Greenhouse Gases Emissions Profile and Forecast: Taos & Vicinity, New Mexico 2009-2030

Prepared for the

Town of Taos, New Mexico

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Local Government Action

Local governments represent a key part of the puzzle for lowering greenhouse gases (GHGs) in the United States. If we are going to meet our goal of keeping global warming within the widely accepted range of 2°C – cities and counties will be absolutely critical actors because of local powers over infrastructure decisions. According to a recent study published by the journal Science (Davis, Caldiera and Matthews, 2010), the bulk of emissions we can expect between now and 2050 will come from GHG emitting sources yet to be built.

Local governments have tremendous powers over land use, transportation, and buildings. According to Architecture 2030 (2011a), "In 2009, 77% of all the electricity produced at power plants in the U.S. was used to just operate buildings." And according to the Growing Cooler Report (Ewing, and others, 2010), "Transportation accounts for a full third of CO_2 emissions in the United States, and that share is growing, rising from 31 percent in 1990 to 33 percent today."
(Martin Chávez, 2011, <u>in</u>
National Geographic – The Great Energy Challenge).

-- Martin Chávez is Executive Director, ICLEI USA and Former Mayor of Albuquerque, New Mexico

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Executive Summary

In January 2007, the Town of Taos approved Resolution 07-04 to endorse the U.S. Conference of Mayors Climate Protection Agreement.

The U.S. Conference of Mayors Climate Protection Agreement has been signed by the mayors of 1,044 cities and towns representing more than 87 million people across the U.S.A. as of November 15, 2010.

Source: U.S. Conference of Mayors
Accessed online at: http://www.usmayors.org/climateprotection/list.asp

The Agreement in part states that the Town "…will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as …Inventory global warming emissions in City operations and in the community, set reduction targets, and create an action plan; …Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO_2 (carbon dioxide); and …Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution."

The Town further resolved to "…work in conjunction with ICLEI Local Governments for Sustainability and other appropriate organizations to track progress and implementation of the U.S. Mayors Climate Protection Agreement…"

ICLEI – Local Governments for Sustainability USA is an association of more than 600 U.S. local governments committed to climate protection and sustainability. New Mexico members as of December 2010 included Alamogordo, Albuquerque, Cimarrón, Las Cruces, Los Alamos County, Santa Fe, Santa Fe County, Silver City and Taos.

Source: ICLEI USA. Accessed online at: http://www.icleiusa.org

The Town of Taos became a member of ICLEI to take advantage of ICLEI's computer programs, decision support tools, greenhouse gas emissions inventory protocols, and skills trainings. One purpose of this report and project is to assist Town of Taos staff in collecting greenhouse gases (GHG) emissions data and using the full suite of ICLEI tools.

Greenhouse Gases Emissions Profile and Forecast
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In late 2009, the Town of Taos applied for and received funding under the American Recovery and Reinvestment Act of 2009 (ARRA) for five projects. These included energy audits of Town-owned buildings; installing 50 kilowatts of solar photovoltaic power on Town Hall; training Town staff in energy-efficient building certification systems; performing a greenhouse gas emissions inventory; and developing a public education program about the Town's recent and new projects on energy use and efficiency goals.

This report conveys the results of a greenhouse gases (GHG) emissions inventory for the base year of 2009. This work is the foundation for the Town of Taos, its neighboring communities, and Taos County to understand the quantities and nature of GHG emissions attributable to energy use and other activities. The report also sets forth recommendations for setting realistic, economical GHG reduction targets and creating a plan for achieving those targets.

This inventory provides estimates for and/or discussions of the following GHG emissions sources and sinks:

- Electricity (CO_2 and other gases; Coal- and Natural-Gas Fired Power Plants)
- Utility-provided Natural Gas (Methane)
- Liquefied Petroleum Gas (LP Gas or Propane)
- On-Road Vehicle Transportation Fuels (Gasoline and Diesel)
- Wood (CO_2; Methane; other gases; partial data available for this report)
- Wastewater Treatment (Nitrous Oxide; data unavailable for this report)
- Solid Waste Disposal (Methane; data unavailable for this report)
- Other Greenhouse Gases and Air Pollutants (Fluorinated Gases; data unavailable for this report, and particulate matter, PM-2.5 & PM-10)
- Land-Use Categories and Activities (Development, Agricultural, Forest, and other)

Energy uses for residential and commercial buildings and vehicular transportation account for the overwhelming bulk of direct and indirect greenhouse gases emissions for Taos and vicinity.

Forest lands of the Carson National Forest in eastern Taos County account for the greatest existing and potential carbon sequestration.

The report also discusses GHG emissions reductions status and potential using solar and wind power. The report discusses GHG emissions sources for which insufficient or no data were available upon which to base reliable estimates.

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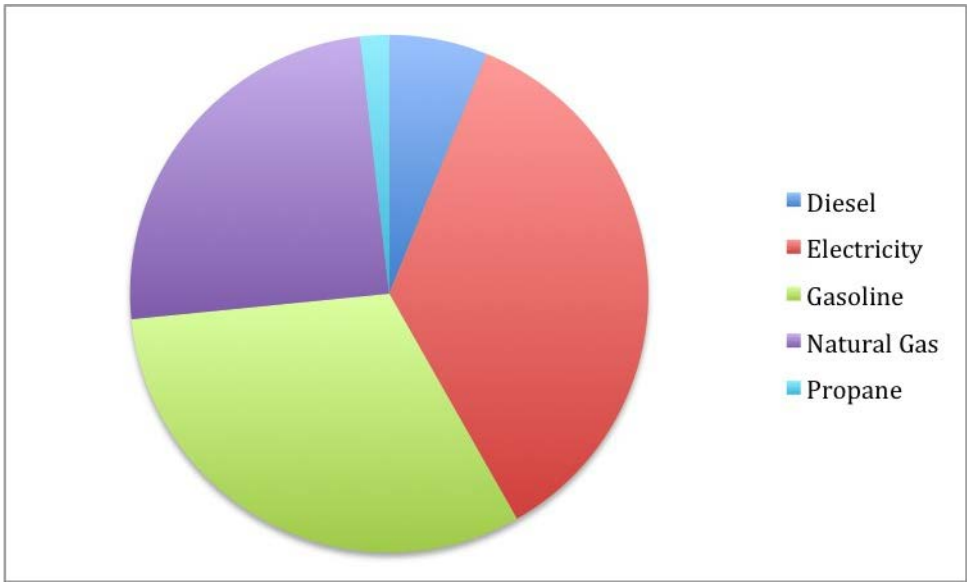
Based on data for the baseline year 2009, Taos County's total GHG emissions from electricity, natural gas, propane and vehicle transportation are estimated to be about 427,276 tons of carbon dioxide equivalent (tCO_2e). Estimated GHG emissions for the Taos Planning Area from the same sources were 203,423 tCO_2e. Estimated GHG Emissions for the Town of Taos were 124,708 tCO_2e from these sources. These must be considered minimum figures until complemented by data from other emissions sources.



Town of Taos Greenhouse Gases (GHG) Emissions by Source for 2009.
Electricity (35.7%), Gasoline (31.6%) and Natural Gas (24.8%) accounted for more than 92 percent of the Town's GHG emissions in 2009.
See Appendix J for GHG emissions data reports for Taos and Vicinity.

Statewide carbon sequestration rates for New Mexico forestlands suggest such lands in Taos County are estimated to sequester 671,000 tCO2e per year through 2020. Additional carbon sequestration potential may be available from other land cover such as shrub lands and grasslands.

Present-day policies and continuing improvements in clean energy technology suggest the GHG emissions could decrease by 50 percent or more by 2030. Such decrease is attainable even with substantial population growth. However, this growth would need to exclude new, major industries that would be reliant on the heavy use of fossil fuels.

The decrease in emissions can be driven by:

- Increased building energy-use efficiency;
- Increased use of passive solar, solar thermal, and geothermal heat pump installations;
- Increased fuel efficiency and fuel switching for passenger and commercial vehicles;
- Reduced vehicle miles traveled using several planning and policy options; and
- Increased generation of electricity using energy sources such as solar, wind, geothermal and biomass power that are responsible for relatively minor GHG emissions.

Taos and vicinity GHG emissions in 2009 mirror global and national trends wherein the majority of emissions are related to residential and commercial building energy use (electricity and natural gas) and on-road vehicular transportation (gasoline and diesel fuel). However, Taos and vicinity lacks industrial development similar to that responsible for major GHG emissions elsewhere.

Taos area decisionmakers should focus strongly on reducing fossil-fuel energy uses for residential and commercial buildings and motor vehicle transportation, while at the same time encouraging local clean energy generation.

Priorities for reducing GHG emissions in Taos and vicinity should focus primarily on energy use by buildings and transportation while minimizing impacts of new industrial and transportation corridor development. The Town and County of Taos should continue to collect data on GHG emissions sources and sinks in order to build and maintain a GHG inventory, become aware of new GHG sources and sequestration opportunities, and set and measure progress towards GHG emissions reduction targets.

Recommendations for the Town of Taos and Vicinity

In terms of reducing greenhouse gases emissions from current levels, priorities for Taos and Taos County are: (1) reducing emissions related to energy use by residential and commercial buildings, and (2) reducing vehicular transportation emissions while allowing development similar to the style of the present day. In addition, both the Town and County of Taos possess abundant and mostly untapped clean energy resources in the forms of solar, wind, geothermal and biomass energy that could greatly offset fossil fuel uses and their consequent emissions. The following are some specific recommendations.

Planning goals for the Town and County of Taos suggest a landscape formed around rural and small community settings in 2030. These goals do not invite increasing greenhouse gases emissions from new industrial and other large-scale development.

Buildings and Transportation

The Town and County of Taos should:

- Continue planning policy approaches favoring energy use and water-use efficiencies and clean energy generation designed to match or exceed state and federal standards. The Town of Taos is well positioned in this regard by means of its commitments to the U.S. Conference of Mayors Climate Protection Agreement (2007), the Taos High Performance Building Ordinance (2009), the 2030 Challenge (2009), energy audits of Town-owned buildings, installing solar photovoltaic power on Town Hall, and other complementary policy actions.

- Investigate accessing energy-use data for a variety of types of residential buildings in the community. A program to collect residential building performance data, especially for pre-2010 buildings and retrofits, would be valuable for monitoring progress towards GHG reduction goals.

- Encourage on-site clean energy generation for residential and commercial buildings. This includes neighborhood-scale facilities such as solar-electric power arrays and solar or geothermal district heating using solar thermal and/or geothermal heat pump systems (U.S. Department of Energy, 2011).

- Focus strongly on improving energy efficiency in schools. Energy use in school complexes is an expensive component of school district budgets, and needs to be treated as energy cost rise. The Taos Municipal School District, in cooperation with other entities such as the Town of Taos and KCEC, should investigate options for obtaining energy audits on all district buildings. These audits will identify those buildings that need the most attention in terms of energy efficiency retrofits.

- Assess energy efficiency aspects of new commercial buildings constructed under the Taos High Performance building Ordinance as data become available. Concurrently, the Town of Taos should investigate accessing energy-use data for a variety of types of existing, older commercial buildings in the community. Some private building owners could be willing to share energy-use data, especially for comparative purposes with similar buildings that might have substantially lower energy costs.

- Assess energy efficiency of new residential buildings using the Home Energy Rating System (HERS) data provided as a condition of receiving a Certificate of Occupancy. HERS data include energy-use projections that can be used to determine GHG emissions and levels of GHG reductions possible with different building types. Concurrently, investigate energy-use data for a variety of types of existing, older residential buildings in the community. Taos area builders have been incorporating innovative energy efficiency measures into buildings for many decades. A program to collect residential building performance data, especially for pre-2010 buildings and retrofits, would be valuable for monitoring progress towards GHG reduction goals.

- Focus strongly on residential heating demands as priorities for GHG reductions for Taos and vicinity by 2030. A wide variety of options are available for heating and heating efficiency for residences including insulation and other weatherization measures, passive solar heating, active solar thermal heating, geothermal heating using heat pumps (U.S. Department of Energy, 2011), and combinations of these.

Residential clean energy opportunities and solutions currently are being created worldwide, and the pace of change in this field of study and practice is rapid. It will be essential for Taos planning staff to research experiences of other USA and worldwide communities in creating self-sustaining clean energy generation. District heating systems powered by a local clean energy generator is one possibility for use in new residential developments. Decisionmakers should participate by creating incentives for all types of residential clean energy systems and practices. Planners should begin identifying specific Town-owned and County-owned lands for residential-scale clean energy installations such as ground-mounted solar photovoltaic (PV) arrays.

- Investigate policy options for obtaining and distributing loans to citizens for making energy efficiency improvements.

- Work with Kit Carson Electric Cooperative, Inc. (KCEC) and other entities to offer on-bill financing for energy generation and energy efficiency improvements at levels less than consumers' current electricity bills (1BOG, 2011).

- Provide energy efficiency weatherization for the homes of low-income citizens.

- Require energy efficiency upgrades of homes at time of sale.

- In concert with KCEC, investigate the experience of other communities, and develop a process for siting electric vehicle charging stations to meet both current demands and the rapidly evolving electric vehicle future.

- Set an example for the potential of electric or hybrid-electric vehicle use by purchasing such vehicles for vehicle fleets, especially passenger vehicles for routinely limited travel distances.

- Implement fuel switching for selected Town vehicles from gasoline and diesel fuel to natural gas, propane, and/or biodiesel.

- Investigate a suite of policy options for reducing driving by Town employees, particularly incentives for ride sharing and work schedule changes designed to reduce numbers of commute trips.

- Investigate promoting development that shortens or eliminates motor vehicle trips and encourages ride sharing, walking, bicycling, and public transit.

- Consider planning and development options that close selected streets or areas to vehicle traffic.

- Create economic disincentives to excessive vehicle travel such as congestion and/or parking pricing.

- Create economic incentives such as pay-as-you-drive insurance, and/or graduated rebates to owners of vehicles with lower emissions and those willing to share rides or vehicles.

State and local governments and metropolitan planning organizations around the United States have also shown that there are ways to reduce demand for motor vehicle travel while preserving or enhancing accessibility to homes, businesses, and leisure activities.

Source: Greene and Plotkin (2011, p. 84).

General Recommendations

The Town and County of Taos should:

- Revise and update Town of Taos and Taos County Long-Range Plans to account for GHG emissions reductions and adaptation to climate change impacts.

- Systematically monitor policy and technology advances applicable to small rural communities that pertain to movement into the new energy economy.

- Schedule periodic meetings among local, state and regional energy policy principals to develop a comprehensive plan for the energy future of Taos County & northern New Mexico.

- Share findings on GHG emissions with the local public, and record comments and suggestions.

- Share findings on greenhouse gases emissions with officials of other communities, especially in the northern New Mexico and southern Colorado region.

- Evaluate industries wanting to locate in Taos County in terms of projected GHG emissions and seek alternatives to exclude industries with high GHG emissions potential.

- Monitor and examine full costs of alternative electric power resources, and examine cost trends for planning purposes.

    - Energy efficiency is significantly cheaper than producing electricity with new power plants, and offers additional economic and environmental benefits.

    - Solar-electric and solar-thermal costs continue to decline while fossil fuel costs continue to rise and/or remain volatile. Examine levelized costs that factor in expenditures for construction, fuel and operations among other costs (U.S. Energy Information Administration, 2011e). Levelized cost comparisons in particular show steady declines in the costs of solar photovoltaic, solar thermal, and wind power over the past thirty years while the cost of fossil fuels and nuclear power have risen substantially while showing high volatility.

- Consider the near- and longer-term costs of transmission, distribution, GHG emissions, and externalities such as air pollution and public health impacts of fossil-fuel energy uses.

- Investigate procuring clean energy and encouraging its greater production by local energy providers.

- Promote locally generated, clean electrical power and distributed generation (DG) solutions to increasing electricity demands.

- In concert with electricity providers (Tri-State; KCEC), promote creation of hybrid clean energy/fossil-fuel power plants at existing locations of fossil-fuel fired power plants with a view toward using fossil fuels as backup or phasing out fossil fuel use.

Greenhouse Gases Emissions Data

The Town and County of Taos should:

- Compile data primarily at the at Taos County level. Many types of data important to GHG emissions are readily available at the County level, but not at the local level.

- Update all population-based data in the GHG inventory to 2010 Census results.

- Seek new data, both for sources not treated in this report and for GHG chemicals created and emitted in the future.

- Ensure data are compatible with State and Federal data formats. In general, ICLEI – USA data format protocols meet this requirement. However, Town staff should better understand State and Federal GHG data protocols as systems for monitoring and reporting GHGs evolve nationwide.

- Produce GHG inventories to match schedule of State of New Mexico inventories. Currently, the State intends to update GHG emissions inventories every four years. The Taos GHG Inventory could be updated on an annual basis, especially using readily available data on electricity, natural gas, and transportation energy consumption.

- Maintain membership in ICLEI USA, and encourage membership for Taos County and other communities in vicinity.

- Work with data suppliers to educate them about importance of the data and compiling data in formats usable with ICLEI USA programs.

- Enter data from energy audits of Town-owned and operated buildings in 2010-11. The results of these energy audits were made available to Town staff in the first quarter of 2011 (Global Energy of Glendower, Inc., 2011). Energy use and resulting GHG emissions for the Town's buildings may then be readily calculated.

- Work with Kit Carson Electric Cooperative, Inc. (KCEC) to obtain data on KCEC's energy audits performed or to be performed under a U. S. Department of Agriculture (USDA) grant beginning in October 2009 (Kit Carson Electric Cooperative, Inc., 2011). Energy audits were to be made for small businesses throughout the KCEC service area, including Taos County. KCEC also promised to ensure energy efficiency evaluations throughout its own facilities and all activities of the cooperative.

- Continue to collect energy-use data and reports from Southern Methodist University (SMU-In-Taos) and UNM-Taos. The GHG Emissions Project obtained energy-use data for building complexes at SMU-In-Taos and UNM-Taos. These data are not included in this report, but have been provided separately to Town staff. The data provide important baseline information on a variety of building types for complexes that are currently undergoing substantial energy efficiency upgrades.

SMU-In-Taos in mid-2010 completed construction of the first commercial or institutional building in the Taos area to achieve the U.S. Green Building Council's (USGBC) LEED Gold certification. Casita Clements, a 3,457 square foot adobe building used as a student residence, may now be used for energy-use comparisons with other similar buildings. Six other student residences ("casitas") on the SMU-In-Taos campus are being retrofitted for energy efficiency, and are being reviewed by the USGBC for LEED certification.

Acknowledgements

Thank you to all the participants from utilities, governments, and local organizations who contributed their time to introduce and share the nature of the Town and County of Taos, compile data, review results, and bring this inventory to realization.

The participants in this inventory process consisted of a group of 100 organizations and individuals that took part in meetings, telephone conversations, and email exchanges to provide emissions-related data, identify emissions sources, suggest available data sources and contacts, confirm methodologies, and review inventory results.

Local government officials and citizens also participated in a presentation of the preliminary results of this inventory to an audience at a special Town of Taos Council Workshop on March 22, 2011.

ICLEI – Local Governments for Sustainability USA (ICLEI USA) provided tools and consulting for collecting greenhouse gases (GHG) emissions data, creating a GHG inventory, choosing emissions reductions measures, and providing materials for developing climate change mitigation and adaptation plans. The Town of Taos benefits from these services through its membership in ICLEI USA.

We acknowledge the State of New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) and the United States Department of Energy (DOE) as co-sponsors, and the American Recovery and Reinvestment Act (ARRA) as the funding source for all work performed in preparing of this report.

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Purpose and Scope

The Foundation for a Continuing Inventory

The work reported in this document is the first of its kind attempted for Taos and vicinity, New Mexico. The results illustrate both the scope and complexities of understanding greenhouse gases (GHG) emissions related to human activities. The results also show where and why certain GHG emissions data are unavailable or unreported. However, the ICLEI USA tools available to local governments and contractors offer systematic means for interpreting existing data and filling in data gaps where needed for future anaylsis.

This document represents a multi-faceted, multi-sectoral approach to understanding GHG emissions and the potential for their reductions. The results provide an important "snapshot" of fossil fuel energy and other emissions sources and sinks for a relatively small community. This report contains basic data and data sources against which energy-use options for the future may be compared. Government officials and others may use these results to plan and prepare for alternative futures in a rapidly changing and often volatile energy economy.

This report provides an important "snapshot" of fossil fuel and other energy uses for a relatively small community, and offers basic data against which energy-use options for the future may be compared.

GHG emissions and other data presented herein may be used to anticipate State and Federal mandates for building energy efficiency and motor vehicle fuel efficiency among other directives. These results are especially significant in seeking the most economical solutions to GHG reductions because solutions must be measured against some known emissions baseline.

Local government staff can update the GHG inventory both occasionally and periodically. Data on principal emissions sources (electricity generation, natural gas deliveries, and motor vehicle transportation, for example) are readily available on an annual or more frequent basis and can be entered at specified times. Data on other sources (aviation, stationary generators, wood burning, for example) can be entered into the database as such data become available.

Meeting Greenhouse Gases Emissions Milestones

A fundamental component of the ICLEI performance-based model for greenhouse gases (GHG) emissions reductions is the milestone process (ICLEI Global, 2011). Each ICLEI initiative incorporates a five-milestone structure to guide participating local governments:

- Establish a baseline;
- Set a target;
- Develop a local action plan;
- Implement the local action plan; and
- Measure results.

Benefits of a Developing a GHG Inventory

The benefits of developing a GHG inventory are many and varied (California Air Resources Board, and others, 2010, p. 4), and include:

Risk Management. Voluntarily reporting GHG emissions may help local governments manage climate risk by documenting early actions to reduce GHG emissions. Future state, federal and international regulatory GHG programs may accept such information.

Informed Decisionmaking. Understanding GHG emissions and how to control them provides support for decisions on energy-use policy and planning. Such understanding may help local governments avoid unintended consequences of today's decisions with respect to the rapidly evolving new energy economy. For example, a current decision on committing to energy from new fossil-fuel, solar or wind energy sources is likely to have repercussions lasting several decades.

Energy Infrastructure and Economics: A GHG inventory helps demonstrate the scale, complexity, economics and governance of the energy production and distribution system for even a small community. Local governments may use GHG inventory results for cost and policy analysis for future energy generation projects.

Addressing Inefficiencies. Accounting for emissions has helped many organizations gain better insights into the relationship between improving efficiency (reducing factor inputs and waste) and reducing emissions. As a result, organizations have redesigned business operations and processes, implemented technological innovations, improved products and services, and ultimately saved money and resources.

Integration of Local and Regional Plans. A GHG inventory and the recommendations it offers provide planning elements for land-use, resource-use, growth, economic, and other formal plans.

Readiness for a Carbon Constrained Future. Identifying emissions sources to develop a GHG profile and management strategies may help local governments prepare for and respond to the potential impact of new regulations.

Determining Data Needs and Addressing Inventory Problems. Understanding the scope of GHG emissions may help local governments adopt protocols for GHG data collection, maintain databases, and correct problems with data and reporting as they occur.

Recognition as an Environmental Leader. Voluntarily reporting GHG emissions provides local governments with a pathway to recognize, publicize, and promote their environmental stewardship.

Stakeholder Education. Assembling an annual GHG emissions inventory can help inform management, constituents, employees, and the public about a local government's GHG emissions profile.

General Approach and Tools

Greenhouse Gases (GHG) emissions inventories are rarely, if ever, based on direct measurement of emissions. Instead, emissions are estimated based on accepted models and calculation methods. This inventory prioritized emissions estimates based on data pertaining to actual activities in Taos, New Mexico and vicinity (e.g., electricity consumed) over modeled data. However, in some cases prorating statewide and countywide data, for example, are the only options upon which to base a calculation. This document explains sources, quality and usefulness of data throughout, and offers suggestions about improving the database.

This inventory draws on well reviewed and accepted calculation methods from the Intergovernmental Panel on Climate Change, U.S. Environmental Protection Agency (USEPA), and those implemented in Local Governments for Sustainability's (ICLEI's) Clean Air and Climate Protection (CACP 2009) software (ICLEI USA, 2011).

The CACP 2009 software tool is used to calculate the basic inventory components and accommodates unique emissions to provide an overall inventory accounting. The CACP software is well suited to the Town of Taos' applications for the following reasons:

- Available to the Town of Taos as a member of ICLEI USA
- Focuses on fundamental carbon intensive areas with readily available data sources
- Easy for Town staff and other organizations maintaining the inventory to learn and use
- Supported by well developed documentation
- Accepted methodology is embedded in the software
- Software is subject to ongoing updates from ICLEI, making it less likely to become outdated when compared to a proprietary tool
- Ongoing support with all aspects of using the software is available from ICLEI USA
- Built-in capacity for GHG emissions reduction measurements within the tool

ICLEI USA provides custom spreadsheets for emission sources not covered directly by the CACP 2009 tool. These spreadsheets and associated data were documented and provided to the Town of Taos as part of this project for ongoing inventory maintenance. The results from these tools will be entered into CACP 2009 program using appropriate or *Other* emissions categories such that CACP 2009 produces a single coherent inventory.

The purpose of this report is to convey the approaches used and the results of the inventory. Full documentation of data sources, emission factors, methodologies, and results can be found in the CACP 2009 tool and accompanying spreadsheets. The appendicies are targeted at the audience that will be maintaining the inventory, and

describe the data, its sources, and how these relate to the inventory.

