from this sector are 0.19 ($MMTCO_2E$) instead of 0.27 ($MMTCO_2E$) as projected in 2004. However, the annual rate of change has consistently been approximately 2.1%. Wastewater emissions are largely a function of population growth and the estimated 1.0% annual estimated population growth has been realized between 2003 and 2007 as projected.

EPA reports the changes noted above reflect that the default factor for N_2O emissions from nitrogen in effluent discharged changed from 0.01 to 0.005 kg N_2O-N/kg sewage N-produced, to be consistent with the US National Inventory. Furthermore, the fraction of the population not on septic was updated from 75% to 79%, also to be consistent with the factors used in the US National Inventory. The combination of these two changes resulted in the net change of emissions in 2007 when compared to 2004.

8.3 Estimation Methodology & Data Sources

The 2008 SIT was used to determine the GHG emissions for this sector. The emissions from these types of facilities are site specific and the NMED Solid Waste and Air Quality bureaus provided more specific data than the default data provided by the SIT.

The data provided by the Solid Waste Bureau in their Annual Reports include the tonnages of waste landfilled and diverted, including tonnages of waste from out-of-state sent to NM for disposal. This information is not compatible with the SIT and is provided in Appendix D.

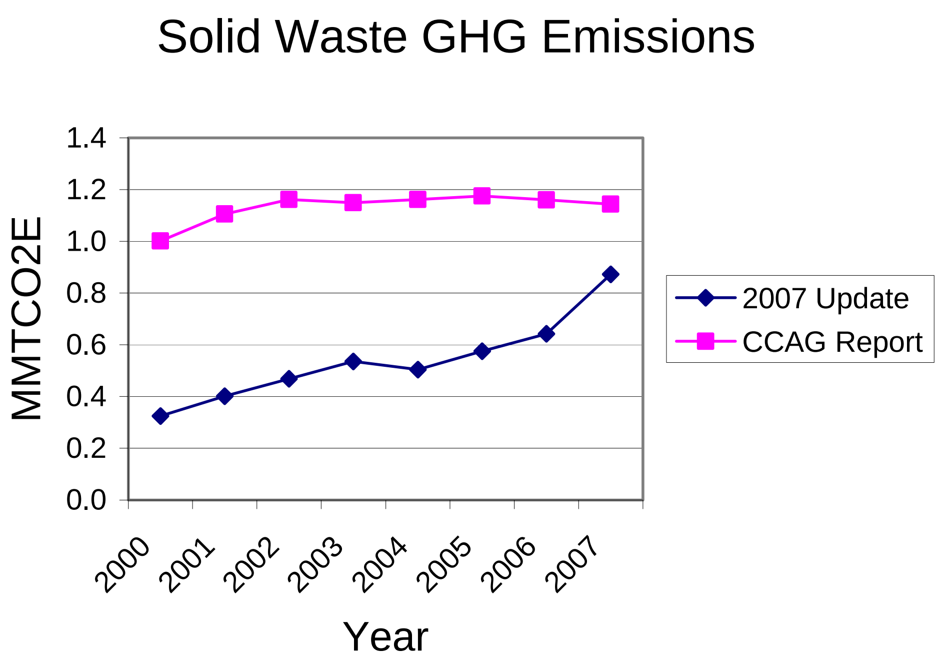
8.4 Comparative Analysis

The 2007 Update shows that emissions are slightly lower than projected in the CCAG Report (see Figure 25). The emissions steadily increase over time without abrupt increases or declines.

The emissions from the waste sector are related to the growth rate in New Mexico. With increased population, emissions from solid waste will increase. The growth rates are projected to increase at 1.2% and the emissions reflect this growth rate.

[47] Ibid.
[48] Ibid.

Figure 25 Comparison of Solid Waste GHG Emissions CCAG Report to 2007 Update



8.5 Significant issues

The growth rate in New Mexico plays an important role in waste emissions. The state population grew 6.7% from 2000-2007 at approximately 1% per year[49]. Analysis done by the Bureau of Business & Economic Research at the University of New Mexico indicates that this growth rate is low in light of other economic and demographic indicators for the state[50].