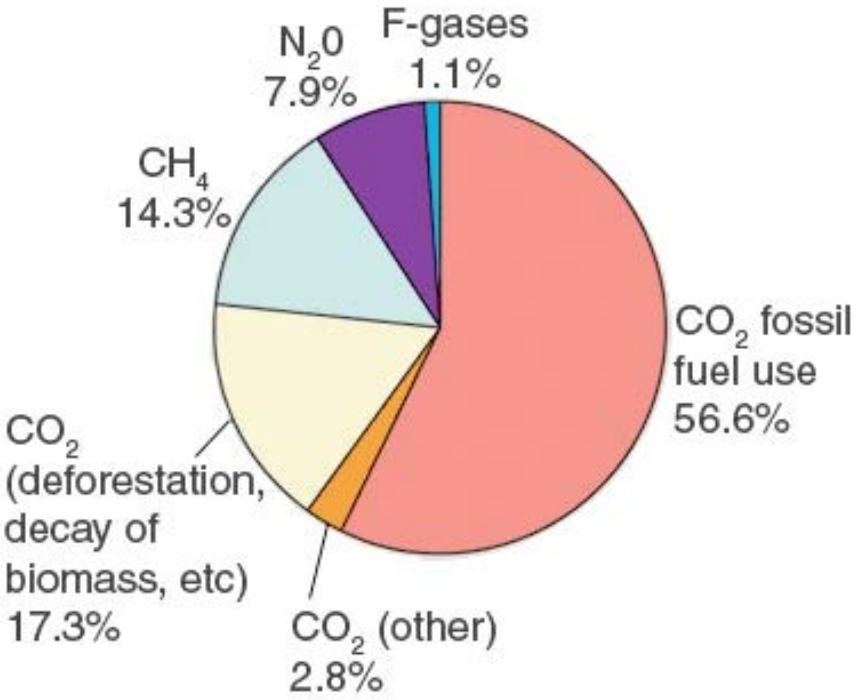
Background

Understanding Greenhouse Gases Emissions

This report discusses greenhouse gases emissions resulting from human activities. These gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (U.S. Environmental Protection Agency (2010a). Table B1 provides a more comprehensive list of greenhouse gases and their sources. The list changes from time to time as humans create new GHGs for various industrial and other purposes.

This report and inventory focuses initially and primarily on CO_2, CH_4, and N_20 as these gases form about 99 percent of GHG emissions, and thereby suggest important opportunities for short- and long-term GHG reductions. As data on F-gases become available for Taos and vicinity, they may be readily entered into the inventory.

Figure 1. – Global Share of Different Anthropogenic GHGs in Total Emissions (International Panel on Climate Change, 2007, p. 36).



Source: U.S. Environmental Protection Agency
Accessed online at: http://www.epa.gov/climatechange/emissions/globalghg.html
Data included in Appendix B.

Once emitted, CO_2 and certain other GHGs remain in Earth's atmosphere for long periods.

Carbon dioxide (CO_2) and certain other greenhouse gases are problematical because of the time it takes for them to break down in Earth's atmosphere. The Atmospheric Lifetime of a greenhouse gas is the time it would take for the amount of a GHG produced by human activities to return to its natural or background level. This process occurs either by the GHG being converted into another chemical compound, or being taken out of the atmosphere by a sink. Average lifetimes can range from about a week for certain aerosols to more than a century for carbon dioxide and chlorofluorocarbons (CFCs). See Appendix B.

Carbon Dioxide (CO_2)

Carbon dioxide (CO_2) is the most abundant greenhouse gas in our atmosphere produced by human (anthropogenic) sources. The concentration of CO_2 in Earth's atmosphere has increased by about 30 percent since the beginning of the industrial revolution in the late 1800s. Most of this increase, about 57 percent, comes from human uses of fossil fuels including coal, oil, and natural gas. Approximately 17 percent of the CO_2 increase comes from changes in land use, such as clearing of forests and cultivation of soils for food production. About 3 percent of CO_2 comes from other sources including cement production and natural gas flaring. CO_2 sources can be found almost everywhere – from cars, to buildings, to cows, to power plants – and investigators are attempting to locate and monitor as many of these sources as possible (USEPA, 2010a,b; International Panel on Climate Change, 2007).

Carbon dioxide sources from human activities can be found almost everywhere --from cars, to buildings, to agriculture, to power plants, to deforestation practices.

Methane (CH_4)

Methane is responsible for about 14 percent of global anthropogenic GHG emissions. "Methane (CH_4) is emitted from a variety of both human-related (anthropogenic) and natural sources. Human-related activities include fossil fuel production, animal husbandry (enteric fermentation in livestock and manure management), rice cultivation, biomass burning, and waste management. These activities release significant quantities of methane to the atmosphere. It is estimated that more than 50 percent of global methane emissions are related to human-related activities. Natural sources of methane include wetlands, gas hydrates, permafrost, termites, oceans, freshwater bodies, non-wetland soils, and other sources such as wildfires." Accessed online at USEPA: http://www.epa.gov/methane/sources.html

Nitrous Oxide (N_2O)

Nitrous oxide (N_2O) is responsible for about 8 percent of anthropogenic GHG emissions. "Nitrous oxide is produced by both natural and human-related sources. Primary human-related sources of N_2O are agricultural soil management, animal manure management, sewage treatment, mobile and stationary combustion of fossil fuels, adipic acid production, and nitric acid production. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests." Accessed online at USEPA: http://www.epa.gov/nitrousoxide/sources.html

Fluorinated Gases (F-gases)

Fluorinated gases are responsible for about 1 percent of anthropogenic GHG emissions. These gases are also called "high global warming potential gases" because of their relative potency as GHGs. Although F-gases constitute a small percentage of current GHG emissions, their emissions are increasing steadily and are of concern with respect to overall GHG emissions reductions planning. "High GWP gases are emitted from a variety of industrial processes including aluminum production, semiconductor manufacturing, electric power transmission, magnesium production and processing, and the production of HCFC-22. In addition, some high GWP gases are being used to replace ozone-depleting substitutes (i.e., chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons) allowing the rapid phase out of these gases." Sulfur Hexafluoride (SF_6) is of particular concern for its widespread use in electrical transmission and distribution. "SF_6 is the electricity industry's preferred gas for electrical insulation, current interruption, and arc quenching in the transmission and distribution of electricity. SF6 is used extensively in circuit breakers, gas-insulated substations, and switchgear." Accessed online at USEPA: http://www.epa.gov/highgwp/sources.html

Greenhouse Gases Overview

Gases that trap heat in the atmosphere are often called greenhouse gases (GHGs). A section of the report at the U.S. Environmental Protection Agency Climate Change Site (USEPA, 2010a); http://www.epa.gov/climatechange/emissions/index.html provides information and data on emissions of greenhouse gases to Earth's atmosphere, and also the removal of greenhouse gases from the atmosphere.

For more information on the science of climate change, please visit EPA's climate change science home page at: http://www.epa.gov/climatechange/science/index.html

The principal greenhouse gases that enter the atmosphere because of human activities are:

Carbon Dioxide (CO2): Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH4): Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

Nitrous Oxide (N2O): Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Fluorinated Gases: Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases"). See also **Fluorocarbons and Sulfur Hexafluoride** at: http://www.fluorocarbons.org/en/homepage.html

(U.S. Environmental Protection Agency, 2010a)

State and Local Policy and Planning

State of New Mexico

New Mexico began studying the State's greenhouse gas (GHG) emissions and systematic reporting on GHG emissions in 2005 in response to an Executive Order of the Governor (New Mexico Office of the Governor, 2005). The Executive Order directed the Climate Change Advisory Group (CCAG) to prepare a report that includes projections of the State's future GHG emissions. The CCAG was also charged with preparing policy recommendations for reducing New Mexico's total GHG to 2000 levels by the year 2012, 10% below 2000 levels by 2020 and 75% by 2050. The CCAG released its "Climate Change Action Plan" in December 2006 together with "New Mexico Greenhouse Gas Inventory and Reference Case Projections 1990-2020." These documents set the stage for additional work including refined and updated GHG emissions reporting on a quadrennial basis, and rules for reporting GHG emissions statewide (New Mexico Environment Department, 2007, 2010; 2010b).

New Mexico and the Town of Taos are among many states and local governments representing about half the USA population that are proposing and implementing a variety of policies and actions to reduce greenhouse gases emissions.

Source: World Resources Institute, 2011, State & Regional Climate Change Policy. Accessed online at: http://www.wri.org/project/state-regional-climate-policy

Town of Taos

The Town of Taos has taken concerted actions since early 2007 that focus on its future in an energy economy based on energy efficiency and energy uses that reduce GHGs. The Town adopted the U.S. Conference of Mayors Climate Protection Agreement in January 2007, and became a member of the ICLEI USA in late 2007. The Town's ICLEI USA membership allows the Town to proceed with a GHGs emissions inventory with the use of software and technical support provided by the ICLEI.

In February 2009, the Town of Taos enacted a High Performance Building Ordinance to begin the process of increasing residential and commercial building energy efficiency. At the same time, the Town also adopted the 2030 Challenge Resolution. This is a longer-term commitment to meeting performance standards using building codes that reduce fossil fuel uses, greenhouse gases emissions, and overall energy consumption in buildings (Architecture 2030, 2011a).

In 2010, the Town of Taos began performing energy audits on the buildings it owns and operates, and began the GHGs emissions inventory that is the subject of this document. In 2011, the Town will install 50 kilowatts of solar photovoltaic power on the Taos Town Hall as a demonstration of the economic and other merits of modern clean energy technology.

Physical Setting

Taos County and the Town of Taos

Taos County is located in extreme north-central New Mexico with its northern border the New Mexico-Colorado state line. The county has an area of 2,205 square miles with elevations ranging from about 6,000 to greater than 13,000 feet. The climate is continental and includes semi-arid, sagebrush-covered terrain in its western parts, transitioning to mountainous, forested terrain of the Sangre de Cristo Mountains whose crest forms the eastern county boundary. Average annual precipitation ranges from about 12 inches per year in the Town of Taos to more than 30 inches per year in the nearby mountains. The Taos Ski Valley reports an annual average snowfall of about 321 inches per year, while about 35 inches of snow per year falls in the Town of Taos.

Taos and Taos County are devoid of major point sources of greenhouse gases (GHG) emissions. The New Mexico Environment Department in its rule-making on GHG emissions defines major point-source emitters as those emitting 25,000 tons per year or more of carbon dioxide equivalent, tCO_2e/yr (Schneider, 2010). For New Mexico, there were 63 emitters reporting GHG emissions in excess of 25,000 tCO_2e/yr in 2008, and none of these were located in Taos County. However, the bulk of electricity consumed by residential, commercial and light industrial uses in Taos County is derived from large point-source GHG emitters outside the county boundaries (Appendix D). In this regard, electrical use throughout Taos County is responsible for a part of the GHG emissions resulting from distant electricity generation.

In terms of GHG sinks, Taos County is mostly covered by vegetation, including forest, shrub land, grasslands, agricultural, riparian, and wetland systems. According to the U.S. Geological Survey (2010a,b), these systems account for more than 98 percent of the land cover in Taos County (Appendix I). These data indicate that Taos County offers potential for GHG emissions sinks through the uptake of CO_2 by living plants (p. 53-54).

The Town of Taos is a focal point for passenger and commercial vehicle traffic with major roadways entering the town from five directions. Tourism and work-related traffic from other areas in recent years have nearly doubled the town's daytime motor vehicle travel compared with travel by local residents. Elsewhere in Taos County, U.S. Highway 285 is a major north-south corridor for passenger and commercial vehicular travel between New Mexico and Colorado. These features of Taos and Taos County combine to produce substantial GHG emissions from motor vehicles (p. 47).

Population and Growth Projections

For using countywide greenhouse gases (GHG) emissions data not available for subunits of Taos County, this report prorates GHG emissions on the basis of Taos County population figures. Thus, the Town of Taos and Taos Planning Area GHG emissions data are adjusted on the basis of population where noted in this report in the absence of more specific data. Additionally, population data are needed for estimating GHG emissions for fuels such as propane (p. 40) where consumption figures are available only on a statewide, per capita basis.

Taos County population is expected to grow from 33,489 in 2009 to 41,145 in 2030. The Town of Taos population is expected to grow from 5,545 in 2009 to 6,797 in 2030, with substantial new growth occurring in the Taos Planning Area.

As more accurate population figures and GHG emissions data by sector become available, these numbers can be readily input into the ICLEI CACP 2009 program to update GHG emissions calculations. Specifically, all population-based information in this report should be updated using 2010 Census data as the data become available within the next few years. See Appendix C for New Mexico, Taos County, Taos Planning Area, and Town of Taos population and growth projections and the data upon which they are based.

The estimated 2009 population for the State of New Mexico was 2,009,671 (U.S. Census Bureau, 2009a) with a projected population of 2,864,796 in 2030 (University of New Mexico, Bureau of Business and Economic Research, UNM-BBER, 2008).

The estimated 2009 Taos County population was 33,489 with a projected population of 41,145 in 2030 (UNM-BBER, 2008). Population in the Town of Taos was estimated at 5,545 in 2009 with a projected population of 6,797 in 2030. Population for the Taos Planning Area – a study area for this report including Ranchos de Taos, Llano Quemado and El Prado – is estimated at 10,644 for 2009 with a projected population of 13,715. The Taos Planning Area is thus estimated to contain about one-third of Taos County population and development.

For comparative purposes, this report includes data from the Taos County Growth Management Plan (Community By Design, 2007, p. 10-11). This plan lists population and projections for four subareas of Taos County for 2000-2050 based on July 2005 census data (Table C6). Because of the different base year and methods of population projections, the figures in the County plan are slightly higher than those given by UNM-BBER in the previous paragraph.

Emissions by Source

Electricity Generation and Consumption

Generating electricity is the single largest source of carbon dioxide (CO_2) emissions in the USA. Electricity generation currently represents about 40 percent of total CO_2 emissions from all CO_2 emissions sources. Electricity generation also accounts for emissions of substantially smaller amounts of methane (CH_4) and nitrous oxide (N_2O). (See p. 23-25 and Appendix B). Residential, commercial and industrial sectors consume most produced electricity for lighting, heating, electric motors, appliances, electronics, and air conditioning (U.S. Environmental Protection Agency, 2010, p. 10).

Generating electricity is responsible for about 40 percent of total carbon dioxide emissions in the USA.

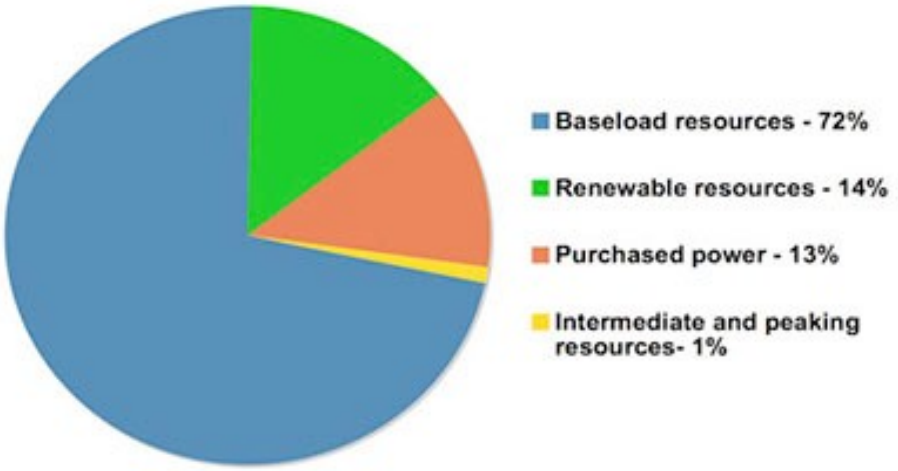
Electricity generation is generally identified as an indirect source of greenhouse gases (GHG) emissions. That is, most GHG emissions are generated at power plants that are typically far from the end-use site where the electricity is consumed. Small amounts of direct GHG emissions occur where electricity is produced at the point of use by generators fueled by gasoline, diesel, natural gas, or other fuels.

Taos and Taos County receive the bulk of their electricity demands from Kit Carson Electric Cooperative, Inc. (KCEC) headquartered in the Town of Taos. KCEC is one of 44 members of Tri-State Generation and Transmission Association, Inc. of Westminster, Colorado (Tri-State). Tri-State generates and transmits electricity to KCEC and other members from a network of power plants located in Wyoming, Colorado, Arizona and New Mexico (Appendix D).

Electrical Power from Tri-State Generation and Transmission Association, Inc.

For 2009-2010, Tri-State shows a system-wide generation profile using about 86 percent fossil fuels (baseload, purchased and peaking power), and 14 percent renewable sources (Figure 2).

Figure 2. -- Tri-State Generation and Transmission Association, Inc. power resources, 2009-2010.



Accessed online at: http://www.tristategt.org/AboutUs/generation.cfm

Tri-State sold a total of 18.6 million megawatt-hours (MWh) to its customers in 2009 (Tri-State 2009 Annual Report, p. 17). KCEC deliveries in three New Mexico counties in 2009 were about 302,500 MWh, or about 1.6 percent of Tri-State's sales (Appendix D). Of this amount, KCEC delivered 210,467 MWh to Taos County customers (Table 1).

Kit Carson Electric Cooperative, Inc. delivers its customers about 1.6 percent of the total electrical power generated by Tri-State Generation and Transmission Association, Inc.

KCEC in its annual report (2009) indicates that the bulk of electricity delivered in its service area was generated at 11 power plants fired by coal, natural gas and diesel fuel (Table D1, Appendix D). A relatively small number of KCEC customers purchase wind energy credits through KCEC's Green Power Option. KCEC is currently adding increments of solar power to its portfolio through local and regional connections to new solar photovoltaic (PV) power plants and distributed solar PV elsewhere in Taos County (Table D4).

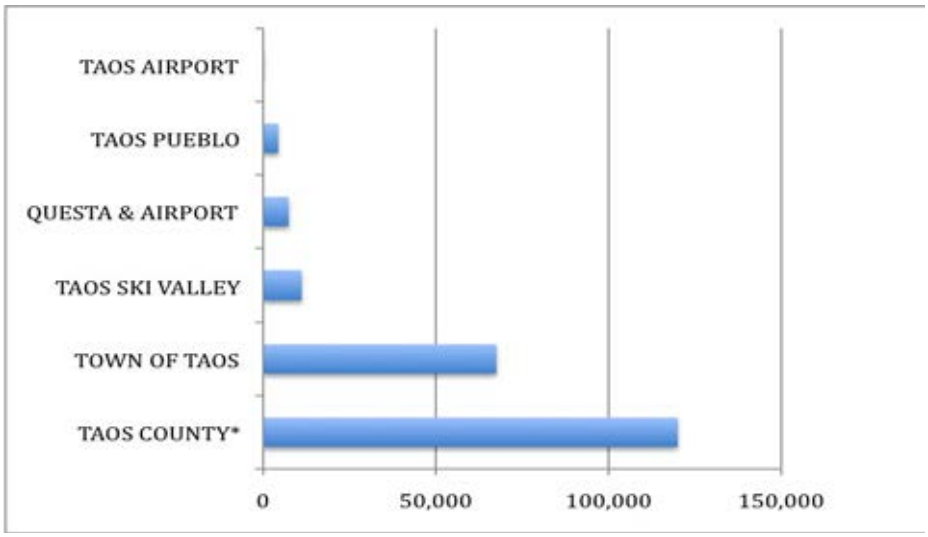
Table 1. – Electricity consumption in megawatt-hours (MWh) for Taos County, NM for 2009.

KCEC SERVICE AREA	TOTAL ELECTRICITY CONSUMPTION (MWh)	PERCENT OF TOTAL
Town of Taos	67,519	32.1
Taos Ski Valley	11,127	5.3
Questa and Airport	7,376	3.5
Taos Pueblo	4,358	2
Taos Airport	52	<0.1
Subtotal	**90,432**	**43.0**
Other Locations in Taos County*	120,035*	57.0*
Total Electricity Consumption, 2009	**210,467**	**100**

*Total for other Taos County locations minus total for Town of Taos, Taos Ski Valley, Questa and Airport, Taos Pueblo and Taos Airport.

*Other towns and communities in Taos County served by KCEC include: Red River, El Prado, Ranchos de Taos, Arroyo Hondo, Valdez, Pilar, Twinning, San Cristobal, Valle Escondido, Pot Creek, Costilla, Amalia, El Rito, Ojo Caliente, Tres Piedras, and many smaller entities.

Figure 3. – Electricity deliveries in Taos County by Kit Carson Electric Cooperative, Inc. (KCEC) in megawatt-hours (MWh) for 2009.



Source: Kit Carson Electric Cooperative, Inc. (written communication, 2010)

Electricity Use and Greenhouse Gases Emissions, Taos County and Town of Taos in 2009

Taos County Electricity Use and Greenhouse Gas Emissions 2009

Based on the data in the preceding section, the following reports illustrate the quantities of specific greenhouse gases (GHG) emissions associated with electricity use in Taos County and Taos. Note that carbon dioxide (CO_2) and carbon dioxide equivalent are reported in tons, whereas nitrous oxide (N_2O) and methane (CH_4) are reported in pounds in this calculation. Compare these reports with the calculations for electricity and other GHG emissions sectors in Appendix J.

Taos County

Community Greenhouse Gas Emissions in 2009

Electricity Use, Summary Report by Sector

	CO2 (tons)	N2O (lbs)	CH 4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential	63,818	1,747	1,699	64,107	46.3	97,354,000
Commercial	74,017	2,026	1,970	74,352	53.7	112,913,000
Total	**137,835**	**3,772**	**3,669**	**138,458**	**100.0**	**210,267,000**

This report has been generated for Taos County, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Town of Taos Electricity Use and Greenhouse Gas Emissions 2009

Town of Taos

Community Greenhouse Gas Emissions in 2009

Electricity Use, Summary Report by Sector

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential	20,492	561	546	20,585	46.3	31,261,000
Commercial	23,768	650	633	23,875	53.7	36,258,000
Total	**44,260**	**1,211**	**1,178**	**44,461**	**100.0**	**67,519,000**

This report has been generated for Town of Taos, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Energy Consumption for Home Heating

New Mexico

New Mexico is one of the top natural gas-producing states in the USA, and its 2010 output accounts for about one-tenth of USA production. Because of accessible natural gas supplies, more than two-thirds of New Mexico households use natural gas as their primary energy source for home heating.

Less than one-tenth of New Mexico's natural gas is used in the state. Most of New Mexico's natural gas is delivered by pipeline to markets in Arizona and to market centers in west Texas that supply the USA Midwest. New Mexico's Blanco Hub, located near Farmington in the San Juan Basin, is a major gathering point for Rocky Mountain natural gas supplies heading to West Coast markets (U.S. Energy Information Administration, 2010b.)

About 83 percent of New Mexico households use either natural gas or propane for home heating compared with about 58 percent of households nationwide (Table 2).

Table 2. – Energy Consumption for Home Heating, New Mexico

Home Heating Fuel/Source	New Mexico Share of Households (Percent)	USA Share of Households (Percent)
Natural Gas	68	51.2
Liquefied Petroleum Gases (LP Gas or Propane)	15	6.5
Subtotal, Natural Gas & LP Gas or Propane	**83**	**57.7**
Fuel Oil	0	9.0
Electricity	12	30.3
Other/None (Wood, Wind, Active & Passive Solar, etc.)	5	1.8

Source: U.S Energy Information Administration, 2010b.

Taos County & Town of Taos

Precise data on home heating in Taos County are unavailable because of restrictions on and difficulties in determining consumption of wood and propane, as discussed in the following sections. Census data for 2000 indicate that 72 percent of households in Taos County used natural gas or propane as primary fuels for home heating, while about 20 percent of households used wood (Table C4). Similar census data for the Town of Taos for 2000 show that 91 percent of households used natural gas or propane for home heating (Table C5). This report uses these and related numbers for GHG emissions estimates with the caveat that the numbers be updated when 2010 census reports become available.

About 93 percent of the natural gas and propane consumed in New Mexico in 2009 was used for space heating (64 percent) and water heating (29 percent).

Source: Global Energy Partners, written communication, 2011.

Natural Gas

Natural gas, a fossil fuel, is composed primarily of methane (CH_4), a very potent greenhouse gas. It is also called "utility gas" because specialized utility companies provide it to customers using a vast network of pressurized underground pipelines.

According to the U.S. Energy Information Administration (2011a), natural gas is a relatively clean burning fossil fuel. "Burning natural gas for energy results in much fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) per unit of heat produced than coal or refined petroleum products. About 117 pounds of carbon dioxide are produced per million Btu equivalent of natural gas compared to over 200 pounds of CO_2 per million Btu of coal and over 160 pounds per million Btu of fuel oil."

Burning natural gas produces about 59 percent of the carbon dioxide (CO_2) produced by burning coal for an equivalent amount of heat. This property of natural gas has influenced many recent shifts from coal to natural gas at power plants in the USA, and has stimulated construction of new natural gas fired power plants. Natural gas as of 2011 also is being considered for use as a transportation fuel and as backup power for utility-scale solar thermal-electric power plants.

For more information, see:
http://www.eia.gov/energyexplained/index.cfm?page=natural_gas_environment

This report does not attempt to quantify the indirect emissions of CH_4, CO_2 and other greenhouse gases related to natural gas extraction and processing outside Taos County and "upstream" from the point of use. Future calculations of GHG emissions might consider these "upstream" emissions as better data on the full life cycles of GHGs become available. These data will be generated as required by state and federal GHG reporting rules, for example, as companies install technologies and adopt practices to reduce methane emissions during exploration and production (U.S. Environmental Protection Agency, 2011e).

Studies by Cornell University in 2011 indicate that natural gas impacts on Earth's atmosphere can be as severe or more severe than those of coal in the short term; that is, on a 20-year time scale. According to Howarth, Santoro, and Ingraffea (2011), methane is a far more potent greenhouse gas than carbon dioxide, but methane has a 10-fold shorter residence time in the atmosphere. This and other studies suggest that the full impact of natural gas, including emissions "upstream" from the point of use due to leaks during production and processing, should be used in planning for alternative energy futures.

Natural gas consumed in the Town of Taos and Taos County is delivered through a statewide pipeline system (U.S. Energy Information Administration, 2010b). The system consists in part of a large pipeline crossing the state from southeast to northwest (Figure E1) plus many interconnecting branch lines and control valves. The pipeline serving Taos County originates southwest of Española, NM where branch lines meet at the Otowi Valve. The pipeline trends northeasterly from that point through Rio Arriba County to Española and thence through the Rio Grande Canyon, paralleling NM Highway 68 into Taos County about four miles southwest of Pilar. In Taos County, the pipeline continues northeasterly into the vicinity of Tierra Blanca where it bends to the north. The pipeline continues west of the Town of Taos to the communities of Arroyo Seco and Arroyo Hondo before continuing north to Questa and east to Red River where it terminates (Figure 4.).

Figure 4. -- Natural Gas Transmission Pipeline Alignment in Taos County, NM, from Taos-Rio Arriba County Line to Red River, NM,

Map produced December 24, 2010 by the National Pipeline Mapping System (NPMS) Public Viewer at https://www.npms.phmsa.dot.gov/PublicViewer/

New Mexico Gas Company (NMGCO, written communication, 2010) delivered approximately 5,266,543 therms of natural gas to customers in the Town of Taos in 2009 (Table E1). For the 2009 population of 5,545, this number equates to a natural gas consumption of about 950 therms per capita. These deliveries consisted of 2,003,741 therms (about 38 percent) to commercial customers, and 3,262,802 therms (about 62 percent) to residential customers.

NMGCO (written communication, 2011) delivered approximately 9,746,038 therms of natural gas to customers in Taos County in 2009 (Table E2). For the 2009 population of 33,489, this number equates to a countywide natural gas consumption of about 291 therms per capita. These deliveries consisted of 3,137,534 therms (about 32 percent) to commercial customers and 6,608,504 therms (68 percent) to residential customers.

Differences in per capita natural gas consumption between the Town of Taos and Taos County are due to a lack of natural gas connections to most rural areas of Taos County. Census data (Tables C4 and C5) indicate that about 90 percent of residents of the Town of Taos are connected to natural gas supplies, whereas fewer than 50 percent of residents countywide have natural gas connections.

Most of the Taos Planning Area is served by or readily accessible to natural gas connections. Therefore, natural gas use in this area is likely to be very similar to that of the Town of Taos. Prorating Town of Taos per capita natural gas consumption to the Taos Planning Area yields an estimated 10,110,000 therms consumed in 2009. Proportioned like the Town of Taos, natural gas deliveries would consist of about 3,235,000 therms to commercial customers and 6,874,000 therms to residential customers.

Subtracting Town of Taos natural gas consumption from Taos County consumption suggests that the per capita use of natural gas outside Taos is about 160 therms per capita. Most of this use is concentrated along the pipeline corridor shown in figure E1, including Taos, Ranchos de Taos, Llano Quemado, El Prado, Arroyo Seco, Arroyo Hondo, Questa, and Red River.

Propane

According to the U.S. Energy Information Administration (2010c), "Propane is an energy-rich gas, C_3H_8. It is one of the liquefied petroleum gases (LP-gases or LPGs) that are found mixed with natural gas and oil. Propane and other liquefied gases, including ethane and butane, are separated from natural gas at natural gas processing plants, or from crude oil at refineries. The amount of propane produced from natural gas and from oil is roughly equal."

Propane is a nonrenewable fossil fuel, like the natural gas and oil from which it is produced. Like natural gas (methane), propane is colorless and odorless. Propane producers odorize the gas by adding a foul-smelling mercaptan to make leaks easy to detect.

As with all fossil fuels, burning propane emits water vapor and carbon dioxide, a greenhouse gas. However, burning propane produces about 65 percent of the carbon dioxide (CO_2) produced by burning coal for an equivalent amount of heat (U.S. Energy Information Administration, 2011d).

Propane's emissions properties and portability also contribute to its use as an alternative transportation fuel. Propane-fueled engines produce much fewer emissions of carbon monoxide and hydrocarbons compared to gasoline engines. This property of propane allows it to be chosen often to fuel indoor equipment such as forklifts.

"The results of this study show that propane is among the most attractive options for avoiding greenhouse gas emissions in every application considered. At the point of use, propane emits fewer greenhouse gases than gasoline, diesel, heavy fuel oil, or E85 ethanol per unit of energy. Natural gas (methane) generates fewer greenhouse gas emissions per British thermal unit than propane, but methane is chemically stable when released into the air and produces a global warming effect 25 times that of carbon dioxide. This means that 1 kilogram of methane produces the same effect in the atmosphere as 25 kilograms of carbon dioxide. Propane's short lifetime in the atmosphere and low carbon content distinguish it from other fuel sources as an important energy option in a carbon-constrained world."

Source: Energetics Incorporated, 2009b.

According to the U.S. Energy Information Administration (2010c), "In residential and many commercial applications, propane is used for heating indoor air, heating water, cooking and refrigerating food, drying clothes, and fueling gas fireplaces and barbeque grills. On farms, propane is used to dry corn and power farm equipment and irrigation pumps. Businesses and industry use propane to run their forklifts and other equipment. Whereas only a small fraction of propane is used for transportation, it is the second largest alternative transportation fuel in use today. Instead of gasoline, propane often fuels fleets of vehicles used by school districts, government agencies, and taxicab companies. In recreational pursuits, hot air balloons use propane to heat the air that makes them rise."

Although propane accounts for less than 2% of all energy used in the United States, it has some very important uses. Propane is the most common source of energy in rural areas that do not have natural gas service. In Taos County, data from the U.S. Census indicate that about 25 percent of households use propane for home heating (Table C4). Only about 4 percent of households in the Town of Taos use propane for home heating because most of the town is served by natural gas (Table C5). For New Mexico, the U.S. Energy Information Administration (2011b) indicates about 15 percent of households statewide use propane for home heating, compared with about 6.5 percent of households nationwide.

Propane companies are not regulated like public utilities such as Kit Carson Electric Cooperative, Inc. (KCEC) or New Mexico Gas Company (NMGCO). The propane industry is highly competitive, and detailed data on propane is deemed market sensitive and held confidential. Thus, public data on propane use are typically available only at the state or regional level in order to protect the competitiveness of local retailers.

Data for 2009 propane sales in New Mexico were not available as of the date of this report. However, average annual propane sales in New Mexico for 2004-2008 were 128,612,000 gallons (American Petroleum Institute, API, 2009; Tables F1 and F2). Using this average as an estimate for 2009 propane sales and a New Mexico population of 2,009,671 in 2009 (U.S. Census Bureau, 2009a) gives a propane use figure of about 64 gallons per capita. According to the API, between 60-70 percent propane sales in New Mexico are for residential uses, with the remainder going to commercial, industrial, retailer, internal combustion, and agricultural uses.

Prorating the New Mexico statewide per capita estimates to a Taos County population of 33,489 in 2009 offers an estimate of propane use equal to about 2,143,300 gallons. Similarly, prorating New Mexico per capita use to the Taos Planning Area yields an estimate of 681,200 gallons, and prorating for the Town of Taos yields an estimate of propane use equal to about 354,880 gallons in 2009.

These numbers for propane are used as first estimates until better data become available. In the CACP 2009 calculations, these numbers produce carbon dioxide emissions estimates of slightly more than 3 percent of total CO_2 emissions for the town and county. This reflects both a minor percentage of CO_2 emissions reported from propane burning nationwide, and slightly higher per capita use of propane in New Mexico than in the USA as a whole. Emissions from propane use for all of Taos County are probably underestimated here because of a relatively larger rural population relying on propane. Similarly, such emissions may be slightly overestimated here for the Town of Taos due to less propane use because of widespread access to natural gas connections.

Wood

Indoor and outdoor wood-burning appliances and fireplaces may emit large quantities of air pollutants, including greenhouse gases. Wood smoke contains hundreds of chemical compounds, including nitrogen oxides, carbon dioxide, carbon monoxide, methane and other organic gases, and fine particles of soot, also known as black carbon (University of Iowa, 2010). The U.S. Energy Information Administration (USEIA) (2010a) and other entities consider wood and wood waste used as fuel as renewable energy sources. Nonetheless, using wood and other biomass for energy or fuel produces some level of greenhouse gases emissions.

The U.S. Environmental Protection Agency established its Burn Wise Program in 2009. The Burn Wise web site provides abundant information on just about everything associated with using wood as a heating and cooking fuel.

See: http://www.epa.gov/burnwise/index.html

The USEIA State Energy Profile for New Mexico (2010b) shows that statewide, wood is used as a primary heating fuel by about 5 percent households, compared with a national average of about 1.8 percent of households. Census data (Tables C4 and C5) suggest that about twenty percent of households in Taos County and less than four percent of households in the Town of Taos use wood as a primary heating and cooking fuel. The number of households using wood as a fuel for primary heating or on an occasional basis is unknown, but may be as much as eighty percent in Taos County.

Throughout Taos County, "...a large portion of the local population relies on fuelwood (primarily piñon and juniper) as a source of heat and for cooking. As the population increases, the demand for fuelwood will also increase."

Source: U.S. Bureau of Land Management (2010, p. 271).

The U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), and a private firewood sales company provided data on wood consumption for Taos County and vicinity for this report. These numbers are only suggestive of wood burned as heating and cooking fuel, and several caveats apply to using these numbers. These numbers reflect fuel wood collections mainly on federal lands. This report makes no determination of fuel wood collected on state or private lands.

Both the BLM and USFS continue to improve estimates of volumes of wood removed from federal lands through more stringent management of wood gathering permits and enforcement of permit requirements. However, the BLM and USFS cannot determine where wood removed from their lands is finally burned other than through anecdotal evidence such as conversations with those who cut and haul the wood. Both BLM and USFS representatives, however, suggest that most wood gathered by permittees in Taos County is probably burned nearby. Further, the BLM and USFS lack the staff to monitor all wood gathering on their lands, and wood removal by people lacking permits is a continuing problem.

For Fiscal Year 2010 (October 1, 2009 to September 30, 2010), the Carson National Forest Supervisor's Office (Taos, NM) and the Camino Real Ranger District (Peñasco, NM) sold 11,834 cords of dead & down firewood, and 988 cords of green firewood. The Tres Piedras Ranger District (Tres Piedras, NM) sold 1,735 cords of dead & down firewood in this same period (written communication, 2010).

The BLM reported sales of 554 permits for a total of 1,801 cords of wood for 2009 with nearly all wood being gathered from BLM lands west of the Rio Grande Gorge in Taos County (oral communication, 2010). The BLM suggests this number may be substantially underreported because of wood gathering by people without permits. Most of the wood on BLM lands in Taos County consists of piñon and/or juniper.

A local private company that is a major seller of firewood reported current sales of 1600 to 2000 cords mixed wood, 300 cords piñon-juniper wood, and 150 to 200 cords scrap wood per year for an estimated total of 2050 to 2500 cords per year (oral communication, 2011).

Table 3. – Selected wood & combustion heat values for representative fuelwood sources in Taos County, NM.

Wood & Combustion Heat Values

(Weight per cord and recoverable heat value in MMBtu*
for dry wood with average moisture content 20%)

Piñon = > 4,000 pounds per cord; 33.5 MMBtu/cord
Douglas Fir = > 4,000 pounds per cord; 26.4 MMBtu/cord
Lodgepole Pine = approx. 3,000 pounds per cord; 19.3 MMBtu/cord
Aspen = 2,290 pounds per cord; 14.7 MMBtu/cord
Cottonwood = 2,110 pounds per cord; 13.5 MMBtu/cord

*MMBtu = 1,000,000 Btu = 1 million Btu

Source: The Engineering Toolbox. Accessed online at:
http://www.engineeringtoolbox.com/wood-combustion-heat-d_372.html

These figures suggest collection and use of at least 18,000 to 19,000 cords of fuel wood associated with the 2009 base year of this report. Using an average weight of 3,000 pounds per cord (Table 3), these numbers suggest use of at least 54 to 57 million pounds (27,000 to 28,500 tons) of fuel wood with a heat value of 360,000 to 380,000 MMBtu. Numbers in these ranges applied in the ICLEI CACP 2009 program yield CO_2 emissions of less than one percent the estimated combined CO_2 emissions for gasoline, electricity, natural gas, diesel and propane in Taos County. However, numbers in these ranges applied in the CACP 2009 program show that wood burning is responsible for substantial increases in methane and particulate emissions. These results and many studies on the emissions and health effects of wood burning suggest attention to obtaining better data on wood fuel use in Taos and vicinity. Also, such data should lead to recommendations for improving the combustion efficiency of wood-burning appliances in a region where many people use wood as a major source of energy.

Biomass and Carbon Dioxide

Trees and other plants (biomass) consume carbon dioxide in order to grow. Therefore, combustion of wood (biomass energy) does not add to the total emission of carbon dioxide as long as the volume of burned biomass does not exceed that produced by new biomass growth. Excessive burning, deforestation, and wildfires can greatly shift the balance between biomass consumption and regrowth. Biomass burning, however, produces substantial quantities of carbon monoxide, methane, particulate matter, and other undesirable emissions.

Because of incomplete data upon which to base wood consumption estimates, this report does not include wood burning in GHG emissions estimates for 2009.

For additional information on the energy and emissions properties of wood and biomass, see U.S. Energy Information Administration (2008c).

Transportation

The transportation sector currently is responsible for about one-third of annual greenhouse gases (GHG) emissions in the USA. In addition to about 33 percent of USA carbon dioxide (CO_2) emissions, combustion of fossil fuels used in transportation produces about 26 percent of USA methane (CH_4) emissions and about 67 percent of USA nitrous oxide (NO_2) emissions (U.S. Environmental Protection Agency, 2009b, p. 3-11 through 3-15).

"Petroleum-based products supply almost all energy consumed for transportation in the USA, with more than half being related to gasoline consumption in automobiles and other highway vehicles. Other fuel uses, especially diesel fuel for freight trucks and jet fuel for aircraft, accounted for the remainder. The primary driver of transportation-related emissions was CO_2 from fossil fuel combustion, which increased by 29 percent from 1990 to 2007. This rise in CO_2 emissions, combined with an increase in HFCs from virtually no emissions in 1990 to 67.0 terragrams (Tg) CO_2e 2007, led to an increase in overall emissions from transportation activities of 28 percent."

Source: U.S. Environmental Protection Agency (2009b, p. 3-12).

This report focuses on on-road motor vehicle fuel use. Among USA domestic transportation sources, light duty vehicles (including passenger cars and light-duty trucks) represent about 61 percent of CO_2 emissions, medium- and heavy-duty trucks 22 percent, commercial aircraft 8 percent, and other sources 10 percent. This reports defers commentary on aviation and off-road travel, and stationary combustion of transportation fuels such as gasoline and diesel fuel until better data on these sources become available.

Emissions From Motor Vehicles Produce Many GHGs Other Than CO2

Mobile combustion produces greenhouse gases other than CO_2, including CH_4, N_2O, and indirect greenhouse gases including nitrous oxides (NOx) carbon monoxide (CO), and non-methane volatile organic compounds (NMVOCs).

N_2O and NOx emissions from mobile combustion are closely related to fuel characteristics, air-fuel mixes, combustion temperatures, and the use of pollution control equipment. N_2O from mobile sources, in particular, can be formed by the catalytic processes used to control NOx, CO, and hydrocarbon emissions.

Carbon monoxide emissions from mobile combustion are significantly affected by combustion efficiency and the presence of post-combustion emission controls. CO emissions are highest when air-fuel mixtures have less oxygen than required for complete combustion. These emissions occur especially in idle, low speed, and cold start conditions.

CH_4 and NMVOC emissions from motor vehicles are a function of the CH_4 content of the motor fuel, the amount of hydrocarbons passing uncombusted through the engine, and any post-combustion control of hydrocarbon emissions (such as catalytic converters).

Source: USEPA, 2010 U.S. Greenhouse Gas Inventory Report, Energy, p. 3-6 to 3-7. Accessed online at: http://www.epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_Chapter3-Energy.pdf

This report treats direct GHG emissions of CO_2, N_2O and CH_4 based on motor vehicle travel within Taos County. As with electricity, natural gas and propane, there are indirect GHG emissions resulting from extracting, transporting, and refining fossil fuels (in this case, oil) to produce transportation fuels. This report does not attempt to quantify the GHG emissions related to transportation fuels outside Taos County and "upstream" from the point of use. This report does not treat indirect GHGs such as NOx, CO, and NMVOCs related to transportation fuels. Future calculations of GHG emissions might consider these "upstream" and indirect emissions as better data on the full life cycles of GHGs become available.

On-Road Motor Vehicle Travel

According to measurements by the New Mexico Department of Transportation (NMDOT, 2011; written communication 2010), daily vehicle miles traveled (DVMT) on roads throughout Taos County in 2009 equaled 924,000 miles (Table H1). This equates to 337,260,000 vehicle miles traveled (VMT) for the full year. For comparative purposes, these numbers represent about 1.3 percent of on-road vehicle travel in New Mexico in 2009.

Using NMDOT data for 64 principal road segments in the Taos Planning Area, estimated DVMT was 307,911 for 2009 (Table H2). This equates to 112,387,515 VMT for the Taos Planning Area for 2009. These numbers represent about 33 percent of on-road vehicle travel in Taos County in 2009.

Using NMDOT data for 20 principal road segments in the Town of Taos, estimated DVMT was 199,640 for 2009 (Table H3). This equates to 72,868,600 VMT for the Town of Taos for 2009. These numbers represent about 22 percent of on-road vehicle travel in Taos County in 2009.

According to the CAPC 2009 output for transportation-related GHG emissions, vehicle emissions for Taos County were an estimated 218,013 tons CO_2e, or 51 percent of total County emissions for 2009. Vehicle emissions for the Taos Planning Area were an estimated 72,650 tons CO_2e, or about 36 percent of total emissions for the area for 2009. Vehicle emissions for the Town of Taos were an estimated 47,104 tons CO_2e, or about 38 percent of total emissions for the Town in 2009. See CAPC reports in Appendix J for comparative GHG emissions for the three geographic areas.

Particle Pollution from Large and Small Airborne Particles

The CACP 2009 program also accommodates data on airborne particulate matter. Particle pollution (also known as "particulate matter") in the air includes a mixture of solids and liquid droplets. Some particles are emitted directly; others are formed in the atmosphere when other pollutants react. Particles come in a wide range of sizes. Those less than 10 micrometers in diameter (PM10) are so small that they can get into the lungs, potentially causing serious health problems. Ten micrometers is smaller than the width of a single human hair.

Coarse Particles (PM10) and Fine Particles (PM2.5) Definitions

Coarse Particles (PM10): Particulate matter in emissions to the atmosphere includes liquid or solid particles such as dust, smoke, mist, fumes, or smog. Particles between 2.5 and 10 microns (micrometers) in diameter are referred to as "coarse." Major sources of coarse particles include crushing or grinding operations, and dust stirred up by vehicles traveling on roads.

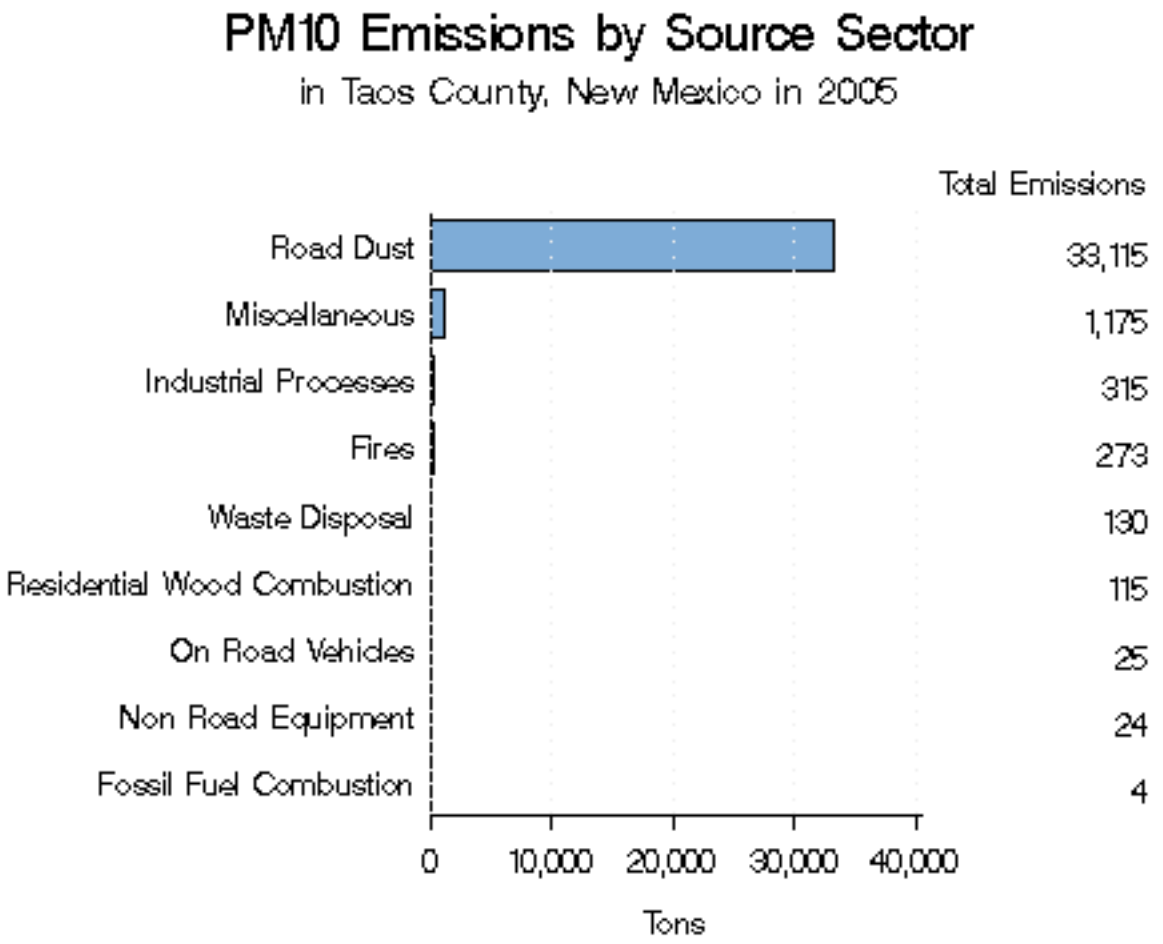
Fine Particles (PM2.5): Particulate matter in emissions to the atmosphere includes liquid or solid particles such as dust, smoke, mist, fumes, or smog. Particles less than 2.5 microns (micrometers) in diameter are called "fine" particles. These particles are so small they can be detected only with an electron microscope. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

Source: AIRNow Particle Pollution (PM10) and (PM2.5), August 30, 2010.
Accessed online at: http://www.airnow.gov/index.cfm?action=aqibasics.particle

The USEPA, NOAA, NPS, tribal, state, and local agencies developed the AIRNow Web site to provide the public with easy access to national air quality information. The Web site offers daily Air Quality Index (AQI) forecasts as well as real-time AQI conditions for over 300 cities across the US, and provides links to more detailed State and local air quality Web sites.