8.6 Key Uncertainties

According to the SIT, the following uncertainties exist. Uncertainty surrounds key elements of these calculations, including the activity data and factors.

1. Uncertainty of Estimating Methane Emissions from Municipal Landfills

There are several sources of uncertainty associated with the recommended method for estimating CH_4 emissions from landfills. CH_4 production is impacted by temperature, rainfall, and landfill design, characteristics that vary by each landfill and cannot be accounted for individually. Additionally, the time period over which landfilled waste produces CH_4 also is not certain. This methodology is based on information from CH_4 recovered from various landfills, which may not be representative of landfills as a whole. Little information is available on the amount of CH_4 oxidized during diffusion through the soil cover over landfills. The assumed ten percent is based on limited measurements.

[49] From the US Census Bureau's annual population estimates from 4/1/00 to 7/1/07 (NST-EST2007), released 12/27/07

[50] Bureau of Business & Economic Research at the University of New Mexico, Statistics at a Glance, 2009. http://bber.unm.edu/

In addition, the methodology presented here assumed the waste composition of all landfills is the same; in reality, waste in different landfills likely varies in composition. The presence of landfill gas recovery systems may affect activity in the anaerobic zones of landfills, since active pumping may draw more air into the fill, thus inhibiting methanogenesis.

2. Uncertainty of Estimating Greenhouse Gas Emissions from Municipal Solid Waste Combustion

There are several sources of uncertainty surrounding the estimates of CO_2 and N_2O from waste combustion, including combustion and oxidation rates, average carbon contents, and biogenic content. Due to variation in the quantity and composition of waste, the combustion rate is not exact. Similarly, the oxidation rate is uncertain because the efficiency of individual combustors varies depending on type of waste combusted, moisture content, and other factors. Average carbon contents are used for "other" plastics, synthetic rubber, and synthetic fibers. However, the actual carbon content of these materials may vary depending on the specific composition of each material. Non-biogenic CO_2 emissions from waste combustion depend on the amount of non-biogenic carbon in the waste, and the percentage of non-biogenic carbon that is oxidized. EPA used simplifying assumptions that (1) all carbon in textiles is non-biomass carbon (i.e., petrochemical-based plastic fibers such as polyester), and (2) the category of rubber and leather is composed almost entirely of rubber. The resulting estimate of CO_2 emissions from waste combustion slightly overstates the emissions.

9 2008 Title V GHG Emissions Reporting

The inaugural GHG reporting year, 2008, required GHG emission reports for carbon dioxide emissions only from Title V sources exclusive of those located on tribal lands and within Bernalillo County. New Mexico has about 150 Title V sources and most of these sources emit carbon dioxide primarily from combustion (see Table 6). NMED created its original GHG reporting rules to require emissions from these sources (i.e., the state's largest facilities). There were a few Title V sources that did not report GHG emissions as they either did not have any CO_2 emissions or did not operate during emissions year 2008. NMED received CO_2 emissions reports from all but eleven of the Title V sources that operated.

New Mexico's 2008 GHG reporting procedures for CO_2 mirrored California Air Resources Board (CARB) GHG reporting rule but also allowed facility operators to voluntarily report emissions to The Climate Registry[51]. The large electric utilities generally used Continuous Emissions Monitoring (CEMS) data to report CO_2 emissions. Owners of combustion sources generally recorded fuel consumption and used emission calculation methods containing default carbon or heat content data to facilitate emissions reporting. Sources not able to use these default data had to analyze fuel to determine its heat and carbon content(s). All facilities recorded and reported fuel consumption. Additional reporting details were required from power plants and petroleum refiners subject to 20.2.87 NMAC.