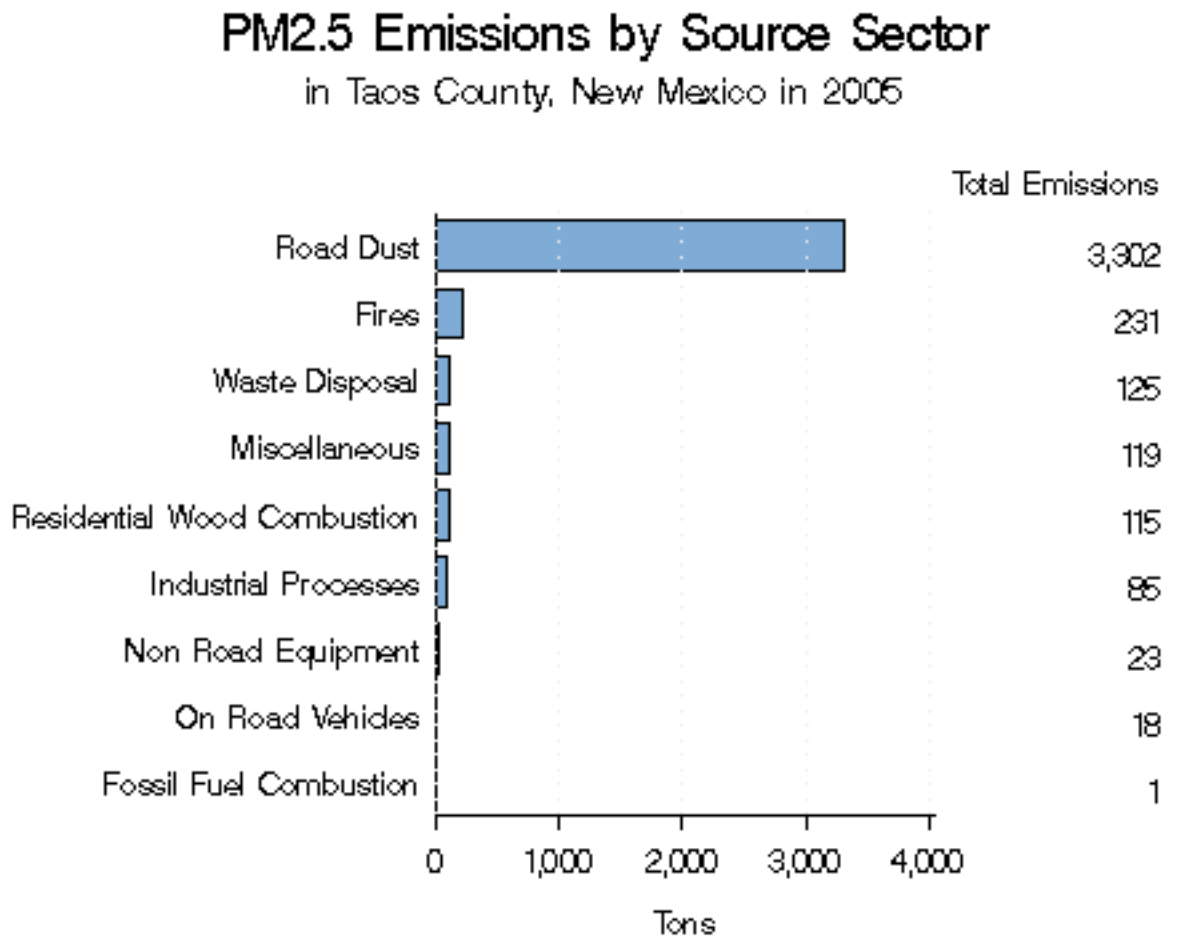
Air emissions sources data for Taos County, New Mexico (Figures 5 and 6) show that the overwhelming quantities of fine and coarse air particle emissions in Taos County arise from road dust. Particle emissions from all other sources are relatively minor.

Figure 5. – Coarse Particle (PM10) Emissions by Source Sector, Taos County, NM in 2005



Source: USEPA Air Emissions Sources, State and County Emissions Summaries, State and County Summaries for New Mexico. Accessed online at: http://www.epa.gov/cgi-bin/broker?_service=data&_debug=0&_program=dataprog.dw_do_all_emis_2005.sas&pol=230&stfips=35

Figure 6. - Fine Particle (PM2.5) Emissions by Source Sector, Taos County, NM in 2005



Source: USEPA Air Emissions Sources, State and County Emissions Summaries, State and County Summaries for New Mexico. Accessed online at: http://www.epa.gov/cgi-bin/broker?_service=data&_debug=0&_program=dataprog.dw_do_all_emis_2005.sas&pol=230&stfips=35

Other Air Emissions Data

The CACP Program also accepts data on other air emissions such as Carbon Monoxide (CO), Lead (Pb), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs) and Sulfur Dioxide (SO_2). Examples of these data for Taos County are available at the USEPA Air Emissions Sources web site, and will be available to Town of Taos staff for entry into the GHG

emissions inventory. Access Air Emissions by Pollutant online at:
http://www.epa.gov/air/emissions/index.htm

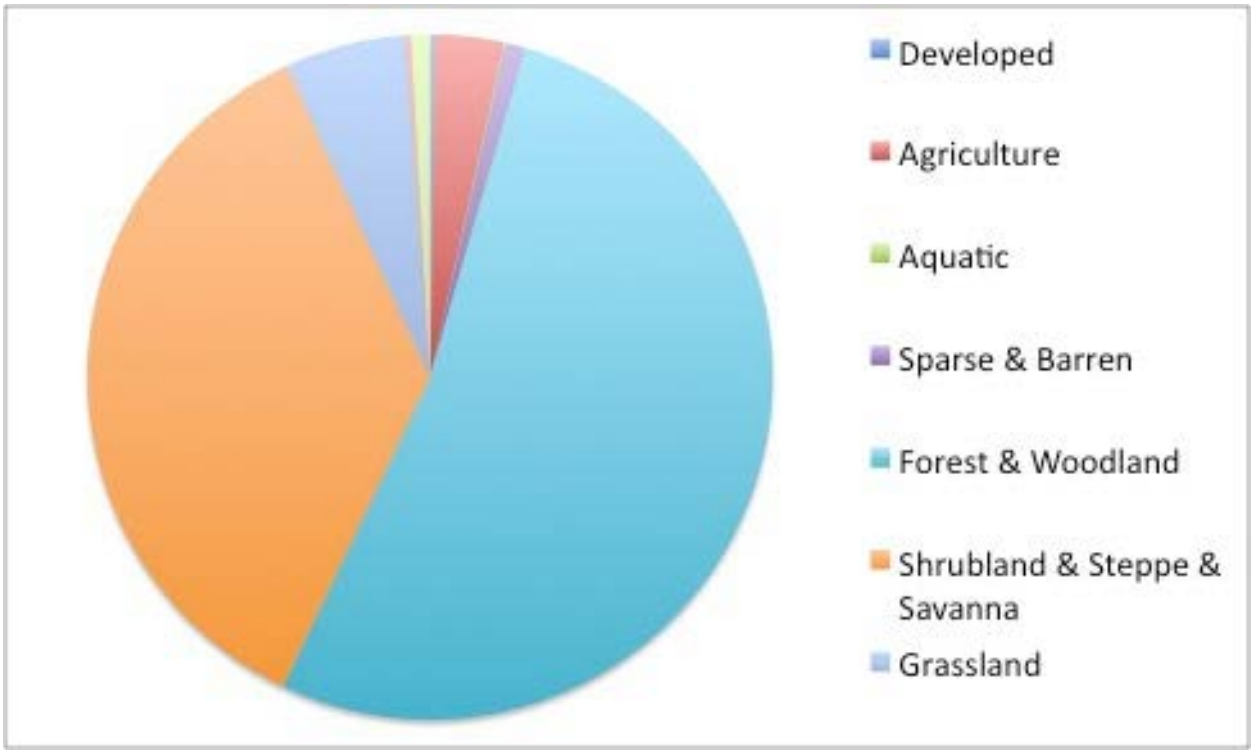
Land Use and Land Cover, Taos and Vicinity, NM

Carbon Sequestration by Forestlands, New Mexico and Taos County

Forestlands account for about 27 percent of New Mexico's land area, or about 32,766 square miles of New Mexico's land area of 121,356 square miles. Using U.S. Forest Service data from Table 3, a CO_2 sequestration rate for forestlands may be calculated to be about 638 metric tons CO_2e per square mile per year. This rate equates to about 579 tons CO_2e per square mile per year for the period 1990-2020.

On a national basis USA forestlands are able to sequester less than 15 percent of anthropogenic (human-caused) GHG emissions.

Figure 5. - Land Cover Summary for Taos County, New Mexico



Source: U.S. Geological Survey (2010).
Figure based on data from Table I2.

Forestlands represent about 1,159 square miles or about 53 percent of land cover in Taos County (U.S. Geological Survey, 2010; Figure 5; Table I2.). This area multiplied by the sequestration rate in the previous paragraph yields an estimated sequestration of about 671,000 tons CO_2e per year for Taos County for 1990-2020. This calculation does not include potential CO_2e sequestration for other land use and land cover categories such as shrub lands and grasslands with moderate sequestration potential.

"Forestland emissions refer to the net CO_2 flux from forested lands in New Mexico, which account for about 27% of the state's land area. As shown in Table 3, U.S. Forest Service data suggest that New Mexico forests and the use of forest products sequestered on average nearly 21 $MMtCO_2e$ per year from 1987 to 1997. The data show an accumulation of carbon in each of the forest carbon pools during this period, except for the harvested wood products and landfilled forestry waste pools. These rates of sequestration are assumed to remain constant through 2020."

Source: New Mexico Climate Change Action Plan (2006, p. 7-1).

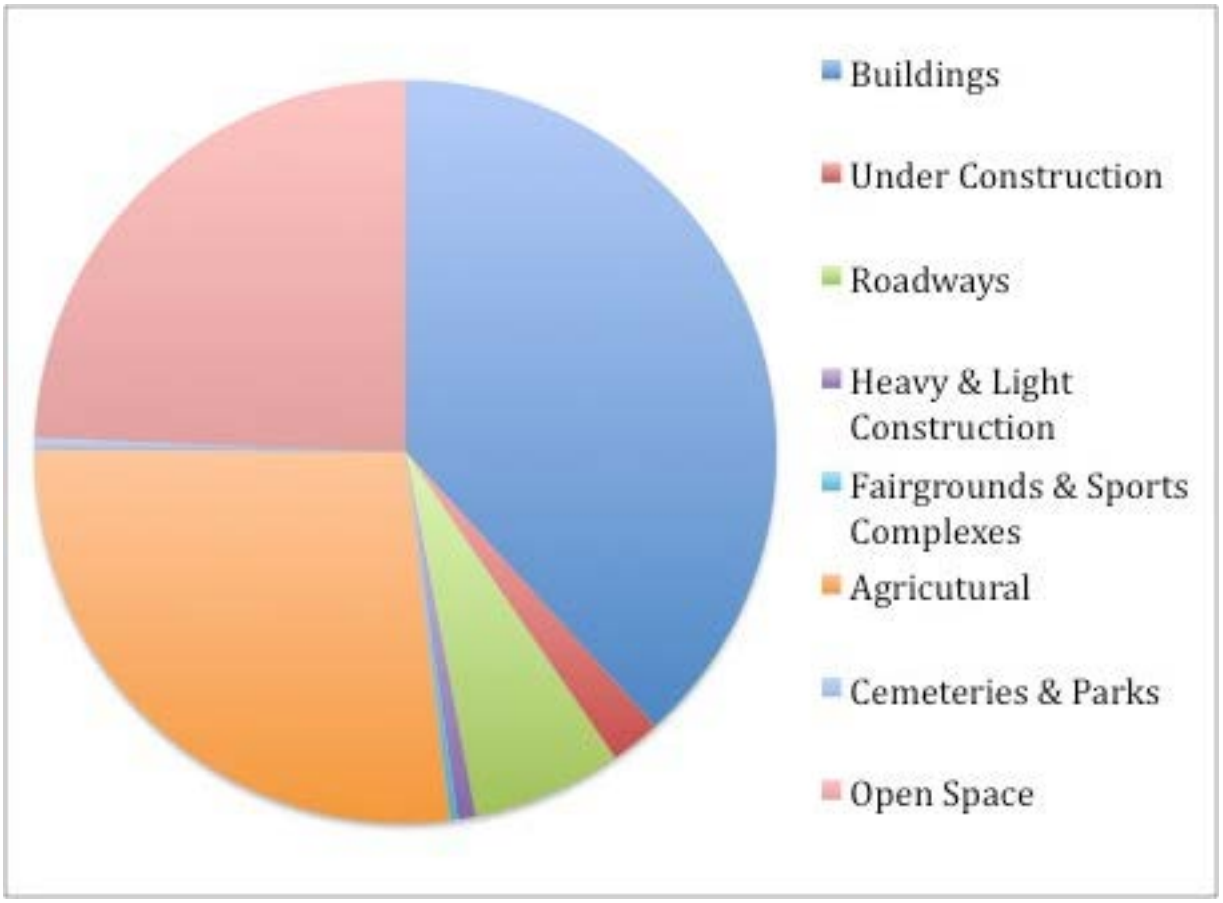
Land uses with carbon sequestration potential in the Town of Taos and Taos Planning Area include undifferentiated open-space and agricultural lands (Table I1). These lands account for less than 15 square miles, or roughly one percent of the area of nearby forestlands. Data to calculate the carbon sequestration potential of open-space and agricultural lands were not available for this report.

Table 3. – Greenhouse Gases Emissions (Sinks) From Forestry,
New Mexico National Forests, 1987-1997 and Projections to 2020

Forest Carbon Pool	**Million Metric Tons Carbon Dioxide Equivalent per year ($MMtCO_2e$/yr) for 1990-2020**
Live and Dead-Standing Trees and Understory	-13.6
Forest Floor and Coarse Woody Debris	-3.1
Soils	-5.9
Wood Products and Landfills	1.8
Total	**-20.9**

Source: New Mexico Climate Change Action Plan (2006, p. 7-1).
Based on USFS data from 1987-1997.

Figure 6. -- Land Cover Summary for Town of Taos, New Mexico



Source: Town of Taos & Taos Planning Area Land-Use Inventory Data and Map, August 2005.
Figure based on data from Table I1.

Priorities for Greenhouse Gases Emissions Reductions

The Taos County Growth Management Plan (Community by Design, 2007, p. 9) states its land use goals in terms of sustainable residential, commercial and industrial development. In general, these goals focus on maintaining a rural character for the county with emphasis on such elements as green building, locally grown food, protecting agricultural lands, careful watershed and aquifer management, tourism, architectural and other development aesthetics, open space, and preserving a natural environment.

"Taos County is comprised of diverse and traditional communities, with strong land and water connections and a rich cultural heritage. Our neighborhoods are places where generations of families can live, work and be involved in their community. We treasure our rural and agricultural traditions rich with diverse and multicultural heritages. We will sustain our cultures and traditions through protecting our historical roots, creating vibrant neighborhoods, encouraging viable locally-based economic development, caring for our natural resources, and protecting the health, safety and prosperity of all Taos County citizens. This will contribute to our community food security and good health and improve the quality of life for ourselves and future generations."

Source: Taos County Vision Statement in Community by Design (2007, p. 9).

The County's planning goals thereby suggest a landscape by 2030 that will be formed by the consequences of population growth around rural and small community settings. The plan does not appear to invite, for example, large-scale industrial development, high-rise buildings, urban commercial sprawl, new major highway corridors, and similar land uses. Growth planning is also constrained by the nearby boundaries of large tracts of lands administered by the U.S. Forest Service, Bureau of Land Management, State of New Mexico, and Taos and Picuris Pueblos.

In terms of reducing greenhouse gases emissions from current levels, the planning goals mean focusing mainly on (1) reducing emissions related to residential and commercial buildings, and (2) reducing vehicular transportation emissions while allowing development similar to the style of the present day. In addition, both the Town and County of Taos possess abundant and mostly untapped clean energy resources in the forms of solar, wind, geothermal and biomass energy that could greatly offset fossil fuel uses and their consequent emissions.

Buildings

The State of New Mexico and the Town of Taos have taken major steps in recent years to require increased residential and commercial energy efficiency through building codes. The 2009 New Mexico Energy Conservation Code (NMECC) requires new buildings and retrofits to meet standards of at least 20 percent greater energy efficiency than those required under the 2006 International Energy Efficiency Code (IECC). The NMECC implementation data is January 2011. The Building Codes Assistance Project (BCAP) estimates that implementing the NMECC would help avoid about 6 trillion Btu of primary annual energy use by 2030 and annual emissions of more than 340,000 metric tons of CO_2 by 2030 (BCAP, 2011).

"Buildings represent one of the main frontiers in the global challenge to increase efficiency and reduce overall energy consumption. Buildings are responsible for 49% of global energy consumption and 47% of greenhouse gas emissions. In a world where energy prices are volatile and energy costs are an increasingly important consideration for property owners and their tenants, buildings provide a wealth of untapped opportunities for increased energy efficiency and advanced energy management."

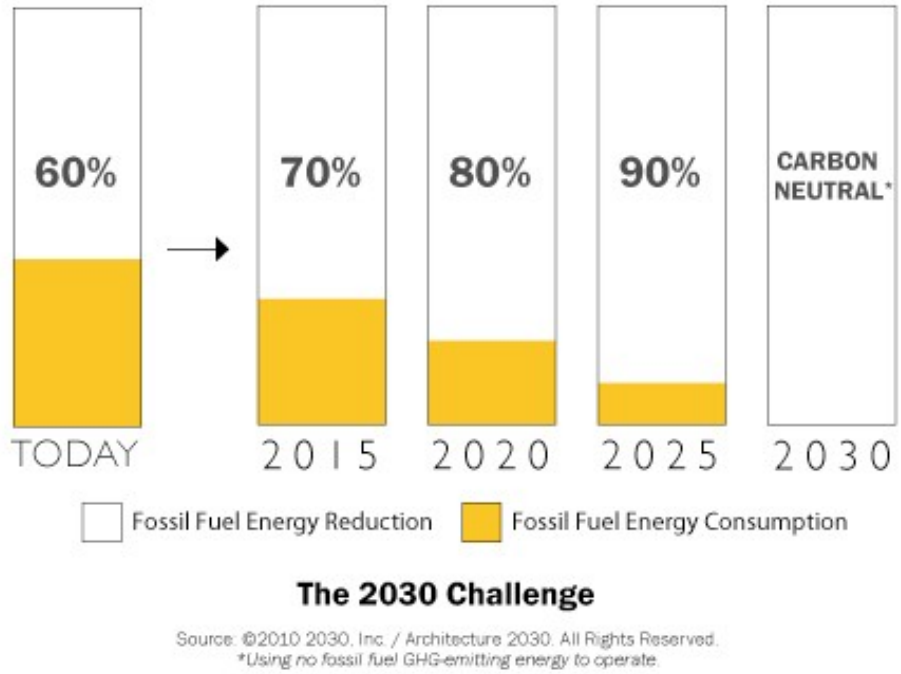
Source: Pike Research, 2011. Executive Summary accessed online at: https://www.pikeresearch.com/wordpress/wp-content/uploads/2011/01/GBS-11-Executive-Summary.pdf

The Town of Taos High Performance Building Ordinance of 2009 requires a phased approached to achieving as much as 30 percent greater energy efficiency for its new buildings and retrofits by 2012. The Town can expect to gain further building energy efficiencies by 2030 by means of its commitment to the 2030 Challenge, continuing building construction practices and innovations that improve energy efficiency, local code upgrades, adherence to new codes mandated by State and Federal governments. The Town can also create or support additional on-site or nearby clean energy generation by means of solar arrays, for example.

In 2009, greenhouse gases (GHG) emissions from residential buildings in the Town accounted for 41,187 tons CO_2e, about 53 percent of building emissions. GHG emissions from commercial buildings in 2009 accounted for 36,416 tons CO_2e or 47 percent of the Town's building emissions. Total GHG emissions from the use of electricity, natural gas and propane for Town buildings in 2009 totaled 77,333 tons CO2e. Based on projected population growth for the Town to 6,797 people, GHG emissions without reductions could exceed 95,000 tons CO_2e in 2030.

Alternatively, meeting the 2030 Challenge means that all new buildings and retrofits show substantial progress toward becoming carbon-neutral by 2030 (Figure 7). The targets may be met not only by implementing energy-efficiency construction practices, but also by generating on-site clean energy, and/or purchasing power from clean energy sources. The Town of Taos is well positioned to approach carbon neutrality in building energy consumption by 2030 because of its combination of forward looking policies and local clean energy resources.

Figure 7. – The 2030 Challenge - Reducing Fossil fuel Energy Consumption in New Buildings and Retrofits to Zero by 2030



*Carbon Neutral means using no fossil-fuel GHG-emitting energy to operate.

Source: The 2030 Challenge/Architecture 2030
Accessed online at:
http://www.architecture2030.org/2030_challenge/the_2030_challenge

Achieving Building Energy Efficiency

The Town of Taos should continue to research and implement energy-use and water-use efficiency building code improvements to match or exceed state and federal standards. The Town has taken initial steps in this direction through both building code revisions in 2009 and energy audits of Town-owned and operated buildings in 2010-11. The results of these energy audits were made available to Town staff in the first quarter of 2011 (GLOBAL Energy of Glendower, Inc., written commun., 2011). Energy use and resulting GHG emissions for the Town's buildings may then be entered into the GHG inventory.

The first step in achieving energy efficiency in existing buildings is performing a comprehensive energy audit of each building. An energy audit will help identify the most economical opportunities for energy savings.

The Town of Taos should work with Kit Carson Electric Cooperative, Inc. (KCEC) to obtain data on KCEC's energy audits performed or to be performed under a U. S. Department of Agriculture (USDA) grant beginning in October 2009 (Kit Carson Electric Cooperative, Inc., 2011). KCEC was awarded $100,000 funding by USDA to be used for renewable energy systems, energy efficiency improvements, feasibility studies and energy audits. Energy audits were to be made for small businesses throughout the KCEC service area, including Taos County. In accepting the grant, KCEC promised to ensure energy efficiency evaluations throughout its own facilities and all activities of the cooperative. KCEC also committed to develop and maintain programs and activities designed to promote energy efficiency and to monitor such programs and measure their results.

The GHG Emissions Project also obtained energy-use data for building complexes at the Southern Methodist University campus (SMU-In-Taos) and the University of New Mexico Klauer Campus (UNM-Taos). These data are not included in this report, but have been provided separately to Town staff. The data provide important baseline information on a variety of building types for complexes that are currently undergoing substantial energy efficiency upgrades.

SMU-In-Taos in mid-2010 completed construction of the first commercial or institutional building in the Taos area to achieve the U.S. Green Building Council's (USGBC) LEED Gold certification. Casita Clements, a 3,457 square foot adobe building used as a student residence, may now be used for energy-use comparisons with other similar buildings. Six other student residences ("casitas") on the SMU-In-Taos campus are being retrofitted for energy efficiency, and are being reviewed by the USGBC for LEED certification. The SMU-In Taos campus includes twenty-four buildings including ten adobe dormitories that are electrically heated.

UNM-Taos is also creating energy efficiency improvements in its new and renovated structures, and began providing on-site electricity generation in 2010 using a 500-kilowatt (kW) solar photovoltaic (PV) panel array. The solar PV array provides 100 percent of the electrical power demands of the campus, and excess power is fed back into the local grid to serve Kit Carson Electric Cooperative, Inc. customers in the Taos area. Town of Taos staff can use data from the UNM-Taos complex to illustrate the comparative economics of energy-efficient building, clean energy generation, and GHG emissions reductions.

The UNM Taos campus is the first community college of its kind in the nation to be 100 percent powered by renewable solar energy.

Source: UNM Taos Solar Array.
Accessed online at: http://taos.unm.edu/solararray/index.html

Focusing on Schools

Drawing from the examples of SMU-In-Taos and UNM-Taos, the Town of Taos should focus on improving energy efficiency in schools. Energy use in school complexes is an expensive component of school district budgets, and needs to be treated as energy cost rise.

Schools and Energy Consumption

"Schools are a black hole for energy consumption. The buildings, which often serve as the hub of communities, are open from early morning to late at night. With air conditioning or heating systems that run continually, it is not unusual for a single building to use hundreds of thousands of gallons of fossil fuel each year. While this energy consumption is a major concern to students, teachers, administrators and the community – who all wish to lessen dependence on fossil fuels – school systems are moving at a glacial pace when it comes to making environmentally conscious decisions regarding what technologies should power their facilities."

Source: Laine and Montgomery, 2010.

Greenhouse Gases Emissions Profile and Forecast
Taos & Vicinity, New Mexico

In January 2011, officials of the Peñasco Independent School District (PISD) in southern Taos County announced that their offices and buildings would be closed on Mondays throughout January and February, the coldest months of the year, in order to reduce energy costs. This means significant energy-use reductions for nine of about forty days of the school calendar, or potential energy cost savings of up to 20 percent. Certain energy uses would continue on days of closure, but energy-use and cost data could be obtained from the district to calculate actual savings. PISD also installed a 50-kilowatt (kW) solar photovoltaic (PV) array in 2010 using funds from the American Recovery and Reinvestment Act of 2009 (ARRA) through New Mexico's Schools with Solar Program. (Table D4). Schools and other commercial building complexes in Taos should look to the PISD school closure experience as one example of policy decisions intended for energy costs reductions.

Certain schools in Taos already benefit from or will soon realize on-site solar electric power generation. The Taos Municipal School District received grant funding from the (ARRA) through New Mexico's Schools with Solar Program in 2010 to construct a 50-kilowatt (kW) solar photovoltaic array. The Taos Charter School in cooperation with Kit Carson Electric Cooperative, Inc. (KCEC) is also installing 50 kW of solar PV power. Whereas these installations offer small offsets against fossil fuel energy uses, they need to be supplemented by a combination of energy efficiency retrofits, policies that reduce energy use, and additional clean energy generation. An estimated 90 percent reduction in fossil fuel electricity use is projected for Taos High School buildings due to the combination of energy efficiency measures and them 50-kilowatt solar photovoltaic array.

The Taos Municipal School District, in cooperation with other entities such as the Town of Taos and KCEC, should investigate options for obtaining energy audits on all district buildings. These audits will identify those buildings that need the most attention in terms of energy efficiency retrofits.

Commercial Buildings

Builders in Taos are now constructing the first commercial buildings to meet the requirements of the Taos High Performance Building Ordinance of 2009. Town staff can assess energy efficiency aspects of these buildings, for example, on a square-footage basis as energy-use data become available. Concurrently, the Town of Taos should investigate the possibility of accessing energy-use data for a variety of types of commercial buildings in the community. Some private building owners could be willing to share energy-use data, especially for comparative purposes with similar buildings that might have substantially lower energy costs.