Total GHG emissions from Title V reporting sources were approximately 24.2 $MMTCO_2$ (See Table 6). The electric services industry consisted of 65% of the total GHG emissions with Public Service Company of New Mexico's coal fired San Juan Generating Station contributing approximately 10.8 $MMTCO_2$. The oil and gas sector contributed approximately 33% of the total emissions with TEPPCO NGL Pipelines LLC contributing the largest share from this sector at 1.34 $MMTCO_2$ (see Figure 26). The top 25 GHG-emitting sources listed in Table 6) contributed approximately 90% or 21.6 $MMTCO_2$ of reported GHG emissions. It's expected that the contribution of GHG emissions from the oil and gas sector will increase slightly in 2009 when GHG emissions inventory reports include methane emissions.

NMED's emissions data collection system used to report 2008 emissions data was cumbersome which increased the potential for data reporting and analysis errors. NMED is in the process of enhancing its data collection system to facilitate reporting and analysis of GHG and criteria pollutant emissions data. The use of natural gas default data did not work well for combustion sources of coal bed methane (CBM) gas as its heating value is lower than conventional gas. CBM gas combustion default data would ease reporting burden for sources combusting CBM gas. The CO_2 vented emissions data from gas processing plants and gas compressors are somewhat limited as our procedures focused on combustion related, not vented, sources of emissions.

[51] http://www.theclimateregistry.org.

The quality and breadth of GHG emissions data may be increased by implementation of the following:

- EPA's mandatory GHG reporting rule;
- Changes to New Mexico's GHG reporting rules;
- Improvements in NMED's emissions data reporting tools; and
- Development of robust oil and gas emissions reporting emissions calculation methods.

Figure 26 2008 CO2 Emissions Reported by NM Title V Sources

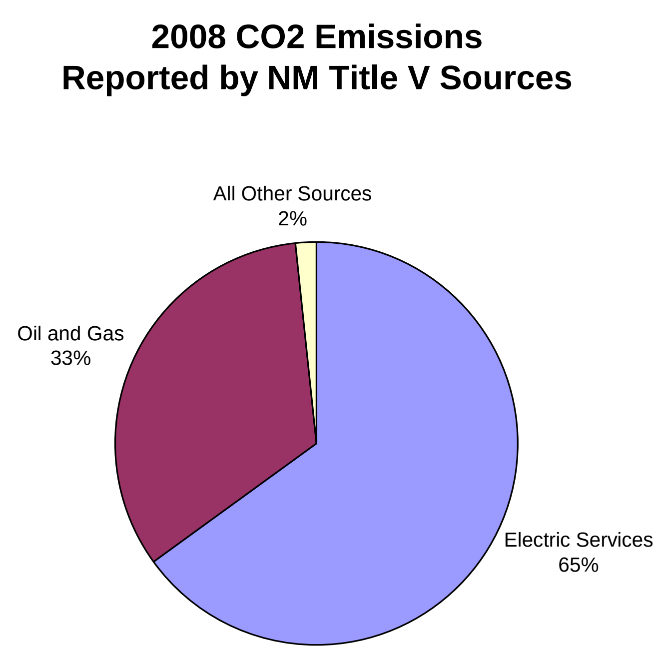


Table 6 2008 Title V GHG Emitting Sources 10,000 metric tons and greater (Thousand Metric Tons).

Facility Name	***AI_ID***	***SIC***	***Emissions***
Public Service Co of NM - San Juan Generating Stn.	1421	4911	10797.5
Prewitt Escalante Generating Station	911	4911	1755.1
Milagro Cogeneration and Gas Plant	1277	1389	1500.5
Val Verde Treater	1182	1321	1340.2
Luna Energy Facility	878	4911	905.8
Xcel Energy - Cunningham Station	604	4911	881.4
Navajo Refining - Artesia Refinery	198	2911	624.2
El Paso Electric - Rio Grande Generating Station	122	4911	461.7
Chaco Gas Plant	1148	1311	395.3
Afton Generating Station	164	4911	329.2
Maddox Station	588	4911	310.0
Ciniza Refinery	888	2911	264.5
Blanco Compressor C and D Station	3552	1311	263.5
San Juan Gas Plant	1177	1321	244.1
Jal No3 Gas Plant	569	1321	226.8
Targa - Eunice Gas Plant	609	1321	187.8
Linam Ranch Gas Plant	589	1321	164.2
Duke Energy Field Services - Eunice Gas Plant	595	1321	146.1
Kutz Gas Plant	1158	1321	141.2
Bluffview Power Plant	3535	4911	135.7
Indian Basin Gas Plant	197	1321	111.3
Intrepid Potash - East KCl Compaction	208	1474	106.6
Bloomfield Refinery	1156	2911	103.5
El Cedro Gas Plant	1002	1311	100.5
Monument Gas Plant	610	1321	96.4
Lovington Refinery	622	2911	93.8
Chino Mine - Hurley Facility	526	1021	87.8
La Jara Compressor Station	1010	1389	82.2
Pecos River Compressor Station	194	4922	81.1
Saunders Gas Plant	612	1321	67.0
Artesia Gas Plant	199	1321	66.1
East Vacuum Liquid Recovery	638	1311	65.4
Denton Gas Plant	568	1321	64.3
Animas Plant	1159	4911	63.1
San Juan River Gas Plant	1252	1321	62.1
Lordsburg Compressor Station	553	4922	61.3
Lybrook Gas Plant	979	4922	58.6
DairiConcepts - Portales	1094	2023	50.7
Rattlesnake Canyon Compressor Station	1423	4922	47.0
Florida Compressor Station	868	4922	45.8
Gobernador/Manzanares Compressor Station	989	4922	44.9
Mosaic Potash Carlsbad Inc	196	1474	43.6
Dogie Canyon Compressor Station	990	4922	42.5
North Eunice Compressor Station	602	1311	42.5

Facility Name	***AI_ID***	***SIC***	***Emissions***
Pump Canyon Compressor Station	1183	4922	41.7
Eunice A Compressor Station	566	4922	41.5
32-8 No2 CDP Compressor Station	1236	1389	40.9
Empire Abo Gas Plant	191	1321	40.6
32-7 CDP Compressor Station	1221	1389	40.3
Monument Compressor Station	571	1311	38.6
Trunk L Compressor Station	1037	1389	37.2
Wingate Fractionation Plant	884	1321	36.8
Afton Compressor Station	123	4922	35.0
South Carlsbad Compressor Station	218	4922	32.9
American Gypsum - Bernalillo (Wallboard) Plant	1104	3275	32.1
Los Alamos National Laboratory	856	9711	31.2
Frances Mesa Compressor Station	1038	1389	30.5
Lordsburg Generating Station	560	4911	29.9
Laguna Seca Compressor Station	1011	1389	29.8
Middle Mesa CDP Compressor Station	1272	1389	27.8
New Mexico State University Campus	144	8221	26.8
Chaco Compressor Station	1189	1389	26.3
Cedar Hill Compressor Station	1331	4922	25.7
Blanco Compressor Station A	1147	4922	24.4
Espinosa Canyon Amine Plant	21709	1311	24.2
Huerfano Pump Station	1201	4619	23.9
Williams Four Corners - 30-5 CDP Compressor Stn.	998	1389	23.8
San Ysidro Pump Station	1114	4619	23.4
Bloomfield Compressor Station	1192	4922	22.8
Trunk N Compressor Station	1303	1389	22.4
Frontier Field Services - Maljamar Gas Plant	565	1321	22.1
Pyramid Generating Station	558	4911	22.1
29-6 CDP No2 Compressor Station	1007	1389	21.3
Golfcourse Booster Station	592	1311	21.1
Monument Booster Station	593	1311	20.6
Thompson Compressor Station	1191	1389	19.8
Pump Mesa Compressor Station	1273	1389	19.4
Targa - Vada Compressor Station	613	1311	18.0
West Eunice Compressor Station	755	1311	17.3
32-8 No3 CDP Compressor Station	1168	1389	17.0
Antelope Ridge Gas Plant	621	1321	16.4
South Hat Mesa Booster Station	665	4922	16.1
San Luis Pump Station	1109	4619	16.0
Trunk B Compressor Station	1350	1389	15.4
Rosa No1 Compressor Station	1367	1389	15.0
Eunice B&C Compressor Station	669	4922	14.7
Horse Canyon Central Delivery Point	1274	1389	14.5
Trunk A Booster Compressor Station	1342	1389	14.5
Quail Booster Station	679	1311	14.3
Buena Vista Compressor Station	1315	4922	13.4
29-6 No4 CDP Compressor Station	1013	1389	13.2
Oil Center Compressor Station	668	4922	13.2
32-9 Central Delivery Point (CDP)	1226	1389	12.5