Energy Efficient HVAC Systems

"Although the primary purpose of heating, ventilation, and air conditioning (HVAC) systems in commercial buildings is occupant productivity, the objective of most changes to HVAC systems in the next five years will be to decrease energy cost. Because of rising energy prices and the drive to reduce greenhouse gas (GHG) emissions associated with building operations, many building owners have begun to manage energy cost actively as an asset, rather than a fixed cost. HVAC accounts for almost one-third of the energy cost in commercial buildings, so these systems hold great potential for energy savings."

Source: Pike Research, 2011. Accessed online at:
http://www.pikeresearch.com/research/energy-efficient-hvac-systems

Pike Research (2011) recognizes important trends in the different ways small, medium-sized, and large commercial buildings are expected to treat energy efficiency in the near term. Pike Research notes that the heating, ventilation, and air-conditioning (HVAC) industry changes slowly and has major consequences for smaller commercial buildings heated and cooled by packaged HVAC units. Newer energy efficiency features are infrequently added to these units. New construction and retrofits of larger commercial buildings, however, are currently designed for 20% to 35% energy cost savings. Designers of larger buildings are not so constrained to the limits of the packaged HVAC units, and therefore tend to add new energy efficiency practices incrementally.

The Pike Research projections indicate opportunities for the Town of Taos to examine the energy efficiency features of standard HVAC packages and other commercial building energy systems and recommend superior, cost effective alternatives. This work could be done in concert with any of several consultants in the local building engineering and construction industry.

Residential Buildings

As with commercial buildings, builders in Taos are now constructing the first residential buildings to meet the requirements of the Taos High Performance Building Ordinance of 2009. Town staff can assess energy efficiency aspects of these buildings using the Home Energy Rating System (HERS) data provided as a condition of receiving a Certificate of Occupancy. HERS data include energy-use projections that can be used to determine GHG emissions and levels of GHG reductions possible with different building types.

Concurrently, the Town of Taos should investigate the possibility of accessing energy-use data for a variety of types of residential buildings in the community. Taos area builders have been incorporating innovative energy efficiency measures into buildings for many decades. Many builders could be willing to share performance data to illustrate the quality of their design and construction practices. A program to collect residential building performance data, especially for pre-2010 buildings and retrofits, would be valuable for monitoring progress towards GHG reduction goals.

A huge array of methods exists for attaining energy efficiency for residences, and information on these methods are widely available within the building industry. For Taos and vicinity, however, certain specifics are of interest. For Taos County as a whole, data on electricity deliveries by Kit Carson Electric Cooperative, Inc. indicate an average electricity use per meter of about 6,000 kilowatt-hours per year (kWh/yr). This number may be compared, for example, with a USA national average household electricity consumption of about 13,000 kWh/yr (U.S. Energy Information Administration, 2008a, Table US3).

The reasons for the large difference in average electricity consumption for Taos and vicinity relative to the USA need further examination. However, much of the difference may be related to a lack of demand for electricity for air conditioning and electrical-resistance heating in Taos and vicinity.

Alternatively, residents of Taos and vicinity (and the State of New Mexico as well) tend to use greater average quantities of natural gas and propane than the average USA consumer. Eighty-three percent of New Mexico households use either natural gas or propane as primary sources of home heating compared with about 58 percent of households nationwide (U.S. Energy Information Administration (2010b). The 83 percent figure for New Mexico may be even higher for Taos and vicinity. The greater volumes of natural gas burned thereby account for significant total GHG emissions in the Taos County communities served by natural gas pipelines (Appendix J).

Notably, natural gas demand is expected to increase substantially with population growth in Taos and vicinity. Most new growth is forecast to occur in areas served by natural gas. Additionally, the fossil fuel industry is already in the process of switching from coal to natural gas for electricity generation in Colorado and New Mexico. This means potential changes in the GHG emissions mix by 2030 for electricity to be provided by Tri-State Generation and Transmission Association, Inc., for example.

The people of Taos and vicinity, New Mexico use far less electricity and far more natural gas per capita than people throughout the rest of the nation.

The preceding paragraphs suggest that decisionmakers focus strongly on residential heating demands as priorities for GHG reductions for Taos and vicinity by 2030. A wide variety of options are available for heating and heating efficiency for residences including insulation and other weatherization measures, passive solar heating, active solar thermal heating, and combinations of these. For any building, heating and heating efficiency should be based on comprehensive energy audit for building plans and retrofits.

Residential clean energy opportunities and solutions currently are being created worldwide, and the pace of change in this field of study is rapid. It will be essential for Taos planning staff to research experiences of other USA and worldwide communities in creating self-sustaining generation of clean energy. District heating systems powered by a local clean energy generator is one possibility for use in new residential developments, for example. Decisionmakers should participate by creating incentives for all types of residential clean energy systems and practices. For clean energy generation, planners should begin identifying specific Town owned and County owned lands for residential-scale clean energy installations such as ground-mounted solar photovoltaic (PV) arrays.

The Town could also investigate a suite of policy options including means for obtaining and distributing loans to citizens for making energy efficiency improvements, working with Kit Carson Electric Cooperative, Inc. (KCEC) to offer on-bill financing at levels less than consumers' current electricity bills, providing energy efficiency weatherization for the homes of low-income citizens, and requiring energy efficiency upgrades of homes at time of sale.

Transportation

Vehicle Miles Traveled and Fuel Efficiency

On-road motor vehicle transportation accounts for about 51 percent of the total greenhouse gases (GHG) emissions for Taos County and about 38 percent of the GHG emissions for the Town of Taos in 2009 based on the data collected for this report. The differences reflect differences in the intensity of residential and commercial development in the County outside the Taos Planning Area, and the volumes of non-local and through traffic on major Taos County arteries. Most traffic on US Highway 285 in western Taos County, for example, likely has origins and destinations outside the County and does not reflect locally based traffic and consequent GHG gases emissions.

"From 1990 to 2007, transportation emissions rose by 29 percent due, in large part, to increased demand for travel and the stagnation of fuel efficiency across the U.S. vehicle fleet. The number of vehicle miles traveled by light-duty motor vehicles (passenger cars and light-duty trucks) increased 40 percent from 1990 to 2007, as a result of a confluence of factors including population growth, economic growth, urban sprawl, and low fuel prices over much of this period. A similar set of social and economic trends has led to a significant increase in air travel and freight transportation by both air and road modes during the time series."

Source: U.S. Environmental Protection Agency (2009b, p. 3-12).

For the USA vehicle fleet consisting mostly of passenger automobiles and light trucks, fuel efficiency measured in miles per gallon (mpg) has remained relatively constant in the range of 20 mpg for the past 20 years. However, this number is expected to rise significantly by 2030. The U. S. Environmental Protection Agency (USEPA) and the U.S. Department of Transportation (USDOT) are expected to announce definitive targets for vehicle fuel efficiency for the 2017 to 2025 model years in late 2011, and finalize rules in 2012. Noteworthy is the Obama administration's call in late 2010 for new cars in the USA to reach an average 62 mpg by 2025. For a variety of reasons, including the emergence of electric and hybrid gasoline-electric and other fuel-efficient vehicles, it is not unreasonable to expect passenger vehicle fuel efficiency for new vehicles to exceed 50 mpg in the USA by 2030.

For 2009, the ICLEI CACP 2009 program calculates Taos and vicinity GHG emissions from motor vehicles using USEPA national fleet average of 21.1 mpg. When USEPA/USDOT targets become available in 2011, these can form the basis for alternative estimates of 2030 GHG emissions using Taos and vicinity population projections in the CACP program.

Another major factor in motor vehicle GHG emissions over the next 20 years will be the growth of the nascent electric and hybrid gasoline-electric vehicle industry. Approximately one dozen automakers are currently manufacturing such vehicles for the global mass market, but significant market penetration is expected to remain minimal for at least the next few years. Nonetheless, planning for 2030 should account for substantial replacement of gasoline and diesel powered vehicles with electric and hybrid-electric vehicles. The USEPA, USDOT and other entities currently are evaluating fuel-use equivalencies and metrics (e.g., miles per kilowatt-hour) for comparing, for example, gasoline and electricity required to power motor vehicles. Recent figures suggest that a gasoline-powered vehicle would need to attain 70 to 90 miles per gallon in fuel efficiency to match the equivalent natural gas or coal energy required to power an electric vehicle.

"Government regulations will soon require all vehicles to use energy more sparingly: By 2016, automakers' fleets must average 35.5 miles per gallon. Despite the considerable hype for EVs, manufacturers are taking a multi-pronged approach to fuel efficiency -- hybrids, plug-in electrics, diesels and more- efficient internal-combustion engines."

Source: Anderson, J.L. (2011) *in* Kiplinger's Personal Finance Magazine.

In general, the bulk of GHG emissions from burning motor vehicle fuels are related to vehicle fuel efficiency and fuel types that are the purview of the States and especially the Federal Government. Nonetheless, there remain many opportunities for local governments to reduce total and per capita vehicle miles traveled and fuel consumption.

Reducing Vehicle Miles Traveled by Policy and Planning

"The enormous value to society of the mobility of people and commodities must be preserved. Because rates of technological progress and future energy prices are uncertain, the GHG mitigation strategy for transportation must be adaptable."

Source: Solutions - Reducing Greenhouse Gas Emissions from U.S. Transportation, (Green and Plotkin, 2011, p. xv.)

Solutions to growing vehicle use with population growth revolve around development planning and policy. Favored methods include promoting development that shortens or eliminates motor vehicle trips and encourages ride sharing, walking, bicycling, and public transit (Green and Plotkin, 2011, p. xi; p. 40-42).

"It has been said that the greatest oil reservoir in the world is the empty seats in American cars."

Source: Solutions - Reducing Greenhouse Gas Emissions from U.S. Transportation, (Green and Plotkin, 2011, p. 34.)

According to the National Research Council (2009 p. 24-28), GHG emissions could be reduced by 10 percent or more by 2050 is 75 to 90 percent of all new development was a compact, mixed-use type with increased residential density. The Town of Taos has many opportunities in this realm to alter the style of growth, both within Town limits and with possible expansion into the Taos Planning Area. Solutions include rearranging transportation geography by closing selected streets to vehicle traffic and economic disincentives such as congestion and parking pricing. Economic incentives might include pay-as-you-drive insurance, and graduated rebates to owners of vehicles with lower emissions and those willing to share rides or vehicles.

"Mitigating GHG emissions by designing communities that are conducive to shorter vehicle trips and non-motorized travel could achieve a 1 to 2 percent reduction in nationwide vehicle travel by 2035 and a 1.5 to 5 percent reduction by 2050. Further, individual communities with a commitment to creating a travel-efficient environment could do substantially more."

Source: Solutions - Reducing Greenhouse Gas Emissions from U.S. Transportation (Green and Plotkin, 2011, p. 85.)

Several USA states, notably California and Oregon, have already installed thousands of electric vehicle charging stations to meet both current demands and the rapidly evolving electric vehicle future. In 2010, Kit Carson Electric Cooperative, Inc. (KCEC) installed a single charging station at its offices in Taos in concert with its new 100-kilowatt solar photovoltaic (PV) parking lot canopy array. Planners and decisionmakers for Taos and vicinity, in concert with KCEC, should investigate the experience of other communities, and develop a process for siting charging stations.

Taos and Taos County should plan locations for electric vehicle charging stations.

The Town of Taos and other local entities could also set an example for the potential of electric or hybrid-electric vehicle use by purchasing such vehicles for vehicle fleets, especially passenger vehicles for routinely limited travel distances. Other options include fuel switching for selected Town vehicles, for example, from gasoline and diesel fuel to natural gas, propane, and/or biodiesel. The Town could also investigate a suite of policy options for its employees, particularly ride-sharing and work schedules designed to reduce numbers of commute trips.

"As witnessed over the past decade, clean tech has proven to be a significant business opportunity, and its growth rates now rival that of earlier technology revolutions like telephony, computers, and the Internet. According to Clean Edge research, the global market for solar photovoltaics (PV) has expanded from just $2.5 billion in 2000 to $71.2 billion in 2010, for example, representing a compound annual growth rate (CAGR) of 39.8 percent. The global market for wind power, which like solar PV we have tracked every year for the past decade, has similarly expanded from a global market worth $4.5 billion in 2000 to more than $60.5 billion today, for a CAGR of 29.7 percent. And these growth rates are not limited to solar and wind. Other clean-tech sectors, such as hybrid electric vehicles, green buildings, and smart grid, have seen similarly spectacular growth rates."

Source: Pernick, and others (2011, p. 2) in Clean Energy Trends 2011.

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Appendices A-K.

Appendix A. – Definitions of Terms

This appendix contains selected definitions related to greenhouse gases, energy, units of measurement, climate change, acronyms, and other terminology used in this report. Many terms are based on scientific information that is being continuously updated, for example, the constituents and global warming potential of greenhouse gases. The definitions (links) here are current as of the beginning of 2011 or the citation date where indicated. For updates, go to the links provided throughout the list or with the citations in the reference section (p. 69-82).

The following links offer more comprehensive lists of terms.

Adaptation - Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. [U.S. Environmental Protection Agency, 2011.] Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature- shock resistant plants for sensitive ones, etc. [Verbruggen, Aviel, 2007, p. 809.]

Anthropogenic - Made by people or resulting from human activities. The term is used in this report primarily in the context of emissions that are produced as a result of human activities. [U.S. Environmental Protection Agency, 2011a.]

Atmospheric Lifetime - The lifetime of a greenhouse gas refers to the approximate amount of time it would take for the anthropogenic increment to an atmospheric pollutant concentration to return to its natural level (assuming emissions cease) as a result of either being converted to another chemical compound or being taken out of the atmosphere via a sink. This time depends on the pollutant's sources and sinks as well as its reactivity. The lifetime of a pollutant is often considered in conjunction with the mixing of pollutants in the atmosphere; a long lifetime will allow the pollutant to mix throughout the atmosphere. Average lifetimes can vary from about a week (sulfate aerosols) to more than a century (chlorofluorocarbons (CFCs), carbon dioxide). [U.S. Environmental Protection Agency, 2011a.]

Biomass -Total dry weight of all living organisms that can be supported at each tropic level in a food chain. Also, materials that are biological in origin, including organic material (both living and dead) from above and below ground, for example, trees, crops, grasses, tree litter, roots, and animals and animal waste. [U.S. Environmental Protection Agency, 2011a.]

Black Carbon - Operationally defined species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal, and/or possible light-absorbing refractory organic matter. [Charlson, R. J., and J. Heintzenberg, 1995, p. 401.]

Btu (British Thermal Unit) - A Btu is a measure of the heat content of fuels. It is the quantity of heat required to raise the temperature of 1 pound of liquid water by 1°F at the temperature that water has its greatest density (approximately 39°F). For Btu conversions to kilowatt-hours of electricity, cubic feet and/or therms of natural gas, gallons of gasoline, gallons of diesel fuel, gallons of heating oil, gallons of propane, and cords of wood, see: http://www.eia.gov/energyexplained/index.cfm?page=about_btu

Carbon Capture and Storage (CCS) - A process consisting of separation of CO_2 from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere. [Verbruggen, Aviel, 2001, p. 811.]

Carbon Dioxide (CO_2) - A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential (GWP) of 1. [U.S. Environmental Protection Agency, 2011a.]

Carbon Dioxide Equivalent (CO_2e) - Commonly, a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents ($MMTCO_2Eq$)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_2Eq$ = (million metric tons of a gas) x (GWP of the gas). [U.S. Environmental Protection Agency, 2011a.]

In this report, the CACP 2009 program produces results in tons of carbon dioxide equivalent (tCO_2e).

Carbon Sequestration - The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned. [U.S. Environmental Protection Agency, 2011a.]

Chlorofluorocarbons - Greenhouse gases covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents, or aerosol propellants. Since they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons and hydrofluorocarbons, which are greenhouse gases covered under the Kyoto Protocol. [U.S. Environmental Protection Agency, 2011a.]

Climate - Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. [U.S. Environmental Protection Agency, 2011a.]

Climate Change - Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- natural processes within the climate system (e.g. changes in ocean circulation);
- human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.). [U.S. Environmental Protection Agency, 2011a.]

Direct Greenhouse Gases (GHG) Emissions – In this report, direct GHG emissions those produced at the point of use of a GHG emitting material For example, motor vehicles produce GHG emissions including CO_2, N_2O. Also see "Upstream" greenhouse gases (GHG) emissions.

DVMT – Daily Vehicle Miles Traveled (DVMT) is a basic measure of vehicular travel on roadways, and is based on actual counts of traffic, notably by state and federal highway and transportation agencies. DVMT in this report and elsewhere is used together with USEPA fleet consumption of motor fuels (e.g., gasoline and diesel fuel) in average miles per gallon for a given year to compute vehicular emissions of the greenhouse gases CO_2, N_2O, and CH_4. [U.S. Environmental Protection Agency, 2009.] DVMT for road segments and/or regions throughout New Mexico may be accessed through the New Mexico Department of Transportation and/or its Annual Traffic Reports online at:
http://nmshtd.state.nm.us/main.asp?secid=14473

Emissions - The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere. [U.S. Environmental Protection Agency, 2011a.]

Fluorocarbons - Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). [U.S. Environmental Protection Agency, 2011a.]

Geothermal Heat Pump - The geothermal heat pump, also known as the ground source heat pump, is a highly efficient renewable energy technology that is gaining wide acceptance for both residential and commercial buildings. Geothermal heat pumps are used for space heating and cooling, as well as water heating. Its great advantage is that it works by concentrating naturally existing heat, rather than by producing heat through combustion of fossil fuels. The technology relies on the fact that the Earth (beneath the surface) remains at a relatively constant temperature throughout the year, warmer than the air above it during the winter and cooler in the summer, very much like a cave. The geothermal heat pump takes advantage of this by transferring heat stored in the Earth or in ground water into a building during the winter, and transferring it out of the building and back into the ground during the summer. The ground, in other words, acts as a heat source in winter and a heat sink in summer (U.S. Department of Energy, 2011).

GHG – Greenhouse gas or greenhouse gases.

Gigawatt (GW) – One thousand megawatts (MW) of electricity.

Global Warming - Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. [U.S. Environmental Protection Agency, 2011a.]

Global Warming Potential (GWP) - Global Warming Potential (GWP) is defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. Inventory are presented in terms of equivalent emissions of carbon dioxide (CO_2), using units of teragrams of carbon dioxide equivalents (Tg CO_2 Eq.). Conversion: Tg = 10^9 kg = 10^6 metric tons = 1 million metric tons. The molecular weight of carbon is 12, and the molecular weight of oxygen is 16; therefore, the molecular weight of CO_2 is 44 (i.e., 12+[16 x 2]), as compared to 12 for carbon alone. Thus, carbon comprises 12/44ths of carbon dioxide by weight. [U.S. Environmental Protection Agency, 2011a.]

Greenhouse Effect - Trapping and build-up of heat in the atmosphere (troposphere) near the Earth's surface. Some of the heat flowing back toward space from the Earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then reradiated back toward the Earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase. [U.S. Environmental Protection Agency, 2011a.]

Greenhouse Gas (GHG) - Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). [U.S. Environmental Protection Agency, 2011a.]

Hydrofluorocarbons (HFCs) - Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 (HFC-152a) to 11,700 (HFC-23). [U.S. Environmental Protection Agency, 2011a.]

Indirect Greenhouse Gases (GHG) Emissions – In this report, indirect GHG emissions are those produced prior to reaching the point of demand or use responsible for generating such emissions. For example, large amounts of the electricity currently used in the USA is produced at fossil-fuel power plants and transmitted by power lines to the point of use. Thus, the GHG emissions associated with the electricity production occur at the power plant that may be hundreds or thousands of miles from the point of use. Similarly, GHG emissions occur during extraction and production of fuels such as oil and natural gas. Thus, GHG emissions may occur in the oil and natural gas fields of sites distant from the point of use in the USA and in foreign countries that supply oil and natural gas to the USA. GHG emissions also occur in transporting oil, natural gas, coal, gasoline, etc. long distances by vehicles, ships, pipelines and other means. Indirect GHG emissions may also be called "upstream" emissions and must be included in a full accounting of all GHG emissions associated, for example, with the direct emissions from burning gasoline in a motor vehicle. Also see "Upstream" greenhouse gases (GHG) emissions.

Kilowatt (kW) - One thousand watts. The output of power generating facilities such as fossil-fuel and nuclear power plants and solar and wind power installations frequently are rated by kilowatts and megawatts (MW). Multiplying this output by the number of hours the plant operates, for example, on a daily, monthly or yearly basis, gives the kilowatt-hours or megawatt-hours of energy produced by the facility. The outputs of small residential and commercial wind turbines and solar panel installations typically are rated at less than 10 kilowatts. Large coal-fired and nuclear power plants may be rated at more than 2,000 megawatts (2,000,000 kilowatts).

Kilowatt-hour (kWh) - A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu. [U.S. Energy Information Administration, 2011c.] Residential and commercial metered electrical energy use in the USA is commonly billed by the kilowatt-hour.

Kyoto Protocol - The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto. It contains legally binding commitments, in addition to those included in the FCCC. Annex B countries agreed to reduce their anthropogenic GHG emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008-2012. The Kyoto Protocol came into force on 16 February 2005. [Verbruggen, Aviel, 2007, p. 817.]

Megawatt (MW) - One million watts of electricity. The energy output of large (utility-scale) power plants including fossil-fuel, nuclear, solar photovoltaic, solar thermal, and wind-turbine facilities is commonly rated in megawatts (MW). Multiplying this output by the number of hours the plant operates, for example, on a daily, monthly or yearly basis, gives electricity production in megawatt-hours (MWh).

Perfluorocarbons (PFCs) - A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases: CF_4 has a global warming potential (GWP) of 5,700 and C_2F_6 has a GWP of 11,900. [U.S. Environmental Protection Agency, 2011a.]
gives the megawatt-hours of energy produced by the facility.

Megawatt-hour (MWh) - One thousand kilowatt-hours or 1million watt-hours.

Mercaptan – Also *thiol*. A colorless gas with a strong, disagreeable odor that is added to otherwise odorless gases like propane and methane enabling people to detect gas leaks by smell.

Methane (CH_4) - A hydrocarbon that is a greenhouse gas with a global warming potential (GWP) most recently estimated at 23 times that of carbon dioxide (CO2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion. [U.S. Environmental Protection Agency, 2011a.]

Metric Ton - Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2,205 pounds (lbs) or 1.1 short tons. 1 short ton = 2,000 pounds (lbs). [U.S. Environmental Protection Agency, 2011a.]

Greenhouse gases (GHG) emissions in this report are expressed in short tons.

Mitigation - Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks. [Verbruggen, Aviel, 2007, p. 818.]

MMBtu – One thousand thousand Btus. One million Btus. A common unit of measurement of Btus.

Natural Gas - Underground deposits of gases consisting of 50 to 90 percent methane (CH_4) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C_3H_8) and butane (C_4H_{10}). [U.S. Environmental Protection Agency, 2011a.]

Nitrous Oxide (N_2O) - A powerful greenhouse gas with a global warming potential of 296 times that of carbon dioxide (CO_2). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning. [U.S. Environmental Protection Agency, 2011a.]

Ozone (O_3) - Ozone, the triatomic form of oxygen (O_3), is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (photochemical smog). high concentrations, tropospheric ozone can be harmful to a wide range of living organisms. Tropospheric ozone acts as a greenhouse gas. In the stratosphere, ozone is created by the interaction between solar ultraviolet radiation and molecular oxygen (O_2). Stratospheric ozone plays a decisive role in the stratospheric radiative balance. Depletion of stratospheric ozone, due to chemical reactions that may be enhanced by climate change, results in an increased ground-level flux of ultraviolet (UV-) B radiation. [U.S. Environmental Protection Agency, 2011a.]

Particulate Matter (PM) - Very small pieces of solid or liquid matter such as particles of soot, dust, fumes, mists or aerosols. The physical characteristics of particles, and how they combine with other particles, are part of the feedback mechanisms of the atmosphere. [U.S. Environmental Protection Agency, 2011a.]

Parts Per Million (ppm) - Number of parts of a chemical found in one million parts of a particular gas, liquid, or solid. [U.S. Environmental Protection Agency, 2011a.]

Propane (LP Gas or Liquefied Petroleum Gas) - Propane is an energy-rich gas, C_3H_8. It is one of the liquefied petroleum gases, including ethane and butane, that are found mixed with natural gas and oil. Propane and other liquefied gases are separated from natural gas at natural gas processing plants, or from crude oil at refineries. Propane is a nonrenewable fossil fuel, like the natural gas and oil from which it is produced. Like natural gas (methane), propane is colorless and odorless. Although propane is nontoxic and odorless, foul-smelling mercaptan is added to it to make gas leaks easy to detect. Like all fossil fuels, propane when burned emits water vapor and carbon dioxide, a greenhouse gas. http://www.eia.gov/energyexplained/index.cfm?page=propane_home

Residence Time - The average time spent in a reservoir by an individual atom or molecule. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere. [U.S. Environmental Protection Agency, 2011a.]

Short Ton – Also, ton. Common measurement for a ton in the United States. A short ton is equal to 2,000 lbs or 0.907 metric tons. [U.S. Environmental Protection Agency, 2011a.]

Sink - Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere. [U.S. Environmental Protection Agency, 2011a.]

Solar Insolation – A measure of solar radiation energy received on a given surface in a given time. Solar insolation is commonly expressed in kilowatt-hours per square meter per day. Average solar insolation for Taos and vicinity, New Mexico, is approximately 6.0-6.5 kWh per square meter per day (Renne and others, 2008, p.7). For simplicity of expression, solar insolation is sometimes called "sun hours per day." This report uses 6.0 sun hours per day as a conservative estimate for calculating solar power generation. For example, a residential solar photovoltaic panel installation in Taos rated at 4 kilowatts could be expected to generate an average of (4 kilowatts x 365 days/year x 6 hours/day) = 8,760 kWh per year.

Sulfur Hexafluoride (SF_6) - A colorless gas soluble in alcohol and ether, slightly soluble in water. A very powerful greenhouse gas used primarily in electrical transmission and distribution systems and as a dielectric in electronics. The global warming potential (GWP) of SF6 is 22,200. [U.S. Environmental Protection Agency, 2011a.]

tCO_2e – Tons of carbon dioxide equivalent. 1 ton = 2,000 pounds; also 1 short ton. See Carbon Dioxide Equivalent (CO_2e) and Global Warming Potential (GWP) above.

Therm - One hundred thousand (100,000) Btu. Therms are commonly used as a measure of the heat content of natural gas that varies from place to place depending upon the purity of the natural gas. In the USA, 1 therm is equivalent to about 0.097 thousand cubic feet of natural gas. 1,000 cubic feet natural gas = approximately 10.25 therms. 1 therm is equivalent to approximately 29.3 kilowatt-hours (kWh) of electricity.

"Upstream" GHG Emissions – "Upstream" as used in this report and elsewhere refers to a point or points in the stream of processes in the life cycle of a material from extraction to processing, use, and final dispersal and disposition. "Upstream" GHG emissions occur during extracting, processing, and producing various fuels and other materials for end uses and consumption. For example, "upstream" GHG emissions related to electricity production occur during coal mining by way of machinery used in mining, release of methane into the atmosphere, or deliberate burning ("flaring") of methane as coal is mined. GHG emissions from trains, barges, ships, trucks, etc. also occur during transport of coal from where it is mined to a power plant where it is burned to produce electricity.

VMT – Vehicle Miles Traveled (VMT) is a measure of real-world vehicular travel for a given roadway or roadways for a given period of time. For example, VMT for a roadway or roadways for a given year equals DVMT x 365 for that year.

Watt (W) - The unit of electrical power equal to one ampere under a pressure of one volt. A Watt is equal to 1/746 horsepower. [U.S. Energy Information Administration, 2011c.]

Weather - Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour to hour, day to day, and season to season.

> **Climate** in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard). [U.S. Environmental Protection Agency, 2011a.]

Appendix B. – Global Anthropogenic Greenhouse Gas Emissions and Sources

CO_2 (Carbon Dioxide) - fossil fuel use = 56.6 percent

CO_2 (Carbon Dioxide) - deforestation, decay of biomass, etc: = 17.3 percent

CO_2 (Carbon dioxide) - other = 2.8 percent

CH_4 (methane) = 14.3 percent

N_2O (nitrous oxide) = 7.9 percent

Fluorinated Gases (F-gases) = 1.1 percent

Hydrofluorocarbons and sources:
http://www.fluorocarbons.org/en/families/hfcs/products_applications.html

HFC-23	Trifluoromethane	Aluminum Smelting
HFC-125	Pentafluoroethane	Air Conditioning (AC), etc.
HFC-134a	1,1,1,2-Tetrafluoroethane	AC, Aerosols, etc.
HFC-143a	1,1,1-Trifluoroethane	Commercial Refrigeration
HFC-152a	Difluoroethane	Industrial Aerosols
HFC-227ea	Hydrofluorocarbon	Medical Aerosols
HFC-236ea	Hydrofluorocarbon	Firefighting Agent
HFC-4310mee	Hydrofluorocarbon	Solvent

Perfluorocarbons and sources:
http://www.fluorocarbons.org/en/families/pfcs/products_applications.html

CF_4	Perfluoromethane	Semiconductor Industry
C_2F_6	Perfluoroethane	Semiconductor Industry
C_4F_{10}	Perfluorobutane	Physics Research
C_6F_{14}	Perfluyorohexane	Heat Transfer Fluid
SF_6	Sulfur Hexafluoride	High Voltage Electricity

Atmospheric Lifetimes and Global Warming Potential of Selected Greenhouse Gases

Greenhouse Gas	Atmospheric Lifetime (years)	Global Warming Potential (GWP)
CO_2	50-200	1
CH_4	12±3	21
N_2O	120	310
HFS-23	264	11,700
HFC-32	5.6	650
HFC-125	32.6	2,800
HFC-134a	14.6	1,300
HFC-143a	48.3	3.800
HFC-152a	1.5	140
HFC-227ea	36.5	2,900
HFC-236fa	209	6,300
HFC-4310mee	17.1	1,300
CF_4	50,000	6,500
C_2F_6	10,000	9,200
C_4F_{10}	2,600	7,000
C_6F_{14}	3,200	7,400
SF_6	3,200	23,900

Source: U.S. Environmental Protection Agency (2010a, p. 1-6 to 1-8).
Accessed online at: http://www.epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_Chapter1-Introduction.pdf

See also: U.S. Energy Information Administration (2011b).
Accessed online at: http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html

Appendix C. – Population Data and Projections and Related Census Data, Taos and Vicinity, Taos County, and State of New Mexico.

Table C1. – Taos County Population and Projections, 2005-2035

Taos County Projected Population July 1, 2005 to July 1, 2035						
2005	2010	2015	2020	2025	2030	2035
31,931	33,879	35,960	38,013	39,743	41,145	42,367

Source: University of New Mexico, 2008

Table C2. – New Mexico Population and Projections, 2005-2035

New Mexico Projected Population July 1, 2005 to July 1, 2035						
2005	2010	2015	2020	2025	2030	2035
1,969,292	2,162,331	2,356,236	2540,145	2,707,757	2,864,796	3,018,289

[Estimate for 2009 = 2,123,723 based on average growth 2005-2010.]

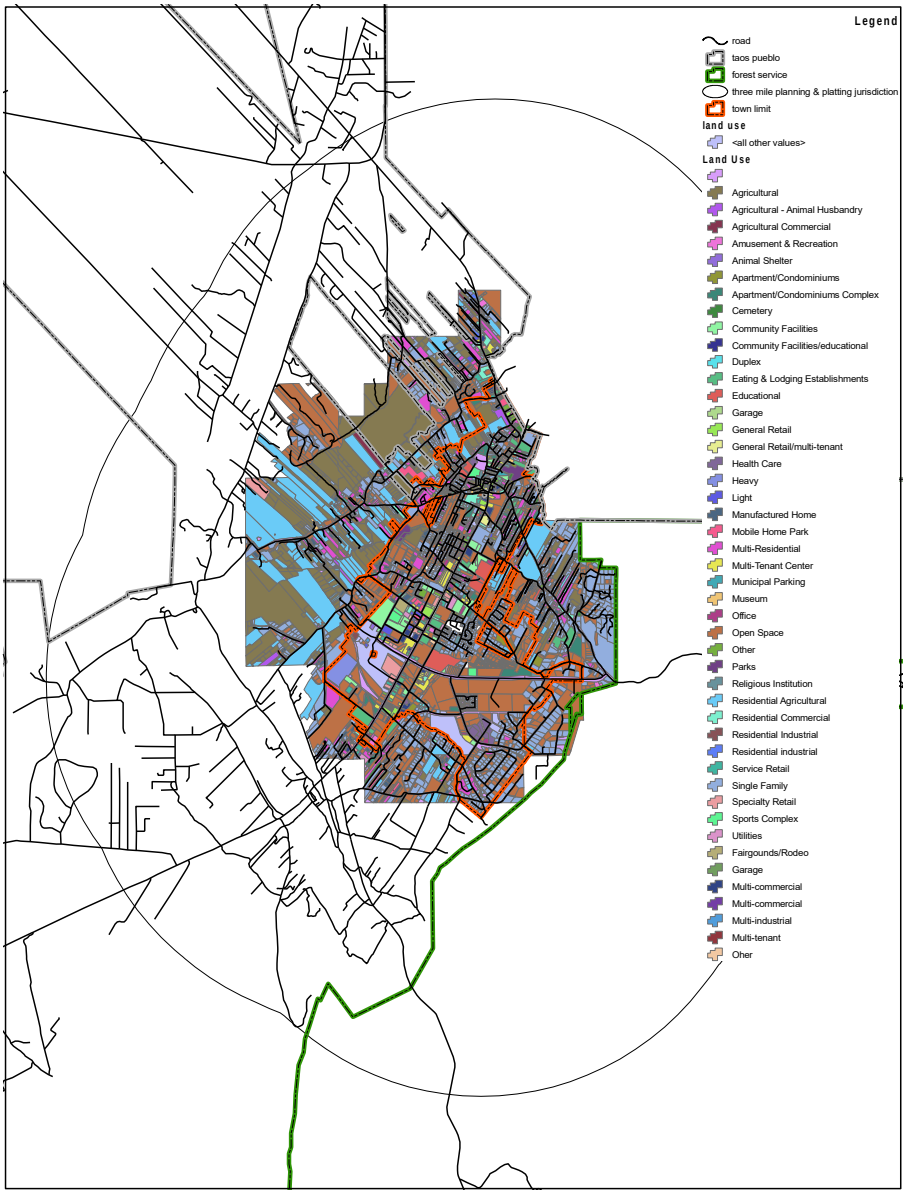
Source: University of New Mexico, 2008

Table C3. – Taos County, Taos Planning Area and Town of Taos Populations Estimates, 2009 - 2030

Geographic Area	**2009**	**2010**	**2020**	**2030**
Taos County	33,489	33,879	38,013	41,145
Taos Planning Area	10,644	10,768	12,671	13,715
Town of Taos	5,545	5,610	6,280	6,797

Source: University of New Mexico, 2008 for Taos County. Taos Planning Area and Town of Taos Population Estimates based on Taos County data and projections.

Figure C1. – Town of Taos and Taos Planning Area, New Mexico



The Taos Planning Area described in this report includes the Town of Taos (inside red boundary) and areas north, west and south that are about three miles outside the Town Limits (oval-shaped line). This area includes Ranchos de Taos, El Prado, Llano Quemado, Blueberry Hill, Lower Las Colonias, and other neighborhoods and communities. The Taos Planning Area does not include Taos Pueblo Lands and Forest Service Lands east of the Town Limits. Map provided by Town of Taos Planning Department, 2010.

Table C4. – Home Heating Fuels and Methods, Taos County, NM in 2000

House Heating Fuel	Number of Houses	Percent of Houses
Utility Gas (Natural Gas)	5953	47.0
Bottled, Tank, or LP Gas (Propane)	3223	25.4
Wood	2548	20.1
Electricity	456	3.6
Solar Energy	360	2.8
Other Fuel	89	0.7
Fuel Oil, Kerosene, Etc.	34	0.3
No Fuel Used	8	0.1
Coal or Coke	4	0.0
Total	**9774**	**100**

Source: U.S. Census Bureau (2000a, p. 4).

Table C5. – Home Heating Fuels and Methods, Town of Taos, NM in 2000

Home Heating Method Reported In 2000 Census	Town of Taos, New Mexico (Households)	Percent
Utility Gas (Natural Gas)	1,844	87
Bottled, Tank or LP Gas (Propane)	79	4
Electricity	107	5
Fuel Oil, Kerosene, etc.	0	0
Coal of Coke	0	0
Other/None (Wood, Wind, Active & Passive Solar, etc.)	80	4
Total	**2,110**	**100**

Source: U.S. Census Bureau (2000b, p.4).

Table C6. – Population Data from the Taos County Growth Management Plan

Taos County Subarea	Communities	2009 Population
Central	Town of Taos, Taos Pueblo, Taos Ski Valley, Arroyo Hondo, Arroyo Seco, Ranchos de Taos, El Prado, and associated neighborhoods such as Tierra Blanca, Taos Canyon, Las Colonias and others.	26,000 or about 70.8 percent of Taos County population.
North	Village of Questa, the Town of Red River, and the smaller communities of San Cristóbal, El Rito, Lama, Cerro, Costilla, Amalia, and others.	5,700 or about 15.5 percent of Taos County population.
South	Picuris Pueblo, Peñasco, Embudo, Pilar, Chamisal, Vadito, and smaller communities.	3,500 or about 9.5 percent of Taos County population.
West	All of Taos County west of the Rio Grande and the communities of Tres Piedras, Ojo Caliente, and smaller neighborhoods.	1,500 or about 4.1 percent of Taos County population.

Source: Community by Design (2007, p. 10-11).

Population Data, Small communities in Taos County, NM

http://www.city-data.com/city/Questa-New-Mexico.html
Questa population in July 2009 = 1898.

http://www.city-data.com/city/Red-River-New-Mexico.html
Population in July 2009 = 513

http://www.city-data.com/city/Ranchos-de-Taos-New-Mexico.html
Ranchos de Taos population in July 2009 = 2,513

http://www.city-data.com/city/Taos-Pueblo-New-Mexico.html
Taos Pueblo population in July 2009 = 1,329

http://www.city-data.com/city/Penasco-New-Mexico.html
Peñasco, NM population in July 2007 = 601

Land Area Data from 2000 Census, New Mexico and Taos County

Taos County Land Area = 2203.17 square miles. Accessed online at:
http://quickfacts.census.gov/qfd/states/35/35055.html

New Mexico Total Land Area = 121,355.53 square miles. Accessed online at:
http://quickfacts.census.gov/qfd/states/35000.html

New Mexico Total Area (Land plus Water Area) = 121,589.48 square miles. Accessed online at: http://www.ipl.org/div/stateknow/popchart.html

Appendix D. – Electricity Generation and Distribution for Taos and Vicinity, NM

Tri-State Generation and Transmission Association, Inc. of Westminster, Colorado (Tri-State) maintains an owned and contracted portfolio of electric energy generation and transmission. The energy is derived from coal, natural gas and oil-fired and combustion turbine generation facilities located throughout Wyoming, Nebraska, Colorado, New Mexico, Arizona and South Dakota (Figure D1). The energy is transmitted throughout Tri-State's 44 member systems, including Kit Carson Electric Cooperative, Inc. (KCEC) headquartered in Taos, NM. Tri-State continues to add new energy resources to its generation mix and more facilities are being planned or currently under construction.

Tri-State also purchases federal hydropower from the Western Area Power Administration, in addition to energy from other renewable energy sources such as wind power, small hydropower and biomass (Figure D2).

Tri-State sold about 18,600,000 megawatt-hours (MWh) of electricity to its member distribution systems in 2009 (Tri-State 2009 Annual Report, p. 17). KCEC (written communication, 2010) delivered about 302,500 MWh of electricity in 2009 to more than 29,000 customers throughout its service area that includes Taos County and parts of Rio Arriba, Colfax and Mora Counties in northern New Mexico. Of this amount, KCEC delivered 210,467 MWh to Taos County customers in 2009.

Kit Carson Electric Cooperative, Inc. sells about 46 percent of its electricity to residential customers, and about 53 percent to commercial and industrial customers in its four-county service area.

KCEC Service Area Boundaries accessed online at:
http://www.kitcarson.com/index.php?option=com_content&view=article&id=52&Itemid=154]

According to the Tri-State 2009 Annual Report, Table D1 shows the breakdown of KCEC deliveries by residential, commercial and other categories. The total is slightly different because of refined data accounting between the Tri-State 2009 report and the 2010 KCEC data summary.

Table D1. – Kit Carson Electric Cooperative, Inc. Electricity Sales in Megawatt-Hours (MWh), Taos, Colfax, and Rio Arriba Counties, NM in 2009.

Category	KCEC Electricity Sales 2009 (MWh)	Percent of Sales
Residential, Farm & Non-Farm	140,302	46.3
Irrigation	0	0.0
Commercial & Industrial	161,885	53.4
Other	848	0.3
Total	**303,035**	**100.0**

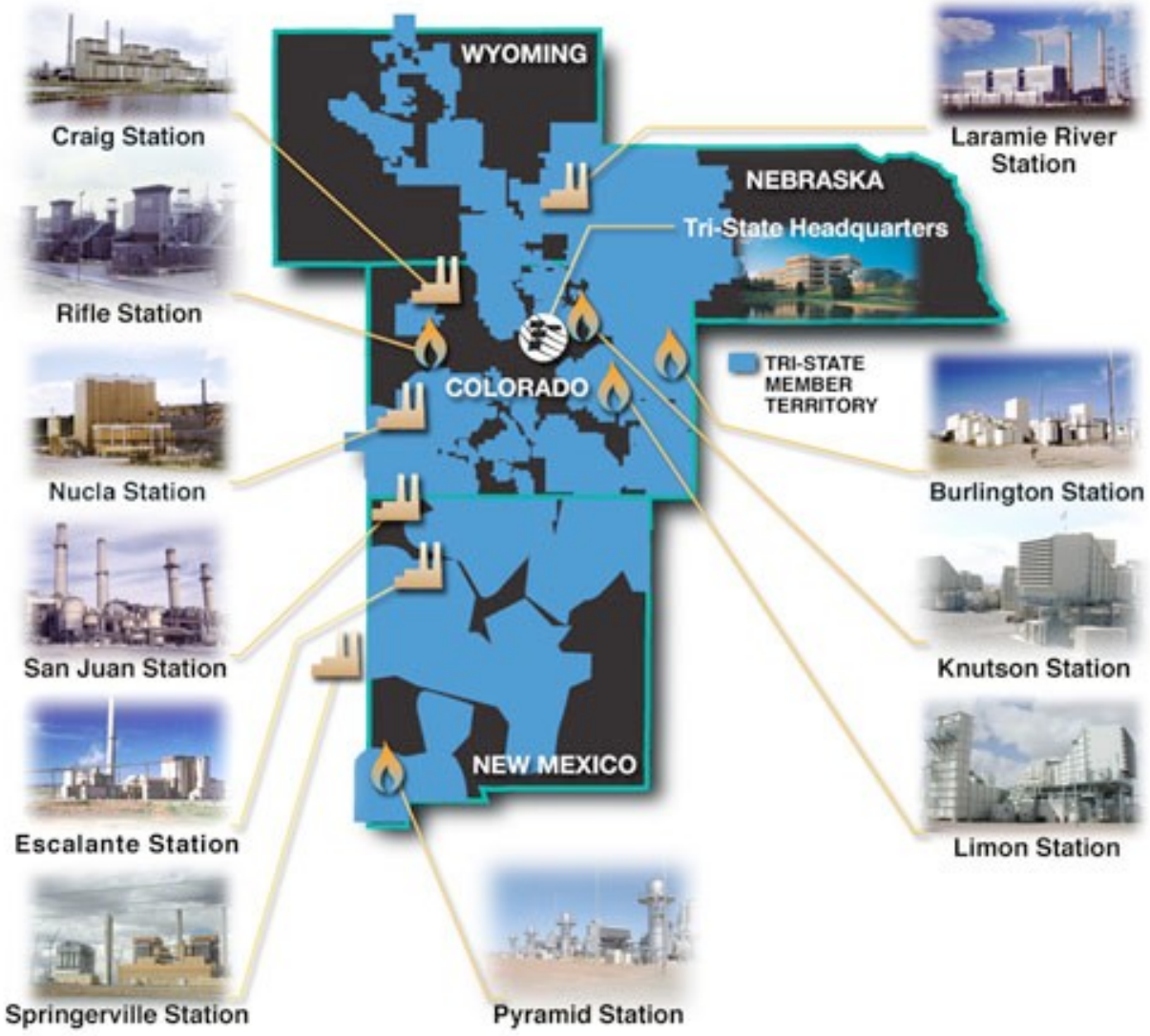
Source: Tri-State Generation and Transmission Association, Inc. (2009, p. 25).

For more information on Tri-State Generation and Transmission Association, Inc., see: http://www.tristategt.org/AboutUs/generation.cfm

For more information about Kit Carson Electric Cooperative, Inc., see: http://www.kitcarson.com/

For more information on the Western Area Power Administration, an agency of the U.S. Department of Energy, see: http://www.wapa.gov/

Figure D1. -- Tri-State Generation and Transmission Association, Inc. facilities include eleven fossil-fuel-fired power plants in four states.



Source: Tri-State Generation and Transmission Association, Inc.
Accessed online at: http://www.tristategt.org/AboutUs/locations.cfm
See Table D1 for information on each power plant.

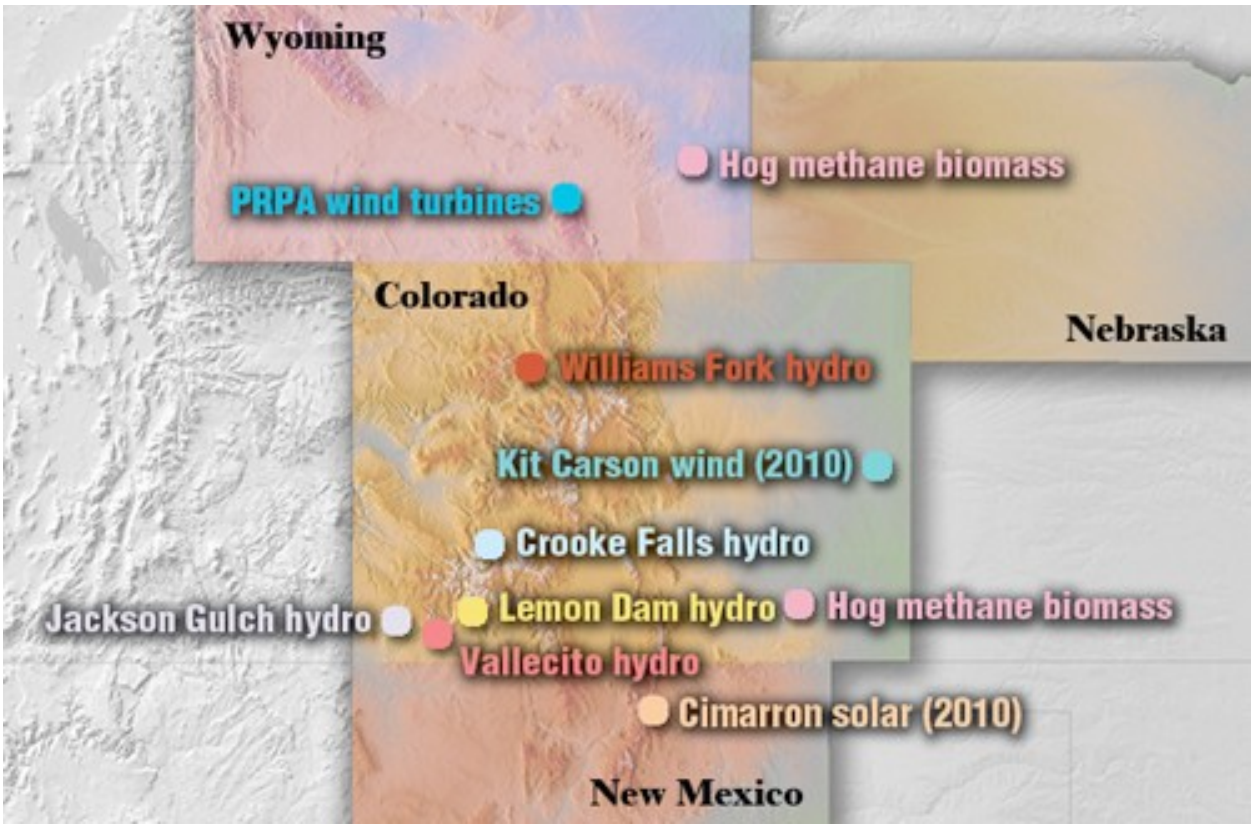
Table D2. – Tri-State Generation and Transmission Association, Inc. Baseload and Peaking Fossil-fuel Power Stations, 2009-2010.

Facility Name	Location	Type	Tri-State Share of Power Output, Megawatts (MW)
Craig Station	Craig, Colorado	Coal-fired/Baseload Power	654
Escalante Station	Prewitt, New Mexico	Coal-fired/Baseload Power	245
Springerville Generating Station	Springerville, Arizona	Coal-fired/Baseload Power	418
Laramie River Station	Wheatland, Wyoming	Coal-fired/Baseload Power	410
Pyramid Generating Station	Lordsburg, New Mexico	Natural Gas/Backup & Peaking Power	160
Limon Generating Station	Limon, Colorado	Natural Gas & Fuel Oil/Peaking Power	140
Frank R. Knutson Generating Station	Brighton, Colorado	Natural Gas & Fuel Oil/Peaking Power	140
Burlington Station	Burlington, Colorado	Diesel Fuel/Backup & Peaking Power	100
Nucla Station	Nucla, Colorado	Coal-fired/Baseload Power	100
Rifle Generating Station	Rifle, Colorado	Natural Gas & Diesel - Combined Cycle/Backup	85
San Juan Generating Station	Farmington, New Mexico	Coal-fired/Baseload Power	40
Total			**2,352**

Source: Tri-State Generation and Transmission Association, Inc.
Accessed online at:
http://www.tristategt.org/AboutUs/baseload-resources.cfm
http://www.tristategt.org/AboutUs/intermediate.cfm
http://www.tristategt.org/AboutUs/peaking.cfm

Tri-State supplements its power generation with power purchases from other generating entities, federal hydroelectricity allocations, and wind, solar and biomass facilities (Figure D2**.).** Tri-State also brought online new wind power in Colorado (Kit Carson Wind, November 29, 2010), and new solar power in New Mexico (Cimarrón I, December 2010).