Facility Name	*AI_ID*	*SIC*	*Emissions*
Bitter Lake Compressor Station	14	4922	11.9
Belen Compressor Station	1590	4922	11.2
Carracas CDP Compressor Station	1009	1389	11.2
Lateral N30 Compressor Station	1347	1389	11.2
Hart Canyon Compressor Station	1181	4922	11.2
MCA Tank Battery No2	624	1311	11.1
Middle Mesa Compressor Station	1193	4922	10.9
Total from sources >10K metric tons			**24040.5**
2008 TV Inventory Total			**24206.6**
Percent of TV mandatory reporting GHG Inventory			**99.3**

Note: Does not include CH4 emissions and underestimates CO2 emissions from sour gas plants.

10 WRAP / WCI Oil and Gas Protocol Development Project

NMED in conjunction with CARB, TCR and WRAP participated in the WRAP oil and gas protocol development project. This project provided a review of the sources and types of GHG emissions from the upstream oil and gas sector, and the following three work products:

1. An oil and gas scoping paper that discusses this sector in the west with a primary focus on four WCI states (including New Mexico) having significant oil and gas sector activities;
2. An analysis on a basin level of significant sources of GHG emissions and an evaluation of emissions calculation methods used to estimate GHG emission from these significant sources; and
3. A voluntary emissions reporting protocol subject to TCR Board approval in January 2010 to facilitate voluntary reporting.

The WRAP process included a Technical Work Group (TWG) consisting of government, industrial and non-governmental entities. Periodic phone conferences and three in-person meetings were held to discuss significant technical and policy issues and review draft documents regarding oil and gas GHG emissions reporting. Although the WRAP oil and gas protocol development process did not result in a mandatory reporting protocol, the work product(s) will inform the WCI mandatory reporting committee's oil and gas model rule development (see http://wrapair.org). Specific areas of interest to the WCI reporting committee include policy issues related to aggregation and contractor emissions, technical issues related to emission calculation, and direct measurement methods for estimating fugitive methane emissions.

WCI's reporting committee expects to develop essential requirements for mandatory reporting of greenhouse gas emissions for oil and gas production and gas processing. This work is now underway and is expected to be completed in 2010. The EPA is expected to promulgate reporting rules for these sectors as amendments to its Mandatory Reporting Rule in 2010, and the WCI reporting committee will then address harmonization of the WCI requirements with the EPA rule. WCI will attempt to minimize harmonization issues by involvement of EPA in the WCI process.

Appendix A: Corn for Grain Produced in New Mexico

Corn for Grain produced in New Mexico 2000 – 2007
Source: NASS

	2000	**2001**	**20002**	**2003**	**2004**	**2005**	**2006**	**2007**
Bushels	160	180	175	180	180	175	185	180

Appendix B: Key Uncertainties in Agricultural Module of SIT

According to the SIT, the following uncertainties exist.

1. Domesticated Animals

The quantity of methane (CH_4) emitted from enteric fermentation from livestock is dependent on the estimates of animal populations and the emission factors used for each animal type. Therefore, the uncertainty associated with the emission estimates stems from those two variables. Animal populations fluctuate throughout the year, and thus using a single point estimate (e.g., horses and sheep), multiple point estimates (e.g., cattle and swine), or periodic estimates (e.g., goats) introduces uncertainty into the average annual estimates of these populations. In addition, there is uncertainty associated with the original population survey methods employed by USDA.