Figure D2. – Tri-State Generation and Transmission Association, Inc. renewable energy power production facilities, 2009-2010.



Source: Tri-State Generation and Transmission Association, Inc.
Accessed online at: http://www.tristategt.org/greenpower/renewable-locations.cfm

Tri-State Generation and Transmission Association, Inc. Wind Power Sources

Platte River Power Authority (PRPA)

In 1998, Tri-State Generation and Transmission Association, Inc. (Tri-State) began purchasing wind generation from a Wyoming wind site under an interim agreement with PacifiCorp, a Midamerican Energy Holdings Company. A year later, the Tri-State signed a 15-year agreement with Platte River Power Authority of Fort Collins, CO to purchase energy from that utility's wind farm near Medicine Bow, WY. Currently, Tri-State purchases approximately 153 megawatt-hours of wind power per month from that site. [For equivalency to Table D1, 153 megawatt-hours per month = (1,836 MW-hr/yr)/(8760 hrs/yr) = 0.21 MW.] Tri-State indicates elsewhere on wind energy web page that it buys one unit's capacity of 660 kilowatts = 0.66 MW from the Platte River Power Authority. Table D3 shows this range of numbers.
See: http://www.tristategt.org/greenpower/WindEnergy.cfm
For PacifiCorp wind energy facilities, see: http://www.pacificorp.com/es/re.html

Basin Electric Power Cooperative (BEPC)

As a member of Basin Electric Power Cooperative in Bismarck, N.D., Tri-State also purchases a portion of its available wind generation from Basin's Prairie Winds Program. Prairie Winds includes six wind project sites totaling 85 megawatts of capacity. Tri-State (oral communication, 2010) purchases about 10 percent of this output, or 8.5 MW.
See: http://www.basinelectric.com:80/About_Us/Corporate/At_a_Glance/index.html

Upon completion of the Kit Carson Windpower Project in eastern Colorado, Tri-State will be generating or purchasing about 60 megawatts or roughly 2.5 percent of its electricity from wind turbines by 2011.

Kit Carson Windpower Project

In July 2009, Tri-State entered into a 20-year agreement with a subsidiary of Duke Energy Corp. to purchase the output of a new 51-megawatt wind farm to be built in east-central Colorado. The Kit Carson Windpower Project, named for the eastern Colorado county in which it will be sited, will be comprised of thirty four 1.5-megawatt General Electric turbines to be erected on a 6,000-acre site northwest of Burlington, CO within the service territory of Tri-State member co-op K.C. Electric Association, Inc. The facility, projected to generate enough electricity to power the requirements of 12,000 to 14,000 homes, is scheduled to be fully operational in December 2010. For details, see:
http://www.tristategt.org/NewsCenter/NewsItems/Kit-Carson-windpower-project.cfm

Table D3. – Tri-State Generation and Transmission, Inc. Wind Power Generation

Facility Owner Name	Facility Location	Power Type	Tri-State Share of Power Generation (MW)
Kit Carson Windpower (Duke Energy Corp.)	Burlington, CO	Wind Turbines (1.5-MW each)	51
Platte River Power Authority (PRPA), Fort Collins, CO	Medicine Bow, Wyoming	Wind Turbines (1.5-MW each)	0.21 – 0.66
Basin Electric Power Cooperative, Bismark, ND	Prairie Winds Program 1, South Dakota	Wind Turbines (1.5-MW each)	8.5
Total			**59.7-60.2**

Source: Tri-State Generation and Transmission Association, 2010. Oral Communication (2010) and accessed online at: http://www.tristategt.org/greenpower/WindEnergy.cfm

Electricity from Wind and Solar Power Generation, Taos and Vicinity, NM

Table D4. -- Town of Taos & Taos County, NM Existing and Potential Solar & Wind Energy Production 2010

Location/Facility Name	Power Generation (Kilowatts, kW)
Tri-State Wind Power, WY, SD, & CO*	60,000 kW (60 Megawatts) wind turbines*****
Cimarrón I Power Plant, Springer, NM*	30,000 kW (30 Megawatts) solar PV*****
Chevron Mining, Questa, NM**	1,000 kW concentrating solar PV (CPV)**
UNM-Taos, Klauer Campus	500 kW solar photovoltaic (PV)
Taos Wastewater Treatment Plant	250 kW solar PV
Town of Taos Outward Link Trail (proposed)***	250 kW solar PV
Kit Carson Electric Cooperative, Inc.	100 kW solar PV
Town of Taos Alexander Gusdorf Eco Park	84 kW solar PV
Peñasco Independent School District	50 kW solar PV
Town of Taos Town Hall	50 kW solar PV
Taos Municipal Schools	50 kW solar PV
KTAO Solar Center	43 kW solar PV
KTAO Picuris Peak Transmitter	8 kW solar PV
Town of Taos Recycling Center	10 kW solar PV
Holy Cross Hospital (KCEC)	?? kW solar PV
Taos Charter School (KCEC)	?? kW solar PV
Weimer Association (KCEC)	?? kW solar PV
Town of Taos Residential and Commercial Solar Photovoltaic (PV) Panels	27 kW solar PV (2009-2010 only)****
Town of Taos Residential and Commercial Solar Thermal Panels	37 kW solar thermal (Based on Btus, 2009-2010 only)****
Taos County Residential Wind Power	?? kW wind ****

*Tri-State Generation & Transmission Association, Inc.
**Chevron Mining CPV solar power connects directly to KCEC electrical transmission grid, and primarily serves Questa, NM.
***Proposed but not funded in 2010.
****Does not include pre-2009 solar PV, solar thermal panel, and wind turbine installations.
*****Quantities of solar and wind power potentially available from Tri-State to KCEC via new Cimarrón and Kit Carson Windpower projects are currently undetermined. For locations and generation capacities, see Figure D2 and Table D3.

Source: Compiled from many sources by the author, 2009-2011.

Residential and Small Commercial Solar Installations, Taos, NM

The New Mexico Energy, Minerals and Natural Resources Department (EMNRD) recently has begun compiling data on residential and small commercial solar photovoltaic and solar thermal installations for the Town of Taos. These data are derived from applications for the New Mexico Solar Tax Credit. By 2011, EMNRD was able to report data on installed facilities and electrical and heat output for 2009-2010 (Table D4).

EMNRD in 2011 also reported 8 solar photovoltaic panel arrays and 13 solar thermal panel arrays installed on individual residences and/or small commercial buildings in the Town of Taos during 2006-2008. We did not find records for small solar installations prior to 2006, although many such facilities have been installed in Taos during the past 30 years. Because solar facilities continue to produce electricity and heat for 25 years or more, we recommend continuing to search out and compile small solar facilities data to add to the information in Table D3. Such data will allow more comprehensive tracking of solar power development in Taos, and provide a part of the overall assessment of actual and potential greenhouse gas emissions reductions.

Table D4 - Town of Taos Residential and Small Business Solar Installations 2009-2010:

Year	Number/Type	Output in kilowatts (kW) or million Btu (MMBtu)	Approximate Output, kilowatt-hours per year (kWh/yr) at 6 sun hours per day
2009	6-Solar Photovoltaic (PV)	15.375kW	33,671 kWh/yr
2010	4-Solar Photovoltaic (PV)	11.640 kW	25,491 kWh/yr
2009	6-Solar Thermal	2,629 MMBtu; 15kW @ 6 sun hours/day	32,850 kWh/yr
2010	2-Solar Thermal	3,942 MMBtu; 22 kW @ 6 sun hours/day	48,180 kWh/yr
Total, 2009-10	**18 Installations**	**64 kW**	**140,192 kWh/yr**

Source: New Mexico Energy, Minerals and Natural Resources Department (written communication, 2011).

Approximate solar insolation in sun hours per day from National Renewable Energy Laboratory, Golden, CO. Accessed online at: http://www.nrel.gov/gis/solar.html

Monitoring Solar Photovoltaic Power Generation and Greenhouse Gases Emissions Avoided, Taos, NM

Certain solar photovoltaic arrays are connected to the Internet for reporting electrical power generation and greenhouse gases emissions avoided in real time. The "live" or real-time data displays show electricity generation by day, week, month, and year or for a user-customized period. The displays show the electricity generated over the lifetime of the facility from the time it went online to the current date.

The displays also show emissions of the greenhouse gases CO_2, and NO_x, and the aerosol SO_2 avoided by using solar power versus fossil fuels to generate the reported electricity.

Examples include the 500-kilowatt solar PV array at the UNM-Taos Campus and the 100-kilowatt solar PV canopy array over the parking lot at Kit Carson Electric Cooperative, Inc.

For information on the UNM-Taos Solar Array, see:
http://taos.unm.edu/solararray/index.html

For a "live" or real-time display of data for the UNM Taos Solar Array, see:
http://view2.fatspaniel.net/PV2Web/merge?&view=PV/standard/Simple&eid=285265

For a "live" or real-time display of data for the KCEC parking lot canopy array, see:
http://siteapp.fatspaniel.net/siteapp/simpleView.jsf?eid=440366

Appendix E. – Natural Gas for Taos and Vicinity, NM

"Although more than two-thirds of New Mexico's households use natural gas as their primary energy source for home heating, State natural gas consumption is low. Less than one-tenth of New Mexico's natural gas is used in the State. New Mexico delivers natural gas via pipeline to consumption markets in Arizona and to market centers in West Texas that supply the Midwest. New Mexico's Blanco Hub, located in the San Juan basin, is a major gathering point for Rocky Mountain natural gas supplies heading to West Coast markets."

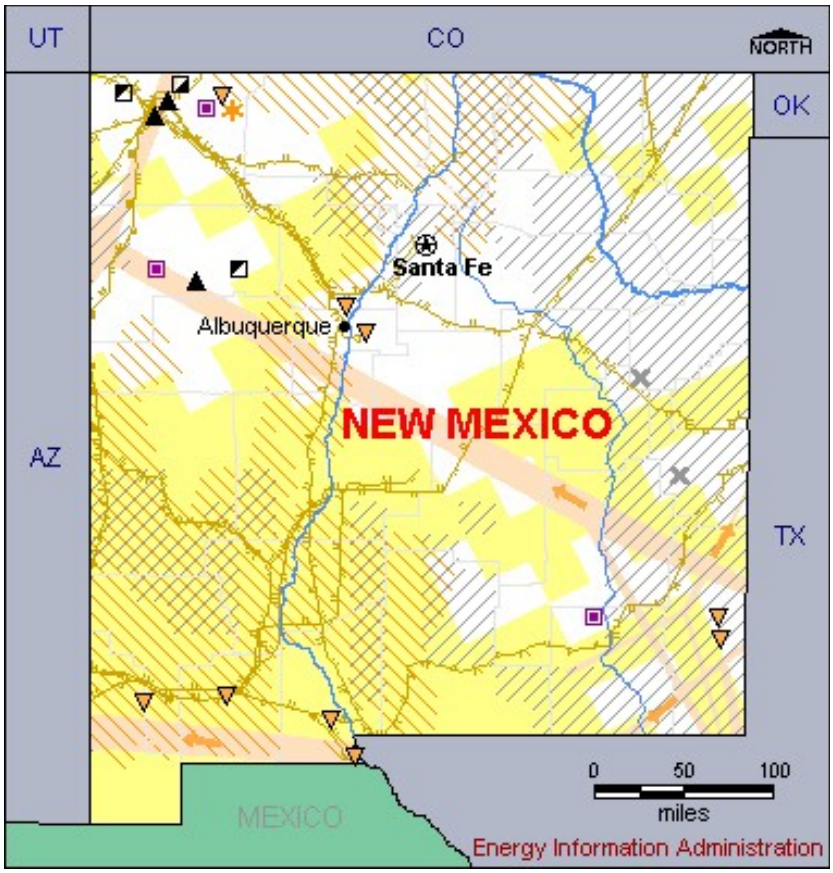


Figure E1. – USEIA energy map of New Mexico. Tan bands with orange arrows show alignments of major natural gas pipelines. See link below for map legend.

Source: U.S. Energy Information Administration, 2010b; Accessed online at: http://www.eia.gov/state/state_energy_profiles.cfm?sid=NM

Table E1. -- Natural Gas Deliveries by Month to the Town of Taos in 2009, in therms.

	Commercial Deliveries
DATE	**THERMS***
2009-01	325,987.251
2009-02	286,328.981
2009-03	217,071.800
2009-04	193,632.259
2009-05	106,914.628
2009-06	76,911.082
2009-07	63,868.383
2009-08	74,969.733
2009-09	74,548.601
2009-10	119,612.301
2009-11	173,683.185
2009-12	290,212.671
al Commercial Deliveries, 2009	**2,003,740.875**

	Residential Deliveries
DATE	**THERMS***
2009-01	523,458.441
2009-02	505,716.751
2009-03	385,887.653
2009-04	344,457.294
2009-05	171,697.768
2009-06	108,062.666
2009-07	87,603.055
2009-08	77,826.615
2009-09	88,722.400
2009-10	178,182.810
2009-11	294,818.838
2009-12	496,367.599
al Residential Deliveries, 2009	**3,262,801.890**

1 therm is equivalent to approximately 29.3 kilowatt-hours (kWh)

Source: New Mexico Gas Company, written communication, 2010.

Table E1. -- Natural Gas Deliveries by Month to Taos County in 2009, in therms.

Commercial Deliveries

DATE	THERMS*
2009-01	502,326.511
2009-02	450,149.498
2009-03	296,643.213
2009-04	350,421.296
2009-05	174,012.613
2009-06	131,109.572
2009-07	114,673.111
2009-08	113,074.981
2009-09	120,694.657
2009-10	178,801.594
2009-11	270,852.088
2009-12	434,794.37
Total Commercial Deliveries 2009	**3,137,553.504**

Residential Deliveries

DATE	THERMS*
2009-01	1049050.91
2009-02	991745.697
2009-03	835734.491
2009-04	690567.295
2009-05	361865.534
2009-06	250530.742
2009-07	197701.729
2009-08	154162.347
2009-09	193058.767
2009-10	324230.704
2009-11	569552.923
2009-12	990303.289
Total Residential Deliveries 2009	**6,608,504.428**

1 therm is equivalent to approximately 29.3 kilowatt-hours (kWh)

Source: New Mexico Gas Company, written communication, 2010.

Appendix F. – Propane for New Mexico

"Propane is a nonrenewable fossil fuel, like the natural gas and oil it is produced from. Like natural gas (methane), propane is colorless and odorless. Although propane is nontoxic and odorless, foul-smelling mercaptan is added to it to make gas leaks easy to detect. Propane-fueled engines produce much fewer emissions of carbon monoxide and hydrocarbons compared to gasoline engines. Like all fossil fuels, propane upon burning emits water vapor and carbon dioxide, a greenhouse gas." Accessed online at USEIA: http://www.eia.gov/energyexplained/index.cfm?page=propane_environment

"Propane naturally occurs as a gas. However, at higher pressure or lower temperatures, it becomes a liquid. Because propane is 270 times more compact as a liquid than as a gas, it is transported and stored in its liquid state. Propane becomes a gas again when a valve is opened to release it from its pressurized container. When returned to normal pressure, propane becomes a gas so that we can use it." Accessed online at USEIA: http://www.eia.gov/energyexplained/index.cfm?page=propane_home

Table F1. – Sales of Odorized Propane in New Mexico by End Use, 2007 and 2008, In Thousands of Gallons

Year	Residential	Commercial	Retailers	Internal Combustion	Industrial	Agricultural	Total
2007	83,142	20,451	3,820	W	W	3,557	121,823
Percent	68	17	3	W	W	3	100
2008	71,698	17,351	3,738	5,859	8,291	3,208	110,326
	65	16	3	5	8	3	100

Source: American Petroleum Institute (2009, p. 4-6).
W = Data withheld to avoid disclosure of individual company data.

Table F2. -- Sales of Odorized Propane in New Mexico, 2004-2008, In Thousands of Gallons

2004	2005	2006	2007	2008	Average 2004-2008
134,959	128,957	146,993	121,823	110,326	128,612

Source: American Petroleum Institute (2009, p. 4-6).

Appendix G. – Fuel Wood for Taos and Vicinity, NM

"Wood is a substantial renewable resource that can be used as a fuel to generate electric power and useful thermal output. Wood for use as fuel comes from a wide variety of sources. The Nation's forestland (or timberland) is the primary, and in most cases original, resource base for fuelwood. Wood for fuel use is also derived from private land clearing and silviculture and from urban tree and landscape residues. A third major wood resource is waste wood, which includes manufacturing and wood processing wastes, as well as construction and demolition debris." Accessed online at USEIA: http://www.eia.doe.gov/cneaf/solar.renewables/page/wood/wood.html

Table G1. – Wood Permits and Estimated Firewood Volume Removed, Carson National Forest lands near Taos, NM, October 1, 2009 through September 30, 2010.

Location	Wood Volume (Cords)	Notes
Carson National Forest Supervisor's Office, Taos, NM and Camino Real Ranger District, Peñasco, NM	11,834 dead and down firewood; 988 cords green firewood	Aggregated numbers do not allow estimating volume used in Taos and vicinity compared with volume used in Peñasco and vicinity.
Tres Piedras Ranger District, Tres Piedras, NM	1,735 dead and down firewood	Some Taos area residents use Carson National Forest west of Tres Piedras for firewood collection.
Total	**14,557**	Dead and down firewood permits are good across Carson National Forest, and there is no requirement to report where the wood is burned.

Source: U.S. Forest Service Supervisor's Office, Carson National Forest, Taos, NM (written communication, 2010)

Table G2. - Wood Permits and Estimated Firewood Volume Removed,
BLM Lands near Taos, NM, 2001-2010.

Year	Permits	Wood Volume (Cords)	Notes*
2001	270	400	
2002	300	401	
2003	246	512	
2004	163	490	
2005	160	408	
2006	135	607	Multiple cords allowed
2007	348	742	Compliance enforcement
2008	202	932	
2009	554	1801	
2010	442	1413	Through 09/24/2010

*Bulk of wood comes from west of Rio Grande Gorge in Taos County, NM.
*Wood volumes may be under-reported by 50% due to non-permitted gathering.

Source: U.S. Bureau of Land Management, oral communication, 2010.

Table G3. **– Sample Private Sector Local Wood Sales, Taos & Vicinity, NM (Annual Averages, 2009-2010)**

Wood Type	Sales (Cords/Year)
Mixed Aspen, Pine, Etc.	1,600-2,000
Piñon-Juniper	300
Scrap (mixed cuttings, bark, etc.)	150-200
Total	**2,050-2,500**

Source: Oral Communication, 2011.

Appendix H. – Motor Vehicle Travel, Taos and Vicinity, NM

Table H1. – Daily Vehicle Miles Traveled (DVMT) by County, New Mexico, 2009.

County (New Mexico)	Daily Vehicle Miles Traveled (DVMT) 2009
Bernalillo	16,088,000
Catron	275,000
Chaves	1,683,000
Cibola	1,863,000
Colfax	955,000
Curry	1,076,000
DeBaca	408,000
Dona Ana	6,300,000
Eddy	2,259,000
Grant	1,092,000
Guadalupe	1,467,000
Harding	87,000
Hidalgo	781,000
Lea	1,448,000
Lincoln	912,000
Los Alamos	386,000
Luna	2,134,000
McKinley	3,456,000
Mora	378,000
Otero	1,836,000
Quay	1,370,000
Rio Arriba	1,233,000
Roosevelt	695,000
Sandoval	3,273,000
San Juan	3,919,000
San Miguel	944,000
Santa Fe	4,745,000
Sierra	512,000
Socorro	1,349,000
Taos	924,000
Torrance	1,392,000
Union	343,000
Valencia	1,598,000
Total	**67,181,000**

Source: New Mexico Department of Transportation, April 8, 2010 (Written Communication); New Mexico Department of Transportation (2011).

Table H2. – Daily Vehicle Miles Traveled (DVMT) by Road Segment, 64 Principal Road Segments, Taos Planning Area, 2009.

Cruz Alta Road Jct NM 68 Southeastward	6,089
Camino Del Medio Jct NM 240 SW Taos Northward	3,743
Gusdorf Road Jct Este Es Road Northward To Canon Bypass	4,324
Chamisa Road Jct NM 68 Northwestward To Paragitas (Camino Del Medio?)	706
Este Es Road Jct NM 68 Southeastward To Maestas Road	3,537
Weimer Road Jct Canon Bypass SE to Santa Cruz & NE to Canon Bypass	10,370
Salazar Road Jct Canon West N to Ranchitos Road	9,977
San Antonio Street Jct Valverde E to Ranchitos Road	175
La Posta Road Jct N 68 NW to Salazar Road	3,052
Ojitos Road Jct NM 68 to W Ranchitos Road	335
Civic Plaza Drive From Camino De La Placita to NM 68	369
Camino De La Placita Jct NM 240 N to NM 68	3,863
Quesnel Street Jct NM 68 E to US 64	298
Don Fernando Street Jct Camino De La Placita E to NM 68	193
Paseo Del Pueblo Norte Jct US 64 to ?	330
Old Talpa Canyon Road Jct NM 68 E to ?	144
Camino De La Merced Jct NM 68 NW to ?	3,866
NM 68 From Jct NM 570 NE to Taos Plaza	93,274
NM 240 Jct NM 68 Ranchos De Taos NW & N to Taos Plaza	20,986
NM 585 Paseo Del Canon Jct NM 68 E to NM 64	6,443
NM 230 Jct Nm 150 N of Taos to Jct 150 Ski Valley Road	7,988
Upper Ranchitos Road Jct NM 240 N 1.9 Miles	291
Lower Las Colonias Road ?	474
El Salto Road Jct NM 150 Arroyo Seco E 2 Miles	306
Los Cordovas Road ?	291
Camino Del Medio Jct Camino De La Merced (S to NM 240?)	367
Taos County Road A005 Jct Upper Ranchitos to ?	31
Blueberry Hill Road Jct NM 240 N to Taos County Road A005	1,569
Lower Las Colonias Road (A008) Jct Blueberry Hill Road W & N to NM 64	1,587
Taos County Road A017 Jct NM 585 NE to ?	138
Taos County Road A018 Jct US 64 NE to ?	122
Taos County Road A019 Jct A017 NW to ?	61
Taos County Road A020 Jct NM 585 NW to ?	199
Taos County Road A021 Jct A020 SW to ?	31
Taos County Road A022 Jct US 64 NE to ?	77
Taos County Road A023 Jct US 64 NE to ?	31
Taos County Road A024 Jct US 64 N to ?	61
Taos County Road A025 Jct A020 NW to ?	92
Taos County Road A029 Jct NM 240 NE t0 ?	260
Taos County Road A030 Millicent Rogers Road Jct A004 to ?	922
Taos County Road A032 Jct A029 to ?	31
Taos County Road A033 Jct A029 SE to ?	77

Table H2 (continued). – Daily Vehicle Miles Traveled (DVMT) by Road Segment, 64 Principal Road Segments, Taos Planning Area, 2009.

Taos County Road A062 Jct A025 SW to ?	15
Taos County Road A063 Jct Jct A025 SW to ?	46
Taos County Road A064 Jct A025 SW to ?	46
Taos County Road A066 Jct A020 NE to ?	31
Taos County Road A068 Jct US 64 NE to ?	15
Taos County Road A069 Jct A020 SW to ?	46
Taos County Road A070 jct A020 SW to ?	46
Taos County Road A071 Jct AB008 SW to ?	77
Taos County Road A102 Jct Nm 240 SE to ?	122
Taos County Road A103 Jct Nm 240 SE to ?	46
Taos County Road A110 Jct AC039 NW to ?	61
Taos County Road A111 Jct AC039 NW to ?	15
Taos County Road A112 Jct A113 NE to ?	31
Taos County Road A113 Jct A112 SE to ?	46
Taos County Road A114 Jct A112 SE to ?	61
Taos County Road A140 Jct AB008 NW to ?	122
Taos County Road BA005 Eototo Road Jct A030 1.1 Miles	168
Taos County Road BA007 Blueberry Hill Road Jct US 64 SW to NM 240	459
Taos County Road AB030 Millicent Rogers Road Jct AB004 to ?	444
NM 150 Jct NM 522/NM150 to Jct NM 585 Cañon East	98,309
NM 518 SMU-In-Taos (Pot Creek) N to Jct NM 68	20,625
Total DVMT for 64 Principal Road Segments in Taos Planning Area	**307,911**
307,911 DVMT x 365 days = 112,387,515 VMT in 2009	

Source: New Mexico Department of Transportation, April 8, 2010 (Written Communication); New Mexico Department of Transportation (2011).

Table H3. – Daily Vehicle Miles Traveled (DVMT) by Road Segment, Town of Taos, 2009.