Emission factors vary in each animal, depending on its production and diet characteristics, as well as genetics. This makes determining an exact emission factor for each state and all possible animal sub-groupings impossible. However, for cattle, these variables were simulated when estimating emissions for the United States (EPA 2004), thus providing a reasonable average for the regions defined in this analysis. While some of the characteristics used for cattle differ from the IPCC default values, a review of the US situation determined that these factors are justified. For other (non-cattle) animal populations there is also uncertainty associated with the emission factors, but it is believed not to vary as drastically within each species.

2. Livestock Manure

Similar to emission estimates of methane from enteric fermentation, emissions from manure management are dependent on the estimates of animal populations and the various factors used for each animal type. Therefore, the uncertainty associated with the emission estimates stems from those variables. Animal populations fluctuate throughout the year, and thus using a single point estimate (e.g., horses and sheep), multiple point estimates (e.g., cattle and swine), or periodic estimates (e.g., goats) introduces uncertainty into the average annual estimates of these populations. In addition, there is uncertainty associated with the original population survey methods employed by USDA.

The largest contributors to uncertainty in emissions from manure management are the lack of extensive data describing the management systems used in each region, and the methane generating characteristics used to estimate emissions from each of these systems. Also, the nitrous oxide emission factors are derived from a limited data set and are provided as global estimates, not country or state specific.

In particular, methane conversion factors (MCFs) vary widely for anaerobic lagoon systems, based on design and handling procedures. The default range from the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000) is between zero and 100 percent, reflecting the vast discrepancies that can occur in this type of system. In the United States, MCFs were estimated based on observed system performance and climatic factors, though the methodology employed introduces additional uncertainty because it is based on data from relatively few systems (EPA 2004).

In addition, there is uncertainty in the maximum methane producing potential (Bo) used for each animal group. This value varies with both animal and diet characteristics, so estimating an average across an entire population introduces uncertainty. While the Bo values used in this analysis vary by animal subcategory to try to reflect as many of these differences as possible, there is not sufficient data available at this time to estimate precise values that accurately portray the Bo for all animal types and feeding situations (EPA 2004).

Finally, nitrous oxide emission factors used for this analysis are the global defaults provided by the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000). These factors are based on limited studies, and do not take into account the fact that US emission factors may vary significantly on both a national and state level.

3. Agricultural Soil Management

The amount of nitrous oxide (N_2O) emissions from managed soils is dependent on a large number of variables besides nitrogen (N) inputs, including soil moisture content, pH, soil temperature, organic carbon availability, oxygen (O_2) partial pressure, and soil amendment management practices. However, the effect of the combined interaction of these variables on N_2O flux is complex and highly uncertain. The IPCC default methodology that is followed here is based only on N inputs and does not incorporate other variables. As noted in the Revised 1996 IPCC Guidelines (IPCC/UNEP/OECD/IEA 1997), this is a generalized approach that treats all soils equally, with the exception of cultivated histosols (EPA 2004). This methodology covers the following three sub-categories: direct emissions due to cropping practices, direct emissions due to animal production, and indirect emissions from agricultural applications of N. Uncertainties exist in both the emission factors and activity data used to derive emission estimates in each sub-category.

As noted in Section 2.2, scientific knowledge is limited regarding N_2O production and emissions from soils to which nitrogen is added. Thus it is not currently possible to develop statistically valid estimates of emission factors for all possible combinations of soil, climate, and management conditions. The emission factors presented throughout this chapter are midpoint estimates based on measurements described in the scientific literature. They are representative of current scientific understanding, but also possess a significant level of uncertainty.

Uncertainties also exist in the default activity data used to derive emission estimates in each sub-category. In particular, the fertilizer statistics do not include non-commercial fertilizers (except estimated manure and crop residues). Site-specific conditions are not taken into consideration when determining the amount of nitrogen excreted from animals. Limited research on nitrogen-fixing crops has resulted in the use of conversion factors that may not account for the variety of conditions in all states. Expert judgment, with its inherent uncertainty, was used to estimate the amount of crop residues left on soils as no data were available.