US 64 Hail Creek Road to Jct NM 585 Entrance to Taos Canyon	55,749
Camino De La Merced Jct NM 68 NW to ?	3,866
NM 68 From South Town Limit N to Taos Plaza	65,235
NM 240 Jct NM 68 Ranchos De Taos NW & N to Taos Plaza	20,986
NM 585 Paseo Del Canon Jct NM 68 E to NM 64	6,443
Cruz Alta Road Jct NM 68 Southeastward	6,089
Camino Del Medio Jct NM 240 SW Taos Northward	3,743
Gusdorf Road Jct Este Es Road Northward To Canon Bypass	4,324
Chamisa Road Jct NM 68 Northwestward To Paragitas (Camino Del Medio?)	706
Este Es Road Jct NM 68 Southeastward To Maestas Road	3,537
Weimer Road Jct Canon Bypass SE to Santa Cruz & NE to Canon Bypass	10,370
Salazar Road Jct Canon West N to Ranchitos Road	9,977
San Antonio Street Jct Valverde E to Ranchitos Road	175
La Posta Road Jct N 68 NW to Salazar Road	3,052
Ojitos Road Jct NM 68 to W Ranchitos Road	335
Civic Plaza Drive From Camino De La Placita to NM 68	369
Camino De La Placita Jct NM 240 N to NM 68	3,863
Quesnel Street Jct NM 68 E to US 64	298
Don Fernando Street Jct Camino De La Placita E to NM 68	193
Paseo Del Pueblo Norte Jct US 64 to ?	330
Total DVMT for 20 Principal Road Segments in Town of Taos	**199,640**
199,640 DVMT x 365 days = 72,868,600 VMT in 2009	

Source: New Mexico Department of Transportation, April 8, 2010 (Written Communication); New Mexico Department of Transportation (2011).

Appendix I. – Land Use and Land Cover, Taos and Vicinity, NM

Table I1. -- Land-Use By Categories, Taos Planning Area, in Acres

Amusement & Recreation (Buildings)	15
Animal Shelter (Building)	2
Apartments/Condominiums (Buildings)	35
Apartments/Condominiums Complexes (Buildings)	86
Community Facilities (Buildings)	103
Duplex Housing (Buildings)	5
Eating & Lodging Establishments (Buildings)	116
Educational (Buildings)	82
Garages (Buildings)	1
General Retail (Buildings)	24
Health Care (Buildings)	34
Manufactured Homes (Buildings)	119
Mobile Home Parks (Buildings)	46
Multi-Commercial (Buildings)	48
Multi-Residential (Buildings)	406
Multi-Tenant (Buildings)	85
Municipal Parking	4
Museums (Buildings)	6
Offices (Buildings)	26
Religious Institution (Buildings)	35
Residential Commercial (Buildings)	67
Residential Industrial (Buildings)	7
Roadway	2
Service Retail (Buildings)	38
Single Family (Buildings)	2,073
Specialty Retail (Mixed Buildings & Lots)	69
Utilities (Electric, Gas, Telephone, Water)	15
Other/Misc (Buildings & Lots)	26
Total Acreage (Buildings)	**3,575**

Table I1 (Continued) – Land Use By Categories, Taos Planning Area, in Acres

Under Construction	206
Roadways	610
Total Acreage (Under Construction & Roadways)	**816**
Heavy Construction/Supply (Buildings/Lots)	50
Light Construction/Supply (Buildings/Lots)	24
Total Acreage (Heavy & Light Construction)	**74**
Fairgrounds/Rodeo Grounds	9
Sports Complex (Lots & Buildings)	21
Total Acreage (Fairgrounds & Sports complexes)	**30**
Agricultural	1,452
Agricultural, Animal Husbandry	26
Agricultural – Commercial	23
Residential Agricultural	1,026
Total Acreage (Agricultural)	**2,527**
Cemeteries	15
Open Space (All Categories)	2,190
Open Space (Vacant Land)	2,098
Open Space (Forested & Wetland)	92
Parks	30
Total Acreage (Open Space, Parks & Cemeteries)	**2,327**
Total Acreage, All Land Uses, Taos Planning Area (2005)	**9,257**

Total Area within Town of Taos Limits = 3563 Acres

Land Area Between Town of Taos Boundaries & 3-Mile Buffer Boundary = 20,300 Acres

Source: Town of Taos Planning Department (written communication, 2010).
Compare with Figure C1.

Table I2. -- Land Cover Summary for Taos County, New Mexico

Land Cover Name	Acres	Square Miles	% Total Area
Human land use	49,236.56	76.96	3.49 %
Developed	3,540.79	5.53	0.25 %
Agriculture	45,695.77	71.43	3.24 %
Aquatic (Open Water)	997.68	1.56	0.07 %
Sparse and barren systems	13,158.83	20.57	0.93 %
Forest and woodland systems	741,482.98	1,159.06	52.58 %
Shrub land, steppe and savanna systems	508,473.90	794.83	36.05 %
Grassland systems	80,554.18	125.92	5.71 %
Recently disturbed or modified	3,757.76	5.87	0.27 %
Riparian and wetland systems	12,668.88	19.80	0.90 %
Total Area, Taos County	**1,410,330.77**	**2,204.58**	**100.00%**

Source: Adapted from U.S. Geological Survey (2010)

Appendix J. – Sample ICLEI USA Clean Air & Climate Protection Program 2009 (CACP 2009) Outputs

The following pages show sample outputs of the ICLEI USA Clean Air and Climate Protection (CACP) 2009 Program (ICLEI USA, 2011). The program uses input data on greenhouse gases (GHGs) and other emissions to generate a wide variety of reports and graphs depending upon user requirements. New data for a given year may be entered into the program, and the program will automatically update the reports.

The reports that follow show GHG emissions for Taos County, Taos Planning Area, and the Town of Taos for the base year 2009. The reports reflect data input for residential and commercial consumption of electricity, natural gas, and propane, and consumption of diesel fuel and gasoline by on-road passenger and commercial motor vehicles. Energy units in the reports are all converted into the energy equivalent of kilowatt-hours (kWh) for reporting consistency and direct comparisons among different forms of energy. The CACP 2009 Program allows report output to be expressed as any of several other energy equivalents such as Btus, Therms, etc., depending upon the needs of the user.

The reports show the overwhelming majority of GHG emissions for Taos and vicinity. Emissions from other, much smaller sources (landfills, aviation, wastewater treatment, etc.) may be added to the reports as data become available.

Taos County

Community Greenhouse Gas Emissions in 2009
Report by Source

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Diesel	35,440	209	215	35,475	8.3	128,779,195
Electricity	137,835	3,772	3,669	138,458	32.4	210,267,000
Gasoline	178,656	23,681	20,105	182,538	42.7	669,973,567
Natural Gas	57,003	215	10,743	57,149	13.4	285,559,470
Propane	13,565	258	4,732	13,655	3.2	57,170,546
Total	422,500	28,135	39,465	427,276	100.0	1,351,749,778

This report has been generated for Taos County, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos County

Community Greenhouse Gas Emissions in 2009
Summary Report by Sector

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential	111,287	2,060	12,059	111,733	26.2	328,142,821
Commercial	97,117	2,185	7,085	97,530	22.8	224,854,194
Transportation	214,096	23,890	20,320	218,013	51.0	798,752,762
Total	422,500	28,135	39,465	427,276	100.0	1,351,749,778

This report has been generated for Taos County, New Mexico
using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos County

Community Greenhouse Gas Emissions in 2009
Indicators Report (Per Capita Emissions)

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	Energy (kWh)
Residential Sector Average *Per capita*	3.3	0.1	0.4	3.3	9,798.5
Commercial Sector Average *Per capita*	2.9	0.1	0.2	2.9	6,714.3
Transportation Sector Average *Per capita*	6.4	0.7	0.6	6.5	23,851.2

This report has been generated for Taos County, New Mexico
using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos County

Community Greenhouse Gas Emissions in 2009
Detailed Report

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential						
Taos County, New Mexico						
Taos County Residential						
Electricity	63,818	1,747	1,699	64,107	15.0	97,354,000
Natural Gas	38,652	146	7,285	38,751	9.1	193,629,167
Propane	8,817	168	3,076	8,876	2.1	37,159,654
Subtotal Taos County Residential	111,287	2,060	12,059	111,733	26.2	328,142,821
Commercial						
Taos County, New Mexico						
Taos County Commercial & Industrial						
Electricity	74,017	2,026	1,970	74,352	17.4	112,913,000
Natural Gas	18,351	69	3,459	18,398	4.3	91,930,303
Propane	4,748	90	1,656	4,780	1.1	20,010,891
Subtotal Taos County Commercial & Industrial	97,117	2,185	7,085	97,530	22.8	224,854,194
Transportation						
Taos County, New Mexico						
Taos County Transportation						
Diesel	35,440	209	215	35,475	8.3	128,779,195
Gasoline	178,656	23,681	20,105	182,538	42.7	669,973,567
Subtotal Taos County Transportation	214,096	23,890	20,320	218,013	51.0	798,752,762
Total	**422,500**	**28,135**	**39,465**	**427,276**	**100.0**	**1,351,749,778**

This report has been generated for Taos County, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos Planning Area

Community Greenhouse Gas Emissions in 2009
Summary Report

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential	73,960	1,055	9,358	74,222	36.5	260,439,481
Commercial	56,330	1,086	5,023	56,551	27.8	155,911,600
Transportation	71,345	7,961	6,772	72,650	35.7	266,173,985
Total	201,635	10,102	21,152	203,423	100.0	682,525,065

This report has been generated for Taos Planning Area, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos Planning Area

Community Greenhouse Gas Emissions in 2009
Report by Source

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Diesel	11,810	70	72	11,822	5.8	42,913,994
Electricity	66,852	1,836	1,734	67,155	33.0	101,987,000
Gasoline	59,535	7,891	6,700	60,828	29.9	223,259,990
Natural Gas	59,126	223	11,143	59,278	29.1	296,193,700
Propane	4,311	82	1,504	4,340	2.1	18,170,380
Total	201,635	10,102	21,152	203,423	100.0	682,525,065

This report has been generated for Taos Planning Area, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos Planning Area

Community Greenhouse Gas Emissions in 2009
Indicators Report (Per Capita Emissions)

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	Energy (kWh)
Residential					
Sector Average					
Per capita	6.9	0.1	0.9	7.0	24,468.2
Commercial					
Sector Average					
Per capita	5.3	0.1	0.5	5.3	14,647.8
Transportation					
Sector Average					
Per capita	6.7	0.7	0.6	6.8	25,007.0

This report has been generated for Taos Planning Area, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Taos Planning Area

Community Greenhouse Gas Emissions in 2009
Detailed Report

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	Equiv CO2 (%)	Energy (kWh)
Residential						
Taos Planning Area, New Mexico						
Taos Planning Area Residential						
Electricity	30,953	850	803	31,093	15.3	47,220,000
Natural Gas	40,205	152	7,577	40,308	19.8	201,408,200
Propane	2,803	53	978	2,821	1.4	11,811,281
Subtotal Taos Planning Area Residential	73,960	1,055	9,358	74,222	36.5	260,439,481
Commercial						
Taos Planning Area, New Mexico						
Taos Planning Area Commercial & Industrial						
Electricity	35,900	986	931	36,062	17.7	54,767,000
Natural Gas	18,921	71	3,566	18,970	9.3	94,785,500
Propane	1,509	29	526	1,519	0.7	6,359,100
Subtotal Taos Planning Area Commercial & Industrial	56,330	1,086	5,023	56,551	27.8	155,911,600
Transportation						
Taos Planning Area, New Mexico						
Taos Planning Area Transportation						
Diesel	11,810	70	72	11,822	5.8	42,913,994
Gasoline	59,535	7,891	6,700	60,828	29.9	223,259,990
Subtotal Taos Planning Area Transportation	71,345	7,961	6,772	72,650	35.7	266,173,985
Total	**201,635**	**10,102**	**21,152**	**203,423**	**100.0**	**682,525,065**

This report has been generated for Taos Planning Area, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Town of Taos

Community Greenhouse Gas Emissions in 2009
Report by Source

	CO2	N2O	CH4	Equiv CO2		Energy
	(tons)	(lbs)	(lbs)	(tons)	(%)	(kWh)
Diesel	7,657	45	47	7,665	6.1	27,824,111
Electricity	44,260	1,211	1,178	44,461	35.7	67,519,000
Gasoline	38,601	5,116	4,344	39,439	31.6	144,754,895
Natural Gas	30,803	116	5,805	30,882	24.8	154,309,681
Propane	2,246	43	783	2,261	1.8	9,466,096
Total	123,568	6,532	12,158	124,708	100.0	403,873,782

This report has been generated for the Town of Taos, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Town of Taos

Community Greenhouse Gas Emissions in 2009
Summary Report

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential	41,036	661	4,651	41,187	33.0	133,014,008
Commercial	36,274	710	3,116	36,416	29.2	98,280,769
Transportation	46,258	5,162	4,390	47,104	37.8	172,579,006
Total	123,568	6,532	12,158	124,708	100.0	403,873,782

This report has been generated for the Town of Taos, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Town of Taos

Community Greenhouse Gas Emissions in 2009
Indicators Report (Per Capita Emissions)

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	Energy (kWh)
Residential Sector Average *Per capita*	7.4	0.1	0.8	7.4	23,988.1
Commercial Sector Average *Per capita*	6.5	0.1	0.6	6.6	17,724.2
Transportation Sector Average *Per capita*	8.3	0.9	0.8	8.5	31,123.4

This report has been generated for the Town of Taos, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Town of Taos

Community Greenhouse Gas Emissions in 2009
Detailed Report

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	Equiv CO2 (tons)	(%)	Energy (kWh)
Residential						
Town of Taos, NM						
Town of Taos Residential						
Electricity	20,492	561	546	20,585	16.5	31,261,000
Natural Gas	19,084	72	3,597	19,133	15.3	95,600,099
Propane	1,460	28	509	1,470	1.2	6,152,909
Subtotal Town of Taos Residential	41,036	661	4,651	41,187	33.0	133,014,008
Commercial						
Town of Taos, NM						
Town of Taos Commercial & Industrial						
Electricity	23,768	650	633	23,875	19.1	36,258,000
Natural Gas	11,720	44	2,209	11,750	9.4	58,709,582
Propane	786	15	274	791	0.6	3,313,187
Subtotal Town of Taos Commercial & Industrial	36,274	710	3,116	36,416	29.2	98,280,769
Transportation						
Town of Taos, NM						
Town of Taos Transportation						
Diesel	7,657	45	47	7,665	6.1	27,824,111
Gasoline	38,601	5,116	4,344	39,439	31.6	144,754,895
Subtotal Town of Taos Transportation	46,258	5,162	4,390	47,104	37.8	172,579,006
Total	**123,568**	**6,532**	**12,158**	**124,708**	**100.0**	**403,873,782**

This report has been generated for the Town of Taos, New Mexico using ICLEI's Clean Air and Climate Protection 2009 Software.

Appendix K. – Primary & Secondary Data Sources

[Additional data sources are available in References section.]

Data Type	Data Source	Contact Information	Notes
Gasoline in Place	Gasoline Distributors and Stations: Polk Oil Company; Chevron; Shell; Giant; Conoco; Other.		New Mexico Department of Transportation (NMDOT) data on Daily Vehicle Miles Traveled (DVMT) used in this report lieu of gasoline sales.
Electricity (Utility)	Kit Carson Electric Cooperative, Inc.	118 Cruz Alta Road Taos, NM 87571 Tel: 575.758.2258 http://www.kitcarson.com/	Local electrical power generation & distribution.
Electricity (Utility)	Tri-State Generation and Transmis-sion Association, Inc.	http://www.tristategt.org/ Annual Reports available online at: http://www.tristategt.org/Financials/annual-report.cfm	Regional electrical power generation and transmission.

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Air Quality Monitoring Data	New Mexico Environ-ment Department, Air Quality Bureau	1301 Siler Road, Building B Santa Fe, NM 87507 505.476.4300 http://www.nmenv.state.nm.us/aqb/ Air Quality Index http://www.airnow.gov/index.cfm?action=aqibasics.aqi	Air Quality Index Guide to Air Quality and Human Health – Publications, Calculators, etc.
Transporta-tion	New Mexico Department of Transporta-tion	Traffic Data Reporting: http://nmshtd.state.nm.us/main.asp?secid=14473 Traffic Survey Report 2008, Accessed online at: http://nmshtd.state.nm.us/upload/images/Programs-Planning-Data%20Acquisition-Traffic%20Data%20Reporting/2008%20Annual%20Reports.pdf Traffic Count Data -- NMDOT, Transportation Planning Division, Traffic Collection Unit: http://nmshtd.state.nm.us/main.asp?secid=10971 Tel: 505.827.5380	Daily Vehicle Miles Traveled, Road Segments Statewide.
Greenhouse Gases Emissions	State of New Mexico NMED Environ-ment and Energy Policy Coordinator	New Mexico Climate Change Initiatives http://www.nmenv.state.nm.us/cc/ Greenhouse Gas Emissions Reporting and Verification http://www.nmenv.state.nm.us/cc/NMEDAQBNewGHGReportingVerificationRules.htm	Greenhouse gases emissions, all sources statewide.

Natural Gas	New Mexico Gas Company	http://www.nmgco.com/ Santa Fe, NM Tel: 505.697.3534	Natural gas deliveries by month, Taos and Taos County, NM; Approximately 10,800 customers in 2011.
Propane	Propane Retailers, Taos, NM area	http://www.usepropane.com/fpr.aspx?site=consumer http://www.usepropane.com/fprResult.aspx?site=consumer&zid=87571# Kit Carson Propane: 575.758.7757; 758.2258; 1.800.688.6780 New Mexico Propane: 575.758.3352 Pendleton Oil & Gas Company: 575.758.2266 Amerigas: 575.758.4249 Ferrellgas: 505.425.7503 Adobe/Zia Propane: 575.587.2231 Northern New Mexico Gas Company: 575.377.3744; 1.800.916.2510 Rio Grande Propane: 575.751.7774	Proprietary data; aggregated data for State of New Mexico available from National Propane Gas Association.
Propane	National Propane Gas Association	Senior Director, Association Management Services 6501 E. Greenway Parkway Suite 103, #457 Scottsdale, AZ 85254 Tel: 866.881.6309 or 480.922.1056	State of New Mexico Annual Odorized Propane Sales.

Building Energy Consump-tion	SMU-In-Taos	SMU in TAOS, Fort Burgwin, NM 6580 HWY 518 Ranchos de Taos NM 87557 Tel: 575.758.8322 (office) http://smu.edu/taos/ Exec. Director, Facilities Management & Sustainability (Dallas, TX) Tel: 214 768 2122	Comparative examples, LEED and conventional buildings and energy consumption
Industry Emissions	Taos Area Asphalt Plants	Northern Paving & Sealcoat: 575.737.9130 A & S Construction: 575.758.3097 Marss: 575.770.4499 Silva's Excavation Inc.: 575.758.4562 Taos Gravel Products: 575.758.4395	NM Standard Specifications for Public Works Construction: http://taosdesignbuild.com/apwa/nm-standard-specifications/
Biomass	Taos Fire Department	Taos Burning Permits Tel: 575.737.2609 323 Camino de la Placita Taos, New Mexico 87571 Tel: 505.758.3386 http://www.taosgov.com/publicsafety/your-safety.php	Waste Burning

Building Energy Consump-tion	Town of Taos Government Owned and Operated Buildings	Taos Grants Administration Tel: 575.751.2029 (office)	Natural Gas & Electricity Use for 16 Town Owned Buildings; Data by month beginning early 2009 and continuing.
Methane	Taos Municipal Landfill	Taos Municipal Landfill: 575.751.3577 Town of Taos 1030 Dea Lane,Taos, NM 87571 (575) 751-2047 Souder-Miller & Associates: http://www.soudermiller.com/ http://www.soudermiller.com/engineering/solid-waste-overview/ Methane emissions data filed with: NMED, Solid Waste Bureau http://www.nmenv.state.nm.us/swb/AnnualReportsandForms.htm Solid Waste Facility Annual Reports: 505.476.3561 (Santa Fe, NM)	Annual, quarterly and monthly reports. Souder-Miller & Associates: Groundwater and Methane Monitoring and Reporting Groundwater and Methane Remediation Systems
Land Use & Land Cover	Town of Taos Planning Department	Town of Taos Community & Economic Development Department Planning Division 400 Camino de la Placita Taos, New Mexico 87571 Tel: 575.751.2037	Town of Taos & Taos Planning Area Data & Map, August 2005; Geographic Information System (GIS) Database.

Aviation Fuel; Airport Operations	Taos Municipal Airport	Airport Manager: 575.758.4995	Take-offs and landings; vehicles; aviation fuel onsite, etc.
Public Transportation	Taos & Regional Transportation, Transit Division	Transportation Superintendent 575.751.4459	Chili Line; Taos Express; Regional Transit
Wastewater Treatment	Taos Wastewater Treatment Plant	Taos Public Utilities Water & Wastewater Tel: 751.2046/2047 CH2M HILL http://www.acecnm.org/firms/ch2mhill.html Taos Office 182 Los Cordovas Road Rancho De Taos, NM 87557 Tel: (575) 751-7714	Electricity & Natural Gas Consumption; N_2O Emissions.
Population	University of New Mexico	University of New Mexico, Bureau of Business and Economic Research http://bber.unm.edu/	See: http://bber.unm.edu/bber_links.html for links to recommended web sites.

Greenhouse Gases Emissions, General	U.S. Energy Information Administra-tion	Voluntary Reporting of Greenhouse Gases Program http://www.eia.doe.gov/oiaf/1605/getstart.html Fuel Carbon Dioxide Emission Coefficients http://www.eia.doe.gov/oiaf/1605/coefficients.html Technical guidelines Voluntary Reporting of Greenhouse Gases (1605(b)) Program http://www.eia.doe.gov/oiaf/1605/January2007_1605bTechnicalGuidelines.pdf	See References for links to specific GHG emissions and other energy data.
Building Energy Consump-tion	University of New Mexico – Taos	Executive Campus Director UNM Taos 1157 County Road 110 Ranchos de Taos, NM 87557 Tel: 575.737.6204 http://taos.unm.edu/index.html Director, Facilities Operations Physical Plant, UNM-Taos Tel: 575.737.6273; 741.1075	Comparative building energy use; On-site solar power generation and energy consumption
Wood; Carbon Sequestra-tion; Land Cover	U.S. Bureau of Land Manage-ment	Taos Field Office 226 Cruz Alta Road Taos, NM 87571-5983Tel: 575.758.8851 http://www.blm.gov/nm/st/en/fo/Taos_Field_Office.html Fire Management Officer - Surface Protection Tel: 575.751.4717	Wood consumption estimates; land-use policies; long-range land-use planning

Wood; Carbon Sequestration; Land Cover	U.S. Department of Agriculture Forest Service	Carson National Forest 208 Cruz Alta Road Taos, NM 87571 Tel: 575.758.6200 http://www.fs.fed.us/r3/carson/ Small Products: Wood gathering permits: http://www.fs.fed.us/r3/carson/permits/index.shtml	Small products; Wood gathering permits; Volumes of wood removed from forest; land-use policies; long-range land-use planning, etc.
Greenhouse Gases Emissions, General and Specific	U.S. Department of Agriculture Forest Service	Rocky Mountain Research Station, Ft. Collins, CO - GHG Studies http://www.fs.fed.us/rmrs/forest-carbon/ Climate Change — Effects on Ecosystems and People, Adaptation and Mitigation http://www.fs.fed.us/rmrs/climate-change/ USFS Climate Change Emphasis http://www.fs.fed.us/climatechange/ USFS Climate Change Research Center http://www.fs.fed.us/ccrc/ USFS Northern Research Station, Newtown Square, PA Tools for Carbon Inventory, Management, and Reporting http://nrs.fs.fed.us/carbon/tools/#cole Carbon Online Estimator http://www.ncasi2.org/COLE/	USDA Forest Service policies, studies, and reports on greenhouse gases emissions and sinks; climate change mitigation and adaptation activities.

Land Use and Land Cover	U.S. Geological Survey	USGS Gap Analysis Program (GAP) Land Cover Viewer http://www.usgs.gov/newsroom/article.asp?ID=2509 http://www.gap.uidaho.edu/landcoverviewer.html http://lc.gapanalysisprogram.com/landcoverviewer/Map.aspx	Regional Land Use and Land Cover Estimates 2010
Solid Waste; Landfill Waste	Waste Manage-ment of New Mexico	Taos Division Town and County of Taos 24663 Highway 64 West Taos, NM 87529 Tel: 575.751.0708 http://newmexico.wm.com/index.html http://newmexico.wm.com/taoscounty/index.html	Volume & type of waste transported; Fleet fuel consumption

Greenhouse Gases Emissions, General and Specific	U.S. Environ-mental Protection Agency	USEPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance: http://www.epa.gov/stateply/resources/inventory-guidance.html] USEPA Calculators: converting GHGs Emissions Numbers into Equivalent Units, accessed online at: http://www.epa.gov/cleanenergy/energy-resources/refs.html USEPA Technology Transfer Network Clearinghouse for Inventories & Emissions Factors http://www.epa.gov/ttn/chief/eiinformation.html Emissions Factors & AP 42, *Compilation of Air Pollutant Emission Factors* http://www.epa.gov/ttn/chief/ap42/index.html Emission Inventory Improvement Program Technical Report Series Volume 3 -Area Sources http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html See other reports and links in References.	Comprehen-sive GHG emissions information, reports, and calculators.

FINAL REPORT, April 14, 2011

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