Additional uncertainty surrounds the emission sub-categories for which state-level data may not be available, i.e., land application of sewage sludge and cultivation of histosols. Emissions of N_2O due to leaching and runoff are also relatively uncertain at this time, due to the uncertainty of the volatilization rates and proportion of leached nitrogen.

4. Agricultural Crop Wastes

The methodologies presented in this chapter account for non-carbon dioxide emissions, including methane, nitrous oxide, carbon monoxide, and nitrogen oxides, from field burning of agricultural residues. As in the Inventory of US GHG and Sinks, major sources of uncertainty in this sector are the quantity of residue burned per year and the variability in states' burning practices (US EPA 2004). Both the emission factors and activity data introduce uncertain elements into the calculations.

The gas emission ratios have a relatively high level of uncertainty as they are region-specific (not country- or state-specific). Low level uncertainty also surrounds residue dry matter content, burning efficiency, and combustion efficiency values used (US EPA 2004).

Since there is no national or state-level collection of data on the fraction of crop residue burned, and burning practices vary by state and crop, these data are highly uncertain. Additional sources of uncertainty include crop production data and residue to crop production ratios at low levels (US. EPA 2004).

Appendix C: Database of State Incentives for Renewables & Efficiency 2008

The following information provided by the Database of State Incentives for Renewables & Efficiency 2008 gives an overview of the RPS program.

Background

In December 2002, the Public Regulatory Commission PRC unanimously approved a renewables portfolio standard (RPS) requiring investor-owned utilities to derive 5% of annual retail sales to New Mexico customers from renewable energy sources by 2006, rising to 10% by 2011. In March of 2004, Senate Bill 43 codified the PRC rules and established additional requirements. New Mexico subsequently doubled its RPS for investor-owned utilities and created a separate standard for rural electric cooperatives in March 2007 (Senate Bill 418).

Summary

In March 2007, New Mexico passed SB 418, which directs investor-owned utilities to generate 20% of total retail sales to New Mexico customers from renewable energy resources by 2020, with interim standards of 10% by 2011 and 15% by 2015. The bill also establishes a standard for rural electric cooperatives of 10% by 2020. Furthermore, utilities are to set a goal of at least 5% reduction in total retail sales to New Mexico customers, adjusted for load growth, by January 1, 2020.

Renewable energy is defined as electric energy generated by low- or zero-emissions generation technology with substantial long-term production potential; solar; wind; geothermal; hydropower facilities brought in service after July 1, 2007; fuel cells that are not fossil fueled; and biomass resources, such as agriculture or animal waste, small diameter timber, salt cedar and other phreatophyte or woody vegetation removed from river basins or watersheds in New Mexico, landfill gas and anaerobically digested waste biomass. Renewable energy does not include electric energy generated from fossil fuel or nuclear facilities.

Utilities document compliance with the RPS through the use of renewable-energy certificates (RECs). A REC represents one kilowatt-hour (kWh) of renewable electricity. RECs used for RPS compliance on or after January 1, 2008 must be registered with the Western Renewable Energy Generation Information System (WREGIS). RECs not used for compliance, sold, or otherwise transferred may be carried forward for up to four years (Database of State Incentives for Renewables & Efficiency 2008).

Appendix D: Annual Solid Waste Reports

Source and Management	2004	2005	2006	2007	2008
Generated in New Mexico	3,004,965	3,077,680	3,279,954	3,226,933	2,962,096
Waste from Out-of-State	564,018	471345	626,598	665,627	613,025
Waste Diverted from Landfills	157,986	114169	406,745	433,186	383,627
Total Solid Waste Disposed in New Mexico Landfills	3,410,997	3,434,856	3,499,807	3,459,374	3,191,494

These numbers are slightly different than the tonnages published in the Annual Report because the data continues to be entered as the facilities annual tonnages are reported.